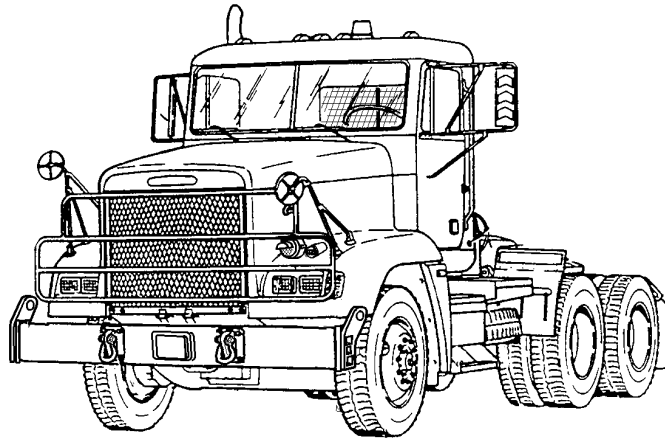


DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

FOR

TRUCK, TRACTOR, LINE HAUL:
52,000 GVWR, 6 X 4, M915A3
(NSN 2320-01-432-4847)



Approved for public release; distribution is unlimited.

HEADQUARTERS, DEPARTMENT OF THE ARMY

May 2001

LIST OF EFFECTIVE PAGES/WORK PACKAGES

NOTE

A vertical line in the outer margins of the page indicates the portion of text affected by the change. Changes to illustrations are indicated by miniature pointing hands. Change to wiring diagrams is indicated by shaded areas.

Dates of issue for original and change pages/work packages are:

Original	28 May 01
Change	Not Applicable

TOTAL NUMBER OF PAGES FOR FRONT AND REAR MATTER IS 40 AND TOTAL NUMBER OF WORK PACKAGES IS 126 CONSISTING OF THE FOLLOWING:

Page/WP No.	*Change No
Cover (Back Blank)	0
A (B Blank)	0
a to g (h Blank)	0
i to v (vi Blank)	0
WP 0001 00 to 0126 00	0
Index-1 to Index-10	0
Authentication Page (Back Blank)	0
Sample DA Form 2028-2	0
Blank DA Form 2028-2	0
Metric Conversion Chart	0
Back Cover	0

* Zero in this column indicates an original page or work package.

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WARNING SUMMARY

This warning summary contains general safety warnings and hazardous materials warnings that must be understood and applied during maintenance of this equipment. Failure to observe these precautions could result in serious injury or death to personnel. Also included are explanations of safety and hazardous materials icons used within the technical manual.



BIOLOGICAL - abstract symbol bug shows that a material may contain bacteria or viruses that present a danger to life or health.



CHEMICAL - drops of liquid on hand shows that the material will cause burns or irritation to human skin or tissue.



EAR PROTECTION - headphones over ears shows that noise level will harm ears.



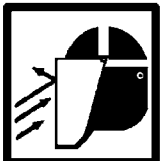
ELECTRICAL - electrical wire to arm with electricity symbol running through human body shows that shock hazard is present.



EYE PROTECTION - person with goggles shows that the material will injure the eyes.



FIRE - flame shows that a material may ignite and cause burns.



FLYING PARTICLES - arrows bouncing off face with face shield shows that particles flying through the air will harm face.



HEAVY OBJECT - human figure stooping over heavy object shows physical injury potential from improper lifting technique.



HEAVY PARTS - hand with heavy object on top shows that heavy parts can crush and harm.



HEAVY PARTS - heavy object on human figure shows that heavy parts present a danger to life or limb.



HOT AREA - hand over object radiating heat shows that part is hot and can burn.



VAPOR - human figure in a cloud shows that material vapors present a danger to life or health.

FOR INFORMATION ON FIRST AID, REFER TO FM 21-11.



WARNING

CARBON MONOXIDE (EXHAUST GASES) CAN KILL!

- Carbon monoxide is a colorless, odorless, deadly poison which, when breathed, deprives the body of oxygen and causes suffocation. Exposure to air containing carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness, and coma. Permanent brain damage or death can result from severe exposure.
 - Carbon monoxide occurs in exhaust fumes of internal combustion engines. Carbon monoxide can become dangerously concentrated under conditions of inadequate ventilation. The following precautions must be observed to ensure safety of personnel when engine of truck is operated.
1. DO NOT operate truck engine in enclosed areas.
 2. DO NOT idle truck engine without adequate ventilation.
 3. DO NOT drive truck with inspection plates or cover plates removed.
 4. BE ALERT for exhaust poisoning symptoms. They are:
 - Headache
 - Dizziness
 - Sleepiness
 - Loss of muscular control
 5. If you see another person with exhaust poisoning symptoms:
 - Remove person from area.
 - Expose to fresh air.
 - Keep person warm.
 - Do not permit physical exercise.
 - Administer cardiopulmonary resuscitation (CPR), if necessary.
 - Notify a medic.
 6. BE AWARE. The field protective mask for nuclear-biological-chemical (NBC) protection will not protect you from carbon monoxide poisoning.

The Best Defense Against Carbon Monoxide Poisoning Is Good Ventilation!



WARNING



ADHESIVES AND SEALING COMPOUNDS

Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive or sealing compound contacts skin or clothing, wash immediately with soap and water.



WARNING

AIR LINES AND FITTINGS

- DO NOT disconnect any air system lines or fittings unless vehicle engine is shut down and air system pressure is relieved. Failure to follow this warning could result in serious injury to personnel.
- Ensure that all air lines and fittings are clear of debris and excess pipe sealing compound does not enter air lines or fittings. Failure to follow this warning could result in injury to personnel and damage to equipment.
- Always wear eye protection when disconnecting air lines. Residual air will be expelled. Failure to follow this warning may result in serious eye injury.



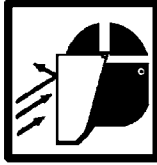
WARNING

BATTERIES



- To avoid eye injury, eye protection is required when working around batteries. DO NOT smoke, use open flame, make sparks or create other ignition sources around batteries. If a battery is giving off gases, it can explode and cause injury to personnel. Remove all jewelry such as rings, ID tags, watches, and bracelets. If jewelry or a tool contacts a battery terminal, a direct short will result in instant heating, injury to personnel, and damage to equipment.
- Sulfuric acid contained in batteries can cause serious burns. If battery corrosion or electrolyte makes contact with skin, eyes or clothing, take immediate action to stop the corrosive burning effects. Failure to follow these procedures may result in death or serious injury to personnel.

1. **Eyes.** Flush with cold water for no less than 15 minutes and seek medical attention immediately.
2. **Skin.** Flush with large amounts of cold water until all acid is removed. Seek medical attention as required.
3. **Internal.** If corrosion or electrolyte is ingested, drink large amounts of water or milk. Follow with milk of magnesia, beaten egg or vegetable oil. Seek medical attention immediately.
4. **Clothing/Equipment.** Wash area with large amounts of cold water. Neutralize acid with baking soda or household ammonia.



WARNING
COMPRESSED AIR

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.



WARNING
DIESEL FUEL HANDLING



- DO NOT perform fuel system checks, inspections or maintenance while smoking or near fire, flames or sparks. Fuel may ignite, causing injury or death to personnel and damage to vehicle.
- Fuel vapors are toxic. Avoid prolonged exposure or breathing of fumes. Work in a well-ventilated area. Failure to follow this warning could result in serious injury to personnel.



WARNING
HAZARDOUS WASTE DISPOSAL

When servicing this vehicle, performing maintenance or disposing of materials such as engine coolant, transmission fluid, lubricants, battery acids or batteries, and CARC paint, consult your unit/local hazardous waste disposal center or safety office for local regulatory guidance. If further information is needed, please contact The Army Environmental Hotline at 1-800-872-3845.



WARNING
HEARING PROTECTION

Hearing protecting is required when operating vehicle at more than 45 mph (72 kph) with windows open for an extended period of time. Hearing protection is also required when personnel are within 1 meter (3.1 ft) of vehicle when operating at low engine idle (600 rpm) and within 3.5 meters (11 ft) of vehicle when operating at high idle (1600 rpm). Failure to follow this warning may result in hearing damage.



WARNING

NBC EXPOSURE

If NBC exposure is suspected, all air cleaner media should be handled by personnel wearing protective equipment. Consult your NBC Officer or NBC NCO for appropriate handling or disposal procedures.



To order this NBC decal use:

National Stock Number (NSN) - 7690-01-114-3702

Part Number (PN) - 12296626

Commercial and Government Entity Code (CAGEC) - 19207



WARNING

R-134A REFRIGERANT



- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.
- DO NOT work in an area where refrigerant may contact an open flame or burning material such as a cigarette. When refrigerant contacts extreme heat, refrigerant breaks down into poisonous phosgene gas which, if breathed, causes severe respiratory irritation. DO NOT breathe fumes from an open flame leak detector.

WARNING

WORK SAFETY



- Hydraulic jack is intended only for lifting truck, not for supporting vehicle to perform maintenance. DO NOT get under truck after it is raised unless it is properly supported with blocks or jackstands. Failure to observe this warning may result in death or injury to personnel.



- Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.



- Improper use of lifting equipment and improper attachment of cables to vehicle can result in serious injury to personnel and equipment damage. Observe all standard rules of safety.



- ALWAYS install hood prop after opening hood. Failure to follow this warning could result in severe injury to personnel.

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TECHNICAL MANUAL
TM 9-2320-302-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 28 May 2001

DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE MANUAL

FOR

TRUCK, TRACTOR, LINE HAUL:
52,000 GVWR, 6 X 4, M915A3
(NSN 2320-01-432-4847)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028 (*Recommended Changes to Equipment Technical Publications*), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is <http://aeps.ria.army.mil>. If you need a password, scroll down and click on "ACCESS REQUEST FORM". The DA Form 2028 is located in the ONLINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or e-mail your letter, DA Form 2028 direct to: AMSTA-LC-CI/TECH PUBS, TACOM-RI, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The e-mail address is: TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

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HOW TO USE THIS MANUAL

This manual is designed to help you maintain the M915A3 Tractor Truck.

FEATURES OF THIS MANUAL:

- A Table of Contents is provided at the beginning of this manual.
- WARNINGS, CAUTIONS, NOTES, subject headings, and other important information are highlighted in **BOLD** print as a visual aid.

WARNING

A WARNING indicates a hazard which results in death or serious injury.

CAUTION

A CAUTION is a reminder of safety practices or directs attention to usage practices that may result in damage to equipment.

NOTE

A NOTE is a statement containing information that will make the procedures easier to perform.

- Statements and words of particular importance are printed in CAPITAL LETTERS to create emphasis.
- Instructions are located with illustrations that show the specific task on which the mechanic is working.
- Dashed leader lines used in illustrations indicate that called out items are not visible (i.e. they are located within the structure).
- Technical instructions include metric units in addition to standard units. A metric conversion chart is provided on the inside back cover.
- An alphabetical index is provided at the end of the manual to assist in locating information not readily found in the Table of Contents.

FOLLOW THESE GUIDELINES WHEN YOU THIS MANUAL:

- Read through this manual and become familiar with its contents before attempting to maintain the vehicle.
- A Warning Summary is provided at the beginning of this manual and should be read before attempting to maintain the vehicle.

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CHAPTER 1
INTRODUCTORY INFORMATION WITH
THEORY OF OPERATION

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GENERAL INFORMATION

0001 00

SCOPE

1. **Type of Manual.** This manual is for use in performing Direct Support and General Support Maintenance on the M915A3 Tractor Truck.
2. **Equipment Name and Model Number.** Truck, Tractor, Line Haul: 52,000 GVWR, 6 X 4, M915A3.
3. **Purpose of Equipment.** The M915A3 Tractor Truck is a 6 X 4 prime mover of semitrailers used primarily to transport containers, bulk cargo, and petroleum products over primary and secondary roads under worldwide climatic conditions in a military environment.

MAINTENANCE FORMS, RECORDS, AND REPORTS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, *Functional User's Manual for the Army Maintenance Management System (TAMMS)*, as contained in the Maintenance Management Update.

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIRS)

If your truck needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF Form 368 (*Product Quality Deficiency Report*). Mail it to us at: Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-LC-CIP-WT, Rock Island, Illinois 61299-7630. We will send you a reply.

CORROSION PREVENTION AND CONTROL (CPC)

1. Corrosion Prevention and Control (CPC) of Army materiel is a continuing concern. It is important that any corrosion problems with this item be reported so that the problem can be corrected and improvements can be made to prevent the problem in future items.
2. While corrosion is typically associated with rusting of metals, it can also include deterioration of other materials, such as rubber and plastic. Unusual cracking, softening, swelling or breaking of these materials may be a corrosion problem.
3. If a corrosion problem is identified, it can be reported using SF Form 368 (*Product Quality Deficiency Report*). Use of key words such as "corrosion," "rust," "deterioration," or "cracking" will ensure that the information is identified as a CPC problem. The form should be submitted to the address specified in DA Pam 738-750.

OZONE DEPLETING SUBSTANCES (ODS)

Listing to be provided by requiring activity.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

For destruction of Army materiel to prevent enemy use, refer to TM 750-244-6.

PREPARATION FOR STORAGE OR SHIPMENT

For preparation for storage or shipment procedures, refer to TM 740-90-1 and MIL-V-62038D.

WARRANTY INFORMATION

The vehicle is warranted by Freightliner Corporation in accordance with TB 9-2320-302-15. Warranty starts on the date found in block 23, DA Form 2408-9 in the logbook. Report all defects in material or workmanship to your supervisor, who will take appropriate action.

NOMENCLATURE CROSS-REFERENCE LIST

COMMON NAME	OFFICIAL NOMENCLATURE
Cold Start System	Ether Quick-start System
Engine Coolant	Antifreeze, Ethylene Glycol Mixture
Gladhand	Quick Disconnect Coupling
Jake Brake	Engine Brake
Komfort Loc®	Seat Belt Adjustment
TufTrac	Rear Suspension System

LIST OF ABBREVIATIONS

NOTE

Refer to MIL-STD-12D for standard abbreviations.

ABBREVIATION	DEFINITION
ABS	Anti-lock Brake System
C	Centigrade or Celsius
CID	Cubic Inch Displacement
cm	Centimeter
CWS	Collision Warning System
ECU	Electronic Control Unit
F	Fahrenheit
GCWR	Gross Combination Weight Rating
GVWR	Gross Vehicle Weight Rating
kg	Kilogram
km	Kilometer
kPa	Kilopascal
kph	Kilometers per Hour
kW	Kilowatt
l	Liter
lb	Pound
lb-ft	Pound Foot
lph	Liters per Hour
m	Meter
mm	Millimeter
MTS	Movement Tracking System
Nm	Newton Meter
PMCS	Preventive Maintenance Checks and Services
psi	Pounds per Square Inch
rpm	Revolutions per Minute

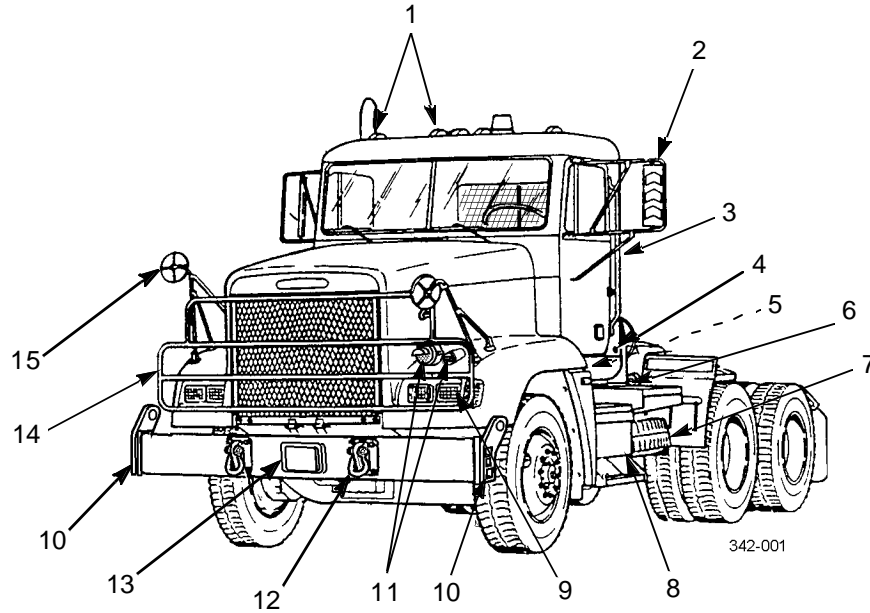
EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES**1. Characteristics.**

- a. The M915A3 Tractor Truck is used to transport M871, M872, and M1062 semitrailers on line haul missions.
- b. It has a Gross Vehicle Weight Rating (GVWR) of 52,000 lb (23,608 kg) and is equipped with a two-way oscillating, sliding fifth wheel compatible with a two-inch kingpin. Maximum towed load on kingpin is 30,000 lb (13,620 kg).

2. Capabilities and Features.

- a. While operating on Class I roads, the fully loaded M915A3 can maintain a speed of 65 mph (105 kph) on level roads and 29 mph (47 kph) while ascending a 3 percent grade. It has a minimum turning diameter, curb-to-curb, of 53 ft 9 in (16.4 m).
- b. Average cruising ranges at Gross Combination Weight Rating (GCWR) with a full tank of fuel will vary based on conditions (e.g., varying loads, prolonged idle, and climatic conditions). Cruising range is optimally 400 miles (640 km).
- c. The M915A3 is equipped with an instrument panel mounted speedometer and tachometer which register truck ground speed and engine speed.
- d. The M915A3 has the following capabilities and features:
 - (1) air-activated front and rear non-asbestos cam brakes with a four-channel anti-lock brake system (ABS) to provide significantly improved handling and braking during emergency stops
 - (2) operation in temperatures from -25°F (-32°C) to +125°F (+52°C), and to -40°F (-40°C) with arctic kit installed
 - (3) start and climb capability of a 20 percent grade at GCWR in both forward and reverse directions
 - (4) fording capability up to 20 in (51 cm) deep for 5 minutes without damage or requiring maintenance before operations can continue
 - (5) two-passenger aluminum corrosion-proof cab with a 90 degree tilt-forward hood for service accessibility
 - (6) six cylinder, 12.7 liter, 430 horsepower, in-line turbocharged diesel engine built by Detroit Diesel
 - (7) Allison HD 4560P six-speed automatic transmission
 - (8) Collision Warning System (CWS) that warns the driver of potentially dangerous driving situations by activating visual and audible alerts.
- e. For operation in arctic conditions, the M915A3 can be equipped with an arctic heater mounted under the cab, above the battery box. This provides heat for the cab and engine cooling system. The arctic heater may be operated prior to starting the engine to provide preheating of engine block.

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS



KEY	COMPONENT	DESCRIPTION
1	Marker Clearance Lights	Indicate outline of truck.
2	Side Mirrors (Heated)	Provide driver with a view of sides of truck and semitrailer, if towing.
3	Grabhandles	Provide a hand hold for personnel climbing on truck.
4	Utility Power Receptacle	Supplies power for work lights. Located on both sides of truck.
5	Air Horn	Provides an audible alert.
6	Master Battery Switch	Provides battery power to truck.
7	Spare Wheel and Tire	Extra wheel and tire used in case of a flat tire.
8	Battery Box and Steps	Holds vehicle batteries and provides steps to access cab.
9	Front Service Lights	Include headlights and turn signals.
10	Bumper Extensions	Provide adjustable attachment point for slings.
11	Blackout Lights	Used during blackout conditions. Include marker and drive lights.
12	Towing Eyes	Provide attachment points for towing device.

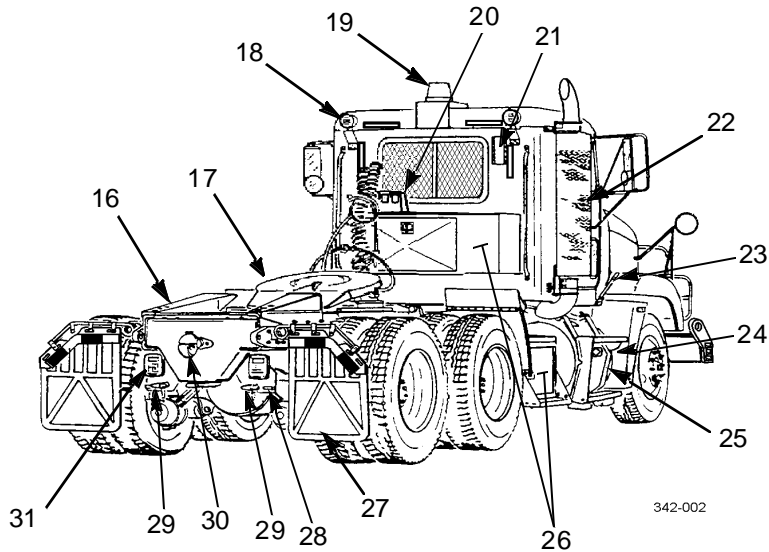
EQUIPMENT DESCRIPTION AND DATA - CONTINUED

0002 00

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

KEY	COMPONENT	DESCRIPTION
13	CWS Antenna	Forward looking collision warning system antenna.
14	Brush Guard	Protects front of hood and components under hood from damage.
15	Spotting Mirrors	Provide added visibility to sides and front of truck.

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED



KEY	COMPONENT	DESCRIPTION
16	Ramp	Sloped surface serves as an approach to fifth wheel and facilitates coupling of semitrailer.
17	Fifth Wheel	Coupling device for semitrailers with kingpins.
18	Utility Lights	Illuminate area in back of cab. There is one light on each side of cab.
19	Strobe Warning Light	Strobe light alerts other vehicles of presence of truck.
20	Intervhicular Receptacles Installation	Contains 12-volt commercial, 24-volt military, and trailer ABS receptacles.
21	Antenna Mount	Mount for radio antenna.
22	Exhaust Muffler	Deadens noise of engine exhaust.
23	Hood Latch	Locks hood closed. Located on both sides of hood.
24	CWS Side Sensor	Side looking collision warning system sensor.
25	Fuel Tank	Holds fuel. Steps mounted to tank provide access to cab.
26	Storage Boxes	Provide stowage area for BII and other items.
27	Mud Flaps	Prevent water and debris from spraying up on passers by or towed semitrailer.

EQUIPMENT DESCRIPTION AND DATA - CONTINUED

0002 00

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS - CONTINUED

KEY	COMPONENT	DESCRIPTION
28	Blackout Lights	Used during blackout conditions.
29	Trailer Gladhands	Provide air supply for trailer brakes.
30	Pintle Hook	Coupling device for trailers with lunettes.
31	Taillights	Contain composite tail, stop, backup, and turn signal lights.

EQUIPMENT DESCRIPTION AND DATA - CONTINUED

0002 00

EQUIPMENT DATA

Dimensions:

Length (Overall)	276 in (701 cm)
Height (Overall)	118 in (300 cm)
Width (Overall)	100 in (254 cm)
Wheelbase	162 in (411 cm)
Ground Clearance	9 in (23 cm)
Angle of Approach	27°

Weights:

Curb	19,080 lb (8662 kg)
GVWR	52,000 lb (23,608 kg)
GCWR	105,000 lb (46,670 kg)
Front Axle (Loaded)	12,000 lb (5448 kg)
Rear Axle (Loaded)	40,000 lb (18,160 kg)

Capacities:

Engine Oil (Refill w/Filters)	41 qt (38.81 l)
Cooling System	65 qt (61.5 l)
Fuel Tank	100 gal. (378.5 l)
Power Steering Reservoir	2 qt (1.9 l)
Transmission	51 qt (48 l)
Rear Axle (Forward/Rear)	13/14.5 qt (12.3/13.7 l)

Engine:

Manufacturer	Detroit Diesel
Type	4-stroke, in-line turbocharged diesel
Model	DDEC IV
Cylinders	6
Displacement	755 CID (12.7 l)
Torque @ 1200 rpm	1400 lb-ft (1898 Nm)
Maximum Horsepower @ 2100 rpm	430 (320.6 kW)
Maximum Governed Speed	2100 rpm
Oil Filter Type	2 full flow, replaceable elements
Oil Filter Quantity	2

Fuel System:

Type	diesel fuel injected
Fuel Filter Type	1 primary, 1 secondary replaceable element

Air Cleaner:

Type	dry element
Quantity	1

EQUIPMENT DESCRIPTION AND DATA - CONTINUED**0002 00****EQUIPMENT DATA - CONTINUED****Cooling System:**

Radiator Working Pressure	10 psi (69 kPa)
Coolant Inhibitor Filter	1 replaceable element

Electrical System:

Type	dual 12/24 volt
Batteries:	
Quantity	4
Voltage	12 volt

Transmission:

Manufacturer	Allison
Model	HD 4560P
Type	6-speed automatic
Shift Selector	pushbutton

Front Axle:

Manufacturer	Rockwell
Type	I-beam, FF961
Rated Capacity	12,000 lb (5448 kg)
Maximum Steering Angle	32°

Rear Axle (Tandem):

Manufacturer	Rockwell, RT 40-145P
Rated Capacity	38,000 lb (17,252 kg)
Ratio	4.44:1
Inter-axle Differential	bevel gear
Traction Control	air controlled

Brake System:

Actuation	air-mechanical
Pressure Range	60-120 psi (414-827 kPa)
Airbrake Chambers:	
Service	2 on front axle
Failsafe (Spring)	4 on forward-rear and rear-rear axles
ABS (Anti-lock Brake System):	
Type	4-channel
Location	front axle and rear-rear axle

Wheels:

Size	22.5 x 8.25 in
Number of Studs/Stud Size	10/1.125 in

Tires:

Type	tubeless, radial on-highway
Size	11R22.5
Ply Rating	14PR
Load Range	H

EQUIPMENT DESCRIPTION AND DATA - CONTINUED

0002 00

EQUIPMENT DATA - CONTINUED

Tires - Continued:

Inflation Pressure (Maximum Load):

Front	105 psi (724 kPa)
Rear	100 psi (690 kPa)
Spare	105 psi (724 kPa)

Steering:

Manufacturer	TRW
Steering Gear Type	single gear
Actuation	hydraulic power booster
Power Steering Pump	Eaton B165R
Turning Diameter	53 ft 9 in (16.4 m)
Steering Column and Wheel:	
Type	tilt, telescoping
Tilt Range	15°
Telescoping Range	2-5/8 in (67 mm)

Suspension:

Front	Single leaf spring w/shock absorbers
Rear	TufTrac w/shock absorbers

Towing Attachments:

Pintle Hook:

Manufacturer	Holland
Model	no. 760
Rated Capacity	30 tons (27.2 metric tons)

Towing Eyes:

Quantity	2 front, 2 rear
Maximum Load Capacity, Each (Up to 45° Angle Front Long. Axis)	60,000 lb (27,240 kg)

Fifth Wheel:

Manufacturer	Holland
Type	36 in (91.4 cm) diameter, 2-way oscillating, low lube
Capacity	30,000 lb (13,620 kg)
Height (Empty)	52 in (132.1 cm)
Pitch (Fwd/Aft)	15/10°
Kingpin Size	2 in (5.1 cm)

Cab:

Manufacturer	Freightliner
Construction	aluminum
Type	2-passenger, tilt-forward hood
Air Deflector	adjustable

EQUIPMENT DESCRIPTION AND DATA - CONTINUED

0002 00

EQUIPMENT DATA - CONTINUED

Accessories:

Utility Lights	2 fixed, top rear of cab
Air Horn	1, under cab

Military Load Classification:

Vehicle w/o Trailer	8
Vehicle w/Trailer:	
M871	14/35
	(unloaded/loaded)
M872	14/46
	(unloaded/loaded)
M1062	11/34
	(unloaded/loaded)

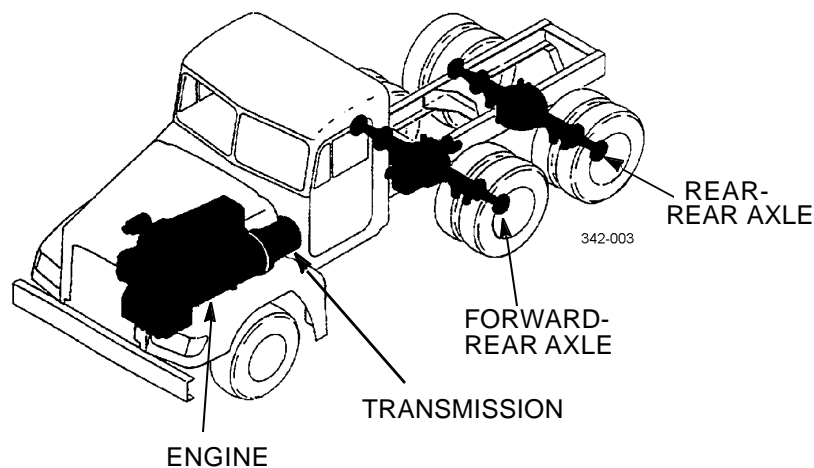
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INTRODUCTION

1. The M915A3 Tractor Truck consists of the following functional systems: drive train, fuel system, exhaust system, cooling system, electrical system, air system, brake system, steering system, traction control system, suspension system, air conditioning system, and collision warning system.
2. This work package explains how the components and systems of the M915A3 work together. A functional description is provided for each major component and system.

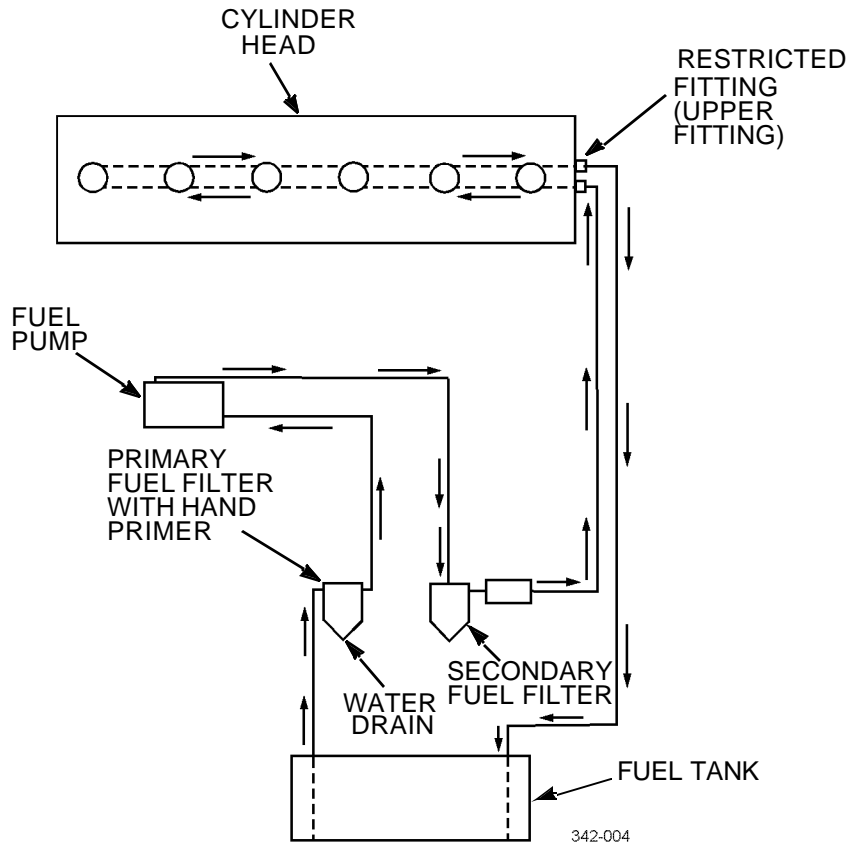
DRIVE TRAIN

The drive train of the M915A3 consists of a Detroit Diesel, DDEC IV engine and an Allison 6-speed automatic transmission connected to RT 40-145P rear tandem axles.

**FUEL SYSTEM**

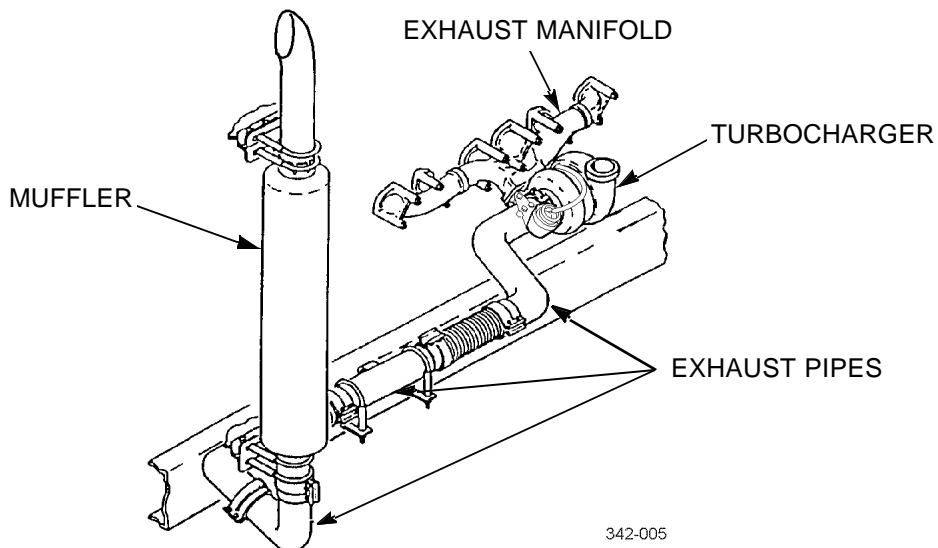
1. Fuel to power the engine is pumped out of the fuel tank by an engine-mounted fuel pump. The engine fuel system consists of one electronic unit injector per cylinder, a transfer pump, low-pressure fuel lines, and primary and secondary fuel filters.
2. The engine is governed by an electronic control system. The system controls idle speed and limits engine maximum speed. The driver controls engine speed through the position of the electronic throttle position sensor (foot pedal).
3. Fuel filters are spin-on types. The primary fuel filter has a hand fuel primer pump and a water drain.
4. Fuel may be drained from the tank through the drain port located on the bottom of the tank.
5. There is a computer-controlled ether quick-start system for use in cold weather.

FUEL SYSTEM - CONTINUED



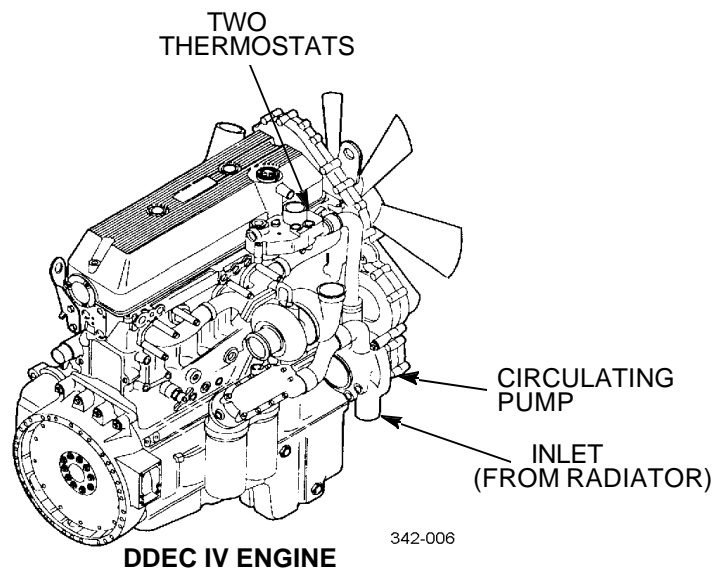
EXHAUST SYSTEM

The exhaust system removes exhaust gases from the engine through the exhaust manifold and turbocharger. The gases flow into exhaust pipes and a muffler to the atmosphere above the cab.



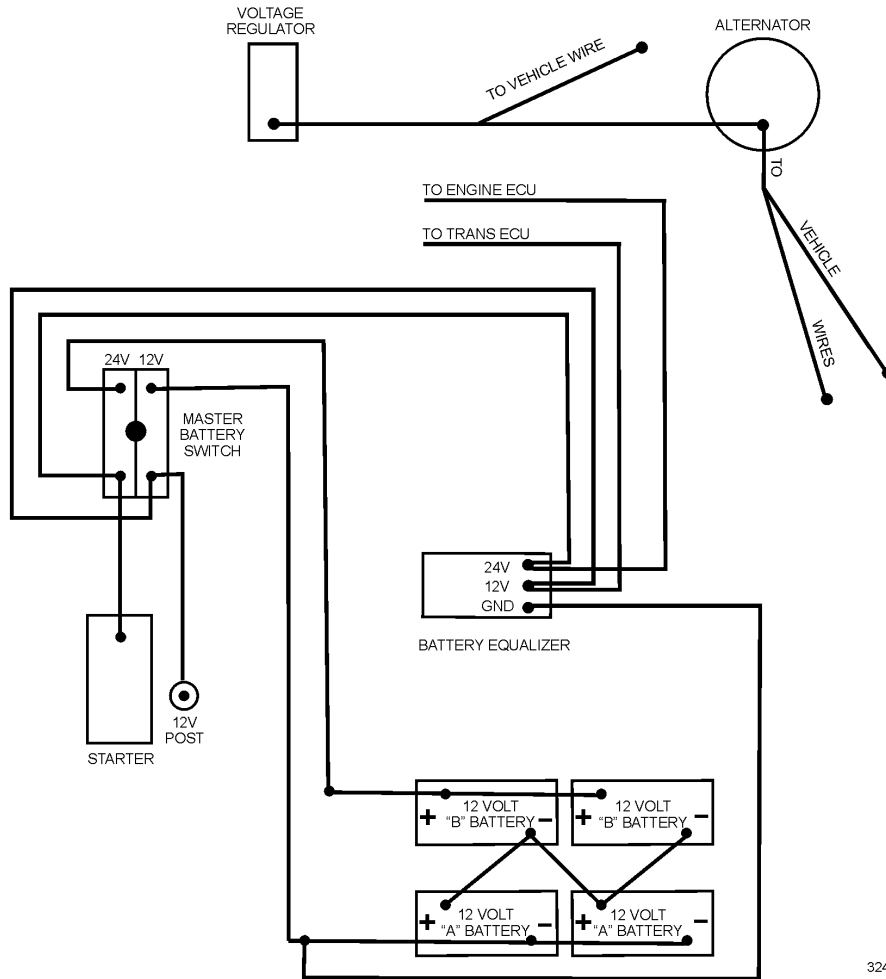
COOLING SYSTEM

The cooling system consists of one circulating pump, a remote-mounted coolant filter, two 180°F (82°C) thermostats for controlling fluid flow, a transmission oil cooler, a radiator, and a belt-driven fan. The cooling system cools the engine by circulating pressurized ethylene glycol based coolant through the engine and radiator.

**ELECTRICAL SYSTEM**

1. Four 12-volt batteries connected in series-parallel supply the 12-volt electrical system and provide 24 volts for the starter motor, blackout lights, accessories, and trailer connectors.
2. The Dual Voltage Alternator Control (DUVAC), mounted on the firewall in the engine compartment, regulates the distribution of 12 and 24 volts.

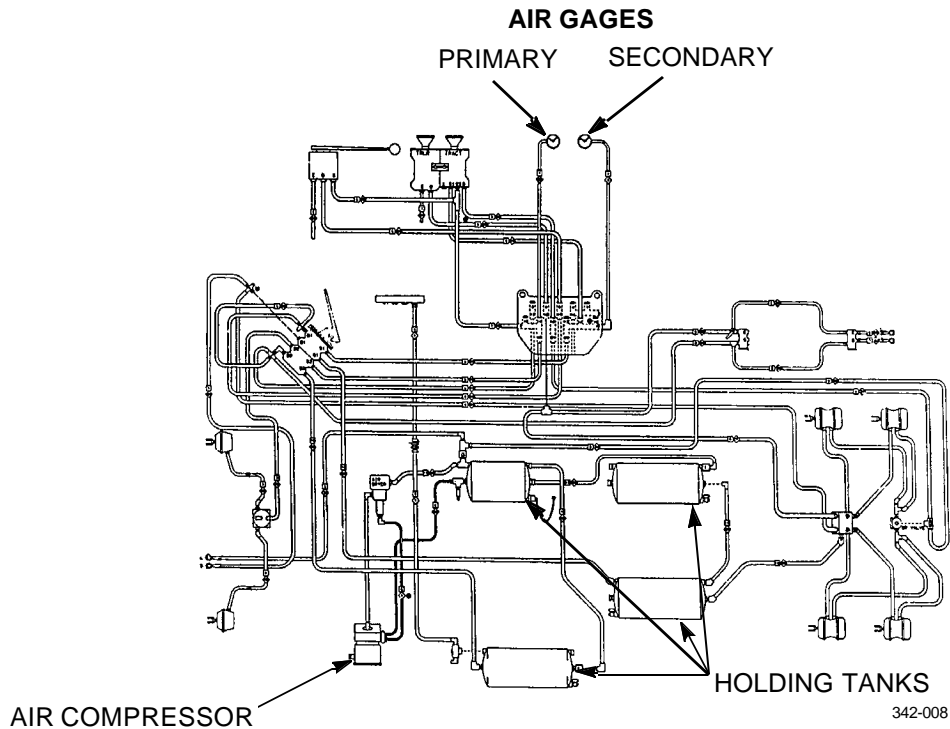
ELECTRICAL SYSTEM - CONTINUED



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AIR SYSTEM

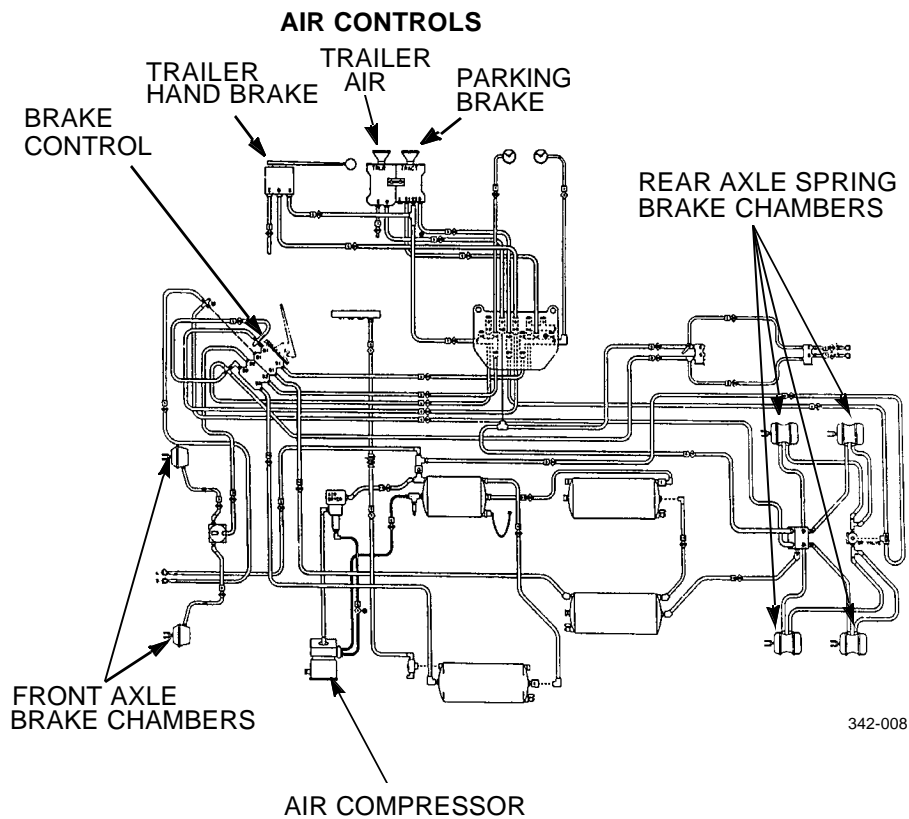
The air system consists of the air compressor, air dryer, air reservoirs, and various air lines. Also included in the air system are air pressure gages, located on the instrument panel, for monitoring air pressure for safe operation of all air-operated components of the vehicle.

**BRAKE SYSTEM**

1. The dual air brake system consists of two independent air brake systems that use a single set of brake controls. Each system has its own reservoirs, plumbing, and brake chambers. The primary system operates the service brakes on the rear axle and the secondary system operates the service brakes on the front axle. On tractor-trailer configurations, service brake signals from both systems are sent to the trailer.
2. Loss of air pressure in the primary system causes the rear service brakes to become inoperative. Front brakes will continue to be operated by secondary system air pressure. In addition, trailer brakes will be operated by the secondary system. Loss of secondary system air pressure causes the front axle brakes to become inoperative. Rear service brakes and trailer brakes will be operated by the primary system.

BRAKE SYSTEM - CONTINUED

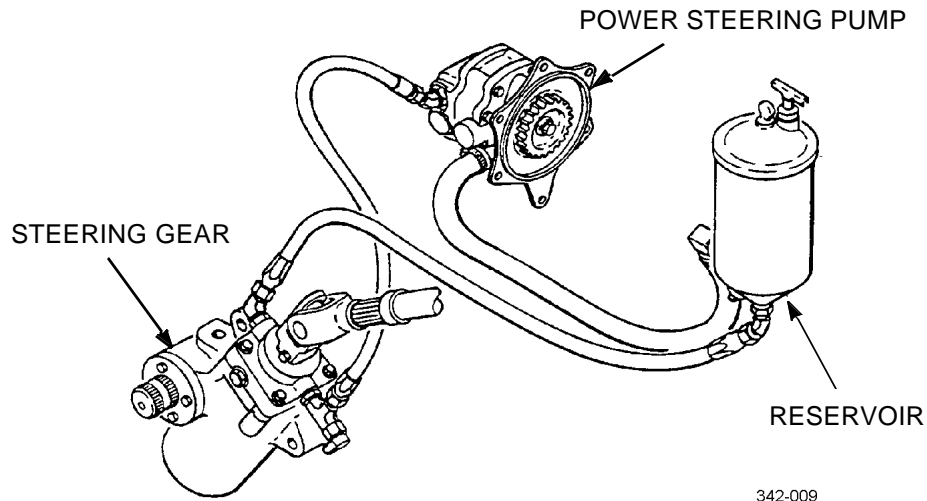
3. The warning light and buzzer inside the cab are activated if air pressure drops below 64 psi (441 kPa) in either brake system. If this happens, check air pressure gages to determine which system has low air pressure. Although vehicle speed can be reduced using the foot brake control pedal, either the front or rear service brakes will not operate, resulting in a longer stopping distance. Bring vehicle to a safe stop and have the air system repaired before continuing.
4. If the primary brake system becomes inoperative, the spring parking brakes automatically apply when air pressure drops to 35-45 psi (241-310 kPa).
5. The vehicle has a four-channel anti-lock brake system (ABS) and cam-operated service brakes with non-asbestos brake-shoes.
6. The M915A3 has automatically adjusting slack adjusters. On all axles, brake chambers have a stroke alert indicator which allows the operator to monitor brakeshoe wear.



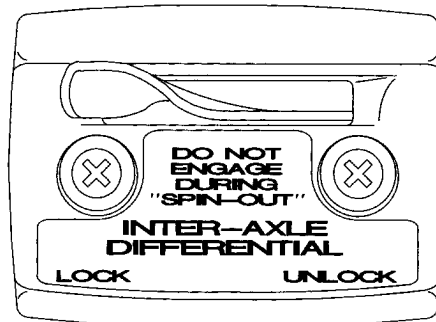
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STEERING SYSTEM

1. The power steering system consists of an integral steering gear (which includes a manual steering mechanism and hydraulic control valve), hydraulic hoses, power steering pump, reservoir, and other components.
2. The power steering pump, driven by the engine, provides the power assist for the steering system.

**TRACTION CONTROL SYSTEM**

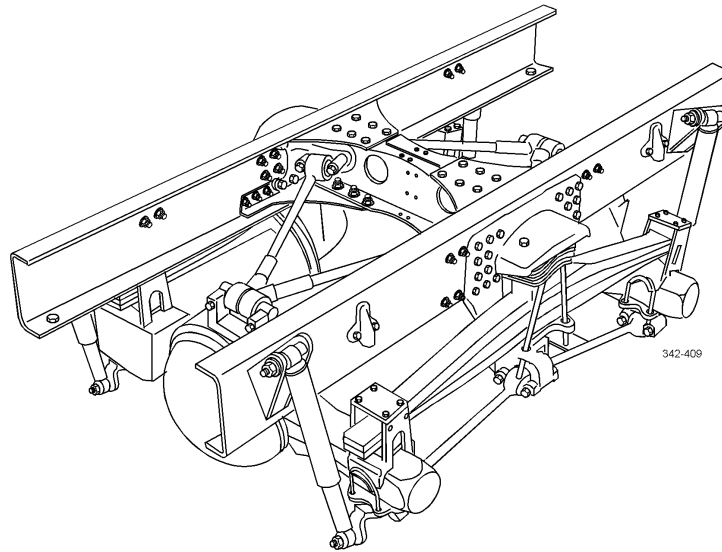
The inter-axle differential lock is controlled by the air operated lever labeled **INTER-AXLE DIFFERENTIAL** on the driver's instrument panel. Under normal driving conditions, the control lever should be in the **UNLOCKED** position. During poor driving conditions, the control lever may be moved to the **LOCKED** position to improve traction. When the inter-axle differential lock is applied, the drive shaft becomes a solid connection between the two rear axles.



342-158

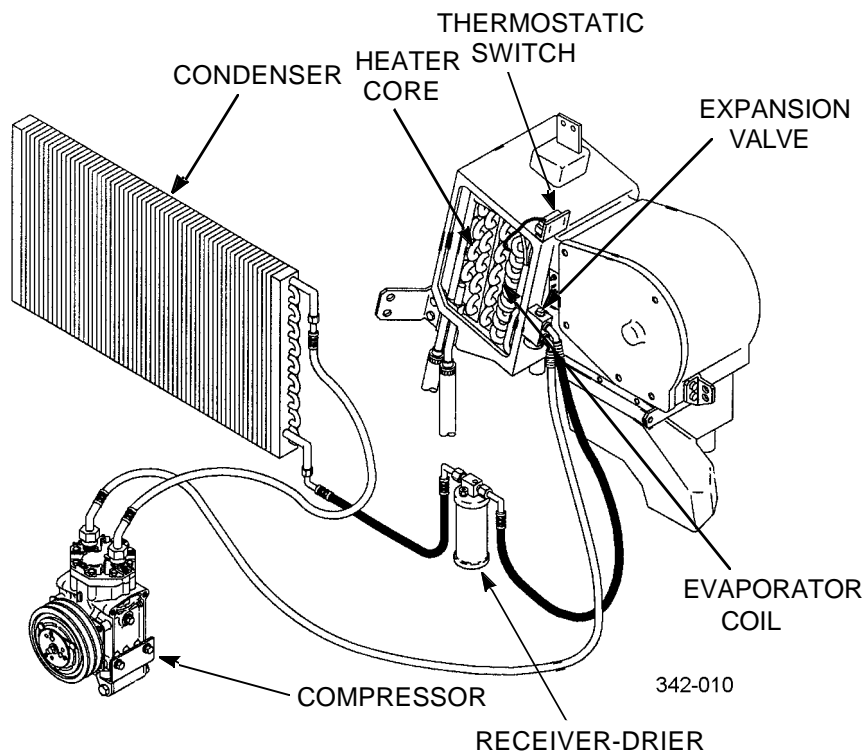
REAR SUSPENSION SYSTEM

The TufTrac rear suspension system consists of two parabolic taper-leaf springs and two shock absorbers per side and an arrangement of torque rods. The rear suspension system is designed to provide a high degree of ground clearance and articulation while maintaining an equal load over each wheel. Ride characteristics are similar, whether loaded or unloaded.



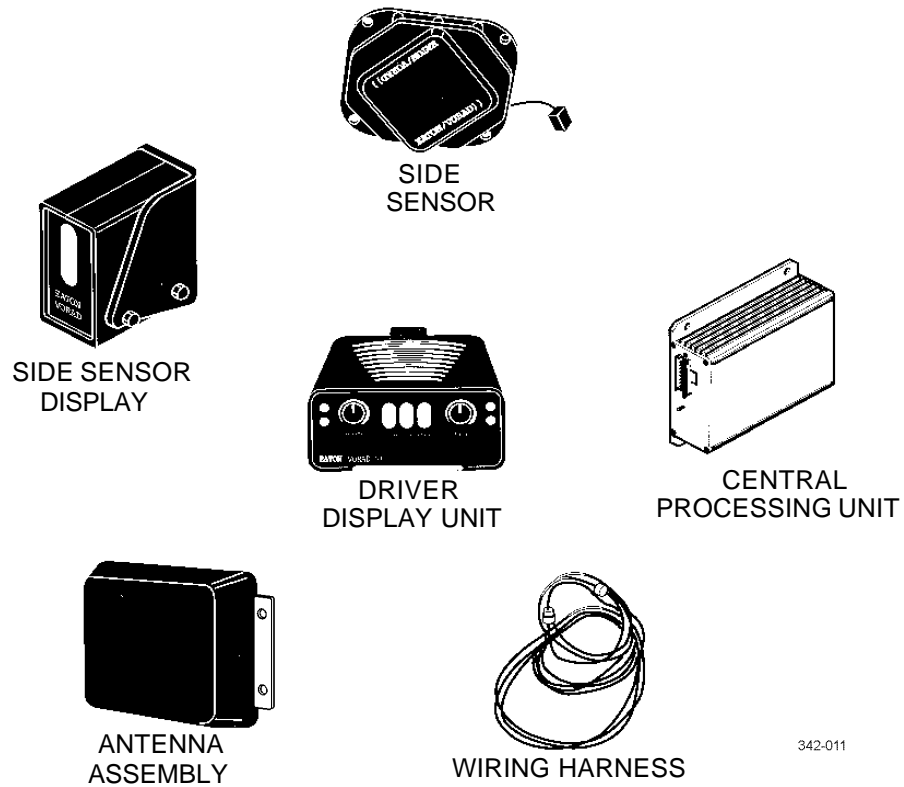
AIR CONDITIONING SYSTEM

1. The air conditioning unit is part of the heater and is mounted under the glove compartment. It is a single unit consisting of a heater core, air conditioning evaporator coil, blower motor, control valves, and air ducts.
2. The system is turned on by the mode control lever on the instrument panel in the cab. The four-speed blower switch controls flow rate.
3. An even cab temperature is maintained by controlling the coolant flow through the heater core, or refrigerant flow through the evaporator coil.



COLLISION WARNING SYSTEM (CWS)

1. The Collision Warning System (CWS) consists of an antenna assembly, central processing unit, driver display unit, side sensor, side sensor display, and wiring harness.
2. The CWS is a forward and side looking radar system that transmits and receives signals reflected off of objects to the front and side of the tractor.
3. The forward looking antenna assembly determines distance, azimuth, and approximate speed of vehicle forward of the tractor.
4. The side sensor detects vehicles or objects from two to ten feet, moving or stationary, alongside the tractor.



342-011

CHAPTER 2
DIRECT SUPPORT AND GENERAL SUPPORT
TROUBLESHOOTING

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INTRODUCTION

This work package contains introductory information on troubleshooting, testing, and repair of the M915A3 Tractor Truck. Make sure the problems are real. Be sure the electrical power is on when needed. Refer to the preliminary troubleshooting procedures before you start troubleshooting, and during troubleshooting, when referenced.

PRELIMINARY TROUBLESHOOTING PROCEDURES**NOTE**

Fluid leaks are classified as either Class I, Class II or Class III

- Class I:* Seepage of fluid, as indicated by wetness or discoloration, not great enough to form drops.
- Class II:* Leakage of fluid great enough to form drops, but not enough to cause drops to drip from the item being checked or observed.
- Class III:* Leakage of fluid great enough to form drops that fall from the item being checked or observed.

Before starting any specific troubleshooting procedures, perform the following:

- a. Visually check for ruptured oil hoses or tubes, and for Class II or Class III leaks.
- b. Check for mechanical jamming or binding caused by rocks or other foreign matter.
- c. Check fluid levels in subject area and service as required (TM 9-2320-302-10 or Unit PMCS).

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TROUBLESHOOTING SYMPTOM INDEX

0005 00

Malfunction/Symptom

Page Number

ENGINE

- 1. Engine Fails to Crank 0006 00-1
- 2. Engine Cranks, But Does Not Start 0006 00-1
- 3. Engine Runs Erratically 0006 00-1
- 4. High Oil Consumption 0006 00-1

TRANSMISSION

Refer to WP 0007 00.

STEERING

- 1. Abnormal Noise 0008 00-1
- 2. No Recovery 0008 00-1
- 3. External Oil Leaks from Steering Gear 0008 00-2
- 4. Oversteer or Darting 0008 00-3
- 5. High Steering Effort in One Direction 0008 00-3
- 6. High Steering Effort in Both Directions 0008 00-3

AIR CONDITIONING SYSTEM

- 1. Warm Airflow When Air Conditioner Is On 0009 00-7
- 2. Low Evaporator Coil Outlet Pressure (Low Compressor Suction Pressure). 0009 00-7
- 3. High Compressor Discharge Pressure 0009 00-7
- 4. Evaporator Outlet Air Temperature Increases as Compressor Discharge Pressure Drops 0009 00-7
- 5. Compressor Operates Too Often or Continuously 0009 00-8
- 6. Quick or Delayed Cycling of Compressor 0009 00-8

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Table 1. Engine Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Engine Fails to Crank.	Using accessory drive, attempt to rotate engine.	If engine cannot be rotated, internal damage is indicated. Remove engine (WP 0010 00).
2. Engine Cranks, But Does Not Start.	<ol style="list-style-type: none"> 1. Inspect engine gear train for correct timing mark alignment. 2. Inspect engine gear train for damaged or missing gear teeth. 	<p>Remove gear case cover and confirm timing mark alignment (WP 0019 00).</p> <p>Replace damaged gear train components (WP 0035 00)</p>
3. Engine Runs Erratically.	<ol style="list-style-type: none"> 1. Inspect engine gear train for correct timing mark alignment. 2. Inspect engine gear train for damaged or missing gear teeth. 	<p>Remove gear case cover and confirm timing mark alignment (WP 0019 00).</p> <p>Replace damaged gear train components (WP 0035 00).</p>
4. High Oil Consumption.	<ol style="list-style-type: none"> 1. Clean and inspect engine for signs of external oil leaks. 2. Inspect rear of engine for signs of leaking oil. 3. Inspect front of engine for signs of leaking oil. 4. Inspect turbocharger for signs of leaking oil. 5. Inspect oil pan for signs of leaking oil. 	<p>If no oil leaks are identified, internal damage is indicated. Remove engine (WP 0010 00).</p> <p>If oil leaks are found, inspect and replace crankshaft rear oil seal (WP 0023 00).</p> <p>If oil leaks are found, inspect and replace crankshaft front oil seal (WP 0031 00).</p> <p>If oil leaks are found, replace or repair turbocharger (WP 0042 00 or WP 0043 00).</p> <p>If oil leaks are found, replace oil pan gasket (WP 0028 00).</p>

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NOTE

Refer to TM 9-2320-302-20 for transmission troubleshooting.

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Table 1. Steering System Troubleshooting Procedures.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<p>1. Abnormal Noise.</p> <p>2. No Recovery.</p>	<ol style="list-style-type: none"> 1. If clicking noise is heard when initiating steering maneuver or when changing directions of turn, some linkage component is probably loose and shifting under load. 2. Check for excessive air in fluid (fluid is foamy) and/or low fluid level. <ol style="list-style-type: none"> 1. Disconnect lower steering column from steering gear and check steering column for binding. 2. Check for sufficient pump pressure as follows: <ol style="list-style-type: none"> (a) Disconnect pressure hose from power steering pump. (b) Connect adapter hose from adapter kit (Item 4, WP 0126 00) to power steering pump. (c) Connect hose from dial end of power steering tester (Item 127, WP 0126 00) to adapter hose. (d) Connect hose from load valve end of power steering tester to pressure hose. <p style="text-align: center;">CAUTION</p> <p>Before performing step e, ensure load valve is completely open to prevent damage to flow/pressure valve.</p> <ol style="list-style-type: none"> (e) With engine idling, rotate steering wheel to left and right for 5 minutes to warm power steering fluid. <p style="text-align: center;">CAUTION</p> <p>To prevent damage to power steering pump during performance of step f, do not allow load valve to be closed for more than 5 seconds.</p>	<p>Tighten or replace loose or defective components.</p> <p>Fill pump reservoir to proper level (TM 9-2320-302-10).</p> <ol style="list-style-type: none"> 1. Replace defective tilt steering column (WP 0090 00). 2. Replace defective universal joint (TM 9-2320-302-20).

Table 1. Steering System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<p>2. No Recovery - Continued.</p>	<p>(f) With engine idling, close load valve and read pressure gage. Pressure must be 900 to 1000 psi (62.07 to 68.97 bars).</p> <p>3. Check for sufficient pump flow as follows:</p> <p>(a) Perform steps a through e of step 2.</p> <p style="text-align: center;">WARNING</p> <p>Maximum flow rate is 7 gpm (26.5 liters/min). Flow rate in excess of 7 gpm (26.5 liters/min) will damage steering gear and could cause loss of steering and injury to personnel.</p> <p>(b) With engine idling, read flow meter. Rate of flow must be 7 gpm (26.5 liters/min).</p> <p>(c) With engine idling, close load valve until pressure gage indicates pump relief and pump relief pressure drops to 0. Immediately open load valve. Flow rate must return to 7 gpm (26.5 liters/min).</p> <p>(d) Run engine at 2100 rpm and fully close load valve until pressure gage indicates pump relief and flow rate drops to 0. Immediately open load valve. Flow rate must return to 7 gpm (26.5 liters/min).</p> <p>4. Check for defective teflon seals in steering control valve.</p> <p>5. Check for steering gear control valve sticking.</p>	<p>If pressure is less than 900 psi (62.07 bars), repair or replace power steering pump (WP 0087 00 or WP 0086 00).</p> <p>Repair or replace power steering pump (WP 0087 00 or WP 0086 00).</p> <p>Repair or replace power steering pump (WP 0087 00 or WP 0086 00).</p> <p>Repair or replace power steering pump (WP 0087 00 or WP 0086 00).</p>
<p>3. External Oil Leaks from Steering Gear.</p>	<p style="text-align: center;">NOTE</p> <p>External leakage is not acceptable from steering gear.</p> <p>1. Check for leak at rubber relief plug (on frame side of steering gear).</p> <p>2. Check for leak at shaft seals.</p>	<p>Repair or replace steering gear (WP 0089 00 or WP 0088 00).</p> <p>Repair or replace steering gear (WP 0089 00 or WP 0088 00).</p>

Table 1. Steering System Troubleshooting Procedures - Continued.

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<p>4. Oversteer or Darting.</p>	<p>1. Disconnect lower steering column from steering gear and check steering column for binding.</p> <p>2. Disconnect steering gear pitman arm and check front end components for binding.</p>	<p>1. Replace defective tilt steering column (WP 0090 00).</p> <p>2. Replace defective universal joint (TM 9-2320-302-20).</p> <p>Replace defective components (TM 9-2320-302-20).</p>
<p>5. High Steering Effort in One Direction.</p>	<p>1. Check for sufficient pump pressure (Malfunction 2, step 2).</p> <p>2. Check for sufficient pump flow (Malfunction 2, step 3).</p> <p>3. Check for defective teflon seals in steering control valve.</p> <p>4. Check for steering gear control valve sticking.</p>	<p>If pressure is less than 900 psi (62.07 bars), repair or replace power steering pump WP 0087 00 or WP 0086 00).</p> <p>Repair or replace power steering pump (WP 0087 00 or WP 0086 00).</p> <p>Repair or replace steering gear (WP 0089 00 or WP 0088 00).</p> <p>Repair or replace steering gear (WP 0089 00 or WP 0088 00).</p>
<p>6. High Steering Effort in Both Directions.</p>	<p>1. Check for sufficient pump pressure (Malfunction 2, step 2).</p> <p>2. Check for sufficient pump flow (Malfunction 2, step 3).</p> <p>3. Check for defective teflon seals in steering control valve.</p> <p>4. Check for steering gear control valve sticking.</p> <p>5. High steering effort in one direction.</p>	<p>If pressure is less than 900 psi (62.07 bars), repair or replace power steering pump WP 0087 00 or WP 0086 00).</p> <p>Repair or replace power steering pump (WP 0087 00 or WP 0086 00).</p> <p>Repair or replace steering gear (WP 0089 00 or WP 0088 00).</p> <p>Repair or replace steering gear (WP 0089 00 or WP 0088 00).</p> <p>Repair or replace steering gear (WP 0089 00 or WP 0088 00).</p>

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PRELIMINARY CHECKS

Before testing the operation of the air conditioning system, make the following checks:

1. Ensure the refrigerant compressor's drive belt is not damaged and is correctly tensioned. Also check the compressor mountings for tightness.
2. Check for broken, burst or cut hoses; also check for loose fittings on all parts.
3. Check for road debris buildup on the condenser coil fins. Using air pressure and a whiskbroom or a soapy spray of water, carefully clean off the condenser; be careful not to bend the fins.
4. Check the color of the moisture indicator sight glass. If the color is a deep cobalt blue, the refrigerant charge is dry. If the indicator is *not* blue, the system is contaminated with moisture. Recover the refrigerant, evacuate the system, replace the receiver-drier, and add a full refrigerant charge (WP 0112 00).
5. If there is not enough airflow, ensure leaves or other debris have not entered the fresh air ports under the windshield. If debris has entered, it could clog the fins of the evaporator core, and block airflow. Also, be sure that all ducts are connected to the dash louvers and that the air-control flaps in the heater housing are moving properly (this requires removal of the right and center dash panel).

PERFORMANCE TESTS

Following is a brief description of symptoms or conditions that could exist if something goes wrong with a refrigerant part.

1. **Receiver-Drier**
 - a. The receiver-drier is normally at outside temperature. To the touch, the entire length of the unit should be the same temperature. If noticeable cool spots exist, replace receiver-drier (WP 0118 00).
 - b. A blockage at the inlet of the unit will cause high head pressures; outlet blockages will cause low head pressures and little or no cooling.
 - c. If the moisture indicator is pink or white (showing that the system is wet), the receiver-drier is saturated with moisture and must be replaced (WP 0118 00).
2. **Cooling System**
 - a. Although they are not physically connected, there is a close tie between vehicle's air conditioner and cooling system. Poor air conditioner cooling can be the result of a problem in the cooling system.
 - b. If the cooling system does not work correctly, the heat of the engine will rise to abnormal levels. The added heat will transfer to the air conditioner, other underhood parts, and may make its way into the cab. The added heat makes it necessary for the air conditioner to work harder and, at the same time, it reduces the air conditioner's ability to cool down the air in the cab. Also, if the water regulating valve isn't closing all the way, heat will enter the cab, giving the impression that the air conditioning system is not working.
 - c. Refer to TM 9-2320-302-20 to troubleshoot engine cooling system.
3. **Expansion Valve**
 - a. Problems that start in the expansion valve show up as follows: when stuck closed, the evaporator coil and the expansion valve will be at outside temperature; when stuck open, both the coil and the valve will be extremely cold with frost or ice buildup.
 - b. Because the expansion valve channels are very small, blockages in the system tend to be found here (the valve is very sensitive to contamination). Usually, the contaminant is water; less than a drop of water is all it takes to make the valve inoperative. When water reaches the valve, the extreme cold that results from the pressure drop freezes the water, forming a block of ice in the valve. After the system shuts down and the valve warms up, the ice melts, and the valve operates again, only to freeze up when the moisture returns.
 - c. On-and-off operation of the expansion valve means that the receiver-drier is not removing moisture from the system. These contaminants should cause the moisture indicator's element to turn white and then pink.

PERFORMANCE TESTS - CONTINUED**4. Refrigerant Compressor.**

- a. Compressor problems usually show in one of four ways: abnormal noise; seizure; leakage; or low suction and discharge pressures.
- b. Resonant compressor noises are not causes for alarm; irregular noise or rattles are likely to be caused by broken parts.

5. Evaporator.

- a. The evaporator coils are basically trouble-free when airflow over the fins is not blocked. External or, less often, internal blockages will cause low suction pressure as well as little or no cooling.
- b. If a leak exists in the system, and it cannot be traced to other parts or fittings, suspect damage to one of the evaporator coils.

6. Condenser.

- a. The condenser is usually trouble-free. Normally, the temperature of the condenser outlet line is noticeably cooler than the inlet line. However, when road debris (such as leaves or dirt buildup) cakes up, airflow over the condenser fins is blocked; air is not able to absorb enough heat to turn the hot refrigerant gas into a liquid. High head pressures will result. In these cases, carefully clean off the outer surfaces of the condenser with compressed air or a soap and water solution; be careful not to bend the fins.
- b. High head pressures will also occur if the condenser's tubing is abnormally bent, blocking the flow of refrigerant. Frost will appear at the point where the flow is restricted.
- c. Less common internal blockages (bits of foreign material or metallic grit buildup) will stop the flow of refrigerant.
- d. A quick test to check that poor system performance is caused by the condenser is to direct a spray of water onto the condenser while the system is running. If the air conditioner cools better because of the assist provided by the water, it is a sign that the condenser is not working.
- e. When troubleshooting a suspected condenser problem, remember that the problem may be caused by the radiator transferring high levels of heat to the condenser. Refer to TM 9-2320-302-20 to troubleshoot the engine cooling system.

7. Thermostatic Switch.

- a. **IMPORTANT:** Before troubleshooting the thermostatic switch, check for a full charge of refrigerant in the system. The compressor will not operate, or will cycle too often, if there is not enough refrigerant in the system.
- b. Quick or delayed cycling of the compressor may be caused by a thermostatic switch that is working, but is out of adjustment. If, after doing the tests below, the switch seems to be out of adjustment, replace it (TM 9-2320-302-20) (the thermostatic switch cannot be recalibrated).
 - (1) Ensure the compressor clutch is operating correctly.
 - (2) Expose the evaporator coil.
 - (3) Start the engine. Place the air conditioner control at its coldest setting; turn on the air conditioner and the fan.
 - (4) Place an accurate thermometer in contact with a tube on the evaporator coil. Ensure the thermometer is in good contact with the tube or you will get a wrong reading.

When the temperature drops below 31°F to 36°F (-1°C to 2°C), the compressor clutch should disengage and remain this way until the temperature rises to 39°F to 44°F (4°C to 7°C).
 - (5) If the compressor did not engage when the temperature was above the accepted high range, do the following test:

PERFORMANCE TESTS - CONTINUED

- (a) Connect a voltmeter or a test light from one of the terminals on the thermostatic switch to ground. Repeat this test with the other terminal on the switch.
- (b) With the engine running and the air conditioner and blower on, both terminals will show voltage when the compressor should be engaged; one terminal will show voltage when the compressor should be disengaged.

If there is no voltage, there is a problem in the electrical system from the batteries to the thermostatic switch. Check all circuits for the cause, and repair or replace the wiring or parts.

In all other cases where the compressor is not engaging and disengaging properly, the thermostatic switch is the cause. Replace it with a new switch (TM 9-2320-302-20).

- (6) Shut down the engine and, to prevent accidental electric shock or shorting during dash assembling, disconnect the batteries.
- (7) Assemble the dash.

8. Line Restrictions

- a. A restricted suction line causes low suction pressure at the compressor and little or no cooling. A restriction in a line between the compressor and the expansion valve can cause high discharge and low suction pressure, and insufficient cooling.
- b. Usually, areas of ice or frost buildup mean a blockage. Parts that often freeze up are probably corroded or inoperative and should be replaced. Parts (such as the expansion valve) that freeze up once in a while may do so because of moisture in the system, which will cause the moisture indicator's element to turn white or pink; if this happens, recover the refrigerant charge, evacuate/recycle the system refrigerant, replace the receiver-drier, and install a new charge (WP 0112 00).

SAFETY PRECAUTIONS

1. Whenever repairs are made to any air conditioner parts that hold refrigerant, you must discharge, purge or flush (if contaminated), evacuate, charge, and leak test the system. In a good system, refrigerant lines are always under pressure and you should disconnect them only after the air conditioning system has been discharged to a refrigerant recovery unit through the service valves on the compressor (WP 0112 00).

**WARNING**

Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to the air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.

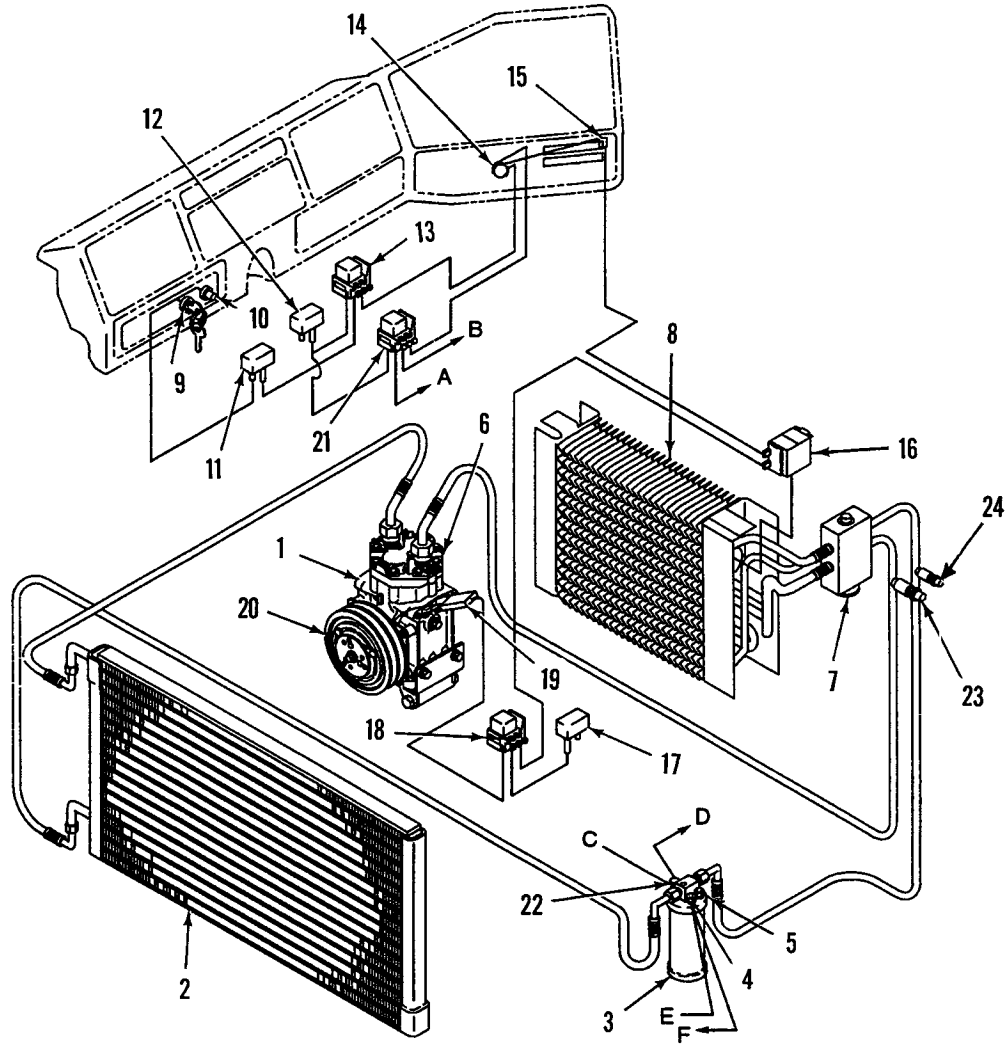
2. Refrigerants are safe when used under the right conditions. Always wear safety goggles and non-leather gloves while discharging, purging, flushing, evacuating, charging, and leak testing the system. Do not wear leather gloves; when refrigerant gas or liquid contacts leather, the leather will stick to your skin.
3. Refrigerant splashed in the eyes should first be treated with a few drops of sterile mineral oil in the eyes, then rinsed with a weak boric acid solution. Do not rub the eyes. Call a doctor right away.
4. Refrigerant splashed on the skin should be treated the same as for frostbite: gently pour cool water on the area, but do not rub the skin. Keep the skin warm with layers of soft, sterile cloth. Call a doctor right away.

SAFETY PRECAUTIONS - CONTINUED**WARNING**

Do not work in an area where refrigerant may contact an open flame or any burning material, such as a cigarette. When it contacts extreme heat, refrigerant breaks down into poisonous phosgene gas which, if breathed, causes severe respiratory irritation. Do not breathe the fumes from an open flame leak detector.

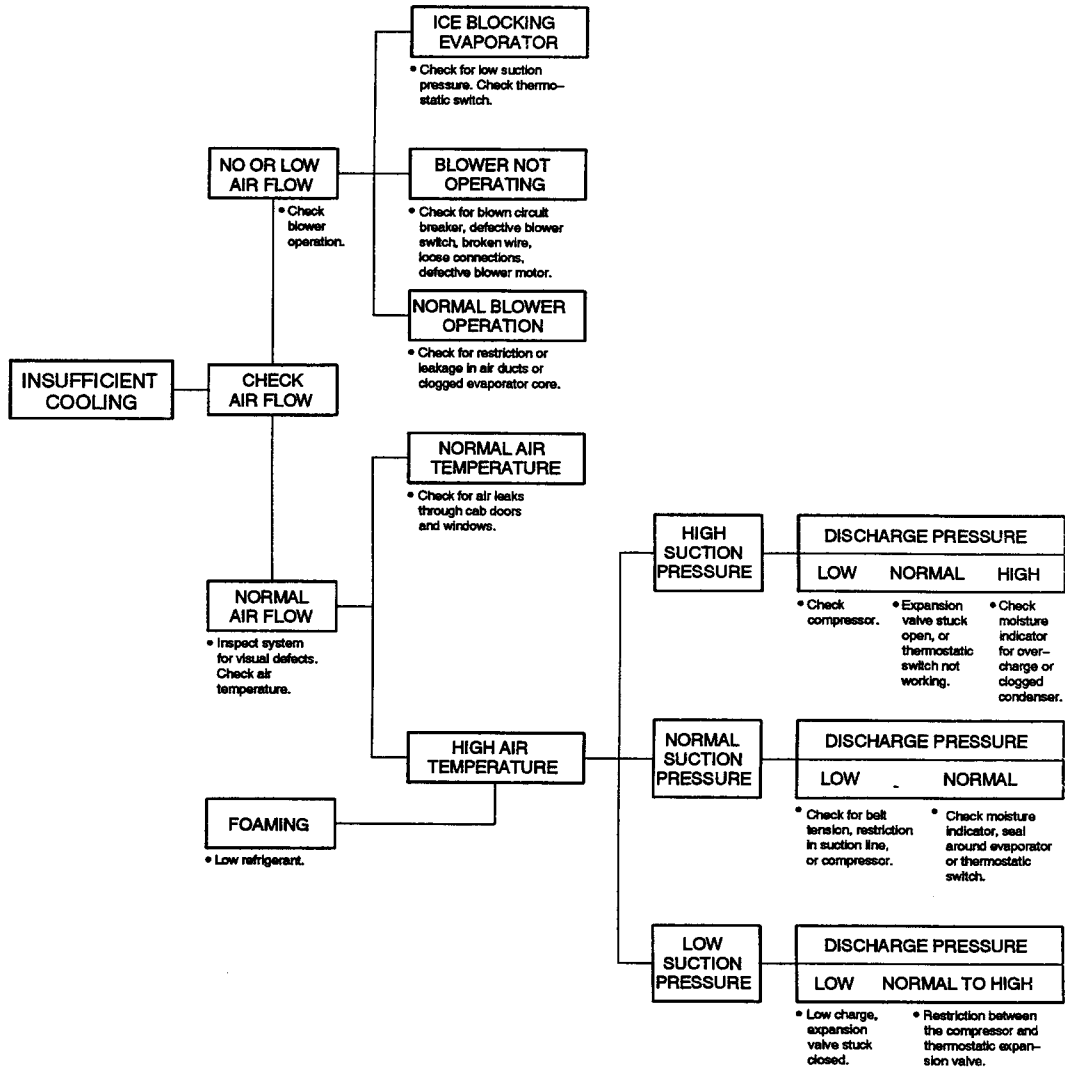
5. Even though refrigerant does not burn, when it contacts extreme heat or flame, poisonous phosgene gas is created. This gas is also produced when an open flame leak detector is used. Phosgene fumes have an acrid (bitter) smell.
6. You must work in an area where there is a constant flow of fresh air when the system is discharged, flushed, charged, and leak tested using an open flame leak detector.
7. Changes in both federal and state laws will affect the way dealerships service air conditioning systems. Under current federal laws, refrigerant must be recovered and recycled by all users to protect the environment, and not released into the atmosphere. Many service operations not directly involving the air conditioning system require the release of the refrigerant charge. Under the new regulations, dealerships not having the required recovery and recycling equipment (and properly trained and certified personnel) will not be allowed to do any of this service work.
8. Because of its very low boiling point, refrigerant must be stored under pressure. To prevent the refrigerant cans from exploding, never expose them to temperatures higher than 125°F (52°C). Never leave refrigerant cans in the sun, and do not store them in sun-exposed areas where heat can build up, such as in gloveboxes, automobile trunks, etc.

AIR CONDITIONING SYSTEM COMPONENTS



- | | | | |
|----------|--------------------------------|----------|------------------------------|
| A | To resistor block | D | To engine fan thermal switch |
| B | To blower motor | E | From a/c clutch relay |
| C | From engine fan thermal switch | F | To compressor clutch |
-
- | | | | | | |
|---|----------------------------|----|-----------------------|----|--------------------------|
| 1 | Compressor | 9 | Ignition Switch | 17 | Circuit Breaker (15A) |
| 2 | Condenser | 10 | Start Button | 18 | A/C clutch Relay |
| 3 | Receiver-drier | 11 | Circuit Breaker (10A) | 19 | Diode |
| 4 | Binary Switch | 12 | Circuit Breaker (30A) | 20 | Compressor Clutch |
| 5 | Moisture Indicator | 13 | Power Relay | 21 | High-speed Relay |
| 6 | High Pressure Relief Valve | 14 | Blower Switch | 22 | Fan Cycling Switch |
| 7 | Expansion Valve | 15 | "On-Off" Microsoft | 23 | Discharger Service Valve |
| 8 | Evaporator | 16 | Thermostatic Switch | 24 | Suction Service Valve |

AIR CONDITIONING SYSTEM TROUBLESHOOTING LOGIC TREE



AIR CONDITIONING SYSTEM TROUBLESHOOTING

Table 1. Problem - Warm Airflow When Air Conditioning Is On.

POSSIBLE CAUSE	REMEDY
There is no refrigerant charge in system.	Repair any leaks, evacuate system (WP 0112 00), replace receiver-drier (WP 0118 00), and add a full charge of refrigerant.
Moisture in system.	If moisture is in system, ice crystals may form at expansion valve, blocking the flow of refrigerant (off and on). Recover refrigerant charge (WP 0112 00), replace receiver-drier (WP 0118 00), evacuate system, and add a full charge of refrigerant (WP 0112 00).

Table 2. Problem - Low Evaporator Coil Outlet Pressure (Low Compressor Suction Pressure).

POSSIBLE CAUSE	REMEDY
The expansion valve is not working	Replace expansion valve (WP 0114 00).
There are restrictions in line to expansion valve.	Remove line restrictions.
There is an insufficient refrigerant charge in system.	Locate leak. Recover refrigerant charge (WP 0112 00), replace receiver-drier (WP 0118 00), and add a full refrigerant charge (WP 0112 00).

Table 3. Problem - High Compressor Discharge Pressure.

POSSIBLE CAUSE	REMEDY
There is an internal restriction in condenser. (Ice buildup on the condenser or a cool spot on the line from the condenser to the receiver-drier).	Replace condenser (WP 0119 00).
Air is present in system.	Repair any leaks, evacuate system (WP 0112 00), replace receiver-drier (WP 0118 00), and add a full charge of refrigerant (WP 0112 00).
Restriction in compressor discharge line.	Repair or replace line (WP 0121 00).

Table 4. Problem - Evaporator Outlet Air Temperature Increases as Compressor Discharge Pressure Drops.

POSSIBLE CAUSE	REMEDY
The expansion valve setting is too low.	Replace expansion valve (WP 0114 00). Add a full charge of refrigerant (WP 0112 00).

AIR CONDITIONING SYSTEM TROUBLESHOOTING - CONTINUED

Table 5. Problem - Compressor Operates Too Often or Continuously.

POSSIBLE CAUSE	REMEDY
There is too little refrigerant in system.	Repair any leaks (WP 0121 00) and add a full charge of refrigerant (WP 0112 00).
There is a restriction in refrigerant system.	Remove restriction from line.

Table 6. Problem - Quick or Delayed Cycling of Compressor.

POSSIBLE CAUSE	REMEDY
Loss of refrigerant is causing a delayed cycling of the compressor.	Add a full charge of refrigerant (WP 0112 00).

CHAPTER 3
DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE INSTRUCTIONS

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POWER PACK REPLACEMENT

0010 00

THIS WORK PACKAGE COVERS

Removal, Power Pack Separation, Power Pack Assembly, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Barring tool, engine (Item 8, WP 0126 00)
- Lift, transmission (Item 75, WP 0126 00)
- Spreader, sling (Item 120, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

- Clamp, seal (P/N KYX00-5833)
- Nut, self-locking (P/N MS51922-33)
- Nut, self-locking (P/N MS51922-49) (26)
- Nut, self-locking (P/N MS51922-57) (2)
- Washer, lock (P/N 103323) (12)
- Washer, lock (P/N 20930-78423) (2)
- Washer, lock (P/N 78328) (2)
- Washer, lock (P/N MS35333-42)
- Straps, tiedown (Item 34, WP 0125 00)
- Tags, marker (Item 35, WP 0125 00)

Personnel Required

Two

Equipment Condition

- Engine oil drained (TM 9-2320-302-10)
- Air system drained (TM 9-2320-302-10)
- Transmission tunnel access cover removed (TM 9-2320-302-20)
- Hood removed (TM 9-2320-302-20)
- Fan impeller and shroud removed (TM 9-2320-302-20)
- Air intake tubes, hoses, and clamps removed (TM 9-2320-302-20)
- Air cleaner, pre-cleaner, and duct assembly removed (TM 9-2320-302-20)
- Alternator/air conditioner belt removed (TM 9-2320-302-20)
- Alternator and alternator adjusting rod removed (TM 9-2320-302-20)
- Fender extensions removed (TM 9-2320-302-20)
- Oil sampling valves removed (TM 9-2320-302-20)
- Driveline disconnected (TM 9-2320-302-20)
- Air conditioner compressor removed (WP 0117 00)
- Transmission oil cooler lines disconnected (TM 9-2320-302-20)
- Transmission wiring harness disconnected (TM 9-2320-302-20)
- Transmission oil fill tube removed (TM 9-2320-302-20)
- Transmission rear mount removed (WP 0070 00)



WARNING



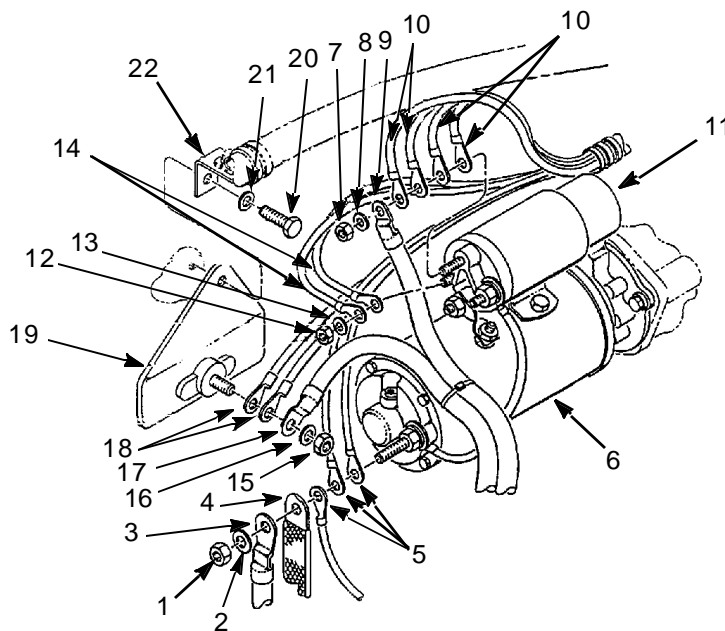
Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

NOTE

Tag all wires, cables, connectors, hoses, and tubes prior to removal to aid in installation.

REMOVAL

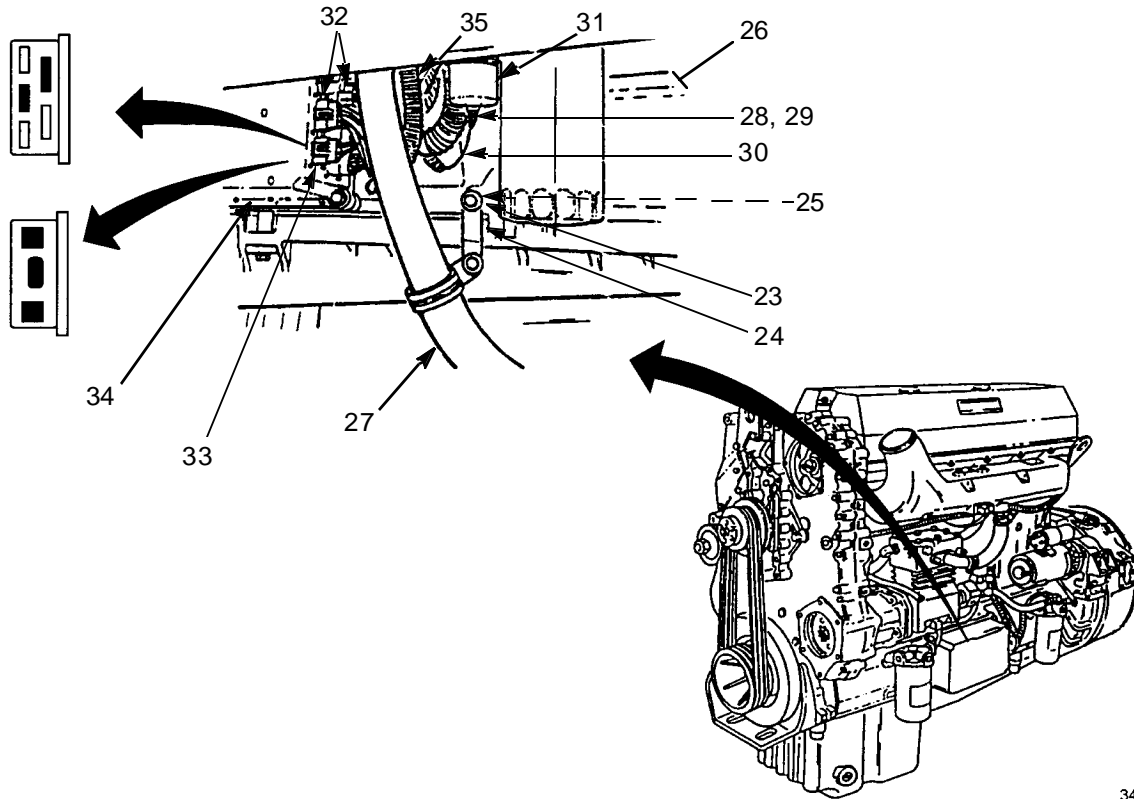
1. Remove nut (1) and washer (2) and disconnect cable (3), ground strap (4), and three wires (5) from starter (6).
2. Remove nut (7) and washer (8) and disconnect cable (9) and four wires (10) from starter solenoid (11).
3. Remove nut (12) and washer (13) and disconnect two wires (14) from starter solenoid (11).
4. Remove nut (15) and washer (16) and disconnect cable (17) and two wires (18) from plate (19).
5. Remove screw (20), washer (21), bracket (22), and plate (19).



342-929

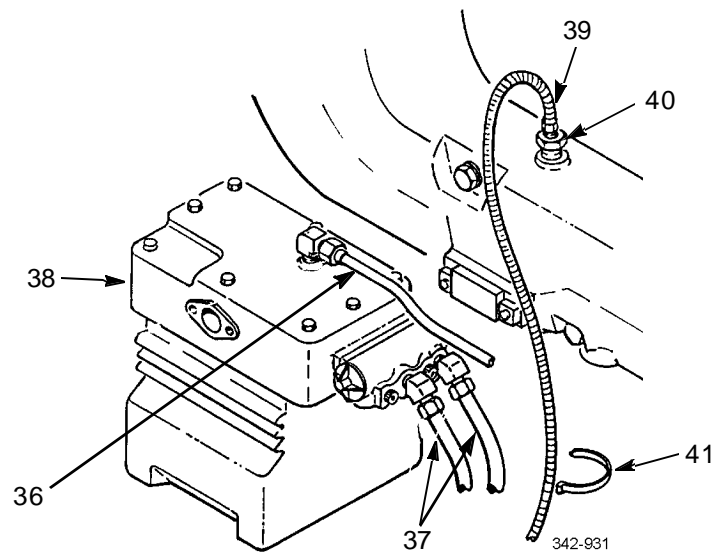
6. Remove screw (23), bracket (24), and spacer (25) from engine block (26). Set cable harness (27) aside.
7. Remove nut (28), washer (29), and wire (30) from fuel pressure sending unit (31).
8. Disconnect electronic control module harness connectors (32 and 33) from connectors located at rear of ECM (34). Cut tiedown straps as required to free harness (35) from engine. Discard tiedown straps.

REMOVAL - CONTINUED



342-930

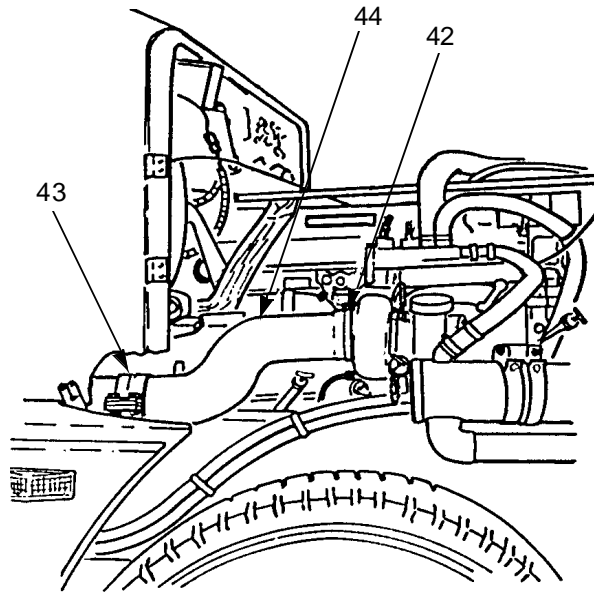
9. Disconnect hose (36) and two tubes (37) from air compressor (38).
10. Remove tube (39), atomizer (40), and tiedown strap (41). Set tube (39) and two tubes (37) aside. Discard tiedown strap.



342-931

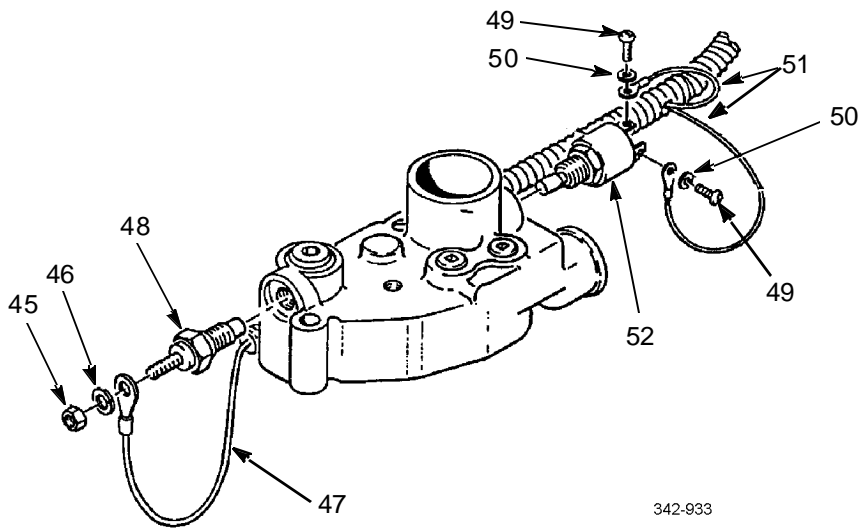
REMOVAL - CONTINUED

11. Remove clamp (42), seal clamp (43), and exhaust pipe (44). Discard seal clamp.



342-932

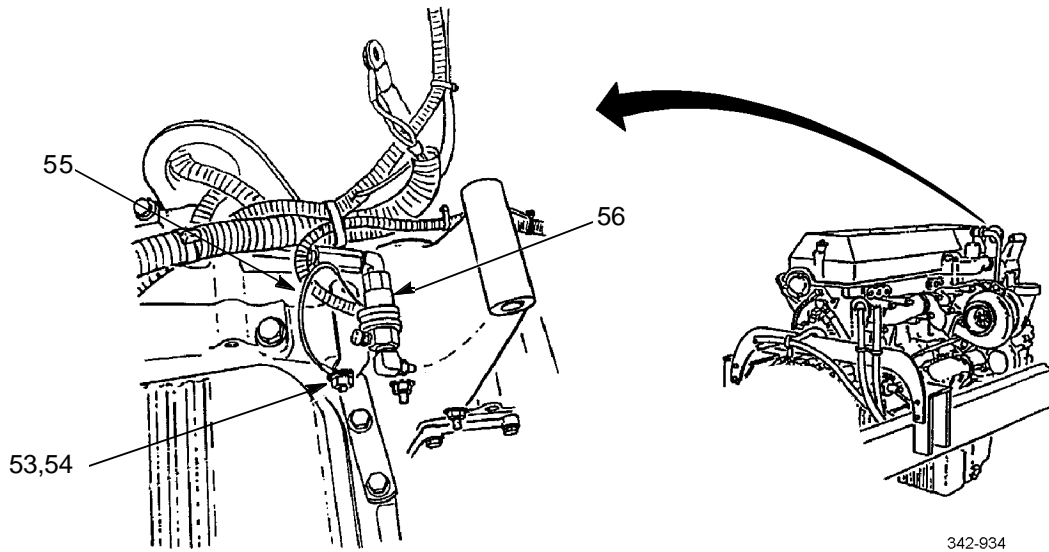
12. Remove nut (45), lock washer (46), and wire (47) from temperature sending unit (48). Discard lock washer.
13. Remove two screws (49), lock washers (50), and wires (51) from temperature sending unit (52). Discard lock washers.



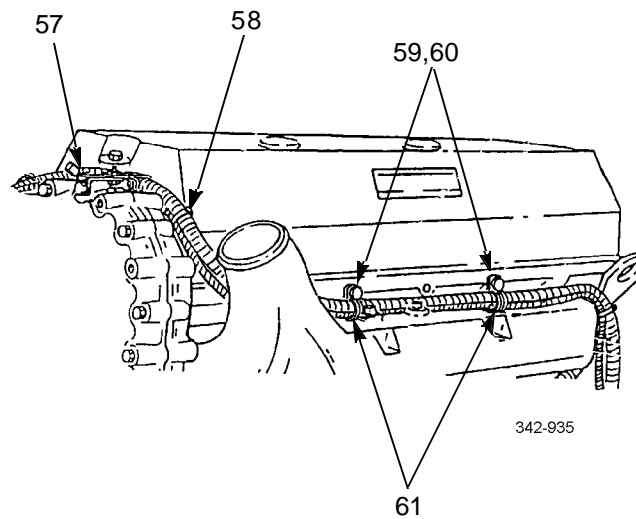
342-933

REMOVAL - CONTINUED

14. Remove nut (53), washer (54), wire (55), and solenoid (56). Reinstall nut.



15. Remove screw (57) and set harness (58) aside. Reinstall screw (57).
 16. Remove two screws (59), washers (60), and clamps (61). Set harness (58) aside.

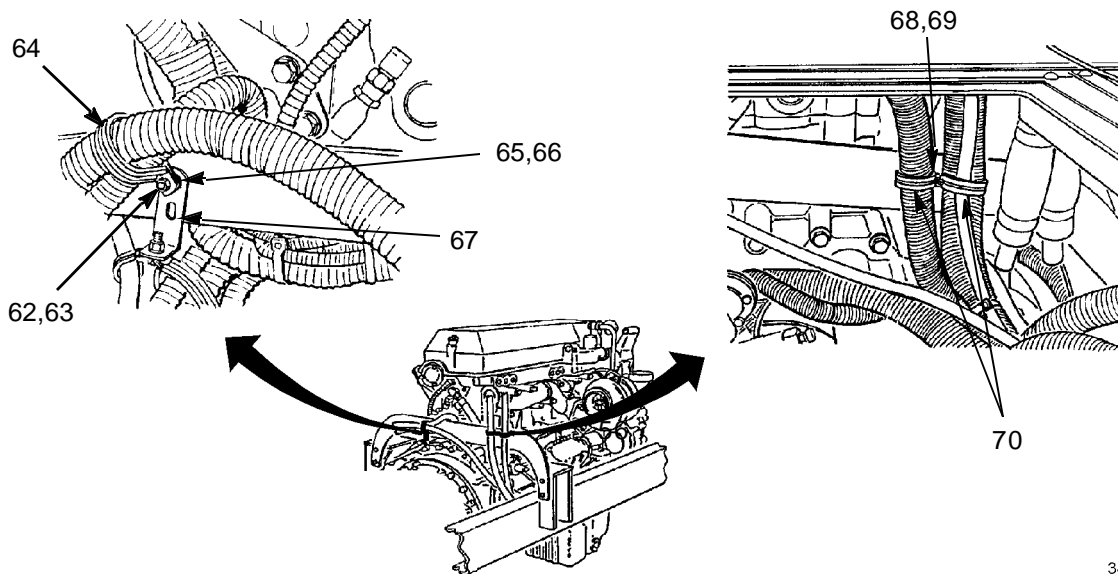


REMOVAL - CONTINUED

NOTE

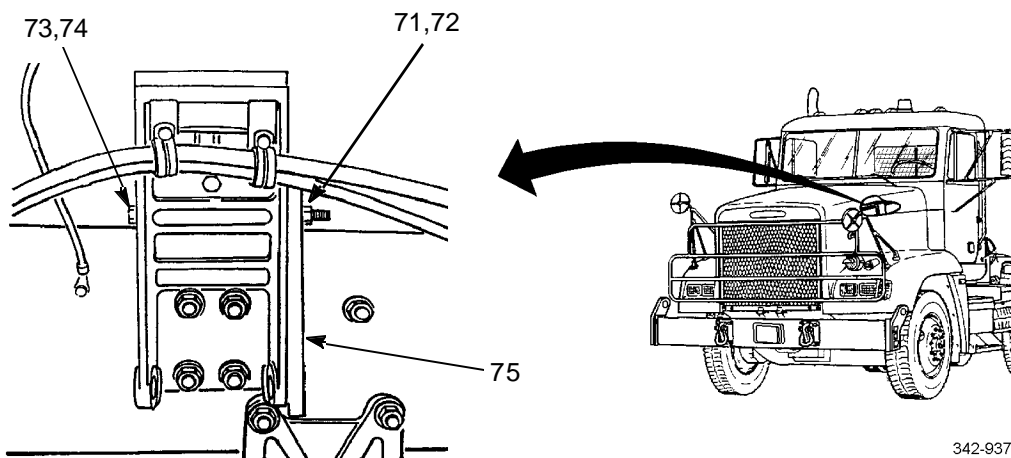
Steps 17 through 19 can be performed through center floor panel of cab.

17. Remove lock nut (62), washer (63), and clamp (64). Discard lock nut.
18. Remove lock nut (65), washer (66), and bracket (67). Discard lock nut.
19. Remove lock nut (68), washer (69), and two clamps (70). Discard lock nut.



342-936

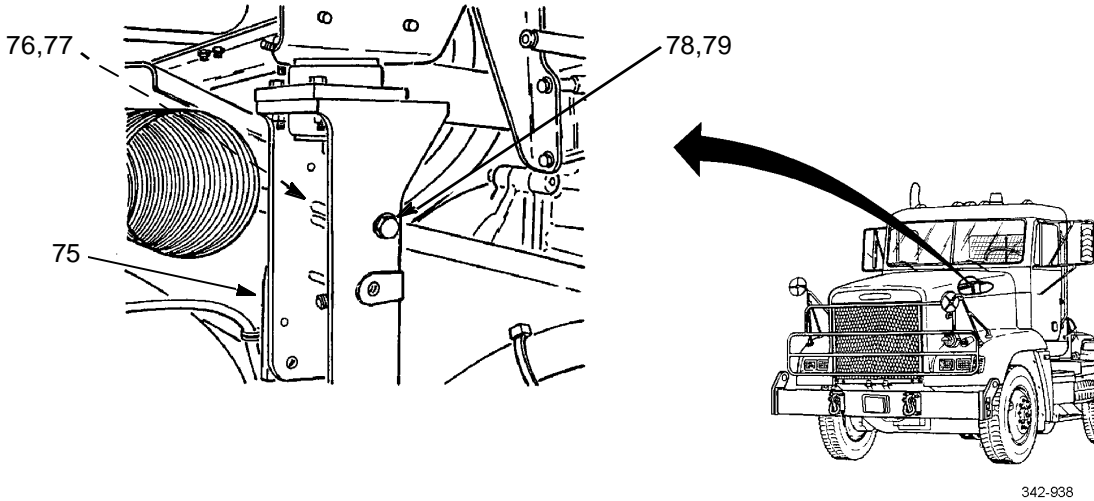
20. Remove nut (71), washer (72), screw (73), and washer (74) from left side of crossmember (75).



342-937

21. Remove nut (76), washer (77), screw (78), and washer (79). Remove crossmember (75).

REMOVAL - CONTINUED

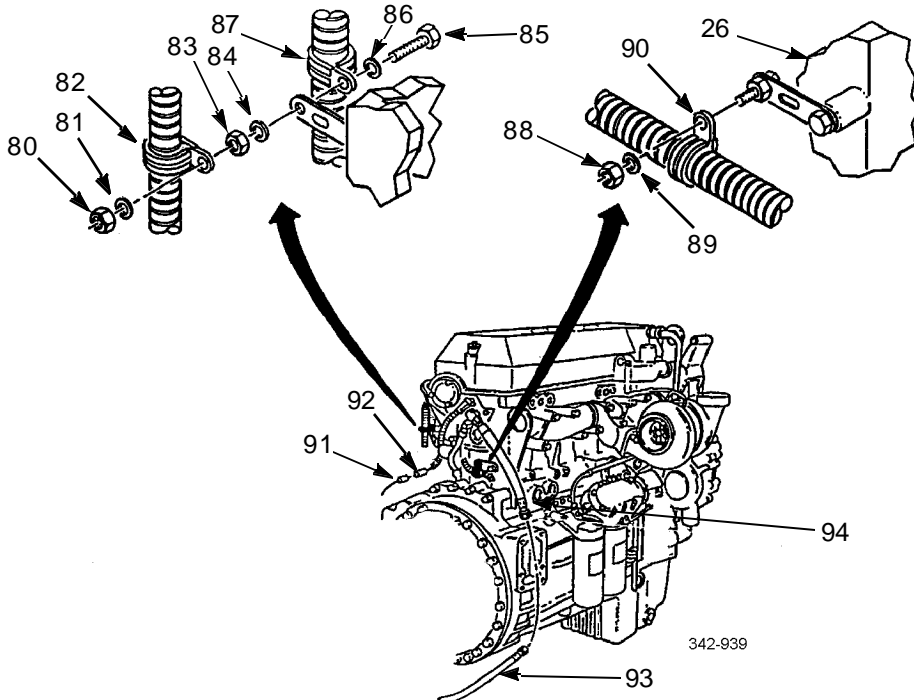


342-938

NOTE

Steps 22 through 26 can be performed through center floor panel of cab.

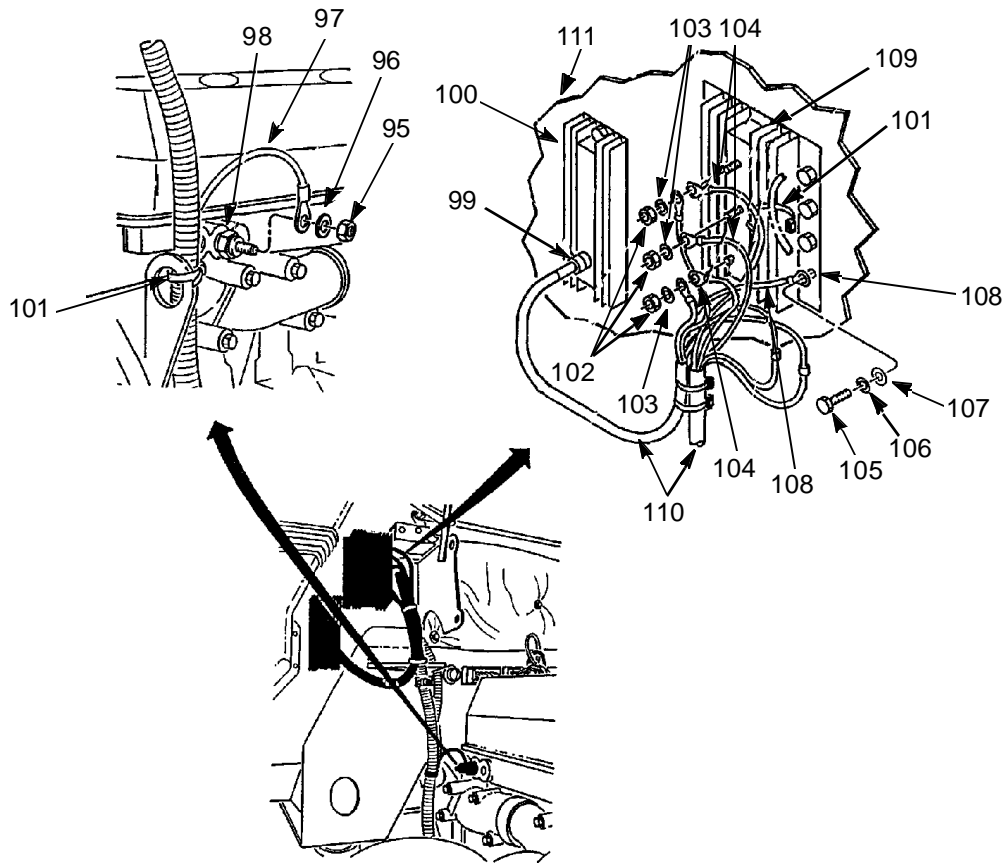
22. Remove lock nut (80), washer (81), and clamp (82). Discard lock nut.
23. Remove lock nut (83), washer (84), screw (85), washer (86), and clamp (87). Discard lock nut.
24. Remove lock nut (88), washer (89), and clamp (90) from rear of engine block (26). Discard lock nut.
25. Disconnect connector (91) from engine brake harness (92).
26. Disconnect fuel return hose (93) from hose (94). Plug fuel return hose and set aside.



342-939

REMOVAL - CONTINUED

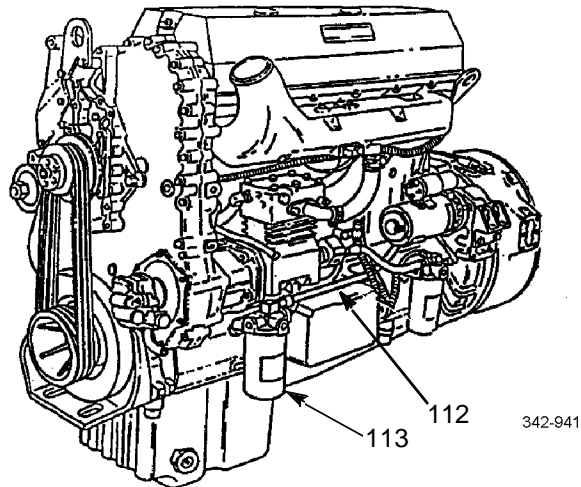
27. Remove nut (95), lock washer (96), and wire (97) from sending unit (98). Discard lock washer.
28. Disconnect plug (99) from voltage regulator (100).
29. Remove two tiedown straps (101), three nuts (102), washers (103), and five wires (104). Discard tiedown straps.
30. Remove screw (105), lock washer (106), washer (107), and ground wire (108) from dual voltage control (109). Feed harness (110) under cab (111) and out of the way. Discard lock washer.



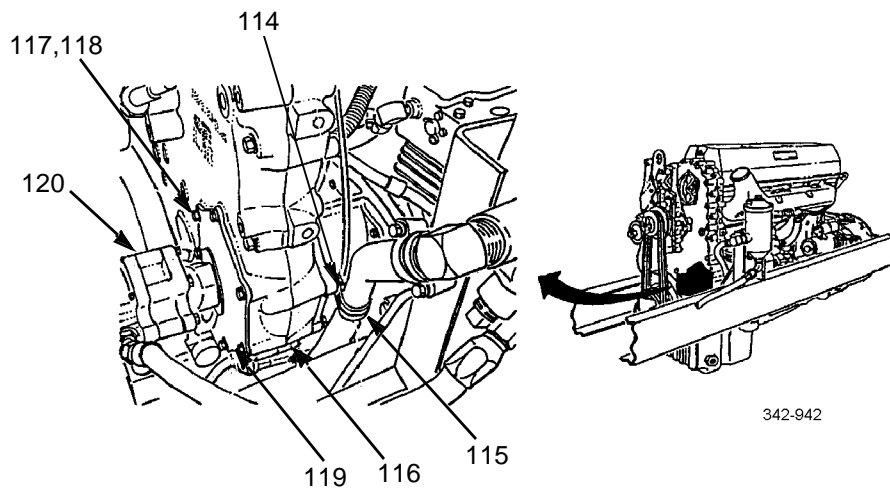
342-940

REMOVAL - CONTINUED

31. Disconnect fuel hose (112) from primary fuel filter (113). Plug fuel hose and set aside.

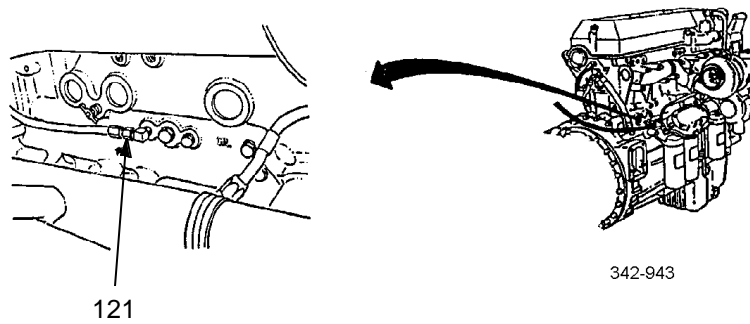


32. Remove screw (114) and clamp (115) from gear case (116).
33. Remove six screws (117), lock washers (118), drive coupler (119), and power steering pump (120). Set power steering pump aside. Discard lock washers.

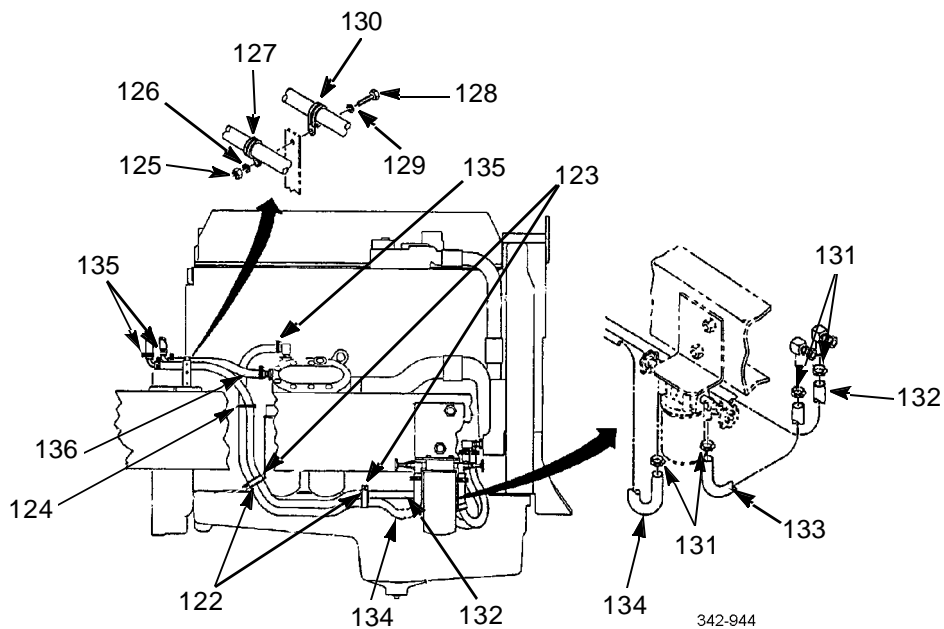


REMOVAL - CONTINUED

34. Disconnect and plug oil pressure hose (121) and set aside.

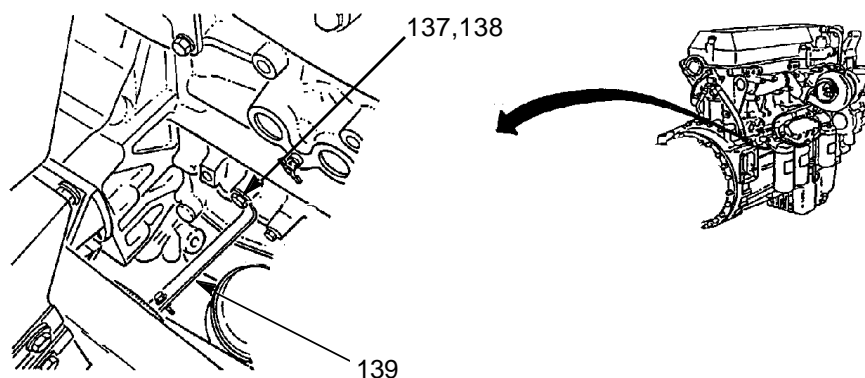


35. Remove two bolts (122), washers (123), and tiedown strap (124). Discard tiedown strap.
 36. Remove lock nut (125), washer (126), clamp (127), screw (128), washer (129), and clamp (130). Discard lock nut.
 37. Remove four clamps (131) and disconnect three hoses (132, 133, and 134).
 38. Remove four clamps (135) and four hoses (132, 133, 134, and 136).



REMOVAL - CONTINUED

39. Remove screw (137) and washer (138) and rotate bracket (139) out of the way.



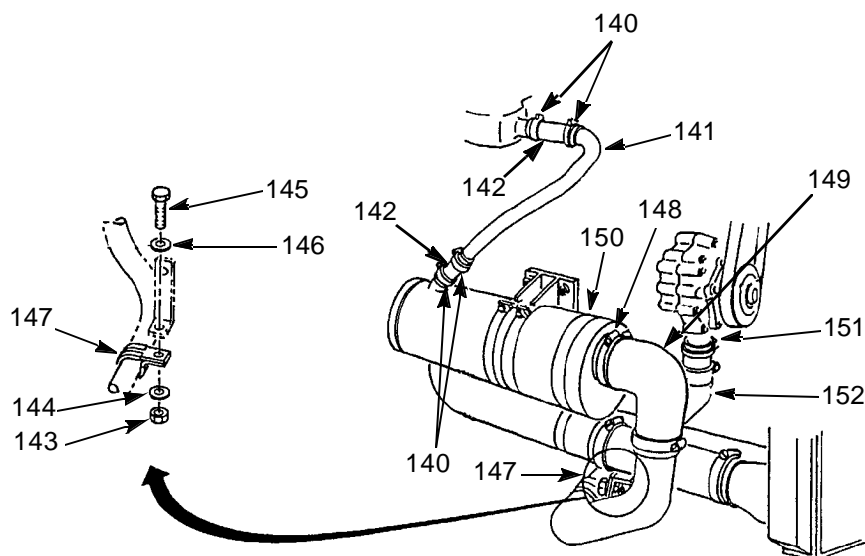
342-945

40. Loosen four clamps (140) and remove pipe (141) and two hoses (142).

41. Remove nut (143), washer (144), capscrew (145), and washer (146) from clamp (147).

42. Loosen clamp (148) and disconnect hose (149) from transmission oil cooler (150).

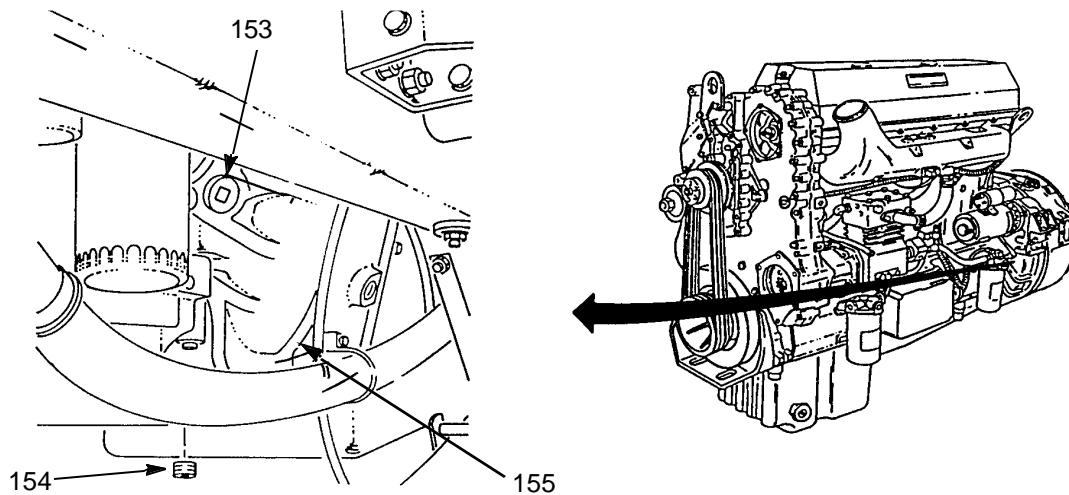
43. Loosen clamp (151) and remove hose and pipe assembly (152).



342-946

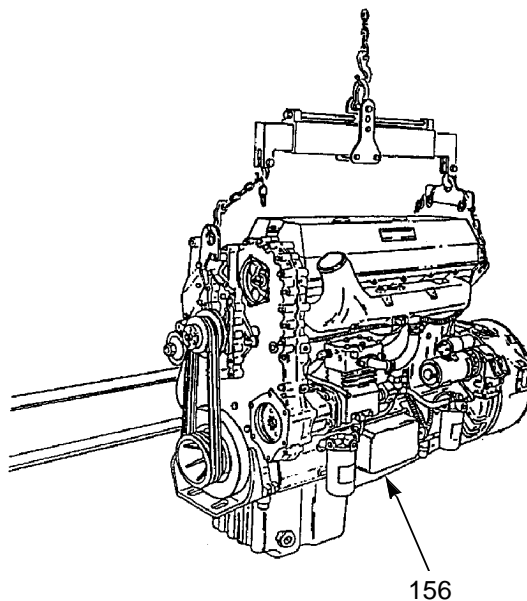
REMOVAL - CONTINUED

44. Remove two plugs (153 and 154) from engine flywheel housing (155).



342-947

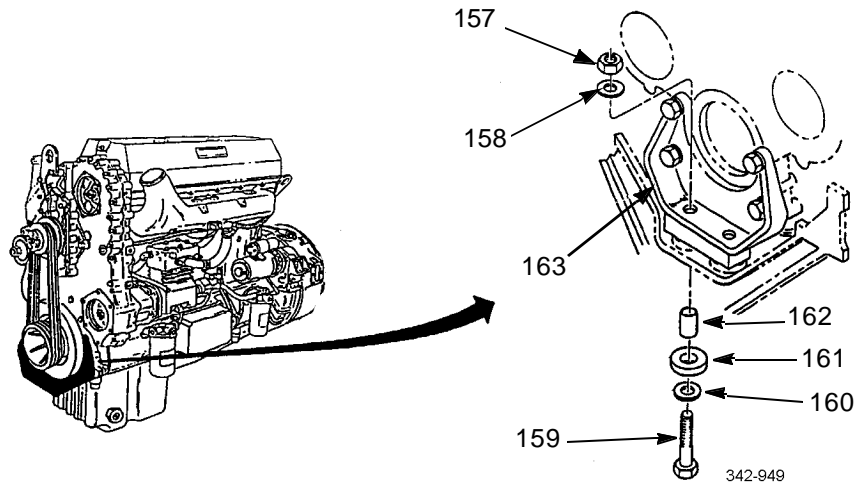
45. Attach suitable hoist and sling spreader to engine (156). Take up slack in lifting chains, but do not lift engine.



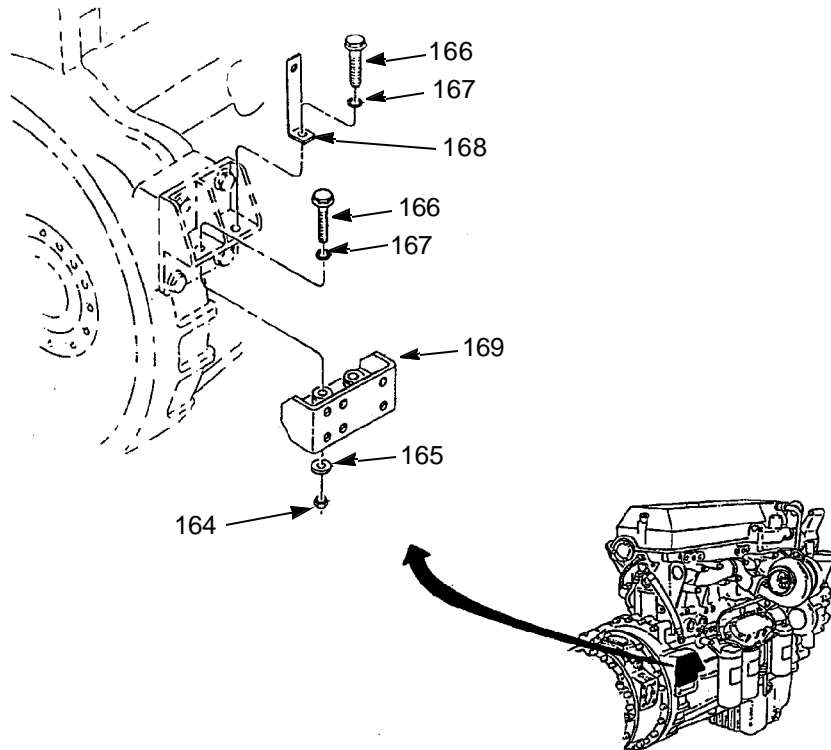
342-948

46. Remove two nuts (157), washers (158), screws (159), washers (160), isolators (161), and sleeves (162) from front engine mount (163).

REMOVAL - CONTINUED

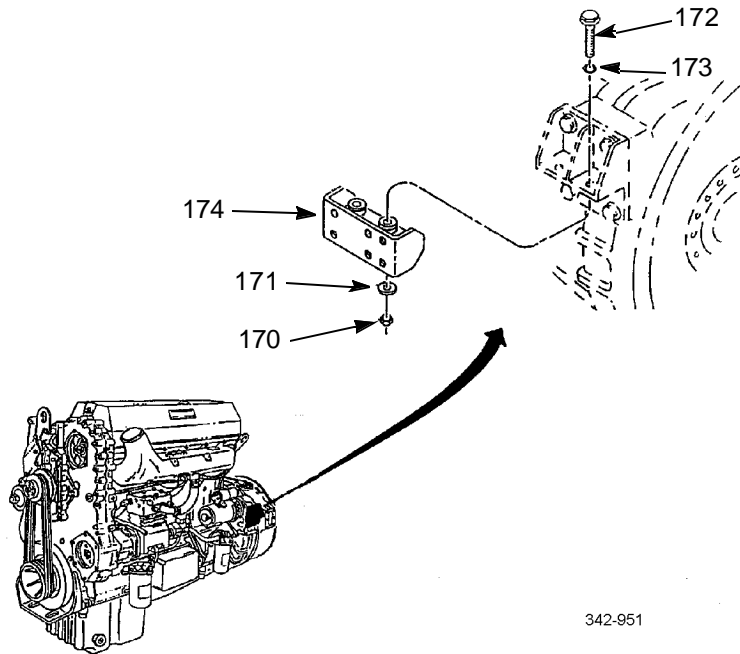


47. Right side only: remove two nuts (164), washers (165), screws (166), washers (167), and bracket (168) from right engine mount (169).



REMOVAL - CONTINUED

48. Left side only: remove two nuts (170), washers (171), screws (172), and washers (173) from left engine mount (174).



WARNING



Power pack weighs 3750 lb (1702 kg). Use hoist with lifting capacity of 5000 lb (2270 kg) to lift and support power pack. Failure to do so could result in injury to personnel.

CAUTION

- Ensure all harnesses, tubes, and hoses are clear of power pack prior to removal. Failure to do so could result in damage to equipment.
- Keep power pack clear of frame. Failure to do so could result in damage to equipment.

49. Using suitable hoist and sling spreader, lift power pack slightly.

50. Adjust load so that front of engine is raised as high as possible to clear frame crossmember. Remove power pack from vehicle.

POWER PACK SEPARATION

WARNING

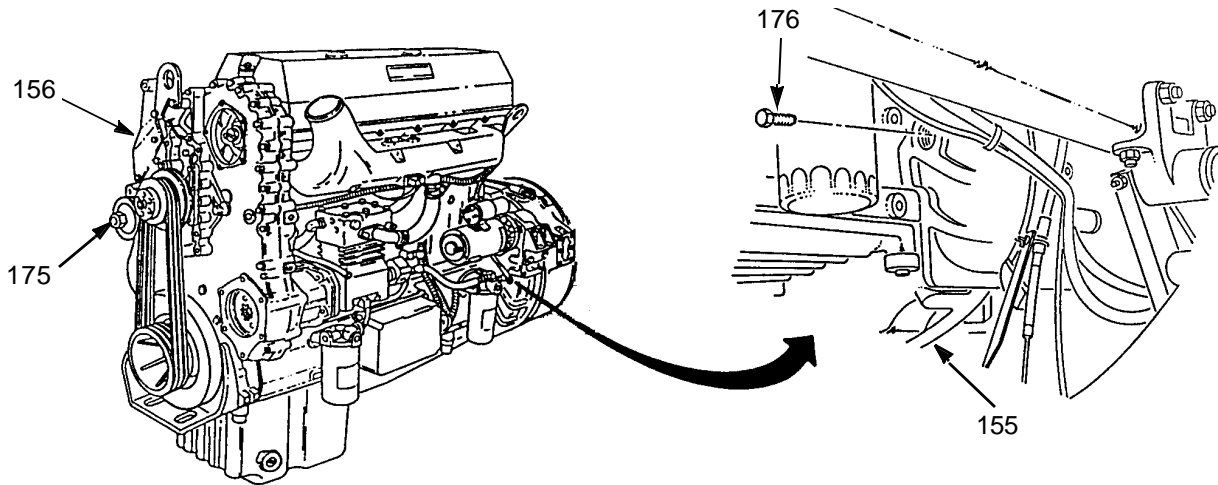
Do not place finger in hole of engine flywheel housing while engine is being barred over. To do could result in serious injury to personnel.

POWER PACK SEPARATION - CONTINUED

CAUTION

- Step 1 must be followed for barring engine over. Any other method could cause damage to equipment.
- If bolts are dropped in engine flywheel housing, retrieve immediately. Failure to do so could result in damage to equipment.

1. Have assistant bar engine (156) over using accessory drive (175). Locate and remove bolt (176) through hole in engine flywheel housing (155). Repeat until 12 bolts have been removed.

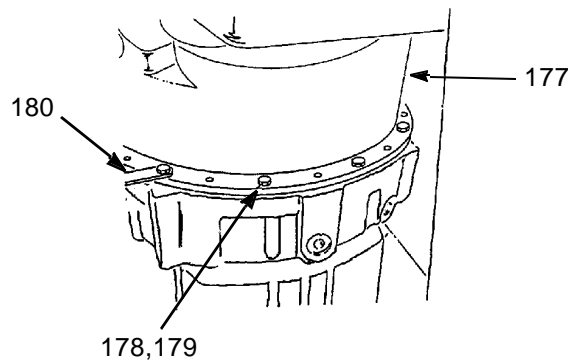


WARNING



Transmission weighs 900 lb (409 kg). Support transmission with transmission lift during removal to prevent possible injury to personnel.

2. Support transmission (177) using transmission lift. Remove 12 screws (178), lock washers (179), and two brackets (180). Discard lock washers.



POWER PACK SEPARATION - CONTINUED

CAUTION

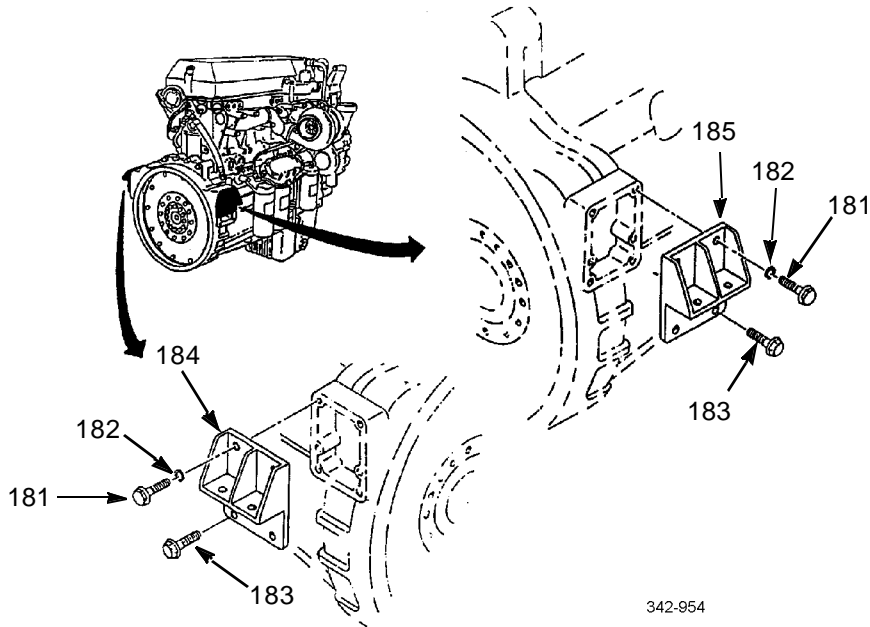
To avoid binding during removal, check frequently to ensure proper alignment between engine and transmission. Failure to do so could result in damage to components.

3. Raise and adjust height of transmission lift to maintain support of transmission (177).
4. Repeat step 3 until transmission (177) can be separated from engine (156).

NOTE

If engine is to be replaced, perform steps 5 and 6 after repositioning engine on suitable stands.

5. Remove two screws (181), washers (182), two screws (183), and right engine leg (184).
6. Repeat step 5 for left engine leg (185).



POWER PACK ASSEMBLY

1. Install right engine leg (184) with two screws (183), washers (182), and screws (181).
2. Repeat step 1 for installation of left engine leg (185).

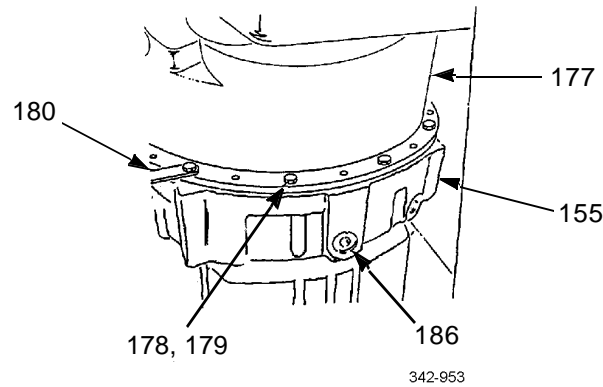
CAUTION

Transmission must be seated squarely against engine flywheel housing to prevent damage to equipment.

3. Support transmission (177) using transmission lift. Position transmission squarely against engine flywheel housing (155).
4. Install two brackets (180), 12 new lock washers (179), and screws (178) in transmission (177). Tighten screws hand-tight.
5. Tighten four screws (178) 90 degrees apart to 40 lb-ft (54 Nm).

POWER PACK ASSEMBLY - CONTINUED

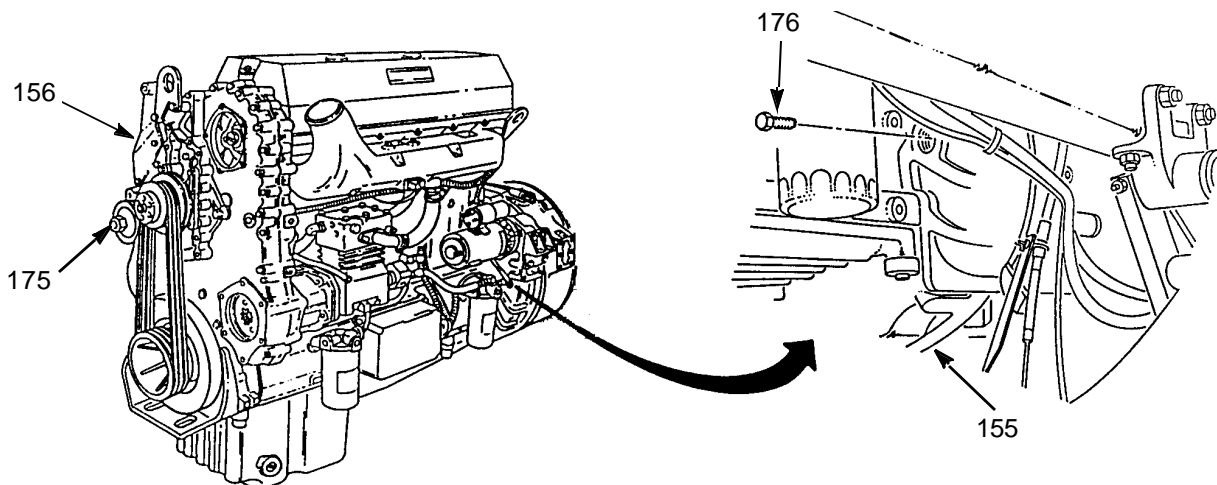
6. Tighten remaining screws (178) to 40 lb-ft (54 Nm).
7. Remove plug (186) and rotate torque converter to align holes in flex plate with holes in torque converter.

**WARNING**

Do not place finger in hole of engine flywheel housing while engine is being barred over. To do so could result in serious injury to personnel.

CAUTION

- Step 8 must be followed for barring over engine. Any other method could cause damage to equipment.
 - If bolts are dropped in engine flywheel housing, retrieve immediately. Failure to do so could result in damage to equipment.
8. Have assistant bar engine (156) over using accessory drive (175). Locate and align holes and install bolt (176) through hole in engine flywheel housing (155). Repeat until 12 bolts have been installed hand-tight.
 9. Tighten 12 bolts (176) to 96-115 lb-ft (130-156 Nm).

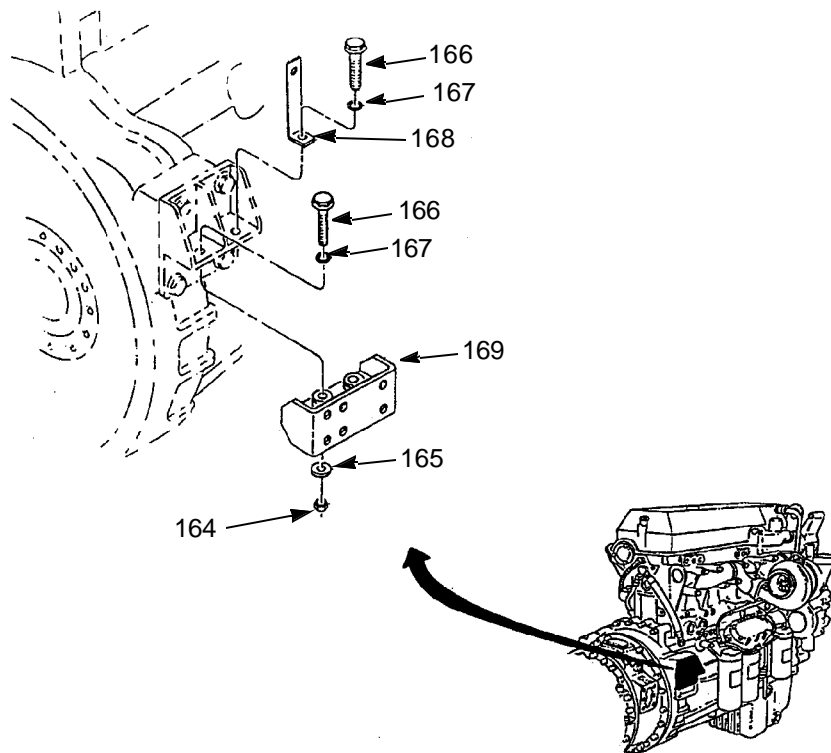


INSTALLATION**WARNING**

Power pack weighs 3750 lb (1702 kg). Use hoist with lifting capacity of 5000 lb (2270 kg) to lift and support power pack. Failure to do so could result in injury to personnel.

CAUTION

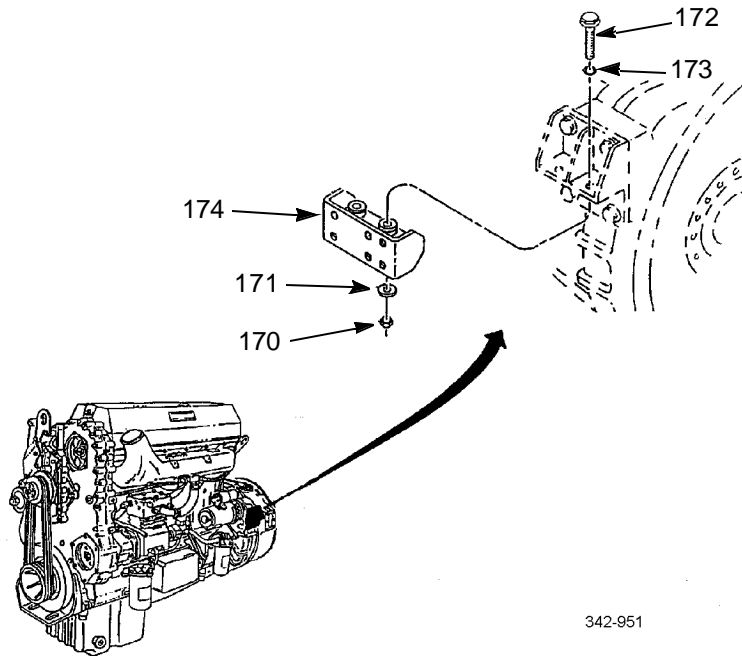
- Ensure all harnesses, tubes, and hoses are clear of power pack prior to installation. Failure to do so could result in damage to equipment.
 - Keep power pack clear of frame. Failure to do so could result in damage to equipment.
1. Using suitable hoist and sling spreader, maneuver power pack into vehicle.
 2. Alternately lower hoist in small increments until power pack is in place.
 3. Right side only: install bracket (168), two washers (167), screws (166), washers (165), and nuts (164) in right engine mount (169). Do not tighten nuts.



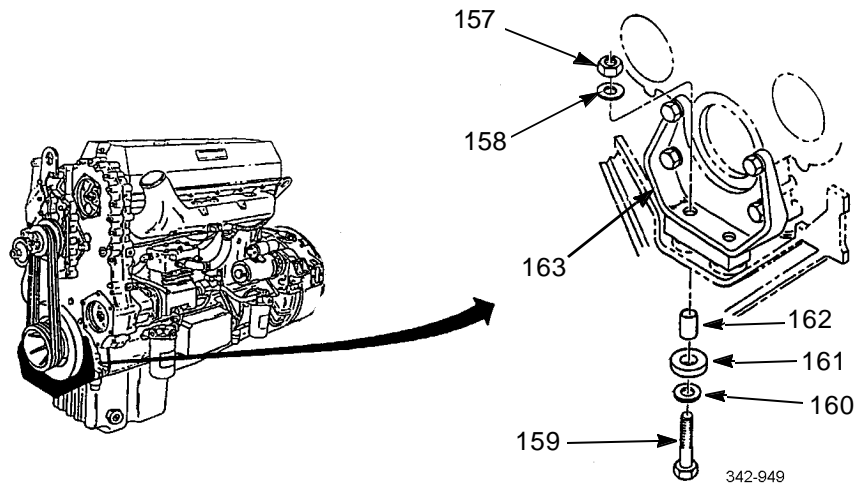
342-950

INSTALLATION - CONTINUED

- Left side only: install two washers (173), screws (172), washers (171), and nuts (170) in left engine mount (174). Do not tighten nuts.

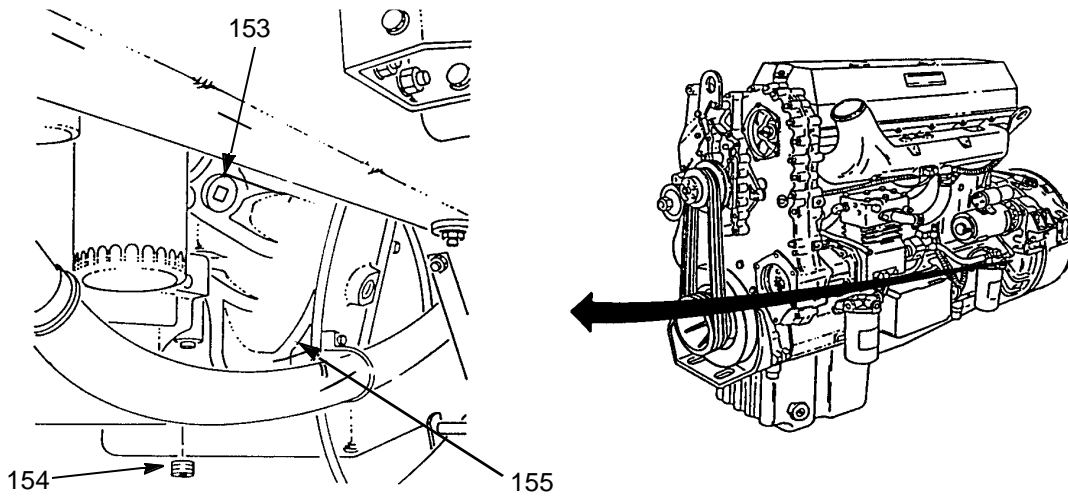


- Install two sleeves (162), isolators (161), washers (160), screws (159), washers (158), and nuts (157) in front engine mount (163).



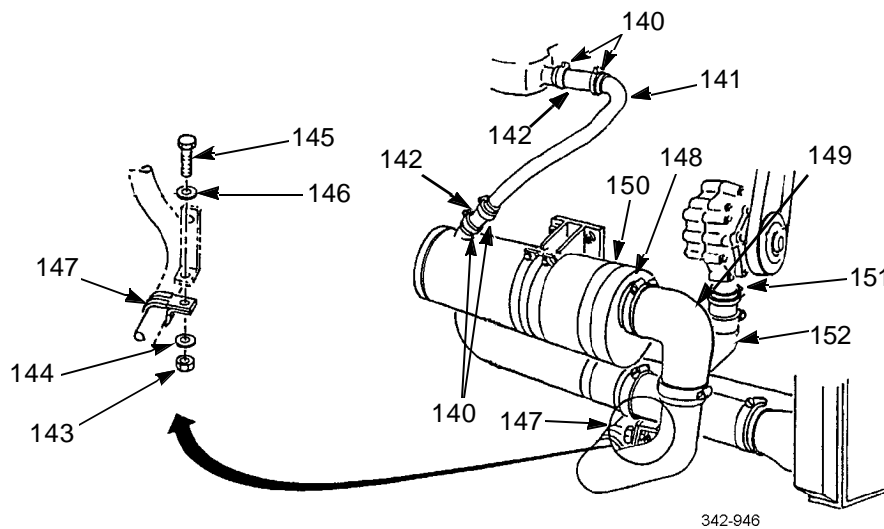
INSTALLATION - CONTINUED

6. Tighten four nuts (164 and 170) on two rear engine mounts (169 and 174).
7. Install two plugs (153 and 154) in engine flywheel housing (155).



342-947

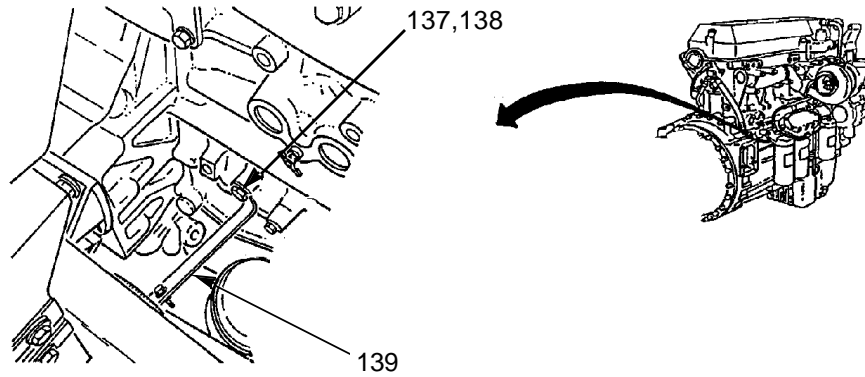
8. Install two hoses (142) and pipe (141) and tighten four clamps (140).
9. Install hose and pipe assembly (152) and tighten clamp (151).
10. Connect hose (149) to transmission oil cooler (150) and tighten clamp (148).
11. Install washer (146), capscrew (145), clamp (147), washer (144), and nut (143).



342-946

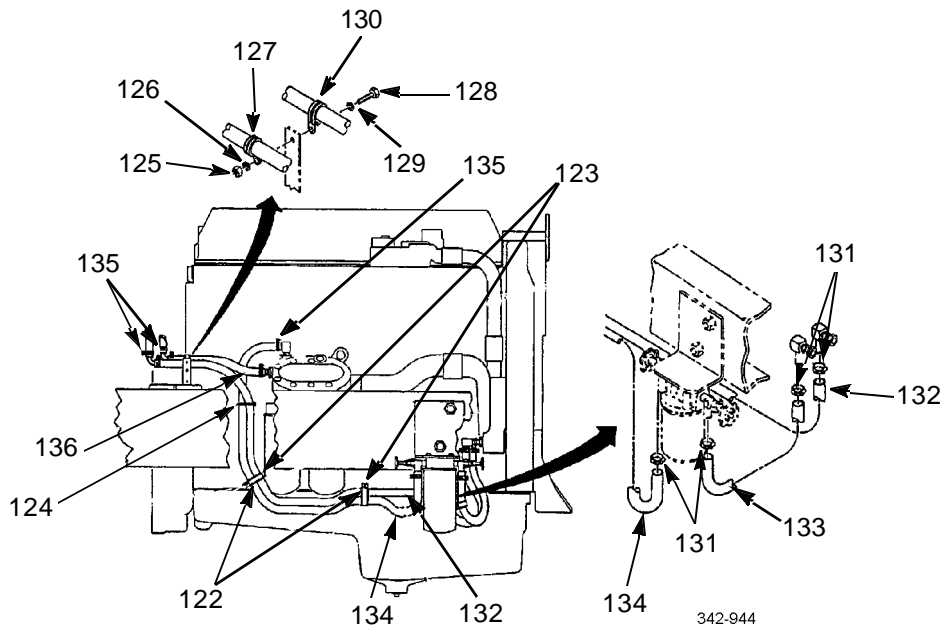
12. Rotate bracket (139) into position and install washer (138) and screw (137).

INSTALLATION - CONTINUED



342-945

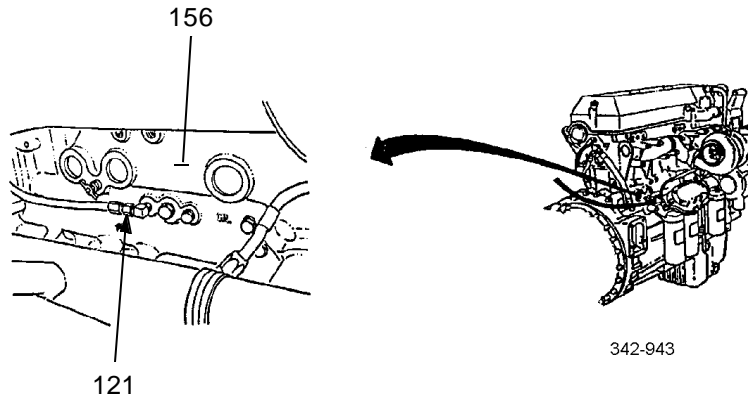
13. Install four hoses (136, 134, 132, and 133) and four clamps (135).
14. Connect three hoses (134, 132, and 133) and install four clamps (131).
15. Install two clamps (123), bolts (122), and new tiedown strap (124).
16. Install clamps (127 and 130) with washer (129), screw (128), washer (126), and new lock nut (125) on bracket.



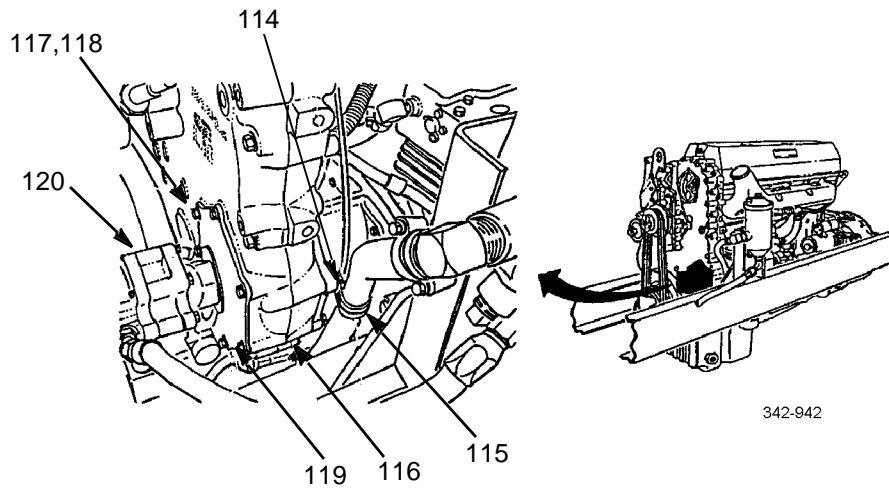
342-944

INSTALLATION - CONTINUED

17. Unplug and connect oil pressure hose (121) to engine (156).

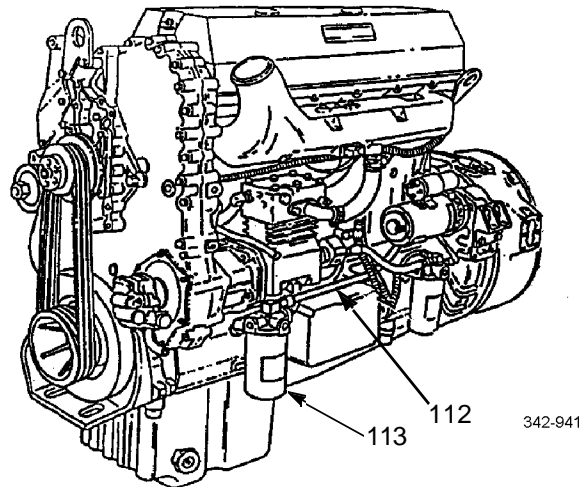


18. Install drive coupler (119) and power steering pump (120) with six new lock washers (118) and screws (117).
 19. Install clamp (115) and screw (114) in gear case (116).

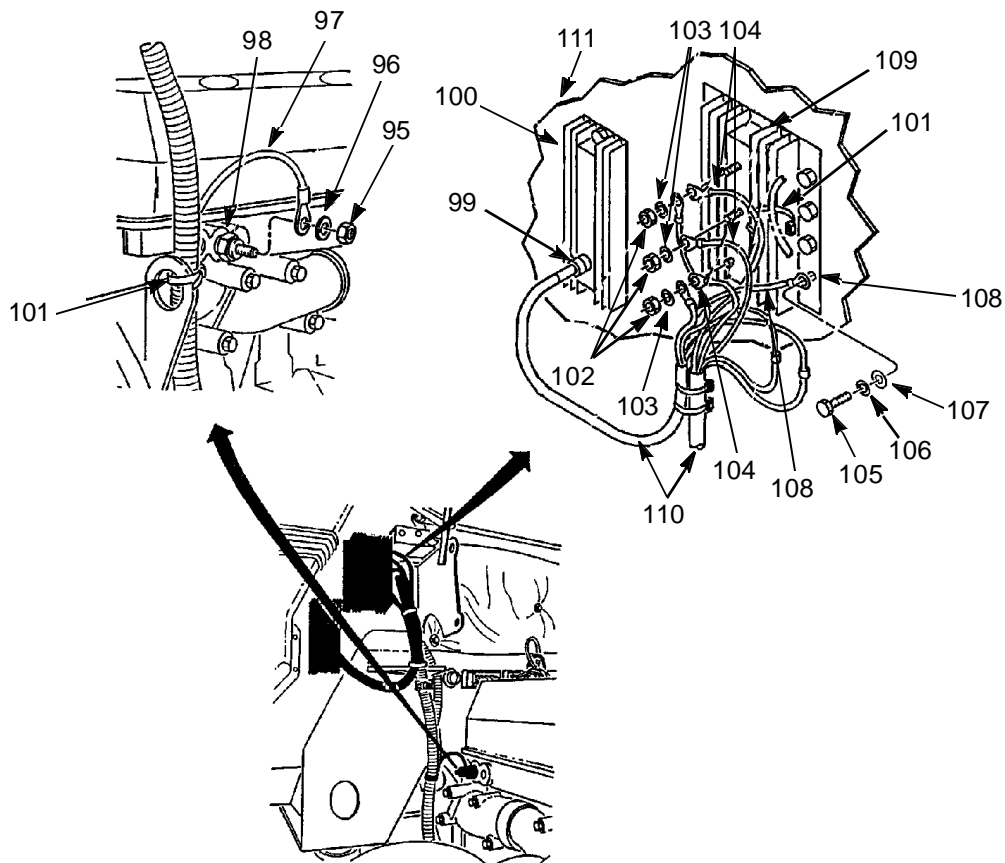


20. Unplug and connect fuel hose (112) to primary fuel filter (113).

INSTALLATION - CONTINUED



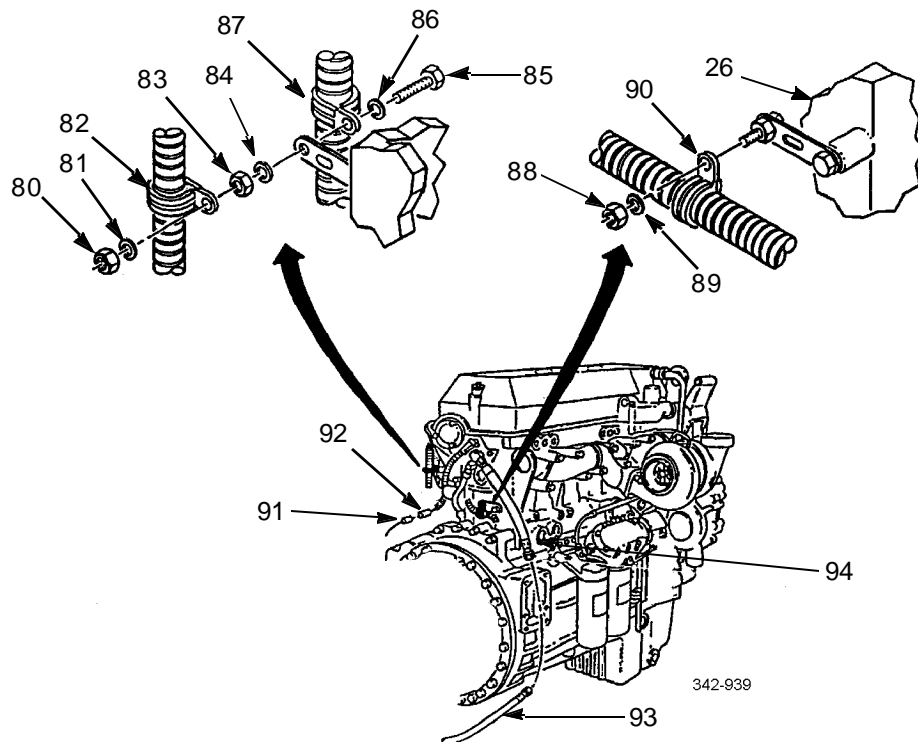
21. Pull harness (110) out from under cab (111). Install ground wire (108), washer (107), new lock washer (106), and screw (105) in dual voltage control (109).
22. Install five wires (104), three washers (103), nuts (102) on dual voltage control (109). Install two new tiedown straps (101).
23. Connect plug (99) to voltage regulator (100).
24. Install wire (97), new lock washer (96), and nut (95) on sending unit (98).



INSTALLATION - CONTINUED**NOTE**

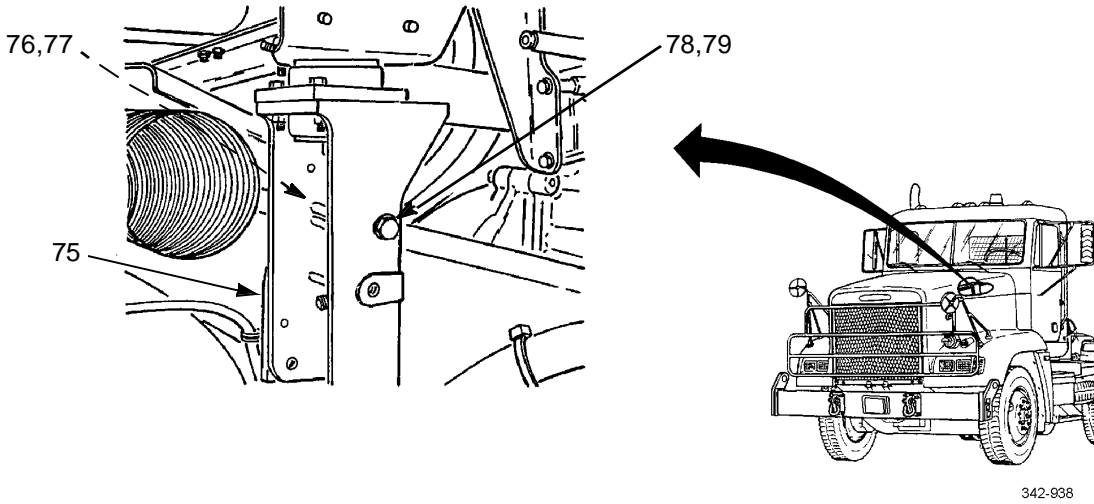
Steps 25 through 29 can be performed through center floor panel of cab.

25. Unplug and connect fuel return hose (93) to hose (94).
26. Connect connector (91) to engine brake harness (92).
27. Install clamp (90) with washer (89) and new lock nut (88).
28. Install clamp (87) with washer (86), screw (85), washer (84), and new lock nut (83).
29. Install clamp (82) with washer (81) and new lock nut (80) on rear of engine.

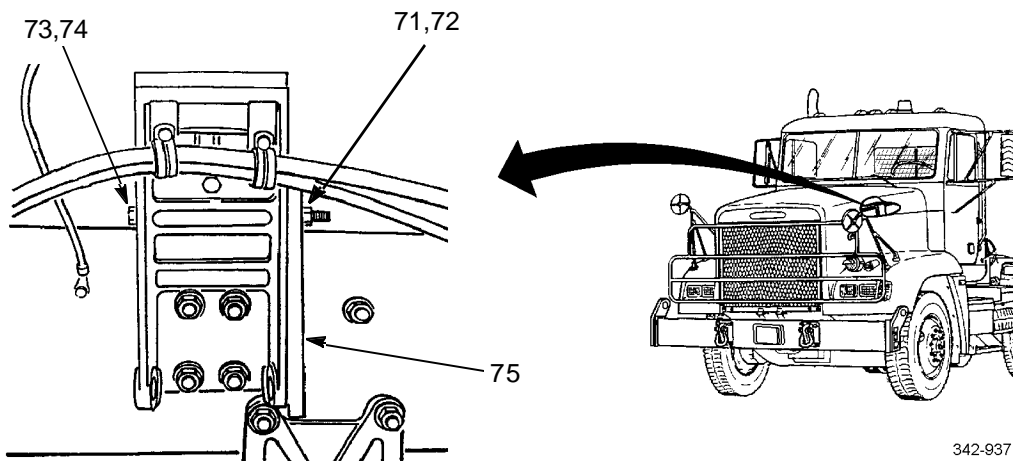


INSTALLATION - CONTINUED

30. Install crossmember (75), washer (79), screw (78), washer (77), and nut (76).



31. Install washer (74), screw (73), washer (72), and nut (71) in left end of crossmember (75).

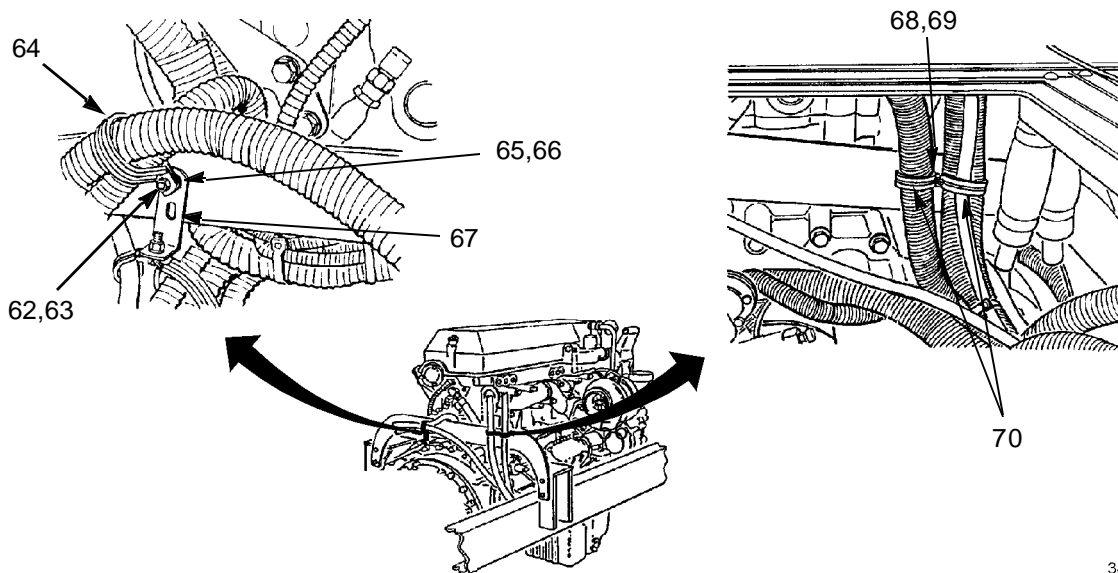


INSTALLATION - CONTINUED

NOTE

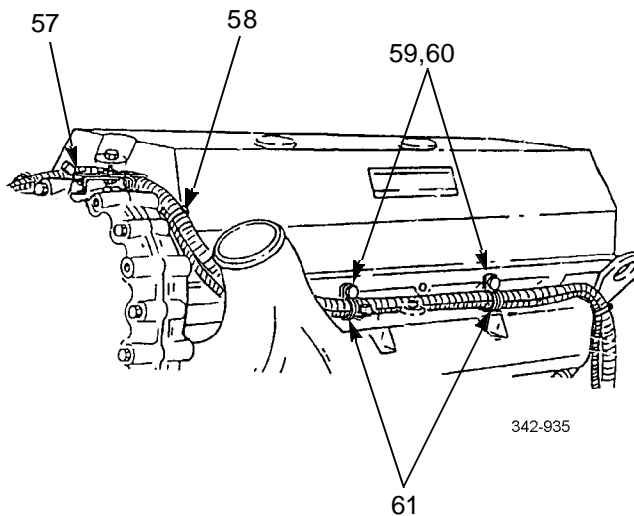
Steps 32 through 34 can be performed through center floor panel of cab.

- 32. Install two clamps (70) with washer (69) and new lock nut (68).
- 33. Install bracket (67), washer (66), and new lock nut (65) on crossmember.
- 34. Install clamp (64) on bracket (67) with washer (63) and new lock nut (62).



342-936

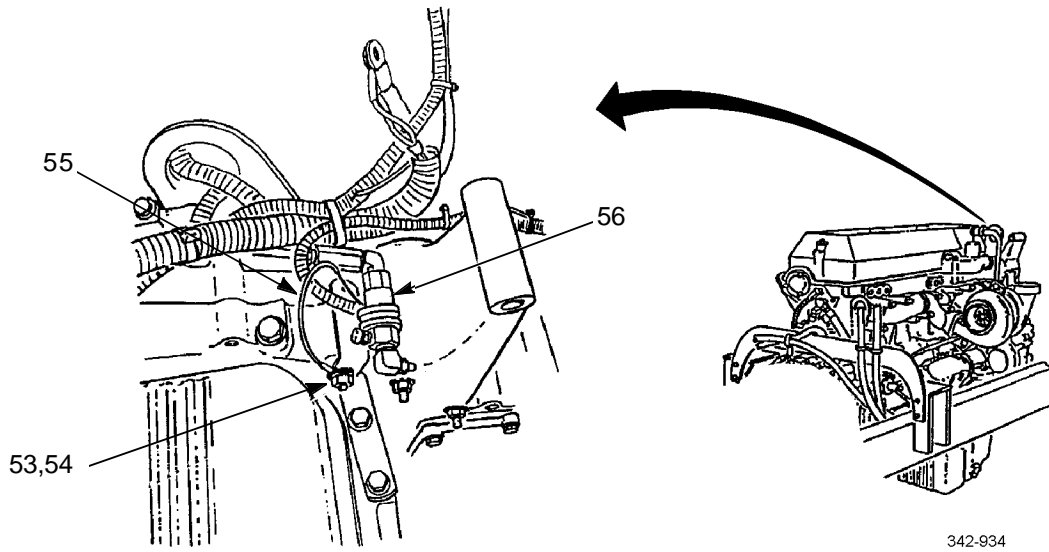
- 35. Position harness (58) and install two clamps (61), washers (60), and screws (59).
- 36. Remove screw (57). Position harness (58) and install screw (57).



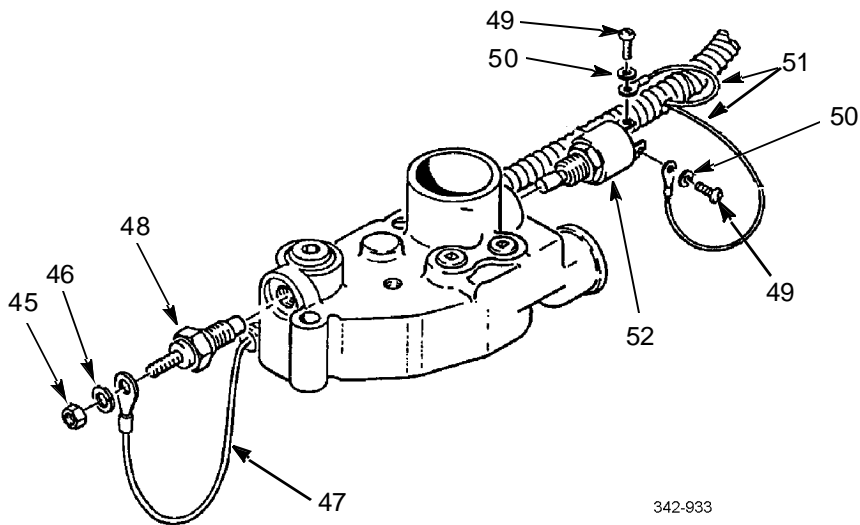
342-935

- 37. Remove nut (53). Install solenoid (56), wire (55), washer (54), and nut (53).

INSTALLATION - CONTINUED

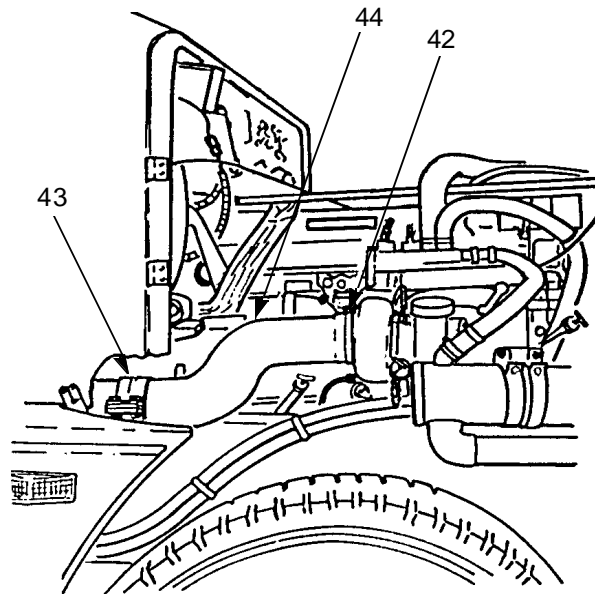


38. Install two wires (51), new lock washers (50), and screws (49) on temperature sending unit (52).
39. Install wire (47), new lock washer (46), and nut (45) on temperature sending unit (48).



INSTALLATION - CONTINUED

40. Install exhaust pipe (44) with new seal clamp (43) and clamp (42).

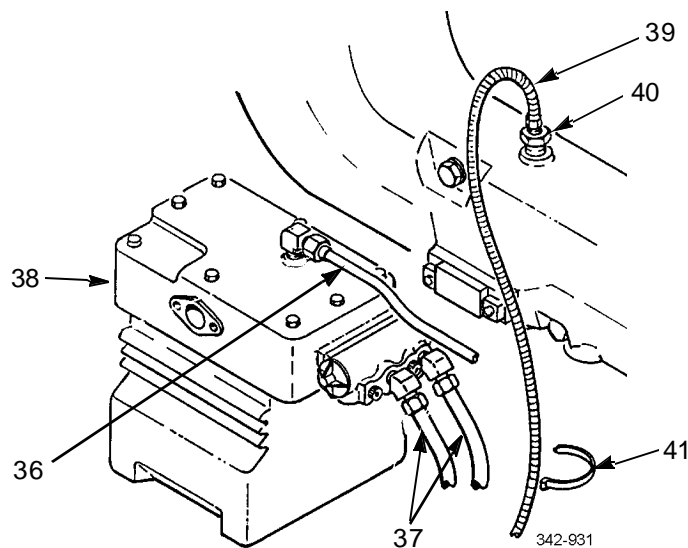


342-932

CAUTION

Ensure arrow on wrench flat of atomizer is facing to front of engine. Failure to do so will cause ether start to malfunction.

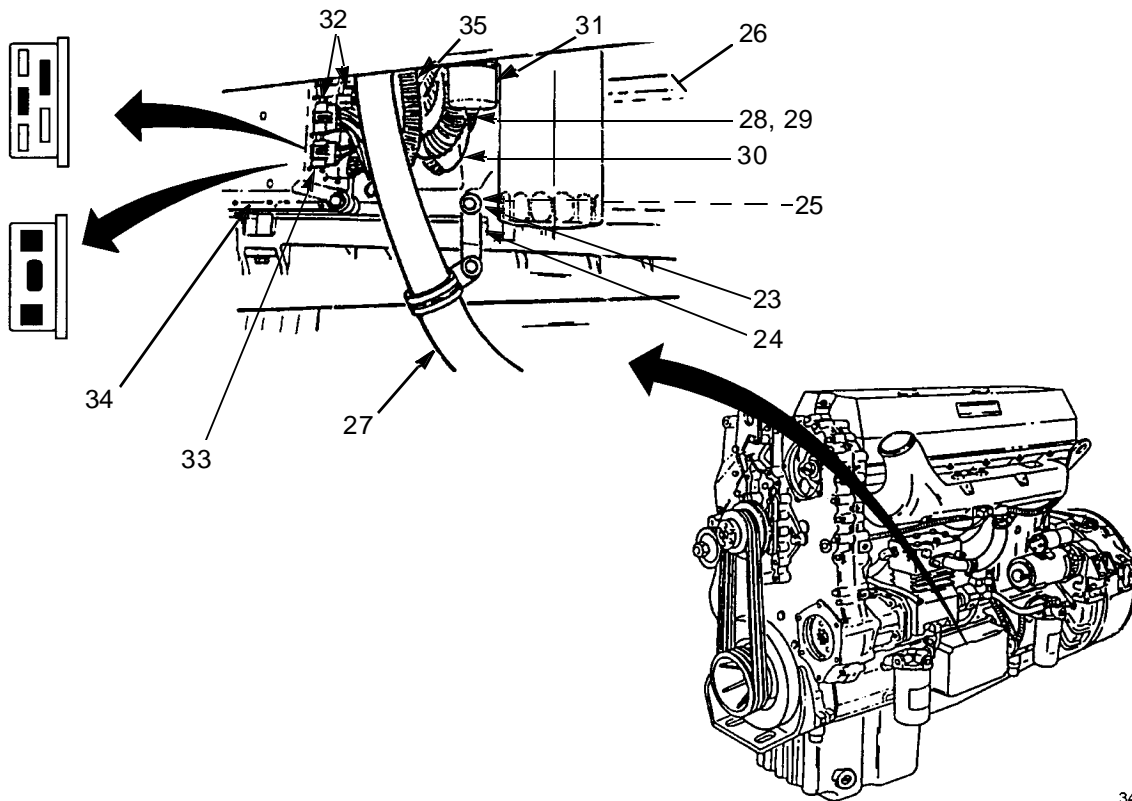
41. Install atomizer (40) and tube (39).
 42. Connect two tubes (37) and hose (36) to air compressor (38). Install new tiedown strap (41).



342-931

INSTALLATION - CONTINUED

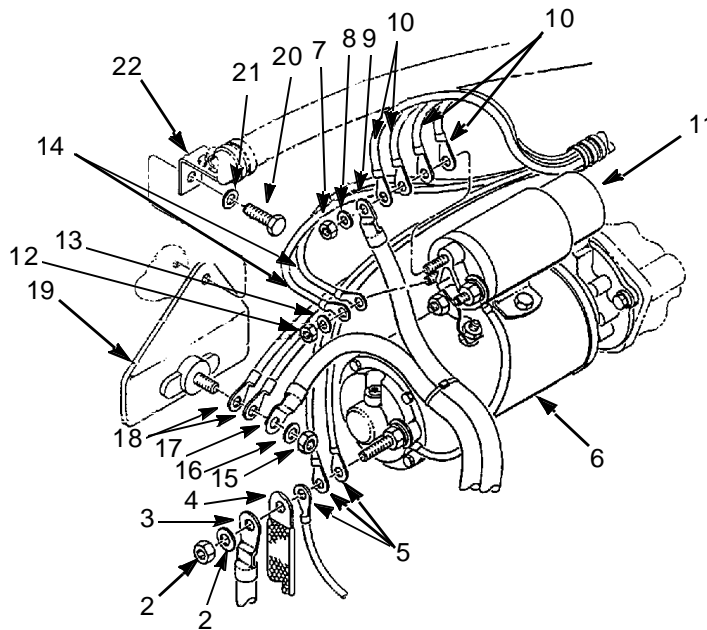
43. Connect electronic control module harness connectors (32 and 33) to connectors located at rear of ECM (34).
44. Install wire (30), washer (29), and nut (28) on fuel pressure sending unit (31).
45. Install bracket (24) on cable harness (27). Install spacer (25), bracket, and screw (23) in engine block (26). Install new tiedown straps as required to secure harness (35).



342-930

INSTALLATION - CONTINUED

46. Install plate (19) and bracket (22) with washer (21) and screw (20).
47. Install two wires (18) and cable (17) on plate (19) with washer (16) and nut (15).
48. Connect two wires (14) to starter solenoid (11) with washer (13) and nut (12).
49. Connect four wires (10) and cable (9) to starter solenoid (11) with washer (8) and nut (7).
50. Connect three wires (5), ground strap (4), and cable (3) to starter (6) with washer (2) and nut (1).



342-929

51. Install transmission rear mount (WP 0070 00).
52. Connect driveline (TM 9-2320-302-20).
53. Install transmission oil fill tube (TM 9-2320-302-20).
54. Connect transmission wiring harness (TM 9-2320-302-20).
55. Connect transmission oil cooler lines (TM 9-2320-302-20).
56. Install oil sampling valves (TM 9-2320-302-20).
57. Install fender extensions (TM 9-2320-302-20).
58. Install alternator and alternator adjusting rod (TM 9-2320-302-20).
59. Install air conditioner compressor (WP 0117 00).
60. Install alternator/air conditioner belt (TM 9-2320-302-20).
61. Install air cleaner, pre-cleaner, and duct assembly (TM 9-2320-302-20).
62. Install air intake tubes, hoses, and clamps (TM 9-2320-302-20).

POWER PACK REPLACEMENT - CONTINUED

0010 00

INSTALLATION - CONTINUED

63. Install fan impeller and shroud (TM 9-2320-302-20).
64. Install hood (TM 9-2320-302-20).
65. Install transmission tunnel access cover (TM 9-2320-302-20).
66. Fill engine with oil (TM 9-2320-302-10).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Personnel Required

Two

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Jack, hydraulic (Item 73, WP 0126 00)

Trestles (Item 135, WP 0126 00)

Equipment Condition

Front ABS quick-release valve removed (TM 9-2320-302-20)

Front crossmember removed (WP 0096 00)

Vibration damper removed (WP 0020 00)

Materials/Parts

Nut, lock (P/N MS51922-57)



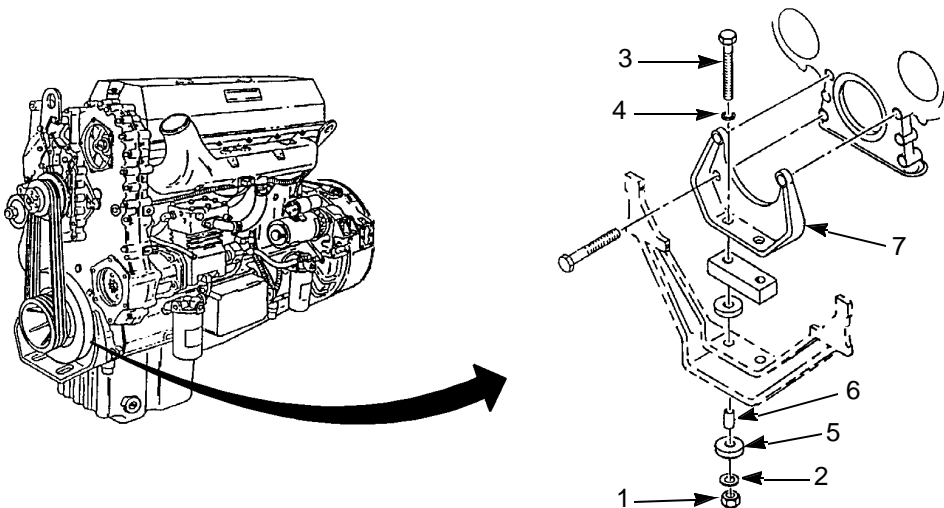
WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL

1. Remove two lock nuts (1), washers (2), screws (3), washers (4), isolators (5), and sleeves (6) from front engine mount adapter (7). Discard lock nuts.



342-1139

REMOVAL - CONTINUED

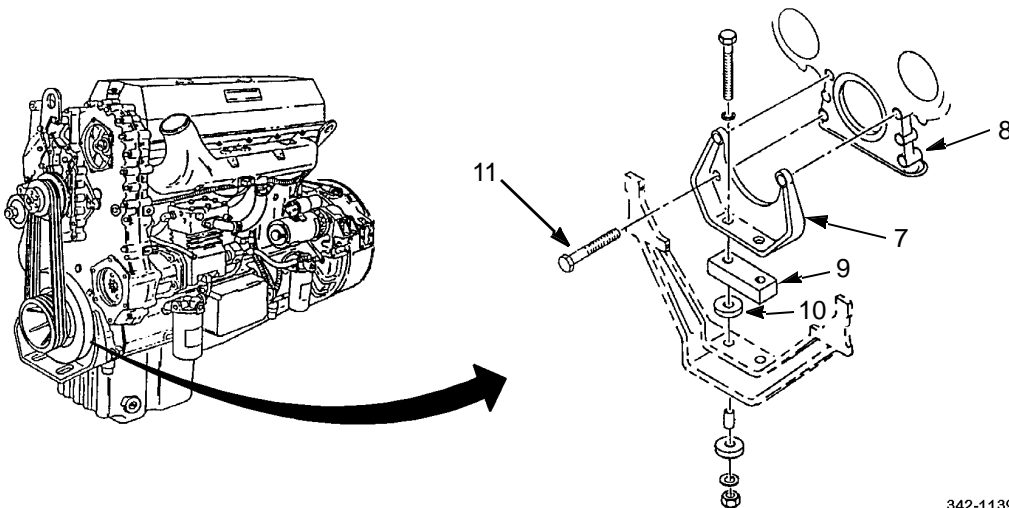


WARNING



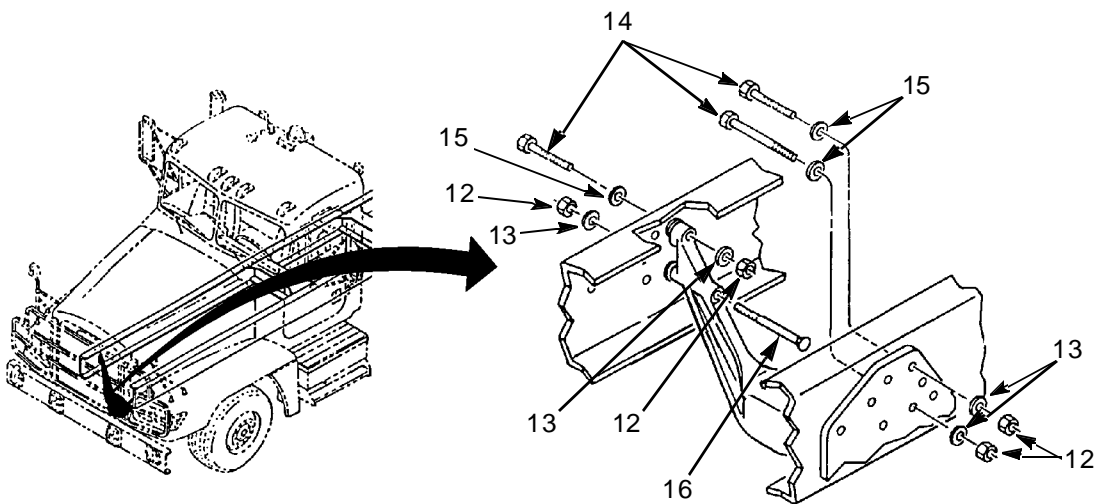
Engine weighs 2850 lb (1294 kg). Support engine from lower block pan rail. Failure to do so could result in injury to personnel and damage to equipment.

2. Support engine (8) and remove spacer (9) and two isolators (10).
3. Remove four bolts (11) and front engine mount adapter (7).



342-1139

4. Remove four nuts (12), washers (13), three capscrews (14), washers (15), and screw (16).

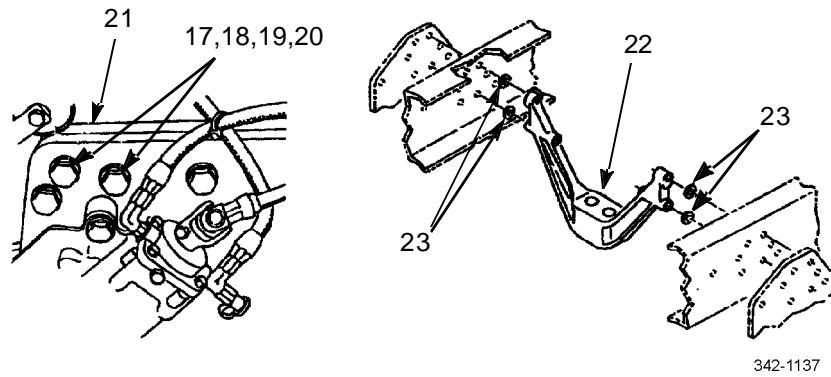


342-1136

5. On left side, remove two nuts (17), washers (18), capscrews (19), and washers (20) from frame (21).

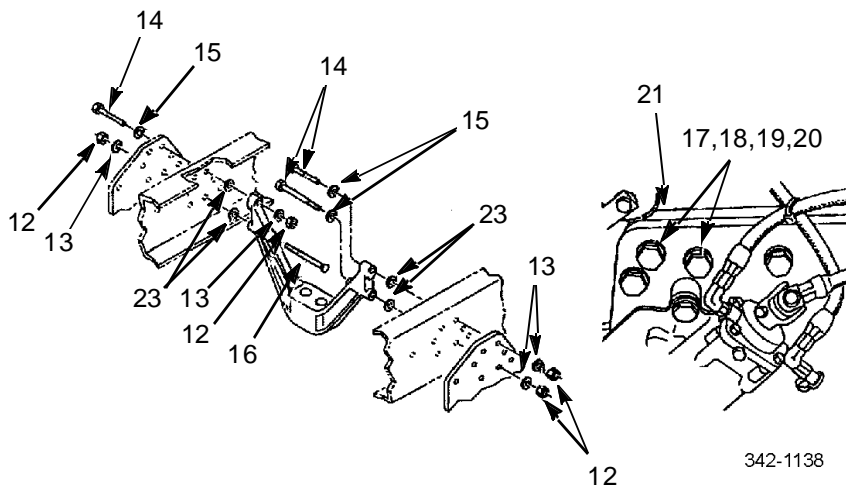
REMOVAL - CONTINUED

6. Repeat step 5 for right side.
7. Remove front engine mount support (22).
8. Remove four spacers (23).



INSTALLATION

1. Install front engine mount support (22).
2. Install four spacers (23).
3. On left side, install two washers (20), capscrews (19), washers (18), and nuts (17) on frame (21).



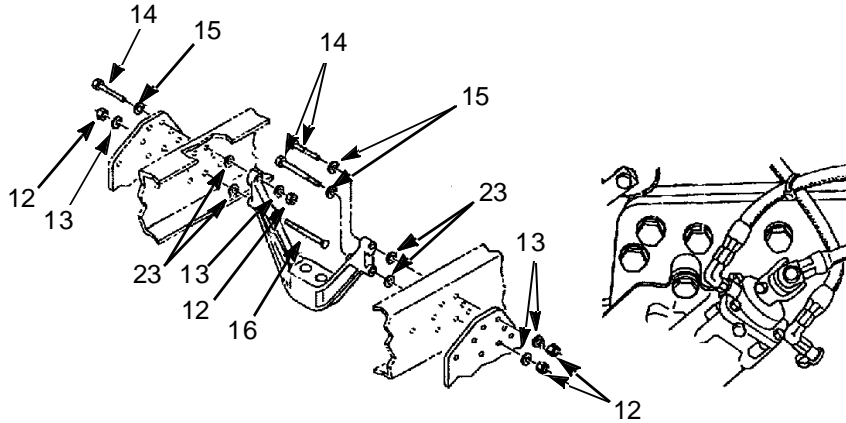
INSTALLATION - CONTINUED

4. Repeat step 3 for right side.

NOTE

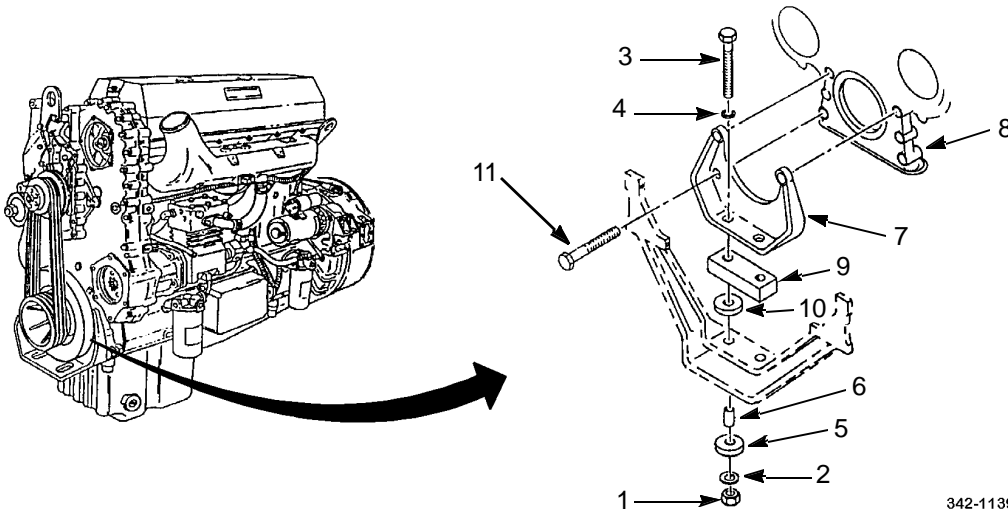
Ensure spacers (23) installed during step 2 do not slip out of place. If spacer is not present, frame will not be in line to allow installation of front crossmember.

5. Install screw (16), three washers (15), capscrews (14), four washers (13), and nuts (12).



342-1138

6. Install front engine mount adapter (7) and four bolts (11).
7. Install two isolators (10) and spacer (9).
8. Lower engine (8) and remove engine support.
9. Install two sleeves (6), isolators (5), washers (4), screws (3), washers (2), and new lock nuts (1).



342-1139

10. Install vibration damper (WP 0020 00).
11. Install front crossmember (WP 0096 00).
12. Install front ABS quick-release valve (TM 9-2320-302-20).

END OF WORK PACKAGE

REAR ENGINE MOUNTS REPLACEMENT

0012 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Personnel Required

Two

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Trestles (Item 135, WP 0126 00)



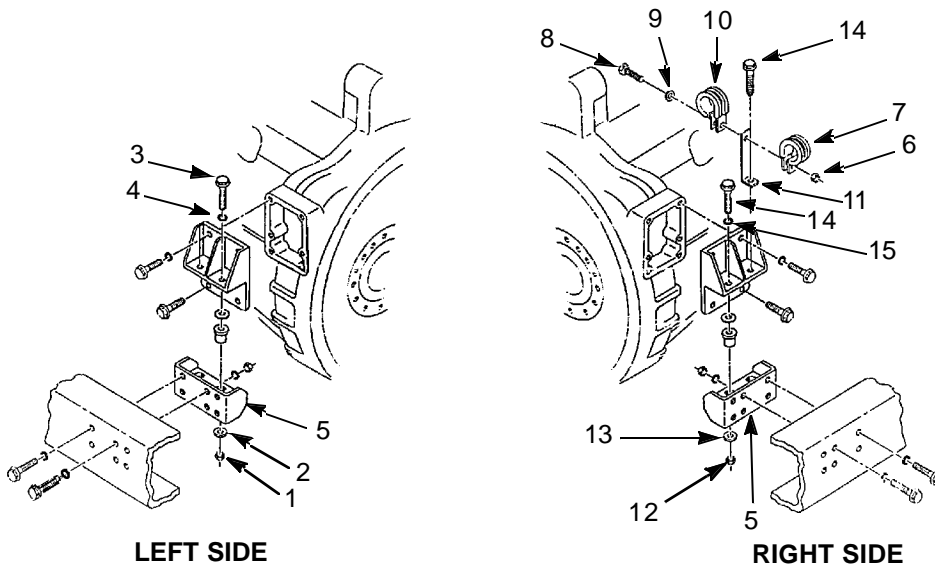
WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL

1. On left side, remove two nuts (1), washers (2), screws (3), and washers (4) from rear engine mount (5).
2. On right side, remove nut (6), clamp (7), screw (8), washer (9), and clamp (10) from bracket (11).
3. On right side, remove two nuts (12), washers (13), screws (14), bracket (11), and washer (15) from rear engine mount (5).



342-1134

REMOVAL - CONTINUED



WARNING



Engine weighs 2850 lb (1294 kg). Use hoist with lifting capacity of 5000 lb (2270 kg) to lift and support engine. Failure to do so could result in injury to personnel.

CAUTION

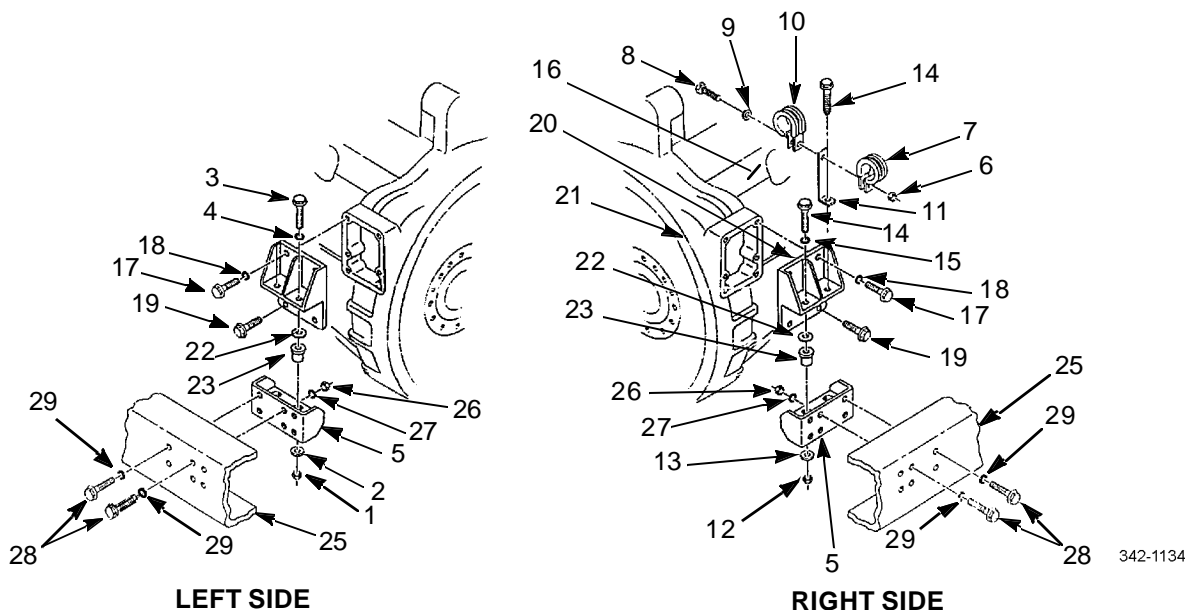
Lift engine only enough to take weight off engine mounts. If engine is lifted too far, wiring harness may be crushed by crossmember.

4. Using suitable lifting device, lift engine (16) slightly.

NOTE

Steps 5 through 8 are for left side.

5. Remove two screws (17), two washers (18), two screws (19), and rear engine leg (20) from flywheel housing (21).
6. Remove two washers (22) and two isolators (23) from rear engine mount (5).

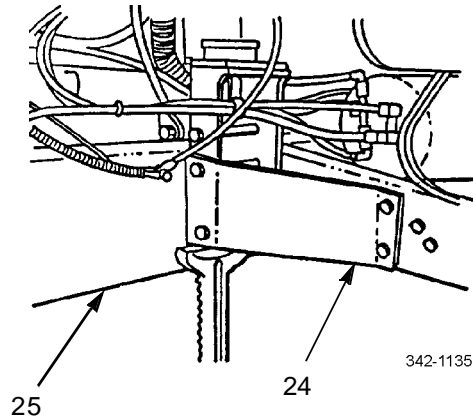


WARNING



Cab weighs 1100 lb (499 kg). Use suitable jack stands to support cab. Failure to do so could result in serious injury to personnel.

7. Using suitable jack stands, support cab at cab mounts (24) as close to frame rail (25) as possible.

REMOVAL - CONTINUED

8. Remove six nuts (26), washers (27), screws (28), washers (29), and rear engine mount (5) from frame rail (25).
9. Repeat steps 5 through 8 for right side.

INSTALLATION**WARNING**

Engine weighs 2850 lb (1294 kg). Use hoist with lifting capacity of 5000 lb (2270 kg) to lift and support engine. Failure to do so could result in injury to personnel.

1. On right side, install rear engine mount (5), six washers (29), screws (28), washers (27), and nuts (26) on frame rail (25).
2. On right side, install two isolators (23) and washers (22) in rear engine mount (5).
3. On right side, install rear engine leg (20), two screws (19), washers (18), and screws (17) in flywheel housing (21).
4. Repeat steps 1 through 3 for left side.
5. Remove jack stands from cab mounts (24).
6. On left side, install two washers (4), screws (3), washers (2), and nuts (1) hand-tight in rear engine mount (5).
7. On right side, install washer (15), bracket (11), two screws (14), washers (13), and nuts (12) on rear engine mount (5).
8. Lower engine (16) onto engine mounts and tighten four nuts (1 and 12) on left and right sides.
9. On right side, install clamp (10), washer (9), screw (8), clamp (7), and new lock nut (6) on bracket (11).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Dispenser, sealant (Item 30, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Tools and Special Tools - Continued

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Compound, gasket forming (Item 12, WP 0125 00)

Equipment Condition

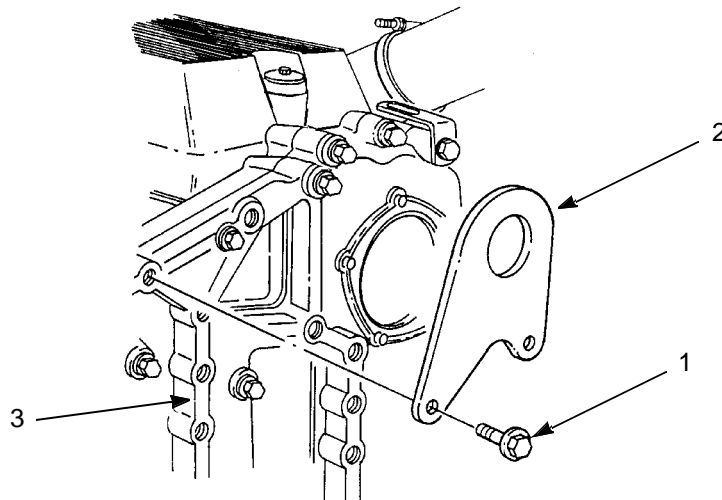
Spindle and housing assembly removed (TM 9-2320-302-20)

REMOVAL

NOTE

If repairing an oil leak, do not remove lifter bracket.

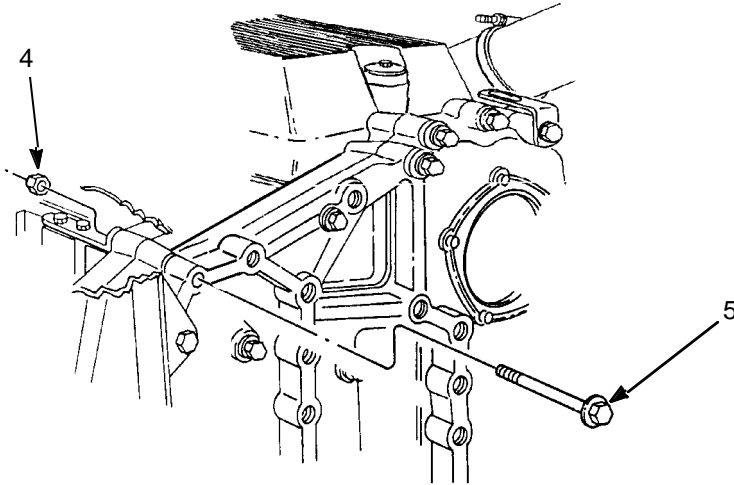
1. Remove two bolts (1) and front engine lifting bracket (2) from fan support bracket (3).



342-974

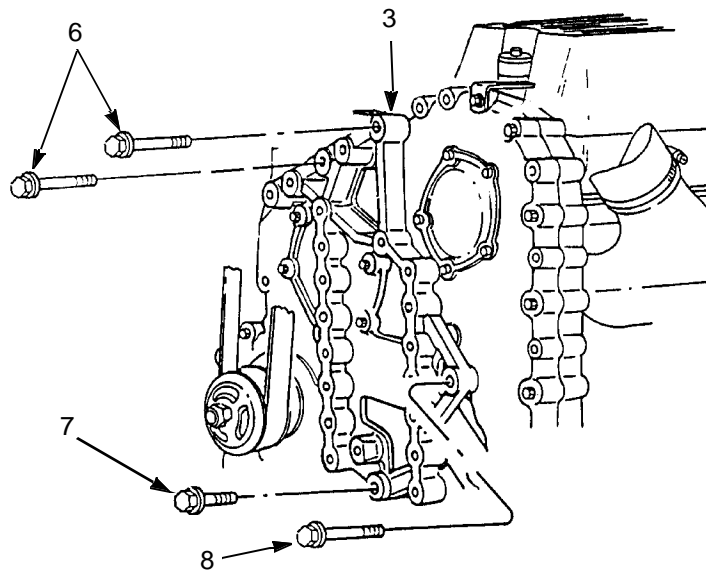
REMOVAL - CONTINUED

2. Hold nut (4) and remove gear housing stabilizer bracket bolt (5).
3. Remove nut (4).



342-975

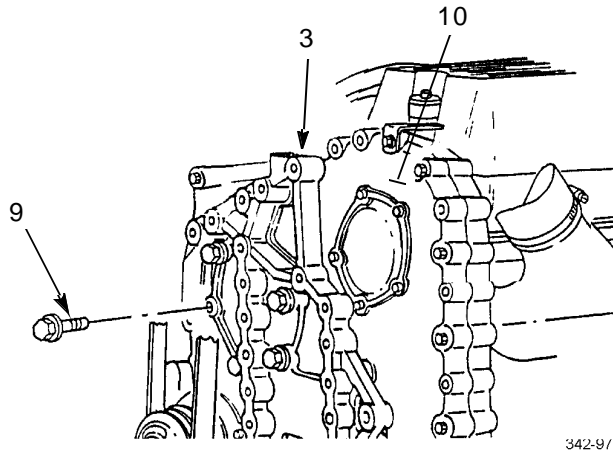
4. Remove two bolts (6) at top of fan support bracket (3).
5. Remove short bolt (7) at bottom of fan support bracket (3).
6. Remove long bolt (8) at right side of fan support bracket (3).



342-976

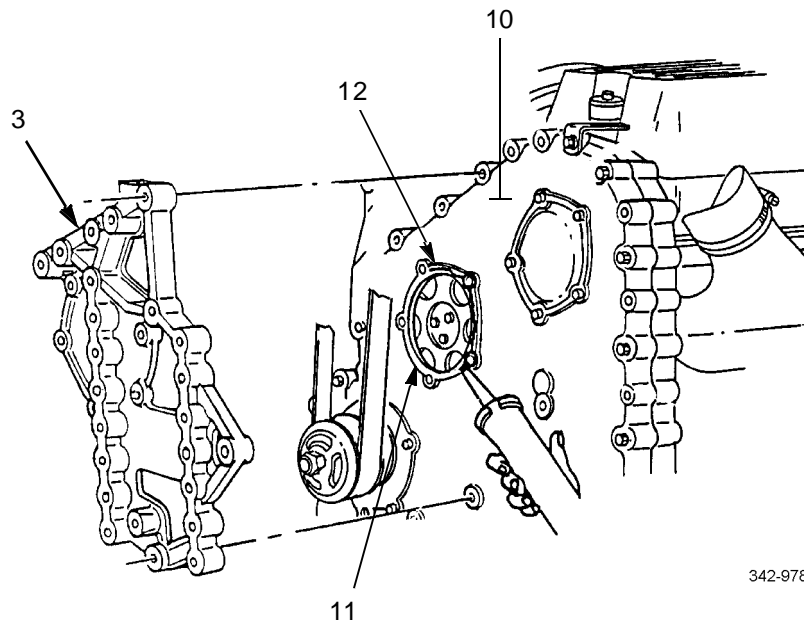
7. Remove five adjustable idler gear cover bolts (9).
8. Using plastic or fiber mallet, tap fan support bracket (3) to break loose from gear case cover (10).

REMOVAL - CONTINUED



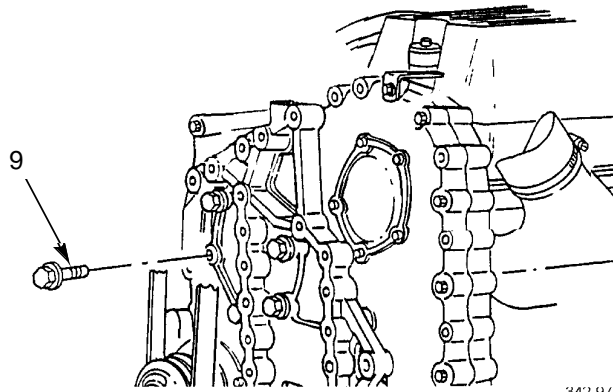
INSTALLATION

1. Apply thin bead of gasket forming compound to machined surface (11) of adjustable idler access hole (12) and position fan support bracket (3) on gear case cover (10).



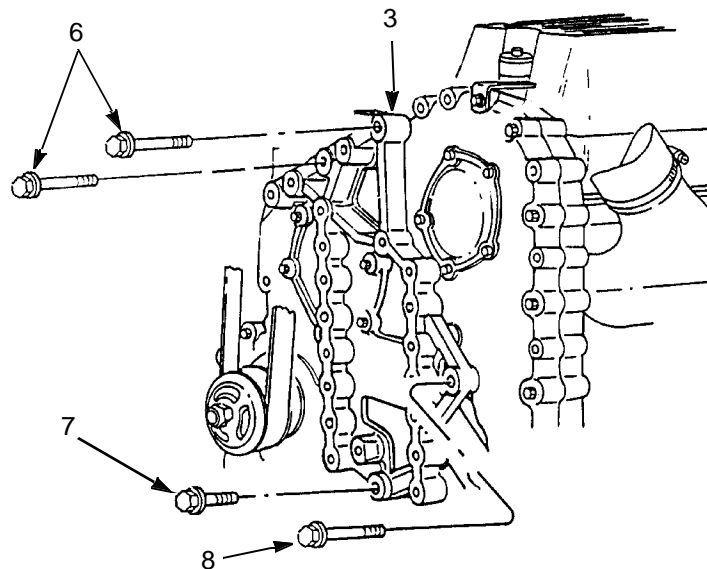
INSTALLATION - CONTINUED

2. Install five adjustable idler gear cover bolts (9) hand tight.



342-977

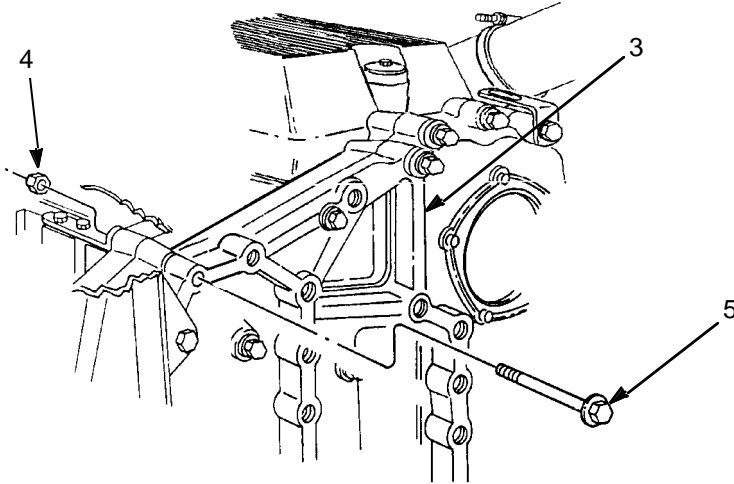
3. Install short bolt (7) through bottom hole in fan support bracket (3) and long bolt (8) through right hand bolt hole. Tighten bolts to 118-148 lb-ft (160-200 Nm).
4. Install two bolts (6) through bolt holes at top of fan support bracket (3). Tighten bolts to 43-54 lb-ft (58-73 Nm).



342-976

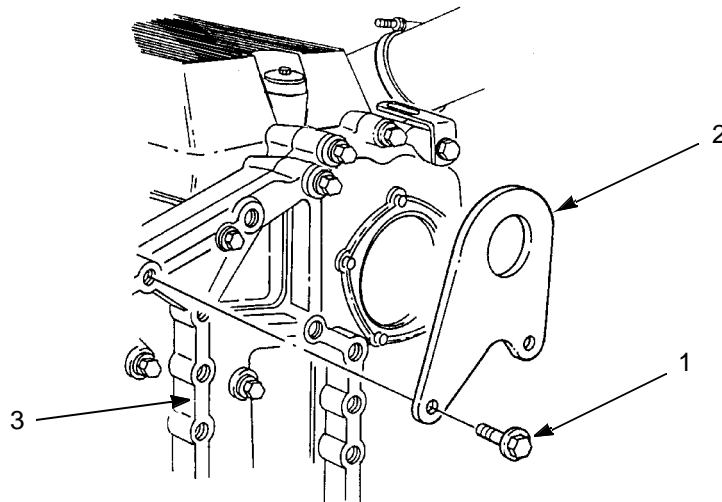
5. Tighten five adjustable idler gear cover bolts (9) to 22-28 lb-ft (30-38 Nm).
6. Install bolt (5) through top left hand bolt hole in fan support bracket (3) and through gear housing stabilizer bracket.
7. Install nut (4) and tighten bolt (5) to 43-54 lb-ft (58-73 Nm).

INSTALLATION - CONTINUED



342-975

8. Position front engine lifting bracket (2) on fan support bracket (3) and install two bolts (1). Tighten bolts to 75-93 lb-ft (102-126 Nm).



342-974

9. Install spindle and housing assembly (TM 9-2320-302-20).

END OF WORK PACKAGE

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AIR INTAKE MANIFOLD REPLACEMENT

0014 00

THIS WORK PACKAGE COVERS

Removal, Inspection, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Guide stud set (Item 43, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Gasket (P/N 23517875) (3)

Ring, seal (P/N 5182977)

Materials/Parts - Continued

Compound, sealing, pipe (Item 18, WP 0125 00)

Oil, lubricating (Item 25, WP 0125 00)

References

TM 9-2320-302-10

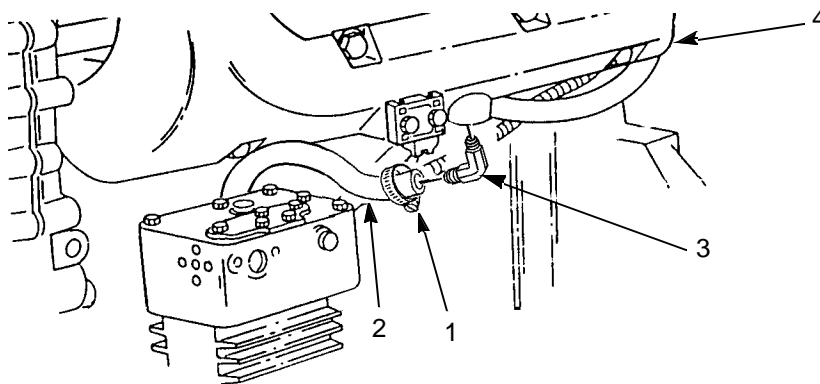
Equipment Configuration

Air intake manifold-to-intercooler tube removed (TM 9-2320-302-20)

Ether atomizer and bushing removed (TM 9-2320-302-20)

REMOVAL

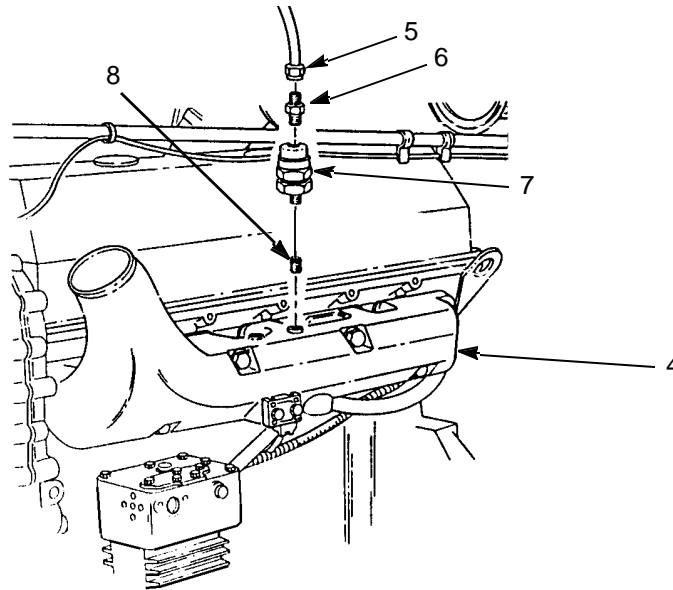
1. Loosen hose clamp (1) and disconnect air compressor inlet hose (2) from air supply connector (3).
2. Remove air supply connector (3) from air intake manifold (4).



342-634

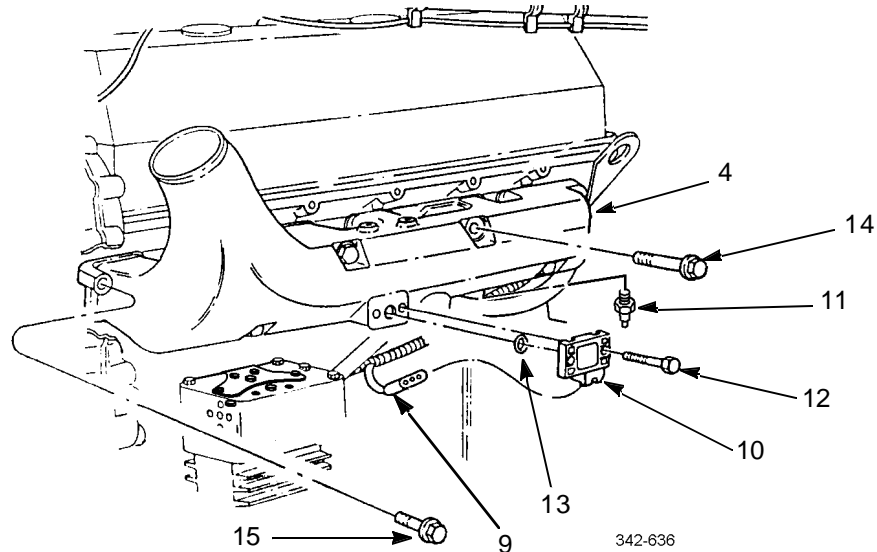
REMOVAL - CONTINUED

3. Disconnect air line connector (5) from fitting (6).
4. Remove fitting (6), check valve (7), and nipple (8) from air intake manifold (4)



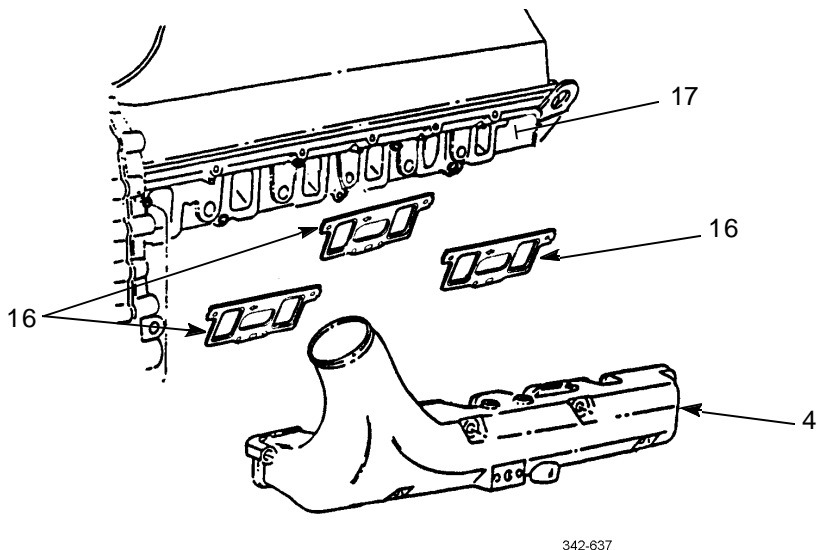
342-635

5. Disconnect engine wiring harness (9) from turbo boost sensor (10) and air temperature sensor (11).
6. Remove air temperature sensor (11) from air intake manifold (4).
7. Remove two retaining bolts (12) and turbo boost sensor (10).
8. Remove and discard seal ring (13).
9. Remove five long bolts (14) and two end short bolts (15) from air intake manifold (4).



342-636

10. Remove air intake manifold (4) and three gaskets (16) from cylinder head (17). Discard gaskets.

REMOVAL - CONTINUED**INSPECTION**

1. Inspect air intake manifold for cracks, particularly in mounting bolt boss areas. If cracked, discard intake manifold.
2. Inspect all parts for wear or damage.

INSTALLATION

1. Install six guide studs in six bolt holes of cylinder head (17).

NOTE

Install gaskets with arrow pointing to front of engine.

2. Install three new gaskets (16) over six guide studs.

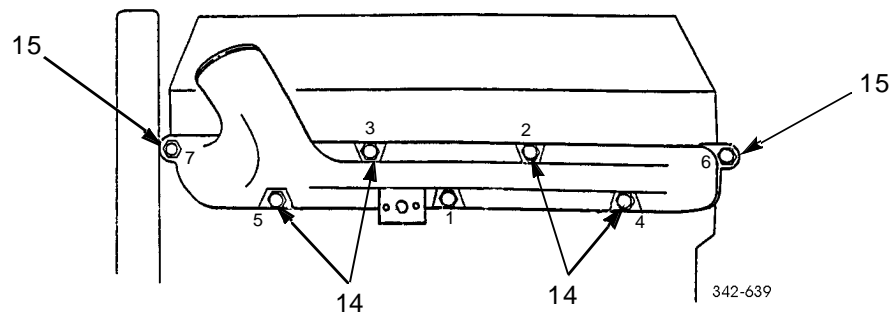
NOTE

Ensure all wires are clear of intake manifold connection points before installing manifold.

3. Install air intake manifold (4) over six guide studs and against cylinder head (17).

INSTALLATION - CONTINUED

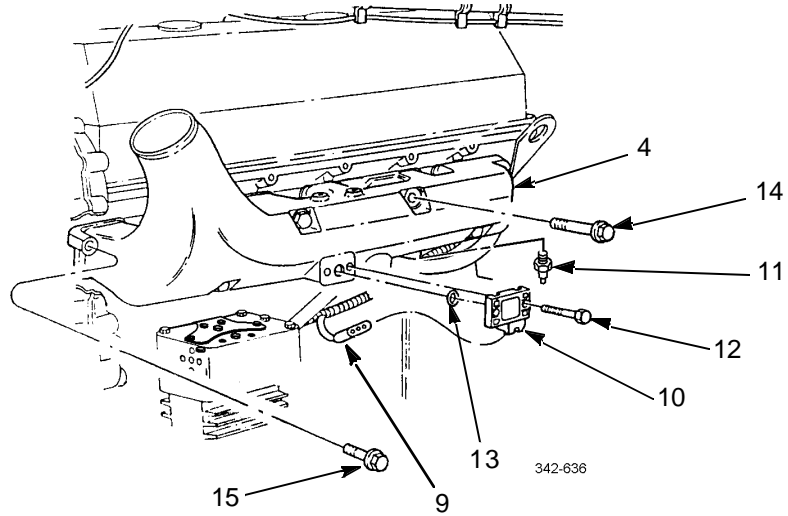
4. Install one long bolt (14) in lower center position of air intake manifold (4) and hand tighten.
5. Remove six guide studs.
6. Install remaining four long bolts (14) in air intake manifold (4). Tighten by hand.
7. Install two short bolts (15) at ends of air intake manifold (4). Tighten by hand.
8. Tighten seven bolts (14 and 15) to 43-54 lb-ft (58-73 Nm), in sequence shown.

**WARNING**

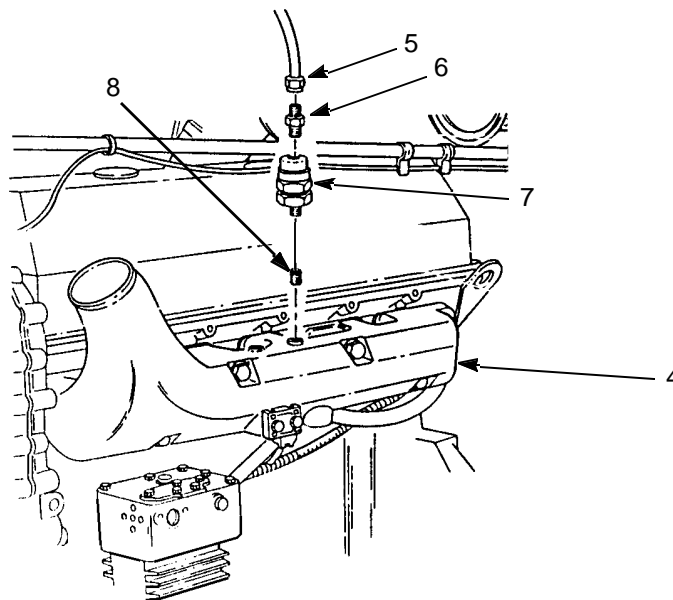
Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water.

9. Coat threads of air temperature sensor (11) with pipe sealing compound and install in air intake manifold (4).
10. Apply lubricating oil to new seal ring (13) and install in intake manifold (4)
11. Install turbo boost sensor (10) on intake manifold (4) and secure in place with two retaining bolts (12). Tighten bolts to 21-26 lb-in (2.4-2.9 Nm).
12. Connect engine wiring harness (9) to turbo boost sensor (10) and air temperature sensor (11).

INSTALLATION - CONTINUED



13. Coat threads of nipple (8) and fitting (6) with pipe sealing compound and install nipple (8), check valve (7), and fitting (6) in intake manifold (4).
14. Connect air line (5) to fitting (6).



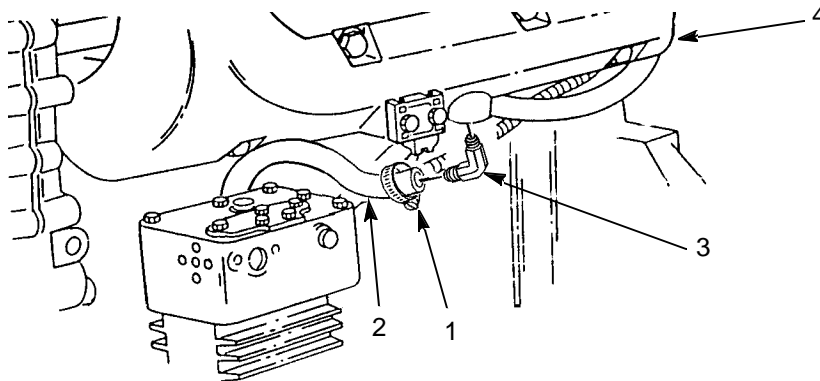
342-635

AIR INTAKE MANIFOLD REPLACEMENT - CONTINUED

0014 00

INSTALLATION - CONTINUED

15. Apply a light coat of pipe sealing compound to threads of air supply connector (3), install in air intake manifold (4), and attach air compressor inlet hose (2) to connector.
16. Position hose clamp (1) and secure in place.



342-634

17. Install air intake intercooler tubing (TM 9-2320-302-20).
18. Install ether atomizer and bushing (TM 9-2320-302-20).
19. Operate vehicle (TM 9-2320-302-10) and check for leaks.

END OF WORK PACKAGE

EXHAUST MANIFOLD REPLACEMENT

0015 00

THIS WORK PACKAGE COVERS

Removal, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Guide stud set (Item 43, WP 0126 00)

Vise, mechanist's (Item 136, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Gasket (P/N 23511666) (3)

Personnel Required

Two

References

TM 9-2320-302-10

Equipment Condition

Turbocharger removed (WP 0042 00)

Breather tube removed (WP 0017 00)



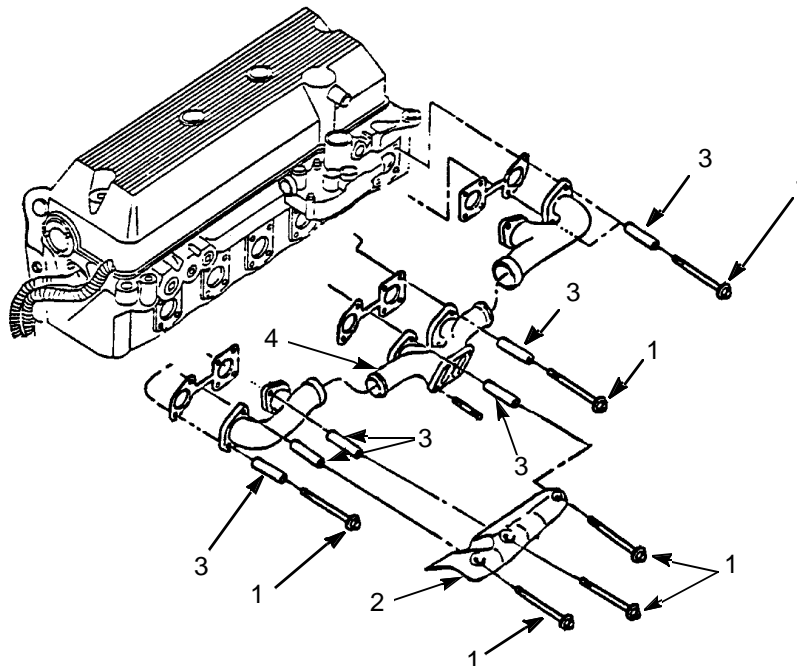
WARNING



Exhaust manifold weighs 60 lb (27 kg). Use assistance and extreme caution during replacement to prevent possible injury to personnel.

REMOVAL

1. Remove six upper bolts (1), heat shield (2), and six spacers (3) from exhaust manifold (4).
2. Install six guide studs in place of removed bolts.



342-640

REMOVAL - CONTINUED

3. Remove remaining six bolts (1), spacers (3), and exhaust manifold (4) assembly from cylinder head (5).
4. Remove and discard three gaskets (6).
5. Secure center section of exhaust manifold (4) in vise. Using brass drift, remove each end section (7) of exhaust manifold.
6. If damaged, remove and discard four turbocharger mounting studs (8).

INSPECTION

1. Inspect exhaust manifold for cracks, particularly in mounting bolt boss areas. If cracked, discard exhaust manifold.
2. Inspect all parts for damage.

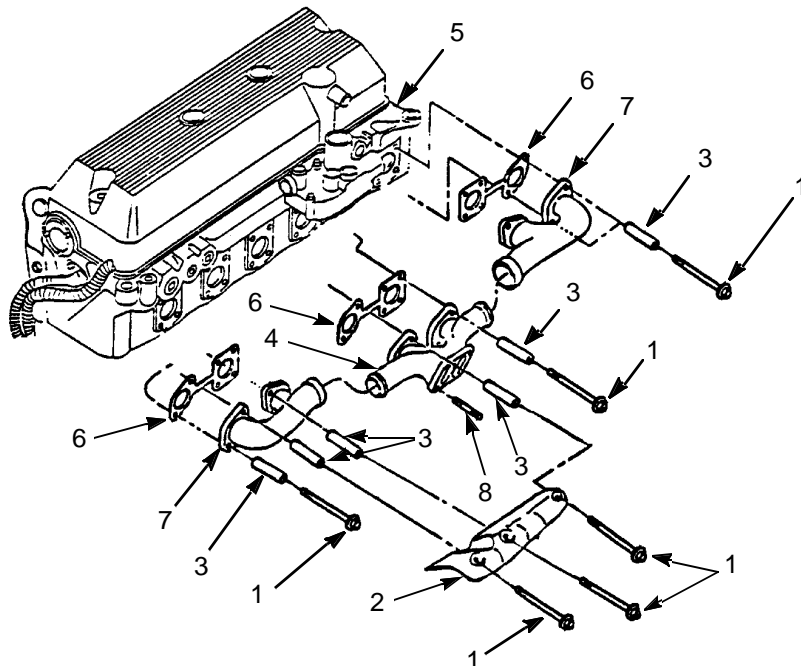
INSTALLATION

1. Secure center section of exhaust manifold (4) in vise.

NOTE

If turbocharger mounting studs were removed, perform steps 2 and 3.

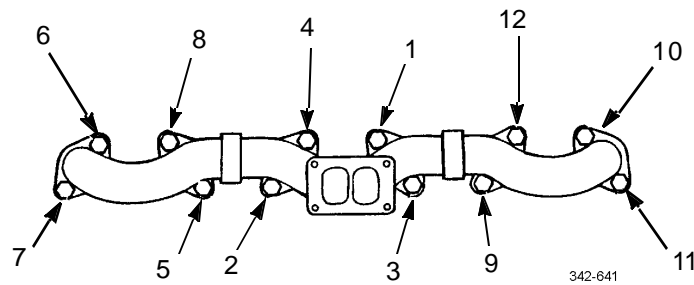
2. Using one nut as jam nut, install two nuts on four turbocharger mounting studs (8).
3. Thread turbocharger mounting studs (8) into exhaust manifold (4) until unthreaded portion of stud bottoms against mounting flange. Tighten studs to 18-24 lb-ft (25-32 Nm). Remove two nuts from each stud.
4. Install exhaust manifold end sections (7) on center section of exhaust manifold (4). Position and seat end sections by tapping with fiber or plastic mallet.
5. Install six guide studs in upper bolt hole locations.
6. Install three new gaskets (6) and exhaust manifold (4) on guide studs.



342-640

INSTALLATION - CONTINUED

7. Install six bolts (1) and spacers (3) in lower bolt holes and tighten hand tight.
8. Remove six guide studs and replace with remaining six bolts (1) and spacers (3). Tighten hand tight.
9. Tighten all bolts (1) to 43-54 lb-ft (58-73 Nm), in sequence shown.

**TIGHTENING SEQUENCE**

10. Install turbocharger (WP0042 00).
11. Install breather tube (WP0017 00).
12. Run engine (TM 9-2320-302-10) and check for leaks.

END OF WORK PACKAGE

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ROCKER ARM COVER REPLACEMENT

0016 00

THIS WORK PACKAGE COVERS

Removal, Cleaning, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Dispenser, sealant (Item 30, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Gasket (P/N 23522269)

Materials/Parts - Continued

Compound, gasket forming (Item 12, WP 0125 00)

Detergent (Item 19, WP 0125 00)

Equipment Condition

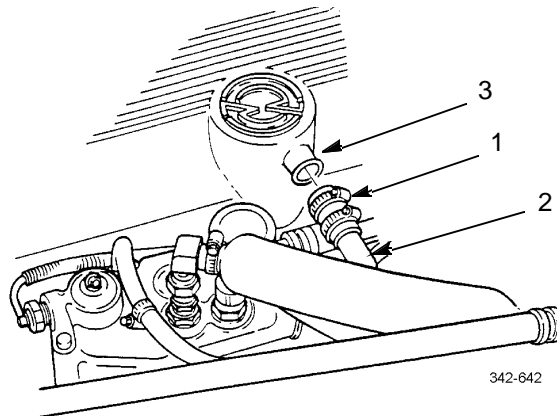
Air cleaner, pre-cleaner, and duct assembly removed (TM 9-2320-302-20)

Thermostat-to-radiator coolant tube removed (TM 9-2320-302-20)

Radiator support rod removed (TM 9-2320-302-20)

REMOVAL

1. Loosen hose clamp (1) and disconnect crankcase breather tube (2) from rocker arm cover neck (3).



342-642

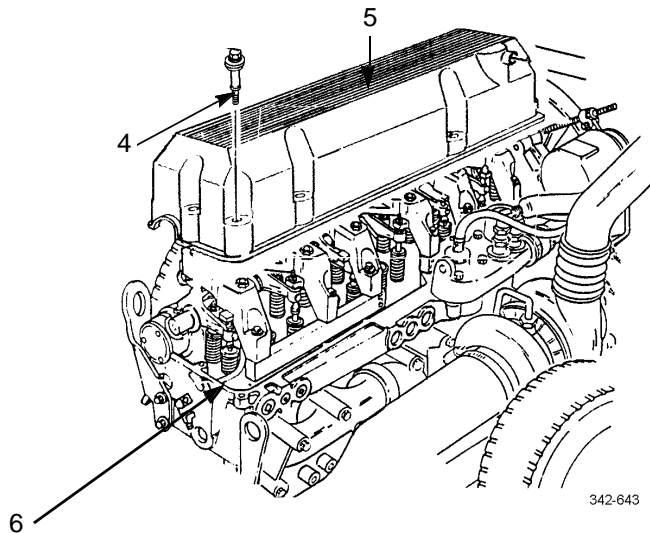
REMOVAL - CONTINUED

2. Remove ten bolt assemblies (4) securing rocker arm cover (5) to cylinder head (6).

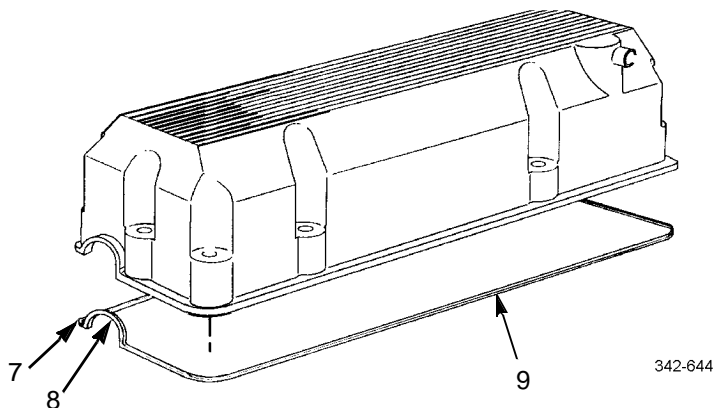
CAUTION

Handle rocker arm cover carefully; dropping or bumping may cause damage.

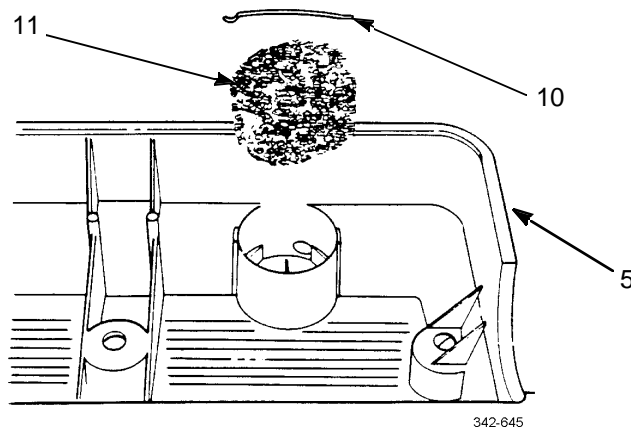
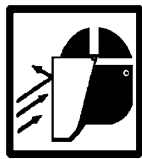
3. Remove rocker arm cover (5) from cylinder head (6).



4. Free gasket saddle corners (7) and saddle arch areas (8). Lift rocker arm cover gasket (9) straight out of rocker arm cover groove to prevent tearing or stretching gasket. If damaged or stretched, discard gasket.



5. Invert rocker arm cover (5) on bench. Press and slide straight end of breather element retaining clip (10) until clip disengages from rocker arm cover. Lift clip upward to disengage curved end.
6. Remove breather mesh element (11) from rocker arm cover (5).

REMOVAL - CONTINUED**CLEANING****WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

1. Clean rocker arm cover gasket and ten bolt assemblies with detergent and water. Dry with compressed air.
2. Clean all old gasket forming compound from rocker arm cover grooves. Clean all dirt and foreign matter from rocker arm cover.
3. Remove old gasket forming compound from corners of cylinder head located at front and rear cam cap area.
4. Clean mesh breather element with detergent and water solution and dry with compressed air.

INSPECTION

1. Inspect rocker arm cover gasket for cuts, nicks, and breaks. If found, discard gasket.
2. Inspect all components for wear or damage.

INSTALLATION

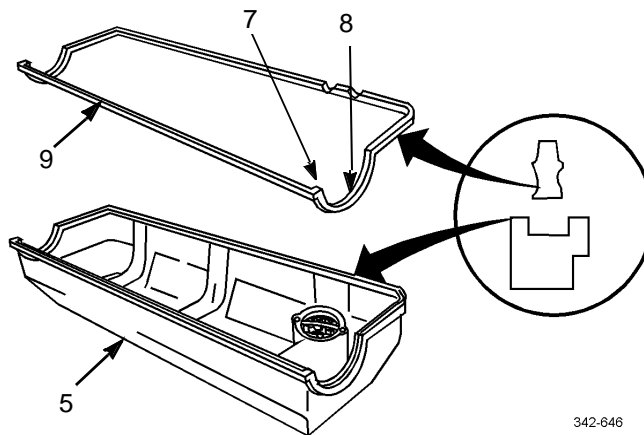
1. Press mesh breather element (11) into breather pocket.
2. Insert curved end of breather element retaining clip (10) into one breather pocket hole. Press and slide straight end of clip into opposite breather pocket hole.

INSTALLATION - CONTINUED

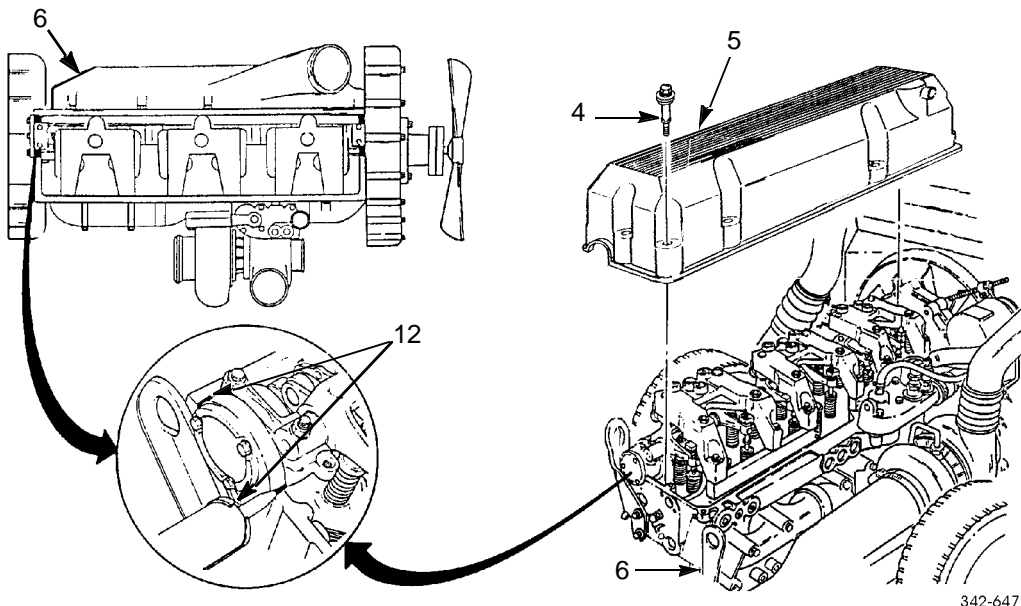
NOTE

To ease gasket installation, lightly spray a solution of soapy water into seal groove of rocker arm cover.

