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SECTION RFD

REAR FINAL DRIVE

RFD

CONTENTS

<p>PRECAUTIONS 2</p> <p style="padding-left: 20px;">Precautions for Servicing Rear Final Drive 2</p> <p>PREPARATION 3</p> <p style="padding-left: 20px;">Special Service Tools 3</p> <p style="padding-left: 20px;">Commercial Service Tools 6</p> <p>NOISE, VIBRATION AND HARSHNESS (NVH)</p> <p>TROUBLESHOOTING 7</p> <p style="padding-left: 20px;">NVH Troubleshooting Chart 7</p> <p>DESCRIPTION 8</p> <p style="padding-left: 20px;">Cross-Sectional View 8</p> <p>DIFFERENTIAL GEAR OIL 9</p> <p style="padding-left: 20px;">Changing Differential Gear Oil 9</p> <p style="padding-left: 40px;">DRAINING 9</p> <p style="padding-left: 40px;">FILLING 9</p> <p style="padding-left: 20px;">Checking Differential Gear Oil 9</p> <p style="padding-left: 40px;">OIL LEAKAGE AND OIL LEVEL 9</p> <p>FRONT OIL SEAL 10</p> <p style="padding-left: 20px;">Removal and Installation 10</p> <p style="padding-left: 40px;">REMOVAL 10</p> <p style="padding-left: 40px;">INSTALLATION 11</p> <p>SIDE OIL SEAL 12</p> <p style="padding-left: 20px;">Removal and Installation 12</p> <p style="padding-left: 40px;">REMOVAL 12</p> <p style="padding-left: 40px;">INSTALLATION 12</p>	<p>CARRIER COVER 14</p> <p style="padding-left: 20px;">Removal and Installation 14</p> <p style="padding-left: 40px;">REMOVAL 14</p> <p style="padding-left: 40px;">INSTALLATION 14</p> <p>REAR FINAL DRIVE ASSEMBLY 15</p> <p style="padding-left: 20px;">Removal and Installation 15</p> <p style="padding-left: 40px;">COMPONENTS 15</p> <p style="padding-left: 40px;">REMOVAL 16</p> <p style="padding-left: 40px;">INSTALLATION 17</p> <p style="padding-left: 20px;">Disassembly and Assembly 18</p> <p style="padding-left: 40px;">COMPONENTS 18</p> <p style="padding-left: 40px;">ASSEMBLY INSPECTION AND ADJUSTMENT.. 19</p> <p style="padding-left: 40px;">DISASSEMBLY 21</p> <p style="padding-left: 40px;">INSPECTION AFTER DISASSEMBLY 26</p> <p style="padding-left: 40px;">ADJUSTING AND SELECTING WASHERS 26</p> <p style="padding-left: 40px;">ASSEMBLY 32</p> <p>SERVICE DATA AND SPECIFICATIONS (SDS) 38</p> <p style="padding-left: 20px;">General Specifications 38</p> <p style="padding-left: 20px;">Inspection and Adjustment 38</p> <p style="padding-left: 40px;">DRIVE GEAR RUNOUT 38</p> <p style="padding-left: 40px;">SIDE GEAR CLEARANCE 38</p> <p style="padding-left: 40px;">PRELOAD TORQUE 38</p> <p style="padding-left: 40px;">BACKLASH 38</p> <p style="padding-left: 40px;">COMPANION FLANGE RUNOUT 38</p> <p style="padding-left: 40px;">SELECTIVE PARTS 38</p>
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PRECAUTIONS

PRECAUTIONS

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Precautions for Servicing Rear Final Drive

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- Before starting diagnosis of the vehicle, understand the symptoms well. Perform correct and systematic operations.
- Check for the correct installation status prior to removal or disassembly. When matching marks are required, be certain they do not interfere with the function of the parts they are applied to.
- Overhaul should be done in a clean work area, a dust proof area is recommended.
- Before disassembly, completely remove sand and mud from the exterior of the unit, preventing them from entering into the unit during disassembly or assembly.
- Always use shop paper for cleaning the inside of components.
- Avoid using cotton gloves or a shop cloth to prevent the entering of lint.
- Check appearance of the disassembled parts for damage, deformation, and abnormal wear. Replace them with new ones if necessary.
- Gaskets, seals and O-rings should be replaced any time the unit is disassembled.
- Clean and flush the parts sufficiently and blow them dry.
- Be careful not to damage sliding surfaces and mating surfaces.
- When applying sealant, remove the old sealant from the mating surface; then remove any moisture, oil, and foreign materials from the application and mating surfaces.
- In principle, tighten nuts or bolts gradually in several steps working diagonally from inside to outside. If a tightening sequence is specified, observe it.
- During assembly, observe the specified tightening torque.
- Add new differential gear oil, petroleum jelly, or multi-purpose grease, as specified.

PREPARATION

PREPARATION

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Special Service Tools

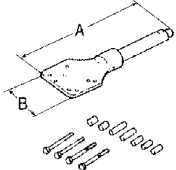
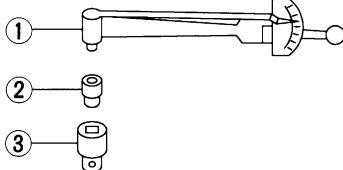
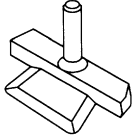
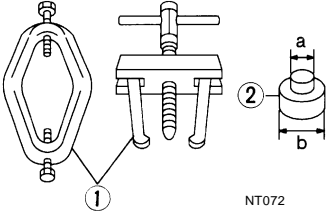
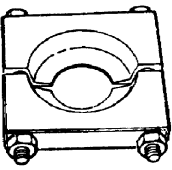
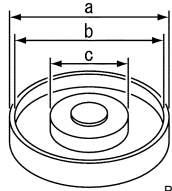
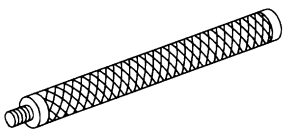
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The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

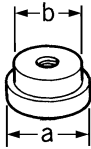
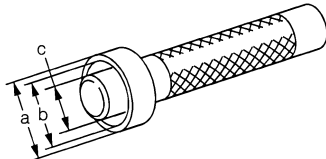
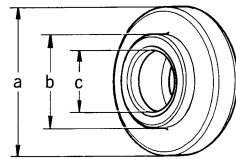
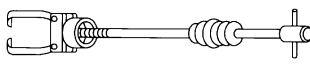
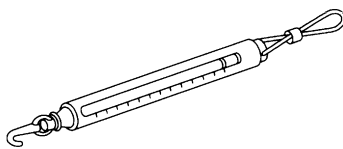

Tool number (Kent-Moore No.) Tool name	Description
KV40104000 (—) Flange wrench	Removing and installing drive pinion lock nut a: 85 mm (3.35 in) dia. b: 65 mm (2.56 in) dia.
KV381054S0 (J-34286) Puller	Removing front oil seal
ST30720000 (J-25405) Drift	<ul style="list-style-type: none"> ● Installing front oil seal ● Installing drive pinion rear bearing outer race a: 77 mm (3.03 in) dia. b: 55.5 mm (2.185 in) dia.
ST36230000 (J-25840-A) Sliding hammer	Removing side flange
KV40104100 (—) Attachment	Removing side flange
KV38100200 (J-26233) Drift	Installing side oil seal a: 65 mm (2.56 in) dia. b: 49 mm (1.93 in) dia.
KV38107900 (J-39352) Protector	Installing side flange

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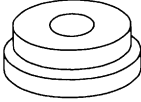
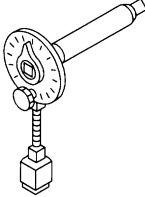
PREPARATION

Tool number (Kent-Moore No.) Tool name	Description
KV38100800 (J-25604-01) Attachment <div style="text-align: center;">  <p style="text-align: right; font-size: small;">SDIA0267E</p> </div>	Securing unit assembly a: 541 mm (21.30 in) b: 200 mm (7.87 in)
ST3127S000 (J-25765-A) Preload gauge 1: GG91030000 (J-25765) Torque wrench 2: HT62940000 (—) Socket adapter (1/2") 3: HT62900000 (—) Socket adapter (3/8") <div style="text-align: center;">  <p style="text-align: right; font-size: small;">NT124</p> </div>	Measuring drive pinion bearing preload torque and total preload torque
KV10111100 (J-37228) Seal cutter <div style="text-align: center;">  <p style="text-align: right; font-size: small;">S-NT046</p> </div>	Removing carrier cover
ST3306S001 (—) Differential side bearing puller set 1: ST33051001 (J-22888-20) Puller 2: ST33061000 (J-8107-2) Base <div style="text-align: center;">  <p style="text-align: right; font-size: small;">NT072</p> </div>	Removing and installing side bearing inner race a: 28.5 mm (1.122 in) dia. b: 38 mm (1.50 in) dia.
ST30031000 (J-22912-01) Puller <div style="text-align: center;">  <p style="text-align: right; font-size: small;">ZZA0700D</p> </div>	Removing drive pinion rear bearing inner race
KV40105230 (—) Drift <div style="text-align: center;">  <p style="text-align: right; font-size: small;">PDIA0591E</p> </div>	Installing drive pinion rear bearing outer race a: 92 mm (3.62 in) dia. b: 86 mm (3.39 in) dia. c: 45 mm (1.77 in) dia.
ST30611000 (J-25742-1) Drift bar <div style="text-align: center;">  <p style="text-align: right; font-size: small;">S-NT090</p> </div>	Installing drive pinion front bearing outer race (Use with ST30613000)

PREPARATION

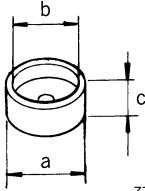
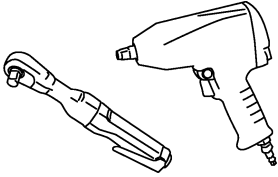
Tool number (Kent-Moore No.) Tool name	Description	
ST30613000 (J-25742-3) Drift  ZZA1000D	Installing drive pinion front bearing outer race a: 72 mm (2.83 in) dia. b: 48 mm (1.89 in) dia.	A B C
KV38100300 (J-25523) Drift  ZZA1046D	Installing side bearing inner race a: 54 mm (2.13 in) dia. b: 46 mm (1.81 in) dia. c: 32 mm (1.26 in) dia.	RFD E
ST30901000 (J-26010-01) Drift  ZZA0978D	Installing drive pinion rear bearing inner race a: 79 mm (3.11 in) dia. b: 45 mm (1.77 in) dia. c: 35.2 mm (1.386 in) dia.	F G H
HT72400000 (—) Slide hammer  S-NT125	Removing differential case assembly	I J
— (J-8129) Spring gauge  NT127	Measuring turning torque	K L
— (J-34309) Differential shim selector tool  NT134	Adjusting drive pinion bearing preload and drive pinion height	M

PREPARATION

Tool number (Kent-Moore No.) Tool name	Description
<p style="text-align: center;">—</p> <p>(J-25269-4) Side bearing disc (2 Req'd)</p>	<p>Selecting drive pinion height adjusting washer</p>
 <p>NT136</p>	
<p>KV10112100 (BT-8653-A) Angle wrench</p>	<p>Tightening bolts for drive gear</p>
 <p>NT014</p>	

Commercial Service Tools

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Tool name	Description
<p>Spacer</p>	<p>Installing drive pinion front bearing inner race</p> <p>a: 60 mm (2.36 in) dia. b: 36 mm (1.42 in) dia. c: 30 mm (1.18 in)</p>
 <p>ZZA1133D</p>	
<p>Power tool</p>	<p>Loosening nuts and bolts</p>
 <p>PBIC0190E</p>	

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

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NVH Troubleshooting Chart

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Use the chart below to help you find the cause of the symptom. If necessary, repair or replace these parts.

Symptom		Possible cause and SUSPECTED PARTS														
	Noise	x	x	x	x	x	x	x	x		x	x	x	x	x	x
Reference page		RFD-26	RFD-20	RFD-26	RFD-21	RFD-21	RFD-9	PR-3, "NVH Troubleshooting Chart"	RAX-4, "NVH Troubleshooting Chart"	RSU-4, "NVH Troubleshooting Chart"	WT-4, "NVH Troubleshooting Chart"	WT-4, "NVH Troubleshooting Chart"	RAX-4, "NVH Troubleshooting Chart"	BR-5, "NVH Troubleshooting Chart"	PS-5, "NVH Troubleshooting Chart"	
		Gear tooth rough	Gear contact improper	Tooth surfaces worn	Backlash incorrect	Companion flange excessive runout	Gear oil improper	PROPELLER SHAFT	REAR AXLE	REAR SUSPENSION	TIRES	ROAD WHEEL	DRIVE SHAFT	BRAKES	STEERING	

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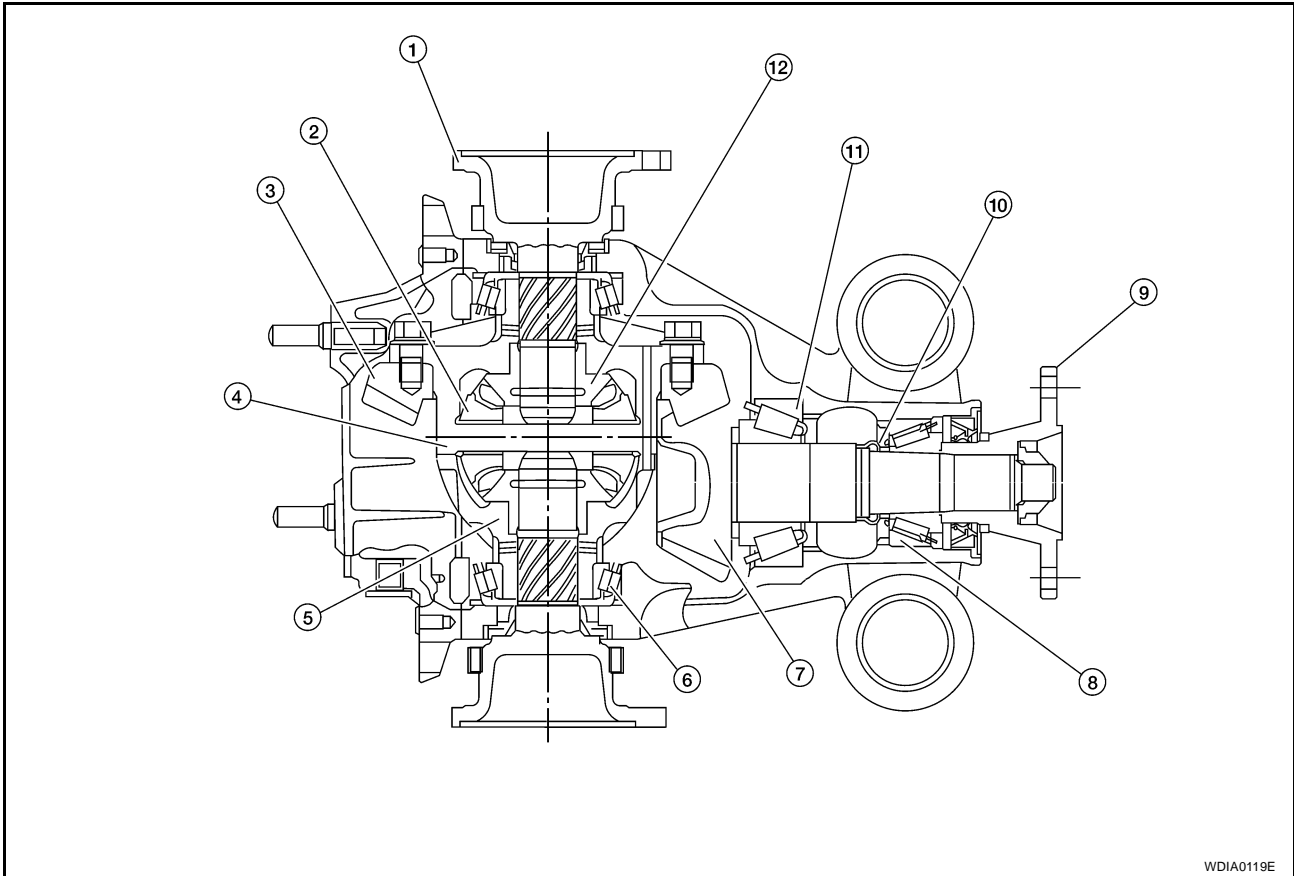
DESCRIPTION

