SECTION : 205-00 Driveline System — General Information

VEHICLE APPLICATION : 2008.0 Falcon

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SPECIFICATIONS

Torque Specifications

Refer to section 205-02 for torque specifications.

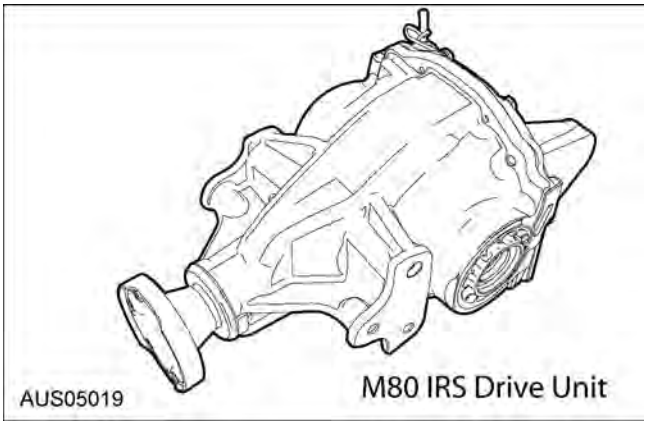
DESCRIPTION AND OPERATION

Driveline System

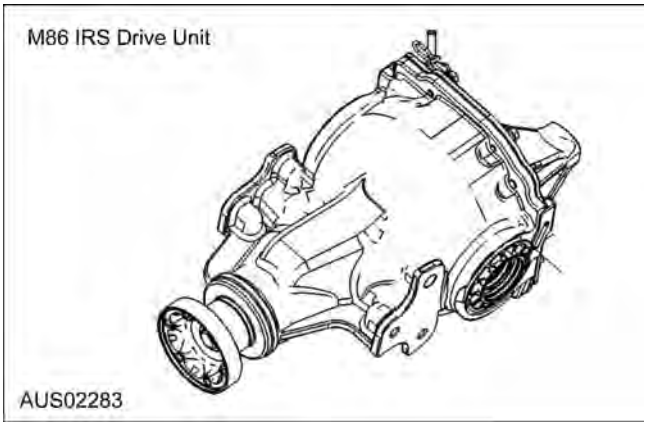
General Specifications

M80 & M86 IRS (Sedan)

M80 IRS



M86 IRS

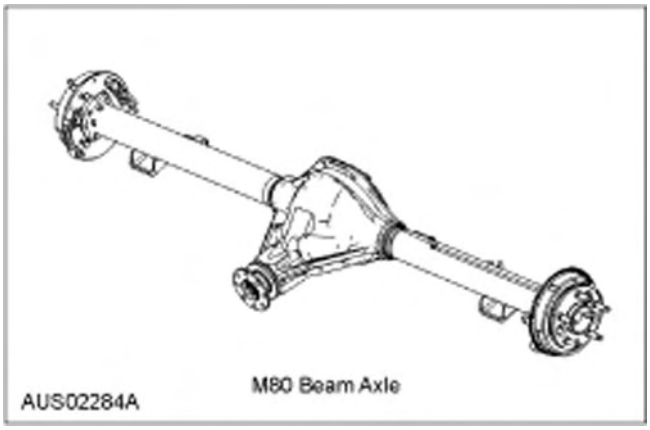


A label identifying the drive unit assembly part number, serial number, final drive ratio and model is fixed to the carrier casting. Three different model final drive units are used in sedan vehicles:

