JLG® GRADALL®

SERVICE MANUAL

GRADALL®

534D-9
534D-10

9134-4004

April 30, 2007

534D-9 Starting Serial No.
0544001 thru 0744407
& 0160000112 thru 0160000446

534D-10 Starting Serial No.
0366001 thru 0366533
& 0160000125 thru 0160000446

CORPORATE OFFICE

JLG INDUSTRIES, INC.
1 JLG DRIVE
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17233-9533
USA
Telephone: (717) 485-5161
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GRADALL DIVISION

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JLG® GRADALL®

OWNER/OPERATOR MANUAL

GRADALL®

534D-9
534D-10

9134-4052

January 11, 2007

534D-9 Starting Serial No.
0544001 thru 0744407
& 0160000112 thru 0160003965

534D-10 Starting Serial No.
0366001 thru 0366533
& 0160000125 thru 0160003965

Form #20219 Original Issue 6/03

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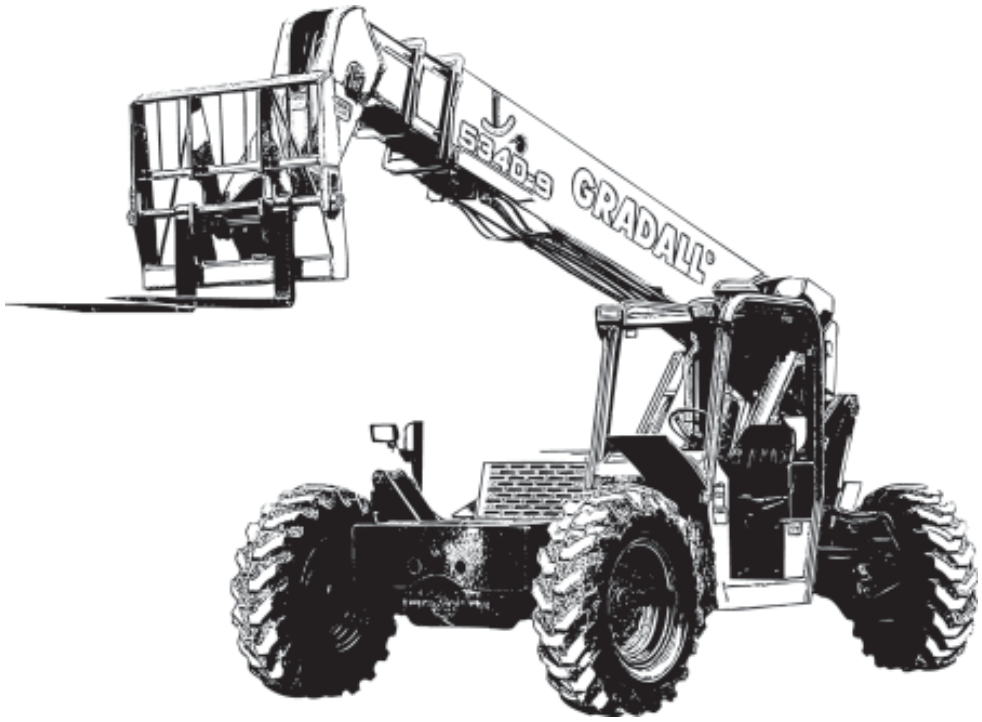
534D-9/534D-10
MATERIAL HANDLER
OWNER/OPERATOR MANUAL

COVERING OPERATION & PERIODIC MAINTENANCE

GRADALL®

material handler



IMPORTANT!

Read and understand this Manual and the Gradall Material Handler Safety Manual before starting, operating or performing maintenance procedures on this machine.

KEEP OPERATOR AND SAFETY MANUALS IN CAB

A JLG Company

Form No. 20219

COVERS MATERIAL HANDLERS 534D-9 & 534D-10
STARTING SERIAL NUMBERS
534D-9 0544001 thru 0744407 and
0160000112 thru 0160003965
534D-10 0366001 thru 0366533 and
0160000125 thru 0160003965

JLG®

Part No. 9134-4052
Revised 01-11-07

IMPORTANT SAFETY NOTICE

Safe operation depends on reliable equipment and proper operating procedures. Performing the checks and services described in this Manual will help keep your GRADALL Material Handler in reliable condition. Following recommended operating procedures can help you avoid accidents. Because some procedures may be new to even the experienced operator, we require that this Manual be read, understood and complied with by all who operate this machine.

Strict attention to and compliance with instructions provided in this Manual, the GRADALL Material Handler Safety Manual, as well as instructional decals and plates affixed to the machine will help prevent injuries to personnel and damage to the equipment. The information provided herein is not intended to cover all situations; it is impossible to anticipate and evaluate all possible applications and methods of operation for this equipment.

This Manual covers recommended operating procedures and basic maintenance checks and services for the Material Handler. Detailed maintenance information is available in the appropriate Service Manual.

Any procedure not specifically recommended by GRADALL must be thoroughly evaluated from the standpoint of safety before it is placed in practice. If you are not sure, contact your GRADALL Material Handler Distributor before operating.

Use only GRADALL authorized parts. The use of counterfeit parts may cause premature failure which could lead to injuries and/or machine damage.

Do not modify this machine without written permission from GRADALL. Use only genuine GRADALL replacement parts.

OTHER NOTICES

GRADALL reserves the right to change specifications without notice.

REVISIONS

This page is provided so you may determine that this Manual is complete and current with respect to Gradall Engineering Specifications.

Page	Date	Revision
	6/03	Original Issue, replaces Owner/Op Manual 9134-4051 (Form #20046).
Cover	01/07	Revised ending serial numbers.

TABLE OF CONTENTS

INTRODUCTION

General
This Manual provides important information regarding safe operating and maintenance requirements for GRADALL Material Handlers.

If you have any questions regarding the material handler, contact your GRADALL Material Handler Distributor.

Operator Qualifications
Operators of the material handler must be in good physical and mental condition, have normal reflexes and reaction time, good vision and depth perception and normal hearing. He must not be using medication which could impair abilities nor be under the influence of alcohol or any other intoxicant during the work shift.

The operator should possess a valid, applicable driver's license and must have completed a training course in the safe operation of this type of material handling equipment.

In addition, the operator must read/view, understand and comply with instructions contained in the following material furnished with the material handler:

- This Owner/Operator Manual
- GRADALL Material Handler Safety Manual
- All warning and instructional decals and plates
- Any optional equipment instructions furnished

The operator must also read, understand and comply with all applicable Employer, Industry and Governmental rules, standards and regulations.

Orientation
When used to describe the location of components in the material handler, the directions "front'", "rear", "right" and "left" relate to the orientation of a person sitting in the operator's seat. ***(See Figure I-1)***

Related Manuals & Decals
Separate publications are furnished with the material handler to provide information concerning safety, replacement parts, maintenance procedures, theory of operation and vendor components. Replacement manuals, decals and instruction plates can be ordered from your GRADALL Material Handler Distributor.

Models Covered
This Manual covers basic information for Gradall Material Handlers. Detailed information for each particular machine is in the maintenance section in the back of this manual. Be certain to refer to proper information for your unit and the operational equipment furnished on your machine.

Serial Number Location
Specify Model Number and Serial Number when ordering parts and when discussing specific applications and procedures with your Distributor. The model/serial number plate is located inside the operator's cab, right wall.
(See Figure I-2)

NOTE!
"Material handler" and handler are used interchangeably throughout this Manual.

NOTE!
Though no offense or discrimination is intended, only the masculine pronouns will be used throughout the remainder of this Manual.

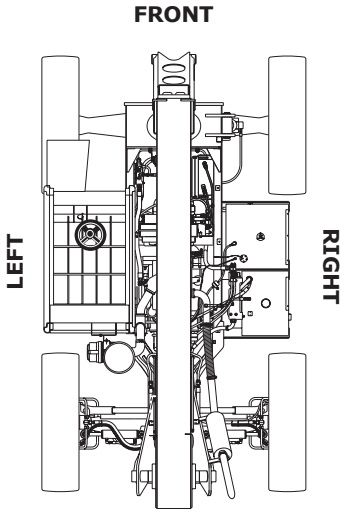


Figure I-1

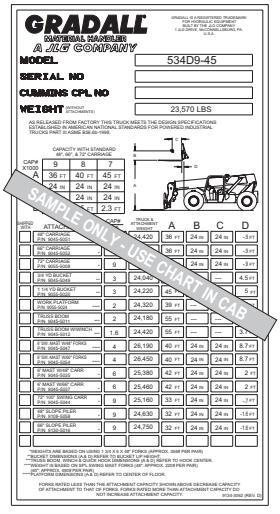


Figure I-2

1.0 SAFETY HIGHLIGHTS

Read and understand all manuals and instructional material listed on cover, inside front cover and introduction page of this Manual before starting, operating or performing maintenance procedures on this equipment.

Operators of this equipment must have successfully completed a training course in the safe operation of this type of material handling equipment.

Regardless of previous experience operating similar equipment, the operator must be given sufficient opportunity to practice with the handler in a safe, open area (not hazardous to people or property) to gain operating skills and the proper "feel" for controls and operating clearances required for safe, efficient operation.

GRADALL Material Handlers are equipped with a right-side rearview mirror. This mirror is intended as an operator's aid and does not replace the requirement for line-of-sight. Certain job site and machine conditions may require use of a signal person to help the operator when picking, placing or transporting a load. Never operate the handler until you know pick-up point, line of travel and landing point are clear. Always be aware that objects in mirror are closer than they appear.

Safety Precautions

Make sure all **DANGER, WARNING, CAUTION and INSTRUCTIONAL DECALS** are in place and can be read. Clean or replace decals as required.

Ensure handler is on a firm, level surface before lifting or placing load. Have surface leveled if necessary. **Unit can tip over if load is raised with handler on a soft or uneven surface.**

Always look in the direction of travel. **Reduce speed and be especially careful when traveling in reverse and/or turning. Be aware of tail swing due to rear-pivot steering.**

If load or conditions obstruct view, **use a signal person** when lifting, carrying or placing a load.

Loose clothing can get caught in moving machinery and can also cause accidental actuation of controls. **Dress properly for the job.**

Be alert to any unusual response to controls. If unusual response is noticed, position handler in a safe area, lower forks to ground, apply parking brake, stop engine and remove key from ignition switch. Tag steering wheel to forbid operation and **notify maintenance personnel.**

Keep hands, gloves, shoes, control knobs and pedals clean. **Slippery controls can cause accidents.** Keep a firm grip on the steering wheel when traveling.

Load capacities are based on load center being within 24 inches (610mm) from front vertical face of forks.

Never service the handler with the engine running.

Release trapped pressure before disconnecting, opening or removing any hydraulic component.

WATCH FOR THESE SYMBOLS ; THEY CALL YOUR ATTENTION TO SAFETY NOTICES.

⚠ DANGER

This symbol indicates an extreme hazard which will result in high probability of death or serious injury if proper precautions are not taken.

⚠ WARNING

This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.

⚠ CAUTION

This symbol indicates a hazard which may result in injury or damage to equipment or property if proper precautions are not taken.

⚠ WARNING

Operator must be seated with seat belt fastened, forward reverse lever in "Neutral" position, parking brake applied and all hydraulic controls in "Neutral" before starting engine.

Keep all windows and mirror(s) clean. Adjust mirror(s) as required for maximum visibility, before and during operation.

Never permit diesel engine to run out of fuel. Doing so can cause severe engine damage.

DO NOT burn or drill holes in forks. Modifying any part of machine or attachment may affect machine capacity and/or stability.

Keep head, arms, hands, legs and all other body parts inside the operator's cab at all times.

DO NOT approach power lines, overhead or underground cables or other power sources with any part of your material handler or load unless all local, state/ provincial and federal regulations have been met and the appropriate utility company has been contacted to de-energize the lines.

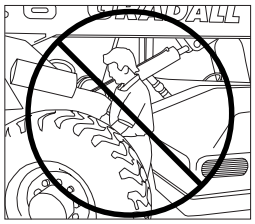
Whenever leaving the cab, perform standard shut-down procedure:

Standard Shut-Down Procedure

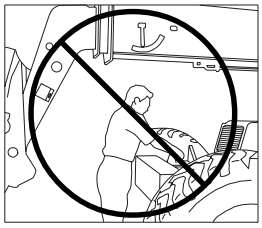
Position the handler in a safe location, apply parking brake, lower forks to ground, move all controls to "Neutral", allow engine to run at low idle for 3 to 5 minutes. Stop engine and remove ignition key. Block wheels.

Pinch Points

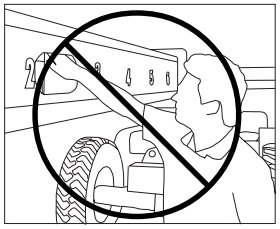
Stay clear of pinch points and rotating parts on the material handler. Getting caught in a pinch point or a moving part can cause serious injury or death. Before performing any maintenance on machine, follow the "STANDARD SHUT-DOWN PROCEDURE".



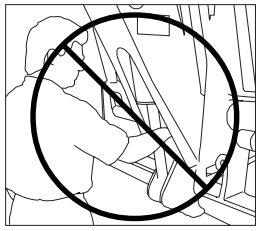
Rear Steering Axle



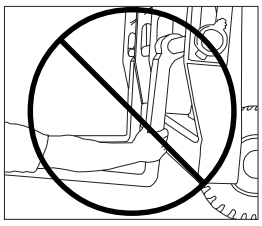
Boom



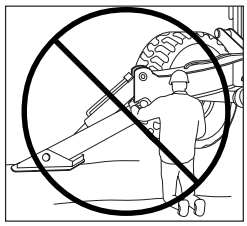
Boom Holes



Attachment Tilt



Carriage Forks



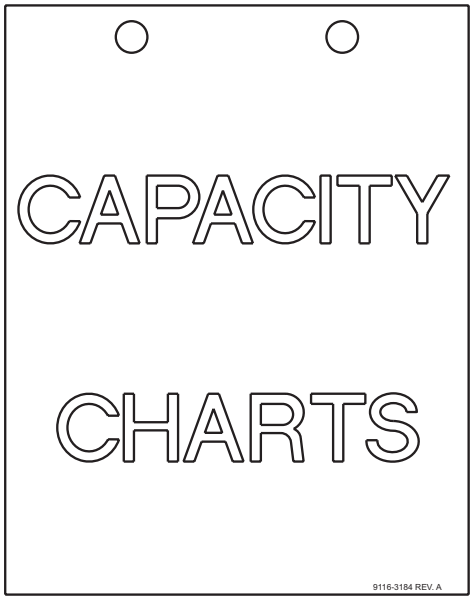
Stabilizers (D10 only)

WARNING

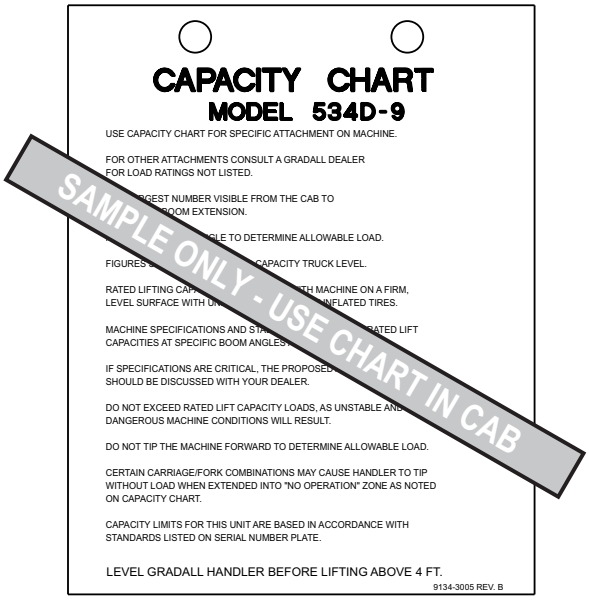
Contact The Gradall Company prior to welding on machine.

2.0 DECALS

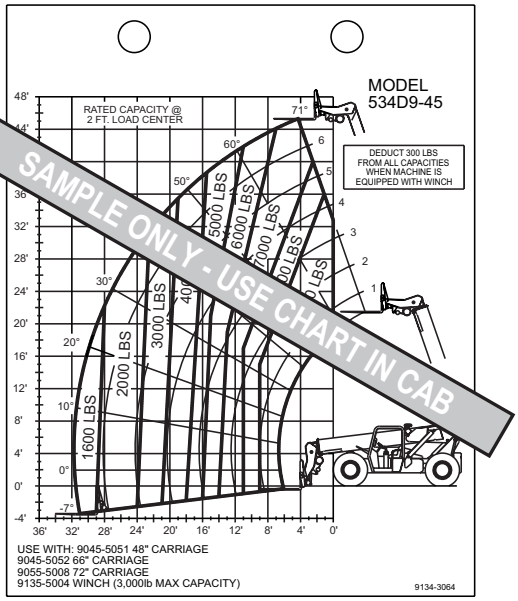
INSIDE THE CAB



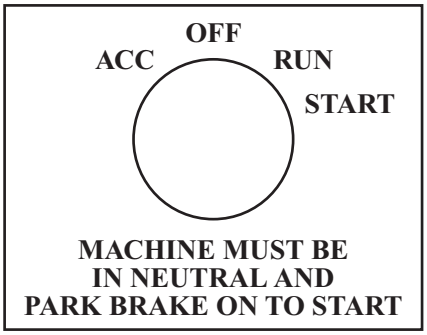
Located on dashboard
P/N 9116-3184



Located on dashboard
P/N 9134-3005

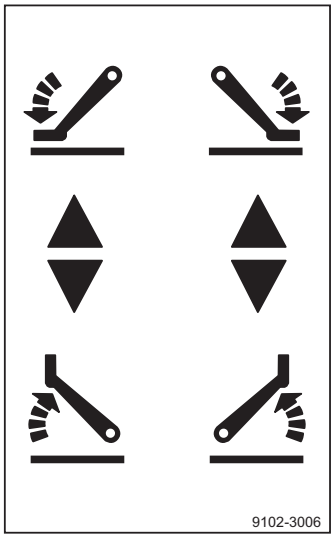


Located on dashboard
P/N 9134-3064



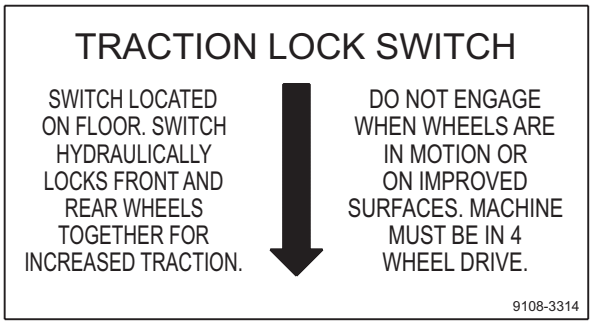
Located on dashboard
P/N 9114-3120

Located on dashboard
P/N 9114-3182

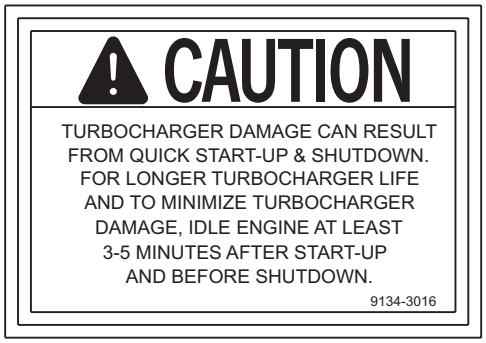


Located on seat pedestal
P/N 9102-3006

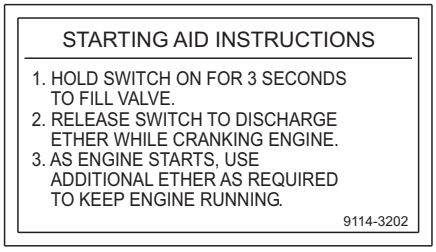
INSIDE THE CAB



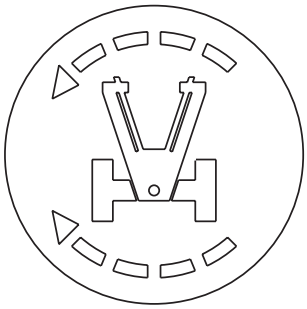
Located on dashboard
P/N 9108-3314



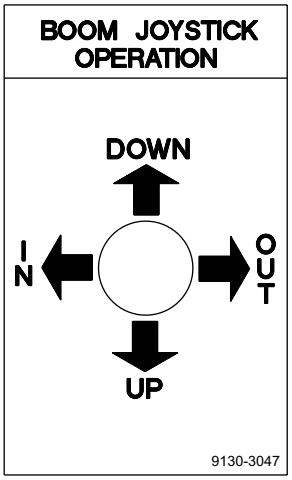
Located on dashboard
P/N 9134-3016



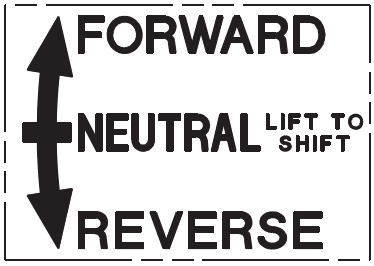
Located on dashboard
(Cummins Engines Only)
P/N 9114-3202



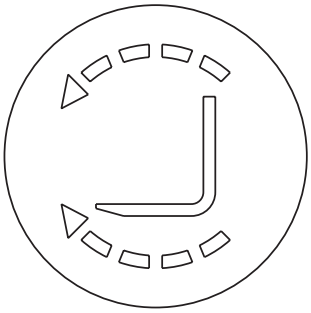
Located on lever knob
P/N 9108-3318



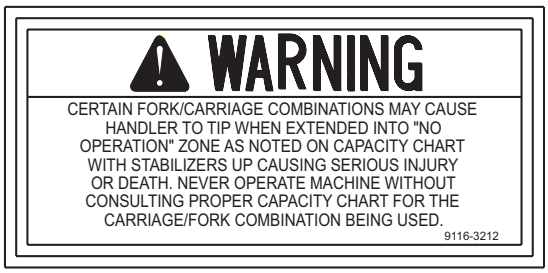
Located on joystick pedestal
P/N 9130-3047



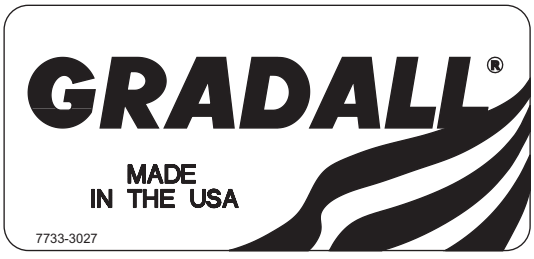
Located on forward/reverse lever
P/N 9116-3028



Located on lever knob
P/N 9108-3317



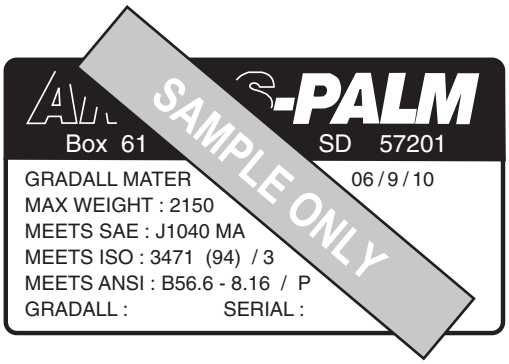
Located on dashboard
P/N 9116-3212



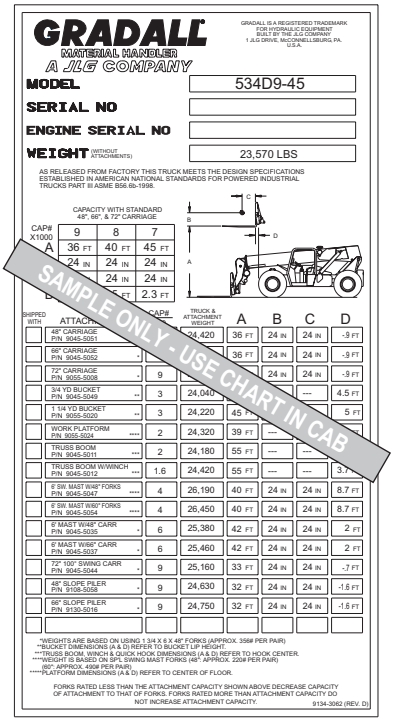
Located on left cab wall
P/N 7733-3027

INSIDE THE CAB

Located on left cab wall
P/N 9114-3283



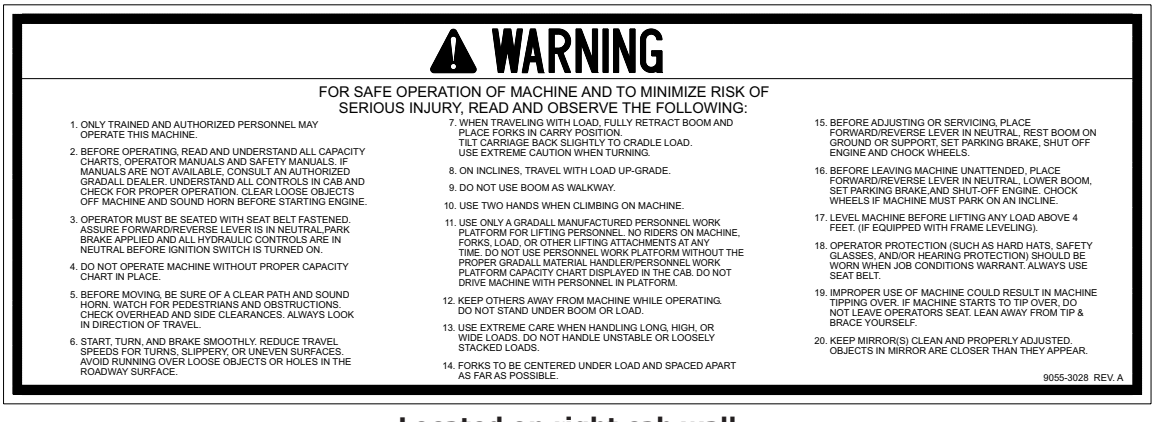
Located on left side, front cab plate
P/N 9116-4097 (enclosed cab)
P/N 9116-4093 (open cab)



Located on right cab wall
P/N 9134-3062 - 534D-9
P/N 9135-3210 - 534D-10

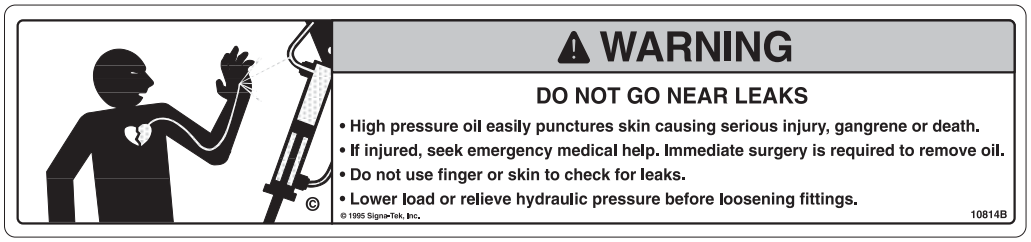
Located on left side, front cab plate
P/N 9116-4094

Located on right cab wall
(Cummins Engines Only)
P/N 9114-3292

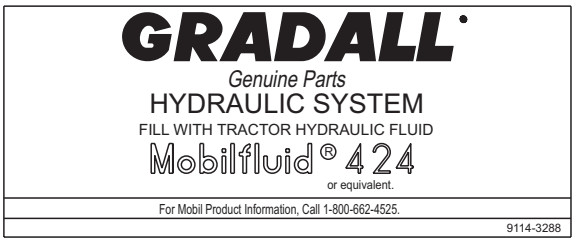


Located on right cab wall
P/N 9055-3028

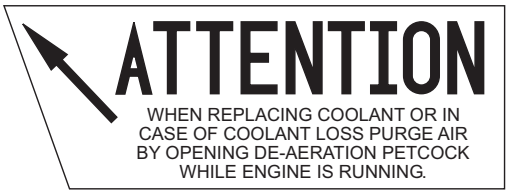
OUTSIDE THE CAB



Located on valve access cover in cab
Located on hydraulic reservoir
P/N 9108-3492

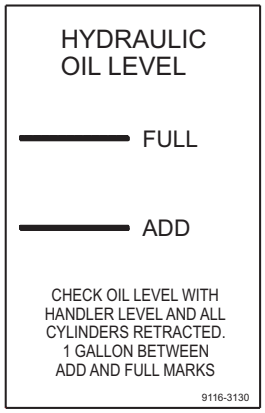


Located on hydraulic reservoir
P/N 9114-3288



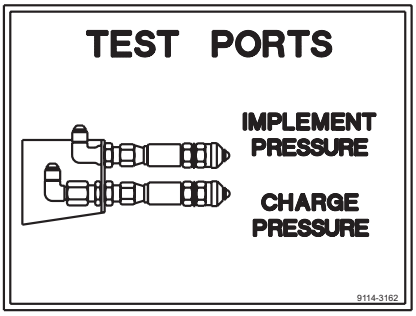
Located on engine
(Cummins Engines Only)
P/N 9116-3256

Located on sheet metal cover of
hydraulic reservoir and fuel tank
P/N 9114-3281



Located on hydraulic reservoir
P/N 9116-3130

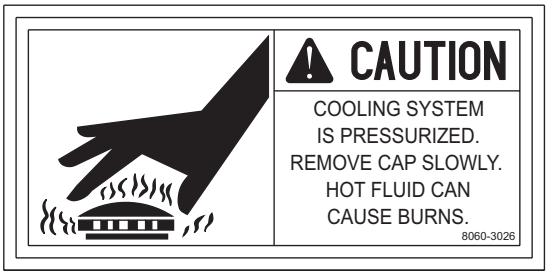
Located on right and left rear frame,
hydraulic reservoir & boom head
P/N 9114-3282



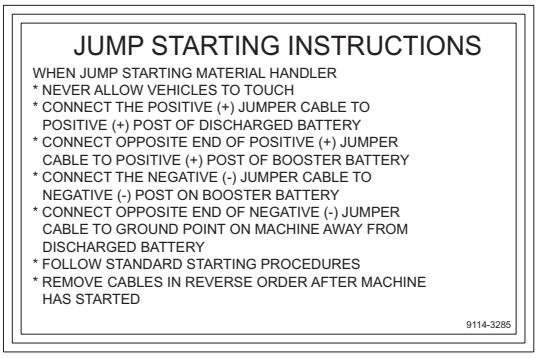
Located on hydraulic filter bracket
P/N 9114-3162

OUTSIDE THE CAB

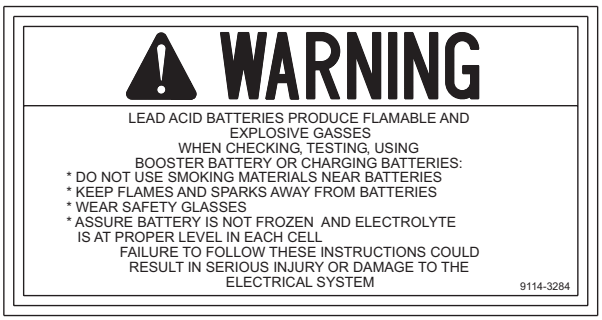
Located on engine compartment
P/N 9114-3280



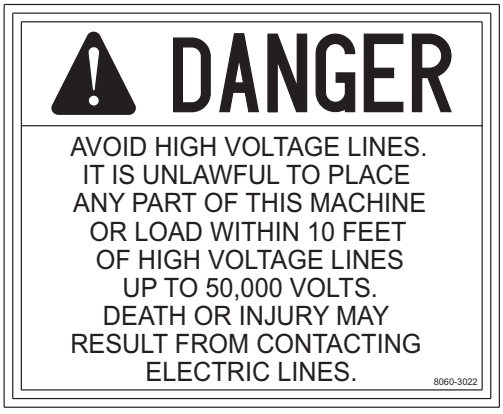
Located on engine cover
P/N 8060-3026



Located beside battery
P/N 9114-3285



Located beside battery
P/N 9114-3284



Located on mud guard
P/N 8060-3022

Located on fuel tank
P/N 9114-3286

Located on boom
P/N 8060-3037

OUTSIDE THE CAB

GRADALL HANDLER
SERVICE INSTRUCTIONS
FOR: 534D-9, 534D-10

SERVICE INTERVALS

	DAILY OR 10 HRS	WEEKLY OR 50 HRS	EVERY 3WKS OR 250 HRS	3 MO. OR 500 HRS	6 MO. OR 1000 HRS	ANNUALLY OR 1500 HRS	TYPE OR EQUIVALENT
DIESEL ENGINE							
AIR CLEANER ELEMENTS	* *						
FUEL FILTERS				CHANGE			
OIL FILTER			CHANGE				
OIL (12 QT.)	CHECK		CHANGE				SAE 15W-40-CD ***
DIESEL FUEL (40 GAL.)	FILL						DIESEL FUEL #2
HYDRAULIC SYSTEM							
(27 GAL.)	CHECK			INSPECT		CHANGE	MOBIL 424
						CHANGE	
[illegible]ATHER/FILTER CAP			CHECK		CHANGE		
(5 G[illegible]			CHECK				MOBIL 424
REAR AXLE WHE[illegible]			CHECK				MOBIL 424
WHEEL NUT TORQUE				TORQUE			
BATTERY & TERMINALS		CHECK					
RADIATOR 3 GAL. WATER 3 GAL ANTI-FREEZE							ETHYLENE GLYCOL ANTI-FREEZE
TIRES: 13.00x24(12 PLY) 65 PSI							
TIRES: 14.00x24(12 PLY) 65 PSI							
TIRES: RADIAL 70 PSI							
CYLINDER FITTINGS EACH END	* * * *	GREASE					MYSTIK TETRIMOLY
REAR AXLE (12) FITTINGS	* * * *	GREASE					MYSTIK TETRIMOLY
FRONT AXLE PIVOT (2) FITTINGS		GREASE					MYSTIK TETRIMOLY
ALL BEARINGS PADS			GREASE				MYSTIK TETRIMOLY
FRONT BOTTOM BEARING PADS		GREASE	CHECK				[illegible] TETRIMOLY
BOOM PIVOT (2) FITTINGS	* * * *	GREASE					[illegible]MOLY
HEAD PIN (2) FITTINGS	* * * *	GREASE					
BOOM SHEAVES (3) FITTINGS	* * * *	GREASE					
QUICK SWITCH (1) FITTING		GREASE					MYSTIK TETRIMOLY
RETRACT & EXTEND CABLE SEE OPERATOR & MAINTENANCE MANUAL			CHECK				

THIS CHART MUST BE USED IN CONJUNCTION WITH SERVICE MANUAL AND RECOMMENDED PROCEDURE.

* CHECK INDICATOR ON HYDRAULIC FILTER. CHANGE FILTER IF NEEDLE IS IN YELLOW AT FULL THROTTLE & AT OPERATING TEMPERATURE.

** CHECK AIR CLEANER RESTRICTION INDICATOR. CLEAN OR CHANGE PRIMARY FILTER IF NECESSARY. SAFETY ELEMENT TO BE CHANGED EVERY 3RD CHANGE OF PRIMARY FILTER ELEMENT.

*** CONSULT DEALER FOR RECOMMENDATIONS AT EXTREME TEMPERATURES.

**** DAILY SERVICE MAY BE REQUIRED FOR OPTIMUM LIFE DEPENDING UPON APPLICATION SEVERITY.

IT IS RECOMMENDED THAT FILTER ELEMENTS AND FRONT AXLE LUBRICANT BE CHANGED AFTER FIRST 50 HRS ON NEW OR REBUILT UNITS.

9134-3073 REV -

SAMPLE ONLY - USE CHART IN CAB

Located on mudguard
P/N 9134-3073

WARNING

ATTACHMENT MUST BE SECURED TO MACHINE.
CHECK TO ASSURE QUICK SWITCH PLUNGER PIN IS FULLY ENGAGED AND LOCKED AFTER ATTACHMENT CHANGE.
IF PLUNGER PIN IS NOT FULLY ENGAGED AND LOCKED ATTACHMENT MAY FALL OFF CAUSING SERIOUS INJURY OR DEATH.

9114-3290

Located on boom head
P/N 9114-3290

WARNING

READ AND UNDERSTAND THE FOLLOWING PRIOR TO LIFTING PERSONNEL.
WHEN LIFTING PERSONNEL USE ONLY A GRADALL MANUFACTURED PERSONNEL WORK PLATFORM.
ALL PERSONNEL IN PLATFORM MUST WEAR A FULL BODY HARNESS WITH LANYARD ATTACHED TO A DESIGNATED ANCHORAGE POINT.
READ AND UNDERSTAND PERSONNEL WORK PLATFORM USER'S MANUAL BEFORE OCCUPYING PERSONNEL WORK PLATFORM.
FAILURE TO COMPLY COULD RESULT IN SERIOUS INJURY OR DEATH.

9055-3026 REV. A

Located on boom head
P/N 9055-3026

WARNING

READ AND UNDERSTAND THE FOLLOWING PRIOR TO LIFTING PERSONNEL.
WHEN LIFTING PERSONNEL USE ONLY A GRADALL MANUFACTURED PERSONNEL WORK PLATFORM.
DO NOT DRIVE MACHINE WITH PERSONNEL IN PLATFORM.
WHEN PERSONNEL ARE IN PLATFORM REMAIN SEATED IN CAB WITH PERSONNEL IN DIRECT LINE OF SIGHT.
OPERATE CONTROLS LIGHTLY AND CAUTIOUSLY WHEN LIFTING PERSONNEL.
READ AND UNDERSTAND PERSONNEL WORK PLATFORM USER'S MANUAL BEFORE LIFTING PERSONNEL.
DO NOT USE PERSONNEL WORK PLATFORM WITHOUT THE PROPER GRADALL MATERIAL HANDLER/PERSONNEL WORK PLATFORM CAPACITY CHART DISPLAYED IN CAB.
FAILURE TO COMPLY COULD RESULT IN SERIOUS INJURY OR DEATH.

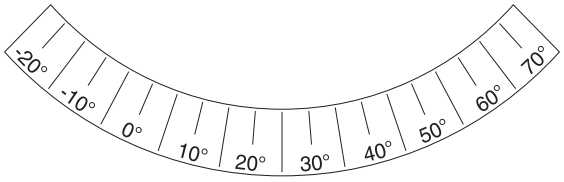
9055-3027 REV. A

Located on mudguard
P/N 9055-3027

ATTACH LANYARD HERE

9055-3032

Located on Personnel Work Platform
P/N 9055-3032



Located on left side of boom
P/N 9100-3031

WARNING

MAXIMUM OCCUPANCY THREE (3) PEOPLE.
DO NOT USE PERSONNEL WORK PLATFORM WITHOUT THE PROPER GRADALL MATERIAL HANDLER/PERSONNEL WORK PLATFORM CAPACITY CHART DISPLAYED IN CAB.
FAILURE TO COMPLY COULD RESULT IN SERIOUS INJURY OR DEATH.

9055-3031 REV. A

Located on Personnel Work Platform
P/N 9055-3031

GRADALL

406 MILL AVE. S.W. NEW PHILADELPHIA, OHIO MADE IN U. S. A.

ATTACHMENT
SERIAL NUMBER
WEIGHT
CAPACITY
HYD. PRESSURE

THE CAPACITY OF FORKLIFT, ATTACHMENT AND FORK COMBINATION MAY BE LESS THAN THE CAPACITY SHOWN ON ATTACHMENT - CONSULT FORKLIFT NAMEPLATE AND ALSO INSURE FORKS ARE OF PROPER SIZE.

9015-3001

Located on attachment
P/N 9015-3001

GRADALL

406 MILL AVE. S.W. NEW PHILADELPHIA, OHIO MADE IN U. S. A.

ATTACHMENT
SERIAL NUMBER
WEIGHT
CAPACITY
HYD. PRESSURE

DO NOT USE PERSONNEL WORK PLATFORM WITHOUT THE PROPER GRADALL MATERIAL HANDLER/PERSONNEL WORK PLATFORM CAPACITY CHART DISPLAYED IN CAB.

9055-3033

Located on Personnel Work Platform
P/N 9055-3033

3.0 OPERATOR'S CAB

OPERATOR'S CAB

The standard cab permits vision from all sides and includes an overhead guard to provide protection from falling objects.

A fully-enclosed cab with windows and a lockable door is available as an option. The top half of the cab door must be secured in the fully-opened or closed position. The bottom half of the cab door can be secured in the closed position only. Be sure the door is fully secured when operating the handler.

The operator's seat is equipped with a seat belt and includes fore and aft adjustment to compensate for variations in operator size. The adjustment release/lock is located beneath front edge of seat. **Wear seat belt when operating machine.**

An optional windshield wiper/washer is available for use with enclosed cabs. A control switch is located on the instrument panel.

A variable-speed defroster fan is available for use with enclosed cabs. An "On/Off" control switch and speed control are located on the base of the fan.

A heater fan is available for use with units equipped with a heater. An "On/Off" switch is located on the dashboard. Hot water to the heater can be controlled by a valve at the engine.

The operator's cab is an S.A.E. "FOPS/ROPS" structure. Do not make any modification to this structure. If damaged, the cab cannot be repaired. It must be replaced.

⚠ WARNING

Never operate the handler unless the overhead guard is in place and in good condition.

⚠ WARNING

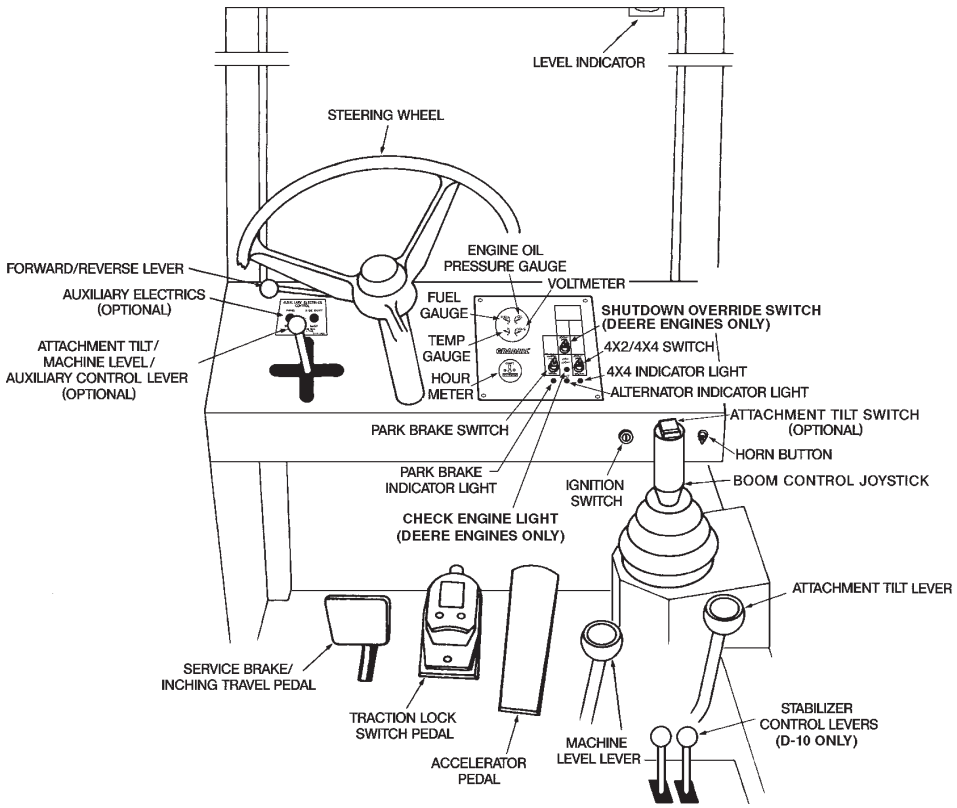
Any modification to this machine must be approved by GRADALL to assure compliance with FOPS/ROPS certification for the cab/machine configuration.

NOTE!

Relevant S.A.E. Recommended Practices:
S.A.E. J1040 for ROPS
S.A.E. J231 for FOPS

CONTROL AND INSTRUMENT IDENTIFICATION

Figure 3-1



Accelerator Pedal: Depress pedal to increase speed and release pedal to decrease speed.

Alternator Indicator Light: Glows (red) to indicate alternator is not charging.

Attachment Tilt Lever: This lever controls tilt of the fork carriage. Speed is proportional to lever actuation and engine RPM. Push lever forward to tilt down; pull lever back to tilt up.

Attachment Tilt Switch (optional): Depress front of switch to tilt down; depress rear of switch to tilt up.

Auxiliary Control Lever (optional): This lever is used to control optional hydraulic attachments. Follow decal instructions for lever/handler movements.

Auxiliary Light Switch (optional): This switch turns auxiliary lights on and off.

Boom Control Joystick: This joystick controls boom elevation and extension. Pull joystick back to raise boom; push joystick forward to lower boom. Move joystick to right to extend boom; move to left to retract boom. Speed of boom movement is proportional to joystick actuation and engine RPM.

Check Engine Light (Deere Engines Only): Glows (red) for 30 seconds before engine shuts down when a "Shutdown" fault is detected.

Engine Coolant Temperature Gauge: This gauge displays engine coolant temperature.

Engine Oil Pressure Gauge: This gauge displays engine oil pressure.

Forward/Reverse Lever: This lever engages forward or reverse travel. Lift & push lever fully forward for forward travel; Lift & pull lever fully backward for reverse travel. Move lever to centered position for "Neutral".

Fuel Gauge: This gauge displays level of fuel in fuel tank.

Heater Fan Switch (optional): This switch turns heater fan on and off.

Horn Button: Depress button to sound horn.

Hourmeter: This meter indicates total time of engine operation in hours and tenths of hours.

Ignition Switch: This switch is actuated by a key. In "ACC" or "RUN" position, voltage is available for all electrical functions. Full clockwise rotation to "START" engages starter motor. Counter-clockwise rotation to "OFF" stops engine and removes voltage from all electrical functions.

Level Indicator: This bubble level indicator enables the operator to determine the left to right level condition of the handler.

Lights Switch (optional): This switch controls optional lighting which may be provided with the handler.

Machine Level Lever: This lever controls the relationship of the handler frame to the front axle. Push the lever forward to tilt frame to left, pull lever back to tilt frame to right.

Parking Brake Switch: This switch controls the application and release of the parking brake.

⚠ WARNING

A brief description of controls and instruments is provided here as a convenience for the operator. These descriptions DO NOT provide complete operation instructions. Read & understand this Manual, and the GRADALL Material Handler Safety Manual.

Parking Brake Indicator Light: Glows (red) to indicate brake is applied.

Rotating Beacon Switch (optional): This switch controls operation of rotating beacon.

Seat Lock Release Lever: This lever unlocks and locks seat position adjustment.

Service Brake/Inching Travel Pedal: This pedal operates the service brakes on the front axle. It also permits slow travel speed while engine speed is kept high for other handler functions. The further the pedal is depressed, the slower the travel speed. Full depression of pedal causes full service brake application.

Shutdown Override Switch (Deere Engines Only): The operator may delay a shutdown for 30 seconds by pushing the "Shutdown Override" switch. The switch resets the shutdown timer to 30 seconds and may be used repeatedly. However, continuously holding the "Shutdown Override" switch will not reset the 30 second timer.

Stabilizer Control Levers (D-10 only): Left lever controls left stabilizer; right lever controls right stabilizer. Push levers forward to lower stabilizers; pull levers back to raise stabilizers.

Starting Aid Switch (Cummins Engines Only): This switch engages and disengages the cold-weather starting aid, if your handler is so-equipped.

Steering Wheel: The steering wheel controls the angle of rear wheels. Turning the steering wheel to the right causes a right turn by angling rear wheels to left. A left turn is caused by angling rear wheels to right.

Traction-Lock Pedal: This pedal operates traction-lock valve which functions to restore traction when a wheel spins in four-wheel drive.

Voltmeter: This gauge indicates alternator output and battery condition.

4x2/4x4 Switch: This switch engages and disengages rear-wheel drive motors. Rear drive motors are engaged for four-wheel drive.

4x4 Indicator Light: Glows (amber) to indicate four-wheel drive is engaged. When park brake is applied, this light will not glow.

4.0 CHECKS & SERVICES BEFORE STARTING ENGINE

To be performed at the beginning of each work shift.

- If spark arrestors are required, be sure they are in place and in good working order.
- Check to be certain that windows and mirror(s) are clean and undamaged. Also make certain that mirror(s) are properly adjusted for operator's view.
- Before removing filler caps or fill plugs, wipe all dirt and grease away from the ports. If dirt enters these ports, it can severely reduce component life.
- When adding fluids, refer to lubrication section of Manual to determine proper type.

WARNING

Use extreme caution when checking items beyond your normal reach. Use an approved safety ladder.

Complete all required maintenance before operating unit.

WARNING

Before operating handler, complete all required maintenance. Replace or repair all damaged, worn or missing components before starting or operating handler. Failure to properly maintain handler could cause serious injury or death.

Service the unit in accordance with the ***"Lubrication and Routine Maintenance" schedule.***

Inspect all structural members, including attachment, for signs of damage.

Inspect unit for obvious damage, vandalism and necessary maintenance. Check for signs of fuel, lubricant, coolant and hydraulic leaks. Open all access doors and look for loose fittings, clamps, components and attaching hardware. Replace hydraulic lines that are cracked, brittle, cut or which show signs of leakage or abrasion.

WARNING

*Use a piece of cardboard or paper to search for leaks. **DO NOT** use bare hands. If anyone is injured by hydraulic fluid, including penetration into the skin, obtain medical help **immediately**!*

5.0 WARM-UP & OPERATIONAL CHECKS

To be performed at beginning of each work shift.

The safety, efficiency and service life of your handler will be increased by performing the operational checks listed below. If any of the items in the following checks are not operating properly, have them repaired prior to the machine being placed into service. Items preceded by an asterisk (*) are optional and may not be furnished on a standard machine.

Before entering the operator's cab, check:

1. Air Filter Restriction Indicator. If needle is in red area, filter is clogged and element must be changed.

During warm-up period, check:

* 2. Heater, defroster and windshield wiper.

* 3. Operating lights and rotating beacon.

4. Voltmeter - should show 13.5 to 14 volts.

When engine warms to operating range, check:

5. Service brake and parking brake.

6. Forward and reverse travel.

7. Steering (stop to stop in both directions) with engine at low idle.

8. "Inching" travel-should be smooth through full pedal travel.

9. Horn and back-up alarm.

10. All boom and attachment functions - operate fully and correctly.

11. Hydraulic level sight gauge, level handler, retract all cylinders and check sight gauge for hydraulic fluid level - refill as required.

12. Hydraulic Filter Condition Indicator - observe engine coolant temperature gauge after starting normal operation. When needle has been in operating range for an hour or so, stop handler in a safe area, apply parking brake, lower attachment fully, shift forward/reverse lever to "Neutral" position and block wheels. With engine running at full throttle, have an assistant check the Hydraulic Filter Condition Indicator. When needle is in red area, filter is clogged and hydraulic oil is bypassing filter. Filter element must be changed before needle reaches red area.

Complete all required maintenance before operating unit.

⚠ CAUTION

Continued operation with hydraulic fluid bypassing the filter may cause severe damage to hydraulic system components.

6.0 ENGINE OPERATION

Starting the Engine

1. Make sure all controls are in "Neutral" and all electrical components (lights, heater, defroster, etc.) are turned off. Set parking brake.

2. Depress accelerator pedal approximately 1/4 to 1/3 of travel from top.

3. Turn ignition switch to "START" to engage starting motor. Release key immediately when engine starts. If engine fails to start within 20 seconds, release key and allow starting motor to cool for a few minutes before trying again.

4. After engine starts, observe oil pressure gauge. If gauge remains on zero for more than ten seconds, stop engine and determine cause. Correct malfunction before restarting engine. Minimum pressure at operating temperature:
   Low idle: 10 PSI (69kPa)

5. Warm up engine at approximately 1/2 throttle until engine coolant temperature reaches operating range.

⚠ WARNING

Operator must be seated with seat belt fastened, forward/reverse lever in "Neutral" position, parking brake applied and all hydraulic controls in "Neutral" before starting engine.

⚠ CAUTION

Turning ignition switch to "START" position while engine flywheel is rotating may cause serious damage to engine and/or starting motor.

NOTE!

Engine will not start unless forward/reverse lever is in "Neutral" and parking brake switch is applied.

Cold-Weather Starting Aids

In cold weather situations, a supplemental starting aid may be required. Gradall-approved starting aids employ ether. If your handler is equipped with an ether starting aid, the following applies:

Cummins Engine
- Hold switch on for 3 seconds to fill valve.
- Release switch to discharge ether while cranking engine.
- As engine starts, use additional ether as required to keep engine running.

Deere Engine
- Ether application is triggered by temperature gauge located on engine.
- At start-up, temperature gauge on engine will detect if ether is needed. Follow normal start-up procedure, shown above.
- Ether is employed and additional will be released if needed, to keep engine running.
- A second battery is added for additional cold-cranking capacity.

⚠ CAUTION

If you use a starting aid employing ether or a similar substance, pay particular attention to manufacturer's warnings. Excessive ether may cause severe engine damage.

Battery-Boosted Starting

If you ever have to battery-boost start (jump-start) your handler, proceed as follows:
- Never allow vehicles to touch
- Connect the positive (+) jumper cable to positive (+) post of discharged battery
- Connect opposite end of positive (+) jumper cable to positive (+) post of booster battery
- Connect the negative (-) jumper cable to negative (-) post on booster battery
- Connect opposite end of negative (-) jumper cable to ground point on machine away from discharged battery
- Follow standard starting procedures
- Remove cables in reverse order after machine has started

Normal Engine Operation

Observe gauges frequently to be sure all engine systems are functioning properly.

The voltmeter shows the "charge/discharge" state of the battery charging system. With the engine running, meter should indicate 13.5 to 14 volts. With engine stopped, meter indicates battery charge (12 volts). The alternator indicator light glows (red) to indicate alternator is not charging.

Be alert for unusual noises or vibration. When an unusual condition is noticed, park machine in safe position and perform standard shut-down procedure. ***(See Page 1.1)*** Report condition to your supervisor or maintenance personnel.

Avoid prolonged idling. Idling causes engine temperature to drop and this permits formation of heavy carbon deposits and dilution of lubricating oil by incompletely-burned fuel. If the engine is not being used, turn it off.

Stopping the Engine

- **To stop engine, perform standard shut-down procedure.**
- **Operate engine at low idle for 3 to 5 minutes before turning it off.** This allows engine coolant and lubricating oil to carry excessive heat away from critical engine areas, including turbocharger.
- **Do not "gun" engine before shut down:** This practice causes incompletely-burned fuel to remove oil film from cylinder walls and dilute lubricant in crankcase.

John Deere Engine Shut-Down Protection Feature

The feature monitors coolant temperature, oil pressure and charge-air temperature. If any of the listed items cause a fault in the system the check engine light will illuminate and the engine will shut down after 30 seconds. Within that 30 second period, lower the boom and apply parking brake. Report condition to your supervisor or maintenance personnel.

⚠ CAUTION

Always keep engine cover closed while engine is running.

NOTE!

In the event of needing to delay a shutdown, ***See "Shutdown Override Switch," Page 3.2.***

NOTE!

In the event of engine or hydraulic failure, parking brakes can be released for towing. ***See "To Release Parking Brake," Page 16.1.***

7.0 BRAKE SYSTEM

General

The brake system includes a service brake and a parking brake. Service and parking brakes are applied through wet disc brake packs located within axle housing.

Because service braking and "inching" (slow travel) functions overlap, some features of inching will be discussed here. ***See "Drive Train" Section, page 10.0,*** for additional information on inching travel. ***(See Figure 3-1 for layout of controls)***

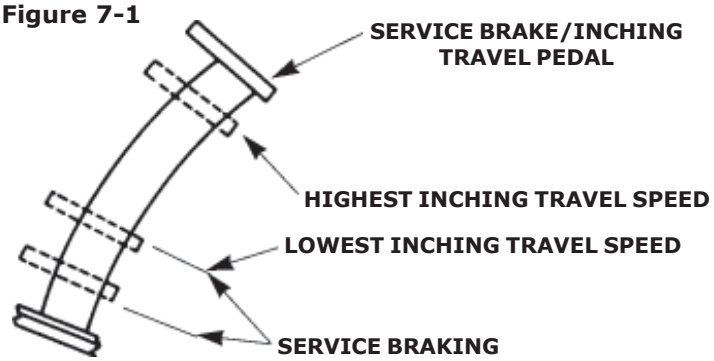
WARNING

Practice inching/braking in a safe, open area until you are thoroughly familiar with handler response.

Inching Travel

Overlap between braking and inching occurs because the same pedal controls both functions; also because both functions control travel speed. However, the methods of controlling travel speed are quite different. Service braking involves a controlled stopping force applied to the front wheels. Inching involves a controlled driving force applied to the driving wheels.

Figure 7-1



Most of the inching travel pedal stroke controls the speed of inching travel. As the pedal nears the bottom of its stroke, service brakes are engaged.

WARNING

If power-assist feature should fail for any reason, it would require greater effort to apply service brake. ***It is extremely important that you never stop the engine while traveling.*** *If power assist fails, stop as soon as possible. Do not drive the handler until problem has been corrected.*

Service Brakes

Depressing service brake/inching travel pedal to braking portion of pedal travel causes controlled hydraulic pressure to be applied to service brakes. The greater the pedal travel, the greater the braking force.

If power-assist fails, it will require much greater force on pedal to apply brake, and stopping distance will be greater.

WARNING

Always move parking brake switch to "On" position before leaving cab.

Never stop engine while traveling. Parking brake will be fully-applied and unit could stop abruptly. A sudden stop could cause load loss.

Parking Brakes

The parking brakes are spring-applied and hydraulically-released.

Hydraulic power to release parking brakes is provided by the hydraulic system and is controlled by the parking brake switch located on the dashboard.

With the engine running and the parking brake switch "Off," parking brakes are disengaged. Moving the switch to "On" releases hydraulic pressure to apply the parking brakes. With switch in "ON" position, four-wheel drive is disabled.

NOTE!

In the event of engine or hydraulic failure, parking brakes can be released for towing. ***See "To Release Parking Brake," page 16.1.***

8.0 PARKING THE HANDLER

Precautions

- Avoid parking on slopes or near an excavation.
- Park on level ground and chock wheels.
- Avoid parking on roads or highways. If it cannot be avoided,be sure to display warning flags during day and flares or flashing lights at night.
- Position boom-head or attachment on ground; never leave machine with boom in air.
- If parking on a slope cannot be avoided, position the handler at a right angle across the slope, straighten rear wheels and chock all wheels.

Parking procedure

1. Using service brake, stop the handler in an appropriate parking area.
2. Move parking brake switch to "On."
3. Shift forward/reverse lever to "Neutral."
4. Position attachment on ground.
5. Allow engine to cool at idle speed for 3 to 5 minutes, stop engine and remove ignition key.
6. Chock wheels as an extra precaution against rolling.
7. Fill fuel tank to minimize condensation.
8. Lock cab and install protective covers, if so-equipped.
9. Disconnect batteries if unit is in an area where tampering is a risk.

9.0 STEERING SYSTEM

- Rear-wheel power steering is provided to reduce operator fatigue and to permit high maneuverability in close quarters.
- It is imperative that the operator practice maneuvering the handler in a safe, open area to become thoroughly familiar with steering response and clearance required for tail swing and load when turning.

⚠ WARNING

Be alert for any increase in effort needed to steer. If any difference is noted, notify maintenance personnel immediately. If power assist feature should fail for any reason, IT WOULD BECOME VERY DIFFICULT TO STEER. For this reason it is extremely important that you NEVER TURN ENGINE OFF WHILE TRAVELING.

In the event power steering fails, stop as soon as possible. Do not drive handler until problem has been corrected.

10.0 DRIVE TRAIN

General

The Material Handler covered by this Manual is equipped with hydrostatic drive. From the operator's standpoint, operation is similar to driving a vehicle equipped with an automatic transmission.

Major components of the system include a front drive axle with a differential and planetaries. The differential receives torque from a variable-displacement piston pump and a motor.

This combination of components eliminates the need for a conventional mechanical transmission and also provides inching travel.

These handlers also have piston motors to provide torque to rear-wheel drive hubs, as well as an electrically-controlled valve which functions to restore tractive effort if conditions cause a wheel to spin.

Operation

Normal Travel. Direction of travel is selected by moving forward/reverse lever forward for forward travel, backward for reverse travel. Move lever to center position for "Neutral". ***(See Figure 3-1 for layout of controls)***

If hydrostatic drive system senses increased travel load, the system will compensate automatically by reducing travel speed to match load and engine RPM.

Inching Travel: Inching travel is provided to permit slow travel speed while maintaining high engine speed for other handler functions.

The service brake/inching travel pedal controls inching travel.

The upper portion of pedal travel actuates a valve which controls travel pump output. The greater the pedal travel, the less the pump flow; the slower the travel.

The lower portion of pedal travel actuates the service brake. The greater the pedal travel, the stronger the brake application. Travel flow is further reduced when brakes begin to apply. ***(See Figure 7-1)***

Four-Wheel Drive: When required by travel conditions, rear-wheel (four-wheel) drive can be engaged by moving switch to "4x4" position. Return unit to two-wheel drive by moving switch to "4x2" position.

Four-wheel drive can be engaged and disengaged while traveling.

When parking brake is applied, four-wheel drive is disabled.

Traction-Lock Switch: This switch (pedal) controls the traction-lock valve which functions to restore tractive effort when a wheel spins in four-wheel drive.

When switch pedal is depressed and held, traction-lock valve functions to cause delivery of full drive pressure to wheels of other axle, regardless of low pressure at spinning wheel.

DO NOT engage traction-lock function on improved surfaces. Unit must be in four-wheel drive to engage the traction-lock function.

DO NOT engage traction-lock function while wheels are turning. Return engine to idle, engage traction-lock and increase RPM. Disengage after traction resumes while in motion.

⚠ WARNING

Bring handler to a complete stop before shifting forward/reverse lever when carrying a load. A sudden change in direction of travel could reduce stability and/or cause load to shift or fall.

⚠ WARNING

Practice inching/braking in a safe, open area until you are thoroughly familiar with response of machine to pedal travel.

⚠ CAUTION

Never disengage rear hubs except when activating tow-bypass procedure.

11.0 LEVELING THE HANDLER

"Leveling" means positioning the handler so that it is level from side to side (left to right).

A level indicator is located in the upper right corner of front window frame to permit operator to determine whether handler frame level. ***(See Figure 3-1)***

There are four very important things to remember about handler leveling:

1. Never engage a load or lift a load more than four feet (1.2m) above ground unless handler is level.

2. A handler with the boom raised and/or an attachment installed is a partially-loaded handler.

3. Once the handler frame is level and the handler has raised a load more than four feet (1.2m) above ground, it must not be moved from this position if such movement could change the level condition. Do not use sway to level handler with load more than four feet (1.2m) above ground.

4. The combination of side tilt and load can cause the handler to tip over.

Two ways to level the handler:
The surface which will support the handler can be leveled. This method must be chosen if it will be necessary to move the handler from its position after the load has been raised over four feet (1.2m) from ground AND such movement could change the level condition.

Remember: The supporting surface must be large enough, smooth enough and firm enough to keep the handler level when it is moved from its position.

The handler may be leveled by means of the frame-leveling system. This method may be chosen when it will not be necessary to move the handler from its position after the load has been raised above four feet (1.2m) from ground - OR - when such movement will not change the level condition of the handler.

Always determine best position for handler to raise load from its present location and also to position load at its destination. **THEN** determine which method of leveling will be required at each location.

FINALLY, consider terrain between present location of load and its destination. Never attempt to transport a load across terrain which could cause handler to tip over.

Leveling Handler Frame:
The handler is designed to permit tilting main frame 8° to left or right to compensate for uneven ground conditions.

The rear axle pivots at the midpoint of the main frame to help ensure that all wheels will remain in contact with the ground.

A hydraulic cylinder provides a rigid connection between front axle and main frame to help ensure a solid work platform and to tilt main frame to left or right.

Optional rear-axle stabilization is available for Material Handlers covered by this manual. This system includes a hydraulic cylinder attached between the frame and the rear axle, as well as flow-restricting valving. This system dampens rear-axle oscillation whenever the boom is raised over 45° from level. **However, the system never locks the rear axle and is not designed to increase lateral stability.**

⚠ WARNING

Raising the boom (loaded or unloaded) when handler is leaning to one side could cause machine to tip over with little or no warning and cause serious injury or death.

⚠ WARNING

Always move boom to carry position (horizontal or below) before leveling frame. Attempting to level machine with boom raised could cause it to tip over.

Leveling Procedure:

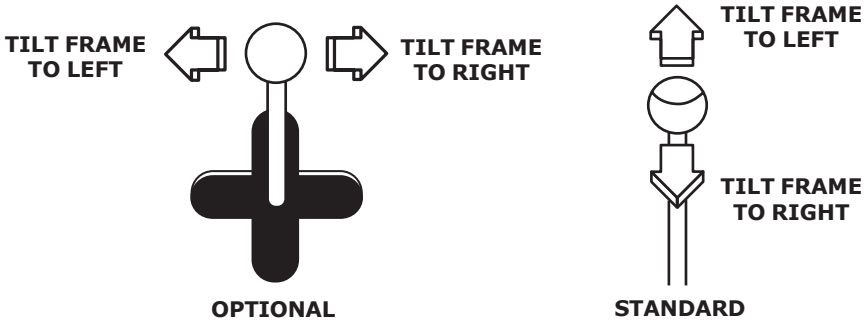
1. Position machine in best location to lift or place load and apply parking brake.
2. Observe level indicator to determine whether machine must be leveled. Note position of indicator for later realignment.
3. If necessary to level handler, position boom in carry position and level machine with the lever.
4. Lift or place load as appropriate.
5. Retract and lower boom to carry position.
6. Realign frame to position noted in step 2.

WARNING

If handler cannot be leveled using leveling system, do not attempt to raise or place load. Have surface leveled.

Frame-Leveling Controls

Figure 11-1



12.0 OPERATING PROCEDURE & TECHNIQUES

Hydraulic Controls

All boom and attachment movements are governed by hydraulic controls. Rapid, jerky operation of hydraulic controls will cause rapid, jerky movement of the load. Such movements can cause the load to shift or fall or may cause the machine to tip over.

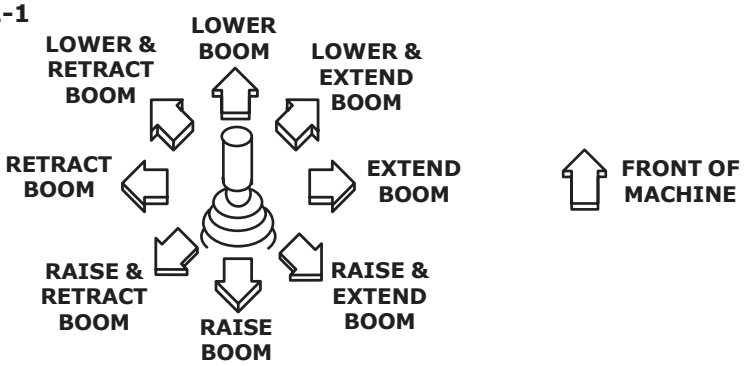
Feathering

Feathering is a control operation technique used for smooth operation. To feather controls, move control lever very slowly until function begins to move, then gradually move lever further until function is moving at desired speed. Gradually move lever toward "Neutral" as load approaches destination. Continue to reduce load speed to bring load to a smooth stop. Feathering effect can be increased by reducing engine speed at beginning and near end of load movement.

Boom Control Joystick

The boom control joystick can be positioned to activate individual boom movements or combinations of boom movements as illustrated:

Figure 12-1



With boom raised above horizontal, forks can be inserted under a load by moving boom control joystick forward and to the right until forks move forward horizontally.

With boom raised above horizontal, forks can be removed from a load by moving boom control joystick back and to the left until forks move rearward horizontally.

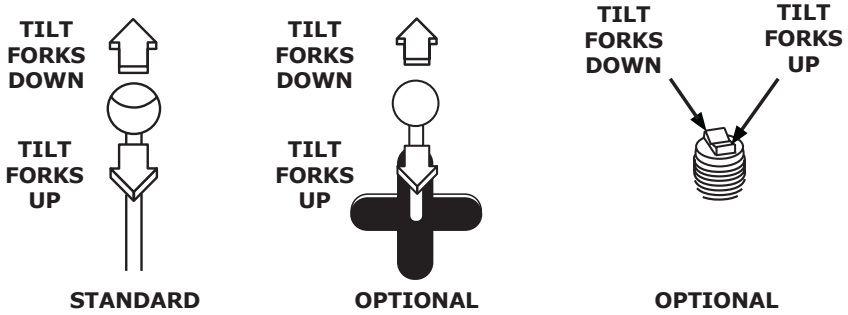
With boom lowered below horizontal, forks can be inserted under a load by moving boom control joystick back and to the right until forks move forward horizontally.

With boom lowered below horizontal, forks can be removed from a load by moving boom control joystick forward and to the left until forks move rearward horizontally.

The closer the boom to horizontal, the less boom raise/lower movement required for inserting and removing forks.

Carriage Tilt Controls

Figure 12-2



NOTE!

Much of the material in this section may be new to even the experienced operator.

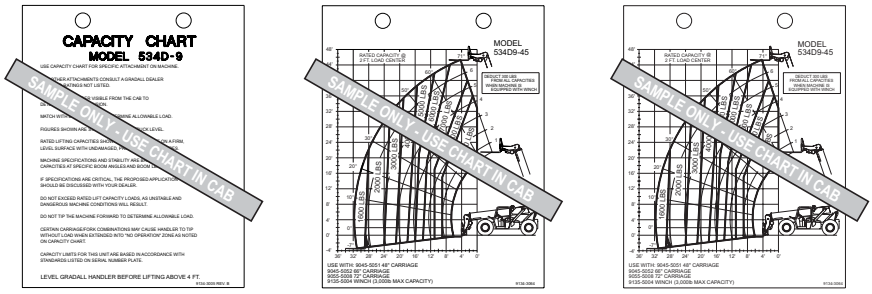
⚠ WARNING

Do not permit lift cylinders to hit the end of their stroke. The jolt could topple loads, causing a hazard to personnel and equipment nearby.

Rated Capacity Chart

The rated capacity chart, located on dashboard, indicates maximum load capacities for handlers equipped with GRADALL-furnished carriage/fork combination. These capacities apply to standard carriage/fork combinations except as stated on the capacity chart.

Figure 12-3



Elevation:

Numbers at left side of sample chart represent elevation to top of horizontal fork as measured from level ground (in feet). Elevation relates to dimension "A" shown on serial number plate, inside cab, front right side.

Boom Extension

Numbers across bottom of sample chart and numbers parallel to boom represent boom reach as measured from front of front tires to extended position.

Number decals on boom relate directly to boom extension. The largest number which can be read from operator's seat indicates total boom extension and must be matched with boom angle to determine load capacity.

Boom extension relates to dimension "D" shown on serial number plate.

Boom Angle

Numbers shown at ends of angled lines represent angle of boom to horizontal as measured from horizontal. Maximum angles are -4° below horizontal with boom fully lowered to 71° above horizontal with boom fully raised.

A boom angle indicator is located on left side of boom-section 1 to show boom angle. **Be sure machine is level from front to rear or indicator will provide incorrect reading.**

Load Center

Loads shown on rated capacity chart are based on the load center being two feet (610mm) above the horizontal surface and two feet (610mm) forward of the vertical surface of the forks.

The load center of a load is the center of gravity of the load. For regularly-shaped loads of the same material, such as a pallet of blocks, the center of gravity can be located by measuring the load to find its center. For irregular loads, or loads of dissimilar materials, keep the heaviest part of the load as close to the heel of the forks as possible.

In all cases, the load center must be centered between the forks.

Load Limits

Some capacities shown on the rated capacity chart are based on machine stability and some are based on hydraulic lift capacity. The "common sense " or "feel" an experienced operator might apply in regard to "tipping loads" **DOES NOT APPLY** to hydraulic load limits. Exceeding load limits can cause damage, or, in some cases, cause the machine to tip over.

⚠ WARNING

All loads shown on rated capacity chart are based on machine being on firm, level ground; the forks being positioned evenly on carriage; the load being centered on forks; proper size tires being properly inflated; and the handler being in good operating condition.

Items needed to Use a Capacity Chart

There are five items you must know and/or have in order to properly use a Capacity Chart:

1. The weight of the load to be lifted
2. The angle of the boom
3. How much boom extension will be needed
4. The proper Capacity Chart
5. A Gradall-approved Attachment

Every Gradall attachment comes with its own Identification Plate. This Plate has the Attachment Serial Number, Part Number, Attachment Capacity and Attachment Weight stamped on it. Make sure that the Capacity Chart you are using matches the attachment exactly. This may be done by matching the attachment part number on the Capacity Chart to the part number stamped on the Identification Plate. The Machine Serial Number Plate is mounted inside the cab and lists all standard attachments that may be used with the machine by part number, at the time it was shipped from the factory. Be aware that a specific Capacity Chart must not only match the attachment, but also the machine model.

The boom angle can be determined by looking at the angle indicator mounted on the side of the boom. **(See figure 12-4)**

The boom extension can be determined by looking at the second boom section. As the second boom section slides out of the main boom, numbers are revealed starting with 1. Each number represents approximately 5 feet of total boom extension. **(See figure 12-4) It is important to remember that these numbers are designed to be read from the *operator's seat only!***

How to read a Capacity Chart

When reading the capacity chart you must check to be sure the correct model number is listed. **(See figure 12-5)** The next thing to look for is that the part number of your attachment is listed under the "Use With" section.
Identify and find the amount of boom extension required, along with the angle of the boom. Trace the boom extension arc down until it intersects with the appropriate boom angle. If the intersection of the boom extension arc and the boom angle line occur within a weight region, the value within that region is the maximum capacity for that particular lift. If the intersection occurs on a bold line separating capacity regions, the smaller of the two values must be used. The regions are clearly marked with heavier outlines as shown on page 12.3. If you do not have the correct capacity chart for your machine and/or attachment, contact your Distributor or Gradall to order one.

Example:
A contractor has purchased a 534D-10 with the 48" Slope Piler Carriage Attachment. **(See figure 12-5)** He knows his attachment may be used with this model since the attachment part number, 9108-5058, matches the attachment part number stamped on the machine Serial Number Plate. He also knows that the Capacity Chart is correct since it is clearly marked for use with a 534D-10 and that the attachment he is using is listed at the bottom by part number. He has determined the weight of the load to be lifted is 3000 lbs. and that he needs to place the load at a boom extension of 5 at a boom angle of 20°. By tracing the boom extension arc down to where the 20° line intersects it, the contractor can see that the maximum weight he can lift, with stabilizers down, is 4000 lbs. In this case, he may lift the load.

NOTE!

Some attachments may not be approved for use with certain machine models.

Figure 12-4
Where to look on the machine.

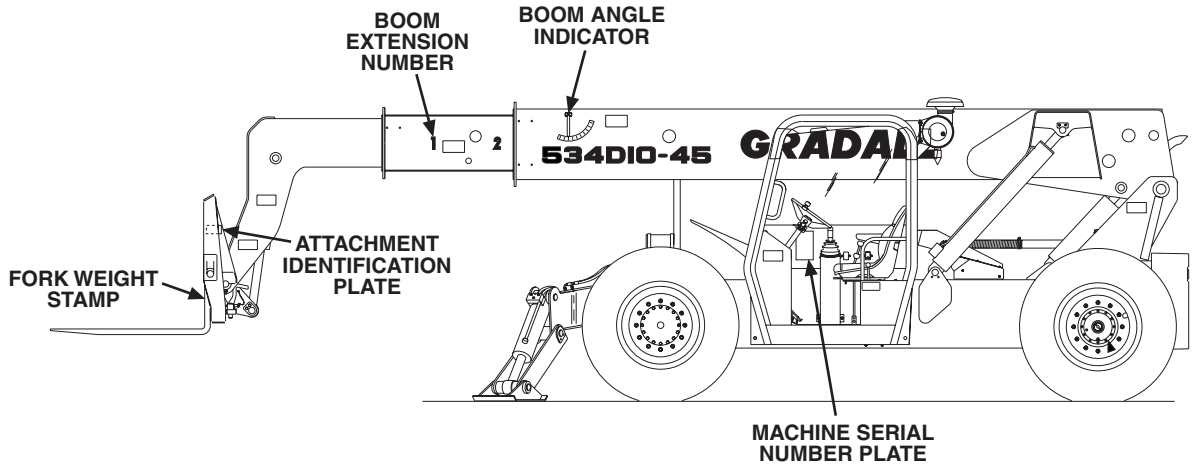
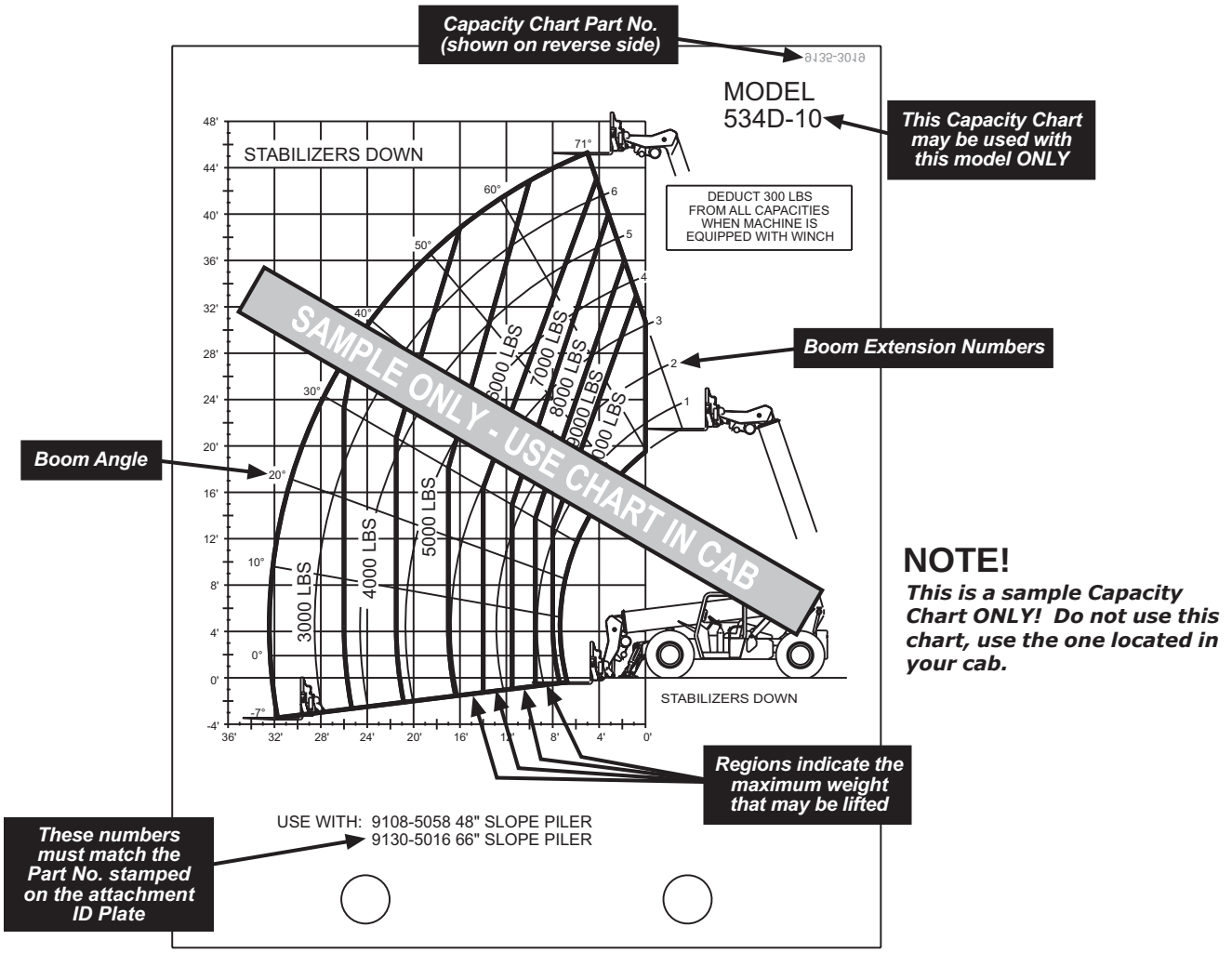


Figure 12-5
Description of items on a Capacity Chart.



13.0 ATTACHMENTS

Approved Attachments

Although the carriage/fork combination is most frequently used, several other GRADALL-approved attachments are available for use with your material handler. Contact your GRADALL Material Handler Distributor for information on approved attachments designed to solve special material handling problems.

The serial number plate lists attachments approved for use with your handler. However, there may be additional approved attachments available. Contact your GRADALL Material Handler Distributor for further information.

Non-Approved Attachments

Do not use non-approved attachments for the following reasons:

- GRADALL cannot establish range and capacity limitations for "will fit," homemade, altered, or other non-approved attachments.
- An overextended or overloaded handler can tip over with little or no warning and cause serious injury or death to the operator and/or those working near the handler.
- GRADALL cannot assure the ability of a non-approved attachment to perform its intended function safely.
- Non-approved attachments may cause structural or other damage to the handler. Such damage could cause dangerous operating conditions resulting in serious injury or death.

⚠ WARNING

Attachments which have not been approved for the use with your handler could cause machine damage or an accident resulting in injury or death.

Carriage/Fork Capacities

The standard carriage/fork capacity chart (located on the dashboard) indicates maximum reach and load capacities for handlers equipped with an approved carriage/fork combination. **These limitations apply to standard, GRADALL-approved carriage/fork combinations, except as stated on the capacity chart.**

Non-standard carriage/fork combinations (greater or lesser capacity) may be furnished by GRADALL at customer's request or may be available for installation because they were furnished for a different application.

If a carriage/fork combination of lesser capacity is used, **the overall machine capacity is reduced** to the capacity stamped on the carriage or forks, whichever is less.

If a carriage/fork combination of greater capacity is used, the overall machine capacity may be reduced because of additional attachment weight and/or other considerations. **Contact your local GRADALL Distributor to determine capacity limitations.**

⚠ CAUTION

The capacity of forklift, attachment and fork combination may be less than the capacity shown on attachment. Consult forklift nameplate and also ensure forks are of proper size.

Forks rated less than the attachment capacity decrease capacity of attachment to that of forks. Forks rated more than attachment capacity do not increase attachment capacity.

Other Attachment Capacities

A serial number/capacity plate is attached to all GRADALL-furnished attachments. **Do not assume that any GRADALL attachment may be used on any GRADALL Material Handler.**

First, check the listing of approved attachments on handler serial number plate. If the attachment in question is not included in the list, contact your local GRADALL Distributor to check whether or not the attachment is approved.

Next, **if the attachment is approved for use** with your handler, compare maximum capacity from attachment serial number plate and value stamped on forks to maximum capacity for that **attachment** as indicated on material handler serial number plate. **The smallest of these values is correct for your handler.**

⚠ WARNING

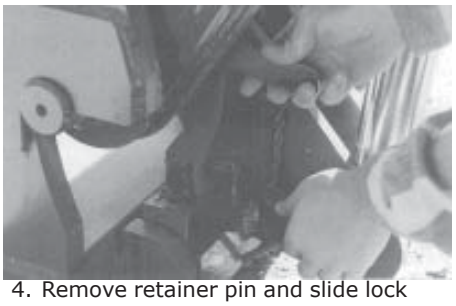
Never use an attachment without the appropriate, GRADALL supplied capacity chart for that particular attachment installed in the handler.

Attachment Installation

1. Retract Quick Switch™ (attachment tilt lever forward) to provide clearance. Check to be sure lock pin is secured in out position with retainer pin.

2. Align boom head pivot with recess in attachment. Raise boom slightly to engage boom head pivot in recess.

3. Engage Quick Switch™ (attachment tilt lever backward).



4. Remove retainer pin and slide lock pin in fully.

5. Secure lock pin in locked position using retainer pin.

6. If attachment is equipped, swing saddles down and pin in place.

⚠ WARNING

This installation procedure is designed for one-man operation. If a helper is involved, shut off the engine before proceeding to steps 4, 5, and 6.

⚠ WARNING

Always be certain that carriage or attachment is properly positioned on boom head and is secured by lock pin and retainer pin. Failure to ensure proper installation could permit carriage/attachment/load to disengage and cause serious injury or death.

Attachment Operation

Operation of the handler equipped with carriage/fork combination is covered in the **GRADALL Material Handler Safety Manual and this Manual.**

Operation of the handler when equipped with other approved attachments is covered in this section or in separate instructions furnished with the attachment. Any separate instructions must be kept in Manual Holder in cab with this **Owner/ Operator Manual.**

Operate a handler equipped with an attachment as a partially-loaded handler. Pay special attention to capacity and range limits for the handler/attachment combination.

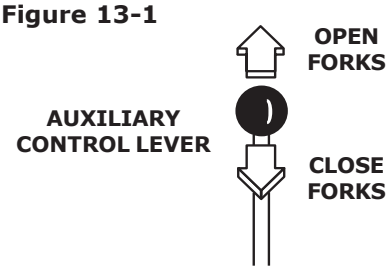
Practice operation of handler and attachment in a safe, open area, not hazardous to yourself, other persons, equipment or property. Become thoroughly familiar with response of handler and attachment to controls before operating in a work situation.

Always consider terrain between present location of load and delivery point. Never attempt to transport a load across terrain which could cause handler to tip over.

Fork Positioner

Capacity:
Maximum load capacity for fork positioner carriage is the same as standard carriage without fork positioner. **Refer to Attachment Capacity Chart.** Capacity varies with boom extension and elevation positions.

Controls:
Figure 13-1



The auxiliary control lever is used to adjust fork position. Pull lever back to close forks, push lever forward to open forks.

Installation Procedure:
1. Remove standard carriage/fork combination or other attachment from boom head. ***(See "Attachment Installation" Page 13.1)***

2. Install carriage/fork combination with positioner.

3. Connect auxiliary hydraulic hoses to positioner cylinders.

Operation:
- Always adjust fork position before engaging load. Moving forks after engaging load could cause load to fall from forks.

WARNING

PRECAUTIONS
- *Always adjust fork position before engaging load.*
- *As with all other attachments, handler must be level before handling a load more than four feet (1.2m) above ground level.* ***(See "Leveling The Handler," Page 11.0)***

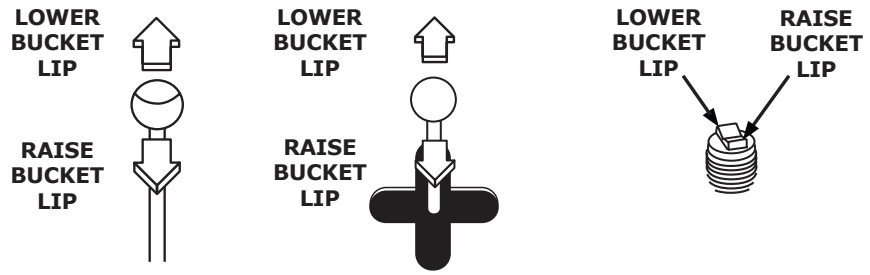
WARNING

Observe all precautions and load capacity limits (listed previously) when handling loads with carriage/ fork positioner.

Light Material Bucket

Capacity:
Maximum capacity of light material bucket is shown on the attachment serial number plate and may be used in areas where it does not exceed capacities shown on standard carriage/fork capacity chart. Capacity must be reduced for areas where maximum bucket capacity would exceed standard carriage/fork capacity chart.

Attachment Tilt Controls:
Figure 13-2



Because the carriage tilt cylinder is used to tilt the bucket, the carriage tilt lever is used to control the bucket. Pull lever back to raise bucket lip push lever forward to lower bucket lip.

Installation Procedure:
1. Remove carriage/fork combination or other attachment from boom head. ***(See Page 13.1)***

2. Install light material bucket on boom head.

3. Retract boom fully and tilt bucket up or down as required to position bottom of bucket parallel with ground.

WARNING

PRECAUTIONS
- *Handler must be level before handling a load more than four feet (1.2m) above ground level.* ***(See Page 11.0)***
- *Retract boom fully before loading bucket. Loading bucket with boom extended could damage structural members or extension chains/cables.*
- *Avoid shock loads; drive into stockpile smoothly to load bucket.*
- *Do not use bucket as a lever to pry heavy material. Excessive prying forces could damage the bucket.*
- *Do not use bucket for "back dragging." This could cause severe damage to Quick Switch fittings.*

WARNING

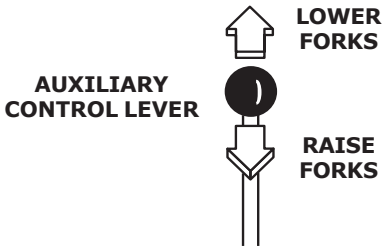
Observe all precautions and load capacity limits (listed previously) when handling loads with light material bucket.

Operation:
- Raise or lower boom to appropriate height for loading material from stockpile.
- Align handler with face of stockpile and drive slowly and smoothly into pile to load bucket. Do not corner-load bucket.
- Tilt bucket up far enough to retain load and back away from pile.
- Lower bucket to carry position 4 feet (1.2m) or less above ground and travel carefully to unloading point. Turn bucket down to dump load.

Mast (6' [1.8m] with 4' [1.2m] or 6' [1.8m] carriage)

Capacity:
Maximum lift capacity (indicated on attachment serial number plate) applies only to certain areas within boom extension/elevation pattern of handler/mast combination. A separate capacity chart must be used for handlers equipped with mast. Study and understand this chart before attempting to handle a load with mast attachment.

Attachment Tilt Controls:
Figure 13-3



The carriage tilt cylinder is used to tilt the mast and the carriage tilt lever controls mast tilt. The auxiliary control lever is used to raise and lower the forks in the mast. Pull lever back to raise forks; push lever forward to lower forks.

Installation Procedure:
1. Remove carriage/fork combination or other attachment from boom head. ***(See Page 13.1)***
2. Install mast on boom head.
3. Connect auxiliary hydraulic hoses to mast cylinder.

Operation:
- Always level handler before raising the boom or the forks, with or without a load.
- To travel with a load, lower forks fully in mast and lower boom to position load 4 feet (1.2m) or less above ground, allowing for best visibility.
- Use mast as required to increase vertical reach of handler.
- Use a signal man to assist in positioning the load if necessary.

Swing Forks

Capacity:
Maximum lift capacity for swing forks is shown on the attachment capacity chart. However, maximum lift capacity applies only to certain areas within boom extension/elevation pattern of handler/swing forks combination. A separate capacity chart must be used for handlers equipped with swing forks. Study and understand this chart before attempting to handle a load with swing forks attachment.

⚠ WARNING

PRECAUTIONS
- *Read additional capacity information under "Capacity" heading.*
- *Because the mast increases lift height, it is especially important to level the handler before lifting a load more than four feet (1.2m) above ground.* ***(See Page 11.0)***

⚠ WARNING

Do not handle a load with Mast attachment until you study and understand the "Mast Capacity Chart." If your handler does not have a "Mast Capacity Chart," ask your supervisor to get one before using the attachment.

⚠ WARNING

Do not handle a load with Swing Forks attachment until you study and understand the "Swing Forks Capacity Chart." If your handler does not have a "Swing Forks Capacity Chart," ask your supervisor to get one before using the attachment.

Attachment Tilt Controls:
Figure 13-4

The carriage tilt cylinder is used to tilt the swing forks up and down and the carriage tilt lever controls fork tilt.

The auxiliary control lever is used to swing the forks to the left and right. Pull lever back to swing forks right; push lever forward to swing forks left.

Installation Procedure:
1. Remove carriage/fork combination or other attachment from boom head. ***(See Page 13.1)***

2. Install swing forks attachment on boom head.

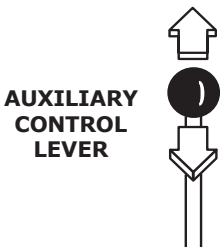
3. Connect auxiliary hydraulic hoses to swing forks attachment.

Operation:
- Always position forks straight ahead before engaging load.
- To travel with load, keep forks in straight ahead position and lower load to 4 feet (1.2m) or less above ground allowing for best visibility.
- Inspect supporting surface at delivery point and have it leveled if necessary.
- Use a signal man to assist in positioning the load if necessary.

Slope Piler Carriage

Capacity:
Maximum lift capacity for the slope piler carriage is shown on the attachment serial number plate. However, maximum lift capacity applies only to certain areas within boom extension/elevation pattern of handler/slope piler carriage combination. A separate capacity chart must be used for handlers equipped with slope piler carriage. Study and understand this chart before attempting to handle a load with slope piler carriage.

Attachment Tilt Controls:
Figure 13-5



The carriage tilt lever controls carriage tilt.

The auxiliary control lever is used to tilt slope piler carriage. Push lever forward to tilt carriage counter-clockwise; pull lever back to tilt clockwise.

Installation Procedure:
1. Remove carriage/fork combination or other attachment from boom head. ***(See Page 13.1)***

2. Install slope piler carriage on boom head.

Operation:
- Connect auxiliary hydraulic hoses to slope piler carriage attachment.
- Approach load with forks centered on load and stop handler.
- Level handler before tilting carriage to engage load.

⚠ WARNING

PRECAUTIONS
- *Read and understand additional capacity information under "Capacity" heading.*
- *Always level forks (horizontally) before swinging load to side. Swinging unleveled forks may result in load slipping from forks.*
- *Because the swing forks can swing the load to the side, it is especially important that the handler be level when handling a load more than four feet (1.2m) above ground.* ***(See Page 11.0)***

⚠ WARNING

PRECAUTIONS
- *Level handler before tilting carriage to engage load.*
- *Always level handler before lifting a load more than four feet (1.2m) above ground.* ***(See Page 11.0)***

⚠ WARNING

Do not handle a load with Slope Piler Carriage attachment until you study and understand the "Slope Piler Carriage Capacity Chart." If your handler does not have a "Slope Piler Carriage Capacity Chart," ask your supervisor to get one before using the attachment.

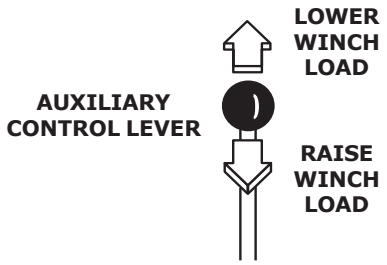
- Tilt carriage to left or right to align forks with load and engage load.
- Raise load slightly and then level carriage.
- Travel with load lowered to travel position 4 feet (1.2m) or less above ground.

Boom Head-Mounted Winch

Capacity:
The boom head-mounted winch maximum load capacity is shown on the standard carriage capacity chart. However, maximum capacity may be used only in areas where it does not exceed capacities shown on standard carriage/ fork capacity chart (located on dashboard). Also note that maximum winch capacity is less than carriage/fork maximum capacity. Capacity rating is based on load being lifted and suspended vertically from the boom and with no load on forks.

Observe the following Special Precautions:
- Never drag the load; lift vertically.
- Use tag line to guide and steady a suspended load. Tag lines must be long enough to keep helpers clear of load and handler.
- Beware of wind. Wind can cause a suspended load to swing and cause dangerous side loads - even with tag lines.
- Start, travel, turn and stop slowly to prevent load from swinging.
- Weight of all rigging (slings, etc.) must be included as part of load.
- Do not attempt to use handler frame-leveling to compensate for load swing.

Attachment Tilt Controls:
Figure 13-6



The auxiliary control lever is used to control the boom head-mounted winch. Pull the lever back to raise winch load; push the lever forward to lower winch load.

Installation Procedure:
1. Install winch on boom head and connect hydraulic hoses at winch motor.
2. Position winch hook directly above balance point of load and secure using appropriate rigging.

Operation:
- Attach tag lines to load and transport load to delivery site.
- While helpers guide load with tag lines, position load at delivery point.

⚠ WARNING

A side load or a swinging load could cause the handler to tip over and/or damage the boom.

⚠ WARNING

PRECAUTIONS
- *Maximum winch load capacity is reduced from normal carriage/fork load rating.*
- *Always level handler before lifting a load.* ***(See Page 11.0)***
- *Travel with load and boom lowered to travel position load 4 feet (1.2m) or less above the ground.*
- *Always lower load to rest before leaving handler.*

⚠ WARNING

Do not handle a load with Boom Head-Mounted Winch attachment until you study and understand the "Boom Head-Mounted Winch Capacity Chart" carefully. If your handler does not have a " Boom Head-Mounted Winch Capacity Chart," ask your supervisor to get one before using the attachment.

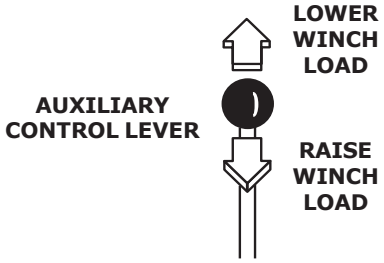
Truss Boom & Truss Boom with Winch

Capacity:
Maximum capacity for the truss boom (with or without winch) is shown on attachment serial number plate. However, maximum lift capacity applies only to certain areas within boom extension/elevation pattern of handler/truss boom combination. A separate capacity chart must be used for handlers equipped with truss boom. Study and understand this chart before attempting to handle a load with truss boom.

Observe the following Special Precautions:

- Never drag the load; lift vertically.
- Use tag line to guide and steady a suspended load. Tag lines must be long enough to keep helpers clear of load and handler.
- Beware of wind. Wind can cause a suspended load to swing and cause dangerous side loads - even with tag lines.
- Start, travel, turn, and stop slowly to prevent load from swinging.
- Weight of all rigging (slings, etc.) must be included as part of load.
- Do not attempt to use handler frame-leveling to compensate for load swing.

Attachment Tilt Controls:
Figure 13-7



The carriage tilt cylinder is used to tilt the truss boom up and down from the handler boom head. The carriage tilt lever controls truss boom tilt.

The auxiliary control lever is used when the truss boom is furnished with a winch. Pull the lever back to raise winch load; push the lever forward to lower winch load.

Installation Procedure:
1. Remove carriage/fork combination or other attachment from boom head. ***(See Page 13.1)***
2. Install truss boom on boom head.

Operation:
- If truss boom winch is furnished, connect auxiliary hydraulic hoses to winch.
- Approach truss or truss bundle with boom above and parallel to load.
- Position truss boom approximately parallel with main boom.
- Position truss boom/winch hook as close as possible to balance point of load and secure load to boom using short slings or other rigging. Be sure rigging will not allow load to slip in any direction.

⚠ WARNING

PRECAUTIONS
- *Because the truss boom extends the reach of the handler, maximum load capacity is reduced.*
- *Because of extended reach, it is especially important to level the handler before lifting a load.* ***(See Page 11.0)***
- *Travel with load and boom lowered to travel position 4 feet (1.2m) or less above ground.*
- *Always lower load to rest before leaving handler.*

⚠ WARNING

Do not handle a load with Truss Boom & Truss Boom with Winch attachment until you study and understand the "Truss Boom & Truss Boom with Winch Capacity Chart." If your handler does not have a "Truss Boom & Truss Boom with Winch Capacity Chart," ask your supervisor to get one before using the attachment.

⚠ WARNING

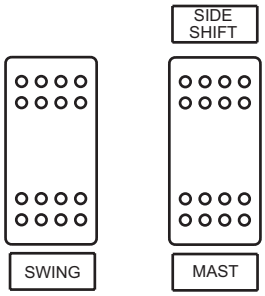
A side load or a swinging load could cause the handler to tip over and/or damage the boom.

- Open clamps at heel of truss boom far enough to clear load and tilt truss boom up until truss/bundle contacts heel of truss boom.
- Close clamps to hold load lightly and secure clamps.
- Transport load to delivery site and attach tag lines if load will be freely suspended.

Swing Mast

Capacity:
Maximum lift capacity is shown on attachment serial number plate. However, maximum lift capacity applies only to certain areas within boom extension/ elevation pattern of handler/swing mast combination. A separate capacity chart must be used for handlers equipped with mast. Study and understand this chart before attempting to handle a load with swing mast attachment.

Controls:
Figure 13-8



The carriage tilt cylinder is used to tilt the mast and the carriage. Tilt lever controls mast tilt.

- Press right switch up to "SIDE SHIFT" to activate side shift function. Move auxiliary hydraulic lever in appropriate direction.
- Press left switch down to "SWING" to activate swing function. Move auxiliary lever in appropriate direction.
- Press right switch down to "MAST" to activate mast function. Move auxiliary lever in appropriate direction.

Installation Procedure:
1. Remove carriage/fork combination or other attachment from boom head. ***(See Page 13.1)***
2. Install swing mast on boom head and connect auxiliary hydraulic hoses to swing mast diversion valve hoses. Also connect electrical cable at boom head.

Operation:
- Always lower carriage fully in mast and position forks straight ahead before engaging load.
- To travel with a load, keep forks straight ahead and lower load to travel position 4 feet (1.2m) or less above ground.
- Inspect supporting surface at delivery point and have it leveled if necessary.
- Level handler before raising load.
- If necessary, perform a "dry-run" (unloaded) of delivery to determine best position for handler.
- Use a signal person to assist in positioning the load if necessary.

⚠ WARNING

PRECAUTIONS
- *Always level forks (horizontally) before swinging load to side. Swinging unleveled forks may result in load slipping from forks.*
- *The swing mast attachment has a smaller load capacity than the standard carriage/fork attach. Study and understand the swing mast capacity chart before handling a load with swing mast.*
- *Read additional capacity information under "Capacity" heading on chart.*
- *Because the swing mast increases lift height and can swing load to side; it is especially important to level handler before lifting a load more than four feet (1.2m) above ground level.* ***(See Page 11.0)***

⚠ WARNING

Do not handle a load with Swing Mast attachment until you study and understand the "Swing Mast Capacity Chart." If your handler does not have a "Swing Mast Capacity Chart," ask your supervisor to get one before using the attachment.

⚠ WARNING

Observe all precautions and load capacity limits when handling loads.

Personnel Work Platform

The material handler operator and personnel in the platform must read and understand the separate personnel work platform manual, included with the attachment, prior to using the platform.

Capacity:
The Gradall personnel work platform is designed to carry a maximum of 3 occupants. The load includes personnel, materials, tools, etc. The maximum capacity of your work platform is based on specific model material handler/ work platform combination. To determine maximum load capacity for given operating ranges, consult the proper load capacity chart (furnished with platform) for the material handler and work platform in use. **If your handler is not equipped with the proper personnel work platform capacity chart, get one before using the attachment.**

Installation Procedure:
1. Remove carriage/fork combination or other attachment from boom head. ***(See Page 13.1)***

Operation:
- Gradall Personnel Work Platforms are approved for use **only** on Gradall Material Handlers equipped with the proper platform capacity chart.
- When lifting personnel, **use only a Gradall manufactured personnel work platform**. No other platform is approved for use on Gradall Material Handlers.

⚠ WARNING

Do not use the Personnel Work Platform until you study & understand the " Capacity Chart". If your handler does not have the correct "Personnel Work Platform Capacity Chart", ask your supervisor to get one before using the attachment.

⚠ WARNING

Do not use a boom mounted winch while the platform is mounted to the boom.

14.0 OBTAINING HYDRAULIC OIL SAMPLE

1. Operate unit until hydraulic oil reaches normal operating temperature.

2. Apply parking brake, lower boom to ground and shift Forward/Reverse lever to "Neutral." Observe Hydraulic Filter Bypass Indicator with engine running at full throttle. Replace filter elements if necessary.

3. Obtain a container to receive waste oil and a **CLEAN** container to receive oil sample.

4. With gauge removed from hose, attach mini-check and hose to test port near right wall of engine compartment. Hose end must be positioned in waste oil container.

5. Allow at least one pint of oil to flow into waste oil container to eliminate any contamination from hose.

6. Move hose to **CLEAN** container to collect sample for analysis.

7. Return hose to waste oil container and disconnect adapter from mini-check test port.

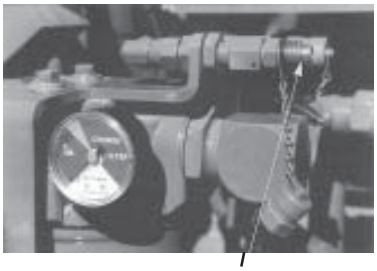
8. Cover sample container immediately with **CLEAN** cap.

9. Stop engine and check oil level in reservoir and replenish as required.

10. Contact your GRADALL Distributor for information concerning oil analysis.

Oil sample containers are available from several sources:

- Oil companies
- Oil suppliers
- Sampling labs



TAKE HYDRAULIC SAMPLE FROM THIS PORT

NOTE!

OIL CLEANLINESS IS CRITICAL The filtration system is designed to maintain a minimum ISO cleanliness level of 18/15.

15.0 LOADING & SECURING FOR TRANSPORT

Loading & Securing Handler For Transport

1. Level the material handler prior to loading.
2. Using a spotter, load the handler with boom as low as possible to keep a low center of gravity.
3. Once loaded, apply parking brake and lower boom until boom or attachment is resting on deck. Move all controls to "Neutral," stop engine and remove ignition key.
4. Secure machine to deck by passing chains through two tie-down lugs on front and rear of machine. ***(See Figures 15-1 & 15-2)***
5. Do not tie down front of boom.

WARNING

Before loading handler for transport, make sure deck, ramps and handler wheels are free of mud, snow and ice. Failure to do so could cause handler to slide, resulting in an accident causing serious injury or death.

Figure 15-1

Figure 15-2

NOTE!

Machine depicted may not be model covered by this manual, however, tie-down locations are similar.

16.0 MOVING HANDLER IN EMERGENCY

The following information assumes the handler cannot be moved under its own power.

Before moving the handler, read all of the following information to understand options available. Then select the appropriate method.

The ability to steer the handler increases the safety of moving the unit in some situations. The steering system permits manual steering if engine or power assist feature fails.

Remember:
- Although manual steering is possible without power assist, **steering will be slow and will require much greater force.**

MOVING SHORT DISTANCES

If it is only necessary to move handler a short distance, less than 100 feet (30m), it is permissible to use a vehicle of sufficient capacity to tow the unit with no previous preparation. Drive wheels will not roll. If the unit must be moved more than 100 feet (30m), but less than 200 yards (182m), it is permissible to use a vehicle of sufficient capacity to tow unit after you:

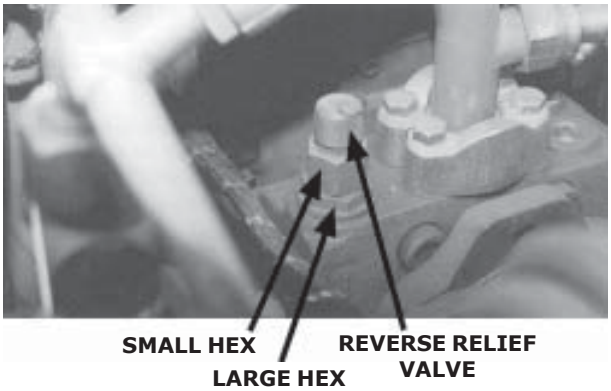
- Activate "Tow Bypass." ***(See below)***
- Release parking brake. ***(See Page 16.1)***

MOVING LONGER DISTANCES

If the handler must be moved more than 200 yards (182m), it must be loaded on to a trailer of sufficient capacity.

TO ACTIVATE TOW BYPASS

Figure 16-1



1. Shut down machine and block wheels.
2. Mark position of relief valve cartridge (small hex).
3. Hold large hex to prevent movement and loosen reverse relief valve cartridge (small hex) two full turns.
4. Repeat steps 2 and 3 for forward relief valve. Front axle drive is now bypassed.
5. Disengage rear drive hubs (Fairfield hubs do not disengage).
6. Before returning machine to service, be certain to **return relief valve cartridges to original position and re-engage rear drive hubs.**

⚠ WARNING

Towing handler with all wheels on ground for more than 200 yards (182m) could cause serious damage to hydraulic drive components.

⚠ CAUTION

Do not operate hydrostatic drive system with rear hubs disengaged as the hydraulic rear-drive motors may be severely damaged.

NOTE!

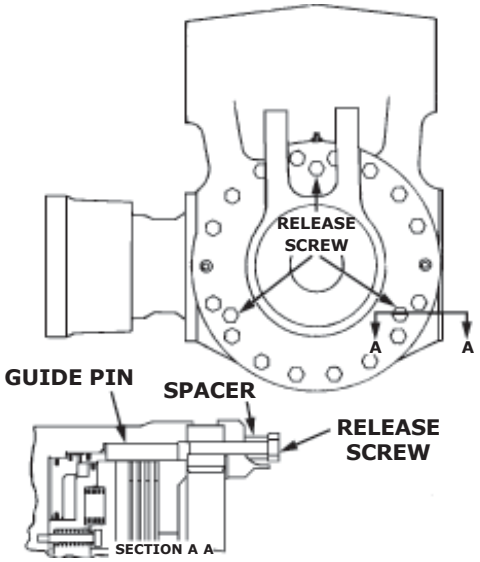
Forward relief valve is located on bottom of pump case directly below reverse relief valve.

TO RELEASE PARKING BRAKE MERITOR AXLE

1. Position unit on level ground, lower attachment to approximately one foot (.3m) from ground, move forward/reverse lever to "Neutral," apply parking brake and stop engine.

2. Block all wheels to prevent inadvertent movement.

Figure 16-2



3. Working one side at a time, remove three release screws and spacers from side of differential housing (located at 12 o'clock, 4 o'clock and 8 o'clock).

4. Put spacers aside and install release screws. Tighten each screw lightly until it just makes contact with guide pin.

5. Working carefully, tighten each release screw only 1/4 turn (90°) at a time, in sequence, until all three screws have been turned one full turn 360°, approximately 50 ft.-lb. (67n.m). Larger turns could cause components to bind and cause brake failure.

6. Repeat this procedure on other side of differential. Parking brake should be released.

TO RESTORE PARKING BRAKE

1. Make certain engine is stopped and all wheels are blocked.

2. Loosen each release screw, only 1/4 turn at a time, in sequence, until each screw has lost contact with guide pin. Then remove release screws.

3. Install previously removed spacer over bolt and install release screws and tighten.

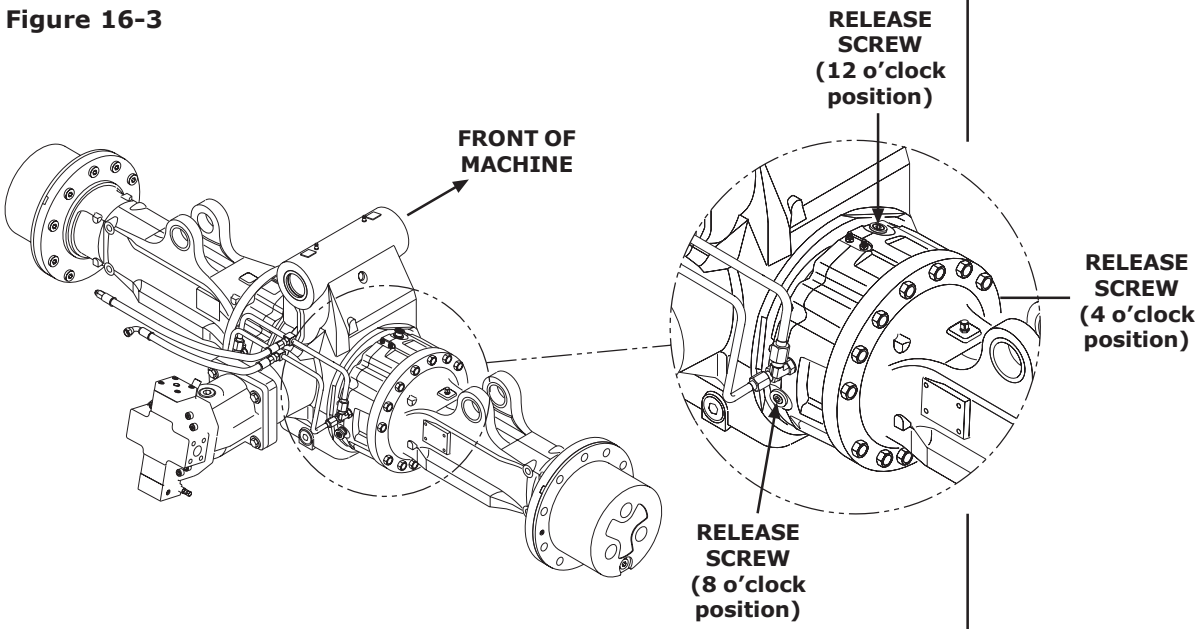
4. Repeat procedure on other side of differential. Parking brake should be restored to operation.

CARRARO AXLE

1. If possible position unit on level ground lower attachment to approximately one foot from ground, move forward/reverse lever to "Neutral", apply parking brake and stop engine.

2. Block all wheels to prevent inadvertent movement.

Figure 16-3



3. Working one side at a time, remove three plugs from differential housing (located at 12 o'clock, 4 o'clock and 8 o'clock). Put plugs aside.

4. Tighten each release screw revealed by the plugs, lightly until some resistance is felt.

5. Working carefully, tighten each release screw only 1/2 turn (180°) at a time, in sequence, until all three screws have been turned approximately five full turns. Larger turns could cause components to bind and cause brake failure.

6. Repeat this procedure on other side of differential. Parking brake should be released.

TO RESTORE PARKING BRAKE

1. Make certain engine is stopped and all wheels are blocked.

2. Loosen each release screw, only 1/2 turn at a time, in sequence, until each screw has lost contact with guide pin. Back out each screw until it bottoms out against the stop. Then screw the bolts back in 1/4 turn.

3. Install plugs over each release screw.

4. Repeat procedure on other side of differential. Parking brake should be restored to operation.

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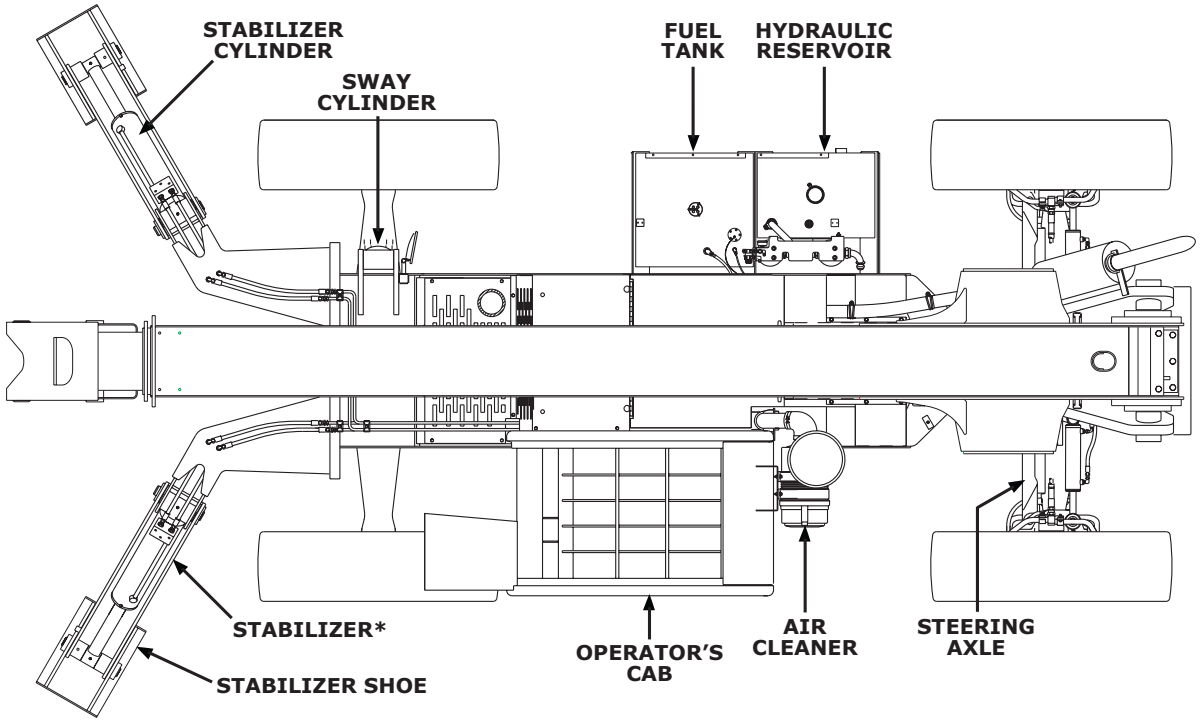
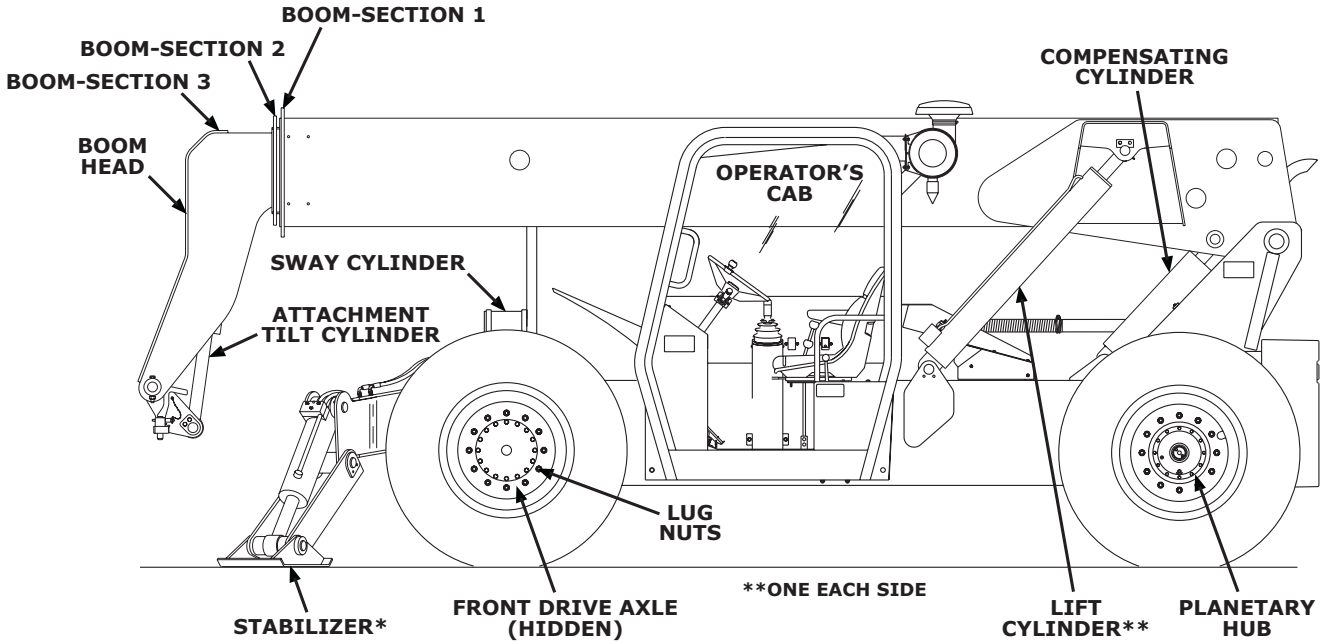
17.0 MAINTENANCE

NOMENCLATURE

Figure 17-1



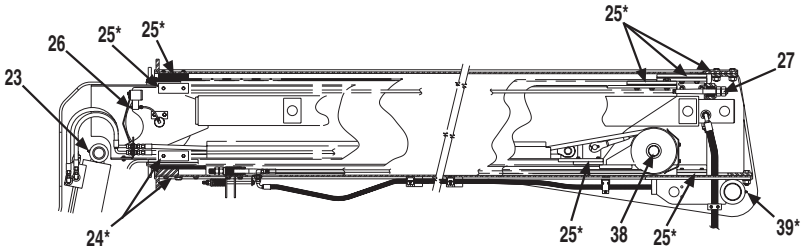


*NOTE!

Stabilizers are standard equipment on all 534D-10 Material Handlers. There are no stabilizers on the 534D-9.

17.1 LUBRICATION & ROUTINE MAINTENANCE

Figure 17-2



SYMBOLS

- • = Lube Fitting
- ⟶ = Other Service
- ∗ = Service Both Sides

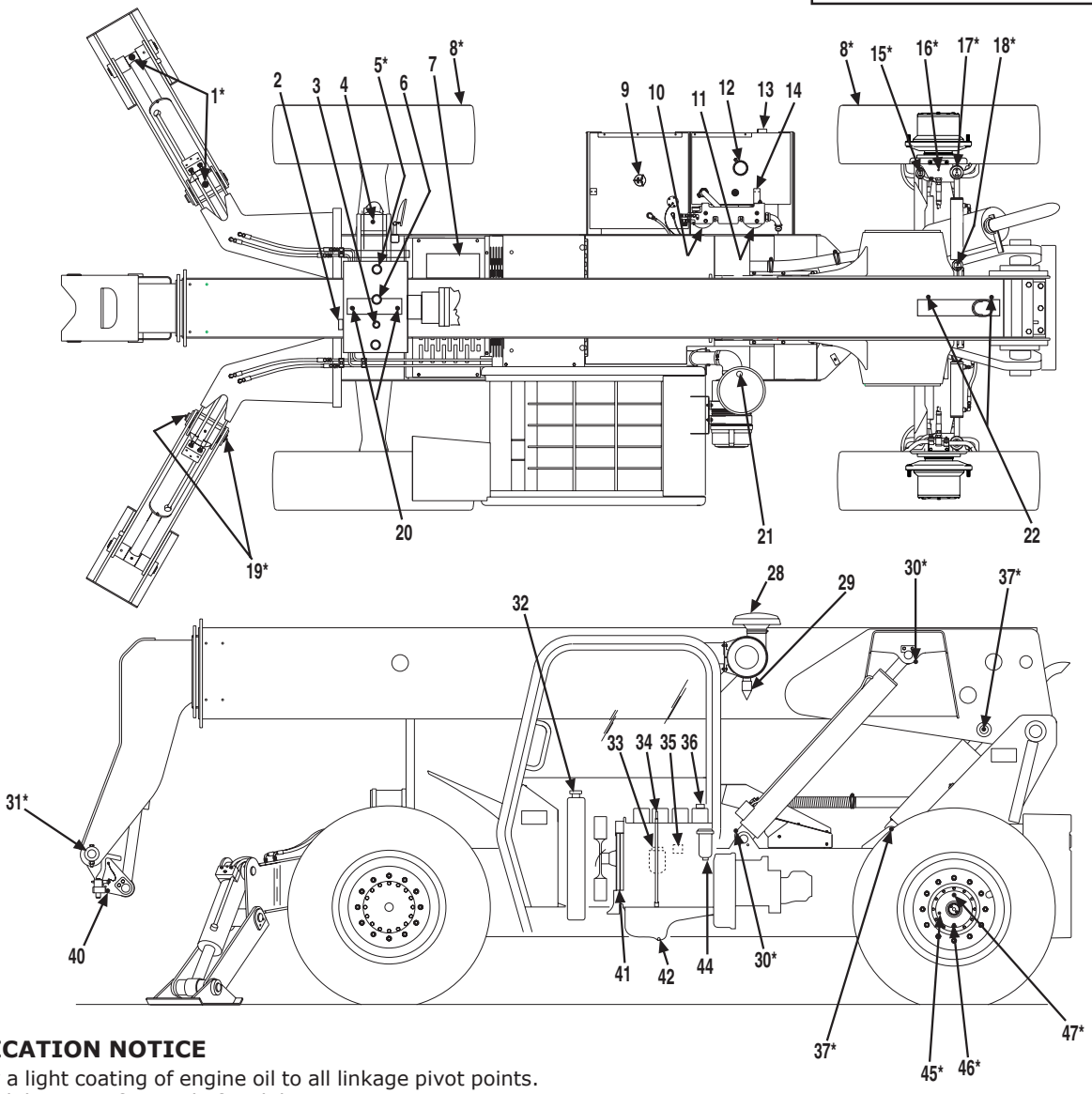
Lubrication Symbols

AF - ANTI-FREEZE (permanent)
CC - COOLANT CONDITIONER
DF - DIESEL FUEL
EO - ENGINE FUEL
HF - HYDRAULIC FLUID
HM - MOLY LUBE (extreme pressure)

FAILURE TO USE GRADALL HYDRAULIC FILTER ELEMENTS COULD VOID WARRANTY

IMPORTANT NOTICE

Be certain to check extend cable adjustment every 5 weeks or 250 hours and adjust as required. Cable damage can occur if cable is not adjusted properly.



LUBRICATION NOTICE

- Apply a light coating of engine oil to all linkage pivot points.
- Clean lubrication fittings before lubricating.
- Intervals shown are for normal (8-hour day) usage and conditions. Adjust intervals for abnormal usage and conditions.
- Drain engine and gear cases after operating when oil is hot.
- Check lubricant levels when lubricant is cool.
- Clean filter and air cleaner housing and reusable elements using solvent or diesel fuel. Dry components thoroughly using lint free cloth.

⚠ CAUTION

Service intervals are based on machine usage of 1500 hours annually. Use of your unit may vary significantly and you must adjust service frequency for your usage to obtain maximum service life. Frequency headings in the following schedule indicate a calendar limit and an operating hour limit. Perform service at whichever interval occurs first.

Daily or Shift (10 hour Maximum) Lubrication & Maintenance

	Lube Symbol	No. of Points
9. Fuel Filler Cap (fill at end of work shift to minimize condensation)	DF	1
10. Hydraulic Return Filter Condition Indicator (check with oil at normal operating temperature and engine running at full throttle - replace element before by-pass indication is reached or at least annually)	-	1
11. Hydraulic Suction Filter (replace filter element when return filter element is replaced)	-	1
13. Hydraulic Level Sight Gauges (level handler, retract all other cylinders and check sight gauges - refill as required)	HF	1
21. Air Cleaner Element Condition Indicator (check for clogged condition (red band showing) and clean or replace element as required - item 28 is air cleaner) **Note: If equipped with safety (small) element, change it every 3rd change of primary (large) element.**	-	1
34. Engine Crankcase Dipstick (level handler and check level - refill as required - item 36 is filler cap)	EO	1

Weekly (or 50 Hour) Lubrication & Maintenance (include all previous periodic services)

1. Stabilizer Cylinder Pivots	HM	4
4. Sway Cylinder Pivots	HM	2
7. Battery (check terminals)	-	1
8. Tires: 534D-9 Standard: 13.00 x 24, 12 ply - 65 PSI (448 kpa) 534D-10 Standard: 14.00 x 24, 12 ply - 65 PSI (448 kpa) Optional: 14.00 x 24, Radial - 70 PSI (482 kpa)	-	4
15. Tie Rod Ends	HM	2
16. King Pins	HM	4
17. Steering Cylinder Rod Pivots	HM	2
18. Steering Cylinder Barrel Pivots	HM	2
19. Stabilizer Arm Pivots	HM	4
20. Front Axle Pivot	HM	2
22. Rear Axle Pivot	HM	2
23. Carriage Tilt Cylinder Pivots	HM	2
24. Boom Bottom Front Slide Bearings (extend boom fully and lube all wear paths - retract and extend boom fully three times and wipe excess lube from bearings)	HM	4
26. Extend Sheave Pin	HM	2
30. Boom Lift Cylinder Pivots	HM	4
31. Boom Head/Carriage Pivot	HM	2
32. Radiator Fill Cap (check level and refill as required)	AF	1
37. Compensating Cylinder Pivots	HM	2
38. Retract Cable Sheave	HM	2
39. Boom Pivot	HM	2
40. QuickSwitch Latch	HM	1
44. Fuel Filter/Water Separator with Drain (drain water)	-	1

At End of First 50 Hours Only

5./6. Planetary and Differential Drain Plugs (drain and refill - wait 5 minutes and fill again - item 2 is level plug)	HF	3

At End of First 30 Days Only (250 Hours Maximum) Lubrication & Maintenance

- Check torque of all items listed in **Torque Chart** (pg 17.2)

5 Week (or 250 Hour) Lubrication & Maintenance (include all previous periodic services)

	Lube Symbol	No. of Points
2. Drive Axle Level Plug (check level and refill as required)	HF	1
12. Hydraulic Reservoir Breather Cap (check and clean or replace cap as required)	-	1
24. Boom Bottom Front Slide Bearings, to be performed by experienced maintenance person - check for damage and excessive wear - no wear permitted past bevel - maximum clearance at top bearing is 1/8 inch (3mm), shim or replace as required; when these bearings require service, check all other slide bearings - shims are 1/16 inch (1.5mm) thick	HM	6
25. Boom Top, Side and Bottom Rear Slide Bearings (extend boom fully and lube all wear paths - retract and extend boom fully three times and wipe excess lube from bearings)	HM	36
27. Boom Extend Cables (check and adjust as required)	-	2
29. Vacuator Valve (rubber cone on bottom - check to be sure cone is clear and undamaged)	-	1
33. Engine Oil Filter (replace filter element)	-	1
41. Drive belts (check condition - replace as required)	-	1
42. Engine Crankcase Drain Plug (drain and refill to level)	EO	1
45. Rear Hub Level Plug (check level and refill as required)	HF	2

- Check torque of all items listed in **Torque Chart** (pg 17.2)

Quarterly (or 500 Hour) Lubrication & Maintenance (include all previous periodic services)

12. Hydraulic System (we recommend that hyd fluid be analyzed to determine condition - drain and refill reservoir if required)	HF	1
14. Hydraulic Reservoir Screen (remove, clean and install when hydraulic oil is drained)	-	1
35. Fuel Strainer (replace)	-	1
44. Fuel Filter/Water Separator with Drain (replace filter element)	-	1

Semi-Annual (or 1000 Hour) Lubrication & Maintenance (Include all previous periodic services)

3. Front Axle Breather (clean or replace)	-	1
5./6. Planetary and Differential Drain Plugs (drain, fill to level, wait 5 minutes and fill to level again - item 2 is level plug)	HF	1
12. Hydraulic Reservoir Breather Cap (clean or replace)	-	1
46. Rear Hub Drain Plug (drain and refill - item 47 is fill plug)	HF	2

Annual (or 1500 Hour) Lubrication & Maintenance (include all previous periodic services)

10. Hydraulic Return Filter (replace filter element)	-	1
11. Hydraulic Suction Filter (replace filter element)	-	1
12. Hydraulic System (unless fluid is analyzed quarterly to determine degree of contamination, reservoir must be drained and refilled on an annual basis)	HF	1
14. Hydraulic Reservoir Screen (remove, clean and install when hydraulic oil is drained)	-	1
32. Engine Cooling System (drain, flush and refill on basis of period suggested by anti-freeze manufacturer and add Liquid Coolant Additive if equipped with Deere engine)	AF/CC	1

DETAILED SERVICE INSTRUCTIONS ARE CONTAINED IN THE GRADALL SERVICE MANUAL FOR YOUR PARTICULAR MATERIAL HANDLER

17.2 RECOMMENDED LUBRICANTS & CAPACITIES

APPLICATION	SYMBOL	WHEN USED	GRADE	SPECIFICATION	CAPACITY*	
Boom Cable Adj. Threads	HM (extreme pres. moly lube)	All Year	-	P/N -1440-3323	-	-
Boom Slide Bearing Paths	HM (extreme pres. moly lube)	All Year	NLGI #2	1440-4595	-	-
Coolant Conditioner (Deere Only)	CC (supplemental coolant additive)	All Year	-	-	0.5 qts	0.48 L
Engine Cooling System Cummins Deere	 AF (anti-freeze) AF (anti-freeze)	 All Year All Year	 ½ & ½ ½ & ½	 Permanent Permanent	 24 qts 24.8 qts	 22.7 L 23.5 L
Engine Crankcase Cummins Deere	 EO (engine oil) EO (engine oil)	 All Year All Year	 15W-40-CD 15W-40-CD	 MIL-L-2104D MIL-L-2104D	 12 qts 14.5 qts	 11.4 L 13.5 L
Front Axle Meritor Carraro	 HF (hydraulic fluid) HF (hydraulic fluid)	 All Year All Year	 ** **	 ** **	 5.28 gal 4.91 gal	 20 L 18.6 L
Fuel Tank	DF (diesel fuel)	All Year	#2	-	40 gal	151.6 L
Grease Fittings	HM (extreme pres. moly lube)	All Year	NLGI #2	1440-4595	-	-
Hydraulic System	HF (hydraulic fluid)	All Year	***	***	47 gal	177.9 L
Rear Hubs	HF (hydraulic fluid)	All Year	**	**	3 pints ea	1.4 L

* Capacities are approximate - check level to be sure.