DESCRIPTION

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Cross-Sectional View

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- | | | |
|------------------------|-------------------------------|---------------------|
| 1. Side flange | 2. Pinion mate gear | 3. Drive gear |
| 4. Pinion mate shaft | 5. Differential case | 6. Side bearing |
| 7. Drive pinion | 8. Drive pinion front bearing | 9. Companion flange |
| 10. Collapsible spacer | 11. Drive pinion rear bearing | 12. Side gear |

DIFFERENTIAL GEAR OIL

DIFFERENTIAL GEAR OIL

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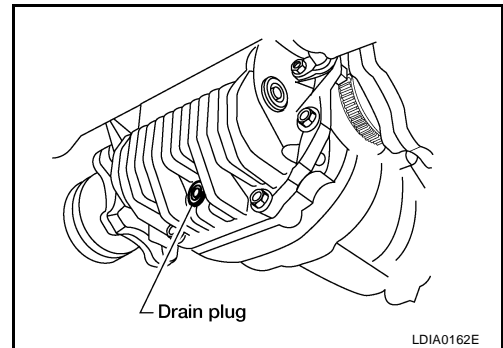
Changing Differential Gear Oil DRAINING

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1. Stop the engine.
2. Remove the drain plug and gasket from the rear final drive assembly to drain the differential gear oil.
3. Install the drain plug with a new gasket to the rear final drive assembly. Tighten to the specified torque. Refer to [RFD-18, "COMPONENTS"](#).

CAUTION:

Do not reuse gasket.



FILLING

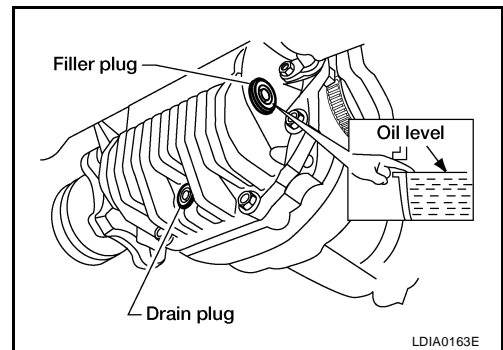
1. Remove the filler plug and gasket from the rear final drive assembly.
2. Fill the rear final drive assembly with new differential gear oil until the level reaches the specified level near the filler plug hole.

Differential gear oil grade and capacity : Refer to [MA-11, "Fluids and Lubricants"](#).

3. Install the filler plug with a new gasket on it to the rear final drive assembly. Tighten to the specified torque. Refer to [RFD-18, "COMPONENTS"](#).

CAUTION:

Do not reuse gasket.



Checking Differential Gear Oil OIL LEAKAGE AND OIL LEVEL

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1. Make sure that differential gear oil is not leaking from the rear final drive assembly or around it.
2. Check the differential gear oil level from the filler plug hole as shown.

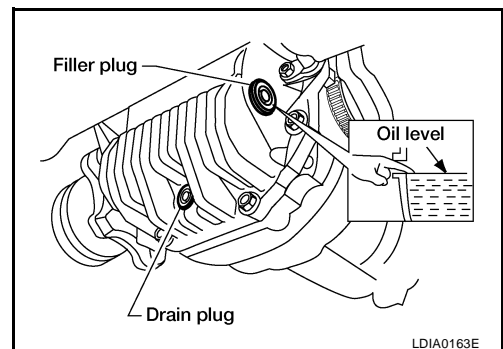
CAUTION:

Do not start engine while checking differential gear oil level.

3. Install the filler plug with a new gasket on it to the rear final drive assembly. Tighten to the specified torque. Refer to [RFD-18, "COMPONENTS"](#).

CAUTION:

Do not reuse gasket.



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FRONT OIL SEAL

FRONT OIL SEAL

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Removal and Installation

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REMOVAL

1. Remove the drive shafts from the rear final drive assembly. Refer to [RAX-7, "Removal and Installation"](#) .
2. Remove the side flanges and side oil seals. Refer to [RFD-12, "Removal and Installation"](#) .
3. Remove the rear propeller shaft. Refer to [PR-10, "Removal and Installation"](#) .
4. Measure the total preload torque. Refer to [RFD-19, "Total Preload Torque"](#) .

NOTE:

Record the total preload torque measurement.

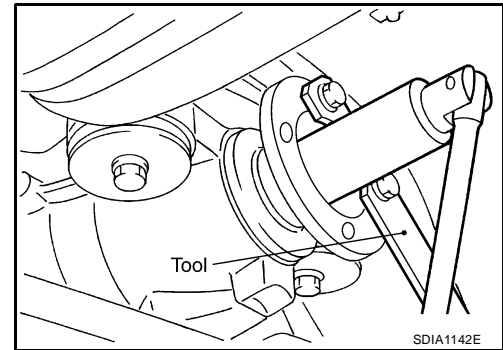
5. Remove the drive pinion lock nut using Tool.

Tool number : KV40104000 (—)

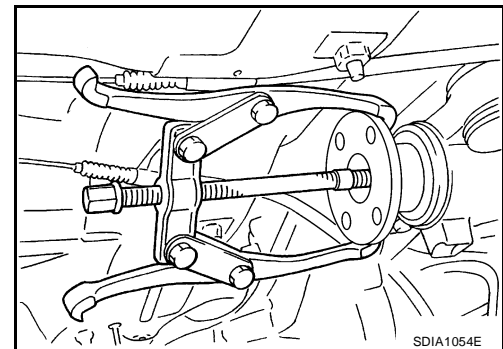
6. Put matching marks on the companion flange and drive pinion using paint.

CAUTION:

Use paint to make the matching marks. Do not damage the companion flange or drive pinion.

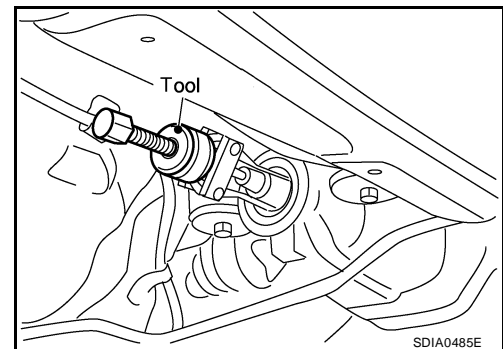


7. Remove the companion flange using suitable tool.



8. Remove the front oil seal using Tool.

Tool number : KV381054S0 (J-34286)



FRONT OIL SEAL

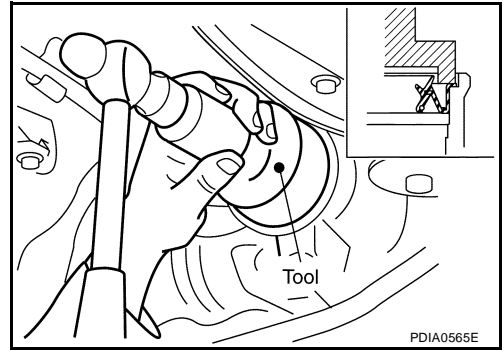
INSTALLATION

1. Apply multi-purpose grease to the lips and differential gear oil to the circumference of the new front oil seal. Then drive the new front oil seal in evenly until it becomes flush with the gear carrier using Tool.

Tool number : ST30720000 (J-25405)

CAUTION:

- Do not reuse front oil seal.
- Do not incline the new front oil seal when installing.
- Apply multi-purpose grease to the lips and differential gear oil to the circumference of the new front oil seal.



2. Install the companion flange to the drive pinion while aligning the matching marks.
3. Apply anti-corrosive oil to the threads of the drive pinion and the seating surface of the new drive pinion lock nut. Then adjust the drive pinion lock nut tightening torque using Tool A, and check the total preload torque using Tool B.

Tool number A: KV40104000 (—)

B: ST3127S000 (J-25765-A)

Total preload torque: Refer to [RFD-19, "Total Preload Torque"](#).

- The total preload torque should be within the total preload torque specification. When not replacing the collapsible spacer, it should also be equal to the measurement taken during removal plus an additional 0.56 N·m (0.06 Kg·m, 5 in·lb).
- If the total preload torque is low, tighten the drive pinion lock nut in 6.8 N·m (0.69 Kg·m, 5ft·lb) increments until the total preload torque is met.

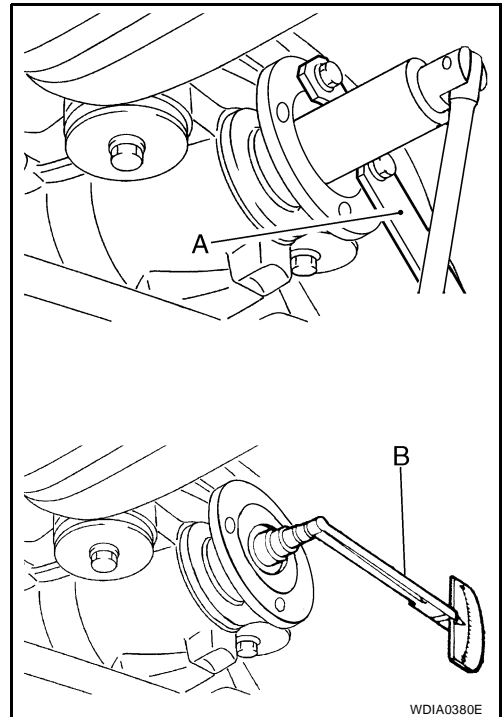
CAUTION:

- Do not reuse drive pinion lock nut.
- Apply anti-corrosive oil to the threads of the drive pinion and the seating surface of the new drive pinion lock nut.
- Adjust the drive pinion lock nut tightening torque to the lower limit first. Do not exceed the drive pinion lock nut specified torque. Refer to [RFD-18, "COMPONENTS"](#).
- Do not loosen drive pinion lock nut to adjust the total preload torque. If the total preload torque exceeds the specifications, replace the collapsible spacer and tighten it again to adjust. Refer to [RFD-18, "Disassembly and Assembly"](#).
- After adjustment, rotate drive pinion back and forth 2 to 3 times to check for unusual noise, rotation malfunction, and other malfunctions.

4. Installation of the remaining components is in the reverse order of removal.

CAUTION:

Check the differential gear oil level after installation. Refer to [RFD-9, "Checking Differential Gear Oil"](#).



SIDE OIL SEAL

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SIDE OIL SEAL

Removal and Installation

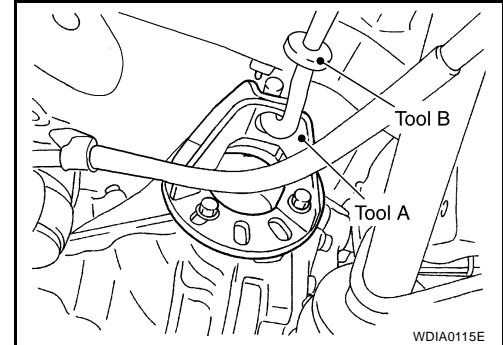
REMOVAL

1. Remove the rear wheel sensor. Refer to [BRC-59, "Removal and Installation"](#) for VDC/TCS/ABS or [BRC-128, "Removal and Installation"](#) for HDC/HSA/VDC/TCS/ABS.
2. Remove the drive shaft from the rear final drive assembly. Refer to [RAX-7, "Removal and Installation"](#).
3. Remove the side flange using Tools.

Tool numbers **A: KV40104100 (—)**
 B: ST36230000 (J-25840-A)

NOTE:

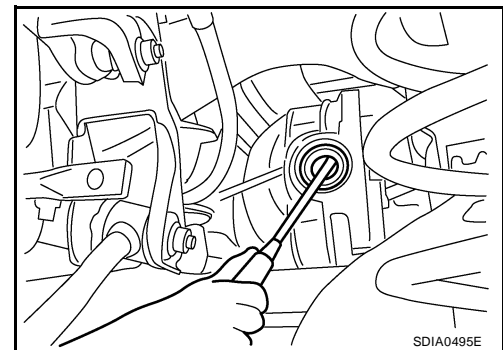
Circular clip installation position: Rear final drive side



4. Remove the side oil seal using suitable tool.

CAUTION:

Do not to damage gear carrier.



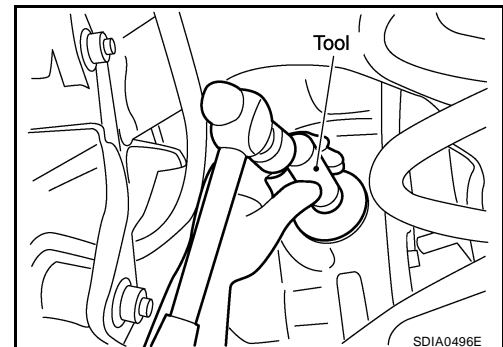
INSTALLATION

1. Apply multi-purpose grease to the lips and differential gear oil to the circumference of the new side oil seal. Then drive the new side oil seal in evenly until it becomes flush with the gear carrier using Tool.