3. Position rocker arm cover gasket (9) in rocker arm cover (5).
4. Install rocker arm cover gasket (9), beginning at corners (7) of saddle arch (8) on each end of rocker arm cover (5). Work back into saddle arch equally from each corner (7), pushing gasket firmly into rocker arm cover groove.
5. Beginning at center of rocker arm cover (5), install long runs of rocker arm cover gasket (9) toward corners (7) of saddle arches (8) and continue until gasket installation is completed.

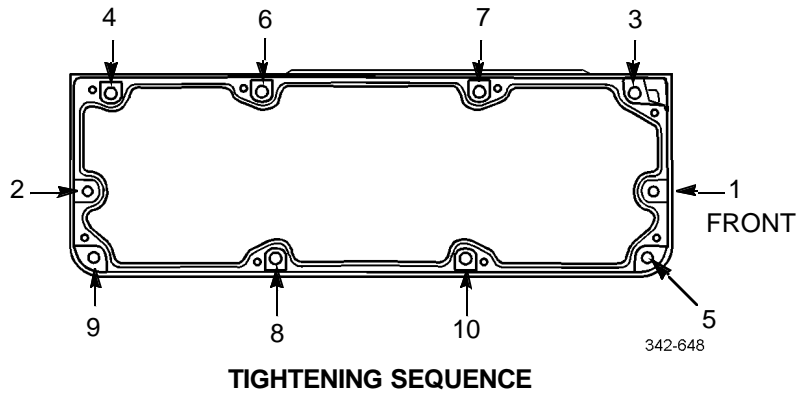


6. Apply a thin bead of gasket forming compound in front and rear corners (12) of cylinder head (6) where front and rear cam caps are located.
7. Position rocker arm cover (5) on cylinder head (6).
8. Install ten bolt assemblies (4) in rocker arm cover (5).

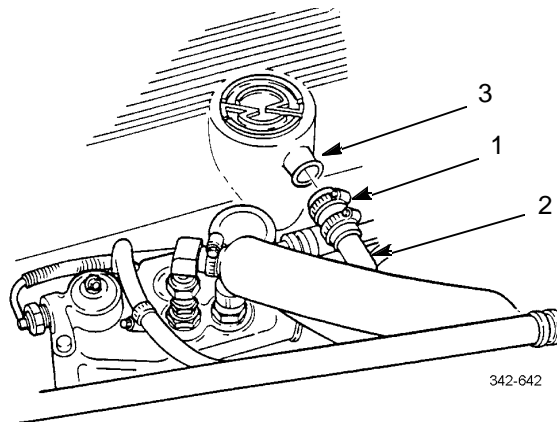


INSTALLATION - CONTINUED

9. In sequence shown, tighten ten bolt assemblies to 22-28 lb-ft (30-38 Nm).



10. Install crankcase breather tube (2) over rocker arm cover neck (3) and secure with hose clamp (1).



11. Install air cleaner, pre-cleaner, and duct assembly (TM 9-2320-302-20).
12. Install thermostat-to-radiator coolant tube (TM 9-2320-302-20).
13. Install radiator support rod (TM 9-2320-302-20).

END OF WORK PACKAGE

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BREATHER TUBE REPLACEMENT**0017 00****THIS WORK PACKAGE COVERS**

Removal, Installation

INITIAL SETUP**Maintenance Level**

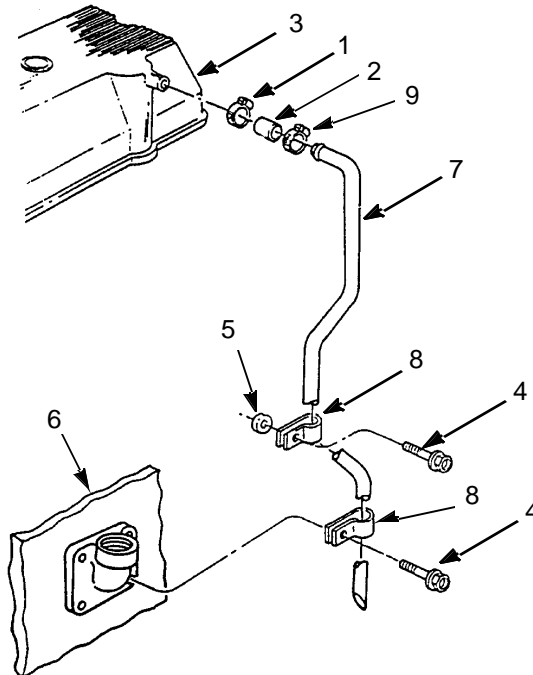
Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

REMOVAL

1. Loosen hose clamp (1) and disconnect hose (2) from rocker arm cover (3).
2. Remove two bolts (4) and spacer (5) from engine block (6).
3. Remove breather tube (7) and two clamps (8).
4. Loosen hose clamp (9) and remove hose (2) from breather tube (7).



342-649

INSTALLATION

1. Install hose (2) on breather tube (7) and tighten hose clamp (9).
2. Install breather tube (7) and two clamps (9).
3. Install spacer (5) and two bolts (4) on engine block (6).
4. Connect hose (2) to rocker arm cover (3) and tighten hose clamp (1).

END OF WORK PACKAGE

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CYLINDER HEAD REPLACEMENT

0018 00

THIS WORK PACKAGE COVERS

Removal, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Clamp, material lift (Item 20, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Gasket (P/N 23506120)

Compound, international, no. 2 (Item 13, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Personnel Required

Two

Equipment Condition

Alternator removed (TM 9-2320-302-20)

Air conditioner compressor removed (WP 0117 00)

Thermostat and thermostat housing cover removed (TM 9-2320-302-20)

Water level sensor removed (TM 9-2320-302-20)

Exhaust manifold removed (WP 0015 00)

Air intake manifold removed (WP 0014 00)

Air compressor cooling lines disconnected (TM 9-2320-302-20)

Camshaft and bearings removed (WP 0026 00)

Fuel injectors removed (WP 0046 00)

Injector wiring harness removed (WP 0069 00)



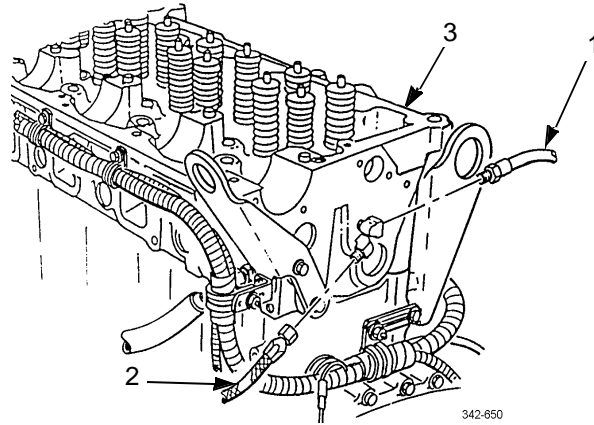
WARNING



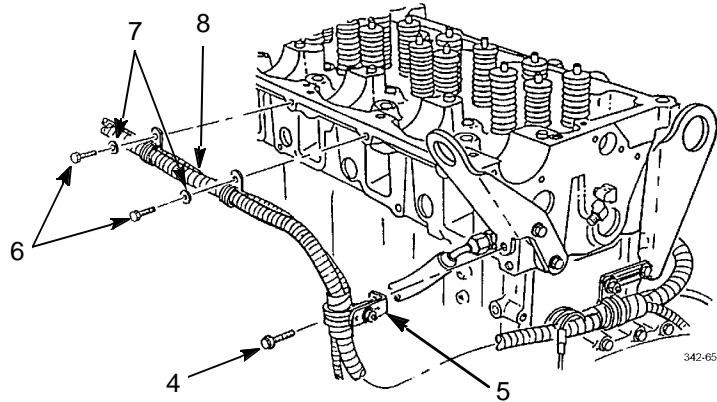
Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL

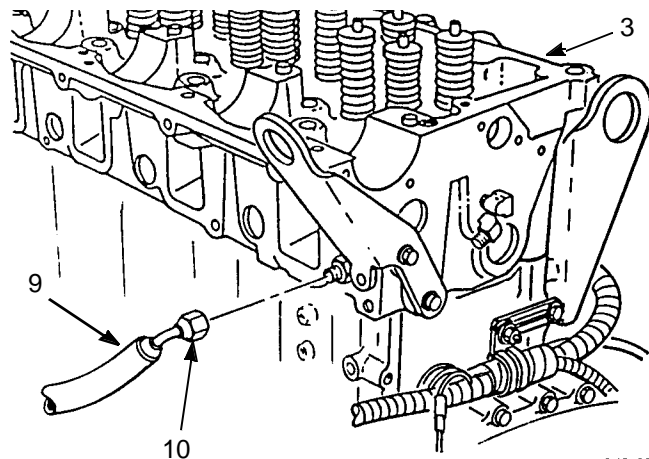
1. Disconnect two fuel lines (1 and 2) from cylinder head (3).



2. Remove bolt (4) and set bracket (5) aside.
3. Remove two bolts (6) and washers (7) and set wiring harness (8) aside.

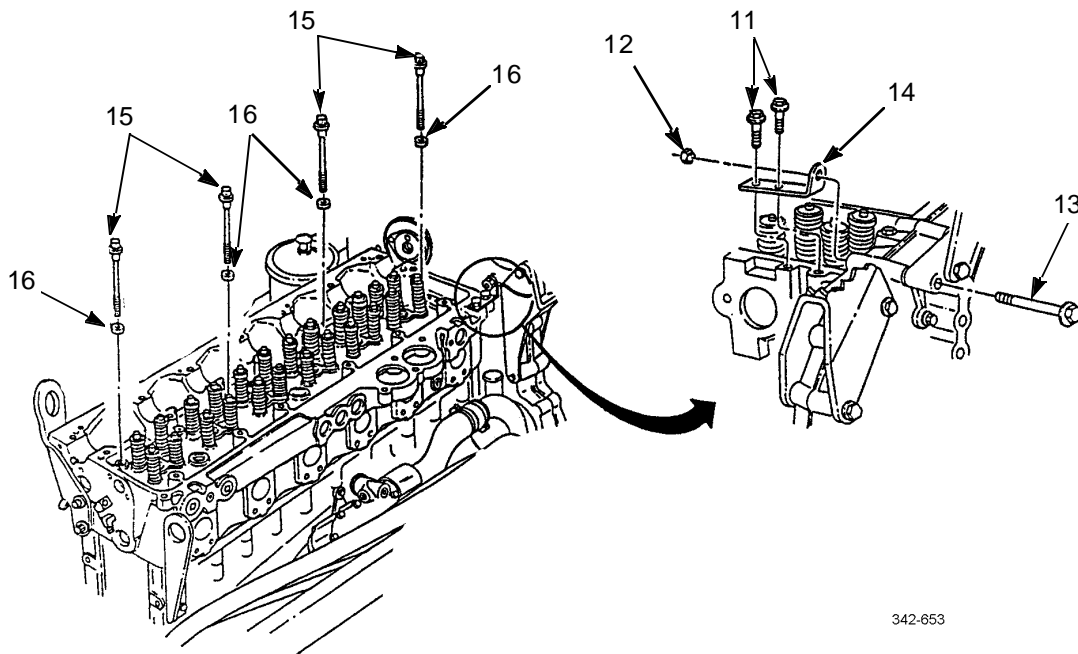


4. Disconnect air compressor hose (9) and clamp (10) from cylinder head (3).



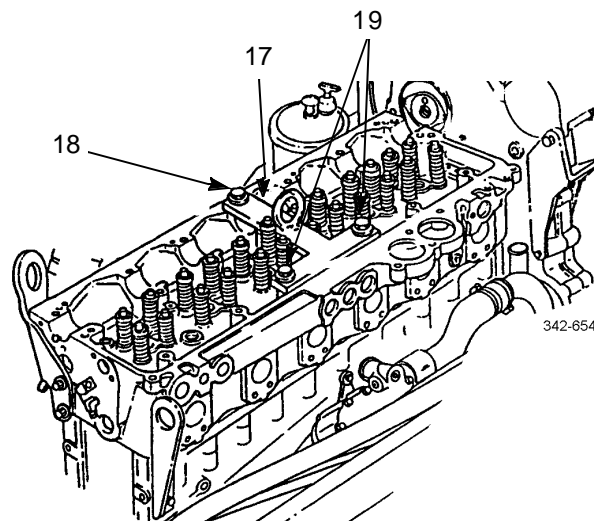
REMOVAL - CONTINUED

5. Remove two bolts (11), nut (12), bolt (13), and bracket (14).
6. Remove 38 cylinder head bolts (15) and washers (16).



342-653

7. Install lifter (17) between fuel injector holes no. 3 and no. 4.
 - a. Install bolt (18) using bolt hole for center cam cap bolt.
 - b. Install two bolts (19) using two tapped holes for engine retarder assembly.

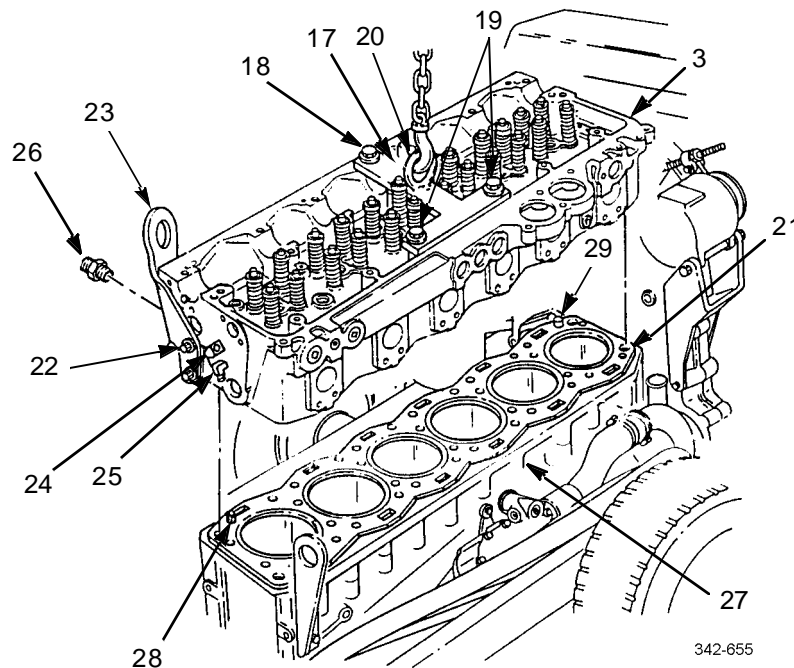


342-654

REMOVAL - CONTINUED

Cylinder head weighs 421 lb (191 kg). Use suitable lifting device to lift and support cylinder head. Failure to do so could result in injury to personnel.

8. Attach suitable lifting device to lifter eye (20) and remove cylinder head (3).
9. Remove and discard cylinder head gasket (21).
10. Remove bolt (22) and left rear lifting bracket (23).
11. Tag and remove elbows (24 and 25) from cylinder head (3).
12. Remove air compressor fitting (26) from cylinder head (3).

**INSPECTION**

1. Ensure piston domes, cylinder head, cylinder block deck surfaces, and injector tubes are clean and free of foreign matter.
2. Inspect cylinder block bolt holes and block-to-head gasket mating surfaces for oil, water, dirt or old gasket material.

INSTALLATION

1. Install left rear lifting bracket (23) and secure to cylinder head (3) with bolt (22). Tighten bolt to 75-93 lb-ft (102-126 Nm).
2. Install new cylinder head gasket (21) on cylinder block (27).

INSTALLATION - CONTINUED

3. Install air compressor fitting (26) in cylinder head (3).
4. Remove tags and install two elbows (24 and 25) in cylinder head (3).
5. Install lifter (17) between fuel injectors no. 3 and no. 4.
 - a. Install bolt (18) using bolt hole for center cam cap bolt.
 - b. Install two bolts (19) using two tapped holes for engine retarder assembly.

**WARNING**

Cylinder head weighs 421 lb (191 kg). Use suitable lifting device to lift and support cylinder head. Failure to do so could result in injury to personnel.

6. Attach suitable lifting device to lifter eye (20) and position cylinder head (3) over engine block (27).
7. Seat cylinder head (3) on diamond dowel (28) and round dowel (29) until full contact is made with cylinder head gasket (21).
8. Remove lifting device from lifter eye (20).

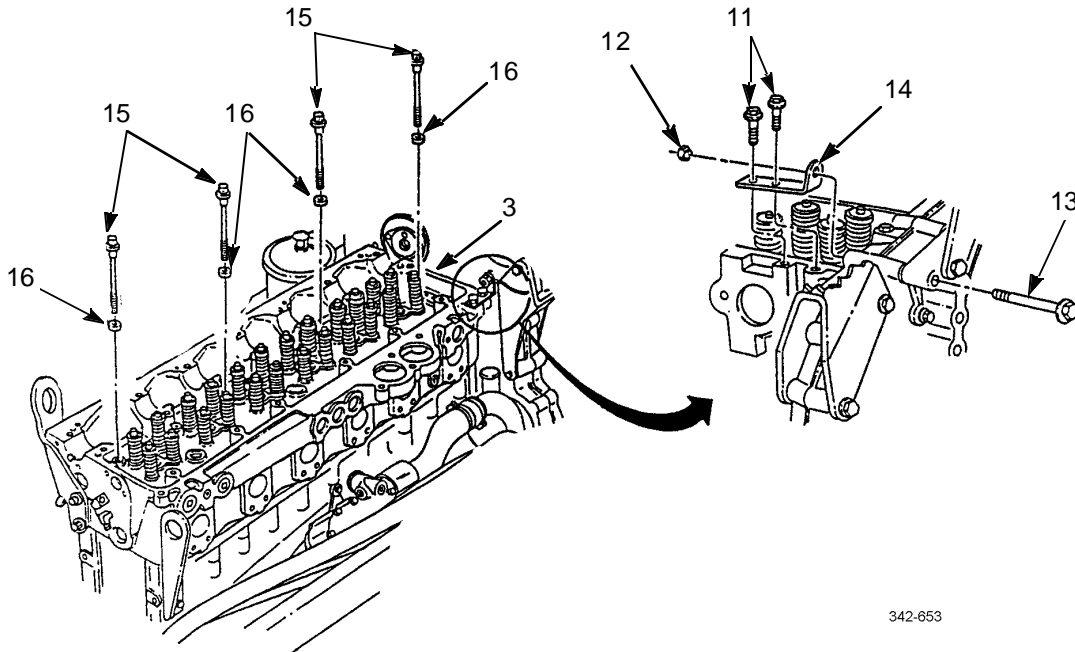
NOTE

If cylinder head is other than one removed, or if resurfaced cylinder head is being installed, three nuts retaining adjustable idler gear must be loosened before installing and tightening camshaft drive gear retaining bolt. Notify General Support Maintenance to perform adjustment.

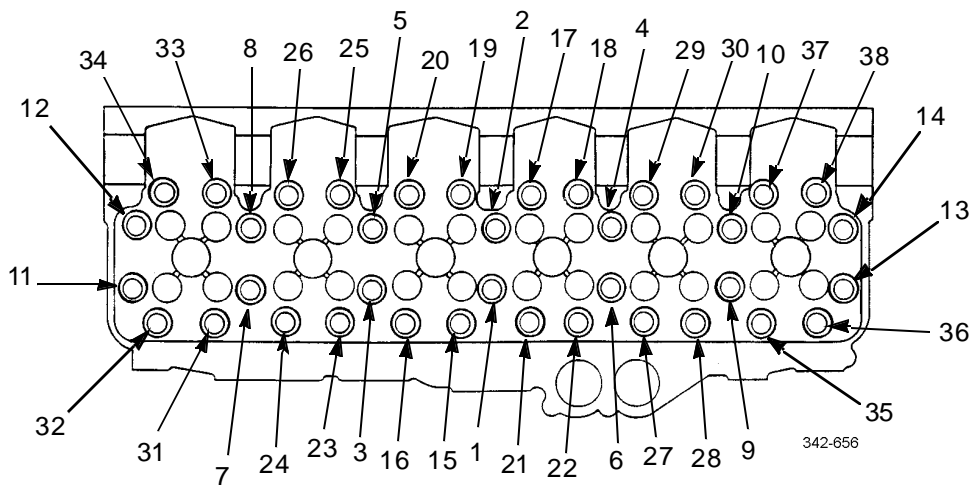
9. Remove lifter (17).

INSTALLATION - CONTINUED

10. Lubricate threads of 38 cylinder head bolts (15) and bolt head contact areas with a small amount of international compound no. 2.
11. Install 38 washers (16) and cylinder head bolts (15) in cylinder head (3).



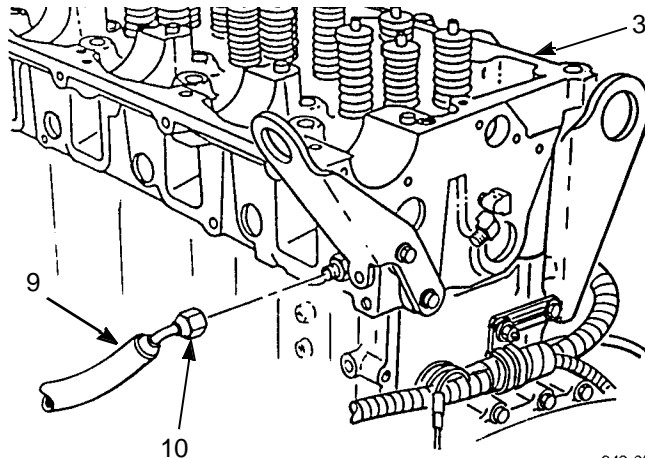
12. Initially tighten 38 cylinder head bolts (15) to 185-210 lb-ft (251-285 Nm), in sequence shown.



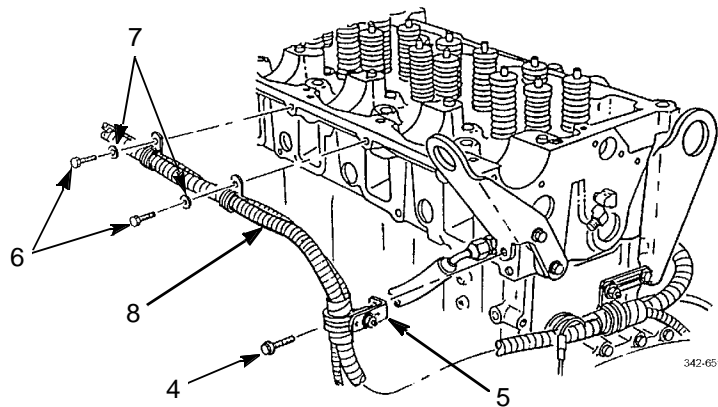
TIGHTENING SEQUENCE

INSTALLATION - CONTINUED

13. Finally tighten 38 cylinder head bolts (15) to same torque and sequence as in step 12.
14. Install bracket (14) on cylinder head (3) and install two bolts (11). Tighten bolts to 43-54 lb-ft (58-73 Nm).
15. Install bolt (13) through gear case cover and housing assembly and install nut (12). Tighten nut to 43-54 lb-ft (58-73 Nm).
16. Connect air compressor hose (9) with clamp (10) to cylinder head (3).

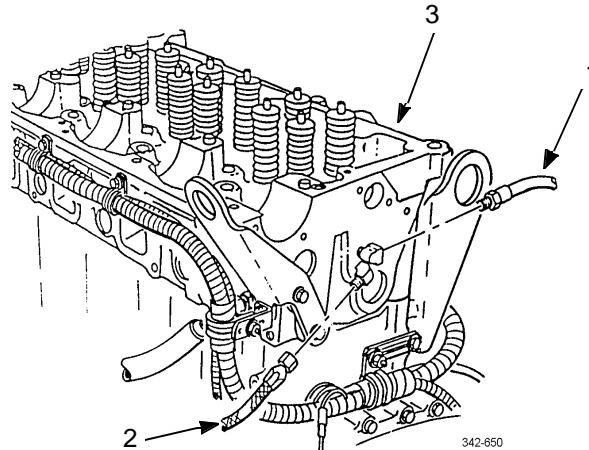


17. Position wiring harness (8) in place and install two washers (7) and bolts (6).
18. Position bracket (5) in place and install bolt (4).



INSTALLATION - CONTINUED

19. Connect two fuel lines (1 and 2) to cylinder head (3).



20. Install injector wiring harness (WP 0069 00).
21. Install fuel injectors (WP0046 00).
22. Install camshaft and bearings (WP 0026 00).
23. Connect air compressor cooling lines (TM 9-2320-302-20).
24. Install air intake manifold (WP 0014 00).
25. Install exhaust manifold (WP0015 00).
26. Install water level sensor (TM 9-2320-302-20).
27. Install thermostat and thermostat housing cover (TM 9-2320-302-20).
28. Install alternator (TM 9-2320-302-20).
29. Install air conditioner compressor (WP 0117 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dispenser, sealant (Item 30, WP 0126 00)
- Guide stud set (Item 43, WP 0126 00)
- Trestles (Item 135, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

- Ring, seal (P/N 5141452)
- Compound, gasket forming (Item 12, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)
- Straps, tiedown (Item 34, WP 0125 00)

References

TM 9-2320-302-20

Equipment Condition

- Alternator removed (TM 9-2320-302-20)
- Water pump removed (TM 9-2320-302-20)
- Air compressor removed (TM 9-2320-302-20)
- Front engine mount adapter removed (WP 0011 00)
- Fan drive support removed (WP 0013 00)
- Accessory drive removed (WP 0021 00)
- Oil pan removed (WP 0028 00)
- Power steering pump removed (WP 0086 00)



WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

NOTE

Procedure may be accomplished in vehicle or on engine stand.

REMOVAL

CAUTION

Use wood blocks on trestles to protect oil pan flange.

1. Install trestles under each side of oil pan flange.

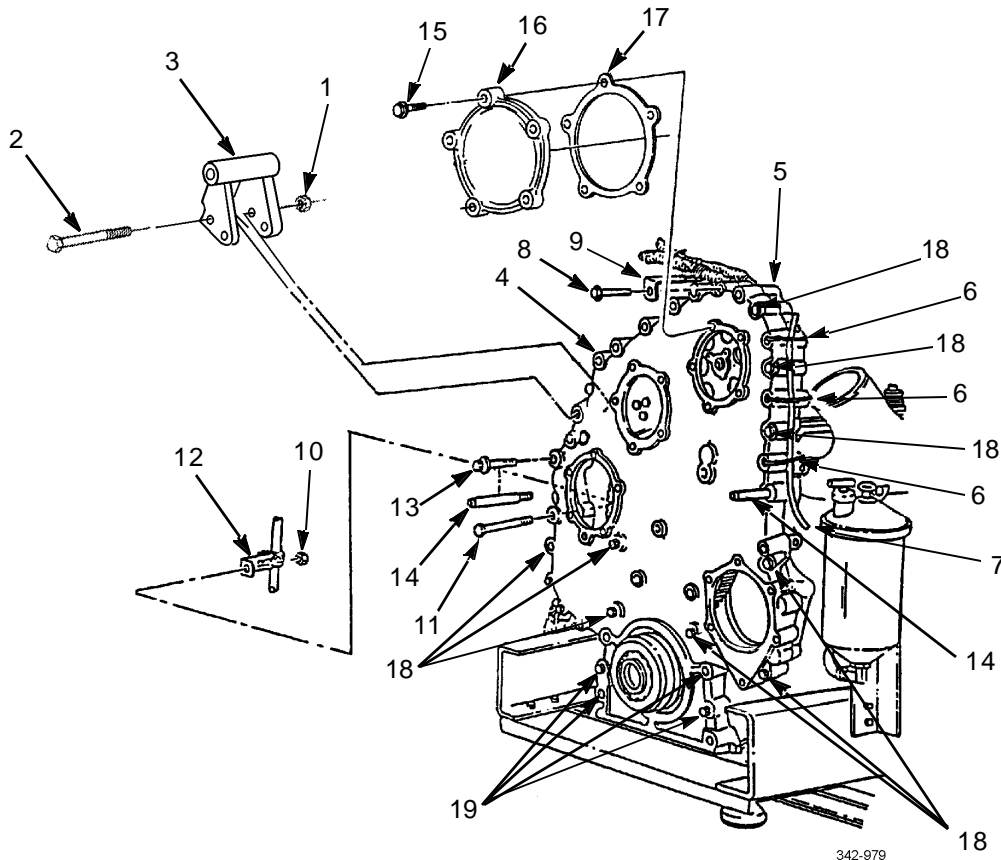
REMOVAL - CONTINUED

2. Remove two nuts (1) and bolts (2) securing alternator mounting bracket (3) on gear case cover (4) and gear housing (5).
3. Remove and discard tiedown straps (6), as required, securing fan clutch solenoid air line (7) and move air line away from gear case cover (4) and gear housing (5).
4. Remove bolt (8) from standoff bracket (9) and gear case cover (4). Move standoff bracket away from gear case cover.
5. Remove nut (10), bolt (11), and standoff bracket (12) from gear case cover (4). Move standoff bracket away from gear case cover.
6. Remove two bolts (13) from opposite sides of gear case cover (4). Replace two bolts (13) with guide studs (14).
7. Remove five bolts (15) from camshaft gear cover (16).
8. Remove camshaft gear cover (16) and gasket (17) from gear case cover (4).

NOTE

Different length bolts are used to secure gear case cover to gear housing. Note location of long and short bolts as an aid for use in installation.

9. Remove ten short bolts (18) and four long bolts (19).



REMOVAL - CONTINUED**WARNING**

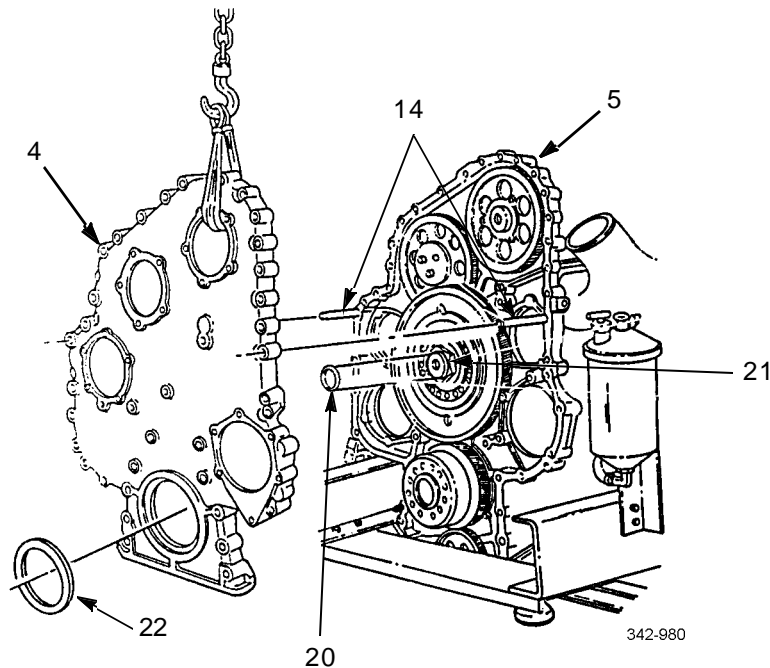
Do not slide gear case cover off guide studs. Failure to observe this warning may result in injury to personnel or damage to equipment.

10. Move gear case cover (4) away from gear housing (5) and position lifting sling through camshaft gear cover opening on gear case cover.



Gear case cover weighs 89 lb (40 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

11. Secure lifting sling to suitable lifting device. Remove gear case cover (4) from two guide studs (14).
12. Remove and discard seal ring (20) between bull/idler gear hub recess (21) and gear case cover (4).
13. Remove two guide studs (14).



14. Remove all old gasket material from mating surfaces of gear case cover (4) and gear housing (5).
15. Remove front oil seal (22) from gear case cover (4). Discard seal.

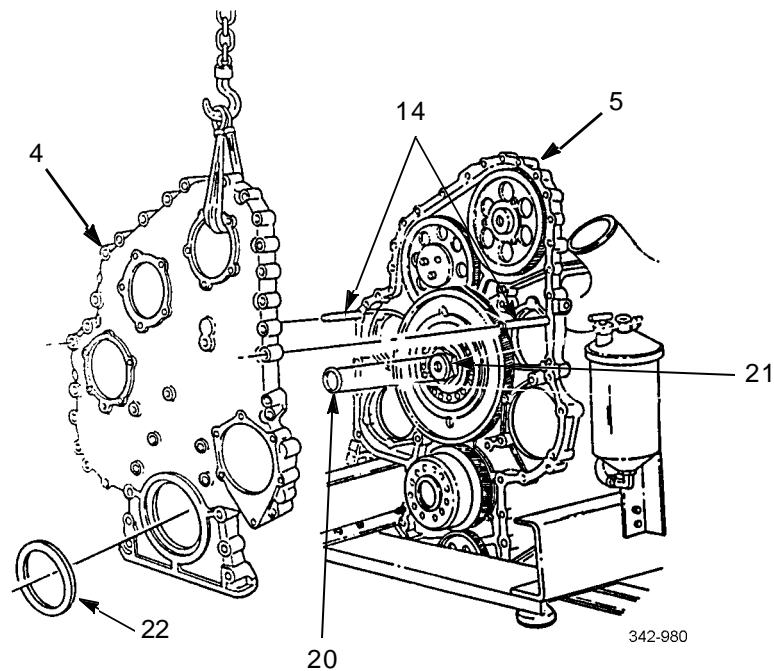
INSTALLATION

1. Position lifting sling through camshaft drive gear cover opening of gear case cover (4) and secure to suitable lift device.

NOTE

Gasket forming compound cures in presence of air. Keep time to minimum between gear case cover installation and tightening gear case cover mounting bolts.

2. Apply continuous thin bead of gasket forming compound to mating surfaces of gear housing (5).
3. Install two guide studs (14) in bolt holes on opposite side of gear housing (5).
4. Install new seal ring (20) in bull/idler gear hub recess (21) using engine lubricating oil to hold seal ring in place.

**WARNING**

Gear case cover weighs 89 lb (40 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

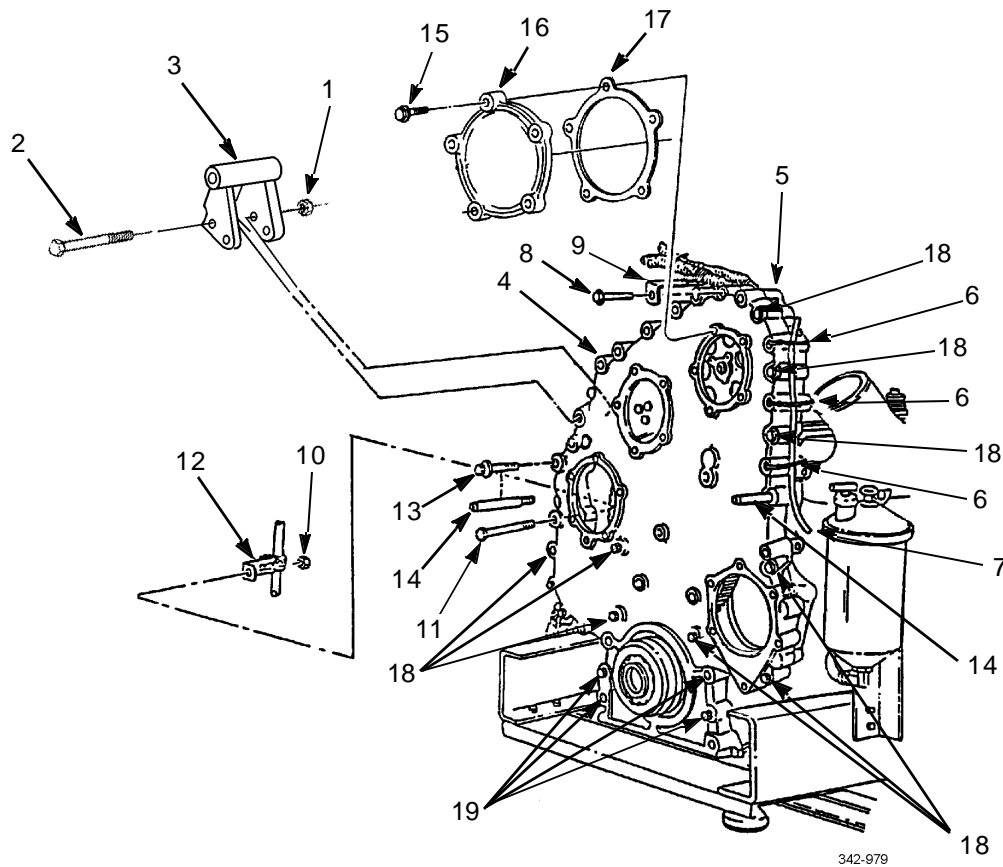
NOTE

Ensure guide studs are positioned in corresponding bolt holes of gear case cover and gear housing.

5. Position gear case cover (4) on two guide studs (14) and remove lifting sling.
6. Install gear case cover (4) against gear housing (5).
7. Install ten short bolts (18).

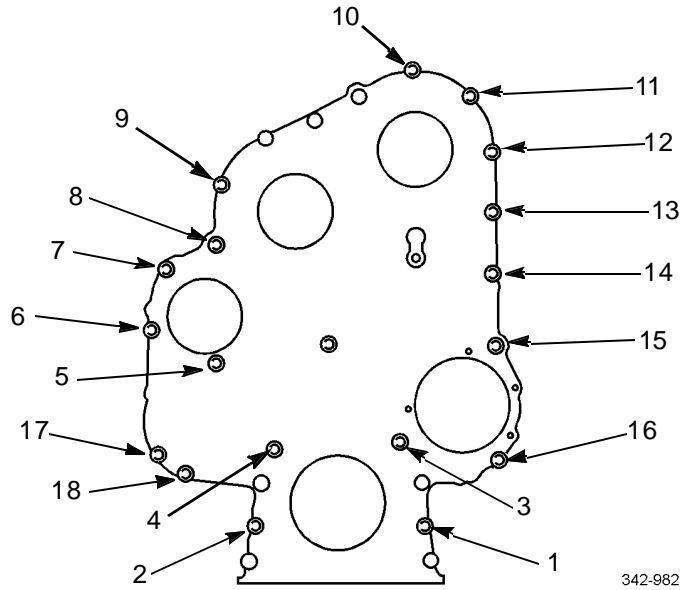
INSTALLATION - CONTINUED

8. Install four long bolts (19).
9. Remove two guide studs (14) and install two bolts (13).
10. Install standoff bracket (9) and bolt (8) to gear case cover (4).
11. Install standoff bracket (12), bolt (11), and nut (10) on gear case cover (4).
12. Secure fan clutch solenoid air line (7) to gear case cover (4) and gear housing (5) with new tiedown straps (6).



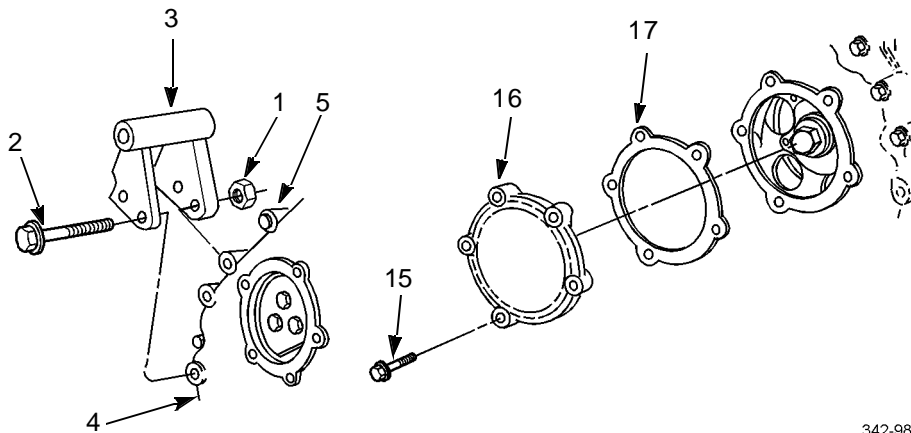
INSTALLATION - CONTINUED

13. Tighten bolts to 43-54 lb-ft (58-73 Nm), in sequence shown.



TIGHTENING SEQUENCE

- 14. Position alternator mounting bracket (3) on gear case cover (4) and gear housing assembly (5). Secure with two bolts (2) and nuts (1). Tighten to 43-54 lb-ft (58-73 Nm).
- 15. Install new gasket (17) and camshaft gear cover (16) on gear case cover (4).
- 16. Install five bolts (15) to secure camshaft gear cover (16). Tighten bolts to 22-28 lb-ft (30-38 Nm).



- 17. Install power steering pump (WP 0086 00).
- 18. Install oil pan (WP 0028 00).
- 19. Install accessory drive (WP 0021 00).
- 20. Install fan drive support (WP 0013 00).

INSTALLATION - CONTINUED

21. Install front engine mount adapter (WP 0011 00).
22. Install air compressor (TM 9-2320 302-20).
23. Install water pump (TM 9-2320-302-20).
24. Install alternator (TM 9-2320-302-20).

END OF WORK PACKAGE

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VIBRATION DAMPER REPLACEMENT

0020 00

THIS WORK PACKAGE COVERS

Removal, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Equipment Condition

Fan belts removed (TM 9-2320-302-20)

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

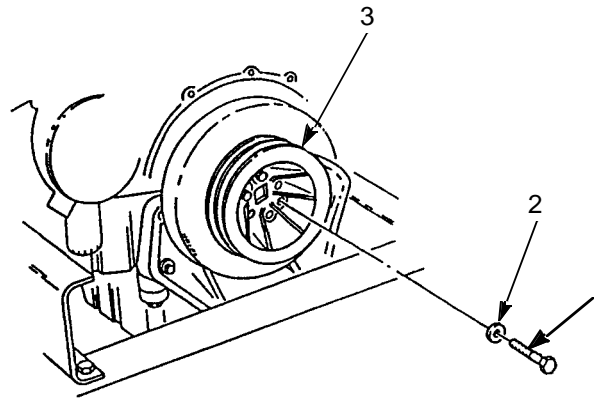
Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

REMOVAL

CAUTION

To prevent damage to pulley and vibration damper, support pulley and damper during removal.

1. Remove six crankshaft pulley attaching bolts (1) and washers (2) from crankshaft pulley (3).

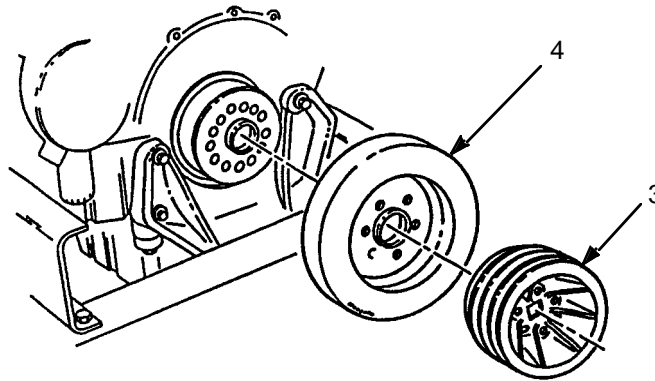


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REMOVAL - CONTINUED**CAUTION**

Do not pry on pulley or damper. If force is needed, use rubber mallet or soft-faced hammer to prevent damage to pulley and damper.

2. Remove crankshaft pulley (3).
3. Remove vibration damper (4).



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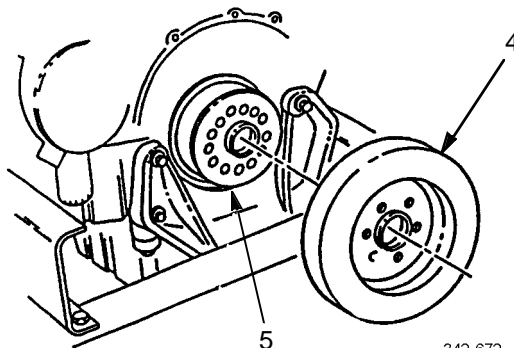
INSPECTION**NOTE**

Vibration damper is replaced during major engine overhaul, crankshaft replacement or when conditions identified below are found.

1. Inspect vibration damper for dents, gouges, fluid leaks or bulges. Replace vibration damper if any of these conditions are found.
2. Inspect crankshaft pulley for cracked, broken or bent flanges. Replace crankshaft pulley if any of these conditions are found.
3. Inspect crankshaft pulley and vibration damper mating surfaces for dirt and other foreign matter prior to installation.

INSTALLATION

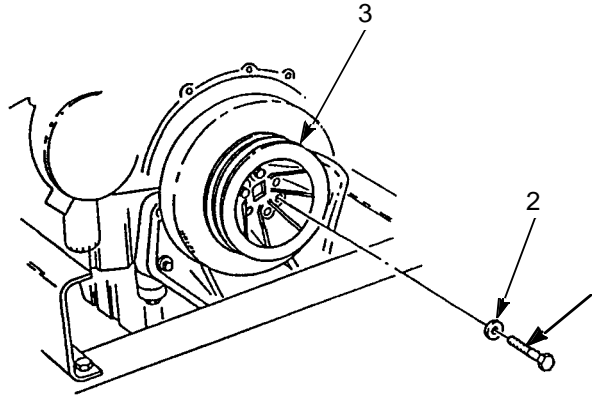
1. Install vibration damper (4) against crankshaft (5), with stamped part number facing away from engine, and seat firmly.



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VIBRATION DAMPER REPLACEMENT - CONTINUED**0020 00****INSTALLATION - CONTINUED**

2. Install crankshaft pulley (3) and seat firmly against vibration damper (4).
3. Install six washers (2) and bolts (1) hand tight.
4. Tighten six bolts (1) to 134-155 lb-ft (182-210 Nm).



342-670

5. Install fan belts (TM 9-2320-302-20).

END OF WORK PACKAGE

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ACCESSORY DRIVE REPLACEMENT

0021 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Checker, gear lash (Item 18, WP 0126 00)

Dial indicator set (Item 29, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Ring, seal (P/N 8929253)

Oil, lubricating (Item 25, WP 0125 00)

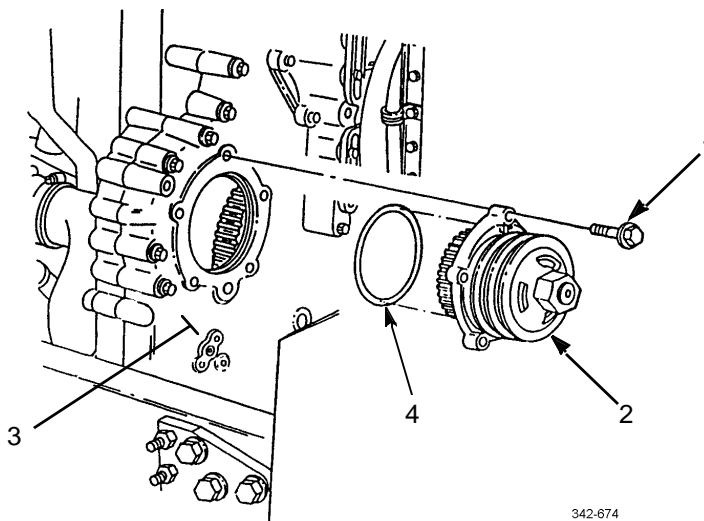
Equipment Condition

Alternator belt removed (TM 9-2320-302-20)

REMOVAL**NOTE**

If necessary, tap accessory drive with a soft-faced mallet to aid in removal.

1. Remove five bolts (1) and accessory drive (2) from gear case cover (3).
2. Remove and discard seal ring (4) from accessory drive (2).



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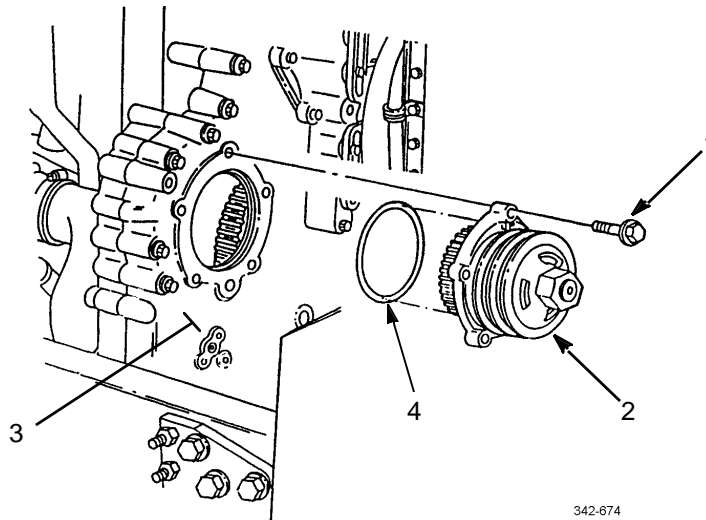
INSTALLATION

1. Lubricate new seal ring (4) with clean lubricating oil and install in groove on accessory drive (2).

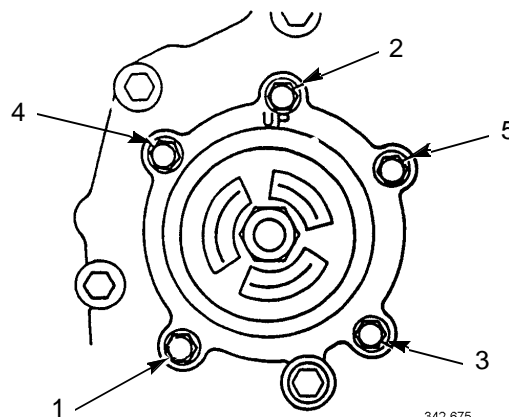
NOTE

Install accessory drive with word UP cast into housing in 12 o'clock position.

2. Install accessory drive (2) on gear case cover (3), engaging accessory drive gear (5) with bull gear (6).
3. Align bolt holes of accessory drive (2) and gear case cover (3). Press accessory drive (2) into place and install five bolts (1).



4. Tighten bolts (1) to 22-28 lb-ft (30-38 Nm), in sequence shown.

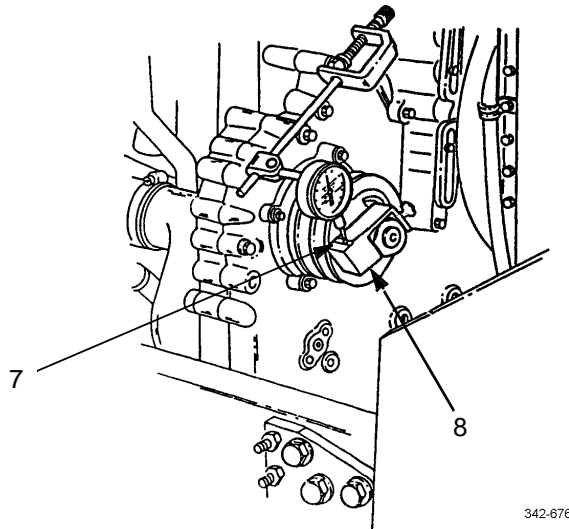


TIGHTENING SEQUENCE

INSTALLATION - CONTINUED**NOTE**

If gear lash specification is not met, replace accessory drive.

5. Use dial indicator with clamp base to measure gear lash between accessory drive gear and bull gear.
 - a. Position dial indicator to read between scribed lines (7) on gear lash checker (8).
 - b. Gear lash should be 0.001-0.010 in (0.025-0.254 mm).



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6. Install alternator belt (TM 9-2320-302-20).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Disassembly, Cleaning and Inspection, Assembly, Installation, Adjustment

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

- Ring, retaining (P/N 012991) (2)
- Ring, seal (P/N 001082)

Materials/Parts - Continued

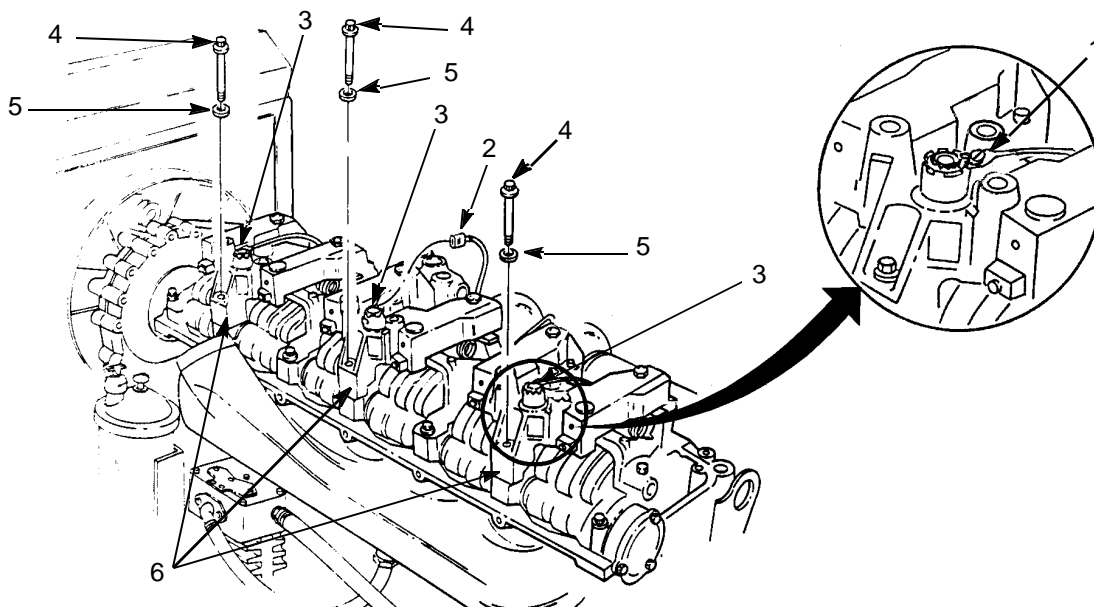
- Ring, seal (P/N 001083)
- Ring, seal (P/N 20229)
- Compound, international, no. 2 (Item 13, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)
- Rags, wiping (Item 31, WP 0125 00)
- Tags, marker (Item 35, WP 0125 00)
- Wipes, lint-free (Item 40, WP 0125 00)

Equipment Condition

- Rocker arm cover removed (WP 0016 00)

REMOVAL

1. Loosen screw (1) on three solenoid terminals and remove three wiring harness connectors (2) from three solenoid valves (3).
2. Remove three bolts (4) and washers (5) from three engine retarders (6).

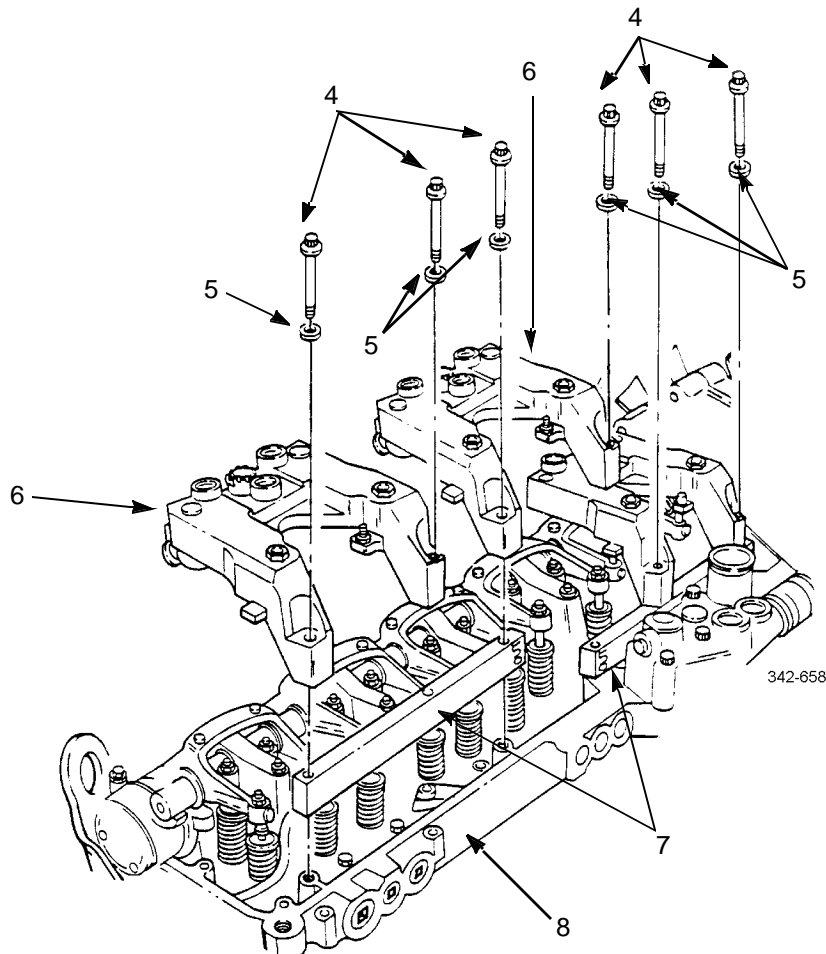


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REMOVAL - CONTINUED**CAUTION**

Do not mix engine retarders. Tag each engine retarder to aid in installation

- Remove six bolts (4), washers (5), three engine retarders (6), and two spacer bars (7) from cylinder head (8).

**DISASSEMBLY****NOTE**

Procedure is the same for all three engine retarder housings.

- Place engine retarder (6) housing on bench.

CAUTION

Do not disassemble or tamper with solenoid valve. Engine damage could result.

- Remove solenoid valve (3) with 12 point socket.

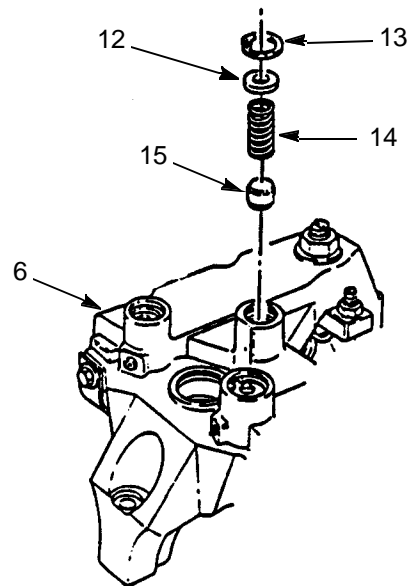
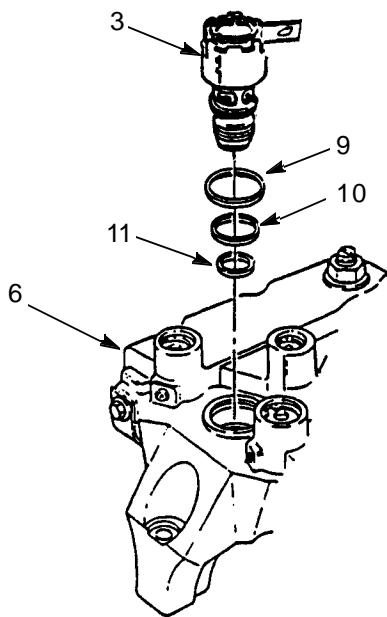
DISASSEMBLY - CONTINUED

3. Remove and discard three seal rings (9, 10, and 11). If seal ring (11) stays in bottom of engine retarder (6) housing, remove with wire.

WARNING

Parts are under spring tension. Release tension slowly to prevent personal injury.

4. Press down on washer (12) and remove retaining ring (13). Discard retaining ring.
5. Remove washer (12) and spring (14).
6. Using a magnet, remove accumulator piston (15) from engine retarder (6) housing.



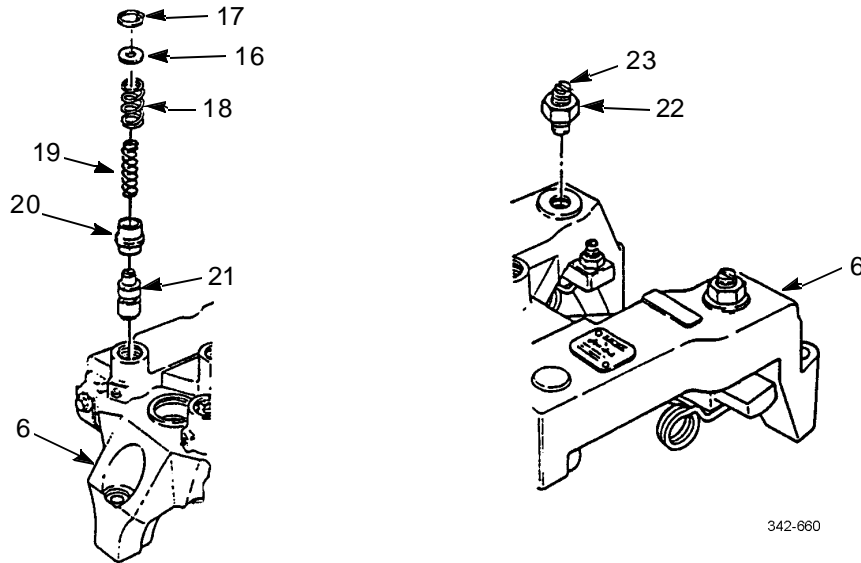
342-659

NOTE

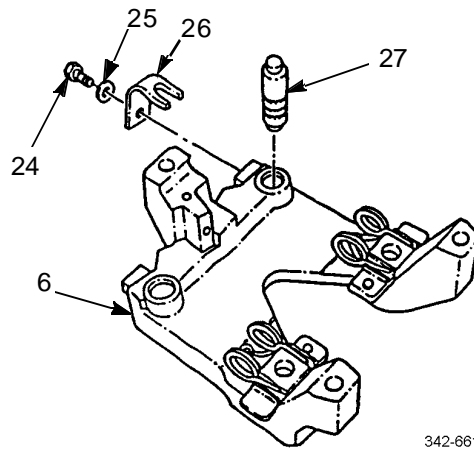
To remove control valve from right side of engine retarder housing, perform steps 7 through 9. Repeat steps to remove control valve from left side of retarder housing.

DISASSEMBLY - CONTINUED

7. Press down on washer (16) and remove retaining ring (17). Discard retaining ring.
8. Remove washer (16), spring (18), spring (19), and collar (20).
9. Remove control valve (21) from engine retarder (6) housing.
10. Loosen lock nut (22) and remove adjusting screw (23) from engine retarder (6) housing.

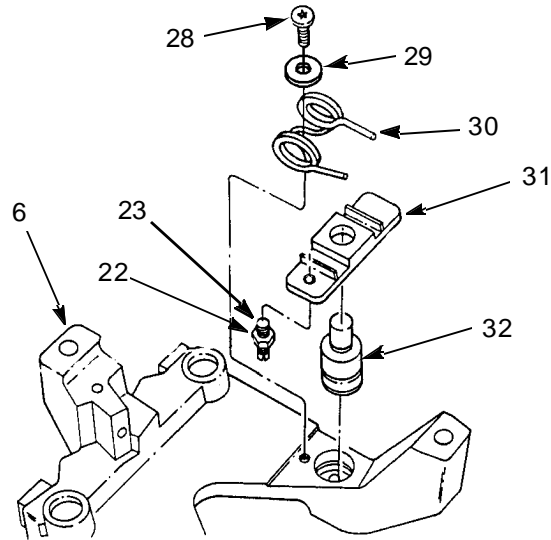


11. Turn engine retarder (6) housing over.
12. Remove screw (24), washer (25), and flat spring (26) from engine retarder (6) housing.
13. Remove master piston (27) from engine retarder (6) housing.



14. Remove screw (28), washer (29), torsion spring (30), slave piston bridge (31), and slave piston (32).
15. Loosen lock nut (22) and remove adjusting screw (23) from piston bridge (31).

DISASSEMBLY - CONTINUED



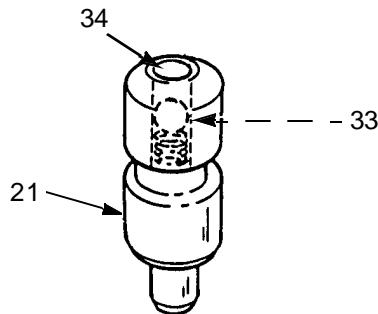
342-662

CLEANING AND INSPECTION

CAUTION

Do not use rags that may leave lint and residue which can plug oil passageways.

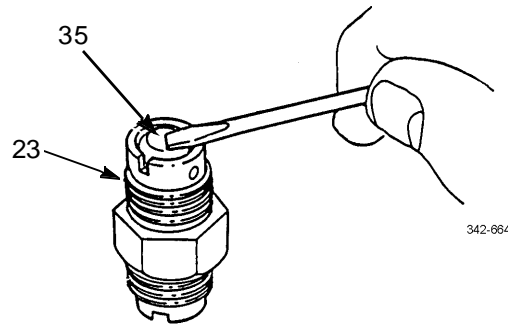
1. Using clean lint-free wipes, clean engine retarder housing bores. Dip control valves and pistons in clean engine lubricating oil.
2. Verify ball (33) moves freely by pushing wire through hole (34) in base of control valve (21). Light pressure on wire should move ball. Ball should return when pressure is released.



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CLEANING AND INSPECTION - CONTINUED

3. Ensure plunger (35) protrudes from bottom of adjusting screw (23).
4. Ensure plunger (35) has light spring pressure when pressed and moves freely.



ASSEMBLY

NOTE

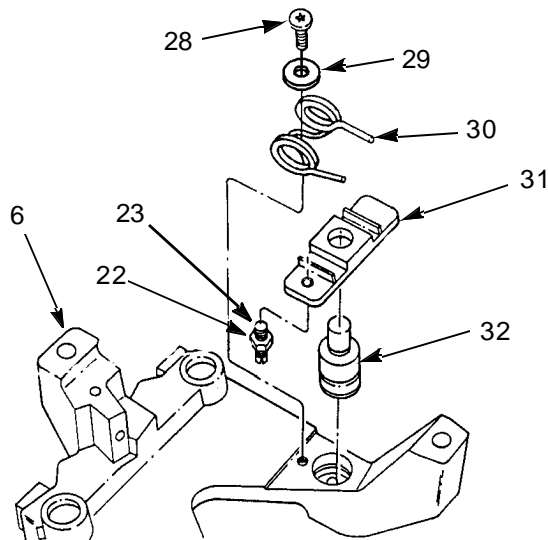
- Procedure is the same for all three engine retarder housings.
- Steps 1 through 12 are for right side of engine retarder housing. The same procedures are to be repeated to assemble the left side.

1. Install adjusting screw (23) and lock nut (22) in slave piston bridge (31).
2. Install slave piston (32) in engine retarder (6).

NOTE

Locate part number on slave piston bridge away from engine retarder housing.

3. Install slave piston bridge (31) with adjusting screw (23) toward center of engine retarder (6) housing.
4. Install torsion spring (30) with ends over slave piston bridge (31).
5. Install screw (28) and washer (29) over center part of torsion spring (30) on engine retarder (6) housing. Tighten screw to 180 lb-in (20 Nm).



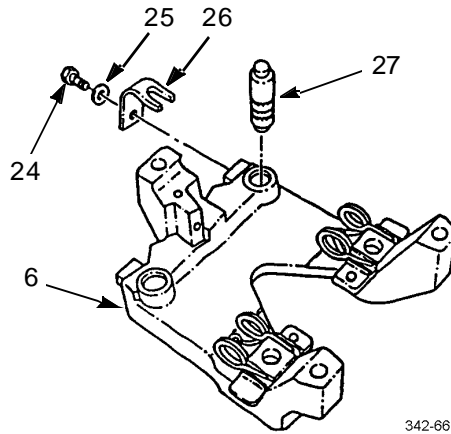
342-662

ASSEMBLY - CONTINUED

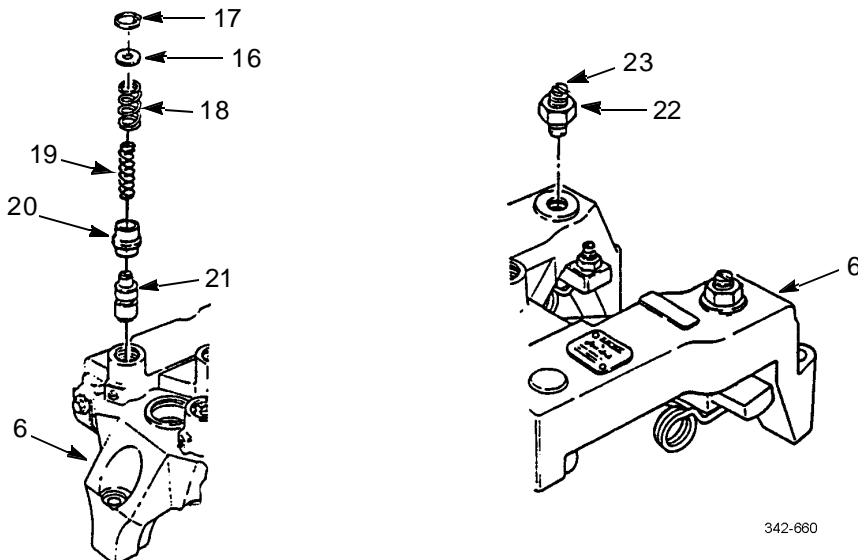
NOTE

Ensure flat spring legs are centered around master piston boss.

6. Install master piston (27), flat spring (26), washer (25), and screw (24) in engine retarder (6) housing. Tighten screw to 100 lb-in (11 Nm).



7. Turn engine retarder (6) housing over.
8. Install adjusting screw (23) and lock nut (22) in engine retarder (6) housing.
9. Hold control valve (21) by stem and drop into engine retarder (6) housing. If binding occurs or if ball is stuck in control valve, replace control valve.
10. Install collar (20) in engine retarder (6) housing with long sleeve area up.
11. Install spring (19) in center of collar (20). Install spring (18) over top of collar.
12. Press washer (16) to compress springs (18 and 19). Install new retaining ring (17). Rotate retaining ring 90 degrees to ensure proper seating in groove.



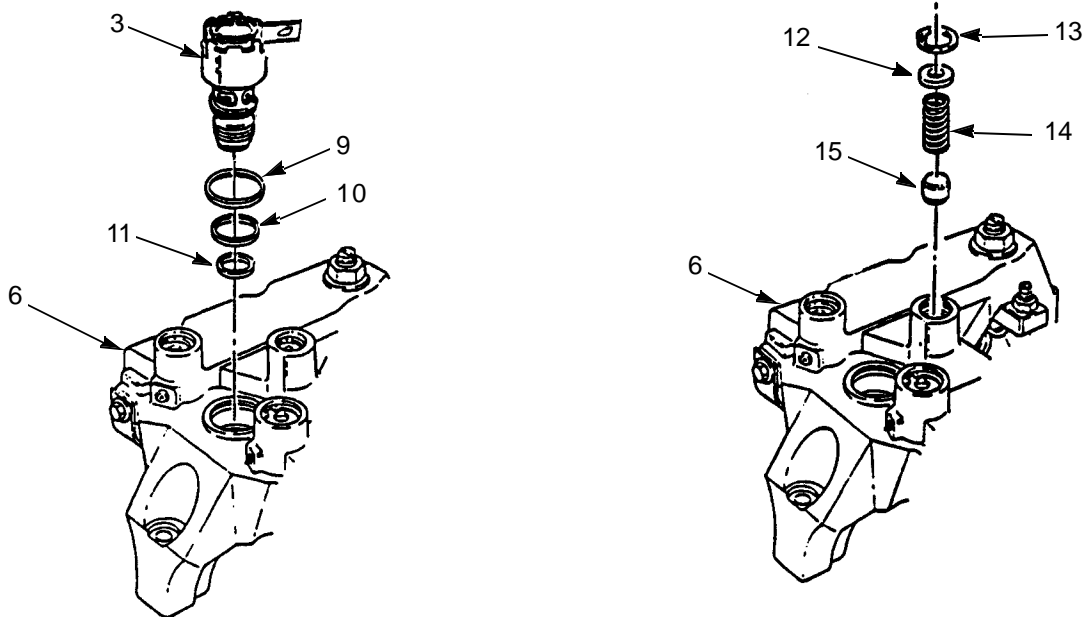
ASSEMBLY - CONTINUED

13. Install accumulator piston (15), spring (14), and washer (12) in engine retarder (6) housing.
14. Press washer (12) to compress spring (14) and install new retaining ring (13). Rotate retaining ring 90 degrees to ensure proper seating in groove.

CAUTION

Be careful not to twist seal rings while installing to prevent damage to equipment.

15. Coat three new seal rings (9, 10, and 11) with clean engine lubricating oil. Install seal rings (9 and 10) on solenoid valve (3).
16. Install seal ring (11) in bottom of engine retarder (6) housing.
17. Thread solenoid valve (3) into engine retarder (6) housing. Tighten solenoid valve to 60 lb-in (7 Nm).



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INSTALLATION**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

CAUTION

Ensure oil is removed from bolt holes to prevent engine block from cracking when tightening bolts.

1. Cover bolt holes with rags to minimize oil spray.

INSTALLATION - CONTINUED

2. Attach tubing to compressed air gun nozzle and clear oil out of bolt holes.

NOTE

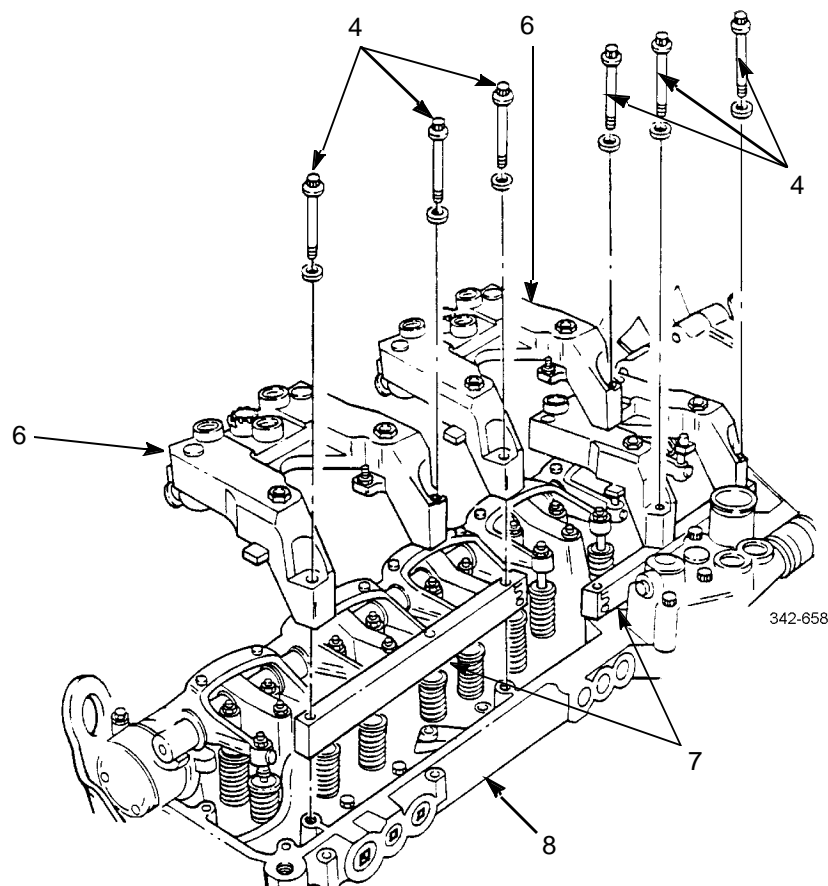
Position word OUT, stamped on each spacer bar, toward mid-engine, facing outside of engine.

3. Position two spacer bars (7) on exhaust manifold side of cylinder head (8). Align bolt holes in spacer bars with engine retarder (6) bolt holes in cylinder head.

CAUTION

Ensure engine retarder housings do not interfere with wiring harnesses. Failure to do so could result in damage to equipment.

4. Install three engine retarder (6) housings over rocker shafts.



5. Apply international compound no. 2 to threads and undersides of head of nine bolts (4).

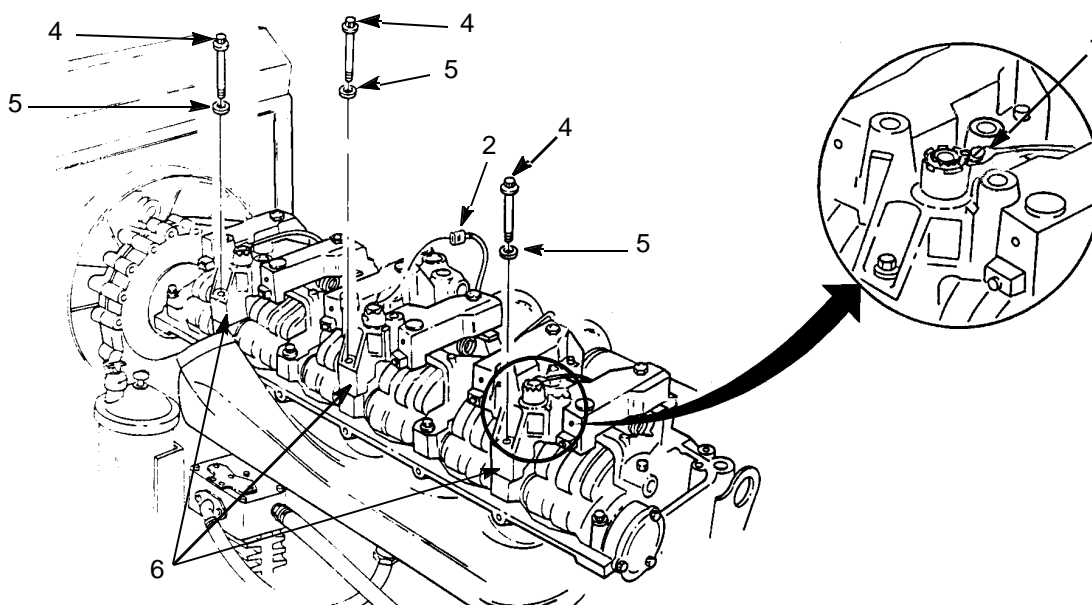
CAUTION

Ensure wires are away from moving parts to prevent possible movement and contact with valve springs.

INSTALLATION - CONTINUED**NOTE**

Before tightening bolts, move engine retarder housing from side to side and locate as far toward camshaft side of the engine as possible.

6. Install nine bolts (4) and washers (5) in engine retarders (6). Tighten bolts to 40 lb-ft (54 Nm).
7. Repeat tightening of nine bolts (4) to 80 lb-ft (108 Nm).
8. Position three wiring harness connectors (2) under three solenoid terminal screws (1). Tighten screws to 12-17 lb-in (1.4-1.9 Nm).



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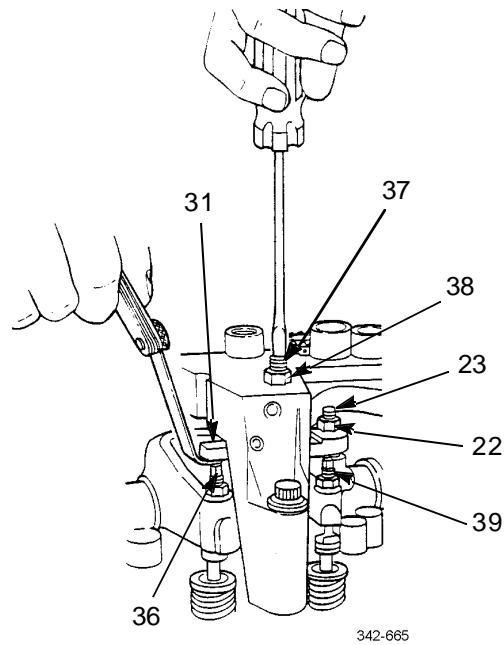
ADJUSTMENT**CAUTION**

Failure to use slave piston adjustment procedure will cause poor engine brake performance and/or serious engine damage. It is necessary to rotate engine to put exhaust valves in closed position for each cylinder being adjusted. Make sure proper engine valve lash has been obtained to prevent damage to equipment.

1. Loosen lock nut (22) and back out adjusting screw (23) in slave piston bridge (31) until end of adjusting screw is flush with bottom surface of slave piston bridge (31).
2. Place 0.023 in (0.584 mm) thickness gage between solid side of slave piston bridge (31) and exhaust rocker arm adjusting screw (36).
3. Loosen lock nut (38) and turn adjusting screw (37) clockwise until light drag is felt on thickness gage.
4. Hold adjusting screw (37) in position and remove thickness gage.
5. Tighten lock nut (38) to 26 lb-ft (35 Nm).
6. Using 0.023 in (0.584 mm) thickness gage, check clearance between adjusting screw (23) and rocker arm adjusting screw (39).
7. Turn adjusting screw (23) clockwise until light drag is felt on thickness gage.

ADJUSTMENT - CONTINUED

8. Hold adjusting screw (23) in position and remove thickness gage.
9. Tighten lock nut (22) to 26 lb-ft (35 Nm).



10. Adjust the remaining engine retarders using steps 1 through 9.
11. Install rocker arm cover (WP0016 00).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Insertor, seal (Item 50, WP 0126 00)
- Remover, seal (Item 101, WP 0126 00)

Materials/Parts

- Seal (P/N 23519651)
- Cloth, abrasive (Item 9, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)

Equipment Condition

- Power pack removed (WP 0010 00)
- Flex plate removed (WP 0025 00)

REMOVAL

NOTE

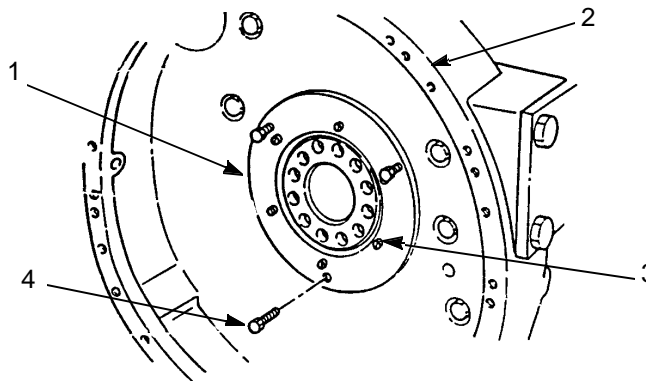
If oil seal remover screws strip out of oil seal sealing casing, remove screws and bolts. Rotate oil seal remover half the distance between existing screw holes in seal casing and repeat steps to remove seal.

1. Position oil seal remover (1) over rear of crankshaft against flywheel housing (2).

NOTE

Oil seal remover screws must be evenly snug against oil seal remover but not overtightened and stripped in oil sealing casing.

2. Install six oil seal remover screws (3) through inner circle of holes in oil seal remover (1) and into oil seal casing.
3. Thread three bolts (4) into outer circle of holes in oil seal remover (1) until bolts contact flywheel housing (2).
4. Working clockwise, turn each bolt (4) one full turn until crankshaft rear oil seal is removed. Discard seal.

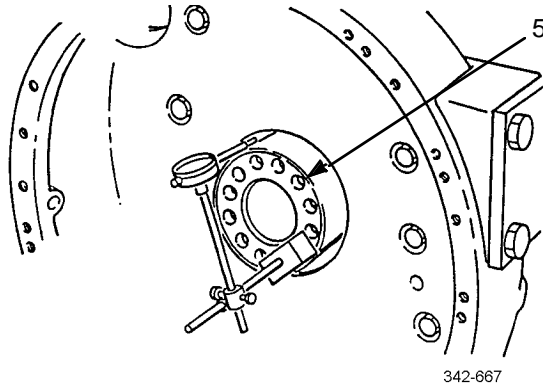


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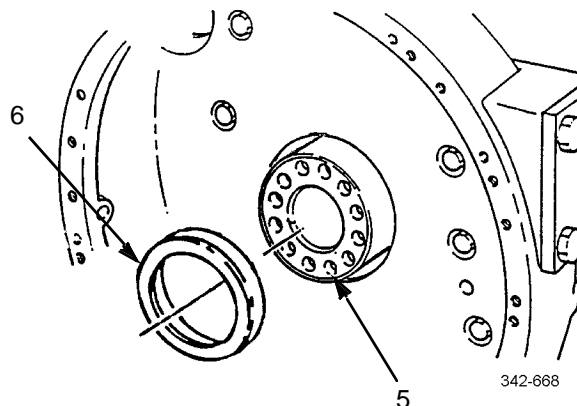
INSPECTION**NOTE**

Minor wear line on crankshaft surface should be evident where contact was made with oil seal. This is normal.

1. Inspect oil seal contact surface of crankshaft (5).
2. Inspect exposed area of crankshaft (5) for dirt, burrs or rough surfaces.
3. If necessary, clean/smooth crankshaft surface with abrasive cloth.
4. Check runout of oil seal bore. Check bore with dial indicator mounted on end of crankshaft (5). This check must be made with flywheel housing cover in place on engine and oil seal removed. Maximum runout of oil seal bore in flywheel housing is 0.013 in (0.330 mm).

**INSTALLATION**

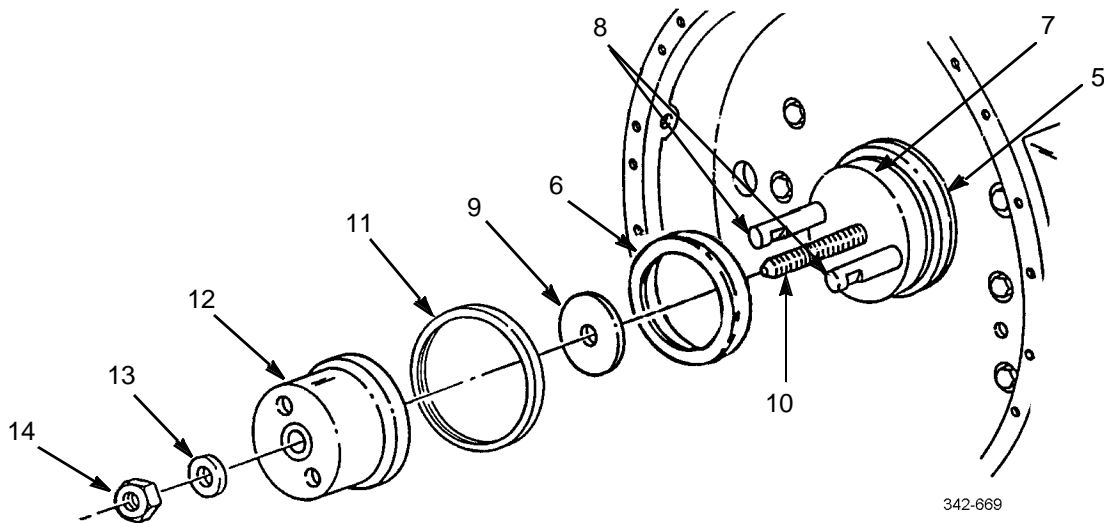
1. Coat outside diameter of new oil seal (6) with light film of clean engine lubricating oil.
2. Coat outside of crankshaft (5) with light film of clean engine lubricating oil.



INSTALLATION - CONTINUED**CAUTION**

Ensure flywheel housing seal bore, rear of crankshaft, and both sides of oil seal installer base and spacer are clean, smooth, and free of any foreign material. Failure to do so may cause damage to equipment.

3. Position seal inserter base (7) on rear of crankshaft (5).
4. Install two guide studs (8) in two flywheel bolt holes 180 degrees apart.
5. Hand tighten two guide studs (8) until seal inserter base (7) is tight against rear of crankshaft (5).
6. Install oil seal (6) onto crankshaft (5) as far as it will go by hand.
7. Install seal inserter spacer (9) on center screw (10).
8. Position seal inserter collar (11) on oil seal (6).
9. Place seal inserter housing (12) over center screw (10) and two guide studs (8). Position seal inserter housing against seal inserter collar (11) and crankshaft rear oil seal (6).
10. Install thrust bearing (13) on center screw (10) with lettered side against seal inserter housing (12).
11. Install nut (14) on center screw (10). Tighten nut until crankshaft rear oil seal (6) is firmly seated.



12. Remove nut (14), thrust bearing (13), seal inserter housing (12), seal inserter collar (11), spacer (9), guide studs (8), and seal inserter base (7) from crankshaft (5).
13. Install flex plate (WP0025 00).
14. Install power pack (WP0010 00).

END OF WORK PACKAGE

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FLYWHEEL HOUSING REPLACEMENT

0024 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Dispenser, sealant (Item 30, WP 0126 00)
- Guide stud set (Item 43, WP 0126 00)
- Lifting, bracket, flywheel (Item 77, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Personnel Required

Two

Materials/Parts

Compound, gasket forming (Item 12, WP 0125 00)

References

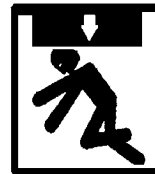
WP 0023 00

Equipment Condition

- Engine installed on stand
- Rear engine mounts removed (WP 0012 00)
- Starter removed (TM 9-2320-302-20)
- Oil pan removed (WP 0028 00)
- Flex plate removed (WP 0025 00)



WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

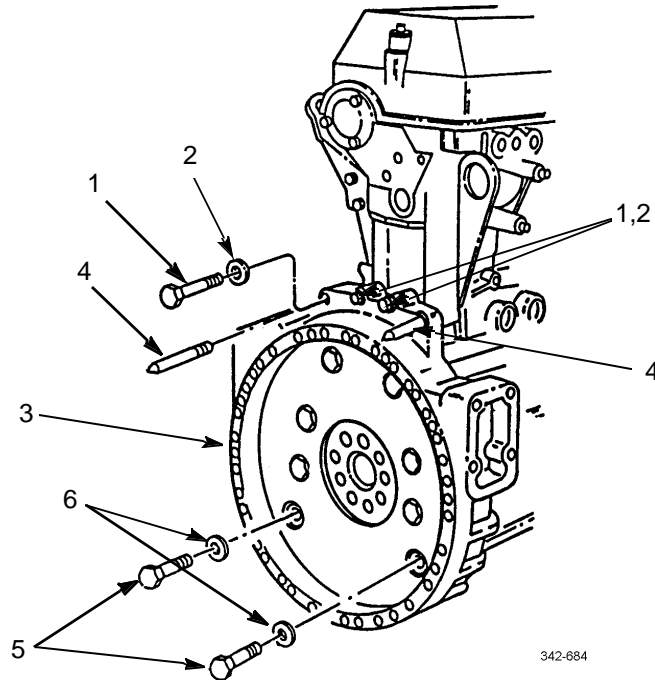
REMOVAL

1. Remove four bolts (1) and washers (2) from flywheel housing (3).
2. Install two guide studs (4).
3. Remove eight bolts (5) and washers (6) from flywheel housing (3).

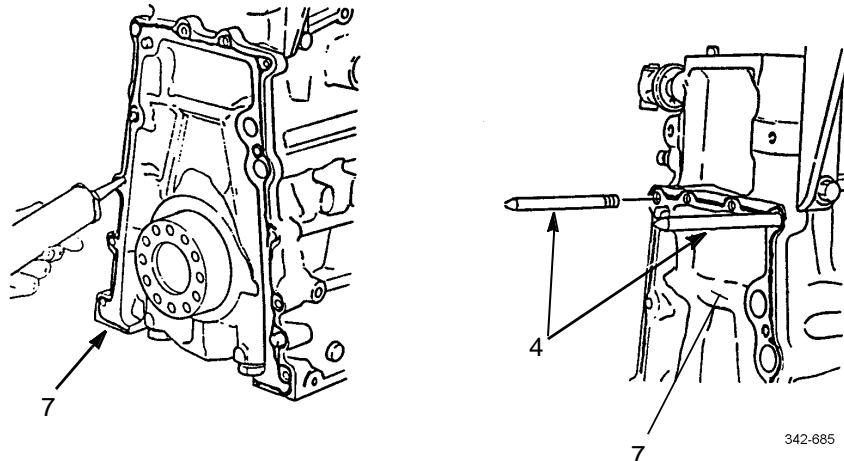
CAUTION

Use soft mallet to tap flywheel housing loose from cylinder block. Failure to use soft mallet could result in damage to equipment.

4. Remove flywheel housing (3).

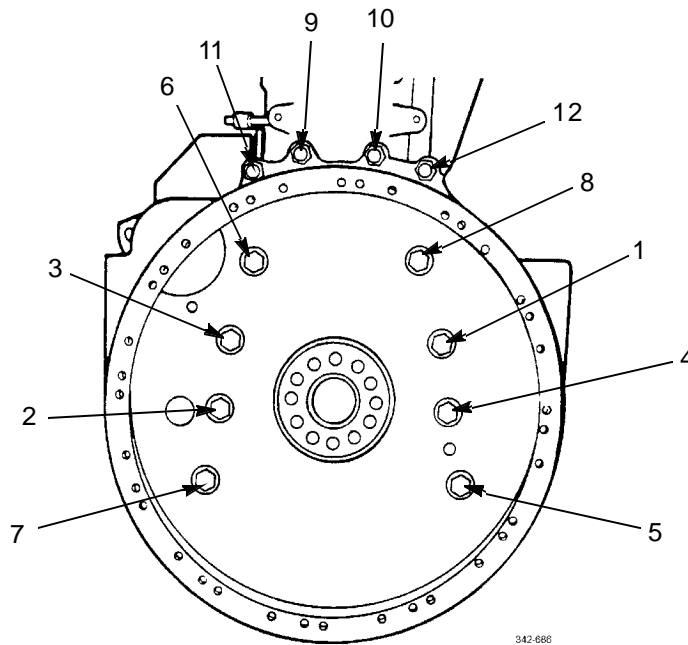


5. Remove and discard crankshaft rear oil seal (WP 0023 00).
6. Remove two guide studs (4) from cylinder block (7).



INSTALLATION

1. Apply continuous thin bead of gasket forming compound to rear face of cylinder block (7) where it contacts flywheel housing (3).
2. Install two guide studs (4) on cylinder block (7).
3. Position flywheel housing (3) carefully on guide studs (4), working it forward until flywheel housing contacts cylinder block (7).
4. Install eight washers (6) and bolts (5), and two washers (2) and bolts (1) hand tight.
5. Remove guide studs (4) and install two remaining washers (2) and bolts (1) hand tight.
6. Tighten 12 bolts (1 and 5) to 118-148 lb-ft (160-201 Nm), in sequence shown.



TIGHTENING SEQUENCE

7. Install crankshaft rear oil seal (WP0023 00).
8. Install flex plate (WP0025 00).

INSTALLATION - CONTINUED**CAUTION**

To prevent damage to equipment, ensure contact between flywheel housing and end of bolt does not occur.

9. Assemble dial indicator (8) to flex plate (9).

NOTE

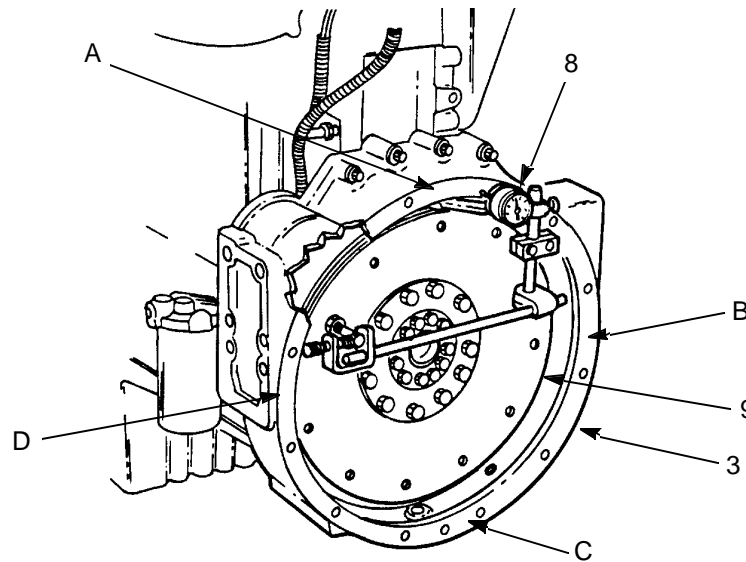
Ensure dial indicator is positioned straight and square with flywheel housing bell face or inside bore of bell, and has adequate travel in each direction.

10. Check flywheel housing concentricity and bolting flange face runout.
11. Ensure engine is in vertical position with flywheel housing (3) end up.
12. Ensure end play is on one direction only. Tap end of crankshaft with soft hammer to position it toward one end of block.

NOTE

Maximum total indicator reading must not exceed 0.013 in (0.33 mm) for bore or face.

13. Adjust dial indicator (8) to read zero. Rotate crankshaft one full revolution, taking readings at 90-degree intervals "A", "B", "C", and "D" (four readings each for bore bolting and face).
14. If runout exceeds maximum limits, remove flywheel housing (3) and check for dirt or foreign material between flywheel housing and cylinder block or oil pan mating surface. Clean mating surfaces, install flywheel housing (3) and perform steps 9 through 13 to recheck runout.



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15. If readings are not within specification, replace flywheel housing (3).
16. Repeat step 9 through 13 to check flywheel concentricity and bolting flange face runout for new flywheel housing.
17. Install oil pan (WP 0028 00).
18. Install starter (TM 9-2320-302-20).
19. Install rear engine mounts (WP0012 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Disassembly, Cleaning and Inspection, Assembly, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Pin, shoulder, headless (Item 82, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Plate, scuff (P/N 5100532)

Compound, international, no. 2 (Item 13, WP 0125 00)

Detergent (Item 19, WP 0125 00)

Personnel Required

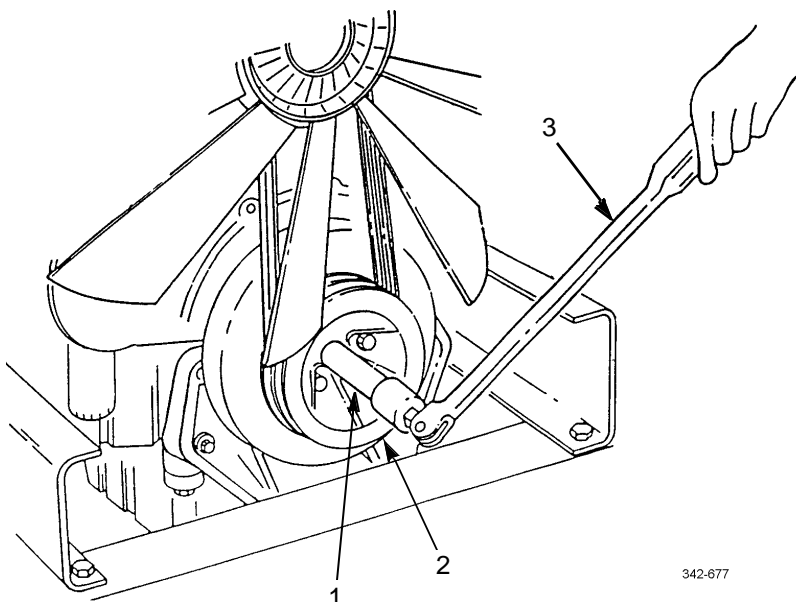
Two

Equipment Condition

Engine mounted on stand

REMOVAL

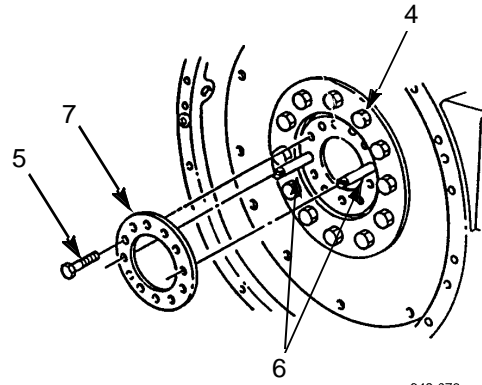
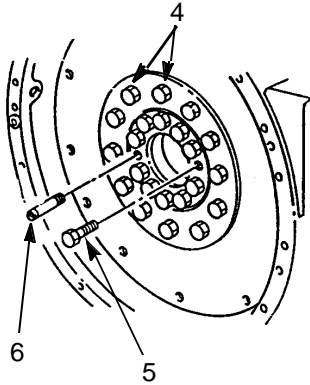
1. Insert 3/4 in extension (1), 4-6 in long, into square opening in center of crankshaft pulley (2). Hold extension with hinged handle bar (3).



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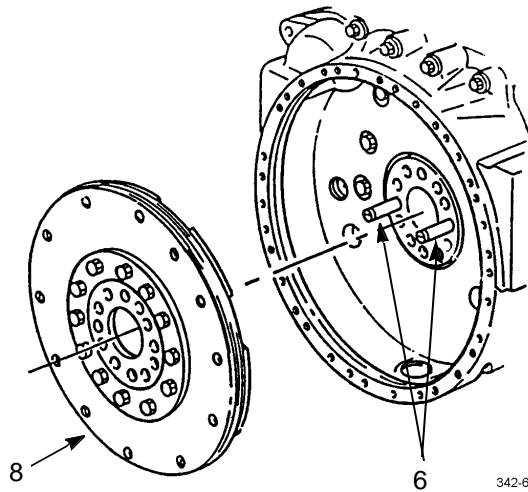
REMOVAL - CONTINUED

2. Hold crankshaft against rotation and loosen 12 bolts (4).
3. Remove two bolts (5) at 3 and 9 o'clock positions and install two guide studs (6).
4. Remove remaining ten bolts (5).
5. Remove and discard scuff plate (7).



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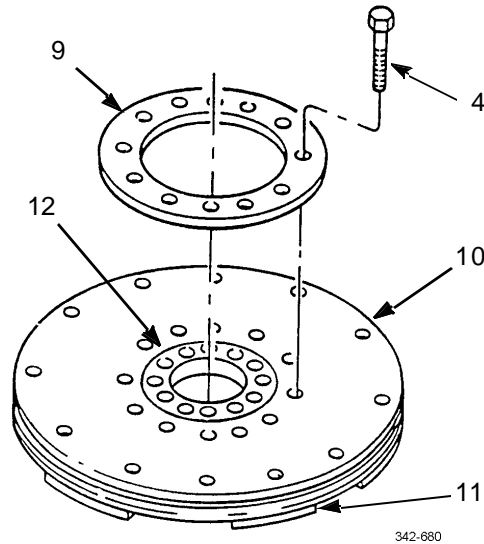
6. Remove flex plate assembly (8) from two guide studs (6).



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DISASSEMBLY

1. Remove 12 bolts (4) securing flex plate (9), four disks (10), and disk assembly (11) to coupling (12).



2. Separate disk assembly (11) from four disks (10).

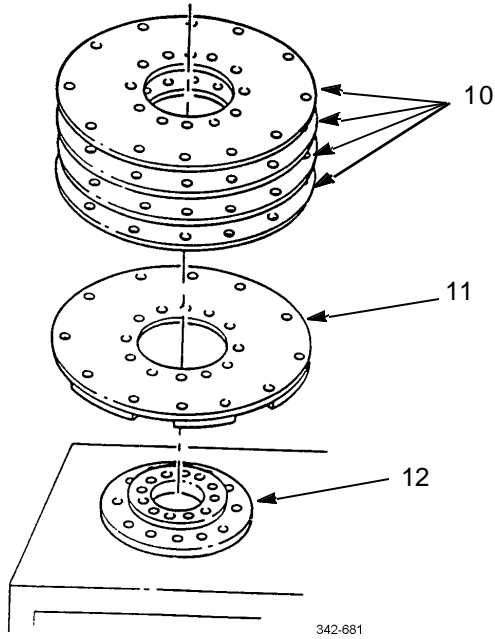
CLEANING AND INSPECTION**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

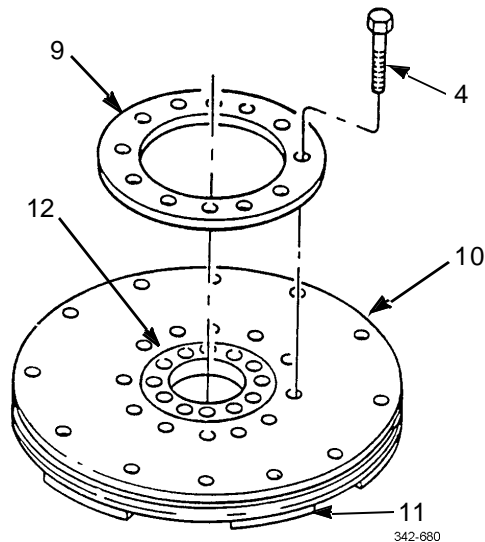
1. Use detergent and water to clean all parts. Dry with compressed air.
2. Ensure all surfaces of coupling, disk assembly, disks, and flex plate are clean and free from any foreign material.
3. Inspect parts for rust, cracks or damage. Replace damaged parts.
4. Inspect all parts for wear. Replace worn parts.

ASSEMBLY

1. Place coupling (12), recessed side down, on bench.
2. Install disk assembly (11) on coupling (12) with reinforcement side down.
3. Install four disks (10) on top of disk assembly (11).



4. Install flex plate (9) on top of four disks (10).
5. Align bolt holes and install 12 bolts (4) hand tight.

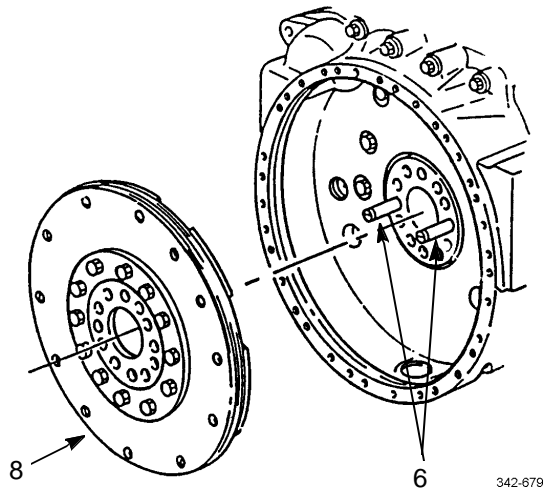


INSTALLATION

NOTE

Ensure mating surfaces of crankshaft butt and flex plate assembly are clean and dry.

1. Install flex plate assembly (8) on two guides studs (6) and slide forward against crankshaft butt.

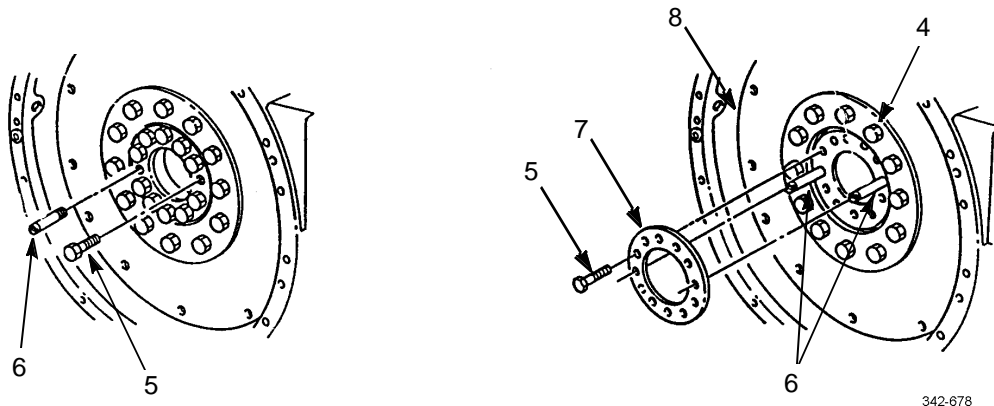


2. Install new scuff plate (7) on two guide studs (6) and slide forward against flex plate assembly (8).

NOTE

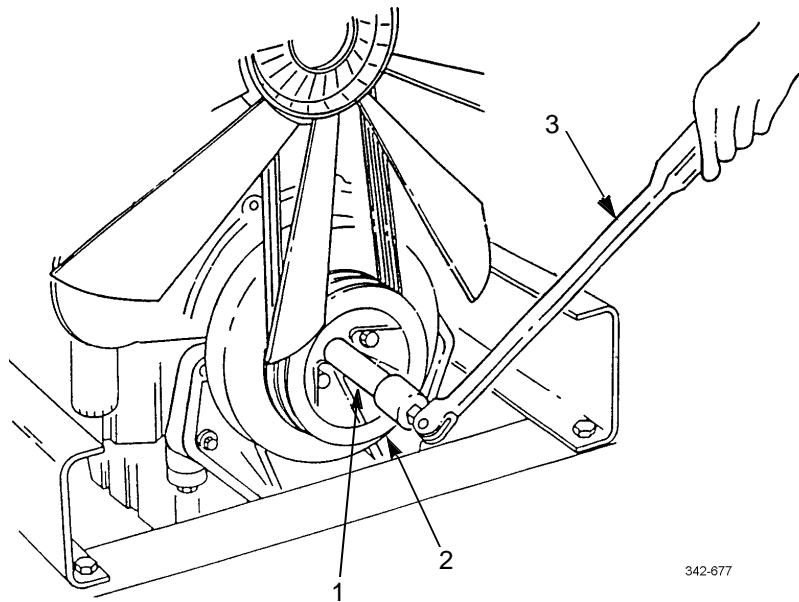
Do not apply international compound no. 2 on underside of bolt heads.

3. Apply international compound no. 2 on threads of 10 bolts (5).
4. Install ten bolts (5) through scuff plate (7) and flex plate assembly (8). Tighten bolts to 50 lb-ft (68 Nm).
5. Remove two guide studs (6) and install remaining two bolts (5). Tighten bolts to 50 lb-ft (68 Nm).

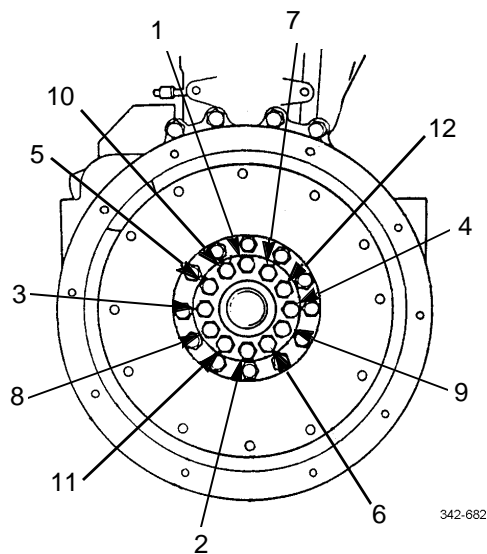


INSTALLATION - CONTINUED

6. Insert 3/4 in extension (1) 4-6 in long, into square opening in center of crankshaft pulley (2) and hold extension with hinged handle bar (3).



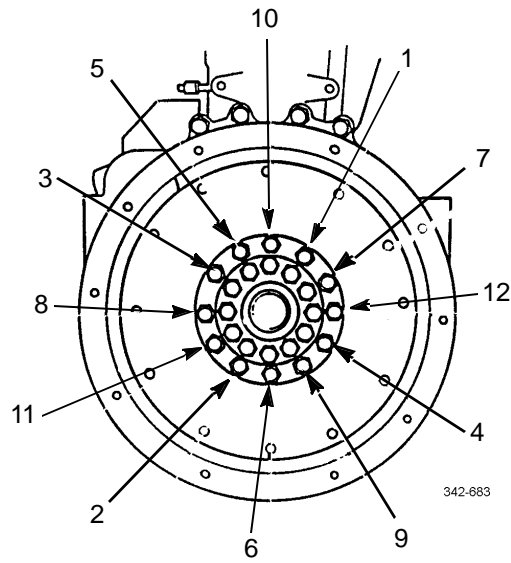
7. Hold crankshaft against rotation and tighten 12 inner bolts, in crisscross sequence shown, to 180-190 lb-ft (244-258 Nm).



TIGHTENING SEQUENCE

INSTALLATION - CONTINUED

8. Tighten 12 outer bolts, in crisscross sequence shown, to 95-115 lb-ft (129-156 Nm).



TIGHTENING SEQUENCE

END OF WORK PACKAGE

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CAMSHAFT AND BEARINGS REPLACEMENT

0026 00

THIS WORK PACKAGE COVERS

Removal, Cleaning, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dispenser, sealant (Item 30, WP 0126 00)
- Pilot, cam gear (Item 81, WP 0126 00)
- Plate, retaining (Item 84, WP 0126 00)
- Socket, socket wrench (Item 116, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

- Bolt (P/N 8929206)
- Bolt (P/N 11504822) (3)
- Ring, seal (P/N 8929410)
- Seal, racetrack (P/N 23522975)
- Seal, stat-o (P/N 23521111) (2)

Materials/Parts - Continued

- Compound, gasket forming (Item 12, WP 0125 00)
- Compound, international, no. 2 (Item 13, WP 0125 00)
- Compound, sealing (Item 16, WP 0125 00)
- Detergent (Item 19, WP 0125 00)
- Gage, bearing clearance (Item 20, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)
- Rags, wiping (Item 31, WP 0125 00)
- Tags, marker (Item 35, WP 0125 00)

Personnel Required

Two

References

WP 0034 00

Equipment Condition

- Engine retarders removed (WP 0022 00)
 - Rocker arm assemblies removed (WP 0027 00)
-



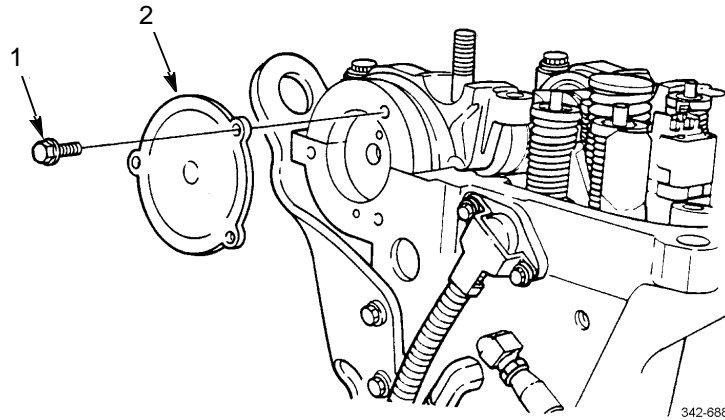
WARNING



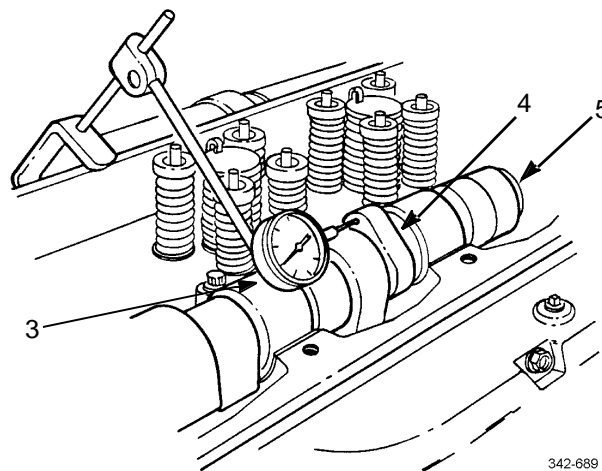
Camshaft weighs 53 lb (24 kg). Attach suitable lifting device prior to removal or installation to prevent possible injury to personnel.

REMOVAL

1. Remove three bolts (1) and rear camshaft cover (2).



2. Attach dial indicator (3) and place pointer in contact with side of camshaft lobe (4).
3. Grasp camshaft (5) between camshaft caps and move camshaft as far forward as possible. Hold in that position and set dial indicator for zero.
4. Move camshaft (5) to rear as far as possible. Read and record total amount of end play. Allowable camshaft end play is 0.003-0.015 in (0.076-0.381 mm).



5. If end play is beyond maximum limit, remove and repair or replace camshaft drive gear assembly (WP0034 00).

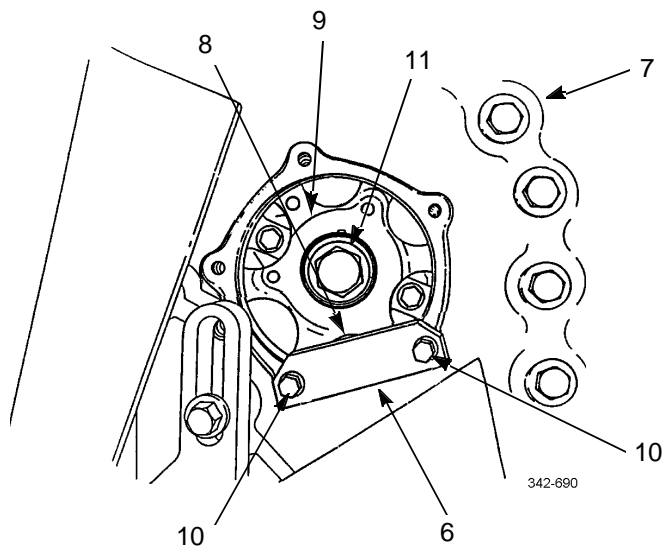
CAUTION

Use ONLY following method to hold camshaft drive gear stationary while loosening camshaft drive gear bolt.

REMOVAL - CONTINUED**NOTE**

After inserting shoe of retaining plate through access hole of camshaft drive gear, it may be necessary to bar engine over slightly to align bolt holes in retaining plate with bolt holes in drive gear access cover. If necessary, bar engine using accessory drive pulley retaining nut to align access hole.

6. Install retaining plate (6) on gear housing (7) engaging one access hole (8) in camshaft drive gear (9). Install two bolts (10) in retaining plate (6) and gear housing (7).
7. Remove camshaft drive gear bolt (11). Discard bolt
8. Remove two bolts (10) and retaining plate (6) from gear housing (7).



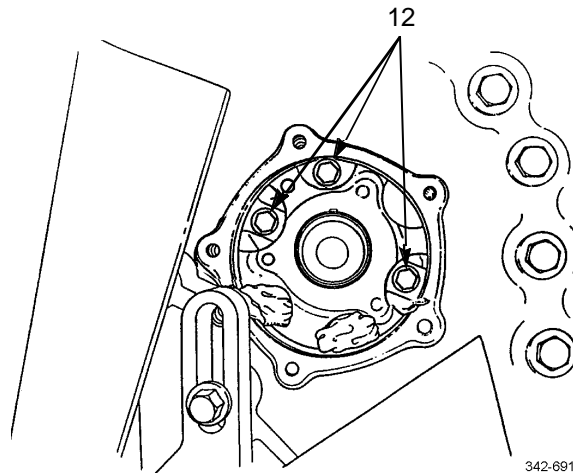
REMOVAL - CONTINUED**CAUTION**

Clean rag may be inserted into gear housing assembly opening to trap bolts in case they are dropped. DO NOT allow rag to drop into gear housing assembly to prevent damage to equipment

NOTE

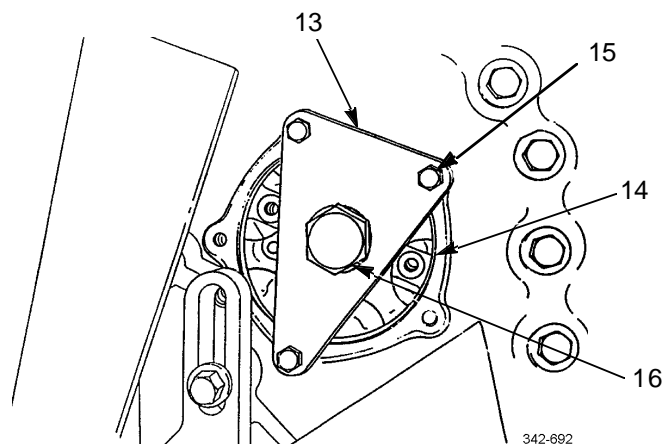
It may be necessary to bar engine over to align access holes in camshaft drive gear with mounting bolts in camshaft thrust plate.

9. Remove and discard three bolts (12).

**NOTE**

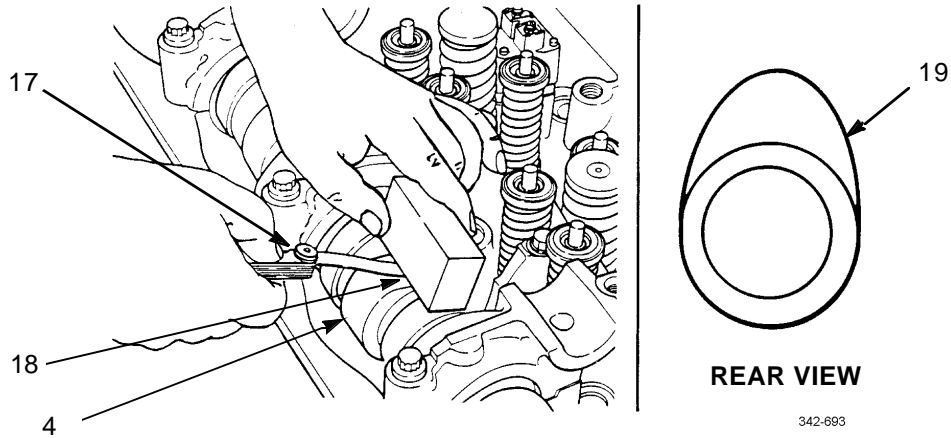
Performing step 10 will move camshaft drive gear hub and thrust plate forward approximately ¼ in (6-7 mm) until thrust plate seal is clear of camshaft front bearing cap and cylinder head.

10. Install cam gear pilot (13) on camshaft drive gear access opening (14) and install three bolts (15). Thread pilot puller screw (16) into end of camshaft drive gear hub until puller screw bottoms out.



REMOVAL - CONTINUED

11. If there is doubt of camshaft acceptability, determine extent of camshaft lobe wear as follows:
 - a. Using set of 0.0015-0.010 in (0.038-0.254 mm) thickness gages (17) and piece of square, hard material (18), measure flats on injector rise side (19) of camshaft lobes (4).
 - b. If flats measure less than 0.003 in (0.076 mm) in depth, but there are no other camshaft defects, camshaft is satisfactory.



REMOVAL - CONTINUED

12. Remove four camshaft cap bolts (20).
13. Using rocker stud socket, remove two rocker shaft studs (21) and seals (22) from camshaft bearing caps (23) no. 1 and no. 7. Discard seals.

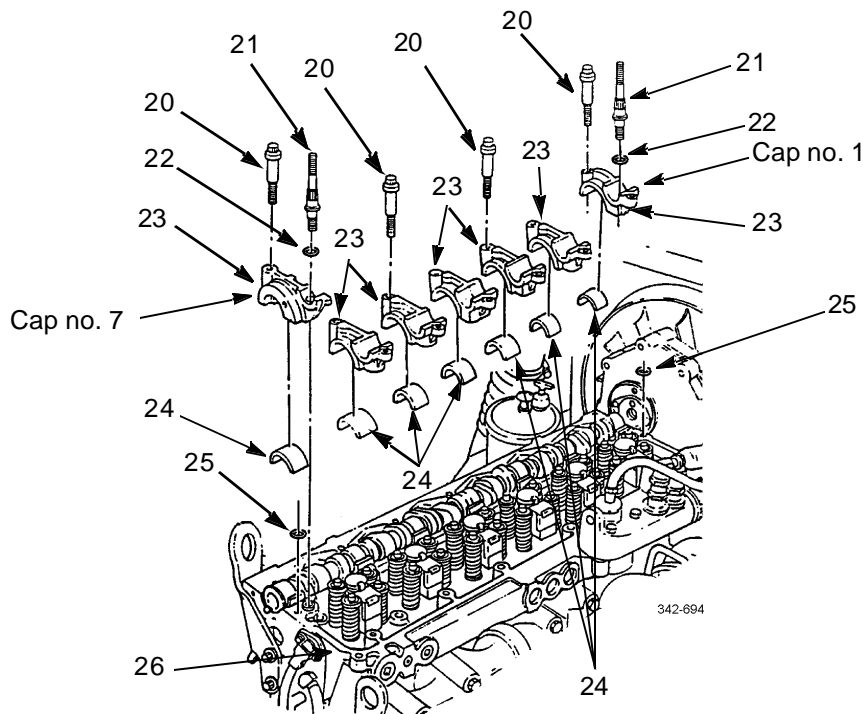
CAUTION

Camshaft bearing caps are numbered and must be kept in sequence and reinstalled in original positions to prevent damage to equipment. Camshaft bearing caps cannot be interchanged or transferred to another cylinder head.

NOTE

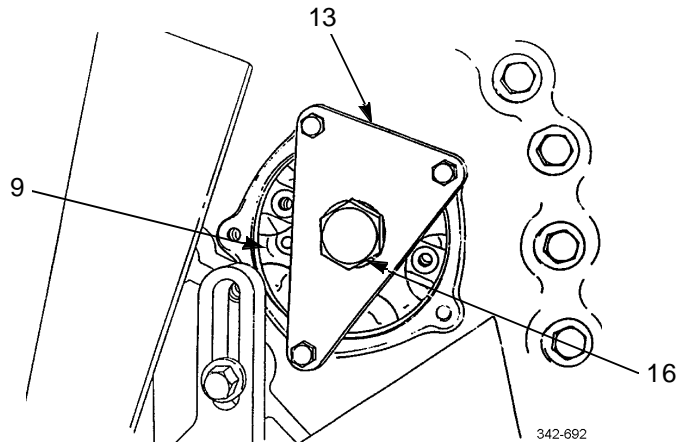
If camshaft bearing shells are to be reused, tag all parts. Shell must be kept with same camshaft bearing cap.

14. Remove seven camshaft bearing caps (23) and seven upper camshaft bearing shells (24) together as units.
15. Remove and discard racetrack seal ring (25) between camshaft bearing cap (23) no. 1 (front) and seal ring between camshaft bearing cap (23) no. 7 (rear) and cylinder head (26).



REMOVAL - CONTINUED

16. Remove pilot puller screw (16). Camshaft gear pilot (13) will remain in place, holding camshaft drive gear (9) in contact with adjustable idler gear.

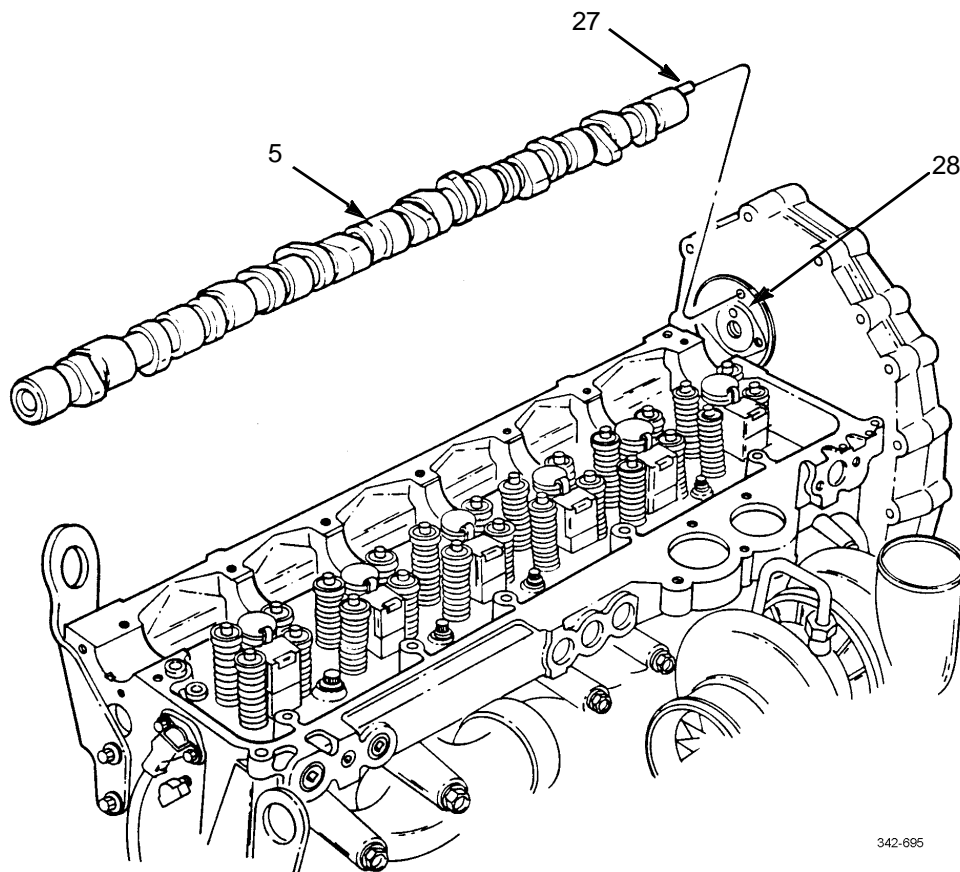
**WARNING**

Camshaft weighs 53 lb (24 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

REMOVAL - CONTINUED**CAUTION**

Due to size and bulk of camshaft, care must be taken and two persons used to lift camshaft. Use non-metallic sling positioned inboard of camshaft bearing no. 1 and no. 7 to prevent damage to equipment.

17. Using slings, slide camshaft (5) toward rear to disengage dowel (27) from camshaft drive gear hub (28). Remove camshaft.

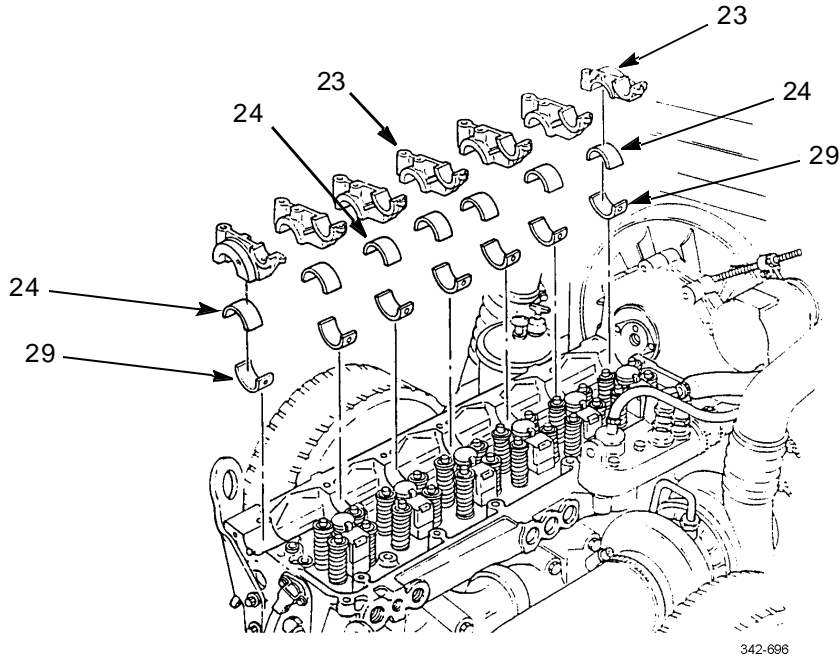


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CAUTION

Upper and lower bearing shells are in sets and cannot be interchanged. If either upper or lower bearing is replaced, upper and lower bearing shells must also be replaced to prevent damage to equipment.

18. Remove seven lower camshaft bearing shells (29). Keep lower bearing shells with their corresponding upper camshaft bearing shells (24) and camshaft bearing caps (23).

REMOVAL - CONTINUED**CLEANING**

1. Clean all removed parts and components in detergent and water.

**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

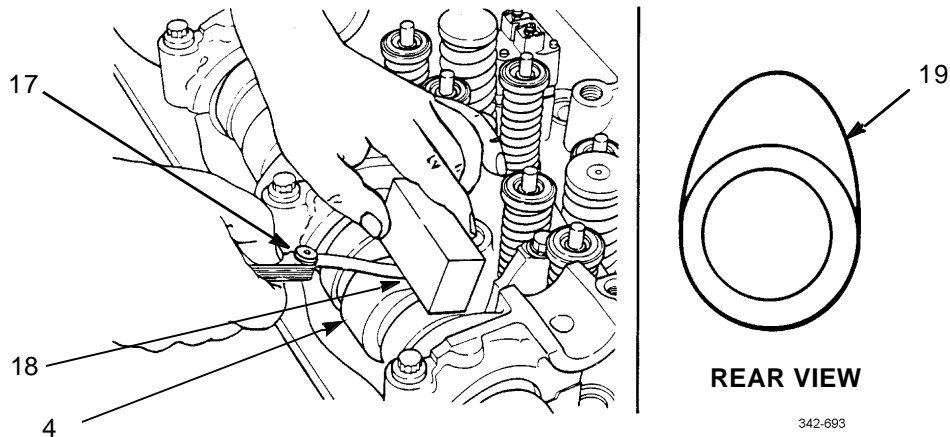
2. Use compressed air to clean all oil passages.

INSPECTION

1. Inspect camshaft lobes and journals for scoring, pitting or flat spots. If camshaft is scored, inspect camshaft follower rollers.

INSPECTION - CONTINUED

2. If there is doubt of camshaft acceptability, determine extent of camshaft lobe wear as follows:
 - a. Using set of 0.0015-0.010 in (0.038-0.254 mm) thickness gages (17) and piece of square, hard material (18), measure flats on injector rise side (19) of camshaft lobes (4).



- b. If flats measure less than 0.0003 in (0.076 mm) in depth, but there are no other camshaft defects, camshaft is satisfactory.

NOTE

If one camshaft bearing needs replacement, replace all camshaft bearing shells.

- c. Inspect camshaft bearings for signs of excessive wear, scoring or pitting.
 - d. Determine camshaft bearing clearance:

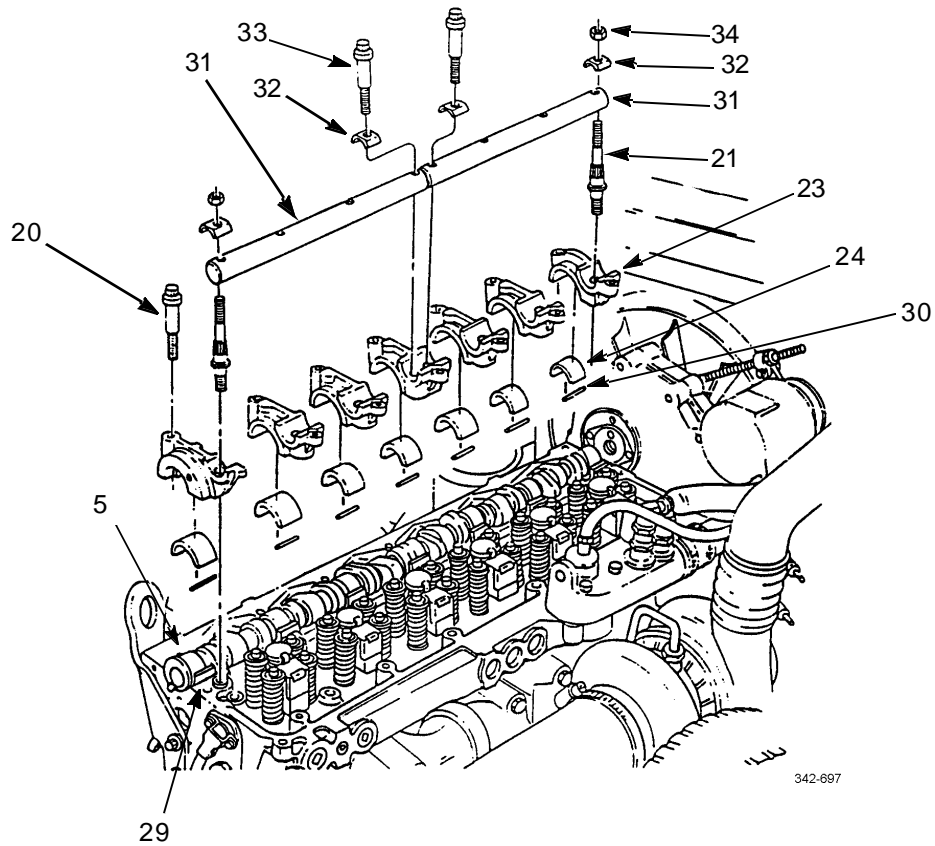
NOTE

Ensure locating tangs are correctly positioned.

- (1) With lower camshaft bearing shells (29) installed in cylinder head, install camshaft (5) on seven lower camshaft bearing shells.
- (2) Install seven upper camshaft bearing shells (24) in seven camshaft bearing caps (23).
- (3) Wipe any oil from camshaft bearing shells and camshaft journals.
- (4) Place a piece of plastiguage (30) full width of each upper camshaft bearing shell (24) about ¼ in (6-7 mm) off center.
- (5) Install camshaft bearing caps (23) and camshaft bearing shells (24) on correct camshaft journals and install seven camshaft cap bolts (20). Tighten bolts to 75-86 lb-ft (102-117 Nm).
- (6) Install two rocker shaft studs (21) in camshaft bearing caps (23) no. 1 and no. 7. Tighten studs to 75-86 lb-ft (102-117 Nm).
- (7) Install two rocker shafts (31) on seven camshaft bearing caps (23).
- (8) Install eight rocker shaft saddle washers (32), six bolts (33), and two nuts (34). Tighten bolts and nuts to 75-86 lb-ft (102-117 Nm).

INSPECTION - CONTINUED

- (9) Remove two rocker shaft nuts (34), six bolts (33), eight saddle washers (32), and two rocker shafts (31).
- (10) Remove two rocker shaft studs (21).
- (11) Remove seven outboard camshaft cap bolts (20), seven camshaft caps (23), and seven bearing shells (24).



INSPECTION - CONTINUED

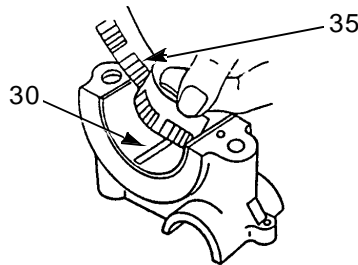
NOTE

Flattened plastigauge will adhere to either bearing shell or camshaft journal.

- (12) Compare width of plastigauge (30) at widest point with graduation scale (35) on plastigauge envelope to determine bearing clearance.

NOTE

Maximum camshaft journal-to-bearing clearance is 0.0035-0.65 in (0.09-0.166 mm); maximum with used parts is 0.0075 in (0.191 mm).



342-698



WARNING



Camshaft weighs 53 lb (24 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

- e. Remove camshaft (5).

NOTE

Ensure locating tangs are correctly positioned.

- f. Remove lower half of bearing shells (29).
- g. Lubricate two upper and lower camshaft bearing shells (24 and 29) for no. 1 and no. 7 with clean engine lubricating oil and install in two respective camshaft bearing caps (23).



WARNING

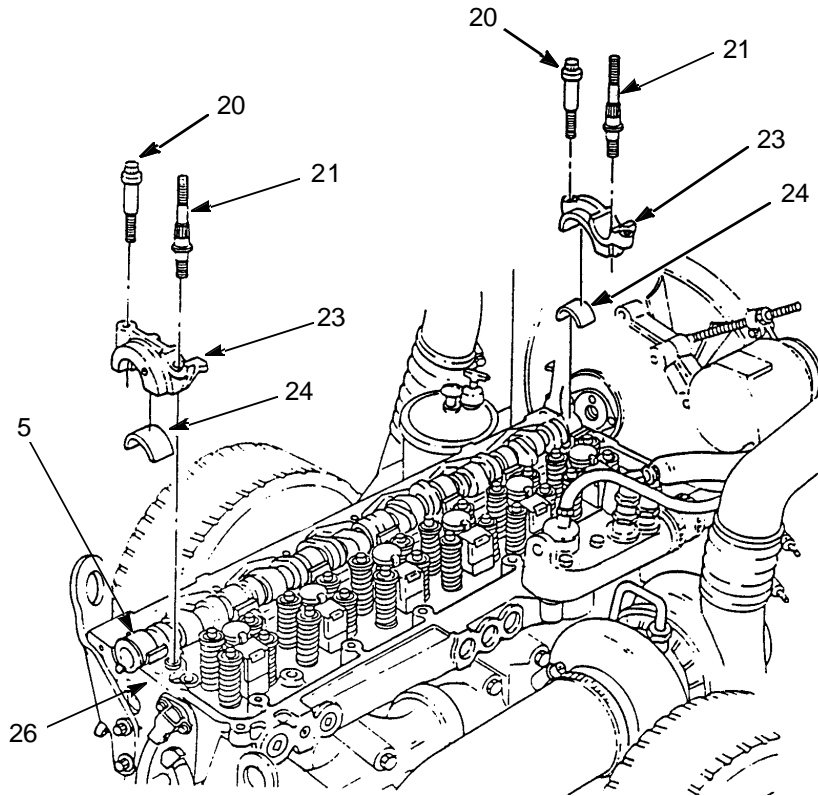


Camshaft weighs 53 lb (24 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- h. Install camshaft (5).

INSPECTION - CONTINUED

- i. Install two camshaft bearing caps (23) no. 1 and no. 7 in cylinder head (26) and install two camshaft cap bolts (20) and two rocker shaft studs (21) in two camshaft bearing caps (23) no. 1 and no. 7. Tighten bolts and studs to 75-86 lb-ft (102-117 Nm). Use rocker stud socket to tighten studs.

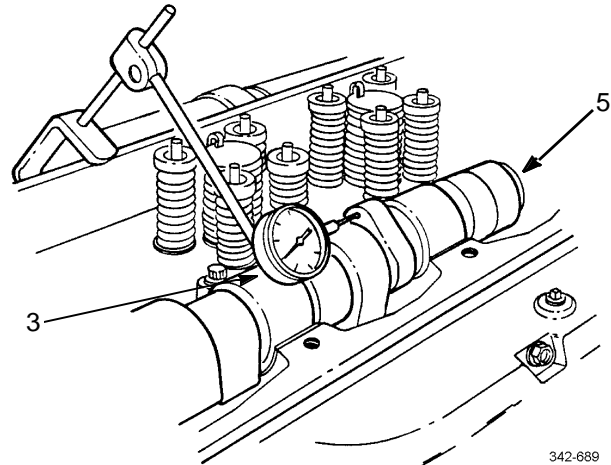


342-699

INSPECTION - CONTINUED**NOTE**

If camshaft runout exceeds 0.002 in (0.050 mm), replace camshaft.

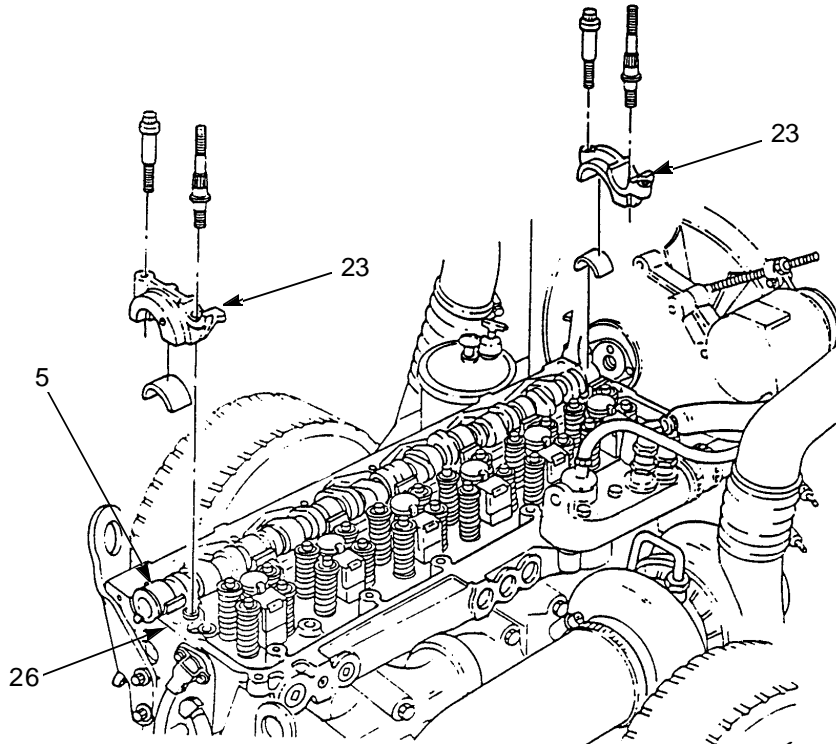
- j. Using dial indicator (3), check runout of camshaft (5) at bearing journal no. 4.
- k. Remove two camshaft bearing caps (23) no. 1 and no. 7 from cylinder head (26).

**WARNING**

Camshaft weighs 53 lb (24 kg). Attach suitable lifting device prior to removal to prevent possible injury to personnel.

INSPECTION - CONTINUED

1. Remove camshaft (5).

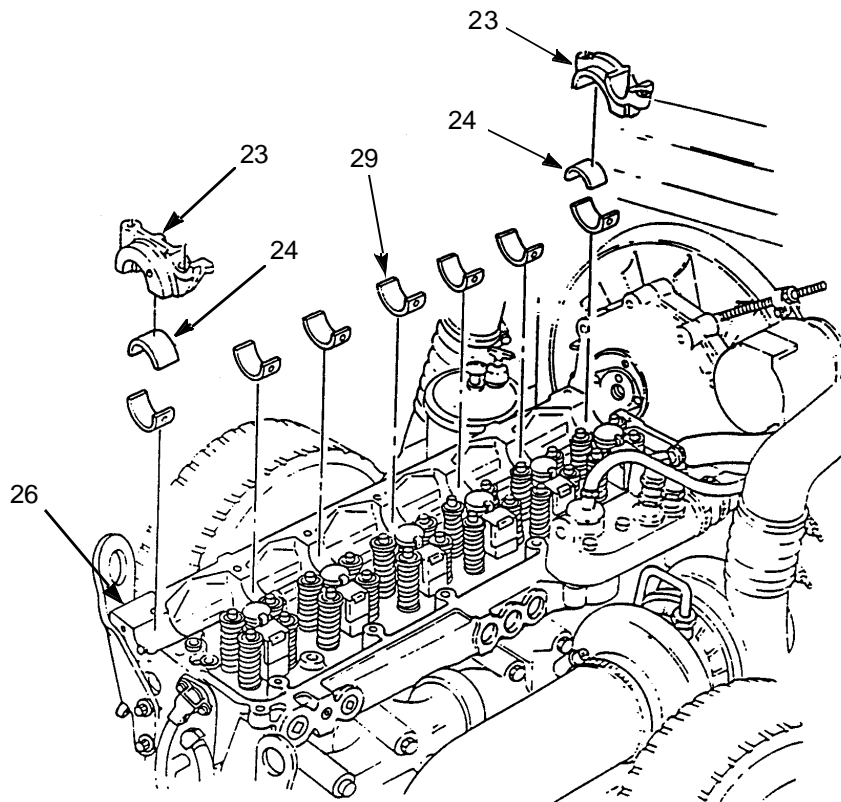


342-699

INSTALLATION**NOTE**

If new bearings are installed, replace upper and lower bearing shells as sets. Observe position of oil holes and locating tangs.

1. Install seven lower bearing shells (29) in cylinder head (26). Lubricate lower camshaft bearing shells with clean engine lubricating oil.
2. Install two upper camshaft bearing shells (24) in camshaft bearing caps (23) no. 1 and no. 7. Lubricate upper camshaft bearing shells with clean engine lubricating oil.



342-700

NOTE

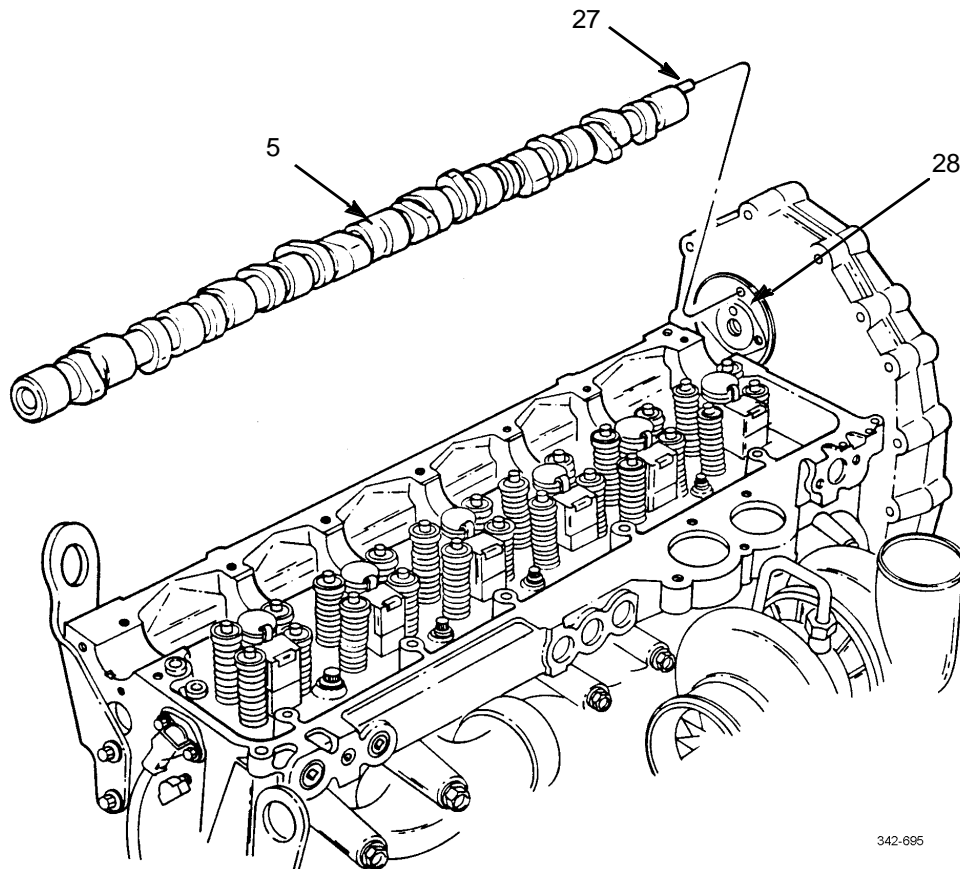
If new camshaft is installed, steam clean camshaft to remove rust preventive and dry with compressed air. Ensure dimple in thrust plate is located at 12 o'clock position before installing camshaft dowel (27) in camshaft drive gear hub (28).

3. Lubricate camshaft lobes and journals with clean engine lubricating oil.

INSTALLATION - CONTINUED**WARNING**

Camshaft weighs 53 lb (24 kg). Attach suitable lifting device prior to installation to prevent possible injury to personnel.

- Using non-metallic sling, lower camshaft (5) into position and slide forward, ensuring camshaft dowel (27) aligns with mating hole in camshaft drive gear hub (28). This will position camshaft bearing journals in lower camshaft bearing shells.



342-695

INSTALLATION - CONTINUED**WARNING**

Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water.

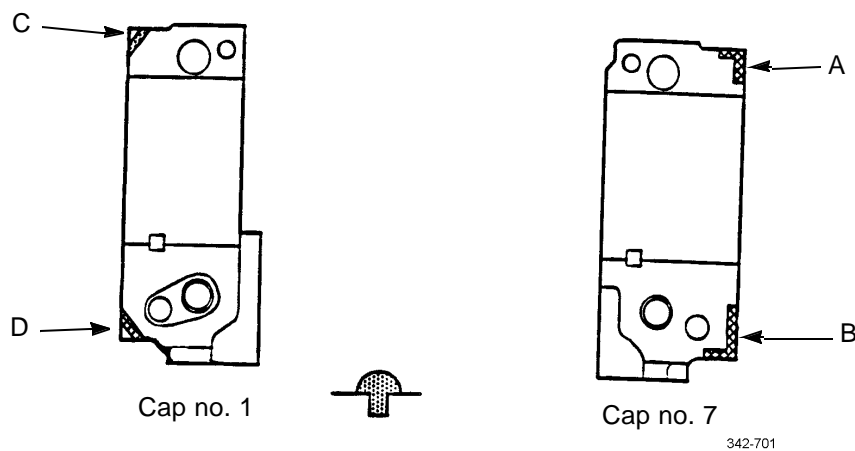
CAUTION

Be careful not to get gasket forming compound or sealing compound on camshaft bearing shell seats and bearing surfaces. Keep time to minimum between installation of camshaft bearing caps no. 1 and no. 7 and tightening of camshaft cap bolts and nuts. Ensure two seal rings are placed on cylinder head before assembling camshaft bearing caps to cylinder head. Failure to do so could result in equipment damage.

NOTE

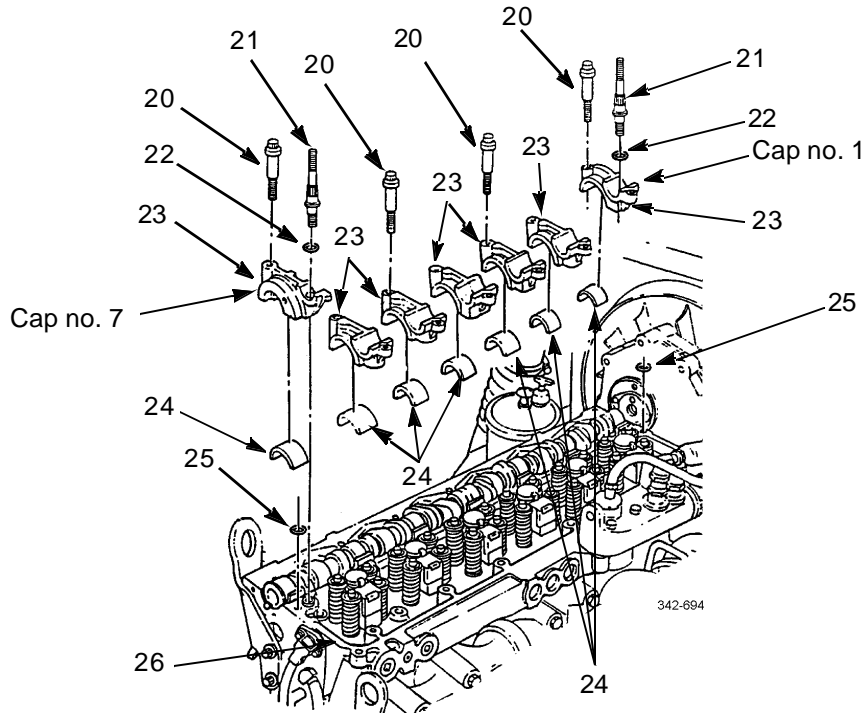
Ensure locating tangs are in correct position.

5. Apply thin bead of gasket forming compound to joint face surfaces A and B of camshaft bearing cap no. 7.
6. Apply thin bead of gasket forming compound to joint groove face surfaces C and D of camshaft bearing cap no. 1.

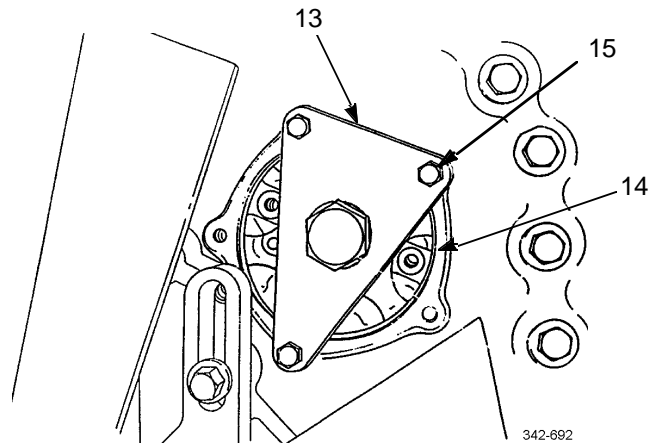


7. Install new seal ring (25) in counterbore under camshaft bearing cap (23) position no. 7 (rear).
8. Install new racetrack seal ring (25) in counterbore under camshaft bearing cap (23) position no. 1.
9. Install two camshaft bearing caps (23) no. 1 and no. 7 with bearing shells in place.
10. Install two studs (21), two seals (22), and two cap bolts (20).
11. Tighten two rocker shaft studs (21) and two camshaft cap bolts (20) on two camshaft bearing caps (23) no. 1 and no. 7 to 75-86 lb-ft (102-117 Nm). Use rocker stud socket to tighten studs.

INSTALLATION - CONTINUED



12. Remove three bolts (15) and camshaft gear pilot (13) from camshaft drive gear access opening (14).



CAUTION

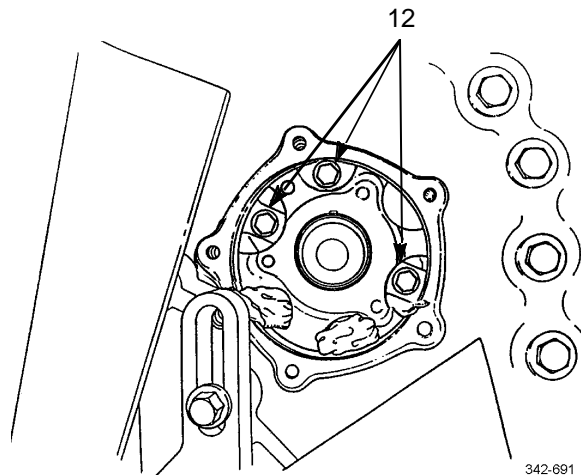
Clean rag may be inserted into gear housing assembly opening to trap bolts in case they are dropped. DO NOT allow rag to drop into gear housing assembly. Failure to follow this caution will result in equipment damage.

NOTE

Ensure camshaft dowel is engaged before performing next step.

INSTALLATION - CONTINUED

13. Install three new bolts (12). Tighten bolts alternately to draw thrust plate straight into gear housing assembly. Tighten bolts to 22-28 lb-ft (30-38 Nm).

**CAUTION**

Camshaft should be held in place while installing camshaft drive gear bolt to prevent disengaging camshaft dowel from drive gear hub.

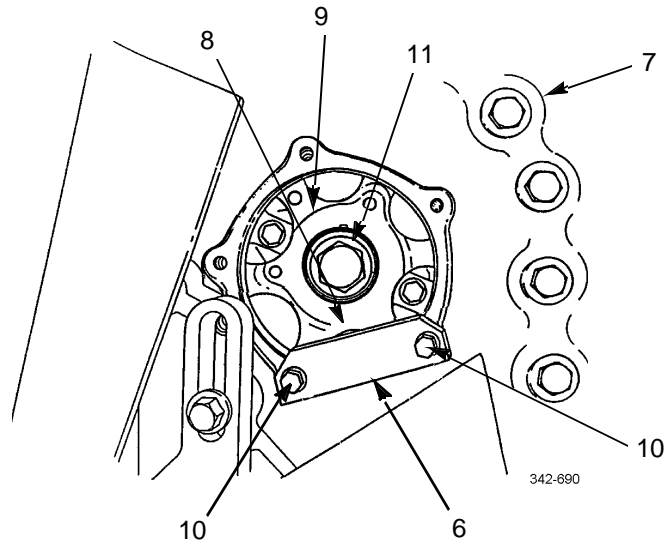
14. Coat threads and underside head of new camshaft drive gear bolt (11) with international compound no. 2 and install bolt hand tight.

NOTE

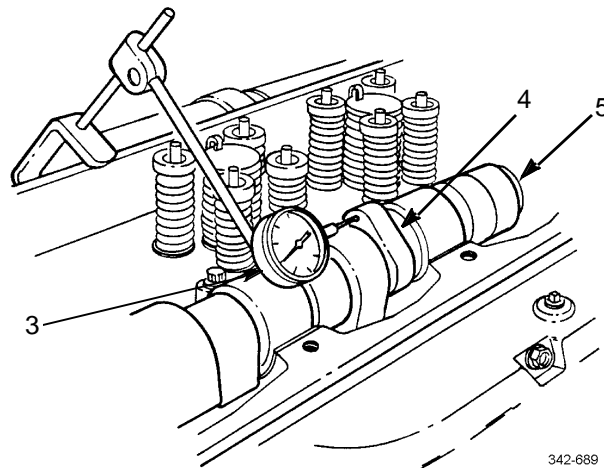
After inserting shoe of retaining plate through access hole of camshaft drive gear, it may be necessary to bar engine over slightly to align bolt holes in retaining plate with bolt holes in drive gear access cover.

15. Install retaining plate (6) on gear housing (7) engaging one access hole (8) in camshaft drive gear (9). Install two bolts (10) in retaining plate and gear housing.
16. Tighten camshaft drive gear bolt (11) to 55 lb-ft (75 Nm). Then turn bolt clockwise 120 degrees.
17. Remove two bolts (10) and retaining plate (6).

INSTALLATION - CONTINUED



18. Using dial indicator (3), place pointer in contact with side of camshaft lobe (4).
19. Move camshaft (5) as far forward as possible. Hold in position and zero dial indicator (3).
20. Move camshaft (5) to rear as far as possible. Read and record total amount of end play. Allowable camshaft end play is 0.003-0.015 in (0.076-0.381 mm).



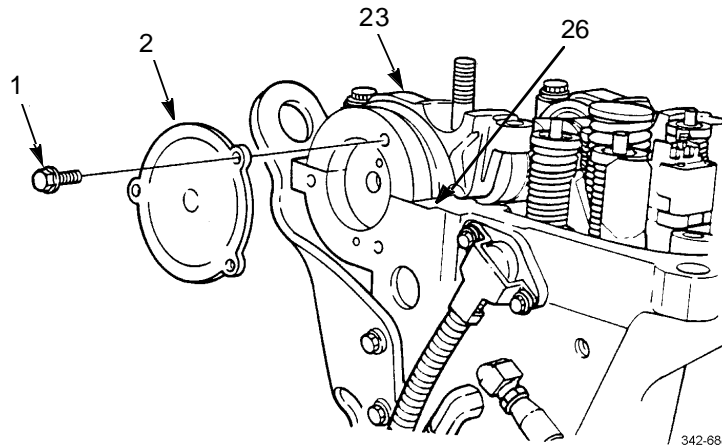
21. If end play is beyond maximum limit, remove and repair or replace camshaft drive gear assembly (WP0034 00)

NOTE

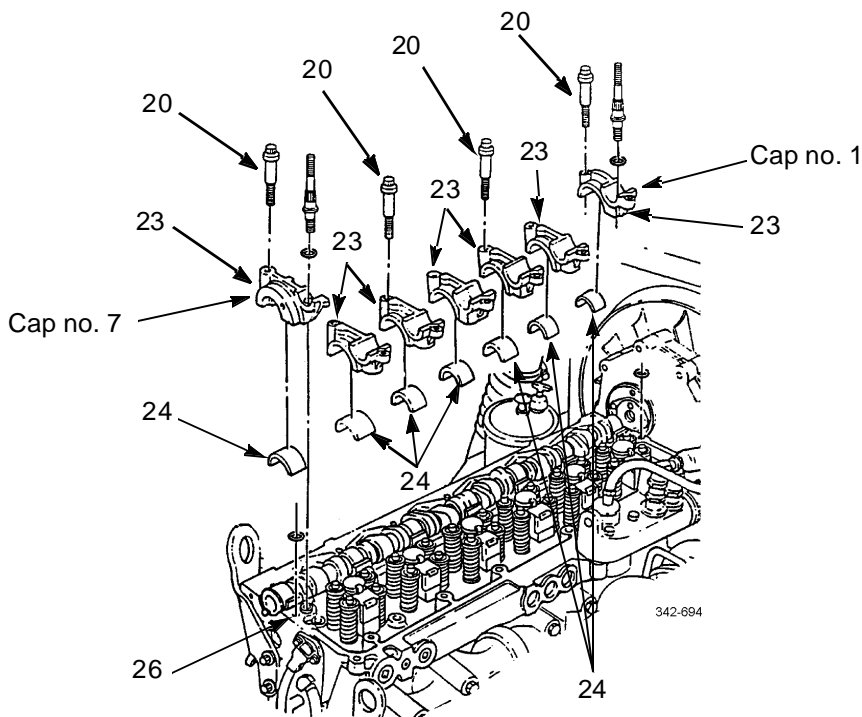
Ensure old gasket forming compound has been removed from rear camshaft cover and surfaces.

INSTALLATION - CONTINUED

22. Apply thin bead of gasket forming compound to camshaft bearing cap (23) no. 7 mating surface and install camshaft bearing cap no. 7 on cylinder head (26).
23. Install rear camshaft cover (2) and three bolts (1). Tighten bolts to 22-28 lb-ft (30-38 Nm).

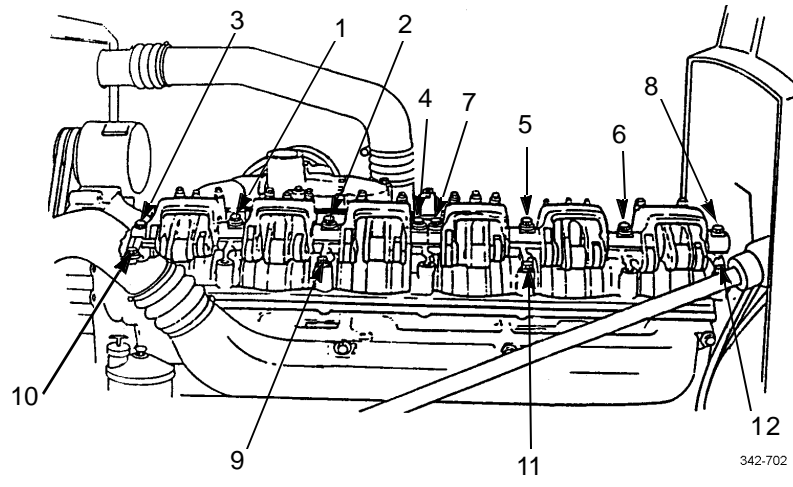


24. Install five camshaft bearing shells (24) in camshaft bearing caps (23) no. 2 through no. 6.
25. Install five camshaft bearing caps (23) on correct saddles on cylinder head (26) and install two camshaft cap bolts (20) hand tight in camshaft bearing caps no. 3 and no. 5.



26. Install rocker arm assemblies (WP 0027 00).
27. Tighten 12 camshaft cap and rocker arm bolts and nuts to 75-86 lb-ft (102-117 Nm), in sequence shown.

INSTALLATION - CONTINUED



TIGHTENING SEQUENCE

28. Install engine retarders (WP 0022 00).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Cleaning, Inspection, Installation, Adjustment

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Caliper, vernier (Item 16, WP 0126 00)
- Gage, profile (Item 39, WP 0126 00)
- Installer, cup plug (Item 58, WP 0126 00)
- Lifter, rocker arm (Item 76, WP 0126 00)
- Pliers, retaining ring (Item 86, WP 0126 00)
- Socket, socket wrench (Item 116, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

- Plug, cup (P/N 9421745) (2)
- Detergent (Item 19, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)
- Rags, wiping (Item 31, WP 0125 00)
- Tags, marker (Item 35, WP 0125 00)
- Wipes, lint-free (Item 40, WP 0125 00)

Equipment Condition

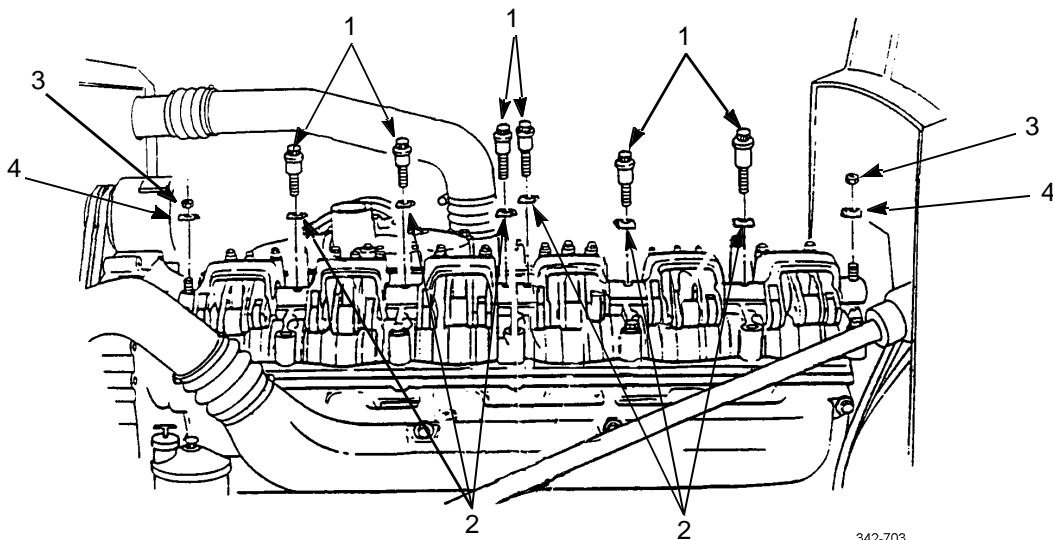
- Engine retarder removed (WP 0022 00)

REMOVAL

CAUTION

Failure to follow procedures below could result in damage to rocker arm shaft.

1. In one turn increments, remove six retaining bolts (1) and saddle spacers (2).
2. Remove two nuts (3) and saddle spacers (4).



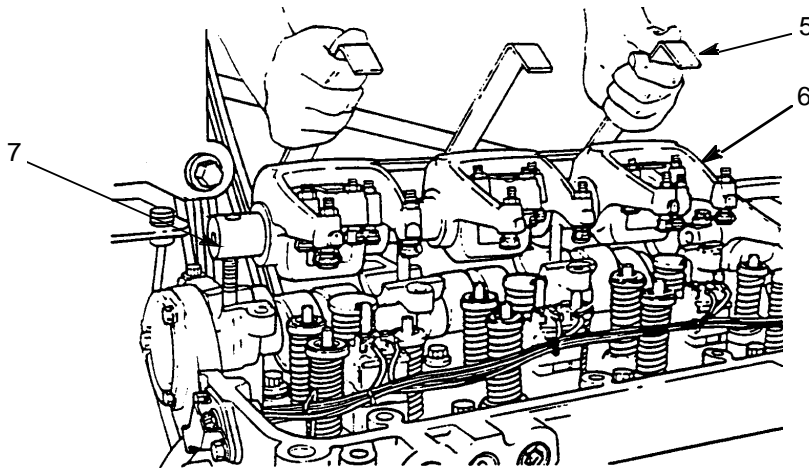
342-703

REMOVAL - CONTINUED

NOTE

Tag rocker arm assemblies by cylinder position prior to removal as an aid in installation. Position lifter fingers under cross arch of exhaust rocker arm assembly (above center section of injector rocker assembly). Lifter fingers fit between intake and injector rockers.

- Using rocker arm lifter (5) on rocker arm assembly sets (6) from cam roller side, lift three rocker arm assembly sets and rocker arm shaft (7) from cylinder head.



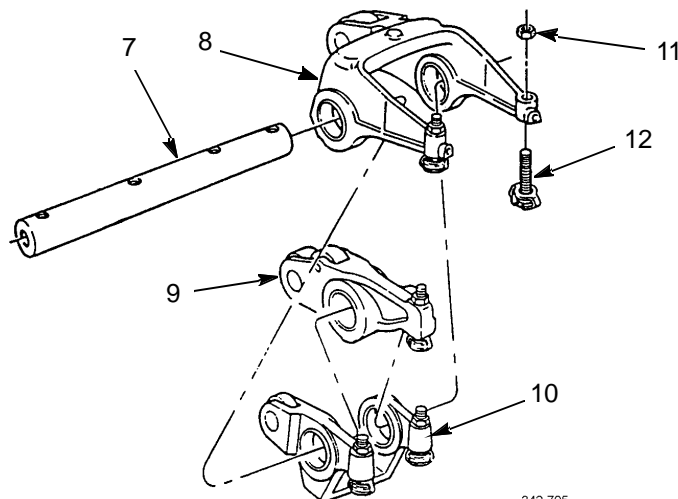
342-704

- Slide exhaust (8), injector (9), and intake (10) rocker arms off rocker arm shaft (7).

NOTE

Note adjusting screw type and rocker arm combination as an aid in installation. Adjusting screws with annular (Allen wrench) adjustment are used on intake (short arm) and injector rocker arms. Hex head adjusting screws are used on exhaust (long arm) rocker arms.

- Remove jamnuts (11) and adjusting screws (12) from each rocker arm.

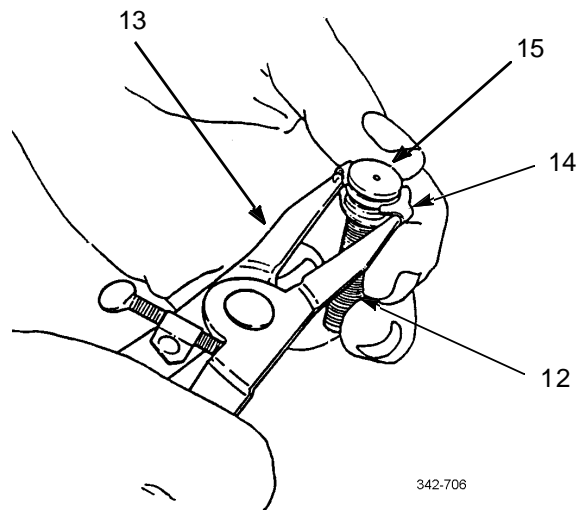


342-705

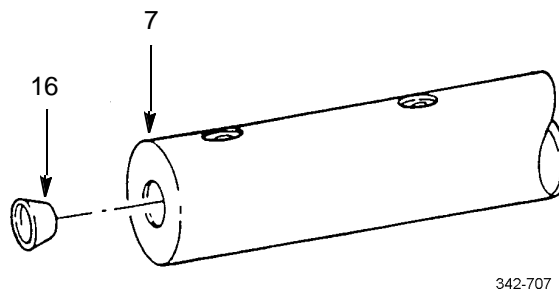
REMOVAL - CONTINUED**CAUTION**

Do not expand retaining clip more than 0.61 in (15.50 mm) when removing intake valve button. To do so could result in damage to equipment.

6. Hold adjusting screw (12) and with retaining ring pliers (13), spread legs of retaining clip (14) and remove intake valve button (15).
7. Remove retaining clip (14) from threaded end of adjusting screw (12).

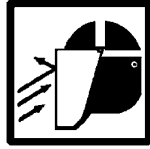


8. Punch hole in two cup plugs (16) at ends of rocker arm shaft (7). Pry cup plugs from shaft. Discard cup plugs.



CLEANING

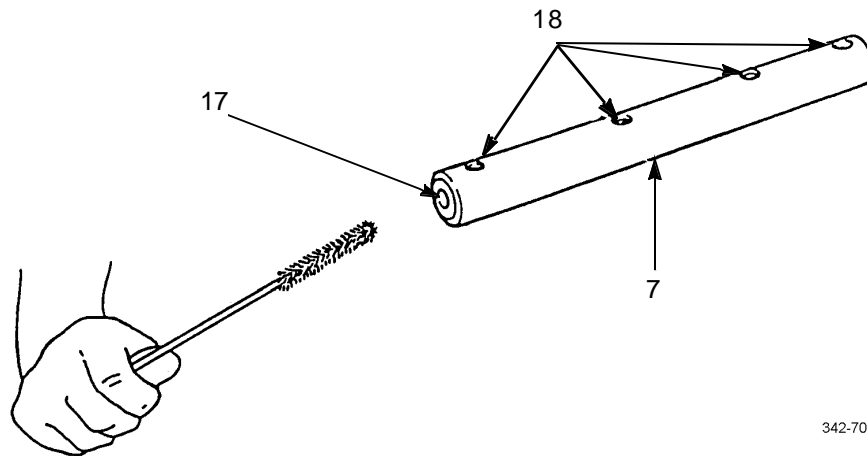
1. Soak rocker arm shaft (7) in solution of detergent and water. Run wire brush through center oil passage (17).



WARNING

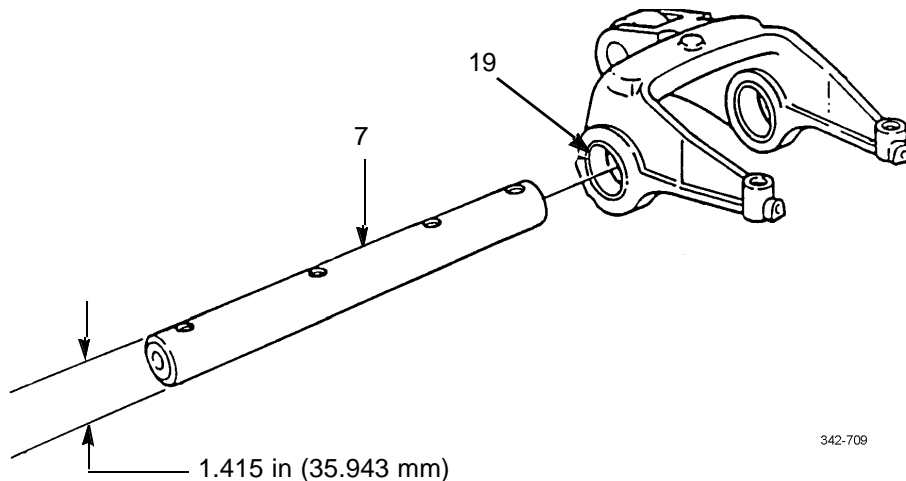
Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

2. Clean out center oil passage (17) and oil holes (18) with compressed air. Wipe exterior with clean, lint-free wipes.



INSPECTION

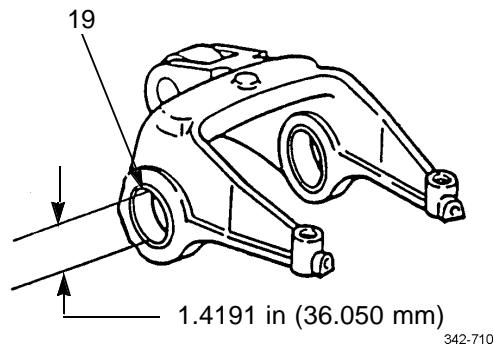
1. Measure rocker arm shaft (7) where contact is made with rocker arm bushings (19). If rocker arm shaft diameter is less than 1.415 in (35.943 mm) minimum, replace shaft.



INSPECTION - CONTINUED**NOTE**

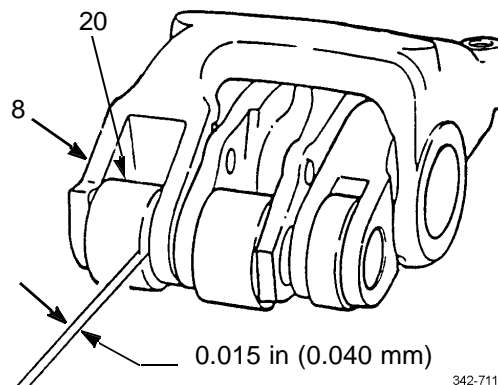
Rocker arm bushing inside diameter is the same for each rocker arm (exhaust, intake, and injector). Exhaust arm only is shown.

- Inspect rocker arm bushings (19) for excessive wear or scoring. Measure rocker arm bushing inside diameter. If diameter is more than 1.4191 in (36.050 mm), replace rocker arm assembly.

**NOTE**

Rocker arms are not matched sets and each rocker arm may be replaced. The checks in step 3 through 5 apply to each rocker arm.

- Check each cam follower roller (20) for scoring, pitting or flat spots. If any of these conditions are evident, replace defective rocker arm.
- Check side clearance between cam follower roller (20) and rocker arm. If more than 0.015 in (0.040 mm) maximum, replace defective rocker arm.
- Ensure cam follower roller (20) turns freely on its pin. If roller does not turn freely, binds or if there is vertical movement between roller and pin, replace defective rocker arm.



INSPECTION - CONTINUED

6. Check rocker arm shaft stud for tightness. Ensure rocker arm shaft studs are tightened to 75-86 lb-ft (101-116 Nm).

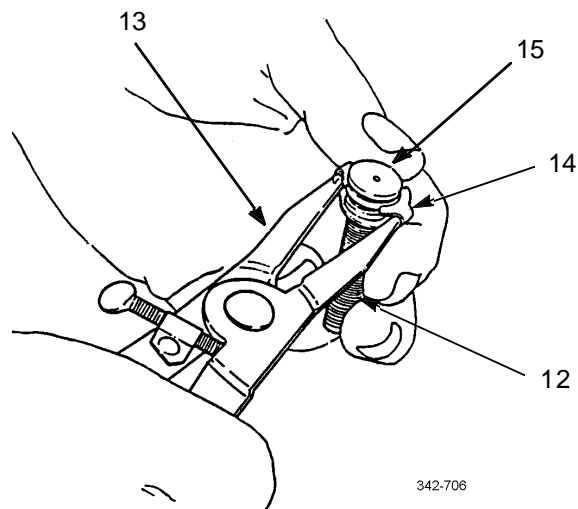
INSTALLATION**CAUTION**

Do not expand retaining clip more than 0.61 in (15.50 mm) when installing retaining clip. To do so could result in equipment damage.

NOTE

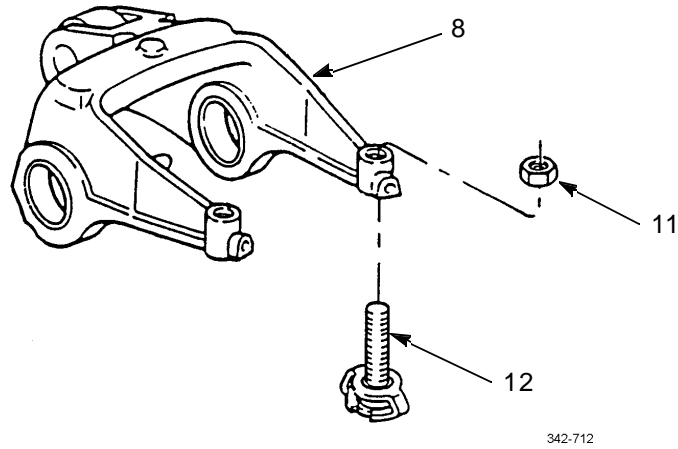
Position concave (dished side) of intake valve button toward adjusting screw ball.

1. Slide retaining clip (14), open end first, onto adjusting screw (12). Spread retaining clip slightly, if necessary, so open end can pass over ball head of adjusting screw.
2. Insert tips of retaining ring pliers (13) between legs of retaining clip (14). Expand clip enough to insert groove on intake valve button (15) onto leg arcs of retaining clip.

**NOTE**

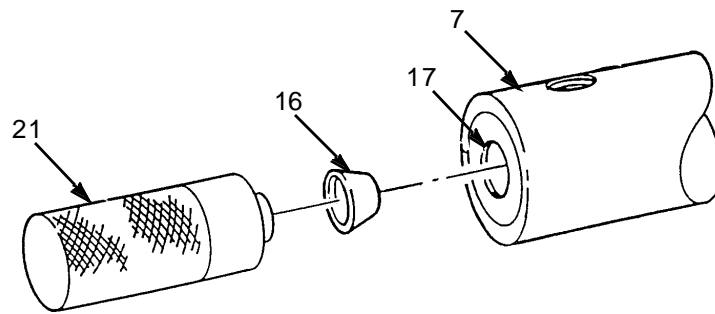
- Adjusting screws with annular (Allen wrench) adjustment are used on intake (short arm) and injector rocker arms. Hex head adjusting screws are used on exhaust (long arm) rocker arms.
 - Only exhaust rocker arm is shown.
3. Thread adjusting screw (12) into correct rocker arm (8), as noted during removal, and loosely install jamnut (11).

INSTALLATION - CONTINUED



342-712

4. Using cup plug installer (21), install new cup plug (16) in center oil passage (17) at each end of rocker arm shaft (7).



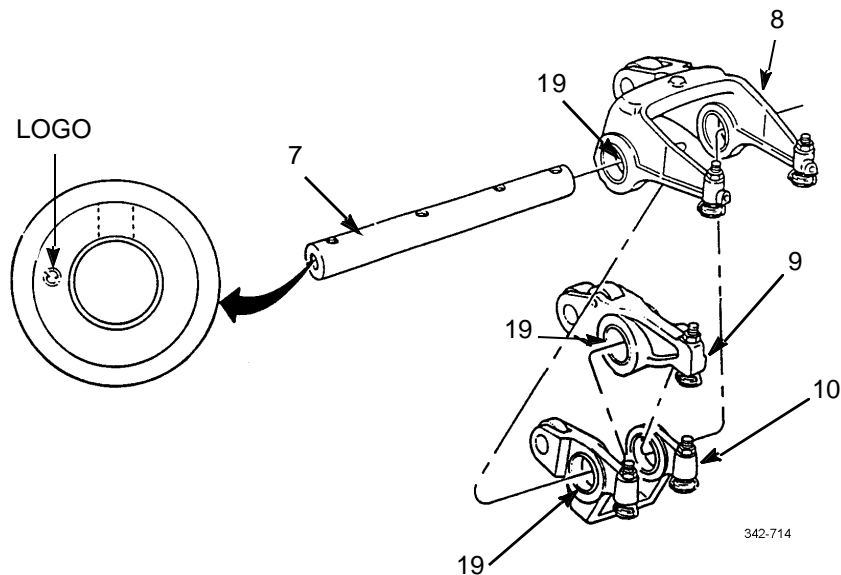
342-713

INSTALLATION - CONTINUED

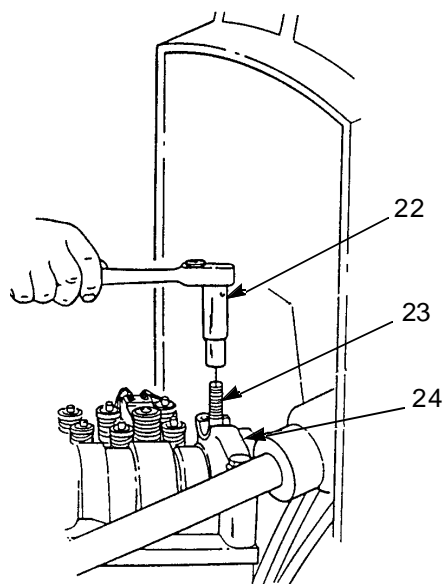
NOTE

If rocker arms are reused, install in previously determined order, with logo on rocker arm shaft facing out-board (front and rear) when seated.

- Lubricate rocker arm bushing (19) with clean engine lubricating oil. Install three rocker arm assembly sets (6), exhaust (8), injector (9), and intake (10), on rocker arm shaft (7), with logo stamped on end of shaft.



- Using rocker stud socket (22), check tightness of rocker arm shaft studs (23) in cam caps (24) no. 1 and no. 7. Tighten studs to 75-86 lb-ft (102-117 Nm).

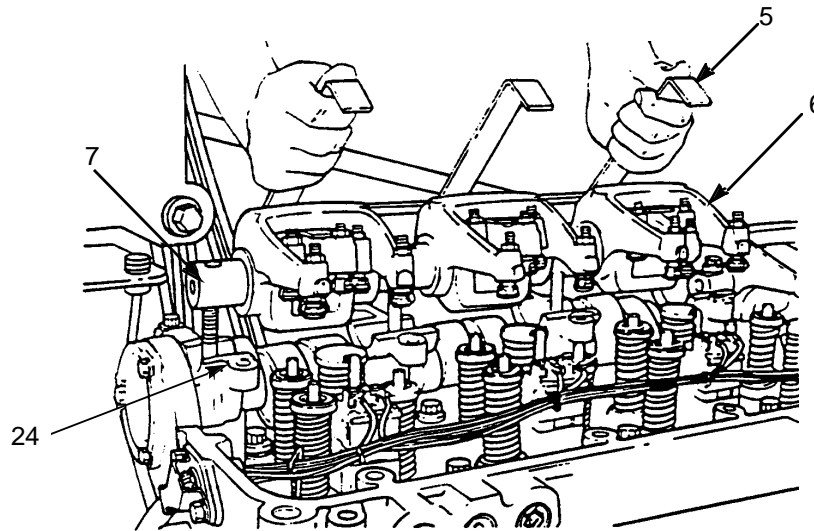


INSTALLATION - CONTINUED

NOTE

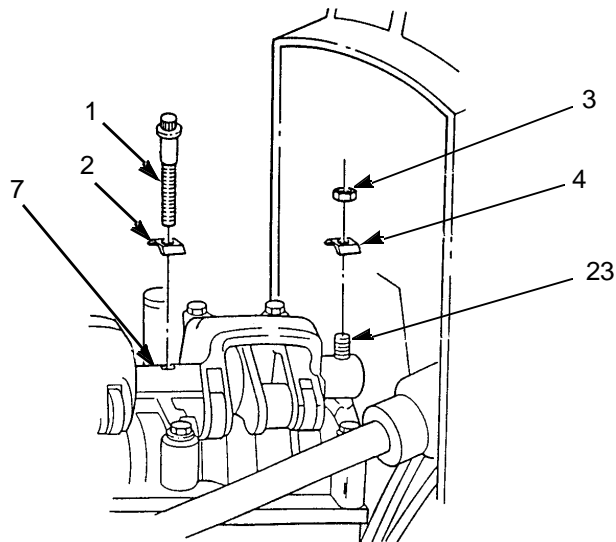
Position lifter fingers under cross arch of exhaust rocker arm assembly (above center section of injector rocker assembly). Lifter fingers fit between intake and injector rockers.

7. Using rocker arm lifter (5) on rocker arm assembly sets (6) from cam roller side, place rocker arm shaft (7) and three rocker arm assembly sets (6) in position on cam caps (24).



342-704

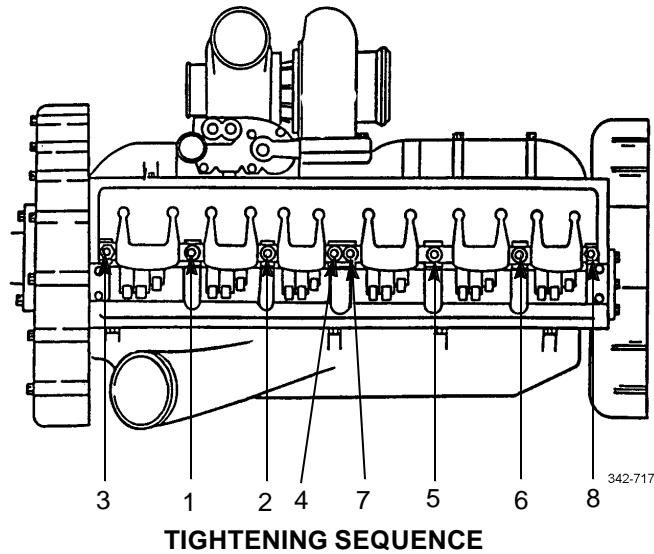
8. Install six saddle spacers (2) on six retaining bolts (1).
9. Install six retaining bolts (1) through rocker arm shaft (7) and cam cap saddles.
10. Install two saddle spacers (4) and nuts (3) on rocker arm shaft studs (23).



342-716

INSTALLATION - CONTINUED

11. Tighten six retaining bolts and two nuts to 75-86 lb-ft (102-117 Nm), in sequence shown.



ADJUSTMENT

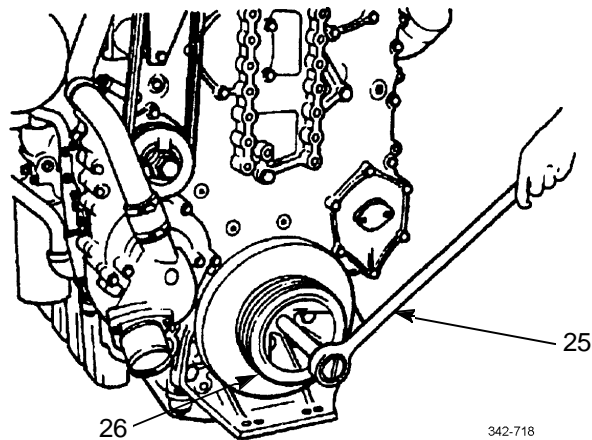
CAUTION

Never set valves and injector of same cylinder at same time. Doing this will result in engine damage.

NOTE

When setting valve lash clearance or injector height, always set them using valve overlap method.

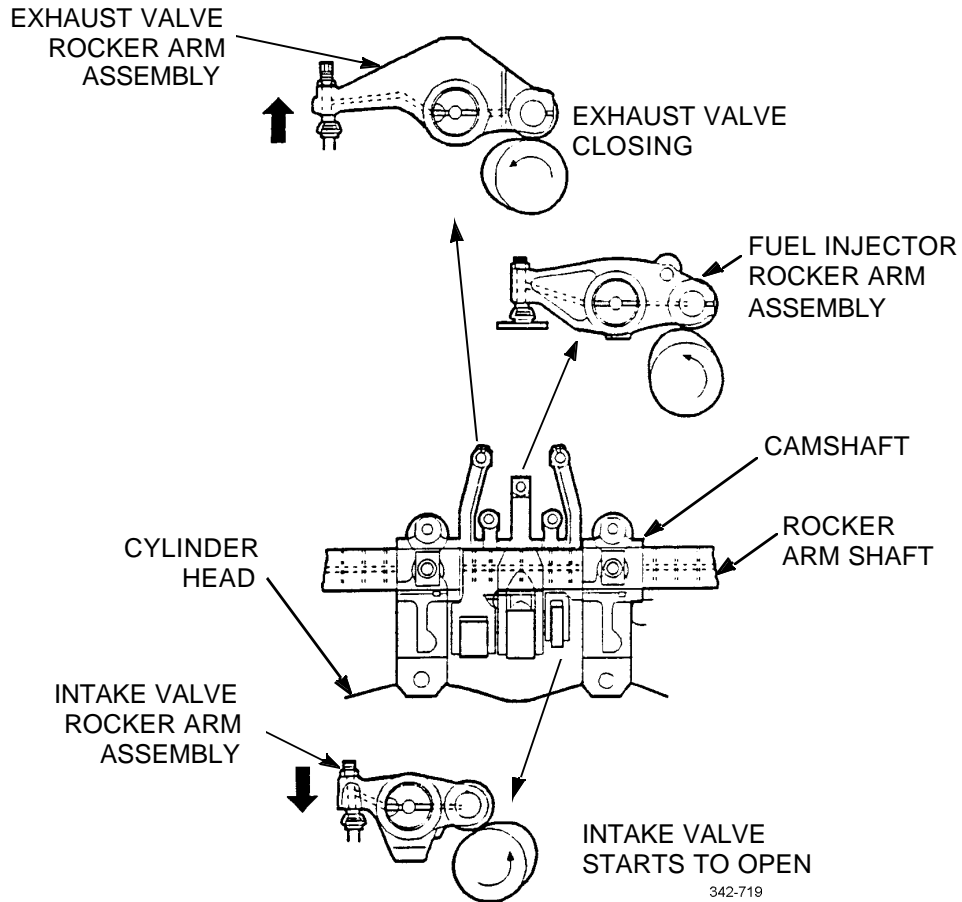
1. Adjust valves and set fuel injector heights as follows:
 - a. Insert a $\frac{3}{4}$ in drive breaker bar (25) or ratchet into square hole in center of crankshaft pulley (26).



ADJUSTMENT - CONTINUED

- b. Bar engine in direction of rotation and observe intake and exhaust valve rollers at any cylinder that is close to TDC (top dead center). Choose a cylinder that has exhaust valves almost completely closed. Just as exhaust valves are closing, intake valves will start to open. This is the valve overlap period.

VALVE OVERLAP PERIOD



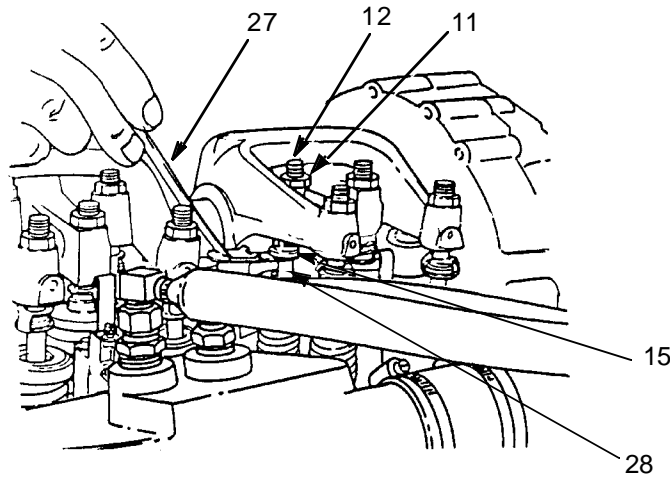
ADJUSTMENT - CONTINUED

- c. Stop engine rotation at time of valve overlap. Note which cylinder this is and follow sequence listed in Table 1 to correctly set valves and injector heights. The timing can be started with any cylinder in valve overlap.

Table 1. Valve Lash and Injector Height Adjustment Sequence.

CYLINDER WITH VALVE OVERLAP	SET VALVES ON CYLINDER NO.	SET INJECTOR HEIGHT ON CYLINDER NO.
6	1	5
2	5	3
4	3	6
1	6	2
5	2	4
3	4	1

- d. Insert 0.008 in (0.203 mm) thickness gage (27) between tip of intake valve stem (28) and intake valve button (15) at end of rocker arm.
- e. Loosen jamnut (11) and turn adjusting screw (12) until thickness gage (27) produces even or smooth pull between intake valve stem (28) and intake valve button (15).
- f. Tighten jamnut (11) to 30-35 lb-ft (41-47 Nm) and remove feeler gage (27).
- g. Insert thickness gage (27) again to ensure adjustment did not change when jamnut (11) was tightened. Readjust as necessary.
- h. Using 0.026 in (0.660 mm) thickness gage, adjust exhaust valves in same manner as intake valves.

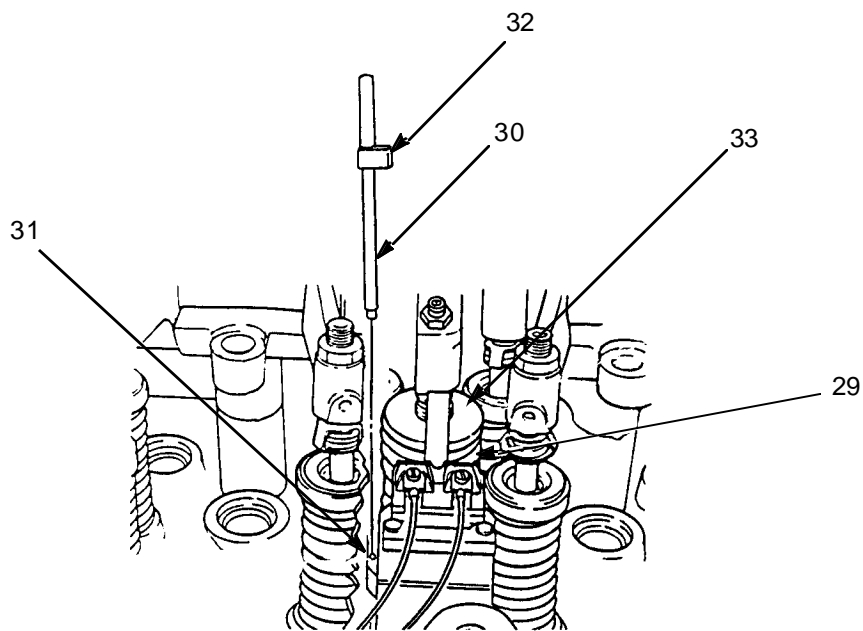


342-720

ADJUSTMENT - CONTINUED**NOTE**

Ensure injector timing height gage is seated on machined surface with tip in pilot hole. Foreign material in pilot hole or on machined surface may prevent accurate setting of injector height.

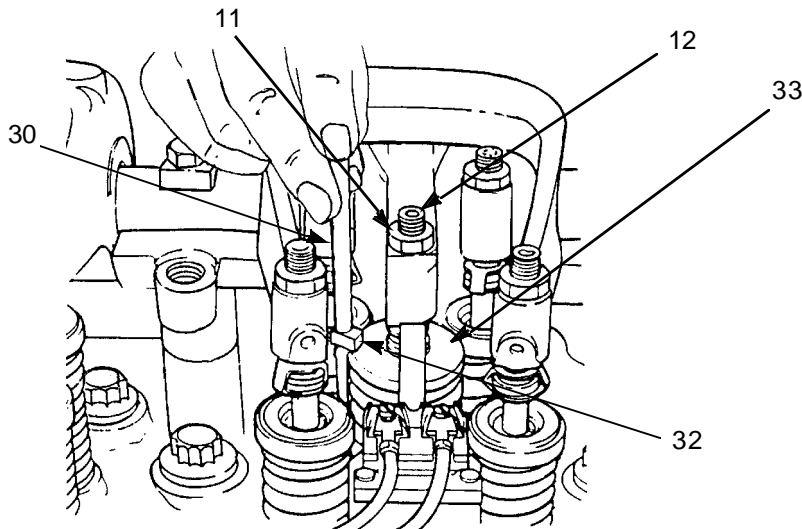
- i. Adjust height of fuel injector (29) for cylinder indicated on valve overlap adjustment sequence Table 1. Position small end of injector timing height gage (30) in hole in fuel injector body (31) with flag (32) of gage toward fuel injector plunger (33), as shown.



342-721

ADJUSTMENT - CONTINUED

- j. Loosen jamnut (11) and turn adjusting screw (12) until flag (32) of injector timing height gage (30) just clears top of fuel injector plunger (33). An accurate feel will be developed. Adjust all injectors to the same feel.
- k. Tighten jamnut (11) to 30-35 lb-ft (41-47 Nm). Check adjustment with injector timing height gage (30) and, if necessary, readjust.
- l. Remove injector timing height gage (30).



342-722

- m. Refer to adjusting sequence, Table 1, and proceed to next cylinder in adjustment sequence.
 - n. Bar engine over in direction of normal rotation until next cylinder in adjustment sequence is in its valve overlap period.
 - o. Repeat valve adjustment and fuel injector height adjustment procedures until all valves and injectors have been adjusted.
2. Install engine retarder (WP 0022 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Cleaning, Inspection, Repair, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Dispenser, sealant (Item 30, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Gasket (P/N 8929102)

O-ring (P/N 2-223V747-75)

Compound, gasket forming (Item 12, WP 0125 00)

Compound, sealing, pipe (Item 18, WP 0125 00)

Personnel Required

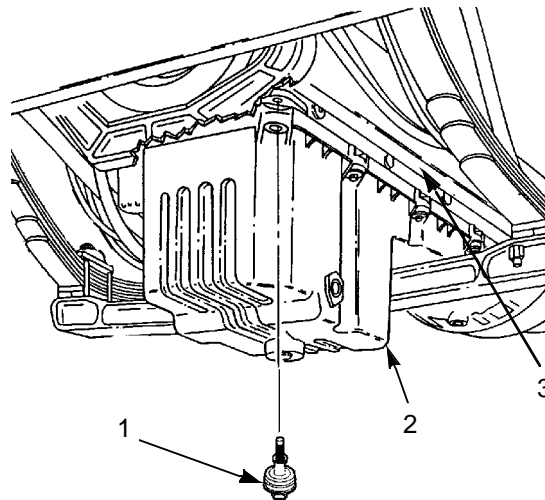
Two

Equipment Condition

Engine oil drained (TM 9-2320-302-20)

REMOVAL

1. Remove ten bolt assemblies (1) securing oil pan (2) to cylinder block (3).



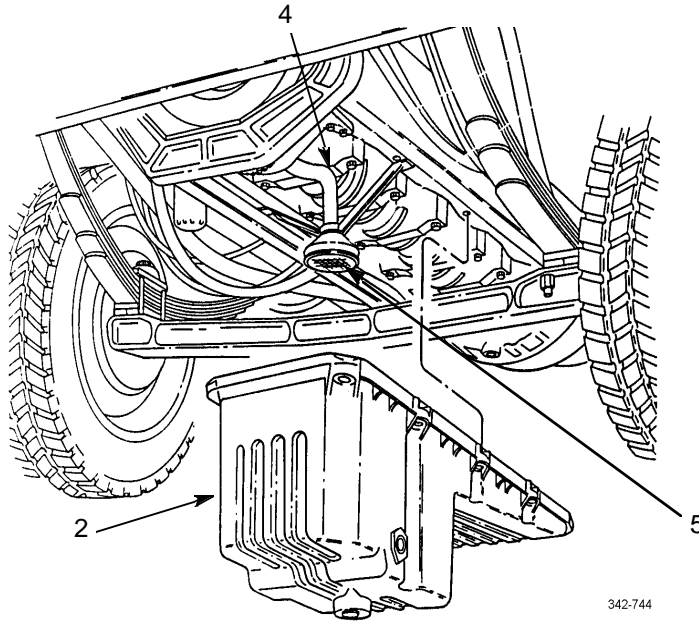
342-743

REMOVAL - CONTINUED

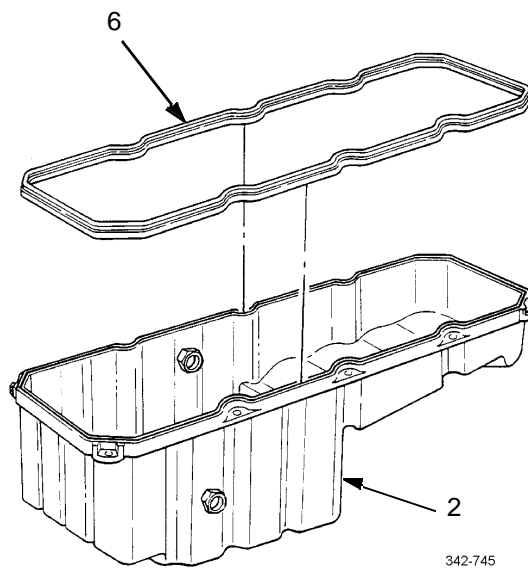
CAUTION

Handle oil pan with care. Dropping or bumping could cause damage.

2. Remove oil pan (2) carefully to avoid damage to oil pump pickup tube (4) and screen assembly (5).



3. Remove oil pan gasket (6) from oil pan (2). Discard gasket.



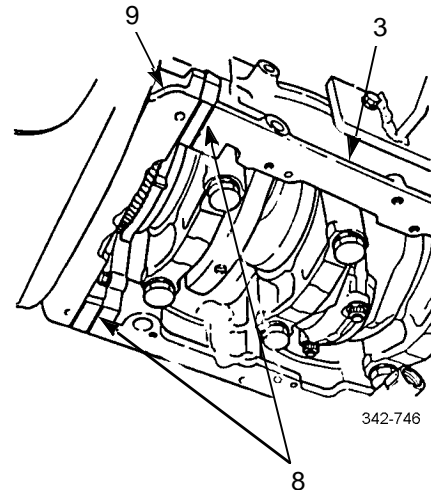
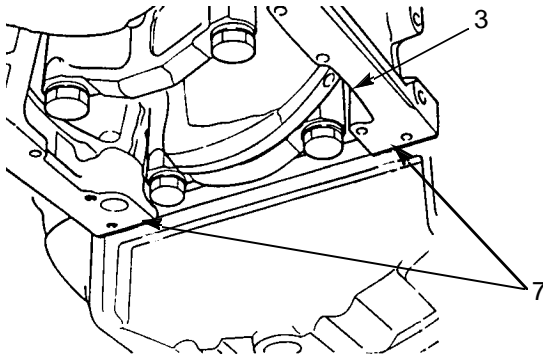
CLEANING**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

CAUTION

Do not use solvents or petroleum distillates to clean components. To do so could result in damage to equipment.

1. Clean bolt assemblies, oil pan, and oil pan gasket surfaces with detergent and water. Dry with compressed air.
2. Remove gasket forming compound from pan rail joint faces of flywheel housing (7), gear housing (8), gear case cover (9), and cylinder block (3) where contact is made with oil pan gasket.



3. Ensure all old gasket forming compound is removed from sealing surfaces.

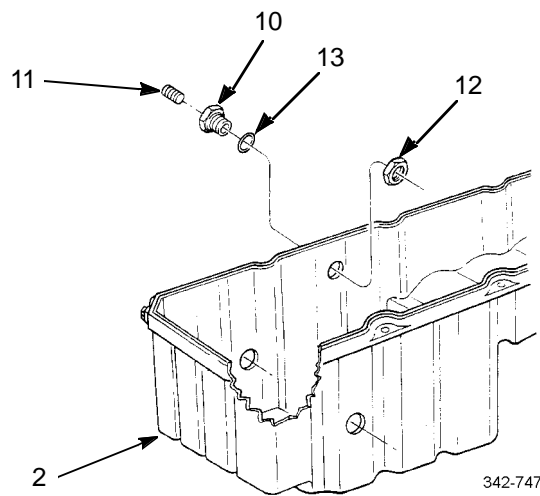
INSPECTION

1. Inspect bolt assembly isolators for dryness, cracks or tears. Replace as necessary.
2. Check oil pan for damage. Replace or repair as necessary.
3. Ensure oil pump pickup tube and screen assembly are not damaged.

REPAIR**CAUTION**

Hold insert to prevent scoring of plastic oil pan. Failure to prevent insert from slipping during removal could cause damage and result in equipment failure.

1. Hold flats of insert (10) to prevent slippage and remove pipe plug (11).
2. Remove nut (12), insert (10), and o-ring (13) from oil pan (2). Discard o-ring.



3. Install new o-ring (13) on flange of insert (10) and install insert in oil pan (2).

CAUTION

Hold insert to prevent scoring of plastic oil pan. Failure to prevent insert from spinning during installation could cause damage and result in equipment failure.

4. Hold insert (10) and install nut (12). Tighten nut to 136-145 lb-ft (184-197 Nm).



Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water.

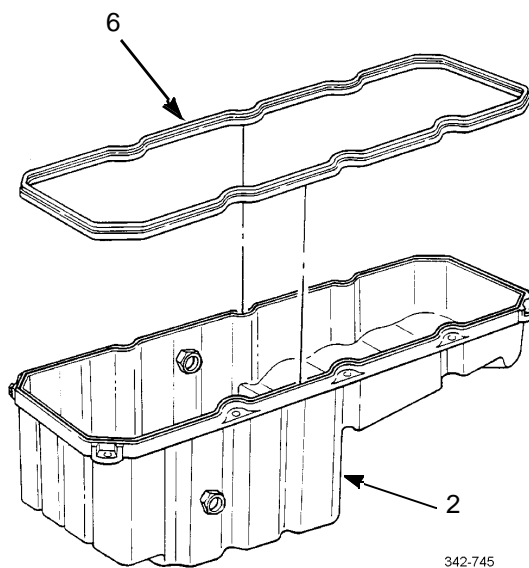
5. Coat threads of pipe plug (11) with pipe sealing compound and install pipe plug in insert (10). Hold insert while tightening pipe plug.

INSTALLATION

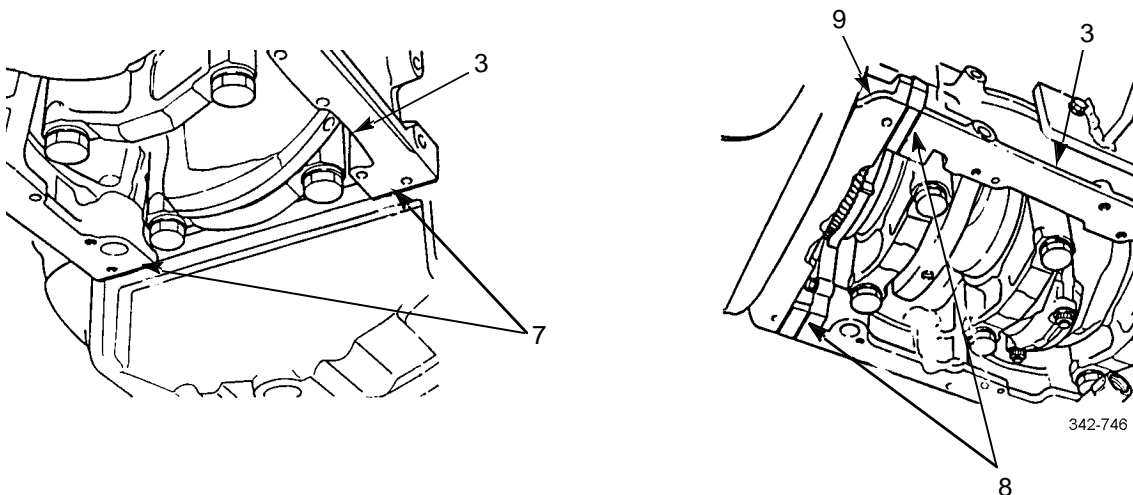
NOTE

To ease installation of oil pan gasket, use a soapy water solution on gasket prior to installing in groove of oil pan.

1. Place new oil pan gasket (6) on oil pan (2) with gasket lip toward oil pan groove.
2. Press oil pan gasket (6) completely down into groove at each corner of oil pan (2). Repeat at points midway between corners, halving distance between installed sections until oil pan gasket is completely installed.



3. Apply a thin bead of gasket forming compound to pan rail, joint faces of flywheel housing (7), gear housing (8), gear case cover (9), and cylinder block (3).

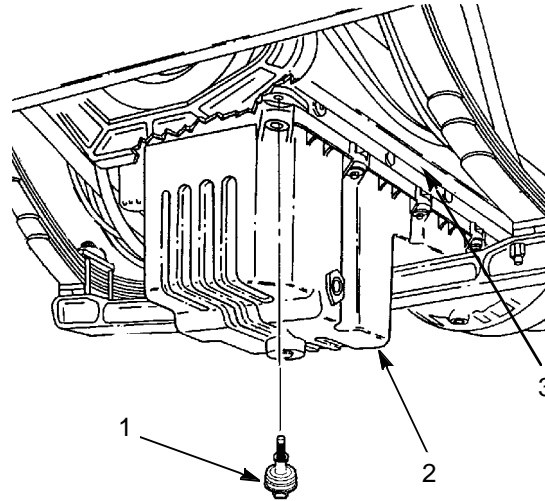


INSTALLATION - CONTINUED

CAUTION

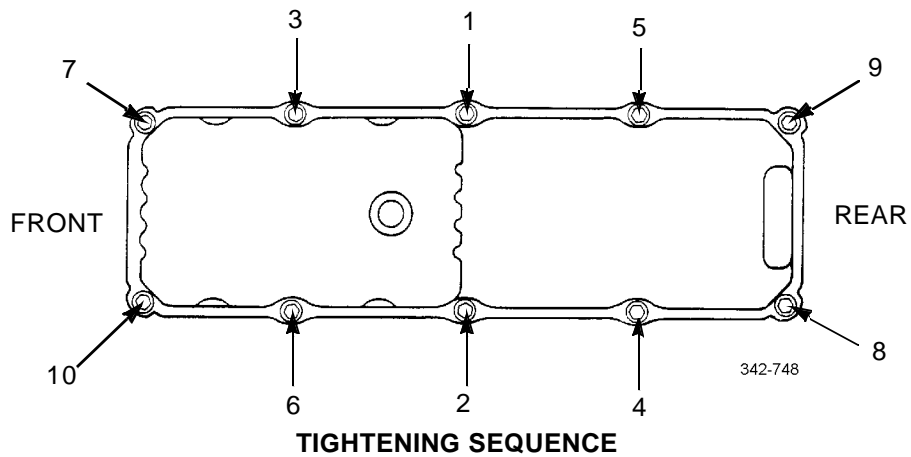
Handle oil pan with care. Dropping or bumping could cause damage.

4. Position oil pan (2) on cylinder block (3) and install ten bolt assemblies (1) hand tight.



342-743

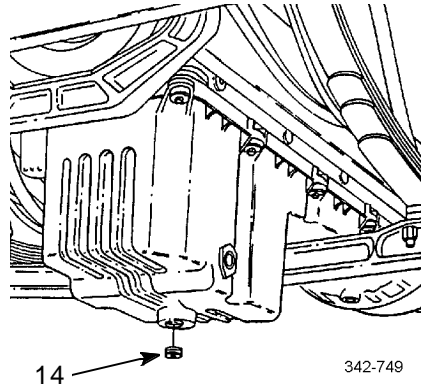
5. Tighten ten bolt assemblies (1) to 18-22 lb-ft (25-30 Nm), in sequence shown.



342-748

INSTALLATION - CONTINUED

6. Install oil pan drain plug (14) and tighten to 33-41 lb-ft (45-56 Nm).



7. Replace engine oil (TM 9-2320-302-20) and check for leaks.

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Disassembly, Inspection, Assembly, Installation

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Caps, vise jaw (Item 17, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Press, arbor (Item 90, WP 0126 00)
- Puller kit, universal (Item 97, WP 0126 00)
- Vise, machinist's (Item 136, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Plate, cover (WP 0122 00)

Materials/Parts

- Gasket (P/N 23505992)
- Nut, lock (P/N 11502812)
- Ring, seal (P/N 23505891)
- Ring, seal (P/N 23505892)
- Lubriplate (Item 23, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)

References

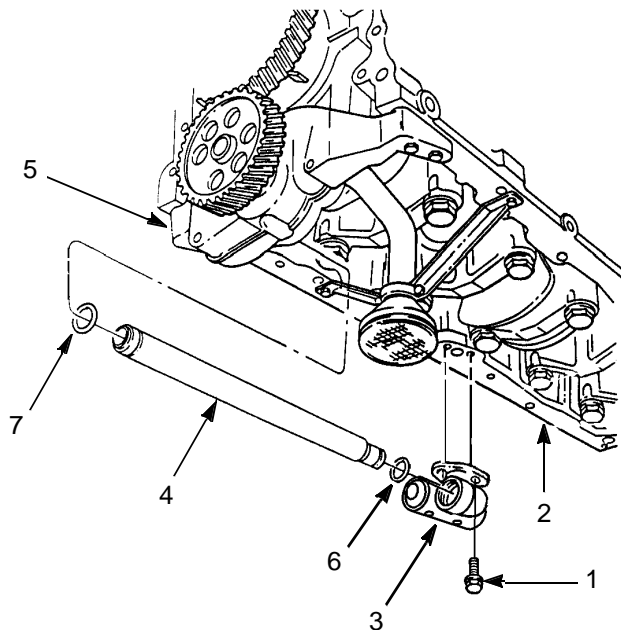
TM 9-237

Equipment Condition

Oil pan removed (WP 0028 00)

REMOVAL

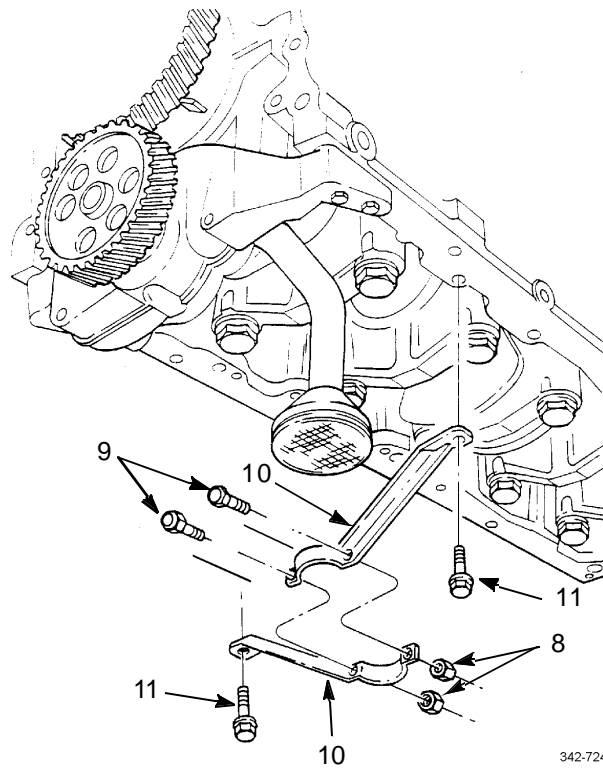
1. Remove two bolts (1) from cylinder block (2).
2. Remove oil pressure relief valve outlet tube elbow assembly (3) and oil outlet tube (4) from oil pump assembly (5).
3. Remove oil outlet tube (4) from tube elbow assembly (3).
4. Remove and discard two seal rings (6 and 7).



342-723

REMOVAL - CONTINUED

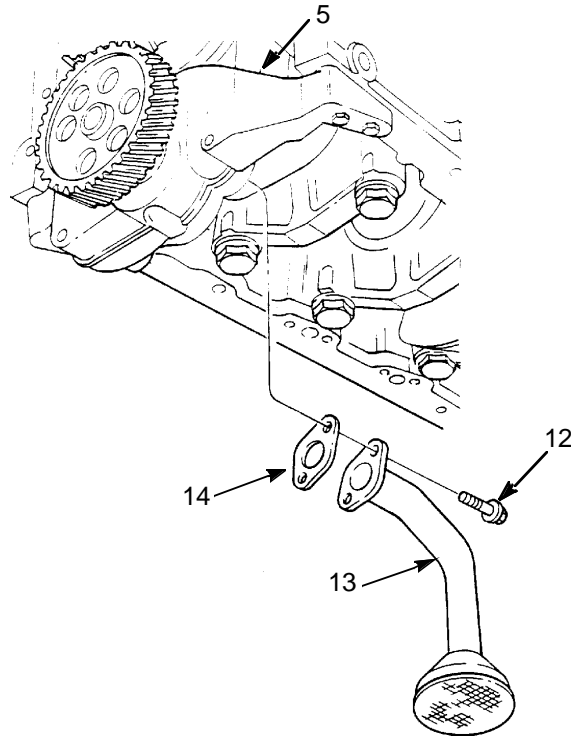
5. Remove two lock nuts (8) and two bolts (9) from inlet oil tube bracket halves (10). Discard lock nuts.
6. Remove two bolts (11) and inlet oil tube bracket halves (10) from cylinder block (2).

**CAUTION**

Oil pump must be adequately supported to prevent pump from dropping when retaining bolts are removed.

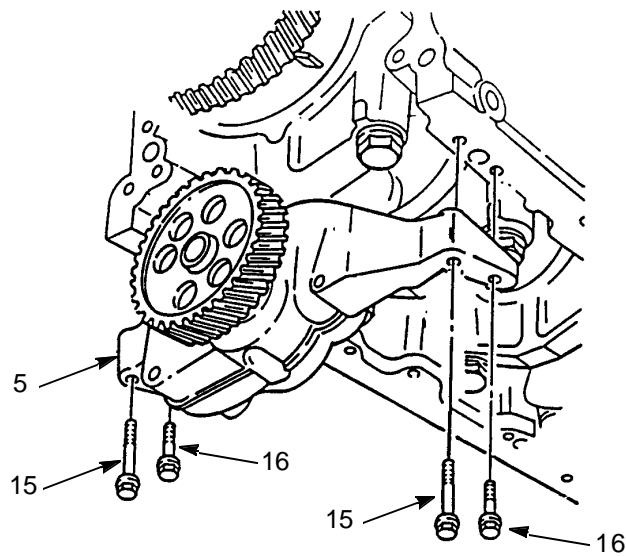
7. Remove two bolts (12), oil inlet tube (13), and gasket (14) from oil pump assembly (5). Discard gasket.

REMOVAL - CONTINUED



342-725

8. Remove two long bolts (15), two short bolts (16), and oil pump assembly (5).



342-726

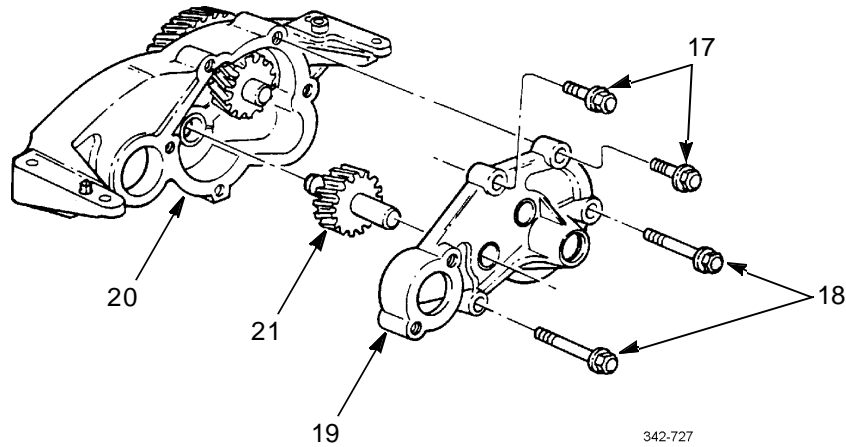
DISASSEMBLY

1. Remove two short bolts (17) and two long bolts (18) from oil pump cover (19) and oil pump body (20).

CAUTION

Use care when removing oil pump cover to prevent damage to equipment. Oil pump driven gear and shaft assembly is retained in oil pump assembly only by cover.

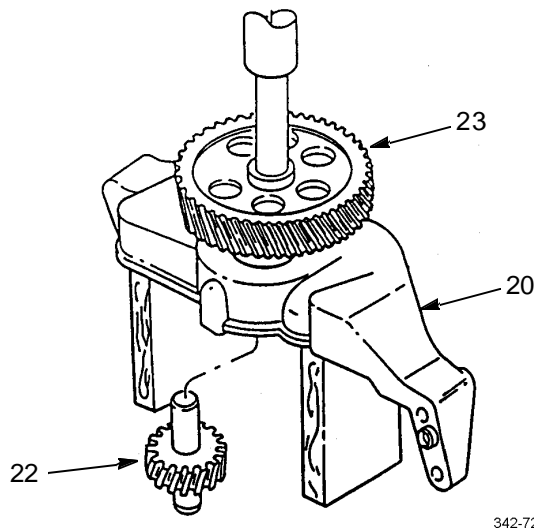
2. Remove oil pump cover (19) and oil pump driven gear and shaft assembly (21) from oil pump body (20).



CAUTION

Do not allow press support to interfere with oil pump drive gear and shaft assembly being pressed out. To do so will result in damage to shaft assembly.

3. Place oil pump body (20), pump cover side down, on press support. Press oil pump drive gear and shaft assembly (22) from oil pump drive gear (23).
4. Remove oil pump drive gear (23) from oil pump body (20).

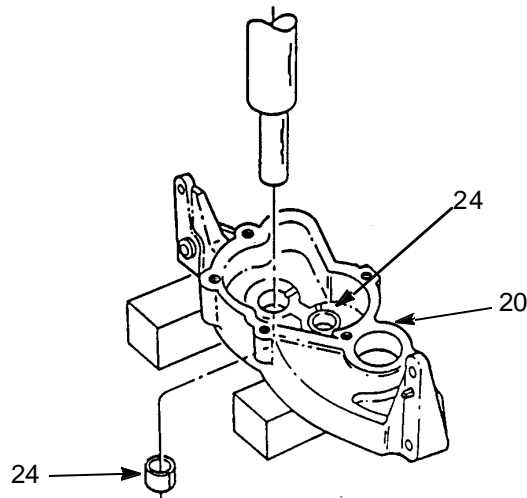


DISASSEMBLY - CONTINUED

NOTE

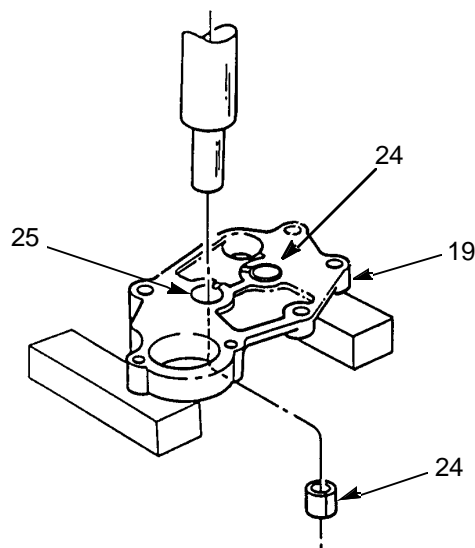
When one or more bushings require replacing, replace all bushings in pump body and pump cover.

5. If bushings are damaged or worn, place oil pump body (20), pump cover side up, on press support. Press two bushings (24) from pump body.



342-729

6. Place oil pump cover (19), pump body side up, on press support. Press out two bushings (24) from bushing bores (25).



342-730

CAUTION

Extreme care should be taken to protect surfaces of mounting legs from electric arc welding slag. Use fabricated protective plate for this purpose. Failure to do so could result in damage to surfaces of mounting legs.

DISASSEMBLY - CONTINUED

NOTE

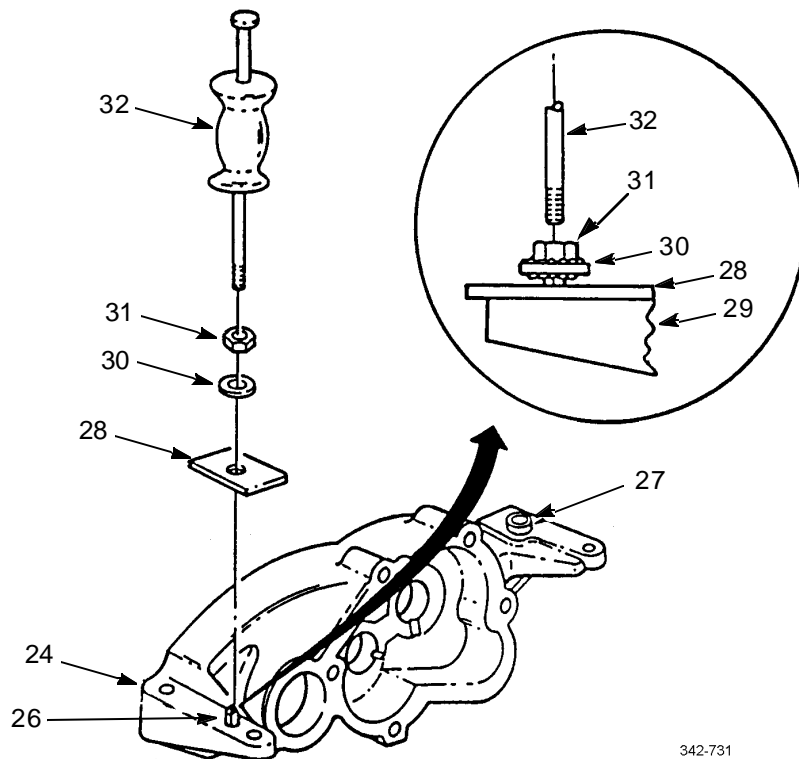
Two steel locating dowels (one solid diamond-shaped dowel and one tubular-shaped dowel) installed on pump body mounting legs are pressed in bores to specified depths. Both dowels are extremely durable and should never need to be replaced.

7. If removal of either dowel (26 or 27) is required, place protective plate (28) on smooth surface of mounting leg (29) over dowel to be removed. Tack weld washer (30) and nut (31) to dowel.

NOTE

Secure pump body in soft-jawed vise with machined (smooth) surfaces of mounting legs facing up.

8. Attach slide hammer (32) to welded nut (31) on dowel (26 or 27) being removed, and apply short upward shocking actions until dowel is freed from bore. Discard dowel with welded nut and washer.



342-731

INSPECTION

1. Inspect all parts for wear or damage.
2. Discard pump body or pump cover if cracked or if evidence of spun bushings on bushing bores is visible.
3. Inspect bushings in pump body and cover. Shaft-to-pump body bushing clearance with new parts is 0.0016-0.0024 in (0.04-0.06 mm). Maximum allowable shaft-to-pump cover bushing clearance with used parts is 0.0035 in (0.089 mm).

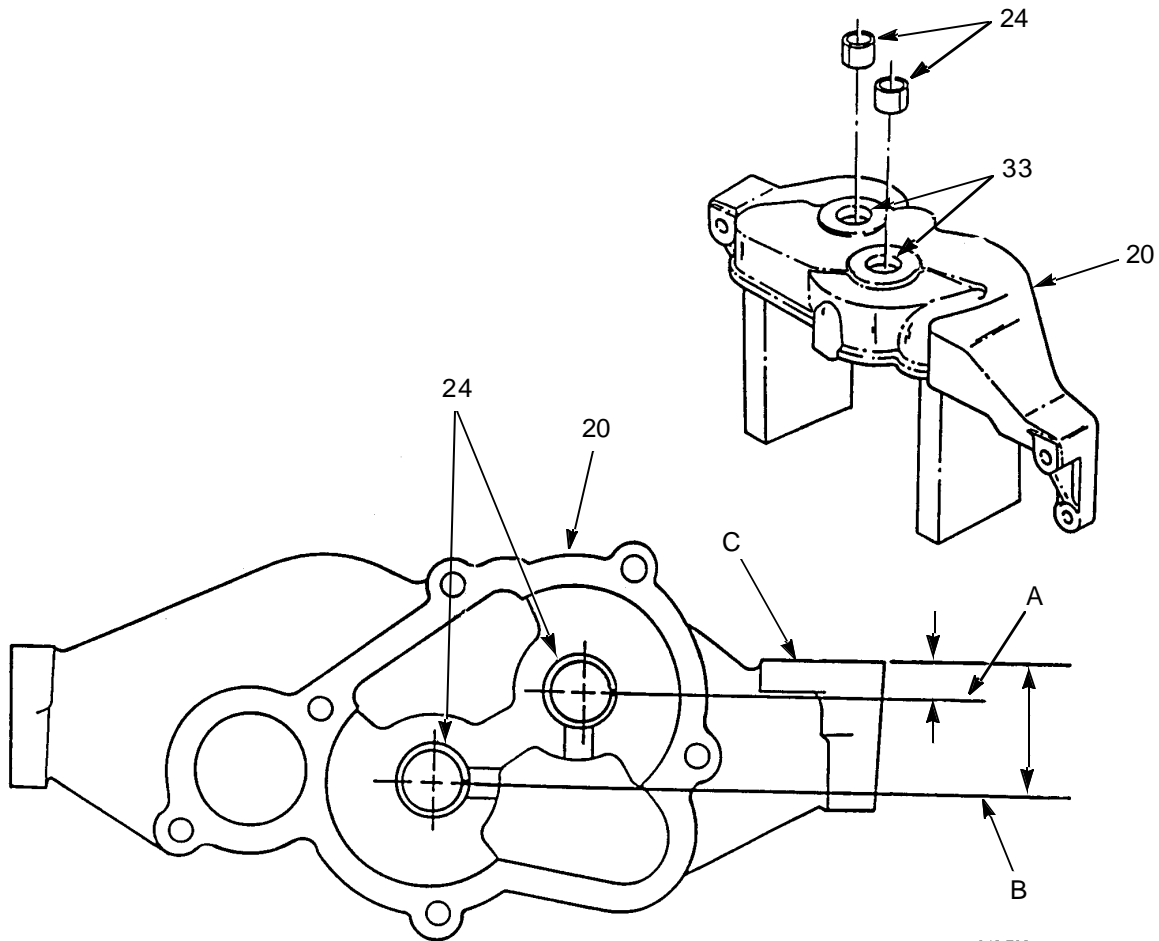
ASSEMBLY

1. Place oil pump body (20), cover side down, on press support.
2. Apply a thin film of lubriplate to bushing bores (33).
3. Position bushings (24) loosely over pump body bushing bores (33).
4. Rotate bushings (24) so split lines (A and B) are parallel with machined surface (C) of pump body (20).
5. When properly aligned, split line (A) should measure 0.461in (11.709 mm) to surface (C). Split line (B) should measure 1.726 in (43.84 mm) to surface (C).

NOTE

Bushings must be installed flush to specified depth below finished surface of pump body.

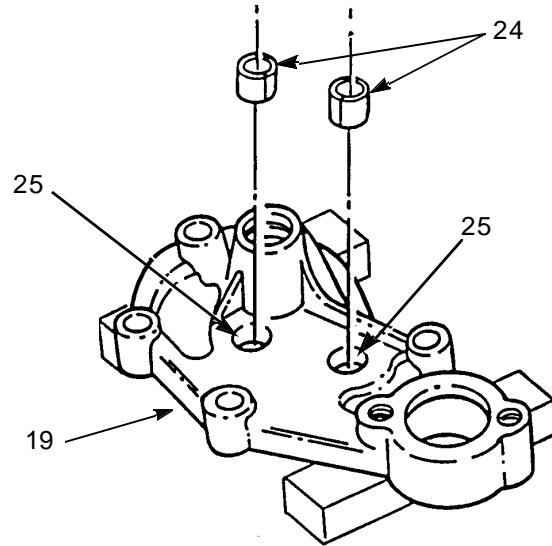
6. Press bushings (24) in pump body bushing bores (33) not more than 0.031 in (0.78 mm) below finished surface of oil pump body (20).



342-732

ASSEMBLY - CONTINUED

7. Place oil pump cover (19), pump body side down, on press support. Apply thin film of lubriplate to bushing bores (25).
8. Position bushings (24) loosely over bushing bores (25).



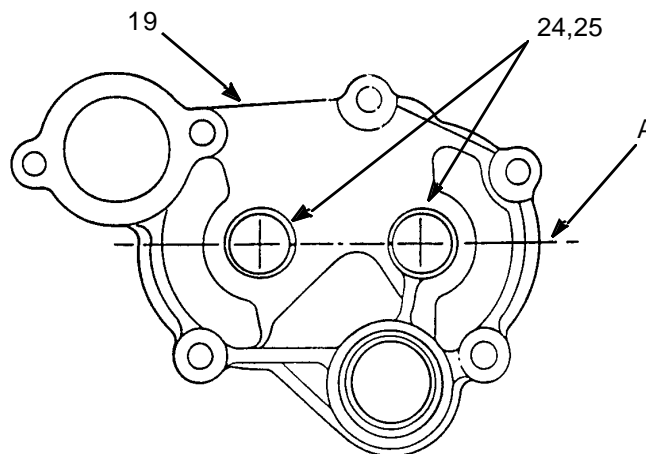
342-733

9. Rotate bushings (24) so split lines (A) are aligned in pump cover bushing bores (25) as shown.

NOTE

Bushings must be installed to specified depths below finished surface of oil pump cover.

10. Press bushings (24) in pump cover bushing bores (25) 0.011-0.031 in (0.28-0.78 mm) below finished surface of oil pump cover (19).



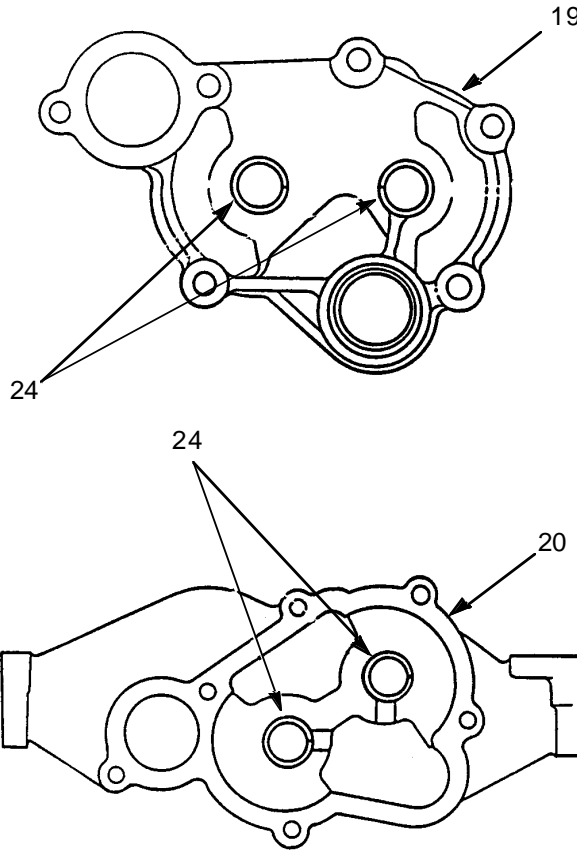
342-734

NOTE

Pump body and pump cover bushings are finished to size after installation in their respective bores. Use single point tooling to avoid smearing oil retention surfaces.

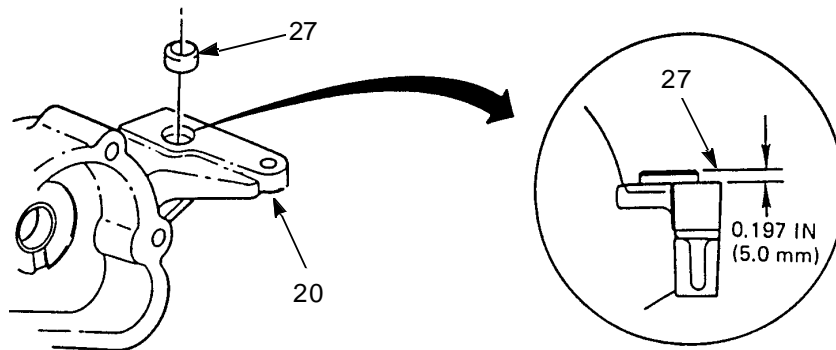
ASSEMBLY - CONTINUED

11. Bore out inside diameter of bushings (24) in oil pump body (20) and oil pump cover (19) to 0.879-0.880 in (22.33-22.35 mm).



342-735

12. If removed, install tubular-shaped dowel (27) in bore of pump body (20) mounting surface. Top of dowel should be 0.197 in (5.0 mm) from mounting surface when properly seated in bore.



