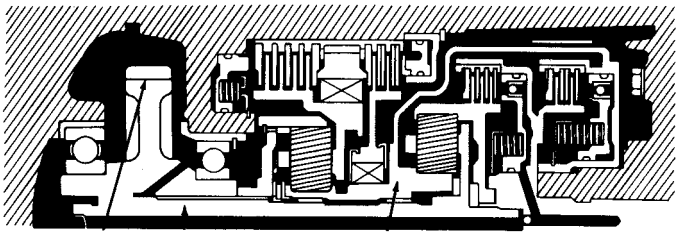
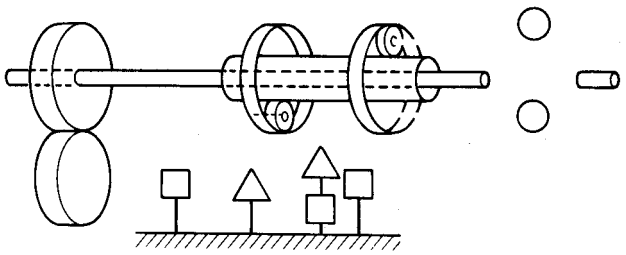
Section 5

POWER FLOW





Lesson Ojectives

1. Given a clutch application chart, identify which holding devices are applied for each gear range
2. Given a clutch application chart and the powerflow model, identify the planetary gear components held for each gear range.
3. Describe the poer flow through the planetary gear sets for the following gear ranges
   a. First gear
   b. Second gear
   c. Third gear
   d. Reverse
5. Identify the gear selector positions which can be used to diagnose a fault in drive range.

Power Flow Model

The planetary gear set cutaway and model shown below are found in Toyota Repair Manuals and New Car Features Books. The model will help you visualize the workings of the holding devices, gear shafts and planetary gear members for all gear positions.

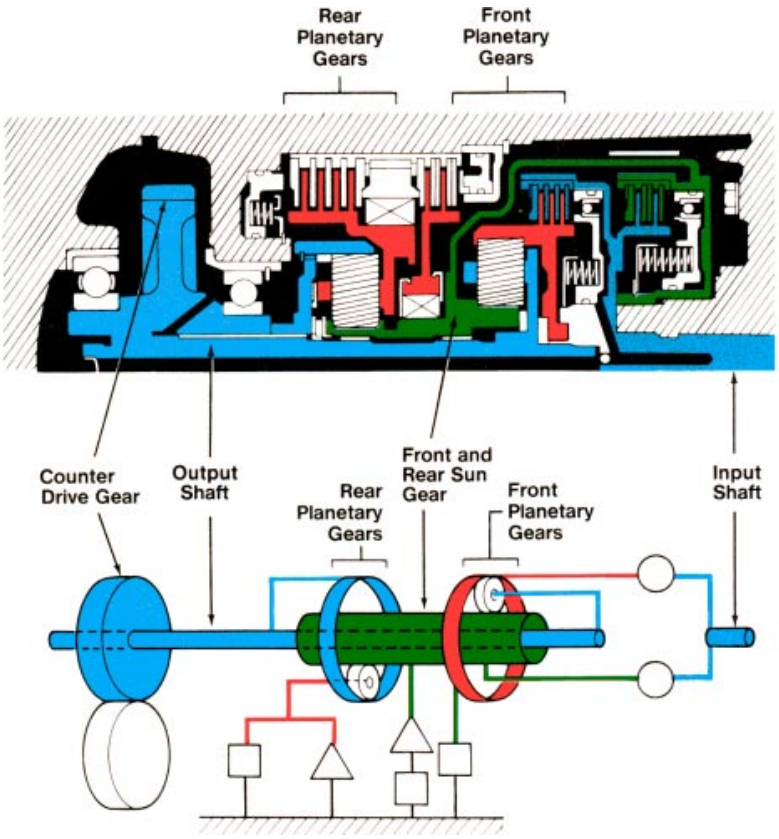
Gear Train Shafts

There are three shafts in the Simpson planetary: the input shaft, sun gear, and the output shaft. The input shaft is driven from the turbine in the torque converter. It is connected to the front planetary ring gear through the multiplate clutches. The sun gear, which is common to both the front and rear planetary gear sets, transfers torque from the front planetary set to the rear planetary set. The output shaft is splined to the carrier of the front planetary gear set and to the ring gear of the rear planetary and then provides turning torque to the rear wheels or the overdrive unit.

The output shaft, for the purposes of power flow, refers to the output of the Simpson planetary gear set. It may be referred to as the intermediate shaft in other references. However, for our purposes in discussing power flow, it will be referred to as the output shaft.

Planetary Gear Shafts

The planetary gear set cutaway and model will help visualize the workings of holding devices, gear shafts, and planetary gear memebers



Holding Devices Multiplate clutches and brakes were discussed in detail earlier, and in the cutaway model on the next page, we can identify their position and the components to which they are connected. The holding devices for the Simpson planetary gear set are identified below with the components they control:

FUNCTION OF HOLDING DEVICES

HOLDING DEVICE		FUNCTION
C_1	Forward Clutch	Connects input shaft and front planetary ring gear.
C_2	Direct Clutch	Connects input shaft and front and rear planetary sun gear.
B_1	2nd Coast Brake	Prevents front and rear planetary sun gear from turning either clockwise or counterclockwise.
B_2	2nd Brake	Prevents outer race of F1i from turning either clockwise or counterclockwise, thus preventing front and rear planetary sun gear from turning counterclockwise.
B_3	1 st and Reverse Brake	Prevents rear planetary carrier from turning either clockwise or counterclockwise.
F_1	No. 1 One-Way Clutch	When B2 is operating, prevents front and rear planetary sun gear from turning counterclockwise.
F_2	No. 2 One-Way Clutch	Prevents rear planetary carrier from turning counterclockwise.

The value of this model can be appreciated when observing the control of the rear carrier by the first and reverse brake (B3) and the one-way clutch No. 2 (F2) and control of the sun gear by the second brake (B2) and the one-way clutch No. 1 (Fl).

Notice that the first and reverse brake (B3) and one-way clutch No. 2 (F2) both hold the rear planetary carrier. Together they provide a great holding force on the carrier to prevent it from turning during low first gear.

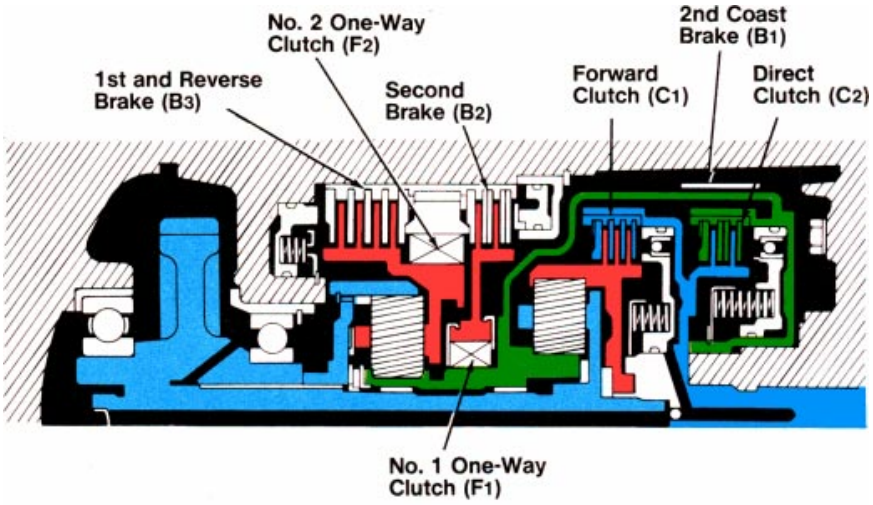
Note also that the second brake (B2) and the one-way clutch No. 1 (Fl) work together to hold the sun gear. The second coast brake (B1) holds the sun gear too. The benefit to this design will be discussed as the power flow is covered for each gear position.

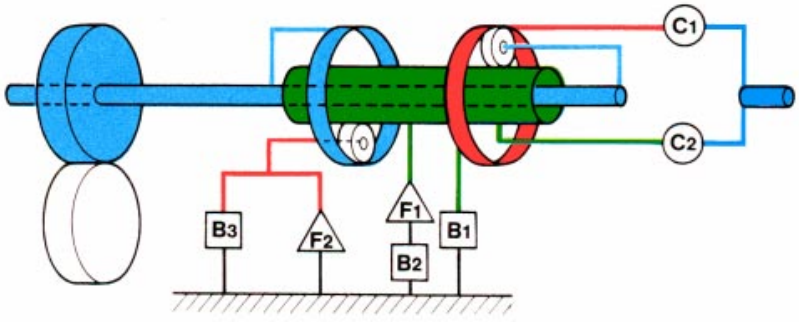
Planetary Holding Devices

The first and reverse brake (B3) and one-way clutch No. 2 (F2) both hold the rear planetary carrier.

The second brake (B2) and the one-way clutch No. 1 (F1) work together to hold the sun gear.

The second coast brake (B1) holds the sun gear also.





Clutch Application Chart

The gear position in which these holding devices are applied can be found on the clutch application chart below. The chard describes which holding devices are applied for a given gear position. If you follow down the left side of the chart to shift lever position ”D” and ”first” gear position, the shaded boxesto the right of the gear position indicate the holding devices used in drive first gear. At the top of the column above the shaded box you will find the code designation for the holding device. For example, in drive first gear, the *forward clutch* (C1) and the *one-way clutch* No. 2 (F2) are applied to achieve first gear.