Tool number : **KV38100200 (J-26233)**

CAUTION:

- Do not reuse side oil seal.
- Do not incline the new side oil seal when installing.
- Apply multi-purpose grease to the lips and differential gear oil to the circumference of the new side oil seal.



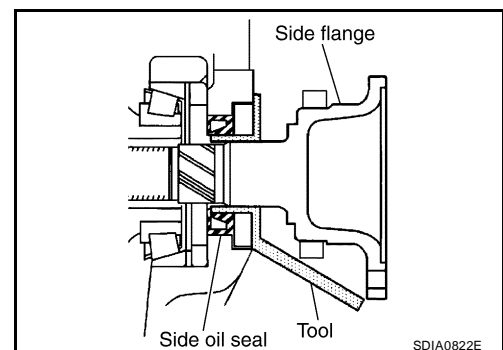
2. Install the side flange using Tool.
 - a. Install the Tool to the side oil seal as shown.

Tool number : **KV38107900 (J-39352)**

- b. Insert the side flange until the serrated part of the side flange has engaged the serrated part of the side gear and remove the Tool.
- c. Drive in the side flange using suitable tool.

NOTE:

Installation is completed when the driving sound of the side flange turns into a sound which seems to affect the whole rear final drive assembly.



3. Installation of the remaining components is in the reverse order of removal.

SIDE OIL SEAL

CAUTION:

Check the differential gear oil level after installation. Refer to [RFD-9, "Checking Differential Gear Oil"](#) .

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CARRIER COVER

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CARRIER COVER

Removal and Installation

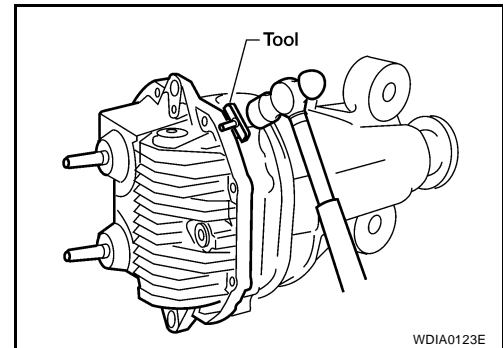
REMOVAL

1. Remove the rear final drive assembly. Refer to [RFD-15, "Removal and Installation"](#) .
2. Remove the carrier cover bolts and separate the carrier cover from the gear carrier using Tool.

Tool number : KV10111100 (J-37228)

CAUTION:

- Do not damage the mating surface.
- Do not insert flat-bladed screwdriver, this will damage the mating surface.



INSTALLATION

1. Apply a 3 mm (0.12 in) bead of sealant to the mating surface of the carrier cover as shown.
 - Use Genuine Silicone RTV or equivalent. Refer to [GI-47, "Recommended Chemical Products and Sealants"](#) .

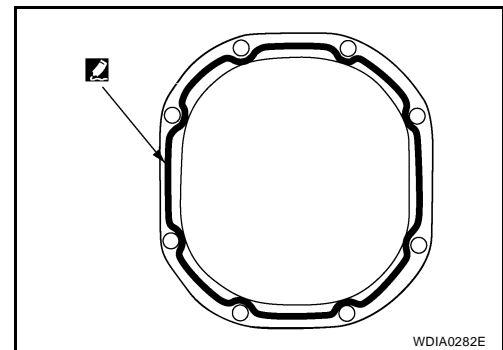
CAUTION:

Remove any old sealant adhering to the mating surfaces. Also remove any moisture, oil, or foreign material adhering to the application and mating surfaces.

2. Install the carrier cover to the gear carrier. Tighten the bolts to the specified torque. Refer to [RFD-18, "COMPONENTS"](#) .
3. Install the rear final drive assembly. Refer to [RFD-15, "Removal and Installation"](#) .

CAUTION:

Fill the rear final drive assembly with recommended differential gear oil. Refer to [RFD-9, "DIFFERENTIAL GEAR OIL"](#) .



REAR FINAL DRIVE ASSEMBLY

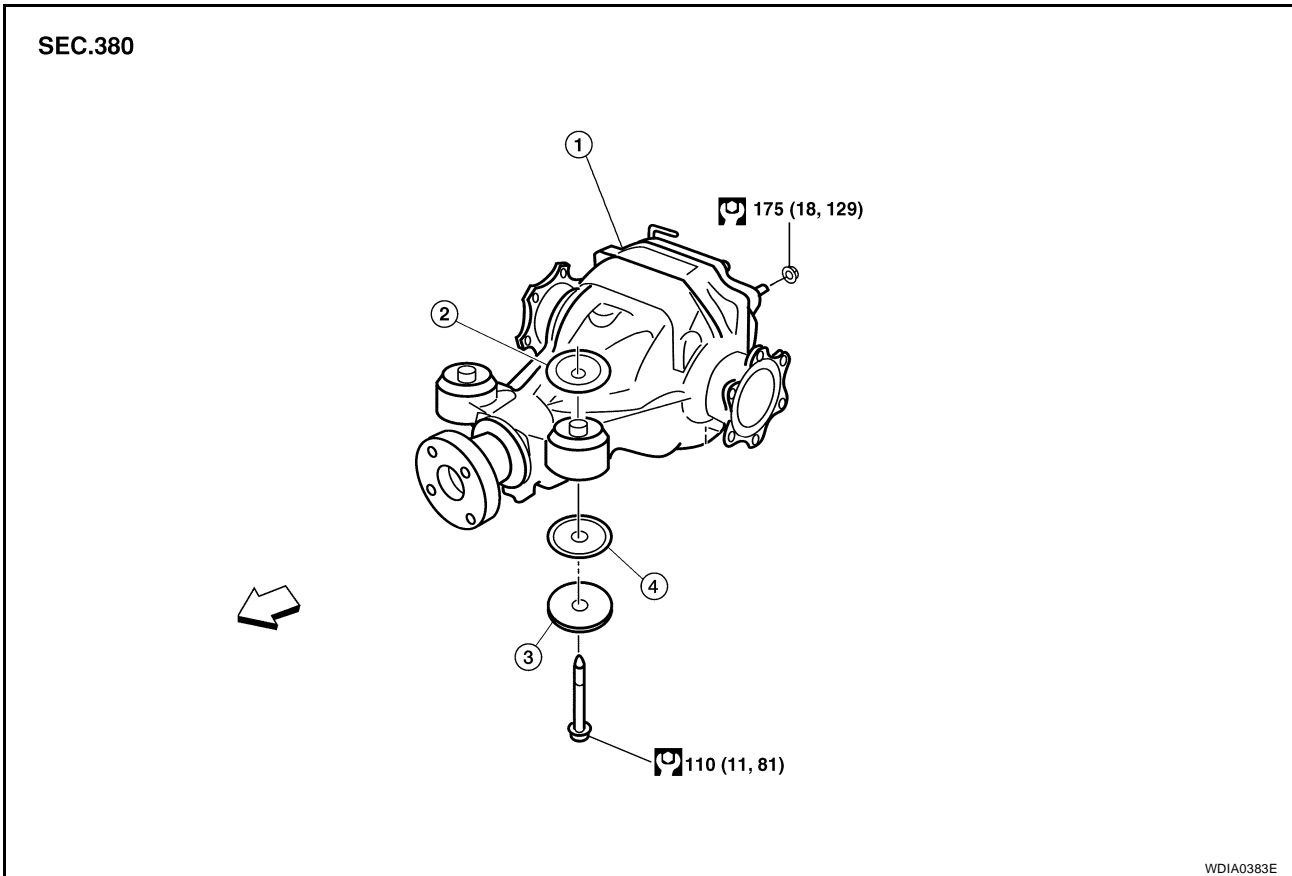
REAR FINAL DRIVE ASSEMBLY

PFP:38300

Removal and Installation COMPONENTS

EDS003A3

Rear Final Drive



- | | | |
|------------------------------|------------------|-----------|
| 1. Rear final drive assembly | 2. Upper stopper | 3. Washer |
| 4. Lower stopper | ⇐: Front | |

A

B

C

RFD

E

F

G

H

I

J

K

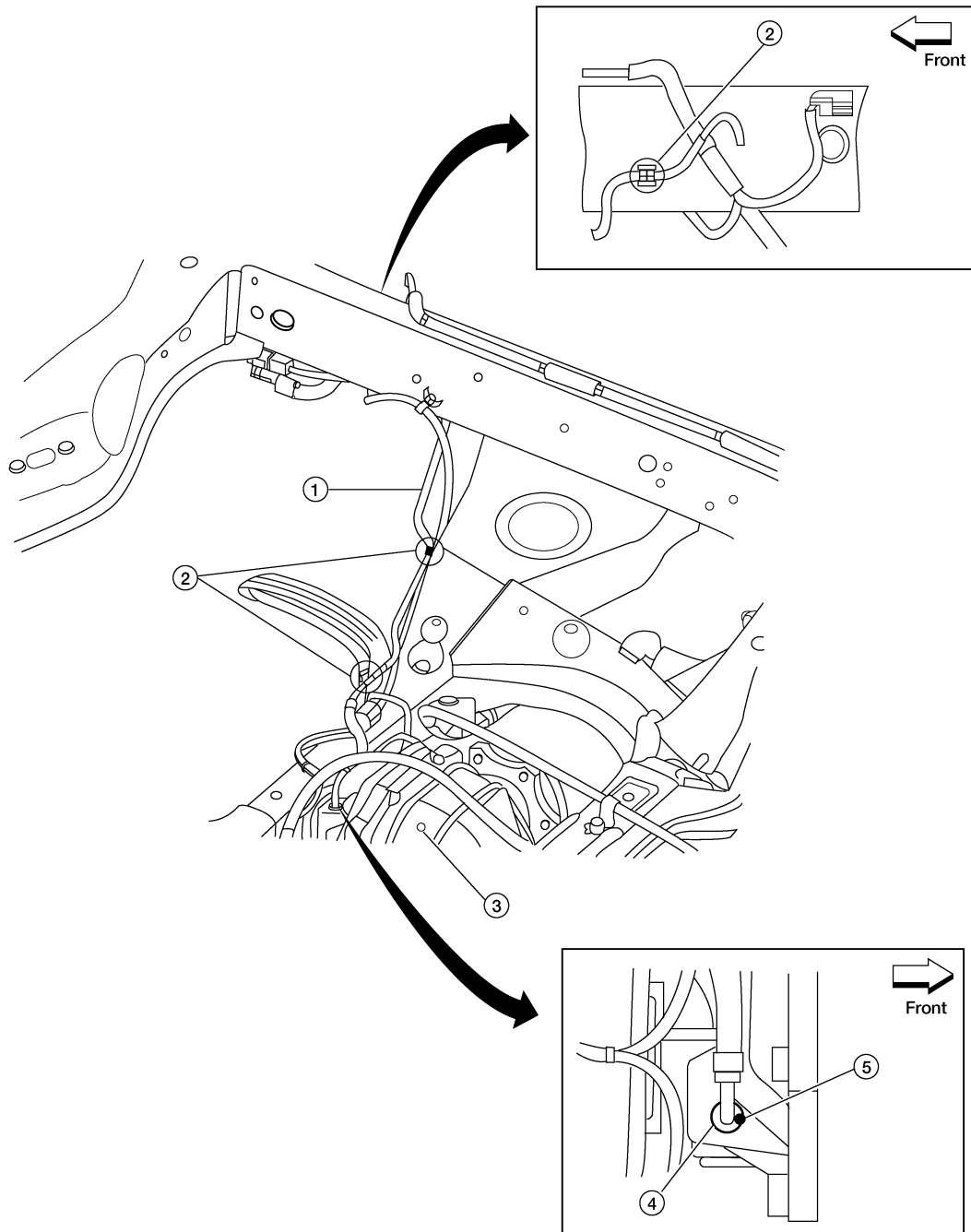
L

M

REAR FINAL DRIVE ASSEMBLY

Rear Final Drive Breather Hose

SEC. 380



1. Breather hose
4. Metal connector

2. Plastic connectors
5. Paint mark

3. Rear final drive assembly

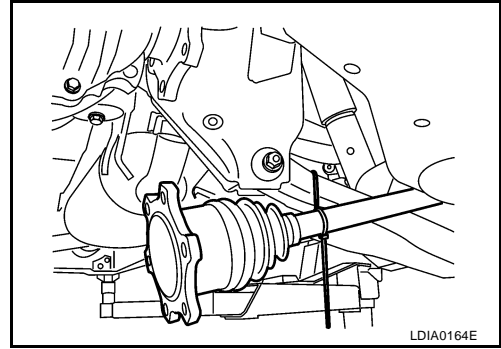
LDIA0166E

REMOVAL

1. Remove the spare tire.
2. Drain the differential gear oil. Refer to [RFD-9, "DIFFERENTIAL GEAR OIL"](#).
3. Remove the rear stabilizer bar. Refer to [RSU-20, "Removal and Installation"](#).

REAR FINAL DRIVE ASSEMBLY

4. Remove the rear propeller shaft. Refer to [PR-10, "Removal and Installation"](#) .
5. Remove the rear drive shafts from the rear final drive assembly and support them using suitable wire. Refer to [RAX-7, "Removal and Installation"](#) .



6. Disconnect the breather hose from the rear final drive assembly.
7. Remove the rear wheel sensors. Refer to [BRC-59, "Removal and Installation"](#) for VDC/TCS/ABS or [BRC-128, "Removal and Installation"](#) for HDC/HSA/VDC/TCS/ABS.

8. Place a suitable jack under the rear final drive assembly.

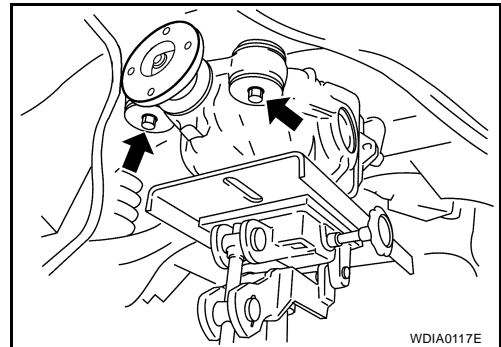
CAUTION:

Do not place the jack on the carrier cover.

9. Remove the nuts and bolts and remove the rear final drive assembly.

CAUTION:

Secure rear final drive assembly to the jack while removing it.



INSTALLATION

Installation is in the reverse order of removal.