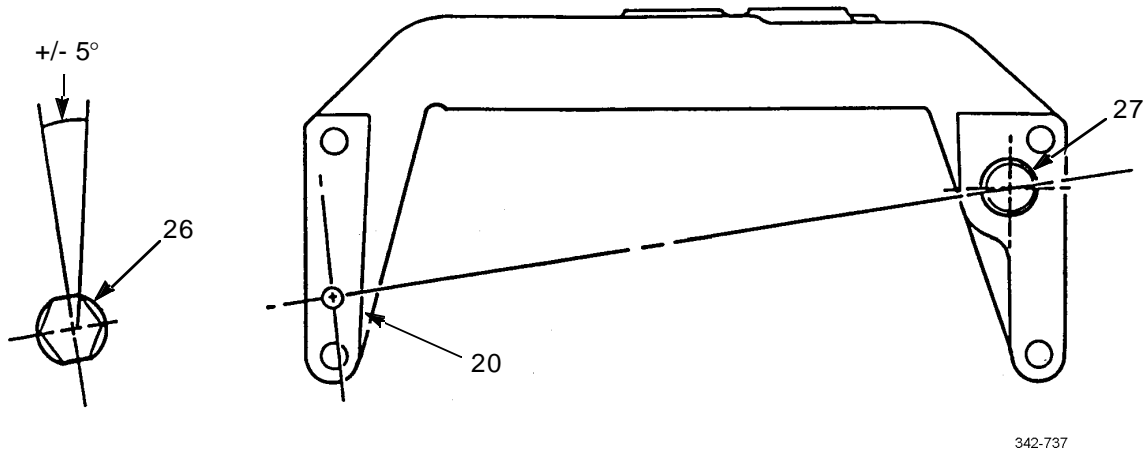
342-736

ASSEMBLY - CONTINUED

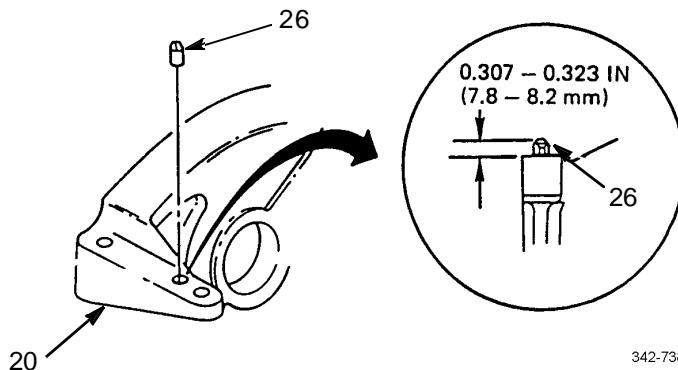
NOTE

Diamond-shaped dowel must be oriented in relation to tubular-shaped dowel before installing in pump body mounting surface.

13. If removed, loosely place diamond-shaped dowel (26) in bore of pump body (20) mounting surface so that angular orientation is perpendicular to center line through tubular-shaped dowel (27) within 5 degrees.



14. Install diamond-shaped dowel (26) in bore of pump body (20) mounting surface. Top of diamond-shaped dowel should be 0.307-0.323 in (7.8-8.2 mm) above surface when properly seated in bore.

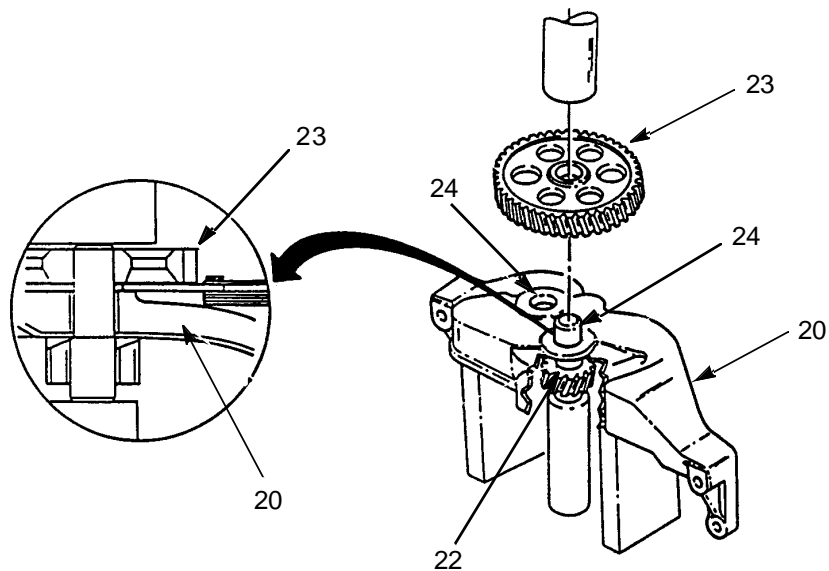


15. Place oil pump body (20), with cover side down, on press support. Lubricate two bushings (24) with clean engine lubricating oil.
16. Apply a thin film of lubriplate to bore of oil pump drive gear (23).
17. Install longer end of internal oil pump drive gear and shaft assembly (22) in right side bushing as view from top rear.

ASSEMBLY - CONTINUED**CAUTION**

- Minimum press force of 1515 lb (7.0 kN) must be obtained to press oil pump drive gear onto oil pump drive gear and shaft assembly, to prevent equipment damage.
- Balance holes in drive gear rim must face pump body to avoid possibility of installing drive gear backwards.

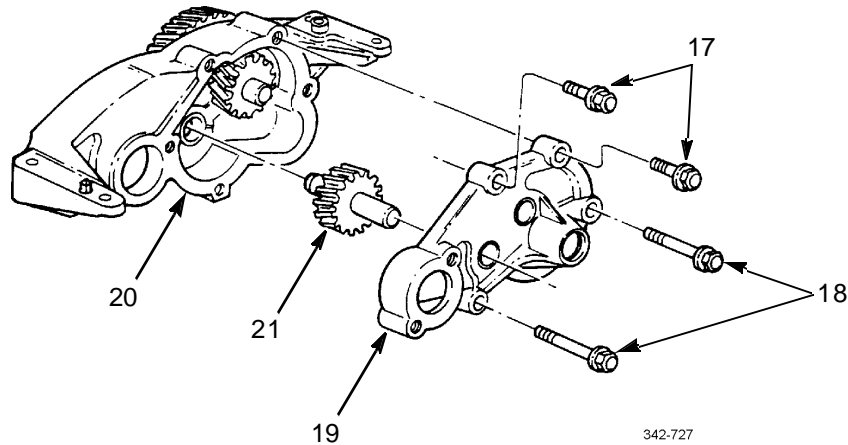
18. Place end of internal oil pump drive gear and shaft assembly (22) on press support. Press oil pump drive gear (23) on oil pump drive gear and shaft assembly. Using feeler gage, ensure that clearance of 0.033-0.044 in (0.84-1.12 mm) is obtained between oil pump drive gear and oil pump body (20).



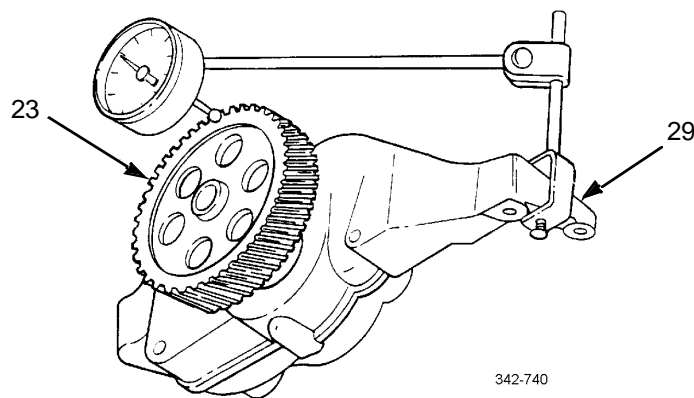
342-739

ASSEMBLY - CONTINUED

19. Install shorter end of oil pump driven gear and shaft assembly (21) in left side bushing in oil pump body (20) as viewed from top rear.
20. Lubricate bushings (24) in oil pump cover (19) with light engine lubricating oil.
21. Install oil pump cover (19) on oil pump body (20).
22. Install two shorter bolts (17) in upper two bolt holes and two longer bolts (18) in lower two bolt holes in oil pump cover (19). Tighten bolts to 22-28 lb-ft (30-38 Nm) in crisscross pattern.



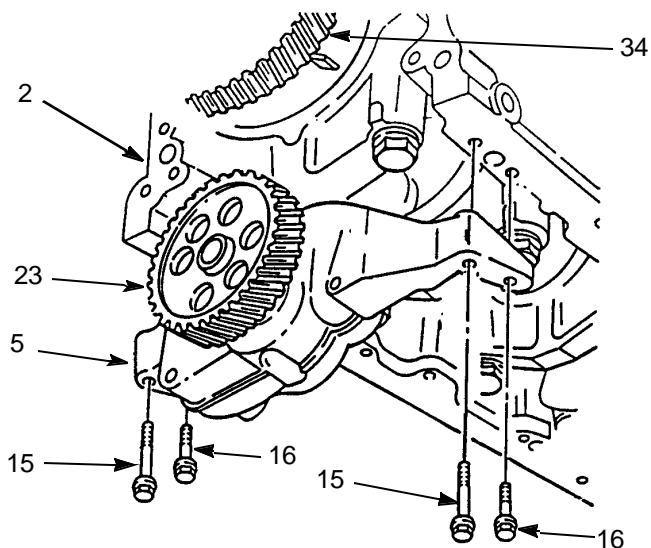
23. Mount dial indicator on machined surface of right side oil pump body mounting leg (29) or on other suitable clamping surface.
24. Measure gear face runout just inboard of oil pump drive gear (23) teeth while rotating gear by hand. Gear face runout must not exceed 0.003 in (0.076 mm). If gear face runout exceeds limits, replace gear.



INSTALLATION

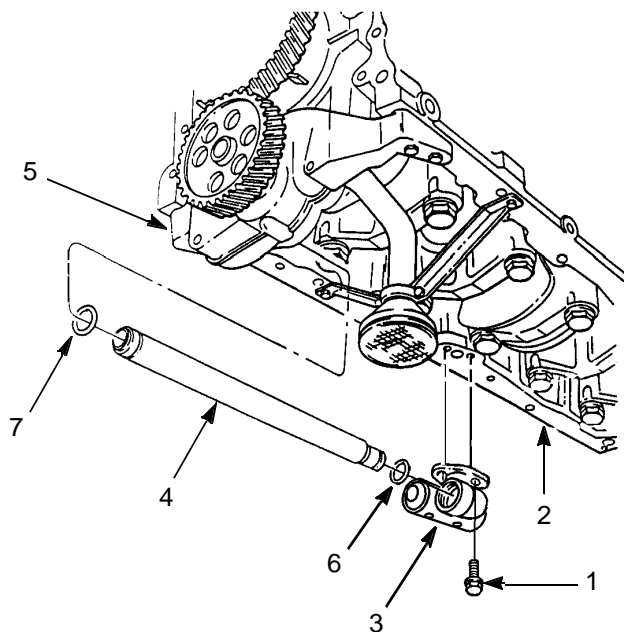
1. Position oil pump assembly (5) on cylinder block (2) with oil pump drive gear (23) engaged with crankshaft gear (34). Ensure tubular-shaped dowel and diamond-shaped dowel are fully seated in cylinder block.
2. Install two long bolts (15) in front bolt holes and two short bolts (16) in rear bolt holes in oil pump assembly (5). Tighten bolts to 43-54 lb-ft (58-73 Nm) in crisscross pattern.

INSTALLATION - CONTINUED



342-726

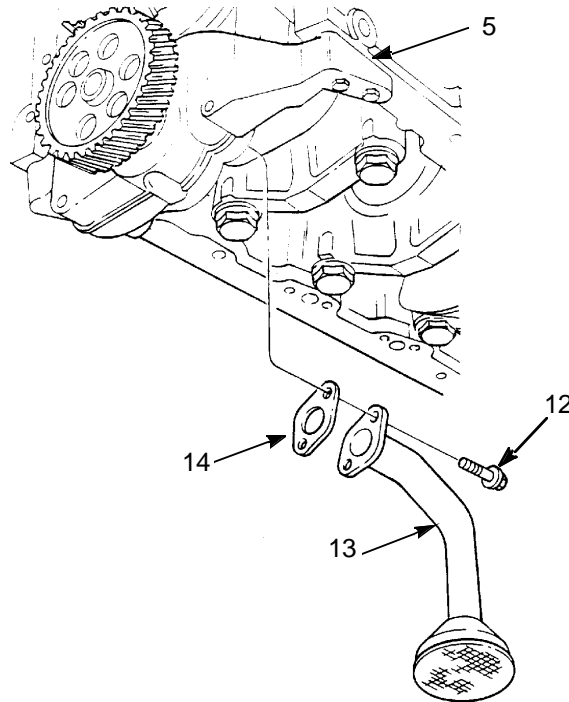
3. Coat two new seal rings (6 and 7) with light engine lubricating oil. Install smaller seal ring (6) on elbow end of oil outlet tube (4). Install larger seal ring (7) on pump end of oil outlet tube.
4. Install larger diameter end of oil outlet tube (4) in outlet neck of oil pump assembly (5) until oil outlet tube bottoms in bore.
5. Install smaller diameter end of oil outlet tube (4) in oil relief valve outlet tube elbow assembly (3) until oil outlet tube bottoms in bore.
6. Position oil pressure relief valve outlet tube elbow assembly (3) on cylinder block (2). Install two bolts (1) and tighten to 22-24 lb-ft (30-33 Nm).



342-723

INSTALLATION - CONTINUED

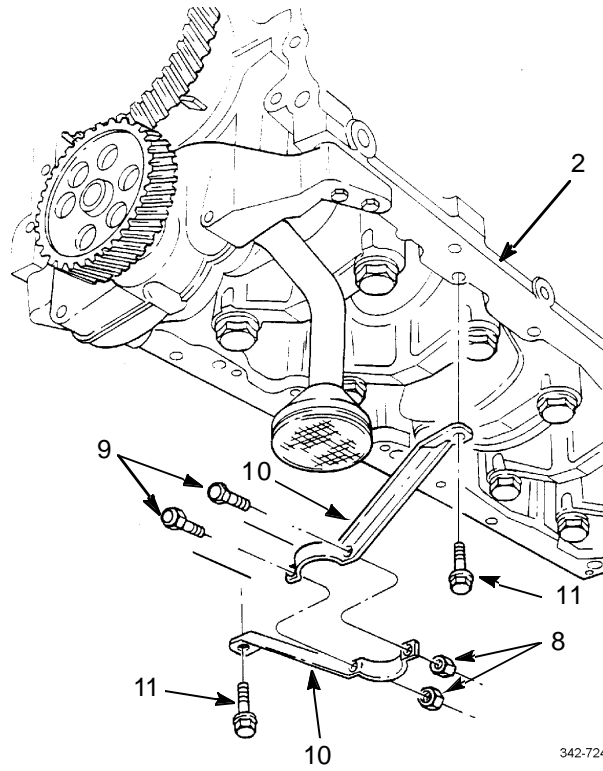
7. Install new gasket (14) and oil inlet tube (13) on oil pump assembly (5). Install two bolts (12) and tighten to 22-24 lb-ft (30-33 Nm).



342-725

8. Install two oil inlet tube bracket halves (10) and bolts (11) on cylinder block (2). Tighten bolts to 43-54 lb-ft (58-73 Nm).
9. Install two bolts (9) and new lock nuts (8) on oil inlet tube bracket halves (10). Tighten bolts to 43-54 lb-ft (58-73 Nm).

INSTALLATION - CONTINUED



342-724

INSTALLATION - CONTINUED**NOTE**

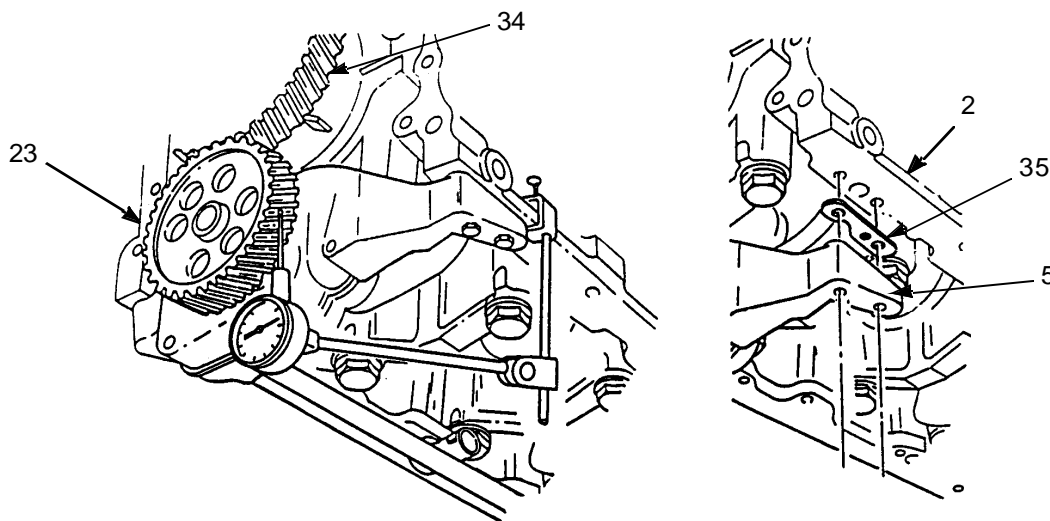
Gear lash measurements between crankshaft gear and oil pump drive gear must be taken with engine in running position.

10. With dial indicator tip resting on tooth of oil pump drive gear (23), measure gear lash between oil pump drive gear and crankshaft drive gear (34). Gear lash should be 0.002-0.009 in (0.051-0.229 mm).
11. If gear lash is not within specifications, perform oil pump removal steps 1 through 8.

NOTE

Same number of shims must be installed under each oil pump mounting leg so that oil pump will always be level on engine block.

12. Install required amount of shims (35) between oil pump assembly (5) and cylinder block (2).
13. Repeat installation steps 1 through 10 to reinstall oil pump assembly (5) and verify gear lash.



342-740

14. Install oil pan (WP 0028 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Oil Pressure Regulator Valve Replacement, Oil Pressure Relief Valve Replacement

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Ring, seal (P/N 23505891)

Materials/Parts - Continued

Ring, seal (P/N 23505892)

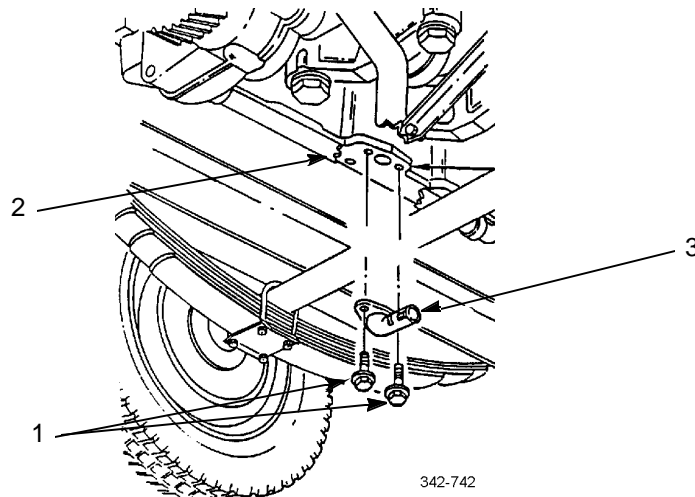
Oil, lubricating (Item 25, WP 0125 00)

Equipment Condition

Oil pan removed (WP 0028 00)

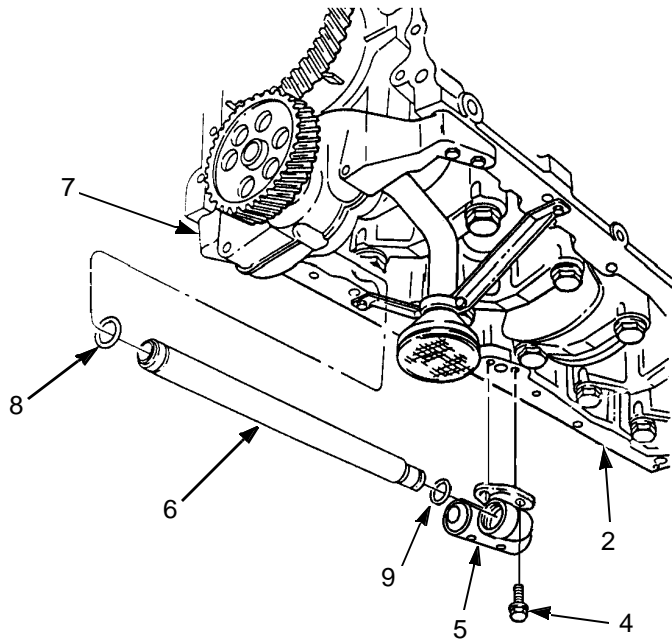
OIL PRESSURE REGULATOR VALVE REPLACEMENT

1. Remove two bolts (1) from cylinder block (2).
2. Remove oil pressure regulator valve (3).
3. Position oil pressure regulator valve (3) on cylinder block (2).
4. Install two bolts (1) and tighten to 22-28 lb-ft (30-38 Nm).
5. Install oil pan (WP 0028 00).



OIL PRESSURE RELIEF VALVE REPLACEMENT

1. Remove two bolts (4) from cylinder block (2).
2. Remove oil pressure relief valve outlet tube elbow assembly (5) from oil outlet tube (6) and remove oil outlet tube from oil pump assembly (7).
3. Remove and discard two seal rings (8 and 9).



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4. Coat two new seal rings (8 and 9) with clean engine lubricating oil.
5. Install smaller seal ring (8) on oil pressure relief valve elbow assembly (5) end of oil outlet tube (6). Install larger seal ring (9) on oil pump end of oil outlet tube.
6. Install larger diameter end of oil outlet tube (6) in outlet neck of oil pump assembly (7) until oil outlet tube bottoms in bore.
7. Install oil pressure relief valve outlet tube elbow assembly (5) on smaller diameter end of oil outlet tube (6) until tube bottoms in bore.
8. Position oil pressure relief valve outlet tube elbow assembly (5) on cylinder block (2).
9. Install two bolts (4) and tighten to 22-24 lb-ft (30-33 Nm).
10. Install oil pan (WP 0028 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Insertor, seal (Item 50, WP 0126 00)

Remover, seal (Item 101, WP 0126 00)

Materials/Parts

Seal (P/N 23518355)

Cloth, abrasive (Item 9, WP 0125 00)

Oil, lubricating (Item 25, WP 0125 00)

Equipment Condition

Vibration damper removed (WP 0020 00)

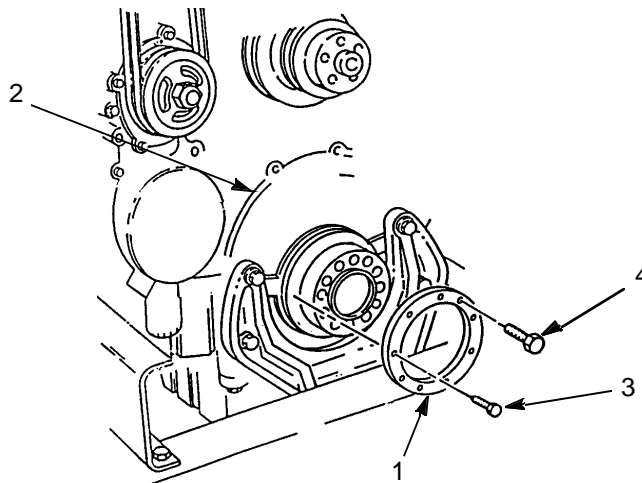
REMOVAL

1. Install seal remover (1) over end of crankshaft and against gear case cover (2). Install six self-tapping screws (3).
2. Install three bolts (4) in seal remover (1) until bolts contact gear case cover (2).

NOTE

If self-tapping screws strip out of seal case, remove six self-tapping screws and three bolts. Rotate seal remover one-half distance between existing screw holes in seal case and repeat steps 1 and 2.

3. Work clockwise and turn three bolts (4), one at a time, one full turn until oil seal is removed. Discard oil seal.



342-750

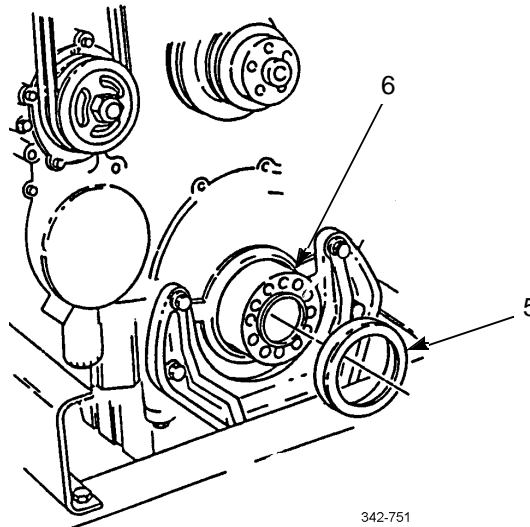
INSPECTION**NOTE**

Minor wear line on crankshaft surface should be evident where contact was made with oil seal. This is normal.

1. Inspect oil seal contact surface of crankshaft for dirt, burrs or rough surfaces.
2. If necessary, clean crankshaft surface with abrasive cloth.

INSTALLATION

1. Coat outside diameter of new oil seal (5) with a light film of clean engine lubricating oil.
2. Coat outside of crankshaft (6) with a light film of clean engine lubricating oil.

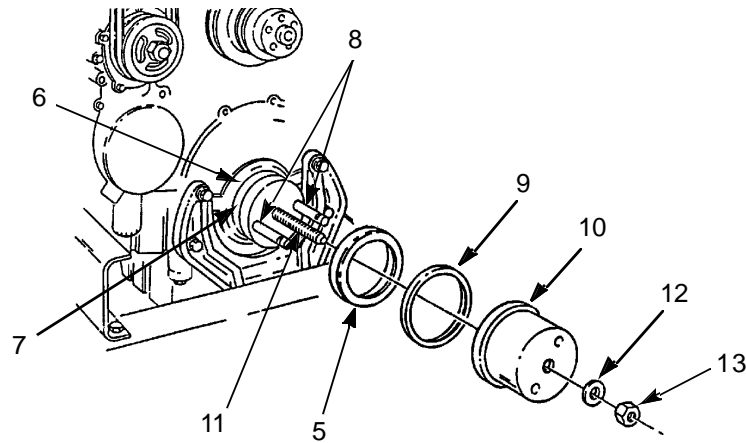
**NOTE**

Ensure butt end of crankshaft, both sides of seal inserter base, and inside of seal inserter housing are clean, smooth, and free of foreign material or damage.

3. Position seal inserter base (7) on front of crankshaft (6).
4. Install two guide studs (8) through two holes in seal inserter base (7) and into two crankshaft pulley/vibration damper mounting bolt holes, 180 degrees apart.
5. Hand tighten two guide studs (8) until seal inserter base (7) is tight against end of crankshaft (6).
6. Install oil seal (5) onto crankshaft (6) as far as it will go by hand.
7. Position seal inserter collar (9) against oil seal (5).
8. Install seal inserter housing (10) over center screw (11) of seal inserter base (7) and two guide studs (8), and against oil seal (5).
9. Install thrust bearing (12) on center screw (11) with case side of thrust bearing against seal inserter housing (10).
10. Install and tighten seal inserter nut (13) until inside surface of seal inserter housing (10) is firmly seated against seal inserter base (7).

INSTALLATION - CONTINUED

11. Remove seal inserter nut (13), thrust bearing (12), seal inserter housing (10), seal inserter collar (9), two guide studs (8), and seal inserter base (7).



342-752

12. Install vibration damper (WP 0020 00).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Disassembly, Cleaning and Inspection, Assembly

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Adapter, motor, hoist (Item 2, WP 0126 00)
- Bracket, engine mounting (Item 11, WP 0126 00)
- Clamp, material lift (Item 20, WP 0126 00)
- Compressor, spring (Item 23, WP 0126 00)
- Compressor, spring (Item 24, WP 0126 00)
- Compressor, spring (Item 25, WP 0126 00)
- Insert set, dowel (Item 55, WP 0126 00)
- Installer, valve guide (Item 69, WP 0126 00)
- Installer, valve stem seal (Item 70, WP 0126 00)
- Installer set, cup plug (Item 72, WP 0126 00)
- Reconditioning set (Item 100, WP 0126 00)
- Remover, valve guide (Item 102, WP 0126 00)
- Remover, valve seat (Item 103, WP 0126 00)
- Remover, valve seat (Item 104, WP 0126 00)
- Replacing tool, engine (Item 107, WP 0126 00)
- Replacing tool, engine (Item 108, WP 0126 00)
- Tester, cylinder (Item 124, WP 0126 00)

Tools and Special Tools - Continued

- Tester, spring resiliency (Item 128, WP 0126 00)
- Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

- Guide, valve (P/N 8929631) (24)
- Insert, exhaust valve (P/N 8929126) (12)
- Insert, intake valve (P/N 8929127) (12)
- Key, valve (P/N 0984-C) (48)
- Kit, exhaust valve (P/N 23507504) (12)
- Kit, intake valve (P/N 23501576) (12)
- Seal, guide (P/N 85.0691-9) (24)
- Adhesive, loctite (Item 3, WP 0125 00)
- Compound, sealing, pipe (Item 18, WP 0125 00)
- Oil, cutting (Item 24, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)
- Paste, Prussian blue (Item 28, WP 0125 00)
- Tags, marker (Item 35, WP 0125 00)

References

TM 9-237

Equipment Condition

Cylinder head removed (WP 0018 00)



WARNING



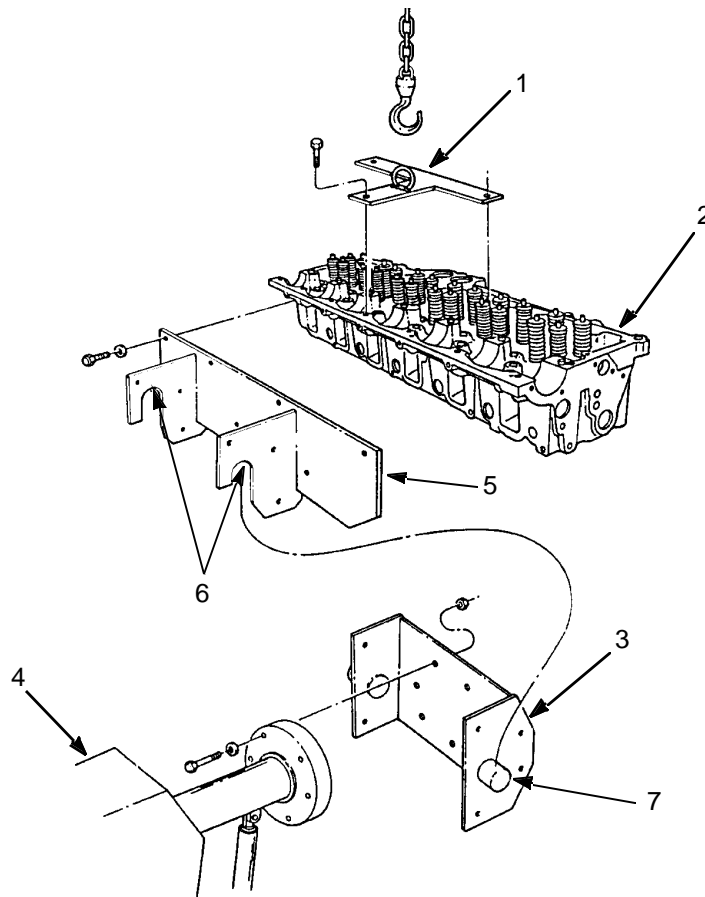
Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

NOTE

Remove and replace valves, valve springs, and valve guides as a matched set. Ensure removed valves, valve springs, and valve guides are installed in same position from which they were removed.

DISASSEMBLY

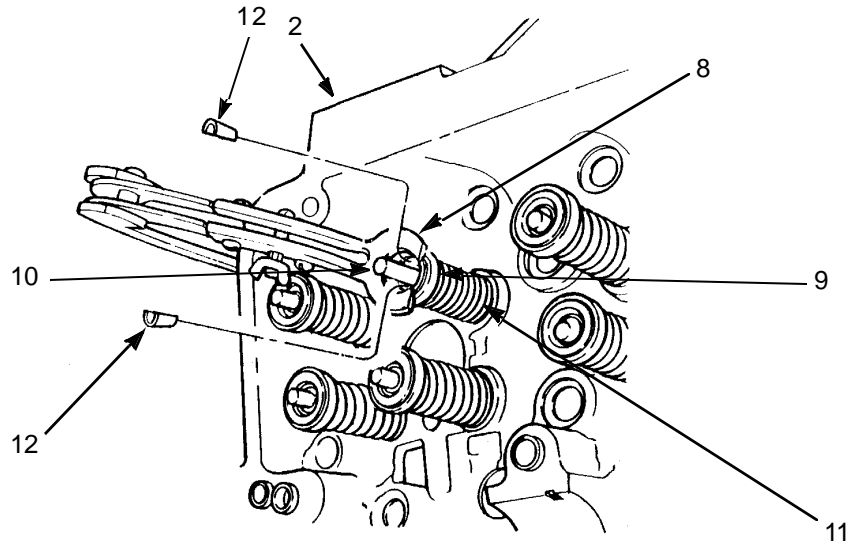
1. Using hardware provided with material lift clamp (1), install material lift clamp on cylinder head (2).
2. Using hardware provided with engine stand adapter plate (3), bolt plate to engine stand (4).
3. Using bolts provided with engine stand adapter plate (3), install engine mounting bracket (5) to cylinder head (2).
4. Using suitable lifting device, lift and mount cylinder head (2) and engine mounting bracket (5) to engine stand adapter plate (3) by engaging slots (6) in engine mounting bracket to dowels (7) on engine stand adapter plate.
5. Using six bolts and nuts provided with engine stand adapter plate (3), secure adapter plate and engine mounting bracket (5) together.
6. Remove material lift clamp (1).
7. Position cylinder head (2) in vertical position.



342-1002

8. With legs of valve spring compressor (8) jaw on valve rotator (9) surrounding stem of valve (10), and with bottom of spring compressor against face of valve, compress valve spring (11).
9. Remove and discard valve keys (12).

DISASSEMBLY - CONTINUED

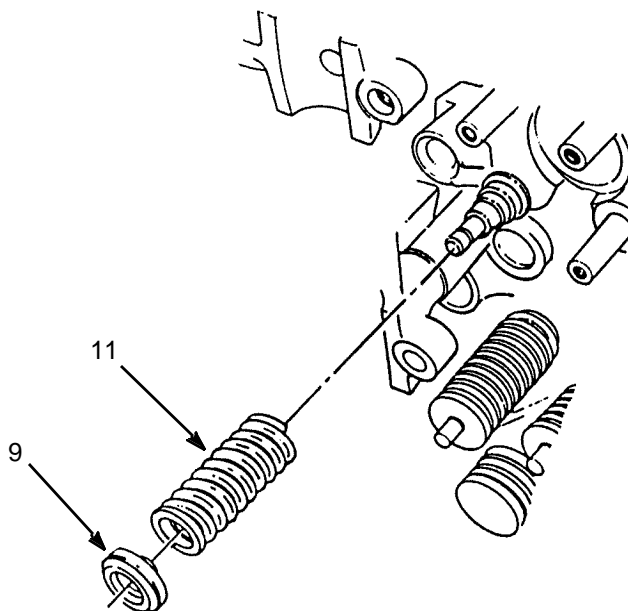


342-1003

NOTE

Tag parts prior to removal for possible reuse.

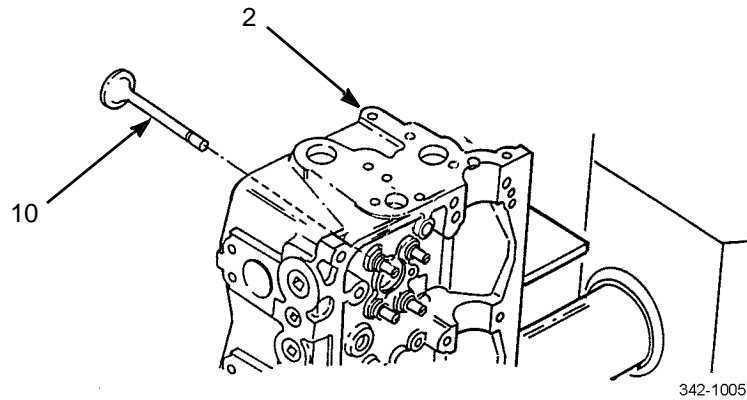
- 10. Release and remove valve spring compressor (8).
- 11. Remove valve rotator (9) and valve spring (11).



342-1004

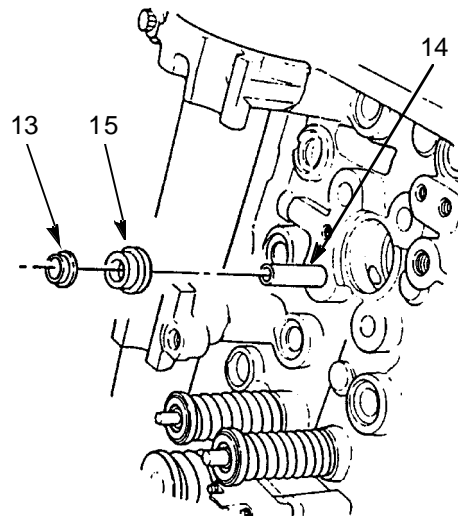
DISASSEMBLY - CONTINUED

12. Remove valve (10) from fire deck side of cylinder head (2).

**NOTE**

Remove and discard valve stem oil seal whenever valve is removed.

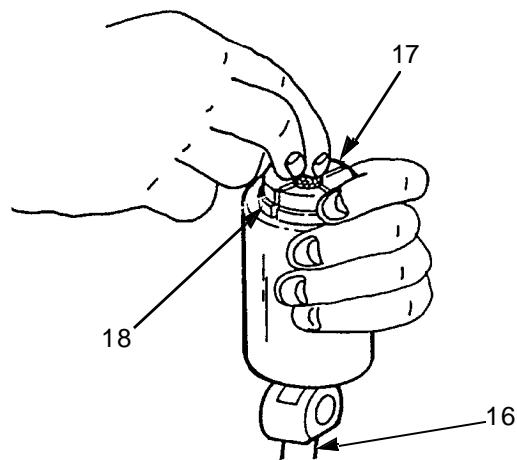
13. Remove valve stem oil seal (13) from top of valve guide (14). Discard oil seal.
14. Remove valve spring seat (15).



DISASSEMBLY - CONTINUED**NOTE**

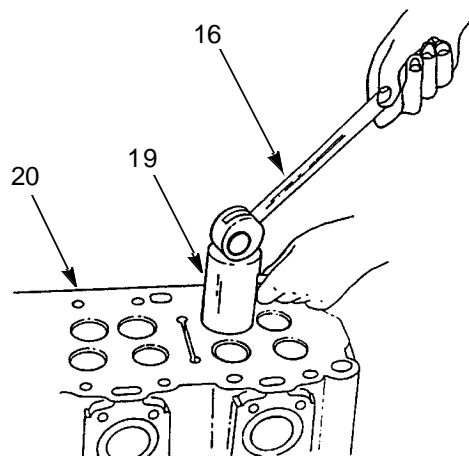
Procedure is the same for both intake and exhaust valve seat inserts, except different collet is used in valve seat remover tool.

15. Position cylinder head (2) fire deck side up.
16. If valve seats are worn or damaged, place valve seat remover handle (16) in vertical position so that no pressure is on internal spring. Adjust valve seat collet (17) opening by turning tapered nut (18) to expand or reduce valve seat collet opening until it will slip through valve seat.



343-1007

17. With valve seat remover handle (16) in vertical position, insert valve seat collet portion of valve seat remover body (19) fully into valve seat.
18. Hold valve seat remover body (19) square with surface of cylinder head fire deck (20) and pull valve seat remover handle (16) until firm resistance is felt. Hold handle in this position.

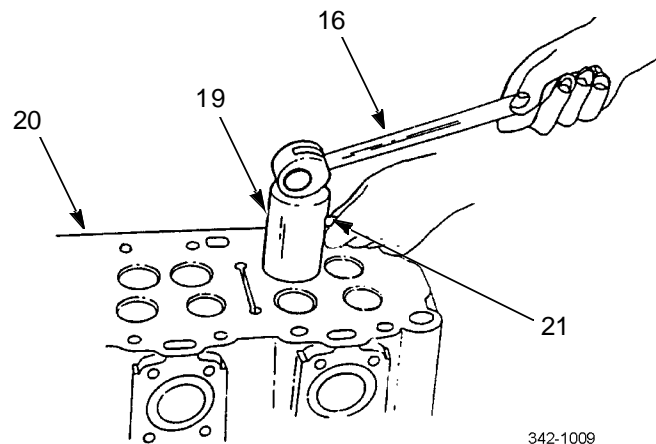


342-1008

DISASSEMBLY - CONTINUED**CAUTION**

Ensure valve seat remover body remains flat on cylinder head fire deck when moving collet handle to prevent damage to collet and to correct engagement of valve seat insert.

19. Hold valve seat remover handle (16) down. Grasp valve seat collet handle (21) and rotate back and forth several times.
20. Hold valve seat remover body (19) flat on cylinder head fire deck (20) and pull valve seat remover handle (16) down until valve seat is removed.
21. Return valve seat remover handle (16) to vertical position and remove valve seat from valve seat collet. Discard valve seat.



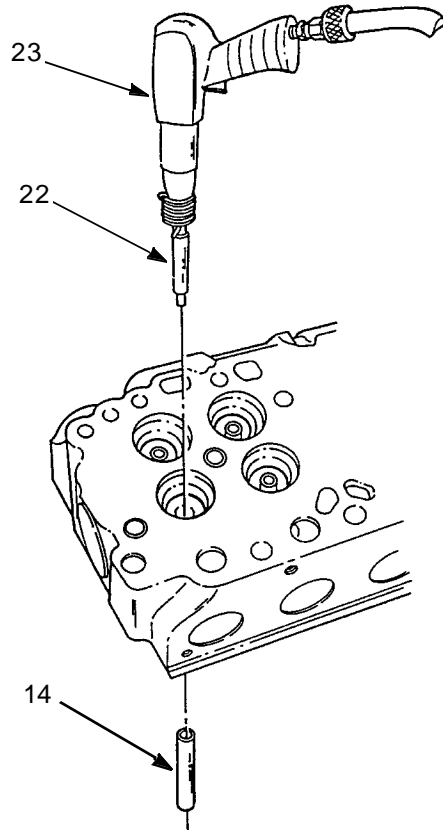
22. If valve guides (14) are worn or damaged, install valve guide remover (22) in air chisel (23) and insert valve guide remover into bottom of valve guide (14) from fire deck side.

WARNING

Valve guide is removed from cylinder head under force. Position heavy block of wood at an angle, beneath guide, to deflect valve guide and prevent personal injury.

23. Hold valve guide remover (22) vertical to cylinder head fire deck and drive valve guide (14) down until free. Discard valve guide.

DISASSEMBLY - CONTINUED

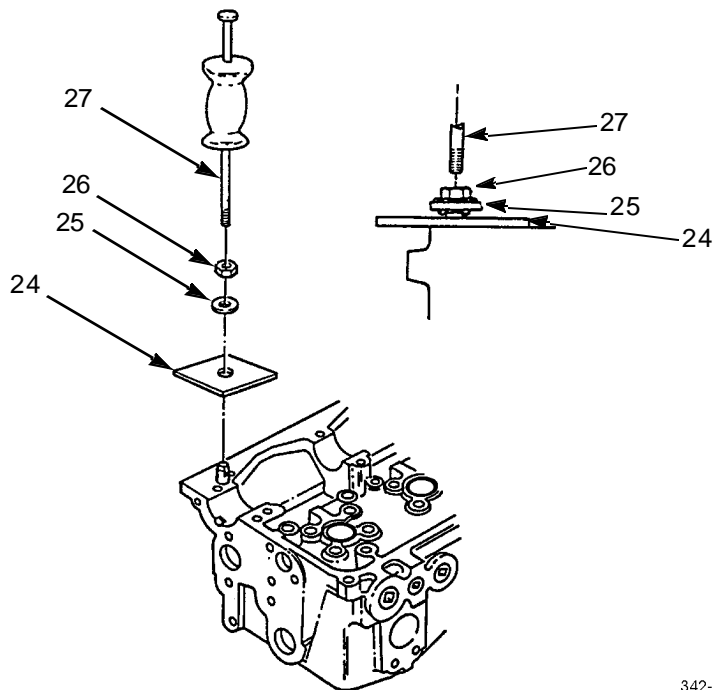


342-1010

DISASSEMBLY - CONTINUED**NOTE**

- Replace dowels and plugs only if necessary.
- Dowel removal procedure is the same for round, diamond, or hollow dowels.
- Cover exposed areas to guard against welding sparks.

24. Fabricate piece of sheet brass (24) with hole large enough to fit over dowel being removed.
25. Tack weld flat washer (25) to top of dowel as shown.
26. Tack weld nut (26) to flat washer (25). Ensure thread of nut matches thread of slide hammer shaft (27).
27. Thread slide hammer shaft (27) into nut (26) and remove dowel.



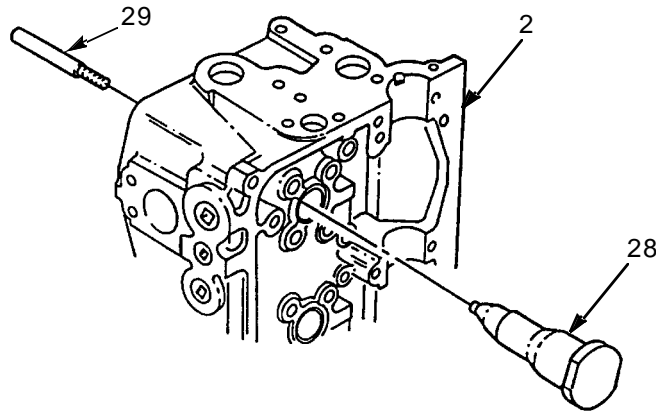
342-1011

NOTE

Cylinder head repair conditions may warrant cylinder head pressure testing before complete head disassembly. Testing should be performed before injector tubes, cup plugs, and pipe plugs are removed. Refer to Inspection steps 2 through 10 for pressure testing.

28. If worn, damaged or leaking, replace injector tubes by placing injector tube installation/removal tool (28) in injector tube. Insert pilot (29) through small opening of injector tube and thread pilot into tapped hole in end of installation/removal tool.
29. Using brass hammer or fiber mallet, tap on end of pilot (29). Carefully drive and lift injector tube, installation/removal tool (28), and pilot from cylinder head (2). If injector tube o-ring seal is not removed with injector tube, remove o-ring seal from cylinder head casting at upper end of injector tube bore. Discard injector tube and o-ring seal.

DISASSEMBLY - CONTINUED



342-1012

30. Remove cup plugs by piercing with screwdriver or chisel and prying plug out of cylinder head.
31. Unscrew pipe plugs and fuse plug.

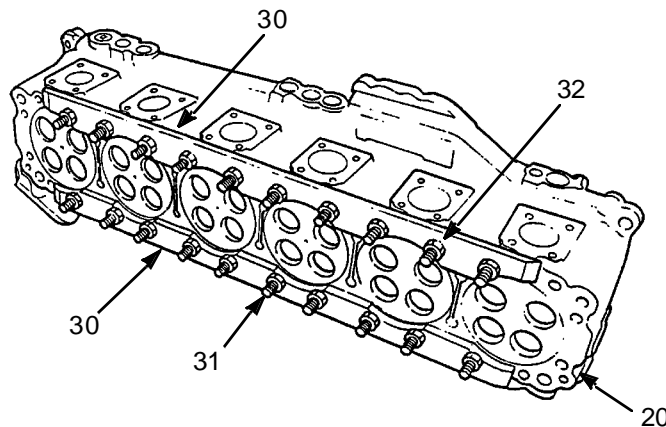
CLEANING AND INSPECTION

1. Steam clean stripped cylinder head.

NOTE

Ensure all cup plugs, pipe plugs, and injector tubes are installed before pressure testing cylinder head.

2. Attach two pressure test kit strips (30) to cylinder head fire deck (20). Install 20 cylinder head bolts (31) through cylinder head and test kit strips. Install and tighten 20 nuts (32) to 120 lb-in (14 Nm).



342-1013

CLEANING AND INSPECTION - CONTINUED

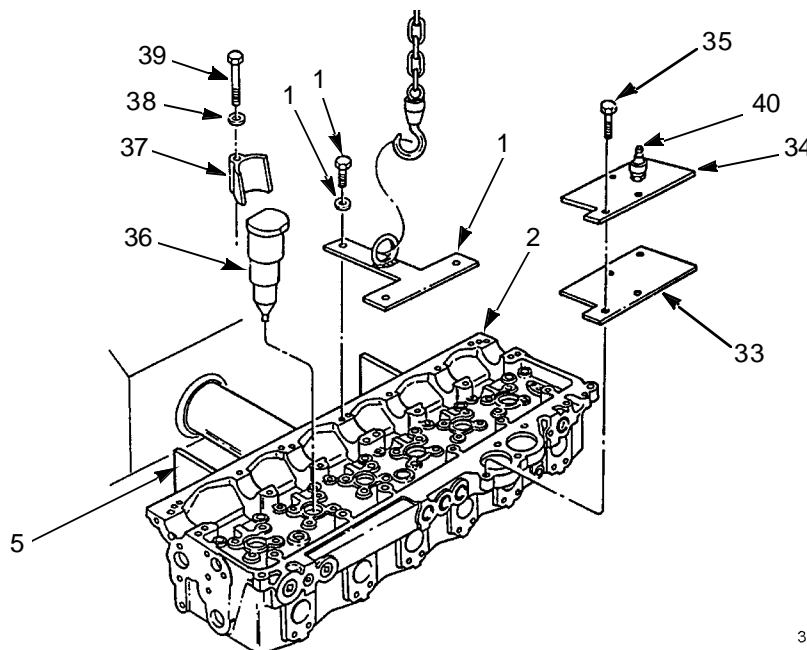
NOTE

- Leaking injector tubes must be replaced. Replace any pipe plug or cup plug where leakage is present.
 - Cylinder head must be pressure tested following replacement of any injector tubes, cup plugs or pipe plugs.
3. Install gasket (33) and pressure test kit thermostat cover plate (34) on cylinder head (2) with bolts (35).
 4. Using hardware provided, install material lift clamp (1).
 5. Install pressure test kit dummy fuel injectors (36) in injector bores.
 6. Install fuel injector hold down clamp (37), washer (38), and hold down bolt (39). Tighten bolt to 43-49 lb-ft (58-66 Nm).
 7. Remove cylinder head (2) from engine mounting bracket (5).

**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

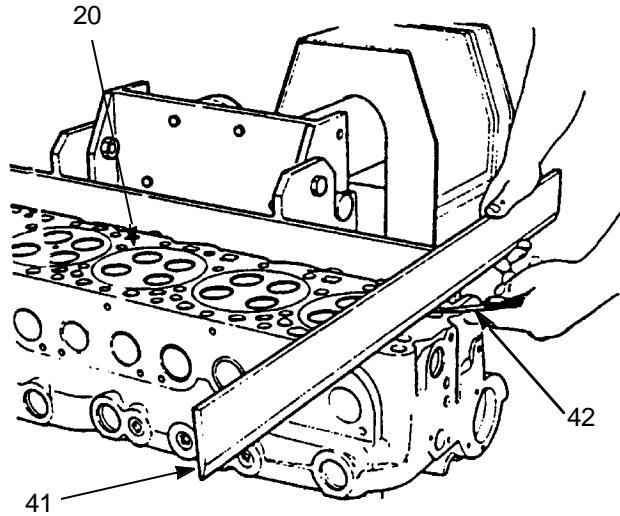
8. Apply 30 psi (207 kPa) air pressure to thermostat cover plate fitting (40).



342-1014

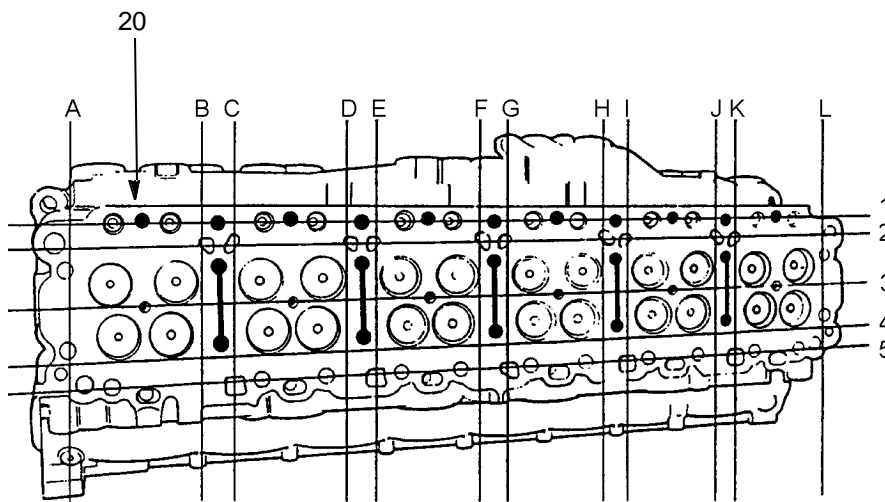
9. Install pipe plugs in temp port and in air compressor coolant port.
10. Immerse cylinder head (2) in water heated to 180°F-200°F (82°C-93°C). Leave cylinder head in water for 20 minutes. Watch for bubbles, indicating crack or leak. If cracked, replace cylinder head.
11. Using heavy straightedge (41) and thickness gage (42), check for warped cylinder head fire deck (20).

CLEANING AND INSPECTION - CONTINUED



342-1015

12. Check cylinder head fire deck (20) for longitudinal warpage in 5 places (1 through 5) and transverse warpage at 12 places (A through L). Fire deck must be flat within 0.011 in (0.279 mm) front-to-rear, and 0.003 in (0.076 mm) side-to-side. If not, resurface fire deck.



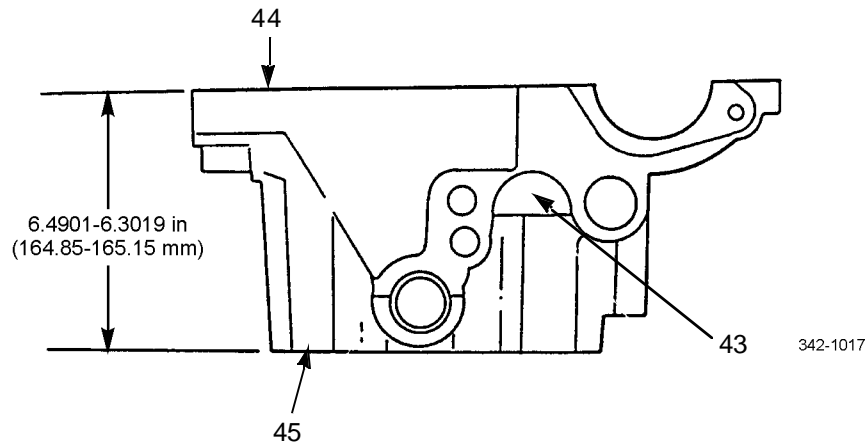
342-1016

CLEANING AND INSPECTION - CONTINUED

CAUTION

Maximum amount of resurfacing is 0.030 in (0.762 mm). Limit resurfacing to 0.030 in (0.762 mm). If exceeded, replace cylinder head to prevent damage to equipment.

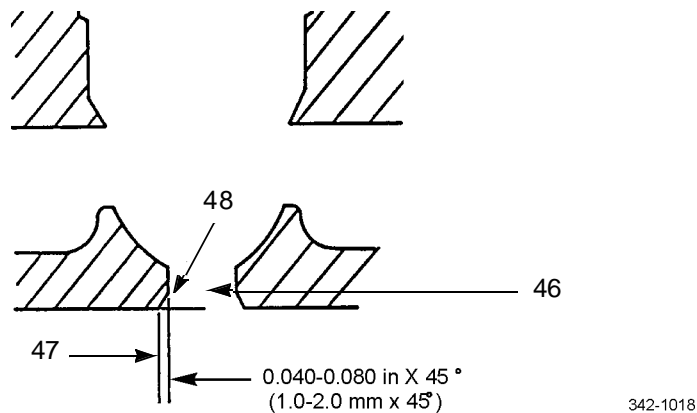
13. Record amount of stock removed from cylinder head by stamping amount removed on pad (43) on front of cylinder head. Measure from top rail (44) to fire deck surface (45). Resurface finish must be 90 U in AA (2.3 UM AA).



NOTE

It may be necessary to restore injector tube counterbore when cylinder head is resurfaced.

14. Ensure countersink injector tube bores (46) land width is 0.040-0.080 in (1.0-2.0 mm) (47) x 45 degrees (48).

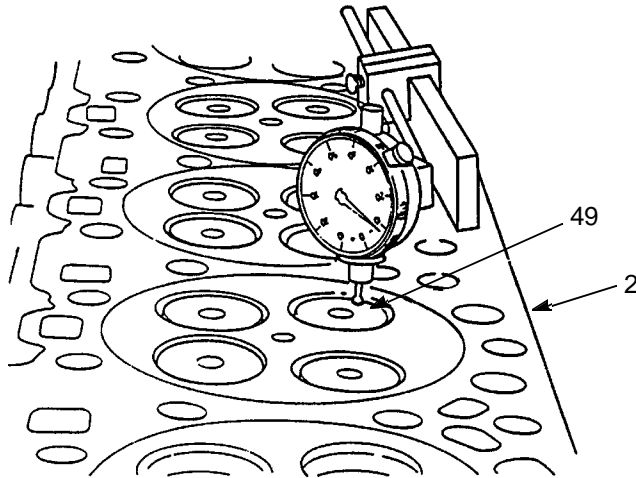


NOTE

If cylinder head fire deck has been resurfaced, valves must be seated deeper to restore valve head recess depth to specification limits. Do not grind new valve seat inserts for this purpose. Reduced-thickness valve seat inserts are available, 0.010, 0.020, and 0.030 in (0.254, 0.508, and 0.762 mm) shallower than standard.

CLEANING AND INSPECTION - CONTINUED

15. Ensure valve heads (49) are recessed from cylinder head (2) fire deck surface by 0.055-0.071 in (1.4-1.8 mm) minimum. If not, install reduced-thickness valve seat inserts.

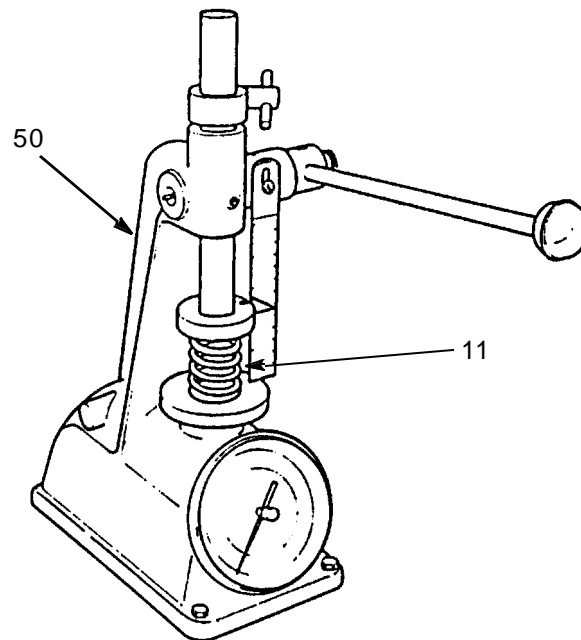


342-1019

NOTE

Replace rotator whenever spring is replaced.

16. Inspect valve springs and replace any that are pitted or cracked.
17. Use valve spring tester (50) to test valve springs (11). Replace spring if spring load is less than 63 lb (280 N) at compressed length of 2.648 in (67.26 mm).



342-1020

CLEANING AND INSPECTION - CONTINUED

NOTE

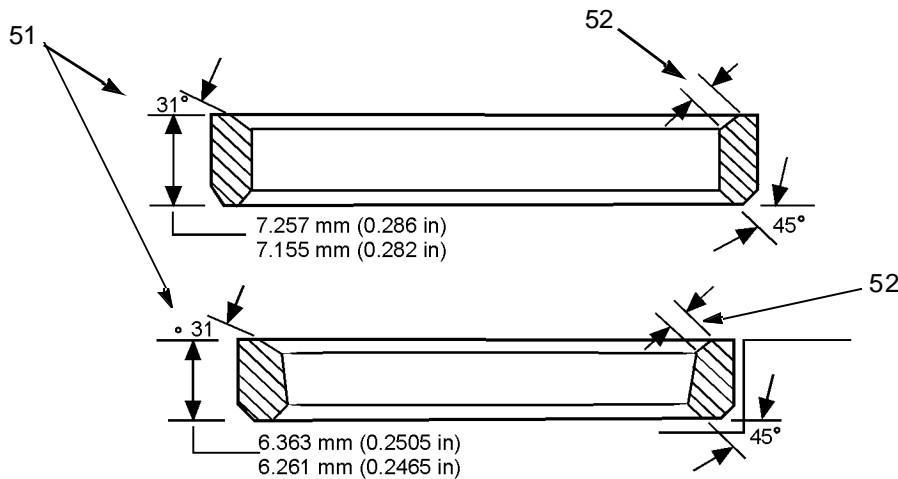
If suitable for reuse, valve may be refaced as long as after refacing, valve rim width is not less than 0.086 in (2.19 mm) for intake valves and 0.094 in (2.39 mm) for exhaust valves.

18. Ensure valve stems are free from scratches or scuff marks. Valve faces must be free from ridges, cracks, and pitting. If necessary, reface valves or install new valves. If valve faces are warped or valve stem is bent, replace valves. Minimum valve stem diameter is 0.342 in (8.679 mm) for intake valve and 0.343 in (8.714 mm) for exhaust valve.
19. Inspect guides for cracks, chipping, scoring, and excessive wear.
20. Measure valve guide bore with small hole gage or gage pin, and measure valve stem diameter with micrometer. Compare measurements to determine valve stem clearance. If clearance is greater than 0.006 in (0.152 mm), valve guide must be replaced.

NOTE

New valve seat inserts are preground. Check for concentricity after installation. Do not grind new valve seat insert unless concentricity exceeds 0.002 in (0.05 mm).

21. Ensure valve seat insert angle (51) is 31 degrees.
22. Ensure valve seat width (52) is 0.084 in (2.14 mm) for intake valves and 0.105 in (2.66 mm) for exhaust valves.



342-1021

ASSEMBLY

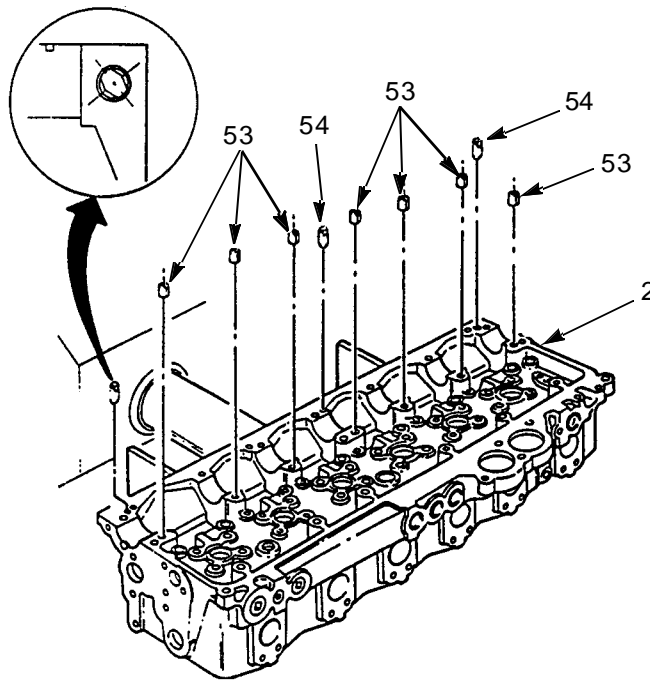
1. If removed, install seven hollow dowels (53) on cylinder head (2) to height of 0.197 +0.010 in (5.0 +0.5 mm).

CAUTION

Ensure diamond dowels are correctly aligned. Failure to do so could result in engine failure.

2. If removed, install three diamond dowels (54) to height of 0.240 +0.010 in (6.1 +0.5 mm). Angular orientation of diamond dowels must be parallel to centerline through dowel holes within +4 degrees, as shown.

ASSEMBLY - CONTINUED



342-1022



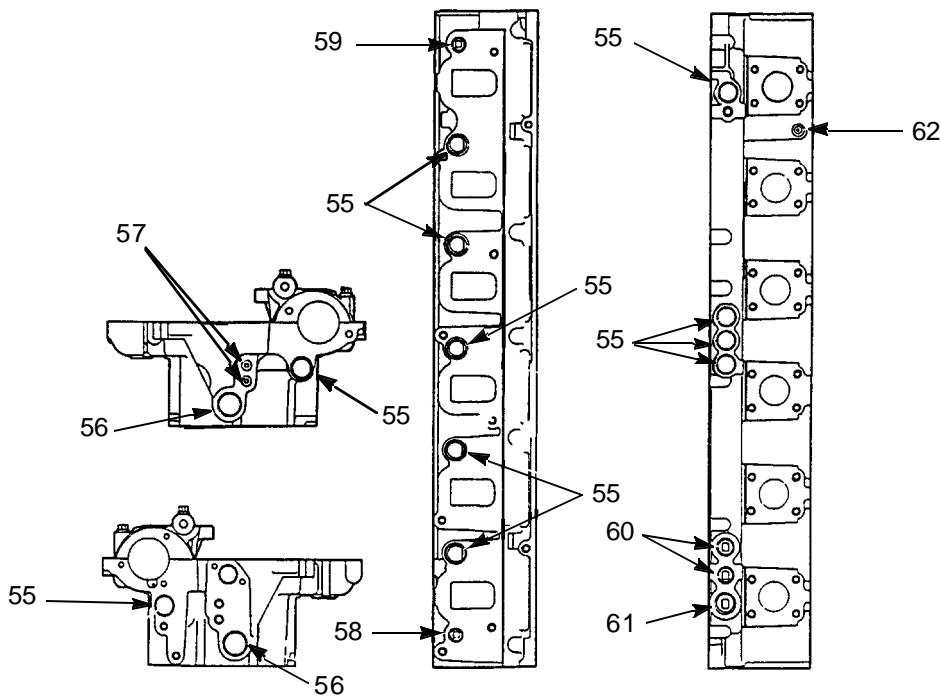
Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water.

NOTE

- Coat inside sealing edges of cup plugs with adhesive.
- Coat pipe plugs with pipe sealing compound.

ASSEMBLY - CONTINUED

3. If removed, use cup plug installer to install 11 cup plugs (55) on top, front, and rear sides of cylinder head. Install cup plugs to 0.098-0.138 in (2.5-3.5 mm) below machined surface.
4. If removed, install two cup plugs (56) on front and rear sides of cylinder head to 0.098-0.138 in (2.5-3.5 mm) below machined surface.
5. Install two square drive pipe plugs (57) on front side of cylinder head, flush-to-below surface.
6. Install connector (58) on left rear side of cylinder head.
7. Install elbow (59) on left front side of cylinder head.
8. Install two pipe plugs (60) on right side rear of cylinder head.
9. Install pipe plug (61) on right side rear of cylinder head.
10. Install fuse plug (62) on right side front of cylinder head.



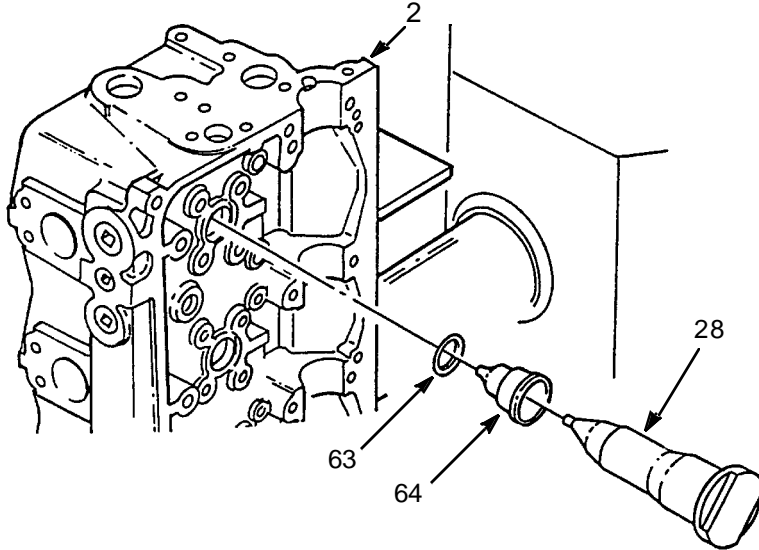
342-1023

NOTE

Do not lubricate outside of injector tube or inside cylinder head injector tube bore.

11. Lubricate new injector tube o-ring seal (63) with lubricating oil. Install o-ring seal over new injector tube (64) until flush against lip.
12. Install injector tube (64) on injector tube reconditioning set installer (28).

ASSEMBLY - CONTINUED

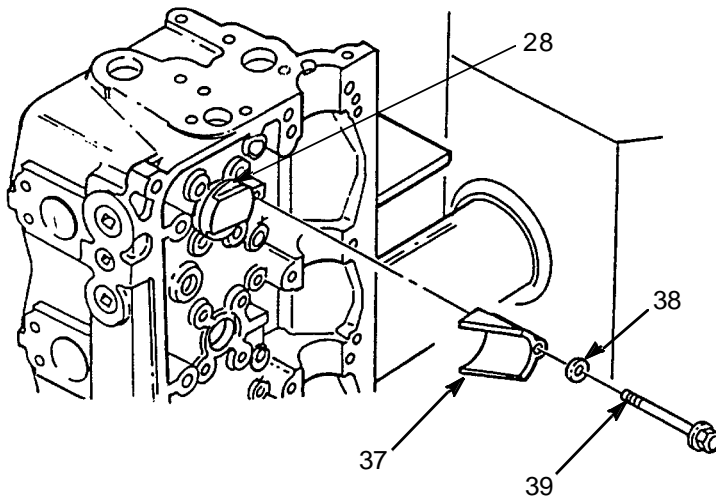


342-1024

NOTE

If injector tube falls off installer during installation, use injector tube reconditioning set tube remover pilot to retain injector tube on installer. Remove pilot after hold down clamp is installed and tightened.

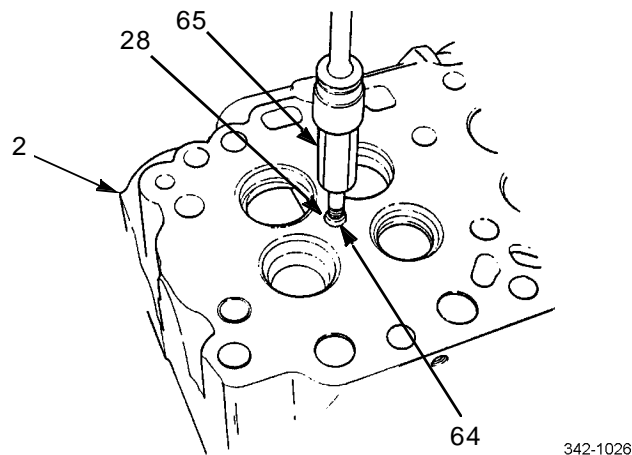
13. Install injector tube reconditioning set installer (28) with injector tube in injector bore. Ensure tip of injector tube goes through small hole in cylinder head (2) fire deck. Tap lightly on end of installer, if necessary, to seat injector tube.
14. Install injector hold down clamp (37), washer (38), and hold down bolt (39) over injector tube reconditioning set installer (28). Tighten bolt to 43-49 lb-ft (58-66 Nm).



342-1025

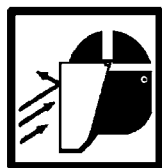
ASSEMBLY - CONTINUED

15. Insert injector tube reconditioning set flaring tool (65) through small hole in bottom of injector tube (64) and rotate flaring tool to engage threads in injector tube reconditioning set installer (28).
16. Using torque wrench and standard 9/16 in socket, thread flaring tool (65) into injector tube reconditioning set installer (28) until it flares injector tube (64).
17. Rotate flaring tool (65) and apply pressure to flare end of injector tube firmly against cylinder head (2). Do not exceed 30 lb-ft (41 Nm).
18. Remove flaring and installer tools. Ensure proper flare.

**NOTE**

Turn reamer in clockwise direction only when inserting and withdrawing reamer.

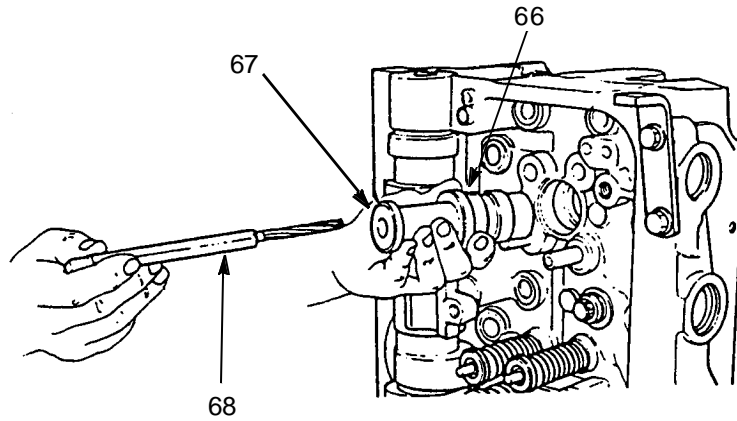
19. Insert injector tube reconditioning set seat reamer pilot (66) into injector bore until it contacts cylinder head. Insert reconditioning set seat tip reamer pilot (67) into seat reamer until it bottoms.
20. Apply a few drops of cutting oil on cutting edges of injector tube reconditioning set tube tip reamer (68) and install in pilot (67).
21. Use speed handle with 7/16 in socket to turn tube tip reamer (68) in clockwise direction. Use light pressure until reamer goes completely through end of injector tube.

**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

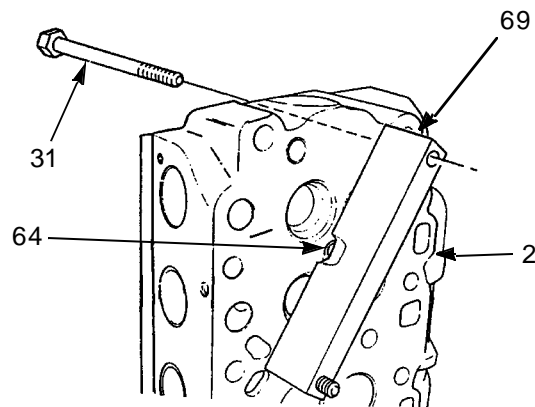
22. Remove reamer and pilot. Use compressed air to clear out injector tube and tip.

ASSEMBLY - CONTINUED



342-1027

23. Install injector tube reconditioning set stop block (69) on cylinder head fire deck (20) using two cylinder head bolts (31). Do not tighten bolts. Position cutout portion of stop block beneath injector tube (64).



342-1028

ASSEMBLY - CONTINUED**CAUTION**

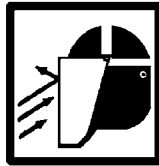
Be careful not to drop reconditioning set seat reamer into pilot or allow seat reamer to strike injector tube. Sharp cutting edges may gouge injector tube causing chatter marks in seat.

24. Install injector tube reconditioning set seat reamer pilot (66) in injector tube bore until it contacts cylinder head (2).

CAUTION

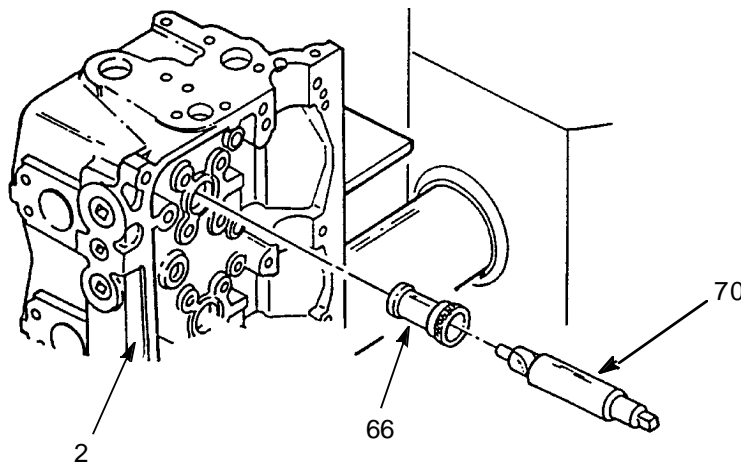
When using seat reamer, use only light pressure. Heavier pressure will result in chatter marks in seat.

25. Apply a few drops of cutting oil on edges of injector tube reconditioning set seat reamer (70) and place gently in pilot (66).
26. Using speed handle with 12-point (23-mm) socket, turn injector tube reconditioning set seat reamer (70) in clockwise direction. Use light pressure until reamer bottoms against injector tube reconditioning set stop block (69).

**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

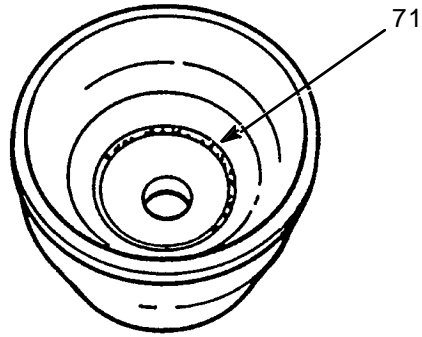
27. Remove reamer and pilot. Using compressed air, clean out injector tube.



342-1029

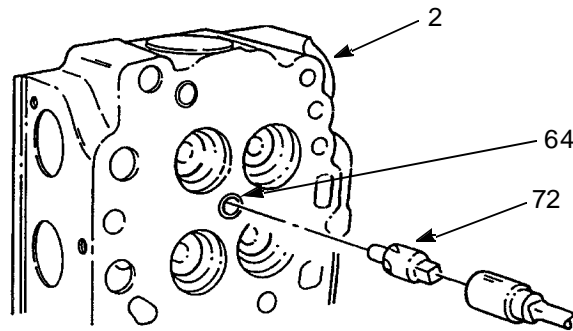
28. Inspect tube seating surface for irregularities or chatter marks (71) in seating surface. If irregularities or chatter marks are present, remove and replace injector tube.

ASSEMBLY - CONTINUED



342-1030

29. Remove two cylinder head bolts and injector tube reconditioning set stop block from cylinder head (2).
30. Insert injector tube reconditioning set tip refinisher (72) into injector tube (64).



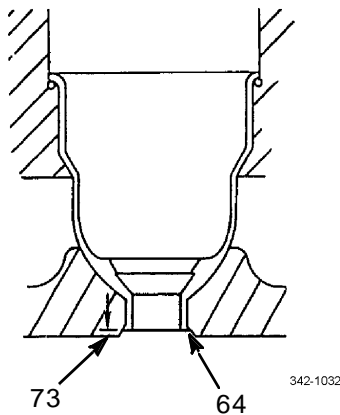
342-1031

ASSEMBLY - CONTINUED

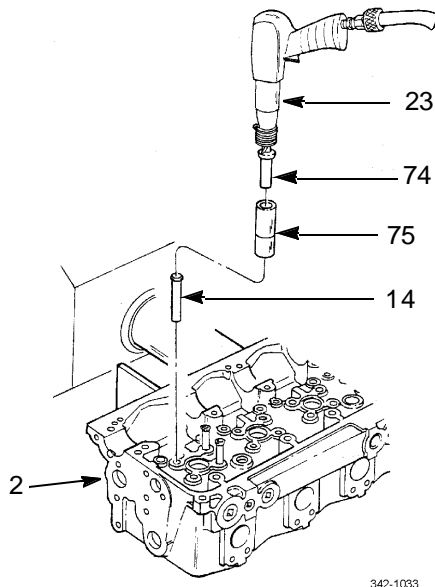
NOTE

- Cylinder head repair conditions may warrant cylinder head pressure testing before complete head assembly. Testing should be performed before intake and exhaust valve components are installed.
- Ensure all cup plugs, pipe plugs, and injector tubes are installed before pressure testing cylinder head. Refer to inspection steps 2 through 10 for testing.

31. Using 12-point (23-mm) socket and speed handle, turn injector tube reconditioning set tip refinisher to remove excess stock, so that lower end of injector tube (64) is from flush to 0.008 in (0.20 mm) (73) below fire deck surface of cylinder head. Remove chips from injector tube.



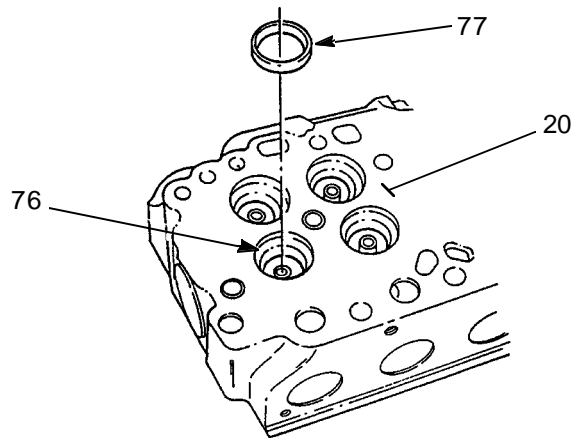
32. Position cylinder head (2) fire deck side down.
33. Insert chamfered end of new valve guide (14) into cylinder head (2) with seal groove up.
34. Insert driver (74) into valve guide installer (75). Install assembly over valve guide (14). Drive valve guide into cylinder head (2) with air chisel (23) until driver bottoms.
35. Check protrusion of valve guide (14) from cylinder head (2). Height should be 1.486 in (37.75 mm).



ASSEMBLY - CONTINUED**NOTE**

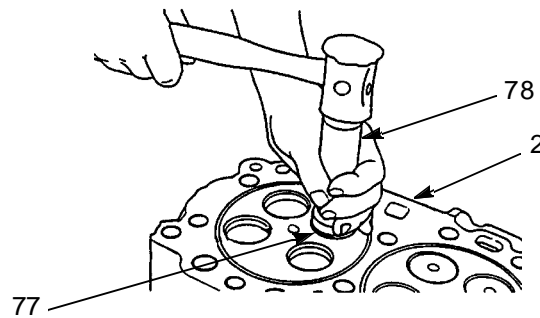
Procedure is the same for both intake and exhaust valve seat inserts, except different tools are used.

36. Position cylinder head fire deck (20) side up.
37. Ensure valve seat insert counterbore (76) is clean and free of carbon deposits, burrs or damage.
38. Seat new valve seat insert (77) squarely in counterbore with valve seat facing up.



342-1034

39. Seat valve seat installer (78) on valve seat insert (77).
40. Install valve seat insert (77) solidly in valve seat in cylinder head (2).



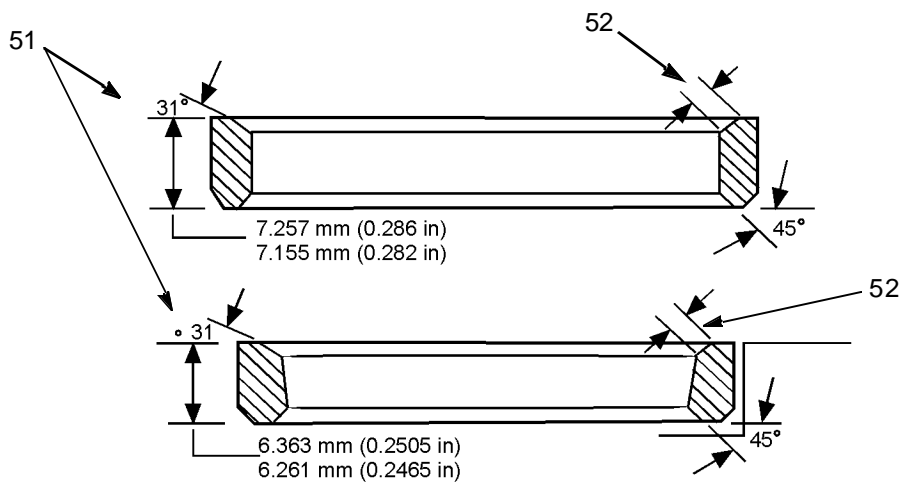
342-1035

ASSEMBLY - CONTINUED

NOTE

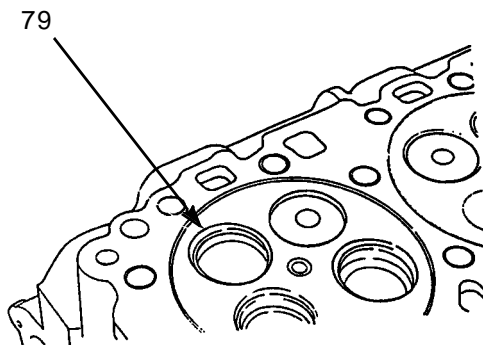
New valve seat inserts are preground. Check for concentricity after installation. Do not grind new valve seat insert unless concentricity exceeds 0.002 in (0.05 mm).

- 41. Ensure valve seat insert angle (51) is 31 degrees.
- 42. Ensure valve seat width (52) is 0.084 in (2.14 mm) for intake valves and 0.105 in (2.66 mm) for exhaust valves.



342-1021

- 43. Grind valve seat (79) lightly for full 360 degrees, only enough to true it up.

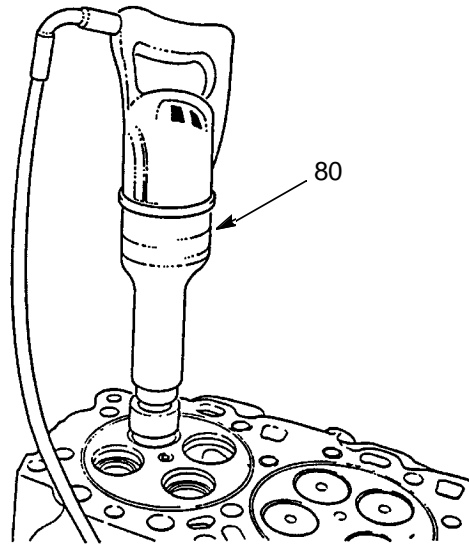


342-1036

ASSEMBLY - CONTINUED**NOTE**

Eccentric grinding method is recommended for fine accurate finish. Grinding wheel contacts valve seat at only one point at any time, and micrometer feed permits controlled, fine adjustment.

44. Grind valve seats to 31 degree angle using valve seat grinder (80).



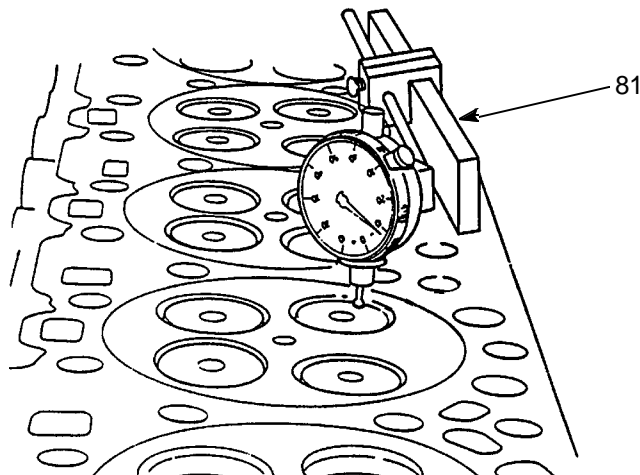
342-1037

45. Clean valve seat thoroughly. Check seat-to-valve face contact by applying light coat of Prussian blue paste to valve seat land. Insert valve in guide and bounce head on seat insert without rotating valve. Full 360 degree contact line should appear centered on valve face.

NOTE

If firedeck has been resurfaced, valves will have to be seated deeper to restore valve head recess depth to specification limits.

46. Valve head recess depth from cylinder head fire deck is increased by grinding valve seat. Check with sled gage (81). Replace valve seat if not between 0.055-0.067 in (1.4-1.6 mm).



342-1019

ASSEMBLY - CONTINUED

47. Position cylinder head step.

NOTE

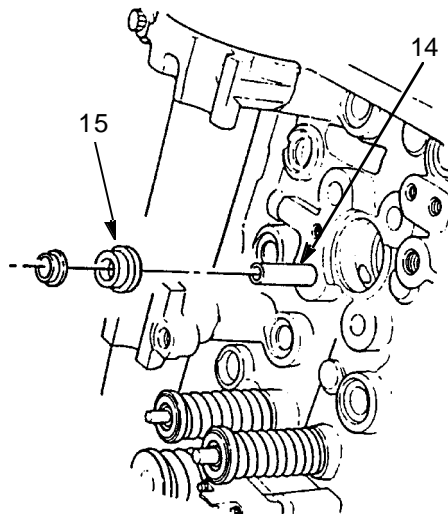
Intake valves have larger faces and are installed in guides on cam side of cylinder head. Smaller exhaust valves are installed in guides on thermostat side of cylinder head.

48. Lubricate valve stem (10) with clean engine lubricating oil and insert valve into valve guide (14) from fire deck side of cylinder head.

CAUTION

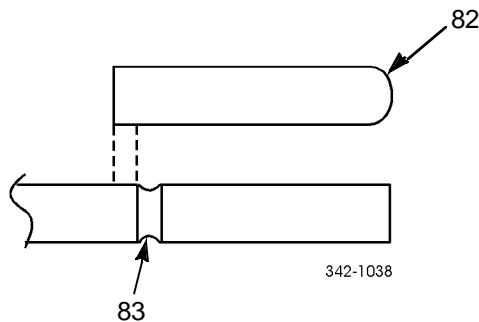
If other than standard valve seat has been installed, use corresponding thicker valve spring seat. Failure to do so could result in damage to equipment.

49. Install valve spring seat (15) over valve guide (14) and against top of cylinder head.



342-1006

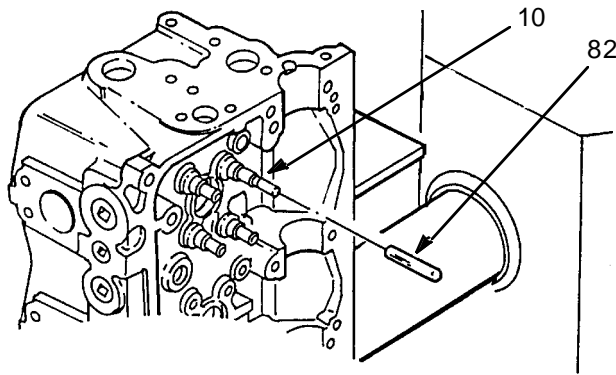
50. Check length of plastic valve kit seal protector cap (82) relative to valve lock groove (83) on valve stem. If seal protector cap extends more than 1/16 in (1.5 mm) beyond groove, trim off excess.



342-1038

51. Hold valve face and install seal protector cap (82) on valve stem (10).

ASSEMBLY - CONTINUED

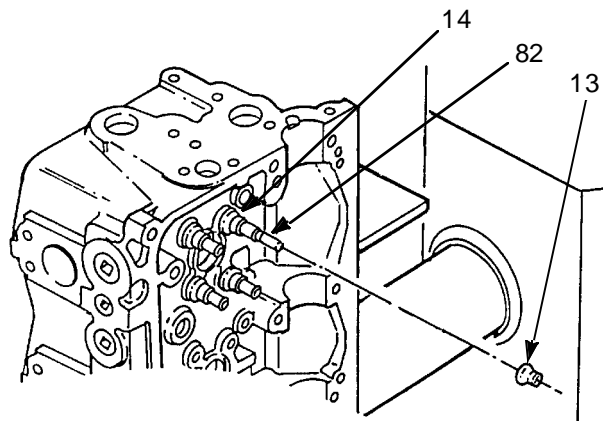


342-1039

NOTE

Ensure all valve spring seats are in place before valve stem oil seals are installed. Install valve stem oil seal dry.

52. Wipe any oil from outside of valve guide (14). Install new valve stem oil seal (13) over seal protector cap (82) against valve guide. Remove seal protector cap (82).
53. Using valve stem seal installer, push valve stem oil seal (13) down until seal lip is fully in groove on valve guide (14). When installer tool contacts head, seal is correctly positioned.

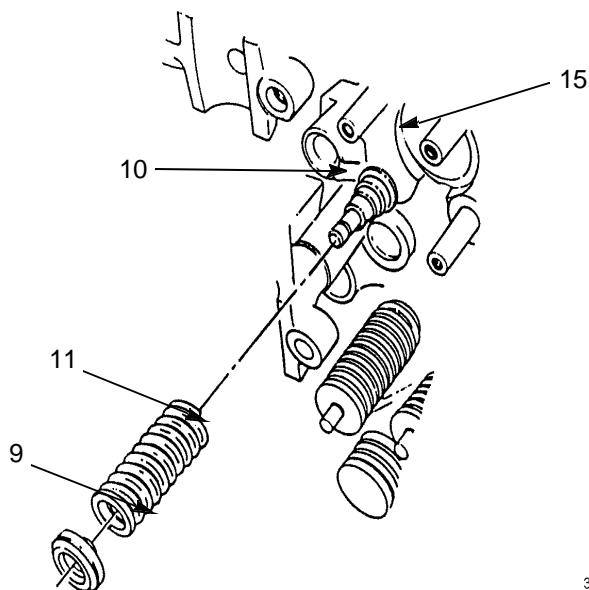


342-1040

ASSEMBLY - CONTINUED**CAUTION**

Position valve spring and rotator so valve lock grooves on valve stem do not contact oil seal. Failure to do so could result in damage to equipment.

54. Install valve spring (11) and valve rotator (9) over valve stem (10) and against valve spring seat (15).

**NOTE**

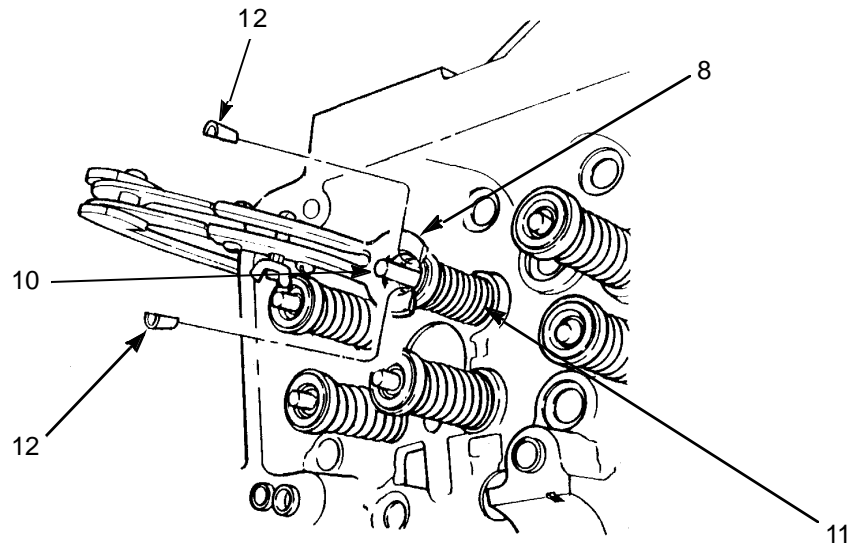
When compressing valve spring, valve rotator should not contact valve stem seal.

55. Using valve spring compressor (8), compress valve spring (11) only enough to install new valve keys (12).

NOTE

Ensure valve key is in place and engaged in valve stem groove before releasing valve spring compressor.

56. Install new valve keys (12).
57. Remove valve spring compressor (8).

ASSEMBLY - CONTINUED

342-1003

58. Using fiber or plastic mallet, strike end of valve stems (10) sharply to seat valve keys (12).
59. Install cylinder head (WP 0018 00).

END OF WORK PACKAGE

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CRANKSHAFT REPLACEMENT

0033 00

THIS WORK PACKAGE COVERS

Removal, Cleaning, Inspection, Installation

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Insertor and remover (Item 52, WP 0126 00)
- Pump, hydraulic ram (Item 98, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)
- Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)
- Wrench set, socket, 3/4 in drive (Item 141, WP 0126 00)

Materials/Parts

- Compound, international no. 2 (Item 13, WP 0125 00)
- Detergent (Item 19, WP 0125 00)
- Gage, bearing clearance (Item 20, WP 0125 00)

Materials/Parts - Continued

- Lubriplate (Item 23, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)
- Rope, 1/2 in nylon (Item 32, WP 0125 00)

Personnel Required

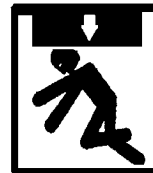
Two

Equipment Condition

- Flywheel housing removed (WP 0024 00)
- Oil pump removed (WP 0029 00)
- Pistons and cylinder assemblies removed (WP 0041 00)
- Bull/idler gear removed (WP 0037 00)
- Timing reference sensor (TRS) removed (TM 9-2320-302-20)
- Synchronous reference sensor (SRS) removed (TM 9-2320-302-20)



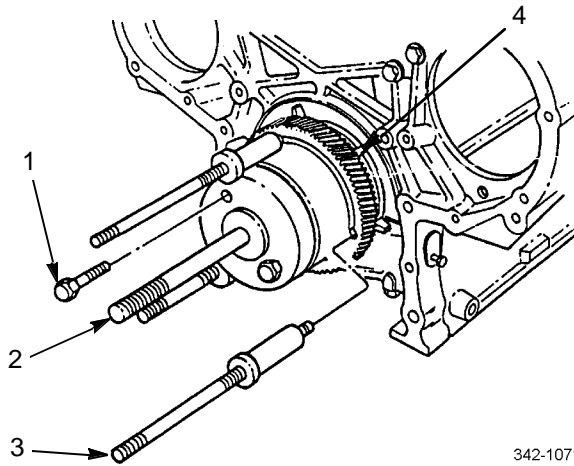
WARNING



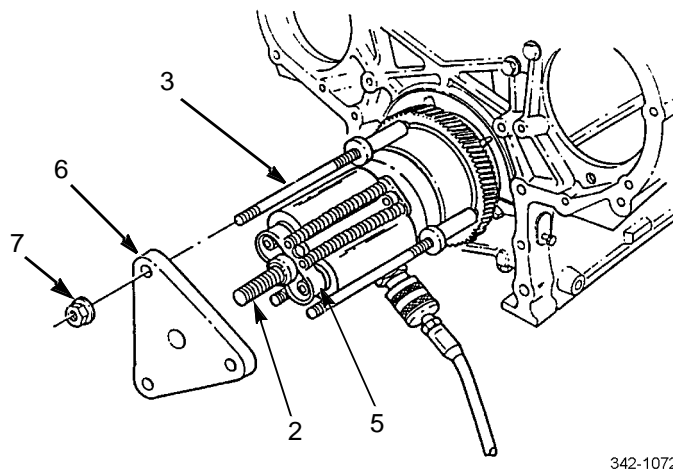
Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL

1. Using two crankshaft gear inserter/remover bolts (1), secure crankshaft gear inserter/remover base post (2) to end of crankshaft. Tighten two bolts to 140-150 lb-ft (190-203 Nm).
2. Thread three crankshaft gear inserter/remover legs (3) into threaded holes in crankshaft timing gear (4). Tighten three inserter/remover legs.



3. Slide hydraulic ram and pump (5) over center rod of inserter/remover base post (2).
4. Install crankshaft gear inserter/remover pressure plate (6) on three inserter/remover legs (3).
5. Install three crankshaft gear inserter/remover retaining nuts (7) on inserter/remover legs (3). Tighten three retaining nuts against inserter/remover pressure plate (6) to 43-54 lb-ft (58-73 Nm).



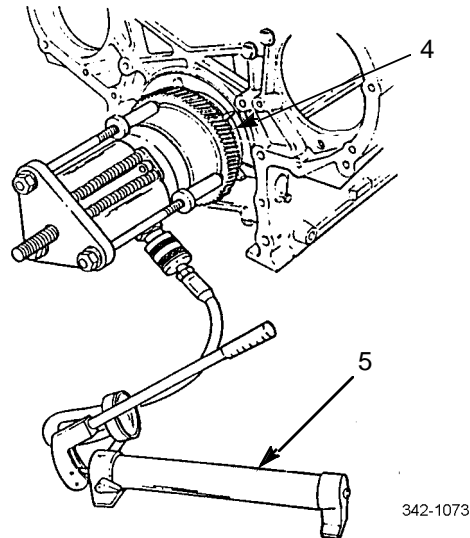
NOTE

Due to manufacturer's tolerances, as much as 9 tons of pressure may be required to remove crankshaft timing gear.

6. Operate hydraulic ram and pump (5) to pull crankshaft timing gear (4) off crankshaft.

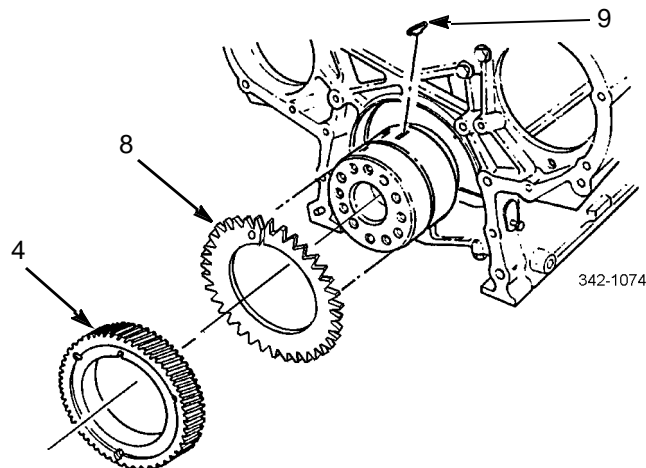
REMOVAL - CONTINUED

- When crankshaft timing gear (4) moves freely, release hydraulic pressure and remove crankshaft gear inserter/remover tool from crankshaft timing gear and crankshaft.

**CAUTION**

Do not use sharp tools to pry on timing wheel or crankshaft timing gear. Use care to prevent damaging crankshaft seal contact surface when removing crankshaft timing gear and timing wheel from crankshaft.

- Remove crankshaft timing gear (4) from crankshaft.
- Remove timing wheel (8) from crankshaft.
- Remove woodruff key (9) from crankshaft.



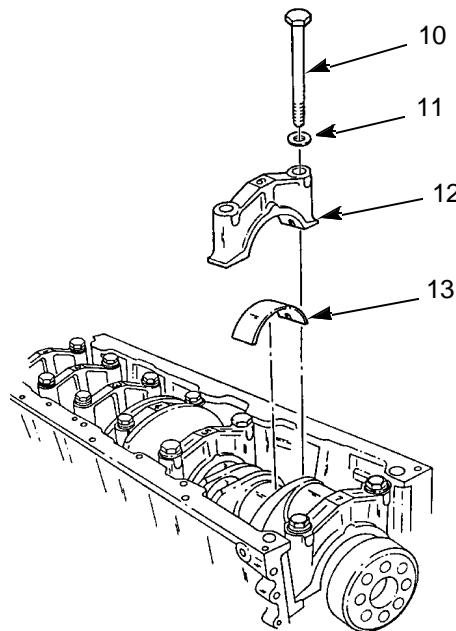
REMOVAL - CONTINUED

11. Rotate engine on stand so crankshaft is in up position.
12. Remove main bearing cap bolts (10) and washers (11).

NOTE

- Place upper main bearing shells and thrust washers with respective main bearing caps and lower main bearing shells. If reused, install upper and lower main bearing shells and thrust bearing in original positions.
- Main bearing caps are bored in position and stamped with position number. Caps must be installed in their original positions, with marked (numbered) side of each cap toward cooler (right) side of cylinder block.
- Slightest burr or particle of dirt between backs of no. 6 main bearing thrust washers and saddle or cap may decrease clearance between washer and crankshaft beyond specified limits.

13. Remove seven main bearing caps (12) and lower main bearing shells (13).



342-1075



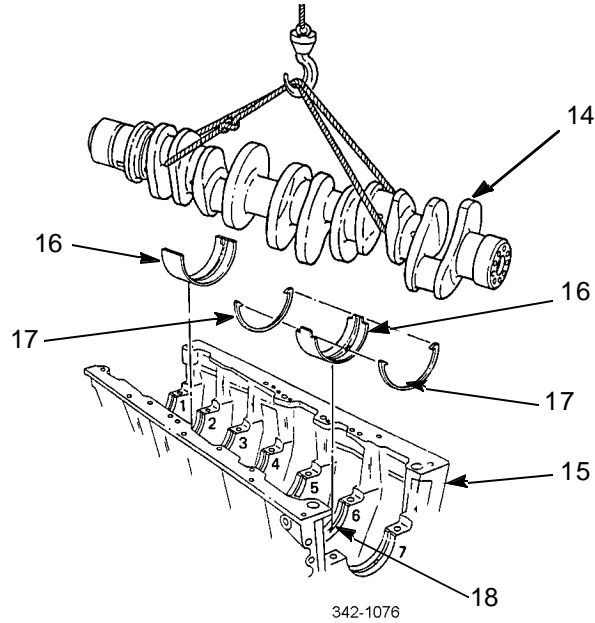
WARNING



Crankshaft weighs 408 lb (185.23 kg). Use suitable lifting device to lift and support crankshaft. Failure to do so could result in serious injury to personnel.

14. Using nylon rope and suitable lifting device, lift crankshaft (14) from cylinder block (15).
15. Remove seven upper main bearing shells (16).
16. Remove two thrust washers (17) from sides of main bearing saddle no. 6 (18).

REMOVAL - CONTINUED



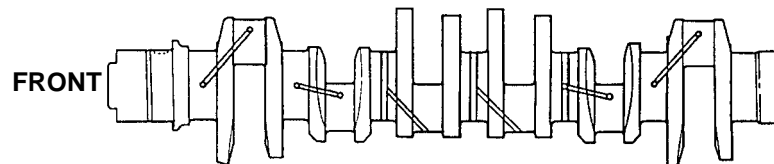
CLEANING



WARNING

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

1. Clean out crankshaft oil passages with bore brush.
2. Clean crankshaft bearings and main bearing caps with detergent and dry with compressed air.



342-1077

INSPECTION**CAUTION**

Vibration damper must be replaced at normal engine overhaul or if crankshaft breakage is experienced. Failure to do so could result in premature crankshaft failure.

NOTE

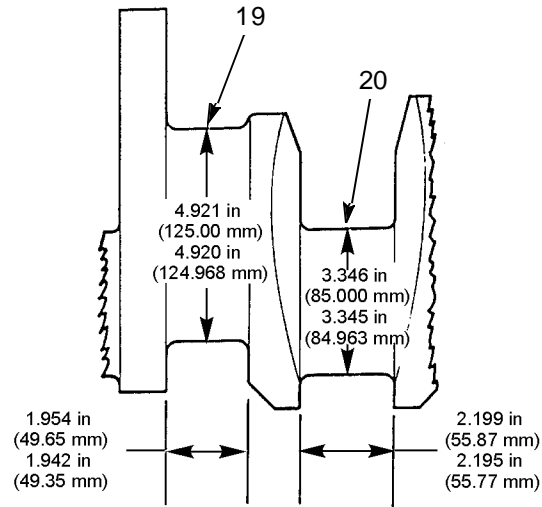
- Crankshaft failures are rare. When crankshaft cracks or breaks completely, thoroughly inspect for contributory factors. Unless abnormal conditions are discovered and corrected, crankshaft failure will be repeated.
 - Ensure all main bearing saddles and thrust bearing counterbores in cylinder block are clean.
 - Each upper main bearing shell is grooved with oil hole. Register oil hole in each upper main bearing shell with oil hole in each main bearing saddle of cylinder block.
 - Install main bearings in sets only. Do not mix old and new main bearing shells on same journal. If old bearings are installed, they must be installed in same journal they were removed from.
1. Inspect crankshaft timing gear keyway for evidence of cracks or wear. Replace crankshaft if damage is evident.
 2. Inspect crankshaft for evidence of overheating. Replace crankshaft if damage is evident.
 3. Check crankshaft journal surfaces for score marks or imperfections. If excessively scored, replace crankshaft.
 4. Check crankshaft thrust surfaces for excessive wear or grooving. If excessively worn, replace crankshaft.
 5. Check crankshaft timing gear for worn or chipped teeth. Inspect timing wheel for bent or damaged teeth. Replace as necessary.
 6. Support crankshaft front and rear journals on V-blocks or inverted engine block with only front and rear upper bearing shells in place. Check intermediate main journals with dial indicator for runout when crankshaft is rotated. Replace crankshaft if runout is greater than maximum shown in Table 1.

Table 1. Intermediate Main Journals Runout.

JOURNAL SUPPORTED ON	JOURNALS MEASURED	MAXIMUM RUNOUT: TOTAL INDICATOR READING
No. 1 and No. 7	No. 2	0.0030 in (0.076 mm)
No 1 and No. 7	No. 3	0.0051 in (0.130 mm)
No. 1 and No. 7	No. 4	0.0060 in (0.152 mm)
No. 1 and No. 7	No. 5	0.0051 in (0.130 mm)
No. 1 and No. 7	No. 6	0.0030 in (0.076 mm)

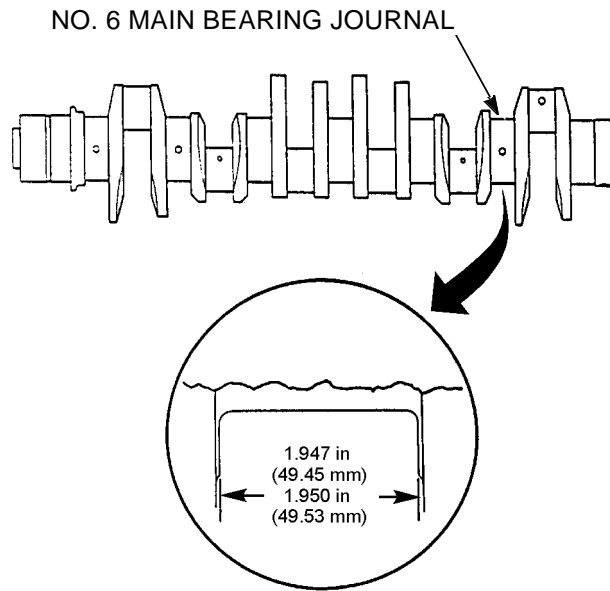
7. Measure all main bearing journals (19) and connecting rod bearing journals (20), as shown, at several places on circumference to determine taper, out-of-round, and journal diameter. Replace crankshaft if not within specifications shown.

INSPECTION - CONTINUED



342-1078

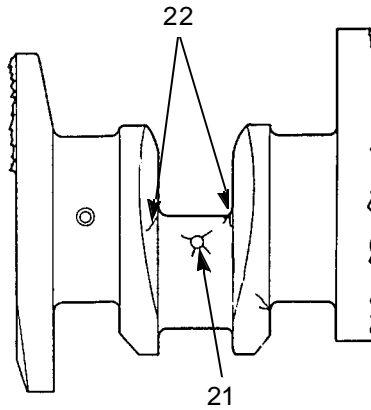
- 8. Measure crankshaft thrust washer surfaces as shown.



342-1079

INSPECTION - CONTINUED

9. Check crankshaft for cracks which start at oil hole (21) and follow journal surface at angle of 45 degrees to axis. Replace any crankshaft with such cracks. Determine presence of cracks not visible to eye by magnetic particle, fluorescent magnetic particle or fluorescent penetrant method.
10. Replace crankshaft if circumferential fillet cracks (22) at connecting rod, or fillet cracks or 45-degree cracks (45 degrees to axis of crankshaft) at main bearing journal are evident.



342-1080

11. Inspect all parts for wear or damage.

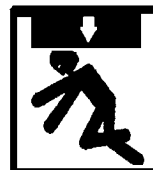
NOTE

- Ensure all main bearing saddles and thrust bearing counterbores in cylinder block are clean.
- Each upper main bearing shell is grooved with oil hole. Register oil hole in each upper main bearing shell with oil hole in each main bearing saddle of cylinder block.
- Install main bearings in sets only. Do not mix old and new main bearing shells on same journal. If old bearings are installed, they must be installed in same journal they were removed from.

12. Invert engine block. Install seven upper main bearing shells (16) in cylinder block journals (23).
13. Wipe oil from bearing shells and crankshaft journals to be checked.



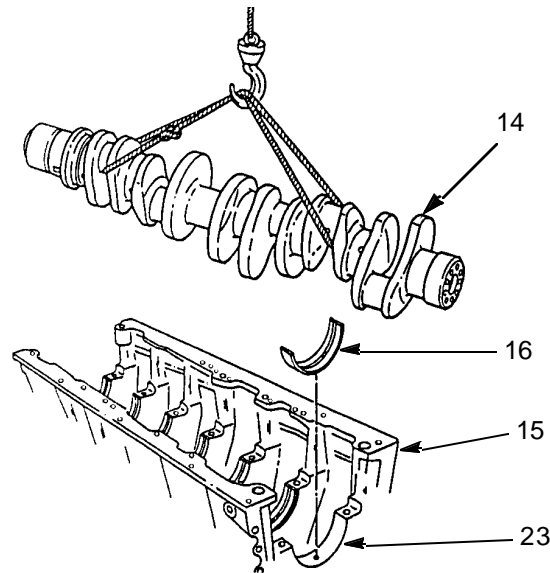
WARNING



Crankshaft weighs 408 lb (185.23 kg). Use suitable lifting device to lift and support crankshaft. Failure to do so could result in serious injury to personnel.

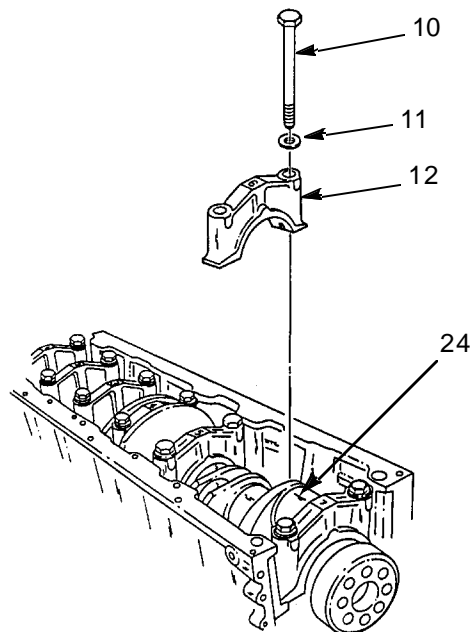
14. Using nylon rope and suitable lifting device, position crankshaft (14) in cylinder block (15) on upper main bearing shells (16).

INSPECTION - CONTINUED



342-1081

15. Using strip of plastigauge (24), measure bearing clearances between crankshaft journals of main bearings. Plastigauge type PG-1 (green) has clearance range of 0.001-0.003 in (0.0254-0.0762 mm). Type PR-1 (red) has clearance range of 0.002-0.006 in (0.0508-0.01524 mm). Type PB-1 (blue) has clearance range of 0.004-0.009 in (0.1016-0.2286).
16. Place piece of plastigauge (24) along full width of each crankshaft main bearing journal about 1/4 in (6.35 mm) off center.
17. Install seven lower main bearing shells and main bearing caps (12).
18. Install 14 washers (11) and main bearing cap bolts (10). Tighten main bearing cap bolts to 347-391 lb-ft (470-530 Nm).



342-1082

INSPECTION - CONTINUED**NOTE**

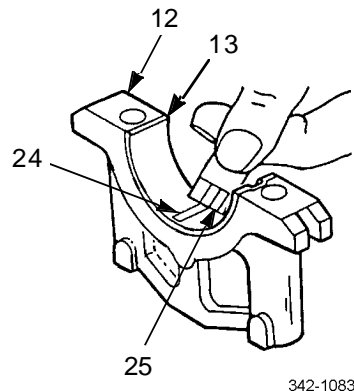
Flattened plastigauge will be found adhering to bearing shell or crankshaft.

19. Remove 14 main bearing cap bolts (10) and washers (11). Remove seven main bearing caps (12) and lower main bearing shells (13).

NOTE

If worn crankshaft maximum connecting rod bearing journal-to-bearing shell clearance, with new shells, exceeds 0.005 in (0.1270 mm), or if maximum main bearing journal-to-bearing shell clearance, with new shells, exceeds 0.0056 in (0.1412 mm), replace crankshaft. Measurements of crankshaft should be accurate to nearest 0.0001 in (0.0025 mm). If main bearing journal taper of used crankshaft exceeds 0.0015 in (0.0381 mm), or if out-of-round clearance is greater than 0.001 in (0.0254 mm), replace crankshaft.

20. Compare width of flattened plastigauge (24) at widest point with graduations on envelope (25) as shown. Number in graduation on envelope indicates bearing clearance in thousandths of an inch. Multiply reading obtained (in thousandths) by 25.4 to obtain metric specifications. Measure each end of plastigauge. Difference between two readings is approximate amount of taper.

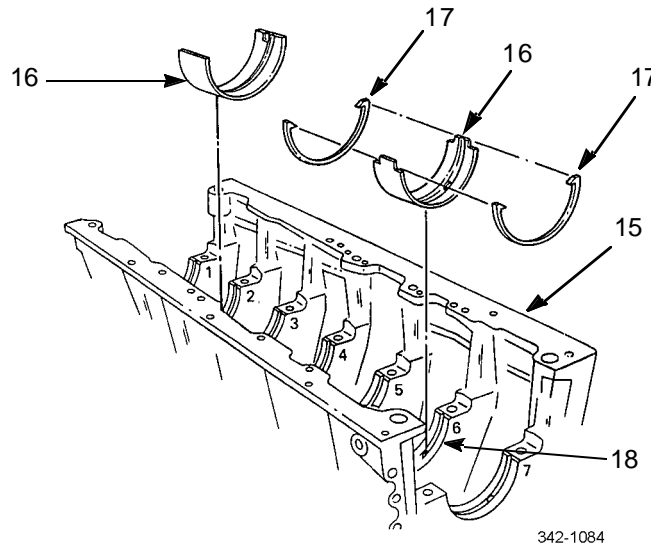
**INSTALLATION****NOTE**

- When new crankshaft is installed, all new main and connecting rod (upper and lower) bearing shells and thrust washers must also be installed.
- If new crankshaft is to be installed, clean it to remove rust preventative and clear out oil passages with compressed air.
- Replace vibration damper at time of normal overhaul or if crankshaft breakage is experienced.

1. Install notched upper main bearing shell (16) in main bearing saddle no. 6 (18), with tang of main bearing shell in notch at parting line of main bearing saddle no. 6.
2. Coat backs of two thrust washers (17), on side without oil grooves, with a thin film of clean engine lubricating oil. Install two thrust washers in counterbore on each side of main bearing saddle no. 6. Engage tangs on ends of thrust washers with notches on ends of notched upper main bearing shell (16).

INSTALLATION - CONTINUED

3. Install remaining upper main bearing shells (16) in main bearing saddles of cylinder block (15), with tangs on upper main bearing shells in notches at parting line of main bearing saddles.

**WARNING**

Crankshaft weighs 408 lb (185.23 kg). Use suitable lifting device to lift and support crankshaft. Failure to do so could result in serious injury to personnel.

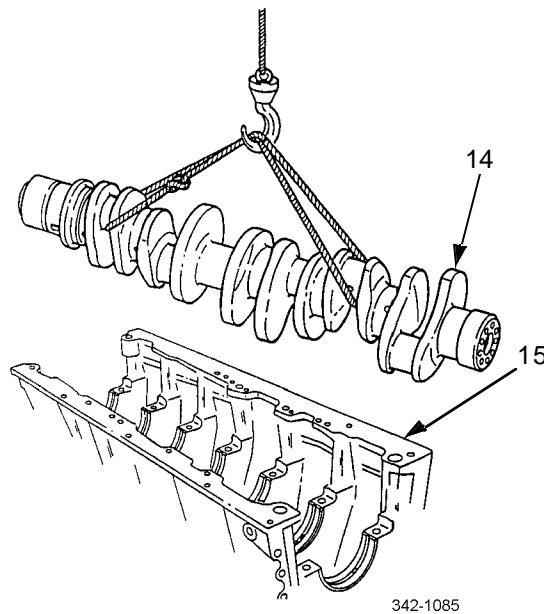
CAUTION

Ensure thrust washers are not dislodged when positioning crankshaft. Failure to do so could result in damage to equipment.

INSTALLATION - CONTINUED**NOTE**

Ensure all crankshaft main bearing journals are clean. Keyway on crankshaft goes to front of engine block.

4. Coat main bearing journals and upper main bearing shells with clean engine lubricating oil. Using nylon rope and suitable lifting device, position crankshaft (14) in cylinder block (15) on upper main bearing shells.
5. Remove nylon rope.

**NOTE**

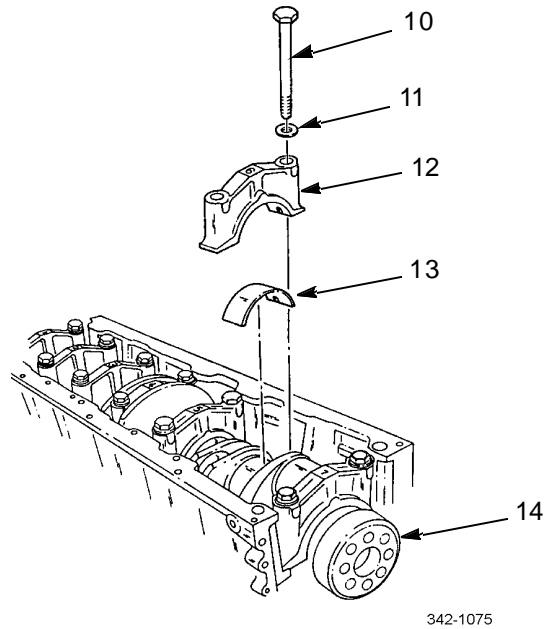
- Ensure saddles of main bearing caps are clean.
 - Install main bearings in sets only. Do not mix old and new bearings on same journal. If old bearings are installed, they must be installed on same journal they were removed from.
6. Install lower main bearing shells (13) in main bearing caps (12), with tang on bearing shells in notch at bearing caps parting line. Coat lower main bearing shells with clean engine lubricating oil.

NOTE

Journal numbers stamped on main bearing caps should be read from oil cooler side of cylinder block beginning with front main bearing cap as no. 1. Note journal number and position main bearing cap and bearing on correct main bearing. Main bearing caps must be installed in their original positions.

7. Install main bearing caps (12) in cylinder block (15). Apply a small amount of international compound no. 2 on threads and undersides of heads of main bearing cap bolts (10). Install washer (11) on each main bearing cap bolt.
8. Install main bearing cap bolts (10) hand tight.
9. Using fiber or plastic mallet, strike main bearing caps (12) sharply toward crankshaft (14).

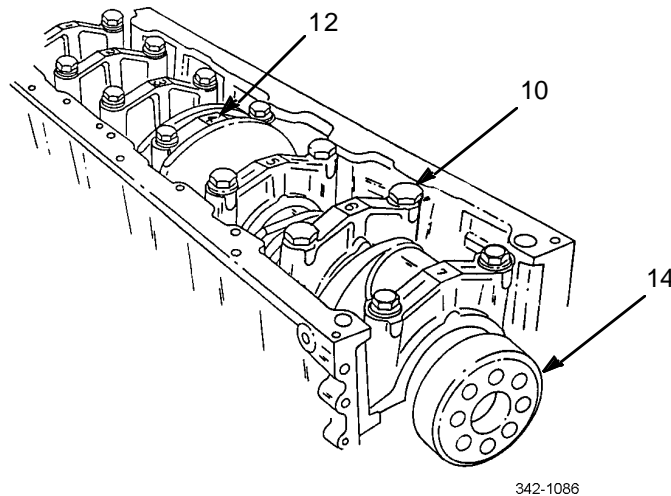
INSTALLATION - CONTINUED



NOTE

Crankshaft will turn freely if bearings are installed properly and all main bearing cap bolts are tightened properly.

10. Tighten all main bearing cap bolts (10) to 30-50 lb-ft (41-68 Nm). Turn crankshaft (14) 1/8 turn to ensure crankshaft is not binding within journals.
11. Beginning at center main bearing cap (12) and working progressively toward each end, tighten all main bearing cap bolts (10) to 173-195 lb-ft (235-264 Nm). Turn crankshaft (14) 1/8 turn to ensure crankshaft is not binding within journals.
12. Repeat tightening sequence and tighten each main bearing cap bolt (10) to 347-391 lb-ft (471-530 Nm). Turn crankshaft (14) 1/8 turn to ensure crankshaft is not binding within journals.



INSTALLATION - CONTINUED

NOTE

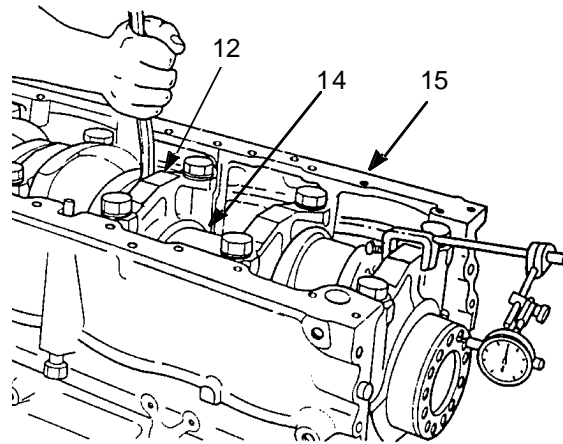
Crankshaft end play is controlled by thrust washers located at no. 6 upper main bearing saddle of engine. Oversize thrust washers are available to correct for excessive end play.

13. Install dial indicator on cylinder block (15) as shown.

NOTE

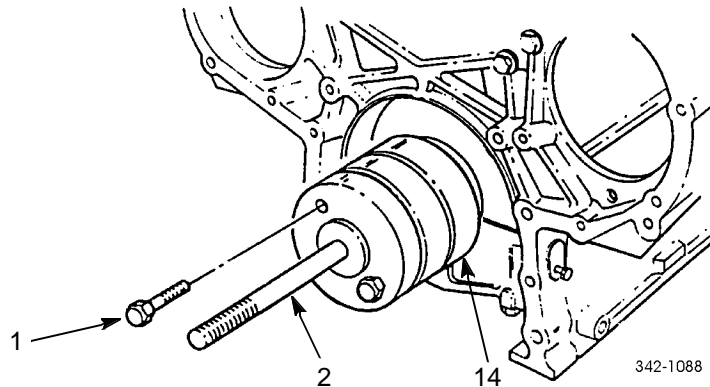
End play should be 0.004-0.017 (0.101-0.419 mm). Insufficient end play can be result of misaligned no. 6 main bearing, jammed upper thrust washer, or burr or dirt on inner face of one or more thrust washers.

14. Using small pry bar (less than 12 in long), move crankshaft (14) toward dial indicator to check crankshaft end play. Keep constant pressure on pry bar and zero pointer on dial indicator.
15. Remove and insert pry bar on other side of main bearing cap. Force crankshaft in opposite direction and note amount of end play on dial indicator.



342-1087

16. Using two crankshaft gear inserter/remover bolts (1), install crankshaft gear inserter/remover base post (2) on front end of crankshaft (14). Tighten bolts to 140-150 lb-ft (190-203 Nm).

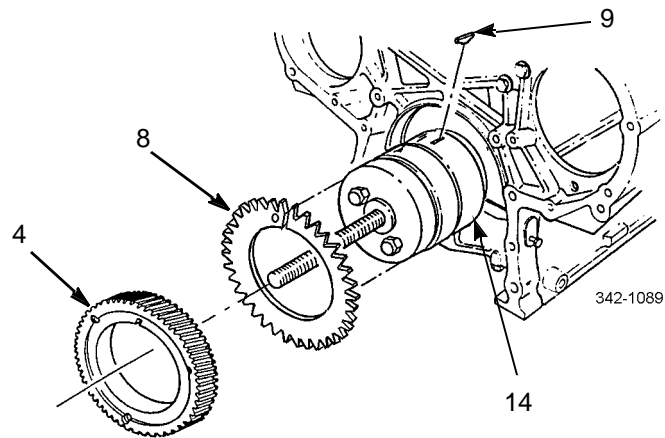


342-1088

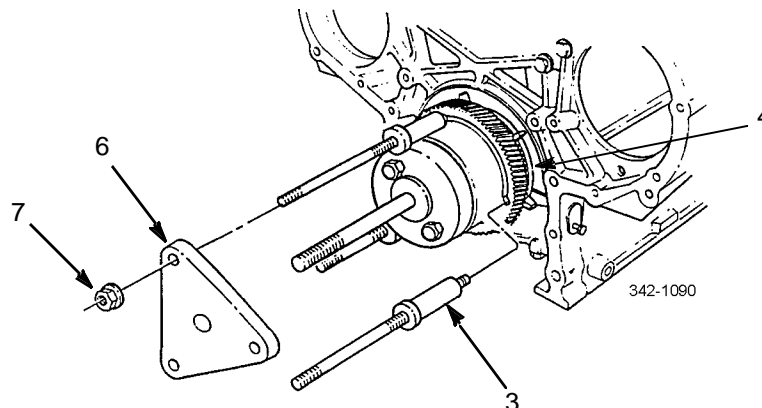
INSTALLATION - CONTINUED**NOTE**

Ensure woodruff key is fully seated and is parallel to crankshaft surface.

17. Install woodruff key (9) in keyway. Tap key with plastic mallet or brass hammer to seat it.
18. Index keyway of timing wheel (8) with woodruff key (9) in crankshaft (14). Slide timing wheel onto crankshaft, with word "out" on timing wheel (8) facing you. Slide timing wheel on as far as it will go by hand.
19. Coat bore of crankshaft timing gear (4) with a film of lubriplate. Index keyway of crankshaft timing gear (4) with woodruff key (9). Tap crankshaft timing gear with plastic hammer or fiber mallet to ensure woodruff key is started in keyway.



20. Install three crankshaft gear inserter/remover legs (3) in threaded holes in crankshaft timing gear (4). Tighten three inserter/remover legs.
21. Install crankshaft gear inserter/remover pressure plate (6) on three inserter/remover legs (3). Seat inserter/remover pressure plate against inserter/remover leg flanges.
22. Install three crankshaft gear inserter/remover retaining nuts (7) on inserter/remover legs (3). Thread retaining nuts past first set of inserter/remover leg threads. Slide retaining nuts past unthreaded portion of shafts and engage second set of threads. Tighten retaining nuts.



INSTALLATION - CONTINUED

23. Install hydraulic ram and pump (5) on crankshaft gear inserter/remover base post (2) threaded rod as shown. Install inserter/remover stop nut (26) on end of inserter/remover base post threaded rod. Tighten stop nut.

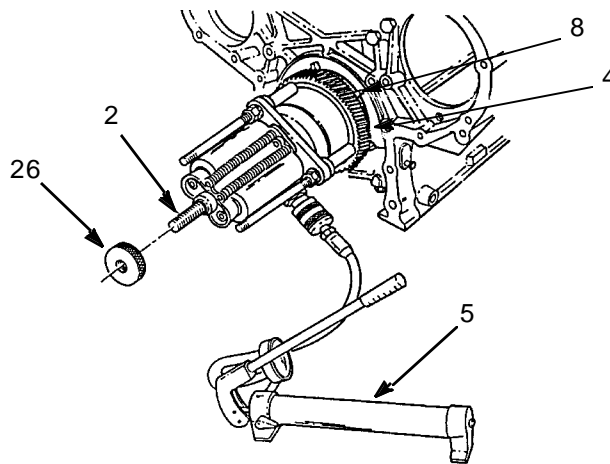
CAUTION

Ensure timing gear is indexed with woodruff key. Failure to do so could result in damage to equipment.

NOTE

Ensure timing wheel is firmly seated against crankshaft flange.

24. Operate hydraulic ram and pump (5) to press crankshaft timing gear (4) on crankshaft until timing gear is firmly seated against timing wheel (8). Obtain maximum force of 3.37 tons (30 kN) when pressing crankshaft timing gear on crankshaft.



342-1091

25. Remove crankshaft gear inserter/remover tool.
26. Measure gearlash between crankshaft timing gear and bull gear assembly. Gearlash must be 0.002-0.009 in (0.051-0.229 mm) for new parts and a maximum of 0.012 in (0.305 mm) for used parts.
27. Install bull/idler gear (WP 0037 00).
28. Install flywheel housing (WP 0024 00).
29. Install pistons and cylinder assemblies (WP 0041 00).
30. Install oil pump (WP0029 00).
31. Install timing reference sensor (TRS) (TM 9-2320-302-20).
32. Install synchronous reference sensor (SRS) (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Disassembly, Cleaning and Inspection, Assembly, Installation

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Dial indicator set (Item 29, WP 0126 00)

Insertor, gear (Item 49, WP 0126 00)

Press, arbor (Item 90, WP 0126 00)

Materials/Parts

Key, woodruff (P/N 8929810)

Ring, seal (P/N 23524912)

Materials/Parts - Continued

Ring, seal (P/N 8929318)

Adhesive (Item 1, WP 0125 00)

Detergent (Item 19, WP 0125 00)

Lubriplate (Item 23, WP 0125 00)

Oil, lubricating (Item 25, WP 0125 00)

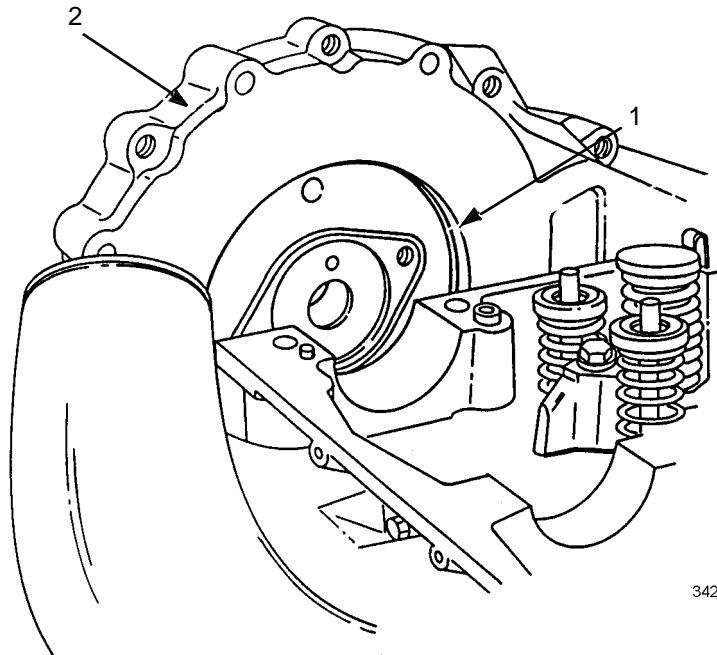
Equipment Condition

Camshaft and bearings removed (WP 0026 00)

Bull/idler gear removed (WP 0037 00)

REMOVAL

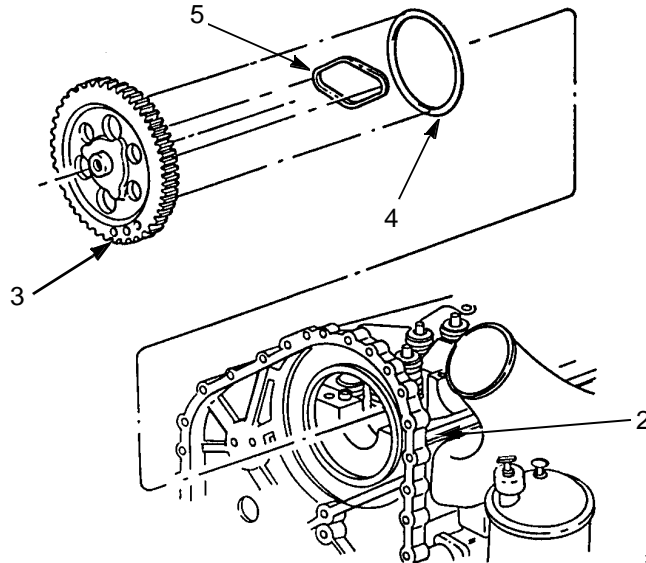
1. Tap rear face of camshaft gear assembly (1) with fiber or plastic mallet until camshaft gear assembly is free of gear housing (2).



342-912

REMOVAL - CONTINUED

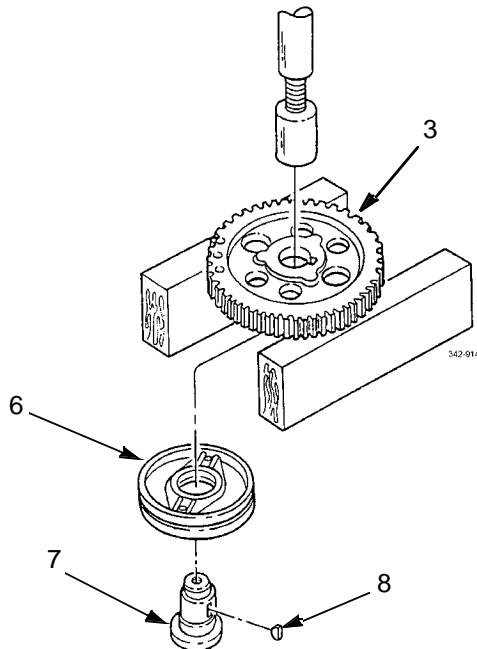
2. Remove camshaft drive gear assembly (3) from gear housing (2).
3. Remove and discard camshaft thrust plate seal ring (4).
4. Remove and discard racetrack-shaped seal (5).



342-913

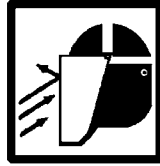
DISASSEMBLY

1. Support camshaft drive gear assembly (3) with camshaft thrust plate (6) facing down.
2. Press hub (7) out of camshaft drive gear.
3. Separate hub (7) from camshaft thrust plate (6).
4. Remove and discard woodruff key (8).



342-914

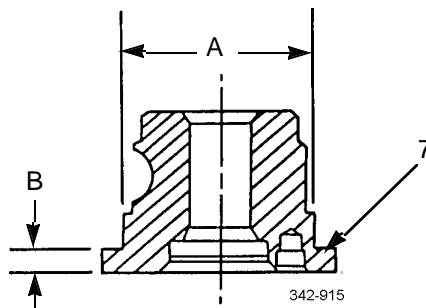
CLEANING AND INSPECTION



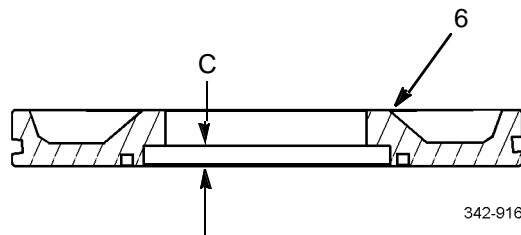
WARNING

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

1. Clean parts with detergent and water solution and dry with compressed air.
2. Inspect seal ring sealing surface of gear housing assembly, thrust plate, and head for cleanliness, burrs or damage.
3. Inspect woodruff key slot in hub and drive gear for evidence of cracks or wear. Replace camshaft drive gear assembly if key slot is damaged.
4. Inspect camshaft drive gear teeth for scoring, pitting or excessive wear. If scoring, pitting or excessive wear is evident, discard gear.
5. Inspect camshaft drive gear hub (7) for scoring, pitting or galling. If excessive, discard hub. Measure diameter (A). Minimum dimension should be 2.283 in (58.0 mm). Measure thrust plate contact area (B). Minimum dimension should be 0.254 in (6.45 mm). If any dimensions are below minimum, discard hub.



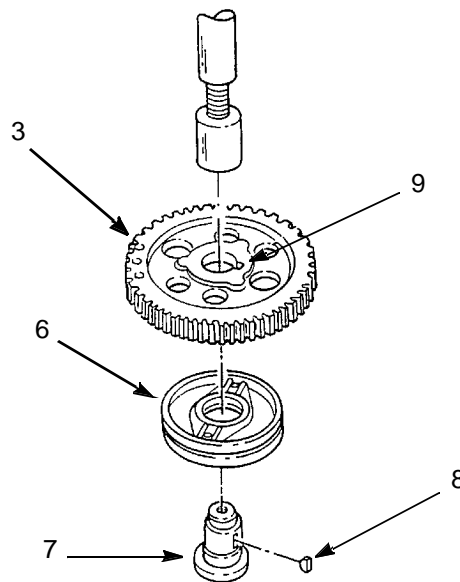
6. Inspect camshaft thrust plate (6) for scoring, pitting or galling. If scoring, pitting or galling is evident, discard thrust plate. Measure thrust plate contact area (C). Minimum dimension should be 0.437 in (11.1 mm). If measurement is below minimum, discard thrust plate



ASSEMBLY**NOTE**

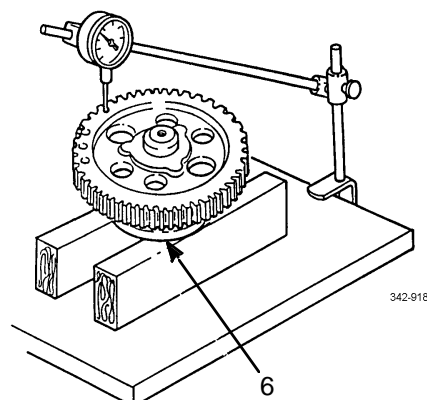
Minimum force of 4500 lb (20 kN) must be obtained when pressing gear on hub. When pressing, only apply force to inner hub of gear.

1. Lubricate contact surfaces of drive gear hub (7) and camshaft thrust plate (6) with clean engine lubricating oil.
2. Install drive gear hub (7) on camshaft thrust plate (6).
3. Install new woodruff key (8) in keyway of drive gear hub (7).
4. Apply a thin film of lubricate to bore of camshaft drive gear (3).
5. Support drive gear hub (7) from engine side. Align keyway (9) of camshaft drive gear (3) with woodruff key (8) in drive gear hub. Press camshaft drive gear onto drive gear hub until gear is firmly seated against hub shoulder.



342-917

6. Support camshaft drive gear thrust plate (6), as shown. With dial indicator, measure camshaft drive gear face runout just inboard of drive gear teeth. Zero dial indicator. Rotate drive gear two full rotations. Maximum allowable total indicated runout is 0.0045 in (0.114 mm).



342-918

INSTALLATION

1. Lubricate new camshaft thrust plate seal ring (4) with clean engine lubricating oil. Install seal ring on thrust plate (6).

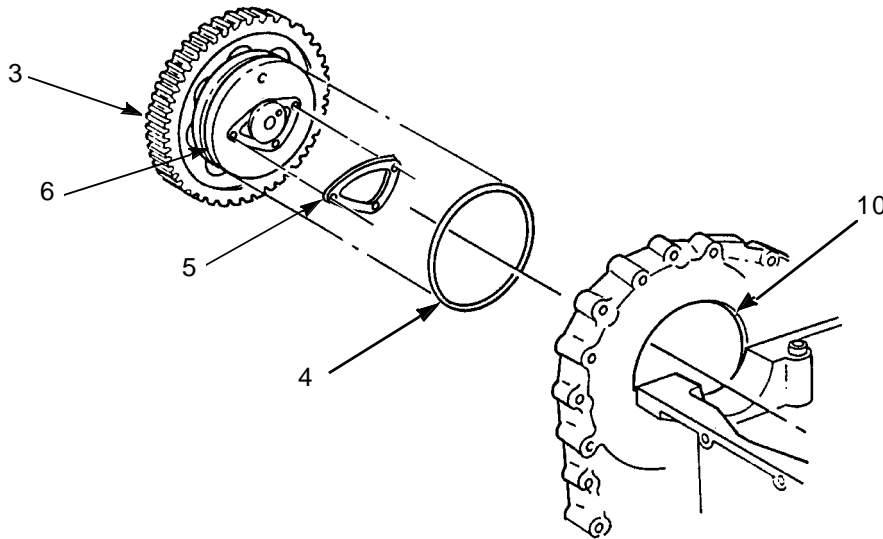


Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water.

CAUTION

Apply adhesive on racetrack-shaped seal only, not on face of thrust plate. Failure to do so could result in damage to equipment.

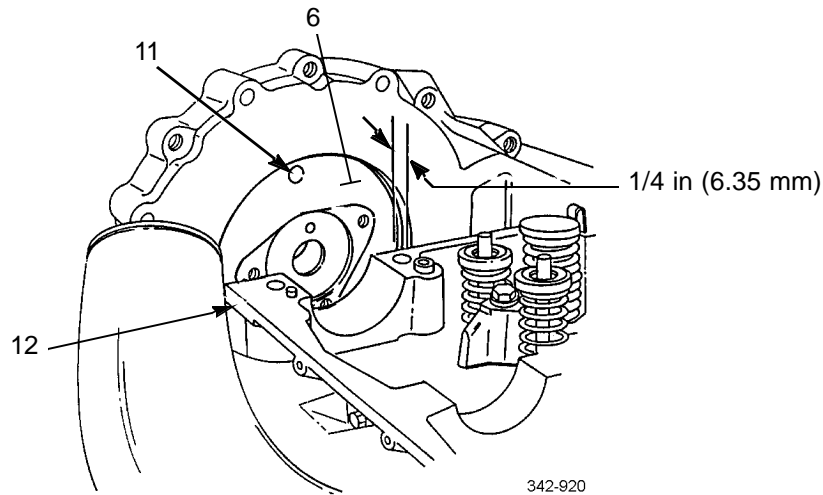
2. Apply a thin coat of adhesive on one side of new racetrack-shaped seal (5). Install seal on engine side of thrust plate (6).
3. Install camshaft drive gear assembly (3) in gear housing opening (10).



342-919

INSTALLATION - CONTINUED

4. Ensure that dimple (11) on rear face of thrust plate (6) is positioned at 12 o'clock. If necessary, tap camshaft drive gear hub toward engine with fiber or plastic mallet until rear face of thrust plate is 1/4 in (6.35 mm) from face of cylinder head (12). Ensure that thrust plate is not tilted in bore.



5. Install camshaft and bearings (WP 0026 00).
6. Install bull/idler gear (WP0037 00).

END OF WORK PACKAGE

GEAR HOUSING ASSEMBLY REPLACEMENT

0035 00

THIS WORK PACKAGE COVERS

Removal, Cleaning and Inspection, Installation

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Clamp, material lift (Item 20, WP 0126 00)

Dispenser, sealant (Item 30, WP 0126 00)

Plate, indexing (Item 83, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Ring, seal (P/N 8929740)

Washer (P/N 5155596)

Washer (P/N 5180370)

Compound, gasket forming (Item 12, WP 0125 00)

Rope, 1/2 in nylon (Item 32, WP 0125 00)

Personnel Required

Two

Equipment Condition

Engine installed on repair stand

Camshaft and bearings removed (WP 0026 00)

Timing reference sensor (TRS) removed (TM 9-2320-302-20)

Synchronous reference sensor (SRS) removed (TM 9-2320-302-20)

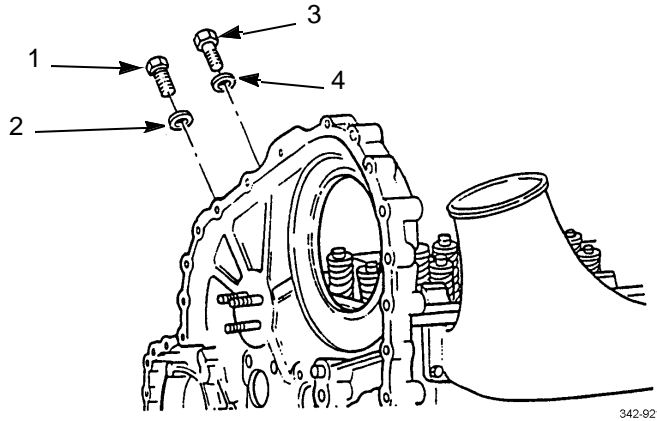
Bull/idler gear removed (WP 0037 00)

Adjustable idler gear removed (WP 0038 00)

Camshaft drive gear removed (WP 0034 00)

REMOVAL

1. Remove bolt (1) and washer (2) from adjustable idler gear oil supply hole. Discard washer.
2. Remove bolt (3) and washer (4) from adjustable idler gear holding access hole. Discard washer.



342-921

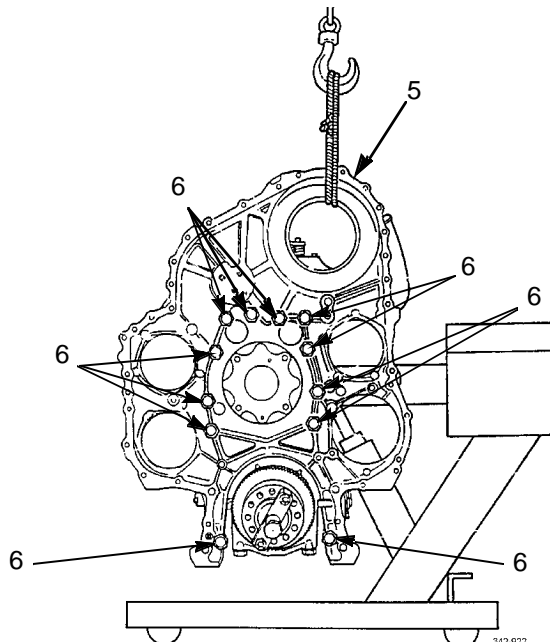


WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

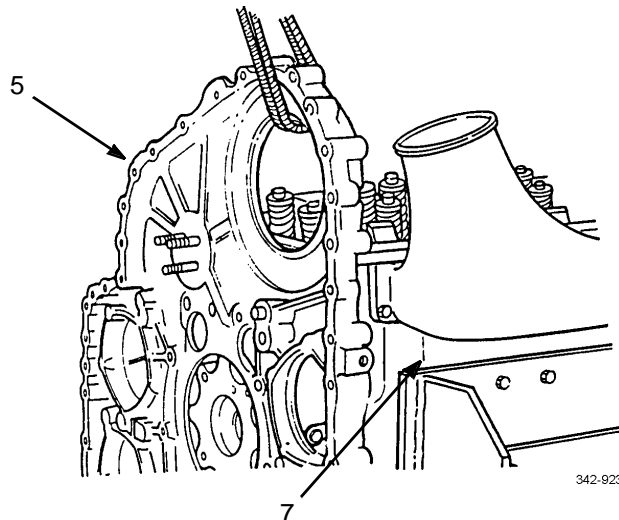
3. Using suitable lifting device and 1/2 in nylon rope through camshaft thrust plate opening, support gear housing assembly (5) and remove 12 bolts (6).



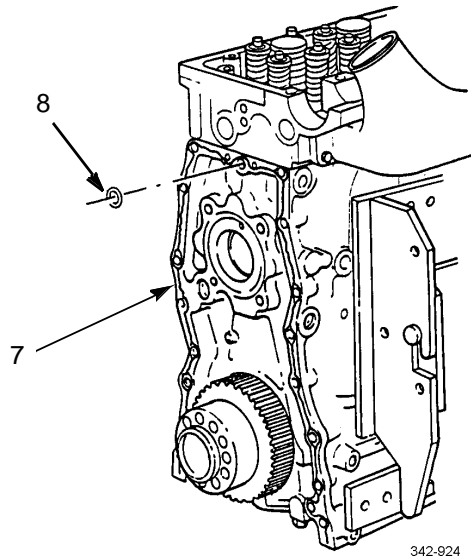
342-922

REMOVAL - CONTINUED

- Using fiber or plastic mallet, tap rear face of gear housing assembly (5) to loosen gear housing assembly from cylinder block (7). Remove gear housing assembly.



- Remove and discard seal ring (8) from counterbore at top center front face of cylinder block (7).

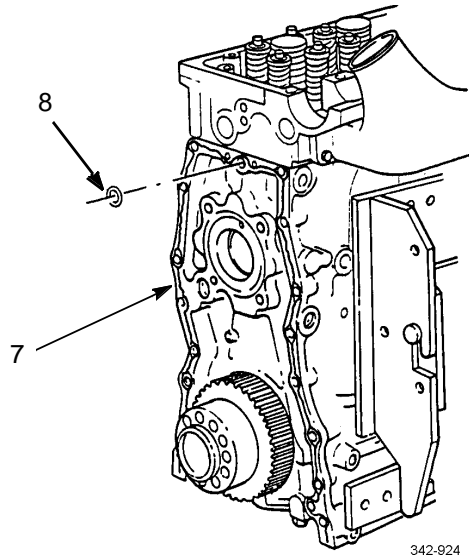
**CLEANING AND INSPECTION**

- Use general cleaning methods to clean all parts. Remove all old gasket forming compound from mating surfaces of gear housing assembly and cylinder block.
- Inspect all parts for wear or damage.

INSTALLATION**CAUTION**

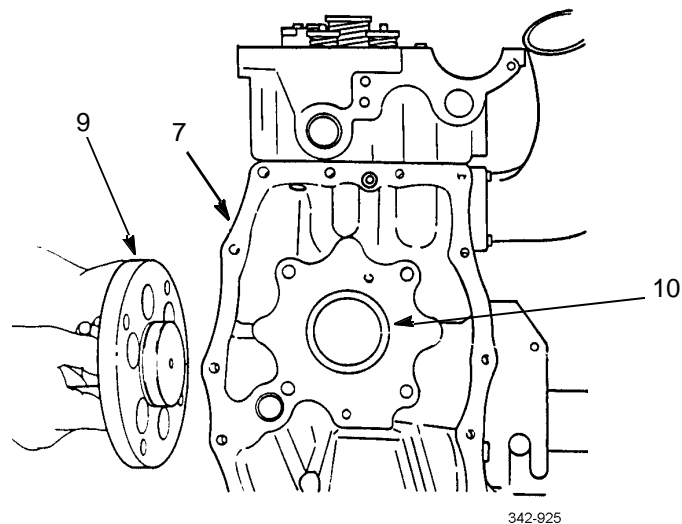
Application of gasket forming compound to gear housing-to-cylinder block mating surfaces at top of cylinder block is critical to prevent damage to equipment.

1. Apply 1/16 in bead of gasket forming compound to cylinder block (7). Smooth bead around block-to-gear housing oil passage carefully to avoid contamination or plugging of oil hole.
2. Install new seal ring (8) in counterbore on top front face of cylinder block (7).

**CAUTION**

Bull/idler gear hub recess must be clean and free of foreign material before installing gear case indexing plate to prevent damage to equipment.

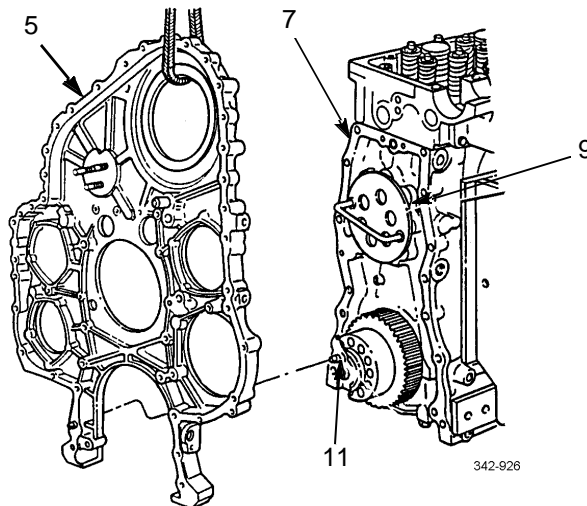
3. Install gear case indexing plate (9) on bull/idler gear hub recess (10) in cylinder block (7).



INSTALLATION - CONTINUED**WARNING**

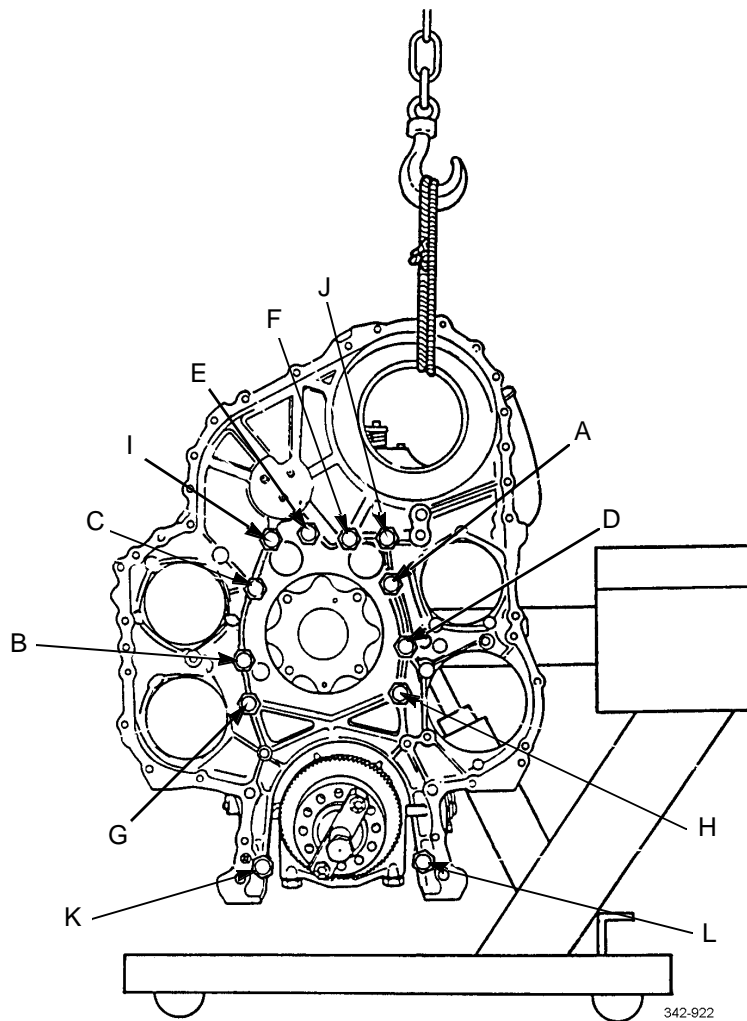
Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

4. Using suitable lifting device and 1/2 in nylon rope through camshaft thrust plate opening, support gear housing assembly (5). Position bull/idler gear hub opening in gear case over gear case indexing plate (9).
5. Index hole in gear housing assembly (5) left leg with diamond dowel (11) in lower left corner of cylinder block (7). Seat gear housing assembly firmly against cylinder block.

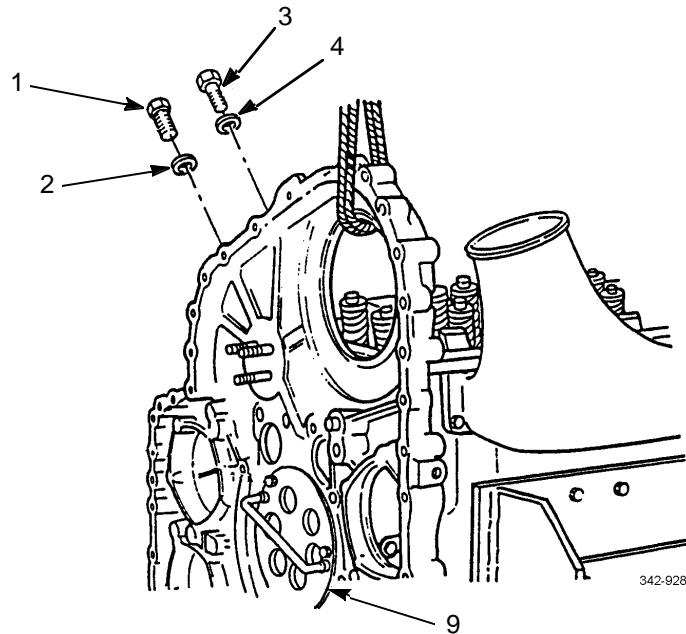


INSTALLATION - CONTINUED

6. Install three shorter bolts in locations E, F, and I.
7. Install nine longer bolts in locations A through D, G, H, and J through L.
8. Tighten bolts to 43-54 lb-ft (58-73 Nm), in letter sequence shown.

**TIGHTENING SEQUENCE**

9. Remove gear case indexing plate (9).
10. Install bolt (1) and new washer (2) in adjustable idler gear oil supply hole. Tighten bolt to 15-19 lb-ft (20-26 Nm).
11. Install bolt (3) and new washer (4) in adjustable idler gear holding access hole. Tighten bolt to 43-54 lb-ft (58-73 Nm).

INSTALLATION - CONTINUED

12. Install camshaft drive gear (WP0034 00).
13. Install adjustable idler gear (WP0038 00).
14. Install bull/idler gear (WP0037 00).
15. Install synchronous reference sensor (SRS) (TM 9-2320-302-20).
16. Install timing reference sensor (TRS) (TM 9-2320-302-20).
17. Install camshaft and bearings (WP 0026 00).

END OF WORK PACKAGE

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CYLINDER BLOCK ASSEMBLY REPAIR

0036 00

THIS WORK PACKAGE COVERS

Disassembly, Cleaning and Inspection, Assembly

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Bolts, eye (Item 9, WP 0126 00)
- Bolts, eye (Item 10, WP 0126 00)
- Caliper, micrometer, inside (Item 14, WP 0126 00)
- Handle, installer (Item 46, WP 0126 00)
- Insert set, dowel (Item 55, WP 0126 00)
- Installer set, cup plug (Item 72, WP 0126 00)
- Puller kit, universal (Item 97, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)
- Wrench set, socket, 3/4 in drive (Item 141, WP 0126 00)

Materials/Parts

- Plug, cup (P/N 5139988) (2)
- Plug, cup (P/N 5139991) (5)
- Adhesive, loctite (Item 3, WP 0125 00)
- Compound, corrosion preventive (Item 11, WP 0125 00)
- Compound, international no. 2 (Item 13, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)

Personnel Required

Two

References

- TM 9-237
- WP 0040 00

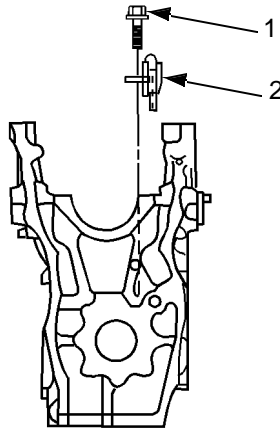
Equipment Condition

- Electronic control module removed (TM 9-2320-302-20)
 - Engine injector wiring harness removed (WP 0069 00)
 - Fuel filter adapters removed (TM 9-2320-302-20)
 - Oil pressure and oil temperature sending units removed (TM 9-2320-302-20)
 - Oil cooler, core, and oil filter adapter removed (TM 9-2320-302-20)
 - Oil dipstick and tube removed (TM 9-2320-302-20)
 - Oil fill tube removed (TM 9-2320-302-20)
 - Cylinder head removed (WP 0018 00)
 - Pistons and cylinder assemblies removed (WP 0041 00)
 - Crankshaft removed (WP 0033 00)
 - Gear housing assembly removed (WP 0035 00)
-

DISASSEMBLY**NOTE**

Cylinder block repair conditions may warrant cylinder block pressure testing before complete block disassembly. Perform testing before removing cylinder liners, cup plugs, and pipe plugs. (Refer to *Cylinder Block Pressure Testing*, WP 0040 00).

1. Turn cylinder block so bottom side is up and remove six bolts (1) and oil spray nozzles (2).



342-892

NOTE

Determine left and right sides of cylinder block by viewing cylinder block from rear (flywheel housing end).

2. Position cylinder block to view right side.

NOTE

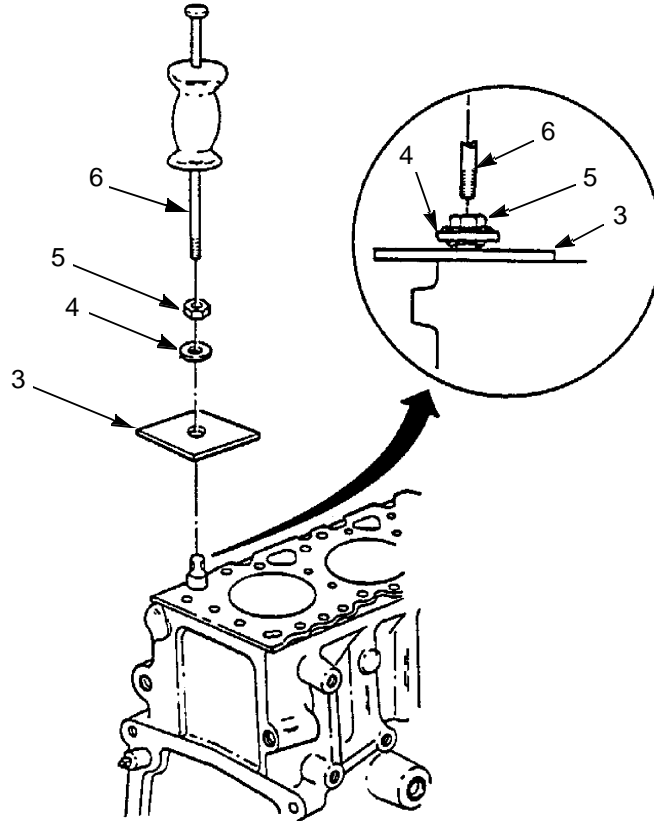
- Procedure is the same for round, diamond or hollow dowels.
 - Replace dowels and plugs only if necessary.
 - Cover exposed areas to guard against welding sparks.
3. If damaged, remove dowels by fabricating a piece of sheet brass (3) with hole large enough to fit over dowel being removed.
 4. Tack weld flat washer (4) to top of sheet brass (3) as shown.

NOTE

Ensure thread of nut matches thread of slide hammer shaft.

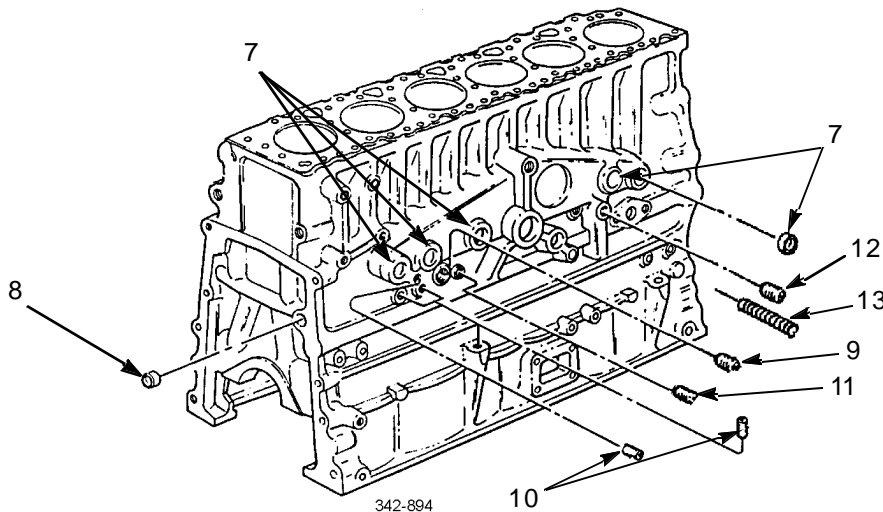
5. Tack weld nut (5) to flat washer (4).
6. Thread slide hammer shaft (6) into nut and remove dowel.

DISASSEMBLY - CONTINUED



342-893

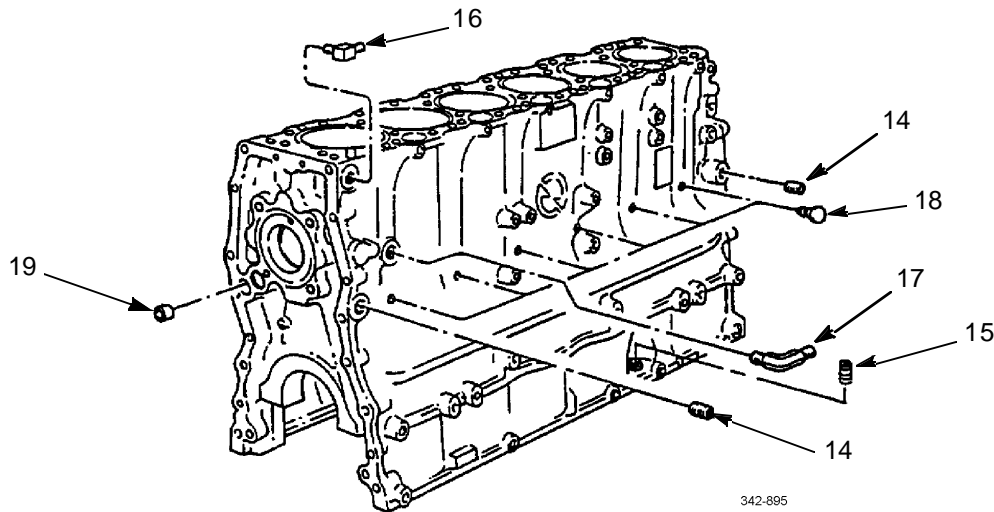
7. If damaged, pierce five cup plug(s) (7) and cup plug (8) with screwdriver or chisel. Remove and discard plug(s).
8. Remove seven pipe plugs (9, 10, 11, and 12) and stud (13).



342-894

DISASSEMBLY - CONTINUED

9. Position cylinder block to view left side.
10. Remove two pipe plugs (14) and pipe plug (15).
11. Remove air compressor oil supply line elbow (16).
12. If installed, remove air compressor coolant supply elbow (17).
13. Remove six weep hole plugs (18).
14. Pierce cup plug (19) with screwdriver or chisel. Remove and discard plug.



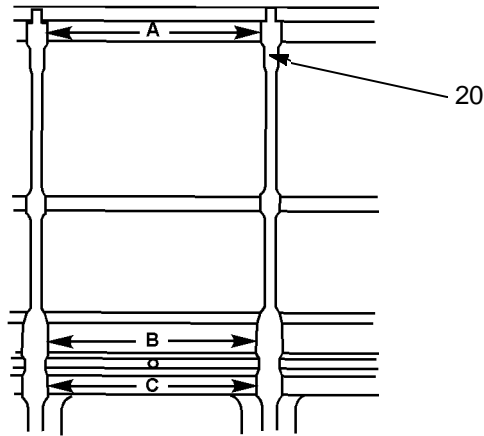
CLEANING AND INSPECTION

1. Use general cleaning methods to clean all parts.
2. Measure each cylinder bore (20) using inside micrometer.
3. Measure each cylinder bore for following dimensions at locations A, B, and C on axis 90 degrees apart. Dimensions are average gage readings at each location (Table 1). Taper and out-of-round should not exceed 0.001 in (0.0253 mm):

Table 1. Cylinder Bore Dimensions.

LOCATION	DIMENSION
A	5.868-5.871 in (149.050-149.120 mm)
B	5.750-5.753 in (146.050-146.120 mm)
C	5.750-5.753 in (146.050-146.120 mm)

CLEANING AND INSPECTION - CONTINUED



342-896

4. If any of above measurements are exceeded, replace cylinder block.

NOTE

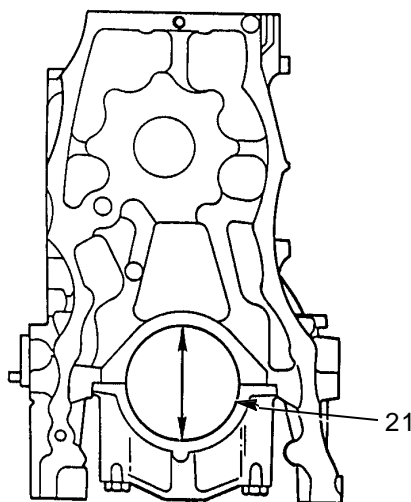
Perform step 5 before gaging main bearing bores.

5. Install main bearing caps in original positions. Lubricate cap bolt threads and head contact surfaces with a small amount of international compound no. 2. Install and tighten main cap bolts to 347-391 lb-ft (470-530 Nm).

NOTE

Replace engine block if not within specification.

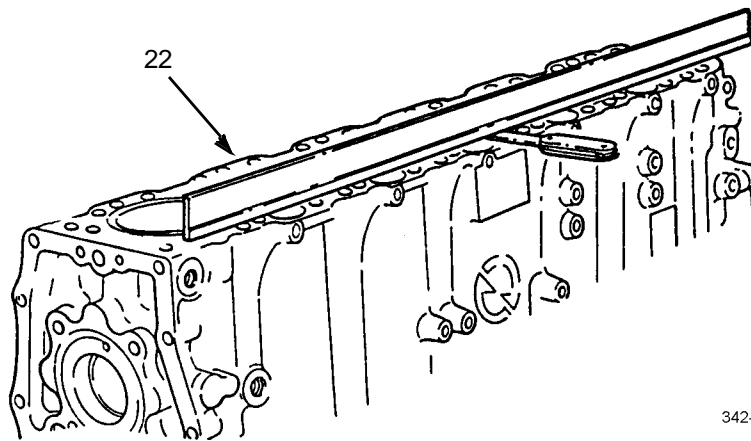
6. Measure each crankshaft main bearing bore (21) in vertical axis with inside micrometer. Dimension should be 5.236-5.237 in (133.000-133.025 mm). If dimension exceeds limits, replace cylinder block.



342-897

CLEANING AND INSPECTION - CONTINUED

7. Check cylinder block deck (22) for flatness with straightedge and thickness gage.

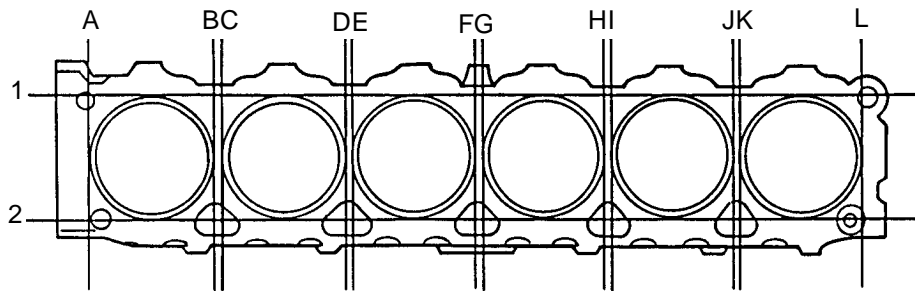


342-898

NOTE

Because camshaft is mounted in cylinder head, resurfacing of block and/or head affects position of camshaft in relation to adjustable idler gear and gear train. Limit resurfacing on cylinder block to maximum of 0.01 in (0.25 mm). Limit resurfacing on block and head to combined total of 0.03 in (0.75 mm). If limits are exceeded, replace cylinder block.

8. Check front-to-rear flatness, next to cylinder liner flanges on both sides, and side-to-side flatness between liner flanges, as shown. Deck must be flat within 0.005 in (0.127 mm) front-to-rear and 0.003 in (0.076 mm) side-to-side. If not, resurface cylinder block.

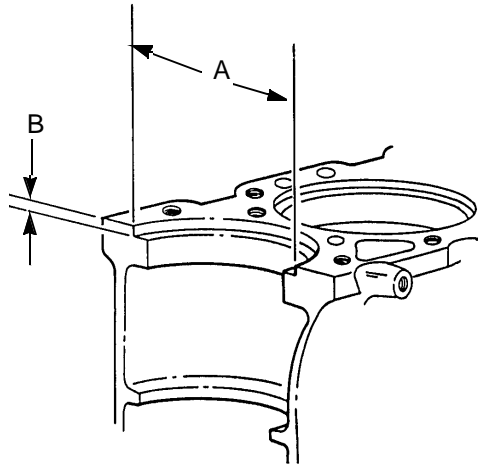


342-899

9. Spray machined surfaces with engine lubricating oil if cylinder block is not to be used immediately. Spray or dip cylinder block in corrosion preventive compound for extended storage.

CLEANING AND INSPECTION - CONTINUED

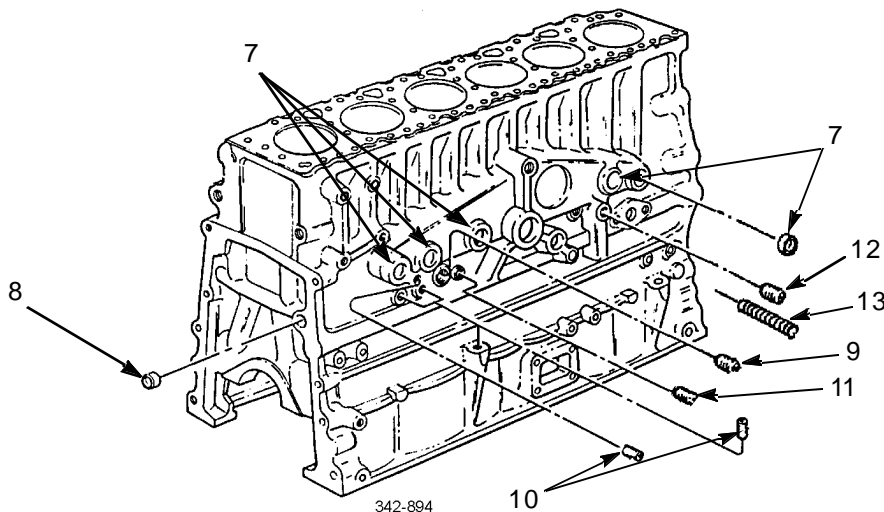
10. Measure cylinder liner counterbore diameter (A) and depth (B). Diameter should be 6.186-6.191 in (157.15-157.25 mm). Depth should be 0.3514-0.3533 in (8.9256-8.9746 mm).



342-900

ASSEMBLY

1. Coat outside sealing edge of five 1-1/2 in diameter cup plugs (7) with loctite adhesive. Using single-side plug installer and handle, install five cup plugs to 0.098-0.118-in (2.5-3.0 mm) below machined surfaces on right side of cylinder block.
2. Coat outside sealing edge of 1.062 in cup plug (8) with loctite adhesive. Using small end of double-ended plug installer and driver handle, install cup plug 0.098-0.118 in (2.5-3.0 mm) below machined surface of rear of cylinder block.
3. Install 3/8 in pipe plug (9) and pipe plug (12).
4. Install four 1/4 in pipe plugs (10 and 11).
5. Install stud (13).



342-894

ASSEMBLY - CONTINUED

6. Position cylinder block to view left side.
7. Coat outside sealing edge of 1.062 in cup plug (19) with loctite adhesive. Using small end of double-ended plug installer and handle, install cup plug 0.098-0.118 in (2.5-3.0 mm) below machined surface of front of cylinder block.
8. Install two 3/8 in pipe plugs (14) and 1/4 in pipe plug (15).

NOTE

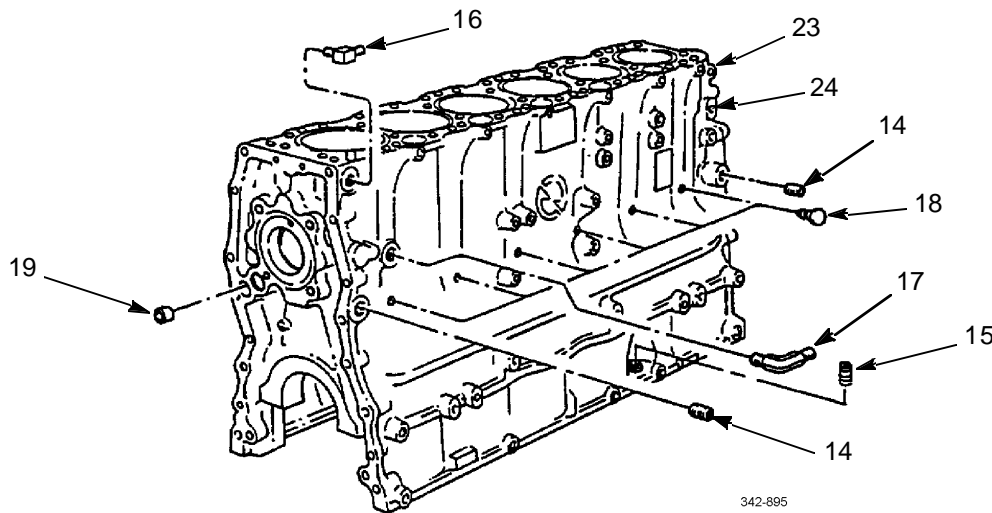
Cylinder block repair conditions may warrant cylinder block pressure testing before complete block assembly. Perform testing after installing cylinder liners, cup plugs, and pipe plugs. (Refer to *Cylinder Block Pressure Testing*, WP 0040 00).

9. Install air compressor oil supply line elbow (16).
10. Install air compressor coolant supply elbow (17).

NOTE

If cylinder block is not being placed in service, perform steps 11 through 15.

11. Install 1/4 in pipe plugs in tapped holes for oil pressure sensor (23) and oil temperature sensor (24).
12. Install 1/4 in pipe plug in place of air compressor oil supply line elbow (16).
13. Install 1/2 in pipe plug in place of air compressor coolant supply elbow (17).
14. Install six plastic weep hole plugs (18).

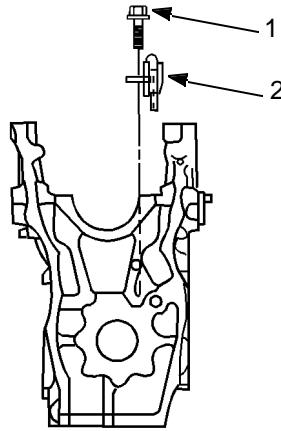


15. Spray or dip cylinder block in corrosion preventive compound for extended storage.

CAUTION

New cylinder blocks are supplied with cover plates in place of oil spray nozzles, which are used to lubricate and cool down pistons. Cover plates must be removed and oil spray nozzles installed in their place. Failure to install nozzles will result in severe engine damage.

16. Turn cylinder block bottom side up and install six oil spray nozzles (2) and bolts (1). Tighten bolts to 22-28 lb-ft (30-38 Nm).

ASSEMBLY - CONTINUED

342-892

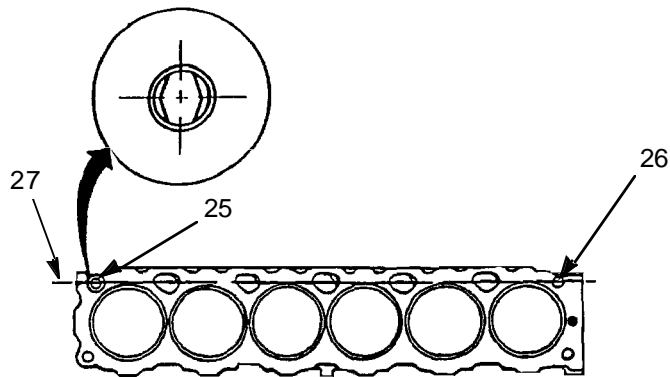
CAUTION

Ensure that diamond dowels are correctly aligned. Orientation is critical to component alignment. Failure to correctly align diamond dowels could result in engine failure.

NOTE

If new cylinder block is being placed in service, perform steps 17 through 22.

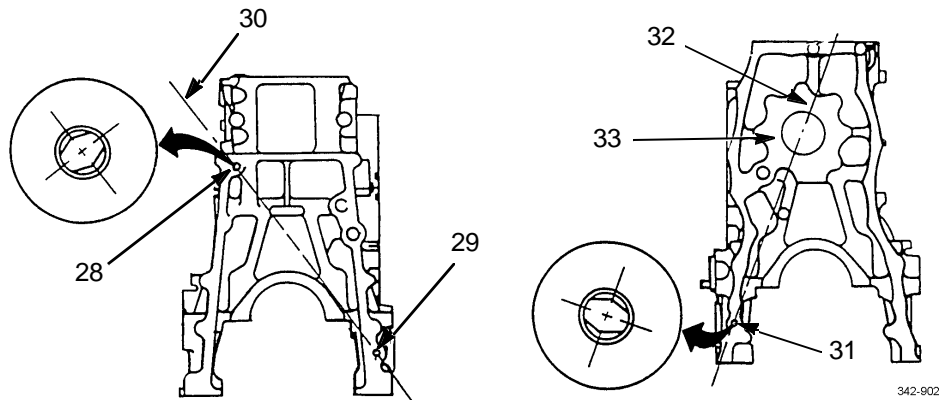
17. Using dowel inserter set, install diamond dowel (25) and round dowel (26) in cylinder block fire deck to height of 0.472 ± 0.002 in (12.0 ± 0.5 mm). Angular orientation of diamond dowel must be perpendicular to centerline (27) through round and diamond dowels within 4 degrees.



342-901

ASSEMBLY - CONTINUED

18. Using dowel inserter set, install diamond dowel (28) and round dowel (29) in rear face of cylinder block to height of 0.472 ± 0.002 in (12.0 ± 0.5 mm). Angular orientation of diamond dowel must be perpendicular to centerline (30) through round and diamond dowels within ± 4 degrees.
19. Using dowel inserter set, install diamond dowel (31) in front face of cylinder block to height of 0.472 ± 0.002 in (12.0 ± 0.5 mm). Angular orientation of diamond dowel must be perpendicular to centerline (32) through bull gear pilot bore (33) and diamond dowel within 4 degrees.



20. Install air compressor oil supply line elbow.
21. Install air compressor coolant supply elbow.
22. Perform cylinder block pressure testing (WP 0040 00).
23. Install six plastic weep hole plugs.
24. Install crankshaft (WP 0033 00).
25. Install pistons and cylinder assemblies (WP 0041 00).
26. Install cylinder head (WP 0018 00).
27. Install gear housing assembly (WP 0035 00).
28. Install oil cooler, core, and oil filter adapter (TM 9-2320-302-20).
29. Install oil fill tube (TM 9-2320-302-20).
30. Install oil dipstick and tube (TM 9-2320-302-20).
31. Install fuel pump and lines (TM 9-2320-302-20).
32. Install fuel filter adapters (TM 9-2320-302-20).
33. Install electronic control module (TM 9-2320-302-20).
34. Install engine injector wiring harness (WP 0069 00).
35. Install oil temperature and oil pressure sending units (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Cleaning and Inspection, Installation

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Alignment stud set (Item 7, WP 0126 00)

Barring tool, engine (Item 8, WP 0126 00)

Dial indicator set (Item 29, WP 0126 00)

Tools and Special Tools - Continued

Protector, crankshaft (Item 92, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Equipment Condition

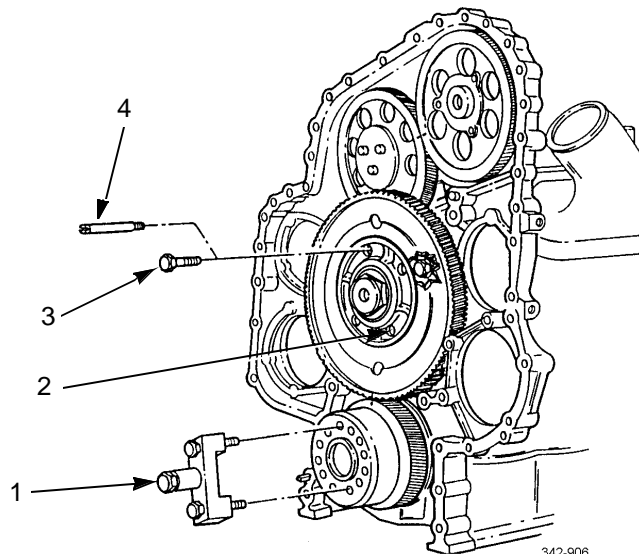
Gear case cover removed (WP 0019 00)

Rocker arm assemblies removed (WP 0027 00)

Engine installed on repair stand

REMOVAL

1. Install engine barring tool (1) on front end of crankshaft. Bar engine over until four access holes (2) in bull/idler gear line up with four bolts (3) in cylinder block.
2. Remove two upper bolts (3) and install two guide studs (4).



BULL/IDLER GEAR REPLACEMENT - CONTINUED

0037 00

REMOVAL - CONTINUED

3. Install crankshaft protector (5) on end of crankshaft over engine barring tool (1).
4. Remove two lower bolts (3).

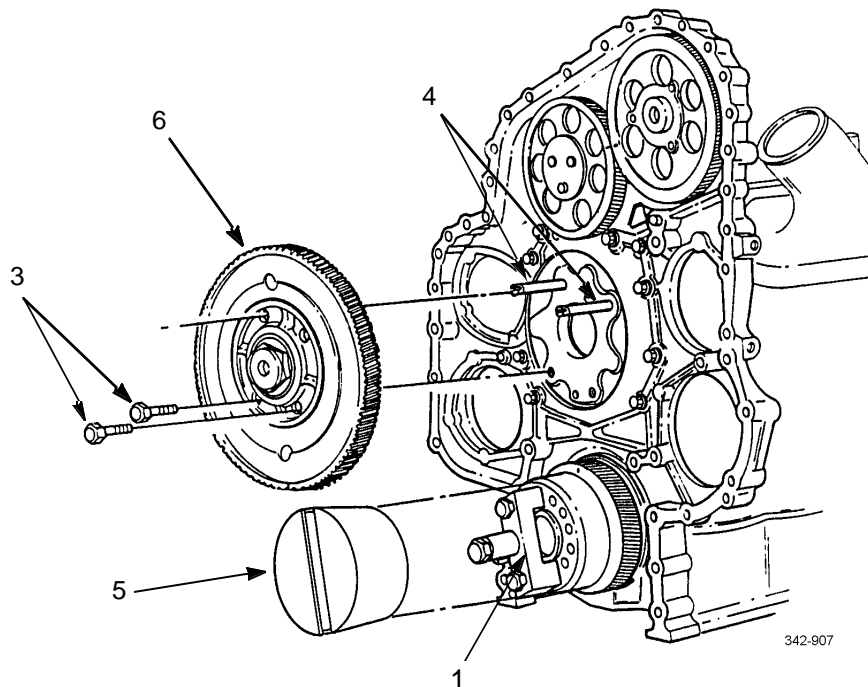
CAUTION

Do not allow bull/idler gear to come in contact with crankshaft oil seal contact surface. Oil leaks may result if this surface is scratched.

NOTE

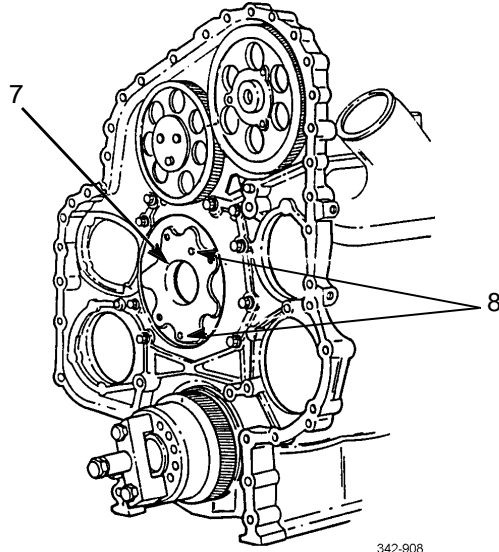
Bull/idler gear will rotate slightly as it is being removed.

5. Grasp bull/idler gear (6) and pull out of cylinder block recess.
6. Remove two guide studs (4).

**CLEANING AND INSPECTION**

1. Use general cleaning methods to clean all parts.
2. Inspect bull/idler gear recess (7) in cylinder block. Ensure surfaces are clean and free of foreign material or damage and that two lubrication holes (8) are clear.

CLEANING AND INSPECTION - CONTINUED



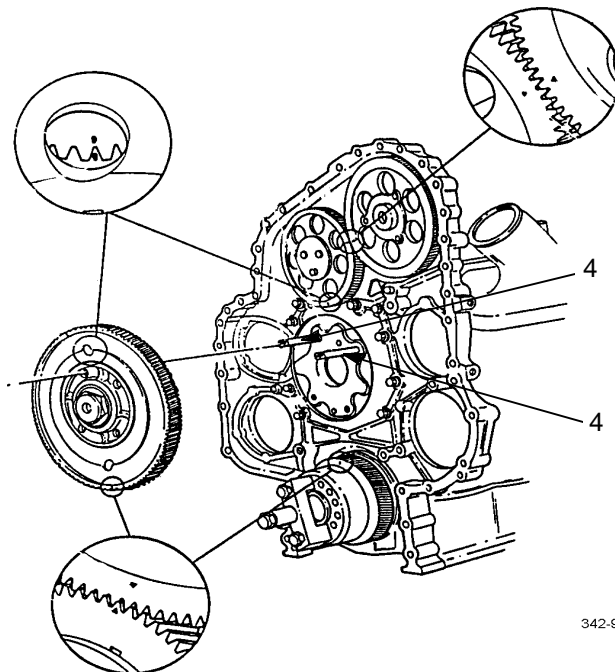
3. Inspect all parts for wear or damage.

INSTALLATION

CAUTION

Ensure all timing marks are aligned as shown. Failure to do so will result in engine damage.

1. Install two guide studs (4) in two upper bull/idler gear bolt holes.



INSTALLATION - CONTINUED

2. Bar engine over until crankshaft timing gear timing mark (9) is at 12 o'clock position.
3. Align timing mark (10) on camshaft drive gear with timing mark (11) on adjustable gear.

CAUTION

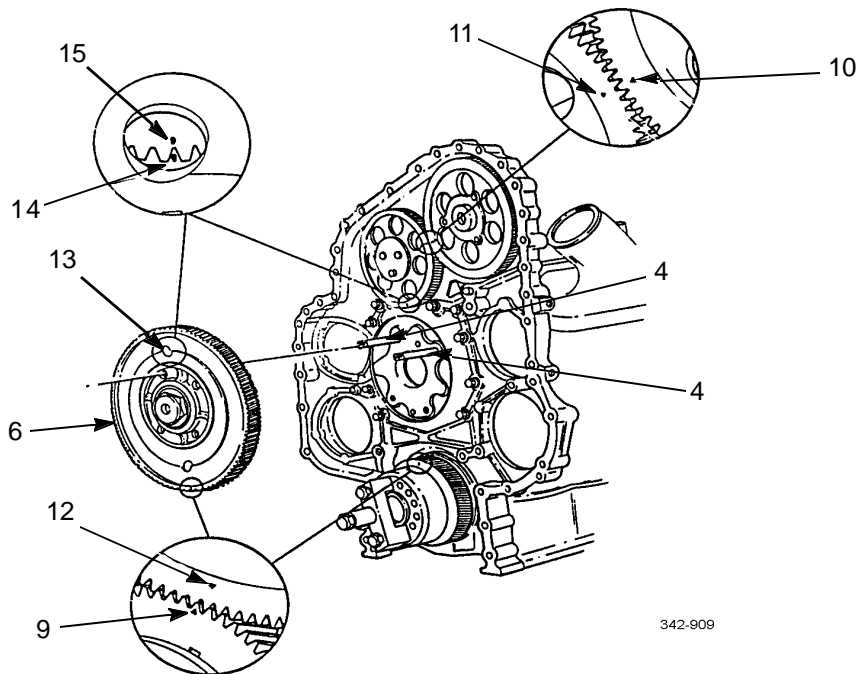
Do not allow bull/idler gear to come in contact with crankshaft oil seal contact surface. Oil leaks may result if this surface is scratched.

4. Install bull/idler gear (6) on two guide studs (4). Slide assembly toward engine, but do not engage any gears.
5. Align timing mark (12) on bull/idler gear (6) with timing mark (9) on crankshaft timing gear. Engage bull/idler gear and crankshaft timing gear only enough to prevent rotation of bull/idler gear.

NOTE

Slight rotation of adjustable idler gear may be necessary to align timing marks.

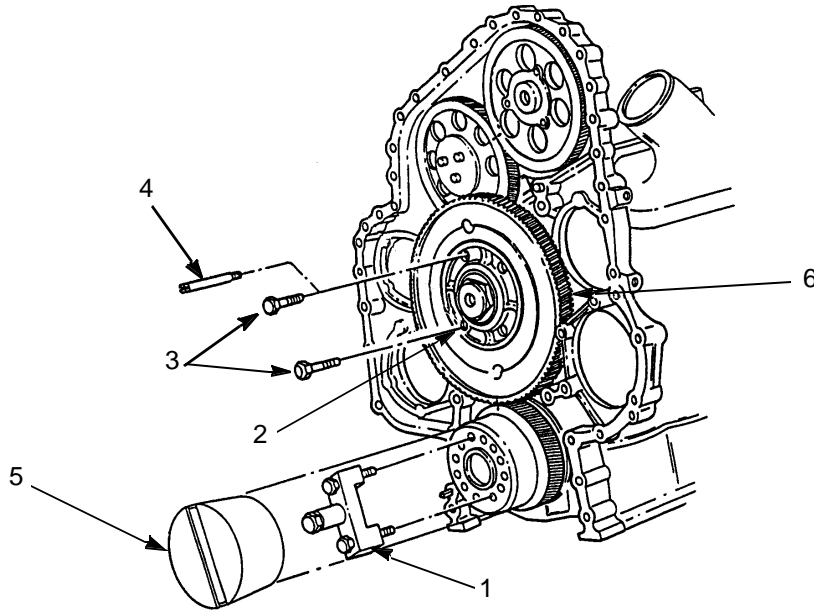
6. Looking through viewing hole (13) in bull/idler gear (6), align timing mark (14) on adjustable idler gear with timing mark (15) on camshaft idler gear.
7. Slide bull/idler gear (6) toward engine, engaging adjustable gear, and seat assembly in recess of gear case and cylinder block.



342-909

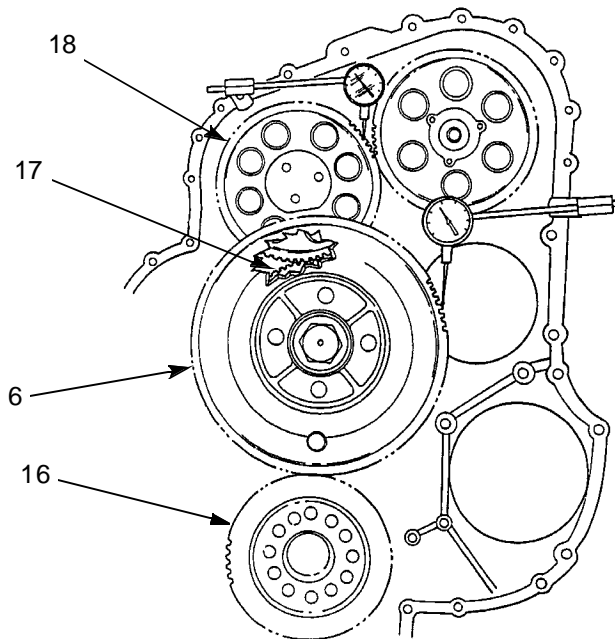
8. Working through two access holes (2) in bull/idler gear (6), install two mounting bolts (3) through hub and into cylinder block. Tighten bolts hand tight.
9. Remove two guide studs (4) and install two remaining mounting bolts (3). Tighten four bolts to 75-86 lb-ft (102-117 Nm).
10. Remove crankshaft protector (5) and engine barring tool (1).

INSTALLATION - CONTINUED



342-910

11. Measure gear lash between crankshaft timing gear (16) to bull/idler gear (6). Allowable lash is 0.002-0.009 in (0.051-0.229 mm) for new parts and a maximum of 0.012 in (0.305 mm) for used parts.
12. Measure gear lash between camshaft idler gear (17) to adjustable idler gear (18). Allowable lash is 0.002-0.009 in (0.051-0.229 mm) for new parts and a maximum of 0.012 in (0.305 mm) for used parts.



342-911

BULL/IDLER GEAR REPLACEMENT - CONTINUED

0037 00

INSTALLATION - CONTINUED

13. Install rocker arm assemblies (WP 0027 00).
14. Install gear case cover (WP0019 00).

END OF WORK PACKAGE

ADJUSTABLE IDLER GEAR REPLACEMENT

0038 00

THIS WORK PACKAGE COVERS

Removal, Inspection, Installation, Adjustment

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Adjuster, lash, cam (Item 5, WP 0126 00)
- Barring tool, engine (Item 8, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

- Cloth, abrasive (Item 9, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)

References

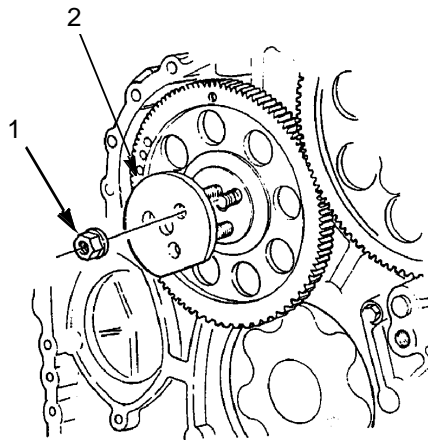
WP 0013 00

Equipment Condition

- Rocker arm assemblies removed (WP 0027 00)
 - Engine installed on repair stand
 - Bull/idler gear removed (WP 0037 00)
-

REMOVAL

1. Remove three nuts (1) and retaining plate (2).



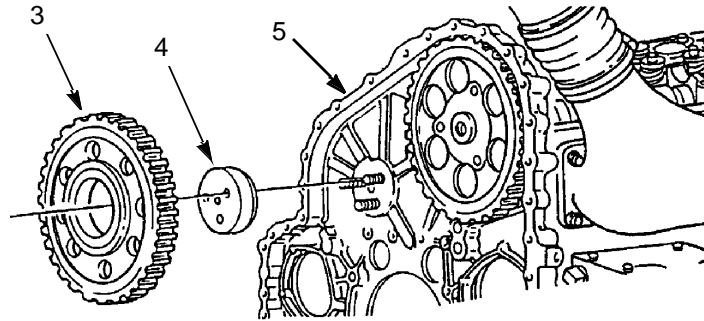
342-1092

ADJUSTABLE IDLER GEAR REPLACEMENT - CONTINUED

0038 00

REMOVAL

- Remove adjustable idler gear (3) and hub (4) from gear housing assembly (5).



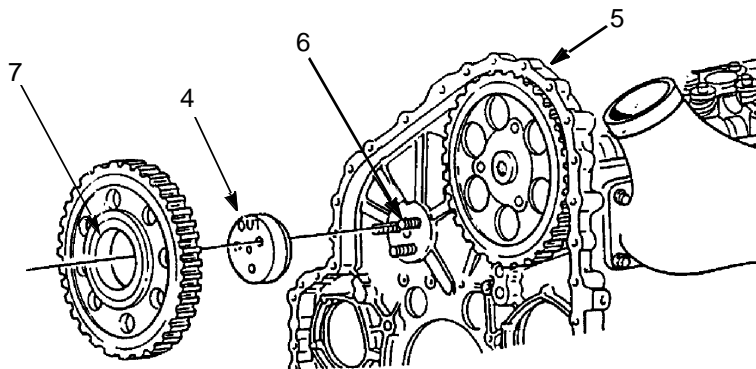
342-1093

INSPECTION

- Examine adjustable idler gear teeth for scoring, pitting, and wear. If damaged or worn, replace adjustable idler gear. Inspect other gear train gears.
- Inspect contact surface of hub for scoring or evidence of overheating (blue discoloration). Replace hub if it has been overheated. Check lubrication hole and gear gallery for blockage. Slight irregularities in hub contact surface may be removed with fine stone or emery cloth.
- Inspect bushing contact surface for signs of scoring, discoloration due to overheating or excessive wear. Allowable clearance between bushing and hub is 0.0013-0.0030 in (0.035-0.078 mm). Replace gear and bushing as an assembly, if clearance is more than allowable or if surface of bushing is scored or has been overheated.

INSTALLATION

- Install hub (4) on three studs (6) in gear housing assembly (5). Word "OUT" stamped on hub must be at top and facing forward. Lubricate hub and adjustable idler gear bushing (7) with clean engine lubricating oil.



342-1094

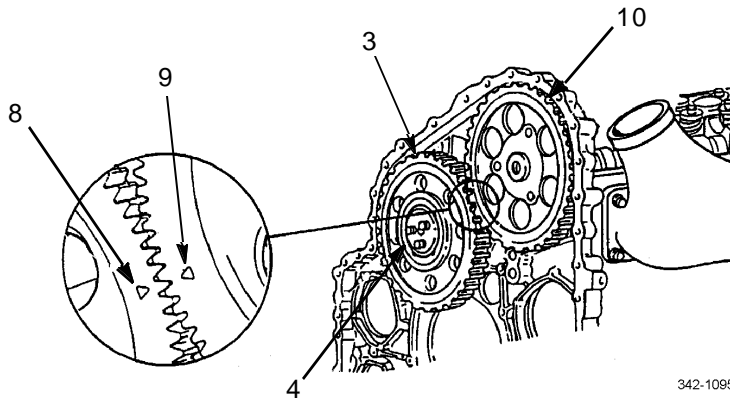
CAUTION

Two timing marks are on adjustable idler gear. Diamond-shaped mark must align with diamond mark on camshaft drive gear. Other mark should be between 5 and 6 o'clock to prevent damage to equipment.

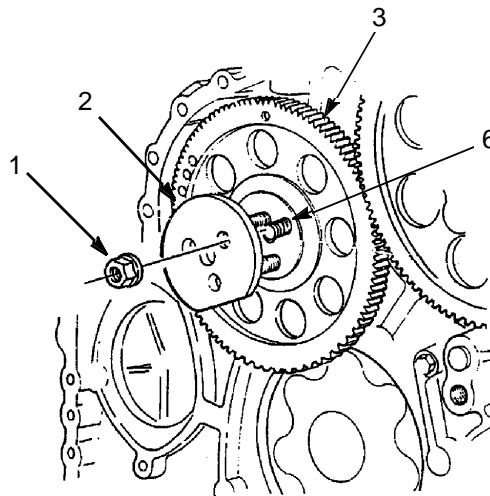
INSTALLATION - CONTINUED**NOTE**

Ensure timing marks on adjustable idler gear are facing outward.

- Align adjustable idler gear diamond timing mark (8) with diamond timing mark (9) on camshaft drive gear (10) and install adjustable idler gear (3) on hub (4).



- Install retaining plate (2) on three studs (6) with relief portion of plate down.
- Install three nuts (1) on studs (6). Tighten nuts to 42-49 lb-ft (57-66 Nm).



- Install bull/idler gear (WP0037 00).
- Measure gear lash between adjustable idler gear (3) and bull/idler gear. Gear lash should be 0.002-0.009 in (0.051-0.0229 mm) for new parts and a maximum of 0.012 in (0.305 mm) for used parts.
- Install gear case cover without fan drive support (WP 0013 00).

INSTALLATION - CONTINUED

- Measure gear lash between adjustable idler gear and camshaft drive gear. Using cam/idler lash adjuster, gear lash should be 0.002-0.009 in (0.051-0.229 mm) for new parts and a maximum of 0.012 in (0.305 mm) for used parts. Reading is one-half of actual measurement. Multiply reading by 2 to determine specification.

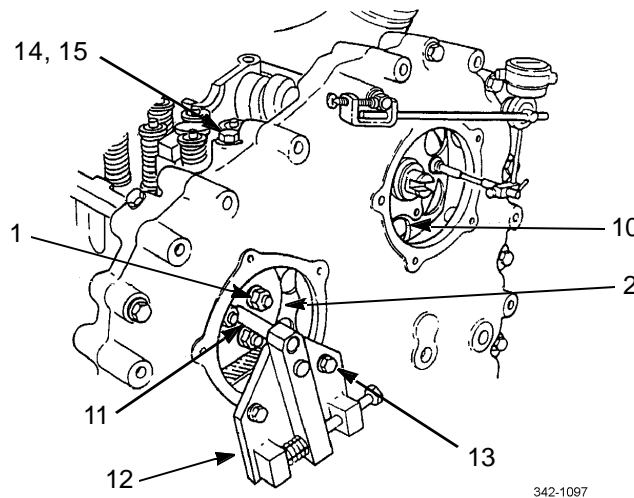
ADJUSTMENT

- Loosen three nuts (1) until hand tight.
- Insert dowel portion of cam/idler lash adjuster (11) in center hole of retaining plate (2).
- Secure engine barring tool (12) to bottom of access cover opening with two access cover bolts (13). Tighten bolts to 20 lb-ft (27 Nm).
- Install cam/idler lash pedestal in threaded hole in leg of camshaft drive gear (10).

NOTE

Ensure dial indicator rests squarely on pedestal flat.

- Mount dial indicator so stem of indicator rests on scribed line of pedestal flat.
- Remove bolt (14) and washer (15).



- Turn adjusting screw (16) clockwise to move adjustable idler gear toward camshaft drive gear (10) until there is zero lash.
- Insert screwdriver through access bolt hole (17) and engage adjustable idler gear tooth to determine gear lash.
- Apply pressure on screwdriver to hold adjustable idler gear in counterclockwise direction and attempt to move camshaft drive gear (10) by hand. Watch dial indicator pointer. If there is zero lash, pointer will not move.

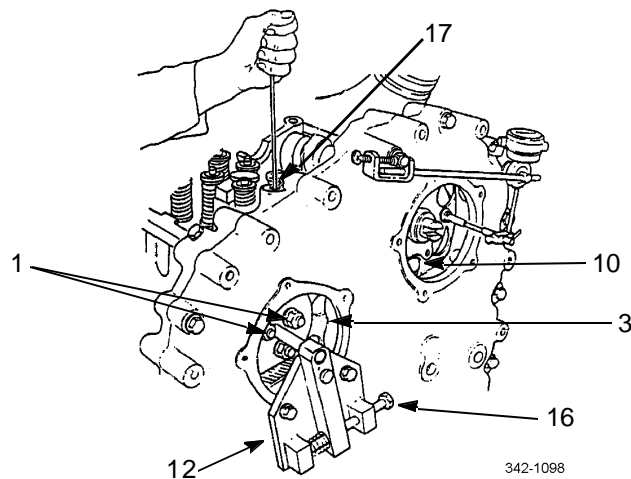
NOTE

Gear lash reading obtained on cam/idler lash pedestal is one-half actual gear lash. Reading on dial indicator must be doubled to determine if specification is met.

- When zero lash is obtained, turn adjusting screw (16) approximately 1-1/2 turns counterclockwise or until correct gear lash is obtained.

ADJUSTABLE IDLER GEAR REPLACEMENT - CONTINUED**0038 00****ADJUSTMENT - CONTINUED**

11. Bar engine to check adjustable idler gear lash on camshaft drive gear (10) at 3, 6, 9, and 12 o'clock positions.
12. When gear lash is 0.002-0.009 in (0.051-0.229 mm) for new parts and a maximum of 0.012 in (0.305 mm) for used parts at all four positions, tighten two top nuts (1) to 42-49 lb-ft (57-67 Nm).
13. Remove cam/idler lash adjuster (12) and tighten lower nut to 42-49 lb-ft (57-66 Nm).
14. Remove gear lash pedestal from camshaft drive gear (10).



15. Install washer (15) and bolt (14). Tighten bolt to 75-86 lb-ft (102-117 Nm).
16. Install rocker arm assemblies (WP 0027 00).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Equipment

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Checker, gear lash (Item 18, WP 0126 00)
- Pliers, retaining ring (Item 88, WP 0126 00)
- Pliers, retaining ring (Item 89, WP 0126 00)
- Press, arbor (Item 90, WP 0126 00)
- Service kit, accessory drive (Item 111, WP 0126 00)
- Vise, machinist's (Item 136, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

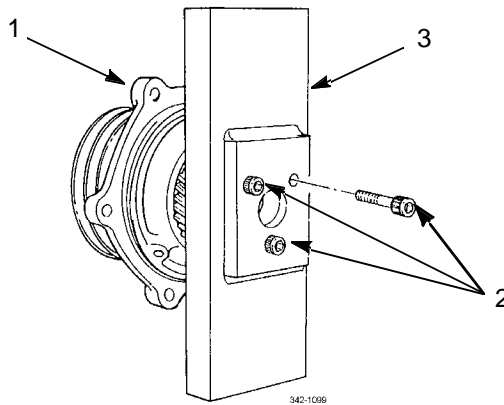
- Bearing, ball (P/N BBA194940)
- Bearing, needle (P/N JH-2216)
- Nut, lock (P/N 11509584)
- Seal, oil (P/N V484156VG)
- Lubriplate (Item 23, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)

Equipment Condition

- Accessory drive removed (WP 0021 00)

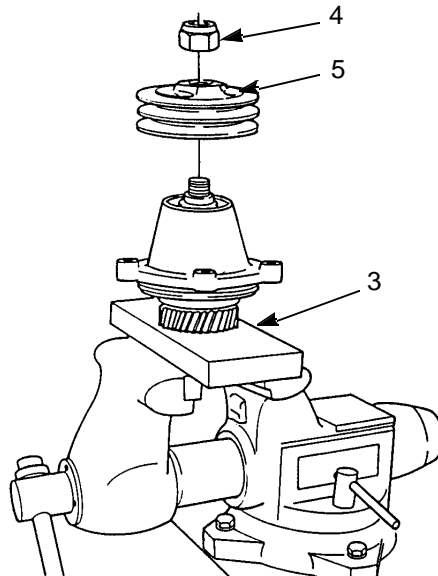
DISASSEMBLY

1. Install accessory drive assembly (1) and three fixture screws (2) on service kit holding fixture (3).



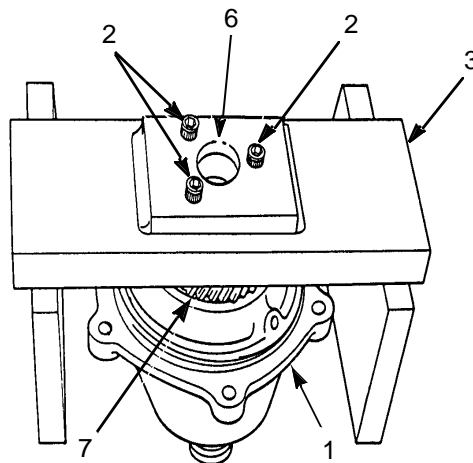
DISASSEMBLY - CONTINUED

2. Place service kit holding fixture (3) in vise and remove accessory drive pulley lock nut (4). Discard lock nut.
3. Remove accessory drive pulley (5) by tapping with rubber hammer or fiber mallet. Remove service kit holding fixture (3) from vise.



342-1100

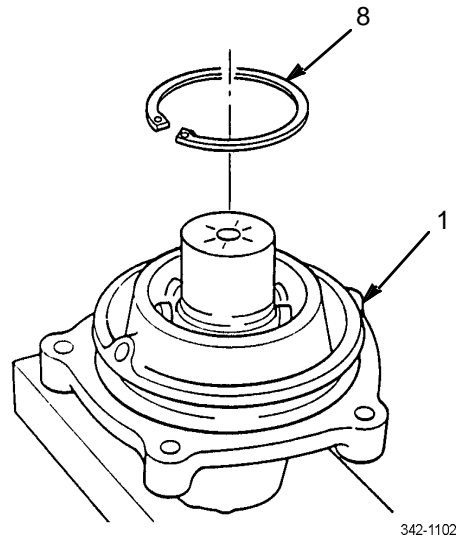
4. Position accessory drive assembly (1) on press bed with service kit holding fixture (3) supported. Using arbor press, apply pressure through holding fixture access hole (6) and press accessory drive assembly (1) out of accessory drive gear (7). Remove three screws (2) and accessory drive gear.



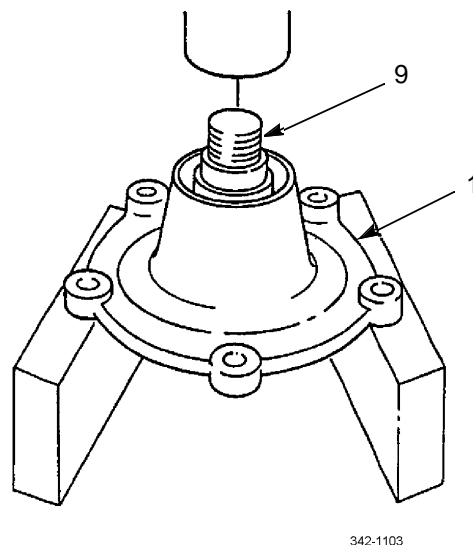
342-1101

DISASSEMBLY - CONTINUED

5. Remove snap ring (8) from accessory drive assembly (1).



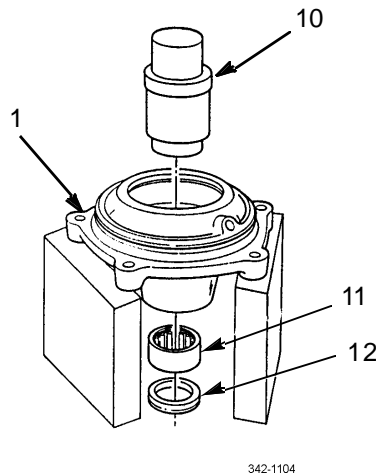
6. Turn accessory drive assembly (1) over and support on machined surface. Using press, apply pressure to pulley end of accessory drive shaft and bearing assembly (9). Remove accessory drive shaft and bearing assembly from accessory drive assembly.



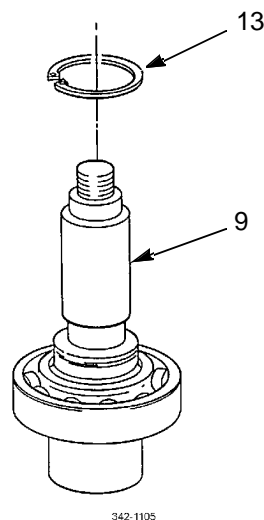
DISASSEMBLY - CONTINUED**NOTE**

Word **INSTALL** and an arrow are etched on needle bearing remover/installer to aid in installation. Place needle bearing identification numbers up against needle bearing remover/installer.

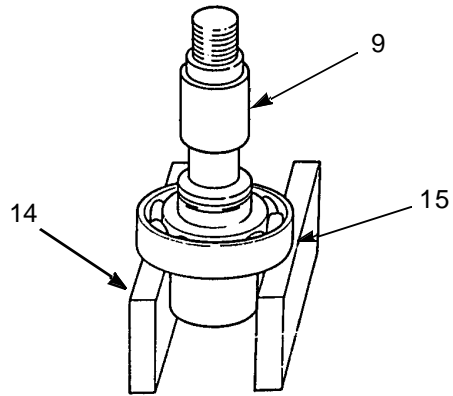
7. Turn accessory drive assembly (1) over and support on attaching bolt bosses. Place long end of service kit needle bearing remover/installer (10) in accessory drive assembly against needle bearing (11). Apply pressure to needle bearing remover/installer and remove and discard needle bearing and oil seal (12).



8. Remove snap ring (13) from accessory drive shaft and bearing assembly (9).



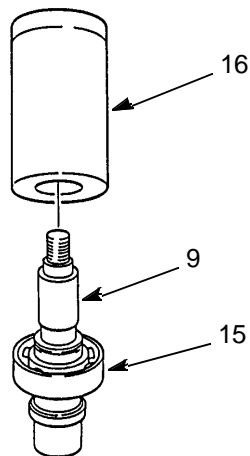
9. Place two steel press plates (14) under ball bearing assembly (15) outer race. Apply pressure to top of accessory drive shaft and bearing assembly (9) and remove and discard ball bearing assembly.

DISASSEMBLY - CONTINUED

342-1106

ASSEMBLY

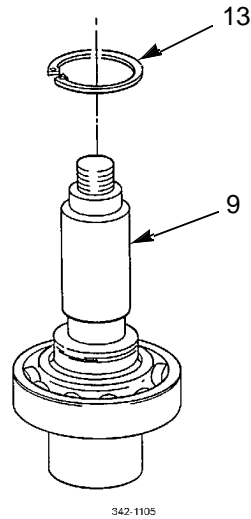
1. Place new ball bearing assembly (15) on accessory drive shaft (9). Place small opening of service kit bearing installer (16) over ball bearing assembly inner race. Press until ball bearing assembly bottoms against shoulder of accessory drive shaft.



342-1107

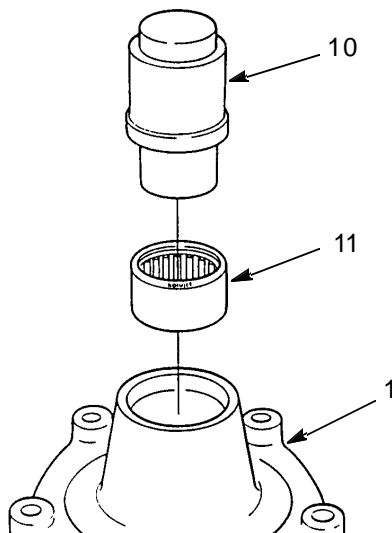
ASSEMBLY - CONTINUED**NOTE**

- Ensure tapered side of snap ring is installed away from bearing.
 - Ensure snap ring is fully seated in groove of accessory drive shaft.
2. Install snap ring (13) in groove of accessory drive shaft (9).

**NOTE**

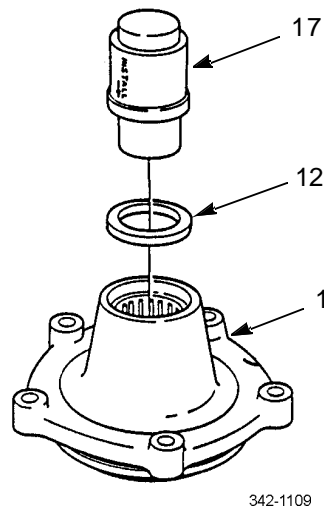
Word **INSTALL** and an arrow are etched on needle bearing installer/remover to aid in installation. Place needle bearing installation numbers up against needle bearing installer/remover.

3. Install new needle bearing (11) in accessory drive housing (1). Using long end of service kit needle bearing installer/remover (10), press needle bearing into accessory drive housing flush to 0.02 in (0.5 mm) below bottom of oil seal counterbore.

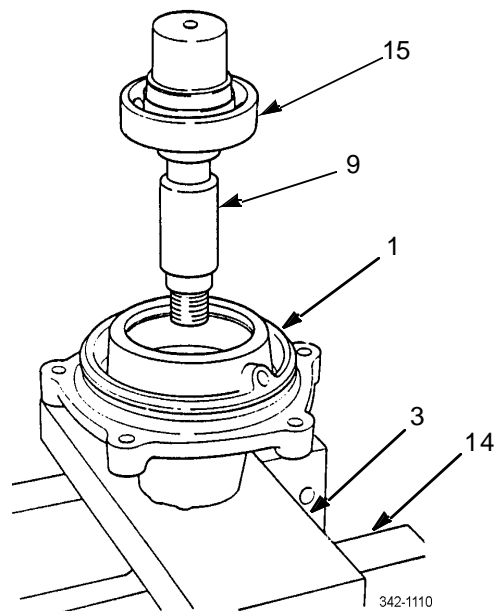


ASSEMBLY - CONTINUED

4. Install new oil seal (12) in accessory drive assembly housing (1). Using service kit seal installer (17) and plastic hammer or fiber mallet, install oil seal flush to 0.01 in (0.25 mm) below face of accessory drive assembly housing.

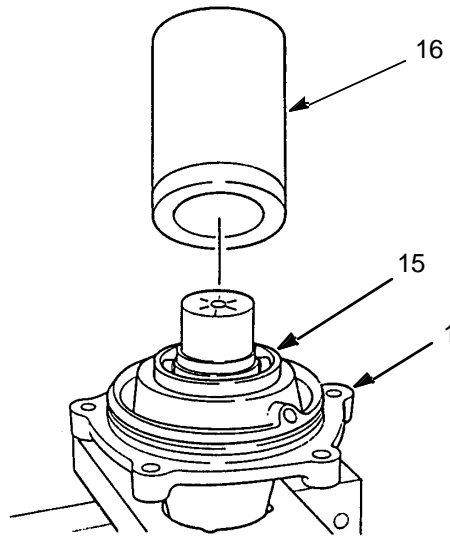


5. Support service kit holding fixture (3) on two steel plates (14) and place accessory drive assembly housing (1) in service kit holding fixture hole. Lubricate ball bearing assembly (15) with clean engine lubricating oil and install accessory drive shaft and bearing assembly (9) in accessory drive assembly housing.



ASSEMBLY - CONTINUED

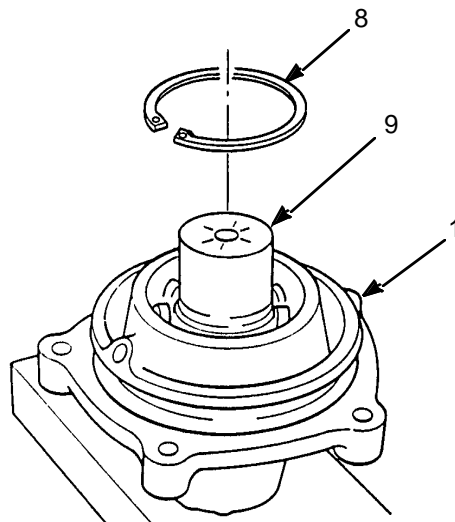
6. Using wide end of service kit bearing installer (16), press on ball bearing assembly (15) outer race until ball bearing assembly is seated against shoulder of accessory drive assembly housing (1).



342-1111

NOTE

- Ensure tapered side of snap ring is installed away from bearing.
 - Ensure snap ring is fully seated in groove of accessory drive assembly.
7. Install snap ring (8) in groove of accessory drive assembly (1).
8. Apply thin film of lubriplate to drive gear end of accessory drive shaft (9).

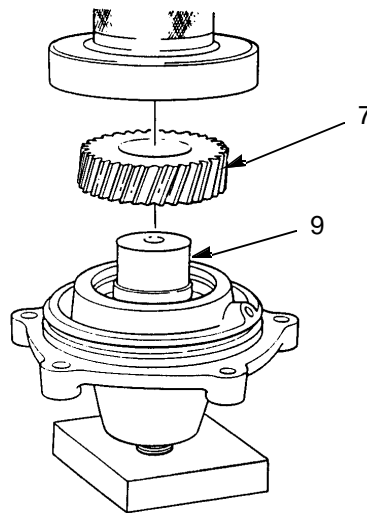


342-1102

ASSEMBLY - CONTINUED**NOTE**

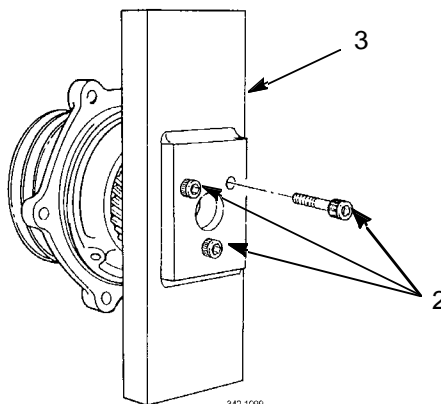
Support opposite end of accessory drive shaft on press bed when pressing gear on shaft.

- Place accessory drive gear (7) on accessory drive shaft (9) with chamfered end of bore toward accessory drive shaft. Using press, install accessory drive gear until accessory drive gear is flush with end of accessory drive shaft. Obtain minimum press load of 4000 lb (17.8 kN).



342-1112

- Install service kit holding fixture (3) and three fixture screws (2) on accessory drive gear (7).
- Install service kit holding fixture (3) in vise.

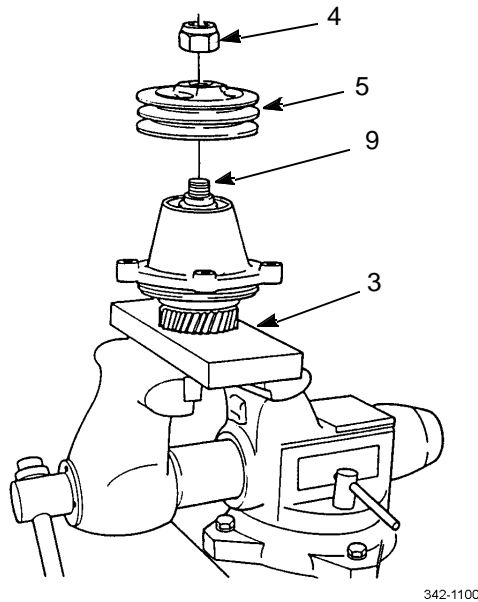


342-1099

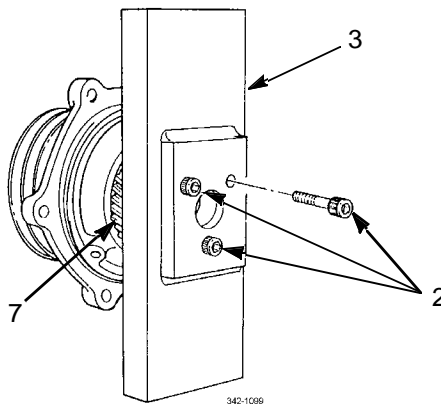
ASSEMBLY - CONTINUED**NOTE**

If necessary, use narrow opening end of service kit bearing installer to seat accessory drive pulley. If pressing is necessary, support opposite gear end of accessory drive shaft.

12. Install accessory drive pulley (5) on accessory drive shaft (9).
13. Install new accessory drive pulley lock nut (4) and tighten to 162-184 lb-ft (220-250 Nm).



14. Remove service kit holding fixture (3) from vise and remove three fixture screws (2) from accessory drive gear (7).



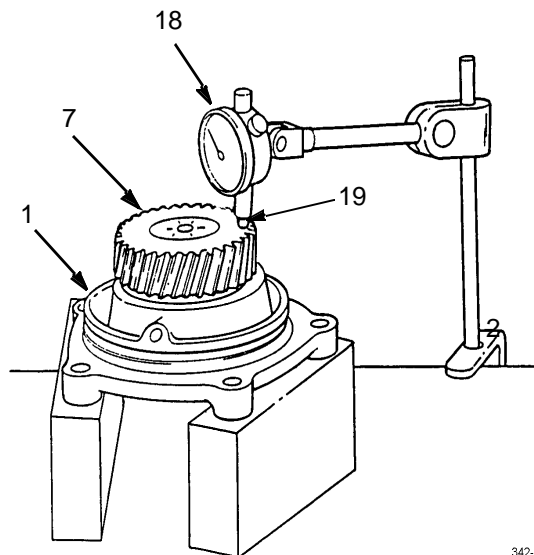
ASSEMBLY - CONTINUED

15. Support accessory drive assembly (1) as shown. Position dial indicator (18) so indicator stem (19) rests on face of accessory drive gear (7) just inboard of accessory drive gear teeth.

NOTE

As accessory drive gear is rotated, dial indicator needle may register to left and right of zero. Total amount of dial indicator needle movement gives total indicated runout (TIR).

16. Zero dial indicator (18). Rotate accessory drive gear (7) two full rotation. Allowable TIR is 0.0015 in (0.04 mm).



342-1113

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Testing

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Adapter, cylinder (Item 1, WP 0126 00)
- Tester, cylinder (Item 123, WP 0126 00)
- Tester, cylinder (Item 124, WP 0126 00)
- Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)
- Screw (P/N 8929129)

Materials/Parts

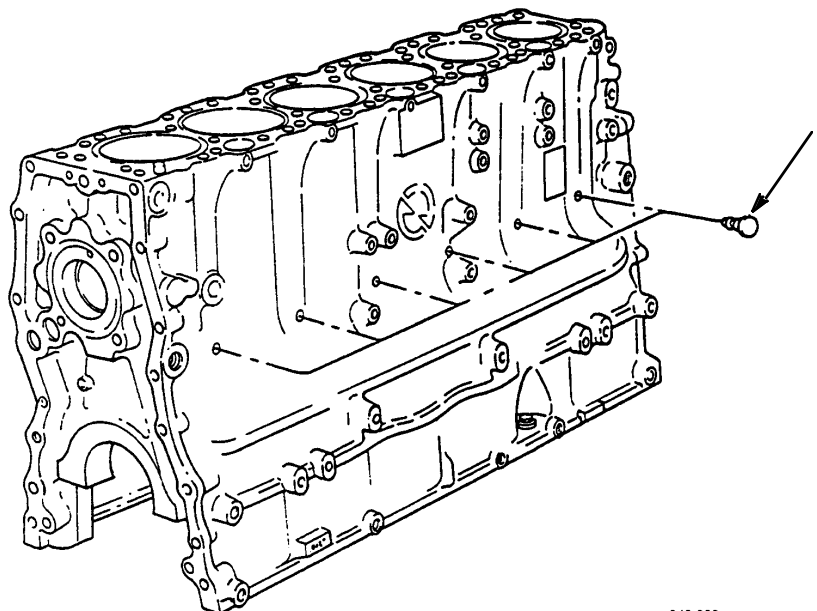
- Plug, pipe (P/N 8923916)
- Detergent (Item 19, WP 0125 00)

Equipment Condition

All components removed from cylinder block except necessary cup plugs, pipe plugs, and cylinder liners used for pressure testing (WP 0036 00).

TESTING

1. If present, remove six weep hole plugs (1).

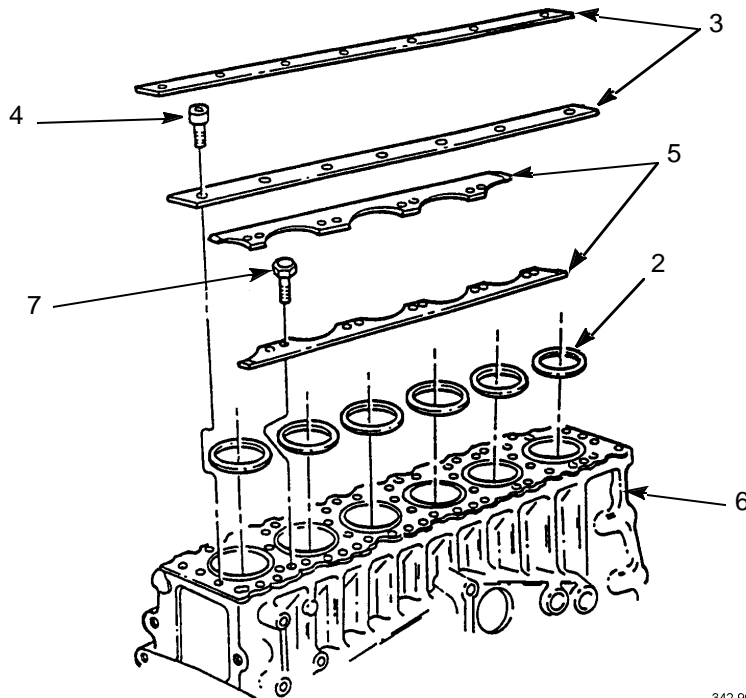


342-903

TESTING - CONTINUED

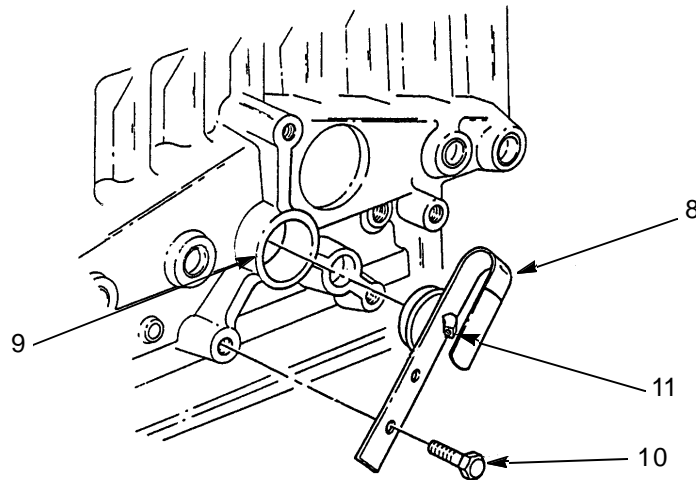
NOTE

- Ensure all hose connectors and elbows are removed from block and holes are properly plugged.
 - Ensure all cup plugs and pipe plugs are in place.
 - Ensure all cylinder liners, cylinder liner seal rings, and crevice seals are in place.
2. From cylinder block pressure test kit, position six test rings (2) on top of cylinder liner flanges. Install two test ring retaining strips (3).
 3. Install 14 bolts (4) and tighten to 170-175 lb-ft (231-237 Nm).
 4. Position two outside sealing strips (5) on cylinder block (6) with rubber surface against cylinder block. Install 20 bolts (7) and tighten to 120 lb-in (14 Nm).



342-904

5. Install water manifold cover (8) in oil cooler neck opening (9). Use bolt (10) supplied to secure water manifold cover.
6. Attach air line to fitting (11) on upper manifold cover.

TESTING - CONTINUED

342-905

**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

7. Apply 20 psi (138 kPa) air pressure to cylinder block using attached air line.
8. Spray cylinder block with detergent and water solution and observe solution for bubbles, indicating cracks or leaks. If cracks are detected, replace cylinder block.
9. Remove air supply line.
10. Remove 20 bolts (7) and two outside sealing strips (5).
11. Remove 14 bolts (4), two test ring retaining strips (3), and six test rings (2).
12. Remove bolt (10) and water manifold cover (8).
13. Clear out all passages and bolt holes with compressed air.

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Inspection, Installation

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Compressor, piston ring (Item 22, WP 0126 00)

Gage, profile (Item 36, WP 0126 00)

Gage, profile (Item 38, WP 0126 00)

Guides, connecting rod (Item 44, WP 0126 00)

Pliers, piston ring (Item 85, WP 0126 00)

Press, cylinder liner (Item 91, WP 0126 00)

Protector, piston (Item 93, WP 0126 00)

Puller, mechanical (Item 94, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Cylinder liner set (P/N 23523948)

Piston ring kit (P/N 23525553)

Cloth, abrasive (Item 9, WP 0125 00)

Compound, international, no. 2 (Item 13, WP 0125 00)

Gage, bearing clearance (Item 20, WP 0125 00)

Oil, lubricating (Item 25, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

References

WP 0040 00

Equipment Condition

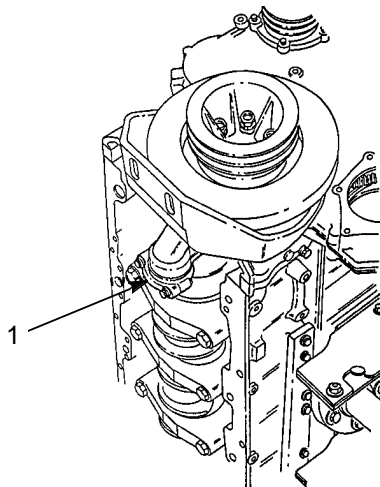
Engine installed on repair stand

Cylinder head removed (WP 0018 00)

Oil pump removed (WP 0029 00)

REMOVAL

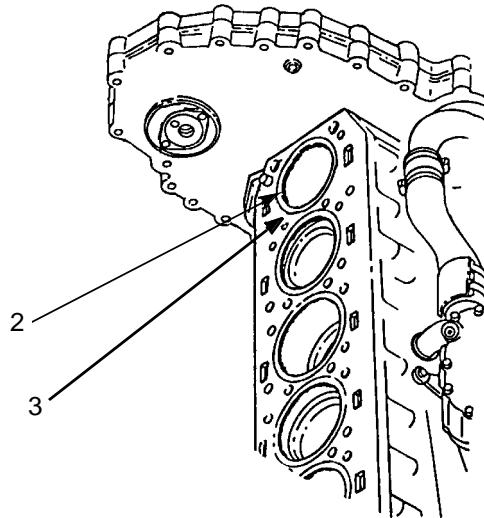
1. Rotate engine on stand so engine gear case is up.
2. Bar engine over until connecting rod (1) of cylinder being serviced is at bottom of travel.



342-1041

REMOVAL - CONTINUED

3. With ridge reamer, remove carbon ridge (2) at top of cylinder liner (3) above upper travel limit of top piston ring.

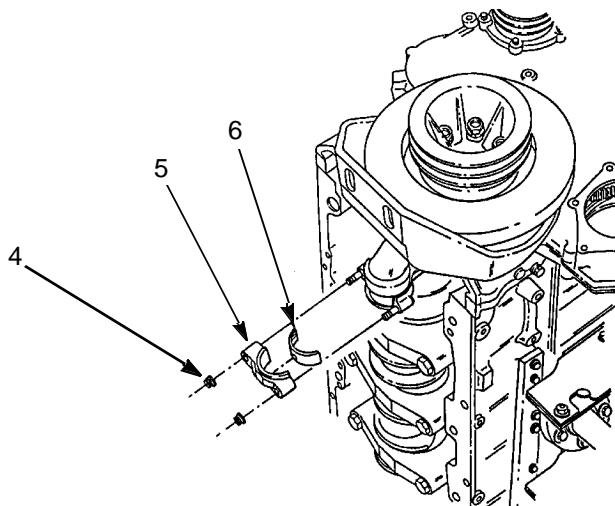


342-1042

NOTE

Ensure connecting rods and caps are stamped with correct location number. If not stamped, stamp correct location (1 through 6) on tang side (cooler side) of rod cap and rod.

4. Remove two connecting rod cap nuts (4), connecting rod cap (5), and lower connecting rod bearing shell (6).



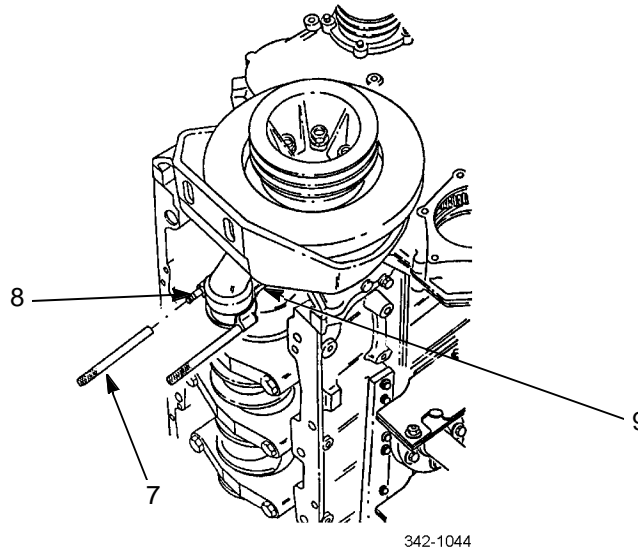
342-1043

REMOVAL - CONTINUED

CAUTION

When removing piston from engine, use care and avoid damaging piston cooling nozzle installed in base of cylinder bore.

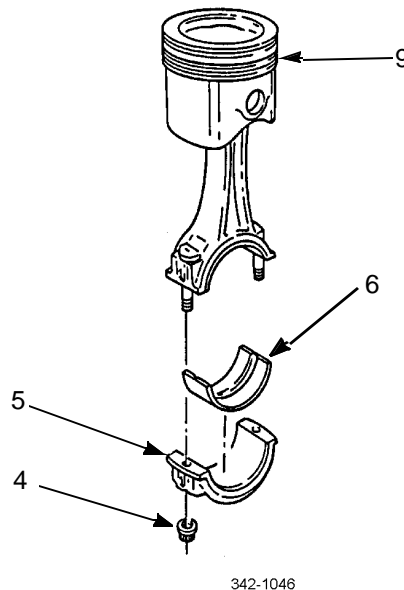
5. Install two connecting rod guides (7) on two connecting rod bolts (8) to protect crankshaft journal. Push connecting rod and piston assembly (9) through top of cylinder block.