Clutch Application Chart for A130 Trans

Shift Lever Position	Gear Position	C_1	C_2	B_1	B_2	B_3	F_1	F_2
P	Parking							
R	Reverse		■			■		
N	Neutral							
D	1st	■						■
	2nd	■			■		■	
	3rd	■	■		■			
2	1st	■						■
	2nd	■		■	■		■	
L	1st	■				■		■
	2nd*	■		■	■		■	

*Down-shift in Lrange, 2nd gear only—no up-shift

The clutch application chart is you key to diagnosis. When a transmission malfunction occurs and your diagnosis leads you to a specific gear, you can refer to this chart to pinpoint the faulty honding device. When the holding device you suspect is used in another gear position, you should be able to detect a failure in that gear position also.

Segments of this application chart will be used in the Power Flow section to familiarize you with their use.

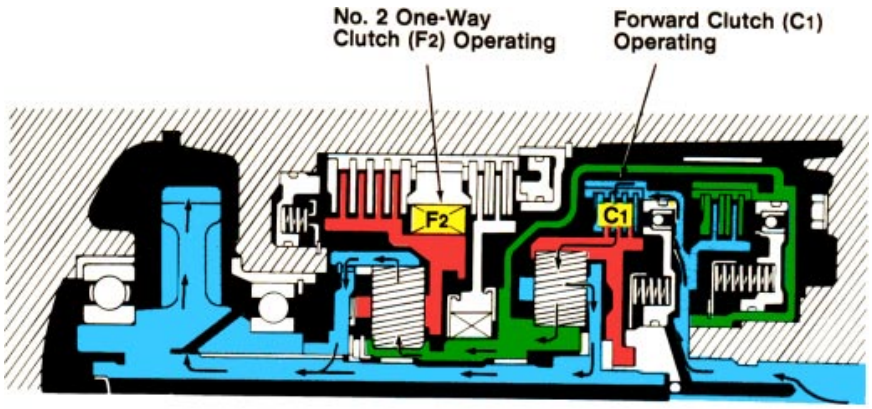
Power Flow Through Simpson Planetary Gear Set

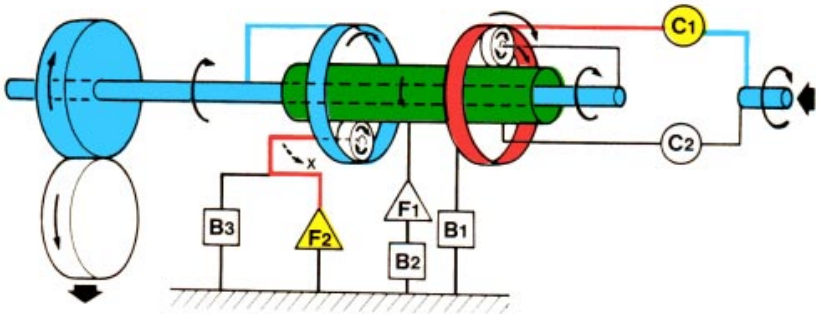
D- or 2-Range First Gear

First gear is unique because it uses both the front and rear planetary gear sets. The forward clutch (C1) is applied in all forward gears and drives the ring gear of the front planetary gear set. When the ring gear rotates clockwise, it causes the pinions to rotate clockwise since the sun gear is not held to the case. The sun gear rotates in a counterclockwise direction. The front planetary carrier, which is connected to the output shaft, rotates, but more slowly than the ring gear; so for practical purposes, it is the held unit. In the rear planetary gear set, the carrier is locked to the case by the one-way clutch No. 2 (F2). Turning torque is transferred to the rear planetary by the sun gear, which is turning counterclockwise. With the carrier held, the planetary gears rotate in a clockwise direction and cause the rear planetary ring gear to turn clockwise. The rear planetary ring gear is connected to the output shaft and transfers torque to the drive wheels.

D- or 2-Range First Gear

First gear is unique because it uses both the front and rear planetary gear sets.





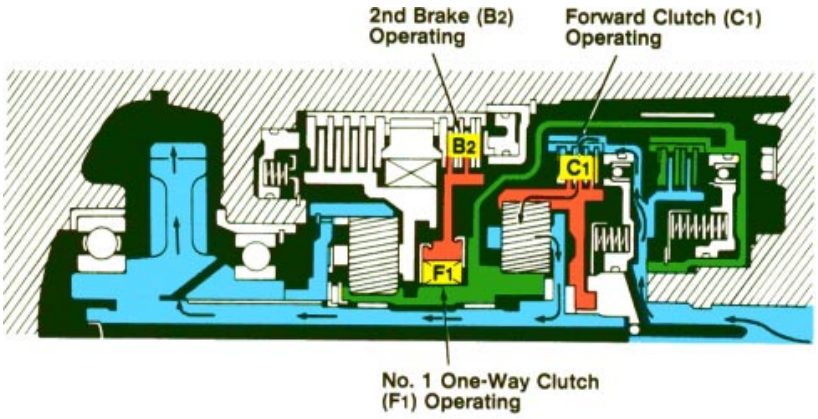
Shift Lever Position	Gear Position	C1	C2	B1	B2	B3	F1	F2
D	1st							

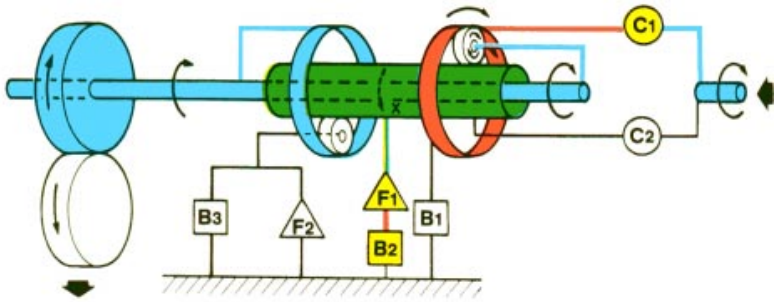
D-Range Second Gear

The forward clutch (C1) connects the input shaft to the front planetary ring gear. The sun gear is driven in a counterclockwise direction in first gear, and by simply applying the second brake (B2), the sun gear is stopped by the one-way clutch No. 1 (Fl) and held to the case. When the sun gear is held, the front pinion gears driven by the ring gear walk around the sun gear and the carrier turns the output shaft.

D-Range Second Gear

Second gear uses the front planetary gear set only.





Shift Lever Position	Gear Position	C1	C2	B1	B2	B3	F1	F2
D	1st							
	2nd							

The advantage of the one-way clutch No. 2 (F2) is in the automatic upshift and downshift. Only one multiplate clutch is applied or released to achieve an upshift to second gear or downshift to first gear.

Notice how the second brake (B2) and the one-way clutch (Fl) both hold the sun gear. The second brake holds the outer race of the one-way clutch to the transmission case when applied. The one-way clutch prevents the sun gear from rotating counterclockwise only when the second brake is applied.

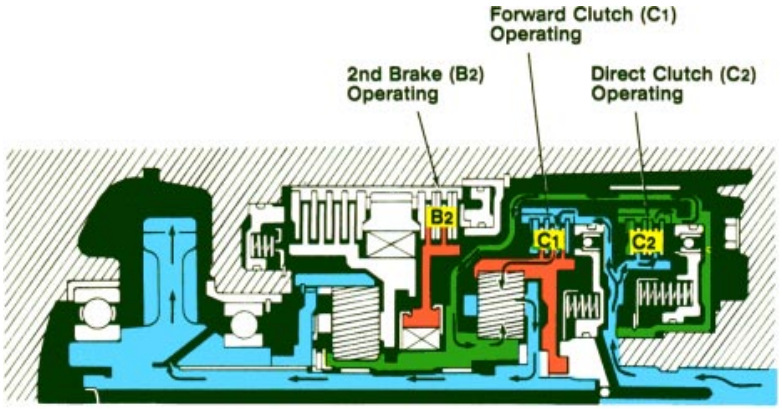
D-Range Third Gear

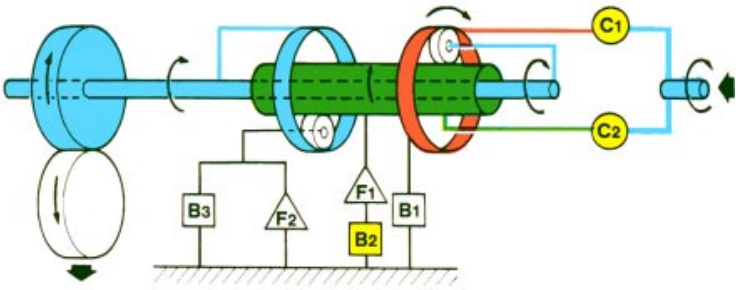
The forward dutch (C1) is applied in all forward gears and connects the input shaft to the front planetary ring gear as it does in all forward gears. The direct clutch (C2) connects the input shaft to the common sun gear. By applying both the direct clutch and the forward clutch, we have locked the ring gear and the sun gear to each other through the direct clutch drum and the input sun gear drum. Whenever two members of the planetary gear set are locked together, direct drive is the result.

Notice that the second brake (B2) is also applied in third gear; however, since the one-way clutch No. 1 (Fl) does not hold the sun gear in the clockwise direction, the second brake has no effect in third gear. So why is it applied in third gear? The reason lies in a downshift to second gear. All that is necessary for a downshift to second gear is to release the direct and reverse clutch (C2). The ring gear provides input torque and the sun gear is released. The carrier is connected to the output shaft and final drive so the output shaft tends to slow the carrier. The pinion gears rotate clockwise turning the sun gear counterclockwise until it is stopped by the one-way clutch No. 1 (Fl). The carrier provides the output to the final drive.

D-Range Third Gear

Third gear uses the front planetary gear set only.