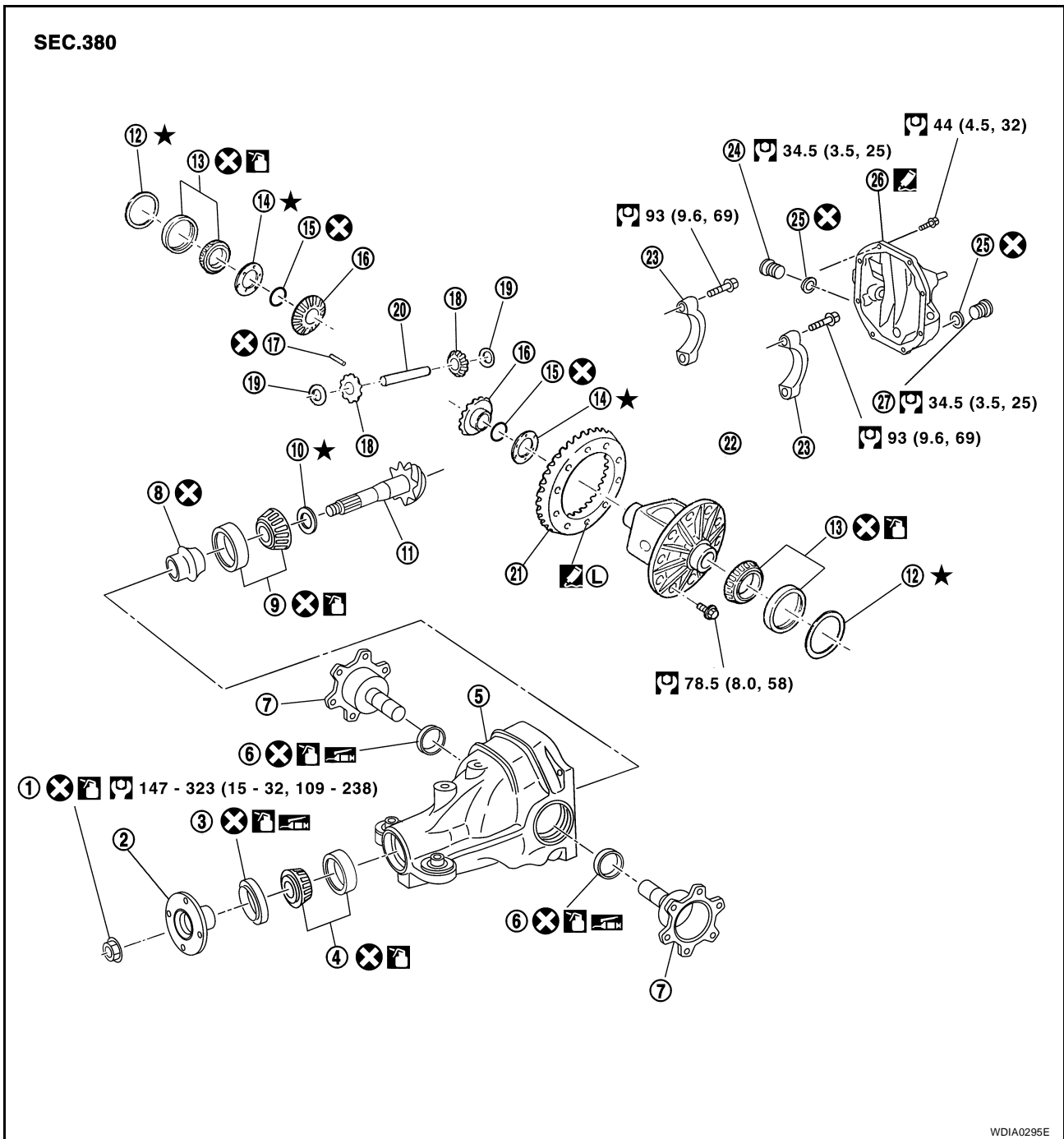
CAUTION:

- When installing the breather hose make sure the painted marking on the metal end of breather hose is to the front of the vehicle and there are no pinched or restricted areas on the breather hose caused by folding or bending when installing it.
- Make sure the breather hose plastic connectors are in the appropriate holes.
- Fill the front final drive assembly with differential gear oil after installation. Refer to [RFD-9, "DIFFERENTIAL GEAR OIL"](#) .

REAR FINAL DRIVE ASSEMBLY

Disassembly and Assembly COMPONENTS

EDS003A4



WDIA0295E

- | | | |
|--|-----------------------------|-----------------------------------|
| 1. Drive pinion lock nut | 2. Companion flange | 3. Front oil seal |
| 4. Drive pinion front bearing | 5. Gear carrier | 6. Side oil seal |
| 7. Side flange | 8. Collapsible spacer | 9. Drive pinion rear bearing |
| 10. Drive pinion height adjusting washer | 11. Drive pinion | 12. Side bearing adjusting washer |
| 13. Side bearing | 14. Side gear thrust washer | 15. Circular clip |
| 16. Side gear | 17. Lock pin | 18. Pinion mate gear |
| 19. Pinion mate thrust washer | 20. Pinion mate shaft | 21. Drive gear |
| 22. Differential case | 23. Side bearing cap | 24. Filler plug |
| 25. Gasket | 26. Carrier cover | 27. Drain plug |

REAR FINAL DRIVE ASSEMBLY

ASSEMBLY INSPECTION AND ADJUSTMENT

- Drain the differential gear oil before inspection and adjustment. Refer to [RFD-9, "DIFFERENTIAL GEAR OIL"](#).
- Remove and install the carrier cover as necessary for inspection and adjustment. Refer to [RFD-14, "CARRIER COVER"](#).

Total Preload Torque

1. Remove the side flanges if necessary. Refer to [RFD-21, "Side Flange"](#).

CAUTION:

The side flanges shaft must removed in order to measure total preload torque.

2. Rotate the drive pinion back and forth 2 to 3 times to check for unusual noise and rotation malfunction.
3. Rotate the drive pinion at least 20 times to check for smooth operation of the bearings.
4. Measure total preload torque using Tool.

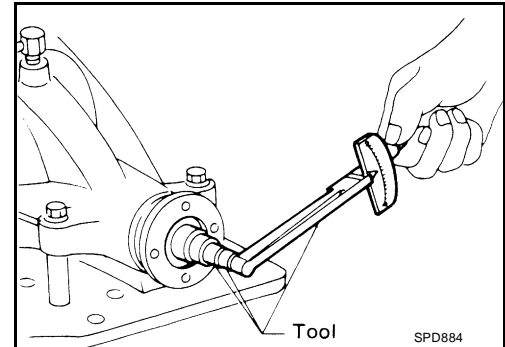
Tool number : ST3127S000 (J-25765-A)

Total preload torque:

2.84 - 3.75 N·m (0.29 - 0.38 kg·m, 26 - 33 in·lb)

NOTE:

Total preload torque = Drive pinion bearing preload torque + Side bearing preload torque



- If the measured value is out of the specification, check and adjust each part. Adjust the drive pinion bearing preload torque first, then adjust the side bearing preload torque.

If the total preload torque is greater than specification

On drive pinion bearings: Replace the collapsible spacer.

On side bearings: Use thinner side bearing adjusting washers by the same amount on each side. Refer to [RFD-39, "Side Bearing Adjusting Washer"](#).

If the total preload torque is less than specification

On drive pinion bearings: Tighten the drive pinion lock nut.

On side bearings: Use thicker side bearing adjusting washers by the same amount on each side. Refer to [RFD-39, "Side Bearing Adjusting Washer"](#).

CAUTION:

Select a side bearing adjusting washer for right and left individually.

Drive Gear Runout

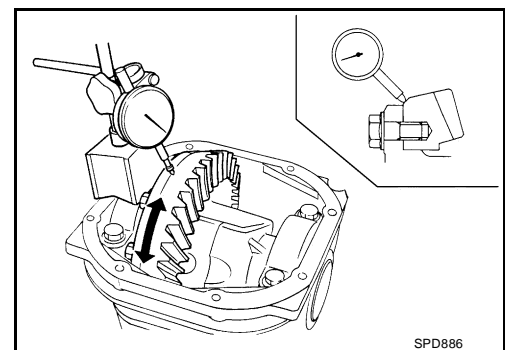
1. Fit a dial indicator to the drive gear back face.
2. Rotate the drive gear to measure runout.

Runout limit : 0.05 mm (0.0020 in) or less

- If the runout is outside of the limit, check the condition of the drive gear assembly. Foreign material may be caught between the drive gear and differential case, or the differential case or drive gear may be deformed.

CAUTION:

Replace drive gear and drive pinion as a set.



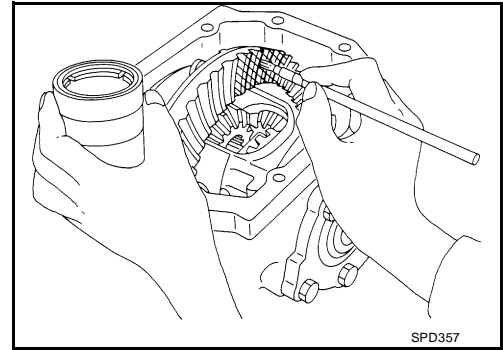
REAR FINAL DRIVE ASSEMBLY

Tooth Contact

1. Apply red lead to the drive gear.

NOTE:

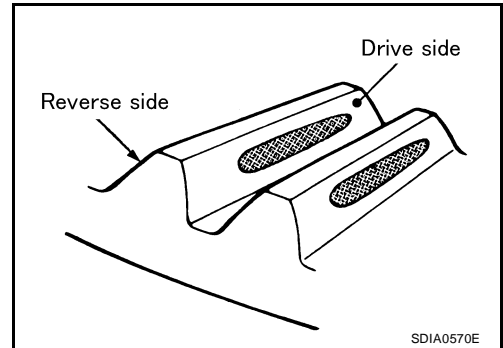
Apply red lead to both faces of three to four gears, at four locations evenly spaced on the drive gear.



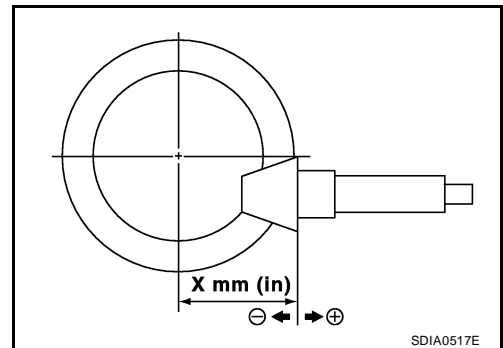
2. Rotate the drive gear back and forth several times. Then check for correct drive pinion to drive gear tooth contact as shown.

CAUTION:

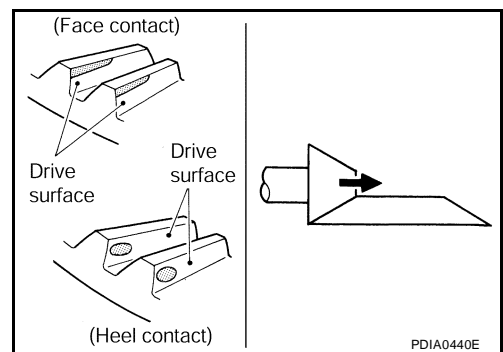
Check tooth contact on drive side and reverse side.



3. If the tooth contact is improperly adjusted, follow the procedure below to adjust the pinion height (dimension X).

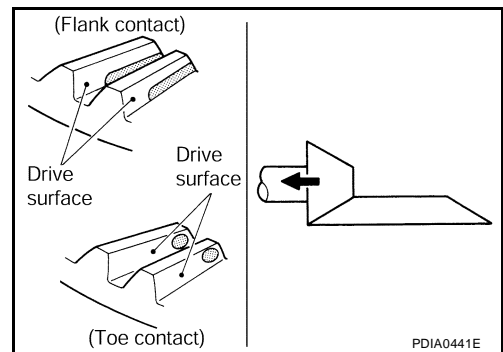


- If the tooth contact is near the face (face contact), or near the heel (heel contact), use a thicker drive pinion height adjusting washers to move the drive pinion closer to the drive gear. Refer to [RFD-39, "Drive Pinion Height Adjusting Washer"](#).



REAR FINAL DRIVE ASSEMBLY

- If the tooth contact is near the flank (flank contact), or near the toe (toe contact), use a thinner drive pinion height adjusting washers to move the drive pinion farther from the drive gear. Refer to [RFD-39, "Drive Pinion Height Adjusting Washer"](#) .



Backlash

1. Fit a dial indicator to the drive gear face to measure the backlash.

Backlash: 0.10 - 0.15 mm (0.0039 - 0.0059 in)

- If the backlash is outside of the specification, change the thickness of the side bearing adjusting washers.

If the backlash is greater than specification:

Make side bearing adjusting washer thicker on drive gear back side, and side bearing adjusting washer thinner on drive gear tooth side by the same amount. Refer to [RFD-39, "Side Bearing Adjusting Washer"](#) .

If the backlash is less than specification:

Make side bearing adjusting washer thinner on drive gear back side, and side bearing adjusting washer thicker on drive gear tooth side by the same amount. Refer to [RFD-39, "Side Bearing Adjusting Washer"](#) .

CAUTION:

Do not change the total thickness of side bearing adjusting washers as it will change the side bearing preload torque.

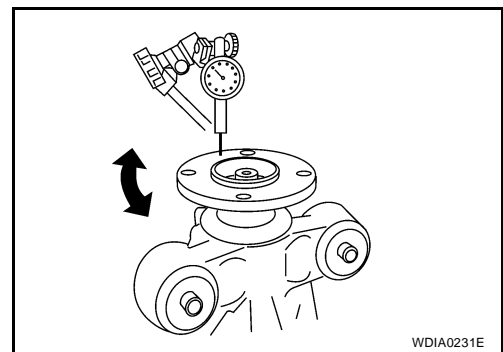
Companion Flange Runout

1. Rotate companion flange and check for runout on the outer face of the companion flange using suitable tool.

Runout limit : 0.08 mm (0.0031 in) or less

2. If the runout is outside of the runout limit, follow the procedure below to adjust.

- a. Rotate the companion flange on the drive pinion by 90°, 180° and 270° while checking for the position where the runout is minimum.
- b. If the runout is still outside of the runout limit after the companion flange has been rotated on the drive pinion, possible cause could be an assembly malfunction of drive pinion and drive pinion bearing or a malfunctioning drive pinion bearing.
- c. If the runout is still outside of the runout limit after repair of the assembly of drive pinion and drive pinion bearing or drive pinion bearing, replace the companion flange.