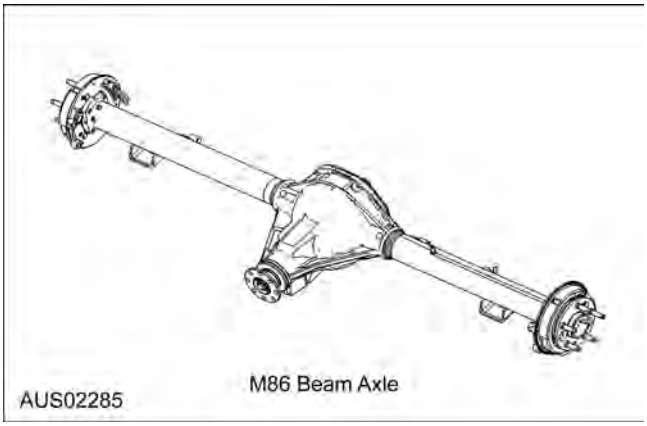
1. M80 final drive units are fitted with 2.73, 327 or 3.45 8" (203mm) diameter gear sets. The M80 final drive unit should be filled with synthetic oil as per section 205-02 specifications. Only conventional M80 differentials are available.
2. M86 final drive units are fitted with 2.73, 3.23, 3.46 or 3.73 8.6" (220mm) diameter gear sets, with or without LSDs. M86 final drive units are fitted to all sedan vehicles powered by a V8 or turbo I6 engine and XR6 LSD Sedans. All M86 final drive units should be filled with synthetic oil as per section 205-02 specifications.

M80 & M86 Beam Axle (Ute)

M80 Beam axle



M86 Beam axle



A label identifying the beam axle assembly part number, serial number, and final drive ratio is fixed to the axle tube adjacent to the carrier.

Two different model beam axles are used on utility vehicles:

1. M80 beam axles are fitted with 2.73, 3.27 or 3.45, 8" (205 mm) diameter gear sets, with or without ABS and with or without LSDs.

NOTE: Upgrading the lubricating oil to synthetic type is recommended for vehicles fitted with a M80 final drive unit where the vehicle will be regularly used for towing. Refer to, Specifications of Section 205-02 for the recommended synthetic lubricant.

2. M86 beam axles are fitted with 2.73, 3.23, 3.46 or 3.73 8.6" (220mm) diameter gear sets, with or without ABS and with or without LSDs. M86 axles are fitted to 1 tonne rated utilities, and all vehicles powered by a V8 or turbo I6 engine.

These axle types are a hypoid type of unitised carrier construction. The two pinion differential case and the drive pinion are mounted in opposed taper roller bearings in the carrier. Differential bearing preload adjustment is provided by either the screw adjusters in IRS drive units or shims in the beam axle

DESCRIPTION AND OPERATION (Continued)

assembly. Pinion bearing preload is regulated by a collapsible spacer and adjusted using the pinion nut.

Torque is transferred from the propshaft to the final drive assembly via the constant velocity type companion flange that is splined to the hypoid pinion. The torque is then transferred from the pinion through the ring gear, differential case, differential pinion cross shaft, differential pinions and side gears to the constant velocity joint halfshafts for conventional differentials. Halfshaft end play is pre-set and is not adjustable. Oil seals are located between the halfshafts and the screw adjusters.

M86 LSDs have a multiplate oil bath type design that is utilised where alternate plates are splined to the differential case and side gear. Compressive preloading of the plates provides frictional resistance to rotation, providing torque transfer to the rear wheel with the least traction.

With a conventional differential, when the rear wheels are under extreme unbalance tractive conditions, such as one wheel on dry road and the other in mud or ice, wheel spin will occur if over acceleration is attempted. However, with the limited slip differential, when the tendency for wheel spin occurs, the friction generated between the friction plates transfers a portion of the driving torque to the non-spinning wheel.

Run in

It is recommended that the vehicle is driven conservatively for the first 1500kms from new, and that towing is avoided during this period. This allows the final drive to bed in correctly and helps assure satisfactory final drive component life. During the run-in period, the vehicle should be driven at normal road speeds (within the posted limits) as final drive loading not vehicle speed is of primary importance.

Towing

Ensure that the vehicle is fitted with a Ford approved tow pack, and that the towing limits for the particular vehicle as designated by Ford and relevant State regulatory bodies are adhered to. The final drive must be filled to the correct level with the correct type of oil to ensure satisfactory performance while towing. Overheating can occur where low oil level or the wrong type of lubricant is used.

Oil Changes

If the vehicle is going to be used for towing on a regular basis, or occasional heavy towing, an oil change after run-in is recommended. Note that this is not part of regular scheduled vehicle maintaince.