Shift Lever Position	Gear Position	C1	C2	B1	B2	B3	F1	F2
D	2nd	■			■		■	
	3rd	■	■					

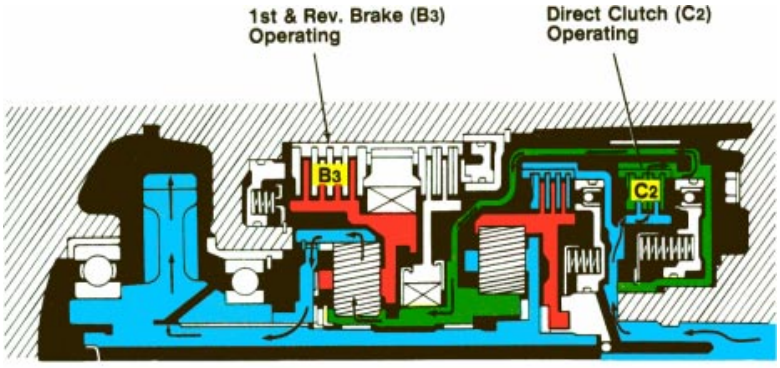
Reverse Range

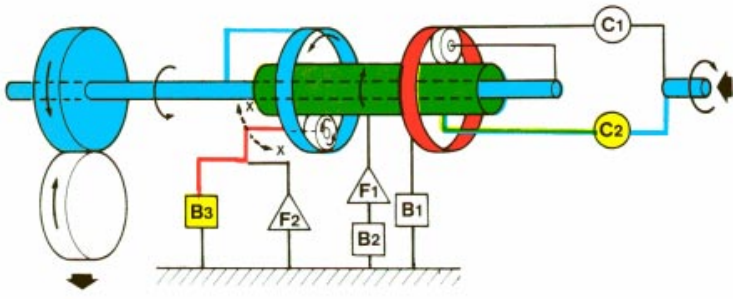
Direct and reverse clutch (C2) is applied in reverse, which connects the input shaft to the sun gear. The first and reverse brake (B3) is also applied, locking the rear carrier to the case. With the carrier locked in position, the sun gear turning in the clockwise direction causes the planetary gears to rotate counterclockwise. The planetary gears will then drive the ring gear and the output shaft counterclockwise.

Up to this point we have examined reverse gear and those forward gear positions which are automatic. That is, with the gear selector in D-position all forward gears are upshifted automatically. The gears can also be selected manually, utilizing additional holding devices. This feature not only provides additional characteristics to the drivetrain but also allows a means of diagnosis for faults in certain holding devices.

Reverse Range

Reverse gear uses the rear planetary gear set only.





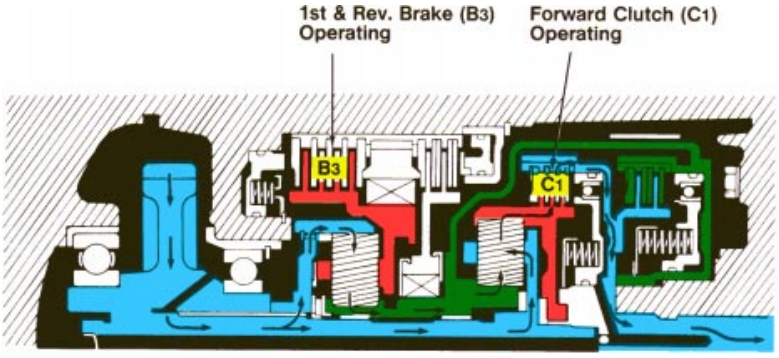
Shift Lever Position	Gear Position	C1	C2	B1	B2	B3	F1	F2
P	Parking							
R	Reverse							

Differences Between D1- and L-Range First Gear

When the gear selector is placed in the L-position, the first and reverse brake (B3) is applied through the position of the manual valve. The first and reverse brake does the same thing as the one-way clutch No. 2 (F2) in the forward direction, as seen in the illustration. When the first and reverse brake (B3) is applied it holds the rear planetary gear carrier from turning in either direction. Whereas the one-way clutch No. 2 only holds the carrier in the counterclockwise direction. The advantage that the first and reverse brake has is that engine braking can be achieved to slow the vehicle on deceleration. In ”D1” only, the one-way clutch No. 2 holds the carrier, so while decelerating, the one-way clutch would release and no engine braking would occur.

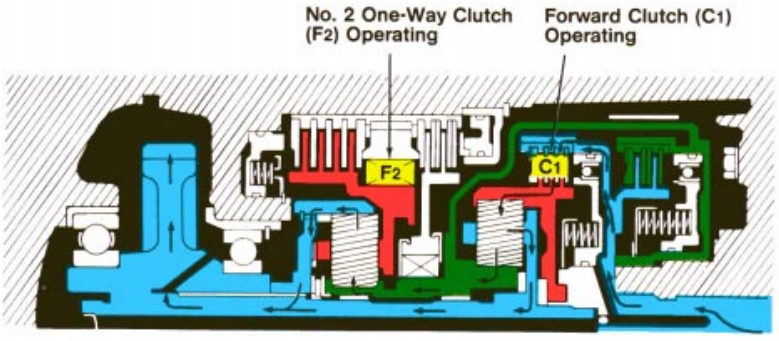
First Gear

First and Reverse Brake (B3) holds the rear carrier.



“L” Range-Engine Braking

The No. 2 On-Way Clutch holds the rear carrier

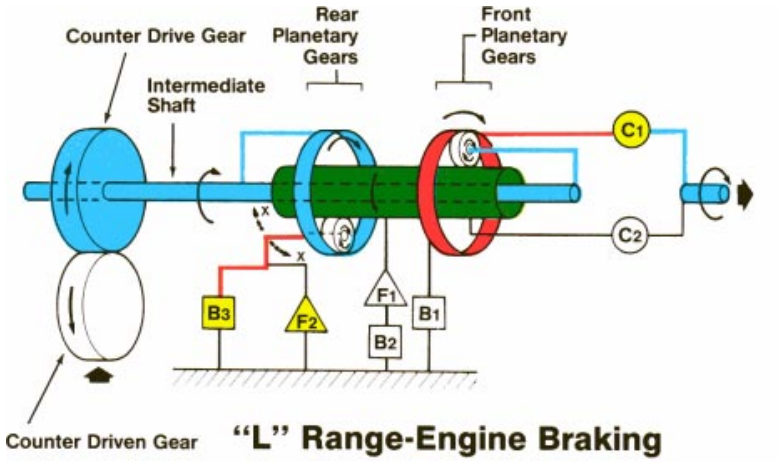


“D” or “2” Range

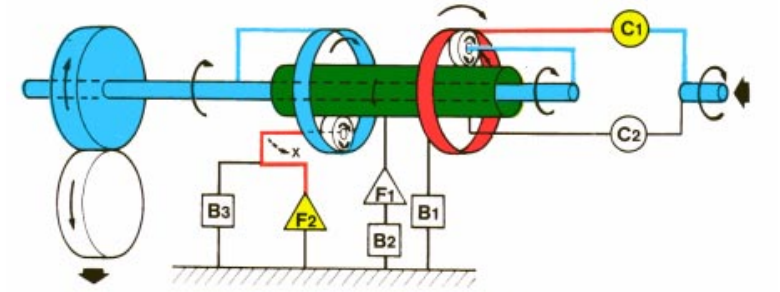
Shift Lever Position	Gear Position	C1	C2	B1	B2	B3	F1	F2
D	1st	■						■
L	1st	■				■		■

First Gear

The rear planetary carrier cannot rotate in either direction.



The rear planetary carrier is held counter-clockwise only and freewheels in the clockwise direction.



Shift Lever Position	Gear Position	C1	C2	B1	B2	B3	F1	F2
D	1st							
L	1st							

Three diagnostic scenarios:

1. If there was slippage in reverse gear but none in "L" position, and no engine braking when decelerating in "L," the first and reverse (B3) would be at fault. Slippage in first gear did not occur because the one-way clutch No. 2 (F2) would have held the rear carrier from turning counterclockwise.
2. If first gear slips in "D1l" and there is no slippage in "L," the one-way clutch No. 1 (Fl) is at fault.
3. There is slippage in first gear with the selector in "D" and "L." The holding device common to both gear positions would be the forward clutch (C1).

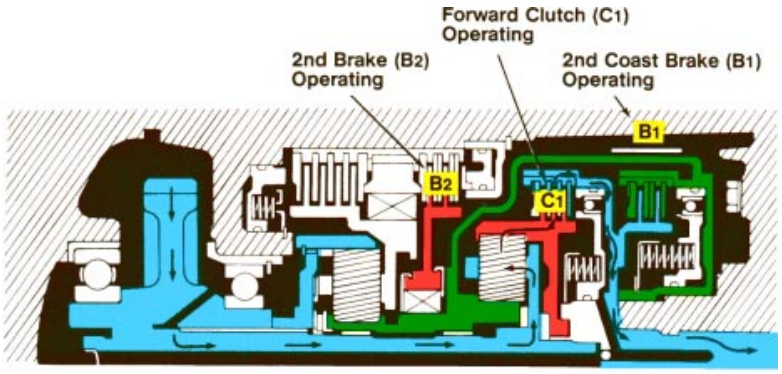
Differences Between D2- and 2-Range Second Gear

When the gear selector is placed in the 2-position, the second coast brake (Bl) is applied by way of the manual valve. When the second coast brake is applied, it holds the sun gear from rotating in either direction. Power flow is the same as when the transmission is driving the wheels with the selector in 2, as when the selector is in D. However, when the transmission is being driven by the wheels on deceleration, the force from the output shaft is transmitted to the front carrier, causing the front planetary pinion gears to revolve clockwise around the sun gear. Since the sun gear is held by the second coast brake, the planetary gears walk around the sun clockwise and drive the front planetary ring gear clockwise through the input shaft and torque converter to the crankshaft for engine braking. In contrast, while in second gear with the selector in D-position, the sun gear is held in the counterclockwise direction only and the sun gear rotates in a clockwise direction and there is no engine braking.