** Fill to level using **Mobilfluid® 424** (GRADALL P/N 1440-4535)

*** Fill to level using **Mobilfluid® 424** -OR- *Citgo Tractor Hydraulic Fluid* (product code 33310)

TORQUE CHART

Check torque using accurate torque wrench to apply maximum torque value shown. DO NOT EXCEED MAXIMUM TORQUE. Excess maximum torque may cause fastener to fail.

ITEM	FREQUENCY*	THREAD SIZE (GRADE)	TORQUE (lubricated)			
			FT.-LB.		Nm	
			MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
Boom Slide Bearings (front)	5 Weeks (250 hrs) 5 Weeks (250 hrs)	3/8-24 (5) 1/2-20 (5)	32 68	37 78	43 92	50 106
Boom Slide Bearings (rear)	If front bearings have worked loose	3/8-24 (5) 1/2-20	32 68	37 78	43 92	50 106
Boom Extend Cable (rear) Adjusting Nut Jam Nut	 5 Weeks (250 hrs) 5 Weeks (250 hrs)	 1-8 1-8	 † 100	 † 110	 † 137	 † 150
Wheel Lug Nuts	3 Months (500 hrs)	-	350	400	476	544
Cab MTG Bolts		7/8-9	450	475	612	646

* Check torque at whichever interval occurs first.

† Refer to appropriate ***Service Manual*** for procedure to check and adjust cables.

17.3 BOOM

CHECKING & ADJUSTING BOOM CABLES

Boom is extended by a cylinder and a pair of cables within the boom.

For more detailed information, including boom cable checks and adjustments, see the appropriate **Service Manual.**

STABILIZER

Stabilizers are furnished as standard equipment on all 534D-10 Material Handlers.

Use stabilizers to increase stability and/or load capacity and in leveling the handler before picking or delivering a load. Study load charts carefully to determine maximum load capacities for various lift situations, with and without stabilizers.

Before using stabilizers to support handler/load on untested surface, perform following procedure:

1. With handler positioned to pick or deliver load and with load on ground or pick point, lower stabilizers enough to level handler and remove weight from front wheels.

2. If required, position signal man to observe and report penetration of stabilizer shoes in supporting surface.

3. With forks beneath load, slowly begin to raise load. Stop immediately if signal man reports excessive or uneven shoe penetration. If shoe penetration is acceptable, proceed with lift. If stopped by signal man, relieve load from forks and proceed with steps 4 and 5.

4. With forks resting on ground, raise stabilizers from surface far enough to install sufficient blocking to overcome excessive or uneven shoe penetration.

5. Repeat steps 3 and 4 until excessive or uneven penetration has been overcome before lifting load.

Transport machine with stabilizers in the "up" position as shown in Figure 17-3.

WARNING

Stabilizers increase stability and load capacity ONLY if they are used properly. Using stabilizers without regard to surface conditions could cause handler to tip over and result in serious injury or death. Always ensure surface can support handler and load.

Figure 17-3

18.0 INSPECTION AND MAINTENANCE LOG

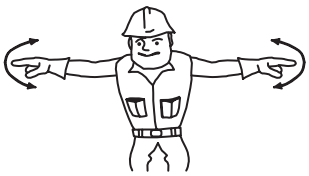
Date	Hourmeter Reading	Comments

HAND SIGNALS

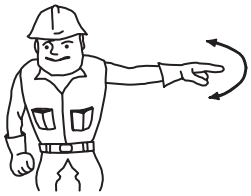
Standard Signals - When handler work conditions require hand signals, they shall be provided or posted conspicuously for the use of both signalman and operator. No handler motions shall be made unless signals are clearly understood by both signalman and operator.

Special Signals - When signals for auxiliary equipment functions or conditions not covered are required, they shall be agreed upon in advance by the operator and signalman.

Instructions - When it is desired to give instructions to the operator other than provided by the established signal system, all handler motions shall first be stopped.

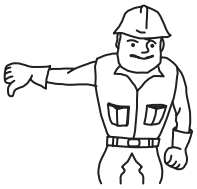


EMERGENCY STOP - With both arms extended laterally, hands open downward, move arms back and forth.

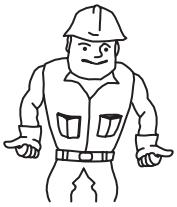


STOP - With either arm extended laterally, hand open downward, move arm back and forth.

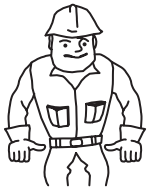
RAISE BOOM - With either arm extended horizontally, fingers closed, point thumb upward.



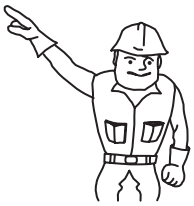
LOWER BOOM - With either arm extended horizontally, fingers closed, point thumb downward.



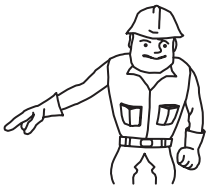
EXTEND TELESCOPIC BOOM - With both hands clenched, point thumbs outward.



RETRACT TELESCOPIC BOOM - With both hands clenched, point thumbs inward.



TILT FORKS UP - With one arm held at side, extend other arm upward at about 45°.



TILT FORKS DOWN - With one arm held at side, extend other arm downward at about 45°.

CLOSE BUCKET - Hold one hand closed and stationary. Rotate other hand in small vertical circle with forefinger pointing horizontally at closed hand.

OPEN BUCKET - Hold one hand open and stationary. Rotate other hand in small vertical circle with forefinger pointing horizontally at open hand.

MOVE SLOWLY - Place one hand motionless in front of hand giving motion signal. (Raise load slowly is shown)

THIS FAR TO GO - With hands raised and open inward, move hands laterally, indicating distance to go.

STOP ENGINE - Draw thumb or forefinger across throat.

CALIFORNIA

Proposition 65 Warning

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

CALIFORNIA

Proposition 65 Warning

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling.

GRADALL®

Printed in USA

LEGEND

MAIN PRESSURE & RETURN LINES

PILOT LINES

DRAIN LINES

ELECTRICAL LINES

12 VOLT BATTERY

FORWARD REVERSE SELECTOR SWITCH

FORWARD

NEUTRAL

REVERSE

2/4 WHEEL DRIVE SWITCH

TRACTION LOCK SWITCH

2/4 WHEEL DRIVE VALVE

INCHING VALVE

F/R SECTION

REAR DRIVE MOTOR

REAR DRIVE MOTOR

FLUSHING VALVE SECTION

220 PSI

.071 DIA

FRONT DRIVE MOTOR (DA CONTROL)

6800 PSI

6300 PSI

380-480 PSI

DRIVE PUMP (DA CONTROL)

SUCTION FILTER B_8 =75

RETURN FILTER B_8 =75

25 PSI

FILLER/ BREATHER

100 MESH

RESERVOIR (NON-PRESSURIZED)

TRACTION LOCK VALVE

.039

50¤

PST1

PST2

STABILIZER CYLINDER

STABILIZER SWITCH

12 VOLT BATTERY

ENGINE OIL PRESSURE SWITCH

OPTIONAL REAR AXLE STABILIZER VALVE

12 VOLT BATTERY

PARK BRAKE SWITCH

IMPLEMENT PUMP 3.627 CU.IN./REV.

PRIORITY FLOW DIVIDER

P (3.25 GPM)

PRIORITY FLOW DIVIDER

STEERING ORBITROL

STEER CYLINDERS

SERVICE BRAKE

PARK BRAKE

PARK BRAKE SOLENOID VALVE

BRAKE VALVE

SWAY CYLINDER

.062

.062

COMPENSATING CYLINDER

TILT CYLINDER

AUX.

AUXILIARY HYDRAULICS (OPTION)

SWAY

TILT

CROWD

2700 PSI

LIFT

3000 PSI

MAIN CONTROL VALVE

JOY STICK

LIFT CYLINDERS

CROWD CYLINDER

THERMAL BYPASS VALVE

120°

70 PSID

HYDRAULIC SCHEMATIC
534D-9
9134-9010

LEGEND

- MAIN PRESSURE & RETURN LINES
- PILOT LINES
- DRAIN LINES
- ELECTRICAL LINES

12 VOLT BATTERY

2/4 WHEEL DRIVE SWITCH

TRACTION LOCK SWITCH

2/4 WHEEL DRIVE VALVE

FORWARD REVERSE SELECTOR SWITCH

NEUTRAL

FORWARD

REVERSE

INCHING VALVE

F/R SECTION

REAR DRIVE MOTOR

REAR DRIVE MOTOR

FRONT DRIVE MOTOR (DA CONTROL)

FLUSHING VALVE SECTION

220 PSI

.071 DIA

DRIVE PUMP (DA CONTROL)

6800 PSI

6800 PSI

6300 PSI

380-480 PSI

FWD

REV

SUCTION FILTER B_8 =75

RETURN FILTER B_8 =75

25 PSI

FILLER/ BREATHER

100 MESH

RESERVOIR (NON-PRESSURIZED)

TRACTION LOCK VALVE

6800 PSI

6800 PSI

50%

50%

.039

PST1

PST2

OPTIONAL REAR AXLE STABILIZER VALVE

STABILIZER CYLINDER

STABILIZER SWITCH

12 VOLT BATTERY

ENGINE OIL PRESSURE SWITCH

THERMAL BYPASS VALVE

120°

70 PSID

12 VOLT BATTERY

PARK BRAKE SWITCH

IMPLEMENT PUMP 3.627 CU.IN./REV.

PRIORITY FLOW DIVIDER

P (3.25 GPM)

PRIORITY FLOW DIVIDER

STEERING ORBITROL

STEER CYLINDERS

SERVICE BRAKE

PARK BRAKE

PARK BRAKE SOLENOID VALVE

BRAKE VALVE

SWAY CYLINDER

.062

.062

COMPENSATING CYLINDER

TILT CYLINDER

3800 PSI

AUX.

AUXILIARY HYDRAULICS (OPTION)

3000 PSI

3000 PSI

SWAY

TILT

3250 PSI

3250 PSI

CROWD

2700 PSI

LIFT

3000 PSI

MAIN CONTROL VALVE

JOY STICK

LIFT CYLINDERS

3800 PSI

3800 PSI

CROWD CYLINDER

3800 PSI

4000 PSI

OUTRIGGER CYLINDERS

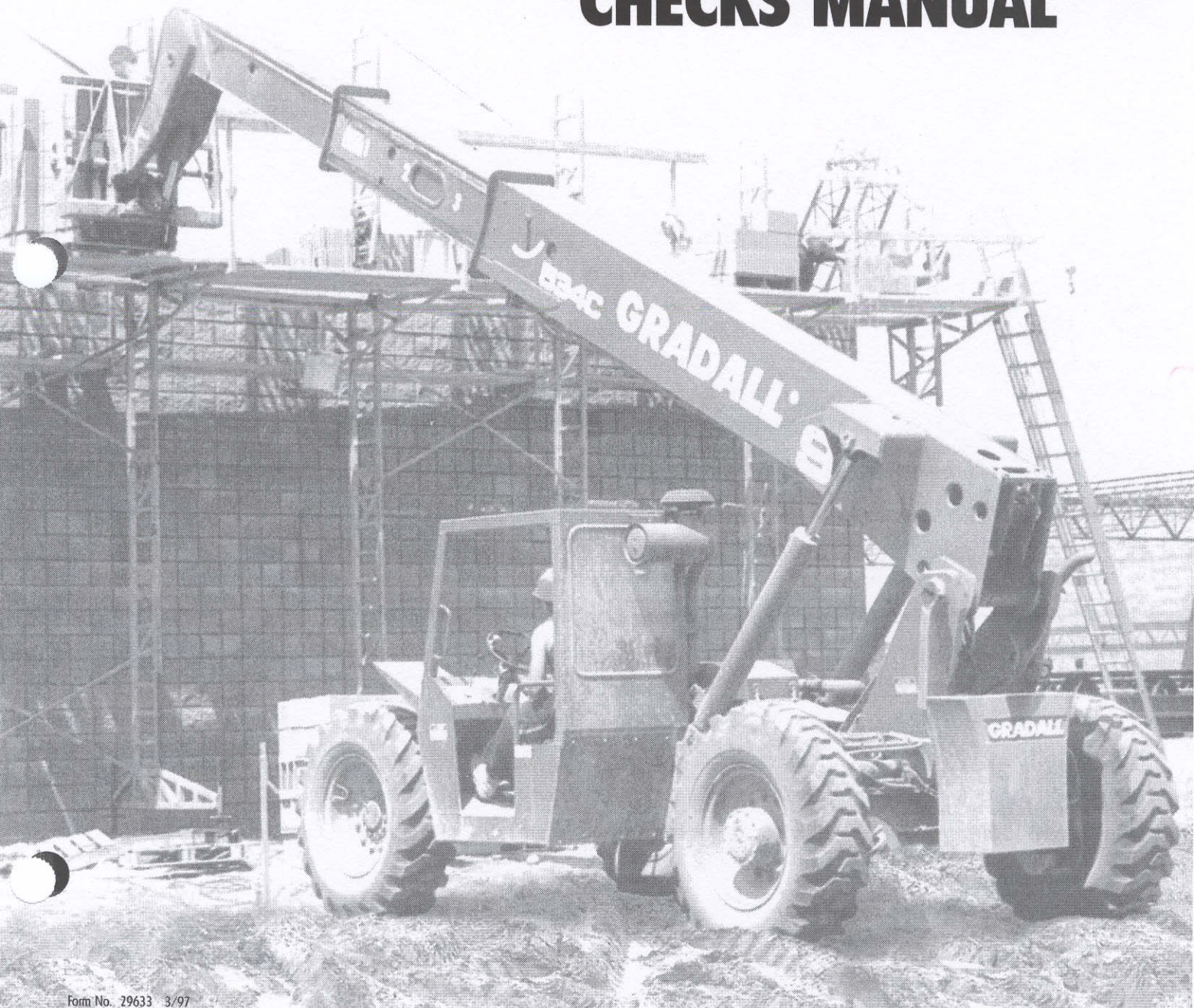
4000 PSI

HYDRAULIC SCHEMATIC
534D-10
9135-9010

GRADALL®

MATERIAL HANDLERS

534C-9 & 534C-10 HYDROSTATIC DRIVE PERFORMANCE CHECKS MANUAL



Form No. 29633 3/97

534C-9 & 534C-10 HYDROSTATIC DRIVE PERFORMANCE CHECKS MANUAL

Table of Contents

NOTE! "HIGH PRESSURE" denotes 10,000 PSI gauge
"LOW PRESSURE" denotes 1,000 PSI gauge

* Component changes occur in production. Where the change affects a particular performance check, it will be noted. All other components shown will be current.

Important Safety Notice

These tests ensure that the Hydrostatic Material Drive System operates to the proper specifications. All tests should be done in a safe, open area. Apply the park brake and leave the shifter in neutral unless otherwise noted. The boom and attachment should rest on the ground unless the machine is being driven. Safe working habits must be used for these checks. Refer to **Operator's Manual** (Form No. 29311) for further information.

Read and understand this Manual, along with **Operation and lubrication Manual**, EMI Handler Safety Manual, **GRADALL Material Handler Safety Manual** and all instructional decals and plates before starting, operating or performing mechanical adjustments and maintenance procedures on this equipment. **Keep Operator and Safety Manuals in cab.**

Safe operation depends on reliable equipment and proper operating procedures. Performing the adjustments and repairs described in this Manual will help to keep your Material Handler in reliable condition. Use of the recommended operating procedures can help you avoid accidents. Because some procedures may be new to even the experienced technician, we recommend that this Manual be read, understood and followed by all who service this unit.

!DANGER, !WARNING, !CAUTION notes in this Manual will help you avoid injury and damage to this equipment. These notes are not intended to cover all eventualities. It is impossible to anticipate and evaluate all possible applications and methods of operation for this equipment.

Any procedure not specifically recommended by GRADALL must be thoroughly evaluated from the standpoint of safety before it is placed in practice. If you are not sure, contact your GRADALL Distributor before operating. Do not modify this machine without written permission from GRADALL

The following symbols are used to call your attention to safety notices

DANGER: This symbol indicates an extreme hazard which could result in high probability of death.

WARNING: This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.

CAUTION: This symbol indicates a hazard which could result in injury or damage to equipment or property if proper precautions are not taken.

Required Tools

Color-coded plastic caps seal the adjustments on components in the hydraulic system. If a GRADALL Distributor makes an adjustment, the component should be sealed with a blue cap.

The tools needed to make these checks are:
1. Tachometer
2. GRADALL pressure testing kit P/N 7713-4197
3. Mechanic's hand tools (Metric included)
4. Blue plastic caps: P/N 8093-4459 (small) and P/N 8093-4460 (large)

General Warning Information

This Manual provides important information for those responsible for understanding, troubleshooting, testing, repairing and/or performing maintenance on the hydrostatic transmission drive system of 534C-9 and 534C-10 Material Handlers.

NOTE! This Manual does not cover any of the implement systems of the machine.

Accidents involving injury or serious machine damage

Immediately notify your GRADALL Distributor of the incident so he may assist you in your investigation of the problem. If he is unavailable, contact the GRADALL Service Department at (330) 339-2211.

Related Manuals and Decals

Separate publications are furnished with your Material Handler to provide information concerning safety, replacement parts operation, maintenance procedures and vendor components. Replacement manuals and decals can be ordered from your GRADALL Distributor.

Orientation

When used to describe location of components on the machine, the directions front, rear, left and right relate to the orientation of a person sitting in the operator's seat in the cab.

Welding

CAUTION

If welding on the machine becomes necessary, place the ground adjacent to the area being welded. This will prevent arcing-between components such as bearings or machined surfaces which could cause machine damage and downtime.

1. Welding rod repairs should meet 70,000 PSI minimum tensile strength, low hydrogen process.

2. The battery leads must be disconnected before welding to prevent damage to electrical components.

Fasteners

1. Grade 8 bolts are used whenever two machined surfaces or major assemblies are bolted together. Torque values for the application will be called out.

2. Grade 5 bolts are used to fasten non-machined areas such as sheet metal. Refer to bolt torque chart in **Operator's Manual.**

3. Dowel pins are used in assemblies to absorb the shear load to these components and assist in correct positioning for bolt insertion.

Testing and Adjustment Precautions

1. Read and understand the manuals named under the important safety notice heading above. Be sure you are familiar with the machine's response to controls.

2. Read and understand all material relating to area to be checked, adjusted or repaired.

3. This Manual covers hydraulic testing and adjustments. Read and understand material related to hydraulics before proceeding with service of any kind on the hydraulic system. When performing maintenance, be sure there is no residual, trapped hydraulic pressure.

4. If you are working with a helper, be sure he understands the procedure. Be certain each of you knows what to

expect from the other, and when to expect it.

5. Be sure you understand all steps of the procedure before testing, adjusting or repairing any component or mechanical assembly. Follow the procedure carefully.

6. Always wear safety glasses, hard hat and any other locally required safety-related, protective apparel when performing testing and adjusting procedures.

7. Thoroughly clean all areas before working on them. Slippery and contaminated surfaces can cause serious accidents or mechanical failure if not removed.

8. Always mechanically secure machine components that could suddenly start in motion and cause injury or damage.

9. Remove key from ignition and place a sign in the operator's cab informing all who come in contact with the machine that it is being worked on and that personnel are on the machine.

Do not move any function.

10. Double check bolt torques.

11. Check that all lubrication fluids are at the correct level.

12. Remove mechanical restraints before restarting and operating the machine following repairs.

13. Clear all personnel from area adjacent to the machine when first operating after a repair or adjustment. This can eliminate the possibility of personal injury if repairs or adjustments were performed incorrectly and/or if the machine performs in an uncontrollable or unexpected manner.

14. Clean machine surfaces before returning it to work.

I. Hydraulic Oil Reservoir

Make sure that the machine is level before retracting all cylinders. Proper level is to full mark +/- 1/4 inch in the sight gauge located on the outside of the reservoir. The system contains 47 gallons of hydraulic oil. Refer to the "Lubrication Specifications Chart" in the **Operator's Manual.** Oil should be in good condition.
See Figure 1 and Figure 2.

FIGURE 1
HYDRAULIC RESERVOIR ASSEMBLY

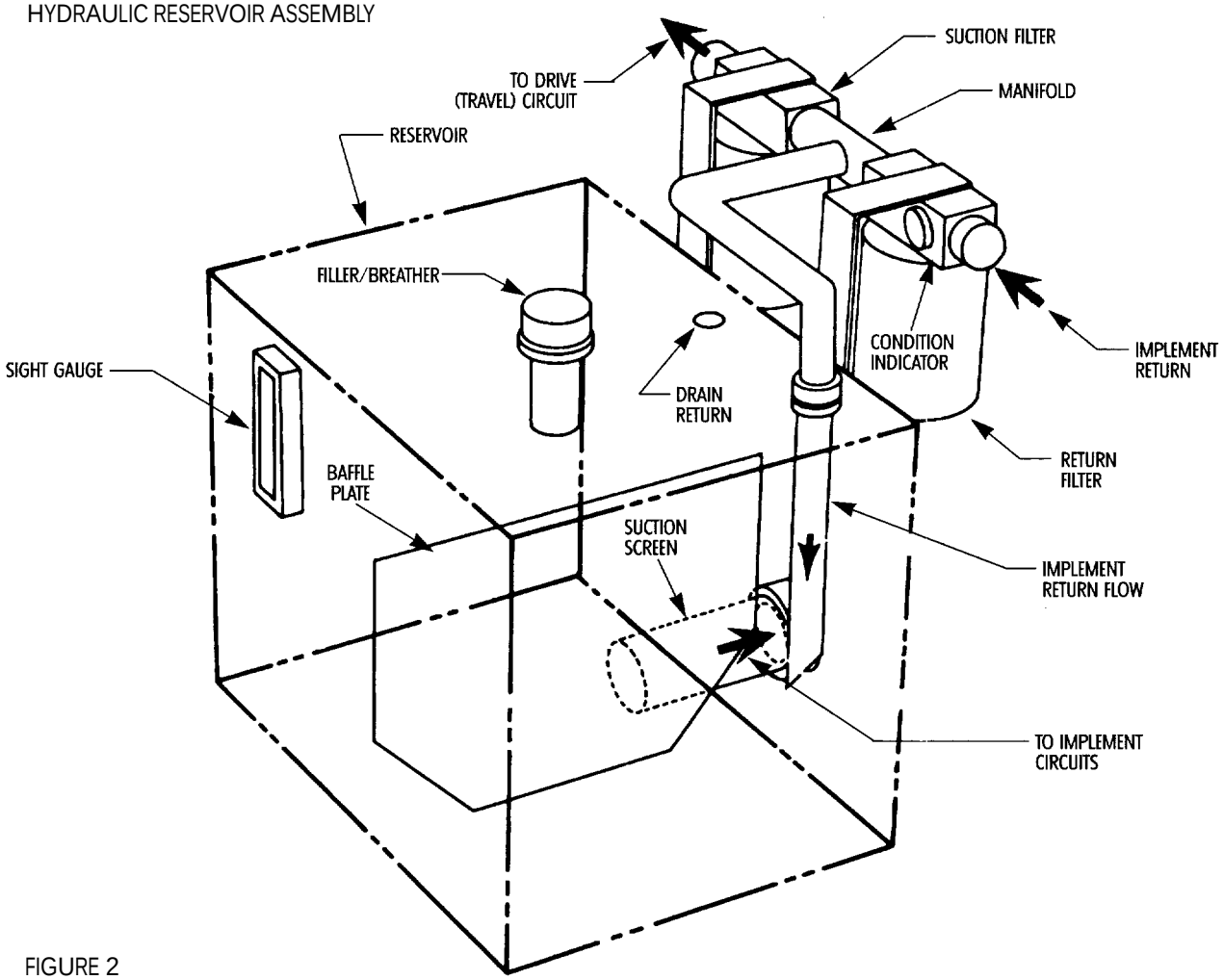
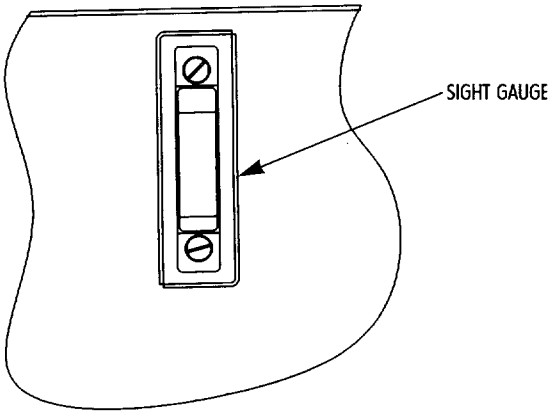


FIGURE 2
SIGHT GAUGE



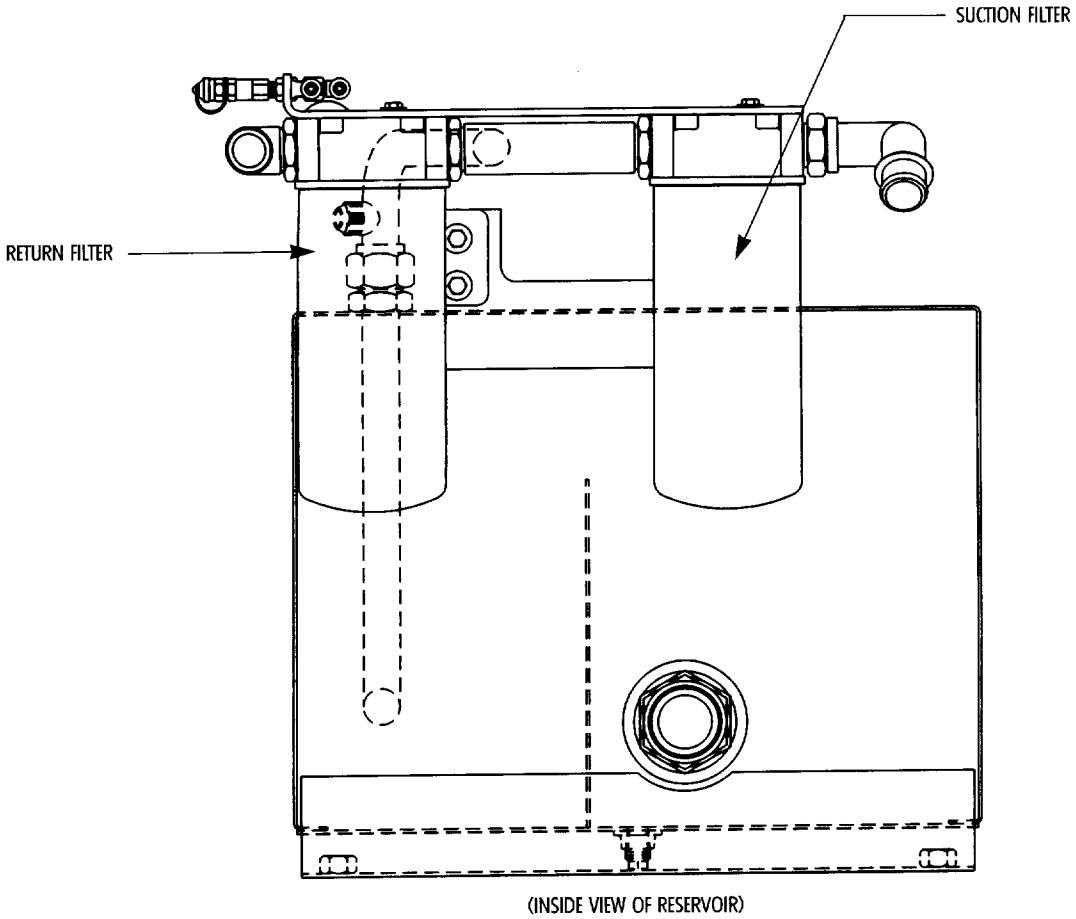
II. Hydraulic Filter Condition

Reason for Hydraulic Filter Condition Check
Dirty suction filters can restrict oil flow to the charge pump. This can lower control pressure which can affect the machine's ability to move, especially when ambient temperature is under 32°F.

Change the hydraulic filters if they have more than 1,000 hours on them. To check hydraulic filter condition, warm the hydraulic system oil to operating temperature (minimum 100°F). Check the filter restriction indicator on the return filter. The indicator should not show filter bypass with the engine at full throttle and the park brake engaged. If it shows bypass, replace the suction and return filters. Use hydraulic filter (P/N 9114-3144) for both suction and return filters. ***See Figure 3.***

Only GRADALL-supplied filters meet or exceed the filtration requirements of the drive system. If any other type of filter was installed, change it to o GRADALL filter and sample oil for condition. Failure to use GRADALL filters may void warranty.

FIGURE 3
HYDRAULIC RESERVOIR ASSEMBLY



III. Engine Speed

Reason for Engine Speed Check

Low engine RPM can reduce control pressure. Control pressure determines machine speed. This condition can slow machine speed at full RPM.

Check engine speed with an adequate tachometer. At low idle, it should be 800-900 RPM. Adjust engine speed using the screw on the injection pump. At full throttle with no load, it should be 2500-2700 RPM. When testing engine speed, make sure the injection pump lever is contacting the stop. The sealed adjustment screw on the pump is not adjustable. Please note the initial adjustment on current accelerator pedals. ***See Figure 4, Figure 5, Figure 6 and Figure 7***

FIGURE 4
ENGINE ASSEMBLY (LEFT SIDE)

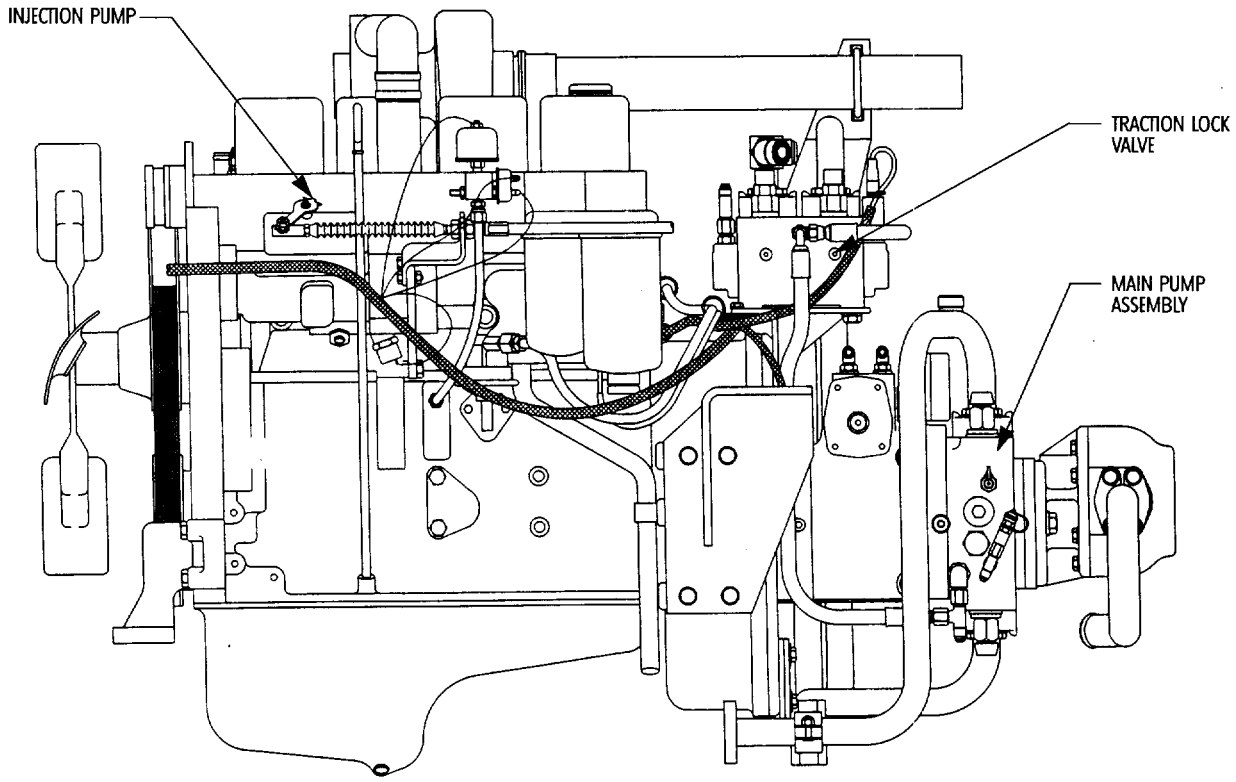


FIGURE 5
BOTTOM OF FLOOR PLATE ASSEMBLY (CURRENT)

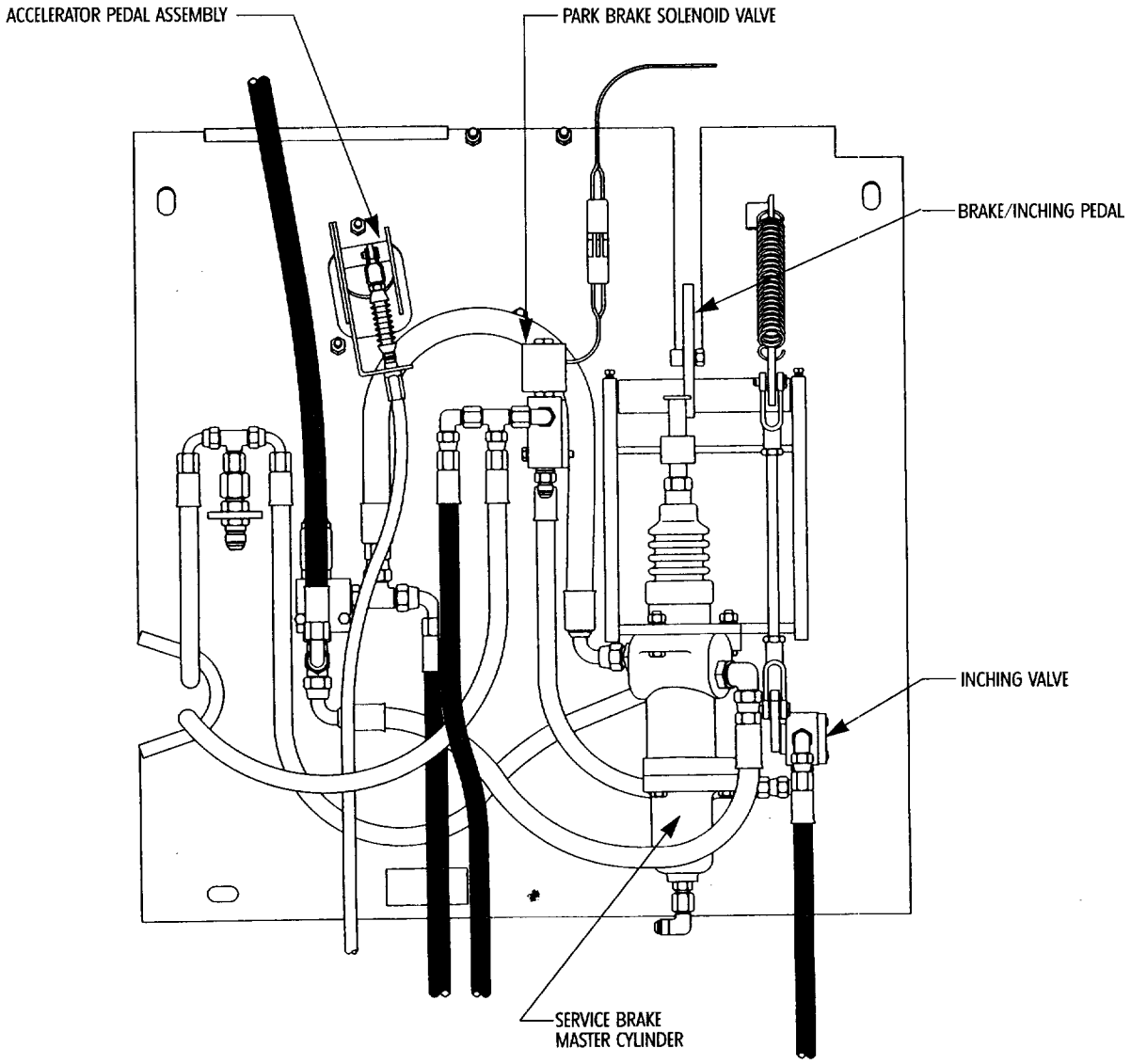


FIGURE 6
ACCELERATOR PEDAL ASSEMBLY (CURRENT)

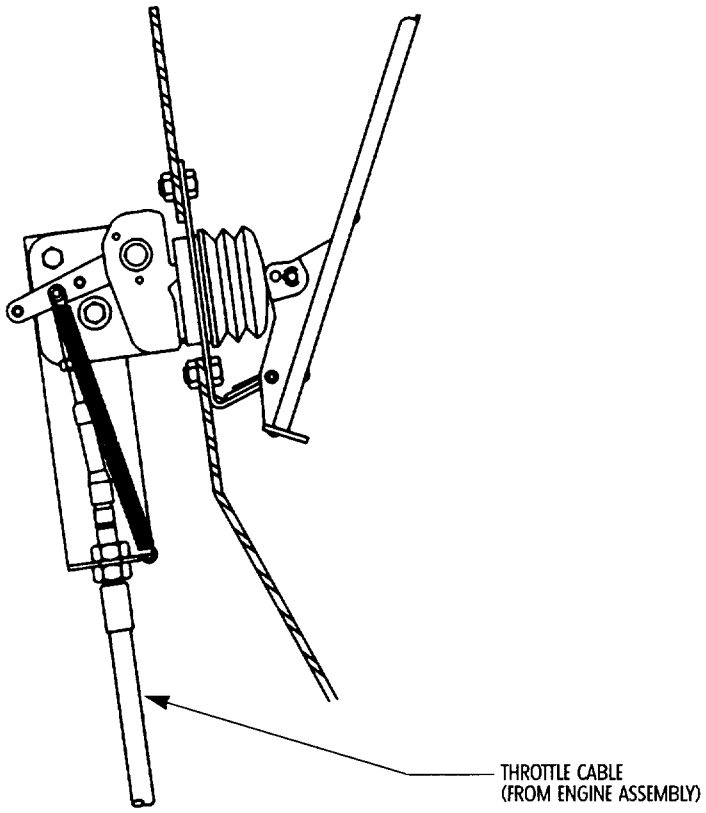
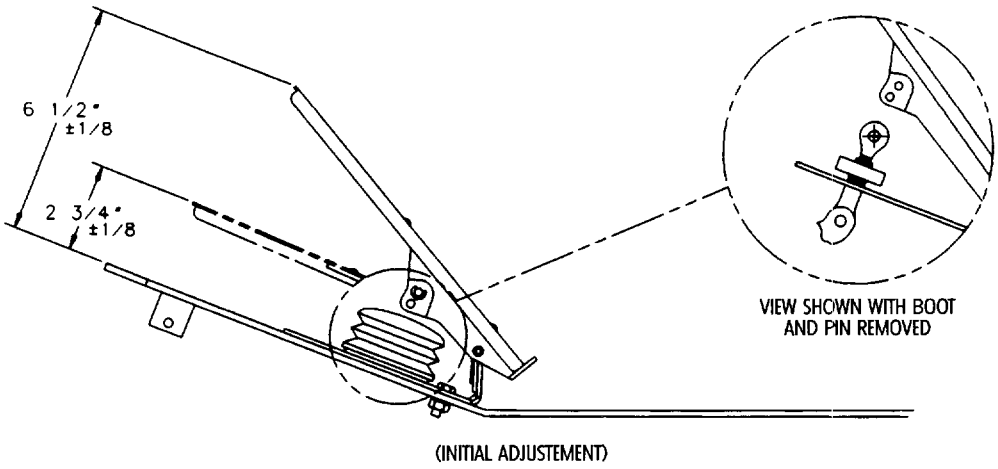


FIGURE 7
ACCELERATOR PEDAL ASSEMBLY (CURRENT)
(AUXILIARY VIEW)



IV. Park Brake

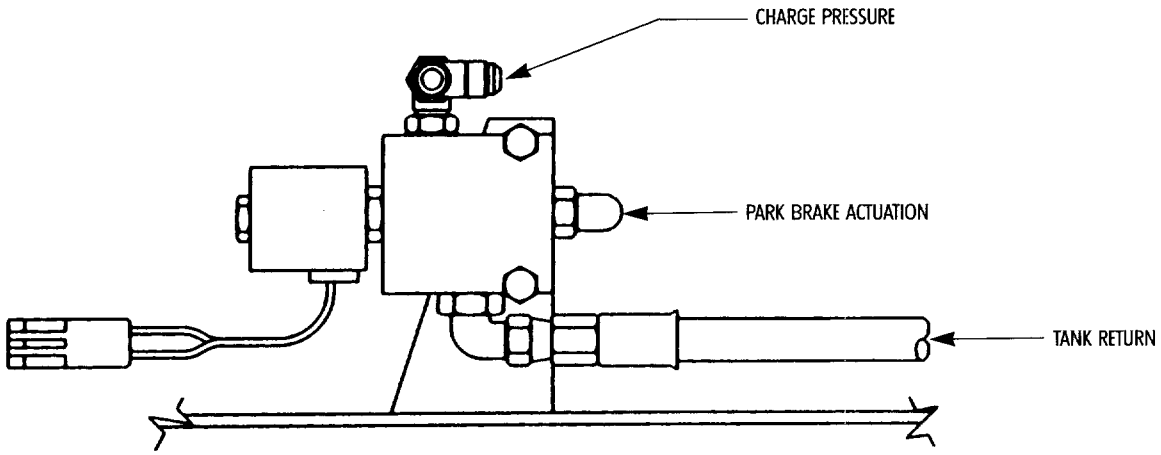
Reason for Park Brake Check
Park brake wear can cause park brake failure and reduce braking effectiveness on a slope.

With the park brake engaged, start the engine. Position the 2WD/4WD switch for two-wheel drive. With the rear wheels aligned straight ahead, move the shift lever to the forward position and run the engine full throttle (2500 RPM-2700 RPM). If the brakes are working properly, the machine will not drive through the brakes.

High backpressure in the actuation line can affect the brake holding power. To determine whether the brake is at fault, remove the brake actuation line and plug. Check the park brake operation again. If the machine does not move, the brake is working properly.

Backpressure should be less than 20 PSI with oil at operating temperature. To check this pressure, tee a low pressure gauge (1,000 PSI), hose and adapter in the brake actuation line. If it is higher, check for proper operation of the park brake solenoid valve. Disconnect the brake actuation line and tank return line at the valve and plug them. There should be no oil flowing from the open port on the park brake solenoid valve. The brake actuation line should not be kinked. There should be no restriction back to the reservoir. ***See Figure 8C.***

FIGURE 8
PARK BRAKE SOLENOID VALVE



There is a 10% wear factor on the 8 original rotor discs in the extended park brake assembly (P/N 9114-4160). Thus, the 2 “thick” discs (0.150") each have a minimum allowable thickness of 0.135". The 6 “thin” discs (0.062") each have a minimum allowable thickness of 0.056".

To remove park brake assembly, remove 4 drive motor nuts and slide motor out of the way. Take snap ring off and remove coupler. This will allow access to pinion nut. Take pinion nut off and remove park brake assembly.

Park Brake Assembly Rotor Discs

Original Thickness	No. of Discs	10% Allowable Wear Thickness
0.150"	2	0.135"
0.062"	6	0.056"

Spring free length is one inch. Anything less reduces brake holding power. Any combination of the above circumstances reduces brake holding capability. ***See Figure 8, Figure 8A, Figure 8B and Figure 8C.***
Also refer to “Page 6-6” in the **Parts Manual** (P/N 2460-4100) for breakdown of park brake assembly.

FIGURE 8A
FRONT AXLE ASSEMBLY
P/N 9114-5139

STARTING
534C-9 SERIAL NO. 0344001
534C-10 SERIAL NO. 0266001

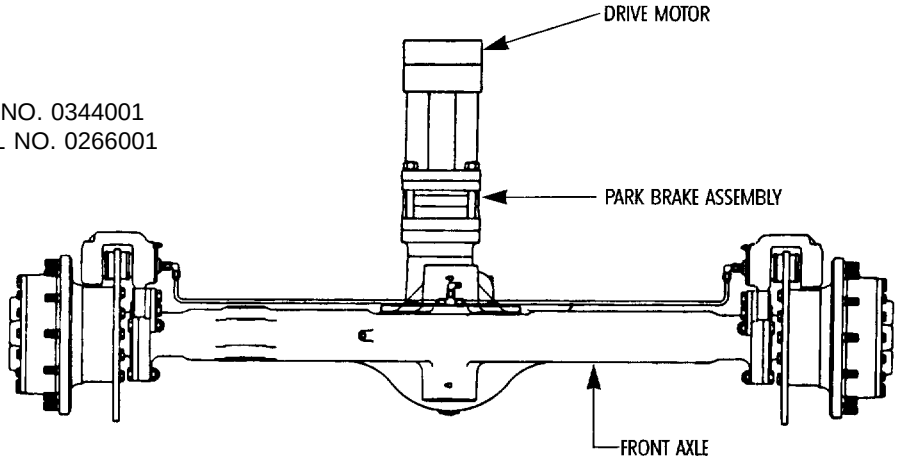


FIGURE 8B
PARK BRAKE ASSEMBLY
P/N 9114-4160

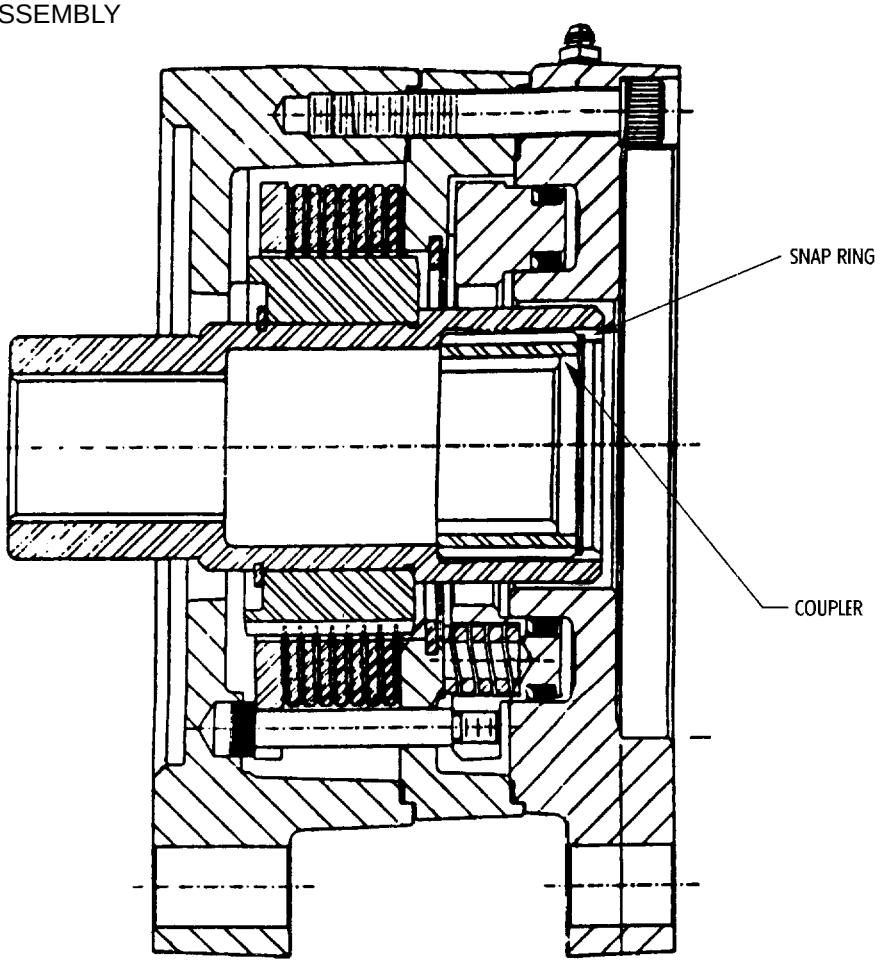
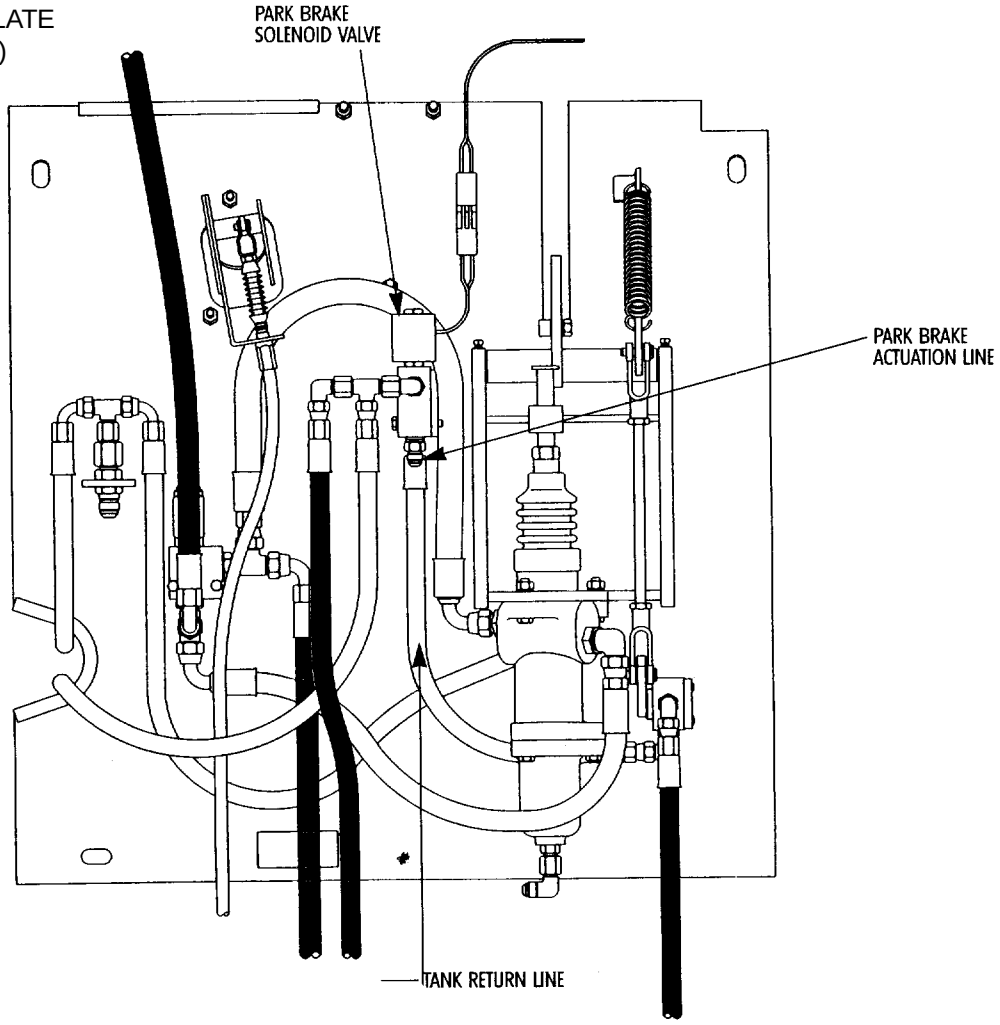


FIGURE 8C
BOTTOM OF FLOOR PLATE
ASSEMBLY (CURRENT)



A new front axle housing went into production starting 534C-9 Serial No. 0344394 and 534C-10 Serial No. 0266057. When the new front motor design went into production, several units later the front axle housing stayed the same. The park brake is internal in the front axle differential assembly. The brake test procedure remains the same. However, the park brake components are different. ***See Figure 8D.***

To check for friction disc wear, the axle must be disassembled and reassembled according to *Rockwell Maintenance Manual No. 9D*. The brake disc thickness is 0.1245". There is an 8-10% maximum wear factor allowed on the discs. The minimum disc thickness allowed is 0.1120". ***See Figure 8E.***

FIGURE 8D
FRONT AXLE ASSEMBLY
P/N 9114-3199

STARTING
534C-9 SERIAL NO. 0344394
534C-10 SERIAL NO. 0266057

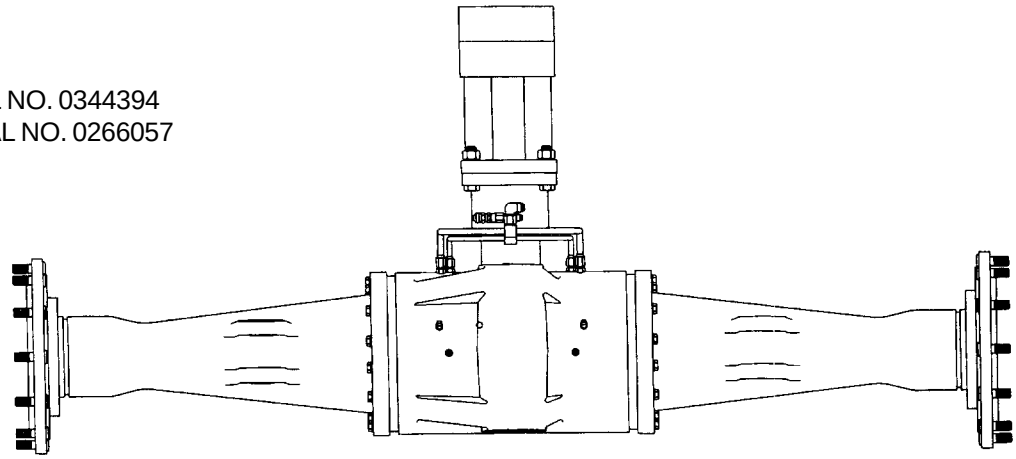
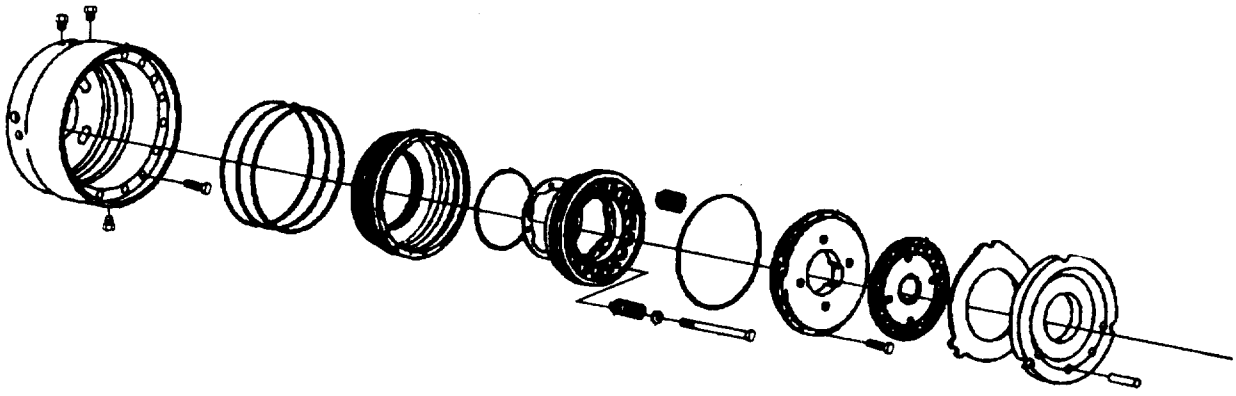


FIGURE 8E
DRIVE TRAIN BRAKE ASSEMBLY



V. Charge Pressure

Reason for Charge Pressure Check

To ensure proper park brake operation, charge pressure needs to be at proper specification. Since temperature can affect results, make certain to test system with warm oil (minimum 100°F). Control pressure is modified charge pressure. If charge pressure is low, control pressure may be low and machine speed reduced. Thus, drive performance is adversely affected by low charge pressure.

Install a low pressure gauge (1,000 PSI), hose and adapter on the charge pump test port. It locates near the front inside of the hydraulic reservoir. NOTE! Before starting, make sure the gauge can be observed in the operator's cab and apply the park brake. Start the engine and run at low idle (800-900 RPM). The gauge should read approximately 380 PSI. At full throttle (2500-2700 RPM), the gauge should read a maximum of 480 psi and never less than 380 PSI. ***See Figure 9.***

NOTE! Throughout test operation, charge pressure should not drop below 380 PSI *and* should move toward 480 PSI as RPM rises, regardless of how many functions are being operated simultaneously.

The charge pump relief (located at the left side of the main drive pump) adjusts as necessary. To adjust the charge pump relief, loosen the locknut and turn the adjusting screw clockwise to increase charge pressure; turn counterclockwise to decrease charge pressure. Be sure to note the amount that the relief turns in either direction. When finished, tighten the locknut and install a blue plastic cap.

To pinpoint the loss of charge pressure, start at the pump. Make sure the machine is in 4WD when testing rear motors. Remove the hose from the G port (charge pump output port) on the pump, install a low pressure gauge (1,000 PSI) on the fitting and plug the hose. Check the charge pressure again and observe the gauge. If the charge pressure comes back to specifications, the loss of pressure is in one of the auxiliary valves. These valves include the 2WD/4WD valve, traction lock valve, park brake solenoid valve and the joystick. Isolate each of these valves to check for the loss of charge pressure. ***See Figure 10.***

Another test to determine the loss of charge pressure is to cap off lines to the drive motors. Reinstall hoses from previous test. Install low pressure gauge (1,000 PSI) on the charge pressure test port. Check each motor separately. Start at the left rear motor. Remove the hoses to the motor at the tubes and plug with ORS #12 plugs (P/N 8471-4002). Cap motor work ports also to prevent dirt from entering the motor with ORS #12 caps (P/N 8471-4006). Start the machine and observe the gauge for charge pressure. Engage drive forward and reverse against the park brake and observe gauge for charge pressure simultaneously. Record the findings. If charge pressure recovers, the motor is defective.If charge pressure does not recover, repeat test for right rear motor. ***See Figure 11.***

Isolate the front drive motor from the circuit if the rear motors are not defective. To isolate it will require two blocking plates (P/N 9108-1667). Install these plates between the front drive motor work ports and the drive hoses. Remove the flange halves and place the blocking plates on the ports and reinstall the hoses and flanges. Again, start the machine and observe the pressure gauge for charge pressure. If the charge pressure recovers, the motor is defective. To confirm, check charge pressure with drive against the park brake. Charge pressure should remain at 380 PSI. ***See Figure 11A.***

The charge pump efficiency also needs to be checked if the previous tests prove inconclusive. Check charge pump flow out of T1 port on the side of the pump. ***(See Figure 12).*** At 850 RPM, there should be 4 GPM. At 2500 RPM, there should be 12 GPM of flow. Disconnect run tee and plug. Measure charge pump flow out of fitting against above specification. The flow readings are checked at 480 psi. If the test is positive on flow, proceed to the next step.

To check internal leakage of the main pump, block off ports A and B at the main pump. If drive motors have already been isolated, continue testing. Install two high pressure (10,000 PSI) gauges, hoses and adapters in drive pump ports MA and MB. Start machine and operate at low idle. If the pump is good, pressure at MA and MB test ports should read 380 PSI. Adjust relief valve to see if pressure responds. Engage forward drive with park brake set, raise engine speed to full throttle and record drive pressure and charge pressure. Repeat this procedure for reverse. Drive pressure should be 6300 PSI in each direction. Charge pressure should remain at 380 PSI and rise to approximately 480 PSI near full throttle. If charge pressure is not achieved, main pump is leaking internally. ***See Figure 12.***

NOTE! Do not stall pump for more than 15 seconds each time.

FIGURE 9
CHARGE PRESSURE
TEST PORT

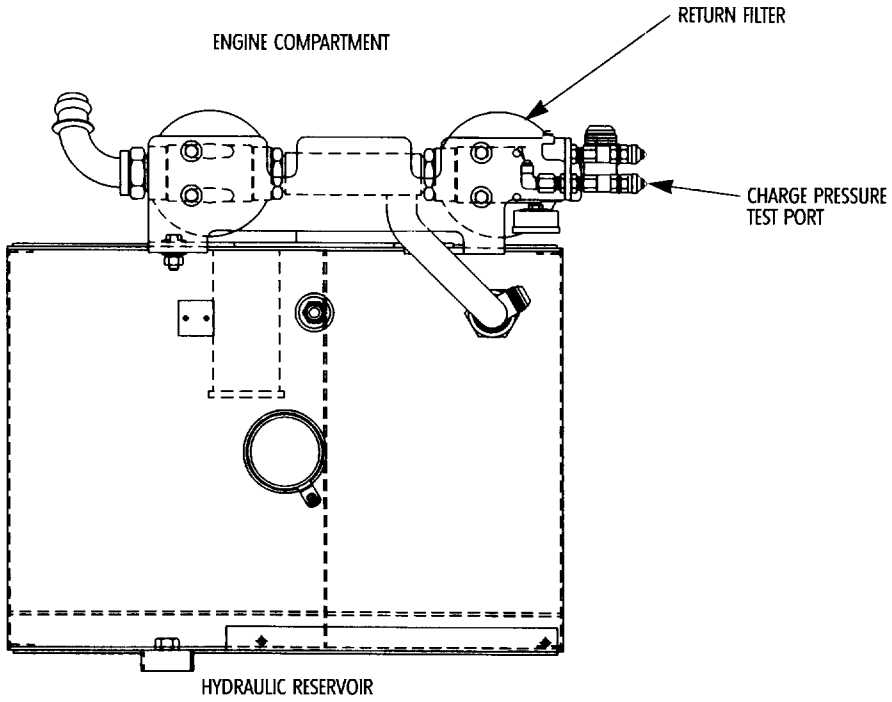


FIGURE 10
MAIN PUMP ASSEMBLY (SIDE VIEW)

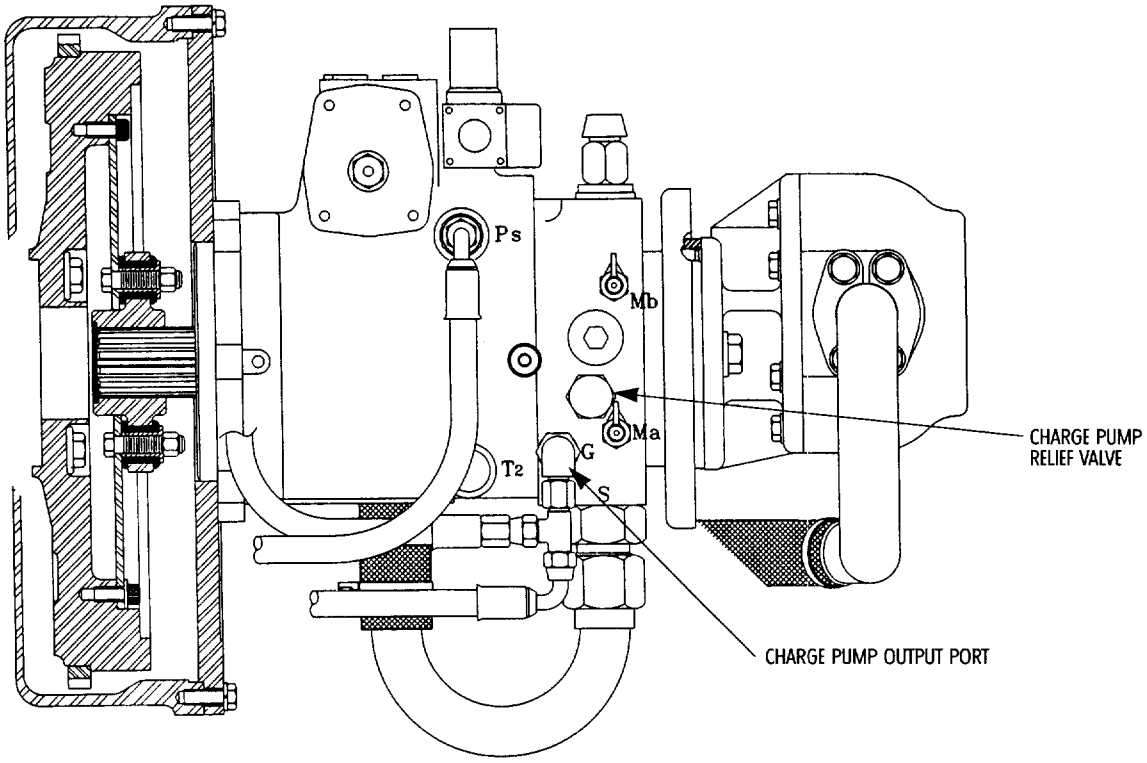


FIGURE 11
REAR DRIVE MOTOR ASSEMBLIES (MOUNTED)

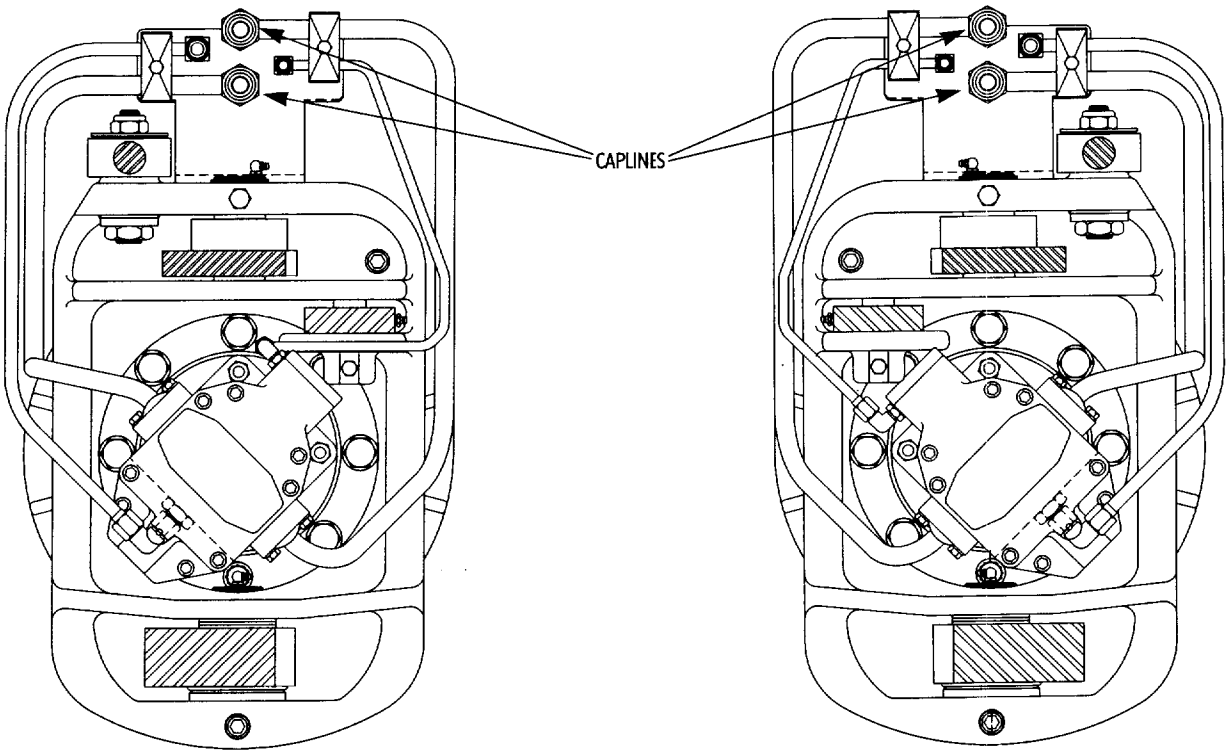


FIGURE 11A
FRONT DRIVE MOTOR (SIDE VIEW)

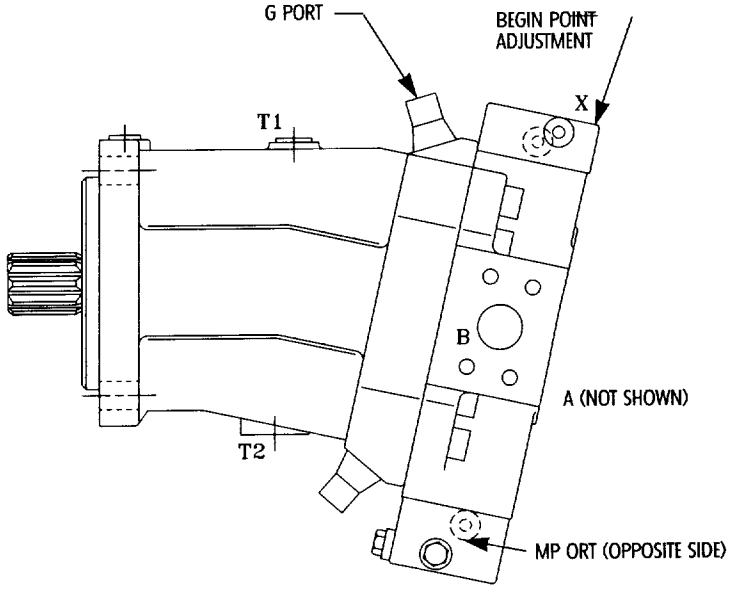
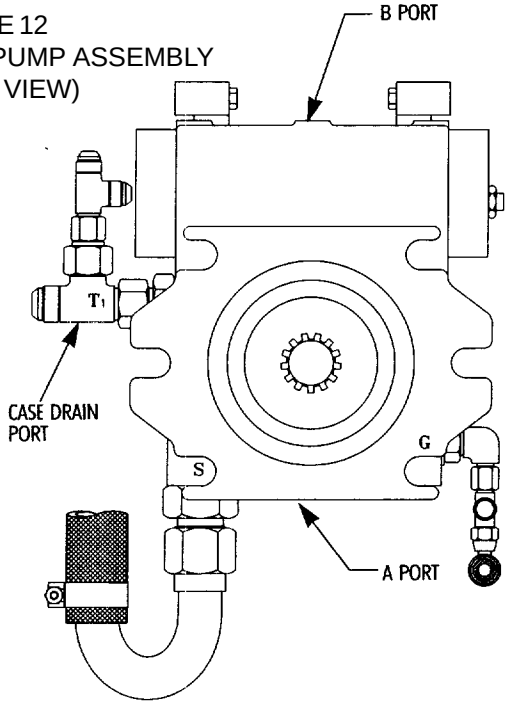


FIGURE 12
MAIN PUMP ASSEMBLY
(REAR VIEW)



VI. Control Pressure

Reason for Control Pressure Check

To ensure control pressure is correct for proper machine speed. For the machine to move at proper engine speed, control pressure should match engine RPM.

Install a low pressure gauge (1,000 PSI), hose and adapter on the drive pump control pressure Ps port. Remove the hose from port and plug. NOTE! Before starting, make sure the gauge can be observed in the operator's cab and apply the park brake. Start the engine and run at full throttle speed (2500-2700 RPM). With the pump in neutral, the gauge should read 380 PSI. This may vary +/- 15 PSI. ***(See Figure 13).***

Use a tachometer to monitor engine speed. Start the engine and run at 1100 RPM. While watching the pressure gauge, move the shift lever to the forward position. The gauge should read 100 PSI. Next repeat the test for reverse. If the machine does not start to move at 1100 RPM engine speed in both directions equally at 100 PSI control pressure, the stroking piston needs centered mechanically.

To check this adjustment, install a clean hose between control ports X1 and X2. They are lotated on the top of the drive pump. ***See Figure 14.*** Remove and plug control hoses from the top of the drive pump ports X1 and X2. Install two high pressure (10,000 PSI) gauges, hoses and adapters in the drive pump ports MA and MB on the side of the pump. Start the engine and operate at low idle. Observe the gauges. Pressure at MA port must be equal to the pressure at MB port. If pressures are not equal, loosen locknut on stroking piston adjustment and turn adjusting screw to equalize pressures. Tighten locknut to secure adjustment. Repeat this procedure with low pressure (1,000 PSI) gauges to fine tune.

If the inching valve and forward/reverse valve work correctly but adjustment does not produce the desired pressure change, replace the control pressure (DA) cartridge located on the left of the drive pump.

FIGURE 13
MAIN PUMP ASSEMBLY (SIDE VIEW)

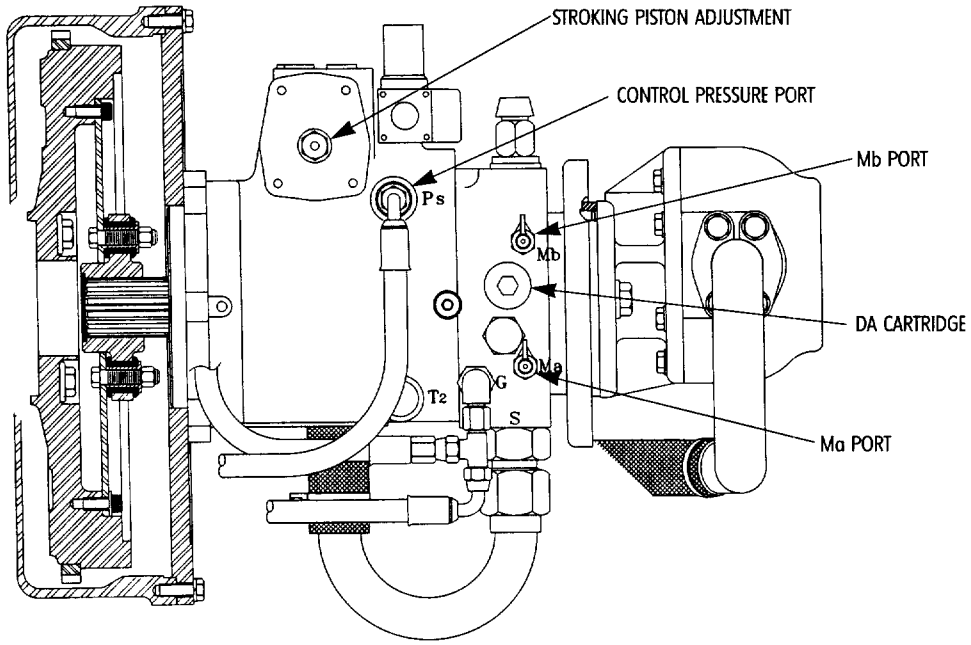
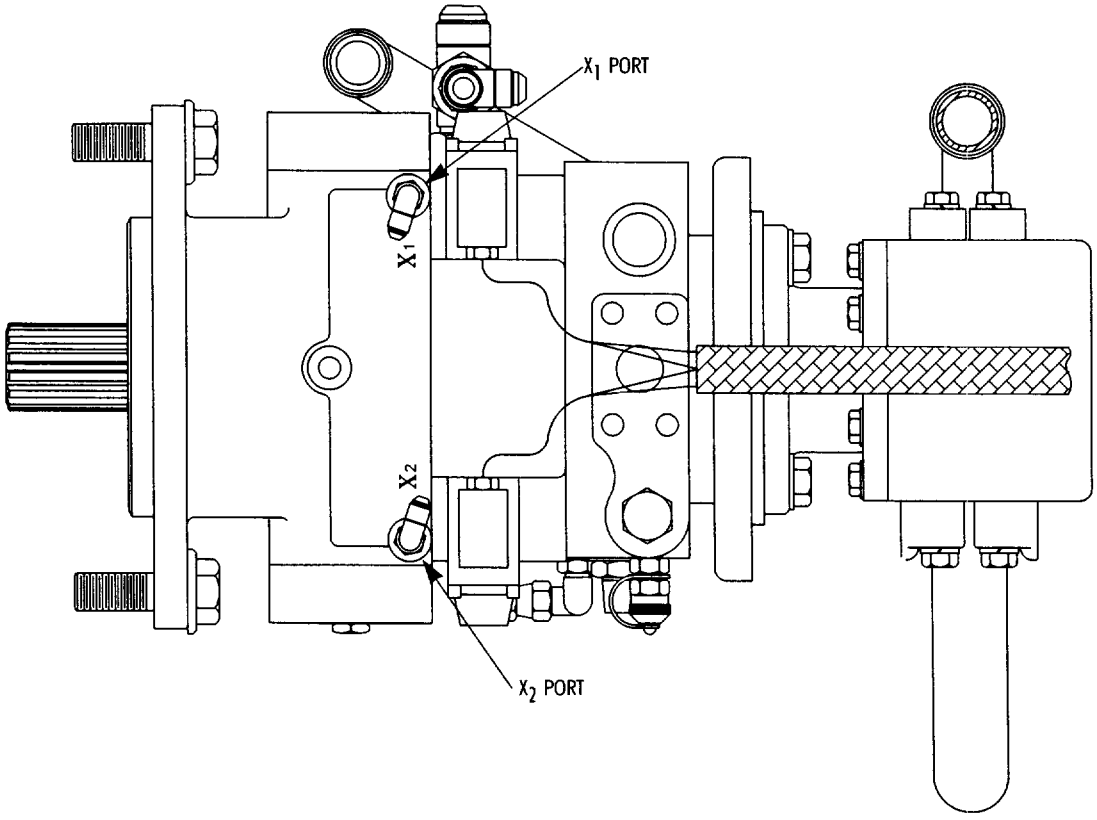


FIGURE 14
MAIN PUMP ASSEMBLY (TOP VIEW)



VII. Inching

Reason for Inching Check

Loss of control pressure can affect machine speed.

A low pressure gauge (1,000 PSI), hose, # 6 run tee and adapter should be teed into the Ps port on the drive pump. Apply the park brake and run the engine at full throttle (2500-2700 RPM). The gauge reading should be the same as in the previous control pressure test. Depress the brake pedal. The control pressure should start to fall after one-half inch of pedal travel. This pressure should drop as the pedal travels farther and the service brakes apply. The controlled linkage length should be 12-1/4 inches from the centerline of the yoke pins. The lever arm position on the inching valve should set 1/8 inch off the pin as a starting point.
See Figure 16 and Figure 17.

Another check for the inching adjustment is to install a high pressure gauge (10,000 PSI), hose and adapter on MA port on the drive pump. With the park brake on, move the shift lever to the forward position. At full throttle, depress the inching/brake pedal slowly. When the roller on the pedal just touches the brake valve plunger, the gauge should read 2,300 PSI +/- 100. ***See Figure 15.***

FIGURE 15
MAIN PUMP ASSEMBLY (SIDE VIEW)

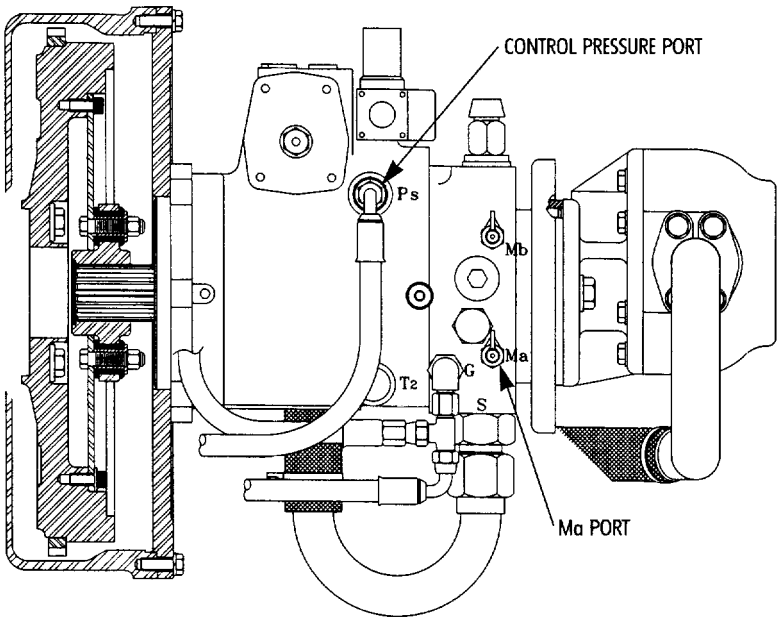


FIGURE 16
FLOOR PLATE ASSEMBLY

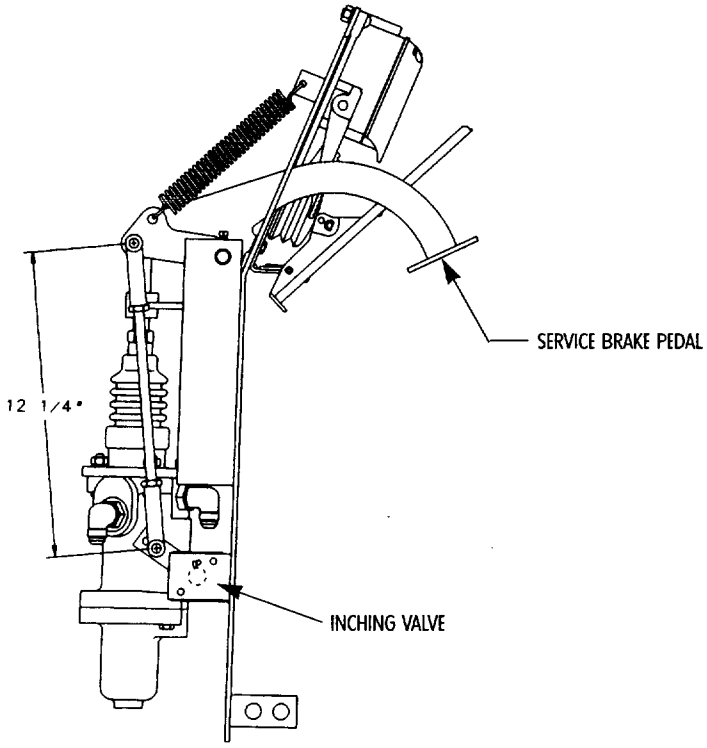
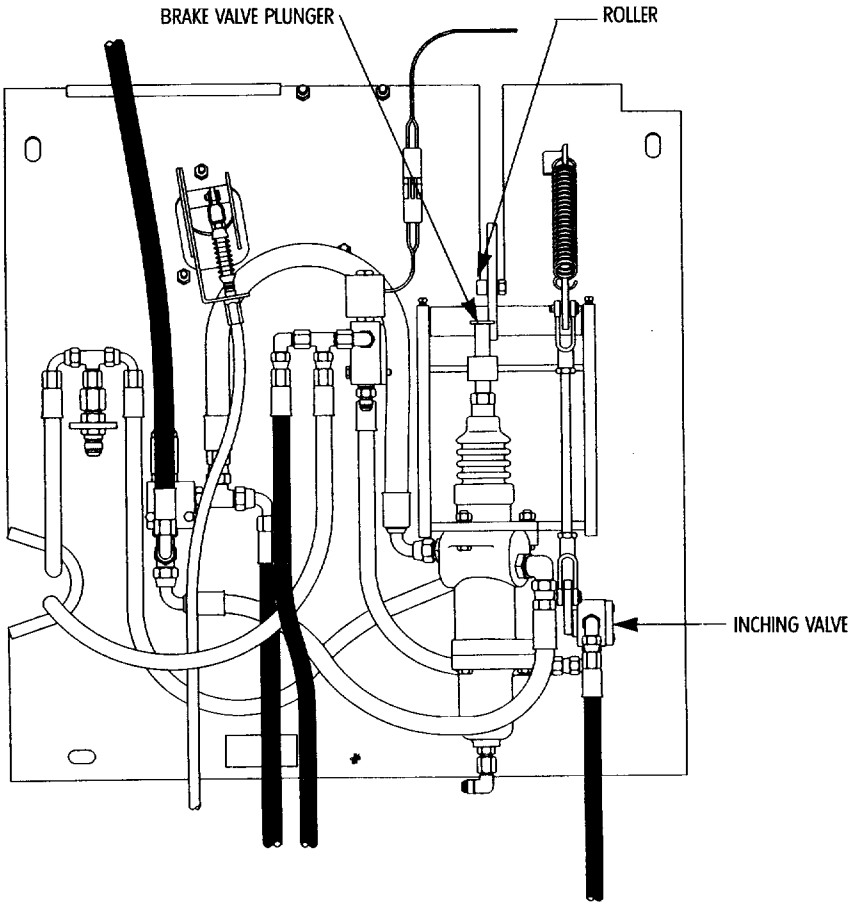


FIGURE 17



VIII. Front Motor Begin Point

Definition: The point at which the front motor begins to stroke toward minimum displacement.

Reason for Front Motor Begin Point Check
Without proper adjustment, machine speed on a flat, smooth surface will not meet specifications. The motor may not be shifting to a maximum speed position.

Install a high pressure gauge (10,000 PSI), hose and adapter on MB port on the drive pump. Adjust the reverse high pressure relief valve to 3,300 PSI by loosening the locknut. The reverse high pressure port relief is on the top left of the pump. Install adopter, test port (P/N 7713-3089), #6 run tee and low pressure gauge (1,000 PSI) into the Ps port of the pump. (Ps port is connection for the inching valve hose). Set the parking brake and block the tires to prevent movement of the machine. Machine should be in 2WD. Shut off the machine. Remove plugs from G and M ports of the front drive motor. G port is found at the bottom of the front drive motor controls. M port locates at the top left side of the controls. ***See Figure 18 and Figure 19***. Install test ports (P/N 7713-3089) in place of the plugs. Attach a high pressure gauge (10,000 PSI) to both test ports.

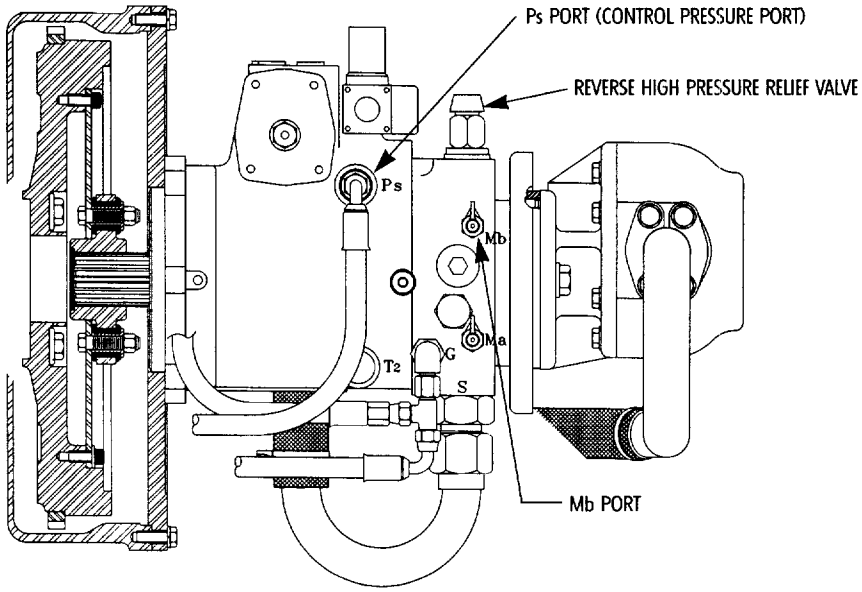
WARNING During the next two steps, to prevent excessive heat in the hydraulic oil and possible damage to hydraulic components, do not operate for more than 30 seconds at a time.

Start engine and raise RPM until gauge on Ps port is at 240 PSI. Maintain this RPM and pressure throughout the test. With pressure on Ps port at 240 PSI, the pressure at G port should read 3,300 PSI. Adjust “begin” point screw on the motor so that M port on motor sees opproximately 1,650 PSI. (NOTE! Begin point screw adjustment is very sensitive.) NOTE! The pressure on M port will not be steady. This is the pressure that shifts the motor to maintain minimum displacement.

Under normal operating conditions, the 3,300 PSI on G port required to shift the motor will not be constant. When this pressure is reached, the motor shifts. Since the pressure supplied is constant, the motor will not stay in a partially shifted position. Reset the reverse high pressure relief valve to 6,800 PSI. Use procedure # 9 drive pump pressure to adjust this relief.

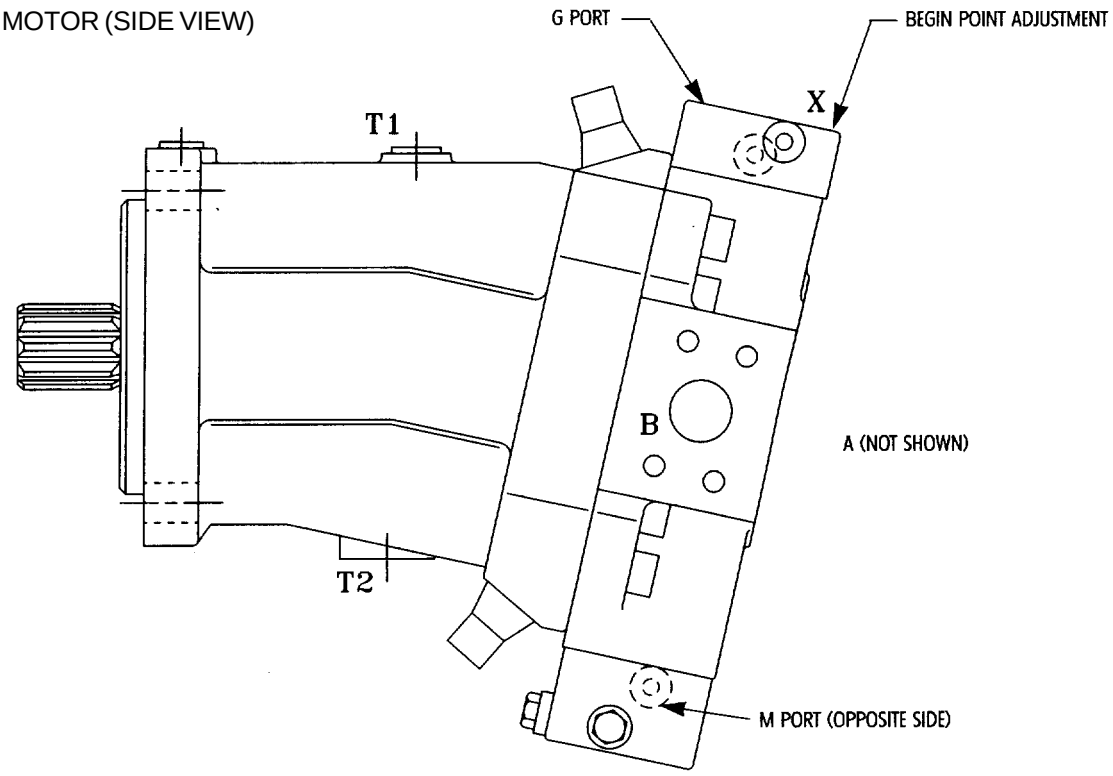
Wrench sizes required: 4mm allen and 10mm box.

FIGURE 18
MAIN PUMP ASSEMBLY (SIDE VIEW)



VIII. Front Motor Begin Point (continued)

FIGURE 19
FRONT DRIVE MOTOR (SIDE VIEW)



For our application, this drive motor is utilized in a 180 degree inversion.

IX. Drive Pump Pressure

Reason for Drive Pump Pressure Check
Drive pump pressure determines the drive power of the machine. Low drive pressure will result in less power.

Install a high pressure gauge (10,000 PSI), hose and adapter on the MA port (located at the bottom of the drive pump). Apply the park brake and put the 2WD/4WD switch in the 2WD position. Move the shift lever to the forward position and run the engine at full throttle (2500-2700 RPM). The gauge reading should be 6,300 PSI. Adjust the POR valve located on top of the pump as necessary. To adjust this relief valve, loosen the lock-nut and turn the adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure. Move the gauge to the MB port of the drive pump to repeat the procedure with the shift lever in the reverse position. ***See Figure 20 and Figure 20A.***

There are also high pressure/anti-cavitation relief valves on the drive pump. These could influence drive system pressure with a low setting or missing O-ring. On machines with 6,300 PSI drive pressure, adjust these valves to 6,800 PSI. Normally, these high pressure relief valves do not require checking. However, if there is a drive power problem and adjustment of the POR valve on the main pump does not change the pressure, these valves may have to be adjusted. Install a high pressure (10,000 PSI) gauge hose and adapter on MA port on the pump. To check these high pressure relief valves, raise the setting on the POR valve on the drive pump. Loosen locknut on POR valve and turn the adjusting screw clockwise one turn to increase pressure. With a high pressure gauge (10,000 PSI) hose and adapter on MA port, set the park brake, put the shifter in forward and run engine at full throttle. Adjust the forward high pressure relief to 6,800 PSI. The forward high pressure relief valve is on the bottom of the pump. Install the high pressure gauge (10,000 PSI), hose and adapter on the MB port and repeat the procedure for reverse. Adjust the reverse high pressure relief to 6,800 PSI. The reverse high pressure relief valve locates on top of the pump. Leave high pressure gauge (10,000 PSI) hose and adapter on MB port. Reset the POR back to original position. With park brake on, put the shifter in reverse and run engine at full throttle. The pressure should be 6,300 PSI. Adjust POR valve as required. ***See Figure 20 and Figure 20A.***

The traction lock valve also has two high-pressure/anti-cavitation relief valves. Normally, these require no adjustment. However, they can adversely affect drive system pressure if, say, they are set too low, or an O-ring is missing. To check these valves, raise the POR valve pressure setting above 6,800 PSI. Set the forward high pressure relief valve on the pump to 6,800 PSI. Then lower the forward high pressure relief valve on the traction lock valve under 6,800 PSI. Turn the valve in 1/8 turn and secure locknut. Repeat the procedure for reverse. Then reset the POR valve to 6,300 PSI. ***See Figure 21.***

FIGURE 20
MAIN PUMP ASSEMBLY
(SIDE VIEW)

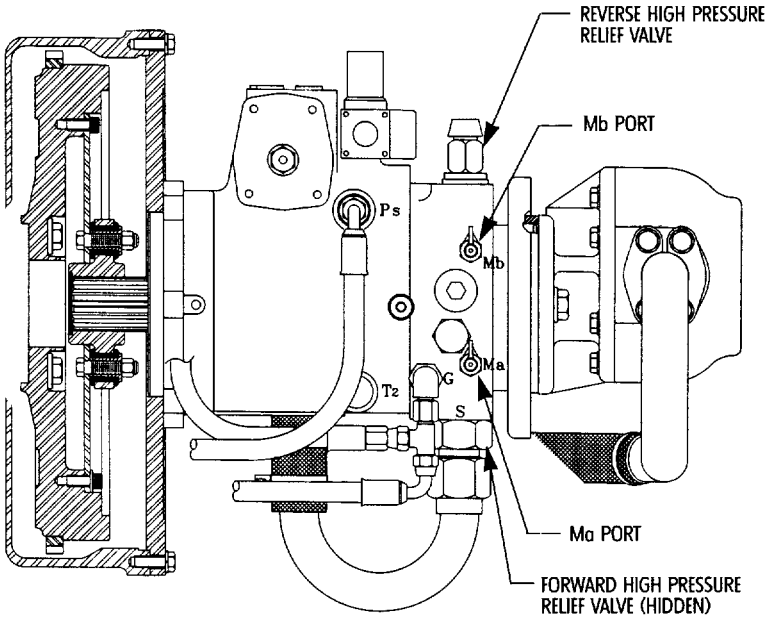


FIGURE 20A
MAIN PUMP ASSEMBLY (TOP VIEW)

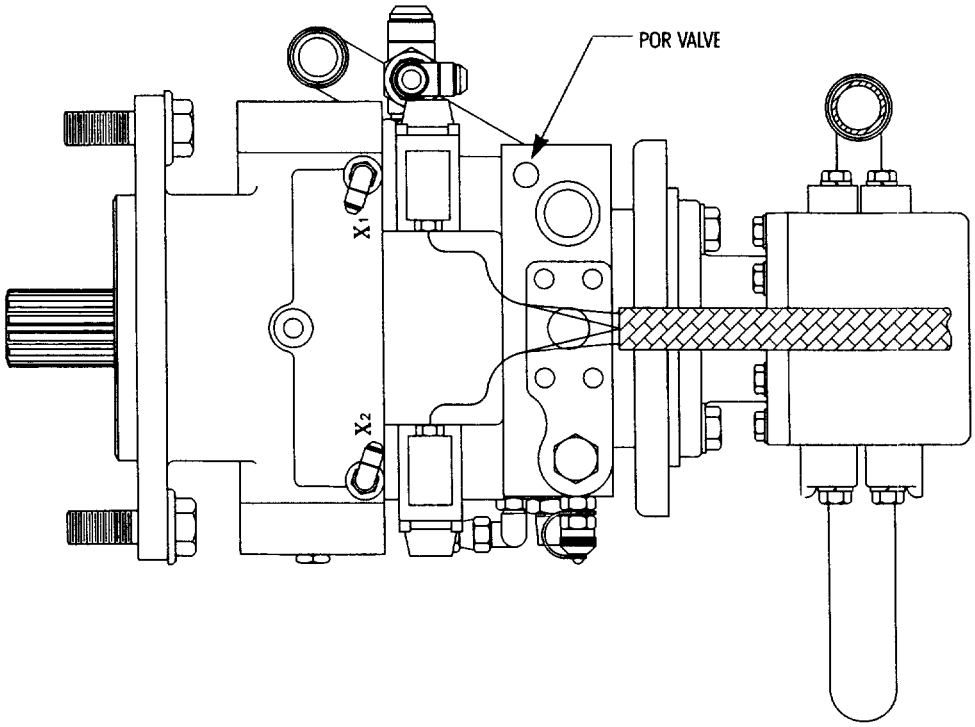


FIGURE 21
TRACTION LOCK VALVE

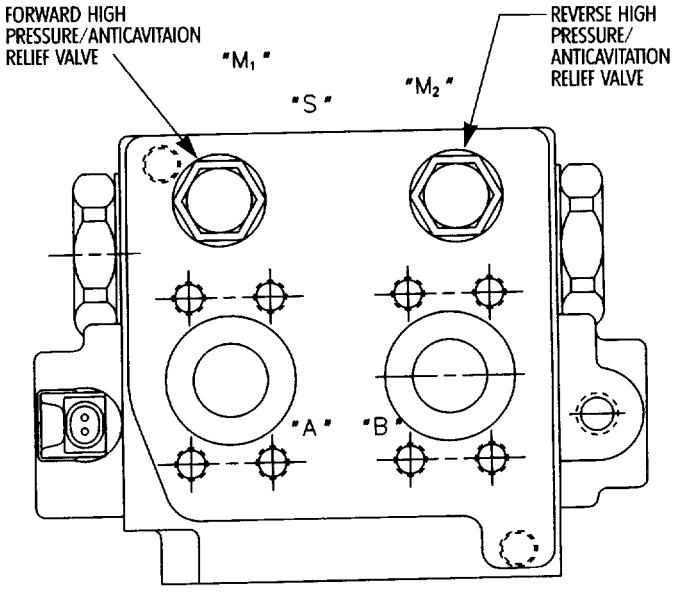
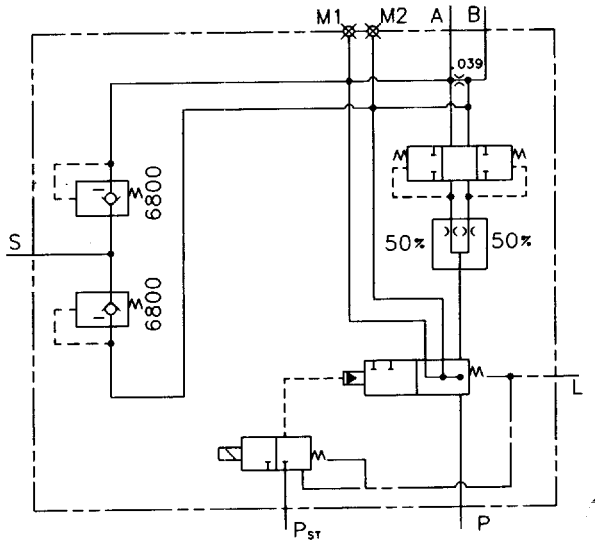


FIGURE 22
TRACTION LOCK VALVE SCHEMATIC



X. Machine Operation

Reason for Machine Operation Check

To ensure that the traction lock valve is operating correctly. Also to check for proper operation of the 2WD/4WD solenoid valve and proper begin point adjustment on the front motor.

After completion of these checks, operate the machine in a flat, smooth open area. Set the machine for 4WD operation. Depress the traction lock switch. Drive the machine at full speed. Release the traction lock switch; the machine should pick up speed. Shift the machine to 2WD and repeat this test. The machine should pick up speed again. If maximum speeds are in question, check machine speed. Run the machine in 2WD and 4WD in forward and reverse at maximum RPM for one minute. In 2WD, the machine will go 100 feet in 3.6-4.0 seconds. In 4WD, the machine will go 100 feet in 10.6-11.6 seconds. The machine must be traveling at full speed at the start of the measured distance.

CALIFORNIA

Proposition 65 Warning

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

Wash hands after handling.

CALIFORNIA

Proposition 65 Warning

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

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PRA 352 Series Planetary Axles

Maintenance Manual No. 9D

Planetary Axle Models
- PRA 352 W2H
- PRA 352 G2H
- PRA 352 G2M
- PRA 353 G2H
- PRA 353 G2M
- PRA 383 G2H
- PROA 352 W2H
- PROA 382 W2H

Service Notes

This publication provides maintenance and service procedures for Meritor PRA 352 series planetary axles. The information contained in this publication was current at the time of printing and is subject to revision without notice or liability.

1. You must understand all procedures and instructions before you begin maintenance and service procedures.
2. You must follow your company's maintenance and service guidelines.
3. You must use special tools, when required, to avoid serious personal injury and damage to components.

Meritor uses the following notations to alert the user of possible safety issues and to provide information that will help to prevent damage to equipment and components.

WARNING

A WARNING indicates a procedure that you must follow exactly to avoid serious personal injury.

CAUTION

A CAUTION indicates a procedure that you must follow exactly to avoid damaging equipment or components. Serious personal injury can also occur.

NOTE: A NOTE indicates an operation, procedure or instruction that is important for proper service. A NOTE can also supply information that can help to make service quicker and easier.

This symbol indicates that fasteners must be tightened to a specific torque value.

Visit Our Web Site

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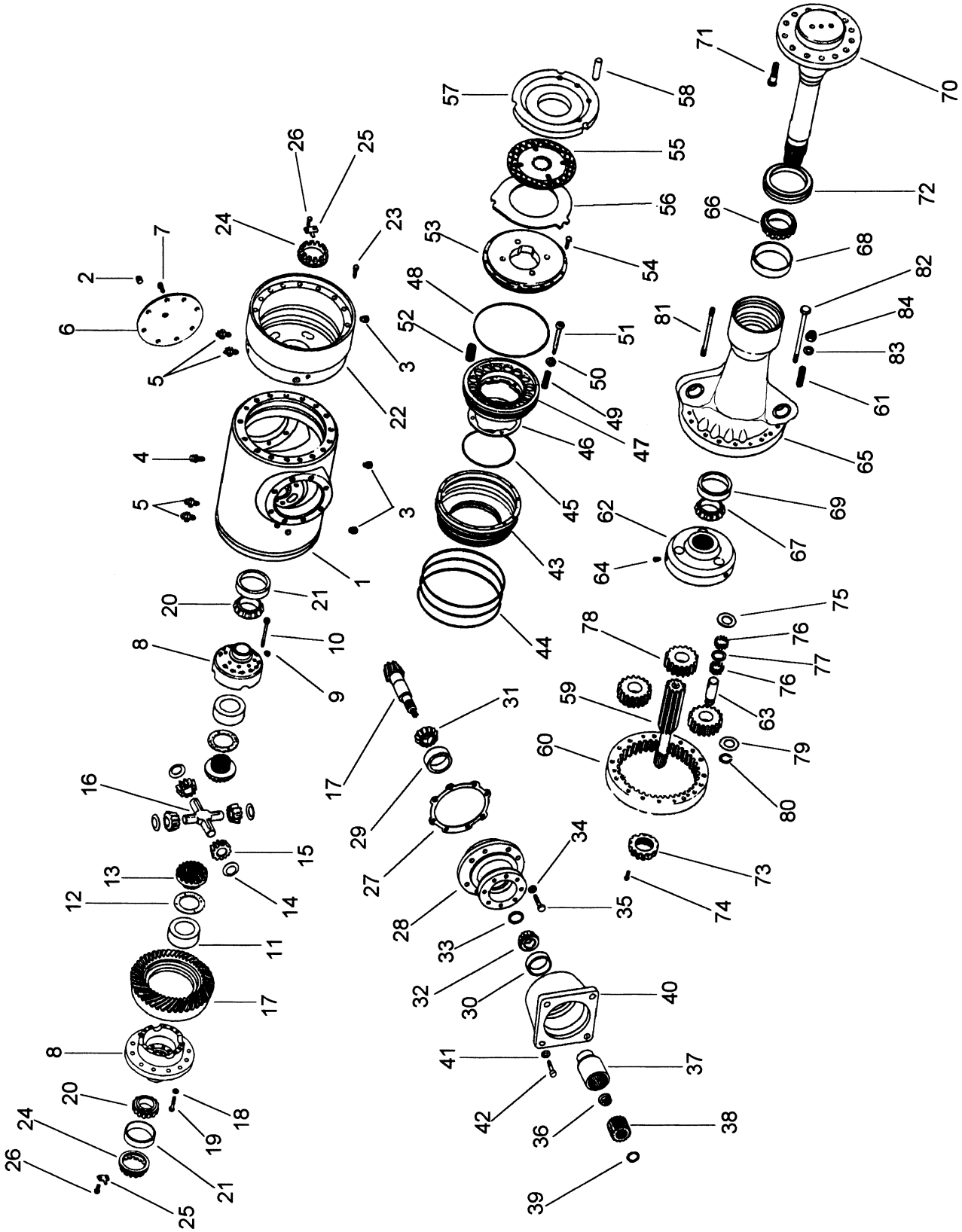
The CD includes product and service information on Meritor's Drivetrain Plus™ component lineup. $20. Order TP-9853.

How to Order

Call Meritor's Customer Service Center at 800-535-5560.

PRA 352 – Trumpet Variation No. 1

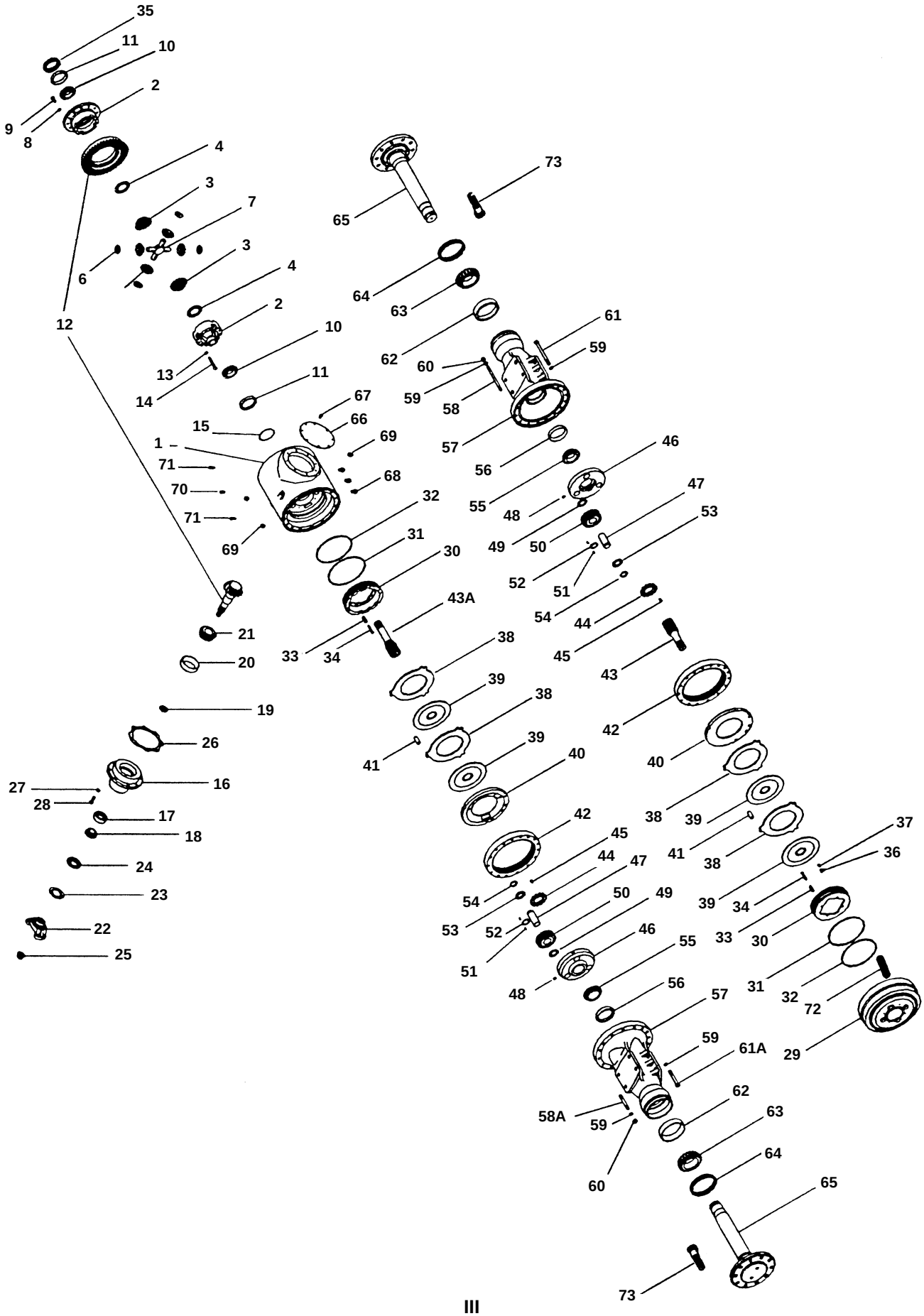


PRA 352 – Trumpet Variation No. 1

Item	Description
1	Central Housing
2	Level Plug
3	Drain Plug
4	Vent Plug
5	Hydraulic Line Bleeder
6	Cover
7	Capscrew
8	Differential Case Assembly
9	Washer
10	Capscrew
11	Spacer
12	Thrust Washer
13	Side Gear
14	Thrust Washer
15	Pinion Gear
16	Spider
17	Spiral Gear & Pinion
18	Washer
19	Capscrew
20	Bearing Cone
21	Bearing Cup
22	Brake Housing
23	Capscrew
24	Adjuster Ring
25	Adjuster Ring Lock
26	Capscrew
27	Pinion Cage Shim
28	Pinion Cage Assembly
29	Bearing Cup
30	Bearing Cup
31	Bearing Cone
32	Bearing Cone
33	Drive Pinion Shim
34	Washer
35	Capscrew
36	Pinion Nut
37	Driven Sleeve
38	Drive Sleeve
39	Snap Ring
40	Motor Adapter Flange
41	Washer
42	Capscrew

Item	Description
43	Outer Piston
44	Piston O-ring
45	Piston O-ring
46	Piston Brake Shim
47	Inner Piston
48	O-ring Piston
49	Spring
50	Washer
51	Bolt–Return Spring
52	Spring
53	Brake Actuating Plate
54	Capscrew
55	Friction Disc
56	Stationary Disc
57	Brake Reaction Plate
58	Brake Disc Lock Pin
59	Sun Gear
60	Ring Gear
61	Capscrew
62	Planetary Pinion Spider
63	Planetary Pinion Shaft
64	Capscrew
65	Housing
66	Bearing Cone
67	Bearing Cone
68	Bearing Cup
69	Bearing Cup
70	Output Axle Shaft
71	Wheel Bolt
72	Axle Shaft Oil Seal
73	Adjusting Nut
74	Adjusting Nut Lock Capscrew
75	Thrust Washer
76	Kit Rollers
77	Roller Spacer
78	Planetary Pinion
79	Washer
80	Snap Ring
81	Stud
82	Capscrew
83	Washer
84	Nut

PRA 352 – Trumpet Variation No. 2

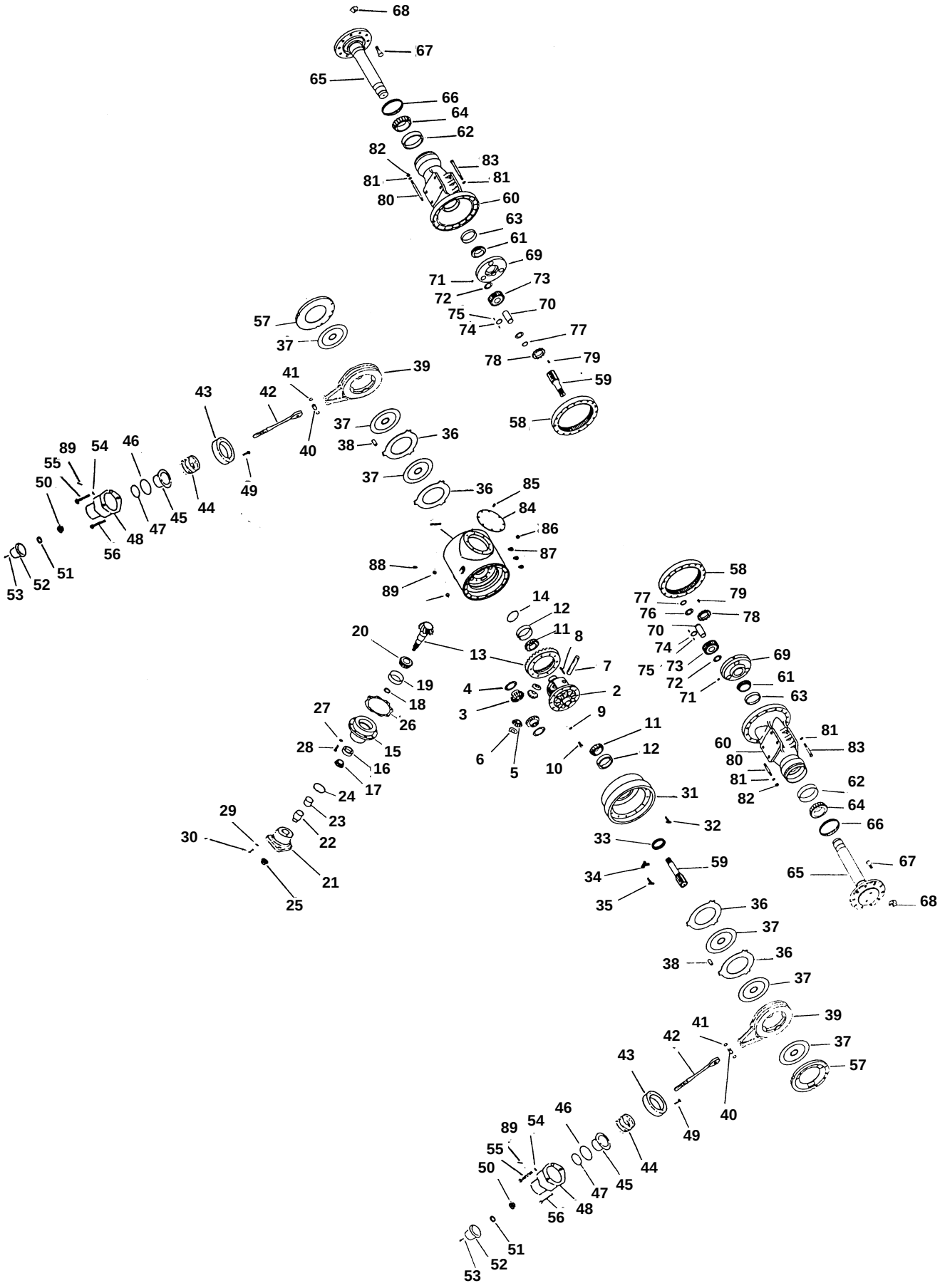


PRA 352 – Trumpet Variation No. 2

Item	Description
1	Center Housing
2	Differential Case Assembly
3	Side Gear
4	Side Gear Thrust Washer
5	Pinion Gear
6	Pinion Gear Thrust Washer
7	Spider Differential
8	Spiral Gear Capscrew Plain Washer
9	Spiral Gear Capscrew
10	Bearing Cone
11	Bearing Cup
12	Spiral Gear & Pinion Assembly
13	Differential Case Plain Washer
14	Differential Case Capscrew
15	Shim Differential Case
16	Pinion Cage
17	Bearing Cup
18	Bearing Cone
19	Pinion Bearing Spacer
20	Bearing Cup
21	Bearing Cone
22	Universal Joint Yoke
23	Oil Slinger
24	Oil Seal
25	Pinion Nut
26	Shim Pinion Cage
27	Pinion Cage Washer
28	Pinion Cage Capscrew
29	Brake Housing
30	Brake Piston
31	Oil Seal Piston
32	Oil Seal Piston
33	Piston Return Spring
34	Return Spring Bolt
35	Adjuster Ring
36	Adjuster Ring Lock
37	Adjuster Ring Lock Capscrew
38	Stationary Disc

Item	Description
39	Friction Disc
40	Brake Reaction Plate
41	Brake Disc Lock Pin
42	Ring Gear
43	Sun Gear, Short
43A	Sun Gear, Long
44	Adjusting Nut
45	Adjusting Nut Lock Capscrew
46	Planetary Pinion Flange
47	Shaft Planetary Pinion
48	Planetary Pinion Axle Capscrew
49	Planetary Pinion Thrust Washer
50	Planetary Pinion
51	Rollers
52	Spacer Rollers
53	Planetary Pinion Plain Washer
54	Snap Ring
55	Bearing Cone
56	Bearing Cup
57	Housing
58	Center Housing Stud
58A	Center Housing Stud
59	Washer
60	Center Housing Stud Nut
61	Center Housing Capscrew
61A	Center Housing Capscrew
62	Bearing Cup
63	Bearing Cone
64	Axle Shaft Oil Seal
65	Axle Shaft
66	Center Housing Cover
67	Center Housing Cover Capscrew
68	Drain Plug
69	Level Plug
70	Vent Plug
71	Hydraulic Bleeder
72	Capscrew
73	Wheel Bolt

PRA 353/383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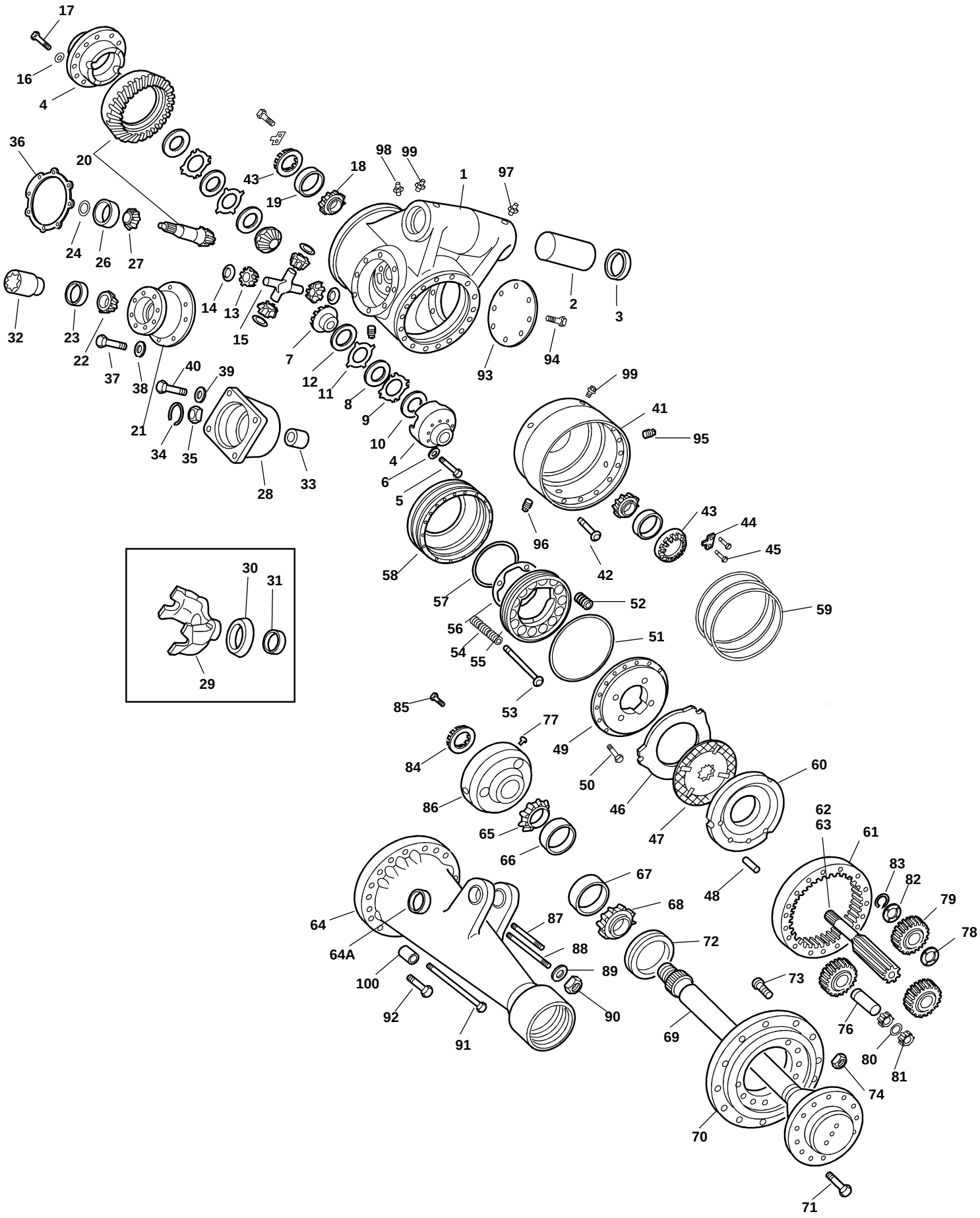
PRA 353/383

Item	Description
1	Center Housing
2	Differential Case
3	Side Gear
4	Thrust Washer
5	Pinion Gear
6	Thrust Washer
7	Differential Pinion Shaft
8	Pinion Shaft Lock Pin
9	Washer
10	Capscrew
11	Bearing Cone
12	Bearing Cup
13	Spiral Gear and Pinion
14	Differential Case Shim
15	Pinion Cage
16	Bearing Cup
17	Bearing Cone
18	Drive Pinion Shim
19	Bearing Cup
20	Bearing Cone
21	Motor Adapter Flange
22	Driven Sleeve
23	Drive Sleeve
24	Snap Ring
25	Pinion Nut
26	Pinion Cage Shim
27	Washer
28	Capscrew
29	Washer
30	Capscrew
31	Brake Housing
32	Capscrew
33	Adjuster Ring
34	Adjuster Ring Lock
35	Capscrew
36	Stationary Disc
37	Friction Disc
38	Brake Disc Lock Pin
39	Brake Assembly
40	Pin
41	Circlip
42	Brake Control Rod
43	Brake Cylinder Support
44	Spring
45	Brake Piston

Item	Description
46	O-ring
47	O-ring
48	Brake Cylinder
49	Capscrew
50	Adjusting Nut
51	Nut
52	Brake Cylinder Cover
53	Capscrew
54	Washer
55	Capscrew
56	Capscrew
57	Reaction Brake Plate
58	Ring Gear
59	Sun Gear
60	Housing
61	Bearing Cone
62	Bearing Cup
63	Bearing Cup
64	Bearing Cone
65	Axle Shaft
66	Axle Shaft Oil Seal
67	Wheel Bolt
68	Wheel Nut
69	Planetary Pinion Spider
70	Planetary Pinion Shaft
71	Capscrew
72	Thrust Washer
73	Planetary Pinion
74	Spacer
75	Kit Rollers
76	Washer
77	Snap Ring
78	Adjusting Nut
79	Adjusting Nut Lock Capscrew
80	Stud M14
81	Washer
82	Nut
83	Capscrew
84	Cover
85	Capscrew
86	Level Plug
87	Drain Plug
88	Vent Plug
89	Hydraulic Line Bleeder

PROA 352/382 (With Mechanical Drive Option)



PROA 352/382 (With Mechanical Drive Option)

Item	Description
1	Main Housing
2	Bushing
3	Trunnion Oil Seal
4	Differential Case Assembly
5	Differential Case Capscrew
6	Differential Case Washer
7	Side Gear
8	Friction Discs Shim Pack
9	Friction Drive Disc
10	Friction Driven Discs
11	Compression Discs
12	Thrust Washer
13	Pinion Gear
14	Pinion Gear Thrust Washer
15	Spider
16	Gear Capscrew Washer
17	Gear Capscrew
18	Differential Case Cone Bearing
19	Differential Case Cup Bearing
20	Gear and Pinion Assembly
21	Pinion Bearing Case
22	Shaft Side Cone Bearing
23	Shaft Side Cup Bearing
24	Pinion Bearing Spacer
25	Not Shown
26	Head Side Cup Bearing
27	Head Side Cone Bearing
28	Adapter Flange
29	Universal Joint Yoke
30	Deflector
31	Pinion Oil Seal
32	Driven Sleeve
33	Drive Sleeve
34	Snap Ring
35	Pinion Nut
36	Pinion Bearing Cage Shim
37	Bearing Cage Capscrew Washer
38	Bearing Cage Capscrew
39	Flange Capscrew Washer
40	Flange Capscrew
41	Brake Housing
42	Brake Housing Capscrew
43	Adjusting Ring
44	Adjusting Ring Lock
45	Lock Capscrew
46	Stationary Disc
47	Friction Disc
48	Brake Disc Lock Pin
49	Action Plate
50	Bolt
51	Medium Oil Seal

Item	Description
52	Spring
53	Return Spring Capscrew
54	Return Spring
55	Inner Piston
56	Shim Pack
57	Small Oil Seal
58	Outer Piston
59	Oil Seal
60	Reaction Plate
61	Ring Gear
62	Short Sun Gear
63	Long Sun Gear
64	Axle Shaft Housing
64A	Bushing
65	Bearing Cone
66	Bearing Cup
67	Bearing Cup
68	Bearing Cone
69	Axle Shaft
70	Wheel Flange
71	Flange Capscrew
72	Axle Shaft Oil Seal
73	Wheel Capscrew
74	Wheel Nut
75	Not Shown
76	Planetary Gear Pin
77	Pin Capscrew
78	Flange Side Thrust Washer
79	Planetary Gear
80	Rollers Spacer
81	Rollers Kit
82	Thrust Washer
83	Snap Ring
84	Adjusting Nut
85	Adjusting Nut Lock Capscrew
86	Planetary Spider
87	Short Stud
88	Long Stud
89	Washer
90	Nut
91	Bolt
92	Brake Release Bolt
93	Main Housing Cap
94	Cap Capscrew
95	Level Plug
96	Drain Plug
97	Grease Plug
98	Vent Plug
99	Bleeder
100	Spacer

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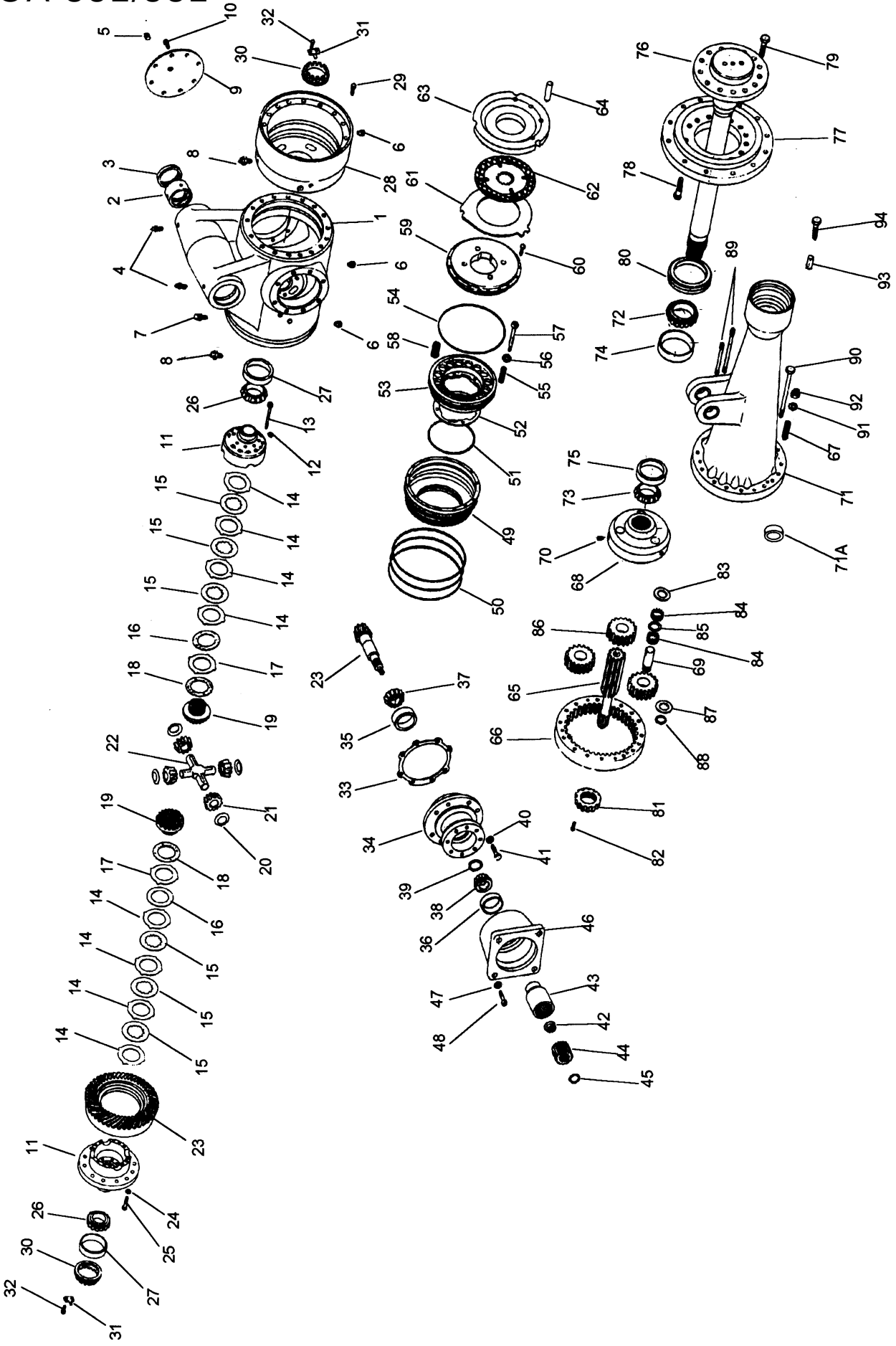

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Item	Description
1	Center Housing
2	Bushing
3	Trunnion Oil Seal
4	Lubrication Fitting
5	Level Plug
6	Drain Plug
7	Vent Plug
8	Hydraulic Line Bleeder
9	Cover
10	Capscrew M8x1,25x16,0
11	Differential Case Assembly
12	Washer
13	Capscrew M10x1,5x80,0
14	Drive Disc
15	Driven Friction Disc
16	Clutch Disc Shim
17	Compression Disc
18	Thrust Washer
19	Side Gear
20	Thrust Washer
21	Pinion Gear
22	Spider
23	Spiral Gear & Pinion
24	Washer
25	Capscrew
26	Bearing Cone
27	Bearing Cup
28	Brake Housing
29	Capscrew
30	Adjuster Ring
31	Adjuster Ring Lock
32	Capscrew
33	Pinion Cage Shim
34	Pinion Cage
35	Bearing Cup
36	Bearing Cup
37	Bearing Cone
38	Bearing Cone
39	Drive Pinion Shim
40	Washer
41	Capscrew
42	Pinion Nut
43	Driven Sleeve
44	Drive Sleeve
45	Snap Ring
46	Motor Adapter Flange
47	Washer
48	Capscrew

Item	Description
49	Brake Piston Assembly
50	O-ring Piston
51	O-ring Piston
52	Piston Brake Shim
53	Brake Piston
54	O-ring Piston
55	Spring
56	Washer
57	Bolt–Return Spring
58	Spring
59	Brake Actuating Plate
60	Capscrew
61	Stationary Disc
62	Friction Disc
63	Brake Reaction Plate
64	Brake Disc Lock Pin
65	Sun Gear
66	Ring Gear
67	Capscrew
68	Planetary Pinion Spider
69	Planetary Pinion Shaft
70	Capscrew
71	Housing
71A	Bushing
72	Bearing Cone
73	Bearing Cone
74	Bearing Cup
75	Bearing Cup
76	Output Axle Shaft
77	Wheel Flange
78	Wheel Bolt
79	Capscrew
80	Axle Shaft Oil Seal
81	Adjusting Nut
82	Adjusting Nut Lock Capscrew
83	Thrust Washer
84	Kit Rollers
85	Spacer
86	Planetary Pinion
87	Washer
88	Snap Ring
89	Stud
90	Capscrew
91	Washer
92	Nut
93	Spacer
94	Brake Release Capscrew

MERITOR™

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Description

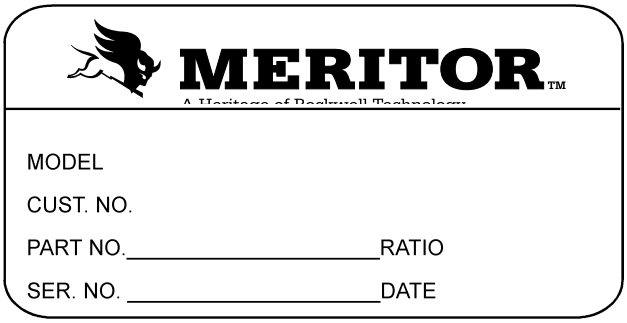
The Meritor PRA 352 Series Planetary Axle is a double reduction single speed unit that has:

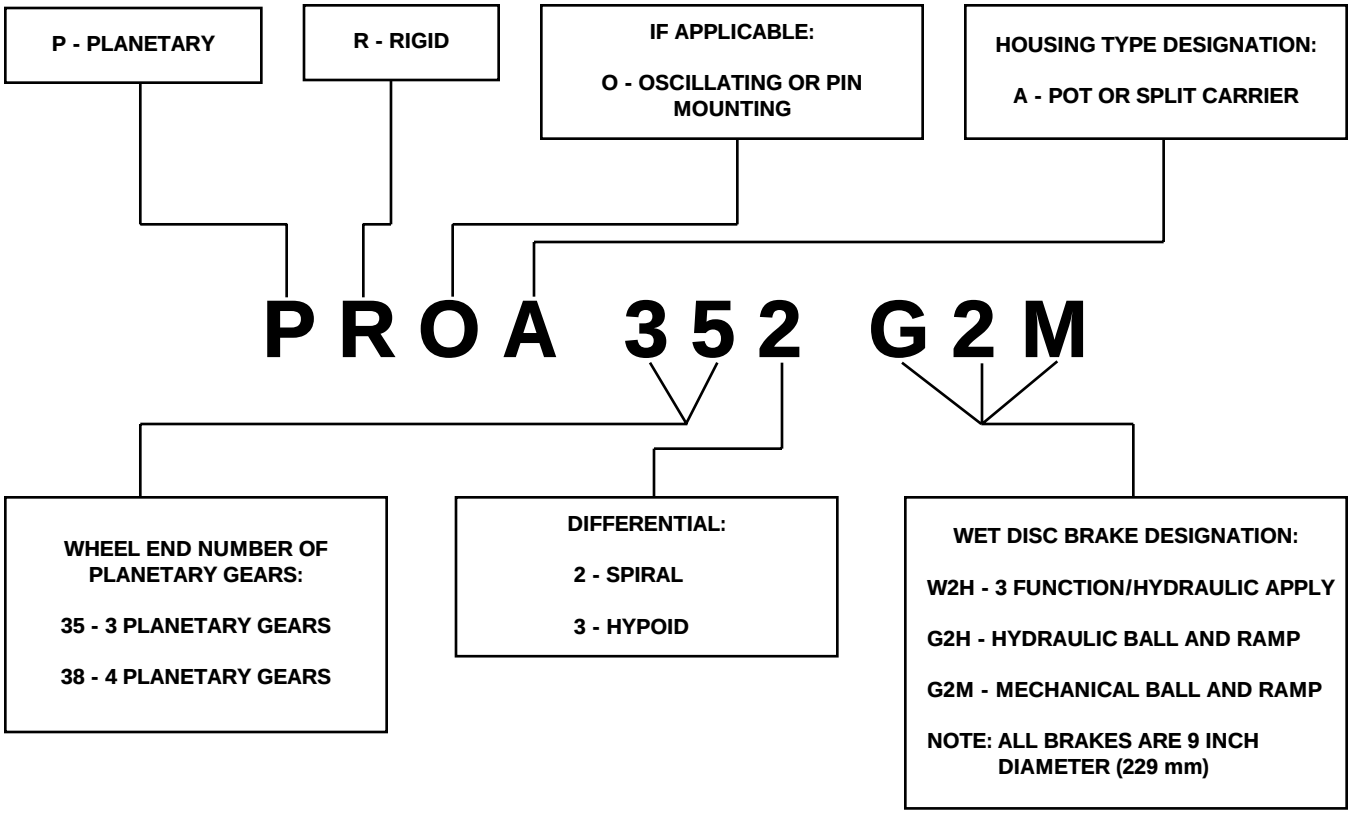
- A hypoid or spiral pinion and ring gear set
- Bevel gears in the differential assembly with 2 or 4 differential pinion gears
- A differential case assembly mounted on two tapered roller bearings
- A planetary system with 3 or 4 planetary pinion gears
- A trunnion mounting option
- An oil bath disc brake system in three different designs:
    1. Ball and Ramp
    2. Hydraulic Apply Wet Disc
    3. Three Function Brake

Identification

A tag on the main housing correctly identifies basic axle specifications.