NOTE

Connecting rod caps are numbered according to cylinder position with matching numbers stamped on tang side of connecting rod. Always assemble rods and caps in original positions as marked.

6. Assemble connecting rod and piston assembly (9), connecting rod cap (5), and lower connecting rod bearing shell (6).
7. Install two connecting rod cap nuts (4) hand tight.



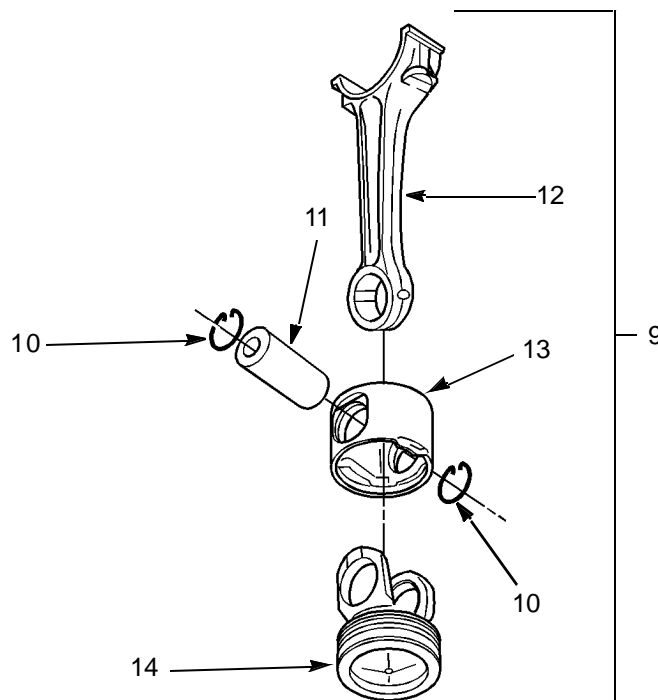
REMOVAL - CONTINUED

8. Repeat procedures in step 2 through 7 for each piston and cylinder being serviced.

NOTE

Piston assembly components should be segregated by cylinder and matchmarked during disassembly to ensure installation in same position.

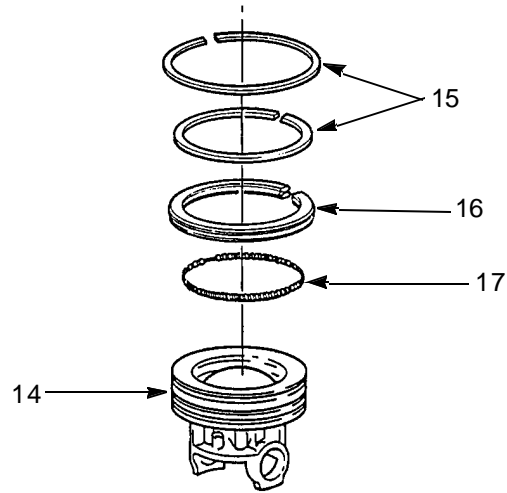
9. Place connecting rod and piston assembly (9) dome side down on workbench.
 10. Remove two piston retaining rings (10) and piston pin (11).
 11. Remove connecting rod (12).
 12. Remove piston skirt (13) from dome (14).



342-1045

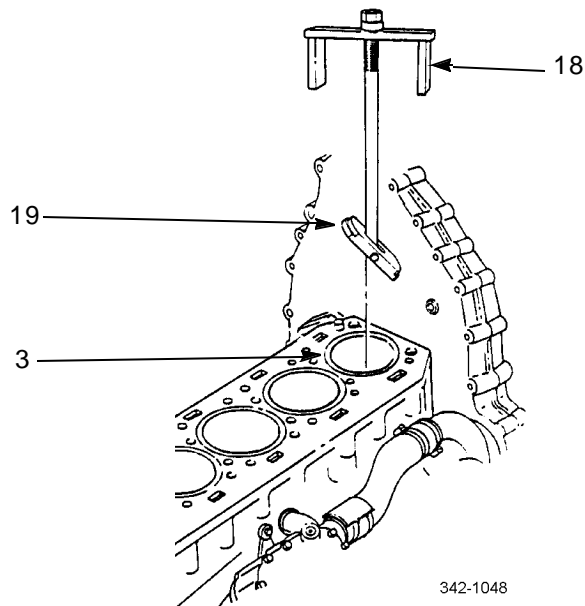
13. Using piston ring pliers, remove and discard fire (top) and middle compression rings (15), lower oil control ring (16), and oil control ring expander (17) from piston dome (14).

REMOVAL - CONTINUED



342-1047

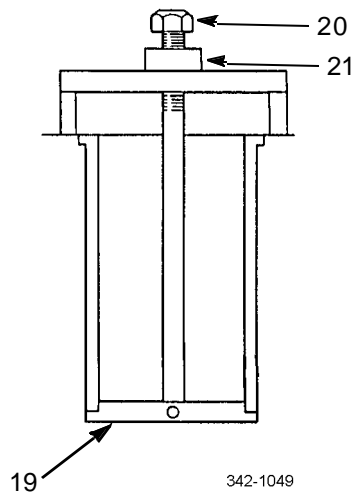
14. Repeat procedures in step 9 through 13 for each piston assembly being serviced.
15. Rotate engine stand so that engine is horizontal and cylinder liners (3) are up.
16. Center cylinder liner puller (18) over cylinder liner (3). Position cylinder liner puller shoe (19) at bottom of cylinder liner with lip on each side engaging bottom edge of liner.



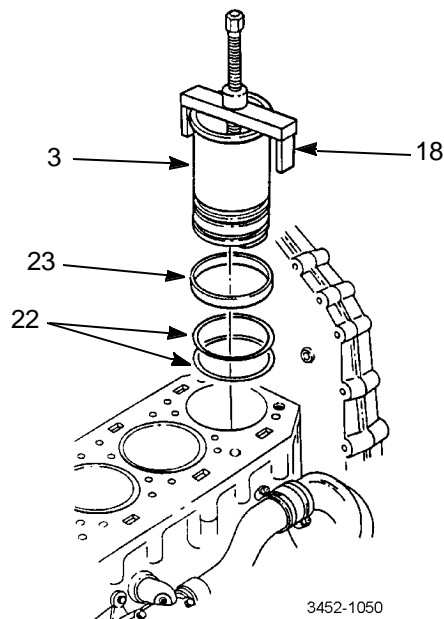
342-1048

REMOVAL - CONTINUED

17. Keep cylinder liner puller shoe (19) in position on cylinder liner bottom and turn cylinder liner puller nut (20) until it contacts cylinder liner puller thrust bearing (21).



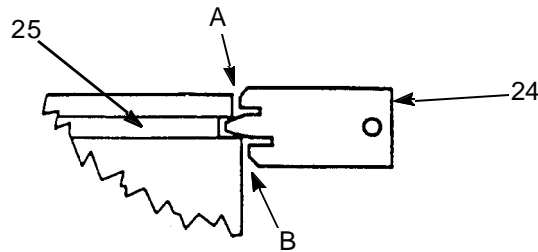
18. Continue tightening until cylinder liner (3) is free in cylinder block bore.
 19. Remove cylinder liner (3) and cylinder liner puller (18) from block.
 20. Remove cylinder liner (3) from cylinder liner puller (18).
 21. Remove and discard two seal rings (22) and crevice seal (23) from cylinder liner (3).



22. Repeat procedures in step 16 through 21 for each cylinder liner (3) being serviced.

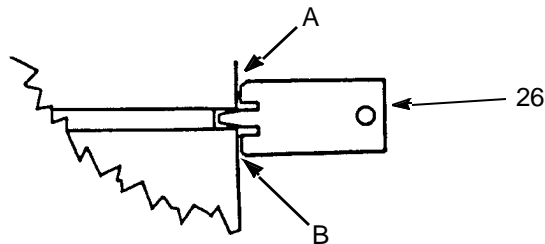
INSPECTION

1. Examine piston skirt and dome for score marks, cracks, damaged ring groove lands or indications of overheating. Replace any piston if any of these conditions are present.
2. Using piston top ring groove gage (24), check tapered fire (top) compression ring groove (25) in piston dome. If shoulder A or B of gage contacts piston dome, discard dome.
3. Insert center tang of piston top ring groove gage (24) into fire compression ring groove (25). Hold gage at 90-degree angle to fire compression ring groove (25) with center tang of gage in ring groove as far as it will go to prevent false readings. There should be no contact of piston by shoulders of gage. If gage makes contact at point A or B, fire compression ring groove is worn beyond usable limits and piston dome must be discarded.
4. Check fire compression ring groove (25) clearance at four locations at 90 degree intervals. Measure ring land parallel to, and at 90-degrees to, wrist pin.



342-1051

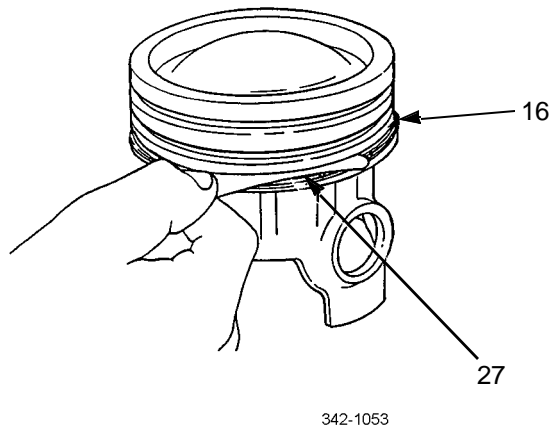
5. Using piston second ring groove gage (26), check second (middle) compression ring groove in same way. If shoulder A or B of gage contacts piston dome, discard dome.



342-1052

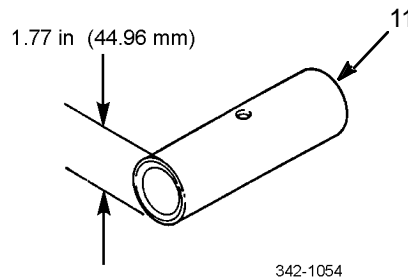
INSPECTION - CONTINUED

6. Hold new oil control ring (16) in oil control ring groove so that oil control ring face is flush with edge of piston dome. Do not push ring to bottom of oil control ring groove. Insert feeler gage (27) between top of oil control ring and ring land of oil control ring groove in piston dome. If clearance is greater than 0.004 in (0.11 mm), discard dome.

**CAUTION**

In order to prevent possible damage to equipment, DO NOT use crocus cloth to polish or refinish piston pin. Piston pins cannot be polished or refinished.

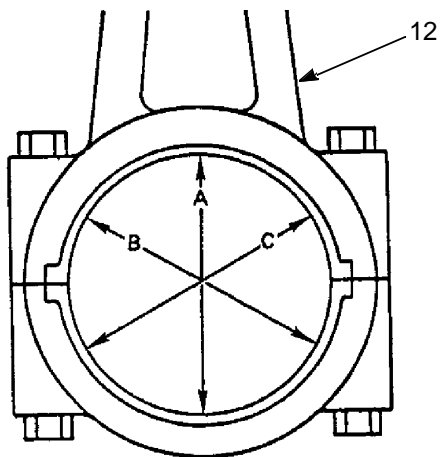
7. If piston pin (11) shows signs of fretting, overheating or is worn to diameter of 1.77 in (44.96 mm), replace piston pin.



8. Replace connecting rod (12) if subjected to any of the following:
- Visual damage (bent)
 - Previous bearing or related failure
 - Connecting rod bluing at top or bottom end
 - Fretting at split line between connecting rod and connecting rod cap
 - Excessive pound-in of rod bolt heads, nuts, and of piston pin bolt and spacer
 - Unusual cylinder wear patterns
 - Gouges, nicks or burrs on machined surface of connecting rods at piston pin end

INSPECTION - CONTINUED

9. Check connecting rod bolts and connecting rod cap nuts for thread damage or fretting on underside of heads. Replace rod bolts and connecting rod cap nuts if either condition is present.
10. Measure connecting rod bore at points A, B, and C. Average of bore readings must be within 3.594-3.595 in (91.288-91.313m).



342-1055

NOTE

- Replace rod and main bearings whenever crankshaft is replaced or engine is rebuilt.
 - Overlay plated bearings may develop very small cracks or small isolated cavities (checking) on bearing surface during engine operation. These are characteristics of, and are not detrimental to, this type of bearing. Bearing should not be replaced for these minor surface imperfections.
11. Inspect bearings for scoring, pitting, flaking, chipping, cracking, loss of overlay or signs of overheating. If any of these conditions are present, discard bearings.

NOTE

Upper connecting rod bearing shells will normally show signs of distress before lower connecting rod bearing shells. If overlay is worn to copper across connecting rod bearing shell, replace all connecting rod bearing shells.

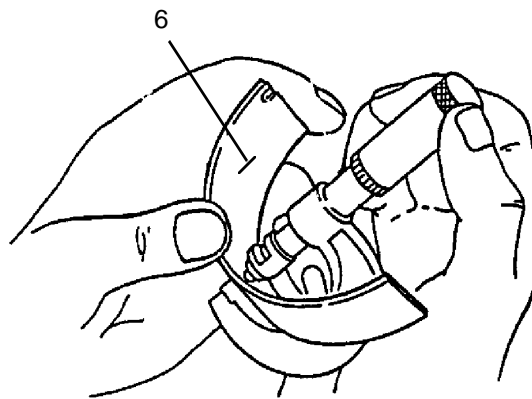
INSPECTION - CONTINUED

12. Inspect backs of bearing shells for bright spots. If such spots are present, replace bearing shells. Inspect connecting rod bearing bores for burrs or foreign particles.

NOTE

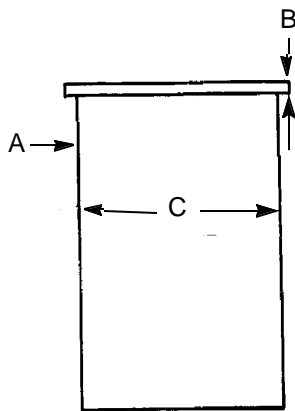
Install new upper and lower connecting rod bearing shells if new crankshaft is used.

13. Using micrometer and ball attachment, measure thickness of connecting rod bearing shell (6). Minimum thickness of worn standard connecting rod bearing shell should not be less than 0.1215 in (3.086 mm). If either upper or lower connecting rod bearing shell of connecting rod set is less than minimum thickness, replace both bearing shells.

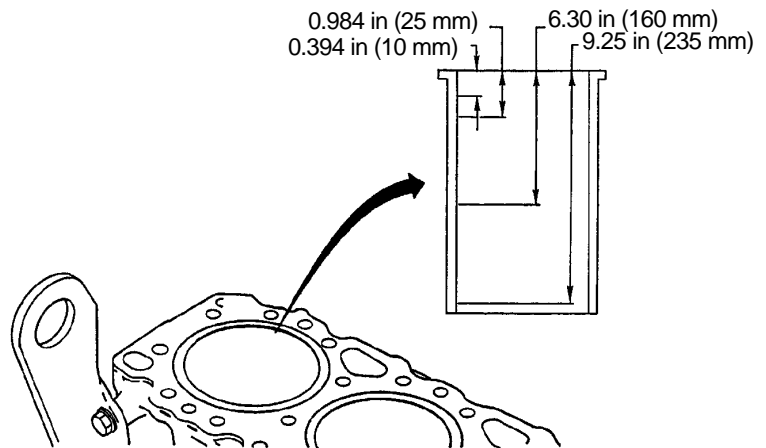


342-1056

14. Examine cylinder liner for cracks, scoring, glazing, ring ridge formation, and cavitation erosion. If any of these conditions are present, liner must be discarded.
15. Examine outside diameter of liner for fretting at flange and cylinder block bore area. If light fretting is present, surface can be restored with abrasive cloth or flat stone.
16. Measure cylinder as follows:



342-1057



342-1058

INSPECTION - CONTINUED

Table 1. Cylinder Liner Dimensions.

CYLINDER LINER	MINIMUM IN (MM)	MAXIMUM IN (MM)	LIMITS IN (MM)
Outside diameter (below flange) (A)	5.864 (148.95)	5.866 (149.00)	
Flange thickness (B)	0.3527 (8.960)	0.3543 (9.000)	
Inside diameter (new) (C)	5.118 (130.00)	5.120 (130.05)	
Inside diameter (used) (C)			5.122 (130.100)
Out-of-round (inside diameter)			0.001 (0.025)
Taper (inside diameter)			0.001 (0.025)

CAUTION

If liners are not to be installed at this time, oil them lightly with clean engine lubricating oil and store them upright in a clean, dry area. To prevent damage, do not allow liners to rest on sides or store anything on top of liners.

NOTE

- Do not hone used liners. Series 60 cylinder liners are honed at the factory with a process that cannot be duplicated in the field.
- When installing used liners in proper bores of cylinder block, measure inside diameter at points shown in liner diagram. Maximum diameter of used liner is 5.122 in (130.100 mm) at any measurement location. Check liner taper and out-of-round. Inside diameter of new service liner is 5.118-5.120 in (130.00-130.05 mm).

17. Coat bore of liner with clean engine lubricating oil and allow liner to sit for 10 minutes to allow oil to work into surface finish. Wipe inside of liner with clean, white paper towels. If dark residue appears on towels, repeat oiling and wiping until residue no longer appears.

INSTALLATION

CAUTION

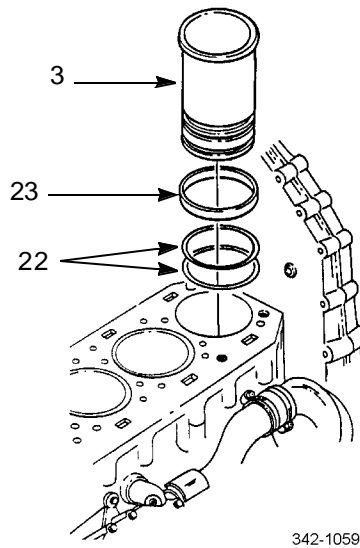
Ensure cylinder block is rotated so that cylinder block deck is up and level. Failure to do so could result in damage to seal rings and crevice seal.

NOTE

Ensure block counter bores and cylinder liner flange are free of foreign material or damage

INSTALLATION - CONTINUED

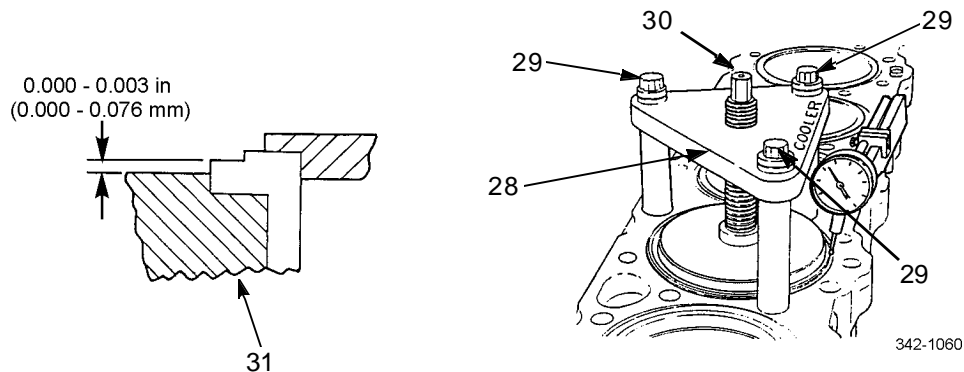
1. Clean inside and outside of new cylinder liner (3) and cylinder block bore.
2. Install new crevice seal (23) and two new seal rings (22) on cylinder liner (3).
3. Coat two seal rings (22) and crevice seal (23) with a thin film of lubricating oil.
4. Coat cylinder block liner bore with lubricating oil where seal rings (22) and crevice seal (23) seat.
5. Install cylinder liner (3) in cylinder block bore by hand until lower seal meets upper crevice seal bore.



NOTE

When correctly positioned, side of cylinder liner installer stamped COOLER is on oil cooler side of cylinder block and cylinder liner installer holding bolts will align with cylinder head bolt holes.

6. Center and install cylinder liner press (28) over cylinder liner (3) and tighten three bolts (29).
7. Turn center bolt (30) of cylinder liner press (28) until cylinder liner (3) bottoms in counterbore. Apply a tightening torque of 44 lb-ft (60 Nm) to center bolt.
8. Using dial indicator, measure cylinder liner (3) protrusion in three equal positions. Measure distance from top of cylinder liner flange to tip of cylinder block (31). Allowable cylinder liner protrusion is 0.000-0.003 in (0.000-0.076 mm) with no more than 0.002 in (0.05 mm) variation between any two adjacent cylinders.

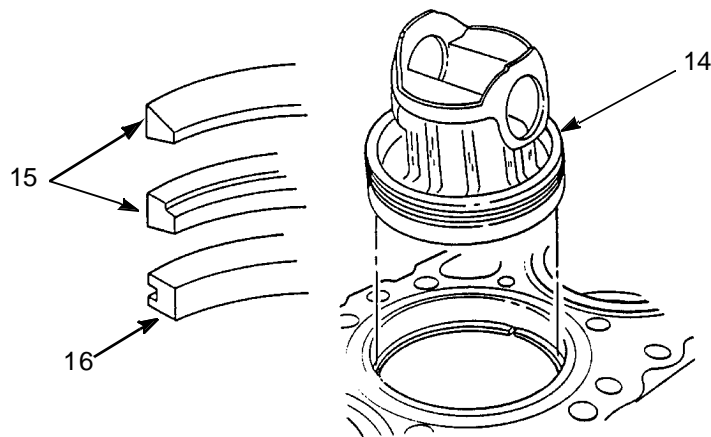


INSTALLATION - CONTINUED

9. Perform procedures in step 1 through 8 for remaining cylinder liners (3) being installed.
10. Perform cylinder block pressure testing (WP 0040 00).

NOTE

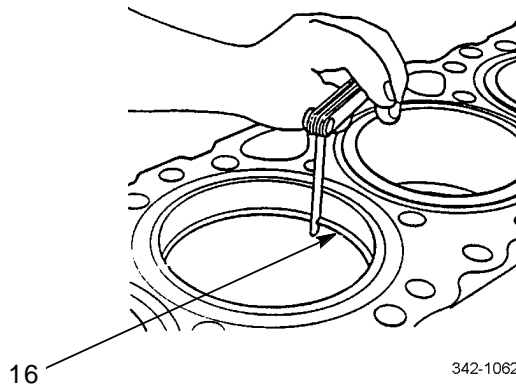
- Fire (top) compression ring has plasma (dull finish) face. Top of fire compression ring is identified by vendor's mark: dimple or color dot located 30 degrees from ring gap.
 - Middle compression ring has chrome (shiny) face. Top of middle compression ring is identified by dimple or color dot located 30 degrees from ring gap. Inner ring edge has groove.
 - Oil control ring has chrome flashed face and can be installed with either side up.
11. Insert three piston rings (15 and 16) inside cylinder liner, one at a time, using piston dome (14) (inserted upside down into liner) to push ring down. Insert piston dome into liner to same depth as ring being positioned. This will ensure rings are parallel with top of liner and positioned in liner within normal areas of ring travel.



342-1061

INSTALLATION - CONTINUED**NOTE**

- Increase insufficient compression ring gap by filing or stoning ends of piston ring. File or stone both ends of piston ring with cutting action from outer surface to inner surface to prevent chipping or peeling of plasma or chrome plate.
 - Piston ring ends must remain square and outer edge chamfer must be approximately 0.015 in (0.381 mm).
12. Measure compression ring gap of top ring as shown. Remove ring (16) from cylinder liner after measurement is completed. Repeat this procedure for each ring and record measurement. Allowable ring end gap is as follows:
- a. Fire ring 0.016-0.024 in (0.40-0.87 mm)
 - b. Compression ring 0.32-0.051 in (0.81-1.30 mm)
 - c. Oil control ring 0.016-0.032 in (0.40- 0.81 mm)



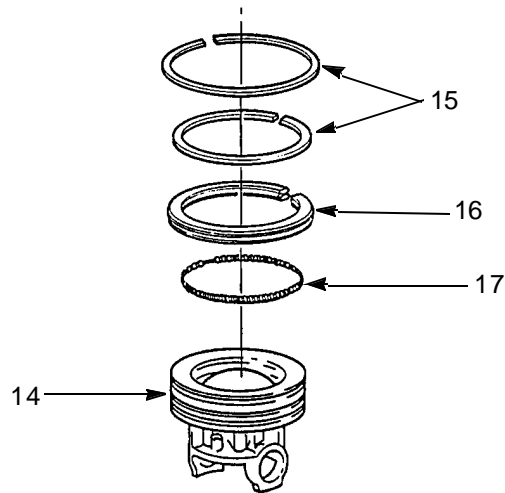
342-1062

INSTALLATION - CONTINUED**CAUTION**

Do not spread rings more than necessary to slip them over piston dome. This will prevent damage to equipment.

NOTE

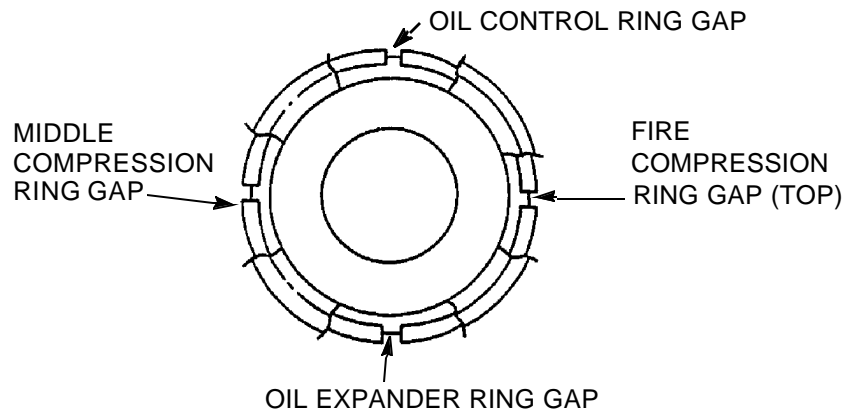
- Do not overlap oil control ring expander ends.
 - Ensure oil control ring expander is fully seated inside oil control ring groove.
13. Install new oil control ring expander (17) in oil control ring groove of piston dome (14).
 14. Install new oil control ring (16) by hand. Oil control ring gap must be positioned 180 degrees from oil control ring expander (17) spring gap.
 15. With piston ring pliers, install new second (middle) compression ring (15) with vendor's mark, dimple or color dot, located 30 degrees from ring gap toward piston dome (14) top.
 16. With piston ring pliers, install new fire (top) compression ring (15) with vendor's mark, dimple or color dot, located 30 degrees from ring gap toward piston dome (14) top.



342-1047

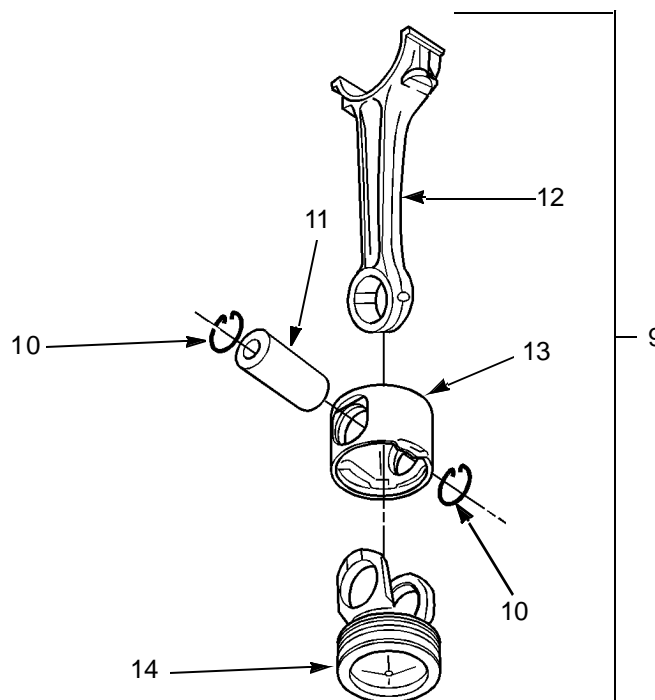
INSTALLATION - CONTINUED

17. Position fire (top) and middle compression ring gaps 180 degrees from each other and 90 degrees from oil control ring and oil expander ring gaps.



342-1063

18. Apply a light coat of clean engine lubricating oil to connecting rod (12) pin bushing, piston pin bushing ends, and piston pin (11). Place piston skirt (13) over piston dome (14) and align piston pin bores in dome and skirt.
19. Install connecting rod (12) inside dome (14) and slide piston pin (11) through piston skirt (13) bore and crown. Using retaining ring pliers, secure piston pin in piston with two retaining rings (10).
20. Place piston assembly (9), dome down, in clean pan. Coat piston assembly liberally with clean engine lubricating oil.



342-1045

INSTALLATION - CONTINUED

21. Perform procedures in step 11 through 20 for remaining connecting rod and piston assemblies.
22. Remove two connecting rod cap nuts and connecting rod cap, temporarily installed during Removal, step 7.

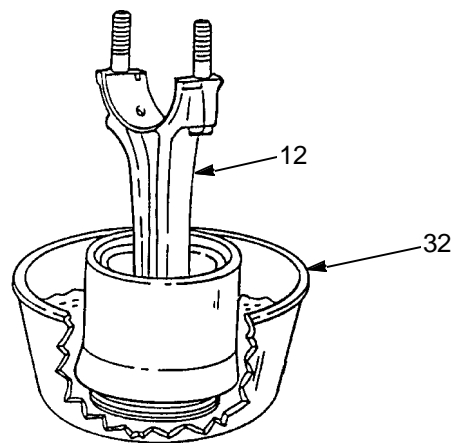
CAUTION

Nicks or burrs on no-tapered inside diameter end of piston ring compressor may result in damage to piston rings. Inspect piston ring compressor for nicks or burrs.

NOTE

Ensure piston ring gaps are staggered.

23. Coat inside of piston ring compressor (32) with clean engine lubricating oil.
24. Install tapered end of piston ring compressor (32) over end of connecting rod (12) and down on piston. Slide piston ring compressor down until it contacts bottom of pan.

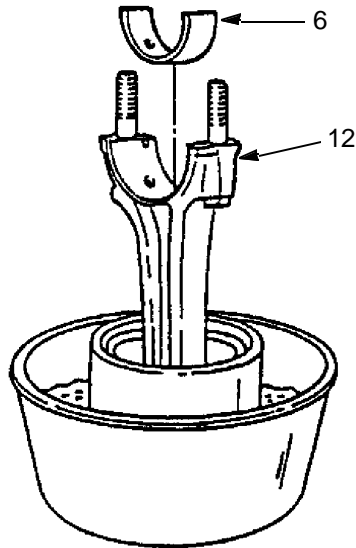


342-1065

25. Position crankshaft connecting rod journal of cylinder being serviced at bottom-dead-center.

INSTALLATION - CONTINUED

26. Install upper connecting rod bearing shell (6) in connecting rod (12). Index tang on bearing shell with notch in connecting rod bearing saddle.

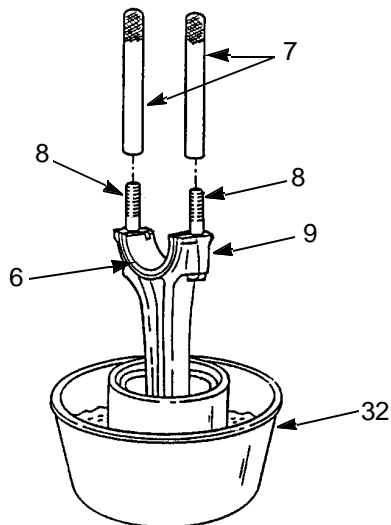


342-1066

NOTE

Perform next step only if not performing plastigauge check

27. Lubricate upper connecting rod bearing shell (6) and crankshaft connecting rod journal with clean engine lubricating oil.
28. Install two connecting rod guides (7) on two connecting rod bolts (8).
29. Lift connecting rod assembly (9) and piston ring compressor (32) out of pan.



342-1067

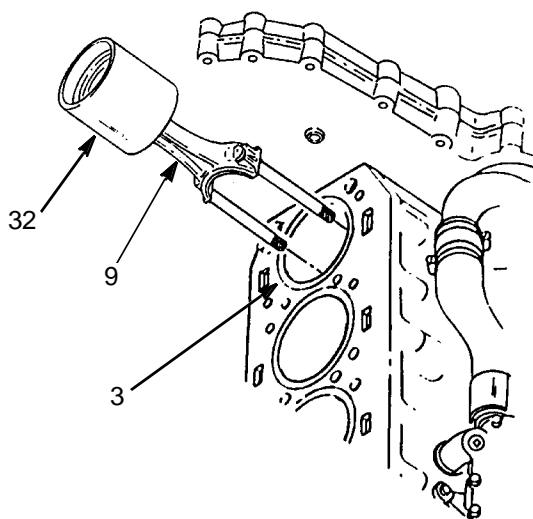
INSTALLATION - CONTINUED**CAUTION**

Number stamped on connecting rod indicates cylinder it should be installed in. Number must be on oil cooler side of cylinder block when installing connecting rod to prevent damage to equipment.

NOTE

Do not allow piston to slide out of bottom of piston ring compressor

30. Place piston ring compressor (32) and connecting rod and piston assembly (9) over cylinder to be serviced. Position piston ring compressor squarely on cylinder liner (3) flange.



342-1068

CAUTION

Do not force connecting rod and piston assembly into cylinder liner as oil control ring expander applies considerable force on oil control ring. Use care to prevent ring breakage.

31. Push connecting rod and piston assembly (9) into cylinder liner by hand until piston is free of piston ring compressor (32).
32. Remove piston ring compressor (32).

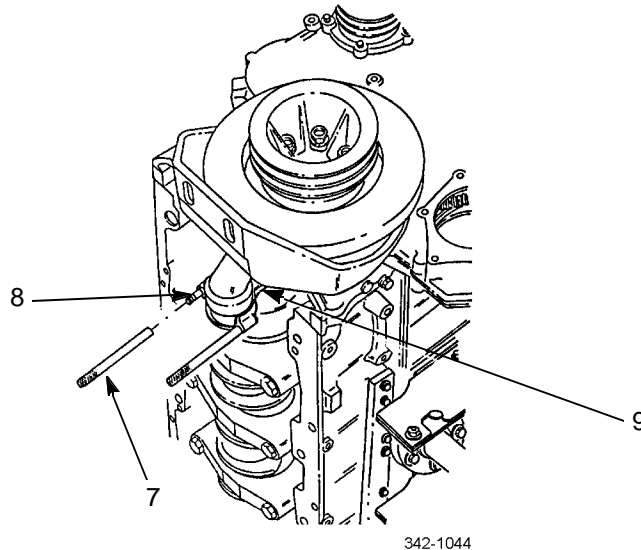
INSTALLATION - CONTINUED**CAUTION**

- Failure to orient piston connecting rod properly during installation may result in connecting rod striking and damaging nozzle. A damaged or loosed nozzle can cause a loss of main gallery pressure or lack of cooling to piston. Severe engine damage would result.
- Use care when loading piston into cylinder liner not to damage piston cooling nozzle installed at base of cylinder bore. Before loading piston into liner, turn connecting rod so that bearing end is offset approximately 10-15 degrees and is not perpendicular to crankshaft. Once rod end is past nozzle, turn rod so it is perpendicular with crankshaft.

NOTE

Ensure two connecting rod bolts have not been unseated or turned.

33. Push or tap connecting rod and piston assembly (9) until upper connecting rod bearing shell is firmly seated on crankshaft journal. Remove two connecting rod guides (7).

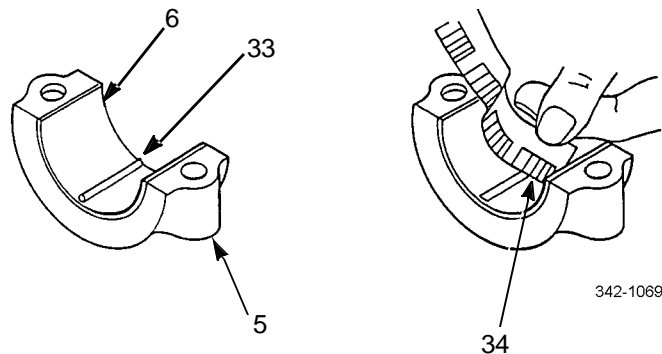
**NOTE**

Perform step 34 only if performing plastigauge check. If not performing plastigauge check, go to step 35.

34. Check clearance between connecting rod bearing shells and crankshaft journal at time of connecting rod and piston assembly installation as follows:
- With upper and lower bearing shells (6) installed in connecting rod and connecting rod cap, wipe any oil from bearing shells and connecting rod journal.
 - Place piece of plastigauge (33) along full width of lower connecting rod bearing shell (6) about ¼ in (6.35 mm) off center.
 - Install connecting rod and rod bolts on crankshaft bearing journal in its corresponding cylinder.

INSTALLATION - CONTINUED

- d. Install connecting rod cap and cap nuts on connecting rod and tighten connecting rod cap nuts to 118-137 lb-ft (160-185 Nm).
- e. Remove connecting rod cap (5) and bearing shell (6).
- f. Flattened plastiguage (33) will adhere to either bearing shell or connecting rod journal. Compare width of plastiguage at widest point with graduations scale (34) on plastiguage envelope to determine connecting rod bearing clearance. Maximum connecting rod bearing to connecting rod journal clearance with used parts is 0.006 in (0.152 mm).
- g. Inspect crankshaft journals before installing bearings.
- h. Coat connecting rod bearing shells and journal with clean engine lubricating oil before assembly.



35. Place lower connecting rod bearing shell (6) in connecting rod cap (5). Index bearing tang with notch in connecting rod cap. Lubricate bearing shell with clean engine lubricating oil.

CAUTION

Number stamped on connecting rod cap indicates cylinder it should be installed in. Number must be on oil cooler side of cylinder block when installing connecting rod cap to prevent damage to equipment.

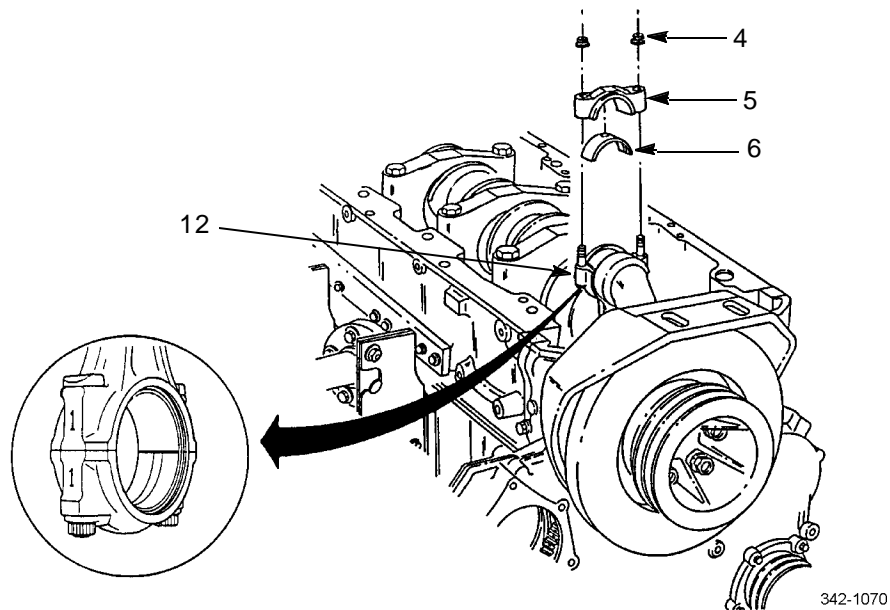
INSTALLATION - CONTINUED

36. Install connecting rod cap (5) and lower connecting rod bearing shell (6) on connecting rod (12).

CAUTION

Ensure connecting rod bolt has not turned in connecting rod before connecting rod cap nut is tightened to prevent damage to equipment.

37. Install two connecting rod cap nuts (4). Tighten cap nuts alternately to 118-137 lb-ft (160-185 Nm). Check connecting rod side clearance by moving connecting rod from crank neck. If there is no clearance, check bearing installation.



38. Install remaining piston and rod assemblies in same manner.
39. Install oil pump (WP0029 00).
40. Install cylinder head (WP0018 00).

END OF WORK PACKAGE

TURBOCHARGER REPLACEMENT

0042 00

THIS WORK PACKAGE COVERS

Removal, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Adapter, torque wrench (Item 3, WP 0126 00)

Shield, turbo protect (Item 113, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Gasket, drain tube (P/N 8929285)

Gasket, exhaust inlet (P/N 8929529)

Materials/Parts - Continued

Oil, lubricating (Item 25, WP 0125 00)

Tape, masking (Item 37, WP 0125 00)

Personnel Required

Two

Equipment Condition

Exhaust pipes removed from turbocharger (TM 9-2320-302-20)

Air intake tubes and hoses removed from turbocharger (TM 9-2320-302-20)

REMOVAL



WARNING

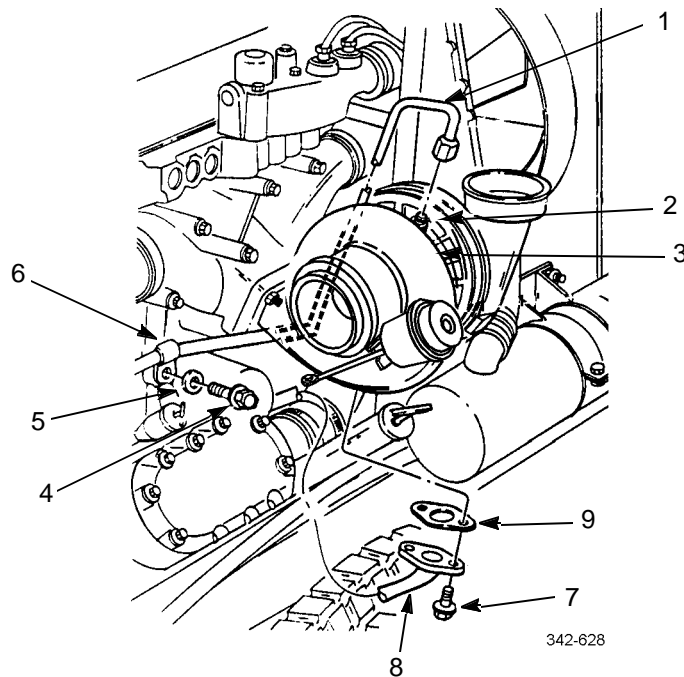
Hot turbocharger and exhaust pipe can cause serious burns. Do not work on exhaust system until it is cool. To do so could result in serious injury to personnel.

NOTE

If removal of wastegate actuator is required, refer to WP 0044 00 for 3K turbochargers. Refer to WP 0045 00 for Garrett turbochargers. Wastegate removal is not required to remove turbocharger.

TURBOCHARGER REPLACEMENT**0042 00****REMOVAL - CONTINUED**

1. Disconnect oil supply line (1) from oil inlet port fitting (2) on top of turbocharger (3).
2. Remove top mounting bolt (4) and washer (5) from oil supply line clip (6) on oil filter adapter upper mounting leg and move away from turbocharger (3).
3. Remove two bolts (7) securing oil drain line (8) to bottom of turbocharger (3).
4. Remove oil drain line (8) and gasket (9). Discard gasket.



5. Remove four nuts (10) and washers (11) securing turbocharger (3) to exhaust manifold (12).

**WARNING**

Turbocharger weighs 50 lb (23 kg). Use two persons or suitable lifting device during removal to prevent personal injury or damage to equipment.

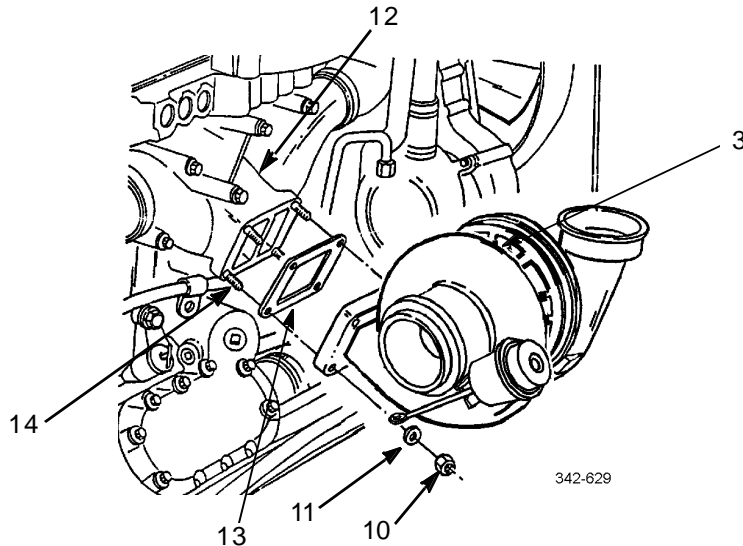
6. Remove turbocharger (3) and gasket (13) from mounting studs (14). Discard gasket.

TURBOCHARGER REPLACEMENT

0042 00

REMOVAL - CONTINUED

7. Tape all openings of turbocharger (3).

**INSPECTION**

1. Inspect turbocharger mounting studs on exhaust manifold for damage or looseness. Tighten stud(s), if loose.
2. Remove and replace damaged stud as follows:
 - a. Remove threaded turbocharger stud by unscrewing, using two nuts, one as a jamnut.
 - b. Thread new stud into exhaust manifold until unthreaded portion of stud is bottomed against mounting flange. Tighten stud(s) to 18-24 lb-ft (24-33 Nm).
3. Inspect mounting flange of exhaust manifold to ensure all gasket material is removed.

INSTALLATION

1. Remove tape from all openings of turbocharger (3).
2. Position new gasket (13) on mounting studs (14).

**WARNING**

Turbocharger weighs 50 lb (23 kg.). Use two persons or suitable lifting device during installation to prevent personal injury or damage to turbocharger.

NOTE

Ensure turbocharger mounting flange is free of all gasket material.

3. Place turbocharger (3) on mounting studs (14) with exhaust outlet side facing toward rear.
4. Install four washers (11) and nuts (10) on mounting studs (14). Tighten nuts to 43-54 lb-ft. (58-73 Nm).

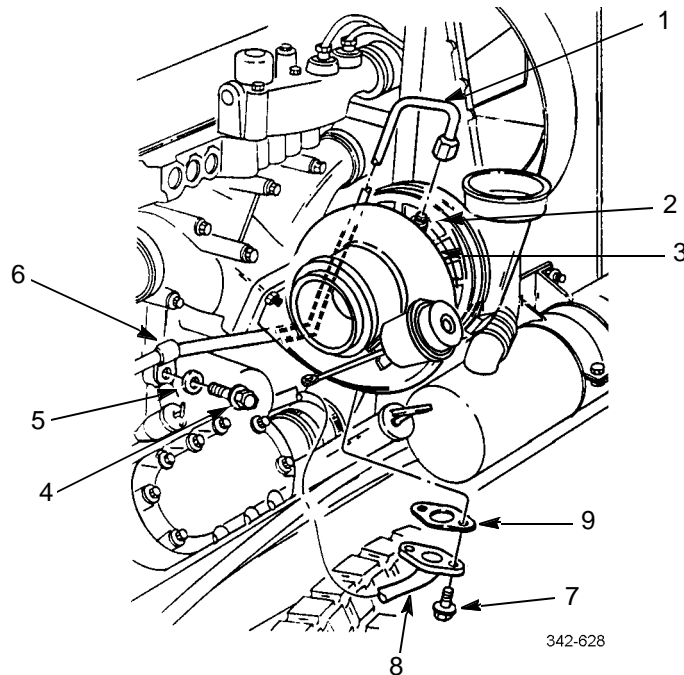
TURBOCHARGER REPLACEMENT**0042 00****INSTALLATION - CONTINUED**

5. Install new gasket (9) and connect oil drain line (8) to bottom of turbocharger (3) with two bolts (7). Tighten bolts to 22-28 lb-ft (30-38 Nm).

CAUTION

Do not use lubricant on inside of air inlet hose or hose contact surfaces of turbocharger compressor housing, intercooler, intercooler ducting or intake manifold. Use of lubricant can cause hose to blow off turbocharger. Failure to lubricate turbocharger will result in premature failure.

6. Pour approximately half-pint of engine lubricating oil into turbocharger (3) through oil inlet port fitting (2) at top of turbocharger (3), while manually rotating compressor wheel.
7. Connect oil supply line (1) to oil inlet port fitting (2). Wipe spilled oil from turbocharger (3) and exhaust manifold.
8. Install oil supply line clip (6) on oil filter adapter and secure with top mounting bolt (4) and washer (5). Tighten bolt to 43-54 lb-ft (58-73 Nm).



9. Install air intake tubes and hoses (TM 9-2320-302-20).
10. Install exhaust pipes (TM 9-2320-302-20).

END OF WORK PACKAGE

TURBOCHARGER REPAIR

0043 00

THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Dial indicator set (Item 29, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Materials/Parts

Compound, antiseize (Item 10, WP 0125 00)

Compound, pipe, sealing (Item 18, WP 0125 00)

Oil, lubricating (Item 25, WP 0125 00)

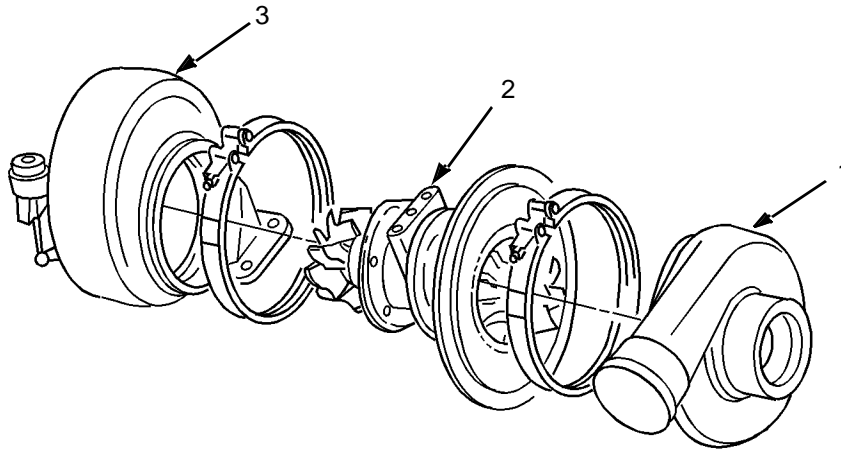
Equipment Condition

Turbocharger removed (WP 0042 00)

Wastegate removed from turbocharger (WP 0044 00
or WP 0045 00)

DISASSEMBLY

1. Scribe match marks on compressor housing (1), center housing (2), and turbine housing (3) to aid in assembly.

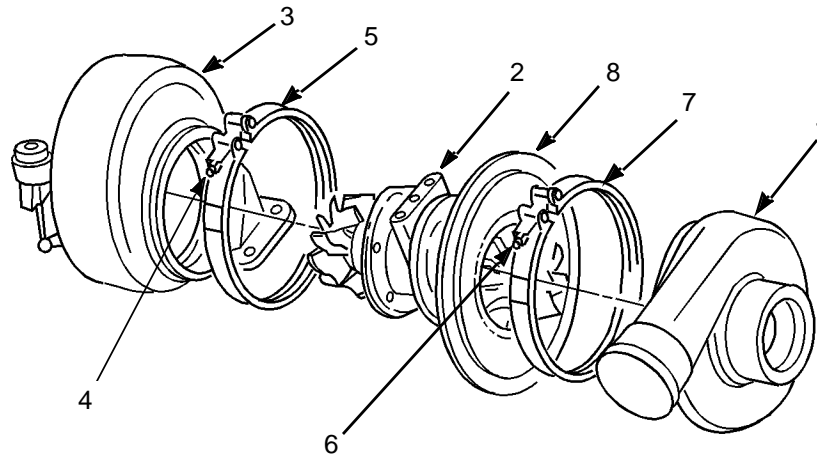


342-983

DISASSEMBLY - CONTINUED**CAUTION**

Tilting or cocking turbine housing during disassembly could damage turbine wheel blades.

2. Loosen coupling nut (4) and remove clamp (5) and turbine housing (3) from center housing (2).
3. Loosen coupling nut (6).
4. Remove compressor housing (1) and clamp (7) from center housing (2). If necessary, loosen compressor housing by tapping with soft mallet.



342-983

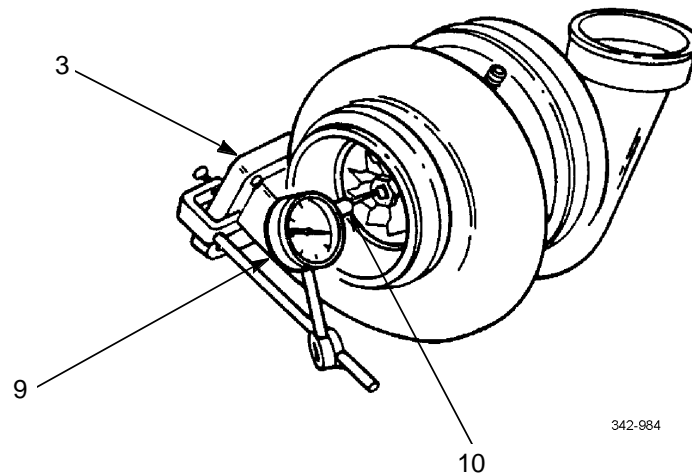
ASSEMBLY

1. Slide clamp (7) over backplate (8).
2. Position compressor housing (1), as marked in disassembly, against backplate (8). Secure with clamp (7). Lubricate threads of clamp lightly with engine lubricating oil and tighten coupling nut (6) to 110-130 lb-in (12-15 Nm).

CAUTION

Ensure coupling nuts are tightened enough to prevent turbine housing from contacting turbine wheel.

3. Position turbine housing (3), as marked in disassembly, against center housing (2). Coat threads of clamp (5) with anti-seize compound. Install clamp and tighten coupling nut (4) to 110-130 lb-in (12-15 Nm).
4. Attach dial indicator (9) to turbine housing (3) so that dial indicator plunger (10) rests on hub end of turbine wheel assembly.
5. Set dial indicator (9) for reading of zero.

ASSEMBLY - CONTINUED**NOTE**

Bearing axial clearance must be 0.0020-0.0032 in (0.051-0.081 mm). If bearing axial clearance does not meet specification, replace turbocharger center housing assembly.

6. Apply manual pressure to compressor wheel and turbine wheel assembly to move assembly as far as it will go away from turbine end of turbocharger (toward dial indicator plunger (10)). Note maximum shaft movement shown on dial indicator (9).
7. Repeat steps 5 and 6 several times to ensure maximum bearing axial clearance, as indicated by maximum turbine wheel assembly movement, has been measured.

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Installation, Adjustment

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Dial indicator set (Item 29, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Materials/Parts

Kit, wastegate actuator (P/N 23523811)

Compound, antiseize (Item 10, WP 0125 00)

NOTE

Turbocharger wastegate actuators are NOT interchangeable.

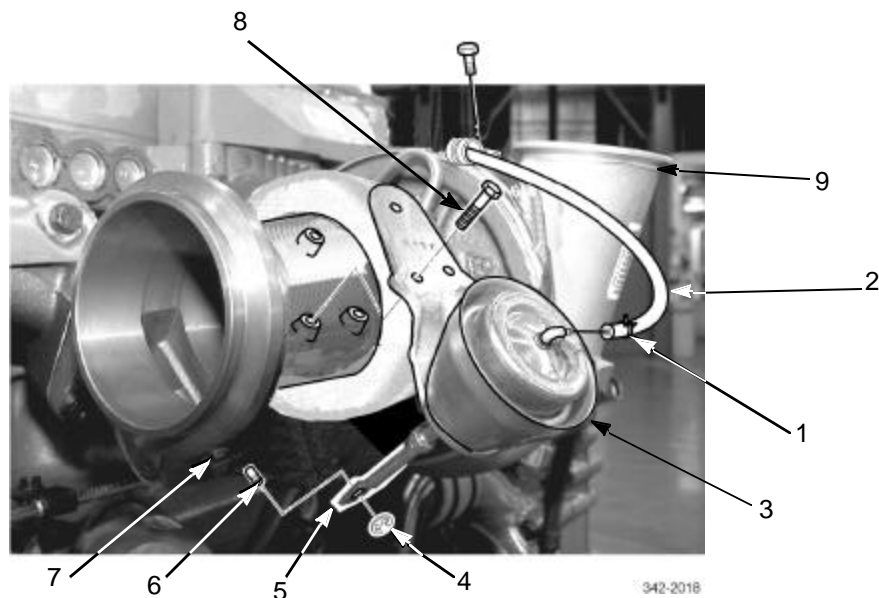
REMOVAL

1. Remove hose clamp (1) and hose (2) from wastegate (3).

CAUTION

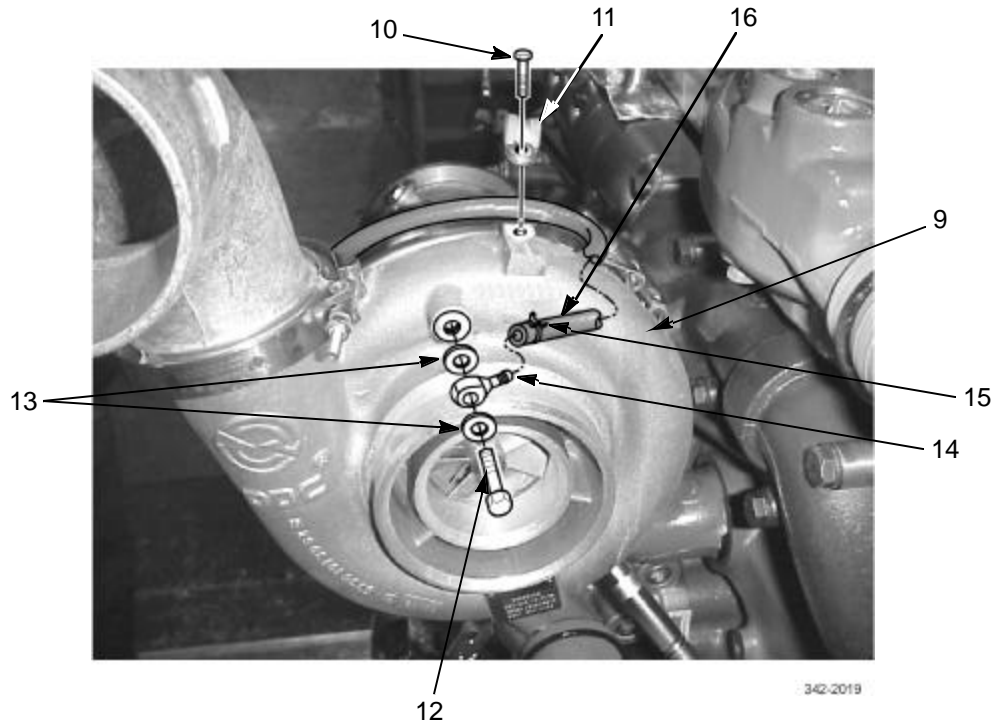
Never remove actuator rod end from stud on turbocharger lever without applying light pressure to wastegate inlet port. Failure to follow this caution could result in damage to wastegate diaphragm.

2. Remove retaining ring (4) securing actuator rod (5) to stud (6) on turbocharger lever (7).
3. Remove three bolts (8) and wastegate (3) from turbocharger (9).



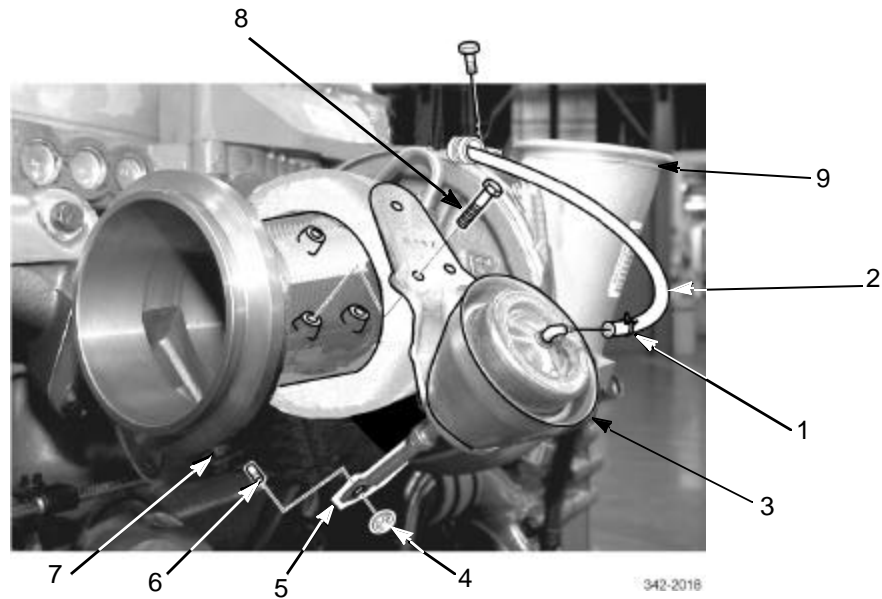
REMOVAL - CONTINUED

4. Remove bolt (10) and hose clip (11).
5. Remove bolt (12), two washers (13), and hose connector (14) from turbocharger (9).
6. Remove hose clip (15) and hose (16) from hose connector (14).

**INSTALLATION**

1. Install hose (16) and hose clip (15) to hose connector (14).
2. Install bolt (12), two washers (13), and hose connector (14) to turbocharger (9).
3. Secure hose (16) to turbocharger (9) with hose clip (11) and bolt (10).
4. Coat three bolts (8) with high temperature antiseize compound.
5. Position wastegate (3) on turbocharger (9) and hand tighten three bolts (8).
6. Secure hose (2) to wastegate (3) with hose clamp (1).
7. Loosen jamnut (17) on actuator rod (5).
8. While holding turbocharger lever (7) down (closed), turn end of actuator rod (5) until hole in rod aligns with stud (6) on turbocharger lever.
9. Secure actuator rod (5) end to stud (6) on turbocharger lever (7) with retaining ring (4).
10. Turn actuator rod (5) end five revolutions in direction of wastegate (3) and tighten jamnut (17).
11. Tighten three bolts (8) to 180 lb-in (20 Nm).

INSTALLATION - CONTINUED

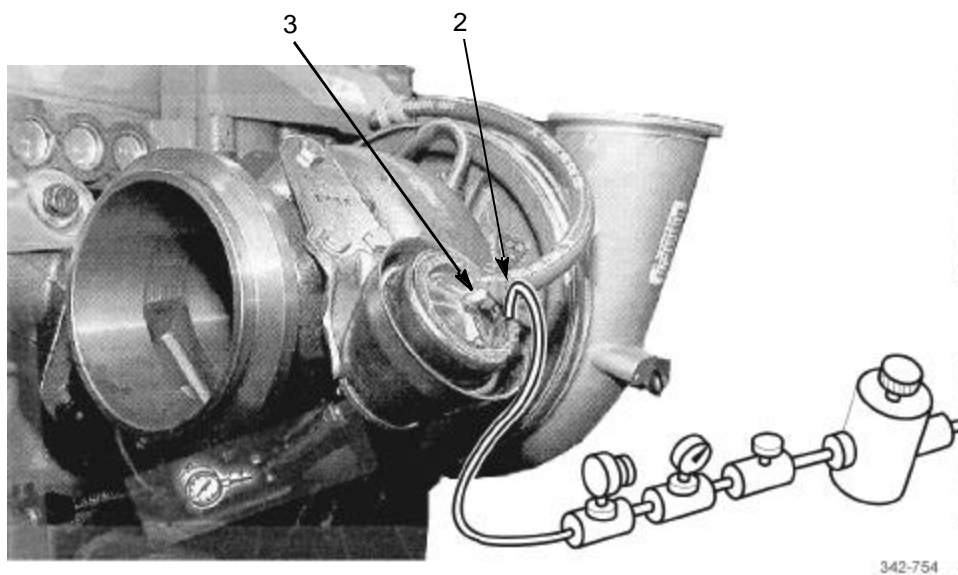


ADJUSTMENT

1. Disconnect hose (2) from wastegate (3).

NOTE

Dial indicator must have a minimum of 0.100 in (2.5 mm) travel for measurement.



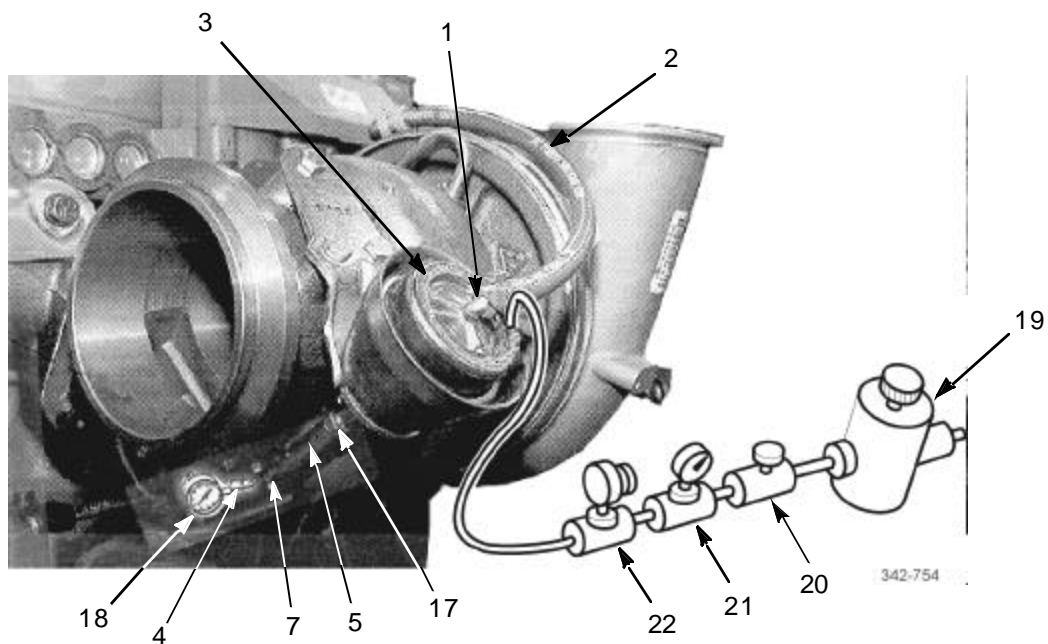
ADJUSTMENT - CONTINUED

2. Attach dial indicator (18) to wastegate actuator rod (5) to measure rod travel.
3. Connect air supply through regulator valve (19), shutoff valve (20), pressure gage (21), and vent valve (22) to wastegate (3).
4. Adjust regulator valve (19) to provide 34 psi (234 kPa) of air pressure to wastegate (3).
5. Close air supply at shutoff valve (20) and observe reading on pressure gage (21).

NOTE

If pressure drops, check actuator hose and fitting connections for leaks. If none are found, replace wastegate actuator.

6. Open vent valve (22) to relieve pressure and observe pressure gage (21) for zero indication. Adjust regulator valve (19) to zero and close vent valve.
7. Adjust dial indicator (18) to contact actuator rod (5) end and adjust to a zero reading.
8. Open air supply at shutoff valve (20) and slowly adjust regulator valve (19) to 34 psi (234 kPa). Switch pressure on and off with vent valve (22) to ensure dial indicator travel from 0.00 in to 0.070 in (1.79 mm) and that pressure reading is consistent.
9. Actuator adjustment should be set for an indication of 0.070-0.075 in (1.79-1.91 mm) actuator rod travel at 34 psi (234 kPa) pressure setting.

**NOTE**

If travel is within limits, relieve and disconnect air pressure to wastegate actuator. If travel is not within limits, proceed to next step to adjust actuator rod travel.

10. Loosen jamnut (17) on actuator rod (5).
11. Remove retaining ring (4) securing actuator rod (5) to wastegate lever (7).

3K TURBOCHARGER WASTEGATE ACTUATOR MAINTENANCE - CONTINUED

0044 00***ADJUSTMENT - CONTINUED***

12. Remove actuator rod (5) from wastegate lever (7). Turn rod 1/2 turn [180 degrees = 0.020 in (0.5 mm)] clockwise to increase, or counterclockwise to decrease setting.
13. Repeat steps 7 and 8 to check if adjustment of travel rod is within limits.
14. Install retaining ring (4) on wastegate lever (7) and tighten jamnut (17) on actuator rod (5).
15. Disconnect regulated air supply from actuator (3). Connect hose (2) to wastegate (3).

END OF WORK PACKAGE

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GARRETT TURBOCHARGER WASTEGATE ACTUATOR MAINTENANCE

0045 00

THIS WORK PACKAGE COVERS

Removal, Installation, Adjustment

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Dial indicator set (Item 29, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Materials/Parts

Clip, retaining (P/N 400702-25)

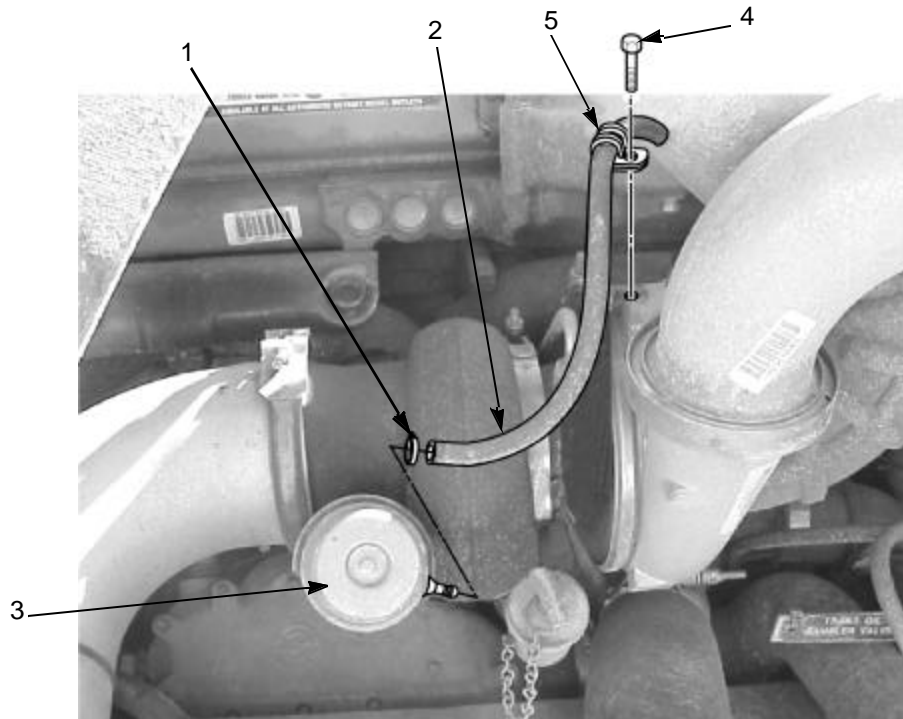
Compound, antiseize (Item 10, WP 0125 00)

NOTE

Turbocharger wastegate actuators are NOT interchangeable.

REMOVAL

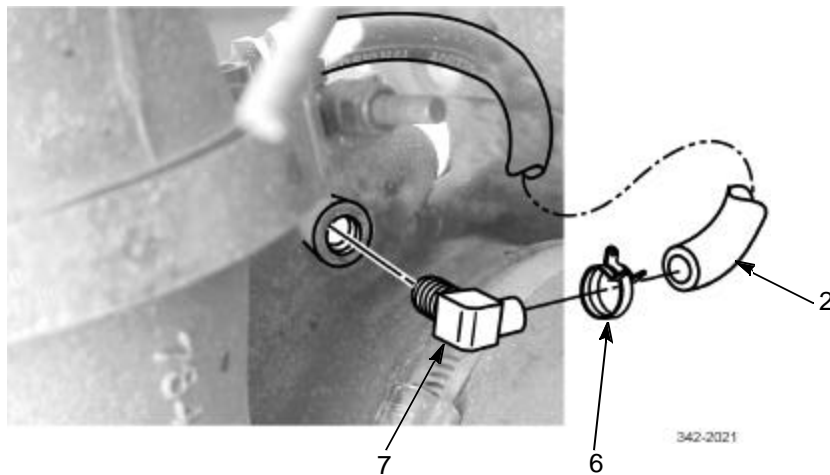
1. Remove hose clip (1) and hose (2) from wastegate (3).
2. Remove bolt (4), hose clamp (5), and hose (2).



342-2020

REMOVAL - CONTINUED

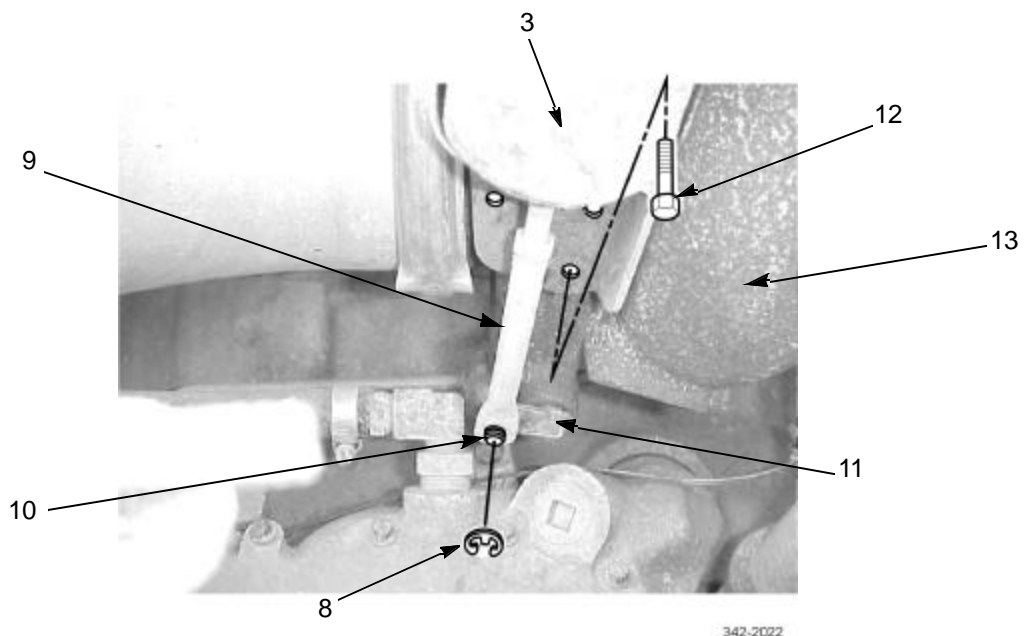
3. Remove hose clip (6) and hose (2) from elbow (7).
4. Remove elbow (7).



CAUTION

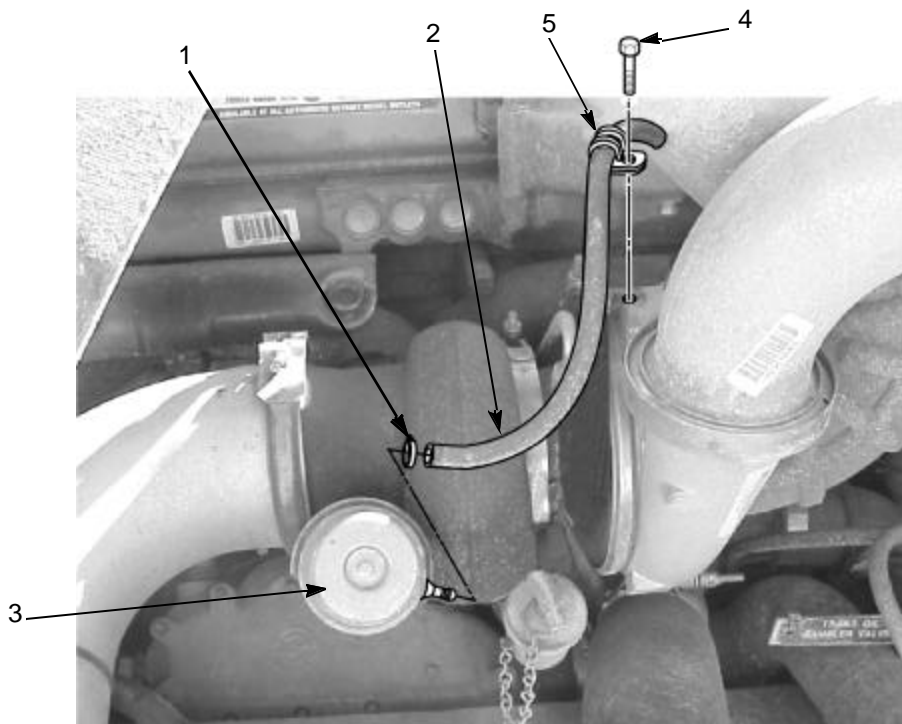
Never remove actuator rod end from stud on turbocharger lever without applying light pressure to wastegate inlet port. Failure to follow this caution could result in damage to wastegate diaphragm.

5. Remove retaining clip (8) securing actuator rod (9) to stud (10) on turbocharger lever (11). Discard retaining clip.
6. Remove three bolts (12) and wastegate (3) from turbocharger (13).



INSTALLATION

1. Coat three bolts (12) with high temperature antiseize compound.
2. Position wastegate (3) on turbocharger (13) and hand tighten three bolts (12).
3. Loosen jamnut (14) on actuator rod (9).
4. While holding turbocharger lever (11) down (closed), turn end of actuator rod (9) until hole in rod aligns with stud (10) on turbocharger lever.
5. Secure actuator rod (9) end to stud (10) on turbocharger lever (11) with new retaining clip (8).
6. Turn actuator rod (9) end five revolutions in direction of wastegate (3) and tighten jamnut (14).
7. Tighten three bolts (12) to 180 lb-in (20 Nm).
8. Install elbow (7).
9. Install hose (2) and hose clip (6) to elbow (7).
10. Install hose (2) and hose clip (1) to wastegate (3).
11. Install hose (2), hose clamp (5), and bolt (4).



342-2020

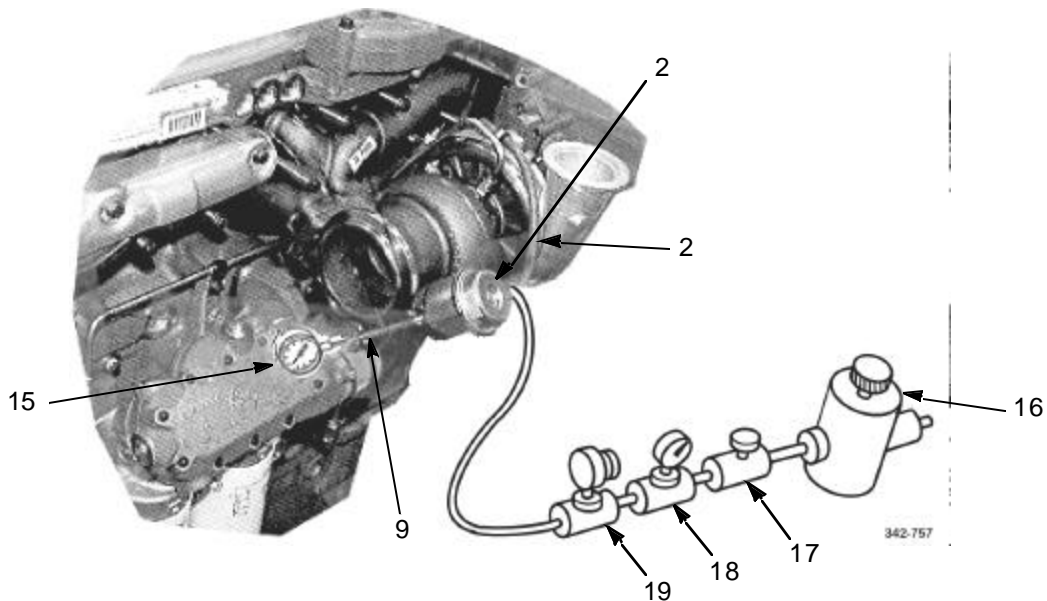
ADJUSTMENT

1. Disconnect hose (2) from wastegate (3).

NOTE

Dial indicator must have a minimum of 0.100 in (2.5 mm) travel for measurement.

2. Attach dial indicator (15) to wastegate actuator rod (9) to measure rod travel.



3. Connect air supply through regulator valve (16), shutoff valve (17), pressure gage (18), and vent valve (19) to wastegate (3).
4. Adjust regulator valve (16) to provide 31 psi (214 kPa) of air pressure to actuator (3).
5. Close air supply shutoff valve (17) and observe reading on pressure gage (18).

NOTE

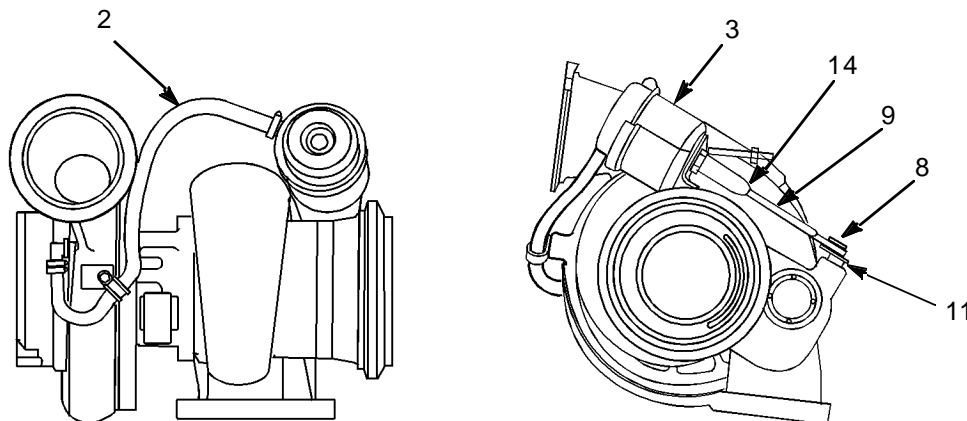
If pressure drops, check actuator hose and fitting connections for leaks. If none are found, replace wastegate actuator.

6. Open vent valve (19) to relieve pressure and observe pressure gage (18) for zero indication. Adjust regulator valve (16) to zero and close vent valve.
7. Adjust dial indicator (15) to contact actuator rod (9) end and adjust to a zero reading.
8. Open air supply shutoff valve (17) and slowly adjust regulator valve (16) to 31 psi (214 kPa). Switch pressure on and off with vent valve (19) to ensure dial indicator travel from 0.00 in to 0.040 in (1.02 mm) and that pressure reading is consistent.
9. Actuator adjustment should be set for an indication of 0.040 (1.02 mm) at 31 psi (214 kPa) pressure setting.

ADJUSTMENT - CONTINUED**NOTE**

If travel is within limits, relieve and disconnect air pressure to wastegate actuator. If travel is not within limits, proceed to next step to adjust actuator rod travel.

10. Loosen jamnut (14) on actuator rod (9).
11. Remove retaining clip (8) securing actuator rod (9) to wastegate lever pin (11).
12. Remove actuator rod (9) from wastegate lever pin (11). Turn rod 1/2 turn [180 degrees = 0.020 in (0.5 mm)] clockwise to increase, or counterclockwise to decrease setting.
13. Repeat steps 7 and 8 to check if adjustment of travel rod is within limits.
14. Install retaining clip (8) on wastegate lever pin (11) and tighten jamnut (14) while holding actuator rod (9).
15. Disconnect hose (2) from regulated air source and reconnect hose to wastegate (3).



342-755

END OF WORK PACKAGE

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FUEL INJECTOR REPLACEMENT

0046 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Pan, drain (Item 80, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

O-ring (P/N 5234669) (2)

O-ring (P/N 5234702)

Antifreeze, ethylene glycol (Item 6, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

Rocker arm cover removed (WP 0016 00)

Rocker arm assemblies removed (WP 0027 00)



WARNING

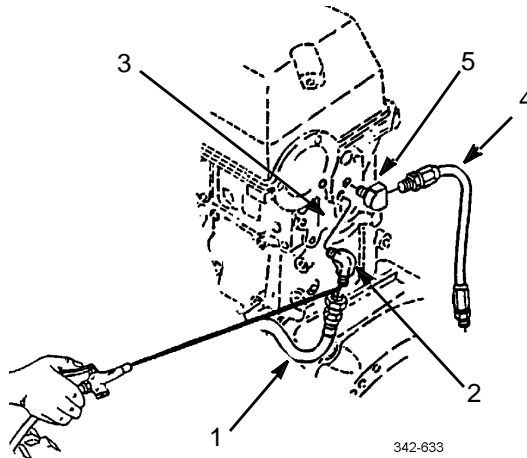


- DO NOT perform fuel system checks, inspections or maintenance while smoking or near fire, flames or sparks. Fuel may ignite, causing injury or death to personnel or damage to equipment.
- Fuel vapors are toxic. Avoid prolonged exposure or breathing of fumes. Work in a well-ventilated area. Failure to do so could result in serious injury to personnel.

REMOVAL**NOTE**

Tag fuel lines, wire terminals, and injectors prior to removal to aid in installation.

1. Disconnect fuel supply hose (1) from elbow fitting (2) at rear of cylinder head (3).
2. Disconnect fuel return line (4) from elbow fitting (5) at rear of cylinder head (3).
3. Place fuel lines (1 and 4) in a suitable container to collect drained fuel.

**WARNING**

Eye protection must be worn to prevent fuel from getting in eyes during fuel removal.

CAUTION

All fuel must be removed from cylinder head before removing an injector to prevent fuel from entering cylinder and causing hydrostatic lock or washdown.

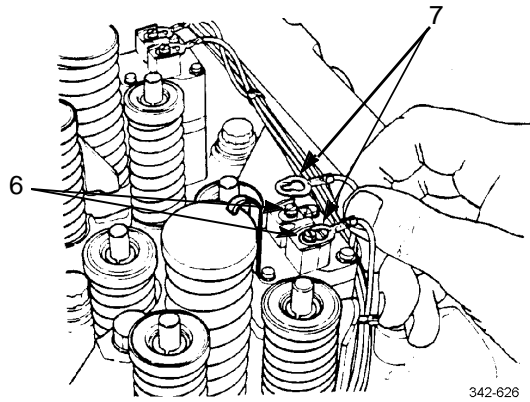
4. Apply low air pressure for 20 to 30 seconds into elbow fitting (2) to purge remaining fuel from cylinder head (3).

NOTE

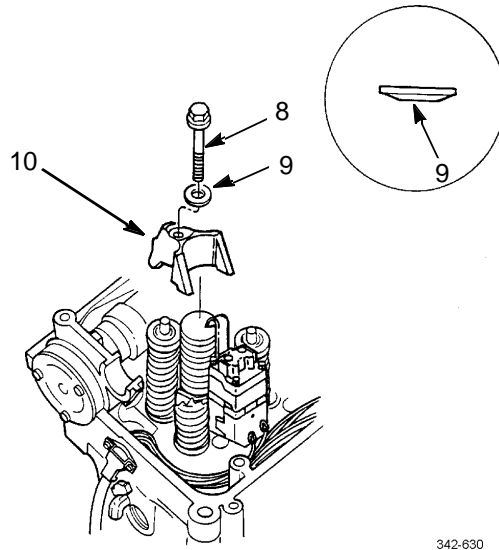
Perform step 5 through 8 for each injector to be removed.

5. Loosen two screws (6) and disconnect injector wiring harness terminals (7).

REMOVAL - CONTINUED



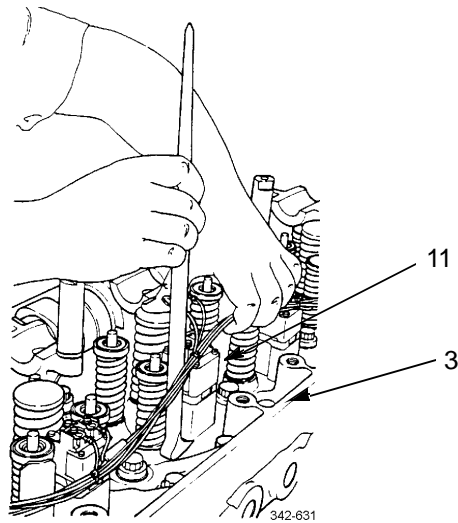
6. Remove holddown bolt (8), washer (9), and holddown clamp (10).



REMOVAL - CONTINUED**CAUTION**

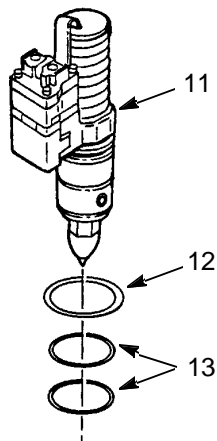
Use extreme care when handling injectors to avoid costly damage by dropping or mishandling.

7. Lift injector (11) from seat in cylinder head (3) by inserting pry bar under injector as shown.

**NOTE**

Use a clean rag in injector hole to keep foreign matter out of engine.

8. Remove three o-ring seals (12 and 13) from injector (11). Discard seals.



342-632

INSTALLATION**NOTE**

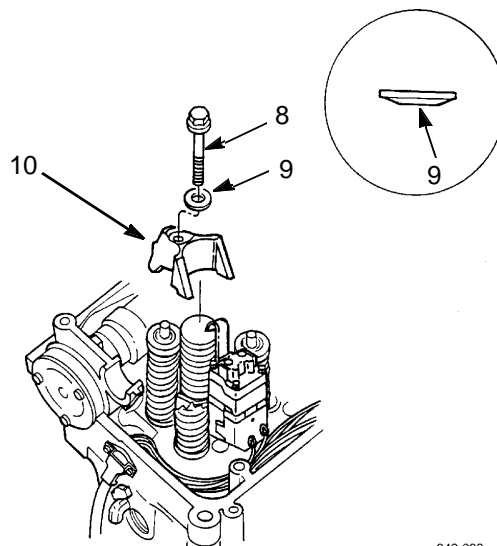
Perform steps 1 through 10 for each injector being installed.

1. Lubricate three new o-ring seals (12 and 13) lightly with clean ethylene glycol.
2. Install larger o-ring seal (12) in upper groove.
3. Install two lower o-ring seals (13) in two lower grooves.

CAUTION

Ensure injector port is free of dirt or other foreign matter which may cause damage to engine.

4. Insert injector (11) into cylinder head (3) and visually align injector for equal clearance between valve springs.
5. Press down on top of injector body until injector (11) is fully seated.
6. Install holddown clamp (10) on injector (11).



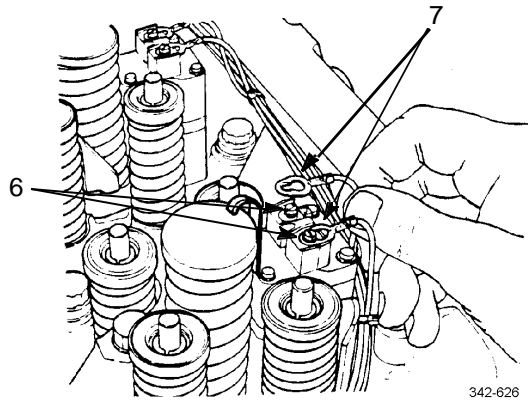
342-630

7. Install and hand tighten washer (9) and holddown bolt (8), with beveled side facing engine.

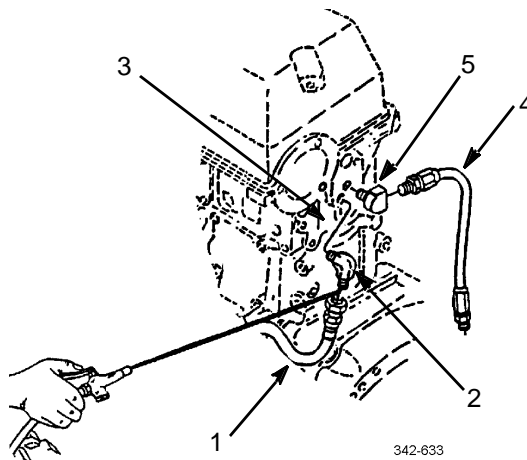
INSTALLATION - CONTINUED**CAUTION**

Check position of injector and holddown clamp to ensure clearance between intake valve spring and injector follower. Failure to do so will result in equipment damage.

8. Tighten holddown bolt (8) to 43-49 lb-ft (58-66 Nm).
9. Connect injector wiring harness terminals (7) and tighten two screws (6) to 12-17 lb-in (1.36-1.92 Nm).



10. Connect fuel supply hose (1) to elbow fitting (2) and fuel return line (4) to elbow fitting (5) at rear of cylinder head (3).



11. Install rocker arm assemblies (WP0027 00).
12. Install rocker arm cover (WP0016 00).

END OF WORK PACKAGE

FUEL INJECTOR SOLENOID REPLACEMENT

0047 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Materials/Parts

Seal (P/N 5234224) (2)

Materials/Parts - Continued

Screw (P/N 5235586) (4)

Tags, marker (Item 35, WP 0125 00)

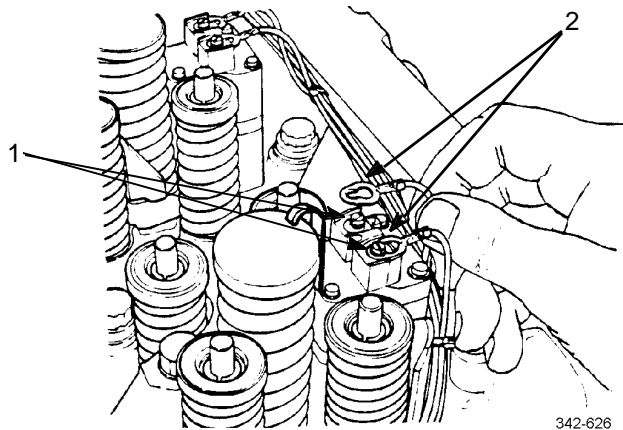
Equipment Condition

Rocker arm cover removed (WP 0016 00)

REMOVAL**NOTE**

- Solenoid may be removed and replaced without removing fuel injector.
- Ensure fuel injector wiring harness lead connectors are tagged prior to removal to aid in installation.

1. Loosen two screws (1) and disconnect fuel injector harness wiring terminals (2).

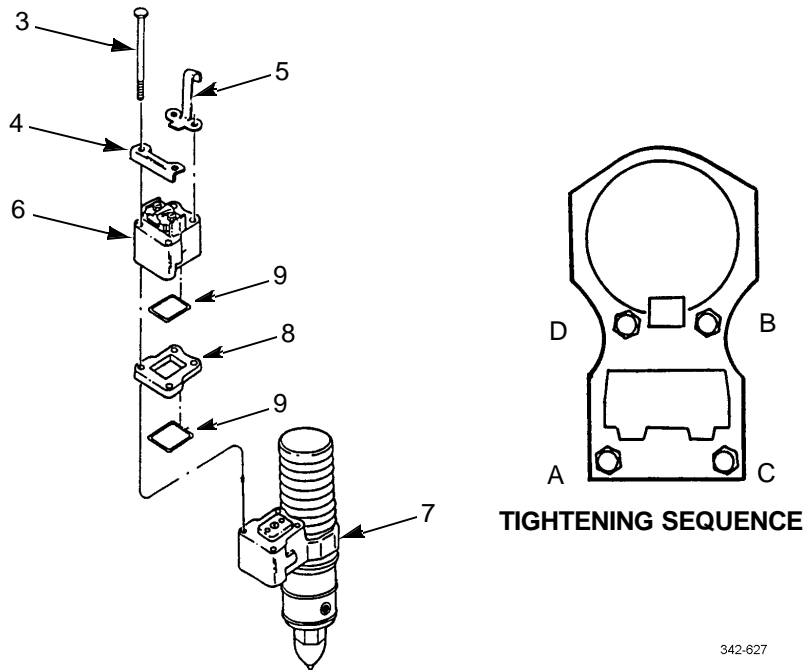


REMOVAL - CONTINUED

NOTE

Load plate and spacer plate are matched to injector and must be retained for new solenoid.

2. Remove four screws (3), load plate (4), and follower retainer (5) from solenoid (6). Discard screws.
3. Remove solenoid (6) from fuel injector body (7).
4. Remove spacer (8) and two seals (9) from fuel injector body (7). Discard seals and retain spacer.



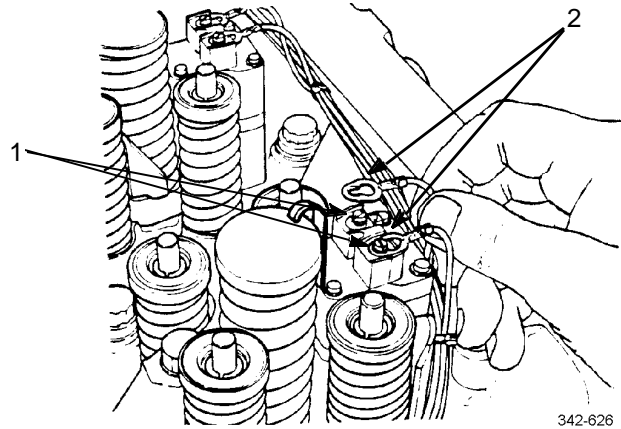
TIGHTENING SEQUENCE

342-627

INSTALLATION

1. Install two new seals (9) and spacer (8) on fuel injector body (7).
2. Position solenoid (6) on spacer (8) and fuel injector body (7).
3. Install four new screws (3) through load plate (4), follower retainer (5), solenoid (6), and spacer (8).
4. Thread four screws (3) into body and tighten all screws until heads contact follower retainer (5) and load plate (4).
5. Tighten screws (3) to 19 lb-in (2 Nm), following sequence shown.
6. Connect fuel injector harness wiring terminals (2) and tighten two screws (1).

INSTALLATION - CONTINUED



342-626

7. Install rocker arm cover (WP0016 00).

END OF WORK PACKAGE

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RADIATOR REPAIR

0048 00

THIS WORK PACKAGE COVERS

Disassembly, Repair, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Gloves (Item 41, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Materials/Parts

Gasket (P/N 05-12295-000) (2)

Nut, self-locking (P/N 32WLF3816) (36)

Grease, GAA (Item 22, WP 0125 00)

References

TM 750-254

Equipment Condition

Radiator removed from vehicle (TM 9-2320-302-20)

DISASSEMBLY

NOTE

Additional items are mounted or attached to radiator when installed in vehicle. These items use radiator hardware for installation. During disassembly, note the location, orientation, size, and quantity of screws, nuts, and bolting bars as an aid in assembly.

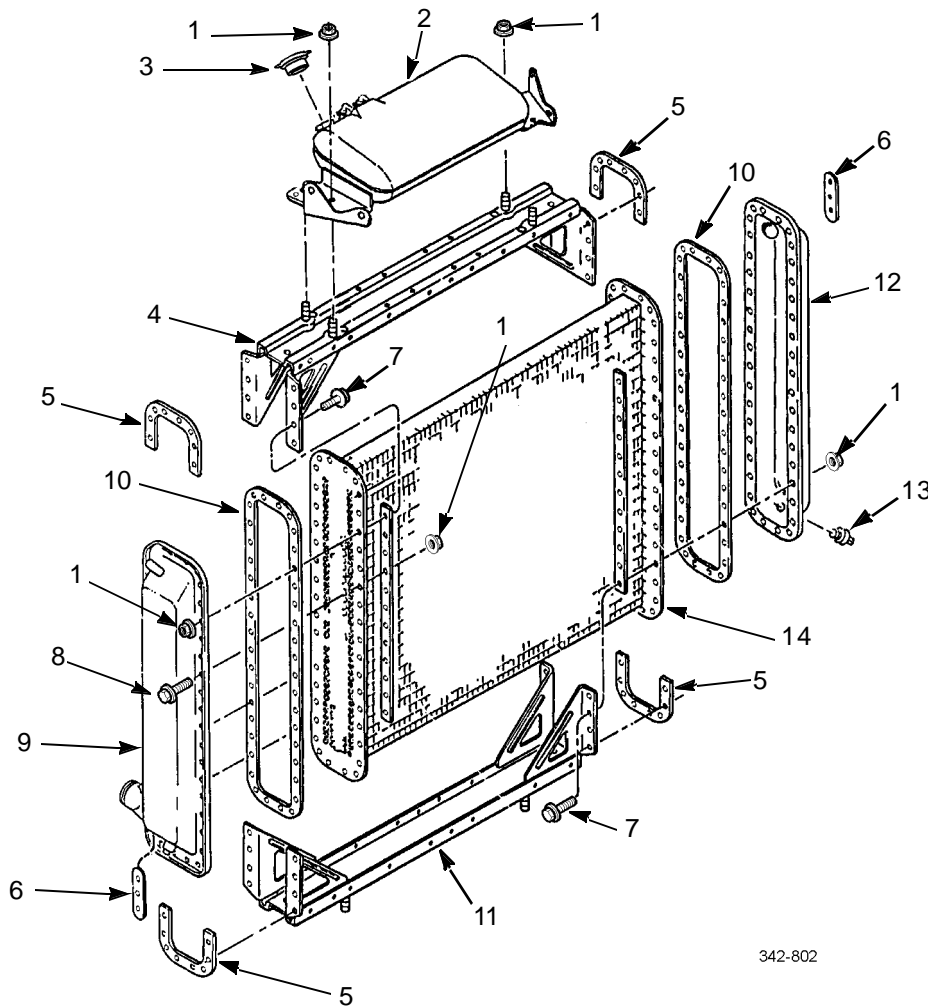
DISASSEMBLY - CONTINUED

1. Remove two lock nuts (1), expansion tank (2), and radiator cap (3) from radiator top channel (4). Discard lock nuts.

NOTE

Position radiator front face down on workbench, with right hand outlet tank over edge. It may be necessary to place radiator on blocks to gain access to end tank hardware.

2. Remove lock nuts (1), bolting bars (5 and 6), and screws (7 and 8) securing right-hand outlet tank (9) and header gasket (10) to top and bottom channel (4 and 11). Discard lock nuts.
3. Remove right-hand outlet tank (9) and header gasket (10). Discard gasket.
4. Remove lock nuts (1), bolting bars (5 and 6), and screws (7 and 8) securing left-hand inlet tank (12) and header gasket (10) to top and bottom channel (4 and 11). Discard lock nuts.
5. Remove left-hand inlet tank (12) and header gasket (10). Discard gasket.
6. Remove drain plug (13) from inlet tank (12).



342-802

DISASSEMBLY - CONTINUED**WARNING**

Radiator core vanes are sharp and can easily cut. Gloves should be worn when handling bare radiator cores to prevent injury to personnel.

CAUTION

Use care when handling or storing radiator cores as core vanes are thin and easily bent. If many vanes are bent, air flow through radiator core will not be sufficient for cooling. Equipment damage will result.

7. Remove top and bottom channels (4 and 11) from radiator core (14).

REPAIR**NOTE**

No more than 12 tubes of radiator core can be blocked off. If more than 12 are blocked, core is not serviceable. Replace with new core prior to assembly.

Refer to TM 750-254 for additional information on radiator repair.

ASSEMBLY

1. Position radiator core (14) front face down on workbench and apply a light coat of grease to surface of each new header gasket (10).
2. Position two new header gaskets (10) on radiator core (14).
3. Place top (4) and bottom (11) channels on radiator core (14).

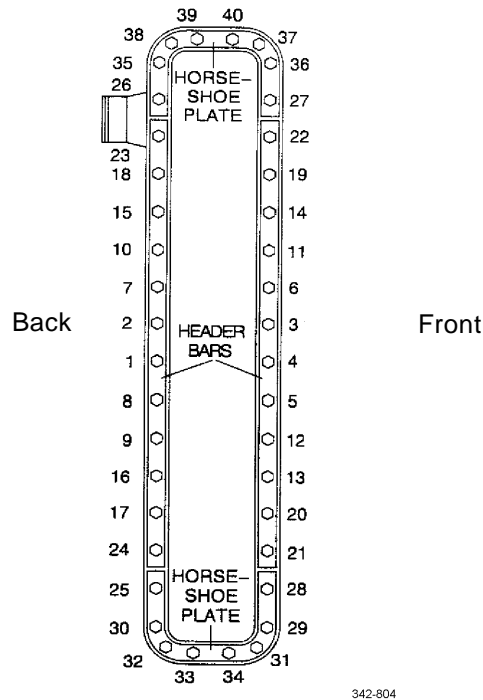
NOTE

Ensure bolting bars, screws, and mounting hardware are installed as noted in disassembly.

4. Install inlet tank (12) with bolting bars (5 and 6), screws (7 and 8), and new lock nuts (1).

ASSEMBLY - CONTINUED

5. Follow tightening sequence and tighten screws to 120 lb-in (1360 Ncm). Repeat sequence and tighten to 180 lb-in (20 Nm).



TIGHTENING SEQUENCE

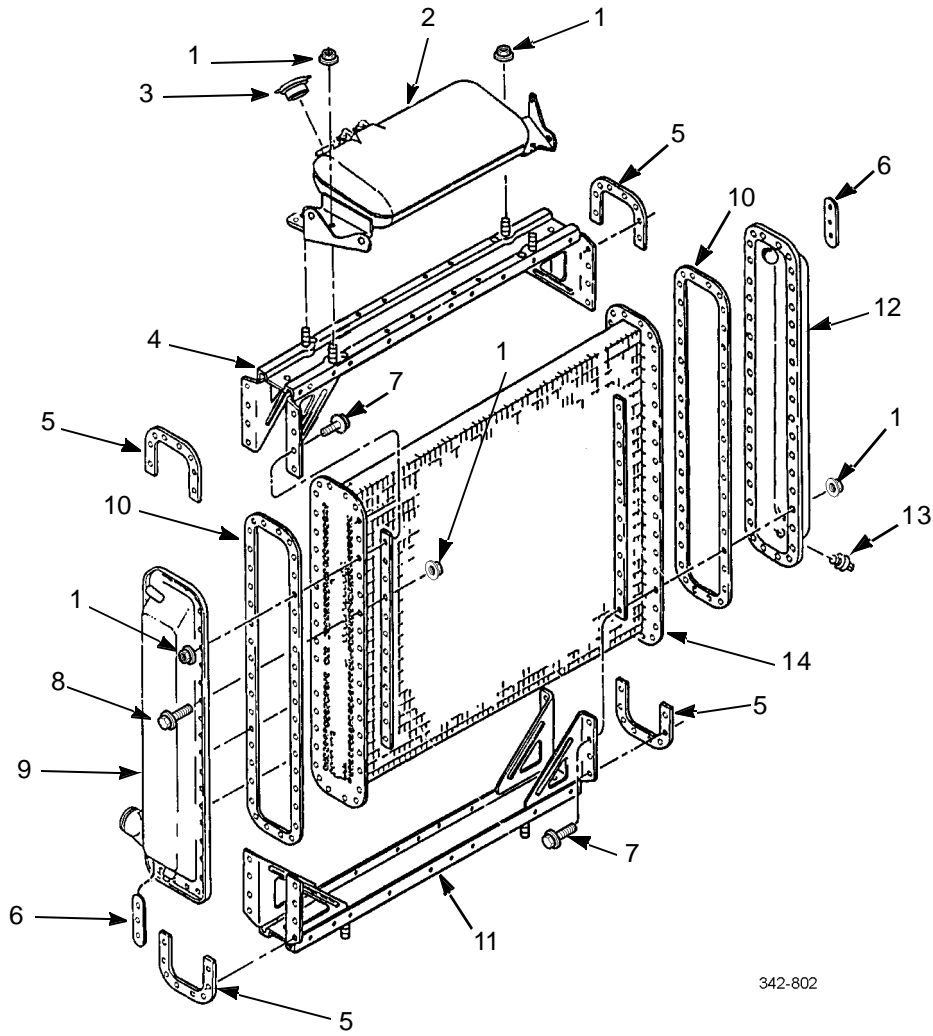
6. Install outlet tank (9) with bolting bars (5 and 6), screws (7 and 8), and new lock nuts (1).
7. Follow tightening sequence and tighten screws to 120 lb-in (1360 Ncm). Repeat sequence and tighten to 180 lb-in (20 Nm).
8. Install two new lock nuts (1), expansion tank (2), and radiator cap (3).

CAUTION

DO NOT apply excessive air pressure when testing radiator. Too much pressure will damage radiator core. Air pressure should not exceed 20 psi (138 kPa).

9. Pressure test radiator.

ASSEMBLY - CONTINUED



END OF WORK PACKAGE

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WATER PUMP REPAIR**0049 00****THIS WORK PACKAGE COVERS**

Disassembly, Assembly, Test and Inspection

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Caps, vise jaw (Item 17, WP 0126 00)

Dial indicator set (Item 29, WP 0126 00)

Dispenser, sealant (Item 30, WP 0126 00)

Pliers, retaining ring (Item 88, WP 0126 00)

Press, arbor (Item 90, WP 0126 00)

Puller kit, mechanical (Item 95, WP 0126 00)

Service kit, water pump (Item 112, WP 0126 00)

Tester, impeller (Item 125, WP 0126 00)

Vise, machinist's (Item 136, WP 0126 00)

Tools and Special Tools - Continued

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Kit, water pump O/H (P/N 23509105)

Compound, corrosion preventive (Item 11,
WP 0125 00)

Compound, gasket forming (Item 12, WP 0125 00)

Compound, sealing (Item 14, WP 0125 00)

Oil, lubricating (Item 25, WP 0125 00)

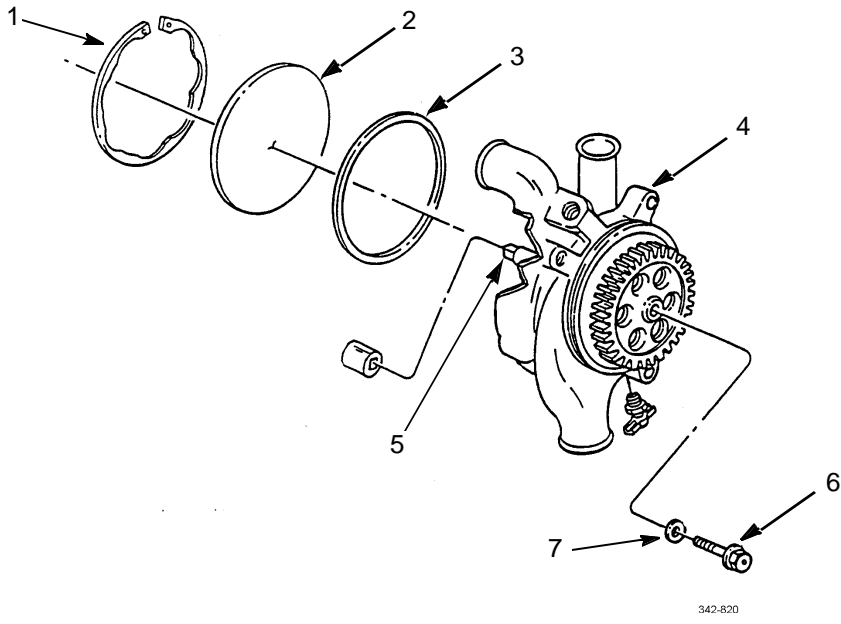
Rags, wiping (Item 31, WP 0125 00)

Equipment ConditionWater pump removed from engine (TM 9-2320-302-
20)**DISASSEMBLY****WARNING**

Due to size and tension of water pump cover snap ring, wear adequate face and eye protection during disassembly to prevent personal injury.

DISASSEMBLY

1. Remove snap ring (1), cover (2), and seal ring (3) from water pump housing (4). Discard seal ring.
2. Hold square end of water pump shaft (5) and remove retaining bolt (6) and washer (7).



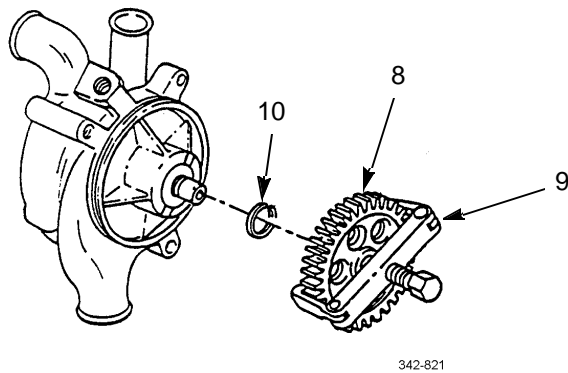
3. Remove drive gear (8) with two-jaw puller (9).



WARNING

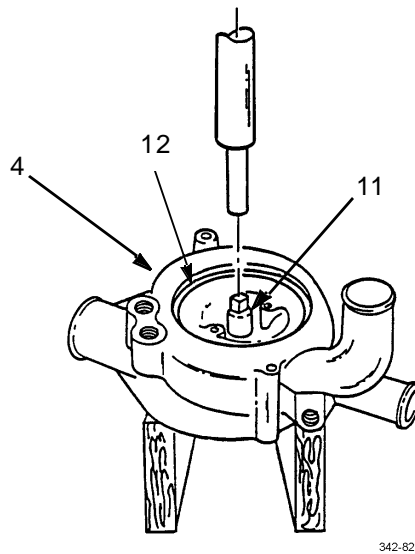
Due to tension of water pump shaft bearing retaining ring, wear adequate face and eye protection during removal to prevent personal injury.

4. Remove retaining ring (10).

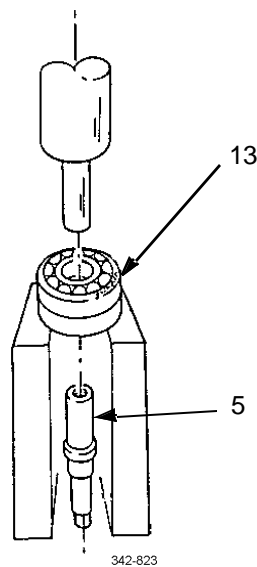


DISASSEMBLY - CONTINUED

5. Support water pump housing (4), impeller side up, and press roller bearing and shaft assembly (11) from water pump housing (4).
6. Remove impeller (12) from water pump housing (4).



7. Support roller bearing and shaft assembly (11) with square end of water pump shaft down. Press shaft (5) from roller bearing (13). Discard roller bearing.



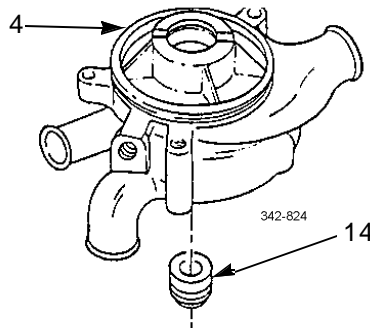
DISASSEMBLY - CONTINUED**CAUTION**

Use care when removing oil seal or water seal, to prevent damage to water pump housing seal bores. Do not allow brass drift to score housing bores. A scored bore will cause coolant leaks and can damage engine.

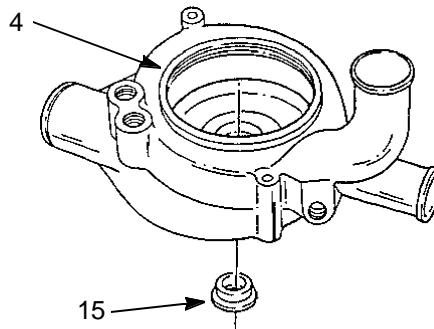
NOTE

Oil seal and water seal must be replaced whenever water pump shaft is removed.

- Place water pump housing (4) on bench, impeller side down, and remove water seal (14) from housing. Discard water seal.



- Place water pump housing (4) on bench, impeller side up, and remove oil seal (15) from housing. Discard oil seal.



342-825

ASSEMBLY**CAUTION**

Do not separate bearing components. Bearing assembly is a matched set of parts and should be assembled as received. Failure to do so could result in bearing misalignment.

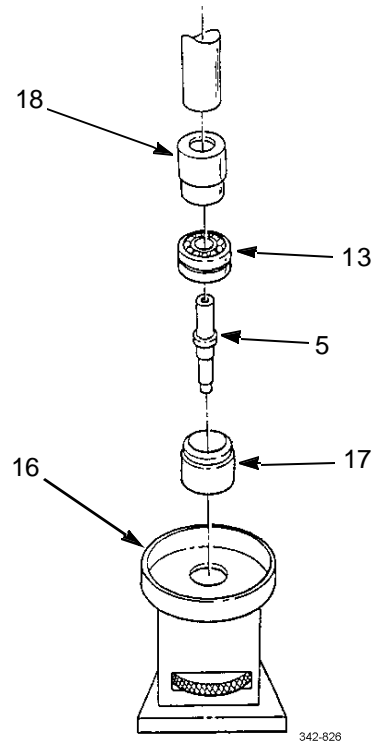
- Place service kit holding fixture (16) on press bed. Install drive shaft support tool (17) in holding fixture. Install square end of water pump shaft (5) in support tool.

NOTE

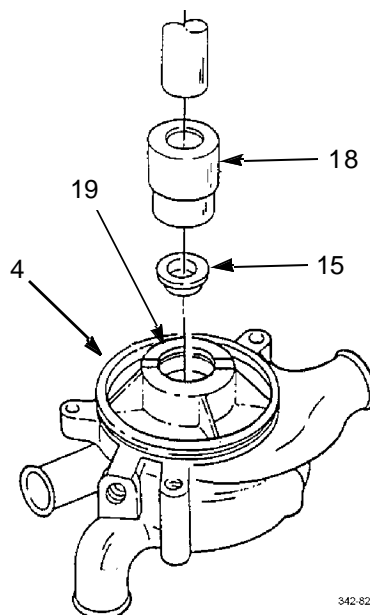
Ensure roller bearing identification numbers are against bearing and seal installer.

- Position new roller bearing (13) on water pump shaft (5) with roller bearing identification numbers up. Using small end of bearing and seal installer (18), press roller bearing on water pump shaft until roller bearing is seated against shoulder of water pump shaft. Remove assembled shaft and bearing from holding fixture.

ASSEMBLY - CONTINUED

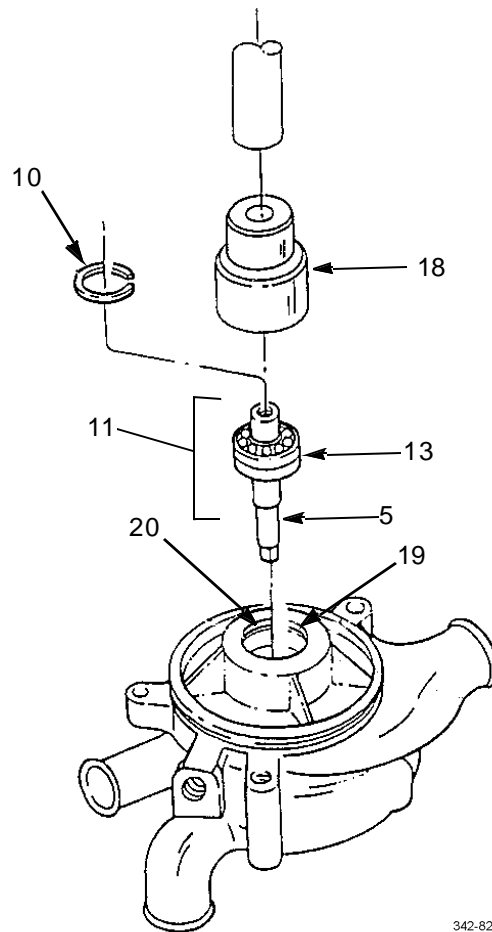


3. Apply a thin film of clean engine lubricating oil to outside diameter of new oil seal (15) and water pump housing bore (19).
4. Support water pump housing (4) on press bed, impeller side down. Using small end of bearing and seal installer (18), press oil seal (15) in water pump housing bore (19).



ASSEMBLY - CONTINUED

5. Apply a thin film of clean engine lubricating oil to sealing lip of oil seal. Lubricate roller bearing (13) assembly. Carefully install square end of water pump shaft (5) through oil seal and position roller bearing assembly in water pump housing bore (19).
6. Using large end of bearing and seal installer (18), press roller bearing and shaft assembly (11) in water pump housing bore (19), until roller bearing (13) is seated against shoulder of water pump housing bore.
7. Install retaining ring (10) in ring groove (20) of water pump housing bore (19).



342-828

NOTE

Ensure retaining ring is fully seated in ring groove.

8. Place holding fixture (16) on press bed. Install extension tool (21) in holding fixture in contact with adjusting wheel (22).

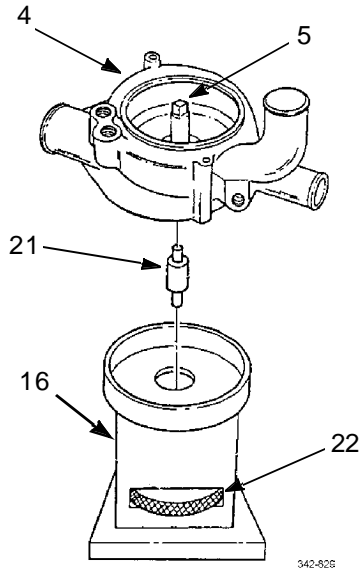
NOTE

Ensure water pump shaft is supported while components are being assembled.

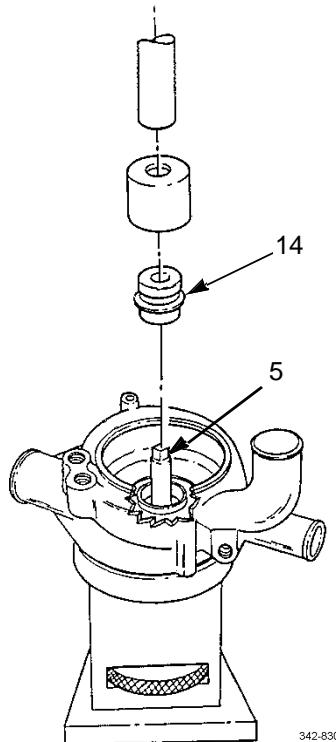
9. Turn water pump housing (4), gear side down, and position water pump shaft (5) over extension tool (21) in holding fixture (16).

ASSEMBLY - CONTINUED

- Turn adjusting wheel (22) until extension tool (21) contacts water pump shaft (5) for support.



- Apply a thin film of corrosion preventive compound to inside diameter of new water seal (14) where contact will be made with water pump shaft (5).



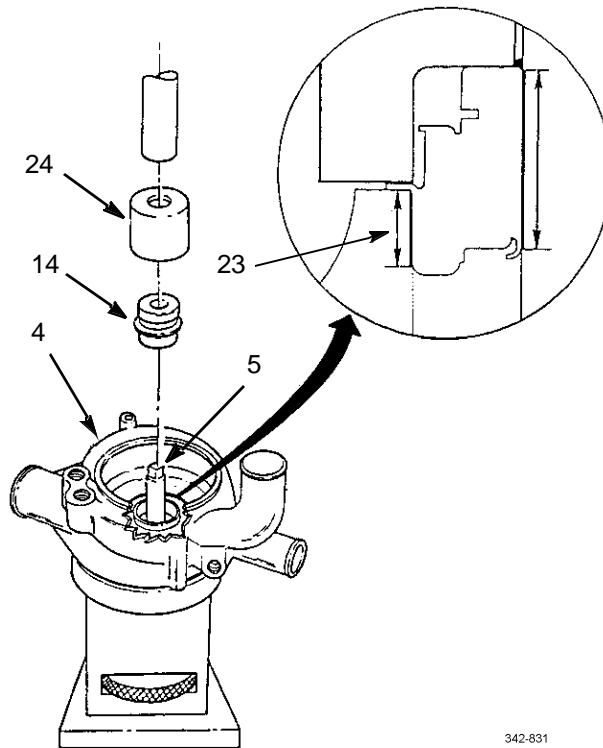
ASSEMBLY - CONTINUED

12. Apply a thin film of gasket forming compound to water seal bore (23) in water pump housing (4).

CAUTION

To prevent damage to equipment, ensure water pump shaft is supported by holding fixture extension.

13. Position new water seal (14) over square end of water pump shaft (5) with closed end of water seal down.
14. Using water seal installer (24), press water seal (14) in water pump seal bore (23) until water seal installer bottoms against water pump seal bore.



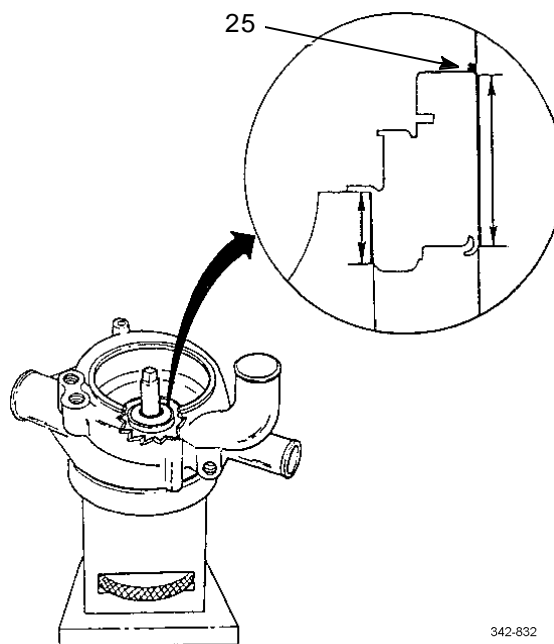
342-831

ASSEMBLY - CONTINUED**WARNING**

Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water

CAUTION

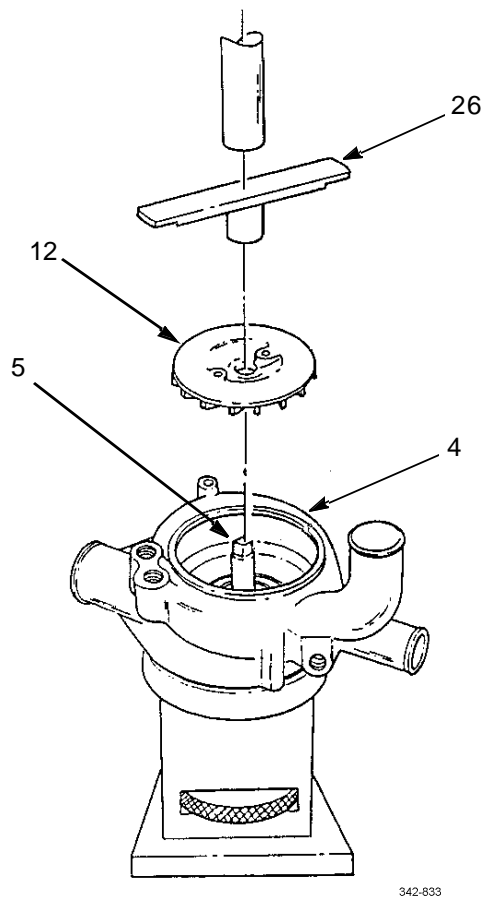
- Use care when applying sealing compound. Too much can cause damage to sealing surface.
 - Wait four (4) hours after applying sealing compound to allow for drying. Water pump shaft must remain vertical and must not be rotated or moved to prevent damage to equipment. Do not pressure test seal for at least four (4) hours.
15. Apply one drop of sealing compound to water seal and water pump shaft contact area (25). Wipe off excess with a clean rag.
 16. Apply a small amount of lubricating oil to water seal and water pump shaft contact area (25).



342-832

ASSEMBLY - CONTINUED

17. Install impeller (12), wide end up, over square end of water pump shaft (5). Using impeller installation tool (26), press impeller on water pump shaft until installation tool is flush against water pump housing (4). Remove installation tool.



18. Turn water pump housing (4) over, impeller side down, on holding fixture (16).

CAUTION

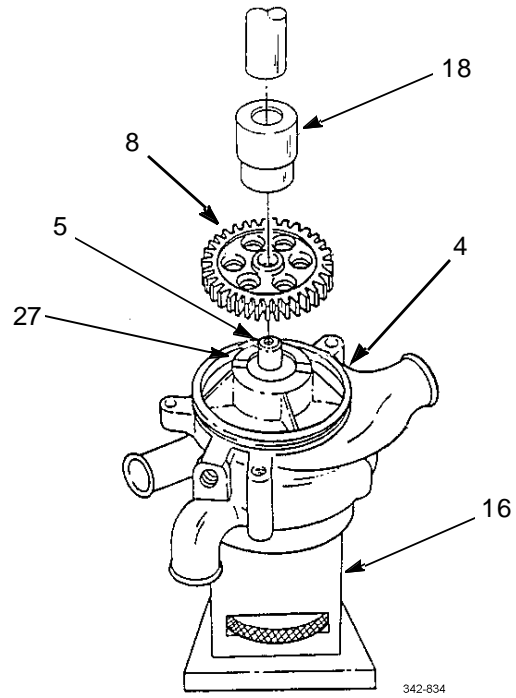
Water pump drive gear may be press fit onto water pump shaft. Support water pump shaft when pressing drive gear onto shaft to prevent damage to bearing.

NOTE

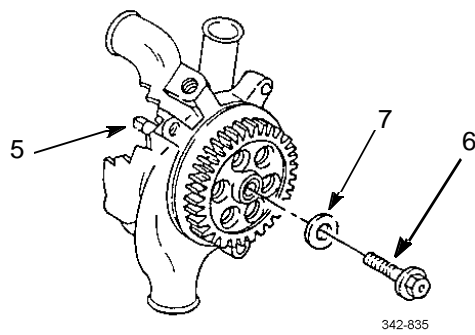
Water pump drive gear may be a slip fit. This is due to manufacturing tolerances and is acceptable.

19. Position drive gear (8) over water pump shaft (5).
20. Using small end of bearing and seal installer (18), press drive gear (8) on water pump shaft (5) until drive gear is seated against bearing inner race (27).

ASSEMBLY - CONTINUED

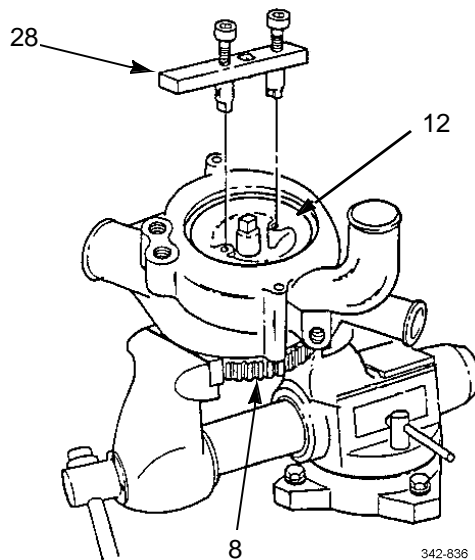


21. Install washer (7) and bolt (6). Hold square end of water pump shaft (5) and tighten bolt to 75-93 lb-ft (102-126 Nm).



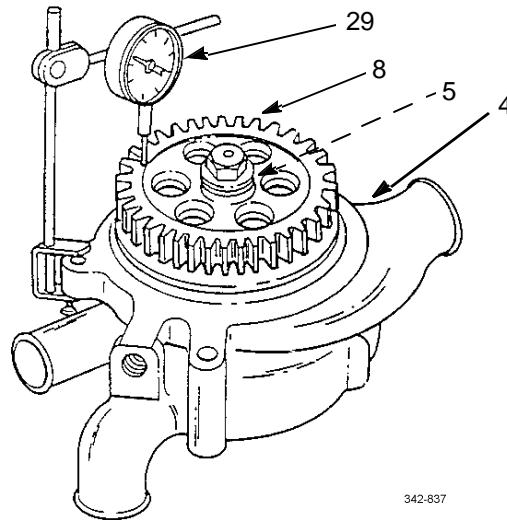
TEST AND INSPECTION

1. Turn water pump over, gear side down. Clamp drive gear (8) in soft-jawed vise with water pump impeller (12) facing up.
2. Install water pump impeller tester (28) in tapped holes provided in impeller (12). Tighten bolts to 156-204 lb-in (18-23Nm).
3. Apply 50 lb-ft (68 Nm) torque in either direction with torque wrench inserted in impeller tester (28). If impeller slippage is detected, remove and discard impeller (12). Install new impeller and retest. Remove impeller tester after testing.

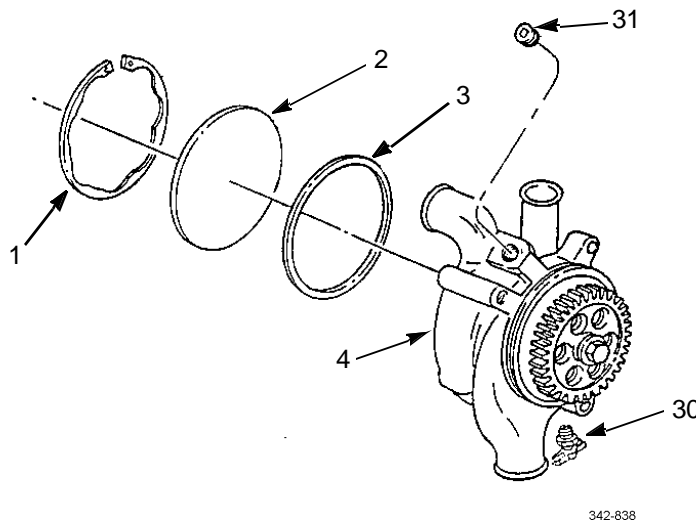


4. Turn water pump over, impeller side down.
5. Attach dial indicator (29) to water pump housing (4). Measure gear face runout just inside of drive gear (8) teeth. Rotate drive gear and measure runout in four places at 90 degree intervals. Maximum allowable runout is 0.0025 in (0.0635 mm).
6. If limit is exceeded, remove drive gear (8) and check for burrs or foreign particles. Install drive gear and recheck runout. If runout still exceeds limits, replace drive gear and/or water pump shaft (5) as necessary.

TEST AND INSPECTION - CONTINUED



7. Install draincock (30), pipe plug (31), new seal ring (3), cover (2), and snap ring (1) in water pump housing (4).



8. Install water pump (TM 9-2320-302-20).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Clamp, C (2) (Item 19, WP 0126 00)

Materials/Parts

Kit, repair (P/N 1033-054335-02)

Seal, dust (P/N 3018-01519-01)

Equipment Condition

Fan clutch removed from vehicle (TM 9-2320-302-20)

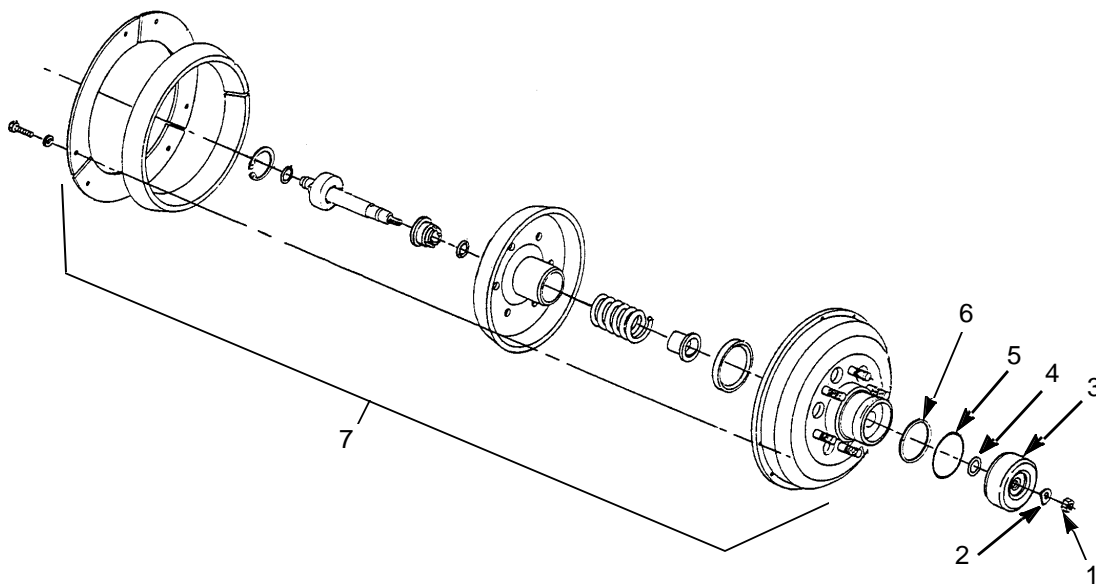
DISASSEMBLY

1. Remove nut (1) tab washer (2), cylinder (3), seal (4), packing (5), and dust seal (6) from clutch assembly (7). Discard nut, tab washer, seal, packing, and dust seal.

WARNING

Housing is under spring tension. Use suitable "C" clamps to hold housing and shaft assembly in place while removing cylinder. Failure to do so could result in injury to personnel.

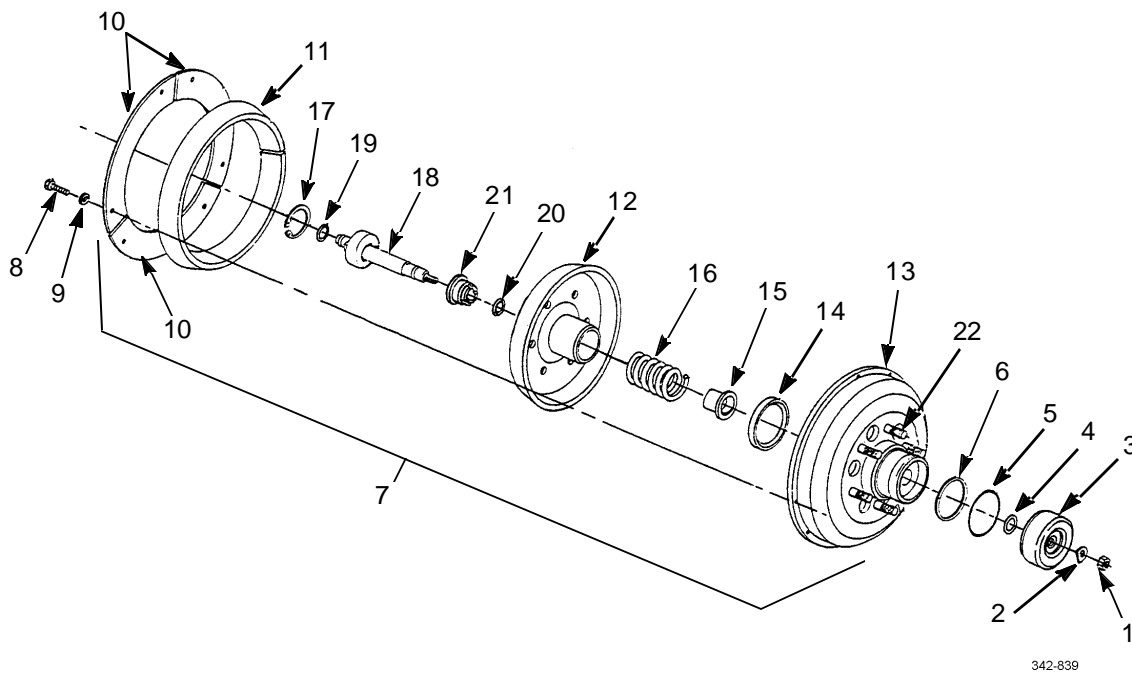
2. Install two "C" clamps on opposite sides of clutch assembly (7).



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DISASSEMBLY - CONTINUED

3. Remove six screws (8), lock washers (9), three retaining plates (10), and lining (11) from shaft assembly (12). Discard screws, lock washers, and lining.
4. Release "C" clamps slowly to relieve spring tension and remove housing (13), seal (14), end cap (15), and spring (16) from shaft assembly (12). Discard seal and spring.
5. Remove retaining ring (17) and piston assembly (18).
6. Remove two packings (19 and 20) and spring carrier (21) from piston. Discard packings.
7. If damaged, remove and discard studs (22) from housing (13).



342-839

ASSEMBLY

1. If removed, install new studs (22) in housing (13).
2. Install two new packings (19 and 20) and spring carrier (21) to piston (18).
3. Install piston assembly (18) and retaining ring (17).
4. Install new spring (16), end cap (15), new seal (14), and housing (13) on shaft assembly (12).
5. Compress housing (13) and shaft assembly (12) using two "C" clamps and install new lining (11), three retaining plates (10), six new lock washers (9), and new screws (8) in shaft assembly.
6. Remove two "C" clamps from opposite sides of clutch assembly (7).
7. Install new dust seal (6), new packing (5), new seal (4), cylinder (3), new tab washer (2), and new nut (1) on clutch assembly (7).
8. Install fan clutch (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Disassembly, Inspection, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Caps, vise jaw (Item 17, WP 0126 00)
- Insertor and remover (Item 53, WP 0126 00)
- Pliers, retaining ring (Item 88, WP 0126 00)
- Pliers, retaining ring (Item 89, WP 0126 00)
- Press, arbor (Item 90, WP 0126 00)
- Puller, kit mechanical (Item 95, WP 0126 00)
- Vise, machinist's (Item 136, WP 0126 00)
- Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

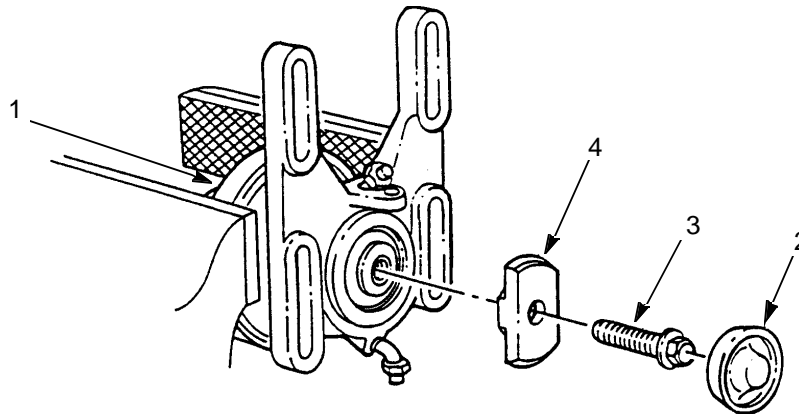
- Ball bearing assembly (P/N 8929530)
- Plug, cup (P/N 8929215)
- Roller bearing assembly (P/N 8929820)
- Seal, oil (P/N V454136RR)
- Adhesive, loctite (Item 3, WP 0125 00)
- Grease, GAA (Item 22, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)

Equipment Condition

Spindle and housing removed (TM 9-2320-302-20)

DISASSEMBLY

1. Secure fan spindle (1) in soft-jawed vise and remove cup plug (2). Discard cup plug.
2. Remove spacer retaining bolt (3) and spacer (4). Remove fan spindle (1) from vise.

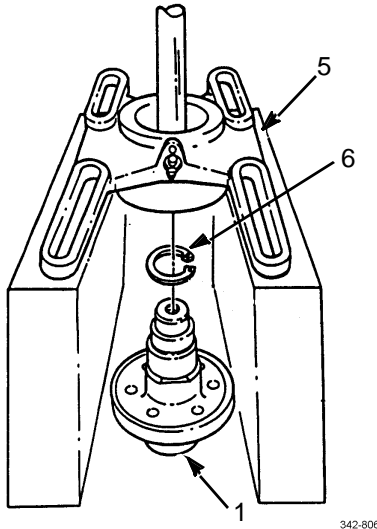


342-805

DISASSEMBLY - CONTINUED**CAUTION**

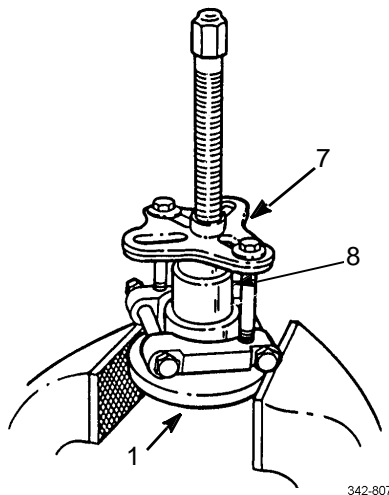
During handling, ensure fan spindle does not drop free from spindle housing causing damage to equipment.

3. Support spindle housing (5) and press fan spindle (1) from housing.
4. Remove inner roller bearing snap ring (6) from fan spindle (1).

**NOTE**

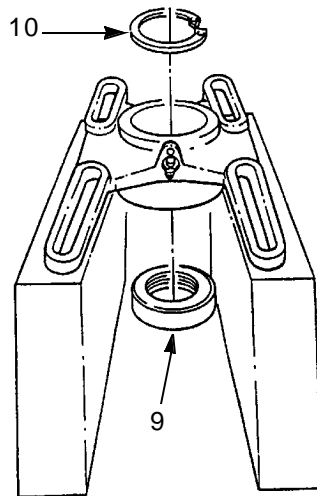
Roller bearing assembly must be replaced whenever inner race is removed from fan spindle or roller bearing is removed from spindle housing.

5. Secure fan spindle (1) in vise. Using puller (7), remove roller bearing inner race (8) from fan spindle. Discard roller bearing inner race.



DISASSEMBLY - CONTINUED

6. Remove and discard oil seal (9).
7. Remove ball bearing retaining snap ring (10).

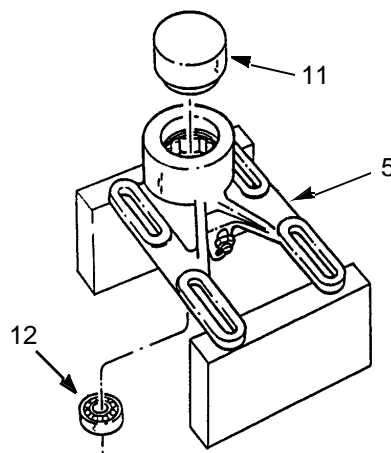


342-808

NOTE

Ball bearing assembly must be replaced whenever fan spindle is removed from spindle housing.

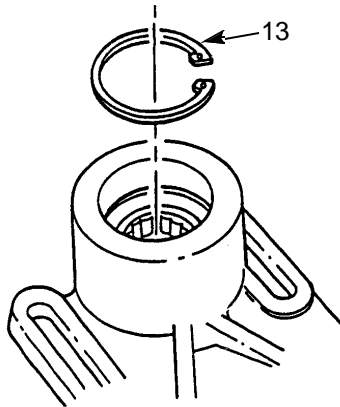
8. Support spindle housing (5) as shown.
9. Using bearing inserter and remover tool (11), remove and discard ball bearing assembly (12).



342-809

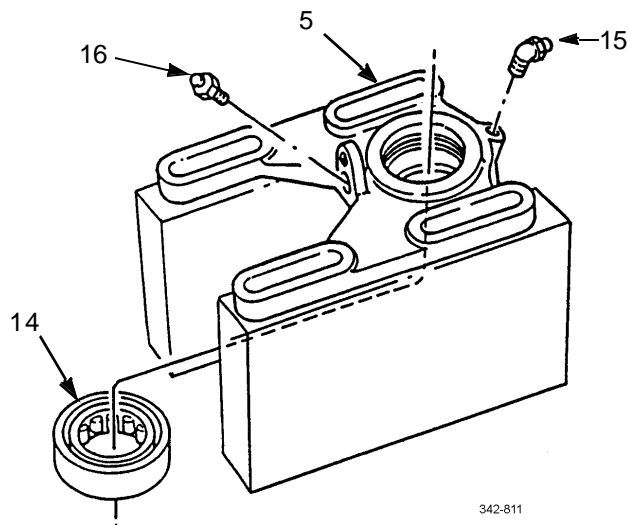
DISASSEMBLY - CONTINUED

10. Remove roller bearing retaining snap ring (13).



342-810

11. Support spindle housing (5) and remove roller bearing (14).
12. Remove grease fitting (15) and lube pressure relief fitting (16).



342-811

INSPECTION

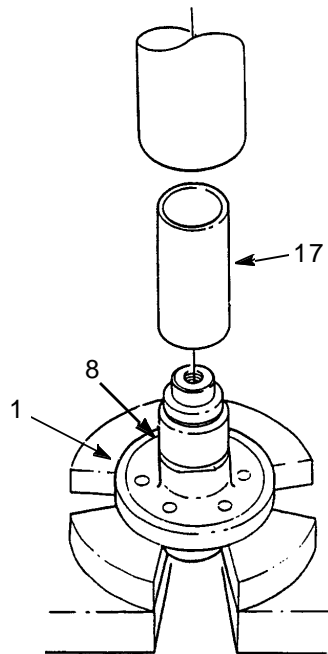
1. Inspect parts for rust, corrosion, nicks, burrs, cracks, and deterioration.
2. Inspect spindle and housing machined surfaces for pits, gouges, and scratches.
3. Inspect for stripped or damaged threads.

ASSEMBLY

NOTE

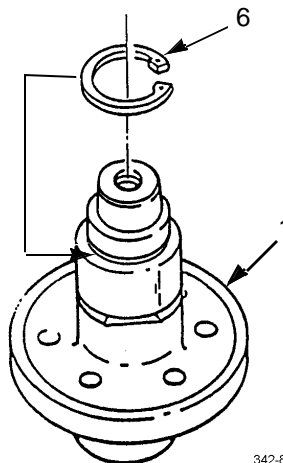
Ensure roller bearing inner race part number is facing up against installing tool.

1. Install new roller bearing inner race (8) on fan spindle (1).
2. Support fan spindle (1) on press bed. Using installing tool (17), press roller bearing inner race (8) against shoulder of fan spindle.



342-812

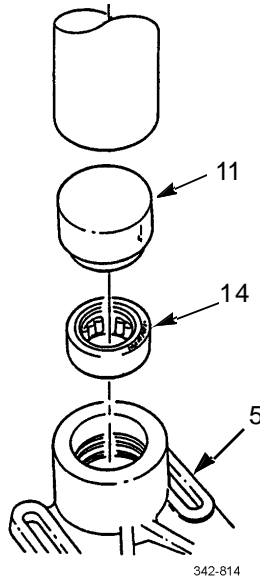
3. Install inner roller bearing snap ring (6) in groove of fan spindle (1). Ensure snap ring is fully seated in groove.



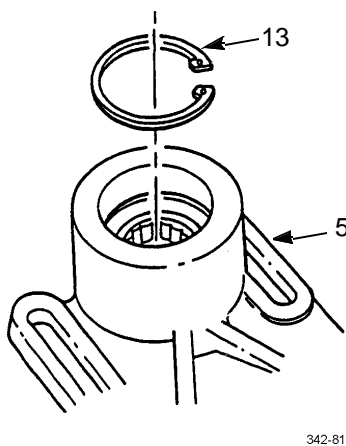
342-813

ASSEMBLY - CONTINUED

4. Pack new roller bearing (14) with grease.
5. Support spindle housing (5) on press bed and install roller bearing (14) in spindle housing. Using stepped side of bearing inserter and remover tool (11), press roller bearing against shoulder of spindle housing.

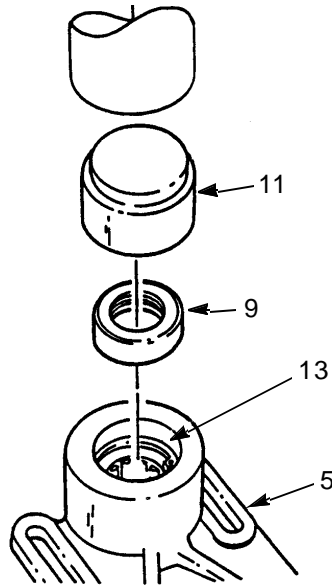


6. Install roller bearing retaining snap ring (13) in groove of spindle housing (5).



7. Using smooth side of bearing inserter and remover (11), press new oil seal (9) in spindle housing (5) against roller bearing retaining snap ring (13).
8. Lubricate lip of new oil seal (9) with clean engine lubricating oil.

ASSEMBLY - CONTINUED



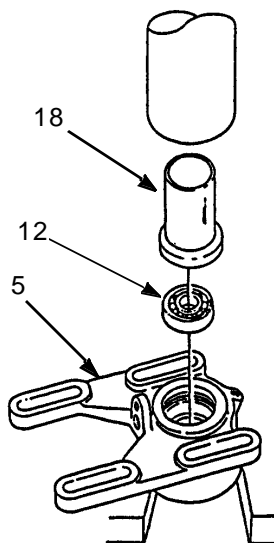
342-815

9. Pack new ball bearing assembly (12) with grease.
10. Turn spindle housing (5) over on press bed and install ball bearing assembly (12) in spindle housing.

NOTE

Ensure ball bearing outer race part number is facing up against installing tool.

11. Using wide end of installing tool (18), press on ball bearing assembly (12) outer race. Press ball bearing assembly firmly against shoulder in spindle housing (5).



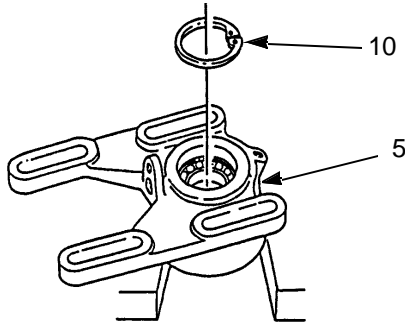
342-816

ASSEMBLY - CONTINUED

NOTE

Ensure snap ring is fully seated in groove of spindle housing.

12. Install ball bearing retaining snap ring (10) in spindle housing (5).

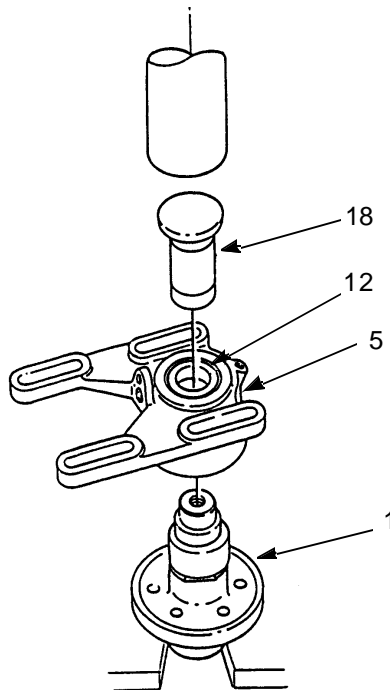


342-817

NOTE

Do not pack spindle housing more than 2/3 full.

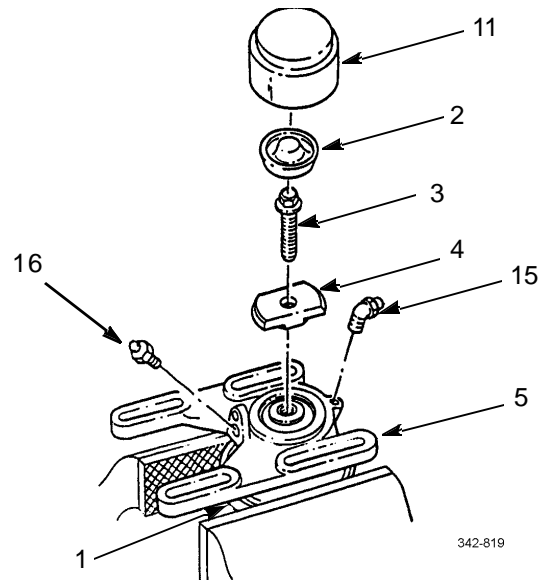
13. Pack spindle housing (5) with grease.
14. Support fan spindle (1) on press bed and carefully install spindle housing (5) on fan spindle.
15. Using narrow end of installing tool (18), press ball bearing assembly (12) inner race on fan spindle (1) until ball bearing assembly inner race is firmly seated against shoulder of fan spindle.



342-818

ASSEMBLY - CONTINUED

16. Secure fan spindle (1) in vise. Install spacer (4) and spacer retaining bolt (3) in spindle housing (5). Tighten bolt to 43-54 lb-ft (58-73 Nm).



17. Coat edge of new cup plug (2) with adhesive. Using flat side of bearing inserter and remover tool (11), press new cup plug in spindle housing (5) until raised center of cup plug is flush with edge of spindle housing.
18. Install lube pressure relief fitting (16) and grease fittings (15). Tighten to 72 lb-in (8 Nm) minimum.
19. Install spindle and housing (TM 9-2320-302-20).

END OF WORK PACKAGE

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ALTERNATOR REPAIR**0052 00**

THIS WORK PACKAGE COVERSDisassembly, Testing, Assembly

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Caps, vise jaw (Item 17, WP 0126 00)

Dial indicator set (Item 29, WP 0126 00)

Multimeter, digital (Item 78, WP 0126 00)

Soldering gun (Item 118, WP 0126 00)

Test stand, automotive generator and starter (Item 122,
WP 0126 00)

Vise, machinist's (Item 136, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Bearing (P/N A0790-79406)

Gasket (P/N 73814)

Materials/Parts - Continued

Nut, tenz (P/N 2364) (3)

Nut, lock (P/N 26175) (3)

Nut, tenz (P/N 2771) (5)

Seal (P/N 57611)

Seal (P/N 79403)

Seal (P/N 79404)

Seal (P/N 79405)

Washer, lock (P/N 2434) (8)

Cloth, abrasive (Item 9, WP 0125 00)

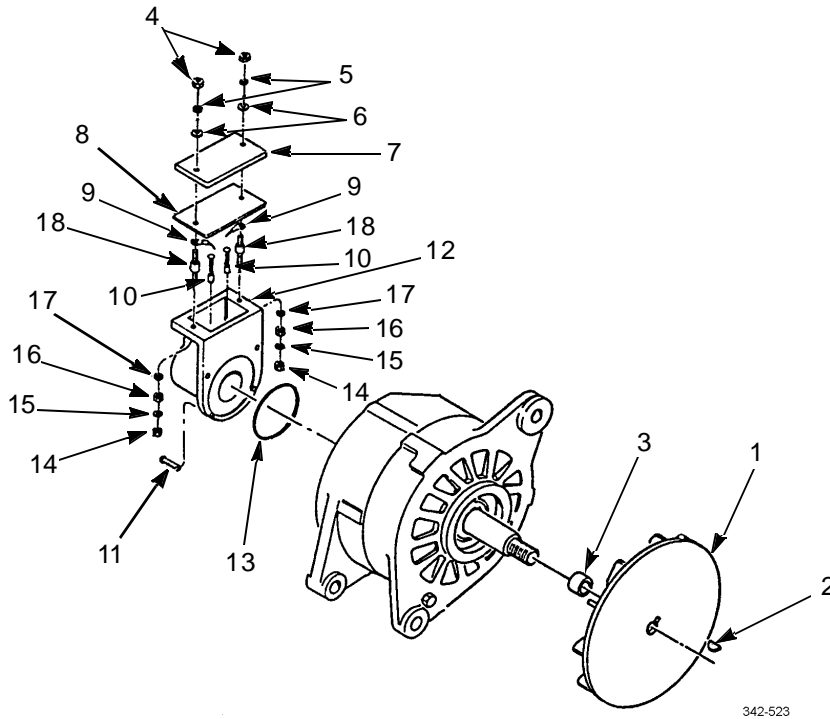
Compound, sealing (Item 14, WP 0125 00)

Solder (Item 33, WP 0125 00)

Equipment ConditionAlternator removed (TM 9-2320-302-20)

DISASSEMBLY

1. Remove fan (1), woodruff key (2), and spacer (3).
2. Remove two nuts (4), lock washers (5), guard washers (6), cover (7), gasket (8), and two jumpers (9). Discard gasket and lock washers.
3. Remove two brushes (10).
4. Remove four screws (11), brush holder (12), and seal (13). Discard seal.
5. Remove two nuts (14), lock washers (15), nuts (16), lock washers (17), and two terminal studs (18). Discard lock washers.



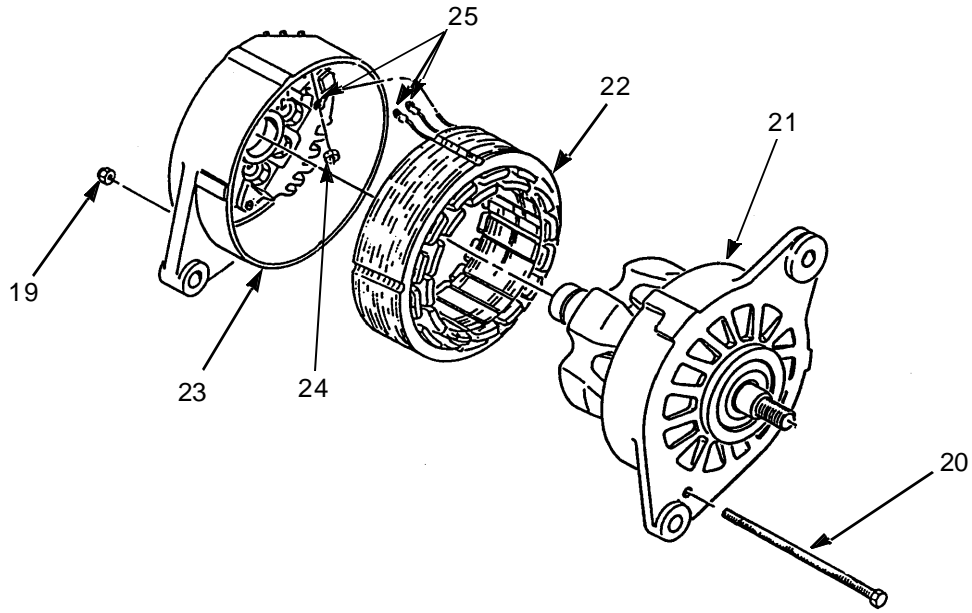
6. Remove three lock nuts (19) and screws (20). Discard lock nuts.

CAUTION

If drive end housing binds, tap gently on mounting ears. Ensure drive end housing separates from stator and stator remains attached to slip ring end housing to avoid damage to stator leads.

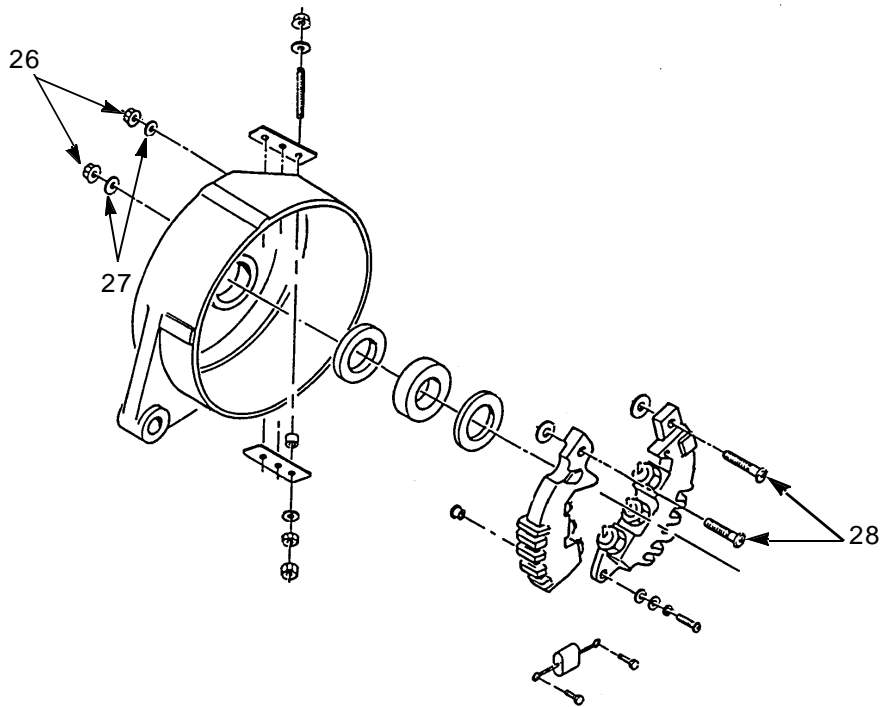
7. Remove rotor and drive end housing (21) from stator (22) and slip ring end housing (23).
8. Remove and discard three tenz nuts (24). Disconnect three leads (25) and remove stator (22).

DISASSEMBLY - CONTINUED



342-524

9. Remove two tenz nuts (26), insulator bushings (27), and terminal screws (28). Discard tenz nuts.



342-525

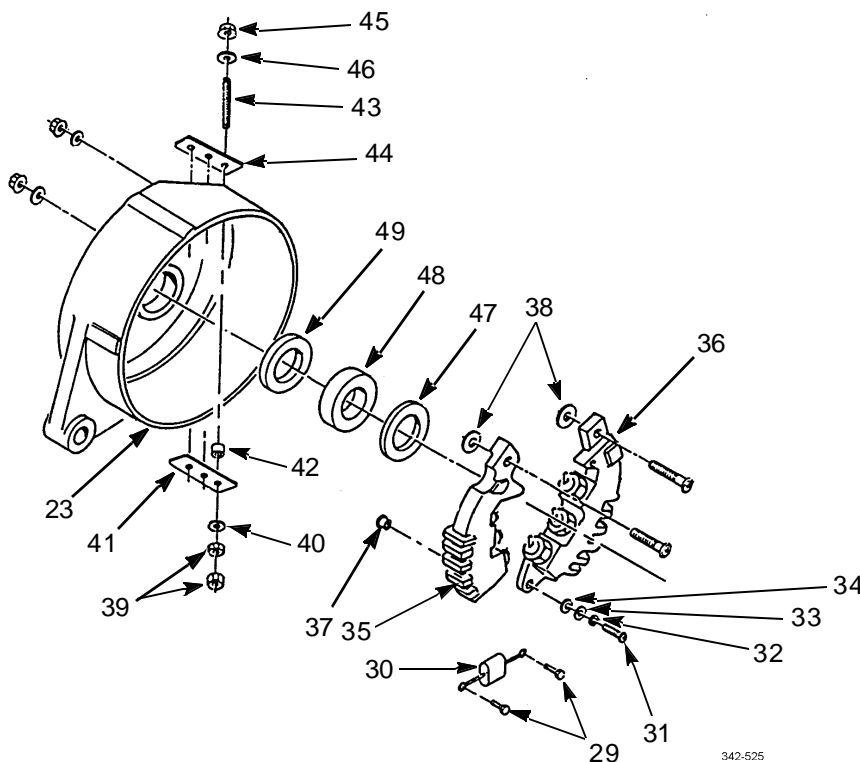
DISASSEMBLY - CONTINUED

10. Remove two screws (29) and capacitor (30).
11. Remove two screws (31), lock washers (32), washers (33), insulating washers (34), positive rectifier (35), and negative rectifier (36). Discard lock washers.
12. Remove two insulator bushings (37) from positive rectifier (35) and negative rectifier (36).

NOTE

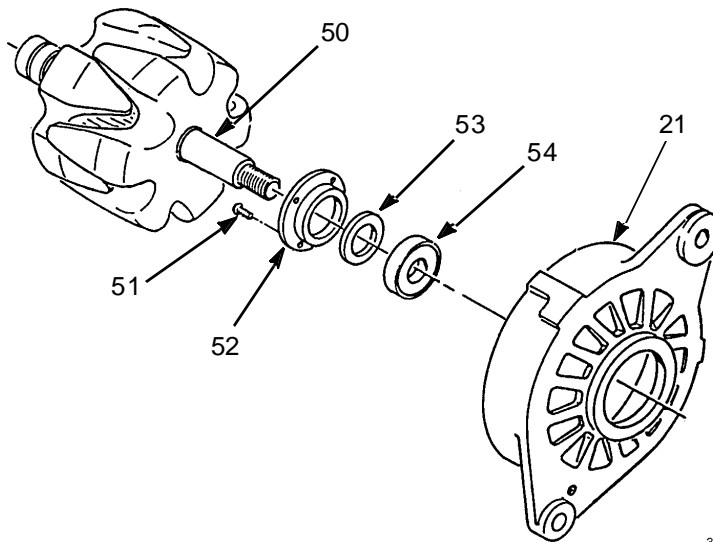
Note position of insulator bushings in slip ring end housing prior to disassembly to aid in assembly.

13. Remove two insulator bushings (38) from slip ring end housing (23).
14. Remove six nuts (39), three washers (40), insulator (41), three insulators (42), three terminal studs (43), and insulator (44).
15. Remove tenz nut (45) and washer (46) from each of three terminal studs (43). Discard tenz nuts.
16. Remove inner seal (47) and bearing (48). Discard seal and bearing.
17. Remove seal (49) from rear of slip ring end housing (23) by tapping equally in all five holes on outside of slip ring end housing. Discard seal.



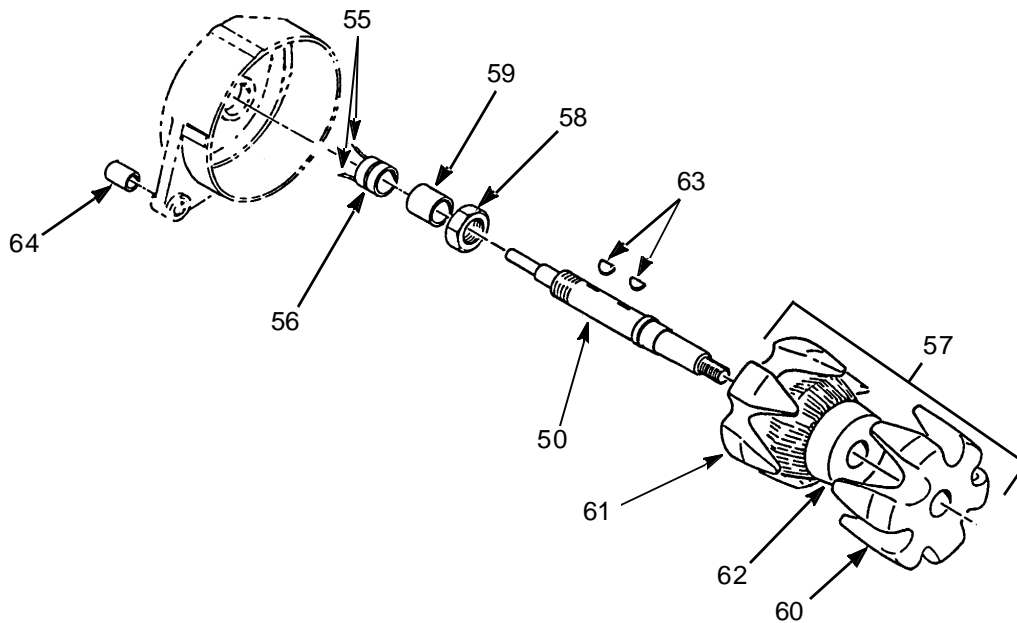
18. Remove rotor and drive end housing (21) from shaft (50).
19. Remove four screws (51), bearing retainer (52), seal (53), and bearing (54). Discard seal.

DISASSEMBLY - CONTINUED



342-526

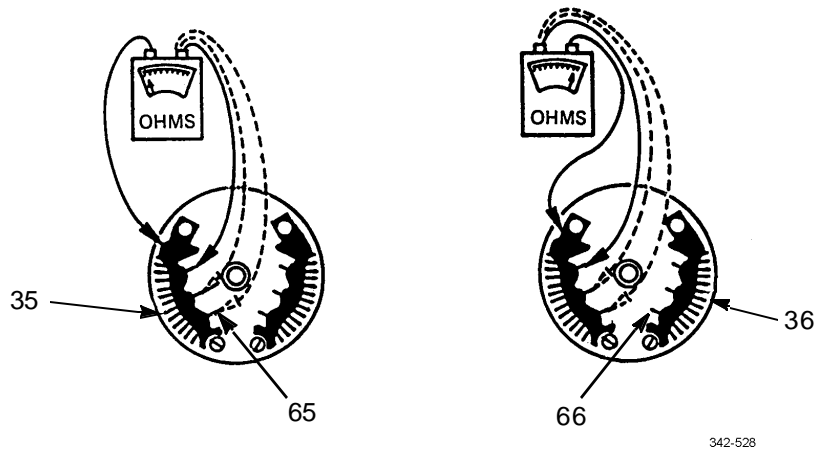
20. Unsolder two leads (55) from slip ring assembly (56).
21. Remove slip ring assembly (56).
22. Place rotor assembly (57) in soft-jawed vise and remove nut (58).
23. Remove inner bearing race (59).
24. Remove two rotor halves (60 and 61), hub (62), and two woodruff keys (63) from shaft (50).
25. If damaged, remove slidable housing (64).



342-527

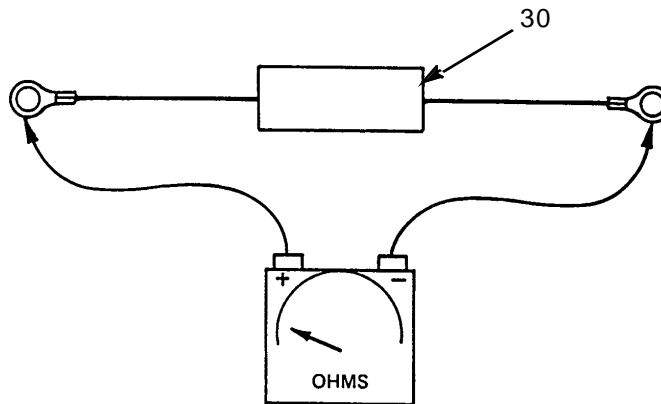
TESTING

1. Test positive rectifier (35) as follows:
 - a. Connect positive lead of diode tester to positive rectifier (35). Touch negative lead to each of three diodes (65). High resistance should be indicated. If any of three diodes show low resistance, replace positive rectifier.
 - b. Reverse test leads so that negative lead is connected to positive rectifier (35). Touch positive lead to each of three diodes (65). Low resistance should be indicated. If any of three diodes show high resistance, replace positive rectifier.
2. Test negative rectifier (36) as follows:
 - a. Connect negative lead of diode tester to negative rectifier (36). Touch negative lead to each of three diodes (66). High resistance should be indicated. If any of three diodes show low resistance, replace negative rectifier.
 - b. Reverse test leads so that positive lead is connected to negative rectifier (36). Touch positive lead to each of three diodes (66). Low resistance should be indicated. If any of three diodes show high resistance, replace negative rectifier.



342-528

3. Check capacitor (30) using ohmmeter with positive and negative leads connected to terminals. If resistance reading is low, replace capacitor.

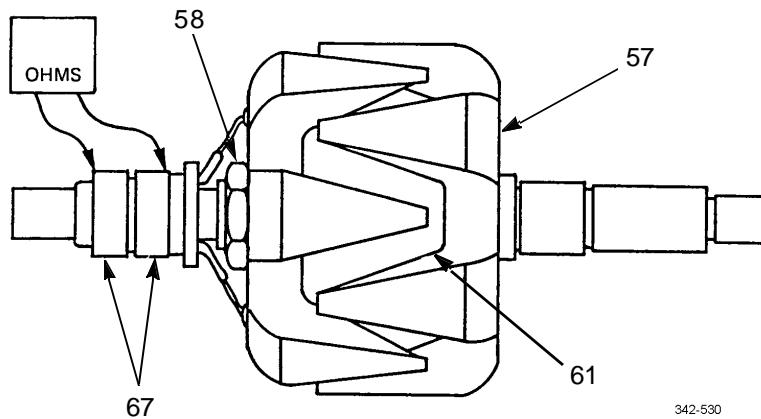


342-529

TESTING - CONTINUED

4. Test rotor assembly (57) as follows:

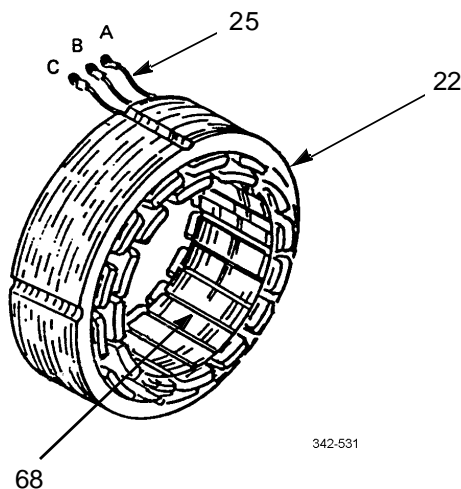
- a. With ohmmeter connected between nut (58) and either of two slip rings (67), no reading should be obtained. If any reading is obtained, rotor coil (61) is grounded and rotor assembly (57) must be disassembled to repair short.
- b. Check rotor coil (61) resistance by connecting ohmmeter across both slip rings (67). Resistance should be 9.6-10.4 ohms. If resistance is outside limits, replace rotor coil.



342-530

5. Test stator (22) as follows:

- a. Connect one ohmmeter lead to bare metal surface on stator lamination (68). Connect other lead to each of three stator leads (25) terminals. High resistance reading should be obtained each time. If there is no reading or ohmmeter reads zero, replace stator.



342-531

b. Connect ohmmeter leads to stator leads (25) terminals as follows and note each reading:

- (1) A and B
- (2) A and C
- (3) B and C

TESTING - CONTINUED

- c. Each measurement in step b should be approximately equal. If difference is great between any two readings, replace stator (22).

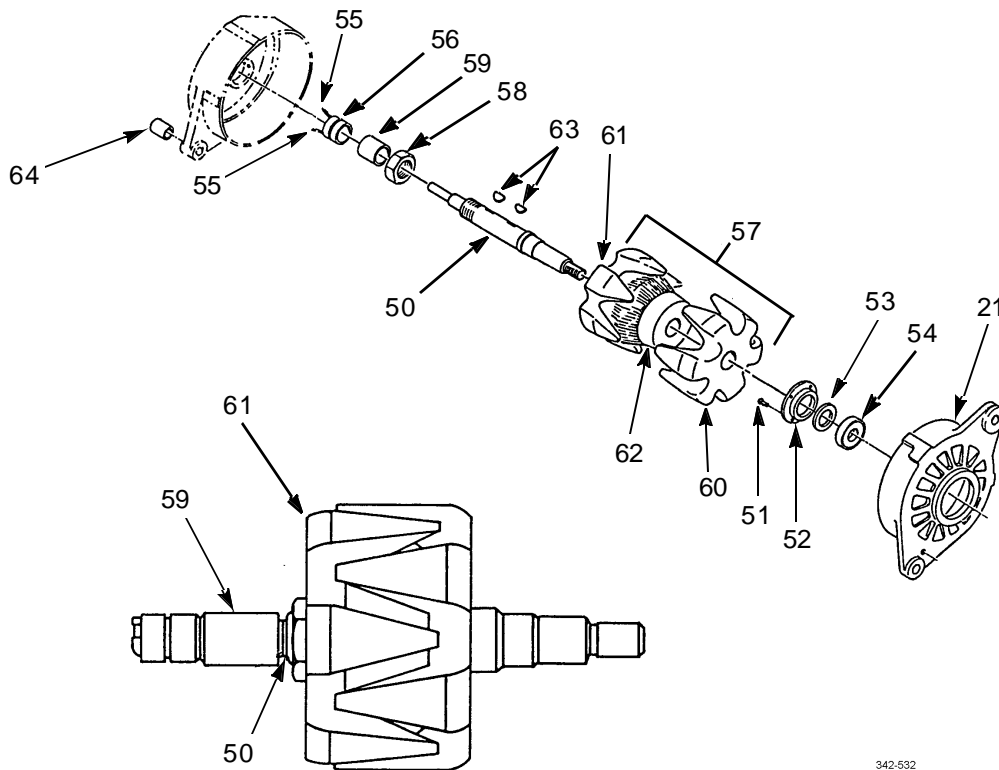
ASSEMBLY

- 1. If removed, install new slidable bushing (64).

CAUTION

If either rotor half has been damaged, both rotor halves must be replaced. Failure to replace both will cause rotor to be out of balance and alternator will not operate properly.

- 2. Install two woodruff keys (63), rotor half (61), hub (62), and rotor half (60) on shaft (50).
- 3. Install inner bearing race (59) with chamfered edge facing away from rotor half (61) until gap of 0.141 in (3.6 mm) is between inner bearing race and shaft (50) threads.
- 4. Place rotor assembly (57) in soft-jawed vise and install nut (58). Tighten nut to 110 lb-ft (149 Nm).



342-532

- 5. Apply a light coating of sealing compound to shaft (50) where slip ring assembly (56) will be installed.

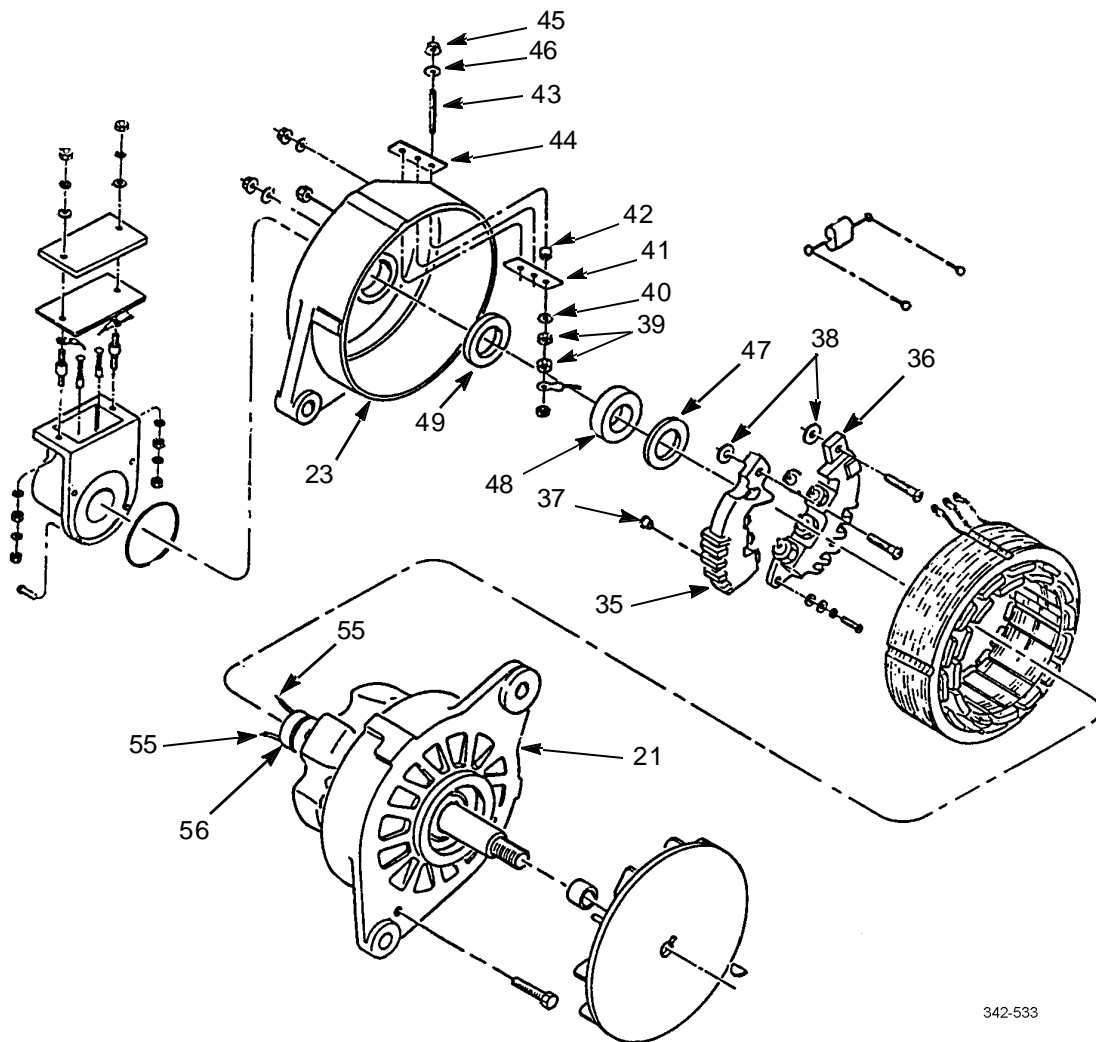
CAUTION

Use extreme care not to damage two terminals located on end of slip ring assembly.

- 6. Install slip ring assembly (56) on shaft (50) until end of slip ring assembly is against inner bearing race (59).
- 7. Install bearing (54), new seal (53), bearing retainer (52), and four screws (51).
- 8. Install shaft (50) in rotor and drive end housing (21).

ASSEMBLY - CONTINUED

9. Mount rotor and drive end housing (21) in soft-jawed vise and, using dial indicator gage with magnetic base, check runout of slip ring assembly (56). Maximum allowable runout is 0.002 in (0.05 mm).
10. If runout is excessive, mount assembly on lathe. Dress slip ring assembly (56) using abrasive cloth.
11. Repeat steps 9 and 10 until proper runout is achieved.
12. Solder two leads (55) to terminals located on end of slip ring assembly (56)



342-533

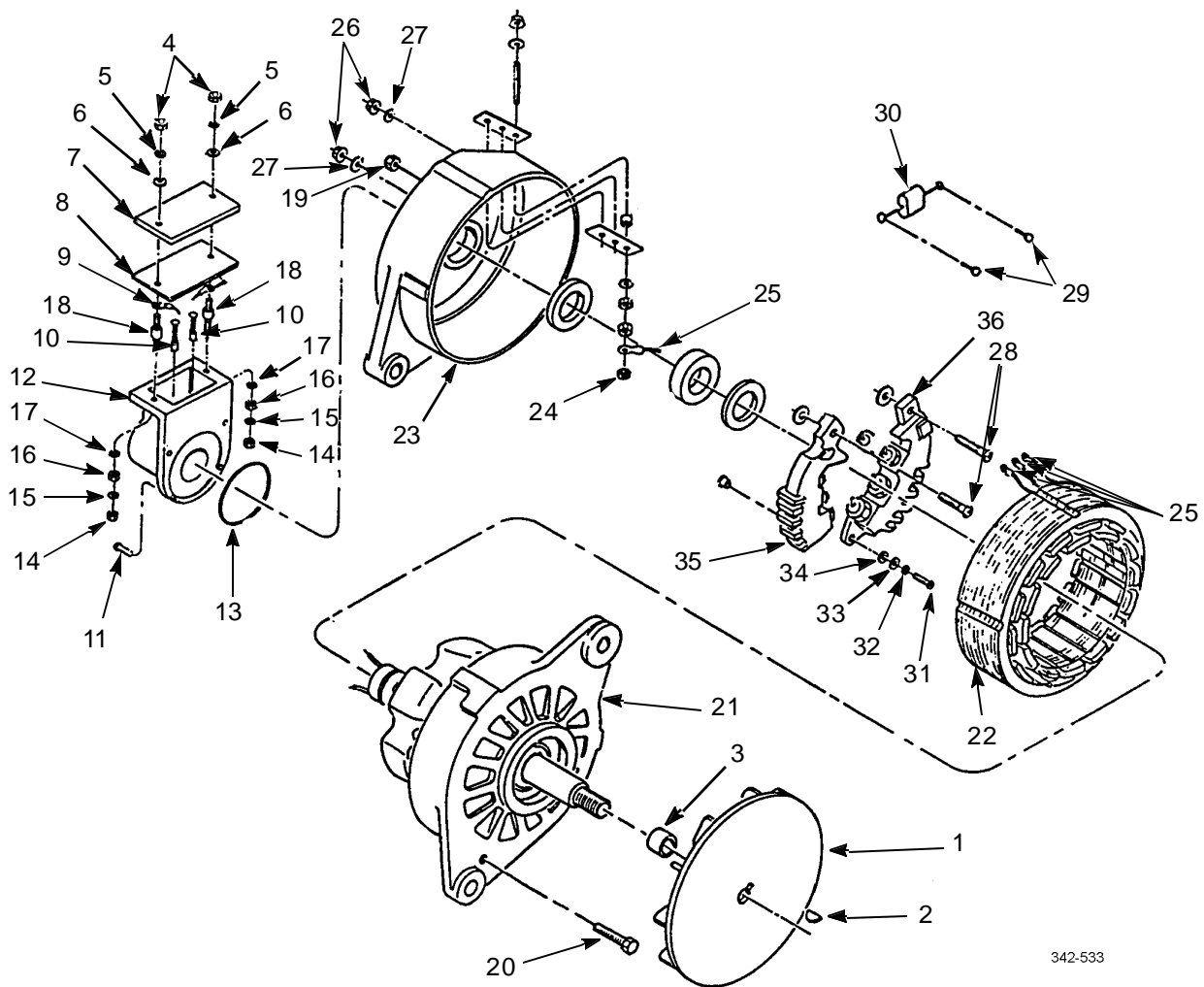
13. Install new seal (49) in rear of slip ring end housing (23).
14. Install new bearing (48) and new inner seal (47).
15. Install washer (46) and new tenz nut (45) on each of three terminal studs (43).
16. Install insulator (44), three terminal studs (43), three insulators (42), insulator (41), three washers (40), and six nuts (39).
17. Install two insulating bushings (38) in slip ring end housing (23).
18. Install two insulating bushings (37) in negative rectifier (36) and positive rectifier (35).

ASSEMBLY - CONTINUED

19. Install negative rectifier (36), positive rectifier (35), two insulating washers (34), washers (33), new lock washers (32), and two screws (31).
20. Install capacitor (30) and two screws (29).
21. Install two terminal screws (28), insulator bushings (27), and new tenz nuts (26).

CAUTION

Use caution to ensure stator leads are not damaged.



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22. Install stator (22) in slip ring end housing (23).
23. Connect three leads (25) and install three tenz nuts (24).
24. Install rotor and drive end housing (21) in stator (22) and slip ring end housing (23).
25. Install three screws (20) and new lock nuts (19).
26. Install two terminal studs (18), new lock washers (17), nuts (16), new lock washers (15), and nuts (14).

ASSEMBLY - CONTINUED

27. Install new seal (13), brush holder (12), and four screws (11).
28. Install two brushes (10).
29. Install two jumpers (9), new gasket (8), cover (7), two guard washers (6), new lock washers (5), and nuts (4).
30. Install spacer (3), woodruff key (2), and fan (1).
31. Install alternator (TM 9-2320-302-20).

END OF WORK PACKAGE

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STARTER SOLENOID REPLACEMENT

0053 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Caps, vise jaw (Item 17, WP 0126 00)

Vise, machinist's (Item 136, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Washer, lock (P/N MS35333-42)

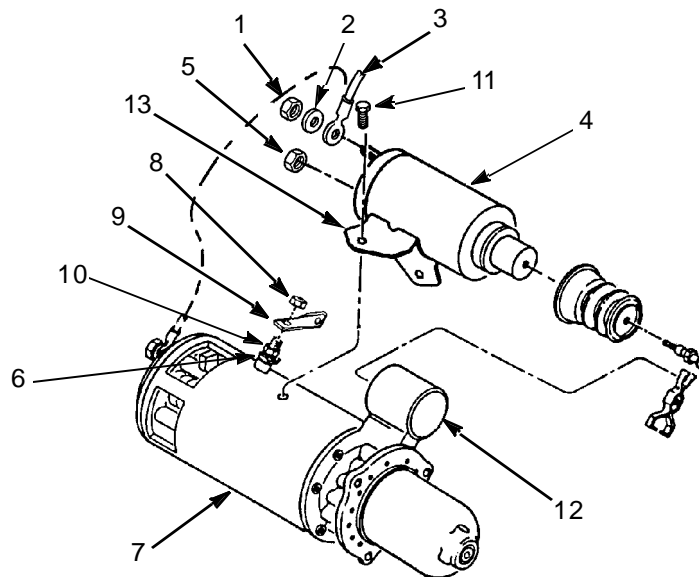
Adhesive, silicone (Item 4, WP 0125 00)

Equipment Condition

Starter removed (TM 9-2320-302-20)

REMOVAL

1. Remove nut (1), lock washer (2), and wire (3) from starter solenoid (4). Discard lock washer.
2. Remove nut (5) from starter solenoid (4).



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3. Hold nut (6) on starter motor (7) and remove nut (8) and jumper (9) from stud (10).
4. Remove two screws (11).
5. Pull starter solenoid (4) away from housing (12) and rotate so that mounting bracket (13) faces away from starter motor (7).

REMOVAL - CONTINUED

6. Remove spool (14) from shift fork (15).

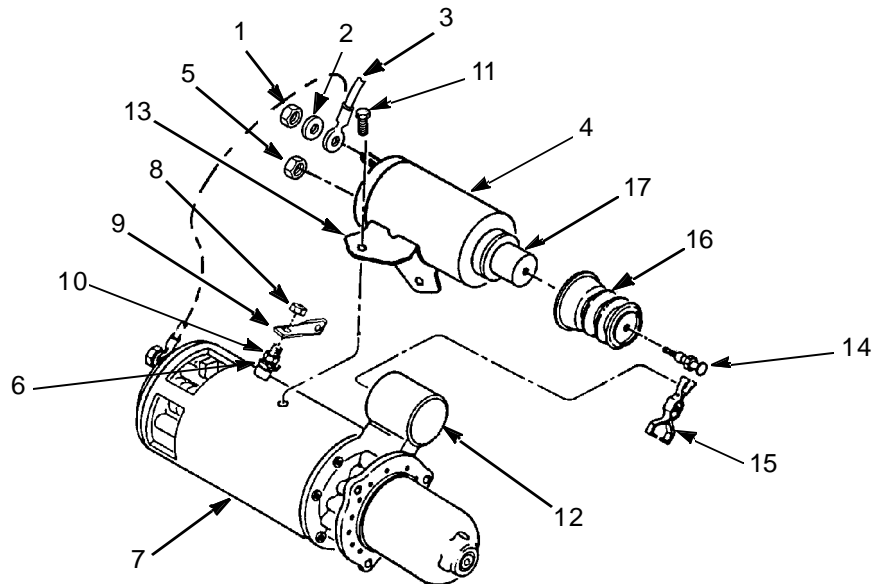
NOTE

It may be necessary to use a soft-jawed vise to hold solenoid plunger for removal of spool.

7. Remove spool (14) and boot (16) from solenoid plunger (17).

INSTALLATION

1. Install boot (16) and spool (14) on solenoid plunger (17).
2. Rotate starter solenoid (4) so that mounting bracket (13) faces away from starter motor (7).
3. Install spool (14) in shift fork (15).
4. Rotate starter solenoid (4) to mounting position and press flush with housing (12).
5. Apply silicone adhesive to threads and install two screws (11).
6. Install jumper (9) on stud (10).
7. Apply silicone adhesive to last ¼ in (6.4 mm) of threads on stud (10). Hold nut (6) and install nut (8). Tighten nut to 21-29 lb-ft (28-39 Nm).
8. Install nut (5) on starter solenoid (4). Tighten nut to 18-22 lb-ft (24-30 Nm).
9. Install wire (3), new lock washer (2), and nut (1) on starter solenoid (4).



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10. Install starter (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)
 Test stand, automotive generator and starter (Item 122, WP 0126 00)

Materials/Parts

Packing (P/N 71038)
 Packing (P/N 71040) (2)
 Packing (P/N 71041)
 Packing (P/N Z053095777) (2)

Materials/Parts - Continued

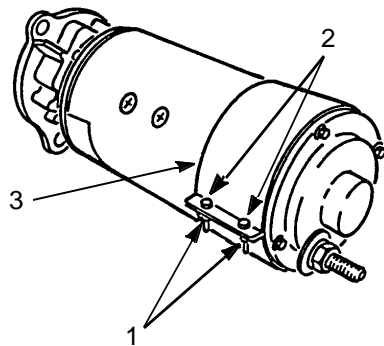
Seal (P/N 97799)
 Washer, lock (P/N 2434) (4)
 Washer, lock (P/N 2523) (9)
 Adhesive, silicone (Item 4, WP 0125 00)

Equipment Condition

Starter solenoid removed (WP 0053 00)

DISASSEMBLY

1. Remove two nuts (1), screws (2), and brush opening band (3).

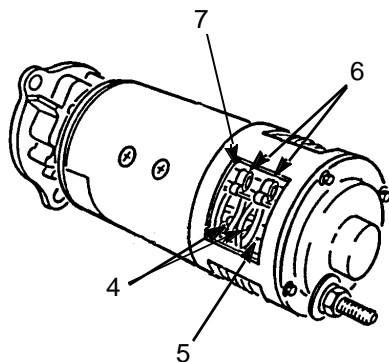


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DISASSEMBLY - CONTINUED**CAUTION**

Do not pull brush leads until spring tension is relieved to prevent damage to equipment.

2. Remove eight screws (4) and four lock plates (5).
3. Pull two springs (6) upward and remove eight brushes (7).



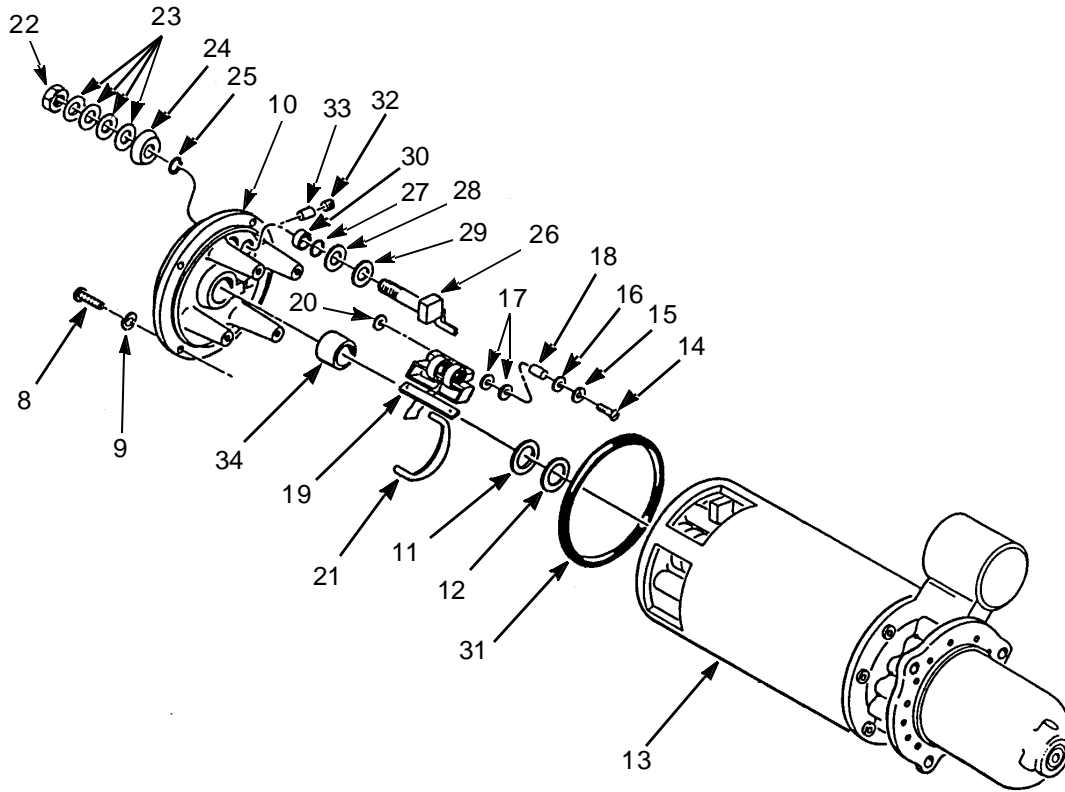
342-545

NOTE

Mark commutator housing and field ring prior to removing commutator housing to aid in installation.

4. Remove four screws (8), lock washers (9), commutator housing (10), insulation washer (11), and washer (12) from field ring (13). Discard lock washers.
5. Remove four screws (14), lock washers (15), washers (16), eight insulation washers (17), and four insulation bushings (18). Discard lock washers.
6. Remove four brush holders (19), insulation washers (20), and ground jumper (21) from commutator housing (10).
7. Remove nut (22), four washers (23), insulator (24), and packing (25) from ground stud (26). Discard packing.
8. Remove ground stud (26) from commutator housing (10).
9. Remove packing (27), insulation washer (28), and washer (29) from ground stud (26). Discard packing.
10. If damaged, remove bushing (30) from commutator housing (10).
11. Remove packing (31), pipe plug (32), and felt wick (33) from commutator housing (10). Discard packing.
12. If damaged, remove bushing (34) from commutator housing (10).

DISASSEMBLY - CONTINUED



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DISASSEMBLY - CONTINUED**NOTE**

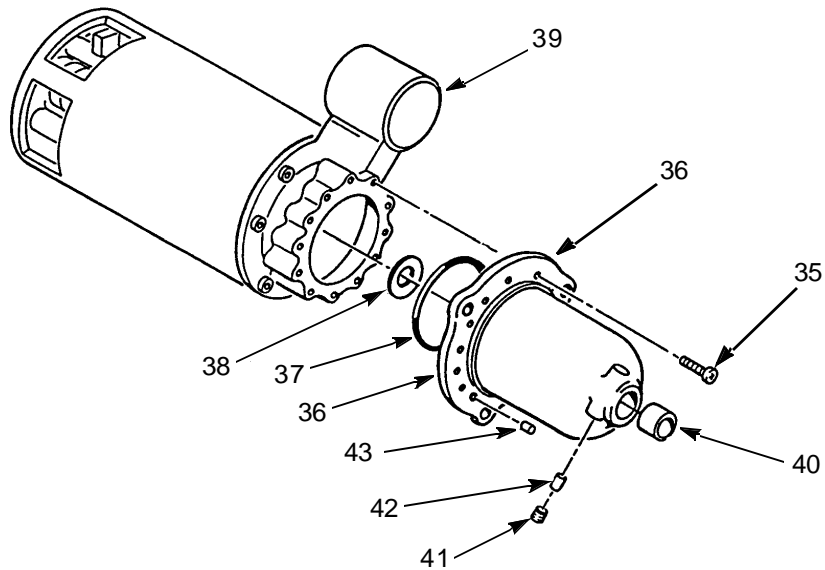
Mark nose housing and shift housing prior to removing nose housing to aid in installation.

13. Remove six screws (35), nose housing (36), packing (37), and washer (38) from shift housing (39). Discard packing.

NOTE

Perform step 14 only if components are damaged.

14. Remove bushing (40), plug (41), felt wick (42), and six plugs (43) from nose housing (36).



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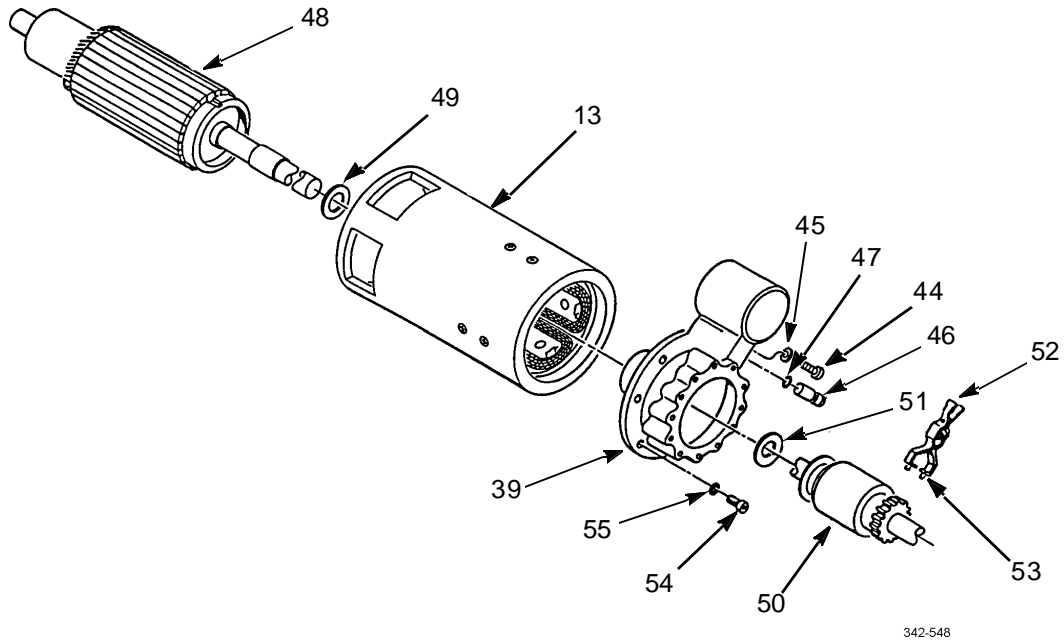
15. Remove screw (44), washer (45), shaft (46), and packing (47) from shift housing (39). Discard packing.
 16. Remove armature (48), washer (49), drive assembly (50), insulator (51), shift lever (52), and two cams (53).

NOTE

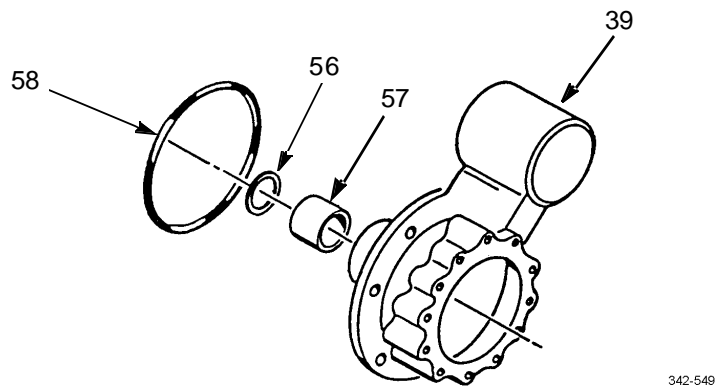
Mark shift housing and field ring prior to removing shift housing to aid in installation.

17. Remove five screws (54), lock washers (55), and shift housing (39) from field ring (13).

DISASSEMBLY - CONTINUED



18. Remove seal (56), bushing (57), and packing (58) from shift housing (39). Discard seal and packing.



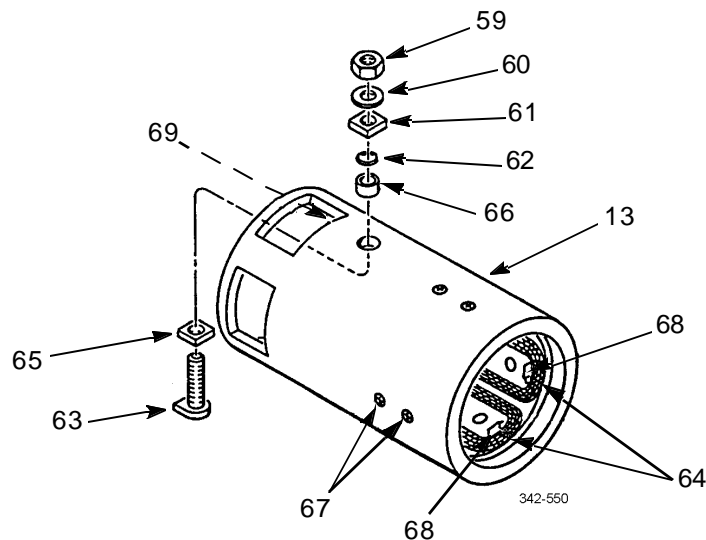
DISASSEMBLY - CONTINUED

19. Remove nut (59), washer (60), insulator (61), and packing (62) from field ring (13). Discard packing.

CAUTION

When removing stud terminal, do not use hammer to tap stud out. To do so could cause damage to components.

20. To remove stud terminal (63), temporarily replace nut (59) flush with end of stud. Using suitable pliers, work stud out while supporting field coil (64).
21. Remove insulator (65) and bushing (66) from field ring (13).
22. Remove eight screws (67), four pole pieces (68), field coil (64), and insulator (69) from field ring (13).

**ASSEMBLY**

1. Install insulator (69) in field ring (13).
2. Install field coil (64) in field ring (13) so that terminal stud holes in field coil and field ring (13) line up.

CAUTION

Pole pieces must be installed so that slot clears field coil contact tab. Failure to do so will cause damage to starter motor.

3. Install four pole pieces (68) and eight screws (67).

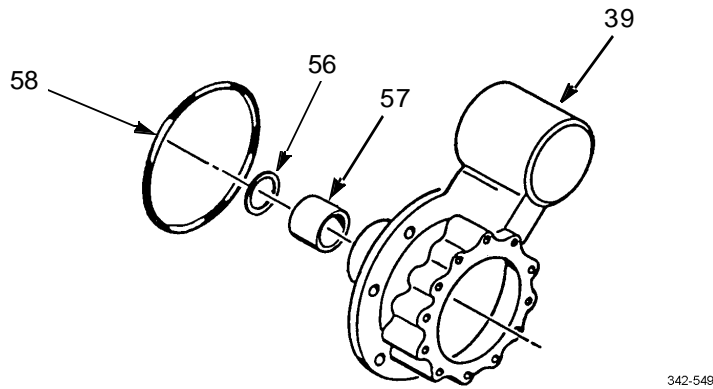
CAUTION

Insulator must be installed between field coil and field ring. Failure to do so will cause a short, damaging starter motor.

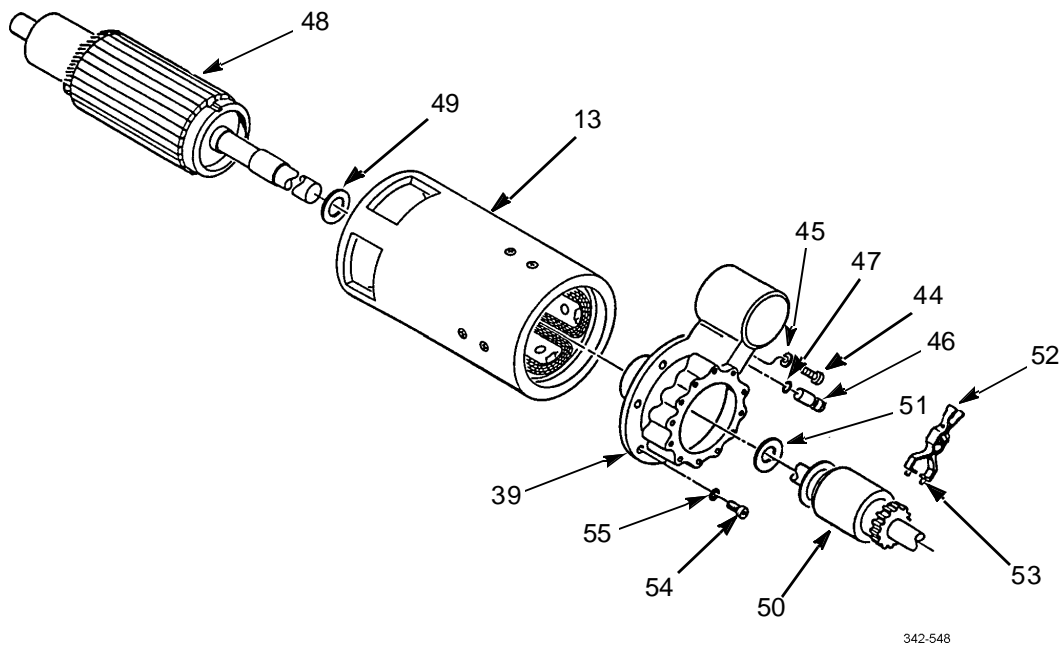
4. Install insulator (65) and stud terminal (63) through field coil (64) and field ring (13).
5. Install bushing (66), new packing (62), insulator (61), washer (60), and nut (59) on stud terminal (63).

ASSEMBLY - CONTINUED

6. Install new packing (58), bushing (57), and new seal (56) in shift housing (39).



7. Install shift housing (39) on field ring (13) with five new lock washers (55) and screws (54).
8. Install two cams (53), shift lever (52), insulator (51), drive assembly (50), washer (49), and armature (48).
9. Install new packing (47), shaft (46), washer (45), and screw (44) in shift housing (39).



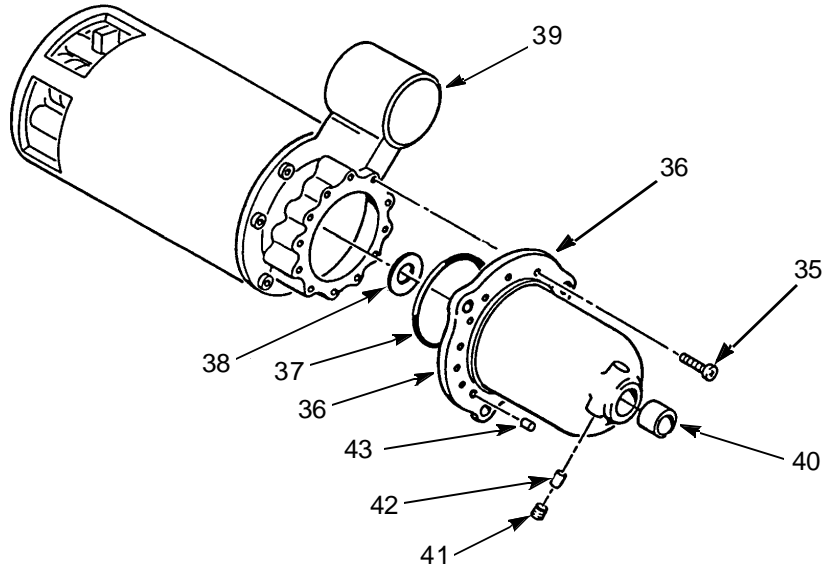
ASSEMBLY - CONTINUED

10. If removed, install six new plugs (43), new felt wick (42), new plug (41), and new bushing (40) in nose housing (36).

NOTE

Install nose housing as noted in disassembly sequence.

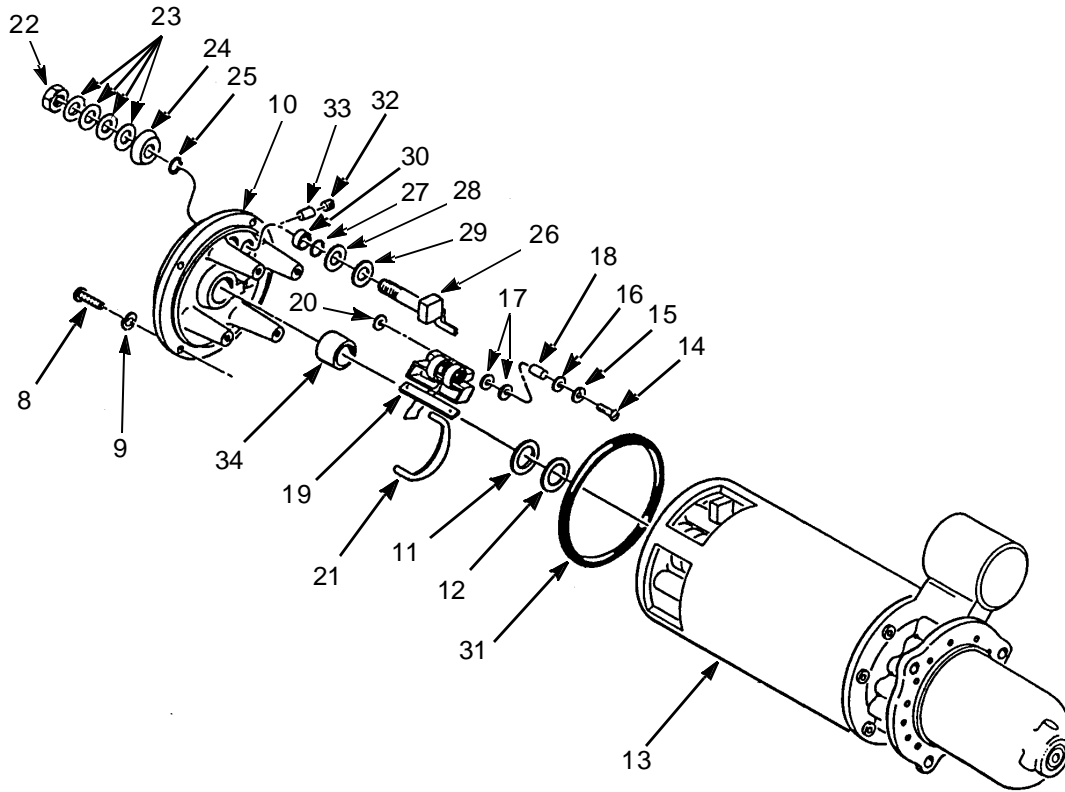
11. Install washer (38), packing (37), nose housing (36), and six screws (35) on shift housing (39).



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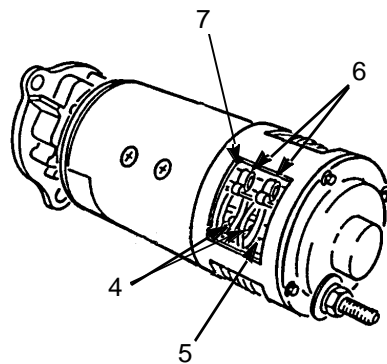
12. If removed, install new bushing (34) in commutator housing (10).
13. Install felt wick (33), pipe plug (32), and new packing (31) in commutator housing (10).
14. If removed, install new bushing (30) in commutator housing (10).
15. Install washer (29), insulation washer (28), and new packing (27) on ground stud (26).
16. Install ground stud (26) in commutator housing (10).
17. Install new packing (25), insulator (24), four washers (23), and nut (22) on ground stud (26).
18. Install ground jumper (21), four insulation washers (20), and brush holders (19) in commutator housing (10).
19. Install four insulation bushings (18), eight insulation washers (17), four washers (16), new lock washers (15), and screws (14).
20. Install insulation washer (11), washer (12), and commutator housing (10) in field ring (13).
21. Apply silicone adhesive to threads of four screws (8) and install four new lock washers (9) and screws (8).

ASSEMBLY - CONTINUED



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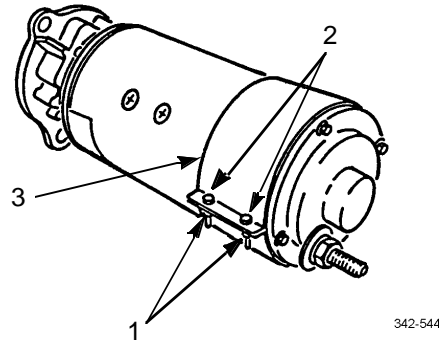
- 22. Pull two springs (6) upward and install brush (7), lock plate (4), and two screws (5).
- 23. Repeat step 22 for remaining brushes (7).



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ASSEMBLY - CONTINUED

24. Install brush opening band (3) with two screws (2) and nuts (1).



25. Install starter solenoid (WP 0053 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

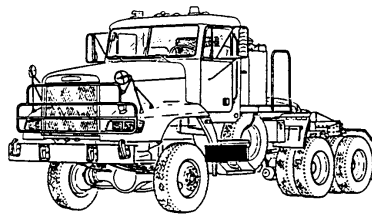
Battery cables disconnected (TM 9-2320-302-20)

REMOVAL

NOTE

- Wiring harness and leads are secured in place by cushion clamps and screw terminals. Only remove hardware securing harness or lead to be removed.
- Tag wiring harness and leads prior to removal to aid in installation.

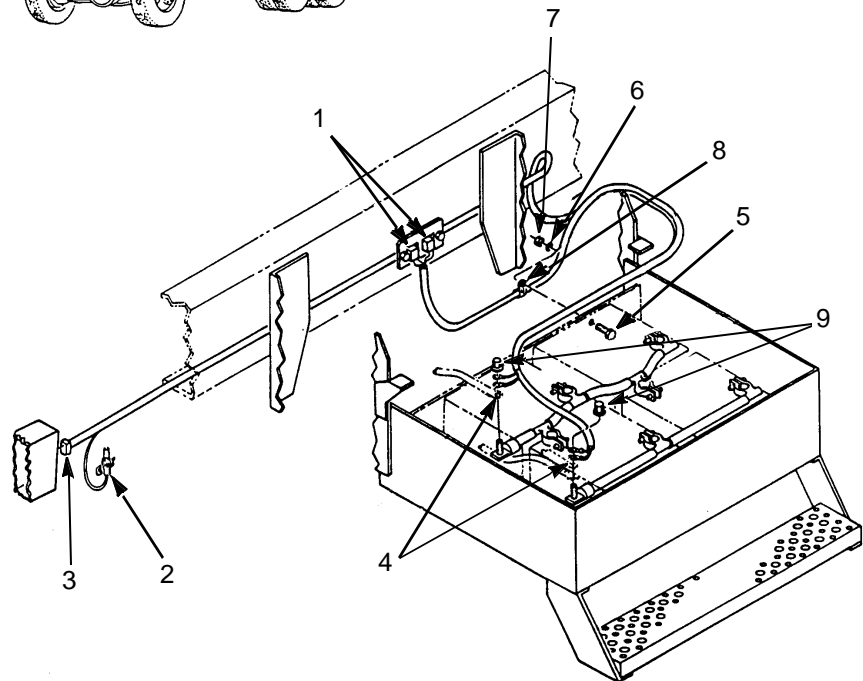
Disconnect and remove engine power wiring harness, using illustration as a guide.



TABLE

QTY

1	Fuse Holder Plug	2
2	1-pin Connector	1
3	6-pin Connector	1
4	Terminal	4
5	Screw	1
6	Washer	1
7	Nut	1
8	Clamp	1
9	Crown Nut	2

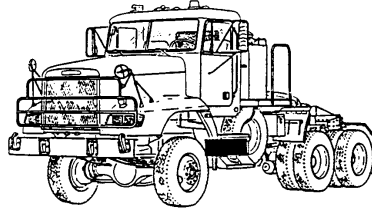


INSTALLATION

NOTE

Wiring harness and leads are secured in place by cushion clamps and screw terminals. Ensure harness is secure and all hardware is tight.

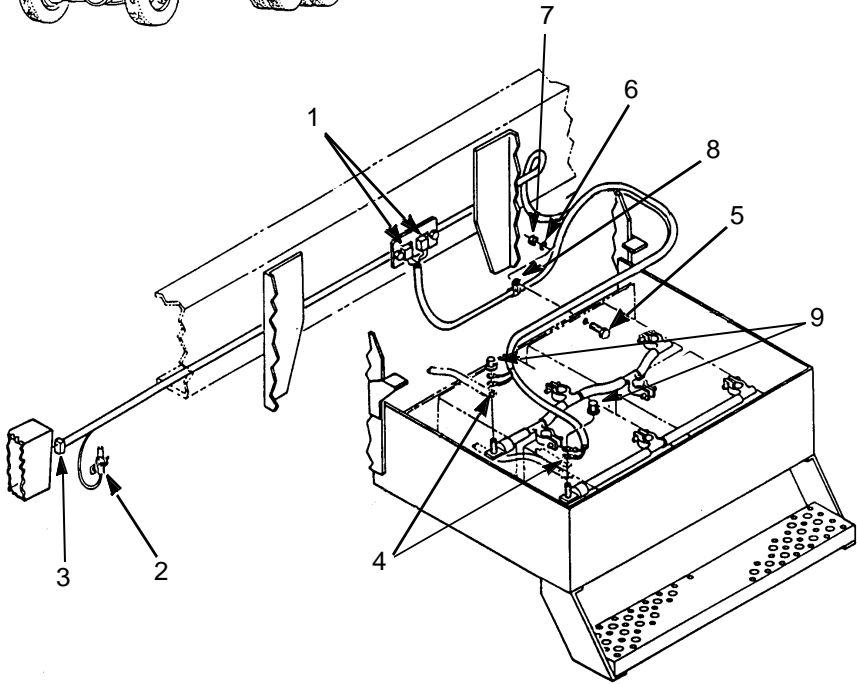
1. Install, connect, and secure engine power wiring harness, using illustration as a guide.



TABLE

QTY

1	Fuse Holder Plug	2
2	1-pin Connector	1
3	6-pin Connector	1
4	Terminal	4
5	Screw	1
6	Washer	1
7	Nut	1
8	Clamp	1
9	Crown Nut	2



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2. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

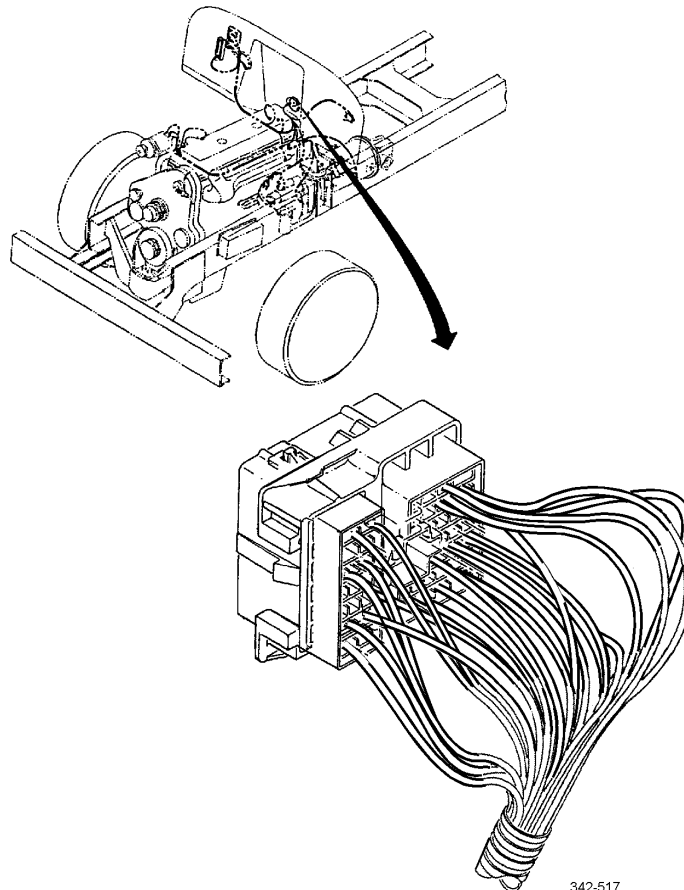
Battery cables disconnected (TM 9-2320-302-20)

REMOVAL

NOTE

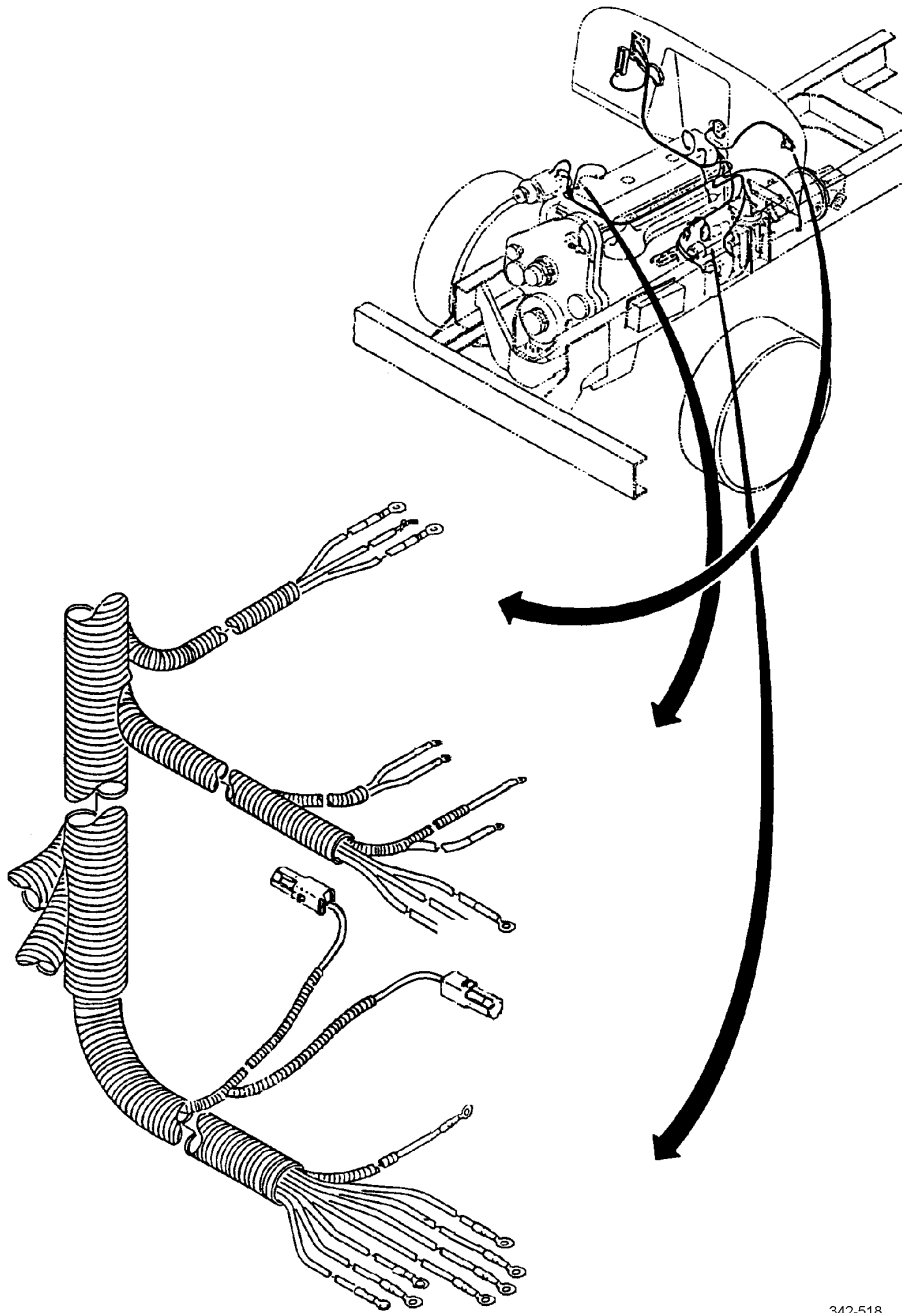
- Wiring harness and leads are secured in place by clips, tiedown straps, cushion clamps, and screw terminals. Only remove hardware securing harness or lead to be removed.
- Tag wiring harness and leads prior to removal to aid in installation.

Disconnect and remove engine wiring harness, using illustrations as a guide.

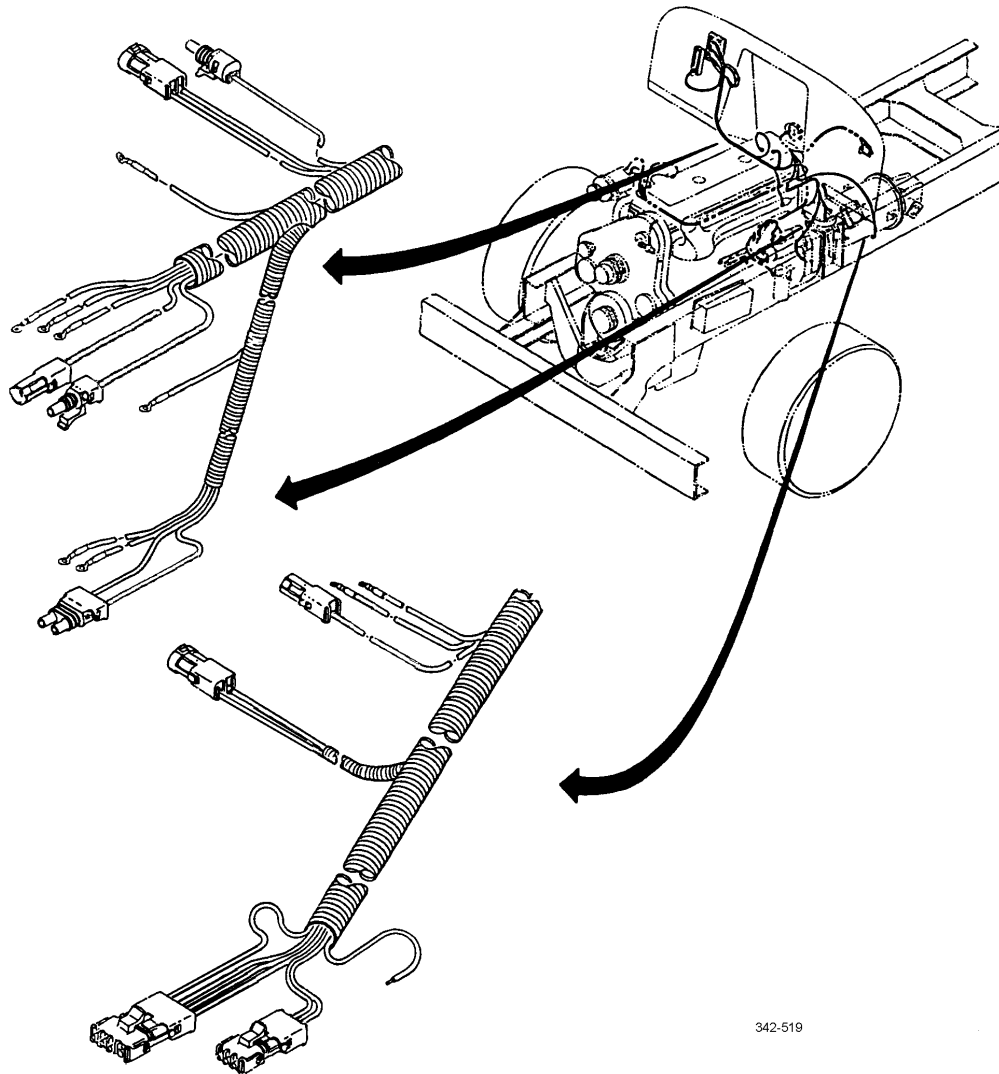


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REMOVAL - CONTINUED



342-518

REMOVAL - CONTINUED**INSTALLATION****NOTE**

Wiring harness and leads are secured in place by clips, new tiedown straps, cushion clamps, and screw terminals. Ensure harness is secure and all hardware is tight.

1. Install, connect, and secure engine wiring harness, using illustrations as a guide.
2. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

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MAIN CAB WIRING HARNESS REPLACEMENT

0057 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

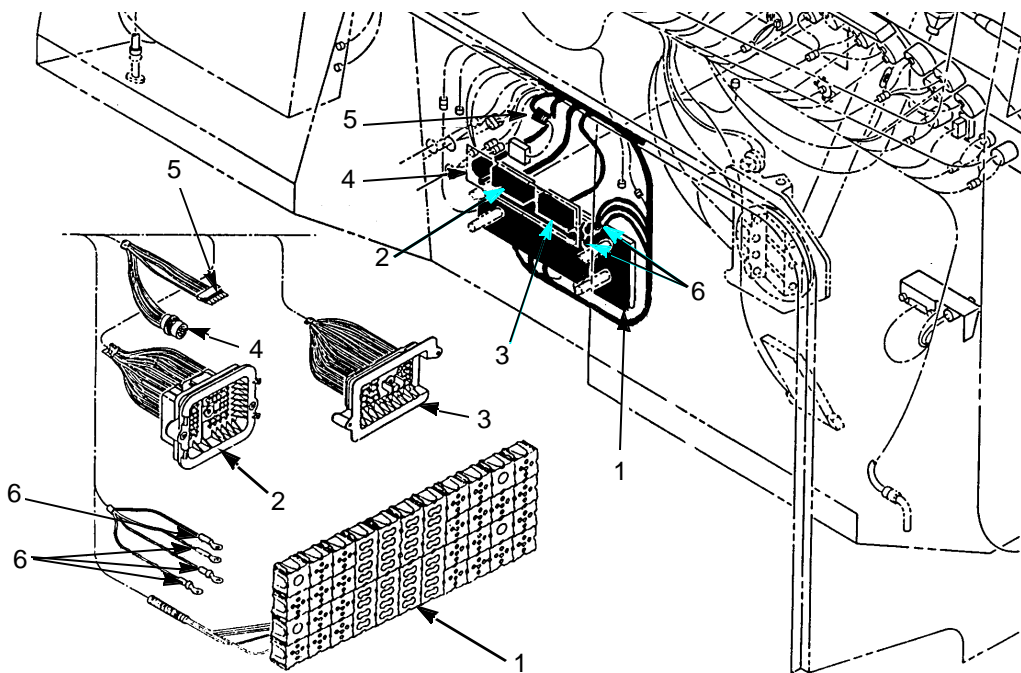
Battery cables disconnected (TM 9-2320-302-20)

REMOVAL

NOTE

- Wiring harness and leads are secured in place by clips, tiedown straps, cushion clamps, and screw terminals. Only remove hardware securing harness to be removed.
- Tag wiring harness and leads prior to removal to aid in installation.

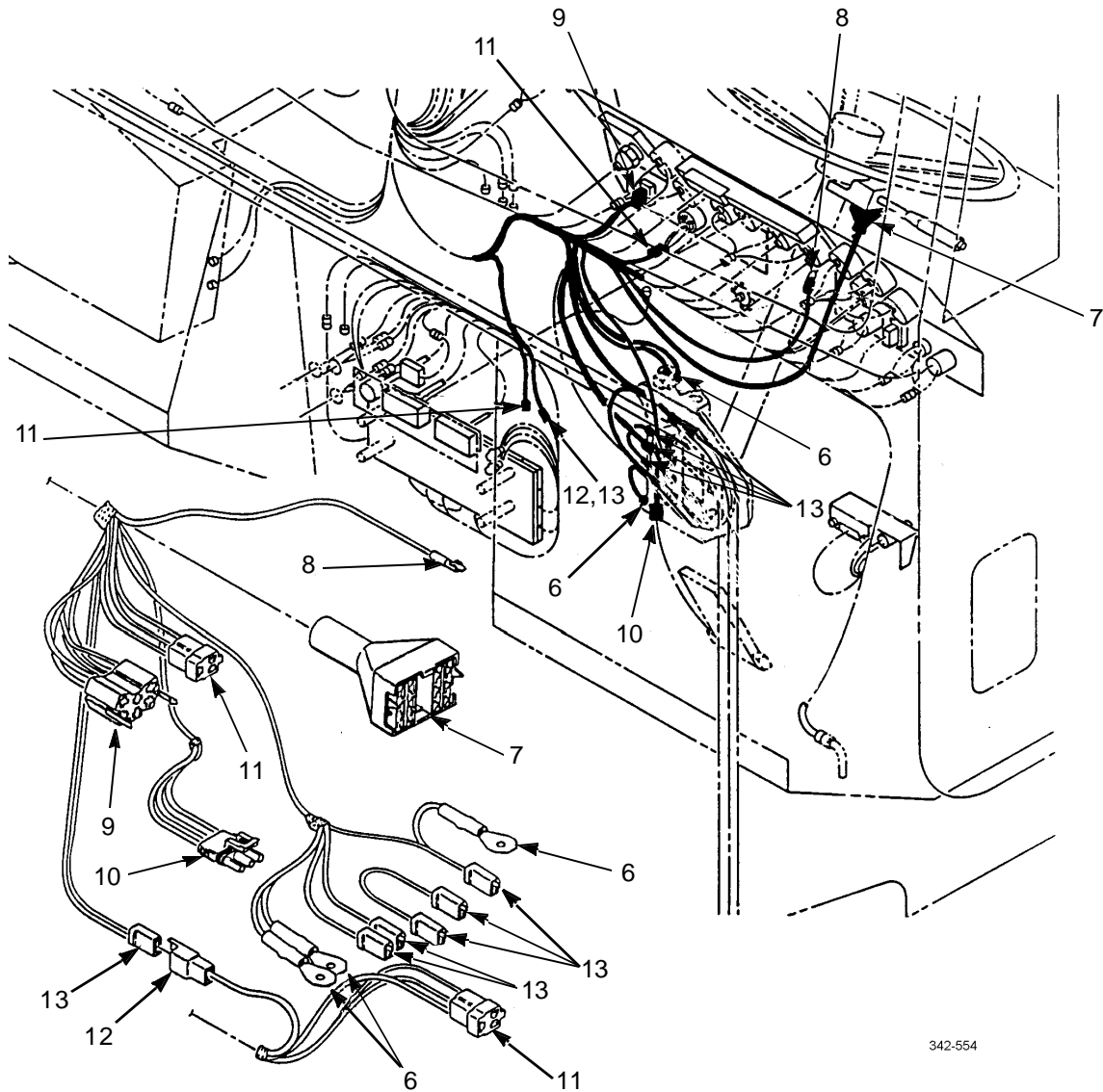
1. Disconnect relay and fuse panel (1).
2. Disconnect 42-pin connector (2), 34-pin connector (3), 32-pin connector (4), 6-pin sealed connector (5), and four ring terminals (6).



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REMOVAL - CONTINUED

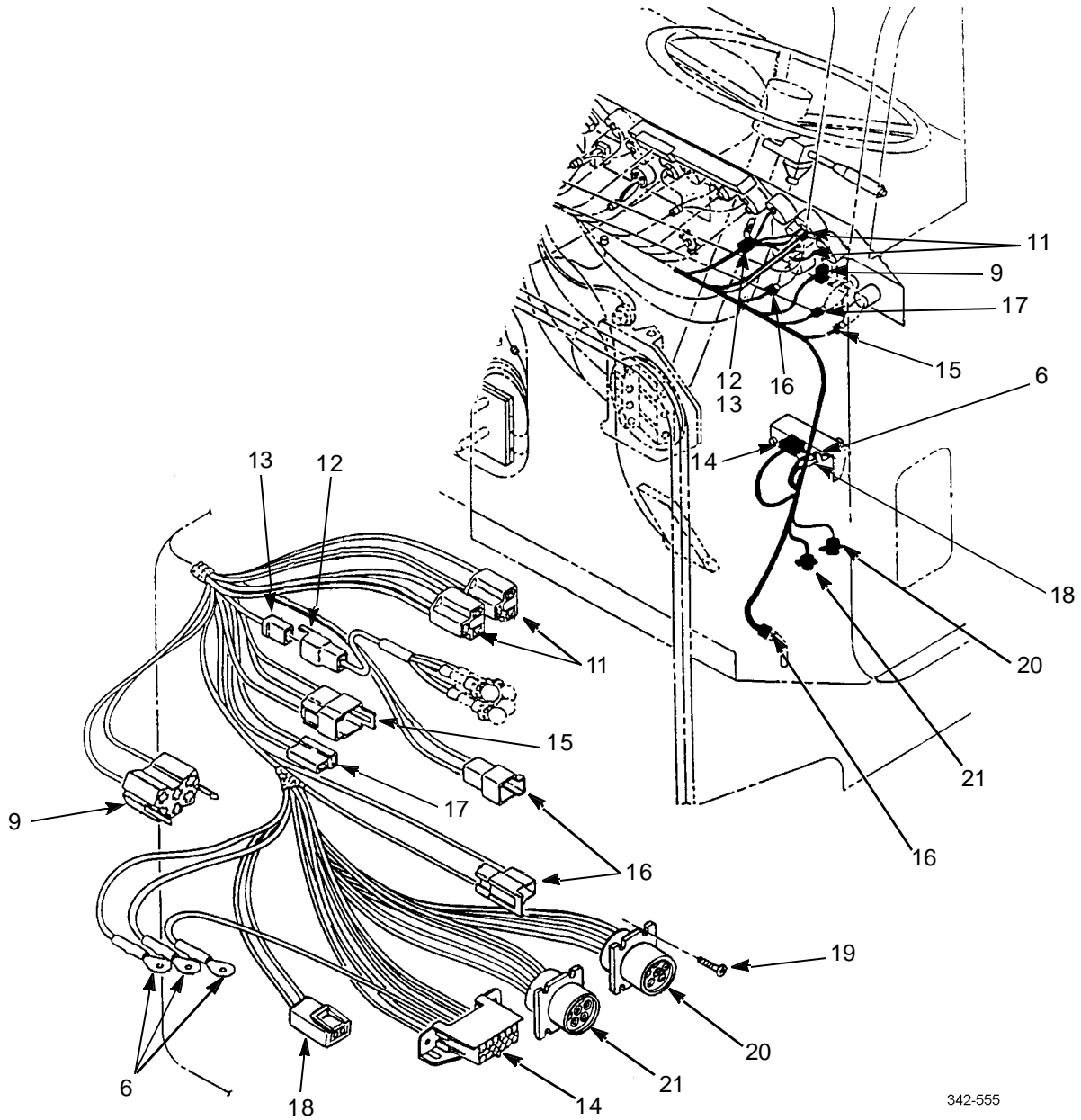
3. Disconnect three ring terminals (6), 12-pin connector (7), female terminal blade (8), 6-pin female connector (9), 3-pin sealed connector (10), two 3-pin female connectors (11), 1-pin male connector (12), and six 1-pin female connectors (13).



