SM1241EN

# Service Manual

# Allison Transmission

## AUTOMATIC MODELS

**AT 540,**
**AT 542(N)(R)(NFE),**
**AT 543,**
**AT 545(N)(R),**
**AT 1542P,**
**AT 1545P(N)**

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# IMPORTANT SAFETY NOTICE

**IT IS YOUR RESPONSIBILITY to be completely familiar with the Warnings and Cautions described in this Service Manual. These Warnings and Cautions advise against the use of specific service methods that can result in personal injury, damage to the equipment, or cause the equipment to become unsafe. It is, however, important to understand that these Warnings and Cautions are not exhaustive. Allison Transmission could not possibly know, evaluate, and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Allison Transmission has not undertaken any such broad evaluation. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service methods selected.**

**Proper service and repair are important to the safe, reliable operation of the equipment. The service procedures recommended by Allison Transmission and described in this Service Manual are effective methods for performing service operations. Some of these service operations require the use of tools specifically designed for the purpose. The special tools should be used when and as recommended.**

# WARNINGS, CAUTIONS, AND NOTES

**Three types of headings are used in this manual to attract your attention:**

**WARNING!**

**is used when an operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.**

**CAUTION:**

**is used when an operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.**

**NOTE:**

**is used when an operating procedure, practice, etc., is essential to highlight.**

# LIST OF WARNINGS

**This manual contains the following warnings —**

**IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.**

- **When checking the transmission fluid level, be sure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are blocked. Unexpected and possible sudden movement may occur if these precautions are not taken.**
- **While conducting a stall check, the vehicle must be positively prevented from moving. Apply the parking brake and service brake, and block the wheels securely. Warn personnel to keep clear of the vehicle and its travel path. Failure to do so can cause serious injury.**
- **Observe safety precautions during hydraulic pressure check procedures. All personnel must stand clear of the vehicle. Take precautions against movement of the vehicle. Be sure that gauges (vacuum, pressure, tachometer) have extended lines so that they can be read from inside the vehicle.**
- **Do not burn discarded Teflon® seals; toxic gases are produced by burning.**
- **Never dry bearings with compressed air. A spinning bearing can disintegrate allowing balls or rollers to become lethal flying projectiles. Also, spinning a bearing without lubrication can damage the bearing.**
- **Be sure all pressure is exhausted from the torque converter before loosening the test fixture nut and removing the test fixture.**
- **The retarder control priority valve and plug and regulator valve and plug are spring-loaded and must be restrained while the retaining pins are being removed.**
- **The retarder control autoflow valve plug is spring-loaded and must be restrained while the snapring is being removed.**

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# Section 1 – GENERAL INFORMATION

## *1–1. SCOPE OF MANUAL*

**a. Coverage**

(1) This Service Manual describes the operation, maintenance, and overhaul procedures for the AT 540, AT 542(N)(R)(NFE), AT 543, AT 545(N)(R), AT 1542P, AT 1545P(N) Series automatic transmissions (Figures 1–1 through 1–4). A description of the major components of the transmissions, the function and operation of the hydraulic system, wear limits, and inspection procedures are included. Torque specifications are given with each assembly step and on the exploded view foldouts at the back of this manual.

(2) Because of similarities of all models, instructions apply generally to all models. Where procedures vary between models, instructions identify specific models.

**b. Illustrations.** Overhaul procedures are illustrated mainly by photographs. Line drawings are used to supplement detailed assembly procedures; cross sections show torque paths and the relationship of assembled parts. Cross sections, color-coded hydraulic schematics, and parts exploded views are on foldouts at the back of this manual. The foldouts may be opened for reference while studying the text.

**c. Maintenance Information.** Each task outlined in this Service Manual has been successfully accomplished by service organizations and individuals. It is not expected that every service organization or individual will possess the required special tooling, training, or experience to perform all the tasks outlined. However, any task outlined herein may be performed if the following conditions are met:

(1) The organization or individual has the required knowledge of the task through:

- Formal instruction in an Allison or Distributor training facility.
- On-the-job instruction by an Allison or Distributor representative.
- Experience in performing the task.

(2) The work environment is suitable to prevent contamination or damage to transmission parts or assemblies.

(3) Required tools and fixtures are available as outlined in the Service Manual.

(4) Reasonable and prudent maintenance practices are utilized.

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**NOTE:**

**Service organizations and individuals are encouraged to contact their local Allison Transmission Distributor for information and guidance on any of the tasks outlined herein.**

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## *1–2. SUPPLEMENTARY INFORMATION*

Supplementary information will be issued, as required, to cover any improvements made after publication of this manual. Check with your dealer or distributor to ensure you have the latest information.

## *1–3. ORDERING PARTS*

**a. Transmission Nameplate.** The nameplate (Figure 1–5) is located on the right-rear side of the transmission. The nameplate shows the transmission serial number, part number (assembly number), and model designation, all three of which **must be supplied** when ordering replacement parts or requesting service information.

**b. Parts Catalog. Do not order** by illustration item numbers on exploded views in this manual. All replacement parts should be ordered from your distributor or dealer. Parts are listed in the current Parts Catalogs PC1235EN.

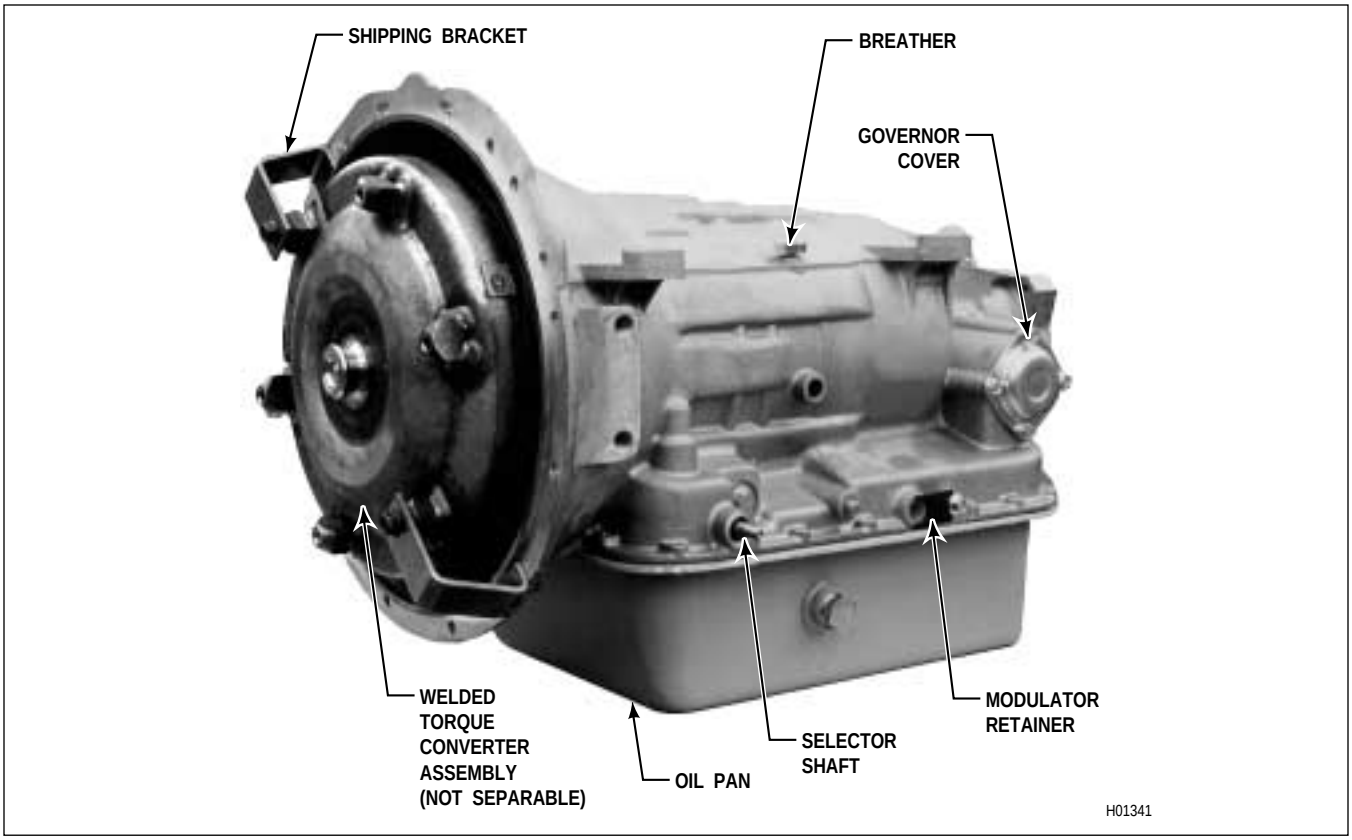



**Figure 1–1. AT 1545 Automatic Transmission — Left-Front View**

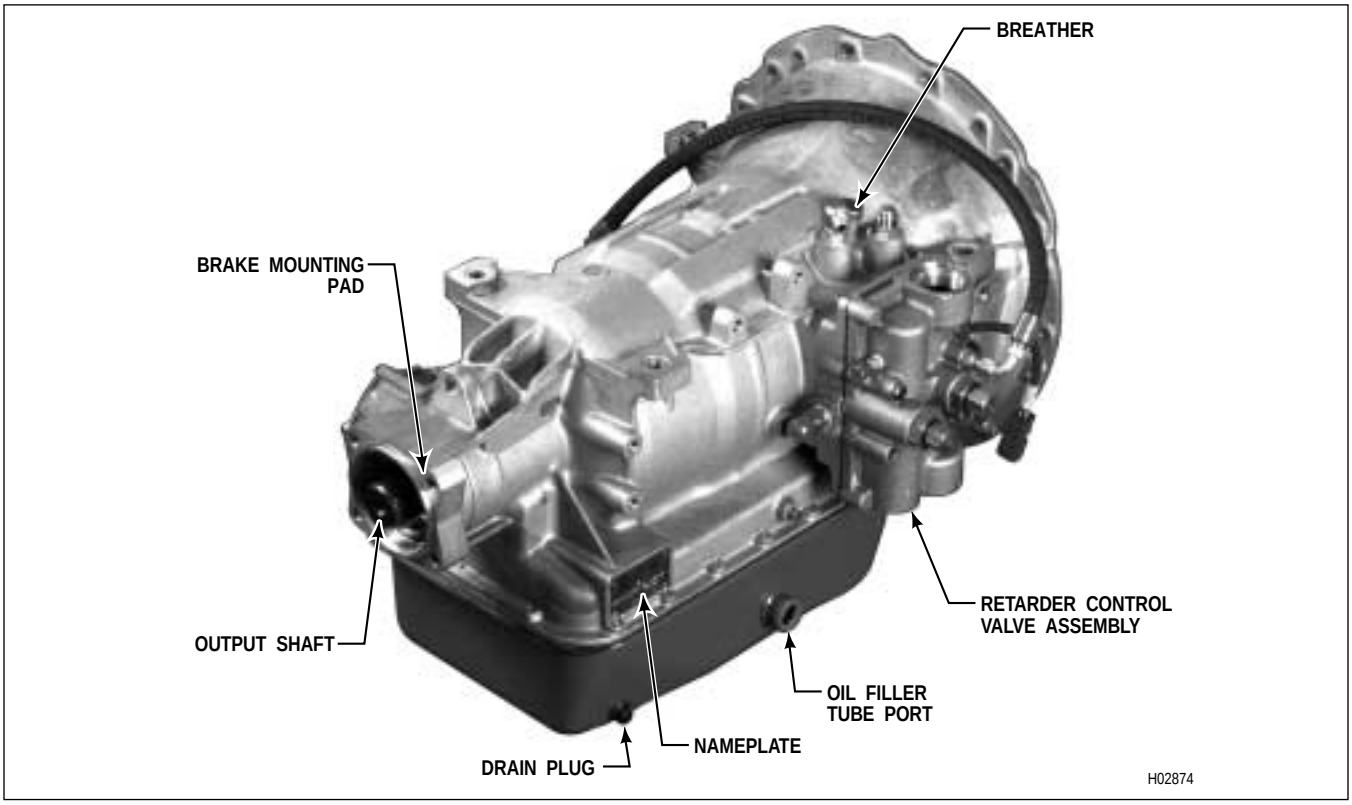



**Figure 1–2. AT 545R Automatic Transmission — Right-Rear View**

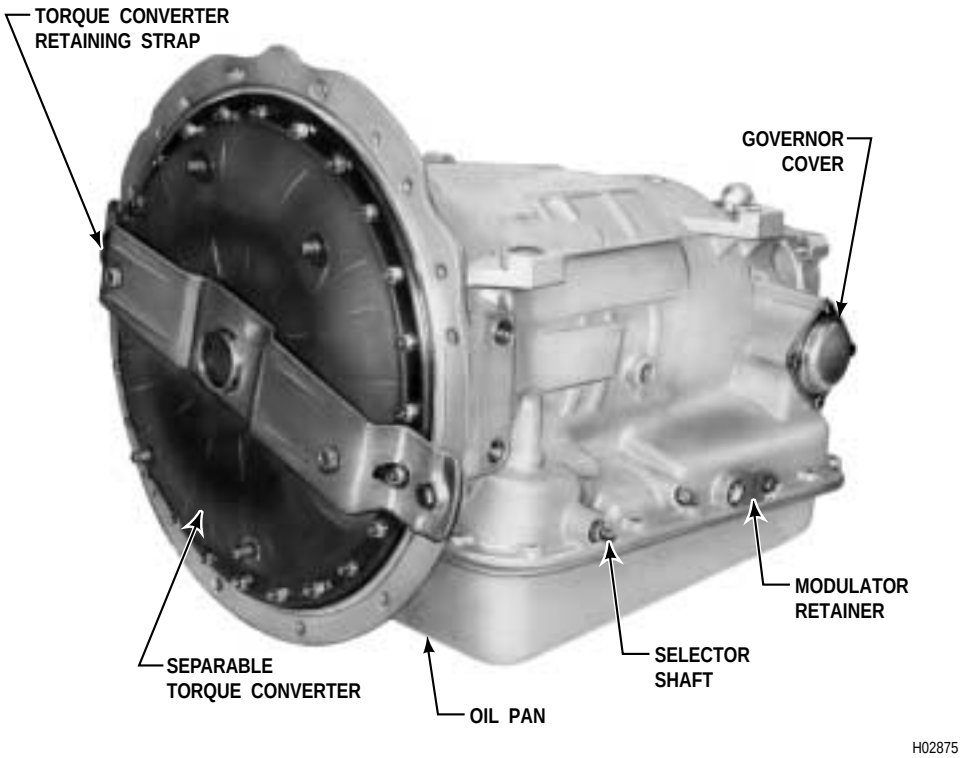



**Figure 1–3. AT 543 Automatic Transmission — Left-Front View**

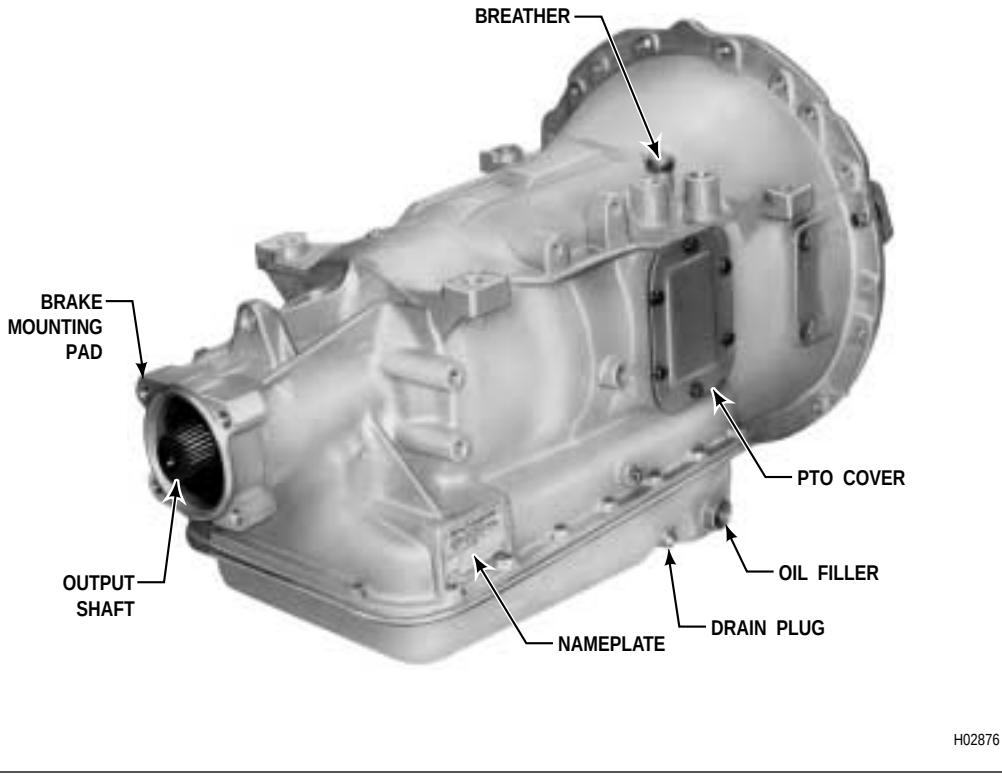



**Figure 1–4. AT 542, 543, 1542 Automatic Transmission — Right-Rear View**

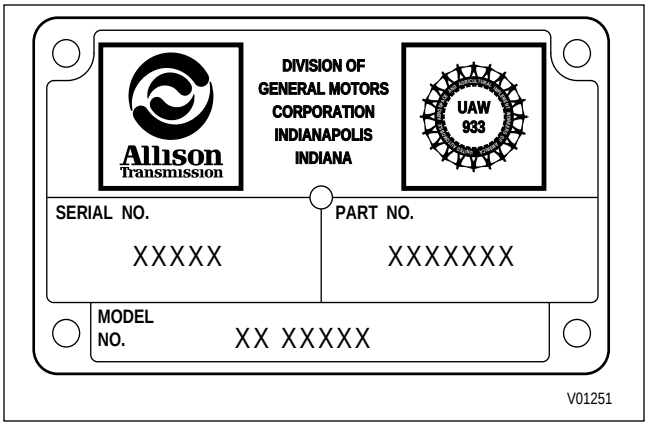



**Figure 1–5. Transmission Nameplate**

## *1–4. GENERAL DESCRIPTION*

**a. Automatic, Four Speeds.** The AT 500 and 1500 Series transmissions have four forward speeds and one reverse. Shifting within the forward ranges selected by the operator is fully automatic.

**b. Torque Converter and Lockup Clutch.** An Allison three-element torque converter (Foldout 1, 2, or 3) transmits power from the engine to the transmission gearing. The torque converter serves as both a fluid coupling and a torque multiplier. AT 1500 Series transmissions also include a lockup clutch in the torque converter assembly.

**c. Planetary Gearing, Clutches.** Ratios for four forward speeds and reverse are established by planetary gearing. The planetary gearing is controlled by multiple-disc, hydraulic clutches. All gearing is in constant mesh.

**d. Main Control Valve Body.** The main control valve body consists of a series of spring-loaded spool valves which are hydraulically actuated by the main pressure produced from the charging pump.

## *1–5. OPERATING INSTRUCTIONS*

Refer to SA1334 for operating instructions.

## *1–6. SPECIFICATIONS AND DATA*

The specifications and data in Table 1–1 are applicable to AT 500 and 1500 Series transmissions.

**Table 1–1. Specifications and Data**

| INPUT RATINGS — AT 1542 DIESEL | | | | | | |
|---|---|---|---|---|---|---|
| | Value | | | | | |
| Parameter | General Truck & Road Sweeper | Transit & Airport Shuttle Bus | Motorhome | School Bus | Inner City & Shuttle Bus | Unit |
| Input Speed | | | | | | |
| Maximum full load governed speed | 4000* | 4000* | 4000* | 4000* | 4000* | rpm |
| Minimum full load governed speed | 2400 | 2400 | 2400 | 2400 | 2400 | rpm |
| Minimum idle speed in drive | 500 | 500 | 500 | 500 | 500 | rpm |
| Input Power | | | | | | |
| Maximum net | 180 (134) | 160 (119) | 180 (134) | 180 (134) | 180 (134) | hp (kW) |
| Input Torque | | | | | | |
| Maximum net | 405 (549) | 340 (461) | 405 (549) | 405 (549) | 405 (549) | lb ft (N·m) |
| Turbine Torque | | | | | | |
| Maximum net | 709 (961) | 585 (793) | 709 (961) | 709 (961) | 709 (961) | lb ft (N·m) |
| Gross vehicle weight (GVW) | 22050 (10002) | 16540 (7500) | 22050 (10002) | 16540 (7500) | 18520 (8401) | lb (kg) |
| Gross combination vehicle weight (GCW) | 22050 (10002) | N/A | 27010 (12252) | N/A | N/A | lb (kg) |
| * 3200 rpm for TC 290 | | | | | | |

**Table 1–1. Specifications and Data *(cont'd)***

| INPUT RATINGS — AT 1542 GASOLINE | | | | | | |
|---|---|---|---|---|---|---|
| | Value | | | | | |
| Parameter | General Truck & Road Sweeper | Transit & Airport Shuttle Bus | Motorhome | School Bus | Inner City & Shuttle Bus | Unit |
| Input Speed | | | | | | |
| Maximum full load governed speed | 4400 | 4400 | 4400 | 4400 | 4400 | rpm |
| Minimum full load governed speed | 3200 | 3200 | 3200 | 3200 | 3200 | rpm |
| Minimum idle speed in drive | 500 | 500 | 500 | 500 | 500 | rpm |
| Input Power | | | | | | |
| Maximum net | 200 (149) | 160 (119) | 200 (149) | 200 (149) | 200 (149) | hp (kW) |
| Input Torque | | | | | | |
| Maximum net | 405 (549) | 340 (461) | 405 (549) | 405 (549) | 405 (549) | lb ft (N·m) |
| Turbine Torque | | | | | | |
| Maximum net | 709 (961) | 585 (793) | 709 (961) | 709 (961) | 709 (961) | lb ft (N·m) |
| Gross vehicle weight (GVW) | 22050 (10002) | 16540 (7500) | 22050 (10002) | 16540 (7500) | 18520 (8401) | lb (kg) |
| Gross combination vehicle weight (GCW) | 22050 (10002) | N/A | 27010 (12252) | N/A | N/A | lb (kg) |
| **INPUT RATINGS — AT 1545 DIESEL** | | | | | | |
| | Value | | | | | |
| Parameter | General Truck & Road Sweeper | Transit & Airport Shuttle Bus | Motorhome | School Bus | Inner City & Shuttle Bus | Unit |
| Input Speed | | | | | | |
| Maximum full load governed speed | 4000* | 4000* | 4000* | 4000* | 4000* | rpm |
| Minimum full load governed speed | 2400 | 2400 | 2400 | 2400 | 2400 | rpm |
| Minimum idle speed in drive | 500 | 500 | 500 | 500 | 500 | rpm |
| Input Power | | | | | | |
| Maximum net | 180 (134) | 160 (119) | 180 (134) | 180 (134) | 180 (134) | hp (kW) |
| Input Torque | | | | | | |
| Maximum net | 405 (549) | 340 (461) | 405 (549) | 405 (549) | 405 (549) | lb ft (N·m) |
| Turbine Torque | | | | | | |
| Maximum net | 709 (961) | 585 (793) | 709 (961) | 709 (961) | 709 (961) | lb ft (N·m) |
| Gross vehicle weight (GVW) | 24250 (11000) | 21000 (9525) | 24250 (11000) | 24250 (11000) | 24250 (11000) | lb (kg) |
| Gross combination vehicle weight (GCW) | 24250 (11000) | N/A | 27010 (12252) | N/A | N/A | lb (kg) |
| * 3200 rpm fors TC 290 | | | | | | |
| **INPUT RATINGS — AT 1545 GASOLINE** | | | | | | |
| | Value | | | | | |
| Parameter | General Truck & Road Sweeper | Transit & Airport Shuttle Bus | Motorhome | School Bus | Inner City & Shuttle Bus | Unit |
| Input Speed | | | | | | |
| Maximum full load governed speed | 4400 | 4400 | 4400 | 4400 | 4400 | rpm |
| Minimum full load governed speed | 3200 | 3200 | 3200 | 3200 | 3200 | rpm |
| Minimum idle speed in drive | 500 | 500 | 500 | 500 | 500 | rpm |
| Input Power | | | | | | |
| Maximum net | 200 (149) | 160 (119) | 200 (149) | 200 (149) | 200 (149) | hp (kW) |
| Input Torque | | | | | | |
| Maximum net | 405 (549) | 340 (461) | 405 (549) | 405 (549) | 405 (549) | lb ft (N·m) |
| Turbine Torque | | | | | | |
| Maximum net | 709 (961) | 585 (793) | 709 (961) | 709 (961) | 709 (961) | lb ft (N·m) |
| Gross vehicle weight (GVW) | 24250 (11000) | 21000 (9525) | 24250 (11000) | 24250 (11000) | 24250 (11000) | lb (kg) |
| Gross combination vehicle weight (GCW) | 24250 (11000) | N/A | 27010 (12252) | N/A | N/A | lb (kg) |
| Note: Conversions between inch and metric units are not necessarily equivalent. | | | | | | |

| | |
|---|---|
| Mounting: | |
| Engine | SAE 3 automotive flywheel housing with flexplate drive |
| Vehicle | One vertical mounting pad each side |
| Drive | Flexplate drive, customer furnished |
| Rotation (viewed from input): | |
| Input | Clockwise |
| Output (in forward ranges) | Clockwise |
| Output location | In line with input |
| Dry weight, approximate (basic configuration): | |
| AT 500 Series | 289 lb (131 kg) |
| AT 1500 Series | 302 lb (137 kg) |
| Parking brake (some models) | Mounting provided at rear of transmission case for OEM-supplied parking brake. |
| Output flange | Supplied by OEM |

Hydraulic System:

| Fluid capacity, approx. (excluding external circuits) | **Fill From Factory** | | **Initial Fill After Rebuild** | | **Refill After Servicing** | |
|---|---|---|---|---|---|---|
| | U.S. Qts | Liters | U.S. Qts | Liters | U.S. Qts | Liters |
| Shallow oil pan — 4.0 inch (102 mm) | 13 | 12 | 15 | 14 | 9 | 8.5 |
| Deep oil pan — 5.3 inch (135 mm) | 20 | 19 | 22 | 21 | 16 | 15 |

| | |
|---|---|
| Temperatures*: | |
| Sump (max) | 250°F (120°C) |
| To cooler — converter-out (max) | 300°F (150°C) |
| To cooler — retarder-out (max) | 330°F (165°C) |
| Normal operation (sump) | 160–200°F (71–93°C) |
| Normal operation (converter-out) | 180–220ºF (82–104ºC) |
| Oil filter | Refer to Paragraph 3–8 |
| Oil pump | Positive displacement |
| Oil type | Refer to Paragraph 3–7 |
| Oil pressure | Refer to Tables 3–4 through 3–9 |
| Clutches | Hydraulic-actuated, spring-released, self-compensating for wear |
| Power takeoff (converter driven): | |
| Mounting | SAE 6-bolt regular duty |
| Drive gear | 6 pitch, 55 teeth, 20˚ pressure angle |

* Temperature gauge kit available in Parts Catalog.

**Table 1–1. Specifications and Data *(cont'd)***

| | |
|---|---|
| Location | Right side (viewed from rear) |
| Rotation | Same as engine |
| Rating (continuous) | 200 lb ft (270 N·m) |
| (intermittent) | 250 lb ft (270 N·m) |
| Torque Converter: | |
| Type | Single-stage, 3-element, multiphase |
| Number of stages | 1 |
| Number of elements | 3 |

Stall torque ratio:

| | AT 540 | AT 542 | AT 543 | AT 545 | AT 1542 | AT 1545 |
|---|---|---|---|---|---|---|
| TC275;1.96:1 | x | x | | x | x | x |
| TC290;1.72:1 | x | x | | x | x | x |
| TC350;3.09:1 | | | x | | | |
| TC370;2.51:1 | | | x | | | |
| TC375;2.13:1 | | | x | | | |
| TC380;1.86:1 | | | x | | | |
| Lockup Clutch | No | No | No | No | Yes (3rd and 4th) | Yes (3rd and 4th) |

| | |
|---|---|
| Typical Shift Sequence (wide open throttle): | |
| AT 500 Series | Auto 1–4 (1C-2C-3C-4C) |
| AT 1500 Series | Auto 1–4 (1C-2C-3C-3L-4L) |
| Shift modulation: | |
| (Gasoline) | Vacuum |
| (Diesel) | Mechanical/Electronic |
| Neutral start and reverse signal switches | Supplied by OEM |
| Speedometer drive: | |
| Type and size | 13/16-20 UNEF thread for SAE regular duty — thread type |
| Drive gears | 5 teeth |
| Driven gear | Supplied by customer |
| Gearing | Constant mesh, spur type, planetary |

TRANSMISSION RATIOS (Mechanical**)

| Range | Clutch(es) Engaged | Ratio |
|---|---|---|
| Park (AT 542N, 545N, 1545N) | First | 0 |
| Neutral | First | 0 |
| First | Forward and first | 3.45:1 |
| Second | Forward and second | 2.25:1 |
| Third | Forward and third | 1.41:1 |
| Fourth | Forward and fourth | 1.00:1 |
| Reverse | Fourth and first | 5.02:1 |

** Overall torque multiplication ratio of transmission (output stalled) is the product of the converter torque multiplication ratio (see torque converter) and the mechanical (gear) ratio.

**NOTES**

# Section 2 – DESCRIPTION AND OPERATION

## *2–1. SCOPE*

This section describes and explains the operation of the components and systems of AT transmissions. Where features are common to all models, no reference will be made to models. Where features are peculiar to a model, the model will be noted.

## *2–2. MOUNTING*

**a. To Engine.** The front of the transmission housing is an SAE size 3 flange. This flange is bolted to the rear of the engine.

**b. To Vehicle.** Two 5/8-11 tapped holes at each side of the transmission are provided for mounting to supports in the vehicle.

## *2–3. INPUT DRIVE*

**a.** For models other than AT 543, six tapped lugs are on the front of torque converter 1 (Foldout 7,B) for attachment of a flexible disk drive. The outer bolt circle of the disk drive is bolted to the lugs. The inner bolt circle is bolted to the engine crankshaft or crankshaft adapter hub.

**b.** For AT 543 models, six threaded studs are on the front of torque converter 2 (Foldout 7,A) for the attachment of a flexible disk drive using nuts 1.

## *2–4. TRANSMISSION HOUSING*

Transmission housing assembly 6 (Foldout 12,A) is cast aluminum. It houses the clutches and gearing, oil pump, governor, main control valve, and oil pan. A parking brake mounting surface is provided at the rear. On the right side is a provision for a power takeoff or for the retarder control valve, depending upon the type of model.

## *2–5. TORQUE CONVERTER ASSEMBLY AND LOCKUP CLUTCH*

### a. Description

(1) AT 500 Series transmissions have torque converters that include a pump, a turbine, and a stator. The pump is driven by the engine. The turbine drives the turbine shaft. The stator is mounted on a freewheel clutch, the hub of which is splined to a stationary ground sleeve. The hub of the torque converter pump drives the transmission input pressure pump.

(2) AT 1500 Series transmissions are equipped with an automotive-style lockup torque converter. In addition to the pump, stator, and turbine assemblies, a lockup clutch and damper assembly is incorporated. A lockup valve, located in the front support assembly, controls flow through the torque converter and provides operation in third and fourth ranges.

(3) AT 540, 542, 545, 1542, or 1545 Series torque converter 1 (Foldout 7,B) is a closed, welded unit that cannot be disassembled.

(4) AT 543 torque converter 2 (Foldout 7,A) is a serviceable assembly.

### b. Operation *(Foldout 1, 2, or 3)*

(1) The torque converter assembly is continuously filled with transmission fluid, which flows through the converter to cool and lubricate it. When the converter is driven by the engine, the pump vanes throw the fluid against the turbine vanes. The impact of the fluid against the turbine vanes tends to rotate the turbine.

(2) The turbine, splined to the turbine shaft, transmits torque to the transmission gearing. At engine idle speed, the impact of fluid against the turbine vanes is minimal. At high engine speed the impact of the fluid is much greater on the turbine, and high torque is produced.

(3) Fluid thrown into the turbine flows to the stator vanes. The stator vanes change the direction of the hydraulic flow (when the stator is locked against rotation), and directs the fluid to the pump in a direction that assists the rotation of the pump. It is the redirection of the fluid by the stator that enables the torque converter to multiply input torque.

(4) Greatest torque multiplication occurs when the turbine is stalled and the pump is rotating at its highest speed. Torque multiplication decreases as the turbine rotates and approaches the speed of the pump.

(5) When turbine speed approaches the speed of the pump, fluid flowing to the stator begins striking the backs of the stator vanes. This rotates the

stator in the same direction as the turbine and pump. At this point, torque multiplication stops and the converter becomes, in effect, a fluid coupling.

(6) Thus, the torque converter accomplishes three main functions. It acts as a disconnect clutch because little torque is transmitted at engine idle speed. It multiplies torque at low turbine/high pump speed to give greater starting or driving effort when needed. And it acts as a fluid coupling to efficiently transmit engine torque to the transmission gearing during drive, other than idle or starting.

(7) For AT 1500 Series models, the engagement of the lockup clutch is controlled by the lockup relay valve which derives its lockup signal from the 3–4 clutch feed pressure. The clutch apply pressure compresses the lockup clutch plate against the front cover. Thus, the converter pump and turbine are locked together and provide a direct drive from the engine to the transmission gearing. As rotational speed of the output shaft decreases, the relay valve automatically releases the lockup clutch. Refer to Paragraph 2–19**f** and **g** for explanation of the hydraulic action.

## *2–6. OIL PUMP ASSEMBLY*

**a. Description** *(Foldout 7,B)*

(1) Oil pump assembly 2 includes, in addition to pump components, front support assembly 17, main-pressure regulator components 24 through 27, and, for AT 1500 Series models, lockup valve components 30 through 33.

(2) The oil pump consists of driven gear 9 and drive gear 10 which are located in pump body 8. Pump body 8 is bolted to front support and bearing assembly 16.

(3) The front support assembly includes stator shaft 19. Front support 21 closes the front of the transmission and supports the torque converter, turbine shaft, and forward clutch.

**b. Operation** *(Foldout 7,B)*

(1) When the torque converter is rotating, its rear hub drives pump drive gear 10. Gear 10 is meshed with the internal teeth of driven gear 9.

(2) The pump gears draw transmission fluid from the sump. When the flow of fluid fills all the requirements in the transmission, pressure is developed. Valve 27 in support 16 regulates the flow of fluid from the pump.

## *2–7. FORWARD CLUTCH AND TURBINE SHAFT*

**a. Description** *(Foldout 8)*

(1) The forward clutch and turbine shaft assembly connects the converter turbine to the other clutches and gearing in the transmission during every operational phase of the transmission, including PTO operation or retarder operation.

(2) The turbine shaft is splined to clutch housing 9 or 14. The external tangs of clutch plates 27 engage housing 9 or 14. The internal splines of clutch plates 28 engage hub 26 which transmits torque to the gearing.

(3) Piston 19 is installed in housing 9 or 14 and is retained by sixteen springs 20, retainer 21, and snapring 22. Clutch plates 27 and 28 are held in housing 9 or 14 by fourth clutch driving hub 29 and are retained by snapring 30.

(4) Some models are equipped with power takeoff drive gear 4 or 32. When used, gear 32 is splined to housing 9 and retained by snapring 31. When used, gear 4 is splined to housing 9 and retained by snaprings 3 and 5.

(5) For models with retarder, refer also to Paragraph 2–16.

**b. Operation** *(Foldout 8)*

(1) Turbine shaft and housing assembly 7 or 11 rotates when the torque converter turbine rotates. Fourth clutch driving hub 29 also rotates along with internal-splined fourth clutch plates 3 (Foldout 9,A). PTO drive gear 4 or 32 (Foldout 8), when included, also rotates.

(2) When hydraulic pressure is directed to the piston bore in housing 9 or 14, piston 19 compresses clutch plates 27 and 28 against driving hub 29. This locks clutch hub 26 to housing 9 or 14. Hub 26 is splined to transmission main shaft 4 (Foldout 10,A).

(3) When the converter turbine rotates and the forward clutch is applied, the transmission main shaft is rotated. This drives the transmission gear set, and drives the output shaft in any forward range.

(4) The forward clutch is engaged only during operation in a forward range, and is always paired with another clutch (either first, second, third, or fourth). It is disengaged during neutral and reverse.

(5) In neutral, the forward clutch housing rotates, driving the power takeoff, if so equipped. In reverse, the forward clutch housing rotates to drive the fourth clutch (which is applied in combination with the first clutch to obtain reverse).

(6) For models with retarder, refer also to Paragraph 2–16.

## *2–8. FOURTH CLUTCH*

**a. Description** *(Foldout 9,A)*

(1) The fourth clutch includes housing assembly 11, piston 8, five external-tanged clutch plates 4, five internal-splined plates 3, and, for models without retarder, backplate 2. For models with retarder, retarder housing 36 (Foldout 8) functions as the fourth clutch backplate.

(2) Piston 8 (Foldout 9,A) is installed in housing 13, and retained by sixteen springs 7, retainer 6, and snapring 5. External-tanged plates 4 engage housing 13. Internal-splined plates 3 are splined to fourth clutch driving hub 29 (Foldout 8). For models without retarder, plates 3 and 4 (Foldout 9,A) are retained in housing 13 by clutch backplate 2 and snapring 1. For models with retarder, plates 3 and 4 are retained in housing 13 by retarder housing 36 (Foldout 8).

(3) The hub of housing 13 (Foldout 9,A) is splined to sun gear shaft 3 (Foldout 10,A). The outer splines on housing 13 (Foldout 9,A) engage internal-splined plates 3 (Foldout 9,B) of the third clutch.

**b. Operation** (Foldout 9,A)

(1) When the fourth clutch is released, internal-splined plates 3 are free of external-tanged plates 4. Plates 3 rotate independent of housing 13, whether housing 13 is stopped or has a different speed or direction of rotation.

(2) When hydraulic pressure is directed to the piston cavity in housing 13, piston 8 compresses plates 3 and 4 against backplate 2 or against retarder housing 36 (Foldout 8). This locks internal-splined plates 3 (Foldout 9,A) to external-tanged plates 4 and, in turn, to housing 13.

(3) When the fourth clutch is engaged, it is locked to fourth clutch driving hub 29 (Foldout 8) and rotates with the turbine shaft.

(4) In fourth range, turbine shaft rotation is transmitted to sun gear shaft 3 (Foldout 10,A) and to transmission main shaft 4 by the engaged forward clutch. The result is direct drive to the output shaft.

(5) In reverse, turbine shaft rotation is transmitted to sun gear shaft 3 while the first clutch (Foldout 10,B) is engaged, resulting in reverse rotation of the transmission output shaft.