DIAGNOSIS AND TESTING

Driveline System

In Vehicle Diagnostics

For other than obvious mechanical failures, careful tests should be made to locate final drive troubles since noises from engine, transmission and wheels may all be attributed to the final drive. A suggested test routine is as follows:- Ensure that the axle lubricant is correct and at the correct level. Drive at low speed until thoroughly familiar with vehicle noises by which time the rear axle assembly should have warmed up. Accelerate gradually from the lowest practical speed in top gear to 110 kilometres per hour (or maximum legal speed), noting any noises and the speeds at which they occur. Release the accelerator and without using the brakes allow the vehicle to lose speed, again noting noise and speed. Next, allow the vehicle to coast to rest from 110 kph with the transmission in neutral position. Any noises common to earlier tests may be eliminated, as the final drive is not under load in these conditions. Engine noise is gauged by gradually accelerating the engine with the vehicle at rest. Noises not eliminated at this stage are most probably final drive gear noise.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
Rear Wheel Noise (Beam Axles)	• Worn brake rotor. • Wheel bolts loose. • Brinnelled or scored bearings. • Insufficient lubrication. • Bent axle shaft or wheel. • Dragging brakes. • Axle shaft retainer plate loose. • Tyre defective. • Damaged or worn C.V. joints (IRS).	Replace/Repair as required
Final Drive Noise	**NOTE:** Final drive noises fall into two categories: Gear Noise and Bearing Noise. • Bearing noise is usually fairly constant throughout the entire speed range and of a pitch that increases in proportion to vehicle speed. • Gear noise is of a periodic nature being produced at various speeds on drive, float, coast and cruise conditions. If the pinion and ring gear have been set up with too little backlash a continuous whine may be produced. **NOTE:** Gear noise is most commonly caused by: • Incorrect mesh of gear teeth (i.e. incorrect pinion head positioning shim or backlash setting shims). • Scored gear teeth - usually the result of incorrect lubricant type or level. • End play in bearings. • Bruised or chipped teeth. • Excessive runout of pinion head or ring gear backface. • Ring gear creeping on differential housing resulting from ring gear bolts loosening - noise from this source usually appears as a sharp metallic sound when shifting from reverse to first gear. **NOTE:** Bearing Noise is usually caused by worn bearings and can be the result of: • Contaminants in the lubricant. • Incorrect preload setting. • Bearings incorrectly mounted - e.g. dirt trapped behind abutment faces during assembly.	Replace/Repair as required
Rear Axle Shaft Breakage (Beam Axle)	• Abnormal clutch operation. • Bent axle tubes/half shafts. • Excessive vehicle loads.	Replace/Repair as required
Overheating of Final Drive Assembly	• Lubricant level incorrect. • Incorrect lubricant type. • Incorrect run-in procedure.	
Loss of Lubricant	• Lubricant level too high. • Breather malfunction. • Damaged or worn oil seals. • Rear cover bolts / filler plug loose. • Rear cover flange distorted. • Rear cover gasket/sealant damaged or incorrectly applied. • Split cover or tubes (beam axles). • Incorrect type of lubricant - can cause foaming. • Loose drain plug, or sealant not replaced on drain plug at refitting.	Replace/Repair as required

DIAGNOSIS AND TESTING (Continued)

Condition	Possible Sources	Action
Excessive Backlash	• Worn axle shaft or halfshaft splines. • Loose wheel nuts. • Loose universal or constant velocity propshaft joint flange mountings. • Excessive backlash in either the differential or hypoid gears. • Bearings worn or incorrectly adjusted. • Worn or loose constant velocity halfshaft joints (IRS).	Replace/Repair as required

Bearing Noise

Defective bearings can produce a whine that varies in proportion to vehicle speed. This will help distinguish between bearing and/or gear noise.