The advantage that ”2” range has over ”D2” is that the engine can be used to slow the vehicle on deceleration, and this feature can be used to aid in diagnosis. For example, a transmission which does not have second gear in D-position but does have second gear while manually shifting can be narrowed to the second brake (B2) or one-way clutch #1 (Fl). These components and related hydraulic circuits become the primary focus in our diagnosis.

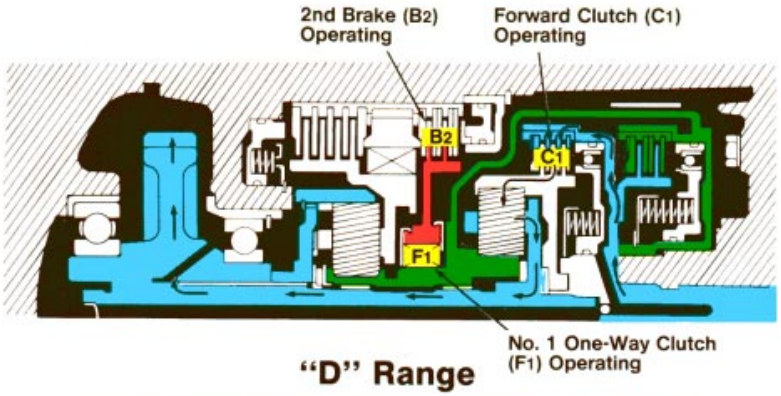
Second Gear

The second coast brake (B1) holds the sun gear.



“2” Range-Engine Braking

The second brake (B2) and No. 1 One-Way Clutch (F1) hold the sun gear.

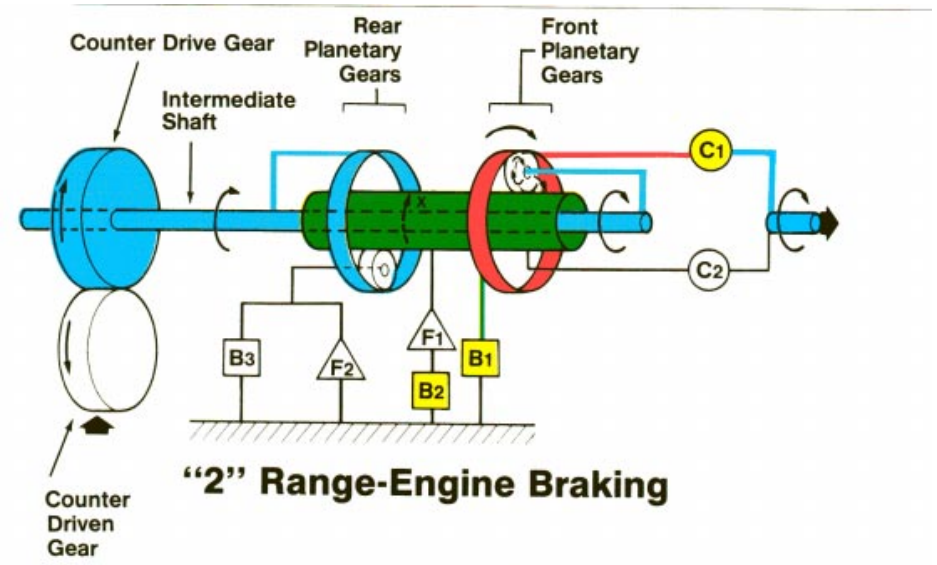


“D” Range

Shift Lever Position	Gear Position	C1	C2	B1	B2	B3	F1	F2
D	2nd							
2	2nd							

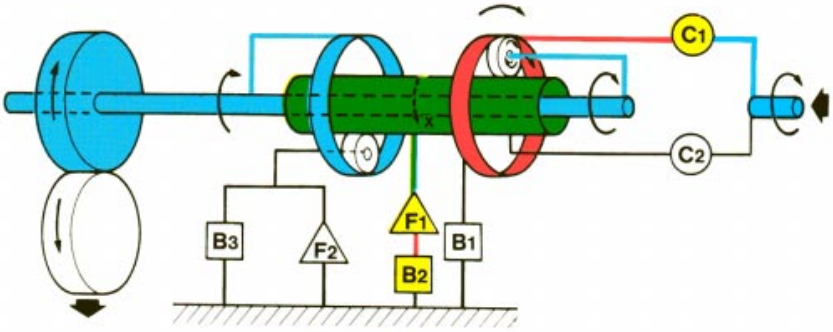
Second Gear

The sun gear cannot rotate in either direction.



"2" Range-Engine Braking

The sun gear is held in the counter-clockwise direction only and freewheels in clockwise direction.



"D" Range

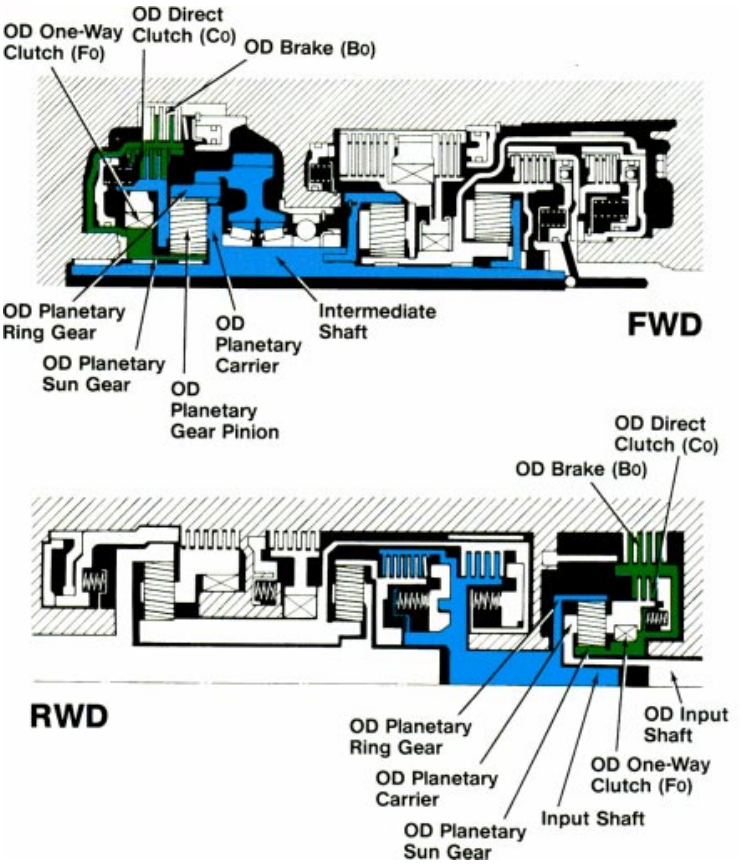
Shift Lever Position	Gear Position	C_1	C_2	B_1	B_2	B_3	F_1	F_2
D	2nd	■			■		■	
2	2nd	■		■	■		■	

Power Flow Through OD Unit

One simple planetary gear set is added to the 3-speed automatic transmission to make it a 4-speed automatic transmission (three speeds forward and one overdrive). This additional gear set can be added in front of or behind the Simpson Planetary Gear Set to accomplish overdrive. When the vehicle is driving in overdrive gear, the speed of the output shaft is greater than that of the input shaft.

OD Planetary Units

This simple planetary gear set can be in front of the Simpson planetaary gear set or behind it.



Holding Devices The holding devices for the overdrive transmission are identified in the following chart with the components they control.

Function of Holding Devices

HOLDING DEVICE		FUNCTION
C_0	O/D Direct Clutch	Connects overdrive sun gear and overdrive carrier.
B_0	O/D Brake	Prevents overdrive sun gear from turning either clockwise or counterclockwise.
F_0	O/D One-Way Clutch	When transmission is being driven by engine, connects overdrive sun gear and overdrive carrier
C_1	Forward Clutch	Connects input shaft and front planetary ring gear.
C_2	Direct Clutch	Connects input shaft and front and rear planetary sun gear.
B_1	2nd Coast Brake	Prevents front and rear planetary sun gear from turning either clockwise or counterclockwise.
B_2	2nd Brake	Prevents outer race of F1 from turning either clockwise or counterclockwise, thus preventing front and rear planetary sun gear from turning counterclockwise.
B_3	1st and Reverse Brake	Prevents rear planetary carrier from turning either clockwise or counterclockwise.
F_1	No. 1 One-Way Clutch	When B2 is operating, prevents front and rear planetary sun gear from turning counterclockwise.
F_2	No. 2 One-Way Clutch	Prevents rear planetary carrier from turning counterclockwise.

Clutch Application Chart

The gear position in which these holding devices are applied can be found on the following clutch application chart. The clutch application chart is similar to the one seen earlier while discussiong power flow through the Simpson planetary gear set; however, three additional holding devices for overdrive have been added. The overdrive direct clutch (C0) and the overdrive one-way clutch (F0) are applied in reverse and all forward gears **except** overdrive. The overdrive brake (B0) is applied in overdrive only.

Clutch Application Chart for A340 Trans

Shift Lever Position	Gear Position	C_0	C_1	C_2	B_0	B_1	B_2	B_3	F_0	F_1	F_2
P	Parking	■									
R	Reverse	■		■				■	■		
N	Neutral	■									
D	1st	■	■						■		■
	2nd	■	■				■		■	■	
	3rd	■	■	■			■		■		
	O/D		■	■	■		■				
2	1st	■	■						■		■
	2nd	■	■			■	■		■	■	
	3rd	■	■	■			■		■		
L	1st	■	■					■	■		■
	2nd*	■	■			■	■		■	■	

*Down-shift only in Lrange and 2nd gear—no up-shift

Segments of this clutch application chart will be used in the overdrive Power Flow section to familiarize you with their use.