## *2–9. SECOND AND THIRD CLUTCH AND CENTER SUPPORT*

**a. Description** *(Foldout 9,B)*

(1) Third clutch includes items 1 through 11. Second clutch includes items 16 through 25. Center support assembly 13 serves the two clutches. The front side of support 15 receives third clutch piston 9. The rear side of support 15 receives second clutch piston 18. Center support 15 directs fluid to both of these clutches, as well as to the fourth clutch.

(2) External-tanged clutch plates 4 and 23 engage the transmission housing, and are always stationary. Internal-splined plates 3 of the third clutch engage housing 13 (Foldout 9,A) of the fourth clutch. Internal-splined plates 24 (Foldout 9,B) of the second clutch engage the external splines of front planetary assembly 8 (Foldout 10,A).

**b. Operation of Third Clutch** *(Foldout 9,B)*

(1) When the third clutch is released, internal-splined plates 3 rotate with fourth clutch housing 13 (Foldout 9,A). The third clutch is released in all ranges except third.

(2) When hydraulic pressure is directed to the third clutch piston cavity (front) of center support 15 (Foldout 9,B), piston 9 compresses plates 3 and 4 against backplate 2. This anchors clutch plates 3 and 4,

and fourth clutch housing 13 (Foldout 9,A) to the transmission housing, stopping rotation. Since housing 13 is splined to sun gear shaft 3 (Foldout 10,A), the shaft is held stationary. This provides a reaction for the gearing and causes the planetaries to produce third range.

**c. Operation of Second Clutch** *(Foldout 9,B)*

(1) When the second clutch is released, internal-splined plates 24 rotate with front planetary carrier assembly 8 (Foldout 10,A). The second clutch is released during all ranges except second.

(2) When hydraulic pressure is directed to the second clutch piston cavity (rear) of center support 15 (Foldout 9,B), piston 18 compresses plates 23 and 24 against backplate 25. This anchors internal-splined plates 24 and external-tanged plates 23 to the transmission housing.

(3) The internal-splines of plates 24 are splined to front planetary carrier assembly 8 (Foldout 10,A), holding the carrier stationary. A compound arrangement in the planetaries produces second range.

## *2–10. FIRST CLUTCH*

**a. Description** *(Foldout 10,B)*

(1) The first clutch includes piston 9, seven external-tanged clutch plates 4, seven internal-splined clutch plates 3, and backplate 2.

(2) Piston 9 is in the rear of the transmission housing. The external tangs of clutch plates 4 engage the transmission housing and are always stationary. Internal-splined plates 3 engage rear planetary ring gear 5 (Foldout 10,B) or 53 (Foldout 10,A).

(3) Piston 9 (Foldout 10,B) is retained in the transmission housing by twenty-two springs 8, retainer 7, and snapring 6. Backplate 2 and clutch plates 3 and 4 are retained in the transmission housing by snapring 1.

**b. Operation** *(Foldout 10,B)*

(1) When the first clutch is released, internal-splined plates 3 and rear planetary ring gear 5 or 53 (Foldout 10,A) rotate. The first clutch is released during operation in all ranges except neutral, first, and reverse.

(2) When hydraulic pressure is directed to the first clutch piston cavity, piston 9 (Foldout 10,B) compresses clutch plates 3 and 4 against backplate 2. This locks internal-splined plates 3 to external-tanged plates 4, which are anchored to the transmission housing. Plates 3, splined to the rear planetary ring gear, hold the ring gear stationary.

(3) The stationary ring gear provides a reaction for the planetary gearing to produce either first range or reverse.

(4) In first range, the driving member is rear planetary sun gear 31 (Foldout 10,A), which receives torque through the turbine shaft, the engaged forward clutch, and the transmission main shaft.

(5) In reverse, the driving member is center sun gear 19 (Foldout 10,A), which receives torque through the turbine shaft, the engaged fourth clutch, and sun gear shaft 3. First range is a simple planetary action (involving only one planetary). Reverse is a compound planetary action (involving two planetary sets).

## *2–11. PLANETARY GEAR UNIT*

**a. Description** *(Foldout 10,A)*

(1) The planetary gear unit includes all of the gears and shafts in the transmission except the turbine shaft and the rear planetary ring gear.

(2) Three planetary gear sets are included in the assembly. These are called front planetary, center planetary, and rear planetary.

(3) The front planetary includes sun gear 6, carrier assembly 8, and ring gear 18. The center planetary includes sun gear 19, carrier assembly 20, and ring gear 30. The rear planetary includes sun gear 31, carrier assembly 36, and ring gear 5 (Foldout 10,B).

(4) The three planetary sets are interconnected by sun gear shaft 3 (Foldout 10,A), main shaft 4, and connecting drum 28. This interconnection of the planetary input, reaction, and output elements, and connection of clutches to the shafts and planetary elements, produces four forward ranges and reverse.

**b. Operation.** Refer to Paragraph 2–19.

## *2–12. SPEEDOMETER DRIVE/SPEED SENSOR WHEEL*

**a. Description** *(Foldout 12,B)*

(1) The speedometer drive consists of drive gear 2 and provision for mounting the driven gear assembly in the transmission housing. Drive gear 2 is a worm gear with a left-hand helix. It is concentric with the transmission output shaft. The drive gear is clamped between adjacent components for rotational drive.

(2) Speed sensor wheel 9 is provided for models that are equipped with an electronic speedometer. The 16-tooth wheel provides a rotating pulse that can be read by an electronic speed sensor.

**b. Operation** *(Foldout 12,B)*

(1) When the transmission output shaft rotates, drive gear 2 or speed sensor wheel 9 rotates.

(2) For mechanical speedometers, the driven gear, supplied by the vehicle manufacturer, rotates clockwise during forward operation (viewed at the drive cable connection on the transmission).

(3) For electronic models, the speed sensor, supplied by the vehicle manufacturer, reads the output speed by "counting" the pulses produced by the teeth of the speed sensor wheel.

## *2–13. GOVERNOR*

**a. Description** *(Foldout 12,A).* Governor assembly 19 is a centrifugal (flyweight) governor, driven by drive gear 1 (Foldout 12,B) and mounted on the transmission output shaft. It is retained by cover 22 (Foldout 12,A).

**b. Operation** *(Foldout 12,A).* When the governor rotates, centrifugal force causes weights to move outward which moves a valve to admit main pressure to the governor circuit. Governor pressure is regulated when the centrifugal force of the weights is balanced by opposing hydraulic pressure. Governor pressure varies with transmission output speed, increasing as output speed increases. Governor pressure, in combination with modulator pressure, controls the automatic shifting of the transmission.

## *2–14. MODULATOR*

**a. Vacuum Modulator** *(Foldout 12,A)*

(1) Vacuum modulator 26 is calibrated and sealed at the factory.

(2) The position of the diaphragm in the modulator varies with vehicle speed, load, and engine throttle opening. When the diaphragm moves, the modulator valve is affected, increasing or decreasing modulation pressure. Modulator and governor pressures control the automatic selection of transmission ranges.

**b. Mechanical Modulator**

(1) The mechanical modulator is attached to the transmission and activated by a cable.

(2) The cable is connected to the fuel control lever at one end and the modulator valve actuator at the other. The fuel control lever moves the cable, controlling the modulator valve.

**c. Electric Modulator**

(1) An electric modulator can be used with electronic or non-electronic engines — any engine which can provide an On/Off signal based on throttle/pedal position.

(2) The 12-volt modulator assembly and the 24-volt modulator assembly utilize an electronic signal to stroke the transmission modulator pin from the closed-throttle position to the full-throttle position. The result is step-modulation.

(3) Step-modulation is a two-phase modulation schedule which utilizes a closed-throttle shift schedule until the throttle position is greater than 80–85 percent, then, remains at a full-throttle shift schedule until the throttle position is less than 60–65 percent.

(4) Electric modulators are compatible with an electronically-controlled engine that can provide an On/Off signal based on throttle position. Consult the respective engine manufacturer to identify the wire that provides this signal. Electronic modulation can also be applicable in mechanically-controlled engines. The modulating system will still require a 12- or 24-volt (dc) signal to stroke the transmission modulator valve.

## *2–15. OIL PAN AND FILTER*

**a. Description** *(Foldout 12,B)*

(1) Oil pan 26 or 33 is a pressed steel assembly providing openings for draining the transmission fluid and for mounting a fill tube and dipstick.

(2) Filter assembly 21, 38, or 46 is either a paper element retained by a steel casing or a brass screen assembly. The filter tube is not integral to the filter.

(3) Transmission fluid from the sump is drawn through the filter by the input oil pump and directed to the hydraulic system. A washer-head screw attaches the filter to the valve body.

(4) Deep pan units also use spacer 41 or 49 and a longer intake tube 40 or 48 between the filter and the valve body.

**b. Function** *(Foldout 12,B)*

(1) Oil pan 26 or 33 serves as the transmission fluid sump and covers the main control valve body assembly and the filter. The oil pan must be removed from the bottom of the transmission to replace the filter.

(2) The filter assembly screens all transmission fluid entering the hydraulic system. The fluid change interval is influenced by whether the transmission is fitted with a paper or with a brass filter. Refer to Paragraph 3–8.

(3) In some models, a magnet in the oil pan helps to accumulate any metal particles in the fluid supply.

## *2–16. HYDRAULIC RETARDER*

**a. Description**

(1) AT 542/545R models have a retarder located on the input side of the transmission that is designed for auxiliary braking for downhill speed control. This 160 hp retarder has a two-stage capacity that, in conjunction with selection of the appropriate ranges, can be used to tailor desired retardation performance to particular duty cycles.

(2) A cross-section of the AT 542/545R is shown on Foldout 3. The main retarder components internal to the transmission are front stator 1 (Foldout 8), the rotor which is a part of forward clutch housing 14, and rear stator 35.

(3) The AT retarder has a dual torus design. The retarder rotor provides high flow and torque generation. Front stator 1 and rear stator 35 are both stationary.

(4) The rotating element (rotor) of the retarder is cast on the OD of forward clutch housing 13. The rotor blades occupy approximately the same area that the optional PTO gear occupies on a PTO-equipped AT transmission. The valve body for the retarder mounts to the transmission PTO pad. Transmission fluid is transferred to and from the retarder through tubes that connect the externally-mounted retarder controls to retarder housing 37.

**b. Operation**

(1) The hydraulic system introduces transmission fluid through the tips of the rear stator blades in rear housing assembly 35 (Foldout 8), which is an extremely low pressure area. The fluid exits the torus through a slot at the OD of the blades.

(2) The retarder fluid is transferred from the retarder housing to the controls through two tubes. The controls turn on the retarder, as well as perform capacity regulation and cooler oil routing.

(3) The retarder is electronically activated by solenoids (Foldout 4,A, B, and C). Main-pressure from Solenoid **H** activates the autoflow valve. This valve routes transmission cooler flow and fills the retarder cavity through a regulator valve and priority valve system.

(4) The routing of the fluid to the cooling system is accomplished with the autoflow valve. When closed, the transmission fluid is routed through both primary and secondary coolers and the filter system. When in retarder mode, the auto-flow valve opens and directs converter-out transmission fluid through the secondary cooler and filter system. Retarder fluid flows through the primary cooler only.

(5) The retarder priority valve allows the regulator valve to feed the retarder if transmission fluid pressure is at an acceptable level. This is done to prevent the apply of the retarder from occurring if main pressure is at a low enough level that the transmission would be unable to acceptably transmit the retarder torque. The priority valve also acts as a retarder capacity interrupt during transmission range shifts, preventing transmission clutch overloads. The priority valve strokes as a result of the usual transmission main pressure drop that occurs when filling a clutch during a range shift. This pressure drop results in the retarder priority valve closing, and retarder capacity being reduced during the shift. This interruption in retarder is so brief that no negative impact on performance is noted. The brief capacity reduction also improves the quality of the downshift while the retarder is activated.

(6) The retarder control system has the ability to incorporate two levels of braking, using a special regulator valve. The regulator valve balances retarder charging pressure against a resisting force that varies at two levels dependent upon the capacity level chosen.

(7) For the lower capacity (50 percent), the valve spring force acts alone to balance the charging pressure to produce torque. The first stage solenoid (Solenoid **H**) is the only solenoid energized for this capacity level.

(8) The control system for the higher capacity level (100 percent) uses the second stage solenoid (Solenoid **F**) in addition to the first stage solenoid. The hydraulic output from Solenoid **H** supplements the spring force via a small plug valve. This raises the charging pressure required to establish a force balance on the regulator valve, resulting in higher braking output when both solenoids are energized.

(9) Retarder torque is generated by the rotating rotor blades which pump transmission fluid into a set of stationary stator blades. The stationary blades, in turn, redirect the fluid back to the rotating blades. The result is a very high velocity hydraulic flow around the torus and the absorption of a large amount of kinetic energy. Cooler flow results from the large pressure drop that the high velocity fluids create between the inlet and outlet locations.

## *2–17. MAIN CONTROL VALVE ASSEMBLY*

Main control valve body assembly 1 (Foldout 11) includes valves, springs, and other components which respond to the manual selection of ranges and control the automatic shifting of the transmission. The valve body assembly is bolted to the bottom of the transmission housing. The transmission housing is channeled to direct the flow of transmission fluid between the valve body and clutches and other components.

## *2–18. HYDRAULIC SYSTEM*

**NOTE:**

**References to up, down, left, or right refer to positions or movements of components on Foldout 5 or 6.**

**a. System Functions.** The hydraulic system generates, directs, and controls the pressure and flow of hydraulic fluid within the transmission. Hydraulic fluid (transmission oil) is the power transmitting medium in the torque converter. Its velocity drives the torque converter turbine. Its flow cools and lubricates the transmission. Its pressure operates the control valves and applies the clutches.

**b. System Schematic** *(Foldout 5 or 6)*. Color-coded foldouts of the hydraulic systems are presented at the back of this manual. The illustrations represent the system as it functions in neutral with the engine idling.

**c. Filter, Pump Circuit.** Transmission fluid is drawn from the sump through a filter screen by the input-driven charging pump. Fluid discharged by the pump flows to the main-pressure regulator valve. A bypass circuit returns fluid to the pump intake when main pressure reaches its scheduled value.

**d. Main-Pressure Circuit** *(Red)*

(1) Transmission fluid from the pump flows into the bore surrounding the main-pressure regulator valve, into an internal passage of the valve, and to the upper end of the valve. Pressure at the upper end of the valve moves the valve downward until fluid flows to the torque converter and, if pump flow is of sufficient volume, to the bypass circuit. Spring force below the

valve, balanced with hydraulic pressure above the valve, creates a regulated main pressure.

(2) The main-pressure circuit to the remainder of the hydraulic system is connected to the main-pressure regulator valve bore at the same point as the pump outlet. Before S/N 34501 (AT 540, 543 models), main pressure is directed to seven points in the system. These are the 3–4 shift signal valve, 2–3 shift signal valve, 1–2 shift signal valve, selector valve, 1–2 relay valve, modulator valve, and governor valve. After S/N 34500 (AT 540, 543 models) and for all other AT models, the trimmer regulator valve and the priority valve are also in the main-pressure circuit.

(3) Although main pressure is controlled primarily by the force of the spring below the regulator valve, modulator pressure (earlier models), and forward regulator pressure reduce main pressure.

(4) On AT 542, 543, 545, 1542, and 1545 models, main pressure remains constant because there is no modulated pressure at the main-pressure regulator valve.

**e. Converter-In (Yellow), Converter-Out (Orange), Lubrication (Green) Circuits**

(1) Converter-in fluid flows through the torque converter continuously to keep it filled and to carry off the heat generated in the converter.

(2) Converter-out fluid, leaving the torque converter, flows to an external cooler (supplied by the vehicle or power unit manufacturer). A flow of air or water over or through the cooler removes the heat from the transmission fluid.

(3) Cooler-out fluid returns to components requiring continuous flow lubrication. Lubrication fluid then returns to the sump.

**f. Selector Valve, Neutral, Forward Regulator Circuit (Orange and Yellow)**

(1) The selector valve is manually shifted to select the operating range desired. The selector valve establishes the hydraulic circuit for operation in the range selected. Shifting within any range is automatic, depending upon speed and throttle position.

(2) Neutral, forward regulator pressure is directed from the selector valve to the main-pressure regulator valve when the selector valve is at any position except reverse. In neutral and in all forward ranges, this pressure pushes downward on the main-pressure regulator valve and reduces main pressure. In reverse, regulator pressure is absent, permitting a higher main pressure.

**g. Governor Valve, Governor Circuit (Green and White)**

(1) Governor feed is main pressure directed to the governor valve. The governor controls the position of the governor valve, which determines the pressure in the governor circuit. When the transmission output is not rotating, governor pressure is approximately 2 psi (14 kPa). When the transmission output rotates, governor pressure varies with the speed of rotation. The greater the speed of rotation, the greater the governor pressure.

(2) Governor pressure is directed to the 1–2, 2–3, and 3–4 shift valves.

**h. Modulator Pressure Circuit (Red and Green)**

(1) Modulator pressure is a regulated, reduced pressure derived from main pressure at the modulator valve. Pressure is applied by either a vacuum modulator or a mechanical actuator. At high vacuum (closed throttle), all pressure is removed from the actuator pin allowing the valve to move rightward. Low vacuum (open throttle) increases the pressure on the actuator pin, due to the spring force in the vacuum modulator, moving the valve leftward.

(2) When the modulator pressure valve moves to the left, modulator pressure is reduced; when it moves to the right, modulator pressure is increased. Since engine vacuum varies with load, throttle opening, and engine speed, the position of the modulator pressure valve, and modulator pressure vary also. On the AT 542, 543, 545, 1542, and 1545 models, this varying pressure is directed to the three shift signal valves and to the trimmer regulator valve. On the AT 540, modulated pressure is directed also to the main-pressure regulator valve.

(3) At the 1–2, 2–3, and 3–4 shift signal valves, modulator and governor pressures act to upshift the valves in proper sequence. At a given governor pressure, the introduction of modulator pressure upshifts a signal valve. A decrease or removal of mod-

ulator pressure causes a downshift if governor pressure alone will not hold the valve upward against spring force.

(4) For the earlier models main-pressure regulator valve, modulator pressure exerts a downward force on the valve. An increase in modulator pressure causes a decrease in main pressure; a decrease in modulator pressure causes an increase in main pressure.

(5) Before S/N 34501, modulator pressure is blocked by the separator plate at the trimmer regulator valve. The trimmer regulator valve is either isolated and not functional or is not present.

(6) After S/N 34500, modulator pressure is directed to the trimmer regulator valve, exerting an upward force against its spring. This causes a reduction in trimmer regulator pressure at the trimmer valves.

**i. Clutch Circuits**

(1) Each of the five clutches has its own circuit. Each clutch, except forward, is connected to a relay valve and a trimmer valve. The forward clutch is connected directly to the selector valve. It does not require connection to a trimmer valve because its application (except in a neutral-to-first range shift) precedes the application of an additional clutch, which is trimmed.

(2) The first clutch circuit (red and white) connects the clutch to the 1–2 relay valve and to the first clutch trimmer valve. In neutral, the 1–2 relay valve is held upward by spring force, and main pressure is directed to the first clutch circuit. The 1–2 relay valve does not move downward unless the 1–2 signal line is charged. This will not occur in neutral because there is no governor pressure to shift the 1–2 signal valve.

**j. Hold Regulator Valve**

(1) The various hold ranges limit the highest range attainable by introducing a pressure which prevents governor pressure from upshifting the signal valves. This pressure is a regulated, reduced pressure derived from main pressure at the hold regulator valve.

(2) Hold regulator pressure at each shift signal valve will push the modulator valve upward, and hold the shift valve down against governor pressure. Thus, when hold regulator pressure is present, an upshift can occur at that shift signal valve only with excessive overspeed.

**k. Automatic Upshifts**

(1) When the transmission is operating in first range (or second range, earlier model transmissions with second range start), with the selector valve at **D** (Drive), a combination of governor pressure and modulator pressure, or governor pressure alone, will upshift the transmission to the next range. At closed or part throttle, modulator pressure assists governor pressure. At full throttle, there is no modulator pressure. Thus, upshifts occur sooner when the throttle is closed and are delayed when the throttle is open.

(2) When governor pressure is sufficient, the first upshift will occur. A further increase in governor pressure (output speed) will cause subsequent upshifts.

(3) In any automatic upshift, the shift signal valve acts first. This directs a shift signal pressure to the relay valve. The relay valve moves downward, exhausting the applied clutch and applying a clutch for the next higher range.

**l. Automatic Downshifts**

(1) Automatic downshifts, like upshifts, are controlled by governor and modulator pressures. Downshifts occur in sequence as governor pressure and/or modulator pressures decrease. Low modulator pressure (open throttle) will cause a sooner downshift; high modulator pressure (closed throttle) will cause a delayed downshift.

(2) In any automatic downshift, the shift signal valve acts first. This exhausts the shift signal holding the relay valve downward. The relay valve then moves upward, exhausting the applied clutch and applying the clutch for the next lower range.

**m. Downshift Inhibiting**

(1) Inherent in the system is a means for preventing downshifts at a too rapid rate. For example, if the vehicle is traveling at a high speed in fourth range

and the selector valve is shifted to **1** (Drive 1), the transmission will not immediately shift to first range. Instead, it will shift 4–3–2–1 as speed decreases (it will remain in fourth range if speed is not decreased sufficiently to allow an automatic downshift).

(2) The progressive downshift occurs because the regulated hold pressure is calibrated to move the signal valves downward against governor pressure only when the governor pressure decreases to a value corresponding to a safe downshift speed. Thus, if speed is too great, governor pressure is sufficient to hold the shift signal valve upward. As governor pressure decreases, the shift signal valves move downward in sequence.

**n. Trimmer Valves**

(1) There are four trimmer valves in the hydraulic system. These are: first clutch trimmer, second clutch trimmer, third clutch trimmer, and fourth clutch trimmer. The purpose of a trimmer is to avoid harsh shifts.

(2) All four trimmers function in the same manner. Each trimmer includes an orificed trimmer valve, a plug, a trimmer spring or springs, and a stop. The trimmer spring or springs hold the plug and trimmer valve to the top of the valve bore.

(3) When any clutch (except forward) is applied, apply pressure is sent also to the upper end of the trimmer valve. Initially, the valve and plug are moved downward against the plug spring until the circuit exhausts. This escape of fluid, as long as it continues, reduces clutch apply pressure. The transmission fluid flows through an orifice in the trimmer valve to the cavity between the trimmer valve and plug. Pressure in this cavity moves the plug downward to the stop. Main pressures above and below the trimmer valve equalize. The pressure below the trimmer valve, because it is acting upon a greater diameter, pushes the trimmer valve to the top of the valve bore. This throttles, then stops, the exhaust of the fluid. When escape of fluid stops, clutch-apply pressure is at maximum value. The plug remains downward, against the stop, until the clutch is released.

(4) When the transmission is shifted into reverse, clutch-apply pressure is directed to the top and bottom of the fourth clutch trimmer valve. This equalizes the pressure at both ends of the valve, thereby holding the trimmer valve and valve plug at the top of the bore. No trimming action occurs in reverse.

(5) Whenever a clutch is released, the spring(s) push the trimmer components to the top of the bore. In this position, the trimmer is reset, ready to repeat its trimming action when the clutch is again engaged.

**o. Priority Valve**

(1) The priority valve ensures that the control system upstream from the valve (governor, modulator, forward clutch) will retain sufficient pressure during shifts to perform its automatic functions.

(2) On models before S/N 34501, main pressure is routed directly to the 1–2 relay valve, thus eliminating the priority valve function until the selector valve is moved. On models after S/N 34500, main pressure is routed directly to the priority valve, thereby including the 1–2 signal valve in those receiving pressure priority.

**p. Trimmer Regulator Valve**

(1) The trimmer regulator valve reduces main pressure to a regulated pressure circuit (red and yellow). The regulated pressure is raised or lowered by changes in modulator pressure.

(2) Trimmer regulator pressure is directed to the spring end of the first and second clutch trimmer valves to increase the clutch-apply pressure of the trimmer valves. A higher modulator pressure (closed throttle) reduces trimmer regulator pressure, resulting in lower clutch-apply pressure. Conversely, a lower modulator pressure (open throttle) results in higher regulator pressure and higher clutch-apply pressure.

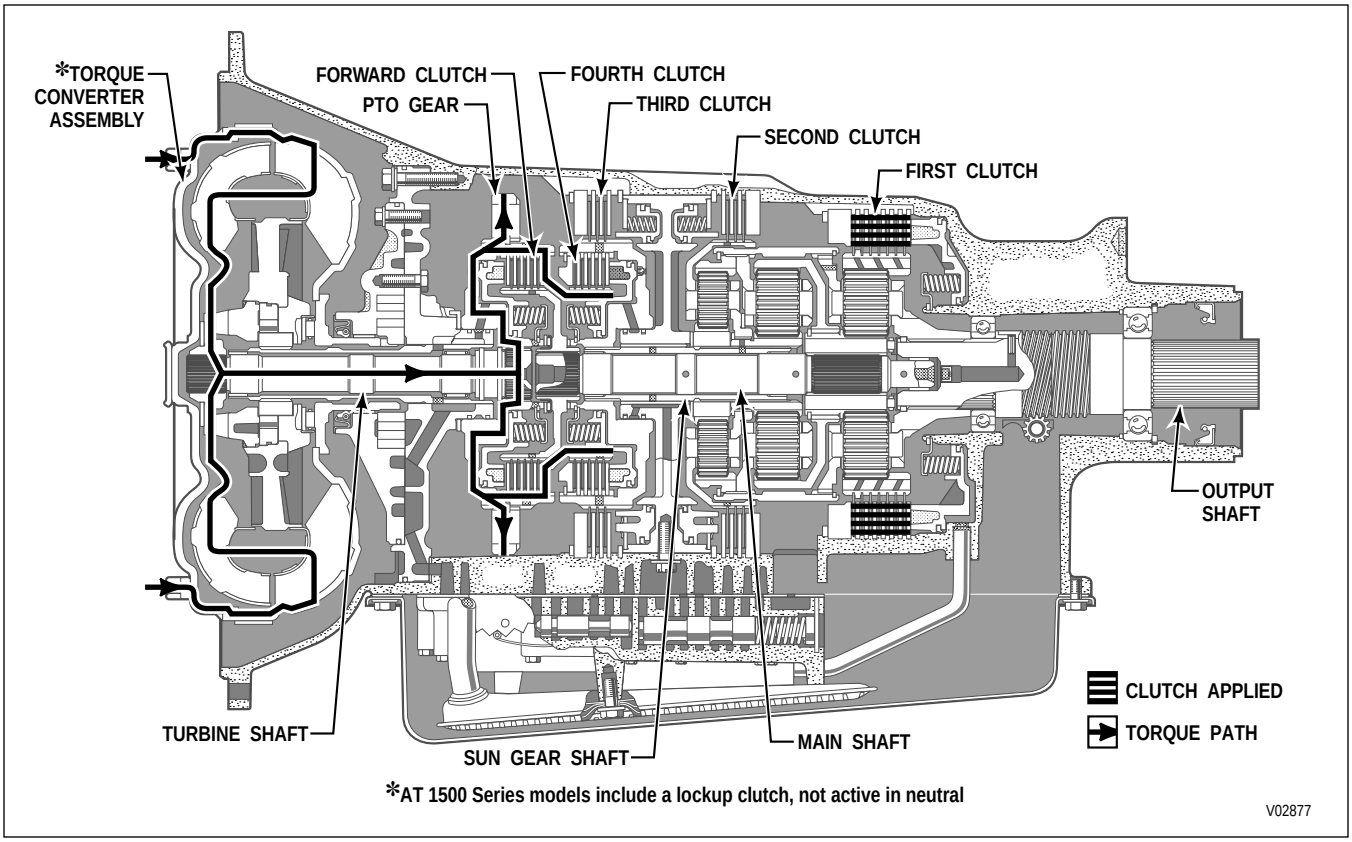



**Figure 2–1. Neutral Power Flow**

(3) Downward movement of the first or second clutch trimmer displaces transmission fluid into the trimmer regulator circuit. The trim boost accumulator valve absorbs the displaced transmission fluid, allowing for smooth clutch application.

## *2–19. TORQUE PATHS THROUGH TRANSMISSION*

**a. Converter Operation.** Power is transmitted hydraulically through the torque converter. The engine drives the converter pump. The pump throws transmission fluid against the vanes of the turbine, imparting torque to the converter turbine shaft. From the turbine, the fluid flows between the vanes of the stator, and re-enters the converter pump where the cycle begins again. The torque path through the torque converter is identical in all drive situations and in neutral. When the engine is idling, impact of the fluid upon the turbine vanes is negligible. When the engine is accelerated, the impact is increased and the torque produced in the converter turbine shaft can exceed the engine torque (by an amount equal to the torque ratio of the converter).

**b. Neutral Operation** *(Figure 2–1)*

(1) Torque produced in the torque converter is not transmitted beyond the turbine shaft and forward clutch housing assembly. Only first clutch is applied. Because two clutches must be applied to produce output shaft rotation, no output rotation occurs.

(2) For AT 1500 Series models, the lockup clutch does not apply during neutral operation.

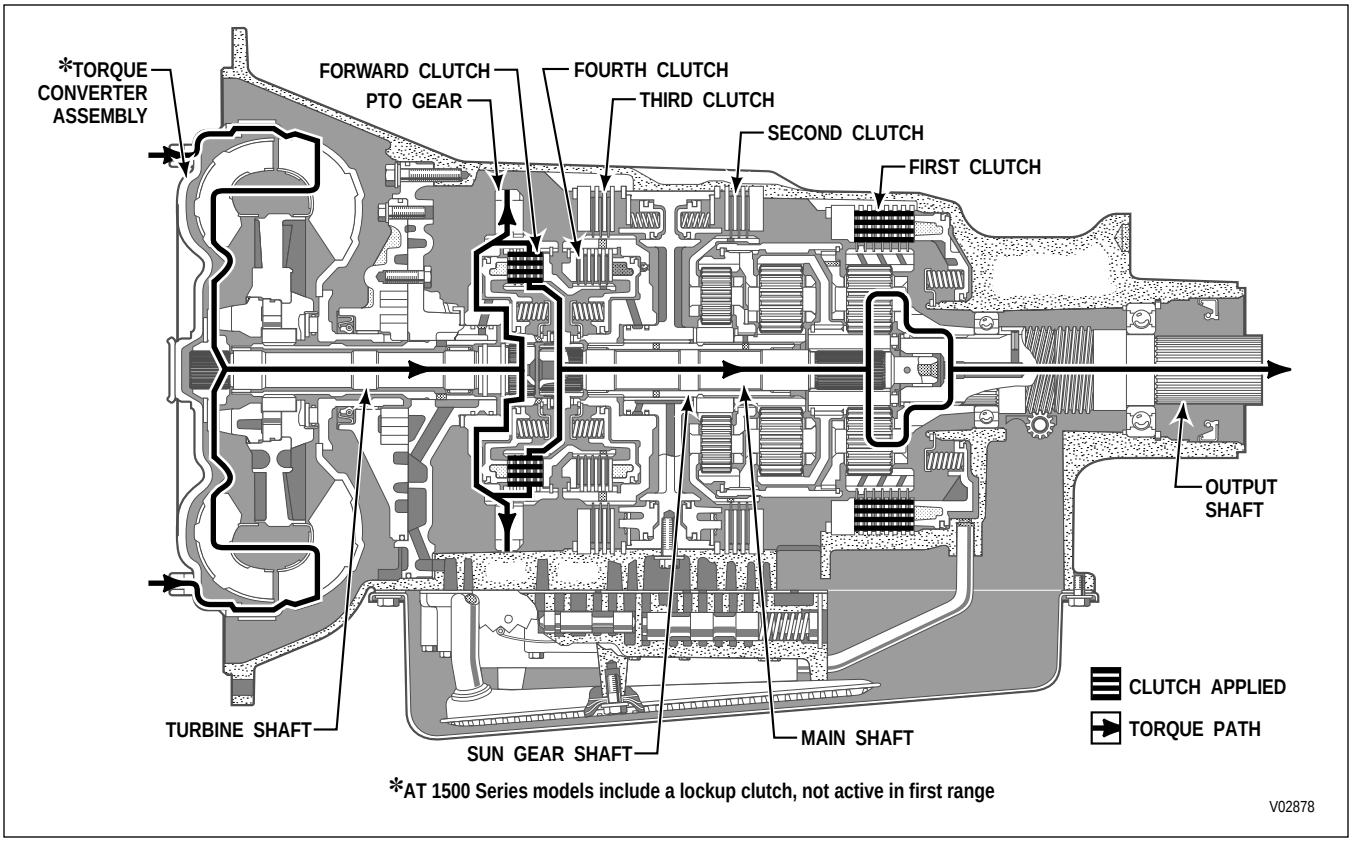



**Figure 2–2. First Range Power Flow**

**c. First-Range Operation** *(Figure 2–2)*

(1) The forward and first clutches are applied. The first clutch application anchors the rear planetary ring gear against rotation. The forward clutch application locks the turbine shaft and transmission main shaft together to rotate as a unit. The rear sun gear is splined to the main shaft and rotates with it and, in turn, rotates the rear planetary pinions. The pinions are part of the carrier assembly which is splined to the transmission output shaft. With the rear ring gear held stationary by the applied first clutch and the rear sun gear rotating the pinions, the rear planetary carrier rotates within the ring gear and drives the output shaft at a speed reduction of 3.45:1.

(2) For AT 1500 Series models, the lockup clutch does not apply during first range operation.

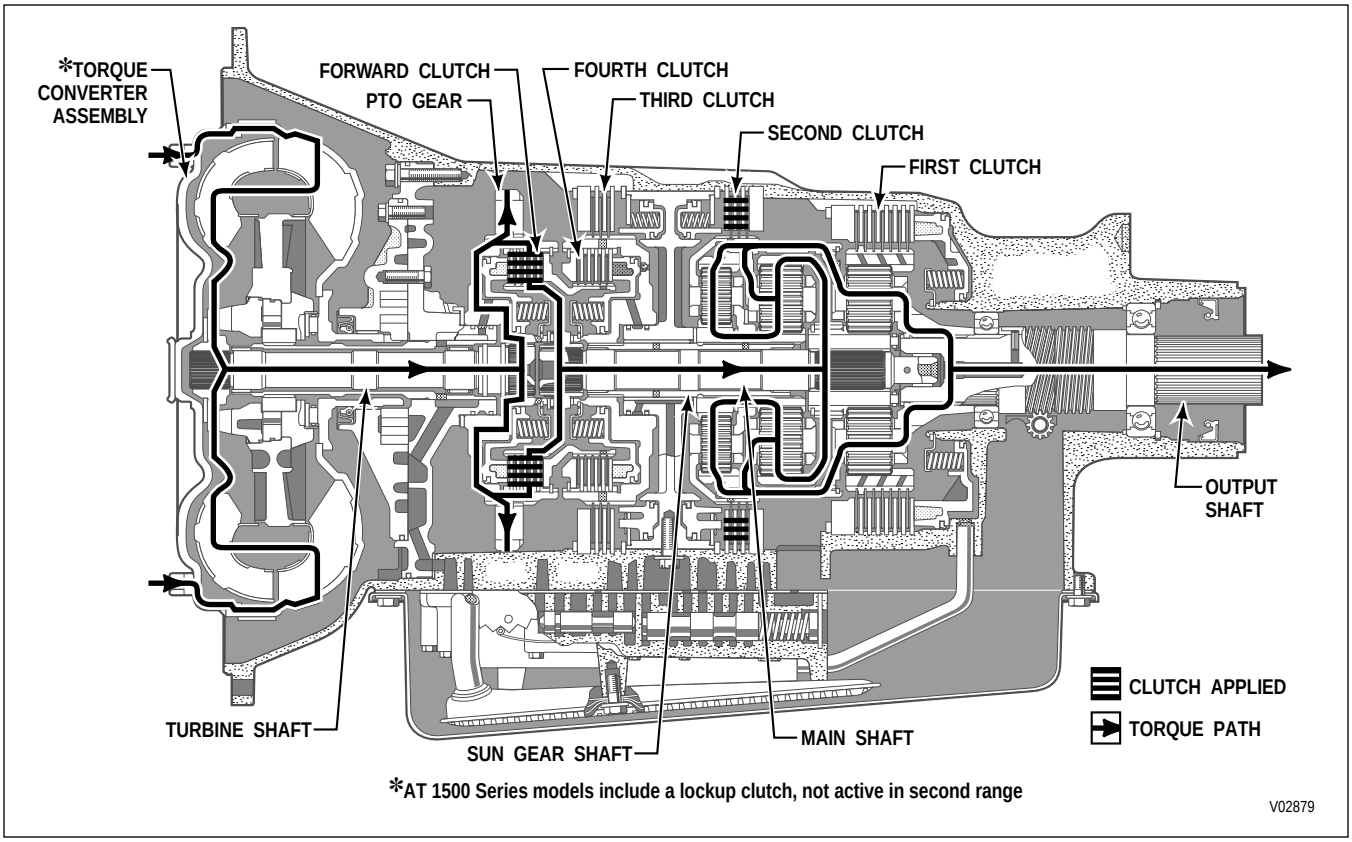



**Figure 2–3. Second Range Power Flow**

**d. Second-Range Operation** *(Figure 2–3)*

(1) The forward and the second clutches are applied. The second clutch application anchors the carrier of the front planetary carrier assembly against rotation. The forward clutch application locks the turbine shaft and main shaft together to rotate as a unit. The rear sun gear is splined to both the rotating main shaft and the center ring gear and all three parts rotate at turbine speed. With the carrier of the front planetary carrier assembly anchored against rotation, the rotating center ring gear rotates the center sun gear via the planetary pinions. This sun gear is splined to the sun gear shaft assembly to which the front sun gear is also splined. The rotating front sun gear rotates the front carrier pinions whose carrier is anchored against rotation by the applied second clutch. In turn, the rotating front carrier pinions rotate the front ring gear, which, along with the center carrier, is splined, via the planetary connecting drum and rear carrier assembly, to the output shaft. Due to this compounding action of the front and center planetary gear sets, there is an output speed reduction of 2.25:1.

(2) For AT 1500 Series models, the lockup clutch does not apply during second range operation.