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4. Disconnect three ring terminals (6), 6-pin female connector (9), two 3-pin female connectors (11), 1-pin male connector (12), 1-pin female connector (13), 12-pin diagnostic connector (14), 3-pin male connector (15), two 2-pin male connectors (16), and 2-pin female connectors (17).
5. Disconnect 2-pin male connector (18).
6. Remove eight screws (19) and remove 6-pin diagnostic connector (20) and 9-pin engine diagnostic connector (21).

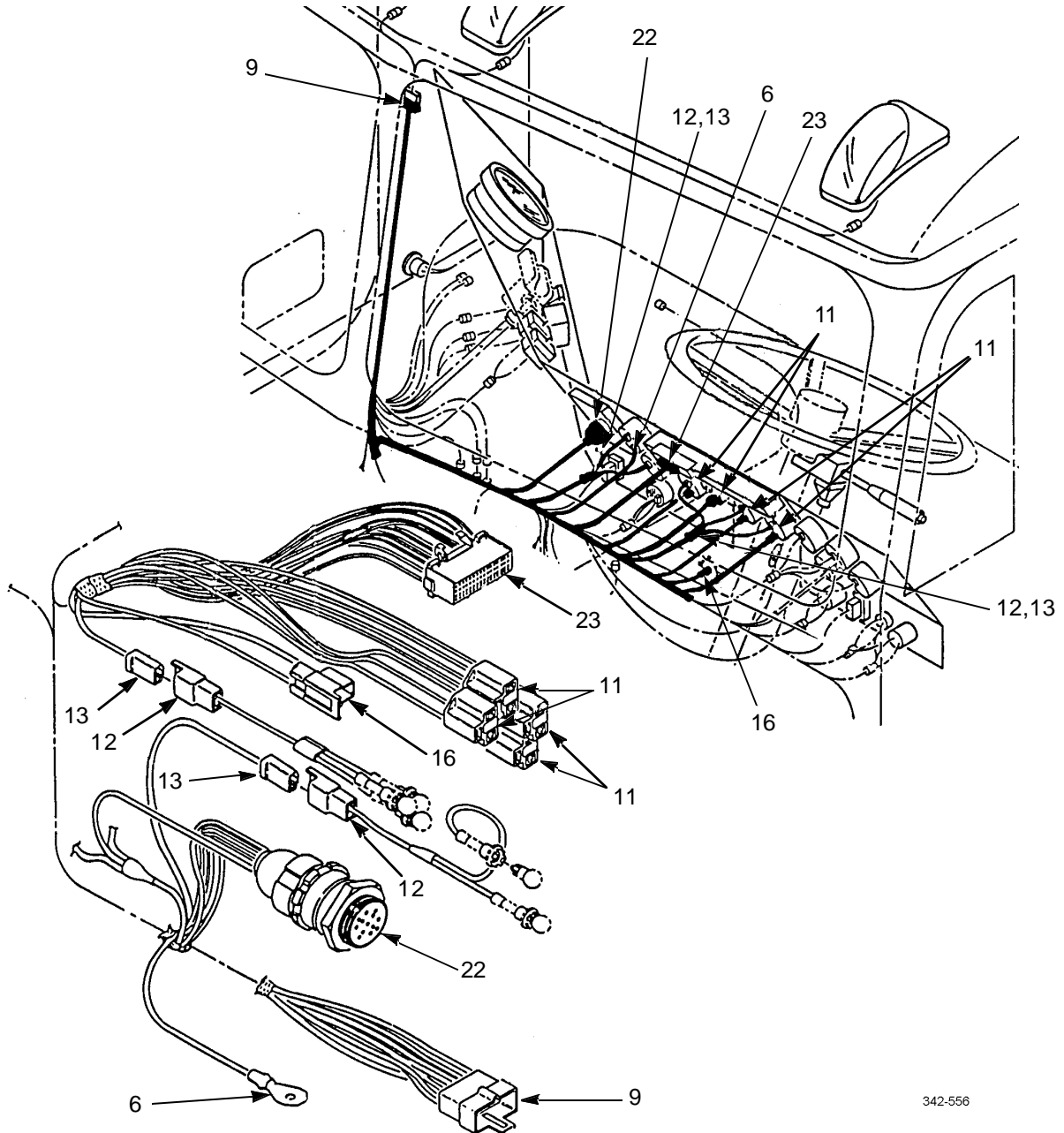
REMOVAL - CONTINUED



342-555

REMOVAL - CONTINUED

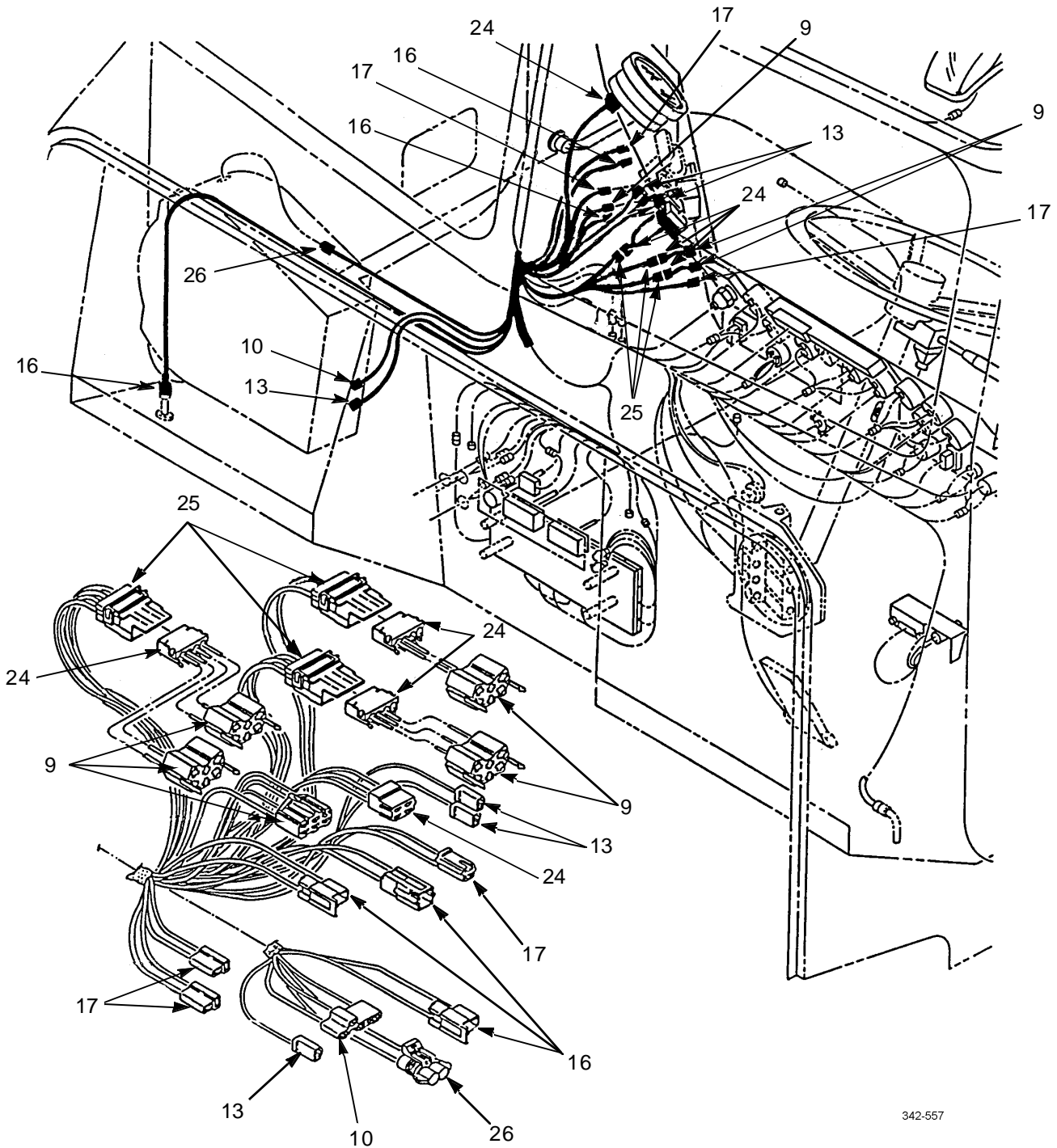
7. Disconnect ring terminal (6), 6-pin female connector (9), four 3-pin female connectors (11), two 1-pin male connectors (12), two 1-pin female connectors (13), 2-pin male connector (16), 12-pin light switch connector (22), and 32-pin connector (23).



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REMOVAL - CONTINUED

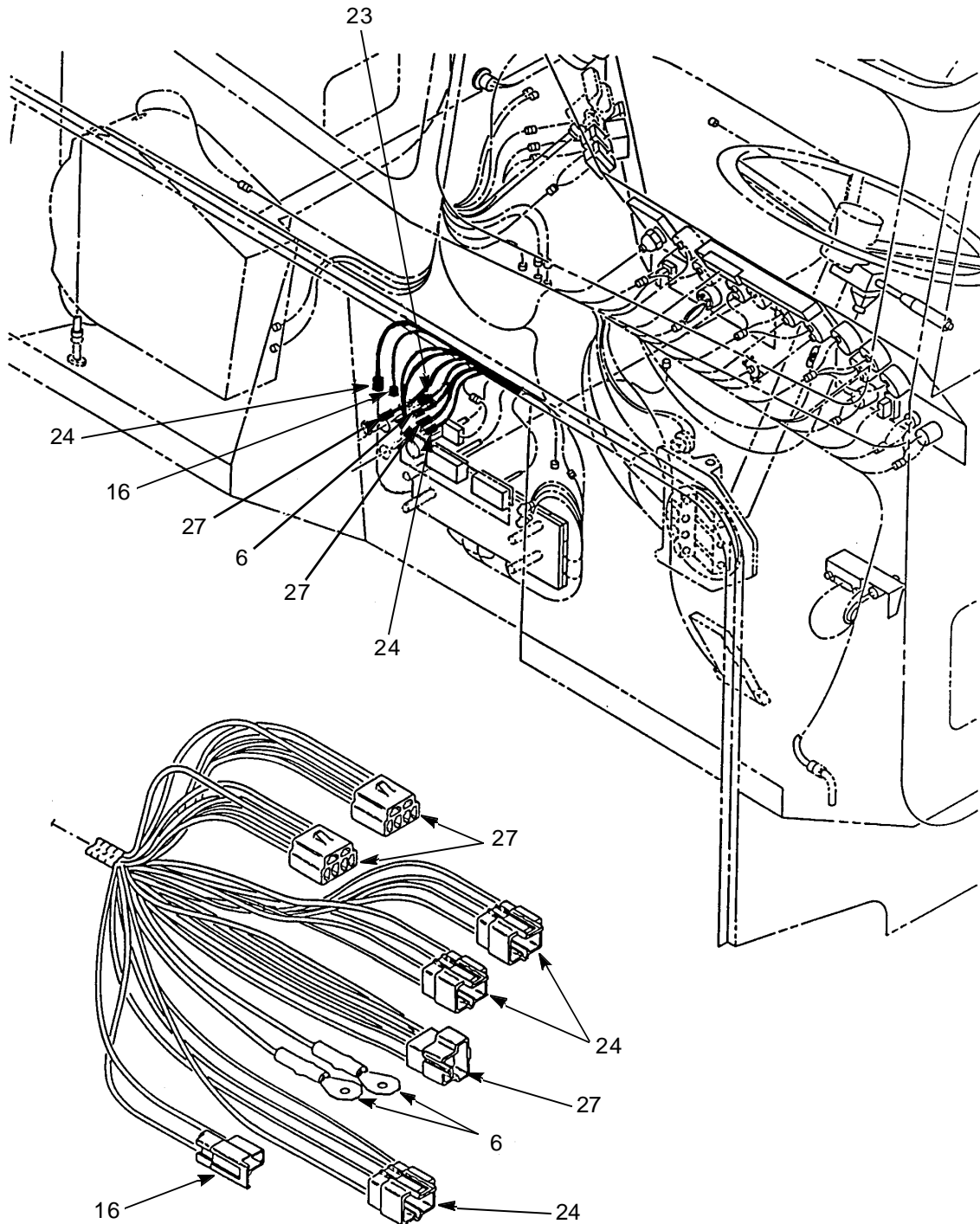
8. Disconnect five 6-pin female connectors (9), 3-pin sealed connector (10), three 1-pin female connectors (13), three 2-pin male connectors (16), three 2-pin female connectors (17), four 4-pin male connectors (24), three 4-pin female connectors (25), and 2-pin sealed connector (26).



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REMOVAL - CONTINUED

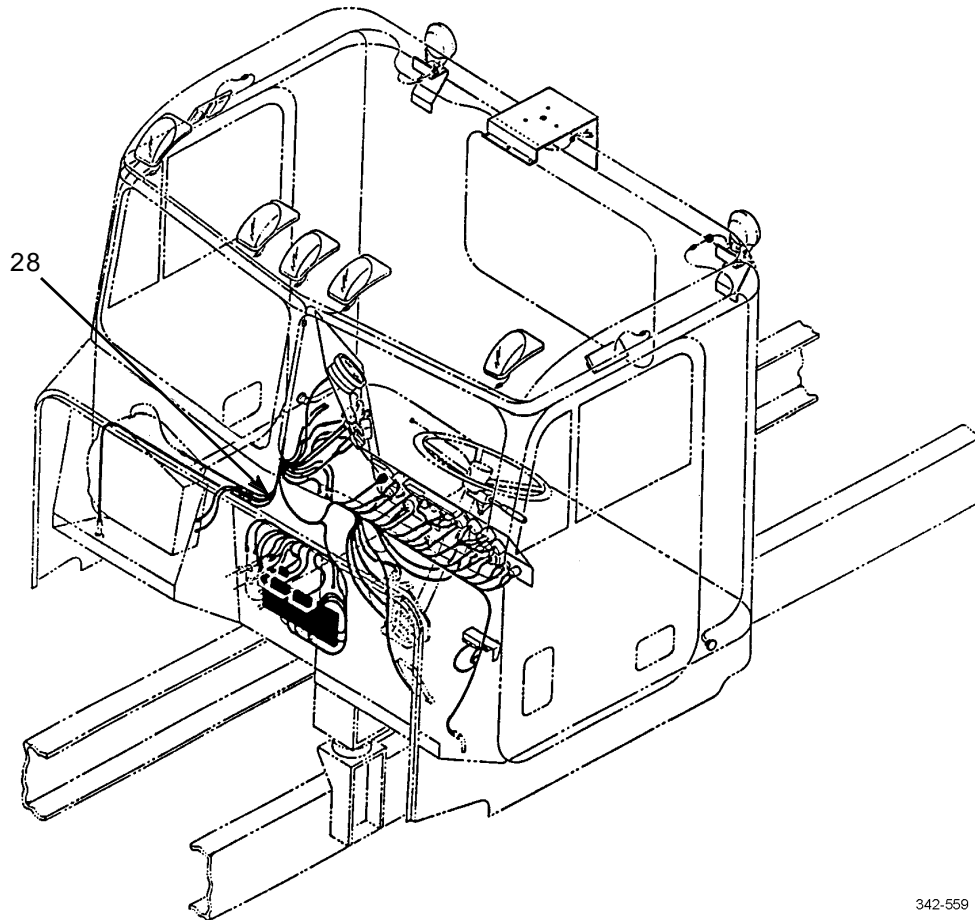
9. Disconnect two ring terminals (6), 2-pin male connector (16), three 4-pin male connectors (24), and three 6-pin male connectors (27).



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REMOVAL - CONTINUED

10. Remove main cab wiring harness (28).



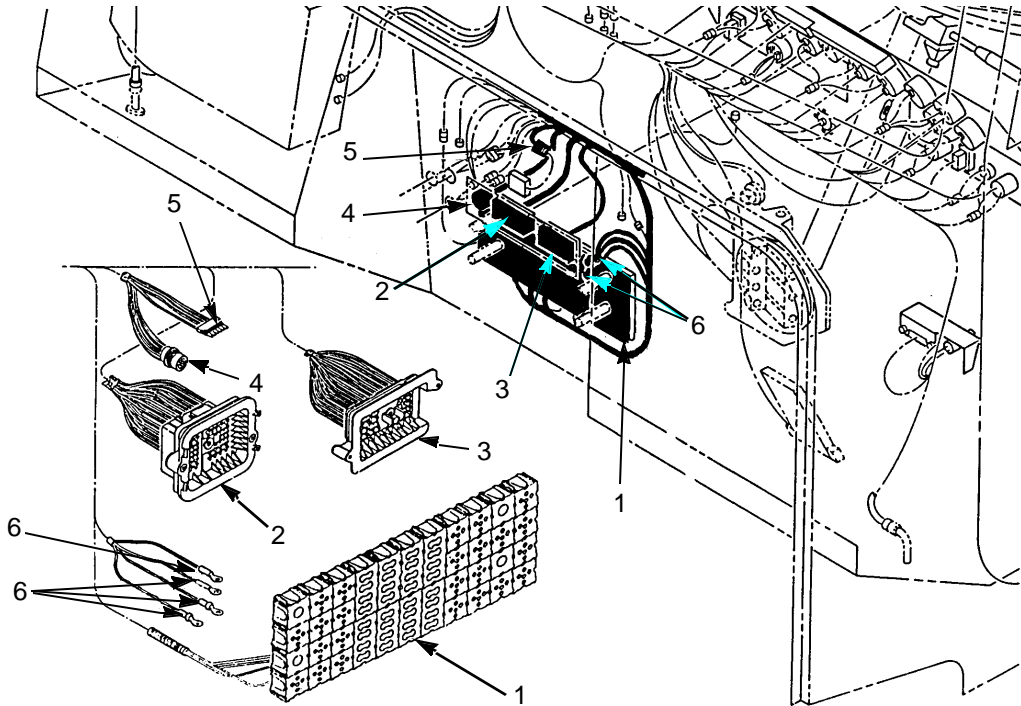
342-559

INSTALLATION**NOTE**

Wiring harness and leads are secured in place by clips, tiedown straps, cushion clamps, and screw terminals. Ensure wiring harness is secure and all hardware is tight.

INSTALLATION - CONTINUED

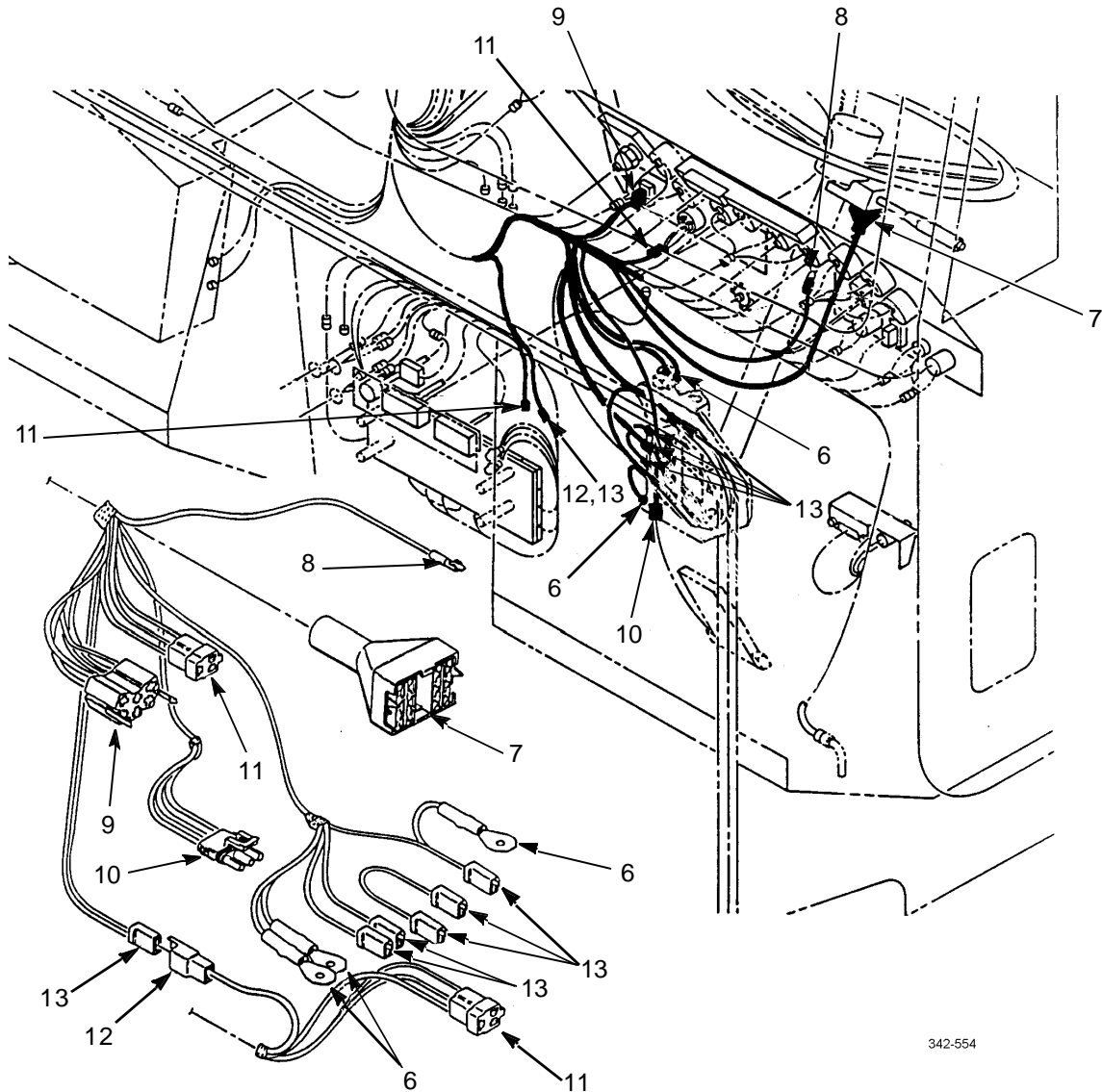
1. Connect relay and fuse panel (1).
2. Connect 42-pin connector (2), 34-pin connector (3), 32-pin connector (4), 6-pin sealed connector (5), and four ring terminals (6).



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INSTALLATION - CONTINUED

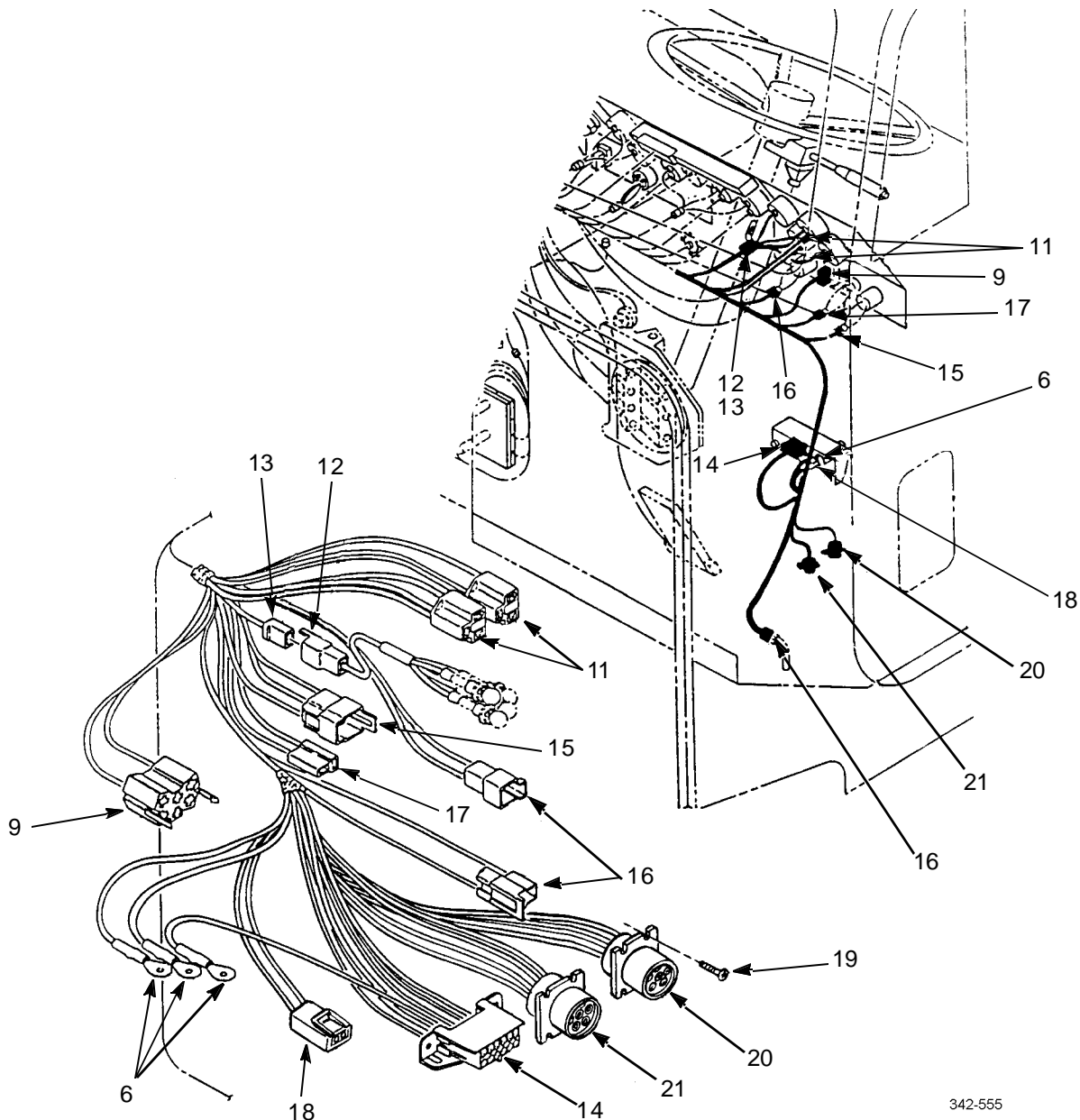
3. Connect three ring terminals (6), 12-pin connector (7), female terminal blade (8), 6-pin female connector (9), 3-pin sealed connector (10), two 3-pin female connectors (11), 1-pin male connector (12), and six 1-pin female connectors (13).



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INSTALLATION - CONTINUED

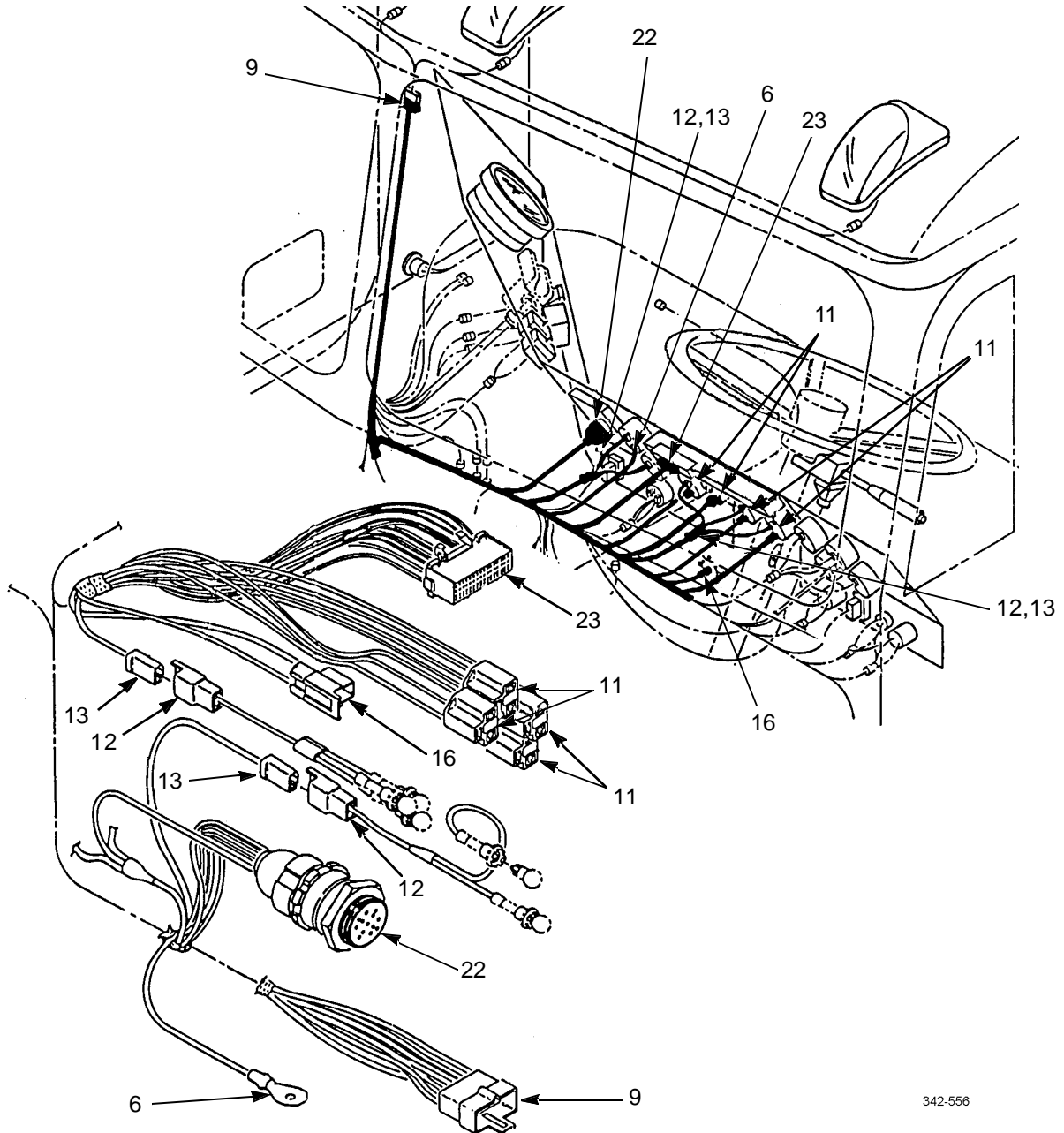
4. Install 9-pin engine diagnostic connector (21) and 6-pin diagnostic connector (20) and secure with eight screws (19).
5. Connect 2-pin male connector (18).
6. Connect three ring terminals (6), 6-pin female connector (9), two 3-pin female connectors (11), 1-pin male connector (12), 1-pin female connector (13), 12-pin diagnostic connector (14), 3-pin male connector (15), two 2-pin male connectors (16), and 2-pin female connectors (17).



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INSTALLATION - CONTINUED

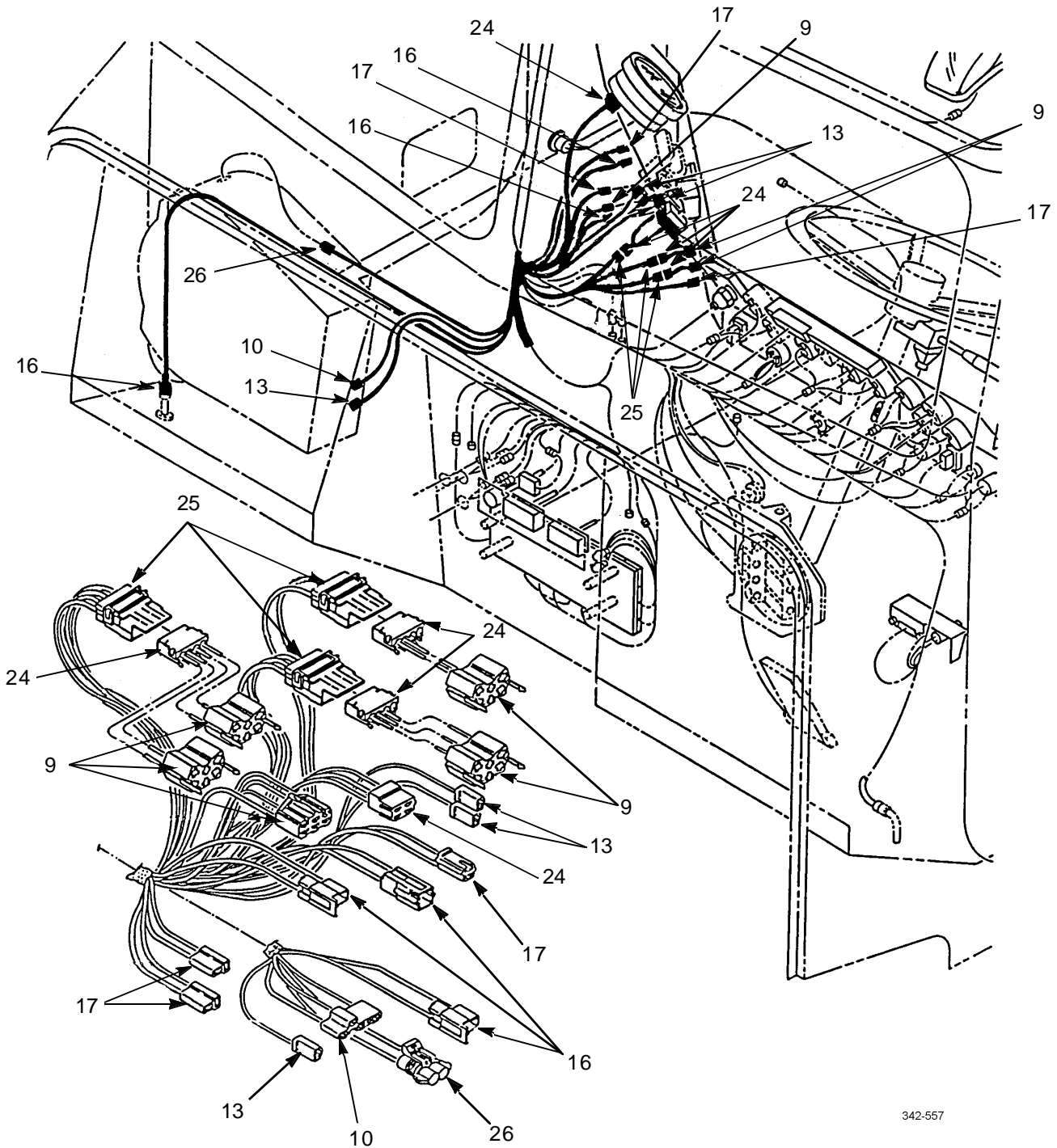
7. Connect ring terminal (6), 6-pin female connector (9), four 3-pin female connectors (11), two 1-pin male connectors (12), two 1-pin female connectors (13), 2-pin male connector (16), 12-pin light switch connector (22), and 32-pin connector (23).



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INSTALLATION - CONTINUED

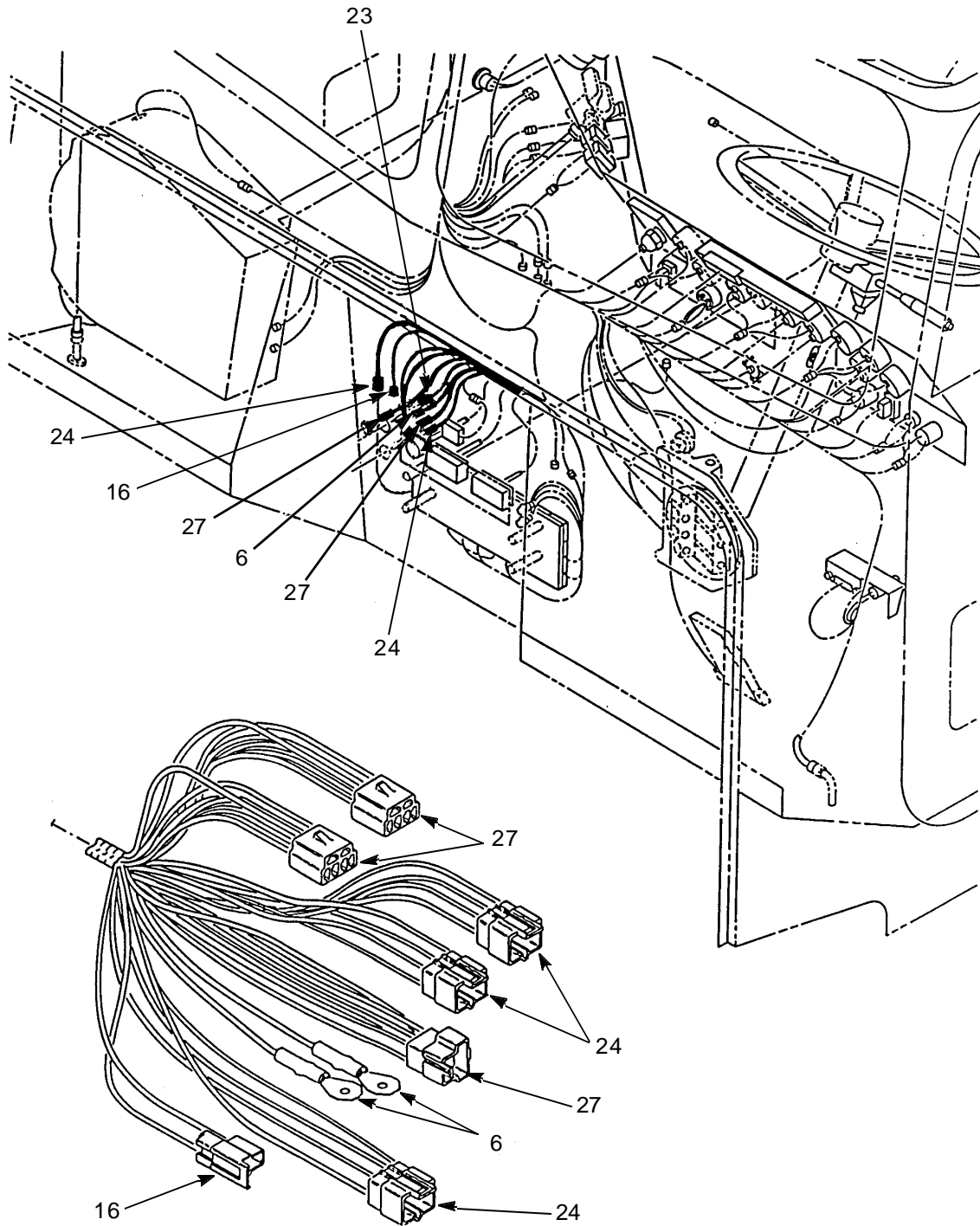
8. Connect five 6-pin female connectors (9), 3-pin sealed connector (10), three 1-pin female connectors (13), three 2-pin male connectors (16), three 2-pin female connectors (17), four 4-pin male connectors (24), three 4-pin female connectors (25), and 2-pin sealed connector (26).



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INSTALLATION - CONTINUED

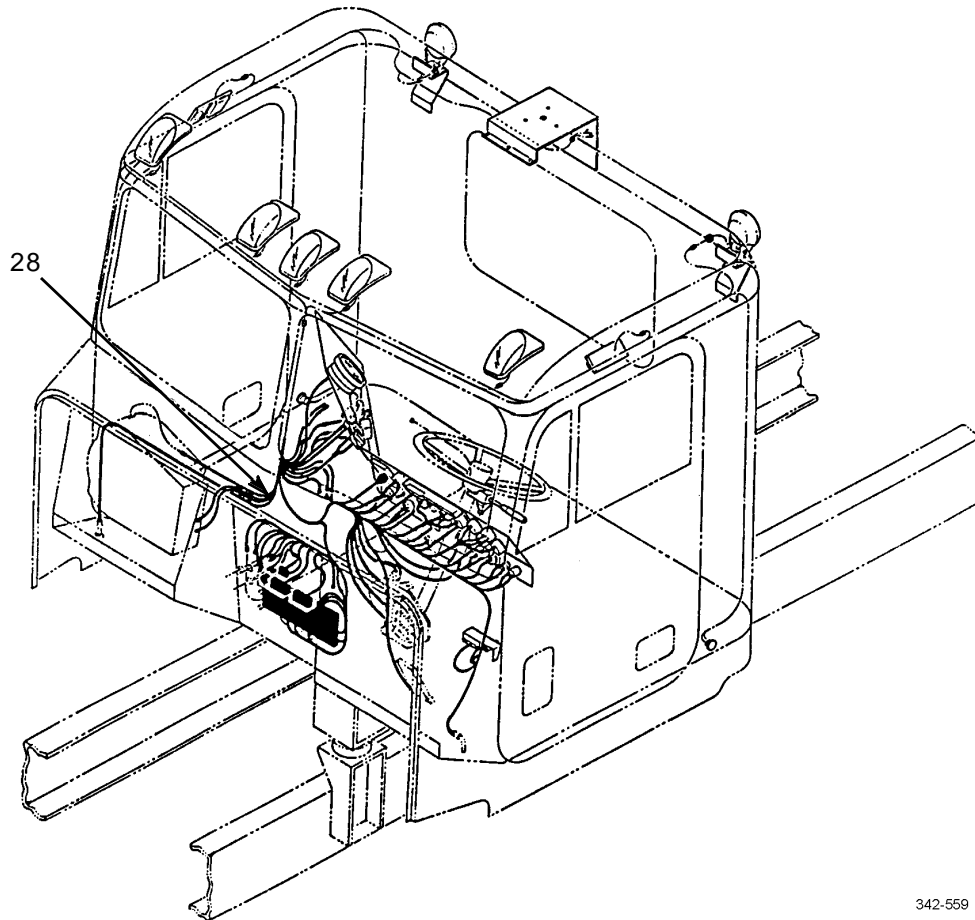
9. Connect two ring terminals (6), 2-pin male connector (16), three 4-pin male connectors (24), and three 6-pin male connectors (27).



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INSTALLATION - CONTINUED

10. Secure main cab wiring harness (28).



342-559

11. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

SWITCH PANEL WIRING HARNESS REPLACEMENT

0058 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

REMOVAL

NOTE

- Wiring harness and leads are secured in place by clips, tiedown straps, cushion clamps, and screw terminals. Only remove hardware securing harness or lead to be removed.
- Tag wiring harness and leads prior to removal to aid in installation.

Disconnect and remove switch panel wiring harness, using illustration as a guide. Discard tiedown straps.

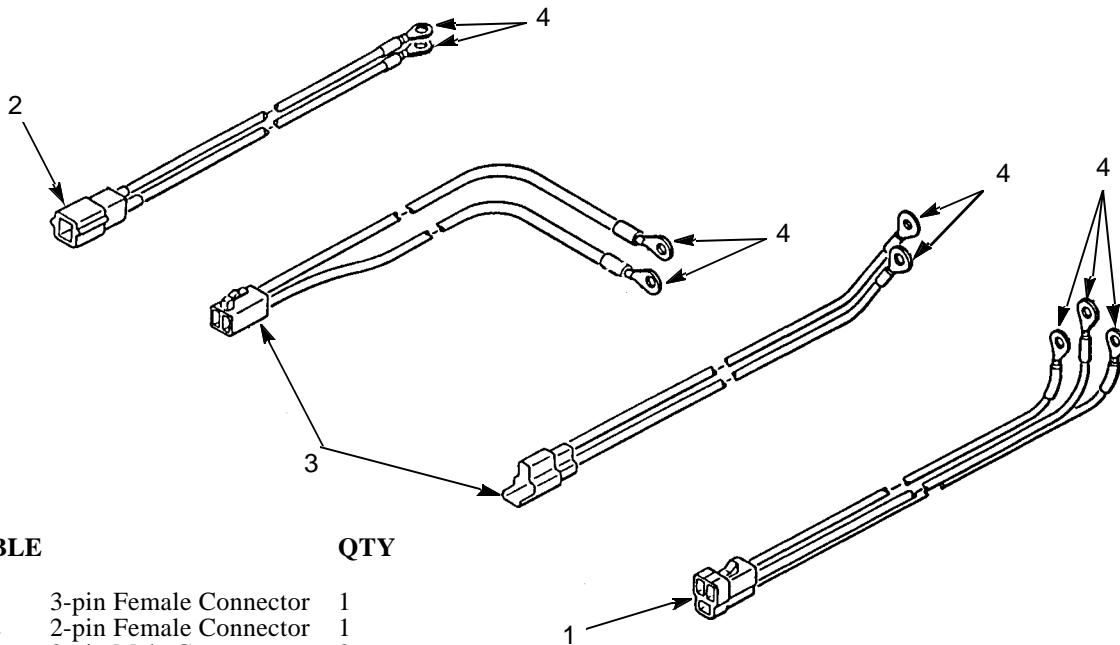
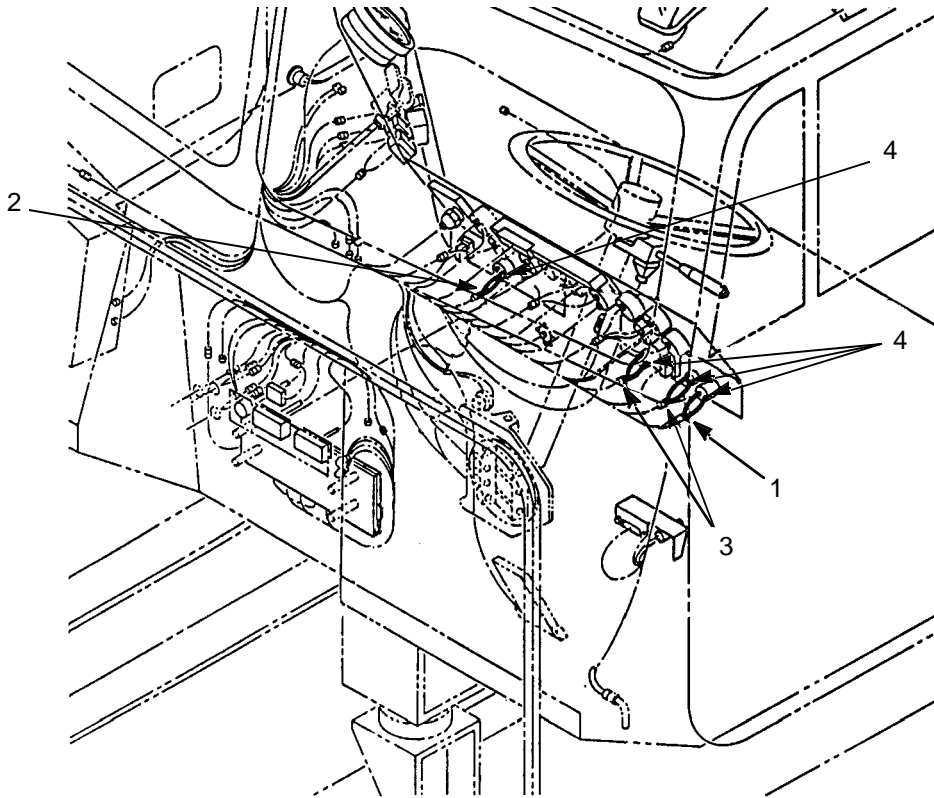
INSTALLATION

NOTE

Wiring harness and leads are secured in place by clips, new tiedown straps, cushion clamps, and screw terminals. Ensure harness is secure and all hardware is tight.

1. Install, connect, and secure switch panel wiring harness, using illustration as a guide.
2. Connect battery cables (TM 9-2320-302-20).

INSTALLATION - CONTINUED



TABLE

QTY

1	3-pin Female Connector	1
2	2-pin Female Connector	1
3	2-pin Male Connector	2
4	Ring Terminal	9

342-537

END OF WORK PACKAGE

TURN SIGNAL/MARKER LIGHT WIRING HARNESS REPLACEMENT

0059 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

NOTE

Procedure is same for left- and right-side harnesses.

REMOVAL

NOTE

Wiring harness and leads are secured by clips, tiedown straps, cushion clamps, and screw terminals. Only remove hardware securing harness or lead to be removed.

Disconnect and remove turn signal/marker light wiring harness, using illustration as a guide. Discard tiedown straps.

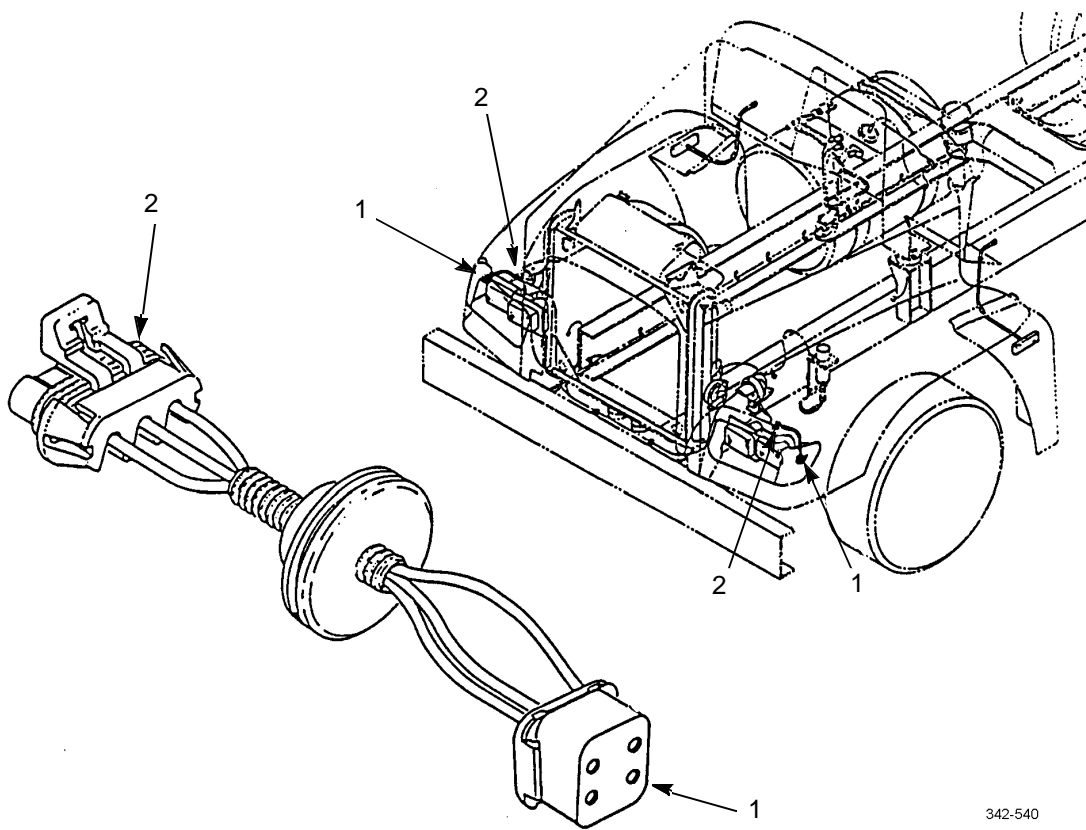
INSTALLATION

NOTE

Wiring harness and leads are secured by clips, new tiedown straps, cushion clamps, and screw terminals. Ensure harness is secure and all hardware is tight.

1. Install, connect, and secure turn signal/marker light wiring harness, using illustration as a guide.
2. Connect battery cables (TM 9-2320-302-20).

INSTALLATION - CONTINUED



TABLE

QTY

1	4-pin Female Connector	2
2	3-pin Female Sealed Connector	2

END OF WORK PACKAGE

TURN SIGNAL (THRU-DECK) WIRING HARNESS REPLACEMENT

0060 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tools and Special Tools

Tool kit, general support (Item 132, WP 0126 00)

Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

NOTE

Procedure is same for left- and right-side harnesses.

REMOVAL

NOTE

Wiring harness and leads are secured by clips, tiedown straps, cushion clamps, and screw terminals. Only remove hardware securing harness or lead to be removed.

Disconnect and remove turn signal (thru-deck) wiring harness, using illustration as a guide. Discard tiedown straps.

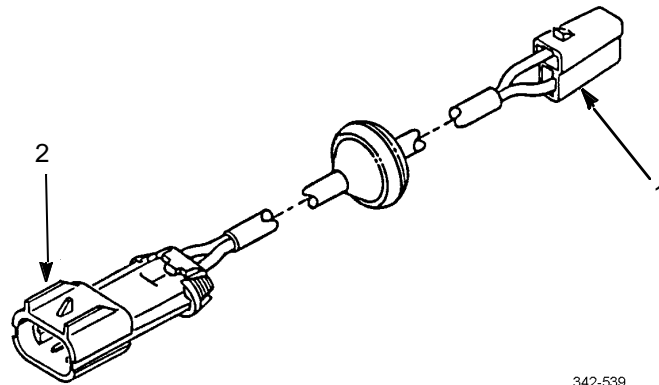
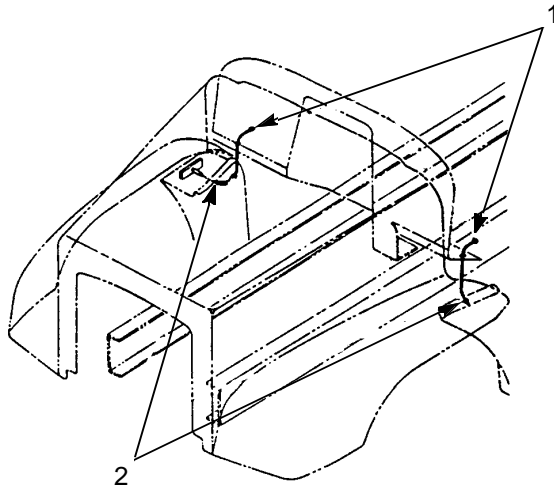
INSTALLATION

NOTE

Wiring harness and leads are secured by clips, new tiedown straps, cushion clamps, and screw terminals. Ensure harness is secure and all hardware is tight.

1. Install, connect, and secure turn signal (thru-deck) wiring harness, using illustration as a guide.
2. Connect battery cables (TM 9-2320-302-20).

INSTALLATION - CONTINUED



342-539

TABLE

QTY

1	2-pin Female Connector	2
2	2-pin Male Sealed Connector	2

END OF WORK PACKAGE

OVERHEAD CAB WIRING HARNESS REPLACEMENT

0061 00

THIS WORK PACKAGE COVERSRemoval, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

Head liners removed (TM 9-2320-302-20)

Battery cables disconnected (TM 9-2320-302-20)

REMOVAL**NOTE**

- Wiring harness and leads are secured by clips, tiedown straps, cushion clamps, and screw terminals. Only remove hardware securing harness or lead to be removed.
- Tags wiring harness and leads prior to removal to aid in installation.

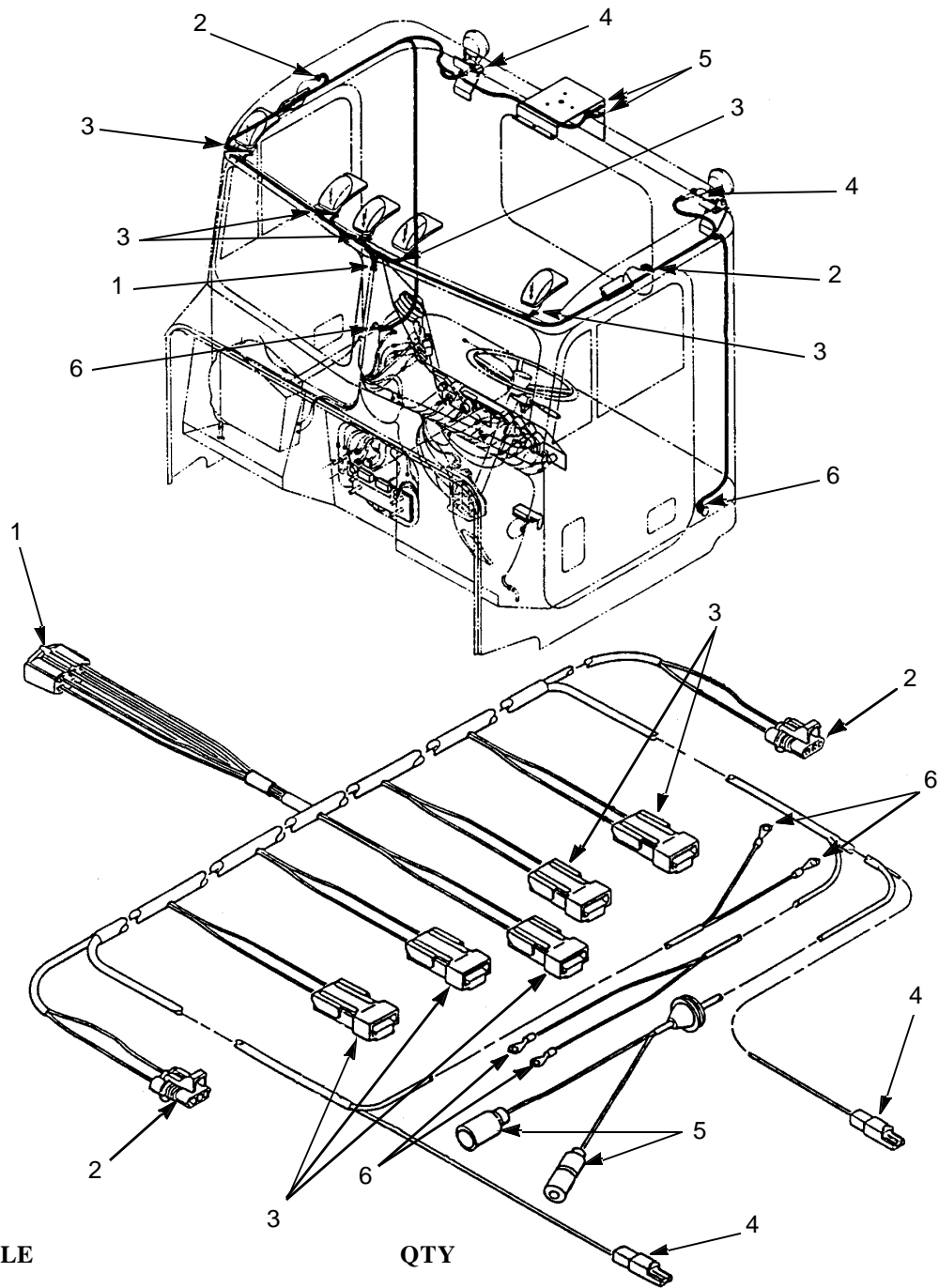
Disconnect and remove overhead cab wiring harness, using illustration as a guide. Discard tiedown straps.

INSTALLATION**NOTE**

Wiring harness and leads are secured by clips, new tiedown straps, cushion clamps, and screw terminals. Ensure harness is secure and all hardware is tight.

1. Install, connect, and secure overhead cab wiring harness, using illustration as a guide.
2. Install head liners (TM 9-2320-302-20).
3. Connect battery cables (TM 9-2320-302-20).

INSTALLATION - CONTINUED



TABLE

QTY

- 1 6-pin Connector
- 2 3-pin Connector
- 3 2-pin Connector
- 4 1-pin Connector
- 5 Cable Connector
- 6 Ring Terminal

- 1
- 2
- 5
- 2
- 2
- 4

342-551

END OF WORK PACKAGE

CHASSIS WIRING HARNESS REPLACEMENT

0062 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

REMOVAL

NOTE

- Wiring harness and leads are secured by clips, tiedown straps, cushion clamps, and screw terminals. Only remove hardware securing harness or lead to be removed.
- Tag wiring harness and leads prior to removal to aid in installation.

Disconnect and remove chassis wiring harness, using illustration as a guide. Discard tiedown straps.

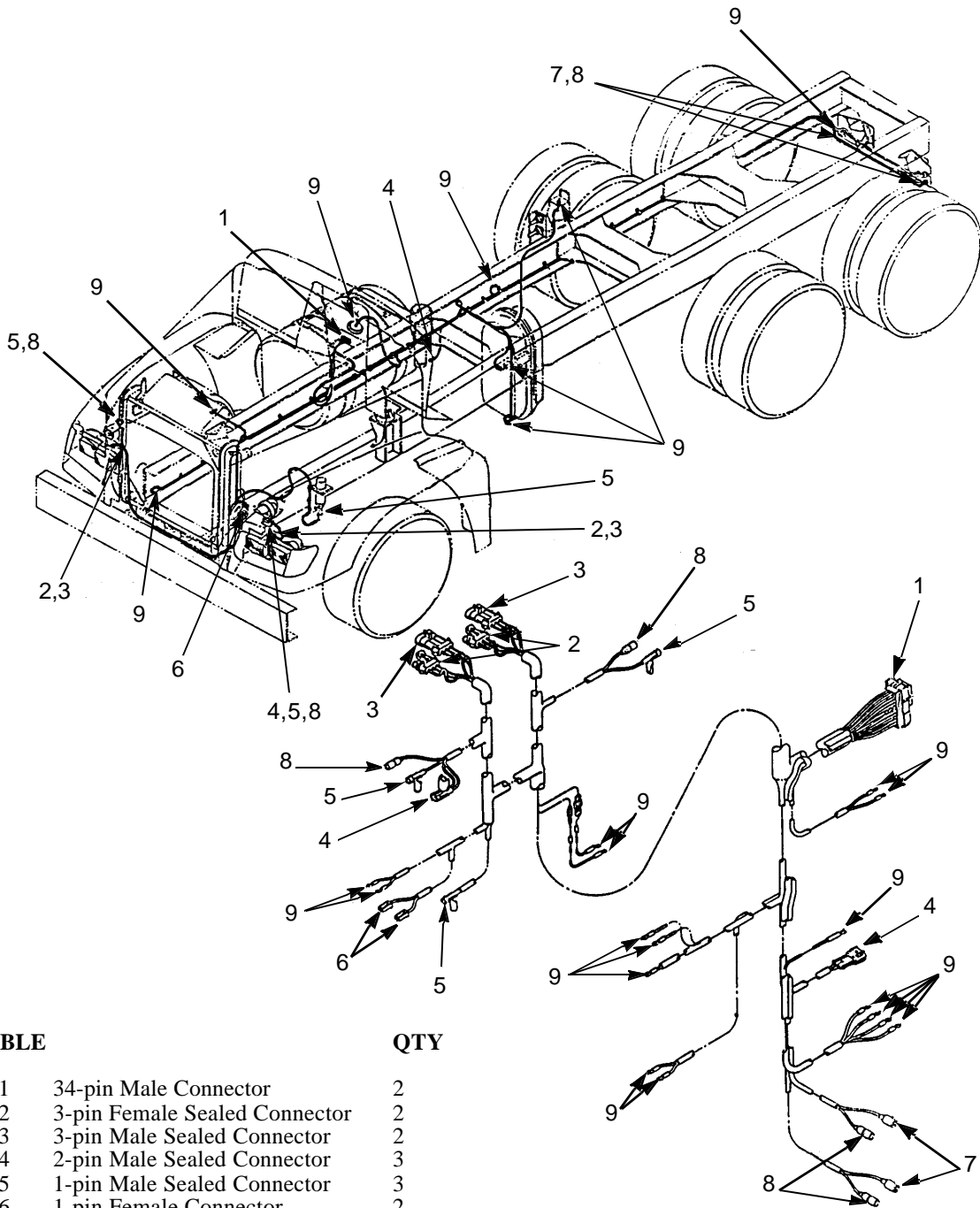
INSTALLATION

NOTE

Wiring harness and leads are secured by clips, new tiedown straps, cushion clamps, and screw terminals. Ensure harness is secure and all hardware is tight.

1. Install, connect, and secure chassis wiring harness, using illustration s a guide.
2. Connect battery cables (TM 9-2320-302-20).

INSTALLATION - CONTINUED



TABLE

		QTY
1	34-pin Male Connector	2
2	3-pin Female Sealed Connector	2
3	3-pin Male Sealed Connector	2
4	2-pin Male Sealed Connector	3
5	1-pin Male Sealed Connector	3
6	1-pin Female Connector	2
7	Male Cable Connector	2
8	Female Cable Connector	4
9	Ring Terminal	17

342-552

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

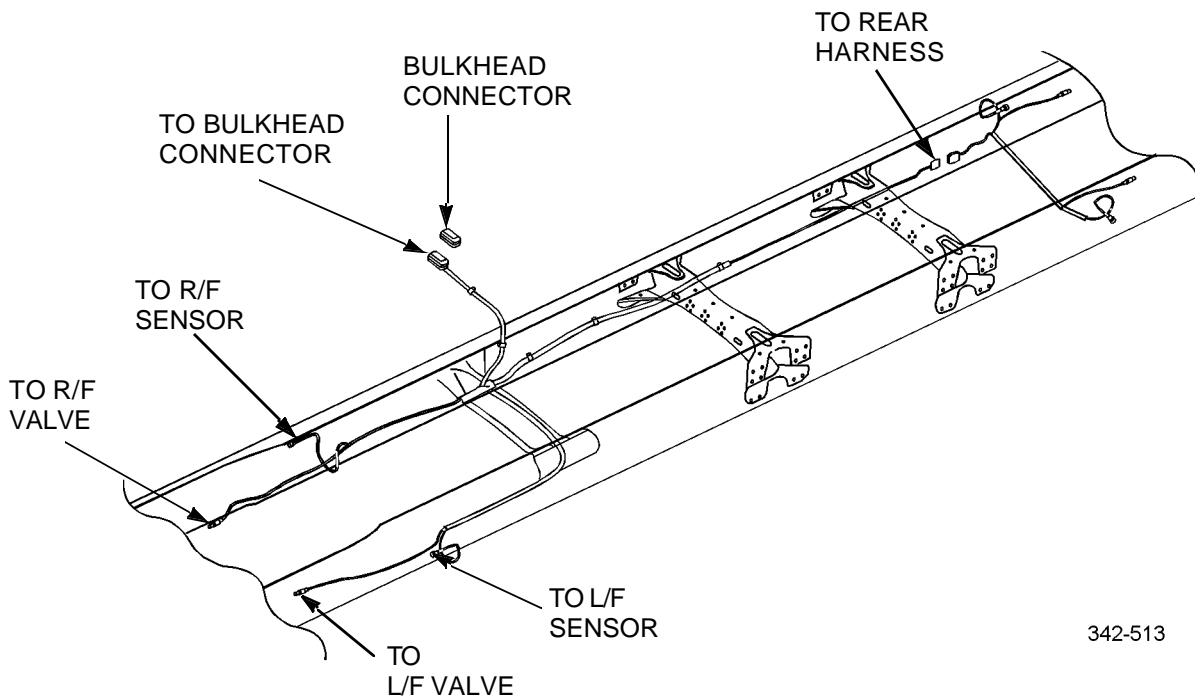
Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

REMOVAL

NOTE

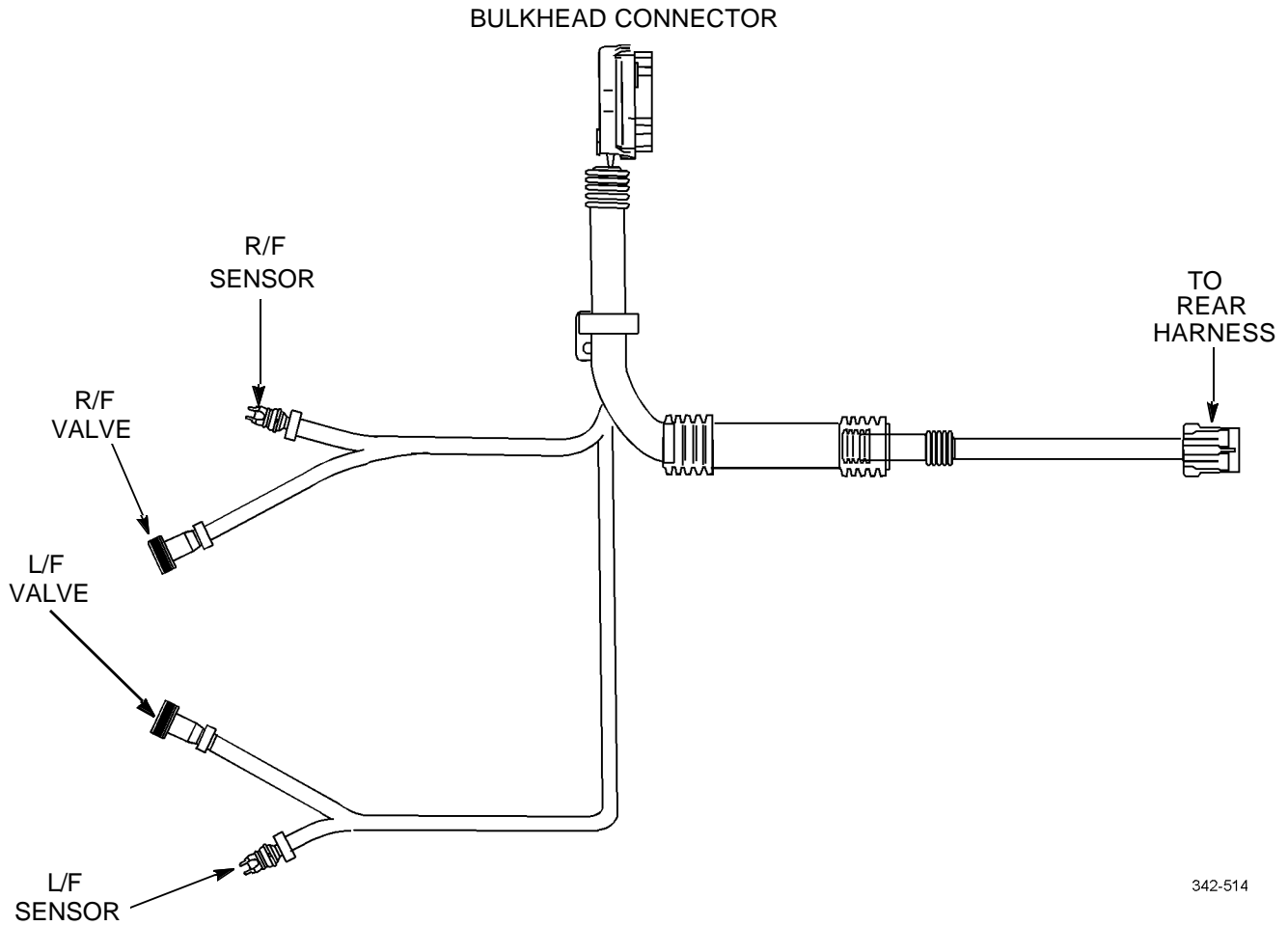
- Note number and location of tiedown straps to aid in installation.
 - Tag wiring harness and leads prior to removal to aid installation.
1. Remove tiedown straps securing front ABS wiring harness. Discard tiedown straps.
 2. Disconnect front ABS wiring harness connections, using illustration as a guide.



342-513

INSTALLATION

1. Connect front ABS wiring harness connections, using illustration as a guide.
2. Install same number of new tiedown straps as were removed, to secure front ABS wiring harness.



342-514

3. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

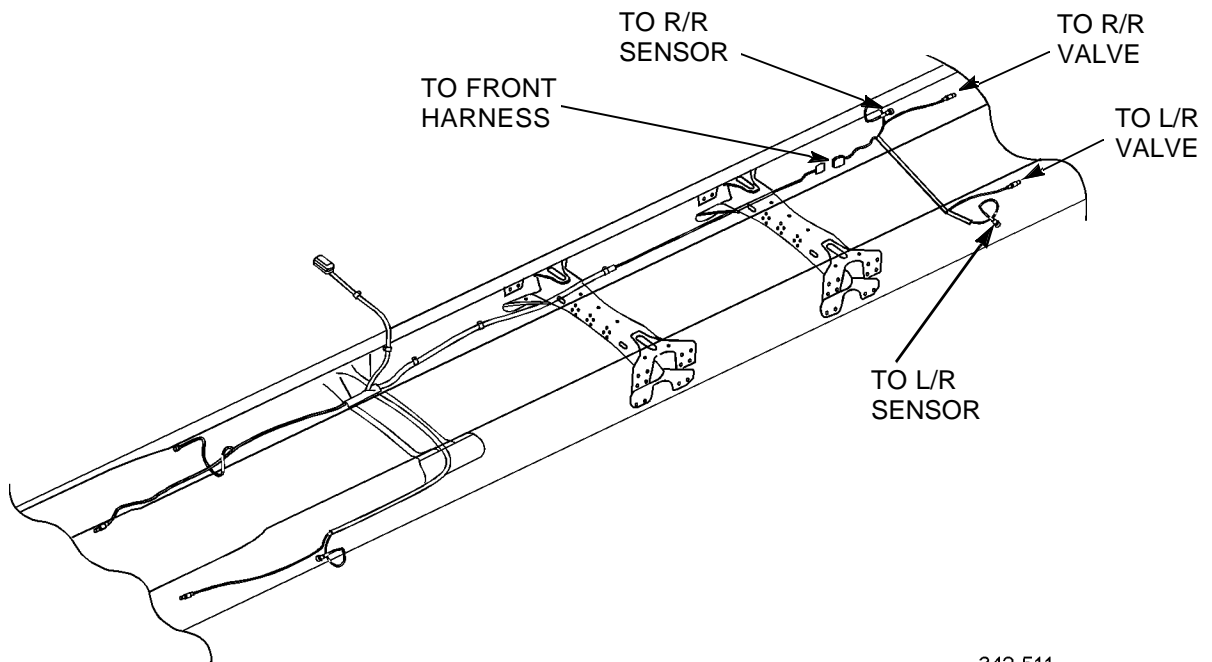
Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

REMOVAL

NOTE

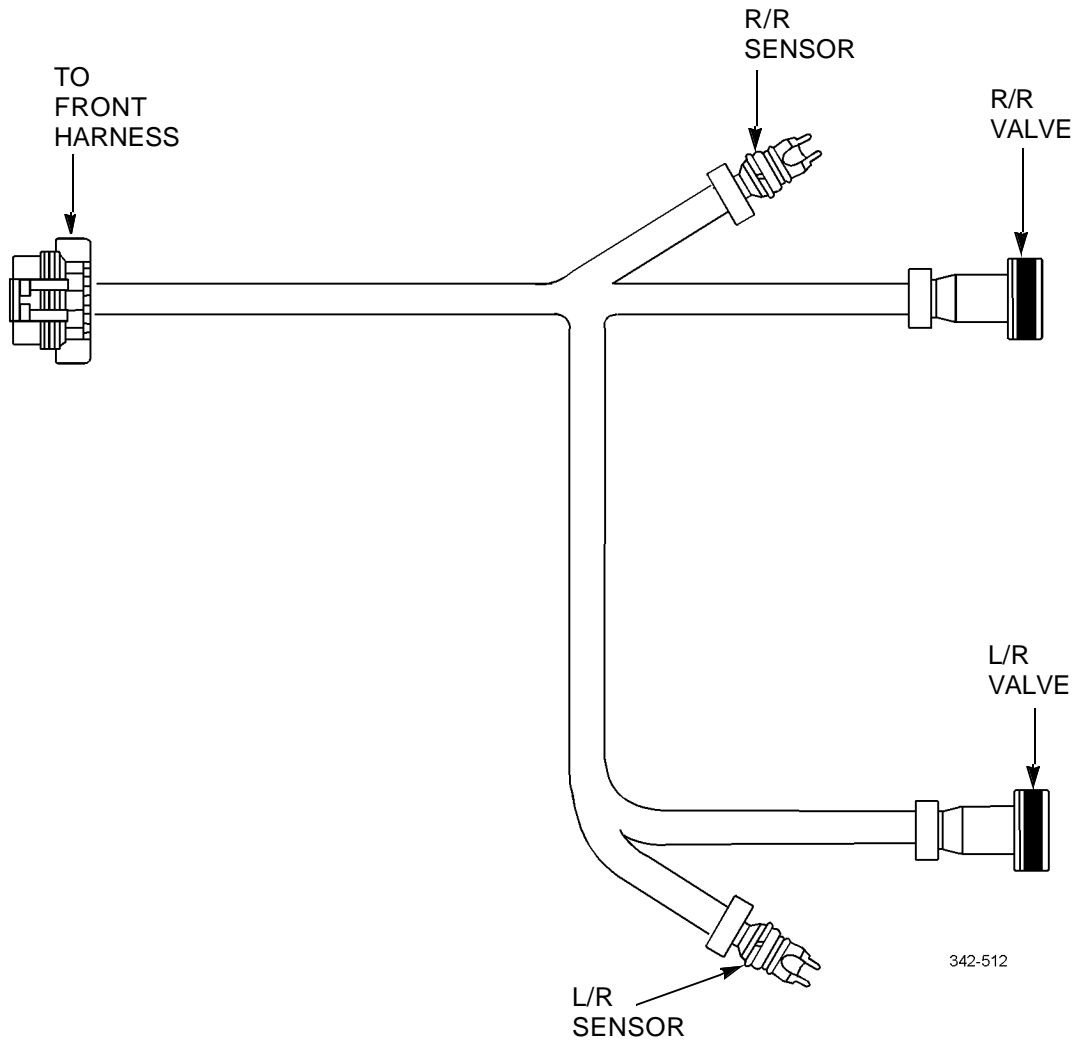
- Note number and location of tiedown straps to aid in installation.
 - Tag wiring harness and leads prior to removal to aid in installation.
1. Remove tiedown straps securing rear ABS wiring harness. Discard tiedown straps.
 2. Disconnect rear ABS wiring harness connections, using illustration as a guide.



342-511

INSTALLATION

1. Connect rear ABS wiring harness connections, using illustration as a guide.
2. Install same number of new tiedown straps as were removed, to secure rear ABS wiring harness.



3. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

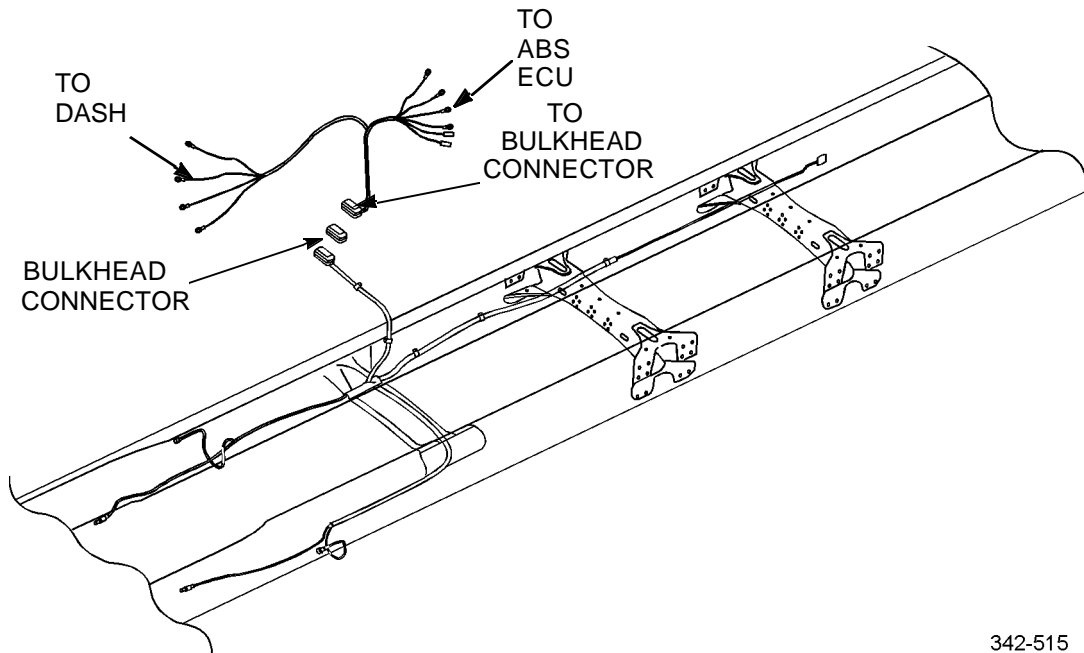
Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

REMOVAL

NOTE

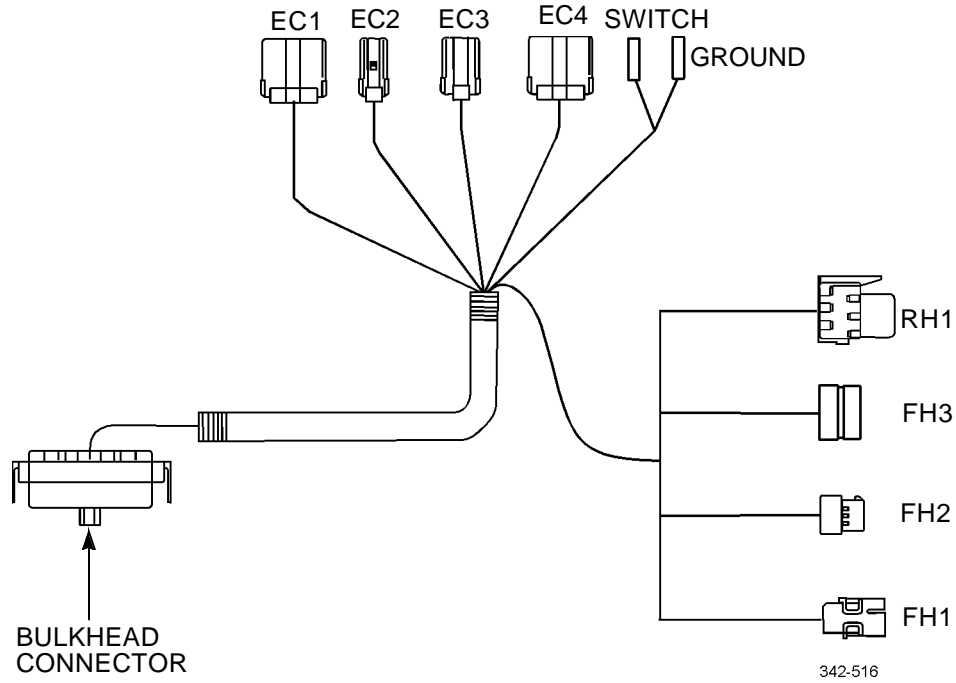
- Note number and location of tiedown straps to aid in installation.
 - Tag wiring harness and leads prior to removal to aid in installation.
1. Remove tiedown straps securing cab ABS wiring harness. Discard tiedown straps.
 2. Disconnect ABS wiring harness connections, using illustration as a guide.



342-515

INSTALLATION

1. Connect ABS wiring harness connections, using illustration as a guide.
2. Install same number of new tiedown straps as were removed, to secure cab ABS wiring harness.



3. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

COLLISION WARNING SYSTEM (CWS) WIRING HARNESS REPLACEMENT

0066 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

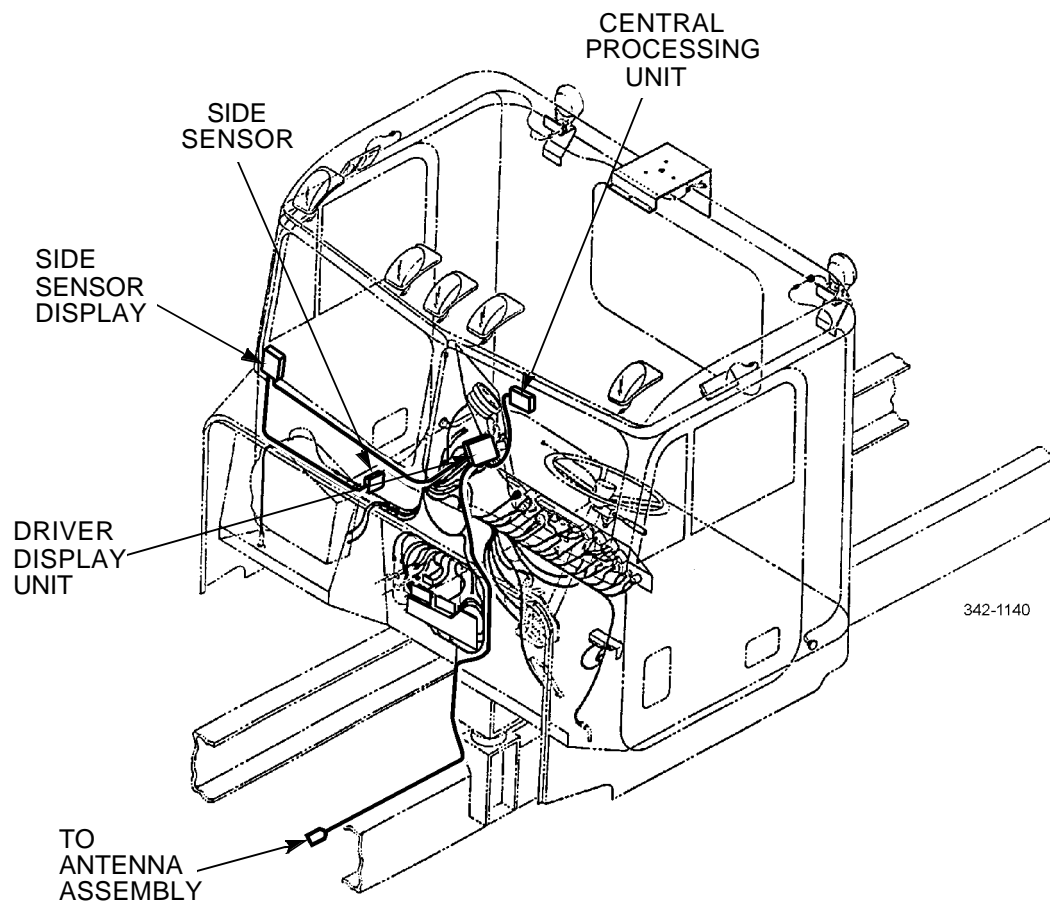
REMOVAL

NOTE

- Wiring harness and leads are secured in place by clips, tiedown straps, cushion clamps and screw terminals. Only remove hardware securing harness or lead to be removed.
- Tag wiring harness and leads prior to removal to aid in installation.

REMOVAL - CONTINUED

Disconnect and remove CWS wiring harness, using illustration as a guide.

**INSTALLATION****NOTE**

Wiring harness and leads are secured in place by clips, new tiedown straps, cushion clamps and screw terminals. Ensure harness is secure and all hardware is tight.

1. Install, connect, and secure CWS wiring harness, using illustration as a guide.
2. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

TAILLIGHT WIRING HARNESS REPLACEMENT

0067 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

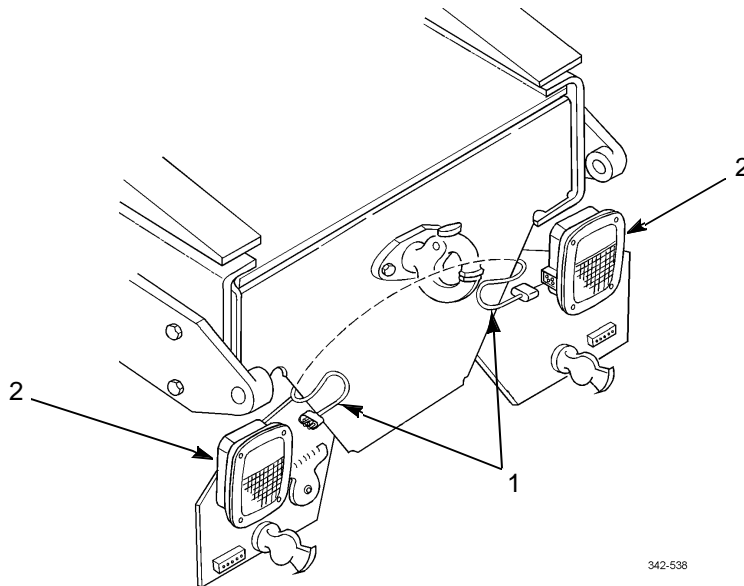
Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

REMOVAL**NOTE**

Note number and location of tiedown straps to aid in installation.

1. Remove tiedown straps securing taillight wiring harness (1). Discard tiedown straps.
2. Disconnect taillight wiring harness (1) from each taillight (2).

**INSTALLATION**

1. Connect taillight wiring harness (1) to each taillight (2).
2. Install same number of new tiedown straps as were removed, to secure taillight wiring harness (1).
3. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

References

TM 9-2320-302-20

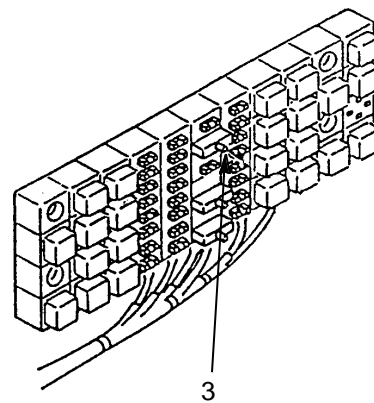
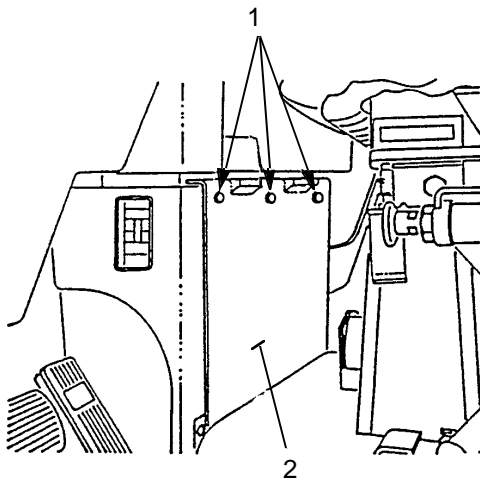
Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

REMOVAL**NOTE**

Tag wiring harness and leads prior to removal to aid in installation.

1. Unlock three fasteners (1) by turning counterclockwise and remove access panel (2).
2. Remove fuse, relay, and circuit breaker holder (TM 9-2320-302-20).
3. Locate circuit 98A on circuit breaker panel (3) and disconnect wiring harness connector from panel.

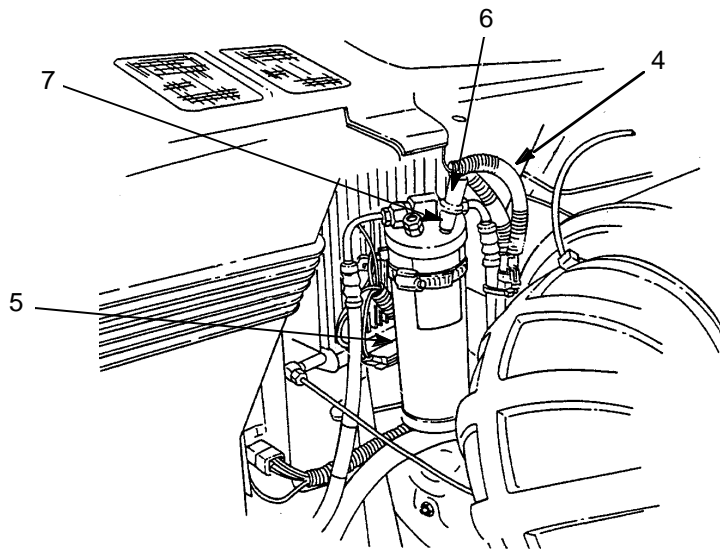


342-541

REMOVAL - CONTINUED**NOTE**

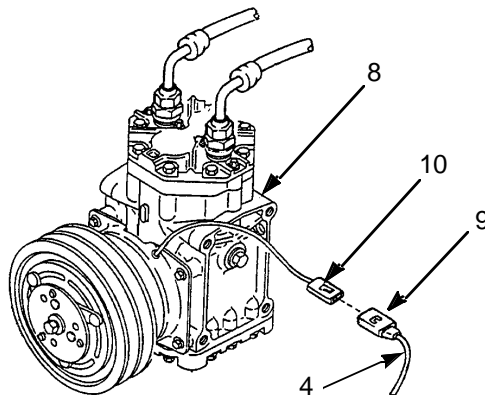
Note number and location of tiedown straps to aid in installation.

4. Trace wiring harness (4) from circuit breaker panel to firewall, removing and discarding tiedown straps.
5. Remove grommet from firewall and feed wiring harness (4) into engine compartment.
6. Trace wiring harness (4) to receiver-drier (5), removing and discarding tiedown straps.
7. Disconnect wiring harness connector (6) from binary switch (7) on receiver-drier (5).



342-542

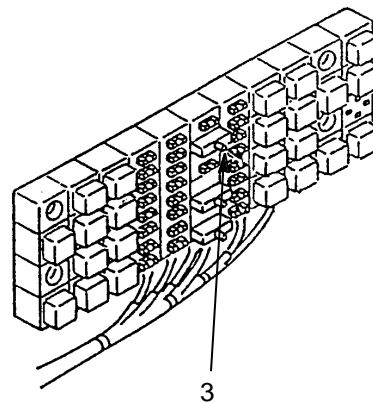
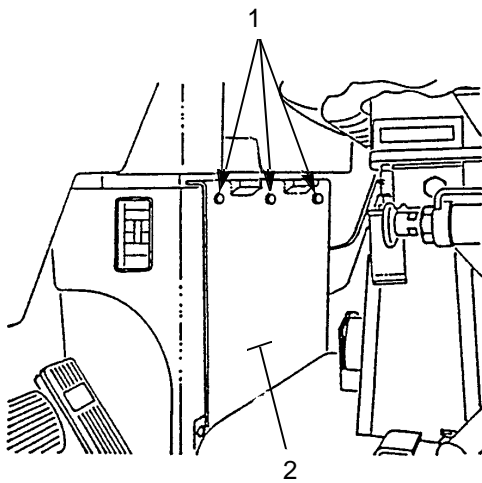
8. Trace wiring harness (4) to compressor (8), removing and discarding tiedown straps.
9. Disconnect wiring harness connector (9) from compressor wiring harness connector (10).



342-543

INSTALLATION

1. Connect wiring harness connector (6) to binary switch (7) on receiver-drier (5).
2. Route one branch of wiring harness (4) to compressor (8), installing new tiedown straps in same place as removed.
3. Connect wiring harness connector (9) to compressor wiring harness connector (10).
4. Install grommet on branch of wiring harness (4) leading to circuit breaker panel (3) inside cab. Route harness through firewall to circuit 98A on circuit breaker panel.
5. Install grommet into firewall and secure wiring harness (4) by installing new tiedown straps in same place as removed.
6. Connect wiring harness connector to circuit 98A on circuit breaker panel (3).



342-541

7. Install fuse, relay, and circuit breaker panel (TM 9-2320-302-20).
8. Install access panel (2) and lock three fasteners (1) by turning clockwise.
9. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

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ENGINE INJECTOR AND ECM WIRING HARNESES REPLACEMENT

0069 00

THIS WORK PACKAGE COVERS

Engine Injector Wiring Harness Removal, Engine Injector Wiring Harness Installation, ECM Wiring Harness Removal, ECM Wiring Harness Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Torque, wrench, 0-300 lb-in (Item 137, WP 0126 00)

Materials/Parts

Straps, tiedown (Item 34, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

Battery cables disconnected (TM 9-2320-302-20)

CAUTION

Grasp connector and terminal body when removing or installing wiring harness connectors. Do not pull on wires or harness to prevent damage to equipment.

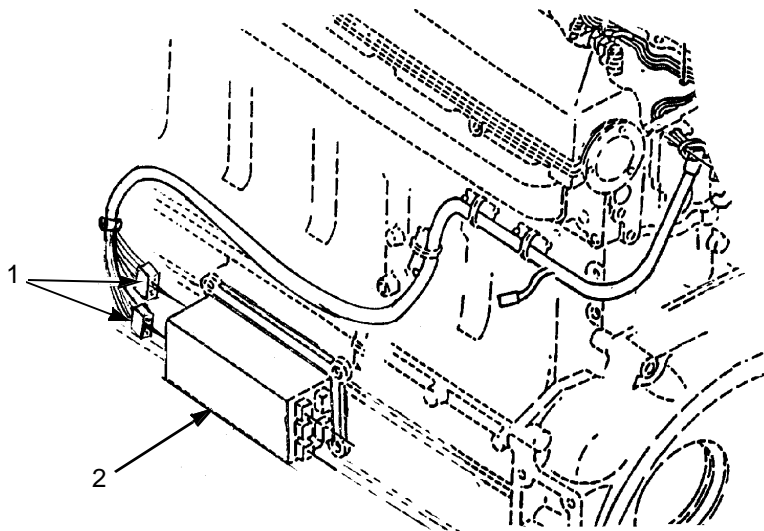
ENGINE INJECTOR WIRING HARNESS REMOVAL

NOTE

- Engine injector wiring harness connectors are top and bottom connectors at front of electronic control module. Do not remove center outboard connector.
 - Ensure all wires are tagged before removal as an aid to installation.
1. Remove rocker arm cover (WP0016 00).

ENGINE INJECTOR WIRING HARNESS REMOVAL - CONTINUED

2. Disconnect locking tangs on two engine injector wiring harness connectors (1) at front of Electronic Control Module (ECM) (2) and disconnect connectors from top and bottom outboard connectors of ECM.



342-1185

3. Remove two screws (3) and harness protector (4) from harness plate (5) at rear of cylinder head (6).
4. Disconnect harness leads (7) from three engine retarder solenoid terminals (8).

NOTE

Do not remove terminal screws from injector. Loosen terminal screws only enough to allow terminal to be disconnected.

5. Loosen terminal screws (9) on each injector and remove terminals (10).
6. Remove guide clip (11) in rear corner drain hole of cylinder head (6).

NOTE

Carefully feed wires and terminals through hole at rear of cylinder head

7. Remove engine injector wiring harness (12).

ENGINE INJECTOR WIRING HARNESS INSTALLATION**NOTE**

When installed correctly, all connectors should reach terminals without strain or repositioning of injector wire.

1. Feed engine injector wiring harness (12) into cylinder head (6) through hole at rear of cylinder head.
2. Position leads of engine injector wiring harness (12) in cylinder head (6) so that wires follow inside rail of cylinder head on oil cooler side of engine under engine retarder assembly.

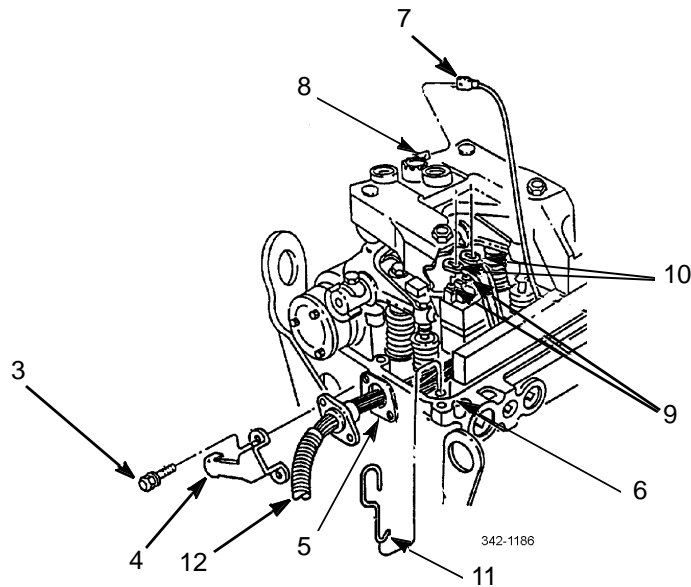
ENGINE INJECTOR WIRING HARNESS INSTALLATION - CONTINUED

3. Begin with two longest leads and install terminals (10) over terminal screws (9) on front injector. Tighten screws to 12-17 lb-in (1.25-1.92 Nm).
4. Perform procedure in step 3 for remaining injector leads.
5. Install harness lead (7) on engine retarder solenoid terminal (8).
6. Perform procedure in step 5 for remaining engine retarder solenoid terminals.
7. Install harness plate (5) and harness protector (4) on engine injector wiring harness (12) and secure to cylinder head (6) with two screws (3). Tighten screws to 84-132 lb-in (10-15 Nm).

NOTE

Ensure wires are against cylinder head rail away from possible contact with exhaust valve spring.

8. Insert guide clip (11) into oil drain hole at rear of cylinder head (6) to retain injector wires in corner away from exhaust valve springs.

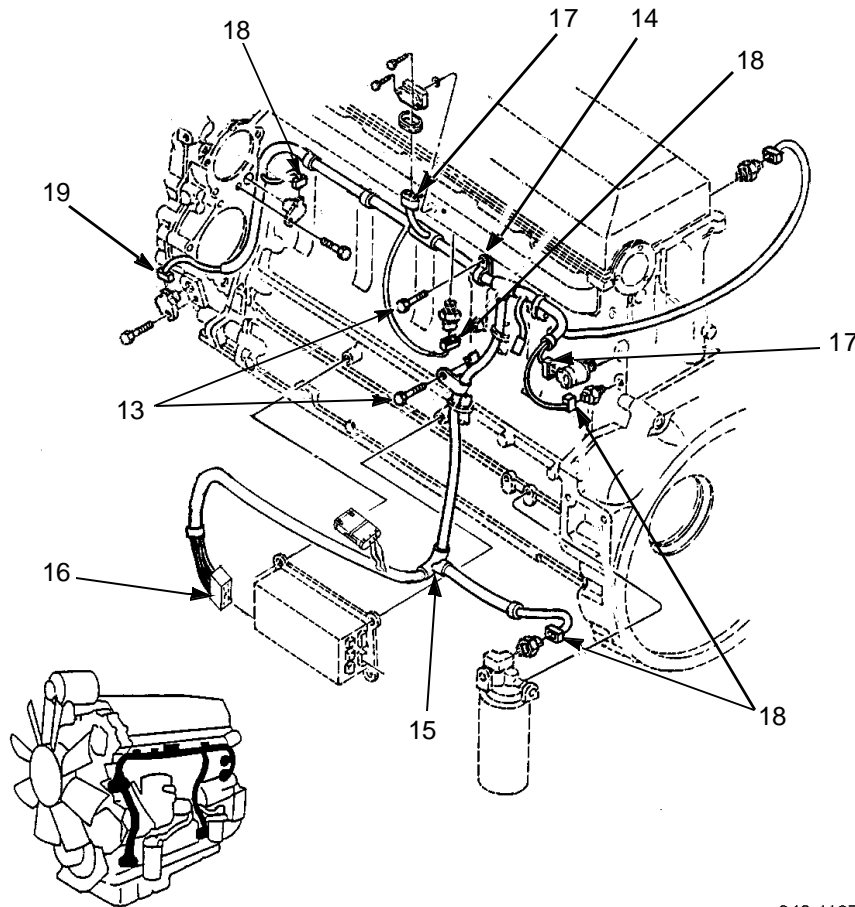


9. Connect two engine injector wiring harness connectors (1) to top and bottom outboard connections on ECM (2). Ensure locking tangs on connectors are engaged.
10. Secure engine injector wiring harness (12) to engine with new tiedown straps as required.
11. Install rocker arm cover (WP0016 00).
12. Connect battery cables (TM 9-2320-302-20).

ECM WIRING HARNESS REMOVAL

NOTE

- Wiring harness and leads are secured in place by cushion clamps, screws, and tiedown straps.
 - Only remove hardware securing harness or lead to be removed.
 - Tag all wires prior to removal to aid in installation.
1. Remove screws (13) and clamps (14) as necessary to release ECM wiring harness (15) from engine.
 2. Use illustration and table as a guide to disconnect and remove ECM wiring harness (15).



342-1187

Connector Number		Qty
16	30-pin Plug	1
17	3-pin Connector	2
18	2-pin Connector	5
19	Connector	1

ECM WIRING HARNESS INSTALLATION

1. Install and connect ECM wiring harness, using illustration and table as a guide.
2. Secure ECM wiring harness (15) to engine with clamps (14) and screws (13).

ECM WIRING HARNESS INSTALLATION - CONTINUED

3. Connect battery cables (TM 9-2320-302-20).

END OF WORK PACKAGE

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TRANSMISSION REPLACEMENT

0070 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Barring tool, engine (Item 8, WP 0126 00)
- Lift, transmission (Item 75, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

- Washer, lock (P/N MS35333-43) (12)

Personnel Required

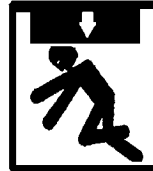
Two

Equipment Condition

- Air system drained (TM 9-2320-302-10)
- Spare tire removed (TM 9-2320-302-10)
- Transmission fluid drained (TM 9-2320-302-20)
- Driveline removed (TM 9-2320-302-20)
- Transmission oil cooler lines disconnected (TM 9-2320-302-20)
- Transmission electrical harness(s) disconnected (TM 9-2320-302-20)
- Transmission tunnel access cover removed (TM 9-2320-302-20)
- Transmission oil fill tube removed (TM 9-2320-302-20)



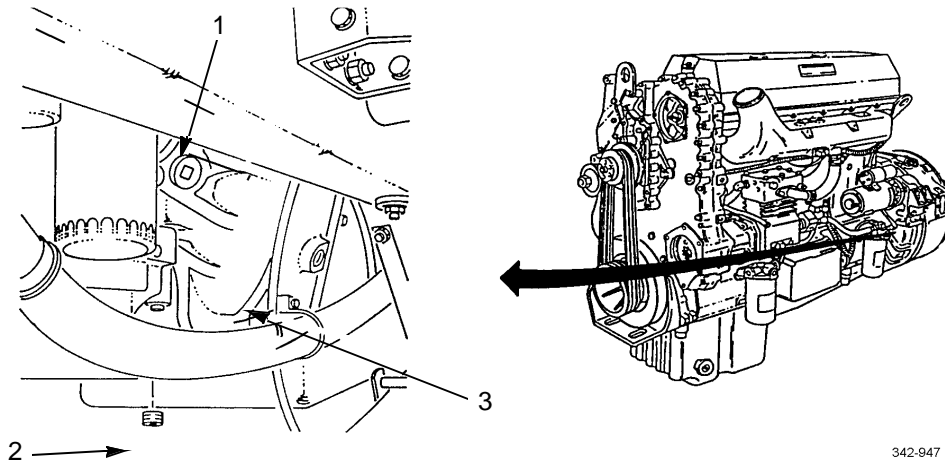
WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL

1. Remove access plug (1) and drain plug (2) from engine flywheel housing (3).



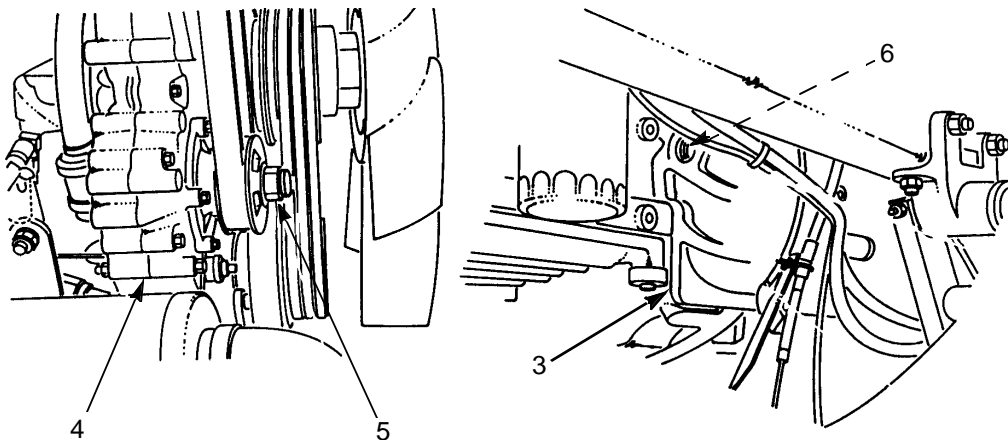
342-947

WARNING

Do not place finger in hole of engine flywheel housing while engine is being barred over. Failure to follow this warning could result in injury.

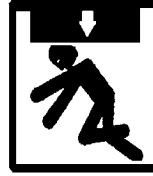
CAUTION

- Step 2 must be followed in barring engine over. Any other method may damage engine.
 - If bolts are dropped in engine flywheel housing, retrieve immediately. Failure to do so could result in damage to equipment.
2. Have an assistant bar engine (4) over using accessory drive (5). Locate and remove bolt (6) through hole in engine flywheel housing (3). Repeat until 12 bolts have been removed.



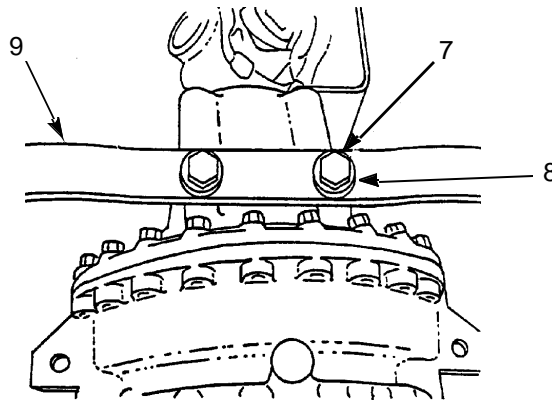
342-1141

REMOVAL - CONTINUED



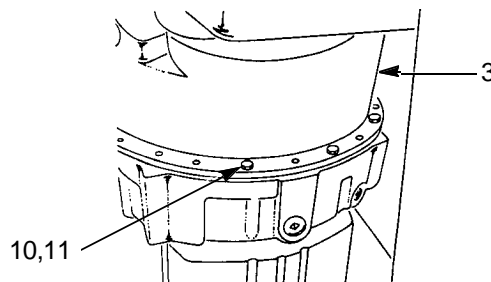
WARNING

- Transmission weighs 900 lb (409 kg). Always support transmission with transmission lift during removal to prevent injury to personnel.
 - Ensure transmission is properly positioned and secure on transmission lift, to prevent injury to personnel or damage to equipment.
3. Position transmission lift directly under transmission and centered. Raise lift into position, but do not attempt to lift transmission.
 4. Remove two bolts (7), washers (8), and rear support spring (9) from transmission.



342-1142

5. Remove 12 bolts (10) and lock washers (11) securing transmission to engine flywheel housing (3). Discard lock washers.



342-1143

6. With assistance, lower transmission from engine and remove from under vehicle.

INSTALLATION



WARNING



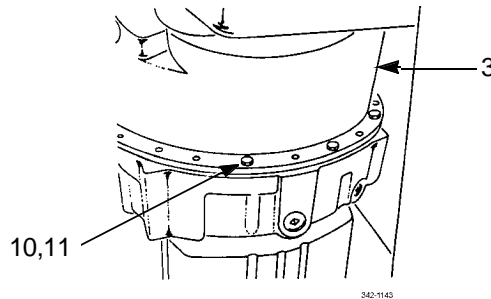
- Transmission weighs 900 lb (409 kg). Always support transmission with transmission lift during installation to prevent injury to personnel.
- Ensure transmission is properly positioned and secure on transmission lift, to prevent injury to personnel or damage to equipment.

1. With assistance, move transmission under vehicle and directly behind engine.

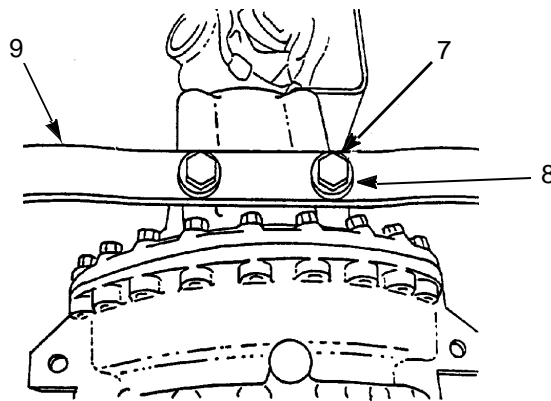
CAUTION

Transmission must be seated squarely against engine flywheel housing to prevent damage to equipment.

2. Lift and position transmission against engine flywheel housing (3).
3. Install 12 new lock washers (11) and bolts (10) to secure transmission to engine flywheel housing (3). Hand tighten bolts.
4. Tighten four transmission mounting bolts 90 degrees apart to 40 lb-ft (54 Nm).
5. Tighten remaining transmission mounting bolts to 40 lb-ft (54 Nm).



6. Install rear support spring (9) on rear of transmission and frame supports with two washers (8) and bolts (7).



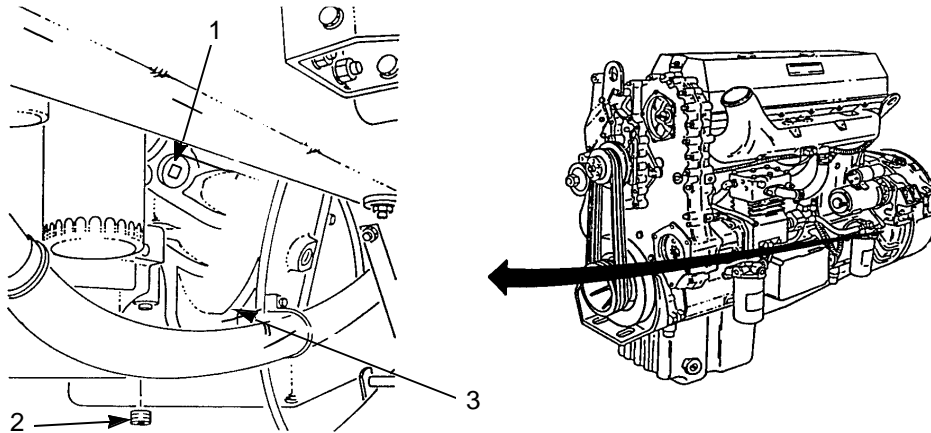
7. Remove transmission lift.

INSTALLATION - CONTINUED

WARNING

Do not place finger in hole of engine flywheel housing while engine is being barred over. Failure to follow this warning could result in injury.

8. Remove access plug (1) and drain plug (2) from engine flywheel housing (3).



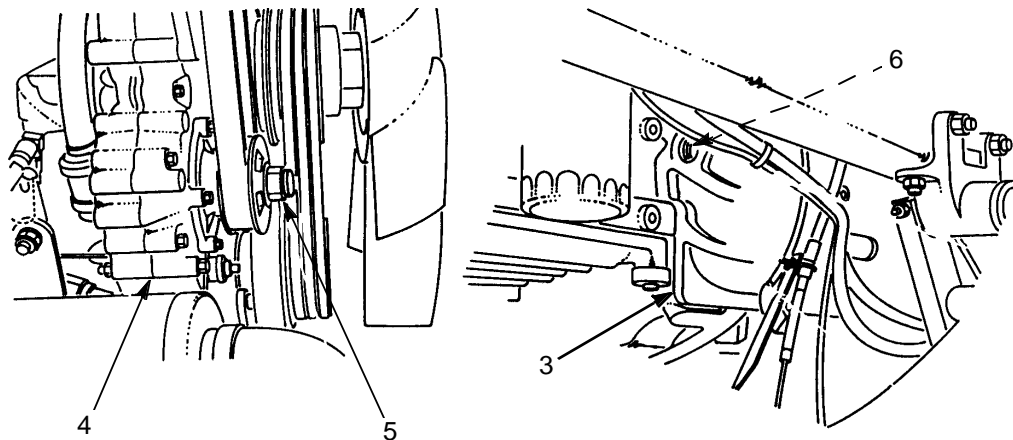
342-947

9. Rotate torque converter to align holes in flex plate with holes in torque converter.

CAUTION

- Step 10 must be followed in barring engine over. Any other method may damage engine.
- If bolts are dropped in engine flywheel housing, retrieve immediately. Failure to do so could result in damage to equipment.

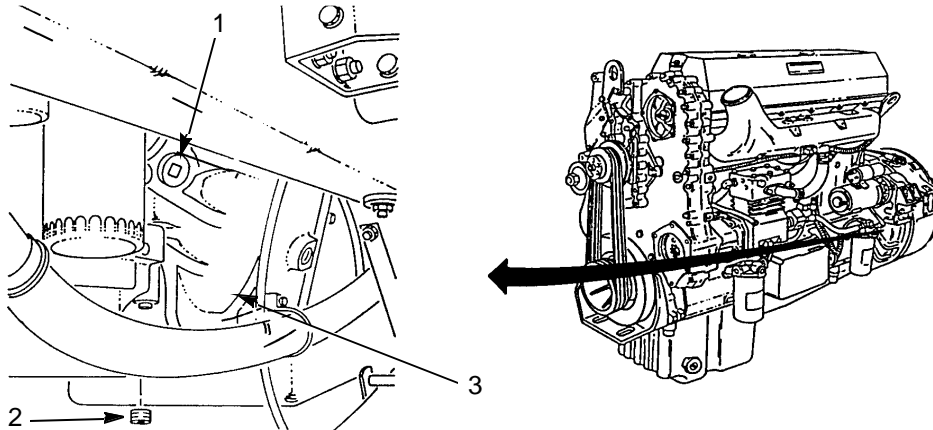
10. Have an assistant bar engine (4) over using accessory drive (5), until placement for bolt (6) has been located through access hole. Install bolt through access hole. Repeat until 12 bolts have been installed.



342-1141

INSTALLATION - CONTINUED

11. Install access plug (1) and drain plug (2) in engine flywheel housing (3).



342-947

12. Install transmission oil fill tube (TM 9-2320-302-20).
13. Connect transmission oil cooler lines (TM 9-2320-302-20).
14. Connect transmission electrical harness(s) (TM 9-2320-302-20).
15. Install driveline (TM 9-2320-302-20).
16. Install transmission access tunnel cover (TM 9-2320-302-20).
17. Refill transmission fluid (TM 9-2320-302-20).
18. Install spare tire (TM 9-2320-302-10).

END OF WORK PACKAGE

TRANSMISSION OVERHAUL

0071 00

THIS WORK PACKAGE COVERS

Disassembly, Module Overhaul, Assembly, Tabulated Data

INITIAL SETUP**Maintenance Level**

General Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Bracket, transmission holding (Item 12, WP 0126 00)

Bracket, transmission holding (Item 13, WP 0126 00)

Caliber, micrometer (Item 15, WP 0126 00)

Compressor, main-pressure relief spring (Item 21, WP 0126 00)

Compressor, spring, C2 (Item 26, WP 0126 00)

Compressor, spring, C5 (Item 27, WP 0126 00)

Gage, micrometer, depth (Item 34, WP 0126 00)

Gage, profile (Item 37, WP 0126 00)

Insertor and remover, spring, C1 (Item 54, WP 0126 00)

Installer, charging pump bushing (Item 57, WP 0126 00)

Installer, front support sleeve (Item 59, WP 0126 00)

Installer, output bearing (Item 60, WP 0126 00)

Installer, output bearing cup (Item 61, WP 0126 00)

Installer, bearing retainer bushing (Item 63, WP 0126 00)

Installer, rotating clutch bushing (Item 64, WP 0126 00)

Installer, seal, input (Item 65, WP 0126 00)

Installer, seal, output (Item 66, WP 0126 00)

Installer, torque converter cover bushing (Item 67, WP 0126 00)

Tools and Special Tools - Continued

Installer, carrier bushing (Item 68, WP 0126 00)

Installer, wear plate (Item 71, WP 0126 00)

Lifting, bracket, flywheel (Item 77, WP 0126 00)

Press, arbor (Item 90, WP 0126 00)

Puller kit, universal (Item 96, WP 0126 00)

Remover, wheel bearing cup (Item 105, WP 0126 00)

Remover/installer, main-pressure spring (Item 106, WP 0126 00)

Test block, pressure switch (Item 121, WP 0126 00)

Tool, torque converter bolt (Item 129, WP 0126 00)

Tool base, spring compressor (Item 130, WP 0126 00)

Tool set, spanner nut (Item 133, WP 0126 00)

Tray set, valve body parts (Item 134, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Converter housing kit (P/N 29524152)

Filter kit (P/N 29526899)

Seal and gasket kit (P/N 29518437)

Seal and gasket kit (P/N 29518442)

Shim kit, torque converter (P/N 29503828)

Oil, lubricating (Item 25, WP 0125 00)

Petrolatum, technical (Item 29, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Personnel Required

Two

Equipment Condition

Transmission installed on maintenance stand

Engine, turbine, and output speed sensors removed (TM 9-2320-302-20)

DISASSEMBLY



WARNING



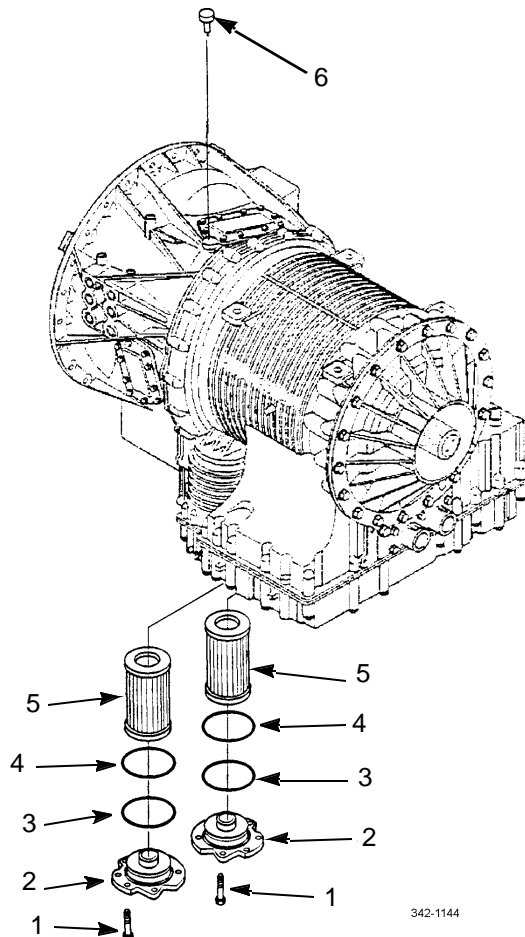
Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

NOTE

Confirm transmission has been drained prior to disassembly.

Removal of Filters and Breather

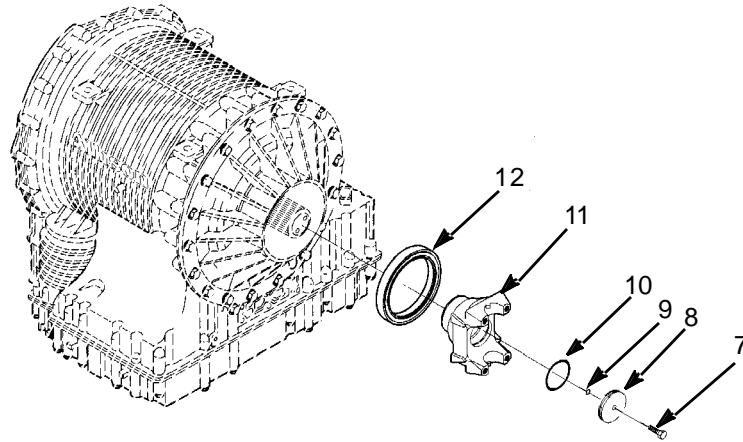
1. Remove 12 bolts (1), two filter covers (2), o-rings (3), square cut seals (4), and filters (5). Discard o-rings, seals, and filters.
2. Remove transmission breather vent (6) from torque converter housing.



342-1144

DISASSEMBLY - CONTINUED**Removal of Output Shaft and Oil Seal**

1. Remove bolt (7), retainer plug (8), and o-rings (9 and 10) from output shaft yoke (11). Discard o-rings.
2. Remove oil seal (12) using puller (J24171-A). Discard oil seal.



342-1145

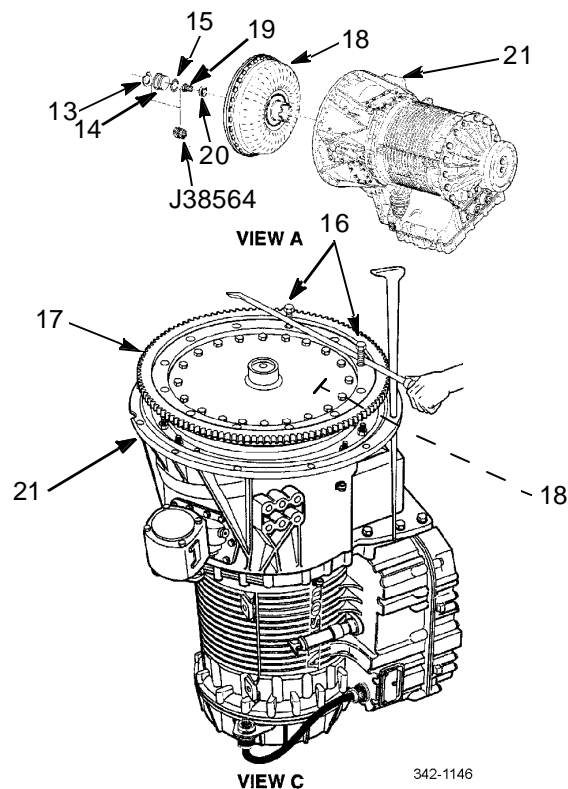
DISASSEMBLY - CONTINUED**Removal of Torque Converter Module**

1. Remove bolts securing torque converter shipping brackets(s). Remove bracket(s).
2. Remove retaining ring (13) securing torque converter plug (14).
3. Using an M6x30-1 bolt threaded into torque converter plug (14), remove torque converter plug and o-ring (15). Discard o-ring.
4. Install two bolts (16) into flexplate adapter (17). Use two bars at an angle to prevent rotation of torque converter (18).

NOTE

While attempting to remove torque converter center bolt, converter will rotate. Follow procedure in step 5 to hold converter stationary.

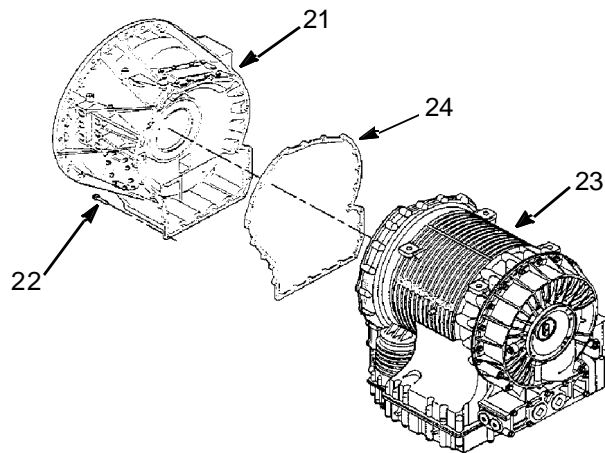
5. Remove converter center bolt (19), using bolt tool (J38564).
6. Remove and tag shim(s) (20).
7. Remove torque converter holding bars and bolts (16).
8. Attach a suitable lifting sling to flexplate adapter (17) by positioning adapter connections equal distances apart from each other.
9. Using a suitable hoist, remove torque converter (18) from torque converter housing (21). Place torque converter on a work bench supported by two wooden blocks.



342-1146

DISASSEMBLY - CONTINUED**Removal of Torque Converter Housing Module**

1. Remove seven bolts (22), from inside of torque converter housing (21), that secure converter housing to main housing (23). Remove remaining 18 bolts from outside of housing.
2. Attach suitable lifting sling and hoist to torque converter housing (21).
3. Remove torque converter housing (21) and gasket (24) from main housing (23). Discard gasket.



342-1147

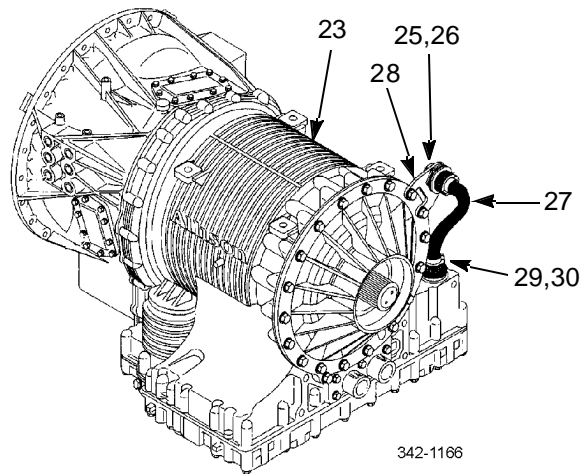
DISASSEMBLY - CONTINUED

Removal of Control Valve Module

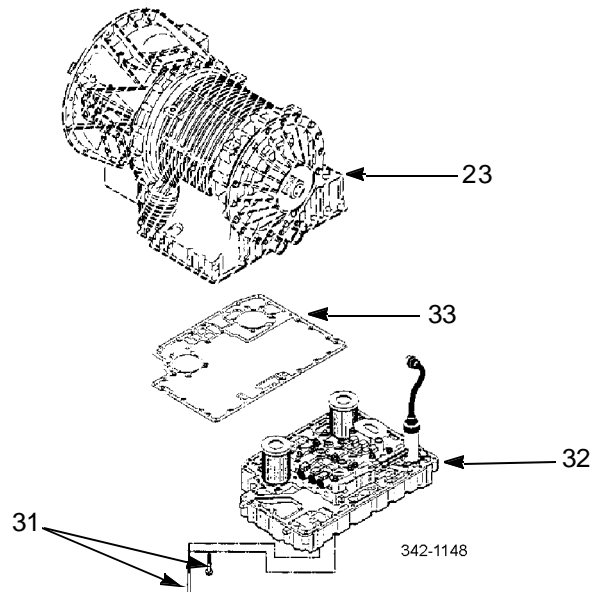
NOTE

Control module and filters may contain residual transmission fluid.

1. Remove retaining nut (25) and lock washer (26) securing feed-through harness (27) to mounting bracket (28). Do not discard lock washer unless damaged.
2. Remove retaining nut (29) and lock washer (30) securing feed-through harness (27) to main housing (23). Do not discard lock washer unless damaged.

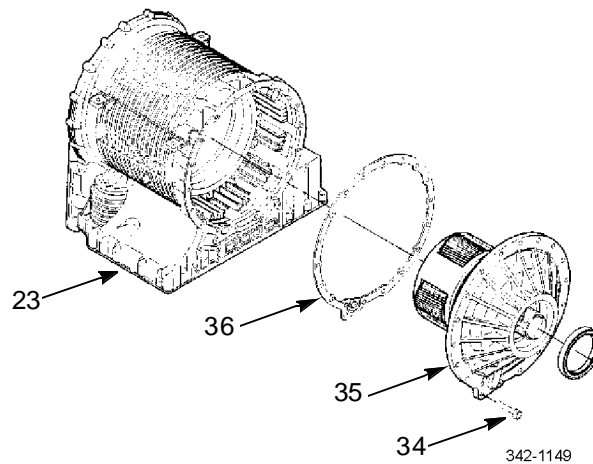


3. Remove 43 bolts (31) securing control module (32) to main housing (23).
4. Loosen control module (32) from main housing (23) by installing jacking screws into control module bolt holes that bottom out against main housing.
5. Remove control module (32) and gasket (33) from main housing (23). Discard gasket.

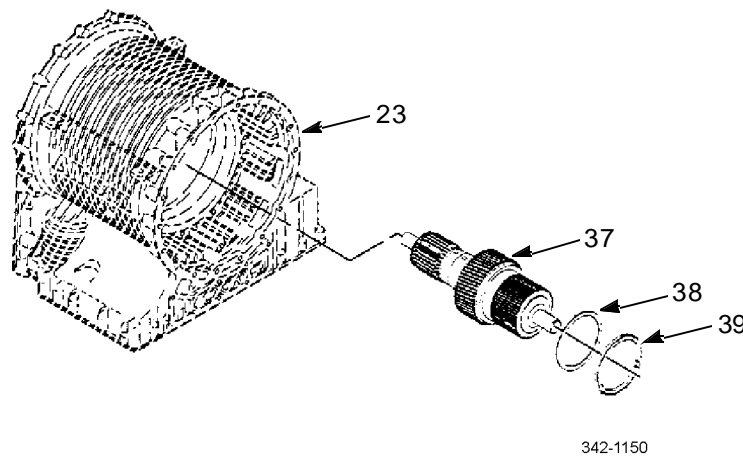


DISASSEMBLY - CONTINUED**Removal of Rear Cover Module**

1. Remove 19 bolts (34) securing rear cover module (35) to main housing (23).
2. Remove rear cover module (35) and gasket (36) from main housing (23). Discard gasket.

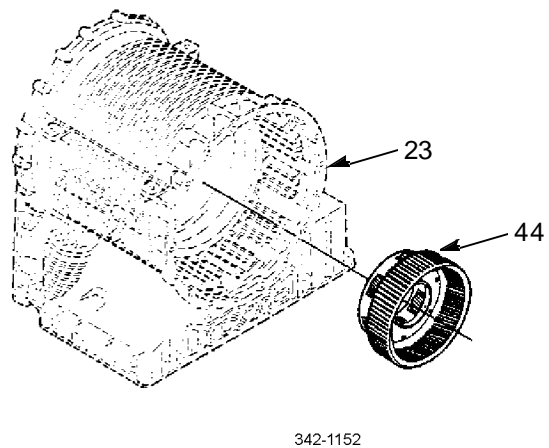
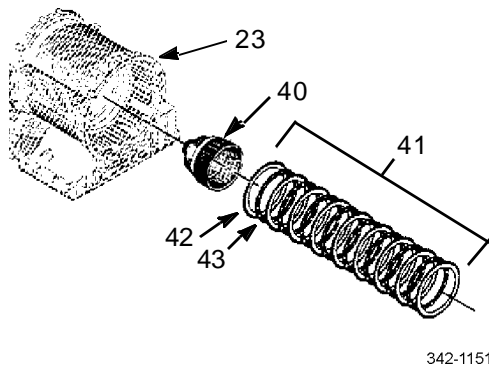
**Removal of Main Shaft Module**

Remove main shaft module assembly (37) with thrust bearing (38) and selective shim (39) from main housing (23). Tag thrust bearing and shim to aid in assembly and identification.



DISASSEMBLY - CONTINUED**Removal of P2 Planetary Module, C5 Clutch Pack, and P1 Planetary Module**

1. Lift P2 planetary module (40) from main housing (23).
2. Lift C5 clutch pack (41), containing eight friction plates (42) and nine steel reaction plates (43), from main housing (23).
3. Measure, tag, and note thickness and cone of each friction plate (42). Minimum thickness is 0.137 in (3.48 mm). Maximum allowable cone is 0.010 in (0.25 mm).
4. Measure, tag, and note thickness and cone of each steel reaction plate (43). Minimum thickness is 0.095 in (2.41 mm). Maximum allowable cone is 0.010 in (0.25 mm).
5. Lift P1 planetary module (44) from main housing (23).

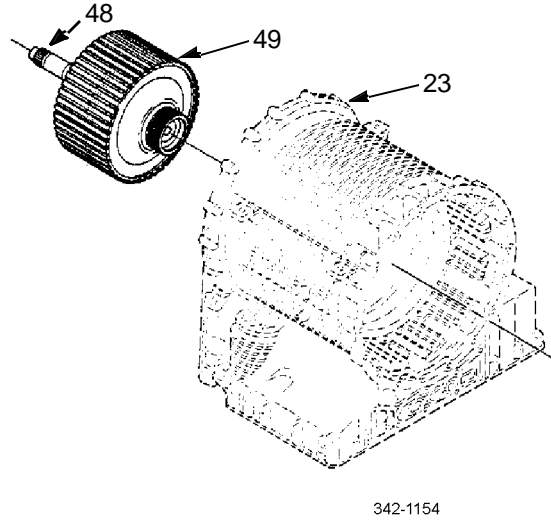
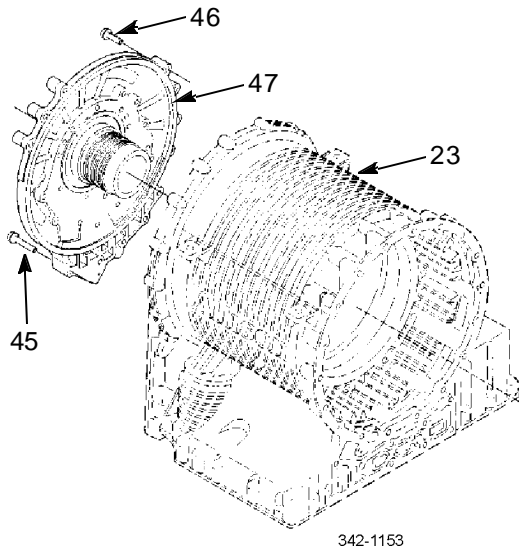
**Removal of Front Support and Charging Pump Module and Rotating Clutch Module****NOTE**

Note size and position of 14 bolts securing front support and charging pump module to main housing, to aid during assembly.

1. Remove seven bolts (45) and seven bolts (46) securing front support and charging pump module (47) to main housing (23).
2. Lift front support and charging pump module (47) from main housing (23).
3. Install an M16 lifting eye bolt into turbine shaft (48). Attach a suitable hoist to lifting eye.
4. Using hoist, remove turbine shaft (48) and rotating clutch module (49) from main housing (23).

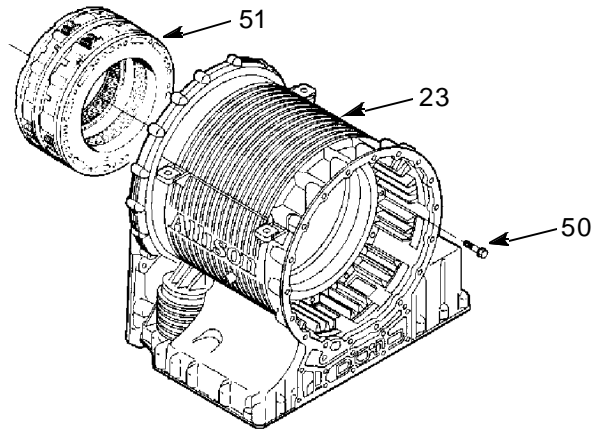
DISASSEMBLY - CONTINUED

Removal of Front Support and Charging Pump Module and Rotating Clutch Module - Continued



Removal of C3/C4 Clutch Assembly

1. Remove 14 bolts (50) securing C3/C4 clutch assembly (51) in main housing (23).
2. Remove C3/C4 clutch assembly (51) by sliding it out of input end of housing.
3. Inspect and measure C5 clutch plate splines inside main housing for wear. Maximum wear allowed is 0.045 in (1.15 mm).



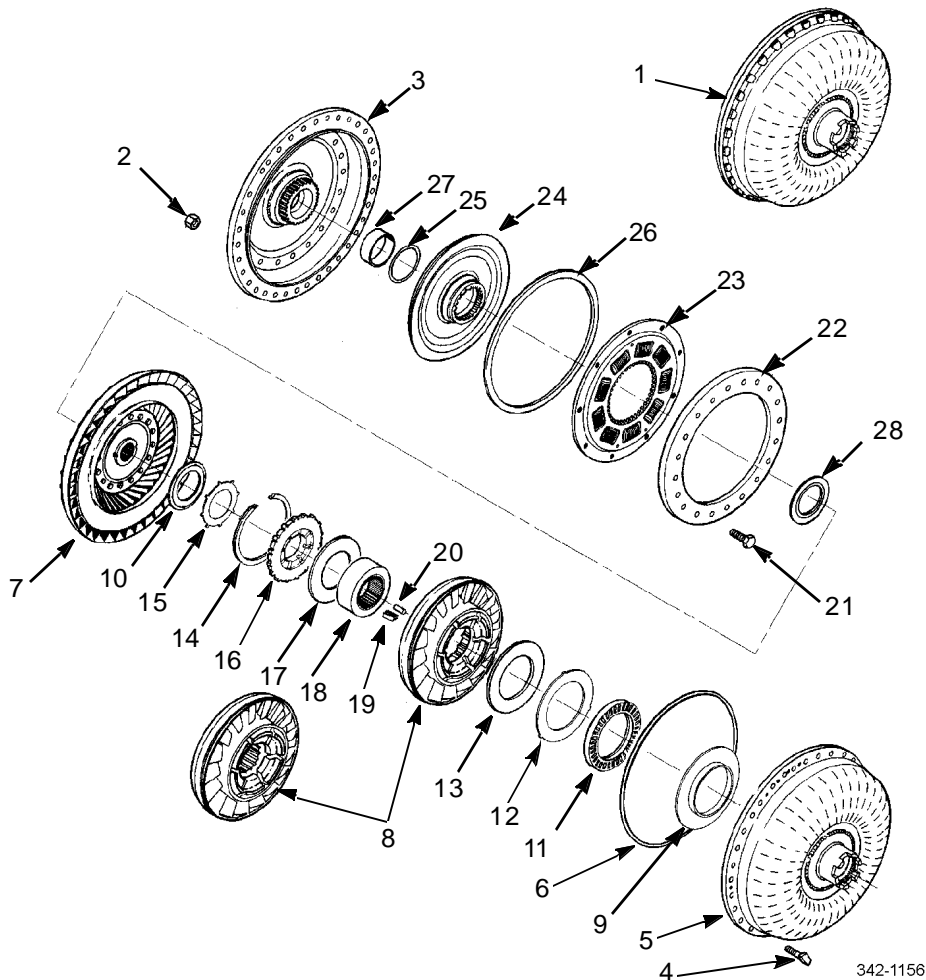
MODULE OVERHAUL

Torque Converter Module Disassembly

NOTE

Prior to disassembling torque converter, note balance marks or mark a line across converter cover to pump assembly with a scribe. These marks will ensure correct assembly of torque converter and reduce balance problems.

1. Place converter assembly (1) on a flat work surface with pump drive tangs downward.
2. Remove 36 nuts (2) from outer diameter of cover assembly (3).
3. Remove 36 T-headed bolts (4) from outer diameter of pump assembly (5).
4. Carefully, without prying, remove cover assembly (3) from pump assembly (5).
5. Remove and discard o-ring (6) from between converter assembly halves.
6. Remove turbine assembly (7) from cover assembly (3).
7. Remove stator assembly (8) from pump assembly (5).
8. Remove thrust bearing race (9) from pump assembly (5).
9. Remove thrust bearing assembly (10) from turbine assembly (7).
10. Remove bearing assembly (11), race (12), and selective shim (13) from pump assembly (5).
11. Remove retaining ring (14) and star plate (15) from stator assembly (8).



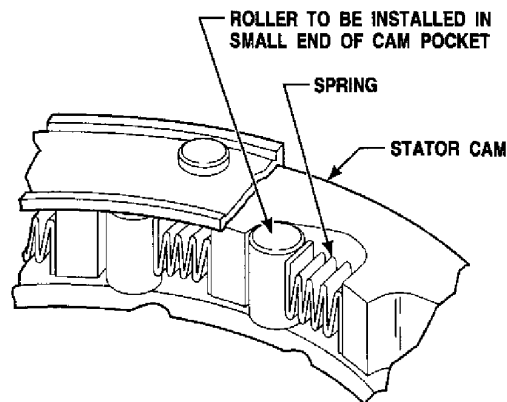
342-1156

MODULE OVERHAUL - CONTINUED**Torque Converter Module Disassembly - Continued**

12. Remove thrust plate (16) from stator assembly (8). Measure, note, and tag thrust plate. Minimum thickness allowed is 0.372 in (9.45 mm).
13. Remove thrust washer (17) from stator assembly (8).
14. Remove stator race (18), 13 springs (19), and rollers (20). Inspect components for damage.
15. Remove 44 bolts (21) securing lockup clutch backup plate (22) to cover assembly (3). Remove backup plate from cover.
16. Measure thickness of backup plate wear surface. Minimum thickness allowed is 0.464 in (11.79 mm). Check for backup plate distortion. Maximum distortion allowed is 0.006 in (0.15 mm).
17. Remove lockup clutch damper assembly (23) from cover assembly (3). Perform the following measurements.
 - a. Lockup clutch thickness: minimum thickness allowed is 0.335 in (8.51 mm).
 - b. Lockup clutch distortion: maximum allowable distortion is 0.020 in (0.51 mm).
 - c. Spline wear check: measure between turbine and lockup clutch damper. Maximum allowable wear is 0.015 in (0.38 mm) on either spline.
18. Remove lockup clutch piston (24), inner seal ring (25), and outer seal ring (26) from cover assembly (3). Measure thickness of lockup clutch piston. Minimum thickness allowed is 0.257 in (6.53 mm).
19. Inspect and measure inside diameter (ID) of converter cover bushing (27). Maximum allowed inside diameter of bushing is 2.634 in (66.90 mm). Remove bushing if replacement is necessary.
20. Remove thrust bearing (28) from converter cover (3).

Torque Converter Module Assembly

1. Install stator race (18) into stator assembly (8).
2. Install 13 springs (19) and rollers (20) into stator assembly (8). Use petrolatum to help hold springs and rollers in place.



342-1157

MODULE OVERHAUL - CONTINUED**Torque Converter Module Assembly - Continued**

3. Install thrust washer (17) and thrust plate (16) on stator assembly (8).
4. Install star plate (15) and retaining ring (14).
5. Install bearing assembly (11), race (12), and selective shim (13) to pump assembly (5).

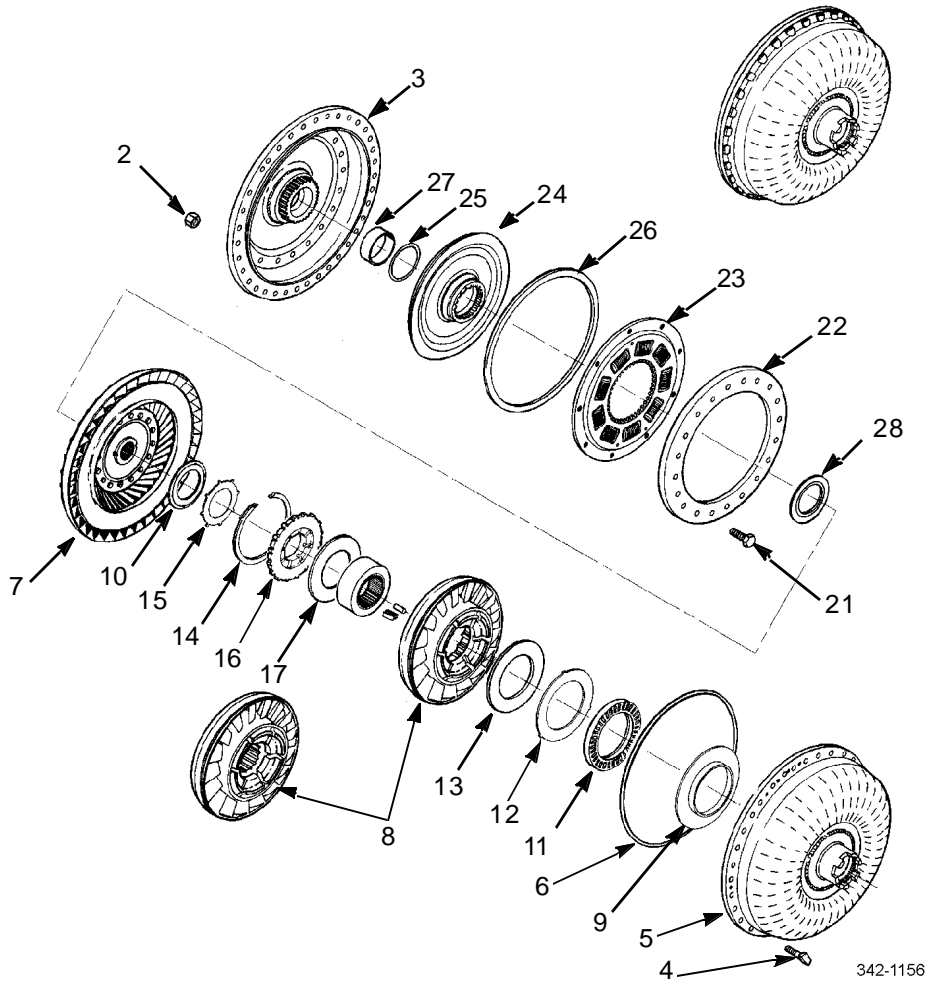
CAUTION

When installing thrust bearings, ensure that locating lip on either inner or outer thrust bearing race is not preventing race from contacting thrust surface of mating part. Failure to follow this caution leads to premature thrust bearing failure and incorrect shim selection to maintain proper internal part clearance.

6. Install thrust bearing assembly (10) into turbine assembly (7).
7. If removed, install new bushing (27) into cover assembly (3), using installer tool (J39949).
8. Insert turbine assembly (7) into converter cover bushing (27). Check for free rotation.
9. Install thrust bearing (28) in cover assembly (3).
10. Install lockup clutch piston inner seal ring (25) on hub of cover assembly (3).
11. Install lockup clutch piston outer seal ring (26) on outside diameter of lockup clutch piston (24).
12. Install lockup clutch piston (24).
13. Install lockup clutch damper assembly (23) in cover assembly (3).
14. Install lockup clutch backup plate (22). Secure backup plate with 44 bolts (21). Tighten bolts to 22-26 lb-ft (30-35 Nm).
15. Install turbine (7) into cover assembly (3), aligning balance mark on turbine with balance mark on lockup clutch damper assembly (23).
16. Install stator assembly (8) in cover assembly (3).
17. Install 36 T-headed bolts (4) into flange of pump assembly (5).
18. Install thrust bearing race (9) into pump assembly (5).
19. Install o-ring (6) onto cover assembly (3).
20. With balance marks aligned, position pump assembly (5) over cover assembly (3).
21. Install four nuts (2) evenly spaced around cover assembly (3) onto T-headed bolts (4). Tighten nuts to 22-26 lb-ft (30-35 Nm).

MODULE OVERHAUL - CONTINUED

Torque Converter Module Assembly - Continued



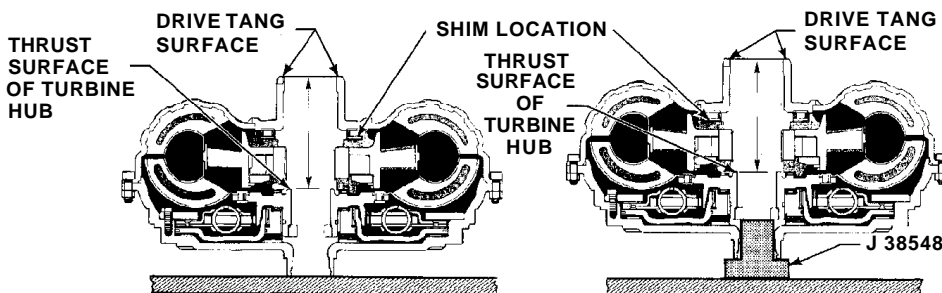
MODULE OVERHAUL - CONTINUED

Torque Converter Module Assembly - Continued

NOTE

Perform steps 22 through 27 to determine torque converter selective shim dimensions.

22. Using a depth micrometer, measure from top of torque converter drive tang surface to thrust surface of turbine hub. This dimension is "A".
23. Remove bolt from tool (J38548). Install tool into torque converter and position converter on work surface so converter is supported by tool.
24. Using a depth micrometer, measure from top of torque converter drive tang surface to thrust surface of turbine hub. This dimension is "B".
25. Subtract dimension "B" from dimension "A" to get dimension "C".
26. Dimension "C" should be 0.0060-0.0139 in (0.153-0.353 mm). If dimension is not correct, a shim is required. If the dimension is correct, proceed to step 29.
27. If a shim is required, select appropriate shim from list below:



342-1158

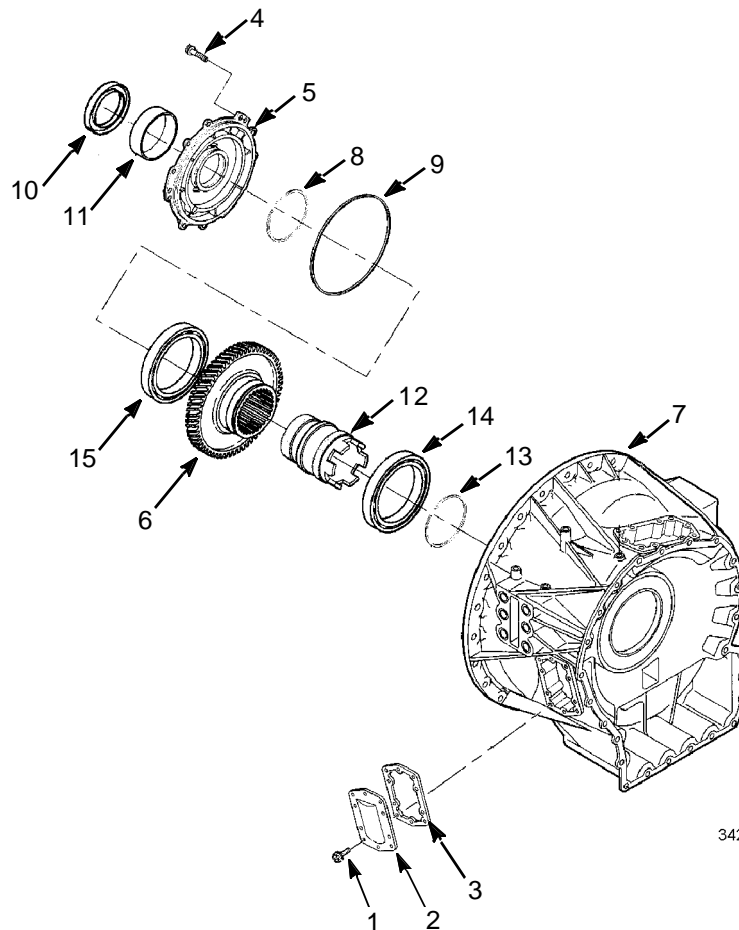
DIMENSION C	USE P/N	SHIM THICKNESS
0.0140-0.0229 inch (0.356-0.581 mm)	29503879	0.009-0.011 inch (0.23-0.27 mm)
0.0230-0.0319 inch (0.585-0.810 mm)	29503880	0.018-0.020 inch (0.46-0.50 mm)
0.0320-0.0394 inch (0.813-1.000 mm)	29503881	0.027-0.029 inch (0.69-0.73 mm)

28. Disassemble torque converter and install selected shim. Repeat step 22 through 27 to confirm dimension "C".
29. Install remaining 32 nuts (2) and tighten to 22-26 lb-ft (30-35 Nm).

MODULE OVERHAUL - CONTINUED

Torque Converter Housing Module Disassembly

1. Remove ten bolts (1), PTO cover (2), and gasket (3). Discard gasket.
2. Remove 11 bolts (4) securing bearing retainer assembly (5) and PTO gear (6) assembly to converter housing (7).
3. Remove seal rings (8 and 9) from bearing retainer (5). Discard seal rings.
4. Remove bearing retainer oil seal (10) using tool (J24171-A). Discard oil seal.
5. Inspect bushing (11) for damage or wear. Maximum allowable bushing ID is 3.511 in (89.19 mm). Remove if damaged or worn.
6. Remove oil pump drive hub (12) from PTO gear (6).
7. Inspect oil pump drive hub (12) for excessive wear on drive tangs. Maximum allowable tang wear is 0.012 in (0.31 mm).
8. Remove seal ring (13) from PTO gear (6).
9. Inspect PTO gear bearings (14 and 15). If damaged, remove and discard.



342-1159

MODULE OVERHAUL - CONTINUED**Torque Converter Housing Module Assembly**

1. If PTO gear bearings (14 and 15) were discarded, install new bearings using tool (J37041).

CAUTION

Oil pump drive hub can be incorrectly installed backwards. Position oil pump drive hub tangs toward oil pump.

2. Install oil pump drive hub (12) into PTO gear (6), aligned with hub tangs toward oil pump.

NOTE

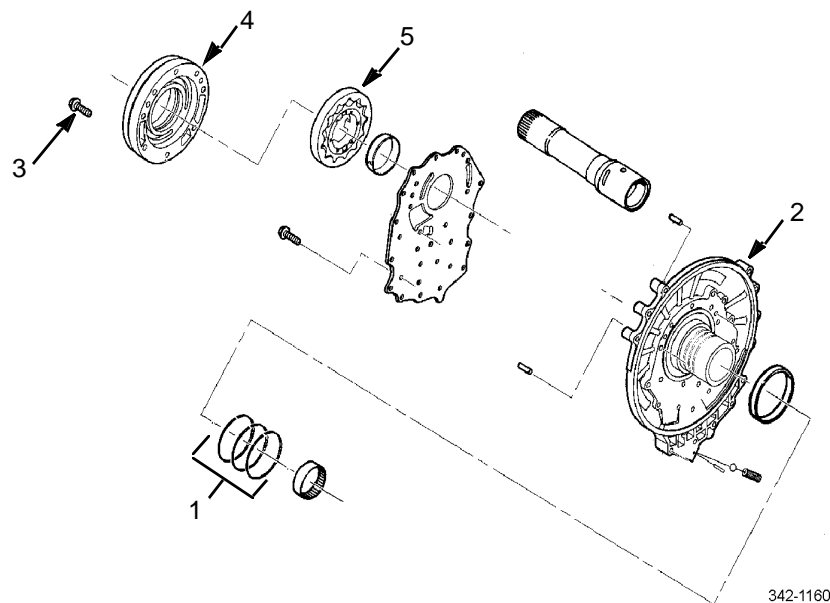
Butt-joint seal rings require special handling during assembly. Seal rings contain materials that absorb moisture from atmosphere, causing them to expand. Check seal ring end clearance before installation to ensure seal ring has not expanded.

3. Install seal ring (13) into seal ring bore of torque converter pump housing and measure end gap with feeler gage. Seal ring end gap must be 0.047-0.065 in (1.19-1.65 mm). If seal ring is not within tolerance, ring has expanded and must be replaced.
4. Remove seal ring (13) from pump housing seal ring bore and install onto PTO gear (6).
5. If removed, install bearing retainer bushing (11) using press and tools (J37038 and J8092).
6. Install new seal ring (9) onto bearing retainer (5) and install new oil seal (10) using press and tools (J37032 and J37034).
7. Install new seal ring (8) into seal ring bore in PTO gear (6) and measure end gap with thickens gage.
8. Seal ring (8) end gap must be 0.047-0.065 in (1.19-1.65 mm). If seal ring is not within tolerance, ring has expanded and must be replaced.
9. Remove seal ring (8) from seal ring bore in PTO gear (6) and install seal ring onto bearing retainer (5).
10. Using a mallet, lightly tap PTO gear (6) assembly into converter housing (7) until gear assembly is seated.
11. Use guide bolts to install bearing retainer assembly (5), rocking retainer while installing into converter housing (7).
12. Install 11 bolts (4) to secure bearing retainer assembly (5) and PTO gear (6) assembly into converter housing (7). Tighten bolts to 38-45 lb-ft. (51-61 Nm).
13. Install PTO cover (2) and new gasket (3) with ten bolts (1). Tighten bolts to 38-45 lb-ft (51-61 Nm).

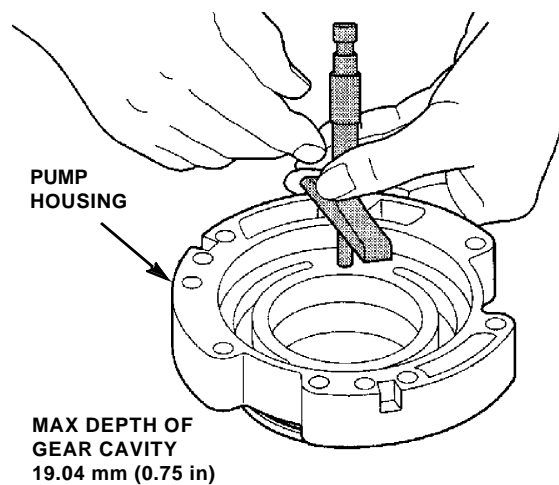
MODULE OVERHAUL - CONTINUED

Front Support and Charging Oil Pump Module Disassembly

1. Remove three seal rings (1) from hub of front support assembly (2).
2. Remove eight bolts (3) securing pump housing assembly (4) to front support assembly (2).
3. Remove pump housing assembly (4) and gear set (5) from front support (2).



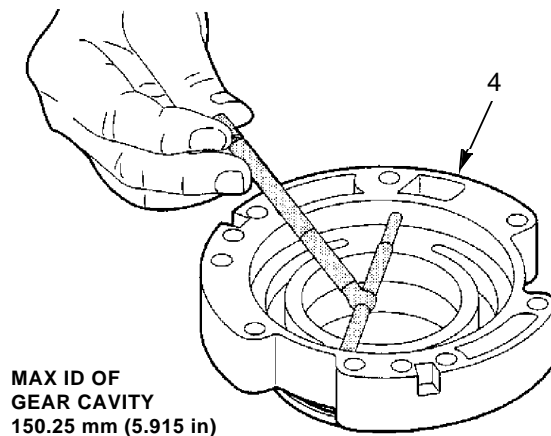
4. Measure gear cavity depth of pump housing (4). Maximum depth allowed is 0.75 in (19.04 mm).



MODULE OVERHAUL - CONTINUED

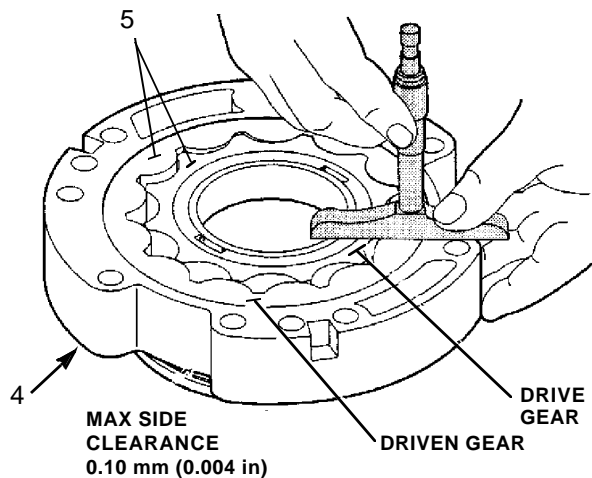
Front Support and Charging Oil Pump Module Disassembly - Continued

5. Measure gear cavity diameter of pump housing (4). Maximum depth allowed is 5.915 in (150.25 mm).



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6. Install gear set (5) into pump housing (4). Measure pump gear side clearance of both gears. Maximum allowable clearance is 0.004 in (0.10 mm).

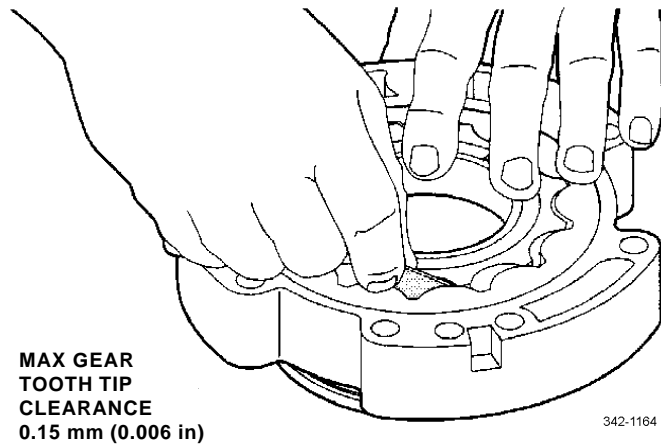


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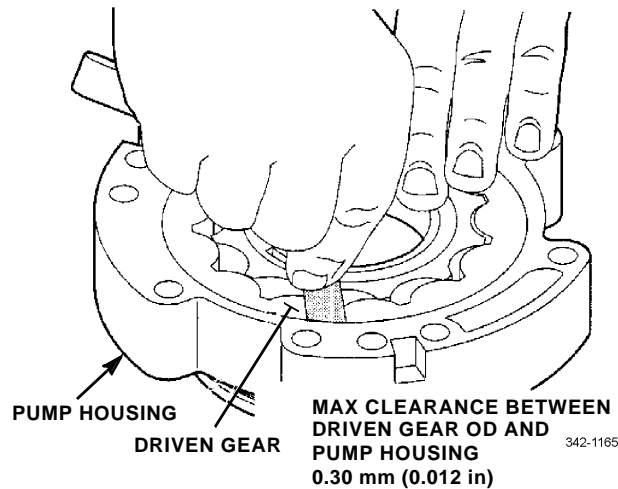
MODULE OVERHAUL - CONTINUED

Front Support and Charging Oil Pump Module Disassembly - Continued

7. Measure gear tooth tip clearance. Maximum allowable clearance is 0.006 in (0.15 mm).



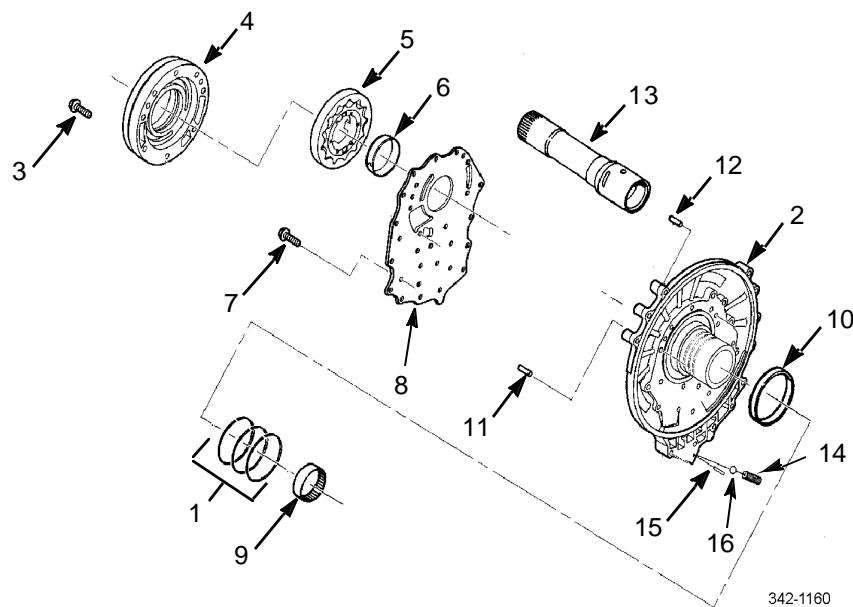
8. Measure driven gear to pump housing clearance. Maximum allowable clearance is 0.012 in (0.30 mm).



9. Inspect and measure bushing (6) inside inner gear of gear set (5). The maximum ID of bushing is 2.635 in (66.93 mm). If bushing is damaged or out of tolerance, remove.
10. Remove 14 bolts (7) securing wear plate (8) to front support (2). Remove wear plate.
11. Inspect roller bearing (9). If damaged, remove using drift and hammer.
12. Inspect and measure front support sleeve (10). Minimum OD diameter of front support sleeve is 4.717 in (119.81 mm). If sleeve is damaged or out of tolerance, remove.
13. Inspect front support dowel pins (11 and 12). If damaged, remove.

MODULE OVERHAUL - CONTINUED**Front Support and Charging Oil Pump Module Disassembly - Continued**

14. Inspect ground sleeve (13). If damaged or worn, press from front support (2).
15. Using tool (J41462), compress spring (14) until load is removed from dowel pin (15). Remove dowel pin and carefully release load on spring by rotating handle on tool in counterclockwise direction. When spring has reached its free length, remove tool. Remove spring and ball (16) from front support (2). Check spring tension in accordance with Table 3, *Wear Limits and Spring Data*, located at the end of this work package.
16. Inspect ball seat area of front support (2) for damage. If damage is found, replace front support.

**Front Support and Charging Oil Pump Module Assembly**

1. Install ball (16) and spring (14) into front support (2). Compress spring using tool (J41462) until dowel pin (15) can be inserted to retain spring. Remove tool.
2. Install ground sleeve (13) on front support (2): press sleeve into front support with machined surface at base of sleeve aligned with arrow cast on front support. Total runout of spline OD may not exceed 0.005 in (0.13 mm).
3. If removed, install dowel pins (11 and 12) in front support (2). Press pins to a height of 0.57 in (14.5 mm) from surface of front support.
4. Install front support sleeve (10) into front support (2), with lubrication hole aligned with relief valve bore.
5. Using a press and tools (J37041 and J37034), install wear plate (8) to front support (2) with 14 bolts (7). Tighten bolts to 38-45 lb-ft (51-61 Nm).
6. If removed, install roller bearing (9) to front support (2) using a press and tools (J37038). Press roller bearing flush to 0.010 in (0.25 mm) below surface.
7. Install gear pump bushing (6) into inner gear of gear set (5). Align staking in pre-staked bushing with slots inside gear of gear set, using tool (J39954).
8. Lubricate gear set (5) with transmission oil and install gear set in pump housing (4).

MODULE OVERHAUL - CONTINUED

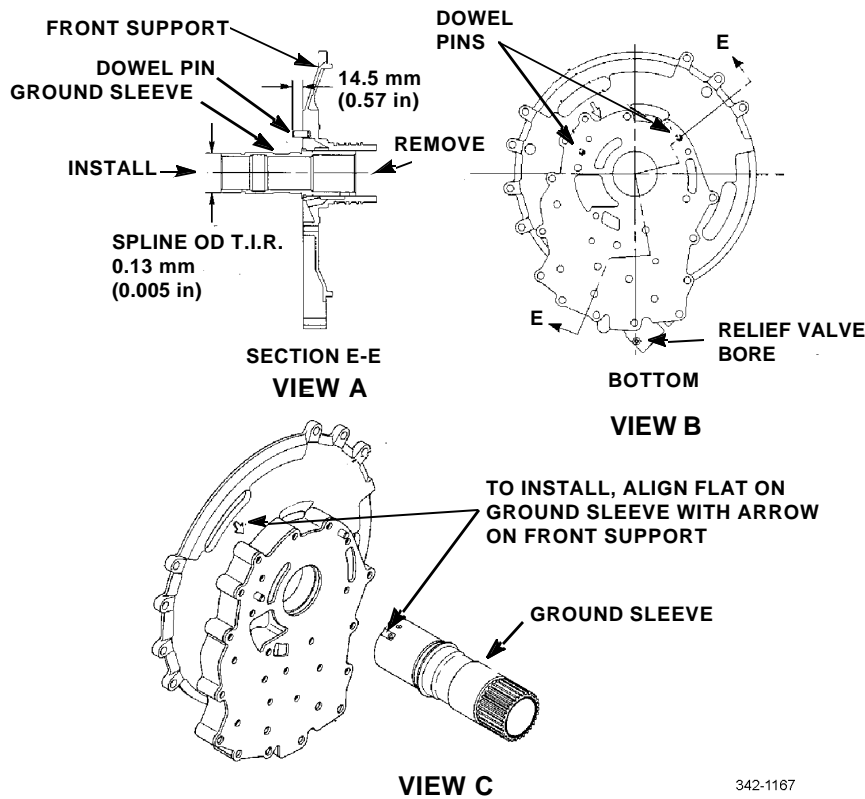
Front Support and Charging Oil Pump Module Assembly - Continued

9. Secure pump housing (4) to front support (2) with eight bolts (3). Tighten bolts to 38-45 lb-ft. (51-61 Nm).

NOTE

Butt-joint seal rings require special handling during assembly. Seal rings contain materials that absorb moisture from atmosphere, causing them to expand. Check seal ring end clearance before installation to ensure seal ring has not expanded.

10. Measure end gap of three rotating seal rings (1) before installation. Insert seal rings into the rotating clutch hub bore of front support (2) and measure end gap with a thickness gage. Seal ring end gap must be 0.040-0.057 in (1.00-1.44 mm).
11. Install three rotating seal rings (1) on front support hub.

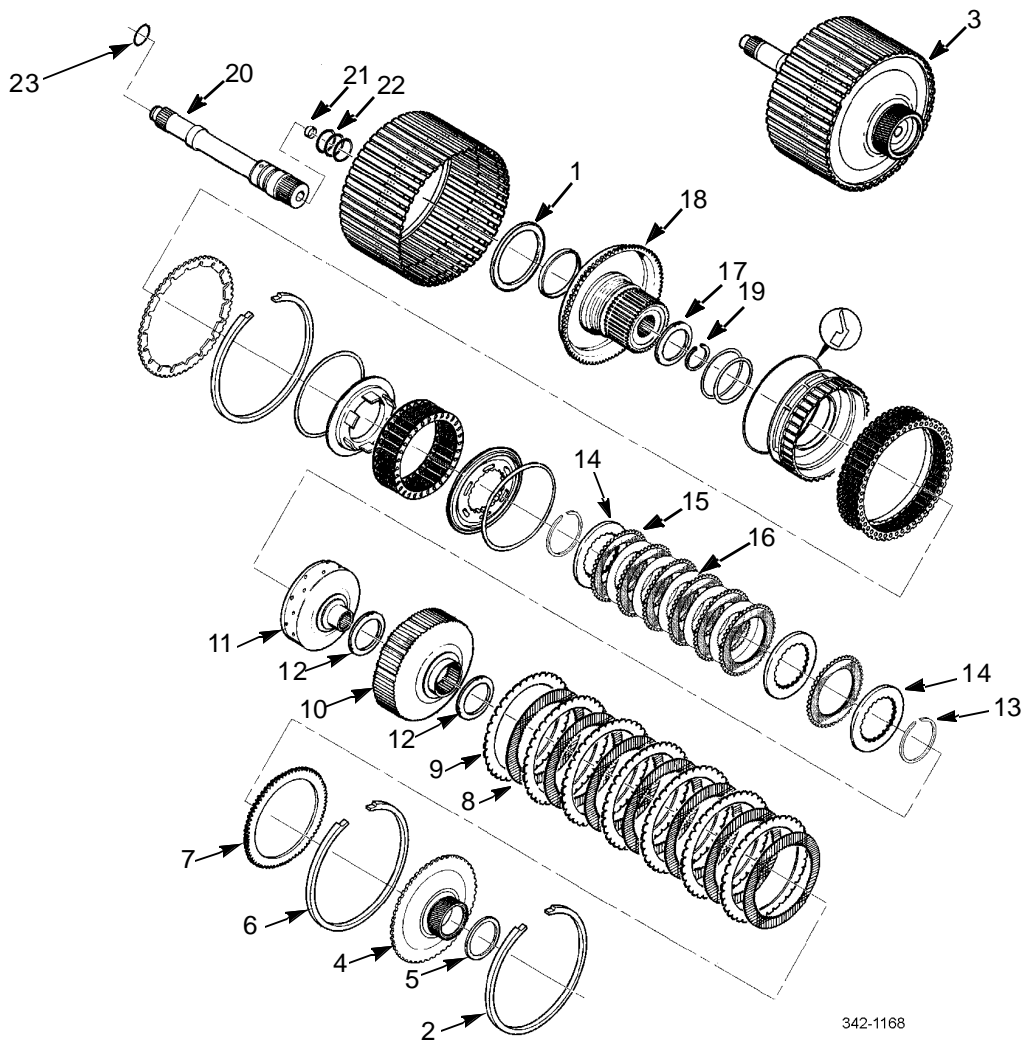


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MODULE OVERHAUL - CONTINUED

Rotating Clutch Module Disassembly

1. Remove thrust bearing (1) and retaining ring (2) from rotating clutch module (3). Inspect thrust bearing. If worn, discard.
2. Remove P1 sun gear assembly (4) and thrust bearing (5) from rotating clutch module (3).
3. Remove C2 retaining ring (6) and backplate (7).
4. Measure wear surface thickness of C2 backplate (7). Minimum thickness allowed is 0.311 in (7.90 mm). Check flatness of backplate. Maximum allowable distortion is 0.006 in (0.15 mm).



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5. Remove C2 clutch pack containing seven friction plates (8) and seven steel reaction plates (9). Perform the following measurements:
 - a. Friction plate thickness: minimum thickness allowed is 0.115 in (2.92 mm).
 - b. Friction plate oil groove depth: minimum depth allowed is 0.008 in (0.20 mm).
 - c. Friction plate cone: maximum cone allowed is 0.010 in (0.25 mm).

MODULE OVERHAUL - CONTINUED**Rotating Clutch Module Disassembly - Continued**

- d. Reaction plate thickness: minimum thickness allowed is 0.095 in (2.41 mm).
- e. Reaction plate cone: maximum cone allowed is 0.010 in (0.25 mm).
6. Remove C2 (10) and C1 (11) drive hubs with two thrust bearings (12). Measure drive hub splines. Maximum allowable spline wear is 0.015 in (0.38 mm).
7. Remove C1 retaining ring (13), two backplates (14), seven friction plates (15), and six steel reaction plates (16). Perform the following measurements:
 - a. Friction plate thickness: minimum thickness allowed is 0.115 in (2.92 mm).
 - b. Friction plate oil groove depth: minimum depth allowed is 0.008 in (0.20 mm).
 - c. Friction plate cone: maximum cone allowed is 0.010 in (0.25 mm).
 - d. Reaction plate thickness: minimum thickness allowed is 0.095 in (2.41 mm).
 - e. Reaction plate cone: maximum cone allowed is 0.010 in (0.25 mm).
 - f. Backplate thickness: minimum thickness allowed is 0.311 in (7.90 mm).
 - g. Backplate flatness: maximum allowable distortion is 0.006 in (0.15 mm).
8. Remove thrust bearing (17) from clutch hub assembly (18).
9. Remove retaining ring (19) and turbine shaft (20) from clutch hub (18).
10. Inspect and measure bushing (21) inside end of turbine shaft (20). Maximum ID allowed is 1.423 in (36.14 mm).
11. Remove three seal rings (22) and o-ring (23) from turbine shaft (20). Discard o-ring.

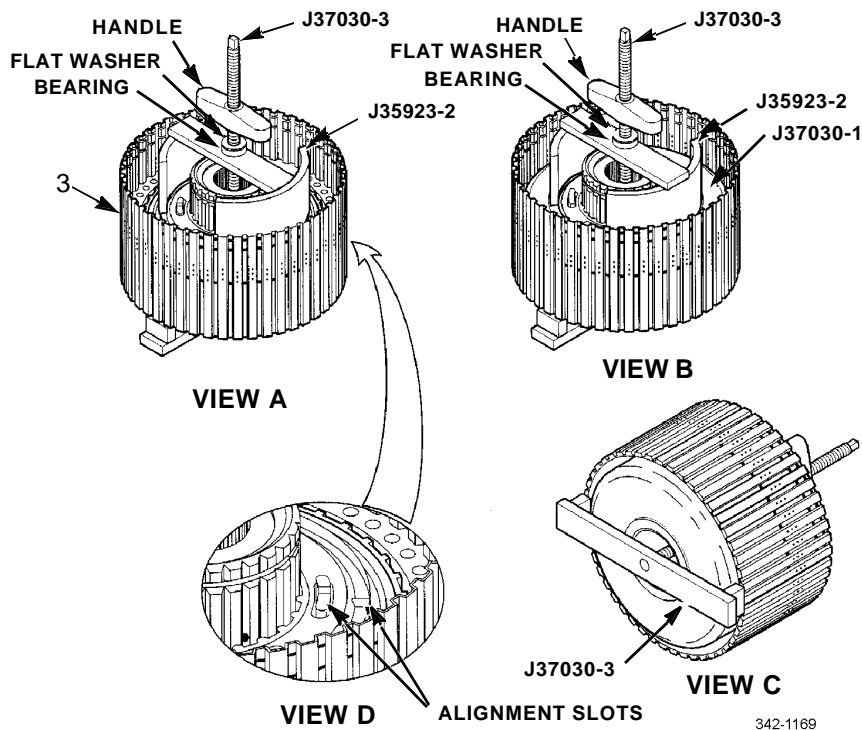
MODULE OVERHAUL - CONTINUED

Rotating Clutch Module Disassembly - Continued

WARNING

The rotating clutch piston springs are highly compressed and must be properly released. Failure to follow this warning may result in personnel injury

12. Place rotating clutch (3) on tool base (J37030-3) so rotating drum is supported by tool tangs (View C).
13. Install tool (J35923-2) with bearing, washer, and handle. Tighten tool, compressing C1 balance piston (24) and C1 spring assembly (25). Remove retaining ring (26) (View A).

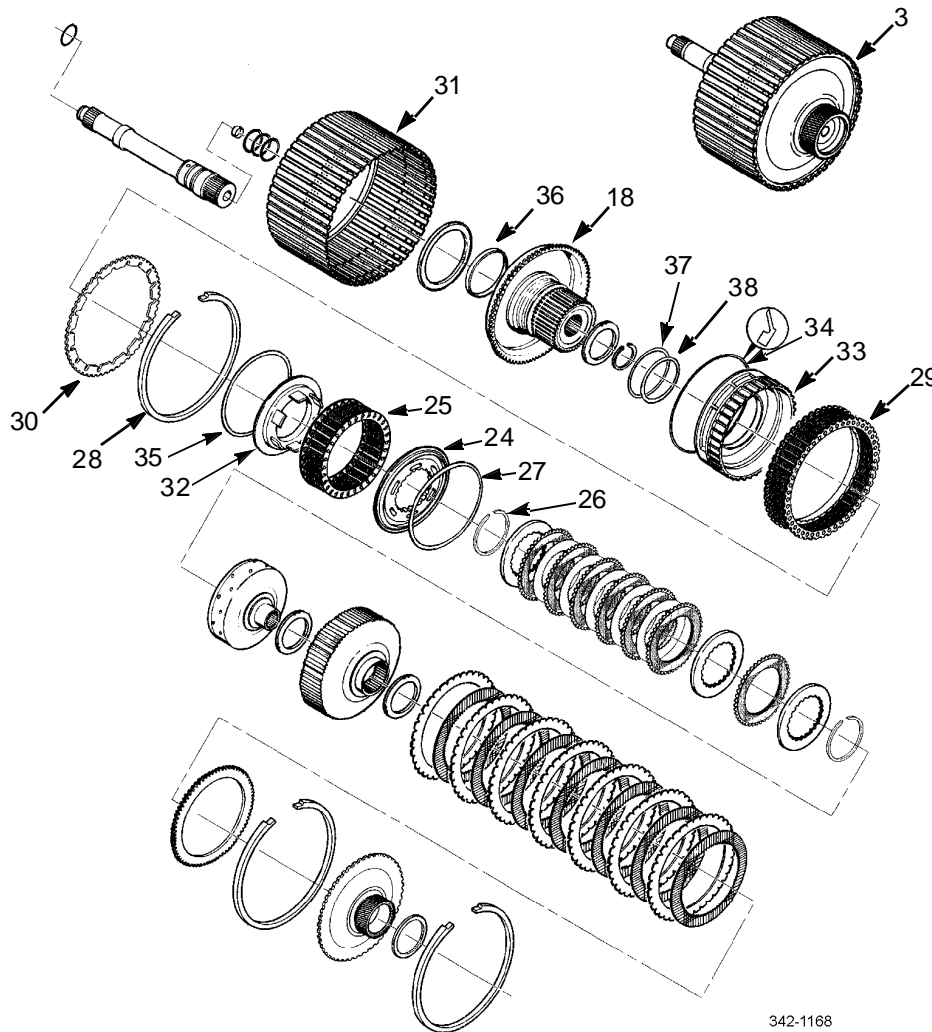


14. Release spring tension by rotating handle in counterclockwise direction. Remove tool (J35923-2) with bearing, washer, and handle.
15. Remove C1 balance piston (24), seal ring (27), and C1 spring assembly (25).
16. Install tools (J37030-3, J37030-1, and J35923), bearing, washer, and handle. Tighten tool and remove retaining ring (28). Remove tools after relieving spring tension. Remove spring assembly (29) and spring plate (30) (View B).

MODULE OVERHAUL - CONTINUED

Rotating Clutch Module Disassembly - Continued

17. Lift rotating drum (31) from clutch hub (18) and C1/C2 pistons (32 and 33). Inspect clutch splines of rotating drum. Maximum spline wear allowed is 0.015 in (0.38 mm).
18. Remove C1/C2 pistons (32 and 33) and seal rings (34 and 35) from clutch hub (18), by rocking pistons from side to side.
19. Inspect and measure ID of rotating clutch hub housing bushing (36). Maximum allowable ID of bushing is 4.735 in (120.27 mm). Remove bushing from clutch hub (18) if replacement is necessary. Avoid damaging bushing bore.
20. Remove piston seal rings (37 and 38) from clutch hub (18).
21. Separate C1 piston (32) and seal ring (35) from C2 piston (33) and seal ring (34) by lightly tapping on C1 piston.



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MODULE OVERHAUL - CONTINUED**Rotating Clutch Module Assembly**

1. If rotating clutch hub bushing (36) was removed, install new bushing using tool (J37040).
2. Install piston seal ring (37) on clutch hub (18), and piston seal ring (38) into C2 piston (33). Install clutch hub and piston seal ring (35) into C1 piston (32).
3. With a mallet, lightly tap C2 piston (33) into clutch hub (18).
4. Align notch on C1 piston (32) with lubrication orifice on rotating drive hub. With a mallet, lightly tap C1 piston onto center of C2 piston (33) and over clutch hub (18).
5. Install rotating drum (31) over clutch hub (18) and C1/C2 pistons (32 and 33).
6. Install C2 spring assembly (29). Index spring assembly with drive hub tangs and splines on C2 piston (33). Ensure C2 spring assembly has made contact with bottom of slots in C2 piston. If spring assembly did not reach bottom, remove spring assembly and reannex in next spline on rotating drum. Repeat this process until C2 spring is in proper position.
7. Install C2 spring plate (30). Index spring plate with drive hub tangs and splines on C2 piston (33).

WARNING

The rotating clutch piston springs are highly compressed and must be properly released. Failure to follow this warning may result in personnel injury

8. Place rotating clutch on tool base (J37030-3) so that rotating drum is supported by tool tangs. Install tool (J37030-1 and J35923-2), that includes bearing, washer, and handle. Tighten tool to compress C2 spring assembly (29) and install retaining ring (28) (View B, page 0072 00-24). Remove tools.
9. Install seal ring (27) onto balance piston (24).
10. Install C1 spring assembly (25). Align mark on balance piston (24) with slot on C1 piston (32). Position balance piston onto the C1 piston.
11. Install tool (J35923-2) with bearing, washer, and handle. Tighten tool, compressing C1 balance piston (24) and C1 spring assembly (25). Install retaining ring (26) (View A, page 0072 00-24). Remove tools.
12. If turbine shaft bushing (21) was removed, replace using tool (J37036).
13. Lubricate with transmission oil and install new o-ring (23) on turbine shaft (20).

NOTE

Butt-joint seal rings require special handling during assembly. Seal rings contain materials that absorb moisture from atmosphere causing them to expand. Check seal ring end clearance before installation to ensure seal ring has not expanded.

14. Install each rotating seal ring (22) into ground sleeve bore and measure end gap. Seal ring end gap must be 0.026-0.040 in (0.65-1.01 mm). Install three rotating seal rings with correct end gap, into rear of turbine shaft (20).
15. Install turbine shaft (20) and retain with retaining ring (19).

CAUTION

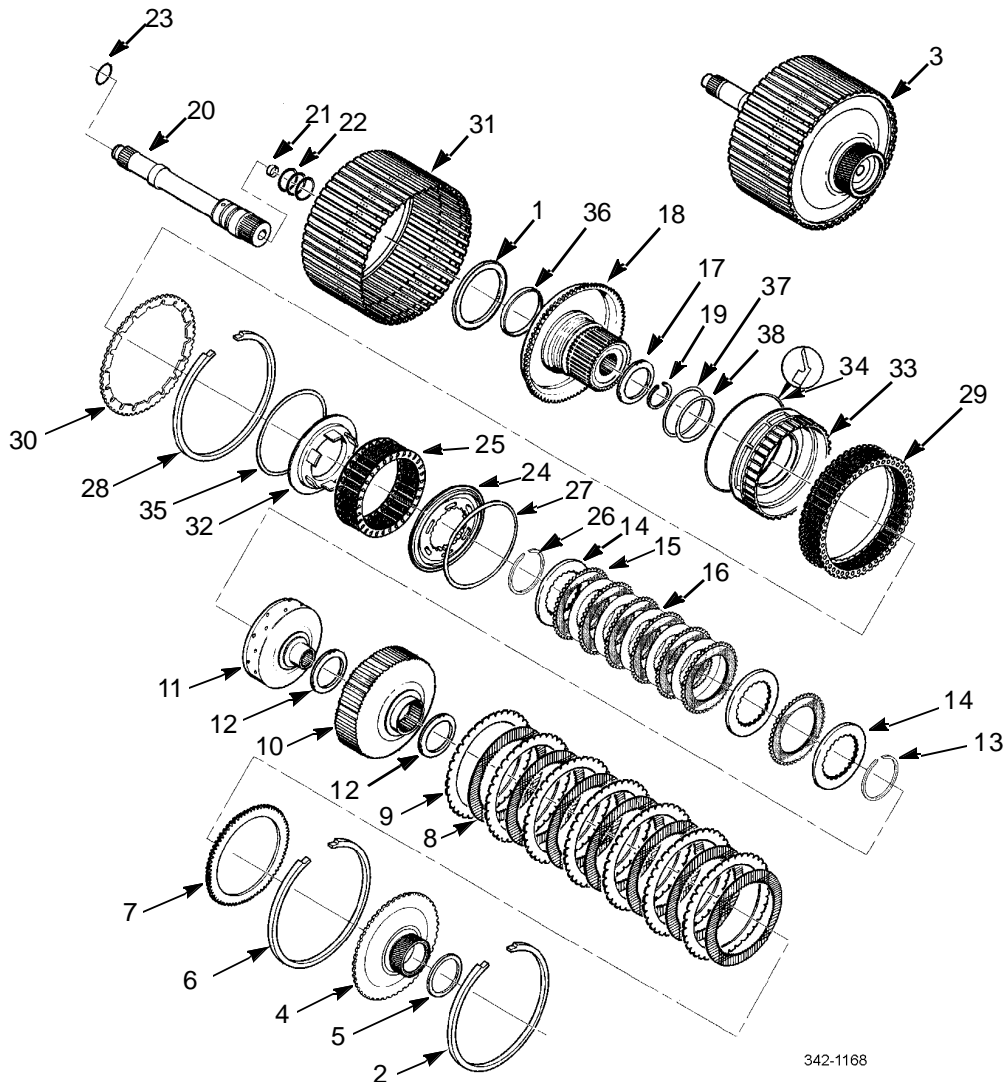
Ensure thrust bearing is assembled with locating lip on either inner or outer thrust bearing race not preventing race from contacting thrust surface of mating part. Failure to follow this caution leads to thrust bearing failure and incorrect shim selection to maintain proper part clearance.

16. Install thrust bearing (17) on rotating clutch hub (18).

MODULE OVERHAUL - CONTINUED

Rotating Clutch Module Assembly - Continued

17. Install C1 clutch pack: first install one backplate (14), then alternately install friction (15) and steel reaction plates (16), starting with a friction plate and ending with a backplate. Secure clutch pack in place with retaining ring (13).
18. Install C1 drive hub (11) over clutch pack while aligning external splines.
19. Install thrust bearing (12) on each side of C2 drive hub (10), then position this group over C1 drive hub (11).
20. Install C2 clutch plates, alternating between friction plates (8) and steel reaction plates (9), starting with steel reaction plates.
21. Install C2 backplate (7) and retaining ring (6).
22. Install thrust bearing (5) on sun gear (4).
23. Install P1 sun gear assembly (4) and retaining ring (2).
24. Install thrust bearing (1) on rotating clutch module (3).



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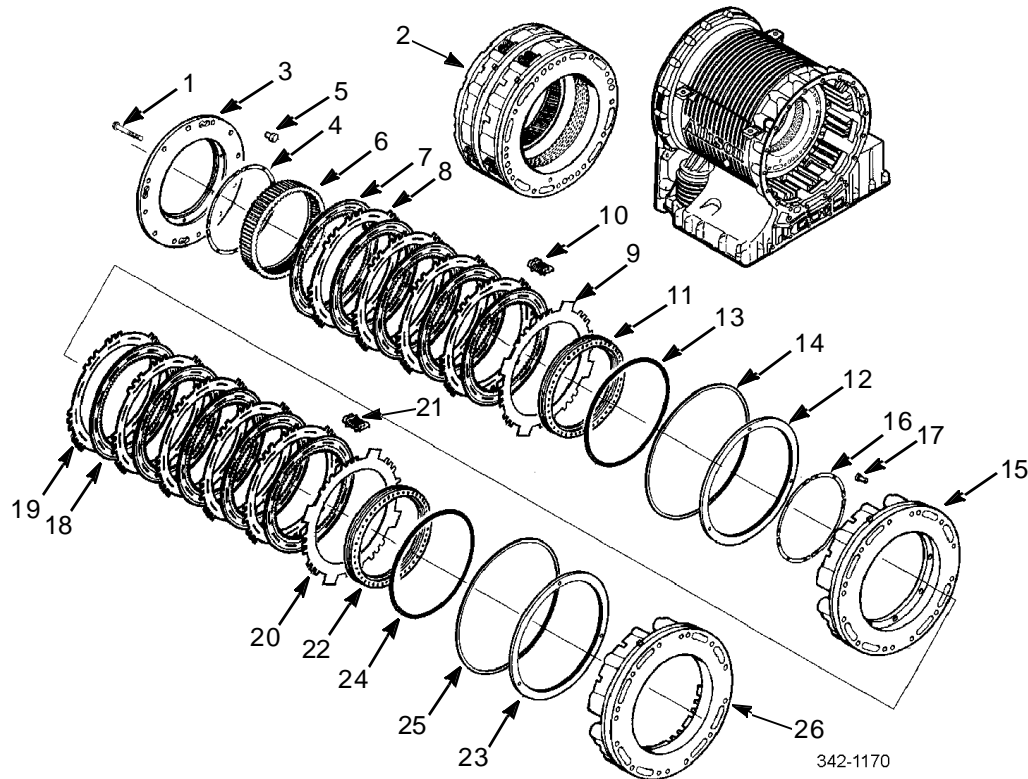
MODULE OVERHAUL - CONTINUED**C3/C4 Clutch Assembly and Main Housing Module Disassembly**

1. Remove 14 bolts (1) securing C3/C4 clutch assembly (2).
2. Remove C3 backplate assembly (3) from clutch assembly (2)
3. Inspect and measure four thrust plates (4), backplate (3), and check 12 rivets (5) on clutch backplate. Perform the following measurements:
 - a. Thrust plate thickness at contact surface: minimum allowable thickness is 0.1109 in (2.818 mm).
 - b. Backplate distortion: maximum allowable distortion is 0.006 in (0.15 mm).
 - c. Backplate step wear: maximum allowable wear is 0.005 in (0.13 mm).If replacement is necessary, remove thrust plates (4) by drilling out rivets (5).
4. Remove P1 ring gear (6) and inspect clutch splines of P1 ring gear. Maximum allowable spline wear is 0.015 in (0.38 mm).
5. Remove and measure C3 clutch pack: five friction plates (7) and four steel reaction plates (8). Perform the following measurements:
 - a. Friction plate thickness: minimum allowable thickness is 0.137 in (3.48 mm).
 - b. Friction plate: maximum allowable cone is 0.010 in (0.25 mm).
 - c. Steel reaction plate thickness: minimum allowable thickness is 0.095 in (2.41 mm).
 - d. Steel reaction plate: maximum allowable cone is 0.016 in (0.40 mm).
6. Remove piston return plate (9) with four return springs assemblies (10) attached.
7. Inspect and measure piston return plate (9). Minimum allowable thickness of plate is 2.162 in (54.91 mm).
8. If return spring assemblies (10) are damaged and require replacement, remove them from piston return plate (9) by separating spring retainer (11) from piston (12).
9. Remove seal rings (13 and 14) from piston (12). Discard seal rings.
10. Remove C3 clutch housing assembly (15) from C3/C4 clutch assembly (2).
11. Inspect and measure four thrust plates (16) on C3 clutch housing (15). Perform the following measurements:
 - a. Thrust plate thickness at contact surface: minimum allowable thickness is 0.1109 in (2.818 mm).
 - b. Backplate distortion: maximum allowable distortion is 0.006 in (0.15 mm).
 - c. Backplate step wear: maximum allowable wear is 0.005 in (0.13 mm).
 - d. Clutch housing splines: maximum allowable wear is 0.045 in (1.15 mm)If replacement is necessary, remove thrust plates (16) by drilling out 12 rivets (17).
12. Remove and measure C4 clutch pack: five friction plates (18) and five steel reaction plates (19). Perform the following measurements:
 - a. Friction plate thickness: minimum allowable thickness is 0.137 in (3.48 mm).
 - b. Friction plate: maximum allowable cone is 0.010 in (0.25 mm).
 - c. Steel reaction plate thickness: minimum allowable thickness is 0.095 in (2.41 mm).
 - d. Steel reaction plate: maximum allowable cone is 0.010 in (0.25 mm).
13. Remove piston return plate (20) with four return springs assemblies (21) attached.
14. Inspect and measure piston return plate (20). Minimum allowable thickness of plate is 2.162 in (54.91 mm).

MODULE OVERHAUL - CONTINUED

C3/C4 Clutch Assembly and Main Housing Module Disassembly - Continued

15. If return spring assemblies (21) are damaged and require replacement, remove them from piston return plate (20) by separating spring retainer (22) from piston (23).
16. Remove seal rings (24 and 25) from piston (23). Discard seal rings.
17. Inspect and measure C4 clutch housing (26). Maximum spline wear allowed is 0.045 in (1.15 mm).



C3/C4 Clutch Assembly and Main Housing Module Assembly

1. Install new seal rings (24 and 25) on piston (23). Install piston with seal rings into C4 housing (26).
2. Install spring retainer (22) on piston (23) and in C4 housing (26).
3. If removed, install new return spring assemblies (21) and attach them securely to piston return plate (20).
4. Install piston return plate (20) with return spring assemblies (21) into C4 clutch housing (26).
5. Install C4 clutch pack, starting with a friction plate (18). Alternately install five friction plates (18) and five steel reaction plates (19).

MODULE OVERHAUL - CONTINUED**C3/C4 Clutch Assembly and Main Housing Module Assembly - Continued****NOTE**

Perform step 6 only if C3 clutch housing was disassembled. If clutch housing was not disassembled, proceed to step 7.

6. Install four thrust plates (16) using 12 rivets (17) into C3 clutch housing (15). Use tool (J39534) to cold form rivets. Insert rivet from front so that preformed head is below active surface of thrust plate. Use cold forming tool to upset rivet at rear of clutch housing to complete riveted joint. A correctly formed rivet upset will be 0.157 in (4.00 mm) in diameter and no more than 0.039 in (1.00 mm) above surface of clutch housing. Thrust plate must be tightly attached to housing; no movement is allowed.
7. Install new seal rings (13 and 14) on piston (12). Install piston with seal rings into C3 clutch housing (15).
8. Install C3 clutch housing assembly (15) on top of assembled C4 clutch housing assembly (26). Ensure index notches on clutch housings are aligned.
9. Install spring retainer (11) on piston (12) and in C3 clutch housing (15).
10. If removed, install new return spring assemblies (10) and attach them securely to piston return plate (9).
11. Install piston return plate (9) with return spring assemblies (10) into C3 clutch housing (15).
12. Install P1 ring gear (6).
13. Install C3 clutch pack: starting with a friction plate (7), alternately install five friction plates and four steel reaction plates (8).

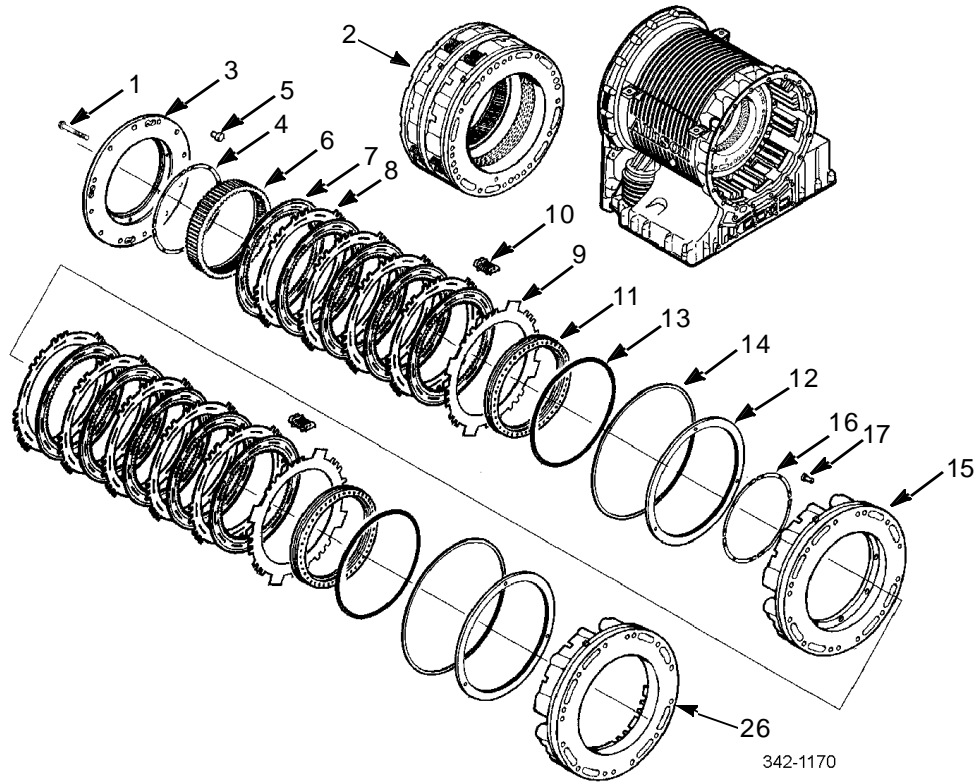
NOTE

Perform step number 14 only if C3 backplate was disassembled. If clutch housing was not disassembled, proceed to step number 15.

14. Install four thrust plates (4) using 12 rivets (5) into C3 backplate (3). Use tool (J39534) to cold form rivets. Insert rivet from front so that preformed head is below active surface of thrust plate. Use cold forming tool to upset rivet at rear of backplate to complete riveted joint. A correctly formed rivet upset will be 0.157 in (4.00 mm) in diameter and no more than 0.039 in (1.00 mm) above surface of backplate. Thrust plate must be tightly attached to backplate; no movement is allowed.
15. Install C3 backplate assembly (3), aligning notches on C3 and C4 housings.
16. Install 14 bolts (1) into C3/C4 clutch assembly (2). Tighten bolts to 38-45 ft-lb (51-61 Nm).

MODULE OVERHAUL - CONTINUED

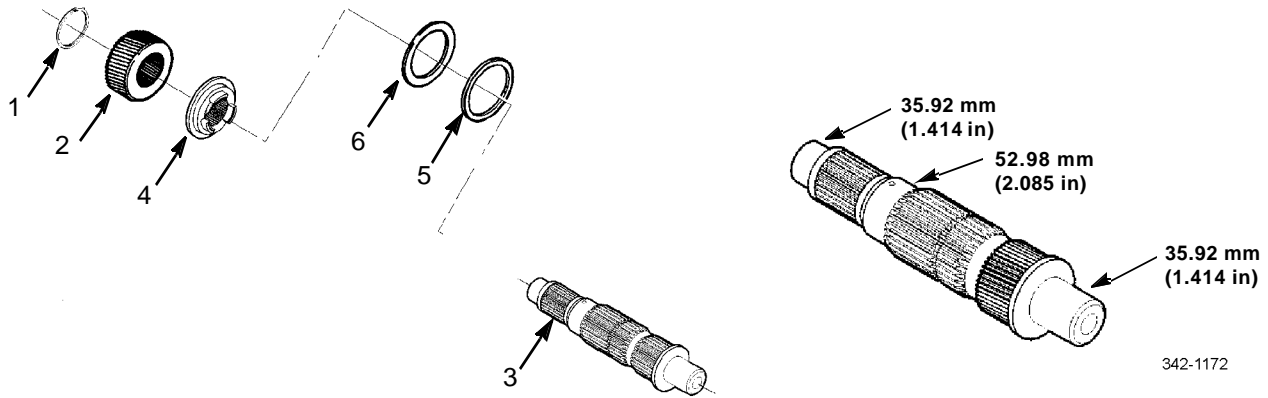
C3/C4 Clutch Assembly and Main Housing Module Assembly - Continued



MODULE OVERHAUL - CONTINUED

Main Shaft Module Disassembly

1. Remove external spiral retaining ring (1) and P2 sun gear (2) from main shaft (3).
2. Remove bearing spacer (4), thrust bearing (5), and selective shim (6) from main shaft (3).
3. Inspect and measure main shaft (3). Inspect for evidence of wear, chipped or cracked splines or teeth. Measure main shaft in accordance with Table 2, *Wear Limits Data*, located at the end of this work package.



Main Shaft Module Assembly

NOTE

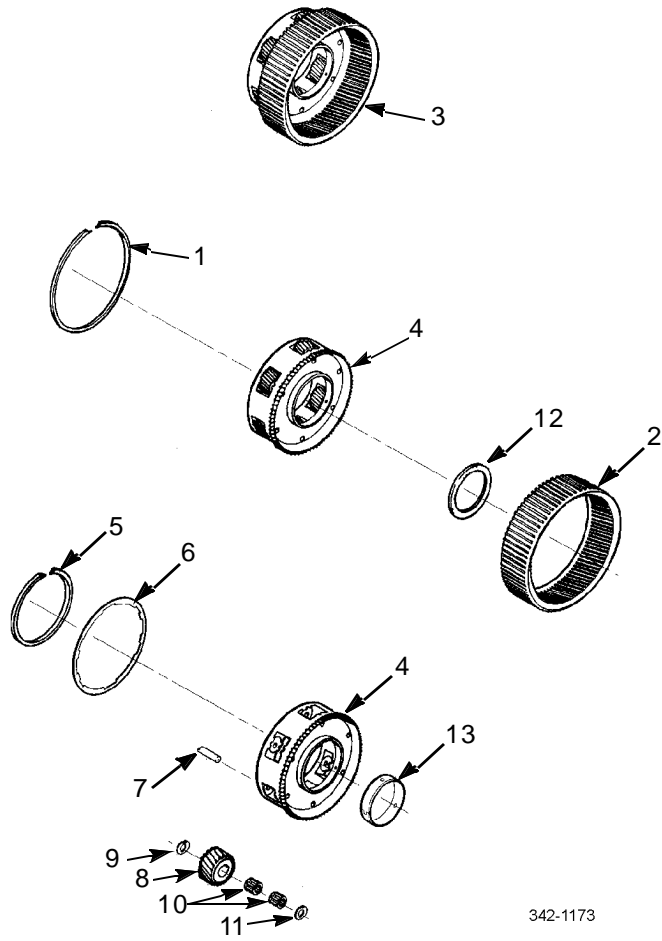
Do not install thrust bearing (5) and selective shim (6) until final transmission assembly. Measurement for selective shim is performed during final buildup.

1. Install bearing spacer (4) on main shaft (3).
2. Install P2 sun gear (2) and external spiral retaining ring (1) on main shaft (3).

MODULE OVERHAUL - CONTINUED

P1 Planetary Module Disassembly

1. Remove internal retaining ring (1) from P2 planetary ring gear (2) and remove P2 planetary ring gear from planetary module (3).
2. Check P1 planetary carrier assembly (4) for pinion end play. Pinion end play must not exceed 0.037 in (0.94 m). Check all six pinion gears.
3. Remove retaining ring (5) and indexing ring (6).
4. Remove six pinion spindles (7) from P1 planetary carrier (4).
5. Remove pinion gear (8), thrust washers (9 and 11), and two bearing assemblies (10) from side of P1 planetary carrier (4). Repeat procedure for remaining pinion gears.
6. Measure thickness and step wear of thrust washers (9 and 11). Minimum thrust washer thickness allowed is 0.055 in (1.40 mm). Maximum step wear allowed is 0.005 in (0.12 mm).
7. Remove thrust bearing (12) from P1 planetary carrier (4).
8. Inspect and measure bushing (13) inside P1 planetary carrier (4) for wear or damage. Maximum ID allowed is 3.516 in (89.32 mm). If bushing is worn, remove and replace.
9. Check spline wear of P1 planetary carrier (4) and P2 planetary ring gear (2). Maximum allowed spline wear is 3.015 in (0.38 mm).



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MODULE OVERHAUL - CONTINUED

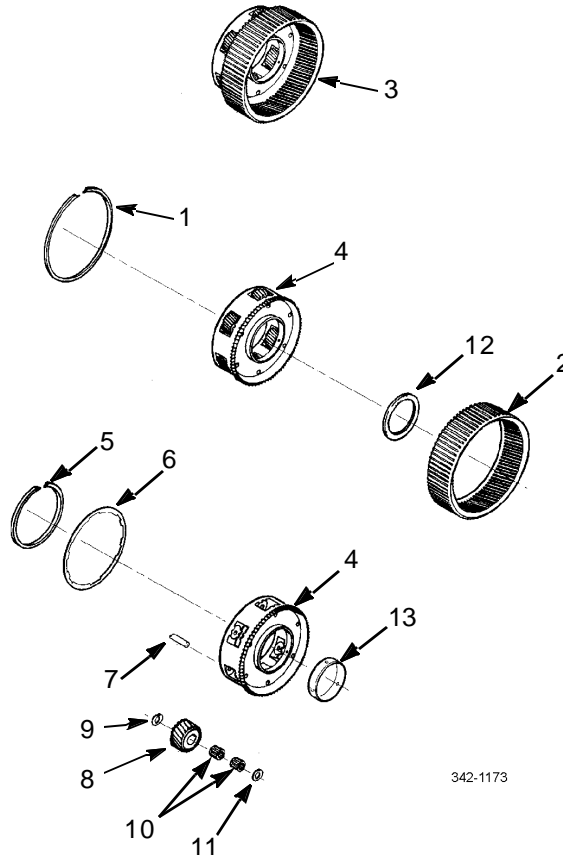
P1 Planetary Module Assembly

1. If removed, install bushing (13) into P1 planetary carrier (4) using a press and tool (J37038). Press new bushing flush to 0.016 in (0.40 mm) below surface.
2. Install two bearing assemblies (10) into center of pinion gear (8). Install thrust washers (9 and 11) inside P1 planetary carrier (4), align thrust washer tangs with slots in planetary, and retain them with petrolatum. Slide pinion gear and bearing assemblies into side of P1 planetary carrier between thrust washers. Repeat procedure for remaining five pinion gears.
3. Install six spindles (7) so that lower step is positioned for proper installation of indexing ring (6).
4. Install indexing ring (6) and retaining ring (5) to secure pinion gears in place.
5. Measure pinion end play. Pinion end play must not exceed 0.037 in (0.94 mm). Check all six pinion gears.
6. Install P2 planetary ring gear (2) over P1 planetary carrier assembly (4).
7. Install internal retaining ring (1) into P2 planetary ring gear (2), connecting P1 planetary carrier assembly (4) and P2 planetary ring gear.

CAUTION

Ensure thrust bearing is assembled with locating lip on either inner or outer thrust bearing race not preventing race from contacting thrust surface of mating part. Failure to follow this caution leads to thrust bearing failure and incorrect shim selection to maintain proper part clearance.

8. Install thrust bearing (12) on P1 planetary carrier (4).

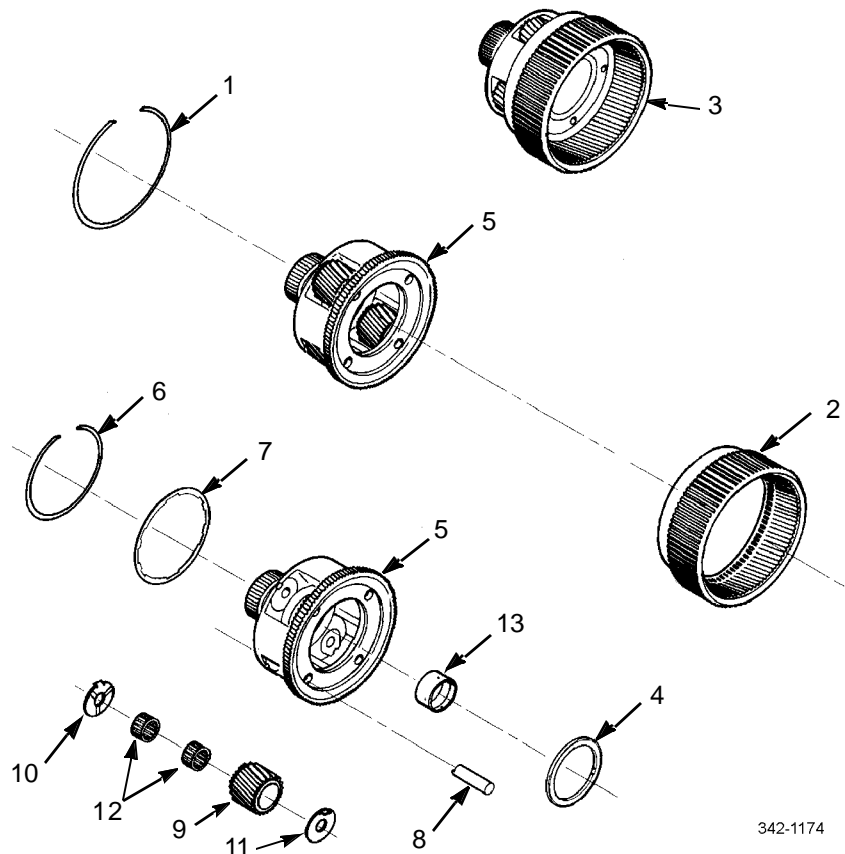


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MODULE OVERHAUL - CONTINUED

P2 Planetary Module Disassembly

1. Remove retaining ring (1) and P3 planetary ring gear (2) from planetary module (3). Remove and inspect thrust bearing (4).
2. Check P2 planetary carrier assembly (5) for pinion end play. Pinion end play must not exceed 0.037 in (0.94 mm). Check all six pinion gears.
3. Remove internal retaining ring (6), indexing ring (7), and four pinion spindles (8) from P2 planetary carrier (5).
4. Remove pinion gear (9), thrust washers (10 and 11), and two bearing assemblies (12) from side of P2 planetary carrier (5). Repeat procedure for remaining pinion gears.
5. Measure thickness and step wear of thrust washers (10 and 11). Minimum thrust washer thickness allowed is 0.055 in (1.40 mm). Maximum step wear allowed is 0.005 in (0.12 mm).
6. Inspect and measure bushing (13) inside P2 planetary carrier (5) for wear or damage. Maximum ID allowed is 2.096 in (53.23 mm). If bushing is worn, remove and replace.
7. Check spline wear of P2 planetary carrier (5) and P3 planetary ring gear (2). Maximum allowed spline wear is 0.015 in (0.38 mm).

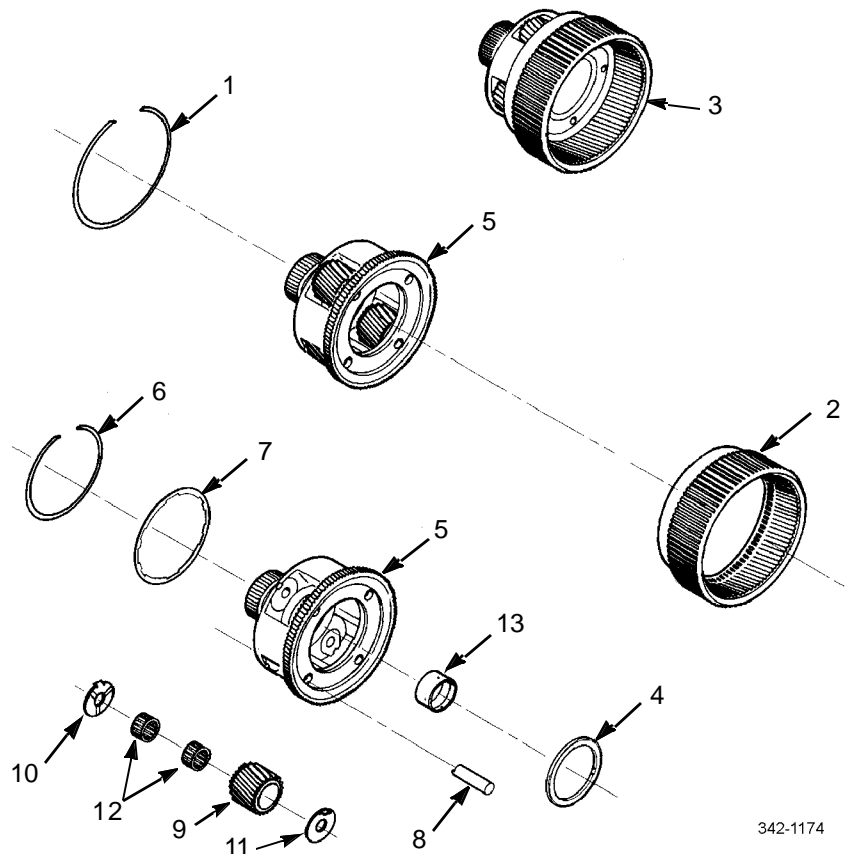


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MODULE OVERHAUL - CONTINUED

P2 Planetary Module Assembly

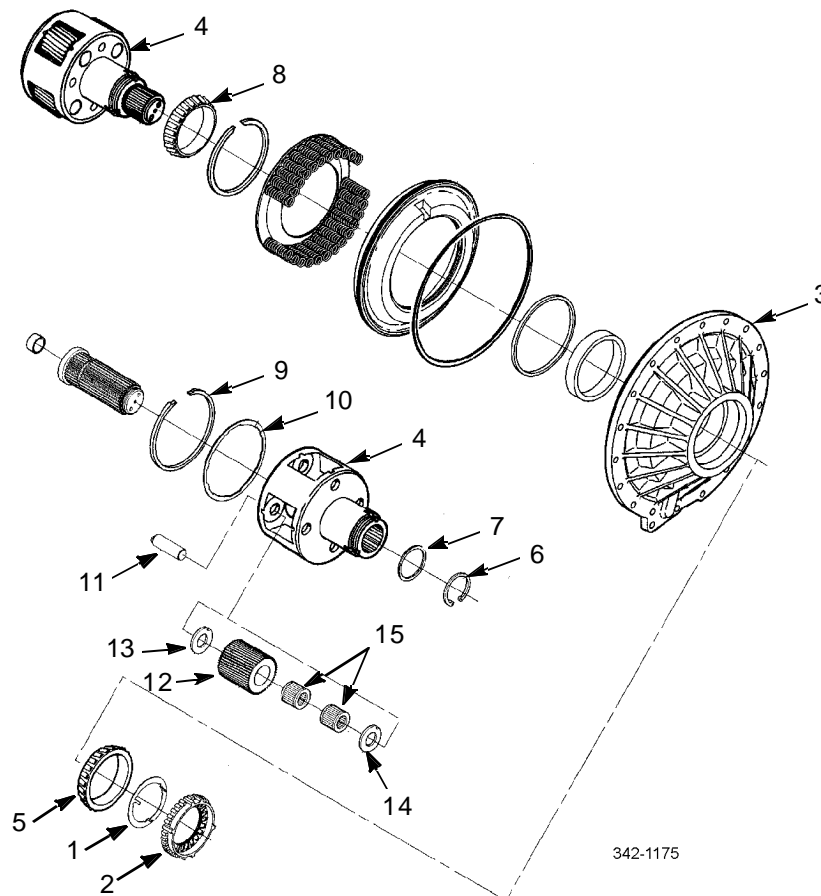
1. If removed, replace bushing (13) into P2 planetary carrier (5) using a press and tool (J37036). Press new bushing flush to 0.016 in (0.40 mm) below surface.
2. Install two bearing assemblies (12) into center of pinion gear (9). Install thrust washers (10 and 11) inside P2 planetary carrier (5), align thrust washer tangs with slots in planetary, and retain them with petrolatum. Slide pinion gear and bearing assemblies into side of P2 planetary carrier between thrust washers. Repeat procedure for remaining five pinion gears.
3. Install four pinion spindles (8) so that lower step is positioned for proper installation of indexing ring (7).
4. Install indexing ring (7) and retaining (6) to secure pinion gears in place.
5. Measure pinion end play. Pinion end play must not exceed 0.037 in (0.94 mm). Check all four pinion gears.
6. Install P3 planetary ring gear (2) over P2 planetary carrier assembly (5).
7. Install retaining ring (1) into P3 planetary ring gear (2) so that P2 planetary carrier and P3 planetary ring gear are assembled.
8. Install thrust bearing (4) on planetary module (3).



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MODULE OVERHAUL - CONTINUED**Rear Cover and P3 Planetary Module Disassembly**

1. Straighten tangs of lock nut retainer (1) to allow removal of bearing retainer lock nut (2). Remove bearing retainer lock nut using tool (J37035). Remove lock nut retainer.
2. Support rear cover assembly (3) so that P3 planetary carrier assembly (4) can be removed. Place tool (J37035-1) over output shaft splines and against threaded shoulder of P3 planetary carrier. Using a hydraulic press or a mallet, press on tool (J37035-1) to separate planetary carrier from rear cover.
3. Inspect rear cover cone and roller bearing (5). If worn or damaged, remove using tool (J3940).

**WARNING**

Place P3 planetary carrier assembly on its side during disassembly to avoid possible hand injury.

4. Remove retaining ring (6) and thrust washer (7) from P3 planetary carrier assembly (4).
5. Inspect planetary carrier cone and roller bearing (8). If worn or damaged, remove.
6. Remove retaining ring (9), indexing ring (10), and four pinion spindles (11) from P3 planetary carrier (4).
7. Remove pinion gear (12), thrust washers (13 and 14), and two bearing assemblies (15) from side of the P3 planetary carrier (4). Repeat procedures for remaining pinion gears. Measure thickness and step wear of thrust washers. Minimum thrust washer thickness allowed is 0.055 in (1.40 mm). Maximum step wear allowed is 0.005 in (0.12 mm).

MODULE OVERHAUL - CONTINUED**Rear Cover and P3 Planetary Module Disassembly - Continued**

8. Inspect and measure bushing (16) inside end of output shaft (17) for damage or wear. The maximum ID of bushing is 1.423 in (36.14 mm).

WARNING

Rear cover spring and retainer assembly contains highly compressed springs. Be extremely careful during disassembly. Personal injury can occur if spring force is not controlled.

9. Remove C5 clutch piston (18) from rear cover (3) by compressing spring and retainer assembly (19), using tool (J37030-3) tool base, washer, bearing, handle, and piston compressor (J37030-2). Remove retaining ring (20) and slowly release spring force.
10. Remove outer seal ring (21) and inner seal ring (22) from C5 clutch piston (18).
11. Inspect bearing cup (23). If worn or damaged, remove using tool (J3940).

Rear Cover and P3 Planetary Module Assembly

1. If removed, install new bearing cup (23), using bearing tool (J37033) and drive sleeve tool (J37034).
2. Install inner seal ring (22) and outer seal ring (21) onto C5 clutch piston (18).
3. Align tang notch on rear of C5 clutch piston (18) with tang in rear cover (3), while installing C5 clutch piston into rear cover.
4. Install spring and retainer assembly (19) while aligning tab in spring and retainer assembly with notch in rear cover (3).

WARNING

Rear cover spring and retainer assembly contains highly compressed springs. Be extremely careful during assembly. Personal injury can occur if the spring force is not controlled.

5. Compress spring and retainer assembly (19) using (J37030-3) tool base, washer, bearing, handle, and piston spring compressor (J37030-2). Install retaining ring (20) and slowly release spring force.
6. If removed, install cone and roller bearing (8). Use driver sleeve tool (J37034) and press bearing against shoulder on P3 planetary carrier (4).
7. If removed, press bushing (16) inside end of output shaft (17) using installer tool (J37036) and a press.
8. Install output shaft (17), thrust washer (7), and retaining ring (6).
9. Install two bearing assemblies (15) into center of pinion gear (12). Install thrust washers (13 and 14) inside P3 planetary carrier (4), align thrust washer tangs with slots in planetary carrier, and retain them with petrolatum. Slide pinion gear and bearing assemblies into side of P3 planetary carrier between thrust washers. Repeat procedure for remaining three pinion gears.
10. Install four pinion spindles (11) so that lower step is positioned for proper installation of indexing ring (10).

MODULE OVERHAUL - CONTINUED

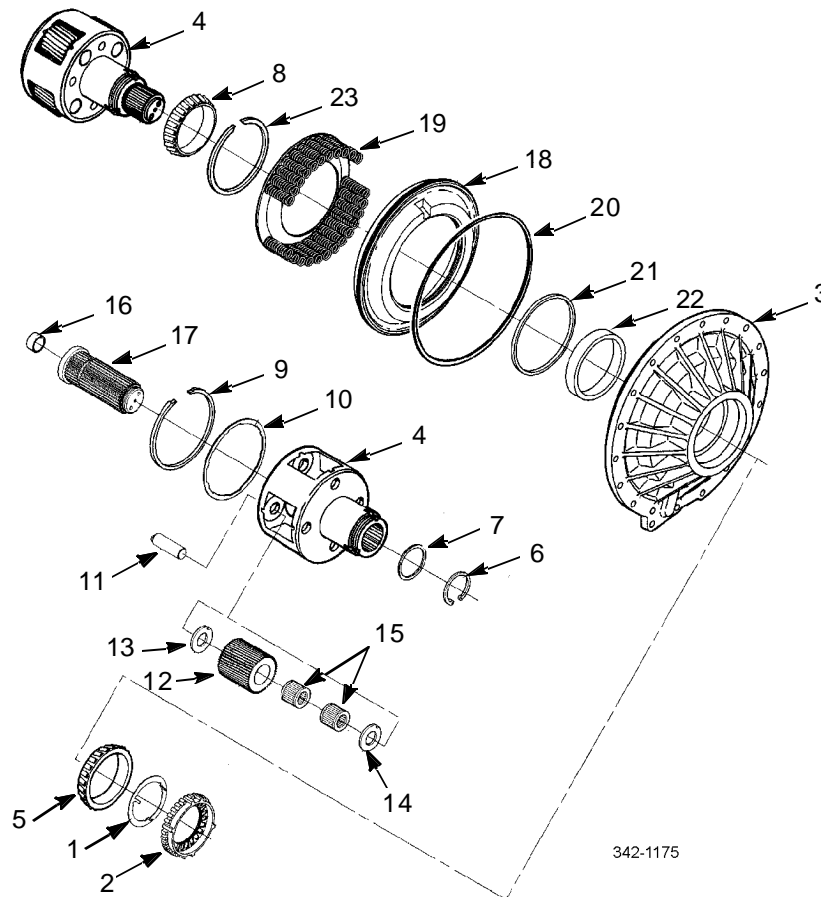
Rear Cover and P3 Planetary Module Assembly - Continued

11. Install indexing ring (10) and retaining ring (9).
12. Measure pinion end play. Pinion end play must not exceed 0.037 in (0.94 mm). Check all four pinions.
13. Place P3 planetary carrier assembly (4) on work bench with output shaft up. Place rear cover (3) over output shaft.
14. If removed, install cone and roller bearing (5) into rear cover assembly (3) using drive sleeve tool J37034.
15. Install new lock nut retainer (1).

CAUTION

Over-tightening bearing retainer lock nut will damage cone and roller bearing assembly.

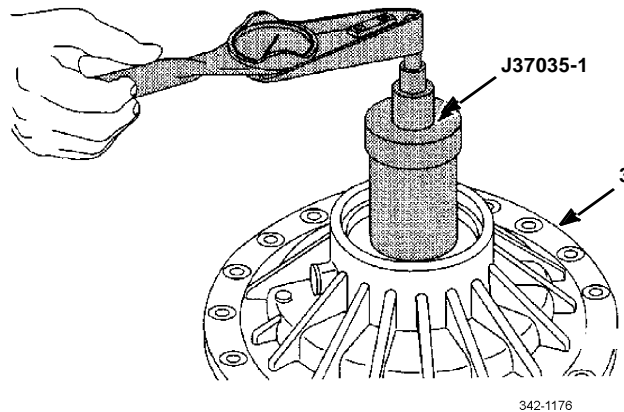
16. Install bearing retainer lock nut (2). Tighten lock nut to 55-65 lb-ft (74-88 Nm).



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MODULE OVERHAUL - CONTINUED**Rear Cover and P3 Planetary Module Assembly - Continued**

17. Position and support rear cover assembly (3) so that turning torque of P3 planetary carrier assembly can be checked after installation of bearing retainer lock nut (2). Use tool (J37035-1) to check turning torque. Maximum turning torque is 27 lb-in (3 Nm).

**Control Valve Module Disassembly****NOTE**

The control valve module assembly springs and other parts can be mistakenly interchanged. Tag each part with its item name as it is removed and use valve tray set (J33163) to simplify correct valve reassembly.

1. Remove bolt (1) and two bolts (2) securing the suction filter housing (3).
2. Remove suction filter housing (3), filter (4), face seal (5), and gasket (6). Discard filter and gasket.
3. Remove four bolts (7) and wiring harness cover plate (8).
4. Tag and disconnect electrical connections.
5. Remove three bolts (9) and control harness assembly (10).
6. Remove three bolts (11) and rotating clutch solenoid body assembly (12).
7. Remove eight bolts (13) and stationary clutch solenoid assembly (14).
8. Remove two bolts (15) and main valve body assembly (16) (see page 0072 00-45 for illustration).

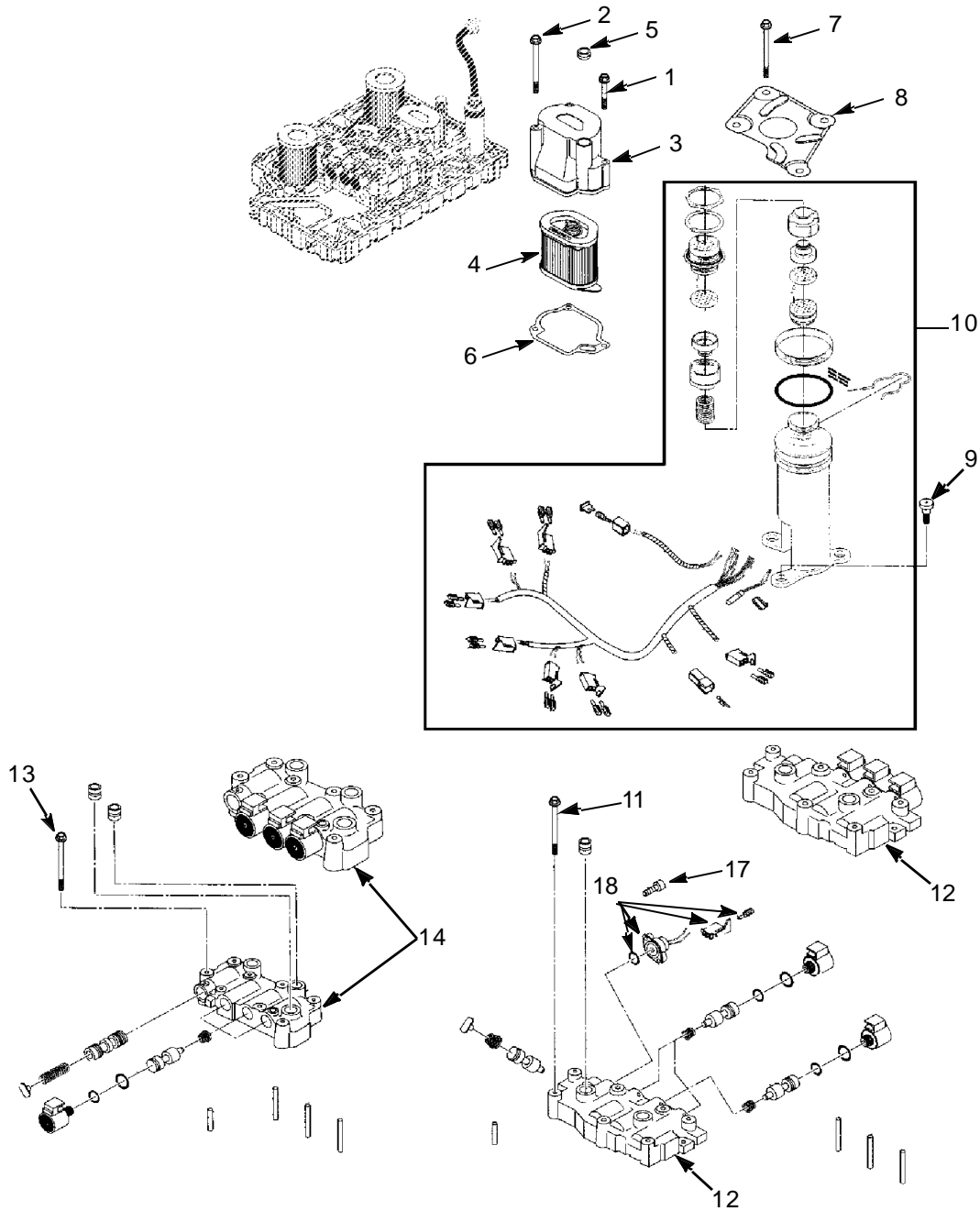
NOTE

Rotating clutch solenoid body disassembly procedures are steps 9 through 14.

9. Remove two bolts (17) and then remove C3 pressure switch (18) from rotating clutch solenoid body assembly (12).
10. Check resistance of C3 pressure switch. Maximum allowable resistance is 2 ohms when contacts are closed and must be 20,000 ohms minimum when contacts are open. Check pressure at which switch opens and closes. Both events must occur between 23-37 psi (159-255 kPa). Test block tool (J33884-25) is used to help make these checks.

MODULE OVERHAUL - CONTINUED

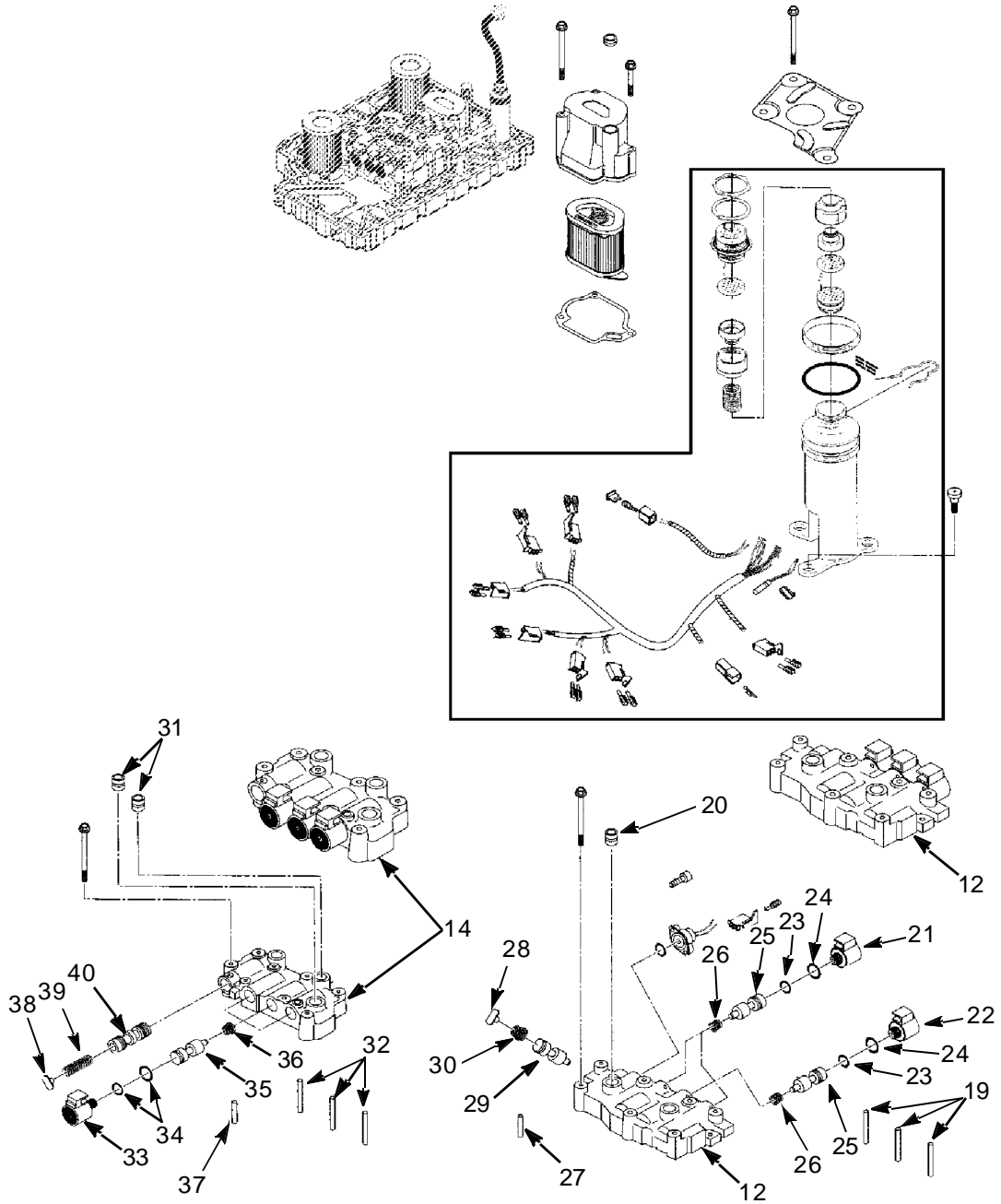
Control Valve Module Disassembly - Continued



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MODULE OVERHAUL - CONTINUED

Control Valve Module Disassembly - Continued



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MODULE OVERHAUL - CONTINUED**Control Valve Module Disassembly - Continued****NOTE**

Solenoid retention pins (19) must be removed from bottom of solenoid body. Note grooved end of pin for positive retention.

11. Remove face seal (20), two solenoids (21), and one solenoid (22) by removing retention pins (19).
12. Remove three smaller o-rings (23) and three larger o-rings (24). Remove three solenoid regulator valves (25) and three springs (26).
13. Check resistance of each solenoid. Resistance must be 2-5 ohms.
14. Remove valve retention pin (27), stop (28), valve (29), and spring (30) from rotating clutch solenoid body (12).

NOTE

Stationary clutch solenoid body disassembly procedures are steps 15 through 20.

15. Remove two seals (31) from stationary clutch solenoid body (14).

NOTE

Solenoid retention pin (32) must be removed from bottom of solenoid body. Note grooved end of pin for positive retention.

16. Remove three solenoid retention pins (32) from bottom of solenoid body (14).
17. Remove three solenoids (33), six o-rings (34), three solenoid regulator valves (35), and three springs (36).
18. Check resistances of solenoids. Resistance must be 2-5 ohms.
19. Remove valve retention pin (37), stop (38), spring (39), and valve (40).

MODULE OVERHAUL - CONTINUED**Control Valve Module Disassembly - Continued**

20. Remove solenoid separator plate (41).

NOTE

Main valve body disassembly procedures are steps 21 through 34.

21. If damaged, remove retention pin (42) from main valve body (16).

NOTE

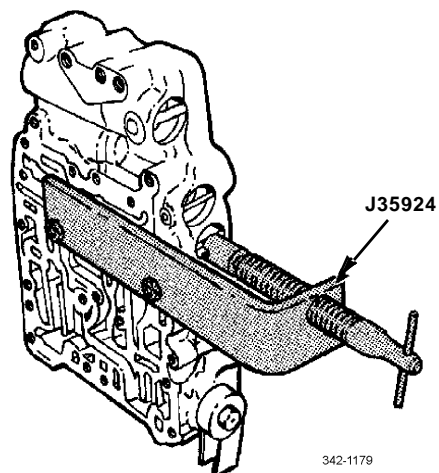
Solenoid retention pins must be removed from bottom of valve body. Note grooved end of pin for positive retention.

22. Remove solenoid retention pin (43) from bottom of valve body (16).
 23. Remove solenoid (44), small o-ring (45), and large o-ring (46).
 24. Check resistances of solenoids. Resistance must be 2-5 ohms.
 25. Remove valve retention pin (47). Remove stop (48), spring (49), and converter flow valve (50).
 26. Remove valve retention pin (51), stop (52), spring (53), and lubrication regulator valve (54).

WARNING

Spring (55) is highly compressed. Be extremely careful during disassembly. Personal injury can occur if spring force is not controlled.

27. Install spring compressor tool (J35924). Compress spring (55), then remove valve retention pin (56). Carefully release spring force by rotating tool handle counterclockwise. Remove spring compressor tool.