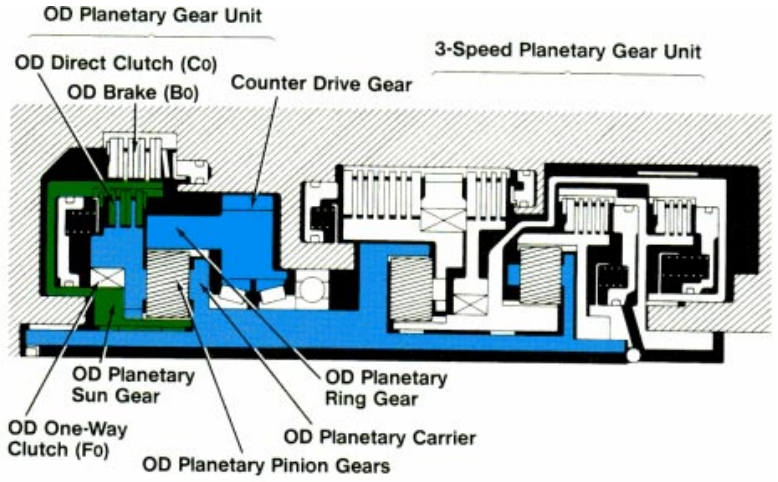
Overdrive is designed to operate at vehicle speeds above 25 mph in order to reduce the required engine speed when the vehicle is operating under a light load. The overdrive planetary gear unit consists mainly of one simple planetary gear set, an overdrive brake (BO) for holding the sun gear, an overdrive clutch (CO) and an overdrive one-way clutch (F0) for connecting the sun gear and carrier.

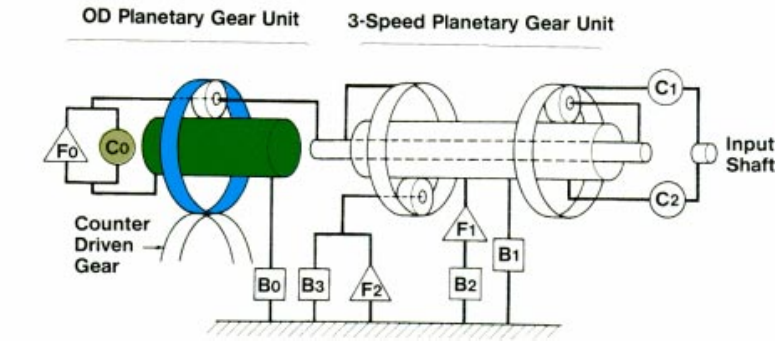
Power is input through the overdrive planetary carrier and output from the overdrive ring gear. The operation of holding devices and planetary members in the forward direction is the same whether it is a front wheel drive or rear wheel drive vehicle. In reverse, however, the overdrive one-way clutch (F0) in the front wheel drive transmission does not hold.

The direction of rotation in the front-mounted OD unit is always clockwise. The direction of rotation in the rear-mounted OD units is mostly clockwise, with the exception of reverse, in which case the intermediate shaft rotates counterclockwise. When the input torque comes into the overdrive unit in a counterclockwise direction, the overdrive one-way clutch (F0) free-wheels. Therefore, when a vehicle with the rear-mounted OD unit is placed in reverse, the overdrive direct clutch (CO) is the only unit holding the OD unit in direct drive. For this reason, when the overdrive direct clutch fails, the vehicle will go forward but will not go in reverse.

OD Planetary Gear Unit

Power is input through the overdrive planetary carrier and output from the overdrive ring gear.



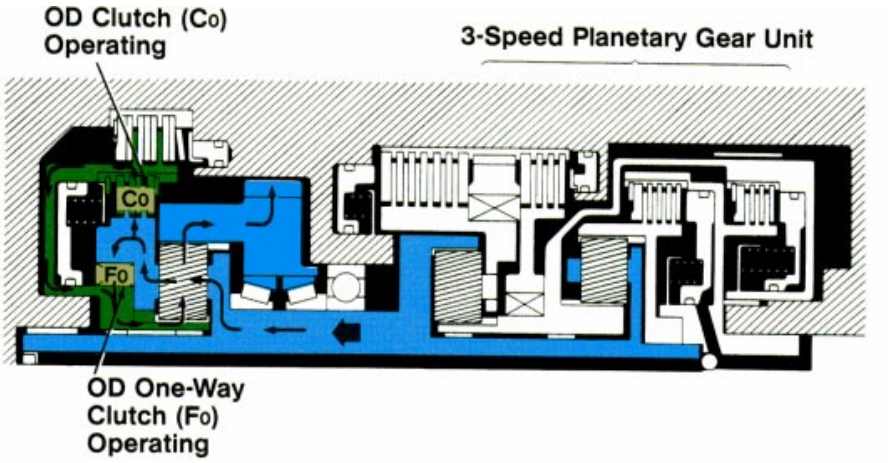


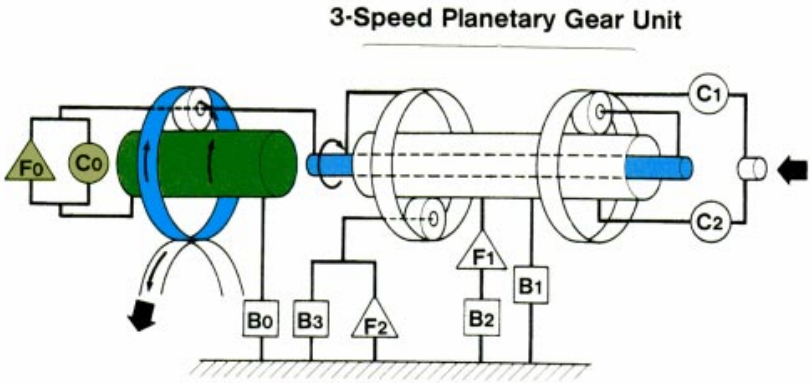
Direct Drive (Not in Overdrive)

The overdrive planetary unit is in direct drive (1:1 gear ratio) for reverse and all forward gears except overdrive. In direct drive the OD direct clutch (CO) and OD one-way clutch (F0) are both applied locking the sun gear to the carrier. With the sun gear and carrier locked together, the ring gear rotates with the carrier and the OD assembly rotates as one unit.

Not in Overdrive

The overdrive planetary unit is in direct drive for reverse and all forward gears except overdrive.





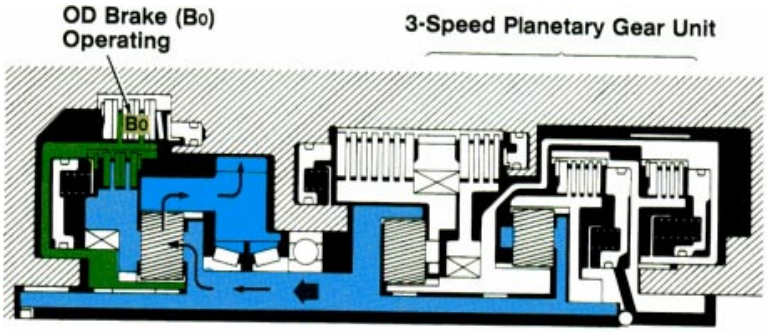
Shift Lever Position	Gear Position	C0	C1	C2	B0	B1	B2	B3	F0	F1	F2
D	1st	■	■						■		■
	2nd	■	■				■		■	■	
	3rd	■	■	■			■		■	■	
	O/D		■	■	■		■				

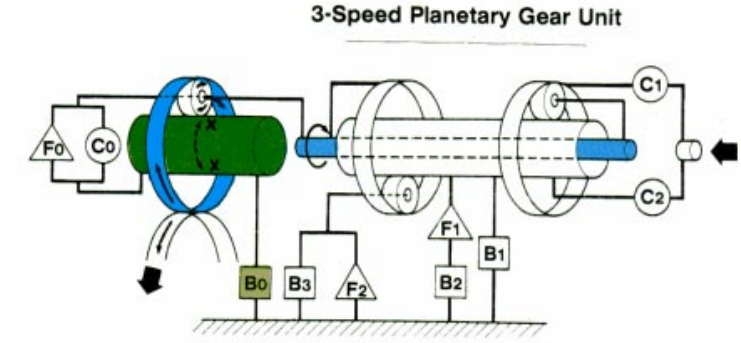
Overdrive

In overdrive, the OD brake (BO) locks the OD sun gear, so when the overdrive carrier rotates clockwise, the overdrive pinion gears revolve clockwise around the overdrive sun gear while rotating around the pinion shafts. Therefore, the overdrive ring gear rotates clockwise faster than the overdrive carrier.

Overdrive

The overdrive ring gear rotates clockwise faster than the overdrive carrier.





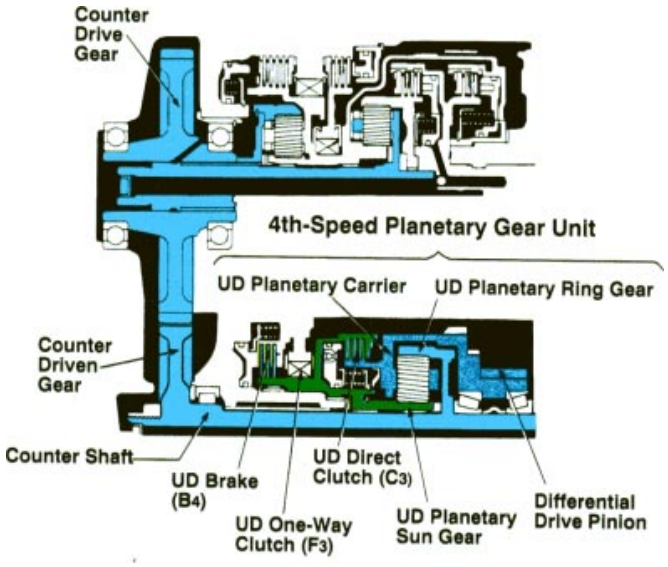
Shift Lever Position	Gear Position	C0	C1	C2	B0	B1	B2	B3	F0	F1	F2
D	1st	■	■						■		■
	2nd	■	■				■		■	■	
	3rd	■	■	■	■		■			■	
	O/D		■	■	■		■				

Power Flow Through Underdrive Unit of A240

The fourth-speed planetary gear unit of the A240 automatic transaxle is mounted on the counter shaft. Both the construction and operation of this unit differ from those of the overdrive planetary gear unit discussed earlier.