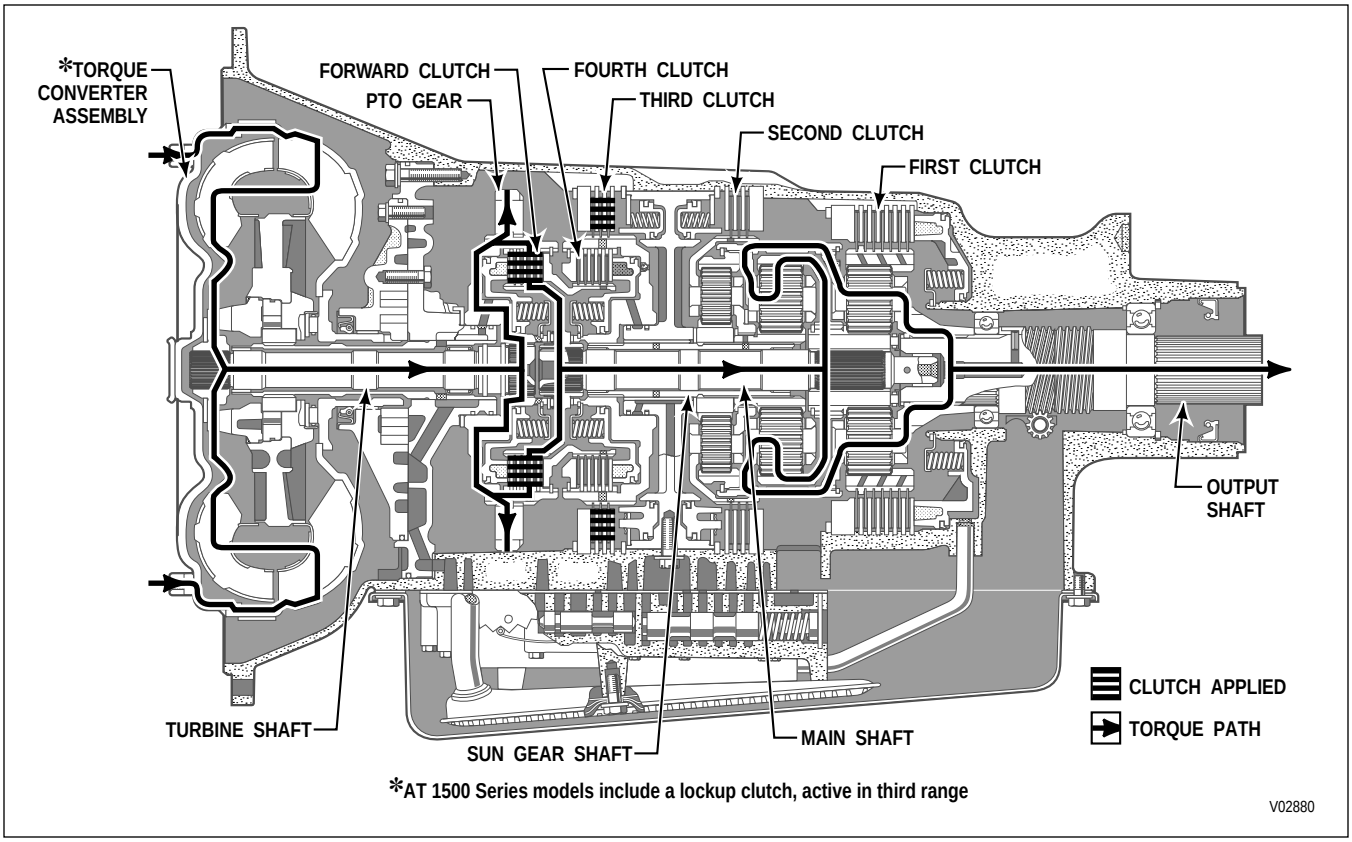



**Figure 2–4. Third Range Power Flow**

**e. Third-Range Operation** *(Figure 2–4)*. The forward and the third clutches are applied. The third clutch application anchors the sun gear shaft against rotation, which, in turn, prevents the center sun gear (splined to rear of shaft) from rotating. The forward clutch application locks the turbine shaft and main shaft together, to rotate as a unit. The rear sun gear is splined to both the main shaft and the center ring gear and rotates at turbine speed. With the center sun gear stationary and the center ring gear rotating, the ring gear drives the center planetary carrier pinions. This carrier (and also the rear planetary carrier) is splined to the planetary connecting drum and rotates with it as a unit. The rear carrier is splined to the transmission output shaft which produces an output ratio of 1.41:1.

**f. Converter Operation** *(AT 1500 Series Models)*. During converter operation, 3–4 clutch feed pressure is exhausted, allowing the lockup valve to remain in the downward (unapplied) position. Main overage flow is routed through the lockup valve to the space between the turbine and stator shafts. From there, fluid passes through slots in the turbine hub to an area between the torque converter cover and piston. Converter-in pressure moves the piston away from the reaction surface and provides the fluid necessary for proper filling of the torque converter elements. Fluid exhausts through slots in the stator and is sent to the cooler circuit.

**g. Lockup Operation** *(AT 1500 Series Models)*. After the 2–3 upshift has occurred, main pressure begins to shift the lockup valve upward. As the lockup shift is made, three simultaneous changes occur: converter-in pressure is exhausted, eliminating the separating force between the converter cover and piston; main overage is routed directly to the cooler circuit; and 3–4 clutch feed pressure is directed to the torque converter creating a pressure differential across the lockup piston. As a result, 3–4 clutch feed pressure applies the lockup clutch, providing increased operating efficiency.

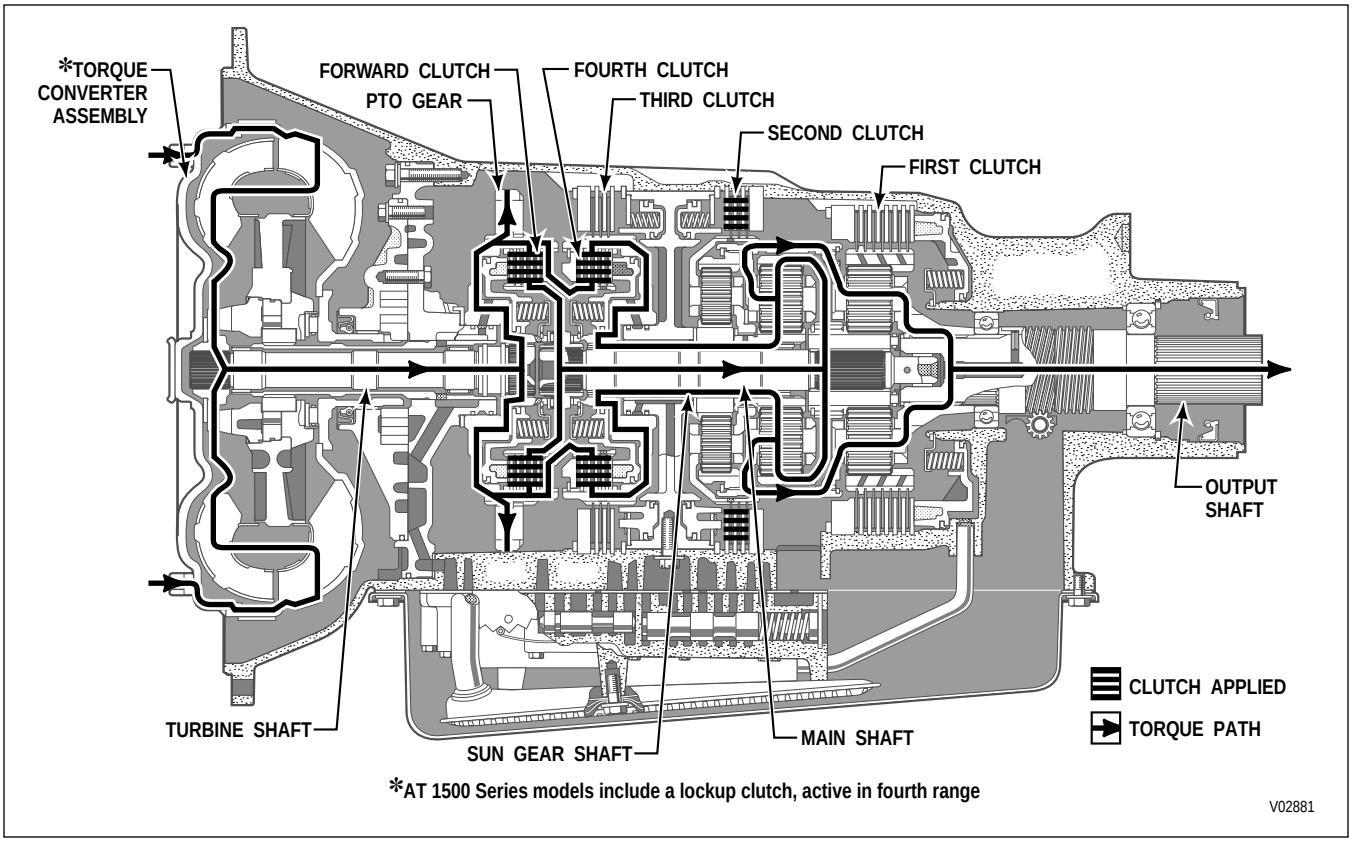



**Figure 2–5. Fourth Range Power Flow**

**h. Fourth-Range Operation** *(Figure 2–5)*. The forward and fourth clutches are applied. With the clutches applied, the transmission main shaft and the sun gear shaft are locked together and rotate as a unit at turbine speed. With the center and rear sun gears rotating at the same speed and their carriers splined to the planetary connecting drum, all components rotate at turbine output speed. The transmission output shaft is splined to the rear carrier and gives an output ratio of 1.00:1.

**i. Fourth-Range Lockup Operation** *(AT 1500 Series Models)*. Except for a momentary shift to converter operation during the upshift, the transmission shifts directly from third range lockup to fourth range lockup.

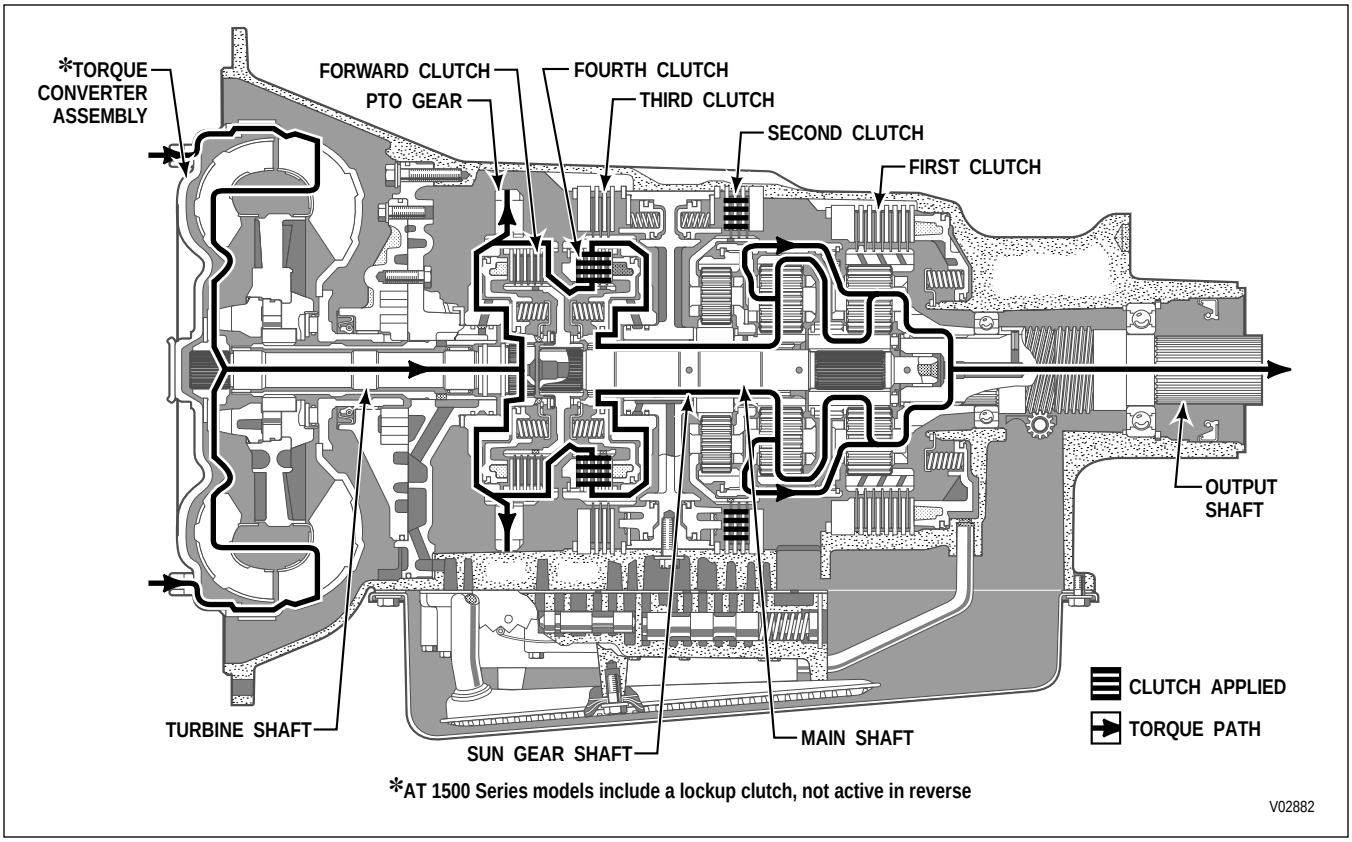



**Figure 2–6. Reverse Power Flow**

**j. Reverse Operation** *(Figure 2–6)*. Reverse is the only range in which the forward clutch is not engaged. In this range, the fourth clutch is applied and this rotates the sun gear shaft assembly (with the front and center sun gears splined to it) at turbine speed. The first clutch is applied also, and anchors the rear ring gear against rotation. The center sun gear rotates the center carrier pinions, which, in turn, rotate the center ring gear in an opposite direction. The center carrier is splined to the planetary connecting drum, which is splined to the rear carrier. The reverse direction of rotation of the center ring gear rotates the rear sun gear. This causes the rear planetary pinions to drive the rear carrier, in a reverse direction, within the stationary ring gear. This compounding action of the center and rear planetaries produces a reverse rotation output ratio of 5.02:1.

# Section 3 – PREVENTIVE MAINTENANCE

## *3–1. SCOPE*

(1) This section outlines the routine and periodical procedures required to maintain the transmission in good operating condition.

(2) For transmission removal and installation guidelines, engine adaptation hardware specifications, and road test checks, refer to the AT Mechanic's Tips, SA1321.

## *3–2. PERIODIC INSPECTION AND CARE*

**a.** Clean and inspect the exterior of the transmission at regular intervals. The severity of service and operating conditions will determine the frequency of such inspections. Inspect the transmission for:

- loose bolts (transmission and mounting components)
- transmission fluid leaks*
- shift linkage freely positioned by transmission detent
- full (and ease of) movement of mechanical modulator linkage
- vacuum or air line and modulator for leaks
- damaged or loose hydraulic lines
- worn or frayed electrical connections
- driveline U-joints and slip fittings
- speedometer cable and fittings
- PTO linkage and driveline

**b.** Check the transmission hydraulic level at the intervals specified in the vehicle operator manual.

## *3–3. IMPORTANCE OF PROPER TRANSMISSION FLUID LEVEL*

**a. Effects of Improper Fluid Level.** Because the transmission fluid cools, lubricates, and transmits hydraulic power, it is important that the proper fluid level be maintained at all times. If the fluid level is too low, the converter and clutches will not receive an adequate supply of fluid. If the level is too high, the fluid will aerate, the transmission will overheat, and fluid may be expelled through the breather or dipstick tube.

**b. Foaming and Aerating**

(1) Transmission performance will be affected when the fluid foams or aerates. The primary cause of aeration is low fluid in the sump, too much fluid in the sump, or a defective or missing sealring on the intake tube.

(2) A low fluid level (denoted on the dipstick) will not completely envelop the fluid filter. Therefore fluid and air are drawn in by the input pump and directed to the clutches and converter, causing converter cavitational noises and irregular shifting. The aeration also changes the viscosity and color of the fluid to a thin milky liquid.

(3) At normal fluid level, the fluid is slightly below the planetary gear units. If the transmission is overfilled, the planetary units will run in the fluid, causing it to become aerated. Overheating and irregular shift patterns can occur when the fluid is aerated.

(4) A defective sealring 20, 37, or 45 (Foldout 12,B) on the filter intake tube will cause the input pump to draw air and fluid from the sump, causing the fluid to become aerated.

## *3–4. DIPSTICK MARKINGS*

Three dipstick variations are available for use with the AT 500 and 1500 Series transmissions. The dipstick will have markings similar to those seen in Figure 3–1, 3–2, or 3–3. Variations in fill tube placement and dipstick orientation may change these dimensions slightly.

* Transmission fluid leaks require immediate attention.

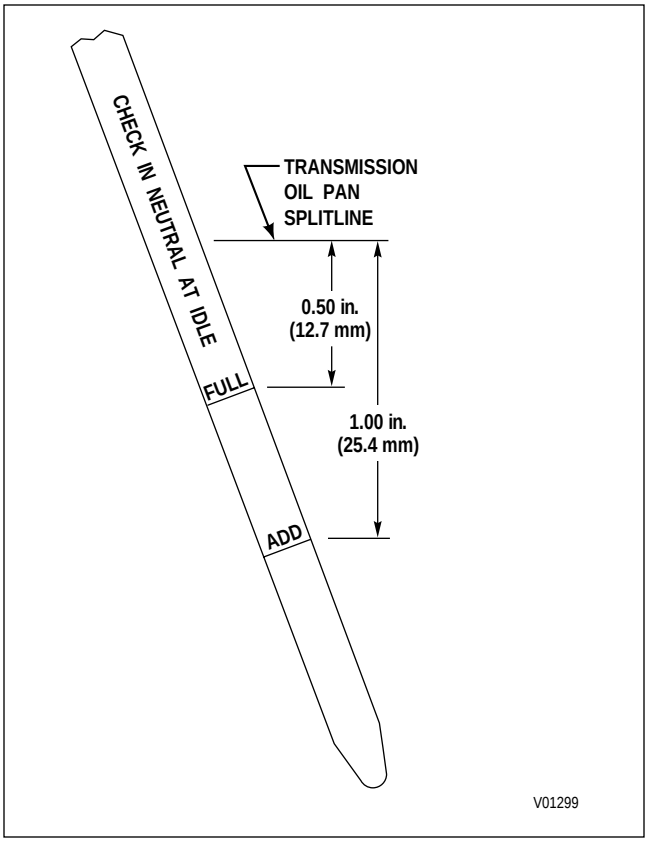



**Figure 3–1. Dipstick With FULL and ADD Markings**

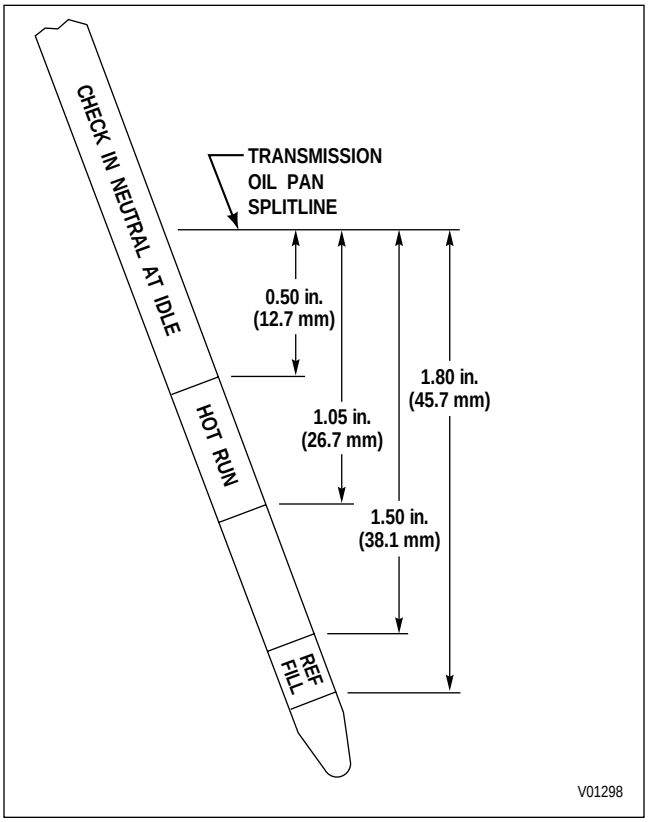



**Figure 3–2. Dipstick With HOT RUN Markings**

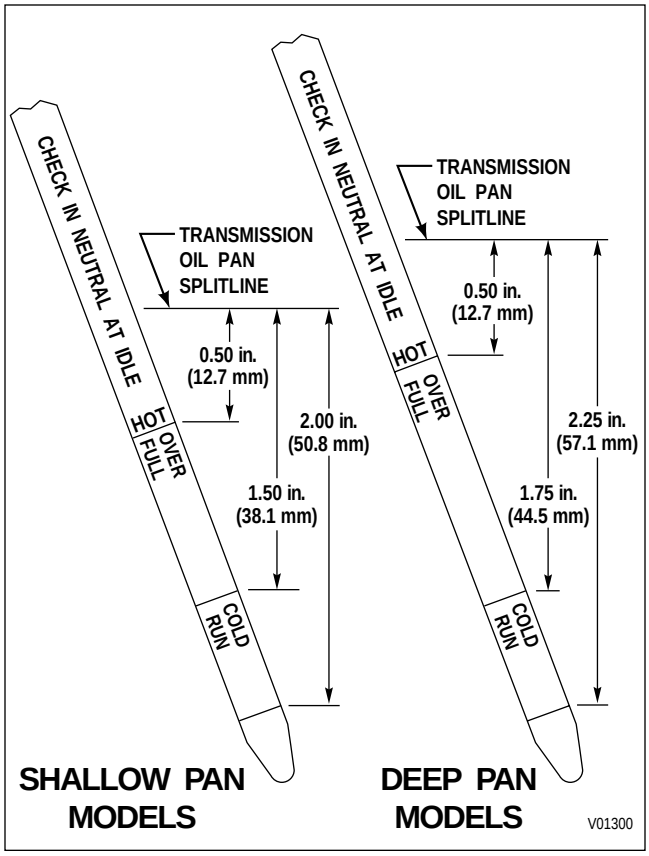



**Figure 3–3. Dipstick With HOT OVERFULL Markings**

## *3–5. TRANSMISSION FLUID LEVEL CHECK PROCEDURE*

**WARNING!**

**When checking the transmission fluid level, be sure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are blocked. Unexpected and possible sudden movement may occur if these precautions are not taken.**

### a. Preparation

(1) Always check the transmission fluid level at least twice. Consistency is important in maintaining accuracy. If inconsistent readings persist, check the transmission breather and the vent hole in the dipstick fill tube to ensure they are clean and free of debris. The vent hole is located on the underside of the fill tube just below the seal of the dipstick cap.

(2) Clean around the end of the fill tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the transmission because it can cause valves to stick, cause undue wear of trans-

mission parts, or clog passages. Check the fluid level by the following procedures and record any abnormal level on your maintenance records.

**b. Cold Check**

---

**NOTE:**

- **A Cold Check is performed with dipsticks similar to those illustrated in Figure 3–2 and 3–3.**
- **The fluid level rises as sump temperature increases. DO NOT FILL above the REF FILL (COLD RUN) band if the transmission fluid is below normal operating temperature.**

---

(1) Park the vehicle on a level surface, apply the parking brake, and block the wheels.

(2) Run the engine at 1000–1500 rpm for one minute to purge air from the system. Allow the engine to idle. Shift to **D** (Drive) and then to **R** (Reverse) to fill the hydraulic circuits with fluid. Then, shift to **N** (Neutral) or **P** (Park). The sump temperature should be 60–120°F (16–50°C).

(3) After wiping the dipstick clean, check the fluid level. If the fluid level is within the REF FILL (COLD RUN) band (Figures 3–2, 3–3), the level is satisfactory for operating the transmission until the fluid is hot enough to perform a Hot Check. If the fluid level is not within these parameters, raise or lower the fluid level to bring it within the band.

(4) Perform a Hot Check at the first opportunity after normal operating temperature is reached (160–200°F (71–93°C) sump temperature; 180–220°F (82–104°C) converter-out temperature).

**c. Hot Check**

---

**NOTE:**

**A Hot Check is performed with all dipstick designs (Figures 3–1 through 3–3).**

---

(1) Operate the transmission until normal operating temperature is reached (160–200°F (71–93°C) sump temperature; 180–220°F (82–104°C) converter-out temperature). Shift to **D** (Drive) and then to **R** (Reverse) to fill the hydraulic circuits with fluid.

(2) Park the vehicle on a level surface and shift to **N** (Neutral) or **P** (Park). Apply the parking brake, block the wheels, and allow the engine to idle.

(3) After wiping the dipstick clean, check the fluid level. The safe operating level is anywhere between the FULL and ADD lines (Figure 3–1), within the HOT RUN band (Figure 3–2), or below the HOT OVERFULL mark and above the COLD RUN band (Figure 3–3).

(4) If the fluid level is outside of these parameters, raise or lower the fluid level to bring it within the correct markings on the dipstick.

## *3–6. KEEPING TRANSMISSION FLUID CLEAN*

Transmission fluid must be handled in clean containers to prevent foreign material from entering the transmission. Lay the dipstick in a clean place while filling the transmission.

**CAUTION:**

**Containers or fillers that have been used to handle antifreeze or engine coolant solution must never be used for transmission fluid. Antifreeze and coolant solutions contain ethylene glycol which, if introduced into the transmission, can cause the clutch plates to fail.**

## *3–7. TRANSMISSION FLUID RECOMMENDATIONS*

**a. Recommended Automatic Transmission Fluid and Viscosity Grade**

(1) Hydraulic fluids (oils) used in the transmission are important influences on transmission performance, reliability, and durability. Use DEXRON®-III fluids for standard duty, highway applications. Use C-4 fluids for severe duty and off-highway applications.

(2) Some DEXRON®-III fluids are also qualified as C-4 fluids. To ensure the fluid is qualified for use in Allison Transmissions, check for a DEXRON®-III or C-4 fluid license, or approval numbers on the container, or consult the lubricant manufacturer. Consult your Allison Transmission dealer or distributor before using other fluid types; fluid types such as Type F, and universal farm fluids may or may not be properly qualified for use in your Allison transmission.

**CAUTION:**

**Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.**

(3) When choosing the optimum viscosity grade of fluid to use, duty cycle, preheat capabilities, and/or geographical location must be taken into consideration. Table 3–1 lists the minimum fluid temperatures at which the transmission may be safely operated. Preheat with auxiliary heating equipment or by running the vehicle with the transmission in neutral for a minimum of 20 minutes before attempting range operation.

**Table 3–1. Operating Temperature Requirements for Transmission Fluid**
(Ambient Temperature Below Which Preheat Is Required)

| Viscosity Grade | Fahrenheit | Celsius |
|---|---|---|
| SAE 0W-20 | –31 | –35 |
| DEXRON®-III | –17 | –27 |
| SAE 10W | –4 | –20 |
| SAE 15W-40 | 5 | –15 |
| SAE 30 | 32 | 0 |
| SAE 40 | 50 | 10 |
| | | (Ref. 13-TR-90.) |

## *3–8. TRANSMISSION FLUID AND FILTER CHANGE INTERVALS*

Transmission fluid and filter change frequency is determined by the severity of transmission service and by the filter equipment installed. Table 3–2 is a general guide. More frequent changes may be required when the fluid is visually contaminated, when operations are subject to high levels of contamination or overheating, or if it is determined by fluid analysis that the fluid is oxidized beyond the limits listed in Table 3–3.

## *3–9. TRANSMISSION FLUID CONTAMINATION*

**a. Examine at Fluid Change.** At each fluid change, examine the fluid which is drained for evidence of dirt or engine coolant (water). A normal amount of condensation will emulsify in the fluid during operation of the transmission. However, if there is evidence of coolant, check the cooler (heat exchanger) for leakage between the coolant and fluid areas. Fluid in the coolant side of the cooler (heat exchanger) is another sign of leakage. This, however, may indicate leakage from the engine oil system.

**b. Metal Particles.** Metal particles in the fluid (except for the minute particles normally trapped in the filter) indicate damage has occurred in the transmission. When these particles are found in the sump, the transmission must be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, cooler, and all other areas where the particles could lodge. (See application of auxiliary filter, Paragraph 3–9**d**.)

**CAUTION:**

**If excessive metal contamination has occurred, replacement of the cooler and replacement of all bearings within the transmission is recommended.**

**c. Coolant Leakage.** If engine coolant leaks into the transmission hydraulic system, immediate action must be taken to prevent malfunction and possible serious damage. The transmission must be completely disassembled, inspected, and cleaned. All traces of the coolant, and varnish deposits resulting from coolant contamination must be removed. Clutch plates contaminated with ethylene glycol must be replaced.

**d. Auxiliary Filter** *(Figure 3–4)*

(1) If a condition occurs that introduces debris into the hydraulic system, completely clean-up the cooler and lines.

**CAUTION:**

**For retarder models, do not add an additional auxiliary filter after a debris-causing condition.**

(2) However, repeated cleaning and flushing may not remove all debris. For models with retarder, replace the main cooler; for models without retarder, installation of an auxiliary filter in the cooler-out line (between cooler and transmission) is required if such a filter does not already exist. This requirement applies whether the transmission is overhauled or replaced by a new or rebuilt unit.

**Table 3–2. Transmission Fluid and Filter Change Intervals**

| Transmission Application | Fluid Change | Internal Sump and Governor Filters | External Auxiliary Filter** |
|---|---|---|---|
| AT 500 Series (On-Highway) (Light-duty)<br><br>(School Bus, NA Motorhome and One-Way Rental) | Paper Filter:<br>25,000 miles (40 000 km) or 12 months*<br><br>Brass Filter:<br>50,000 miles (80 000 km) or 24 months* | Paper Filter in Shallow Pan (4.0 inches) or Deep Pan (5.3 inches):<br>25,000 miles (40 000 km) or 12 months*<br><br>Brass Screen Filter in Shallow Pan (4.0 inches) or Deep Pan (5.3 inches):<br>50,000 miles (80 000 km) with no time limit | After first 5000 miles (8 000 km) and at 25,000 miles (40 000 km) or 12 months*, thereafter |
| AT 500 Series (On-Highway) (Heavy-duty) (Models With Retarder) | 25,000 miles (40 000 km) or 12 months* | Paper Filter in Shallow Pan (4.0 inches) or Deep Pan (5.3 inches):<br>25,000 miles (40 000 km) or 12 months*<br><br>Brass Screen Filter in Shallow Pan (4.0 inches) or Deep Pan (5.3 inches):<br>50,000 miles (80 000 km) with no time limit | After first 5000 miles (8 000 km) and at normal fluid change intervals thereafter |
| AT 500 Series (Off-Highway) | 1000 hours max or 12 months* | Paper Filter in Shallow Pan (4.0 inches) or Deep Pan (5.3 inches):<br>at each fluid change interval<br><br>Brass Screen Filter in Shallow Pan (4.0 inches) or Deep Pan (5.3 inches):<br>at each fluid change interval | After first 500 hours, and at normal fluid change intervals, thereafter |

* Whichever occurs first.

** An Allison high-efficiency oil filter may be used until the Change Filter light indicates it is contaminated or until it has been in use for three years, whichever occurs first. No mileage restrictions apply.

**Table 3–3. Fluid Oxidation Measurement Limits**

| Measurement | Limit |
|---|---|
| Viscosity | ±25% change from new fluid |
| Carbonyl absorbance | + 0.3 A*/0.1 mm change from new fluid |
| Total acid number | + 3.0 change from new fluid |
| Solids | 2% by volume maximum |

*A = Absorbance units

Refer to SIL 17-TR-83 for fluid analysis techniques and data interpretation.

Consult your local industrial yellow pages for fluid analysis firms. Use one fluid analysis firm. Results between firms cannot be accurately compared.

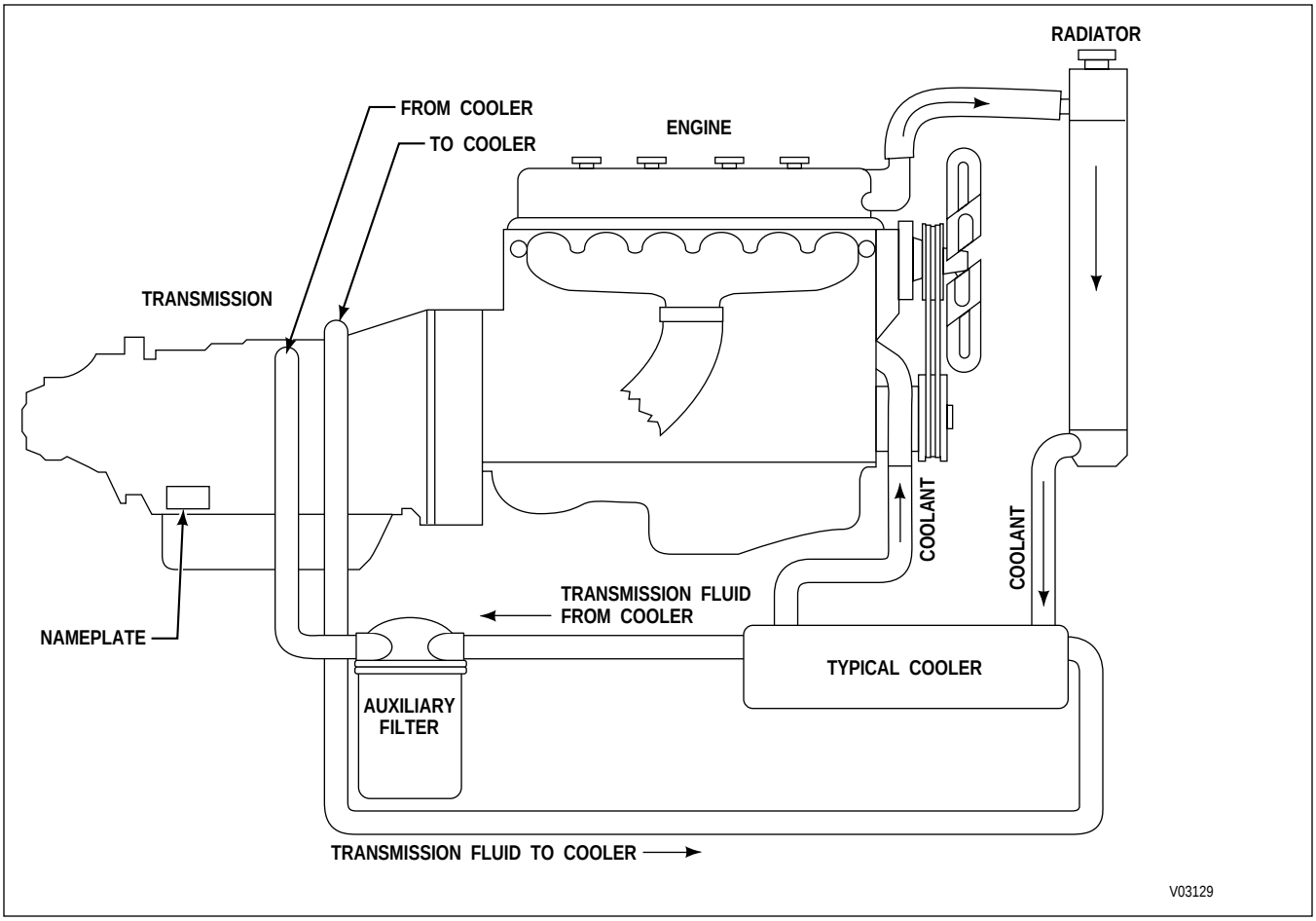



**Figure 3–4. Installation of Auxiliary Filter (Models Without Retarder)**

(3) If any doubt exists about the clean-up of the cooler, replace the cooler.

(4) The auxiliary filter must have a 40 micron filter element and a maximum filter pressure drop of 3 psi (21 kPa) at 4.5 gal/min (17 l/min) at 180–200°F (82–93°C). The maximum external circuit pressure drop must not exceed 35 psi (241 kPa) at 4.5 gal/min (17 l/min) at 180–200°F (82–93°C).

(5) Use one of the following recommended auxiliary filters:

| Filter Assembly | Filter Element |
|---|---|
| Allison 29501482* | Allison 29510922* |
| AC PM 13-16 | PF 897 |
| AC PM 16-1 | PF 141 |
| Fram HP 1-1 | HP 1 |
| Purolator OF-15C-1 | OF-2C-1 |
| Purolator PER-20-10 | PER-20 |

* high efficiency

(6) Install the filter into the line from the cooler to the transmission. Use a hose long enough to allow power pack movement. Proper hose size will permit a minimum flow rate of 4.5 gal/min (17 l/min). The hose must have a burst pressure of not less than 200 psi (1379 kPa), and a minimum inside diameter at fittings of 0.391 inch (9.93 mm). The hose must meet SAE 100 R5 specification, with an operating range of –40 to +300°F (–40 to 149°C).

(7) The total cooler circuit (to and from the cooler) pressure drop must not exceed 35 psi (241 kPa) in neutral, at 2400 rpm and at normal operating temperature. Filter bypass opening pressure on units not equipped with a pressure indicator (ΔP switch) must be 5–9 psi (34–62 kPa). Filter bypass opening pressure on units equipped with a 5.5–8.5 psi (38–59 kPa) pressure indicator (ΔP switch) must be 10.5–13.5 psi (72–93 kPa).

(8) External auxiliary filter element change intervals can be determined according to Paragraph 3–8.

## *3–10. TRANSMISSION FLUID AND FILTER CHANGE PROCEDURES*

**a. Disassembly** *(Foldout 12,B)*

(1) The transmission should be at operating temperature to assist draining. Shift the transmission to **N** (Neutral) or **P** (Park) and turn off the engine.

(2) Drain the transmission fluid by removing the drain plug and washer and disconnecting the fill tube from the oil pan.

(3) Remove twenty-one washer-head screws 28 or 31 that retain oil pan 26 or 33 to the transmission housing. Discard pan gasket 22, 39, or 47. Clean pan 26 or 33 with mineral spirits.

(4) Remove the screw or bolt and washer that retains internal filter assembly 21, 38, or 46. Remove the filter and intake tube 18, 40, or 48. Remove sealring 20, 37, or 45 and discard.

(5) Clean or replace governor circuit screen 12. The screen is located in the governor feed tube bore. Replacement of the screen can only be accomplished by removing governor feed tube 13. This tube and the two remaining tubes are held in place by the main control valve body. Refer to Paragraph 5–3**h** for main control valve body removal procedures and Paragraph 7–10**a** for main control valve body installation.

**b. Assembly** *(Foldout 12,B)*

(1) Install a new sealring onto the top end of the intake tube. Lubricate the sealring with transmission fluid.

(2) Insert the intake tube and sealring into the hole in the bottom of the transmission. Install new filter assembly 21, 38, or 46 (including grommet) onto the intake tube.

(3) If deep pan 33 is used, retain the filter (earlier models) with one 5⁄16-18 x 2¼ inch bolt and one 5⁄16 inch washer. For later models with high-capacity filter, install the 5⁄16-18 x 5⁄8 inch washer-head screw. If shallow pan 26 is used, retain the filter with one 5⁄16-18 x 5⁄8 inch washer-head screw. Tighten either the screw or the bolt to 10–15 lb ft (14–20 N·m).

**CAUTION:**

**Do not use gasket-type sealing compounds, fibrous greases, or nonsoluble, vegetable-base cooking compounds any place inside the transmission or where they could be flushed into the transmission hydraulic system.**

(4) Place the pan gasket onto the oil pan. **Do not use** any substance as a gasket retainer.