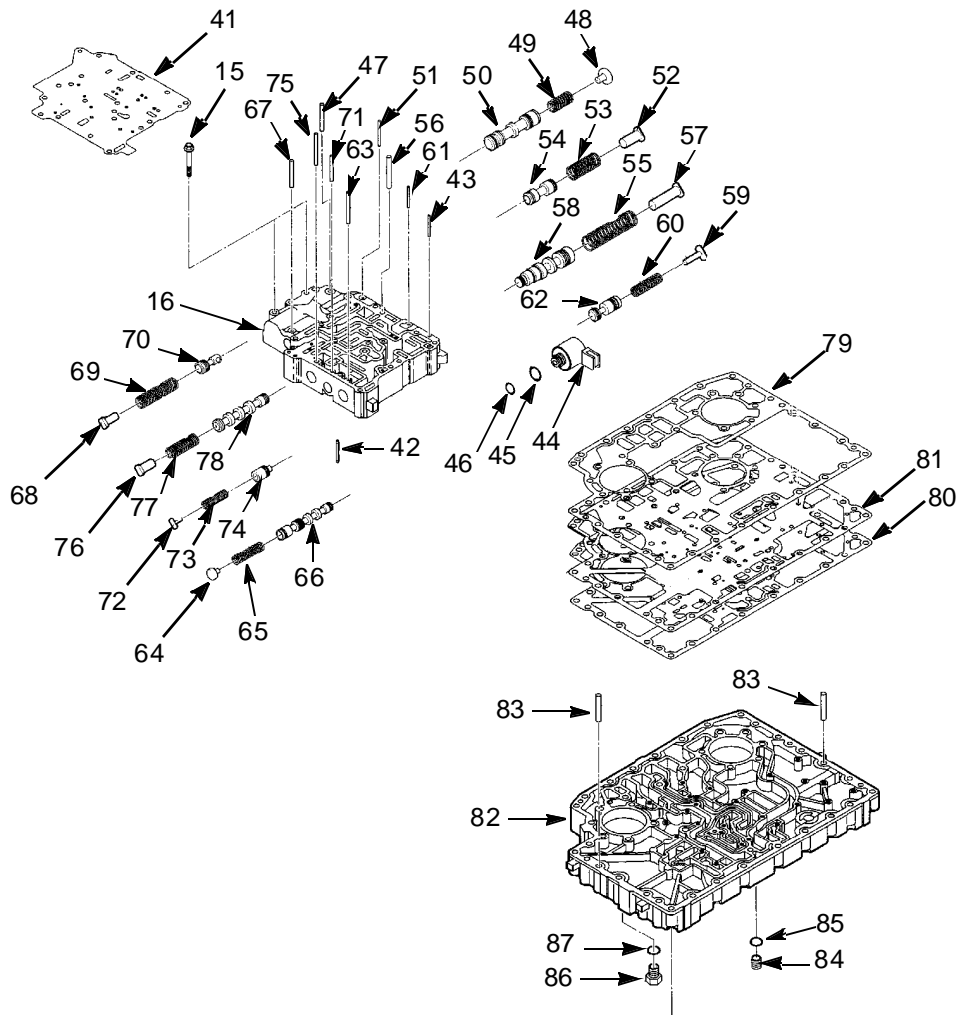


28. Remove stop (57), spring (55), and main regulator valve (58).
 29. Push against stop (59) to compress spring (60) and remove valve retention pin (61). Slowly release pressure against stop (59) and remove stop, spring, and main control valve (62).
 30. Remove valve retention pin (63), stop (64), spring (65), and C2 latch valve (66).
 31. Remove retention pin (67), stop (68), spring (69), and exhaust back pressure valve (70).

MODULE OVERHAUL - CONTINUED

Control Valve Module Disassembly - Continued

32. Remove retention pin (71), stop (72), spring (73), and C1 latching valve (74).
33. Remove retention pin (75), stop (76), spring (77), and converter regulator valve (78).



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34. Remove gaskets (79 and 80) and separator plate (81) from channel plate assembly (82). Discard gaskets.

NOTE

Channel plate disassembly procedures are steps 35 through 37.

35. If damaged, remove two pins (83) from channel plate assembly (82).
36. Remove drain plug (84) and o-ring (85) from channel plate assembly (82). Discard o-ring.
37. Remove eight pressure tap plugs (86) and o-rings (87) from channel plate assembly (82). Discard o-ring.

MODULE OVERHAUL - CONTINUED**Control Valve Module Assembly****NOTE**

Channel plate assembly procedures are steps 1 through 4.

1. Install eight pressure tap plugs (86) and new o-rings (87). Tighten plugs to 7-10 lb-ft (10-13 Nm).
2. Install drain plug (84) and new o-ring (85). Tighten drain plug to 18-24 lb-ft (25-32 Nm).
3. If removed, install two pins (83) in channel plate assembly (82).
4. Install new gaskets (79 and 80) with separator plate (81) on channel plate assembly (82).

NOTE

Main valve body assembly procedures are steps 5 through 18.

5. Install converter regulator valve (78), spring (77), and stop (76).
6. Install valve retention pin (75) by pushing against stop (76) to compress spring (77).
7. Install C1 latching valve (74), spring (73), and stop (72). Install retention pin (71).
8. Install exhaust back pressure valve (70), spring (69), and stop (68). Install retention pin (67).
9. Install C2 latch valve (66), spring (65), and stop (64). Install retention pin (63).

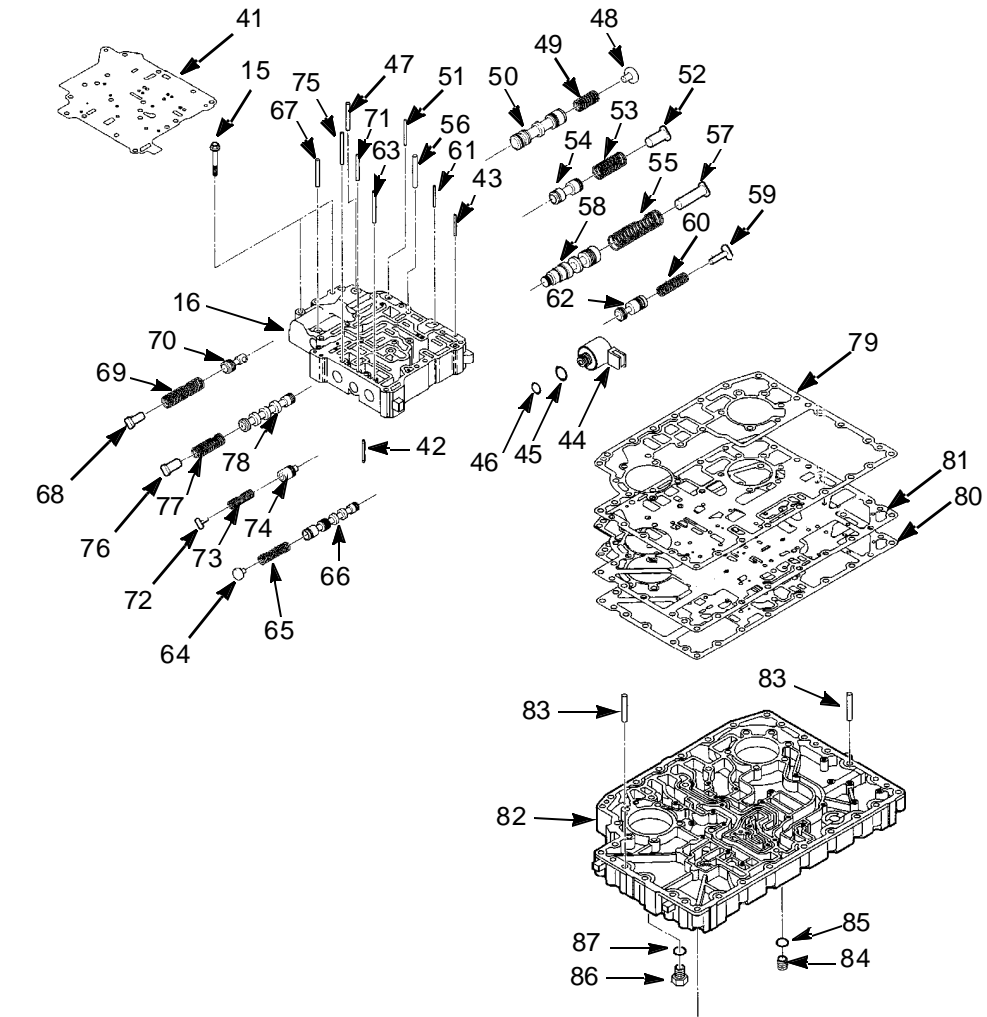
WARNING

Spring (55) is highly compressed. Be extremely careful during assembly. Personal injury can occur if spring force is not controlled.

10. Install main control valve (62), spring (60), and stop (59). Install retention pin (61).
11. Install main regulator valve (58), spring (55), and stop (57).
12. Using spring compressor tool (J35924), compress spring (55) and install valve retention pin (56).
13. Carefully remove compressor tool.
14. Install lubrication regulator valve (54), spring (53), and stop (52). Install retention pin (51).
15. Install converter flow valve (50), spring (49), and stop (48). Install retention pin (47).
16. Install new small o-ring (45) and new large o-ring (46) on solenoid (44). Install solenoid.
17. Install solenoid retention pin (43), smooth side first, from bottom of main valve body assembly (16).
18. If removed, install retention pin (42) in main valve body assembly (16).

MODULE OVERHAUL - CONTINUED

Control Valve Module Assembly - Continued



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MODULE OVERHAUL - CONTINUED**Control Valve Module Assembly - Continued****NOTE**

Stationary clutch solenoid body assembly procedures are steps 19 through 22.

19. Install valve (40), spring (39), and stop (38) in stationary clutch solenoid body (14). Install retention pin (37).
20. Install three springs (36), solenoid regulator valves (35), six new o-rings (34), and three solenoids (33).
21. As valve bores are filled, install three solenoid retention pins (32), smooth end first from bottom of solenoid body.
22. Install two new seals (31) in stationary clutch solenoid body (14).

NOTE

Rotating clutch solenoid body assembly procedures are steps 23 through 27.

23. Install spring (30), valve (29), and stop (28) in rotating clutch solenoid body (12) with retention pin (27).
24. Install three springs (26), three solenoid regulator valves (25), new smaller o-rings (23), and new larger o-rings (24).
25. Install face seal (20), two solenoids (21), and solenoid (22).
26. Install solenoid retention pins (19), smooth end first, from bottom of rotating clutch solenoid body (12).
27. Install pressure switch assembly (18) and two bolts (17). Tighten bolts to 44-71 lb-in (5-8 Nm).

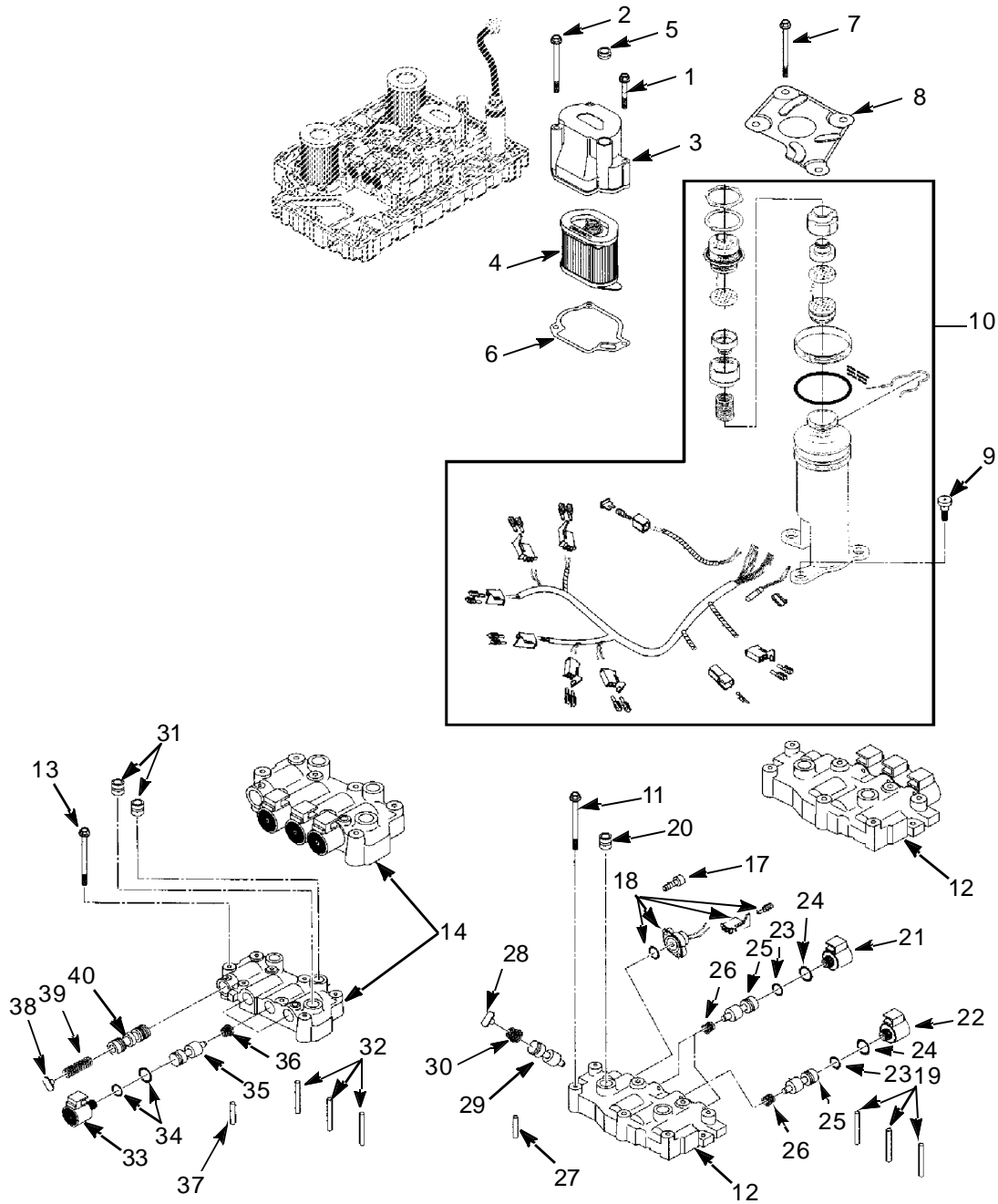
NOTE

Control valve module assembly procedures are steps 28 through 37.

28. Install main valve body assembly (16) and two bolts (15) (see page 0072 00-45 for illustration). Tighten bolts only finger tight.
29. Install control harness assembly (10) with three bolts (9). Tighten bolts to 18-26 lb-in (2-3 Nm).
30. Install new gasket (6), new face seal (5) and new filter (4) in suction filter housing (3).
31. Install suction filter housing (3) with bolts (1) and two bolts (2). Tighten bolts only finger tight.
32. Install solenoid separator plate (41).
33. Install stationary clutch solenoid body assembly (14) with eight bolts (13). Tighten bolts only finger tight.
34. Install rotating clutch solenoid body (12) with three bolts (11). Tighten bolts only finger tight.
35. Install wiring harness cover plate (8) with four bolts (7). Tighten bolts only finger tight.
36. Connect all electrical connectors. Remove tags.
37. Evenly tighten cover plate bolts (7), suction filter bolts (1 and 2), valve body bolts (11, 13, and 9). Tighten all bolts to 7-10 lb-ft (10-13 Nm).

MODULE OVERHAUL - CONTINUED

Control Valve Module Assembly - Continued



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ASSEMBLY**WARNING**

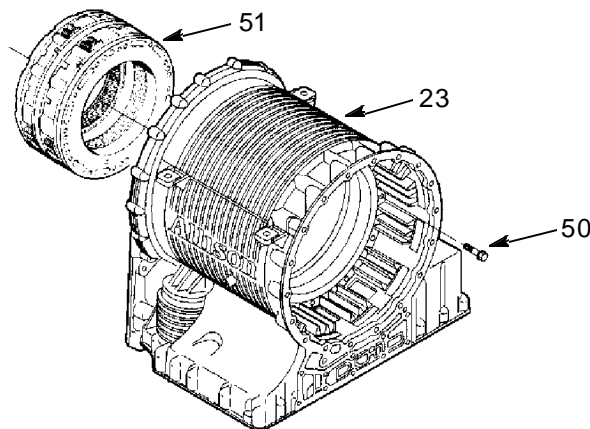
Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

NOTE

- Ensure all transmission components are cleaned and well lubricated before reassembling transmission assembly.
- Before beginning assembly, attach bracket (J41445) and holding fixture (J35926) to main transmission housing. Use a suitable hoist to mount fixture and housing on a repair stand.
- Ensure main housing is horizontal when installing C3/C4 clutch Module.

Installation of C3/C4 Clutch Assembly

1. Install C3/C4 clutch assembly (51) through input end of main housing (23), aligning bolt holes in clutch assembly with holes in main housing.
2. Install two bolts (50), 180 degrees from each other, to hold clutch in place.
3. Rotate transmission housing on stand and install remaining 12 bolts (50). Tighten bolts to 38-45 lb-ft (51-61 Nm).

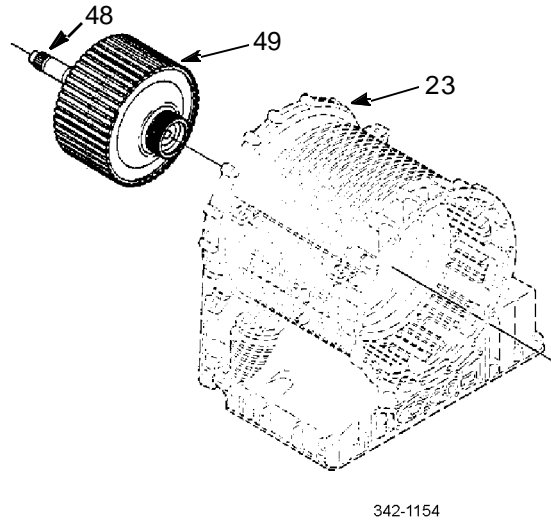
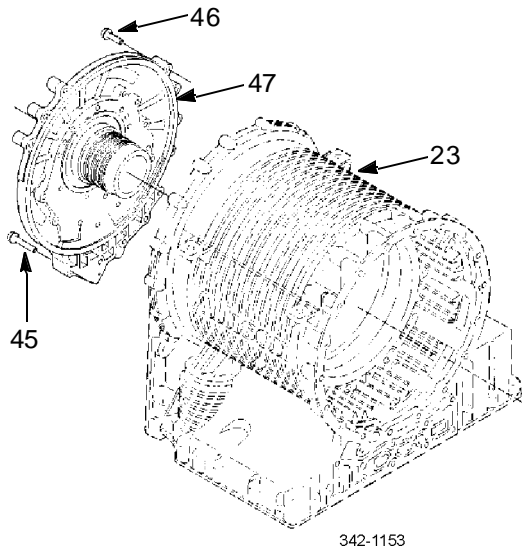


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Installation of Rotating Clutch Module and Front Support and Charging Pump Module

1. Install an M16 eye bolt into turbine shaft (48). Using a suitable hoist, install rotating clutch module (49) into main housing (23). Remove eye bolt.
2. Lower front support and charging pump module (47) over top of turbine shaft (48).
3. Align bolt holes in front support and charging pump module (47) with threaded holes in main housing (23).
4. Install seven bolts (46) and seven bolts (45) in front support and charging pump module (47). Tighten bolts to 38-45 lb-ft (51-61 Nm).

ASSEMBLY - CONTINUED

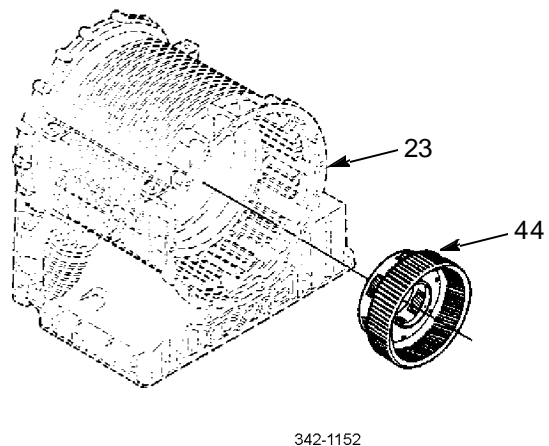
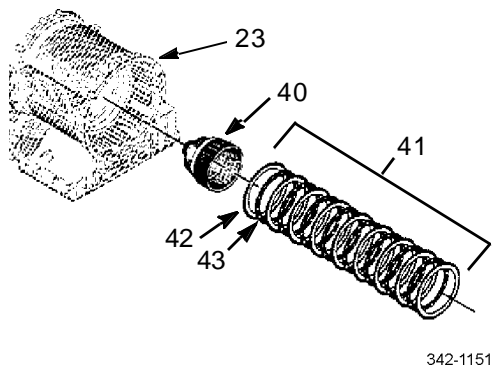


Installation of P1/P2 Planetary Modules

1. Install P1 planetary module (44), consisting of P1 carrier and P2 ring gear.
2. Mesh P1 pinion gears with P1 ring gear inside C3/C4 clutch assembly.
3. Install P2 planetary module (40), consisting of P2 carrier and P3 ring gear.
4. Mesh P2 pinion gears with P2 ring gear during installation.

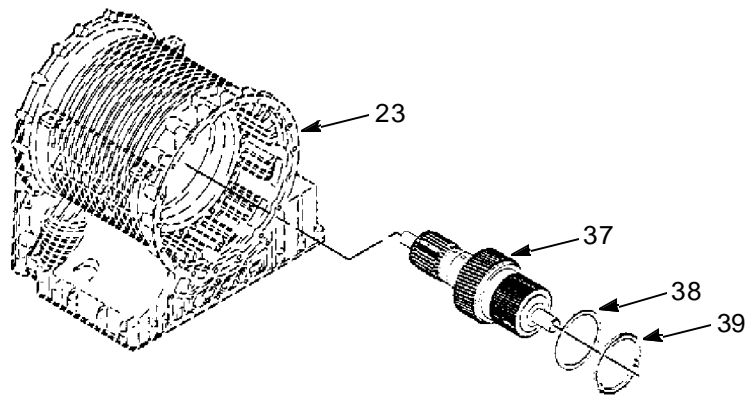
Installation of C5 Clutch Pack

1. Install C5 clutch pack (41) in main housing (23). Clutch pack consists of nine steel reaction plates (43) and eight friction plates (42), stacked alternately, starting with a steel reaction plate.
2. Stack all plates so that plate cone faces same direction. Steel plates mesh with main housing (23) and reaction plates mesh with P3 ring gear.



ASSEMBLY - CONTINUED**Installation of Main Shaft Module and Selective Shim Measurement**

1. Install main shaft module assembly (37) in main housing (23), without selective shim (39) and thrust bearing (38).



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2. Place a straightedge across rear cover mounting surface.
3. Measure dimension "A", from top of straightedge to selective shim thrust surface on main shaft bearing spacer.
4. Measure dimension "B", thickness of straightedge. Subtract "B" from "A"; remainder is dimension "C".

ASSEMBLY - CONTINUED

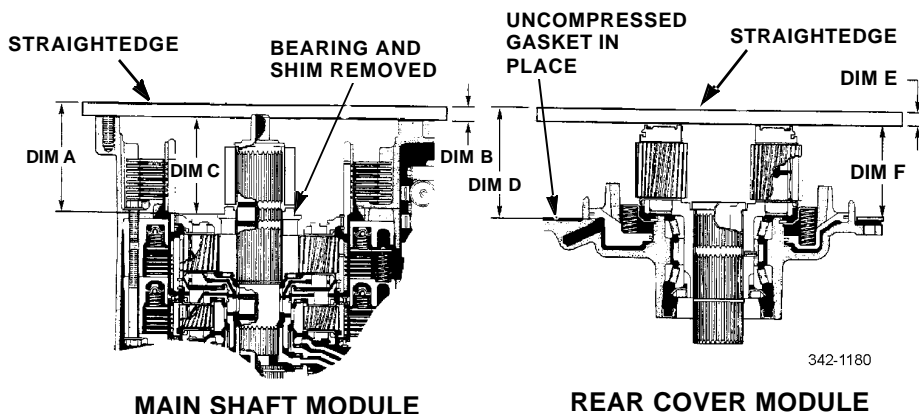
Installation of Main Shaft Module and Selective Shim Measurement - Continued

5. Place rear cover, output end down (facing work bench). Install an uncompressed gasket on rear cover mounting surface and place a straightedge across P3 planetary carrier.
6. Measure dimension "D", from top of straightedge to rear cover mounting gasket.
7. Measure dimension "E", thickness of straightedge. Subtract dimension "E" from dimension "D"; remainder is dimension "F".
8. Dimension "G" is remainder of "C" minus "F" and determines thickness of selective shim (39).

CAUTION

Ensure thrust bearing is assembled with locating lip on either inner or outer thrust bearing race, not preventing race from contacting thrust surface of mating part. Failure to follow this caution leads to thrust bearing failure and incorrect shim selection to maintain proper part clearance.

9. Install proper thickness selective shim (39) and thrust bearing (38).



PROCEDURE: FORMULA (C) - (F) = G

DIM G	USE P/N	SHIM ID
4.574-4.843 mm (0.180-0.190 in)	29503218	1 Notch
4.844-5.113 mm (0.192-0.201 in)	29503219	2 Notches
5.114-5.383 mm (0.202-0.212 in)	29503220	3 Notches
5.384-5.653 mm (0.213-0.223 in)	29503221	4 Notches
5.654-5.923 mm (0.224-0.233 in)	29503222	5 Notches
5.924-6.193 mm (0.234-0.244 in)	29503223	6 Notches
6.194-6.463 mm (0.245-0.254 in)	29503224	7 Notches

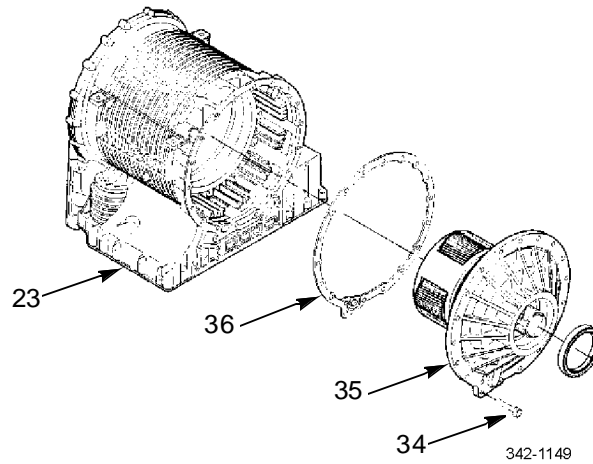
ASSEMBLY - CONTINUED**Installation of Rear Cover Module**

1. Install new rear cover gasket (36) on main housing (23).
2. Place rear cover module (35) on main housing (23) using suitable hoist and sling as a lifting fixture.
3. Install 19 bolts (34). Evenly tighten bolts to 66-81 lb-ft (90-110 Nm).
4. Retighten retainer lock nut using tool (J37035-1) to 55-65 lb-ft (74-88 Nm).

NOTE

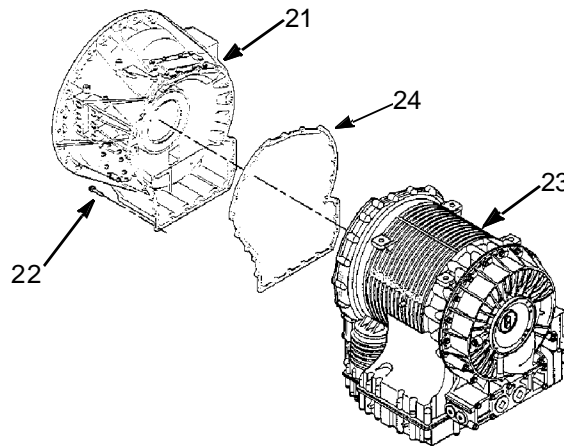
Do not reuse lock nut retainer locking tang once it has been bent. If all tangs have been used (bent), replace lock nut retainer.

5. Locate one new locking tang on retainer and bend it up to hold retainer lock nut.



ASSEMBLY - CONTINUED**Installation of Torque Converter Housing Module**

1. Position transmission with input end up. Install a new converter housing gasket (24) on main housing (23).
2. Lower torque converter housing (21) onto main housing (23) while rotating PTO drive gear to align gear teeth with charging pump.
3. Install seven bolts (22) into inside of torque converter housing (21). Use of mechanical fingers or similar tool may be required to insert and start bolts.
4. Install remaining 18 bolts (22). Tighten all bolts to 55-65 lb-ft (74-88 Nm)



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Installation of Torque Converter Module and Selective Shim Measurement**NOTE**

- Torque converter is installed over turbine shaft which rotates inside stator shaft or ground sleeve. Splines on ground sleeve engage converter stator. Splines on turbine shaft engage converter turbine. End of turbine shaft is threaded and machined to accept converter retaining bolt and lockup seal ring.
- Splines of ground sleeve and turbine shaft must engage with their respective splines in torque converter module. Tangs on converter-pump hub must engage charging pump's drive gear or PTO oil pump drive gear hub.

1. Using a suitable hoist and sling, install torque converter module (18) into torque converter housing (21).
2. Ensure that torque converter module (18) is properly seated. Rotate PTO gear to engage pump hub with charging pump.
3. Install converter end play gage tool (J38548) and tighten attaching bolts to 20-25 lb-ft (27-34 Nm). Install two bolts (16) into flexplate adapter (17). Use two bars at an angle to prevent turbine shaft rotation.
4. Measure from top of end play gage tool (J38548) to face of turbine shaft and record it as dimension "B". Subtract dimension "B" from dimension "A" to determine dimension "C" (Note dimension "A" is height of tool J38548, 3.937 inch (100.00 mm).

ASSEMBLY - CONTINUED

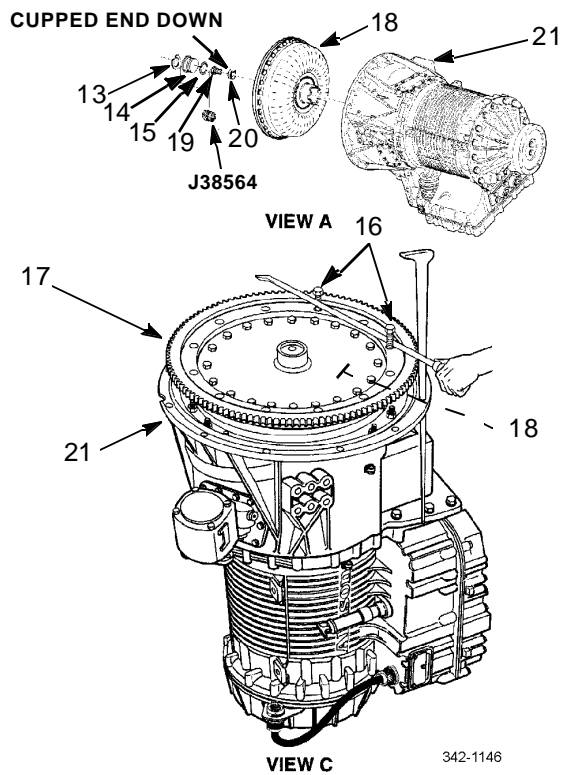
Installation of Torque Converter Module and Selective Shim Measurement - Continued

5. Use dimension "C" and Table 1, *Torque Converter Selective Shims*, located at the end of this work package, to determine proper selective shim part number.
6. Remove torque converter end play tool (J37548).
7. Install selective shim (20) with step side down, toward turbine shaft. Install converter center bolt (19) with converter tightening tool (J38564) and retaining ring (13).

NOTE

Turbine and turbine shaft may rotate while attempting to tighten retaining bolt. Prevent turbine shaft from turning in same manner as in step number 3.

8. Tighten converter center bolt (19) to 74-88 lb-ft (100-120 Nm). Remove retaining ring (13) and tool (J38564) and replace with converter plug (14), o-ring (15), and retaining ring (13).
9. Install torque converter shipping bracket. Tighten shipping bracket mounting bolts to 38-45 lb-ft (51-61 Nm).

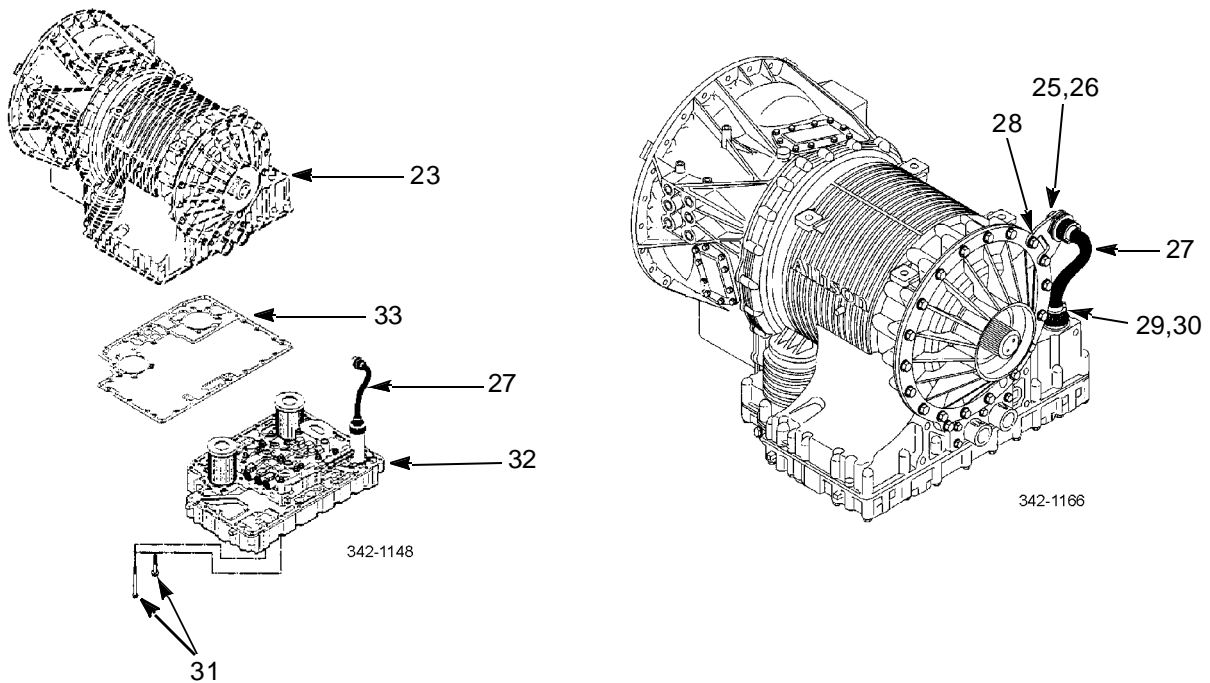


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ASSEMBLY - CONTINUED

Installation of Control Valve Module

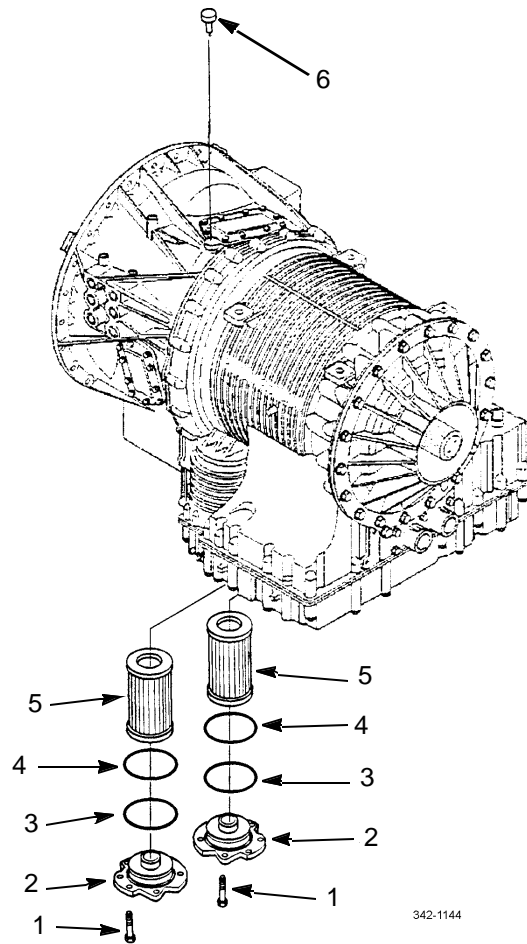
1. Position transmission in a vertical position, torque converter up.
2. Install two guide pins in two main housing bolt holes. Install new control module gasket (33) over guide pins.
3. Lubricate wiring harness feed-through hole with petrolatum.
4. With assistance, guide control module (32) onto main housing (23) and pass feed-through harness (27) through feed-through hole in the main housing.
5. Align control module (32) bolt holes with guide pins. Ensure feed-through harness standoff is aligned with hole in main housing (23).
6. Lower control module (32) over guide pins until it seats against main housing (23) and feed-through harness standoff seats against tapered hole in main housing.
7. Remove guide pins and install 43 bolts (31). Evenly tighten bolts to 38-45 lb-ft (51-61 Nm).
8. Install retaining nut (25) and lock washer (26) to secure feed-through harness (27) to mounting bracket (28).
9. Install retaining nut (29) and lock washer (30) to secure feed-through harness (27) to transmission housing (23).



ASSEMBLY - CONTINUED

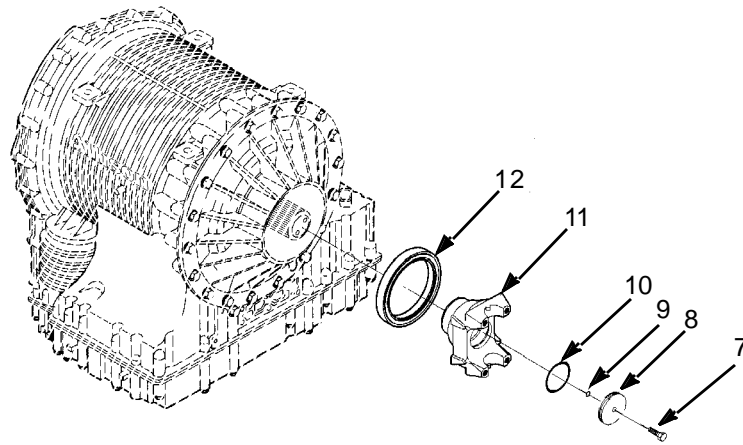
Installation of Filters and Breather

1. Install 12 bolts (1), two filter covers (2), new o-rings (3), new square cut seals (4), and new filters (5) in control module.
2. Install transmission breather vent (6) in torque converter housing.



ASSEMBLY - CONTINUED**Installation of Output Shaft and Oil Seal**

1. Install new oil seal (12) in rear cover.
2. Install output yoke (11) and new o-ring (10).
3. Insert bolt (7) through retainer plug (8). Install a new o-ring (9) on bolt so that o-ring seats against retainer plug.
4. Install retainer plug (8) into yoke (11). Tighten bolt (7) to 38-45 lb-ft (51-61 Nm).



342-1145

5. Install engine, turbine, and output speed sensors (TM 9-2320-302-20).

TABULATED DATA

Table 1. Torque Converter Selective Shims.

DIMENSION C	USE P/N	SHIM THICKNESS (REF.)	ID NO.
0.4129-0.6598 mm (0.0163-0.0259 in)	29505688	4.000 mm (0.157 in)	0
0.6597-0.8378 mm (0.0260-0.0329 in)	29505681	4.203 mm (0.165 in)	1
0.8379-1.0158 mm (0.0330-0.0399 in)	29505682	4.381 mm (0.172 in)	2
1.0159-1.1938 mm (0.0400-0.0469 in)	29505683	4.559 mm (0.179 in)	3
1.1939-1.3708 mm (0.0470-0.0539 in)	29505684	4.736 mm (0.186 in)	4
1.3709-1.5488 mm (0.0540-0.0609 in)	29505685	4.914 mm (0.193 in)	5
1.5489-1.7268 mm (0.0610-0.0679 in)	29505686	5.092 mm(0.200 in)	6
1.7269-1.9048 mm (0.0680-0.0749 in)	29507793	5.230 mm (0.207 in)	7
1.9049-1.9733 mm (0.0750-0.0776 in)	29507794	5.448 mm (0.214 in)	8

Table 2. Wear Limits Data.

DESCRIPTION	WEAR LIMIT	
	MM	INCHES
TORQUE CONVERTER MODULE		
Converter Cover Bushing, Maximum ID	66.91	2.634
Lockup Piston Assembly, Minimum Thickness	6.53	0.257
Damper Assembly Plate, Maximum Distortion	0.51	0.020
Damper Assembly Plate, Minimum Thickness	8.51	0.335
Turbine-to-damper, Maximum Spline Wear	0.38	0.015
Backplate, Maximum Distortion	0.15	0.006
Backplate, Minimum Wear Surface Thickness	11.79	0.464
Turbine Hub, Minimum OD	66.69	2.626
Stator Thrust Plate, Minimum Thickness	9.45	0.372
Converter Pump Hub, Minimum OD	88.99	3.504
TORQUE CONVERTER HOUSING MODULE - PTO EQUIPPED		
Bearing Retainer Bushing, Maximum ID	89.19	3.511
Oil Pump Drive Hub Seal, Minimum End Gap	1.18	0.046
Oil Pump Drive Hub Seal, Maximum End Gap	1.66	0.065
Oil Pump Drive Hub, Maximum Tank Wear	0.31	0.012

Table 2. Wear Limits Data.

DESCRIPTION	WEAR LIMIT	
	MM	INCHES
FRONT SUPPORT AND CHARGING PUMP MODULE		
Pump Housing Bushing, Maximum ID	89.19	3.511
Pump Housing Gear, Maximum Cavity Depth	19.04	0.750
Pump Housing Gear, Maximum Cavity Diameter	150.25	5.915
Driven Gear-to-pump Housing, Maximum Diametric Clearance	0.30	0.012
Gear Set, Maximum Gear Tooth Tip Clearance	0.15	0.006
Pump Gear Bushing, Maximum ID	66.93	2.635
Ground Sleeve, Minimum OD in Bushing Area	66.67	2.625
Spline OD, Maximum Total Runout	0.13	0.005
Front Support, Minimum OD	119.81	4.717
Front Support Seal, Minimum End Gap	1.00	0.040
Front Support Seal, Maximum End Gap	1.44	0.057
ROTATING CLUTCH MODULE		
Turbine Shaft Bushing, Maximum ID	36.14	1.423
Turbine Seal, Minimum End Gap	0.65	0.026
Turbine Seal, Maximum End Gap	1.01	0.040
Drum Spline, Maximum Wear	0.38	0.015
Rotating Clutch Hub Bushing, Maximum ID	120.27	4.735
C1, C2 Clutch Backplate, Minimum Thickness	7.90	0.311
C1, C2 Clutch Backplate, Maximum Distortion	0.15	0.006
C1, C2 Friction Plate, Maximum Cone	0.25	0.010
C1, C2 Friction Plate, Minimum Thickness	2.92	0.115
C1, C2 Friction Plate, Minimum Oil Groove Depth	0.20	0.008
C1, C2 Reaction Steel Plate, Maximum Cone	0.25	0.010
C1, C2 Reaction Steel Plate, Minimum Thickness	2.41	0.095
C1, C2 Drive Hub, Maximum Spline Wear	0.38	0.015*
C2 Backplate, Minimum Thickness	7.90	0.311
C2 Backplate, Maximum Distortion	0.15	0.006
MAIN HOUSING MODULE		
Backplate, Maximum Step Wear	0.13	0.005
Backplate, Maximum Distortion	0.15	0.006
P1 Ring Thrust Plate, Minimum Thickness at Wear Point	2.82	0.111

Table 2. Wear Limits Data - Continued.

DESCRIPTION	WEAR LIMIT	
	MM	INCHES
MAIN HOUSING MODULE - CONTINUED		
P1 Ring Gear Spline, Maximum Wear	0.38	0.015
C3, C4, C5 Friction Plate, Maximum Cone	0.25	0.010
C3, C4, C5 Friction Plate, Minimum Thickness	3.485	0.137
C3, C4, C5 Reaction (Steel) Plate, Maximum Cone	0.25	0.010
C3, C4, C5 Reaction (Steel) Plate, Minimum Thickness	2.41	0.095
C3, C4, Clutch Housings, Maximum Spline Wear	1.15	0.045
Main Housing, Maximum Spline Wear	1.15	0.045
MAIN SHAFT MODULE - WIDE RATIO AND CLOSE RATIO		
Main Shaft Bearing Journal, Minimum OD	52.98	2.086
Main Shaft Pilots (Both Ends), Minimum OD	35.92	1.414
P1 PLANETARY MODULE		
P1 Planetary Carrier Assembly, Maximum Pinion End Play	0.94	0.037
P1 Carrier Bushing, Maximum ID	89.32	3.517
P1 Pinion Thrust Washer, Minimum Thickness	1.40	0.055
P1 Pinion Thrust Washer, Maximum Step Wear	0.12	0.005
P2 Ring Gear Spline, Maximum Wear	0.38	0.015
P2 PLANETARY MODULE		
P2 Planetary Carrier Assembly, Maximum Pinion End Play	0.94	0.037
P2 Carrier Bushing, Maximum ID	53.23	2.096
P2 Pinion Thrust Washer, Minimum Thickness	1.40	0.055
P2 Pinion Thrust Washer, Maximum Step Wear	0.12	0.005
P3 Ring Gear Spline, Maximum Wear	0.38	0.015
REAR COVER AND P3 MODULE		
P3 Planetary Carrier Assembly, Maximum End Play	0.94	0.037
Output Shaft Bushing, Maximum ID	36.14	1.423
Output Shaft, Maximum Spline Wear	0.38	0.015
P3 Pinion Thrust Washer, Minimum Thickness	1.40	0.055
P3 Pinion Thrust Washer, Maximum Step Wear	0.12	0.005
OUTPUT FLANGE AND YOKE		
Journal Seal, Maximum OD	85.0	3.346

Table 3. Wear Limits and Spring Data.

SPRING	PART NUMBER	COLOR CODE	NO. OF COILS	WIRE DIA MM (IN)	SPRING OD MM (IN)	APPROX FREE LENGTH MM (IN)	LENGTH UNDER LOAD	
							MM (IN)	N (LB)
Stator	29501300	No Code	N/A	N/A	N/A	17.8 (0.70)	5.7 (0.224)	0.9 (0.2)
Main Relief	29507709	No Code	10	3.25 (0.128)	17.96 (0.707)	52.4 (2.06)	40.7 (1.60)	474 (106.5)
C2 Return	29505719	No Code	11.5*	2.04* (0.080)	19.06* (0.750)	70.76* (2.786)	28.2 (1.110)	5185** (1165.6)
C1 Return	29509453	No Code	12*	2.10* (0.083)	16.0* (0.630)	57.53* (2.265)	34.8 (1.37)	4649** (1045.4)
C3 Return	29506206	No Code	13*	2.10* (0.083)	15.0* (0.590)	52.3* (2.06)	35.4 (1.39)	274.4** (61.69)
C3 Retainer	29507882	No Code	4*	2.36* (0.093)	12.62* (0.497)	11.2* (0.44)	9.3 (0.37)	16408** (3689)
C3 Retainer	29515628	No Code	4*	2.36* (0.093)	12.62* (0.497)	11.1* (0.44)	10.40 (0.41)	15403** (3463)
C4 Return	29506206	No Code	13*	2.10* (0.083)	15.0* (0.590)	52.3* (2.06)	35.4 (1.39)	274.4** (61.69)
C4 Retainer	29507882	No Code	4*	2.36* (0.093)	12.62* (0.497)	11.2* (0.44)	9.3 (0.37)	16408** (3689)
C4 Retainer	29515628	No Code	4*	2.36* (0.093)	12.62* (0.497)	11.1* (0.44)	10.40 (0.41)	15403** (3463)
Retarder	6880775	Yellow/ Red Stripe	12	1.93 (0.076)	16.61 (0.654)	53.8 (2.12)	35.30 (1.390)	81.4 (18.30)
Retarder Control	29510495	Silver	7.5	1.40 (0.055)	15.1 (0.594)	3.08 (1.212)	18.0 (0.71)	33 (7.42)
Retarder Control	29512792	Lt. Green (on end)	7.5	1.40 (0.055)	15.09 (0.594)	33.69 (1.326)	18.0 (0.71)	40 (9.0)
Retarder Control	29510494	Orange	7	1.60 (0.063)	15.50 (0.610)	27.8 (1.09)	18.0 (0.71)	44 (9.9)

* Individual springs

** For complete spring assembly

0071 00-63

TM 9-2320-302-34

Table 3. Wear Limits and Spring Data - Continued.

SPRING	PART NUMBER	COLOR CODE	NO OF COILS	WIRE DIA MM (IN)	SPRING OD MM (IN)	APPROX. FREE LENGTH MM (IN)	LENGTH UNDER LOAD	
							MM (IN)	N (LB)
Retarder Exh. Back	23049391	No Code	17	0.61 (0.024)	7.80 (0.307)	29.2 (1.14)	18.2 (0.72)	2 (0.5)
C5 Return	29503036	No Code	12*	2.10* (0.083)	17.00* (0.669)	57.3* (2.26)	37.6 (1.48)	3086** (693.8)
Solenoid Regulator	29502195	No Code	4	0.67 (0.026)	11.05 (0.440)	6.5 (0.26)	3.45 (0.14)	3 (0.7)
Accumulator Relay	29507455	Silver	12.8	1.28 (0.050)	11.68 (0.460)	43.6 (1.72)	20.0 (0.79)	47 (10.6)
Overdrive	23049332	Orange	12	0.76 (0.030)	7.75 (0.305)	26.6 (1.05)	12.5 (0.49)	12.0 (2.7)
Solenoid Regulator	29502195	No Code	4	0.67 (0.026)	11.05 (0.440)	6.5 (0.26)	3.45 (0.14)	3 (0.7)
Lockup	23049326	Yellow	10	1.37 (0.054)	14.1 (0.555)	42.1 (1.66)	17.0 (0.67)	49 (11.0)
Lube Regulator	23049327	Red	13	1.22 (0.048)	11.1 (0.437)	46.3 (1.82)	3.5 (0.93)	47 (10.6)
Main Regulator	29500963	Lt. Blue	15	2.87 (0.113)	22.00 (0.866)	98.5 (3.88)	54.6 (2.15)	305 (68.6)
Control Main	23049325	Orange	10	1.83 (0.072)	14.8 (0.583)	44.6 (1.76)	24.0 (0.95)	131 (29.5)
C2 Latch	29501071	Lt. Green	11	1.32 (0.052)	11.43 (0.450)	41.3 (1.63)	19.0 (0.75)	71.0 (16.0)
Exh. Back	23049391	No Code	17	0.61 (0.024)	7.80 (0.307)	29.2 (1.14)	18.2 (0.72)	2 (0.5)
C1 Latch	6885065	Blue	12	1.37 (0.054)	16.26 (0.640)	46.2 (1.82)	29.2 (1.15)	18 (4.0)
Converter Regulator	29507456	Pink	10.2	1.53 (0.060)	11.00 (0.433)	30.3 (1.19)	22.8 (0.90)	54 (12.1)

* Individual springs

** For complete spring assembly

0071 00-64

TM 9-2320-302-34

FRONT AXLE ASSEMBLY REPLACEMENT

0072 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Jack, hydraulic (Item 73, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)

Wrench set, socket, 3/4 in drive (Item 141, WP 0126 00)

Materials/Parts

Pin, cotter (P/N MS24665-357) (3)

Compound, adhesive (Item 10, WP 0125 00)

Compound, sealing (Item 15, WP 0125 00)

Personnel Required

Two

Equipment Condition

Front brake spider and brake chamber bracket removed (TM 9-2320-302-20)

ABS sensors removed (TM 9-2320-302-20)

Front shock absorbers removed (TM 9-2320-302-20)



WARNING

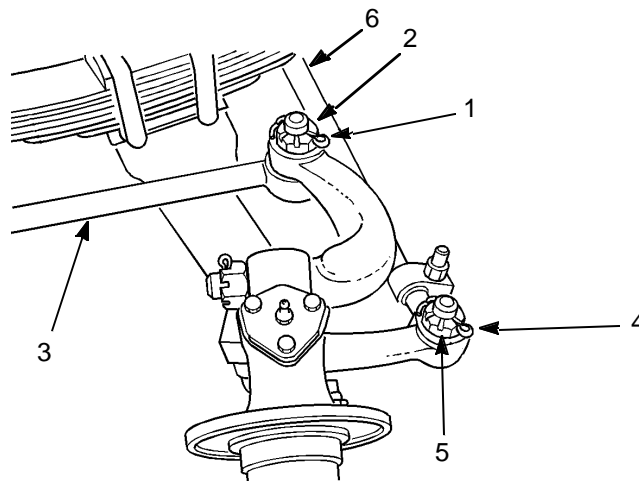


Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL**NOTE**

Procedure is same for both sides except where noted.

1. On left side, remove cotter pin (1) and castellated nut (2) and set drag link (3) aside. Discard cotter pin.
2. Remove two cotter pins (4), castellated nuts (5), and tie rod (6). Discard cotter pins.



342-1115

**WARNING**

Front axle weighs 1060 lb (481 kg). Support front axle with a suitable floor jack during removal to prevent possible injury to personnel.

NOTE

Ensure front of vehicle is blocked up enough to allow removal of axle.

3. Position suitable floor jack under center of axle (7) and secure axle to floor jack.

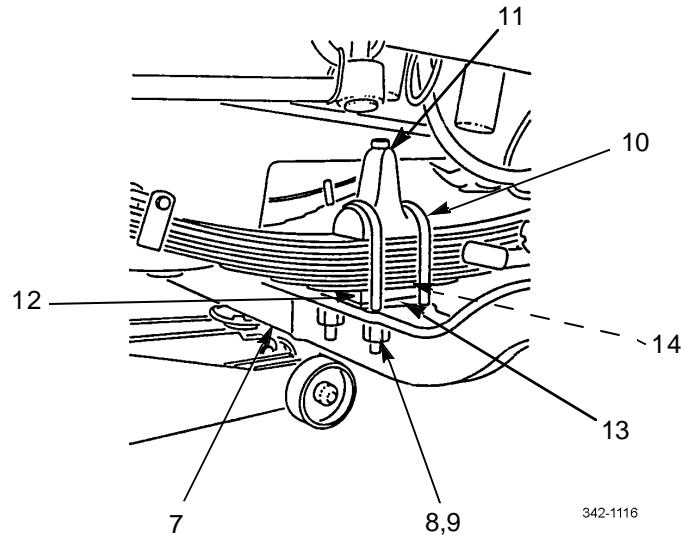
NOTE

Note position of axle stops during removal to aid in installation.

4. Remove eight nuts (8), washers (9), four U-bolts (10), and two axle stops (11).
5. Lower axle (7) and remove from vehicle.
6. Remove spacer (12) and shim (13).
7. Remove pin (14) from spacer (12).

REMOVAL - CONTINUED

8. Using lifting device, remove axle (7) from floor jack.

**INSTALLATION****WARNING**

Front axle weighs 1060 lb (481 kg). Support front axle with a suitable floor jack during installation to prevent possible injury to personnel.

NOTE

Procedure is same for both sides except where noted.

1. With axle (7) installed and secured on suitable floor jack, position axle under vehicle.
2. Coat bottom of shim (13) with sealing compound and install shim on axle (7) with wide end of shim toward rear of vehicle.
3. Install pin (14) in spacer (12).
4. Coat top of spacer (12) with sealing compound and install spacer on top of shim (13).
5. Install axle (7).
6. Coat bottom and U-bolt saddles of two axle stops (11) with sealing compound. Coat threads of U-bolts (10) with anti-seize compound.
7. Install two axle stops (11), four U-bolts (10), eight washers (9), and eight nuts (8) on axle (7). Tighten nuts to 380-460 lb-ft (515-624 Nm).
8. Remove floor jack from under vehicle.
9. Install tie rod (6) and two castellated nuts (5). Tighten nuts to 165-180 lb-ft (224-244 Nm).
10. Install two new cotter pins (4) through castellated nuts (5).
11. On left side, install drag link (3) and castellated nut (2). Tighten nut to 165-180 lb-ft (224-244 Nm).
12. Install new cotter pin (1) through castellated nut (2).

INSTALLATION - CONTINUED

13. Install front shock absorbers (TM 9-2320-302-20).
14. Install ABS sensors (TM 9-2320-302-20).
15. Install front brake spider and brake chamber bracket (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Adjustment

INITIAL SETUP

Maintenance Level

Direct Support

Materials/Parts

Compound, antiseize (Item 10, WP 0125 00)

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)

Wrench set, socket, 3/4 in drive (Item 141, WP 0126 00)

ADJUSTMENT

NOTE

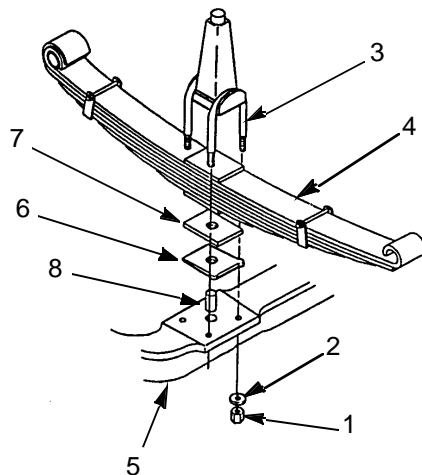
The following caster adjustment must be performed with the assistance of a local Freightliner dealer or a supporting Contractor Logistic Support (CLS) maintenance activity.

1. Measure caster angle. Angle must be +3.5 to +6.5 degrees.

NOTE

Perform steps 2 through 9 if caster angle is incorrect.

2. Remove four nuts (1) and washers (2) from two U-bolts (3).



342-1117

ADJUSTMENT - CONTINUED**WARNING**

Before removing shim(s), ensure vehicle is properly supported to prevent possible injury to personnel.

3. Raise spring (4) high enough from axle (5) to allow removal of shim(s) (6).
4. Remove spacer (7), shim(s) (6), and dowel (8).
5. Install dowel (8) in axle (5).

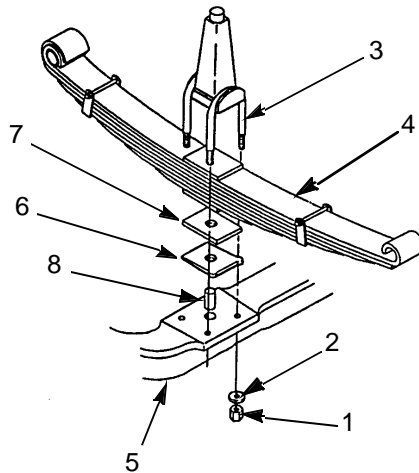
WARNING

If more than one shim is to be added, shims must be welded together prior to installation. Failure to do so may cause shim slippage resulting in equipment damage and/or injury to personnel.

NOTE

Install shims with tapered end toward front of vehicle.

6. Install new shim(s) (6) to obtain +3.5 to +6.5 degrees of caster angle.



342-1117

NOTE

Ensure dowel protrudes through shim(s) enough to hold spacer in place. If dowel does not protrude into spacer, replace dowel.

7. Install spacer (7).
8. Lower spring (4) onto axle (5).
9. Coat threads of two U-bolts (3) with antiseize compound.
10. Install four washers (2) and nuts (1) on two U-bolts (3). Tighten nuts to 380-460 lb-ft (515-624 Nm).

END OF WORK PACKAGE

TIE ROD MAINTENANCE

0074 00

THIS WORK PACKAGE COVERSRemoval, Disassembly, Assembly, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Materials/Parts

Pin, cotter (P/N MS24665-357) (2)

Tools and Special Tools

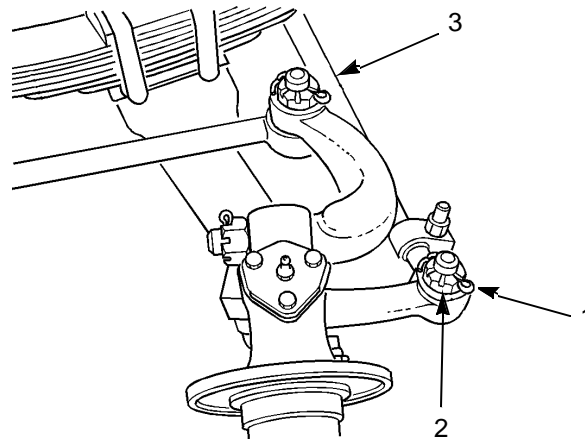
Tool kit, general mechanic's (Item 132, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

ReferencesTM 9-2320-302-20

REMOVAL

Remove cotter pin (1) and castellated nut (2) at each end of tie rod (3). Remove tie rod. Discard cotter pins.

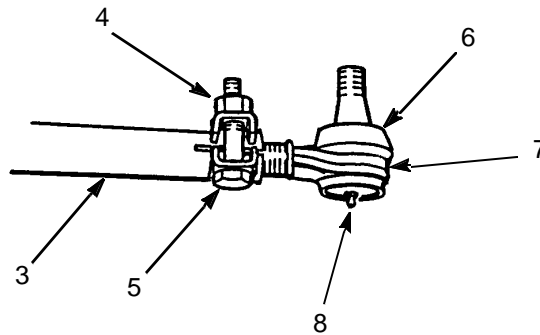


342-1115

DISASSEMBLY**NOTE**

Procedure is same for both tie rod ends.

1. Remove lock nut (4) and capscrew (5).
2. Remove dust cover (6).



342-1118

NOTE

- Note number of turns necessary to remove tie rod end.
 - Left tie rod end has left-hand threads and right tie rod end has right-hand threads.
3. Remove tie rod end (7) from tie rod (3).
 4. If damaged, remove lubrication fitting (8).

ASSEMBLY**NOTE**

Procedure is same for both tie rod ends.

1. If removed, install new lubrication fitting (8).

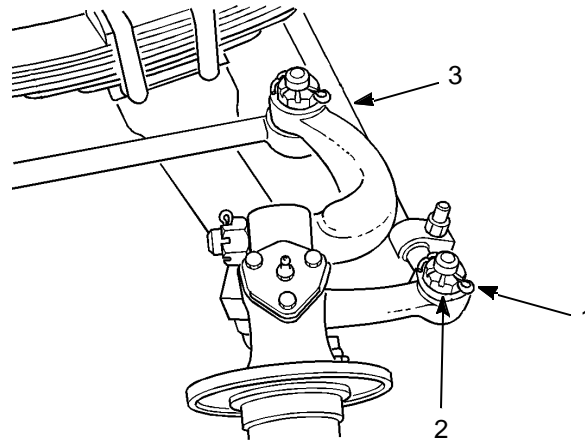
NOTE

Left tie rod end has left-hand threads and right tie rod end has right-hand threads.

2. Install tie rod end (7) on tie rod (3), the same number of turns noted during disassembly.
3. Install dust cover (6).
4. Install capscrew (5) and lock nut (4).

INSTALLATION

1. Install each end of tie rod (3) with castellated nut (2) and new cotter pin (1). Tighten castellated nuts to 165-180 lb-ft (224-244 Nm).



342-1115

2. Check front axle toe-in alignment (TM 9-2320-302-20).

END OF WORK PACKAGE

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FRONT CROSS TUBE ARM REPLACEMENT

0075 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Materials/Parts

Pin, cotter (P/N MS24665-357)

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Multiplier, torque wrench (Item 79, WP 0126 00)

Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)

Wrench set, socket, 3/4 in drive (Item 141, WP 0126 00)

Equipment Condition

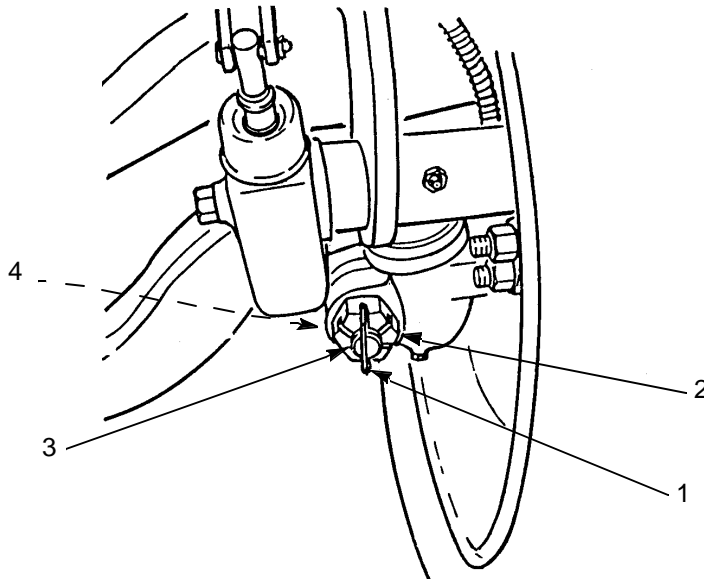
Tie rod removed (WP 0074 00)

NOTE

Procedure is same for both cross tube arms.

REMOVAL

Remove cotter pin (1), castellated nut (2), cross tube arm (3), and woodruff key (4). Discard cotter pin.



342-1119

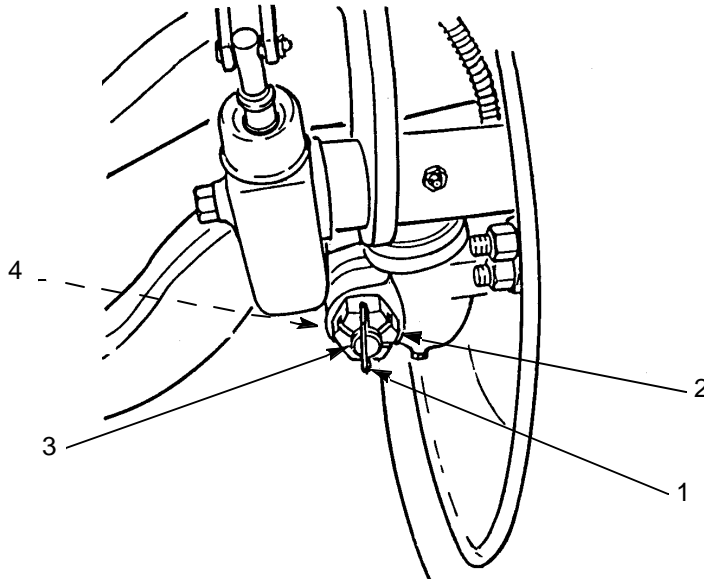
INSTALLATION

1. Install woodruff key (4), cross tube arm (3), and castellated nut (2). Tighten nut to 550-740 lb-ft (746-1003 Nm).

CAUTION

Castellated nut may be tightened to 1025 lb-ft (1390 Nm) for purpose of installing cotter pin. Overtightening may damage steering arm.

2. Install new cotter pin (1).



342-1119

3. Install tie rod (WP 0074 00).

END OF WORK PACKAGE

FRONT STEERING ARM REPLACEMENT

0076 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Multiplier, torque wrench (Item 79, WP 0126 00)

Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)

Wrench set, socket, 3/4 in drive (Item 141, WP 0126 00)

Materials/Parts

Pin, cotter (P/N MS24665-357)

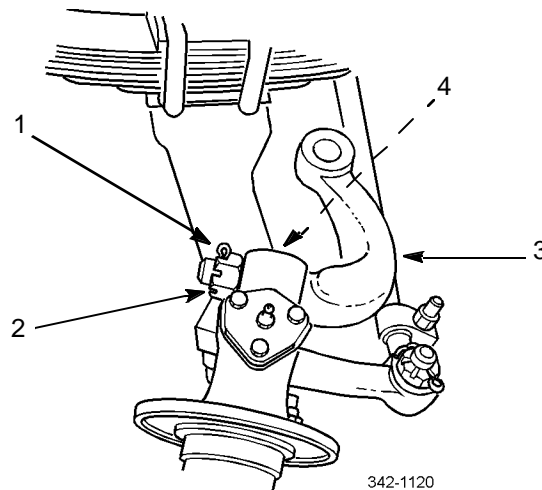
Equipment Condition

Drag link removed (TM 9-2320-302-20)

Front brake spider and brake chamber bracket removed (TM 9-2320-302-20)

REMOVAL

Remove cotter pin (1), castellated nut (2), steering arm (3), and woodruff key (4). Discard cotter pin.

**INSTALLATION**

1. Install woodruff key (4), steering arm (3), and castellated nut (2). Tighten nut to 775-1050 lb-ft (1051-1424 Nm).

CAUTION

Castellated nut may be tightened to 1450 lb-ft (1966 Nm) for purpose of installing cotter pin. Overtightening may damage steering arm.

2. Install new cotter pin (1).
3. Install drag link (TM 9-2320-302-20).

FRONT STEERING ARM REPLACEMENT - CONTINUED

0076 00

INSTALLATION - CONTINUED

4. Install front brake spider and brake chamber bracket (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Driver, bushing (Item 33, WP 0126 00)
- Jack, hydraulic (Item 73, WP 0126 00)
- Press, arbor (Item 90, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

- Bushing (P/N 1225-W-985) (2)
- Gasket (P/N 3208-M-1027) (2)
- Seal assembly (P/N A-1205-B-1432) (2)

Materials/Parts - Continued

- Seal assembly (P/N A-1205-X-1428) (2)
- Shim (P/N 2203-K-3001)
- Shim (P/N 2203-L-3002)
- Tags, marker (Item 35, WP 0125 00)

References

TM 9-2320-302-10

Equipment Condition

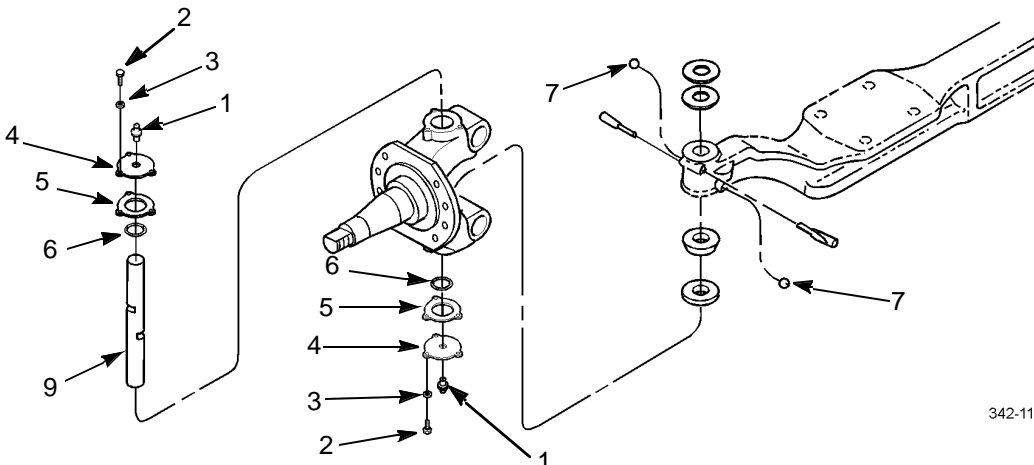
- Tie rod removed (WP 0074 00)
- Front cross tube arm removed (WP 0075 00)
- Front steering arm removed (WP 0076 00)

NOTE

Procedure is same for both steering knuckles.

REMOVAL

1. If damaged, remove two lubrication fittings (1).
2. Remove six cap screws (2), flat washers (3), two caps (4), gaskets (5), and seal assemblies (6). Discard gaskets and seal assemblies.
3. Remove two nuts (7).



342-1121

REMOVAL - CONTINUED

NOTE

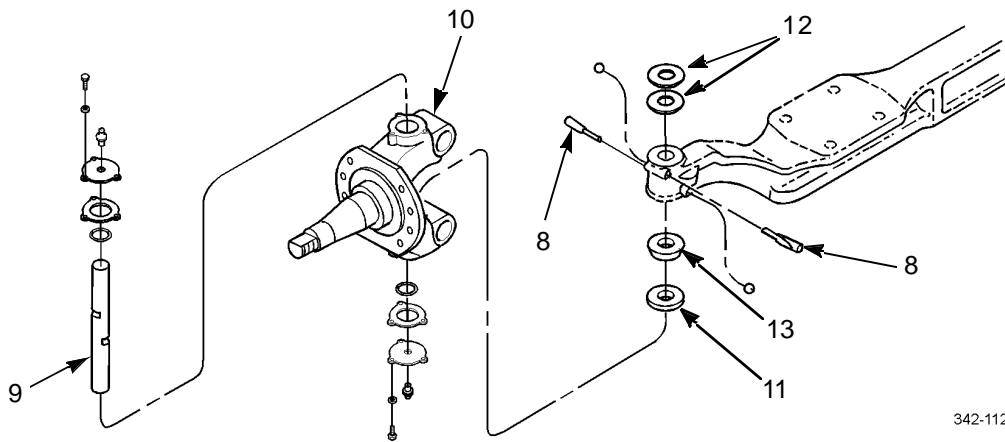
Tag draw keys prior to removal to aid in installation.

4. Remove two draw keys (8).

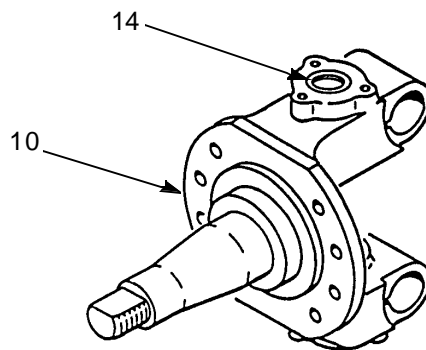
CAUTION

Be careful when removing pin. If pin is dropped, damage may occur.

5. Remove pin (9).
6. Remove steering knuckle (10), thrust bearing (11), shim(s) (12), and seal assembly (13). Discard seal assembly and shim(s).



7. Remove two bushings (14) from steering knuckle (10). Discard bushings.

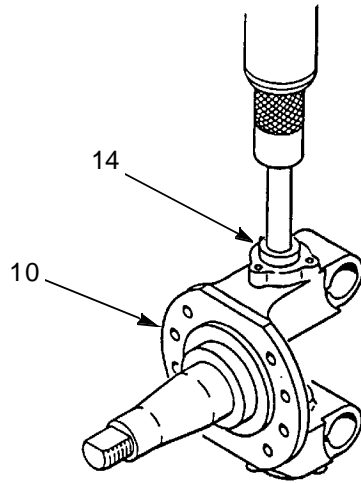


INSTALLATION

1. Using bushing driver, install two new bushings (14) as follows:
 - a. Press bushing (14) into steering knuckle (10) 1/8 in (3.2 mm) and relieve pressure.
 - b. Press bushing (14) into steering knuckle (10) another 1/2 in (12.7 mm) and relieve pressure.

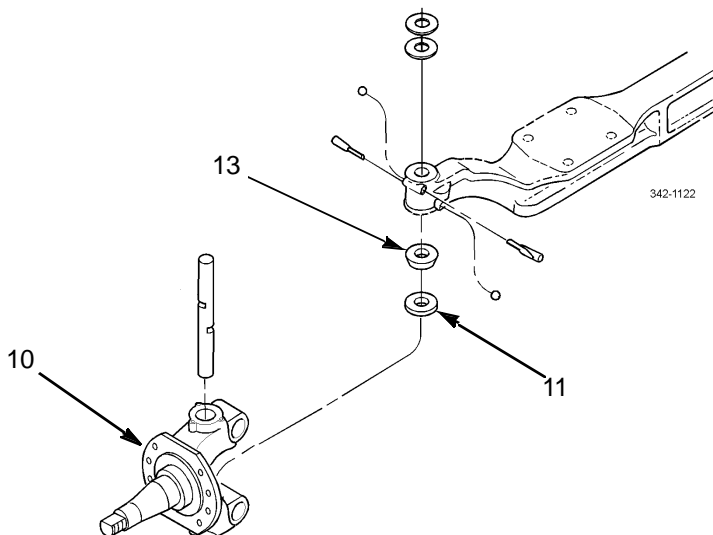
INSTALLATION - CONTINUED

- c. Press bearing (14) into steering knuckle (10) another 5/16 in (7.9 mm) below seal counterbore.



342-1124

2. Install new seal assembly (13) on chamfered side of thrust bearing (11).
3. Install steering knuckle (10).
4. Install thrust bearing (11) and seal assembly (13).
5. Using suitable jack, raise steering knuckle (10) until seal assembly (13) is flush with bottom side of axle.
6. Using thickness gage, measure distance between top side of axle and steering knuckle (10).



342-1122

INSTALLATION - CONTINUED**WARNING**

Shims are delicate and sharp. Use extreme caution when aligning shims to prevent cutting fingers or bending inside diameter of shims. Damage to shims will require complete disassembly and replacement of damaged parts.

7. Install new shims (12) of thickness equal to measurement from step 6.

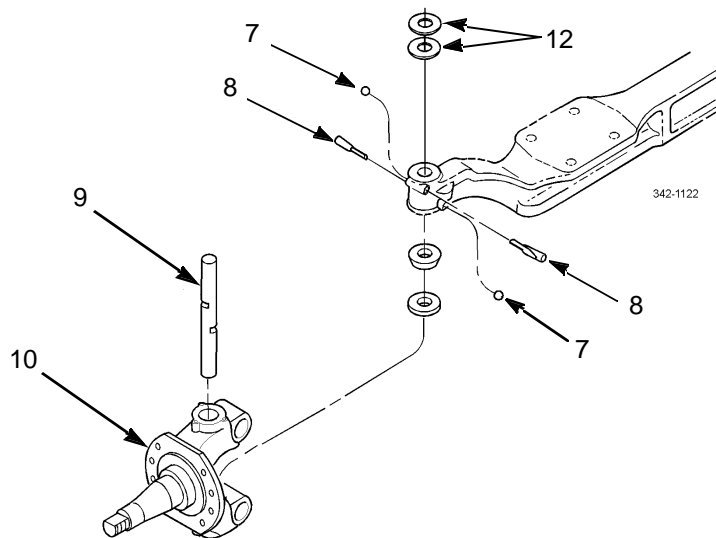
CAUTION

Ensure shim(s) is not blocking passage for pin installation to prevent damage to equipment.

NOTE

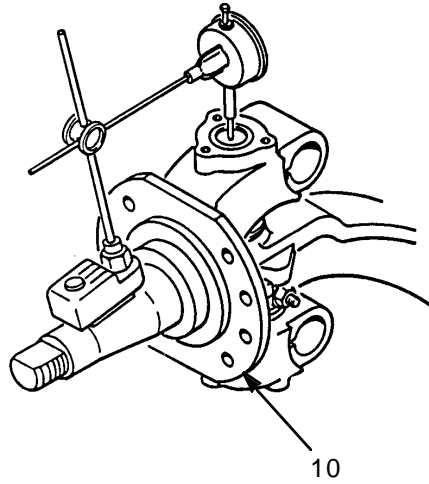
- Ensure draw key slots align with draw key holes.
- If pin will not pass completely through steering knuckle, but did pass through shim(s), lower jack to align thrust bearing and seal assembly to allow passage of pin.

8. Install pin (9) in steering knuckle (10).
9. Install two draw keys (8) and nuts (7). Tighten nuts to 30-40 lb-ft (41-54 Nm).



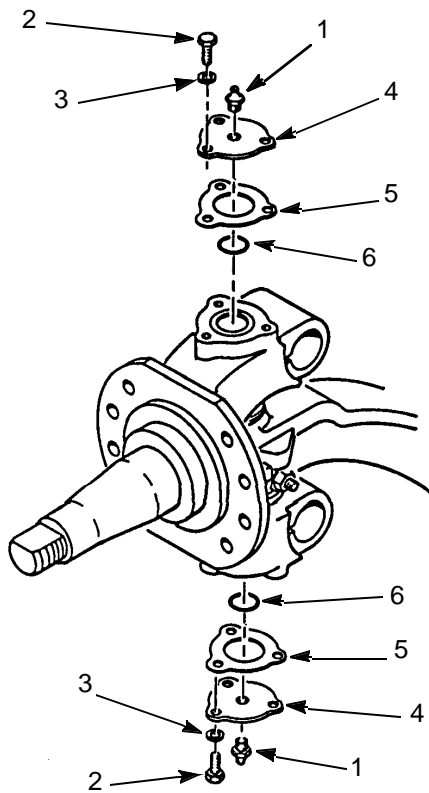
10. Position steering knuckle (10) in straight-ahead position and install dial indicator on steering knuckle as shown.
11. Pry up on steering knuckle (10) while observing dial indicator. Vertical end play must be 0.001-0.025 in (0.03-0.64 mm). If vertical end play is less than 0.001 in (0.03 mm), remove shim(s) (12) to achieve vertical end play. If vertical end play is more than 0.025 in (0.64 mm), add shim(s) to reduce vertical end play.
12. If shim(s) (12) is to be added or removed, perform removal steps 3 through 7 and installation steps 1 through 11 until correct vertical end play is achieved.

INSTALLATION - CONTINUED



342-1125

13. Install two new seal assemblies (6), new gaskets (5), caps (4), six flat washers (3), and cap screws (2). Tighten cap screws to 20-30 lb-ft (27-41 Nm).
14. If removed, install two new lubrication fittings (1).



342-1126

FRONT STEERING KNUCKLE REPLACEMENT - CONTINUED

0077 00

INSTALLATION - CONTINUED

15. Install front steering arm (WP 0076 00).
16. Install front cross tube arm (WP0075 00).
17. Install tie rod (WP 0074 00).
18. Lubricate steering knuckle (TM 9-2320-302-10).

END OF WORK PACKAGE

REAR AXLE REPLACEMENT

0078 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Jack, hydraulic (Item 73, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Nut, lock (P/N 23-09247-210) (16)

Tags, marker (Item 35, WP 0125 00)

Personnel Required

Two

Equipment Condition

Air system drained (TM 9-2320-302-10)

Rear brakeshoes removed (TM 9-2320-302-20)

Drivelines removed (TM 9-2320-302-20)

Rear ABS sensors removed (TM 9-2320-302-20)

Axle oil drained (TM 9-2320-302-20)

Rear shock absorbers removed (TM 9-2320-302-20)



WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL

NOTE

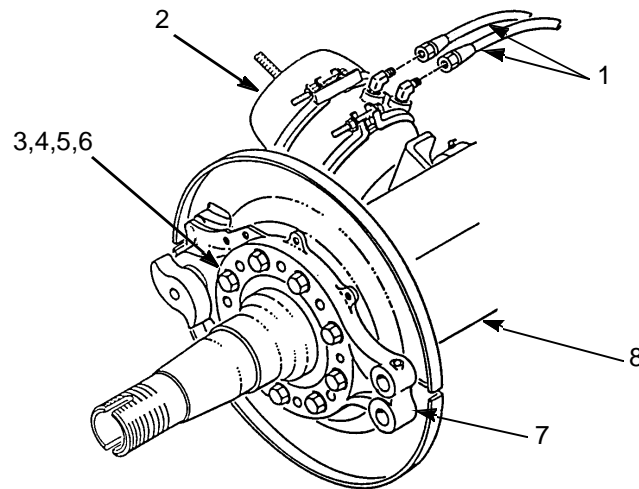
Tag air lines to aid in installation.

1. Disconnect two air lines (1) from brake chamber (2).

NOTE

Note position of spider assembly prior to removal to aid in installation.

2. Remove eight lock nuts (3), washers (4), screws (5), washers (6), and spider assembly (7) from axle housing (8). Discard lock nuts.
3. Repeat steps 1 and 2 for opposite side of axle housing (8).



342-1127



WARNING



Axle housing is heavy and can injure personnel if dropped. Support axle housing during removal to prevent injury to personnel.

4. Using suitable hydraulic jack, support axle housing (8).
5. Remove two nuts (9) and screws (10) to disconnect two v-rods (11) from top of axle housing (8).

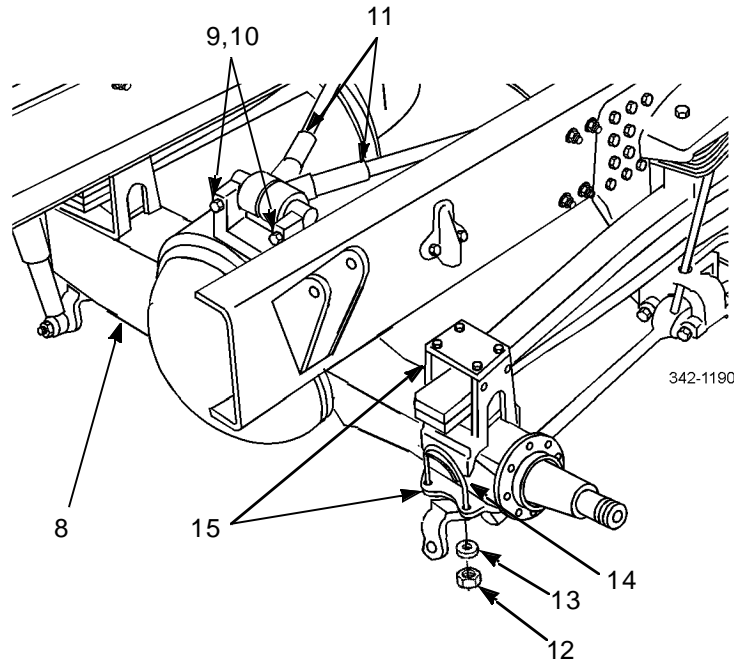
NOTE

Note position of axle clamps on axle for installation.

6. Remove four nuts (12), washers (13), and two u-bolts (14) from axle clamp (15).
7. Remove top half of axle clamp (15) from axle housing (8).
8. Position bottom half of axle clamp (15) downward, away from axle housing (8).
9. Repeat steps 6 through 8 for opposite side of axle housing (8).

REMOVAL - CONTINUED

10. Remove axle housing (8) from under vehicle.
11. If new rear axle housing (8) will not be equipped with brake chambers (2), remove brake chambers (TM 9-2320-302-20).



INSTALLATION

1. If new rear axle housing (8) is not equipped with brake chambers, install brake chambers (TM 9-2320-302-20).

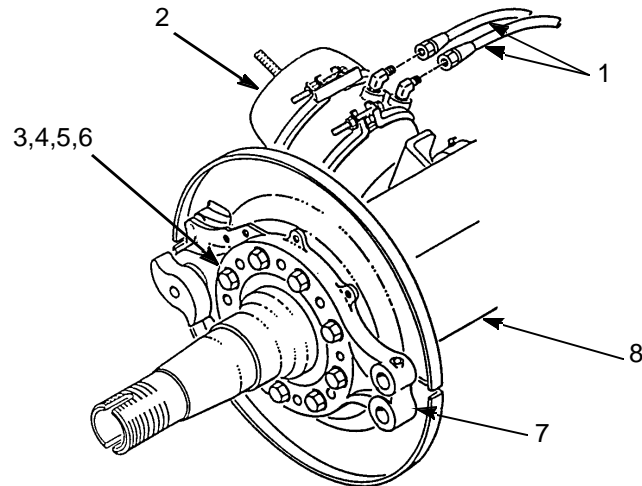


Axle housing is heavy and can injure personnel if dropped. Support axle housing during installation to prevent injury to personnel.

2. Using hydraulic jack, position axle housing (8) under vehicle.
3. Position bottom half of axle clamp (15) upward against axle housing (8).
4. Position top half of axle clamp (15) to top of axle housing (8).
5. Install two u-bolts (14), four washers (13), and nuts (12) to axle clamp (15). Tighten nuts initially, in diagonal sequence, to 60 lb-ft (81 Nm). Tighten nuts again in diagonal sequence to 130 lb-ft (176 Nm). Apply final torque of 200 lb-ft (271 Nm).
6. Repeat steps 3 through 5 for opposite side of axle housing (8).
7. Connect two v-rods (11) to top of axle housing (8) with two screws (10) and nuts (9). Tighten nuts to 427 lb-ft (579 Nm).
8. Remove hydraulic jack.

REAR AXLE REPLACEMENT - CONTINUED**0078 00****INSTALLATION - CONTINUED**

9. Install spider assembly (7) on axle housing (8) with eight washers (6), screws (5), washers (4), and new lock nuts (3). Tighten lock nuts to 135-145 lb-ft (183-197 Nm).
10. Connect two air lines (1) to brake chamber (2).
11. Repeat steps 9 and 10 for opposite side of axle housing (8).



342-1127

12. Install rear shock absorbers (TM 9-2320-302-20).
13. Install rear brakeshoes (TM 9-2320-302-20).
14. Install drivelines (TM 9-2320-302-20).
15. Fill axle with oil (TM 9-2320-302-20).
16. Install rear ABS sensors (TM 9-2320-302-20).
17. If new rear axle was installed, align tandem axles.

END OF WORK PACKAGE

FORWARD-REAR AXLE DIFFERENTIAL CARRIER REPLACEMENT**0079 00****THIS WORK PACKAGE COVERS**

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Jack, hydraulic (Item 73, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Compound, sealing (Item 14, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Personnel Required

Two

Equipment Condition

Air system drained (TM 9-2320-302-10)

Axle shafts removed (TM 9-2320-302-20)

Drivelines disconnected (TM 9-2320-302-20)

Axle oil filter removed (TM 9-2320-302-20)

Axle oil drained (TM 9-2320-302-20)

**WARNING**

- Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.
- Spilled gear oil is very slippery. Wipe up any spilled oil immediately. Failure to do so could result in serious injury to personnel.

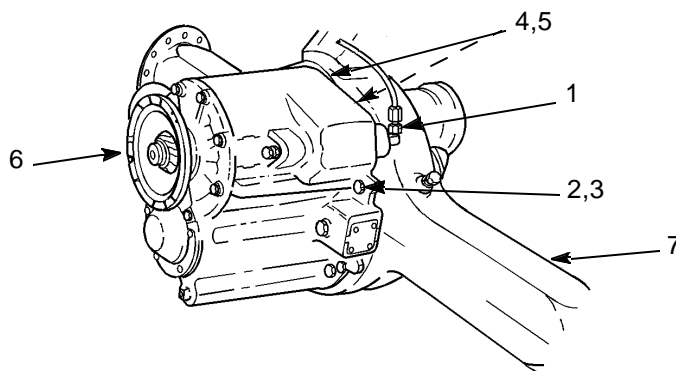
REMOVAL

1. Disconnect air line (1).



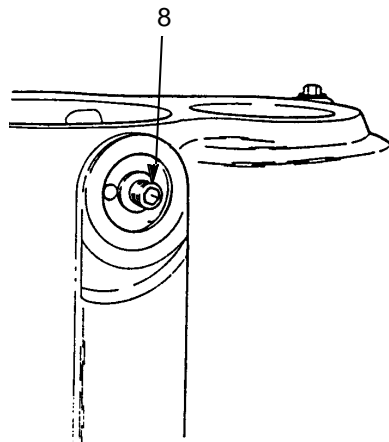
Forward-rear axle differential carrier weighs 1160 lb (527 kg). Support with suitable floor jack prior to removal to prevent possible injury to personnel.

2. Remove ten cap screws (2) and washers (3), and two nuts (4) and washers (5).
3. Loosen differential carrier (6) by tapping around flange.
4. Remove differential carrier (6) from axle (7) and lower differential carrier (6) onto floor jack. Roll differential carrier from under vehicle.



342-1132

5. If damaged, remove oil filter adapter (8).



342-1131

INSTALLATION

1. If removed, install new oil filter adapter (8).

**WARNING**

Forward-rear axle differential carrier weighs 1160 lb (527 kg). Support with suitable floor jack prior to installation to prevent possible injury to personnel.

CAUTION

Ensure both mating surfaces have been completely cleaned to prevent damage to equipment.

2. Position differential carrier (6) on floor jack and roll differential carrier into position under vehicle.

**WARNING**

Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water.

3. Apply sealing compound around mating surface of axle (7).
4. Attach suitable hoist and install differential carrier (6) with two washers (5) and nuts (4).
5. Install ten washers (3) and cap screws (2). Tighten cap screws and two nuts (4) to 150-230 lb-ft (203-312 Nm).
6. Connect air line (1).
7. Install axle oil filter (TM 9-2320-302-20).
8. Connect drivelines (TM 9-2320-302-20).
9. Install axle shafts (TM 9-2320-302-20).
10. Fill axle with oil (TM 9-2320-302-20).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Gloves, welder's, leather (Item 41, WP 0126 00)
- Holding bar, pinion (Item 47, WP 0126 00)
- Multiplier, torque wrench (Item 79, WP 0126 00)
- Press, arbor (Item 90, WP 0126 00)
- Puller, mechanical (Item 95, WP 0126 00)
- Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)

Materials/Parts

- Nut, lock (P/N 40X-1026)
- Nut, lock (P/N 40X-1145)

Materials/Parts - Continued

- Seal, oil (P/N A-1205-W-1895)
- Seal, o-ring (P/N 5X-1034) (2)
- Adhesive, silicone rubber (Item 5, WP 0125 00)
- Grease, GAA (Item 22, WP 0125 00)
- Oil, lubricating (Item 26, WP 0125 00)
- Paste, Prussian blue (Item 28, WP 0125 00)
- Rags, wiping (Item 31, WP 0125 00)
- Solder (Item 33, WP 0125 00)

Personnel Required

Two

References

TM 9-214

Equipment Condition

Forward-rear axle differential carrier removed (WP 0079 00).

DISASSEMBLY

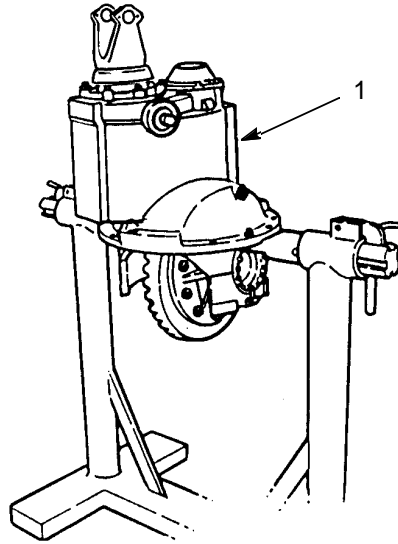


WARNING

Forward-rear axle differential carrier weighs 1160 lb (526 kg). Attach suitable lifting device when lifting assembly to prevent possible injury to personnel.

DISASSEMBLY - CONTINUED

1. Install differential carrier (1) on repair stand.



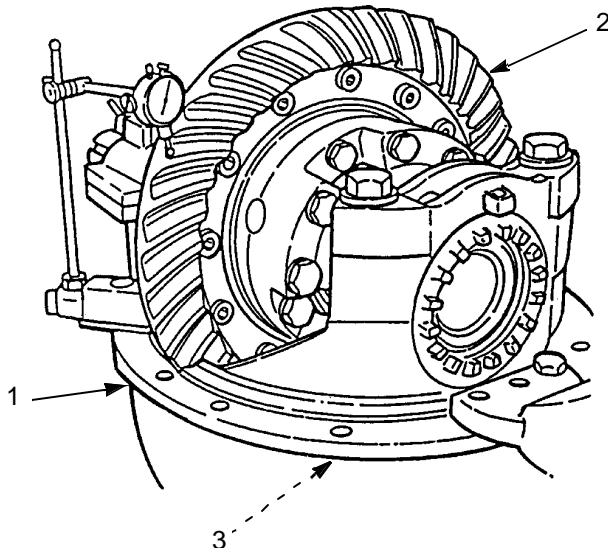
342-1228

2. Turn differential carrier (1) so that ring gear (2) is up.

NOTE

If reinstalling same ring gear and drive pinion, perform steps 3 through 6 to measure backlash.

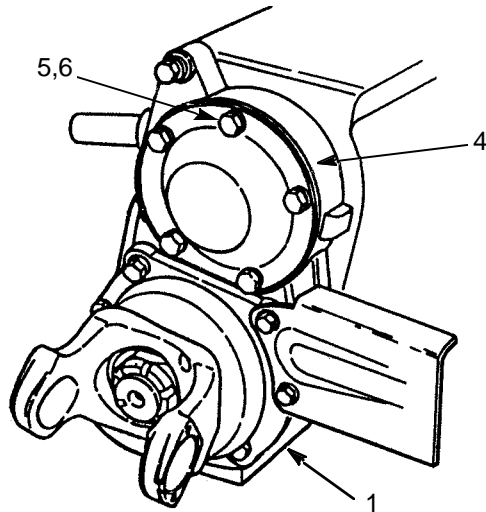
3. Move ring gear (2) so that ring gear teeth fully engage with drive pinion (3) teeth.
4. Install dial indicator on flange of differential carrier (1) so that tip of indicator is against drive side of tooth on ring gear (2). Adjust dial indicator to zero.
5. Rotate ring gear (2) in both directions and record reading.
6. Repeat step 5 twice more in different locations.



342-1197

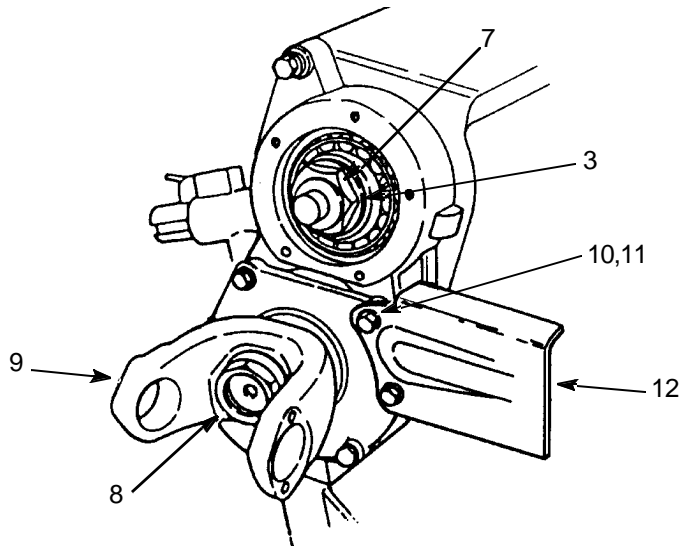
DISASSEMBLY - CONTINUED

7. Rotate differential carrier (1) to horizontal position with pinion cover (4) at top.
8. Remove five cap screws (5), washers (6), and pinion cover (4).



342-1229

9. Loosen nut (7) on drive pinion (3).
10. Using pinion holding bar, loosen lock nut (8) on yoke (9).
11. Remove seven cap screws (10), washers (11), and filter shield (12).



342-1230

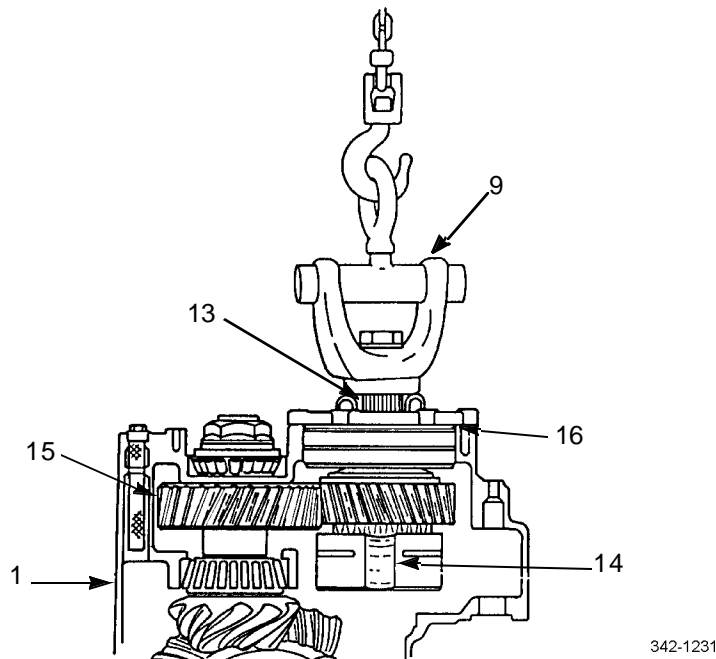
DISASSEMBLY - CONTINUED

12. Rotate differential carrier (1) until yoke (9) faces up and install suitable lifting device through yoke (9).

NOTE

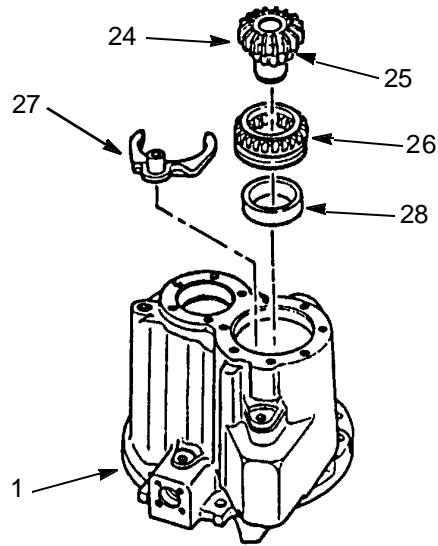
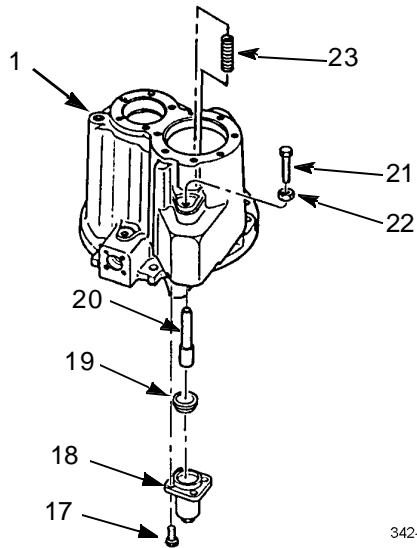
There are two notches on side of pinion differential case. When one is aligned with helical driven gear, pinion differential case can be removed.

13. Rotate input shaft (13) until one notch on pinion differential case (14) is aligned over helical driven gear (15).
 14. Lift input shaft (13) from differential carrier (1).
 15. Remove shims (16). Measure and record thickness of shim pack.

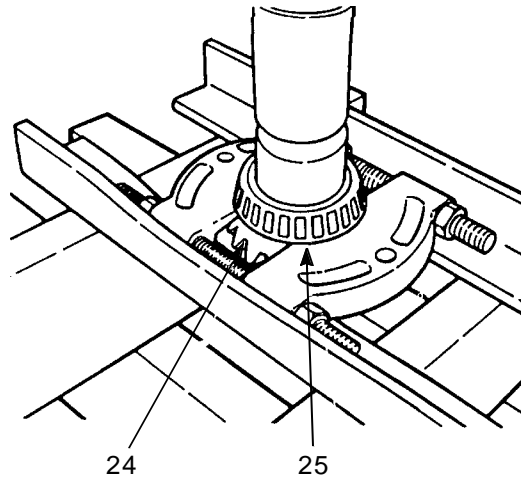


16. Remove four socket head screws (17), cover (18), seal (19), and shift shaft (20). Discard seal.
 17. Remove adjusting screw (21) and jamnut (22) from differential carrier (1).
 18. Remove spring (23) from differential carrier (1).
 19. Remove side gear (24) with bearing cone (25), clutch (26), and fork (27) from differential carrier (1).
 20. Remove bearing cup (28) from differential carrier (1).

DISASSEMBLY - CONTINUED

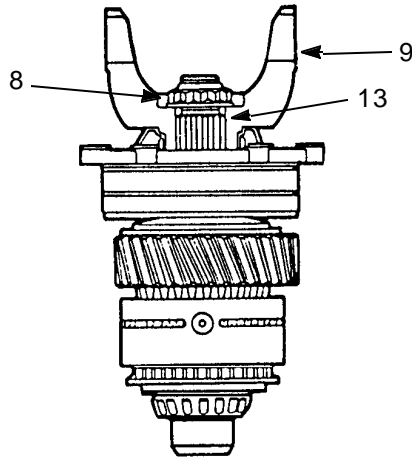


21. Remove bearing cone (25) from side gear (24).



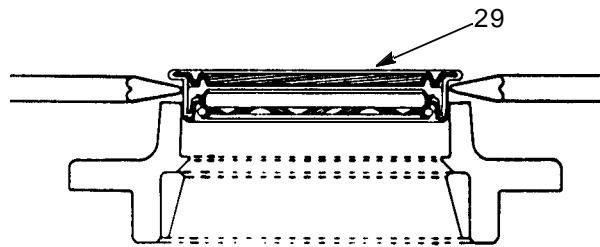
DISASSEMBLY - CONTINUED

22. Remove and discard lock nut (8) from yoke (9).
23. Using yoke puller, remove yoke (9) from input shaft (13).



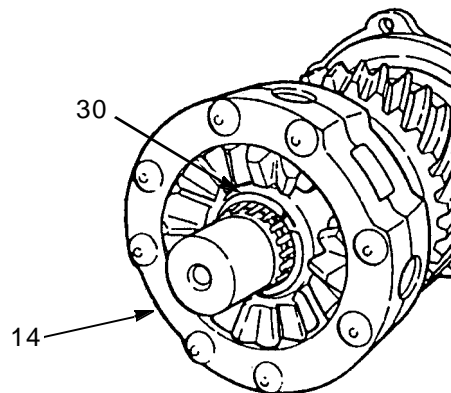
342-1235

24. Remove and discard oil seal (29).



342-1136

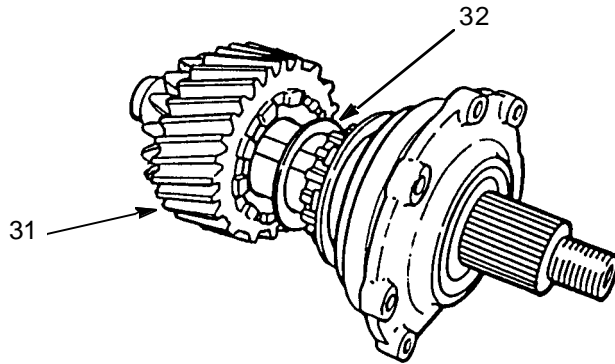
25. Remove snap ring (30) and pinion differential case (14).



3423-1237

DISASSEMBLY - CONTINUED

26. Remove gear (31) and thrust washer (32).

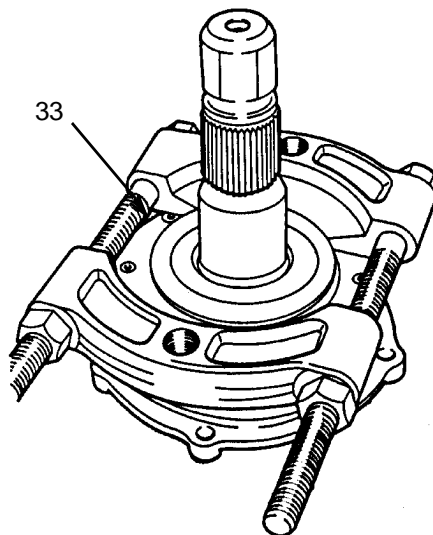


342-1238

CAUTION

Use care when installing bearing puller. If puller touches rivets, oil pump could be damaged.

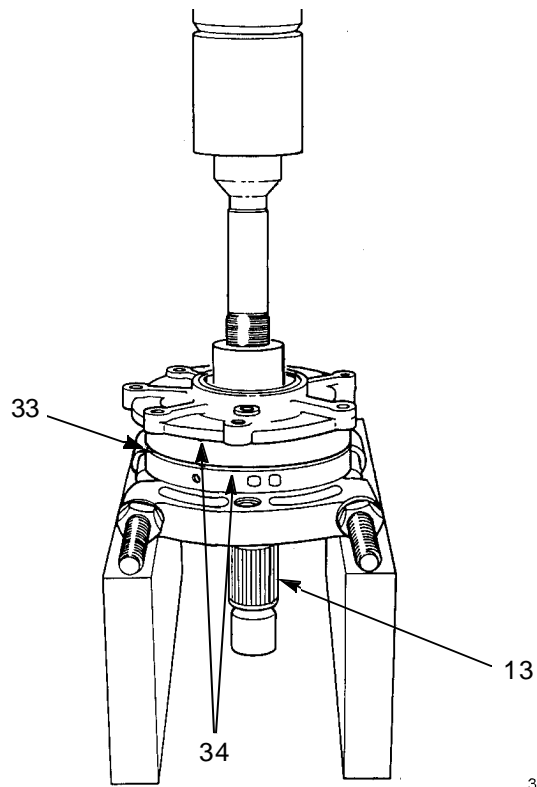
27. Install bearing puller under pump (33)



342-1239

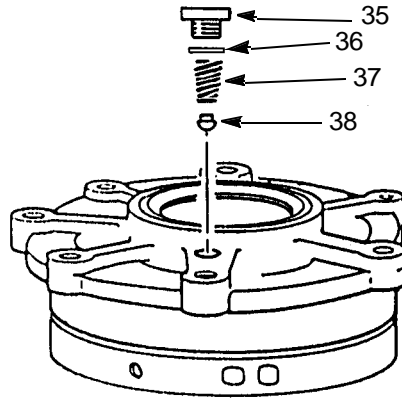
DISASSEMBLY - CONTINUED

28. Using press, with bearing puller down, press input shaft (13) from oil pump (33).
29. Remove and discard two packings (34).



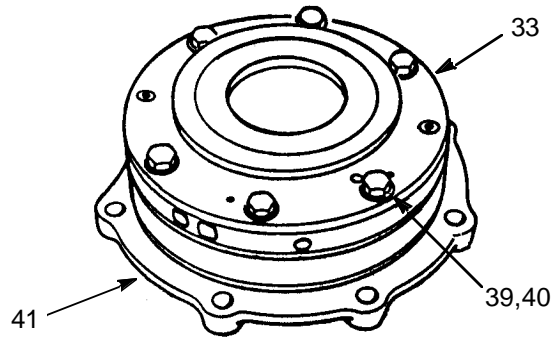
DISASSEMBLY - CONTINUED

30. Remove plug (35), washer (36), spring (37), and relief valve (38).



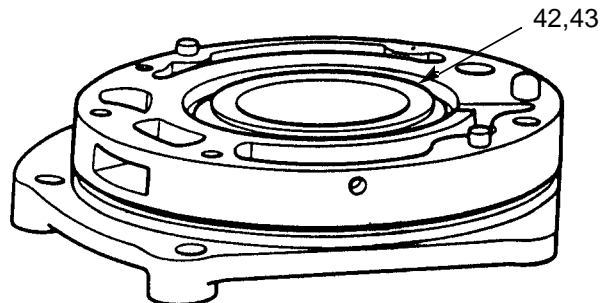
342-1241

31. Remove six cap screws (39), washers (40), and oil pump (33) from bearing cage (41).



342-1242

32. Remove bearing cone (42) and bearing cup (43).



342-1243

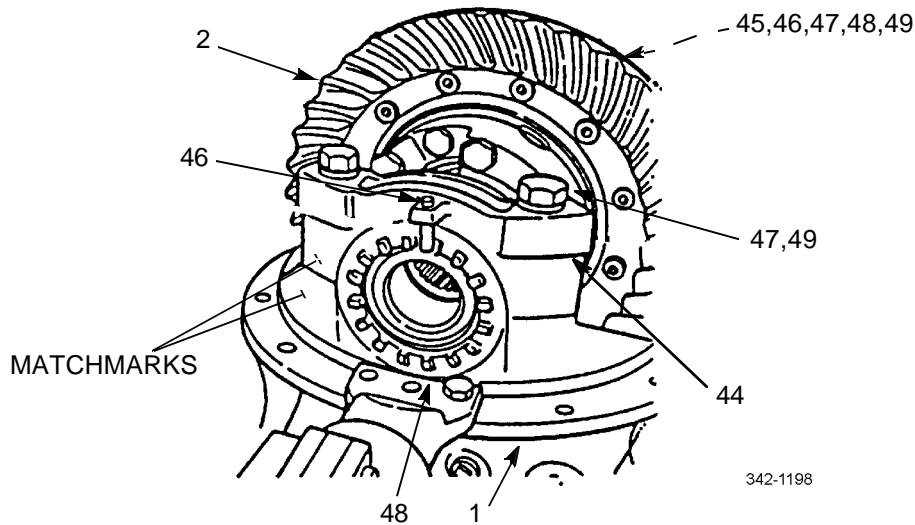
DISASSEMBLY - CONTINUED

33. Rotate differential carrier (1) until ring gear (2) faces up.
34. Matchmark position of two bearing caps (44 and 45) on differential carrier (1).
35. Remove pin (46) from two bearing caps (44 and 45).
36. Loosen four cap screws (47).

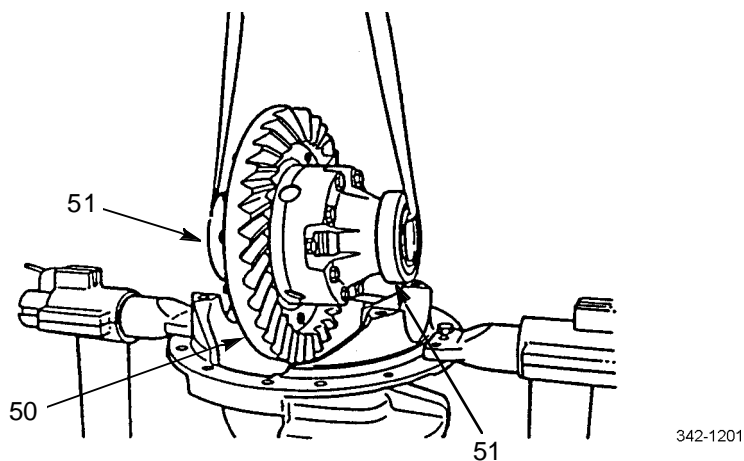
CAUTION

To prevent damage to adjusting rings, do not hit adjusting rings with hammer or use hammer and drift pin to loosen rings.

37. Loosen two adjusting rings (48).
38. Remove four cap screws (47), washers (49), two bearing caps (44 and 45), and two adjusting rings (48).

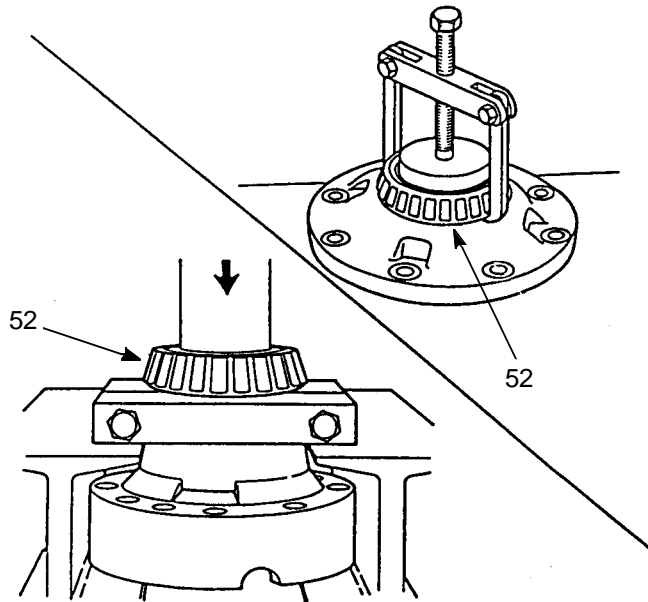


39. Using suitable lifting device, remove ring gear subassembly (50) and two bearing cups (51).



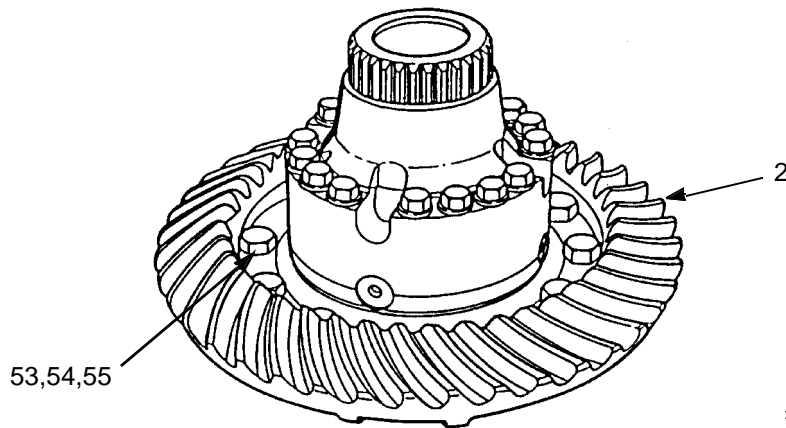
DISASSEMBLY - CONTINUED

40. Using bearing puller, remove two bearing cones (52).



342-1244

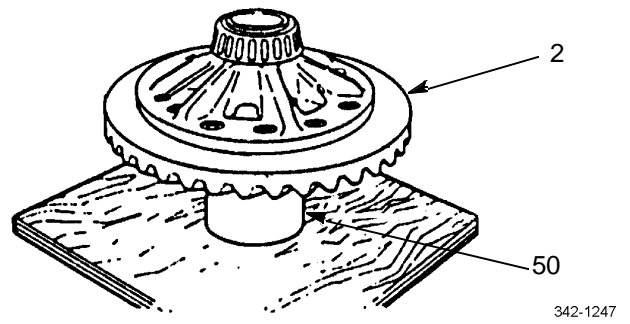
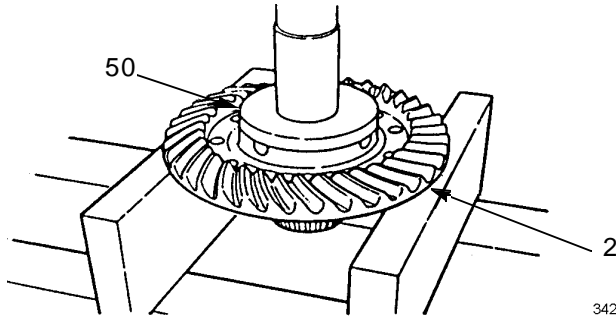
41. Remove 12 nuts (53), washers (54), and bolts (55) from ring gear (2).



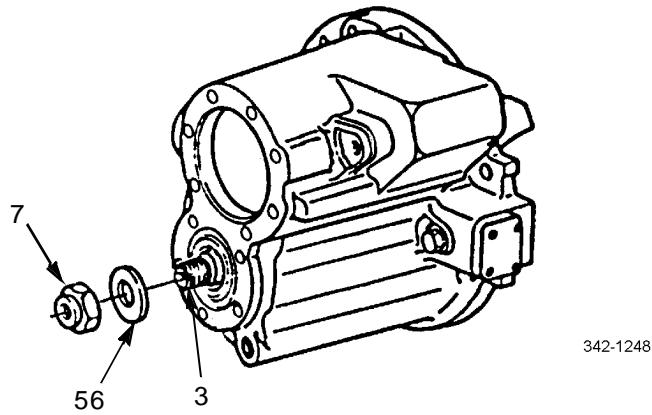
342-1245

DISASSEMBLY - CONTINUED

42. Remove ring gear (2) from ring gear subassembly (50).

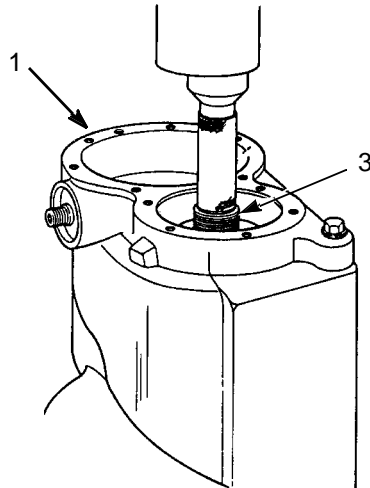


43. Remove nut (7) and washer (56) from drive pinion (3).



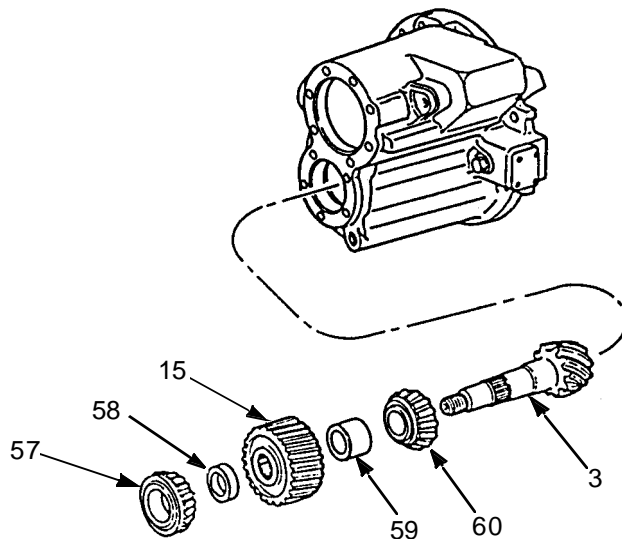
DISASSEMBLY - CONTINUED

44. Using press, remove drive pinion (3) from differential carrier (1).



342-1249

45. Remove bearing cone (57), spacer (58), and gear (15) from differential carrier (1).
 46. Remove spacer (59) and bearing cone (60) from drive pinion (3).



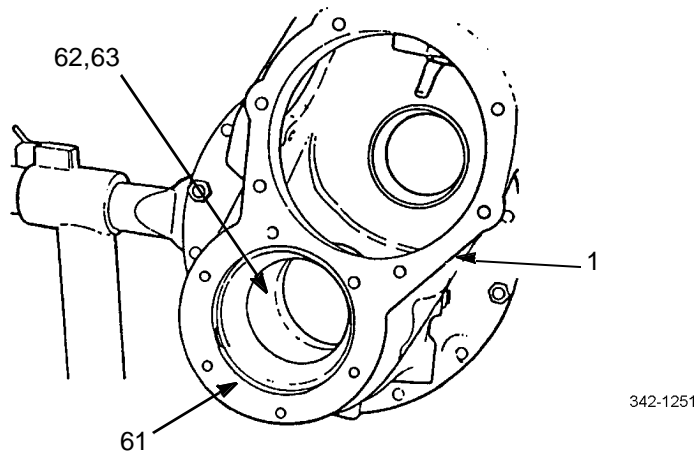
342-1250

DISASSEMBLY - CONTINUED

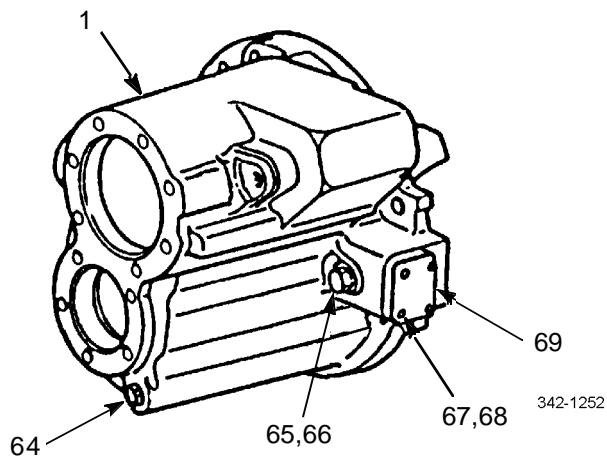
NOTE

Perform steps 47 and 48 only if bearings are damaged or if pinion and ring gear are being replaced.

- 47. Remove outer bearing cup (61).
- 48. Remove inner bearing cup (62) and shim(s) (63) from differential carrier (1). Measure and record thickness of shim(s).



- 49. Remove screen/plug assembly (64), plug (65), washer (66), four cap screws (67), washers (68), and cover (69) from differential carrier (1).



ASSEMBLY**WARNING**

Forward-rear axle differential carrier weighs 1160 lb (526 kg). Attach suitable lifting device when lifting assembly to prevent possible injury to personnel

NOTE

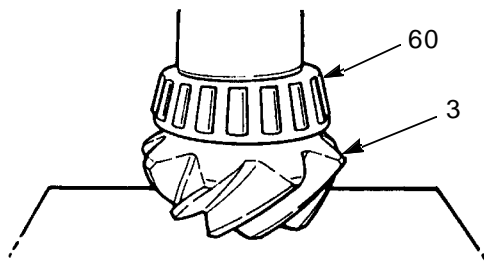
- If installing new ring gear and drive pinion, perform steps 1 through 6.
- Replace ring gear and drive pinion as matched set. Gear set match number is on head of drive pinion and front face or outer diameter of ring gear.
- Pinion cone variation number is used to adjust depth of pinion in differential carrier. Pinion cone variation number is on end of gear head of drive pinion or outer diameter of ring gear.

1. Record new pinion cone variation number.
2. Record old pinion cone variation number.
3. If old pinion cone variation number is +, subtract number from shim pack thickness in disassembly step 48.
4. If old pinion cone variation number is -, add number to shim pack thickness in disassembly step 48.
5. If new pinion cone variation number is +, add number to shim pack thickness determined in step 3 or 4.
6. If new pinion cone variation number is -, subtract number from shim pack thickness determined in step 3 or 4.

NOTE

Coat all bearing cones and bearing cups with axle oil prior to installation.

7. Using press, install inner bearing cone (60) on drive pinion (3) until bottom of inner bearing cone touches bottom of drive pinion.



342-1253

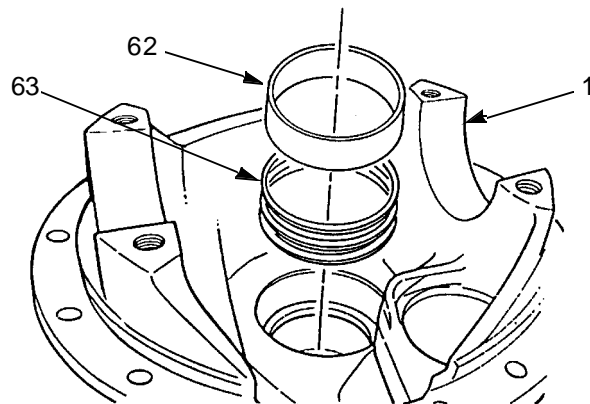
ASSEMBLY - CONTINUED

8. Install differential carrier (1) on press with legs of differential carrier toward top of press.

NOTE

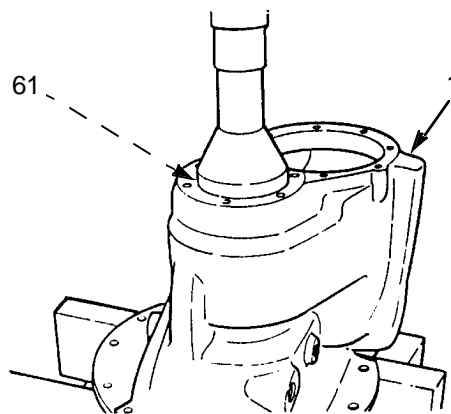
If installing new ring gear and drive pinion, use shim pack thickness determined in step 5 or 6. If installing same ring gear and drive pinion, use shim pack removed in Disassembly step 48.

9. Install shim pack (63). Using press, install inner bearing cup (62) in differential carrier (1) until bottom of inner bearing cup touches shim pack.



342-1254

10. Turn differential carrier (1) over and install supports so that differential carrier is level on press.
11. Using press, install outer bearing cup (61) until bottom of outer bearing cup touches bottom of bore.



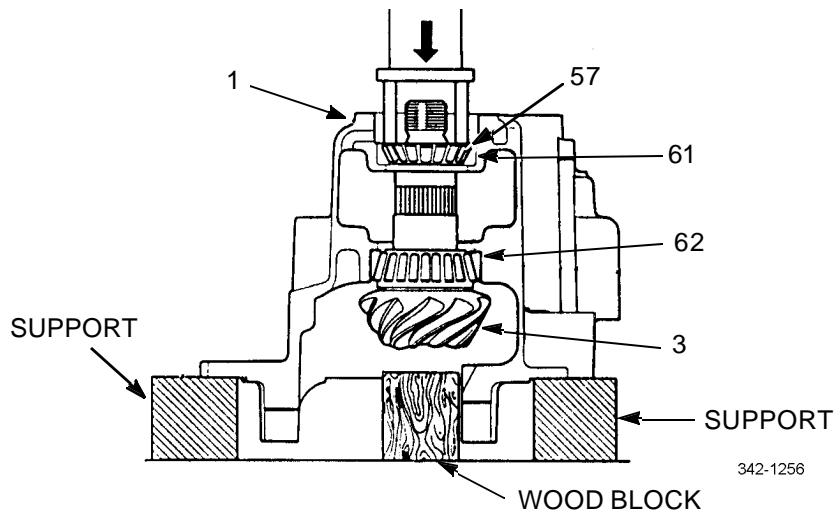
342-1255

12. Install drive pinion (3) from bottom of differential carrier (1). Install support under head of drive pinion.

ASSEMBLY - CONTINUED**NOTE**

Apply no more than two tons of pressure to seat bearing cups.

13. Install outer bearing cone (57) on shaft of drive pinion (3). Using press, seat two bearing cups (61 and 62).
14. Using press, remove drive pinion (3).
15. Remove outer bearing cone (57).



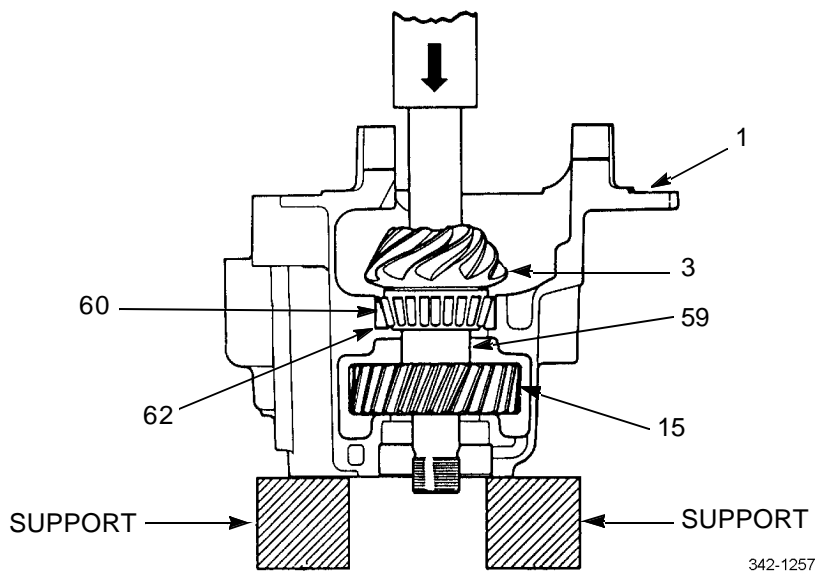
ASSEMBLY - CONTINUED

16. Install differential carrier (1) on press with legs of differential carrier toward top of press.
17. Install gear (15) with splines toward front of differential carrier (1).
18. Install large diameter spacer (59) on top of gear (15) with spacer toward inner bearing cup (62).
19. Install drive pinion (3) in gear (15). Ensure splines on drive pinion engage splines in gear.

CAUTION

To prevent damage to cup, cone, and drive pinion, do not apply pressure after inner bearing cone touches inner bearing cup.

20. Using press, press drive pinion (3) into gear (15) until inner bearing cone (60) touches inner bearing cup (62).



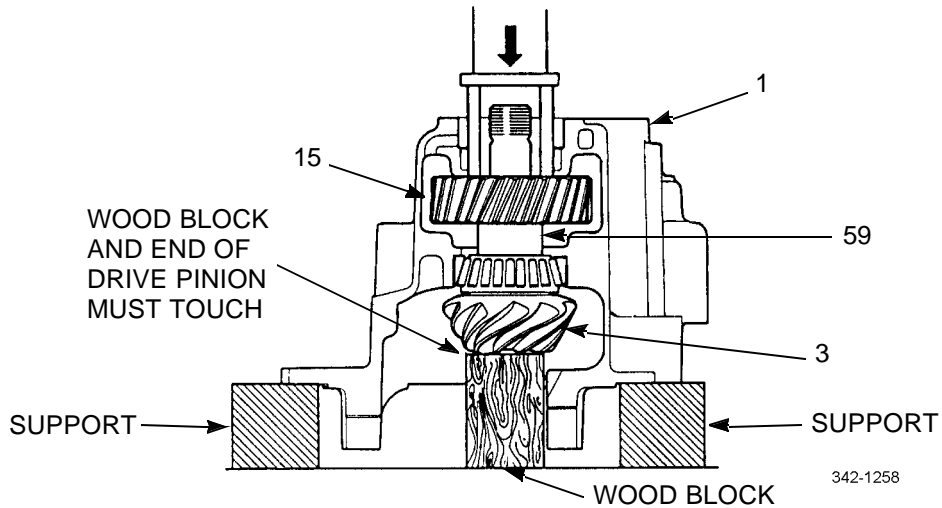
21. Turn differential carrier (1) over and install supports so that differential carrier is level on press.

CAUTION

To prevent damage to spacer, do not apply pressure after gear touches spacer in front of inner bearing on drive pinion.

22. Using press and sleeve that fits inside pinion bore of differential carrier (1), press gear (15) on drive pinion (3) until gear touches spacer (59).
23. Cut two pieces of lead or solder approximately 9/16-in long, 5/8-in wide, and thicker than spacer removed in disassembly step 45.
24. Install two lead pieces opposite each other on top of gear (15).

ASSEMBLY - CONTINUED

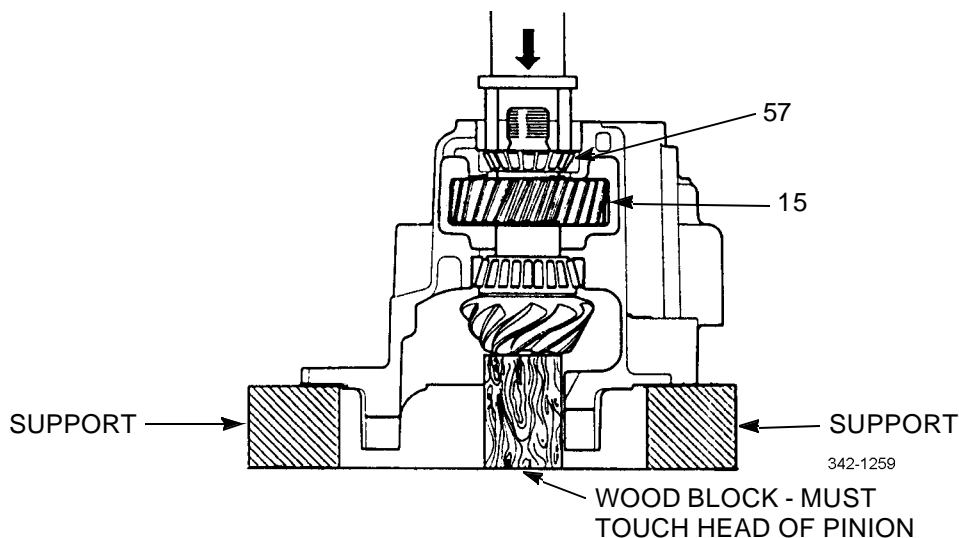


25. Install outer bearing cone (57) on top of lead pieces.
26. Using press, apply two tons of pressure to outer bearing cone (57).
27. Release pressure and remove wood block.

CAUTION

To prevent damage to equipment, do not press shaft of drive pinion out of gear.

28. Using press, remove outer bearing cone (57) and lead pieces.
29. Measure thicknesses of compressed lead pieces. Add measurements of two lead pieces and divide by two to determine average size of pieces. Add 0.004 in (0.100 mm) to average size. Use this dimension to determine size of spacer (removed in disassembly, step 45) to be installed between gear (15) and outer bearing cone (57).



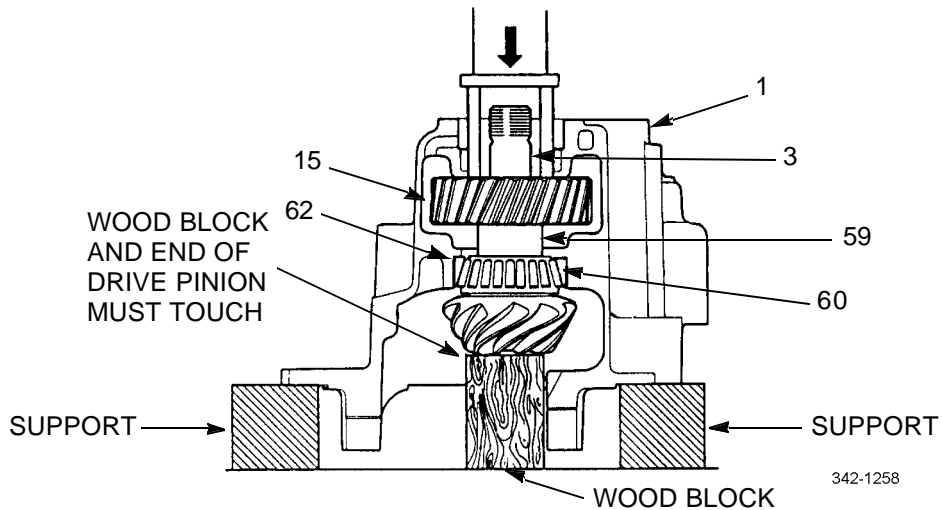
ASSEMBLY - CONTINUED

30. Place wood block under head of drive pinion (3) so that inner bearing cone (60) touches inner bearing cup (62). Remove supports from under differential carrier (1).

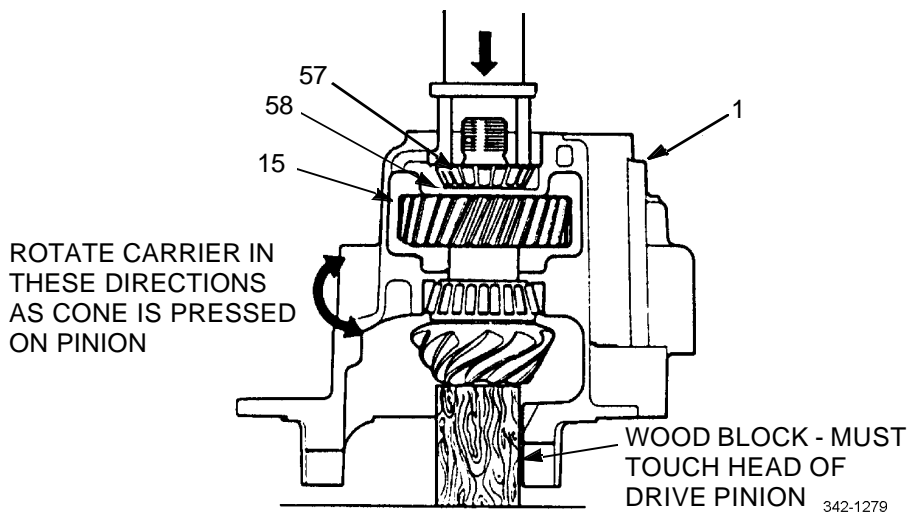
CAUTION

To prevent damage to spacer, do not apply pressure after gear touches spacer in front of inner bearing on drive pinion.

31. Using press and sleeve that fits inside pinion bore of differential carrier (1), press gear (15) on drive pinion (3) until gear touches spacer (59). Do not remove wood block.



32. Install spacer (58) in front of gear (15).
33. Install outer bearing cone (57).
34. Using press, apply two tons of pressure to outer bearing cone (57). Move differential carrier (1) in both directions while installing outer bearing cone.
35. Relieve pressure and remove differential carrier (1) from press. Install differential carrier on repair stand.

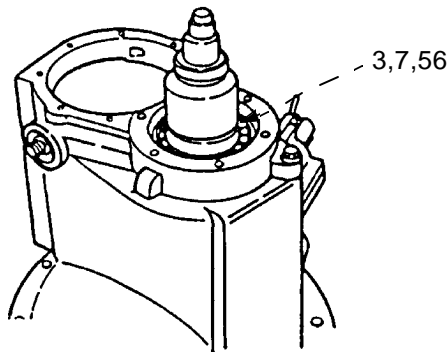


ASSEMBLY - CONTINUED

NOTE

Drive pinion must be held in place with fixture holding gear teeth or with wood blocks between pinion gear and differential carrier case.

36. Install washer (56) and nut (7) on drive pinion (3) and tighten to 1200-1500 lb-ft (1625-2035 Nm).
37. Using inch-pound torque wrench, rotate drive pinion (3). Check reading on dial while turning torque wrench. New drive pinion gear reading must be 5-45 lb-in (0.56-5.08 Nm). Used drive pinion gear reading must be 10-30 lb-in (1.13-3.39 Nm).
38. If preload is not within limits, remove and replace spacers, disassembly steps 45 and 46. Install thicker spacer to decrease preload or thinner spacer to increase preload. Repeat steps 32 through 37 until correct preload is obtained.



342-1260

CAUTION

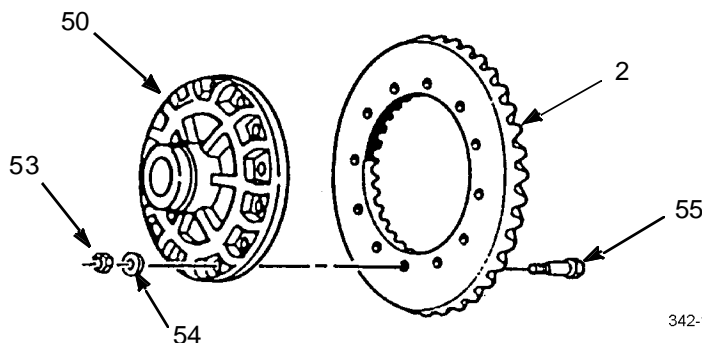
- To prevent damage to case, do not press cold ring gear on ring gear subassembly.
 - To maintain temper of metal and reliability of part, do not use open flame to heat ring gear.
39. Expand ring gear (2) in tank of water heated to 160-180°F (71-82° C) for 10-15 minutes.



WARNING

Hot gear can cause burns. Wear heat-resistant gloves.

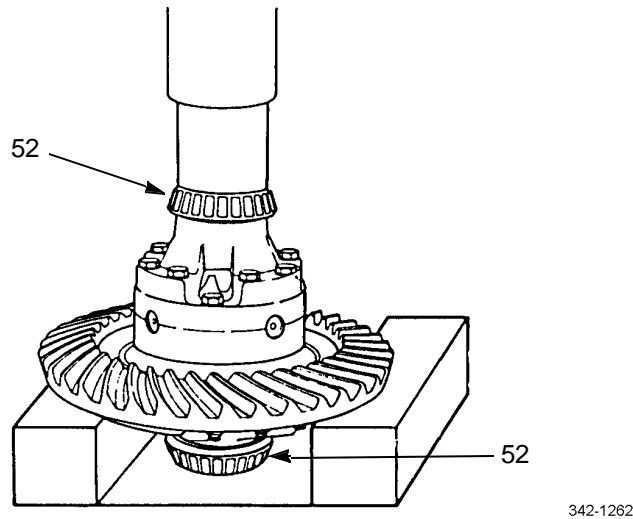
40. Remove ring gear (2) from tank and install on ring gear subassembly (50). If ring gear does not fit easily, reheat and install again.
41. Install 12 bolts (55), washers (54), and nuts (53). Tighten nuts to 190-225 lb-ft (260-350 Nm).



342-1261

ASSEMBLY - CONTINUED

42. Install two bearing cones (52).



WARNING

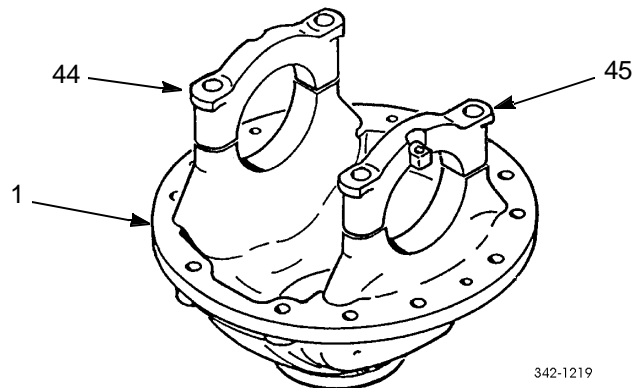


Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water.

CAUTION

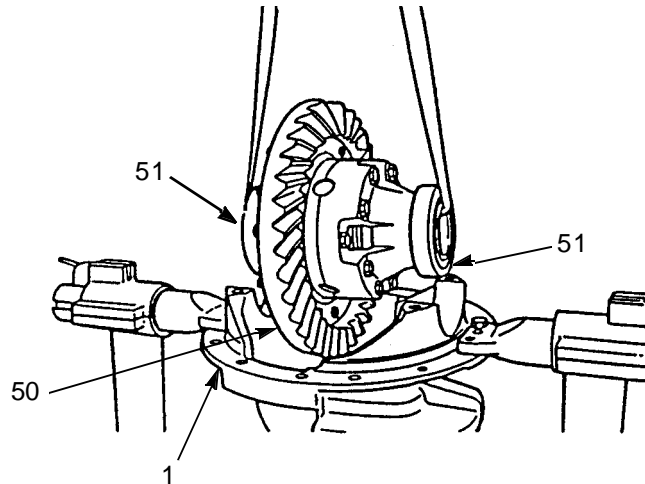
Ensure all old adhesive has been removed from differential carrier and bearing caps to prevent damage to equipment.

43. Set two bearing caps (44 and 45) on differential carrier (1) and apply a continuous bead of adhesive around entire smooth ground surfaces on both sides. Do not apply adhesive to threaded areas.
44. Remove two bearing caps (44 and 45).



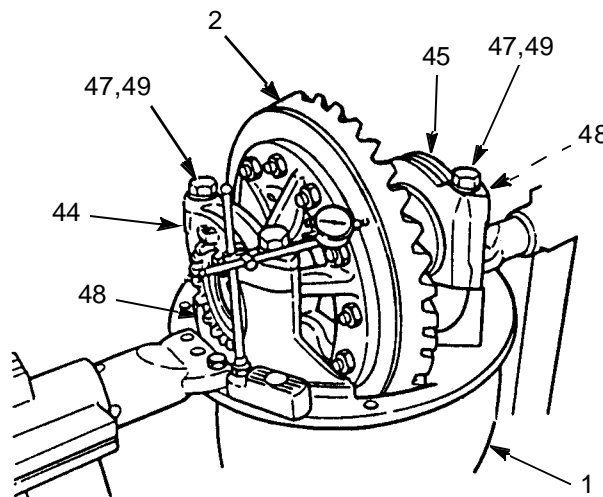
ASSEMBLY - CONTINUED

45. Install two bearing cups (51).
46. Using suitable lifting device, install ring gear subassembly (50) in differential carrier (1).



342-1201

47. Install two bearing caps (44 and 45), four cap screws (47), and washers (49).
48. Install two adjusting rings (48) in differential carrier (1).
49. Tighten four cap screws (47) to 345-430 lb-ft (470-585 Nm).
50. Install dial indicator on flange of differential carrier (1) with plunger against back surface of ring gear (2).



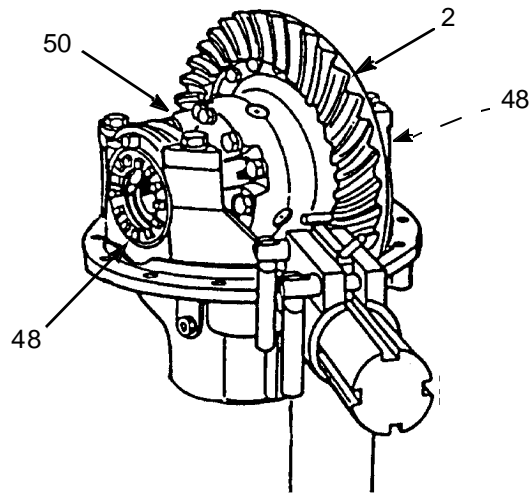
342-1220

ASSEMBLY - CONTINUED

CAUTION

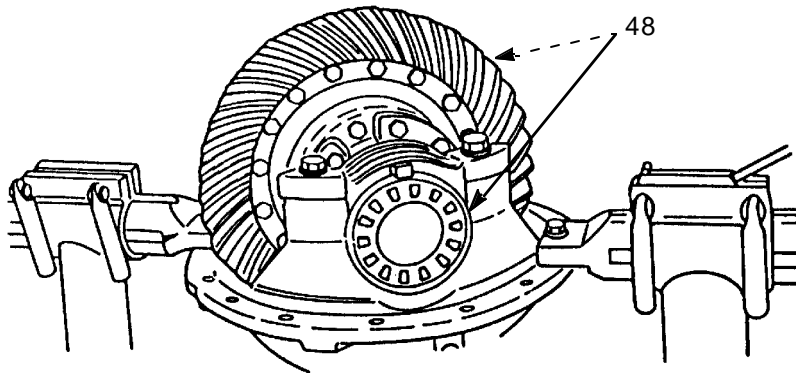
Pry bars must not touch bearing cones to prevent damage to bearing cones.

51. Loosen adjusting ring (48) on gear side of ring gear (2) until small amount of end play shows on dial indicator when ring gear is moved left and right with two pry bars between two adjusting rings and ends of ring gear subassembly (50).
52. Tighten adjusting ring (48) loosened in step 51 until no end play shows on dial indicator.



342-1222

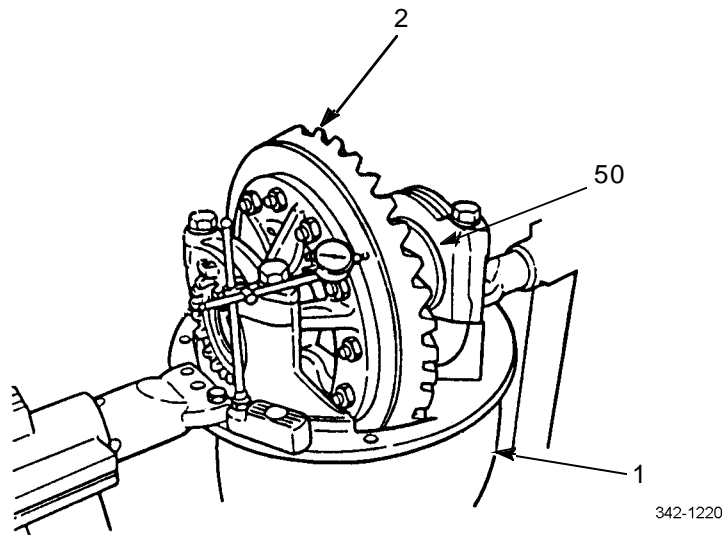
53. Tighten two adjusting rings (48) one notch from zero end play measured in step 52. Bearing preload is now set.



342-1221

ASSEMBLY - CONTINUED

54. Adjust dial indicator to zero.
55. Rotate ring gear (2) while reading dial indicator. Runout must not exceed 0.008 in (0.200 mm).
56. If runout is exceeded, perform disassembly step 37 and 38.
57. Inspect all ring gear subassembly (50) parts and differential carrier (1) for possible excessive runout causes. Replace defective part(s).
58. Repeat steps 45 through 55.



ASSEMBLY - CONTINUED

59. Attach dial indicator on mounting flange of differential carrier (1) so plunger is against tooth surface on drive side of ring gear (2). Adjust dial indicator to zero.

NOTE

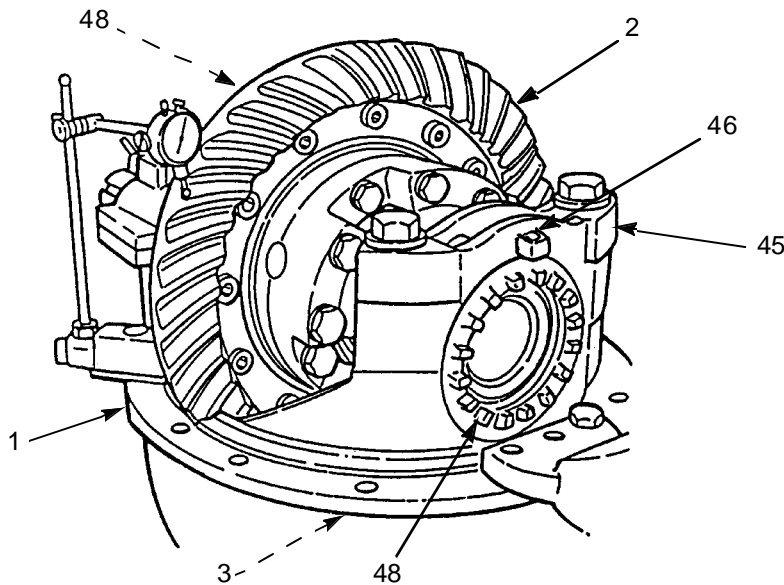
Move ring gear only when adjusting backlash.

60. While holding drive pinion (3) in position, rotate ring gear (2) slightly in both directions against drive pinion teeth. Note measurement.

NOTE

- If same ring gear and drive pinion has been installed, adjust backlash to setting recorded in disassembly step 5.
- If new ring gear and drive pinion has been installed, adjust backlash to 0.01 in (0.25 mm).

61. If backlash measurement is less than specified, loosen adjusting ring (48) on back surface of ring gear (2) and equally tighten adjusting ring on tooth side of ring gear. Repeat step 60.
62. If backlash measurement is more than specified, loosen adjusting ring (48) on tooth side of ring gear (2) and equally tighten adjusting ring on back of surface of ring gear. Repeat step 60.
63. Repeat steps 59 through 62 until backlash meets specification. Record setting for use when adjusting pinion bearing pre-load.



342-1197

NOTE

Always check tooth contact pattern on drive side of ring gear teeth.

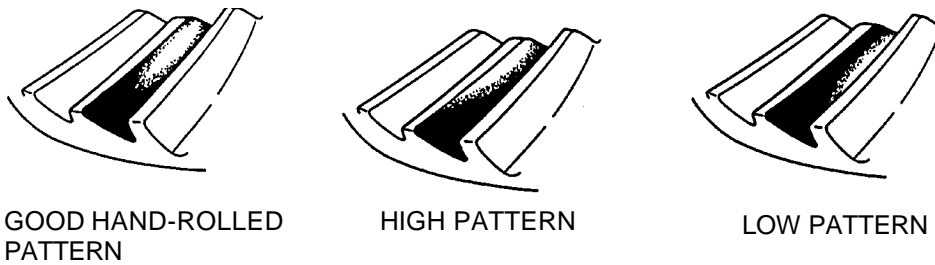
64. Apply Prussian blue dye to approximately 12 teeth of ring gear (2). Rotate ring gear so marked gear teeth are next to drive pinion (3).
65. To get contact pattern, rotate ring gear (2) forward and backward until marked gear teeth go past drive pinion (3) six times. Repeat, if needed, for clearer pattern.

ASSEMBLY - CONTINUED

NOTE

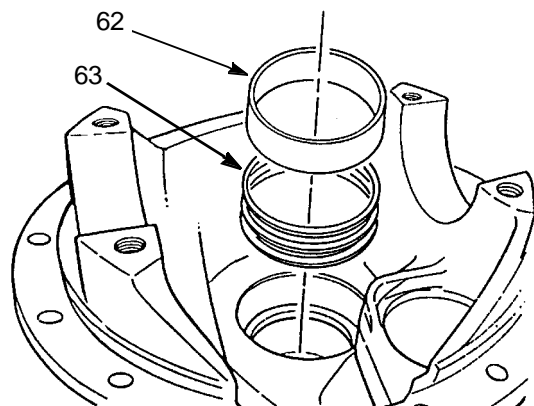
- Location of good hand-rolled contact pattern for new gear set is toward toe of gear tooth and in center between top and bottom of tooth.
- Location of good hand-rolled contact pattern for used gear set must match wear pattern in ring gear. Contact pattern will be smaller than wear pattern.
- During tooth contact pattern checks, backlash can be adjusted within specification limits, if needed, to change pattern location.

66. Compare contact pattern with examples shown.



342-1263

67. If contact pattern requires adjustment, perform disassembly steps 38,39, and 43 through 45.
68. Remove inner bearing cup (62) and shim pack (63).
69. To correct high contact pattern, add shim(s) to shim pack (63).
70. To correct low contact pattern, remove shim(s) from shim pack (63).
71. Perform steps 8 through 66 to determine contact pattern.
72. If contact pattern is too far toward heel of gear teeth, repeat step 62 to decrease backlash to move pattern toward toe of gear teeth.
73. If contact pattern is too far toward toe of gear teeth, repeat step 61 to increase backlash to move pattern toward heel of gear teeth.



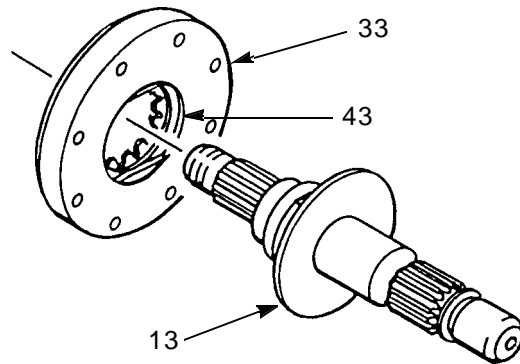
342-1254

74. Install pin (46) in bearing caps (44 and 45) so that pin is between lugs of adjusting ring (48).

ASSEMBLY - CONTINUED**CAUTION**

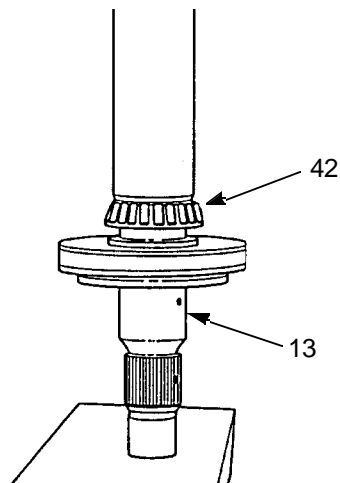
To prevent damage to oil pump, ensure drive flats in bore of oil pump are aligned with input shaft.

75. Install oil pump (33) and bearing cup (43) on input shaft (13).



342-1264

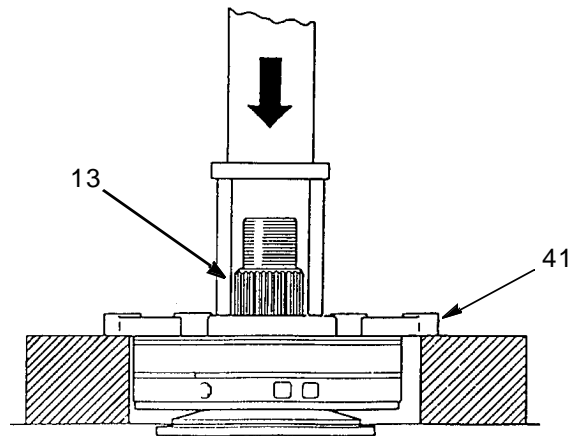
76. Install bearing cone (42) on input shaft (13).



342-1265

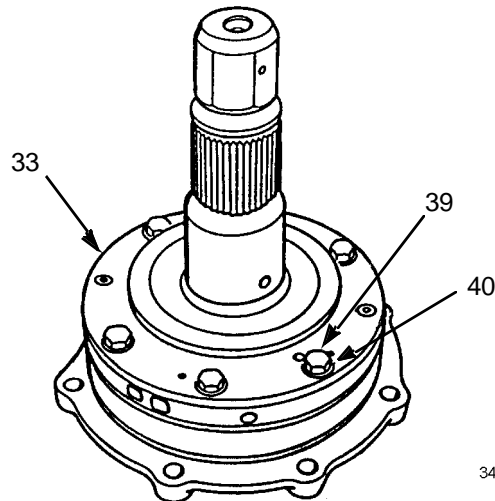
ASSEMBLY - CONTINUED

77. Install bearing cage (41) on input shaft (13).



342-1266

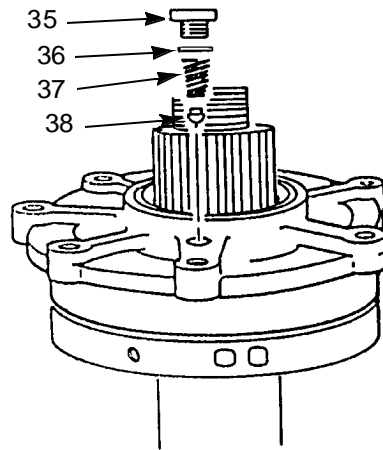
78. Install six cap screws (39) and washers (40) in oil pump (33). Tighten cap screws to 21-26 lb-ft (28-35 Nm).



342-1267

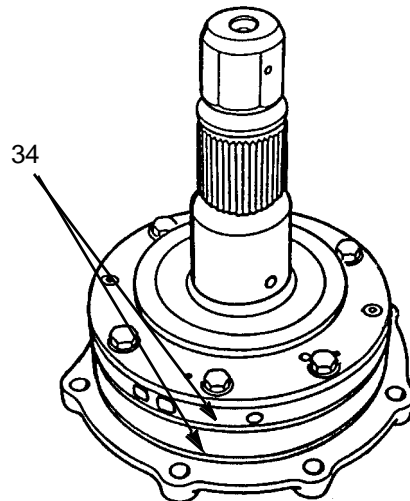
ASSEMBLY - CONTINUED

79. Install relief valve (38), spring (37), washer (36), and plug (35).



342-1268

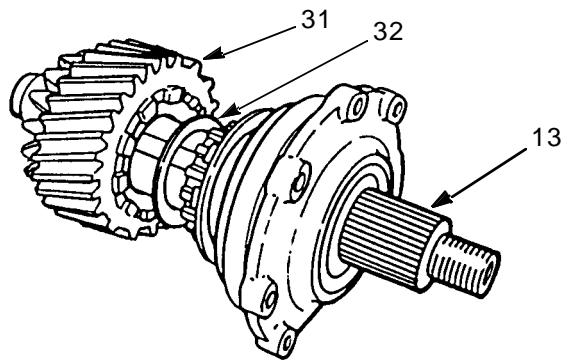
80. Install two new packings (34).



342-1267

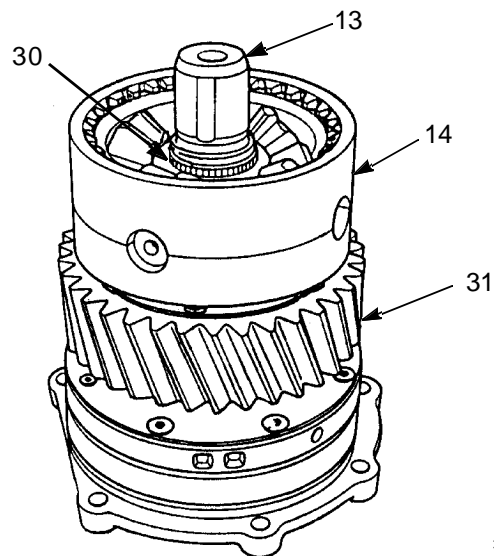
ASSEMBLY - CONTINUED

81. Install thrust washer (32) in pilot bore on gear (31).
82. Install gear (31) on input shaft (13).



342-1238

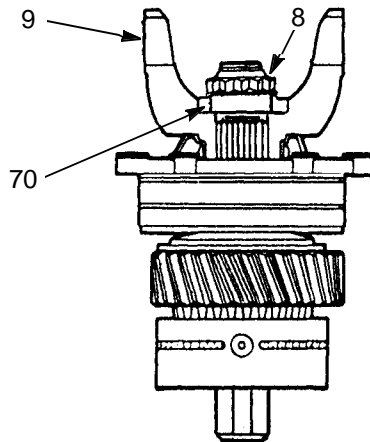
83. Install pinion differential case (14) with screw heads facing gear (31) and snap ring (30) on input shaft (13).



342-1269

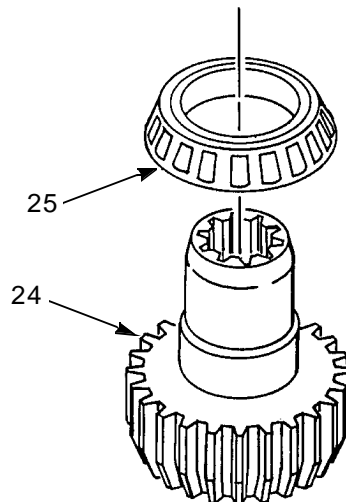
ASSEMBLY - CONTINUED

84. Install yoke (9), an 0.5-in (12.7 mm) assembly spacer (70), and lock nut (8). Hand tighten lock nut.



342-1270

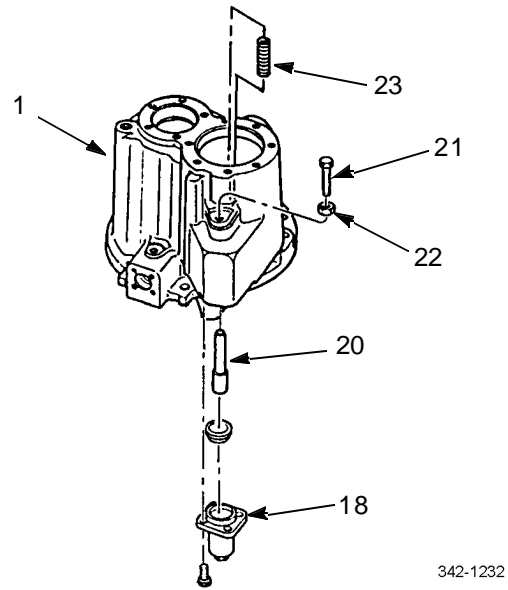
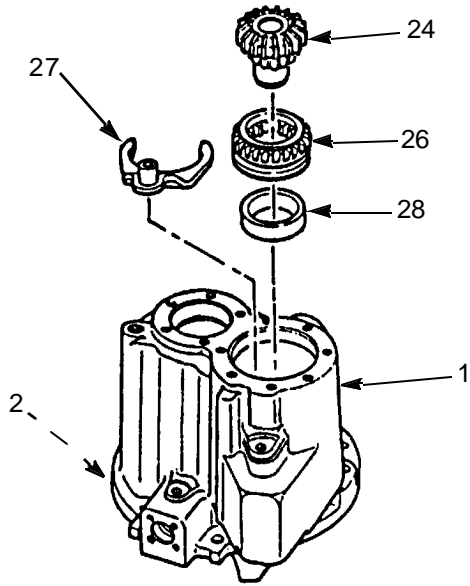
85. Install bearing cone (25) on side gear (24).



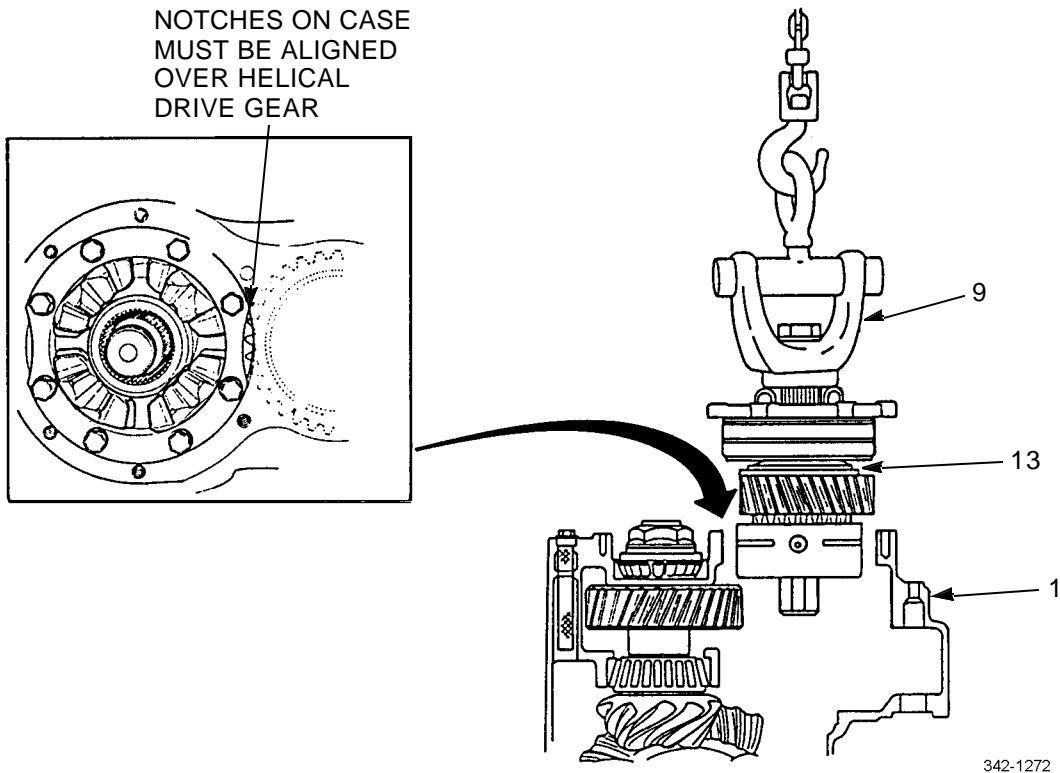
342-1271

86. Rotate differential carrier (1) so that ring gear (2) is toward floor.
87. Install bearing cup (28) in differential carrier (1).
88. Install fork (27), clutch (26), and side gear (24) in differential carrier (1).
89. Install spring (23) in differential carrier (1).
90. Install jamnut (22) and adjusting screw (21) in differential carrier (1).
91. Install shift shaft (20), new seal (19), cover (18), and four socket head screws (17). Tighten screws to 49-76 lb-in (5.5-8.5 Nm).

ASSEMBLY - CONTINUED

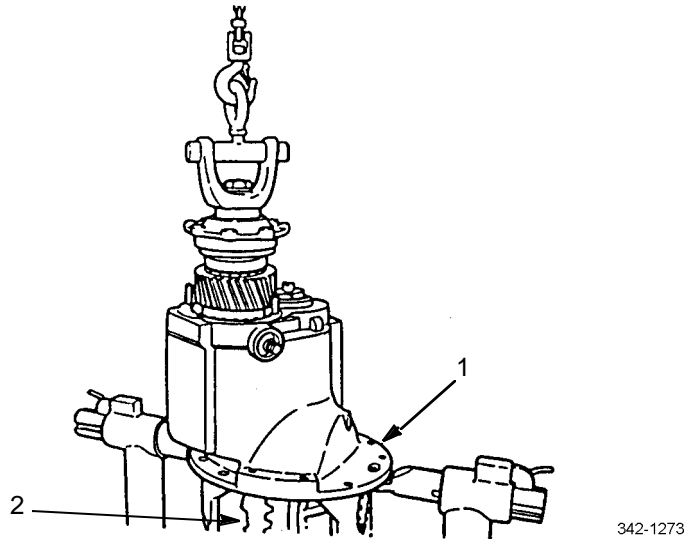


92. Connect suitable lifting device through yoke (9) and install input shaft (13) in differential carrier (1).



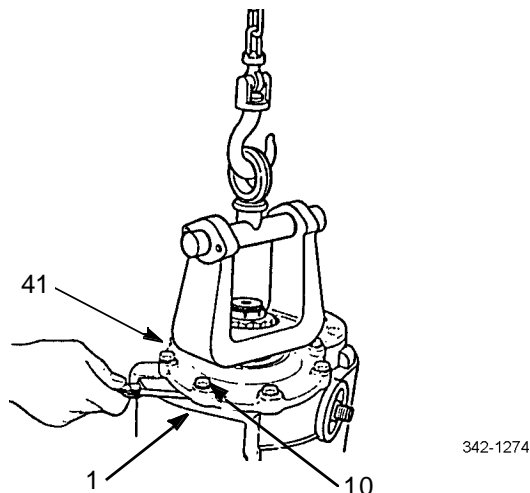
ASSEMBLY - CONTINUED

93. Install wood block between ring gear (2) and differential carrier (1) to prevent ring gear from rotating.

**NOTE**

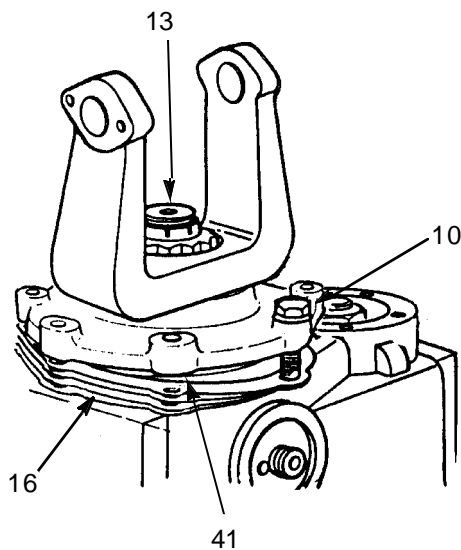
Rotate input shaft in both directions to ensure bearings are correctly installed.

94. Install seven cap screws (10) and hand tighten.
95. Measure gap between bearing cage (41) and differential carrier (1) at four equally spaced places on bearing cage. Note measurements.
96. Add four measurements obtained in step 95 and divide by four to get average. Add 0.005 in (0.13 mm) to determine thickness of shim pack to be installed.



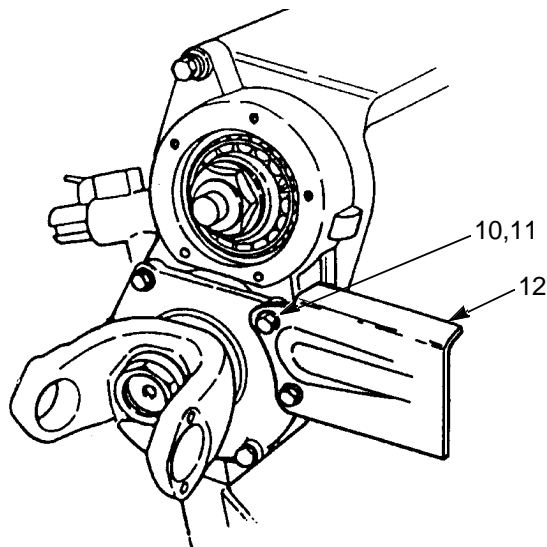
ASSEMBLY - CONTINUED

97. Using at least three shims with thickest in middle, assemble new shim pack (16).
98. Remove seven cap screws (10).
99. Using suitable lifting device, lift input shaft (13) 1/4 - 1/2 in (6-12 mm).
100. Install shim pack (16) under bearing cage (41). Ensure shim pack installation pattern matches bearing cage installation pattern.



342-1275

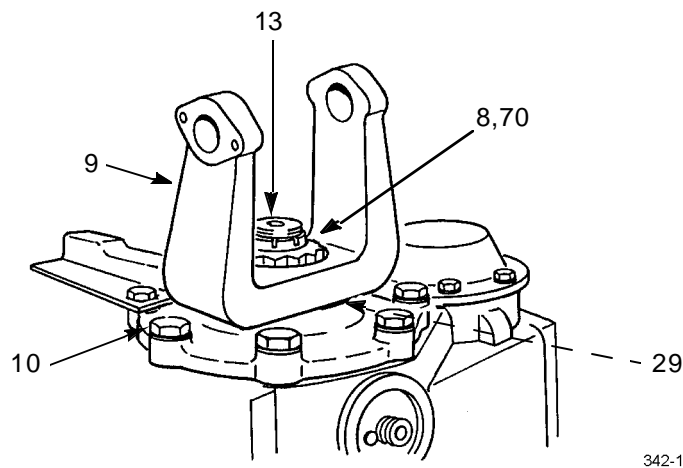
101. Install filter shield (12), seven washers (11), and cap screws (10).



342-1230

ASSEMBLY - CONTINUED

102. Lower input shaft (13) and remove lifting device.
103. Tighten seven cap screws (10) to 75-95 lb-ft (100-130 Nm). Rotate input shaft (13) in each direction to ensure bearings are installed correctly.
104. Remove lock nut (8), 0.5 in (12.7 mm) assembly spacer (70), and yoke (9).
105. Install new oil seal (29), yoke (9), and lock nut (8). Using pinion holding bar, tighten lock nut to 450-600 lb-ft (610-815 Nm).
106. Rotate input shaft (13) and push yoke (9) toward differential carrier (1) to ensure input shaft is at bottom of travel.

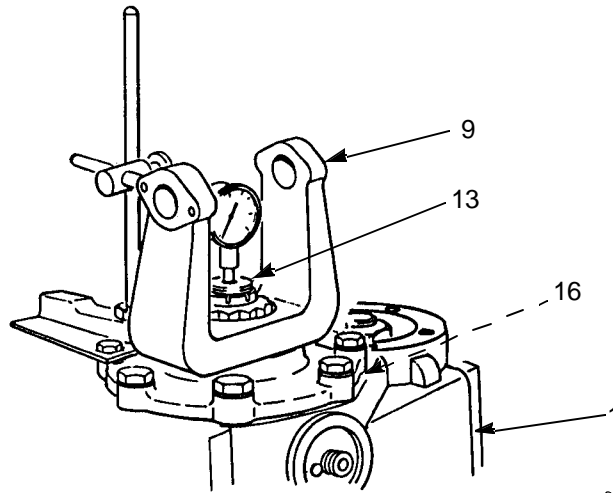


342-1276

107. Install dial indicator with point on end of input shaft (13). Zero dial indicator.
108. Using pry bar, pry up on flange of yoke (9) and read dial indicator. Acceptable reading is 0.002-0.008 in (0.05-0.2mm).

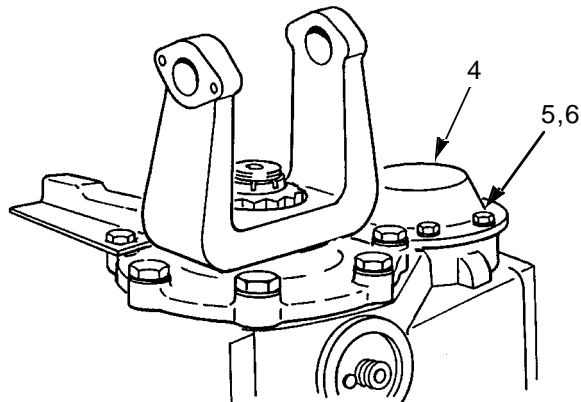
ASSEMBLY - CONTINUED

109. If input bearing end play is not within specification, add or remove shim(s) from shim pack (16). Repeat steps 98 through 103.



342-1277

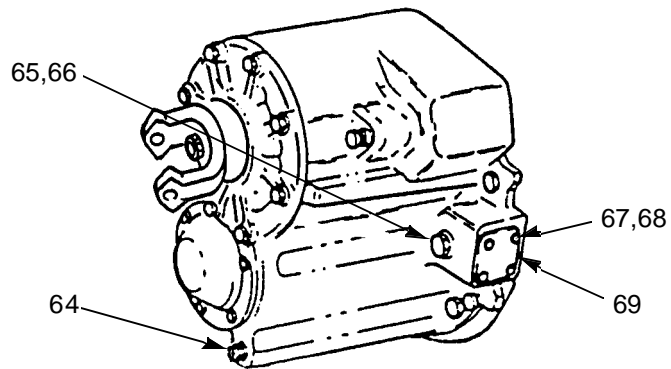
110. Install pinion cover (4), five washers (6), and cap screws (5). Tighten cap screws to 45-55 lb-ft (60-75 Nm).



342-1276

ASSEMBLY - CONTINUED

111. Install cover (69), four washers (68), four cap screws (67), washer (66), plug (65), and screen/plug assembly (64).



342-1278

112. Install forward-rear axle differential carrier (WP 0079 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Jack, hydraulic (Item 73, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

Compound, sealing (Item 14, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Equipment Condition

Axle shafts removed (TM 9-2320-302-20)

Intermediate driveline disconnected (TM 9-2320-302-20)

Axle oil drained (TM 9-2320-302-20)

Personnel Required

Two



WARNING



- Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.
- Spilled gear oil is very slippery. Wipe up any spilled oil immediately. Failure to do so could result in serious injury to personnel.

REMOVAL

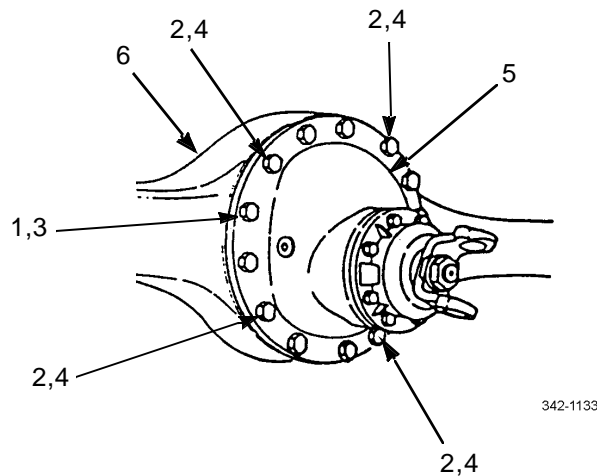
NOTE

If axle assembly has been removed from vehicle, perform steps 1 through 3 only.

REMOVAL - CONTINUED**WARNING**

Rear-rear differential carrier weighs 860 lb (390 kg). Support with suitable floor jack prior to removal to prevent injury to personnel.

1. Remove 12 screws (1 and 2) and flat washers (3 and 4).
2. Loosen differential carrier (5) by tapping around flange.
3. Remove differential carrier (5) from axle (6).
4. Lower differential carrier (5) onto floor jack and roll differential carrier from under vehicle.

**INSTALLATION****WARNING**

Rear-rear differential carrier weighs 860 lb (390 kg). Support with suitable floor jack prior to installation to prevent injury to personnel.

NOTE

If axle assembly has been removed from vehicle, perform steps 3 through 5 only.

1. Position differential carrier (5) on floor jack and roll differential carrier into position under vehicle.

INSTALLATION - CONTINUED**WARNING**

Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If adhesive or sealing compound gets on skin or clothing, wash immediately with soap and water.

CAUTION

Ensure both mating surfaces have been completely cleaned to prevent damage to equipment.

2. Apply sealing compound around mating surface of axle (6).
3. Attach suitable hoist and install differential carrier (5) to axle (6) with four flat washers (4) and screws (2) in four corner locations around differential carrier. Hand tighten screws.
4. Seat differential carrier (5) and tighten four screws (2) in crisscross pattern.
5. Repeat step 4 until differential carrier (5) is completely seated. Tighten four screws (2) to 150-230 lb-ft (203-312 Nm).
6. Install eight flat washers (3) and screws (1). Tighten screws in crisscross pattern to 150-230 lb-ft (203-312 Nm).
7. Connect intermediate driveline (TM 9-2320-302-20).
8. Install axle shafts (TM 9-2320-302-20).
9. Fill axle with oil (TM 9-2320-302-20).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Holding bar, pinion (Item 47, WP 0126 00)
- Multiplier, torque wrench (Item 79, WP 0126 00)
- Press, arbor (Item 90, WP 0126 00)
- Scale (Item 110, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)

Materials/Parts

- Nut, lock (P/N 40X-1026)
- Seal, oil (P/N A-1205-H-2426)
- Adhesive, silicone rubber (Item 5, WP 0125 00)
- Grease, GAA (Item 22, WP 0125 00)
- Oil, lubricating (Item 26, WP 0125 00)
- Paste, Prussian blue (Item 28, WP 0125 00)
- Rags, wiping (Item 31, WP 0125 00)
- Wire, 14 gage (Item 41, WP 0125 00)

Personnel Required

Two

Equipment Condition

Rear-rear axle differential carrier removed (WP 0081 00)

DISASSEMBLY



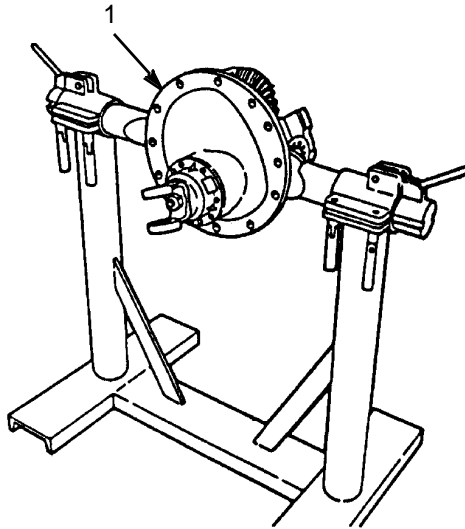
WARNING



Rear-rear axle differential carrier weighs 860 lbs (390 kg). Attach suitable floor jack prior to disassembly to prevent possible injury to personnel.

DISASSEMBLY - CONTINUED

1. Install differential carrier (1) on repair stand.



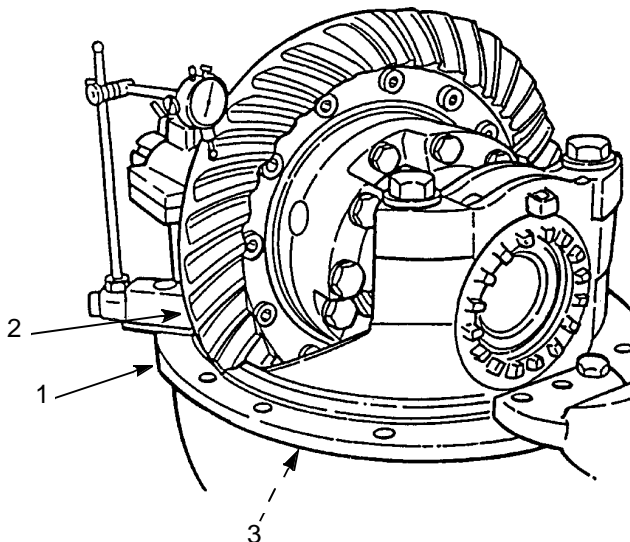
342-1196

2. Turn differential carrier (1) so ring gear (2) is up.

NOTE

If reinstalling same ring gear and drive pinion, perform steps 3 through 5 to measure backlash.

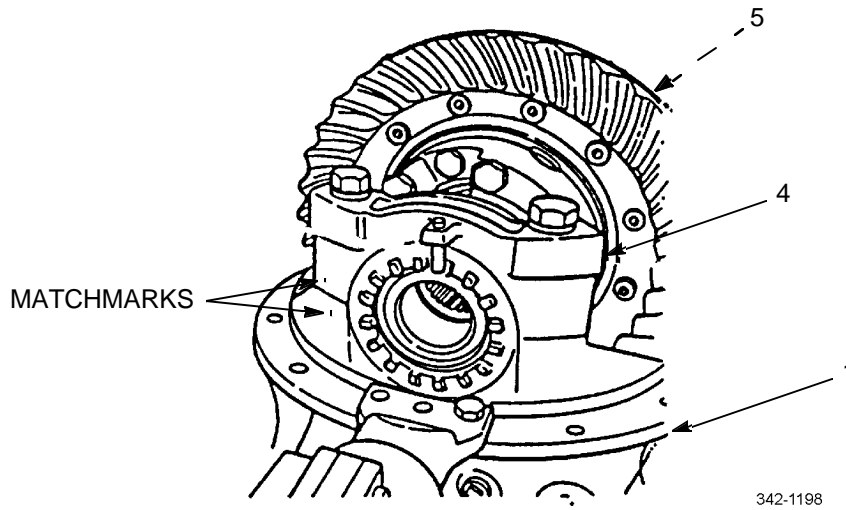
3. Move ring gear (2) so ring gear teeth fully engage with drive pinion (3).
4. Install dial indicator on flange of differential carrier (1) so that tip of indicator is against drive side of tooth on ring gear (2). Adjust dial indicator to zero.
5. Rotate ring gear (2) in both directions and record reading.
6. Repeat step 5 two more times in different locations.



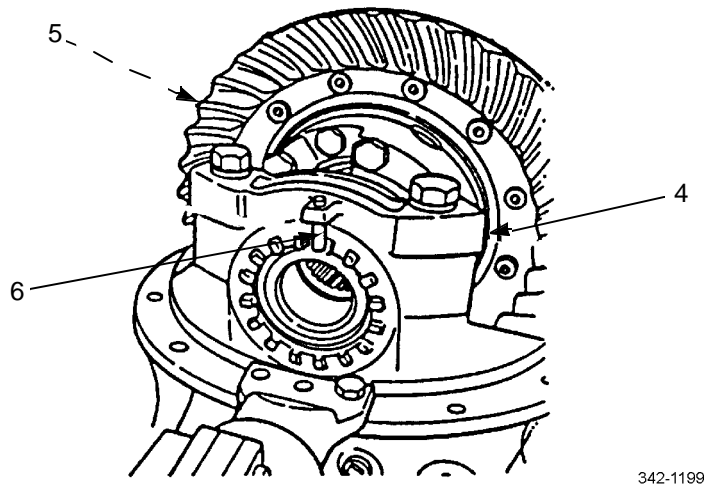
342-1197

DISASSEMBLY - CONTINUED

7. Matchmark position of two bearing caps (4 and 5) on differential carrier (1).



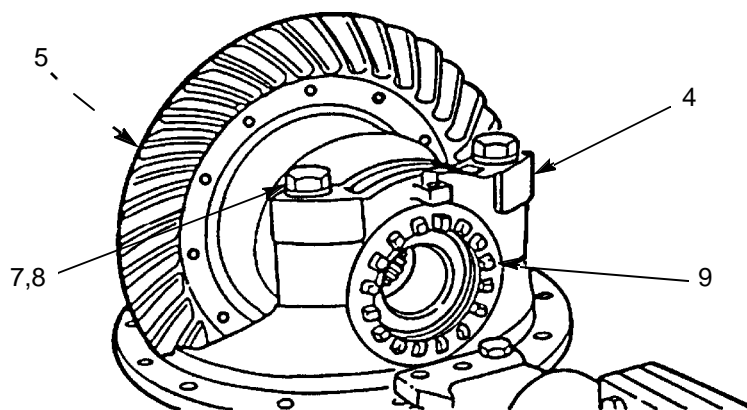
8. Remove pin (6) from two bearing caps (4 and 5).



DISASSEMBLY - CONTINUED**CAUTION**

To prevent damage to adjusting rings, do not hit adjusting rings with hammer or use hammer and drift pin to loosen rings.

9. Remove four cap screws (7), washers (8), two bearing caps (4 and 5), and two adjusting rings (9).



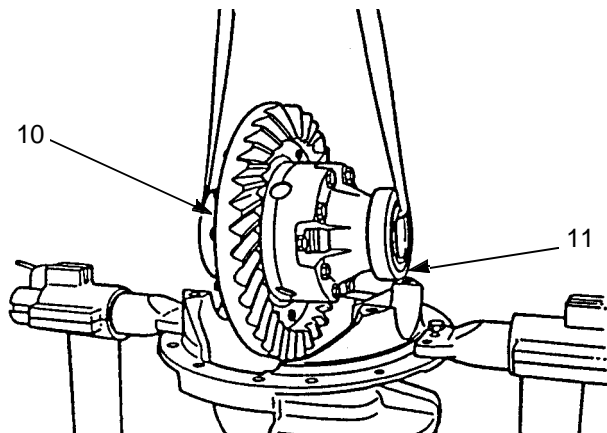
342-1200

10. Attach lifting device to ring gear subassembly (10).

NOTE

Ring gear and assembled parts must be tilted to clear casting inside carrier.

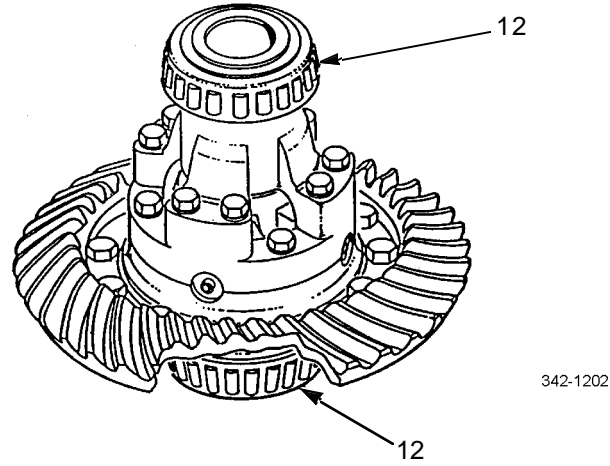
11. Remove ring gear subassembly (10) and two bearing cups (11).
12. Place ring gear subassembly (10) on clean work surface and remove lifting device.



342-1201

DISASSEMBLY - CONTINUED

13. Remove two bearing cones (12).



14. Remove 12 nuts (13), washers (14), and bolts (15) from ring gear (2).

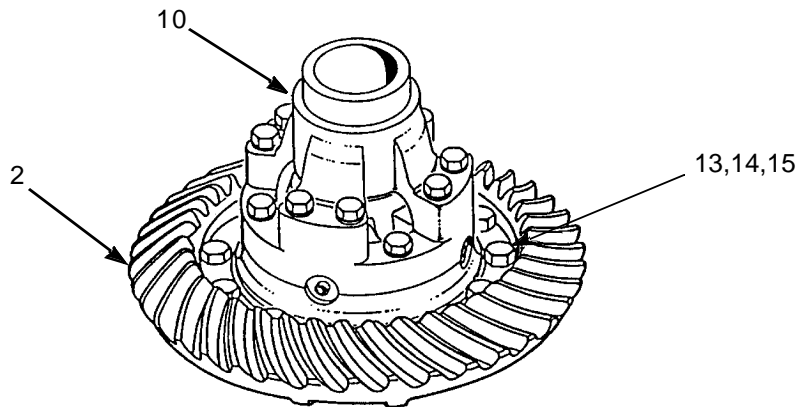


WARNING



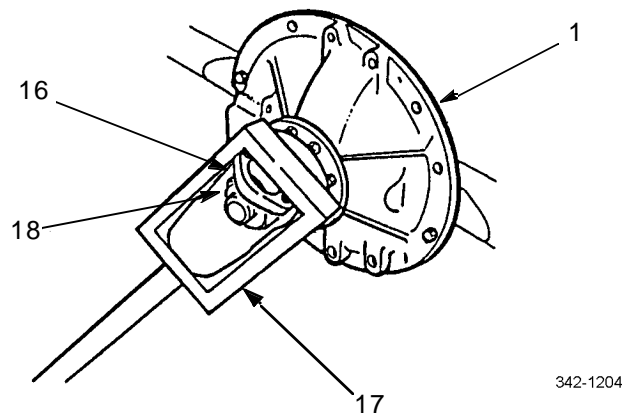
Ring gear is heavy and can injure personnel if dropped. Do not put hands under ring gear.

15. Remove ring gear (2) from ring gear assembly (10).

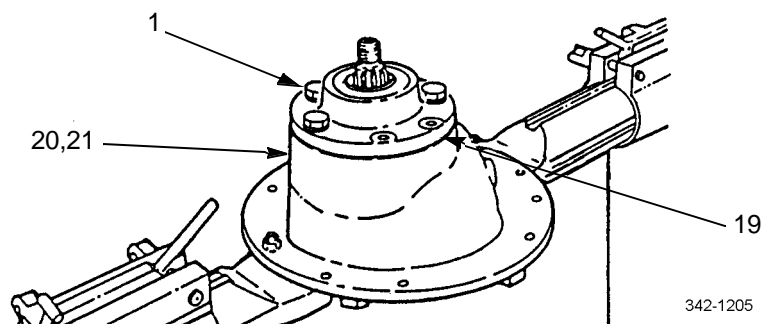


DISASSEMBLY - CONTINUED

16. Rotate differential carrier (1) so that yoke (16) is in horizontal position.
17. Using yoke holder bar (17) to hold yoke (16) in place, loosen lock nut (18).
18. Rotate differential carrier (1) so that yoke (16) faces up.
19. Remove lock nut (18) and yoke (16). Discard lock nut.



20. Matchmark bearing cage assembly (19) and differential carrier (1). Remove eight cap screws (20), washers (21), and bearing cage assembly (19).

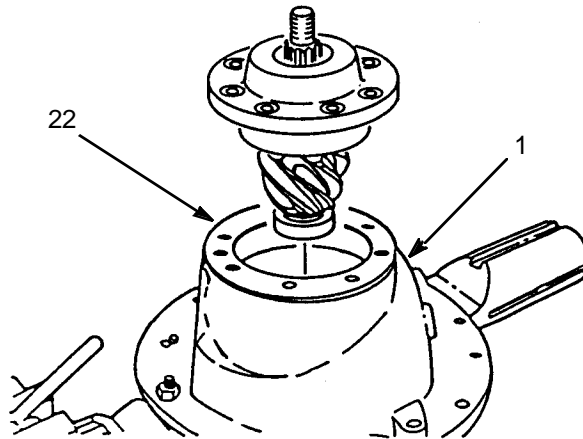


DISASSEMBLY - CONTINUED

NOTE

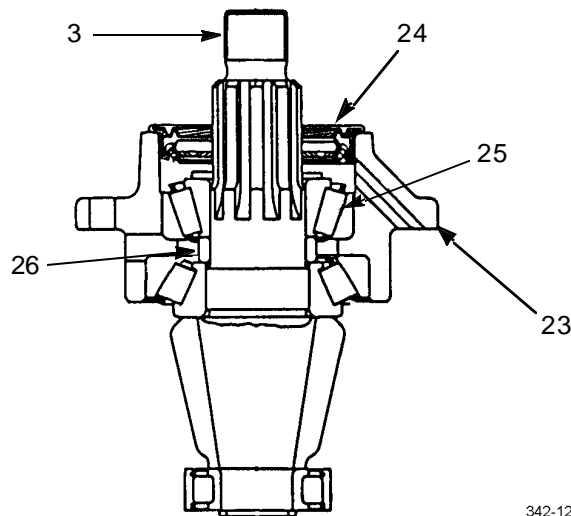
- If shims are in good condition, keep shims together to use for assembly.
- If shims are damaged, measure and record thickness of shim pack before discarding shims.

21. Remove shim pack (22) from differential carrier (1).



342-1206

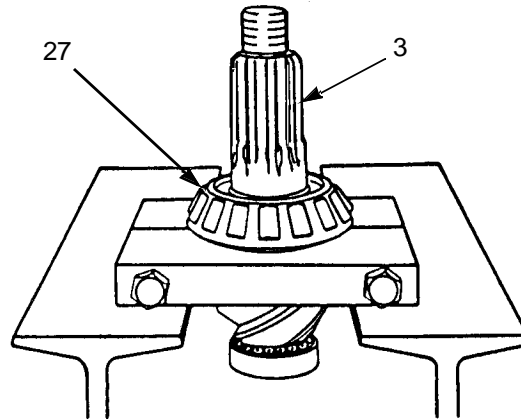
22. Press drive pinion (3) through bearing cage (23).
23. Remove and discard oil seal (24).
24. Remove outer bearing cone (25) from bearing cage (23).
25. Remove spacer(s) (26) from drive pinion shaft (3).



342-1207

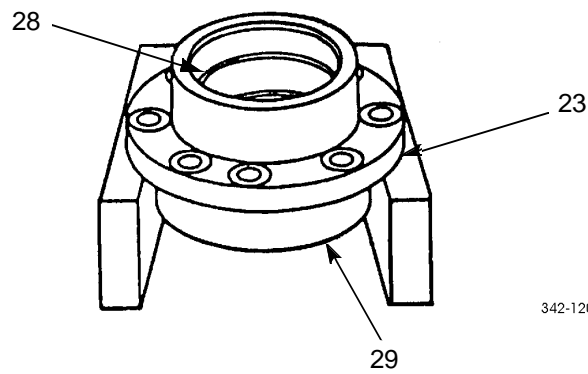
DISASSEMBLY - CONTINUED

26. Remove inner bearing cone (27) from drive pinion shaft (3).



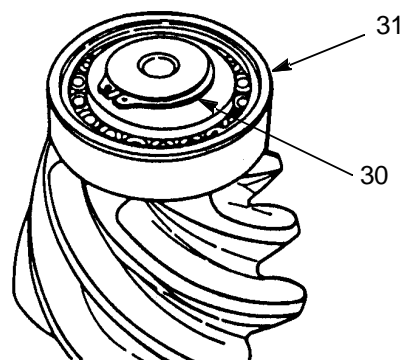
342-1208

27. Remove two bearing cups (28 and 29) from bearing cage (23).



342-1209

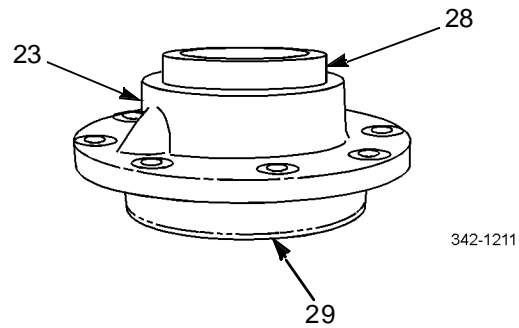
28. Remove retaining ring (30) and spigot bearing (31).



342-1210

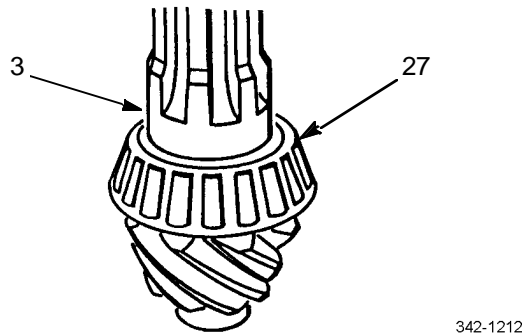
ASSEMBLY

1. Install bearing cups (28 and 29) in bearing cage (23).

**NOTE**

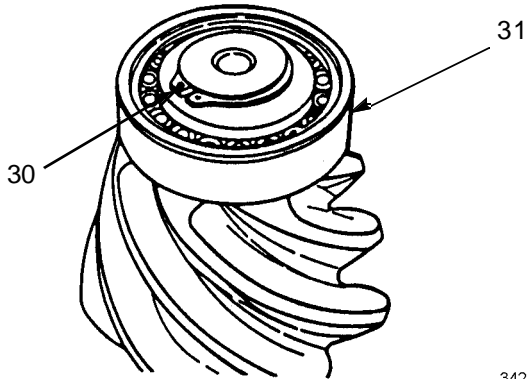
Apply light coat of lubricating oil to all bearing cups and cones prior to installation.

2. Install inner bearing cone (27) on drive pinion shaft (3) until bearing cone is flat against drive pinion shaft gear head.

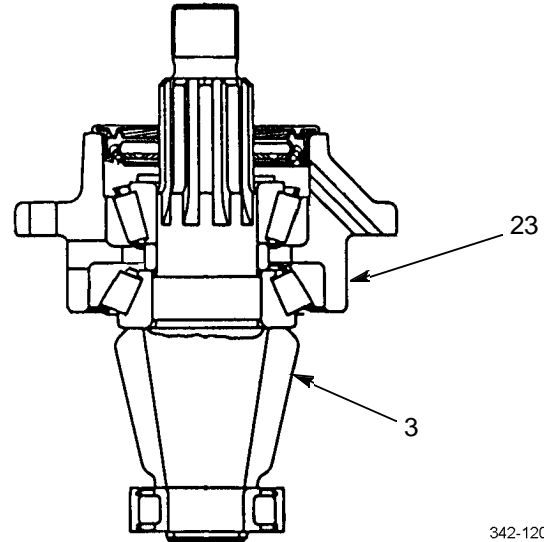


ASSEMBLY - CONTINUED

3. Install spigot bearing (31) and retaining ring (30).
4. Install drive pinion shaft (3) in bearing cage (23).

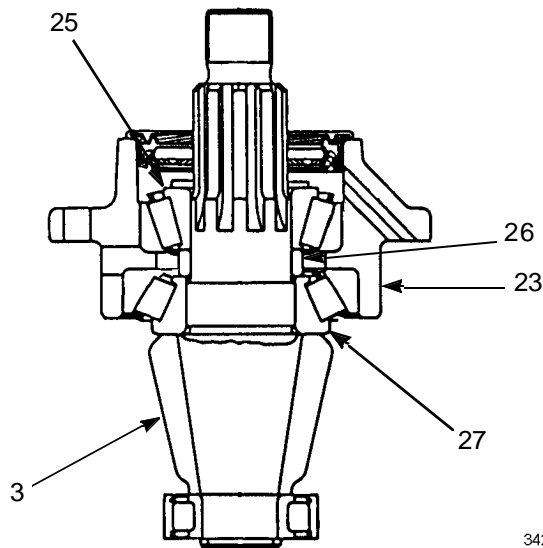


342-1210



342-1207

5. Install spacer(s) (26) on drive pinion shaft (3).
6. Install outer bearing cone (25) on drive pinion shaft (3) against spacers (26).
7. Apply 25 tons (22.7 Mt) of pressure to two bearing cones (24 and 27) and as pressure is applied, rotate bearing cage (23) several times so that two bearing cones make normal contact.



342-1207

ASSEMBLY - CONTINUED

NOTE

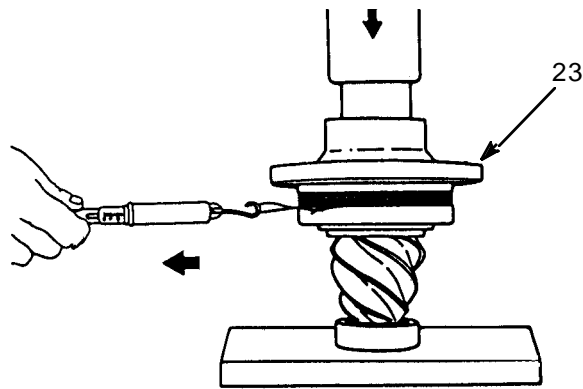
To perform steps 10 and 11, a 20 in (50.8 cm) piece of 14 gage wire must be used.

8. Maintain pressure and wrap 14 gage wire around bearing cage (23) several times.

NOTE

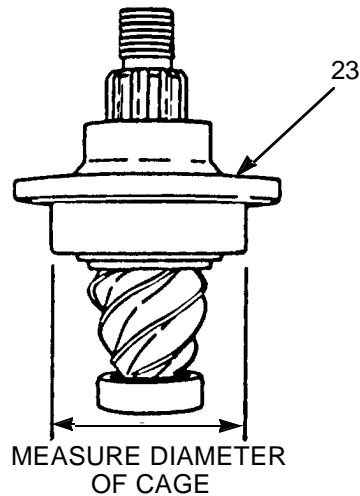
For accuracy, reading must be taken while bearing cage is rotating.

9. Attach spring scale to end of wire and pull. As bearing cage (23) rotates, read and record value on scale.



342-1213

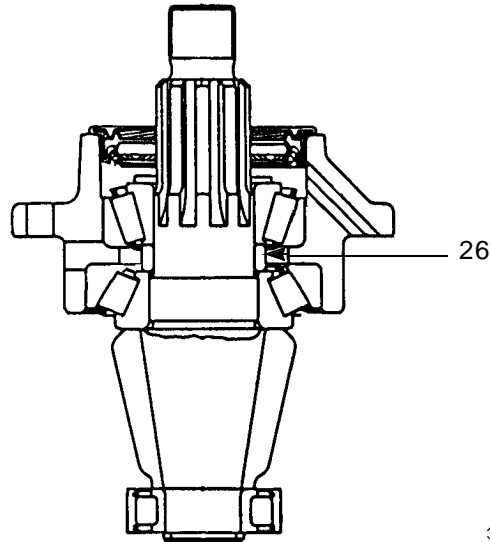
10. Measure diameter of bearing cage (23) where wire was wrapped and divide measurement in half to determine radius.



342-1214

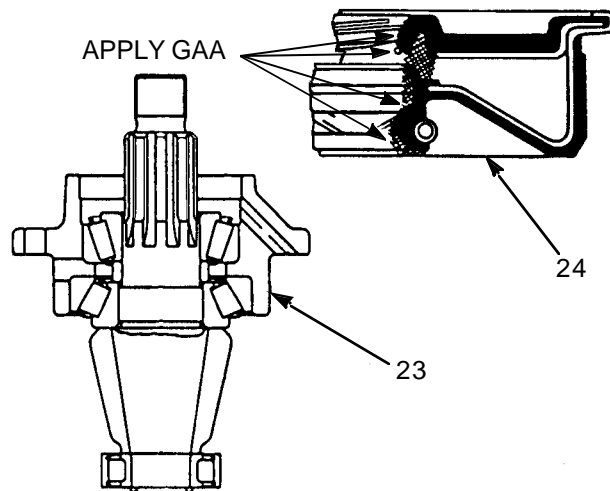
ASSEMBLY - CONTINUED

11. Multiply reading from step 9 by radius from step 10 to determine preload. New pinion drive gear preload must be 5-45 lb-in (0.56-5.08 Nm). Used pinion drive gear preload must be 10-30 lb-in (1.13-3.39 Nm).
12. If preload is not within limits, install thicker spacer (26) to decrease preload or thinner spacer to increase preload.



342-1207

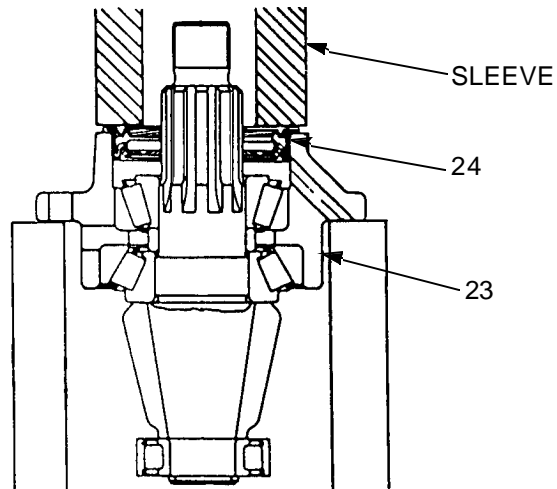
13. Repeat steps 7 through 12 until correct preload is obtained.
14. Coat outside of new oil seal (24) and bore of bearing cage (23) with GAA.



342-1215

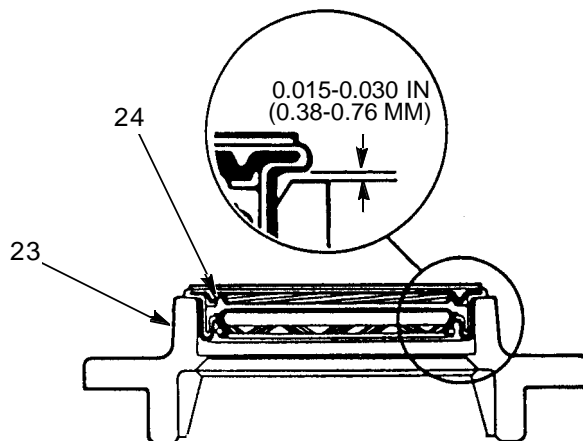
ASSEMBLY - CONTINUED

15. Install oil seal (24) in bearing cage (23).



342-1216

16. Using thickness gage, check gap between oil seal (24) and bearing cage (23) at several points around oil seal. Gap must be within 0.015 – 0.030 in (0.38 – 0.76 mm). Difference between largest and smallest gap must not exceed 0.01 in (0.25 mm).



342-1217

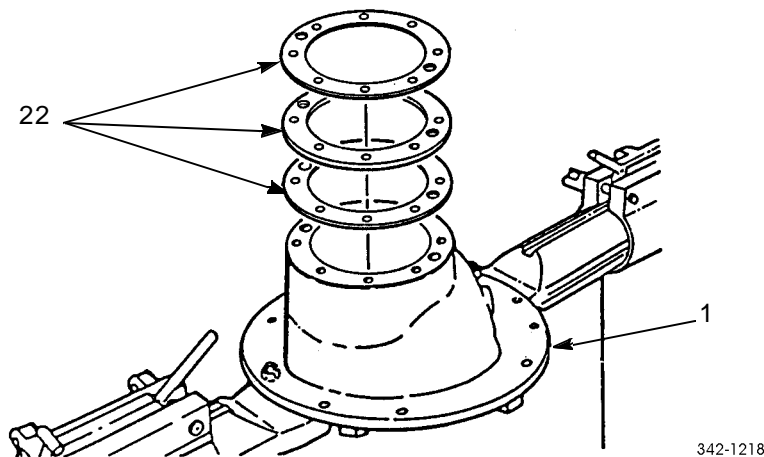
ASSEMBLY - CONTINUED**NOTE**

- If installing new ring gear and drive pinion, perform steps 19 through 24.
- Replace ring gear and drive pinion as matched set. Gear set match number is on gear head of drive pinion and front face or outer diameter of ring gear.
- Pinion cone variation number is used to adjust depth of pinion in differential carrier. Pinion cone variation number is on end of gear head of drive pinion or outer diameter of ring gear.

17. Record new pinion cone variation number.
18. Record old pinion cone variation number.
19. If old pinion cone variation number is +, subtract number from shim pack thickness in disassembly step 21.
20. If old pinion cone variation number is -, add number to shim pack thickness in disassembly step 21.
21. If new pinion cone variation number is +, add number to shim pack thickness determined in step 19 or 20.
22. If new pinion cone variation number is -, subtract number from shim pack thickness determined in step 19 or 20.

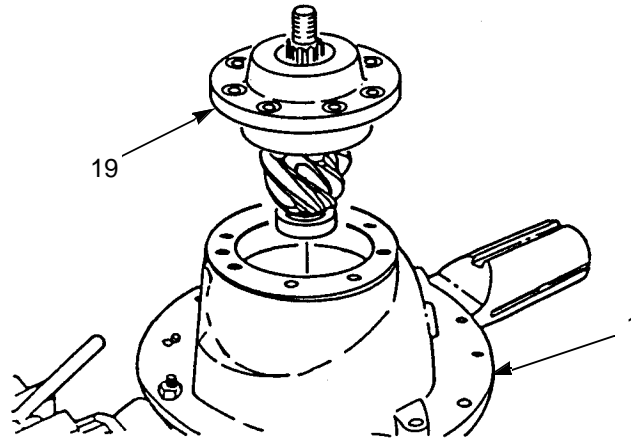
NOTE

- If installing same ring gear and drive pinion, use shim pack removed in disassembly step 21.
 - If installing new shim pack, use at least three shims with thickest shim in middle of pack.
23. Aline oil slots on shim pack (22) with oil slots on differential carrier (1) and install shim pack.



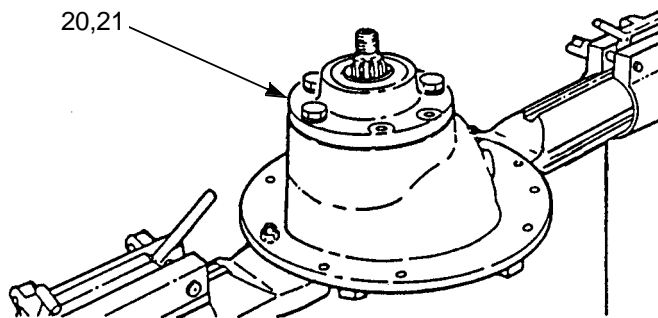
ASSEMBLY - CONTINUED

24. Install bearing cage assembly (19) in differential carrier (1).



342-1206

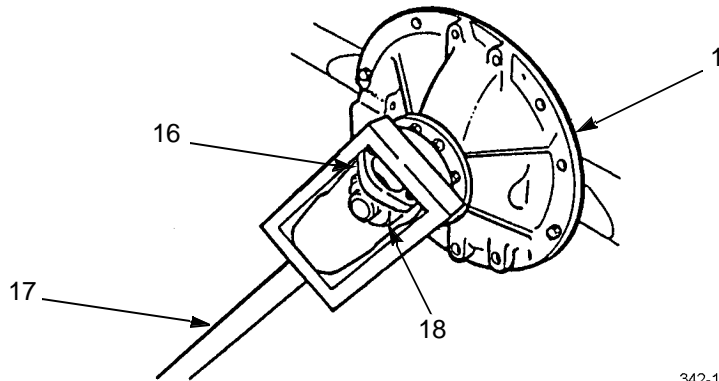
25. Install eight washers (21) and cap screws (20). Tighten cap screws to 74-96 lb-ft (100-130 Nm).



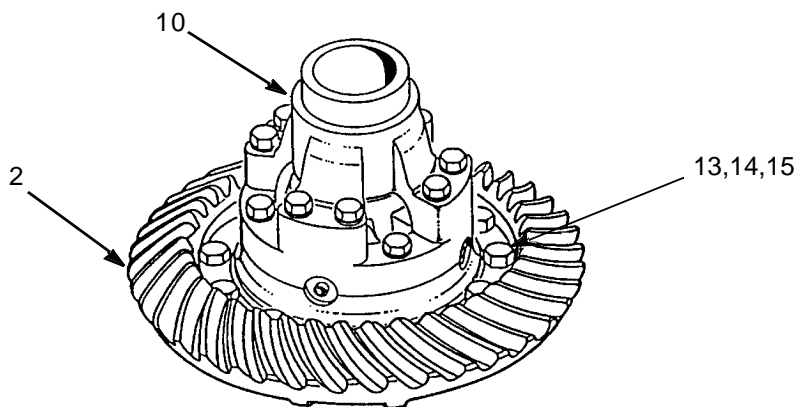
342-1205

ASSEMBLY - CONTINUED

26. Install yoke (16) and new lock nut (18).
27. Rotate differential carrier (1) so that yoke (16) is in horizontal position.
28. Using yoke holder bar (17) to hold yoke (16) in place, tighten lock nut (18) to 1000-1230 lb-ft (1356-1668 Nm).

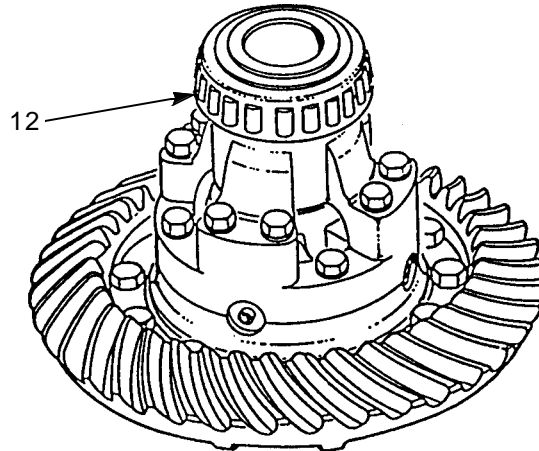


29. Install ring gear (2) on ring gear subassembly (10).
30. Install 12 bolts (15), washers (14), and nuts (13). Tighten nuts to 190-225 lb-ft (258-305 Nm).



ASSEMBLY - CONTINUED

31. Install two bearing cones (12).



342-1280

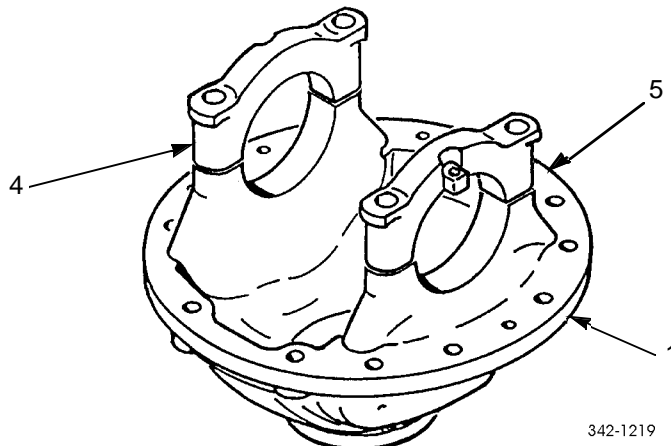
**WARNING**

Adhesives and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death keep away from open fire and use in well ventilated area. If adhesive or sealing compound contacts skin or clothing, wash immediately with soap and water.

CAUTION

Ensure all old adhesive has been removed from differential carrier and bearing caps to prevent damage to equipment.

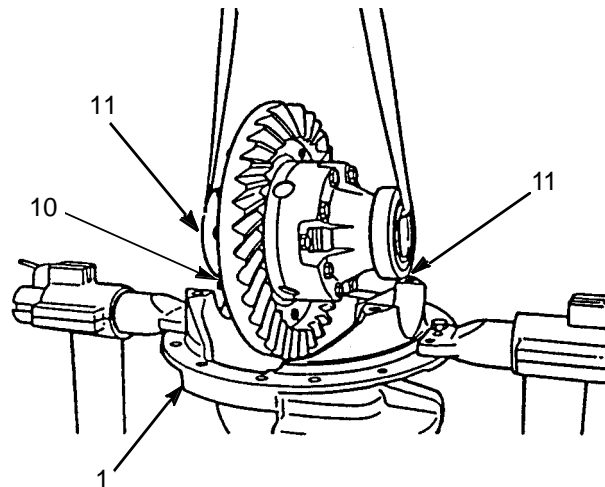
32. Set two bearing caps (4 and 5) on differential carrier (1) and apply continuous bead of adhesive around entire smooth ground surfaces on both sides. Do not apply adhesive to threaded areas.
33. Remove two bearing caps (4 and 5).



342-1219

ASSEMBLY - CONTINUED

34. Install two bearing cups (11).
35. Using suitable lifting device, install ring gear subassembly (10) in differential carrier (1).



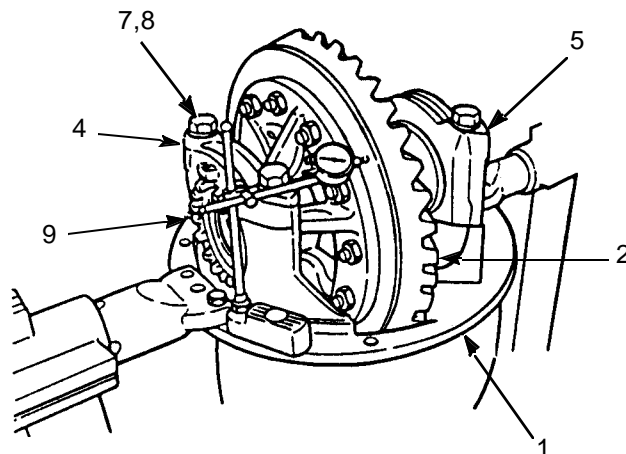
342-1201

36. Install two bearing caps (4 and 5), four cap screws (7), and washers (8).

NOTE

If there is a problem performing step 37, tighten four cap screws to 10-20 lb-ft (14-27 Nm).

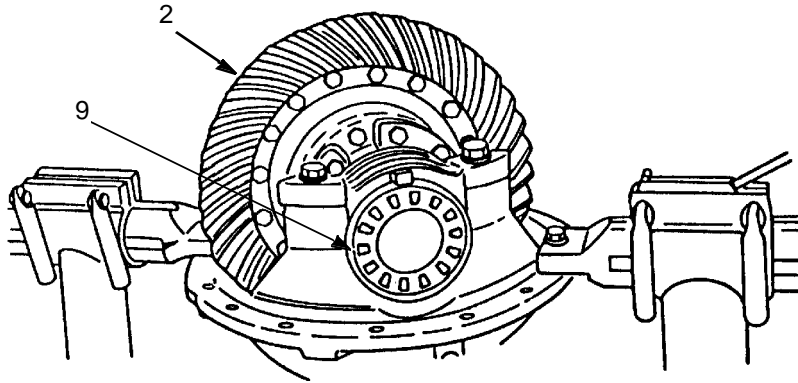
37. Install two adjusting rings (9) in differential carrier (1).
38. Tighten four cap screws (7) to 347-431 lb-ft (471-584 Nm).
39. Install dial indicator on flange of differential carrier (1) with plunger against back surface of ring gear (2).



342-1220

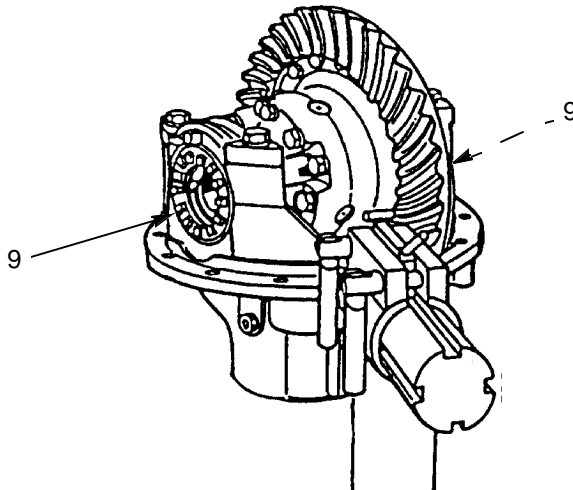
ASSEMBLY - CONTINUED

40. Loosen adjusting ring (9) on gear side of ring gear (2) so small amount of end play shows on dial indicator when ring gear is moved left and right.



342-1221

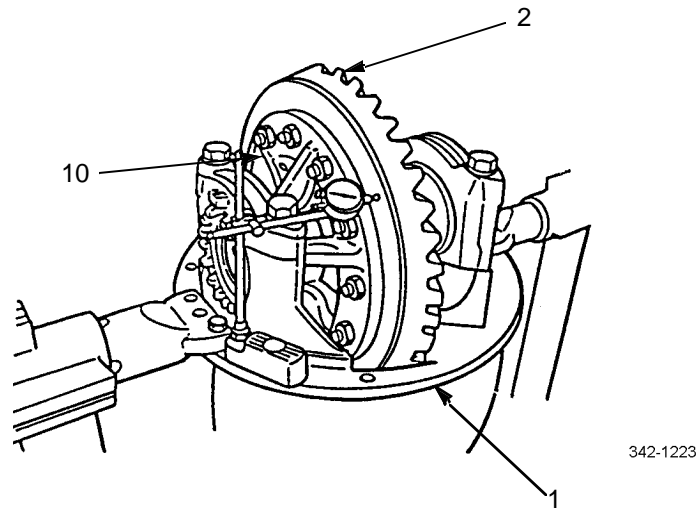
41. Tighten adjusting ring (9) loosened in step 40 so no end play shows on dial indicator.
42. Tighten two adjusting rings (9) one notch from zero end play measured in step 40. Bearing preload is now set.
43. Adjust dial indicator to zero.



342-1222

ASSEMBLY - CONTINUED

44. Rotate ring gear (2) while reading dial indicator; runout must not exceed 0.008 in (0.200 mm).
45. If runout is exceeded, perform disassembly steps 9 through 11.
46. Inspect all ring gear subassembly (10) parts and differential carrier (1) for possible excessive runout caused. Replace defective part(s).



47. Repeat steps 36 through 46.
48. Attach dial indicator on mounting flange of differential carrier (1) so that plunger is against tooth surface on drive side of ring gear (2) and zero indicator.

NOTE

Move ring gear only when adjusting backlash.

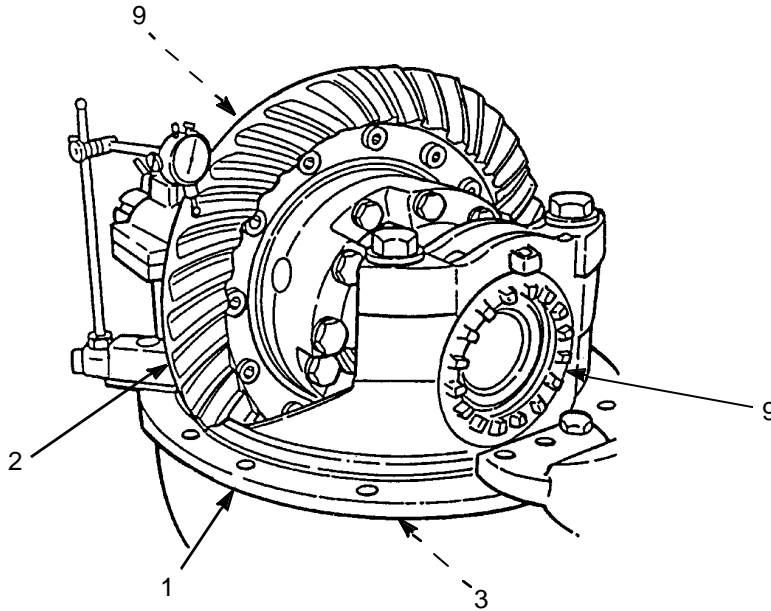
49. While holding drive pinion shaft (3) in position, rotate ring gear (2) slightly in both directions against drive pinion shaft. Note measurement.

NOTE

- If same ring gear and drive pinion have been installed, adjust backlash to setting recorded in disassembly, step 5.
- If new ring gear and drive pinion have been installed, adjust backlash to 0.012 in (0.305 mm).

50. If backlash measurement is less than specified, loosen adjusting ring (9) on back surface of ring gear (2) and equally tighten adjusting ring (9) on tooth side of ring gear. Repeat step 49.
51. If backlash measurement is more than specified, loosen adjusting ring (9) on tooth side of ring gear (2) and equally tighten adjusting ring (9) on back surface of ring gear. Repeat step 49.
52. Repeat steps 49 through 51 until backlash meets specification. Record setting for use when adjusting pinion bearing pre-load.

ASSEMBLY - CONTINUED

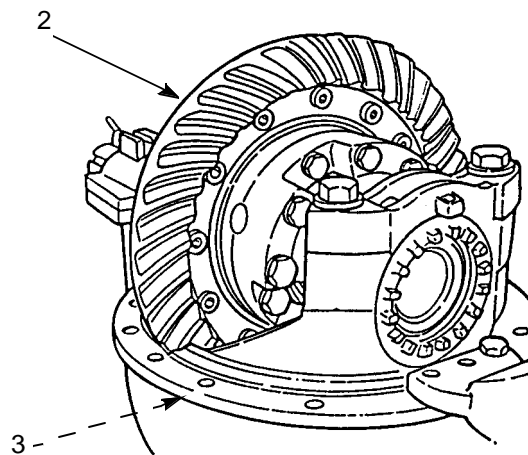


342-1197

NOTE

Always check tooth contact pattern on drive side of ring gear teeth.

53. Apply Prussian blue dye to approximately 12 teeth of ring gear (2). Rotate ring gear so marked gear teeth are next to drive pinion shaft (3).
54. To get contact pattern, rotate ring gear (2) forward and backward until marked gear teeth go past drive pinion shaft (3) six times. Repeat, if needed, for clearer pattern.



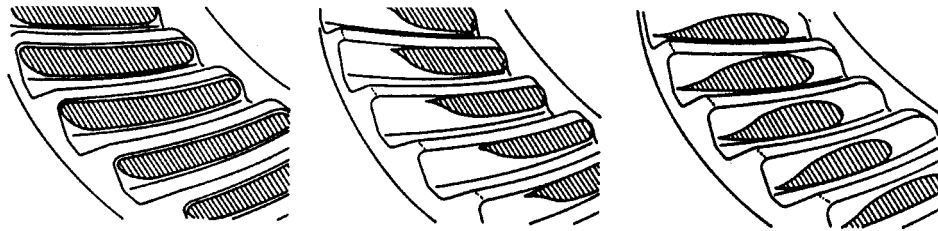
342-1224

ASSEMBLY - CONTINUED

NOTE

- Location of good hand-rolled contact pattern for new gear set is toward toe of gear tooth and in center between top and bottom of tooth.
- Location of good hand-rolled contact pattern of used gear set must match wear pattern in ring gear. Contact pattern will be smaller than wear pattern.
- During tooth contact pattern checks, backlash can be adjusted within specification limits, if needed, to change pattern location.

55. Compare contact pattern with examples shown.



342-1225

GOOD HAND-ROLLED PATTERN

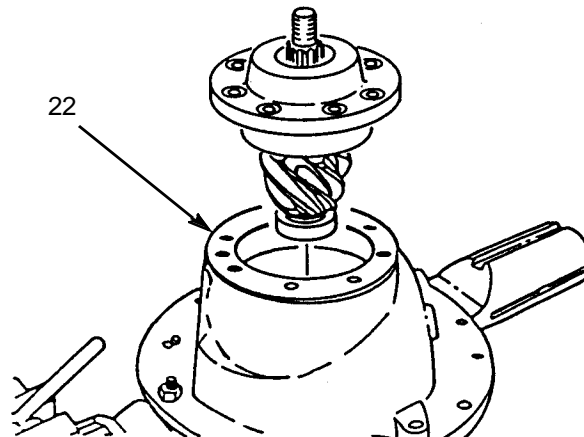
HIGH PATTERN

LOW PATTERN

56. If contact pattern requires adjustment, perform disassembly steps 16 through 21.

57. Perform steps 23 through 28 and 53 through 55.

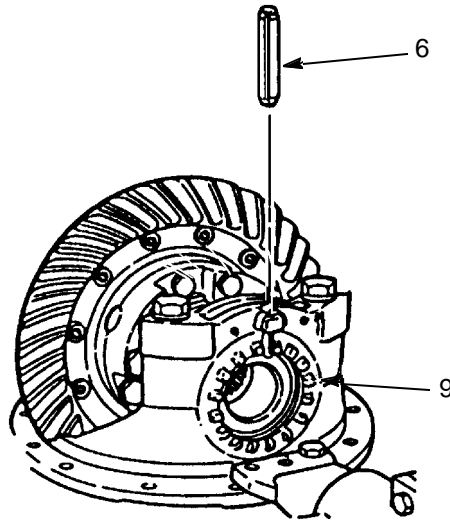
- a. To correct high contact pattern, decrease thickness of shim pack (22).
- b. To correct low contact pattern, increase thickness of shim pack (22).



342-1206

ASSEMBLY - CONTINUED

58. If contact pattern is too far toward heel of tooth, repeat step 50.
59. If contact pattern is too far toward toe of tooth, repeat step 51.
60. Install two pins (6) between lugs of two adjusting rings (9).



342-1226

61. Install rear-rear axle differential carrier (WP0081 00).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Caps, vise jaw (Item 17, WP 0126 00)
- Vise, machinist's (Item 136, WP 0126 00)

Materials/Parts

- Kit, repair (P/N 82TV196)
- Washer, lock (P/N 202981) (4)
- Grease, aircraft (Item 21, WP 0125 00)

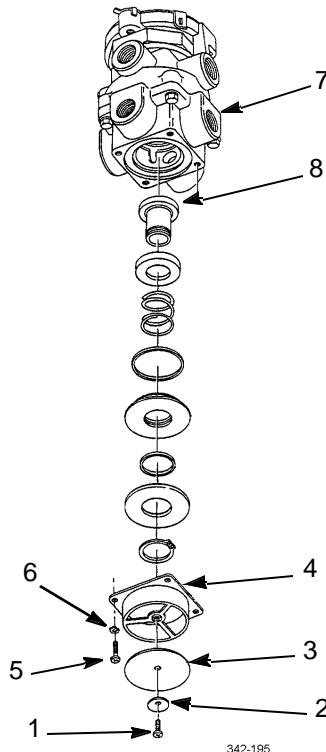
Equipment Condition

Foot brake valve removed (TM 9-2320-302-20)

DISASSEMBLY

NOTE

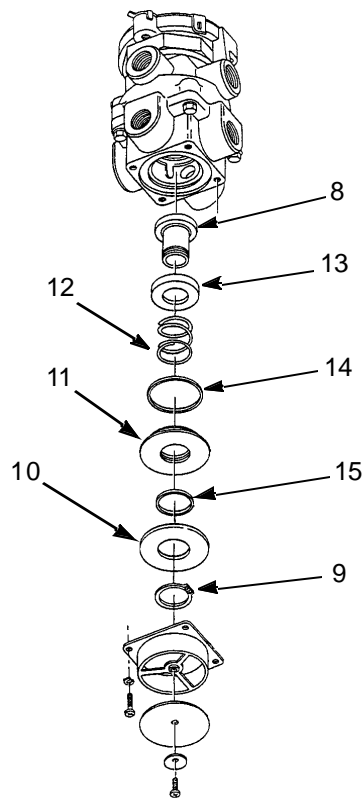
- To assist in disassembly, place foot brake valve in a soft-jawed vise.
 - Discard all components of repair kit.
1. Remove screw (1), washer (2), and diaphragm (3) from cover (4).
 2. Remove four screws (5), lock washers (6), and cover (4) from lower body (7).
 3. Remove valve (8) assembly from lower body (7).



DISASSEMBLY - CONTINUED**NOTE**

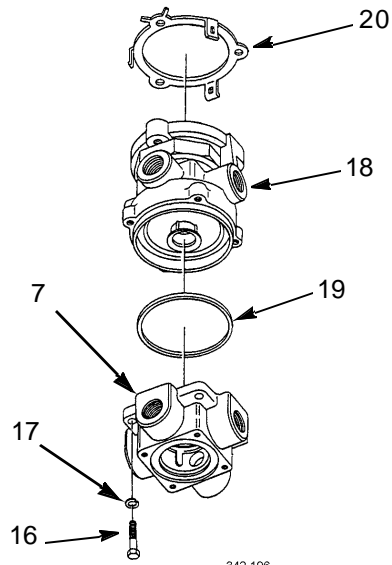
Perform steps 4 and 5 to disassemble valve assembly.

4. While holding valve (8) assembly in collapsed position, remove retaining ring (9) from valve.
5. Release washer (10) and remove washer, retainer (11), spring (12), and seat (13) from valve (8). Remove two preformed packings (14 and 15) from retainer.



6. Remove four screws (16), lock washers (17), and lower body (7) from upper body (18). Remove preformed packing (19) from lower body.
7. Remove primary piston retainer (20) from upper body (18).

DISASSEMBLY - CONTINUED



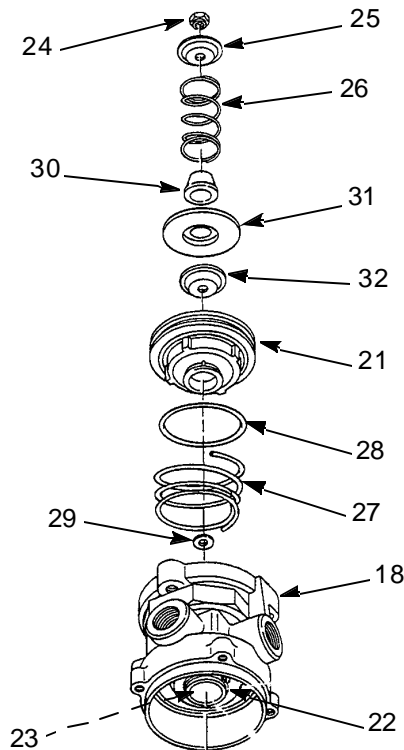
342-196

DISASSEMBLY - CONTINUED

WARNING

Internal components are under spring pressure. Use care when disassembling. Failure to hold components in position may result in injury to personnel.

8. While holding primary piston (21) and piston (22) in position in upper body (18), use a screwdriver in head of screw (23) to prevent screw from turning.
9. Remove lock nut (24), retainer (25), and spring (26) from screw (23). Remove screwdriver and gradually release primary piston (21) and piston (22).
10. Remove primary piston (21) and spring (27) from upper body (18). Remove preformed packing (28) and rubber washer (29) from primary piston.
11. Remove sleeve nut (30), spring seat (31), and rubber spring (32) from primary piston (21).



342-197

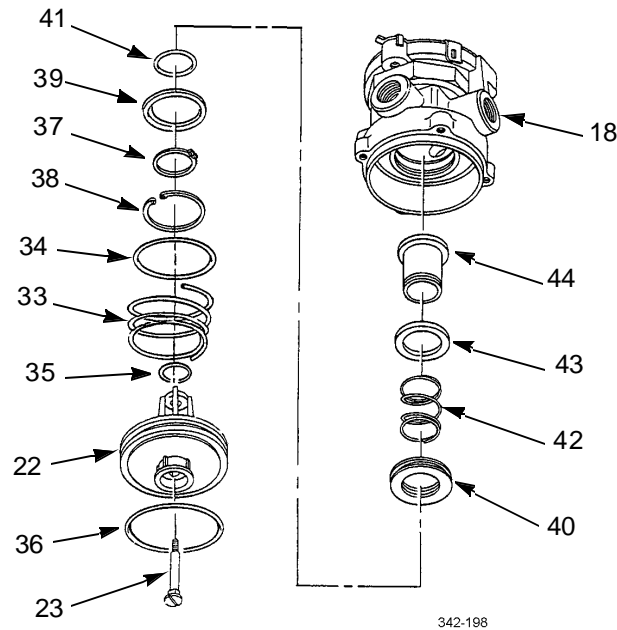
12. Remove screw (23), piston (22), spring (33), and retainer (34) from upper body (18). Remove two preformed packings (35 and 36) from piston.

NOTE

Step 13 removes valve assembly from upper body.

13. Remove retaining ring (37), retaining clip (38), washer (39), retainer (40), preformed packing (41), spring (42), seat (43), and valve (44) from upper body (18).

DISASSEMBLY - CONTINUED



ASSEMBLY

NOTE

- To assist in assembly, place foot brake valve in a soft-jawed vise.
- Install new repair kit parts on assembly.

1. Apply a light coating of grease to surfaces of preformed packings, preformed packing grooves and piston bores of upper body (18).

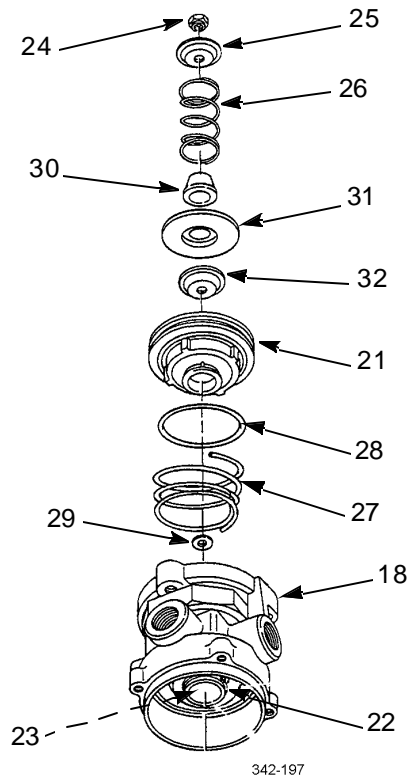
NOTE

Perform step 2 to install valve assembly to upper body.

2. Install valve (44), seat (43), spring (42), preformed packing (41), retainer (40), washer (39), and retaining clip (38) to upper body (18) with retaining ring (37).
3. Install two preformed packings (35 and 36) to piston (22). Install retainer (34), spring (33), piston (22), and screw (23) to upper body (18).

ASSEMBLY - CONTINUED

4. Install rubber spring (32) and spring seat (31) to primary piston (21) with sleeve nut (30).
5. Install rubber washer (29) and preformed packing (28) to primary piston (21). Install spring (27) and primary piston to upper body (18).

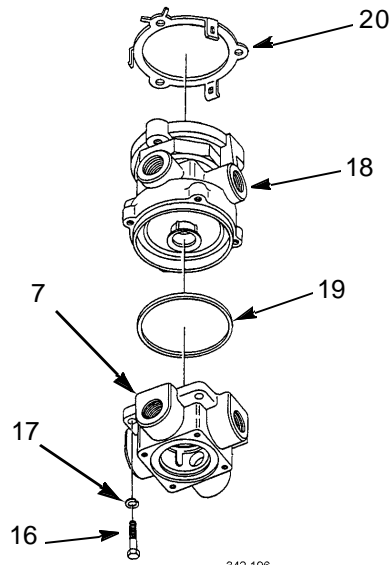


WARNING

Internal components are under spring pressure. Use care when assembling. Failure to hold components in position may result in injury to personnel.

6. While holding primary piston (21) and piston (22) compressed, and using a screwdriver to prevent screw (23) from turning, install spring (26) and retainer (25) to screw with lock nut (24).
7. Install primary piston retainer (20) to upper body (18).
8. Install preformed packing (19) to lower body (7) and install lower body to upper body (18) with four lock washers (17) and screws (16).