1. Pinion bearing noise can be identified as a constant grinding noise. Pinion bearings are rotating at a higher speed than differential side bearings or axle shaft bearings. The noise is most noticeable during light acceleration between 30 to 40 km/h.
2. Wheel bearing noise may be confused with rear axle noise. To differentiate between wheel bearings and rear axle, drive the vehicle on a smooth road at a medium low speed. With traffic permitting, turn the vehicle sharply right and left. If noise is caused by wheel bearings, the noise will increase on the defective bearings because of side loading.
3. Side bearings will produce a constant grinding noise of a slower nature than pinion bearing, (side bearing noise cannot be determined by the wheel bearing test), but will be of a similar frequency as axle shaft bearings.

Gear Tooth Contact Pattern Check

Paint the gear teeth with suitable gear marking compound. Wrap a cloth around the companion flange to act as a brake. Rotate the ring gear back and forth (use a box wrench on the drive gear attaching bolts for a lever) until a clear tooth contact pattern is obtained (approximately 4 ring gear rotations in both directions).

After diagnosing the tooth pattern, make the appropriate adjustments as explained in the following pages. Drive and coast patterns indicating changes required to obtain the correct operating position of the gears is illustrated in the "ideal tooth contact pattern on ring gear" diagram. The movement of tooth contact patterns with changes in gear location can be summarised as follows:

1. Decreasing backlash moves the drive gear closer to the pinion:
   - Drive pattern (convex side of gear) moves slightly lower and toward the toe.
   - Coast pattern (concave side of gear) moves lower and toward the toe.
2. Increasing backlash moves the drive gear away from the pinion:
   - Drive pattern moves slightly higher and toward the heel.
   - Coast pattern moves higher and toward the heel.
3. Thicker pinion shim with the backlash constant moves the pinion closer to the drive gear.
   - Drive pattern moves deeper on the tooth (flank contact) and slightly toward the toe.
   - Coast pattern moves deeper on the tooth toward the heel.
4. Thinner pinion shim with the backlash constant moves the pinion further from the drive gear:
   - Drive pattern moves toward the top of the tooth (face contact) and toward the heel.
   - Coast pattern moves toward the top of the tooth and slightly toward the toe.

If the patterns are not correct, make the changes as indicated.

When the pattern is correct, remove the marking compound from the gear teeth. Regardless of all previous measurements and other factors, the tooth contact pattern must be correct for successful rear axle operation.

The Ideal Tooth Pattern

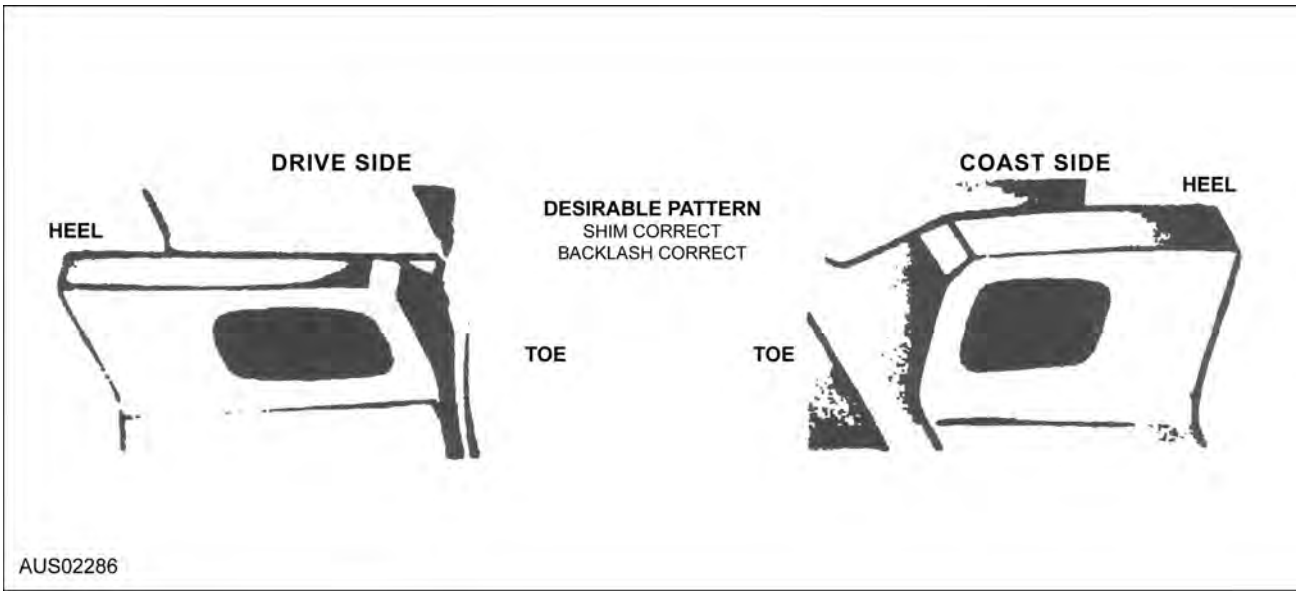
The ideal tooth pattern is not a rigid standard but merely a general rule. In general, desirable tooth patterns should have the following characteristics:

- The drive pattern should be fairly well centred on the tooth.
- The coast pattern should be centred on the tooth but may be slightly toward the toe.
- Some clearance between the pattern and the top of the tooth is desirable.
- There should be no hard lines where the pressure is high.

The individual gear set need not conform exactly to the ideal pattern in order to be acceptable. Characteristic differences between individual gear sets will result in patterns that are acceptable yet different from those illustrated.

DIAGNOSIS AND TESTING (Continued)

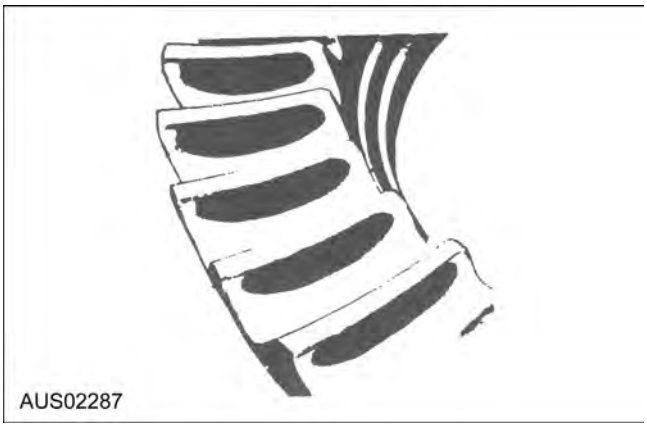
Ideal Tooth Contact Pattern on Ring Gear



Acceptable Pattern

The drive pattern shown was rolled on a hunting-type gear set. Since each pinion tooth came into contact with each ring gear tooth, the pattern is a result of the combined tooth contacts. Therefore, the pattern is uniform from tooth to tooth.

Acceptable Gear Tooth Contact Pattern



Unacceptable Pattern

An erratic tooth pattern on a hunting gear set indicates gear set runout and is caused by one of the following conditions:

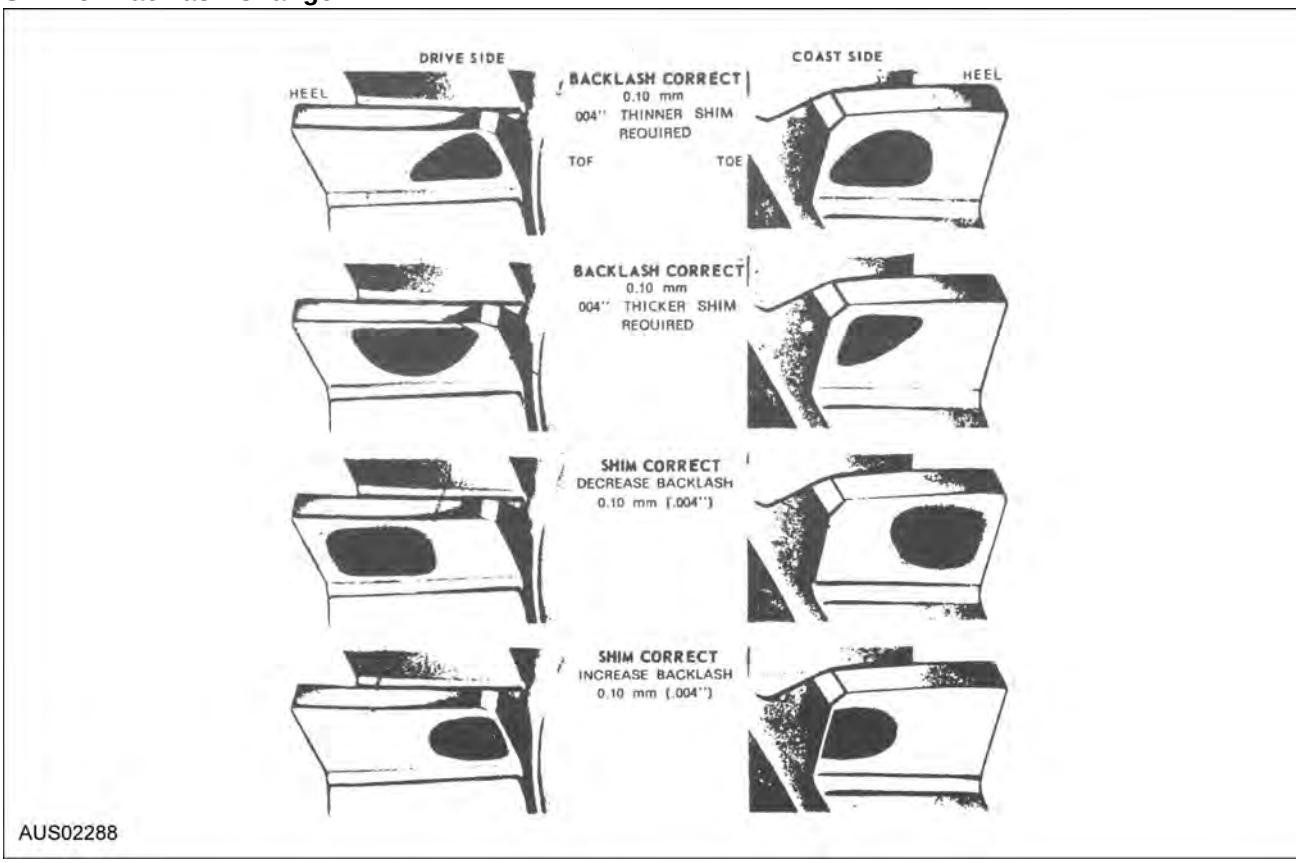
- Foreign matter between differential hemisphere gear locating base and back face of crown wheel.
- Faulty gear set.

Shim and Backlash Changes

The patterns shown are typical of gear sets that have either an incorrect backlash or an incorrect shim adjustment. Since each gear set rolls a characteristic pattern, the patterns shown should be considered as typical only and should be used as a guide rather than a rigid standard. The drive pattern is rolled on the convex side of the tooth, and the coast pattern is rolled on the concave side.

DIAGNOSIS AND TESTING (Continued)

Typical Gear Tooth Contact Patterns Indicating Shim or Backlash Change



Driveline Vibration

For information regarding driveline, Refer to Section 205-01.

Limited Slip Differentials (M86)

LSD Chatter

When encountering complaints of limited slip chatter, the vehicle should be warmed up for 10 minutes and then driven in tight circles (slightly less than full steering lock), five times clockwise and five times anti-clockwise at approximately 10 km/h to allow lubricant to work in between the friction surfaces.

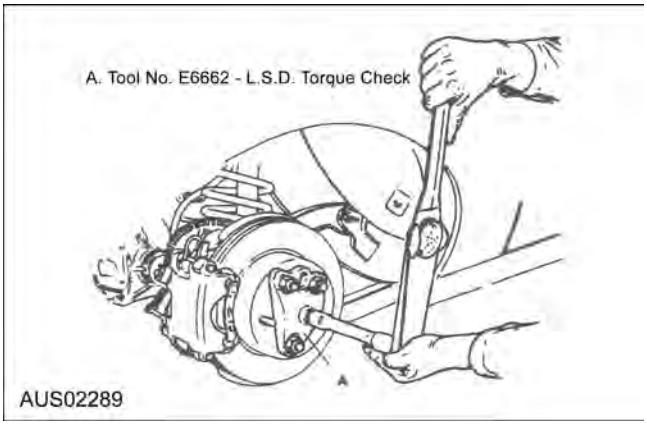
If the chatter persists, drain the lubricant, refill the axle with the specified lubricant and repeat the aforesaid procedure. It may be necessary to drive the vehicle 10-20 km before re-evaluating to allow the new lubricant to take affect. Should chatter still be evident, dismantling of the differential for further inspection and repair will be necessary.