(5) Install the oil pan. Guide the pan and gasket carefully into place. Guard against dirt or foreign material entering the pan. Retain the pan to the housing with **four** 5⁄16-18 washer-head screws, installed **by hand** into the corners of the pan.

(6) Install the remaining seventeen washer-head screws **by hand**, carefully threading each through the gasket and into the transmission. Bottom all of the screws before tightening any of them.

(7) Evenly tighten all twenty-one screws to 10–15 lb ft (14–20 N·m). Check gasket fit while the screws are being tightened.

(8) Install the filler tube at the side of the pan.

(9) Check Dimension **A** (Figure 3–5) to determine what oil pan boss is present. If Dimension **A** is 0.570–0.580 inch (14.48–14.73 mm), then tighten the tube fitting to 65–75 lb ft (88–102 N·m); if Dimension **A** is 0.670–0.680 inch (17.02–17.27 mm), then tighten the tube fitting to 90–100 lb ft (122–136 N·m).

(10) Install the drain plug and washer. Tighten the plug to 15–20 lb ft (20–27 N·m).

(11) Replace the external auxiliary filter element (cooler-out line), if present. Refer to Paragraph 3–9**d**.

(12) Refill the transmission with fluid.

| Fluid Fill | Rebuild | Servicing |
|---|---|---|
| Shallow oil pan — 4.0 inch (102 mm) | 15 U.S. qts. (14 liters) | 9 U.S. qts. (8.5 liters) |
| Deep oil pan — 5.3 inch (135 mm) | 22 U.S. qts. (21 liters) | 16 U.S. qts. (15 liters) |

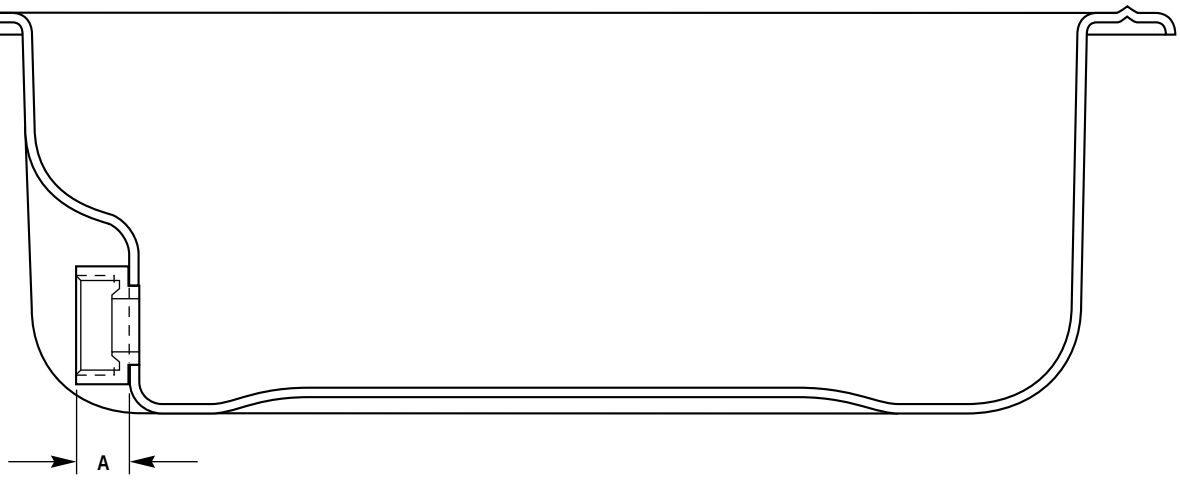
(13) Check the fluid level as outlined in Paragraph 3–5.

(14) Refer to Table 3–2 and determine when the next fluid and filter changes will be required. If labels are available (Figure 3–6), fill in the appropriate dates and affix the labels in a conspicuous location in the vehicle.

## *3–11. BREATHER*

(1) The breather is located at the top of the transmission housing. It serves to prevent pressure buildup within the transmission and must be kept clean and the passage open. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Use care when cleaning the transmission. Spraying steam, water, or cleaning solution directly at the breather can force the water or solution into the transmission.

(2) Earlier model breathers should be equipped with a neoprene shroud (Figure 3–7). If the breather is not so equipped or if the present shroud is damaged, install a new shroud.




| Dimension A | Torque Specifications |
|---|---|
| 0.570–0.580 in. (14.48–14.73 mm) | 65–75 lb ft (88–102 N·m) |
| 0.670–0.680 in. (17.02–17.27 mm) | 90–100 lb ft (122–136 N·m) |

***NOTE:*** *Except for Dimension A, the oil pan in Figure 3–5 does not represent all AT oil pan configurations.*

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**Figure 3–5. Measuring the Length of Oil Pan Boss to Identify Torque Requirements**

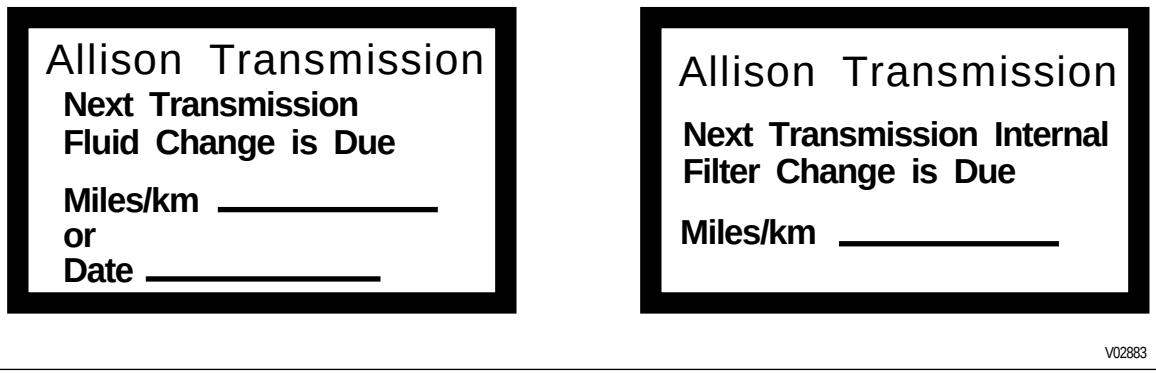


**Figure 3–6. Fluid and Filter Change Reminder Labels**

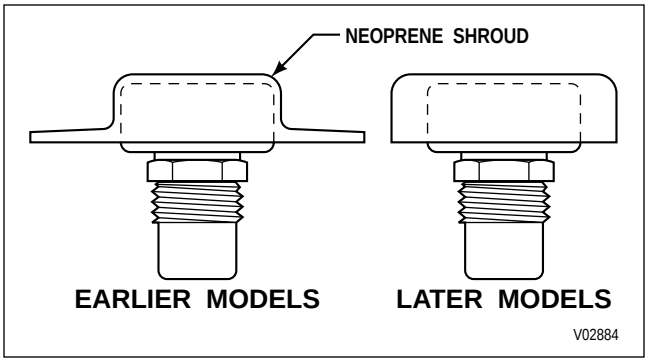


**Figure 3–7. Breather Configurations**

## *3–12. LINKAGE*

**a. Shift Selector Lever and Control Linkage**

**CAUTION:**

**Manual selector shafts that are center drilled at their outer ends require an M10 x 1.5-6G nut (metric thread). Shafts that are undrilled require a ⅜-16 nut (standard inch series). Use of the wrong nut will damage both the shaft and nut. Torque for either nut is 15–20 lb ft (20–27 N·m).**

(1) To install the shift selector lever and nut, refer to the latest edition of the AT Mechanic's Tips, SA1321.

(2) Proper adjustment of the shift selector control linkage is important as the shift selector detents must correspond exactly to those in the transmission. Periodic inspections should be made for bent or worn parts, loose threaded connections, loose bolts, and accumulation of grease and dirt. All moving joints must be kept clean and well lubricated. For connecting and adjusting the shift selector control linkage, refer to the latest edition of the AT Mechanic's Tips, SA1321.

**b. Mechanical Actuator Adjustment.** It is imperative the mechanical linkage be properly adjusted for efficient performance. For installing and adjusting the mechanical modulator control, refer to the latest edition of the AT Mechanic's Tips, SA1321.

**c. Other Linkage Adjustments.** For adjustments to other linkage, such as PTO, speedometer, etc., refer to the latest edition of the AT Mechanic's Tips, SA1321.

## *3–13. ADJUSTMENT OF SHIFT POINTS*

**NOTE:**

**Transmission shift points cannot be satisfactorily adjusted if the transmission has the wrong governor installed. Check the three-digit code on the head of the governor with the code shown in the Allison Parts Catalog (SA1235) for the governor listed for your transmission assembly part number. If the letter "M" follows the three-digit code, the governor is a service replacement assembly. If the "M" is not included, the governor was installed at original factory build.**

**a. Calibrated on Test Stand or in Vehicle**

(1) Proper timing of shift speed points is necessary for maximum transmission performance. Shifts may be adjusted on the test stand when the transmission is rebuilt or overhauled, or during road testing of the vehicle.

(2) The Kent Moore Valve and Governor Test Stand (J 25000-1) with adapter J 25000-225 or Aidco (Model 250) is designed to check five principal transmission functions. It performs a checking procedure on the governor, modulator, hold regulator, shift points (up-down-inhibit), and a trimmer regulator check. If a test stand is not available, satisfactory calibration of shift points may be made after road testing of the vehicle.

**b. Location of Adjusting Components**

(1) Shift points are changed by changing the positions of adjusting rings that determine the retaining force of valve springs in the main control valve body. Refer to items 4 or 82, and 51, 58, 64, and 70 on Foldout 11.

(2) Special tool J 24314 is used to depress and rotate the adjusting rings. Clockwise rotation increases spring force and raises the shift point; counterclockwise rotation reduces spring force and lowers the shift point.

**NOTE:**

**Each notch of adjustment alters the shift point approximately 40 output shaft rpm or 2 mph (mph will vary based on axle ratio and tire size).**

**c. Checks Before Adjusting Shift Points**

(1) When calibration is to be made during a road test or on a test stand, certain preparations must be made.

(2) Warm up the transmission or test stand setup to normal operating temperature of 160–220°F (71–104°C).

(3) Check the engine governor setting, and adjust if required, to conform to the transmission's engine speed requirements.

(4) Check the engine for satisfactory performance before checking shift points.

(5) For diesel applications, check the linkage that controls the mechanical modulator valve actuator for proper travel, routing, and operation. For most gasoline applications, check condition and routing of vacuum modulator lines, hoses, and connections.

(6) Check the selector linkage for proper range selection.

(7) Provide accurate instrumentation for observing speeds, temperatures, pressures, vacuum, etc.

**d. Calibration by Road Test Method**

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**NOTE:**

**Before road test, determine the vehicle tachometer error with a test tachometer. Make corrections for error, as required, in subsequent tests.**

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(1) Note the governed speed of the engine. This is the base speed from which checks and adjustments are made.

(2) Drive the vehicle and check the engine speed (at full throttle) at which each upshift occurs. Each upshift should occur as follows:

1–2 — within 400 rpm to engine governed speed.*

2–3 — within 300 rpm to engine governed speed.*

3–4 — within 200 rpm to engine governed speed.*

* Vehicle loaded

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**NOTE:**

**If all full throttle upshift points are too low by approximately the same amount, check adjustment of the modulator external linkage.**

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(3) If an upshift speed does not reach the specified rpm, the shift point may be raised by adjusting (increasing) the spring force on the 1–2, 2–3, or 3–4 shift signal valve. If the upshift speed exceeds the specified rpm, or if upshift does not occur at all, the spring force must be reduced. Adjust the force on only the springs for valves that do not upshift at the proper speed.

(4) Refer to Sections 5, 6, and 7 for procedures covering removal and replacement of affected components.

**e. Calibration by Speedometer Readings Method**

(1) When a tachometer is not available for checking shift points, the vehicle speedometer can be used.

(2) Check the top speed of the vehicle in each selector hold position (first, second, third ranges). Record the top speed for each.

(3) For checking the shift points, place the selector at **D** (Drive) so that all automatic shifts can occur. Drive the vehicle at full throttle from a standing start until the 3–4 upshift occurs, recording the mph at which each upshift occurs.

(4) Compare the upshift speeds with the hold speeds recorded in Paragraph 3–13**e**(2). The 2–3 upshift should occur at approximately two mph below the top speed of second range. The 3–4 upshift should occur at approximately two mph below the top speed for third range. The 1–2 upshift is not to be adjusted relative to hold speed. The 2–1 downshift at closed throttle should occur at 3–5 mph (4–8 km/h).

**f. Calibration by Test Stand Method**

(1) Tables 3–4 through 3–9 provide detailed information required for adjusting shift points.

(2) The adjustment procedures are as outlined in Paragraph 3–13**d**, except the base for checks and adjustments is output shaft speed instead of engine governed speed.

**Table 3–4. Hold Regulator Pressure**

| rpm Valve Body | Spring No. | Color Code | Pressure | |
|---|---|---|---|---|
| | | | psi | kPa |
| 2400 | 6836785 | White | 39–43 | 269–296 |
| 2600 | 6837952 | Green | 44–48 | 303–331 |
| 2600/3000 Hold | 6836977 | Orange | 44–48 | 303–331 |
| 2700/2800 Hold | 6837953 | Blue | 46–50 | 317–345 |
| 2800 | 6837953 | Blue | 46–50 | 317–345 |
| 2800/3200 Hold | 6837952 | Green | 44–48 | 303–331 |
| 3000 | 6836976 | White With Yellow Stripe | 42–46 | 290–317 |
| 3200 | 6837952 | Green | 44–48 | 303–331 |
| 3400 | 6837953 | Blue | 46–50 | 317–345 |
| 3600 | 6836784 | Yellow | 36–40 | 248–276 |
| 3800 | 6836785 | White | 39–43 | 269–296 |
| 4000 | 6836785 | White | 39–43 | 269–296 |

**Table 3–5. Modulator Pressure**

| Modulator Spring Part Number | Color Code and Modulator Valve Usage | Pressure | |
|---|---|---|---|
| | | psi | kPa |
| 23012948 | White with Orange Stripe<br>23013764 Modulator Valve | 50–53 | 345–365 |
| 6880980 | Solid Light Blue with Red Stripe<br>23013764 Modulator Valve | 42–45 | 290–310 |

**Table 3–6. Governor Pressure**

| Governor Assemblies | Code Number | 440 rpm | 800 rpm | 1500 rpm | 2200 rpm |
|---|---|---|---|---|---|
| 6881466 | 460 (Old Code 91) | 7–10<br>(48–69) | 21.5–24.5<br>(148–169) | 38.0–42.5<br>(265–293) | 55.5–63.0<br>(383–434) |
| 6885570 | 461 (Old Code 54) | 9–13<br>(62–90) | 38–42<br>(262–290) | 64.0–70.0<br>(441–483) | 103–112<br>(710–772) |
| 6885571 | 462 (Old Code 52) | 8.5–11.5<br>(59–79) | 27.5–30.5<br>(190–210) | 54.5–61.0<br>(376–421) | 82.6–91<br>(570–627) |

## Table 3–7. AT 500 Shift Points — Models With S/N 3210302450 and Before (Without Lockup)

| Engine Governed Speed — rpm | | | 2400 | 2400 | 2600 | 2800 | 3000 | 3200 | 3400 | 3600 | 3800/4000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AT 545 Parts Catalog Valve Body Group | | | J[1] | J[2] | G | F | E | D | B | A | C |
| Range | Throttle Position | Shift | Transmission Output Speed (rpm) at Start of Shift | | | | | | | | |
| Drive | Full | 1–2* | 580–640 | 580–640 | 595–655 | 595–655 | 710–770 | 770–830 | 770–830 | 900–960 | 900–960 |
| | | 2–3 | 865–1000 | 865–1000 | 955–1090 | 1045–1180 | 1130–1265 | 1220–1355 | 1310–1445 | 1400–1535 | 1490–1625 |
| | | 3–4** | 1455–1595 | 1455–1595 | 1595–1735 | 1735–1875 | 1880–2020 | 2020–2160 | 2165–2305 | 2305–2445 | 2450–2590 |
| | Closed | 4–3**+ | 305–555 | 370–660 | 350–610 | 490–685 | 410–680 | 530–750 | 675–970 | 150–600 | 300–700 |
| | | 3–2+ | 400–560 | 475–655 | 465–630 | 520–665 | 550–760 | 590–810 | 620–875 | 405–720 | 455–765 |
| | | 2–1* | 20–300 | 20–360 | 20–300 | 20–300 | 20–300 | 20–450 | 20–450 | 50–450 | 50–450 |
| DR3 | Full | 4–3** | 1820–2120 | 1820–2120 | 1980–2280 | 2100–2370 | 2240–2690 | 2290–2770 | 2400–2890 | 2600–3050 | 2760–3240 |
| DR2 | | 3–2 | 1060–1350 | 1060–1350 | 1200–1470 | 1270–1530 | 1330–1700 | 1380–1740 | 1470–1850 | 1570–1990 | 1700–2130 |
| DR1 | | 2–1* | 660–900 | 660–900 | 735–970 | 770–1010 | 910–1080 | 930–1100 | 960–1200 | 900–1340 | 1000–1450 |
| Modulator Pressure psi (kPa) | | | 50–53 (345–365) | 42–45 (290–310) | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) |
| Hold Regulator Pressure psi (kPa) | | | 39–43 (269–296) | 39–43 (270–296) | 44–48 (303–331) | 46–50 (317–345) | 42–46 (290–317) | 44–48 (303–331) | 46–50 (317–345) | 36–40 (248–276) | 39–43 (269–296) |

1 Prior to S/N 3210279820.

2 S/N 3210279820 thru 3210302450.

* For 2nd range start, check for manual shift function only.

** For no 4th range, this shift should not occur.

\+ 4–2 downshift is acceptable.

Full throttle position is 0 inch (0 mm) Hg vacuum.

Closed throttle position is 19–21 inch (483–533 mm) Hg vacuum.

Notice: To update units prior to S/N 3210302450 to later configuration, refer to SIL 14-TR-85.

## Table 3–8. AT 500 Shift Points — Models After S/N 3210302450 (Without Lockup)

| Engine Governed Speed — rpm | | | 2400 | | 2600 | | 2800 | | 3000 | | 3200 | | 3400 | 3600 | 3800 | 4000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AT 545 Parts Catalog Valve Body Group | | | J, R | U | G, M | P | F, H, K, L | | E, N, S | V | D | | B | A | C, Q | T |
| AT 542 Parts Catalog Valve Body Group | | | B, Q | | F, J | | E | N | C | K | D | M | G | H | A, P | L |
| Range | Throttle Position | Shift | Transmission Output Speed (rpm) at Start of Shift | | | | | | | | | | | | | |
| Drive | Full | 1–2* | 580-640 | 580-640 | 595-655 | 595-655 | 595-655 | 625-680 | 710-770 | 595-655 | 770-830 | 650-710 | 770-830 | 900-960 | 970-1030 | 980-1045 |
| | | 2–3 | 865-1000 | 970-1090 | 955-1090 | 955-1180 | 1045-1180 | 1000-1135 | 1130-1265 | 955-1090 | 1220-1355 | 1045-1180 | 1310-1445 | 1400-1535 | 1490-1625 | 1600-1700 |
| | | 3–4** | 1455-1595 | 1455-1595 | 1595-1735 | 1595-1735 | 1735-1875 | 1665-1810 | 1880-2020 | 1595-1735 | 2020-2160 | 1740-1880 | 2165-2305 | 2305-2445 | 2450-2590 | 2555-2710 |
| | Closed | 4–3**+ | 510-740 | 510-740 | 550-780 | 670-970 | 670-990 | 600-810 | 600-970 | 550-780 | 700-1100 | 500-795 | 850-1370 | 150-600 | 300-700 | 200-765 |
| | | 3–2+ | 400-610 | 435-620 | 460-650 | 610-750 | 510-680 | 485-645 | 500-730 | 460-650 | 580-820 | 395-660 | 610-880 | 405-720 | 455-765 | 445-700 |
| | | 2–1* | 40-370 | 40-370 | 40-370 | 220-500 | 40-370 | 50-375 | 140-460 | 40-370 | 230-500 | 40-295 | 230-500 | 50-450 | 50-450 | 75-480 |
| DR3 | Full | 4–3** | 1820-2120 | 1820-2120 | 1980-2280 | 1980-2280 | 2100-2370 | 2100-2370 | 2240-2690 | 2150-2475 | 2290-2770 | 2290-2770 | 2400-2890 | 2600-3050 | 2760-3240 | 2760-3240 |
| DR2 | | 3–2 | 1060-1350 | 1060-1350 | 1200-1470 | 1200-1470 | 1270-1530 | 1270-1530 | 1330-1700 | 1325-1580 | 1380-1740 | 1380-1740 | 1470-1850 | 1570-1990 | 1700-2130 | 1700-2130 |
| DR1 | | 2–1* | 660-900 | 660-900 | 735-970 | 735-970 | 770-1010 | 770-1010 | 910-1080 | 805-1095 | 930-1100 | 930-1100 | 960-1200 | 900-1340 | 1000-1450 | 1000-1450 |
| Modulator Pressure psi (kPa) | | | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) | 50-53 (345-365) |
| Hold Regulator Pressure psi (kPa) | | | 39-43 (269-296) | 39-43 (270-296) | 44-48 (303-331) | 44-48 (303-331) | 46-50 (317-345) | 46-50 (317-345) | 42-46 (290-317) | 44-48 (303-331) | 44-48 (303-331) | 44-48 (303-331) | 46-50 (317-345) | 36-40 (248-276) | 39-43 (269-296) | 39-43 (269-296) |

* For 2nd range start, check for manual shift function only.

** For no 4th range, this shift should not occur.

\+ 4–2 downshift is acceptable.

Full throttle position is 0 inch (0 mm) Hg vacuum.

Closed throttle position is 19–21 inch (483–533 mm) Hg vacuum.

Notice: To update units prior to S/N 3210302450 to later configuration, refer to SIL 14-TR-85.

**Table 3–9. AT 1500 Shift Points**
**(With Lockup)**

| Engine Governed Speed — rpm | | | 2400 | 2600 | 2800 | 3000 | | 4000 |
|---|---|---|---|---|---|---|---|---|
| AT 1500 Parts Catalog Valve Body Group | | | Y, AE | W, X, AD, AF | AB | AT 1542 | AT 1545 AK | AG |
| Range | Throttle Position | Shift | Transmission Output Speed (rpm) at Start of Shift | | | | | |
| Drive | Full | 1–2* | 580–640 | 595–655 | 595–655 | 595–655 | 710–770 | 980–1045 |
| | | 2–3 | 865–1000 | 955–1090 | 1045–1180 | 955–1090 | 1130–1265 | 1600–1700 |
| | | 3–4 | 1560–1705 | 1700–1845 | 1845–1985 | 1700–1845 | 1985–2130 | 2680–2840 |
| | Closed | 4–3+ | 525–755 | 625–830 | 710–1135 | 625–830 | 660–990 | 310–885 |
| | | 3–2+ | 400–610 | 460–650 | 510–680 | 460–650 | 500–730 | 445–700 |
| | | 2–1* | 40–370 | 40–370 | 40–370 | 40–370 | 140–460 | 75–460 |
| DR3 | Full | 4–3 | 1820–2120 | 1980–2280 | 2100–2370 | 2150–2475 | 2240–2690 | 2760–3240 |
| DR2 | | 3–2 | 1060–1350 | 1200–1470 | 1270–1530 | 1325–1580 | 1330–1700 | 1700–2130 |
| DR1 | | 2–1* | 660–900 | 735–970 | 770–1010 | 805–1095 | 910–1080 | 1000–1450 |
| Modulator Pressure psi (kPa) | | | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) | 50–53 (345–365) |
| Hold Regulator Pressure psi (kPa) | | | 39–43 (269–296) | 44–48 (303–331) | 46–50 (317–345) | 42–46 (290–317) | 42–46 (290–317) | 39–43 (269–296) |

* For 2nd range start, check for manual shift function only.

\+ 4–2 downshift is acceptable.

Full throttle position is 0 inch (0 mm) Hg vacuum.

Closed throttle position is 19–21 inch (483–533 mm) Hg vacuum.

NOTICE: To update units prior to S/N 3210302450 to later configuration, refer to SIL 14-TR-85.

## *3–14. TRANSMISSION STALL TEST AND NEUTRAL COOL-DOWN CHECK*

**a. Purpose**

(1) Stall testing is performed to determine whether a power complaint is due to an engine problem or transmission malfunction.

(2) Stall speed is the maximum engine rpm attainable when the engine is at full throttle and when the torque converter turbine is not moving, or "stalled."

(3) During a stall test, compare actual engine speed at full throttle stall with established vehicle manufacturer's specifications.

---

**NOTE:**

**Engine stall point data can be obtained from the vehicle manufacturer or from the equipment dealer or distributor.**

---

(4) Stall tests are used as troubleshooting procedures only — do not perform them as general checks or maintenance.

**b. Stall Testing Preparation**

(1) Make sure the fuel control linkage goes to full throttle and does not stick when released.

(2) Check the air induction system for restrictions.

(3) Perform a cold check of the transmission fluid level and adjust as necessary.

(4) Install an accurate tachometer (do not rely on the vehicle tachometer).

(5) Install a temperature gauge with the probe in the transmission converter-out (to cooler) line.

**WARNING!**

**While conducting a stall check, the vehicle must be positively prevented from moving. Apply the parking brake and service brake, and block the wheels securely. Warn personnel to keep clear of the vehicle and its travel path. Failure to do so can cause serious injury.**

(6) Block the vehicle wheels.

(7) Start the engine and let the transmission sump warm to normal operating temperature 160–200°F (71–93°C).

(8) Perform a hot check of the transmission fluid level and adjust as necessary.

(9) Turn all engine accessories OFF.

(10) Notify everyone to stay clear of the vehicle.

**CAUTION:**

**Never maintain the stall condition for more than 30 seconds at any one time because of the rapid rise in fluid temperature. Do not let the converter-out fluid temperature exceed 300°F (149°C). Do not rely on converter-out fluid temperature to limit stall duration. During stall conditions, internal temperatures rise much faster than converter-out fluid temperature. Allow the system to cool between stall checks by performing the cool-down as described in Paragraph 3–14*e*. If the stall test is repeated, do not let the engine overheat.**

---

**NOTE:**

- **For vehicles with engines not equipped with smoke controls, proceed to Paragraph *c*.**
- **For vehicles with engines equipped with smoke controls, skip Paragraph *c* and proceed to Paragraph *d*.**

---

**c. Stall Test Procedures — Vehicles Without Smoke-Controlled Engines**

(1) Apply the vehicle parking and service brakes.

(2) Shift to **D** (Drive).

(3) Slowly accelerate to full throttle.

(4) When the tachometer levels off, record the maximum engine rpm attained.

(5) Slowly release the throttle.

(6) Shift to **N** (Neutral) or **P** (Park).

(7) Skip Paragraph **d** and proceed immediately with Paragraph **e** — Cool-Down Check.

**d. Stall Test Procedures — Vehicles With Smoke-Controlled Engines**

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**NOTE:**

**Because smoke controls and throttle-delay mechanisms inhibit engine acceleration, the stall testing may need to be performed while the vehicle is moving.**

---

(1) Locate an isolated area to perform the driving stall test.

(2) Select a hold range that will limit road speed (usually 2nd or 3rd range).

(3) Operate the engine at full throttle, maximum governed rpm.

(4) Slowly depress the vehicle service brakes while staying at full throttle.

(5) When the vehicle comes to a stop, record the engine rpm — this is stall speed.

(6) Proceed immediately with Paragraph **e** — Cool-Down Check.

**e. Neutral Cool-Down Check Procedure**

(1) The neutral cool-down check determines if the transmission fluid cools properly following an engine load condition. Perform this check immediately after the engine speed has been recorded in the stall test.

(2) Record the converter-out fluid temperature.

(3) With the transmission remaining in **N** (Neutral) or **P** (Park), run the engine at 1200–1500 rpm for two minutes to cool the fluid.

(4) At the end of two minutes, record the converter-out fluid temperature. Converter-out fluid temperature should return to within the normal operation.

**f. Results**

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**NOTE:**

**Environmental conditions, such as ambient temperature, altitude, engine accessory loss variations, etc., affect the power input to the converter. Under such conditions, a stall speed deviation up to ±150 rpm from specification can be accepted as within normal range.**

---

(1) If the engine stall speed is more than 150 rpm below the stall speed specified by the engine manufacturer, an engine problem is indicated, such as the need for a tune-up.

(2) If the engine stall speed is more than 150 rpm above specification, a transmission problem is indicated, such as slipping clutches, cavitation, or torque converter failure.

(3) An extremely low stall speed, such as 33 percent of the specified engine stall rpm, during which the engine does not smoke, could indicate a freewheeling torque converter stator.

(4) If the engine stall speed conforms to specification, but the transmission fluid overheats, refer to the cool-down check. If the fluid does not cool during the two-minute cool-down check, a stuck torque converter stator could be indicated.

(5) If the engine stall speed conforms to specification and the cool-down check shows that transmission fluid cools properly, refer to Table 3–12, Section C for troubleshooting procedures.

## *3–15. PRESERVATION AND STORAGE*

**a. Storage, New Transmissions** *(prior to installation)*. New transmissions are tested at the Allison factory with preservative oil and drained prior to shipment. The residual oil remaining in the transmission provides adequate protection to safely store the transmission for up to one year (stored inside in conditions of normal climate and with all shipping plugs installed) without further treatment.

**b. Preservation Methods.** When the transmission is to be stored or remain inactive for an extended period (one or more years), specific preservation methods are recommended to prevent damage due to rust, corrosion, and organic growth in the oil. Preservation methods are presented for storage with and without transmission fluid.

**c. Storage, One Year — Without Transmission Fluid**

(1) Drain the transmission fluid.

(2) Spray two ounces (60 milliliters) of VCI #10 through the fill tube.

(3) Seal all openings and the breather with moisture-proof tape.

(4) Coat all exposed, unpainted surfaces with preservative grease such as petrolatum (MIL-C-11796, Class 2).

(5) If additional storage time is required, repeat Steps (2), (3), and (4) at yearly intervals.

**d. Storage, One Year — With Transmission Fluid** *(Normally in a Vehicle Chassis)*

(1) Drain the transmission fluid and replace the filter element(s).

(2) Fill the transmission to operating level with a mixture of one part VCI #10 (or equivalent) to 30 parts Allison-approved transmission fluid. Refer to Paragraph 3–7. Add ¼ teaspoon of Biobor® JF (or equivalent) for every 3 gallons (1 ml for every 10 liters) of fluid in the system.

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**NOTE:**

**When calculating the amount of Biobor® JF required, use the total volume of the system, not just the quantity required to fill the transmission. Include external lines, filters, and the cooler.**

---

(3) Run the engine for approximately five minutes at 1500 rpm with the transmission in neutral.

(4) Drive the vehicle. Make sure the transmission shifts through all gears.

(5) Continue running the engine at 1500 rpm with the transmission in neutral until normal operating temperature is reached.

**WARNING!**

**Apply the parking brake, service brake, and block the vehicle securely. Warn personnel to keep clear of the vehicle and its travel path. Failure to do so can cause serious injury.**

**CAUTION:**

**Never maintain the stall condition for more than 30 seconds at any one time because of the rapid rise in fluid temperature. Do not let the converter-out fluid temperature exceed 300°F (149°C). Do not rely on converter-out fluid temperature to limit stall duration. During stall conditions, internal temperatures rise much faster than converter-out fluid temperature. Allow the system to cool between stall checks by performing the cool-down as described in Paragraph 3–14*e*. If the stall test is repeated, do not let the engine overheat.**

(6) If normal operating temperature is less than 225°F (107°C), with the vehicle wheels blocked and the parking brake and service brake applied, shift the transmission to **D** (Drive) and stall the converter. When converter-out temperature reaches 225°F (107°C), stop the engine. Do not exceed 225°F (107°C).

(7) As soon as the transmission is cool enough to touch, seal all openings and the breather with moisture-proof tape.

(8) Coat all exposed, unpainted surfaces with preservative grease such as petrolatum (MIL-C-11796, Class 2).

(9) If additional storage time is required, repeat steps (2) through (8) at yearly intervals; except, it is not necessary to drain the transmission each year. Just add Motorstor and Biobor® JF (or equivalents).

**e. Restoring Transmission to Service**

(1) Remove all tape from openings and the breather.

(2) Wash off all external grease with mineral spirits.

(3) If the transmission is new, drain the residual preservative oil. Refill the transmission to the proper level as specified in Paragraphs 3–5 and 3–7.

(4) If the transmission was prepared for storage without transmission fluid, drain the residual oil and replace the filter element(s). Refill the transmission to the proper level as specified in Paragraphs 3–5 and 3–7.

(5) If the transmission was prepared for storage with transmission fluid, it is not necessary to drain and refill the transmission with new transmission fluid. Check for proper fluid level as specified in Paragraph 3–5. Add or drain fluid as required to obtain the proper level.

## *3–16. REPLACEMENT OF COMPONENTS WHILE TRANSMISSION IS IN THE VEHICLE CHASSIS*

**a. Replacement of Selector Shaft Seal** *(Foldout 12,B)*

(1) Remove control linkage from selector shaft 60. Place seal remover J 26401 over the end of the selector shaft. Screw the remover into seal 61 sufficiently to cause engagement. Then, using a wrench, tighten the screw in the remover to draw the seal from the bore.

(2) Clean the housing bore before installing a new seal. Refer to Paragraph 4–6**f** for seal preparation. Install the seal, lip first, onto the selector shaft. Using seal installer J 26282, install the seal into the housing. The seal is positioned satisfactorily when its outer surface is clear of the lead chamfer in the bore.

(3) Install and adjust the control linkage as outlined in Paragraph 3–12**a**.

**b. Removal of Output Flange, Output Seal**

(1) Disconnect the vehicle drive shaft from the transmission output shaft.

(2) Remove the flange retaining bolt, washer, and flange retainer washer. Discard the bolt.

(3) Remove the transmission output flange from the output shaft.

(4) Remove the seal from the rear of the transmission housing. Do not damage the seal bore.

**c. Removal of Output Shaft Bearing** *(Foldout 12,B)*

(1) Remove internal snapring 5 from the rear of the transmission housing.

(2) To remove output shaft bearing 4, first count the number of balls in the bearing (Figure 3–8). If the bearing has nine balls, select J 38086-1 puller legs (three required). If the bearing has ten balls, select J 24463-2 puller legs (two required). Assemble the selected legs with puller body J 24420-B and bolt J 24463. Engage each puller leg into the bearing by placing the foot of the leg between two bearing balls. Then twist the leg so that the foot is forced under the bearing races. Adjust the center screw and each of the leg nuts until puller body J 24420-B is perpendicular to the rear face of the transmission housing (Figure 3–8). Tighten the center screw and remove the output bearing.

**d. Removal of Speedometer Drive Gear or Speed Sensor Wheel and Selective Spacer** *(Foldout 12,B)*. Remove selective spacer 3 and speedometer drive gear 2 or speed sensor wheel 9 from the output shaft. Note the number of grooves on selective spacer 3 for accurate replacement.

**e. Installation of Speedometer Drive Gear or Speed Sensor Wheel and Selective Spacer** *(Foldout 12,B)*

(1) Install speedometer drive gear 2 or speed sensor wheel 9 onto the output shaft.

(2) Check selective spacer 3 for damage. If replacement is required, select a spacer with the same number of external grooves as the one it replaced. If spacer identification is impossible, refer to Paragraph 7-6**a** for replacement procedures.

(3) Install selective spacer 3 onto the output shaft.

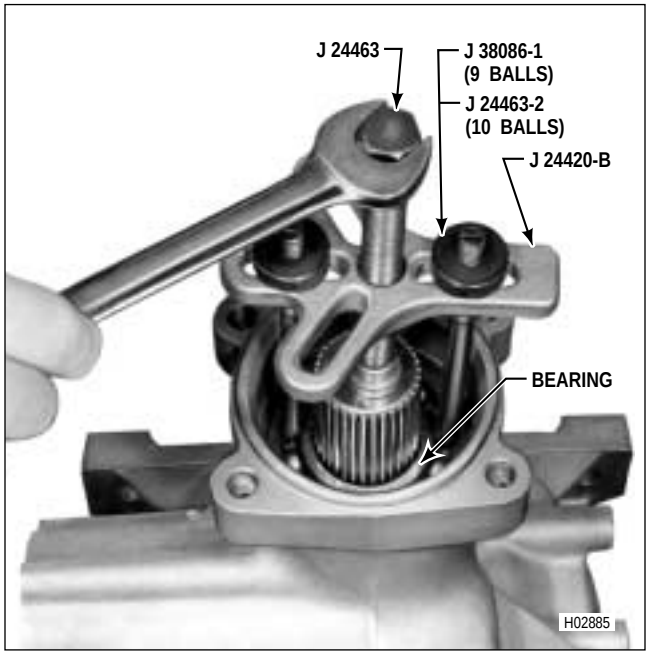



**Figure 3–8. Removing Ten-Ball Bearing from Output Shaft**

**f. Installation of Output Shaft Bearing and Snapring**

(1) Clean the bearing bore. Make sure snapring 9 (Foldout 12,A) is seated in its groove and is not damaged.

(2) Using tool J 24446, install bearing 4 (Foldout 12,B) into the transmission housing. The tool will seat the bearing squarely against snapring 9 (Foldout 12,A).

(3) Install snapring 5 (Foldout 12,B), beveled side outward, into its groove in the transmission housing. Be sure the snapring is fully expanded.

**g. Installation of Output Seal** *(Foldout 12,B)*

(1) Refer to Paragraph 4-6**f** for preparation of seal 6.

(2) Start the seal, lip first, squarely into the rear bore of the transmission housing.

(3) Using installer tool J 23631, drive the seal into the housing until the installer seats against the housing.

**h. Installation of Output Flange**

(1) Lubricate the splines of the shaft and output flange and install the output flange onto the output shaft.

**CAUTION:**

**Do not use a hammer or mallet to drive the flange onto the output shaft. Hammering the flange onto the shaft could damage the internal, caged roller bearings and output bearing.**

(2) Install the flange retainer washer into the flange. Retain the flange to the output shaft with one ½-20 x 1½ inch Type BH patch bolt (P/N 29510838) and one 17⁄32 inch hardened plain washer (P/N 9411417) (Figure 3–9). Do not use the earlier style bolt. Tighten the bolt to 102–121 lb ft (138–164 N·m).

(3) Connect the vehicle drive shaft to the transmission output flange. (See vehicle installation manual for alignment procedure, if required).

## *3–17. TROUBLESHOOTING — BEFORE REMOVAL OR OPERATION OF TRANSMISSION*

**a. Visual Inspection.** Do not operate the vehicle prior to completing the procedures described in this Paragraph. Inspect for transmission fluid leakage. Visually inspect all splitlines, connections, valve bodies, fluid level indicator tube, and plugs and hoses at the transmission and cooler. Fluid leakage at splitlines may be caused by loose mounting bolts or defective gaskets. Tighten all bolts, plugs, and connections where leakage is found. If mounting bolts are tight and fluid continues to leak, install a new gasket. Fluid leaking from the fluid level indicator tube may be caused from foaming and aerating (Paragraph 3–3**b**). Check linkage (Paragraph 3–12).