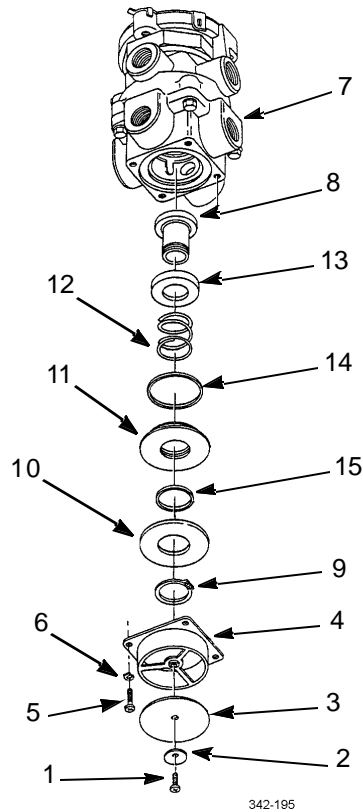
ASSEMBLY - CONTINUED



342-196

ASSEMBLY - CONTINUED

9. Install two preformed packings (14 and 15) to retainer (11) and install seat (13), spring (12), retainer, and washer (10) to valve (8) with retaining ring (9).
10. Install valve (8) assembly to lower body (7).
11. Install cover (4) to lower body (7) with four lock washers (6) and screws (5).
12. Install diaphragm (3) to cover (4) with washer (2) and screw (1).
13. Install foot brake valve (TM 9-2320-302-20).



END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Disassembly, Inspection, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Plate, cover (WP 0122 00)
- Caps, vise jaw (Item 17, WP 0126 00)
- Inserter and remover (Item 51, WP 0126 00)
- Pliers, retaining ring (Item 89, WP 0126 00)
- Press, arbor (Item 90, WP 0126 00)
- Vise, machinist's (Item 136, WP 0126 00)
- Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

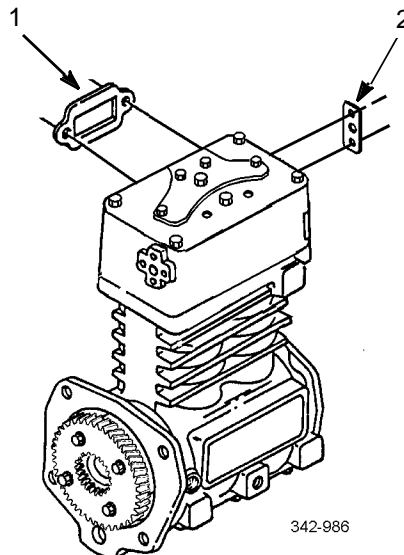
- Crankshaft bearing kit (P/N 107969)
- Cylinder head maintenance kit (107516)
- Piston and rod kit (P/N 108842)
- Piston ring kit (P/N 107639)
- Unloader kit (P/N 107515)
- Oil, lubricating (Item 25, WP 0125 00)
- Tags, marker (Item 35, WP 0125 00)

Equipment Condition

- Air compressor removed (TM 9-2320-302-20)
- Governor removed (TM 9-2320-302-20)

DISASSEMBLY

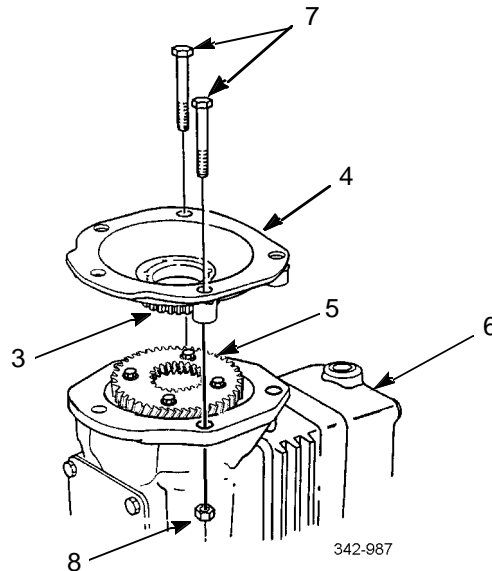
1. If installed, remove two gaskets (1 and 2). Discard gaskets.



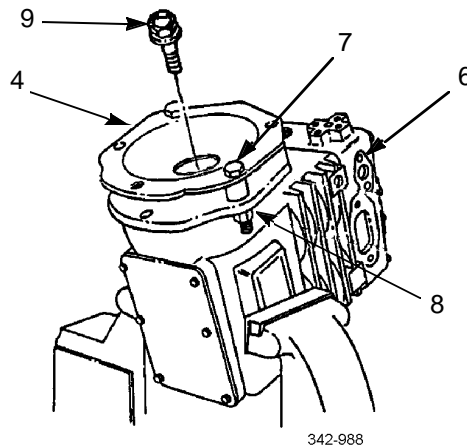
342-986

DISASSEMBLY - CONTINUED

2. Engage teeth (3) of cover plate (4) with air compressor drive (5). Align spacer legs of cover plate with mounting bolt holes in flange face of air compressor (6). Install two bolts (7), nuts (8), and cover plate on flange face of air compressor.



3. Secure air compressor (6) in soft-jawed vise and remove drive hub retaining bolt (9).
4. Remove two nuts (8), bolts (7), and cover plate (4).



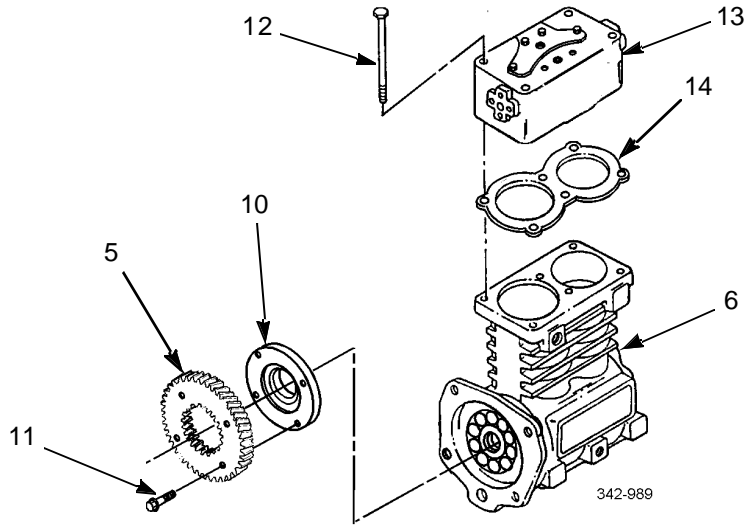
5. Remove drive hub (10) and drive gear (5) from crankshaft.
6. Remove four bolts (11) from drive hub (10) and drive gear (5).
7. Remove air compressor (6) from vise.

NOTE

It may be necessary to tap cylinder head with fiber or plastic mallet to break cylinder head gasket seal.

DISASSEMBLY - CONTINUED

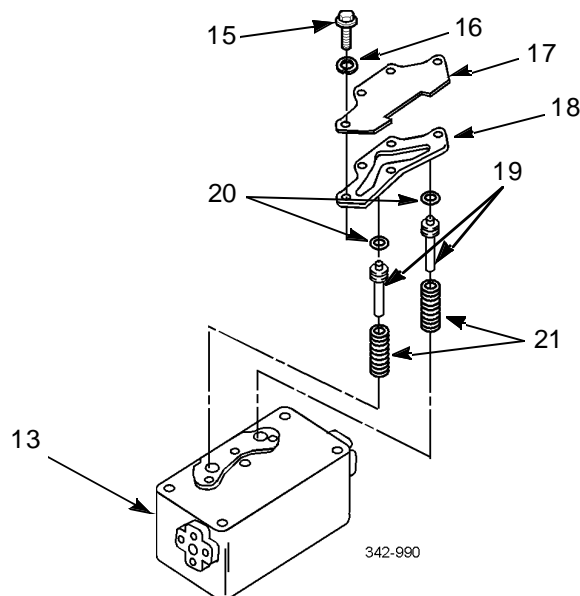
8. Remove six bolts (12), cylinder head (13), and cylinder head gasket (14). Discard gasket.



WARNING

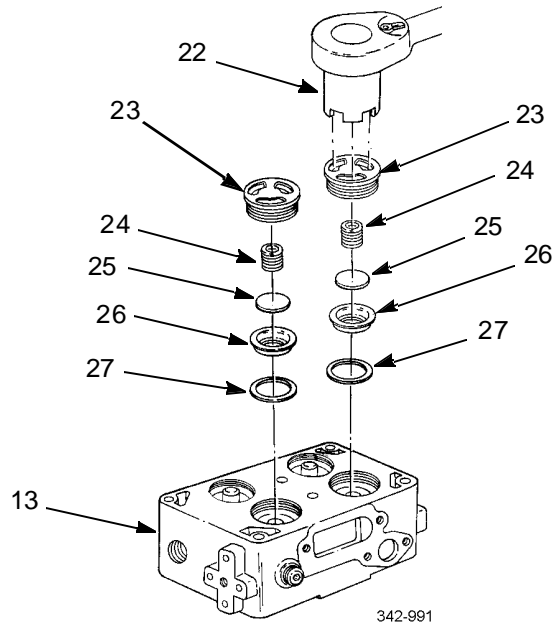
Unloader cover plate is under spring tension. Use care when removing bolts securing unloader cover plate to prevent injury to personnel.

9. Place cylinder head (13) on bench, deck side down, and remove four bolts (15) and lock washers (16). Discard lock washers.
10. Remove unloader cover plate (17) and gasket (18). Discard gasket.
11. Remove unloader piston (19), seal ring (20), and unloader spring (21) from each bore.

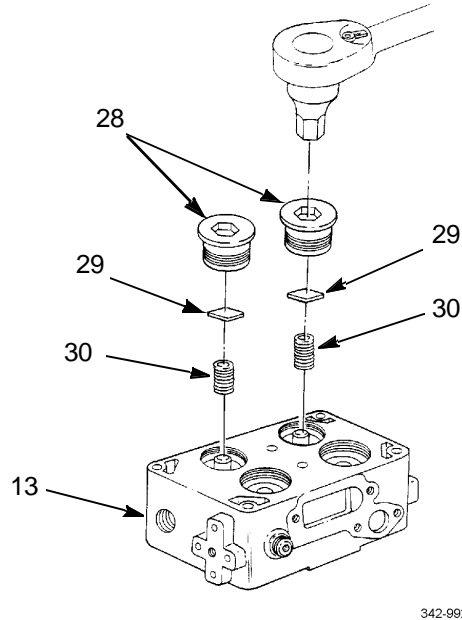


DISASSEMBLY - CONTINUED

12. Place cylinder head (13) on bench, deck side up, and insert inserter and remover tool (22) in inlet valve stop (23). Remove inlet valve stop.
13. Remove inlet valve spring (24), inlet valve (25), inlet valve seat (26), and copper gasket (27) from bore. Discard gasket.
14. Repeat step 12 and 13 for second valve stop (23).



15. Remove two discharge valve seats (28).
16. Remove two discharge valves (29) and springs (30) from bores of cylinder head (13).



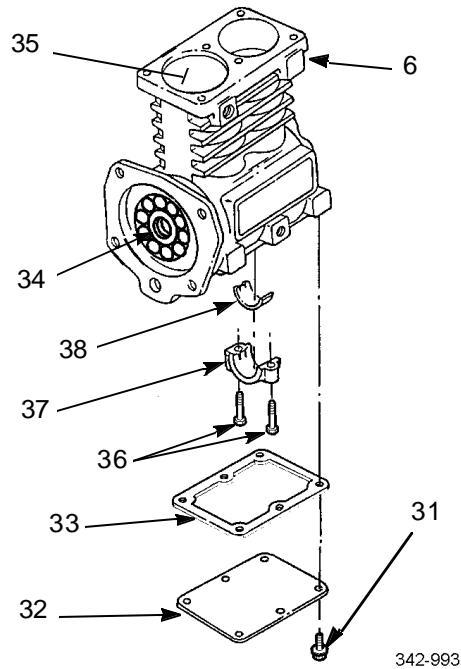
17. Remove six bolts (31), crankcase cover (32), and gasket (33). Discard gasket.
18. Rotate crankshaft (34) until connecting rod and piston assembly (35) is at bottom of travel.

DISASSEMBLY - CONTINUED

CAUTION

Connecting rod caps are not interchangeable and must be kept with connecting rods to prevent damage to equipment.

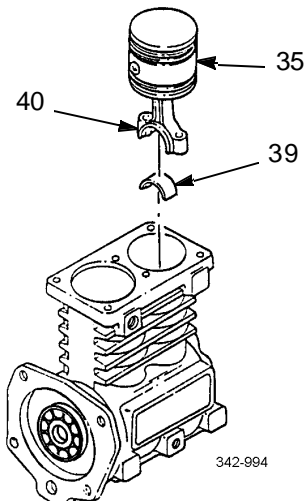
19. Remove two connecting rod bolts (36), connecting rod cap (37), and lower bearing insert (38). Discard bearing insert.



CAUTION

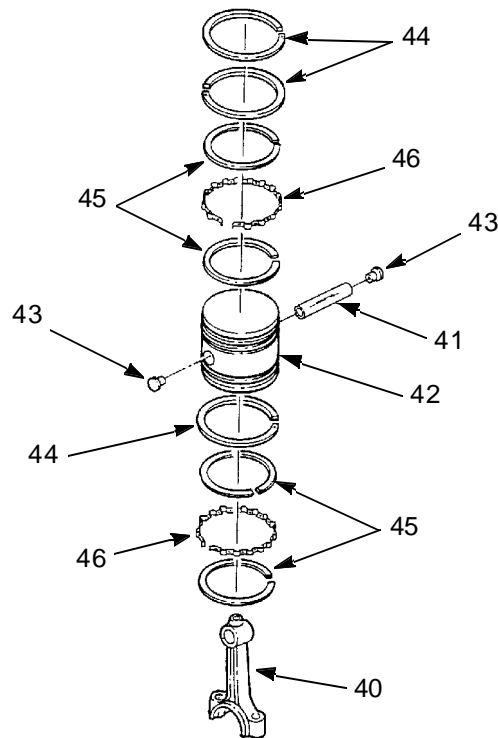
Mark or tag pistons and note location in air compressor prior to removal to prevent premature air compressor failure.

20. Remove connecting rod and piston assembly (35) from cylinder bore.
21. Remove upper bearing insert (39) from connecting rod (40). Discard bearing insert.



DISASSEMBLY - CONTINUED

22. Push wrist pin (41) out of piston (42) and connecting rod (40).
23. Pull plastic wrist pin button (43) from each end of wrist pin (41).
24. Remove three piston rings (44).
25. Remove four oil control rings (45) and two oil ring expanders (46).



342-995

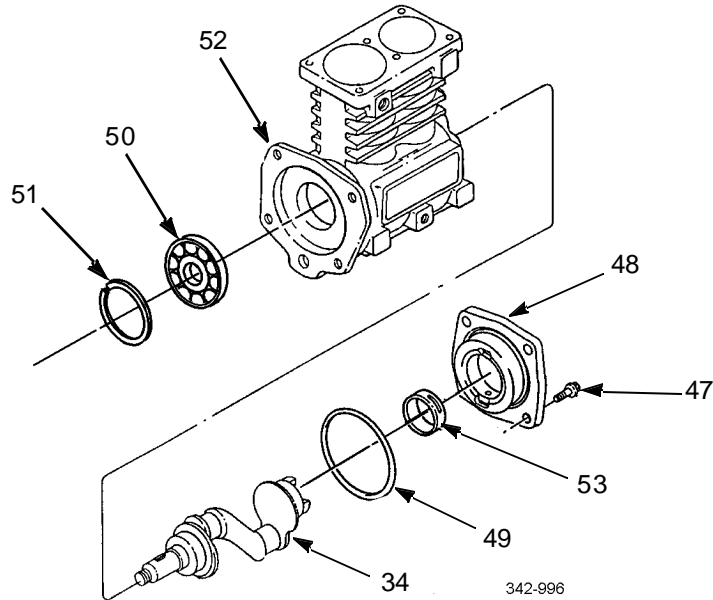
26. Remove four bolts (47) and rear cover (48).
27. Remove seal ring (49) from groove in rear cover (48).
28. Press crankshaft (34) out of ball bearing (50) to rear and remove.
29. Remove retaining ring (51).

CAUTION

Use care when removing crankshaft ball bearing to prevent damage to bearing bore.

30. Using brass drift and hammer, remove ball bearing (50) by tapping around inside edge and driving ball bearing toward air compressor mounting flange (52).
31. Using brass drift and hammer, remove crankshaft rear sleeve bearing (53) by tapping around inside edge of sleeve and driving sleeve bearing away from rear cover (48).

DISASSEMBLY - CONTINUED



INSPECTION

Inspect crankshaft for galling, pitting, cracks or other damage. Replace if damaged.

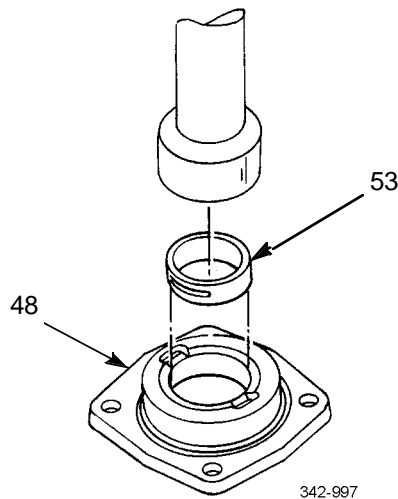
ASSEMBLY

1. Position rear cover (48) face down on press bed.

NOTE

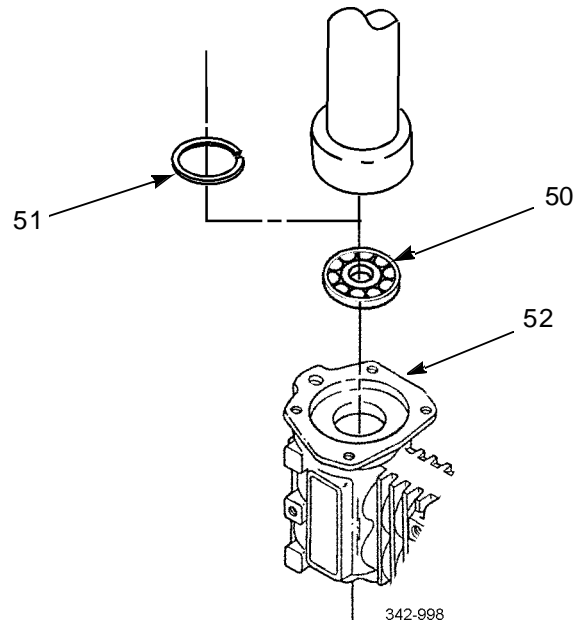
Ensure slot in bearing is lined up with oil passage in rear cover.

2. Position crankshaft rear sleeve bearing (53) in bore of rear cover (48) with slot in bearing lined up with oil passage.
3. Press crankshaft rear sleeve bearing (53) in bore of rear cover (48) until flush.



ASSEMBLY - CONTINUED

4. Position air compressor mounting flange (52) face up on press bed.
5. Position ball bearing (50) in bore of air compressor mounting flange (52).
6. Press ball bearing (50) into bore of air compressor mounting flange (52) until outer race of bearing bottoms out in flange bore.
7. Install retaining ring (51) in ring groove.



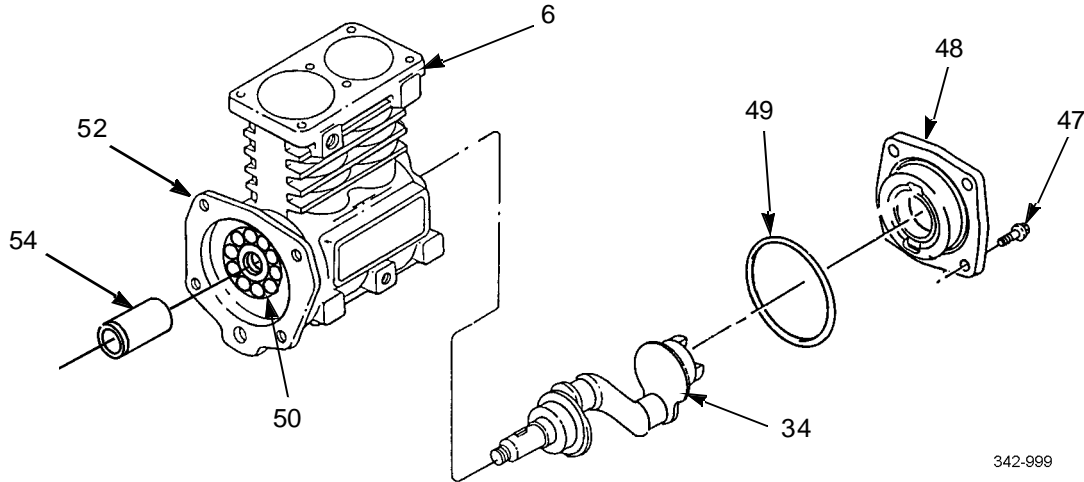
8. Position air compressor mounting flange (52) face down on press bed. Support inner race of ball bearing (50) with sleeve (54).
9. Insert crankshaft (34) through air compressor (6) into ball bearing (50). Press crankshaft into inner race of ball bearing until inner race bottoms out on shoulder of crankshaft.
10. Install seal ring (49) in groove of rear cover (48).

NOTE

Ensure oil supply to cover is on outboard side of air compressor.

11. Position rear cover (48) on crankshaft (34) against air compressor (6).
12. Align bolt holes in rear cover (48) with holes in air compressor (6). Install four bolts (47) and tighten to 175-225 lb-in (20-25 Nm) in a crisscross pattern.

ASSEMBLY - CONTINUED

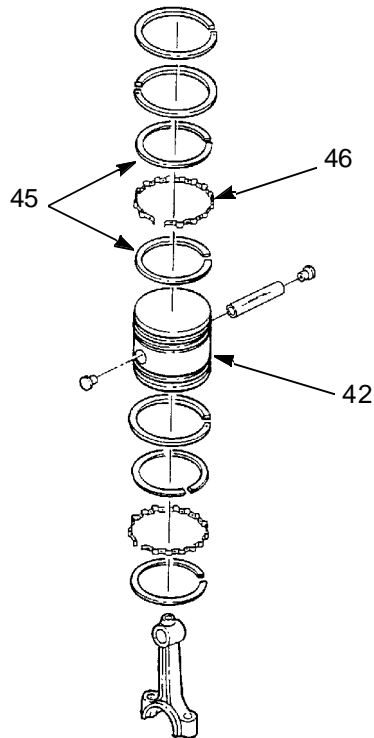


342-999

NOTE

Oil control rings may be installed with either side up

13. With dome of piston (42) up, install two oil control rings (45) in upper oil ring groove of piston.
14. Install oil ring expander (46) in oil ring groove between oil control rings (45).



342-995

ASSEMBLY - CONTINUED**CAUTION**

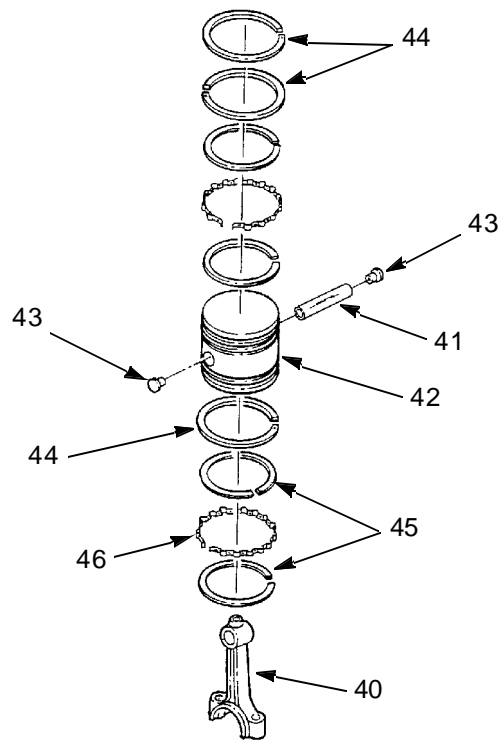
Dot appearing on one side of second and top piston rings, 30 degrees from ring gap, indicates top of second and top piston rings. Top of second and top piston rings must be installed facing piston dome to prevent damage to equipment.

15. Install second and top piston rings (44) in top two ring grooves of piston (42).

CAUTION

Dot appearing on one side of third piston ring, 30 degrees from ring gap, indicates top of third piston ring. Top of third piston ring must be installed facing piston dome to prevent damage to equipment.

16. Install third piston ring (44) in top groove of lower ring grooves on piston (42).
17. Install two oil control rings (45) in bottom oil ring groove on piston (42).
18. Install oil ring expander (46) in groove between oil control rings (45).
19. Position connecting rod (40) and insert wrist pin (41) through piston (42) to connecting rod bore in opposite side of piston.
20. Center wrist pin (41) and push plastic wrist pin button (43) in each end of wrist pin.



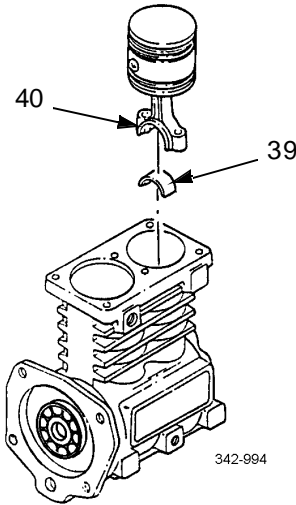
342-995

ASSEMBLY - CONTINUED

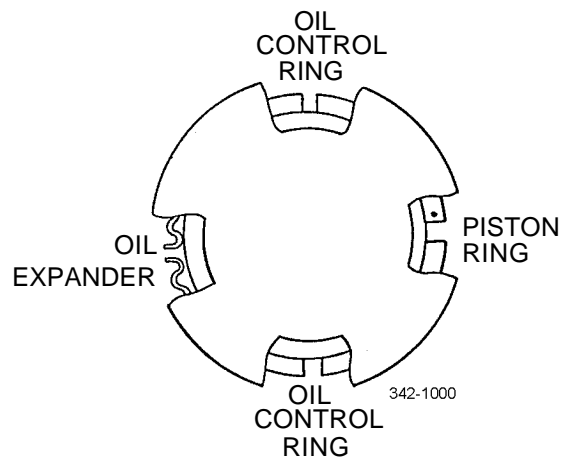
CAUTION

Tangs on one end of connecting rod upper bearing insert must be installed in corresponding notches on side of connecting rod bearing saddle to prevent damage to equipment.

21. Install new upper bearing insert (39) in connecting rod (40) bearing saddle.



22. Stagger piston ring gap, two oil control ring gaps, and oil expander ring gap 90 degrees from each other, as shown.



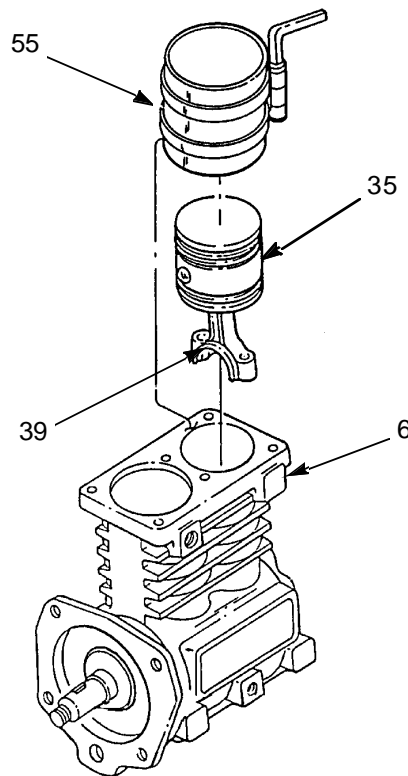
ASSEMBLY - CONTINUED

23. Coat connecting rod and piston assembly (35) liberally with clean engine lubricating oil and insert in ring compressor (55).
24. Apply a film of clean engine lubricating oil to surface of connecting rod upper bearing insert (39) and insert connecting rod and piston assembly (35) in cylinder bore.
25. Position crankshaft (34) with journal at bottom of its travel.

CAUTION

To prevent damage to crankshaft, use care to guide connecting rod on crankshaft journal when pushing piston assembly in cylinder bore. Pistons must be installed in same location. Failure to do so could result in premature air compressor failure.

26. With ring compressor (55) square against top of air compressor (6) body, push connecting rod and piston assembly (35) into cylinder bore.



342-1001

CAUTION

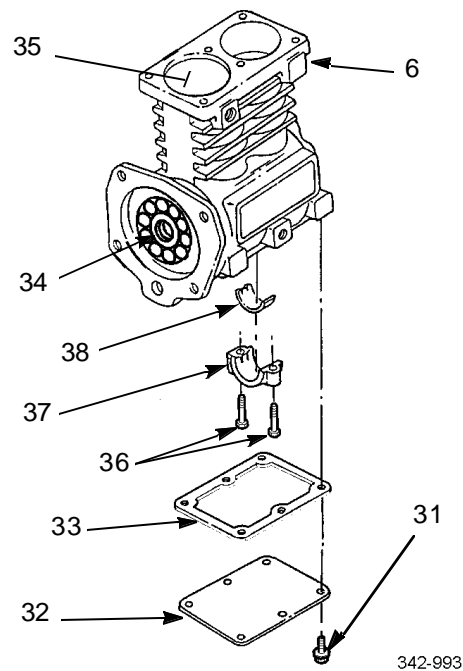
Tangs on one end of connecting rod lower bearing insert must be installed in corresponding notches on side of connecting rod bearing saddle to prevent damage to equipment.

27. Install new connecting rod lower bearing insert (38) in connecting rod cap (37).
28. Apply a film of clean engine lubricating oil to connecting rod lower bearing insert (38).

ASSEMBLY - CONTINUED**CAUTION**

Connecting rod bearing insert tangs should be on same side of connecting rod and connecting rod cap to prevent damage to equipment. Ensure connecting rod is fully seated on crankshaft journal to prevent damage to equipment.

29. Position connecting rod cap (37) on connecting rod so that wide ear on connecting rod cap matches corresponding ear on connecting rod.
30. Install two connecting rod bolts (36) and tighten to 80-100 lb-in (9-11 Nm).
31. Position new gasket (33) and crankcase cover (32) on bottom of air compressor (6) body.
32. Install six bolts (31) and tighten to 175-228 lb-in (20-25 Nm).



ASSEMBLY - CONTINUED

33. Support cylinder head (13) on bench, deck side up, and install new copper gasket (27) in bore.
34. Install inlet valve seat (26) in bore with raised side of valve seat toward deck of cylinder head (13).

NOTE

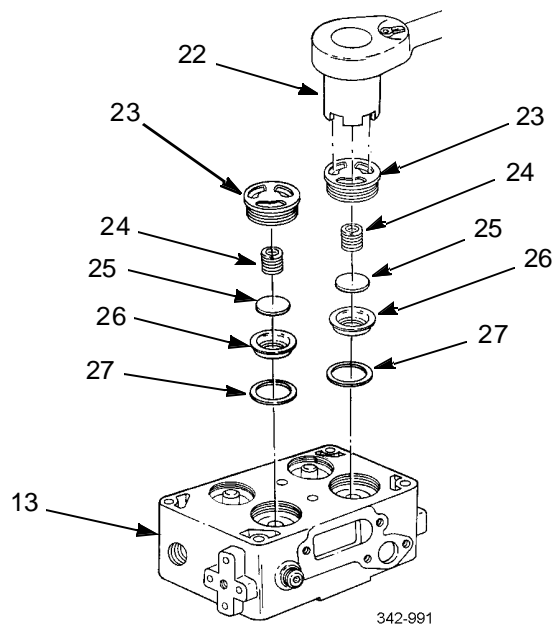
Ensure inlet valve is centered on inlet valve seat.

35. Install inlet valve (25) on top of inlet valve seat (26).

NOTE

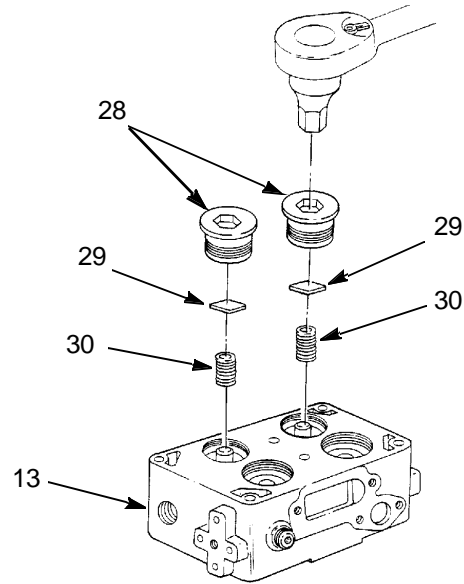
Ensure inlet valve spring is centered on inlet valve.

36. Install inlet valve spring (24) on top of inlet valve (25).
37. Thread inlet valve stop (23) carefully into cylinder head (13) until inlet valve spring (24) is seated on inlet valve stop.
38. Using insert inserter and remover tool (22), tighten inlet valve stop (23) to 70-90 lb-ft (95-122 Nm).
39. Repeat step 33 through 38 for other cylinder head bore.



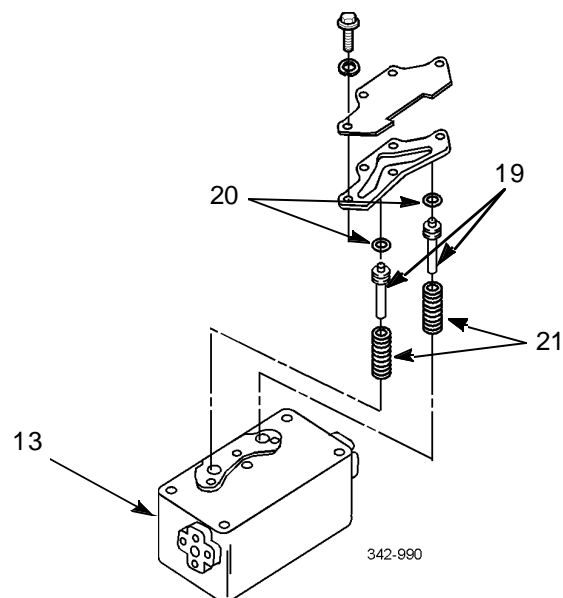
40. Insert discharge valve spring (30) in discharge valve bore.
41. Place discharge valve (29) on top of discharge valve spring (30) and center in discharge valve bore.
42. Thread discharge valve seat (28) carefully into cylinder head (13) until discharge valve (29) is seated.
43. Tighten discharge valve seat (28) to 70-90 lb-ft (95-122 Nm).
44. Repeat step 40 through 43 for other discharge valve bore

ASSEMBLY - CONTINUED



342-992

45. Install seal ring (20) between raised lands on unloader piston (19).
46. Install unloader spring (21) on opposite end of unloader piston (19).
47. Support cylinder head (13) on bench, deck side down, and install long end of unloader piston (19) assembly in unloader bore.
48. Repeat steps 45 through 47 for second unloader piston.



342-990

ASSEMBLY - CONTINUED**NOTE**

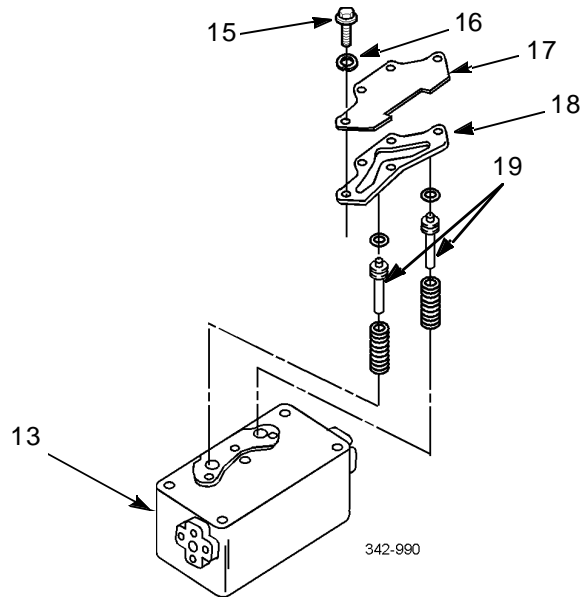
Ensure old gasket material is removed from mating surfaces of unloader cover plate and cylinder head.

49. Position new gasket (18) on cylinder head (13) and align bolt holes in gasket with bolt holes in cylinder head.

CAUTION

Ensure seal rings are not cut when pressing unloader pistons in bores, to prevent damage to equipment. DO NOT allow old gasket material to drop in bores, to prevent damage to equipment.

50. Position unloader cover plate (17) on top of exposed unloader pistons (19). Press unloader cover plate carefully to press unloader pistons in bores.
51. Hold down unloader cover plate (17) and install four new lock washers (16) and bolts (15). Tighten bolts to 175-225 lb-in (20-25 Nm).

**NOTE**

- If beaded cylinder head gasket is used, install gasket with bead side toward cylinder head. Unbeaded cylinder head gasket can be installed with either side up.
- Ensure old gasket material is removed from mating surfaces of cylinder head and air compressor body.

52. Position new cylinder head gasket (14) on deck of air compressor (6).

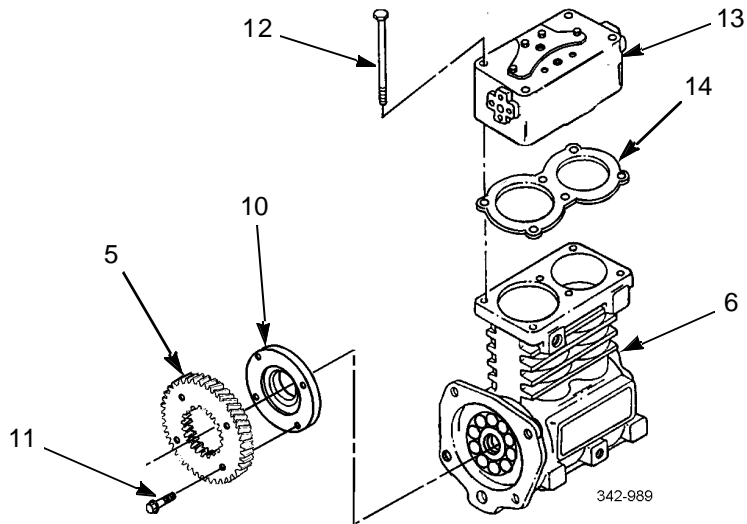
NOTE

Cylinder head should be positioned with air inlet and discharge flange on right side of air compressor when viewed from rear.

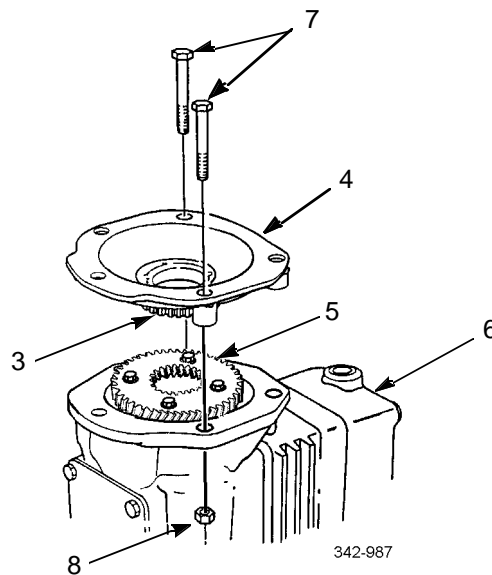
53. Position cylinder head (13) on air compressor (6).
54. Install six bolts (12) and tighten bolts to 25-30 lb-ft (34-41 Nm).

ASSEMBLY - CONTINUED

55. Attach drive hub (10) to drive gear (5) and secure with four bolts (11). Tighten bolts to 43-54 lb-ft (58-73 Nm).
56. Position drive hub (10) and drive gear (5) on crankshaft and ball bearing.

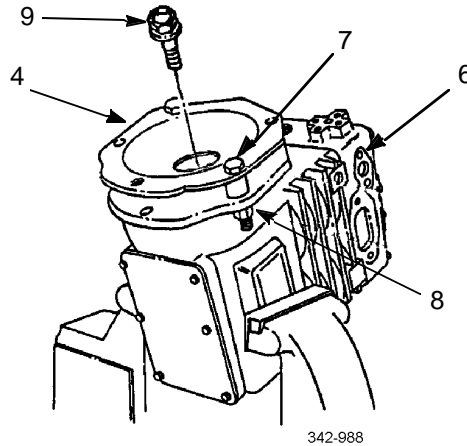


57. Engage teeth (3) of cover plate (4) with teeth in drive gear (5). Align spacer legs of cover plate with mounting bolt holes in flange face of air compressor (6). Secure cover plate to air compressor with two bolts (7) and nuts (8).

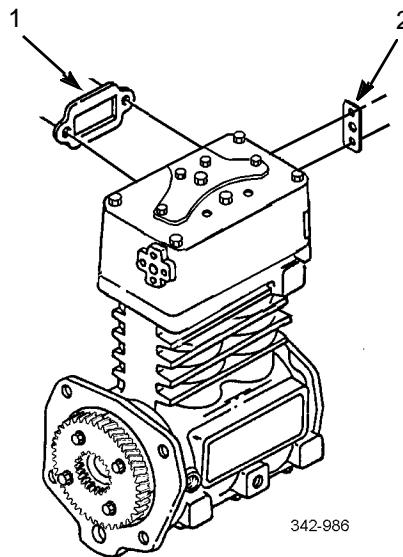


ASSEMBLY - CONTINUED

58. Secure air compressor (6) in soft-jawed vise and install drive hub retaining bolt (9). Tighten bolt to 220-255 lb-ft (298-346 Nm).
59. Remove two nuts (8), bolts (7), and cover plate (4).



60. Install two new gaskets (1 and 2).



61. Install governor (TM 9-2320-302-20).
62. Install air compressor (TM 9-2320-302-20).

END OF WORK PACKAGE

BRAKE DRUM REPAIR

0085 00

THIS WORK PACKAGE COVERS

Repair

INITIAL SETUP

Maintenance Level

Direct Support

Materials/Parts

Cloth, abrasive (Item 9, WP 0125 00)

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Lathe, brake drum (Item 74, WP 0126 00)

Equipment Condition

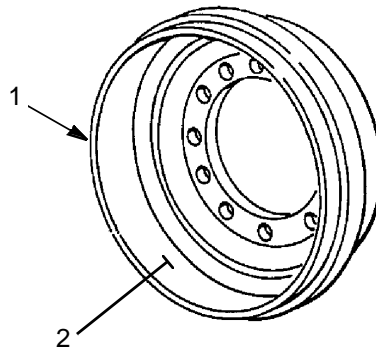
Brake drum removed from vehicle (TM 9-2320-302-20)

REPAIR

CAUTION

If maximum inside diameter is exceeded, to prevent damage to equipment, brake drum must be replaced.

1. Check brake drum inside diameter. Refer to Table 1 for diameter.
2. Brake drum (1) must be round within 0.003 in (0.076 mm). If brake drum is out-of-round, machine brake drum. Refer to Table 1 for machining specifications.



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3. Check brake drum surface (2) for cracks or badly scored finish. If brake drum is cracked or scored, machine brake drum. Refer to Table 1 for machining specifications.
4. Check brake drum surface (2) for glossy or heat spots. If glossy or heat spots are visible, clean brake drum surface with abrasive cloth.
5. Check brake drum (1) for external or mating surface cracks. If cracks are visible, replace brake drum.
6. Check brake drum (1) for balance weight. If balance weight is missing, replace brake drum.

REPAIR - CONTINUED

Table 1. Machining Specifications.

	INSIDE DIAMETER (NEW) IN (MM)	MACHINE BRAKE DRUM IN (MM)	MAXIMUM INSIDE DIAMETER IN (MM)
M915A3 FRONT	15.0 (381.0)	0.12 (4.00)	15.12 (384.00)
M915A3 REAR	16.5 (419.1)	0.12 (4.00)	16.62 (422.15)

7. Install brake drum (TM 9-2320-302-20).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tool and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Seal, o-ring (P/N 8929318)

Washer, lock (P/N 000127 008203) (6)

Materials/Parts - Continued

Oil, lubricating (Item 25, WP 0125 00)

References

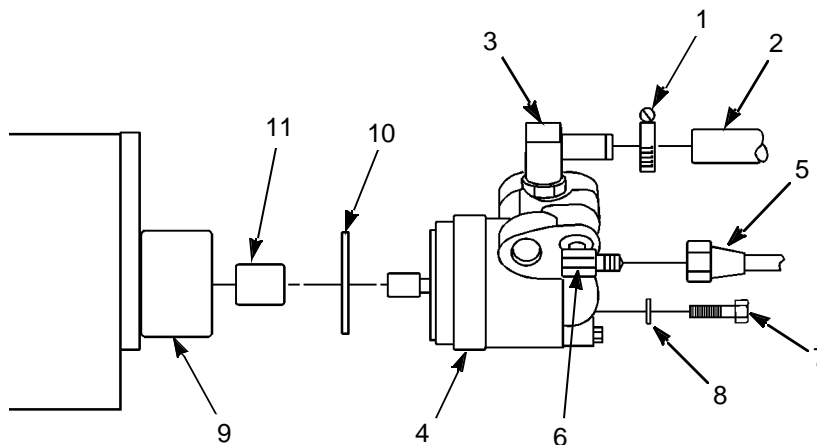
TM 9-2320-302-10

Equipment Condition

Power steering reservoir drained (TM 9-2320-302-20)

REMOVAL

1. Remove hose clamp (1), hose (2), and adapter (3) from power steering pump (4).
2. Remove power steering line (5) and elbow (6) from power steering pump (4).
3. Remove six screws (7) and lock washers (8) securing power steering pump (4) to gear case cover (9). Discard lock washers.
4. Pull power steering pump (4), o-ring seal (10), and gear coupling (11) from gear case cover (9). Discard o-ring seal.

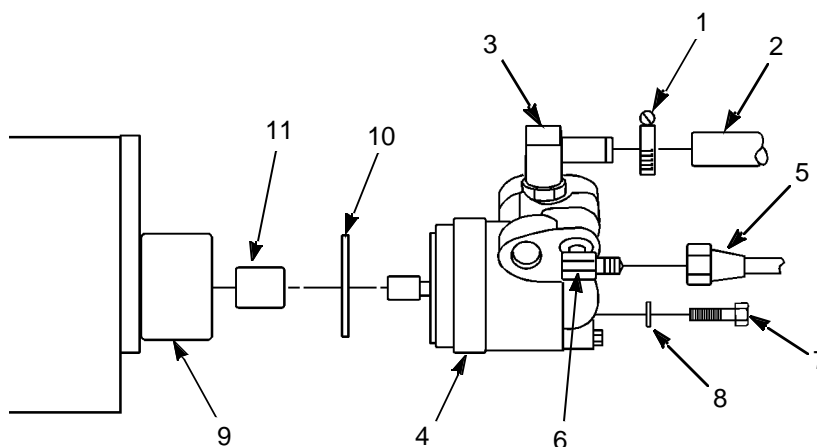


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INSTALLATION**NOTE**

Apply a light coating of lubricating oil to seal prior to installation

1. Install gear coupling (11) and new o-ring seal (10) on power steering pump (4).
2. Position power steering pump (4) on gear case cover (9) and secure with six screws (7) and new lock washers (8). Tighten screws to 17-25 lb-ft (23-34 Nm).
3. Install elbow (6) and power steering line (5).
4. Install adapter (3), hose (2), and hose clamp (1).



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5. Fill power steering reservoir (TM 9-2320-302-20).
6. Start vehicle (TM 9-2320-302-10) and check system for leaks.

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Disassembly, Inspection, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Pliers, retaining ring (Item 87, WP 0126 00)

Materials/Parts

Gasket set (P/N 20510093-25Z)

O-ring (P/N 3-908N552-90)

Materials/Parts - Continued

Rotary pump parts kit (P/N ERS-28310)

Oil, lubricating (Item 25, WP 0125 00)

References

TM 9-2320-302-20

Equipment Condition

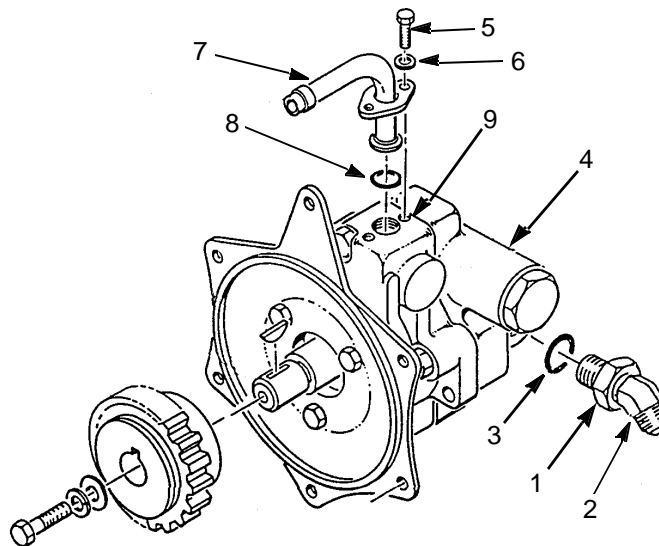
Power steering pump removed (WP 0086 00)

DISASSEMBLY

NOTE

Note position of elbow and tube prior to disassembly to aid in assembly.

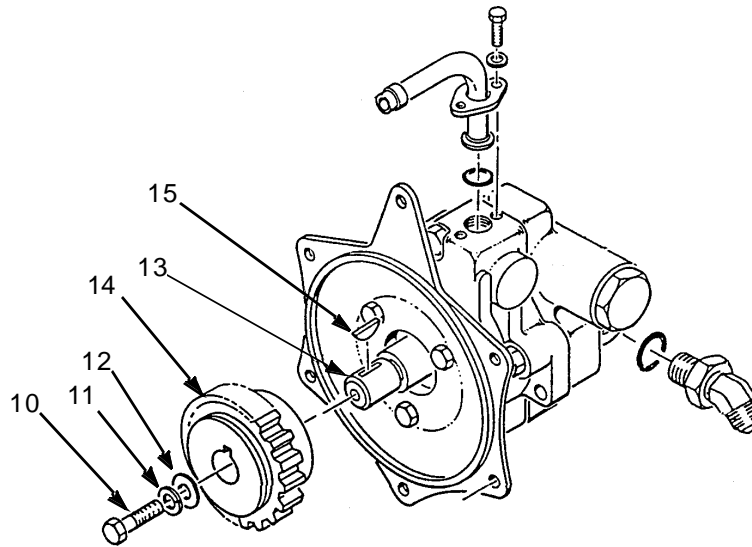
1. Loosen jam nut (1) and remove elbow (2) and packing (3) from rear cover (4). Discard packing.
2. Remove two bolts (5), washers (6), tube (7), and gasket (8) from pump body (9). Discard gasket.



342-799

DISASSEMBLY - CONTINUED

3. Remove screw (10) and two washers (11 and 12) from shaft (13).
4. Remove gear (14) from shaft (13).
5. Remove woodruff key (15) from shaft (13).



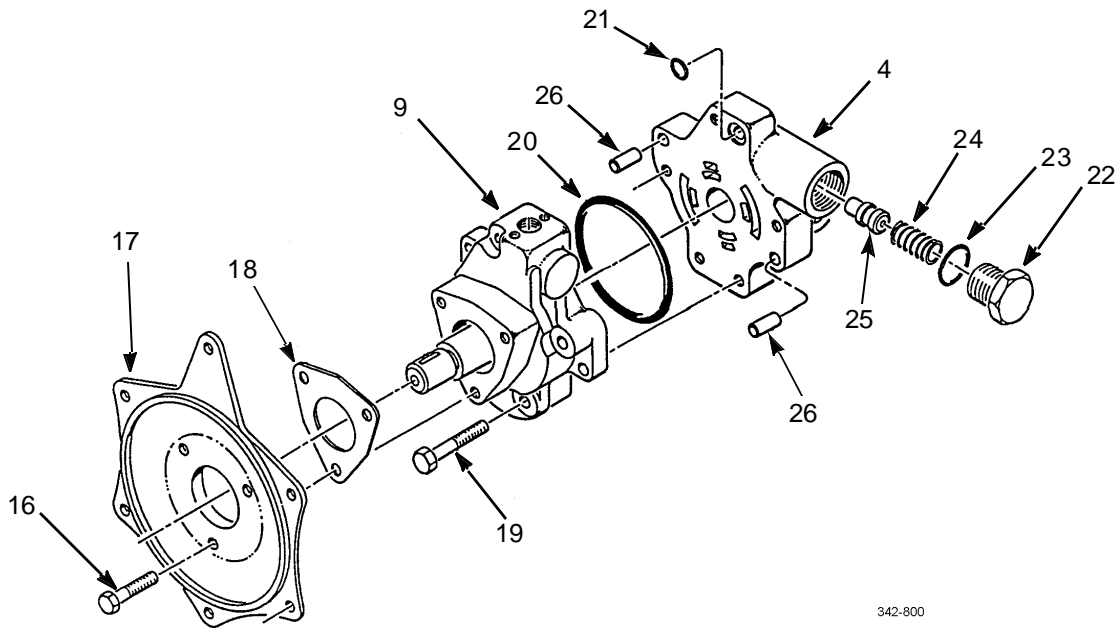
342-799

NOTE

Note position of flange prior to disassembly to aid in assembly.

6. Remove three screws (16), flange (17), and gasket (18) from pump body (9). Discard gasket.
7. Remove five screws (19) and rear cover (4) from pump body (9).
8. Remove and discard large packing (20) and small packing (21) from pump body (9).
9. Remove valve cap (22), packing (23), spring (24), and valve (25) from rear cover (4). Discard packing.
10. If damaged, remove and discard two guide pins (26) from rear cover (4).

DISASSEMBLY - CONTINUED



342-800

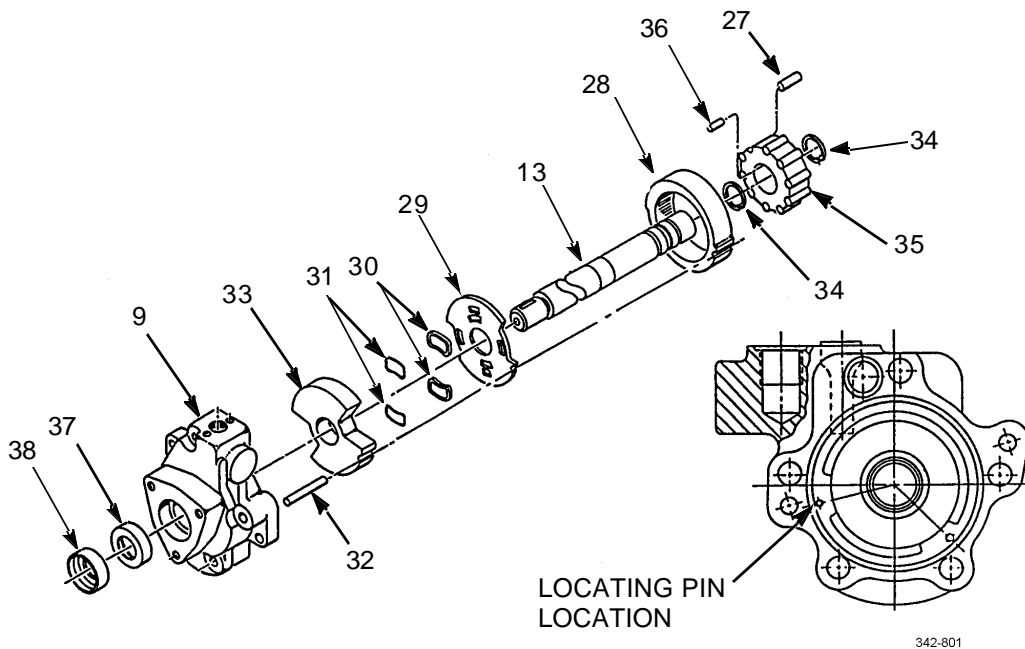
DISASSEMBLY - CONTINUED

11. Remove shaft (13) from pump body (9).

NOTE

Ensure locating pin position is marked to aid in assembly.

12. Remove ten rollers (27), cam (28), port plate (29), two seals (30), two O-rings (31), locating pin (32), and end plate (33) from pump body (9). Discard rollers, cam, port plate, seals, o-rings, and locating pin.
13. Remove two snap rings (34), carrier (35), and drive pin (36) from shaft (13). Discard carrier and drive pin.
14. Remove and discard two seals (37 and 38) from pump body (9).



INSPECTION

1. Inspect shaft for wear, burning, and scoring in areas of bushings, oil seals, and spline drive. If found, replace shaft.
2. If pump has been disassembled because of hard steering, and no other parts show any wear or damage, replace valve and spring.

ASSEMBLY

NOTE

Coat all interior components with a light coat of clean engine lubricating oil prior to assembly.

1. Install new seal (37), with lip facing bushing, until seal is seated against inside lip of pump body (9).
2. Install new seal (38), with lip facing outward, until seal is seated against seal (37).
3. Install new drive pin (36), new carrier (35) and two snap rings (34) on shaft (13).
4. Install two new o-rings (31) and two new seals (30) in end plate (33).

ASSEMBLY - CONTINUED

5. Install end plate (33) on pump body (9) with two seals (30) facing up.

CAUTION

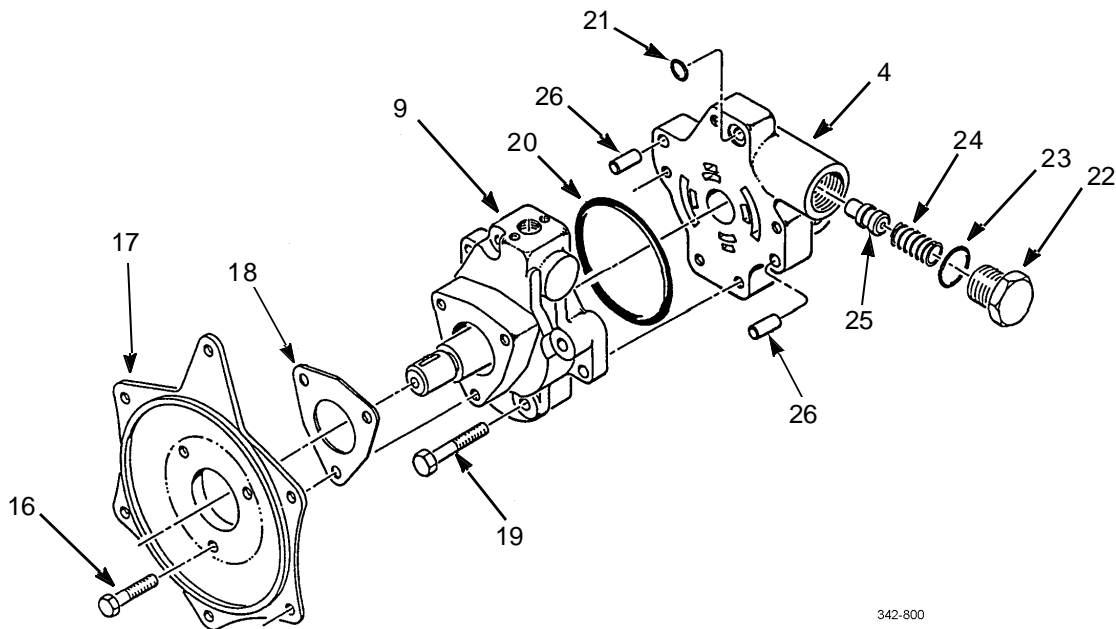
Failure to install locating pin in correct position may cause pump to operate in reverse, which could result in equipment damage.

6. Install new locating pin (32) in lower left hole of end plate (33).

NOTE

If seals can be seen, port plate must be reversed.

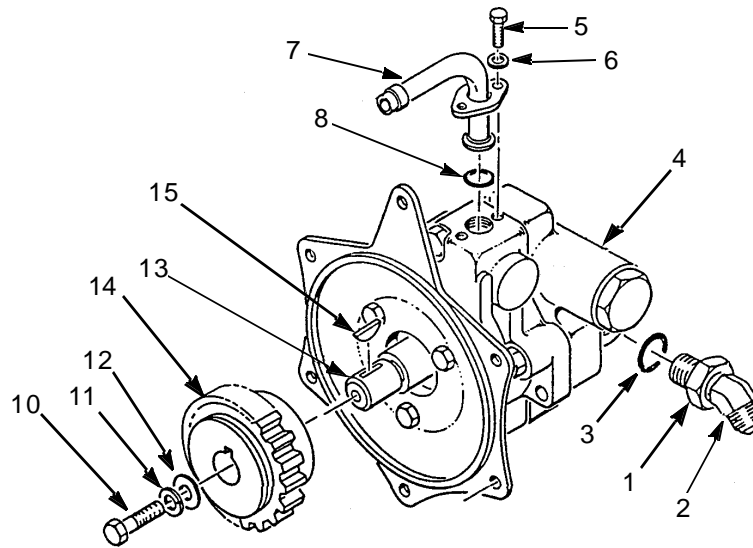
7. Install new port plate (29) and new cam (28) with arrow on cam pointing up toward locating pin (32).
8. Install shaft (13) and ten new rollers (27).
9. If removed, install two new guide pins (26) in rear cover (4).
10. Install valve (25), spring (24), new packing (23), and valve cap (22).
11. Install new small packing (21) and new large packing (20) in pump body (9).
12. Install cover (4) and secure to pump body (9) with five screws (19).
13. Install new gasket (18) on pump body (9).
14. Install flange (17), as noted during disassembly, and secure with three screws (16).



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ASSEMBLY - CONTINUED

15. Install woodruff key (15) in shaft (13).
16. Install gear (14) on shaft (13) until gear bottoms out.
17. Install two washers (11 and 12) and screw (10) on shaft (13).
18. Install tube (7) with new gasket (8) and secure in place with two washers (6) and bolts (5).
19. Install new packing (3) and elbow (2) with jam nut (1) on rear cover (4).



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20. Install power steering pump (WP 0086 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Personnel Required

Two

Tools and Special Tool

Tool kit, general mechanic's (Item 132, WP 0126 00)

Pan, drain (Item 80, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Equipment Conditions

Drag link removed (TM 9-2320-302-20)

Power steering reservoir drained (TM 9-2320-302-20)

Lower end of universal steering shaft disconnected (TM 9-2320-302-20)

Materials/Parts

Washer, lock (MS35338-147)

Rags, wiping (Item 31, WP 0125 00)

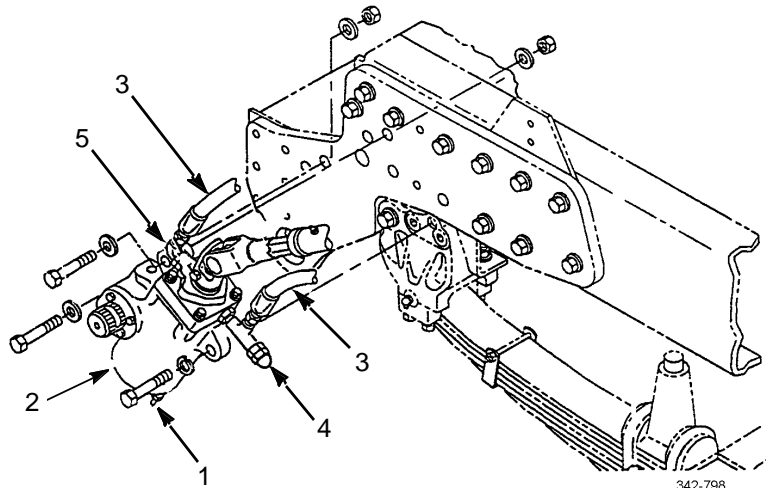
Tags, marker (Item 35, WP 0125 00)

REMOVAL

WARNING

Spilled power steering fluid is very slippery. Clean up any spilled fluid immediately. Failure to do so could result in serious injury to personnel.

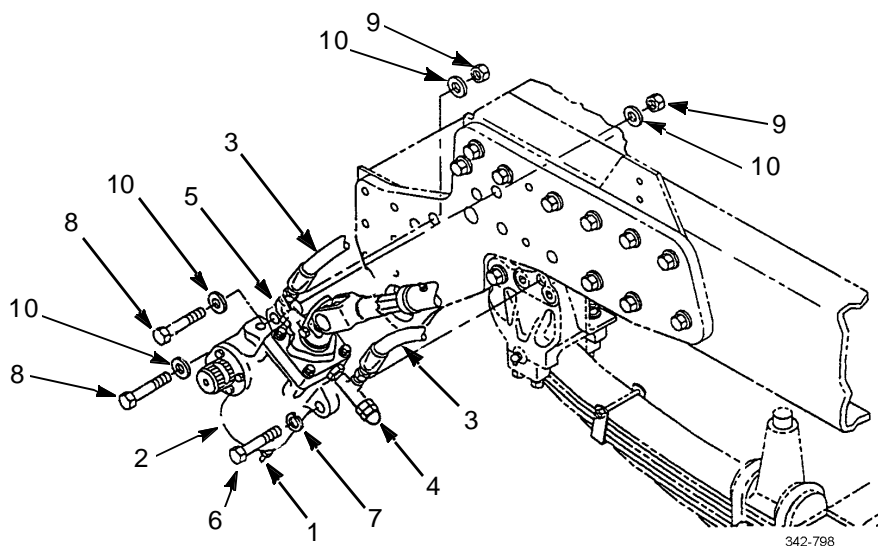
1. Remove drain plug (1) from steering gear (2) and drain power steering fluid into container.
2. Disconnect and tag two hoses (3) from tee (4) and elbow (5).



REMOVAL - CONTINUED**NOTE**

Note orientation of hose fittings prior to removal aid in installation.

3. Remove tee (4) and elbow (5) from steering gear (2).
4. Remove screw (6) and lock washer (7). Discard lock washer.
5. While an assistant supports steering gear (2), remove two screws (8), nuts (9), four washers (10), and steering gear.

**INSTALLATION**

1. Install elbow (5) and tee (6) and orient as noted in removal.
2. With assistance, position steering gear (2) and install two screws (8), four washers (10), and two nuts (9). Tighten nuts to 34-47 lb-ft (47-63 Nm).
3. Install new lock washer (7) and screw (6).
4. Connect two hoses (3) to tee (4) and elbow (5).
5. Connect lower end of universal steering shaft (TM 9-2320-302-20).
6. Install drag link (TM 9-2320-302-20).
7. Install drain plug (1) in steering gear (2).
8. Fill power steering reservoir (TM 9-2320-302-20).
9. Check system for operation and leaks.

END OF WORK PACKAGE

STEERING GEAR REPAIR

0089 00

THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Adjusting tool (Item 6, WP 0126 00)
- Caps, vise jaw (Item 17, WP 0126 00)
- Dial indicator set (Item 29, WP 0126 00)
- Handle, drive (Item 45, WP 0126 00)
- Insertor, bearing (Item 48, WP 0126 00)
- Installation tool, seal (Item 56, WP 0126 00)
- Installer, output shaft (Item 62, WP 0126 00)
- Socket, socket wrench, 19 mm, deep well (Item 117, WP 0126 00)
- Spanner attachment (Item 119, WP 0126 00)
- Vise, machinist's (Item 136, WP 0126 00)
- Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Tools and Special Tools - Continued

- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)
- Wrench set, socket attachment, torx (Item 142, WP 0126 00)

Materials/Parts

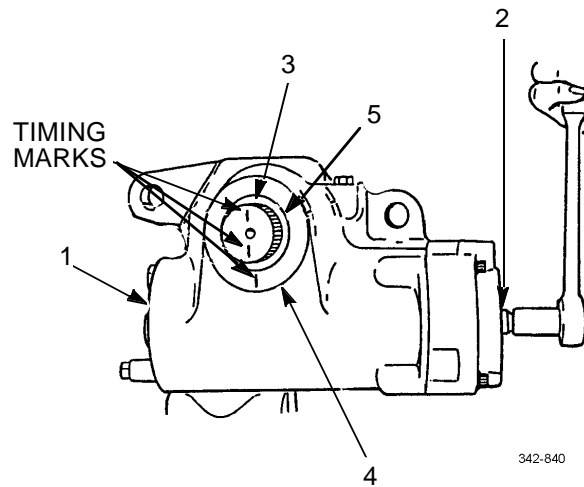
- Bearing, roller (P/N 071020)
- Fitting, lubrication (P/N 037027)
- Retainer (P/N 062005)
- Seal kit (P/N TAS650006)
- Screw, adjusting (P/N 062005)
- Grease, GAA (Item 22, WP 0125 00)
- Oil, lubricating (Item 25, WP 0125 00)
- Tags, marker (Item 35, WP 0125 00)
- Tape, masking (Item 37, WP 0125 00)

Equipment Condition

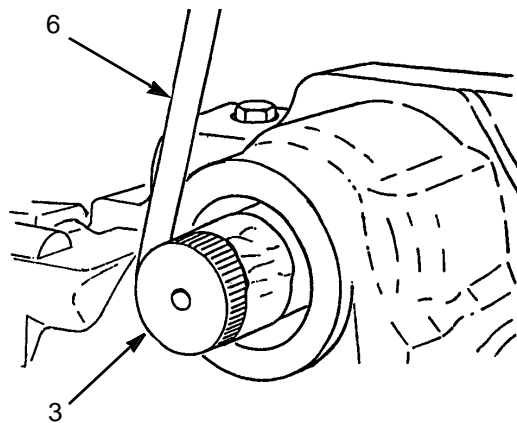
- Steering gear removed from vehicle (WP 0088 00)
-

DISASSEMBLY

1. Place steering gear assembly (1) in vise.
2. Using 19 mm deep socket, rotate input shaft (2) until timing marks on sector shaft (3) and housing (4) line up.
3. Remove and discard seal (5) from housing (4).

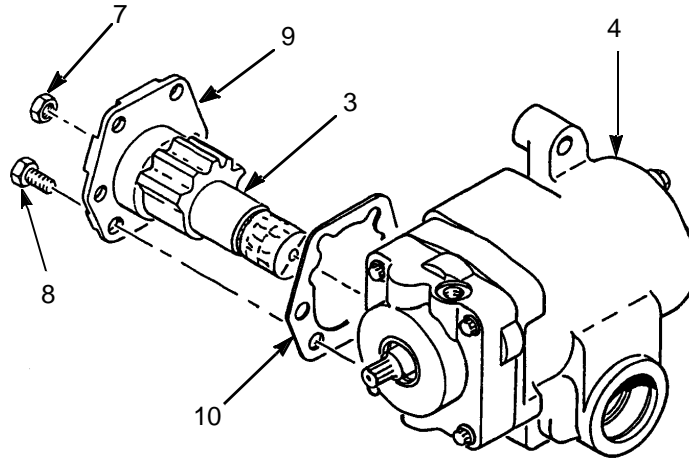


4. Remove any paint or corrosion from sector shaft (3).
5. Cover spined end of sector shaft (3) with masking tape (6).



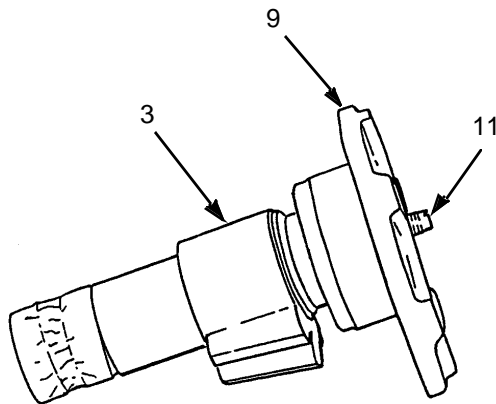
6. Remove nut (7), six screws (8), side cover (9), sector shaft (3), and gasket (10) from housing (4). Discard gasket.

DISASSEMBLY - CONTINUED



342-842

7. Remove sector shaft (3) from side cover (9) by turning adjusting screw (11) clockwise.



342-843

DISASSEMBLY - CONTINUED

NOTE

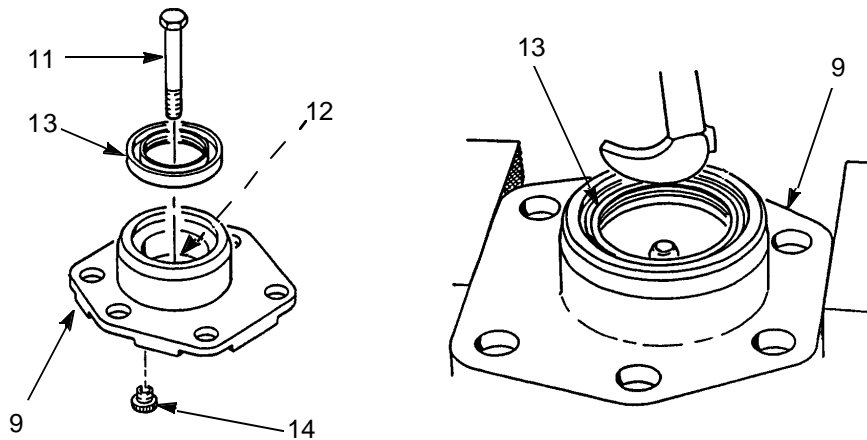
Remove adjusting screw to install temporary screw to pry against during bearing removal.

8. Install 1/2-20 UNF 2 X 3 in screw in adjusting screw hole (12) in side cover (9).

CAUTION

Use care when removing seal to prevent damage to side cover bushing.

9. Remove and discard seal (13) from side cover (9).
10. Remove temporary screw and replace with adjusting screw (11).
11. Remove vent plug (14) from side cover (9).

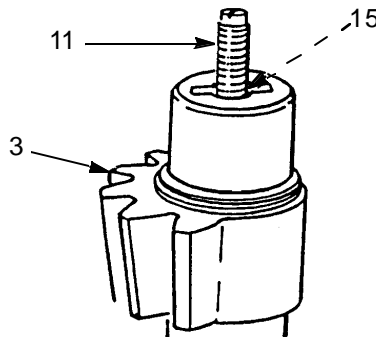


342-844

NOTE

If adjusting screw or retainer are damaged, perform steps 12 and 13.

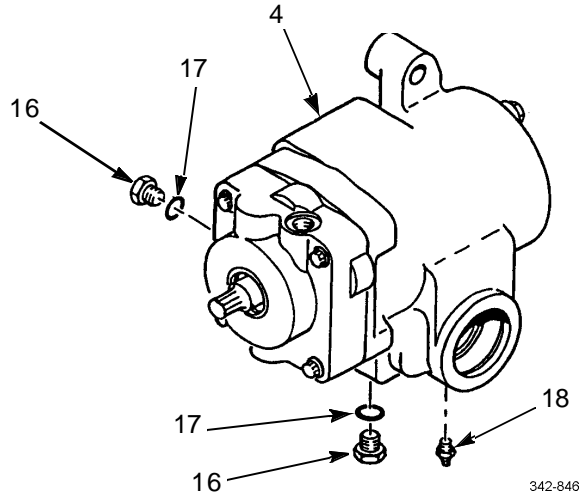
12. Place sector shaft (3) in soft-jawed vise.
13. Unstake, remove, and discard retainer (15) and adjusting screw (11).



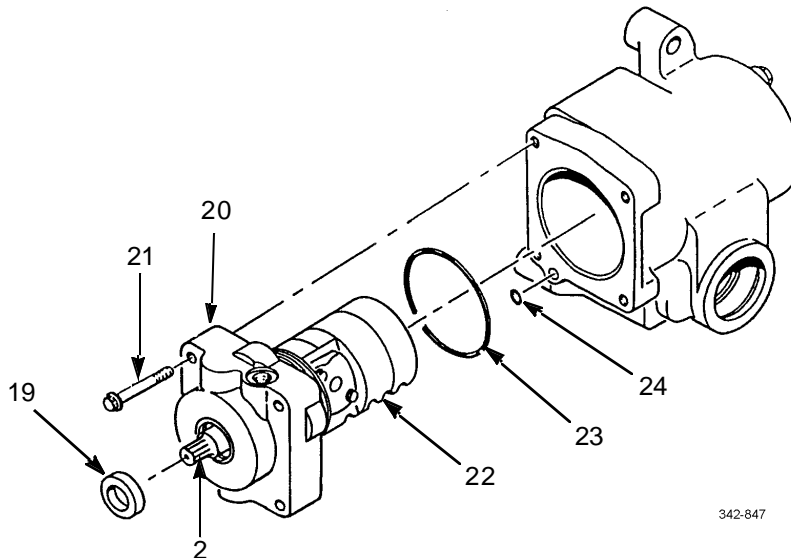
342-845

DISASSEMBLY - CONTINUED

14. Remove two plugs (16), packings (17), and grease fitting (18) from housing (4). Discard packings and grease fitting.



15. Remove and discard seal (19) from valve housing (20).
16. Remove any paint or corrosion from input shaft (2).
17. Remove four torx-head screws (21), valve housing (20), input shaft (2), and rack piston (22) as an assembly. Remove and discard two packings (23 and 24).

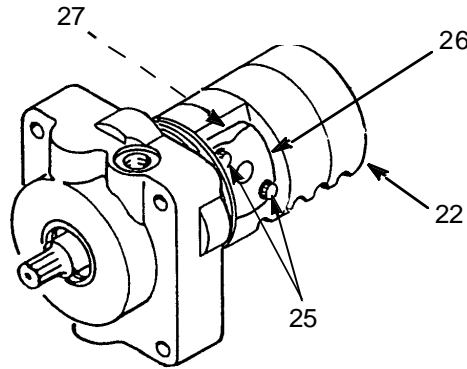


DISASSEMBLY - CONTINUED

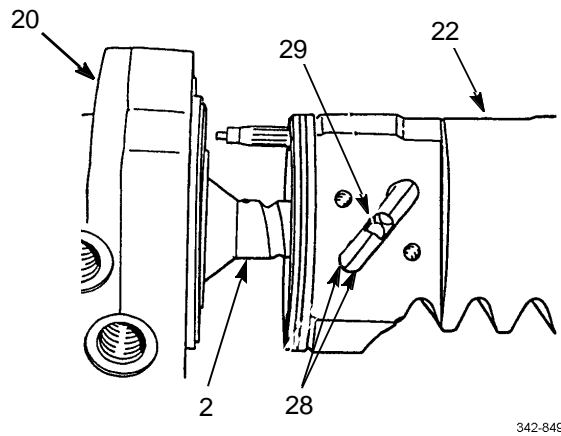
CAUTION

Position rack piston so that return cap faces up during removal. Failure to do so could result in loss of one or more balls of 32 ball set. If any balls are lost or damaged, balls must be replaced as a set.

18. Using torx socket, remove two screws (25), return cap (26), and seal (27) from rack piston (22). Discard screws and seal.

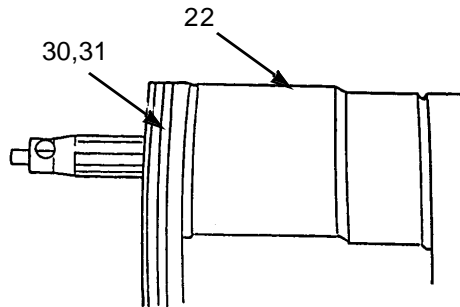


19. Remove two guide halves (28) and 32 balls (29) by rotating input shaft (2). Discard guide halves.
20. Remove rack piston (22) from valve housing (20) and input shaft (2).



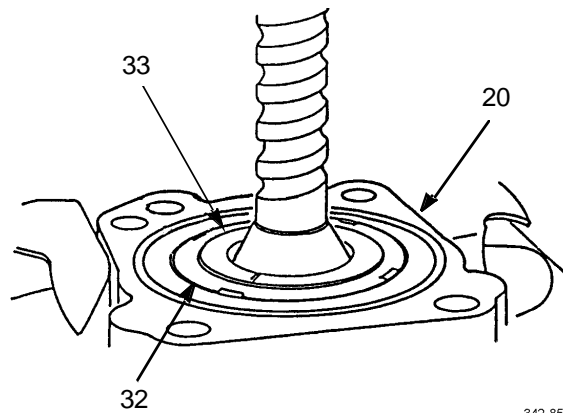
DISASSEMBLY - CONTINUED

21. Remove and discard seal ring (30) and packing (31) from rack piston (22).



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22. Place valve housing (20) in vise.
23. Unstake valve housing (20) from adjuster lock nut (32). Unstake adjuster lock nut from adjuster (33).



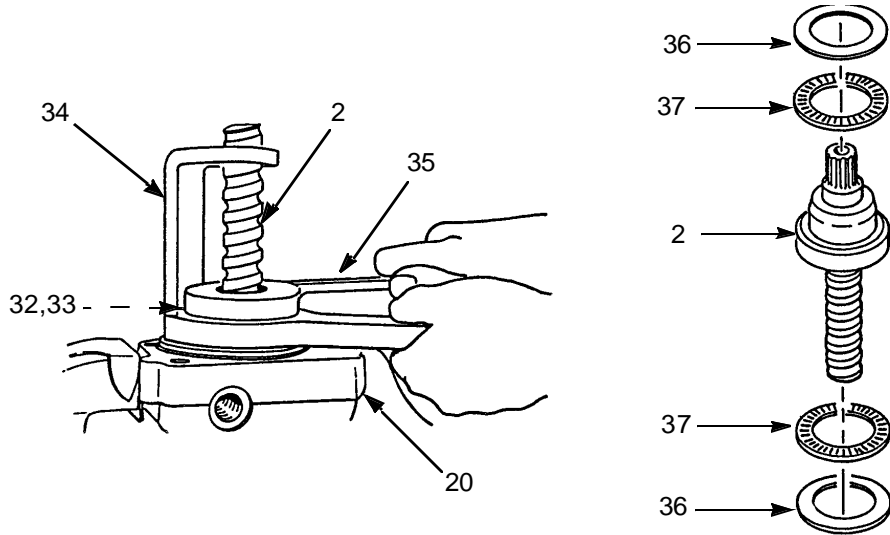
342-851

DISASSEMBLY - CONTINUED

NOTE

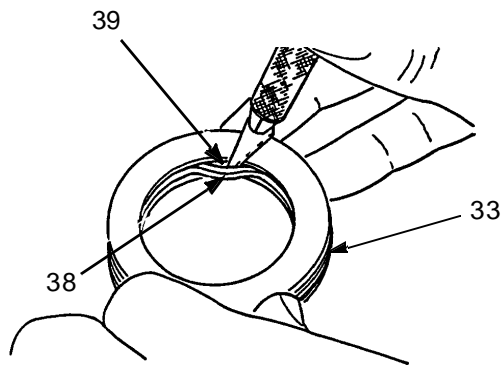
Tag thrust bearings and washers prior to disassembly to aid in assembly.

24. Using spanner wrenches (34 and 35), remove adjuster lock nut (32), adjuster (33), input shaft (2), two washers (36), and two thrust bearings (37) from valve housing (20).



342-852

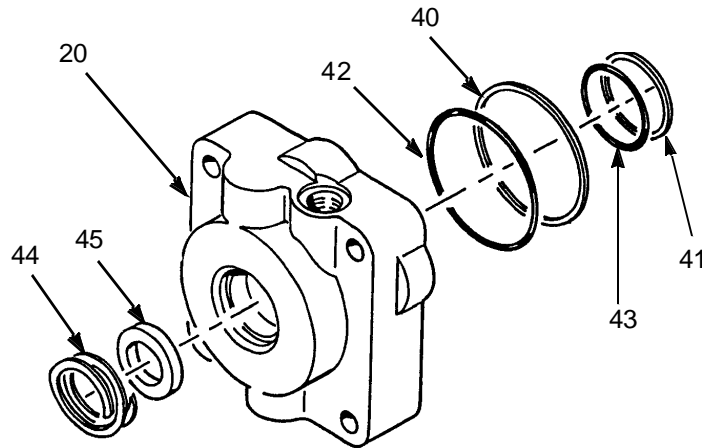
25. Remove and discard seal ring (38) and packing (39) from adjuster (33).



342-853

26. Remove and discard two seal rings (40 and 41) and two packings (42 and 43) from valve housing (20).
27. Reverse valve housing (20) in vise and remove and discard retaining ring (44).
28. Remove and discard seal (45).

DISASSEMBLY - CONTINUED



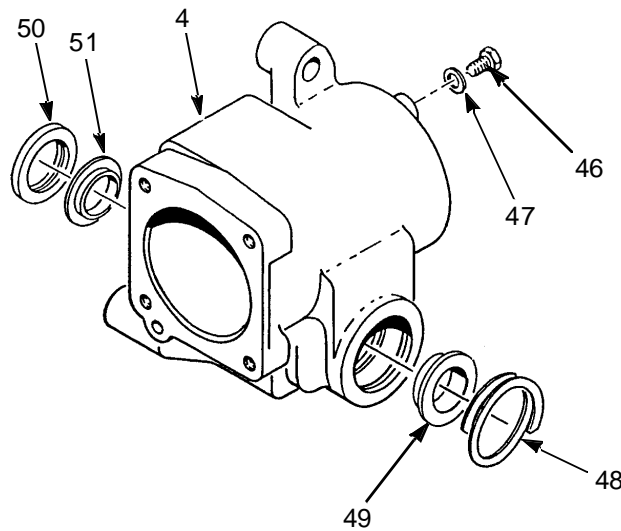
342-854

- 29. Remove screw (46) and washer (47) from housing (4).
- 30. Remove and discard retaining ring (48) and seal (49).

CAUTION

Use care not to tap against housing bore when tapping seal and trunnion washer from housing. Failure to do so will result in damage to housing.

- 31. Tap seal (50) and trunnion washer (51) from housing (4). Discard seal.

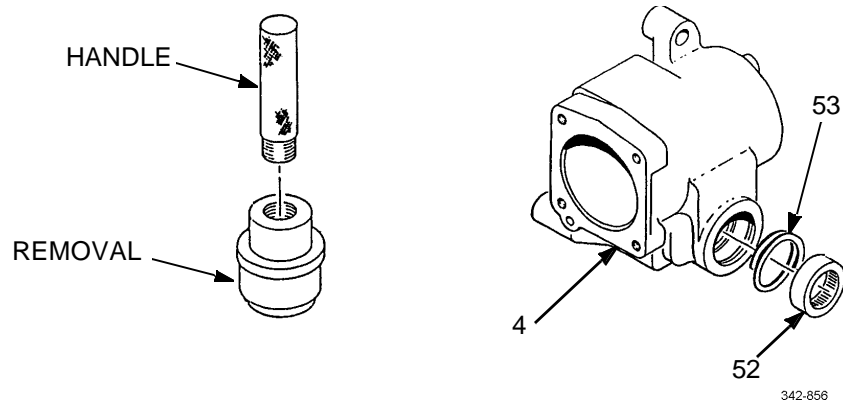


342-855

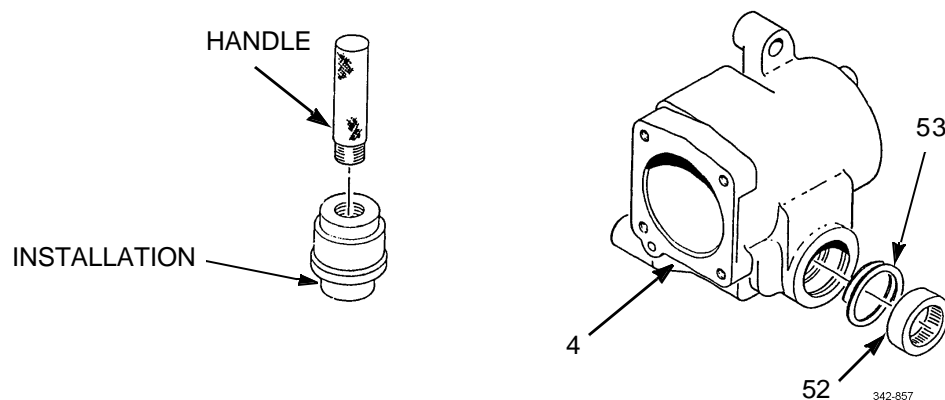
DISASSEMBLY - CONTINUED**CAUTION**

When using removal end of bearing and seal tool, place tool only on roller bearing and not on retaining ring. Failure to do so will result in damage to retaining ring and housing.

32. Using removal end of bearing inserter and drive handle, remove and discard roller bearing (52).
33. Remove and discard retaining ring (53) from bearing side of housing (4).

**ASSEMBLY**

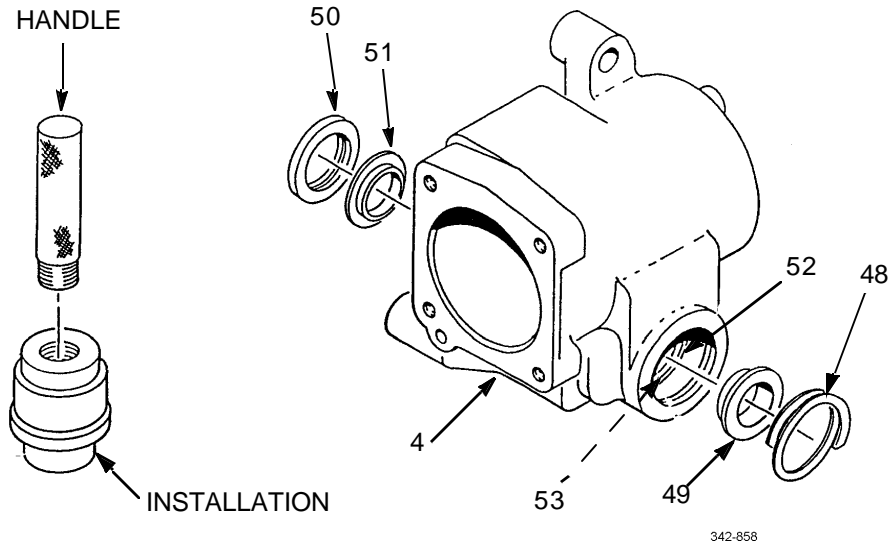
1. Install new retaining ring (53) in inside ring groove of housing (4).
2. Install new roller bearing (52), using installation end of bearing inserter and drive handle.



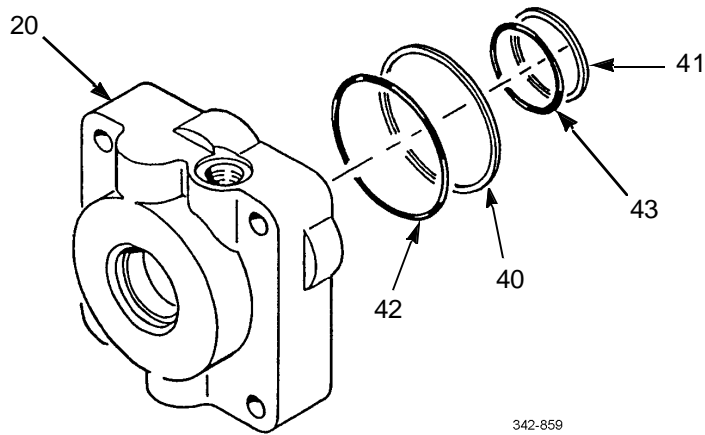
3. Install trunnion washer (51) in housing (4) with beveled side facing away from retaining ring (53).
4. Place new seal (50) on installation end of bearing inserter with spring toward shoulder of tool.
5. Install seal (50).

ASSEMBLY - CONTINUED

- Install new seal (49) and new retaining ring (48). Pack roller bearing (52) with grease.

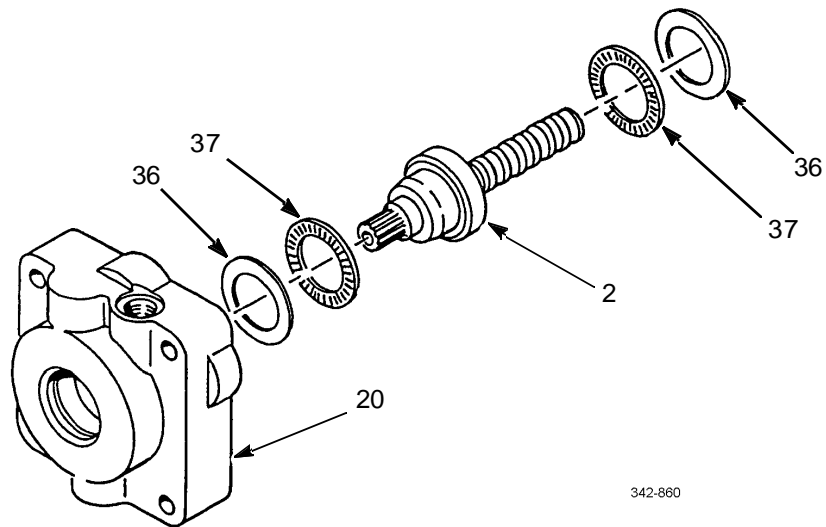


- Place valve housing (20) in vise. Apply a light coat of lubricating oil to two new packings (42 and 43) and two new seal rings (40 and 41). Install packings and seal rings.

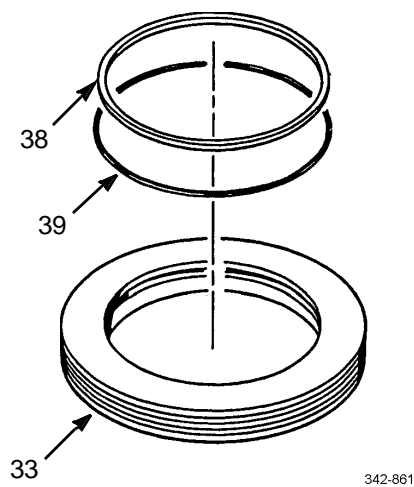


ASSEMBLY - CONTINUED

8. Apply a light coat of lubricating oil to thrust bearing (37) and washer (36). Install thrust bearing and washer on input shaft (2).
9. Install input shaft (2) in valve housing (20).
10. Apply a light coat of grease to thrust bearing (37) and washer (36). Install thrust bearing and washer.

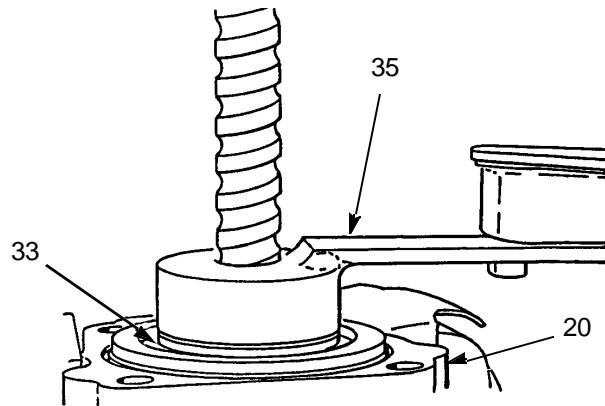


11. Install new packing (39) and new seal ring (38) in adjuster (33).



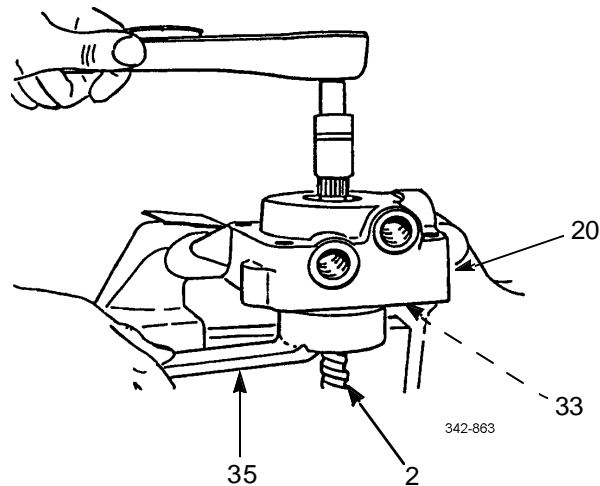
12. Using spanner wrench (35), install adjuster (33) in valve housing (20). Tighten adjuster to 132-180 lb-in (14.9-20.3 Nm), to seat components, then back off 1/4 to 1/2 turn.

ASSEMBLY - CONTINUED



342-862

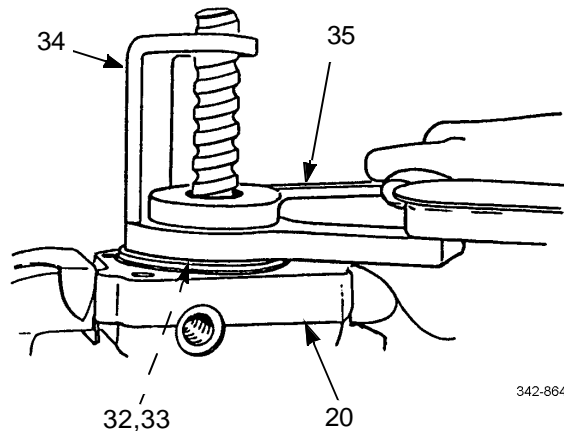
13. Reverse valve housing (20) in vise.
14. Using 19 mm deep well socket, rotate input shaft (2). Note amount of torque required to rotate input shaft in each direction.
15. Using spanner wrench (35), tighter adjuster (33) so that torque reading on input shaft (2) is 5-10 lb-in (0.56-1.13 Nm) higher than noted in step 14. Maximum torque required to rotate input shaft must not exceed 22 lb-in (2.5 Nm).



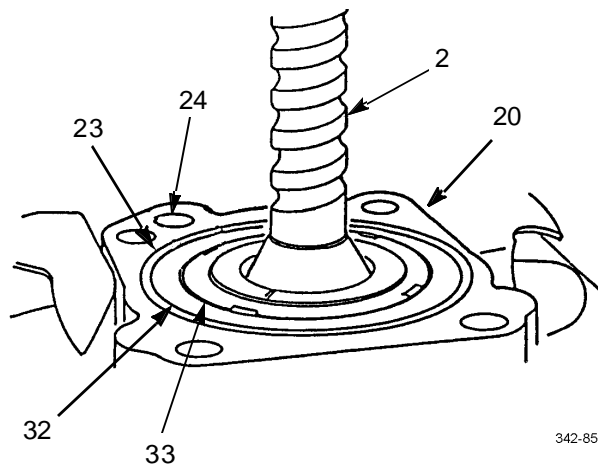
342-863

ASSEMBLY - CONTINUED

16. Reverse valve housing (20) in vise.
17. Apply a light coat of lubricating oil to new adjuster lock nut (32).
18. Using spanner wrenches (34 and 35), install adjuster lock nut (32) while holding adjuster (33) in place. Tighten adjuster lock nut to 101-122 lb-ft (137-165 Nm). Check torque reading noted in step 14. If torque reading is not within 5-10 lb-in (0.56-1.13 Nm) higher, remove adjuster lock nut, back off adjuster ½ turn, and repeat steps 13 through 18.



19. Stake valve housing (20) in clockwise-most corner of two opposing slots of adjuster lock nut (32). Stake adjuster lock nut on adjuster (33) in one place at threaded area. Check torque reading on input shaft (2). Reading must not exceed 22 lb-in (2.5 Nm).
20. Apply a light coat of lubricating oil to two new packings (23 and 24) and install packings in valve housing (20).

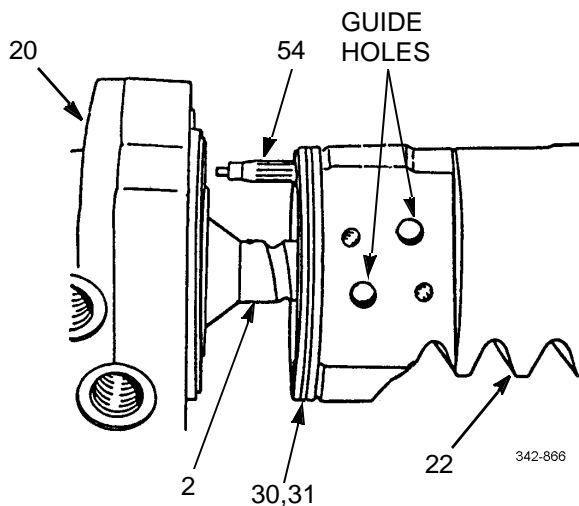


21. Apply a light coat of lubricating oil to new packing (31) and new seal ring (30). Install packing and seal ring on rack piston (22).

ASSEMBLY - CONTINUED**WARNING**

Do not allow valve housing to contact poppet. Such contact could cause steering problems or loss of steering resulting in possible injury to personnel.

22. Place rack piston (22), with guide holes up, on padded pedestal high enough so that valve housing (20) can rotate when assembled. Insert worm end of input shaft (2) into rack piston (22) close to maximum depth. Ensure valve housing does not contact poppet (54). Line up rack piston guide holes with worm track grooves on input shaft.

**WARNING**

Do not force guide halves into place. Force may damage guide halves, which could cause loss of steering, resulting in possible injury to personnel.

NOTE

Rotate input shaft slightly if necessary, to ensure guide halves are properly seated.

ASSEMBLY - CONTINUED

23. Install two new guide halves (28) by hand in rack piston (22).

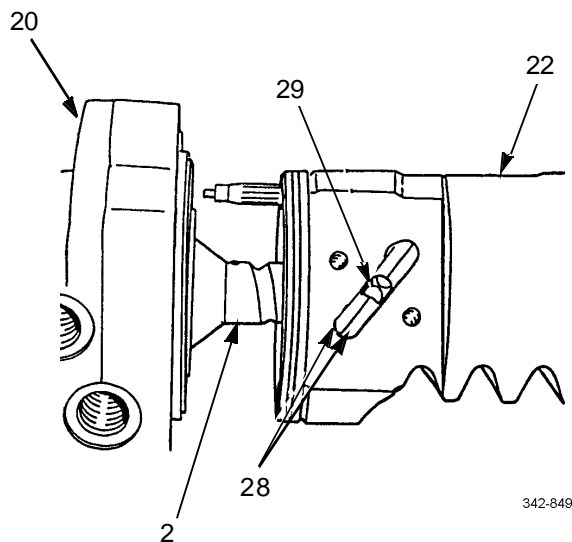
WARNING

Guide halves must be held in place during installation of balls. Failure to do so will result in balls being trapped outside closed ball track, causing steering lockup and possible injury to personnel. Failure to install all 32 balls in guide halves will also result in steering lockup and possible injury to personnel.

NOTE

- Rotate input shaft slightly, if necessary, to ensure guide halves are properly seated.
- If guide halves are unseated during or after ball loading, remove all balls and input shaft from rack piston and repeat steps 21 and 22.
- Ensure all 32 balls are installed.

24. Install 32 balls (29) in slot in guide halves (28).



25. Apply a light coat of grease to new seal (27) and install in return cap (26).
26. Using torx socket, install return cap (26) and two new screws (25) in rack piston (22). Tighten screws alternately to 168-264 lb-in (19-30 Nm).

WARNING

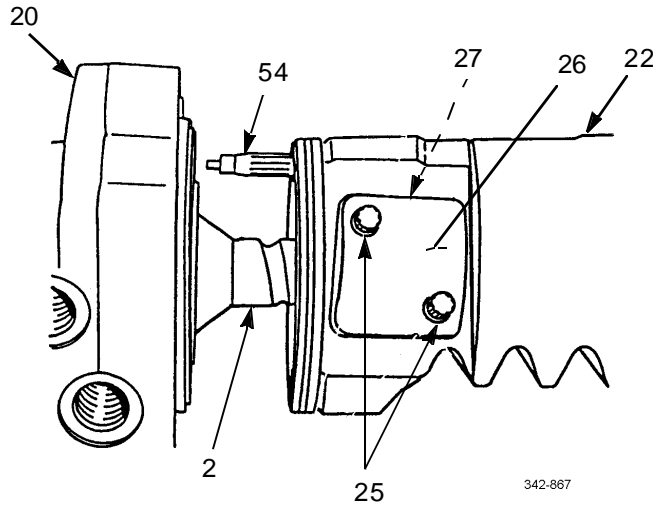
Do not allow valve housing to move more than 2.72 in (69.1mm) away from rack piston. If this occurs, balls will be out of place, resulting in possible loss of steering and injury to personnel.

CAUTION

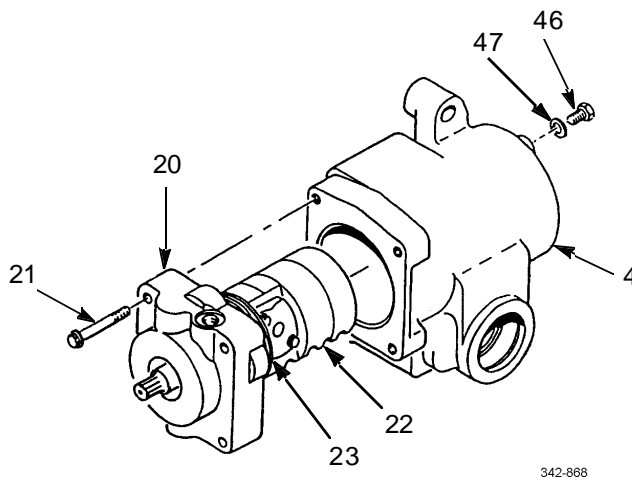
During step 27, do not allow poppet (54) to touch valve housing (20). To do so will result in incorrectly pre-set poppet.

27. Rotate input shaft (2) into and out of rack piston (22) several times while checking for smooth movement.
28. If input shaft (2) does not move smoothly, remove balls (29) and rack piston (22) and repeat steps 21 through 27.

ASSEMBLY - CONTINUED



29. Place housing (4) in vise. Install washer (47) and screw (46) in housing and tighten screw to 38-42 lb-ft (52-57 Nm). Apply a light coat of lubricating oil to bore of housing.
30. Apply a light coat of lubricating oil to seal ring (23).
31. Install rack piston (22) and valve housing (20) assembly in housing (4).
32. Apply a light coat of lubricating oil to four torx-head screws (21). Using torx socket, install torx-head screws in housing (4). Tighten screws alternately to 75-85 lb-ft (102-115 Nm).

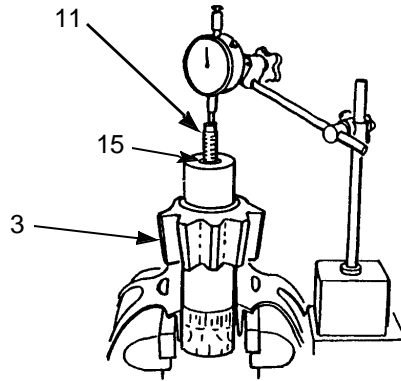


ASSEMBLY - CONTINUED

NOTE

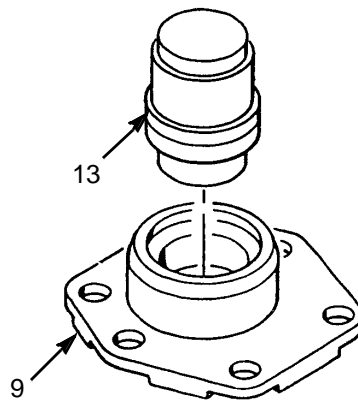
If adjusting screw was removed, perform steps 33 through 36.

33. Place sector shaft (3) in soft-jawed vise, apply a light coat of grease to new adjusting screw (11), and install adjusting screw and new retainer (15).
34. Tighten adjusting screw (11) so that end play is 0-0.002 in (0-0.05 mm) but adjusting screw can still be turned by hand. Check end play by hand with dial indicator.
35. Stake retainer (15) into two slots in sector shaft (3).
36. Ensure adjusting screw (11) can still be turned by hand and end play is still 0-0.002 in (0-0.05 mm). If not, repeat disassembly step 13 and installation steps 32 through 35.



342-869

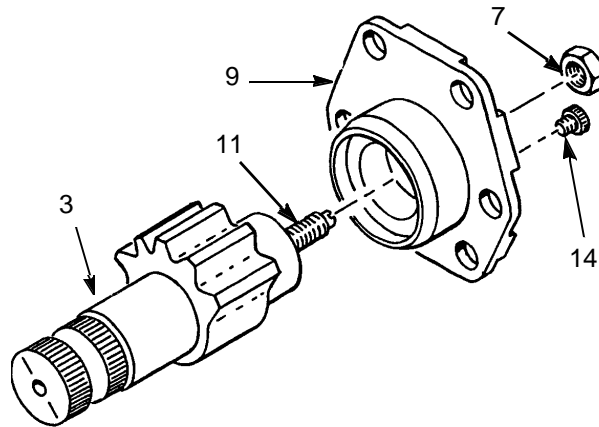
37. Apply a light coat of lubricating oil to bushing in side cover (9) and new seal (13). Install seal on installation end of bearing inserter with spring side toward shoulder of tool.
38. Install seal (13) in side cover (9).



342-870

ASSEMBLY - CONTINUED

39. Apply a light coat of lubricating oil to bearing surface of sector shaft (3). Install sector shaft in side cover (9) by threading adjusting screw (11) counterclockwise until solid, then backing off 1/2 turn so that side cover rotates freely.
40. Install vent plug (14) and nut (7) hand tight.

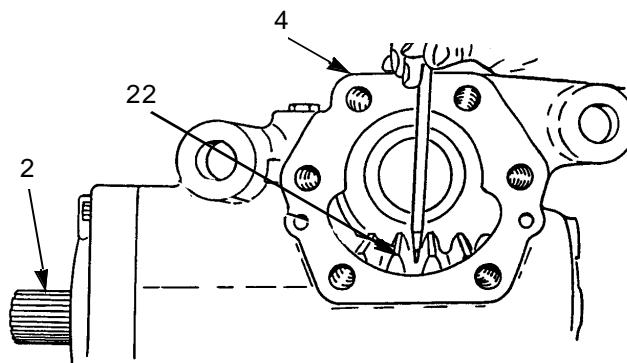


342-871

WARNING

Rack piston and sector shaft must be meshed correctly. Failure to do so will severely limit gear travel in one direction, resulting in possible injury to personnel.

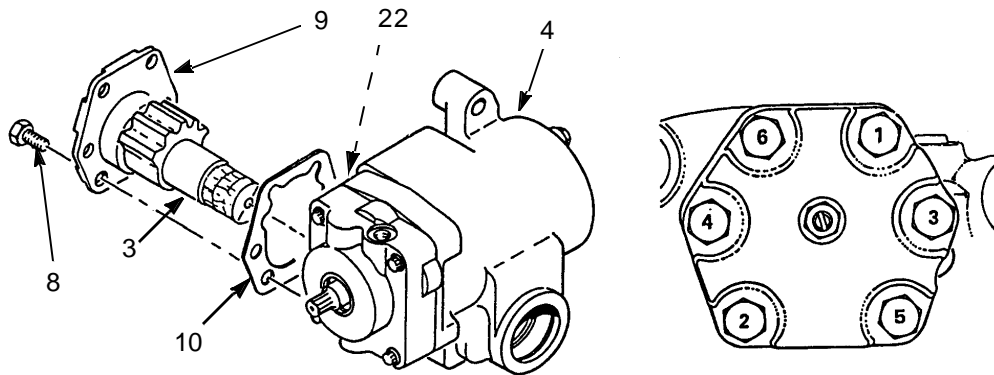
41. Rotate input shaft (2) so that valley between second and third tooth of rack piston (22) is even with and centered in opening of housing (4).



342-872

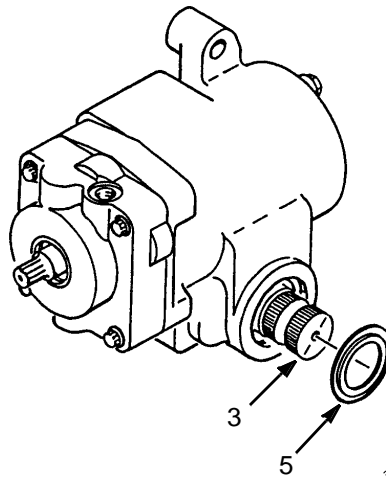
ASSEMBLY - CONTINUED

42. Replace masking tape on sector shaft (3) with one layer of new masking tape.
43. Install new gasket (10), sector shaft (3), and side cover (9) as an assembly in housing (4). Center tooth of sector shaft (3) must be in valley between second and third tooth of rack piston (22).
44. Apply a light coat of lubricating oil to six screws (8). Install screws in housing (4) and tighten to 160-180 lb-ft (217-244 Nm) in sequence shown.



342-873

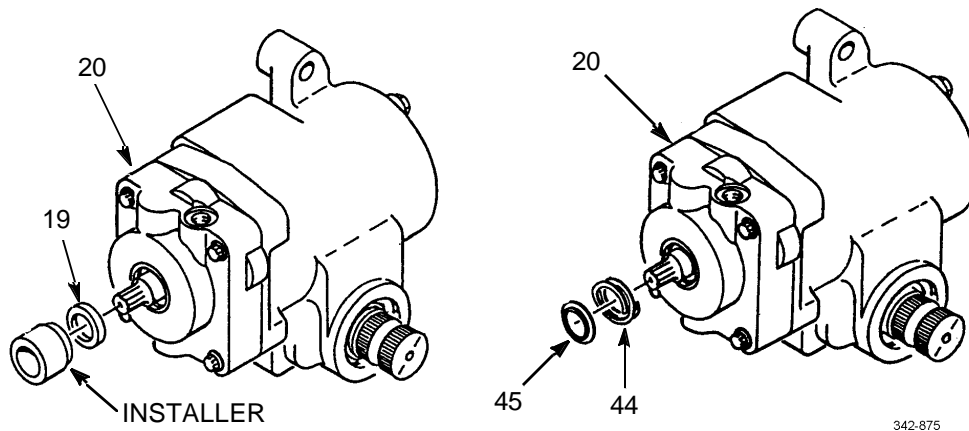
45. Pack trunnion area of sector shaft (3) with grease. Apply a light coat of grease to new seal (5) and install seal in sector shaft.



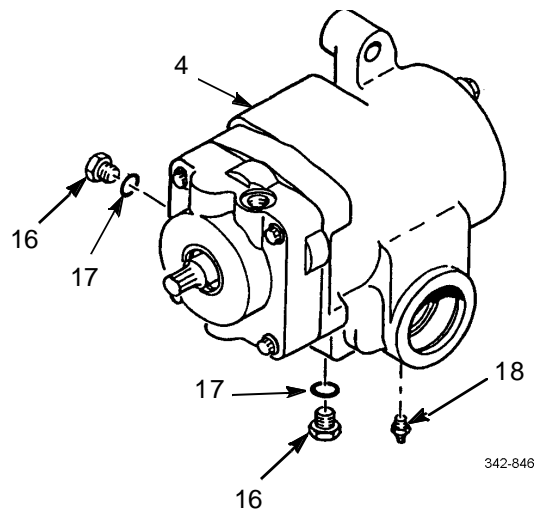
342-874

46. Apply a light coat of grease to new seal (19). Using small end of input seal installer, tap seal into valve housing (20) until shoulder of input seal installer rests against valve housing. Clean off any seal material that may have shredded off.
47. Install new retaining ring (44) and pack end of valve housing (20) with grease.
48. Apply a light coat of grease to new seal (45) and install seal in valve housing (20).

ASSEMBLY - CONTINUED

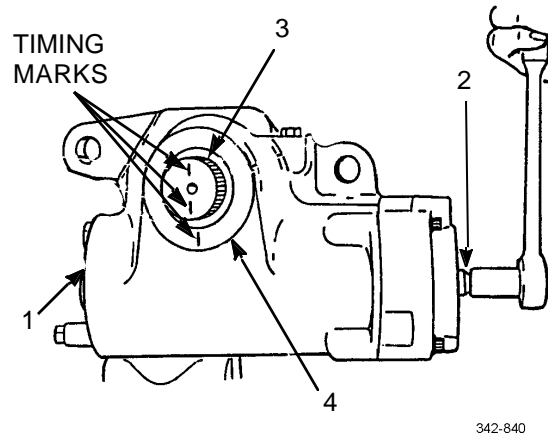


49. Install new grease fitting (18), two new packings (17), and plugs (16) in housing (4).



ASSEMBLY - CONTINUED

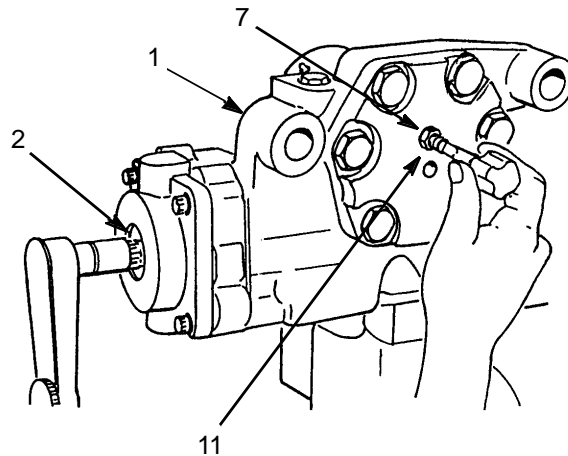
50. Ensure timing marks on sector shaft (3) and steering gear assembly (1) are aligned. If not, turn input shaft (2) with 19 mm deep well socket to align timing marks.



WARNING

Do not rotate input shaft more than 1-1/2 turns from center position. Doing so will incorrectly set poppets, causing steering problems resulting in possible injury to personnel.

51. Loosen nut (7).
52. Tighten adjusting screw (11) so that input shaft (2) requires torque of 45-50 lb-in (5.1-5.6 Nm) to turn 180 degrees from center in both directions.
53. Back off adjusting screw (11) ½ turn and note torque required to turn input shaft (2) 180 degrees from center in both directions.
54. Tighten adjusting screw (11) so that torque required to turn input shaft (2) 180 degrees from center in both directions increases 6-8 lb-in (0.68-0.90 Nm) from reading noted in step 53.
55. Hold adjusting screw (11) firmly against steering gear assembly (1) and tighten nut (7) to 40-45 lb-ft (54-61 Nm).
56. Check torque reading on input shaft (2). If reading exceeds 40 lb-in (4.5 Nm), repeat steps 51 through 56.



57. Install steering gear (WP 0088 00).

END OF WORK PACKAGE

STEERING COLUMN REPLACEMENT

0090 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Bolt (P/N 14-09683-000)

Nut (P/N 115307A)

Materials/Parts - Continued

Compound, sealing (Item 17, WP 0125 00)

Detergent (Item 19, WP 0125 00)

Primer, adhesive (Item 30, WP 0125 00)

References

TM 9-2320-302-10

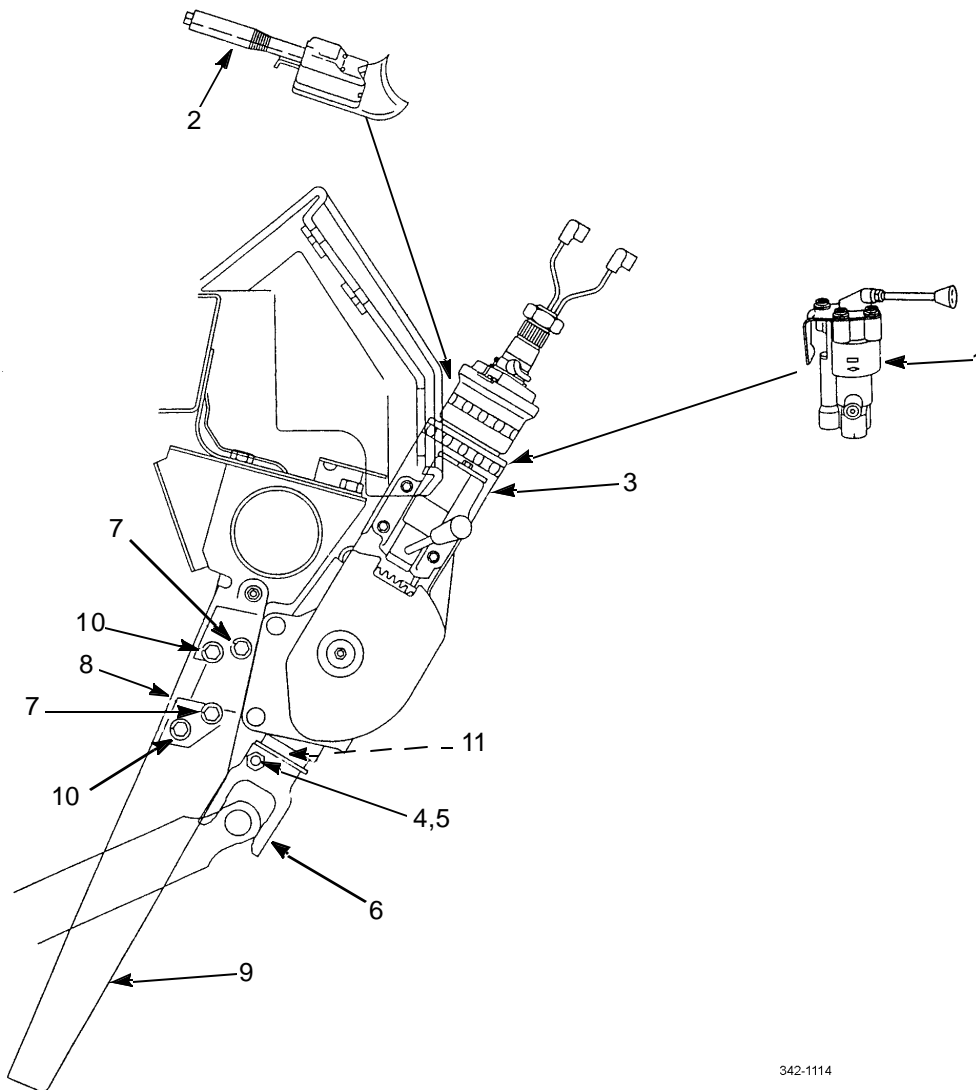
Equipment Condition

Steering wheel removed (TM 9-2320-302-20)

Steering column covers removed (TM 9-2320-302-20)

REMOVAL

1. Loosen clamp and remove trailer brake control valve (1).
2. Loosen clamp screw and remove turn signal switch (2).
3. Disconnect connector from turn signal switch (2).
4. Disconnect horn wire from steering column (3).



342-1114

REMOVAL - CONTINUED**NOTE**

Heat base of yoke, if necessary, for ease in removal.

5. Remove nut (4) and bolt (5) from steering column yoke (6) and separate yoke from steering column (3). Discard nut and bolt.
6. Remove two screws (7) and spacer block (8) from steering column (3) and steering column bracket (9).
7. Loosen two screws (10) and remove steering column (3) from vehicle.

INSTALLATION

1. Position steering column (3) on steering column bracket (9) and install two screws (7). Tighten screws to 180 lb-in (20 Nm).
2. Tighten two screws (10) to 180 lb-in (20 Nm).
3. Using wire brush and liquid detergent, clean serrations of steering column yoke (6) and steering column shaft (11).
4. Apply adhesive primer to steering column shaft (11). Let dry for five minutes.
5. Apply sealing compound to inside of steering column yoke (6) and install yoke to steering column shaft (11).
6. Install new bolt (5) and nut (4). Tighten nut to 37 lb-ft (50 Nm).
7. Apply sealing compound to exposed threads of screw.
8. Connect horn wire to steering column (3).
9. Connect connector to turn signal switch (2).
10. Install turn signal switch (2) to steering column (3) and tighten clamp screw.
11. Install trailer brake control valve (1) and tighten clamp.
12. Install steering column covers (TM 9-2320-302-20).
13. Install steering wheel (TM 9-2320-302-20).
14. Test drive vehicle (TM 9-2320-302-10) and check steering.

END OF WORK PACKAGE

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FIFTH WHEEL REPLACEMENT

0091 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Personnel Required

Two

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Equipment Condition

Air system drained (TM 9-2320-302-10)

Materials/Parts

Nut, lock (P/N MS51922-1)

Nut, lock (P/N MS51922-49) (14)

**WARNING**

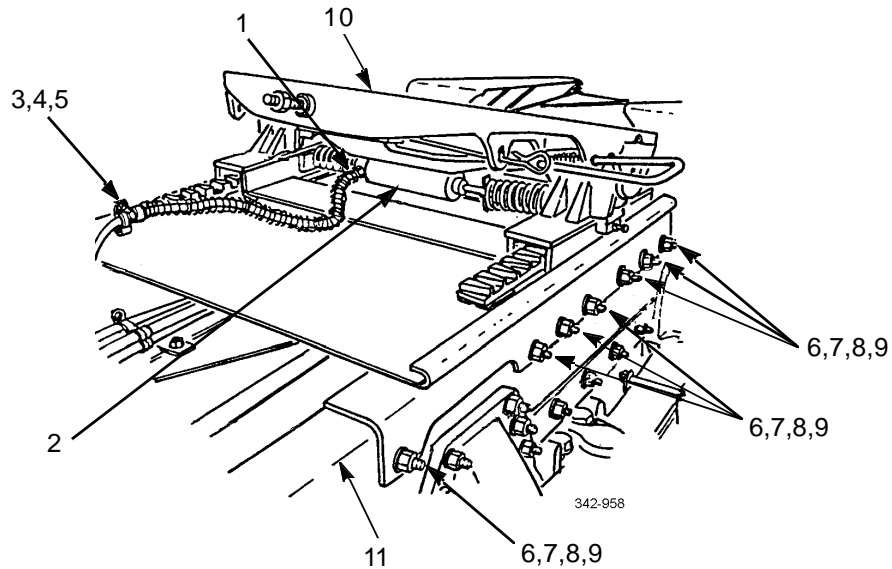
- Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.
- Fifth wheel weighs 550 lb (249.7 kg). Use hoist with lifting capacity of 800 lb (363.2 kg) to remove fifth wheel. Failure to do so could result in injury to personnel.

FIFTH WHEEL REPLACEMENT - CONTINUED

0091 00

REMOVAL

1. Disconnect air hose (1) from cylinder (2).
2. Remove lock nut (3), screw (4), and clamp (5). Discard lock nut.
3. Remove 14 lock nuts (6), washers (7), screws (8), and washers (9) from fifth wheel (10). Discard lock nuts.
4. Using suitable lifting device, remove fifth wheel (10) from frame (11).

**INSTALLATION**

1. Using suitable lifting device, align and install fifth wheel (10) on frame (11).
2. Install 14 washers (9), screws (8), washers (7), and new lock nuts (6).
3. Install clamp (5), screw (4), and new lock nut (3).
4. Connect air hose (1) to cylinder (2).

END OF WORK PACKAGE

SLIDE BRACKET AND PLATE REPAIR

0092 00

THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP**Maintenance Level**

Direct Support

References

TM 9-2320-302-20

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

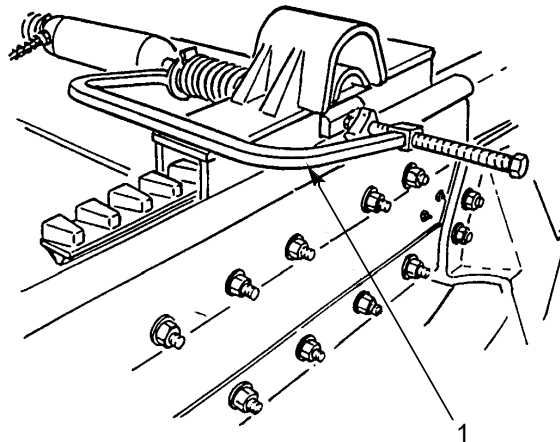
Slider, spring compression (Item 114, WP 0126 00)

Equipment Condition

Top plate removed (WP 0093 00)

DISASSEMBLY

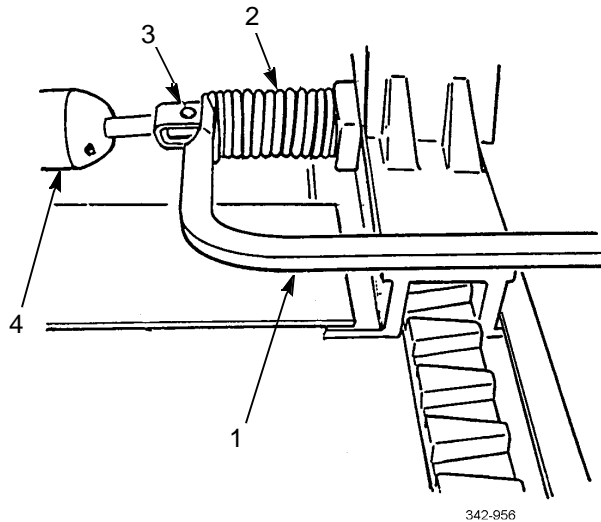
1. Install spring compressor tool (1).



342-955

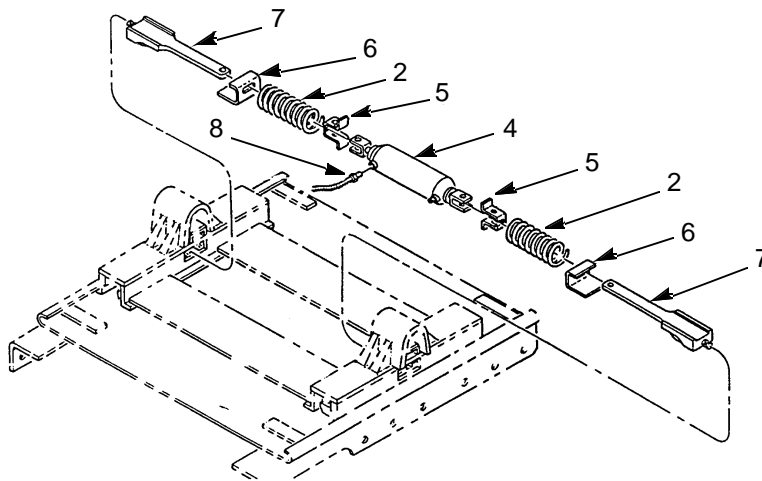
DISASSEMBLY - CONTINUED

2. Compress spring (2). Remove pin (3) and swing air cylinder (4) out of the way.
3. Remove spring compressor tool (1).



342-956

4. Remove spring retainer (5), spring (2), pin retainer (6), and plunger assembly (7).
5. Repeat steps 1 through 4 for opposite side plunger assembly.
6. Disconnect air hose (8) and remove air cylinder (4).



342-957

ASSEMBLY

1. Install air cylinder (4) and connect air hose (8).
2. Install plunger assembly (7), pin retainer (6), spring (2), and spring retainer (5).
3. Install spring compressor tool (1).
4. Compress spring (2) and place air cylinder (4) in position.
5. Install pin (3) and release spring compressor tool (1).

SLIDE BRACKET AND PLATE REPAIR - CONTINUED

0092 00

ASSEMBLY - CONTINUED

6. Repeat steps 2 through 5 for opposite side plunger assembly.
7. Install top plate (WP 0093 00).
8. Adjust fifth wheel (TM 9-2320-302-20).

END OF WORK PACKAGE

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TOP PLATE REPLACEMENT

0093 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Kit (P/N RK-04413)

Compound, antiseize (Item 10, WP 0125 00)

Personnel Required

Two



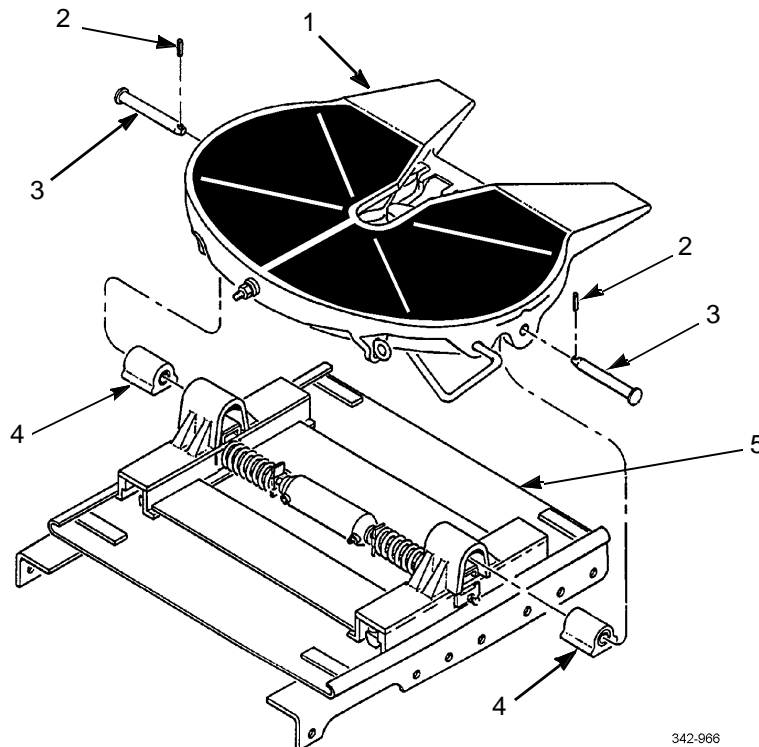
WARNING



- Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.
- Top plate weighs 320 lb (145 kg). Use hoist with lifting capacity of 500 lb (227 kg) to remove or install top plate. Failure to do so could result in injury to personnel.

TOP PLATE REPLACEMENT - CONTINUED**0093 00****REMOVAL**

1. Using suitable lifting device, support top plate (1) and remove two roll pins (2). Discard roll pins.
2. Remove two pivot pins (3) and top plate (1). Discard pivot pins.
3. Remove and discard two cushion supports (4) from slide bracket (5).



342-966

INSTALLATION

1. Install two new cushion supports (4) in slide bracket (5).
2. Coat two new pivot pins (3) with antiseize compound.
3. Using suitable lifting device, align top plate (1) with slide bracket (5) and install two new pivot pins (3) and two new roll pins (2).

END OF WORK PACKAGE

TOP PLATE REPAIR

0094 00

THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Personnel Required

Two

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Tester, kingpin lock (Item 126, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

References

TM 9-2320-302-10

TM 9-2320-302-20

TM 9-237

Materials/Parts

Kit (P/N RK-65015)

Kit (P/N RK-65017)

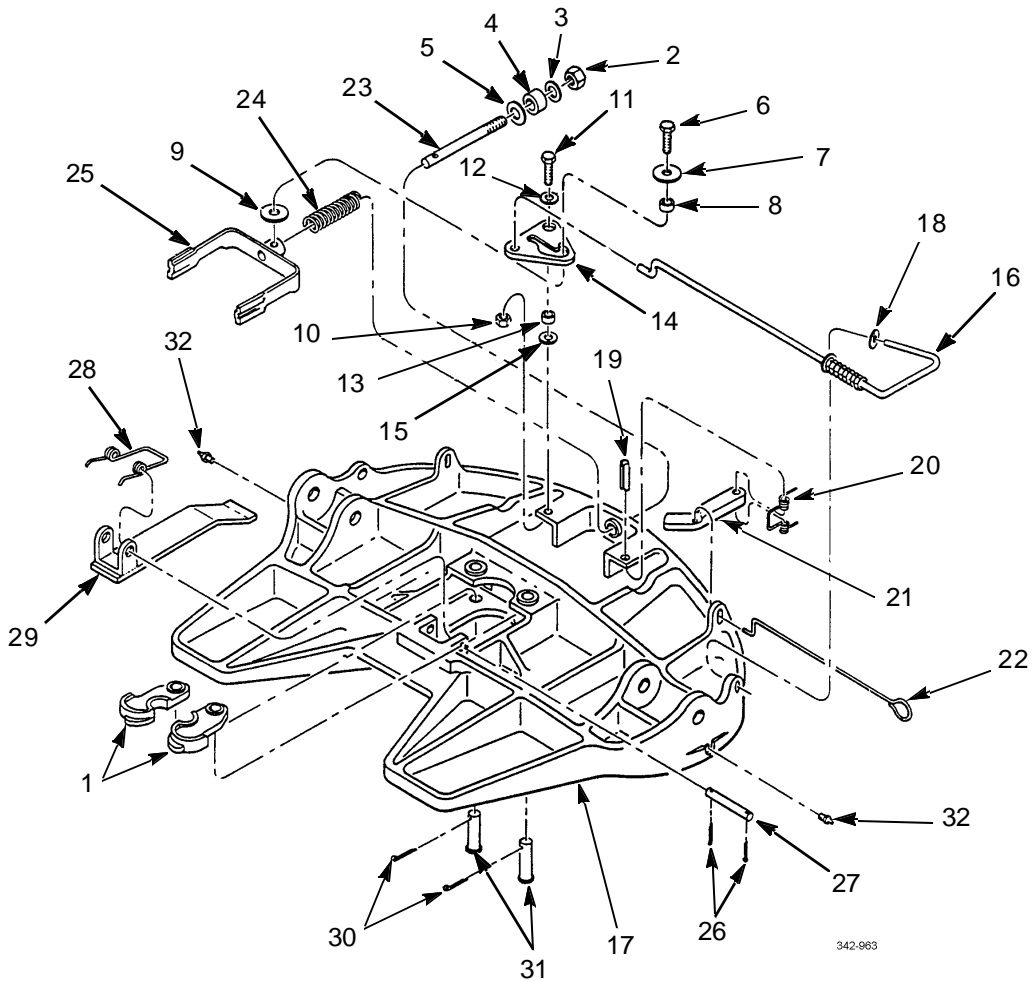
Compound, antiseize (Item 10, WP 0125 00)

Equipment Condition

Top plate removed (WP 0093 00)

DISASSEMBLY

1. Ensure locks (1) are in closed position.
2. Remove and discard nut (2), washer (3), rubber washer (4), and lock-adjust tag (5).
3. Remove and discard screw (6), washer (7), roller (8), and washer (9).
4. Remove and discard lock nut (10), screw (11), washer (12), roller (13), cam plate (14), and washer (15).



5. Remove primary lock handle (16) from top plate (17).
6. Remove and discard washer (18) from primary lock handle (16).
7. Remove roll pin (19), spring (20), lock bar (21), and handle (22). Discard roll pin, spring, and lock bar.

DISASSEMBLY - CONTINUED



WARNING

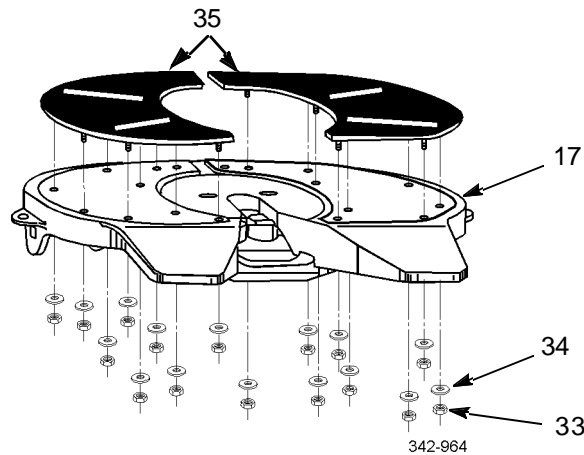
When removing spring, compress spring slightly and relieve tension slowly. Failure to do so could cause spring to fly off, resulting in injury to personnel.

8. Remove and discard shaft (23), spring (24), and yoke (25) from top plate (17).
9. Remove two cotter pins (26), pin (27), spring (28), and lock guard (29). Discard cotter pins, pin, and lock guard.
10. Remove two pins (30), pins (31), and locks (1). Discard cotter pins and pins.
11. If damaged, remove two grease fittings (32) from top plate (17).

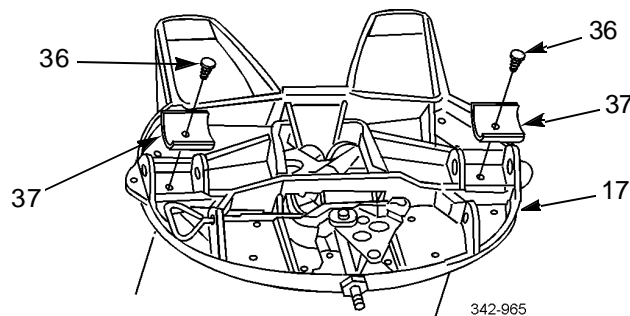
NOTE

Lube plates must be replaced as a pair.

12. Remove 18 lock nuts (33), washers (34), and two lube plates (35) from top plate (17). Discard lock nuts.



13. Remove two retaining clips (36) and two pocket inserts (37) from top plate (17).

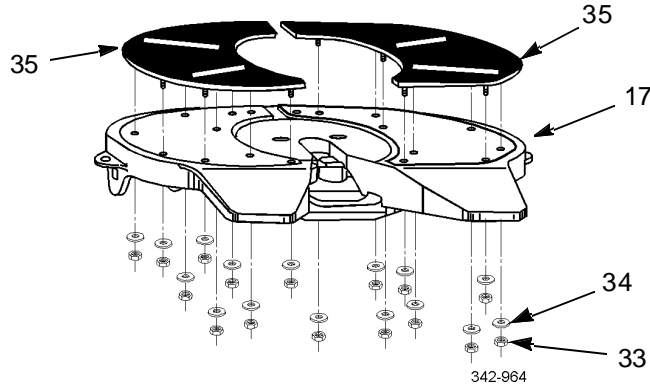


ASSEMBLY

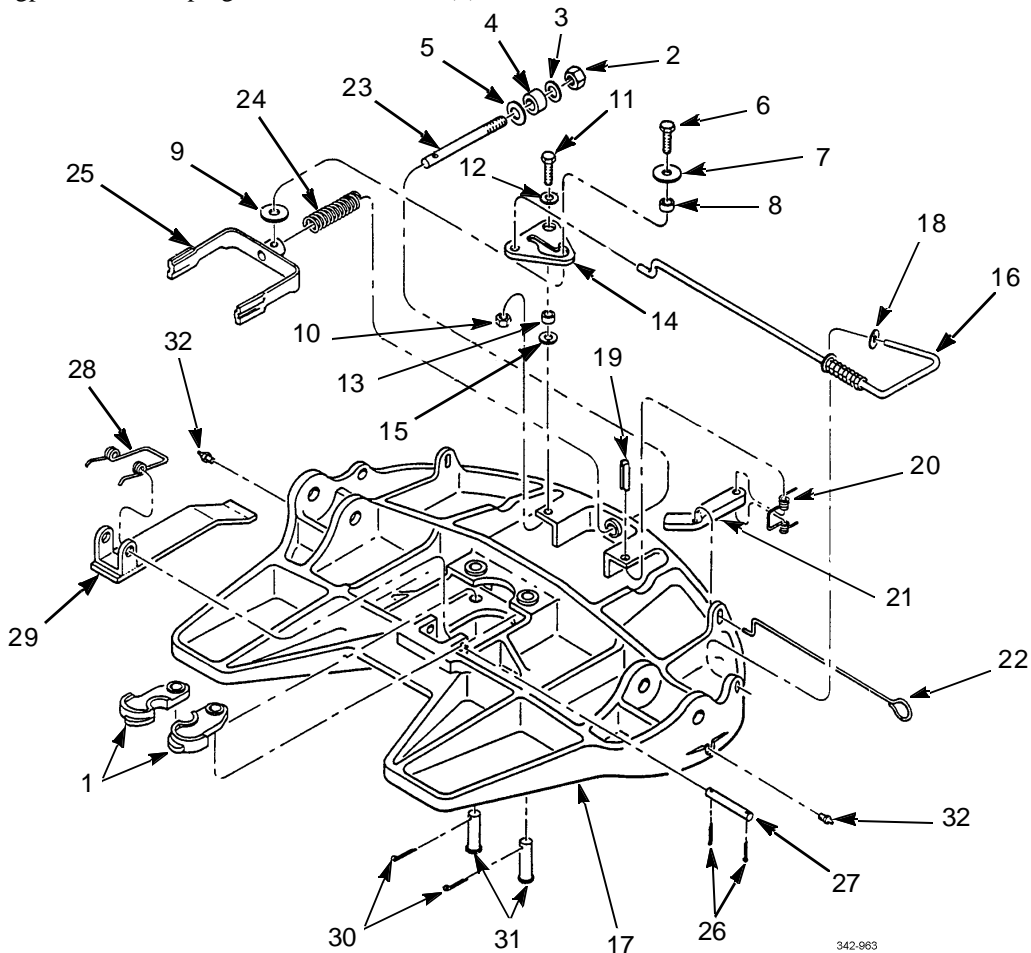
1. Install two pocket inserts (37) on top plate (17) and secure with two retaining clips (36).
2. Ensure top plate mating surface is clean and dry.

ASSEMBLY - CONTINUED

3. Install two lube plates (35) to top plate (17) with 18 washers (34) and new lock nuts (33).
4. Tighten lock nuts (33) to 156 lb-in (18 Nm).



5. If removed, install two new grease fittings (32).
6. Coat pin holes of two locks (1) with antiseize compound and install two locks with larger opening facing toward top of top plate (17).
7. Install two new pins (31) and new pins (30).
8. Install new lock guard (29), spring (28), new pin (27), and two new cotter pins (26).
9. Install kingpin lock tester plug between two locks (1) and close locks.



ASSEMBLY - CONTINUED**NOTE**

- Tips of yoke must be flush (1/32 in) with ends of two locks. If yoke falls short, grind outside edges of yoke tips evenly until yoke fits exactly. If yoke extends beyond two locks, build up outside edges of yoke tops using low-hydrogen E70XX welding rod. After welding, grind beads smooth and even until yoke fits exactly.
 - Ensure threaded hole is up when installing shaft.
10. Install new spring (24) and new shaft (23) on yoke (25).
 11. Install handle (22), new lock bar (21), new spring (20), and new roll pin (19).
 12. Install new washer (18) on primary lock handle (16).
 13. Install primary lock handle (16) in top plate (17).
 14. Install new cam plate (14) on primary lock handle (16).

NOTE

Install washers with rounded sides facing away from cam plate.

15. Install new washer (15), new roller (13), new washer (12), new screw (11), and new lock nut (10) in top plate (17).
16. Install new washer (9), new roller (8), new washer (7), and new screw (6) in cam plate (14).
17. Install new lock-adjust tag (5), new rubber washer (4), new washer (3), and new nut (2) on shaft (23).

WARNING

Locks must be closed while adjusting to ensure contact is made with locks, yoke, and top plate. Failure to do so will result in loss of trailer and possible injury to personnel.

18. Tighten nut (2) until plug fits snugly, but can just be rotated by hand.
19. Open two locks (1) and remove kingpin lock tester plug.
20. Install top plate (WP 0093 00).
21. Lubricate fifth wheel (TM 9-2320-302-10).
22. Adjust fifth wheel (TM 9-2320-302-20).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Materials/Parts

Nut, lock (P/N MS51922-33) (6)

Nut, lock (P/N MS51922-49) (6)



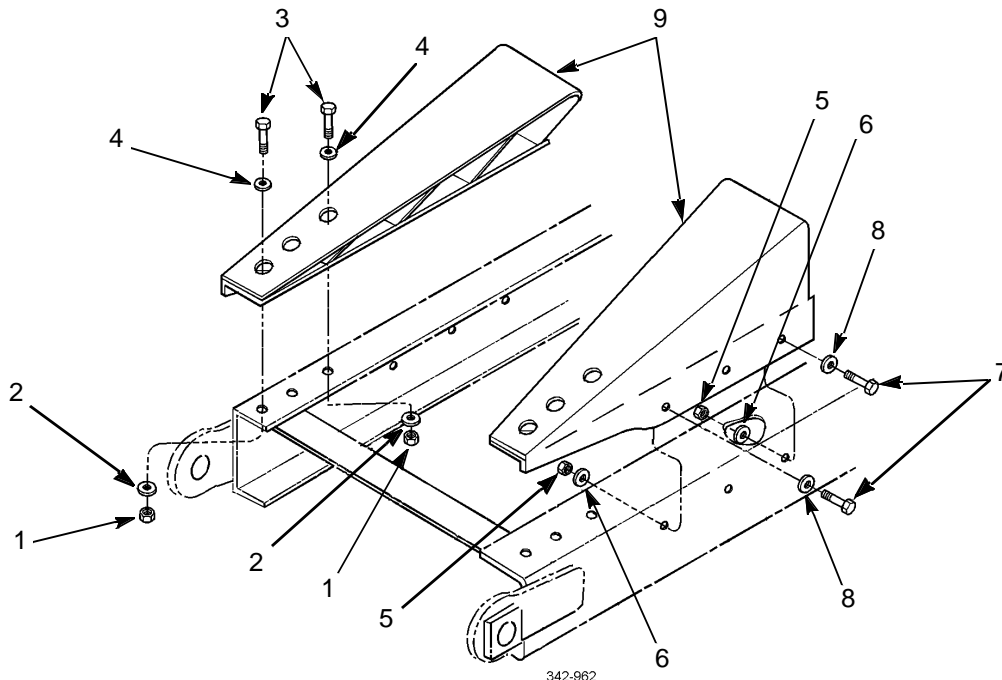
WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL

1. Remove three lock nuts (1), washers (2), screws (3), and washers (4). Discard lock nuts.
2. Remove three lock nuts (5), washers (6), screws (7), and washers (8). Discard lock nuts.
3. Remove ramp (9) from vehicle.



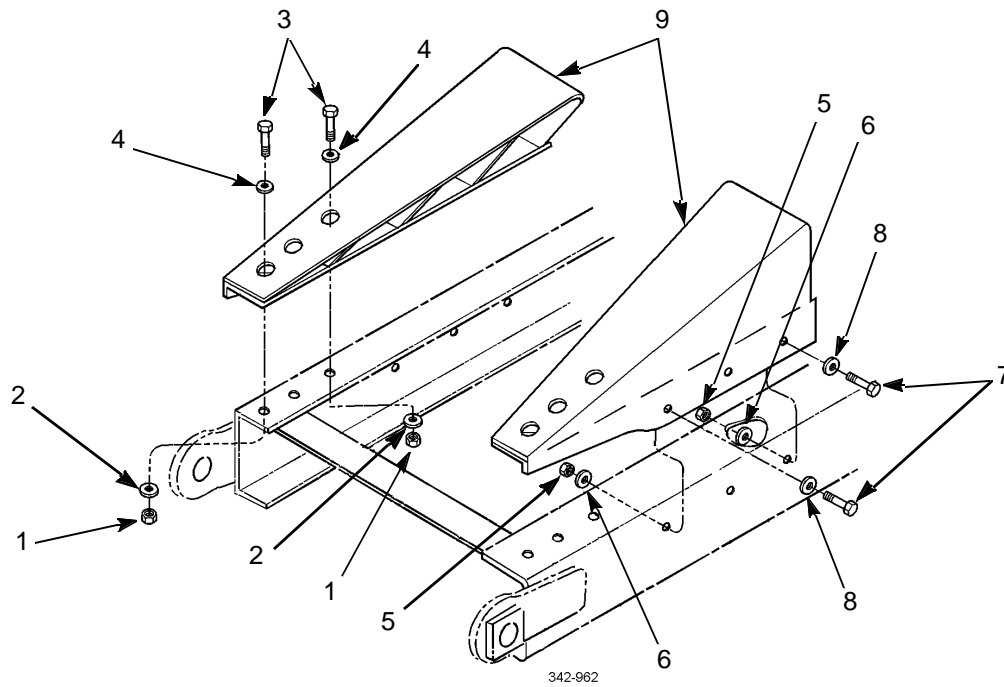
342-962

REMOVAL - CONTINUED

4. Repeat steps 1 through 3 to remove other ramp (9)

INSTALLATION

1. Position ramp (9) to vehicle.
2. Install ramp (9) with three washers (8), screws (7), washers (6), and new lock nuts (5).
3. Install three washers (4), screws (3), washers (2), and new lock nuts (1).
4. Repeat steps 1 through 3 to install other ramp (9).



END OF WORK PACKAGE

CROSSMEMBER REPLACEMENT

0096 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)
- Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)
- Wrench set, socket, 3/4 in drive (Item 141, WP 0126 00)

Materials/Parts

- Nut, lock (P/N 23-09901-116) (12)
- Nut, lock (P/N MS51922-1) (4)
- Nut, lock (P/N MS51922-33) (22)
- Nut, lock (P/N MS51922-49) (12)

Equipment Condition

- Taillight brackets removed (TM 9-2320-302-20)
 - Pintle hook removed (TM 9-2320-302-20)
-



WARNING

Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

NOTE

This task covers replacement of the REAR crossmember and is typical of procedures used to replace other crossmembers of the vehicle.

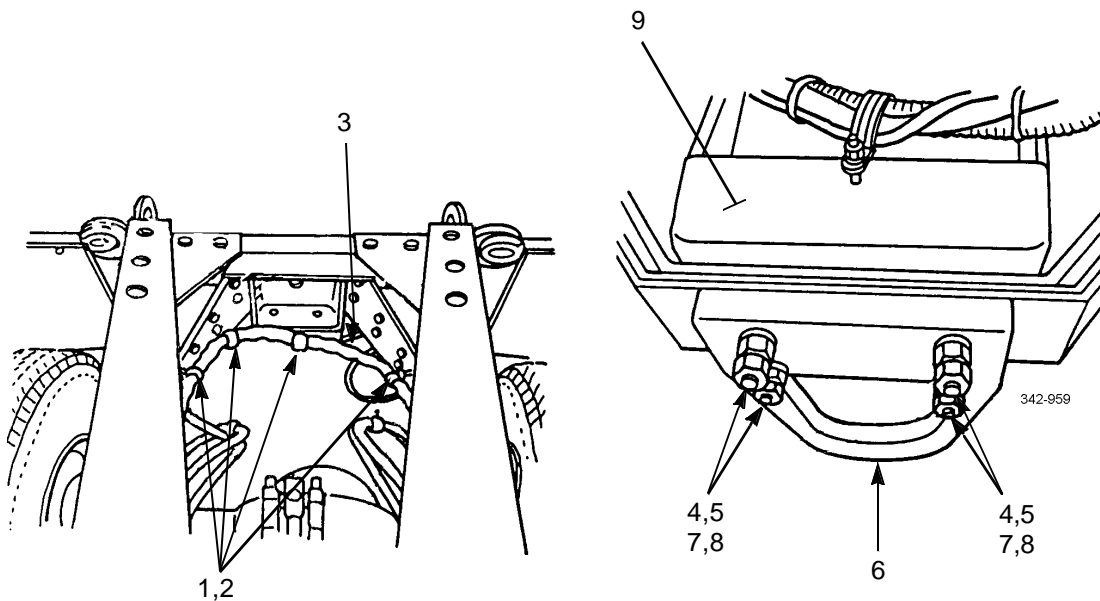
REMOVAL

1. Remove four lock nuts (1) and clamps (2) and set wiring harness (3) aside. Discard lock nuts.

NOTE

Vehicle may utilize huckbolts instead of screws and lock nuts. Replace all loose or damaged huckbolts with grade 8 screws and lock nuts.

2. Remove eight lock nuts (4), four washers (5), towing bracket (6), four screws (7), four washers (8), and reinforcement assembly (9). Discard lock nuts.



3. Remove five lock nuts (10), washers (11), screws (12), washers (13), two spacers (14), and left side gusset (15). Discard lock nuts.
4. Repeat step 3 for right side gusset (16).



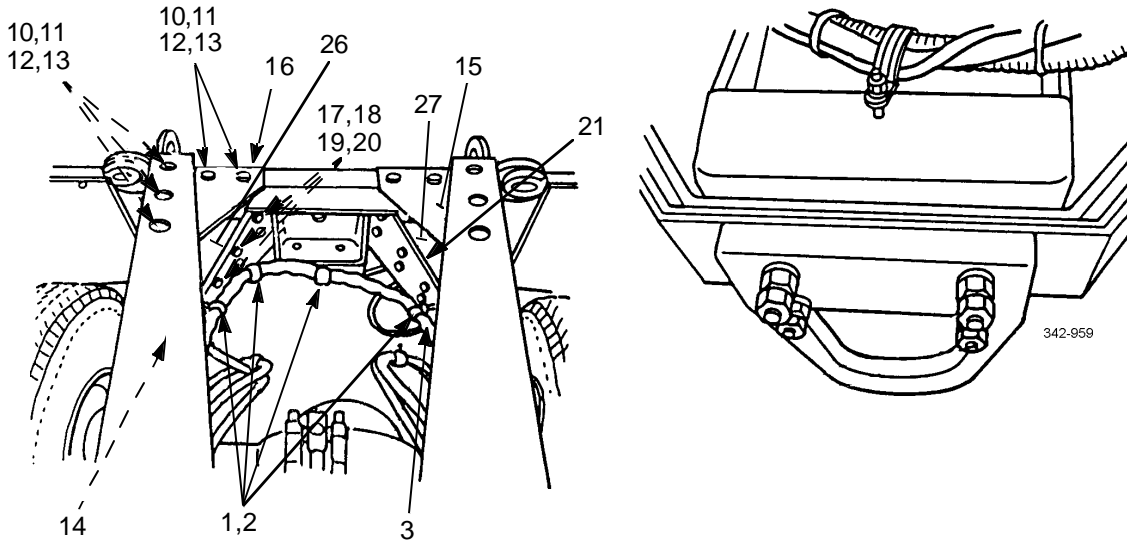
WARNING



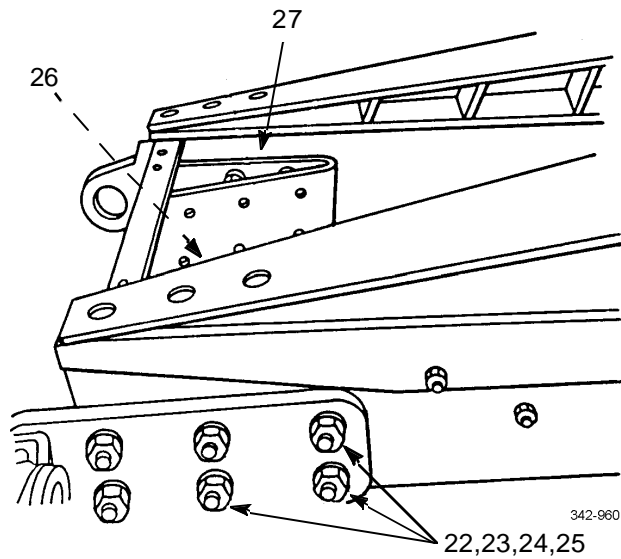
Plate weighs 96 lb (44 kg). Use hoist with lifting capacity of 200 lb (91 kg) to remove plate. Failure to do so could result in injury to personnel.

5. Attach hoist and remove 12 lock nuts (17), washers (18), screws (19), washers (20), and plate (21). Discard lock nuts.

REMOVAL - CONTINUED



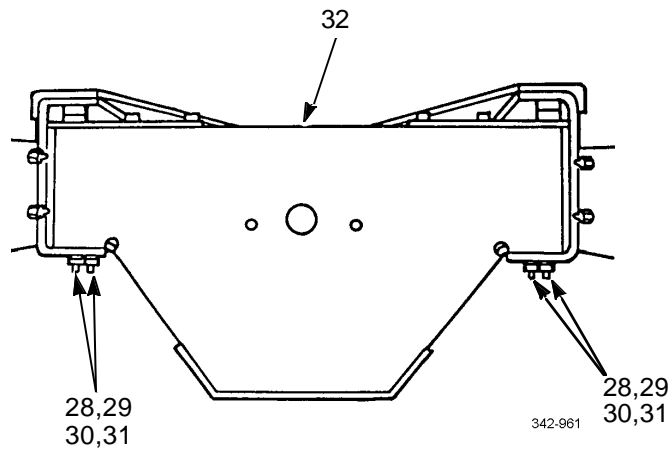
6. Remove four lock nuts (22), washers (23), screws (24), washers (25), and right side support (26). Discard lock nuts.
7. Repeat step 6 for left side support (27).



REMOVAL - CONTINUED**WARNING**

Rear crossmember weighs 460 lb (209 kg). Use hoist with lifting capacity of 600 lb (272 kg) to remove rear crossmember. Failure to do so could result in injury to personnel.

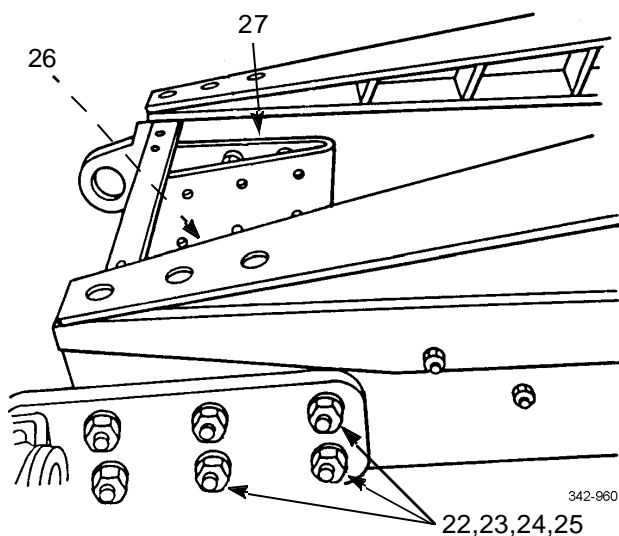
8. Attach hoist and remove four lock nuts (28), washers (29), screws (30), washers (31), and rear crossmember (32). Discard lock nuts.

**INSTALLATION****WARNING**

Rear crossmember weighs 460 lb (209 kg). Use hoist with lifting capacity of 600 lb (272 kg) to install rear crossmember. Failure to do so could result in injury to personnel.

1. Install rear crossmember (32) with four washers (31), screws (30), washers (29), and new lock nuts (28).
2. Install right side support (26) with four washers (25), screws (24), washers (23), and new lock nuts (22).
3. Repeat step 2 for left side support (27).

INSTALLATION - CONTINUED

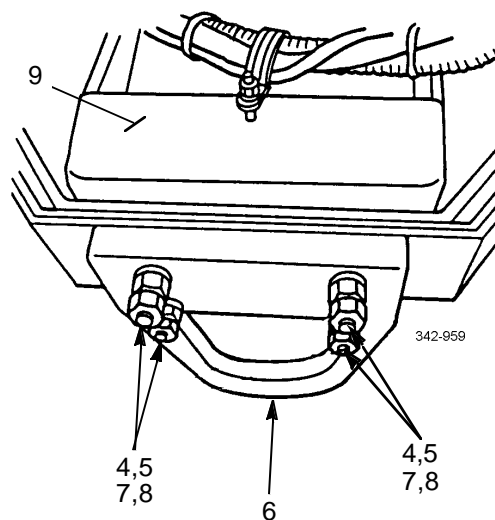
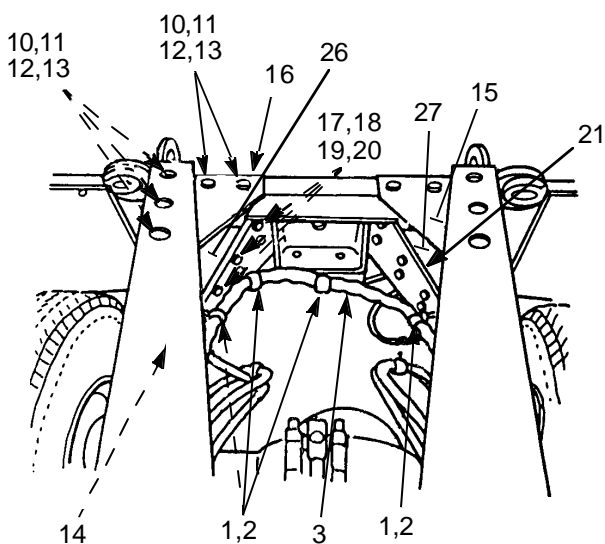


WARNING



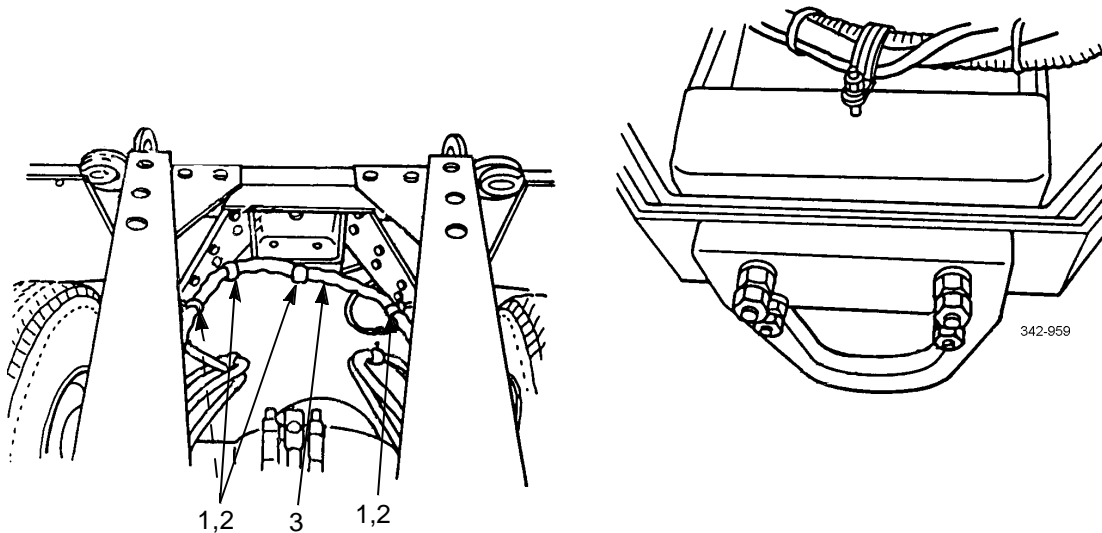
Plate weighs 96 lb (44 kg). Use hoist with lifting capacity of 200 lb (91 kg) to install plate. Failure to do so could result in injury to personnel.

4. Attach hoist and install plate (21) with 12 washers (20), screws (19), washers (18), and new lock nuts (17).
5. Install right side gusset (16), two spacers (14), five washers (13), screws (12), washers (11), and new lock nuts (10).
6. Repeat step 5 for left side gusset (15).
7. Install reinforcement assembly (9), four washers (8), screws (7), towing bracket (6), four washers (5), and eight new lock nuts (4).



INSTALLATION - CONTINUED

8. Move wiring harness (3) into position and install four clamps (2) and new lock nuts (1).

**NOTE**

Perform steps 9 through 12 for this and other crossmembers.

9. Tighten 1/2-13 grade 8 lock nuts to 68 lb-ft (92 Nm).
10. Tighten 5/8-11 grade 8 lock nuts to 136 lb-ft (184 Nm).
11. Tighten 3/4-10 grade 8 lock nuts to 241 lb-ft (327 Nm).
12. Tighten 1"-8 grade 8 lock nuts to 582 lb-ft (789 Nm).
13. Install pintle hook (TM 9-2320-302-20).
14. Install taillight brackets (TM 9-2320-302-20).

END OF WORK PACKAGE

FRONT CAB MOUNTS REPLACEMENT

0097 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Sling, beam type (Item 115, WP 0126 00)

Materials/Parts

Clamp, seal (P/N 04-19249-000)

Nut, lock (P/N MS51922-1) (4)

Materials/Parts - Continued

Nut, lock (P/N MS51922-17) (4)

Nut, lock (P/N MS51922-57)

Personnel Required

Two

Equipment Condition

Fender extension removed (TM 9-2320-302-20)



WARNING

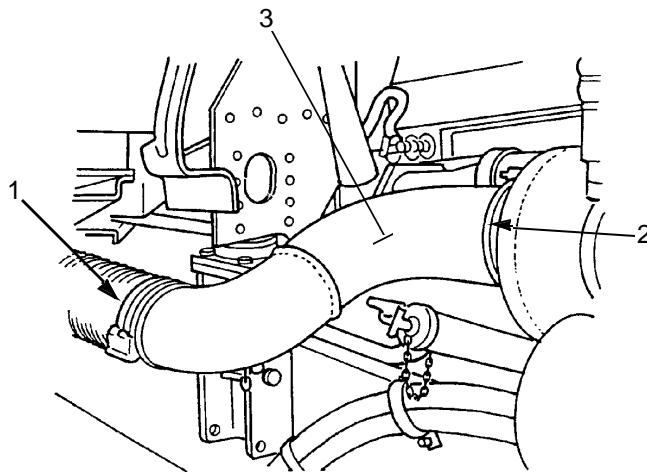


Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

REMOVAL

NOTE

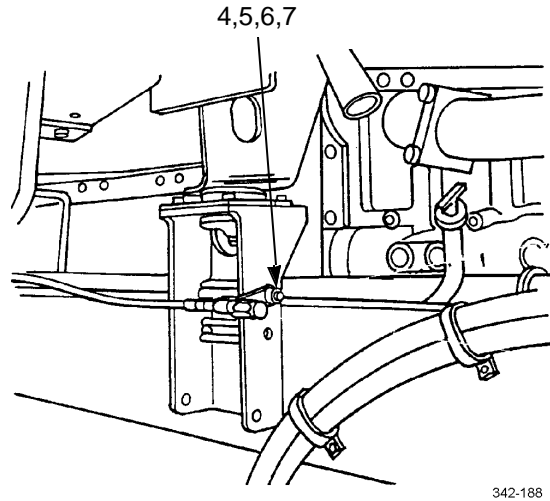
- Procedure is the same for both sides, except as noted.
 - Perform step 1 on right side.
1. Remove seal clamp (1), v-clamp (2), and outlet pipe (3). Discard seal clamp.



342-187

REMOVAL - CONTINUED

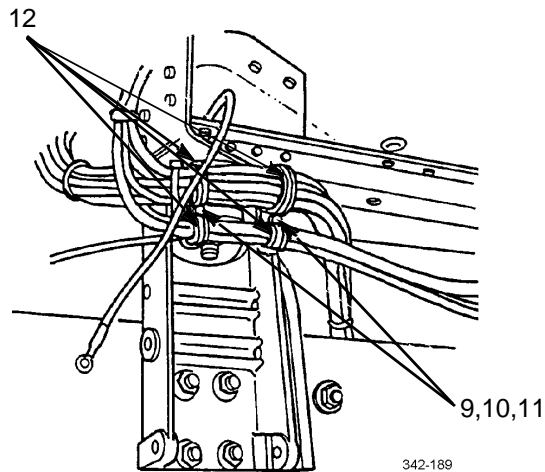
2. Remove nut (4), washer (5), bolt (6), and washer (7).



NOTE

Perform step 3 on left side.

3. Remove two lock nuts (9), washers (10), screws (11), and four clamps (12). Discard lock nuts.



REMOVAL - CONTINUED

NOTE

Perform step 4 on left side.

4. Remove lock nut (13), washer (14), and screw (15). Disconnect cable (16) and set aside. Discard lock nut.
5. Remove lock nut (17), washer (18), and resilient mount (19). Discard lock nut.

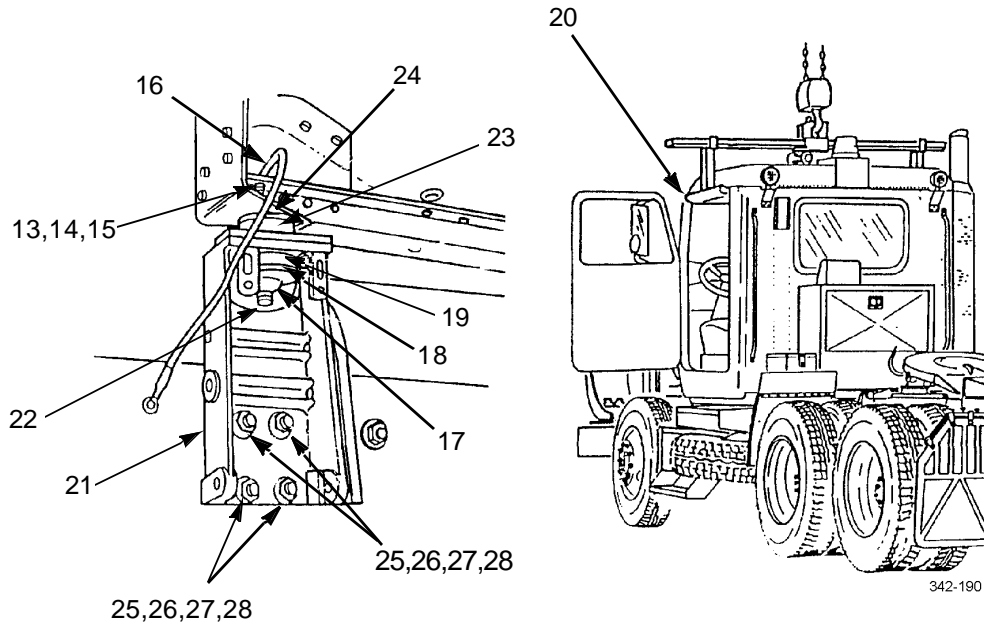


WARNING



Cab assembly weighs 1100 lb (499 kg). Use hoist with lifting capacity of 1400 lb (636 kg) to support cab assembly. Failure to do so could result in injury to personnel and/or damage to equipment.

6. Using cab sling and hoist, lift cab assembly (20) enough to remove all slack and not allow cab assembly to drop when front cab mounts (21) are removed.
7. Remove screw (22), washer (24), and bushing (23).
8. Remove four lock nuts (25), washers (26), screws (27), washers (28), and front cab mount (21). Discard lock nuts.

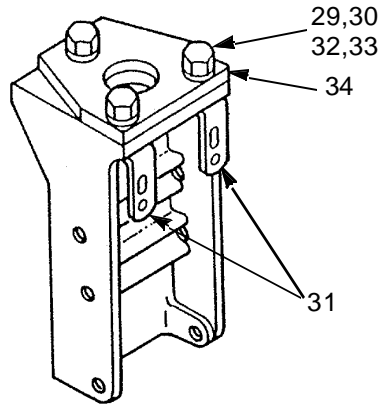


REMOVAL - CONTINUED

NOTE

Perform step 9 on left side.

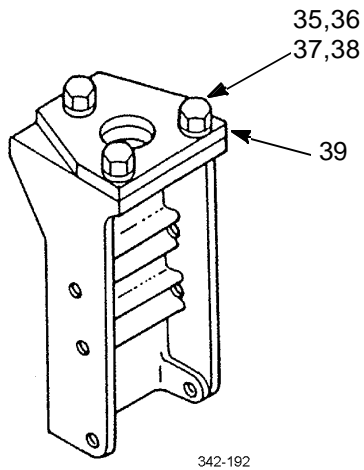
9. Remove three lock nuts (29), washers (30), two brackets (31), three screws (32), washers (33), and plate (34). Discard lock nuts.



NOTE

Perform step 10 on right side.

10. Remove three lock nuts (35), washers (36), screws (37), washers (38), and plate (39). Discard lock nuts.



INSTALLATION



WARNING



Cab assembly weights 1100 lb (499 kg). Use hoist with lifting capacity of 1400 lb (636 kg) to support cab assembly. Failure to do so could result in injury to personnel and/or damage to equipment.

NOTE

- Procedure is the same for both sides except as noted.
- Perform step 1 on right side.

1. Install plate (39), three washers (38), screws (37), washers (36), and new lock nuts (35).

NOTE

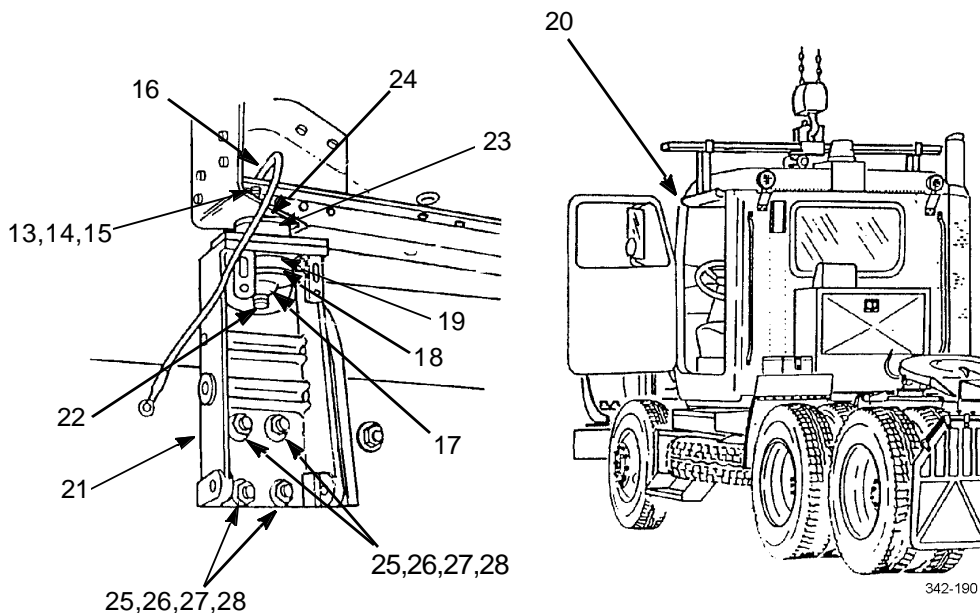
Perform step 2 on left side.

2. Install plate (34), three washers (33), screws (32), two brackets (31), three washers (30), and new lock nuts (29).
3. Install front cab mount (21) with four washers (28), screws (27), washers (26), and new lock nuts (25).
4. Install bushing (23), washer (24), and screw (22).
5. Install resilient mount (19), washer (18), and new lock nut (17).
6. Lower cab assembly (20) and remove cab sling and hoist.

NOTE

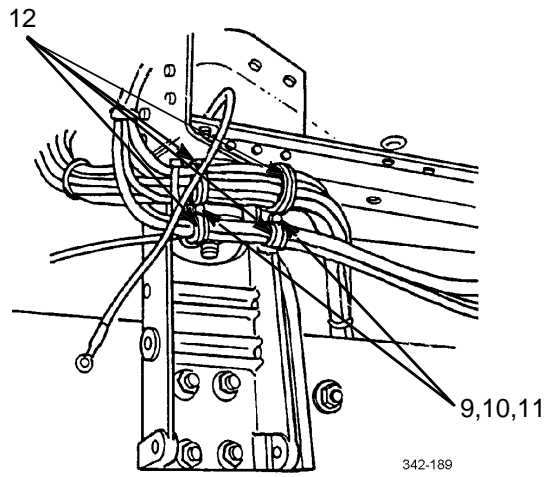
Perform steps 7 and 8 on left side.

7. Connect cable (16) and install screw (15), washer (14), and new lock nut (13).

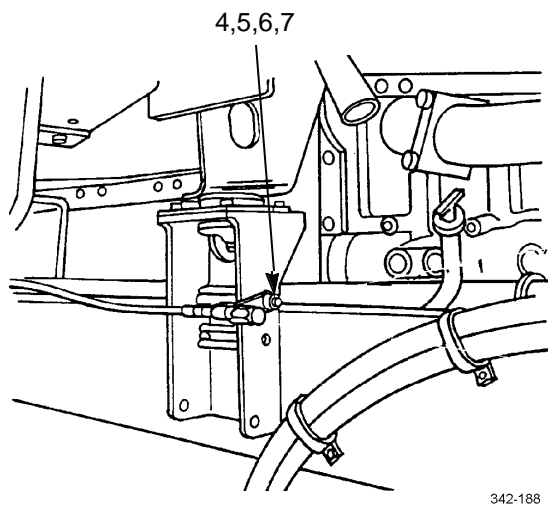


INSTALLATION - CONTINUED

8. Install four clamps (12) with two screws (11), washers (10), and new lock nuts (9).



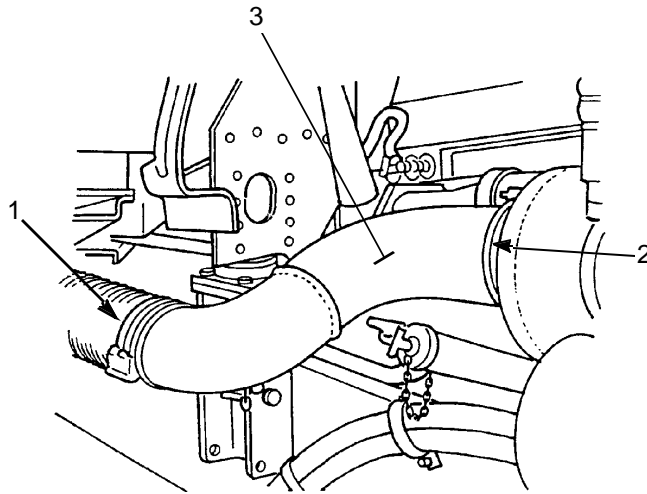
9. Install washer (7), bolt (6), washer (5), and nut (4).



INSTALLATION - CONTINUED**NOTE**

Perform step 10 on right side.

10. Install outlet pipe (3), v-clamp (2), and new seal clamp (1).
11. Install fender extension (TM 9-2320-302-20).



END OF WORK PACKAGE

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REAR CAB MOUNTS REPLACEMENT

0098 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Sling, beam type (Item 115, WP 0126 00)

Personnel Required

Two

Equipment Condition

Front cab mounts removed (WP 0097 00)

Materials/Parts

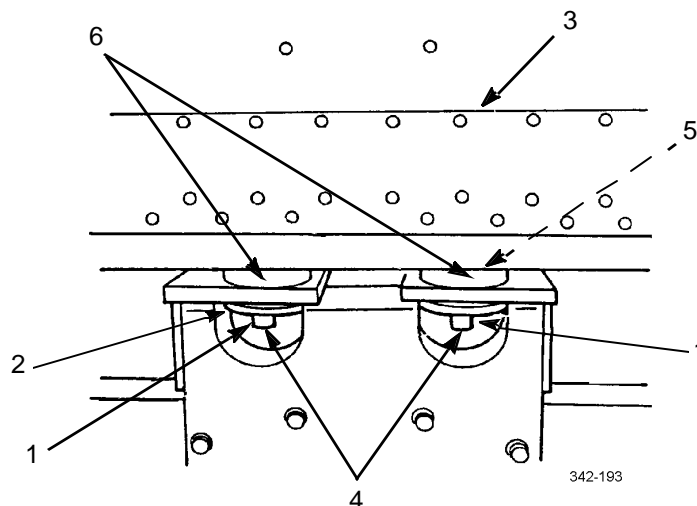
- Nut, lock (P/N MS51922-17) (8)
- Nut, lock (P/N MS51922-49) (2)



- Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.
- Cab assembly weighs 1100 lb (499 kg). Use hoist with lifting capacity of 1400 lb (636 kg) to support cab assembly. Failure to do so could result in injury to personnel and/or damage to equipment.

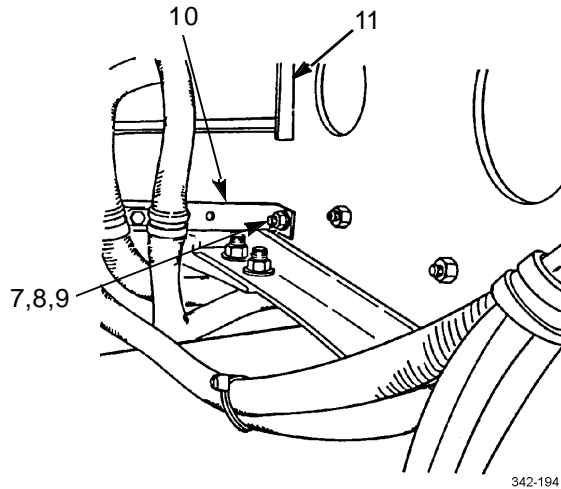
REMOVAL

1. Remove two lock nuts (1) and washers (2). Discard lock nuts.
2. Lift cab assembly (3) approximately 5 in (13 cm).
3. Remove two screws (4), washers (5), and resilient mounts (6).



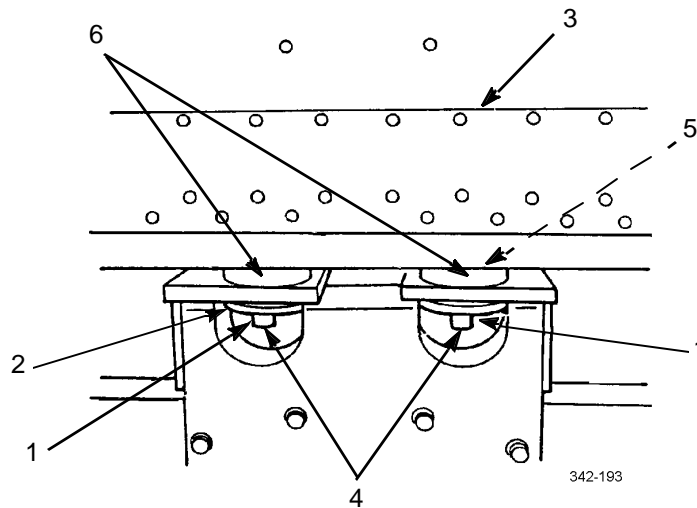
REMOVAL - CONTINUED.

4. Remove eight lock nuts (7), screws (8), washers (9), and bracket (10). Discard lock nuts.
5. Remove bracket (11).



INSTALLATION

1. Install bracket (11).
2. Install bracket (10) with eight washers (9), screws (8), and new lock nuts (7).
3. Install two resilient mounts (6), washers (5), and screws (4).
4. Lower cab assembly (3) and maintain just enough support to keep slack out of chain.
5. Install two washers (2) and new lock nuts (1).
6. Install front cab mounts (WP 0097 00).



END OF WORK PACKAGE

FRONT SPRING REPLACEMENT

0099 00

THIS WORK PACKAGE COVERSRemoval, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Jack, hydraulic (Item 73, WP 0126 00)

Trestle, hoist, portable (2) (Item 135, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Wrench, torque, 100-600 lb-ft (Item 140, WP
0126 00)Wrench set, socket, 3/4 in drive (Item 141, WP
0126 00)**Personnel Required**

Two

Equipment Condition

Front wheel removed (TM 9-2320-302-10)

Front shock absorber removed (TM 3-2320-302-20)

**WARNING**

Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

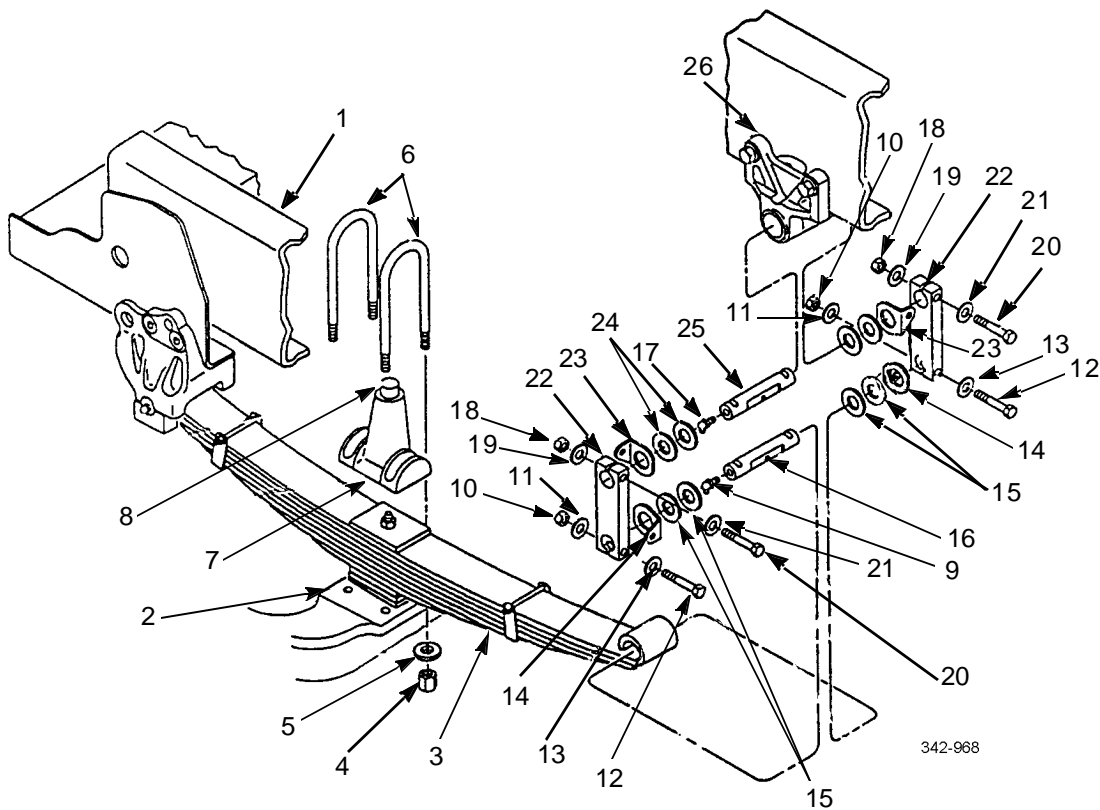
REMOVAL

- Using floor jack and two trestles, lift and support frame (1) and front axle (2) to relieve weight from spring (3).

NOTE

Axle stop is offset to one side to align with frame. Note position of axle stop prior to removal to aid in installation.

- Remove four nuts (4), washers (5), two U-bolts (6), and axle stop (7) from front axle (2) and spring (3).



- Remove stop cushion (8) from axle stop (7) if excessively worn or damaged (TM 9-2320-302-20).
- Remove grease fitting (9), two nuts (10), washers (11), screws (12), washers (13), wear plates (14), four shims (15), and pin (16) from rear end of spring (3).
- Remove grease fitting (17), two nuts (18), washers (19), screws (20), washers (21), shackles (22), wear plates (23), four shims (24), and pin (25) from rear spring hanger (26).

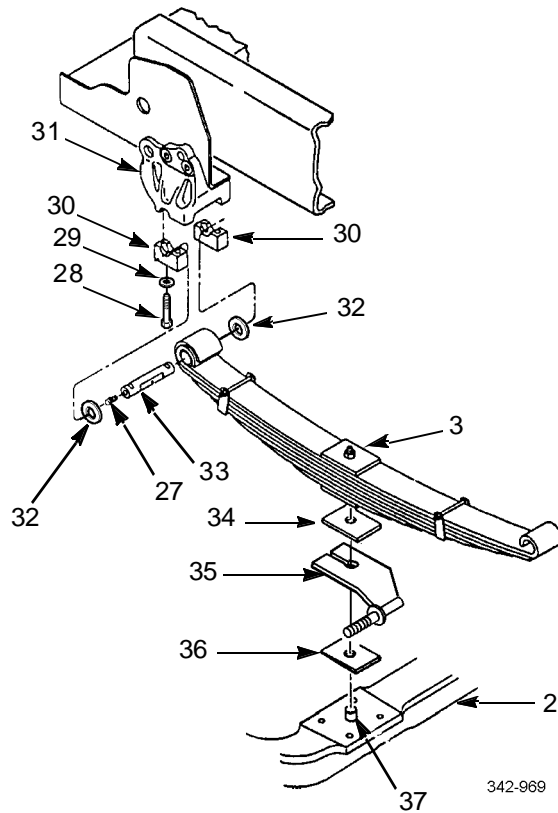
REMOVAL - CONTINUED

6. Remove grease fitting (27), four screws (28), washers (29), and two saddle caps (30).
7. Lower front axle (2) to allow spring (3) to clear front spring hanger (31). Remove two washers (32) and pin (33) from front of spring (3).

NOTE

Note position and number of shim(s) prior to removal to aid in installation.

8. With assistance, remove spring (3), spacer (34), shock absorber bracket (35), shim(s) (36), and pin (37) from front axle (2).



INSTALLATION

WARNING

Shim(s) is used to adjust caster alignment. Failure to install shim(s) correctly will cause hard steering and could result in injury to personnel.

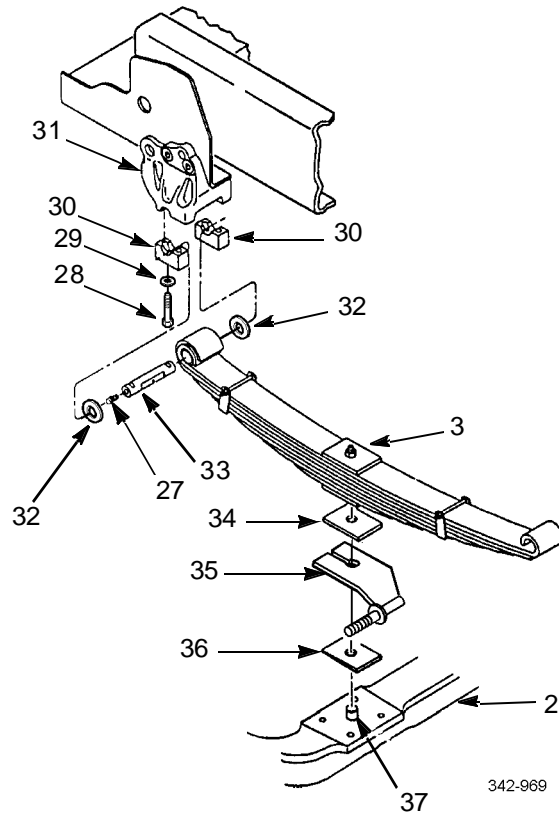
1. With assistance, install pin (37), shim(s) (2), shock absorber bracket (35), spacer (34), and spring (3) on front axle (2).

NOTE

Install pin so that grooves line up with holes in shackle, allowing screws to be installed.

INSTALLATION - CONTINUED

2. Install pin (33) and two washers (32) in spring (3).
3. Using floor jack, raise front axle (2) so that front end of spring (3) is positioned in front spring hanger (31). Install two saddle caps (30), four washers (29), screws (28), and grease fitting (27). Tighten screws to 50 lb-ft (68 Nm).



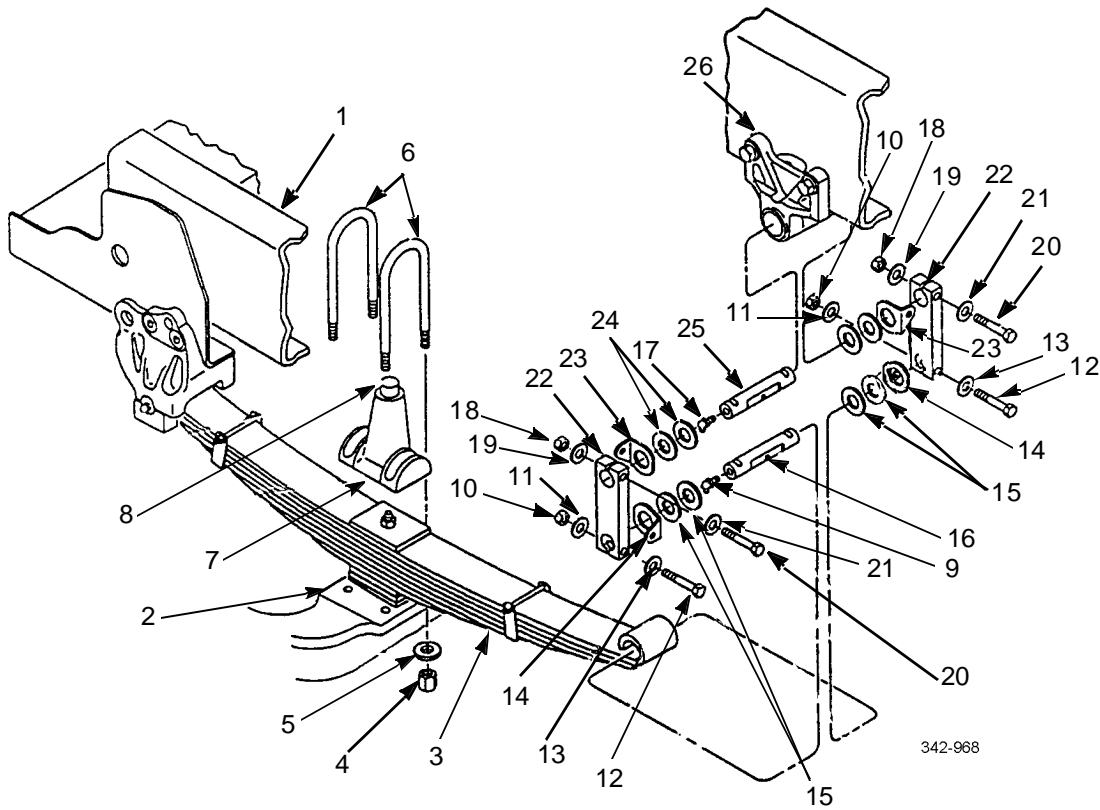
4. Install pin (25), four shims (24), two wear plates (23), shackles (22), washers (21), screws (20), washers (19), nuts (18), and grease fitting (17) in rear spring hanger (26).
5. Position spring (3) in two shackles (22) and install four shims (15), two wear plates (14), and pin (16).
6. Align grooves in pin (16) with holes in two shackles (22) and check end play. End play should be no more than 1/32 in (0.8 mm). Add shims (15) to correct end play. If possible, add same number of shims on each side of pin.
7. Install two washers (13), screws (12), washers (11), nuts (10), and grease fitting (9).

CAUTION

Incorrect installation of axle stop will cause damage to axle and frame during use.

8. Install axle stop (7) in position noted during removal. Install two U-bolts (6), four washers (5), and nuts (4). Tighten nuts to 380-460 lb-ft (515-624 Nm).
9. If removed, install stop cushion (8) in axle stop (7) (TM 9-2320-302-20).

INSTALLATION - CONTINUED



10. Install front shock absorber (TM 9-2320-302-20).

11. Install front wheel (TM 9-2320-302-10).

END OF WORK PACKAGE

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FRONT SPRING HANGERS REPLACEMENT

0100 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Equipment Condition

Front spring removed (WP 0099 00)

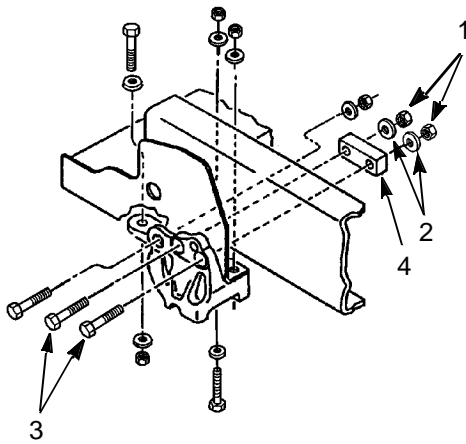
Steering gear removed (left side only) (WP 0088 00)

REMOVAL

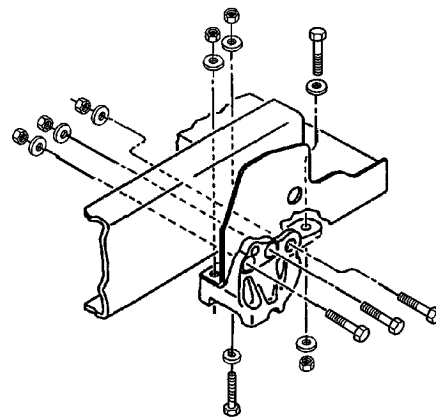
NOTE

- Vehicle may utilize huckbolts instead of screws and nuts. Replace all loose or damaged huckbolts with grade 8 screws and lock nuts.
- Perform steps 1 through 3 on left front side of vehicle.

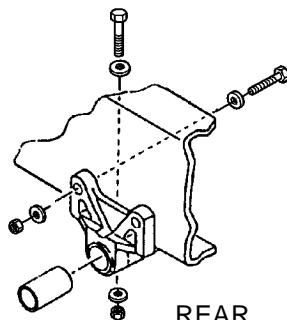
1. Remove two lock nuts (1), washers (2), screws (3), and threaded block (4). Discard lock nuts.



LEFT FRONT



RIGHT FRONT



REAR

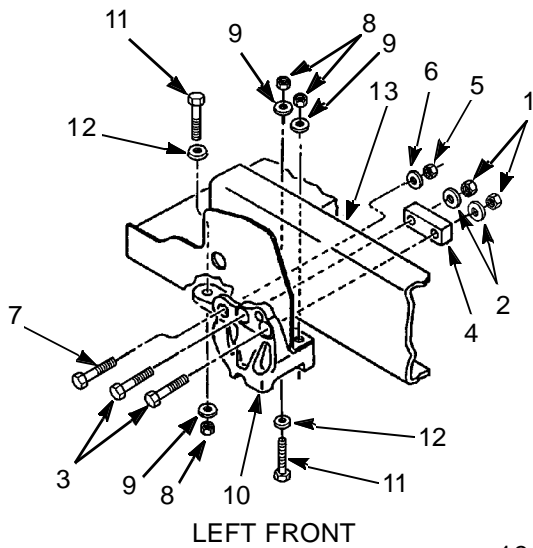
342-967

FRONT SPRING HANGERS REPLACEMENT - CONTINUED

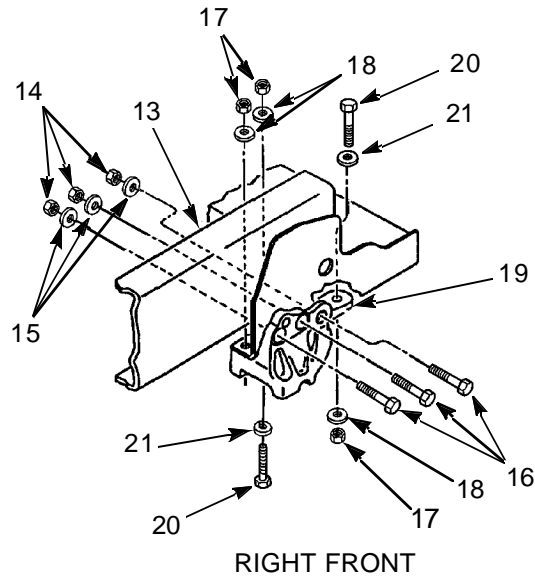
0100 00

REMOVAL - CONTINUED

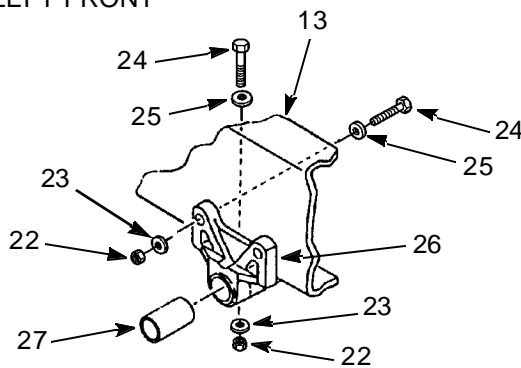
2. Remove lock nut (5), washer (6), and screw (7). Discard lock nut.
3. Remove three lock nuts (8), washers (9), left front spring hanger (10), three screws (11), and washers (12) from frame (13). Discard lock nuts.



LEFT FRONT



RIGHT FRONT



REAR

342-967

NOTE

Perform steps 4 and 5 on right front side of vehicle.

4. Remove three lock nuts (14), washers (15), and screws (16).
5. Remove three lock nuts (17), washers (18), right front spring hanger (19), three screws (20), and washers (21) from frame (13). Discard lock nuts.

NOTE

Perform steps 6 and 7 for rear spring hangers.

6. Remove four lock nuts (22), washers (23), screws (24), washers (25), and rear spring hanger (26) from frame (13). Discard lock nuts.
7. If damaged, remove bushing (27) from rear spring hanger (26).

INSTALLATION**NOTE**

Perform steps 1 and 2 for rear spring hangers.

1. If removed, install new bushing (27) in rear spring hanger (26).
2. Install four washers (25), screws (24), rear spring hanger (26), four washers (23), and new lock nuts (22) on frame (13).

NOTE

Perform steps 3 and 4 on right front side of vehicle.

3. Install three washers (21), screws (20), right front spring hanger (19), three washers (18), and new lock nuts (17) on frame (13).
4. Install three screws (16), washers (15), and new lock nuts (14).

NOTE

Perform steps 5 through 7 on left front side of vehicle.

5. Install three washers (12), screws (11), left front spring hanger (10), three washers (9), and new lock nuts (8).
6. Install screw (7), washer (6), and new lock nut (5).
7. Install threaded block (4), two screws (3), washers (2), and new lock nuts (1).
8. Tighten 1/2-13 grade 8 lock nuts to 80 lb-ft (108 Nm).
9. Tighten 5/8-11 grade 8 lock nuts to 160 lb-ft (217 Nm).
10. Install steering gear (left side only) (WP 0088 00).
11. Install front spring (WP 0099 00).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Jack, hydraulic (Item 73, WP 0126 00)
- Trestle, hoist, portable (2) (Item 135, WP 0126 00)
- Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Materials/Parts

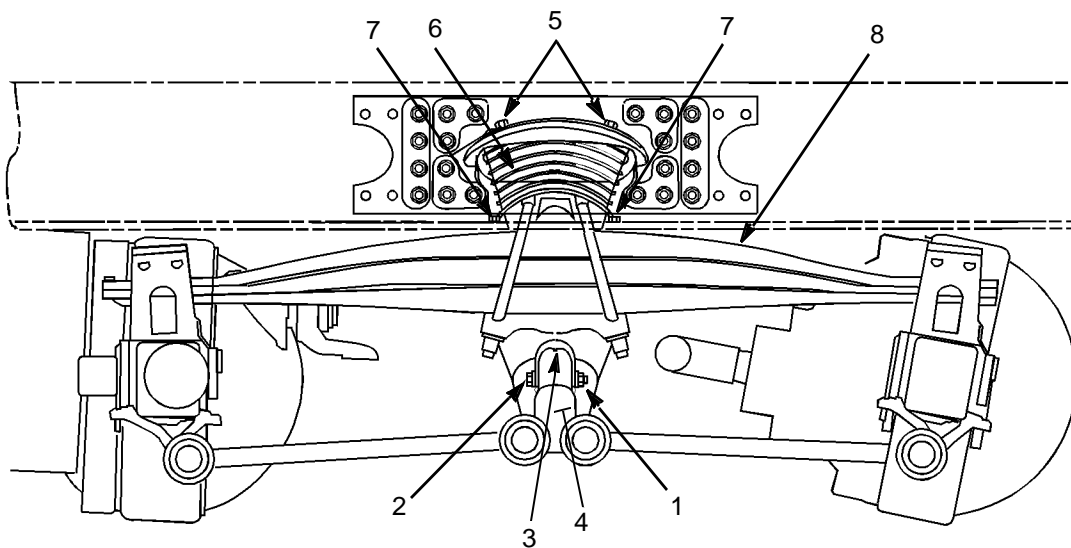
- Screw (P/N 23-12576-125) (2)
- Adhesive, loctite (Item 2, WP 0125 00)

Personnel Required

Two

REMOVAL

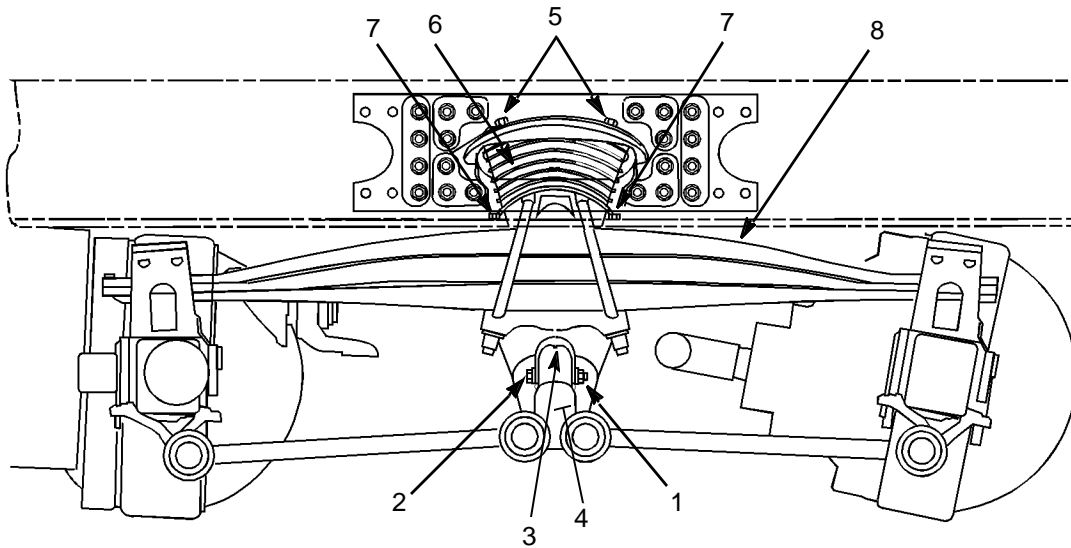
1. Remove nut (1), screw (2), and rebound stop (3) from mounting bracket (4).
2. Remove two screws (5) from center bearing (6).
3. Using floor jack, lift rear of vehicle and place a trestle under each frame rail. Lower vehicle onto trestles.
4. Remove two screws (7) and center bearing (6) from top of spring assembly (8). Discard screws.



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REAR SUSPENSION CENTER BEARING REPLACEMENT - CONTINUED**0101 00****INSTALLATION**

1. Install center bearing (6) to vehicle with two screws (5). Tighten screws to 68 lb-ft (92 Nm).
2. Using floor jack, raise rear axle until bottom of center bearing (6) contacts spring assembly (8).
3. Apply adhesive to threads of two new screws (7). Install center bearing (6) to top of spring assembly (8) with screws. Tighten screws to 155 lb-ft (210 Nm).
4. Remove trestles and floor jack.
5. Install rebound stop (3) to mounting bracket (4) with screw (2) and nut (1). Tighten nut to 68 lb-ft (92 Nm).



342-973

END OF WORK PACKAGE

REAR SPRING ASSEMBLY REPLACEMENT**0102 00****THIS WORK PACKAGE COVERS**

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Personnel Required

Two

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Jack, hydraulic (Item 73, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

References

TM 9-2320-302-10

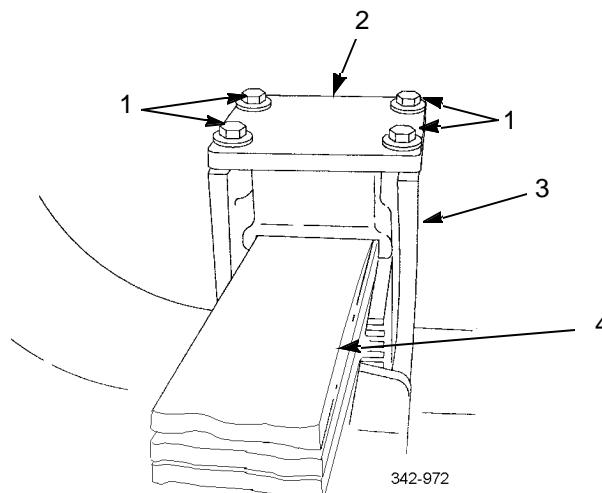
TM 9-2320-302-20

**WARNING**

Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

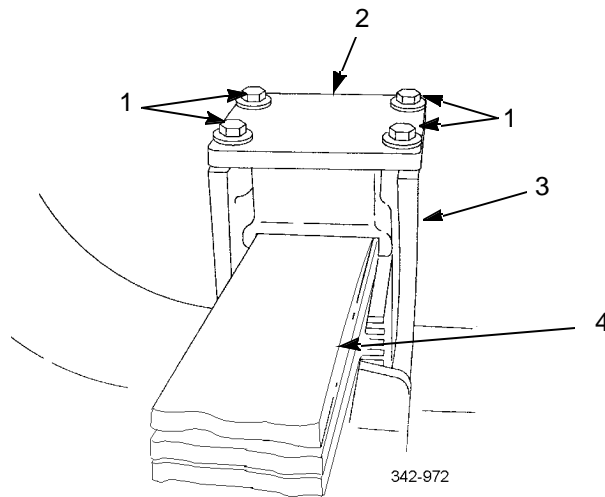
REMOVAL

1. Remove four screws (1) and top pad (2) from each of two axle clamps (3).
2. Remove rear suspension center bearing (WP 0101 00).
3. With rear of vehicle still raised, remove wheels (TM 9-2320-302-10).
4. Using a suitable lifting device, remove rear spring assembly (4) from vehicle.



INSTALLATION

1. Using a suitable lifting device, position rear spring assembly (4) to vehicle.
2. Install rear suspension center bearing (WP 0101 00).
3. Install top pad (2) to each of two axle clamps (3) with four screws (1). Tighten screws to 37 lb-ft (50 Nm).



4. Install wheels (TM 9-2320-302-10).
5. Tighten wheel lug nuts (TM 9-2320-302-20).

END OF WORK PACKAGE

REAR SUSPENSION CONTROL ROD AND V-ROD REPLACEMENT

0103 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Jack, hydraulic (Item 73, WP 0126 00)

Trestle, hoist, portable (2) (Item 135, WP 0126 00)

Tools and Special Tools - Continued

Wrench, torque, 50-250 lb-ft (Item 139, WP 0126 00)

Wrench, torque, 100-600 lb-ft (Item 140, WP 0126 00)

Wrench set, socket, 3/4 in drive (Item 141, WP 0126 00)

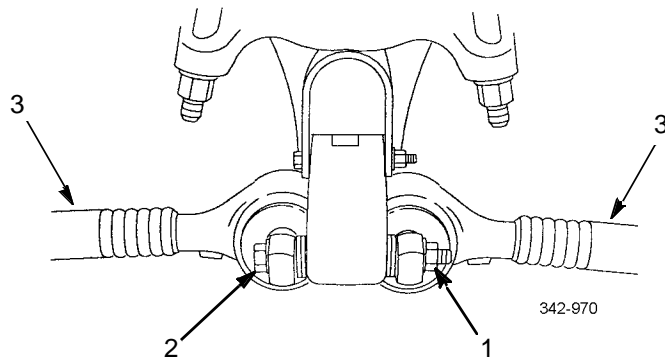
Personnel Required

Two

REMOVAL

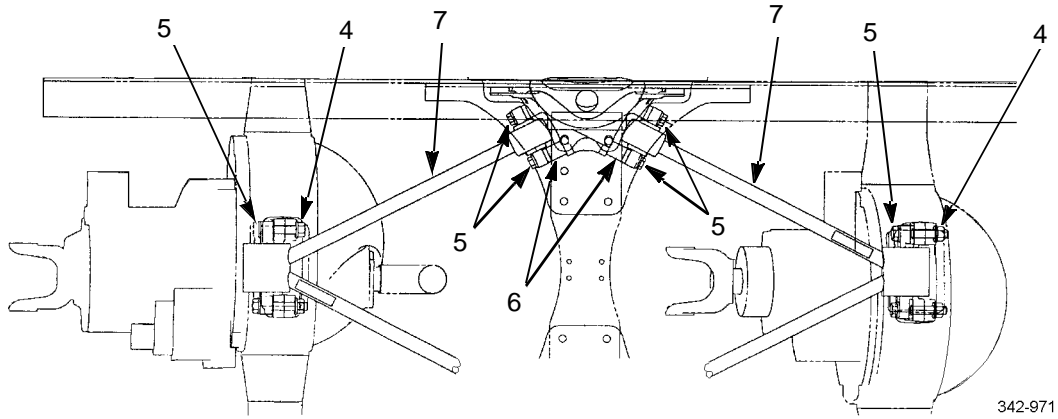
NOTE

- To remove control rods, perform steps 1 and 2.
 - To remove V-rods, perform steps 1 and 3.
1. Using floor jack, lift rear of vehicle and place a trestle under each frame rail. Lower vehicle onto trestles.
 2. Remove four nuts (1), screws (2), and two control rods (3) from vehicle.



REMOVAL - CONTINUED

- Remove two nuts (4), six screws (5), spacers (6), and two V-rods (7) from vehicle.



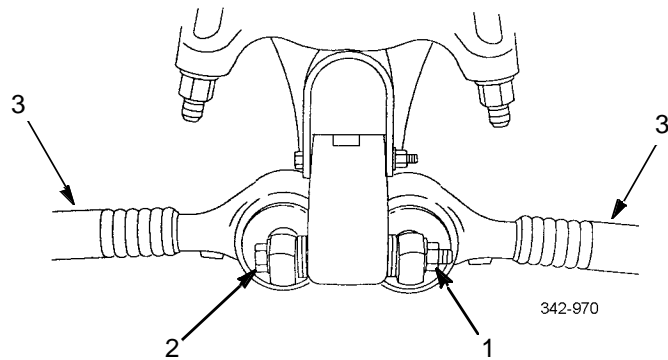
342-971

INSTALLATION

NOTE

- To install V-rods, perform steps 1 through 3 and 5.
- To install control rods, performs steps 4 and 5.
- When installing V-rods, ensure labels on rods are facing upward. Forward V-rods are marked "FDA". Rear V-rods are marked "RDA".

- Position two V-rods (7) to vehicle and loosely install spacers (6), six screws (5), and two nuts (4).
- Tighten four screws (5) at frame bracket to 136 lb-ft (184 Nm).
- Tighten nut (4) at each axle bracket to 427 lb-ft (579 Nm).
- Install two control rods (3) to vehicle with four screws (2) and nuts (1). Tighten nuts to 136 lb-ft (184 Nm).



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- Remove trestles and floor jack.

END OF WORK PACKAGE

CAB REPLACEMENT

0104 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Sling, beam type (Item 115, WP 0126 00)

Materials/Parts

Nut, kep

Nut, lock (P/N MS51922-49) (2)

Nut, lock (P/N MS51922-57) (2)

Personnel Required

Three

Equipment Condition

Cab doors removed (WP 0107 00)

Muffler and exhaust stack removed (TM 9-2320-302-20)

Exterior grabhandles removed (TM 9-2320-302-20)

Fender extensions removed (TM 9-2320-302-20)

Hood latches removed (TM 9-2320-302-20)

Utility lights removed (TM 9-2320-302-20)

Clearance lights removed (TM 9-2320-302-20)

Windshield wiper linkage removed (TM 9-2320-302-20)

Voltage regulator removed (TM 9-2320-302-20)

Dual voltage alternator control (DUVAC) removed (TM 9-2320-302-20)

Starter regulator removed (TM 9-2320-302-20)

Foot brake valve removed (TM 9-2320-302-20)

Rear window removed (WP 0110 00)

Windshield removed (WP 0109 00)

Radio mounting bracket removed (TM 9-2320-302-20)

Equipment Condition - Continued

Transmission shift control removed (TM 9-2320-302-20)

Floor mats removed (TM 9-2320-302-20)

Arctic heater removed (TM 9-2320-302-20)

Cab air ducts removed (WP 0111 00)

Head liners removed (TM 9-2320-302-20)

Beacon warning light bracket removed (TM 9-2320-302-20)

Sunvisors removed (TM 9-2320-302-20)

Air horn and valve removed (TM 9-2320-302-20)

Interior grabhandle removed (TM 9-2320-302-20)

Cab liners removed (TM 9-2320-302-20)

Electronic throttle removed (TM 9-2320-302-20)

Steering column support bracket removed (TM 9-2320-302-20)

Brake pedal removed (TM 9-2320-302-20)

Cab overhead wiring harness removed (TM 9-2320-302-20)

Chassis wiring harness removed (TM 9-2320-302-20)

Air tubes removed (TM 9-2320-302-20)

Anti-lock brake system (ABS) electronic control unit removed (TM 9-2320-302-20)

Anti-lock brake system (ABS) fuse and relay panel removed (TM 9-2320-302-20)

Cab anti-lock brake system (ABS) wiring harness removed (TM 9-2320-302-20)

Collision Warning System (CWS) wiring harness removed (WP 0066 00)



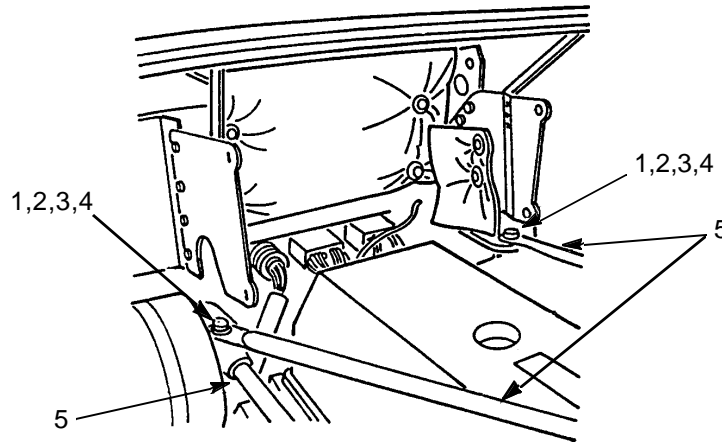
WARNING



Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

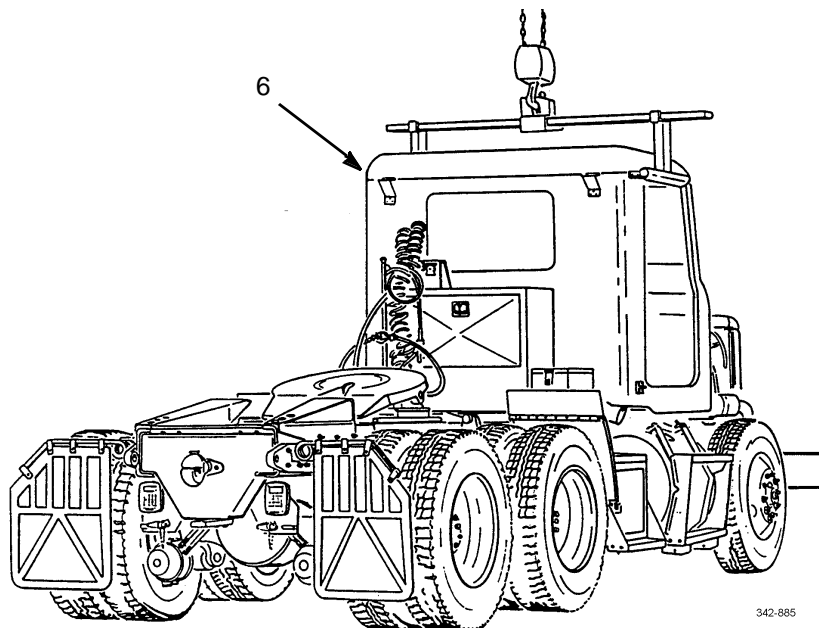
REMOVAL

1. Remove two nuts (1), washers (2), bolts (3), and washers (4) and swing three radiator support rods (5) out of the way.



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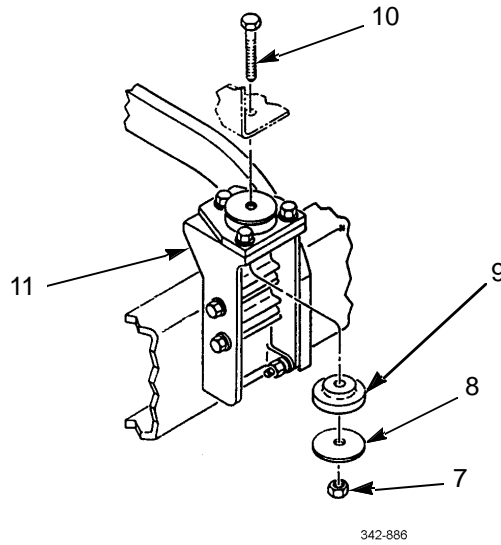
2. Attach sling and hoist to cab assembly (6). Remove all slack from chain.



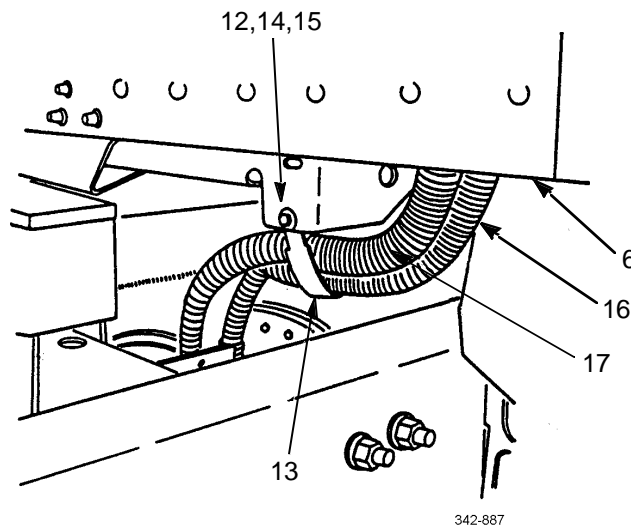
342-885

REMOVAL - CONTINUED

3. Remove two lock nuts (7), washers (8), resilient mounts (9), and screws (10) from front cab mounts (11). Discard lock nuts.

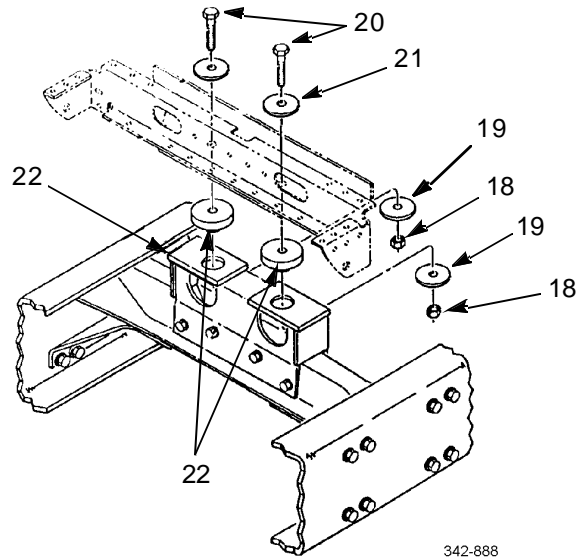


4. Remove kee nut (12), clamps (13), screw (14), and washer (15). Discard kee nut.
5. Carefully pull two wiring harnesses (16 and 17) from cab assembly (6).



REMOVAL - CONTINUED

- Remove two lock nuts (18), washers (19), screws (20), washers (21), and resilient mounts (22) from rear cab mount (23). Discard lock nuts.



WARNING



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CAUTION

Lift cab assembly slowly and check for parts that may still be connected to cab and vehicle structure. Failure to do so may result in damage to equipment.

- Remove cab assembly (6) from frame structure.

INSTALLATION



WARNING



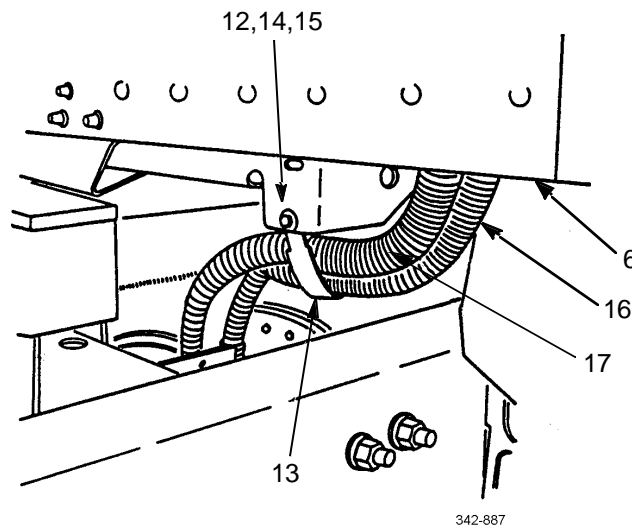
Use extreme caution when handling heavy parts. Provide adequate support and use assistance during procedure. Ensure that any lifting device used is in good condition and of suitable load capacity. Keep clear of heavy parts supported only by lifting device. Failure to follow this warning may result in death or injury to personnel.

INSTALLATION - CONTINUED

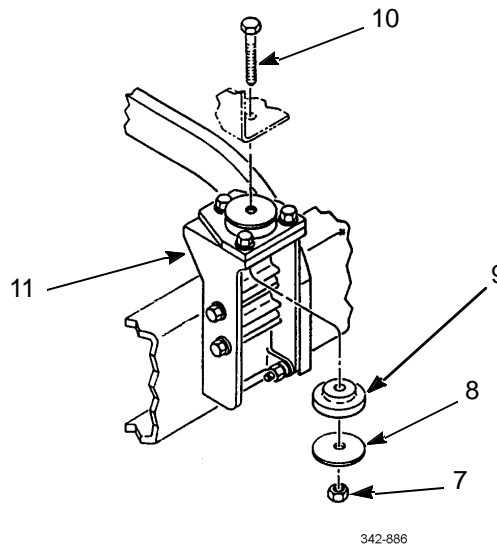
CAUTION

Check underside of cab assembly as it is lowered in place. Make sure nothing is between cab and frame structure. Failure to do so may result in damage to equipment.

1. Attach sling and hoist to cab assembly (6). Position cab assembly on frame structure.
2. Install two resilient mounts (22), washers (21), screws (20), washers (19), and new lock nuts (18) in rear cab mount (23).
3. Carefully install two wiring harnesses (16 and 17) in cab assembly (6). Secure with washer (15), screw (14), and new kep nut (12).

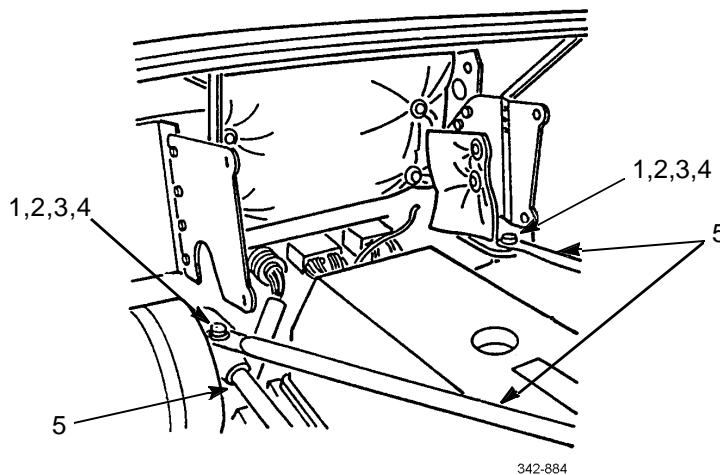


4. Install two screws (10), resilient mounts (9), washers (8), and new lock nuts (7) in front cab mounts (11).



INSTALLATION - CONTINUED

5. Remove sling and hoist from cab assembly (6).
6. Swing three radiator support rods (5) into place and install two washers (4), bolts (3), washers (2), and nuts (1).



7. Install Collision Warning System (CWS) wiring harness (WP 0066 00).
8. Install cab anti-lock brake system (ABS) wiring harness (TM 9-2320-302-20).
9. Install anti-lock brake system (ABS) fuse and relay panel (TM 9-2320-302-20).
10. Install anti-lock brake system (ABS) electronic control unit (TM 9-2320-302-20).
11. Install air tubes (TM 9-2320-302-20).
12. Install chassis wiring harness (TM 9-2320-302-20).
13. Install cab overhead wiring harness (TM 9-2320-302-20).
14. Install brake pedal (TM 9-2320-302-20).
15. Install steering column support bracket (TM 9-2320-302-20).
16. Install electronic throttle (TM 9-2320-302-20).
17. Install cab liners (TM 9-2320-302-20).
18. Install interior grabhandle (TM 9-2320-302-20).
19. Install sunvisors (TM 9-2320-302-20).
20. Install head liners (TM 9-2320-302-20).
21. Install arctic heater (TM 9-2320-302-20).
22. Install transmission shift control (TM 9-2320-302-20).
23. Install air horn and valve (TM 9-2320-302-20).
24. Install beacon warning light bracket (TM 9-2320-302-20).
25. Install cab air ducts (WP 0111 00).
26. Install floor mats (TM 9-2320-302-20).
27. Install radio mounting bracket (TM 9-2320-302-20).
28. Install windshield (WP 0109 00).
29. Install rear window (WP 0110 00).

INSTALLATION - CONTINUED

30. Install foot brake valve (TM 9-2320-302-20).
31. Install starter regulator (TM 9-2320-302-20).
32. Install dual voltage alternator control (DUVAC) (TM 9-2320-302-20).
33. Install voltage regulator (TM 9-2320-302-20).
34. Install windshield wiper linkage (TM 9-2320-302-20).
35. Install clearance lights (TM 9-2320-302-20).
36. Install utility lights (TM 9-2320-302-20).
37. Install hood latches (TM 9-2320-302-20).
38. Install fender extensions (TM 9-2320-302-20).
39. Install exterior grabhandles (TM 9-2320-302-20).
40. Install muffler and exhaust stack (TM 9-2320-302-20).
41. Install cab doors (WP 0107 00).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

General, Inspection, Rivet Replacement, Aluminum Repair

INITIAL SETUP

Maintenance Level

General Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Drill, electric, portable (Item 31, WP 0126 00)
- Drill set, twist (Item 32, WP 0126 00)
- Riveter, blind hand (Item 109, WP 0126 00)

Materials/Parts

- Compound, sealing (Item 14, WP 0125 00)
- Tool kit, body and fender repair (Item 39, WP 0125 00)

GENERAL

1. The body is constructed from aluminum alloys that have been heat treated to obtain high strength. Welding cannot be used to make body repairs. Heat generated in welding will reverse the heat treatment process and cause a great reduction in strength of material.
2. The hood is made of SMC (sheet molding compound). Cracks, splits or holes may be repaired with a glass-reinforced plastic laminate repair kit (WP 0106 00).
3. Solid 3/16-in diameter aluminum rivets are the primary method of joining body components. Rivets are inserted into a hole through two pieces of metal. A second head is formed by manual or pneumatic impacting or by squeezing the rivet. A bucking bar is used to back up the rivet to form the rivet head. When making repairs, use blind rivets of the same size or oversize diameter with the appropriate grip length.
4. Blind structural aluminum rivets of 3/16-in diameter are used in applications where there is access from only one side of the part. Blind rivets are installed using a tool that pulls on the rivet stem causing a bulbed head to form on the back side of the part. Fastening is complete when the stem breaks off. High strength is obtained in blind structural rivets by mechanically locking the remaining stem inside the rivet body.
5. Steel pull-type lock bolt fasteners in 3/16 and 1/4-in diameters are used where tension or high-shear loads exist. Lock bolts are two-piece unthreaded fasteners. One part is a high-strength, steel-headed bolt-like part with serrations on its shank. The mating part is a collar that is swaged over the serrations causing the fastener to be locked in place.
6. To facilitate repairs to the body, it is acceptable to replace lock bolts and rivets with 1/4 in AN4 series bolts. Do not replace lock bolts with rivets. Standard threaded fasteners should not be used, as these will quickly wear the aluminum structure. Bolt lengths should be chosen so that the cylindrical portion of the bolt is bearing on all members being joined. Bolts are designated as NA4-XX or AN4C-XX, where XX defines grip length. Tighten all bolts to 70-75 lb-in (8 Nm).
7. All riveted joints have adhesive foam between both components riveted together. The purpose of this tape is to ensure watertight joints and to ensure aluminum components will not wear prematurely. Tape may be either 1 in or 2 in wide, depending on the joint. Replace adhesive tape with the same size removed during disassembly. The only time adhesive foam tape is to be replaced is if a riveted joint is completely taken apart.

INSPECTION

1. **General.** The damaged area should be thoroughly cleaned and inspected to determine cause and extent of damage. Body parts should be inspected for holes, cracks, dents, distortion or breaks. Fasteners should be inspected for breaks, stretching, looseness, cocked heads or hole elongation. Seams, flanges, and joints should be inspected for straightness or local deformation as an indication that fasteners may have been stretched or holes elongated. It is possible for this to happen and for fasteners to still appear to be tight in their holes. In addition, make a thorough inspection of adjacent areas to determine if high loads have been transmitted from the damaged area to other areas. This can result in secondary damage in the form of distorted panels or seams, loosened or sheared fasteners, elongated fastener holes, and cracks.
2. **Classification.** After extent of damage has been determined, affected parts should be classified in one of the following categories:
 - Negligible Damage
 - Damage Repairable by Patching
 - Damage Repairable by Insertion
 - Damage Necessitating Replacement of Parts
 - a. **Negligible Damage.** Minor dents, nicks, scores, cracks, and holes in body panels which are within or are brought within reasonable limits by a simple procedure without extensive rework. These defects should be considered more serious if located in main structural members such as body side rails, a pillar or floor crossmembers rather than in body panels such as cowls or rear wheelhouses. Deep wrinkles of undetermined origin in body panels should not be classed as negligible until the source of wrinkles has been investigated and positively identified. Damage other than small dents, holes, nicks, and scratches will require repair or replacement of the part. Refer to repair of negligible damage below.
 - (1) **Negligible Cracks.** Isolated cracks less than 0.50 in (1.27 cm) long may be classified as negligible cracks provided they are stop drilled at each end to stop propagation.
 - (2) **Negligible Holes.** Isolated holes no more than 0.50 in (1.27 cm) diameter after they are made round with smooth edges are classified as negligible holes, provided the distance from the edge of the hole to the nearest line of rivets exceeds the diameter of the hole.
 - (3) **Negligible Dents and Distortion.** Small dents and distorted areas may be classified as negligible, if they can be repaired by hammering or bending without causing the material to crack. Heat may not be used for reforming.
 - b. **Damage Repairable by Patching.** Damage beyond negligible must be repaired or the section replaced. Patches can often be applied over damaged body panels. Damaged area must first be trimmed to remove sharp edges or notches that could cause start of new cracks. Patch must then be sized to overlap the area to allow for attaching rivets. Refer to *Repair by Patching* on page 0105 00-12.
 - c. **Damage Repairable by Insertion.** In certain cases, patch repairs may not be desirable because of impracticality or because a flush surface is desired. In this case, damaged area must be cut away and a partial replacement of equivalent material inserted flush with adjacent areas and backed up with a doubler. Refer to *Repair by Insertion* on page 0105 00-13.
 - d. **Damage Necessitating Replacement of Parts.** Parts are too badly damaged for repair, or replacement is easier than repair; repair for welded assemblies such as body mounts. Welded assemblies cannot be rewelded without destroying their strength and must be replaced.

INSPECTION - CONTINUED

3. **Rivet Failure.** Signs of rivet failure include tipped heads, looseness, and chipped or cracked paint. If heads are tipped in the same direction and rivets are loose in consecutive groups, the joint has undergone excessive load. Rivet heads that are tipped in different directions and are not in groups may be improperly installed. With chipped or cracked paint, it may be necessary to remove paint to check true condition of rivets. Rivets subjected to critical loads, but showing no distortion, should be inspected if failure is suspected. The head should be drilled off, and the shank should be carefully punched out. Failure is indicated by notched rivet shank and misaligned holes. Flush rivets showing head slippage within the dimple or countersink indicate either sheet bearing or rivet shear failure and must be removed for inspection and replacement. If failure of rivets cannot be detected by visual inspection, the joint can be checked by drilling and punching out several rivets. If rivet shanks are notched, rivets should be replaced with next larger size rivets. If rivet holes show elongation due to local failure in tearing of the sheet, next larger size rivet must be used in replacement. Any deformation of the sheet around rivet, tear outs or cracks between rivets usually indicates partially failed or damaged rivets. Complete repair of the joint will require replacement by the next larger size rivets. Use the next 1/32-in larger diameter rivet to obtain a tight joint when original hole has been enlarged. If original size rivet is installed, rivet will not be able to carry its share of shear load, and the joint will not meet its strength requirements.
4. **Lock Bolt Failure.** Lock bolts are used to withstand tension loads and high-shear loads. These fasteners are installed in holes with an interference fit. No looseness can be permitted. Lock bolts showing evidence of being stretched, broken, loose in holes or having heads that do not set flat against the surface must be replaced. Guidelines used in *Rivet Failure*, above, for detecting rivet failures also apply to lock bolts.

RIVET REPLACEMENT**NOTE**

When removing rivets, be careful not to enlarge rivet holes. This will require use of an oversize or larger rivet for replacement.

1. **Solid Rivet Removal.**
 - a. File flat surface on manufactured head, if accessible. It is always preferable to work on manufactured head rather than a head that is bucked over. Manufactured head will always be more symmetrical around shank.
 - b. Indent center of filed surface with center punch.

CAUTION

Use drill slightly smaller than diameter of rivet shank to avoid making rivet hole oversized.

- c. Using drill slightly smaller than diameter of rivet shank, drill through rivet head.
 - d. Support back of rivet using sharp chisel. Cut rivet head along direction of rivet line or panel edge to prevent distortion of panel and shear off weakened rivet head.
 - e. Support panel from opposite side and drive out shank with pin punch. If rivet is unduly tight because of swelling between sheets, drill rivet shank out with undersize drill.
2. **Blind Rivet Removal.**
 - a. File small flat on rivet head.
 - b. Center punch flat. Support rivet backside, if possible.
 - c. Using small drill about the size of rivet pin, drill off tapered end of pin that forms lock.
 - d. Shear lock using pin punch to drive out pin.
 - e. Pry out remainder of locking collar.
 - f. Using drill slightly smaller than rivet shank, drill almost through rivet head.

RIVET REPLACEMENT - CONTINUED

- g. Pry off rivet head with pin punch.
- h. Tap out rivet shank with pin punch.

3. **Lock Bolt Removal.**

NOTE

If lock bolt head is inaccessible, locking collar must be removed. Remove collars by grinding or splitting collars axially with sharp chisel.

- a. Work from head side of lock bolt, if accessible. File small flat on head, if rounded.
- b. Center punch head.
- c. Using hardened drill slightly smaller than bolt head, drill through head. In cases where lock bolts are too hard to be drilled with available drills, grind head down using cutoff wheel or carbide bit in die grinder. When using grinder method, cut head down until very thin, but do not grind completely off or touch body part with grinding tool.
- d. Support head and use pin punch to pry off head or shear off with sharp chisel.

CAUTION

Be careful not to distort lock bolt or lock bolt hole to prevent damage to equipment.

- e. Drive lock bolt out of hole with pin punch.

4. **Rivet Hole Drilling.**

- a. Center punch all new rivet locations. Center punch mark must be large enough to prevent drill from slipping out of position and must not dent surface of material. To prevent denting, place bucking bar behind material during punching.
- b. Make sure drill is correct size (Tables 1 and 2) and point is properly ground. Number 10 drill is used to install standard 3/16-in blind rivets.

Table 1. Drill Sizes for Solid Shank Rivets.

RIVET DIAMETER (IN)	DRILL SIZE	DRILL DIAMETER (IN)
1/16	#51	0.0670
3/32	#41	0.0960
1/8	#30	0.1285
5/32	#21	0.1590
3/16	#10	0.1910
1/4	F	0.2570
5/16	P	0.3230
3/8	W	0.3860

RIVET REPLACEMENT - CONTINUED

Table 2. Drill Sizes for Blind Rivets.