When ordering parts, be sure to specify information stamped on the name plate. This information will allow easy identification of correct parts.





Remove Axle

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

WARNING

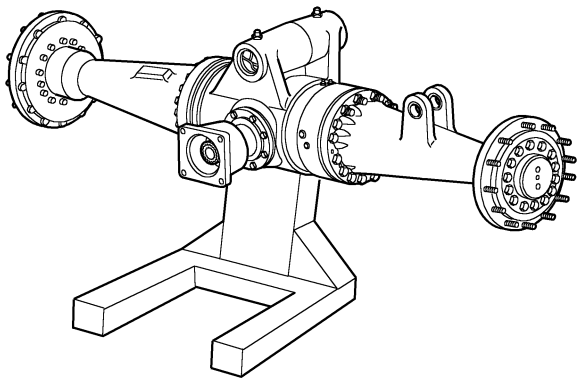
Support vehicle with safety stands. Do not work under a vehicle only supported by jacks. Jacks can slip or fall over and cause serious personal injury.

NOTE

While the housing configuration of the axle you service may differ from the figures shown, service instructions remain the same for all axle models addressed in this manual.

1. Make sure vehicle is on level surface.
2. Place blocks under wheels not being serviced to keep vehicle from moving.
3. Raise vehicle so that wheels to be serviced are off the ground. Support vehicle with safety stands.
4. Remove axle from vehicle.
5. Plug fluid lines that were connected to axle.
6. Place axle in appropriate repair stand. Center main housing on stand. **Figure 2.1.**
7. Remove drain plugs from brake housing and main housing with 12 mm Allen wrench. Drain axle oil.

Figure 2.1



The PROA 352 axle is shown to illustrate procedures in this maintenance manual

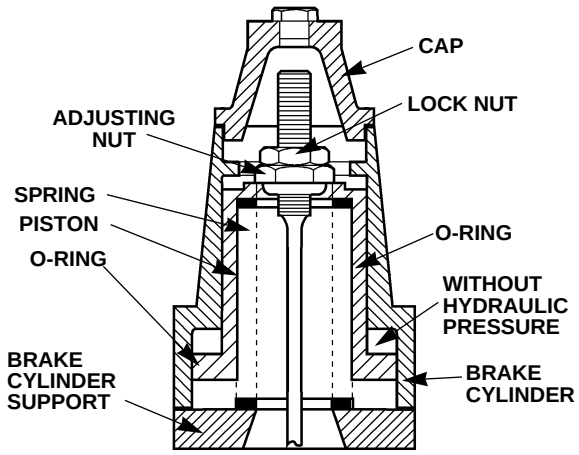
Disassemble Ball and Ramp Brake

NOTE

- ***Identify all parts before disassembly to ensure proper reassembly.***
- ***To disassemble hydraulic apply wet disc brake, go to page 5.***
- ***To disassemble three function brake, go to page 5.***

Figure 2.2.

Figure 2.2



1. Remove brake cylinder cover.
2. Remove nut and nut lock.
3. Loosen brake cylinder capscrews.
4. Remove brake cylinder assembly from main housing.

⚠ *CAUTION*

Loosen and remove brake cylinder capscrews alternately to avoid spring load damage to parts.

5. Disassemble brake cylinder assembly. Remove brake release capscrew. Loosen and remove brake cylinder capscrews alternately to avoid spring load to be supported by only one capscrew.
6. Remove spring, piston and O-ring seals. Do not cut or scratch them.
7. Clean cylinder and brake support surfaces. Do not damage ground surfaces.
8. Put parts of each brake cylinder assembly in separate plastic bags to avoid mixing them.

Disassemble Trumpet Assembly

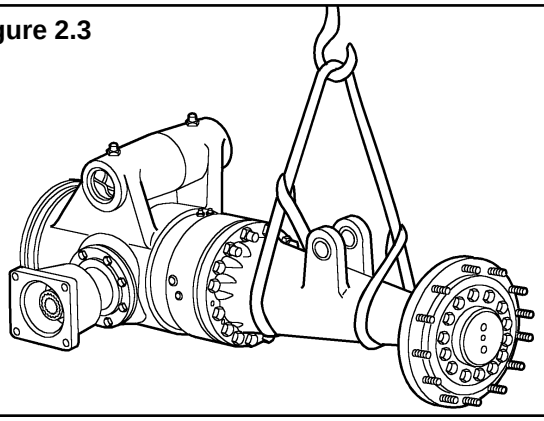
⚠ *WARNING*

To avoid serious personal injury and possible damage to components, be very careful when using lifting devices during removal and disassembly procedures.

- **Inspect to make sure that neither lifting strap is damaged.**
- **Do not subject lifting straps to any shock or drop loading.**

1. Support trumpet to be serviced with lifting device. **Figure 2.3.**
2. Loosen and remove trumpet nuts and bolts.

Figure 2.3



NOTE

For three function brake design: If bleeder and pressure ports of brake piston are open, the trumpet assemblies and ring gear will come off the center section easily without using puller holes. Cover pressure ports with rags to avoid contact with escaping oil.

3. Use two puller holes in trumpet flange to remove trumpet assembly from main housing.

NOTE

Use steps 1 through 3 to remove second trumpet assembly.

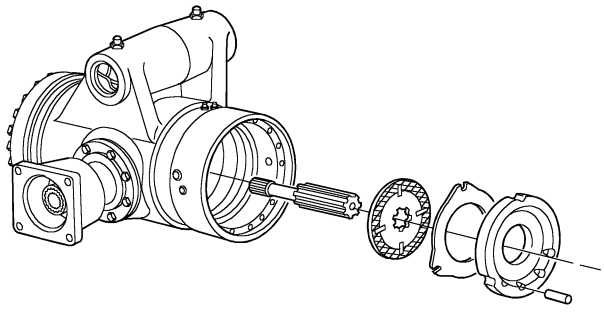
4. Remove ring gears from both sides through the two threaded puller holes. (Thread: M14 x 1.5 x 6 g).

⚠ *WARNING*

Do not hit steel parts with a steel hammer during removal and disassembly procedures. Parts can break and cause serious personal injury.

5. From main housing, remove sun axle shaft, spacers (if used), compression plates, stationary discs, friction discs, lock pins and expansive plate assemblies. To make lock pin removal easier, hit main housing with brass hammer. **Figure 2.4.**

Figure 2.4



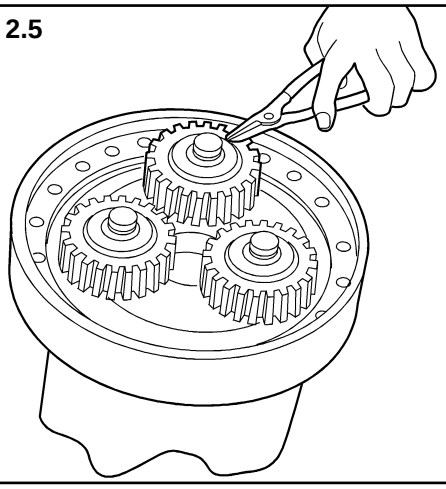
Disassemble Planetary System and Axle Shaft

NOTE

Before removing planetary gears, place housing in horizontal position or place cloth between pinion gear flange and housing flange to keep rollers from falling down into housing. To avoid mixing them, be sure to put rollers and spacers of each planetary gear in separate plastic bags.

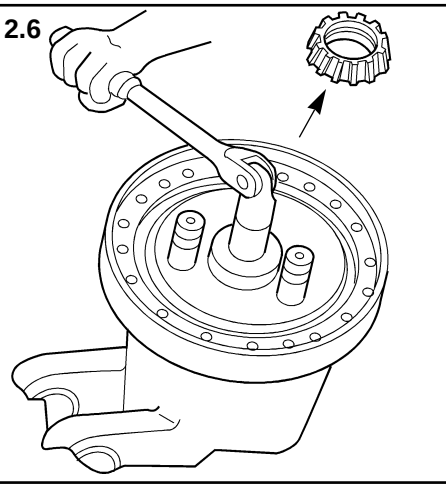
1. With pliers, remove snap rings. Disassemble planetary gears and rollers. **Figure 2.5.**

Figure 2.5



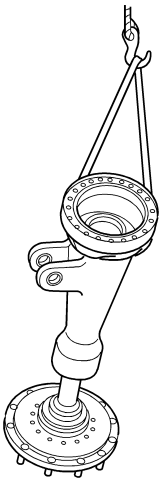
2. Remove axle shaft adjusting nut lock.
3. Remove axle shaft adjusting nut lock with special tool, illustrated in Section 6. **Figure 2.6.**

Figure 2.6



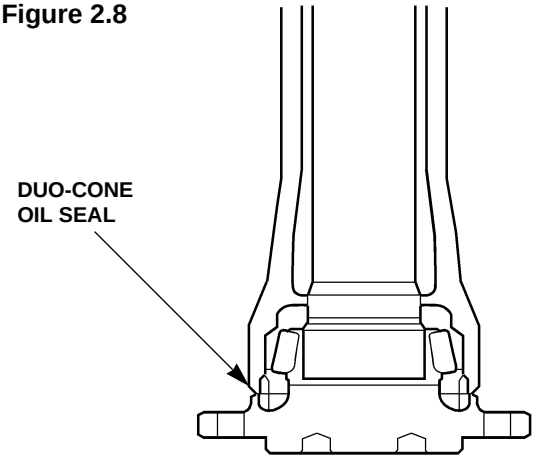
4. Remove pinion gear flange. Lift it through planetary gear pins.
5. Remove axle shaft assembly and cone bearing. If necessary, use press. **Figure 2.7.**

Figure 2.7



6. If necessary to change bearing cups, remove them with correct puller.
7. If necessary to replace DUO-CONE oil seal or axle shaft roller bearing cone, use correct puller. **Figure 2.8.**

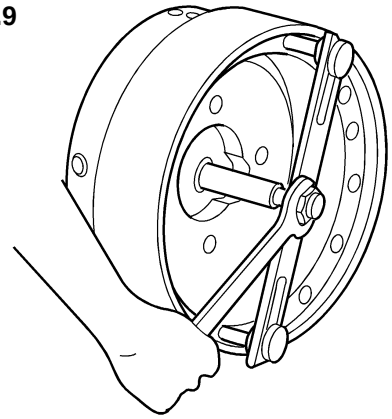
Figure 2.8



Disassemble Hydraulic Apply Wet Disc Brake

1. Remove piston return spring capscrews.
2. Remove return springs.
3. Remove brake piston assembly. **Figure 2.9.**

Figure 2.9

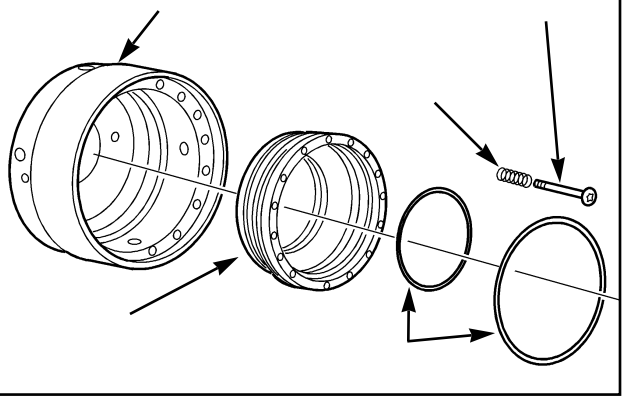


CAUTION

Ground oil seal surfaces must be properly protected to avoid damage. Whenever necessary, use No. 600 sandpaper to correct any damage.

4. If necessary, replace brake piston oil seals. **Figure 2.10.**

Figure 2.10



5. Follow steps 1 through 4 to disassemble the second brake piston.

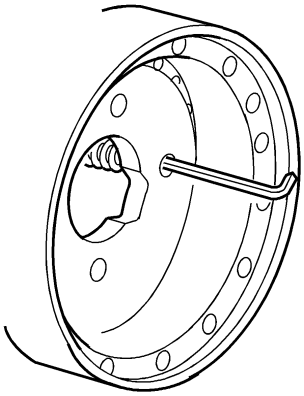
Disassemble Three Function Wet Disc Brake

NOTE

Do not disassemble brake piston unless necessary.

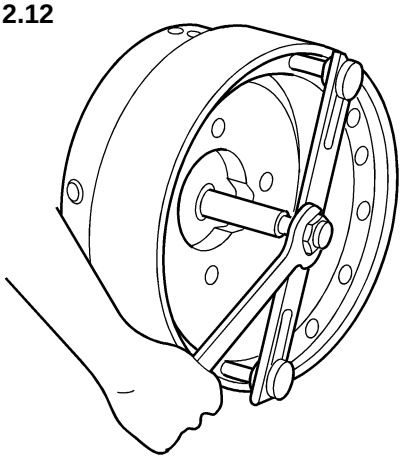
1. Remove return spring capscrews with 4 mm Allen wrench. Remove return springs and washers. **Figure 2.11.**

Figure 2.11



2. Remove brake piston assembly from brake housing as shown in **Figure 2.12** or place brake housing on a bench with the opening turned down. Inject 80 psi (5.5 bar) compressed air through inlet of service brake to eject brake piston.
3. Remove shims.

Figure 2.12



⚠ *WARNING*

- ***Use a special tool or press to compress the brake assembly to avoid serious personal injury from the spring pressure.***
- ***Observe all WARNINGS and CAUTIONS provided by the press manufacturer concerning press operation to avoid serious personal injury and damage to components.***

4. Compress brake piston assembly as shown in **Figure 2.13**; or place assembly in press and apply 1000 lbs. (450 kg) pressure.
5. Remove action plate capscrews. **Figures 2.13 and 2.14.**

Figure 2.13

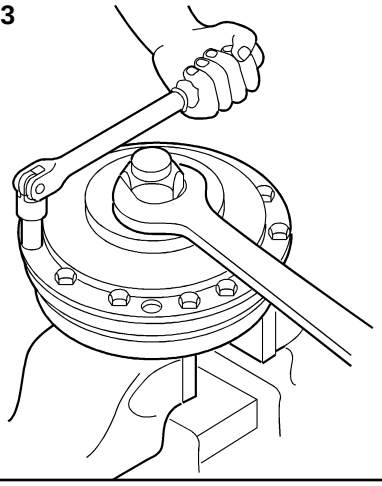
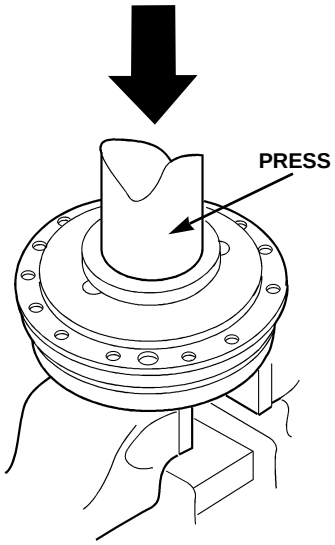


Figure 2.14

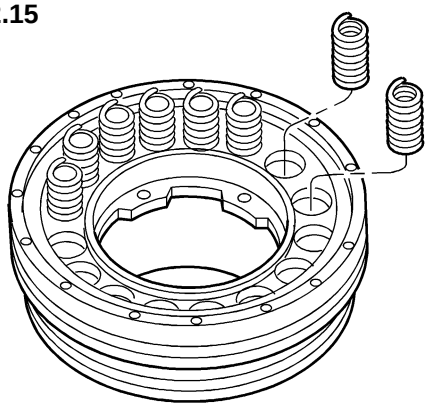


⚠ *CAUTION*

Before removing action plate and other parts, mark the original assembly positions of all brake piston assembly parts. This procedure will make reassembly easier.

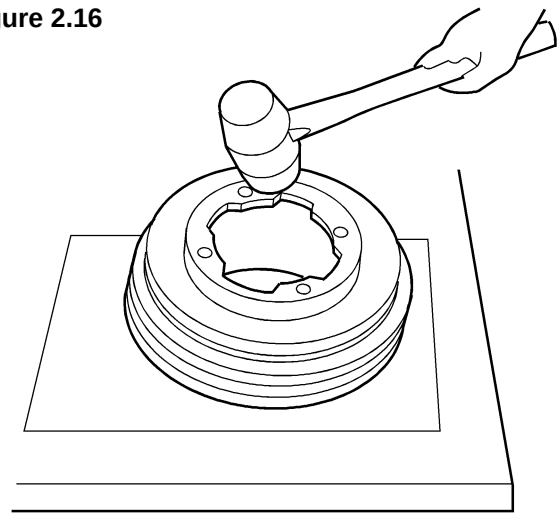
6. Remove action plate and springs. **Figure 2.15.**

Figure 2.15



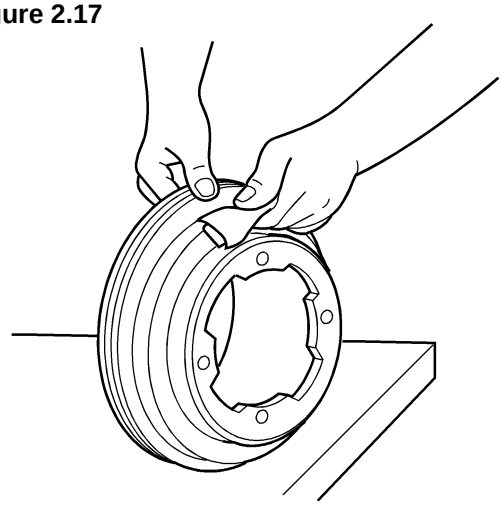
7. Remove internal piston by placing brake piston assembly on bench with action plate support surface turned down. Tap internal piston with rubber mallet. **Figure 2.16.**

Figure 2.16



8. Use sand paper on piston surfaces if they have nicks or hits. **Figure 2.17.**

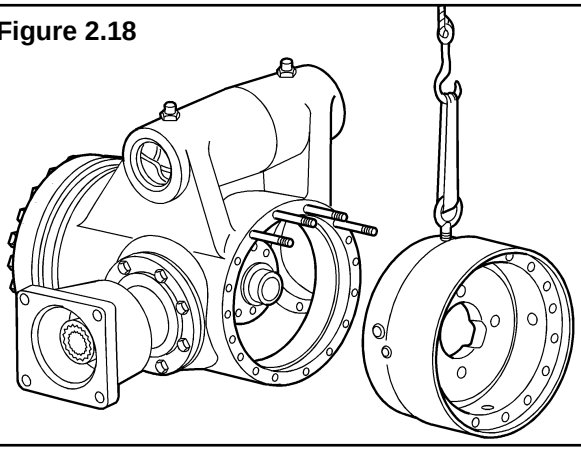
Figure 2.17



Disassemble Main Housing

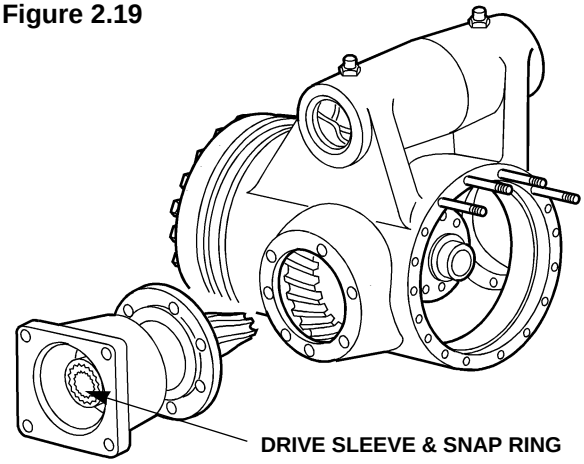
1. Remove adjusting nut capscrew lock.
2. Remove adjusting nut capscrew and adjusting nut.
3. Remove brake housing capscrews that are set deep in brake housing flange. Use long 6mm Allen wrench.
4. Remove brake housing from main housing. Hit brake housing with brass hammer or use two slots to remove it from main housing. Be careful not to hit ring gear. **Figure 2.18.**

Figure 2.18



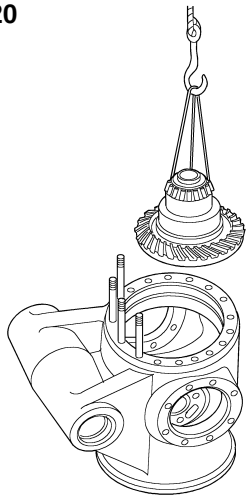
5. Depending on ring gear position, remove pinion bearing cage capscrews.
6. Remove pinion bearing cage assembly from main housing. **Figure 2.19.**
7. Remove drive sleeve and snap ring. **Figure 2.19.**

Figure 2.19



8. Remove differential case assembly. **Figure 2.20.**

Figure 2.20

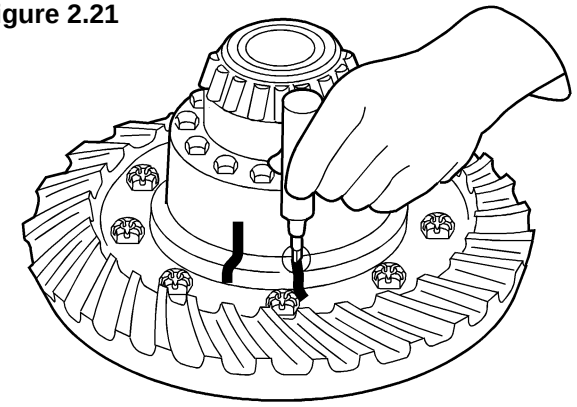


9. Remove main housing cover.

Disassemble Differential Case

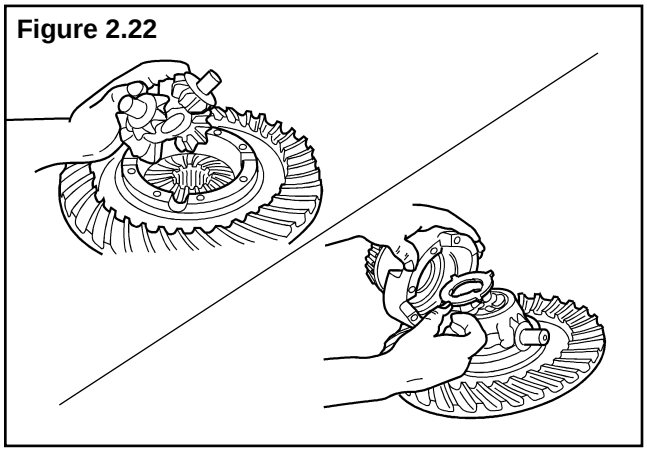
1. Before disassembling differential case, mark position of both halves and spider cross for easier reassembly. **Figure 2.21.**

Figure 2.21



2. Remove differential case capscrews.
3. Separate differential case halves. If necessary use a brass or rubber hammer to separate halves.
4. Remove spider cross, differential pinions, side gears and washers. If differential case is "Limited Slip," remove friction disc pack. **Figure 2.22.**

Figure 2.22



5. If differential case is "integral," remove differential pinion axle lock capscrew and differential pinion axle. Then turn side gears and remove differential pinions, side gears and washers. **Figures 2.23, 2.24 and 2.25.**

Figure 2.23

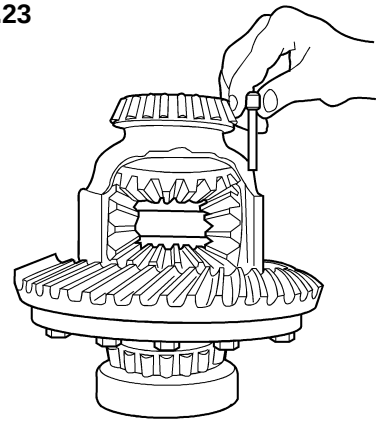


Figure 2.24

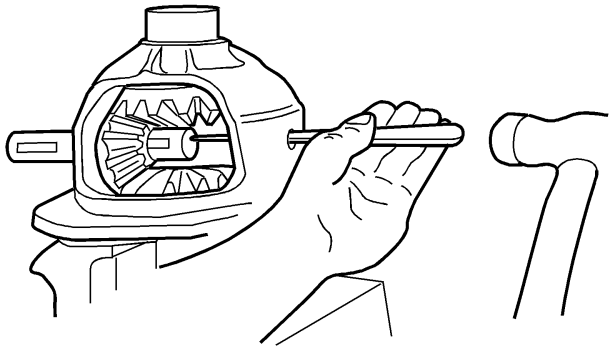
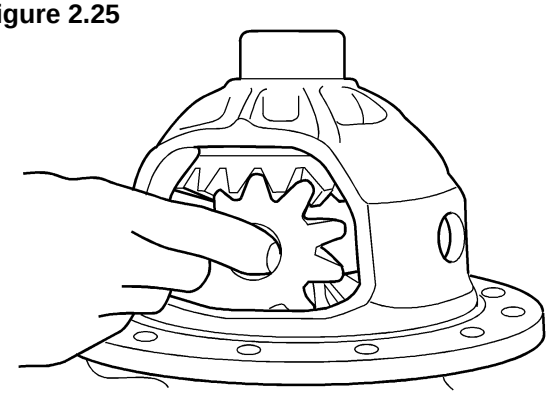


Figure 2.25



6. If necessary, separate ring gear from differential case. Remove capscrews and washers that fasten ring gear. With brass hammer, tap ring gear to separate it from differential case. **Figures 2.26 and 2.27.**

Figure 2.26

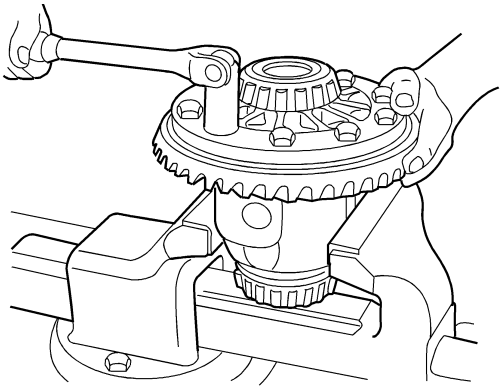
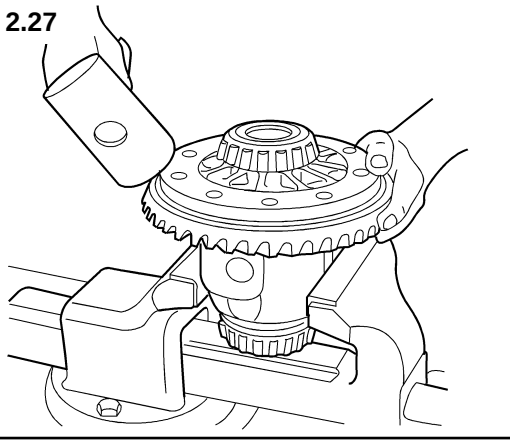


Figure 2.27

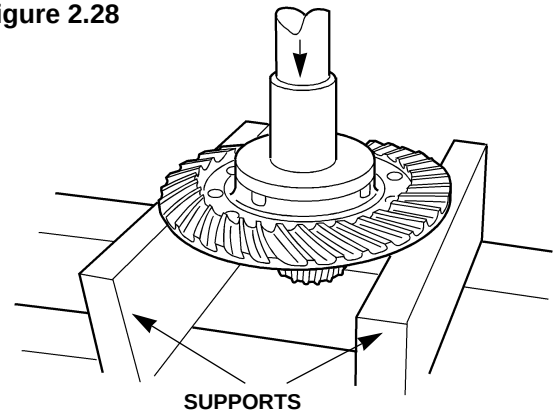


WARNING

Observe all WARNINGS and CAUTIONS provided by the press manufacturer concerning press operation to avoid serious personal injury and possible damage to components during removal and disassembly procedures.

7. If differential case has two halves, remove ring gear with a press after capscrews have been removed **(Figure 2.26)**. Use appropriate metal or wood supports. **Figure 2.28.**

Figure 2.28



8. If necessary, remove cone bearings from differential case. Use appropriate puller or press. **Figures 2.29, 2.30 and 2.31.**

Figure 2.29

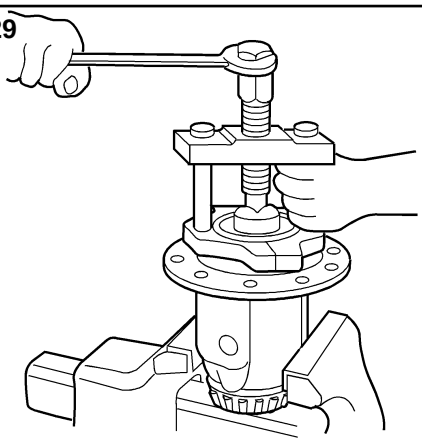


Figure 2.30

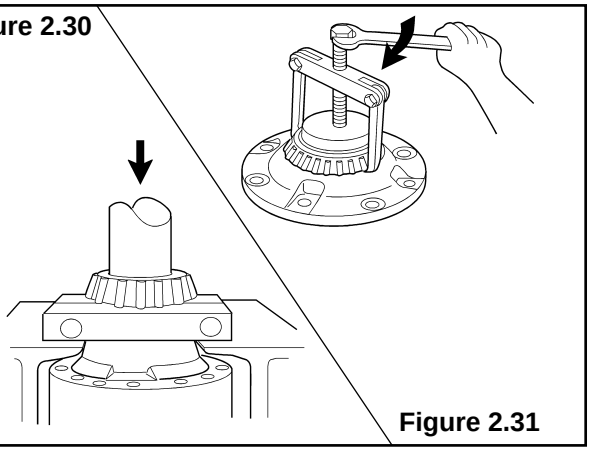


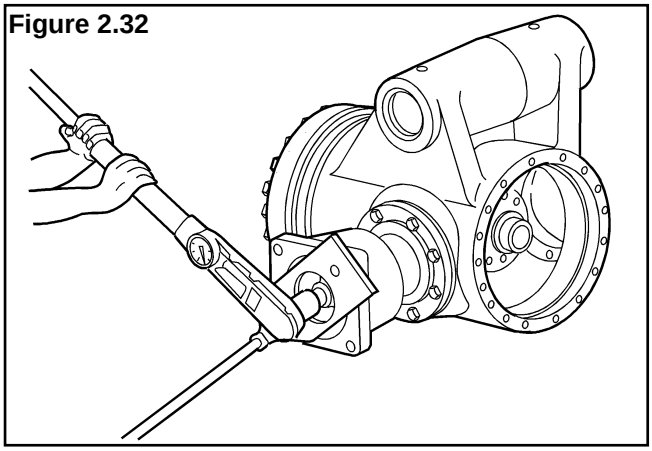
Figure 2.31

Disassemble Pinion Bearing Cage

1. If pinion bearing cage was not removed, hold yoke, flange or splined sleeve with appropriate holder to remove pinion nut. **Figure 2.32**

   If pinion bearing cage was already removed, place it on main housing and fasten with two capscrews.

Figure 2.32

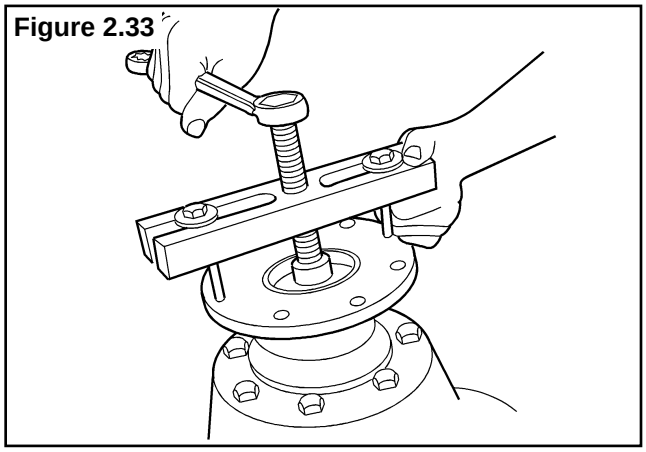


CAUTION

Do not use a hammer or mallet to loosen or remove yoke, flange or splined sleeve. The hammer or mallet can damage the parts or cause alignment problems. Do not damage the oil seal surface area.

2. Remove yoke, flange or splined sleeve from drive pinion with appropriate puller tool. **Figure 2.33.**

Figure 2.33

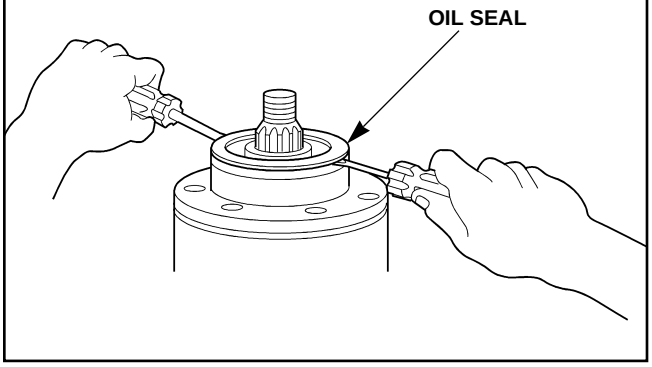


CAUTION

To avoid oil leaks, be careful not to damage the mounting surface of the bearing cage.

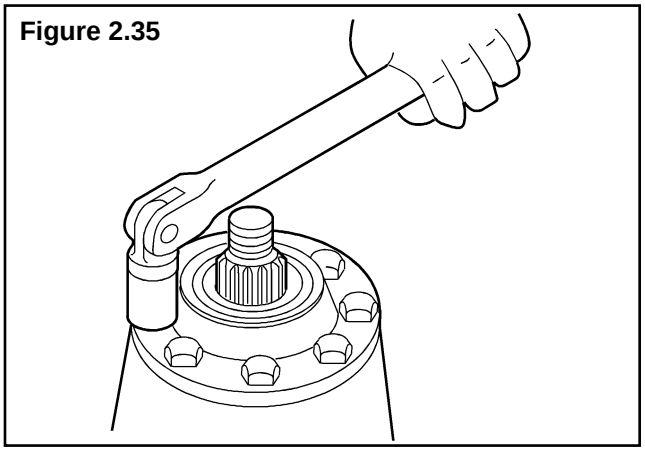
3. Remove pinion oil seal. Pry at several points around circumference between seal, flange and bearing cage. **Figure 2.34.**

Figure 2.34



4. Remove capscrews and washers that fasten pinion bearing cage on main housing. **Figure 2.35.**

Figure 2.35

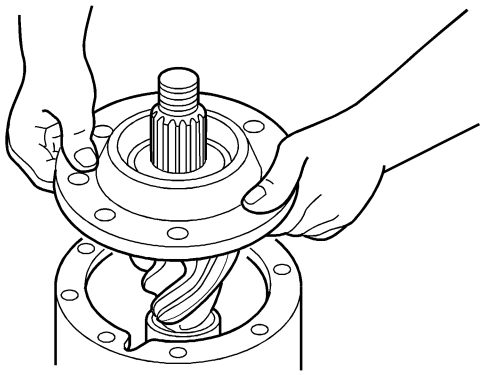


⚠ CAUTION

Do not use pry bar to remove bearing cage from carrier. A pry bar can damage bearing cage, shims and main housing.

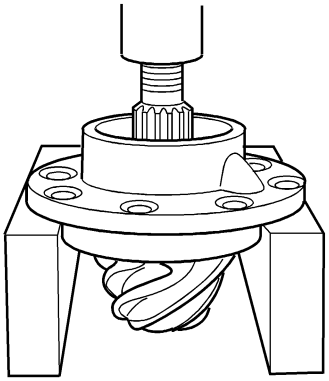
5. Remove pinion bearing cage and shims from main housing. If bearing cage is tight within the main housing, hit bearing cage at several points around flange area with leather, plastic or rubber mallet. **Figure 2.36.**

Figure 2.36



6. If shims are in good condition, keep them together for use later when main housing is reassembled.
7. Before damaged shims are discarded, measure and record total thickness of the pack. The dimension will be needed to calculate depth of drive pinion in main housing when gear set is installed.
8. Place drive pinion and bearing cage in press with pinion shaft toward top assembly. Support bearing cage under flange area with metal or wood blocks. Press drive pinion through bearing cage. **Figure 2.37.**

Figure 2.37



NOTE

The inner bearing cone and bearing spacer will remain on the pinion shaft.

9. If pinion bearing needs to be replaced, remove inner and outer bearing cups from inside of cage. Use a press and sleeve, bearing puller or small drift and hammer. **Figures 2.38 and 2.39.**

Figure 2.38

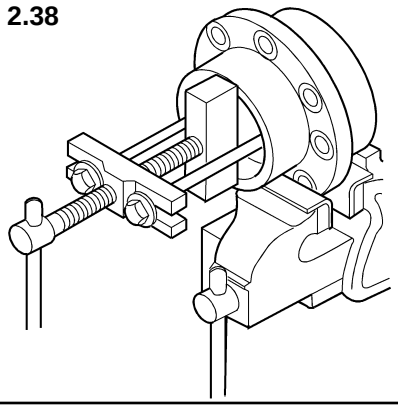
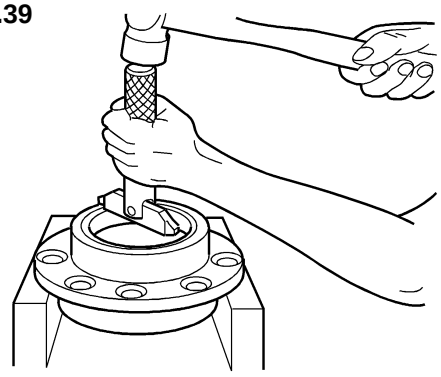
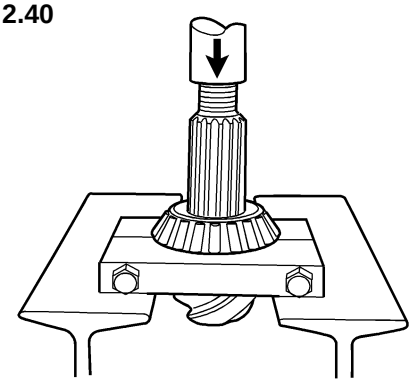


Figure 2.39



10. If pinion bearings need to be replaced, remove inner bearing cone from drive pinion with press or bearing puller. Puller must fit under inner face of cone to remove cone correctly without damage. **Figure 2.40.**

Figure 2.40



NOTE

If bearing cup is changed, the bearing cone must also be replaced. The cup and cone must come from the same manufacturer.

Clean Ground and Polished Parts

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

WARNING

If you use cleaning solvents, hot solution tanks or alkaline solutions incorrectly, serious personal injury can occur. To prevent serious personal injury, follow the instructions supplied by the manufacturer of these products. Do not use gasoline to clean parts. Gasoline can explode and cause serious personal injury.

- Use a cleaning solvent to clean ground or polished parts or surfaces. Kerosene or diesel fuel oil can be used for this purpose. NEVER USE GASOLINE.
- Remove gasket material from parts. Be careful not to damage ground surfaces.
- DO NOT clean ground or polished parts in a hot solution tank, water, steam or alkaline solution.

Clean Parts With Rough Finish

- Parts with a rough finish can be cleaned with cleaning solvent or in a hot solution tank with a weak alkaline solution.
- Parts must remain in hot solution tanks until completely cleaned and heated.
- Parts must be washed with water until the alkaline solution is removed.

Clean Axle Assemblies

- A complete axle assembly can be steam cleaned on the outside to remove dirt.
- Before the axle is steam cleaned, close or put a cover over all openings in the axle assembly. Examples of openings are breathers and hydraulic inlets.

Dry Cleaned Parts

- Dry the parts immediately after cleaning and washing.
- Dry the parts with soft clean paper or rags.

CAUTION

Damage to bearings can be caused if dried by rotating with compressed air.

- Except for bearings, parts can be dried with compressed air.

Prevent Corrosion

- Apply axle lubricant to cleaned and dried parts that are not damaged and are to be assembled.
- Apply a special material that prevents corrosion to all surfaces. If parts are to be stored, wrap the parts in special paper that prevents rust and corrosion.

Inspect Parts

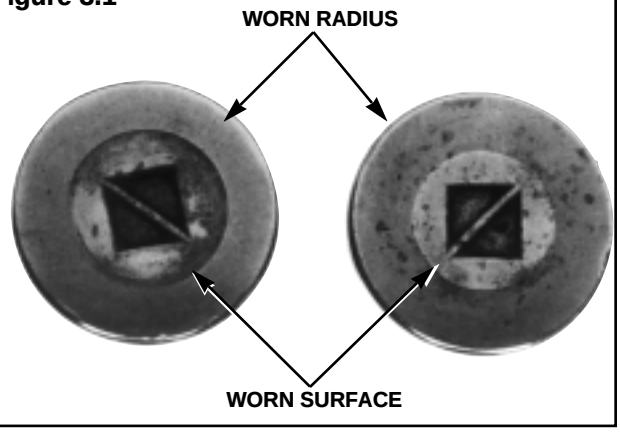
It is very important to inspect all parts carefully and completely before the axle or carrier is assembled. Check all parts for wear and replace damaged parts. Replacement of damaged or worn parts will prevent breakdown of assembly later.

Inspect Tapered Roller Bearings

Inspect the cup, cone, rollers and cage of all tapered roller bearings in the assembly. If any of the following conditions exist, the bearing must be replaced:

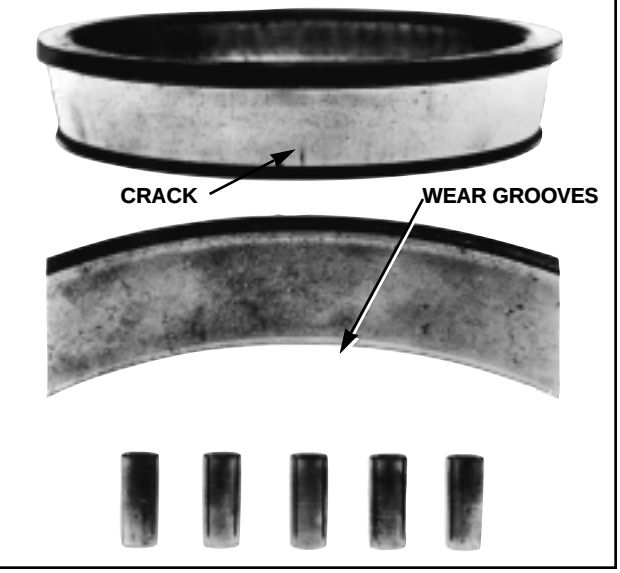
- The center of the large diameter end of the rollers are worn level with, or below the surface.
- The center of the large diameter end of the rollers are worn to a sharp edge. **Figure 3.1.**

Figure 3.1



- A visible roller groove in the cup or cone inner race surfaces. The groove can be seen at the small or large diameter end of both parts. **Figure 3.2.**

Figure 3.2

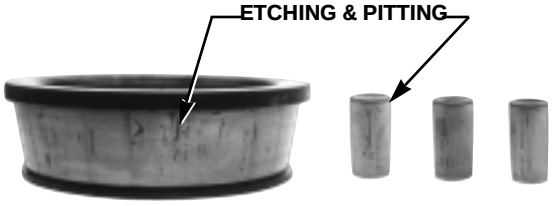


- Deep cracks or breaks in the cup, cone inner race or roller surfaces.
- Bright wear marks on the outer surface of the roller cage. **Figure 3.3.**

Figure 3.3

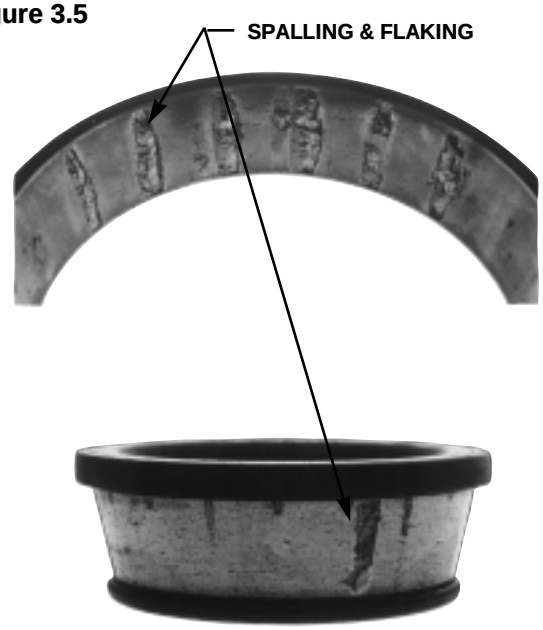
- Damage on rollers and on surfaces of the cup and cone inner race that touch the rollers. **Figure 3.4.**

Figure 3.4



- Damage on the cup and cone inner race surfaces that touch the rollers.**Figure 3.5.**

Figure 3.5



Inspect Hypoid Pinion and Ring Gear Sets

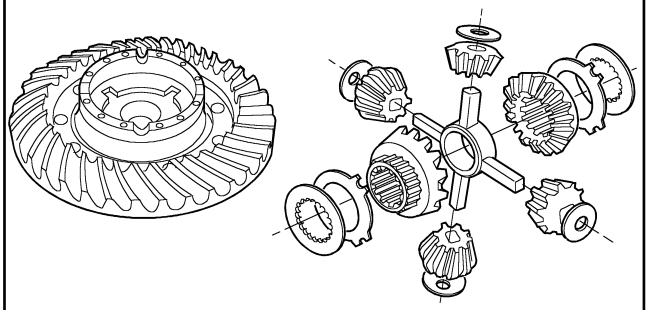
CAUTION

- ***Hypoid drive pinions and ring gears are machined in matched sets. When a drive pinion or ring gear of a hypoid set needs to be replaced, both drive gear and pinion must be replaced at the same time.***
- ***Inspect hypoid pinions and gears for wear and damage. Gears that are worn or damaged must be replaced. Also verify the cone bearing seats and spline in the pinion shaft.***

Inspect Main Differential Assembly

Parts that are damaged must be replaced. Inspect the following parts for wear or stress. **Figure 3.6.**

Figure 3.6



- Inside surfaces of both case halves
- Both surfaces of all thrust washers
- Four trunnion ends of spider cross
- Teeth and splines of both side gears
- Teeth and bore of all differential pinions
- Friction disc packs if used

CAUTION

Always replace old or worn thrust washers, differential side gears and pinion gears in sets to avoid higher stress and early damage to parts.

Inspect Axle Shafts

- For wear and cracks at flange, shaft and splines. Replace axle shaft if required.

Inspect Main Housing

- For fractures and burrs in machined areas.

Inspect Yoke

- For wear at seal journal area. Replace yoke, flange or sleeve if either shows too much wear at seal journal area.

Inspect Planetary System Parts

- For existence of cracks, pitting, breaks or sharp edges on planetary gear teeth, planetary gear axles and rollers.

Inspect Brakes

- For condition of friction discs, brake piston springs and internal brake housing surfaces.

Repair or Replace Parts

General Information

Replace worn or damaged parts of an axle assembly. The following are some examples to check for repair and possible replacement:

- Replace any fastener if corners of the head are worn.
- Replace washers if damaged.
- Replace gaskets, oil seals or grease seals at the time of axle repair.
- Clean parts and apply new liquid gasket material where required when axle is assembled.
- Remove nicks, marks and burrs from parts having machined or ground surfaces. Use a fine file, India stone, emery cloth or crocus cloth for this purpose.
- Clean and repair threads of fasteners and holes. Use a die or tap of the correct size or a fine file for this purpose.

CAUTION

Threads must be without damage and clean so that accurate adjustment and correct torque values can be applied to fasteners and parts.

- Tighten all fasteners to correct torque values. See chart in Section 6 for fastener torque values.

WARNING

Do not repair axle housings by bending or straightening. Repair of axle housings by bending or straightening can cause poor performance and possible unsafe operation of the axle. This can cause serious personal injury.

Repair Welding

In the interest of safety and preserving the service life of drive axle assemblies, Meritor recommends that assemblies are not repair welded. Repair welding can detract from the structural integrity of a component, particularly to heat treated parts where the benefit of heat treatment may be nullified by welding.

Since it can be extremely hazardous and detrimental to repair weld components of any kind, repair welding can be approved only where stringent controls are imposed and equipment, customarily located at manufacturing facilities, is employed, so as to minimize the potentially detrimental effects of repair welding.

Liquid Adhesive

Meritor uses the following liquid adhesives to retain threaded fasteners:

Product	Type	Color	Cure Time
Loctite	271 High	Red	2 hours
	241 Medium	Blue	6 hours
	221 Low	Violet	6 hours
Three Bond			
	1305 High	Red	5 hours
	1334 Medium	Green	5 hours
	1341 Low	Blue	10 hours

Disassemble Locked Sets

CAUTION

Do not use impact wrenches or strike components with a hammer.

To disassemble sets originally locked with liquid adhesive, use the regular mechanical disassembly procedure.

If the removal of a capscrew, for example, becomes difficult due to a worn head or unusually high breakaway torque, the locking strength can be reduced by heating the threaded area to approximately 300°F (150°C). Heat slowly to avoid thermal stresses on the differential case and gears.

Cleaning

WARNING

To avoid serious personal injury, trichloroethylene must not come in contact with your skin. Do not smoke and avoid breathing vapors in closed rooms without ventilation. Do not use trichloroethylene near flames, welding operations or hot surfaces exceeding 900°F (482°C).

Clean capscrew, nut or bolt tapped hole and fastener thread carefully. Use a cleaning solvent such as trichloroethylene or equivalent to remove dirt, oil, grease or moisture.

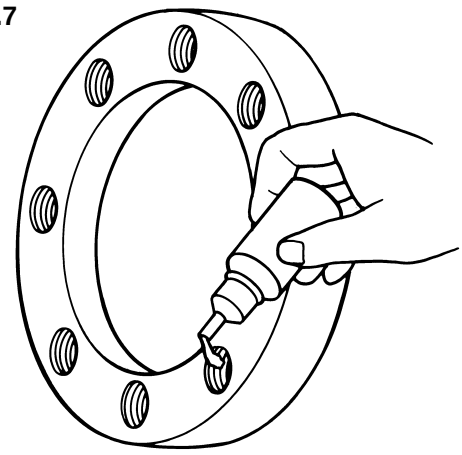
Reassembly

- Check the type of liquid adhesive to be used and where the adhesive is to be applied.
- In threaded holes where fasteners did not require removal, check each one for tightness by applying the minimum amount of specified torque.
- If fasteners do not rotate, they are tightened properly.
- If fasteners rotate to any degree, they must be removed and liquid adhesive must be applied.

Application

1. Apply liquid adhesive to:
   - Bolt threads when component has open hole. Before installing bolts, visually check to make sure that liquid adhesive has filled gap between threads.
   - Threaded hole when component has blind hole. Allow 4 to 6 drops to run down side of each hole. If liquid adhesive is applied to bolt, trapped air in hole will create back pressure and “blow out” liquid adhesive as bolt advances. **Figure 3.7.**

Figure 3.7



2. Tighten fasteners with recommended torque. (T)

Apply Silicone Gasket Material

Liquid gasket material used by Meritor:

- Loctite FAG 3
- Neutral Silicon, Dow Corning 768 or Rhodia 567/666
- Three Bond 1134
- Loctite 515

WARNING

Small amounts of acid vapor are present when applying some gasket materials. To prevent possible serious personal injury, make sure there is good ventilation in the work area. If liquid gasket material gets in your eyes, flush eyes with water for 15 minutes. Have eyes checked by doctor.

CAUTION

The amount of liquid gasket material applied must not exceed 0.125 in. (3.18 mm) diameter bead. Too much gasket material can block lubrication passages and result in damage to component.

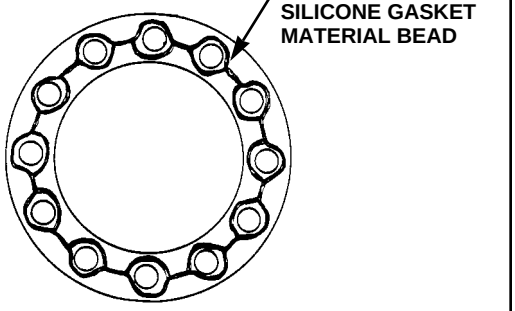
1. Remove all old gasket material from both surfaces.
2. Clean the surfaces where liquid gasket material will be applied. Remove all oil, grease, dirt and moisture.
3. Thoroughly dry both surfaces.
4. Apply according to the following procedures:

- **Three Bond 1134 or Loctite 515:** Apply approximately a 0.125 inch (3.18 mm) diameter continuous bead of liquid gasket material around one surface.
- **Loctite FAG 3:** Apply to one surface with a paint brush.

  Also apply all gasket material around edge of all fastener holes on that surface. **Figure 3.8.**

5. Assemble components quickly to permit gasket material to compress evenly between parts.

Figure 3.8



6. Tighten fasteners with required torque. See Torque Chart, Section 6. T

DUO-CONE Oil Seal: Mount and Install

NOTE

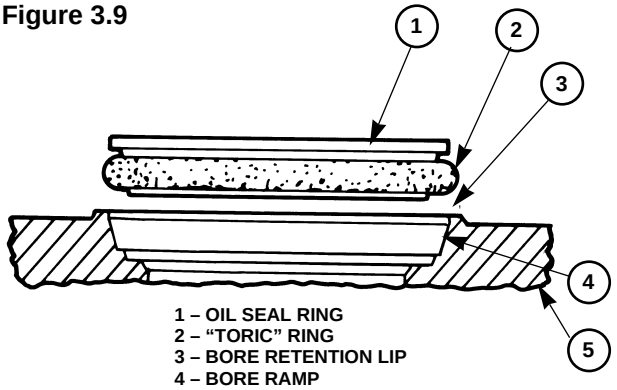
- ***Always follow correct procedures when mounting and installing DUO-CONE oil seals. Many DUO-CONE oil seal leaks result from errors made during mounting or installation of oil seal components.***
- ***Never let oil touch Toric ring or lodging ramps before both oil seal rings are installed in their mounting position.***

⚠ *WARNING*

To avoid serious personal injury, trichloroethylene must not come in contact with your skin. Do not smoke and avoid breathing vapors in closed rooms without ventilation. Do not use trichloroethylene near flames, welding operations or hot surfaces exceeding 900°F (482°C).

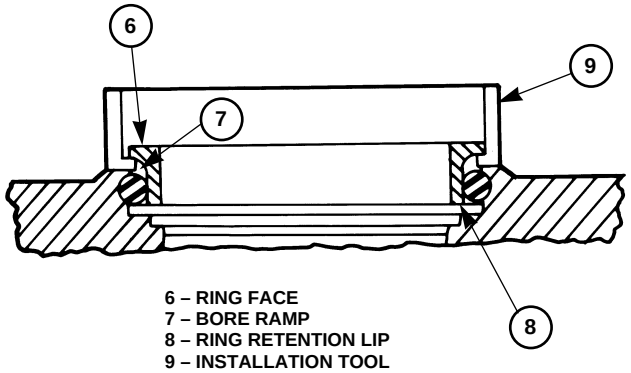
1. Remove any dust, oil or foreign material from Toric ring (2), lodging ramps (4, 7), ring retention lips (3, 8), oil seal ring (1) and ring bore (5). Clean components with trichloroethylene and a clean cotton cloth or a paper towel. **Figures 3.9 and 3.10.**

Figure 3.9



1 – OIL SEAL RING
2 – "TORIC" RING
3 – BORE RETENTION LIP
4 – BORE RAMP
5 – RING BORE

Figure 3.10

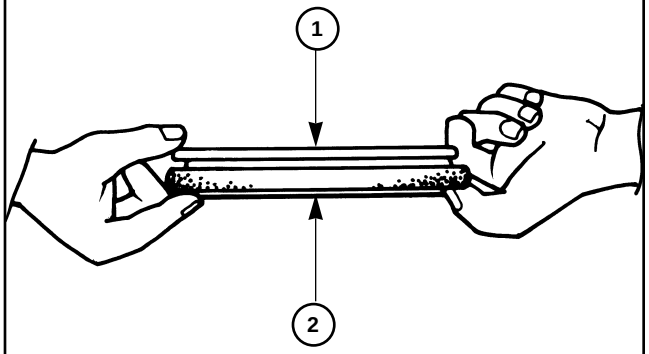


6 – RING FACE
7 – BORE RAMP
8 – RING RETENTION LIP
9 – INSTALLATION TOOL

⚠ *CAUTION*

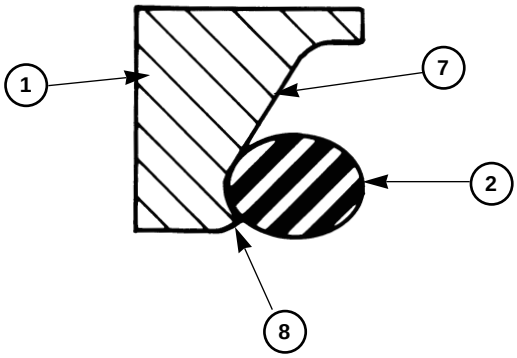
Make sure that Toric ring (2) is seated in oil seal ring (1). Be careful when you work with Toric ring. Cuts and scratches in Toric ring may cause leaks. **Figure 3.11.**

Figure 3.11



2. Place Toric ring (2) in oil seal ring (1) in button of ring ramps (7) and against ring retention lip (8). **Figure 3.12.**

Figure 3.12

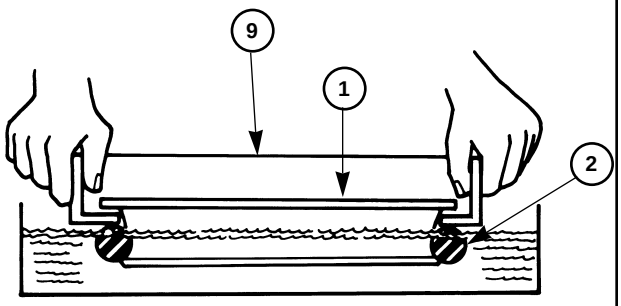


NOTE

Do not use any liquid that leaves a film of oil or does not evaporate quickly.

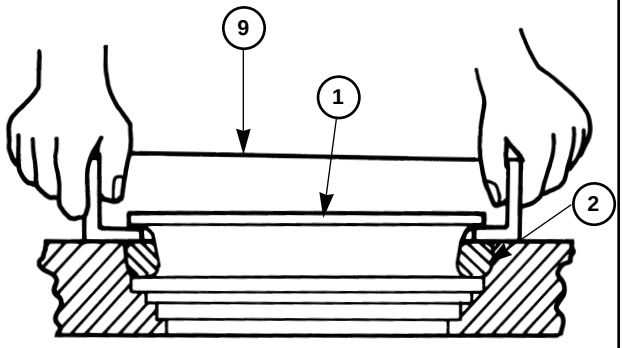
3. Place installation tool (9) under oil seal ring with Toric ring (2). Submerge ring in receptacle filled with trichloroethylene until entire surface of Toric ring is wet. **Figure 3.13.**

Figure 3.13



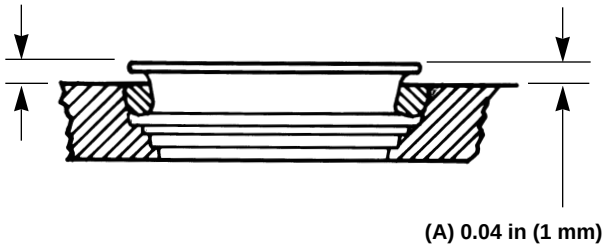
4. With Toric ring surface wet (2), use installation tool (9) to install oil seal ring and Toric ring perpendicular to ring bore. Use a rapid and uniform pressure to push Toric ring under ring retention lip. **Figure 3.14.**

Figure 3.14



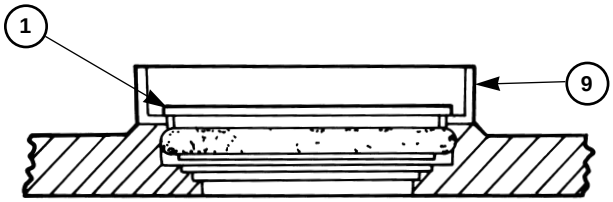
5. Verify mounting distance (A) in at least four places spaced 90 degrees apart. The difference in the mounting distance (A) around ring cannot be more than 0.04 inches (1 mm). **Figure 3.15.**

Figure 3.15



6. If adjustments are necessary, use installation tool (9) to push ring. Do not use your hands. **Figure 3.16.**

Figure 3.16

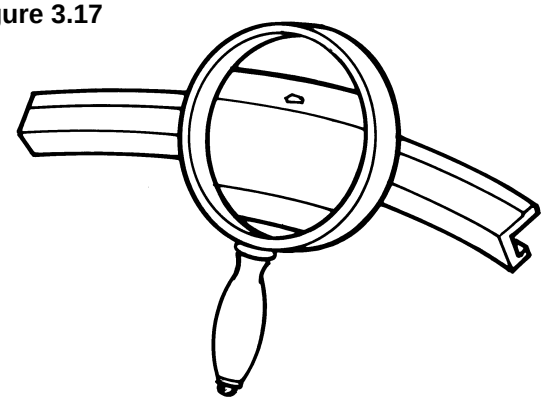


7. Toric ring may become distorted if not entirely wet or if there is a sharp edge on the retention lip and bore.

⚠ CAUTION

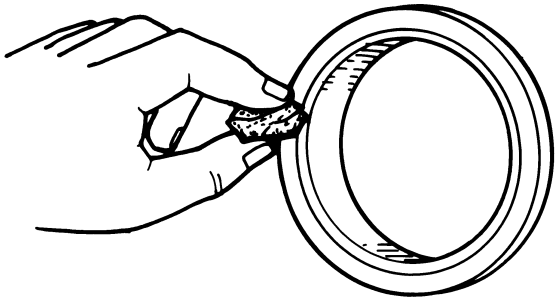
- ***Misalignment or a twisted Toric ring may cause leakage in the DUO-CONE oil seal. If installation was not correct, remove oil seal from bore and repeat steps 3-6.***
- ***A Toric ring must never slide on any ramp of oil seal ring or bore. To prevent sliding, wait at least two minutes for trichloroethylene to evaporate before continuing with installation. When in the correct position, Toric ring must roll only on ramps.***
- ***A small piece of lint can separate the oil seal surfaces and cause leaks.*** **Figure 3.17.**

Figure 3.17



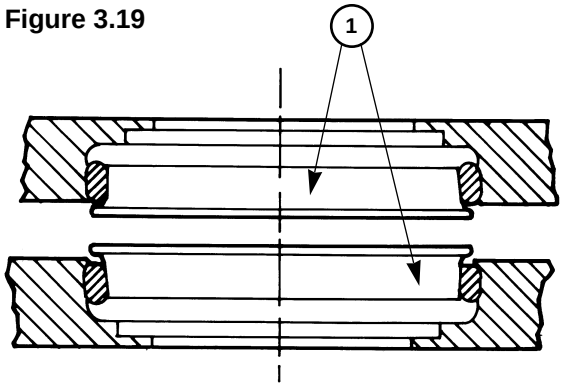
8. Clean oil seal surfaces with lint-free cloth or paper.
9. Apply a thin, uniform film of clean oil on oil seal surfaces with cloth or clean finger. Do not get oil on Toric ring. **Figure 3.18.**

Figure 3.18



10. Make sure both bores are correctly aligned and concentric. Move slowly and carefully. **Figure 3.19.**

Figure 3.19



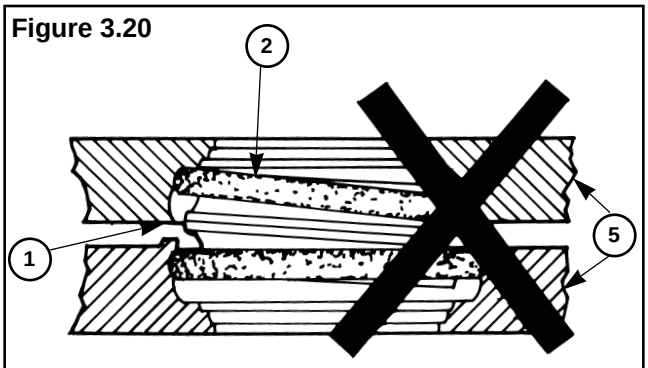
⚠ CAUTION

Do not force rings abruptly against each other. A strong impact may break the oil seal components. When seal is installed properly, fasten all components well.

If DUO-CONE oil seal is installed incorrectly, these conditions can result:

- Toric ring can warp. **Figure 3.20.**

Figure 3.20



- Warped ring can cause irregular pressure on ring surface resulting in oscillating movements of oil seal.
- Different pressures on oil seal surfaces can cause seepage, wear and leaks.
- Oscillating oil seals allow dirt to enter.

Figure 3.21 shows an incorrect installation of an oil seal in its mounting position. The upper bore is stopped and the lower lodge is rotating.

Figure 3.21

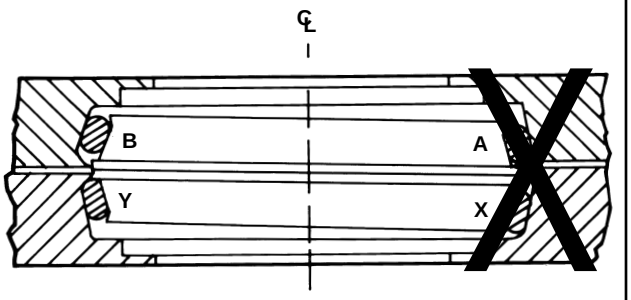
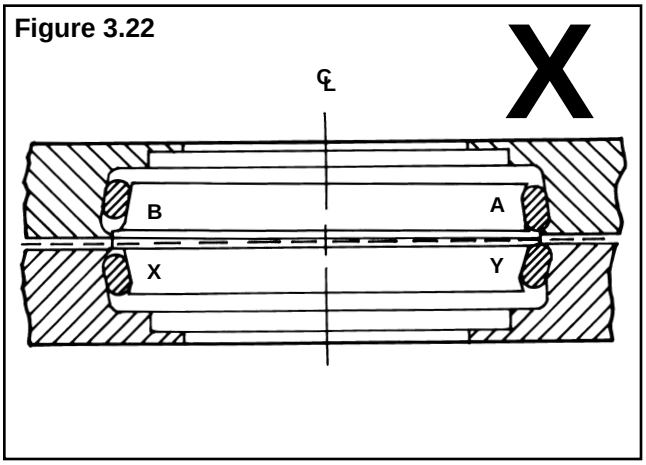


Figure 3.22 shows the same lower bore after rotation of 180 degrees. In this position, high pressure occurs on points “A” and “Y”. This high pressure variation may damage rings. Points “B” and “X” will develop low pressure and possible leakage.

Figure 3.22



Assemble Differential Case

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. Apply specified lubricant on all parts of differential case assembly before installation.

⚠ CAUTION

Never attempt to press a cold ring gear on the flanged half of the differential case. A cold ring gear will damage the case because of the tight fit. The tight fit can cause misalignment or excessive runout and will make final backlash and teeth contact adjustments very difficult.

⚠ WARNING

Wear safe clothing and gloves to protect yourself from serious personal injury when you touch the hot ring gear.

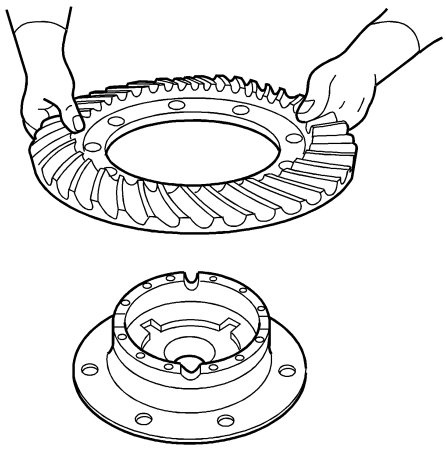
2. Expand ring gear bore by heating ring gear in tank of water heated 160°F to 180°F (71°C to 82°C) for 10 to 15 minutes. DO NOT USE AN OPEN FLAME SUCH AS A TORCH FOR THIS PROCEDURE.
3. Install ring gear on case half or in the integral differential case.

⚠ WARNING

To avoid serious personal injury be careful when using Loctite or Three Bond adhesive during assembly and installation procedures. Follow the manufacturer's instructions for safe use to prevent irritation to eyes and skin. Wash after skin contact. If the Loctite or Three Bond adhesive gets in the eyes, flush the eyes with water for 15 minutes. Have eyes checked by doctor.

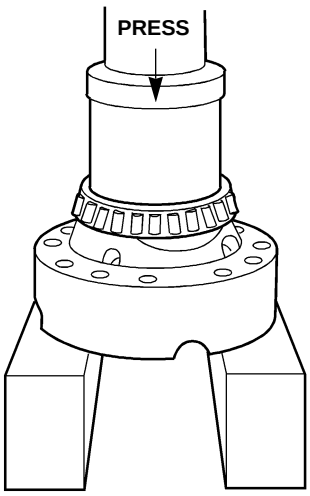
4. Apply Loctite 271 or Three Bond 1305 adhesive to ring gear fasteners. See Section 3, "Liquid Adhesive." Install ring gear fasteners and fasten with the specified torque, 66-75 lb-ft (90-100 N•m). **Figure 4.1.** T

Figure 4.1



5. Assemble new cone bearings in both halves of differential case or in both sides if it is an integral differential case. **Figure 4.2.**
6. Install side gear in flanged case half.

Figure 4.2

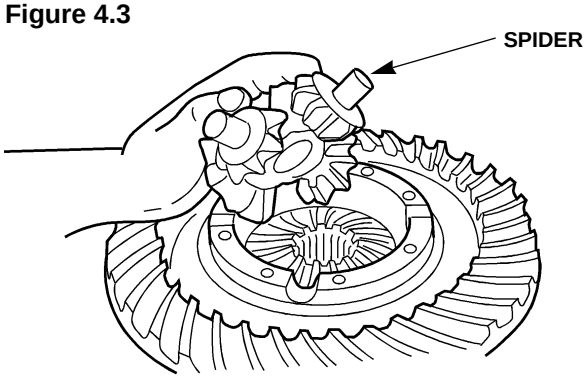


NOTE

For limited slip differential, go to step 12.

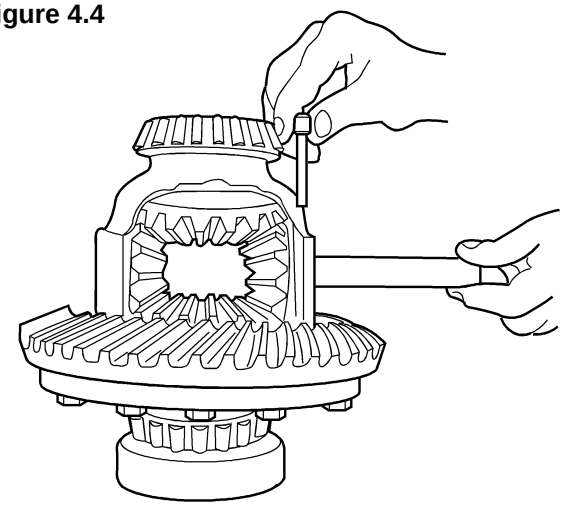
7. Install spider cross, differential pinions and washers on original assembly position. **Figure 4.3.**

Figure 4.3



   a. If you have an integral differential case, install side gears and washers in each original assembly side.
   b. Install differential pinions in the correct position by turning side gears until pinion holes are aligned with differential pinion axle holes. **Figure 4.4.**
   c. Install differential pinion washers.

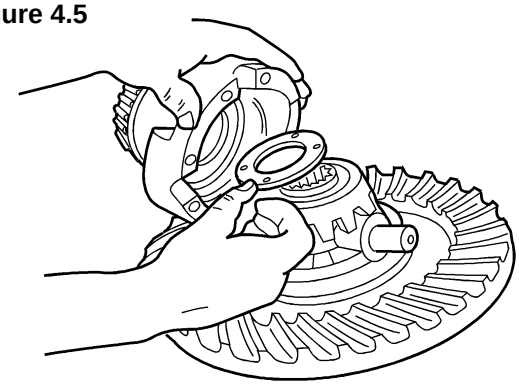
Figure 4.4



   d. Install differential pinion axle and lock capscrew. Fasten capscrew to specified torque 17-23 lb-ft (23-31 N•m).

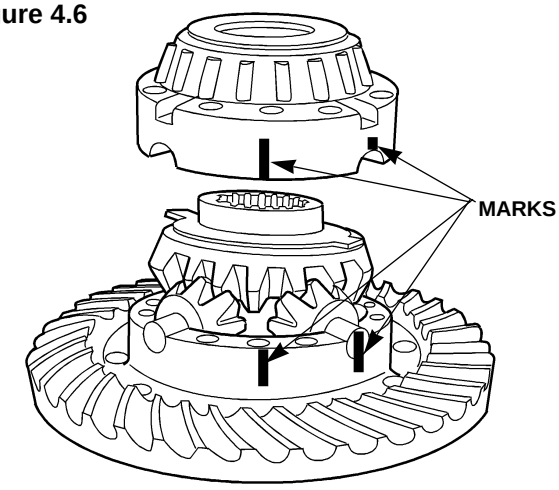
8. Install other side gear over spider and differential pinions. **Figure 4.5.**

Figure 4.5



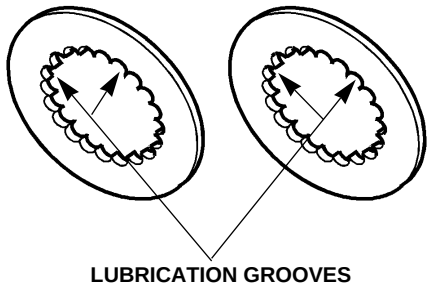
9. Place plain half of differential over flanged half. Rotate plain half as needed to align match marks. **Figure 4.6.**

Figure 4.6



10. Apply Loctite 271 or Three Bond 1305 liquid adhesive to capscrews. Install four capscrews into case halves equally spaced and tighten to 48-64 lb-ft (64-87 N•m). T
11. Install other capscrews into case halves. Tighten the capscrews to 48-64 lb-ft (64-87 N•m). T
12. Assemble Limited Slip Differential Case.
    a. Follow steps 1 to 5.
    b. Place flanged case half on bench.
    c. Begin stacking of the disc pack with a drive disc followed by driven friction discs. Make sure lubrication grooves are aligned. **Figure 4.7.**

Figure 4.7



Maintain the following sequence:

1) Drive disc
2) Driven friction disc
3) Drive disc
4) Driven friction disc
5) Drive disc
6) Driven friction disc
7) Drive disc
8) Shims (Do not stack until measurements are complete.)
9) Compression disc
10) Thrust washer (on side gear side)

    d. Place disc pack stack in vise. Use micrometer to determine “D”, the height (thickness) of limited slip disc stack (includes thrust washer and compression disc). Take four readings, one at each of four points. Average readings to determine “D”. **Figures 4.8 and 4.9.**

Figure 4.8

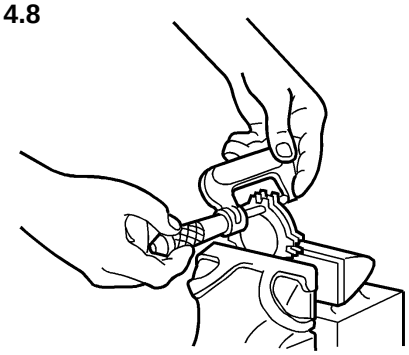
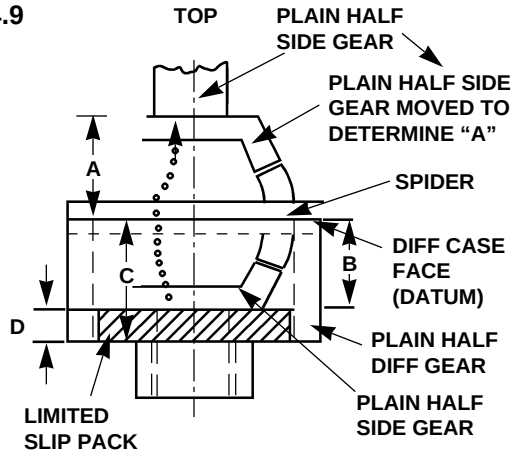


Figure 4.9



A: Differential case half flange to back of differential side gear distance.

B: Differential case face to side gear seat.

C: Differential case half depth.

D: Stack height (thickness).

    e. Use depth gauge to determine “C”, depth of differential case half. Take four readings. Average readings for result. **Figure 4.9.**

f. Place removed plain half side gear on top as shown in **Figure 4.10.** Use depth gauge to determine “A”, distance from differential case half flange to backside of differential side gear. Take four readings. Average readings for result. **Figure 4.10.**

g. Determine clearance dimension: B-A=(C-D)-A. Clearance dimension must be greater than 0.05 mm and less than 0.15 mm.

h. Use proper shim thickness to achieve clearance specified in step G.

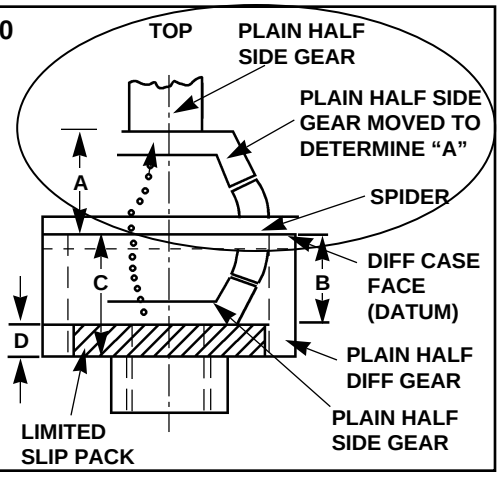
i. Assemble friction discs in differential case using sequence in step C including shims. Make sure discs are lubricated.

j. Drop side gear spline through disc pack.

k. Repeat steps “A” through “I” for the plain differential case half.

l. Follow steps 9 through 11 to assemble differential case.

Figure 4.10

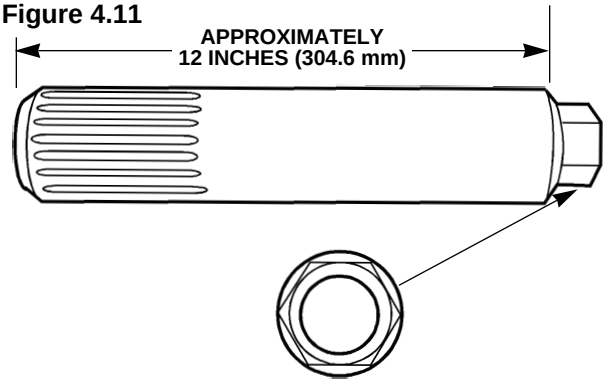


Check Rotating Resistance of Differential Gears (Not Limited Slip)

NOTE

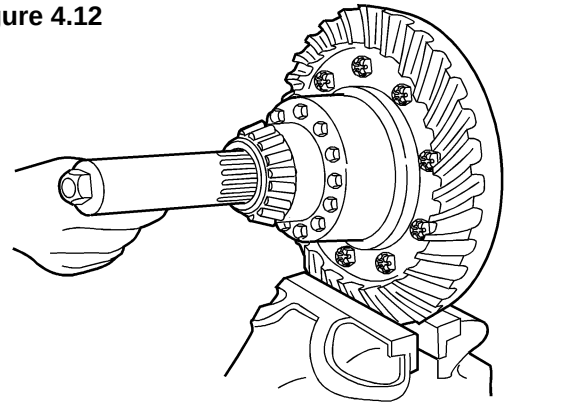
Make tool to check rotating resistance of the differential gears, 50 lb-ft (68 N•m). The tool can be made from a sun gear that matches the spline of the differential side gear. **Figure 4.11.**

Figure 4.11



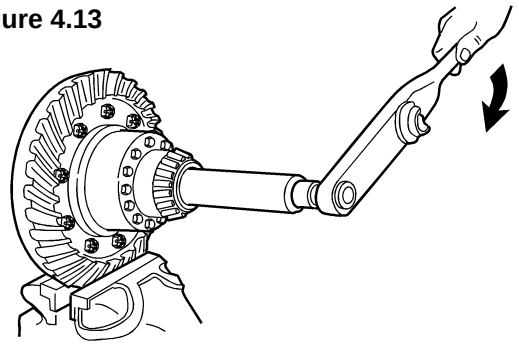
1. Place differential case assembly in a vise with soft metal covers on the vise jaws. Install the tool into differential until splines of tool and one side gear are engaged. **Figure 4.12.**

Figure 4.12



2. Attach torque wrench to the tool nut and rotate differential gears. As differential rotates, read torque value indicated on dial. **Figure 4.13.** T

Figure 4.13



3. If torque value exceeds specification of 50 lb-ft (68 N•m), disassemble gears from differential case. T
4. Check differential case halves, spider, gears and thrust washers for problem that causes excessive torque value. Repair or replace parts.
5. After parts are repaired or replaced, assemble parts and repeat steps 1 to 4.

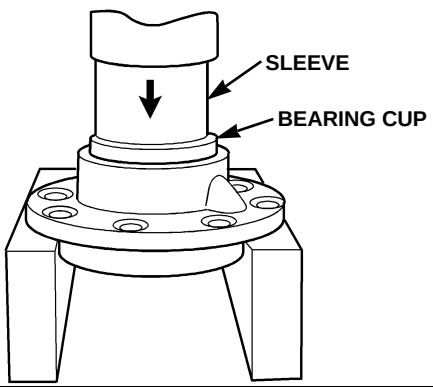
Assemble Drive Pinion and Bearing Cage

⚠ *WARNING*

Observe all WARNINGS and CAUTIONS provided by the press manufacturer concerning press operation to avoid serious personal injury and possible damage to components during assembly and installation procedures.

1. Place bearing cage in press. **Figure 4.14.**

Figure 4.14.



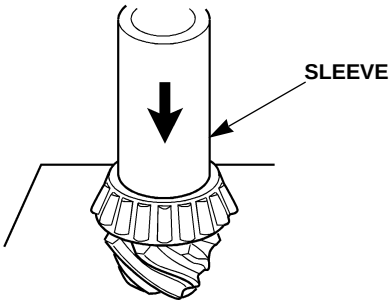
2. Support bearing cage with metal or wood blocks.
3. Press the bearing cup into bore of bearing cage until cup is flat against bottom of bore. Use correct size sleeve to install bearing cup.

NOTE

Use same procedure for both bearing cups.

4. Put drive pinion in press. The gear head (teeth) must face toward the bottom.
5. Press inner bearing cone on shaft of drive pinion until cone is flat against gear head. Use a sleeve of the correct size against bearing inner race. **Figure 4.15.**

Figure 4.15

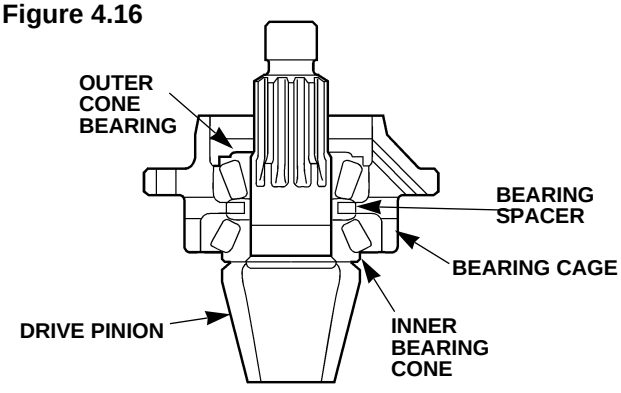


6. Apply axle lubricant on bearing cups in cage and bearing cones.
7. Install drive pinion into bearing cage.
8. Install bearing spacer(s) in pinion shaft against inner bearing cone. **Figure 4.16.**

NOTE

Spacer(s) controls preload adjustment of drive pinion bearings.

Figure 4.16



9. Install outer bearing cone on pinion shaft against spacer. **Figure 4.16.**

NOTE

Do not install pinion oil seal in bearing cage before bearing preload adjustment. Continue adjusting preload of pinion bearings.

10. Press outer cone bearing with 10 ton force and check preload of bearings. **Figure 4.16.**

Adjust Pinion Bearing Preload (Without Press)

NOTE

- ***If the preload value is below the specified range, install a thinner bearing spacer.***
- ***If the preload value is over the specified range, install a thicker bearing spacer.***

Calculation Example:

Data:
Radius: 9.3 cm (3.65 in)
Load: 2.3 Kg (5.0 lbs)

Calculation Procedure:
2.3 Kg x 9.3 cm = 21.4 Kg-cm
5.0 lb x 3.65 in = 18.25 lb-in.

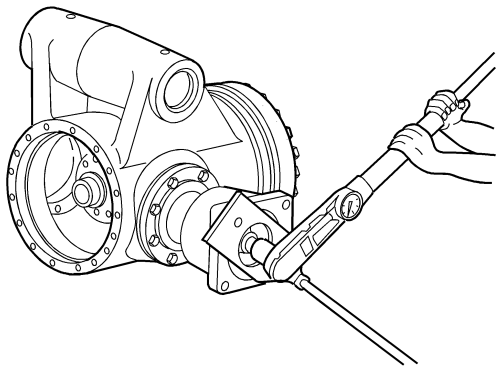
Conversion to N•m:
21.4 x 0.098 = 2.1 N•m
18.25 x 0.113 = 2.1 N•m

NOTE

- ***To convert lb-in to N•m: multiply by 0.113***
- ***Kg-cm to N•m: multiply by 0.098***

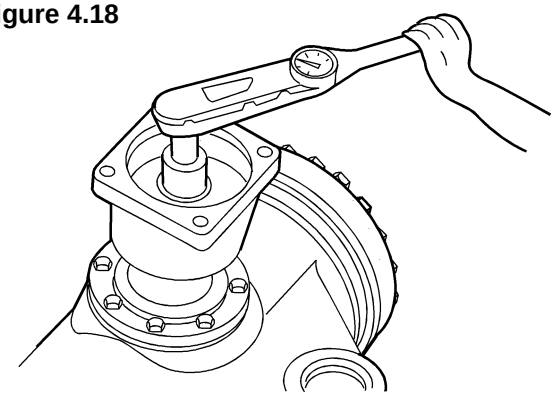
1. Lubricate bearing cups and cones with specified oil.
2. Install yoke or flange without pinion oil seal.
3. Install pinion bearing cage assembly on main housing without bearing cage shims.
4. Fasten bearing cage assembly on main housing with two capscrews. Apply minimum specified torque of 67 lb-ft (90 N•m). T
5. Use appropriate tool to fasten pinion through yoke, flange or splined sleeve. **Figure 4.17.**

Figure 4.17



6. Tighten pinion nut with minimum torque value of 465 lb-ft (630 N•m). T
7. Rotate pinion bearing cage several times so bearings make normal contact.
8. Attach torque wrench on drive pinion nut. Rotate pinion and check if preload is in specified range. Make the reading during the rotation, not the starting value. **Figure 4.18.**

Figure 4.18



9. If the pinion bearing preload torque value is under or above the specified preload torque of 5-20 lb-in (0.55-2.2 N•m), change shims to thick or thinner size as necessary. Repeat pinion bearing preload check. T

10. After getting specified preload, remove bearing cage from main housing and disassemble yoke or input flange.

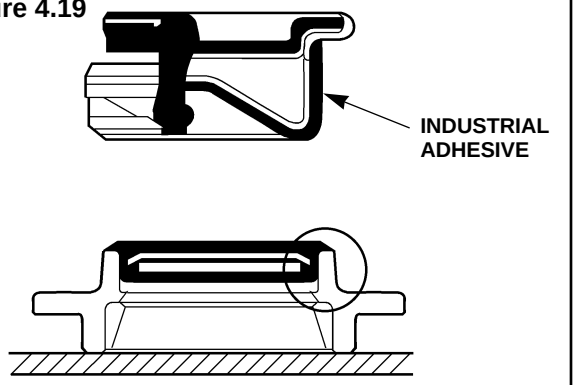
⚠ CAUTION

Make sure oil seal lips are clean and free from dirt. Dirt can cause leakage between seal and yoke or flange.

11. Install pinion oil seal with the appropriate tool:

    a. Apply extreme pressure lithium soap grease to oil seal lips. **Figure 4.19.**

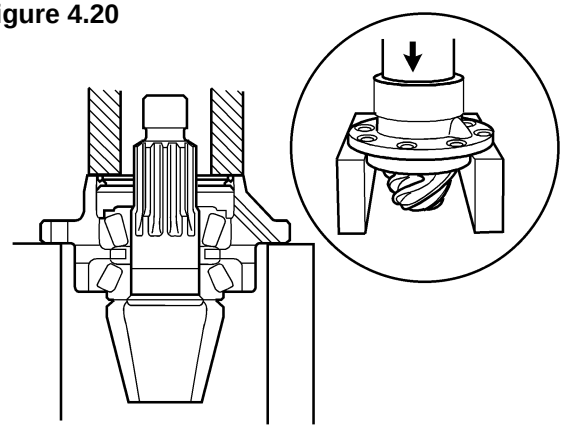
Figure 4.19



    b. Apply 3M Industrial Adhesive or equivalent to oil seal outer surfaces. **Figure 4.19.**

    c. Press oil seal into bearing until seal flange is flat against top of bearing cage. Use the correct size sleeve or seal driver that fits against metal flange of seal. The diameter of the sleeve must be larger than diameter of flange. **Figure 4.20.**

Figure 4.20



    d. Install yoke or flange and pinion nut into pinion.

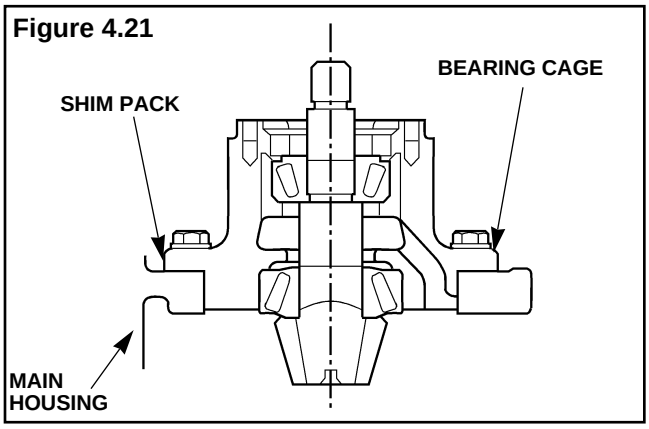
    e. Tighten pinion nut to specified torque after installing pinion bearing cage into main housing of 465-570 lb-ft (630-775 N•m). (T)

Adjust Thickness of Pinion Bearing Cage Shim Pack (Depth of Pinion)

NOTE

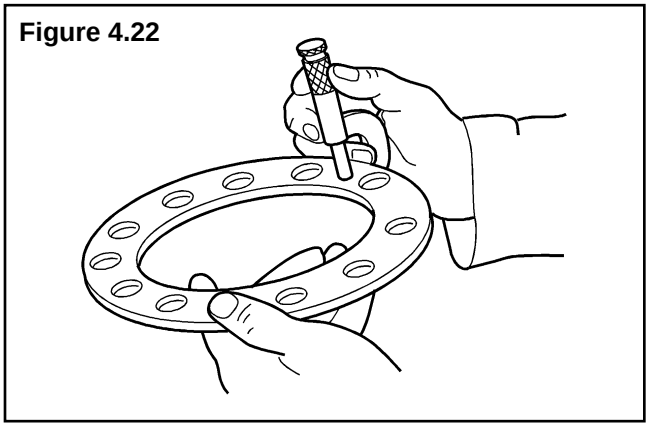
Use this procedure if a new drive pinion and ring gear set is installed or if the depth of the drive pinion has to be adjusted. **Figure 4.21.**

Figure 4.21



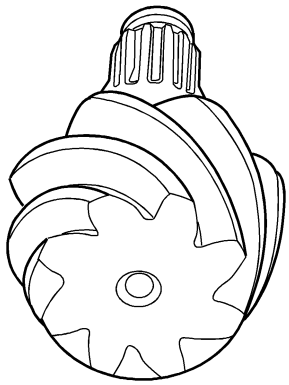
1. Use a micrometer to measure the thickness of the old shim pack that was removed from under the pinion cage. Record the measurement for later use. **Figure 4.22.**

Figure 4.22



2. Record the pinion cone (PC) variation number on the old drive pinion that is being replaced. If the PC variation number cannot be located, assemble the gear set with the shim pack found in step 1. **Figure 4.23.**

Figure 4.23



NOTE

The pinion cone number (PC) can be either 1,000ths of an inch (0.000 inch) or 100ths of a millimeter (0.00 mm). Examples:

PC+3, PC–3, +3 OR -3 = .003 inch (.076 mm)
PC+.03, PC–.03MM , + .03 OR –.03 = .03 mm

- ***To change inches to millimeters, multiply inches by 25.40***
- ***To change millimeters to inches, multiply millimeters by 0.039.***

3. If the old pinion cone number is a plus (+), subtract the number from the old shim pack thickness that was measured in step 2.
4. If the old pinion cone number is a minus (–), add the number to the old shim pack thickness that was measured in step 2.

NOTE

The value calculated in step 3 or 4 is the thickness of the standard shim pack without a variation.

5. Look at the pinion cone (PC) variation number on the new drive pinion that will be installed. Record the number for later use.
6. If the new pinion cone number is a plus (+), add the number to the standard shim pack thickness that was calculated in step 3 or 4.
7. If the new pinion cone number is a minus (–), subtract the number from the standard shim pack thickness that was calculated in step 3 or 4.

NOTE

The value calculated in step 6 or 7 is the thickness of a new shim pack that will be installed.

EXAMPLES	Inches	mm
1.		
Old shim pack thickness	0.030	0.76
Old PC number, PC+2 (+0.05mm)	–0.002	–0.05
Standard shim pack thickness	0.028	0.71
New PC number, PC+5 (+0.13mm)	+0.005	+0.13
New shim pack thickness	0.033	0.84
2.		
Old shim pack thickness	0.030	0.76
Old PC number, PC–2 (–0.05mm)	+0.002	+0.05
Standard shim pack thickness	0.032	0.81
New PC number, PC+5 (+0.13mm)	+0.005	+0.13
New shim pack thickness	0.037	0.94
3.		
Old shim pack thickness	0.030	0.76
Old PC number, PC+2 (+0.05mm)	–0.002	–0.05
Standard shim pack thickness	0.028	0.71
New PC number, PC–5 (–0.13mm)	–0.005	–0.13
New shim thickness	0.023	0.58
4.		
Old shim pack thickness	0.030	0.76
Old PC number, PC–2 (–0.05mm)	+0.002	+0.05
Standard shim pack thickness	0.032	0.81
New PC number, PC–5 (–0.13mm)	–0.005	–0.13
New shim pack thickness	0.027	0.68

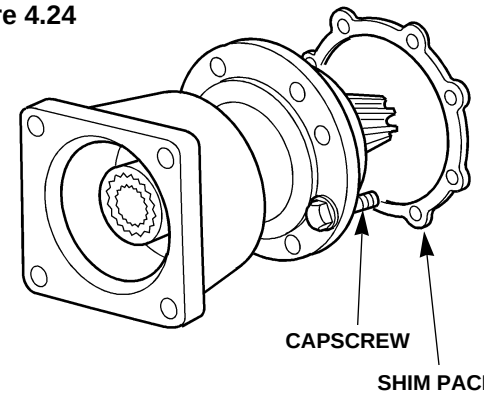
Install Pinion Bearing Cage Assembly on Main Housing

NOTE

Use minimum of three shims in pack. If pack is made from different thickness shims, install thinnest shims on both sides of pack for maximum sealing.

1. Install correct shim pack between bearing cage and main housing. **Figure 4.24.**

Figure 4.24

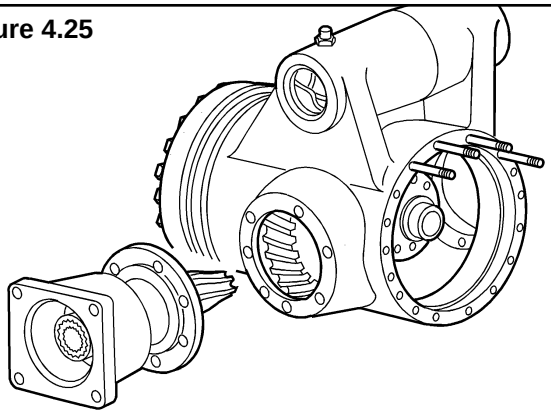


WARNING

Do not hit steel parts with a steel hammer during assembly and installation procedures. Parts can break and cause serious personal injury.

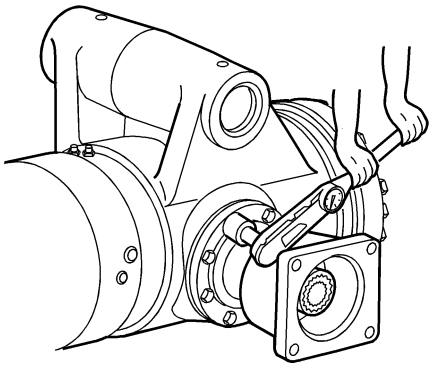
2. Install drive pinion and bearing cage into carrier. If necessary, use rubber, plastic or leather mallet to tap assembly into position. **Figure 4.25.**

Figure 4.25



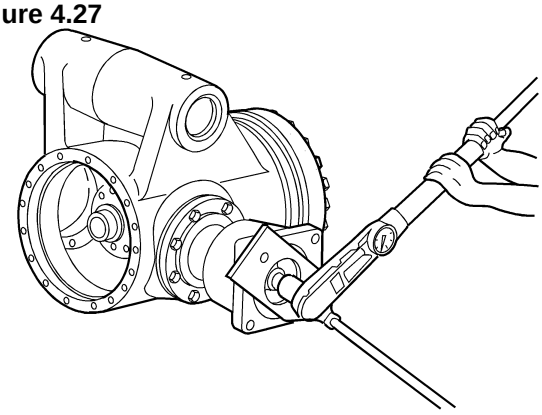
3. Install two capscrews and washers that fasten bearing cage. Tighten to minimum torque of 67 lb-ft (90 N•m). **Figure 4.26.** T

Figure 4.26



4. Install yoke or flange and pinion nut. Fasten yoke or flange with appropriate tool. Tighten pinion nut to minimum specified torque of 465-570 lb-ft (630-775 N•m). **Figure 4.27.** T

Figure 4.27



CAUTION

The fit between input yoke or flange splines and drive pinion is tight. To install yoke or flange into pinion, use pinion nut and appropriate tool to fasten it. Never use hammer or mallet. A hammer or mallet will damage yoke or flange.

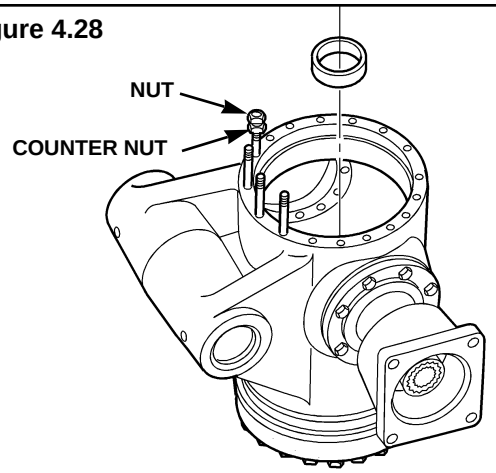
5. If ring gear is mounted on opposite brake housing side, loosen two capscrews that fasten pinion bearing cage. Remove cage and mount it after differential case is assembled.

   If ring gear is mounted on brake housing side, install other capscrews that fasten pinion bearing cage. Tighten the capscrews to a torque of 67-91 lb-ft (91-120 N•m). T

Install Differential Housing Assembly into Main Housing (With Shims)

1. The preload of differential bearings is adjusted by selecting proper shim pack to obtain a torque of 15-35 lb-in (1.7-4.0 N•m). T
2. Install shims. Combine two shims to obtain desired thickness. **Figure 4.28.**

Figure 4.28

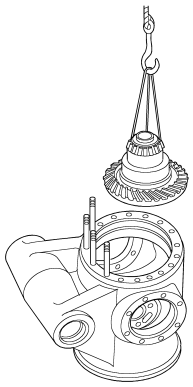


NOTE

Usually a 0.102-0.104 inch (2.60-2.65 mm) shim pack thickness is enough to obtain specified backlash and differential bearing preload.

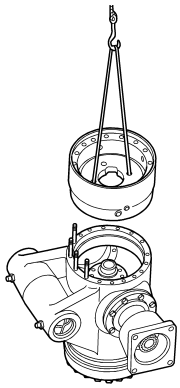
3. Install differential case bearing cup, axle shaft housing and brake housing studs into main housing until the thread is completely attached. Apply Three Bond 1134 liquid gasket material on stud threads. **Figure 4.28.**
4. Install differential case assembly. **Figure 4.29.**

Figure 4.29



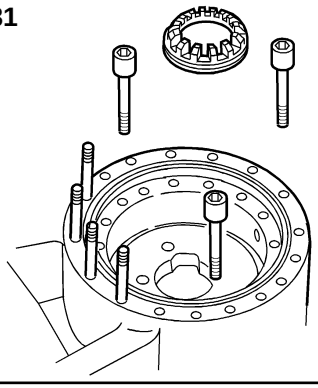
5. Install brake housing and other differential case bearing cup. **Figure 4.30.**

Figure 4.30



6. Install three bolts to adjust differential on brake housing. Tighten to a torque of 19-26 lb-ft (26-36 N•m). **Figure 4.31.** T

Figure 4.31



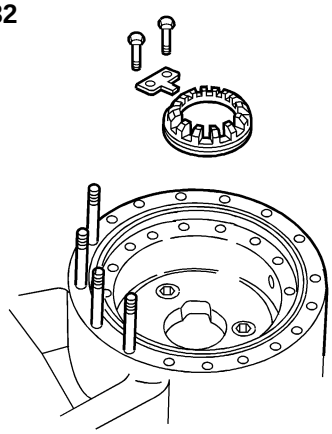
7. Install differential case bearing adjusting nut on brake housing. **Figure 4.31.**
8. Install pinion bearing cage assembly and shim pack.
9. Check backlash, differential preload and teeth contact. See Section 5, “Adjustments.”

WARNING

Small amounts of acid vapor are present when applying some liquid gasket materials during assembly and installation procedures. To prevent possible serious personal injury, make sure there is good ventilation in the work area. If the liquid gasket material gets in eyes, flush eyes with water for 15 minutes. Have eyes checked by doctor.

10. If all adjustments are within specifications, remove brake housing. Apply liquid gasket material to main housing surface.
11. Install three bolts into the brake housing to adjust differential. Tighten them to 19-26 lb-ft (26-36 N•m). T
12. Apply medium torque liquid adhesive, Loctite 241 or Three Bond 1334, to lock capscrews. Install adjusting nut lock and capscrews. Tighten capscrews to 80-115 lb-in (9-13 N•m). **Figure 4.32.** T

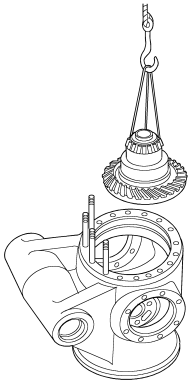
Figure 4.32



Install Differential Housing Assembly into Main Housing (With Adjusting Ring 2 Sides)

1. Install adjusting ring into main housing.
2. Install bearing cup.
3. Install differential case assembly into main housing. **Figure 4.33.**

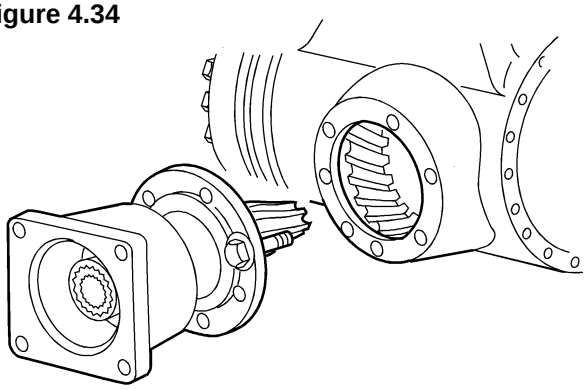
Figure 4.33



4. Install brake housing and other differential case bearing cup. **Figure 4.30.**
5. Install three bolts to adjust the differential on brake housing. Tighten to 19-26 lb-ft (26-36 N•m). **Figure 4.31.** T
6. Install differential case bearings adjusting nut into brake housing. **Figure 4.31.**

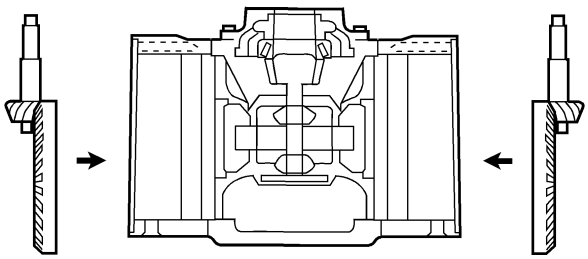
7. Install pinion bearing cage assembly and shim pack. **Figure 4.34.** See “Install Pinion Bearing Cage Assembly on Main Housing,” page 31.

Figure 4.34



8. Adjust adjusting rings with the following procedure. **Figure 4.35.**

Figure 4.35



   a. Tighten ring gear side adjusting ring to eliminate backlash between ring gear and pinion.

   b. Unfasten same adjusting ring from four to five slots.

   c. Tighten opposite side adjusting ring to obtain a preload of 15-35 lb-ft (1.7-4.0 N•m). Discount pinion bearing preload measured before. T

9. Check backlash, differential preload and teeth contact. See Section 5, “Adjustments.”

10. If all adjustments are within specifications, remove brake housing. Apply liquid gasket material to main housing surface.

WARNING

To avoid serious personal injury, be careful when using Loctite. Follow the manufacturer’s instructions for safe use to prevent irritation to eyes and skin. Wash after skin contact. If the Loctite gets in eyes, flush with water for 15 minutes. Have eyes checked by a doctor.

11. Apply high torque liquid adhesive, Loctite 271 or Three Bond 1334, on stud threads.

12. Install studs that fasten brake housing and axle shaft housing to main housing. Tighten studs until resistance is met.

13. Install bearing cup and brake housing into main housing. Align holes at mark made during disassembly.

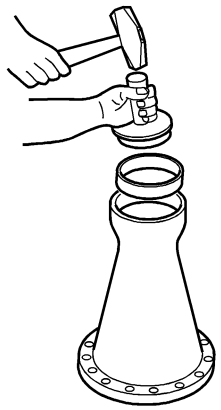
14. Install 3 bolts into the brake housing to adjust differential. Tighten them to 19-26 lb-ft (26-36 N•m). **Figure 4.31.** T

15. Apply medium torque liquid adhesive, Loctite 241 or Three Bond 1334, to lock capscrews. Install adjusting nut lock and capscrews. Tighten capscrews to 80-115 lb-in (9-13 N•m). T

Assemble Axle Shaft

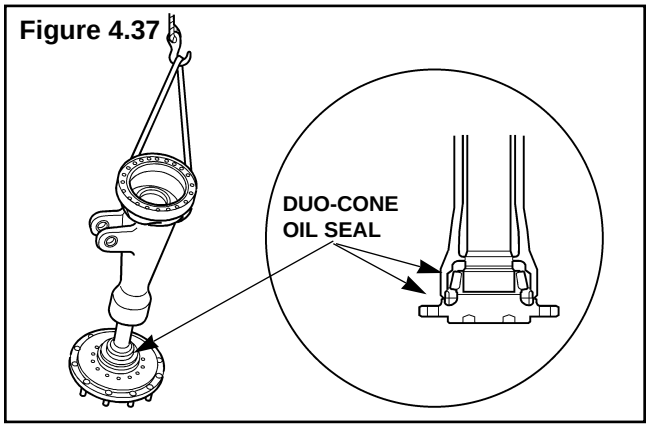
1. Use correct size sleeves to install cups into bores in axle shaft housing until cups are flat against bottom of bores. **Figure 4.36.**

Figure 4.36



2. Install Duo-Cone oil seal into axle shaft and into axle shaft housing bore as specified on page 18. **Figure 4.37.**

Figure 4.37



3. With a correct size sleeve, use a press to install flange side cone bearing. Install axle shaft into axle shaft housing. **Figure 4.37.**

Assemble Trumpet Assembly

WARNING

Observe all WARNINGS and CAUTIONS provided by the press manufacturer concerning press operation to avoid serious personal injury and possible damage to components during assembly and installation procedures.

1. Use press to install new planetary pin into spider. Make sure proper dimensions are used and holes are aligned. **Figures 4.38 and 4.39.**

Figure 4.38

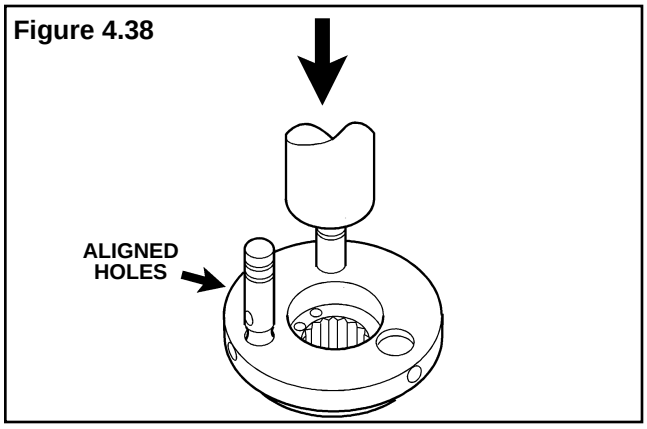
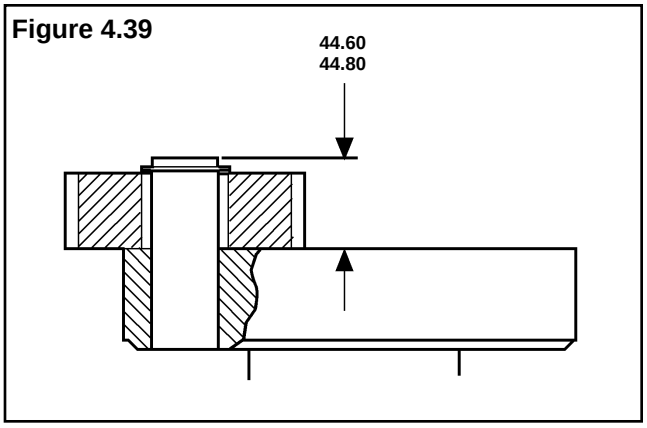


Figure 4.39



WARNING

To avoid serious personal injury, be careful when using Loctite. Follow the manufacturer's instructions for safe use to prevent irritation to eyes and skin. Wash after skin contact. If the Loctite gets in eyes, flush with water for 15 minutes. Have eyes checked by a doctor.

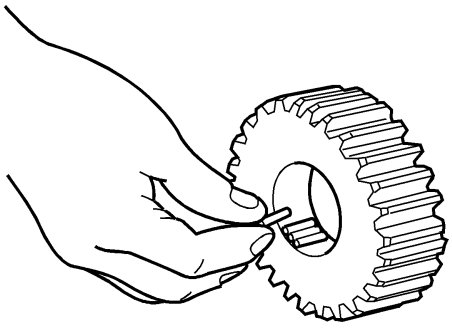
2. Apply Medium Torque liquid adhesive, Loctite 241 or Three Bond 1334, to threads of planetary gear axle lock capscrews. Install and tighten to 17-23 lb-ft (23-31 N•m). T

CAUTION

Rollers must come from the same manufacturer and have the same tolerance range. Replace spacers and washers when a new roller is used.

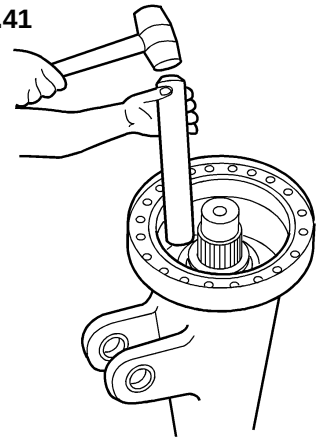
3. Apply grease, Shell-71032 Alvania EP-2 or Texaco - 995 Multifak EP-2, on each gear hole. Install rollers and spacers into planetary gears. **Figure 4.40.**

Figure 4.40



4. Install bearing cone. **Figure 4.41.**

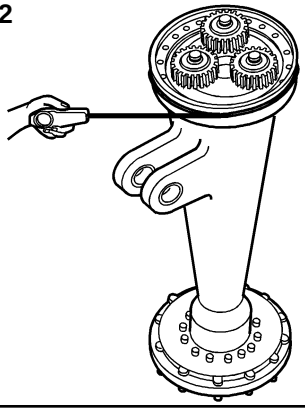
Figure 4.41



5. Install planetary spider and axle shaft bearing adjusting nut.
6. Measure trumpet flange radius. With a spring scale, check the trumpet assembly preload before tightening adjusting nut.

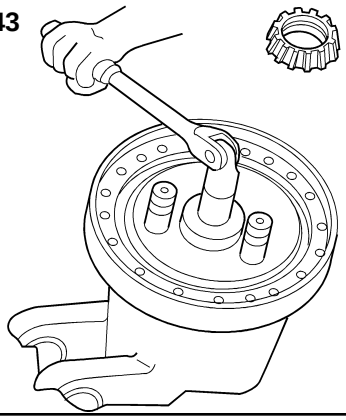
   The value will be obtained by multiplying the number read on the spring scale dial by the flange radius. Make note of the value. **Figure 4.42.**

Figure 4.42



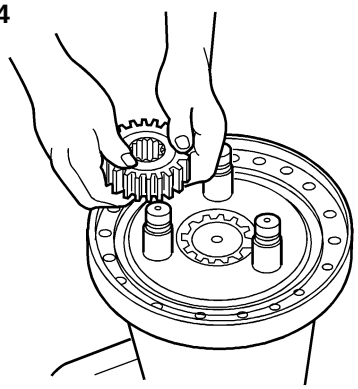
7. Tighten adjusting nut with special tool shown on page 60. At the same time, manually rotate the trumpet to assure a correct fit between bearing cups and cones and get desired preload. **Figure 4.43.**

Figure 4.43



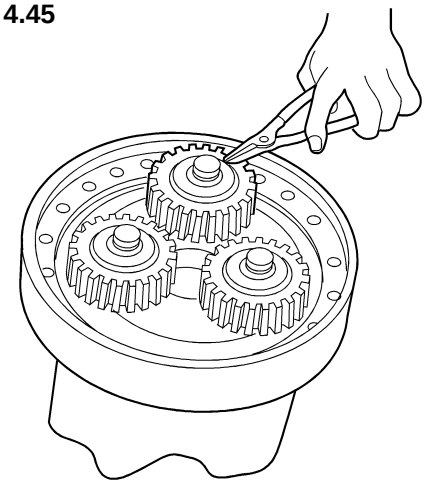
8. Check trumpet assembly preload and subtract value obtained before tightening adjusting nut. Value must be 15-35 lb-in (1.7-4 N•m). T
9. Apply Medium Torque liquid adhesive, Loctite 241 or Three Bond 1334, on adjusting nut lock capscrew threads. Install adjusting nut lock capscrew. Tighten to 17-23 lb-ft (23.0-30.5 N•m). T
10. Install inner washer, planetary gears and rollers into flange. **Figure 4.44.**

Figure 4.44



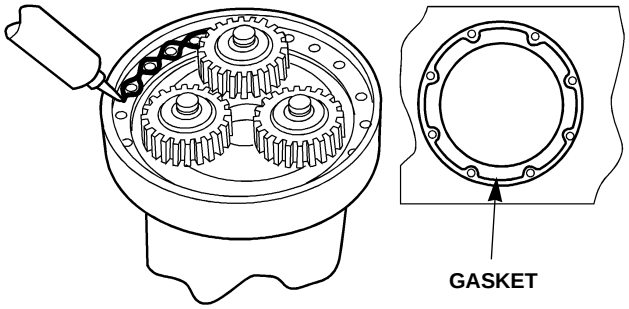
11. Install outer washers.
12. With correct pliers, install snap rings. **Figure 4.45.**

Figure 4.45



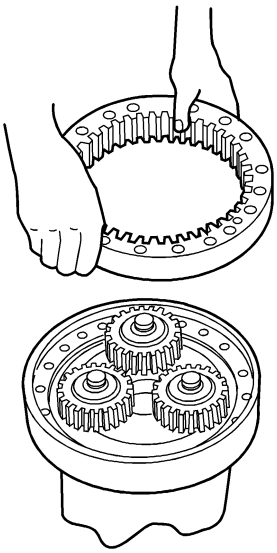
13. Apply liquid gasket material on contact surfaces of trumpet and ring. **Figure 4.46.**

Figure 4.46



14. Install ring gear into trumpet. Use reference marks made during disassembly to align holes and contact surface. **Figure 4.47.**

Figure 4.47



Assemble Hydraulic Apply Brake Housing Assembly

NOTE

- ***To assemble three function brake, see page 39.***
- ***To assemble ball and ramp brake, see page 43.***

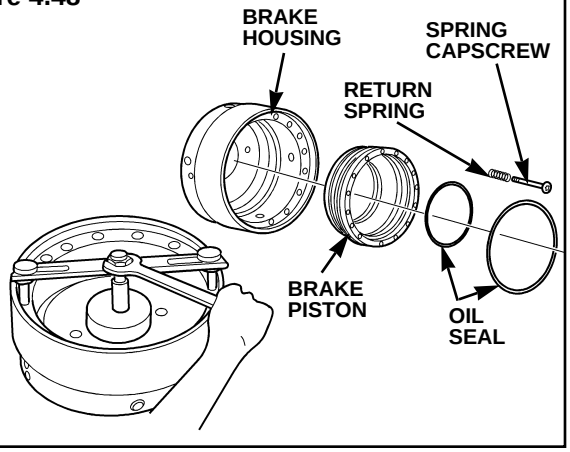
1. Check to see if the piston lodging surfaces on brake housing is free of sharp edges, nicks and burrs. Repair any damage if possible or replace the part.
2. Repeat Step 1 on outer surfaces of brake piston.
3. Apply a thin film of oil, SAE W140 or SAE 90, to piston and bore. Apply a dense layer of oil to brake housing chamfer.
4. Carefully install piston oil seals.

NOTE

Before pressing piston into brake housing, rotate piston 15 to 20 degrees. If piston does not turn easily, disassemble the piston and find the cause of the interference.

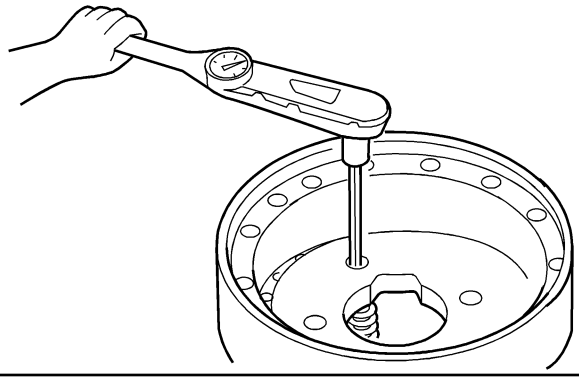
5. With a manual press, carefully install piston into brake housing. Do not damage oil seals. If there is resistance in installing the piston, do not proceed. **Figure 4.48.**

Figure 4.48



6. Apply high torque liquid adhesive, Loctite 271 or Three Bond 1305, to capscrew threads. Install return springs and return spring capscrews. Tighten to 80-115 lb-in (9.0-13.0 N•m). T **Figure 4.49.**

Figure 4.49



Hydraulic Apply Brake Housing Functional Test

NOTE

- ***This test procedure is only for the hydraulic apply brake system.***
- ***To perform this test, it is necessary to use a device which permits the observation of possible leaks through oil seals and if the piston return system is working. For an accurate evaluation, the device must allow piston displacement of 0.157 to 0.197 inch (4-5 mm).***

1. Connect brake housing assembly into hydraulic system equipped with 1000 psi (69 bar) manometer.
2. Activate the cylinder at least five times with 600 psi (41.4 bar). Check for leaks.
   - If there are no leaks, proceed to Step 3.
   - If there are leaks, disassemble brake housing assembly, find and correct the problem.
3. Wait five minutes, then apply 600 psi (41.4 bar) to the cylinder again.