DISASSEMBLY

Side Flange

1. Drain the differential gear oil if necessary.
2. Remove the side flange using Tools.

Tool numbers A: KV40104100 (—)
B: ST36230000 (J-25840-A)

REAR FINAL DRIVE ASSEMBLY

NOTE:

Circular clip installation position: Rear final drive side

3. Remove the side oil seal using suitable tool.

CAUTION:

Do not to damage gear carrier.

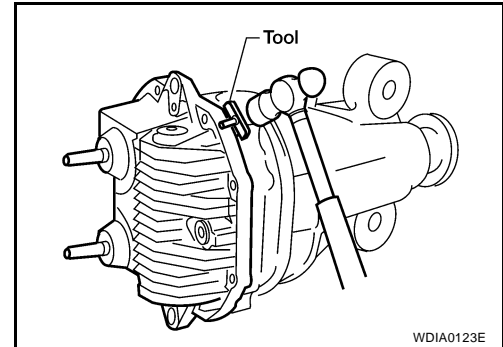
Differential Assembly

1. Remove the side flanges. Refer to [RFD-21, "Side Flange"](#).
2. Remove the carrier cover bolts.
3. Remove the carrier cover bolts and separate the carrier cover from the gear carrier using Tool.

Tool number : KV10111100 (J-37228)

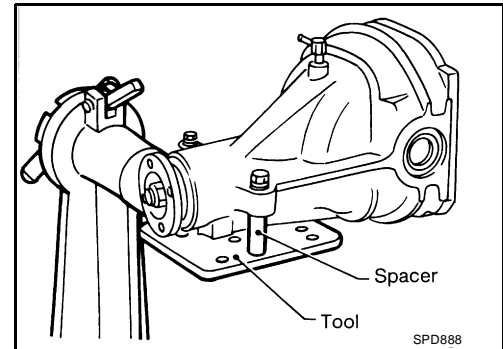
CAUTION:

- Do not damage the mating surface.
- Do not insert flat-bladed screwdriver, this will damage the mating surface.



4. Mount the carrier on the Tool using two 45 mm (1.77 in) spacers.

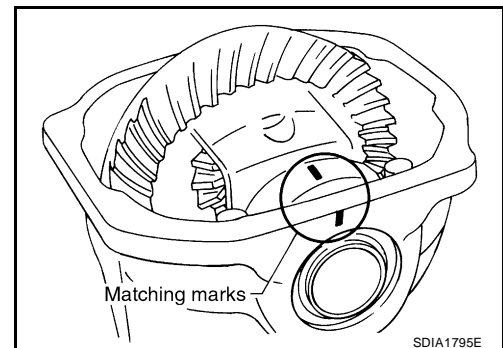
Tool number : KV38100800 (J-25604-01)



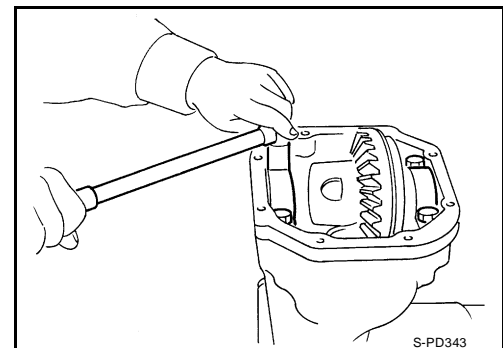
5. For proper reinstallation, paint matching marks on one side of the side bearing cap and gear carrier.

CAUTION:

- For matching marks, use paint. Do not damage side bearing cap or gear carrier.
- Side bearing caps are line-board during manufacture. The matching marks are used to reinstall them in their original positions.



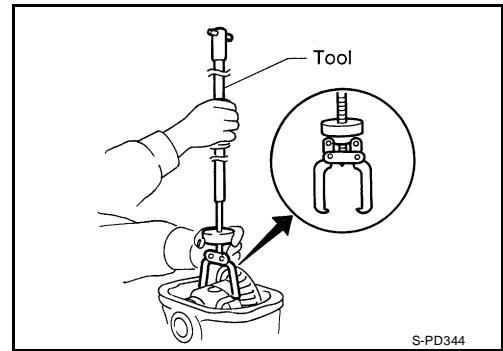
6. Remove the side bearing caps.



REAR FINAL DRIVE ASSEMBLY

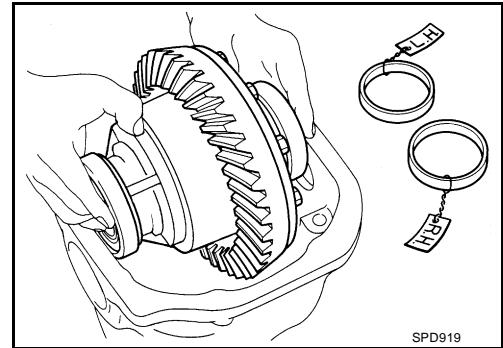
7. Lift the differential case assembly out using Tool.

Tool number : HT72400000 (—)



CAUTION:

- Keep side bearing outer races together with inner race. Do not mix them up.
- Keep side bearing adjusting washers together with side bearings.



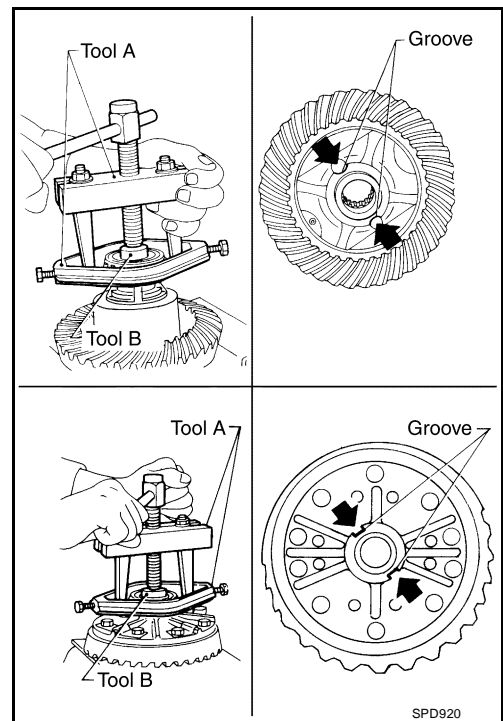
8. Remove the side bearing inner races using Tools.

Tool number A: ST33051001 (J-22888-20)

B: ST33061000 (J-8107-2)

CAUTION:

- Engage Tool jaws in bearing groove to prevent damage.
- Place copper plates between the side bearing and drive gear and the vise to prevent damage.
- Do not remove side bearing inner race unless it is being replaced.



REAR FINAL DRIVE ASSEMBLY

9. For proper reinstallation, paint matching marks on the differential case and drive gear.

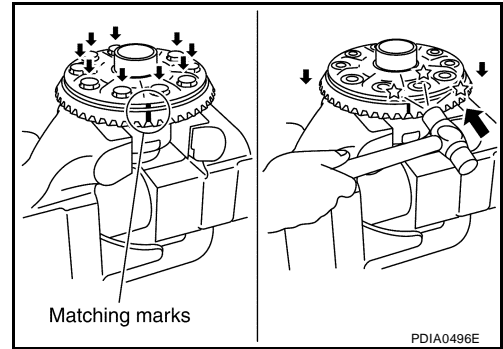
CAUTION:

Use paint for matching marks. Do not damage differential case or drive gear.

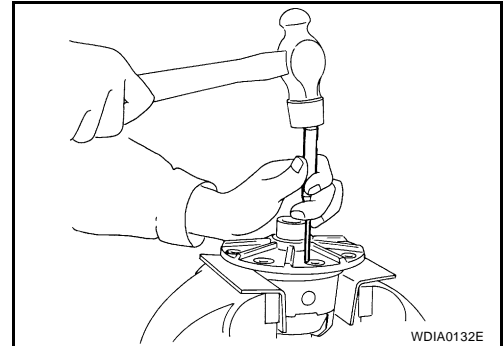
10. Remove the drive gear bolts.
11. Tap the drive gear off the differential case using suitable tool.

CAUTION:

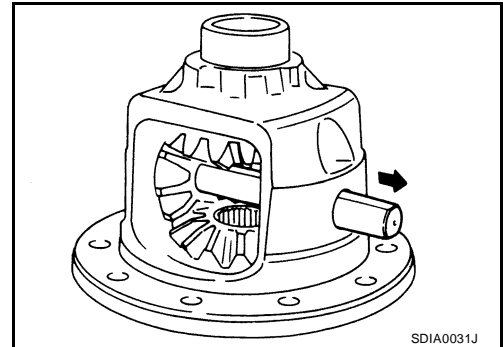
Tap evenly all around to keep drive gear from bending.



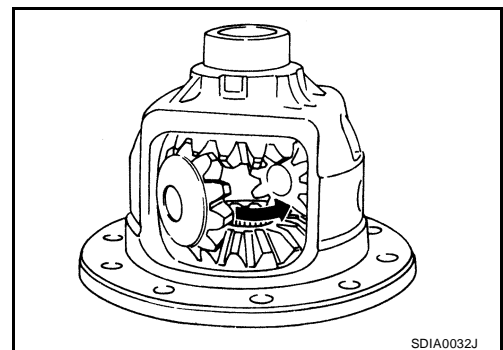
12. Remove the lock pin of the pinion mate shaft from the drive gear side using suitable tool.



13. Remove the pinion mate shaft.



14. Turn the pinion mate gear, then remove the pinion mate gear, pinion mate thrust washer, side gear and side gear thrust washer from the differential case.



Drive Pinion Assembly

1. Remove the differential assembly. Refer to [RFD-22, "Differential Assembly"](#).

REAR FINAL DRIVE ASSEMBLY

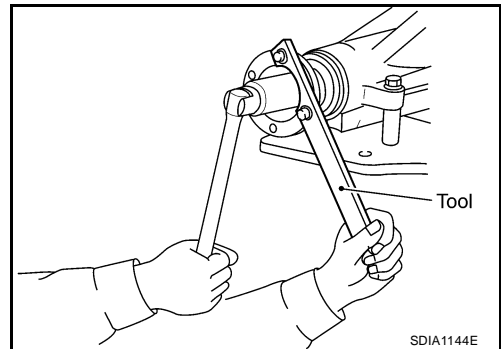
2. Remove the drive pinion lock nut using Tool.

Tool number : KV40104000 (—)

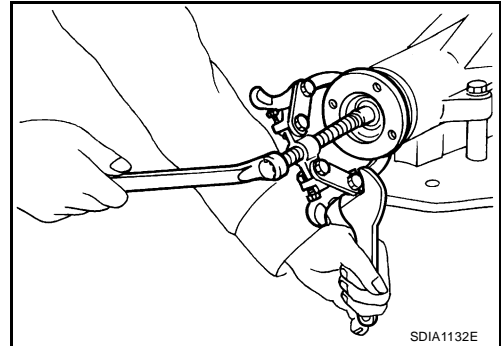
3. Put matching marks on the companion flange and drive pinion using paint.

CAUTION:

Use paint to make the matching marks. Do not damage the companion flange or drive pinion.



4. Remove the companion flange using suitable tool.



5. Press the drive pinion assembly (with rear inner bearing race and collapsible spacer) out of the gear carrier.

CAUTION:

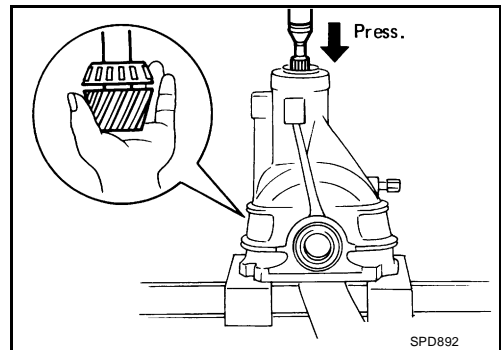
Do not drop drive pinion assembly.

6. Remove the front oil seal.

CAUTION:

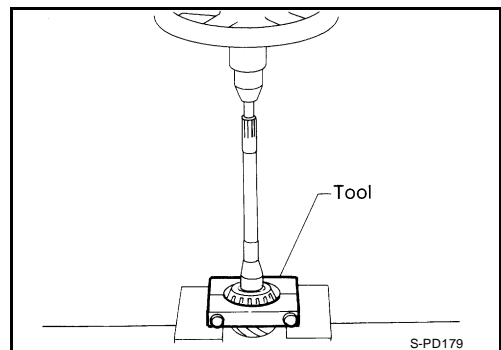
Do not damage gear carrier.

7. Remove the drive pinion front bearing inner race.



8. Remove the drive pinion rear bearing inner race and drive pinion height adjusting washer using Tool.

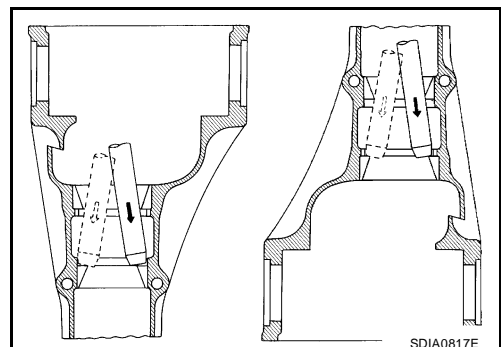
Tool number : ST30031000 (J-22912-01)



9. Remove the drive pinion front and rear bearing outer races by tapping them uniformly using suitable tool.

CAUTION:

Do not damage gear carrier.



REAR FINAL DRIVE ASSEMBLY

INSPECTION AFTER DISASSEMBLY

Clean the disassembled parts. Then inspect the parts for wear or damage. If wear or damage are found, follow the measures below.

Drive Pinion and Drive Gear

- If the drive pinion and drive gear teeth do not mesh or line-up correctly, determine the cause and adjust, repair, or replace as necessary.
- If the drive pinion or drive gear are worn, cracked, damaged, pitted or chipped (by friction) noticeably, replace with new drive pinion and drive gear.
- Drive pinion and drive gear are supplied in matched sets only. Matching numbers on both drive pinion and drive gear are etched for verification. If a new drive pinion and drive gear set are being used, verify the numbers of each drive pinion and drive gear before proceeding with assembly.

Bearing

- If bearings are chipped (by friction), pitted, worn, rusted, scratched, or unusual noise is coming from bearing, replace with new bearing assembly (as a new set).
- Bearing must be replaced with a new one whenever disassembled.

Side Gear and Pinion Mate Gear

- If any cracks or damage are found on the surface of the teeth, replace with new one.
- If any worn or chipped marks are found on the side of the side gear and pinion mate gear which contact the thrust washer, replace with new one.
- Replace both side gear and pinion mate gear as a set when replacing side gear or pinion mate gear.