In Vehicle Limited Slip Differential Torque Testing

To test the Limited Slip Differential (LSD) for correct operation proceed as follows:

1. Drive vehicle 10 km to warm up axle oil.
2. Chock the front wheels.
3. Raise the rear of the vehicle, remove one rear wheel and attach the Special Tool No. E6662.
4. Lower the rear of the vehicle to simulate normal ride height (ie. For IRS, lower arms should be horizontal to the ground).
5. Place the transmission in neutral and release the park brake.
6. Ensure that there is no brake drag affecting wheel rotation.
7. Attach a torque meter to the special tool, and rotate the axle.

The torque required to rotate the axle shaft for a used M86 L.S.D. unit should be between 50 and 130 Nm. Reading should be steady within 10 Nm.



DIAGNOSIS AND TESTING (Continued)

If the torque required to continuously rotate the wheel is outside the specification check the differential for improper assembly and/or rework.

Inspection after Removal & Dismantling

Thoroughly clean all parts. Always use new solvent when cleaning bearings. Oil the bearings immediately after cleaning to prevent rusting. Inspect the parts for any major defects. Clean the inside of the case, particularly the oil ports, before rebuilding and installing. Inspect individual parts as outlined below.

Hypoid and Differential Gears

The pattern taken during dismantling should help in judging if the gears can be re-used. Worn gears cannot be rebuilt to correct a noisy condition. Gear scoring is the result of excessive shock loading or the use of an incorrect lubricant. Scored gears must be replaced. Examine the teeth and thrust surface of the differential gears.

Wear on splines, thrust surfaces, or thrust washers can contribute to excessive driveline backlash.

Bearings

Check bearing cups for rings, scores, galling or erratic wear patterns. Pinion bearing cups must be solidly seated. Check by attempting to insert a 0.05 mm feeler between the cups and the bottom of their bores.

The cone and roller assemblies on the differential case and the rear cone and roller on the pinion should be checked before being removed from the differential case or pinion. When these cones and rollers have been removed the cones and rollers and their respective bearing cups should be discarded. When revolved in the cups, bearing rollers must turn without roughness. Examine the roller ends for wear. Stepwear on the roller ends indicates the bearing preload was incorrect or the rollers were slightly misaligned.

Drive Pinion Flange

Check the flange mating face for damage and wear. The end of the flange contacting the bearing cone and the seal surface must be free from surface imperfections like burrs and scoring.

Carrier Casting

Make sure that the differential bearing bores are smooth and the differential bearing preload spacer abutment faces are not damaged.

Differential Case

Carefully examine the case bearing hubs for damage. The bearing assemblies will fail if they do not seat against the shoulder on the hubs correctly.

Limited Slip Differential (LSD)

Thoroughly clean and dry all parts and check the following:

- The LSD plates and disc must be in good condition. If any one member of either stack shows evidence of excessive wear or scoring, the complete stack is to be replaced on both sides of the assembly.
- Side and pinion gears should be checked for extreme wear and possible cracks. The external teeth of the side gear, which retain the concentric groove discs, should also be checked for wear or cracks.
- If replacement of one gear is required due to wear, etc., then both side gears, pinion mate gears, and washers are to be replaced.
- If excessive wear is evident on the cross pin, it should be replaced.
- If wear is evident on any one of the clutch retainer clips, all four clips must be replaced.
- If scoring, wear or metal pick-up is evident on the machined surfaces of the differential case, then replacement of the case is necessary.