Underdrive Planetary Gear Unit

Overdrive is accomplished through the counter drive and driven gears



The overdrive ratio is accomplished through the counter drive and driven gears on the rear of the transmission. The counter drive gear is larger in diameter and has more gear teeth than the counter driven gear. The input torque to the underdrive unit is already in overdrive and the underdrive unit runs at a reduction gear ratio in first through third gears and reverse.

Holding Devices

The holding devices for the underdrive transmission are identified in the following chart with the components they control.

Function of Holding Devices

HOLDING DEVICE		FUNCTION
C_1	Forward Clutch	Connects input shaft and front planetary ring gear.
C_2	Direct Clutch	Connects input shaft and front and rear planetary sun gear.
C_3	U/D Clutch	Connects underdrive sun gear and underdrive planetary carrier.
B_1	2nd Coast Brake	Prevents front and rear planetary sun gear from turning either clockwise or counterclockwise.
B_2	2nd Brake	Prevents outer race of F_1 from turning either clockwise or counterclockwise, thus preventing the front and rear planetary sun gear from turning counterclockwise.
B_3	1st and Reverse Brake	Prevents rear planetary carrier from turning either clockwise or counterclockwise.
B_4	U/D Brake	Prevents underdrive sun gear from turning either clockwise or counterclockwise.
F_1	No. 1 One-Way Clutch	When B_2 is operating, this clutch prevents the front and rear planetary sun gear from turning counterclockwise.
F_2	No. 2 One-Way Clutch	Prevents rear planetary carrier from turning counterclockwise.
F_3	U/D One-Way Clutch	Prevents underdrive planetary sun gear from turning clockwise.

Clutch Application Chart

The gear position in which these holding devices are applied can be found on the following clutch application chart. The clutch application chart is similar to the one seen earlier; however, three additional holding devices for the underdrive have replaced those of the overdrive unit. The *underdrive brake* (B4) is applied in reverse and all forward gears except overdrive. The *underdrive one-way clutch* (F3) is applied in all forward gears only. The *underdrive clutch* (C3) is applied in overdrive only.

Clutch Application Chart for A240 Trans

Shift Lever Position	Gear Position	C_1	C_2	C_3	B_1	B_2	B_3	B_4	F_1	F_2	F_3
P	Parking							■			
R	Reverse		■				■	■			
N	Neutral							■			
D	1st	■						■		■	■
	2nd	■				■		■	■		■
	3rd	■	■			■		■			■
	O/D	■		■		■					
2	1st	■						■		■	■
	2nd	■			■	■		■	■		■
	3rd*	■	■			■		■			■
L	1st	■					■	■		■	■
	2nd*	■			■	■		■	■		■

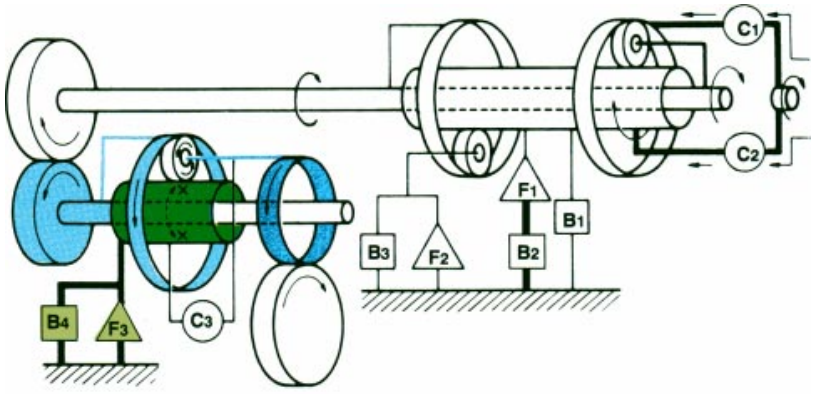
***Down-shift only in the 3rd gear for the 2 range and 2nd gear for the L range—no up-shift**

Other Than Fourth Gear

When the transmission is in a gear other than fourth gear, the *underdrive brake* (B4) and the *underdrive one-way clutch* (F3) operate, locking the underdrive sun gear to the transmission case. When the sun gear is locked, the ring gear drives the pinion gears and they walk around the sun gear while rotating counterclockwise. The result is that rotation of the carrier is a slower speed than the ring gear rotation. In truth we have a gear reduction through the underdrive planetary gear set.

Underdrive Power Flow Other Than Fourth Gear

The sun gear is held to the case, output is a gear reduction from the planetary carrier.



Other Than 4th Gear

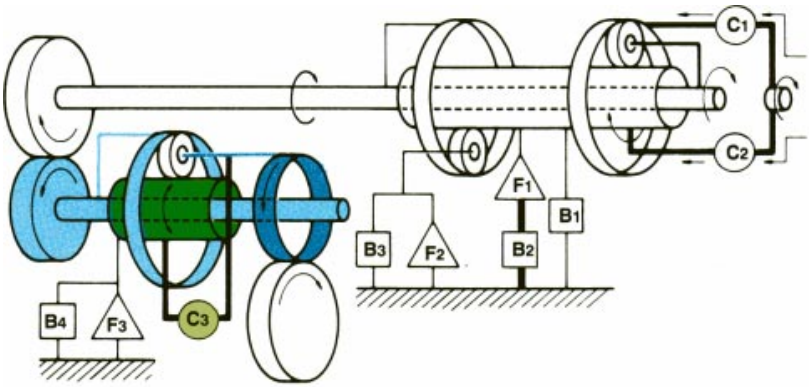
Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	B4	F1	F2	F3
D	1st	■						■		■	■
	2nd	■	■			■		■	■		■
	3rd	■	■	■		■		■			■
	O/D	■	■	■		■					

Fourth Gear

In fourth gear, the *underdrive direct clutch* (C3) is operating locking the sun gear with the planetary carrier and the planetary gear set rotates as a unit. The differential drive pinion is driven by the planetary carrier. The actual overdrive gear ratio takes place in the counter drive and driven gears.

Underdrive Power Flow Fourth Gear

The sun gear and the carrier are locked together probiding direct drive within the underdrive planetary gear set.



4th Gear

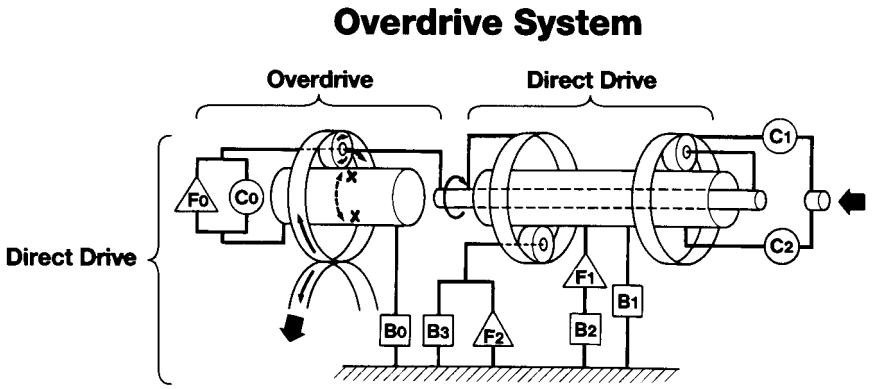
Shift Lever Position	Gear Position	C1	C2	C3	B1	B2	B3	B4	F1	F2	F3
D	1st	■						■		■	■
	2nd	■				■		■	■		■
	3rd	■	■			■		■			■
	O/D	■	■	■		■					

Contrasting Overdrive and Underdrive Systems

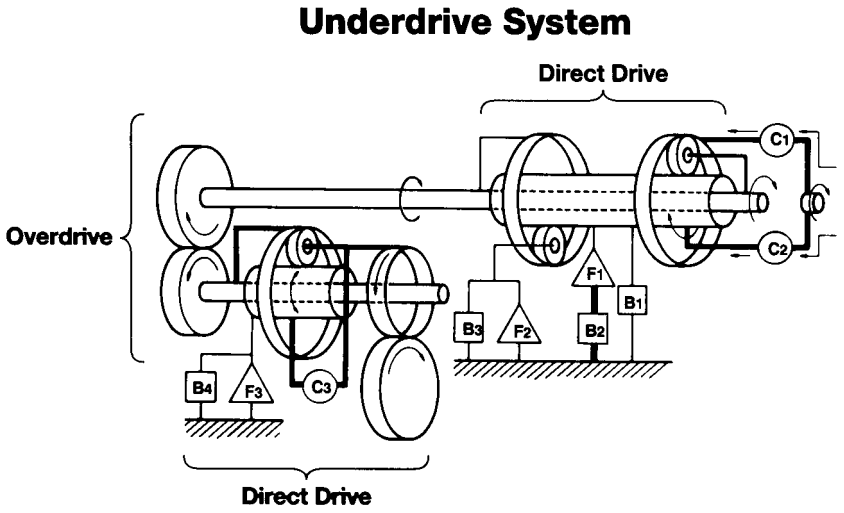
The single greatest advantage that the underdrive system has over other overdrive systems is that while cruising, all planetary gear sets are in direct drive and fewer parts are moving. For example, the Simpson planetary is in direct drive, the underdrive is in direct drive, overdrive is accomplished in the drive and driven gears. The overdrive system, on the other hand, has the Simpson planetary gear set in direct drive, the overdrive unit in the overdrive mode with the sun gear held, the planetary carrier driving the ring gear in overdrive, and the drive and driven gears providing direct drive.