- If there are no leaks, proceed to Step 4.
- If there are leaks, disassemble brake housing assembly, find and correct the problem. Repeat Steps 1 to 3.

4. Wait five minutes, then apply 75 to 110 psi (5.1 to 7.6 bar) to the cylinder again.
   - If there are no leaks, the assembly is assembled correctly.
   - If there are leaks, find and correct the problem. Repeat the test again.

Assemble Three Function Brake Housing Assembly

NOTE
Before assembling brake housing assembly, make sure that all surfaces and bores of brake housing and piston are free of dirt, burrs and nicks.

1. Select piston shim pack with the following procedure:
   a. Position parts of piston assembly in a press. Measure the dimension “A” under 441 lb (200 Kg) pressure. **Figure 4.50.**
   b. Measure the dimension “B”. **Figure 4.51.**

Figure 4.50

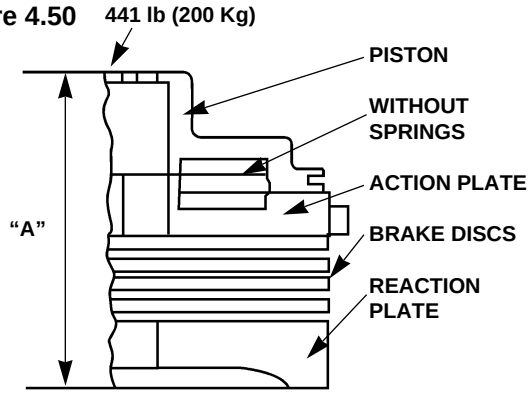
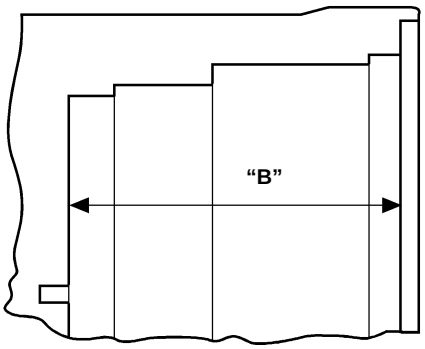


Figure 4.51



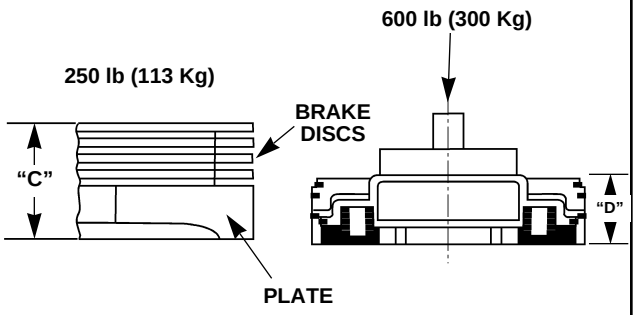
   c. The shim pack thickness is the difference between dimension “B” and dimension “A” minus 0.06 in. (1.5 mm):

      B-A-0.06 in. (1.5 mm) = shim pack thickness

   d. If brake piston is assembled, the shim pack thickness, under press pressure of 441 lbs (200 Kg), is the difference between dimension “B” minus the sum of dimensions “C” and “D” minus 0.06 in. (1.5 mm):

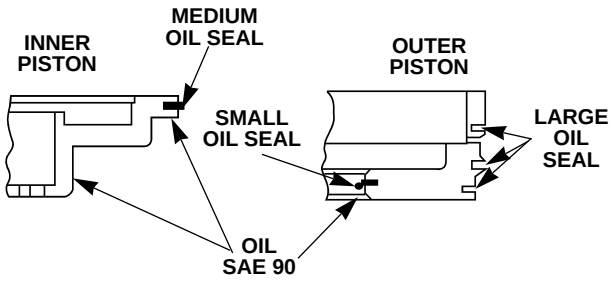
      B-(C+D) -0.06 (0.15) = shim pack thickness. **Figure 4.52.**

Figure 4.52



2. Lubricate internal brake housing surfaces, inner and outer piston surfaces and oil seal bores with SAE 90 oil. **Figure 4.53.**

Figure 4.53

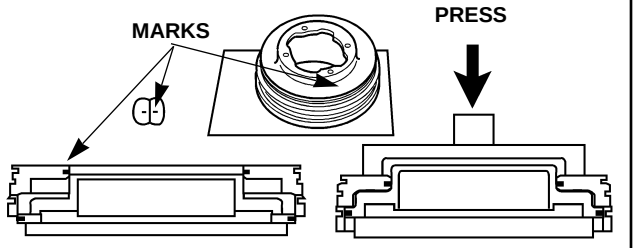


NOTE

Each piston assembly has three different sizes of oil seals: three large, one medium, one small.

3. Install medium oil seal into inner piston bore and install the small oil seal into the outer piston bore. **Figure 4.53.**
4. ONLY use a manual press to install inner piston into outer piston. Be careful not to damage oil seals. Do not force the inner piston assembly. **Figure 4.54.**

Figure 4.54

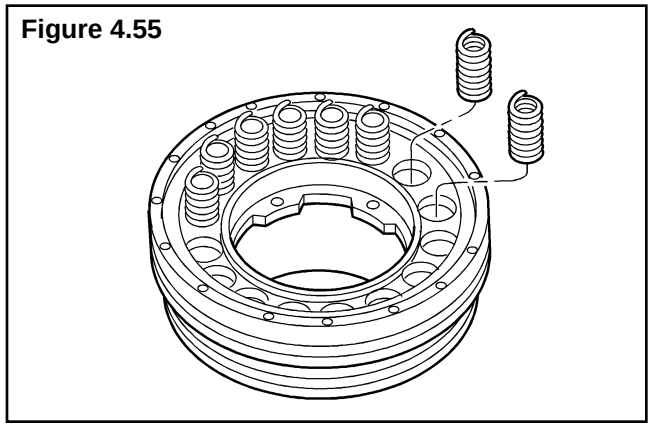


NOTE

Rotate pistons until marks are aligned. If inner piston does not rotate easily, disassemble it and find the cause. **Figure 4.54.**

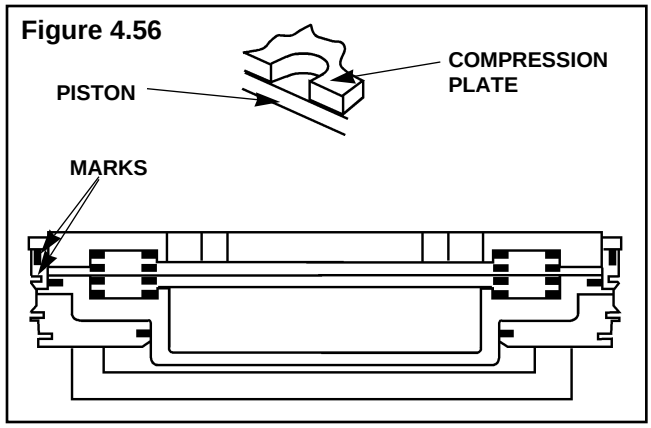
5. Install springs into bores in inner piston. **Figure 4.55.** For brake with 12 springs, jump one bore each three. **Figure 4.55.**

Figure 4.55



6. Install compression plate on piston. Correctly align the fastener holes. Use marks on piston and lock pin slot. **Figure 4.56.**

Figure 4.56



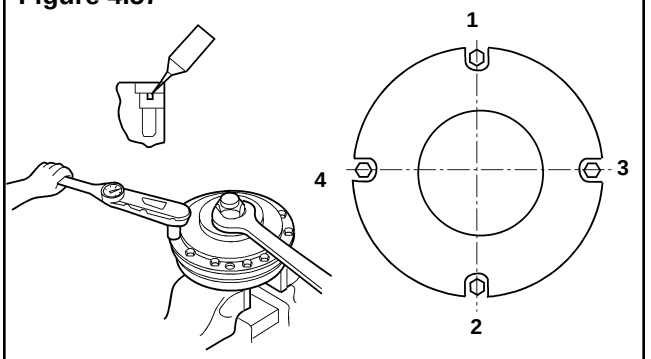
7. Apply pressure to the compression plate until it is flat against the piston.

⚠ *WARNING*

To avoid serious personal injury, be careful when using Loctite. Follow the manufacturer's instructions for safe use to prevent irritation to eyes and skin. Wash after skin contact. If the Loctite gets in eyes, flush with water for 15 minutes. Have eyes checked by a doctor.

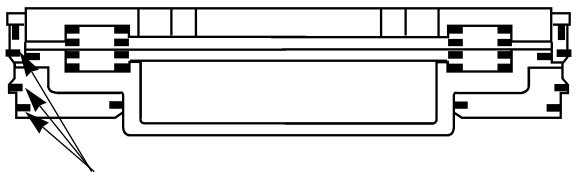
8. Apply medium torque liquid adhesive, Loctite 241 or Three Bond 1334 in threaded external piston bolt holes. Install action plate bolts as shown in **Figure 4.57** and apply a pretorque of 30 lb-in (3.3 N•m). Tighten to specified torque of 120-140 lb-in (13.5-16 N•m). T

Figure 4.57



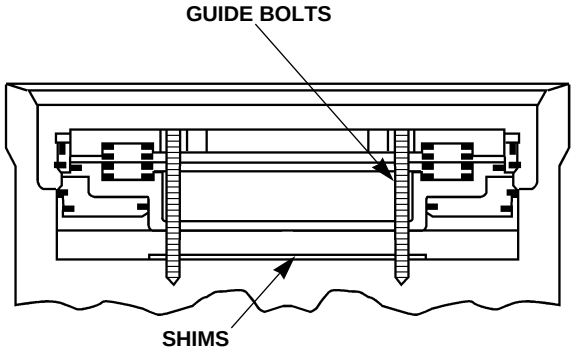
9. Install three larger oil seals into outer piston. Make sure the oil seals fit in the bores. **Figure 4.58.**

Figure 4.58



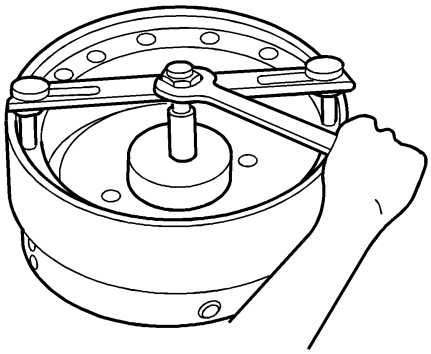
10. Install shim pack into brake housing. Use bolts to align holes. **Figure 4.59.**

Figure 4.59



11. Remove guide bolts and manually install brake piston assembly into brake housing. Rotate piston assembly 15 to 20 degrees. The rotation must be easy and without resistance. If there is any resistance, disassemble the brake piston assembly and find the cause.
12. Use bolts as guide and align piston and holes. Use marks made during disassembly as reference. **Figure 4.60.**

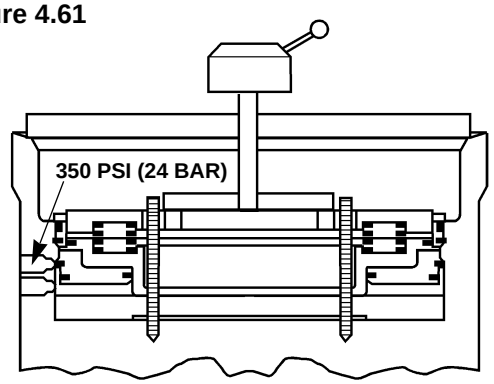
Figure 4.60



13. With a manual press on brake housing, apply pressure to brake piston until the springs compress. Make sure oil seals fit in bores. **Figure 4.60.**

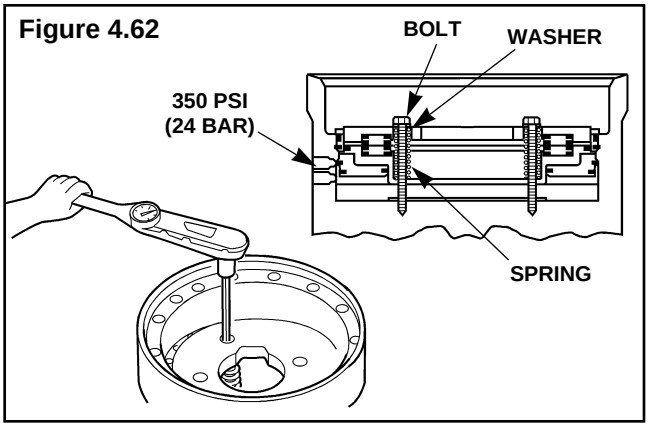
14. With piston still compressed, apply 350 psi (24 bar) into parking brake to make sure oil seals fit in bores. **Figure 4.61.**

Figure 4.61



15. Keep the parking brake under 350 psi (24 bar) pressure and remove the manual press and guide pins.
16. Apply medium torque liquid adhesive, Loctite 241 or Three Bond 1334, to return spring holes and bolt threads. Install return springs, washers and return spring bolts into brake housing. Tighten bolts to 80-115 lb-in (9-13 N•m). **Figure 4.62.** T

Figure 4.62



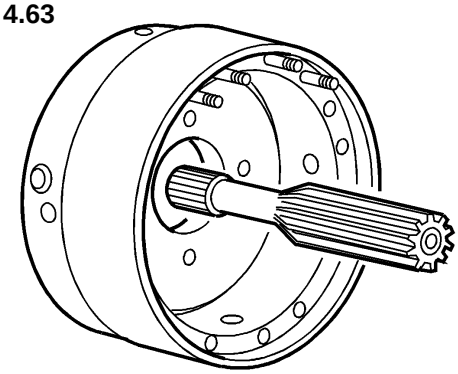
NOTE

Use same procedure to install other brake piston assemblies into main housing.

Assemble Ball and Ramp Brakes, Brake Discs, Reaction Plate and Pins

1. Install sun gear. **Figure 4.63.**

Figure 4.63

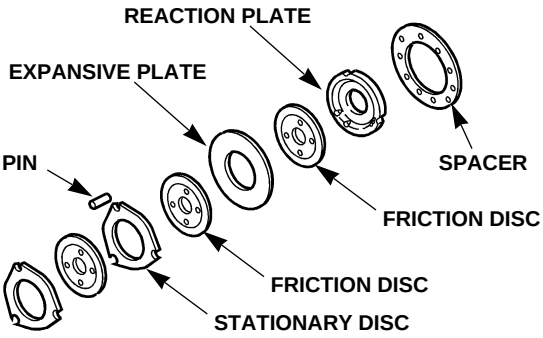


NOTE

After assembly, friction disc lubrication holes must be perfectly aligned.

2. Install friction and stationary discs alternately. Make sure friction disc is against brake piston.
3. For ball and ramp brakes, discs must be installed alternately and a friction disc must be on each side of the expansive plate. **Figure 4.64.**

Figure 4.64

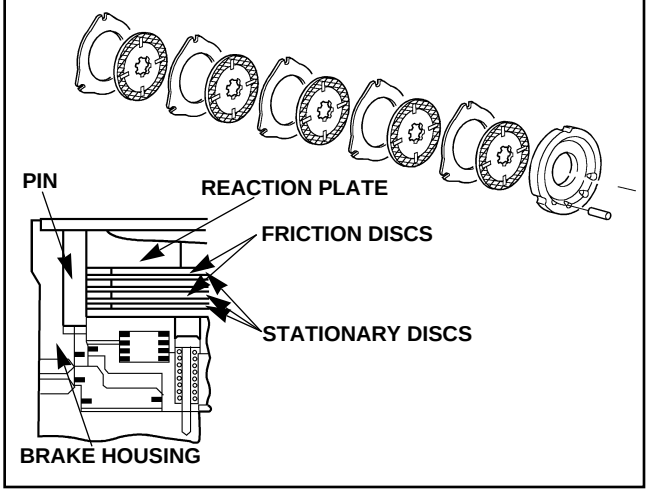


4. Install stationary disc lock pins.
5. Install reaction plate with lubrication hole on down side of axle.
6. If there is an outer spacer, install it on brake housing surface. Use liquid gasket material.

Assemble Three Function Brakes, Brake Discs, Reaction Plate and Pins

1. Lubricate all brake components with same oil specified for axle. See page 53.
2. Install sun gear. **Figure 4.63.**
3. Apply 350 psi (24 bar) into parking brake.
4. Install friction and stationary discs, guide pins and reaction plate. **Figure 4.65.**

Figure 4.65



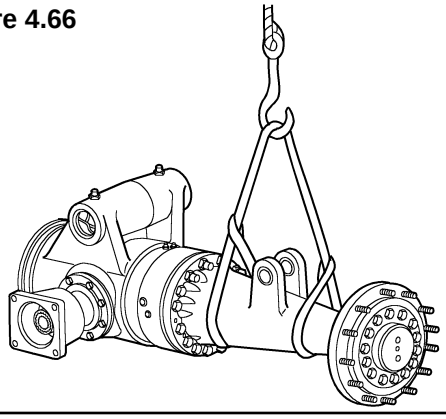
Install Housing Assembly into Main Housing

NOTE

If axle is equipped with three function brake, keep parking brake pressurized.

1. Install housing assembly. Make sure that the mark made during disassembly is correctly positioned to ensure alignment of the fastener holes. **Figure 4.66.**

Figure 4.66

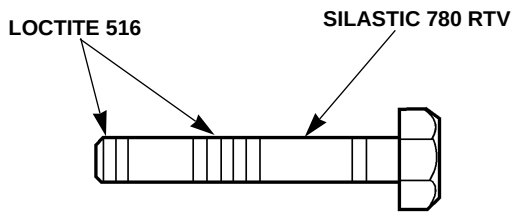


2. Install capscrews and nuts that fasten housing to main housing.
   - Tighten grade 12.9 capscrew 170-200 lb-ft (230-271 N•m). T
   - Tighten grade 10.9 capscrew 135-170 lb-ft (183-230 N•m). T
   - Tighten stud nuts 120-150 lb-ft (160-205 N•m). T
3. Release pressure from parking brake.
4. Apply liquid gasket material, Loctite 515 or Three Bond 1134, on surface of cover that fastens to main housing and on capscrew threads. Install cover and capscrews on main housing. Tighten capscrews to 20-27 lb-ft (27-36 N•m). T

Assemble Three Function Brake Release Bolts and Sleeves

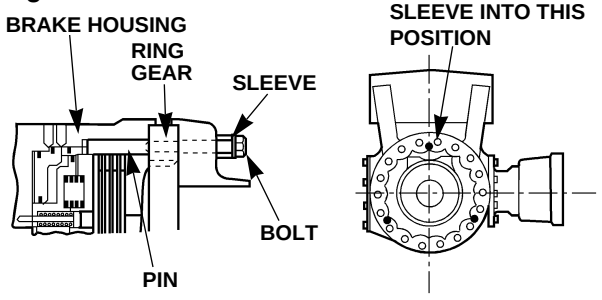
1. Apply Loctite 516 on bolt threads. **Figure 4.67.**

Figure 4.67



2. Apply liquid gasket material, Silastic 780 RTV Dow Corning, on non-threaded bolt shaft. **Figure 4.67.**
3. Install bolts and sleeves. Tighten to 25-34 lb-ft minimum (34-46 N•m). **Figure 4.68.** T
   - Assemble 2 larger bolts, 3.346 in. (85 mm) with larger sleeves, 1 in. (26 mm)
   - Assemble shorter bolt, 3.070 in. (78 mm) with shorter sleeve, 0.750 in. (19 mm).

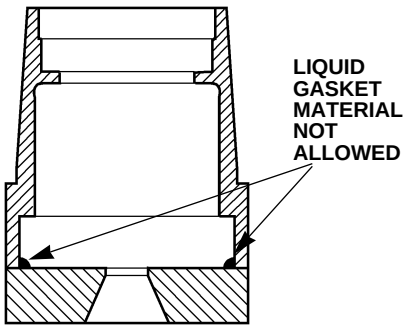
Figure 4.68



Assemble Ball and Ramp Brake Cylinder Assembly and Install on Main Housing

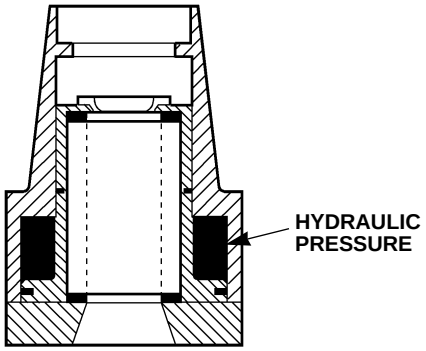
1. Apply liquid gasket material FAG-3 on brake cylinder surface that fastens to brake cylinder support. Assemble brake cylinder, oil seals, piston and brake cylinder support. Tighten capscrews that fasten brake cylinder support 19-26 lb-ft (26-36 N•m). **Figure 4.69.** T

Figure 4.69



2. While out of the axle, connect cylinder assembly to hydraulic system. Apply 400 psi (27.6 bar) pressure to compress spring until piston is against brake cylinder. Repeat this operation four to five times to make sure there is no leakage. **Figure 4.70.**

Figure 4.70

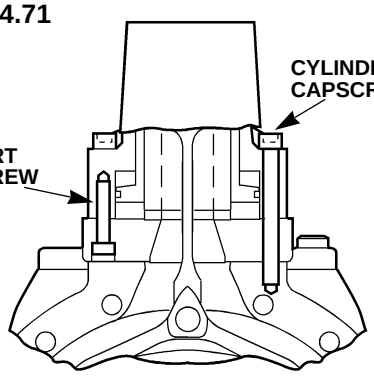


CAUTION

Do not use brake fluid in the hydraulic system. Use Shell Donax TD or Shell Tellus 32 or equivalent.

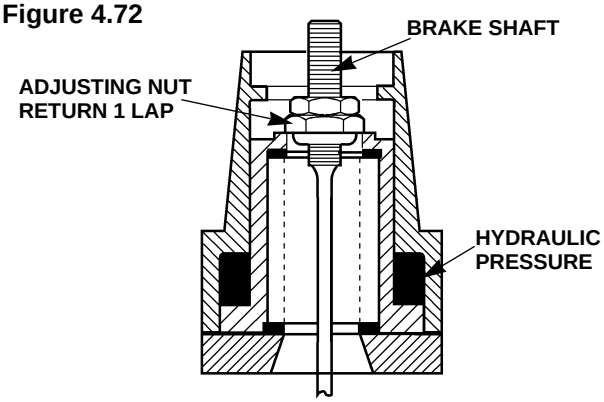
3. Install brake cylinder assembly onto main housing. **Figure 4.71.**

Figure 4.71



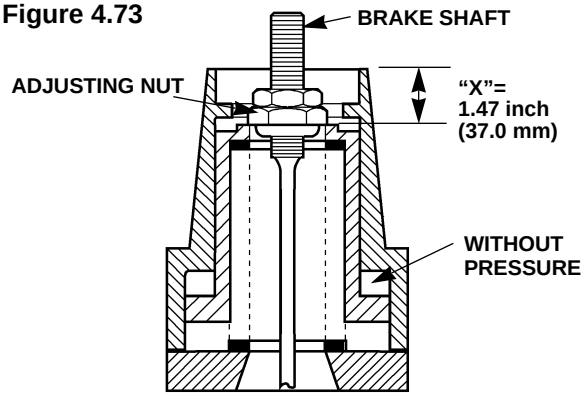
4. While the cylinder is pressurized with 400 psi (27.6 bar), apply liquid adhesive, Loctite 221 or Three Bond 1341, on threads of brake shaft. Install adjusting nut until it rests against piston. DO NOT TIGHTEN ADJUSTING NUT. Loosen the adjusting nut one full turn. **Figure 4.72.**

Figure 4.72



5. Release cylinder pressure to ZERO so piston returns back against adjusting nut. Check dimension “X” as shown in **Figure 4.73.**

Figure 4.73



If dimension “X” is smaller than 1.47 inch (37.0 mm), tighten adjusting nut until the dimension is reached. If dimension gets larger, unfasten the nut. This adjustment must be made with piston activated.

6. After 1.47 inch (37.0 mm) dimension is obtained, apply specified pressure to brake and check the brake torque on pinion as shown in chart.

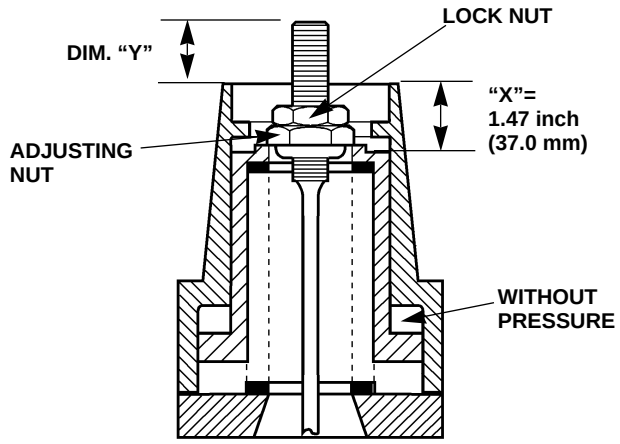
Torque Reduction	Disc No.	Pressure	Torque
PRA-382 17.08:1	06	275 psi min (19 bar min)	950-1200 lb-ft (1288.0-1559.0 N•m)
PRA-353 46.00:1	06	275 psi min (19 bar min)	350-500 (474.5-678.0 N•m)

NOTE

To obtain the desired brake torque, fasten or unfasten the adjusting nut. For each 0.04 inch (1 mm) turned on dimension "X", the variation in torque is 4%.

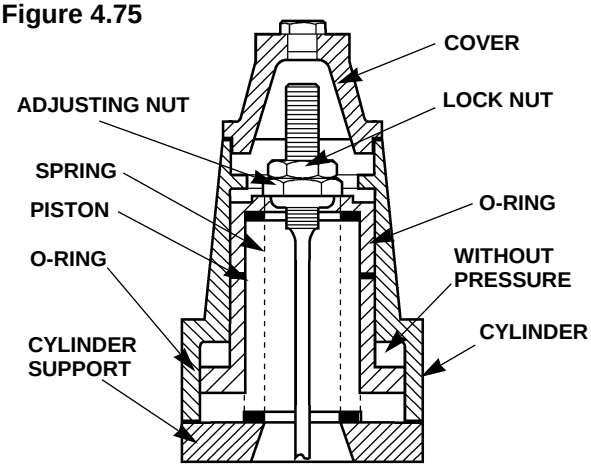
7. After obtaining the desired brake torque, install nut lock as shown in **Figure 4.74.** Tighten to 60-90 lb-in (80-120 N•m).

Figure 4.74



8. Install cover. **Figure 4.75.**

Figure 4.75



9. The dimension "Y" must be equal with ± 0.02 inch (0.5 mm) on each side. If dimension is larger on one of the sides after adjustment, disassemble and find the cause.

NOTE

Do not check the brake torque before the wheel has turned at least two times with the brake activated.

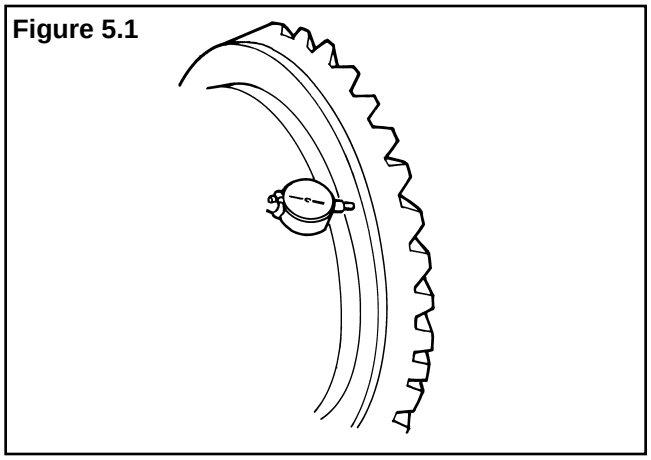
Check Ring Gear Runout Specification: 0.008 inch (0.20 mm)

⚠ *WARNING*

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. Attach magnetic base dial indicator to mounting flange of main housing. **Figure 5.1.**

Figure 5.1



2. Set dial indicator so plunger or pointer is against back surface or ring gear. **Figure 5.1.**
3. Set dial indicator to **ZERO**.
4. Rotate differential and ring gear assembly while you read dial indicator. Ring gear runout must not exceed 0.008 inch (0.20 mm). If runout exceeds specifications, remove differential and ring gear assembly from main housing.
5. Check differential parts including carrier for problem that caused ring gear runout to exceed specifications. Repair or replace parts if necessary.

⚠ *CAUTION*

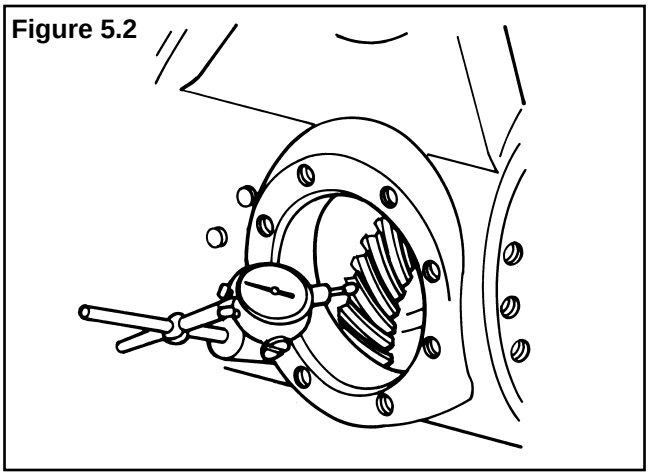
Shock load failure will distort the differential case flange and transfer damage to ring gear. In this case, differential carrier must be discarded.

6. After parts are repaired or replaced, install main differential case and ring gear assembly into carrier. Repeat steps 1 to 5.

Adjust Pinion and Ring Gear Backlash Specification: 0.005-0.015 inch (0.13-0.38 mm)

1. Attach dial indicator on mounting flange of carrier.
2. Set dial indicator so plunger is against a tooth surface. **Figure 5.2.**
3. Set dial indicator to **ZERO**.

Figure 5.2



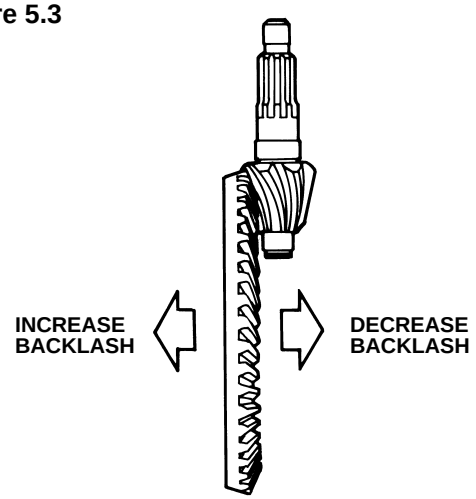
NOTE

- ***When you adjust backlash, only move ring gear. Do not move drive pinion.***
- ***If you are using old ring gear and pinion, it is recommended that you maintain original backlash.***

4. Hold drive pinion in position.
5. While you read dial indicator, rotate differential and ring gear a small amount in both directions against teeth of the drive pinion. If backlash reading is within specified range of 0.005-0.015 inch (0.13-0.38 mm), continue by checking tooth contact patterns. If backlash reading is not within specifications, adjust backlash as needed.

6. Loosen one bearing adjusting ring one notch, then tighten opposite ring the same amount to keep differential roller bearing preload. **Figure 5.3.**

Figure 5.3



NOTE

When you adjust backlash, only move ring gear. Do not move drive pinion.

- ***Backlash is increased by moving ring gear away from drive pinion.***
- ***Backlash is decreased by moving ring gear toward drive pinion.***

7. Repeat steps two to six until backlash is within specifications. Record setting for use when you adjust pinion bearing preload.

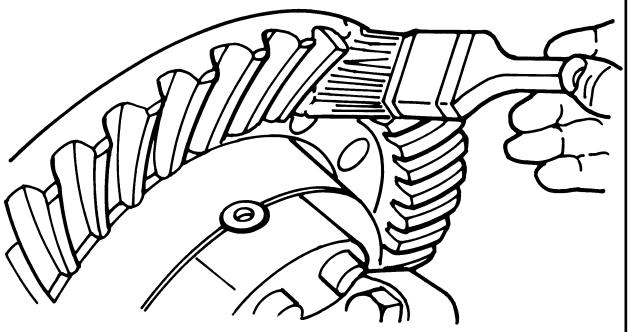
Teeth Contact Patterns

In the following procedures, movement of the contact pattern along length of tooth is indicated as toward the “heel” or “toe” of the ring gear. **Figure 5.4.**

Verification Procedure

1. Apply a marking compound to approximately 12 teeth of ring gear. Rotate ring gear so that the 12 gear teeth are next to drive pinion. **Figure 5.5.**

Figure 5.5



2. Apply load on ring gear with wood pry bar. Rotate gear forward and backward so 12 gear teeth go past the drive pinion six times to get contact patterns. Repeat if needed to get a more clear pattern. **Figure 5.6.**

Figure 5.6

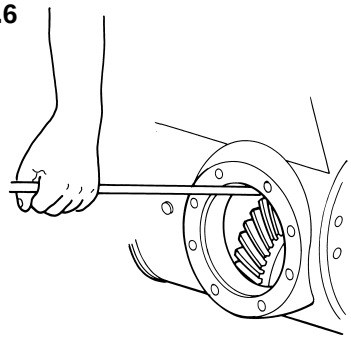
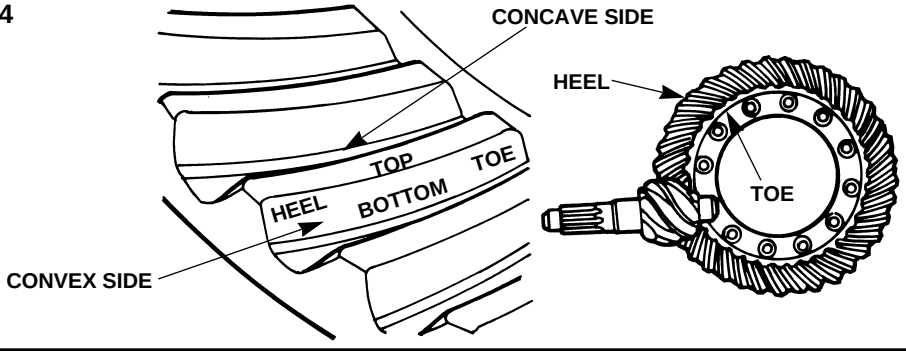
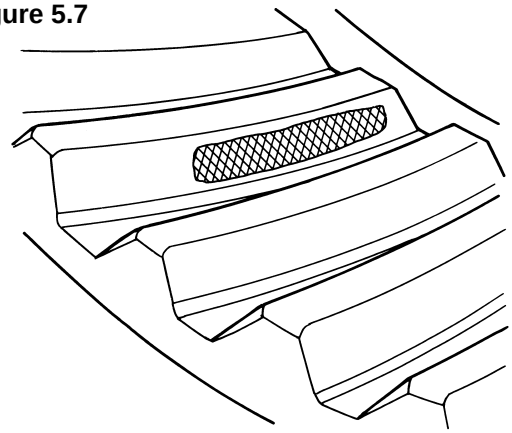


Figure 5.4



3. Compare contact patterns on ring gear teeth to good contact patterns in **Figure 5.7.** If contact patterns are not satisfactory, go to Incorrect Contact Patterns on this page.

Figure 5.7

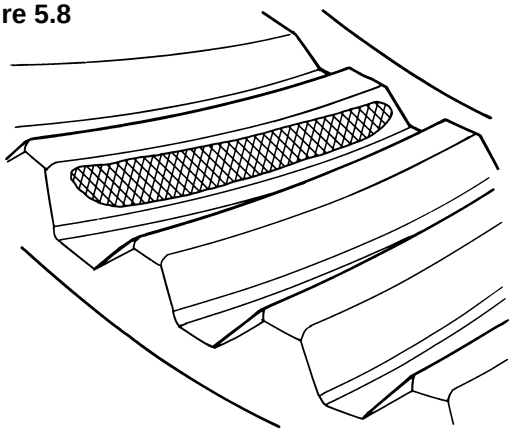


Correct Contact Patterns

The location of a good hand-rolled contact pattern for a new gear set is toward toe of gear tooth and in center, between top and bottom of tooth. **Figure 5.7.**

When carrier is being operated under load, pattern will extend approximately the full length of tooth. The top of pattern will be near top of gear tooth. **Figure 5.8.**

Figure 5.8



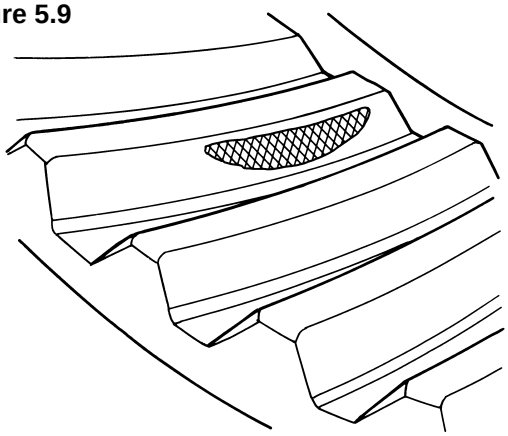
The location of a good hand-rolled pattern for a used gears set must match wear pattern in ring gear. The contact pattern will be smaller in area than the wear pattern.

Incorrect Contact Patterns

High Contact Pattern:

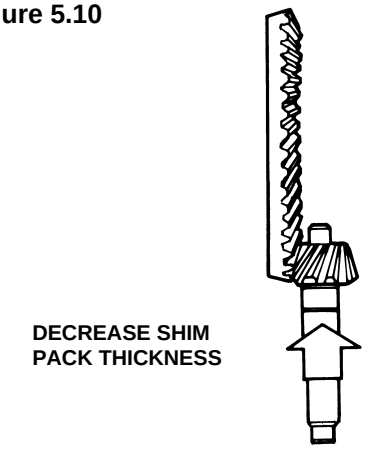
A high contact pattern indicated that drive pinion was not installed deep enough into carrier. **Figure 5.9.**

Figure 5.9



- To correct a high-contact pattern, decrease thickness of shim pack under bearing cage. This will move drive pinion toward ring gear. **Figure 5.10.**

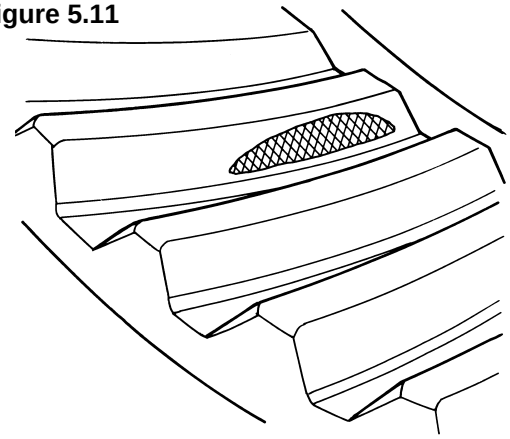
Figure 5.10



Deep Contact Pattern

A deep contact pattern indicates that the drive pinion was installed too far in the carrier.
Figure 5.11.

Figure 5.11



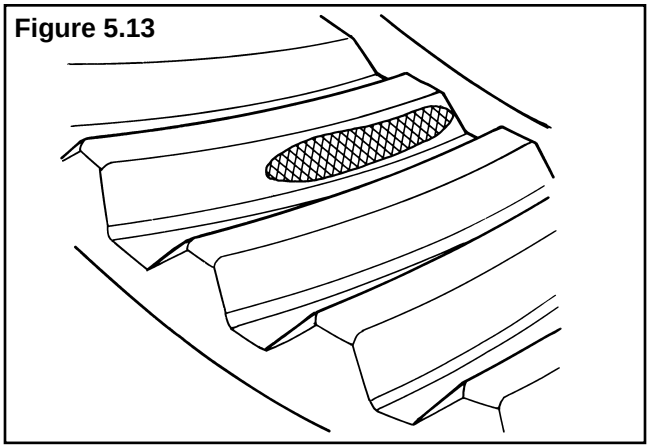
- To correct a deep contact pattern, increase thickness of shim pack under bearing cage. This will move the drive pinion away from the ring gear. **Figure 5.12.**

Figure 5.12

Variations Along Length of Gear Teeth

Adjust backlash of ring gear within specification range to move contact patterns to correct location along length of gear teeth.When toe contact pattern indicates that backlash is very low and gear is too close to drive pinion: **Figure 5.13.**

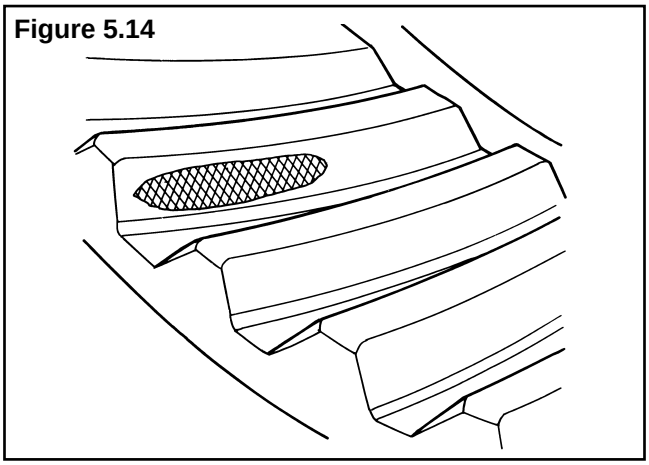
Figure 5.13



- Withdraw ring gear by decreasing shim pack thickness or loosening the gear side adjusting ring and tightening opposite side adjusting ring.

  When heel contact pattern indicates that backlash is very high and gear is too far away from drive pinion: **Figure 5.14.**

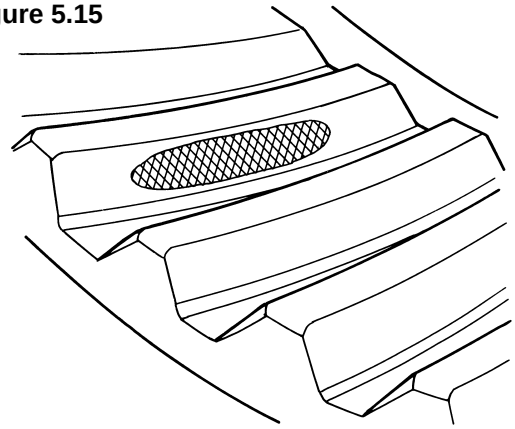
Figure 5.14



- Approach ring gear by increasing shim pack thickness or loosening gear opposite side adjusting ring and tightening gear side adjusting ring.

An acceptable contact pattern is centralized between toe and heel along the length of gear teeth. **Figure 5.15.**

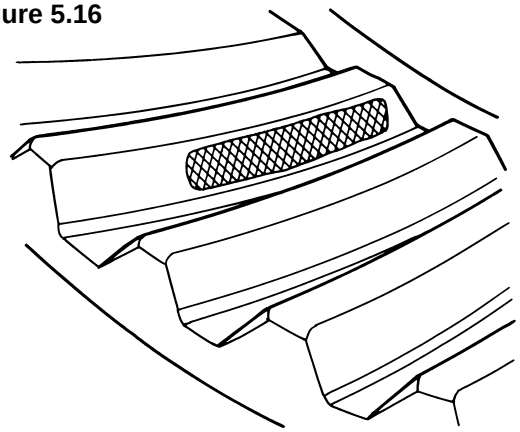
Figure 5.15



In cases where it is not possible to get a good contact pattern, the contact pattern shown in **Figure 5.15** is acceptable. If the acceptable contact pattern is not achieved, change the ring gear and pinion set.

Figure 5.16 indicates a good contact pattern. It is toward the toe and centralized between the top and bottom of the gear teeth.

Figure 5.16



Replace Lubricant

1. Install and tighten drain plug in central housing and brake housing. (T)
2. Clean area around fill/level plug. Remove fill/level plug from carrier inspection cover.

WARNING

- ***Use only the type of fluid specified by the equipment manufacturer. Do not use or mix different types of fluid. The wrong fluid will damage the rubber parts of the assemblies which could cause loss of braking and serious personal injury.***
- ***Do not reuse fluid. Used fluid can be contaminated and can cause incorrect operation which could result in serious personal injury.***

3. Add specified oil until oil level is even with bottom of fill/level hole. See Section 6, “Specifications.”
4. Install and tighten fill/level plugs. (T)
5. Road test vehicle in an unloaded condition for one-two miles (1.6-3.2 km) at speeds not more than 25 mph (40 kph). Check the lubricant levels and the torque of all fasteners.

PRA 352 Series Planetary Drive Axle
Oil Change Intervals and Specifications

Off-Highway Operation Intervals ①				Meritor Specification	Military Specification	Oil Description
Initial Oil Change	Check Oil Level	Petroleum Oil Change	Synthetic Oil Change			
100 operating hours ① or 1240-3100 miles (2000-5000 km) (whichever comes first)	250 operating hours ①	1,500 operating hours or twice a year (whichever comes first)	—	0-84	—	Petroleum Base SAE 10W, 20W or 10W/30 ②

NOTES:

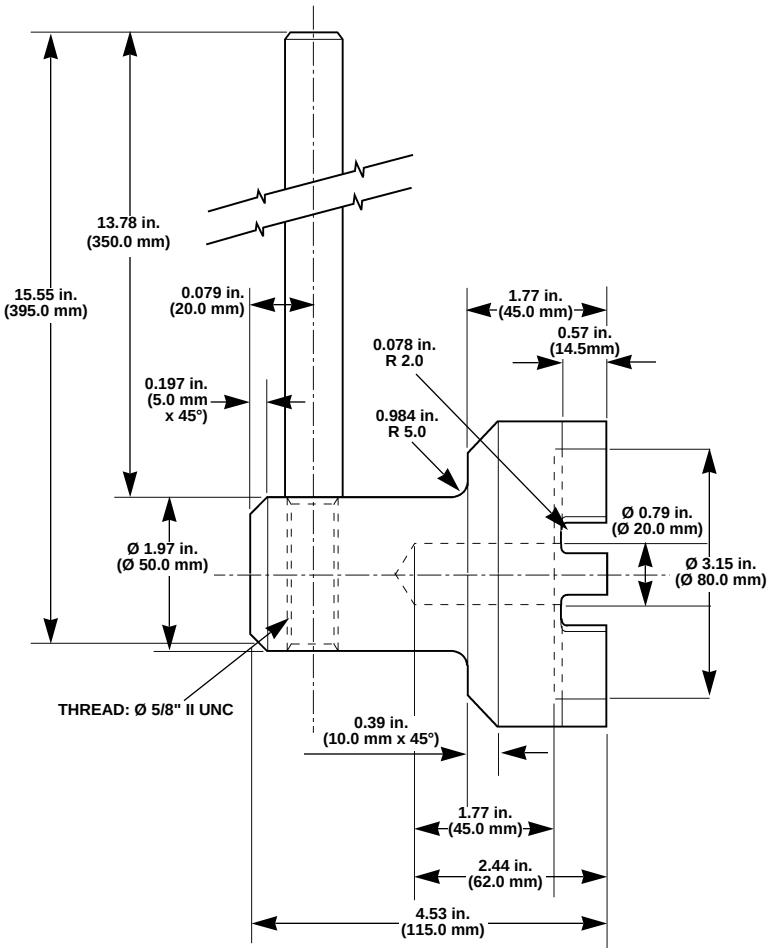
① The checking interval depends on the individual operating conditions, speeds and loads. Severe operating conditions may require more frequent intervals.

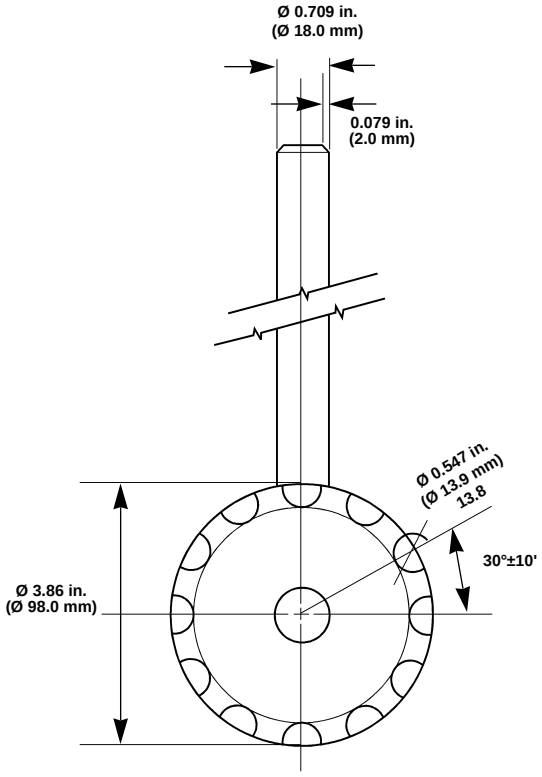
② Tractor oil universal fluid, 'TOU' types formulated for wet disc brakes, is recommended for use in the wet disc brake housing. Make sure that the specifications of the tractor fluid are the same as the recommended specifications of the vehicle manufacturer.

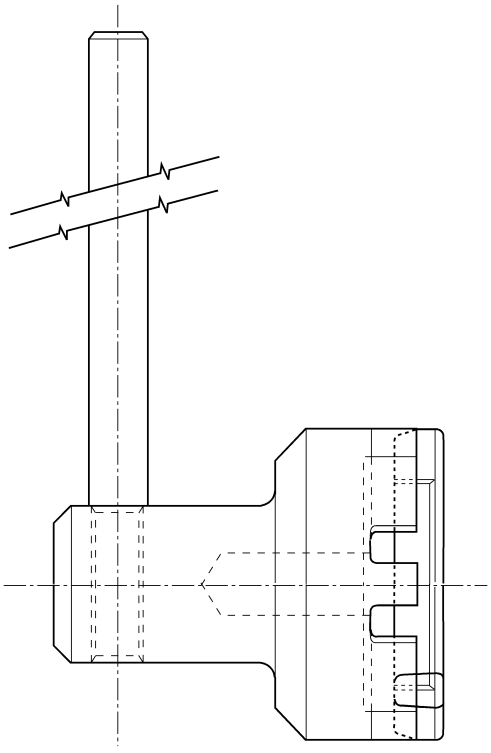
CAUTION

- ***The operating temperature of the coolant must never reach or exceed 250°F (120°C). If the operating temperature of the coolant reaches or exceeds 250°F (120°C), the internal components of the brake will be damaged. A forced cooling system may be required to assure the coolant temperature remains below 250°F (120°C).***
- ***Use only the brake hydraulic fluid specified by the manufacturer of the vehicle. Do not use different hydraulic fluids. The wrong fluid will damage the seals on the piston.***

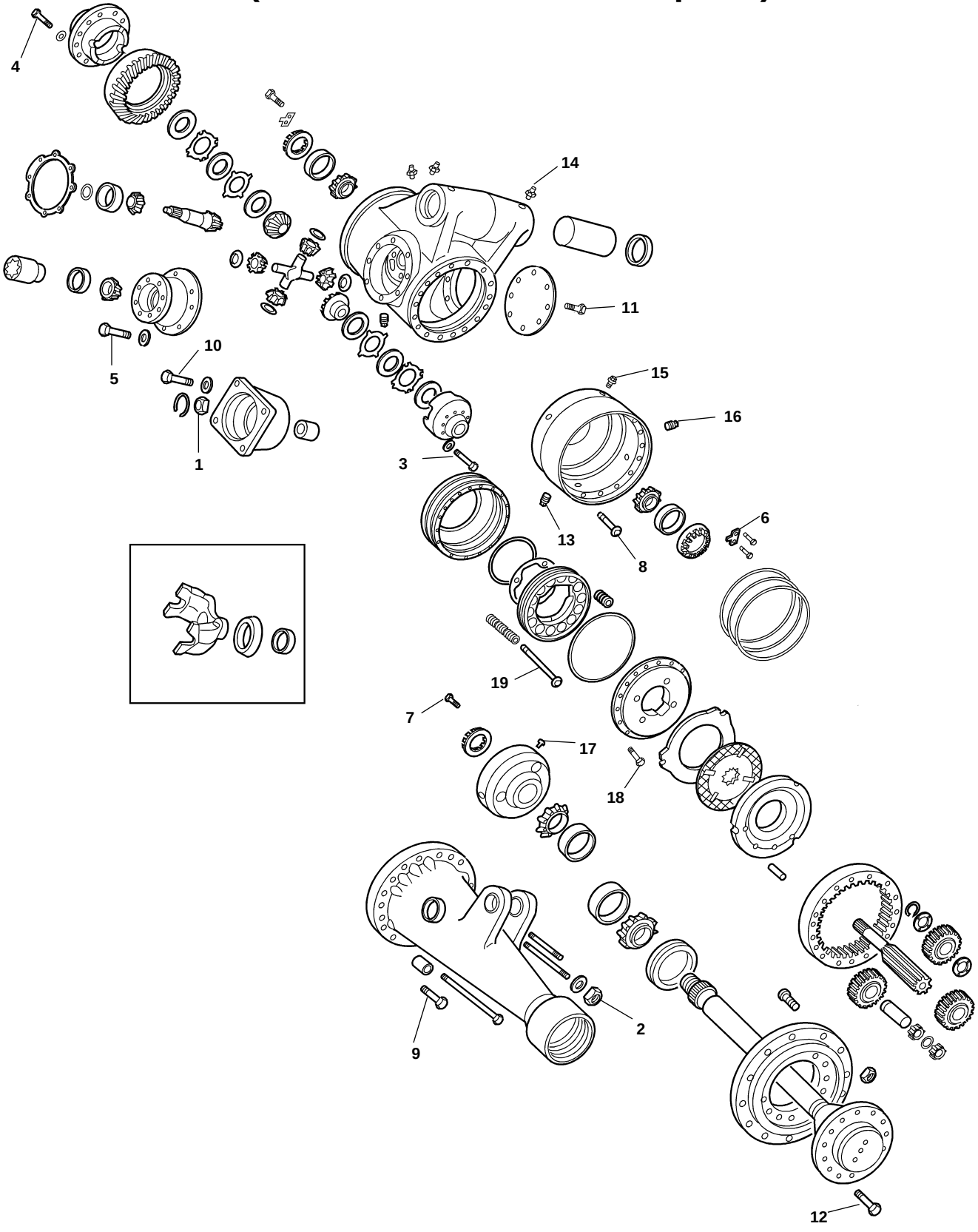
Nut Lock Special Tool







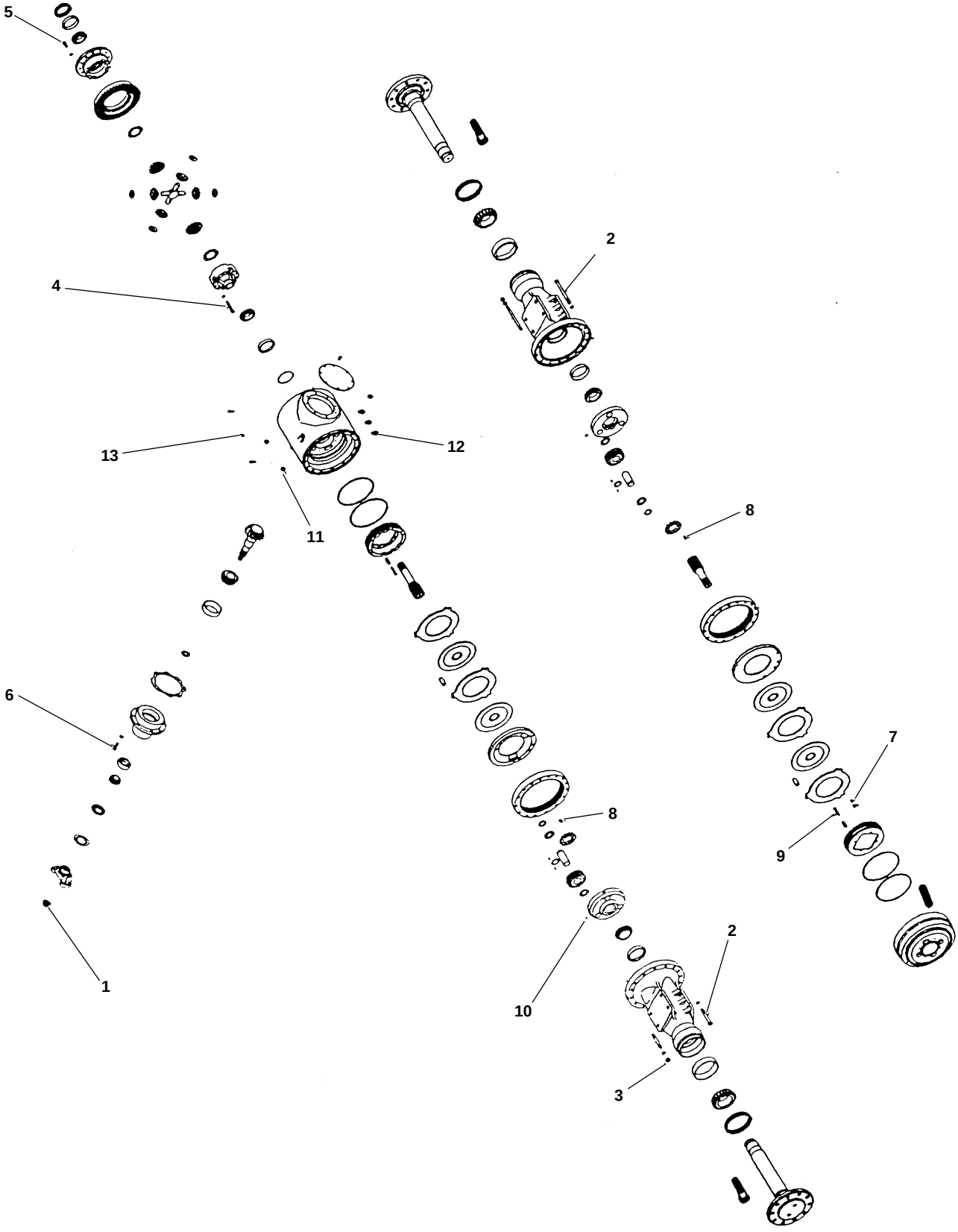
PROA 352/382 (With Mechanical Drive Option)



Torque Chart - PROA 352/382

ITEM	DESCRIPTION/THREAD	TORQUE
1	Pinion Nut - M24 x 1.5-6H	465-570 lb-ft (630-775 N•m)
2	Nut (Stud - Center Housing) M14 x 1.5-6H	120-150 lb-ft (160-205 N•m)
3	Capscrew (Differential Case) M10 x 1.5-8G	48-64 lb-ft (64-87 N•m)
4	Capscrew (Spiral Gear) M10 x 1.0-6G	66-75 lb-ft (90-100 N•m)
5	Capscrew (Pinion Cage) M12 x 1.75-8G	67-91 lb-ft (91-120 N•m)
6	Capscrew (Lock Adjuster Ring) M6 6G	80-115 lb-in (9.0-13.0 N•m)
7	Capscrew (Adjusting Nut Lock) M8 x 1.25-6G	17-23 lb-ft (23-30 N•m)
8	Capscrew (Brake Housing) M8 x 1.25-6G	19-26 lb-ft (26-36 N•m)
9	Capscrew (Brake Releaser) M12 x 1.75-6G	25-34 lb-ft (34-46 N•m)
10	Capscrew (Flange Adapter) .3750” x 16UNC2A	39.0-53.0 lb-ft (53-72 N•m)
11	Capscrew (Center Housing Cover) M8 x 1.25-6G	20-27 lb-ft (27-36 N•m)
12	Capscrew (Axle Shaft Flange) M20 x 1.5-6G	470-575 lb-ft (635-780 N•m)
13	Drain Plug	35 lb-ft (47 N•m)
14	Grease Fitting	31-40 lb-in (3.5-4.5 N•m)
15	Vent Plug	15 lb-ft (20 N•m)
16	Level Plug	35 lb-ft (47 N•m)
17	Capscrew (Planetary Pinion Axle) M10 x 1.5-6G	17-23 lb-ft (23-31 N•m)
18	Bolt (Action Plate) M6 x 1.5-6G	120-140 lb-in (13.5-16.0 N•m)
19	Capscrew (Return Spring) M6 x 1.0-6G	80-115 lb-in (9.0-13.0 N•m)

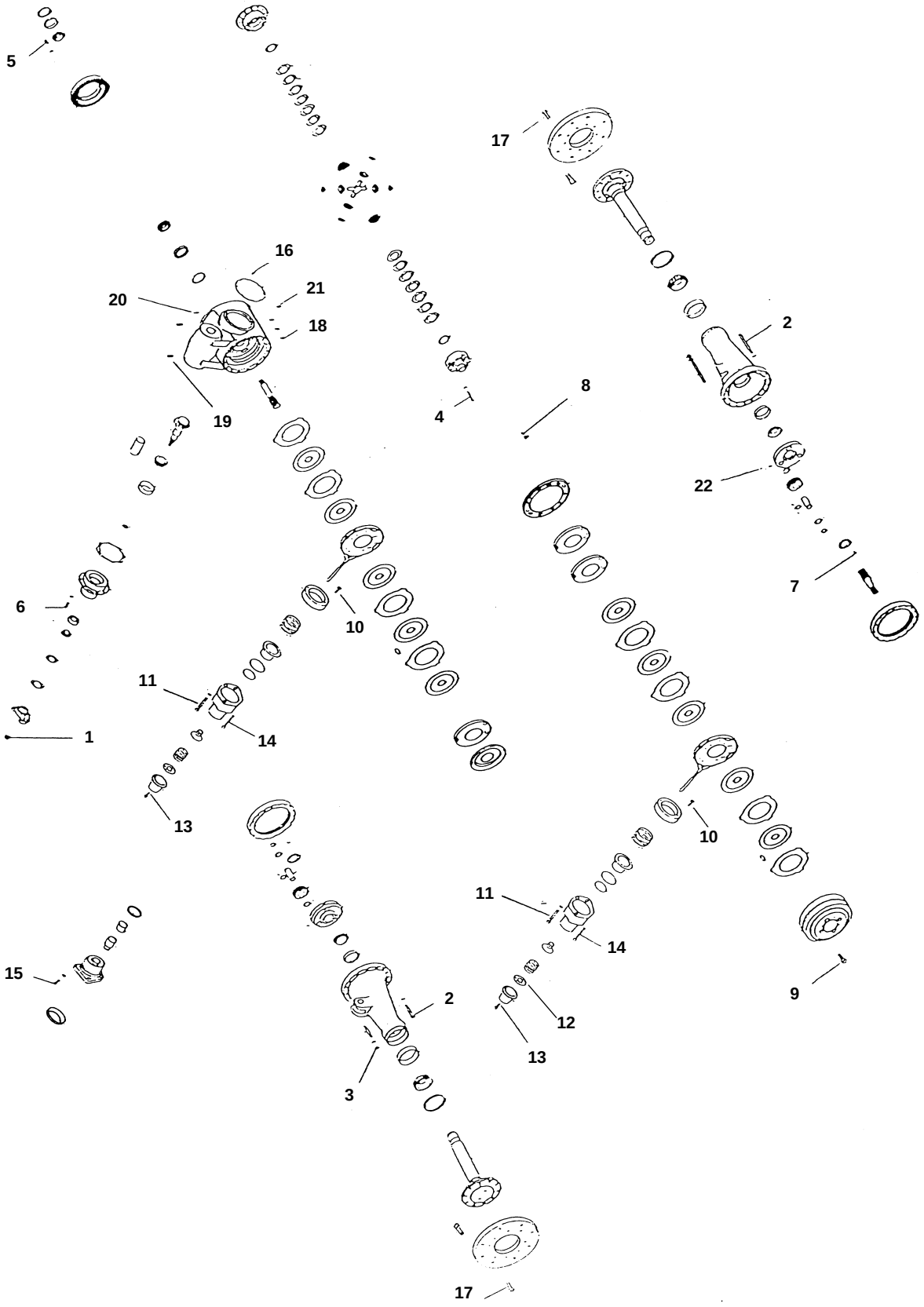
PRA 352 – Trumpet Variation No. 2



Torque Chart - PRA 352

ITEM	DESCRIPTION/THREAD	TORQUE
1	Pinion Nut - M24 x 1.5-6H	465-570 lb-ft (630-775 N•m)
2	Capscrew (Center Housing) - M14 x 1.5-6G	150-185 lb-ft (205-250 N•m)
3	Nut (Stud - Center Housing) - M14 x 1.5-6H	120-150 lb-ft (160-205 N•m)
4	Capscrew (Differential Case) - M10 x 1.5-6G	48-64 lb-ft (64-87 N•m)
5	Capscrew (Spiral Gear) - M10 x 1.0-6G	66-75 lb-ft (90-100 N•m)
6	Capscrew (Pinion Cage) - M12 x 1.75-6G	67-91 lb-ft (90-125 N•m)
7	Capscrew (Lock - Adjuster Ring) - M6-6G	80-115 lb-in (9-13 N•m)
8	Capscrew - Adjusting Nut Lock - M8 x 1.25-6G	17-23 lb-ft (23-31 N•m)
9	Bolt - Return Spring - M6 x 1.0-6G	80-115 lb-in (9.0-13.0 N•m)
10	Capscrew (Planetary Pinion Axle) - M10 x 1.5-6G	17-23 lb-ft (23-31 N•m)
11	Plug - Level - M24 x 1.5	35 lb-ft min. (47 N•m min.)
12	Plug - Drain - M24 x 1.5	35 lb-ft min. (47 N•m min.)
13	Plug - Vent - M12 x 1.5	15 lb-ft min. (20 N•m min.)

PROA 352 G2H, G2M



Torque Chart - PROA 352, G2H, G2M

ITEM	DESCRIPTION/THREAD	TORQUE
1	Pinion Nut - M24 x 1.5-6H	465.0-570 lb-ft (630-775 N•m)
2	Capscrew (Center Housing) M14 x 1.5-6G	180.0-215.0 lb-ft (245-290 N•m)
3	Nut (Stud - Center Housing) M14 x 1.5-6H	120-150 lb-ft (160-205 N•m)
4	Capscrew (Differential Case) M10 x 1.5-6G	48-64 lb-ft (64-87 N•m)
5	Capscrew (Spiral Gear) M10 x 1.0-6G	66-75 lb-ft (90-100 N•m)
6	Capscrew (Pinion Cage) M12 x 1.75-6G	67.0-91.0 lb-ft (91-120 N•m)
7	Capscrew (Lock Adjuster Ring) M6 6G	80.0-115.0 lb-in (9-13 N•m)
8	Capscrew (Adjusting Nut Lock) M8 x 1.25-6G	17-23 lb-ft (23-31 N•m)
9	Capscrew (Brake Housing) M8 x 1.25-6G	19-26 lb-ft (26-36 N•m)
10	Capscrew (Brake Cylinder Support) M8 x 1.25-6G	19-26 lb-ft (26-36 N•m)
11	Capscrew (Brake Cylinder) M10 x 1.5-6G	48-64 lb-ft (64-87 N•m)
12	Cover (Brake Cylinder) M80 x 1.5-6G	60-90 lb-ft (80-120 N•m)
13	Capscrew (Brake Cylinder Cover) M12 x 1.75-6G	22-30 lb-ft (30-41 N•m)
14	Capscrew (Brake Releaser) M12 x 1.75-6G	22-30 lb-ft (30-41 N•m)
15	Capscrew (Flange Adapter) .3750" x 16UNC2A	39.0-53.0 lb-ft (53-72 N•m)
16	Capscrew (Center Housing Cover) M8 x 1.25-6G	19-26 lb-ft (26-36 N•m)
17	Capscrew (Axle Shaft Flange) M20 x 1.5-6G	470-575 lb-ft (635-780 N•m)
18	Drain Plug	35.0 lb-ft (47 N•m)
19	Grease Fitting	10.0 lb-ft (14 N•m)
20	Vent Plug	15.0 lb-ft min. (20 N•m min.)
21	Level Plug	35.0 lb-ft min. (47 N•m min.)
22	Capscrew (Planetary Pinion Axle) M10 x 1.5-6G	17.0-23.0 lb-ft (23-31 N•m)

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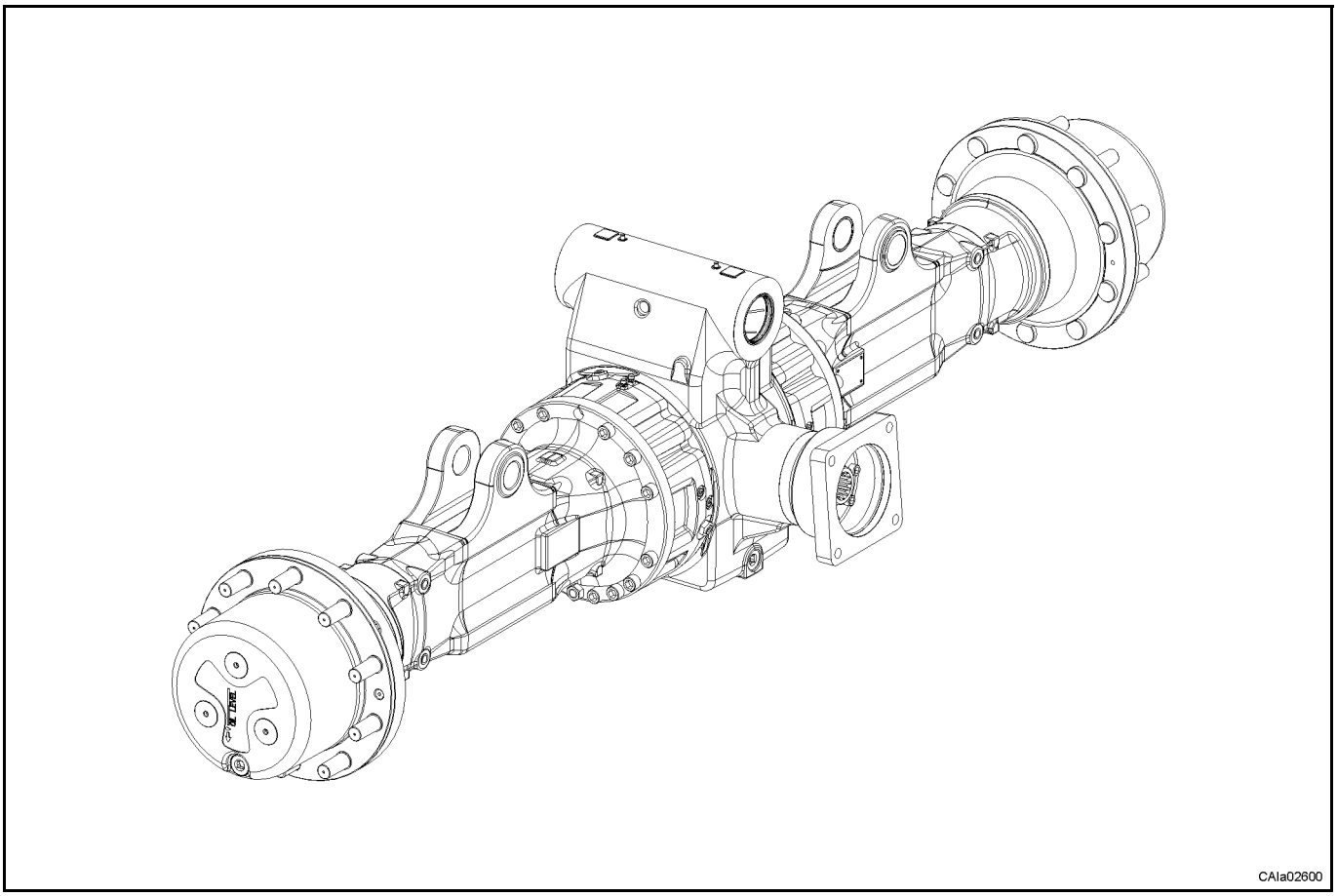

MANUALE DI RIPARAZIONE

REPAIR MANUAL

ASSALE ANTERIORE - *FRONT AXLE*

Mod. 28.46M

Rif. CA144840

Edition date: 12/2002

P/N: CA357248

Indice

Index

A INFORMAZIONI GENERALI

A *GENERAL INFORMATION*

A.1 Utilizzo del manuale

Destinatari

- Installatore.
- Utilizzatore.
- Manutentore.

Manutenzione

PRENDERE VISIONE DI TUTTO IL MANUALE poiché il buon funzionamento ed il rendimento degli organi meccanici dipendono principalmente da una costante e corretta manutenzione e assicurano la durata e l'integrità del prodotto.
Nell'eventualità di guasti od anomalie il tempestivo intervento da parte di personale specializzato garantisce una durata più lunga del gruppo, evitando danni maggiori nel tempo.

Riparazione

Le procedure per lo smontaggio/montaggio consentono di eseguire la revisione totale del prodotto e sono descritte in sequenza con l'ausilio di illustrazioni, per una guida completa e sicura all'esecuzione di ogni operazione.
Nella descrizione delle operazioni si presuppone che il gruppo sia stato rimosso dal veicolo. Per la rimozione dal veicolo si dovrà consultare il manuale fornito a tale proposito dal costruttore del veicolo stesso.
La conoscenza approfondita del prodotto consente la corretta valutazione del tipo di intervento da eseguire, che può richiedere solamente lo smontaggio di alcuni componenti operando solo parzialmente nel gruppo.

A.1 Manual use

End users

- *Installer*
- *User*
- *Maintenance operator*

Maintenance

CONSULT THIS MANUAL THOROUGHLY, as proper functioning and good efficiency of mechanical organs depends mostly on constant and correct routine maintenance ensuring product integrity and expected life duration.
In case of any damages or anomalies, quick intervention of specialized personnel can avoid future impairment and lengthen the working life.

Repair

The disassembly/assembly procedures have been outlined for a total product overhauling. They have also been described in sequence through photographs with relevant explanation for specific interventions, thus obtaining a complete and safe guide for each and every phase of an operation.
Operation description presumes that the unit has already been removed from the vehicle. The manual supplied by the vehicle manufacturer should be consulted in case of a overhauling or maintenance intervention requiring the removal of the machine.
Moreover, the attentive product inspection leads to a correct repair work estimation that could merely require dismounting only few components, and thus operating partially on the group.

A.2 Proprietà delle informazioni

Questo manuale contiene informazioni di proprietà riservata. Tutti i diritti sono riservati.

Questo manuale non può essere riprodotto o fotocopiato, tutto o in parte, senza il preventivo consenso scritto di CARRARO S.p.A. L'uso di questo materiale documentale è consentito solo al cliente a cui il manuale è stato fornito come corredo del prodotto, e solo per scopi di uso, manutenzione e riparazione.

CARRARO S.p.A. dichiara che le informazioni contenute in questo manuale sono congruenti con le specifiche tecniche e di sicurezza della macchina a cui il manuale si riferisce. Il fabbricante non si assume alcuna responsabilità per danni diretti o indiretti a persone, cose o animali, conseguenti all'uso di questo materiale documentale o della macchina in condizioni diverse da quelle previste.

A.2 Information property

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A.3 Convenzioni e definizioni

Convenzioni

Le illustrazioni nel manuale NON sono in scala quindi NON sono attendibili valutazioni delle dimensioni dei componenti basate sulle stesse.
Le illustrazioni hanno il compito di evidenziare le corrette procedure da condurre sulla macchina e sui suoi componenti, per questo potrebbero non rappresentare esattamente gli elementi di questa macchina ma componenti meccanici simili.

Definizioni

Lato sinistro: parte sinistra del gruppo vista nel senso di marcia del veicolo.
Lato destro: parte destra del gruppo vista nel senso di marcia del veicolo.

Convenzioni tipografiche

Nota: informazioni importanti, evidenziate al di fuori del testo a cui si riferiscono.
Attenzione: procedure la cui totale o parziale inosservanza può produrre danni alla macchina o alle apparecchiature ad essa collegate.
Pericolo: procedure la cui totale o parziale inosservanza può produrre lesioni o danni alla salute dell'operatore.

Unità di misura

Nel manuale si utilizzano le unità di misura del sistema internazionale (SI). Per la conversione al sistema anglosassone riferirsi alla seguente tabella.

Tabella di conversione

S.I.		GB/USA SYSTEM	
1	(mm)	0.03937	(in)
10	(mm)	0.3937	(in)
25.4	(mm)	1	(in)
6.4516	(cm²)	1	(sq. in)
1	(m²)	1550	(sq. in)
16.378	(cm²)	1	(cu. in)
0.473	(dm²)	1	(U.S. pint)
1	(l)	61.02	(cu. in)
1	(l)	0.2642	(U.S. gal)
1.772	(g)	1	(oz)
0.4536	(kg)	1	(lb)
0.00070308	(kg/mm²)	1	(lb/sq. in)
1	(bar)	14.51	(psi)
1	(kg.m)	7.246	(lb.ft)
1(daN)= 10 (N)= 1,02 (kg.f)		2.24	(lb.f)

A.3 Agreements and definitions

Agreements

Illustrations like pictures, drawings and components of this manual are NOT in scale, because of limited space and editing limits, therefore they are NOT reliable to obtain values about size or weight.
Illustrations are supposed to point out the correct methods to working on the machine and its components, therefore they could not display exactly the same elements.

Definitions

***Left side:** it is the left side of the unit considering the vehicle running conditions.*
***Right side:** it is the right side of the unit considering the vehicle running conditions.*

Typographic agreements

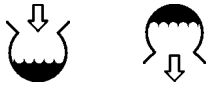
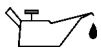
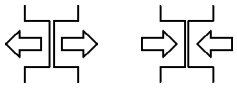
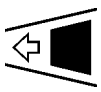
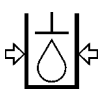
***Note:** The notes, pointed out externally to the text they refer, include important information.*
***Warning:** Warning indications point out the procedures, whose partial or complete non-observance can damage the machine or the connected equipment.*
***Danger:** Danger indications point out the procedures, whose partial or complete non-observance can injure the operator.*

Measurements

This manual indicates all measurements in International System (SI). Use the following conversion table to convert Imperial Measure.

Conversion table

Simbologia ***Symbology***

DESCRIZIONE	SIMBOLI / SYMBOLS	DESCRIPTION
ATTENZIONE/PERICOLO		WARNING/DANGER
RIMOZIONE/INSTALLAZIONE anelli-guarnizioni-filtri		REMOVE/INSTALL seals-gaskets-filters
RIEMPIMENTO o RABBOCCO OLIO/ SCARICO OLIO		OIL FILLING OR OIL LEVEL/OIL DRAIN
LUBRIFICAZIONE/INGRASSAGGIO		LUBRICATION/GREASING
REGOLAZIONE/MISURAZIONE coppie di serraggio-precarichi-giochi		ADJUSTMENTS/MEASUREMENTS tightening torques-preloads-backlash
ATTREZZATURE SPECIALI		SPECIAL TOOLS
APPLICAZIONE SIGILLANTI/COLLANTI		SEALING/LOCKING FLUIDS APPLICATION
TRACCIATURA		MARKING
SMONTAGGIO/MONTAGGIO DI PARTICOLARI INGOMBRI O SOTTOGRUPPI		DISASSEMBLY/ASSEMBLY OF BULKY PARTS OR SUBASSEMBLIES
ATTENZIONE: rispettare il verso di montaggio		WARNING: respect assembly orientation
PULIRE ACCURATAMENTE		CLEANING CAREFULLY
IMMETTERE FLUIDO IN PRESSIONE		APPLY PRESSURIZED FLUID

A.4 Indicazioni generali

La macchina deve essere controllata e/o riparata solo da personale tecnico specializzato che sia a conoscenza delle sue particolari caratteristiche e delle relative norme di sicurezza (prevenzione infortuni).

Prima di svolgere qualsiasi operazione, pulire accuratamente il gruppo rimuovendo eventuali incrostazioni ed accumuli di terriccio e/o grasso.

Tutti gli organi meccanici smontati devono essere accuratamente puliti con prodotti adeguati, per evitare possibili danni. Verificarne l'integrità, sostituendoli in caso di danni, usura, incrinature, grippaggi o difetti che potrebbero comprometterne il buon funzionamento.
In particolar modo si deve verificare l'integrità delle parti in movimento (cuscinetti, ingranaggi, alberi) e delle parti di tenuta (anelli OR, anelli di tenuta), soggette a maggiori sollecitazioni, usura, invecchiamento.
Si raccomanda di sostituire ad ogni revisione o riparazione gli organi di tenuta.
Si ricordi che l'eventuale sostituzione di un componente della coppia conica comporta la sostituzione anche dell'altro.

Utilizzare solo le parti di ricambio e la viteria indicate, inoltre usare utensili metrici per la viteria metrica e inglesi per la viteria inglese.

Come indicato, alcune operazioni sono distruttive per gli elementi rimossi. Leggere attentamente le descrizioni delle varie fasi dell'intervento ed operare con attenzione per non compromettere la funzionalità di altri elementi.

A.4 General description

The machine should be checked and/or repaired only by qualified technicians, acquainted with its peculiar features and well aware of all safety instructions.

Before performing any operation it is advisable to carry out unit cleaning accurately by removing oil/ grease encrustations and accumulation.

All disassembled mechanical parts must be cleaned accurately with suitable products to avoid possible damage. Parts should be replaced if damaged, worn out, cracked, seized, etc. as they could affect proper working.
Rotating parts (bearings, gears, shafts) and that of hardware/fasteners (O-Ring, oil seals) should be examined carefully, as they are subject to major stress, wearing and ageing.
We highly advise to replace tightening parts during every teardown or repair.
In case of replacement of one part of the bevel gear set this operation requires the replacement of the other part too.

Use appropriate spare parts, nuts and bolts to avoid any other problems. Moreover, use metric tools for metric nuts and bolts and Imperial tools for the others.

Some repairs are destructive for some axle components. Carefully reading and thorough understanding of these instructions will avoid damage to other components unnecessarily.

A.5 Indicazioni generali per le operazioni di riparazione

Prima di iniziare le operazioni di smontaggio e montaggio leggere attentamente le seguenti avvertenze.

Anelli di tenuta per alberi

Per il montaggio degli anelli di tenuta attenersi alle seguenti raccomandazioni:
- Pulire accuratamente l'albero ed assicurarsi che non sia danneggiato, rigato od ovalizzato nelle zone di contatto con gli anelli.
- Montare gli anelli in modo che il labbro sia rivolto verso il lato olio.
- Lubrificare il labbro degli anelli (usare preferibilmente olio) e riempire per 3/4 di grasso la camera degli anelli stessi.
- Montare gli anelli usando un appropriato calettatore. Non usare il martello direttamente sugli anelli.
- Non danneggiare gli anelli durante il montaggio dell'albero.

Anelli OR

Lubrificarli adeguatamente prima di inserirli nella propria sede evitando "arrotolamenti" durante il montaggio dell'albero.

Spessori di registro

Per le registrazioni utilizzare gli appropriati spessori di registro, misurandoli singolarmente.
La misurazione del pacco completo o la stampigliatura riportata sugli spessori stessi può risultare non sempre affidabile: verificare.

Cuscinetti

Per un corretto montaggio è consigliabile riscaldarli in forno ad una temperatura di 80°C - 90°C prima di montarli sui rispettivi alberi o raffreddarli prima di inserirli nelle relative sedi con piantaggio esterno.
Usare sempre gli estrattori idonei per rimuovere i cuscinetti.
Prima di rimontarli, pulirli, ispezionarli e lubrificarli.

Spine elastiche

Al montaggio delle spine elastiche ad intaglio assicurarsi che l'intaglio delle stesse sia orientato nel senso dello sforzo sollecitante la spina. Le spine elastiche a spirale invece non necessitano di alcun orientamento.

Sigillante

Usare sigillanti secondo le specifiche. Assicurarsi che le parti da sigillare siano pulite, asciutte e completamente prive di grasso.

A.5 Recommendations for repair operations

Before starting any disassembly and assembly operations, read carefully the following recommendations.

Shafts seals

Respect the following recommendations during shaft seal assembly:
- Clean shaft very carefully and ensure that the part in contact with the shaft seal is not damaged, cut or out of roundness.
- Assemble the seals so that the lip is fitted towards the oil side.
- Lubricate seal lips (use oil) and fill 3/4 of seal cavity with grease.
- Use appropriate drivers. Do not use a hammer directly on the seals.
- Do not damage the seals while assembling the shaft.

O-rings

Lubricate adequately before inserting them at the right place and avoid o-ring rolling while inserting the shaft.

Adjusting shims

Use appropriate adjusting shims and measure each one separately.
Complete group measurement or stampings on the shims are not always reliable: check.

Bearings

Its advisable to heat up bearings to 80°C - 90°C before assembling them onto their respective shafts or to cool them (dry ice) before inserting them into corresponding bore.
Always use suitable extractors to remove the bearings.
Before reassembling the bearings, clean, check and lubricate them.

Split pins

Before assembling elastic pins, make sure that the notch is oriented towards the stressing force.
Spiral elastic pins do not need orientation.

Sealing

Use sealing as advised by specifications. Ensure that parts to be sealed are clean, dry and completely grease free.

Scarico dell'olio

Prima di intervenire sul prodotto è necessario scaricare l'olio dal gruppo.
Attenzione: smaltire gli oli esausti nel rispetto delle vigenti norme.

Oil drain

Before disassembly, oil should be drained out.

***Warning:** disposal of used oil must be done according to laws.*

Pulizia

Lavare accuratamente tutte le parti in movimento relativo (ingranaggi, cuscinetti, ecc.) utilizzando gasolio o cherosene.
E' da evitare l'uso di benzina e soluzioni acquose alcaline. Evitare lavaggi con vapore o acqua calda perché sarebbe difficile eliminare completamente l'umidità superficiale.
Asciugare accuratamente tutti i particolari mediante un getto d'aria o stracci per evitare di rigare le superfici con residui abrasivi.
Tutte le superfici devono essere ricoperte da un leggero strato di lubrificante per proteggerle da eventuali ossidazioni.

Cleaning

Wash all moving parts (gears, bearings, etc.) accurately with diesel fuel or kerosene.
Avoid gasoline and watery alkaline solutions. Do not wash with steam or hot water, as it will be very difficult to eliminate surface humidity.
Dry all parts with a rag or air jet to avoid scratching from abrasive residuals.
All surfaces should be covered with lubricant so as to protect it from future oxidation.

Controlli

Verificare accuratamente tutti i cuscinetti, gli anelli esterni eventualmente ancora piantati nelle proprie sedi e i perni su cui rotolano i rullini. Sostituire quei particolari che presentano tracce di usura o di danneggiamento.
Controllare che tutti gli ingranaggi non presentino avarie od usure eccessive delle dentature: gli smussi dei denti non devono essere deteriorati.
Controllare che tutti i tratti scanalati siano privi di usure eccessive o di altri danneggiamenti.
Sostituire i particolari avariati con ricambi originali.
Dopo ogni smontaggio è buona norma sostituire le guarnizioni di tenuta sugli alberi rotanti.

Checks

Examine accurately all bearings, external rings which may be still stuck in their position and pivot pins on which rolls rotate. Replace those which are worn out or damaged.
Gears should not be spoiled and teething should not be excessively worn out. Teeth smoothing should not be deteriorated.
Check all grooves: assure that they are not worn out or damaged.
Replace spoiled parts with original spare parts.
Replace seals on rotating shafts, before reassembly.

Estremità di flange ed attrezzi

Prestare la massima attenzione quando si martellano le estremità di attrezzi o di flange per evitare di compromettere la funzionalità e l'integrità sia degli attrezzi che dei componenti su cui si opera.

Ends of flanges and tools

Be careful when hammering tool or flange ends, in order to avoid jeopardizing functionality and integrity of either the tools or the components on which you are operating.

Metodi di riassemblaggio

Per riassemblare il gruppo si deve impiegare un'adeguata attrezzatura di sostegno.
Per posizionare il gruppo, per smontare e rimontare la corona dentata e per sostenere la scatola ingranaggi è necessario un sistema di sollevamento.
Per facilitare le operazioni di smontaggio e montaggio utilizzare un disegno di assieme del gruppo.

Reassembly methods

In order to reassemble the group, an appropriate fixture must be used.
In order to position the group, to disassemble and reassemble the ring gear and to support the gear housing, a lifting system is needed.
To make disassembling and assembling operations easier, use a group assembly drawing.

Impiego di lubrificante

Per ottenere una corretta lubrificazione ed una esatta temperatura di funzionamento negli assali CARRARO, è importante usare i lubrificanti raccomandati (Sez.C.4), mantenendone il livello costante secondo quanto indicato nel presente manuale.

Lubricant use

In order to lubricate the CARRARO axles correctly and to reach the exact operation temperature, it is important to use the recommended lubricants (Section C.4), keeping their level constant as indicated in this manual.

B INFORMAZIONI SULLA SICUREZZA

B SAFETY INSTRUCTIONS

B.1 Indicazioni generali per la sicurezza

IMPORTANTE:
Prima di iniziare qualsiasi tipo di operazione leggere attentamente questo capitolo.

Precauzioni per la sicurezza:

Il corretto uso e la corretta riparazione dei prodotti Carraro e dei loro componenti sono molto importanti per la sicurezza e l'affidabilità.
Le procedure raccomandate e descritte in questo manuale sono testate, quindi sono effettivi metodi operativi. Seguire strettamente ogni procedura facendo uso sia del testo che delle illustrazioni.
Alcune di queste procedure mostrano l'uso di appositi strumenti progettati perché le operazioni vengano condotte in modo chiaro e corretto.
Alcuni strumenti specifici devono essere usati dove necessario per eseguire determinate operazioni.
E' impossibile trattare ogni metodo di lavoro o tutte le possibili metodologie per svolgerlo e le rischiose conseguenze di ognuna, perciò chi usa procedure o strumenti non consigliati deve sapere che la sicurezza dell'operatore e del veicolo saranno messi a repentaglio.

Pericolo

Gli occhiali di sicurezza devono essere indossati sempre durante l'esecuzione di tutte le operazioni di montaggio o smontaggio.

B.1 General safety recommendations

IMPORTANT:
Before proceeding with any operations please read this chapter very carefully.

Safety precautions:

Correct use and repair of Carraro products and of their components is very important for safety and reliability.
Recommendations and all described procedures given in this manual have been experimented and hence are effective operational methods. Please follow every procedure. Use the text as well as the illustrations.
Certain procedures show use of special tools, designed so that the operations can be carried out in a clear and correct manner.
Special tools must be used when a particular operation is being carried out.
It is impossible to advise every working method or know all possible methodologies for carrying it out or to predict risky consequences of each operation. Hence, performing procedures or using instruments which have not been advised could be dangerous for the operator/ mechanic as well as the vehicle.

Danger

Safety goggles must be worn while carrying out every assembling or disassembling operations.

B.2 Simboli di sicurezza

Identificazione delle informazioni sulla sicurezza

Questo è il simbolo di allarme per la sicurezza; quando lo trovate sulla macchina o sul manuale, siete avvisati del pericolo potenziale di incidenti o danni alla persona. Seguite i suggerimenti e le raccomandazioni per operare in sicurezza.

Significato delle scritte di avvertimento

PERICOLO

AVVISO

ATTENZIONE

Una scritta di avvertimento (PERICOLO, AVVISO o ATTENZIONE), viene usata sulla macchina insieme al simbolo di allarme per la sicurezza.
I segnali PERICOLO o AVVISO sono utilizzati vicino ad aree pericolose. PERICOLO identifica la situazione più pericolosa.
Precauzioni generali sono invece segnalate da ATTENZIONE.

Seguire le istruzioni di sicurezza !

Leggere con cura tutti i messaggi sulla sicurezza di questo manuale.

Modifiche non autorizzate possono compromettere il funzionamento, la sicurezza d'impiego e la durata.
Se non comprendete le istruzioni del manuale, contattate il rappresentante a voi più vicino.

B.2 Safety symbols

Recognize safety information

This is the safety alarm symbol; whenever you find it in the manual or see it on the machine, you are being warned about potential danger of accidents or harm to personnel. Follow the do's and don't's to operate in total safety.

Understanding written warnings

DANGER

WARNING

CAUTION

Written warning (DANGER, WARNING or CAUTION) is used along with an alarm symbol on the machine.
DANGER or WARNING signs are used near danger zones, while CAUTION sign indicates general precaution.

Follow safety instructions !

Read all suggestions given in this instruction manual very carefully.

Unauthorized changes could endanger the functioning, work safety and work span.
If you do not understand this instruction manual, contact the nearest sales representative.

B.3 Precauzioni generali

In ogni movimento dovranno essere osservate le norme sulla prevenzione infortuni, tutte le regole generali di sicurezza e di medicina del lavoro.
Prima di procedere nelle operazioni di manutenzione o sistemazione di eventuali problemi, assicurarsi del buon stato e del buon funzionamento delle attrezzature quali banchi di sostegno, cavalletti, martelli, leve, estrattori e chiavi apposite facilitando le operazioni da svolgere in modo ottimale riducendo i rischi sia per gli organi ed i componenti del prodotto che della incolumità dell'operatore.
Tutte le modifiche arbitrarie apportate al prodotto sollevano la CARRARO SpA da ogni responsabilità per qualsiasi danno o incidente.
Il prodotto, se utilizzato in un impiego diverso da quello previsto, è da considerarsi soggetto a "uso non previsto". CARRARO SpA declina ogni responsabilità per danni o incidenti risultanti da un uso diverso da quello previsto; tali conseguenze saranno a carico esclusivo del cliente.

Norme per la manutenzione in sicurezza

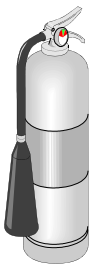
1 Operare in ambiente pulito e asciutto.
2 Non lubrificare, manipolare o registrare il gruppo in moto.
3 Tenere lontani mani, piedi, indumenti da parti in movimento.
4 Essere sempre pronti per i principi di incendio. Tenere a portata di mano estintore e cassetta di pronto soccorso.
5 Tenere in evidenza il n° di telefono di un medico, ambulanza, ospedale e vigili del fuoco presso il proprio telefono.

B.3 General precautions

Observe safety instructions, accident prevention rules and all general safety regulations in each and every step at work.
Before going ahead with maintenance or repair work ensure that all the tools, the supporting bench, stands, levers, extractors and spanners are in good condition so that the work can be carried out easily.
Risks to various parts and components will also be reduced in this way and working condition for the operator will also be safer.
CARRARO SpA declines any responsibility in case of an accident or damage resulting due to changes made arbitrarily on product.
The product is used for any other purpose different from the one foreseen, than CARRARO SpA declines any responsibility.
In this case all consequences will be at the customer's expense.

Safety maintenance rules

1 Operate in a clean and dry environment.
2 Do not lubricate, handle or adjust the group underway.
3 Keep your hands, feet and clothing away from moving parts.
4 Always be prepared for fires. Keep the extinguisher and the first aid kit within reach.
5 Keep the phone numbers of a doctor, an ambulance, a hospital and the fire department within reach near the telephone set.



6 Usare indumenti e protezioni adatte allo scopo come: tuta, guanti protettivi e cuffie.
7 Usare protezioni auricolari appropriate a salvaguardare l'udito, come tappi o cuffie per le orecchie contro rumori molesti o fastidiosi.

6 Wear suitable clothing and protection such as overalls, safety gloves and ear safety devices.
7 Use suitable ear protection, like ear plugs, to keep out noise and prevent injury to the ears.

Una prolungata esposizione al rumore può danneggiare l'udito.

8 Le attrezzature richiedono la piena attenzione dell'operatore. Non usare cuffie per ascoltare musica mentre si interviene sul prodotto o gruppo.

Eliminazione dei rischi residui

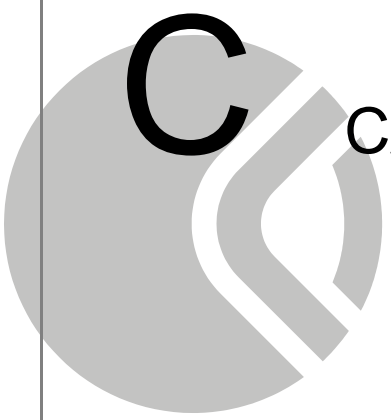
- Rischio di schiacciamento e cesoiamento dovuto alla presenza di elementi in movimento.
  Attenzione
  Eseguire tutte le operazioni di manutenzione a macchina ferma.
- Rischio dovuto all'inalazione di gas nocivi che si possono sviluppare scaldando le vernici durante eventuali saldature.
  Attenzione
  Utilizzare postazioni di lavoro dotate di sistemi di evacuazione di polveri e fumi.
  Lasciate disperdere i fumi per almeno 15 minuti prima di saldare o riscaldare, o riprendere a lavorare sul gruppo.
- Rischio di incendio dovuto ai solventi utilizzati e all'olio presente.
  Attenzione
  Tenere lontano dalla zona di lavoro ogni fonte di calore.
  Quando si usano solventi o svernicianti, rimuoverli con acqua e sapone prima di saldare.
  Rimuovere i contenitori di solvente, sverniciante o altri prodotti infiammabili dall'area di lavoro.
- Rischio dovuto alla caduta, allo sganciamento o alla violenta espulsione di oggetti od olio.
  Attenzione
  Questi rischi residui e le procedure per eliminarli completamente, sono evidenziati dettagliatamente nelle procedure di montaggio e smontaggio. Seguire attentamente, durante la manutenzione, tutte le procedure di sicurezza indicate nel manuale.

A prolonged exposure to noise can damage your hearing.

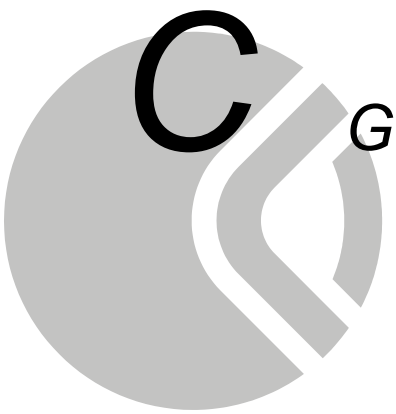
8 The operator must be very careful with the equipment. Do not use headphones to listen music while you are working on the product or on the group.

Residual risk elimination

- *Risk of squashing and shearing due to the presence of moving parts.*
  Warning
  Carry out all maintenance operations when the machine is stationary.
- *Risk due to inhalation of poison gases that can be produced by heating the varnishes during any welding.*
  Warning
  Use work stations equipped with dust and fume discharging systems.
  Let the fumes disperse for at least 15 minutes, before welding or reheating, or working on the group again.
- *Risk of fire due to the solvents used and to the oil in the machine.*
  Warning
  Keep away any heat sources from the working area. When solvents or paint removers are used, they should be removed with soap and water, before welding.
  Remove any containers of solvent, paint remover or any other inflammable products from the working area.
- *Risk due to fall, drop or violent ejection of objects or oil.*
  Warning
  These residual risks and the suitable relative procedures to eliminate them completely are pointed out, in detail, in the assembly and disassembly procedures. During maintenance, follow carefully all the safety procedures indicated in the manual.



C CARATTERISTICHE GENERALI



C *GENERAL SPECIFICATIONS*

C.1 Usi previsti

Questo assale è stato progettato e costruito, secondo specifiche fornite dal cliente, per essere installato in veicoli di tipo industriale con la funzione di trasmettere la potenza dal motore alle ruote, consentendo anche:

- l'aumento della forza di trazione con riduzione del numero di giri;
- la compensazione della velocità delle ruote interne con quelle esterne durante la sterzata.

Non installare mai questo assale su macchine diverse da quelle per cui e stato progettato e costruito.

L'assale, se utilizzato in un impiego diverso da quello previsto, è da considerarsi soggetto ad "uso non previsto".
CARRARO SpA declina ogni responsabilità per danni o incidenti risultanti da un uso diverso da quello previsto; tali conseguenze saranno a carico esclusivo del cliente.
Costituisce inoltre un elemento essenziale, nell'ambito dell'uso previsto, l'osservanza scrupolosa delle modalità di funzionamento e delle regolari manutenzioni e riparazioni specificate da CARRARO SpA.

C.1 Foreseen uses

This axle has been designed and manufactured, according to the customer's technical specifications, to be mounted on industrial machines to transmit the power from the engine to the wheels and to allow:

- *increasing of tractive force, reducing the number of revolutions*
- *adjusting of inner wheels' speed with outer wheels' speed during steering.*

Never mount this axle on machines different from the ones for which it has been designed and manufactured

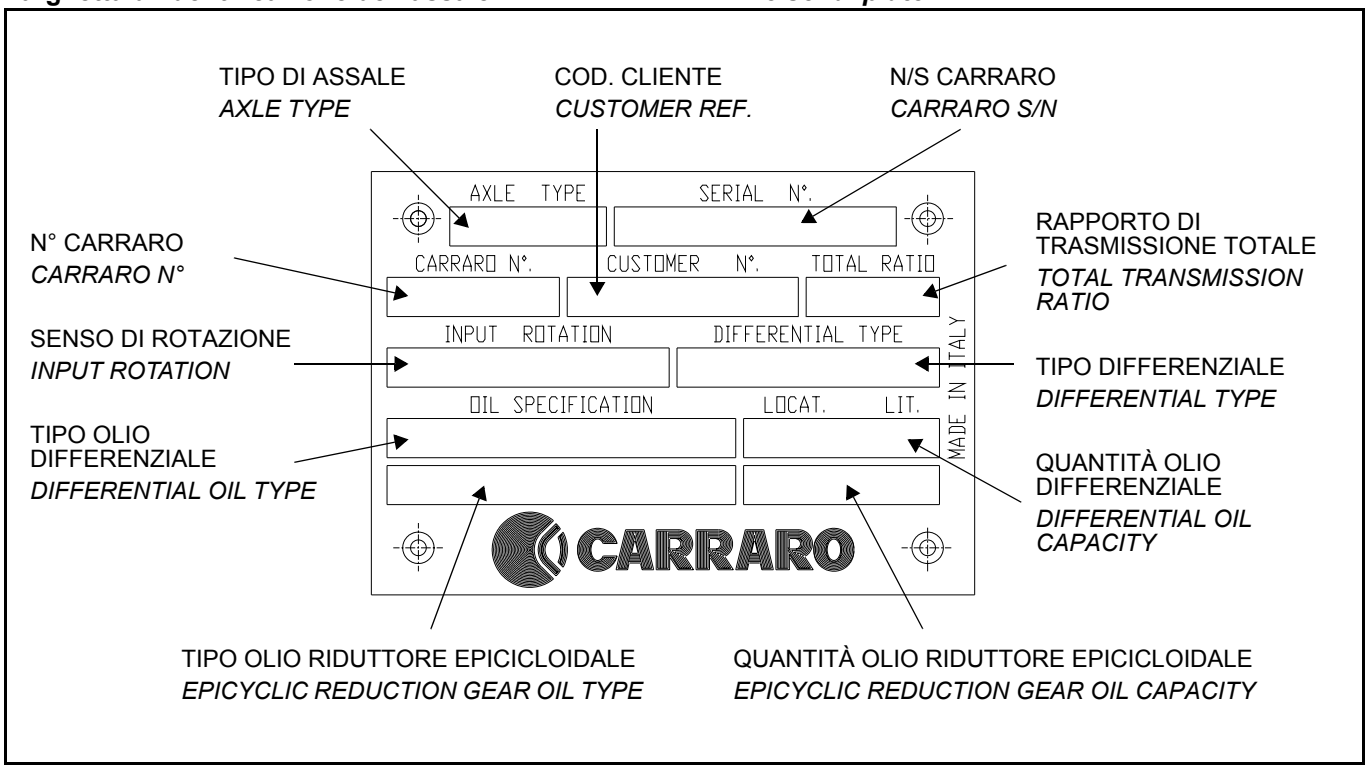
If the axle is used for any other purpose than the one foreseen, CARRARO SpA declines any responsibility regarding damages or accidents caused by it. All consequences will be at the expense of the client.
However, when used as foreseen, operational formalities as well as regular maintenance repair specifications given by CARRARO SpA are to be observed strictly.

C.2 Identificazione del prodotto

Targhetta di identificazione dell'assale

C.2 Product identification

Axle serial plate



C.3 Descrizione generale

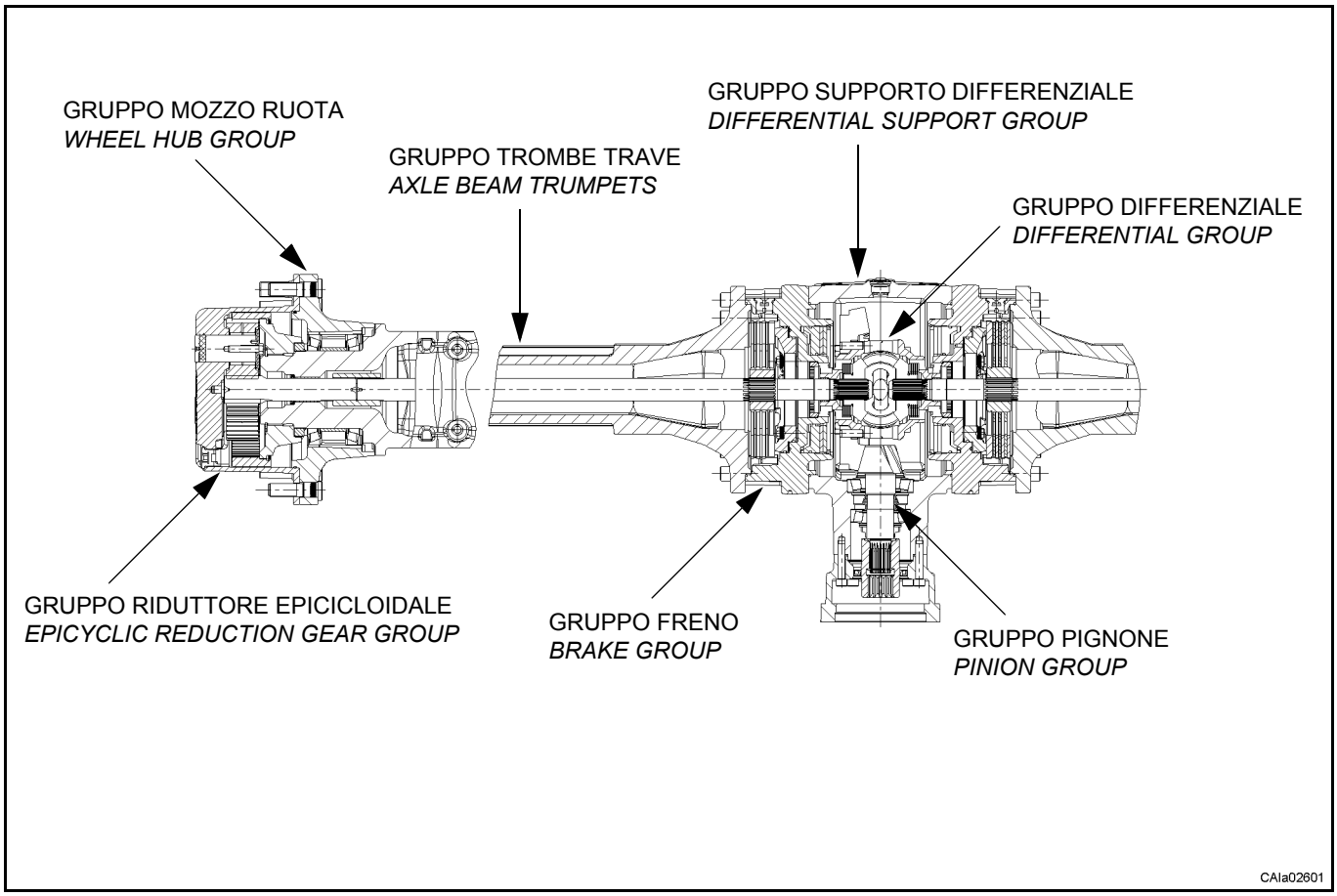
L'assale descritto in questo manuale è costituito dai seguenti gruppi

- MOZZO RUOTA: elementi di supporto della ruota e del riduttore epicicloidale
- RIDUTTORE EPICICLOIDALE: treno portasatelliti con elementi di riduzione
- TROMBE TRAVE: struttura di supporto principale dell'assale
- SUPPORTO DIFFERENZIALE: struttura di supporto del differenziale e di registrazione della coppia conica
- DIFFERENZIALE: scatola differenziale e corona della coppia conica
- GRUPPO PIGNONE: pignone con gli elementi di registrazione e supporto
- GRUPPO FRENO: componenti del freno con gli elementi di supporto

C.3 General description

The axle described in this manual consists mainly of following groups

- *WHEEL HUB: wheel support parts containing the epicyclic reduction gears*
- *EPICYCLIC REDUCTION GEAR: planetary carrier with reduction/transmission parts*
- *AXLE BEAM TRUMPETS: load-bearing shell structure of the axle*
- *DIFFERENTIAL SUPPORT GROUP: differential housing with ring bevel gear adjusting system*
- *DIFFERENTIAL GROUP: differential parts with ring bevel gear*
- *PINION GROUP: pinion with adjusting and support parts*
- *BRAKE GROUP: brake parts and brake shell structure*



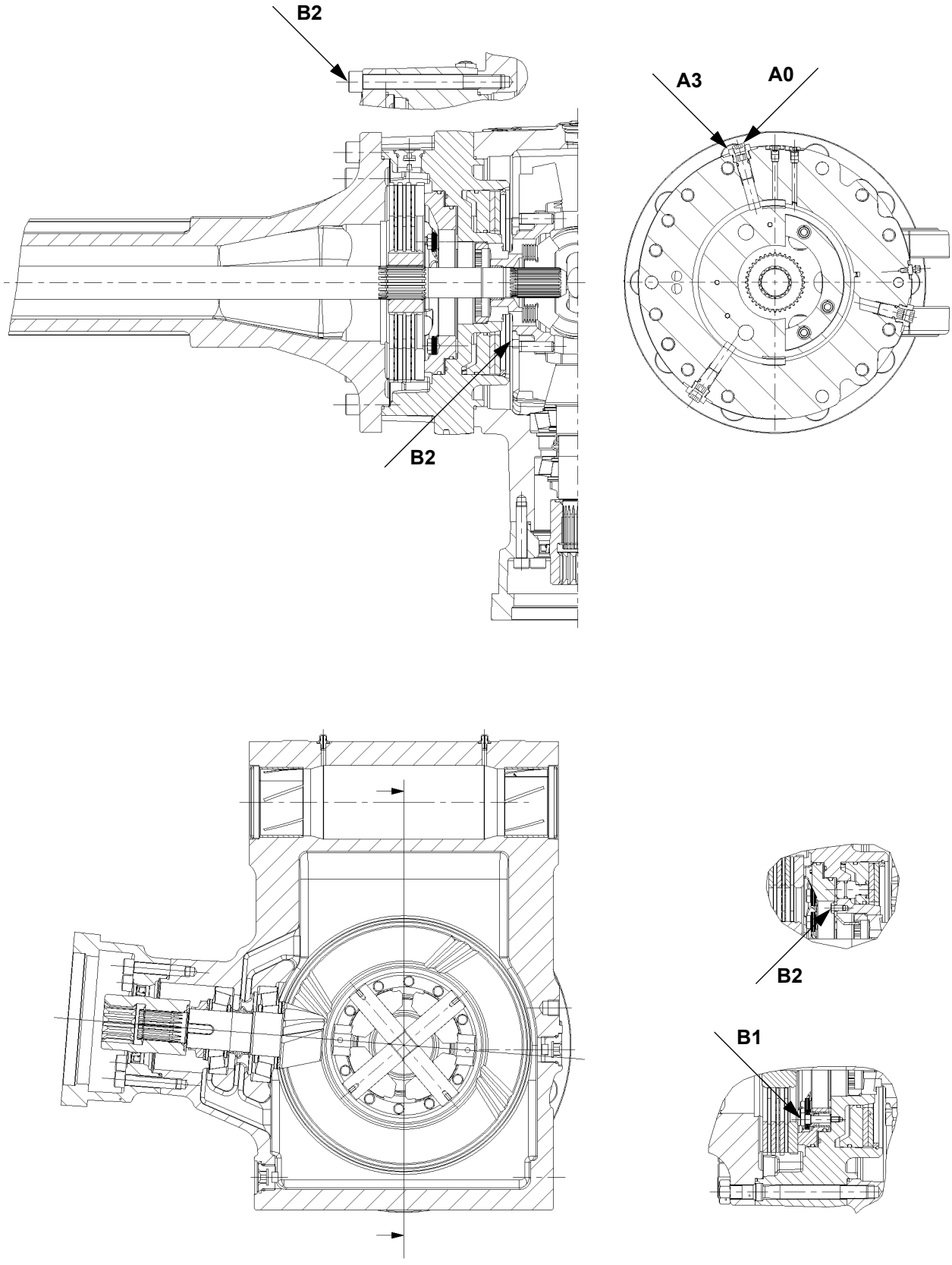
C.4 Caratteristiche Tecniche — *C.4 Technical Features*

MACCHINA	**Assale Anteriore - *Front Axle***	*MACHINE*
CODICE	**CA144840**	*CODE*
MODELLO	**28.46M**	*MODEL*
TIPO DIFFERENZIALE	**Limited slip**	*DIFFERENTIAL TYPE*

DESCRIZIONE	VALORI VALUES	DESCRIPTION
Riduzione coppia conica	4.777 / 1	*Bevel gear ratio*
Riduzione riduttore epicicloidale	6.923 / 1	*Epicyclic reduction gear ratio*
Riduzione totale	33.076 / 1	*Total ratio*
Peso a secco	646 Kg	*Dry weight*
Rotazione in entrata SENSO ORARIO SENSO ANTIORARIO	 ● ○	*Input rotation* *CLOCK WISE (C.W.)* *COUNTER CLOCK WISE (C.C.W.)*
Gioco di accoppiamento coppia conica	0.15÷0.25 mm	*Bevel gear set backlash*
Precarico cuscinetti pignone conico (misurato sul D=35 mm senza anelli di tenuta)	P= 9.2÷13.7 N	*Pinion bearings preloading (measured on D=35 mm without seals)*
Precarico totale cuscinetti corona-pignone (misurato sul D=35 mm senza anelli di tenuta)	T= (P+1.9)÷(P+2.9) N	*Total pinion-ring gear bearing preloading (measured on D=35 mm without seals)*
Spessore nominale disco differenziale	2.7 / 1.6 mm	*Nominal differential disk thickness*
Usura max disco differenziale (per ogni disco)	0.15 / 0.30 mm	*Maximum differential disk wearing (each disk)*
Spessore nominale controdisco differenziale	1.3 mm	*Nominal differential counterdisk thickness*
Tipo freno	A dischi in bagno d'olio Wet discs brake	*Type of brake*
Numero dischi freno per lato	3	*Number of brake disks each side*
Spessore nominale disco freno	4.83 mm	*Nominal brake disk thickness*
Usura max disco freno (per ogni disco)	0.8 mm	*Maximum brake disk wearing (each disk)*
Spessore nominale controdisco freno	5/10.8 mm	*Nominal brake counterdisk thickness*
Temperatura di esercizio freni	-40 °C ÷ 130 °C	*Brakes operating temperature*
Pressione max di esercizio	44 bar	*Maximum operating pressure*
Pressione disinnesto freni	18 bar	*Brakes disengagement pressure*
Quantità olio freni	Vedi manuale veicolo *See vehicle manual*	*Brakes oil capacity*

DESCRIZIONE	VALORI VALUES	DESCRIPTION
Specifica olio freni: USARE I TIPI DI OLIO INDICATI OPPORTUNAMENTE ADDITIVATI.	Vedi manuale veicolo *See vehicle manual*	*Brakes oil specification:* *USE RECOMMENDED OIL ENRICHED IN ADDITIVES.*
Quantità olio differenziale	16 litri/*litres*	*Differential oil capacity*
Quantità olio riduttore epicicloidale per lato	1.5 litri/*litres*	*Epicyclic reduction gear oil capacity each side*
Specifica olio: USARE I TIPI DI OLIO INDICATI OPPORTUNAMENTE ADDITIVATI. Nota: NON USARE OLIO DI SINTESI O VEGETALE SENZA IL CONSENSO DEL COSTRUTTORE DELL'ASSALE	API GL4	*Oil specification:* *USE RECOMMENDED OIL ENRICHED IN ADDITIVES.* *Note: DO NOT USE SYNTHETIC OR VEGETABLE OIL WITHOUT CONSENT OF THE AXLE MANUFACTURER*
Specifica grasso *usare solo per manicotto scanalato (vedi: sezione D.1)	TECNOLUBE SEAL POLYMER 400/L (DIN = KHER1R ISO-I-XMR-XM2) ROCOL SAPPHIRE-2*	*Grease specification* **use on splined sleeve only (see: section D.1)*
Sigillante scatola (**A0**) **Vedi:** Sigillanti e collanti	SILASTIC 30849 DOW CORNING 7091	*Housing sealant (**A0**)* ***See:** Sealing compounds and adhesives*

Sigillanti e collanti ***Sealing compounds and adhesives***



Posizione Applicazione Adesivi/Sigillanti ***Adhesive/Sealant Application Position***	
	Applicare sulle superifici a contatto
	Apply on the contact surfaces
	Applicare sulla filettatura delle viti / sui perni
	Apply on bolts thread / on pins

Sigillante per guarnizioni ***Gasket sealant***				
Rif.Carraro ***Carraro Ref.***	**Presenza** ***Presence***	**Marca e tipo di adesivo** **Adhesive make and type**	**Caratteristiche tecniche** **Technical characteristics**	**Resistenza** **Strength**
A1	○	Loctite® 510 Superbond® 529	Sigillatura superfici piane Flat surface sealing	Alta High
A2	○	Loctite® 573 Superbond® 519	Sigillatura superfici piane Flat surface sealing	Bassa Low
A3	●	Loctite® 518 Superbond® 539	Sigillatura superfici irregolari Uneven surface sealing	Alta High

Adesivi per frenatura organi filettati ***Thread parts sealant***				
Rif.Carraro ***Carraro Ref.***	**Presenza** ***Presence***	**Marca e tipo di adesivo** **Adhesive make and type**	**Caratteristiche tecniche** **Technical characteristics**	**Resistenza** **Strength**
B1	●	Loctite® 542 Superbond® 321	Frenatura organi filettati Locking of threaded parts	Media Medium
B2	●	Loctite® 270 Superbond® 331	Frenatura organi filettati Locking of threaded parts	Alta High
B3	○	Loctite® 986/AVX Superbond® 438	Frenatura organi filettati Locking of threaded parts	Alta, appl. speciali High, special appl.

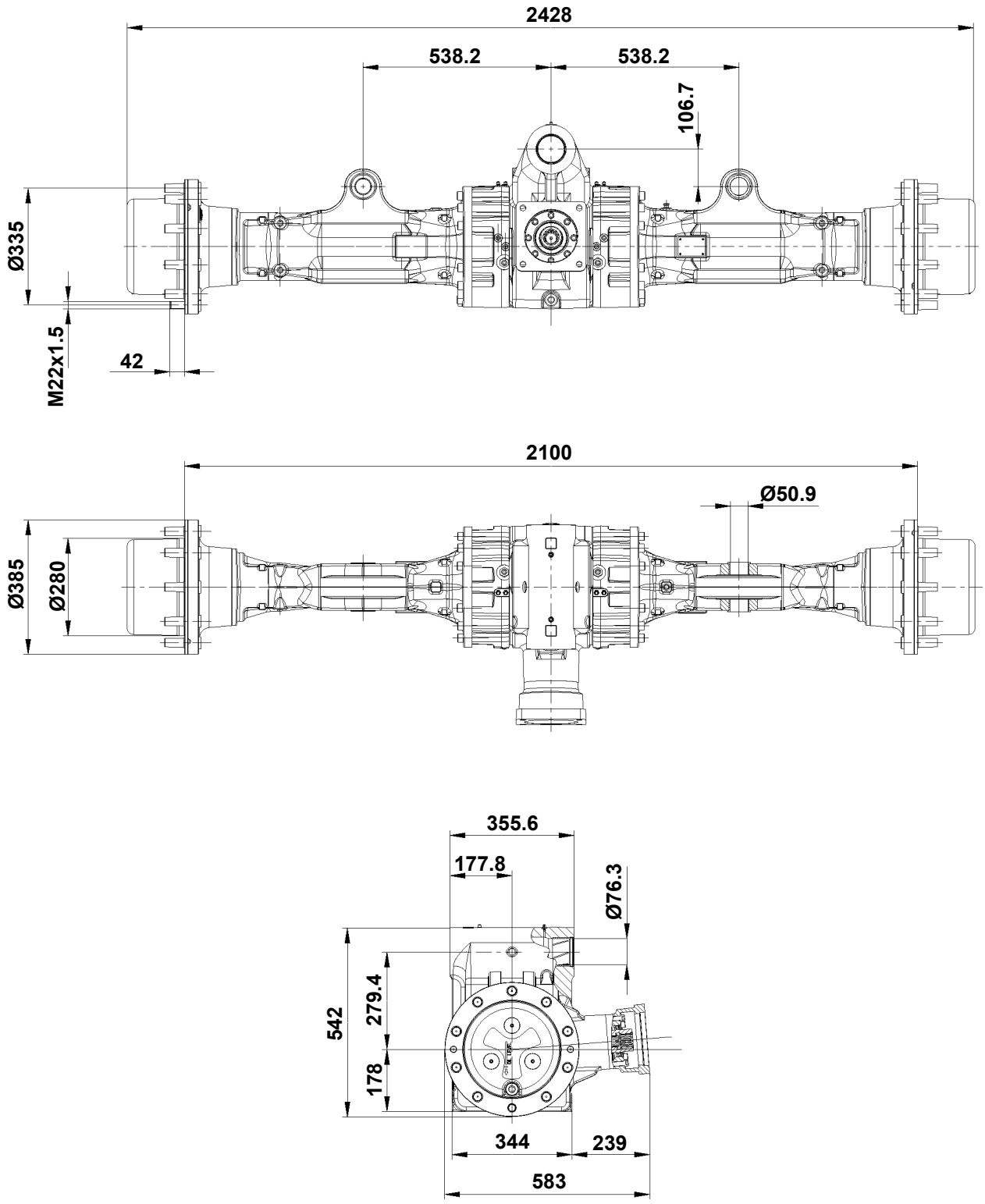
Adesivi per fissaggio particolari ***Fixing parts sealant***				
Rif.Carraro ***Carraro Ref.***	**Presenza** ***Presence***	**Marca e tipo di adesivo** **Adhesive make and type**	**Caratteristiche tecniche** **Technical characteristics**	**Resistenza** **Strength**
C1	○	Loctite® 405 Superbond® istant 25	Adesivo per fissaggio Fixing adhesive	Fissaggio medio Medium bond
C2	○	Loctite® 638 Superbond® 433	Adesivo per fissaggio Fixing adhesive	Fissaggio forte Strong bond
C3	○	Loctite® 542 Superbond® 321	Adesivo per fissaggio Fixing adhesive	Fissaggio medio Medium bond
C4	○	Loctite® 496 Superbond® SB14	Adesivo per fissaggio gomma Rubber fixing adhesive	Fissaggio forte Strong bond

Dimensioni d'ingombro

(Millimetri)

Overall dimensions

(Millimeters)



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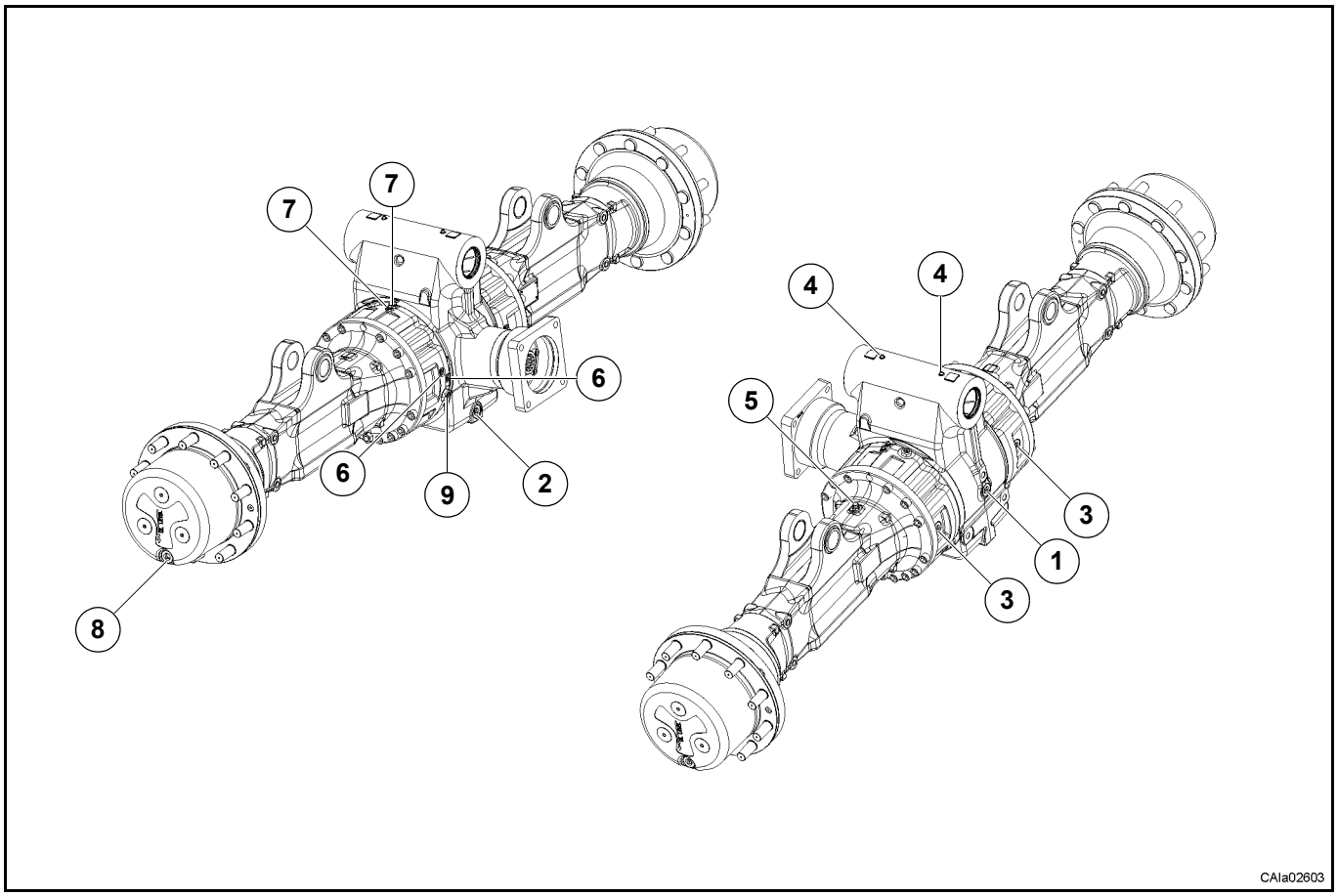
C.5 Cambio olio e verifiche

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

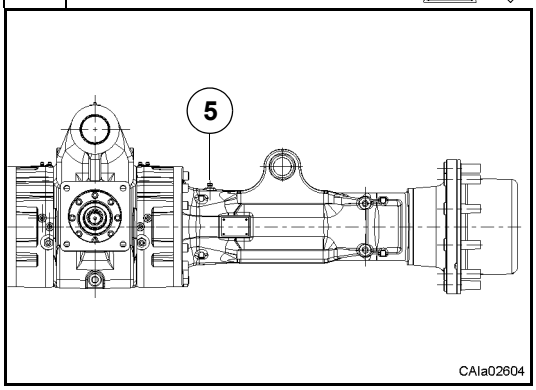
C.5 Oil change and checks

Some of the following pictures may not show exactly your axle, but the procedure is the same.



DESCRIZIONE	POSIZIONE / POSITION	DESCRIPTION
Tappo carico e livello olio	**1**	Oil filling and level plug
Tappo scarico olio	**2**	Oil drain plug
Foro ispezione freni	**3**	Brake inspection hole
Punti di ingrassaggio	**4**	Greasing point
Sfiato olio	**5**	Oil breather
Porte ingresso olio freni	**6**	Service brakes oil port
Sfiati olio freni	**7**	Brakes bleeding plug
Tappo carico, livello e scarico olio riduttore epicicloidale	**8**	Filling, level and drain plug of epicyclic reduction gear oil
Sistema di sgancio freno parcheggio	**9**	Parking brake disengagement system

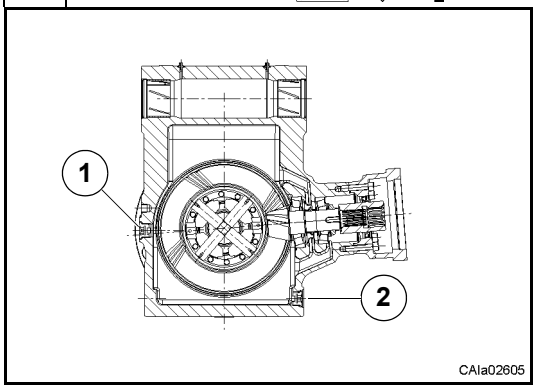
1



Pericolo: rischio di violenta espulsione di getti d'olio, seguire tutte le procedure di sicurezza indicate in questo manuale e dal costruttore del veicolo.
Vedi: cap.B - INFORMAZIONI SULLA SICUREZZA
Prima di scaricare l'olio dal corpo dell'assale, agire sull'apposito sfiato (**5**) per eliminare l'eventuale pressione interna.