Side Gear Thrust Washer and Pinion Mate Thrust Washer

- If any chips (by friction), damage, or unusual wear are found, replace with new one.

Gear Carrier

- If any wear or cracks are found on the contact sides of gear carrier, replace with new one.

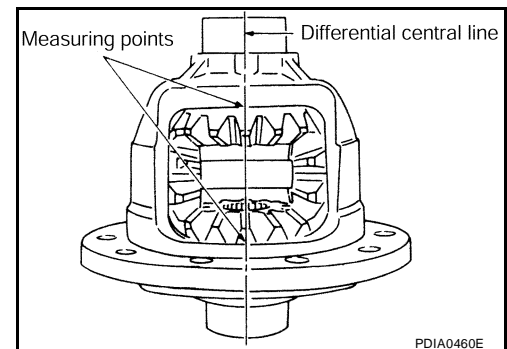
Companion Flange

- If any chips (about 0.1mm, 0.004 in) or other damage on the companion flange surface which contacts the front oil seal lips are found, replace with new one.

ADJUSTING AND SELECTING WASHERS

Side Gear Back Clearance

- Assemble the differential parts if they are disassembled. Refer to [RFD-34, "Differential Assembly"](#).
1. Place the differential case straight up so that the side gear to be measured is upward.



REAR FINAL DRIVE ASSEMBLY

- Using feeler gauges, measure the clearance between the side gear back and differential case at three different points, while rotating the side gear. Average the three readings to calculate the clearance. (Measure the clearance of the other side as well.)

Side gear back clearance: 0.2 mm (0.008 in) or less.

- If the side gear back clearance is outside of the specification, use a thicker or thinner side gear thrust washer to adjust. Refer to [RFD-38, "Side Gear Thrust Washer"](#).

If the side gear back clearance is greater than specification:

Use a thicker side gear thrust washer.

If the side gear back clearance is less than specification:

Use a thinner side gear thrust washer.

CAUTION:

- Insert feeler gauges with the same thickness on both sides to prevent side gear from tilting.
- Each gear should rotate smoothly without excessive resistance during differential motion.
- Select a side gear thrust washer for right and left individually.

NOTE:

Side gear back clearance is clearance between side gear and differential case for adjusting side gear backlash.

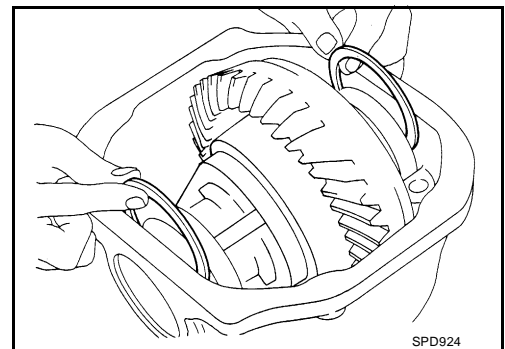
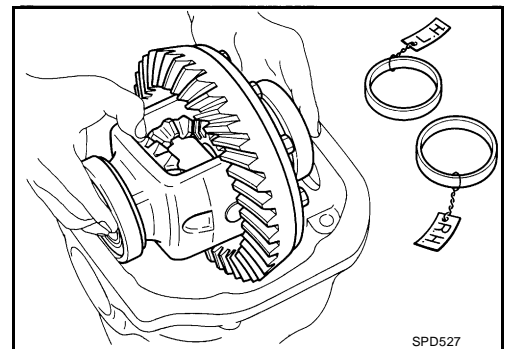
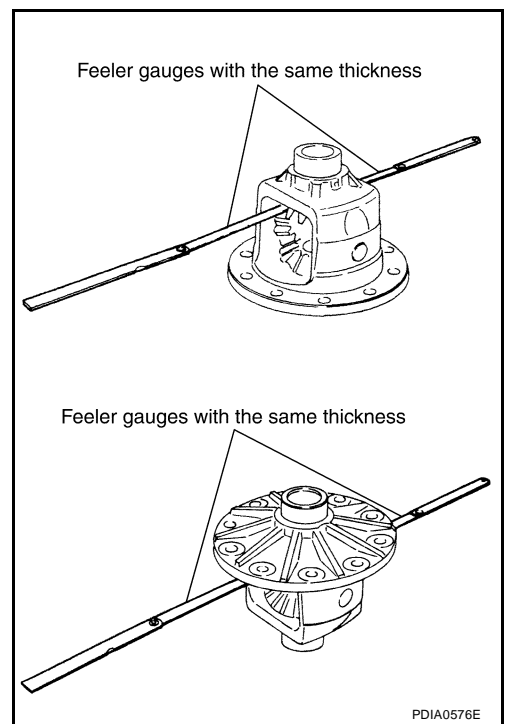
Side Bearing Preload Torque

- A selection of side bearing adjusting washers is required for successful completion of this procedure.
- Apply differential gear oil to the side bearings, and install the differential case assembly with the side bearing outer races into the gear carrier.

CAUTION:

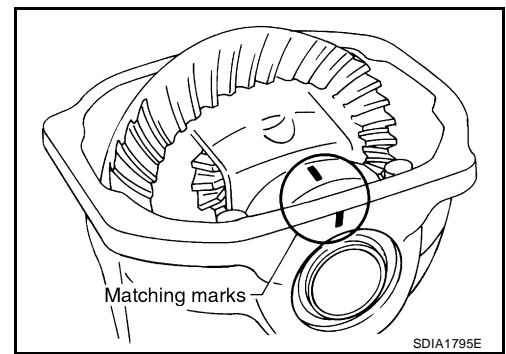
Do not reuse side bearing outer race when replacing side bearing inner race (replace as a set).

- Insert the left and right original side bearing adjusting washers in place between side bearings and gear carrier.



REAR FINAL DRIVE ASSEMBLY

- Align the matching mark on the side bearing cap with the matching mark on the gear carrier.
- Install the side bearing caps and tighten the side bearing cap bolts to the specified torque. Refer to [RFD-18, "COMPONENTS"](#).
- Turn the differential assembly several times to seat the side bearings.



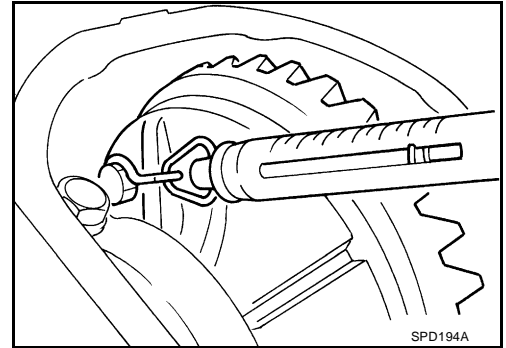
- To determine side bearing preload torque, measure the pulling force of the differential assembly at the drive gear bolt using Tool.

Tool number : — (J-8129)

Specification : 34.2 - 39.2 N (3.5 - 4.0 kg, 7.7 - 8.8 lb)
of pulling force at the drive gear bolt

NOTE:

If pulling force of the differential assembly at the drive gear bolt is within specification, side bearing preload torque will also be within specification. Refer to [RFD-38, "PRELOAD TORQUE"](#).



- If the pulling force is outside the specification, use a thicker or thinner side bearing adjusting washer to adjust. Refer to [RFD-39, "Side Bearing Adjusting Washer"](#).

If the pulling force is less than the specification:

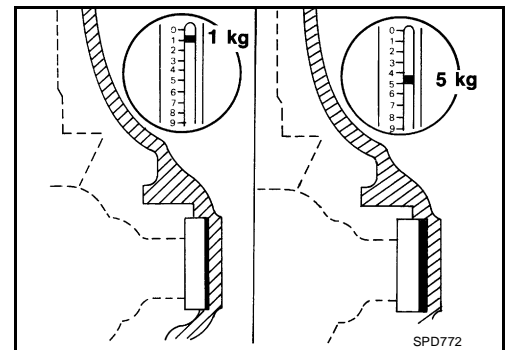
Use a thicker side bearing adjusting washer.

If the pulling force is greater than the specification:

Use a thinner side bearing adjusting washer.

CAUTION:

Select a side bearing adjusting washer for right and left individually.

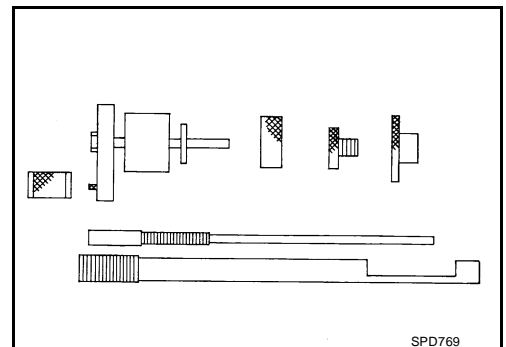


- Record the total amount of washer thickness required for the correct side bearing preload torque.

Drive Pinion Height

- Make sure all parts are clean and that the bearings are well lubricated.
- Assemble the drive pinion bearings onto the Tool.

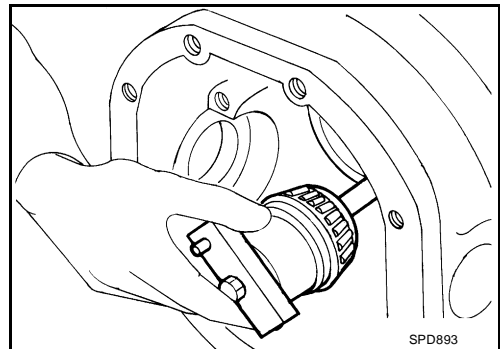
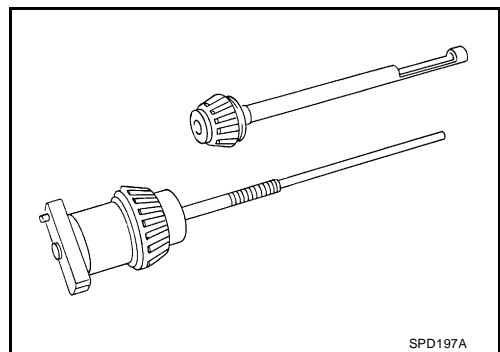
Tool number : — (J-34309)



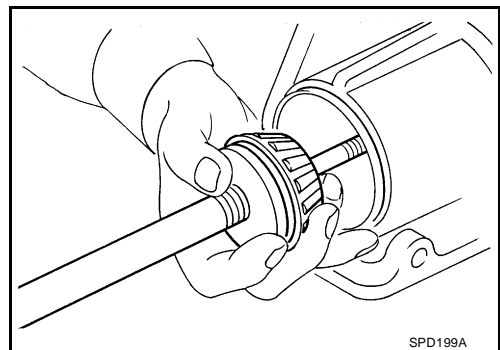
REAR FINAL DRIVE ASSEMBLY

- **Drive pinion front bearing;** make sure the J-34309-3 drive pinion front bearing seat is secured tightly against the J-34309-2 gauge anvil. Then turn the J-34309-5 drive pinion front bearing pilot to secure the drive pinion bearing in its proper position.
- **Drive pinion rear bearing;** the J-34309-8 drive pinion rear bearing pilot is used to center the drive pinion rear bearing only. The J-34309-4 drive pinion rear bearing locking seat is used to lock the drive pinion rear bearing to the assembly.
- **Installation of J-34309-9 and J-34309-16;** place a suitable 2.5 mm (0.098 in) thick plain washer between J-34309-9 and J-34309-16. Both surfaces of J-34309-9 and J-34309-16 must be parallel with a clearance of 2.5 mm (0.098 in).

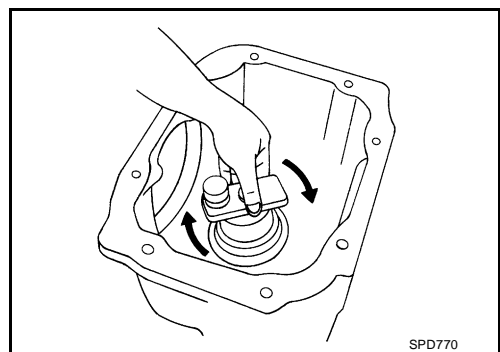
3. Install the drive pinion rear bearing inner race into the gear carrier. Then insert the drive pinion height adjusting washer selector tool, J-34309-1, gauge screw assembly.



4. Assemble the drive pinion front bearing inner race and the J-34309-2 gauge anvil. Assemble them together with the J-34309-1 gauge screw in the gear carrier. Make sure that the drive pinion height gauge plate, J-34309-16, will turn a full 360°. Tighten the two sections together by hand.



5. Turn the assembly several times to seat the drive pinion bearings.



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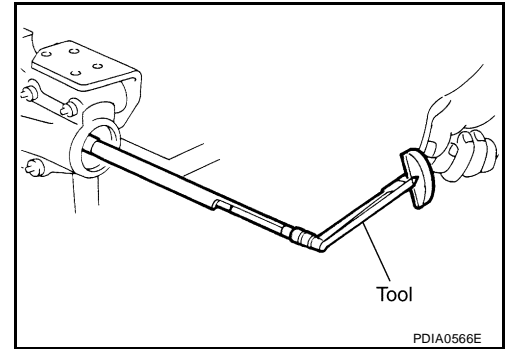
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REAR FINAL DRIVE ASSEMBLY

6. Measure the turning torque at the end of the J-34309-2 gauge anvil using Tool.

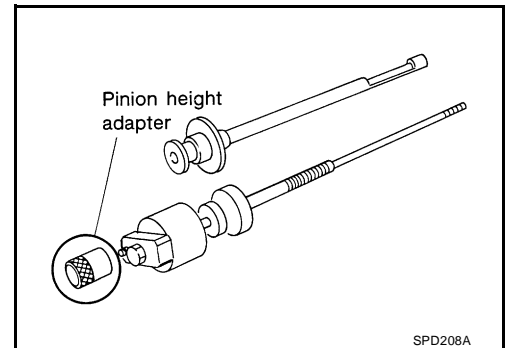
Tool number : ST3127S000 (J-25765- A)

Turning torque: 1.0 - 1.3 N-m (0.11 - 0.13 kg-m,
9 - 11 in-lb)



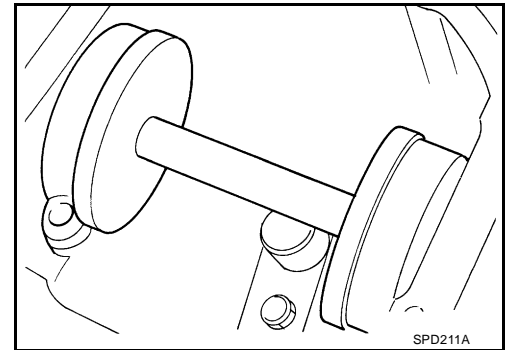
7. Place the J-34309-11 "R200A" drive pinion height adapter onto the gauge plate and tighten it by hand.