**b. Vacuum Modulator Check**

(1) **Vacuum diaphragm leak check.** Insert a pipe cleaner into the vacuum modulator connector pipe as far as possible and check for the presence of transmission fluid. If fluid is found, replace the modulator.

**NOTE:**

**Gasoline or water vapor may settle in the vacuum side of the modulator. If this is found without the presence of transmission fluid, the modulator need not be changed.**

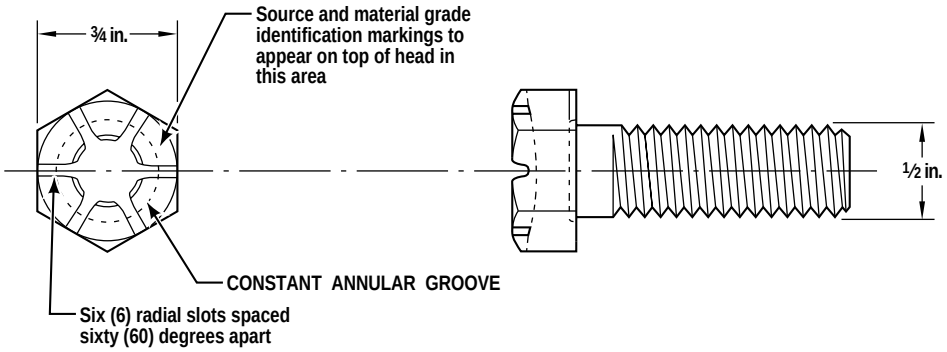
(2) **Atmospheric leak check**. Apply a liberal coating of soap bubble solution to the vacuum connector pipe seam, crimped upper-to-lower housing seam, and threaded screw seal. Using a short piece of rubber tubing, apply air pressure to the vacuum pipe by blowing into the tube and observe for leak bubbles. If bubbles appear, replace the modulator.

**NOTE:**

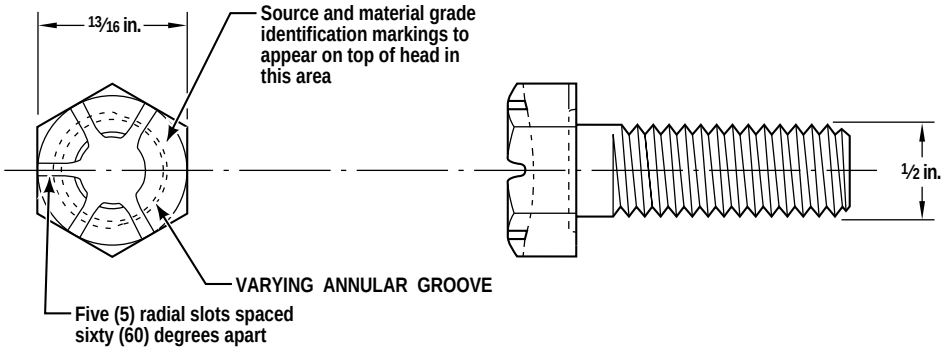
**Do not use any method which will produce more than 6 psi (41 kPa) air pressure, as pressure over 6 psi (41 kPa) may damage the modulator.**

(3) **Modulator comparison check**. Using a comparison gauge (Figure 3–10), compare the load of a known good modulator with the assembly in question.

- Install a modulator that is known to be acceptable on either end of the gauge.
- Install the modulator in question on the opposite end of the gauge.
- Holding the modulators in a horizontal position, bring them together under pressure until either modulator sleeve end just touches the line in the center of the gauge. The gap between the opposite modulator sleeve end and the gauge line must be 0.062 inch (1.57 mm) or less. If the distance is greater than this amount, replace the modulator in question.




**EARLIER BOLT**
P/N 23014159
STANDARD (TYPE AA PATCH) SAE GRADE 8
¾ in. HEXAGON HEAD
SIX (6) GRADE ID MARKINGS*
CONSTANT UNDERHEAD FILLET**




**LATER BOLT**
P/N 29510838
NON-STANDARD (TYPE BH PATCH) SAE GRADE 8
OFFSET, 13/16 in. HEXAGON HEAD
FIVE (5) GRADE ID MARKINGS***
VARYING UNDERHEAD FILLET**

* Radial slots spaced approximately sixty (60) degrees apart.
** Annular groove at the junction of the head bearing surface and the bolt shank.
*** Radial slots spaced approximately sixty (60) degrees apart; may be random relative to hexagon but shall be oriented such that three (3) wide slots are symmetrically over span of large recess diameter.

V01301

**Figure 3–9. Identification of Flange Retaining Bolt**

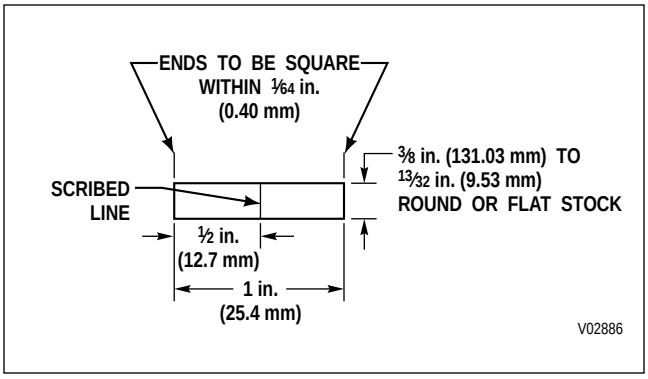



**Figure 3–10. Gauge for Comparing Vacuum Modulators**

(4) **Sleeve alignment check**. Roll the main body of the modulator on a flat surface and observe the sleeve for concentricity to the can. If the sleeve is concentric and the plunger is free, the modulator is acceptable.

(5) A modulator passing all checks in Steps (1) through (4) should be an acceptable part.

## *3–18. TROUBLESHOOTING — BEFORE REMOVAL AND DURING OPERATION*

### a. Determine Cause of Trouble

(1) If the inspections in Paragraph 3–17 do not reveal the cause of the problem and the vehicle is operable, further troubleshooting is necessary. Do not remove the transmission from the vehicle until the cause of the trouble listed in the troubleshooting chart is checked.

(2) The engine and transmission must be regarded as a single package during troubleshooting. A thorough study of the description and operation of the components and hydraulic system will be helpful in determining the cause.

**b. Proper Engine Tuning.** In order to make a thorough test of the transmission while it is mounted in the vehicle, be sure that the engine is properly tuned and the fluid level in the transmission is correct. Refer to Paragraph 3–5 for checking fluid level.

### c. Hydraulic Pressure Checking Procedures

**WARNING!**

**Observe safety precautions during hydraulic pressure check procedures. All personnel must stand clear of the vehicle. Take precautions against movement of the vehicle. Be sure that gauges (vacuum, pressure, tachometer) have extended lines so that they can be read from inside the vehicle.**

(1) Table 3–10 is for checking main pressure on transmissions having demodulated main pressure.

(2) Table 3–11 is for checking main pressure on transmissions having modulated main pressure.

(3) Table 3–12 is for checking retarder pressure.

(4) The pressure check points are shown in Figures 3–11, 3–12, and 3–13.

## *3–19. TROUBLESHOOTING — TRANSMISSION REMOVED FROM VEHICLE*

When the malfunction of a transmission is not ascertained by tests or inspections before removal from the vehicle, the transmission may be mounted in a test stand and checked (if a test stand is available). Particular attention must be given to proper fluid level and to proper linkage adjustment in every transmission test.

## *3–20. TROUBLESHOOTING PROCEDURES*

Table 3–13, Troubleshooting Chart, lists possible causes of transmission troubles and their remedies. Capital letters indicate the symptom; numerals following the symptom indicate several possible causes; corresponding numerals in the right column indicate remedies for the causes.

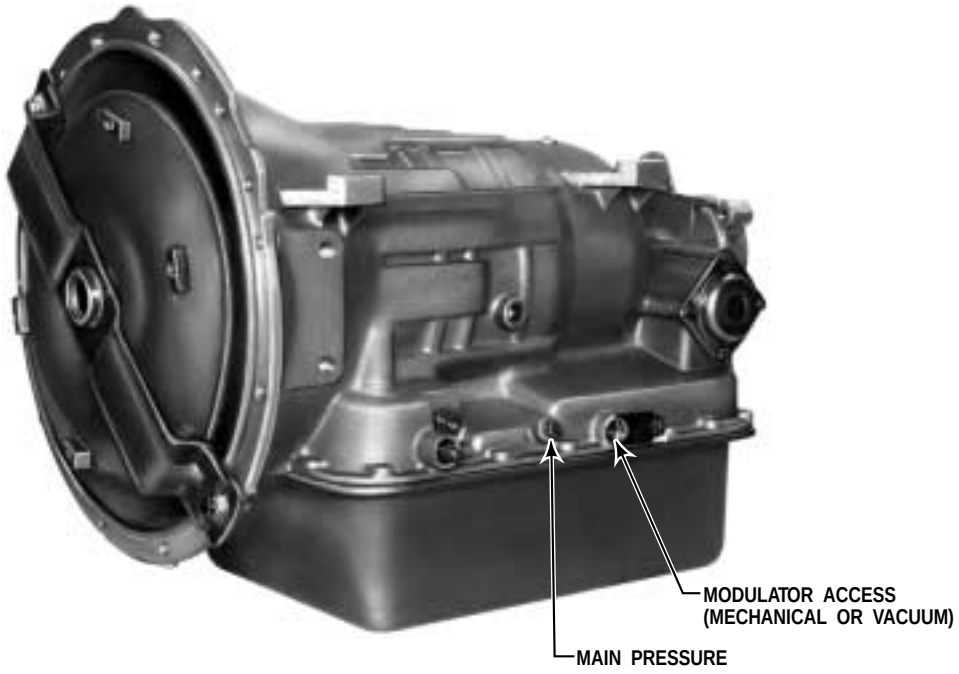



**Figure 3–11. Transmission Check Points**

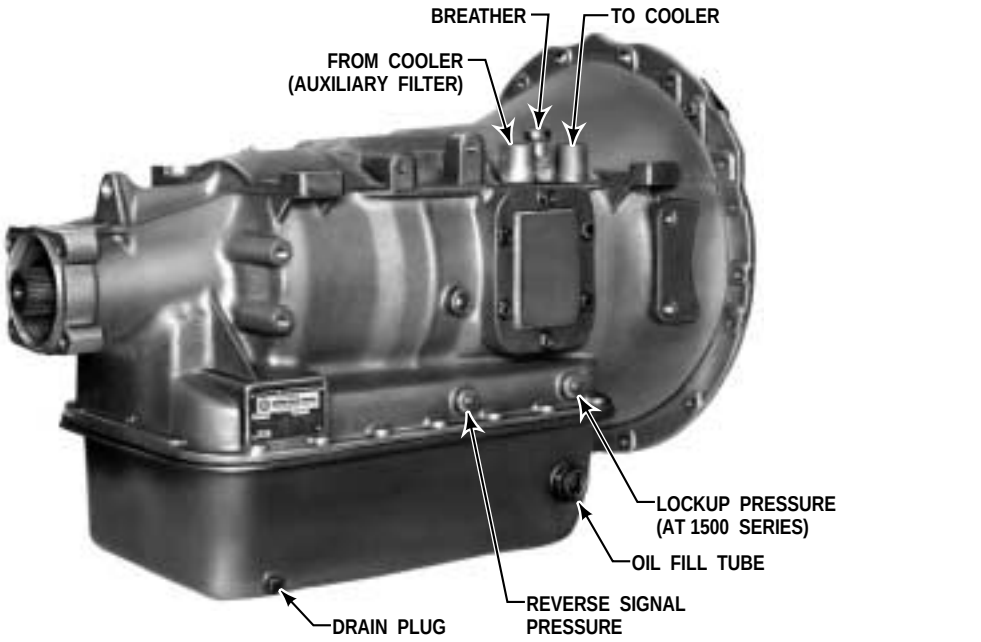



**Figure 3–12. Transmission Check Points (Models Without Retarder)**

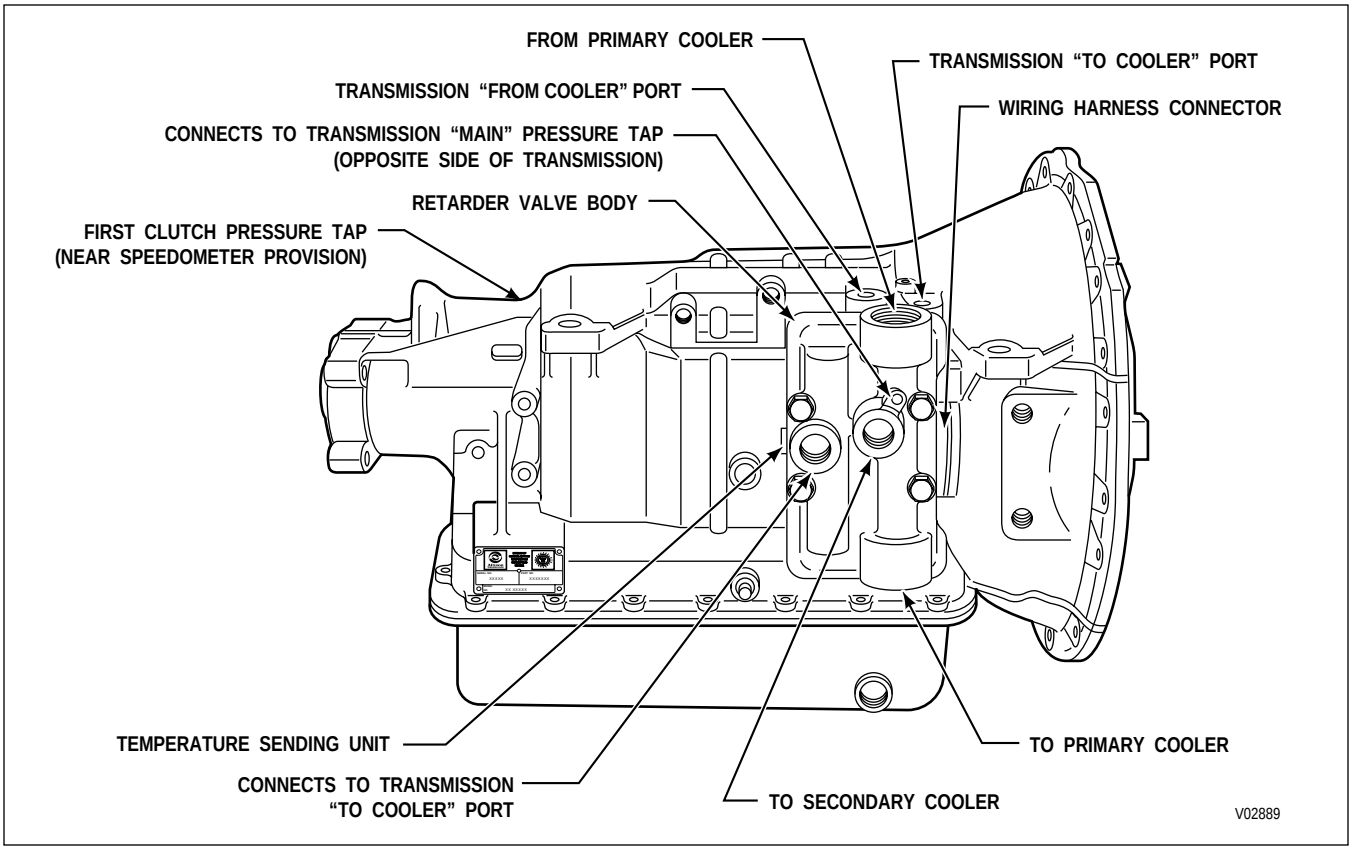



**Figure 3–13. Transmission Check Points (Models With Retarder)**

**Table 3–10. Main Pressure Check Procedure (Models With Demodulated Main Pressure)**

**WARNING!**

**Observe safety precautions during hydraulic pressure check procedures. All personnel must stand clear of the vehicle. Take precautions against movement of the vehicle. Be sure that gauges (vacuum, pressure, tachometer) have extended lines so that they can be read from inside the vehicle.**

PROCEDURES:

(1) All transmission fluid level and pressure checks must be made at normal operating temperatures (160–200°F (71–93°C) sump; 180–220˚F (82–104˚C) converter-out). Check transmission fluid level.

(2) Connect 0–300 psi (0–2068 kPa) oil pressure gauge. Connect tachometer.

(3) Check Neutral and Forward pressures with engine running at 1200 rpm, brakes applied.

(4) Check Reverse pressure, with engine running at 2500 rpm, brakes applied. Reconnect driveline.

(5) Check Lockup pressures with transmission in third and fourth range, with engine at full throttle.

| | | | |
|---|---|---|---|
| NEUTRAL 135-155 psi (931–1068 kPa) | FORWARD 135–155 psi (931–1068 kPa) | REVERSE 230–275 psi (1586–1896 kPa) | LOCKUP 120 psi min (827 kPa min) |

**Table 3–11. Main Pressure Check Procedure (Models With Modulated Main Pressure)**

**WARNING!**

**Observe safety precautions during hydraulic pressure check procedures. All personnel must stand clear of the vehicle. Take precautions against movement of the vehicle. Be sure that gauges (vacuum, pressure, tachometer) have extended lines so that they can be read from inside the vehicle.**

**NOTE:**
**Perform procedures (1), (2), (3), (4), and (5) from Table 3–10.**

| | VACUUM MODULATOR | MECHANICAL MODULATOR |
|---|---|---|
| | Install a tee in the modulator line and connect a vacuum gauge to measure pressure. | Disconnect the modulator cable from the throttle linkage. |
| NEUTRAL | Make sure there are 15 inches or more vacuum. Main pressure should be 90–110 psi (621–758 kPa). | Push or pull the cable to the idle position against the internal stop. Main pressure should be 90–110 psi (621–758 kPa). |
| | If main pressure is 135–155 psi (931–1068 kPa), the transmission has demodulated main pressure. Use Table 3–10. | |
| | | Push or pull the actuator cable to full throttle position against internal stop. |
| NEUTRAL | 135–155 psi (931–1068 kPa) | 135–155 psi (931–1068 kPa) |
| FORWARD | 135–155 psi (931–1068 kPa) Uncouple the output flange. | 135–155 psi (931–1068 kPa) Uncouple the output flange. |
| REVERSE | 230–275 psi (1586–1896 kPa) | 230–275 psi (1586–1896 kPa) Properly adjust mechanical linkage. |

**Table 3–12. Retarder Pressure Check Procedure**

PROCEDURES:

(1) Remove the temperature probe and install 0–100 psi (0–689 kPa) oil pressure gauge.

(2) Drive the vehicle until the transmission reaches fourth range.

(3) Apply the retarder, 100 percent.

(4) 100 percent apply pressure should be 50–62 psi (345–427 kPa).

(5) Release the retarder and re-apply the retarder at 50 percent.

(6) 50 percent apply pressure should be 20–32 psi (138–220 kPa).

NOTE: Retarder pressure will drop during downshift.

**Table 3–13. Troubleshooting Chart**

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **A. Abnormal Automatic Shifts** | | |
| Shifts occurring at too high speed | Governor valve malfunctioning (stuck). | Clean or replace governor screen and/or governor. The governor may be disassembled for cleaning and inspection only if the kit consisting of two governor weight pins and cover gasket is available. Refer to Paragraphs 5–3**e**, 5–3**h**(5), 6–5, 7–10**a**, and 7–11**a**. |
| | Vacuum modulator vacuum hose to engine kinked or leaking — light throttle shifting delayed. | Replace hose. Be sure vacuum line is free from kinks or bends and not close to exhaust components. |
| | Vacuum modulation delayed. | Replace vacuum modulator. Be sure that O-ring is installed and that the modulator vacuum fitting is facing forward and positioned 10° below horizontal. Refer to Paragraphs 5–3**c** and 7–11**b**. |
| | Mechanical actuator cable kinked, broken, or not properly adjusted. | Replace, adjust, or repair cable. Full actuator control cable travel must correspond with full throttle (push or pull system). Refer to the latest edition of SA1321, AT Mechanic's Tips. |
| | Mechanical actuator malfunctioning. | Replace actuator. |
| | Shift signal valve adjustment too high. | Adjust shift points. Refer to Paragraph 3–13. |
| | Valves sticking. | Replace or rebuild main control valve assembly. Refer to Paragraph 6–6. |
| | Improper modulation. | Inspect and replace, if necessary, modulator valve and modulator body. Refer to Paragraphs 6–6**a**(5) and 6–6**b**(16). |

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **A. Abnormal Automatic Shifts *(cont'd)*** | | |
| Shifts occurring at too low speed — full throttle | Governor spring weak or missing. | Replace governor. Refer to Paragraphs 5–3**e** and 7–10**a**. |
| | Mechanical actuator kinked, broken, or not properly adjusted. | Replace, adjust, or repair cable. Full actuator control cable travel must correspond with full throttle (push or pull system). Refer to the latest edition SA1321, AT Mechanic's Tips. |
| | Shift signal valve spring adjustment too loose. | Tighten spring adjusting ring to specification. Refer to Paragraph 3–13. |
| | Modulator valve stuck open. | Check spring adjustment. Clean or replace modulator valve. Refer to Paragraphs 6–6**a**(5) and 6–6**b**(16). |
| Rough shifting | Governor valve malfunctioning. | Clean or replace governor screen and/or governor. The governor may be disassembled for cleaning and inspection only if the kit consisting of two governor weight pins and cover gasket is available. Refer to Paragraphs 5–3**e**, 5–3**h**(5), 6–5, 7–10**a**, and 7–11**a**. |
| | Vacuum modulator valve spring not properly adjusted — vacuum hose kinked or leaking. | Check spring adjustment. Replace hose. Refer to Paragraph 3–13. |
| | Mechanical actuator cable kinked, broken, or not properly adjusted. | Replace, adjust, or repair cable. Full actuator control cable travel must correspond with full throttle (push or pull system). Refer to the latest edition of SA1321, AT Mechanic's Tips. |
| | Mechanical actuator malfunctioning. | Replace actuator. |
| | Vacuum modulator failed. | Replace vacuum modulator. Be sure that O-ring is installed and that the modulator vacuum fitting is facing forward and positioned 10° below horizontal. Refer to Paragraphs 5–3**c** and 7–11**b**. |

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **A. Abnormal Automatic Shifts *(cont'd)*** | | |
| Rough shifting *(cont'd)* | Trimmer valves sticking (broken spring). | Replace or rebuild main control valve body assembly. Refer to Paragraph 6–6. |
| | Control valves sticking. | Replace or rebuild main control valve body assembly. Refer to Paragraph 6–6. |
| | Modulator valve sticking. | Clean modulator valve. Check vacuum modulator. Adjust spring. Refer to Paragraphs 6-6**a** and 6-6**b**. |
| | Engine idle speed too fast (**N** to **D**). | Adjust engine idle screw. Refer to vehicle service manual. |
| | Shift selector linkage out of adjustment. | Adjust linkage. Refer to the latest edition of SA1321, AT Mechanic's Tips. |
| No specific shift; i.e., 1–2, 2–3, 3–4 (up or down) | Governor valve malfunctioning. | Clean or replace governor screen and/or governor. The governor may be disassembled for cleaning and inspection only if the kit consisting of two governor weight pins and cover gasket is available. Refer to Paragraphs 5–3**e**, 5–3**h**(5), 6–5, 7–10**a**, and 7–11**a**. |
| | Specific range valves malfunctioning (sticking). | Replace or rebuild main valve body assembly. Refer to Paragraph 6–6. |
| Shift flare during range shifts, AT 545 models only. | Incorrect trimmer valves installed. | Replace trimmer valves. Refer to Paragraph 6–6**a**(9). |
| **B. Abnormal Activities or Responses** | | |
| Excessive creep in first range and reverse | Engine idle speed set too high. | Adjust to correct idle speed. Refer to vehicle service manual. |
| | Shift selector linkage unhooked. | Hook up shift selector linkage — quadrant gates must agree with transmission model. Detent positions at transmission must conform with gates on quadrant. Refer to vehicle service manual and to the latest edition of SA1321, AT Mechanic's Tips. |

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **B. Abnormal Activities or Responses *(cont'd)*** | | |
| Vehicle moves backward in neutral | Shift selector linkage out of adjustment. | Repair or replace linkage.* |
| | Fourth clutch failed and dragging. | Rebuild fourth clutch. Refer to Paragraphs 5–3**l** and 7–6**b**. |
| | Shift selector linkage defective or broken. | Repair or replace linkage.* |
| | Main pressure low. | Refer to Chart E, Low Pressure. |
| | Shift selector not engaged at control valve. | Install or replace parts involved (inside oil pan). Refer to Paragraphs 5–3**h** and 7–10**a**. |
| | Low fluid level. | Fill to proper fluid level. Refer to Paragraphs 3–4 through 3–10. |
| Vehicle moves forward in neutral | Incorrect idle speed. | Adjust to correct idle speed. |
| | Shift selector linkage out of adjustment. | Repair or replace linkage.* |
| | Forward clutch failed and dragging. | Rebuild forward clutch. Refer to Paragraph 6–8. |
| Reverse warning buzzers and/or vehicle backup lights come on during forward operation. | Improper 1–2 relay valve installed. | Install new 1–2 relay valve. Refer to Paragraph 6–6**a**(11). |
| **C. Abnormal Stall Check Speed** | | |
| High stall speeds | Low fluid level. | Add fluid to proper level. Refer to Paragraphs 3–4 through 3–10. |
| | Clutch pressure low. | Refer to Chart E, Low Pressure. |
| | Forward clutch slippage.** | Rebuild forward clutch. Refer to Paragraph 6–8. |
| | First clutch slippage.** | Rebuild first clutch. Refer to Paragraphs 5–3**q** and 7–4**a, b**. |

* Shift selector linkage must be free and secure. Hook up shift selector linkage — quadrant gates must agree with transmission model. Detent positions at transmission must conform with gates on quadrant. Refer to vehicle service manual and to Paragraph 3–12**a**.

** Clutch slippage may be recognized by alternate racing and loading of the engine, which is at times, accompanied by a violent chatter. Refer to slippage charts.

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **A. Abnormal Stall Check Speed *(cont'd)*** | | |
| High stall speeds *(cont'd)* | Fourth clutch (reverse) slipping. | Rebuild fourth clutch. Refer to Paragraph 6–11. |
| Low stall speeds | Engine not performing efficiently (may be due to plugged or restricted injectors or high altitude conditions). | Refer to engine manufacturer's manual or vehicle service manual. |
| | Broken converter parts. | Replace or rebuild converter assembly.*** Refer to Paragraph 6–4. |
| | Stall speeds of 50 percent of normal (implies freewheeling stator). | Replace or rebuild converter assembly.*** Refer to Paragraph 6–4. |
| **B. Leaking Fluid** | | |
| Fluid leaking into converter housing | Engine crankshaft rear oil seal leakage. | Refer to vehicle service manual. |
| | Metal-encased lip type seal at front of input charging pump leaking. | Replace pump seal. Refer to Paragraphs 6–7**a**(6) and 6–6**d**(10) or (12). |
| | Seal around OD of oil pump leaking. | Replace OD pump seal. Refer to Paragraphs 6–7**a**(5) and 6–6**d**(13). |
| | Cracked weld in torque converter assembly leaking. | Replace or repair converter assembly.*** Refer to Paragraph 6–4. |
| | Torque converter pump hub worn at seal area. | Replace torque converter pump hub.*** Refer to Paragraph 6–4. |
| Fluid leak at output shaft | Faulty or missing seal at output flange. | Install new seal in rear of transmission housing. Refer to Paragraphs 3–16**b** and **g**. |
| | Flange worn at seal surface. | Replace flange. Refer to Paragraphs 3–16**b** and **h**. |

*** Note: Except for AT 543 models, no repairs can be made because the torque converter assembly is closed and welded after assembly of the internal parts.

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **C. Low Pressure** | | |
| Low main pressure in all ranges | Low fluid level. | Add fluid to the proper level. Refer to Paragraphs 3–4 through 3–10. |
| | Filter element(s) clogged. | Replace filter or element(s). Refer to Paragraph 3–10. |
| | Sealring on intake tube leaking or missing. | Install new sealring onto the top end of the intake tube. Refer to Paragraph 7–10**b**. |
| | Main-pressure regulator valve spring weak. | Replace spring. Refer to Paragraphs 6–7**a** and 6–7**d**. |
| | Main control valve body leakage. | Replace or rebuild main control valve body assembly. Refer to Paragraph 6–6. |
| | Valves sticking (trimmer relays, and main pressure regulator). | Replace or rebuild main control valve body assembly. Refer to Paragraph 6–6. |
| | Input charging pump worn or damaged. | Replace or rebuild pump. Refer to Paragraphs 5–3**i**, 6–7, and 7–8**b**. |
| | Missing priority valve. | Replace missing valve. Refer to Paragraphs 6–6**a** and 6–6**b**. |
| Low main pressure in first range, normal pressure in other forward ranges | First range circuit leakage in control valve body. | Replace or rebuild main control valve body assembly. Refer to Paragraph 6–6. |
| | Excessive leakage at first clutch piston seals. | Overhaul transmission. Replace piston seals. |
| Low lubrication pressure | Low fluid level. | Add fluid to the proper level. Refer to Paragraphs 3–4 through 3–10. |
| | Engine idle speed too low. | Refer to vehicle service manual. |
| | Cooler lines restricted or leaking. | Check for kinks or leakage. Reroute or replace lines as necessary. |
| | Excessive internal fluid leakage. | Check other pressures in this chart. Also check valve body mounting bolts. Refer to Paragraph 7–10**a**. |

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **D. Slippage†/**** | | |
| Excessive slippage and clutch chatter in only one range | Clutch slipping in that range. | Rebuild the specific clutch that is slipping and replace piston seals. |
| | Excessive fluid leakage in range piston seals. | Overhaul clutch and piston assembly. |
| | Fluid leakage in valve components for that particular range. | Replace or rebuild main control valve body assembly. Refer to Paragraph 6–6. |
| | Trimmer valve stuck open. | Replace or rebuild main control valve body assembly. Check trimmer valve for freedom of movement. Refer to Paragraph 6–6. |
| | Cycling priority valve. | Replace or rebuild main control valve body assembly. Inspect priority valve. Refer to Paragraph 6–6. |
| Slippage in all forward ranges | Low fluid level. | Add fluid to proper level. Refer to Paragraphs 3–4 through 3–10. |
| | Clutch main pressure low. | Refer to Chart E, Low Pressure |
| | Forward clutch slipping. | Rebuild forward clutch and replace piston seals. Refer to Paragraph 6–8. |
| | Sealrings on front support hub broken. | Replace sealrings. Refer to Paragraphs 5–3**i** and 7–8**b**. |
| Slippage in fourth range and reverse only | Fourth clutch slipping. | Rebuild clutch and replace piston seals. Refer to Paragraph 6–11. |
| | Trimmer valve sticking. | Replace or rebuild main control valve body assembly. Inspect trimmer valve. Refer to Paragraph 6–6. |
| | Broken sealrings on center support assembly hub. | Replace sealrings. Refer to Paragraphs 6–12**a** and 6–12**c**. |
| | Clutch piston sealrings cut. | Replace sealrings. Refer to Paragraphs 6–11**a** and 6–11**c**. |
| | Check balls not seating in rotating clutch housings. | Inspect check balls for contamination and proper operation. Refer to Paragraph 4–5**p**. |

† If unit is modified for split shaft PTO, all external circuitry must be removed before troubleshooting.

** Clutch slippage may be recognized by alternate racing and loading of the engine, which is at times, accompanied by a violent chatter.

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **A. Slippage†/** *(cont'd)* | | |
| Slippage in first range and in reverse; proper function in other forward ranges | First clutch slipping. | Overhaul clutch and replace piston seals. Refer to Paragraphs 5–3**q** and 7–4**a**. |
| | Piston sealrings cut. | Replace sealrings. Refer to Paragraphs 5–3**p** and 7–4**a**. |
| | Clutch-apply feed tube loose or leaking. | Reset or replace feed tube. Refer to Paragraphs 5–3**h** and 7–10**a**. |
| **B. Excessive Flare — Engine Speed Rise on Full-Throttle Upshifts** | | |
| Excessive engine flare | Sticking trimmer valve. | Replace or rebuild main control valve body assembly. Inspect trimmer valves and confirm correct springs. Refer to Paragraph 6–6. |
| | Incorrect or weak trimmer valve springs. | Replace or rebuild main control valve body assembly. Refer to Paragraph 6–6. Check trimmer valve springs. Refer to Paragraph 8–2. |
| | Piston seals leaking or clutch plates slipping in range involved. | Overhaul transmission. |
| | Broken hook-type sealrings. | Replace sealrings. |
| | Forward clutch piston seals leaking or clutch plates slipping (all upshifts). | Overhaul forward clutch and piston assembly. Refer to Paragraph 6–8. |
| | Sticking governor valve. | Clean or replace governor screen and/or governor. The governor may be disassembled for cleaning and inspection only if the kit consisting of two governor weight pins and cover gasket is available. Refer to Paragraphs 5–3**e**, 5–3**h**(5), 6–5, 7–10**a**, and 7–11**a**. |
| **C. Overheating in all Ranges** | | |
| Overheating in all ranges | Cooler lines restricted. | Remove restrictions, clean or replace lines. Refer to vehicle service manual. |

† If unit is modified for split shaft PTO, all external circuitry must be removed before troubleshooting.

** Clutch slippage may be recognized by alternate racing and loading of the engine, which is at times, accompanied by a violent chatter.

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **A. Overheating in all Ranges *(cont'd)*** | | |
| Overheating in all ranges *(cont'd)* | Broken parts in torque converter.†† | Replace or repair torque converter assembly. Refer to Paragraph 6–4.*** |
| | Aerated fluid. | Adjust fluid to proper level. Check for defective sealring at intake tube. Check for defective input charging pump. Refer to Paragraphs 3–4 through 3–10, 5–3**g**, 5–3**i**, 6–7, 7–8**b,** and 7–10**b**. |
| | Cooler flow loss due to internal leakage. | Overhaul transmission. |
| **J. Transmission Throws Transmission Fluid Out of Fill Tube and/or Breather** | | |
| Transmission throws fluid out of fill tube and/or breather | Dipstick loose. | Tighten cap. Replace if necessary. |
| | Fluid level too high. | Drain to proper fluid level. Refer to Paragraphs 3–4 through 3–10. |
| | Fluid level too low. | Fill to proper fluid level. Refer to Paragraphs 3–4 through 3–10. |
| | Vacuum modulator failed. | Replace vacuum modulator. |
| | Fill tube not vented or is plugged. | Check for blockage and clean if necessary. |
| | Breather stopped up (clogged). | Clean or replace breather. Refer to Paragraph 3–11. |
| | Water in transmission fluid. | Drain and replace fluid. Refer to Paragraphs 3–4 through 3–10. |
| | Dipstick gasket worn. | Replace gasket or dipstick. |
| | Improper dipstick marking (improper fluid level). | Replace dipstick. Refer to Paragraph 3–4. |

†† Can also result in excessive fuel consumption.

*** Note: Except for AT 543 models, no repairs can be made because the torque converter assembly is closed and welded after assembly of the internal parts.

**Table 3–13. Troubleshooting Chart *(cont'd)***

| Problem | Probable Causes | Suggested Remedies |
|---|---|---|
| **K. Dirty Transmission Fluid** | | |
| Dirty fluid | Failure to change fluid at proper interval. | Change fluid and install new filter or element(s). Refer to Paragraph 3–10. |
| | Excessive heat. | Refer to Chart H, Overheating. |
| | Clutch failure. | Overhaul transmission. |
| | Damaged filter or element(s). | Replace filter or element(s). Refer to Paragraph 3–10. |
| | Engine rear oil seal failed. | Replace engine rear oil seal. Refer to engine repair manual. |
| **L. Noise Occurring Intermittently (Buzzing)** | | |
| Noise occurring intermittently (buzzing) | Low fluid level. | Add fluid to proper level. Refer to Paragraphs 3–4 through 3–10. |
| | Air leak at intake tube (O-ring damaged). | Replace intake tube seal and filter. Refer to Paragraphs 5–3**g**, and 7–10**b**. |
| | Clogged filter or element(s). | Replace filter or element(s). Refer to Paragraph 3–10. |
| | Aerated fluid. | Improper fluid level. Refer to Paragraphs 3–4 through 3–10. |
| | Damaged filter or element(s). | Replace filter or element(s). Refer to Paragraph 3–10. |
| **M. Vehicle Will Not Push Start** | | |
| Vehicle will not push start | Normal operation (no push-start pump). | Do not attempt to push start. |
| **N. Accelerated Clutch Wear, AT 545 Only** | | |
| Accelerated clutch wear in clutches that experience extended trim times | Incorrect trimmer valves installed. | Replace trimmer valves. Refer to Paragraph 6–6**a**(9). |

# Section 4 – GENERAL OVERHAUL INFORMATION

## *4–1. SCOPE*

This section provides general information for overhaul, cleaning, inspection, and general assembly procedures for the transmission. It provides illustrations and explanations for the fabrication of improvised tooling. A listing and illustration of special tools is included for your convenience.

## *4–2. TOOLS AND EQUIPMENT*

**a. Improvised Tools and Equipment**. The following items may be improvised.

- Work table — 1500 pound (700 kg) capacity (Figure 4–1)
- Gauge for comparing vacuum modulator (Figure 3–9).