Danger: *risk of violent oil ejection, follow carefully all the safety procedures indicated in this manual and in the vehicle manual.*
See: *cap.B - SAFETY INSTRUCTIONS*
*Before draining the oil from axle housing, use the breather (**5**) to release possible internal pressure.*

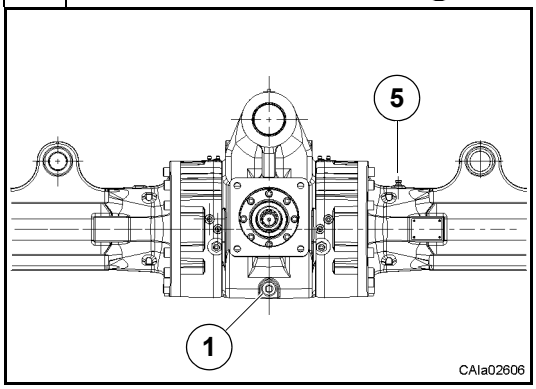
2



Per scaricare l'olio dal corpo centrale svitare prima il tappo di livello (**1**) e poi il tappo di scarico (**2**).
Pericolo: rischio di violenta espulsione di getti d'olio.
Vedi: punto precedente.
Scaricare completamente l'olio.
Pulire il tappo (**2**) e richiuderlo alla coppia prevista (Sez.C.6).

*To drain the oil remove the level plug (**1**) and the drain plug (**2**).*
Danger: *risk of violent oil ejection.*
See: *the first point.*
Drain all oil.
*Clean the plug (**2**) and tighten it to the prescribed torque (Sec.C.6).*

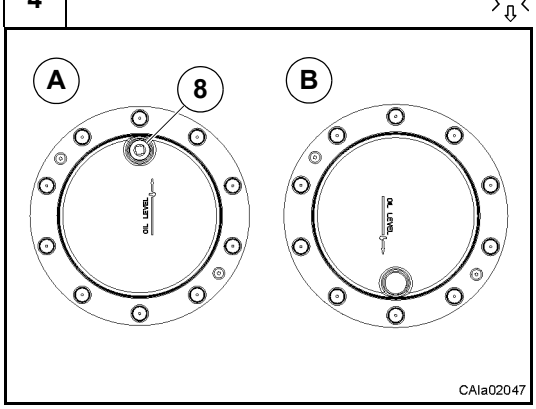
3



Prima di svitare il tappo di livello dell'olio (**1**), agire sempre sull'apposito sfiato (**5**) per eliminare l'eventuale pressione interna.
Riempire con l'olio prescritto a filo del foro di carico.
Attendere che l'olio fluisca nell'assale quindi verificare il livello e rabboccare se necessario.
Riavvitare il tappo (**1**) alla coppia prevista (Sez.C.6).

*Before draining the oil from the plug (**1**), always use the breather (**5**) to release possible internal pressure.*
Fill to the bottom of the fill plug hole with the specified oil.
Wait to allow the oil to flow through the axle. Check oil level and fill to the specified level if necessary.
*Close the plug (**1**) to the prescribed torque (Sec.C.6).*

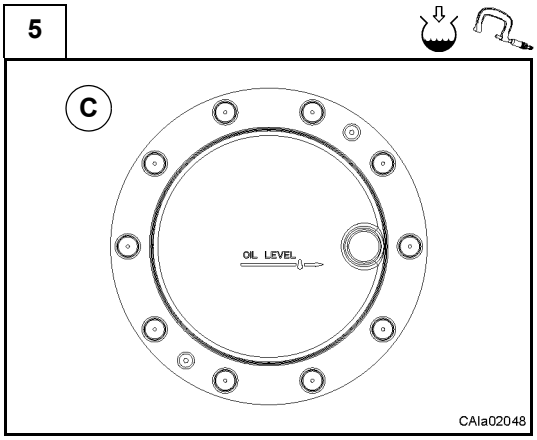
4



Prima di scaricare l'olio dal riduttore epicicloidale, ruotarlo in modo da portare il tappo olio (**8**) nel punto più alto [posizione A].
Svitare il tappo parzialmente per eliminare l'eventuale pressione interna.
Ruotare il riduttore con il tappo (**8**) rivolto verso il basso [posizione B].
Togliere il tappo e lasciar defluire tutto l'olio.

*Before draining the oil from wheel end rotate the wheel end so that the plug (**8**) is at the highest position [pos.A] and partially unscrew to release possible pressure.*
*Rotate the wheel end so that the plug (**8**) is toward the ground [pos.B].*
Remove the plug and drain the oil.

5



Ruotare il riduttore fino a portare la linea “livello olio” parallela al suolo [pos.C].
Riempire con olio prescritto (Sez.C.4). Il livello dell’olio deve essere a filo del foro.
Serrare il tappo alla coppia prevista (Sez.C.6).

Rotate the wheel end so that the “oil level” line is parallel to the ground.
Fill to the bottom of the fill plug hole with specified oil (Sec.C.4).
Tighten the plug to the prescribed torque (Sec.C.6).

Programma di lubrificazione

Gli intervalli di lubrificazione indicati sono per un impiego normale della macchina, nel caso di impieghi particolarmente gravosi lubrificare con maggior frequenza.

Service schedule

Specified lubrication intervals are for standard-duty use.
Severe operating conditions require shorter lubrication intervals.

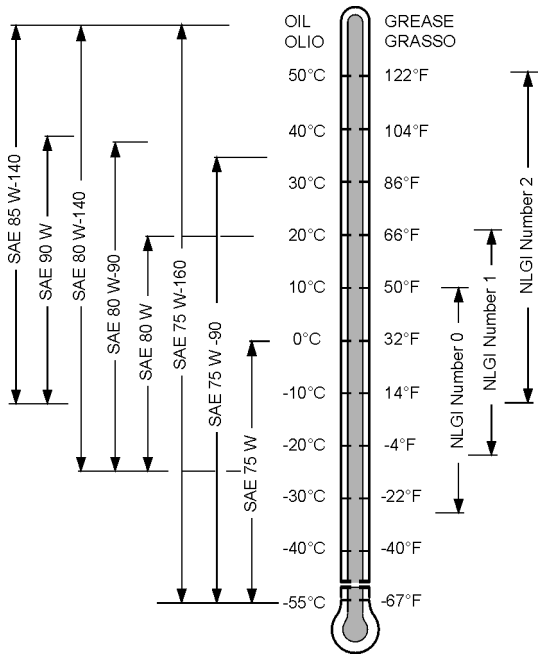
Operazione	**▲ Primo Intervento** ***First time***	**◆ Ad ogni stagione od ogni 1500 ore**(1) ***Seasonally or every 1500 operating hours***(1)	***Operation***
Cambio olio assale	150 - 200 ore/*hours* ●	◆ ■	*Axle oil change*
Operazioni di lubrificazione	▲ ■	◆ ■	*Lubrication works*
Controllo e rabbocco olio	50 - 100 ore/*hours* ■	mensilmente/*monthly* ●	*Check and adjust oil level*
Pulizia tappo magnetico scarico olio	150 - 200 ore/*hours* ■	ad ogni cambio olio/ *every oil change* ●	*Clean magnetic oil plugs*
Pulizia sfiato olio	▲ ■	mensilmente/*monthly* ●	*Clean oil breather*
Ingrassaggio	150 - 200 ore/*hours* ●	settimanalmente/*weekly* ●	*Greasing*

● operazioni eseguibili solamente da personale autorizzato dal costruttore
■ operazioni eseguibili solamente da personale addestrato
(1) quale delle due condizioni si verifica prima

● *this operation must be performed only by personnel authorized by the manufacturer*
■ *this operation must be performed only by trained personnel*
(1) *which of both conditions comes first*

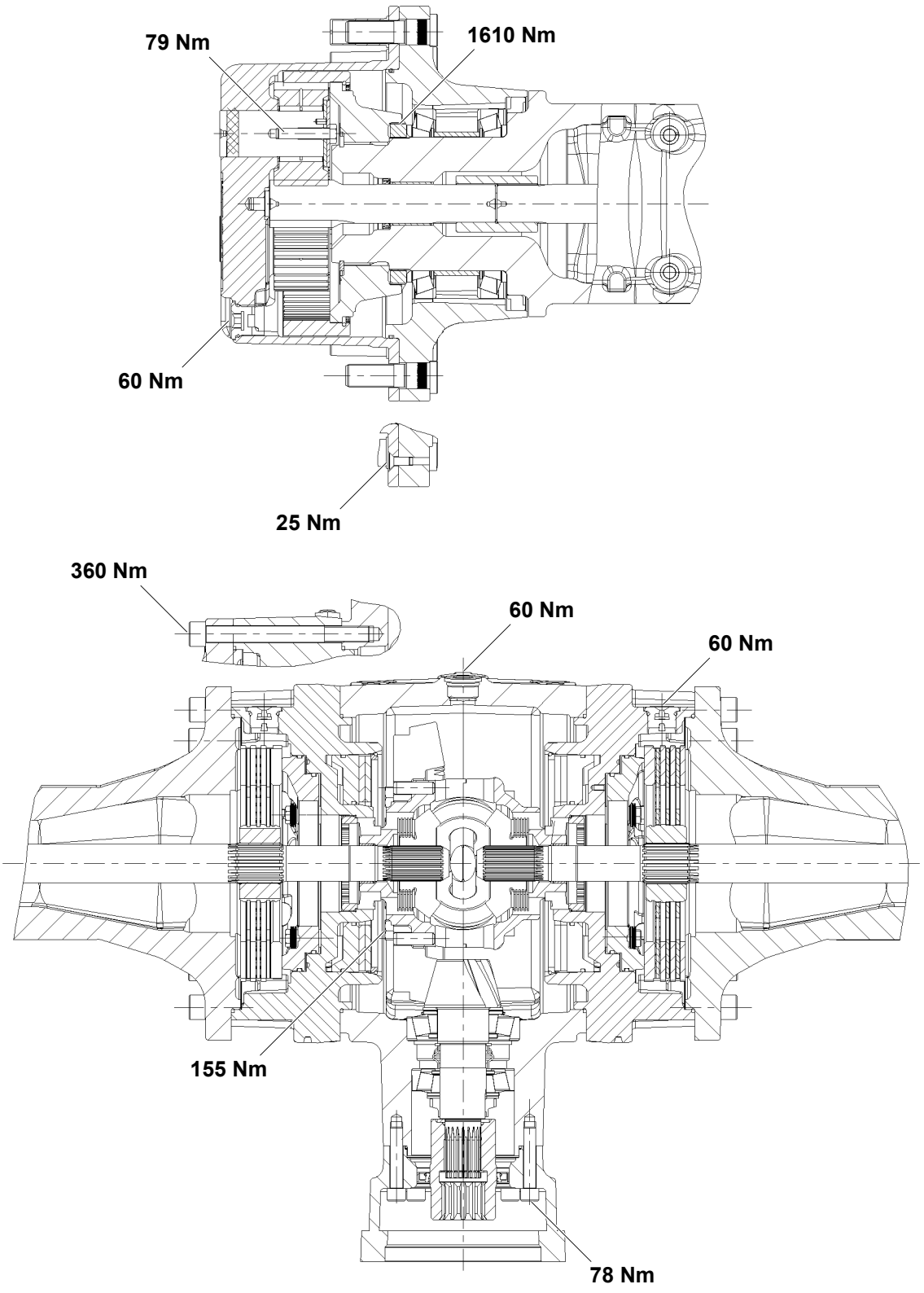
Campi di applicazione dei lubrificanti

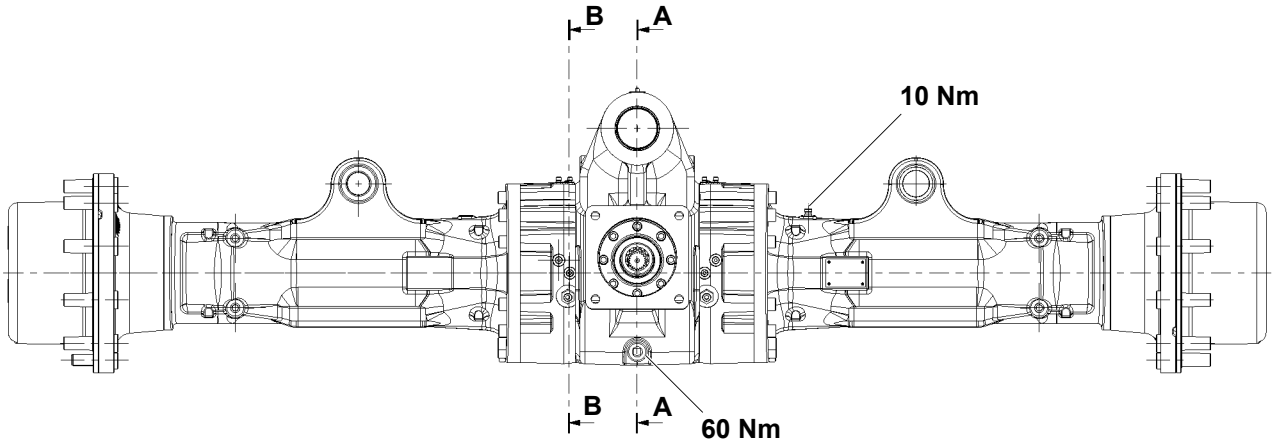
Lubricants application range

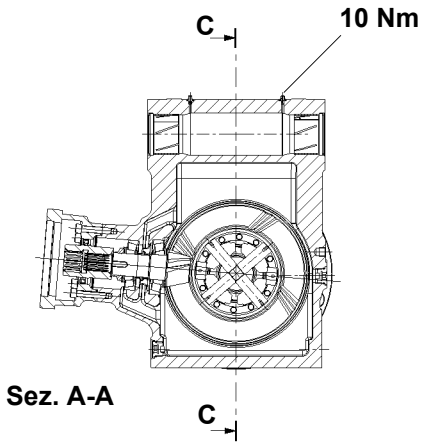


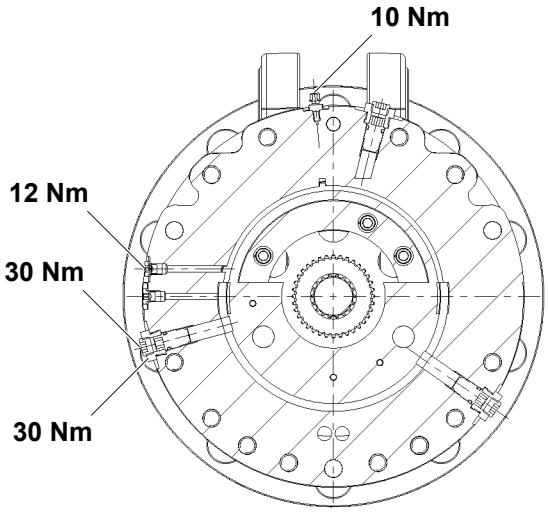
C.6 Coppie di serraggio

C.6 Tightening torques

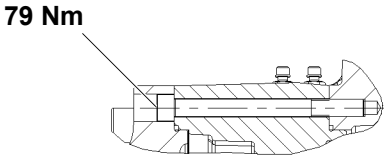


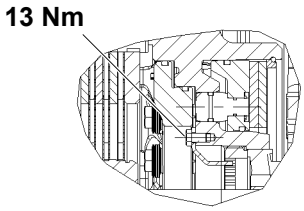




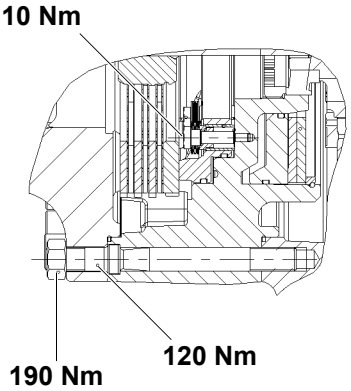


Sez. B-B





Sez. C-C



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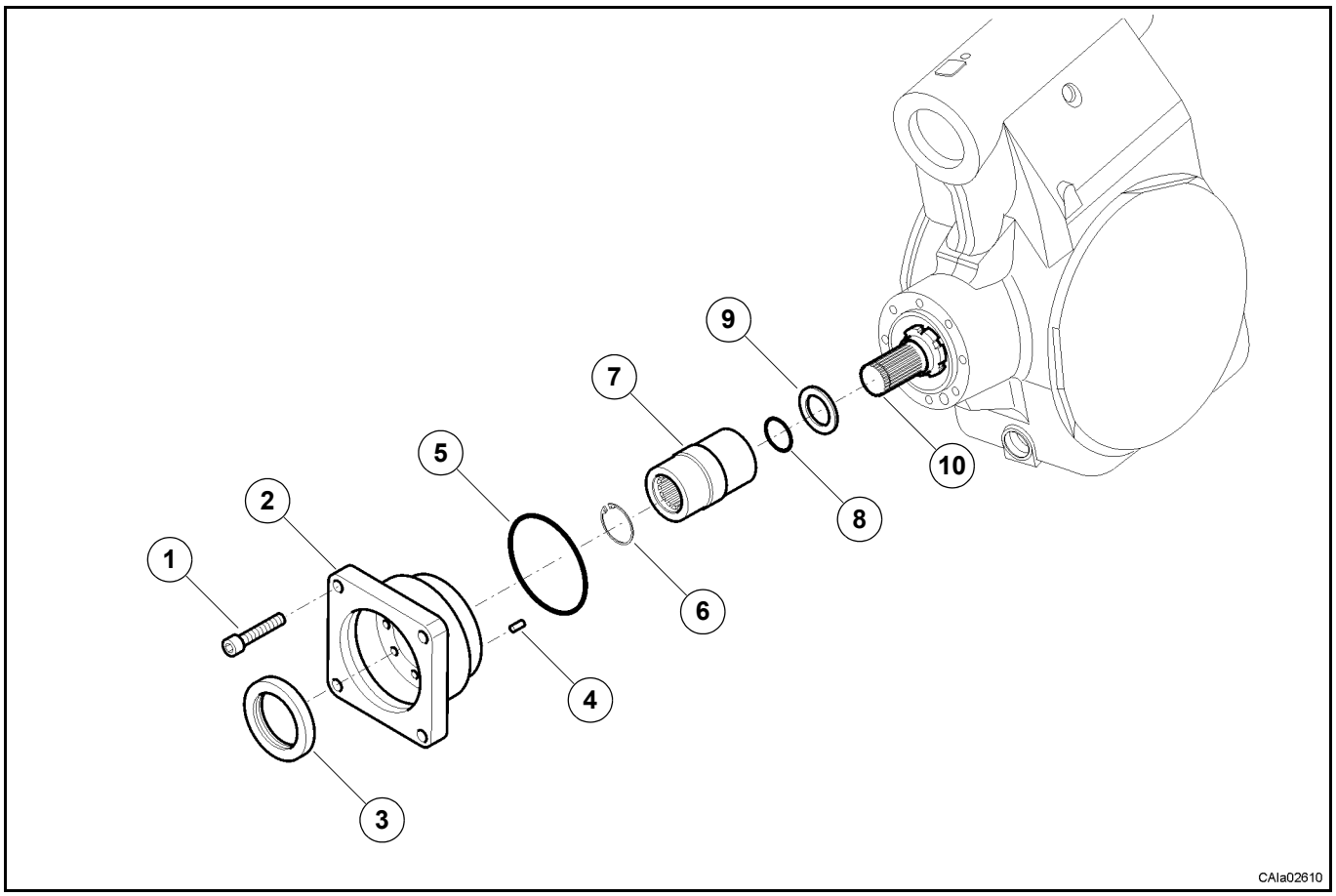
D OPERAZIONI DI MONTAGGIO E SMONTAGGIO

D DISASSEMBLY AND ASSEMBLY OPERATIONS

D.1 Gruppo flangia

D.1 Flange group



D.1.1 Smontaggio

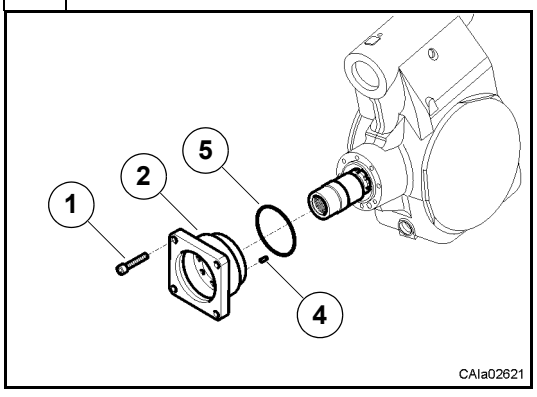
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.
Nota: per lo smontaggio del gruppo pignone vedi prima le procedure descritte alla sezione D.7.

D.1.1 Disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

***Note:** before disassemble the pinion group see the procedure described in the section D.7.*

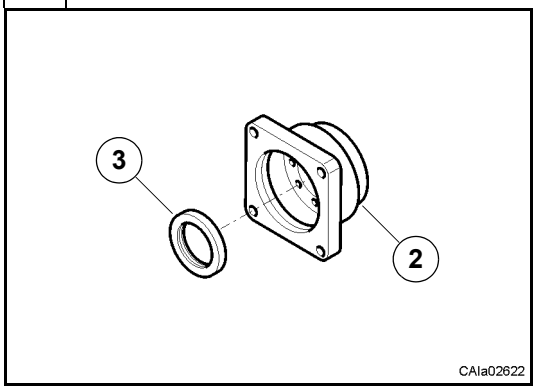
1



Rimuovere le viti di fissaggio (**1**) della flangia (**2**)
Sfilare la flangia (**2**) e recuperare la spina (**4**).
Rimuovere l'anello OR (**5**) dalla flangia (**2**).

*Remove the fastening screw (**1**) of the flange (**2**).*
*Take the flange (**2**) out and collect the pin (**4**).*
*Remove the O-Ring (**5**) from the flange (**2**).*

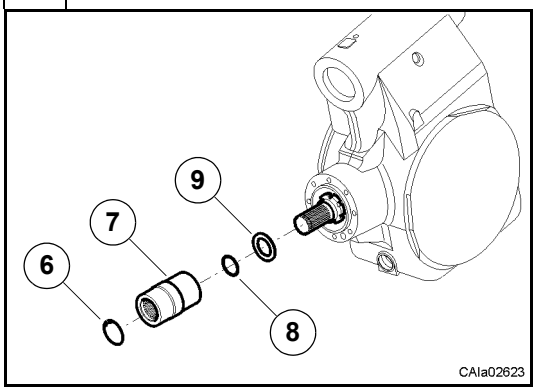
2



Rimuovere l'anello di tenuta (**3**) dalla flangia (**2**).
Nota: è un'operazione distruttiva per l'anello di tenuta (**3**).

*Remove the seal ring (**3**) from the flange (**2**).*
***Note**: this is a destructive operation for the seal ring (**3**).*

3



Rimuovere l'anello d'arresto (**6**) dal codolo del pignone (**10**).
Nota: è un'operazione distruttiva per l'anello d'arresto (**6**).
Sfilare il manicotto (**7**) e recuperare l'anello OR (**8**) e la rondella (**9**).

*Remove the lock ring (**6**) from the pinion end (**10**).*
***Note**: this is a destructive operation for the lock ring (**6**).*
*Take the splined sleeve (**7**) out, then collect the O-Ring (**8**) and washer (**9**).*

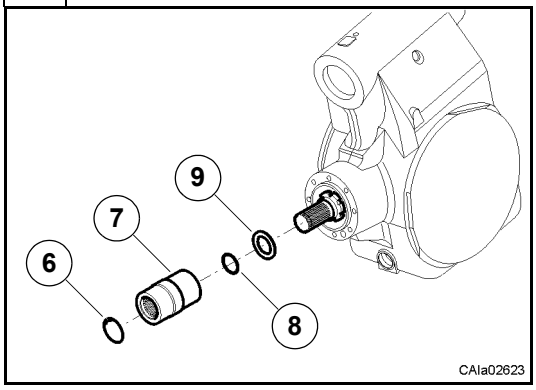
D.1.2 Montaggio

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.1.2 Assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

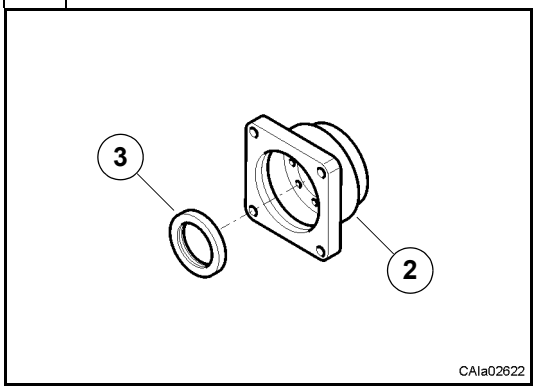
1



Inserire la rondella (**9**) ed un nuovo anello OR sul codolo del pignone (**8**).
Assemblare il manicotto scanalato (**7**) al codolo del pignone.
Assemblare l'anello d'arresto (**6**) al codolo del pignone (**10**).

*Insert the washer (**9**) and new O-Ring (**8**) onto the pinion end.*
*Assemble the splined sleeve (**7**) to the pinion end.*
*Assemble the lock ring (**6**) to the pinion end (**10**).*

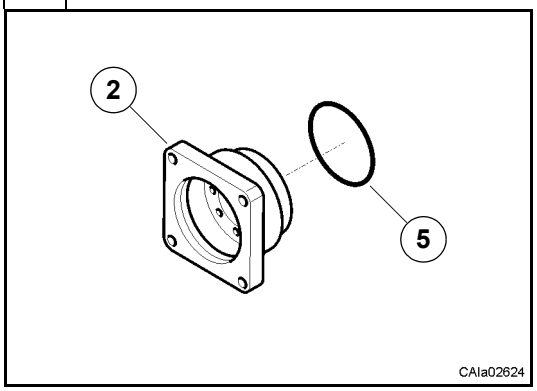
2



Assemblare l'anello di tenuta (**5**) nella flangia (**2**) con il battitoio CA715632 ed un martello.
Nota: lubrificare l'anello di tenuta (**5**) con grasso (Sez. C.4).

*Insert the seal ring (**5**) into the flange (**2**) with the special tool CA715632 and a hammer.*
***Note:** grease carefully the seal ring (**5**) (Sec. C.4).*

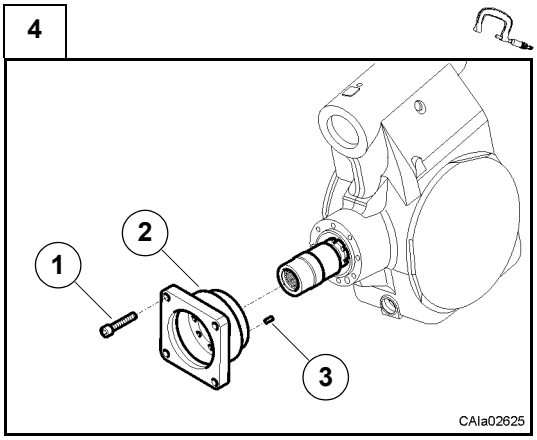
3



Montare un nuovo anello OR (**5**) nella flangia (**2**).
Nota: lubrificare l'anello OR (**5**) con grasso specifico (Sez. C.4).

*Assemble a new O-Ring (**5**) in the flange (**2**).*
***Note:** grease carefully the O-Ring (**5**) (Sec. C.4).*

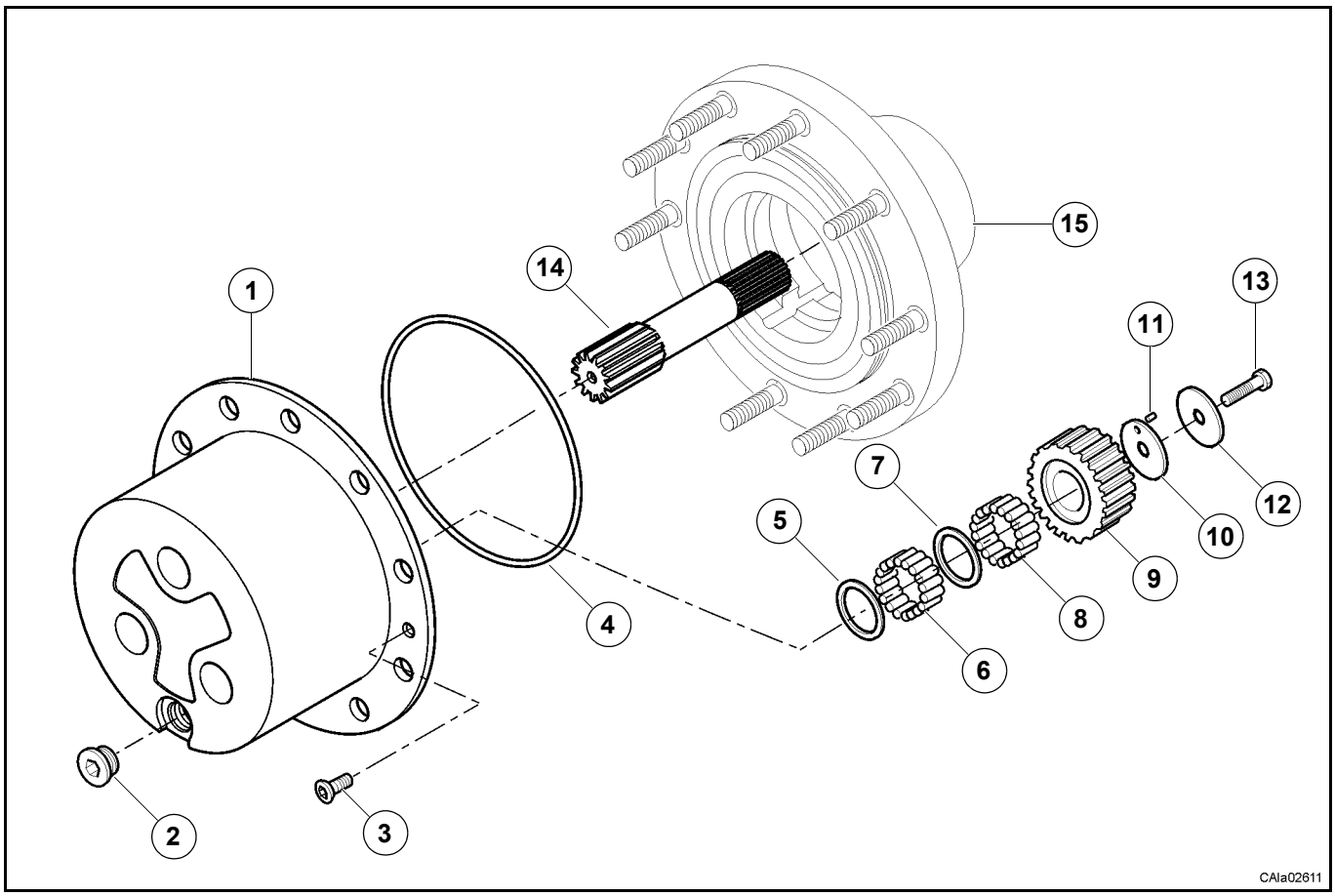
4



Assemblare la flangia (**2**) con la spina (**4**) al supporto differenziale.
Assemblare le viti di fissaggio (**1**) della flangia (**2**) alla coppia prescritta (Sez.C.6).

*Assemble the flange (**2**) and the pin (**4**) to the differential support.*
*Assemble the fastening screw (**1**) of the flange (**2**) to the specified torque (Sez.C.6).*

D.2 Gruppo riduttore epicicloidale *D.2 Epicyclic reduction gear group*



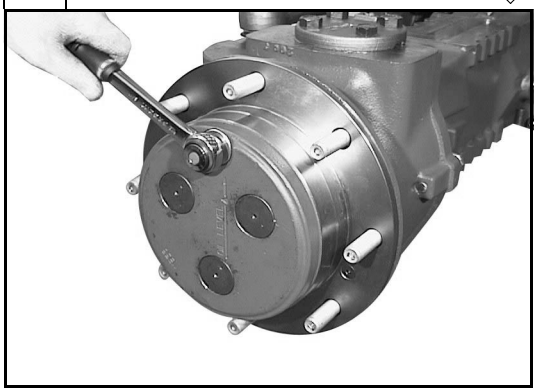
D.2.1 Smontaggio

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.2.1 Disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

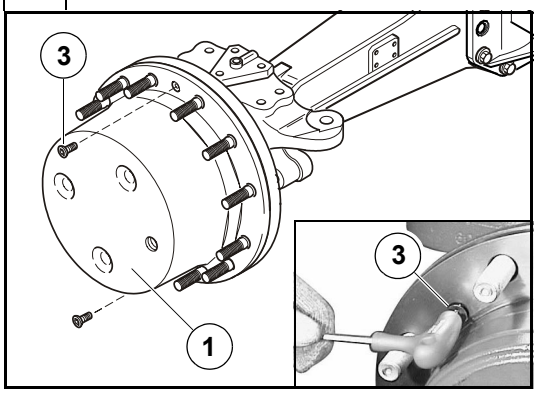
1



Scaricare completamente l'olio dal riduttore epicicloidale e dal corpo dell'assale.
Vedi: sezione C.5.

Drain the oil completely from the epicyclic reduction gear and axle body.
See: *section C.5.*

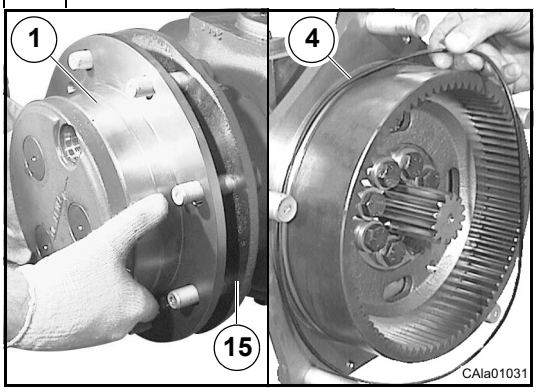
2



Svitare le due viti di fissaggio (**3**) del treno portasatelliti (**1**).

*Unscrew both fastening screws (**3**) of the planetary carrier (**1**).*

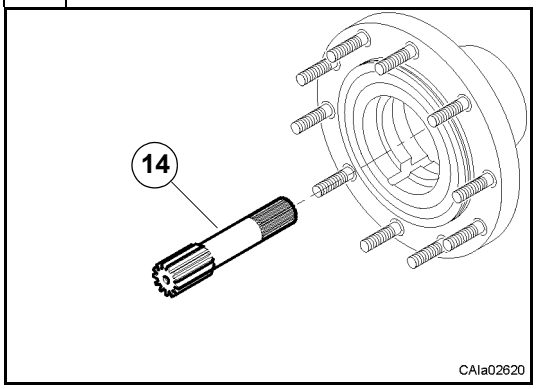
3



Rimuovere il treno portasatelliti (**1**) dal mozzo ruota (**15**) e recuperare il relativo anello OR (**4**).
Posizionare il treno portasatelliti (**1**) su di un piano e verificarne le condizioni di usura.

*Remove the planetary carrier (**1**) from the wheel hub (**15**) and collect the relative O-Ring (**4**).*
*Position the planetary carrier (**1**) on a workbench and check its wear conditions.*

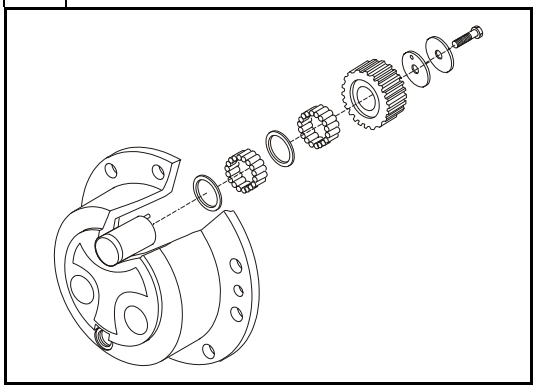
4



Rimuovere l'albero (**14**) dal mozzo ruota (**15**).

*Remove the shaft (**14**) from the wheel hub (**15**).*

5



Per eseguire l'eventuale sostituzione degli ingranaggi satelliti (**9**):
- rimuovere la vite di fissaggio (**13**) di ogni ingranaggio satellite (**9**);
- rimuovere le rondelle (**12**) e (**10**);
- estrarre i satelliti (**9**) dai perni;
- recuperare i relativi rullini (**8**) e (**6**) verificandone le condizioni;
- recuperare le rondelle di rasamento (**7**) e (**5**).

*To carry out any possible replacements of the planetary gears (**9**):*
*- remove the fastening screws (**13**) on every planetary gear (**9**);*
*- remove the washers (**12**) and (**10**);*
*- take the planetary gears (**9**) out of the pins;*
*- collect the needle bearings (**8**) and (**6**) checking their conditions;*
*- collect the thrust washers (**7**) and (**5**).*

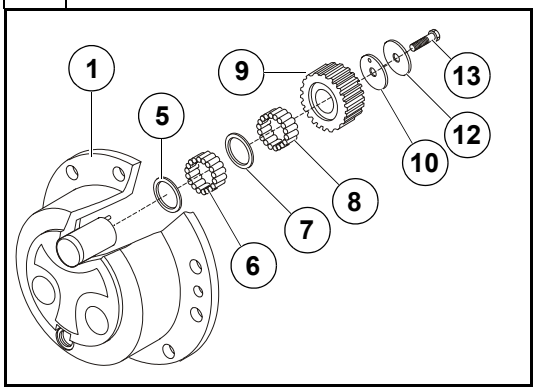
D.2.2 Montaggio

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.2.2 Assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

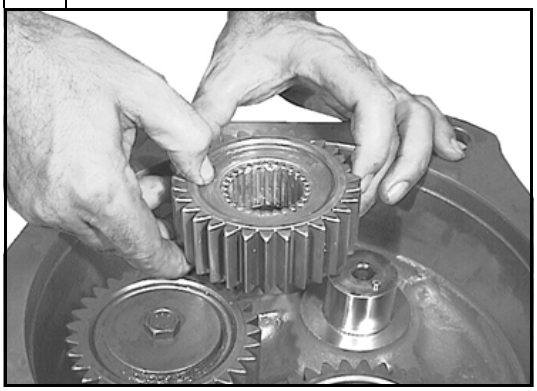
1



Recuperare tutti i componenti del riduttore epicicloidale: il treno portasatelliti (**1**), le ralle di rasamento (**5**) e (**7**), l'ingranaggio satellite (**9**) ed i relativi rullini (**6**) e (**8**), le ralle (**10**) e (**12**), la vite di fissaggio (**13**) di ogni perno.
Nota: con nuovi satelliti (**9**) è consigliabile montare nuovi rullini (**8**) e (**6**).

*Collect all epicyclic reduction gear parts: the planetary carrier (**1**), the thrust washers (**5**) and (**7**), the planetary gear (**9**) with the roller bearings (**6**) and (**8**), the washers (**10**) and (**12**), the fixing screw (**13**) of every planetary carrier pin.*
***Note:** with new planetary gears (**9**) it is advisable to assembly new roller bearings (**8**) and (**6**).*

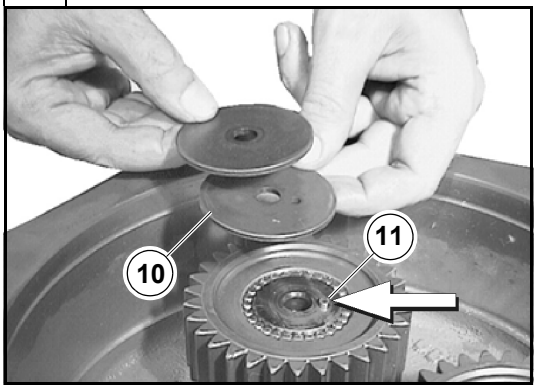
2



Posizionare su un banco di lavoro il treno porta satelliti (**1**).
Inserire i rullini (**6**) e (**8**) con interposta la ralla di rasamento (**7**) all'interno degli ingranaggi satelliti (**9**).
Nota: ingrassare bene i rullini (**6**) e (**8**).
Inserire nei perni del treno porta satelliti (**1**) le ralle di rasamento (**5**) e gli ingranaggi epicicloidali (**9**) completi.

*Position the planetary carrier (**1**) on a workbench.*
*Insert the needles bearing (**6**), (**8**) and the thrust washer (**7**) in the epicyclic gears (**9**).*
***Note:** grease well the needles (**6**) and (**8**).*
*Insert the thrust washers (**5**) and the assembled epicyclic gears (**9**) in the planetary carrier (**1**) pins.*

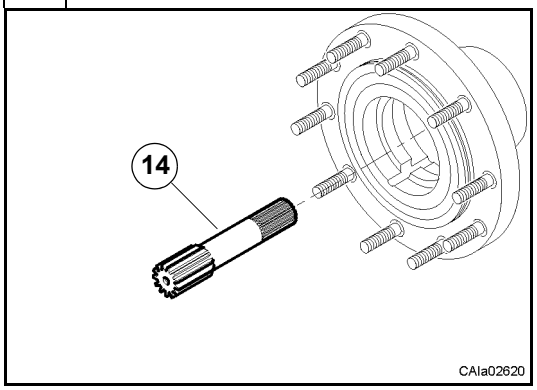
3



Montare le ralle di rasamento (**10**) e (**12**) nei perni del treno porta satelliti (**1**).
Nota: la ralla intermedia (**10**) ha un foro che serve da centraggio con la spina (**11**) piantata sui perni del treno portasatelliti (**1**).
Montare le relative viti di arresto (**13**), serrandole con chiave dinamometrica alla coppia prevista (Sez.C.6).

*Fit the thrust washers (**10**) and (**12**) to the planetary carrier (**1**) pins.*
***Note:** the intermediate thrust washers (**10**) has a hole for centering with the dowel pin (**11**) fitted on the planetary carrier (**1**) pins.*
*Assemble the retaining screw (**13**), then tighten them with dynamometric wrench to the requested torque (Sec. C.6).*

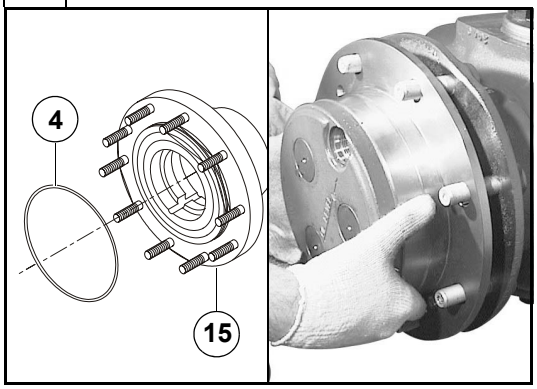
4



Assemblare l'albero (**14**) al mozzo ruota (**15**).

*Assemble the shaft (**14**) to the wheel hub (**15**).*

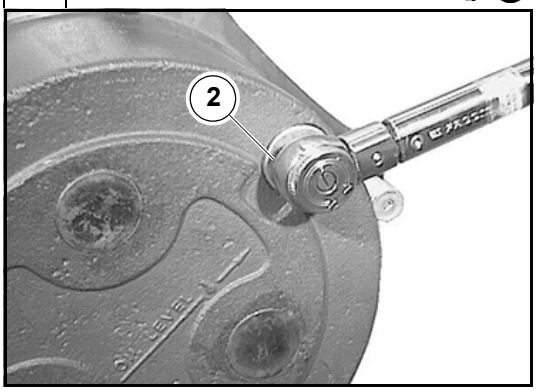
5



Inserire un nuovo anello OR (**4**) lubrificato sul mozzo ruota (**15**).
Montare il gruppo riduttore epicicloidale sul mozzo ruota (**15**).
Assemblare le viti di fissaggio (**3**) e serrarle alla coppia prevista (Sez.C.6).

*Assemble a new lubricated O-Ring (**4**) on the wheel hub (**15**).*
*Fit the epicyclic reduction gear assembly to the wheel hub (**15**).*
*Assemble the screws (**3**) and tighten them to the prescribed torque (Sec.C.6).*

6

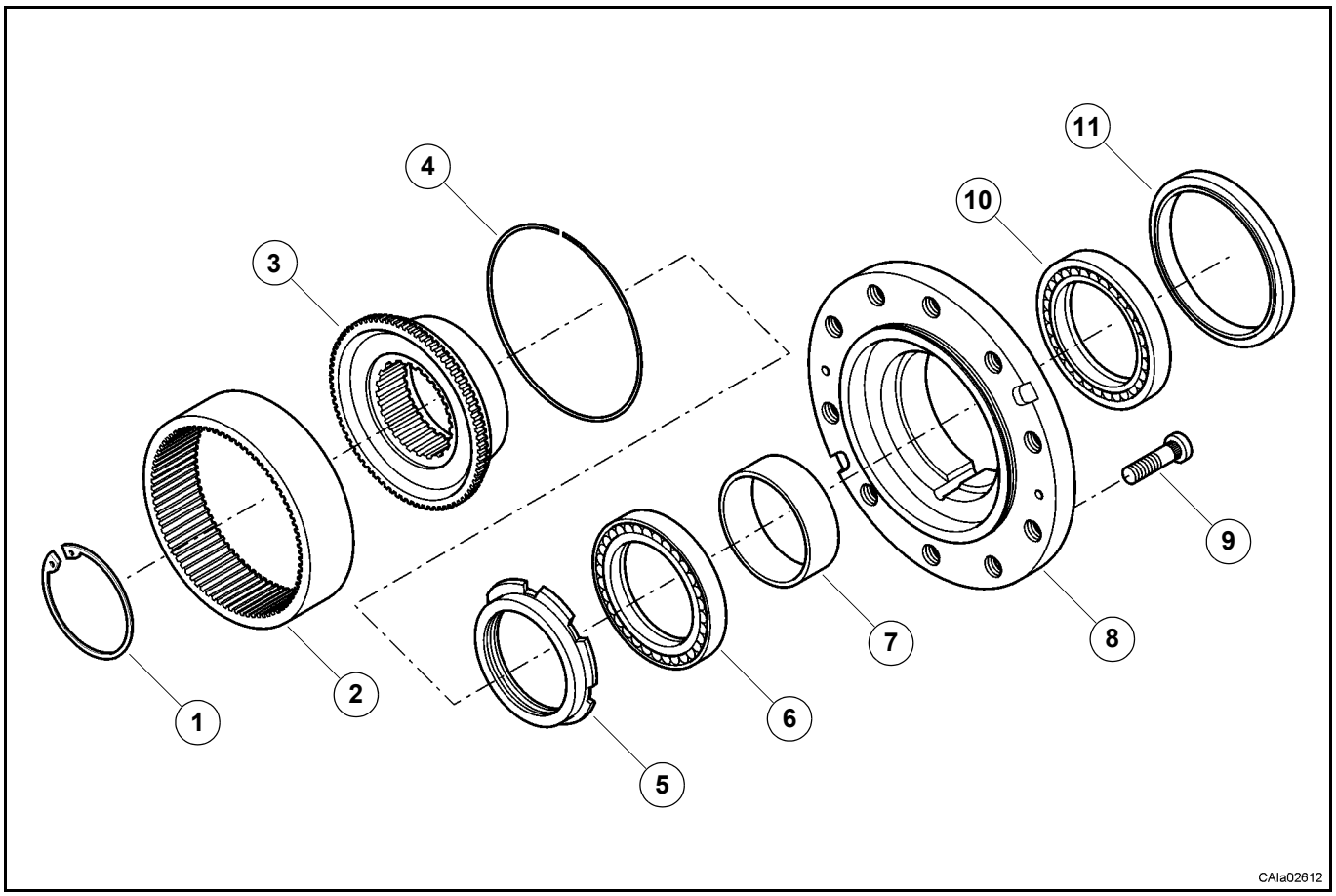


Ripristinare l'olio nel riduttore epicicloidale e nel corpo dell'assale.
Vedi: sezione C.5.
Montare il tappo (**2**) sul treno portasatelliti (**1**), e serrare alla coppia prevista (Sez.C.6) con chiave dinamometrica.

Top up the oil in the epicyclic reduction gear and axle body.
***See:** section C.5.*
*Fit the plug (**2**) on the epicyclic reduction gear (**1**) and tighten to the prescribed torque using a torque wrench (Sec.C.6).*

D.3 Gruppo mozzo ruota

D.3 Wheel hub group



D.3.1 Smontaggio

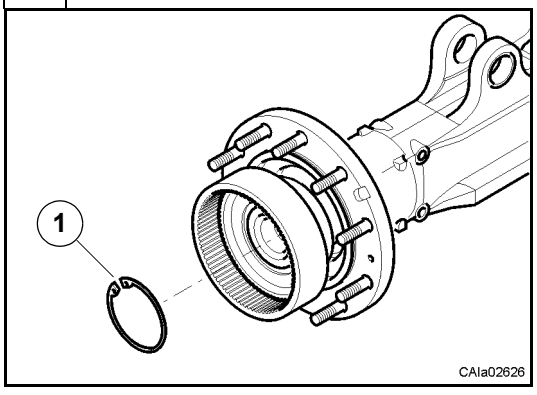
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.
Nota: per lo smontaggio del gruppo mozzo ruota vedi prima le procedure decritte alla sezione D.2.

D.3.1 Disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

***Note:** before disassemble the wheel hub group see the procedure described in the section D.2.*

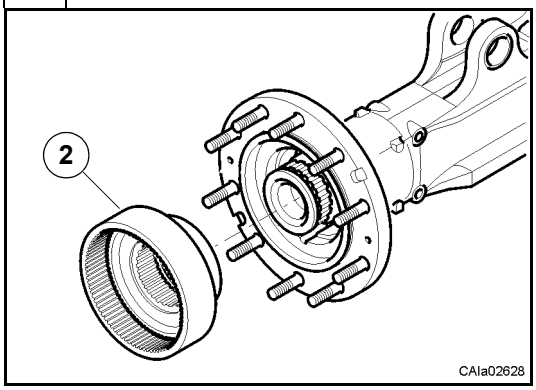
1



Rimuovere l'anello d'arresto (**1**) dall'estremità della tromba trave.

*Remove the lock ring (**1**) from the beam trumpets end.*

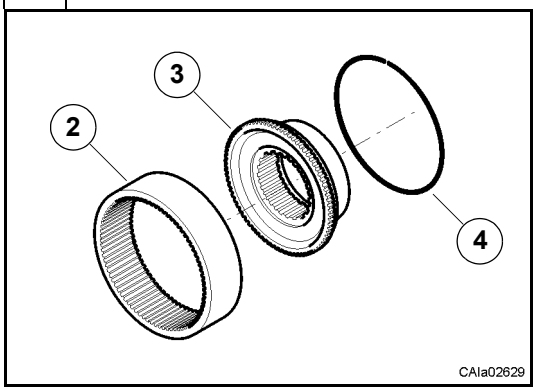
2



Sfilare la corona dentata (**2**) con il mozzo fermo corona (**3**).
Nota: potrebbe essere necessario l'utilizzo di un estrattore.

*Remove the ring gear (**2**) and the wheel carrier (**3**).*
***Note:** may be necessary the use of an extractor.*

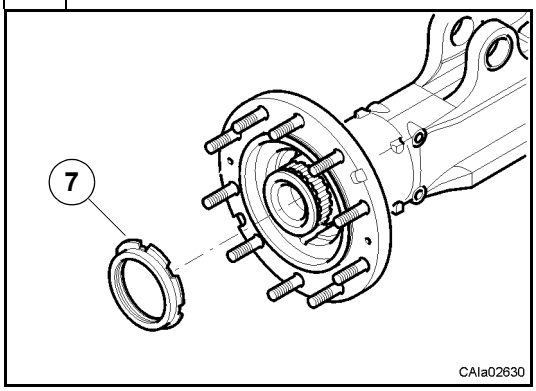
3



Rimuovere l'anello d'arresto (**4**) dalla corona (**2**).
Separare il mozzo (**3**) dalla corona dentata (**2**).
Verificare lo stato di usura dei particolari.

*Remove the lock ring (**5**) from the ring gear (**2**).*
*Disassemble the ring gear (**2**) from the wheel carrier (**3**).*
Check the wear conditions of the components.

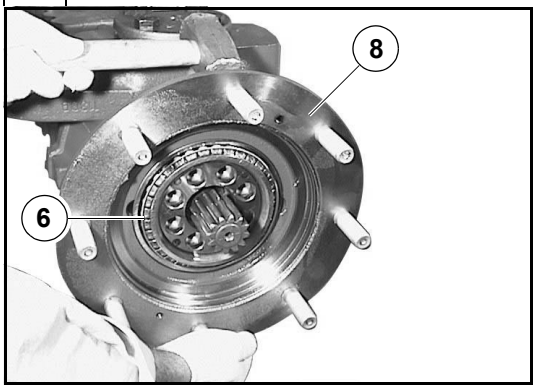
4



Svitare la ghiera (**5**) con la chiave speciale CA715631.
Nota: si consiglia l'utilizzo di un moltiplicatore di coppia meccanico.

*Remove the ring nut (**5**) using the special wrench CA715631.*
***Note:** it's advisable to use a mechanical torque multipliers.*

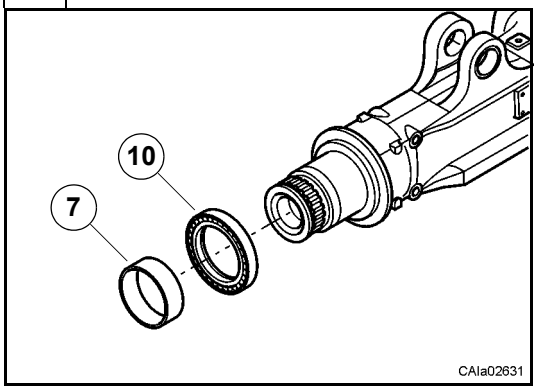
5



Sfilare il mozzo ruota (**8**) facilitando lo smontaggio con leve e martello.
Nota: recuperare il cono del cuscinetto (**6**).

*Remove the wheel hub (**8**) using levers and a hammer to facilitate the operation.*
***Note:** collect the bearing cone (**6**).*

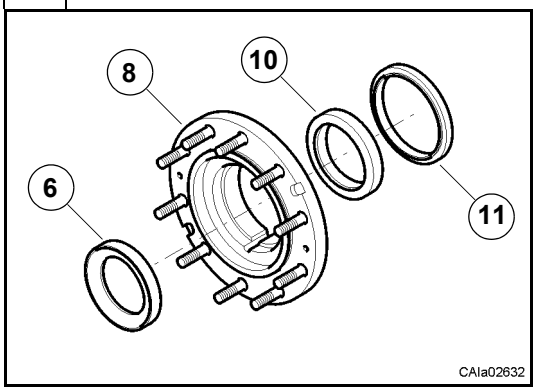
6



Rimuovere il distanziale (**7**) ed il cono del cuscinetto (**10**) dall'estremità della tromba trave.

*Remove the spacer (**7**) and bearing cone (**6**) from the beam trumpets end.*

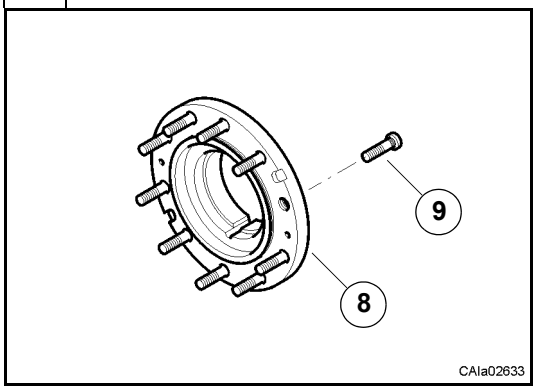
7



Posizionare su di una superficie piana il mozzo ruota (**8**) ed estrarre l'anello di tenuta (**11**) con una leva.
Nota: è un'operazione distruttiva per l'anello di tenuta (**11**).
Rimuovere le coppe dei cuscinetti (**6**) e (**10**), da entrambi i lati del mozzo ruota (**8**).
Togliere il cono del cuscinetto (**10**) dalla tromba trave, utilizzando un estrattore da commercio.

*Position the wheel hub (**7**) on a flat surface and take the seal ring (**11**) out with a lever.*
***Note**: this is a destructive operation for the seal ring (**11**).*
*Take the bearing cups (**6**) and (**10**) out, on both sides of the wheel hub (**8**).*
*Remove the bearing cone (**10**) from the axle beam trumpet, using a suitable extractor.*

8



Esaminare le condizioni della filettatura delle colonnette (**9**).
Rimuovere le colonnette (**9**) danneggiate dal mozzo ruota (**8**) con un battitoio ed un martello.
Nota: è un'operazione distruttiva per le colonnette (**9**).

Check the condition of the stud bolts thread.
*Remove the damaged stud bolts (**9**) from the wheel hub (**8**), using a pad and a hammer.*
***Note**: this is a destructive operation for the stud bolts (**9**).*

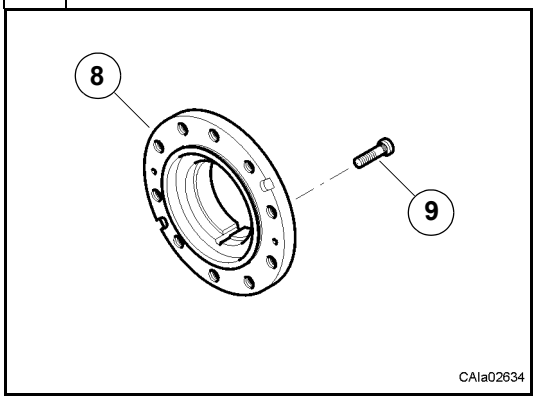
D.3.2 Montaggio

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.3.2 Assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

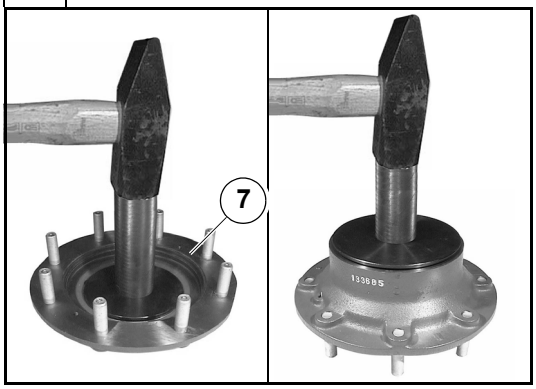
1



Assemblare le colonnette (**9**) al mozzo ruota (**8**) con un battitoio ed un martello.

*Assemble the stud bolts (**9**) to the wheel hub (**8**), using a pad and a hammer.*

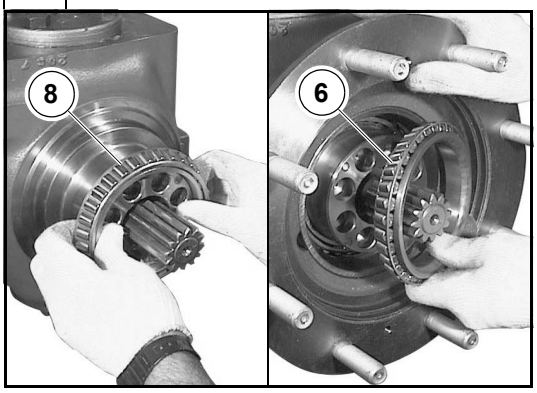
2



Piantare le coppe dei cuscinetti a rulli conici (**6**) e (**10**) sul mozzo ruota (**8**) utilizzando l'attrezzo speciale CA715118 sotto l'azione di una pressa o di un martello.
Inserire l'anello di tenuta (**11**) nel mozzo ruota (**8**) con il battitoio CA715633 ed un martello.

*Force both bearing cups (**6**) and (**10**) to their wheel hub (**8**) housings, using the special tool CA715118 under a press or with a hammer.*
*Insert the seal ring (**11**) into the wheel hub (**8**) with the special tool CA715633 and a hammer.*

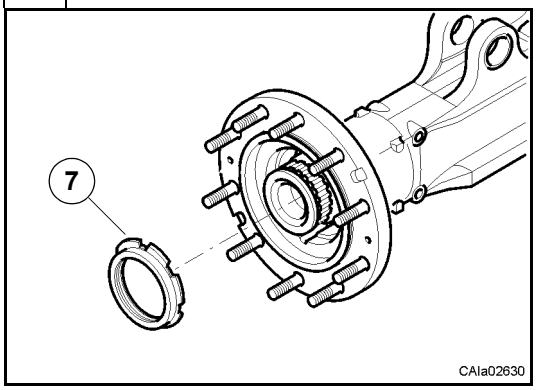
3



Montare il cono del cuscinetto a rulli conici (**10**) ed il distanziale (**7**) sul codolo della tromba trave.
Assemblare il mozzo ruota (**8**) alla tromba trave e posizionare l'altro cono del cuscinetto (**6**).

*Assemble the bearing cone (**10**) and spacer (**7**) on the axle beam trumpet end.*
*Assemble the wheel hub (**8**) on the axle beam trumpet and fit the other bearing cone (**6**) in position.*

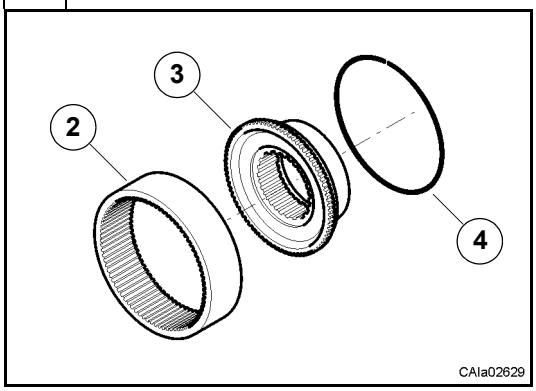
4



Assemblare la ghiera (**5**) con la chiave speciale CA715631.
Serrare la ghiera alla coppia prevista (Sez.C.6).
Nota: si consiglia l'utilizzo di un moltiplicatore di coppia meccanico.

*Assemble the ring nut (**5**) using the special wrench CA715631.*
Tighten the ring nut to the requested torque (Sec.C.6).
***Note:** it's advisable to use a mechanical torque multipliers.*

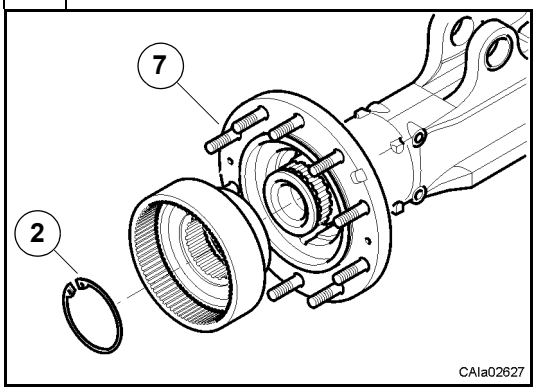
5



Preassemblare il mozzo fermo corona (**3**) e la corona epicicloidale (**2**) con l'anello d'arresto (**4**).

*Preassemble the wheel carrier (**3**) and the epicyclic ring gear (**2**) with the lock ring (**4**).*

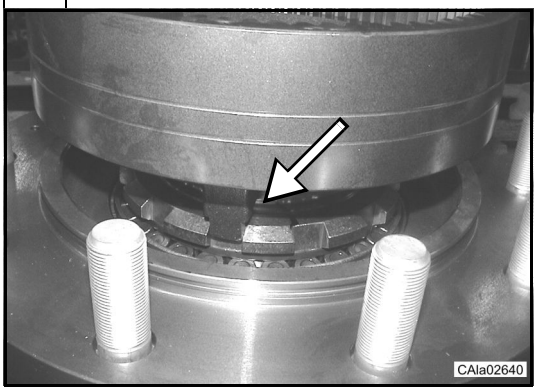
6



Montare il gruppo mozzo fermo corona sul mozzo ruota (**7**).
Vedi: punto successivo.
Assemblare l'anello d'arresto (**1**) all'estremità della tromba trave.

*Assemble the wheel carrier group on the wheel hub (**7**).*
***See:** next point.*
*Assemble the lock ring (**1**) to the beam trumpets end.*

7

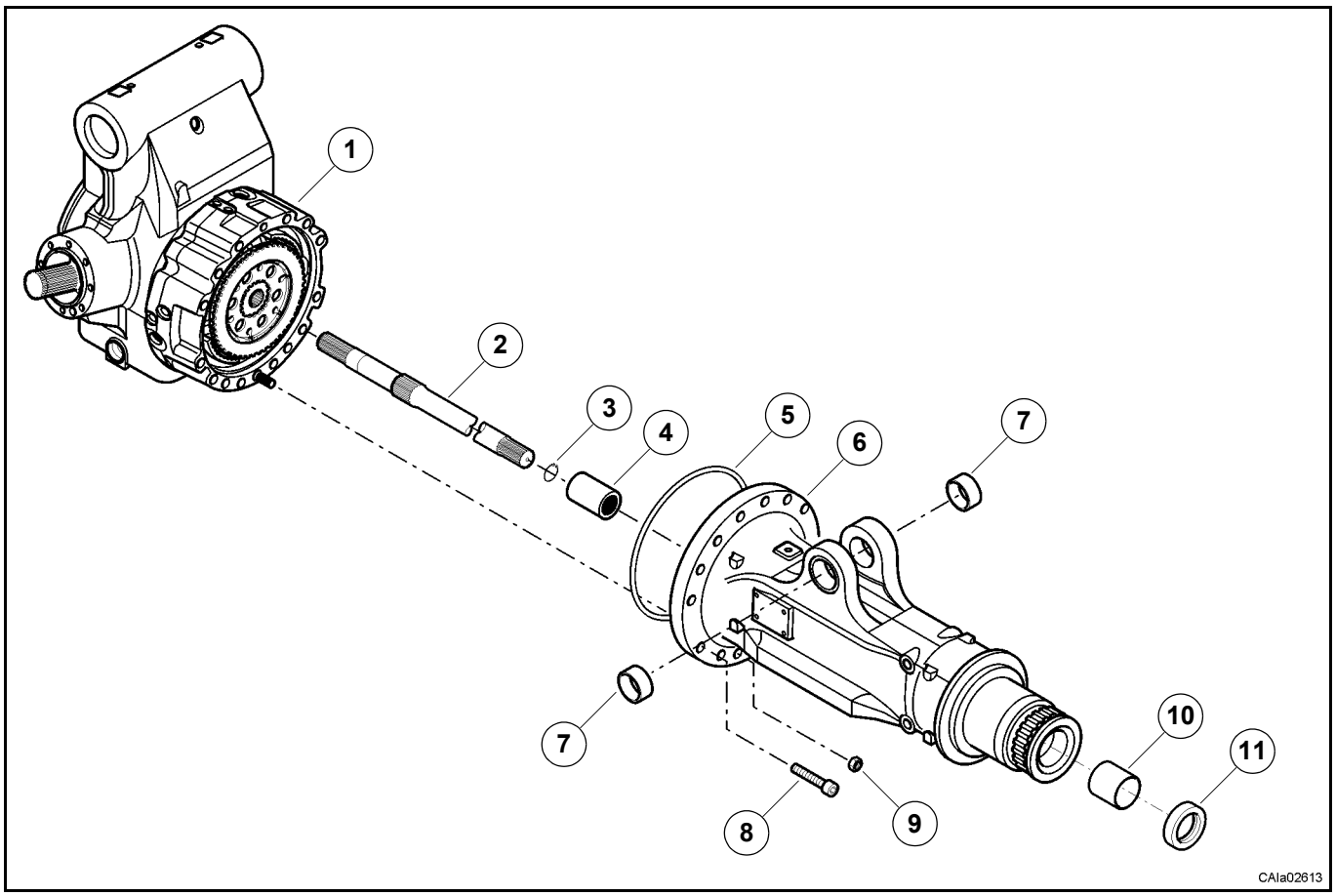


Nota: verificare la corretta posizione del mozzo fermo corona (**3**).

***Note:** check the wheel carrier (**3**) position.*

D.4 Gruppo trombe trave

D.4 Axle beam trumpets group



D.4.1 Smontaggio

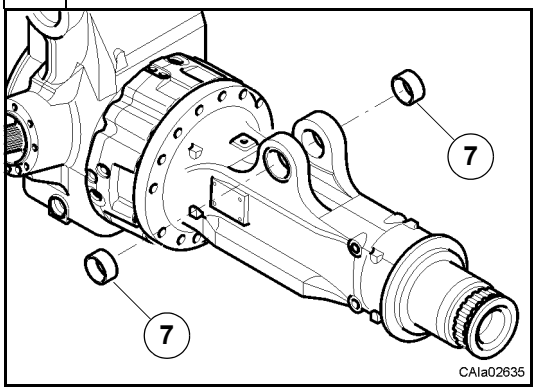
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.
Nota: per lo smontaggio del gruppo trombe trave vedi prima le procedure descritte alla sezione D.3.

D.4.1 Disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

***Note:** before disassemble the axle beam trumpets group see the procedure described in the section D.3.*

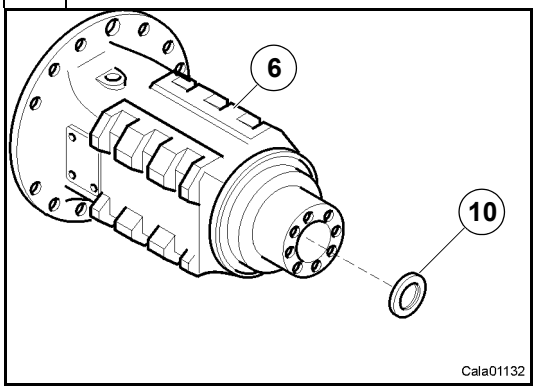
1



Estrarre le boccole (**7**) dalla tromba trave (**6**) con un punzone ed un martello.
Nota: è un'operazione distruttiva per le boccole.

Take the bushes (**7**) *out of the beam trumpet* (**6**) *with a punch and a hammer.*
***Note:** this is a destructive operation for the bushes.*

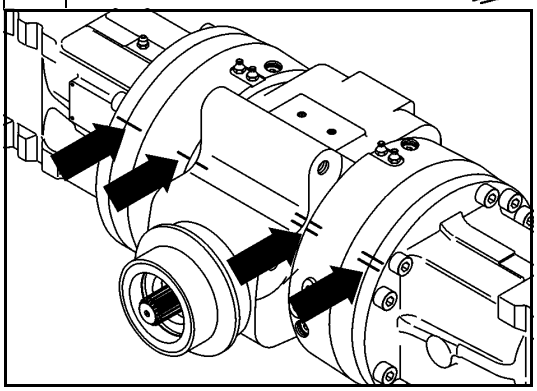
2



Estrarre l'anello di tenuta (**10**) dalla tromba trave (**6**) con una leva.
Nota: è un'operazione distruttiva per l'anello di tenuta.

Take the seal ring (**10**) *out of the beam trumpet* (**6**) *with a lever.*
Note: *this is a destructive operation for the seal ring.*

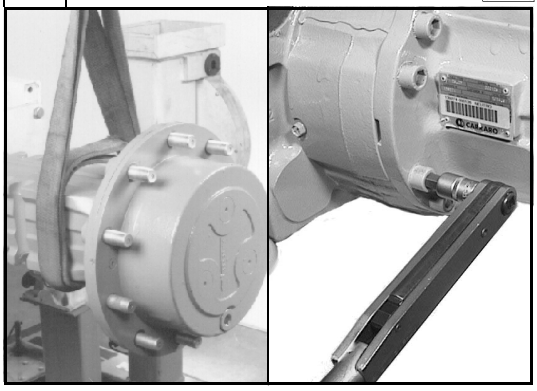
3



Fare dei segni di riferimento indelebili sulle trombe trave, sui cilindri freno e sul corpo centrale trave, per identificare con sicurezza parte destra e parte sinistra.

Put alignment marks on the beam trumpets, on the brake cylinders and on the central body, in order to identify the right side and the left side with certainty.

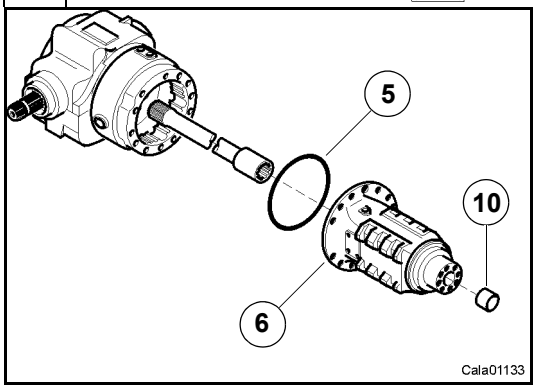
4



Attenzione: disporre l'assale su supporti adatti a sostenere sia il corpo centrale trave che le due trombe trave, anche dopo la loro separazione, o assicurare i gruppi separatamente con funi o cinghie ad un sistema di sollevamento.
Svitare e togliere le viti di fissaggio (**8**) ed il dado (**9**).

Warning: *Position the axle on supports fitted to hold either the central body and the two beam trumpets, even after their disjunction, or secure the disjointed groups to a lifting device with ropes or belts.*
*Unscrew and remove the fastening screws (**8**) and nut (**9**).*

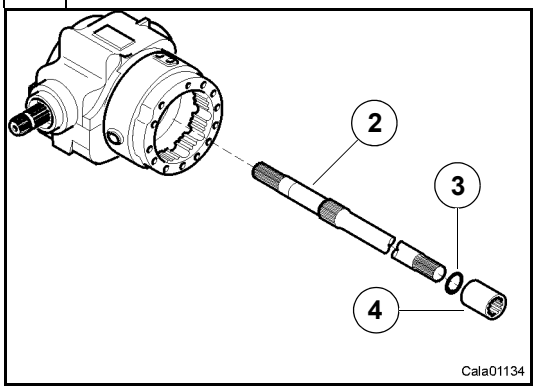
5



Staccare la tromba trave (**6**) e recuperare l'anello OR (**5**).
Attenzione: rimossa la tromba trave, il gruppo freno ed il semiasse lungo sono liberi.
Estrarre la bronzina (**10**) dalla tromba trave (**6**) solo se le condizioni di usura lo richiedono.
Attenzione: non rovinare la sede della bronzina.

*Remove the beam trumpet (**6**) and collect the O-Ring (**5**).*
Warning: *once the beam trumpet has been removed, the brake group and the long half-shaft are free.*
*Remove the bush (**10**) from the beam trumpet (**6**) only if the wear conditions require this.*
Warning: *be careful not to damage the bush housing.*

6



Estrarre l'albero (**2**) con il manicotto scanalato (**4**).
Solo se necessario rimuovere l'anello d'arresto (**3**) dal manicotto scanalato.

*Remove the shaft (**2**) and the splined sleeve (**4**).*
*Only if necessary remove the snap ring (**3**) from the splined sleeve.*

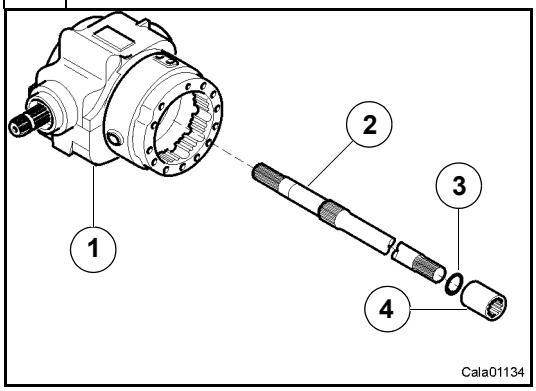
D.4.2 Montaggio

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.4.2 Assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

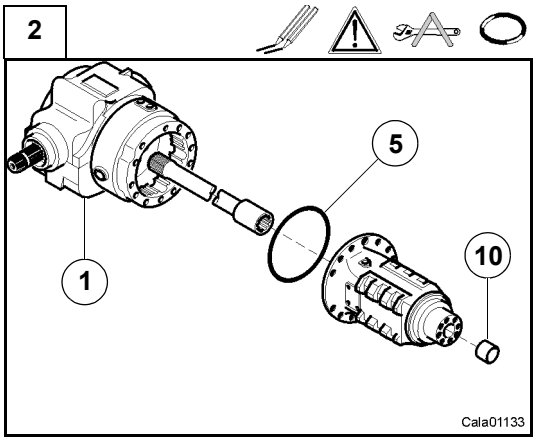
1



Verificare che l'anello d'arresto (**3**) sia montato nel manicotto scanalato (**4**).
Preassemblare il gruppo albero (**3**) / manicotto scanalato (**4**) ed inserirlo nel corpo trave centrale (**1**).

*Check that the snap ring (**3**) is already assembled on the splined sleeve (**4**).*
*Pre-assemble the group shaft (**3**) / splined sleeve (**4**) and insert it on the central body (**1**).*

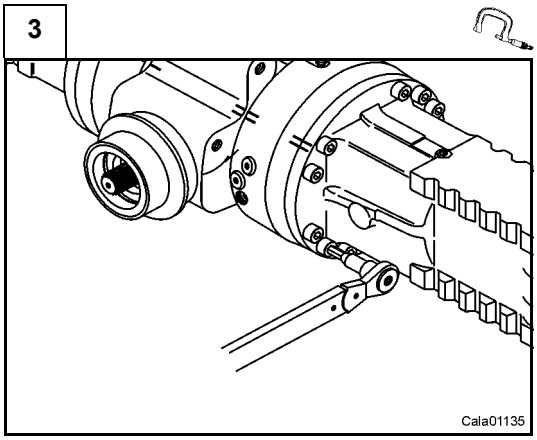
2



Montare nella tromba trave (**6**) la bronzina (**10**) utilizzando il battitoio CA715531 ed un martello.
Montare un nuovo anello OR (**5**) nella tromba trave.
Nota: prima del montaggio, verificare i segni di riferimento eseguiti in fase di smontaggio per il corretto posizionamento delle trombe trave.
Attenzione: sostenere opportunamente i gruppi come già indicato nella fase di smontaggio.
Montare la tromba trave sul corpo centrale (**1**), facendo attenzione all'allineamento dei fori di fissaggio.

*Assemble on the beam trumpet (**6**) the bush (**10**) with the special tool CA715531 and a hammer.*
*Assemble a new O-Ring (**5**) into the beam trumpet.*
***Note:** in order to place precisely the beam trumpet, before assembly, check the reference marks carried out during disassembly.*
***Warning:** support the groups properly as already pointed out for disassembly phase.*
*Assemble the beam trumpet on the central body (**1**), being careful to the fastening holes alignment.*

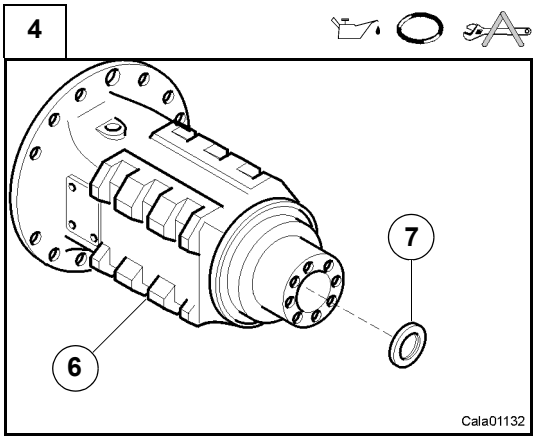
3



Avvitare il dado (**9**) e le viti di fissaggio (**8**) e serrarli alla coppia prevista (Sez.C.6)

*Screw in the nut (**9**) and fastening screws (**8**) to the requested torque (Sec.C.6).*

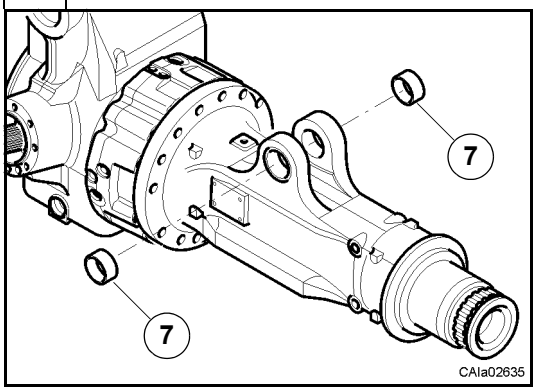
4



Montare un nuovo anello di tenuta (**11**) ben lubrificato nella tromba trave (**6**) con l'attrezzo CA715636 ed un martello.

*Assemble a new well lubricate seal ring (**11**) in the beam trumpet (**6**) using the special tool CA715636 and a hammer.*

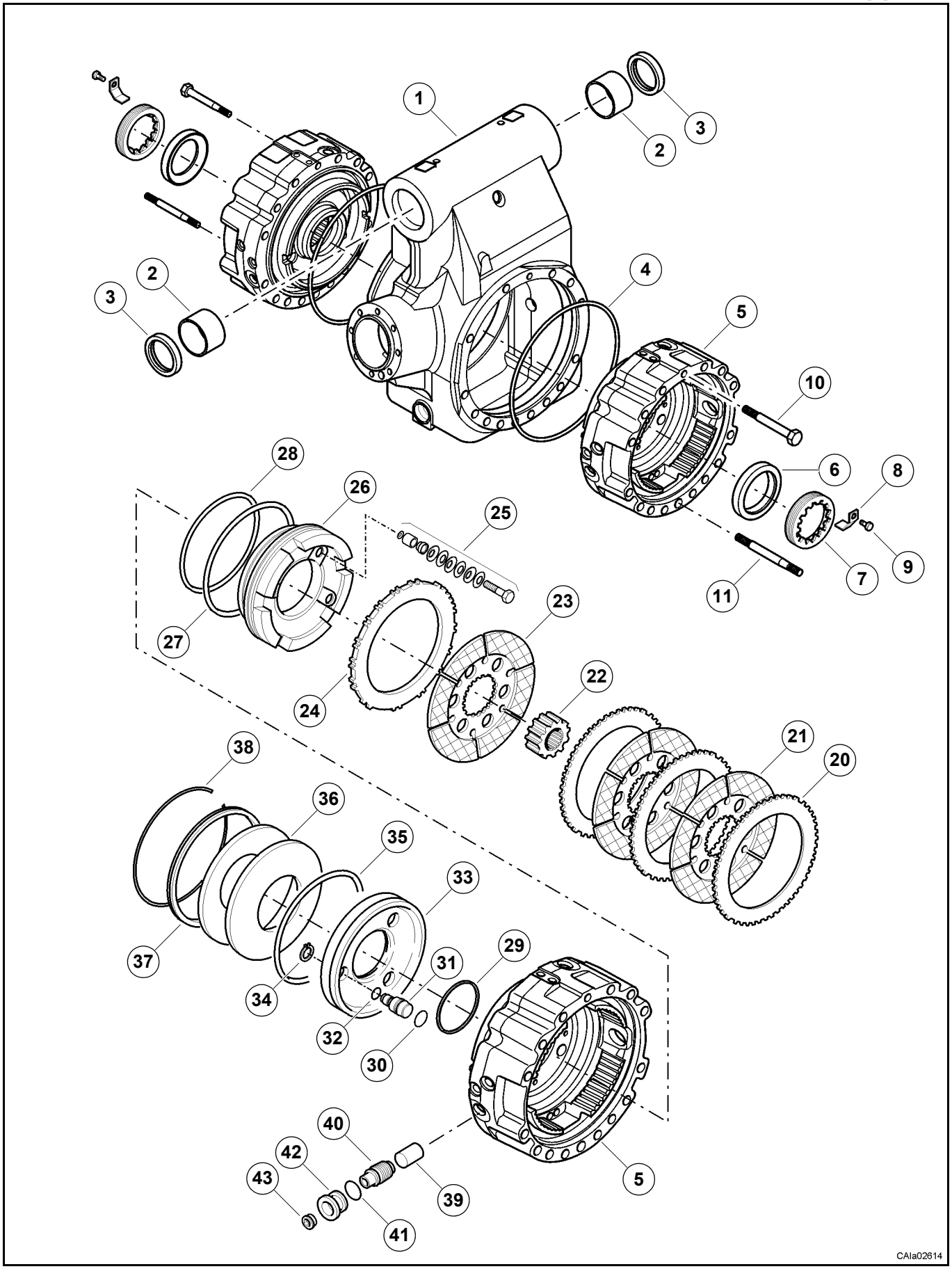
5



Inserire le boccole (**7**) nella tromba trave (**6**) con l'attrezzo CA715635 ed un martello.

*Assemble the bushes (**7**) to the beam trumpet (**6**) with the special tool CA715635 and a hammer.*

D.5 Freno e supporto differenziale *D.5 Brake and differential support*



D.5.1 Smontaggio

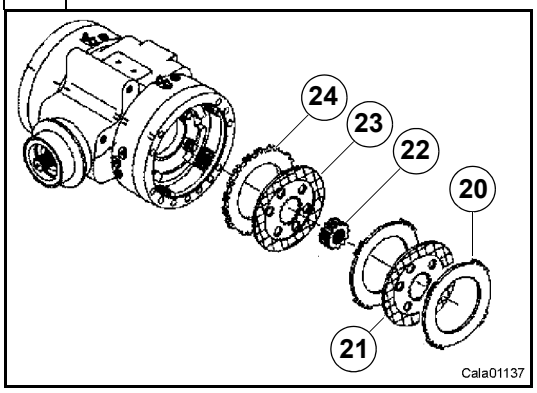
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.
Nota: per lo smontaggio del gruppo freno e supporto differenziale vedi prima le procedure descritte alla sezione D.4.

D.5.1 Disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

***Note:** before disassemble the brake and differential support group see the procedure described in the section D.4.*

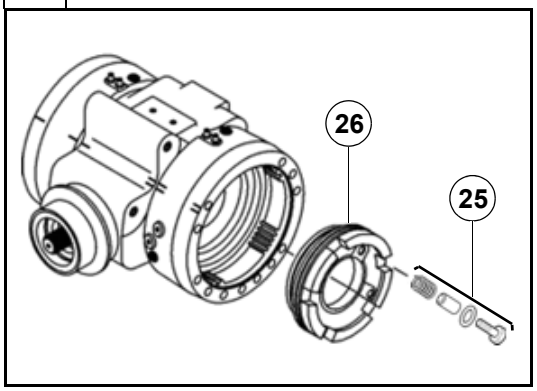
1



Rimuovere i componenti: controdischi freno (**20**) e dischi freno (**21**), mozzo traino dischi freno (**22**), disco freno (**23**) e controdisco freno (**24**).
Nota: ricordare la posizione del mozzo scanalato per il montaggio.

*Remove the components: brake counter plates (**20**) and brake plates (**21**), brake disk carrier (**22**), brake plate (**23**) and brake counter plate (**24**).*
***Note:** remember the position of the the splined disk carrier, it must be reassembled in the same position.*

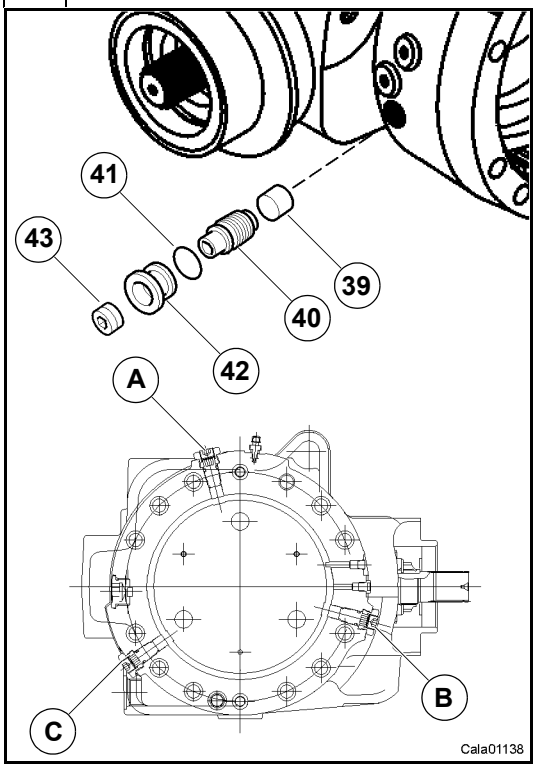
2



Svitare e togliere le viti del kit self-adjust (**25**) recuperandone tutti i componenti.
Recuperare il pistone freno positivo (**26**).

*Unscrew and remove the self-adjust kit's (**25**) screw and collect all the components.*
*Collect the brake piston positive (**26**).*

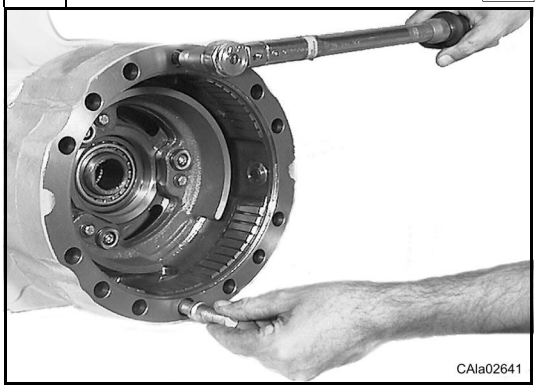
3



Togliere i tappi (**43**) e svitare completamente le viti (**42**) dalle viti freno parcheggio (**A**, **B** e **C**).
Svitare alternativamente le viti (**40**) fino a rimuoverle completamente.
Recuperare gli anelli OR (**41**) ed i perni (**39**).

*Remove the plugs (**43**) and unscrew completely the screws (**42**) from the parking brake screws (**A**, **B** and **C**).*
*Unscrew alternately the screw (**40**) until they are completely removed.*
*Collect the O-Rings (**41**) and the pins (**39**).*

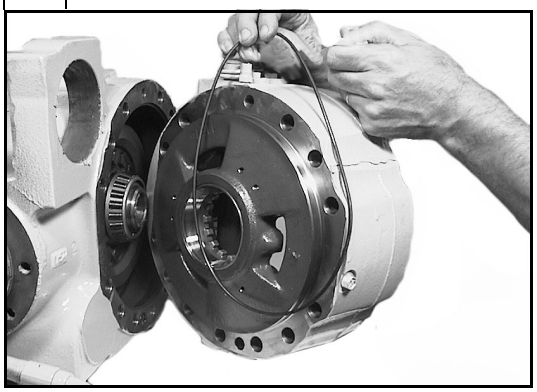
4



Assicurare il cilindro freno (**5**) ad un paranco con funi o cinghie di sicurezza.
Svitare e togliere il prigioniero (**11**) e la vite di fissaggio (**10**).
Attenzione: questa operazione libera la scatola differenziale.

*Secure the brake cylinder (**5**) to a hoist with ropes or safety belts.*
*Unscrew and remove the fastening stud bolt (**11**) and screw (**10**).*
***Warning:** the differential box is free.*

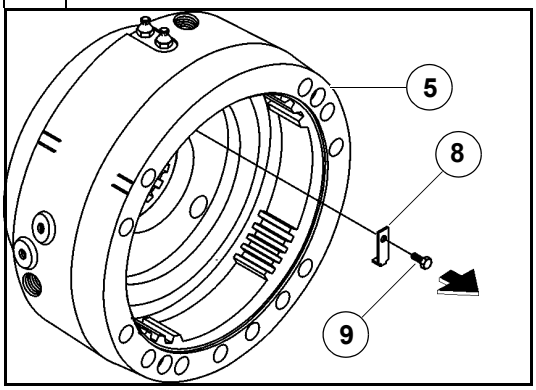
5



Recuperare l'anello OR (**4**) dal cilindro freno (**5**).

*Collect the O-Ring (**4**) from the brake cylinder (**5**).*

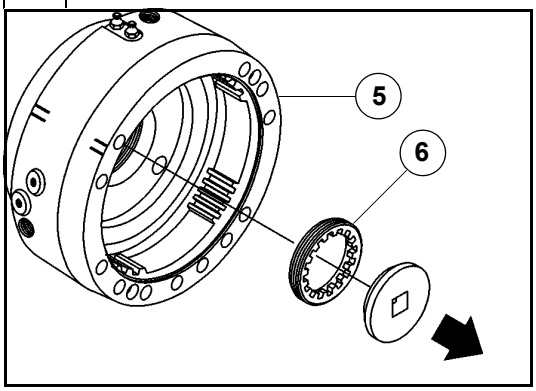
6



Svitare e togliere la vite (**9**) ed il fermo ghiera (**8**) dal cilindro freno (**5**).

*Unscrew and remove the screw (**9**) and the ring nut retainer (**8**) from the brake cylinder (**5**).*

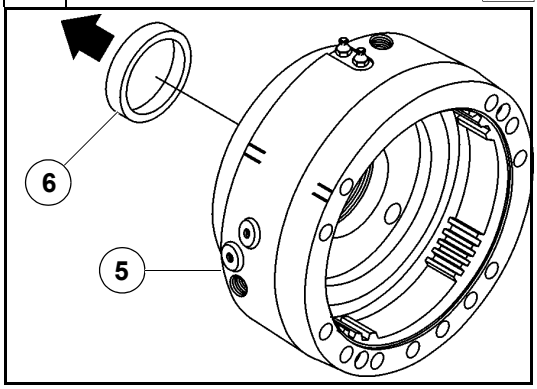
7



Svitare e togliere la ghiera (**7**) dal cilindro freno (**5**) con l'attrezzo CA119030.

*Unscrew and remove the adjuster ring nut (**7**) from the brake cylinder (**5**) with the tool CA119030.*

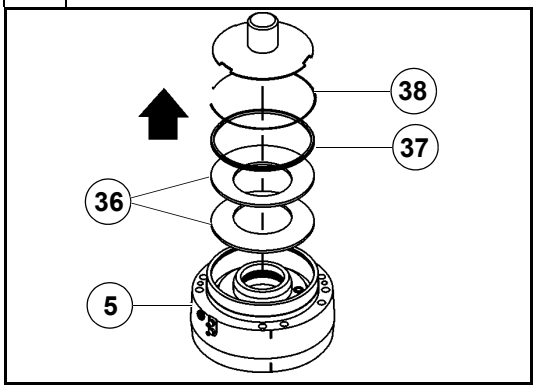
8



Estrarre la coppa del cuscinetto (**6**) dal cilindro freno (**5**) con un battitoio.
Attenzione: non invertire le coppe dei cuscinetti se non vengono sostituiti.

*Use a driver to remove the bearing cup (**6**) from the brake cylinder (**5**).*
***Warning:** do not mismatch the bearings cup if they are not going to be replaced.*

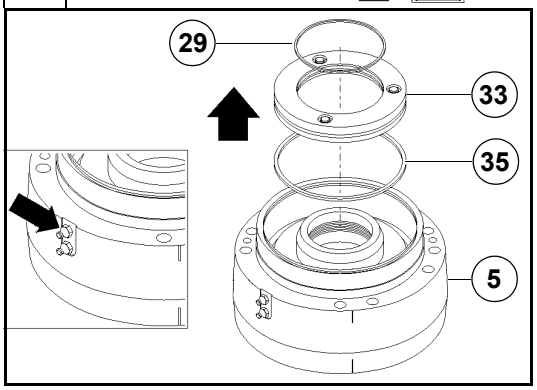
9



Posizionare il cilindro freno (**5**) sotto l'azione di una pressa e con l'ausilio dell'attrezzo CA715056 togliere l'anello d'arresto (**38**).
Eseguire un rilascio della spinta della pressa lento e graduale, recuperare quindi il manicotto (**37**) e le molle a tazza (**36**).

*Position the brake cylinder (**5**) under a press and with the tool CA715056 remove the snap ring (**38**).*
*Relase the load of the press slowly and gradually, them collect the sleeve (**37**) and the belleville washers (**36**).*

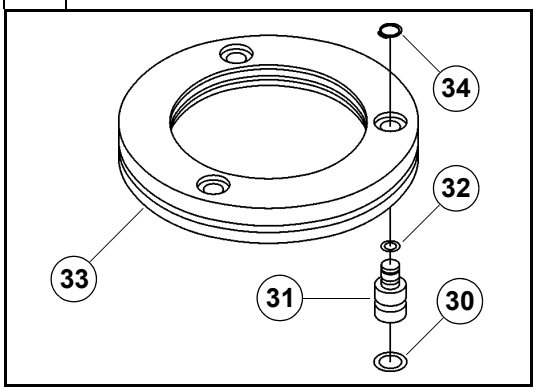
10



Per l'estrazione del pistone freno negativo (**33**) utilizzare il foro di mandata del freno applicando la minima pressione d'olio o aria necessaria per l'espulsione.
Attenzione: questa operazione deve essere condotta con la massima cautela.
Recuperare gli anelli OR (**29**) e (**35**) dal pistone freno negativo.

*In order to extract the negative brake piston (**33**) use the hydraulic connection applying the lowest oil or air pressure necessary to dislodge the piston.*
***Warning:** this operation must be performed with extreme care.*
*Collect the O-Rings (**29**) and (**35**) from the negative brake piston.*

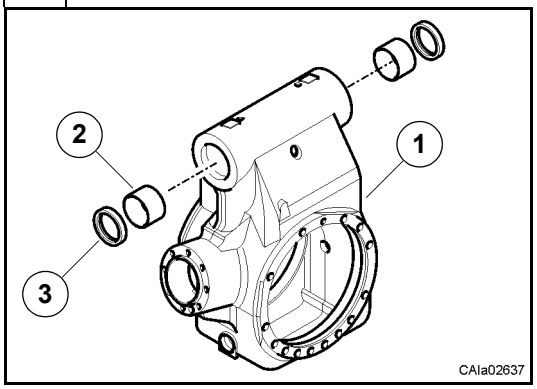
11



Togliere l'anello d'arresto (**34**) dal pistone freno negativo (**33**) ed estrarre il perno di spinta (**31**).
Recuperare gli anelli OR (**30**) e (**32**) dal perno di spinta.

*Remove the snap ring (**34**) from the negative brake piston (**33**) and extract the thrust pin (**31**).*
*Collect the O-Rings (**30**) and (**32**) fom the thrust pin.*

12



Estrarre l'anello di tenuta (**3**) dal corpo centrale (**1**) con una leva.
Nota: è un'operazione distruttiva per gli anelli di tenuta.
Rimuovere le boccole (**2**).

Take the seal ring (**3**) *out of the central body* (**1**) *with a lever.*
***Note:** this is a destructive operation for the seal rings.*
Remove the bushes (**2**).

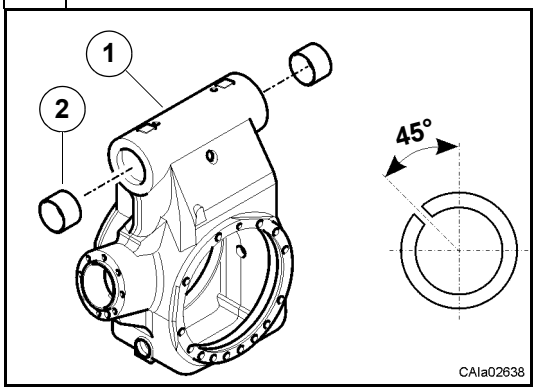
D.5.2 Montaggio

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.5.2 Assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

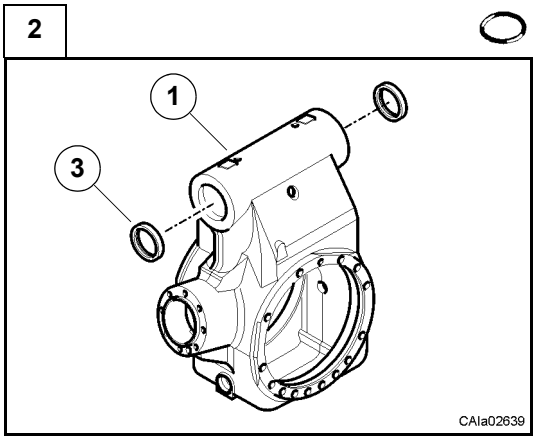
1



Assemblare le boccole (**2**) al corpo centrale (**1**) utilizzando l'attrezzo speciale CA715634 ed un martello.
Nota: rispettare la posizione indicata.

Assemble the bushes (**2**) to *the central body* (**1**) *with the special tool CA715634 and a hammer.*
Note: *position the bushes as shown.*

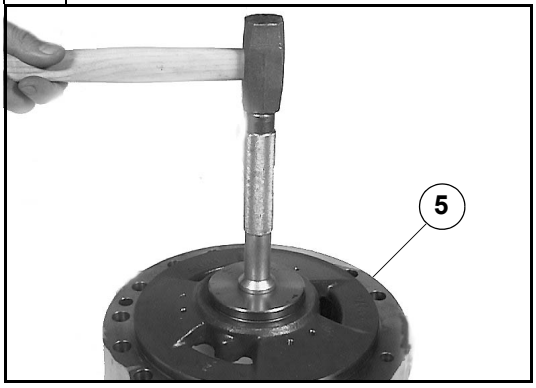
2



Assemblare l'anello di tenuta (**3**) al corpo centrale (**1**) con l'attrezzo speciale CA715181 ed un martello.

Assemble the seal ring (**3**) *to the central body* (**6**) *with the special tool CA715181 and a hammer*.

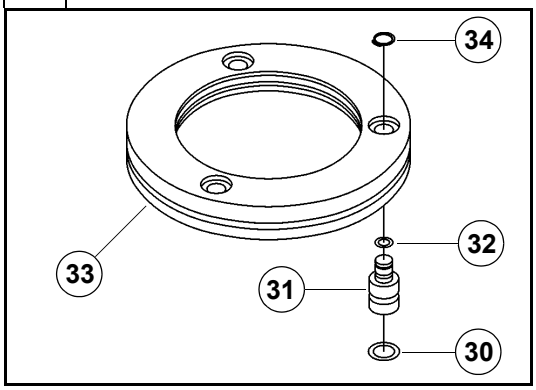
3



Posizionare il cilindro freno (**5**) su di una superficie piana e piantare la coppa (**6**) del cuscinetto con il battitoio CA715583.
Attenzione: non invertire le coppe dei cuscinetti se non vengono sostituiti.

*Position the brake cylinder (**5**) on a flat surface and force the bearing cup (**6**) using the special tool CA715583.*
Warning: *do not mismatch the bearings cup if they are not going to be replaced.*

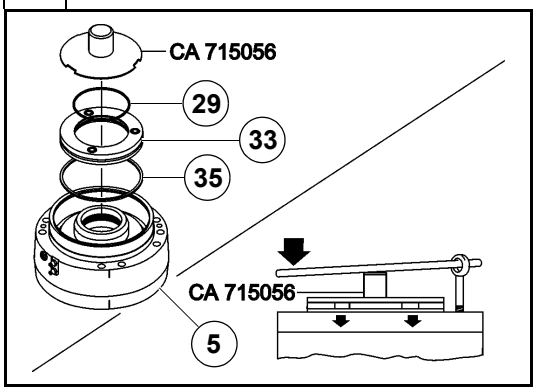
4



Montare nuovi anelli OR (**30**) e (**32**) ben lubrificati nei perni di spinta (**31**).
Inserire i perni di spinta nel pistone freno negativo (**33**) e bloccarli con gli anelli d'arresto (**34**).

*Assemble new well lubricated O-Rings (**30**) and (**32**) to the thrust pins (**31**).*
*Insert the thrust pins into the negative brake piston (**33**) and lock them with the snap rings (**34**).*

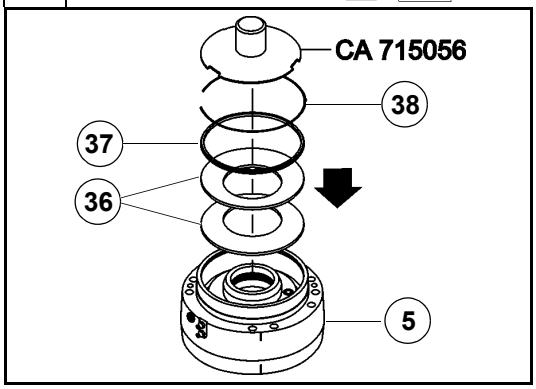
5



Montare nuovi anelli OR (**29**) e (**35**) ben lubrificati nel pistone freno negativo (**33**).
Inserire il pistone freno negativo nel cilindro freno (**5**) utilizzando l'attrezzo CA715056 ed una leva come illustrato in figura.

*Assemble new well lubricated O-Rings (**29**) and (**35**) to the negative brake piston (**33**).*
*Insert the negative brake piston into the brake cylinder (**5**) using the tool CA715056 and a lever as is shown in figure.*

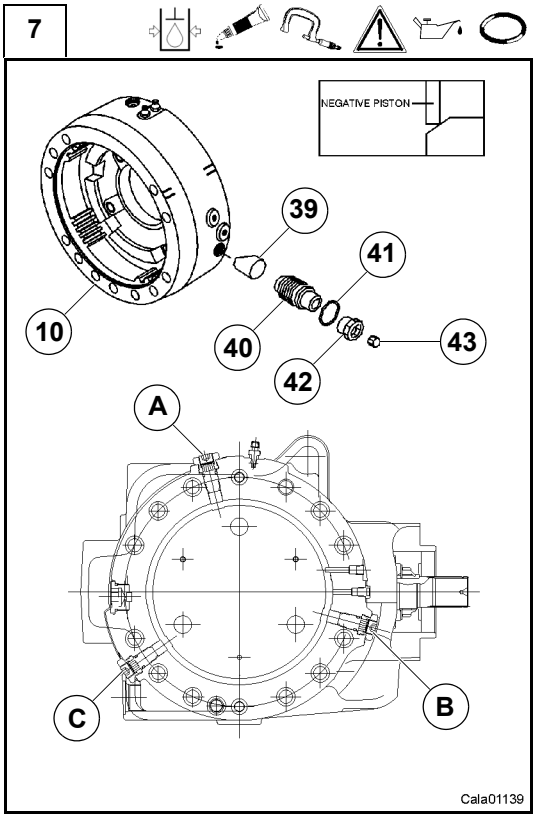
6



Posizionare le molle a tazza (**36**) ben centrate, in modo che l'ultima sia concava, il manicotto (**37**) con la sede per l'anello d'arresto (**38**) verso l'esterno, e l'attrezzo CA715056 nel cilindro freno (**5**).
Sotto l'azione di una pressa esercitare una spinta tale da poter montare l'anello d'arresto (**38**).
Pericolo: possibile rapida espulsione delle molle a tazza.
Utilizzando la pressa come potezione di sicurezza, allontanare con cautela e solo di pochi millimetri l'attrezzo CA715056 dalle molle a tazza. Applicare olio alla pressione di circa 20 bar alla mandata olio freno e far compiere almeno tre corse di lavoro al pistone freno (**5**) verificandone la tenuta idraulica degli anelli OR ed il corretto inserimento dell'anello d'arresto (**38**).

*Position the belleville washer (**36**) well matched, with the last disc on top must be concave side up, the sleeve (**37**) with the snap ring seat outermost, and the tool CA715056 into the brake cylinder.*
*Using a press, apply a pressure on the entire assembly until the snap ring (**38**) can be fitted.*
***Danger:** it is possible a rapid ejection of the belleville washer.*
*Using the press as safety protection, move away with caution and only for few millimetres the special tool CA715056 from the belleville washer. Apply an oil pressure of about 20 bar through the hydraulic connection, in order to do at least three stroke of the brake piston (**8**) and check the tightness of the O-Rings and the correct insertion of the snap ring (**38**).*

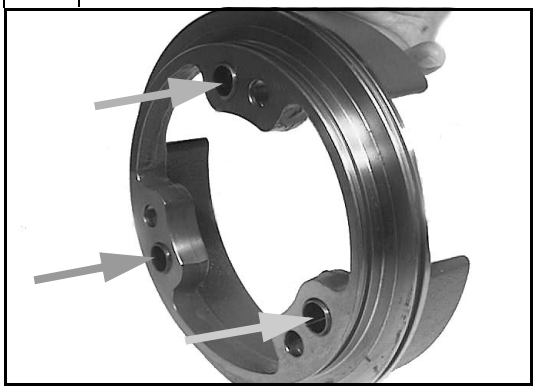
7



Montare nuovi anelli OR (**41**) ben lubrificati nelle viti (**42**).
Montare i perni (**39**) e le viti (**40**) al cilindro freno (**5**) nelle posizioni **A**, **B** e **C**.
Attraverso la mandata applicare una pressione d'olio di circa 20 bar nel cilindro freno ed avvitare le tre viti (**40**) fino al contatto con il pistone freno negativo (**33**).
Attenzione: il piano inclinato dei perni (**39**) deve appoggiarsi contro il pistone freno negativo (**33**), come indicato in figura.
Completare l'operazione chiudendo con un ulteriore quarto di giro le tre viti (**40**).
Applicare sigillante (**A3**) sotto la testa delle viti (**42**) (Sez.C.4).
Tolta la pressione, completare l'operazione di assemblaggio avvitando le viti (**42**) ed i tappi (**43**) alle coppie previste (Sez.C.6).

*Assemble new well lubricated O-Ring (**41**) to the screws (**42**).*
*Assemble the pins (**39**) and the screws (**40**) into the brake cylinder (**5**) to the positions **A**,**B** and **C**.*
*Apply an oil pressure of about 20 bar through the hydraulic connection of the brake cylinder and screw the three screws (**40**) till to touch the negative brake piston (**33**).*
***Warning:** the pin's ramp (**39**) must seat against the negative brake piston (**33**), as is shown in figure.*
*Carry out the adjustment tightening the three screws (**40**) a further of quarter turn.*
*Apply sealant (**A3**) under the screw heads (**42**) (Sec.C.4).*
*Drop the oil pressure and complete the assembly screwing and tightening the screws (**42**) and the plugs (**43**) to the prescribed torques (Sec.C.6).*

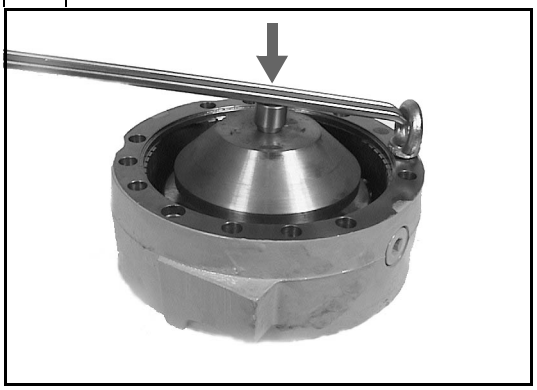
8



Recuperare il pistone freno (**26**).
Spingere le boccole nelle sedi dei self-adjust con l'attrezzo CA715033 ed un martello, fino a pareggiarle con la superficie interna di appoggio del pistone.

*Collect the brake piston (**26**).*
With special tool CA715033 and a hammer, push the washers into the self-adjust housings till they are aligned with the piston supporting inner surface.

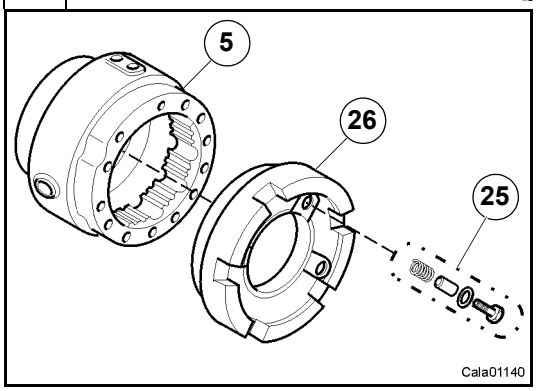
9



Inserire il pistone (**26**) nel cilindro freno (**5**) e posizionare l'attrezzo cod. CA715056 o un disco piano sul pistone.
Nota: posizionare il pistone freno positivo (**26**) con una cava in corrispondenza al foro di ricircolo olio del cilindro freno (**5**).
Con una leva ben ancorata, magari ad un golfare, esercitare una pressione appena sufficiente ad inserire il pistone nella flangia freno.

*Insert the piston (**26**) into the brake cylinder (**5**) and position the special tool code CA715056 or a flat disk on the piston.*
***Note:** position the positive brake piston (**26**) with a slot aligned with the hydraulic connection on the brake cylinder (**5**).*
With a lever anchored to an eyebolt, exert a pressure just enough to insert the piston into the brake flange.

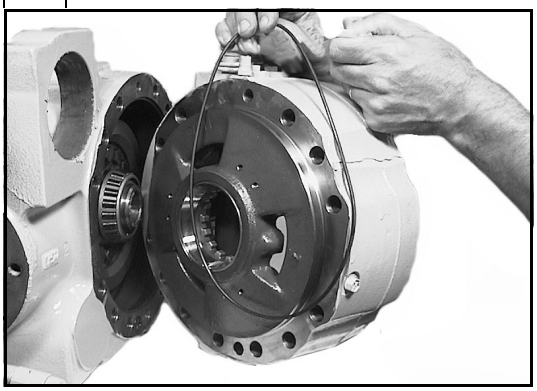
10



Montare i componenti del kit self-adjust (**25**) e serrare le viti alla coppia prevista (Sez. C.6).

*Assemble the self-adjust kit (**25**) and tighten the screws to the prescribed torque (Sec. C.6).*

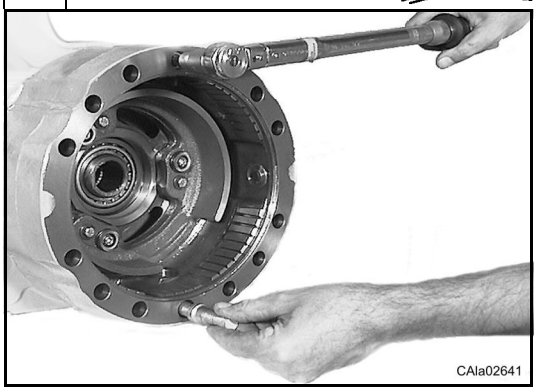
11



Montare un nuovo anello OR (**4**) ben lubrificato nella sede del cilindro freno (**5**).

*Assemble a new well lubricated O-Ring (**4**) on the brake cylinder (**5**) housing.*

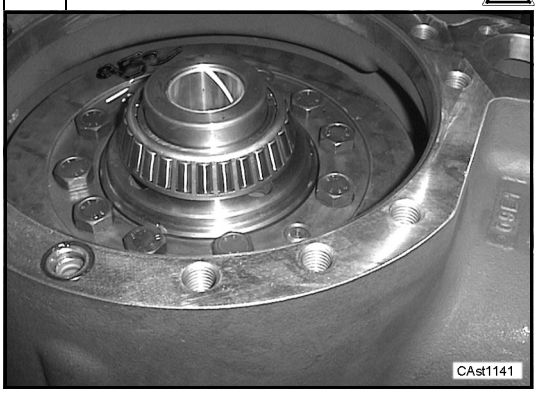
12



Montare il cilindro freno (**5**) sinistro sul corpo centrale (**1**). Serrare il prigioniero (**11**) e la vite (**10**) di fissaggio alla coppia prevista (Sez.C.6).
Nota: verificare che i segni di riferimento fatti allo smontaggio tra il cilindro freno (**5**) ed il corpo centrale (**1**) coincidano.

*Assemble the left brake cylinder (**5**) on the central body (**1**). Tighten the fastening stud bolt (**11**) and screw (**10**) to the requested torque (Sec.C.6).*
***Note:** check that the reference marks made during the disassembly between the left brake cylinder (**5**) and the central body (**1**) coincide.*

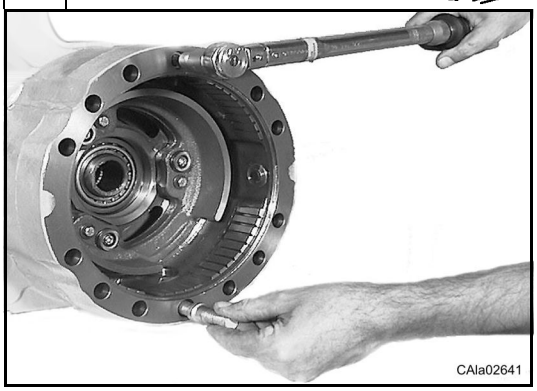
13



Montare la scatola differenziale.
Attenzione: verificare che la corona dentata sia montata dal lato giusto.

Assemble differential housing.
Warning: *check the correct assembly side of the bevel gear.*

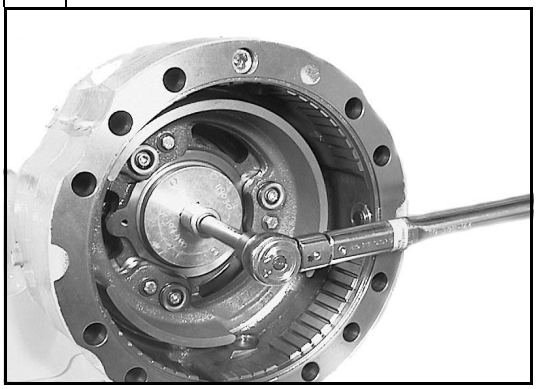
14



Montare il cilindro freno (**5**) destro sul corpo centrale (**1**). Serrare il prigioniero (**11**) e la vite (**10**) di fissaggio alla coppia prevista (Sez. C.6).
Nota: verificare che i segni di riferimento fatti allo smontaggio tra il cilindro freno (**5**) destro ed il corpo centrale (**1**) coincidano.

*Assemble the right brake cylinder (**5**) on the central body (**1**). Tighten the fastening stud bolt (**11**) and screw (**10**) to the requested torque (Sec. C.6).*
Note: *check that the reference marks made during the disassembly between the right brake cylinder (**5**) and the central body (**1**) coincide.*

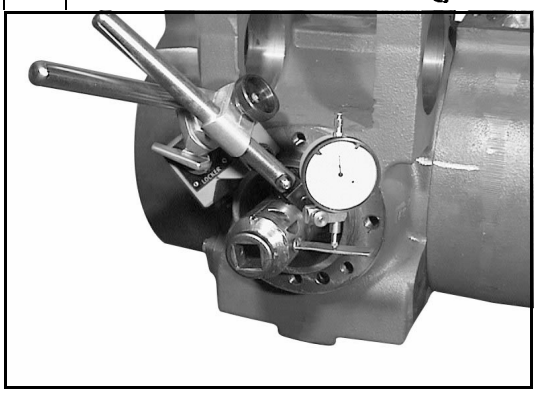
15



Avvitare entrambe le ghiere di registrazione (**7**) utilizzando l'attrezzo CA119030 fino ad eliminare il gioco e precaricare leggermente i cuscinetti del differenziale.

*Screw both adjuster ring nuts (**7**) using the tool CA119030 till the backlash is eliminated and the differential bearings are slightly preloaded.*

16



Montare l'attrezzo CA715146 sul codolo del pignone.
Muovere il codolo del pignone alternativamente ed annotare il gioco fra pignone e corona, rilevato con un comparatore, in modo che il tastatore sia a contatto ed a 90° con la superficie della staffa dell'attrezzo CA715146 in corrispondenza della tacca di riferimento.
Verificare se il valore del gioco rilevato rientra nel campo predefinito:

0.15÷0.25 mm

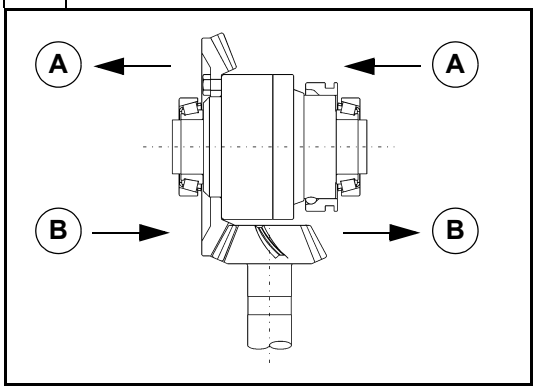
Effettuare la registrazione agendo sulle due ghiere di registrazione (**7**) con l'attrezzo CA119030.

Assemble the tool CA715146 on the pinion end.
Move the pinion end alternatively and note the pinion-ring gear backlash, measured with a comparator, so that the feeler stylus is in contact and at 90° with the bracket surface of the tool CA715146 in correspondance to the reference mark.
Check if the measured backlash value is within the requested range:

0.15÷0.25 mm

*Carry out the adjustment by operating on the two adjuster ring nuts (**7**) with the tool CA119030.*

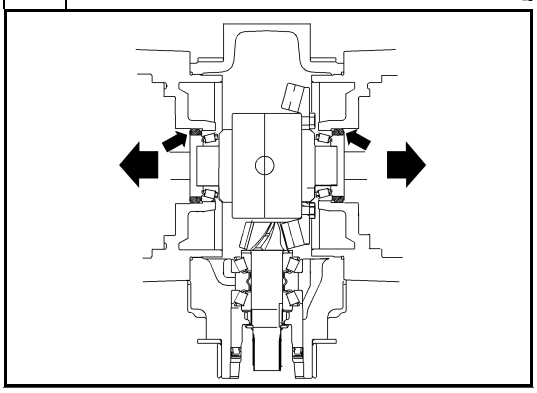
17



Registrare le ghiere (**7**) ricordando che:
- se **il gioco rilevato è inferiore** al campo di tolleranza dato, avvitare la ghiera dal lato opposto alla corona e svitare la ghiera opposta della stessa quantità (**A**);
- se **il gioco rilevato è superiore** al campo di tolleranza dato, avvitare la ghiera dal lato della corona e svitare la ghiera opposta della stessa quantità (**B**).

*Adjust the ring nuts (**7**), remembering that:*
*- if **the measured backlash is less** than the given tolerance range, screw the ring nut from the side opposite to the ring gear and unscrew the opposite one of the same measure (**A**);*
*- if **the measured backlash is greater** than the given tolerance range, screw the ring nut from the side of the ring gear and unscrew the opposite one of the same measure (**B**).*

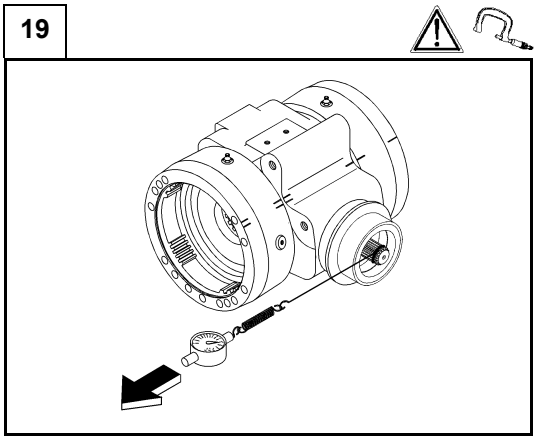
18



Effettuata la registrazione del gioco pignone-corona verificare anche che ci sia un minimo di precarico sui cuscinetti della scatola differenziale
Ripetere l'intera sequenza delle operazioni citate fino al raggiungimento delle condizioni indicate.

Once the adjustment of the pinion-bevel gear backlash has been carried out, check also that there is a minimum preloading on the differential housing bearings.
Repeat the whole sequence of the above mentioned operations till the indicated conditions are reached.

19



Stabilito il gioco pignone-corona, misurare il precarico totale **T** dei cuscinetti (sistema pignone-corona), utilizzando un dinamometro con la corda avvolta sul codolo scanalato del pignone. Il valore misurato deve rientrare nel seguente campo:

T=(P+1.9)÷(P+2.9) daN

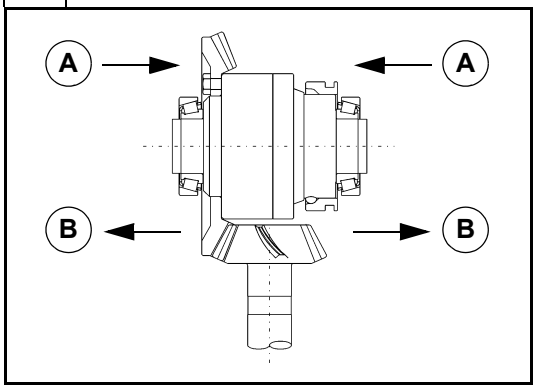
dove **P** è il precarico effettivo misurato sul pignone.
Attenzione: tutti i precarichi vanno misurati senza anelli di tenuta.
Vedi: procedure descritte alla sezione D.7

*Once the pinion-ring gear backlash has been established, measure the total preloading **T** of the bearings (pinion-crown bevel gear system), using a dynamometer whose cord is wound on the pinion splined end. The measured value should be within the following range:*

T=(P+1.9)÷(P+2.9) daN

*where **P** is the effectively measured pinion preloading.*
***Warning:** all the preloadings should be measured without the seal rings.*
***See:** procedure described in the section D.7.*

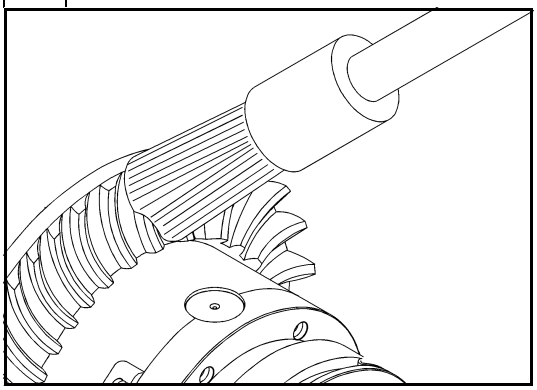
20



Se la misurazione non rientrasse nel campo prescritto, controllare bene l'assemblaggio di ogni singolo componente ed intervenire sulle ghiere di registrazione (**7**) del supporto differenziale:
- se **il precarico totale è inferiore** al campo dato, avvitare della stessa quantità le ghiere di registrazione, mantenendo inalterato il valore del gioco pignone-corona (**A**);
- se **il precarico totale è superiore** al campo dato, svitare della stessa quantità le ghiere di registrazione, mantenendo inalterato il valore del gioco pignone-corona (**B**).

*If the measurement is not within the requested range, check well the assembly of each component and operate on the adjuster ring nuts (**7**) of the differential support:*
*- if **the total preloading is less** than the given range, screw in both adjuster ring nuts by the same measure, keeping the pinion-ring gear backlash value unchanged (**A**);*
*- if **the total preloading is greater** than the given range, unscrew both adjuster ring nuts by the same measure, keeping the pinion-ring gear backlash value unchanged (**B**).*

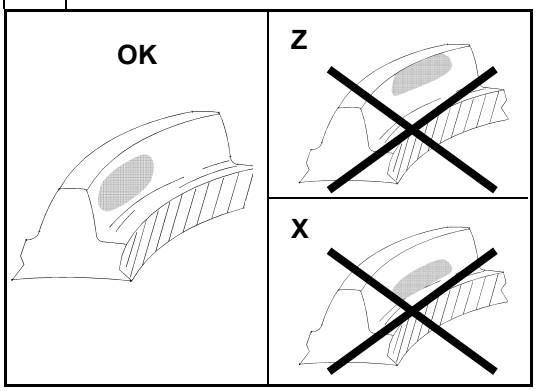
21



NOTA
Per verificare l'impronta di contatto dei denti della coppia conica, sporcare con minio la corona e rilevare il contatto.
L'esame dell'impronta di contatto deve essere eseguito sempre sui denti della corona conica, e su ambedue i fianchi.

NOTE
To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.
The marking test should be always carried out on the ring bevel gear teeth and on both sides.

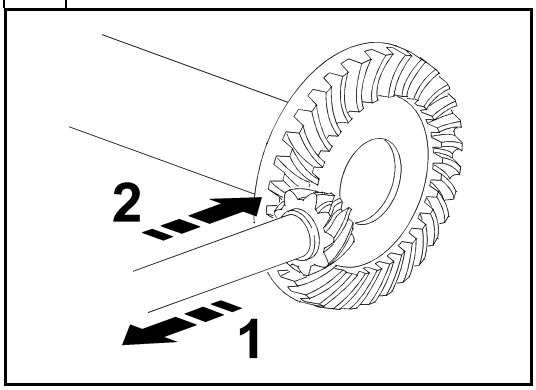
22



OK -> Contatto corretto:
Se la registrazione della coppia conica è ben fatta, il contatto delle superfici delle dentature risulterà regolare.
Z -> Eccessivo contatto sulla cresta del dente:
Avvicinare il pignone alla corona ed allontanare poi la corona dal pignone per regolare il gioco.
X -> Eccessivo contatto alla base del dente:
Allontanare il pignone dalla corona ed avvicinare poi la corona al pignone per regolare il gioco.

***OK** -> Correct contact:*
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.
***Z** -> Excessive contact on the tooth tip:*
Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.
***X** -> Excessive contact at the tooth base:*
Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.