CAUTION:
Make sure all machined surfaces are clean.

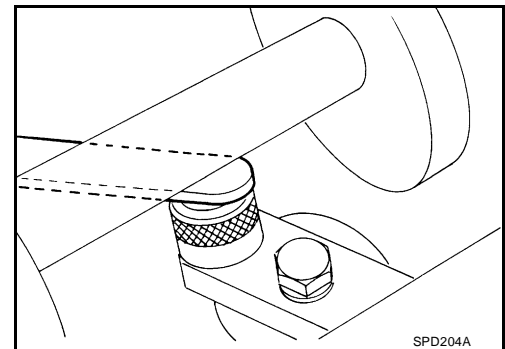


8. Position the side bearing discs, Tool, and arbor firmly into the side bearing bores. Install the side bearing caps and tighten the side bearing cap bolts to the specified torque. Refer to [RFD-18, "COMPONENTS"](#).

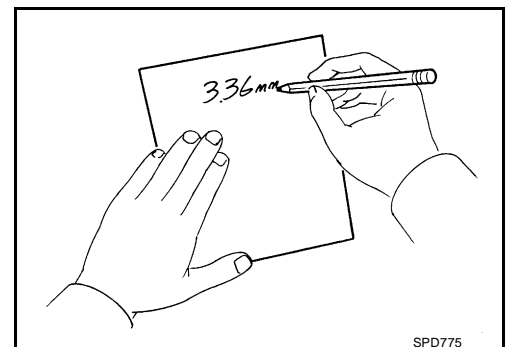
Tool number : — (J-25269-4)



9. Select the correct standard drive pinion height adjusting washer thickness. Select by using a standard gauge of 3 mm (0.12 in) and your J-34309-101 feeler gauge. Measure the distance between the J-34309-11 drive pinion height adapter, including the standard gauge and the arbor.



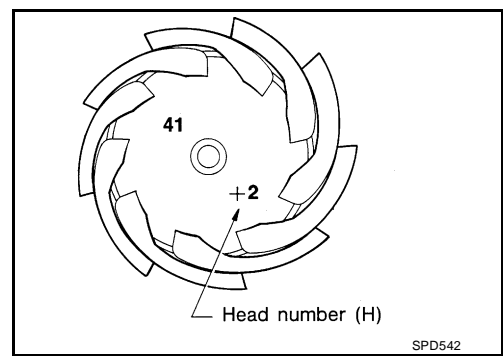
10. Write down the exact measurement (the value of feeler gauge).



REAR FINAL DRIVE ASSEMBLY

11. Correct the drive pinion height adjusting washer size by referring to the drive pinion “head number”.

There are two numbers painted on the drive pinion. The first one refers to the drive pinion and drive gear as a matched set. This number should be the same as the number on the drive gear. The second number is the drive pinion “head number”. It refers to the ideal drive pinion height from standard for quietest operation. Use the following chart to determine the correct drive pinion height adjusting washer.

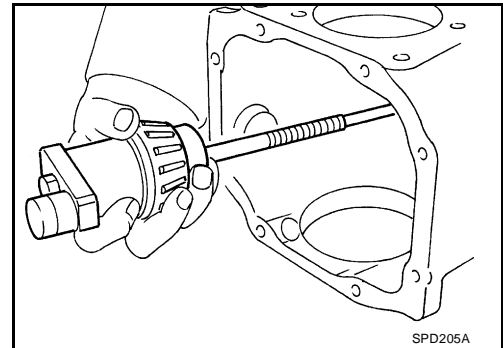


Head number	Add or remove from the standard drive pinion height adjusting washer thickness measurement
- 6	Add 0.06 mm (0.0024 in)
- 5	Add 0.05 mm (0.0020 in)
- 4	Add 0.04 mm (0.0016 in)
- 3	Add 0.03 mm (0.0012 in)
- 2	Add 0.02 mm (0.0008 in)
- 1	Add 0.01 mm (0.0004 in)
0	Use the selected washer thickness
+1	Subtract 0.01 mm (0.0004 in)
+2	Subtract 0.02 mm (0.0008 in)
+3	Subtract 0.03 mm (0.0012 in)
+4	Subtract 0.04 mm (0.0016 in)
+5	Subtract 0.05 mm (0.0020 in)
+6	Subtract 0.06 mm (0.0024 in)

12. Select the correct drive pinion height adjusting washer. Refer to [RFD-39, "Drive Pinion Height Adjusting Washer"](#).

13. Remove the Tool from the gear carrier and disassemble to retrieve the drive pinion bearings.

Tool number : — (J-34309)



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REAR FINAL DRIVE ASSEMBLY

ASSEMBLY

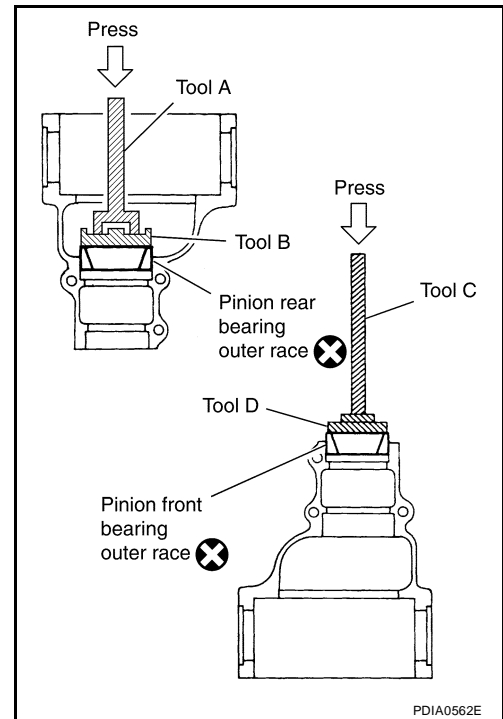
Drive Pinion Assembly

1. Install the drive pinion front and rear bearing outer races using Tools.

Tool number **A:** ST30720000 (J-25405)
 B: KV40105230 (—)
 C: ST30611000 (J-25742-1)
 D: ST30613000 (J-25742-3)

CAUTION:

- First tap the drive pinion bearing outer race until it becomes flush with the gear carrier.
- Do not reuse drive pinion front and rear bearing outer race.

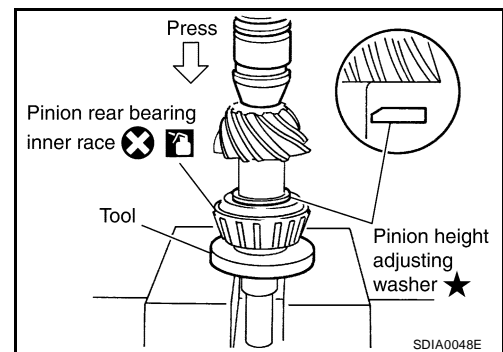


2. Select a drive pinion height adjusting washer. Refer to [RFD-28, "Drive Pinion Height"](#).
3. Install the selected drive pinion height adjusting washer to the drive pinion. Press the drive pinion rear bearing inner race to it using Tool.

Tool number : ST30901000 (J-26010-01)

CAUTION:

- Install the drive pinion height adjusting washer in the proper direction as shown.
- Do not reuse drive pinion rear bearing inner race.



4. Assemble the collapsible spacer to the drive pinion.

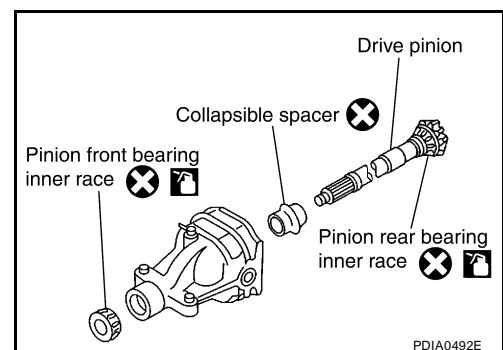
CAUTION:

Do not reuse collapsible spacer.

5. Apply differential gear oil to the drive pinion rear bearing, and install the drive pinion assembly to the gear carrier.
6. Apply differential gear oil to the drive pinion front bearing, and install the drive pinion front bearing inner race to the drive pinion assembly.

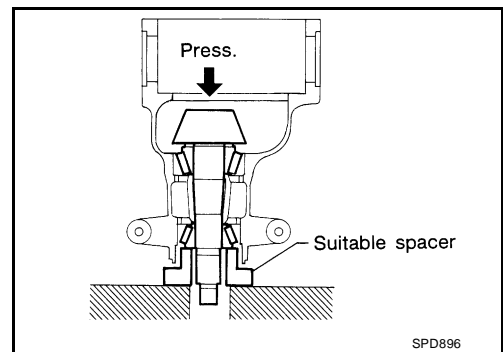
CAUTION:

Do not reuse drive pinion front bearing inner race.



REAR FINAL DRIVE ASSEMBLY

7. Press the drive pinion front bearing inner race to the drive pinion as far as drive pinion lock nut can be tightened using suitable spacer.

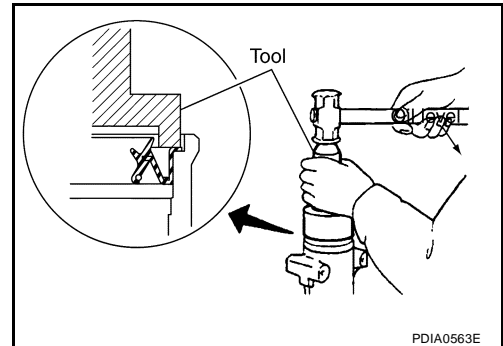


8. Apply multi-purpose grease to the lips and differential gear oil to the circumference of the new front oil seal. Then drive the new front oil seal in evenly until it becomes flush with the gear carrier using Tool.

Tool number : ST30720000 (J-25405)

CAUTION:

- Do not reuse front oil seal.
- Do not incline the new front oil seal when installing.
- Apply multi-purpose grease to the lips and differential gear oil to the circumference of the new front oil seal.



9. Install the companion flange to the drive pinion while aligning the matching marks.
10. Apply anti-corrosive oil to the threads of the drive pinion and the seating surface of the new drive pinion lock nut. Then adjust the drive pinion lock nut tightening torque using Tool A, and check the drive pinion bearing preload torque using Tool B.

Tool number A: KV40104000 (—)

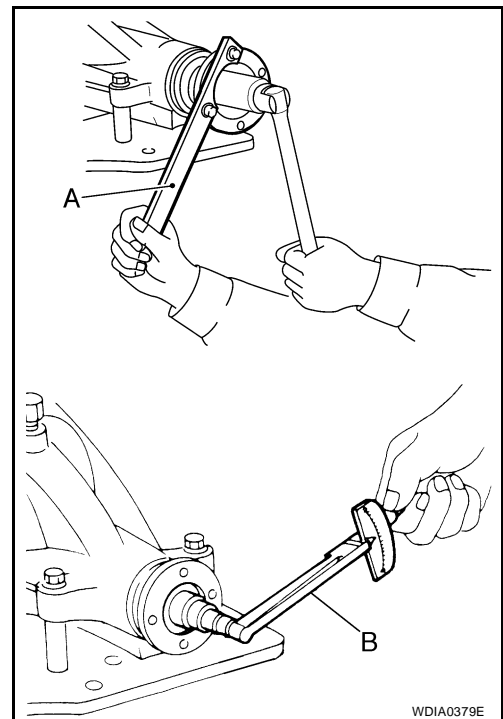
B: ST3127S000 (J-25765-A)

Drive pinion bearing preload torque:

2.65 - 3.23 N·m (0.27 - 0.32 kg·m, 24 - 28 in·lb)

CAUTION:

- Do not reuse drive pinion lock nut.
- Apply anti-corrosive oil to the threads of the drive pinion and the seating surface of the new drive pinion lock nut.
- Adjust the drive pinion lock nut tightening torque to the lower limit first. Do not exceed the drive pinion lock nut specified torque. Refer to [RFD-18, "COMPONENTS"](#).
- If the drive pinion bearing preload torque exceeds the specified value, replace collapsible spacer and tighten it again to adjust. Do not loosen drive pinion lock nut to adjust the drive pinion bearing preload torque.
- After adjustment, rotate drive pinion back and forth 2 to 3 times to check for unusual noise, rotation malfunction, and other malfunctions.

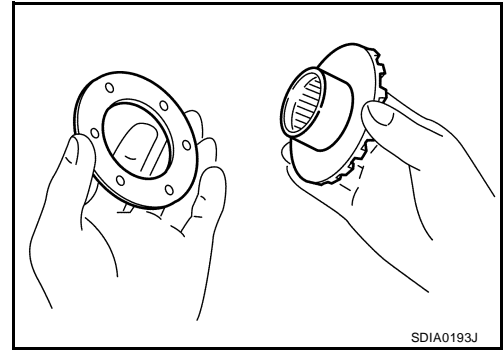


11. Check companion flange runout. Refer to [RFD-21, "Companion Flange Runout"](#).
12. Install the differential case assembly. Refer to [RFD-34, "Differential Assembly"](#).

REAR FINAL DRIVE ASSEMBLY

Differential Assembly

1. Install side gear thrust washers with the same thickness as the ones installed prior to disassembly, or reinstall the old ones on the side gears.

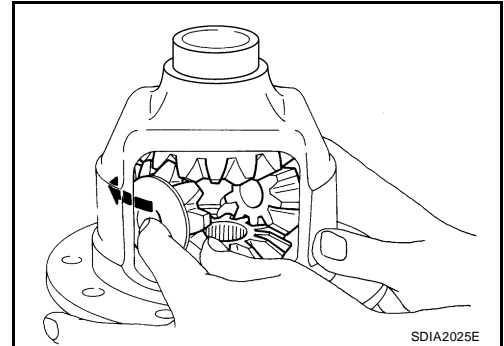


2. Install the side gears and side gear thrust washers into the differential case.

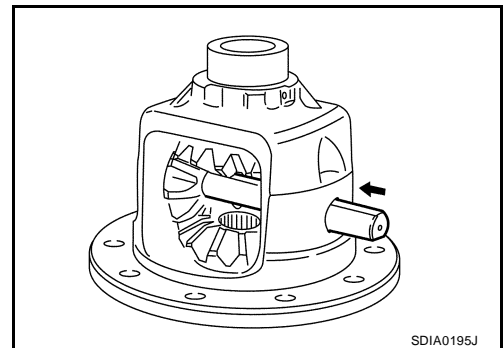
CAUTION:

Make sure that the circular clip is installed to side gears.