**NOTE:**

**The transmission holding fixture (Figure 5–1) may be mounted on the work table.**

**b. Special Tools**. Special tools are illustrated in Figures 4–2 through 4–4. They are identified in the table following the illustrations. These special tools are available from:

Kent-Moore Tool Division*
29784 Little Mack
Roseville, Michigan 48066

Aidco, Inc.*
800 Liberty Street
Adrian, Michigan 49221

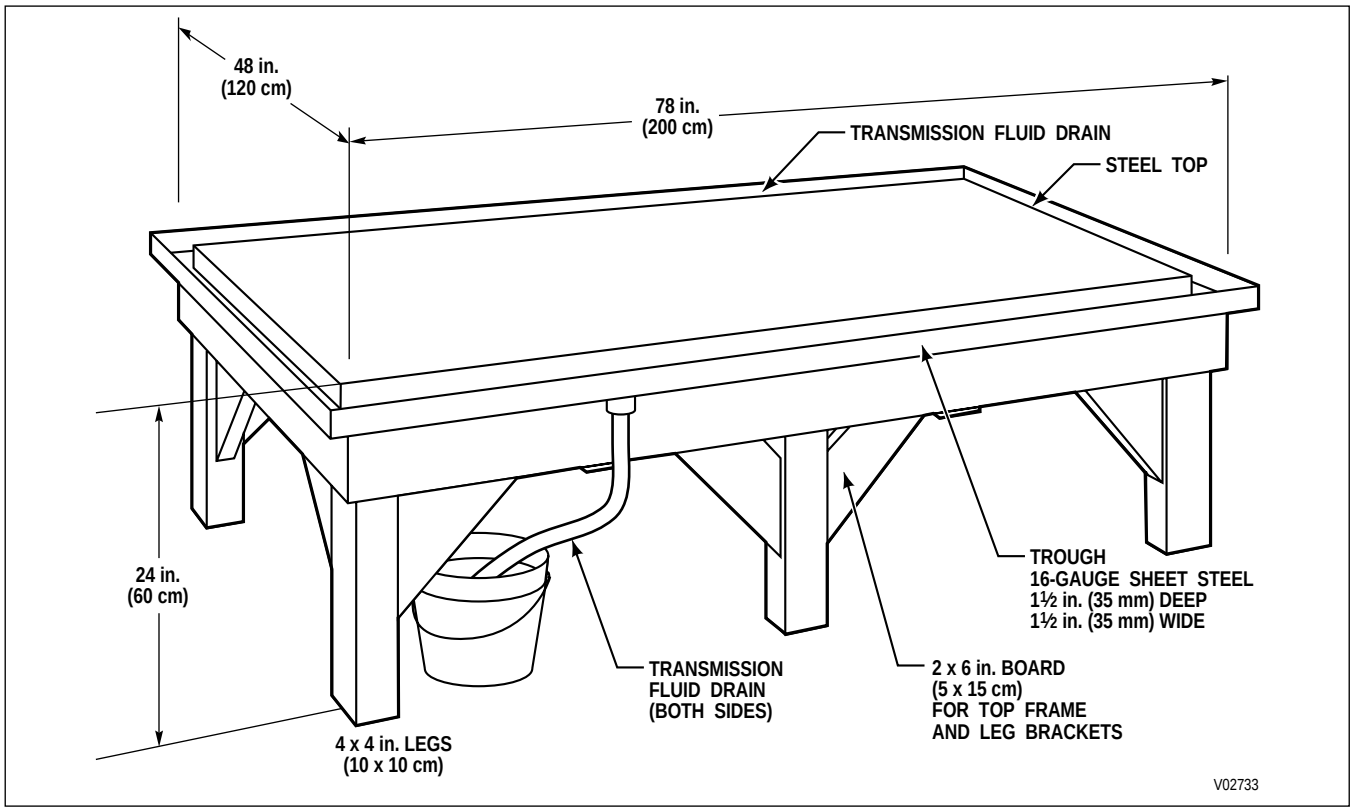



**Figure 4–1. Typical Work Table**

* **We believe these sources and their tools to be reliable**. There may be additional manufacturers of such a tool. General Motors does not endorse, indicate any preference for, or assume any responsibility for the products or tools from these firms, or for any such items which may be available from other sources.

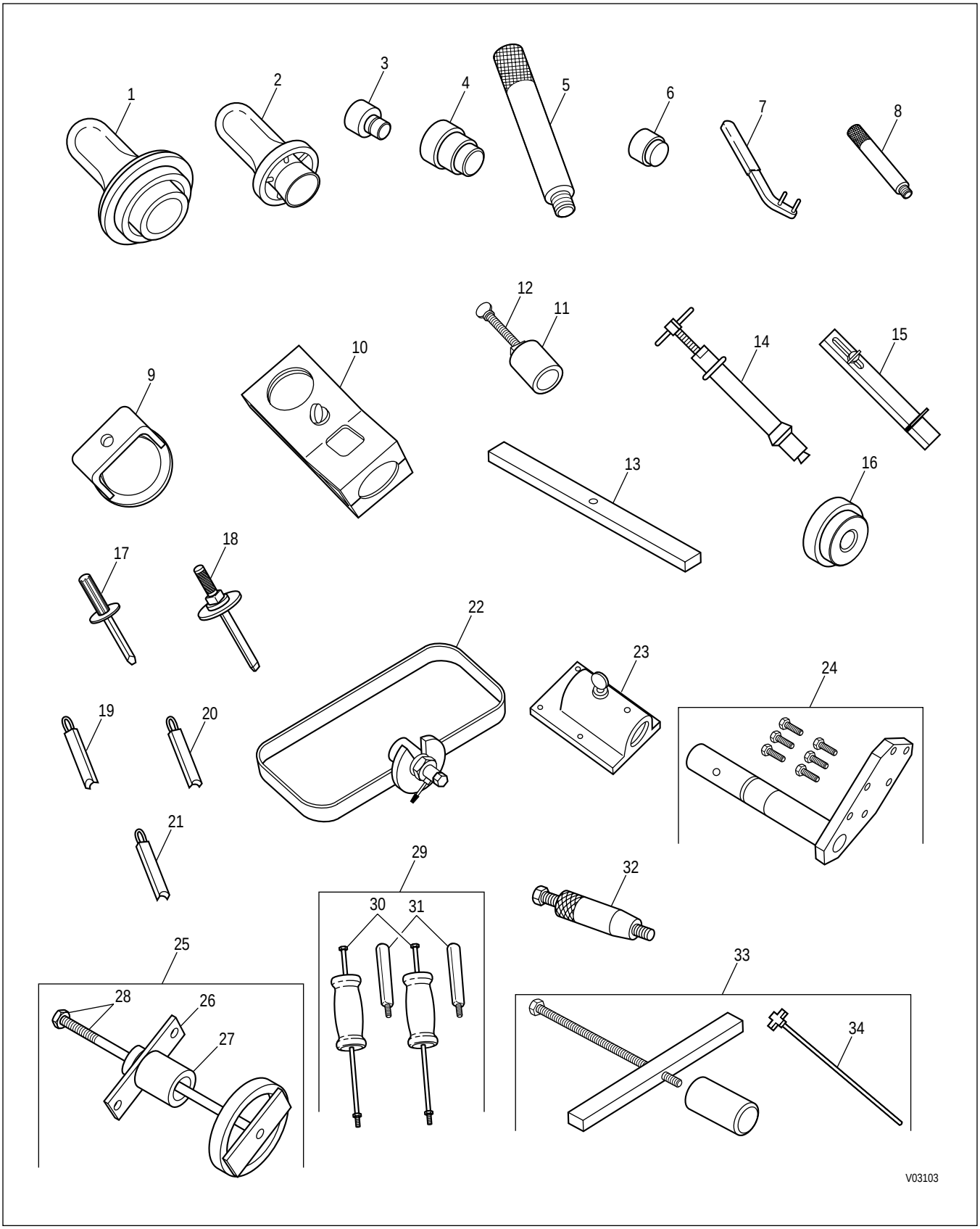



**Figure 4–2. Special Tools (1 thru 34)**

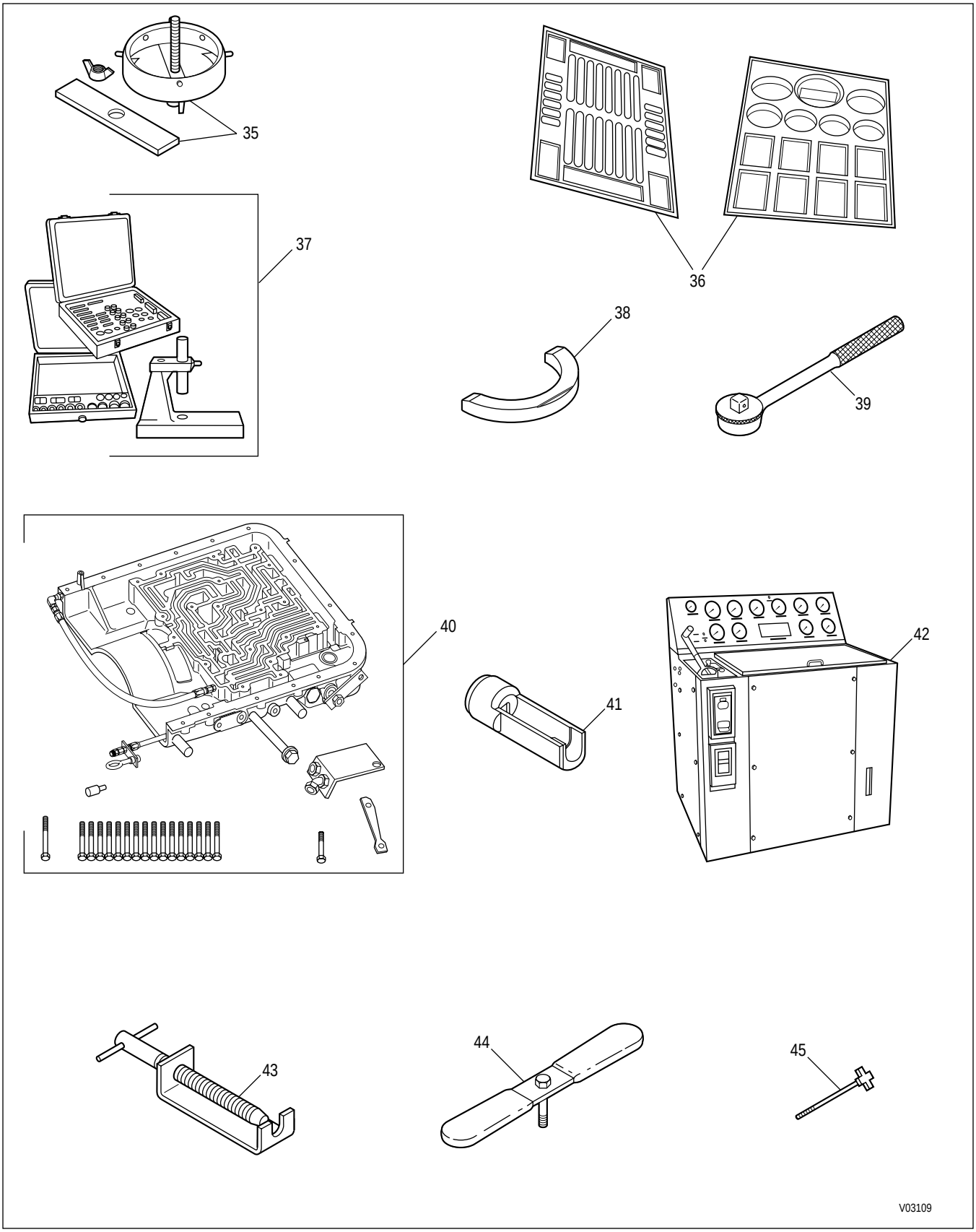



**Figure 4–3. Special Tools (35 thru 45)**

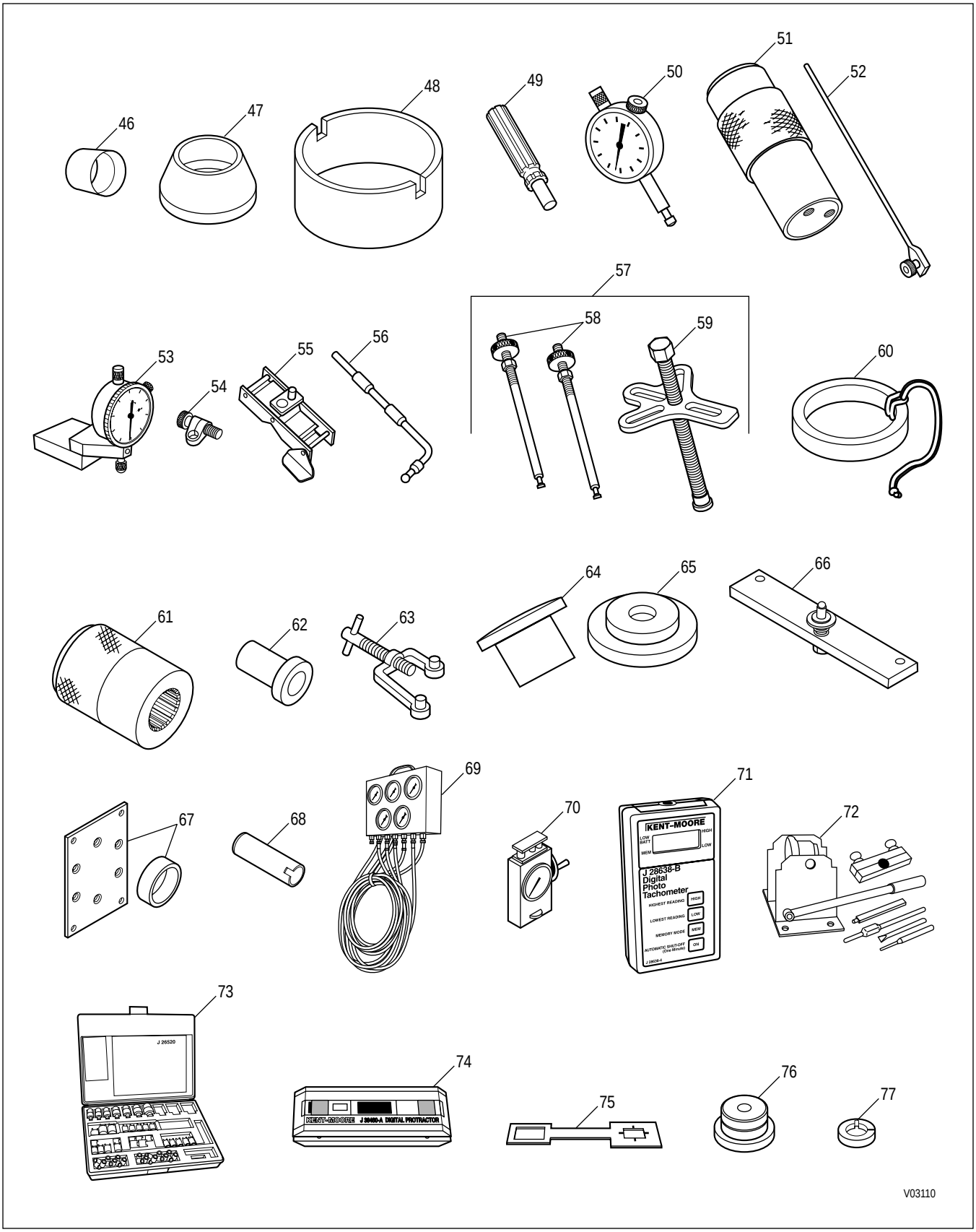



**Figure 4–4. Special Tools (46 thru 77)**

**Table 4–1. Special Tools**

| Tool No. | Figure | Item | Description | Ref. Paragraph |
|---|---|---|---|---|
| J 3289-20 | 4–2 | 23 | Transmission holding fixture base (used with J 23642-01) | 5–3**a** |
| J 3453 | 4–4 | 75 | Universal yoke and flange holder | NR |
| J 5959-1 | 4–4 | 50 | Dial indicator (used with J 5959-3, J 5959-7, J 7872-2, J 7872-3, and J 24602) | 6–3**b** |
| J 5959-3 | 4–4 | 52 | Rod ¼ x 10½ inches (used with J 5959-1, J 5959-7, J 7872-2, J 7872-3, and J 24602) | 6–3**b** |
| J 5959-7 | 4–4 | 54 | Lug attachment (used with J 5959-1, J 5959-3, J 5959-7, J 7872-2, J 7872-3, and J 24602) | 6–3**b** |
| J 6125-1B | 4–2 | 29, 30 | Front support slide hammer (2) | 5–3**i** |
| J 6125-2 | 4–2 | 31 | Slide hammer adapter (2) | 5–3**i** |
| J 7872-2 | 4–4 | 55 | Magnetic clamp (used with J 5959-1, J 5959-3, J 5959-7, J 7872-3, J 24602) | 6–3**b** |
| J 7872-3 | 4–4 | 56 | Swivel adapter (used with J 5959-1, J 5959-3, J 5959-7, J 7872-2) | 6–3**b** |
| J 8092 | 4–2 | 5 | Universal driver handle (used with J 23615, J 24451, J 24778, J 25356) | 6–9**d**, 6–14**b** |
| J 21279-01 | 4–4 | 67 | Engine stand adapter plate | |
| J 21359-A | 4–2 | 2 | Oil pump seal installer | 6–9**d** |
| J 21362 | 4–4 | 46 | Forward and fourth clutch inner seal protector | 6–10**b**, 6–12**b** |
| J 21369-E | 4–2 | 22 | Converter leak test fixture | 6–3**c** |
| J 21409 | 4–4 | 48 | Seal protector (tangless piston) forward and fourth clutch (same as J 23779-01 without tang slots) | NR |
| J 21795-4 | 4–2 | 12 | Thumb screw for J 24352 | 7–6**a** |
| J 23549 | 4–4 | 65 | Stator thrust bearing installer (used with J 24202-4) | 6–4**c** |
| J 23614-A | 4–2 | 6 | Stator shaft front bushing installer (also front and rear sun gear shaft bushings) (models without lockup) | 6–9**b**, 6–14**b** |
| J 23615 | 4–2 | 3 | Stator shaft rear bearing installer (used with J 8092) | 6–9**d** |
| J 23616 | 4–2 | 9 | Forward and fourth clutch spring compressor | 6–10**a**, **c**, 6–12**a**, **c** |
| J 23619-01 | 4–2 | 19 | Forward clutch clearance gauge (for housings without ID groove) | 6–10**b**, 6–12**b** |
| J 23630-02 | 4–2 | 25 | First clutch spring compressor assembly (includes J 23630-1, J 23630-2, J 23630-3) | 5–3**q**, 7–4**a**, 7–6**a** |
| J 23630-1 | 4–2 | 27 | First clutch spring compressor | 5–3**q**, 7–4**a**, **f**, **k** |
| J 23630-2 | 4–2 | 26 | First clutch spring compressor base (used separately to position components during end play measurement and thrust washer selection) | 7–4**a**, 7–6**a**, 7–8**b** |
| J 23630-3 | 4–2 | 28 | Press bolt and nut | 5–3**q**, 7–4**a** |

**Table 4–1. Special Tools *(cont'd)***

| Tool No. | Figure | Item | Description | Ref. Paragraph |
|---|---|---|---|---|
| J 23631 | 4–2 | 1 | Output shaft seal installer | 3–16**g**, 7–9**a** |
| J 23632-01 | 4–2 | 15 | Spacer selection gauge | 7–6**a** |
| J 23633 | 4–2 | 13 | Thrust washer selection gauge bar | 7–8**a** |
| J 23642-01 | 4–2 | 24 | Transmission holding fixture and shaft (used with J 3289-20) | 5–3**a**, 7–12**a** |
| J 23643 | 4–2 | 10 | Center support lifting bracket | 5–3**n**, 7–5**b** |
| J 23715 | 4–2 | 20 | First clutch clearance gauge | 7–4**b** |
| J 23716 | 4–2 | 21 | Third clutch clearance gauge | 7–7**a**, 7–12**b** |
| J 23717-C | 4–2 | 33 | Center support compressor assembly (used with J 34127) | 7–5**b** |
| J 23717-4 | 4–2 | 34 | Snapring gauge (replaced by gauge J 34127) | |
| J 23718-02 | 4–4 | 68 | Output shaft positioning sleeve | NR |
| J 23779-01 | 4–4 | 48 | Forward and fourth clutch outer seal protector | NR |
| J 24202-4 | 4–4 | 51 | Driver handle (used with J 23549) | 6–4**c** |
| J 24216-01 | 4–4 | 47 | First clutch inner seal protector | 7–4**a** |
| J 24218-1 | 4–4 | 60 | Stator roller retainer ring ($2\frac{13}{16}$ inch OD) | 6–4**d** |
| J 24314 | 4–2 | 7 | Shift valve adjusting ring tool | 3–13**b**, 6–6**b** |
| J 24352 | 4–2 | 11 | Sun gear shaft retainer assembly | 7–6**a**, **b** |
| J 24420-B | 4–4 | 59 | Rear bearing puller body (used with J 24463-2 or J 38086-A) | 3–16**c** |
| J 24446 | 4–4 | 61 | Rear bearing installer (with or without output shaft installed) | 3–16**f**, 7–6**a** |
| J 24451 | 4–2 | 4 | Output shaft bushing installer (used with J 8092) | 6–14**b** |
| J 24453 | 4–4 | 49 | Retainer ring installer | 6–13**c** |
| J 24463 | 4–4 | 57 | Rear bearing puller assembly (in vehicle) (includes J 24420-B and J 24463-2 or J 38086-1) | 3–16**c** |
| J 24463-2 | 4–4 | 58 | Rear bearing puller legs (2) (used with J 24420-B) (use if bearing is a 10-ball bearing) | 3–16**c** |
| J 24602 | 4–2 | 14 | Converter end play gauge (used with J 5959-1, J 5959-3, J 5959-7, J 7872-2, and J 7872-3) | 6–3**b** |
| J 24773-A | 4–3 | 43 | Pump support assembly remover | 5–3**i** |
| J 24778 | 4–4 | 62 | Center support bushing installer (models without lockup) | 6–13**c** |
| J 24787 | 4–4 | 63 | Main-pressure regulator valve installer or remover | 6–9**a**, **d** |
| J 25000-1 | 4–3 | 42 | Valve body and governor test stand (used with J 25000-225) | 3–13**a** |
| J 25000-225 | 4–3 | 40 | Valve body test stand adapter (used with J 25000-1) | 3–13**a** |

**Table 4–1. Special Tools *(cont'd)***

| Tool No. | Figure | Item | Description | Ref. Paragraph |
|---|---|---|---|---|
| J 25356 | 4–4 | 64 | Front pump bushing installer | 6–9**d** |
| J 25587-01* | 4–3 | 37 | Planetary rebuilding kit | 6–16**b**, **d** |
| J 25587-1 | 4–3 | | Swaging fixture | 6–16 |
| J 25587-2 | 4–3 | | Pin remover and installer adapter | 6–16 |
| J 25587-3 | 4–3 | | Support block | 6–16 |
| J 25587-4 | 4–3 | | Support block | 6–16 |
| J 25587-6 | 4–3 | | Pin remover and installer spacer | 6–16 |
| J 25587-10 | 4–3 | | Pin installer | 6–16 |
| J 25587-14 | 4–3 | | Pin installer | 6–16 |
| J 25587-16 | 4–3 | | Pin remover | 6–16 |
| J 25587-17 | 4–3 | | Bottom swaging tool holder | 6–16 |
| J 25587-20 | 4–3 | | 5⁄8 inch loading pin | 6–16 |
| J 25587-22 | 4–3 | | ½ inch loading pin | 6–16 |
| J 25587-25 | 4–3 | | Swaging tool | 6–16 |
| J 25587-27 | 4–3 | | Swaging tool | 6–16 |
| J 25587-49 | 4–3 | | 5⁄8 inch guide pin | 6–16 |
| J 25587-50 | 4–3 | | ½ inch guide pin | 6–16 |
| J 26282 | 4–2 | 8 | Selector shaft seal installer | 3–16**a**, 6–15**b** |
| J 26401 | 4–2 | 32 | Selector shaft seal remover | 3–16**a**, 6–15**a** |
| J 26417-A | 4–4 | 69 | Pressure gauge set | NR |
| J 26470 | 4–4 | 72 | Governor rebuilding set | 6–5 |
| J 26520 | 4–4 | 73 | Master thread repair kit | NR |
| J 26857 | 4–4 | 53 | Pump gear gauge set | 6–9**c** |
| J 26995 | 4–4 | 70 | Spring tester | NR |
| J 28501 | 4–2 | 16 | Front planetary bushing installer | 6–16**c** |
| J 28638-B | 4–4 | 71 | Digital phototach kit | NR |
| J 28684 | 4–2 | 17 | Governor pin installer | 6–15**b** |
| J 28708 | 4–2 | 18 | Governor pin remover | 6–15**a** |
| J 29198-1 | 4–3 | 38 | Front and center support rotating sealring groove gauge | 6–9**a**, 6–13**a** |
| J 29612 | 4–3 | 39 | Valve body torque wrench, preset | 6–6**b**, 7–10**a**, 7–12**c** |
| J 29863 | 4–3 | 44 | Valve body lifter, hand tool | 5–3**h**, 6–6**b**, 7–10**a** |
| J 33163 | 4–3 | 36 | Valve body parts tray set | 6–6**a** |

* All J 25587 numbers are components of Planetary Rebuilding Kit J 25587-01. Additional components of the kit are used in the rebuild of planetary assemblies in other Allison models.

**Table 4–1. Special Tools *(cont'd)***

| Tool No. | Figure | Item | Description | Ref. Paragraph |
|---|---|---|---|---|
| J 33184*** | 4–3 | 35 | Fourth clutch hub drilling fixture | NR |
| J 33410 | 4–3 | 41 | Neutral start switch wrench | 7–12**e** |
| J 34127 | 4–3 | 45 | Selective snapring gauge for center support (used with J 23717-C) | 7–5**b** |
| J 34814 | 4–4 | 66 | PTO backlash gauge | 7–14**b** |
| J 38086-1 | NI | NI | Remover leg (3) (used with J 24420-B) (use if bearing is a 9-ball bearing) | 3–16**c** |
| J 38460-A | 4–4 | 74 | Digital protractor | NR |
| J 39735 | 4–4 | 62 | Center support bushing installer (AT 1500 Series only) | 6–13**c** |
| J 39736-01 | 4–2 | 11 | Sun gear shaft retainer (AT 1500 Series only) | 7–6**a**, **b** |
| J 39736-02 | 4–2 | 12 | Thumb screw for J 29736-01 (AT 1500 Series only) | 7–6**a** |
| J 39737 | 4–2 | 6 | Sun gear shaft bushing installer (AT 1500 Series only) | 6–14**b** |
| J 39738 | 4–3 | 43 | Pump support assembly remover (AT 1500 Series only) | 5–3**i** |
| J 39739 | 4–4 | 76 | Oil pump bushing installer (AT 1500 Series only) | 6–9**d** |
| J 39757 | 4–2 | 2 | Oil pump seal installer (AT 1500 Series only) | 6–9**d** |
| J 39794 | 4–2 | 4 | Stator shaft rear bearing installer (AT 1500 Series only) | 6–9**d** |
| J 39795 | 4–4 | 77 | Turbine shaft end play checker (AT 1500 Series only) | NR |
| 250** | 4–3 | 42 | Valve body and governor test stand | 3–13**a** |

** Aidco, Inc.

*** No longer available.

**c. Mechanic's Tools, Shop Equipment**. The following tools, in addition to the common tools ordinarily required, should be available:

- Snapring pliers
- Micrometer
- Depth micrometer
- Dial indicator set
- Headless guide bolts M6-1 x 80 mm (2)
- Headless guide bolts,5⁄16-18 x 4 inch (2)
- Suitable hoist — ½ ton (500 kg) capacity

**CAUTION:**

**Caustic cleaning compounds will damage some transmission parts. Use only mineral spirits.**

- Container of mineral spirits for cleaning parts
- A 100 inch pound (12 Newton meter) torque wrench
- A 100 foot pound (130 Newton meter) torque wrench
- A 250 foot pound (350 Newton meter) torque wrench

- A hot plate or heating equipment (for heating bearings or other interference-fit parts to aid assembly)
- A press for disassembly and assembly of spring-loaded clutches, valves, and interference-fit parts
- Clean, lint-free shop cloths (do not use waste)
- Boxes, receptacles for parts
- Supply of wood blocks
- Oil-soluble, non-fibrous grease (petrolatum)
- Non-hardening sealer (for plugs, seals, etc.)

## *4–3. REPLACEMENT PARTS*

**a. Ordering Information.** Refer to the latest edition of Parts Catalog PC1235EN for parts information.

**b. Parts Normally Replaced.** The following parts are normally replaced at each transmission overhaul.

- Gaskets
- Washers or snaprings damaged by removal
- Center support bolt
- Oil seals, piston sealrings

**WARNING!**

**Do not burn discarded Teflon® seals; toxic gases are produced by burning.**

## *4–4. CAREFUL HANDLING*

During all rebuild procedures, handle parts and subassemblies carefully to prevent nicking, scratching, and denting. Parts which have close operating clearance can bind if damaged. Parts which depend upon smooth surfaces for sealing may leak if scratched. This is very important concerning parts of the control valve body assembly (valves, when dry, must move freely by their own weight in their bores). Carefully handle and protect such parts during removal, cleaning, inspection, and installation. Keep the parts clean while in containers awaiting installation.

## *4–5. CLEANING AND INSPECTION*

**NOTE:**

**For detailed inspection criteria, refer to GN1948EN, AT Technician's Guide.**

**a. Dirt-Free Assembly.** All parts must be clean to permit effective inspection. It is very important that no dirt or foreign material be allowed to enter the transmission. Even minute particles can cause the malfunction of close-fit parts, such as valves.

**b. Cleaning Parts**

(1) Clean all metallic parts thoroughly with mineral spirits or by steam-cleaning. Do not use caustic soda solution for steam cleaning.

(2) Dry parts (except bearings) with compressed air. Lubricate steam-cleaned parts with transmission fluid immediately after drying.

(3) Clean hydraulic passages by working a piece of soft wire back and forth through the passages and flushing with mineral spirits. Dry the passages with compressed air.

(4) After cleaning, examine parts (especially hydraulic passages) to make certain they are entirely clean. Reclean them if necessary.

(5) Use only petroleum base solvents for cleaning oil seals. Solvents such as trichloroethylene, benzol, acetone, and all aromatics are harmful to seals made from polyacrylate rubber.

**c. Cleaning Bearings**

**WARNING!**

**Never dry bearings with compressed air. A spinning bearing can disintegrate allowing balls or rollers to become lethal flying projectiles. Also, spinning a bearing without lubrication can damage the bearing.**

(1) Wash bearings that have been in service thoroughly in mineral spirits.

(2) If the bearings are particularly dirty or filled with hardened grease, soak them in mineral spirits before trying to clean them.

(3) Before inspection, lubricate the bearings with transmission fluid.

**d. Inspecting Bearings**

(1) Inspect bearings for roughness of rotation. Replace a bearing if its rotation is still rough after cleaning and lubricating.

(2) Inspect bearings for scored, pitted, scratched, cracked, or chipped races, and for excessive wear of rollers or balls. If one of these defects is found, replace the bearing.

(3) Inspect bearing housing and shaft for grooved, burred, or galled conditions that would indicate that the bearing had been turning in the bore or on the shaft. If the damage cannot be repaired with crocus cloth, replace the defective part.

(4) When installing a bearing on a shaft, heat the bearing to 200°F (93°C) in a hot transmission fluid bath (approximately 30 minutes). Use the proper size installation sleeve and a press to seat the bearing.

(5) If a bearing must be removed or installed without a sleeve, press only on the race **which is adjacent to the mounting surface**. If a press is not available, seat the bearing with a drift and hammer, driving against the supported race.

**CAUTION:**

**Replace any bearing that has been subjected to metal contamination (Paragraph 3–9*b*).**

**e. Keeping Bearings Clean.** Because the presence of dirt or grit in bearings is usually responsible for bearing failures, it is important to keep bearings clean during removal and installation. Observance of the following rules will do much to ensure maximum bearing life.

(1) Do not remove the wrapper from new bearings until ready to install them.

(2) Do not remove the grease in which new bearings are packed.

(3) Do not lay bearings on a dirty bench; place them on clean, lint-free paper.

(4) If assembly is not to be completed at once, wrap or cover the exposed bearings with clean paper or lint-free cloth to keep out dust.

**f. Inspecting Cast Parts, Machined Surfaces**

(1) Inspect bores for wear, scratches, grooves, and dirt. Remove scratches and burrs with crocus cloth. Remove foreign matter. Replace parts that have scratches or grooves that cannot be removed with crocus cloth.

(2) Inspect all hydraulic passages for obstructions. If an obstruction is found, remove it with compressed air, or by working a soft wire back and forth through the passage and flushing it out with cleaning solvent.

(3) Inspect mounting faces for nicks, burrs, scratches, and foreign matter. Remove such defects with crocus cloth or a soft stone. If scratches cannot be removed with crocus cloth, replace the part.

(4) Inspect threaded openings for damaged threads. Chase damaged threads with the correct size used tap (a new tap can cut oversize). A threaded insert may be used if the insert will not be subjected to high hydraulic pressure. Inserts used in high pressure areas will leak fluid.

(5) Inspect snapring grooves in transmission housing for nicks or shavings that would prevent the snaprings from fully seating in the grooves. Clean up any damage with crocus cloth.

(6) Replace housings or other cast parts that are cracked. Magnaflux and rinse planetary carriers using approximately 8000 ampere-turns (8 amperes in 1000 turn coil) to determine if fractured. Replace the carrier if cracked.

(7) Inspect all machined surfaces for damage that could cause fluid leakage or other malfunction of the part. Rework or replace the defective parts.

**CAUTION:**

**Distortions and imperfections in the hydraulic circuit tracks will cause severe fluid leakage leading to transmission failure.**

(8) Inspect the hydraulic circuit tracks in the valve bod(ies) and transmission housing main control valve body mounting surface for porosity, broken lands, cracks, dirt, and land surface imperfections. The tracks identified in Figure 4–5 will assist in locating troubled areas.

### g. Inspecting Bushings, Thrust Washers

(1) Inspect bushings for scores, burrs, roundness, sharp edges, and evidence of overheating. Remove scores with crocus cloth. Remove burrs and sharp edges with a scraper or knife blade. If the bushing is out-of-round, deeply scored, or excessively worn, replace it, using the proper size replacer tool.

**CAUTION:**

**Whenever it is necessary to cut out a defective bushing, do not damage the bore into which the bushing fits.**

(2) Inspect thrust washers for distortion, scores, burrs, and wear. Replace if defective or worn.

### h. Inspecting Oil Seals, Gaskets

(1) Replace all sealrings (except hook-type), oil seals, and composition gaskets.

(2) Inspect hook-type sealrings for wear, broken hooks, and distortion.

(3) Install a new hook-type sealring if the ring shows any wear on the outside diameter, or if there is excessive side wear. The sides of the sealring must be smooth within 0.005 inch (0.13 mm) maximum side wear. The sides of the shaft groove (or the bore) into which the sealring fits should be smooth, 50 microinches (1.27 micrometers) equivalent and square with the axis of rotation within 0.002 inch (0.05 mm). If the sides of the grooves have to be reworked, install a new sealring.

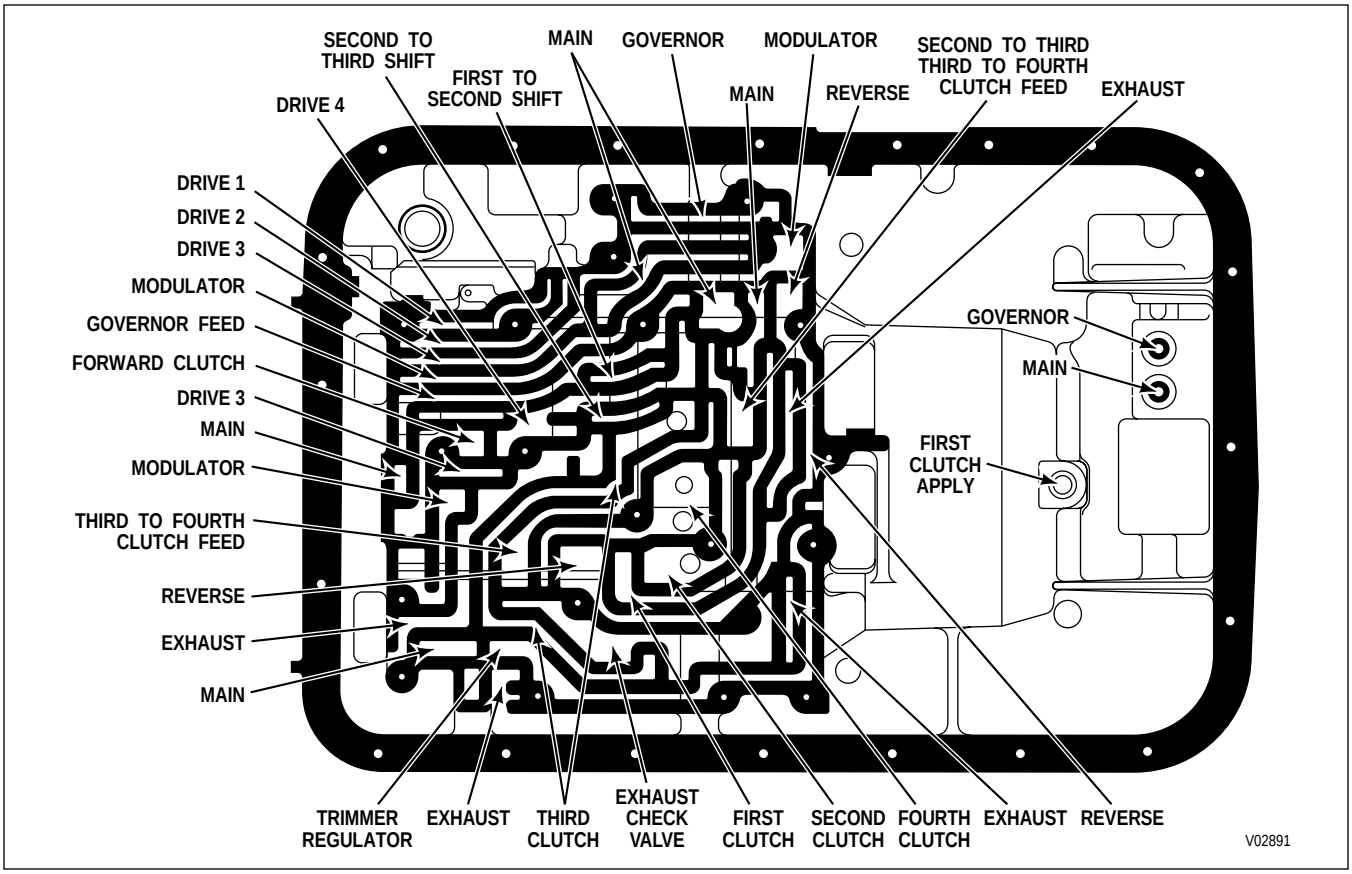



**Figure 4–5. Transmission Housing — Main Control Valve Body Mounting Surface Tracks**

**i. Inspecting Gears**

**CAUTION:**

**Do not attempt to correct the governor driven gear with the use of a soft stone. If the governor driven gear is scuffed, nicked, burred or has broken teeth, replace the governor assembly.**

(1) Inspect gears for scuffed, nicked, burred, or broken teeth. If the defect cannot be removed with a soft honing stone, replace the gear.

(2) Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace the gear.

(3) Inspect the thrust face of gears for scores, scratches, and burrs. Remove such defects with a soft honing stone. If scratches and scores cannot be removed with a soft stone, replace the gear.

**j. Inspecting Splined Parts.** Inspect splined parts for stripped, twisted, chipped, or burred splines. Remove burrs with a soft stone. Replace the part if other defects are found. Spline wear is not considered detrimental except where it affects tightness of fit of the splined parts.

**k. Inspecting Threaded Parts.** Inspect parts for burred or damaged threads. Remove burrs with a soft honing stone or fine file. Clean up damage on small threads by chasing threads with a used die. Clean up damage on large threads with a fine file. Replace part if damage cannot be cleaned up.