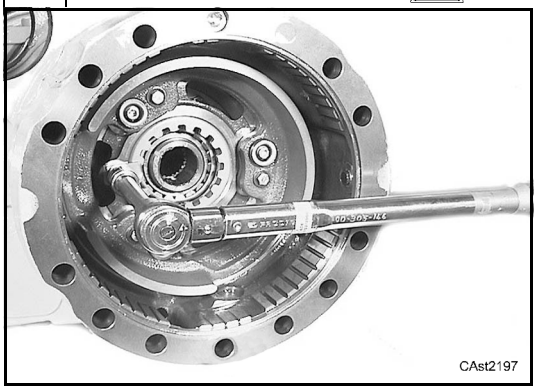
23



Spostamenti per le correzioni:
1 -> spostare il pignone per modifica contatto tipo X
2 -> spostare il pignone per modifica contatto tipo Z

Movements to correct:
***1** -> move the pinion for type X contact adjustment*
***2** -> move the pinion for type Z contact adjustment.*

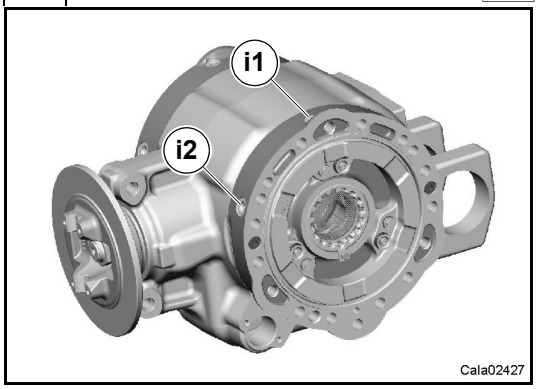
24



Dopo aver completato tutte le operazioni di registro, montare i fermi ghiera (**8**) e le rispettive viti (**9**) serrandole alla coppia prevista (Sez.C.6).
Attenzione: ruotare le ghiere di registrazione (**7**) il minimo indispensabile per permettere il montaggio.

*Once all the adjustment operations have been completed, fit the adjuster ring nut retainers (**8**) and their respective screws (**9**), tightening them to the requested torque (Sec.C.6).*
***Warning:** turn the adjuster ring nuts (**7**) slightly in order to allow the assembly.*

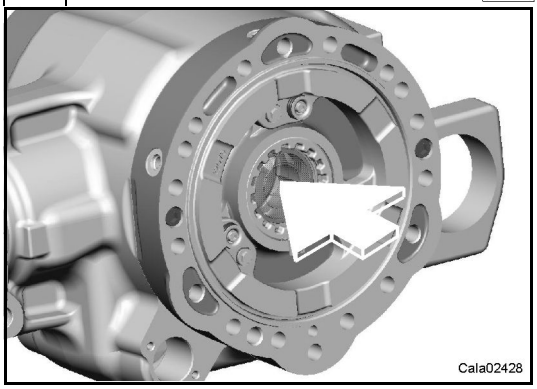
25



Rimuovere attacchi, sfiatatoi ed eventuali tappi dagli ingressi olio freni (**i1**) e (**i2**).
Vedi: (**6**) e (**7**) in sezione C.5
Pericolo: possibile espulsione di olio dall'assale.

*Remove straight threads, bleeds or plugs from the service brake oil port (**i1**) and (**i2**).*
***See:** (**6**) and (**7**) in section C.5*
***Danger:** risk of ejection of oil from the axle.*

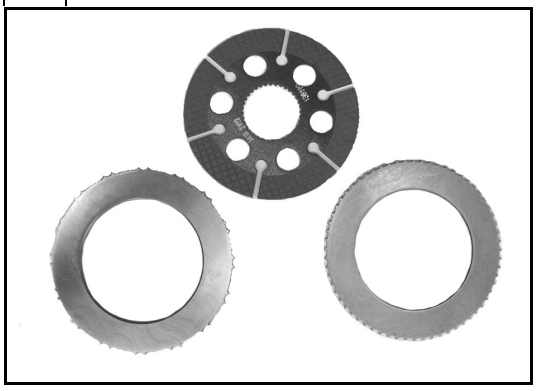
26



Spingere il pistone (**26**) del freno in battuta utilizzando il tampone speciale CA715056 con il manico intercambiabile CA119033 ed un martello.
Attenzione: posizionare il tampone con cura per non danneggiare il pistone.

*Push the brake piston (**26**) at the end of stroke using the special pad CA715056 and the handle CA119033 with a hammer.*
***Warning:** position the pad with accuracy to do not damage the brake piston.*

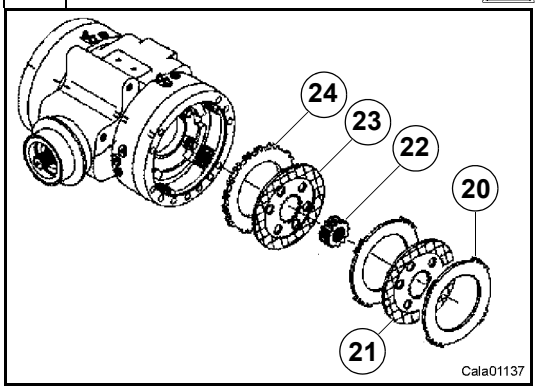
27



Verificare che i dischi freno (**21** e **23**) ed i controdischi freno (**20** e **24**) non presentino tracce di bruciatura; in caso contrario sostituirli. Verificare inoltre l'usura dei dischi freno (Sez.C.4) e sostituirli se necessario.
Nota: se si installano nuovi dischi freno, prima del montaggio immergerli nell'olio prescritto (Sez.C.4).

*Check that the brake plate (**21** and **23**) and the brake drive plate (**20** and **24**) do not present any sign of burning; on the contrary, replace them. Furthermore check brake plate wear (Sec.C.4) and if necessary replace it.*
***Note:** if new brake plate are installed, before assembling they should be dipped in the prescribed oil (sec.C.4).*

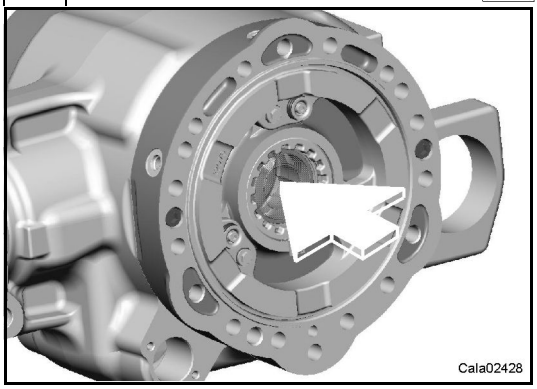
28



Rimontare tutti gli elementi del gruppo freno come indicato in figura: controdisco freno (**24**) e disco freno (**23**), mozzo traino dischi freno (**29**) e controdischi freno (**20**) e dischi freno (**21**).
Attenzione: alla corretta posizione del gradino sul diametro esterno del mozzo traino dischi freno (**22**).
Nota: inserire i dischi freno con i fori allineati.

*Reassemble all the components of the brake grup as is shown in figure: brake counterplate (**24**), brake plate (**23**), brake disk carrier (**22**), brake counterplates (**20**) and brake plates (**21**).*
***Warning:** to the correct position of the step on the external diameter of the brake disk carrier (**22**).*
***Note:** assemble brake disks with holes aligned.*

29

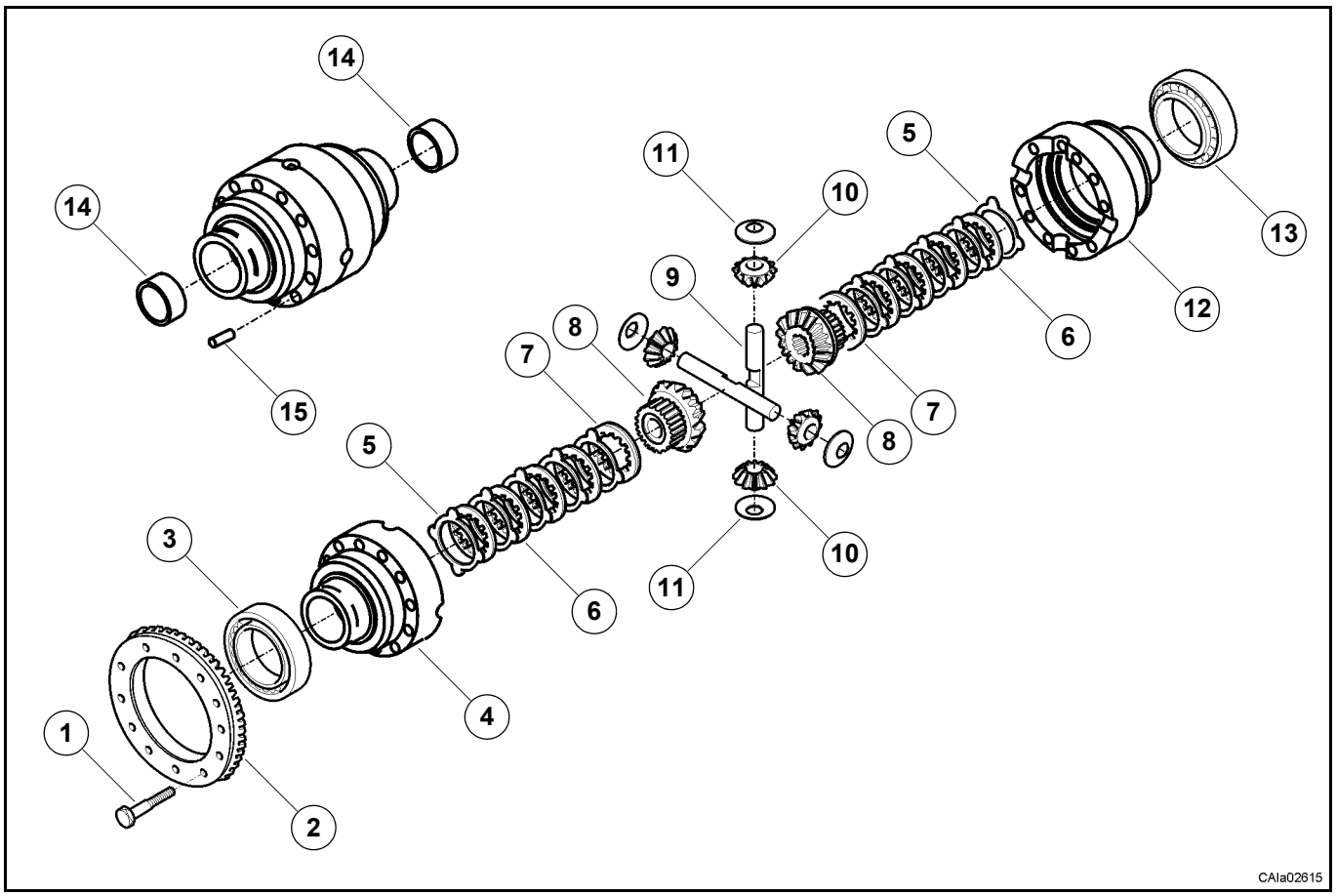


Attenzione: nel caso si sostituiscano solo i dischi freno, spingere il pistone (**26**) del freno in battuta utilizzando il tampone speciale CA715056 con il manico intercambiabile CA119033 ed un martello.
Nota: posizionare il tampone con cura per non danneggiare il pistone.

***Warning:** when replace the brake disk only, push the brake piston (**26**) at the end of stroke using the special pad CA715056 and the handle CA119033 with a hammer.*
***Note:** position the pad with accuracy to do not damage the brake piston.*

D.6 Gruppo differenziale

D.6 Differential group



D.6.1 Smontaggio

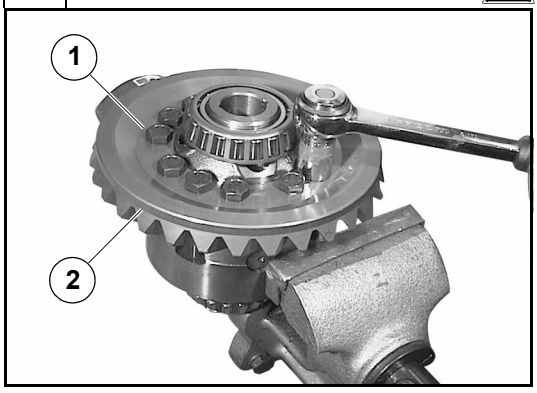
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.
Nota: per lo smontaggio del gruppo differenziale vedi prima le procedure descritte alla sezione D.5.

D.6.1 Disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

***Note:** before disassemble the differential group see the procedure described in the section D.5.*

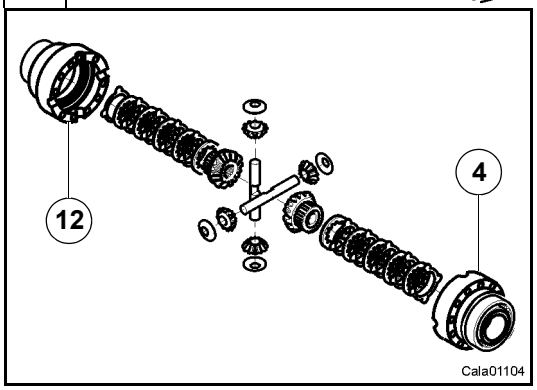
1



Bloccare il differenziale in una morsa.
Svitare le viti (**1**) di fissaggio e rimuovere la corona conica (**2**).
Attenzione: questa operazione libera anche le due semiscatole differenziale (**4**) e (**12**), non disperderne i componenti.

Lock the differential with a clamp.
*Unscrew the fastening screws (**1**) and remove the bevel gear crown (**2**).*
***Warning:** this will make both differential half boxes (**4**) and (**12**) free, so take care not to drop the internal components.*

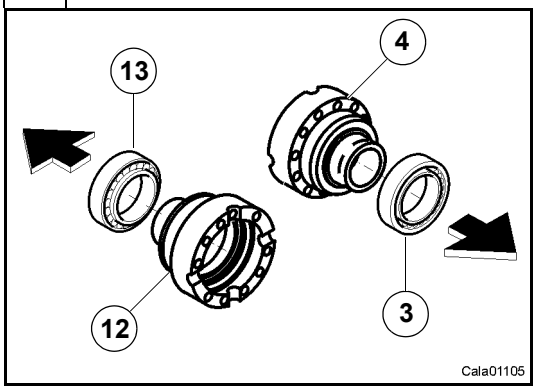
2



Disassemblare la scatola differenziale nelle due semiscatole (**4**) e (**12**) complete dei rispettivi elementi.
Nota: fare dei segni di riferimento sulle due semiscatole prima di separarle, per ripristinare la loro posizione relativa in fase di montaggio.
Disassemblare tutti i particolari.
Verificare le condizioni di funzionalità e lo stato di usura dei componenti.

*Disassemble the differential box in two half boxes (**4**) and (**12**) complete with the relative components.*
***Note**: mark the two half boxes before disjoining them, in order to reassemble them in the same position as the one before disassembling.*
Disassemble all the components.
Check the operating and wear conditions of the components.

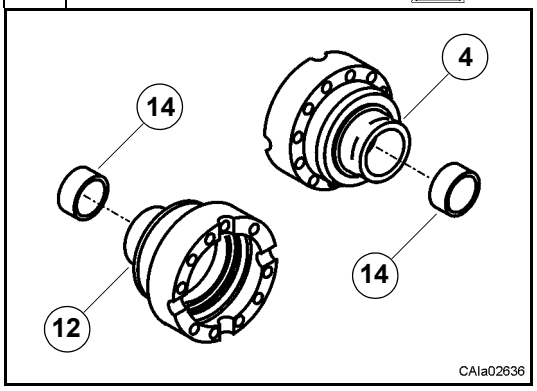
3



Per estrarre i cuscinetti (**3**) e (**13**) dalle semiscatole (**4**) e (**12**), utilizzare due leve oppure un estrattore a tre punti di presa da commercio.

*Take the bearings (**3**) and (**13**) out of the half boxes (**4**) and (**12**), using two levers or a three-hold extractor.*

4



Estrarre le boccole (**14**) dalle semiscatole (**4**) e (**12**) solo se le condizioni di usura lo richiedono.
Nota: è un'operazione distruttiva per le boccole (**5**).
Attenzione: non rovinare la sede delle boccole.

*Remove the bush (**14**) from the half boxes (**4**) and (**12**) only if the wear conditions require this.*
***Note**: this is a destructive operation for the bushes (**14**).*
***Warning:** be careful not to damage the bush housing.*

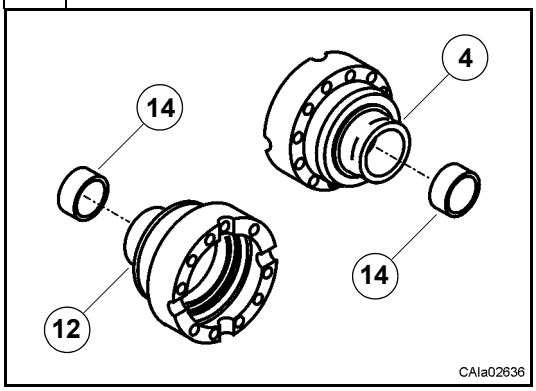
D.6.2 Montaggio

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.6.2 Assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

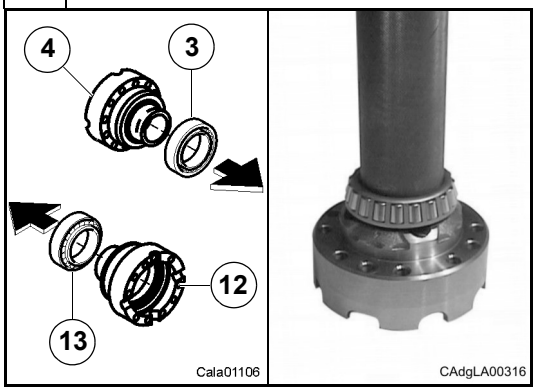
1



Assemblare le boccole (**14**) alle semiscatole (**4**) e (**12**) con l'attrezzo speciale CA715637 ed un martello.

*Assemble the bushes (**14**) to the half boxes (**4**) and (**12**) with the special tool CA715637 and a hammer.*

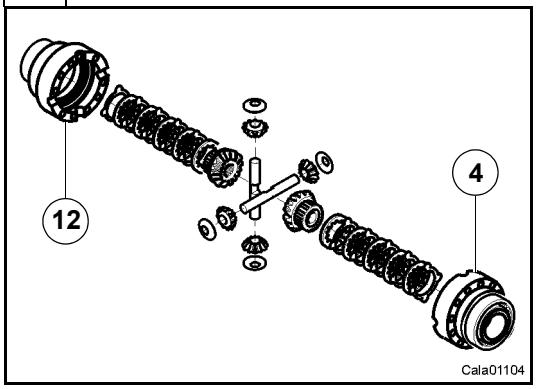
2



Montare le piste interne dei nuovi cuscinetti a rulli conici (**3**) e (**13**) sulle semiscatole (**4**) e (**12**), utilizzando il battitoio CA119230 ed un martello.

*Assemble the cones of the new taper roller bearings (**3**) and (**13**) on the half boxes (**4**) and (**12**), using the special tool CA119230 and a hammer.*

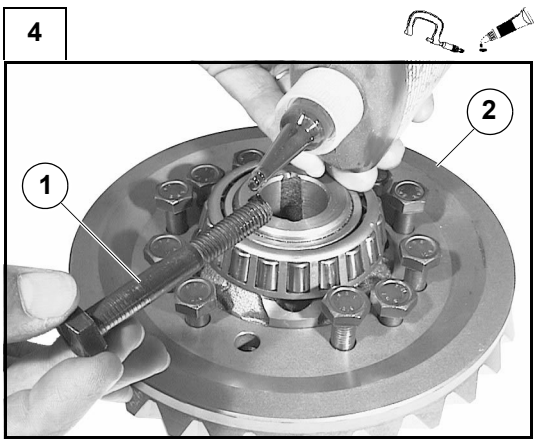
3



Posizionare una semiscatola differenziale (**4**) o (**12**) sul banco di lavoro ed assemblare con attenzione gli elementi interni (controdischi bloccaggio differenziale (**5**), dischi bloccaggio differenziale (**6**) e (**7**), ingranaggi planetari (**8**), perni portasatelliti (**9**), ingranaggi satelliti (**10**), rondelle di rasamento (**11**)) come in figura.
Nota: il primo disco (**7**) deve essere orientato con il materiale d'attrito verso i dischi e la superficie liscia verso il planetario (**8**).
Unire le due semiscatole, allineando i riferimenti praticati sulle stesse.

*Position a half box (**4**) or (**12**) on a workbench and assemble all inner components (locking differential counterdiscs (**5**), locking differential discs (**6**) and (**7**), sun gears (**8**), spiders (**9**), spider gears (**10**), thrust washers (**11**)), as shown in figure.*
***Note:** the first disk (**7**) must be assembled with friction material on the disks side and the flat surface on the sun gear (**8**) side.*
Join the two half boxes, aligning the reference marks made upon them.

4

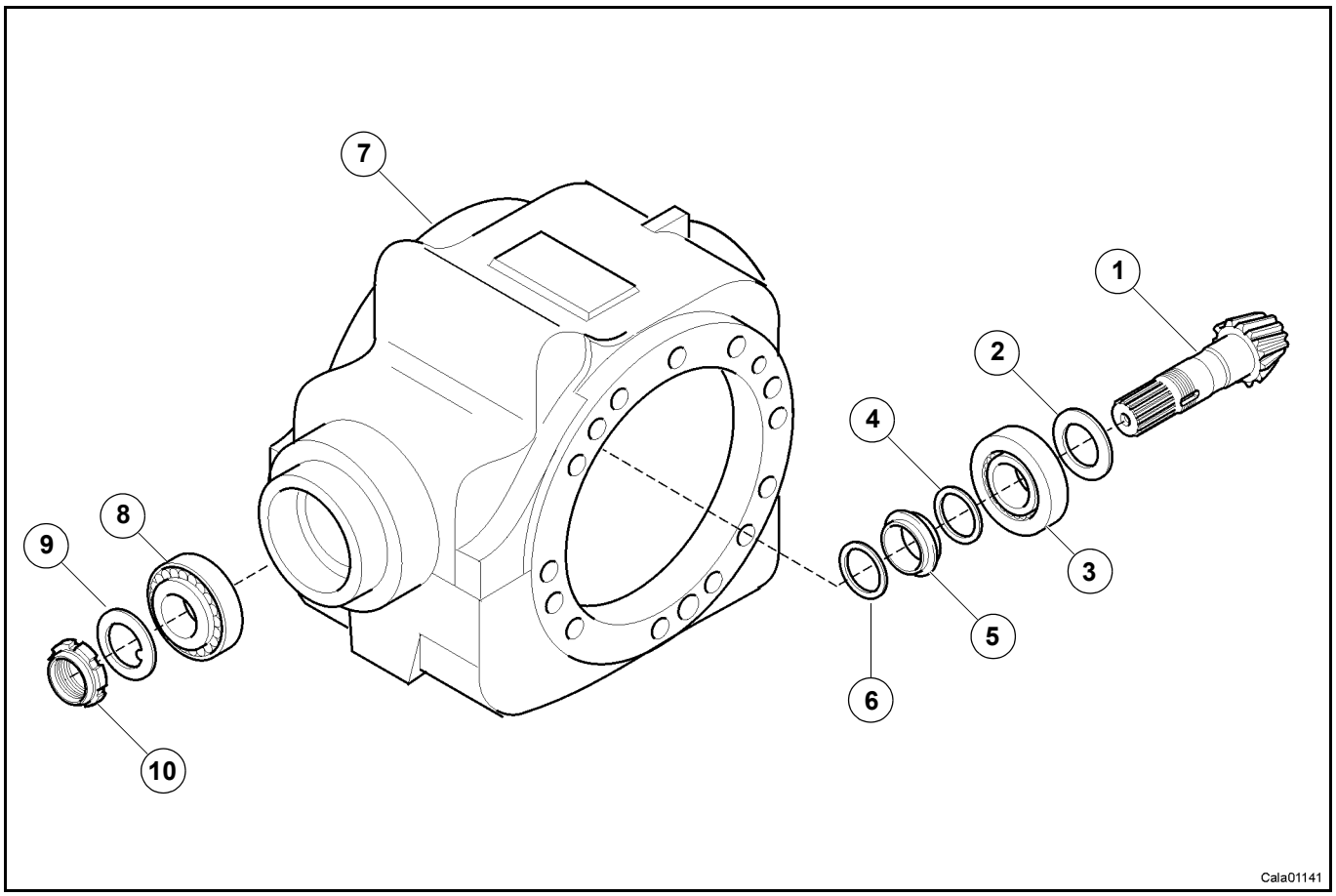


Posizionare la corona conica (**2**) sulla semiscatola differenziale (**4**).
Nota: verificare la posizione delle spine di centraggio (**15**).
Applicare sigillante (**B2**) sul filetto delle viti (**1**) (Sez.C.4) e serrarle alla coppia prevista (Sez.C.6).

*Position the bevel crown gear (**2**) on the half box (**4**).*
***Note:** check dowel pins (**15**) position.*
*Apply sealant (**B2**) on the thread (Sec.C.4) and tighten the screws (**1**) to the requested torque (Sec.C.6).*

D.7 Gruppo pignone

D.7 Pinion group



D.7.1 Smontaggio

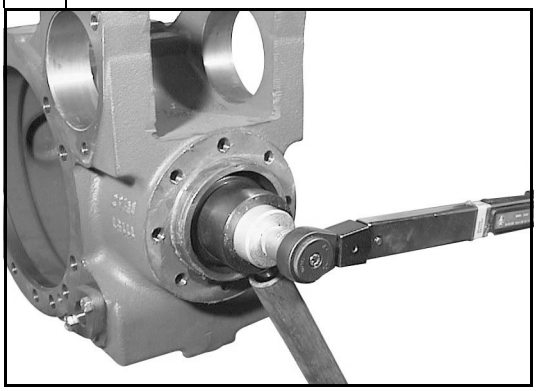
Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.
Nota: per lo smontaggio del gruppo pignone vedi prima le procedure descritte alla sezione D.6

D.7.1 Disassembly

Some of the following pictures may not show exactly your axle, but the process is the same.

***Note:** before disassemble the pinion group see the procedure described in the section D.6.*

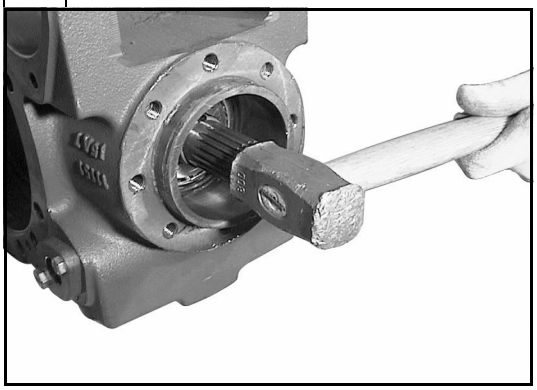
1



Svitare la ghiera (**10**) di serraggio utilizzando le attrezzature CA119060 e CA715022.
Nota: operazione distruttiva per la ghiera (**10**).
Togliere la ghiera e recuperare la rondella fermo ghiera (**9**).

*Unscrew the lock nut (**10**) using special tools CA119060 and CA715022.*
***Note:** this operation will irretrievably damage the lock nut (**10**).*
*Remove the lock nut and collect its retaining washer (**9**).*

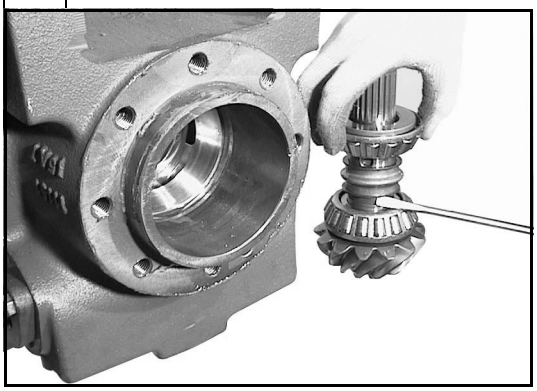
2



Battere con un martello di materiale tenero sul codolo per sfilare il pignone conico (**1**).

*Tap the end shaft with a soft hammer to remove the bevel pinion (**1**).*

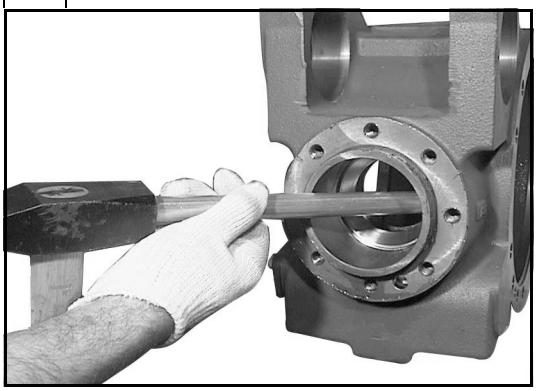
3



Tolto il pignone conico (**1**) recuperare le rondelle (**4**) e (**6**), il distanziale elastico (**5**) ed il cono del cuscinetto (**8**).

*Once the bevel pinion (**1**) has been removed, collect the washers (**4**) and (**6**), the collapsible spacer (**5**) and the bearing cone (**8**).*

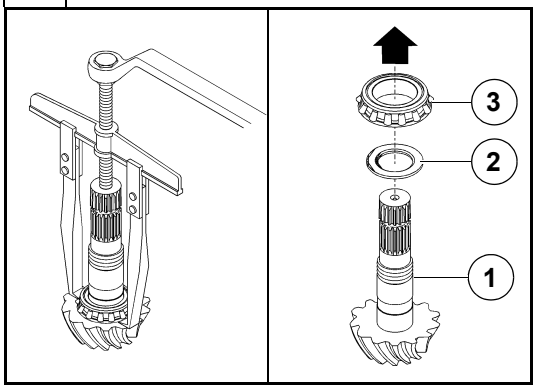
4



Estrarre le coppe dei cuscinetti a rulli conici (**3**) e (**8**) con un battitoio ed un martello.

*Remove bearing cups (**3**) and (**8**) from central body with a drift and a hammer.*

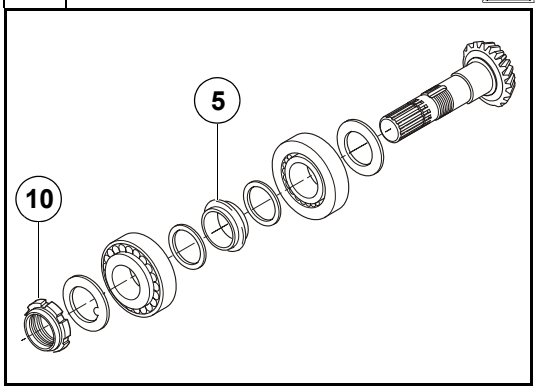
5



Togliere il cono del cuscinetto (**3**) dal pignone conico (**1**) utilizzando un estrattore di presa da commercio.
Recuperare lo spessore (**2**) sottostante.

*Remove the bearing cone (**3**) of the bevel pinion (**1**) with a standard extractor.*
*Collect the shim (**2**).*

6



Controllare le condizioni di tutti i particolari del pignone.
Attenzione: la ghiera (**10**) ed il distanziale elastico (**5**) in fase di rimontaggio devono essere sostituiti.

Check all pinion components for wear.
Warning: *the ring nut (**10**) and the collapsible spacer (**5**) must be replaced when reassembling the unit.*

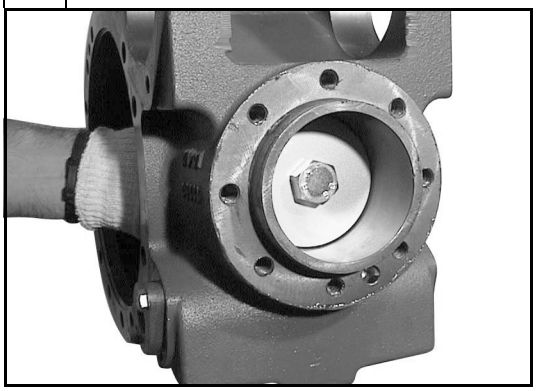
D.7.2 Montaggio

Alcune figure che seguono potrebbero non mostrare esattamente il vostro assale, ma la procedura rimane la stessa.

D.7.2 Assembly

Some of the following pictures may not show exactly your axle, but the process is the same.

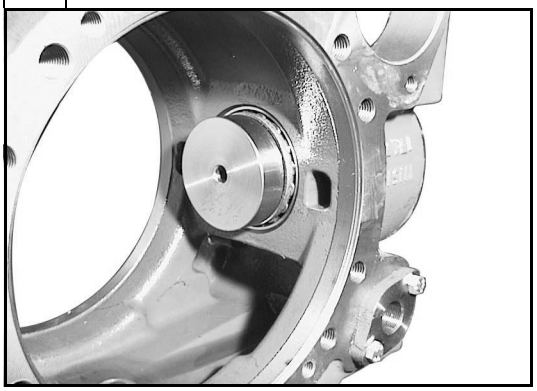
1



Posizionare su un banco di lavoro il corpo centrale (**7**).
Piantare le coppe dei cuscinetti (**3**) e (**8**) nelle proprie sedi con il kit attrezzature speciali CA715639.

*Place the central body (**7**) on a workbench.*
*Fit the bearing cups (**3**) and (**8**) into their seats using the special tools kit CA715639.*

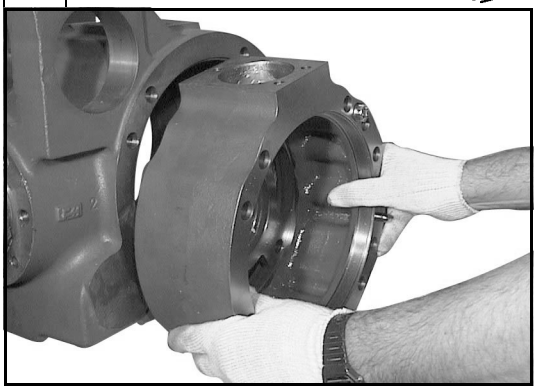
2



Inserire nelle sedi i coni dei cuscinetti (**3**) e (**8**) ed il falso pignone CA715638.
Serrare con la ghiera (**10**) fino ad eliminare il gioco.

*Insert into the seats the bearing cups (**3**) and (**8**) and the false pinion CA715638.*
*Tighten the ring nut (**10**) to eliminate the backlash.*

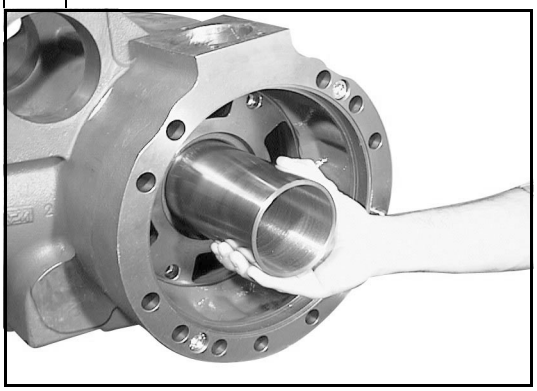
3



Verificare il corretto posizionamento dei cilindri freno destro e sinistro utilizzando i riferimenti riportati sui medesimi e sul corpo centrale (**7**). Montare i cilindri freno fissandoli con le rispettive viti (avvitarne almeno due diametralmente opposte per ogni cilindro).

*Check the correct positioning of the right and left brake cylinder, using the reference marks on them and on the central body (**7**).*
Assemble the brake cylinders and fix them with their screws (screw in at least two ones diametrically-opposed for each cylinder).

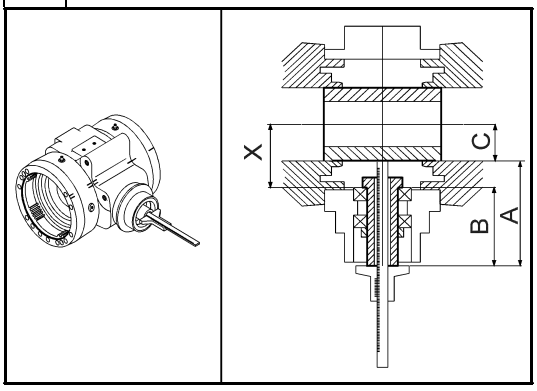
4



Introdurre nel corpo centrale (**7**) la falsa scatola differenziale CA715578.
Verificare che la falsa scatola differenziale sia inserita in entrambe le sedi dei cilindri freno.

*Insert the false differential box CA715578 into the central body (**7**).*
Check that the false differential box is inserted in both brake cylinder's housings.

5



Per registrare la coppia conica misurare con un calibro di profondità la distanza "**A**".
Determinare il valore "**X**" come segue:

X=(A+C)-B mm

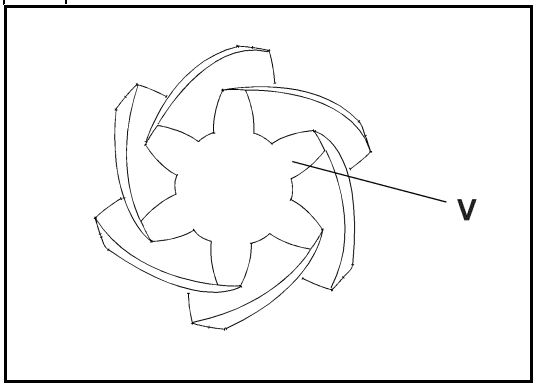
dove "**B**" e "**C"** sono valori noti.

*To adjust bevel gear/pinion measure the distance "**A**" with a depth gauge.*
*Calculate the value "**X**" as follows:*

X=(A+C)-B mm

*where "**B**" and "**C**" are known.*

6



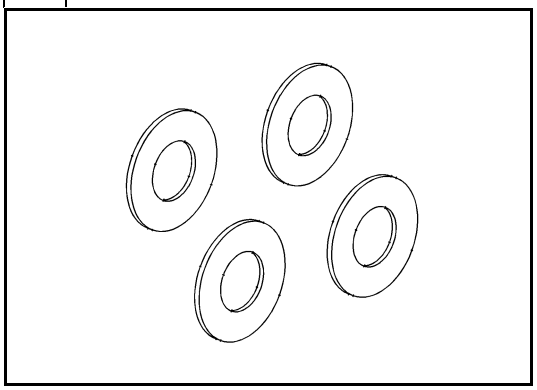
Dal valore "**X**" sottrarre il valore "**V**"(stampigliato sulla testa del pignone) per ottenere il valore "**S**".

S=X-V mm

*From the value "**X**" deduct the value "V" (stamped on the pinion head) to get the value "**S**".*

S=X-V mm

7

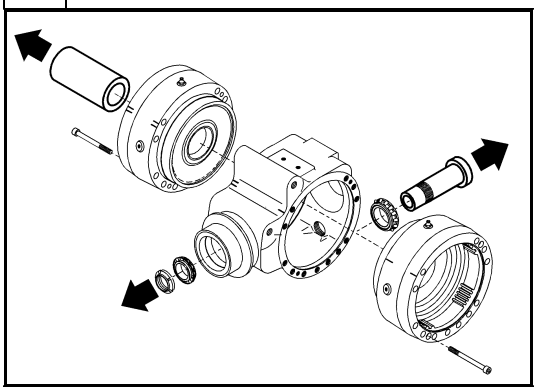


Scegliere uno spessore di valore (**S**) tra la gamma di spessori a disposizione ed inserirlo sul codolo sotto la testa del pignone.

GAMMA SPESSORI - SHIMS RANGE										
Spess./Thick. (mm)	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4
Q.ty	---	---	---	---	---	---	---	---	---	---

*Select a shim with thickness equal to (**S**) among the range available and fit it on the shaft under the pinion head.*

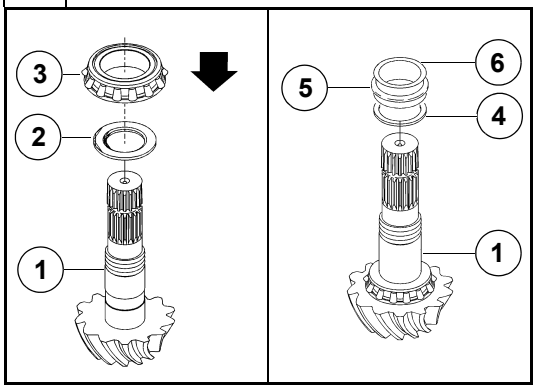
8



Rimuovere il falso pignone CA715638, i cuscinetti (**3**) e (**8**) e la ghiera (**10**) dal corpo centrale (**7**).
Smontare la falsa scatola differenziale CA715578 dai cilindri freno e successivamente svitare le viti per rimuovere i cilindri freno.

*Remove the false pinion CA715638, the bearings (**3**) and (**8**) and the ring nut (**10**) from the central body (**7**).*
Disassemble the false differential box CA715578 from the brake cylinders and then unscrew the screws to remove the brake cylinders.

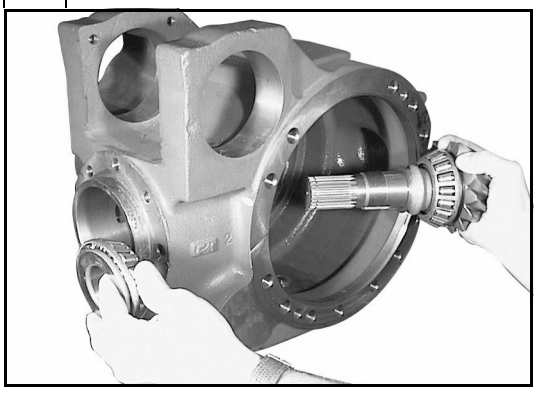
9



Dopo aver scelto ed inserito lo spessore (**2**) adatto con lo smusso rivolto verso l'ingranaggio, piantare il cuscinetto (**3**) nell'albero del pignone (**1**) sotto l'azione di una pressa con il battitoio CA715433, assicurandosi che sia ben assestato.
Inserire gli spessori (**4**) e (**6**) ed un nuovo distanziale elastico (**5**).
Nota: utilizzare sempre un distanziale elastico (**5**) nuovo.

*Once you have chosen and inserted the suitable shim (**2**) with the chamfer against the gear, force the bearing (**3**) into the pinion shaft (**1**) with the special tool CA715433 under a press, making sure that it is well set.*
*Insert the shims (**4**) and (**6**) and a new collapsible spacer (**5**).*
***Note:** use always a new collapsible spacer (**5**).*

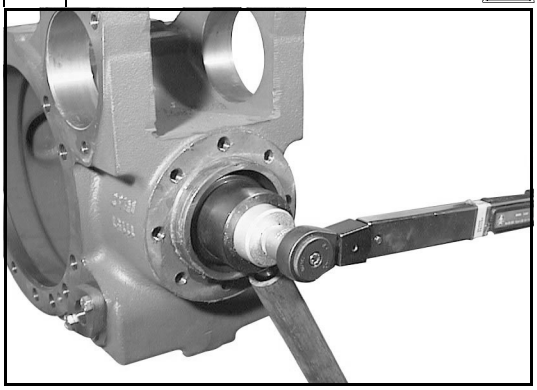
10



Inserire il gruppo pignone conico (**1**) preassemblato nel corpo centrale (**7**) ed il cuscinetto (**8**) sul codolo pignone, come in figura.
Per eseguire il piantaggio del cuscinetto (**8**), utilizzare il battitoio CA715433 ed un martello.
Si consiglia di contrapporre un'azione resistente alla forza battente ad esempio con una mazza.

*Insert the bevel pinion (**1**) unit into the central body (**7**) and the bearing (**8**) into the pinion shaft, as shown in figure.*
*In order to force the bearing (**8**) into position, use the special tool CA715433 and a hammer.*
It is advisable to offer resistance, for example with a sledge, to the beating force.

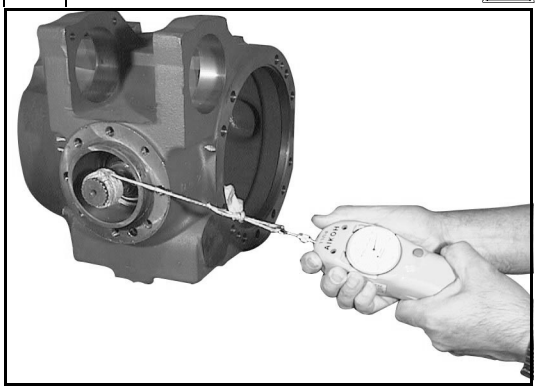
11



Inserire la rondella fermo ghiera (**9**) ed avvitare una nuova ghiera di serraggio (**10**) sul codolo del pignone.
Avvitare la ghiera (**10**) utilizzando le chiavi per ghiera CA119060 e fermo pignone CA715022.
Attenzione: la coppia di serraggio è data dalla misurazione del precarico sui cuscinetti (**3**) e (**8**); serrare la ghiera (**10**) progressivamente.
Nota: se il serraggio è eccessivo il distanziale elastico (**5**) dovrà essere sostituito e la procedura ripetuta.
Al momento di verificare il precarico è opportuno dare piccoli colpi con martello in materiale tenero alle estremità del pignone (**1**) per favorire l'assestamento dei cuscinetti (**3**) e (**8**).

*Insert the ring nut washer (**9**) and screw a new lock ring nut (**10**) on the pinion end.*
*Screw the ring nut (**10**) in, using the wrench for ring nut CA119060 and for pinion retainer CA715022.*
***Warning:** the torque setting is given by the preloading measurement on bearings (**3**) and (**8**); tighten the ring nut (**10**) gradually.*
***Note:** if the tightening is excessive, the elastic spacer (**5**) must be replaced and the procedure repeated.*
*When you check the preloading, it is advisable to beat slightly both pinion ends (**1**) with a soft hammer, so as to help setting the bearings (**3**) and (**8**).*

12

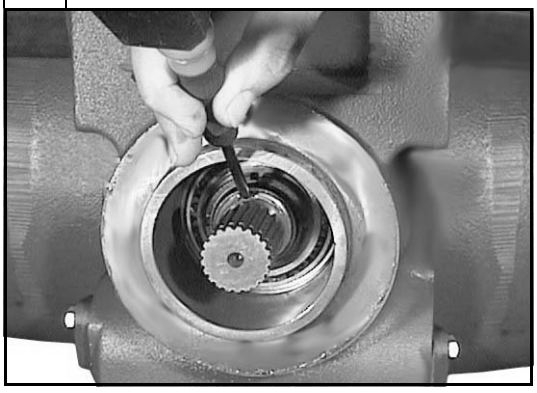


Effettuare la misurazione del precarico **P** dei cuscinetti conici (**3**) e (**8**), utilizzando un dinamometro con la corda, avvolta sul codolo scanalato del pignone (**1**).
La regolazione si effettua aumentando gradualmente il serraggio della ghiera (**10**), facendo attenzione a non eccedere.
Attenzione: tutti i precarichi devono essere misurati senza anello di tenuta.

P=9.2÷13.7 daN

*Carry out the preloading measurement **P** of the pinion taper roller bearings (**3**) and (**8**), using a dynamometer whose cord is wound on the end of pinion spline (**1**).*
*The adjustment is carried out by increasing the ring nut (**10**) torque gradually, being careful not to exceed.*
***Warning:** all preloadings must be measured without the seal ring.*

13

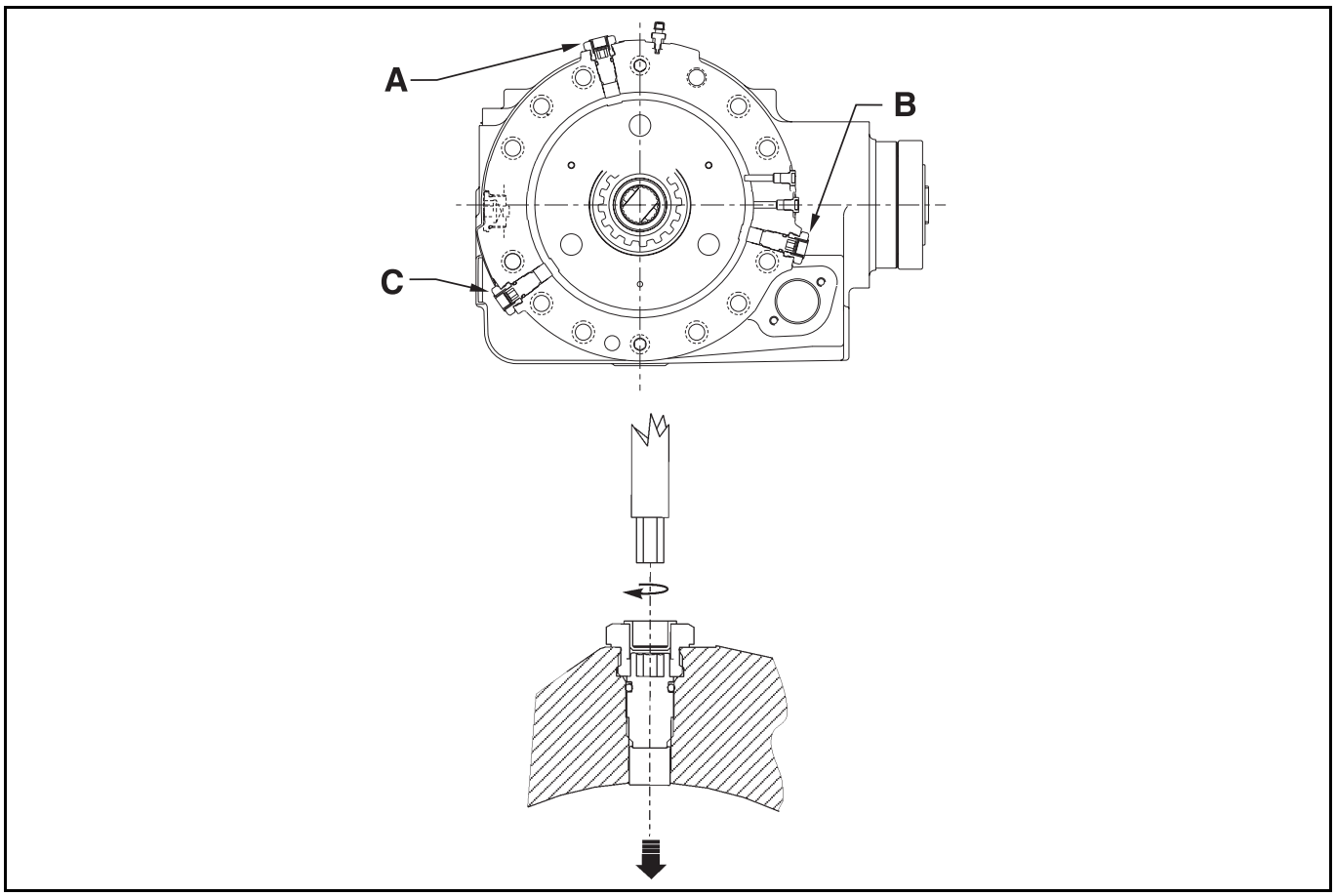


Ottenuto il prescritto valore di precarico, cianfrinare la ghiera (**10**) utilizzando martello e punzone.

*Once the requested preloading value is achieved, stake the ring nut (**10**), using a hammer and a chisel.*

D.8 Sbloccaggio freno parcheggio

D.8 Parking brakes release



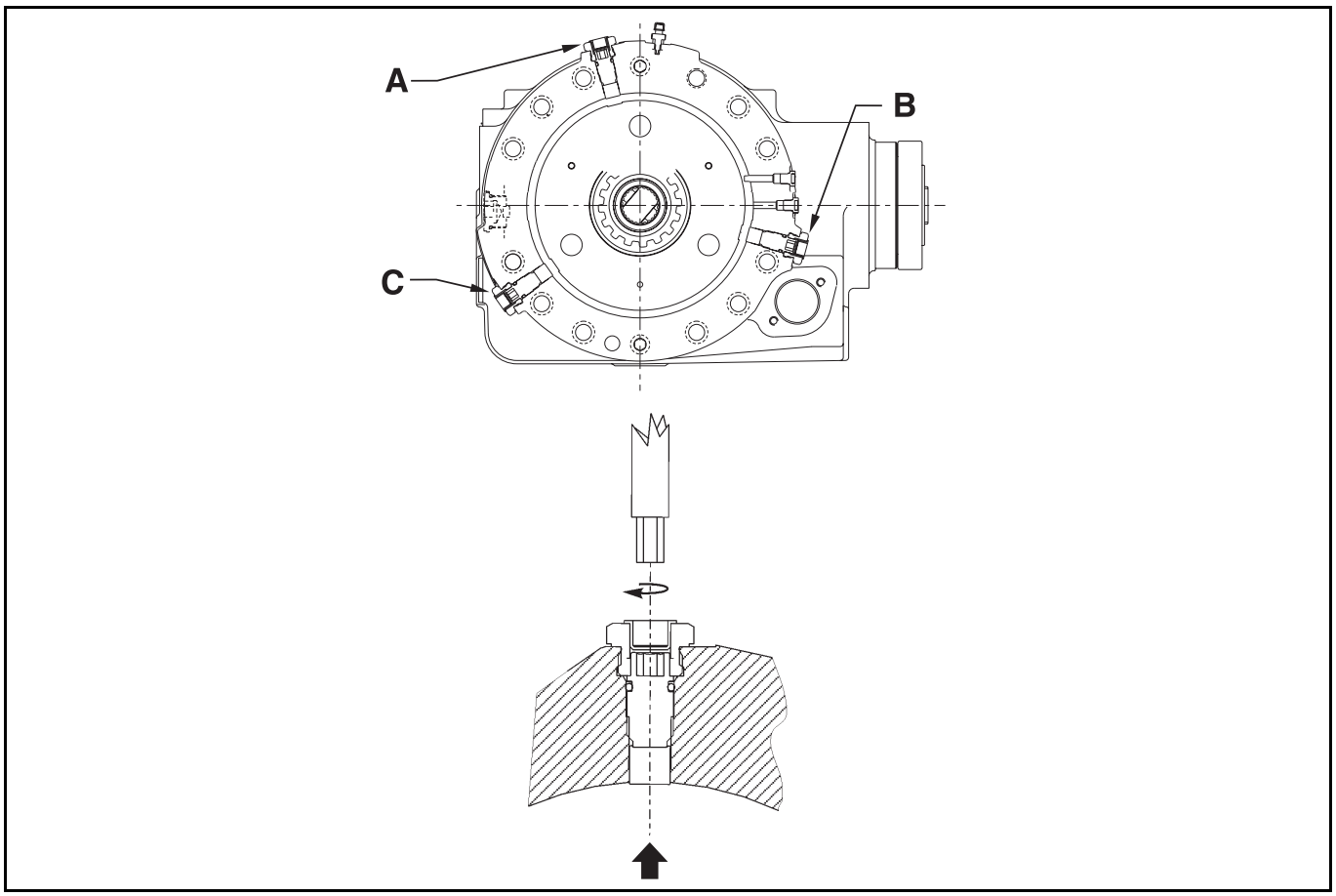
ATTENZIONE

BLOCCARE LE RUOTE. Il non farlo può essere molto pericoloso o addirittura mortale per l'operatore. Bloccare tutte e quattro le ruote per impedire il movimento del veicolo una volta che il freno è stato disinserito.
Per disabilitare i freni di parcheggio è necessaria una chiave a brugola da 8 mm.
Fare un segno sulla testa delle viti per poter contare il numero di giri che ciascuna vite dovrà fare mentre eseguite la procedura.
Sdraiarsi sotto l'assale ed individuate le sei viti di rilascio (tre per ciascun lato) alla base dell'assale.
Avvitare alternativamente di 1/2 giro alla volta in senso orario le viti di rilascio freno A,B e C fino a quando si inizia a sentire una certa resistenza.
Avvitare alternativamente di 1/2 giro alla volta le viti A, B e C per **5 ÷ 5.5** giri.
Spostarsi da sotto il veicolo e liberare l'area circostante dal personale non coinvolto dalle operazioni.
Rimuovere con attenzione i ceppi di bloccaggio dalle quattro ruote e trainare il veicolo in un luogo sicuro.
Bloccare nuovamente le quattro ruote e continuare con le operazioni che necessitano.

WARNING

***BLOCK ALL FOUR WHEELS**. Failure to do so could result in death or serious injury from vehicle roll away. Block all four wheels to prevent the vehicle from moving once the parking brake is disabled.*
An 8 mm allen head socket will be needed to properly disable the parking brakes.
Mark a line on the socket so you can accurately count the number of turn each bolt makes as you perform the procedure.
Lie down under the axle and locate the six brake release bolts (three bolts per side) at the base of the axle.
Alternately screw 1/2 turn brake release bolts A, B & C inxard direction (clockwise) until you first begin to feel resistance.
*Alternately screw 1/2 turn the bolts A, B and C inward direction of **5 ÷ 5.5** turns.*
To get out from under the vehicle and clear the area of any unnecessary personnel.
Carefully remove the blocking from each of the four tires and tow the vehicle to asecure location.
Block all four wheels and continue following the procedure.

D.9 Riattivazione freno parcheggio *D.9 Re-activating parking brakes*



ATTENZIONE

BLOCCARE LE QUATTRO RUOTE. Il non farlo può essere molto pericoloso o addirittura mortale per l'operatore. Bloccare tutte e quattro le ruote, sdraiarsi sotto l'assale e, utilizzando la chiave dinamometrica, svitare alternativamente le viti di rilascio A, B e C (in senso antiorario) di 1/2 giro.
Di nuovo svitare alternativamente di 1/2 giro le viti A, B e C fino a quando la coppia si riduce bruscamente. Continuare a svitare alternativamente le viti A, B e C fino a quando si avverte che la testa della vite va a contatto con la vite speciale. Riavvitare poi in senso inverso le viti A, B e C di 1/4 di giro.
I freni di parcheggio sono a questo punto riattivati e le ruote bloccate.
Rimuovere quindi i ceppi dalle quattro ruote.
Verificare l'efficienza del freno di parcheggio.
Rimuovere i cartelli di pericolo o di avviso dal volante e dalla chiave d'accensione.

WARNING

BLOCK ALL FOUR WHEELS*. Failure to do so could result in death or serious injury from vehicle roll away. After you have locked all four wheels, lie down under the axle. Using the torque wrench, alternately unscrew brake release bolts A, B and C outward direction (counterclockwise) 1/2 turn.*
Again, alternately unscrew brake release bolts A, B and C outward direction 1/2 turn until the torque drops off sharply. Alternately unscrew brake release bolts A, B and C outward direction (counterclockwise) until feel the bolts flange begin to contact against the special screw. Screw the bolts A, B and C inward direction 1/4 turn.
The parking brakes should now be re-activated and the wheels are locked.
Remove the blocking from the four tires.
Verify that parking brake works properly.
Remove any warning tags from the ignition lock key and from the steering wheel.

D.10 Prove dopo montaggio

D.10.1Procedure di collaudo

Passo 1
A motore spento, sollevare l'assale della ruota motrice sino a che i pneumatici si siano staccati da terra.

Passo 2
Ingranare la marcia in modo che il pignone sia bloccato.

Passo 3
Con l'aiuto di un'altra persona collocata al lato opposto, iniziare la prova di montaggio ruotando per quanto possibile entrambe le ruote nel senso di marcia avanti. (Entrambe le ruote dovrebbero bloccarsi dopo poco)

Passo 4
Con il pignone sempre bloccato, liberare la ruota di destra e ruotare la ruota di sinistra nel senso (marcia avanti).
Se il montaggio è corretto si dovrà verificare che la ruota giri liberamente senza eccessivi sforzi, e la ruota di destra ruoti in senso opposto.
Ripetere l'operazione nel senso opposto (retro marcia).

SE UNA DELLE RUOTE NON GIRA LIBERAMENTE IN ENTRAMBE LE DIREZIONI, ricontrollare passo passo il montaggio.
Controllare anche che i freni siano regolati in modo da consentirne il corretto funzionamento.

D.10 Testing after assembly

D.10.1Testing methods

Step 1
With engine off, lift the axle so that the tyres get away from the ground.

Step 2
Engage the gear so that the pinion gets locked.

Step 3
With the help of another person standing on the opposite side, begin the assembly testing by rotating as much as possible both the wheels forward. (Both the wheels should get blocked after a while.)

Step 4
Keeping the pinion locked, free the right wheel and rotate the left one in the line of march. Rotate the right wheels in the opposite direction.
The wheel will move freely without difficulty and the right wheel will move in the opposite direction if the assembly has been carried out correctly.
Repeat the same operation in the opposite direction (reverse gear).

IF ONE WHEEL DOES NOT ROTATE FREELY IN BOTH DIRECTIONS, then check step by step all assembly operations.
Check and see that the brakes are regulated correctly and functioning properly.

E RICERCA GUASTI

E TROUBLESHOOTING

PROBLEMA	POSSIBILI CAUSE										
	1	2	3	4	5	6	7	8	9	10	11
- Vibrazioni delle ruote; resistenza del pneumatico anteriore; rottura del/i semiasse/i.	●	●	●		●						●
- Difficoltà nello sterzare; il veicolo tende ad andare dritto mentre è in curva.	●	●	●	●							●
- Non vi è azione del differenziale; inceppamento in curva.	●			●	●						●
- Rumore eccessivo nella trasmissione.	●	●	●	●	●		●		●		●
- Usura eccessiva del pneumatico.	●	●	●	●	●	●	●				●
- Rumore di attrito.	●			●	●			●	●	●	●
- In marcia avanti si avvertono vibrazioni, rumore intermittente.	●	●	●		●						●

PROBLEMS	POSSIBLE CAUSES										
	1	2	3	4	5	6	7	8	9	10	11
- Wheel vibration; front tyre resistance; halfshaft breakage.	●	●	●		●						●
- Steering is difficult; vehicle goes straight while its turning.	●	●	●	●							●
- No differential action; jamming while steering.	●			●	●						●
- No differential action; jamming while steering.	●	●	●	●	●		●		●		●
- Uneven wear of tyre.	●	●	●	●	●	●	●				●
- Friction noise.	●			●	●			●	●	●	●
- Vibration during forward drive, intermittent noise.	●	●	●		●						●

1 Installazione scorretta / assale difettoso
Correggere l'installazione oppure, se il differenziale non supera una delle fasi di prova, ripararlo o sostituirlo.

2 Sovraccarico / distribuzione scorretta del peso
Togliere il peso in eccesso e ridistribuire il carico, rispettando le istruzioni relative al veicolo.

1 Incorrect installation / defective axle
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2 Overloading / incorrect weight distribution
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3 Raggio di rotazione dei pneumatici diversi

Un pneumatico con raggio più piccolo provoca un parziale slittamento della ruota quando si applica energia. L'altro pneumatico con raggio maggiore dovrà sopportare tutto il lavoro. Sostituire il pneumatico o regolare la pressione di entrambi sino a che il raggio di rotazione sia uguale.

4 Semiasse rotto

E' sconsigliato usare un veicolo con un solo semiasse. E' possibile tuttavia spostare il veicolo a vuoto con il differenziale bloccato per pochi metri.

5 Semiasse piegato

Sostituire i semiassi.

6 Differenziale bloccato

Funzionamento anomalo del differenziale e/o rottura del dispositivo di comando del bloccaggio di comando. Verificare l'installazione, eventualmente smontare e verificare i componenti.
I veicoli impostati per angoli di sterzata ampi, possono procedere a scatti, avere difficoltà di sterzo e provocare un consumo del pneumatico nelle curve strette.
Ridurre l'angolo di sterzata minimo e decelerare quando il motore inizia a procedere a scatti.

7 Allineamento scorretto della ruota

Verificare l'integrità della struttura, e cuscinetti lato ruota.

8 Parti dell'assale consumate o difettose

Controllare le condizioni della corona dentata, dell'ingranaggio del pignone, dei cuscinetti, delle guarnizioni, ecc. Sostituire dove necessario.

9 Corpi estranei nella scatola dell'assale o montaggio scorretto di alcune sue parti

Controllare se vi sono corpi estranei. Controllare il montaggio delle parti dell'assale.

10 Regolazioni della coppia conica scorrette: parti di trasmissione consumate

(ingranaggi di trasmissione, giunti, ecc.). Sostituire o regolare secondo necessità.

11 Uso scorretto del prodotto

Rivedere le istruzioni rilasciate dal produttore del veicolo.

3 Different rotation radius of the tyres

If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied.The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyre.

4 Broken halfshaft

It is not advisable to operate the vehicle with a broken halfshaft. It is acceptable to move the vehicle (engine off unloaded) a few meters away only.

5 Bent halfshaft

Replace halfshaft.

6 Blocked differential

Abnormal functioning of the differential or breakage/ blockage of command device. Verify assembly and all components.
Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.

7 Incorrect wheel adjustment

Verify group integrity and wheel side bearings.
Adjusting according.

8 Spoiled or worn out axle parts

Check the condition of ring gear, pinion gear, bearings etc. Replace when ever necessary.

9 Contamination in the axle box or incorrect assembly of parts

Look for foreign particles. Check assembly of the various parts of the axle.

10 Incorrect adjustment of bevel gear set: Parts of the transmission worn out.

(transmission gears, U joints, etc.)
Replace or adjust as required.

11 Incorrect use of the product

See the vehicle producer‘s instructions once again.

E.1 Controllo ed esame dei guasti

Questo capitolo offre una guida descrittiva ed esplicativa di problemi che si possono comunemente riscontrare sugli assali o di avarie che si possono verificare. La guida suggerisce anche le corrette procedure di riparazione.

Problema	Causa	Azione consigliata
Rottura verso l'estremità esterna del dente corona dentata	1. Carico dell'ingranaggio eccessivo rispetto a quello previsto 2. Regolazione ingranaggio scorretto (gioco eccessivo) 3. Dado del pignone allentato.	Sostituire la coppia conica. Seguire attentamente le operazioni raccomandate di regolazione del gioco della corona dentata e del pignone e per la rilevazione dell'impronta del dente.
Rottura verso l'estremità interna del dente corona dentata	1. Urto da carico 2. Regolazione ingranaggio scorretto (gioco insufficiente) 3. Dado del pignone allentato	Sostituire la coppia conica. Seguire attentamente le operazioni raccomandate di regolazione del gioco della corona dentata e del pignone e per la rilevazione dell'impronta del dente
Denti del pignone e della corona dentata erosi o rigati	1. Lubrificazione insufficiente 2. Lubrificante sporco 3. Lubrificante errato o con additivi impoveriti 4. Cuscinetti del pignone consumati che provocano un gioco assiale del pignone e un contatto tra pignone e corona scorretto.	Sostituire la coppia conica. Sostituire i cuscinetti del pignone facendo attenzione a sistemare correttamente la corona, il pignone e i precarichi dei cuscinetti. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Denti della corona e del pignone surriscaldati. Guardare se i denti dell'ingranaggio hanno perso la colorazione	1. Funzionamento prolungato a temperatura eccessiva. 2. Lubrificante scorretto 3. Livello dell'olio basso 4. Lubrificante sporco.	Sostituire la coppia conica. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Denti del pignone di comando butterati	1. Uso estremamente intenso 2. Lubrificazione insufficiente	Sostituire la coppia conica. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Corpo trave dell'assale piegato	1. Sovraccarico del veicolo 2. Veicolo incidentato 3. Urto da carico	Sostituire il corpo trave dell'assale
Cuscinetti consumati o butterati	1. Lubrificazione insufficiente 2. Lubrificante sporco 3. Uso estremamente intenso 4. Consumo normale 5. Dado del pignone allentato.	Sostituire i cuscinettii. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Le guarnizioni perdono olio	1. Funzionamento prolungato con temperatura dell'olio eccessiva. 2. Guarnizione dell'olio montata male 3. Bordo della guarnizione tagliata o intaccata 4. Lubrificante sporco	Sostituire la guarnizione e la superficie di accoppiamento se danneggiata. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Usura eccessiva della scanalatura della flangia di entrata.	1. Uso intenso 2. Dado del pignone allentato 3. Gioco assiale del pignone	Sostituire la flangia Controllare che la scanalatura del pignone non sia eccessivamente consumata Sostituire la coppia conica, se necessario.
Rottura per fatica del dente dell'ingranaggio del pignone. Guardare se la linea di frattura ad onda è ben delineata (linea di arresto).	1. Uso intenso 2. Sovraccarico continuo	Sostituire la coppia conica.

Problema	Causa	Azione consigliata
Rottura denti pignone e corona	Carico d'urto dei componenti del differenziale	Controllare e/o sostituire altri componenti differenziale.
Scanalature dell'ingranaggio planetario consumate (gioco eccessivo)	Uso intenso	Sostituire il gruppo ingranaggi differenziale. Sostituire il semiasse, se necessario.
Superfici della ralla di rasamento consumate o graffiate	1. Lubrificazione insufficiente 2. Lubrificazione scorretta 3. Lubrificante sporco	Sostituire tutte le ralle graffiate e quelle con uno spessore di 0,1 mm inferiore a quello delle ralle nuove. Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Diametro interno del cuscinetto a rulli conici del pignone consumato	1. Uso intenso 2. Gioco assiale del pignone eccessivo 3. Lubrificazione inadeguata 4. Lubrificante sporco	Sostituire il cuscinetto Controllare il gioco assiale del pignone Usare il lubrificante corretto, riempire fino al giusto livello e sostituirlo agli intervalli raccomandati.
Semiasse ritorto o rotto	Funzionamento intenso del veicolo, sovraccarico	Sostituire il semiasse
Semiasse spezzato presso la flangia ruota	1. Supporto della ruota allentato 2. Corpo trave piegato	Sostituire il semiasse Controllare la distorsione del corpo trave. Accertarsi che il sostegno della ruota non sia consumato o mal regolato.

E.1 Troubleshooting

This chapter is a descriptive and explanatory guide to common axle problems. This guide suggests the correct repair procedures to be followed.

Problem	Cause	Action
Ring gear tooth broken on the outer side	*1. Excessive gear load compared to the one foreseen* *2. Incorrect gear adjustment (excessive backlash)* *3. Pinion nut loosened*	*Replace bevel gear set* *Follow carefully the recommended operations for the adjustment of bevel gear set backlash*
Ring gear tooth broken on the inner side	*1. Load bump* *2. Incorrect gear adjustment (insufficient backlash)* *3. Pinion nut loosened*	*Replace bevel gear set* *Follow carefully the recommended operations for the adjustment of bevel gear set backlash.*
Pinion or ring gear teeth worn	*1. Insufficient lubrication* *2. Contaminated oil* *3. Incorrect lubrication or depleted additives* *4. Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring.*	*Replace bevel gear set.* *Follow carefully the recommended operations for the adjustment of bevel gear set backlash.* *Use correct lubricants, fill up to the right levels and replace according to the recommended program.*
Overheated ring and pinion teeth. See if gear teeth have faded	*1. Prolong ed functioning at high temperatures* *2. Incorrect lubrication* *3. Low oil level* *4. Contaminated oil*	*Replace bevel gear set.* *Use proper lubrication, fill up to right level and replace at recommended program.*
Pinion teeth pitting	*1. Excessive use* *2. Insufficient lubrication*	*Replace bevel gear set.* *Use correct lubrication, fill up to the right level and substitute at recommended intervals*
Axle beam body bent	*1. Vehicle over loaded* *2. Vehicle's accident* *3. Load bump*	*Replace axle beam body*
Worn out or pitted bearings	*1. Insufficient lubrication* *2. Contaminated oil* *3. Excessive use* *4. Normal wear out* *5. Pinion nut loosened*	*Replace bearings.* *Use correct lubrication fill up, to the right level and replace at recommended intervals*
Oil leakage form gaskets and seals	*1. Prolonged functioning at high temperature of the oil* *2. Oil gasket assembled incorrectly* *3. Seal lip damaged* *4. Contaminated oil*	*Replace the gasket or seal and matching surface if damaged.* *Use correct lubrication and replace at recommended intervals.*
Excessive wearing out of input flange spline	*1. Exhaustive use* *2. Pinion nut loosened* *3. Pinion axle backlash*	*Replace the flange.* *Check that the pinion spline is not excessively worn out.* *Replace bevel gear set if required.*
Fatigue failure of pinion teeth *See if the fracture line is well defined (wave lines, beach lines)*	*1. Exhaustive use* *2. Continuous overload*	*Replace bevel gear set*
Pinion and ring teeth breakage	*1. Crash load of differential components*	*Check and/or replace other differential components.*

Problem	***Cause***	***Action***
Side gear spline worn out. *Replace all scratched washers (Excessive backlash)*	*Excessive use*	*Replace differential gear group.* *Replace halfshaft if required*
Thrust washer surface worn out or scratched.	*1. Insufficient lubrication* *2. Incorrect lubrication* *3. Contaminated oil*	*Use correct lubrication and fill up to right level.* *Replace at intervals recommended.* *Replace all scratched washers and those with 0,1mm thickness lower than the new ones.*
Inner diameter of tapered roller bearing worn out.	*1. Excessive use* *2. Excessive pinion axial backlash* *3. Insufficient lubrication* *4. Contaminated oil*	*Replace bearing.* *Check pinion axial backlash.* *Use proper lubrication, fill up to right level and replace at recommended intervals.*
Bent or broken halfshaft	*Vehicle intensively operated or overloaded*	*Replace*
Halfshaft broken at wheel side	*1. Wheel support loosened* *2. Beam body bent*	*Replace* *Check that wheel support is not worn out or wrongly adjusted.*

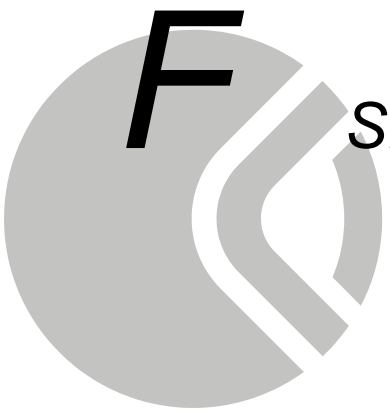
E.2 Diagnosi per problemi all'assale

Problema	Causa	Azione consigliata
Rumore durante la guida	1. Gioco tra corona dentata e pignone eccessivo 2. Pignone e corona dentata consumati 3. Cuscinetti del pignone consumati 4. Cuscinetti del pignone allentati 5. Gioco assiale del pignone eccessivo 6. Cuscinetti del differenziale consumati 7. Cuscinetti del differenziale allentati 8. Eccessiva scentratura della corona dentata 9. Livello lubrificante basso 10. Lubrificante di grado povero od errato 11. Semiasse piegato	1. Regolare 2. Sostituire 3. Sostituire 4. Regolare 5. Regolare 6. Sostituire 7. Regolare 8. Sostituire 9. Rabboccare 10. Sostituire 11. Sostituire
Rumore durante l'andatura in folle	1. I rumori provenienti dall'assale con il veicolo in movimento di solito si sentono durante l'andatura in folle anche se non molto forti 2. Errato gioco tra pignone e corona (il rumore che si sente decelerando sparisce all'aumentare della velocità). 3. Usura scanalatura pignone o flangia entrata	1. Regolare o sostituire (vedere sopra) 2. Regolare 3. Sostituire
Rumore intermittente	1. Corona dentata danneggiata 2. Bulloni della scatola del differenziale allentati	1. Sostituire coppia conica 2. Serrare a coppia
Rumore costante	1. Danni sui denti della corona dentata o del pignone 2. Cuscinetti usurati 3. Scanalature del pignone consumate 4. Semiasse piegato	1. Sostituire coppia conica 2. Sostituire 3. Sostituire 4. Sostituire
Rumore in curva	1. Satelliti planetari differenziale consumati 2. Scatola differenziale e/o perni del differenziale consumati 3. Ralle di rasamento del differenziale consumate 4. Scanalature del semiasse consumate	1. Sostituire 2. Sostituire 3. Sostituire 4. Sostituire

E.2 Axle problems and diagnosis

Problem	*Cause*	*Action*
Noise while driving	*1. Excessive backlash between pinion and ring gear* *2. Worn out pinion and gear ring* *3. Worn out pinion bearings* *4. Pinion bearings loosened* *5. Excessive axial pinion backlash* *6. Worn out differential bearings* *7. Differential bearings loosened* *8. Ring gear out of roundness* *9. Low lubricant level* *10. Poor or wrong lubricant* *11. Bent halfshaft*	*1. Adjust* *2. Replace* *3. Replace* *4. Adjust* *5. Adjust* *6. Replace* *7. Adjust* *8. Replace* *9. Oil level* *10. Replace* *11. Replace*
Noise while driving in neutral	*1. Noise coming from axle are usually heard when vehicle moves in neutral gear but are not loud.* *2. Incorrect backlash between pinion and ring (sound heard while decelerating disappears while increasing the speed)* *3. Pinion or input flange worn out*	*1. Replace or adjust (see above)* *2. Replace* *3. Adjust*
Intermittent noise	*1. Ring gear damaged* *2. Differential box bolts loosened*	*1. Replace bevel gear set* *2. Tighten to torque*
Constant noise	*1. Ring gear teeth or pinion damaged* *2. Worn out bearings* *3.Pinion spline worn out* *4. Bent halfshaft*	*1. Replace bevel gear set* *2. Replace* *3. Replace* *4. Replace*
Noise while seering	*1. Worn out differential gears* *2. Worn out differential box or spider* *3. Differential thrust washers worn out* *4. Half shaft spline worn out*	*1. Replace* *2. Replace* *3. Replace* *4. Replace*

F ATTREZZATURE SPECIALI



F SPECIAL TOOLS

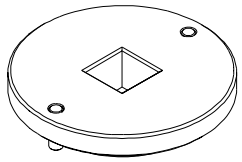
F.1 Attrezzature speciali

Battitoi e tamponi per il montaggio di tenute, cuscinetti e bronzine devono essere utilizzati con il manico intercambiabile CA119033; se ne raccomanda l'uso abbinato ad un'impugnatura di sicurezza per la protezione delle mani (da commercio).

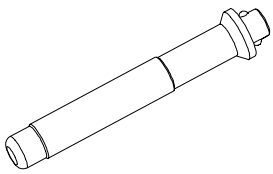
F.1 Special tools

The special drifts/pad used to assembly the seals, bearings and bushes should always be used with the interchangeble handle CA119033; its use is recommended togheter with a suitable safety handle in order to protect the hands.

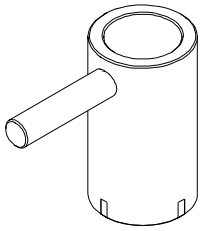
CA119030 Chiave / *Wrench*



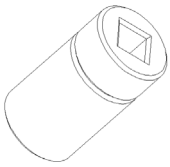
CA119033 Manico / *Handle*



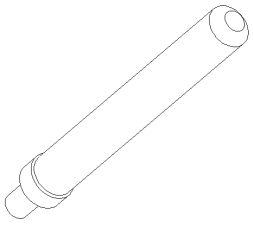
CA119060 Chiave / *Wrench*



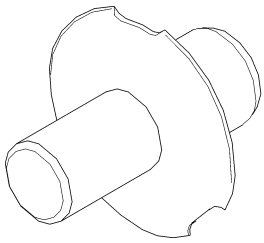
CA715022 Chiave / *Wrench*



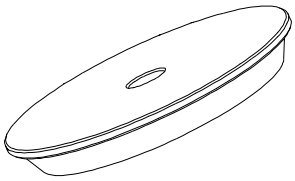
CA715033 Battitoio / *Driver*



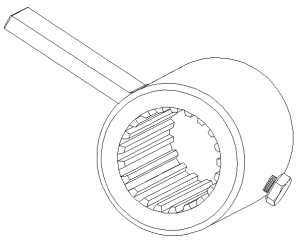
CA715056 Chiave / *Wrench*



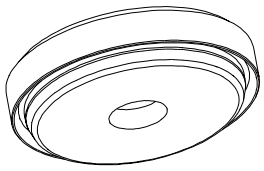
CA715118 Battitoio / *Driver*



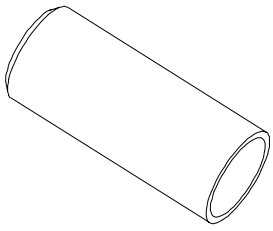
CA715146 Attrezz. mis. gioco / *Backlash meas. tool*



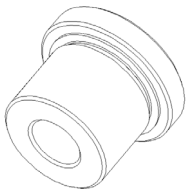
CA715181 Battitoio / *Driver*



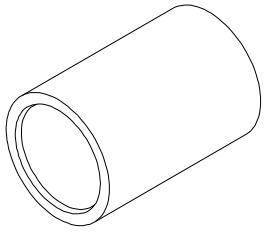
CA715433 Battitoio / *Driver*



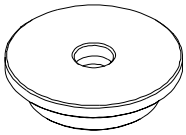
CA715531 Battitoio / *Driver*



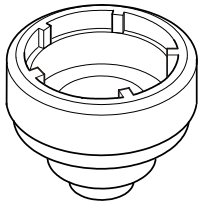
CA715578 Falsa scatola differenziale / *False differential box*



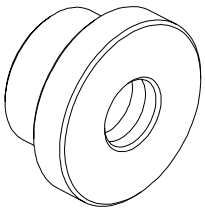
CA715583 Battitoio *Driver*



CA715631 Chiave *Wrench*



CA715632 Battitoio *Driver*



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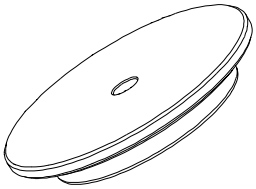

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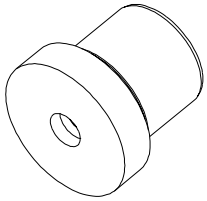
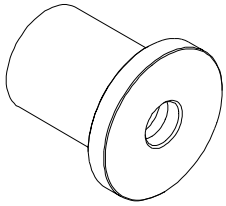
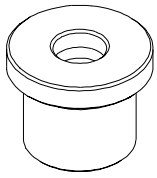


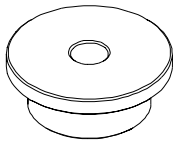
CA715635 Battitoio *Driver*



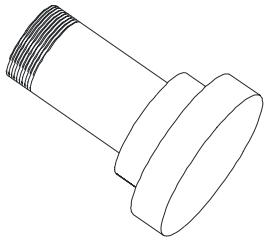
CA715636 Battitoio *Driver*



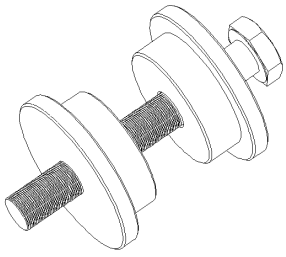
CA715637 Battitoio *Driver*



CA715638 Falso pignone *False pinion*



CA715639 Kit inserimento cuscinetti *Bearing insertion kit*



PowerWheel® Service Manual
Model 8 Series B
Double Reduction
Wheel Drives

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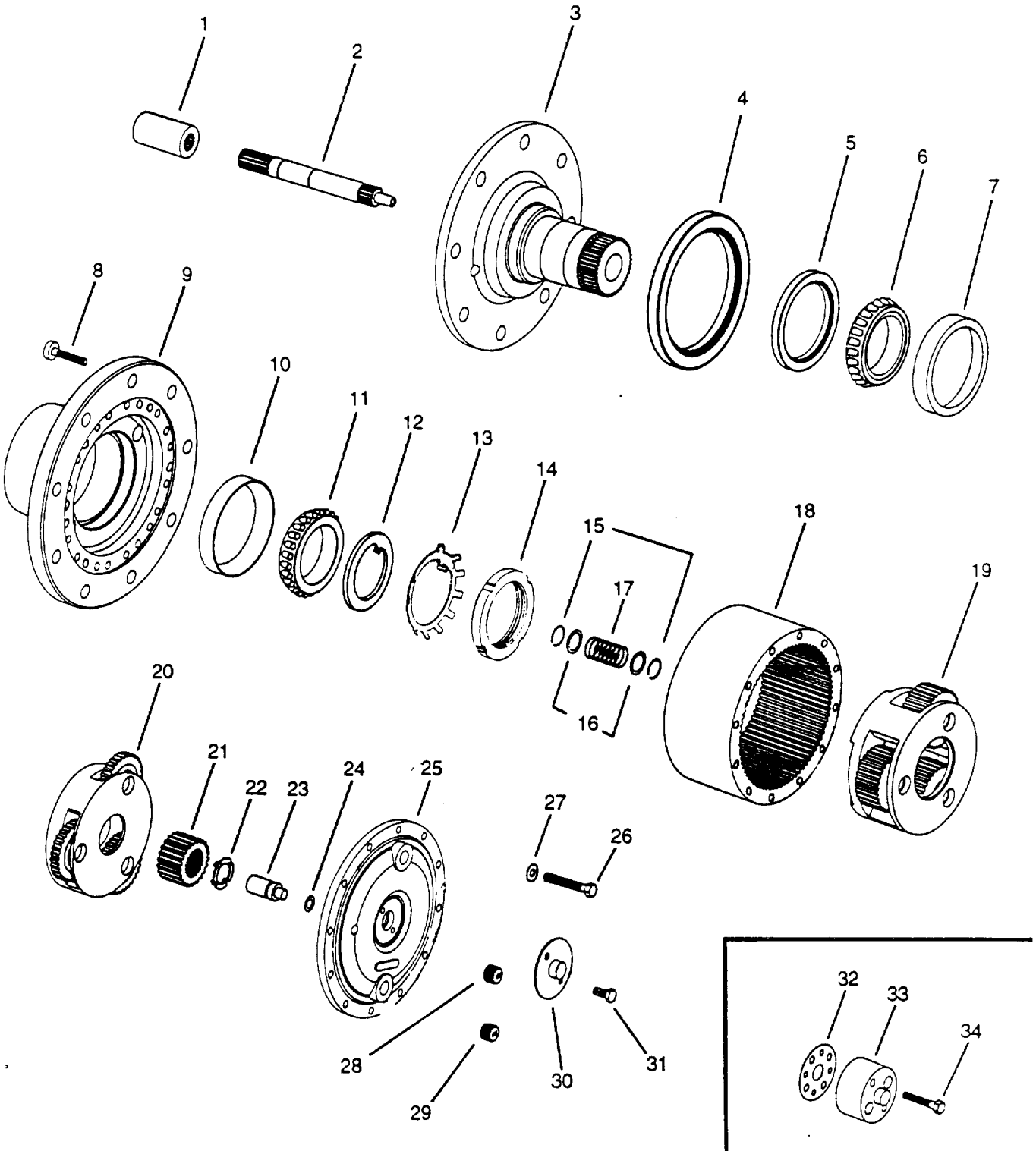
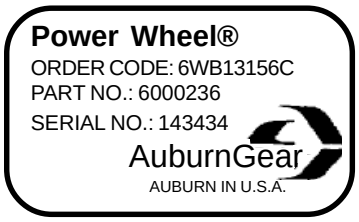


IDENTIFICATION

IMPORTANT: All Power Wheel units and kits are shipped with a name plate that includes the Auburn Gear part number and order code as shown.

Example:



In addition to the nameplate, Power Wheel drives are stamped with an identification number which appears on the cover or hub flange as shown.
Example**: 6000236-A-4-9**
When ordering parts, the information included on the nameplate or the stamped identification number is necessary to accurately identify the drive and obtain
the correct replacement parts. Once this information has been obtained, contact Auburn Gear for appropriate parts list.

DISASSEMBLY OF POWER WHEEL

STEP 1
Slide the coupling (1) from the splines on input shaft (2).
STEP 2
Position the assembly upright on face of spindle (3).
STEP 3
Remove the disengage cover (30) if necessary.
STEP 4
Remove twelve bolts (26) and flat washers (27) and the large cover (25) from the unit. The thrustwasher (22) and the disengage plunger (23) usually remain attached to the large cover (25) when it is removed. Remove thrustwasher (22), disengage plunger (23), and O-ring (24) from the large cover (25).
STEP 5
Remove primary sun gear (21) from end of input shaft (2).
STEP 6
Remove the primary carrier assembly (20).
STEP 7
Remove the secondary carrier assembly (19). It may be necesary to remove the ring gear (18) first, if difficulty is encountered in removing the carrier assembly.
STEP 8
Remove the input shaft (2) from the spindle (3). Remove the retaining rings (15), washers (16), and disengage spring (17) from input shaft (2) only if replacement is requlred.
STEP 9
If not previously removed (see step 7) remove ring gear (18) from hub (9). It may be necessary to strike ring gear (18) with a rubber mallet to loosen from hub (9).
STEP 10
One lockwasher (13) tab will be engaged in the bearing nut (14) slot; bend back to release. Remove the bearing nut (14), lockwasher (13), and thrustwasher (12). **NOTE: A special service tool is required for the removal of the bearing nut. Contact Auburn Gear for procurement of service tool.**
STEP 11
Press spindle (3) from hub (9). NOTE: Bearing cone (11) has been designed with a press fit with respect to spindle (3). Considerable force will be required to remove cone from spindle.
STEP 12
Remove the oil seals (4) and (5) and bearing cones (6) and (11) from hub (9). Inspect bearing cups (7) and (10) in position and remove only if replacement is required.

ASSEMBLY OF POWER WHEEL

STEP 1
Press new bearing cups (7 & 10) in each side of the hub (9). It is recommended that bearing cups (7 & 10) and cones (6 & 11) be replaced in sets.
STEP 2
Assemble bearing cone (6) into cup (7) at seal end of hub (9) and press a new seal (5) into hub (9). Install boot seal (4) on hub (9) if unit is so equipped.
STEP 3
Position spindle (3) upright on bench. Lubricate lips of seals (4) and (5) and lower hub (9) onto spindle (3). Hub (9) shouid be centered as it is lowered over spindle (3) to prevent seal damage.
STEP 4
Assemble bearing cone (11) over spindle end. Press bearing cone (11) over spindle bearing journal using press and cylindrical bearing tool AG08404B. Press bearing cone (11) down until roller just touches cup (10). (OPTIONAL: Use hammer and bearing tool AG08404B to install cup (11) over spindle (3). Take care when using this method to avoid pressing cone (11) too far. As in other method, rollers should just touch cup (10)).
STEP 5
Install thrust washer (12) and bearing nut (14). DO NOT install lockwasher (13) at this time.
STEP 6
Place rolling torque tool AG08771C over spindle (3) and bolt or pin to hub (9).STEP 7
Check initial rolling torque by installing an inch-lb. torque wrench on center nut of rolling torque tool and turning hub (9) slowly and steadily with the torque wrench. Note mean torque. An initial bearing rolling torque of greater than 52 in-lbs. means that the cone (11) was pressed on too tightly in step 4. In this case, back off bearing cone (11) by pressing spindle (3) out of cone (11) until initial preload is relieved.
STEP 8
Torque bearing nut (14) with bearing nut wrench AG07366B until a bearing rolling torque of 44-52 in-lbs., with a boot seal installed, or 4048 in-lbs., without a boot seal, is reached. This may require several trials of pressing the cone (11) by torqueing the nut (14) and then checking the rolling torque. Rotate hub (9) by hand as nut is being tightened in order to seat bearings. NOTE: Up to 250 ft-lbs. of torque may have to be applied to bearing nut (14) in order to press cone (11) into position.
STEP 9
Remove bearing nut (14) and install lockwasher (13). Install nut (14).
STEP 10
Re-torque bearing nut (14) to 65-75 ft-lbs.
STEP 11
Secure bearing nut (14) by bending a lockwasher (13) tab into one of four bearing nut slots. If no tab aligns with a slot, the nut may be tightened until one of the slots aligns with a lock washer tab.
STEP 12
Assemble a washer (16), spring (17), a second washer (16), and a retaining ring (15) in the middle grooves of input shaft (2). Install a second retaining ring (15) in groove near small end of input shaft (2).
STEP 13
Assemble the splined end of the input shaft (2) down into spindle (3).
STEP 14
Assemble the secondary carrier assembly (19) to spindle (3) at splines.
STEP 15
Clean mating surfaces and apply a bead of silicone sealant to face of hub (9) that mates with ring gear (18). (See instructions on sealant package). Assemble ring gear (18) to hub (9) being careful to align bolt holes.
STEP 16
Assemble the primary carrier assembly (20) into the ring gear (18). It will be necessary to rotate carrier to align secondary sun gear (part of primary carrier assembly (20)) with planet gear teeth in secondary carrier assembly (19). Assemble primary sun gear (21) over input shaft (2). Rotate primary sun gear (21) to align input shaft (2) to gear splines and gear teeth in primary carrier assembly (20).
STEP 17
Lubricate O-ring (24) and assemble in groove inside cover hole, push disengage plunger (23) into cover (25) with pointed end facing inside of unit.

STEP 18
Assemble the thrust washer (22) with tangs engaged with cover (25). NOTE: A small amount of grease applied to the back side of thrust washer (22) will hold washer in place. Apply a bead of silicone sealant to end face of ring gear (18) Assemble cover (25) aligning holes of cover and ring gear. Assemble the twelve 3/8-16 x 6-1/2 inch grade 8 bolts (26) and flat washers (27). Torque bolts to 45-50 ft-lbs.

STEP 19
Assemble the disengage cover (30) with dimpled center protruding out if wheel is to be used to drive the vehicle. Assemble and torque the two 5/16-18 x 1/2 inch bolts (31). Torque bolts to 10-20 ft-lbs.

STEP 20
Invert the Power Wheel assembly and assemble the coupling (1), with counterbore out, to the input shaft (2).

NOTE: When installing a hydraulic motor to the Power Wheel drive it is necessary to place an O-ring or gasket (not supplied by Auburn Gear) between the motor and planetary drive. O-ring sizes--SAE A: 2-042, SAE B: 2-155, SAE C: 2-159.

CARRIER ASSEMBLIES

It is recommended that the primary and secondary carrier assemblies (19 & 20) be serviced in their entirety to protect the integrity of the Power Wheel drive.

LUBRICATION RECOMMENDATIONS

IMPORTANT: POWER WHEEL PLANETARY DRIVES ARE SHIPPED WITHOUT LUBRICANT AND MUST BE FILLED TO THE PROPER LEVEL PRIOR TO START UP.

Observe lubrication recommendations given by the original equipment manufacturer. When specific recommendations are not available, use mild extreme pressure lubricant API-GL 5, No. 80 or 90 when filling the Power Wheel under normal temperature ranges between 0-120 F (-18 to 49 C). Power Wheel is to be half full of oil when unit is mounted level and horizontal. Use drain and fill plug located in cover. Oil to be changed after first 50 hours of operation with subsequent changes every 1000 hours or yearly, which ever comes first. If unit is to be operated vertically. if ambient conditions are outside the specified range, or if the oil temperature exceeds 200 F (93 C) contact Auburn Gear for oil and level recommendations.

TOWING VEHICLE

CAUTION: The Power Wheel will not normally be damaged by towing; however, the hydraulic drive components may be damaged unless the Power Wheel is disengaged from the drive motor. Road speeds in excess of 25 MPH should be avoided unless clearly specified to be permissible by the equipment manufacturer.

TO DISENGAGE POWER WHEEL

CAUTION: For units equipped with the standard spring disconnect, assemble the disengage cover (30) with the dimpled center protruding inward. For units equipped with the optional quick disconnect, push in center plunger of disconnect.

STORAGE

A protective film is applied to the Power Wheel at the factory to prevent rust during shipment. Additional protection may be required if the Power Wheel is to be stored for an extended period of time.

SEALING COMPOUND

Silastic RTV 732 sealer and General Electric Silimate RTV No. 1473 or RTV No. 1503 are currently recommended for sealing gasket surfaces. Sealant should be applied in a continuous bead, which should be centered on the surface to be sealed but should move to the inside of the hole at each bolt hole location. For service requirements order Auburn Gear Part number 604101.

SPECIFICATIONS

Maximum intermittent output torque .....100.000 lb in (11.300 Nm)
Maximum input speed..... 5.000 RPM
Oil capacity .....57 oz (1685 ml)

ITEM NO.	DESCRIPTION *	NO. USED IN ASS'Y.	ITEM NO.	DESCRIPTION *	NO. USED IN ASS'Y.
1	Coupling	1	18	Ring Gear	1
2	Input Shaft	1	19	Secondary Carrier Assembly	1
3	Spindle	1	20	Primary Carrier Assembly	1
4	Boot Seal 604403	1	21	Primary Sun Gear	1
5	Oil Seal 604409	1	22	Thrust Washer	1
6	Bearing Cone 14-00-133-007	1	23	Disengage Plunger	1
7	Bearing Cup 14-00-133-006	1	24	"O" Ring 614101	1
8	Wheel Bolt	8-10	25	Large Cover	1
9	Hub	1	26	Hex Head Bolt (Grade 8)	12
10	Bearing Cup 613314	1	27	Flat Washer	12
11	Bearing Cone 613315	1	28	Magnetic Plug 14-00-052-002	1
12	Thrust Washer	1	29	Pipe Plug	1
13	Lock Washer	1	30	Disengage Cover 14-02-039-005	1
14	Bearing Nut	1	31	Hex Head Bolt	2
15	Retaining Ring	2	32	Quick Disconnect Gasket	1
16	Washer	2	33	Quick Disconnect Assembly	1
17	Disengage Spring	1	34	Hex Head Bolt	2

* Contact Auburn with part number and order code of drive to obtain the apropriate parts list. Refer to parts list for the specific part numbers and quantities.

Model 8 Series B Power Wheel® Service Kits

Part No.	Description	Included Items
593 RR Shown	Model 8 Series B Bearing Locknut Tool Not	Not Shown

GRADALL®

material handlers

532/534 Boom Maintenance

Form No. 29906

Issued 11/99

REVISIONS

- This page is provided so you may determine that this Manual is complete and current with respect to Gradall Engineering Specifications.

Page	Date	Revision

532/534 Boom Maintenance
Table of Contents

Covers Material Handlers:
532C-6/534C-6 Starting Serial No. 0188002 Through 0488378
534C-9 Starting Serial No. 0344004 Through 0444189
534C-10 Starting Serial No. 0266001 Through 0266139
534D-6 Starting Serial No. 0588001
534D-9 Starting Serial No. 0544001
534D-10 Starting Serial No. 0366001

Read and understand this Manual along with the appropriate *Owner/Operator Manual*, the *Gradall Material Handler Safety Manual*, the *EMI Rough Terrain Forklift Safety Manual* and all instructional decals and plates before starting, operating or performing mechanical adjustments and maintenance procedures on this equipment. Keep Operator and Safety Manuals in the operator's cab.

Orientation

When used to describe the location of components on the machine, the directions "front","rear","left", and "right" indicate the point of view of a person sitting in the operator's seat in the cab.

Fastener and Fitting Torque

Torque values for mechanical fasteners and hydraulic fittings are given in "Appendix A" and "Appendix B". They must be adhered to at all times. **LOCTITE 242** (P/N 1440-3364) must be used on all bolt threads. **LOCTITE 545** (P/N 1440-4043) must be used on all hydraulic fittings. Whenever a hydraulic hose is tightened, two wrenches must be used; one to tighten the hose, the other to hold it from twisting. Hoses must lie and roll free of twist.

Preparing The Material Handler For Service

1. Before performing any maintenance or service, position the material handler in a safe, open, level area, well away from traffic lanes, buildings, other equipment or personnel.
2. Set the park brake and shift the transmission to "Neutral."
3. Lower the forks to the ground.
4. Place the controls in "Neutral," idle the engine 3 minutes for gradual cooling then shut the engine off.
5. Cycle the hydraulic controls, remove the ignition key and fasten a "Do Not Operate" tag to the steering wheel.
6. Dismount from the material handler facing the machine using the proper hand rails, grab irons and/or ladders provided. Always maintain 3-point contact with the handler while dismounting or mounting.
7. If you must park on a slope or incline, position the material handler at right angles to the slope and chock the wheels.

DANGER

Since you will occasionally have to perform service/maintenance procedures with the material handler running, you must take extra precautions to avoid being injured, perhaps fatally. At a minimum this means:

- Set the park brake.
- Chock the wheels.
- Avoid all exposed moving parts.
- Post a warning in the operator's cab that you are working on the machine.
- Work with an assistant.
- Maintain vision to assistant allowing you to know where he is and what he is doing.

Additional Maintenance/Service Precautions

- Refer to the safety decals on the machine and in the relevant *Owner/Operator Manual* before attempting any repair or adjustment.
- If you are working with someone else, make sure they understand the procedure. Make sure each of you knows what to expect and when to expect it. Make sure each of you knows where the other is at all times.
- Make sure you wear all the protective clothing and personal safety gear necessary to perform the service safely.
- Make sure there is adequate light and ventilation in the work area.
- Remove oil, grease, mud, snow, water or any other substance that might cause slippery surfaces from all climbing, walking and working areas.

Note!

Steps 4 and 5 clearly relate to maintenance and service procedures performed with the machine shut down. Although ideal, this may not be possible. Some procedures can only be performed with the machine running. Therefore, this list of precautions headed "Preparing the Material Handler for Service" should be modified according to the specific circumstances of a particular service/maintenance procedure.

- Clean around the area to be serviced to minimize any possibility of contamination.
- Use only the correct tools to perform any check, service or repair.
- Make sure any lifting and supporting devices you use are stable and strong enough to handle the weight of the material handler or component.
- Remove only the guards/covers on the area being serviced. Replace all guards/covers immediately upon completion of the task.
- If the material handler has special optional equipment, make sure that the appropriate maintenance and operational requirements are understood by everyone who operates and services the machine.

What This Manual Covers

This Manual covers maintenance and repair procedures for the three-section boom assembly of all 532 and 534 Series Gradall Material Handlers. Specifically this includes; 532C-6, 534C-6/T, 534C-9/C-10, 534D-6/T & 534D-9/D-10. Mechanical adjustments, replacement, removal and reinstallation of major components are covered. Hydraulic system operations are not discussed. Refer to appropriate manuals for this information. Areas requiring special attention are so indicated.

Illustrations and pictures used are taken from various models. They are typical with regards to assembly and component location and should be used for reference only.

Information in the various charts, tables and illustrations is correct at the time of printing. Refer to the appropriate current *Gradall Parts Manual* to verify correct component Part Numbers.

Special Note on Boom Cables

The extension/retraction boom cables used on all Gradall 532 and 534 Series Material Handlers are made of wire rope. All wire ropes in service should be inspected regularly for damage and evidence of wear. Refer to the *Wire Rope Users' Manual* and *OSHA Wire Rope Excerpts*, both published by the American Iron and Steel Institute Committee of Wire Rope Producers.

Users of Gradall Material Handlers equipped with wire rope should conduct a thorough inspection of all wire rope boom cables at least once a month, keeping full and accurate records as to the condition of the ropes. Any deterioration will lead to the depletion of original rope strength which is sufficient cause to replace the rope.

Listed below are some conditions that warrant wire rope replacement:

- Corrosion of wire rope.
- More than one broken wire in any one strand. Breaks in valleys between strands indicate problems (fatigue, breakage) in wires not necessarily visible on the surface.
- More than one broken wire near attached fittings.
- Heavy wear and/or broken wires in rope sections under sheaves where rope travel is limited.
- Evidence of reduction in original rope diameter, allowing for normal stretch factors.
- Excessive abrasion, scrubbing and cleaning of outside wires.
- Pitting, kink damage or evidence of other kinds of mechanical trauma.

In addition to inspecting wire rope boom cables regularly, inspect all sheaves, guards, guides and other surfaces which are in contact with the rope during boom operation. Any defect/damage to the above listed components poses a risk to the integrity of the rope.

DO NOT reach into the Boom until you are CERTAIN the keys have been removed from the ignition.

A fully comprehensive set of inspection procedures and guidelines (including replacement recommendations) is practically unattainable because of the many variables involved. In the final analysis, SAFETY depends largely on the good judgment of competent service personnel in determining:

(i) Damage to wire ropes
(ii) The remaining service life expectancy of the wire rope. If there is **any doubt**, the rope **must** be replaced
(iii) The proper procedures to replace worn or damaged rope

If you have any questions, including inquiries about the American Iron and Steel Institute publications mentioned above, please call your Authorized Gradall Distributor or Gradall Product Support at (330) 339-2211.

THE FOLLOWING SYMBOLS CALL YOUR ATTENTION TO IMPORTANT SAFETY NOTICES:

This symbol indicates an extreme hazard which would result in high probability of death or serious injury if proper precautions are not taken.

This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.

This symbol indicates a hazard which could result in injury or damage to equipment or property if proper precautions are not taken.

DANGER, WARNING and CAUTION notes in this Manual will help you avoid injury and damage to the equipment.

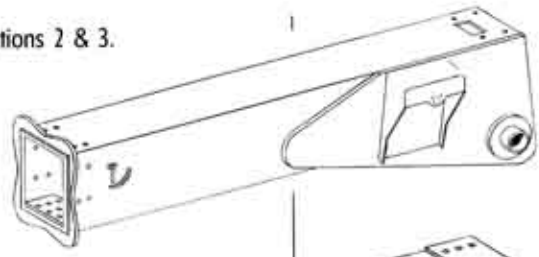
Any procedure not specifically recommended by Gradall must be thoroughly evaluated from the standpoint of SAFETY before it is placed in practice. If you are not sure, contact your Authorized Gradall Distributor.

Do not modify this machine without written permission from Gradall.

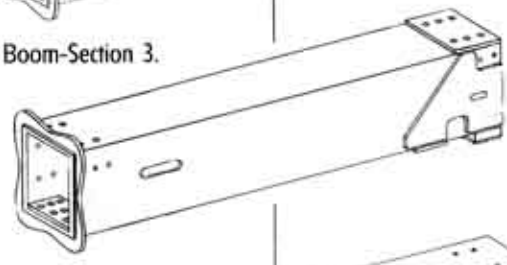
Note on Using the Manual

This Manual contains a series of maintenance and repair procedures for the Boom Assembly of all 532 and 534 Series Material Handlers. In every instance—unless otherwise noted—there are certain basic precautions and steps you should take before working on the machine. These precautions are outlined in the "Introduction" under the heading "Preparing the Material Handler for Service." You must read, understand and comply with these instructions in every instance before working on the machine. You must also observe the general warnings listed under the heading, "Additional Maintenance/Service Precautions," also in the "Introduction."

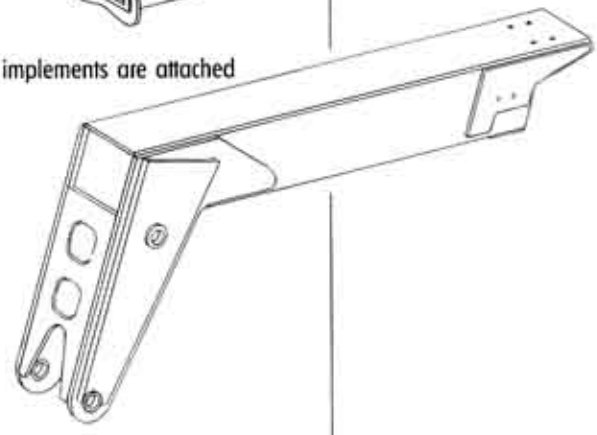
BOOM-SECTION 1
Base boom connected to the carrier frame that houses Boom-Sections 2 & 3.



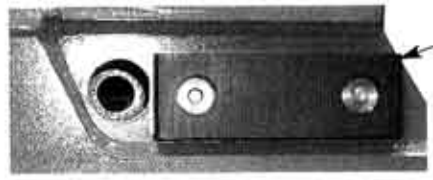
BOOM-SECTION 2
Intermediate Boom-Section, located inside Boom-Section 1, houses Boom-Section 3.



BOOM-SECTION 3
Outer Boom-Section located inside Boom-Section 2. Working implements are attached to the boom head end of this section.



BEARING PAD
Also known as a "Slider Pad" or a "Wear Pad". Mounts to the boom and contacts mating boom surface. Reduces friction during boom extension and retraction. Keeps Boom-Sections centered with each other.

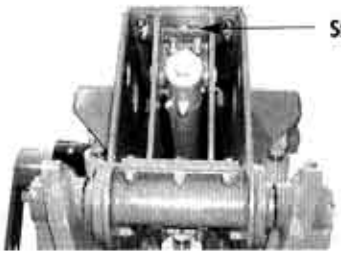


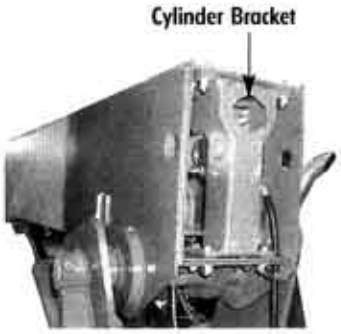
BEARING PAD SPACER
Mounts on the inside of a bearing pad, facing the boom surface. Provides a solid surface for boom bearing pad shims. Gradall Part Number and thickness is stamped on each spacer.

SHIM
Metal plate used to fill the space between components, allowing the component to be properly placed against a solid surface, (bearing pad, strongback, etc). Gradall Part Number and thickness are stamped on each shim.

Push Beam (534C-9/C-10 & D-9/D-10 only)
Weldment that houses the crowd cylinder and the extension cable sheave assembly. Mounts to the rear of Boom-Section 2.

Strongback
Also known as the Cylinder Bracket on the 532C-6, 534C-6 & 534D-6. Located at the inside rear of Boom-Section 1. Extension cables and the base end of the crowd cylinder are mounted to this weldment.





Crowd Cylinder
Extends and retracts the complete Boom Assembly.
534C-9/C-10: Located inside the push beam. Rod eye pinned to the push beam; base end pinned to the strongback.
532C-6, 534C-6 & 534D-6: Rod eye pinned to the cylinder bracket and barrel-mounted to the rear of Boom-Section 2.

Tilt Cylinder
Tilts the boom attachments forward or backward. Located in the boom head of Boom-Section 3.

Boom Cable
Wire Rope that mechanically extends and retracts Boom-Section 3.

Boom Cable Sheave
Grooved rollers that the boom cables ride on. As the sheave rotates, the cable is extended or retracted from its anchor point. There are extension and retraction sheaves used in the boom assembly. They are located at the front end of the push beam and the rear of Boom-Section 2.

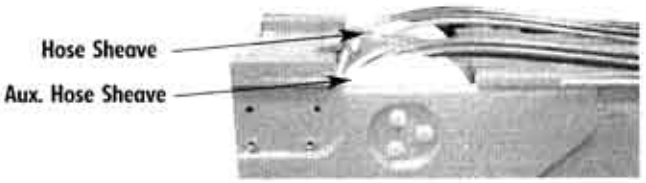
534D-6 Extend Cable Sheave
Front View

Hydraulic Hoses

Located inside boom assemblies. Used to carry fluid to the attachment; fastened to the end of Boom-Section 3.

Hose Sheave

Located at the inside left of Boom-Section 2. The plastic roller is designed with lips on the outer edge of the OD. As the booms extend and retract, the roller rotates against the hoses, maintaining the proper radius point of the hose. The lips keep the hose captive on the roller.

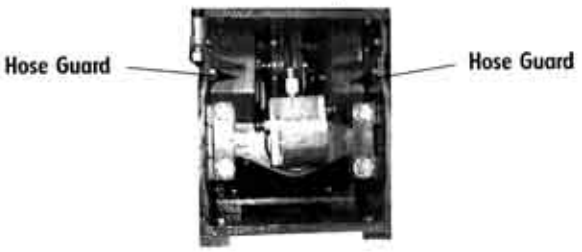


Note!

Boom-Section inverted 180° (upside-down)

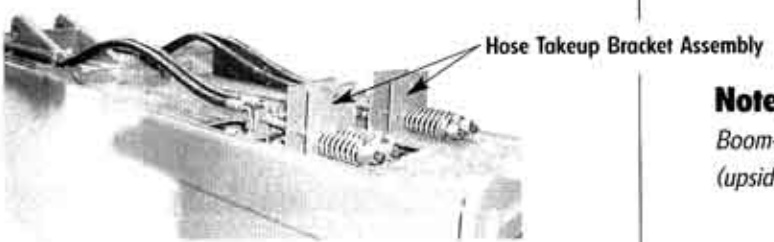
Hose Guard Plate

Located in the back of the hose sheave, the hose guard plate protects the hoses from contamination and prevents them from jumping the lips of the hose sheave.



Hose Take-Up Assembly

Located at the outside bottom of Boom-Section 1, the Hose Take-Up Assembly weldment absorbs sudden shocks which impact the tilt circuit and auxiliary circuit hydraulic hoses, minimizing the possibility of hose failure.

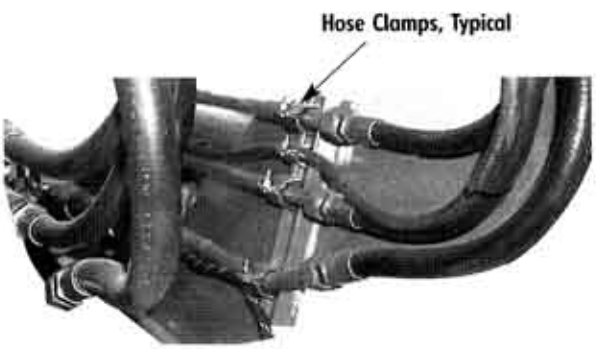


Note!

Boom-Section Inverted 180° (upside-down)

Hose Clamp Sets

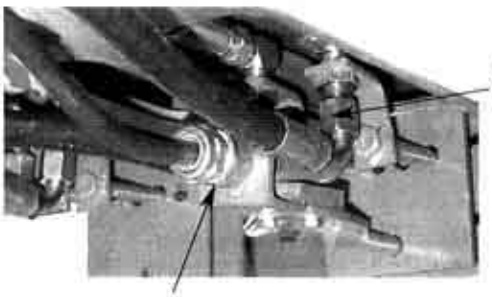
Keep hydraulic hoses located in a fixed position. Hose movement and damage is minimized when hoses are properly clamped.



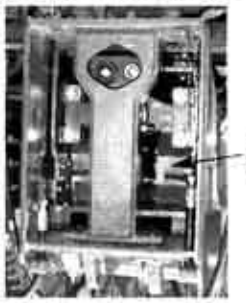
Auxiliary Circuits

Special attachments may require additional hydraulic and electric circuits. These circuits are fed to the attachments through the right side of the boom assembly. They are similar to the standard circuits in the left side of the boom.

Front Bottom, Boom-Section 1:
Cable Take-Up Bracket



Rear View Boom Assembly

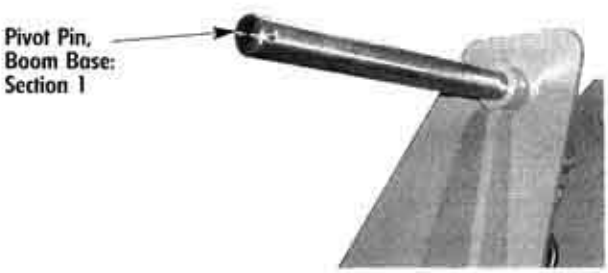


Fasteners

Refer to Appendix "A" at the rear of this Manual for correct torque values.
LOCTITE 242 (P/N 1440-3364) must be used on all fasteners when setting the torque.

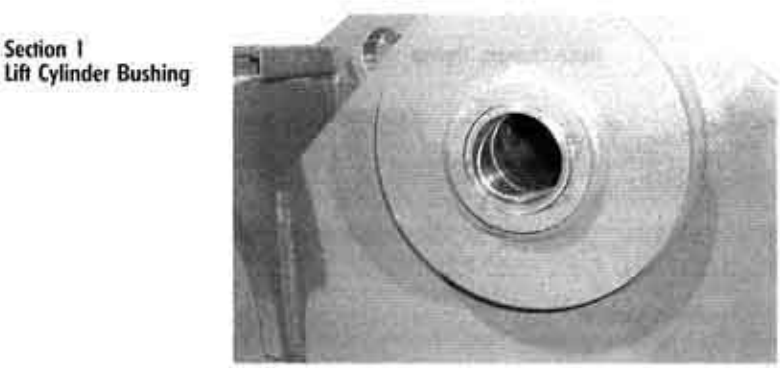
Pins

Special dimensioned pins are used in some locations to fasten components together. During installation and removal, care must be taken to protect the outside surface and any lubrication passages.



Bushings

Bushings equipped with lubrication grooves are used in conjunction with pins. Lubricate ID and OD of bushings before installation in parent bore and pin installation.



Optimum Boom Assembly Performance and Service Life depend on proper adjustment and alignment of components. A boom is considered in proper adjustment as long as the following criteria are met:

- Boom-Sections centered to each other.
- Extension/Retraction cables are adjusted properly, resulting in simultaneous extension and retraction of Boom-Section 3, proportional to the crowd cylinder, throughout partial and/or full boom travel.
- Hydraulic circuit hoses (including Auxiliary Hydraulic and Electric) are properly installed, resulting in stress-free movement during boom extension/retraction cycle.

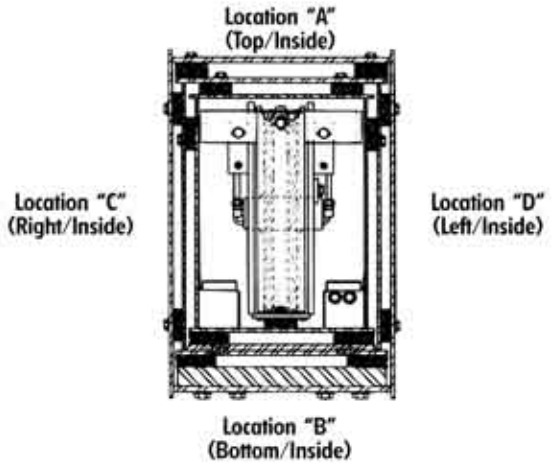
BOOM ADJUSTMENT PROCEDURE:

CENTERING OF BOOM-SECTIONS TO EACH OTHER

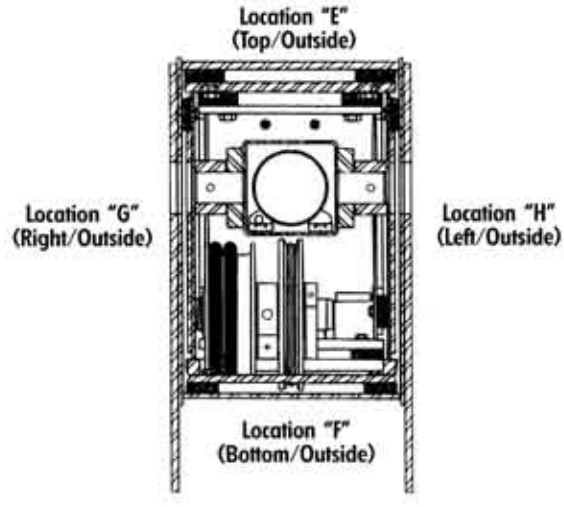
BEARING PAD PACKAGE

Boom bearing pads (sometimes called slider pads or wear pads), spacers and shims are used as a package to achieve proper centering of Boom-Sections to each other. For the purpose of clarification, the area and location of bearing pad packages are referenced below.

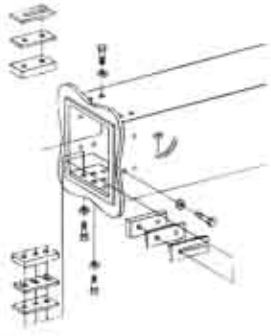
END VIEW AREA 1 & 2



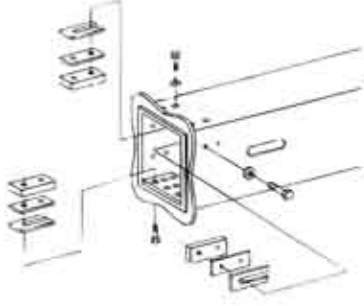
END VIEW AREA 3 & 4



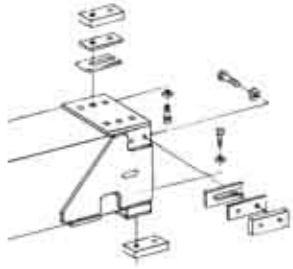
BOOM-SECTION 1:
AREA 1, FRONT INSIDE



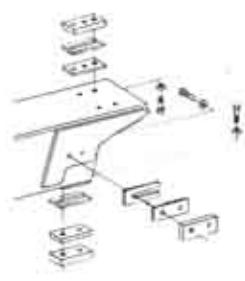
BOOM-SECTION 2:
AREA 2, FRONT INSIDE



BOOM-SECTION 2:
AREA 3, REAR OUTSIDE



BOOM-SECTION 3:
AREA 4, REAR OUTSIDE



Note

The 534C9/10 and 534D9/10 booms require 3 bolts on the bottom front bearing pads on section one. They also require 3 bolts on the boom bearing pads on the bottom front and top rear of section two and the top rear of section three. All other boom bearing pads as well as all the boom bearing pads on the 532/534C6 and 534D6 require two bolts.

Boom Wear Pad Adjustments

To maximize boom service life, wear pads must be carefully adjusted at all times. The following Service Notes are a general guide for properly adjusting boom wear pads:

General Service Notes

- Familiarize yourself with all bearing pad package components.
- Add bearing pad spacers (backing plates) and shims as required to fit boom within 1/16" of tight fit to mating outer boom.
- Boom-Sections 2 and 3 should be evenly centered to outer Boom-Section 1. Spacer and shim packs should be equal (within 1 shim) side to side and top to bottom.
- It may be possible on new booms for bearing pads only to be installed. There may not be room for spacers and shims.
- Insert spacers between pad and shim.
- Be sure no pad sits directly on the slotted surface of a shim.
- Bolts must not extend beyond the chamfer on the bearing pad. The length of pad bolts depends on the number of shims used.
- If no shim is used with the bearing pad, two washers are installed under the head of the bolt against the boom. Remove one washer if a shim is installed at a later date, otherwise the bearing pad will not be securely held in place by the bolt.
- Grease bearing pads and pad slide area on the boom with *Mystik Tetrimoly* grease (or equivalent) (Gradall P/N 1440-4595).
- Apply **LOCTITE 242** (Gradall P/N 1440-3364) to all bolt threads.
- Bearing pad bolt torques are:
  3/8" bolt: 32-37 ft-lb
  1/2" bolt: 76-86 ft-lb
- Do not overtorque pad mounting bolts. Overtorqueing will pull the pad nut through the pad. The pad will then fall out of the boom.
- Booms should not be adjusted so tight that the lube is wiped off the sliding path.
- Visual checking of the witness lines left on the bearing slide path may assist in determining which side of the boom is not making proper contact with the bearing pad.
- If a wedge is used to assist in shifting a Boom-Section for adjustment, be certain it is removed before activating the boom circuit. Damage to the boom structure will occur if the boom is retracted with a wedge left installed. Do not use more than one wedge at a time during the adjustment operation.
- You can use .060" thick shim stock as a feeler gauge to check boom clearance to bearing pad.
- Shims and spacers are stamped with their part number and thickness for quick reference. Check the ones you are installing against the ones installed in the same area. Make sure you install the right ones.

Boom Adjustment Procedure:
Area 1 and Area 2 (Pad location "A" & "B")

→ Inspection

1. Extend the boom three-quarters of total travel. (Extend at least 1 ft. beyond access holes.)
2. Lower the boom using slight down-pressure to remove Boom-Section weight from the bottom.
3. Using a feeler gauge, measure the gap between the bearing pad and the boom at Area "2", location "B".

.060" Shim (used as feeler gauge)

4. If the gap is more than $^{1}/_{16}$", shims must be added to bring the boom into tolerance.

Note!

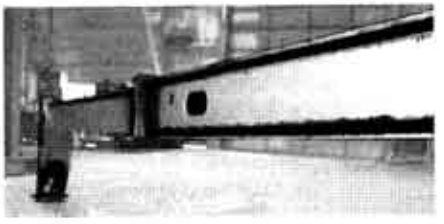
Shim packs should be equal top to bottom (within 1 shim), location "A" and "B". If an unequal amount of shim must be added, first add the shims to location "A" then equalize the shim pack at the next adjustment. Do not use more than 3 levels of shims. The bottom of the boom, Location "B", is most critical. Shim pack levels must ***always*** *be equal (within 1 shim) at this location.*

→ Adjustment

1. Loosen the bearing pad mounting bolts at locations "A" or "B" (or both) and add required shims.
2. Shims are stamped with the Gradall Part Number and thickness. Check the part number on the shim in the area you are installing additional ones and make sure they are the same.
3. Apply ***LOCTITE* 242** to the threads on the pad mounting bolts.
4. Re-torque the bearing pad mounting bolts.
5. Repeat "Inspection" Steps 3 & 4 and "Adjustment" Steps 1 & 2 for Area 1, Location "B".

Area 1 & 2

Extend the Boom, Slight Down-Pressure



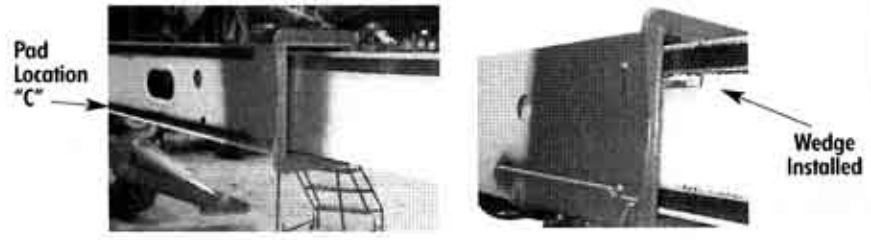
Area 1, Location B

ADJUSTMENT PROCEDURE:

AREA 1 AND AREA 2 (PAD LOCATION "C" & "D")

→ **Inspection**

1. Extend the boom three-quarters of total travel. (Extend at least 1 ft. beyond access holes)
2. Lower the boom to 1ft. of ground clearance.
3. Install a wedge between Boom-Section 2 and 3 at Area 2, Location "C".



4. Hammer a wedge into the area between Boom-Section 3 and 2 at Location "C", forcing it against the opposite side (Location "D").

CAUTION **Do not distort the side plates of the boom sections.**

5. Using a feeler gauge, measure the gap between the bearing pad and the boom at Area 2, Location "C".
6. If the gap is more than 1/16", shims must be added to bring the boom into tolerance.

Note!

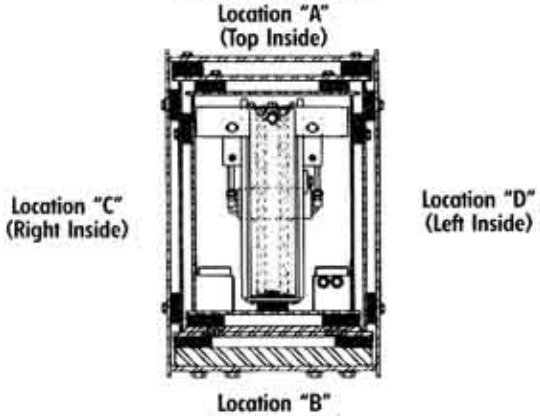
Shim packs should be equal side to side (within 1 shim), Location "C" & "D". If an unequal amount of shim must be added, equalize the shim pack at the next adjustment.

→ **Adjustment**

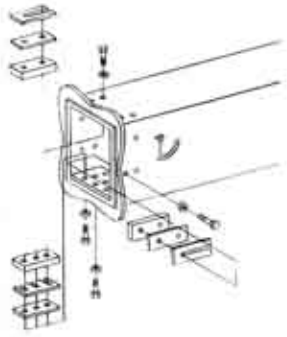
1. Loosen the bearing pad mounting bolts at locations "C" or "D" (or both) and add the required shims.
2. Shims are stamped with their Gradall Part Number and thickness. Check the shims already in place and make sure you are installing the right ones.
3. Apply ***LOCTITE* 242** to the threads on the pad mounting bolts.
4. Re-torque the bearing pad mounting bolts.
5. Remove wedge installed in Step 3.
6. Repeat "Inspection" Steps 3-6 and "Adjustment" Steps 1-5 for Area 1, Location "C".

CAUTION If a wedge was used to move the Boom-Sections for checking, **be certain it is removed** before activating the boom circuit. Failure to do so will damage the boom structure. Do not use more than one wedge at a time for the adjustment operation.

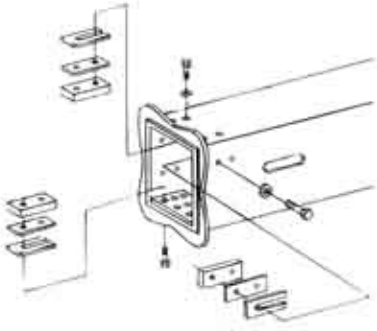
END VIEW AREA 1 & 2



BOOM-SECTION 1: AREA 1, FRONT INSIDE



BOOM-SECTION 2: AREA 2, FRONT INSIDE



SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

Note!

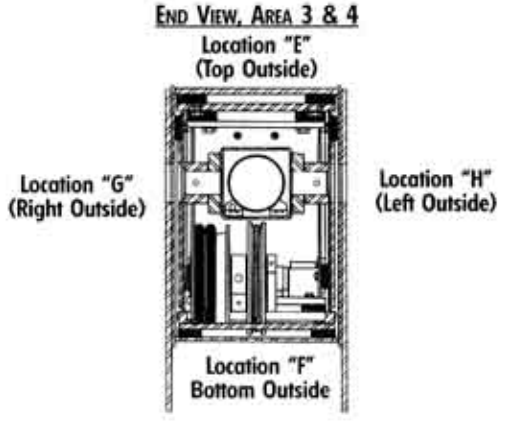
If two washers were installed under the head of the pad mounting bolts and a shim was added, it is imperative that one washer be removed. Otherwise the bolt will not secure the pad nut properly.

ADJUSTMENT PROCEDURE:

AREA 3 & 4 (PAD LOCATION "E" & "F")

→ **Inspection**

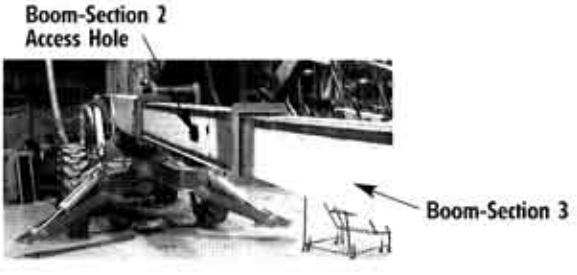
1. Retract the boom assembly within 1 ft. of full retraction.
2. Raise the boom assembly approximately 30° so that the weight of the assembly will force the boom package to rest against the bottom plate at the rear.
3. At the rear of the boom, use a feeler gauge to check the bearing pad clearance between Boom-Sections 1 & 2 and Boom-Sections 2 & 3 at Area 3 and the top of Area 4, Pad Location "E". Visually check pad location "F" at this time.