NOMINAL DIAMETER (IN)				OVERSIZE DIAMETER (IN)			
RIVET DIAMETER	DRILL SIZE	MINIMUM	MAXIMUM	RIVET DIAMETER	DRILL SIZE	MINIMUM	MAXIMUM
1/8	#30	0.129	0.132	1/8	#27	0.143	0.146
5/32	#20	0.160	0.164	5/32	#16	0.176	0.180
3/16	#10	0.192	0.196	3/16	#5	0.205	0.209

NOTE

- While drilling, hold drill at 90-degree angle to material surface. Avoid letting drill wobble, making oblong holes.
- Avoid excessive pressure. Let drill bit do cutting.
- Do not push drill through material.
- c. Place drill in center mark for new rivet locations or align drill with old hole when replacing old rivets with oversize rivets. When using power drill, give bit a few turns with fingers before starting motor. This will help ensure drill does not jump out of position when motor is started.
- d. Remove all burrs with metal countersink or file.

NOTE

Ensure no chips are trapped between sheets of metal.

- e. Clean away all drill chips.
- f. Apply sealing compound to hole and surrounding area.

5. **Hole Countersinking**

NOTE

Some rivet installations in body require that rivet head be flush with material surface. In these instances, countersunk or flush head rivets are used.

- a. When using countersunk rivets, rivet holes must be countersunk with tool having 100-degree taper so rivet head will fit flush with surface.
- b. When using hand-operated countersink, hole must be tried with rivet so that recess will not be too deep or too shallow. It is best to use countersink with stop so that depth of countersink can be controlled. Typical countersinking dimensions for blind rivets are shown in Table 3. Minimum sheet thickness that can be machined for 100-degree countersink rivets is given in Table 4.
- c. Do not remove edge of hole on blind side of joint.

RIVET REPLACEMENT - CONTINUED

Table 3. Countersinking Dimensions for 100-Degree Countersunk Blind Rivets.

COUNTERSINKING DIMENSIONS (100°)		
RIVET DIAMETER (IN)	C (IN)	
	MINIMUM	MAXIMUM
1/8	0.222	0.228
5/32	0.283	0.289
3/16	0.350	0.356

Table 4. Minimum Sheet Gage for 100-Degree Machine Countersink.

RIVET SIZE (IN)	3/32	1/8	5/32	3/16	1/4
GAGE (IN)	0.040	0.050	0.064	0.072	0.072

6. **Solid Rivet Installation.**

NOTE

When replacing rivets during repair, use same rivet size and type, if possible. If hole has been damaged, it will be necessary to drill hole oversize and use next larger rivet or oversize blind rivet.

- a. After drilling and prior to driving rivets, parts to be joined must be secured to prevent slipping during riveting. C-clamps may be used, or any of several varieties of skin fasteners may be inserted in previously drilled holes.

CAUTION

When riveting thin gage materials, be careful handling rivet tools to avoid damaging material.

- b. Solid rivets are available in various lengths. Correct length rivet must be chosen so bucked head is not too small or too large to form tight fit. Use Table 5 to determine proper rivet length.
- c. Three common methods of driving or setting rivets are: hand, squeeze, and pneumatic gun. All three methods use principle of upsetting or heading rivet shank against bucking bar.

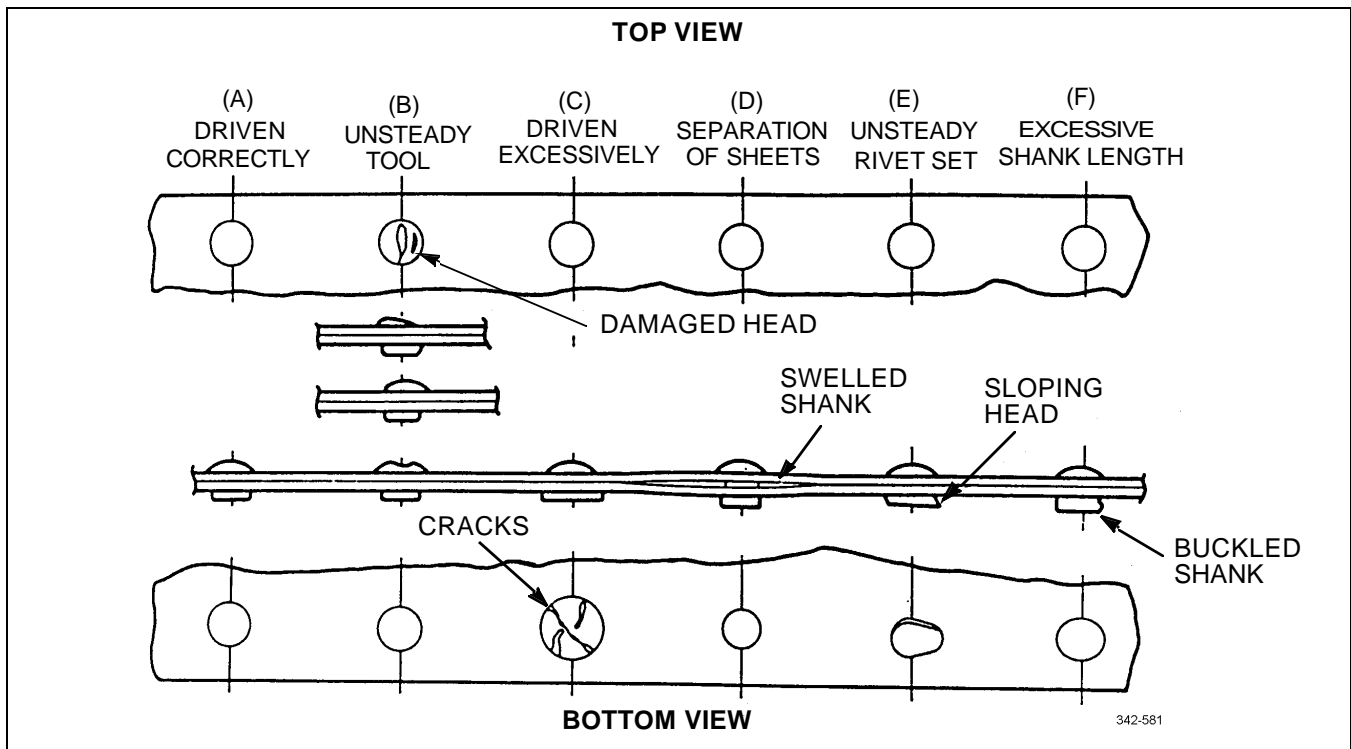
RIVET REPLACEMENT - CONTINUED

Table 5. Calculating Correct Solid Rivet Length.

RIVET DIAMETER	MATERIAL THICKNESS	ADD
1/4 in or less	2 in or less	1-1/2 x diameter of rivet
1/4 in or less	over 2 in	1-1/2 x diameter of rivet + 1/16 in for every 2 in of material thickness
5/16 in or more	1 in or less	1-1/2 x diameter of rivet
5/16 in or more	over 1 in	1-1/2 x diameter of rivet + 1/16 in for every 1 in of material thickness

7. **Rivet Driving Practices and Precautions** Riveting is the major means of joining body parts. Proper procedures must be followed to maintain high-quality workmanship. Table 6 lists types of faulty rivet installations, causes, and corrective action to be taken.

Table 6. Correctly and Incorrectly Driven Rivet.



IMPERFECTION	CAUSE	REMEDY	ACTION
None	None	None	None
Cut head	Improperly held tools.	Hold riveting tools firmly against work.	Replace rivet.
Excessive flat head, resultant head cracks	Excessive driving, too much pressure on bucking bar.	Improve riveting technique.	Replace rivet.

RIVET REPLACEMENT - CONTINUED

Table 6. Correctly and Incorrectly Driven Rivet - Continued.

IMPERFECTION	CAUSE	REMEDY	ACTION
Sheet separation	Work not held firmly together and rivet shank swelled.	Fasten work firmly together to prevent slipping.	Replace rivet.
Sloping head	(a) Bucking bar not held firmly. (b) Bucking bar permitted to slide and bounce over rivet.	Hold bucking bar firmly without too much pressure.	Replace rivet.
Buckled shank	Improper rivet length and E above.	E, above, and rivet of proper length.	Replace rivet.

8. **Blind Rivet Driving Practices and Precautions.**

- a. Rivets should be inspected for proper installation. Grip length of each rivet is marked on top of rivet head to provide positive identification. Use of proper grip length will produce rivet installation where locking collar is flush with top surface of rivet head. Tolerance limit on flushness is 0.020 in (0.5 mm).
- b. For proper rivet installation, it is imperative that holes be properly prepared, tools be in good working order, and rivets be properly applied. When problems occur, source of trouble could be in any of these areas.

9. **Blind Rivet Installation.**

CAUTION

- Proper length rivet must be selected for each application to prevent damage to equipment. Rivet lengths are sized by range of material thickness that rivet will grip.
- Rivets can tolerate only 1/16-in variation in material thickness for each particular rivet length to prevent damage to equipment. Rivet grip lengths are called out as dash number at end of manufacturers part number.
- For double dimpled sheets, add countersunk head height to materials thickness to prevent damage to equipment.

NOTE

- Prior to installing blind rivets, hole must be prepared and parts must be aligned and clamped firmly in place. These steps are the same as for solid riveting operations (refer to *Rivet Hole Drilling* on page 0105 00-4).
- Proper drill sizes for standard and oversize blind rivets are given in Table 2.
- Countersinking dimensions and minimum sheet gage for countersunk blind rivets are shown in Tables 3 and 4.
- Grip lengths are determined as shown in Table 7.
- Use rivet installation tool kit, D-100-MIL-I, and puller head adapters, if required, for all blind rivets.

RIVET REPLACEMENT - CONTINUED**Table 7. Rivet Grip Length Determination.**

MATERIAL THICKNESS RANGE (IN)		RIVET GRIP NO.
MINIMUM	MAXIMUM	
	1/16	1
	1/8	2
1/8	3/16	3
3/16	1/4	4
1/4	5/16	5
5/16	3/8	6
3/8	7/16	7
7/16	2	8
2	9/16	9
9/16	5/8	10
5/8	11/16	11
11/16	3/4	12

- a. Insert rivet stem into pulling head of rivet gun or adapter.
- b. Hold rivet gun in line with axis of rivet as accurately as possible.
- c. Apply steady, firm pressure against rivet head.
- d. Squeeze handles of manual gun. Rivet clamping action will pull sheets together, seat rivet head, and break stem flush with head of rivet.

ALUMINUM REPAIR**CAUTION**

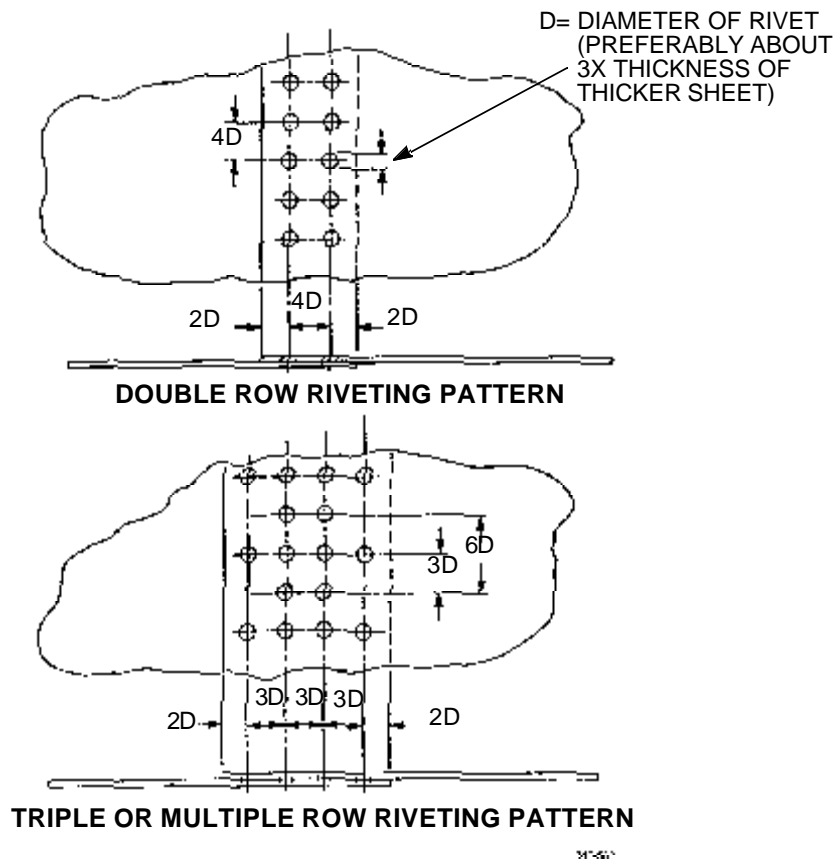
Repairs should not be made on body using welding or heat for forming. Heat will weaken material and cause further problems.

1. **Material.** Aluminum material used for repair should be of the same alloy and temper as original, if possible. In general, 6061-T6 should be used. Material thickness must be the same or thicker. This alloy will work well for flat repairs, but is not well suited to bending because it is hard and cracks easily when bent sharply. When bends must be made, use softer 6061-T4 aluminum alloy and increase material thickness by at least 50 percent. As a rule of thumb, 6061-T4 should be bent with minimum bend radius of one to two times material thickness, whereas 6061-T6 requires at least three times material thickness radius for bends. In all cases, bends should be closely inspected for cracks. Suitable method for avoiding bending cracks is to obtain angles that are extruded from 6061-T6 alloy, or use preformed angles for repairs.
2. **Foam Adhesive Tape.** Where it is necessary to remove parts, note that foam adhesive tape is used in joints. Use care in parts removal to avoid unnecessary distortion. Parts should be separated by peeling them apart using knife or chisel to start peeling action. Before parts are assembled, remove any remaining foam adhesive tape from joints so parts will fit together with good, even contact.

ALUMINUM REPAIR - CONTINUED

3. **Rivet Patterns.**

- a. Rivet patterns are denoted by rivet spacing and rivet edge distance. Rivet edge distance is distance from center of rivet to nearest edge of sheet. Rivet spacing is defined from center of rivet to center of adjacent rivet.
- b. Required rivet spacing is determined by strength needed in joint. General feel for strength required can be obtained by inspecting rivet patterns in surrounding areas. Body repairs made using single rows of rivets should be performed using rivet spacing not greater than 1-1/2 in (4 cm), and not less than 5/8 in (16 mm). Use 1 in rivet spacing as general practice for repairs. Rivet spacing used in original construction may be greater due to additional strength obtained by using foam adhesive tape. Do not use rivet edge distances less than 3/8 in (5 mm).
- c. High-strength joints or large area patches may require use of double or multiple rows of rivets to obtain sufficient strength.



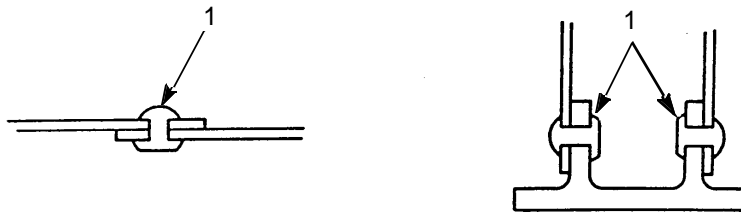
CAUTION

Be careful not to distort original holes to prevent damage to equipment.

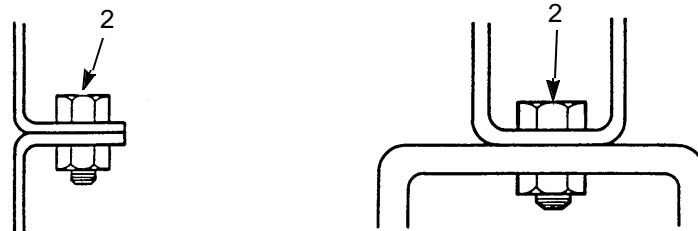
- d. Care must be taken to ensure rivet hole patterns are transferred accurately in the case where part with no holes is mated to one which already has rivet holes. Hole patterns may be transferred using one of the following:
 - (1) Lay new part in place and use holes in mating part as drill template. New part must be underneath mating part.
 - (2) Use removed part as drill template by clamping old and new parts together. Parts must nest flat and rivet flange must be undistorted.

ALUMINUM REPAIR - CONTINUED4. **Joint Design**

- a. Loads are applied through joint to fasteners holding joint together. These loads are applied to fasteners in form of shear loads or tension loads. If load is perpendicular to axis of fasteners, fastener is loaded in shear. Fastener is loaded in tension when load is along axis of fastener, causing pull on each end of fastener.
- b. Rivets (1) are designed to be loaded in shear. Do not create new joints during repairs that cause rivets to be used in tension application. Bolts (2) should be used for tension applications or substituted for rivets in very high shear load applications.



RIVETS LOADED IN SHEAR



BOLTS REPLACING RIVETS LOADED IN TENSION

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5. **Repair Parts Preparation**

- a. Paint repair parts or patches with epoxy primer before installation.
- b. Apply sealing compound to mating surfaces to prevent corrosion.
- c. Install part or patch as detailed in *Repair by Patching* and *Repair by Insertion* on pages 0105 00-12 and 0105 00-13.
- d. Paint repaired area with epoxy primer.
- e. Paint repaired area with polyurethane, as required.

6. **Repair of Negligible Damage.**

- a. Negligible cracks, as defined in classification above, are repaired by drilling small hole at each end of crack to stop crack propagation. This is called stop drilling. Table 8 gives proper drill sizes for stop drilling cracks.
- b. Negligible holes are repaired by rounding and smoothing edges of hole to alleviate stress risers caused by sharp notches.

CAUTION

Never use heat to reform parts. Heat greatly reduces part strength.

- c. Small dents and distorted areas may be repaired by bending or hammering as long as operation does not cause materials to crack or tear. Sharp bends should not be attempted.

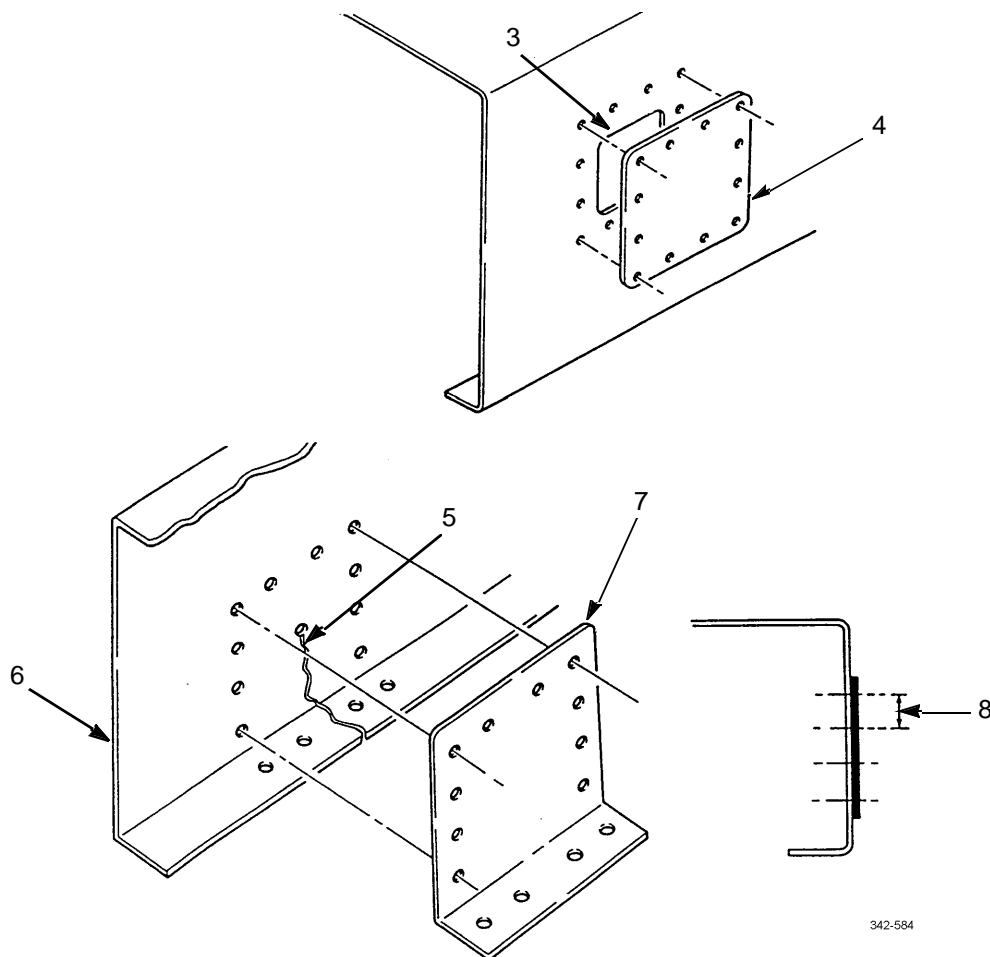
ALUMINUM REPAIR - CONTINUED

Table 8. Stop Drill Sizes for Negligible Cracks.

SHEET THICKNESS (IN)	MINIMUM STOP DRILL SIZE NO.
0-0.032	40
0.033 and thicker	30

7. **Repair by Patching.**

- a. Most body panel damage that exceeds limits of negligible damage may be repaired by patching. This procedure involves removal of damaged area (3) and application of a patch (4) to cover the area.
- b. The damaged area (3) is prepared by removal of the damage followed by rounding or smoothing of all corners and edges. This helps ensure that cracks will not spread into undamaged areas.
- c. In the case of a large crack (5), it may be desirable to stop-drill crack rather than cut out a portion of a panel (6) or structural member.
- d. Repair is completed by applying a large overlapping patch (7) over the area that was damaged. The overlap must be sufficient to allow the observance of proper rivet edge distance (8) (refer to *Rivet Patterns* on page 0105 00-10).



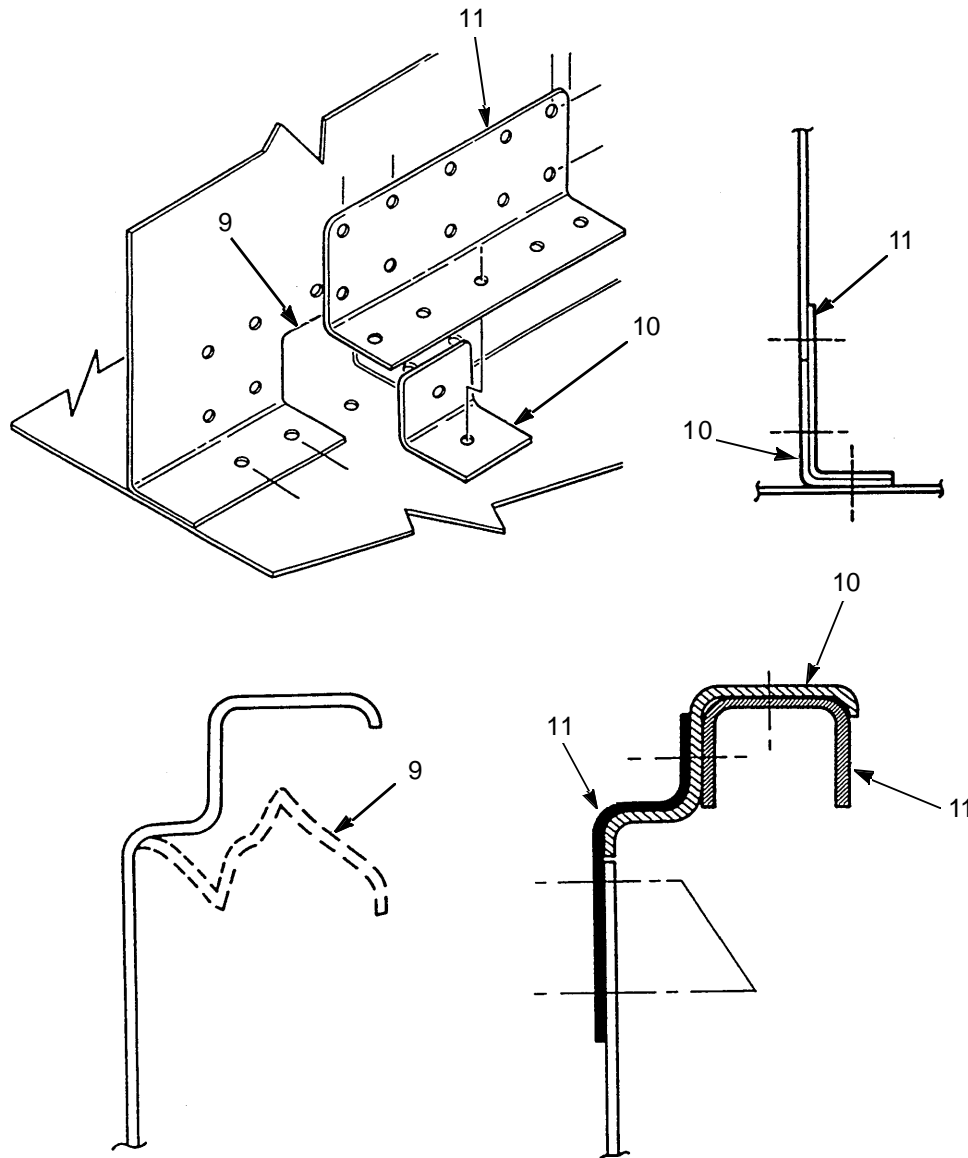
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ALUMINUM REPAIR - CONTINUED

- e. Large areas of damage are best repaired using a patch that is attached with multiple rows of rivets (refer to *Rivet Patterns* on page 0105 00-10).

8. Repair by Insertion

For damage larger or more severe in nature than crack or hole, it is often desirable to remove damaged area (9), insert piece of material (10) into removed area, and reinforce this with doubler (11). This is repair by insertion. This method of repair is typically stronger and stiffer than an added patch.



342-585

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Inspection, Repair

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Drill, electric, portable (Item 31, WP 0126 00)

Drill set, twist (Item 32, WP 0126 00)

Materials/Parts

Glass, reinforced plastic

Tool kit, body and fender repair (Item 39, WP 0125 00)

INSPECTION

1. The SMC (sheet molded compound) hood consists of several parts including fenders, hood, and inner reinforcements which are bonded together with a structural adhesive and rivets. If the hood is damaged, determine which parts are affected.
2. Damage at any joint between two parts is not repairable. For example, if fender and reinforcements bonded inside the fender are damaged, replace the entire hood assembly.
3. If a joint between two parts has separated and there is no damage at the joint, the parts can be rebonded. Or, if a part is damaged and adjoining parts are not, the damaged part can be separated from the hood and new or used parts can be bonded in place. A section of a part can be replaced as long as the section does not include a joint between two parts. Fenders and headlight reinforcements are available as replacement parts or for use in section replacements. If the damage is such that parts cannot be replaced or a section replacement cannot be done, replace the entire hood assembly.
4. For repairing a small crack or hole, refer to *Crack or Small Hole Repair* below.
5. For repairing larger areas, refer to *Section Replacement (Repair of Punctures and Large Fractures)* on page 0106 00-3.
6. For replacing or rebonding parts, refer to *Hood Component Rebonding* on page 0106 00-7.

REPAIR

1. **Crack or Small Hole Repair.** A crack (fracture) or small hole through the laminate requires repair with a fiberglass reinforced patch.
 - a. Locate damage on hood. Apply hand pressure all around damaged area to check for concealed damage.

REPAIR - CONTINUED**WARNING**

Solvents can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If solvent gets on skin or clothing, wash immediately with soap and water.

- b. Clean area with xylene or equivalent solvent. Inspect area closely.
- c. If sound-absorbent liner is present on underside of damaged area, remove panel(s) to provide adequate working area.
- d. If repairing crack (1), use 1/8-in diameter bit to drill hole (2) completely through uncracked laminate. Drill hole 1/8-in (3 mm) from each end of crack to prevent crack from lengthening.

**WARNING**

Wear goggles and air purifying respirator when cutting, grinding or sanding during fiberglass repairs. Ground dust and particles could cause temporary or permanent damage to eyes, and if inhaled, could cause respiratory irritation.

- e. On engine side of hood (3), use router bit on grinder or drill to grind away shallow recess. Grind recess to one-quarter depth of laminate (4) and 1/2 in (13 mm) outward from all sides of damage. Taper outside edge of ground area (5). If repairing crack (1), grind outward to drilled hole (2) at end of crack, but not beyond.
- f. Use 100-220 grit sandpaper to scuff area at least 1 in (25 mm) away from fracture on all sides (6). Scuff thoroughly to give surface to which patch can stick.

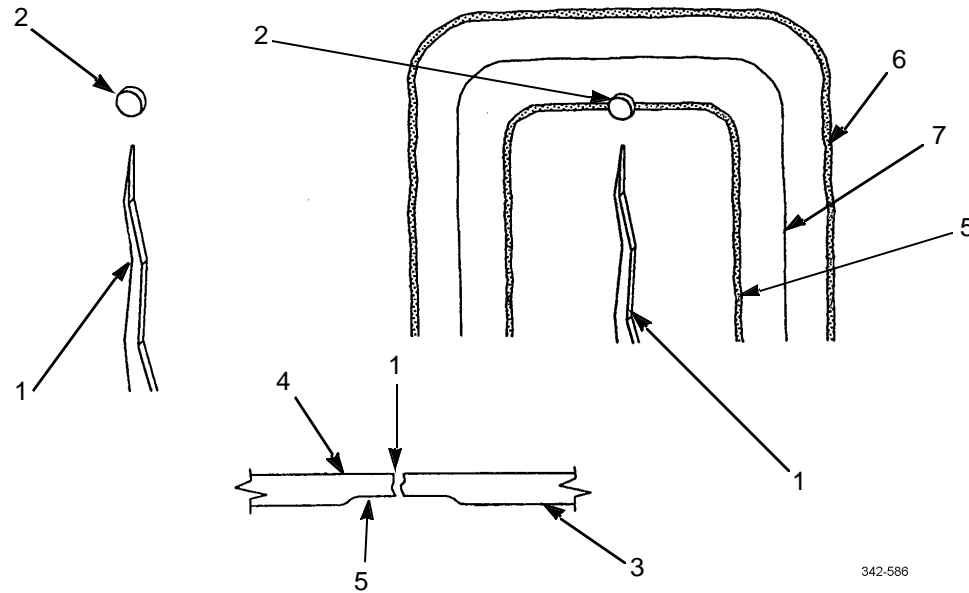
**WARNING**

Compressed air used for cleaning or drying purposes, or for clearing restrictions, should never exceed 30 psi (207 kPa). Wear protective clothing (goggles/shield, gloves, etc.) and use caution to avoid injury to personnel.

- g. Blow dust away with compressed air and wipe area with clean cloth.
- h. If necessary, align panel sections on both sides of crack (1), using weights or clamps to establish original panel profile.
- i. Using razor knife, cut section of woven fiberglass cloth (7) to overlay crack (1) about 3/4 in (19 mm).
- j. Using wooden stir stick and measuring in spoonfuls, mix equal volumes of magnolia 58 A and B epoxy resins on clean sheet of glass, metal or section of scrap laminate. Mix 15 seconds.
- k. Use stir stick to spread thin layer of mixed epoxy resins over scuffed area (6).

REPAIR - CONTINUED

- l. Lay fiberglass cloth (7) on repair area, centered over damage. Using stir stick, firmly press fiberglass cloth into epoxy to completely soak fiberglass cloth.
- m. Apply another layer of epoxy resins over fiberglass cloth (7).



- n. Allow 2-5 minutes for epoxy to start gelling. It may take more time in cool temperatures, less in hot temperatures.

NOTE

For smoother surface, press piece of masking tape, wider than repair, directly over wet epoxy and smooth before epoxy hardens. Tape can be removed when epoxy sets up after 15 minutes.

- o. Patch should be hard enough in 15 minutes to allow sanding to smooth, flat surface, if required.
 - p. Repair damage on outside surface of hood, and paint surface on both sides.
2. **Section Replacement (Repair of Punctures and Large Fractures).** On large damaged areas (for example, structural damage on side surface of the hood covering a square foot area), it may be easier to do a section replacement rather than to make a patch. Fenders and headlight reinforcements are available for use in section replacements, or a second damaged hood must be available as scrap with the needed section intact.

CAUTION

Piece of SMC laminate from another SMC laminate hood must be used for section replacement. Use of any other material may not allow necessary bonding for repair.

- a. To determine extent of damage, push in on area immediately surrounding and underneath damaged area.

REPAIR - CONTINUED

Solvents can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in well-ventilated area. If solvent gets on skin or clothing, wash immediately with soap and water.

- b. Clean area with xylene or equivalent solvent. Inspect area closely.
- c. If sound-absorbent liner is present on underside of damaged area, remove panel(s) to provide adequate working area.

NOTE

If damage extends to joint where part is bonded to another, separate part with heat gun and putty knife before cutting.

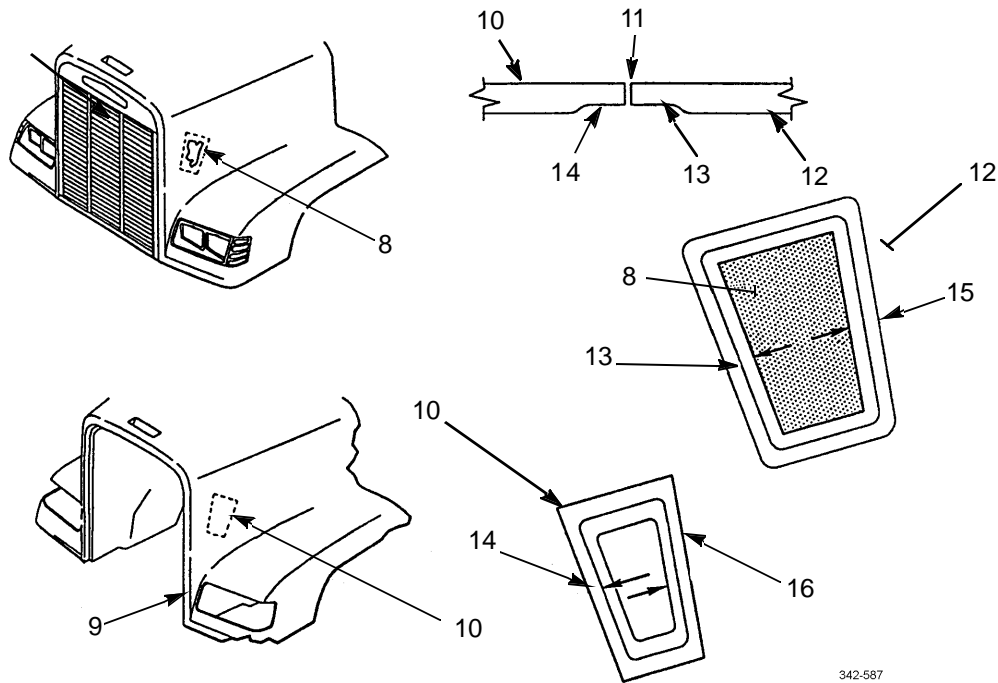
- d. Using saber saw, cut out large, straight-sided panel (8) containing damaged area.

NOTE

If damage is next to, but does not include, headlight reinforcement, remove headlight reinforcement from replacement section, not from hood.

- e. From scrap hood (9) or new part, cut patch (10) from same area slightly larger than original panel (8). Trim patch to fit both size and contour of original panel.
- f. Sand patch (10) edges to allow 1/16-1/8 in (2-3 mm) gap (11) around panel (8).
- g. On engine side of hood (12), use router bit on grinder or drill to grind away shallow recess. Grind recess to one-quarter depth of laminate (13) and 1/2 in (13 mm) outward from all sides (14) of panel (8) area. Grind 1/2 in (13 mm) inward from all sides (14) on engine side of patch (10). Slightly taper outside edge of ground area around panel and inside edge of ground area on patch.
- h. Using 110-220 grit sandpaper, scuff area at least 1 in (25 mm) out from sides (15) of panel (8) area. Scuff at least 1 in (25 mm) in from sides (16) of patch (10). Scuff thoroughly to give surface to which patch can stick. Completely sand off any undercoating sprayed on these areas.
- i. Bevel edges of outer sides of both panel (8) and patch (10) to about 45 degrees.
- j. Using 220 or higher grit sandpaper, gently feather back outer painted surfaces about 1/2 in (13 mm) beyond edges of repair areas of panel (8) and patch (10).
- k. Blow dust away with compressed air and wipe area with clean cloth.

REPAIR - CONTINUED



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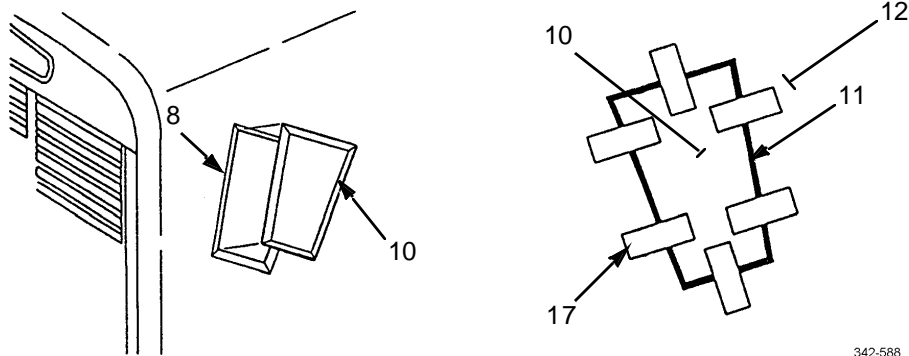
1. If patch (10) is close enough to edge, use clamps to temporarily secure patch during repair. If patch is too far from edge to use clamps, use bond strips (17).
 - (1) Cut scrap SMC into strips (17). Make enough strips to hold patch (10) in place, about one every 6 in (15 cm). If surface of patch is contoured or curved, use many small strips. Larger strips could deform curves.
 - (2) On engine side of hood (12), use 220 grit sandpaper to scuff-sand areas on hood and patch (10) where strips (17) will be bonded.

REPAIR - CONTINUED

NOTE

If joint between parts was separated for repair, rebond joint. Refer to *Hood Component Rebonding* on page 0106 00-7.

- (3) Hold patch (10) in place and bond strips (17) to hood (12) and patch where scuffed. Use Lord Fuser 320/322 to bond strips.
- (4) Apply light pressure and heat from heat gun to area for 3-5 minutes.
- (5) After Lord Fuser 320/322 has hardened, use 100-220 grit sandpaper to scuff strips.
- (6) Blow dust away with compressed air and wipe area with clean cloth.



- m. Using razor knife, cut sections of woven fiberglass cloth (18) to fully cover gap (11) between hood (12) and patch (10), all around patch. Fiberglass cloth should overlay about 3/4 in (19 mm) on both sides of gap.
- n. Using wooden stir stick and measuring in spoonfuls, mix equal volumes of Magnolia 58 A and B epoxy resins on clean sheet of glass, metal or section of scrap laminate. Mix 15 seconds.
- o. Use stir stick to spread thin layer of mixed epoxy resins over scuffed area on unexposed side of repair.
- p. Lay cut sections of fiberglass cloth (18) on repair area, centered over gap (11). Using stir stick, firmly press fiberglass cloth into epoxy to completely soak fiberglass cloth.
- q. Apply another layer of epoxy resins over fiberglass cloth (18).
- r. After 2-5 minutes, epoxy will start gelling. It may take more time in cool temperatures, less in hot temperatures.

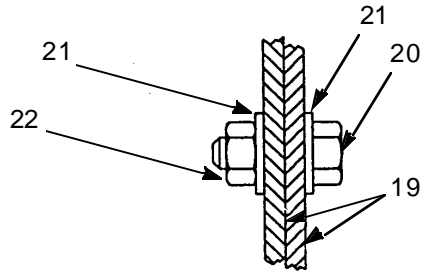
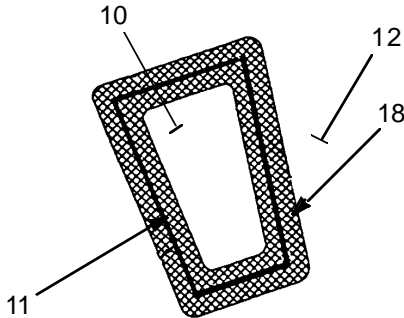
NOTE

For smoother surface, press piece of masking tape, wider than repair, directly over wet epoxy and smooth before epoxy hardens. Tape can be removed when epoxy sets up after 15 minutes.

- s. After body filler has hardened, sand unexposed side of repair area to smooth flat surface, if required.

REPAIR - CONTINUED

- t. Repair damage on outside surface of hood, and paint surface on both sides.



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3. **Hood Component Rebonding.**

NOTE

If parts cannot be separated, work folded medium-grit sandpaper or section of steel hacksaw blade between two surfaces to remove old adhesive.

- a. If rebonding joint that has separated or replacing damaged part, completely separate part or parts using heat gun and putty knife. Remove as much of old adhesive as possible. Heat gun will soften adhesive and allow it to be peeled off SMC.
- b. Scuff surfaces with 100-220 grit sandpaper.
- c. Clean surfaces are to be bonded with Ashland 6036 primer or methylene chloride. Inspect area closely to be sure all old adhesive is removed.
- d. If replacing large part, such as fender, align part on hood and clamp in place. Drill hole through bonding surfaces (19) and install clamping bolt (20) in hole. Install two washers (21), one on each bonding surface. Install nut (22) on clamping bolt. There should be enough clamping bolts to hold hood in place and keep bonding surfaces together, one bolt every 12-18 in (30-45 cm). Remove part for application of adhesive.
- e. Using manufacturer's instructions, mix enough Ashland Pliogrip 6600/6622 adhesive to bond parts together, about 3/8 in (10 mm) diameter bead at bonding surface (19). Adhesive will cure in 7-10 minutes.
- f. Put adhesive in standard caulking gun and cut nozzle so 3/8 in (10 mm) diameter bead can be dispensed. If parts could not be completely separated, cut nozzle so adhesive can be injected between surfaces.
- g. Dispense 3/8 in (10 mm) diameter bead of adhesive between all bonding surfaces (19).
- h. Within 5 minutes of dispensing adhesive bead, align part on hood and clamp firmly in place. If a large part (fender, for example), install clamping bolts. Tighten clamps or clamping bolts just enough to ensure uniform amount of pressure is applied along seam. Ideally, adhesive should be compressed to form bondline 1 in (25 mm) wide and 0.030 in (0.76 mm) thick.
- i. Before adhesive cures, remove excess adhesive that squeezes out edges of bond.
- j. Bond will be secure in about 1 hour. Remove clamps.
- k. If holes were drilled for clamping bolts, repair holes using instructions in *Crack or Small Hole Repair* on page 0106 00-1.

END OF WORK PACKAGE

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CAB DOOR REPLACEMENT

0107 00

THIS WORK PACKAGE COVERS

Removal, Cleaning, Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Personnel Required

Two

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Equipment Condition

Rear view mirror removed (TM 9-2320-302-20)

Materials/Parts

Tape, foam, 48-02454-106x27 (WP 0122 00)

NOTE

Procedure is the same for both doors.

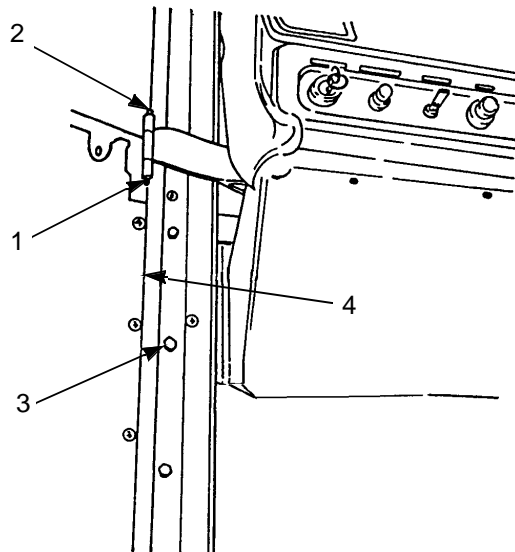
REMOVAL

1. Remove capnut (1) and socket head screw (2).

WARNING

Due to size of door and angle for removal, use minimum of two personnel to remove door. Failure to do so could result in injury to personnel.

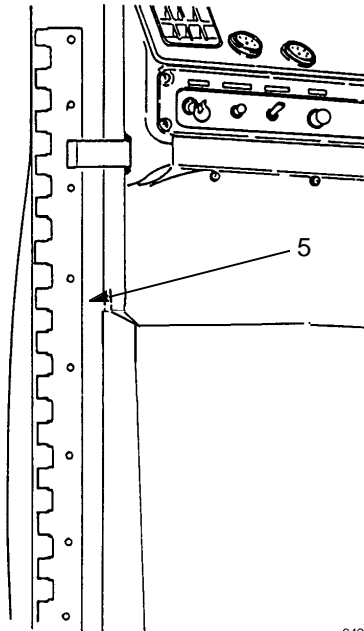
2. Remove eight capscrews (3) and door (4).



342-590

REMOVAL - CONTINUED

3. Remove and discard foam tape (5).



342-591

CLEANING

1. Use general cleaning methods to clean all parts.
2. Ensure that all traces of old foam tape have been removed.

INSPECTION

1. Inspect door seals and window channels for damage.
2. Inspect door locks, regulators, and release handles for proper operation. If damaged, refer to door repair (WP 0108 00).

INSTALLATION**CAUTION**

Make sure all old foam tape has been removed. Failure to do so could cause water leakage and damage.

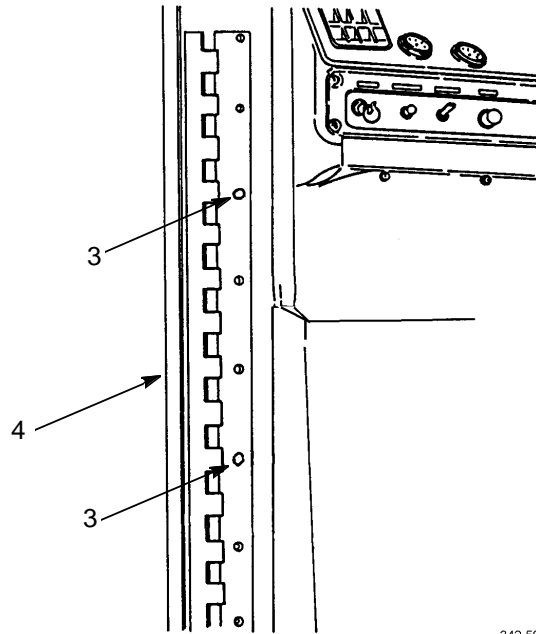
1. Install new foam tape (5) and, using a sharp tool, cut holes for installation of capscrews (3).

WARNING

Due to size of door and angle for installation, use minimum of two personnel to install door. Failure to do so could result in injury to personnel.

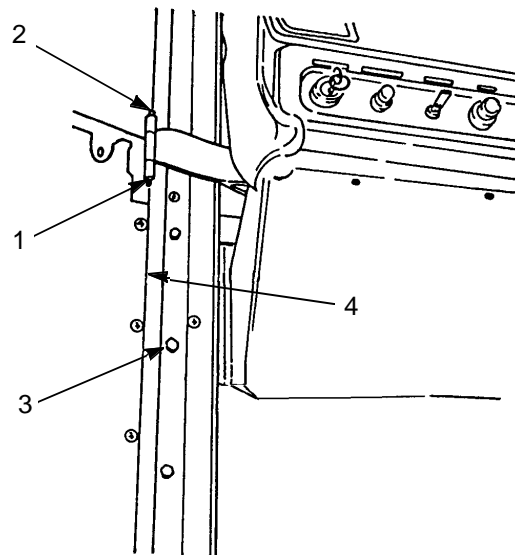
2. Position door (4) and install two capscrews (3) in locations indicated.

INSTALLATION - CONTINUED



342-592

3. Perform door adjustment (TM 9-2320-302-20).
4. Install remaining six capscrews (3).
5. Install socket head screw (2) and capnut (1).



342-590

6. Install rear view mirror (TM 9-2320-302-20).

END OF WORK PACKAGE

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CAB DOOR REPAIR

0108 00

THIS WORK PACKAGE COVERS

Disassembly, Assembly

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Gloves (Item 41, WP 0126 00)

Materials/Parts

Compound, sealing (Item 14, WP 0125 00)

Grease, GAA (Item 22, WP 0125 00)

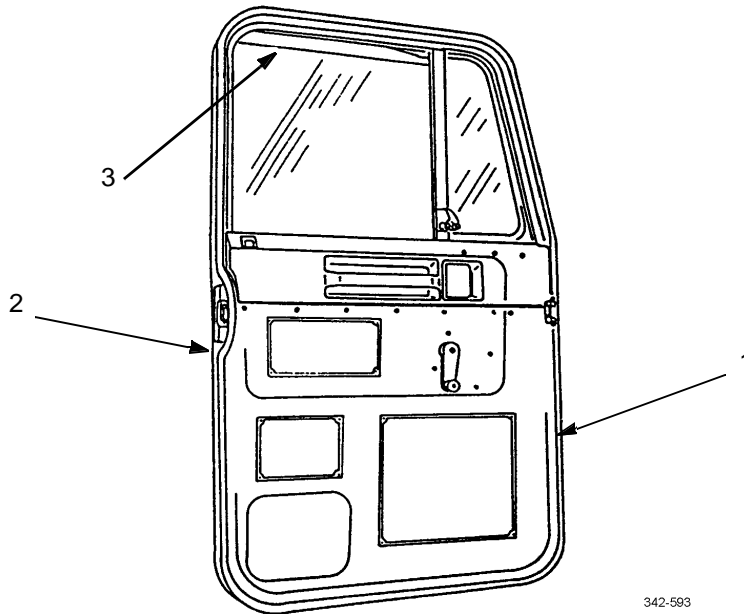
Tags, marker (Item 35, WP 0125 00)

Equipment Condition

Cab door removed (WP 0107 00)

DISASSEMBLY

1. If damaged, remove and discard seal (1) from door (2).
2. Lower window glass (3).



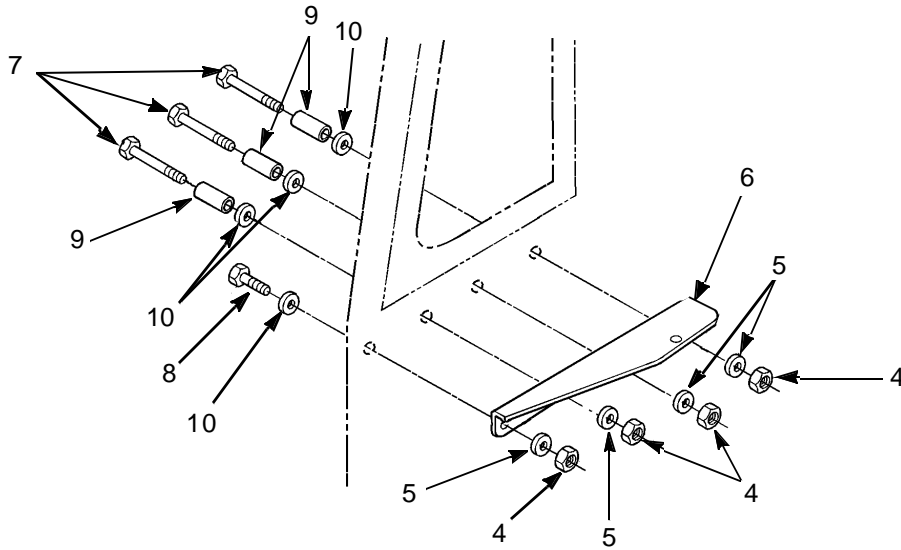
342-593

DISASSEMBLY - CONTINUED

NOTE

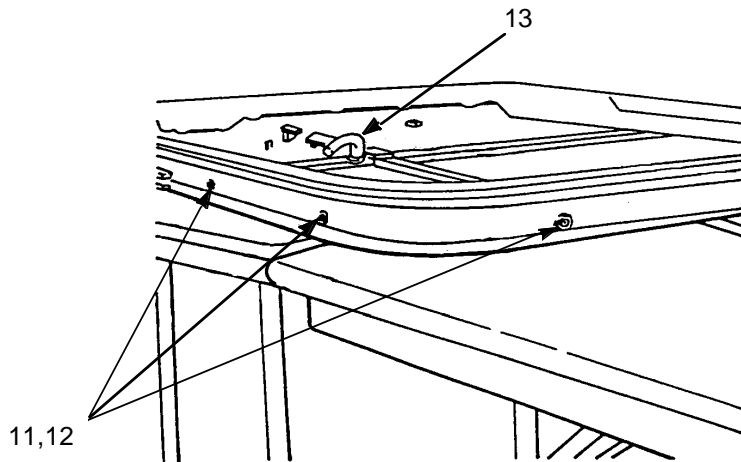
Tag screws, spacers, and washers during disassembly to aid in assembly.

- Remove four nuts (4), washers (5), bracket (6), three screws (7), cap screw (8), three spacers (9), and four washers (10).



342-594

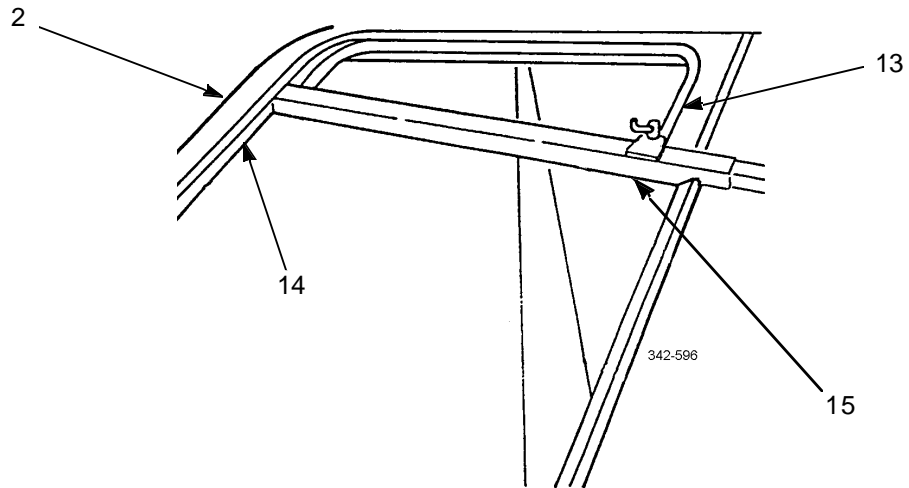
- Remove three screws (11) and washers (12) from vent window (13).



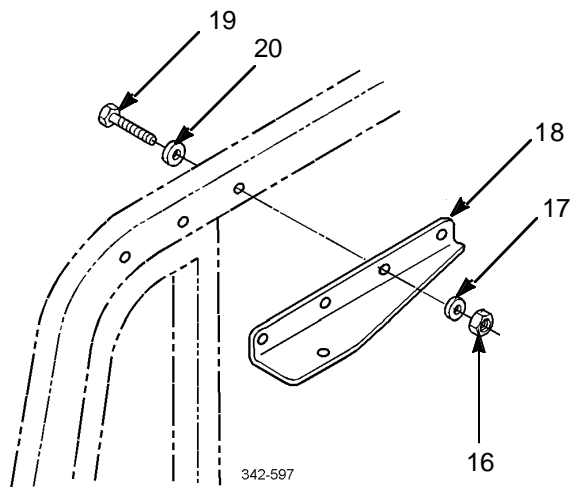
342-595

- Remove 10 in (25.4 cm) of window channel (14) from door (2) to allow removal of vent window (13).
- Remove window channel (15) from vent window (13).
- Remove vent window (13) from door (2).

DISASSEMBLY - CONTINUED

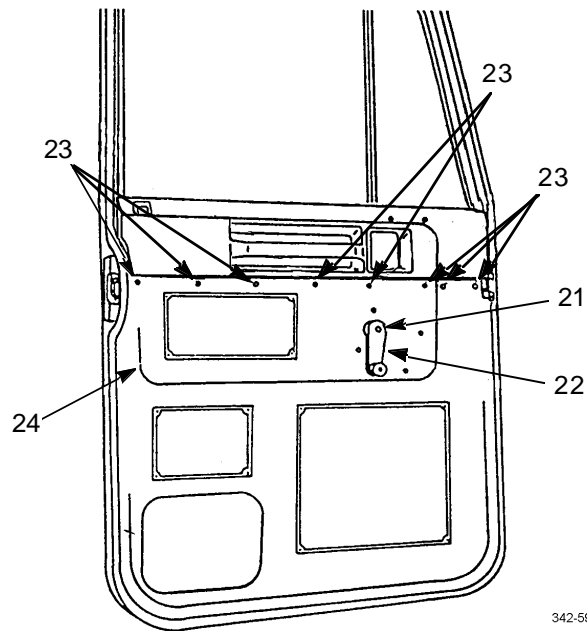


8. Remove four nuts (16), washers (17), bracket (18), four cap screws (19), and washers (20).

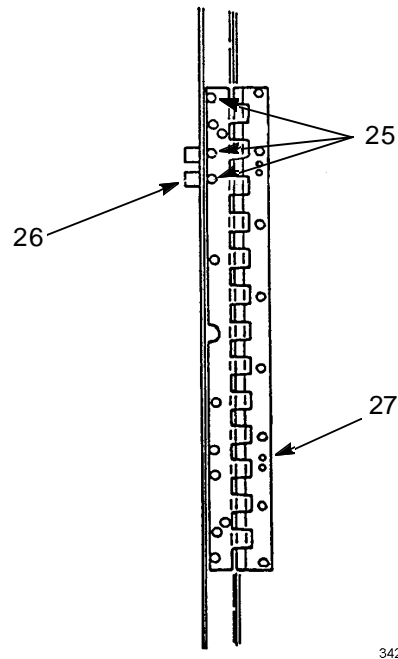


DISASSEMBLY - CONTINUED

9. Remove screw (21) and window crank (22).
10. Remove eight screws (23) from inside door panel (24).

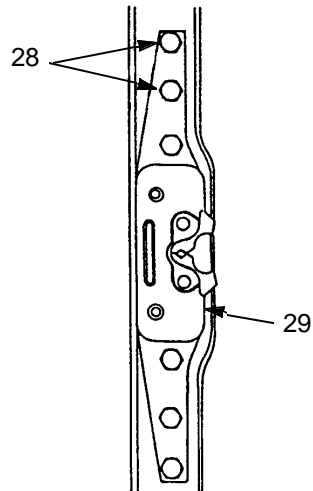


11. Remove three cap screws (25) and check arm bracket (26) from door hinge (27).



DISASSEMBLY - CONTINUED

12. Remove top two cap screws (28) from door latch assembly (29).



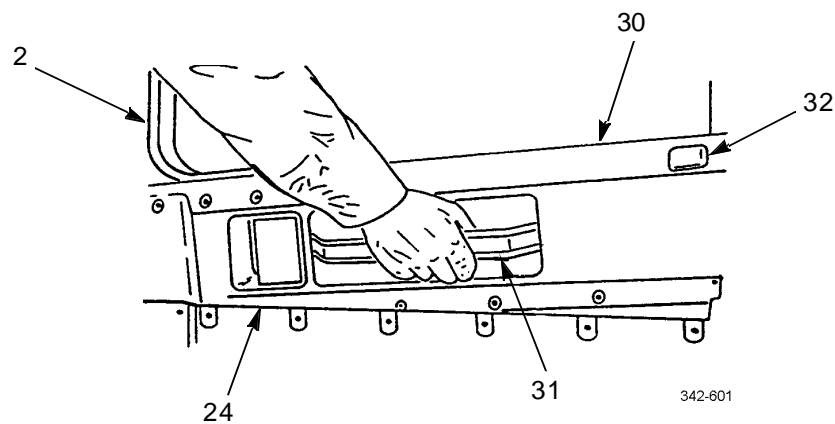
342-600

13. Remove sill (30) as follows:

CAUTION

Do not attempt to completely separate sill from door after completion of step b. To do so could damage interior door components.

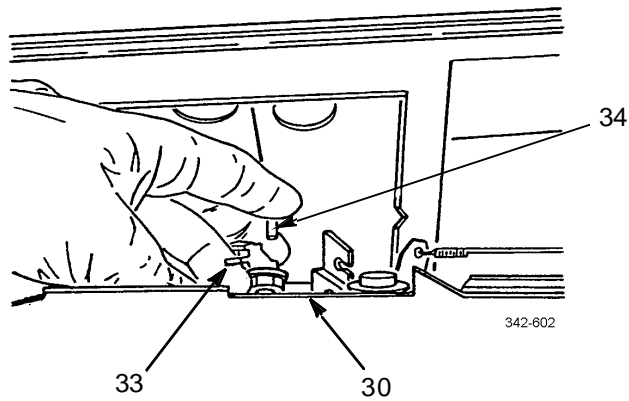
- Grip sill door handle (31), lean sill (30) away from door (2), and pull sill upward until entire lower edge of sill unseats from inside door panel (24).
- Lean sill (30) away from door (2) and push door lock button (32) free.



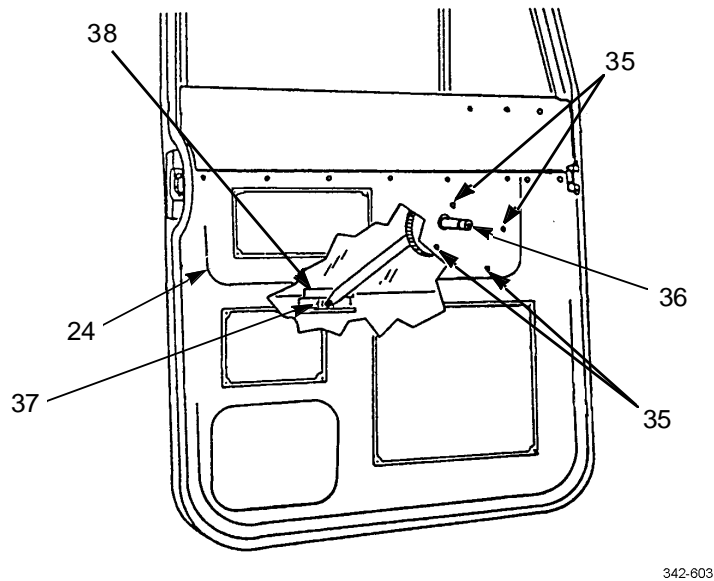
342-601

DISASSEMBLY - CONTINUED

- c. Disconnect release handle rod retainer (33) from release handle rod (34) and remove sill (30).



- 14. Remove four screws (35) from window regulator (36).
- 15. Disengage window regulator roller (37) from one end of window lift channel (38).
- 16. Remove window regulator (36) from inside door panel (24).

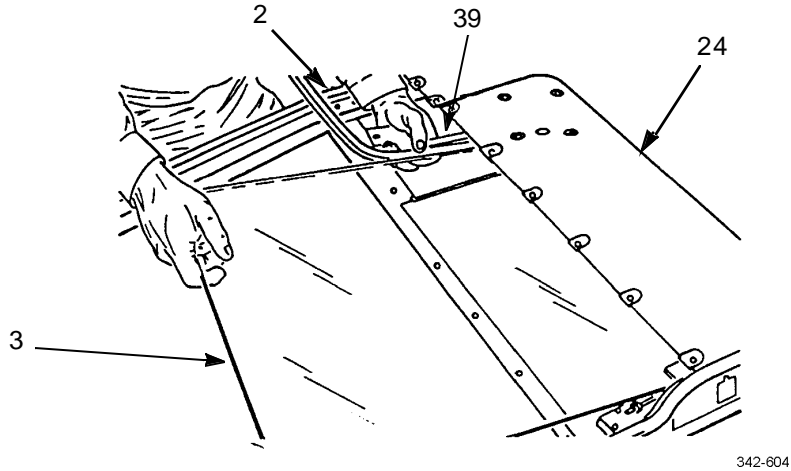


DISASSEMBLY - CONTINUED

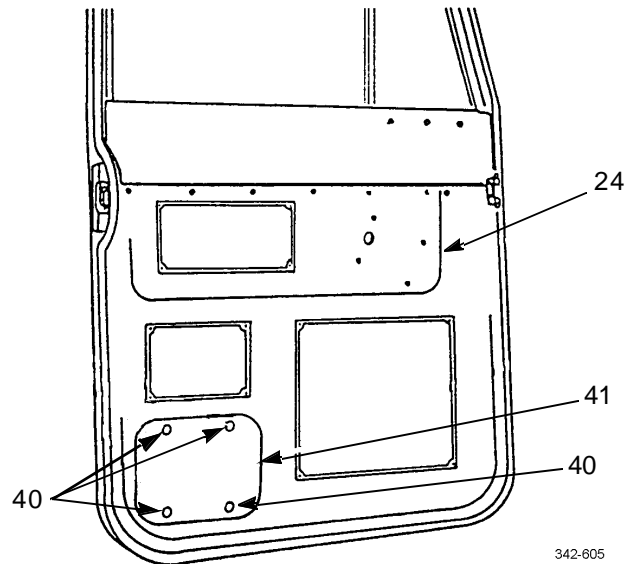
WARNING

Wear protective gloves when handling glass. Failure to do so could result in injury to personnel.

17. Tilt window guide (39) toward hinge side of door (2) and carefully pull window glass (3) toward top of door. At the same time, lift window glass toward inside door panel (24) until window glass is completely removed from door.

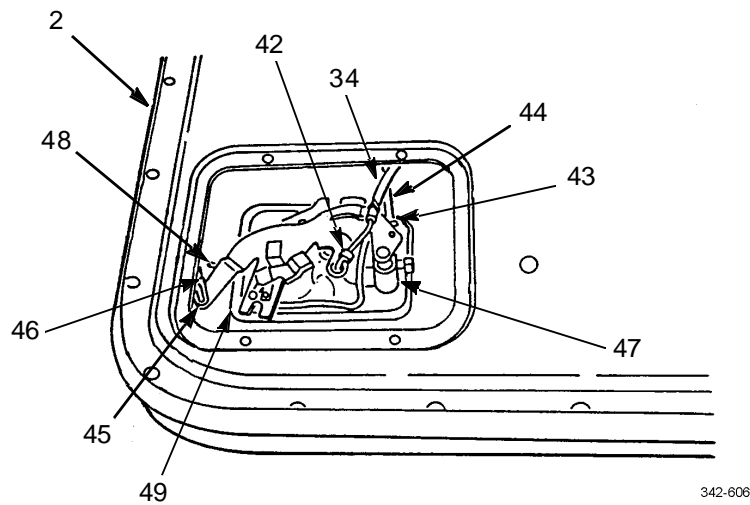


18. Remove four screws (40) and cover plate (41) from inside door panel (24).

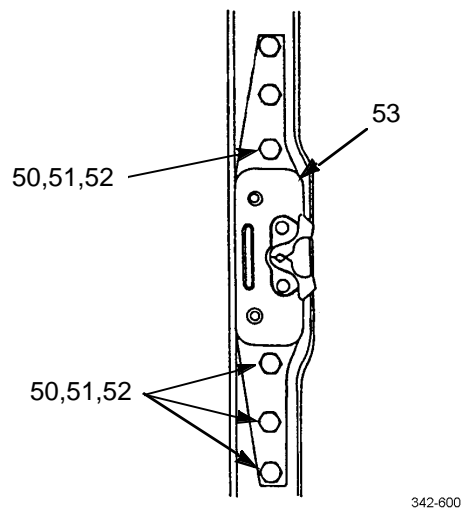


DISASSEMBLY - CONTINUED

19. Disconnect release handle retainer (42) and remove release handle rod (34).
20. Disconnect door lock retainer (43) and remove door lock rod (44).
21. Disconnect door latch retainer (45) and remove door latch rod (46) from exterior handle assembly (47).
22. Remove stud (48) from exterior handle assembly (47).
23. Remove fastening clip (49) and exterior handle assembly (47) from door (2).

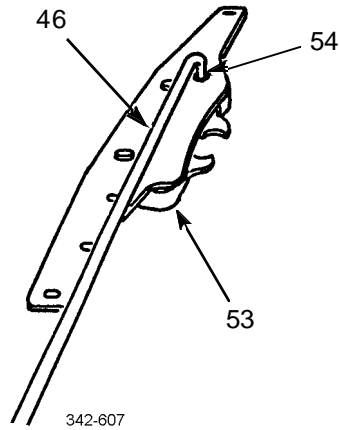


24. Remove four nuts (50), washers (51), cap screws (52), and door latch assembly (53).

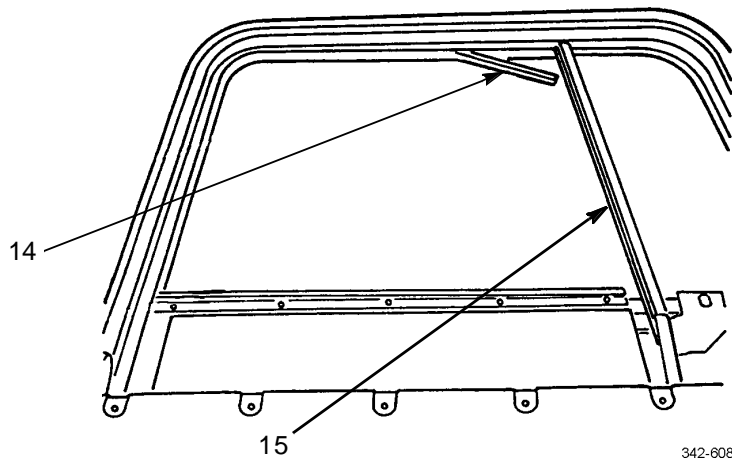


DISASSEMBLY - CONTINUED

25. Disconnect door latch retainer (54) and remove door latch rod (46) from door latch assembly (53).

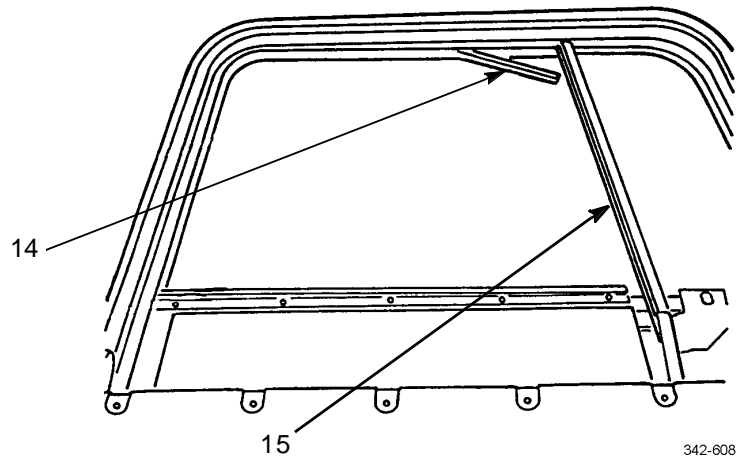


26. Remove two window channels (14 and 15).

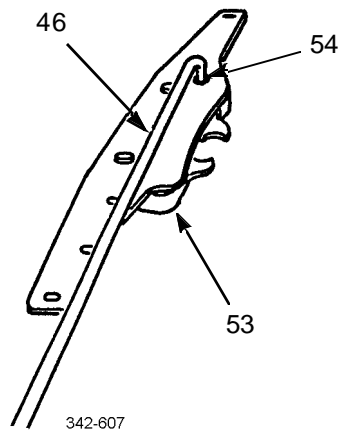


ASSEMBLY

1. Install two window channels (14 and 15).

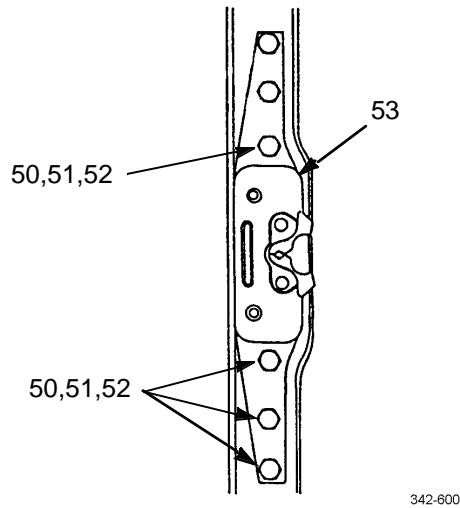


2. Install door latch rod (46) on door latch assembly (53) and connect door latch retainer (54).

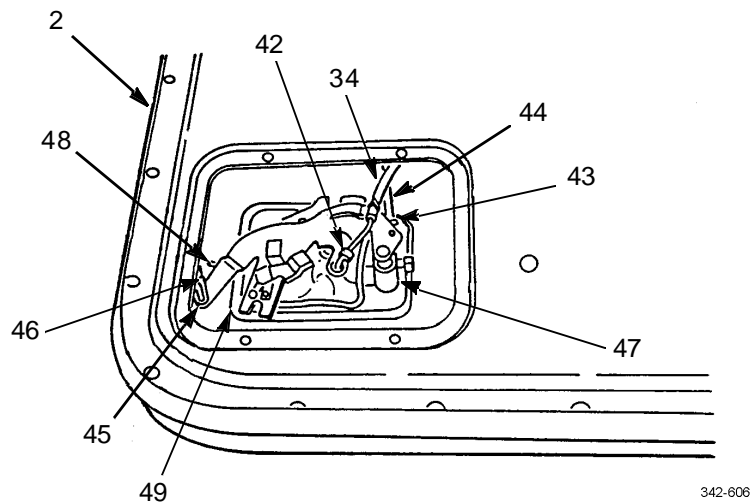


ASSEMBLY - CONTINUED

3. Install door latch assembly (53), four cap screws (52), washers (51), and nuts (50).

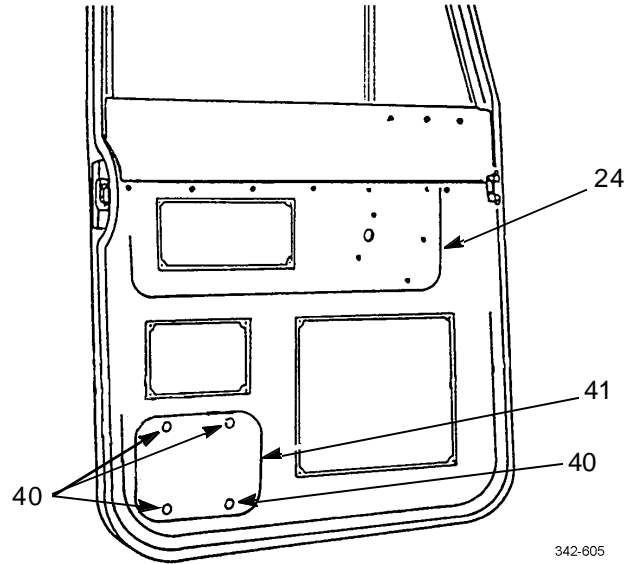


4. Lubricate all rotating points of exterior handle assembly (47) with grease.
5. Install exterior handle assembly (47) and fastening clip (49) in door (2).
6. Install stud (48) in exterior handle assembly (47).
7. Install door latch rod (46) in exterior handle assembly (47) and connect door latch retainer (45).
8. Install door lock rod (44) in exterior handle assembly (47) and connect door lock retainer (43).
9. Install release handle rod (34) in exterior handle assembly (47) and connect release handle retainer (42).



ASSEMBLY - CONTINUED

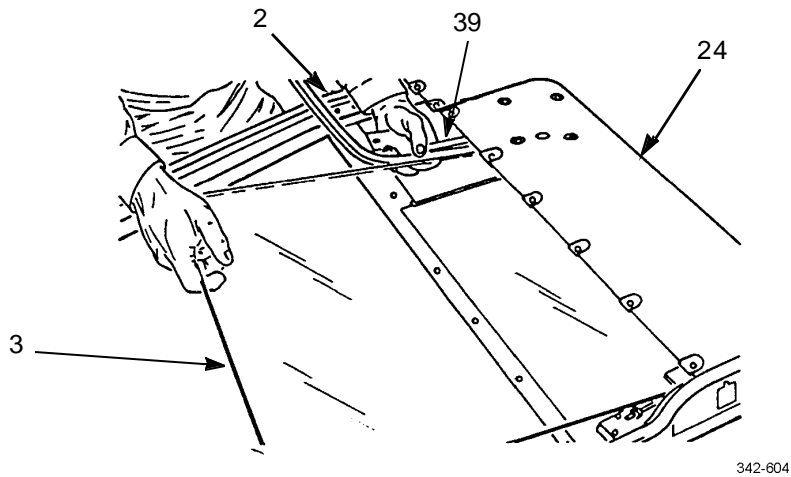
10. Install cover plate (41) and four screws (40) on inside door panel (24).



WARNING

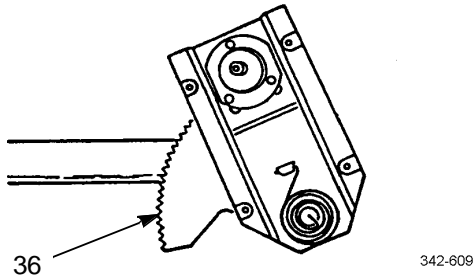
Wear protective gloves with handling glass. Failure to do so could result in injury to personnel.

11. Tilt window guide (39) toward hinge side of door (2), and with window glass (3) tilted toward inside door panel (24), carefully install window glass.

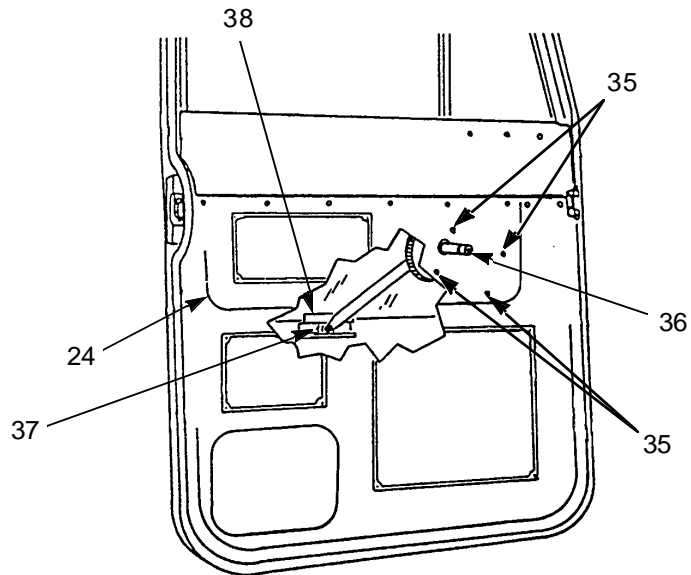


ASSEMBLY - CONTINUED

12. Lubricate teeth on window regulator (36) with grease.



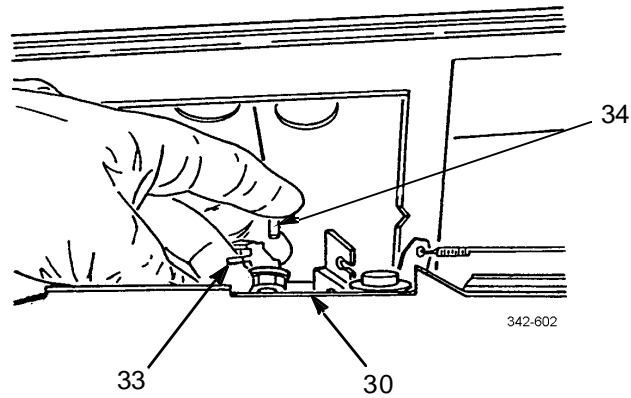
13. Install window regulator (36) in inside door panel (24).
14. Insert window regulator roller (37) in one end of window lift channel (38).
15. Install four screws (35) in window regulator (36).



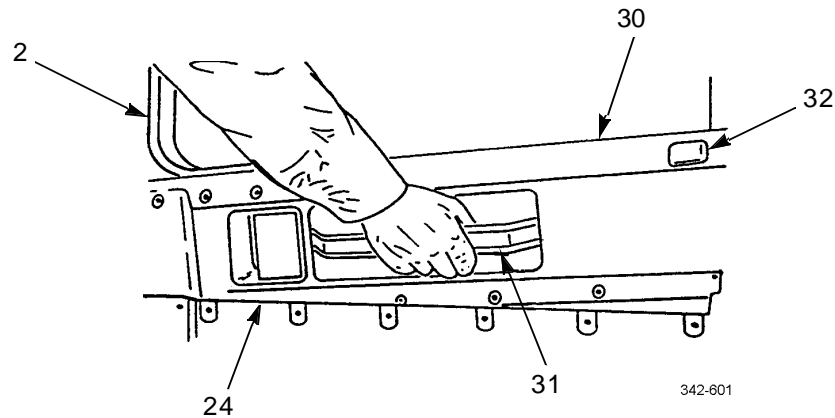
ASSEMBLY - CONTINUED

16. Insert sill (30) as follows:

- a. Install sill (30) just enough to allow installation of release handle rod (34) and connect release handle rod retainer (33).

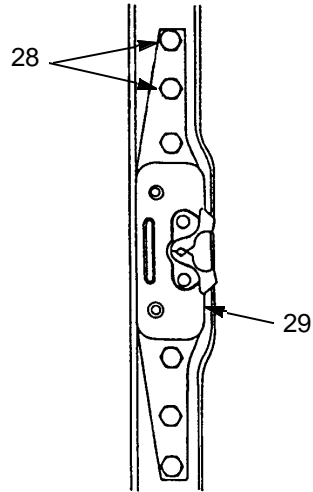


- b. Lean sill (30) away from door (2) and insert door lock button (32).
- c. Grip sill door handle (31), lean sill (30) away from door (2), and push sill downward until lower edge of sill is seated on inside door panel (24).



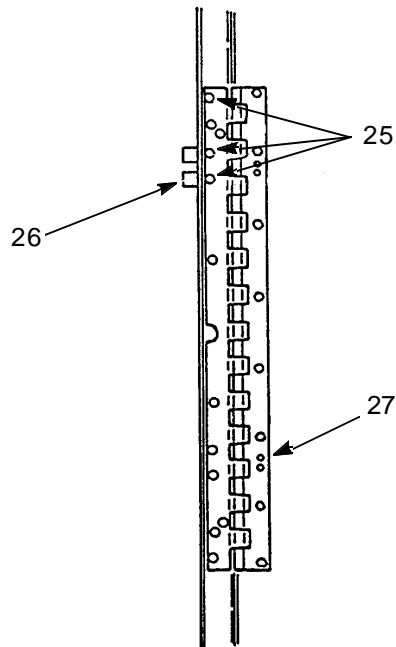
ASSEMBLY - CONTINUED

17. Install top two cap screws (28) in door latch assembly (29).



342-600

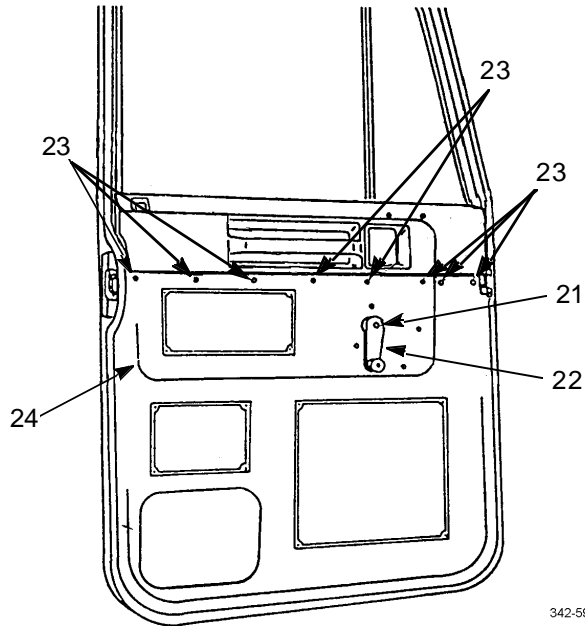
18. Install check arm bracket (26) and three cap screws (25) in door hinge (27).



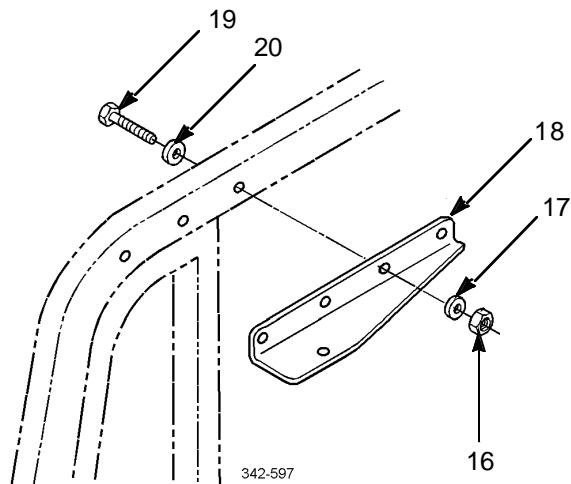
342-599

ASSEMBLY - CONTINUED

19. Install eight screws (23) in inside door panel (24).
20. Install window crank (22) and screw (21).

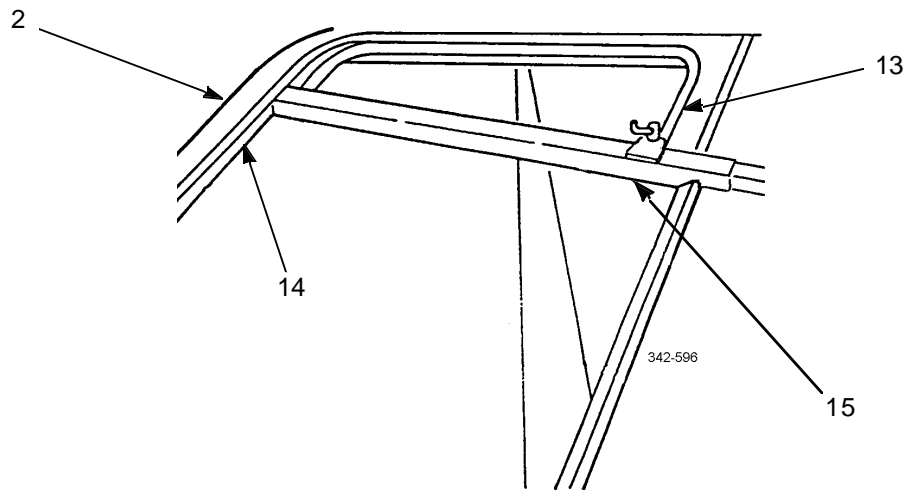


21. Install four washers (20), cap screws (19), bracket (18), four washers (17), and nuts (16).

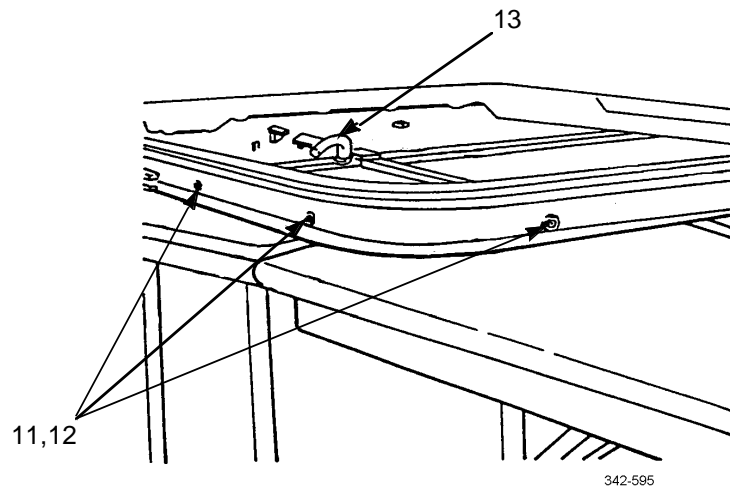


ASSEMBLY - CONTINUED

22. Install vent window (13) in door (2).
23. Install window channel (15) in vent window (13).
24. Install remainder of window channel (14) in door (2).

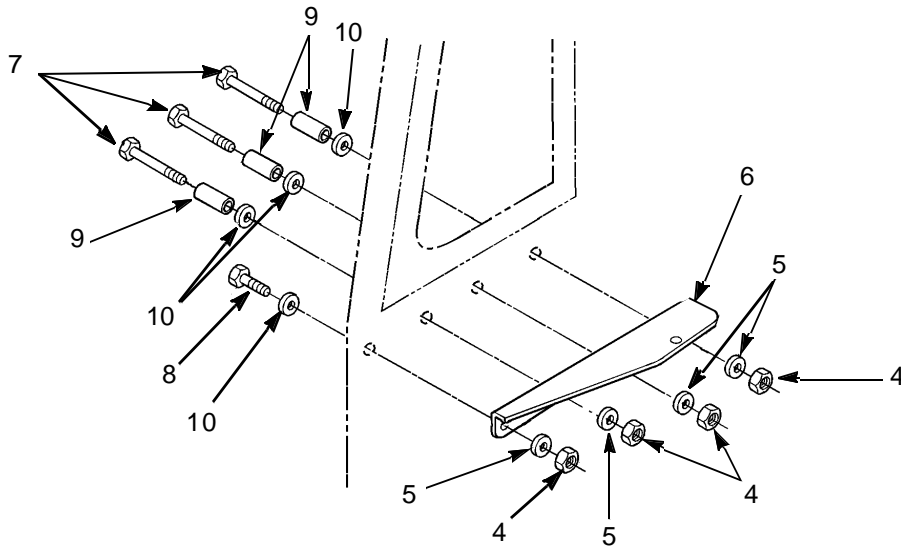


25. Install three washers (12) and screws (11) in vent window (13).



ASSEMBLY - CONTINUED

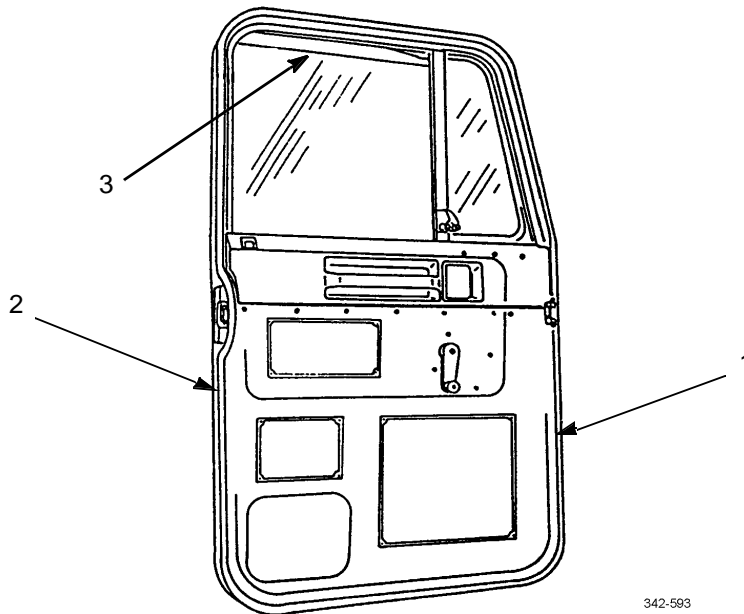
26. Install four washers (10), three spacers (9), cap screw (8), three screws (7), bracket (6), four washers (5), and nuts (4).



342-594

27. Raise window glass (3).

28. If removed, install new seal (1) on door (2) and apply sealing compound to each end of seal joint.



342-593

29. Install cab door (WP 0107 00).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Cleaning and Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Gloves (Item 41, WP 0126 00)

Wrench set, socket attachment, torx (Item 142, WP 0126 00)

Materials/Parts

Mount, resilient, locking strip (P/N 18-23531-00)

Materials/Parts - Continued

Seal, nonmetallic, special (P/N 18-23530-00)

Detergent (Item 19, WP 0125 00)

Personnel Required

Two

Equipment Condition

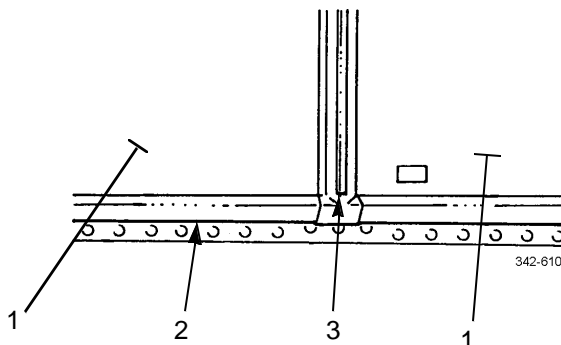
Windshield wiper and wiper arms removed (TM 9-2320-302-20)

REMOVAL

NOTE

Steps 1 through 3 are the same for each windshield glass.

1. If windshield glass (1) is cracked due to any cause other than being hit by a flying object, mark seal (2) at location of crack.
2. Using windshield pick, remove and discard lockstrip (3).



REMOVAL - CONTINUED

WARNING

Wear protective gloves when handling glass. Failure to do so could result in injury to personnel.

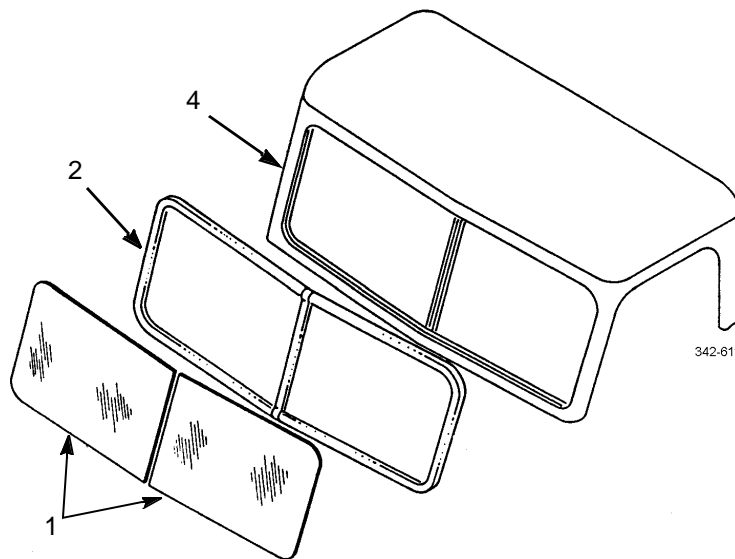
CAUTION

When handling windshield glass, be careful not to nick or splinter edges of glass. Chipped edges could cause cracking later.

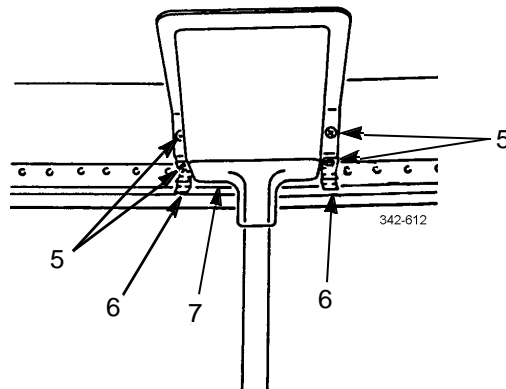
NOTE

If removing windshield glass only, perform step 3. If removing seal or windshield glass and seal, perform steps 3 through 11.

3. Apply pressure to edge of windshield glass (1) from inside cab (4). Using windshield pick, lift windshield glass out of seal (2) and remove.
4. Remove seal (2) from mounting flange of cab (4).

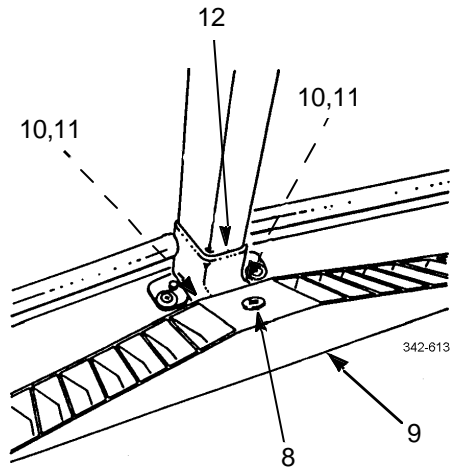


5. Remove torx screws (5), two brackets (6), and cover (7).

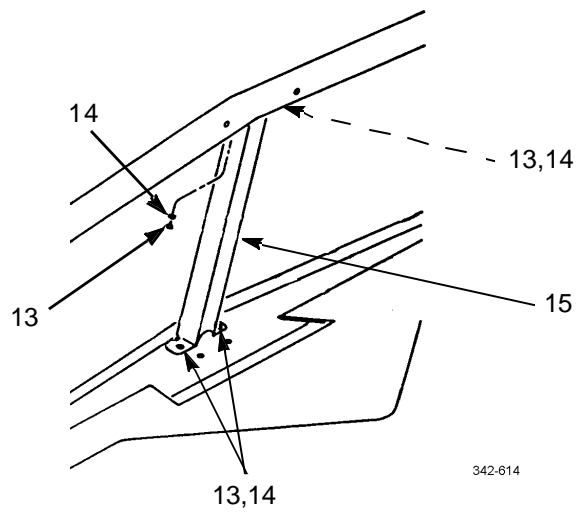


REMOVAL - CONTINUED

6. Remove torx screw (8) and defroster vent (9).
7. Remove two torx screws (10), washers (11), and cover (12).

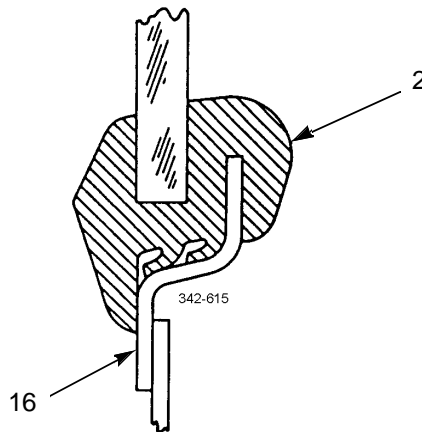


8. Remove four screws (13), washers (14), and windshield support (15).

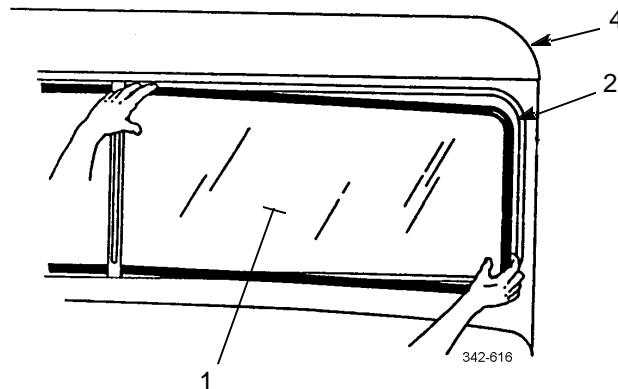


REMOVAL - CONTINUED

9. Cut away portion of seal (2) molded around cab flange (16).



10. Remove each windshield glass (1) and seal (2) as an assembly from cab (4).
 11. Remove seal (2) from each windshield glass (1).

**CLEANING AND INSPECTION**

1. Use general cleaning methods to clean all parts (TM 9-2320-302-20).
2. If windshield is removed due to criteria outlined in Removal step 1, inspect channel of seal (where marked) for foreign objects, and inspect mounting flange of cab for irregularities.
3. Inspect all parts for wear or damage.

INSTALLATION**WARNING**

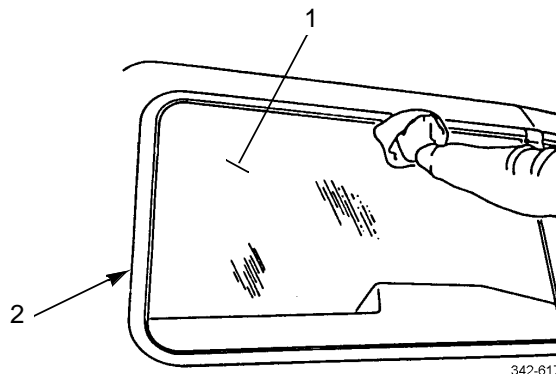
Wear protective gloves when handling glass. Failure to do so could result in injury to personnel.

CAUTION

- When handling windshield glass, be careful not to nick or splinter edges of glass. Chipped edges could cause cracking later.
- Do not use windshield sealant. Windshield sealant compounds are not needed and, if applied unevenly, can cause leaks resulting in water damage.

NOTE

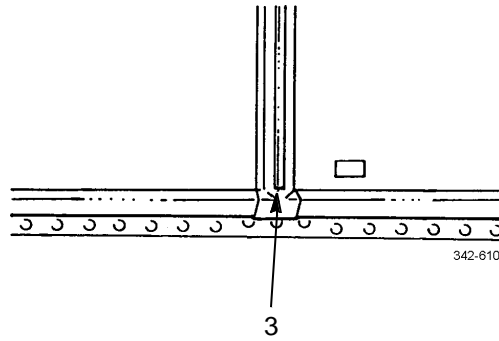
- Manufacturer's ID number must be at lower center corner of windshield glass when installed.
 - If installing windshield glass only, perform steps 1 through 7. If installing seal or windshield glass and seal, perform steps 8 through 23.
 - Steps 1 through 7 are the same for each windshield glass.
1. Lubricate window channel of seal (2) with soap and water solution.
 2. Slide windshield glass (1) into window channel of seal (2) as far as it will go without forcing.
 3. Stretch seal (2) around outside of windshield glass (1) and install windshield glass in window channel of seal.
 4. Using windshield pick, alternate between top and bottom of mounting flanges of cab (4) to work seal (2) over mounting flange.
 5. With assistant pushing lightly on outside of windshield glass (1), finish working seal (2) over mounting flange of cab (4).
 6. Finish sealing windshield glass (1) and seal (2) by gently pushing all the way around outside edge.



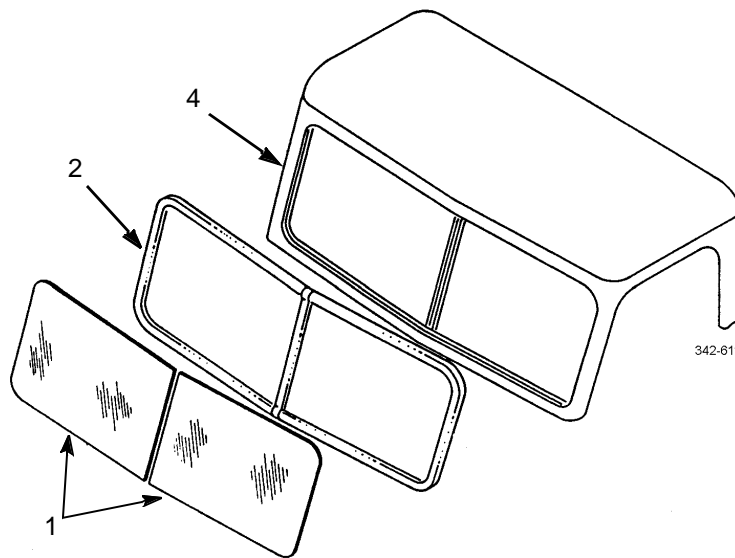
342-617

INSTALLATION - CONTINUED

7. Install new lockstrip (3).

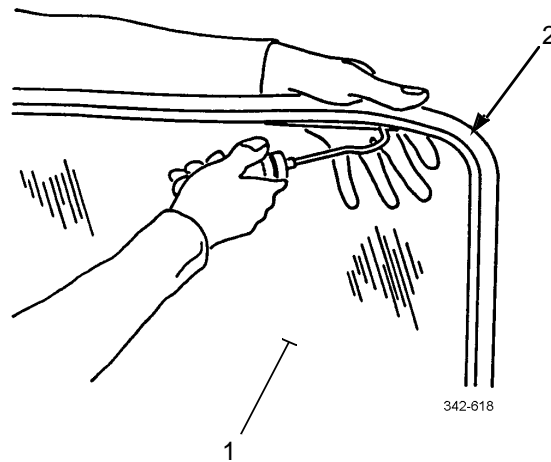


8. Install each windshield glass (1) in center strip of seal (2) until windshield glass bottoms out in channel of seal.
9. Install outside edge of seal (2) on outside edge of each windshield glass (1) until windshield glass bottoms out in channel of seal.
10. Install remainder of seal (2) on each windshield glass (1) until windshield glass bottoms out in channel of seal.

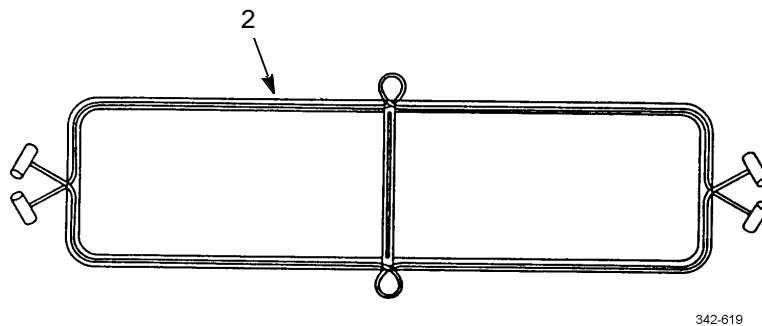


INSTALLATION - CONTINUED

11. Using windshield pick, go all the way around between each windshield glass (1) and seal (2) to make sure seal is properly seated.



12. Install two cords in outside groove in seal (2) and leave safety loops in center.
13. Using soap and water solution, lubricate cord channel of seal (2).

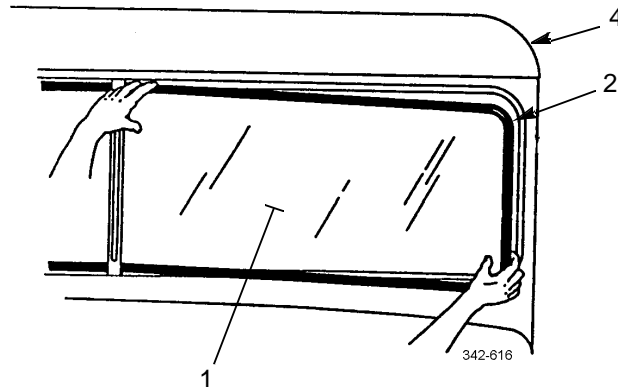


INSTALLATION - CONTINUED

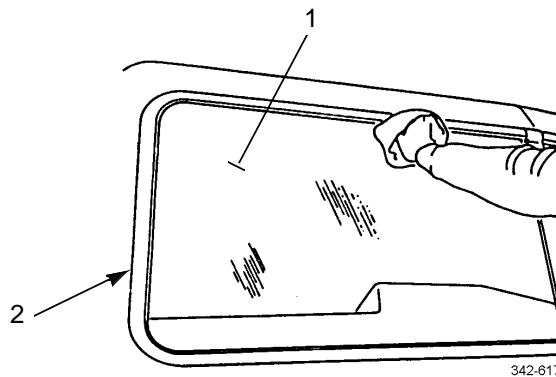
14. Wet mounting flange of cab (4) with clear water.
15. Place windshield glass (1) assembly into windshield opening of cab (4).
16. With assistant pushing lightly on bottom center of windshield glass (1) assembly, pull one end of lower cord around corner of windshield glass assembly; go to other side and pull lower cord around other corner of windshield glass assembly. Have assistant push lightly at top center of windshield assembly. Repeat for top cord.

NOTE

- If cord binds or starts to tear seal, use safety loop at center and pull back toward point where cord is bound.
 - If safety loop is not needed, it will pull out when cord is pulled to seat final portion of seal.
17. With assistant applying light pressure to center of windshield glass (1) assembly, pull both ends of either top or bottom cord alternately until only a few inches from center (pull both ends at same time). Repeat for other cord.

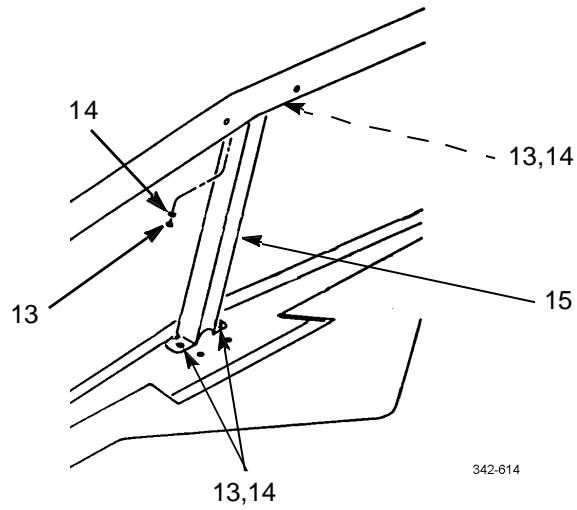


18. Finish seating windshield glass (1) and seal (2) by gently pushing all the way around outside edge.



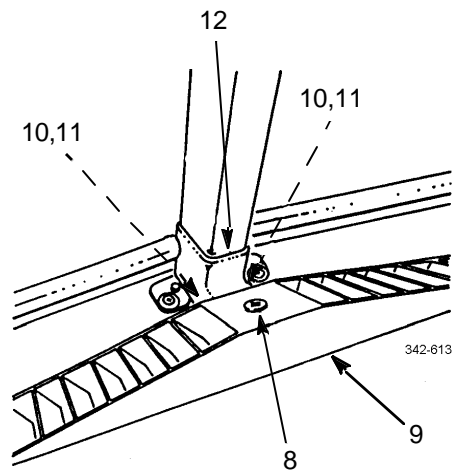
INSTALLATION - CONTINUED

19. Install windshield support (15) with four washers (14) and screws (13).



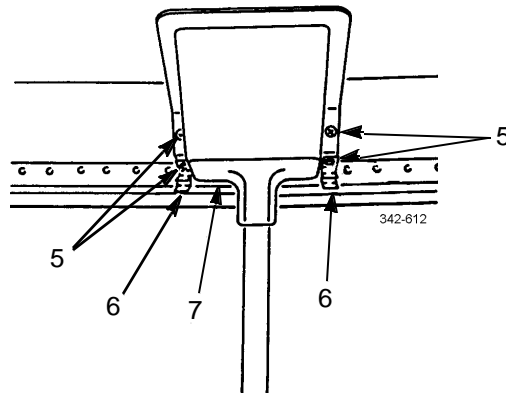
20. Install cover (12) with two washers (11) and torx screws (10).

21. Install defroster vent (9) with torx screw (8).

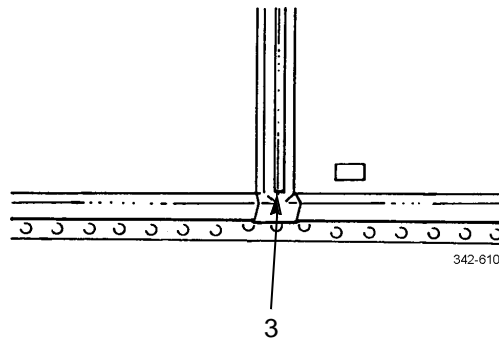


INSTALLATION - CONTINUED

22. Install cover (7), two brackets (6), and four torx screws (5).



23. Install new lockstrip (3).



24. Install windshield wiper and wiper arms (TM 9-2320-302-20).

END OF WORK PACKAGE

REAR WINDOW REPLACEMENT

0110 00

THIS WORK PACKAGE COVERS

Removal, Cleaning and Inspection, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Gloves (Item 41, WP 0126 00)

Materials/Parts

Compound, sealing (Item 14, WP 0125 00)

Detergent (Item 19, WP 0125 00)

Personnel Required

Two

REMOVAL

WARNING

Wear protective gloves when handling glass. Failure to do so could result in injury to personnel.

NOTE

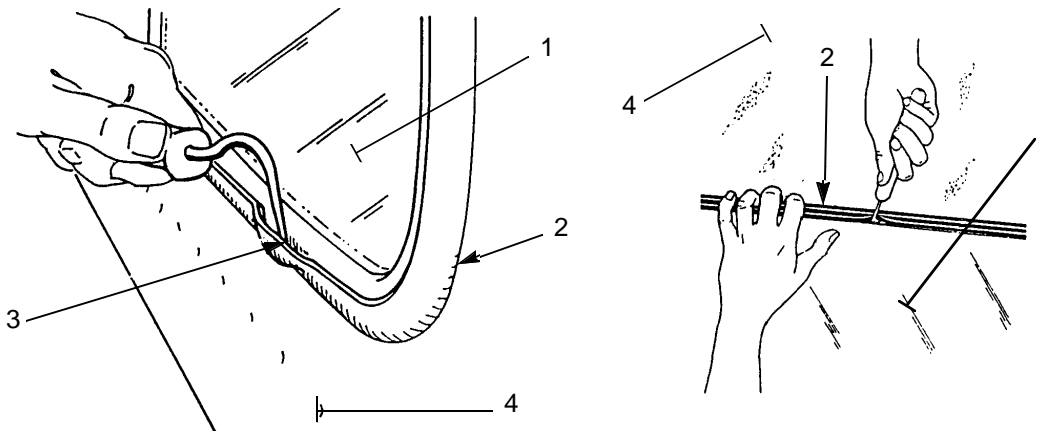
If removing rear window glass only, perform steps 1 through 3. If removing rear window glass and seal, perform steps 1 through 5.

1. If rear window glass (1) is cracked due to any cause other than being hit by a flying object, mark rubber extrusion (2) at location of crack.
2. Using windshield pick, release locking strip (3) from rubber extrusion (2).

CAUTION

When handling glass, be careful not to nick or splinter edges. Chipped edges could cause cracking later.

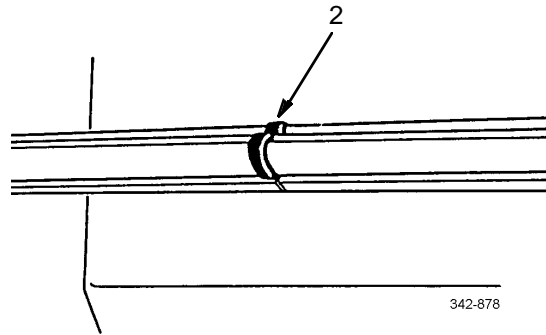
3. Apply pressure to one edge of rear window glass (1) from inside of cab (4). Using windshield pick, lift and remove rear window glass out of rubber extrusion (2).
4. Remove rubber extrusion (2) from cab (4).



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REMOVAL - CONTINUED

5. Remove sealing compound from between ends of rubber extrusion (2).

**CLEANING AND INSPECTION**

1. Use general cleaning methods to clean all parts (TM 9-2320-302-20).
2. If rear window glass has been removed under criteria outlined in Removal step 1, inspect channel of rubber extrusion where marked for foreign objects. Inspect mounting flange of cab for irregularities.
3. Inspect all parts for wear or damage.

INSTALLATION**WARNING**

Wear protective gloves when handling glass. Failure to do so could result in injury to personnel.

CAUTION

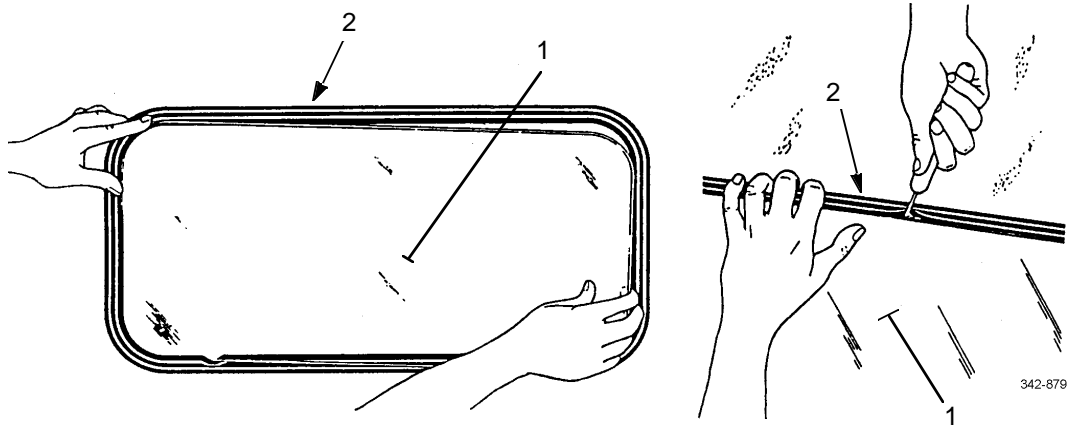
- When handling glass, be careful not to nick or splinter edges. Chipped edges could cause cracking later.
- Do not use sealant around rear window glass. Sealing compounds are not needed and, if applied unevenly, can cause leaks resulting in water damage.

NOTE

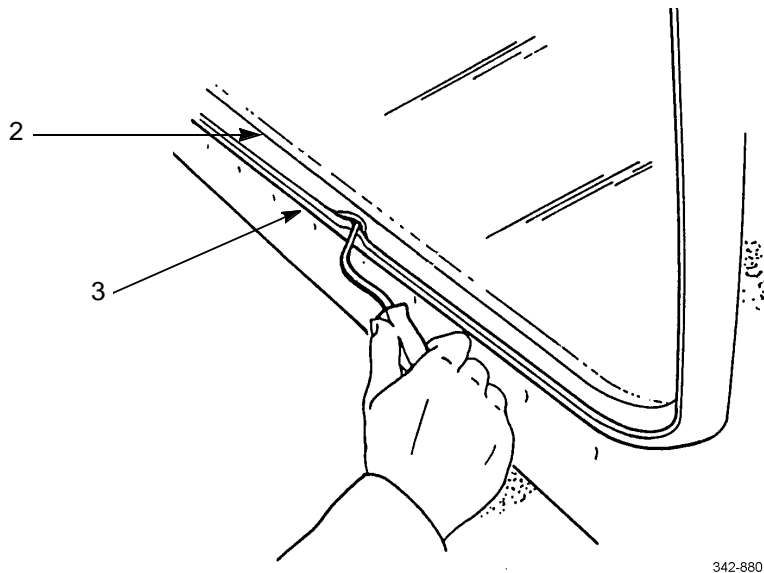
If installing rear window glass only, perform steps 1 through 4. If installing rear window glass and seal, perform steps 1 through 6.

1. Lubricate rear window channel of rubber extrusion (2) with detergent and water solution.
2. Slide rear window glass (1) into window channel of rubber extrusion (2) as far as it will go without forcing.
3. Using windshield pick, alternate between top and bottom or rear window glass (1) and work rubber extrusion (2) over edge of rear window glass.

INSTALLATION - CONTINUED

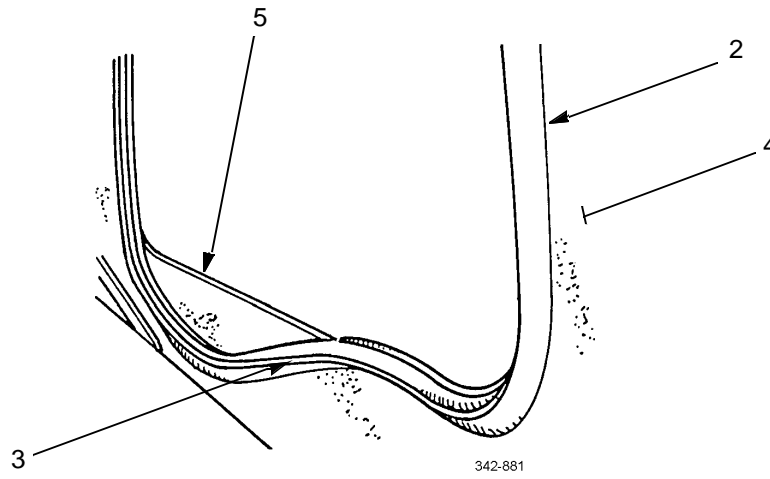


4. Using windshield pick, install locking strip (3) in rubber extrusion (2).

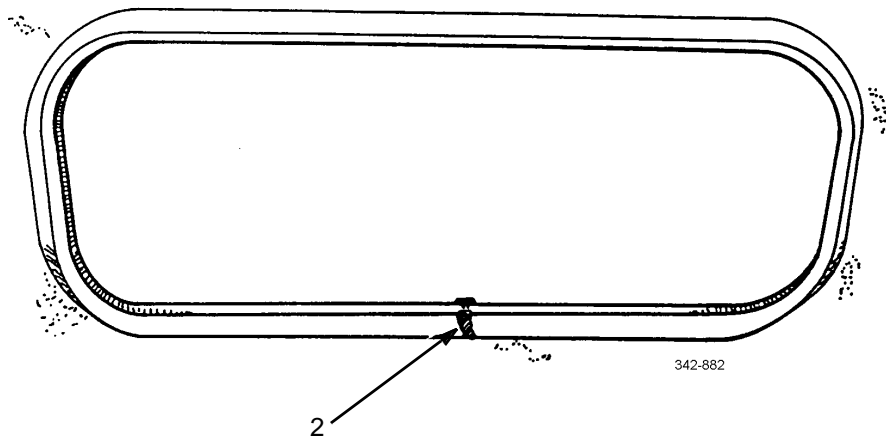


INSTALLATION - CONTINUED

5. With locking strip (3) facing out, install rubber extrusion (2) over mounting flange (5) of cab (4).



6. Apply sealing compound ONLY at point where both ends of rubber extrusion (2) meet.



END OF WORK PACKAGE

AIR DUCTS REPLACEMENT

0111 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

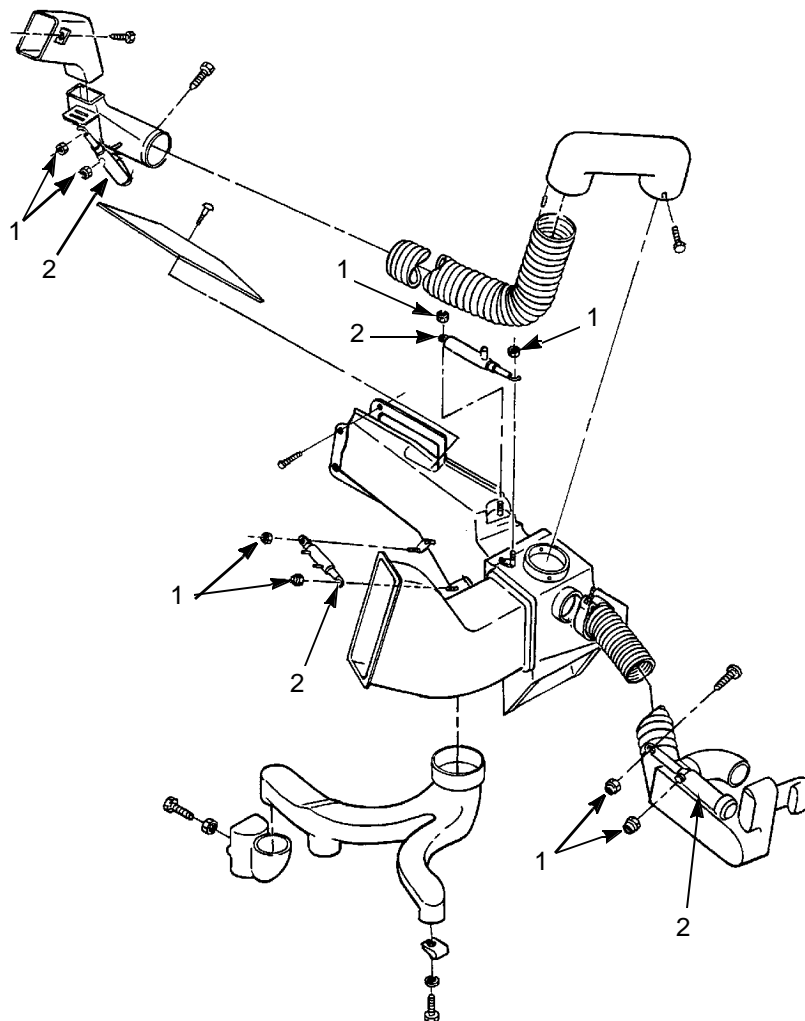
Equipment Condition

Air system drained (TM 9-2320-302-10)

Dash panels removed for access (TM 9-2320-302-20)

REMOVAL

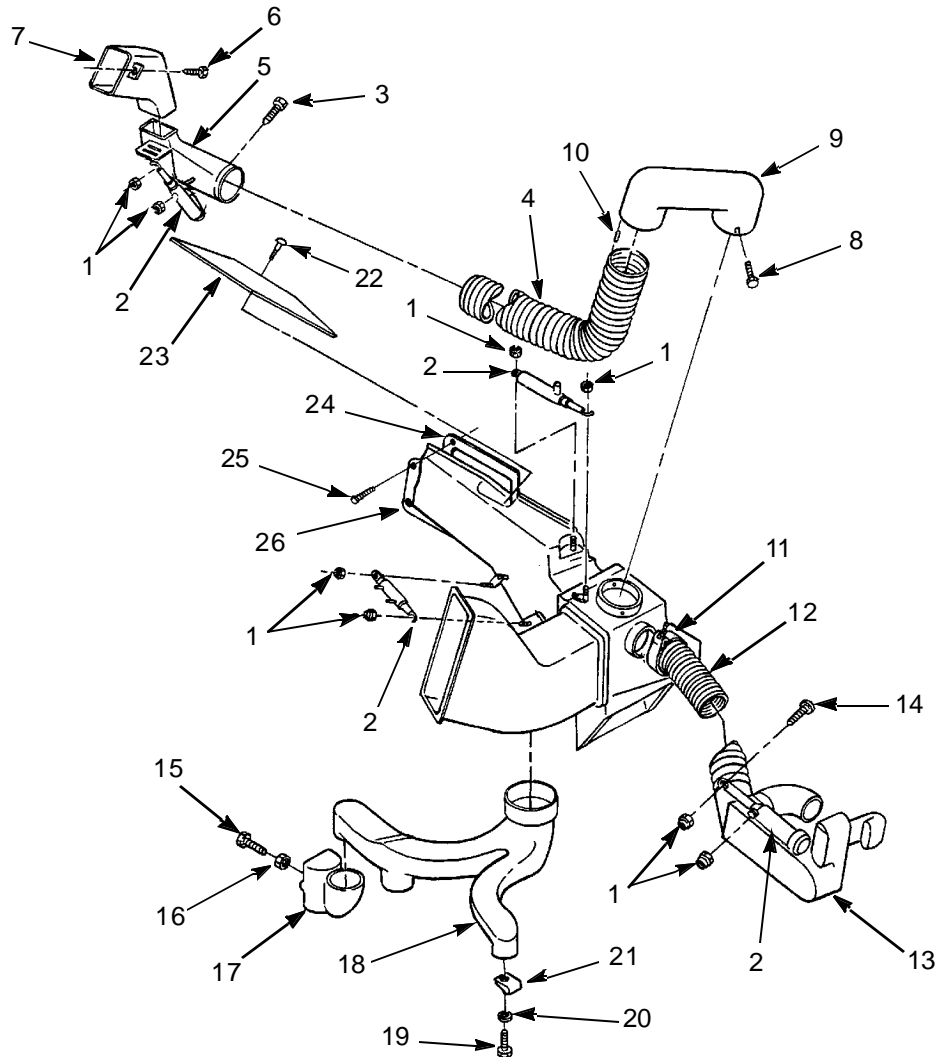
1. Remove eight retainers (1) and four air cylinders (2).



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REMOVAL - CONTINUED

2. Remove two self-tapping screws (3) and separate flex tubing (4) from duct (5).
3. Remove two screws (6), duct outlet (7), and duct (5).
4. Remove two self-tapping screws (8), duct (9), and flex tubing (4).
5. Remove five clips (10) and separate flex tubing (4) from duct (9).
6. Remove hose clamp (11), flex tubing (12), and duct outlet (13).
7. Remove two self-tapping screws (14) and separate flex tubing (12) from duct outlet (13).
8. Remove self-tapping screw (15), speed nut (16), and outlet duct (17) from duct (18).
9. Remove self-tapping screw (19), washer (20), spring nut (21), and duct (18).
10. Remove screw (22), vent (23), and gasket (24).
11. Remove three self-tapping screws (25) and face duct (26).



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INSTALLATION

1. Install face duct (26) and secure with three self-tapping screws (25).
2. Install gasket (24), vent (23), and secure with screw (22).
3. Install duct (18) and secure with spring nut (21), washer (20), and self-tapping screw (19).
4. Secure outlet duct (17) to duct (18) with speed nut (16) and self-tapping screw (15).
5. Connect flex tubing (12) to duct outlet (13) and secure with two self-tapping screws (14).
6. Connect flex tubing (12) to face duct (26) and secure with hose clamp (11).
7. Connect flex tubing (4) to duct (9) and secure with five clips (10).
8. Connect duct (9) to face duct (26) and secure with two self-tapping screws (8).
9. Connect flex tubing (4) to duct (5) and secure with two self-tapping screws (3).
10. Install duct (5) to duct outlet (7) and secure with two screws (6).
11. Install four air cylinders (2) and secure with eight retainers (1).
12. Install dash panels (TM 9-2320-302-20).

END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Recovery, Evacuating/Recycling, Purging, Flushing, Charging

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Gloves, rubber (Item 40, WP 0126 00)

Goggles (Item 42, WP 0126 00)

Reclaimer, refrigerant (Item 99, WP 0126 00)

References

TM 9-2320-302-10

TM 9-2320-302-20

Materials/Parts

Adhesive, loctite (Item 2, WP 0125 00)

Cap set (Item 7, WP 0125 00)

Oil, refrigerant (Item 27, WP 0125 00)

Refrigerant, R-134a (Item 38, WP 0125 00)

**WARNING**

- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

RECOVERY

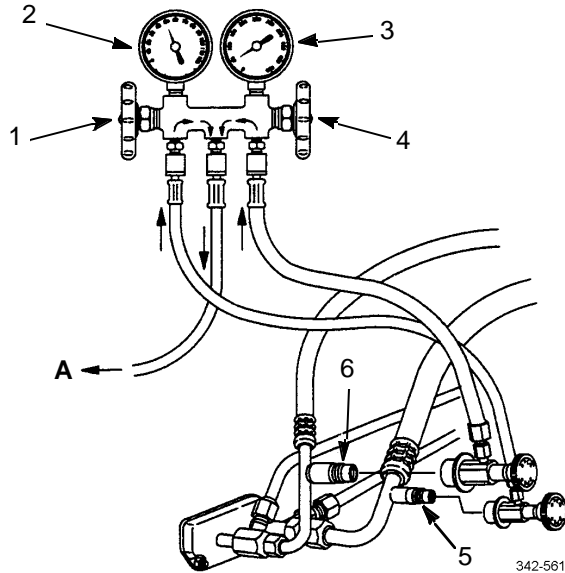
1. Remove caps from suction and discharge valves. Valves are located at firewall on passenger side of vehicle.
2. Wearing protective goggles and non-leather gloves, attach recovery/recycling station's hoses to valves.

NOTE

Push down firmly on hose connectors until a clicking sound is heard. This will ensure coupler is locked.

- a. Ensure recovery/recycling station's valves are closed.
- b. Connect red high-side hose to discharge service valve.
- c. Connect blue low-side hose to suction service valve.
- d. Turn knob clockwise on each coupler to open schrader valves.

RECOVERY - CONTINUED



- A To Recovery Station**
- 1 Manifold Suction Hand Valve (Open)
 - 2 Low-Side Gage
 - 3 High-Side Gage
 - 4 Manifold Discharge Hand Valve (Open)
 - 5 Suction Service Valve
 - 6 Discharge Service Valve

- 3. Follow recovery/recycling manufacturer's instructions and recover all refrigerant from system.

NOTE

- Always comply with all local regulations regarding refrigerant disposal. You may be subject to substantial penalties for improper disposal.
- Any time air conditioning system refrigerant is evacuated, replace receiver-drier.

- 4. Replace receiver-drier (WP 0118 00).

NOTE

If system is contaminated with moisture, compressor oil must be replaced with clean oil. If system is heavily contaminated with desiccant or grit, replace compressor and expansion valve.

- 5. Service air conditioner compressor (WP 0117 00).

EVACUATING/RECYCLING

NOTE

System must have been recovered and compressor filled with correct amount of refrigerant oil. Replace receiver-drier if system is opened.

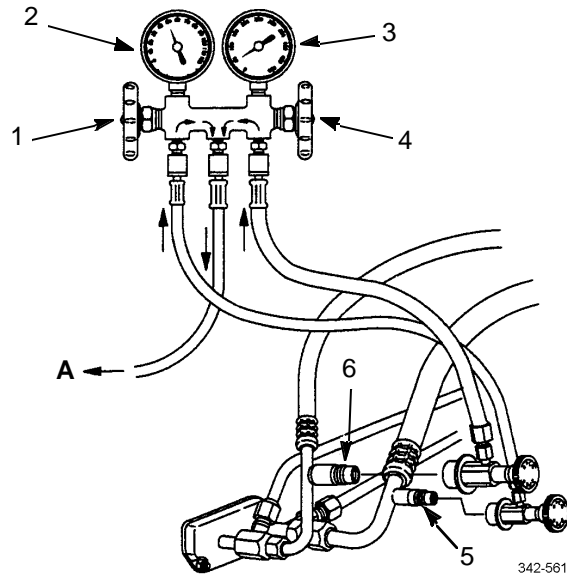
- 1. Wearing protective goggles and non-leather gloves, attach recovery/recycling station's hoses to valves.

NOTE

Push down firmly on hose connectors until a clicking sound is heard. This will ensure coupler is locked.

- a. Ensure recovery/recycling station's valves are closed.
- b. Connect red high-side hose to discharge service valve.
- c. Connect blue low-side hose to suction service valve.
- d. Turn knob clockwise on each coupler to open shradar valves.

EVACUATING/RECYCLING - CONTINUED



- A To Vacuum Pump**
- 1 Manifold Suction Hand Valve (Open)
- 2 Low-Side Gage
- 3 High-Side Gage
- 4 Manifold Discharge Hand Valve (Open)
- 5 Suction Service Valve
- 6 Discharge Service Valve

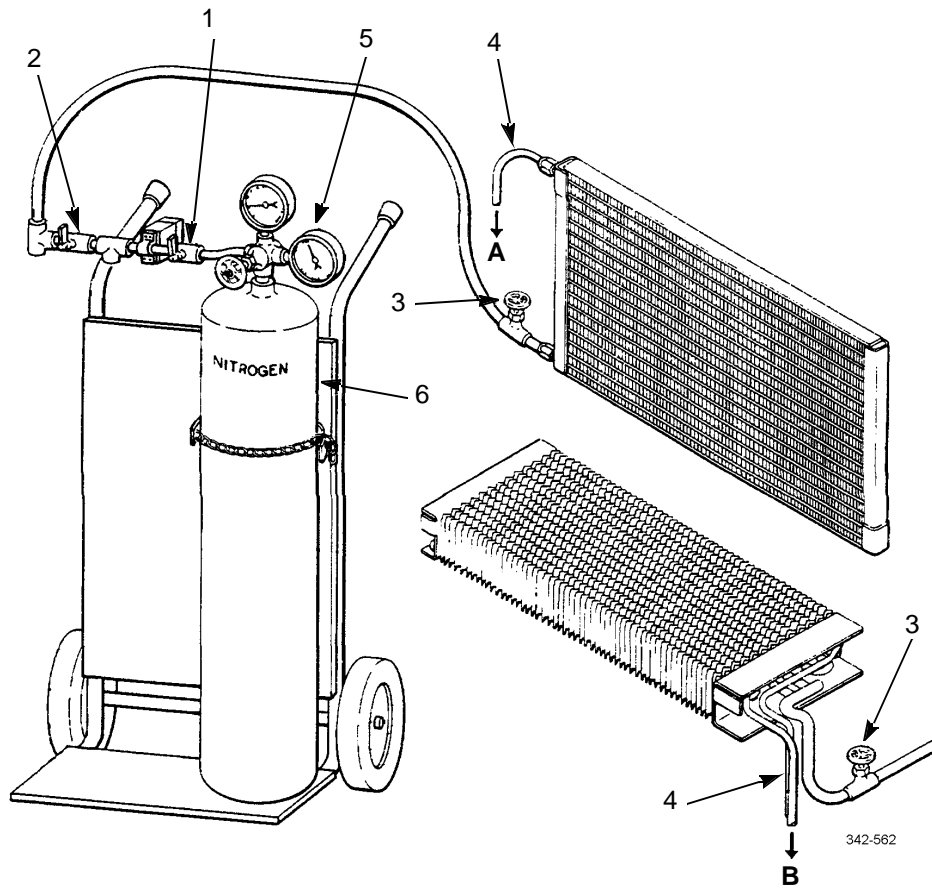
2. Follow recovery/recycling manufacturer's instructions and evacuate/recycle refrigerant system.

PURGING

NOTE

Dry nitrogen gas is recommended for purging. A pressure regulator is required to regulate between 0 to 200 psi (0-1379 kPa). Commercial cylinders of nitrogen contain pressures in excess of 2000 psi (13,780 kPa); this pressure must be reduced to 200 psi (1379 kPa) for purging.

1. Recover system refrigerant.
2. Disconnect both ends of line or part being purged. Tightly cap rest of system.
3. Ensure valves (1, 2, and 3) are closed.



<p>A</p> <p>1 Nitrogen Bottle Control Valve</p> <p>2 Purging Control Valve</p> <p>3 Supply Line Valve</p>	<p>B</p> <p>4 Drain Line</p> <p>5 Nitrogen Bottle Regulator/Gage</p> <p>6 Nitrogen Bottle</p>
--	--

4. Connect supply line valve (3) to outlet end of part or line.
5. Connect drain line (4) to inlet end of part or line.
6. Place outlet of drain line into a recycling system container.

PURGING - CONTINUED

7. Adjust nitrogen bottle regulator (5) to 200 psi (1379 kPa). Open nitrogen bottle control valve (1) and purging control valve (2). Then, slowly open supply line valve (3). Check drain line (4) for gas flow.
8. Let nitrogen flow at 200 psi (1379 kPa) and let it flow for 1 to 2 minutes. If part or line was very wet, allow it to flow until there is no trace of refrigerant oil or solid bits of dirt or grit flowing from drain tube.
9. Close nitrogen bottle control valve (1) and purging control valve (2) first, then close supply line valve (3).
10. Disconnect supply line valve (3) and drain line (4). Tightly cap both ends of part or line.

FLUSHING

1. Recover refrigerant system.
2. Disconnect both ends of part or line being flushed. Tightly cap lines to rest of system.
3. Heat R-134a refrigerant in a dial-a-charge or pressurize refrigerant as recommended by manufacturer.
4. Connect dial-a-charge outlet hose to outlet side of system (this will ensure that R-134a will flow in reverse direction of normal flow).
5. Connect a line from inlet side of system to a recovery/recycling station.

NOTE

If system is extremely contaminated, install a receiver-drier inline as a pre-filter for recovery/recycling station.

6. Turn on recovery/recycling station and open outlet valve for dial-a-charge. Allow about 2 pounds (1 kilogram) of R-134a to flow through system.
7. Close supply line valve and wait for recovery station to shut off.
8. Disconnect supply line and drain line from dial-a-charge and recovery station. Connect lines to nitrogen bottle.
9. Purge system and check collection bottle for contaminants. Repeat process if needed.
10. Disconnect lines from part and tightly cap both ends of part.

CHARGING**NOTE**

Before charging, system must be recovered and evacuated with recovery and recycling station connected to service and discharge port connections.

1. Obtain enough refrigerant to fully charge system. Set tank on a scale and weigh for correct amount of refrigerant to enter system. This prevents overcharging, which could cause damage to compressor.
2. Charge refrigerant system:

NOTE

If equipped with a recovery, recycling, and recharging system, charge system on high side following manufacturer's instructions. If charging from a bulk container, perform following steps:

- a. Turn tank (bulk container) upside down. With engine off, open high side hand valve. DO NOT open low side hand valve.
- b. Allow refrigerant to enter system until correct charge (by weight) has entered. Close high side hand valve.
- c. Start engine and run it at 1500 rpm. Set cab air conditioner controls at maximum cooling and fan speed; refrigerant compressor must engage.

CHARGING - CONTINUED

- d. If a charge did not enter system, place tank (bulk container) in upright position, then open LOW SIDE valve to draw vapor into system; leave valve open until correct weight of refrigerant has entered system, then close low side valve.

NOTE

If refrigerant is slow to enter system because of low outside temperatures, vaporization can be quickened by placing refrigerant tank in a tub of warm water, no warmer than 125°F (52°C).

3. Disconnect high side hose. With engine running, open low side and high side hose valves to recover refrigerant from lines.
4. Shut down engine.
5. Leak test air conditioning system (TM 9-2320-302-20).
6. Check operation of air conditioning system (TM 9-2320-302-10).

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

- Tool kit, general mechanic's (Item 132, WP 0126 00)
- Dispenser, sealant (Item 30, WP 0126 00)
- Gloves, rubber (Item 40, WP 0126 00)
- Goggles (Item 42, WP 0126 00)
- Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

- Packing, preformed (P/N 2-011C944-70)
- Packing, preformed (P/N 2-015C944-70)
- Adhesive, loctite (Item 2, WP 0125 00)

Materials/Parts - Continued

- Cap set (Item 7, WP 0125 00)
- Compound, gasket forming (Item 12, WP 0125 00)
- Oil, refrigerant (Item 27, WP 0125 00)
- Rags, wiping (Item 31, WP 0125 00)
- Tags, marker (Item 35, WP 0125 00)
- Tape, insulation (Item 36, WP 0125 00)

Personnel Required

Two

References

TM 9-2320-302-20

Equipment Condition

- Cooling system drained (TM 9-2320-302-20)
- Refrigerant recovered (WP 0112 00)



WARNING



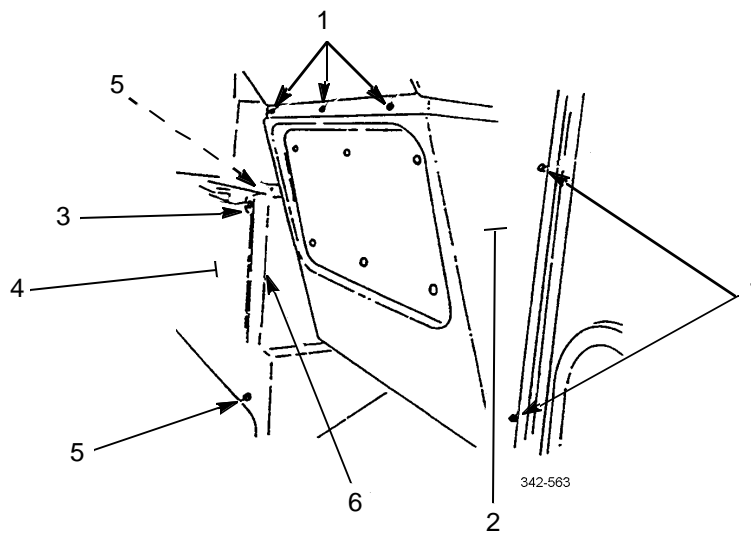
- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

REMOVAL

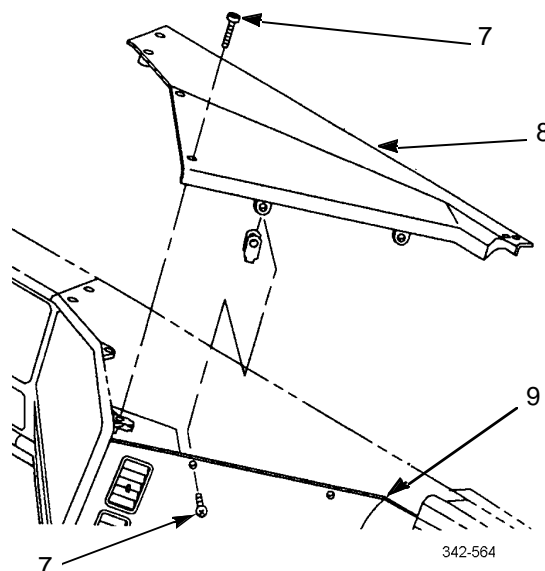
NOTE

Tag all lines and wires prior to removal to aid in installation.

1. Remove nine screws (1) and cover (2).
2. Remove three screws (3) and cover (4).
3. Remove two screws (5) and cover (6).

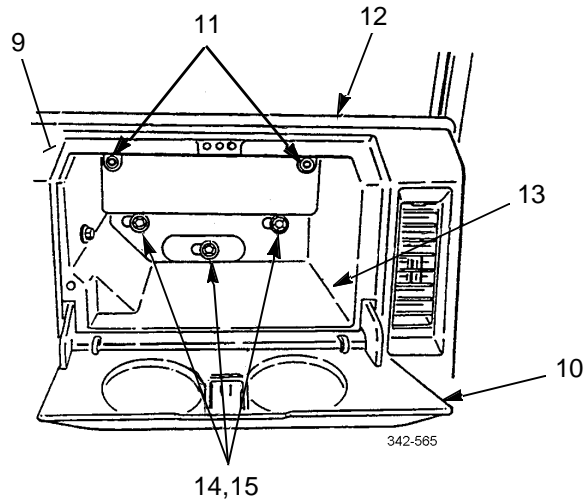


4. Remove seven screws (7) and cover (8) from dash (9).

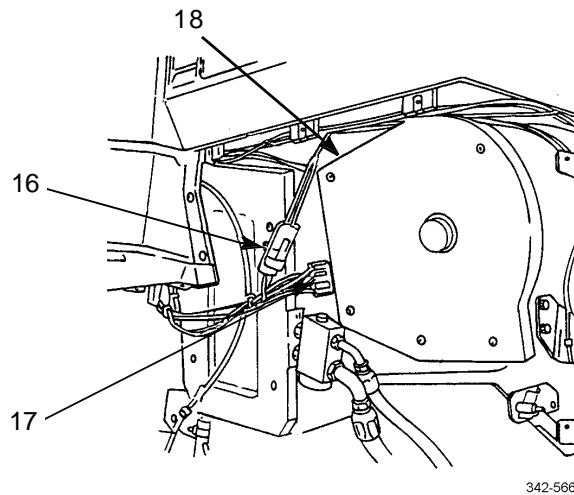


REMOVAL - CONTINUED

5. Open glove box door (10) and remove two screws (11) and top panel (12) from compartment (13).
6. Remove three nuts (14), spring washers (15), and compartment (13) from dash (9).

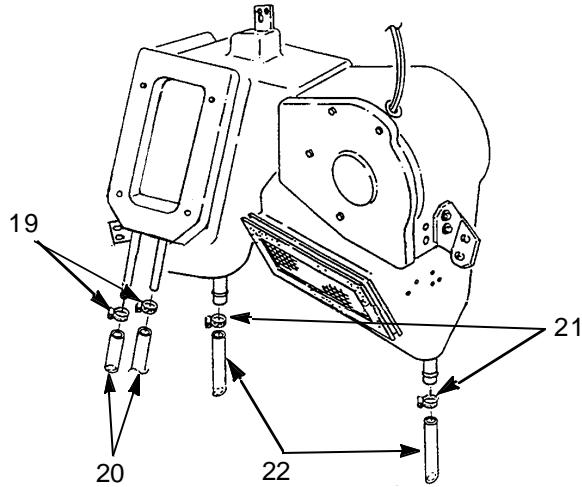


7. Disconnect two flex hoses from ducts behind compartment (13).
8. Disconnect blue air line from air cylinder behind compartment (13).
9. Disconnect connectors for blower motor (16), resistor block (17), and thermostatic switch (18).



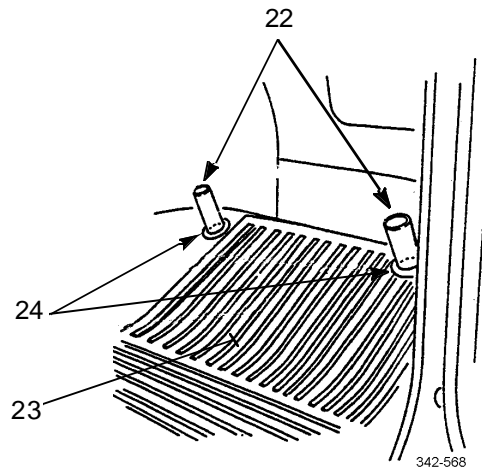
REMOVAL - CONTINUED

10. Place rags on cab floor, loosen two hose clamps (19), and remove heater core hoses (20).
11. Loosen two hose clamps (21) and remove drain tubes (22).



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12. On cab floor (23), remove sealant (24) from drain tubes (22) and remove drain tubes.



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WARNING

Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.

REMOVAL - CONTINUED

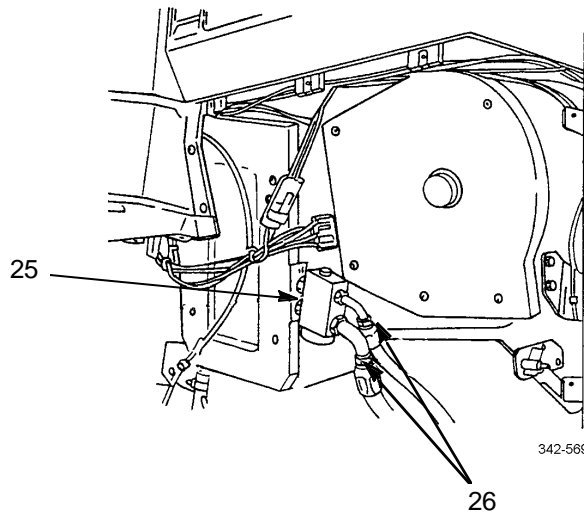
CAUTION

Water and dirt can damage refrigerant system. Five minutes of not being capped is the limit for any hose or component. DO NOT blow shop air through refrigerant hoses. Shop air is wet (humid).

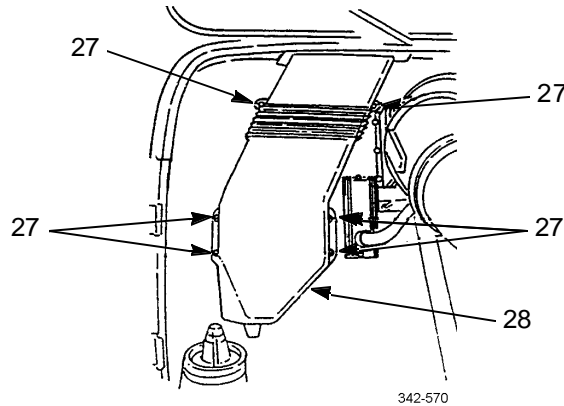
NOTE

DO NOT disconnect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

13. Remove insulation tape from expansion valve (25). Disconnect two refrigerant lines (26) from expansion valve.
14. Cap expansion valve (25) and refrigerant lines (26)

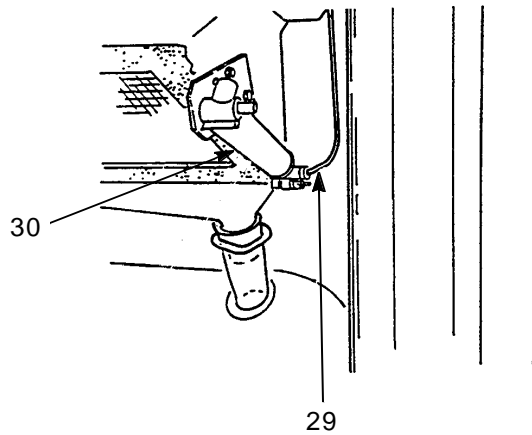


15. Remove six screws (27) and fresh air duct assembly (28) on engine side of cab firewall.
16. Remove gasket forming compound from duct and push rubber boot inside cab.



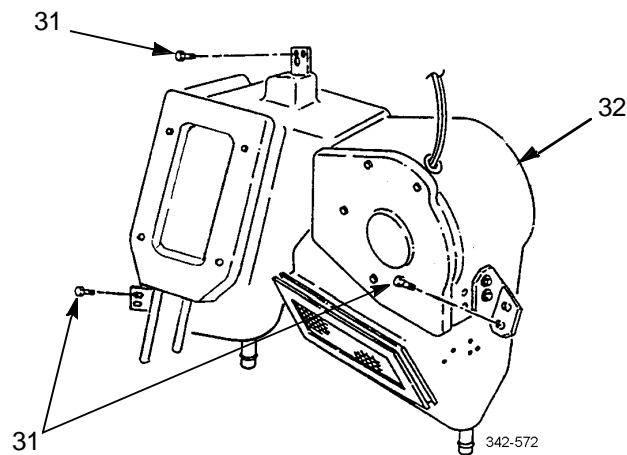
REMOVAL - CONTINUED

17. Disconnect air line (29) from air cylinder (30) by pushing in on cover ring, then pulling out on air line.



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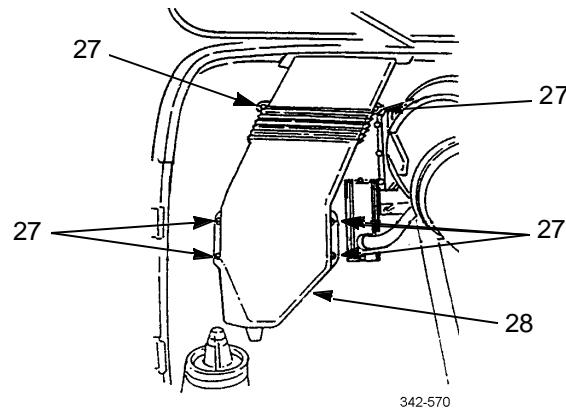
18. Remove six screws (31) holding HVAC unit (32) in place.
19. With assistance, lift HVAC unit (32) from vehicle.



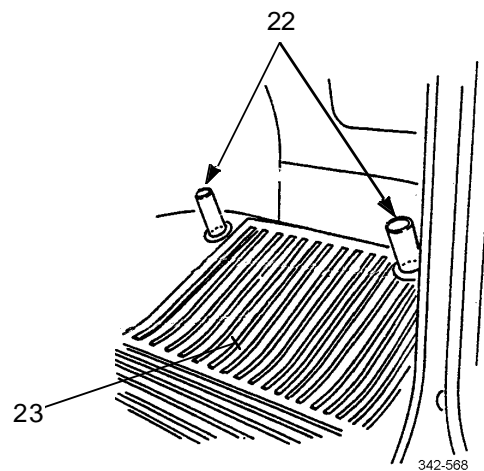
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INSTALLATION

1. With assistance, lift HVAC unit (32) into vehicle.
2. Secure HVAC unit (32) with six screws (31). Tighten screws to 48 lb-ft (65 Nm).
3. Connect air line (29) to air cylinder (30) by pushing air line into fitting as far as it will go, then gently pulling back on air line to lock it in place.
4. Pull rubber boot through firewall from engine side.
5. On engine side of fire wall, apply gasket forming compound to fresh air duct assembly (28) and secure with six screws (27).

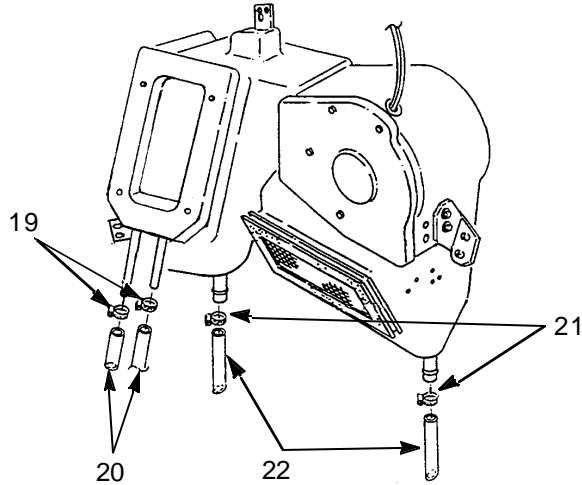


6. Slide drain tubes (22) through openings in cab floor (23).



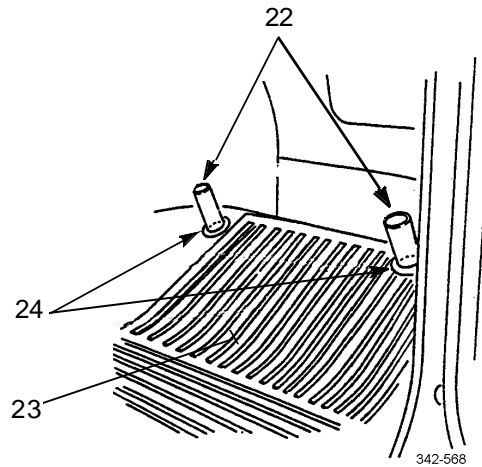
INSTALLATION - CONTINUED

7. Connect drain tubes (22) and secure with two hose clamps (21).
8. Install heater core hoses (20) and tighten two hose clamps (19).



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9. Apply sealant (24) around drain tubes (22) on cab floor (23).



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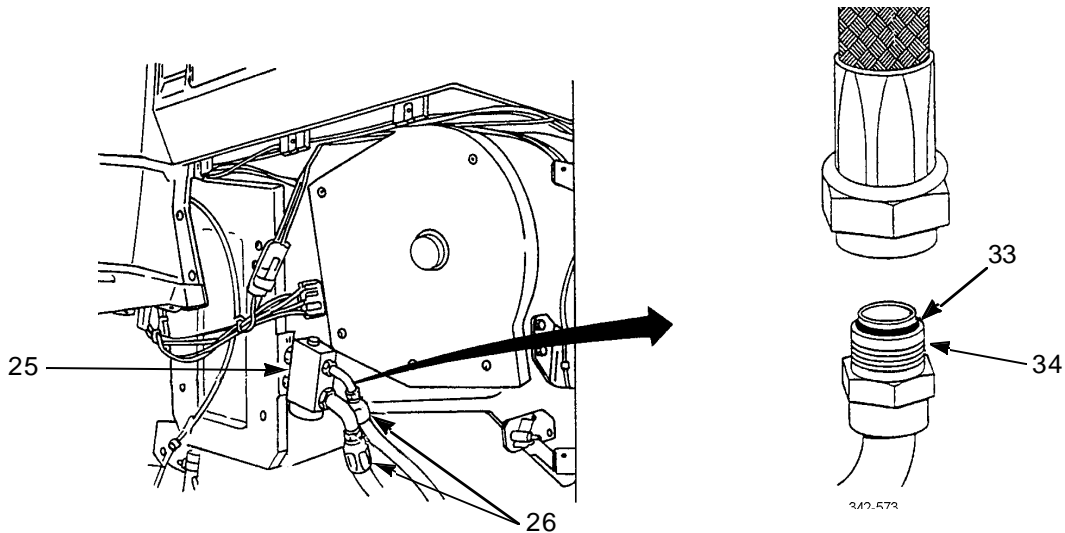
WARNING

Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.

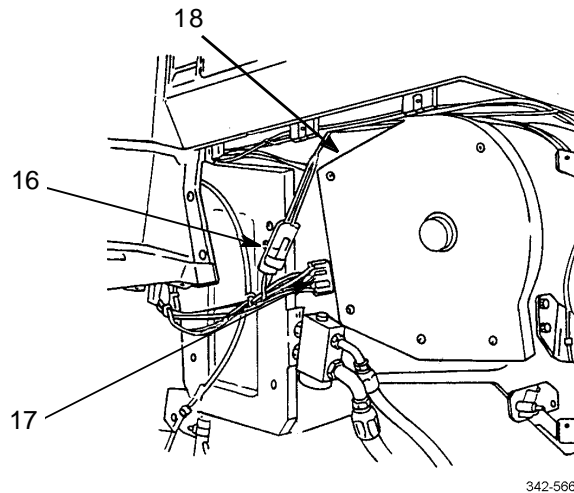
10. Remove caps from refrigerant lines (26) and expansion valve (25).

INSTALLATION - CONTINUED

11. Install new preformed packings (33) and lubricate them with refrigerant oil.
12. Apply loctite to male fitting threads (34) and connect two refrigerant lines (26) to expansion valve (25). Remove tags.
13. Torque refrigerant line connections (WP 0123 00)



14. Apply insulation tape to refrigerant lines (26) and expansion valve (25).
15. Connect connectors for blower motor (16), resistor block (17), and thermostatic switch (18).



16. Connect blue air line to air cylinder behind compartment (13).
17. Connect two flex hoses to ducts behind compartment (13).

NOTE

Any time air conditioning system is evacuated, replace receiver-drier.

18. Replace receiver-drier (WP 0118 00).

INSTALLATION - CONTINUED

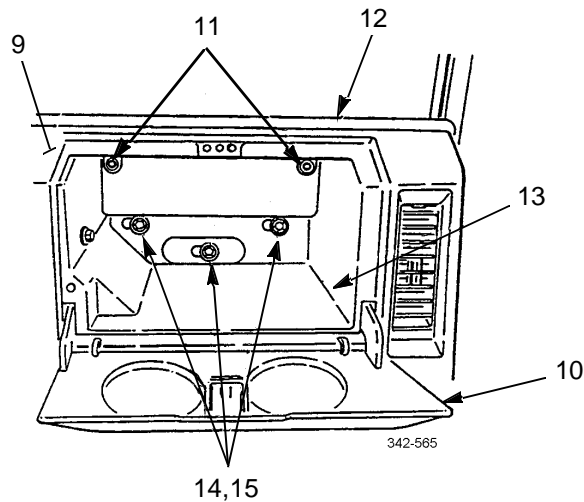
19. Charge system with refrigerant (WP 0112 00).
20. Add refrigerant oil to compressor to replace that which was lost during system discharge (WP 0116 00).



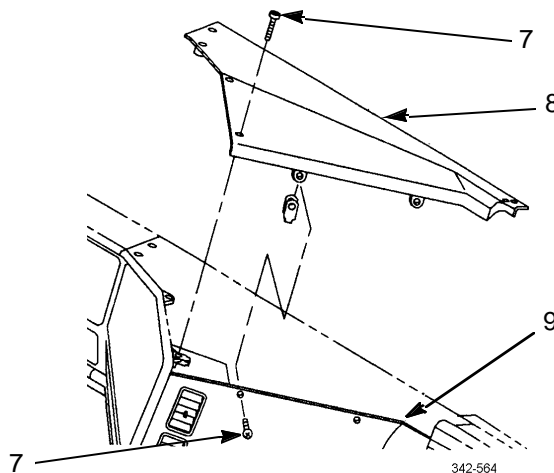
WARNING

Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

21. Leak test air conditioner system (TM 9-2320-302-20).
22. Install compartment (13) into dash (9) and secure with three nuts (14) and spring washers (15).
23. Install top panel (12) to compartment (13) and secure with two screws (11).

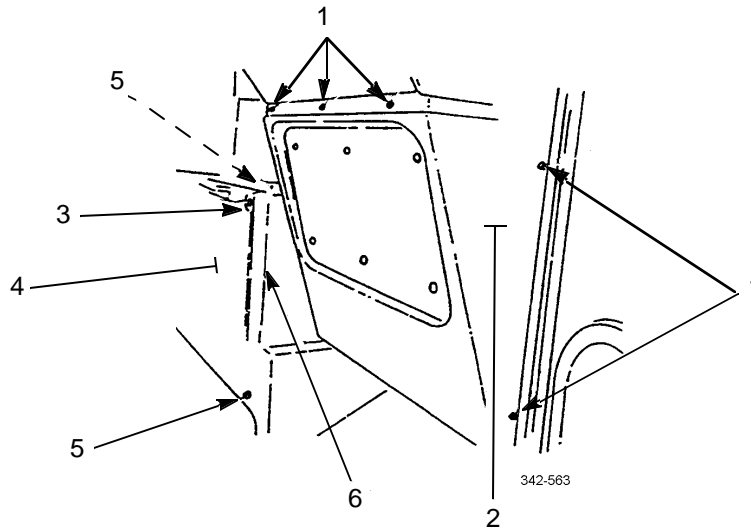


24. Position cover (8) on dash (9) and secure with seven screws (7).



INSTALLATION - CONTINUED

25. Position cover (6) on dash (9) and secure with two screws (5).
26. Position cover (4) on dash (9) and secure with three screws (3).
27. Position cover (2) on dash (9) and secure with nine screws (1).



END OF WORK PACKAGE

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THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP

Maintenance Level

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Crowfoot attachment set (Item 28, WP 0126 00)

Gloves, rubber (Item 40, WP 0126 00)

Goggles (Item 42, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Packing, preformed (P/N 2-011C944-70)

Packing, preformed (P/N 2-015C944-70)

Adhesive, loctite (Item 2, WP 0125 00)

Materials/Parts - Continued

Cap set (Item 7, WP 0125 00)

Caulk, strip (Item 8, WP 0125 00)

Oil, refrigerant (Item 27, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Tape, insulation (Item 36, WP 0125 00)

References

TM 9-2320-302-20

Equipment Condition

Refrigerant recovered (WP 0112 00)



WARNING

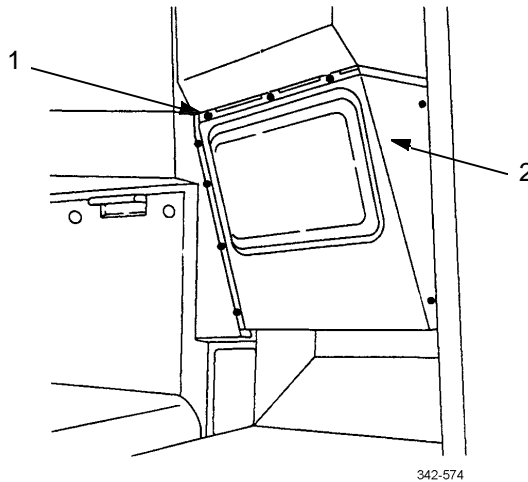


- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

REMOVAL**NOTE**

Tag all lines and wires prior to removal to aid in installation.

1. Remove nine screws (1) and cover (2).



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**WARNING**

Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.

2. Remove insulation tape and strip caulk around expansion valve (3).

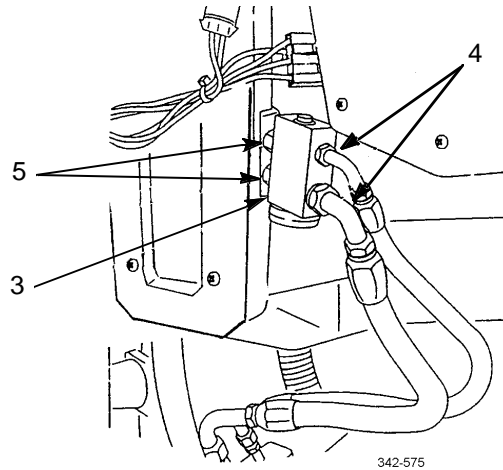
CAUTION

Water and dirt can damage refrigerant system. Five minutes of not being capped is the limit for any hose or component. DO NOT blow shop air through refrigerant hoses. Shop air is wet (humid).

NOTE

DO NOT disconnect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

3. Tag and disconnect refrigerant lines (4) and evaporator coil inlet and outlet lines (5) from expansion valve (3). Install plugs in refrigerant lines, evaporator coil inlet and outlet lines, and expansion valve. Discard preformed packings.

REMOVAL - CONTINUED

4. Remove expansion valve (3).

INSTALLATION

1. Remove plugs from refrigerant lines (4), evaporator coil inlet and outlet lines (5), and expansion valve (3).
2. Install new preformed packings and lubricate with refrigerant oil.
3. Apply loctite to male fitting threads and connect refrigerant lines (4) and evaporator coil inlet and outlet lines (5) to expansion valve (3).

NOTE

DO NOT connect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

4. Using wrenches, tighten evaporator coil lines (5) to 216 lb-in (25 Nm).
5. Tighten refrigerant lines (4): tighten large hose to compressor to 24 lb-ft (33 Nm); tighten small hose from receiver-drier to 144 lb-in (16 Nm).

NOTE

Any time air conditioning system refrigerant is evacuated, replace receiver-drier.

6. Replace receiver-drier (WP 0118 00).
7. Evacuate and charge system with refrigerant (WP 0112 00).
8. Add refrigerant oil to compressor to replace that which was lost during system discharge (WP 0116 00).

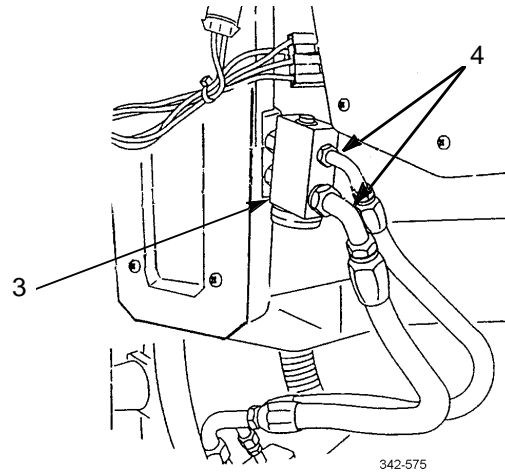
**WARNING**

Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.

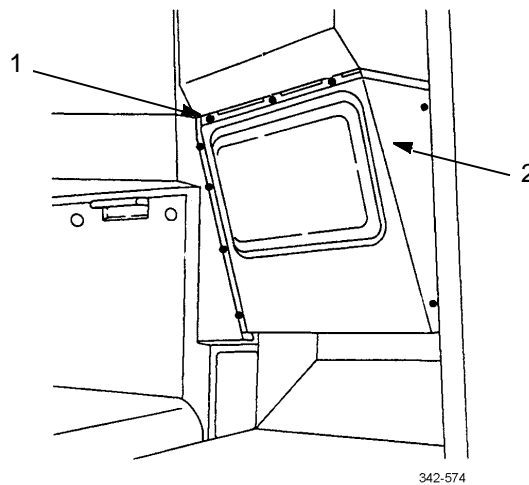
9. Leak test air conditioner system (TM 9-2320-302-20).

INSTALLATION - CONTINUED

10. Wipe expansion valve (3) and refrigerant line (4) connections clean. Wrap line connections with insulation tape.



11. Wrap expansion valve (3) with strip caulk.
12. Install dash panel (2) and nine screws (1).



END OF WORK PACKAGE

AIR CONDITIONER EVAPORATOR COIL REPLACEMENT**0115 00****THIS WORK PACKAGE COVERS**

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Crowfoot attachment set (Item 28, WP 0126 00)

Gloves, rubber (Item 40, WP 0126 00)

Goggles (Item 42, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Packing, preformed (P/N 2-011C944-70)

Packing, preformed (P/N 2-015C944-70)

Adhesive, loctite (Item 2, WP 0125 00)

Materials/Parts - Continued

Cap set (Item 7, WP 0125 00)

Caulk, strip (Item 8, WP 0125 00)

Oil, refrigerant (Item 27, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Tape, insulation (Item 36, WP 0125 00)

References

TM 9-2320-302-20

Equipment Condition

Refrigerant recovered (WP 0112 00)

**WARNING**

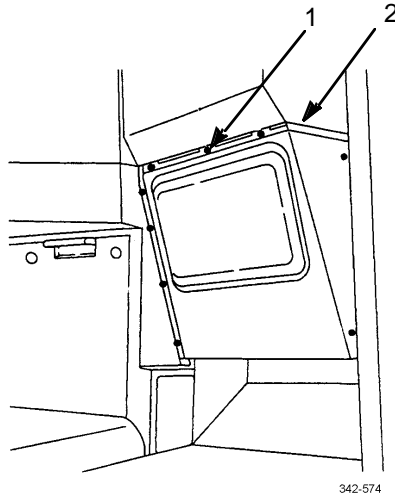
- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

REMOVAL**NOTE**

Tag all lines and wires prior to removal to aid in installation.

REMOVAL - CONTINUED

1. Remove nine screws (1) and cover (2).

**WARNING**

Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.

2. Remove insulation tape and strip caulk around expansion valve (3).
3. Remove four screws (4) and cover (5).

CAUTION

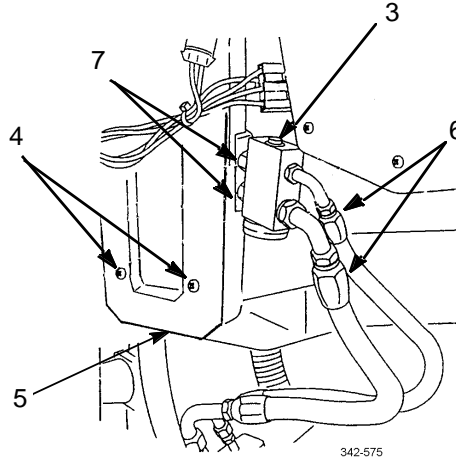
Water and dirt can damage refrigerant system. Five minutes of not being capped is the limit for any hose or component. DO NOT blow shop air through refrigerant hoses. Shop air is wet (humid).

NOTE

DO NOT disconnect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

4. Tag and disconnect refrigerant lines (6) and evaporator coil inlet and outlet lines (7) from expansion valve (3). Install plugs in refrigerant lines, evaporator coil inlet and outlet lines, and expansion valve. Discard preformed packings.

REMOVAL - CONTINUED



5. Remove thermostatic switch and sensor tube from evaporator coil (TM 9-2320-302-20).

WARNING

Failure to wear protective gloves could result in serious skin cuts due to sharp edges on evaporator coil fins.

6. Wearing protective gloves, slide evaporator coil up and out of housing

INSTALLATION

1. Wearing protective gloves, slide evaporator coil into housing.
2. Insert thermostatic switch and sensor tube. Tip of sensor tube must be in direct contact with a fin and be inserted at least 4 inches (10 cm) into evaporator (TM 9-2320-302-20).
3. Remove plugs from refrigerant lines (6), evaporator coil inlet and outlet lines (7), and expansion valve (3).
4. Install new preformed packings and lubricate with refrigerant oil.
5. Apply loctite to male fitting threads and connect refrigerant lines (6) and evaporator coil inlet and outlet lines (7) to expansion valve (3).

NOTE

DO NOT connect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

6. Using wrenches, tighten evaporator coil lines (7) to 216 lb-in (25 Nm).
7. Tighten refrigerant lines (6): large hose to compressor to 24 lb-ft (33 Nm); tighten small hose from receiver-drier to 144 lb-in (16 Nm).

NOTE

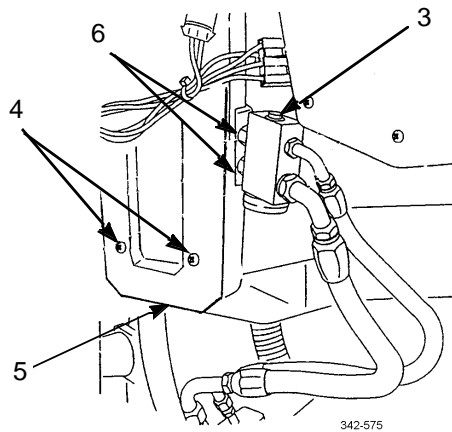
Any time air conditioning system refrigerant is evacuated, replace receiver-drier.

8. Replace receiver-drier (WP0118 00).
9. Evacuate and charge system with refrigerant (WP 0112 00).
10. Add refrigerant oil to compressor to replace that which was lost during system discharge (WP 0116 00).

INSTALLATION - CONTINUED**WARNING**

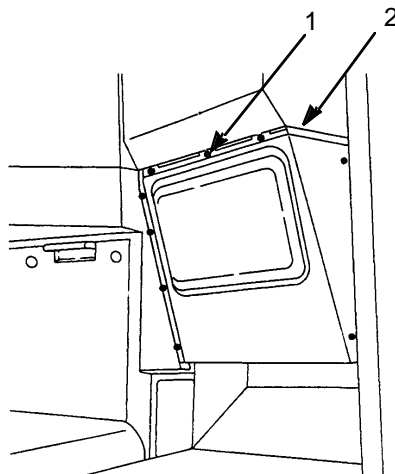
Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

11. Leak test air conditioner system (TM 9-2320-302-20).
12. Wipe expansion valve (3) and refrigerant line (6) connections clean. Wrap line connections with insulation tape.
13. Wrap expansion valve (3) with strip caulk.
14. Install cover (5) and four screws (4).



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15. Install cover (2) and nine screws (1).



342-574

END OF WORK PACKAGE

THIS WORK PACKAGE COVERS

General Information, Service

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Gage, oil level (Item 35, WP 0126 00)

Gloves, rubber (Item 40, WP 0126 00)

Goggles (Item 42, WP 0126 00)

Materials/Parts

Oil, refrigerant (Item 27, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

References

TM 9-2320-302-20

Equipment Condition

Refrigerant recovered (WP 0112 00)

**WARNING**

- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

GENERAL INFORMATION**CAUTION**

- Always use correct refrigerant oil in R-134a air conditioning system. Never mix oils. If wrong oil is used, or if oils are mixed, compressor could seize due to improper lubrication.
- Refrigerant oil must be from a container that has not been opened or that has been tightly sealed since its last use. Tubing, funnels or other equipment used to transfer refrigerant oil should be very clean and dry. Failure to follow this caution may result in contamination of system.

NOTE

Replacing only the amount of refrigerant oil that was removed during evacuation may result in wrong oil charge; oil charge may have been incorrect prior to evacuation. The only way to ensure proper oil charge is to check oil level in compressor with an oil level gage.

1. When handling refrigerant oil:
 - a. Oil should be free of water, dust, metal powder, and other foreign substances.
 - b. DO NOT mix refrigerant oil with other types or viscosities of oil.
 - c. Quickly seal oil container after use. Refrigerant oil absorbs moisture when exposed to air for any period of time.

GENERAL INFORMATION - CONTINUED

2. Air conditioning system should have approximately 14 fl oz (414 ml) of refrigerant oil. There should be 10 fl oz (296 ml) in compressor.
3. Each major component has approximately 2 fl oz (59 ml) of refrigerant oil. Therefore, additional oil must be added to compressor when a major component is replaced.

EXAMPLE:

If condenser and receiver-drier are to be replaced, first check oil level in compressor. Compressor should have 10 fl oz (296 ml). Add oil if needed. Then, after replacing condenser and receiver-drier, add an additional 4 fl oz (118 ml) of oil to compressor. Entire system should then have approximately 14 fl oz (414 ml).

SERVICE

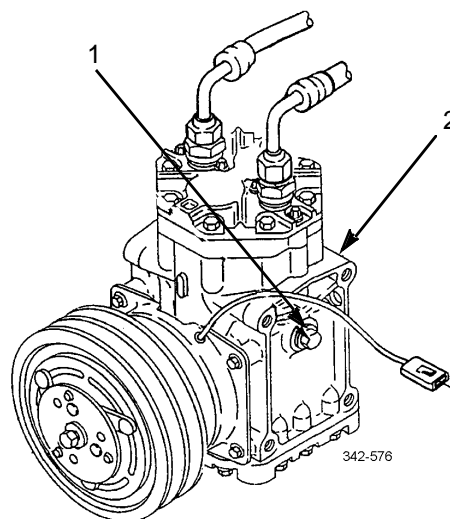


WARNING



- DO NOT remove air conditioner compressor oil fill plug without first recovering refrigerant from system. Failure to recover system could cause uncontrolled release of high pressure refrigerant, which can freeze skin and eye tissue causing serious injury or blindness.
- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.

1. Remove oil fill plug (1) and preformed packing from compressor (2). Retain preformed packing if not damaged or if there are no signs of leaks.
2. Use oil level gage to check oil level in compressor (2).
 - a. If gage bottoms out before going in more than 3 in (7.6 cm), it is hitting compressor crankshaft. Rotate drive plate by hand and insert gage until it contacts bottom of sump.



SERVICE - CONTINUED

- b. Use Table 1 to determine oil quantity in compressor (2).

Table 1. Determination of Compressor Capacity.

OIL LEVEL GAGE DEPTH IN INCHES (MM)	OIL QUANTITY IN FLUID OZ (ML)
7/8 in (22.2 mm)	6 fl oz (177 ml)
1 in (25.4 mm)	8 fl oz (237 ml)
1 1/8 in (28.6 mm)	10 fl oz (296 ml)
1 7/16 in (36.5 mm)	12 fl oz (355 ml)
1 11/16 in (43 mm)	14 fl oz (414 ml)

- 3. Add or remove oil from compressor (2) so that oil charge in compressor is 10 fl oz (296 ml).
- 4. Add additional oil to compressor (2) based on number of air conditioning components replaced. Total charge should be 14 fl oz (414 ml).
- 5. Ensure preformed packing and threads of oil fill plug (1) are clean. Install preformed packing over threads of oil fill plug being careful not to twist preformed packing,
- 6. Install oil fill plug (1) and tighten snugly.

NOTE

Any time air conditioning system refrigerant is evacuated, replace receiver-drier.

- 7. Replace receiver-drier (WP0118 00).
- 8. Charge air conditioning system (WP 0112 00).



WARNING

Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

- 9. Leak test air conditioning system (TM 9-2320-302-20).

END OF WORK PACKAGE

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AIR CONDITIONER COMPRESSOR REPLACEMENT

0117 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Gloves, rubber (Item 40, WP 0126 00)

Goggles (Item 42, WP 0126 00)

Materials/Parts

Nut, lock (6)

Packing, preformed (P/N 2-013C557-70) (2)

Washer, lock (P/N AN935-616) (6)

Adhesive, loctite (Item 2, WP 0125 00)

Materials/Parts - Continued

Cap set (Item 7, WP 0125 00)

Oil, refrigerant (Item 27, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

References

TM 9-2320-302-20

Equipment Condition

Alternator belt removed (TM 9-2320-302-20)

Refrigerant recovered (WP 0112 00)

**WARNING**

- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.
- DO NOT disconnect refrigerant lines from air conditioner compressor without first recovering refrigerant from system. Failure to recover system could cause uncontrolled release of high pressure refrigerant, which can freeze skin and eye tissue causing serious injury or blindness.

REMOVAL**NOTE**

If air conditioner compressor is being removed as an equipment condition for engine replacement, DO NOT disconnect refrigerant hoses and lines. Perform ONLY the following four steps:

- Disconnect compressor clutch electrical lead.
- Cut tiedown straps securing refrigerant hoses.
- Remove compressor mounting bolts.
- Move compressor from mounting bracket to truck frame and secure in place to prevent damage.

REMOVAL - CONTINUED

1. Disconnect compressor clutch electrical lead (1) from engine harness (2).

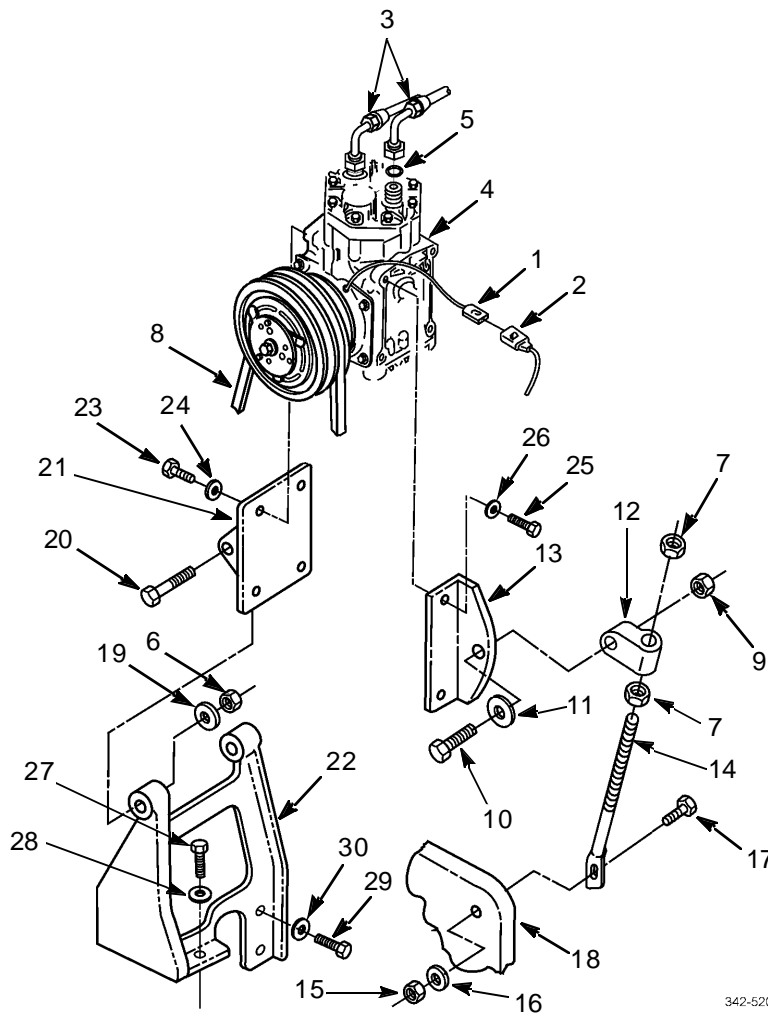
CAUTION

Water and dirt can damage refrigerant system. Five minutes of not being capped is the limit for any hose or component. DO NOT blow shop air through refrigerant hoses. Shop air is wet (humid).

NOTE

DO NOT disconnect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

2. Tag and disconnect two hoses (3) from top of compressor (4).
3. Remove two preformed packings (5) and install protective plugs in hoses (3) and compressor fittings. Discard preformed packings.
4. Loosen two lock nuts (6) and two jamnuts (7).



5. Allow compressor (4) to tilt and remove compressor drive belt (8) from pulley of compressor.

REMOVAL - CONTINUED

6. Remove lock nut (9), screw (10), washer (11), and link end (12) from bracket (13). Discard lock nut.
7. Remove two jamnuts (7) and link end (12) from adjustment rod (14).
8. Remove lock nut (15), washer (16), screw (17), and adjustment rod (14) from engine (18). Discard lock nut.
9. Remove two lock nuts (6), washers (19), and screws (20) to separate bracket (21) from bracket (22). Discard lock nuts.
10. Remove compressor (4) with brackets (13 and 21) from engine (18).
11. Remove four screws (23), lock washers (24), and bracket (21) from compressor (4). Discard lock washers.
12. Remove four screws (25), lock washers (26), and bracket (13) from compressor (4). Discard lock washers.
13. Remove screw (27) and washer (28) from bracket (22).
14. Remove two screws (29), washers (30), and bracket (22) from engine (18).

INSTALLATION

1. Install bracket (22) to engine (18) with two washers (30) and screws (29).
2. Install washer (28) and screw (27) to bracket (22).
3. Install bracket (13) to compressor (4) with four new lock washers (26) and screws (25).
4. Install bracket (21) to compressor (4) with four new lock washers (24) and screws (23).
5. Position compressor (4) to engine (18).
6. Install bracket (22) to bracket (21) with two screws (20), washers (19), and new lock nuts (6). Do not fully tighten lock nuts.
7. Install adjustment rod (14) to engine (18) with screws (17), washer (16), and new lock nut (15).
8. Install two jamnuts (7) and link end (12) to adjustment rod (14).
9. Install link end (12) to bracket (13) with screw (10), washer (11), and new lock nut (9). Do not fully tighten lock nut.
10. Position compressor drive belt (8) over compressor (4) pulley.
11. Adjust two jamnuts (7) to tighten compressor belt (8) and tighten jamnuts against link end (12).
12. Tighten two lock nuts (6) and lock nut (9).
13. Remove protective plugs from hoses (3) and compressor fittings, install two new preformed packings (5), and lubricate with refrigerant oil.

NOTE

DO NOT connect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

14. Apply loctite to threads of compressor (4) fittings and install two hoses (3).
15. Connect compressor clutch electrical lead (1) to engine harness (2).

NOTE

Any time air conditioning system refrigerant is evacuated, replace receiver-drier.

16. Replace receiver-drier (WP 0118 00).
17. Install and adjust alternator belt (TM 9-2320-302-20).
18. Charge air conditioning system (WP 0112 00).

INSTALLATION - CONTINUED**WARNING**

Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

19. Leak test air conditioning system (TM 9-2320-302-20).

END OF WORK PACKAGE

AIR CONDITIONER RECEIVER-DRIER REPLACEMENT

0118 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Gloves, rubber (Item 40, WP 0126 00)

Goggles (Item 42, WP 0126 00)

Materials/Parts

Packing, preformed (P/N J200AR11) (2)

Adhesive, loctite (Item 2, WP 0125 00)

Cap set (Item 7, WP 0125 00)

Materials/Parts - Continued

Oil, refrigerant (Item 27, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Tags, marker (Item 35, WP 0125 00)

Equipment Condition

Binary switch removed (TM 9-2320-302-20)

Refrigerant recovered (WP 0112 00)

Fan cycling switch removed (WP 0120 00)

**WARNING**

- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

REMOVAL**CAUTION**

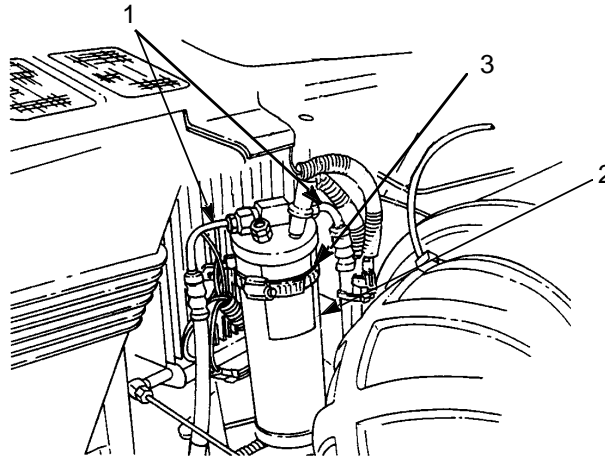
Water and dirt can damage refrigerant system. Five minutes of not being capped is the limit for any hose or component. **DO NOT** blow shop air through refrigerant hoses. Shop air is wet (humid).

NOTE

- The receiver-drier and moisture indicator are one unit and cannot be replaced separately.
- If desiccant cartridge inside receiver-drier has fallen apart, evacuate system and replace expansion valve and refrigerant compressor (desiccant matter cannot be removed from these parts). A desiccant cartridge may fall apart from too much moisture in system because of poor evacuation of system or lack of maintenance.
- **DO NOT** disconnect or connect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

REMOVAL - CONTINUED

1. Tag and disconnect refrigerant lines (1) from receiver-drier (2). Install plugs in refrigerant lines. Remove and discard preformed packings.
2. Loosen hose clamp (3) attaching receiver-drier (2) to mounting bracket and remove receiver-drier.



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INSTALLATION

1. Position receiver-drier (2) in mounting bracket. Tighten hose clamp (3).
2. Remove plugs from refrigerant lines (1) and line ports on new receiver-drier (2).
3. Install new preformed packings and apply refrigerant oil to preformed packings.
4. Apply loctite to male fitting threads and connect refrigerant lines (1) to receiver-drier (2). Apply proper torque in accordance with WP 0123 00.
5. Service air conditioner compressor (WP 0116 00).
6. Install fan cycling switch (WP 0120 00).
7. Install binary switch (TM 9-2320-302-20).
8. Charge air conditioning system (WP0112 00).

**WARNING**

Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

9. Leak test air conditioning system (TM 9-2320-302-20).

END OF WORK PACKAGE

AIR CONDITIONER CONDENSER REPLACEMENT

0119 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)
 Crowfoot attachment set (Item 28, WP 0126 00)
 Gloves, rubber (Item 40, WP 0126 00)
 Goggles (Item 42, WP 0126 00)
 Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)
 Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Packing, preformed (P/N J200AR11)
 Packing, preformed (P/N 2-013C557-70)
 Adhesive, loctite (Item 2, WP 0125 00)
 Cap set (Item 7, WP 0125 00)
 Oil, refrigerant (Item 27, WP 0125 00)
 Rags, wiping (Item 31, WP 0125 00)
 Tags, marker (Item 35, WP 0125 00)

References

TM 9-2320-302-20

Equipment Condition

Refrigerant recovered (WP 0112 00)

**WARNING**

- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

REMOVAL**CAUTION**

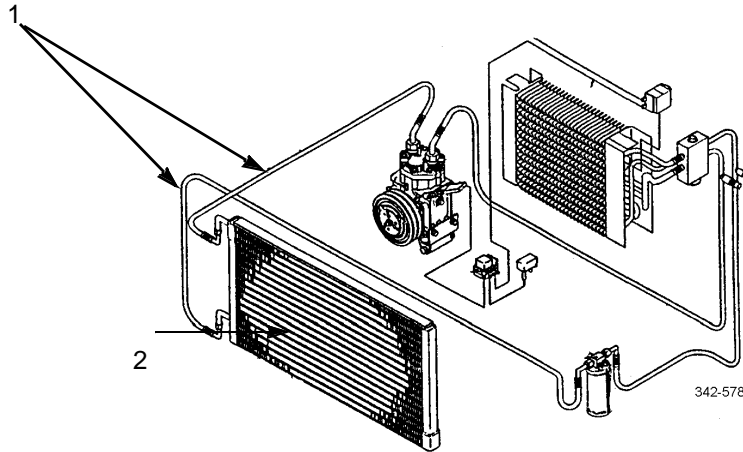
Water and dirt can damage refrigerant system. Five minutes of not being capped is the limit for any hose or component. DO NOT blow shop air through refrigerant hoses. Shop air is wet (humid).

NOTE

DO NOT disconnect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

REMOVAL - CONTINUED

1. Tag and disconnect refrigerant lines (1) from condenser (2). Install plugs in refrigerant and condenser lines. Remove and discard preformed packings.
2. Remove fasteners attaching condenser (2) to radiator.

**INSTALLATION**

1. Position condenser (2) on radiator and install fasteners.
2. Remove plugs from refrigerant lines (1) and line ports on new condenser (2).
3. Install new preformed packings and apply refrigerant oil to preformed packings.
4. Apply loctite to male fitting threads and connect but do not tighten refrigerant lines (1) to condenser (2).

NOTE

DO NOT connect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

5. Tighten connections in accordance with WP 0123 00.

NOTE

Any time air conditioning system refrigerant is evacuated, replace receiver-drier.

6. Replace receiver-drier (WP0118 00).
7. Service air conditioner compressor (WP 0116 00).
8. Charge air conditioning system (WP 0112 00).

INSTALLATION - CONTINUED**WARNING**

Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

9. Leak test air conditioning system (TM 9-2320-302-20).

END OF WORK PACKAGE

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AIR CONDITIONER FAN CYCLING SWITCH REPLACEMENT**0120 00****THIS WORK PACKAGE COVERS**

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Crowfoot attachment set (Item 28, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Oil, refrigerant (Item 27, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Equipment Condition

Refrigerant recovered (WP 0112 00)

References

TM 9-2320-302-20

**WARNING**

- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

REMOVAL**CAUTION**

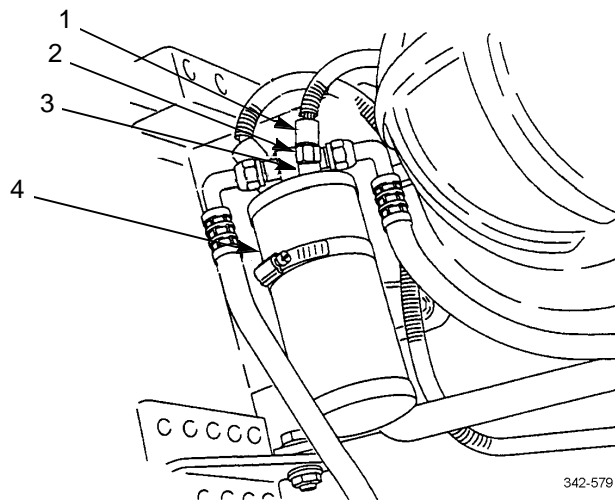
Water and dirt can damage refrigerant system. Five minutes of not being capped is the limit for any hose or component. **DO NOT** blow shop air through refrigerant hoses. Shop air is wet (humid).

NOTE

DO NOT disconnect or connect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

REMOVAL - CONTINUED

1. Disconnect harness connector (1) from fan cycling switch (2).
2. Unscrew fan cycling switch (2) from coupling (3) on receiver-drier (4). Remove and discard preformed packing.

**INSTALLATION**

1. Lubricate new preformed packing with refrigerant oil and install over male threads of coupling (3) on receiver-drier (4).
2. Screw fan cycling switch (2) into coupling (3). Tighten switch to 20-25 lb-ft (27-34 Nm).
3. Connect harness connector (1) to fan cycling switch (2).

NOTE

Any time air conditioning system refrigerant is evacuated, replace receiver-drier.

4. Replace receiver-drier (WP0118 00).
5. Service air conditioner compressor (WP 0116 00).
6. Charge air conditioning system (WP 0112 00).

**WARNING**

Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

7. Leak test air conditioning system (TM 9-2320-302-20).

END OF WORK PACKAGE

AIR CONDITIONER HOSE REPLACEMENT

0121 00

THIS WORK PACKAGE COVERS

Removal, Installation

INITIAL SETUP**Maintenance Level**

Direct Support

Tools and Special Tools

Tool kit, general mechanic's (Item 132, WP 0126 00)

Crowfoot attachment set (Item 28, WP 0126 00)

Gloves, rubber (Item 40, WP 0126 00)

Goggles (Item 42, WP 0126 00)

Wrench, torque, 0-300 lb-in (Item 137, WP 0126 00)

Wrench, torque, 15-75 lb-ft (Item 138, WP 0126 00)

Materials/Parts

Gasket (P/N 22-46774-000)

Preformed packing (as required)

Adhesive, loctite (Item 2, WP 0125 00)

Materials/Parts - Continued

Cap set (Item 7, WP 0125 00)

Caulk, strip (Item 8, WP 0125 00)

Oil, refrigerant (Item 27, WP 0125 00)

Rags, wiping (Item 31, WP 0125 00)

Tape, insulation (Item 36, WP 0125 00)

References

TM 9-2320-302-20

Equipment Condition

Refrigerant recovered (WP 0112 00)

**WARNING**

- Use care to prevent refrigerant from touching your skin or eyes. Liquid refrigerant, when exposed to air, quickly evaporates and will freeze skin or eye tissue. Serious injury or blindness may result if you come in contact with liquid refrigerant.
- Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

REMOVAL

1. The following air conditioning system hoses can be replaced:
 - a. Compressor-to-tube assembly on firewall
 - b. Compressor-to-condenser
 - c. Receiver-drier-to-tube assembly on firewall
 - d. Receiver-drier-to-expansion valve
 - e. Tube assembly (on firewall)-to-expansion valve (2 places)
2. Remove insulation tape from each hose connection.

REMOVAL - CONTINUED

NOTE

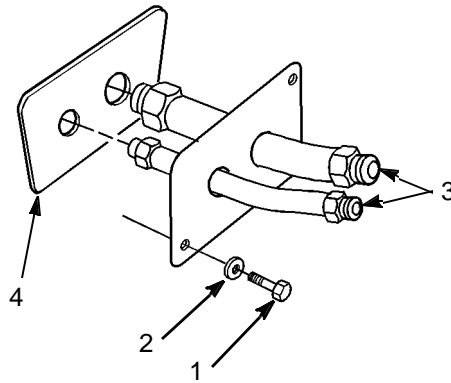
DO NOT disconnect or connect refrigerant fittings using only one wrench. Hold one fitting in place using a wrench and turn other fitting with a second wrench.

3. Disconnect each end of hose connection.

CAUTION

Water and dirt can damage refrigerant system. Five minutes of not being capped is the limit for any hose or component. DO NOT blow shop air through refrigerant hoses. Shop air is wet (humid).

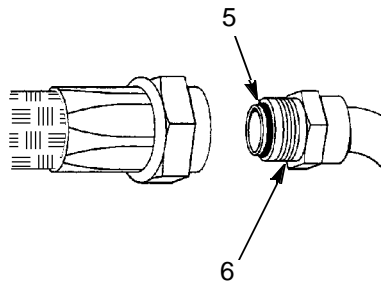
4. Cap each opening where hose was disconnected.
5. At firewall, remove two screws (1), washers (2), tube assembly (3), and gasket (4). Discard gasket.



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INSTALLATION

1. Install gasket (4) on tube assembly (3) and tube assembly on firewall.
2. Install two washers (2) and screws (1).
3. Install and lubricate new preformed packing (5) with refrigerant oil.
4. Apply loctite to male threads (6) and connect each end of hose.



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5. Tighten connections (WP 0123 00).

INSTALLATION - CONTINUED

6. Apply insulation tape at each end of hose connection.
7. Wrap remainder of hose with strip caulk.

NOTE

Any time air conditioning system refrigerant is evacuated, replace receiver-drier.

8. Replace receiver-drier (WP0118 00).
9. Service air conditioner compressor (WP 0116 00).
10. Charge air conditioning system (WP 0112 00).

**WARNING**

Refrigerant R-134a air conditioning systems should not be pressure tested or leak tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in a fire or explosion, which could cause personnel injury or death.

11. Leak test air conditioning system (TM 9-2320-302-20).

END OF WORK PACKAGE

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INTRODUCTION

1. This work package includes complete instructions for making items authorized to be manufactured at Direct Support Maintenance. It also includes instructions for fabricating select tools.
2. A Part Number Index (Table 1) in alphanumeric order is provided for cross-referencing the part number of the item to be manufactured to Table 2, which covers fabrication criteria.
3. All bulk materials needed for manufacture of an item are listed by part number or specification number.

Table 1. Part Number Index.

PART NUMBER	NAME	TABLE NUMBER
48-02454-106X27	TAPE, URETH FOAM	2
5516170	HOSE	2
77551	HOSE	2
77620-7.5	HOSE	2

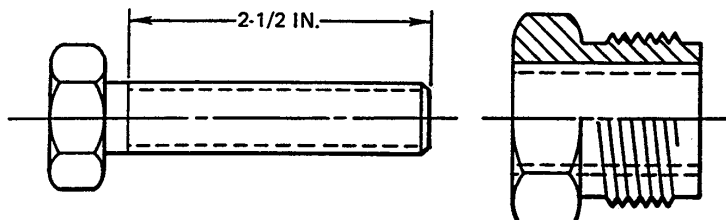
MANUFACTURED ITEMS

Table 2. Manufactured Items.

PART NUMBER	NAME	MFG FROM	DESCRIPTION
48-02454-106X27	TAPE, URETH FOAM	V40624	12 FT LONG
5516170	HOSE	5118149	2-1/2 IN LONG
77551	HOSE	IC-26-31C	82 IN LONG
77620-7.5	HOSE	IC-26-31C	90 IN LONG

FABRICATED TOOLS

1. **Item 1.**
 - a. **Materials.**
 - (1) Capscrew, Hex, 1/2 x 2-1/2 x 13 UNC, P/N 23-9440-300
 - (2) Sleeve, P/N 166JX



342-889

FABRICATED TOOLS - CONTINUED

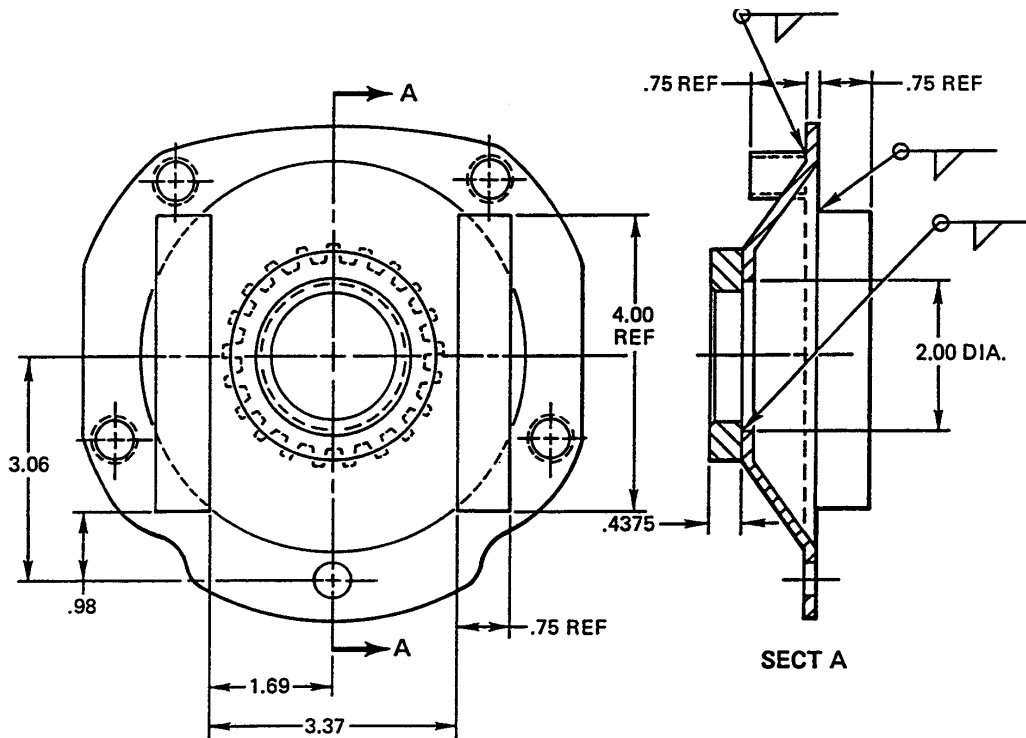
b. **Fabrication Notes.**

- (1) Drill and tap sleeve, P/N 166JX, for 1/2 x 13 UNC thread.
- (2) Extend length of thread to 2-1/2 in.
- (3) Install screw in sleeve as shown.

2. **Item 2.**

a. **Materials.**

- (1) Cover Plate, P/N 5122281
- (2) Coupling, P/N 5141773
- (3) Bar Stock, 3/4 x 1/2 x 4 in (2)
- (4) Tubing, Heavy Wall, 1/2 in Inside Diameter, 3/4 in Long (4)



342-890

b. **Fabrication Notes.**

- (1) Cut 2 in diameter hole in center of raised portion of cover plate, P/N 5122281.
- (2) Cut 7/16 in from end of coupling, P/N 5141773.
- (3) Weld four tube sections onto raised side of cover plate, centered on four bolt holes as shown.
- (4) Place shim(s) and 7/8 in section of coupling in hub of either air compressor or air compressor drive. Install cover plate using two bolts to secure it to air compressor or drive. Ensure that coupling contacts cover plate.

ILLUSTRATED LIST OF MANUFACTURED ITEMS - CONTINUED

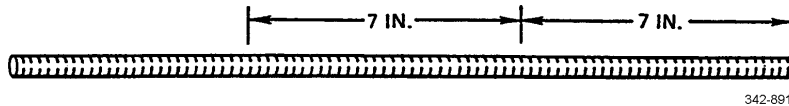
0122 00

FABRICATED TOOLS - CONTINUED

- (5) Tack weld coupling to cover plate. Remove cover plate from air compressor or drive and finish welding coupling to cover plate. Ensure that inside diameter of coupling is free of excess weld.
- (6) Weld two pieces of bar stock to opposite side of cover plate as shown.

3. **Item 3.**a. **Materials.**

Rod, 1/2 x 20 x 13 UNC, P/N 1 213X20INLGSTL



342-891

b. **Fabrication Notes.**

- (1) Cut two 7 in lengths
- (2) Remove all burrs and sharp edges

END OF WORK PACKAGE

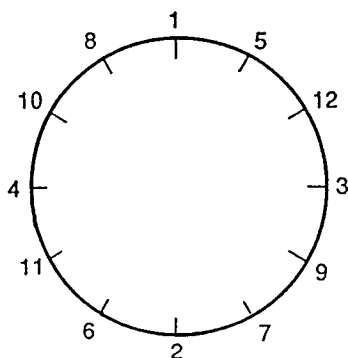
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SCOPE

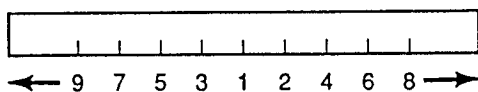
1. This work package lists standard torque values, as shown in Table 1, and provides general information for applying torque. Special torque values and tightening sequences are indicated in the maintenance procedures for applicable components.
2. Air conditioner refrigerant line torque specifications are provided in Table 2.

GENERAL

1. Always use the torque values listed in Table 1 when the maintenance procedure does not give a specific torque value.
2. Unless otherwise indicated, standard torque tolerance shall be $\pm 10\%$.
3. Torque values listed are based on clean, dry threads. Reduce torque by 10% when engine oil is used as a lubricant. Reduce torque by 20% if new plated cap screws are used.
4. Cap screws threaded into aluminum may require reductions in torque of 30% or more of Grade 5 cap screw torque. Cap screw threaded into aluminum must also attain two cap screw diameters of thread engagement.
5. If the maintenance procedures do not specify a tightening order, use the following guides:
 - a. Unless otherwise specified, lubricate threads of fasteners with oil (OE/HDO-10 or OEA).
 - b. When tightening fasteners above 30 lb-ft (41 Nm), use the torque pattern but only tighten to 70 percent of final value (multiply final value by 0.7); then repeat the pattern until final value is reached.
 - c. Tighten circular patterns using the circular torque pattern, and straight patterns using the straight torque pattern.



CIRCULAR TORQUE PATTERN



STRAIGHT TORQUE PATTERN

CAUTION

If replacement cap screws are of higher grade than originally supplied, use torque specifications for the original. This will prevent equipment damage due to overtightening.

Table 1. Torque Limits.






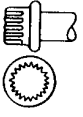
CURRENT USAGE	MUCH USED	MUCH USED	USED AT TIMES	USED AT TIMES
QUALITY OF MATERIAL	INDETERMINATE	MINIMUM COMMERCIAL	MEDIUM COMMERCIAL	BEST COMMERCIAL
SAE Grade Number	1 or 2	5	6 or 7	8
Cap screw Head Markings			 	 
Manufacturer's marks may vary				
These are all SAE Grade 5 (3 line)				
CAP SCREW BODY SIZE INCHES - THREAD	TORQUE LB-FT - (NM)	TORQUE LB-FT (NM)	TORQUE LB-FT (NM)	TORQUE LB-FT (NM)
1/4 20 28	5 (7) 6 (8)	8 (11) 10 (14)	10 (14)	12 (16) 14 (19)
5/16 18 24	11 (15) 13 (18)	17 (23) 19 (26)	19 (26)	24 (33) 27 (37)
3/8 16 24	18 (24) 20 (27)	31 (42) 35 (47)	34 (46)	44 (60) 49 (66)
7/16 14 20	28 (38) 30 (41)	49 (66) 55 (75)	55 (75)	70 (95) 78 (106)
1/2 13 20	39 (53) 41 (56)	75 (102) 85 (115)	85 (115)	105 (142) 120 (163)
9/16 12 18	51 (69) 55 (75)	110 (149) 120 (163)	120 (163)	155 (210) 170 (231)
5/8 11 18	83 (113) 95 (129)	150 (203) 170 (231)	167 (226)	210 (285) 240 (325)
3/4 10 16	105 (142) 115 (156)	270 (366) 295 (400)	280 (380)	375 (508) 420 (569)
7/8 9 14	160 (217) 175 (237)	395 (536) 435 (590)	440 (597)	605 (820) 675 (915)
1 8 14	235 (319) 250 (339)	590 (800) 660 (895)	660 (895)	910 (1234) 990 (1342)

Table 2. Refrigerant Line Torque Specifications.

OUTSIDE DIAMETER OF METAL TUBE (IN)	TORQUE FOR STEEL TUBES* LB-FT (NM)	TORQUE FOR ALUMINUM OR COPPER* TUBES
1/4	10-15 (14-20)	60-80 (680-940)
3/8	30-35 (41-47)	11-13 (15-18)
1/2	30-35 (41-47)	15-20 (20-27)
5/8	30-35 (41-47)	21-27 (28-37)
3/4	30-35 (41-47)	28-33 (38-45)

* When tightening fittings, always use torque reading for softer metal when unlike metals are used.

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CHAPTER 4
SUPPORTING INFORMATION

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SCOPE

This work package lists all forms, field manuals, technical bulletins, technical manuals, and other publications referenced in this manual and which apply to Direct Support and General Support Maintenance of the M915A3 Line Haul Tractor Truck.

PUBLICATIONS INDEXES

The following indexes should be consulted frequently for latest changes or revisions and for new publications relating to material covered in this technical manual.

Consolidated Index of Army Publications and Blank Forms DA Pam 25-30
 Functional User’s Manual for the Army Maintenance Management System DA Pam 738-750
 U.S. Army Equipment Index of Modification Work Orders DA Pam 750-10

FORMS

Refer to DA Pam 738-750, *The Army Maintenance Management System (TAMMS)*, for instructions on the use of maintenance forms.

Equipment Inspection and Maintenance Worksheet DA Form 2404
 Equipment Log Assembly (Records) DA Form 2408
 Maintenance Request Form DA Form 2407
 Preventive Maintenance Schedule and Record DD Form 314
 Processing and Deprocessing Record for Shipment, Storage and Issue of Vehicles and Spare Engines DD Form 1397
 Product Quality Deficiency Report SF Form 368
 Recommended Changes to Equipment Technical Publications DA Form 2028-2
 Recommended Changes to Publications and Blank Forms DA Form 2028
 Report of Discrepancy (ROD) SF Form 364

FIELD MANUALS

Metal Body Repair and Related Operations FM 43-2
 Operation and Maintenance of Ordnance Material in Extreme Cold Weather (0°F to -65°F) FM 9-207

TECHNICAL BULLETINS AND SUPPLY BULLETINS

Color, Marking, and Camouflage Painting of Military Vehicles, Construction Equipment,
 and Materiel Handling Equipment TB 43-0209
 Corrosion Prevention and Control Including Rustproofing Procedures for Tactical Vehicles and Trailers TB 43-0213
 Solder and Soldering TB SIG 222
 Warranty Bulletin for M915A3 Tractor Truck TB 9-2320-302-15

TECHNICAL MANUALS

Administrative Storage of Equipment TM 740-90-1
 Cooling Systems: Tactical Vehicles TM 750-254
 Inspection, Care, and Maintenance of Antifriction Bearings TM 9-214
 Materials Used for Cleaning, Preserving, Abrading and Cementing Ordnance
 Materiel and Related Materials, Including Chemicals TM 9-247
 Operator’s Manual for M915A3 Tractor Truck TM 9-2320-302-10
 Operator’s Manual for Welding Theory and Application TM 9-237
 Painting Instruction for Field Use TM 43-0139
 Procedures for Destruction of Tank-automotive Equipment to Prevent Enemy Use TM 750-244-6

REFERENCES - CONTINUED

0124 00

TECHNICAL MANUALS - CONTINUED

Repair Parts and Special Tools Lists for M915A3 Tractor Truck..... TM 9-2320-302-24P
Unit Maintenance Manual for M915A3 Tractor Truck..... TM 9-2320-302-20

OTHER PUBLICATIONS

Abbreviations for Use on Drawings and in Specifications, Standards, and
Technical Documents MIL-STD-12D
Army Medical Department Expendable/Durable Items CTA 8-100
Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items CTA 50-970
Vehicle, Wheeled, Preparation for Shipment and Limited Storage of MIL-V-62038D

SCOPE

This work package lists expendable and durable items you will need to maintain the M915A3 Truck Tractor. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, *Expendable/Durable Items (Except Medical, Class V Repair Parts, and Heraldic Items)*, or CTA 8-100, *Army Medical Department Expendable/Durable Items*.

EXPLANATION OF COLUMNS

1. **Column (1) - Item Number.** This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the item [e.g., Use adhesive (Item 1, WP 0125 00)].
2. **Column (2) - Level.** This column identifies the lowest level of maintenance that requires the listed item.
 F - Direct Support Maintenance
 H - General Support Maintenance
3. **Column (3) - National Stock Number.** This is the National Stock Number assigned to the item which you can use to requisition it.
4. **Column (4) - Description, CAGEC, and Part Number.** This provides the other information you need to identify the item.
5. **Column (5) - Unit of Measure (U/M).** This column shows the physical measurement or count of an item, such as gallon, dozen, gross, etc.

Table 1. Expendable and Durable Items List.

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION, CAGEC, AND PART NUMBER	(5) U/M
1	F	8040-00-664-4318	ADHESIVE: General Purpose, Type II (18876) 9995460 1 Pint Can	PT
2	F	8040-01-250-3969	ADHESIVE: Loctite (05972) 242	ML
3	F	8040-01-129-7171	ADHESIVE: Loctite (05972) 620	OZ
4	F	8040-00-142-9823	ADHESIVE: Silicone Rubber (81349) MIL-A-46106	KIT
5	F	8040-00-728-3088	ADHESIVE: Silicone Rubber, White (78500) 1199-T-3842	KIT
6	F	6850-00-181-7929 6850-00-181-7933	ANTIFREEZE: Permanent, Ethylene Glycol, Inhibited (81349) MIL-A-46153 1 Gallon Bottle 5 Gallon Can	GAL GAL
7	F	5340-00-450-5718	CAP SET: Protective, Dust and Moisture Seal (19207) 10935405	EA

Table 1. Expendable and Durable Items List - Continued.

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION, CAGEC, AND PART NUMBER	(5) U/M
8	F		CAULK: Strip (64678) 48-00118-001	EA
9	H		CLOTH: Abrasive, Emery, Fine (80204) ANSI B74.18	
		5350-00-584-5654	50-Sheet Package	EA
10	F		COMPOUND: Antiseize, High Temperature (73165) 51008	
		8030-00-597-5367	25 Pound Can	LB
11	F		COMPOUND: Corrosion Preventive (81349) MIL-C-16173	
		8030-00-062-6950	1 Quart Can	QT
12	F		COMPOUND: Gasket Forming, Silicone (05972) 77MA	
			8 Ounce Tube	OZ
			(05972) 77C	
			13 Ounce Cartridge	OZ
13	F		COMPOUND: International No. 2 (72582) 5198563	QT
14	F		COMPOUND: Sealing (81349) MIL-S-46163	
		8030-00-111-2762	50 CC Bottle	CC
		8030-00-111-2763	Box of 10 Bottles, 10 CC Each Bottle	CC
15	F		COMPOUND: Sealing, Dissimilar Metal Protection (71961) 6099	
		8030-01-392-3276	1 Gallon Can	GAL
16	F		COMPOUND: Sealing, Loctite (05972) 635	OZ
17			COMPOUND: Sealing (05972) 680	OZ
18	F		COMPOUND: Sealing, Pipe (05972) 079-21	
		8030-00-081-2286	50 CC Bottle	CC
		8030-00-081-2327	Box of 10 Bottles, 10 CC Each Bottle	CC
19	F		DETERGENT: General Purpose, Liquid (83421) 7930-00-282-9699	
		7930-00-282-9699	1 Gallon Can	GAL

Table 1. Expendable and Durable Items List - Continued.

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION, CAGEC, AND PART NUMBER	(5) U/M
20	F	5210-00-640-6177	GAGE: Bearing Clearance Box of 12 0.001-0.003 Inch Clearance Range, Green Color (77220) PG-1	EA
		5210-00-640-6178	0.002-0.006 Inch Clearance Range, Red Color (77220) PLASTIGAGEPR1	EA
		5210-00-640-6176	0.004-0.009 Inch Clearance Range, Blue Color (77220) PLASTIGAGEPB1	EA
21	F	9150-00-119-9291	GREASE: Aircraft (81349) MIL-G-4343 2 Ounce Tube	OZ
		9150-00-269-8255	1.75 Pound Can	LB
22	F	9150-01-197-7693	GREASE: Automotive and Artillery, GAA (81349) M-10924 14 Ounce Cartridge (M-10924-B)	OZ
		9150-01-197-7688	1-1/4 Ounce Tube (M-10924-A)	OZ
		9150-01-197-7690	2-1/4 Pound Can (M-10924-C)	LB
		9150-01-197-7692	35 Pound Can (M-10924-E)	LB
		9150-01-197-7691	120 Pound Drum (M10924-F)	LB
23	F	7050-00-961-7663	LUBRIPLATE: Lubricant (90536) ST40334	OZ
24	F	9150-00-825-9161	OIL: Cutting (77247) 22F 1 Gallon Can	GAL
		9150-00-189-6727	OIL: Lubricating, OE/HDO 10 (81349) MIL-L-2104 1 Quart Can	QT
25	F	9150-00-186-6668	5 Gallon Can	GAL
		9150-00-191-2772	55 Gallon Drum, 18 Gage (MILL2104)	GAL
		9150-01-048-4591	OIL: Lubricating, GO 85/140 (81349) MIL-PRF-2105 1 Quart Can	QT
26	F	9150-01-035-5395	5 Gallon Can	GAL
		9150-01-035-5396	55 Gallon Drum	GAL

Table 1. Expendable and Durable Items List - Continued.

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION, CAGEC, AND PART NUMBER	(5) U/M
27	F	9150-01-410-8972	OIL: Lubricating, Refrigerant Compressor, Synthetic Ester (59595) CAPELLA HFC-68NA 1 Quart Can	QT
28	H	8010-01-329-6150	PASTE: Prussian Blue, Bearing Surface, Permatex (10670) 35V 2 Ounce Tube	OZ
29	H	9150-00-250-0926	PETROLATUM, TECHNICAL (81348) VV-P-236 1.75 Pound Can	LB
30	F	8040-01-024-6993	PRIMER: Adhesive (05972) 73656 6 Ounce Can	OZ
31	F	7920-00-205-1711	RAG: Wiping (64067) 7920-00-205-1711 50 Pound Bale	LB
32	F		ROPE: Nylon, ½ Inch Diameter	
33	F	3439-00-555-4629	SOLDER: Lead-tin Alloy, Rosin Core (81348) QQ-S-571 11 Pound Spool	LB
34	F	5975-00-984-6582 5975-00-935-5946 5975-00-903-2284	STRAP: Tiedown, Electrical Components Box of 100 (96906) MS3367-1-0 6 Inch Length, 1.75 Inch Maximum Bundle, Black (96906) MS3367-2-1 13.35 Inch Length, 4 Inch Maximum Bundle, Brown (96906) MS3367-4-0 4 Inch Length, Black	EA EA EA
35	F	9905-00-537-8954	TAG: Marker (64067) 9905-00-537-8954 Bundle of 50	EA

Table 1. Expendable and Durable Items List - Continued.

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION, CAGEC, AND PART NUMBER	(5) U/M
36	F	5640-00-580-6276	TAPE: Insulation, Thermal 2 Inches Wide (73030) HS7495-618 30-Foot Length	FT
37	F	7510-00-266-6709	TAPE: Pressure-sensitive, Adhesive, Masking 1.5 Inches Wide (58536) A-A-883 60-Yard Roll	YD
38	F	6830-01-439-0614	TETRAFLUOROETHANE: Technical, Refrigerant, R-134A Type (4V886) R134A 43-Pound Cylinder	LB
39	F	5180-00-754-0643	TOOL KIT: Body and Fender Repair (50980) SC5180-90-N34	EA
40	F	8305-01-301-1031	WIPES: Lint-free (28480) 92193W	EA
41	F		WIRE: 14 Gage	

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TOOL IDENTIFICATION LIST

0126 00**SCOPE**

This work package lists all common tools and supplements and special tools/fixtures needed to maintain the M915A3 Tractor Truck at Direct Support and General Support Maintenance.

EXPLANATION OF COLUMNS IN THE TOOL IDENTIFICATION LIST

1. **Column (1) - Item Number (No.)**. This number is assigned to the entry in the list and is referenced in the initial setup of maintenance tasks to identify the item (e.g., Tool kit, general mechanic's, Item 132, WP0126 00).
2. **Column (2) - Item Name**. This column lists the item by noun nomenclature and other descriptive features (e.g., Tester, Cylinder).
3. **Column (3) - National Stock Number**. This is the National Stock Number (NSN) assigned to the item. Use it to requisition the item.
4. **Column (4) - Part Number/CAGEC**. Indicates the primary number used by the manufacturer (individual, company, firm, corporation or Government activity) which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items. The manufacturer's Commercial and Government Entity Code (CAGEC) is also included, in parentheses.
5. **Column (5) - Unit of Measure (U/M)**. This column shows the physical measurement or count of an item, such as gallon, dozen, gross, etc.

Table 1. Tool Identification List.

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
1	Adapter, Cylinder	4910-01-319-6971	J38768-A (33287)	TM 9-2320-302-24P
2	Adapter, Motor, Hoist	3950-01-319-6973	J35635 (33287)	TM 9-2320-302-24P
3	Adapter, Torque Wrench	5120-00-215-8200	11663358-2 (19207)	TM 9-2320-302-24P
4	Adapter Kit, Mechanical	4940-01-353-7038	J 28593 (33287)	TM 9-2320-302-24P
5	Adjuster, Lash, Cam-I	5120-01-322-8885	J35596 (33287)	TM 9-2320-302-24P
6	Adjusting Tool, Worm	5120-01-371-7369	J 37070 (33287)	TM 9-2320-302-24P
7	Alignment Stud Set		J43431 (33287)	TM 9-2320-302-24P
8	Barring Tool, Engine	5120-01-322-3498	J36237 (33287)	TM 9-2320-302-24P
9	Bolt, Eye	5306-01-294-3028	993-042 (75377)	TM 9-2320-302-24P
10	Bolt, Eye, Cylinder Block Lift Tool	5306-01-319-1987	J35595 (33287)	TM 9-2320-302-24P
11	Bracket, Engine Mounting	2510-01-320-8905	J35636 (33287)	TM 9-2320-302-24P
12	Bracket, Transmission Holding		J35926 (33287)	TM 9-2320-302-24P
13	Bracket, Transmission Holding		J41445 (33287)	TM 9-2320-302-24P
14	Caliper, Micrometer, Inside: 2-12 in. range	5210-00-221-1921	124BZ (57163)	SC 4910-95-A31
15	Caliper, Micrometer, Outside: 0-1 in. Range	5210-00-540-2973	T230RL (57163)	SC 4910-95-A02
16	Caliper, Vernier: English and metric measurements, 0-6 in. and 1-150 mm	5210-01-113-1548	GGG-C-111 (81348)	SC 4910-95-A31
17	Caps, Vise Jaw: 4 in.	5120-00-221-1506	A-A-2938 (58536)	SC 4910-95-A31
18	Checker, Gear Lash	5120-01-353-2520	J 38662 (33287)	TM 9-2320-302-24P
19	Clamp, C	5120-00-203-6431	A-A-431 (58536)	SC 4910-95-A31
20	Clamp, Material Lift	3940-01-324-4713	J35641-A (33287)	TM 9-2320-302-24P
21	Compressor, Main-Pressure Relief Spring		J41462 (33287)	TM 9-2320-302-24P
22	Compressor, Piston Ring	5120-01-353-8567	J 35598-A (33287)	TM 9-2320-302-24P
23	Compressor, Spring	5120-01-353-2522	J24203-3 (33287)	TM 9-2320-302-24P
24	Compressor, Spring		J8062-1 (33287)	TM 9-2320-302-24P
25	Compressor, Spring		J8062-3 (33287)	TM 9-2320-302-24P

TOOL IDENTIFICATION LIST - CONTINUED

0126 00

Table 1. Tool Identification List - Continued.

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
26	Compressor, Spring, C2 (use with J37030-3)		J37030-1 (33287)	TM 9-2320-302-24P
27	Compressor, Spring, C5 (use with J37030-3)		J37030-2 (33287)	TM 9-2320-302-24P
28	Crowfoot Attachment Set: Socket Wrench	5120-01-429-1110	214FC (55719)	GSA Catalog
29	Dial Indicator Set	5210-00-794-9178	J5959-01 (33287)	SC 4910-95-A31
30	Dispenser, Sealant	5120-00-061-1283	45RCT (88736)	SC 4910-95-A31
31	Drill, Electric, Portable: 3/8 in. size	5130-00-935-7354	6635 (55111)	SC 4910-95-A31
32	Drill Set, Twist	5133-00-293-0983	800434 (19203)	SC 4910-95-A31
33	Driver, Bushing	5120-01-353-2521	PT 4365-1 (33287)	TM 9-2320-302-24P
34	Gage, Depth, Micrometer: 0-6 in. Range	5210-00-619-4045	52-225-015 (1E258)	GSA Catalog
35	Gage, Oil Level		99-431 (0W4A6)	GSA Catalog
36	Gage, Profile		J35884-A (33287)	TM 9-2320-302-24P
37	Gage, Profile	5220-01-388-1460	J38548 (33287)	TM 9-2320-302-24P
38	Gage, Profile		J38689-A (33287)	TM 9-2320-302-24P
39	Gage, Profile		J42749 (33287)	TM 9-2320-302-24P
40	Gloves, Chemical and Oil Protective: rubber	8415-00-641-4601	ZZ-G-381 (81348)	SC 4910-95-A74
41	Gloves, Welders': leather	8415-00-268-7859	A-A-50022 (58536)	SC 4910-95-A31
42	Goggles, Industrial	4240-00-816-3819	WA60-5H0746-0315 (74936)	SC 4910-95-A31
43	Guide Stud Set	5120-01-322-3505	J36107 (33287)	TM 9-2320-302-24P
44	Guides, Connecting Rod		J43661 (33287)	TM 9-2320-302-24P
45	Handle, Drive	5120-00-677-2259	J8092 (33287)	TM 9-2320-302-24P
46	Handle, Installer	5120-00-977-5578	J7079-2 (33287)	TM 9-2320-302-24P
47	Holding Bar, Pinion	5120-01-166-0573	J 3453-1 (33287)	TM 9-2320-302-24P
48	Insertor, Bearing	5120-01-354-2943	J 37071-A (33287)	TM 9-2320-302-24P
49	Insertor, Gear	5120-01-322-1132	J35949 (33287)	TM 9-2320-302-24P
50	Insertor, Seal	5120-01-322-1129	J35686-B (33287)	TM 9-2320-302-24P

TOOL IDENTIFICATION LIST - CONTINUED

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Table 1. Tool Identification List - Continued.

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
51	Insertor and Remover	5120-01-338-7182	J25447-B (33287)	TM 9-2320-302-24P
52	Insertor and Remover	5120-01-322-2360	J35642 (33287)	TM 9-2320-302-24P
53	Insertor and Remover	5120-01-322-6222	J36310-A (33287)	TM 9-2320-302-24P
54	Insertor and Remover, Spring	5120-01-388-5623	J35923-2 (33287)	TM 9-2320-302-24P
55	Insertor Set, Dowel	5120-01-322-3500	J36224 (33287)	TM 9-2320-302-24P
56	Installation Tool, Seal	5120-01-354-0468	J 37073 (33287)	TM 9-2320-302-24P
57	Installer, Charging Pump Bushing		J39954 (33287)	TM 9-2320-302-24P
58	Installer, Cup Plug	5120-01-333-4744	J36326 (33287)	TM 9-2320-302-24P
59	Installer, Front Support Sleeve and PTO Bearing		J37041 (33287)	TM 9-2320-302-24P
60	Installer, Output Bearing		J37034 (33287)	TM 9-2320-302-24P
61	Installer, Output Bearing Cup (use with J37034)		J37033 (33287)	TM 9-2320-302-24P
62	Installer, Output Shaft	5120-01-054-4042	J-24202-1A (33287)	TM 9-2320-302-24P
63	Installer, P1 Carrier Bushing and Ground Sleeve Bearing, Pump Body Bushing, and Bearing Retainer Bushing		J37038 (33287)	TM 9-2320-302-24P
64	Installer, Rotating Clutch Bushing		J37040 (33287)	TM 9-2320-302-24P
65	Installer, Seal, Input		J37032 (33287)	TM 9-2320-302-24P
66	Installer, Seal, Output		J37031 (33287)	TM 9-2320-302-24P
67	Installer, Torque Converter Cover Bushing		J39949 (33287)	TM 9-2320-302-24P
68	Installer, Turbine Shaft Bushing/ Output Bushing/P2 Carrier Bushing		J37036 (33287)	TM 9-2320-302-24P
69	Installer, Valve Guide	5120-01-322-3501	J33191-A (33287)	TM 9-2320-302-24P
70	Installer, Valve Stem Seal		J39109 (33287)	TM 9-2320-302-24P
71	Installer, Wear Plate		J39534 (33287)	TM 9-2320-302-24P
72	Installer Set, Cup Plug	5120-01-322-2359	J35653 (33287)	TM 9-2320-302-24P
73	Jack, Hydraulic, Hand: 12 ton capacity	5120-00-224-7330	67224 (07505)	SC 4910-95-A31

TOOL IDENTIFICATION LIST - CONTINUED

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Table 1. Tool Identification List - Continued.

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
74	Lathe, Brakedrum	4910-01-028-9848	4100 (4T928)	SC 4910-95-A31
75	Lift, Transmission and Differential	4910-00-585-3622	49(79260)	SC 4910-95-A31
76	Lifter, Rocker Arm	5120-01-322-6116	J35996-A (33287)	TM 9-2320-302-24P
77	Lifting, Bracket, Flywheel	5120-01-116-6049	J-24365 (33287)	TM 9-2320-302-24P
78	Multimeter, Digital	6625-01-265-6000	27/FM W/ACCE (89536)	SC 4910-95-A31
79	Multiplier, Torque Wrench	5120-00-169-2986	PD1201 (92059)	SC-4910-95-A31
80	Pan, Drain: 4 gallon capacity	4910-00-387-9592	450 (05463)	SC 4910-95-A31
81	Pilot, Cam Gear	5120-01-322-3508	J35906 (33287)	TM 9-2320-302-24P
82	Pin, Shoulder, Headless	5315-01-333-2771	J36235 (33287)	TM 9-2320-302-24P
83	Plate, Indexing	3460-01-319-5533	J35651 (33287)	TM 9-2320-302-24P
84	Plate, Retaining	3040-01-319-0848	J35652-B (33287)	TM 9-2320-302-24P
85	Pliers, Piston Ring	5120-01-142-2459	J22405-02 (33287)	TM 9-2320-302-24P
86	Pliers, Retaining Ring	5120-01-322-6888	J36347 (33287)	TM 9-2320-302-24P
87	Pliers, Retaining Ring: external, 0.038-1.000 in. diameter	5120-00-288-9717	0200 (79136)	SC 4910-95-A31
88	Pliers, Retaining Ring: internal, 0.120 in. diameter, 3.15-6.5 in. ring diameter	5120-00-293-0186	4200-3174865PC4 (80064)	SC 4910-95-A31
89	Pliers, Retaining Ring: internal, 1.75 to 2 in. ring size	5120-00-293-0045	0300 (79136)	SC 4910-95-A31
90	Press, Arbor: hand operated	3444-00-449-7295	A-A-51194 (80244)	SC 4910-95-A31
91	Press, Cylinder Liner	3449-01-319-5599	J35597-A (33287)	TM 9-2320-302-24P
92	Protector, Crankshaft	2815-01-321-9248	J35994 (33287)	TM 9-2320-302-24P
93	Protector, Piston	5120-01-048-2156	J24210 (33287)	TM 9-2320-302-24P
94	Puller, Mechanical	5120-01-322-1128	J35791 (33287)	TM 9-2320-302-24P
95	Puller Kit, Mechanical: gear and bearing	5180-00-423-1596	GGGP781 (81348)	SC 4910-95-A31
96	Puller Kit, Universal	5180-01-048-2153	J24171-A (33287)	TM 9-2320-302-24P
97	Puller Kit, Universal	5180-00-313-9496	1178 (45225)	SC 4910-95-A31
98	Pump, Hydraulic Ram	4320-01-320-4618	J35951-175 (33287)	TM 9-2320-302-24P

TOOL IDENTIFICATION LIST - CONTINUED

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Table 1. Tool Identification List - Continued.

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
99	Reclaimer, Refrigerant, R134A	4250-01-396-8928	EEEAC304A (55719)	GSA Catalog
100	Reconditioning Set	5120-01-322-3507	J33880 (33287)	TM 9-2320-302-24P
101	Remover, Seal	5120-01-322-1131	J35993 (33287)	TM 9-2320-302-24P
102	Remover, Valve Guide	5120-01-322-3506	J34696-B (33287)	TM 9-2320-302-24P
103	Remover, Valve Seat	5120-00-494-1836	J23479-271 (33287)	TM 9-2320-302-24P
104	Remover, Valve Seat	5120-01-322-8883	J23479-460-A (33287)	TM 9-2320-302-24P
105	Remover, Wheel Bearing Cup	5120-00-784-6482	J3940 (33287)	TM 9-2320-302-24P
106	Remover/Installer, Main-Pressure Spring		J35924 (33287)	TM 9-2320-302-24P
107	Replacing Tool, Engine	5120-01-322-1133	J33190 (33287)	TM 9-2320-302-24P
108	Replacing Tool, Engine	5120-01-322-2955	J34983 (33287)	TM 9-2320-302-24P
109	Riveter, Blind Hand: 3/32 in., 1/8 in., 5/32 in., and 3/16 in. diameters	5120-00-017-2849	250K (10054)	SC 4910-95-A74
110	Scale	4910-00-707-9178	J544-01 (33287)	TM 9-2320-302-24P
111	Service Kit, Accessory Drive	5120-01-322-3499	J36024 (33287)	TM 9-2320-302-24P
112	Service Kit, Water Pump	5120-01-322-6115	J35988-C (33287)	TM 9-2320-302-24P
113	Shield, Turbo Protect	4910-01-127-7959	J26554-A (33287)	TM 9-2320-302-24P
114	Slider, Spring Compression	4910-01-165-6015	TFTLN-2500 (74410)	TM 9-2320-302-24P
115	Sling, Beam Type	3940-01-353-8561	J-39520 (33287)	GSA Catalog
116	Socket, Socket Wrench	5120-01-322-1123	J36003-A (33287)	TM 9-2320-302-24P
117	Socket, Socket Wrench: 19 mm, deep well, 12 pt	5120-01-348-9154	SM19 (55719)	G5A Catalog
118	Soldering Gun	3439-00-542-0396	8200G3 (97049)	SC 4910-95-A31
119	Spanner Attachment	5120-01-353-8490	J 37464 (33287)	TM 9-2320-302-24P
120	Spreader, Sling	3940-01-354-9446	38841 (45225)	TM 9-2320-302-24P
121	Test Block, Pressure Switch		J33884 (33287)	TM 9-2320-302-24P
122	Test Stand, Automotive Generator and Starter	4910-00-767-0218	MILT4544 (81349)	SC 4910-95-A02
123	Tester, Cylinder	4910-01-320-4638	J29006-5 (33287)	TM 9-2320-302-24P
124	Tester, Cylinder	4910-01-319-6990	J36223-D (33287)	TM 9-2320-302-24P

TOOL IDENTIFICATION LIST - CONTINUED

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Table 1. Tool Identification List - Continued.

(1) ITEM NO.	(2) ITEM NAME	(3) NATIONAL STOCK NUMBER	(4) PART NUMBER/ CAGEC	(5) REFERENCE
125	Tester, Impeller	5120-01-322-2358	J35687 (33287)	TM 9-2320-302-24P
126	Tester, Kingpin Lock	4910-01-157-3571	TFTLN-1000 (74410)	TM 9-2320-302-24P
127	Tester, Power Steering	4910-01-160-3618	J-26487-B (33287)	TM 9-2320-302-24P
128	Tester, Spring Resiliency: 0-500 grams	6635-00-182-7534	L20 (08292)	SC 4910-95-A31
129	Tool, Torque Converter Bolt		J38564 (33287)	TM 9-2320-302-24P
130	Tool Base, Spring Compressor, C1, C2, and C5		J37030-3 (33287)	TM 9-2320-302-24P
131	Tool Kit, Electrical Connector Repair	5180-00-876-9336	7550526 (19204)	SC 4910-95-A31
132	Tool Kit, General Mechanic's: Automotive	5180-00-177-7033	SC5180-90-N26 (50980)	SC 5180-95-N26
133	Tool Set, Spanner Nut Torque		J37035 (33287)	TM 9-2320-302-24P
134	Tray Set, Valve Body Parts		J33163 (33287)	TM 9-2320-302-24P
135	Trestle, Hoist, Portable: 7 ton capacity	3950-00-251-8013	306 (79805)	SC 4910-95-A31
136	Vise, Machinist's	5120-00-293-1439	504M2 (79416)	SC 4910-95-A31
137	Wrench, Torque: 3/8 in. drive, 0-300 lb-in capacity	5120-00-776-1841	2163993 (10001)	SC 4910-95-A31
138	Wrench, Torque: 3/8 in. drive, 15-75 lb-ft capacity	5120-01-355-1734	QC2FR75 (55719)	SC 4910-95-A31
139	Wrench, Torque: 50-250 lb-ft capacity	5120-01-042-0982	VB-2503MFR (27464)	SC 4910-95-A31
140	Wrench, Torque: 3/4 in. drive, 100-600 lb-ft capacity	5120-01-113-9564	7379 (45225)	SC 4910-95-A31
141	Wrench Set, Socket: 3/4 in. drive	5120-00-204-1999	FEDSTD353 (06542)	SC 4910-95-A31
142	Wrench Set, Socket Attachment: screwdriver, torx, 1/4 and 3/8 in. drive	5120-01-178-6342	J-29843 (33287)	GSA Catalog

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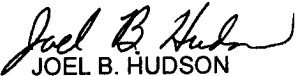
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ITEM	PAGE	PARA-	LINE	FIGURE NO.	TABLE	RECOMMENDED CHANGES AND REASON
	0035 00-1	Initial Setup				Item number for Oil, Lubricating is not correct

SAMPLE

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THE METRIC SYSTEM AND EQUIVALENTS

<p>Linear Measure</p> <p>1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches 1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches 1 Kilometer = 1000 Meters = 0.621 Miles</p> <p>Weights</p> <p>1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces 1 Kilogram = 1000 Grams = 2.2 Pounds 1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons</p> <p>Liquid Measure</p> <p>1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces</p>	<p>Square Measure</p> <p>1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches 1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet 1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles</p> <p>Cubic Measure</p> <p>1 Cu Centimeter = 1,000 Cu Millimeters = 0.06 Cu Inches 1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet</p> <p>Temperature</p> <p>$5/9 (^{\circ}\text{F} - 32) = ^{\circ}\text{C}$ 212° Fahrenheit is equivalent to 100° Celsius 90° Fahrenheit is equivalent to 32.2° Celsius 32° Fahrenheit is equivalent to 0° Celsius $9/5 \text{ C}^{\circ} + 32 = \text{F}^{\circ}$</p>
--	--

APPROXIMATE CONVERSION FACTORS

To Change	To	Multiply By
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Sq Inches	Sq Centimeters	6.451
Sq Feet	Sq Meters	0.093
Sq Yards	Sq Meters	0.836
Sq Miles	Sq Kilometers	2.590
Acres	Sq Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Sq Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

To Change	To	Multiply By
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Sq Centimeters	Sq Inches	0.155
Sq Meters	Sq Feet	10.764
Sq Meters	Sq Yards	1.196
Sq Kilometers	Sq Miles	0.386
Sq Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Sq Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621