**l. Inspecting Snaprings.** Inspect all snaprings for nicks, distortion, and excessive wear. Replace the snapring if any of these defects are found. The snapring must snap tight in its groove for proper functioning.

**m. Inspecting Springs.** Inspect springs for signs of overheating, permanent set, or wear due to rubbing adjacent parts. Replace the spring if any one of these defects are found. Refer to the spring chart at the end of Section 8.

**n. Inspecting Clutch Plates**

(1) Inspect friction-faced steel plates (internal-splined plates) for burrs, imbedded metal particles, severely pitted faces, excessive wear, cone, cracks, distortion, and damaged spline teeth. Remove burrs, using a soft honing stone. Replace plates which have other defects.

(2) Inspect steel plates (external tanged plates) for burrs, scoring, excessive wear, cone, distortion, imbedded metal, galling, cracks, breaks, and damaged tangs. Remove burrs and minor surface irregularities, using a soft honing stone. Replace plates which have other defects.

(3) The amount of cone in clutch plates is determined by measuring the distance between the inside diameter of the plate and a flat surface (Figure 4–6). Discard plates having excessive cone (refer to Wear Limits, Section 8).

**o. Inspecting Swaged, Interference-Fit Parts.** If there is evidence of looseness, replace the assembly.

**p. Inspecting Balls in Clutch Housings.** Inspect all balls in rotating clutch housings for free movement. The minimum movement is 0.040 inch (1.02 mm). Any restriction could prevent the ball from seating during clutch application. Inspect staking that retains the balls.

**q. Inspecting Seal Contact Surfaces**

(1) Inspect the surfaces that contact the sealing area or lip of any seal. Correct any roughness, scoring, pitting, or wear that permits transmission fluid leakage or causes damage to the seal. Replace the affected part if defects cannot be corrected.

(2) Inspect sealring groove thrust faces for wear and surface finish condition. There must be no step, edge lip, or rough finish on the face. The thrust face of the sealring groove is always the face that is farthest from the fluid feed area between a pair of seals.

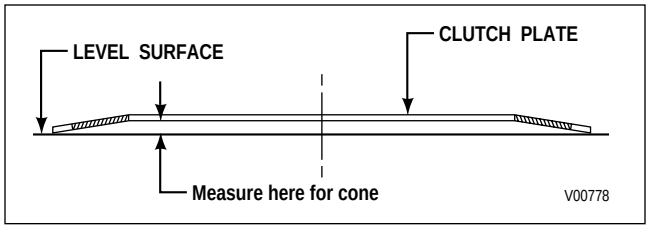



**Figure 4–6. Method of Measuring Clutch Plate Cone**

## *4–6. ASSEMBLY PROCEDURES*

**a. Clutches, Pistons**

(1) Establish clutch pack clearances prior to assembly. After clearances have been established, soak friction faced clutch plates in transmission fluid for at least two minutes and install each plate so that any cone is in the same direction as the cone of the adjacent plates.

(2) Apply a generous amount of transmission fluid to the piston cavity prior to final assembly.

**b. Parts Lubrication.** During final assembly, lubricate all moving parts with transmission fluid. The lubricant will help protect the friction surfaces and ferrous metals until the unit is in service.

**c. External Pipe Plugs, Hydraulic Fittings**

**CAUTION:**

**Inaccurate torque can cause leakage and cracked housings. Tighten all pipe plugs to the torque specified in the assembly step and on the exploded views.**

(1) **New Precoated Plugs**. New plugs that are precoated with Teflon® need no preparation for assembly.

(2) **Reused or Uncoated Plugs, Hydraulic Fittings**. Prepare the threads with a small amount of nonhardening sealant, such as Loctite® Pipe Sealant with Teflon®, or equivalent. **Do not use** Teflon® tape.

**d. Oil-Soluble Grease**

**CAUTION:**

- **Do not use gasket-type sealing compounds, fibrous greases, or nonsoluble, vegetable-base cooking compounds any place inside the transmission or where they could be flushed into the transmission hydraulic system.**
- **Do not use any substance as a gasket retainer.**

Use only oil-soluble grease with a low melting point (petrolatum) to temporarily retain parts, step-joint sealrings, scarf-cut sealrings, and hook-type sealrings during assembly with mating parts. The oil-soluble grease will help keep the sealrings centered in their grooves and will help protect the parts from damage.

**e. Lip-Type Seals** *(Metal-Encased)*

**CAUTION:**

**Do not use high-temperature grease on transmission internal parts.**

(1) When replacing metal-encased lip-type seals, make sure the spring-loaded lip side is toward the transmission fluid to be sealed in (toward the inside of the unit). Coat the inside of the seal with high temperature grease such as MIL-G-81322, Mobile Grease No. 28 (Mobile Oil Co.), Aeroshell Grease No. 22 (Shell Oil Co.), or equivalent, to protect the seal during shaft installation and to provide lubrication during initial operation.

(2) Allison seals are precoated with a dry sealant. The sealant is usually colored for easy identification. The precoated seals do not require any additional sealant before installation.

**f. Interference-Fit Parts.** Assembly of interference-fit parts may be accomplished by heating and chilling the respective parts. The female part can be heated in an oven or hot transmission fluid bath to 300°F (149°C), and the male part can be chilled in dry ice. Either one or both parts may require a thermal process. However, if the chill process is used for a ferrous alloy part, coat the components with transmission fluid to prevent rust due to frost and moisture.

**g. Sleeve-Type Bearings and Bushings.** The use of a locking compound such as Loctite® Sleeve Retainer 601, or equivalent, is recommended to retain bushings and sleeve-type bearings that have press-fit tolerances.

**h. Bearings** *(Ball or Roller)*

(1) When installing a bearing on a shaft, heat the bearing to 200°F (93°C) in an oven or in a transmission fluid bath. Bearings must be heated long enough for sufficient expansion. Heating time is determined by the size of the bearing. Forty-five minutes is sufficient for the largest bearing in these transmissions. Use the proper size installation sleeve and a press to seat the bearing.

(2) If a bearing must be removed or installed without a sleeve, **press only on the race which is adjacent to the mounting surface.** If a press is not available, seat the bearing with a drift and a hammer, driving against the supported race.

## *4–7. REMOVING (OR INSTALLING) TRANSMISSION*

**a. Drain Transmission Fluid.** Drain the transmission fluid from the transmission before removal from the vehicle. For better drainage, the transmission should be warm. Because applications will differ, consult the vehicle service manual for specific instructions for transmission removal and installation.

**b. Check Linkages and Lines.** Make sure that all linkage controls, cooler lines, temperature connection, input and output couplings, transmission fluid filler tube and other equipment such as attached parking brake handle, etc., and mounting bolts are disconnected before transmission removal. Carefully place hydraulic lines out of the way of damage and cover all openings to keep out dirt.

---

**NOTE:**

**Position jack or joint sling to coincide with the transmission center of gravity.**

---

**c. Remove, Clean Transmission.** Clean the exterior of the transmission. If steam cleaning is used, disassemble and dry the transmission immediately because condensation allowed to remain in the transmission could cause rust.

**d. Transmission Installation**

(1) Use a transmission jack to raise the transmission into mounting position. Mount the transmission.

(2) Make all connections from vehicle to transmission.

(3) Verify all mechanical and electrical connections.

(4) Fill the transmission with transmission fluid (Paragraph 3–5 through 3–10) and road test after installation.

## *4–8. WEAR LIMITS*

Refer to Table 8–1 for general and specific information covering parts fits, clearances, and wear limits.

## *4–9. SPRING SPECIFICATIONS*

Refer to Table 8–2 for spring identification and specifications.

## *4–10. TORQUE SPECIFICATIONS*

Torque specifications are given with each assembly procedure. Also, the exploded view foldouts state torque specifications for all threaded fasteners and plugs. The charts on the foldouts are keyed by capital letters to correspond with capital letters at the end of items in the legend.

# Section 5 – DISASSEMBLY OF TRANSMISSION

## *5–1. SCOPE*

This section covers disassembly of the transmission into subassemblies.

## *5–2. GENERAL INFORMATION*

**a. General Information.** Refer to Sections 4 and 8 for general information as follows:

| Paragraph | Title |
|---|---|
| 3–16 | Replacement of Components While Transmission is in the Vehicle Chassis |
| 4–2 | Tools and Equipment |
| 4–3 | Replacement Parts |
| 4–4 | Careful Handling |
| 4–5 | Cleaning and Inspection |
| 8–1 | Wear Limits Data |

**b. Removal of Exterior Hoses and Lines.** Remove hoses 1 and 4 (Foldout 13) and adapters as required, and any other exterior vehicle components attached to the transmission.

## *5–3. TRANSMISSION DISASSEMBLY*

**CAUTION:**

**The torque converter must be held into the transmission by a retaining device as shown in Figures 1–1 and 1–3. Be sure the retainer is in place before lifting the transmission.**

**a. Mounting of Transmission in Table-Mounted Holding Fixture**

---

**NOTE:**

- **For retarder-equipped models, proceed with Step (1).**
- **For models without retarder, skip Steps (1) through (5) and proceed with Step (6).**

---

(1) Remove four bolts 36 (Foldout 13) and remove retarder control valve body assembly 18 and transfer plate assembly 6 as an assembly.

(2) Remove gasket 1 and two jumper tubes 2.

(3) Remove four bolts 4 and flat washers 5 from the transfer plate assembly. Lift transfer plate assembly 6 from retarder control valve body assembly 18.

(4) Remove gasket 16, separator plate 17, and a second gasket 16.

(5) Refer to Paragraph 6–7 for rebuild of the retarder control valve body assembly. Refer to Paragraph 6–8 for rebuild of the transfer plate assembly. Skip Step (6) and proceed with Step (7).

(6) Remove PTO or six bolts 3 (Foldout 12,A), PTO cover 2, and gasket 1.

(7) Mount holding fixture J 23642-01 (Figure 5–1) onto PTO mounting pad.

(8) Install fixture base J 3289-20 onto work table.

(9) Using hoist as shown in Figure 5–1, lift transmission and holding fixture so that holding fixture J 23642-01 can be installed into fixture base J 3289-20. (Or, mount the transmission in a suitable turnover stand.)

(10) Secure fixture in fixture base and position the transmission with the torque converter upward (Figure 5–2).

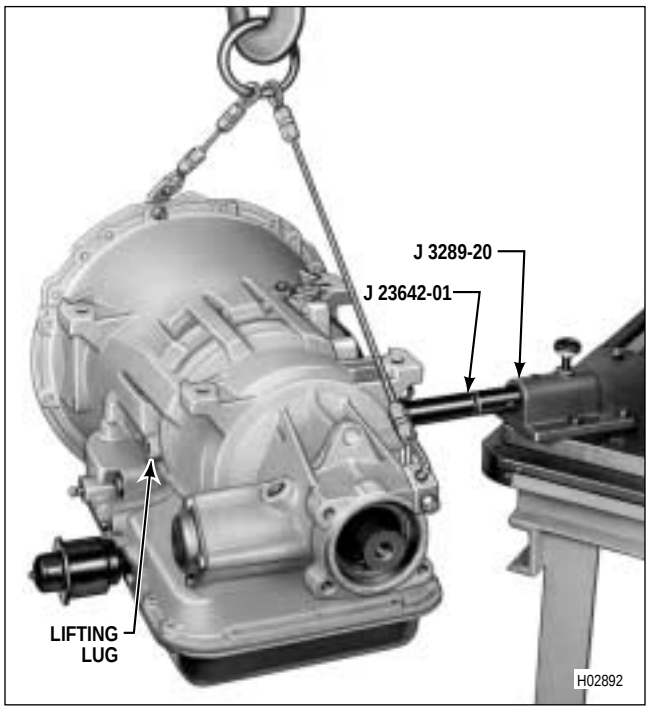



**Figure 5–1. Transmission in Holding Fixture**

**b. Removal of Torque Converter**

(1) Remove the bolts and nuts that hold the converter retaining device to the transmission housing.

(2) Attach a three-strand sling to the torque converter. Lift the converter from the transmission housing and place it on a work table (Figure 5–2).

(3) Refer to Paragraph 6–3 for inspection (and, for AT 543, rebuild) of the torque converter.

**c. Removal of Vacuum Modulator, Mechanical Actuator**

(1) Rotate the transmission, oil pan side upward.

(2) Remove the bolt and retainer from the transmission case (Figure 5–3).

(3) Remove the vacuum modulator (Figure 5–4). Remove the sealring from the modulator.

(4) For earlier models, remove the modulator valve actuator rod from the transmission case (Figure 5–4). Later model transmissions have an actuating rod retained in the modulator valve body. Refer to Paragraph 3–17**b** for vacuum modulator check.

**d. Removal of Breather**

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**NOTE:**

**Remove breather only if necessary.**

---

(1) Insert the end of a flat head screwdriver between the breather flange and main housing. Pry the breather up until there is room to insert a 7⁄16 inch wrench between the breather flange and main housing. Insert open end of 7⁄16 inch wrench under breather shroud 17 (Foldout 12,A) or under the shrouded cap of breather 7.

(2) Gently tap opposite end of wrench until open end of wrench is fully seated around breather 7.

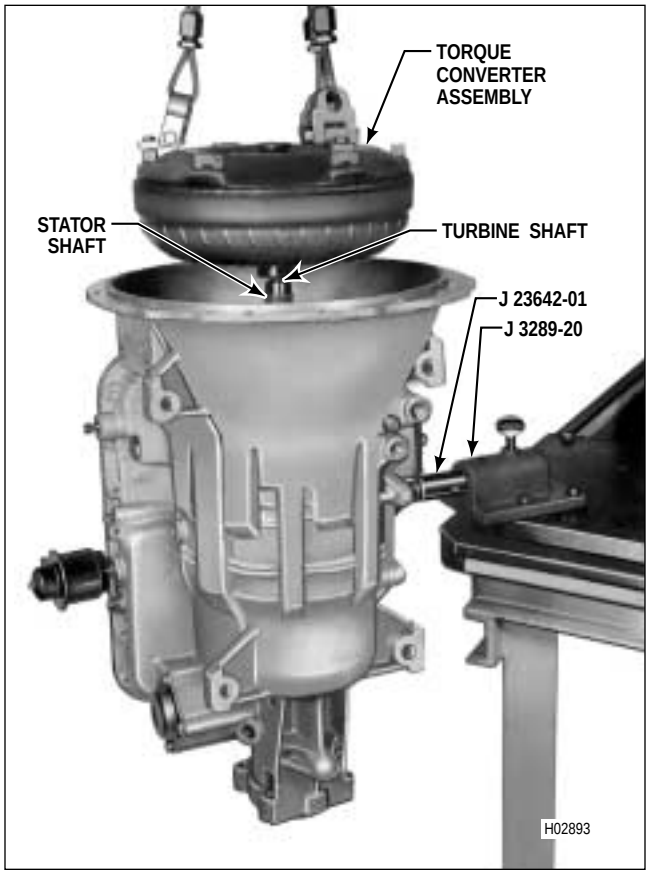


**Figure 5–2. Removing Torque Converter During Overhaul**

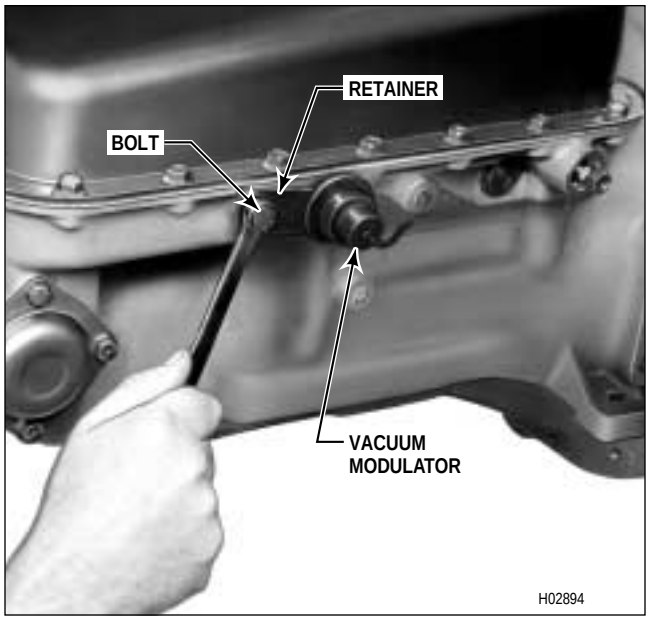


**Figure 5–3. Removing Vacuum Modulator Retainer Bolt**

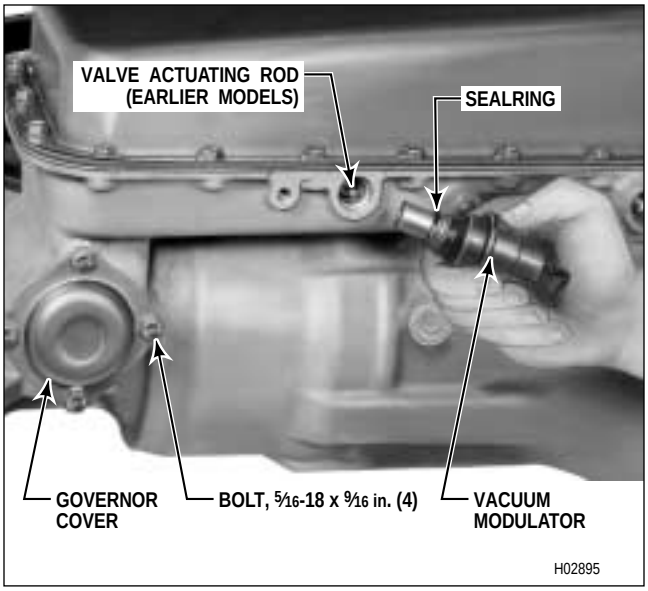


**Figure 5–4. Removing Vacuum Modulator**

(3) Firmly holding the end of the wrench opposite the breather, tap upward on the flat of the wrench, as near to the breather as possible. In most cases, two or three firm taps will release breather 7 from the transmission housing.

---

**NOTE:**

**If the breather is being removed so that a remote breather can be installed, use Allison-recommended breather adapter P/N 6884028.**

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### e. Removal of Governor

(1) Remove the four bolts that retain the governor cover (Figure 5–4). Remove the cover.

(2) Remove the governor assembly (Figure 5–5), rotating it clockwise to disengage the drive gears. Refer to Paragraph 6–5 for governor assembly inspection and rebuild.

(3) Remove the governor cover gasket.

### f. Removal of Oil Pan

(1) Remove the twenty-one screws that retain the oil pan.

(2) Remove the oil pan (Figure 5–6). Remove the pan gasket.

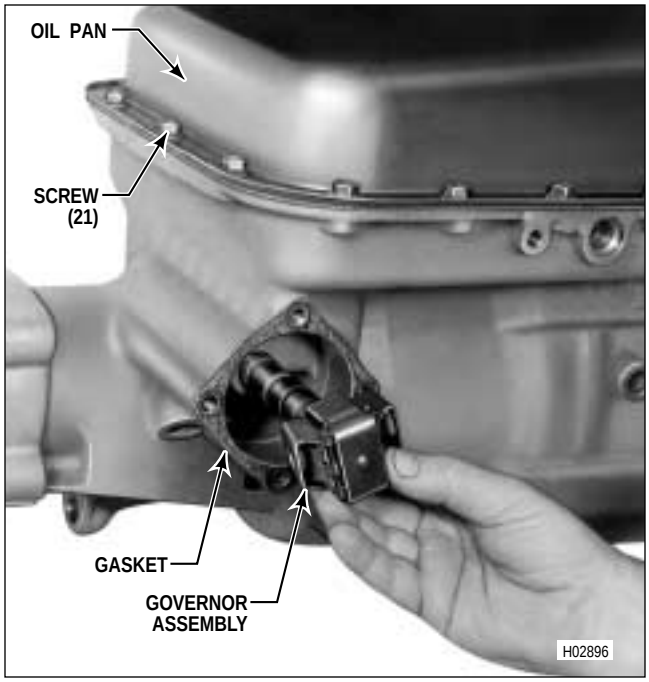


**Figure 5–5. Removing Governor Assembly**

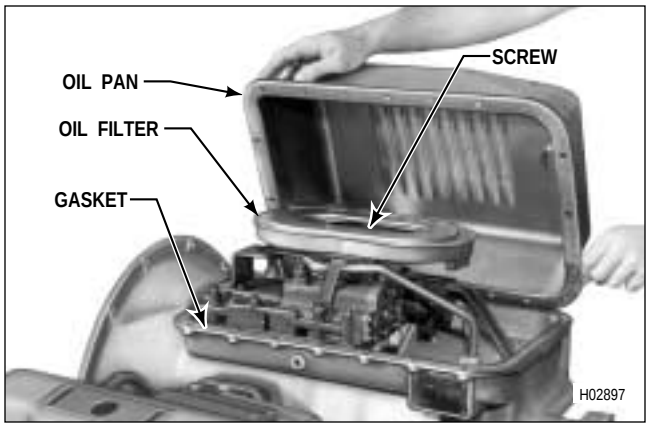


**Figure 5–6. Removing Oil Pan**

### g. Removal of Filter

(1) Remove washer-head screw 23 or 35 (Foldout 12,B), or bolt 42 and washer 43 that retains the filter (Figure 5–6). Remove the filter.

(2) Remove the intake tube and sealring (Figure 5–7).

### h. Removal of Main Control Valve Body

(1) Remove the bolt that retains the detent spring (Figure 5–7). Remove the spring.

(2) On later models, remove the two 3 inch bolts (Figure 5–7) that retain the first (reverse) clutch feed tube. Remove the tube.

(3) Remove the sixteen (seventeen or eighteen, earlier models) ¼-20 bolts that retain the main control valve body and filter spacer (if present).

**CAUTION:**

**Do not allow selector valve 53 (Foldout 11) to drop out of the main control valve body when the body is removed. Either tape or wire it in place, or remove it from the front of the valve body.**

(4) Install valve body handling tool J 29863 into the drilled boss in center of body and remove the main control valve body (Figure 5–7) by lifting upward on the body and the attached feed tubes.

(5) Remove the two feed tubes (three, earlier models). Remove the governor circuit screen, located in the governor feed tube bore (Figure 5–7).

(6) Refer to Paragraph 6–6 for rebuild of the main control valve body assembly.

(7) For earlier models, apply a small amount of oil-soluble grease to the end of a **nonmagnetic** rod (¼ inch diameter). Insert the rod (greased end first) into the valve body cavity and remove the steel check ball (Figure 5–8).

(8) Remove the center support anchor bolt and flat washer (Figure 5–8).

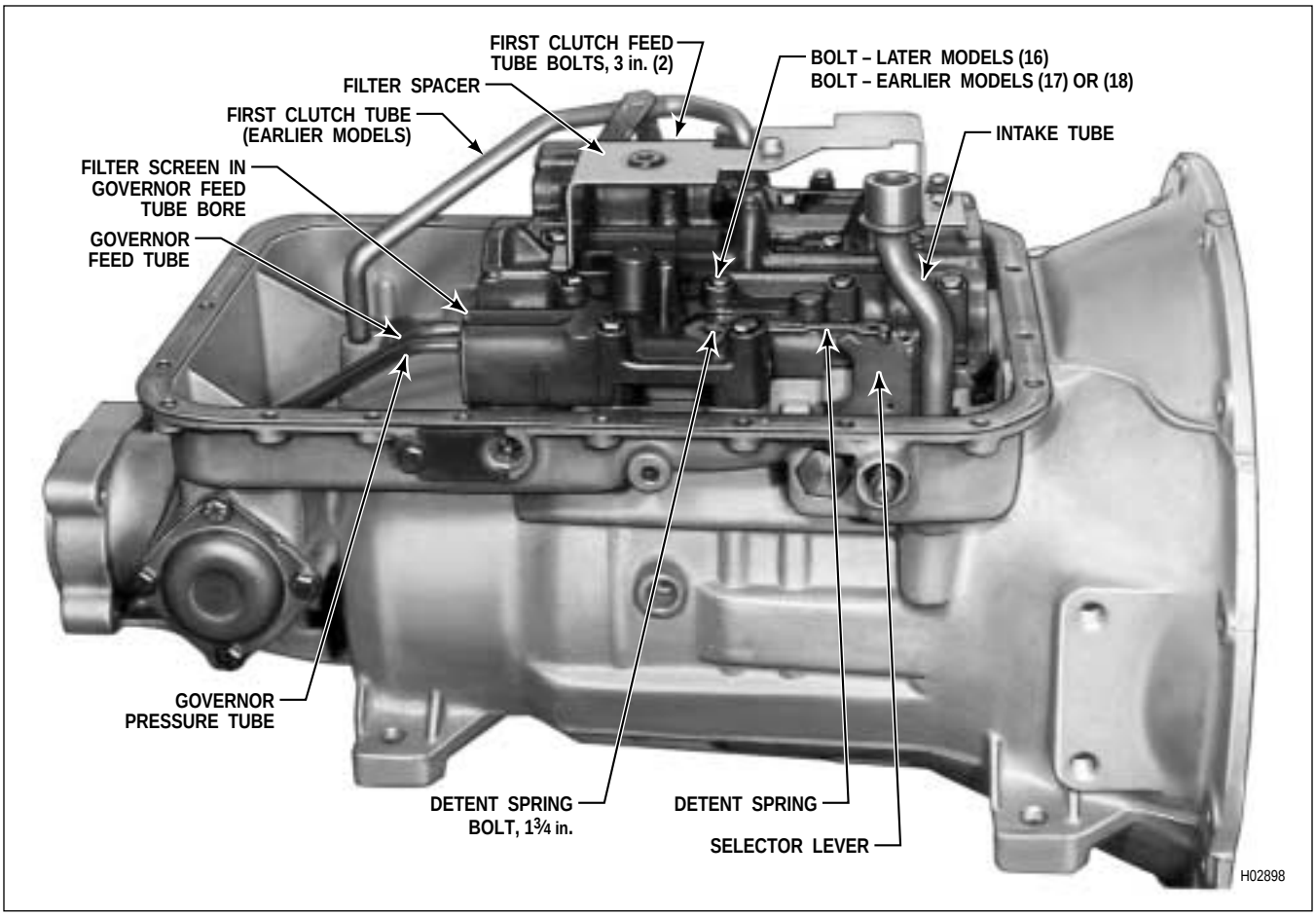


**Figure 5–7. Removing Main Control Valve Body**

**i. Removal of Pump**

(1) Rotate the transmission so that the torque converter end is upward.

(2) Remove the nine bolts and washers from the outer bolt circle that retain the front support. Discard the washers.

(3) For retarder models, remove six M6-1 bolts 39 (Foldout 7,B) and rubber-coated washers 40.

**NOTE:**

**The pump body can be removed by either of two methods. If the slide hammer (J 6125-1B) method is to be used, proceed to Step (4). If puller J 24773-A (J 39738 AT 1500 Series) method is to be used, skip Steps (4) and (5) and proceed to Step (6).**

(4) Remove two bolts and washers from the locations in the pump body as shown in Figure 5–9 or 5–10. Install two J 6125-B slide hammers into J 6125-2 adapters.

**NOTE:**

**The two holes where the slide hammers are shown in place in Figures 5–9 and 5–10 are threaded for the J 6125-2 adapters.**

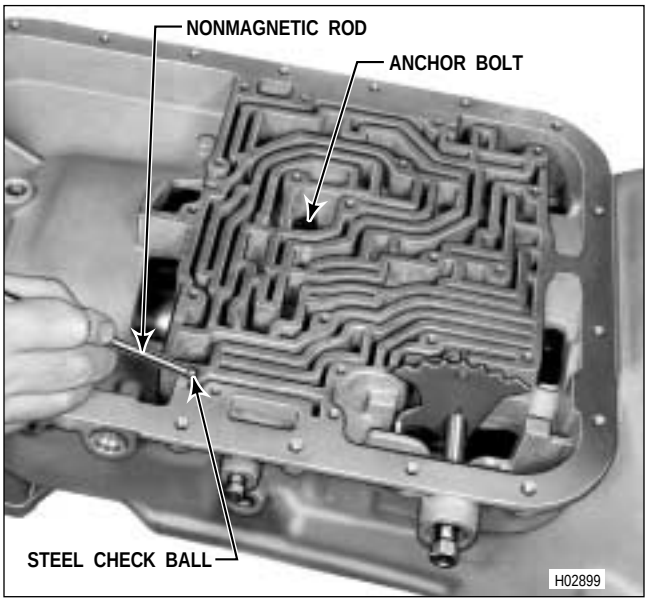


**Figure 5–8. Removing Governor Check Ball (Earlier Models)**

(5) Install the assembled slide hammers into the pump. Hammer upward with the slide hammers to loosen the pump assembly. When free, lift the pump assembly out of the transmission case. Remove the slide hammers, and replace the two bolts and washers removed. Do not tighten the bolts. Proceed to Step (7).

(6) Install tool J 24773-A, AT 500 Series; or J 39738, AT 1500 Series below the ground sleeve splines. Turn the screw against the turbine shaft, drawing the pump assembly up and out of the main case. Remove the tool.

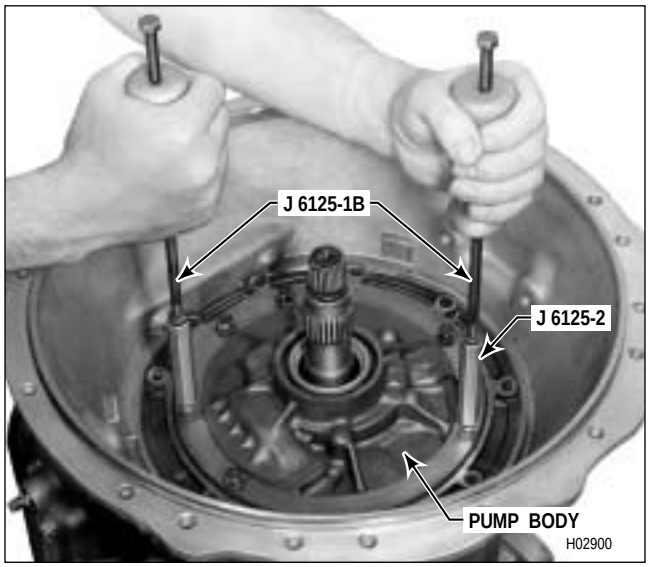


**Figure 5–9. Removing Pump Assembly (Models without Retarder)**

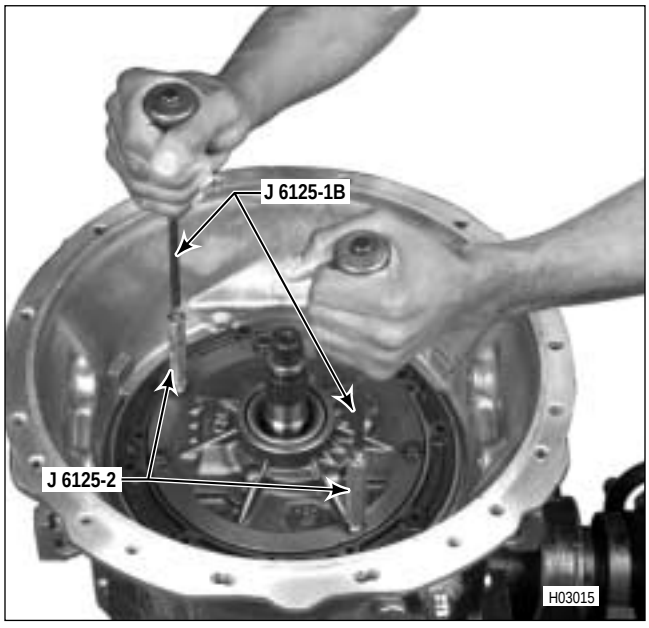


**Figure 5–10. Removing Pump Assembly (Models with Retarder)**

(7) Remove two hook-type sealrings 38 (Foldout 7,B) and thrust washer 37 from the pump assembly. Refer to Paragraph 6–7 for rebuild of the pump assembly.

(8) Remove the front support gasket (Figure 5–11 or 5–12).

---

**NOTE:**

- **For models without retarder, proceed with Paragraph 5–3*j*.**
- **For models with retarder, skip Paragraph 5–3*j* and proceed with Paragraph 5–3*k*.**

---

### j. Removal of Forward Clutch and Turbine Shaft

(1) Grasp the turbine shaft (Figure 5–11) and lift out the forward clutch and turbine shaft assembly.

(2) Remove thrust washer 33 (Foldout 8) from the rear of the forward clutch assembly. Refer to Paragraph 6–9 for rebuild of the forward clutch and turbine shaft assembly.

### k. Removal of Retarder Components, Forward Clutch and Turbine Shaft

(1) Grasp the turbine shaft 14 and lift out the forward clutch and turbine shaft assembly (Figure 5–13).

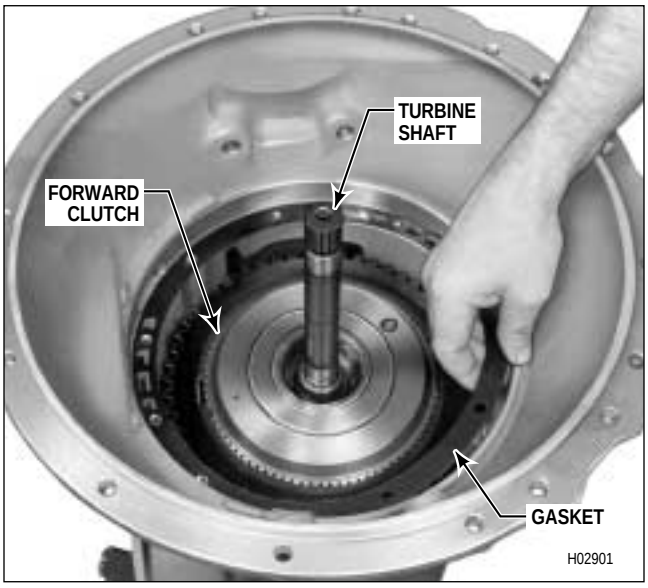


**Figure 5–11. Removing Front Support Gasket (Models Without Retarder)**

(2) Lift the front stator from the forward clutch assembly (Figure 5–13).

(3) Remove thrust washer 31 (Foldout 8) from the rear of the forward clutch assembly. Refer to Paragraph 6–8 for rebuild of the forward clutch and turbine shaft assembly.

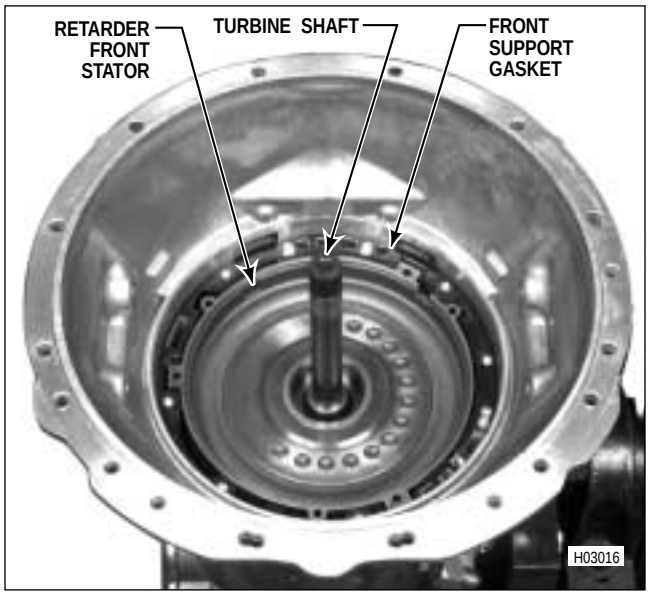


**Figure 5–12. Removing Front Support Gasket (Models With Retarder)**

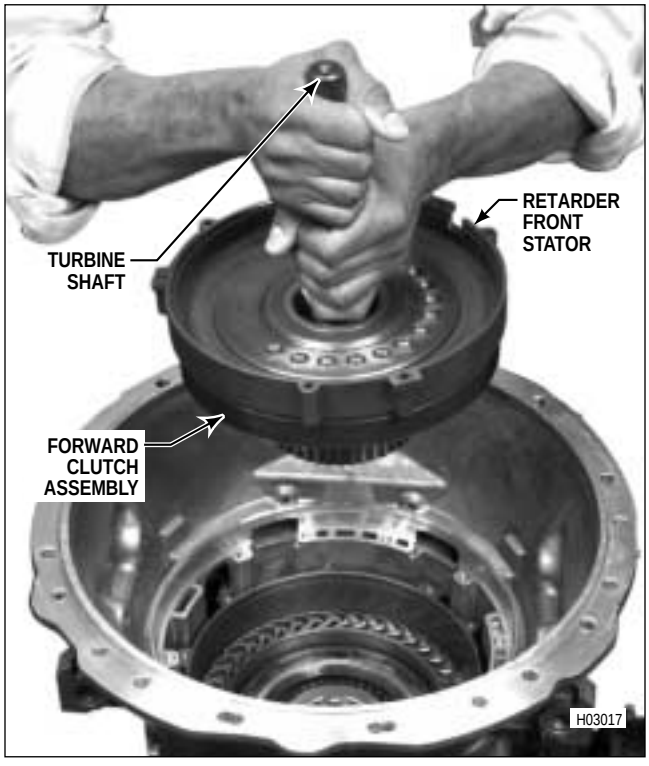


**Figure 5–13. Removing Forward Clutch and Turbine Shaft Assembly and Front Stator (Models With Retarder)**

(4) Remove the retarder housing assembly (Figure 5–14). Refer to Paragraph 6–10 for rebuild.

### l. Removal of Fourth Clutch

(1) Grasp the spring retainer on the fourth clutch (Figure 5–15), and lift out the fourth clutch assembly. Refer to Paragraph 6–11 for rebuild of the fourth clutch assembly.

(2) Remove the sun gear shaft (Figure 5–16).