4. Lower and extend the boom until Boom-Section 3, Area 4, and all pad locations clear the access holes in Boom-Section 2 by at least 1 ft.
5. Using a feeler gauge, check the pad clearance for Area 4, Pad location "F". It may be possible for a boom to show the pad clearance when fully retracted and no pad clearance when extended. If no pad clearance is evident when extended, do not add shims at this time.
6. If there is more than $^{1}/_{16}$", shims must be installed to bring the boom into tolerance.

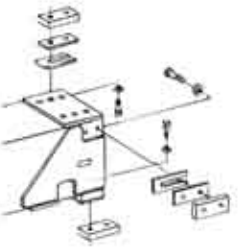
Note!

Shim pack levels should be equal top to bottom (within 1 shim) pad locations "E" and "F". If the shim pack level is unequal after this adjustment, equalize at the next adjustment.

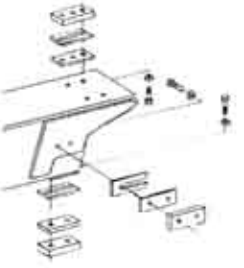


Boom Bearing Pads are now fully adjusted.

BOOM-SECTION 2:
AREA 3, REAR OUTSIDE



BOOM-SECTION 3:
AREA 4, REAR OUTSIDE



SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

Adjustment Procedure:

Area 4, (Pad Location "G" & "H")

→ **Inspection**

1. With the engine off, reach through the access hole, install a wedge between Boom-Sections 2 and 3 at Area 4, Pad Location "G". Force Boom-Section 3, Area 4 against the opposite side Pad Location "H" to check the clearance.
2. Using a feeler gauge, check the clearance between the boom and the bearing pad at Area 4, Pad Location "G".
3. If there is more than .060" clearance present, shims must be installed to bring the boom into tolerance.

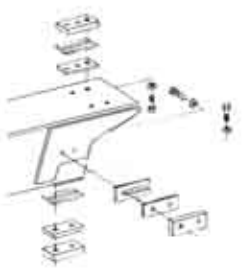
Note!

Shim pack levels should be equal side to side (within 1 shim), pad locations "G" and "H". If the shim pack level is unequal after this adjustment, equalize at the next adjustment.

→ **Adjustment**

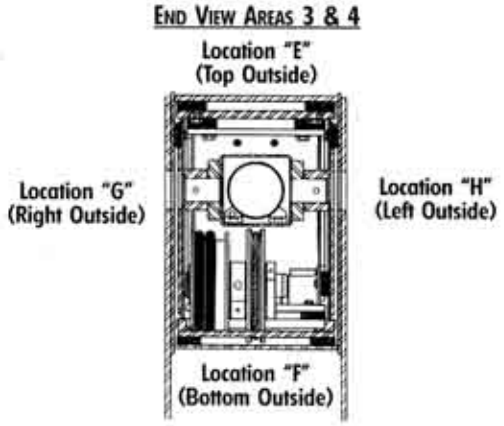
1. Loosen the bearing pad mounting bolts at location "G" or "H" (or both) and add required shims.
2. Shims are stamped with the Gradall Part Number and thickness. Check the part number on the shim being installed against the one previously installed to be certain they are the same.
3. Apply **LOCTITE 242** to the threads on the bearing pad mounting bolts.
4. Re-torque the bearing pad mounting bolts.
5. Remove the wedge installed under "Inspection", Step 1.

Boom-Section 3:
Area 4, Rear Outside



See note on page 2.0 for boom bearing pad bolt quantities

End View Areas 3 & 4



Boom-Section 2
Access Hole

Boom-Section 3
- Right side Location "G"
- Left side Location "H"

Inside View Location "G"
(From Opposite Side Access Hole)

ADJUSTMENT PROCEDURE:

AREA 3 & AREA 4 (PAD LOCATION "E", "F", "G" & "H")

→ **INSPECTION**

1. Raise the boom assembly to approximately 30° and retract to approximately 1ft. of full retraction. Shims for Area 3, Pad Locations "E", "F", "G" & "H" and Area 4, Pad Location "E" are added at the rear of the boom assembly.
2. Using a feeler gauge, measure the clearance between the boom and the bearing pad at all the above locations.
3. If there is clearance of more than 1/16" at Area 3 and/or Area 4 pad Location "E" and "F", shims are normally first added to Pad Location "E" at the rear of the boom assembly.

NOTE!

Shim packs should be equal (within 1 shim). Do not have more than one extra shim level at any bearing point.

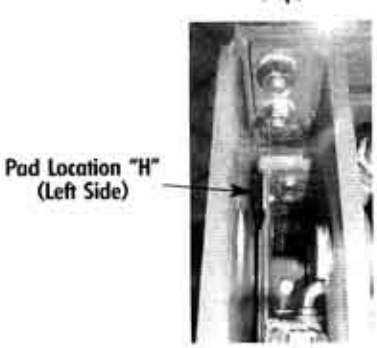
→ **Adjustment**

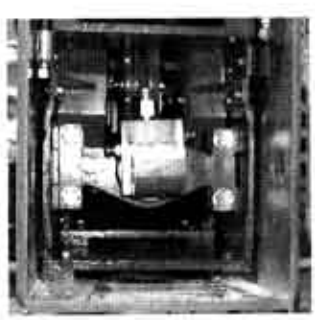
(Pad Location "F")

1. To add shims to Pad Location "F", wedge up the Boom-Section for clearance.
2. Shims are stamped with their Gradall Part Number and thickness. Check the part number on the shim being installed against the part number of the one previously installed to be certain they are the same.
3. Loosen bearing pad mounting bolt and install shims as required.
4. Apply ***LOCTITE* 242** to the mounting bolt threads.
5. Re-torque the bearing pad mounting bolts.
6. Remove any wedges you installed.

REAR VIEW

AREA 3





→ **Adjustment**
(Pad Locations "G" & "H")

1. To add shims to Area 3 or 4, Pad Location "G" or "H", install a wedge to Pad Location "G" to force the boom to the opposite side Pad Location "H".
2. Install a shim, remove the wedge and repeat step 29 on opposite side, Pad Location "H".
3. Apply ***LOCTITE* 242** to the bearing pad mounting bolt threads.
4. Re-torque the bearing pad mounting bolts.
5. Remove any wedges you installed.

REAR VIEW, TYPICAL

Pad Location "H"
(Left Side)

Pad Location "G"
(Right Side)

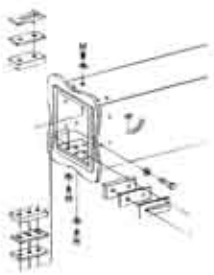
The Boom Bearing Pads are now fully adjusted.

AREA 1 AND AREA 2

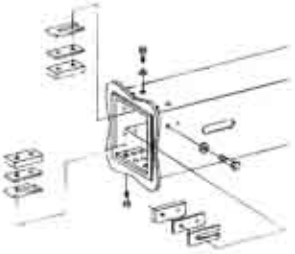
Bearing pad removal from Area 1 and Area 2 is accomplished with the boom extended approximately three fourths of the total stroke. If the pinch point is tight, you may have to remove shims and spacers from the opposite bearing pad.

Record quantities and Part Numbers of the spacers and shims removed from each location. This will assist you in reinstalling the bearing pad, spacer and shim package.

BOOM-SECTION 1:
AREA 1, FRONT INSIDE

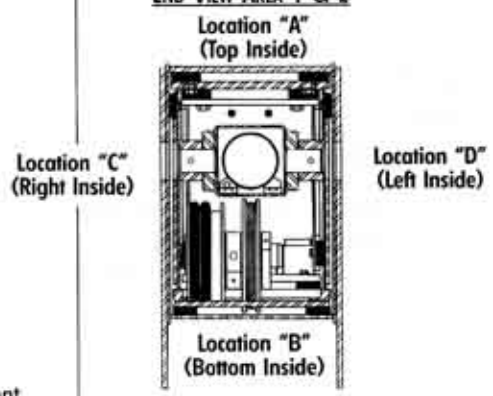


BOOM-SECTION 2:
AREA 2, FRONT INSIDE



SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

END VIEW AREA 1 & 2



→ **Removal**

Pad Location "A"

1. Raise the boom assembly approximately 1 ft. off the ground.
2. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the bearing pad mounting bolts and washers.
4. Remove the shims, spacers and the bearing pad.

→ **Removal**

Pad Location "B"

1. Lower the boom assembly to ground and apply minimal down-pressure, sufficient to provide clearance at Location "B".
2. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the bearing pad mounting bolts and washers.
4. Remove shims, spacers and bearing pads.

→ **Removal**

Pad Location "C" & "D"

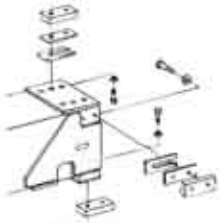
1. If the boom is tight, install a wedge to the side and force the boom to the opposite side.
2. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the bearing pad mounting bolts.
4. Remove shims, spacers and bearing pads.
5. Remove the wedge installed in Step 1.

Area 3 and Area 4, Pad Location "E"

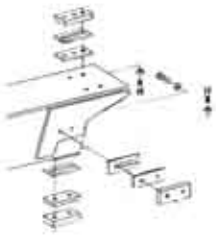
→ **Removal**

1. Steam-clean or pressure-wash the rear of the boom assembly.
2. Retract the boom fully, then extend 1 ft.
3. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
4. If necessary, use a wedge to shift the Boom-Section to the opposite side to create clearance for bolt removal. If additional clearance is required, remove the shim pack from the side opposite the bearing pad being removed.
5. Remove the bearing pad mounting bolts.
6. Remove shims, spacers and bearing pads.
7. Remove the wedge installed in Step 4.

Boom-Section 2:
Area 3; Rear Outside



Boom-Section 3:
Area 4; Rear Outside



See note on page 2.0 for boom bearing pad bolt quantities

Area 4

→ **Removal**

Pad Location "F"

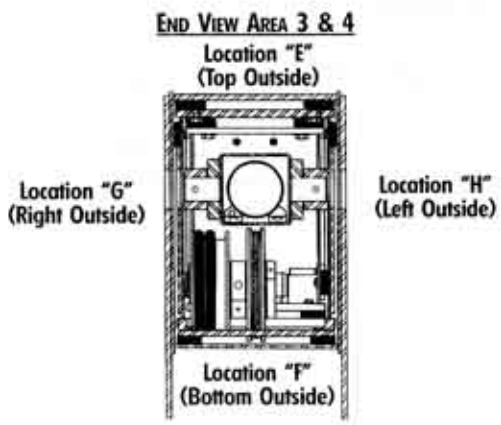
1. Extend Boom-Section 3 past the access holes in Boom-Section 2.
2. Lower the boom to 1 ft. off ground. The front of the boom will pivot down, creating clearance at Pad Location "F".
3. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
4. Through the access hole, remove the bearing pad mounting bolts at Pad Location "F".
5. Remove the shims, spacers and bearing pads.

→ **Removal**

Pad Location "G" & "H"

1. Extend Boom-Section 3 past the access holes in Boom-Section 2.
2. Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Install a wedge at pad location "G" or "H" and force the Boom-Section to the opposite side.
4. Remove the bearing pad mounting bolts.
5. Remove shims, spacers and bearing pads.
6. Remove the wedge installed in Step 3.
7. Repeat Steps 2 thru 5 for opposite side bearing pad removal.

End View Area 3 & 4



GENERAL

- It may be possible for a bearing pad only to be installed if there is insufficient clearance for spacers or shims.
- If no spacer or shim is installed, or if only the spacer is installed with the bearing pad, use two (2) flat washers under the head of the bearing pad mounting bolt. This will ensure the bolt will not protrude past the chamfer on the pad.
- **Do Not** install a shim against a bearing pad. This will ruin the integrity of the fastener system.
- If there is not room for a spacer and a shim, use only the spacer.
- Use ***LOCTITE* 242** (Gradall P/N 1440-3364) on all bearing pad mounting bolts.
- Bearing pad mounting bolt torques are:
  3/8" bolt: 32-37 ft-lb
  1/2" bolt: 76-86 ft-lb
- **Do Not** overtorque mounting bolts. This could pull the bearing pad nut through the bearing, causing the bearing pad to fall out of the boom.
- Lube bearing pad slide paths.
- Shims and spacers are stamped with the Gradall Part Number and thickness. Check replacement parts against the original to be certain the correct parts are being used.

DANGER **Remove the key from the ignition and fasten a "do not operate" tag to the steering wheel before working on or inside the boom.**

BEARING PAD INSTALLATION

1. Refer to bearing pad removal instructions for boom area and bearing pad placement, Sections 2 & 3.
2. Refer to the Part Numbers of shims and spacers removed.
3. Refer to the quantity of shims removed.
4. Place the new package (bearing pad, spacer and shims) to installation area using the same quantity that was removed.
5. **Do Not** install a shim directly against the bearing pad.
6. Install the bearing pad mounting bolts. Determine whether one or two flat washers must be used under the bolt head at this time.
7. Apply ***LOCTITE* 242** to the mounting bolt threads.
8. Torque the mounting bolts to 32-37 ft-lb (3/8" bolt) or 76-86 ft-lb (1/2" bolt).

Note!

After new bearing pads are installed, you will have to check the boom for correct adjustment. Readjust if necessary.

534C-9/C-10/& 534 D-9/D-10 Bearing Pad, Spacer, Shim Data: 40' & 45' Boom

Part Number	Pad	Shim	Spacer	Dimension	Boom-Section	Area	Location
9112-3018	X				3	4	B
9112-3019	X				2, 3	2, 3, 4	A, F
9114-3168	X				1, 2, 3	1, 2, 3, 4	A, C, G, H
9103-3186	X				1, 3	4, 1	A, C, D
9112-3021	X				2	2	C, D, G, H
9103-3185	X				1	1	A
9103-3187	X				1		Push Beam
9114-3083	X				1		Crowd Cylinder
9103-1236			X	.060"	1, 2, 3	1, 3, 4	A, C, D, G, H
9112-1083			X	.060"	2,3	2, 3, 4	A, F, C, D
9114-1302		X		.060"	1, 2, 3	1, 2, 3, 4	A, B, E
9114-1303		X		.060"	1, 2, 3	4	A, B, E
9020-5870		X		.060"	1, 2, 3	1, 2, 3, 4	A, C, D, G, H
9112-1082		X		.060"	2, 3	2, 3, 4	A, B, C, D, F
9112-1157		X		.134"			Strong Back
9112-1023		X		.060"			Strong Back
9112-1024		X		.036"			Strong Back

534C-6, & 534D-6 Bearing Pad, Spacer, Shim Data: 42' Boom

Part Number	Pad	Shim	Spacer	Dimension	Boom-Section	Area	Location
9112-3019	X				2, 3	3, 4	F
9108-3297	X				2, 3	3, 4	E
9103-3186	X				1, 2, 3	1, 3, 4	C, D, G, H
9112-3021	X				2	2	C, D
9108-3063	X				1, 2	2	B
9103-3185	X				1	1	A
9103-3187	X				**	**	**
9112-1081		X		.06	3	3, 4	A E
9020-5870		X		.06	1, 3	1, 3, 4	C, D, G, H
9112-1082		X		.06	2	2	C, D
9108-1171		X		.06	1	1	B
9112-1023		X		.0598	1		*
9112-1024		X		.0359	1		*
9112-1157		X		.1340	1		*
9108-1447			X	.132	3, 2	3, 4	E
9103-1236			X	.06	2, 3	3, 4	C, D, G, H
9112-1083			X	.06	2	2	A, C, D
9108-1172			X	.132	1, 2		B

* Rear of Boom, Crowd Cylinder Bracket

** Extension Cable Bracket

532C-6 & 534C-6 Bearing Pad, Spacer, Shim Data: 36' Boom

Part Number	Pad	Spacer	Shim	Dimension	Boom-Section	Area	Location
9112-3019	X				2, 3	2, 3, 4	A, F
9108-3297	X				2, 3	3, 4	E
9103-3186	X				1, 2, 3	1, 3, 4	C, D, G, H
9103-3185	X				1	1	A
9112-3021	X				3	4	G, H
9108-3063	X				1, 2, 3	1, 2	B, F
9103-3187	X						*
9108-1447		X		.132	3, 2	3, 4	E
9103-1236		X		.060	1, 2, 3	1, 3	A, C, D, G, H
9108-1172		X		.132	1, 2	1, 2	B
9112-1083		X		.060	2	2	A
9112-1081			X	.060	3, 2	3, 4	E
9112-1024			X	.0359	1		**
9112-1023			X	.0598	1		**
9020-5870			X	.060	2, 3	1, 2, 4	A, C, D, G, H
9112-1082			X	.060	1, 2	1, 2	C, D
9112-1157			X	.134	1		**
9108-1171			X		2	2	B

* Extension Cable Bracket

** Crowd Cylinder Mounting Bracket

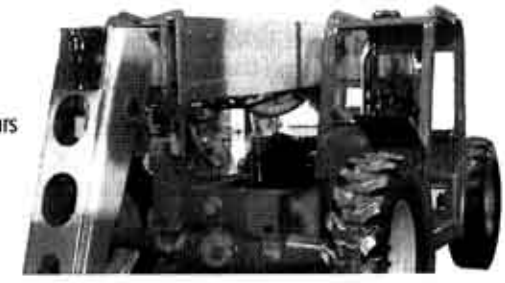
While the booms can be separated from each other on the machine, Gradall recommends against this procedure. It is much safer, more efficient and more cost-effective to remove the complete boom assembly from the machine and place it on stanchions (horses) for separation. Work can then progress at a normal working height.

(5A) REMOVAL OF THE COMPLETE BOOM ASSEMBLY FROM THE MACHINE

→ Preparation

1. Position the handler in a safe, level, open area away from personnel and equipment.
2. Apply the parking brake, shift the Forward/Reverse lever to "Neutral" and turn the rear wheels straight forward.
3. Level the boom assembly.
4. Turn off the ignition switch, remove the key and fasten a "do not operate" tag to the steering wheel.
5. Chock the wheels to prevent machine movement during removal operation.

MACHINE READY FOR BOOM REMOVAL: WHEELS STRAIGHT, BOOM LIFTED INTO PLACE, SLING AT BALANCE POINT



→ Stage 1

1. Procure a crane and lifting tackle capable of safely lifting 5000 lb.
2. Install a tag line to the front of the boom to help guide the boom once it clears the machine.
3. Fasten slings to Boom-Section 1 at the balance point.
4. Take the weight off the boom assembly.

→ Stage 2

1. Identify and tag all hydraulic hoses and electrical cables.
2. Separate, plug and cap all hoses and electrical cables. With the crowd cylinder hoses blocked off, the Boom-Sections will be locked in position, preventing run-out.
3. Carefully remove pins from the compensation and lift cylinders. Do not let the cylinders fall uncontrolled. Carefully place them in a position of rest. Block the lift cylinder in place to ensure it does not fall against the engine. Do not install blocking over the engine valve cover.

4. Confirm the crane still has the weight of the boom in a balanced position.
5. Carefully remove the boom base pivot pin.
6. Lift the boom assembly free of the machine and place in the designated work area.

BOOM BASE PIVOT PIN

(5B) Reinstalling the Complete Boom Assembly to the Machine

→ Preparation

- Select a work area with sufficient space to work safely and efficiently.
- Clean the work area.
- Procure tools required for this operation.
- Procure a crane or hoist and slings capable of lifting 5000 lb.
- If working with a helper, be certain each of you know your individual assignments.
- Mechanically fasten the Boom-Sections together to prevent unexpected uncontrolled movement if the crowd cylinder is removed or the crowd cylinder hydraulic line is opened or removed.
- Procure hydraulic fluid for topping off the hydraulic system. Use only Gradall–approved fluids.

Machine Ready for Boom Reinstallation: Wheels Straight, Boom Lifted into Place, Sling at Balance Point

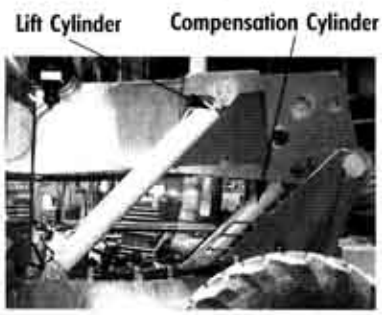
→ Stage 1

1. Install slings around the boom assembly at the balance point.
2. Make a trial lift to be certain the balance point is correct.
3. Connect a tag line to the front of the boom assembly to aid placement of the assembly.
4. Lubricate all cylinder and boom assembly mounting wear bushings and pins.
5. Lift the assembly and position the mounting base for pivot pin installation.
6. Install the mounting base pin and lock in position using a stover nut.
7. Position the boom assembly bores correctly to install the cylinder pins.

Note!

Using the sway circuit will aid Steps 5, 6, and 7.

8. Install the cylinder pins and lock in position using **LOCTITE 242** (Gradall P/N 1440-3364) on the pin keeper threads.



Boom Base Pivot Pin Location

→ Stage 2

1. Apply **LOCTITE 545** (Gradall P/N 1440-4043) to all hydraulic fittings.
2. Connect all hydraulic hoses to the proper circuits and torque. Refer to identification tags applied during removal operation.
3. Connect auxiliary electrics if the machine is so equipped.
4. Check the torque on all mounting and cylinder locking pins.
5. Refill the hydraulic system (if necessary).

→ Stage 3

1. Remove lifting tackle and tag line.
2. Drive the machine to an area with sufficient space for full boom circuit operation.
3. Start up the machine and cycle all boom functions a sufficient length of time to warm up the hydraulic system to at least 120°F.
4. After completion of Step 3, check all circuits for hydraulic leaks, correcting where necessary.
5. Re-check the hydraulic system capacity level; fill up if necessary.

→ Stage 4

1. Inspect boom bearing pads for correct adjustment. If adjustment is required see Section 2, "Boom Adjustment".
2. Inspect retraction and extension cable for proper installation and adjustment. If adjustment is required, see Section 7.
3. Inspect hydraulic hose installations to ensure they are not rolling under twist. If they are under twist, readjust by loosening fittings and clamps to relieve the twist. Re-torque using two wrenches at the fittings. Tighten all hose clamps.
4. Inspect auxiliary circuit electric cable for proper installation. It should be tight and roll simultaneous with the auxiliary hydraulic hoses. Correct if necessary.

The Boom should now be properly installed and ready to return to service.

(5C) Separating Boom-Sections 2 and 3 From Boom-Section 1

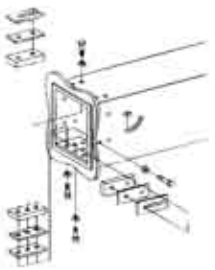
→ Preparation

- Review all Safety issues before commencing.
- Select a safe, clean area with sufficient space to work on the assembly.
- Procure lifting tackle and a crane capable of lifting 5000 lb.
- Place the boom assembly upside down (inverted 180°) on stanchions.
- If working with a helper, be certain each of you know your individual assignments.
- Procure tags for identification of hoses and components removed.
- Designate area placement of removed components.

Stage 1

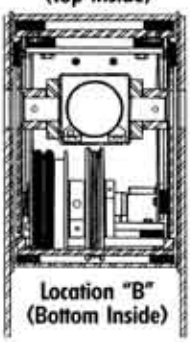
→ **1.** Remove all bearing pads at the front inside of Boom-Section 1, Area 1, Pad Locations A, B, C, D.

Boom-Section 1
Area 1: Front Inside

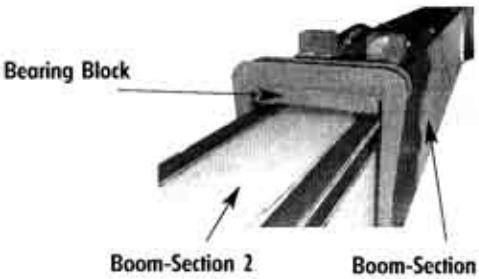


See note on page 2.0 for boom bearing pad bolt quantities

End View Area 1 & 2



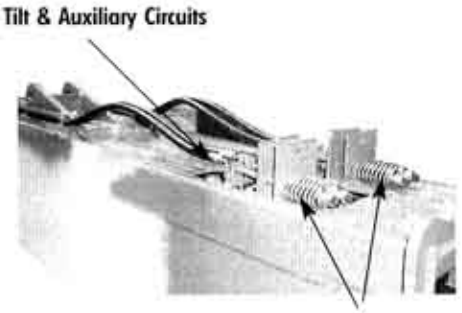
2. Remove the bearing block from the front inside of Boom-Section 1, Area 1.



Note! *Boom-Sections Upside-Down*

3. Loosen the hose take-up brackets.

4. Separate, plug and cap tilt circuit (and auxiliary) hydraulic hoses inside the boom at the hose take-up bracket.

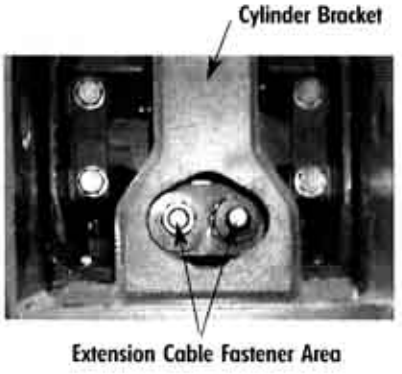


Note! *Boom Upside-Down*

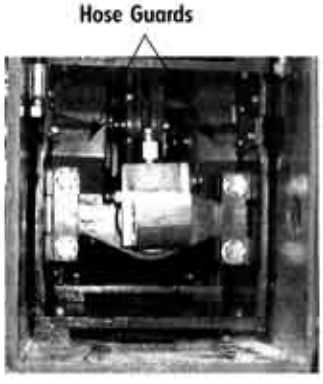
5. If auxiliary electrics are present, separate the electric plug at the hose take-up area.

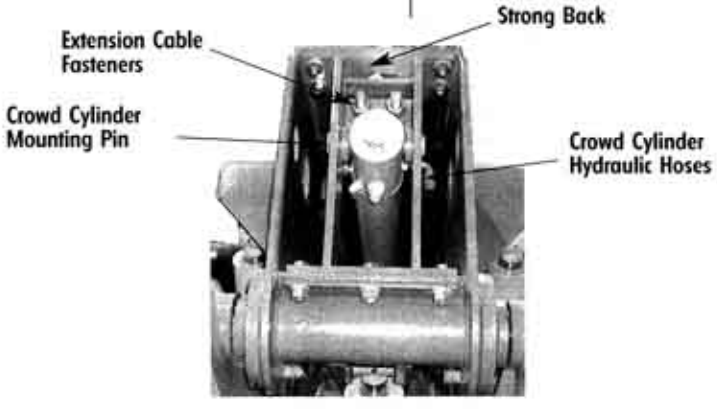
→ **Stage 2**

1. Loosen the retraction cable and remove all fasteners from the retraction cable adjusting block, located at the front of Boom-Section 1.



2. At the rear of the boom assembly (strong back/cylinder bracket), remove all fasteners from the extension cables, using one wrench to hold and one to turn.
3. Separate, cap and plug the crowd cylinder hydraulic hoses.
4. Remove the crowd cylinder mounting pins and fasteners.
5. At the rear of the boom assembly, remove the hose guards.
6. Remove the strong back (cable bracket) from the rear of the boom assembly.





→ **Stage 3**

1. Fasten lifting tackle to Boom Sections 2 and 3, lift and partially pull out of Boom Section 1.
2. Place stanchions under Boom Sections 2 and 3 and take off the weight, letting them rest on stanchions.
3. Reinstall lifting tackle at the balance point of Boom Sections 2 and 3 and slowly extract them from Boom Section 1, protecting all hydraulic hoses and cables.
4. Place Boom Sections 2 and 3 in the designated work area for the next operation.

(5D) Separating Boom-Section 3 from Boom-Section 2

The procedures listed in this section are complete for separating Boom-Sections from each other. Reassembly procedures are given in Section 6, *"Assembling Boom-Sections 1, 2 & 3"*. These procedures are given using shop conditions only, with the Boom-Sections inverted 180° (upside down).

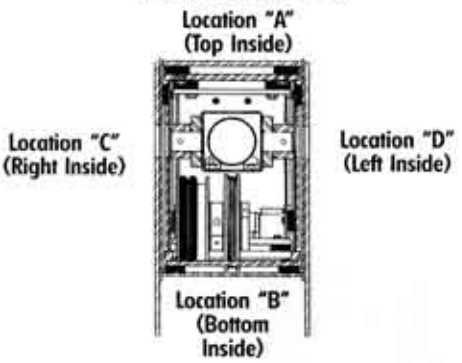
→ Preparation

- Review preparation parameters from Section 5C.
- Review all Safety Issues.
- Select an appropriate place to store Boom-Section 3 after removal from Boom-Section 2

→ Stage 1

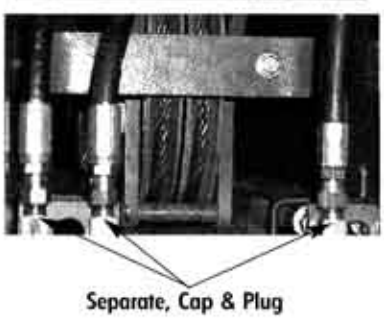
1. Remove all bearing pads from the inside front of Boom-Section 2, Area 2, Pad Locations A, B, C, D.

End View Area 1 & 2



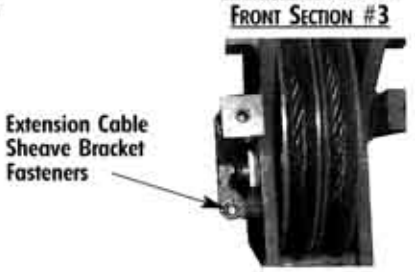
2. Separate, plug and cap tilt circuit hydraulic hoses (and auxiliary circuits) at the inside front of Boom-Section 3 at the boom head section.

Tilt & Auxiliary Circuit Hoses - Step 2



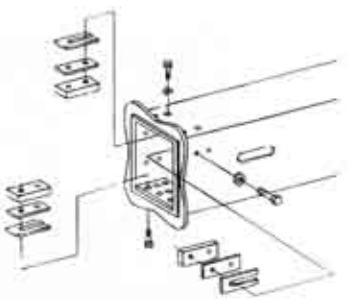
3. **534C-9/C-10 & 534D-9/D-10:**
   Remove all extension cable sheave components from the pivot beam front.
4. **532C-6, 534C-6 & 534D-6:**
   Remove extension cable sheave bracket fasteners from the front of the crowd cylinder.

Extend Cable Sheave
Front Section #3



5. **532C-6, 534C-6 & 534D-6:**
   Pull extension cable sheave bracket free of Boom-Section 3 and set aside for repair or reinstall.

Boom-Section 2:
Area 2, Front Inside

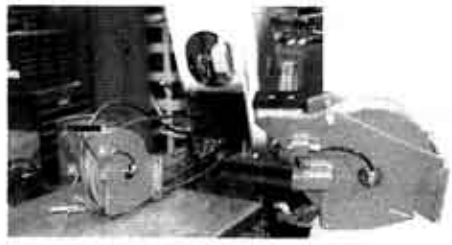


See note on page 2.0 for boom bearing pad bolt quantities

534C-9/C-10 & 534D-9/D10:
Extend Cable Sheave & Push Beam

5. **532C-6, 534C-6 & 534D-6:**
Pull extension cable sheave bracket free of Boom-Section 3 and set aside for repair or reinstall.

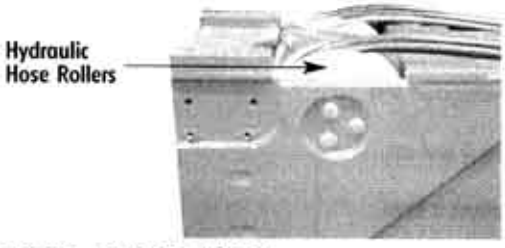
532C-6, 543C & D-6
EXTENSION CABLE BRACKET



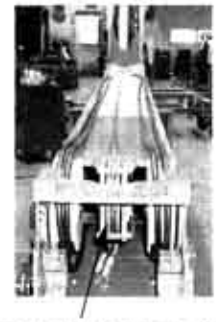
6. Pull the extension cables free of the sheave brackets and lay them on the boom.

→ **Stage 2**

1. At the rear of the boom, remove all retraction cable sheave components.
2. Remove hydraulic hose rollers and components.



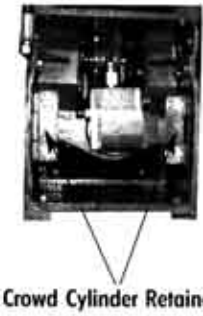
REAR SECTION 2 & 3:
HOSES AND RETRACTION CABLE



Retraction Cable Sheave, Step 1

3. **532C-6, 534C-6 & 534D-6:**
Remove crowd cylinder retainers.

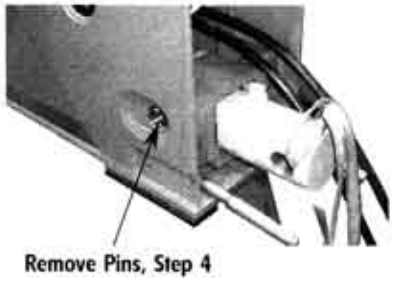
532C-6, 534C-6 & 534D-6



Crowd Cylinder Retainers

4. **534C-9/C-10 & 534D-9/D-10:**
Remove all push beam pins and fasteners.

PUSH BEAM MOUNTING PIN AREA



Remove Pins, Step 4

534C-9/C-10 & 534D-9/D-10

Push Beam

→ **Stage 3**

1. **534C-9/C-10 & 534D-9/D-10:** From the front of Boom-Section 3, pull the push beam free of the boom assemblies.

2. **532C-6, 534C-6 & 534D-6:** From rear of Boom-Section 2 pull the crowd cylinder free of the boom assembly.

3. Place hydraulic hoses and cables inside Boom-Section 3 for protection.

Boom-Section 3, Front Inside: Cable & Hoses Inside Boom

532C-6, 534C-6 & 534D-6

→ **Stage 4**

1. Install lifting tackle to Boom-Section 3.
2. Take the weight and pull Boom-Section 3 from Boom-Section 2 far enough to rest at the balance point.
3. Place stanchions under Boom-Section 3 and release the weight, letting it rest on the stanchions.
4. Reinstall lifting tackle at Boom-Section 3 balance point and slowly extract it from Boom-Section 2.
5. Place Boom-Section 3 in the designated work area for the next operation.

The Boom-Sections are now separated. No special instructions are required for component removal and/or replacement. Refer to "Section 6" for reassembly of Boom-Sections.

The procedures listed in this section are complete for assembling the bare boom weldment to final assembly of the boom. Assembly procedures start with Boom-Section 3, followed in order by Boom-Sections 2 and 1. They also are given using shop conditions only, with the Boom-Sections inverted 180° (upside-down).

The instructions cover all 532 and 534 "C" and "D" series booms of any length. Deviations from standard procedures that cover all models are indicated with appropriate notations.

It would not be practical to attempt to cover every repair situation that might occur in the field. Therefore, these instructions cover the complete boom assembly and individual components. You may have to adapt these procedures to fit specific field situations.

⚠ CAUTION!

- Use **LOCTITE 242** (Gradall P/N 1440-3364) on all bolt threads.
- Use **LOCTITE 545** (Gradall P/N 1440-4043) on all hydraulic tube fittings.
- Torque fasteners and hydraulic fittings to the values given in Appendix "A" & Appendix "B".
- Shim bearing pads to 1/16" of tight fit. You may have to final adjust the bearing pads after the boom is installed on the machine and hydraulic power is available.
- Follow instructions given in Section 2 for bearing pad adjustment.
- Coat the interior of all bushings and sheaves with *Mystik Tetrimoly* grease (Gradall P/N 1440-4595) prior to installation of pins and bushings.
- Bearing pads and slide areas must be lubricated with *Mystik Tetrimoly* grease or equivalent.

Note!

Assembly of the Boom-Sections is quite complex. Close attention to the instructions is extremely important. Normal mechanic's tools are required, as well as a hoist capable of lifting 5000 lb. to handle the weight of the complete boom assembly.

(6A) Boom-Section 3 Assembly

→ Preparation

- Select an area with sufficient space to work safely and efficiently.
- Clean the work area.
- Procure all tools and lifting devices required for this operation.
- Use crane capable of lifting 5000 lbs.
- Gather and identify parts to be used.
- If working with a helper, be certain each of you know your individual assignments.
- Use stanchions (work horses) of sufficient capacity to hold boom assemblies safely.

→ Stage 1, Boom Weldment, Bearing Pads

1. Place Boom-Section 3 upside-down on stanchions.

Boom-Section 3, Upside-Down

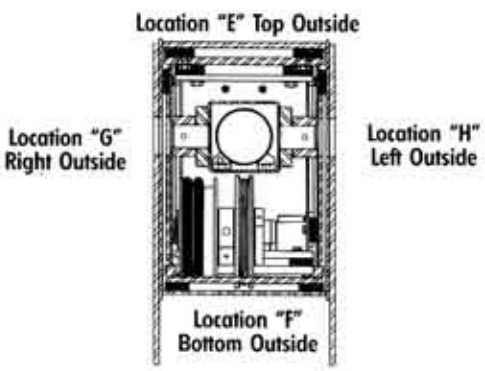
2. Clean the inside and outside boom surfaces.
3. Inspect tilt carriage bushings in the boom head section for damage or excessive wear. Bushing ID when new is 2.511-2.512". Replace if worn more than 1/16" or damaged.

4. Install bearing pads, spacers and shims to the rear of the boom, Area 4, at the following locations:
   534C-6/534D-6; All pad locations.
   534C-9/C10, 534D-9/D10; Locations "B", "C", & "D".

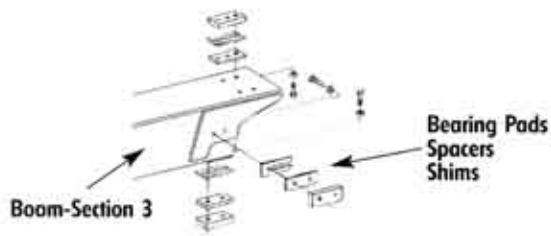
Note!

Do Not install spacers and shims to bearing pads at Location "E" at this time. This will make insertion into Boom-Section 2 easier.

END VIEW AREA 3 & 4



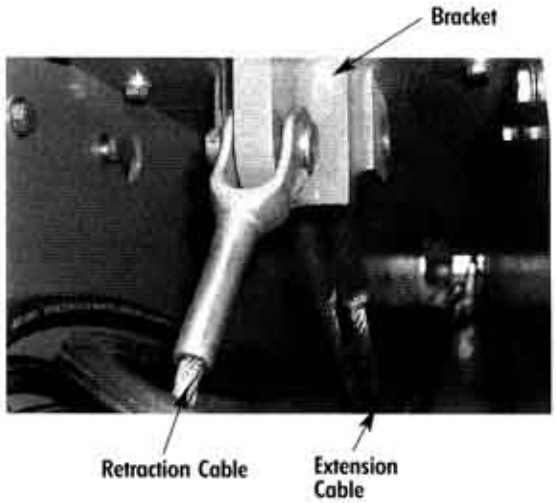
BOOM-SECTION 3
AREA 4, - REAR OUTSIDE



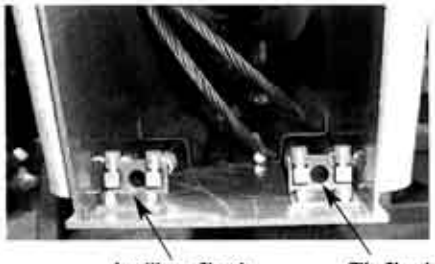
SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

→ **Stage 2, Cables and Hoses**

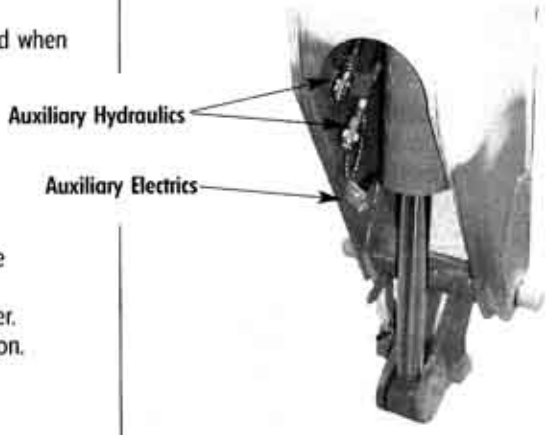
1. Install single retraction cable and double extension cable to the bracket at the inside rear of the boom.



2. Install tilt circuit hoses and auxiliary circuit hoses and electric cables and brackets inside protected areas.
3. Bolt hose brackets in place at the front of the boom.

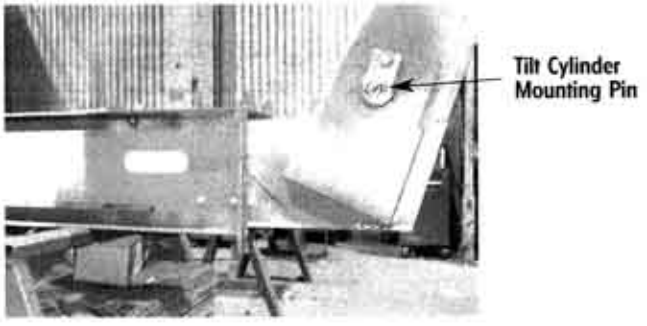


4. Lubricate Bearing pad paths.
5. Lay cable and hose inside Boom-Section 3 to protect against being pinched when installed into Boom-Section 2.



→ **Stage 3, Tilt Cylinder and Auxiliary Circuits**

1. Install hoses for the tilt cylinder.
2. Install hoses and electric cables for any auxiliary circuits.
3. Lift the tilt cylinder and place it inside the boom head section, lining up the mounting pin bores.
4. Install the mounting pin through the boom head section and the tilt cylinder.
5. Apply ***LOCTITE* 242** to the keeper bolt and lock the mounting pin in position.



Boom-Section 3 is now ready for insertion into Boom-Section 2.

(6B) Boom-Section 2 Assembly

→ Preparation

- Clean the work area.
- Gather and identify parts to be used.
- If working with a helper, be certain each of you knows your individual assignments.
- Procure proper lifting tackle to safely lift and install components to each other.
- Use stanchions of sufficient capacity to hold Boom-Sections 1 & 2.
- Be certain the work area has sufficient space to work safely.

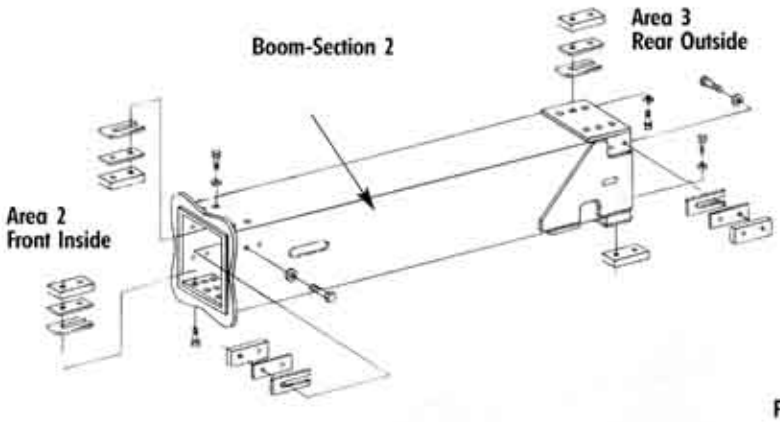
Assembly

→ Stage 1, Boom Weldment, Bearing Pads

1. Place Boom-Section 2 upside-down on stanchions.
2. Clean the inside and outside of Boom-Section 2 thoroughly.
3. Lubricate the inside of the boom at the bearing slide path area.
4. Install Boom-Section 3 into Boom-Section 2. Install through the front of Boom-Section 2.

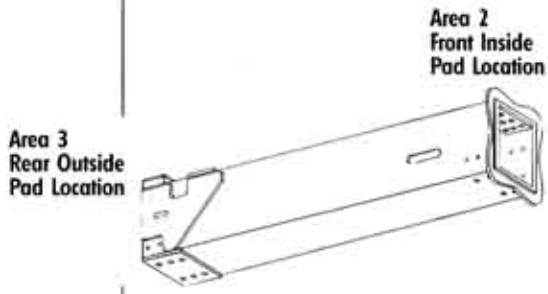
Typical Installation

5. Install bearing pads, spacers and shims to the rear boom Area 3 and front boom Area 2. **Do Not install pads to locations "F" and "H" yet.** This will make insertion into Boom-Section 1 easier.
6. Install bearing pads, spacers and shims at Pad Location "E" (See Section 6A, "Boom-Section 3 Assembly," Stage 1, Step 4 on page 6.1).



See note on page 2.0 for boom bearing pad bolt quantities

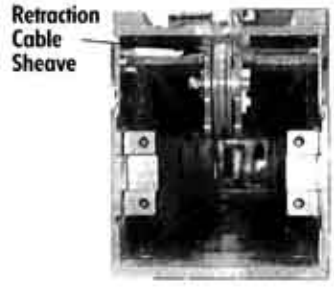
Boom-Section 2 (Upside-Down)



→ **Stage 2, Retract Cable and Hose Sheaves**

532C-6, 534C-6 & 534D-6 ONLY!

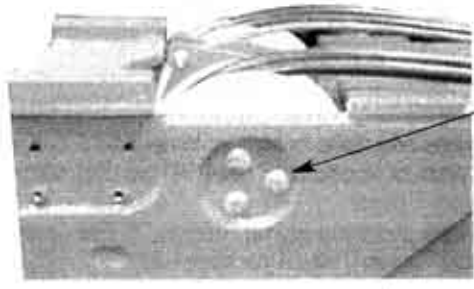
1. Install the retraction cable sheave to the bracket at rear of Area 3.
2. Install the cable around the sheave and lock it in place using ***LOCTITE* 242** on threads.
3. Install the cable adjustment block to the cable at the other end.



RETRACTION CABLE ADJUSTMENT BLOCK

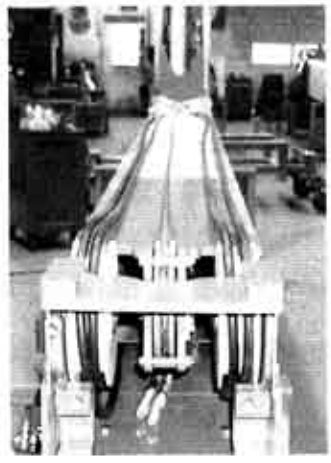
4. Install the tilt (and auxiliary electric/hydraulic) circuit hose rollers and hoses to the rear of the boom at Area 3.

HOSE ROLLERS AND HOSES



5. Lay out hoses and cable to the top of the boom in preparation for installation into Boom-Section 1.
6. Lubricate all bearing pad slide surfaces.

BOOM-SECTIONS 2 & 3 UPSIDE-DOWN:
STANDARD & AUXILIARY CIRCUITS INSTALLED



→ **Stage 3, Crowd Cylinder**

532C-6, 534C-6 & 534D-6 ONLY!

Install the crowd cylinder into the boom assembly. The crowd cylinder is installed through the rear of the boom assembly.

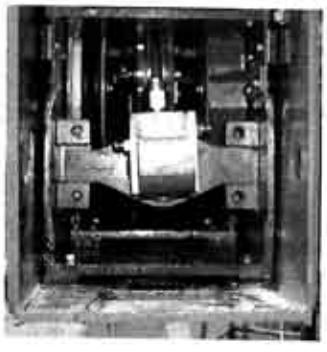
1. Clean the threads at the extension cable sheave mounting area.
2. Feed the cylinder into the boom until the base anchor area is secured into the bracket at the rear of Boom-Section 2.
3. Install the crowd cylinder retainers and torque the bolts to 340-365 ft-lb.

Crowd Cylinder Mounting Bolts Extension Cable Sheave

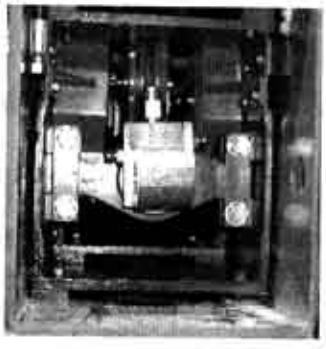
Crowd Cylinder

534D-6 Crowd Cylinder Base End

Rear of Booms: Crowd Cylinder Installed into Brackets



Retainer Plates Installed & Torqued

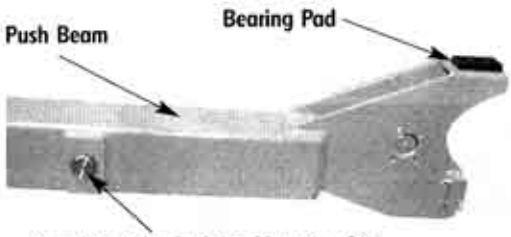


→ Stage 3, Crowd Cylinder & Push Beam Assembly

534C-9/C-10 & 534D-9/D-10 ONLY!

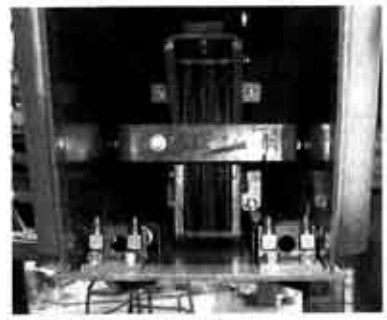
Part One

1. Clean the push beam weldment and all parts for the extension sheave assembly.
2. Install the crowd cylinder into the push beam.
3. Install the mounting pin and hardware at the crowd cylinder rod eye.

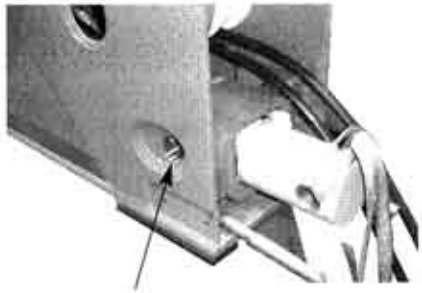


4. Through the front of Boom-Section 3, partially insert the push beam leaving the sheave bracket extended for accessibility.
5. Install the extension cables and feed the threaded end through the sheave bracket. The cable end will not feed through the sheave bracket with the sheave installed.
6. Lay out the cables over boom head toward the rear of boom assembly.
7. Install the extension cable sheave assembly complete; ie. sheaves, pins, lube system, bearing pads.
8. Feed the cables around the sheave.
9. Install the cable guide and guide bar.
10. Install the push beam mounting pins and locking hardware at the rear of Boom-Section 2.

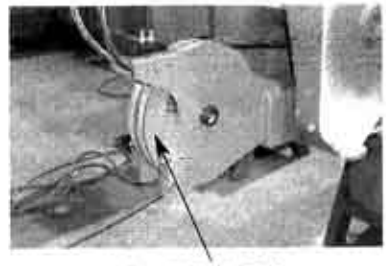
EXTENSION SHEAVE BRACKET: FRONT CROWD CYLINDER



Cable Guide & Guide Bar



Install Mounting Pins Here



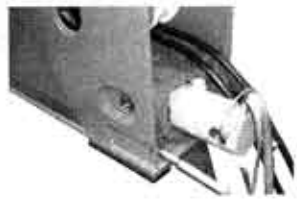
Install Cable Before Sheave Components

Part Two

1. Install the push beam fully into Boom-Section 2, lining up the mounting pin bores.
2. Install the push beam mounting pins and locking hardware at the rear of Boom-Section 2.

Mounting Pin Area

PUSH BEAM MOUNTING PIN AREA



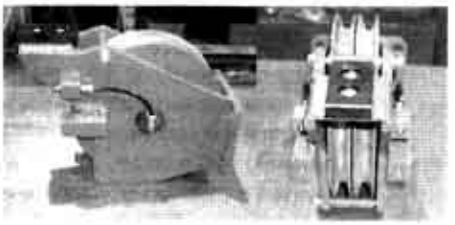
Boom-Sections 3 & 2 are now ready for insertion into Boom-Section 1.

→ Stage 4, Extension Cable Sheave

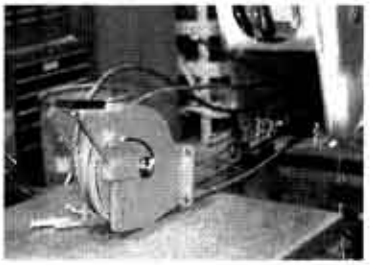
532C-6, 534C-6 & 534D-6

1. Gather and clean parts to assemble the cable extension sheave.
2. Assemble the extension cable sheave bracket assembly. See the appropriate current *Gradall Parts Manual* for applicable parts.
3. Place the cable extension sheave bracket on the work table, in front of Boom-Section 3.
4. Feed the extension cable around the sheaves in the bracket.
5. Install the cable guards on the sheave assembly.

Extension Cable Sheave Bracket Assembly



Extension Cable (Steps 3 & 4)

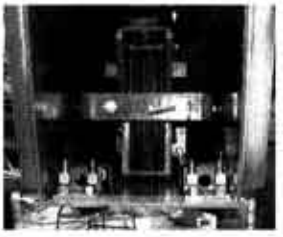


6. Pulling the cables to the rear of the boom assembly, install the sheave bracket on the crowd cylinder mounting bolts.
7. Install and torque the nuts at the crowd cylinder and the cable extension bracket.
8. Install the guide bar to the cable extension sheave bracket.

Crowd Cylinder Mounting Bolts

Extension Cable Installed on Sheave

Guide Bar



(6C) Boom-Section 1 Assembly

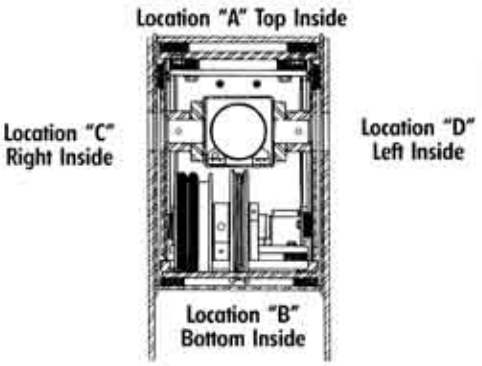
→ Preparation

- Clean the work area.
- Gather and identify all the parts to be used.
- Use stanchions of sufficient capacity to hold Boom-Sections 1, 2 & 3.
- Be certain the work area has sufficient space to work safely.
- If working with a helper, be certain each of you knows your individual assignments.
- Review the assembly operation for this Boom-Section.

→ Stage 1, Boom Weldment

1. Place Boom-Section 1 upside-down on stanchions.
2. Clean the inside and outside of Boom-Section 1 thoroughly.
3. Lubricate the inside of the boom at the bearing slide path area.

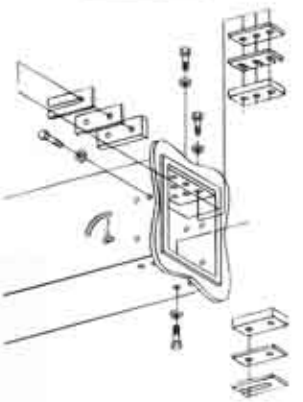
End View Area 1 & 2



4. Through the front of Boom-Section 1, install Boom-Sections 2 & 3.

Typical Installation

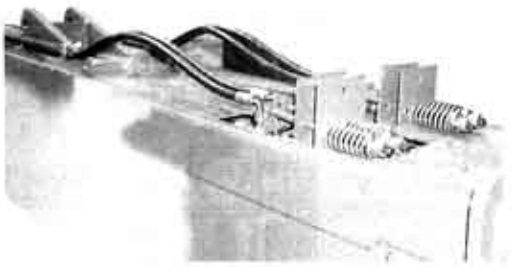
View with Boom-Section 1: Upside-Down



See note on page 2.0 for boom bearing pad bolt quantities

→ Stage 2, Bearing Pads & Hose Take-Up Assembly

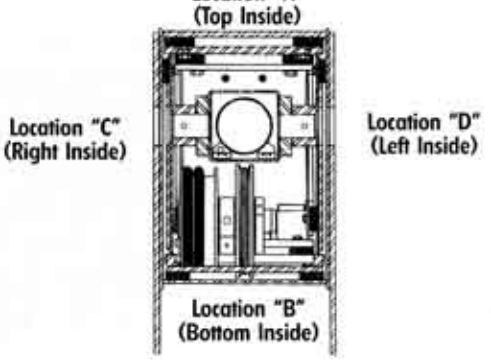
1. Install hose take-up assembly components to the front of the boom. Tighten components and fasten all hoses.
2. Install the retraction cable adjusting block. **Do Not tighten the cable yet!**

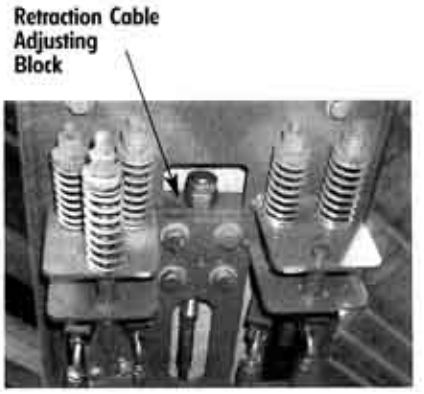


3. Install bearing block to the front inside of Boom-Section 1. This is the block on which the boom bearing pads mount at Area 1, Pad Location "B".

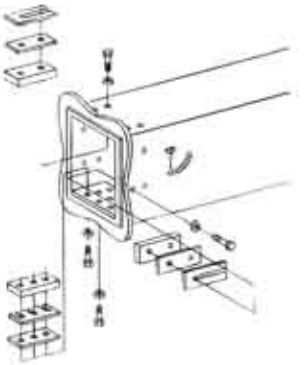
4. Install bearing pads, spacers and shims at Area 1, Pad Location A, B, C, D.
5. Torque the bearing block bolts 265-290 ft-lb and bearing pad mounting bolts to 68-78 ft-lb using ***LOCTITE* 242** on threads.

END VIEW AREA 1 & 2





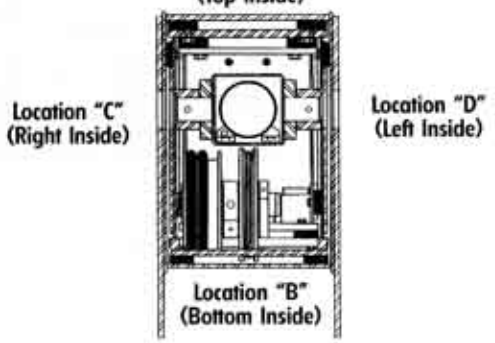
AREA 1 FRONT INSIDE - BOOM-SECTION 1



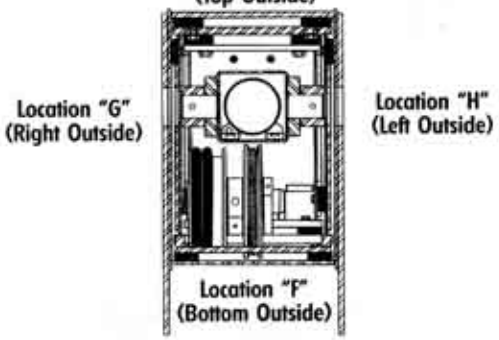
SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

6. Install and adjust bearing pads at Pad Location "F" & "H" (See 6B, Boom Section 2 Assembly. Stage 1, Step 5 on page 6.4).
7. Adjust the front inside pads at Area 1 and 2 Pad Locations A, B, C, D.
8. If necessary, at the rear of the boom assembly, readjust the bearing pads at Areas 3 and 4.

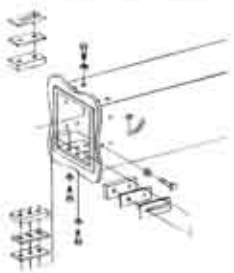
END VIEW AREA 1 & 2



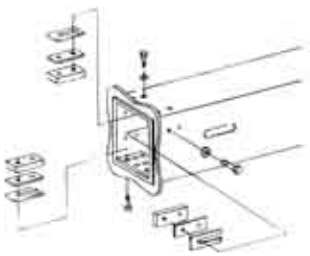
END VIEW AREA 3 & 4



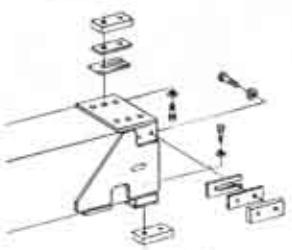
BOOM-SECTION 1
AREA 1, FRONT INSIDE



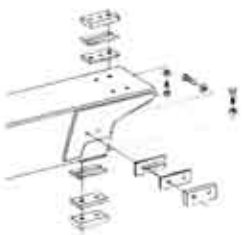
BOOM-SECTION 2
AREA 2, FRONT INSIDE



BOOM-SECTION 2
AREA 3, REAR OUTSIDE

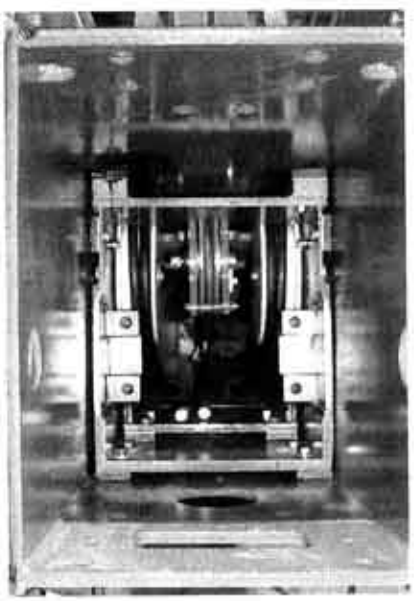


BOOM-SECTION 3
AREA 4, REAR OUTSIDE



SEE NOTE ON PAGE 2.0 FOR BOOM BEARING PAD BOLT QUANTITIES

BOOM ASSEMBLY REAR AREA 3 & 4

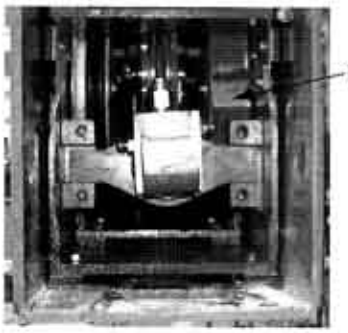


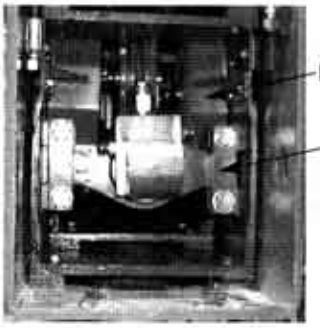
→ **Stage 3**

Boom Assembly Rear, Crowd Cylinder and Mounting Bracket, Extension & Retraction Cables

532C-6, 534C-6 & 534D-6 ONLY!

1. Install the standard and auxiliary circuit hose guards at the sheave area located in the rear of the Boom.

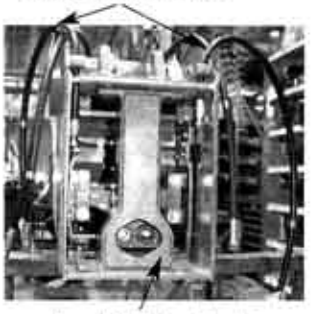


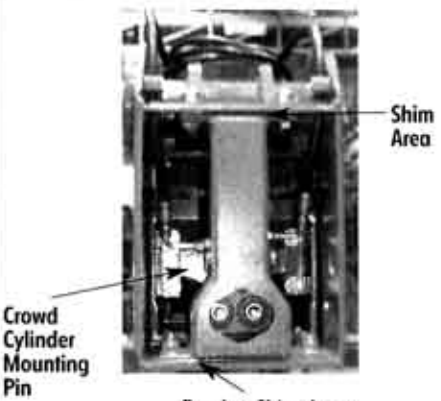


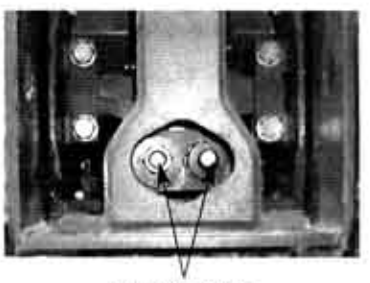
2. Place the crowd cylinder bracket inside the rear of Boom-Section 1. **Do not bolt in place yet!**
3. Insert the extension cables through the adjustment holes in the crowd cylinder mounting bracket. Make sure the cables are not crossed.
4. Install the crowd cylinder rod eye in the bracket. Lock it in place with the pin and snap rings.
5. Install the crowd cylinder bracket fasteners.
6. Measure the top and bottom clearance between Boom-Section 1 and the crowd cylinder bracket.
7. Install shims as required between the crowd cylinder and Boom-Section 1.
8. Torque the crowd cylinder bracket mounting bolts (see Appendix A), and apply ***LOCTITE* 242** to threads.
9. Install springs and nuts on the extension cables.
10. Tighten the retraction cable at the adjusting block.
11. Tighten the cable until its end lines up with the front of the cable adjustment access hole. When tightening, make sure that the wire rope is not turning.
12. **534C-9/C-10 & 534D-9/D-10:**
    The cable is tightened until the third thread from the end lines up with the cable adjustment access hole. When tightening, make sure that the wire rope is not turning.
13. Tighten the extension cables' adjusting nut until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the cable is not turning.
14. Install and torque the cable jam nuts to 100 ft-lb.
15. Install all hydraulic circuit hoses to the crowd cylinder.

Note!

See Stage 4 for 534C-9/C-10 & 534D-9/D-10 Strong Back Installation.



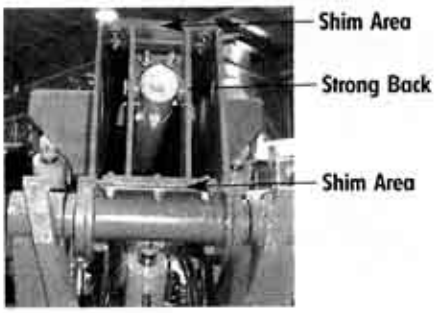




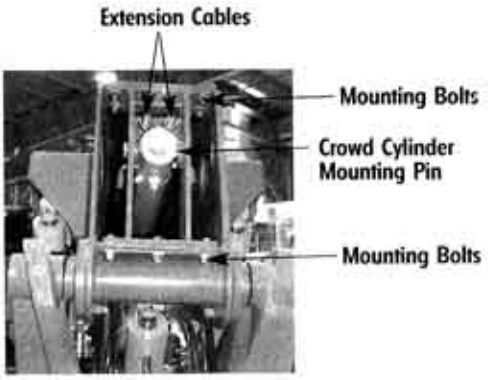
→ Stage 4, Strong Back Installation

534C-9/C-10 & 534D-9/D-10 ONLY!

1. Place the strong back in place at the rear of Boom-Section 1.
2. Install and lock the crowd cylinder mounting pin.
3. Measure the clearance between the top and bottom of the strong back to Boom-Section 1.
4. Install shims as required at the top and bottom of the strong back.

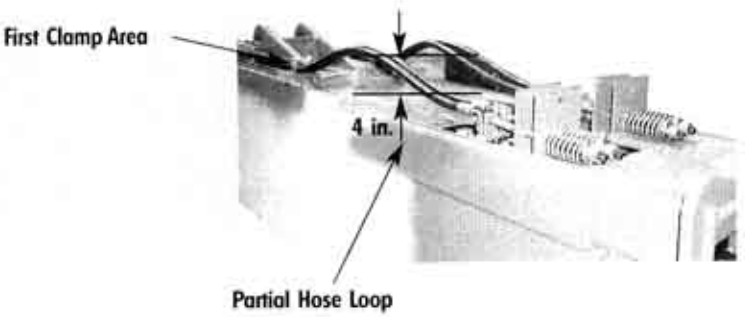


5. Install and torque the strong back mounting bolts.
6. Install extension cables and hardware into the strong back.
7. Tighten the extension cables' adjusting nut until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the cable is not turning.
8. Torque cable jam nuts to 100 ft-lb.
9. Install the crowd cylinder hoses.

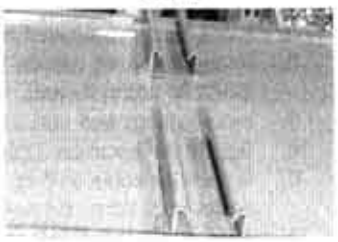


→ Stage 5, Hose Take-Up Assembly, Hydraulic Hoses & Clamps

1. Install the hose clamps for the tilt and auxiliary circuit hoses. **Do Not tighten them yet!**
2. At the area between the hose take-up bracket to the first hose clamp, adjust the hoses to form a 4" partial loop from the bottom of the boom to the hoses.
3. Tighten all hose clamps.



CHANNEL USED FOR HOSE CLAMPS; TYPICAL

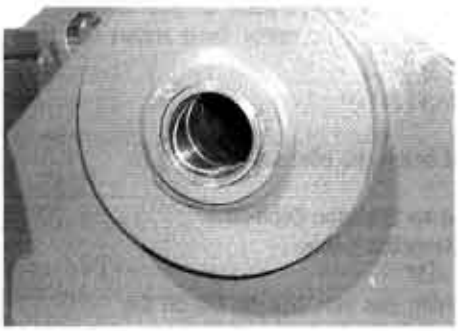


HOSE CLAMP; TYPICAL

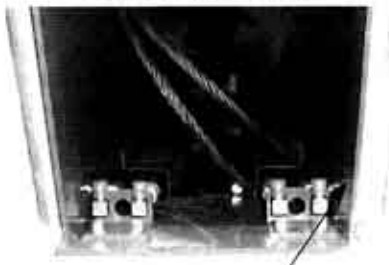
4. Connect Quick-Disconnect tilt circuit hoses (and auxiliary circuits) located at the boom head area of Boom-Section 3 to the fittings at the front of Boom-Section 3.
5. Install the lift cylinder bushings.

Boom-Section 3, Head

Lift Cylinder Bushing



Boom-Section 3, Front



Auxiliary Hydraulic and Electric Connection

7.0 Boom Cables

The extension/retraction cables are made from wire rope. Review the reference to Boom Cables in the "Safety" section of this Manual for safety related parameters. The boom cables are an important component of your Gradall Material Handler. They mechanically provide the extension/retraction force of Boom-Section 3.

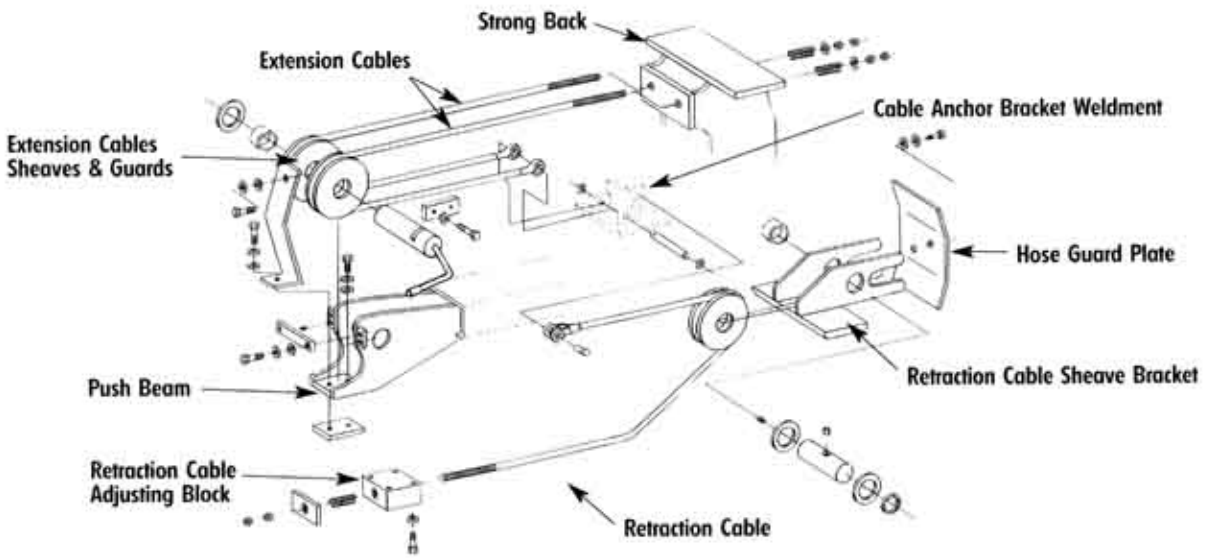
"Boom Cable Data" (see below) covers part numbers used, length, and key specifications. Please review this table to be certain you are using the correct cable for your operation. **Do Not** use cable other than that supplied by Gradall for replacement. These cables are specifically designed for Gradall Material Handlers.

General Cable Information

- Cables are pre-stretched; lengths cited below are after pre-stretching.
- Threaded stud, Galvanized Plating.
- Safe Lock Closed Socket Terminal used on Extension Cable.
- Safe Lock or Spelter Socket used on Retraction Cable.
- Boom Cable length tolerances: +0.5" -1.0".
- Use 2 wrenches when torqueing adjusting jam nuts. Use the flat on the threaded cable end to hold the cable straight, eliminating twist.

Boom Cable Data

Model	Boom Length	Boom Cable Part Number	Cable Length	Cable Diameter	Thread Size	Socket Style
Retraction Cable						
534C & D-10	45'	9113-3356	198 1/2"	1/2"	7/8 - 14	Open
534C-6	42'	9112-3147	191 1/2"	3/8"	3/4 - 10	Open
532C-6, 534D-6	36'	9112-2013	161 1/2"	3/8"	3/4 - 10	Open
534C & D-9 & 10	40'	9114-3027	177 1/2"	1/2"	7/8 - 14	Open
Extension Cable						
534C & D-10	45'	9114-3355	386"	9/16"	1" - 8	Closed
534C & D-9 & 10	40'	9114-3026	344"	9/16"	1" - 8	Closed
534C-6	42'	9112-3146	383"	1/2"	7/8 - 14	Closed
532C-6, 534D-6	36'	9112-3012	323"	1/2"	7/8 - 14	Closed



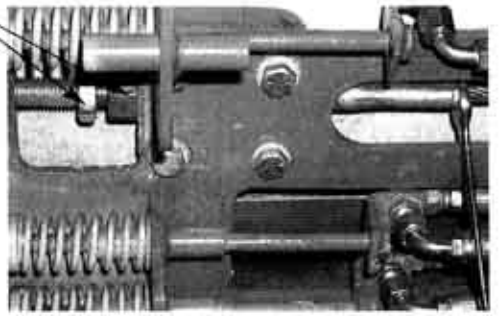
(7A) Cable Adjustments

The cables are adjusted by tightening and/or backing off the adjusting nuts at the threaded end of the cable. Tightening the retraction cable adjusting nut pulls Boom-Section 3 in, to the rear. Tightening the extension cable adjusting nut pulls the boom out, to the front. The opposite cable adjusting nut usually must be loosened whenever this procedure is performed. The cables are properly adjusted whenever the following parameters are met:

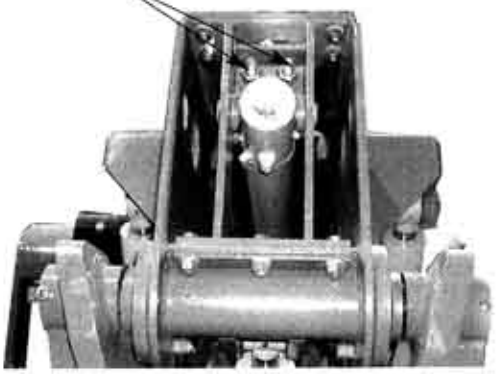
534C9/C-10 & 534D-9/D-10:
Crowd cylinder rod eye pin is centered in the side access hole of the push beam and/or 17 1/2" dimension from Boom-Section 3 boom head front to the front of Boom-Section 2.

532C-6, 534C6 & 534D-6:
15" dimension from Boom-Section 3 boom head front to the front of Boom-Section 2.

Retraction Cable Adjusting and Jam Nut

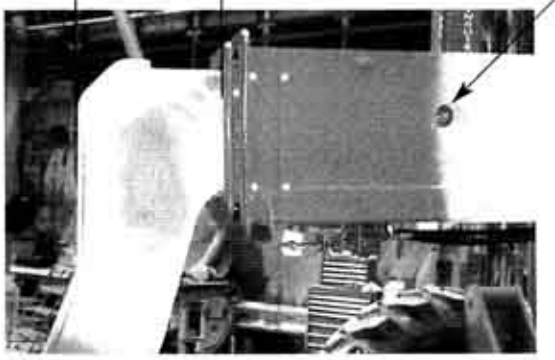


Extension Cable Adjusting and Jam Nut



Cable Adjustment Guide
534C-9/C-10 & 534-9/D-10D: 17 1/2"
532C-6, 534C & D-6: 15"

Push Beam Crowd Cylinder Rod Eye Access Hole: 534C9/C-10 & 534D-9/D-10



(7B) Retraction Cable Removal

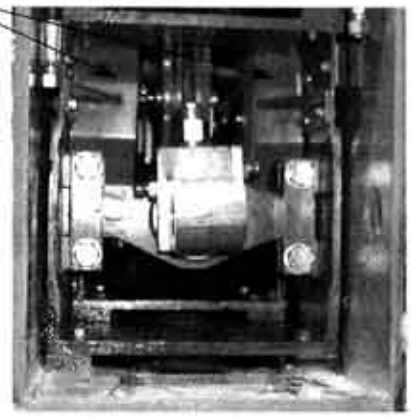
Removal of the retraction cable is a difficult operation; but it can be accomplished. You must be able to reach into the rear of the boom assembly to unfasten the retraction cable socket from the cable anchor bracket weldment. If you can't reach this bracket, the booms must be separated.

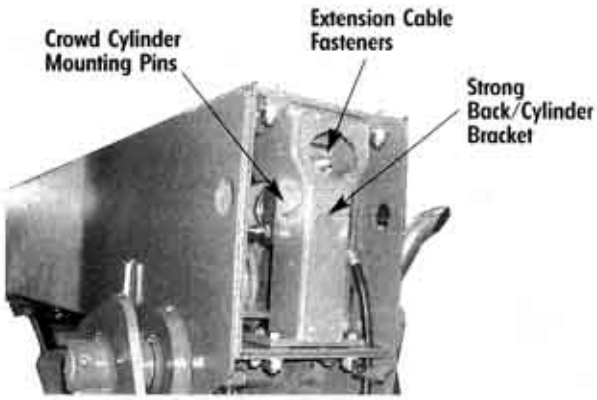
→ Preparation

- Retract the boom assembly fully.
- Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel. **DO NOT** reach into the boom until you are **CERTAIN** that keys have been removed from the ignition.
- Place the machine in a level, open area with sufficient space to work safely.
- Procure tools and platforms required for this operation.
- Procure a rope to tie to the cable end. This rope must be of sufficient length to allow accessibility whenever the cable is removed. This will assist in reinstallation.
- If working with a helper, be certain each of you know your individual assignments.

→ Stage 1

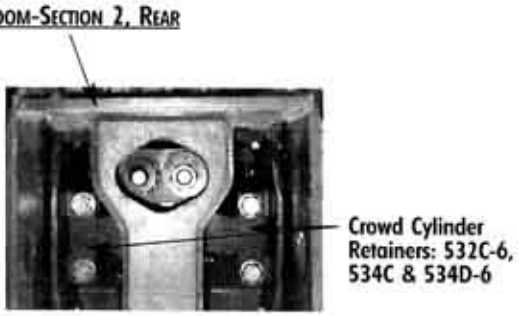
1. Remove the hose guards from the rear of Boom-Section 1.
2. Remove the crowd cylinder mounting pins from the strong back/cylinder bracket.
3. Remove the extension cable fastener hardware from the strong back/cylinder bracket.
4. Pull the cable free of strong back/cylinder bracket. Fasten a rope to the cable end to aid in reinstallation.
5. Remove the strong back/cylinder bracket mounting hardware.
6. Remove the strong back/cylinder bracket from the rear of the machine.

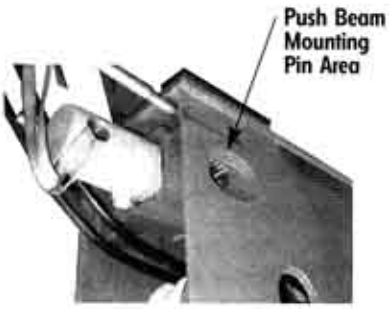




→ **Stage 2**

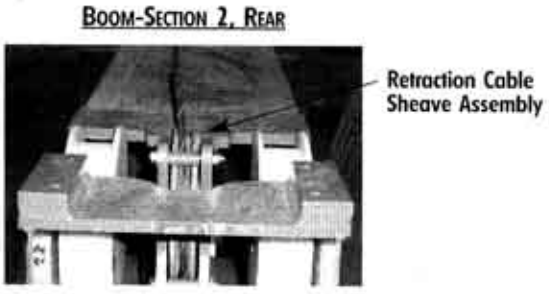
1. **534C & D-9 & 10:**
   Remove the push beam mounting pins.
2. At the front of Boom-Section 3, pull the push beam clear of Boom-Section 3.
3. Separate, plug and cap the crowd cylinder hoses.
4. **532C-6, 534C-6 & 534D-6:**
   At the rear of Boom-Section 2, remove the crowd cylinder retainers.
5. Drop the crowd cylinder to the bottom of the boom to give more clearance for access to the inside of the booms in the second section. The cylinder must be removed from the retainer area.

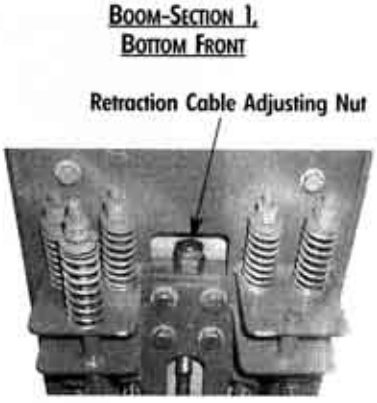




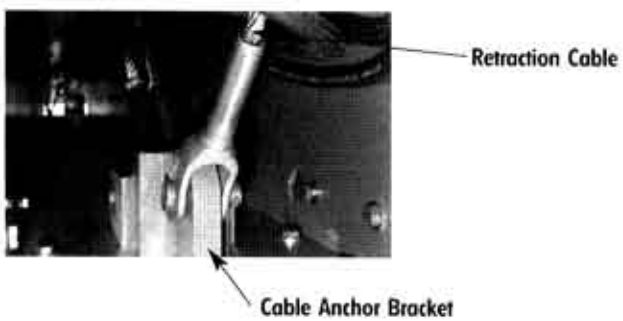
→ **Stage 3**

1. At the bottom front of Boom-Section 3, loosen the retraction cable adjustment fasteners.
2. Remove all the retraction cable sheave components.





3. Reaching inside the boom rear, at the cable anchor bracket weldment, remove the cotter pin from the retraction cable pin.
4. Remove the retraction cable pin. The retraction cable should now be free.
5. Pull the cable from the boom assembly through the rear. Remove the ropes, and leave them in place to aid in reinstallation.



(7C) Retraction Cable Reinstallation

To reinstall the retraction cable, you must be able to reach into the rear of the boom assembly to the cable anchor bracket weldment. The anchor bracket is welded to the bottom rear boom plate of Boom-Section 3. If you can't reach the bracket, the booms will have to be separated. Be certain that the keys have been removed from the ignition and fasten a "do not operate" tag to the steering wheel before you reach into the boom.

→ Preparation

- Place the machine in a level, open area with sufficient space to work safely.
- Procure the tools and platforms required for this operation.
- If working with a helper, review each of your duties.
- Be certain that the boom assembly is still retracted fully. If not, mechanically push the boom into the correct position before commencing reinstallation. **DO NOT** reach into the beam assembly while sections are being mechanically retracted/extended.

→ Stage 1

1. Fasten a rope to the retraction cable and pull the cable through the Boom-Sections to the approximate final position. Remove the rope.
2. Install the retraction cable socket end with mounting hardware to the cable anchor bracket weldment.

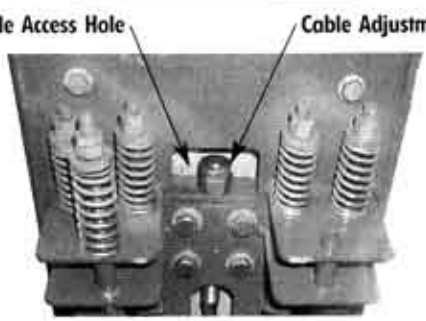
Cable Anchor Bracket

3. Install the retraction cable threaded end through the rear cable sheave bracket and cable adjusting block, bolted to the bottom front of Boom-Section 1.

Retraction Cable Sheave Assembly

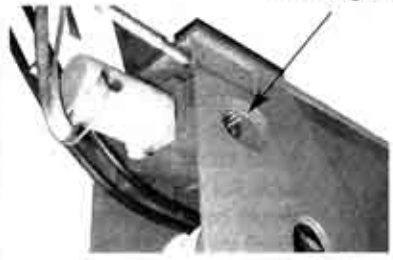
4. Feed the cable into the inside bottom front of Boom-Section 1 to the cable adjustment access hole.

Boom-Section 1, Bottom Front



5. **534C-9/C-10 & 534D-9/D-10:**
   At the front of Boom-Section 3, feed the push beam toward the rear of the boom assemblies to line up the push beam mounting pins.
6. Install the push beam mounting pins and fasteners.
7. **532C-6, 534C-6 & 534D-6:**
   Reinstall the crowd cylinder into the retainers at the rear of Boom-Section 2.
8. Reinstall and torque the crowd cylinder retainer fasteners.

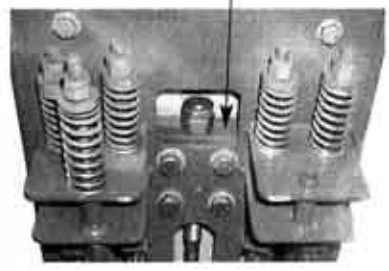
Push Beam Mounting Area



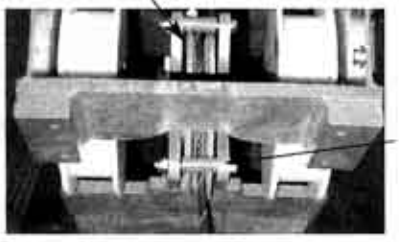
→ **Stage 2**

1. Install the retraction cable to the cable adjustment block at the bottom front of Boom-Section 1.
2. Install the retraction cable sheave and all the related components. Be certain the cable guards are installed.

Cable Adjustment Block



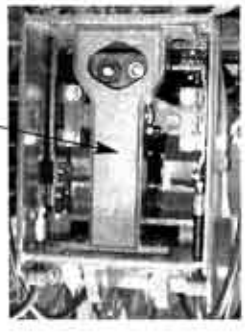
Retraction Cable Sheave



Cable Guard

3. Install the hose guards to the rear of the boom.
4. Place the strong back/cylinder bracket in place at the rear of Boom-Section 1.

Cylinder Bracket



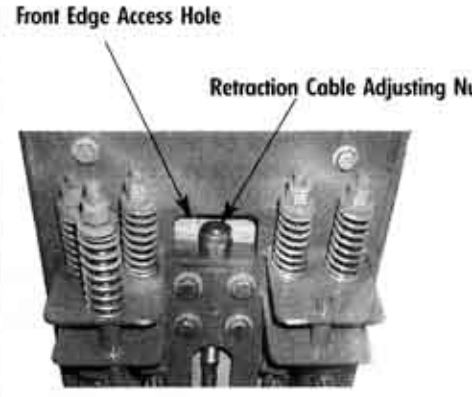
→ **Stage 3**

1. Install the crowd cylinder into the strong back/cylinder bracket.
2. Install previously removed shims to the top and bottom of the strong back/cylinder bracket.
3. Torque the strong back/cylinder bracket fasteners and apply ***LOCTITE* 242** to threads.
4. Reconnect the crowd cylinder hydraulic hoses.
5. Reinstall fasteners and springs to the extension cable threads at the strong back/cylinder bracket.

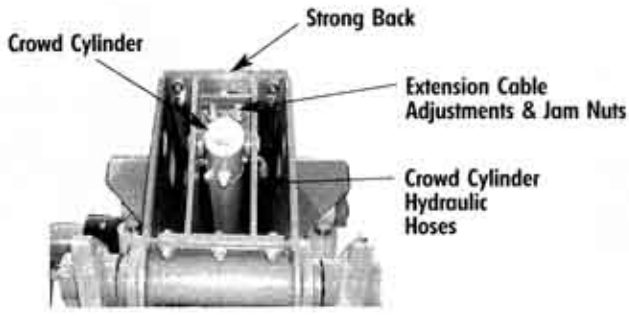
→ **Stage 4**

534C-9/C-10 & 534D-9/D-10 ONLY!

1. At the retraction cable adjusting block, located at the inside bottom front of Boom-Section 1, tighten the cable adjusting nut until the third thread lines up with the front edge of the access hole.
2. Install the jam nut to the adjusting nut and torque to 100 ft-lb.
3. At the strong back, tighten the extension cable adjusting nut until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the cable is not twisting.
4. Install the jam nut and torque to 100 ft-lb.
5. Adjust the cables to specifications given on page 7.1.



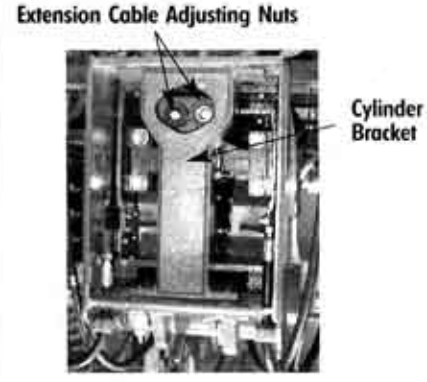
BOOM REAR 534C-9/C-10 & 534D-9/D-10



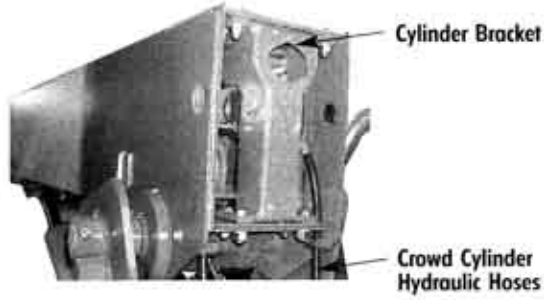
→ **Stage 4**

532C-6, 534C-6 & 534D-6 ONLY!

1. At the retraction cable adjusting block located at the inside front bottom of Boom-Section 1, tighten the cable adjusting nut until the front of the threaded end lines up with the front edge of the access hole.
2. Install the jam nut against the adjusting nut and torque to 100 ft-lb.
3. At the cable adjusting bracket, tighten the extension cable adjusting nuts until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the wire rope is not twisting.
4. Install the jam nut against the adjusting nuts and torque to 100 ft-lb.
5. Adjust the cables to specifications given on page 7.1.



532C-6, 534C-6 & 534D-6



The Retraction Cable should now be correctly installed.

(7D) Extension Cable Removal

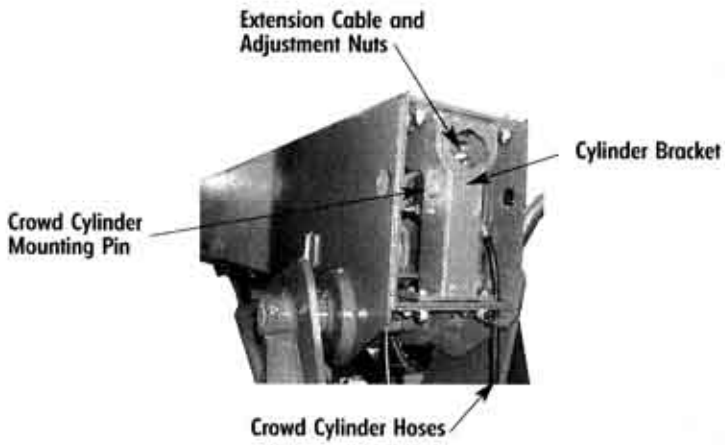
Removal of the extension cable is a difficult operation, but it can be accomplished. You must be able to reach into the rear of the boom assembly to unfasten the extension cable socket from the cable anchor bracket weldment. The bracket is welded to the rear bottom plate of Boom-Section 3. If you can't reach this bracket, the booms must be separated. Make sure that the keys have been removed from the ignition and fasten a "do not operate" tag to the steering wheel before you reach into the boom.

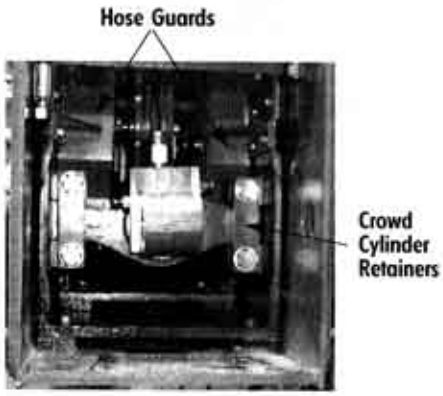
→ Preparation

- Retract the boom assembly fully.
- Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel. **DO NOT** reach into the boom until you are **CERTAIN** that keys have been removed from the ignition.
- Place the machine in a level, open area with sufficient space to work safely.
- Procure the tools and platforms required for this operation.
- Procure a rope to tie to the cable. This rope must be of sufficient length to allow access to each end whenever it is pulled through the boom assemblies with the cable.
- If working with a helper, review each of your duties.

→ Stage 1

1. Remove the hose guards from the rear of Boom-Section 1.
2. Separate, plug and cap the crowd cylinder hoses.
3. Remove the crowd cylinder mounting pins from the strong back/cable bracket.
4. Remove the extension cable mounting hardware from the strong back/cylinder bracket at the rear of boom.
5. Pull the cable free of the strong back/cylinder bracket. Fasten a rope to the cable end to aid in reinstallation.
6. Remove the strong back/cylinder bracket from the ear of the boom assembly. Keep the top and bottom shim packs together and identified. This will make assembly easier.

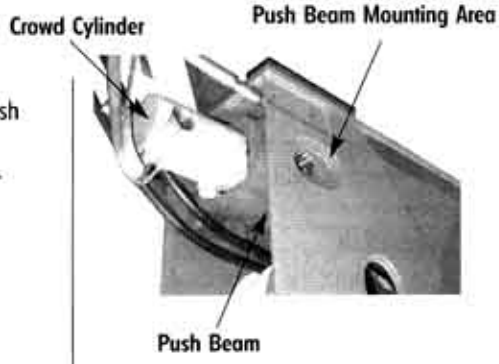




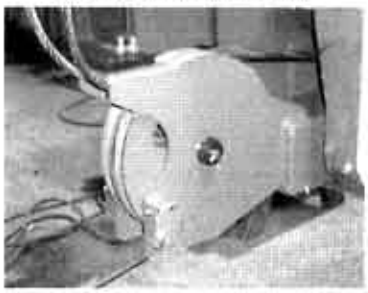
→ **Stage 2**

534C-9/C-10 & 534D-9/D-10 ONLY!

1. Remove the push beam mounting hardware.
2. Pull the push beam extension cable sheave bracket free of Boom-Section 3.
3. Remove all extension cable sheave bracket components from the front of the push beam.
4. Pull the extension cable through the push beam extension cable sheave bracket.



PUSH BEAM SHEAVE BRACKET

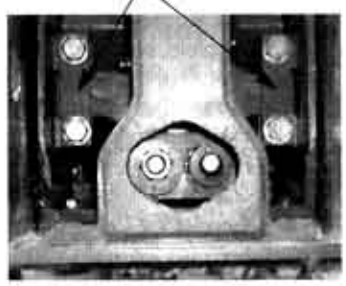


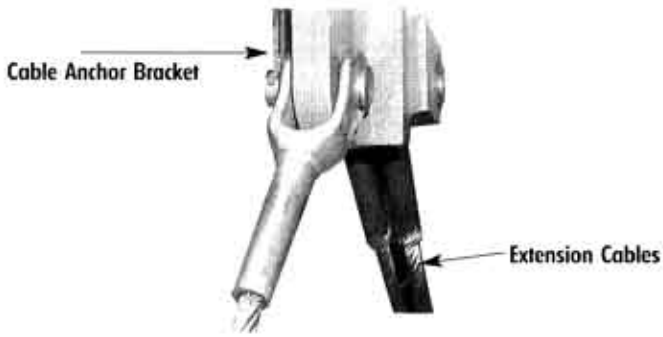
→ **Stage 2**

532C-6, 534C-6 & 534D-6 ONLY!

1. Remove the crowd cylinder retainers from the rear of Boom-Section 2.
2. Drop the crowd cylinder to the bottom of the boom. This will give more clearance for access to the cable anchor bracket welded to the bottom rear of Boom-Section 3.
3. At Boom-Section 3, front boom head, remove the extension cable sheave bracket assembly components. This will allow the passage of the threaded end of the cable through the sheave bracket.

Crowd Cylinder Retainers





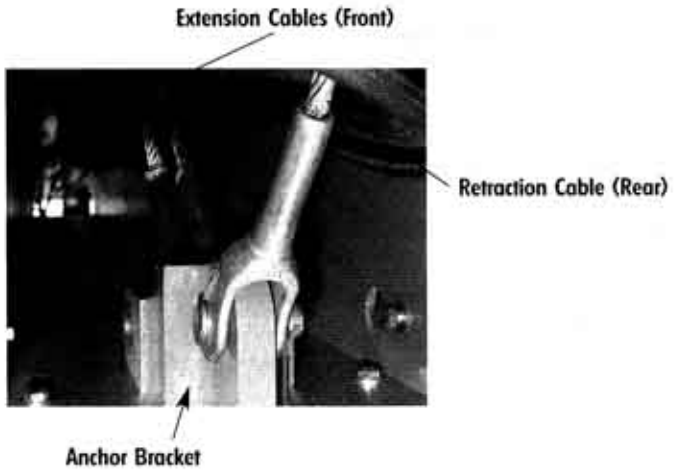
4. Pull the extension cable free of the sheave bracket.

EXTENSION CABLE SHEAVE BRACKET

→ **Stage 3**

532C-6, 534C-6 & 534D-6

1. If required for clearance access, pull the crowd cylinder free of the boom through the back of the boom assembly. To do this, you will have to remove the extension cable sheave bracket from the front of the crowd cylinder.
2. Reach inside the rear of Boom-Section 3, and remove the extension cable retaining ring (snap ring) and the extension cable pin. This pin is located at the front of the cable anchor bracket weldment which is welded to the bottom rear of Boom-Section 3.
3. The extension cable is now free and can be removed from the boom.
4. Tie a rope to the extension cable socket end to aid in reinstallation.



(7E) Extension Cable Reinstallation

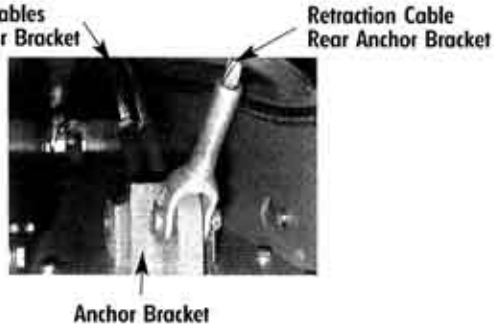
To reinstall the extension cable, you must be able to reach into the rear of the boom assembly to the cable anchor bracket weldment. The anchor bracket is welded to the bottom rear boom plate of Boom-Section 3. If you can't reach the bracket, the booms must be separated. Make sure the keys have been removed from the ignition and fasten a "do not operate" tag to the steering wheel before you reach into the boom.

→ Preparation

- Place the machine in a level, open area with sufficient space to work safely.
- Procure the tools and platforms required for this operation.
- If working with a helper, review each of your duties.
- Be certain the boom assembly is still retracted fully. If not, mechanically push the boom into the correct position. **DO NOT reach into the boom assembly while sections are being mechanically retracted/extended.**

→ Stage 1

1. Tie a rope to the extension cable threaded end and pull the cable to the anchor bracket weldment area.
2. Install the extension cable socket end and the mounting hardware to the cable anchor bracket weldment.

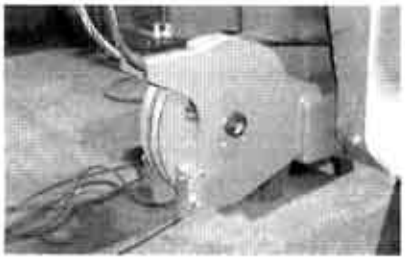


3. **532C-6, 534C-6 & 536D-6:**
   If it has been removed, install the crowd cylinder into the boom assembly from the rear.
4. If it has been removed, install the extension cable sheave bracket to the front of the crowd cylinder.

532C-6, 534C-6 & 534D-6
Extension Cable Sheave Bracket

5. Install the extension cable threaded end through the sheave bracket and feed to the rear of the boom.
6. **534C-9/C10 & 534D-9/D-10:**
   Assemble all extension cable sheave bracket components to the front of the push beam. Be certain that the cable threaded end is inserted through the sheave bracket before the sheave components are installed.

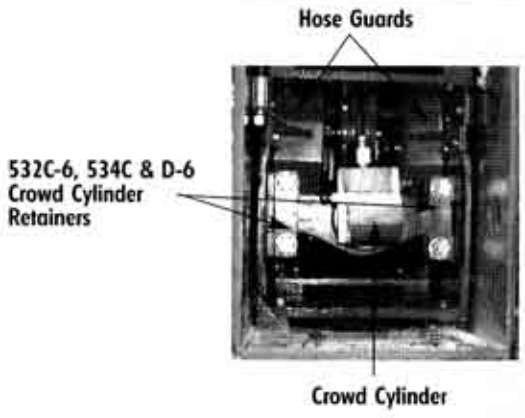
534C-9/C-10 & 534D-9/D-10
Push Beam Front,
Extension Cable Sheave Bracket



→ **Stage 2**

1. **534C-9/C-10 & 534D-9/D-10:**
   Insert the push beam fully into Boom-Section 2.
2. **532C-6, 534C-6 & 534D-6:**
   Insert the crowd cylinder fully into Boom-Section 2.

532C-6, 534C-6 & 534D-6

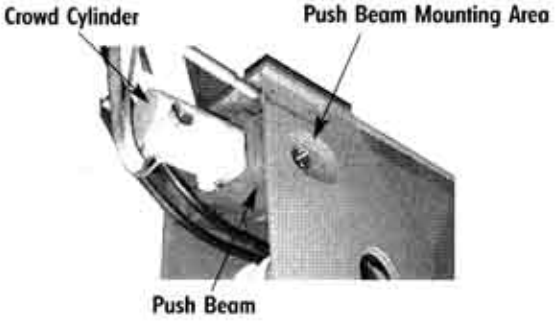


3. Install the push beam mounting hardware or crowd cylinder retainers.
4. Install the tilt and auxiliary circuit hose guards at the rear of Boom-Section 1.

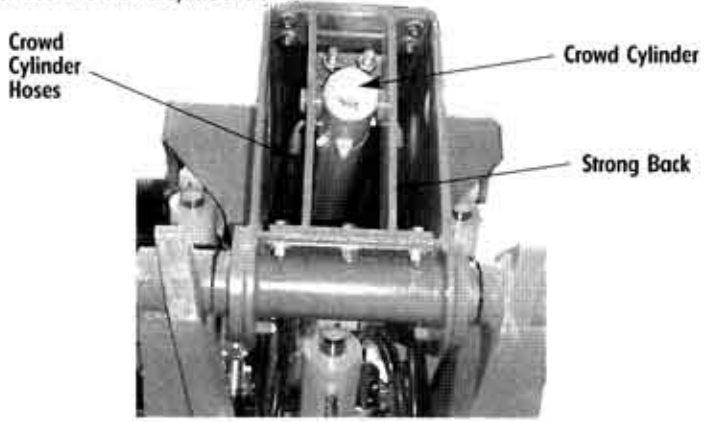
→ **Stage 3**

1. Place the strong back/cable bracket in place at the rear of Boom-Section 1.

534C/C-10 & 534D-9/D-10



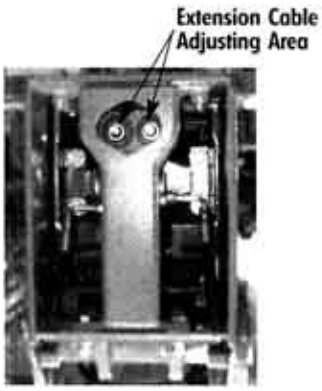
2. Install the crowd cylinder and mounting hardware into the strong back/cable bracket.
3. Replace the removed shim packs to the strong back/cable bracket.
4. Install and torque the strong back/cable bracket fasteners by applying ***LOCTITE* 242** to threads.
5. Reconnect the crowd cylinder hoses.



→ **Stage 4**

1. Feed the extension cables into the strong back/cable bracket mounting area. Be certain that the cables are stress-free and not twisted. Remove the rope.
2. Install the cable adjusting hardware. Tighten the extension cables' adjusting nuts until gap between cable flat washer and strong back is 1/32 to 1/16 inch. Gap for both washers should be equal. When tightening, make sure that the wire rope is not turning.

532C-6, 534C-6 & 534D-6
CYLINDER BRACKET



534C-9/C-10 & 534D-9/D-10
STRONG BACK

3. Install the jam nut against the adjusting nut and torque to 100 ft-lb. Make sure that the cable is not twisting.
4. Adjust the boom cables to the parameters given on page 7.1.

The Extension Cable is now installed.

Hydraulic hoses are used to carry fluid to the tilt cylinder and/or auxiliary circuits. At the boom, the hoses are fastened to the hose take-up weldment at the front outside/inside bottom of Boom-Section 1. They are then fed around a roller, through a protective channel at the top left and right of Boom-Section 3, to the front head of Boom-Section 3. At that point, another connection is made to carry fluid to the tilt or auxiliary circuit. Tilt circuit hoses are fed through the left side of the boom. Auxiliary circuit hoses are fed through the right side of the boom.

Hoses must be of correct length, laying straight and flat, rolling free of twist and torqued per values in "Appendix B". **LOCTITE 545** (Gradall P/N 1440-4043) must be used on all connections. Two wrenches should be used when tightening hoses to prevent twisting. Use one wrench on the swivel hose fitting; the other on the fixed hose fitting.

Gradall strongly recommends against using generic hoses as replacements. Hoses for Gradall Material Handlers are specifically designed for use in this application. There is no way to ensure that generic hoses will meet Gradall's strict application performance requirements.

TILT AND AUXILIARY CIRCUIT HOSE REMOVAL/REINSTALLATION

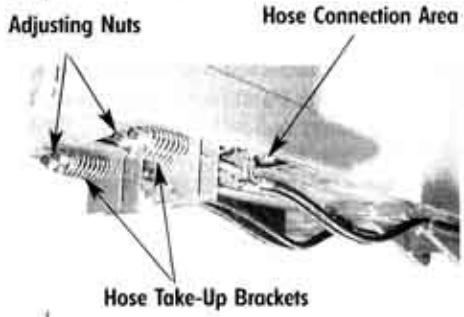
Hoses normally can be removed and reinstalled simply by connecting a union to the fittings on the hose (joining them together) then pulling them through the boom assembly until they are free. You may have to remove the hose guard at the roller assembly. If this doesn't work, follow the procedures listed below.

→ Preparation

- Retract the boom fully level.
- Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel.
- Procure the tools and work platforms to allow the work to progress safely.
- Procure a rope to assist pulling the hose to the correct location during reinstall.
- If working with a helper, be certain each of you know your assigned duties.
- Review the removal/reinstallation procedure.

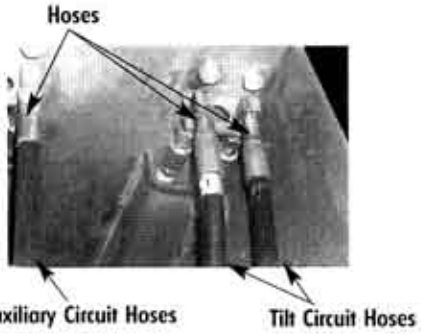
→ Removal, Stage 1

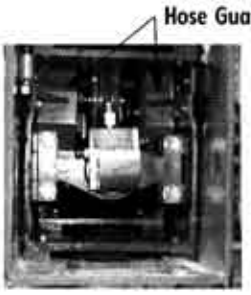
1. Loosen the adjusting nuts at the hose take-up bracket to relieve the tension on the hose assemblies.
2. At the inside of the hose take-up brackets, separate, plug, and cap all hoses to be removed.



→ Removal, Stage 2

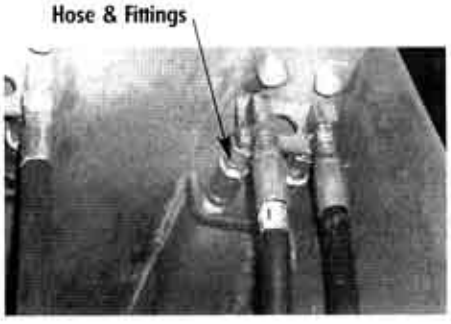
1. At the rear of the boom, remove the hose guard for the hose being removed.
2. At the front of Boom-Section 3, separate, cap, and plug the hose to be removed. Tie a rope to the hose end.
3. Through the rear, pull the separated hose free of the boom assembly.
4. At the hose take-up bracket area, pull the hose free of the boom assembly.



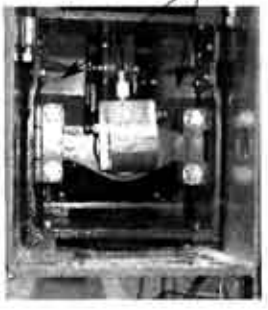


→ Reinstallation

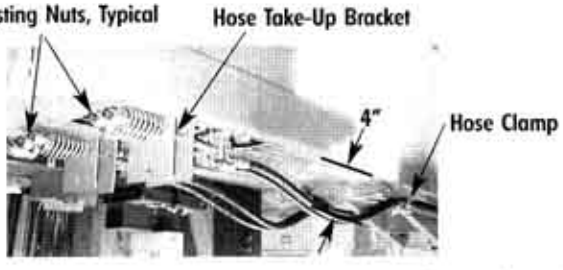
1. Tie the rope to the hose end.
2. Installing the hose at the hose bracket take-up area, pull the hose to the rear of the boom.



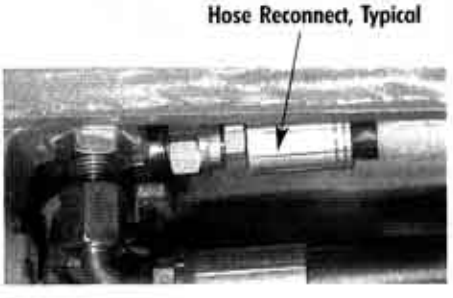
Steps 1 & 3



3. Feed the hose around the roller and pull it through the protective channels in Boom-Section 3 to the boom head at the front.
4. At the boom head, apply **LOCTITE 545** to the fittings, connect and torque the hoses and install clamps.
5. Install the hose guard at the rear boom roller.
6. Apply **LOCTITE 545** to the hose fittings at the hose take-up bracket area; connect and torque the hose.



7. Tighten the hose take-up bracket adjusting nuts. Ensure 4" dimension (boom bottom to hose) is held at the hose area between the take-up bracket and the first hose clamp.



The Hose is now correctly installed.

ELECTRIC BOOM CABLE

The electric cable is fed through the right side of the boom assembly in a fashion similar to the auxiliary hydraulic hoses. The electric cable lies adjacent to the hydraulic hoses and moves in unison with them, whenever the booms are extended and retracted. The receptacle and socket connector are equipped with a strain relief fitting to prevent wires from pulling loose. This strain relief is tie-wrapped to the cable. **DO NOT** install a cable without the strain relief connected.

The socket end of the electric cable is fastened to the front boom head of Boom-Section 3. It is secured with a bracket at this location. A strain relief fitting is installed at the cable take-up weldment and support. These assemblies are located in the area adjacent to the hydraulic hose take-up weldment.

The receptical and socket are equipped with six contact points. One contact point is usually extra and is plugged using Gradall Part No. 8348-1301. Refer to the following chart for identification in the socket (as viewed from the wire insertion end).

ELECTRICAL WIRE DATA

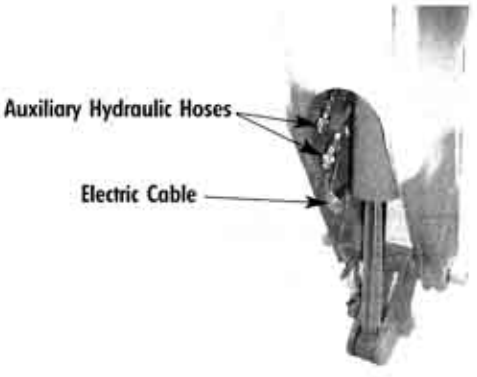
Socket Body Letter	Wire Color	Wire Function
"TM"	Orange	Panel
"A"	Blue	Open/Extra
"S"	Black	Mast
"RT"	Green	Swing
"LT"	Red	Side Shift
"C"	Green/Yellow	Ground

Electric Cable Removal

→ **Stage 1**

1. Retract the boom fully level.
2. At the front of Boom-Section 3 boom head, unfasten the electrical socket and clamps.
3. Remove the socket from the electrical cable.
4. Remove the strain relief fitting and the tube at the boom head from the boom and cable.
5. Tie a rope to the cable end; this will aid in reinstallation.

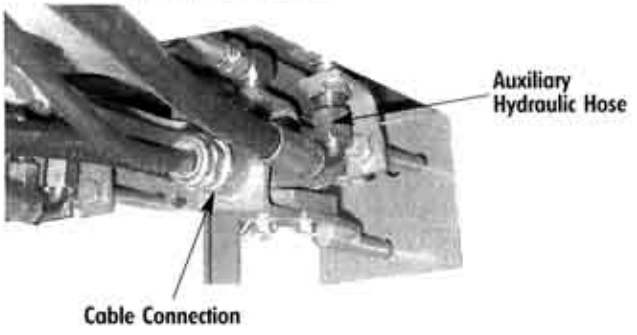
Boom Head



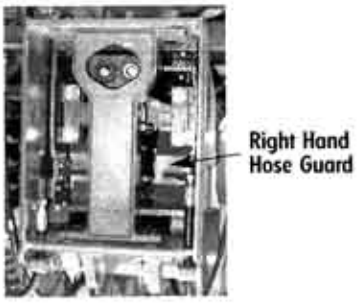
→ **Stage 2**

1. At the rear of the boom, remove the hose guard from the right side roller.
2. Pull the electric cable to the rear, free of the boom assembly.
3. At the bottom front of Boom-Section 1, remove the cable take-up weldment and support.
4. Pull the electric cable free of the boom through the cable take-up weldment.
5. Remove the remaining cable clamps and unplug the receptacle.

Boom-Section 1, Bottom Front, Cable Take-Up Bracket



Rear View Boom Assembly



The Electric Cable is now free of the Boom assembly.

Electric Cable Installation

It is assumed the electric cable has been removed and related parts are still left off the boom assembly. The electric socket must not be installed at this time. The cable must be well tensioned in the area between the strain reliefs at the boom head and Boom-Section cable take-up brackets.

→ Stage 1

1. Tie the rope to the cable and feed it through the strain relief fitting and cable take-up weldment tube, then feed to the rear through the cable take-up weldment located at the bottom front of Boom-Section 1. The cable lies in the bottom plate area between Boom-Sections 1 and 2.
2. Feed electric cable around right side hose roller, through top protection channel, then to the boom head at the front of Boom-Section 3.
3. Install the hose guard at right side hose roller located at the rear of Boom-Section 2.

Boom Head

→ Stage 2

1. At front boom head of Boom-Section 3, feed the cable through the tube weldment, and install the strain relief fittings on cable. Do not tighten at this time.
2. Pull the electric cable through the boom to correct position at boom head
3. Install cable wires into the socket. See "Electrical Wire Data" on page 9.0 for wire locations.
4. Install the socket into the bracket at the boom head. Tighten the strain relief fitting at the socket and tube. Install and tighten the cable clamps at the boom head.

→ Stage 3

1. Install the cable take-up weldment and support at the bottom front of Boom-Section 1.
2. Tighten the strain relief fittings at the cable take-up weldment area.
3. Install the cable clamps to the bottom front of Boom-Section 1.
4. Plug the receptacle connector into the frame cable wiring harness.

Front Bottom Boom Section 1
Cable Take-Up Bracket

The Electric Cable is now correctly installed.

10.0 Crowd Cylinder Removal and Installation

The crowd cylinder hydraulically extends and retracts Boom-Section 2. A cable sheave arrangement is designed into the system to extend and retract Boom-Section 3 proportional to Boom-Section 2. While similar in operation, there are slight differences in cylinder design for 532C-6, 534C-6 & 534D-6 machines verses 534C-9/C-10 & 534D-9/D-10 machines.

The 534C-9/C-10 & 534D-9/D-10 cylinder is installed in a push beam. The base end of the cylinder mounts into a structure at the rear of Boom-Section 1 called a strong back. The rod eye end of the cylinder mounts into the push beam. The push beam is fastened to the rear of Boom-Section 2. As the cylinder rod extends or retracts, the push beam moves Boom-Section 2 proportional.

The 532C-6 and 534C-6 & 534D-6 cylinder rod end is fastened to a cable bracket mounted to the rear of Boom-Section 1 (similar to the strong back of the 534C-9/C-10 & 534D-9/D-10). The rear of the cylinder barrel is designed with a mount that fits into a retainer bracket at the rear of Boom-Section 2. The front of the cylinder barrel is equipped with mounting bolts to hold the cable sheave assembly. As the cylinder rod extends and retracts the barrel movement moves Boom-Section 2 proportional.

Re-pack kits for the crowd cylinders are available from your Authorized Gradall Distributor.

Removing and Reinstalling the Crowd Cylinder:

534C-9/C-10 & 534D-9/D-1 ONLY!

→ Preparation

- Review all safety issues before commencing work.
- Place the machine in a safe, level, uncongested working area.
- Apply the brakes and chock the wheels.
- Procure a crane and lifting tackle capable of lifting 1000 lb.
- If working with a helper, be certain each of you know your assigned duties.
- Select a location to place the cylinder once it has been removed.
- Pressure-wash or steam-clean the machine so that you have a clean safe working surface.

→ Removal

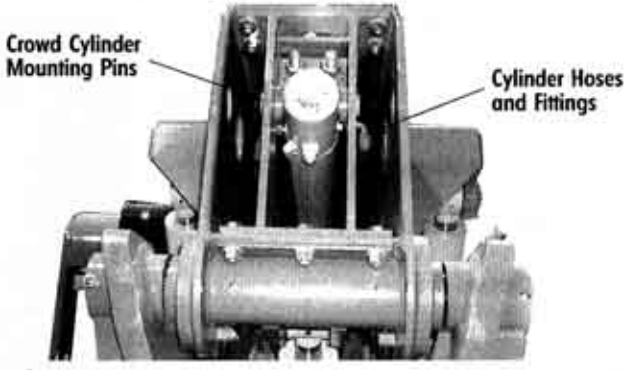
1. Retract the boom and line up the push beam crowd cylinder rod eye access holes in all Boom-Sections.
2. Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the cylinder rod eye mounting pin.
4. Separate, plug and cap the crowd cylinder hoses at the rear of the boom assembly.
5. Remove the crowd cylinder fittings from the rear of the cylinder barrel.
6. Attach lifting tackle to the cylinder, remove the mounting pins and carefully pull the crowd cylinder free of the machine through the strong back.
7. Place the crowd cylinder in the designated area for the next operation.

→ **Reinstallation:**

1. Feed the crowd cylinder into the push beam and line up the rod eye to the access holes. Be certain that the bearing pad is installed at the rod end of the cylinder.
2. Install the rod eye mounting pin and secure.

3. Install the crowd cylinder base mounting pin into the strong back and secure.

REAR BOOM ASSEMBLY STRONG BACK



4. Apply **LOCTITE 545** (Gradall P/N 1440-4043) to cylinder fittings and install into the barrel.
5. Apply **LOCTITE 545** to fittings and reconnect the hydraulic hoses.

The Crowd Cylinder is now installed.

Removing and Reinstalling the Crowd Cylinder:
532C-6 & 534C-6 & 534D-6 ONLY!

→ Preparation

- Review all safety issues before commencing work.
- Place the machine in a safe, level, uncongested working area.
- Apply the brakes and chock the wheels.
- Procure a crane and lifting tackle capable of lifting 1000 lb.
- If working with a helper, be certain each of you knows your assigned duties.
- Select a location to place the cylinder once it has been removed.
- Pressure-wash or steam-clean the machine so that you have a clean safe working surface.

→ Removal

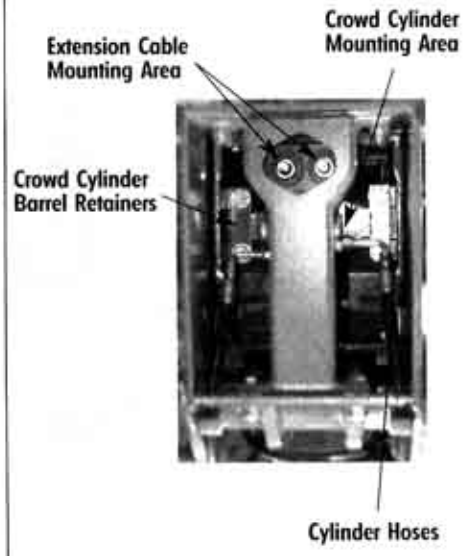
1. Level and retract the boom within approximately 1 ft. of full retraction. The boom sections should be positioned to allow the top rear cable access holes to line up.
2. Remove the keys from the ignition and fasten a "do not operate" tag to the steering wheel.
3. Remove the extension cable adjusting hardware from the rear cable bracket. Reaching through the top rear access hole, install a wrench to cable end flat. This will keep the cable from twisting during removal.
4. At the boom head of Boom-Section 3, remove the four extension cable sheave bracket mounting nuts.
5. At the boom rear cable bracket, remove the crowd cylinder mounting pins and hardware.
6. Remove the cable bracket from Boom-Section 1. Identify top and bottom shim packs to aid in reinstallation.
7. Disconnect the hydraulic hoses from the crowd cylinder.
8. Fasten lifting tackle to the crowd cylinder and take the weight off the cylinder.
9. Remove the crowd cylinder retainers from the rear of Boom-Section 2.
10. Through the back of the boom, carefully pull the crowd cylinder free.
11. Pull the extension cables free of the boom while extracting the crowd cylinder. Keep tension against the sheave bracket. This will pull the sheave bracket toward the rear to the inside cable anchor bracket.
12. Place the crowd cylinder in the designated area for the next operation.

→ Reinstallation

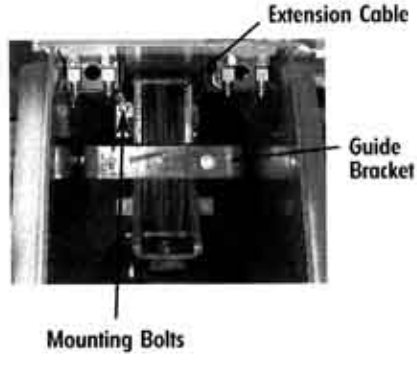
1. Lift and feed the cylinder into the boom assembly, through the rear.
2. Carefully install the cylinder into the extension cable sheave assembly bracket. The sheave bracket will be located at the cable anchor bracket area, inside Boom-Section 3. Be careful not to damage the sheave bracket mounting bolts while installing the cylinder into the bracket.
3. Keep tension on the extension cable sheave while the crowd cylinder is being fully inserted.
4. Install the crowd cylinder retainers at the rear of Boom-Section 2 rear. Apply **LOCTITE 242** (Gradall P/N 1440-3364) to the threads and torque as required.
5. Place the cylinder bracket in place at the rear of Boom-Section 1.
6. Install the crowd cylinder mounting pins into the cylinder bracket.
7. Install and torque the cylinder bracket fasteners. Use **LOCTITE 242** on the threads.
8. Apply **LOCTITE 545** (Gradall P/N 1440-4043) to the hydraulic fittings and reconnect the crowd cylinder hoses.
9. Reinstall the extension cables and the hardware. Adjust as required.

The Crowd Cylinder is now installed.

Cylinder Bracket - Rear



Boom Head, Front Extension Cable Sheave Bracket (Hoses removed for clarity)



Appendix A: Fastener Torque Chart

The following bolt torque charts covering English and Metric fasteners are the ones used by Gradall Engineering. Gradall ratings are for lubricated fasteners. Do not exceed the allowable rating. **Remember!** An over-torqued bolt in most cases will fail as rapidly as an under-torqued one.

Lubricated English Bolts

BOLT SIZE	GRADE 5 BOLTS			GRADE 8 BOLTS		
	Torque (ft-lb.)	Tolerance + or - (ft-lb.)	Clamp Load (lb.)	Torque + or - (ft-lb.)	Tolerance + or - (ft-lb.)	Clamp Load (lb.)
1/4 - 20	9	+3 -0	2,700	10	+3 -0	3,000
1/4 - 28	11	+3 -0	3,300	12	+3 -0	3,600
5/16 - 18	17	+5 -0	4,080	20	+5 -0	4,800
5/16 - 24	19	+5 -0	4,560	24	+5 -0	5,760
3/8 - 16	30	+5 -0	6,000	40	+5 -0	8,000
3/8 - 24	32	+5 -0	6,400	48	+5 -0	9,600
7/16 - 14	44	+10 -0	7,540	68	+10 -0	11,660
7/16 - 20	48	+10 -0	8,230	76	+10 -0	13,030
1/2 - 13	68	+10 -0	10,200	100	+10 -0	15,000
1/2 - 20	76	+10 -0	11,400	115	+10 -0	17,250
9/16 - 12	100	+10 -0	13,330	140	+10 -0	18,670
9/16 - 18	112	+10 -0	14,930	160	+10 -0	21,330
5/8 - 11	140	+15 -0	16,800	200	+15 -0	24,000
5/8 - 18	168	+15 -0	20,160	215	+15 -0	25,800
3/4 - 10	240	+25 -0	24,000	340	+25 -0	34,000
3/4 - 16	265	+25 -0	26,500	370	+25 -0	37,000
7/8 - 9	360	+35 -0	30,860	530	+35 -0	45,430
7/8 - 14	390	+35 -0	33,430	560	+35 -0	48,000
1 - 8	545	+50 -0	40,875	795	+50 -0	59,625
1 - 14	570	+50 -0	42,750	840	+50 -0	63,000
1 1/8 - 7	710	+50 -0	47,330	1175	+50 -0	78,330
1 1/8 - 12	795	+50 -0	53,000	1325	+50 -0	88,330
1 1/4 - 7	1005	+75 -0	60,300	1680	+75 -0	100,800
1 1/4 - 12	1105	+75 -0	66,300	1850	+75 -0	111,000
3/8 - 6	1310	+75 -0	71,450	2200	+75 -0	120,000
1 3/8 - 12	1500	+75 -0	81,820	2490	+75 -0	135,820
1 1/2 - 6	1745	+75 -0	87,250	2910	+75 -0	145,500
1 1/2 - 12	1945	+75 -0	97,250	3280	+75 -0	164,000

Appendix A: Fastener Torque Chart

Metric Fasteners

Nominal Size	Stress Area (mm^2)	CLASS 4.6		CLASS 8.8		CLASS 9.8		CLASS 10.9		CLASS 12.9	
		400 Megapascals Min. Tensile Str.		830 Megapascals Min. Tensile Str.		900 Megapascals Min. Tensile Str.		1040 Megapascals Min. Tensile Str.		1220 Megapascals Min. Tensile Str.	
		(Nm)	(ft-lb.)	(Nm)	(ft-lb.)	(Nm)	(ft-lb.)	(Nm)	(ft-lb.)	(Nm)	(ft-lb.)
M 2.0	2.1	0.14	0.10	0.37	0.27	0.40	0.30	0.52	0.38	0.61	0.45
M 2.5	3.4	0.28	0.21	0.76	0.56	0.82	0.61	1.06	0.78	1.24	0.92
M 3.0	5.0	0.51	0.37	1.35	1.00	1.47	1.08	1.88	1.39	2.21	1.63
M 3.5	6.8	0.80	0.59	2.13	1.57	2.31	1.70	2.96	2.18	3.47	2.56
M 4.0	8.8	1.18	0.87	3.15	2.32	3.41	2.52	4.38	3.23	5.14	3.79
M 5.0	14.2	2.39	1.76	6.36	4.69	6.90	5.09	8.86	6.54	10.59	7.67
M 6.0	20.1	4.05	2.99	10.81	7.97	11.72	8.65	15.05	11.10	17.66	13.02
M 6.3	22.6	4.78	3.53	12.76	9.41	13.84	10.21	17.77	13.11	20.84	15.37
M 8.0	36.6	9.84	7.26	26.25	19.36	28.46	20.99	36.54	26.95	42.87	31.62
M 10.0	58.0	19.49	14.37	51.99	38.35	56.38	41.58	72.38	53.39	84.91	62.63
M 12.0	84.3	33.99	25.07	90.68	66.88	98.33	72.52	126.25	93.12	148.10	109.23
M 14.0	115.0	54.10	39.90	144.32	106.45	156.49	115.42	200.93	148.20	235.70	173.85
M 16.0	157.0	84.40	62.25	255.18	166.08	244.17	180.09	313.50	231.22	367.76	271.24
M 20.0	245.0	164.64	121.43	439.24	323.96	476.28	351.29	611.52	451.03	717.36	529.10
M 24.0	353.0	284.66	209.95	759.43	560.13	823.48	607.37	1057.31	779.83	1240.30	914.80
M 30.0	561.0	565.49	417.08	1508.64	1112.72	1635.88	1206.56	2100.38	1549.16	2463.91	1817.29
M 36.0	817.0	988.24	728.89	2636.49	1944.58	2858.85	2108.58	3670.62	2707.31	4305.92	3175.88
M 42.0	1120.0	1580.54	1165.75	4216.66	3110.05	4572.29	3372.35	5870.59	4329.93	6886.66	5079.34

Note!