Comparing Fourth Gear

Overdrive is accomplished through OD planetary gear set.

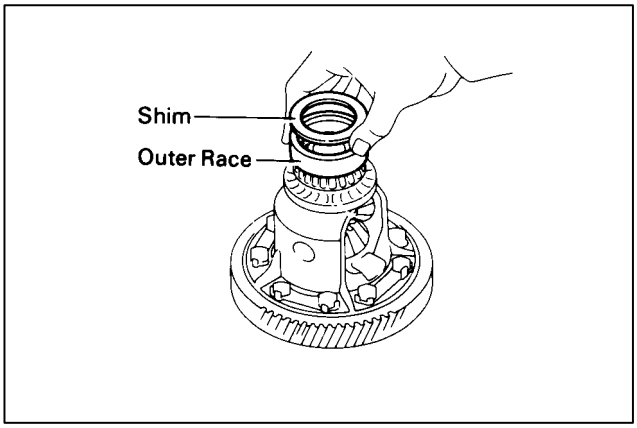


Overdrive is accomplished through the drive and driven gear.



PROCEDURE

Adjustment of Differential Side Bearing Preload

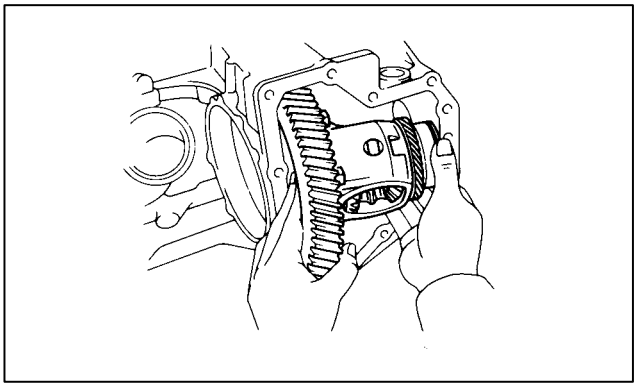


Perform the following procedures. Write-in the measurement or specification in each of the boxes.

1. Place outer race and adjusting shim onto RH side bearing.

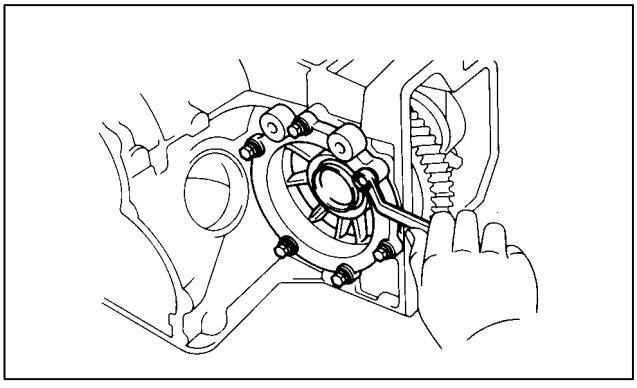
Use the adjusting shim which was removed or one 2.40 mm (0.0945 in.) thick.

Adjustment Shim Thickness: _____



2. Place differential case into transaxle case.

Be sure to install the adjusting shim.

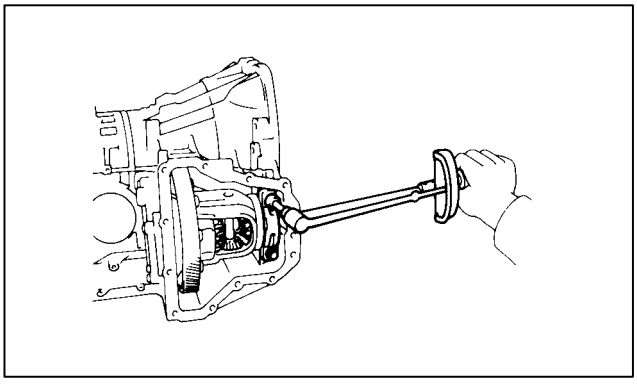


3. Install LH bearing retainer.

a. DO NOT install the O-ring yet.

b. Do not coat the bolt threads with sealant yet.

c. Temporarily tighten the bolts evenly and gradually while turning the ring gear.



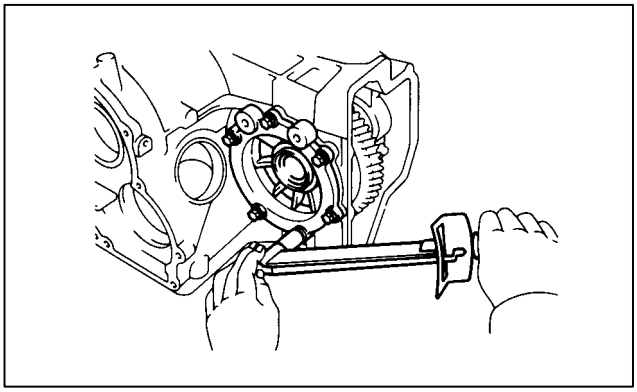
4. Install RH side bearing cap.

Tighten the bolts evenly and gradually while turning the ring gear.

Torque: _____ **Ft.-Lbs.**

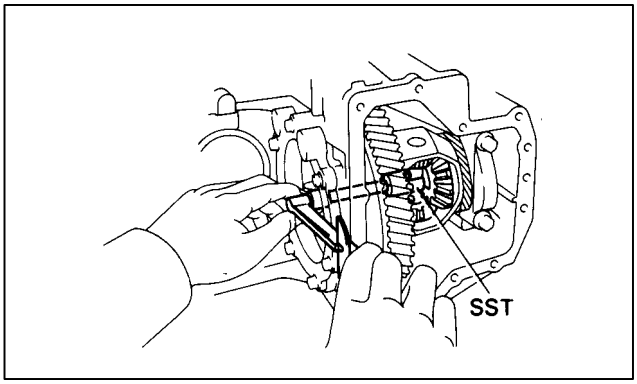
PROCEDURE

Adjustment of Differential Side Bearing Preload



5. Tighten LH bearing retainer

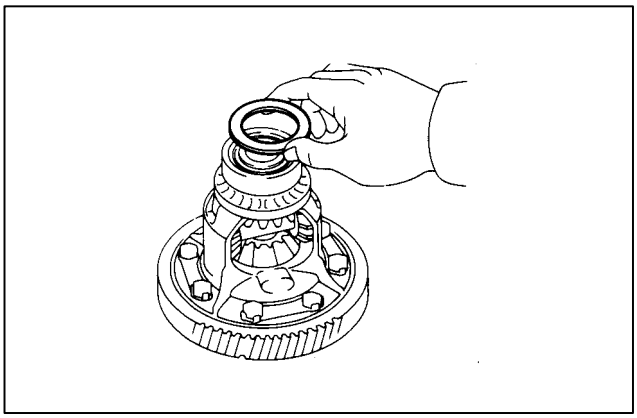
Torque:	Ft.-Lbs.



6. Adjust Side Bearing Preload

Using SST and a torque wrench, measure the preload of the ring gear. (SST 09564-32011)

Preload (at Starting)	Spec.	Measured
New Bearing		
Reused Bearing		



If the preload is not within specification, remove the differential case assembly. Reselect the RH adjusting shim.

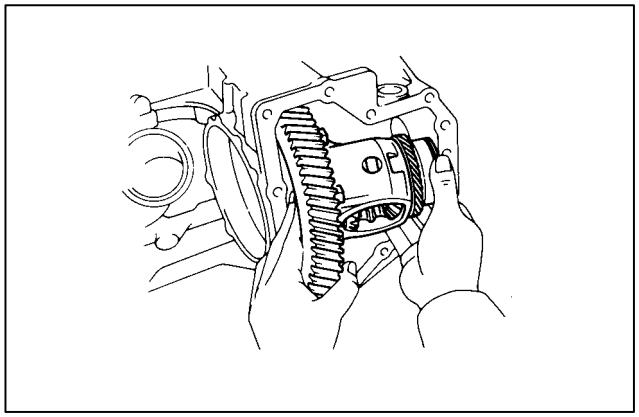
Thickness mm (in.)	Thickness mm (in.)
1.90 (0.0748)	2.40 (0.0945)
1.95 (0.0768)	2.45 (0.0965)
2.00 (0.0787)	2.50 (0.0984)
2.05 (0.0807)	2.55 (0.1004)
2.10 (0.0827)	2.60 (0.1024)
2.15 (0.0846)	2.65 (0.1043)
2.20 (0.0866)	2.70 (0.1063)
2.25 (0.0886)	2.75 (0.1083)
2.30 (0.0906)	2.80 (0.1103)

Hint:
The preload will change about 3-4 kg-cm (2.6-3.5 in.-lbs, 0.3 - 0.4 Nm) with each shim thickness.

Original Shim:	mm
Torque Change required	in.lbs.
Recommendend Shim	mm

PROCEDURE

Adjustment of Differential Side Bearing Preload



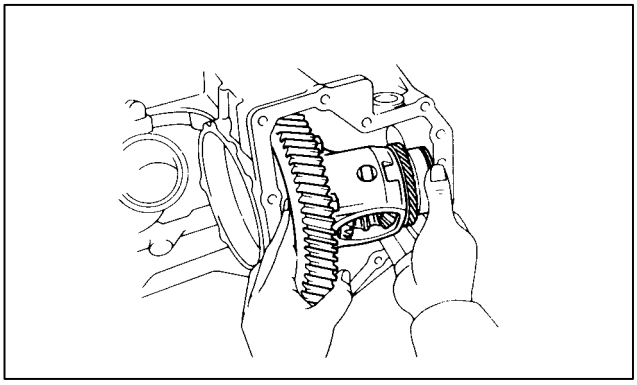
7. Remove differential case and component parts.