3. Install the pinion mate thrust washers to the two pinion mate gears. Then install the pinion mate gears with the pinion mate thrust washers by aligning them in diagonally opposite positions and rotating them into the differential case.



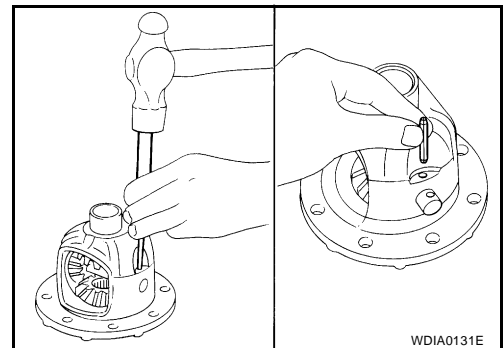
4. Align the lock pin hole on the differential case with the lock pin hole on the pinion mate shaft, and install the pinion mate shaft.
5. Measure the side gear end play. If necessary, select the appropriate side gear thrust washers. Refer to [RFD-26, "Side Gear Back Clearance"](#).



6. Drive a new lock pin into the pinion mate shaft until it is flush with the differential case using suitable tool.

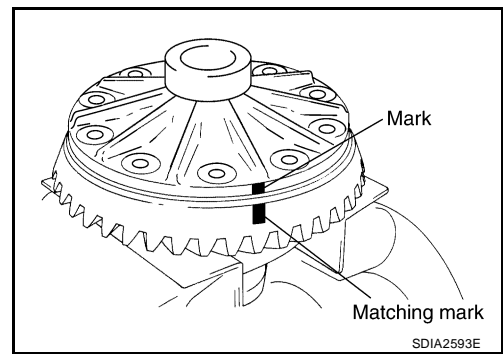
CAUTION:

Do not reuse lock pin.



REAR FINAL DRIVE ASSEMBLY

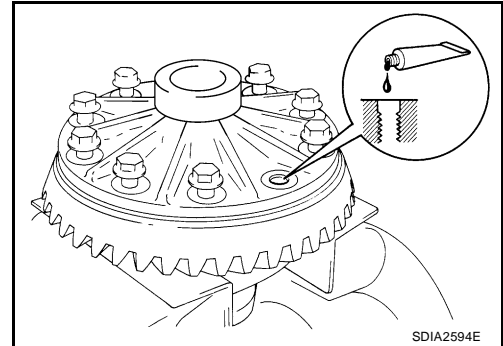
7. Align the matching mark of the differential case with the mark of the drive gear, then place the drive gear onto the differential case.



8. Apply thread locking sealant into the threaded holes of the drive gear and install the bolts.
- Use Genuine Medium Strength Thread Locking Sealant or equivalent. Refer to [GI-47, "Recommended Chemical Products and Sealants"](#).

CAUTION:

Make sure the drive gear back and threaded holes are clean.

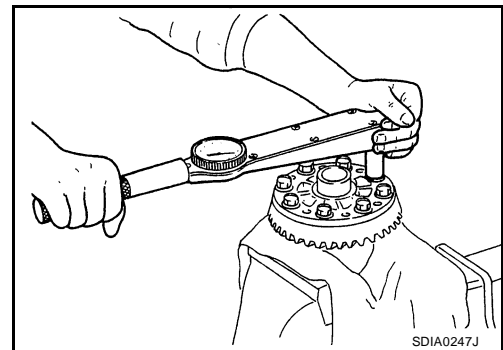


9. Tighten the drive gear bolts to the specified torque. Refer to [RFD-18, "COMPONENTS"](#). After tightening the drive gear bolts to the specified torque, tighten an additional 31° to 36° using Tool.

Tool number : KV10112100-A (BT-8653-A)

CAUTION:

- Always use Tool. Avoid tightening based on visual check alone.
- Tighten drive gear bolts in a crisscross pattern.



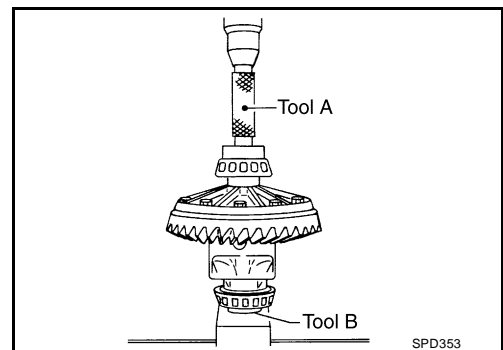
10. Press the side bearing inner races into the differential case using Tools.

Tool number A: KV38100300 (J-25523)

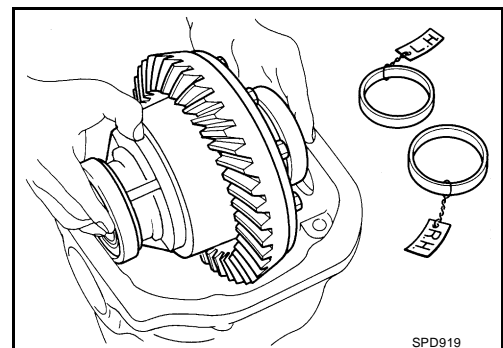
B: ST33061000 (J-8107-2)

CAUTION:

Do not reuse side bearing inner race.



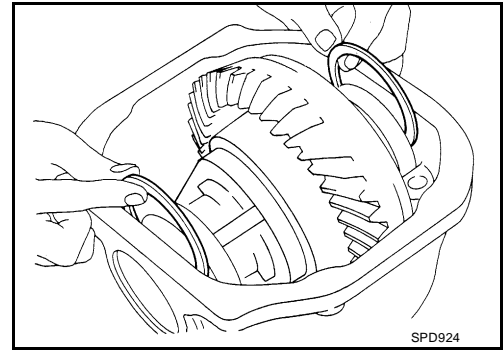
11. Install the differential case assembly with the side bearing outer races into the gear carrier.
12. Measure the side bearing preload torque. If necessary, select the appropriate side bearing adjusting washers. Refer to [RFD-27, "Side Bearing Preload Torque"](#).



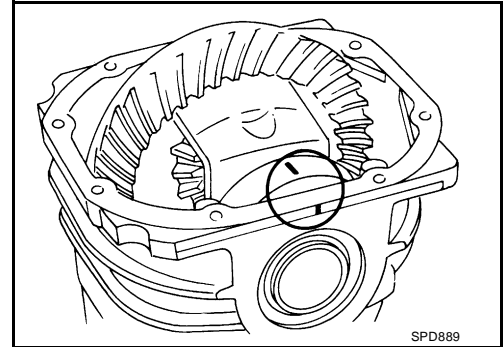
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REAR FINAL DRIVE ASSEMBLY

13. Insert the selected left and right side bearing adjusting washers in place between the side bearings and gear carrier.



14. Install the side bearing caps with the matching marks aligned and tighten the side bearing cap bolts to the specified torque. Refer to [RFD-18, "COMPONENTS"](#).



15. Check and adjust the drive gear runout, tooth contact, drive gear to drive pinion backlash, and total preload torque. Refer to [RFD-19, "Drive Gear Runout"](#), [RFD-20, "Tooth Contact"](#), [RFD-21, "Backlash"](#) and [RFD-19, "Total Preload Torque"](#).
Recheck the above items.

16. Install the side flanges. Refer to [RFD-36, "Side Flange"](#).

17. Apply a 3.2mm (0.126 in) bead of sealant to the mating surface of the carrier cover.

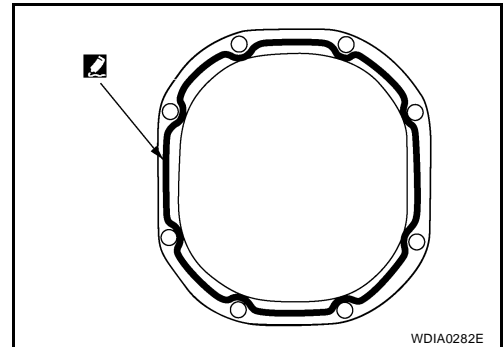
- Use Genuine Silicone RTV or equivalent. Refer to [GI-47, "Recommended Chemical Products and Sealants"](#).

CAUTION:

Remove any old sealant adhering to the mating surfaces. Also remove any moisture, oil, or foreign material adhering to the application and mating surfaces.

18. Install the carrier cover to the gear carrier. Tighten the bolts to the specified torque. Refer to [RFD-18, "COMPONENTS"](#).

19. Install the side flange. Refer to [RFD-36, "Side Flange"](#).



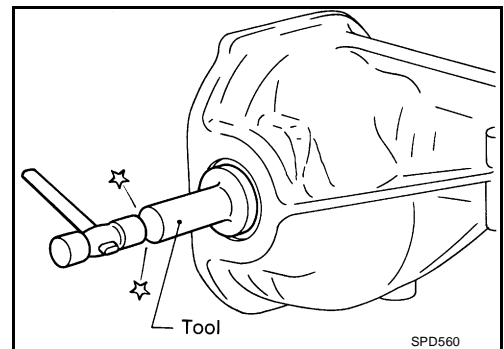
Side Flange

1. Apply multi-purpose grease to the lips and differential gear oil to the circumference of the new side oil seal. Then drive the new side oil seal in evenly until it becomes flush with the gear carrier using Tool.

Tool number : KV38100200 (J-26233)

CAUTION:

- Do not reuse side oil seal.
- Do not incline the new side oil seal when installing.
- Apply multi-purpose grease to the lips and differential gear oil to the circumference of the new side oil seal.



REAR FINAL DRIVE ASSEMBLY

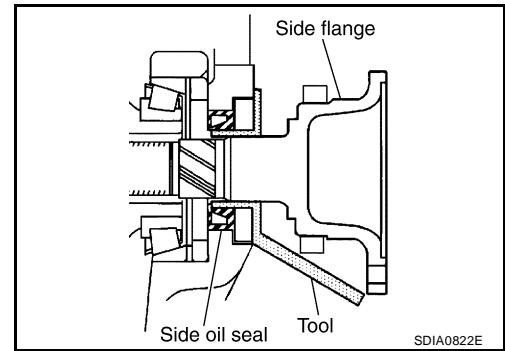
2. Install the side flange using Tool.
- a. Install the Tool to the side oil seal as shown.

Tool number : KV38107900 (J-39352)

- b. Insert the side flange until the serrated part of the side flange has engaged the serrated part of the side gear and remove the Tool.
- c. Drive in the side flange using suitable tool.

NOTE:

Installation is completed when the driving sound of the side flange turns into a sound which seems to affect the whole rear final drive assembly.



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SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

PF0:00030

General Specifications

EDS003A5

Applied model	VQ40DE	
	2WD	4WD
Final drive model	R200	
Gear ratio	3.133	3.357
Number of teeth (Drive gear/Drive pinion)	47/15	47/14
Oil capacity (Approx.)	1.4 ℓ (3 US pt, 2-1/2 Imp pt)	
Number of pinion gears	2	
Drive pinion adjustment spacer type	Collapsible	

Inspection and Adjustment DRIVE GEAR RUNOUT

EDS003A6

Unit: mm (in)

Item	Runout limit
Drive gear back face	0.05 (0.0020) or less

SIDE GEAR CLEARANCE

Unit: mm (in)

Item	Specification
Side gear back clearance (Clearance between side gear and differential case for adjusting side gear backlash)	0.2 (0.008) or less (Each gear should rotate smoothly without excessive resistance during differential motion.)

PRELOAD TORQUE

Item	Specification
Drive pinion bearing preload torque	2.65 - 3.23 N·m (0.27 - 0.32 kg-m, 24 - 28 in-lb)
Side bearing preload torque (reference value determined by drive gear bolt pulling force)	0.20 - 0.52 N·m (0.02 - 0.05 kg-m, 2 - 4 in-lb)
Drive gear bolt pulling force (by spring gauge)	34.2 - 39.2 N (3.5 - 4 kg, 7.7 - 8.8 lb)
Total preload torque (Total preload torque = drive pinion bearing preload torque + Side bearing preload torque)	2.84 - 3.75 N·m (0.29 - 0.38 kg-m, 26 - 33 in-lb)

BACKLASH

Unit: mm (in)

Item	Specification
Drive gear to drive pinion gear	0.10 - 0.15 (0.0039 - 0.0059)

COMPANION FLANGE RUNOUT

Unit: mm (in)

Item	Runout limit
Outer side of the companion flange	0.08 (0.0031) or less

SELECTIVE PARTS

Side Gear Thrust Washer

Unit: mm (in)

Thickness	Part number*	Thickness	Part number*
0.75 (0.0295)	38424 0C000	0.87 (0.0343)	38424 0C004
0.78 (0.0307)	38424 0C001	0.90 (0.0350)	38424 0C005
0.81 (0.0319)	38424 0C002	0.93 (0.0366)	38424 0C006
0.84 (0.0331)	38424 0C003		

*: Always check with the Parts Department for the latest parts information.

SERVICE DATA AND SPECIFICATIONS (SDS)

Drive Pinion Height Adjusting Washer

Unit: mm (in)

Thickness	Part number*	Thickness	Part number*
3.05 (0.1201)	38154 0C000	3.17 (0.1248)	38154 0C004
3.08 (0.1213)	38154 0C001	3.20 (0.1260)	38154 0C005
3.11 (0.1224)	38154 0C002	3.23 (0.1272)	38154 0C006
3.14 (0.1236)	38154 0C003	3.26 (0.1283)	38154 0C007

*: Always check with the Parts Department for the latest parts information.

Side Bearing Adjusting Washer

Unit: mm (in)

Thickness	Part number*	Thickness	Part number*
2.00 (0.0787)	38453 N3100	2.35 (0.0925)	38453 N3107
2.05 (0.0807)	38453 N3101	2.40 (0.0945)	38453 N3108
2.10 (0.0827)	38453 N3102	2.45 (0.0965)	38453 N3109
2.15 (0.0846)	38453 N3103	2.50 (0.0984)	38453 N3110
2.20 (0.0866)	38453 N3104	2.55 (0.1004)	38453 N3111
2.25 (0.0886)	38453 N3105	2.60 (0.1024)	38453 N3112
2.30 (0.0906)	38453 N3106	2.65 (0.1043)	38453 N3113

*: Always check with the Parts Department for the latest parts information.

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SERVICE DATA AND SPECIFICATIONS (SDS)