To check Gradall torque values, set the torque wrench at 95% of rated torque value and check the fastener. If the torque wrench releases before the fastener moves, assume that fastener torque is correct. When setting Gradall torque values, use values given on the chart, not exceeding allowances.

CODE 61 4-BOLT SPLIT FLANGE BOLT TORQUE

SAE DASH SIZE	FLANGE SIZE	BOLT SIZE	BOLT TORQUE ft-lb.
-12	3/4	3/8-16	25+/-4.5
-16	1	3/8-16	31+/-4.5
-20	1 1/4	7/16-14	41+/-5
-24	1 1/2	1/2-13	52+/-6
-32	2	1/2-13	60+/-6

CODE 62 4-BOLT SPLIT FLANGE BOLT TORQUE

SAE DASH SIZE	FLANGE SIZE	BOLT SIZE	BOLT TORQUE ft-lb.
-12	3/4	3/8-16	30+/-4.5
-16	1	7/16-14	46+/-4.5
-20	1 1/4	1/2-13	69+/-6
-24	1 1/2	5/8-11	125+/-8

ORS FACE SEAL; TUBE/HOSE TO FITTING

SAE DASH SIZE	THREAD SIZE	TUBE SIDE ASSEMBLY TORQUE ft-lb.
-4	9/16-18	18+/-1
-6	11/16-16	27+/-2
-8	13/16-16	40+/-2
-10	1-14	63+/-3
-12	1 3/16-12	90+/-4
-16	1 7/16-12	120+/-8
-20	1 11/16-12	140+/-8
-24	2 1/2-12	165+/-8

Note!

Aluminum material ports use 50% of the steel torque value.

SAE FITTINGS; STRAIGHT & ADJUSTABLE

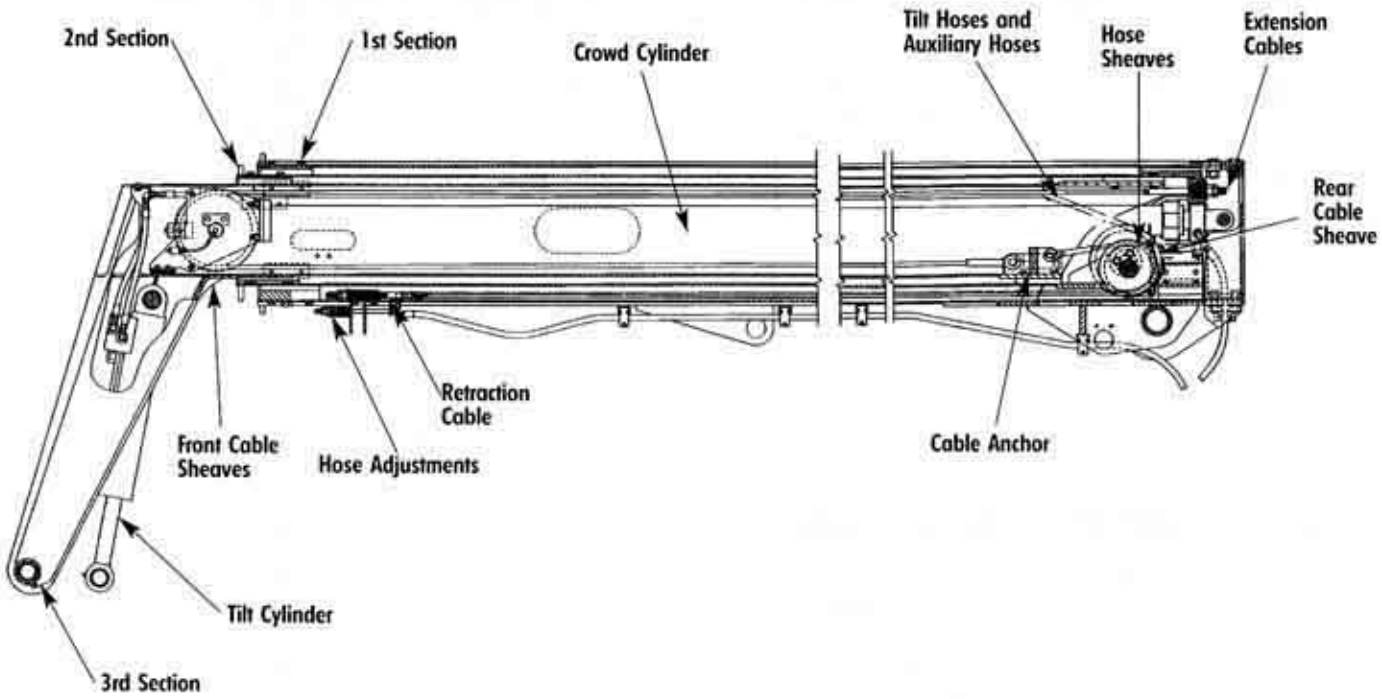
SAE DASH SIZE	THREAD SIZE	PORT SIDE ASSEMBLY TORQUE ft-lb.
-2	5/16-24	7.5+/-.5*
-3	3/8-24	14+/-1*
-4	7/16-20	16+/-1
-5	1/2-20	22+/-1*
-6	9/16-18	35+/-1
-8	3/4-16	60+/-2
-10	7/8-14	105+/-5
-12	1 1/16-12	140+/-6
-14	1 3/16-12	145+/-6*
-16	1 5/16-12	210+/-8
-20	1 5/8-12	260+/-12
-24	1 7/8-12	315+/-12
-32	2 1/2-12	325+/-15*

* TORQUE VALUES WITH AN ASTERISK ARE FROM JIC FITTING TORQUE CHART

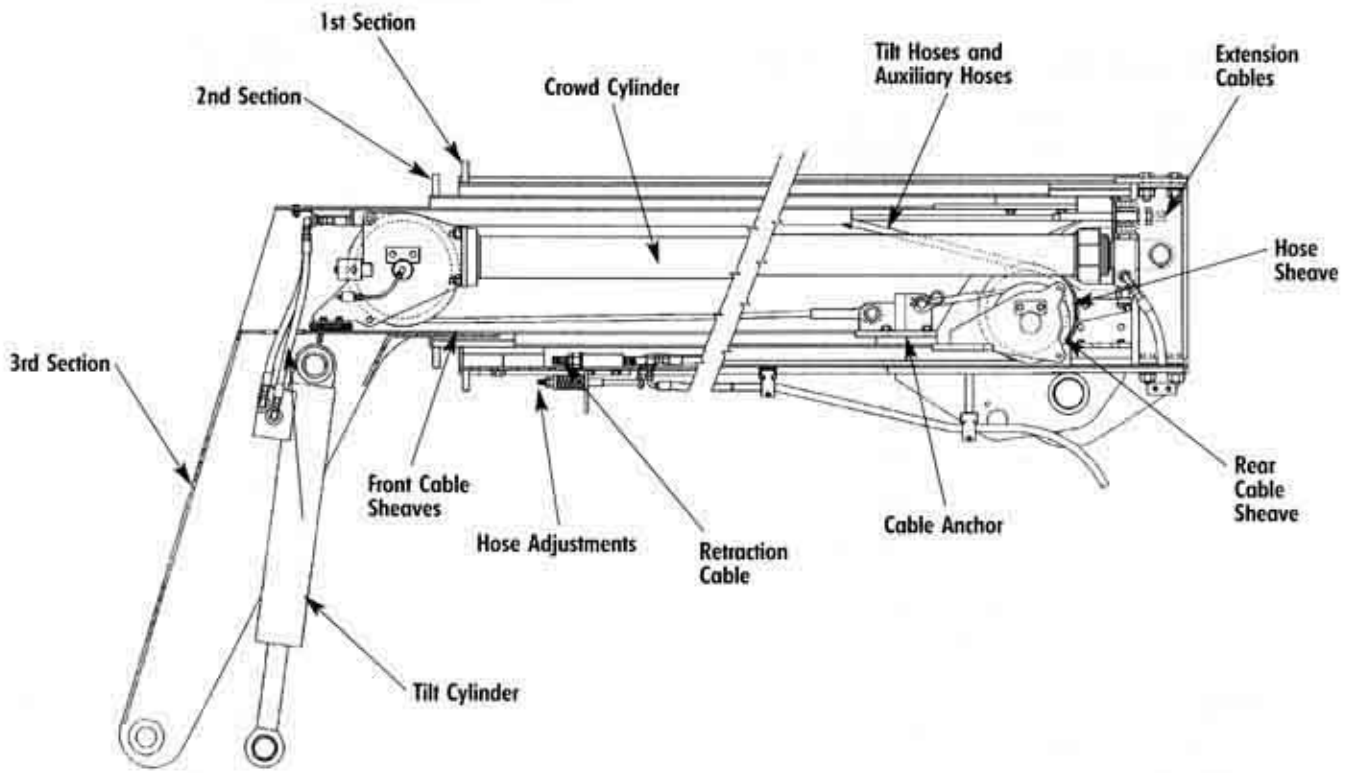
JIC 37° TUBE/HOSE TO FITTING

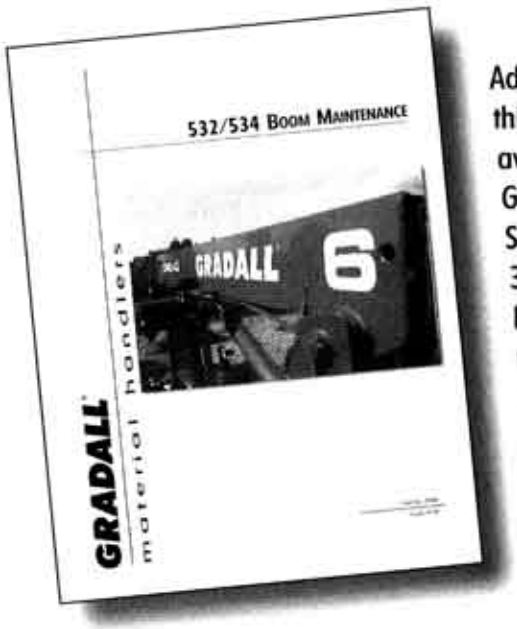
SAE DASH SIZE	THREAD SIZE	TUBE SIDE ASSEMBLY TORQUE ft-lb.
-2	5/16-24	3+/-1
-3	3/8-24	6+/-1
-4	7/16-20	12+/-1
-5	1/2-20	15+/-1
-6	9/16-18	21+/-1
-8	3/4-16	45+/-2
-10	7/8-14	60+/-5
-12	1 1/16-12	85+/-5
-14	1 5/16-12	105+/-5
-16	1 5/16-12	120+/-5
-20	1 5/8-12	170+/-10
-24	1 7/8-12	200+/-15
-32	2 1/2-12	270+/-20

APPENDIX C: 534C-6 AND D-6



APPENDIX C: 534C-9/C-10 AND 534D-9/D-10





Additional copies of this Manual are available from Gradall Product Support. Call 330-339-2211, Ext. 385. Ask for the complete list of available Technical Manuals for Gradall Material Handlers.

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USER FORK WEAR STANDARDS

Reprinted from ASME/ANSI B56. 1-1993

6.2.8 Inspection and Repair of Forks in Service on Fork Lift Trucks

(a) Forks in use shall be inspected at intervals of not more than 12 months (for single shift operations) or whenever any defect or permanent deformation is detected. Severe applications will require more frequent inspection.

(b) Individual Load Rating of Forks. When forks are used in pairs (the normal arrangement), the rated capacity of each fork shall be at least half of the manufacturer's rated capacity of the truck, and at the rated load center distance shown on the lift truck nameplate.

6.2.8.1 Inspection. Fork inspection shall be carried out carefully by trained personnel with the aim of detecting any damage, failure, deformation, etc., which might impair safe use. Any fork which shows such a defect shall be withdrawn from service, and shall not be returned to service unless it has been satisfactorily repaired in accordance with para. 6.2.8.2.

(a) Surface Cracks. The fork shall be thoroughly examined visually for cracks and if considered necessary, subjected to a non-destructive crack detection process, special attention being paid to the heel and welds attaching all mounting components to the fork blank. This inspection for cracks must also include any special mounting mechanisms of the fork blank to the fork carrier including bolt type mountings and forged upper mounting arrangements for hook or shaft type carriages. The forks shall not be returned to service if surface cracks are detected.

(b) Straightness of Blade and Shank. The straightness of the upper face of the blade and the front face of the shank shall be checked. If the deviation from straightness exceeds 0.5% of the length of the blade and/or the height of the shank, respectively, the fork shall not be returned to service until it has been repaired in accordance with para. 6.2.8.2.

(c) Fork Angle (Upper Face of Blade to Load Face of the Shank). Any fork that has a deviation of greater than 3 deg. from the original specification shall not be returned to service. The rejected fork shall be reset and tested in accordance with para. 6.2.8.2.

(d) Difference in Height of Fork Tips. The difference in height of one set of forks when mounted on the fork carrier shall be checked. If the difference in tip heights exceeds 3% of the length of the blade, the set of forks shall not be returned to service until repaired in accordance with para. 6.2.8.2.

(e) Positioning Lock (When Originally Provided). It shall be confirmed that the positioning lock is in good repair and correct working order. If any fault is found, the fork shall be withdrawn from service until satisfactory repairs has been effected.

(f) Wear.

(1) Fork Blade and Shank. The fork blade and shank shall be thoroughly checked for wear, special attention being paid to the vicinity of the heel. If the thickness is reduced to 90% of the original thickness, the fork shall not be returned to service.

(2) Fork Hooks (Where Originally Provided). The support face of the top hook and the retaining faces of both hooks shall be checked for wear, crushing, and other local deformations. If these are apparent to such an extent that the clearance between the fork and the fork carrier becomes excessive, the fork shall not be returned to service until repaired in accordance with para. 6.2.8.2.

(g) Legibility of Marking (When Originally Provided). If the fork marking in accordance with para. 7.25.2 is not clearly legible, it shall be renewed. Marking shall be renewed per instructions from original supplier.

6.2.8.2 Repair and Testing

(a) Repair. Only the manufacturer of the fork or an expert of equal competence shall decide if a fork may be repaired for continued use, and the repairs shall only be carried out by such parties. It is not recommended that surface cracks or wear be repaired by welding. When repairs necessitating resetting are required, the fork shall subsequently be subjected to an appropriate heat treatment, as necessary.

Courtesy of Kenhar Products Inc.

Kenhar

FORM #29903

Important rim and wheel safety precautions

NOTICE!

An inflated tire and rim can be very dangerous if misused or worn-out. Many accidents, some fatal, have resulted from improper handling and operation of truck rims and wheels. It is, therefore, of the utmost importance that the precautions outlined on this page be carefully followed by all persons servicing truck rims and wheels to avoid personal injuries and costly damage.

How to prevent rim accidents during tire mounting

Always inflate tire in safety cage or use a portable lock ring guard. This is a safeguard against improper assembly, inadvertently mismatched parts, and other assembly errors. Remember, an inflated tire contains potentially explosive energy that can blow improperly assembled rings loose. In emergency situations, where a safety cage or portable safety device is not available, use a clip-on type air chuck so that the operator can stand clear during tire inflation. **Important,** when clip-on air chuck is used, line pressure must be restricted to maximum inflation capacity of tire.

Use properly matched parts only. Rim base and rings must be matched according to size and type. This information is stamped on each Firestone part.

Replace damaged parts. Abuse during road operations or in mounting the tire can cause dents, cracks, or distortions which weaken the parts. Inspect for and replace damaged parts.

Periodically inspect and remove rust and other foreign matter. Accumulation of such material in the rim gutter can prevent the proper fitting of rings. Parts that are excessively corroded are weakened and should be replaced. Use of a rust preventative compound (not containing water) during mounting will minimize rusting.

Do not use over-size or over-inflated tires. Use only recommended size rims for tires and do not exceed maximum inflation pressure for the rim.

Follow manufacturer's recommended mounting procedures.

ADDED PRECAUTION: **Re-check assemblies just prior to inflation, particularly if they have been rolled across the floor or have received rough handling between mounting and inflation.**

During tire demounting

Completely deflate tire prior to demounting. The tire should be deflated prior to removal of the tire and rim assembly from the vehicle. Remove the valve core to insure complete deflation.

DO NOT STAND IN FRONT OF RIM/TIRE DURING DEFLATION.

Follow recommended demounting procedures.

Check for damaged or worn parts. Mark defective parts for destruction to preclude their future use.

During vehicle operation

Before putting new vehicles into service, clamps and wheel nuts should be checked for proper torque.

Do not overload rims or wheels. Insure that the combination of load and vehicle weight does not exceed the rated load of the rims or wheels used. Rims and wheels are designed to sustain their rated load using the maximum tire size recommended for that rim width by the Tire & Rim Association.

Inspect rims and wheels for damage during tire checks and at periodic maintenance intervals. Remove and replace defective parts.

Do not exceed maximum inflation pressures. This is determined by the size and ply rating of the tire, but is not to exceed the maximum inflation listed for the rim or wheel. It is also important to maintain uniform inflation in both tires of a dual assembly so that weight is equally sustained.

Do not run vehicle on one tire of dual assembly. When there is loss of air in a dual tire the carrying capability is reduced and the load must be sustained by the other tire and rim. Both tires should be inflated to balanced, recommended pressures before further operation.

Never re-inflate a tire that has been run flat or seriously underinflated without first breaking rim down and reassembling rim. It is especially important to make sure the lock ring is secure in the gutter and has not been damaged prior to re-inflation.

After first 50 to 100 miles of service re-check clamp and wheel nut torque. Loose wheel nuts can cause excessive wear around bolt holes, dangerous wheel vibration, and metal fatigue failure. Excessive torque is also dangerous in that it can cause stud or wheel breakage.

THE GRADALL COMPANY
406 Mill Ave., S.W. New Philadelphia, Ohio 44663

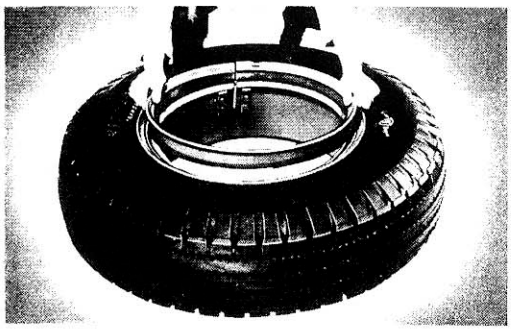
Form No. 0009

How to mount and demount ACCU-RIDE 5° Commander and 3-piece convertible rims

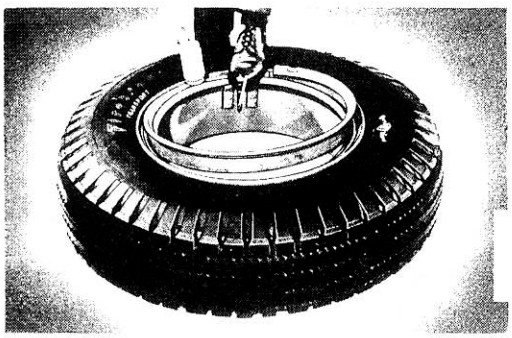
(Procedure applies to tires on both demountable rims and disc wheels)

Tools required: 1 rim mallet / 1 rim tool

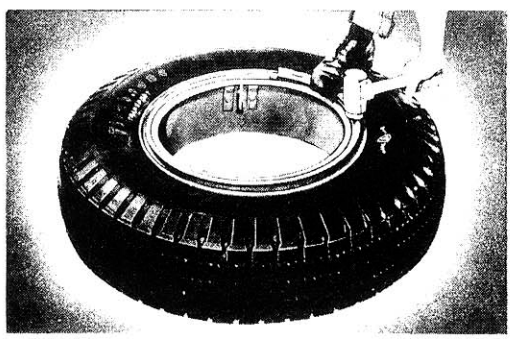
MOUNTING



After applying tire and tube in usual manner, place removable side ring (flange) on bead of tire. Then insert tapered toe of lock ring between side ring and rim base.

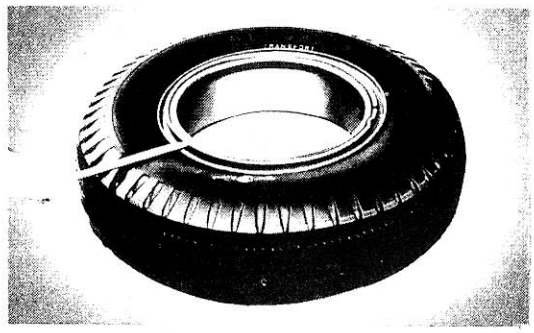


To fasten lock ring, hold with foot at one end of split and hammer end of ring into place with rim mallet.

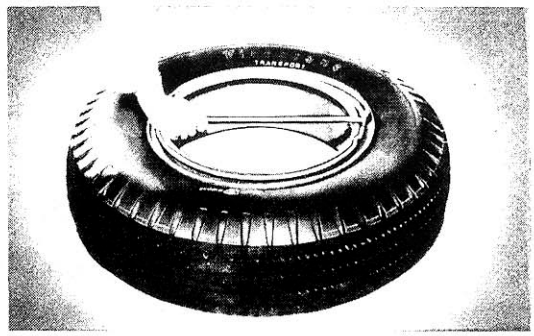


Continue progressively around the rim, holding ring with foot and hammering until entire ring is seated. Check seating of rings and inflate tire to recommended pressure.

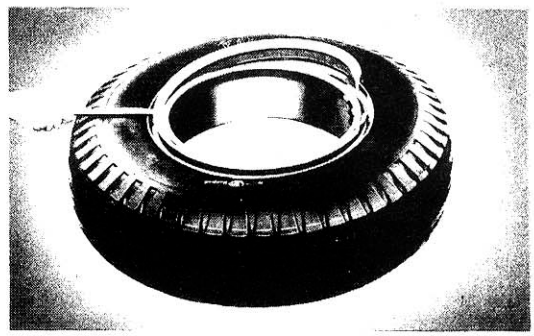
DEMOUNTING



Standing clear of rim, completely deflate tire by removing valve core or using deflator cap. Place tapered end of rim tool in depression in lock ring, or between rings, and press down on side ring to free bead. Continue downward pressure on side ring progressively around the tire until the bead is completely freed from the bead seat.



To disengage lock ring from the gutter, insert rim tool in removing notch, near split in the ring, and push downward. If desired, a second similar tool may be used to facilitate removal.



Insert the rim tool between the lock ring and side ring and press downward to pry ring up. Move progressively around the rim until lock ring is free, then lift off lock and side rings. Turn assembly over, unseat tire bead, stand tire up and remove rim base.

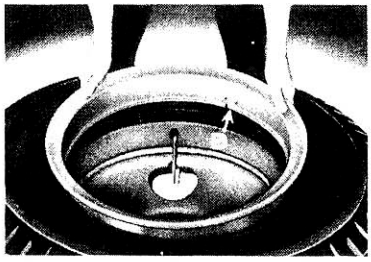
SAFETY PRECAUTIONS

1. **Use only parts free from damage or heavy rust.**
2. **Insure that lock ring is completely installed before inflating tire. Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand clear during inflation.**
3. **Insure that tire is completely deflated prior to removal of rings.**
4. **Split lock rings used with continuous side rings must not butt.**
5. **Do not inflate a flat or seriously underinflated tire while tire is on vehicle. Remove and make sure all parts are serviceable and fully reassemble before reinflating tire.**

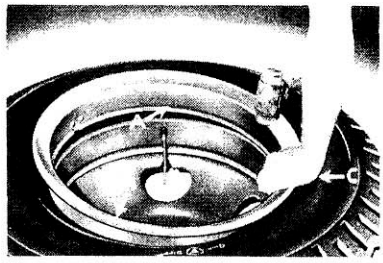
How to mount and demount ACCU-RIDE RH5° rims

Tools Required: 1 Rim Mallet
1 Rim Tool

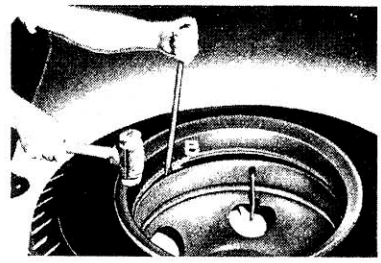
MOUNTING



Place disc portion of wheel on floor with rim gutter up. Apply tire with valve pointing in direction desired. Place side ring in position with operating notch located between two embossings (point B) approximately three inches from valve, on either side.

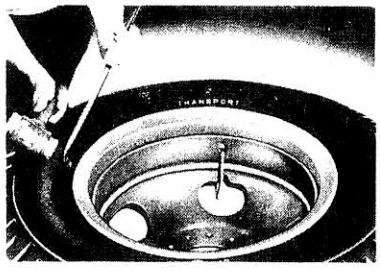


The two cutaway portions opposite each other in the inner diameter of the ring (points A) are placed so as to span the rim gutter. At point C, opposite valve, force half of ring into the gutter as far as possible using hand and rim mallet.

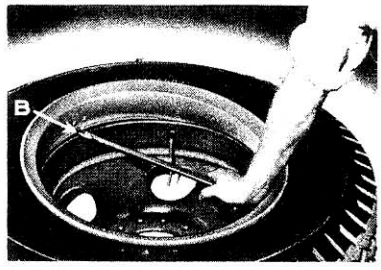


Insert straight end of rim tool in operating notch (point B), then pull in direction indicated by arrow. Retain pressure with tool and strike ring downward with mallet at point between tool slot and cutaway portion, thereby engaging ring over rim gutter at that point. Remove tool and strike additional blows progressively toward other cutaway portion until entire toe of ring has passed over the rim gutter. Check seating of ring as shown below and inflate tire to recommended pressure.

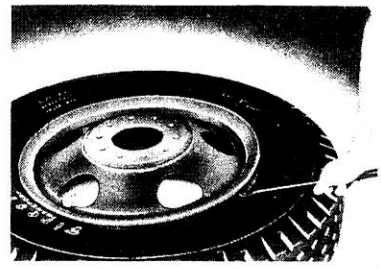
DEMOUNTING



CAUTION: Staying clear of rim, make certain tire is completely deflated. To loosen tire bead from side ring, drive curved bead-loosening end of above recommended rim tool, or a larger tire tool, between ring and bead. Pry downward on bead and repeat this operation around the ring until bead is loose.



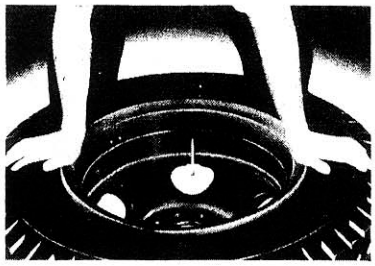
Remove ring by putting straight end of rim tool into notch in ring located between embossings (point B). Push ring downward at point opposite operating notch. Force tool handle downward as illustrated, causing ring to disengage from rim gutter. Continue operation, prying away from rim gutter with flat end of tool until free.



Turn assembly over and unseat tire bead from back flange in same manner as loosening bead from side ring in first step. Stand tire up and remove rim base.

NOTE: It is unnecessary to free the side ring from the tire bead if tire is to be removed for tube repair and immediately replaced. Simply loosen bead from back (permanent) flange as in third demounting step. Then turn the assembly over and remove ring, with tire attached, as in second demounting step.

IMPORTANT: RH-5° side rings are not interchangeable on other size RH-5° bases. Make certain side ring is right size for the rim base you are using.



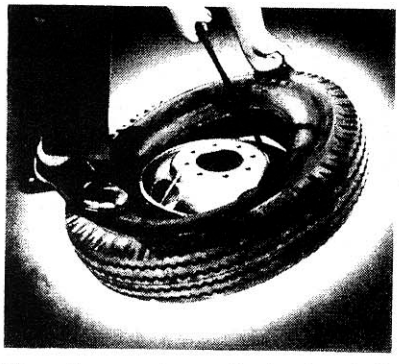
SAFETY PRECAUTIONS:

1. **Before inflating tire, be certain side ring has completely cleared the gutter of rim base. In this position, the side ring can be depressed by hand. This can be easily felt and seen. DO NOT INFLATE IF SIDE RING DOES NOT MOVE FREELY.**
2. **Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand aside during inflation.**
3. **Use only parts free from damage or heavy rust, especially at the area of contact between the rim base and side ring.**
4. **Insure that tire is completely deflated prior to removal of side ring.**
5. **Do not inflate a flat or seriously underinflated tire while tire is on vehicle. Remove and make sure all parts are serviceable and fully reassemble before reinflating tire.**

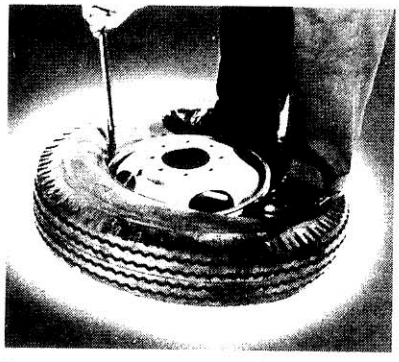
How to mount and demount ACCU-RIDE RHP rims

Tools required: 2 rim tools
1 rim mallet
1 tire tool (thin end)

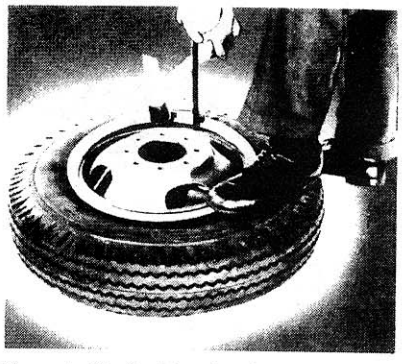
MOUNTING



Place tire on rim so that valve is in line with valve hole and insert valve through valve hole. Force first bead down into well of rim just to side of valve with foot. Mount first bead over rim gutter with rim tool progressing from each side of foot to point approximately opposite foot.

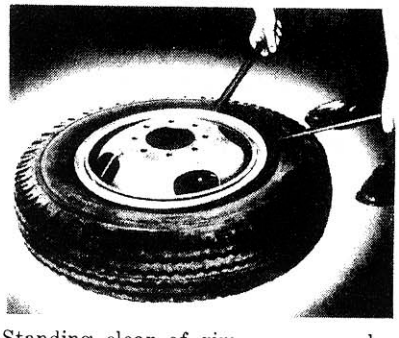


To apply second bead, start at point opposite valve and press bead toe over rim gutter and into rim well with foot pressure. Mount remainder of bead over rim gutter by means of thin tire tool, being careful not to pinch tube.

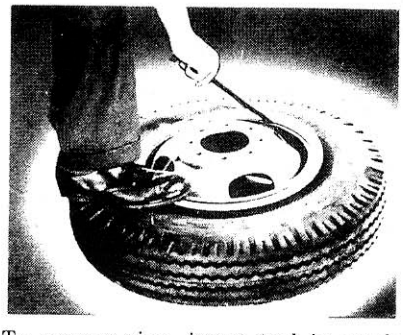


Place half of side ring in rim gutter with cutaway portions in position as shown. Insert thin end of rim tool or heavy screw driver and pull ring outward toward centered position. Strike with mallet, forcing rim into gutter.

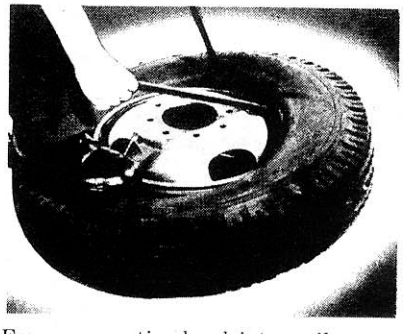
DEMOUNTING



Standing clear of rim, remove valve core to completely deflate tire. Place tire and wheel on floor with side ring up. To loosen first bead, drive hooked end of rim tool between tire and rim flange and press downward on bead. Progress around rim, using 2 tools, as shown.



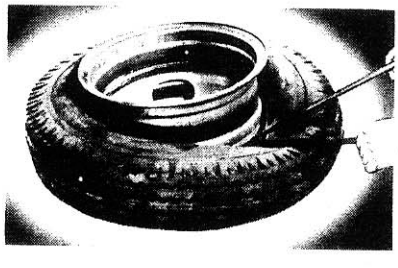
To remove ring, insert tool in notch and force ring opposite of notch into gutter, then pry off. Pry out and up on side ring, carefully but firmly. (Be careful not to bend side ring.)



Force upper tire bead into well opposite the valve slot and with tire tool pry opposite portion of bead over edge of rim.

Turn tire over and by means of rim tools, loosen bead on opposite bead seat. This can be further aided by using foot pressure.

Make sure one portion of second bead is still in the rim well, then pry opposite portion of bead over edge of rim. This will free the tire from the rim.



SAFETY PRECAUTIONS:

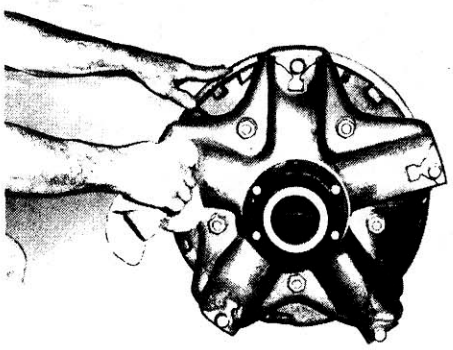
1. **Use only parts free from damage or heavy rust.**
2. **Insure that side ring is completely seated before inflating tire.**
3. **Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand aside during inflation.**
4. **Insure that tire is completely deflated prior to removal of rings.**
5. **Do not mount 16.5 diameter tubeless tires on 16" diameter rims.**

How to properly install ACCU-RIDE rims and wheels

Proper installation of rims and wheels on a vehicle is essential to safe, economical, trouble-free service. Use only the specified sizes of studs, nuts and clamps.

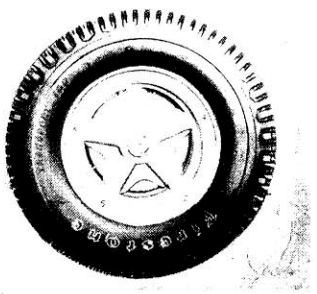
RECOMMENDED INSTALLATION PROCEDURE

DEMOUNTABLE RIMS



Make sure that all parts, including rims, rings, spacer bands and cast wheel studs are free from damage, dirt or rust. Replace any defective parts.

Place rims and spacer band on wheel. Secure clamps evenly in position and draw up nuts alternately in the sequence shown at right. Do **not** tighten them fully, however. This procedure will permit the inside rim to properly align itself on the 28° mounting bevel on the back of the cast wheel, thus avoiding damaging wheel wobble.



Then, tighten nuts fully, using same alternate sequence. Be sure to tighten these nuts **only** to the torque level recommended in the table below and to maintain them at that level through planned, periodic checks.

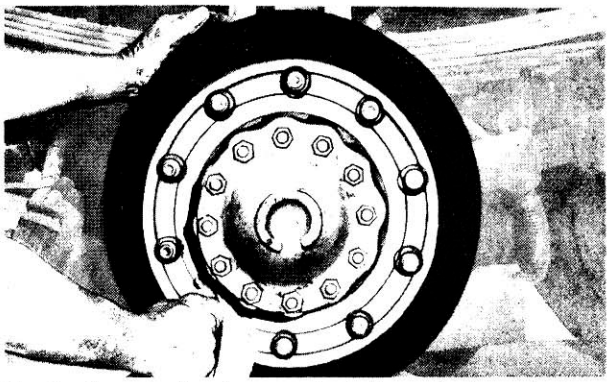
SPOKE WHEELS*	
Thread Size	Torque Ft.-Lbs. (Dry)
5/8 - 11	150 - 175
3/4 - 10	200 - 250
1 - 8	400 - 450
1 - 14	400 - 450

CAUTION: *Insufficient* mounting torque can cause rim slippage, resulting in broken valves, worn parts and damaged tires. *Excessive* mounting torque can cause damage by stripping studs, collapsing spacer bands or forcing rims into an out-of-round condition.

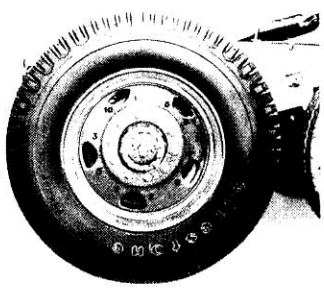
Wrenches for Demountable Rims and Disc Wheels: Double-end socket wrenches for rims and disc wheels normally are adequate to install and remove Accu-Ride rims and wheels, when used with a 3-foot bar. A 150-pound man, exerting his entire weight, 2.5 feet out on a bar, can apply 375 foot-pounds of torque to a wrench (150 x 2.5). Air wrenches, however, sometimes are used to save time and labor. The torque they deliver depends on the air line pressure from which they operate. Periodic checks by torque wrench, or other means, should be made to insure accuracy of these air wrenches.

***NOTE: After first 50 to 100 miles of service re-check clamp & wheel nut torque.**

DISC WHEELS



Check all parts for damage, including wheels and rings. Insure that studs, nuts and mounting faces of hub and wheels are clean and free from grease. Replace any defective parts.



Mount single wheel or inner dual wheel (also, outer dual wheel for hub - type mounting) over studs, being careful not to damage stud threads. Draw up nuts alternately in the sequence shown at left. Do **not** tighten them fully, however. This procedure will permit the uniform seating of nuts and insure the even, face-to-face contact of wheels and hub.

Tighten nuts fully, using the same alternate sequence. Mount the outer wheel (for double cap mounting) and repeat the entire procedure. In each case, be sure to tighten wheel nuts only to the torque level recommended in the table below and to maintain them at that level through planned, periodic checks.

Note: When inner cap nuts are re-tightened, be sure first to loosen outer cap nuts several turns; then, re-tighten them.

DISC WHEELS*		
Application	Thread Size	Torque Ft.-Lbs. (Dry)
Passenger Type Mtg.	7/16-20	80-90
	1/2-20	80-90
	9/16-18	110-120
	5/8-18	125-140
In-Out Coined Mtg.	9/16-18	175-200
	5/8-18	175-200
		1-pc. nut / 2-pc. nut
Piloted Mtg.	11/16-16	300-350 / 200-250
	3/4-16	450-500 / 300-350
	7/8-14	..... / 350-400
Ball Seat Mtg.	3/4-16	450-500
	1-1/8-16	450-500
Heavy Duty Ball Seat Mtg.	15/16-12	750-800
	1-5/16-12	750-800

CAUTION: *Insufficient* mounting torque can cause wheel shimmy, resulting in damage to parts and extreme tire tread wear. *Excessive* mounting torque can cause studs to break and discs to crack in the stud hole area.

Proper maintenance of ACCU-RIDE rims and wheels

Accu-Ride rims and wheels are thoroughly tested in Firestone laboratories, on Firestone test tracks and by both small and large fleets on the highways of America. All these tests, plus a rigid quality-control program, insure maximum performance of all Accu-Ride rims and wheels. In order, however, to maintain their built-in quality and to insure maximum service and safety a continuous maintenance program is advisable. Maintenance procedures should be carried out during all tire inspections and changes and at periodic maintenance intervals depending upon road and environmental conditions of operation.

RIM AND WHEEL MAINTENANCE DURING TIRE INSPECTIONS

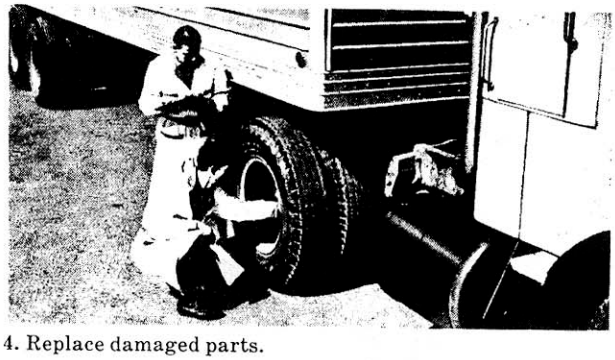
1. Check all metal surfaces thoroughly while making tire inspections, including areas between duals and on inboard side of wheel. Watch for:

excessive rust or corrosion build-up
cracks in metal
bent flanges, resulting from road obstructions
deep rim tool marks on rings or in gutter areas
loose, missing or damaged nuts or clamps
bent or stripped studs
damaged or missing rim drive plates
matched rim parts

2. Pull damaged rims or wheels.

CAUTION: Excessively corroded or cracked rims or rings can be dangerous. Deflate tires prior to the removal of rims or wheels from the vehicle.

3. Mark damaged or hazardous areas with chalk so that part will be removed from service.



4. Replace damaged parts.

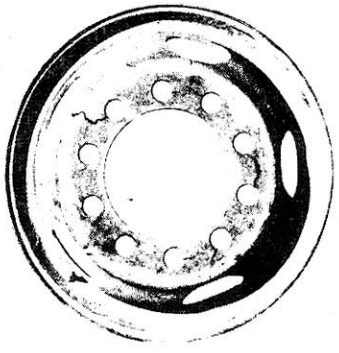
CAUTION: Insure that replacements are made with the proper sizes and types of rims and rings.

5. Inflate tires only to recommended air pressures.

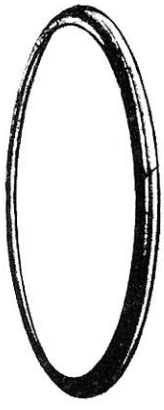
RIM AND WHEEL MAINTENANCE DURING TIRE CHANGES

1. Check all metal surfaces as in No. 1, above. A more thorough check may be made, however, after the tire has been demounted. Watch particularly for the damages illustrated below and refer to recommendations in this section of the catalog if corrective measures are required.

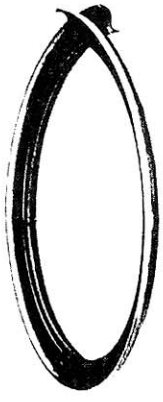
Cracks in the rim base, in the back flange and gutter areas. These are caused by deep rim tool marks, overloading and overinflating tires and using larger than recommended tire sizes.



Cracks in the wheel disc, between stud holes or hand holes. These are caused by loose wheel nuts, improper installation procedures and use of incorrect sizes or types of attaching parts.



Cracks through side ring, spreading laterally through the entire section. These are caused by improper mounting and demounting techniques, impact with road obstructions, and excessive clamping torques.



Sprung side ring, resulting from improper mounting procedures.

Erosion and chipping of bead seat of lock ring, resulting from excessive corrosion. This may occur with this part as well as others if protective measures described on following page are not taken.

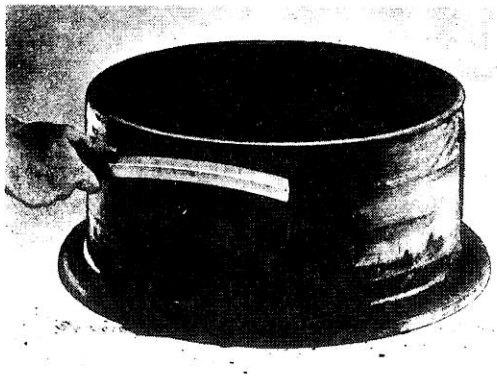
2. Replace damaged parts.

CAUTION: Insure that replacements are made with the proper sizes and types of rims and rings.

NOTE: Openings between ends of split side rings must not be less than 3/32" except where the ring design calls for an abutting condition, or more than 5/16" after ring is seated-in during operation. Split lock rings used with endless side rings must not butt.

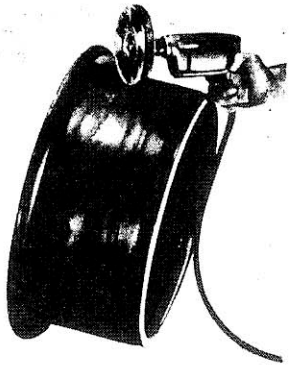
(Continued)

Proper maintenance of ACCU-RIDE rims and wheels
(continued)

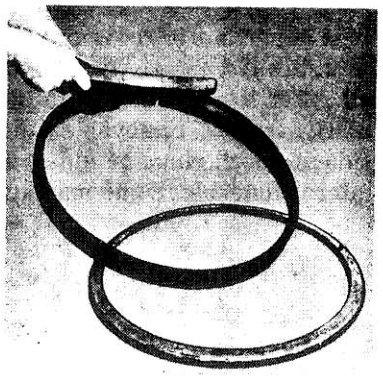


3. Thoroughly remove rust, dirt and other foreign materials from all surfaces. Hand or electric wire brushes, sand blasting or chemical baths may be used.

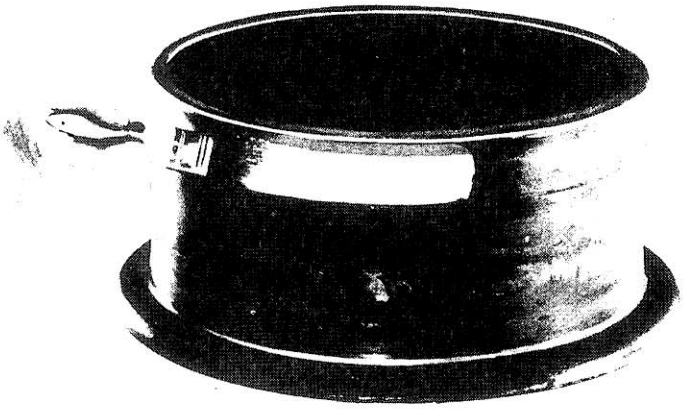
Gutter of rim base should be cleared of rust and other materials obstructing safe, positive seating of rings.



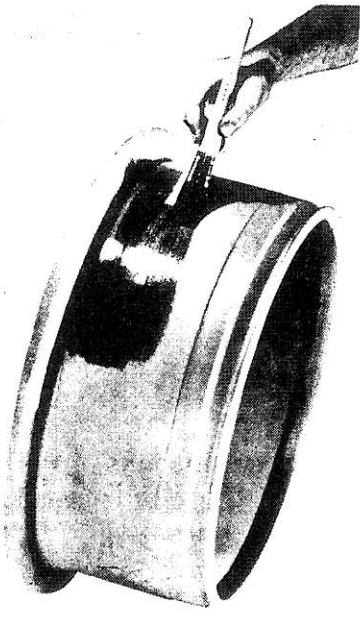
Bead seat areas of rim should be free of rust and rubber deposits. This is especially important for drop-center tubeless rims, because the 15° bead seat is the air-sealing element.



Rings should be cleaned with wire brush. Pay particular attention to seating surfaces and bead seat areas.



4. Paint rim by brush or spray with a fast-drying metal primer. Surfaces should be clean and dry prior to painting. Insure that bare metal areas on outside or tire side of rim are covered. This is especially important on drop-center tubeless rims, because warm and sometimes moist air is in constant contact with the metal surface on the tire side of the rim.

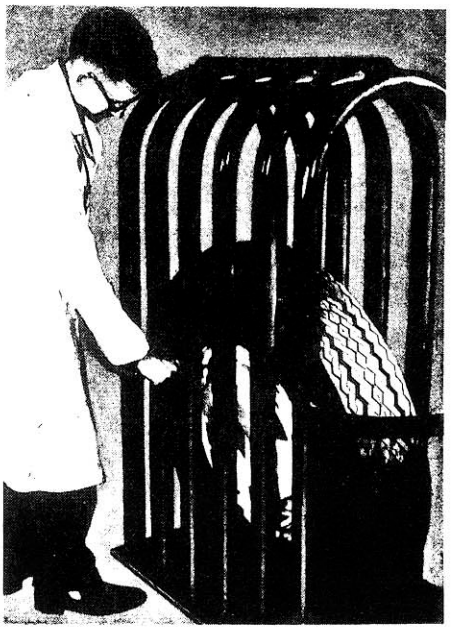


5. Lubricate tire side of rim base just prior to mounting tire. Avoid the use of any lubricant which contains water or solvent that is injurious to rubber. A combination lubricant and rust-preventive compound is preferable. This protective measure is of particular importance with drop-center tubeless rims as the air in the tire is contained by the tire-side rim surface.

6. Inflate tire only to recommended air pressure.

SAFETY PRECAUTIONS

1. **Insure that rings are properly seated, prior to inflation.**
2. **Use safety cage or lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck, so that operator may stand aside during inflation. When clip-on air chuck is used, pressure must be restricted to max. inflation capacity of tire or rim, whichever is lower.**
3. **Air tank should incorporate moisture trap when used with drop-center tubeless rims in order to reduce the moisture in contact with the metal rim surfaces.**



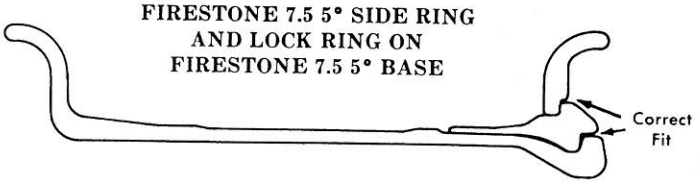
How to Insure Greater Safety and Service by Properly Matching Side and Lock Rings

It is important to recognize that the various types of highway rims produced by their manufacturers all differ to some degree in design. This is particularly true of removable rings and, as a result, side and lock rings of different rim types are not interchangeable. Some may appear to be, but they actually do not fit properly on the rim base. Serious accidents to personnel have resulted from the use of mismatched rings.

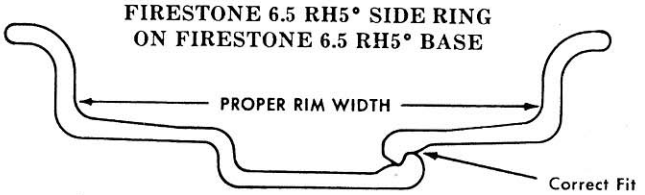
The drawings below illustrate a few of the potentially dangerous conditions which can result from the mismatching of rings and bases.

CORRECT

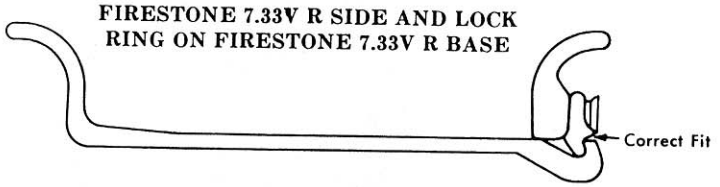
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON FIRESTONE 7.5 5° BASE



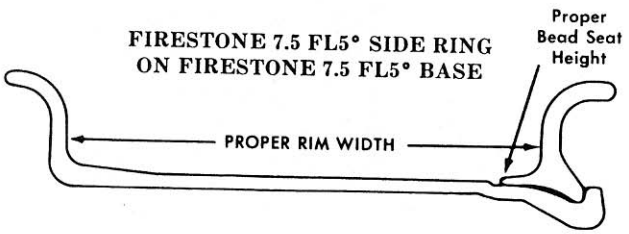
FIRESTONE 6.5 RH5° SIDE RING ON FIRESTONE 6.5 RH5° BASE



FIRESTONE 7.33V R SIDE AND LOCK RING ON FIRESTONE 7.33V R BASE

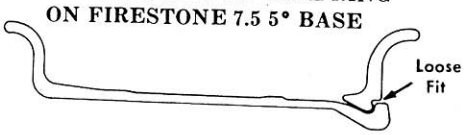


FIRESTONE 7.5 FL5° SIDE RING ON FIRESTONE 7.5 FL5° BASE

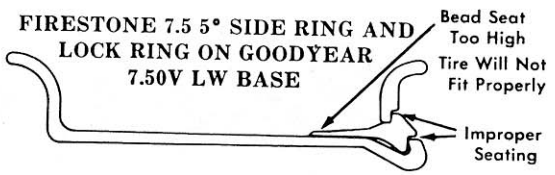


INCORRECT

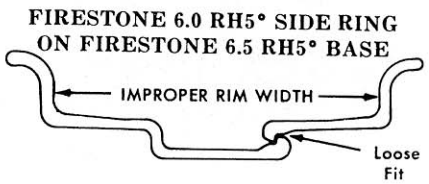
GOODYEAR 7.50V LW SIDE RING ON FIRESTONE 7.5 5° BASE



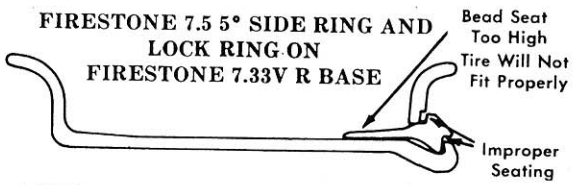
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON GOODYEAR 7.50V LW BASE



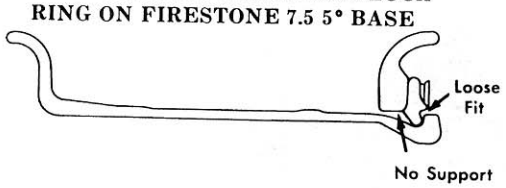
FIRESTONE 6.0 RH5° SIDE RING ON FIRESTONE 6.5 RH5° BASE



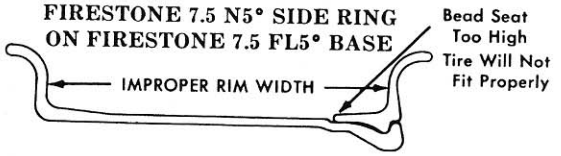
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON FIRESTONE 7.33V R BASE



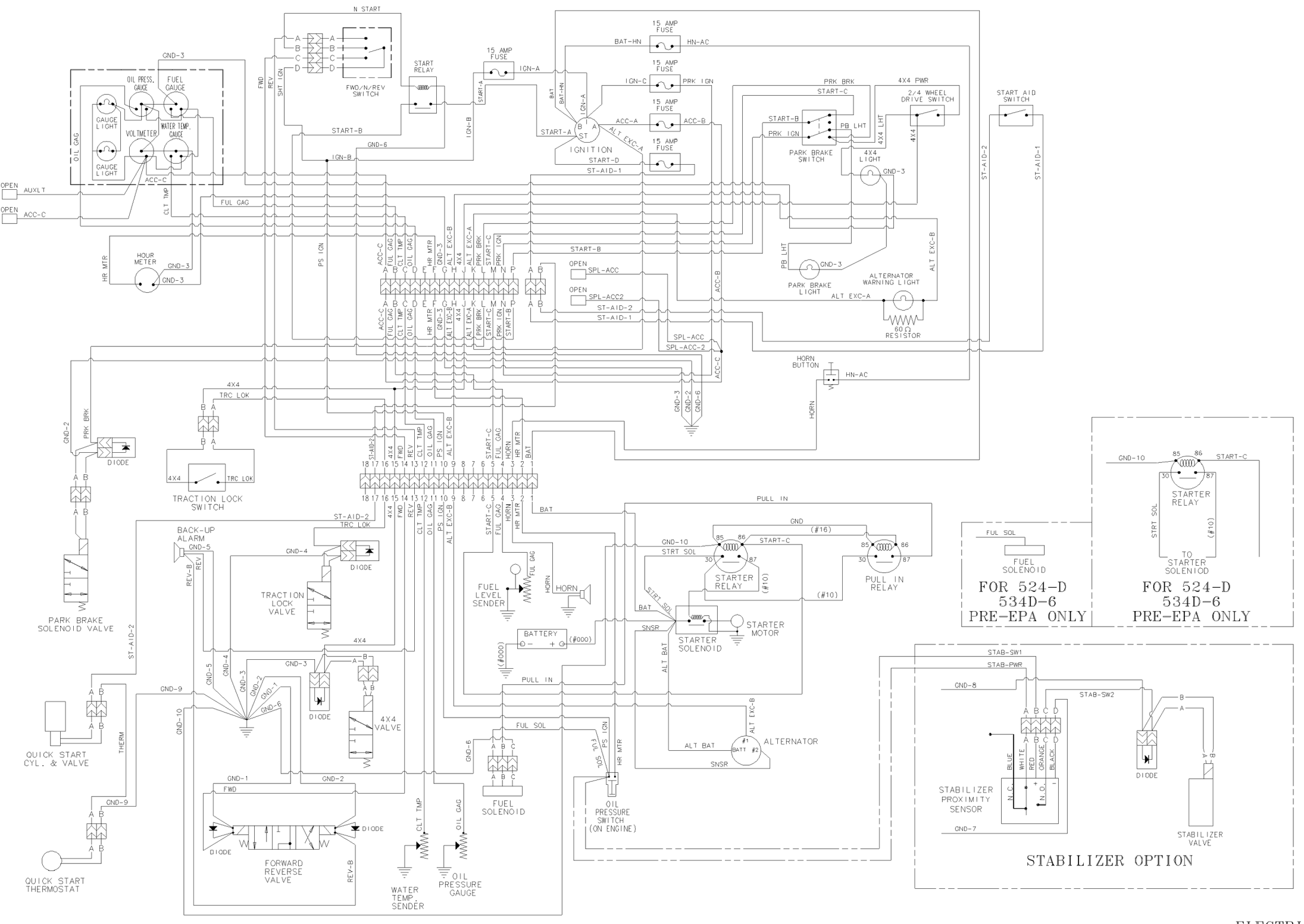
FIRESTONE 7.33V R SIDE AND LOCK RING ON FIRESTONE 7.5 5° BASE



FIRESTONE 7.5 N5° SIDE RING ON FIRESTONE 7.5 FL5° BASE



NOTE: When in doubt of component compatibility, refer to the U.S. Department of Transportation, National Highway Traffic Safety Administration's Multipiece Rim / Wheel Matching Chart. Chart is available from D.O.T. NHTSA Office of Defect Investigation, all rim and wheel distributors and all Firestone Sales Offices.

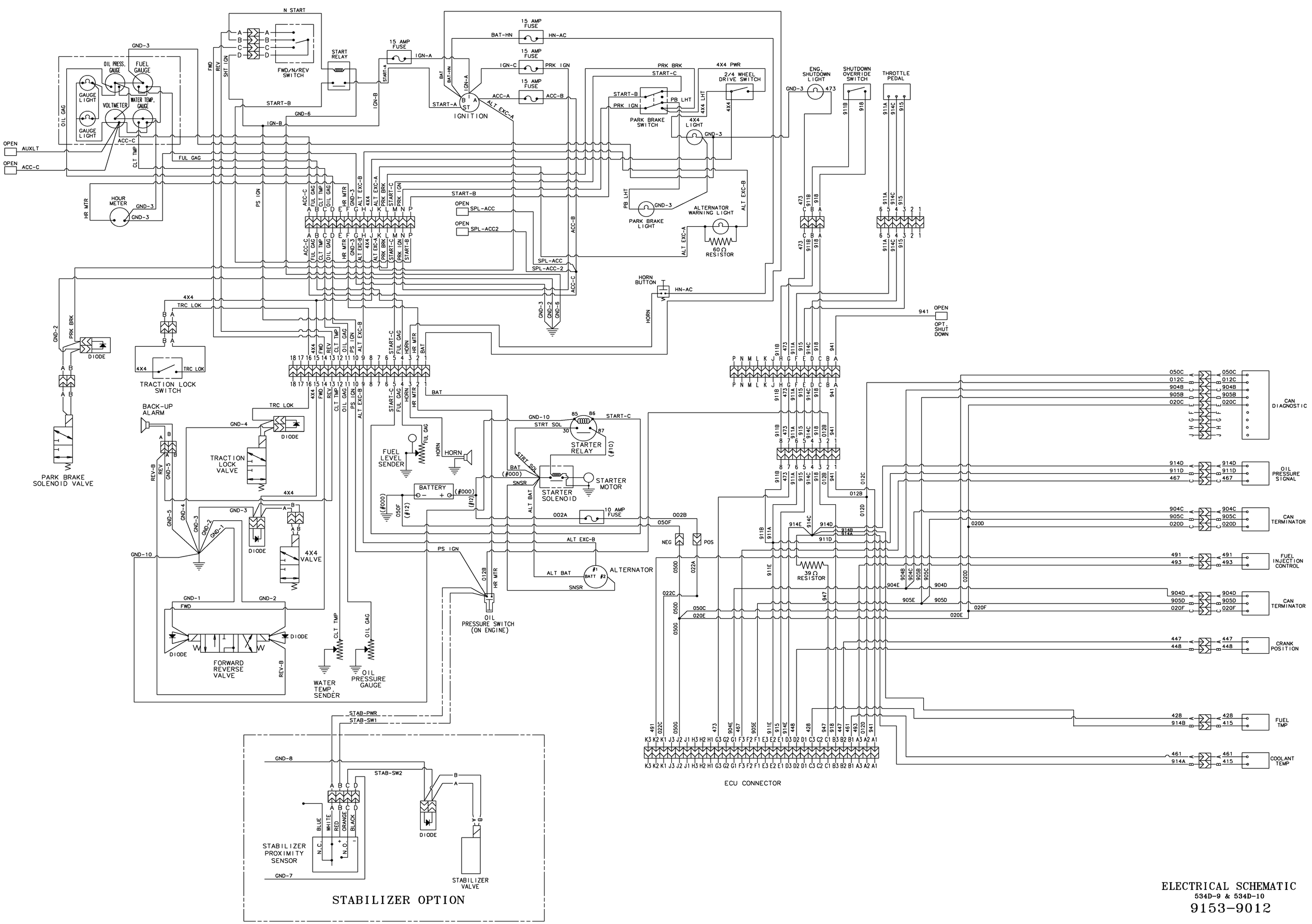


KEY		
WIRE DESIGNATION	WIRE COLOR/STRIPE	WIRE GAGE
ACC-A	ORANGE/TAN	16
ACC-B	ORANGE/BLUE	16
ACC-C	ORANGE/RED	16
ALT BAT	RED/WHITE	6
ALT EXC-A	VIOLET/RED	16
ALT EXC-B	VIOLET/RED	16
AUXLT	BLACK	16
BAT	RED	8
BAT-HN	RED	16
CLT TMP	BLUE/VIOLET	16
FUL GAG	BLUE/BLACK	16
FUL SOL	VIOLET	16
FWD	BROWN/WHITE	16
GND-1	BLACK	16
GND-2	BLACK	16
GND-3	BLACK	16
GND-4	BLACK	16
GND-5	BLACK	16
GND-6	BLACK	12
GND-7	BLACK	16
GND-8	BLACK	16
GND-9	BLACK	16
GND-10	BLACK	16
HN-AC	ORANGE/VIOLET	16
HORN	VIOLET/YELLOW	16
HR MTR	BLUE/RED	16
IGN-A	ORANGE/GRAY	16
IGN-B	ORANGE/LT GREEN	16
IGN-C	ORANGE/DK GREEN	16
N-START	BROWN/LT. GREEN	16
OIL GAG	BLUE/BROWN	16
PB LHT	BLACK	16
PRK BRK	VIOLET	16
PRK IGN	ORANGE/BLACK	16
PS IGN	ORANGE/YELLOW	16
PULL IN	VIOLET/WHITE	12
REV	BROWN/YELLOW	16
REV-B	BLUE	16
SHT IGN	ORANGE/BROWN	16
SNSR	RED/BLACK	16
SPL ACC	ORANGE	16
SPL ACC2	ORANGE/VIOLET	16
STAB-PWR	ORANGE/LT GREEN	16
STAB-SW1	ORANGE/DR GREEN	16
STAB-SW2	VIOLET	16
START-A	VIOLET/BROWN	16
START-B	VIOLET/BROWN	16
START-C	VIOLET/BROWN	16
START-D	VIOLET/ORANGE	16
ST-AID-1	VIOLET/ORANGE	16
ST-AID-2	VIOLET/ORANGE	16
STRT SOL	RED/VIOLET	10
THERM	VIOLET/ORANGE	16
TRC LOK	BROWN/GRAY	16
4X4	BROWN	16
4X4 LHT	BLACK	16
4X4 PWR	BALCK	16

ELECTRICAL SCHEMATIC

524-D 534D-6 534D-6T 534D-9 534D-10

9134-9012



ELECTRICAL SCHEMATIC

534D-9 & 534D-10

9153-9012

KEY		
WIRE DESIGNATION	WIRE COLOR/STRIPE	WIRE GAGE
ACC-A	ORANGE/TAN	16
ACC-B	ORANGE/BLUE	16
ACC-C	ORANGE/RED	16
ALT BAT	RED/WHITE	6
ALT EXC-A	VIOLET/RED	16
ALT EXC-B	VIOLET/RED	16
AUXLT	BLACK	16
BAT	RED	8
BAT-HN	RED	16
CLT TMP	BLUE/VIOLET	16
FUL GAG	BLUE/BLACK	16
FWD	BROWN/WHITE	16
GND-1	BLACK	16
GND-2	BLACK	16
GND-3	BLACK	16
GND-4	BLACK	16
GND-5	BLACK	16
GND-6	BLACK	12
GND-7	BLACK	16
GND-8	BLACK	16
GND-10	BLACK	16
HN-AC	ORANGE/VIOLET	16
HORN	VIOLET/YELLOW	16
HR MTR	BLUE/RED	16
IGN-A	ORANGE/GRAY	16
IGN-B	ORANGE/LT GREEN	16
IGN-C	ORANGE/DK GREEN	16
N-START	BROWN/LT. GREEN	16
OIL GAG	BLUE/BROWN	16
PB LHT	BLACK	16
PRK BRK	VIOLET	16
PRK IGN	ORANGE/BLACK	16
PS IGN	ORANGE/YELLOW	16
REV	BROWN/YELLOW	16
REV-B	BLUE	16
SHT IGN	ORANGE/BROWN	16
SNSR	RED/BLACK	16
SPL ACC	ORANGE	16
SPL ACC2	ORANGE/VIOLET	16
STAB-PWR	ORANGE/LT GREEN	16
STAB-SW1	ORANGE/DK GREEN	16
STAB-SW2	VIOLET	16
START-A	VIOLET/BROWN	16
START-B	VIOLET/BROWN	16
START-C	VIOLET/BROWN	16
STRT SOL	RED/VIOLET	10
TRC LOK	BROWN/GRAY	16
4X4	BROWN	16
4X4 LHT	BLACK	16
4X4 PWR	BLACK	16

KEY		
WIRE DESIGNATION	WIRE COLOR/STRIPE	WIRE GAGE
002A	RED	12
002B	RED	12
012B	RED	16
012C	RED	18
012D	RED	16
020C	BLACK	18
020E	BLACK	18
020F	BLACK	18
022A	RED	12
022C	RED	16
050C	BLACK	18
050D	BLACK	12
050G	BLACK	16
050F	BLACK	12
428	GRAY	18
447	PURPLE	18
448	GRAY	18
461	BROWN	18
467	PURPLE	16
473	ORANGE	16
491	BROWN	16
493	ORANGE	16
904B	YELLOW	18
904C	YELLOW	18
904D	YELLOW	18
904E	YELLOW	18
905B	DR. GREEN	18
905C	DR. GREEN	18
905D	DR. GREEN	18
905E	DR. GREEN	18
911A	BROWN	16
911B	BROWN	16
911D	BROWN	16
911E	BROWN	16
914A	YELLOW	16
914B	YELLOW	16
914C	YELLOW	16
914D	YELLOW	16
914E	YELLOW	16
915	DR. GREEN	16
918	GRAY	16
941	BROWN	16
947	PURPLE	16

ELECTRICAL SCHEMATIC

534D-9 & 534D-10

9153-9012

Cyclopac® Service Procedures

Proper air cleaner servicing results in maximum engine protection against the ravages of dust. Proper servicing can also save time and money by maximizing filter life and dust cleaning efficiency.

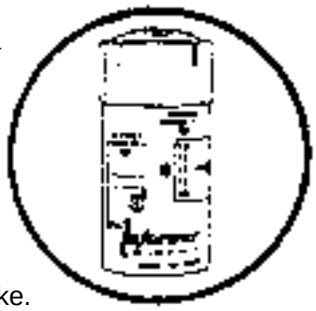
Two of the most common problems:

A) Over Servicing. New filter elements increase in dust cleaning efficiency as dust builds up on the media. Don't be fooled by filter appearance.... the filter should look dirty. By using proper filter measurement tools you will use the full life of the filter at maximum efficiency.

B) Improper Servicing. Your engine is vulnerable to abrasive dust contaminants during servicing. The most common cause of engine damage is careless servicing procedures. By following the steps shown, you can avoid unnecessary risk to the engine.

Measure Restriction

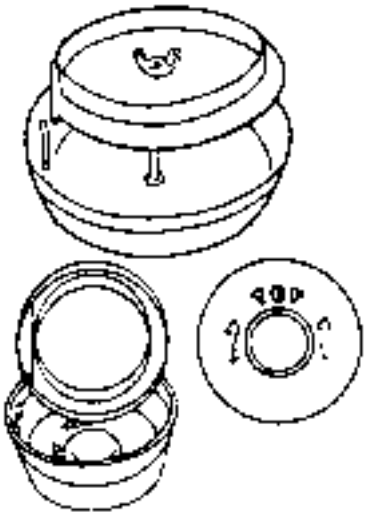
Measure the restriction of the air cleaner with a Donaldson restriction indicator, such as The Informer, a service gauge, or water manometer at the restriction tap provided in the air cleaner, the transfer pipe, or the blower intake.



One of two conditions will exist
(1) If the reading indicates the maximum restriction (per engine manufacturer's recommendations), change out the filter.
(2) If the reading shows below the maximum, the filter still has life left and should not be touched.

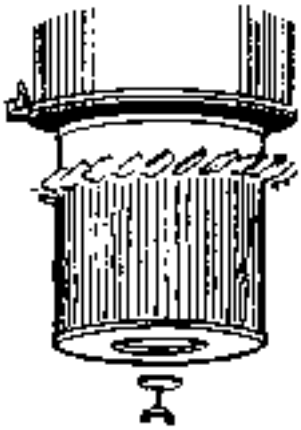
Empty the Dust Cup

Dust should not be allowed to build up closer than one inch from the baffle. On models equipped with a Donaldson Vacuator valve, dust cup service is cut to a minimum; all that is necessary is a quick check to see that the Vacuator valve is not inverted, damaged, or plugged.



Filter Servicing

When restriction indicates that filter servicing is required, loosen the wingnut and remove the primary filter. Before installing new filter, inspect the filter and gasket for shipping or storage damage. (See service tips on reverse side of this document.) Carefully install new element and wingnut.



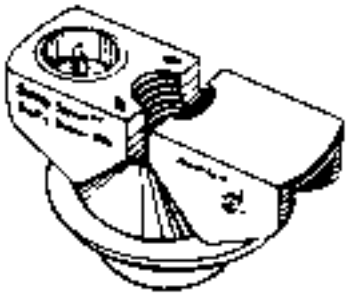
Always use authentic replacement Donaldson filters, which have been engineered to fit the air cleaner and engine intake system exactly.

Cover the Inlet

Don't leave the air inlet exposed! If the new filter won't be installed immediately, cover the opening to prevent stray contaminant from entering the induction system.

Safety Element Service

For Maximum engine protection and air cleaner service life, replace the safety filter **every third** primary filter change or cleaning, or as indicated by the Donaldson Safety Signal service indicator. Note that the safety element is not intended to be cleaned.



Reinstall the Dust Cup

Be sure the dust cup is sealed 360° around the air cleaner body. Reset the restriction indicator to green.

Check Connections

Ensure that all connections between the air cleaner and the engine are tight and leak-free.

Donaldson®

Air Filter Service Tips

7 Important Steps to Follow

(1) Remove the old element gently to prevent knocking dust off of it.

2) Always clean the inside of the housing carefully

3) Always clean the gasket sealing surfaces of the housing

4) Check for uneven dirt patterns in your old filter that indicate gasket leakage

5) Press your fresh gasket to see that it springs back

6) Make sure the gasket seats evenly

7) Ensure an airtight fit on all connections and ducts

T

The Important "Don't"

<u>Don't</u> remove filter for inspection.

Never rap a filter to clean it. Rapping only damages the filter.

<u>Never</u> judge the filter's life by looking at it. Measure how restricted its airflow is.

<u>Never</u> leave an air cleaner open longer than necessary.

<u>Don't</u> ignore a worn or damaged gasket in the housing....replace it!

Don't use a damaged or bunched filter.

Never use a warped cover on a housing.

Never substitute an incorrect filter model number.

Brochure No. F114004 (4/96) Replaces 1400-23

For more Information, Contact:

Donaldson

P.O. Box 1299
Minneapolis, MN 5544-1399 USA
Tel: 800-374-1374
FAX: (612) 887-3716

Interleuvenlaan, 1
B-3001 Leuven, Belgium
Tel. (32)-(16)-383811
Telefax: (32)-(16)-400077
Telex: 23205 Beldo B

Open Center HYDRAULIC POWER BRAKE VALVE

SERVICE MANUAL

MICO Incorporated
1911 Lee Boulevard (Zip Code 56003-2507)
P.O. Box 8118/North Mankato, MN U.S.A. 56002-8118
Phone: (507) 625-6426 Facsimile: (507) 625-3212

MICO West Division
701 East Francis Street (Zip Code 91761-5514)
P.O. Box 9058/Ontario, CA U.S.A. 91762-9058
Phone: (909) 947-4077 Facsimile: (909) 947-6054

Form No. 81-460-047 Revised 10/95 Printed in U.S.A.

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SYSTEM SCHEMATIC (TYPICAL)

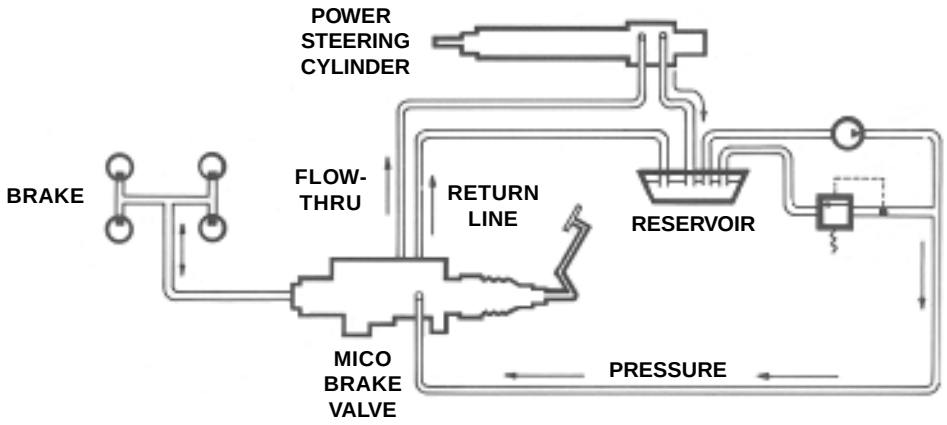


FIGURE 1

PERFORMANCE DATA (Typical)

Flow capacity.....See Specification Chart (page 7)
System pressure.....0 - 2000 psi
Brake line pressure.....See Specification Chart (page 7)
Master cylinder, capacity.....3.1 $in.^3$
Push rod travel with power.....0.2" (approx.)
Push rod force with power..... .340 lbs. at 1500 psi brake line pressure
225 lbs. at 250 psi brake line pressure (Model 06-460-652 only)
Push rod travel without power.....1.844" (approx.)
Push rod force without power.....1500 lbs. at 725 psi
518 lbs. at 250 psi (Model 06-460-652 only)

NOTE: Brake system rubber parts (Buna-N) must be compatible with mineral based hydraulic oil.

DESCRIPTION AND OPERATION OF THE MICO OPEN CENTER HYDRAULIC POWER BRAKE VALVE

The MICO Open Center Brake Valve will provide hydraulic power braking when installed in an open center hydraulic circuit. It can be used in conjunction with other hydraulic devices such as power steering, also installed in the same circuit. Using a single pump to provide flow and pressure, the brake valve should be installed in the system circuitry, in series, between the pump relief valve and the other hydraulic devices. The entire pump flow is directed thru the brake valve and is available to actuate the downstream devices. The brake valve requires a very small volume of oil for its operation; therefore, it does not interfere with the rest of the circuit, nor does usual actuation of the downstream hydraulic devices affect operation of the brake valve . Full system pressure is always available for operating the rest of the system.

The MICO Brake Valve provides a single-fluid system using the systems hydraulic oil to operate the brakes. Synthetic rubber wheel-cylinder cups must be used to prevent swelling.

This valve reduces the braking effort to any required degree depending on pedal ratio. Brake pedal force is directly proportional to brake line pressure, thus giving a sense of feel in the operation of the brakes. Manual braking is always available whenever the hydraulic power system is not functioning. This is accomplished by a mechanical follow through within the brake valve. A longer pedal stroke, usually with increased pedal effort, will be expected when braking in this condition.

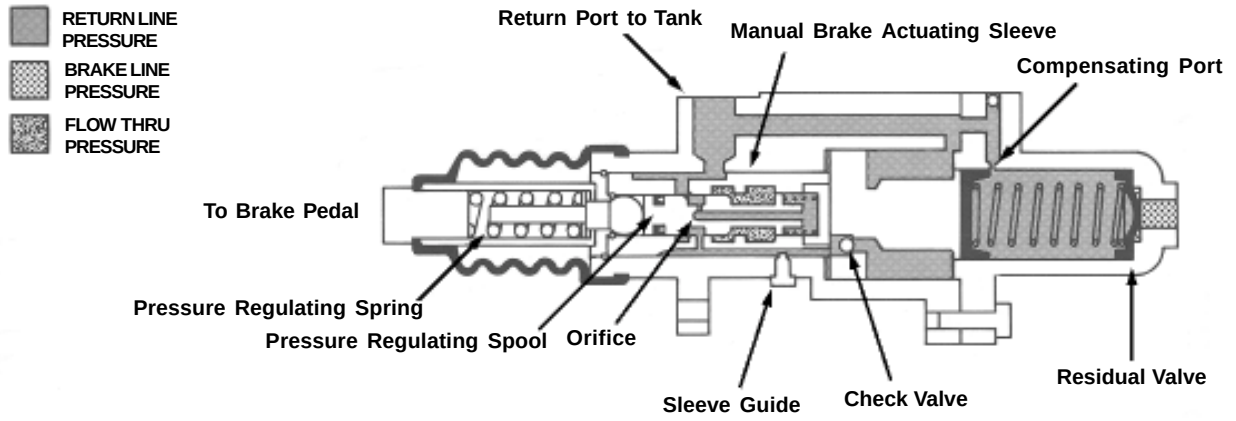
The manner in which the hydraulic power brake valve funtions will be discussed in the following paragraphs.

Oil from the pump flows through the brake valve and on to the downstream hydraulic unit as indicated (Figure 3). Sections of the valve which are communicated to the return port and the tank when the valve is not operating are shown (Figure 2). The compensating port (Figure 2) provides for thermal expansion of the oil in the brake lines and the master cylinder.

The residual valve (Fig. 2), if used, maintains pressure of 12-20 PSI in the brake lines when the pedal

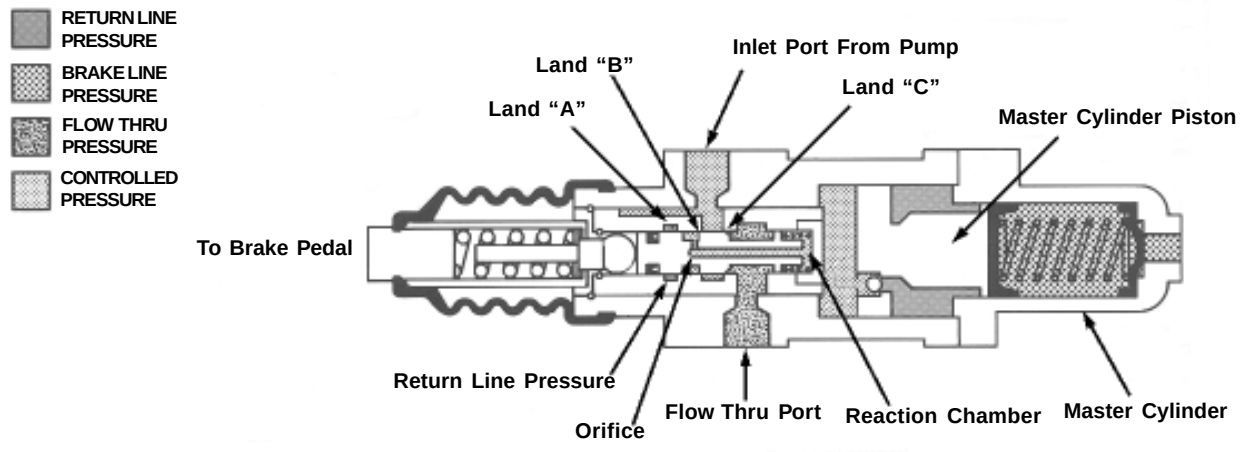
Schematic of Brake Valve in Neutral

FIGURE 2

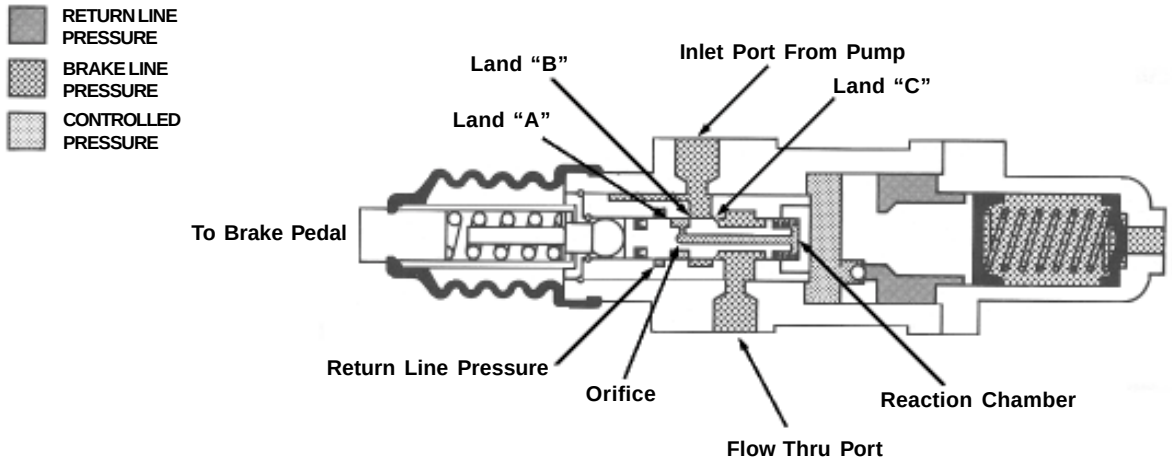


Brake Valve Actuated -- Power Steering in Neutral

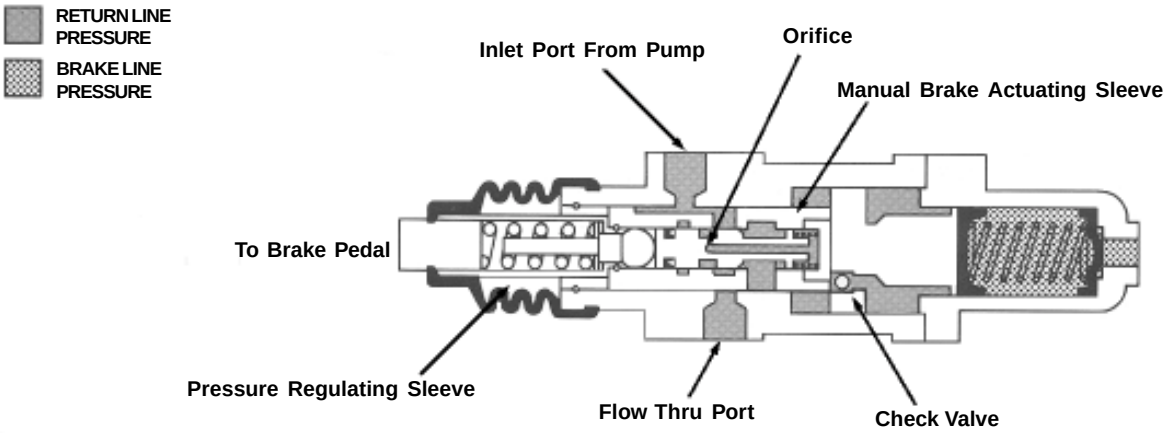
FIGURE 3



Hydraulic System Pressure Equal to Brake Line Pressure **FIGURE 4**



Schematic of Brake Valve in Manual Operation **FIGURE 5**



is released. In drum brake systems, this low pressure aids in preventing air from entering the brakes when the vehicle is at rest. The residual valve is removed from models designed for disc brake systems because of the drag which would develop in this type of brake, even at these relatively low pressures.

When force is applied to the brake pedal, this force acts through the PRESSURE REGULATING SPRING to shift the PRESSURE REGULATING SPOOL restricting the flow of oil at LAND "C" to build up pressure when there is no requirement for pressure to the power steering or other hydraulic device (Figure 3). As the pressure builds up, a small amount of oil flows through the ORIFICE and down through the passage inside the spool to the REACTION CHAMBER (Figure 3). At the same time, oil flows along a groove in the outside diameter of the MANUAL BRAKE ACTUATING SLEEVE into the chamber ahead of the MANUAL BRAKE ACTUATING SLEEVE (Figure 2). Flow to the area ahead of the MANUAL BRAKE ACTUATING SLEEVE moves the MASTER CYLINDER PISTON, building up pressure in the MASTER CYLINDER which, in turn, builds pressure in the brake lines. Pressure in the REACTION CHAMBER moves the SPOOL back a small amount against the PRESSURE REGULATING SPRING, and when the hydraulic pressure balances against the PRESSURE REGULATING SPRING the pressure is controlled to the MASTER CYLINDER. The ORIFICE controls the rate of flow to the REACTION CHAMBER; hence, the rate of pressure increases and stability of the pressure regulating spool is controlled. Therefore, system efficiency is maintained since the power brake valve does not momentarily take all of the fluid from the pump. When the pedal effort is released, the spring in the REACTION CHAMBER returns the pressure regulating spool to neutral. This closes LAND "B" to pressure and opens LAND "A" which allows the oil ahead of the spool in the REACTION CHAMBER to flow to the return port as well as the oil ahead of the MANUAL BRAKE ACTUATING SLEEVE. The spring in the MASTER CYLINDER returns the MASTER CYLINDER PISTON.

In case the downstream power hydraulic system requires a pressure that is equal to or greater than

one-half the brake line pressure, the PRESSURE REGULATING SPOOL shifts a minute amount and the pressure is regulated across LAND "A" and LAND "B" (Figure 4).

If the pressure required by the brake valve is lower than that required by the power steering, the power steering will not normally interfere with the operation of the brake (Figure 4).

NOTE: Brake line pressure can exceed preset specifications in the unusual condition of a simultaneous brake application and sudden elevation of the steering pressure above the value.

In the standard MICO Open Center Valve, the pressure in the REACTION CHAMBER and ahead of the MASTER CYLINDER PISTON is equal to one-half of the brake line pressure. To accomplish this, the area of the MASTER CYLINDER PISTON is twice the area of the MASTER CYLINDER. Therefore, any pressure that is applied to the MASTER CYLINDER PISTON will be multiplied by two to determine the master cylinder pressure. The pressure regulating spring can be factory set to normally limit brake line pressure regardless of system pressure.

This valve will act as a manual brake master cylinder, in the event of failure in the hydraulic circuit supplying power to it. The PRESSURE REGULATING SLEEVE contacts the MANUAL BRAKE ACTUATING SLEEVE which, in turn, pushes directly on the master cylinder piston, thereby building pressure in the MASTER CYLINDER (Figure 5). This requires a longer stroke in the pedal. This amount of pressure that can be generated in the brake lines in manual operation is proportional to the pedal ratio and the effort which the operator is able to exert on the pedal. In most cases, the operator is not able to build as much pressure in the brake line as can be done in power operations. The ports from the pump are restricted when the valve is actuated manually; however, as soon as the engine is started, hydraulic pressure will push the MANUAL BRAKE ACTUATING SLEEVE back against the retaining ring which contains it and the valve again functions with power. This is rather an abrupt action when the engine is started, causing the brake pedal to return to its power mode position, and it is suggested that the brakes not be applied manually when starting the engine.

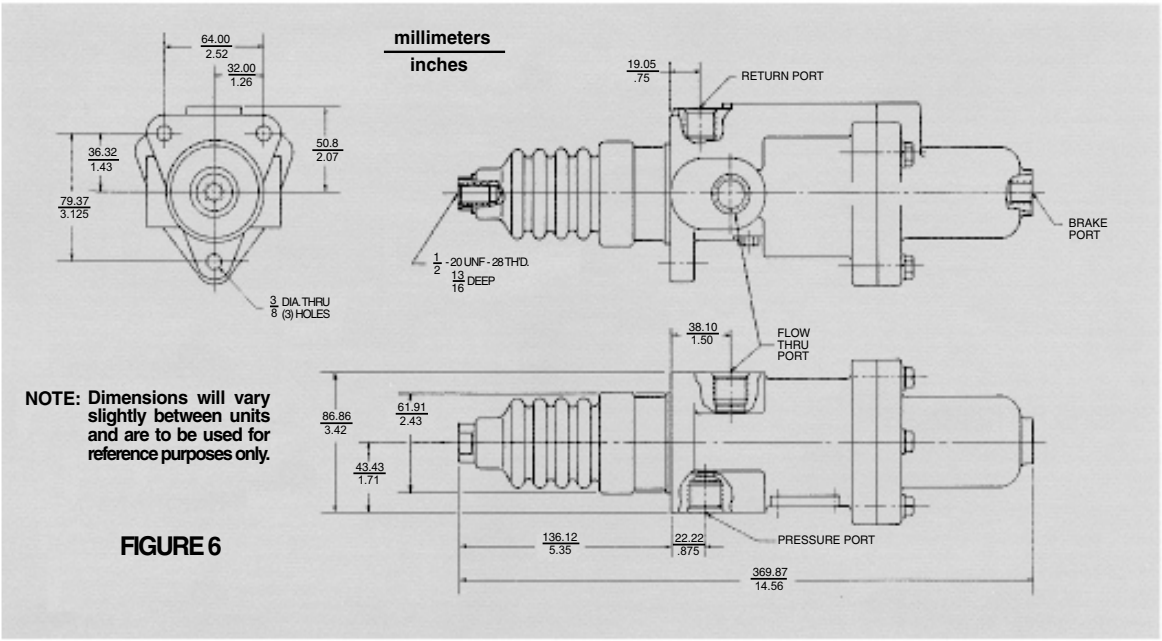


FIGURE 6

INSTALLATION INSTRUCTIONS

1. Mount MICO Open Center Power Brake Valve on vehicle and complete push rod and pedal hook-up. NOTE: It is important that the system reservoir be mounted above the brake valve, or that the return line have a vertical section of one foot directly above the valve.
2. The pedal assembly must have its own return spring. DO NOT rely on the internal spring in the valve for this function.
3. Pedal should be adjusted to allow 1/32" clearance between pressure regulating rod and actuator.
4. Bleed system (see bleeding instruction on page 14).
5. Be sure all hydraulic fittings are tight and visually check system for leaks with power applied.

THREE OPEN CENTER HYDRAULIC POWER BRAKE VALVE DESIGNS

PRIMARY CUP DESIGN

The Primary Cup Design uses a residual valve. This valve will maintain a pressure of 12 - 20 PSI in the brake lines when the pedal is released. When used in drum brake systems this low pressure aids in preventing air from entering the brakes when the vehicle is at rest.

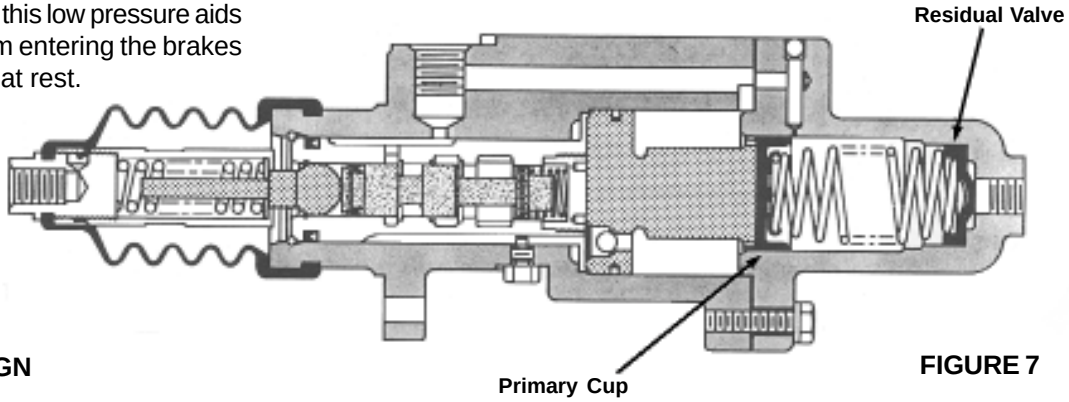


FIGURE 7

RING SEAL DESIGN

The Ring Seal Design is used mainly in disc brake systems. The residual valve is removed from models designed for disc brake systems because of the pressure they maintain in the brake lines when the pedal is released. Even these relatively low pressures (12 - 20 PSI) would develop drag in this type of brake.

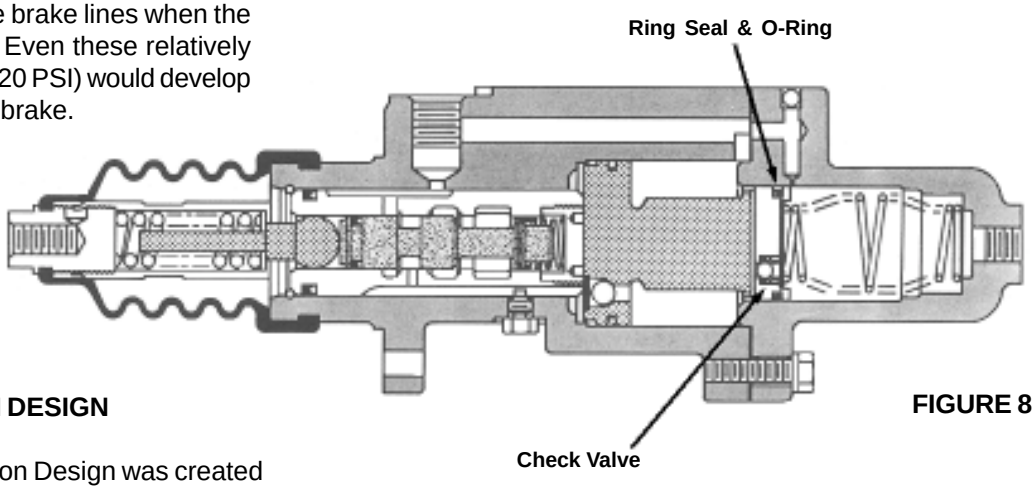


FIGURE 8

SLIDING PISTON DESIGN

The Sliding Piston Design was created with a specific function in mind. A specially designed piston slides inside the primary piston when the brake pedal is actuated. If primary piston strokes too far, the brake pedal will be pulled down with a short abrupt stroke. This indicates to the operator that maintenance is required.

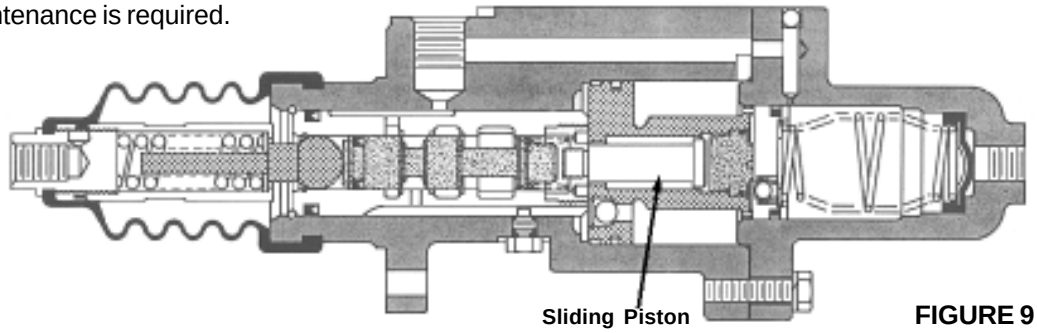


FIGURE 9

SPECIFICATIONS CHART

Part Number	Brake Port	Pressure Port	Flow Thru Port	Return Port	Brake Line Pressure (with power)	Flow Capacity
* 06-460-520	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1850 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-658						
06-460-522	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1850 psi ± 50 psi	3-24 gpm
* 06-460-550	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
* 06-460-560	1/2-20 UNF	SAE No. 8	SAE No. 8	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
* 06-460-570	9/16-18 UNF	SAE No. 8	SAE No. 8	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-662						
* 06-460-580	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
* 06-460-588	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-664						
* 06-460-610	9/16-18 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	950 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-666						
* 06-460-620	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
06-460-642	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
* 06-460-650	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-656						
* 06-460-654	9/16-18 UNF	SAE No. 8	SAE No. 8	SAE No. 10	1500 psi ± 50 psi	3-12 gpm
Complete unit replaced by 06-460-676						
* 06-460-656	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-24 gpm
* 06-460-658	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1850 psi ± 50 psi	3-24 gpm
* 06-460-660	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1150 psi ± 50 psi	3-24 gpm
* 06-460-662	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1550 psi ± 50 psi	3-24 gpm
* 06-460-664	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-12 gpm
* 06-460-666	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	950 psi ± 50 psi	3-24 gpm
06-460-668	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1000 psi ± 50 psi	3-12 gpm
* 06-460-670	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1550 psi ± 50 psi	3-8 gpm
06-460-672	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	750 psi ± 50 psi	3-24 gpm
* 06-460-674	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-12 gpm
06-460-676	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-12 gpm
06-460-678	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1700 psi ± 50 psi	3-24 gpm
* 06-460-680	1/2-20 UNF	SAE No. 8	SAE No. 8	SAE No. 10	1550 psi ± 50 psi	3-8 gpm
Complete unit replaced by 06-460-670						
06-460-682	1/2-20 UNF	SAE No. 8	SAE No. 8	SAE No. 10	750 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-460-672						
06-460-684	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1100 psi ± 50 psi	3-12 gpm
* 06-460-686	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1500 psi ± 50 psi	3-12 gpm
Complete unit replaced by 06-460-674						
06-461-520	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1850 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-461-658						
06-461-550	1/2-20 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	1500 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-461-656						
06-461-610	9/16-18 UNF	SAE No. 10	SAE No. 10	1/2-14 NPTF	950 psi ± 50 psi	3-24 gpm
Complete unit replaced by 06-461-666						
06-461-656	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-24 gpm
06-461-658	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1850 psi ± 50 psi	3-24 gpm
06-461-660	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1150 psi ± 50 psi	3-24 gpm
06-461-666	9/16-18 UNF	SAE No. 10	SAE No. 10	SAE No. 10	950 psi ± 50 psi	3-24 gpm
06-461-674	1/2-20 UNF	SAE No. 10	SAE No. 10	SAE No. 10	1500 psi ± 50 psi	3-12 gpm

• For use with drum brakes (has residual check valve)

NOTE: The valves should be used within the flow capacities indicated above for optimum performance. Valves are functional at lower flows but response is reduced. At the higher flow operation higher pressure drops are seen.

OPEN CENTER HYDRAULIC BRAKE VALVE
PRIMARY CUP DESIGN
(Refer to Figure 10)

Disassembly

1. Remove boot (item 1) and pressure regulating spring assembly (item 2).

   CAUTION: Pressure regulating spring assembly has been set at the factory and should never be disassembled, re-adjusted or interchanged with another valve.

2. Separate end cap (item 21) from housing (item 11).

   CAUTION: Care must be taken as end cap is under tension of spring (item 19).

   Remove gasket (item 14).
3. Remove primary cup (item 17), retainer (item 18), spring (item 19) and residual valve (item 20) from end cap (item 21).
4. Remove cap screw (item 13) from under side of housing (item 11). Remove o-ring (item 12) from cap screw.
5. Remove retaining ring (item 8) from housing (item 11).
6. Remove sleeve (item 10) by pulling on push rod (item 4). Remove cup (item 9) from sleeve.
7. Remove piston (item 16) from housing (item 11). Remove piston ring (item 15) from piston.
8. Remove retaining ring (item 3) carefully with a small flat tool. Do not scratch bore of sleeve (item 10).
9. Remove push rod (item 4), spool (item 6) and spring (item 7) from sleeve (item 10). Remove cup (item 5) from spool (item 6).

Inspection

Clean and inspect all component parts for scratches, cracks or wear. Replace any parts that are excessively worn or damaged.

CAUTION: If spool (item 6), sleeve (item 10) or bore of housing (item 11) are in any way damaged, scratched or broken, the entire assembly must be replaced. These parts are select-fitted and are not interchangeable or replaceable with service items.

Assembly

1. Install new cup (item 9) on sleeve (item 10) and new cup (item 5) on spool (item 6).

   CAUTION: Lips on cups (items 5 & 9) should be away from ends of spool (item 6) and sleeve (item 10).

2. Place spring (item 7) in sleeve (item 10).
3. Install spool (item 6) in sleeve (item 10). Note direction of spool.
4. Install push rod (item 4) in sleeve (item 10) and secure it with new retaining ring (item 3).
5. Install new o-ring (item 12) on cap screw (item 13) and install in housing (item 11).
6. Carefully install sleeve (item 10) into housing (item 11).

   CAUTION: Make sure that groove on sleeve will engage cap screw (item 13).

   Install retaining ring (item 8).
7. Install new piston ring (item 15) on piston (item 16) and install in housing (item 11).
8. Place new residual valve (item 20), spring (item 19) and retainer (item 18) in end cap (item 21).

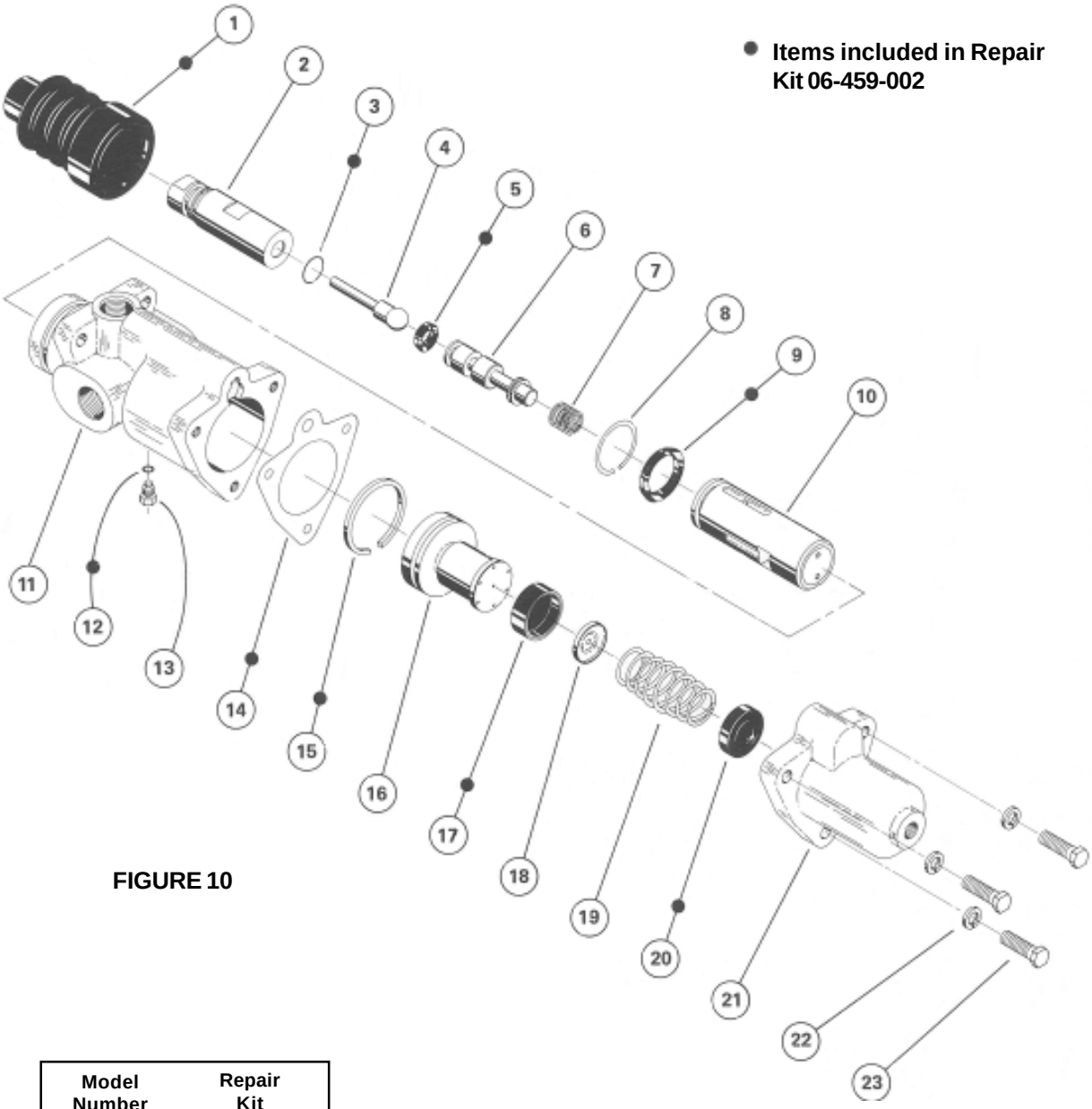
   CAUTION: Residual valve must be checked for proper seating in end cap.

9. Place new gasket (item 14) on mounting face of end cap (item 21) and new primary cup (item 17) on end of spring (item 19).
10. Assemble end cap (item 21) with its components to housing (item 11) making sure lip on primary cup (item 17) has properly engaged bore of housing.
11. Install lock washer (items 22) and bolts (items 23). Torque 16 to 18 ft. lbs.
12. Install pressure regulating spring assembly (item 2) on push rod (item 4). Install new boot (item 1).

SEE BLEEDING SECTION FOR COMPLETE BLEEDING INSTRUCTIONS

PARTS LIST

ITEM		DESCRIPTION
1	•	BOOT
2		PRESSURE REGULATING SPRING ASSEMBLY
3	•	RETAINING RING
4		PUSH ROD
5	•	CUP
6		SPOOL
7		SPRING
8		RETAINING RING
9	•	CUP
10		SLEEVE
11		HOUSING
12	•	O-RING
13		CAP SCREW
14	•	GASKET
15	•	PISTON RING
16		PISTON
17	•	PRIMARY CUP
18		RETAINER
19		SPRING
20	•	RESIDUAL VALVE
21		END CAP
22		LOCKWASHERS
23		BOLTS



● **Items included in Repair Kit 06-459-002**

FIGURE 10

Model Number	Repair Kit
06-460-520	06-459-002
06-460-522	06-459-002
06-460-550	06-459-002
06-460-560	06-459-002
06-460-570	06-459-002
06-460-580	06-459-002
06-460-588	06-459-002
06-460-610	06-459-002
06-460-620	06-459-002
06-460-650	06-459-002
06-460-680	06-459-002
06-460-686	06-459-002

OPEN CENTER HYDRAULIC BRAKE VALVE
RING SEAL DESIGN
(Refer to Figure 11)

Disassembly

1. Remove boot (item 1) and pressure regulating spring assembly (item 2).

   CAUTION: Pressure regulating spring assembly has been set at the factory and should never be disassembled.

2. Separate end cap (item 21) from housing (item 11).

   CAUTION: Care must be taken as end cap is under tension of spring (item 20).

   Remove gasket (item 14).

3. Remove piston & poppet assembly (item 17) and spring (item 20) from end cap (item 22).

   CAUTION: If you have model 06-460-566, you will also have to remove residual valve (item 21).

4. Remove cap screw (item 13) from under side of housing (item 11). Remove o-ring (item 12) from cap screw.
5. Remove retaining ring (item 8) from housing (item 11).
6. Remove sleeve (item 10) by pulling on push rod (item 4). Remove cup (item 9) from sleeve.
7. Remove piston (item 16) from housing (item 11). Remove piston ring (item 15) from piston.
8. Remove retaining ring (item 3) carefully with a small flat tool. Do not scratch bore of sleeve (item 10).
9. Remove push rod (item 4), spool (item 6) and spring (item 7) from sleeve (item 10). Remove cup (item 5) from spool (item 6).

Inspection

Clean and inspect all component parts for scratches, cracks or wear. Replace any parts that are excessively worn or damaged.

CAUTION: If spool (item 6), sleeve (item 10) or bore of housing (item 11) are in any way damaged, scratched or broken, the entire assembly must be replaced. These parts are select-fitted and are not interchangeable or replaceable with service items.

Assembly

1. Install new cup (item 9) on sleeve (item 10) and new cup (item 5) on spool (item 6).

   CAUTION: Lips on cups (items 5 & 9) should be away from ends of spool (item 6) and sleeve (item 10).

2. Place spring (item 7) in sleeve (item 10).
3. Install spool (item 6) in sleeve (item 10). Note direction of spool.
4. Install push rod (item 4) in sleeve (item 10) and secure it with retaining ring (item 3).
5. Install new o-ring (item 12) on cap screw (item 13) and install in housing (item 11).
6. Carefully install sleeve (item 10) into housing (item 11).

   CAUTION: Make sure that groove on sleeve will engage cap screw (item 13)

   Install retaining ring (item 8).

7. Install piston ring (item 15) on piston (item 16) and install in housing (item 11).
8. Install new o-ring (item 18) and new ring seal (item 19) on new piston & poppet assembly (item 17).
9. Install spring (item 20) and piston & poppet assembly (item 17) in end cap (item 22).

   NOTE: If you have model 06-460-566, you will have to install new residual valve (item 21). You must also check residual valve for proper seating in end cap.

CAUTION: Extreme care must be taken so as not to scratch teflon seal (item 19) when installing piston & poppet assembly (item 17) in end cap (item 22).

10. Place new gasket (item 14) on mounting face of end cap (item 22) and assemble, with its components, to housing (item 11).
11. Install lock washers (item 23) and bolts (item 24). Torque 16 to 18 ft. lbs.
12. Install pressure regulating spring assembly (item 2) on push rod (item 4). Install new boot (item 1).

SEE BLEEDING SECTION FOR COMPLETE BLEEDING INSTRUCTIONS

PARTS LIST

ITEM	DESCRIPTION
1 * •	BOOT
2	PRESSURE REGULATING SPRING ASSEMBLY
3	RETAINING RING
4	PUSH ROD
5 * •	CUP
6	SPOOL
7	SPRING
8	RETAINING RING
9 * •	CUP
10	SLEEVE
11	HOUSING
12 * •	O-RING
13	CAP SCREW
14 * •	GASKET
15 *	PISTON RING
16	PISTON
17 * •	PISTON & POPPET ASSEMBLY
18 * •	O-RING
19 * •	RING SEAL
20	SPRING
21 *	RESIDUAL VALVE
22	END CAP
23	LOCKWASHERS
24	BOLTS

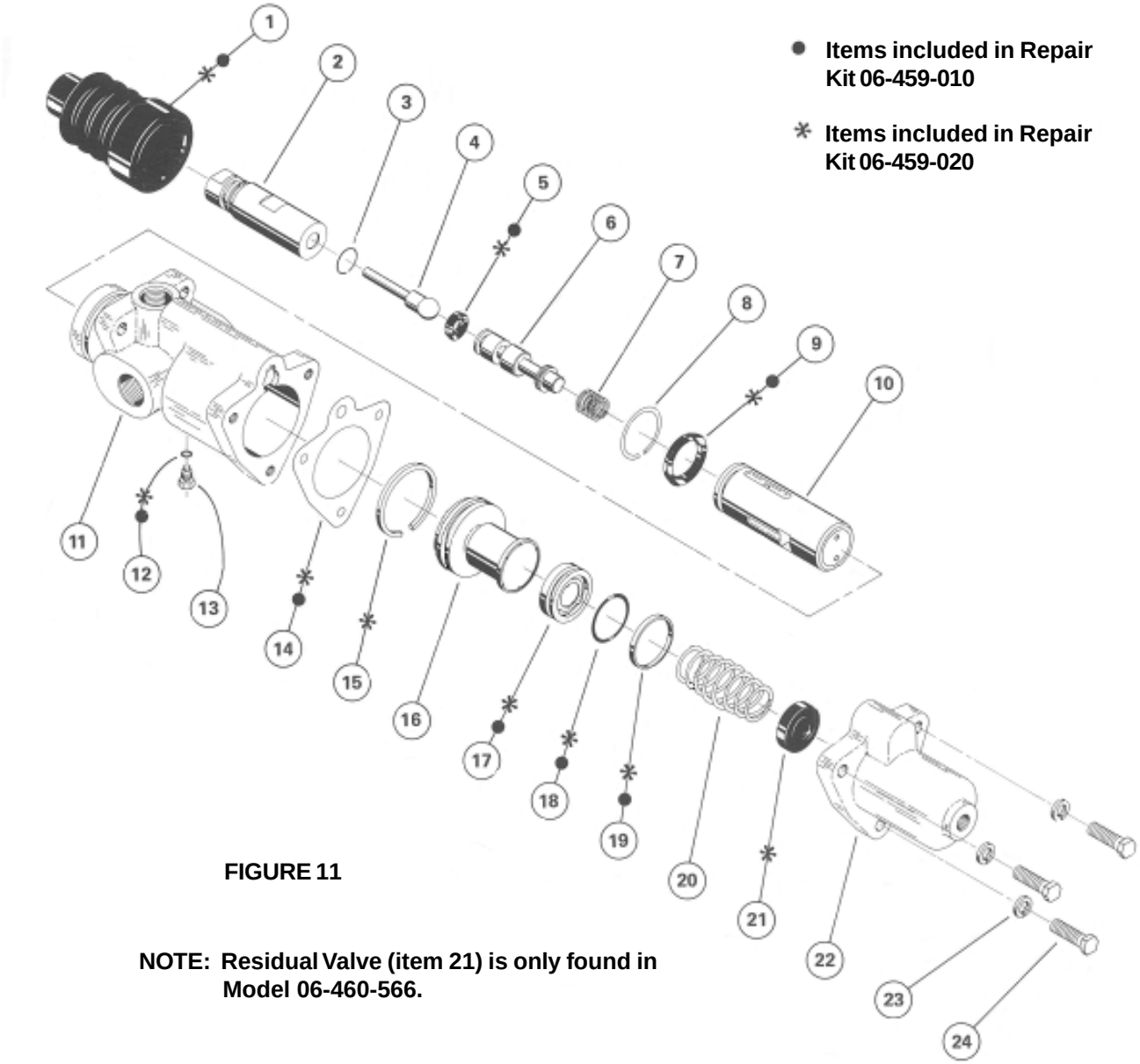


FIGURE 11

NOTE: Residual Valve (item 21) is only found in Model 06-460-566.

Model Number	Repair Kit
06-460-654	06-459-010
06-460-656	06-459-020
06-460-658	06-459-020
06-460-660	06-459-020
06-460-662	06-459-020
06-460-664	06-459-020
06-460-666	06-459-020
06-460-668	06-459-010
06-460-670	06-459-020
06-460-672	06-459-010
06-460-674	06-459-020
06-460-676	06-459-010
06-460-678	06-459-020
06-460-682	06-459-010

OPEN CENTER HYDRAULIC BRAKE VALVE
SLIDING PISTON DESIGN
(Refer to Figure 12)

Disassembly

1. Remove boot (item 1) and pressure regulating spring assembly (item 2).

   CAUTION: Pressure regulating spring assembly has been set at the factory and should never be disassembled.

2. Separate end cap (item 20) from housing (item 3).

   CAUTION: Care must be taken as end cap is under tension of spring (item 18).

   Remove gasket (item 6).
3. Remove piston & poppet assembly (item 15), spring (item 18) and residual valve (item 19) from end cap (item 20).
4. Remove cap screw (item 5) from under side of housing (item 3). Remove o-ring (item 4) from cap screw.
5. Remove sleeve & piston assembly (item 14) from housing (item 3). Remove cup (item 12) and piston ring (item 13) from sleeve & piston assembly (item 14).
6. Remove retaining ring (item 7) carefully with a small flat tool. Do not scratch bore of sleeve & piston assembly (item 14).
7. Remove push rod (item 8), spool (item 10) and spring (item 11) from sleeve & piston assembly (item 14). Remove cup (item 9) from spool (item 10).

Inspection

Clean and inspect all component parts for scratches, cracks or wear. Replace any parts that are excessively worn or damaged.

CAUTION: If spool (item 10), sleeve (item 14) or bore of housing (item 3) are in any way damaged, scratched or broken, the entire assembly must be replaced. These parts are select-fitted and are not interchangeable or replaceable with service items.

Assembly

1. Install new cup (item 12) and new piston ring (item 13) on sleeve & piston assembly (item 14).

   CAUTION: Lips on cup (item 12) should be away from end of sleeve (item 14).

2. Install new cup (item 9) on spool (item 10).

   CAUTION: Lips on cup (item 9) should be away from end of spool (item 10).

3. Insert spool (item 10) and push rod (item 8) into sleeve & piston assembly (item 14). Secure with retaining ring (item 7).
4. Carefully install sleeve & piston assembly (item 14) into housing (item 3).

   CAUTION: Make sure that groove on sleeve will engage screw (item 5).

5. Install new o-ring (item 4) on cap screw (item 5) and install in housing (item 3).
6. Install new o-ring (item 16) and new ring seal (item 17) on new piston & poppet assembly (item 15).
7. Place residual valve (item 19), spring (item 18) and piston & poppet assembly (item 15) in end cap (item 20).

   NOTE: Residual valve must be checked for proper seating in end cap.

CAUTION: Extreme care must be taken so as not to scratch ring seal (item 17) when installing piston & poppet assembly (item 15) in end cap (item 20).

8. Place new gasket (item 6) on mounting face of end cap (item 20) and assembly, with its components, to housing (item 3).
9. Install lock washers (items 21) and bolts (items 22). Torque 16 to 18 ft. lbs.
10. Install pressure regulating spring assembly (item 2) on push rod (item 8). Install new boot (item 1).

SEE BLEEDING SECTION FOR COMPLETE BLEEDING INSTRUCTIONS

PARTS LIST

ITEM		DESCRIPTION
1	•	BOOT
2		PRESSURE REGULATING SPRING ASSEMBLY
3		HOUSING
4	•	O-RING
5		CAP SCREW
6	•	GASKET
7		RETAINING RING
8		PUSH ROD
9	•	CUP
10		SPOOL
11		SPRING
12	•	CUP
13	•	PISTON RING
14		SLEEVE & PISTON ASSEMBLY
15	•	PISTON & POPPET ASSEMBLY
16	•	O-RING
17	•	RING SEAL
18		SPRING
19	•	RESIDUAL VALVE
20		END CAP
21		LOCKWASHERS
22		BOLTS

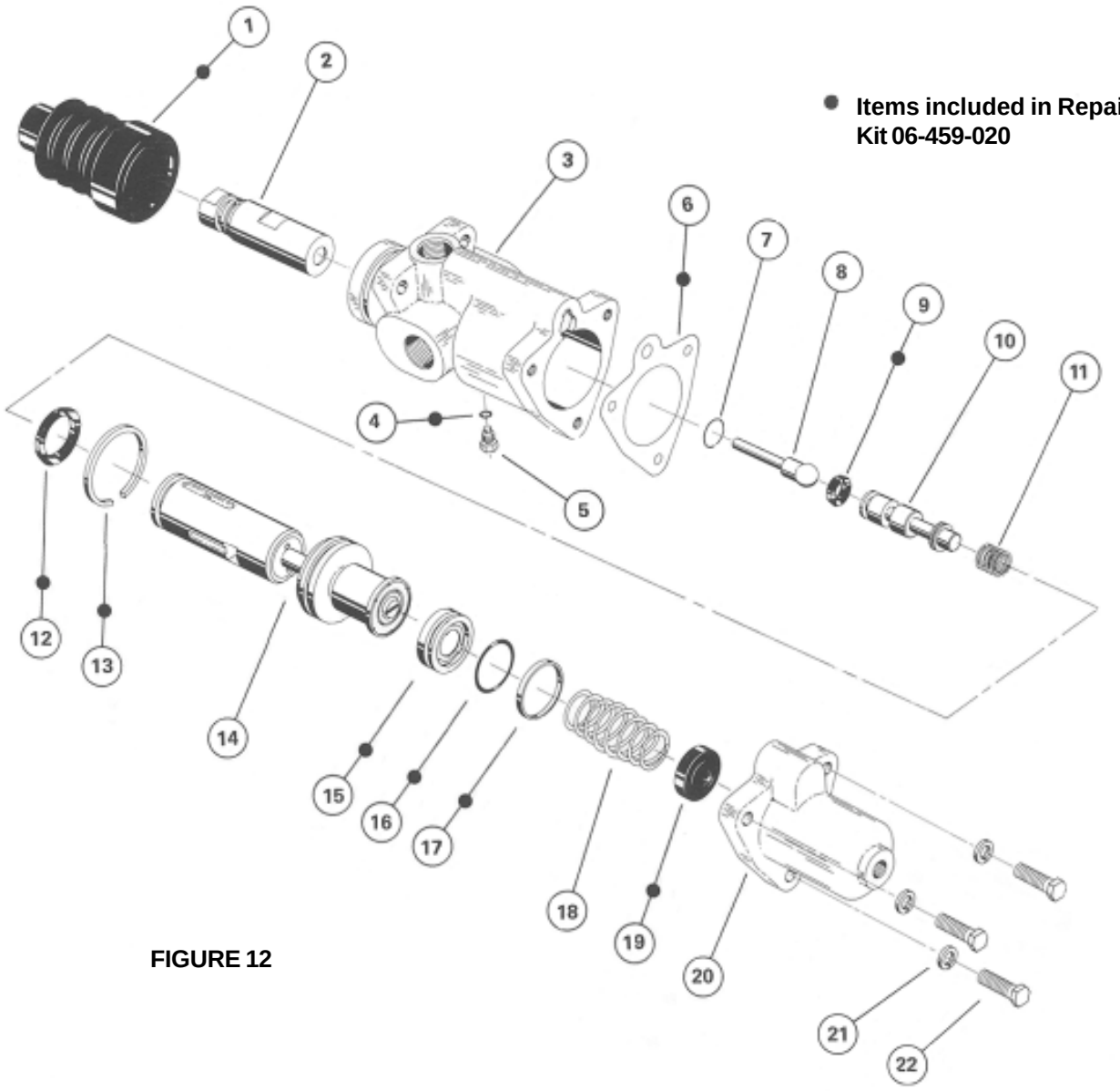


FIGURE 12

Model Number	Repair Kit
06-460-642	06-459-020
06-460-684	06-459-020

GENERAL SERVICE DIAGNOSIS

With Engine Off --

PEDAL GOES TO FLOOR

1. Brake not adjusted
1. **Check adjustment**
2. Air in system
2. **Bleed brakes**
3. Inoperative brakes
3. **Check brakes**
4. Blown hydraulic line
4. **Check brake line**
5. Worn out primary cup
5. **Check by making sure brakes are properly adjusted, in good operating condition, and system well bled. If pedal continues to go to the floor, service brake valve.**

SPONGY PEDAL

1. Air in system
1. **Bleed brakes**

PEDAL IS FIRM BUT STOPS TOO NEAR FLOOR

1. Brakes out of adjustment
1. **Adjust brakes**
2. Inoperative brakes
2. **Check for wear**
3. Displacement problem
3. **Wheel cylinders too large for valve to handle properly. Consider alternate braking valve.**

PEDAL IS FIRM BUT BRAKING IS INADEQUATE TO STOP VEHICLE IN EVENT OF ENGINE FAILURE

1. Pedal ratio too small
1. **Increase pedal ratio**
2. Brakes inoperative
2. **Check brakes for wear or oily brakes**

With Engine Running --

PEDAL GOES DOWN PART WAY THEN BOUNCES BACK

1. Insufficient flow from pump
1. **Check and fill reservoir**
2. Small volume from pump at idle
2. **Crack throttle and recheck**
3. Brakes not adjusted
3. **Check adjustment**
4. Air in system
4. **Bleed system**

NO POWER STEERING OR OTHER DOWNSTREAM HYDRAULIC ACTION AT ANY TIME

1. Hydraulic lines crossed
1. **Recheck circuit**
2. No hydraulic action at any time
2. **Check and fill reservoir. Check relief valve setting on pump. Check for proper rotation at pump, vee belt, sheared keys, etc.**

NO OR SLOW POWER STEERING WITH BRAKES APPLIED

1. Recheck relief valve on pump for proper setting
2. Check and fill reservoir
3. Check and tighten pump belt if necessary

BLEEDING

The MICO Open Center Power Brake Valve and remaining brake system are sometimes difficult to bleed. The difficulty arises when the hydraulic oil used does not flow easily through lines and small holes by means of gravity. Generally, to effectively remove air, oil must be forced into the brake valve master cylinder cavity and the rest of the system.

CAUTION: Make sure the machine is in a safe and controlled state before attempting any servicing including bleeding the brake system.

Manual and pressure bleeding are two methods of bleeding a brake system. MICO recommends using one of these two methods of bleeding the Open Center Power Brake Valve and the rest of the brake system.

CAUTION: Be sure brake valve is installed properly and brakes adjusted correctly before beginning bleeding procedures.

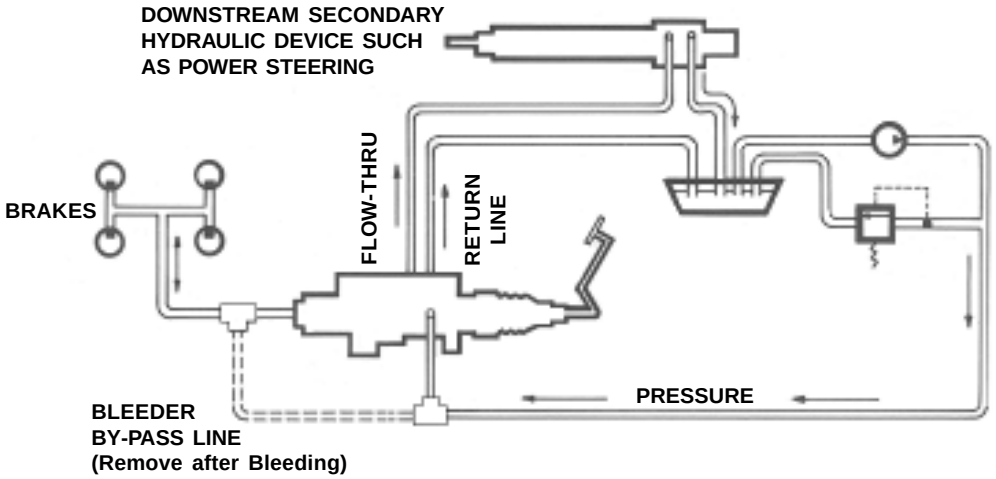
MANUAL BLEEDING PROCEDURES

1. Start engine and allow enough time to pass for the system to become filled and thoroughly flushed with oil.
2. With engine still running, one person can stroke the brake pedal while another person opens and closes the brake bleeder screws.
3. Only on the down stroke of the brake pedal, open bleeder screw on the brake closest to brake valve first. When all flow stops from bleeder, close it and allow pedal to return to rest.
4. Wait at least 30 seconds and repeat the process until all air has been expelled from that brake. Then go on to the next closest brake bleeder and repeat process until all brakes have been bled.
5. Stop engine and depress brake pedal. Pedal should be hard, not spongy, and fairly high. If pedal is too spongy and/or travels too far, repeat bleeding process.
6. It is a characteristic of the brake valve to kick the pedal back when actuated if system is not bled with engine running.

PRESSURE BLEEDING PROCEDURE

1. Refer to Figure 13. Install a small BLEEDER BY-PASS LINE as shown. A 1/4" size line or hose is sufficient.
2. Start engine and allow enough time to pass for the system to become filled and thoroughly flushed with oil.
3. It is necessary to develop between 50-200 PSI at the inlet to brake valve. A method to throttle the oil will be needed if the system does not already have a secondary hydraulic device downstream from the brake valve. THIS PRESSURE SHOULD BE HELD THROUGHOUT THE BLEEDING PROCESS AND SHOULD NOT EXCEED 250 PSI.
4. DO NOT STEP ON THE BRAKE PEDAL DURING THIS BLEEDING PROCESS.
5. Oil will now be forced directly into the brake line by the pump and fill the brake valve master cylinder cavity. This may take a minute or two.
6. Continue to hold the bleed pressure while bleeding each brake starting with the line and brake closest to the brake valve.
7. Allow a sufficient amount of fluid to pass at brake bleeder screw to insure all air is removed from each bleeder point.
8. Continue this method until all brakes and lines are bled.
9. When all brakes are bled and fittings tight, release the 50-200 PSI pressure and SHUT OFF ENGINE.
10. Remove the bleeder by-pass line and plug the connections. Be sure not to lose fluid or ingest air at the brake line connection when removing bleeder by-pass line.
11. With engine off, step on brake pedal. It should be fairly high and hard. If a spongy pedal is felt, the system still contains air. If pedal strokes downward too far, check and readjust brakes and repeat bleeding process.
12. When the pedal is satisfactory, restart engine and actuate brake pedal several times. Now check for leaks.

FIGURE 13



BLEEDING SCHEMATIC

MICO has made every attempt to present accurate information in catalogs, brochures and other printed material. MICO can accept no responsibility for errors from unitentional oversights that may exist. Due to a continuous program of product improvement, both materials and specifications are subject to change without notice or obligation.