If the preload is adjusted within specification, remove the bearing retainer, differential case, RH side bearing, and shim.

Be careful not to lose the adjusted shim.

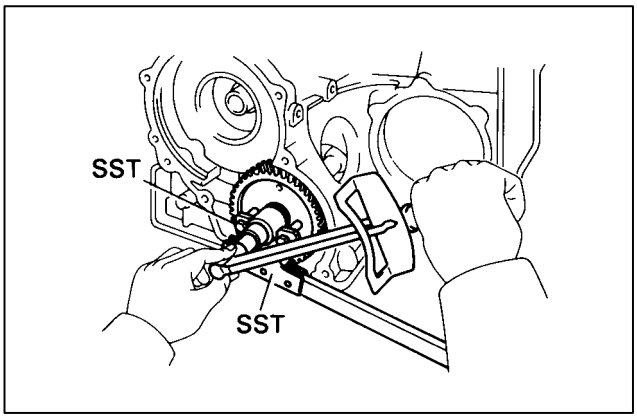
Instructor OK ☐

PROCEDURE
Drive Pinion Preload



Perform the following procedures. Write in the measurement or specification in each of the boxes.

1. Remove the differential case, outer race, and adjusting shim.



2. Adjust drive pinion preload.

a. Coat the threads and surface of the nut with MP grease

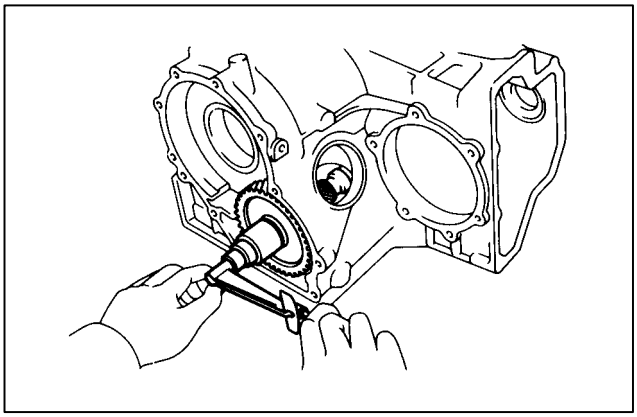
b. Using SST to hold the gear, tighten the nut.

Torque: _____ **Ft.-Lbs.**

SST 09330-00021, 09350-32014 (09351-32031)

c. Turn the gear counterclockwise and clockwise several times.

d. Using a torque wrench, measure the preload of the drive pinion.



Preload (at Starting)	Spec.	Measured
New Bearing		
Reused Bearing		

- If the preload is greater than specified, replace the bearing spacer.
- If the preload is less than specified, retighten the nut

_____ ft.-lbs., at a time until the specified preload is reached.

If the maximum torque is exceeded while retightening the nut, replace the bearing spacer and repeat the preload procedure.

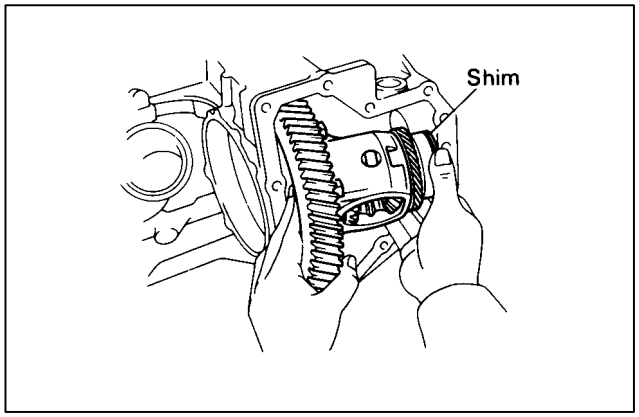
Do not back off the nut to reduce the preload.

Maximum Torque: _____ **Ft.-Lbs.**

e. If the preload is adjusted within specification, make a note of it.

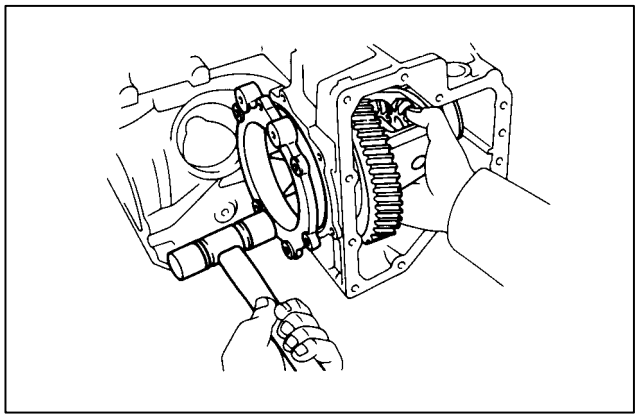
Preload: _____ **In.-Lbs.**

PROCEDURE
Drive Pinion Preload (Continued)



3. Place differential case into transaxle case.

Be sure to install the adjusting shim.

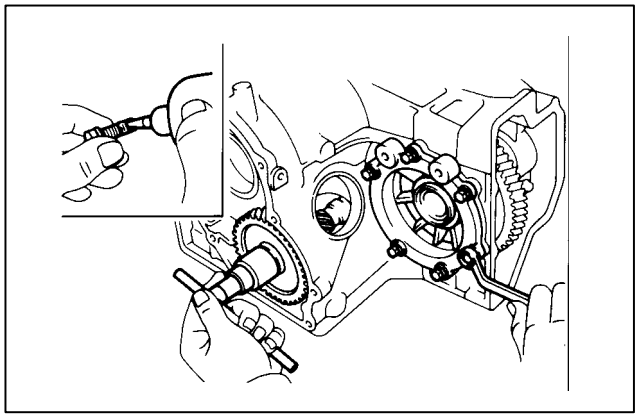


4. Install LH Bearing Retainer

a. Install a new O-ring.

b. Position the retainer by tapping it while holding the differential case center with the retainer.

c. Clean the threads of the bolts and case with white gasoline.

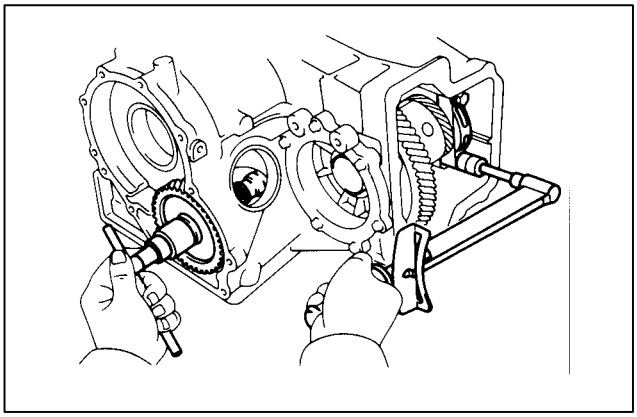


d. Coat the threads of the bolts with sealer.

Sealer: Part No. 08833-00070, THREE BOND 1324 or equivalent.

e. Temporarily tighten the bolts evenly and gradually while turning the ring gear.

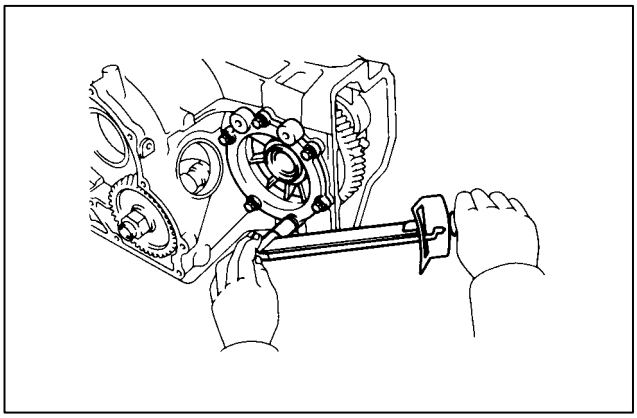
PROCEDURE
Drive Pinion Preload (Continued)



5. Install RH Side Bearing Cap

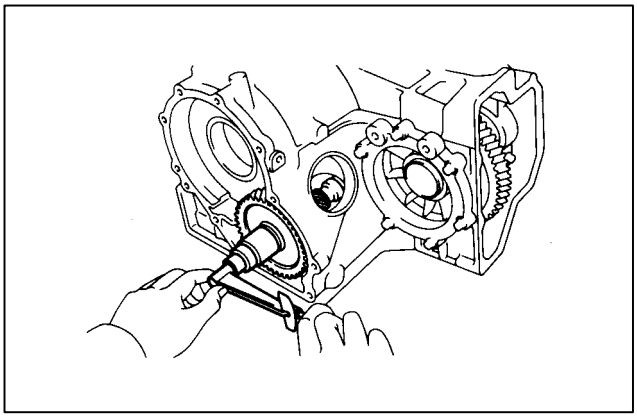
Tighten the bolts evenly and gradually while turning the ring gear.

Torque:	**Ft.-Lbs.**



6. Tighten LH Bearing Retainer

Torque:	**Ft.-Lbs.**



7. Measure Total Preload

Using torque meter, measure the total preload of the drive pinion shaft.

Total preload specification (at starting):

Drive pinion preload	**in.-lbs.**
ADD: New bearing	**in.-lbs.**
Reused bearing	**in.-lbs.**
Total preload specification	**in.-lbs.**
Measured Preload:	**in.-lbs.**

If the preload is not within specification, redisassemble and readjust.

Instructor OK	