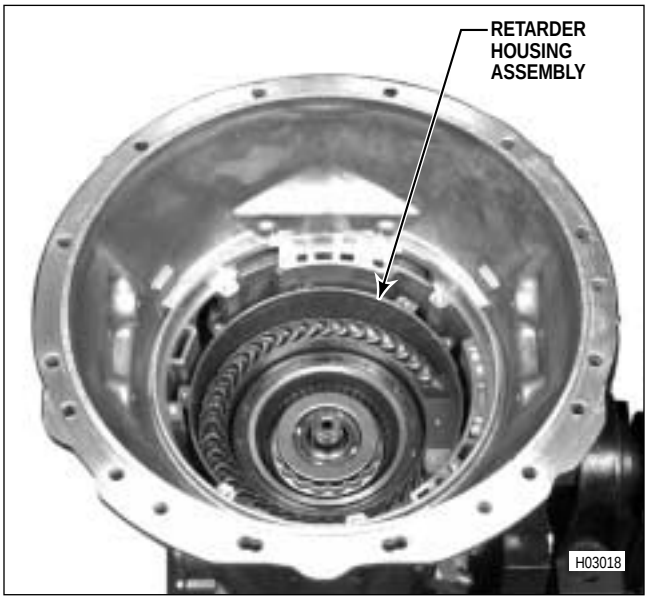


**Figure 5–14. Removing Retarder Housing Assembly (Models With Retarder)**

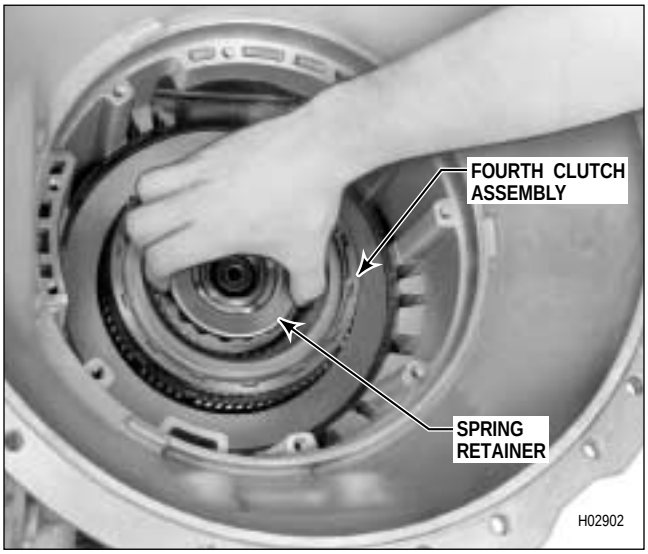


**Figure 5–15. Removing Fourth-Clutch Assembly**

### m. Removal of Third Clutch

**NOTE:**

- **For models without retarder, proceed with Step (1).**
- **For models with retarder, skip Steps (1) and (2) and proceed with Step (3).**

(1) Remove the snapring that retains the third clutch backplate (Figure 5–16).

(2) Remove the backplate (Figure 5–16).

(3) Remove six (models without retarder) or seven (models with retarder) third clutch plates (Figure 5–17).

### n. Removal of Center Support Assembly

(1) Remove the snapring that retains the center support assembly (Figure 5–17). This is a selective thickness snapring.

(2) Install center support lifting bracket J 23643 into the recess between the hook-type sealrings on the center support hub (Figure 5–18).

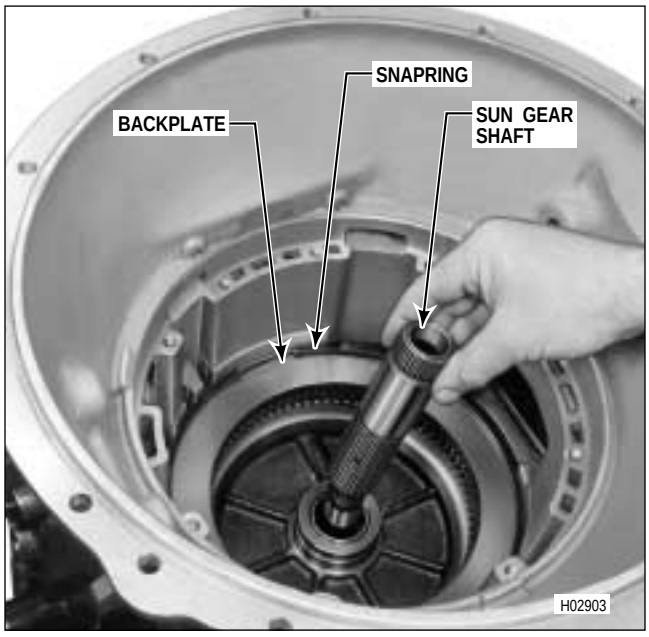


**Figure 5–16. Removing Sun Gear Shaft Assembly (Models Without Retarder)**

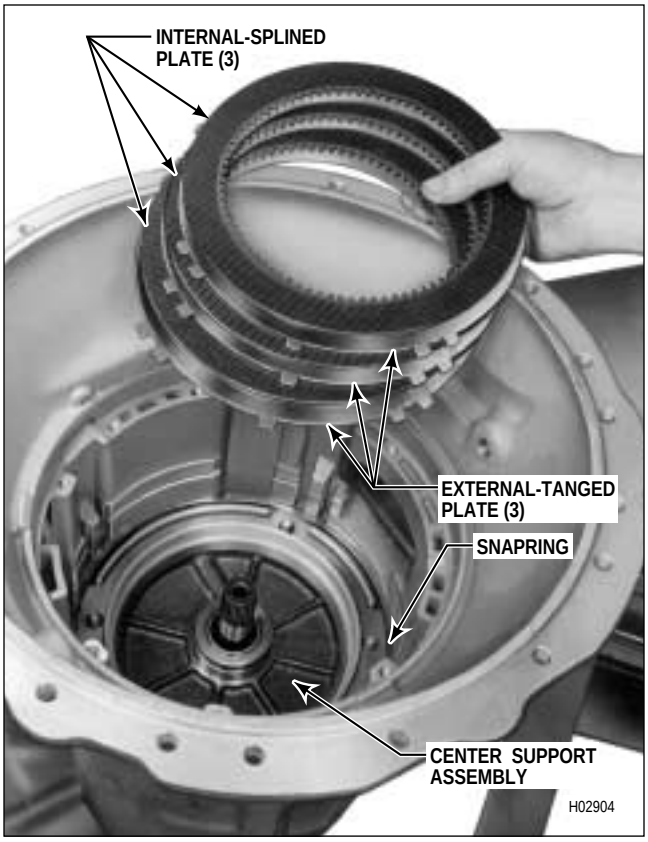


**Figure 5–17. Removing Third Clutch Plates**

**CAUTION:**

**The center support is fitted to the transmission case with very little clearance. It may bind in the case if the case is cold. Heat the case slightly, if necessary. DO NOT USE a torch to heat the case. A sun lamp, or a current of warm air is sufficient. If the support assembly starts upward and then binds, tap it downward and lift again.**

(3) Lift carefully, straight upward, on the lifting bracket to remove the center support assembly. Refer to Paragraph 6–12 for rebuild of the center support assembly.

(4) Remove thrust washer 5 (Foldout 10,A) from the front planetary sun gear (Figure 5–19).

**o. Removal of Planetary Gearing**

(1) If not previously removed, remove the rear output flange.

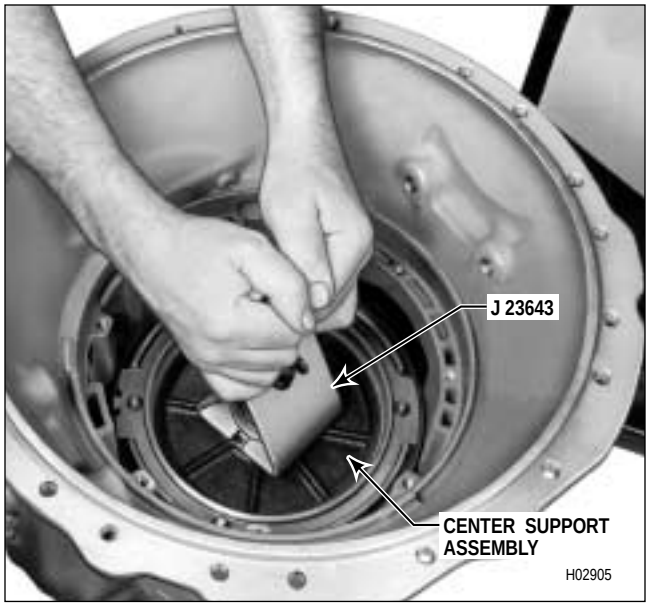


**Figure 5–18. Removing Center Support Assembly**

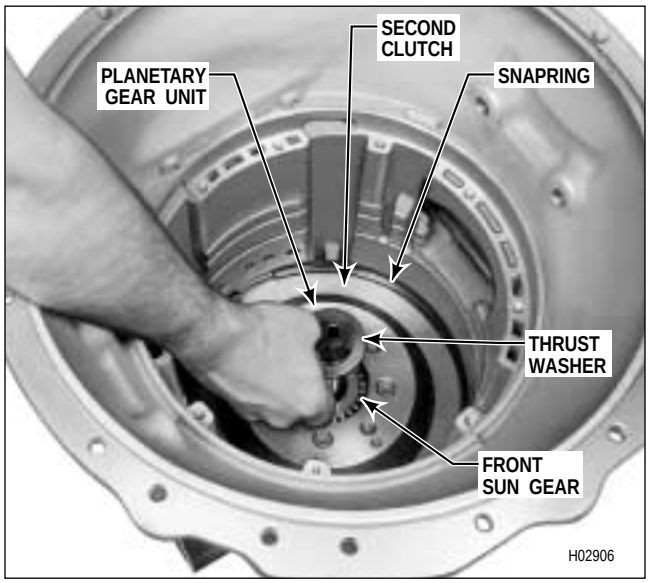


**Figure 5–19. Removing Front Sun Gear Thrust Washer**

**NOTE:**

**It may be necessary to tap upward on the output shaft with a soft-faced mallet while lifting on the gear unit.**

(2) Grasp the transmission main shaft, and lift the planetary gear unit out of the transmission case (Figure 5–20).

(3) Refer to Paragraph 6–11 for rebuild of the planetary gear unit.

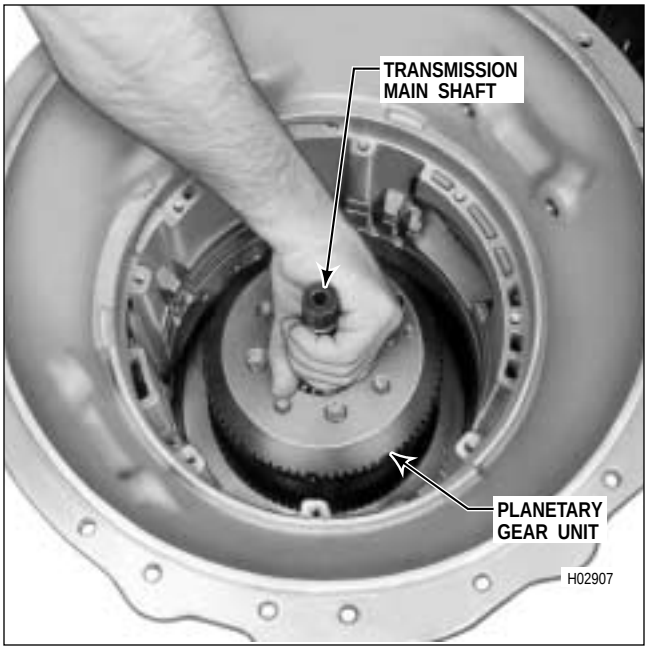


**Figure 5–20. Removing Planetary Gear Unit**

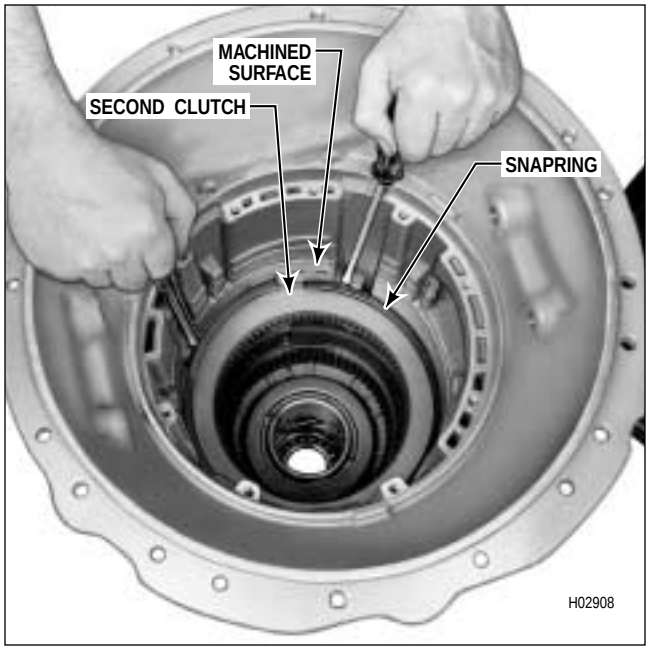


**Figure 5–21. Removing Second Clutch Snapring**

(4) Governor drive gear 1 (Foldout 12,B), speedometer drive gear 2 or speed sensor wheel 9, and spacer 3 may come out with the gear unit, or may stay in the transmission. Remove these parts.

### p. Removal of Second Clutch

**CAUTION:**

**When removing the second clutch snapring, do not allow the snapring to drag across the machined surface (surface with four holes through it). Dragging the snapring may result in leaks between the passages and/or leaks to the sump.**

(1) Remove the snapring that retains the second clutch (Figure 5–21).

(2) Remove three external-tanged and three internal-splined second clutch plates (Figure 5–21).

(3) Remove the second clutch backplate (Figure 5–22).

### q. Removal of First Clutch

(1) Remove snapring 1 (Foldout 10,B) that retains first clutch backplate 2. Remove the backplate.


**Figure 5–22. Removing Second Clutch Backplate**

(2) Remove the ring gear and clutch pack as a unit from the main case. On earlier models, the rear ring gear is part of the rear carrier assembly and is removed with the planetary gear unit.

(3) Install first clutch spring compressor assembly J 23630-02 (Figure 5–23). Tighten nut J 23630-3 until the snapring is clear of the spring retainer.

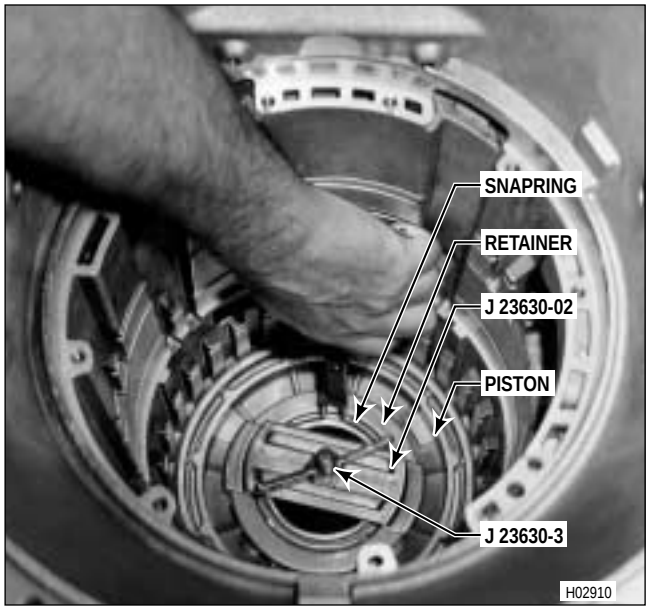


**Figure 5–23. Removing First Clutch Spring Retainer Snapring**

**WARNING!**

**When removing the first clutch snapring, do not allow the spring retainer to catch in the snapring groove. Failure to observe this warning may result in personal injury and damage to the spring retainer.**

(4) Remove the snapring. Remove the compressor assembly.

(5) Remove the spring retainer and the twenty-two piston return springs.

(6) Remove the first clutch piston (Figure 5–23). Remove the two lip-type sealrings from the piston.

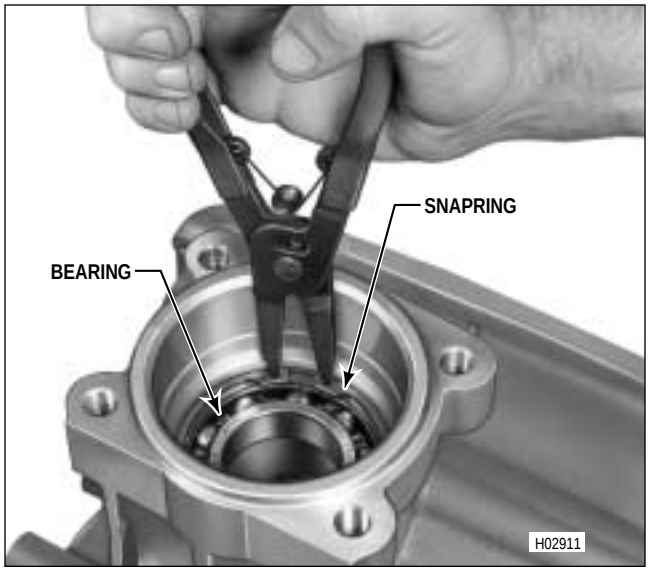


**Figure 5–24. Removing Output Shaft Bearing Snapring**

### r. Removal of Output Shaft Seal and Bearing

(1) Rotate the transmission so that the output is upward. Remove output seal 6 (Foldout 12,B) from the rear of the transmission housing.

(2) Clean the bore from which the seal was removed.

(3) Remove the snapring that retains the output shaft bearing (Figure 5–24).

(4) Remove the bearing from its bore.

(5) Remove the transmission housing, with its remaining attached parts, from the transmission holding fixture. Refer to Paragraph 6–14 for rebuild of the transmission housing.

# Section 6 – REBUILD OF SUBASSEMBLIES

## *6–1. SCOPE*

This section contains the rebuild procedures for the subassemblies which were removed in Section 5.

## *6–2. GENERAL INFORMATION FOR SUBASSEMBLY REBUILD*

Refer to Sections 4 and 8 for general overhaul information as follows:

| Paragraph | Description |
|---|---|
| 4–2 | Tools and Equipment |
| 4–3 | Replacement Parts |
| 4–4 | Careful Handling |
| 4–5 | Cleaning and Inspection |
| 4–6 | Assembly Procedures |
| 4–10 | Torque Specifications |
| 8–1 | Wear Limits Data |
| 8–2 | Spring Data |

## *6–3. INSPECTING AND TESTING TORQUE CONVERTER*

**CAUTION:**

**Allison Transmission Division GM recommends only genuine Allison torque converters for use with any AT 500, 1500 Series Allison transmissions. Any transmission damage that may occur as a result of using a converter other than a new Allison converter or a genuine Allison replacement is the responsibility of the owner and will not be covered by Allison warranty.**

**NOTE:**

**Because the torque converter assembly for models other than the AT 543 is closed and welded after assembly of the internal parts, no repairs can be made. The assembly can be tested, however, to determine its condition in two areas. End play of the internal elements can be measured, and the outer shell can be tested for leaks.**

**a. Preliminary Inspection.** Clear the torque converter of transmission fluid. Examine the fluid for evidence of foreign matter or metal particles, indicating transmission or converter internal damage.

**b. End Play Check**

(1) To check for end play, support the converter assembly on the converter cover (pump hub upward). Place converter end play gauge J 24602 into the converter pump hub (Figure 6–1).

(2) Retain the body of the gauge in the pump hub with one hand while rotating the center screw with the other hand, locking the gauge to the turbine hub. Do not overtighten.

(3) Assemble J 5959-1, J 5959-3, J 5959-7, J 7872-2, and J 7872-3 as shown in Figure 6–1. Install the above items onto the converter pump hub as shown.

(4) Adjust lug attachment J 5959-7 so the dial will make firm contact with the top of end play gauge J 24602.

(5) Set the dial to read zero and lift J 24602 as far as possible.

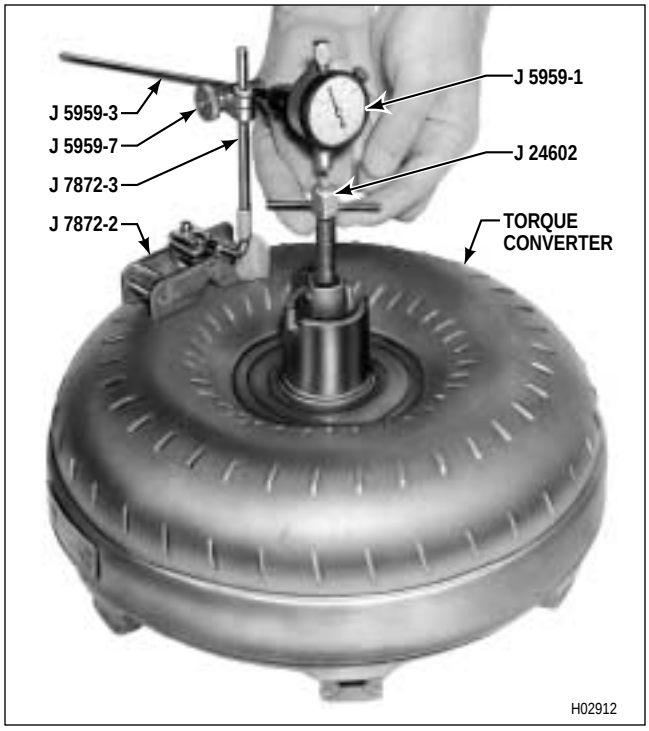


**Figure 6–1. Checking End Play of Torque Converter Element**

(6) The dial indicator reading must not exceed the values listed in Table 6–1. If the converter end play exceeds the value listed, replace the torque converter assembly.

**Table 6–1. Converter Turbine End Play**

| Converter | Max End Play |
|---|---|
| New Converter | 0.016 inch (0.41 mm) |
| Used Converter | 0.037 inch (0.94 mm) |

**c. Leak Check**

(1) To check for leaks, install leak test fixture J 21369-E onto the converter (Figure 6–2). The center body must be installed first, with its nut loosened (toward top of body).

(2) Place the converter and the center body in the fixture bracket. Tighten the nut firmly to seal the center body in the torque converter hub.

(3) Pressurize the converter to 75 psi (517 kPa) maximum. Submerge the pressurized assembly in water and observe closely for bubbles that indicate leakage. If the assembly leaks, replace it.

**WARNING!**

**Be sure all pressure is exhausted from the torque converter before loosening the text fixture nut and removing the test fixture.**

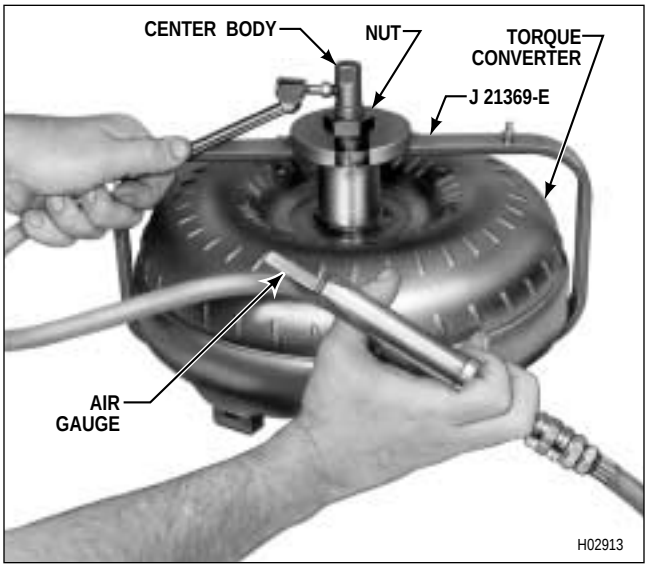


**Figure 6–2. Pressurizing Torque Converter for Leak Test**

(4) Release the air from the torque converter by pushing on the valve stem in the air fitting on the center body.

**d. Inspection of Hub**

(1) Inspect the converter hub seal and bushing area for scoring, burrs, scratches and nicks. There must be no cracks starting at the weld area.

(2) In order to pass inspection, the OD of the hub in the bushing wear area must be 1.872–1.875 inch (47.54–47.63 mm) for AT 500 Series (other than AT 543), and 1.999–2.000 inch (50.77–50.80 mm) for AT 1500 Series torque converters.

**e. Preparation for Reuse of Converter.** If the torque converter is to be reused, flush the converter to remove any foreign material.

## *6–4. TORQUE CONVERTER ASSEMBLY — AT 543 MODELS*

**a. Preliminary Check of End Play.** Check the torque converter for end play of internal components as outlined in Paragraph 6–3**b**. Record the end play for subsequent selection of spacer 10 (Foldout 7,A).

**b. Disassembly** *(Foldout 7,A)*

(1) Remove six retainers 3 and spacers 4 from cover 5.

(2) Remove the twenty-four nuts that retain the converter front cover (Figure 6–3).

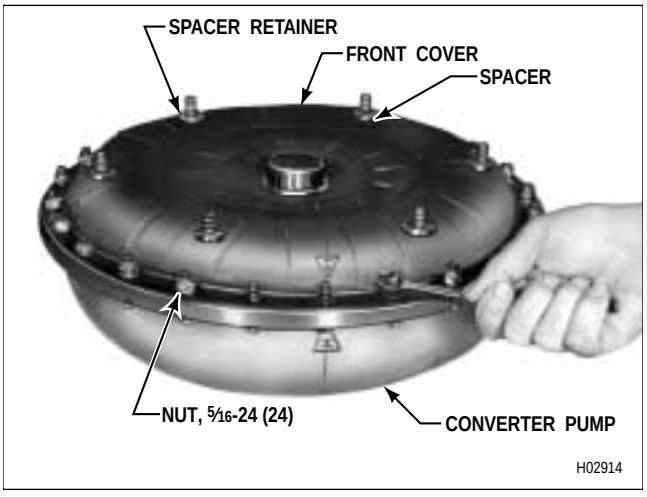


**Figure 6–3. Removing (or Installing) Torque Converter Cover Nuts (AT 543)**

(3) Remove the front cover (Figure 6–4). Remove the front cover sealring.

(4) Remove two bearing races, bearing, and bearing spacer (Figure 6–5).

**NOTE:**

**Some of these parts may have adhered to the cover when it was removed.**

(5) Lift off the converter turbine (Figure 6–6).

(6) Lift off the stator assembly, using care that the freewheel roller race does not fall out (Figure 6–7).

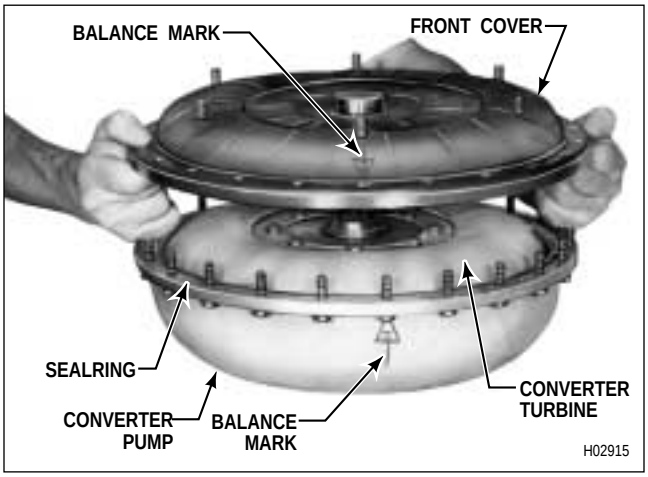


**Figure 6–4. Removing (or Installing) Torque Converter Cover (AT 543)**

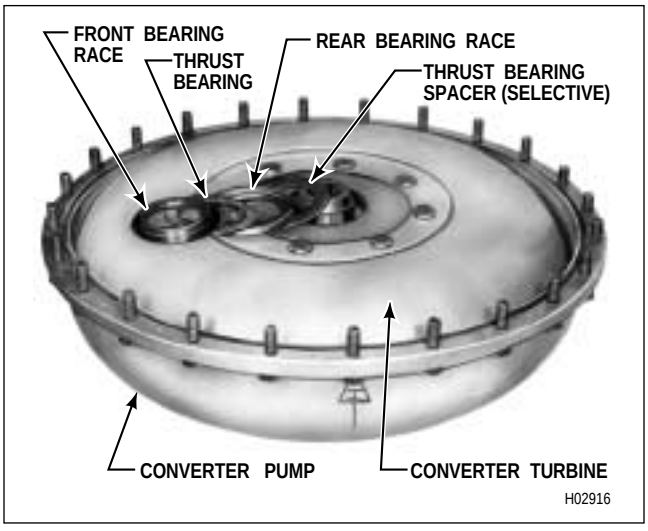


**Figure 6–5. Removing (or Installing) Spacer, Bearing, and Races at Front of Torque Converter Turbine (AT 543)**

(7) Position the stator assembly front downward, and remove the freewheel roller race by rotating it clockwise while lifting.

(8) Remove ten rollers 26 (Foldout 7,A) and ten springs 27.

(9) Thoroughly inspect needle bearing assembly 24. Wash and flush the needle bearing assembly thoroughly with mineral spirits. Dry the bearing and lubricate it with transmission fluid. Install freewheel roller race 25 into stator and bearing assembly 15. Rotate the stator and bearing assembly against the freewheel race. If there is no roughness or binding, the needle bearing assembly may be left in the stator and cam assembly and reused. Check the needle bearing end of freewheel race 25 for smooth finish. Replace freewheel race 25 and bearing 24 if the bearing end of the race is scratched or contains chatter marks.

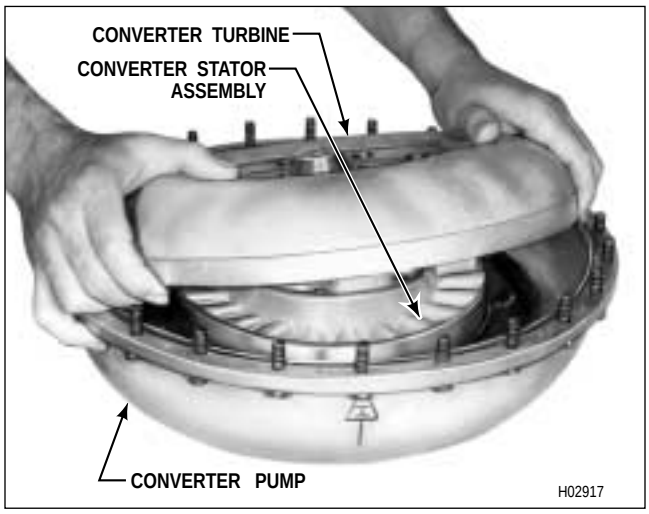


**Figure 6–6. Removing (or Installing) Torque Converter Turbine (AT 543)**

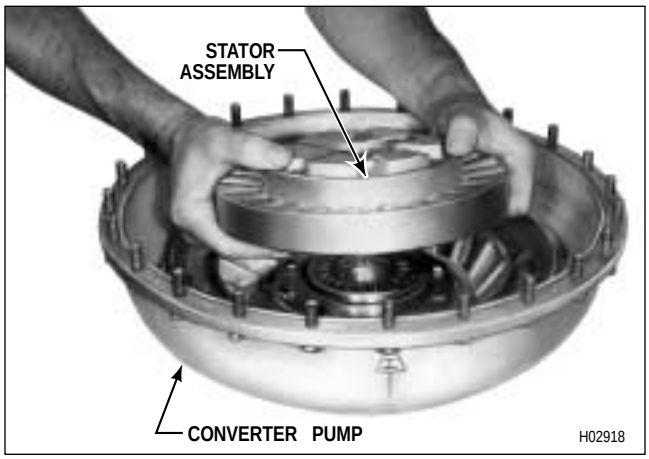


**Figure 6–7. Removing (or Installing) Torque Converter Stator Assembly (AT 543)**

(10) Remove the needle bearing assembly and bearing race from the converter pump (Figure 6–8).

(11) Flatten the corners of lockstrips 29 (Foldout 7,A). Remove eight bolts 28 and the lockstrips.

(12) Remove hub 30 and gasket 31 from converter pump 35.

(13) Do not remove bolts 36 unless new bolts are needed.

---

**NOTE:**

- **If needle bearing assembly 24 needs replacement but stator assembly 16 does not need to be replaced, proceed to Paragraph 6–4*c*.**
- **If stator and bearing assembly 15 is damaged, replace the assembly.**

---

**c. Replacement of Needle Bearing Assembly in Stator Assembly**

**CAUTION:**

**Do not scratch or nick any stator bores. Do not attempt to disassemble the stator and cam assembly unless replacement is required.**

(1) Place the stator assembly on a work table front side upward. Tap the bearing gently from its bore. Do not nick or scratch the aluminum bore during removal.

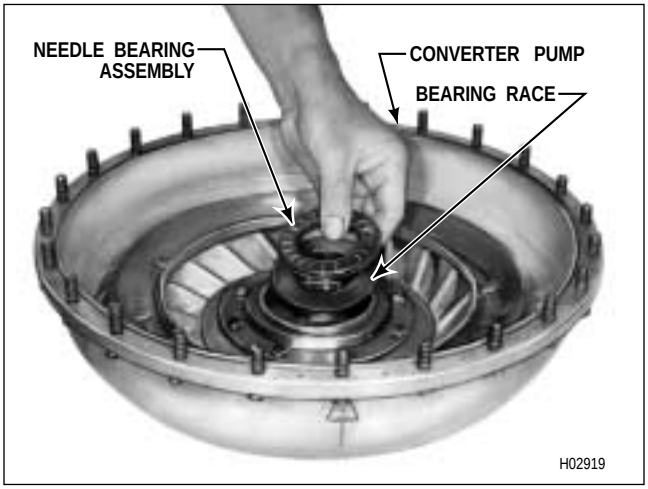


**Figure 6–8. Removing (or Installing) Torque Converter Pump Bearing and Race (AT 543)**

(2) Place a new bearing assembly into the aluminum bore of the stator. Using bearing installer tool J 23549 and handle J 24202-4, install the thrust bearing (Figure 6–9).

**CAUTION:**

**Apply the load only to the outer shell of the bearing during installation (Figure 6–9).**

(3) Drive the bearing assembly to a height of 0.025–0.035 inch (0.64–0.89 mm) above the shoulder in the side plate (Figure 6–10). The installing tool will seat on the stator area surrounding the bearing when the bearing is properly installed.

**d. Assembly** *(Foldout 7,A)*

(1) Install new gasket 31 onto converter pump 35. Install hub 30 into pump 35. Align the holes in the hub and gasket with the holes in the pump.

(2) Install four new lockstrips 29 and eight ¼-20 x ⅝ inch bolts 28 through hub 30 and into pump 35. Tighten the bolts to 9–11 lb ft (12–15 N·m). Bend the corners of the lockstrips against the bolt heads.

(3) Replace any converter pump flange bolts 36 necessary and make sure any weights are in their original positions if pump bolts have been removed.

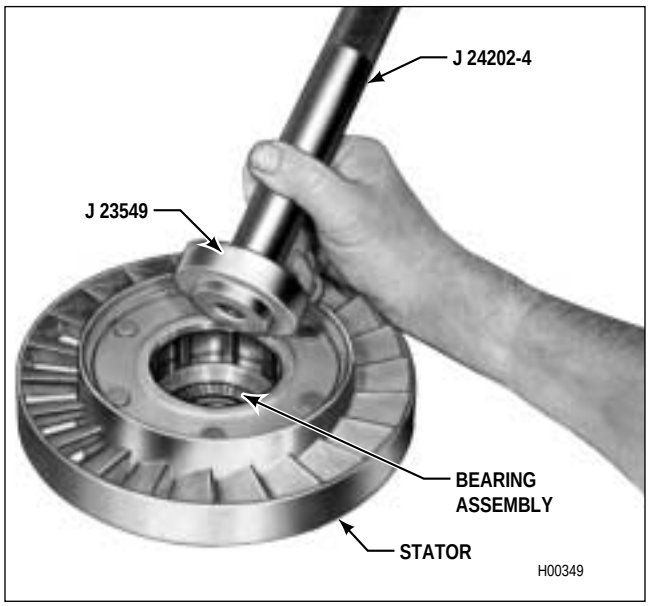


**Figure 6–9. Installing Stator Thrust Bearing (AT 543)**

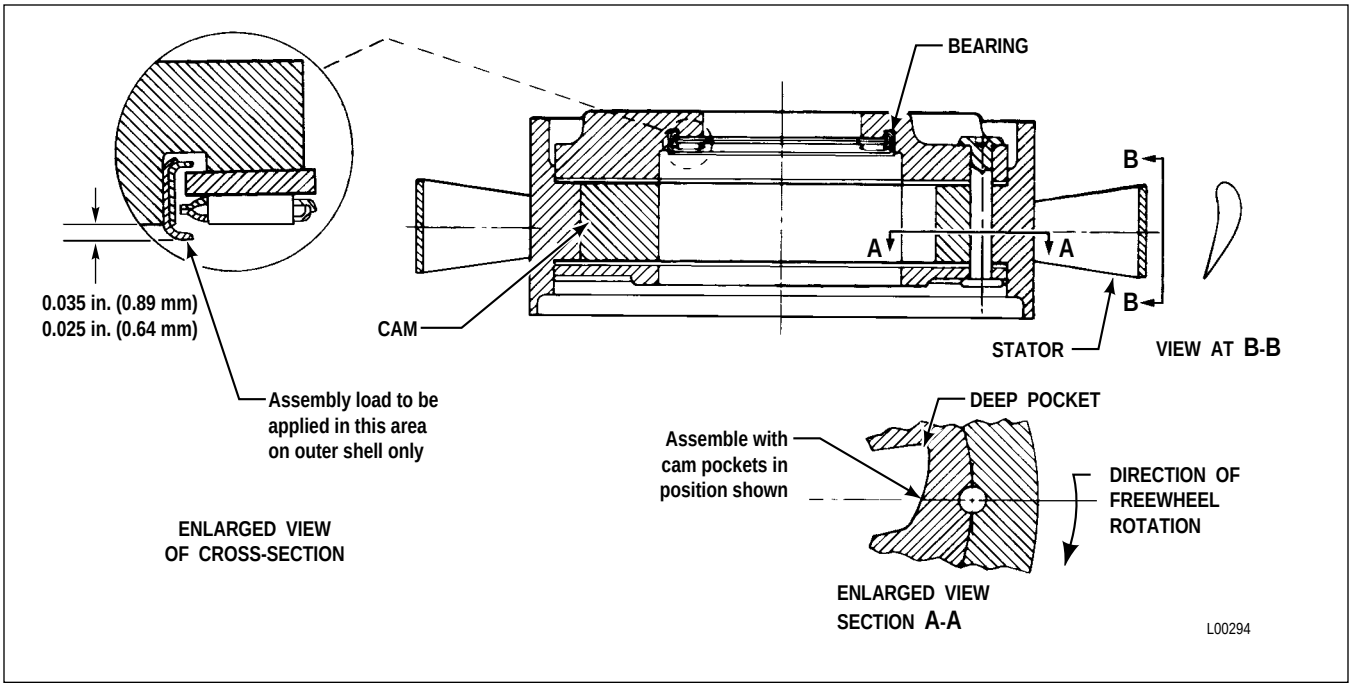


**Figure 6–10. Stator Bearing Installation (AT 543)**

(4) Install the bearing race and needle bearing assembly into the converter pump hub (Figure 6–8).

(5) Place the stator and bearing assembly on the work table with the bearing side down (Figure 6–11). Cover the bottoms of the stator cam pockets with oil-soluble grease. Install collapsible retainer J 24218-1 with cord attached as shown in Figure 6–11.

(6) Install ten freewheel rollers and ten springs. The open end of the spring touching the roller must be toward the center of the stator cam assembly (Figure 6–12). The rollers are installed in the shallow ends of the cam pockets.

(7) Install the freewheel roller race, in the position shown in Figure 6–11, until the race engages the rollers. Rotate the race in a clockwise direction while pressing downward until the race touches the collapsible retainer. Lift up on the stator assembly and pull on the cord to remove the retainer. Continue rotating the race while pressing downward. When the race is fully seated, rotate it firmly in the opposite direction to lock the stator and cam assembly.

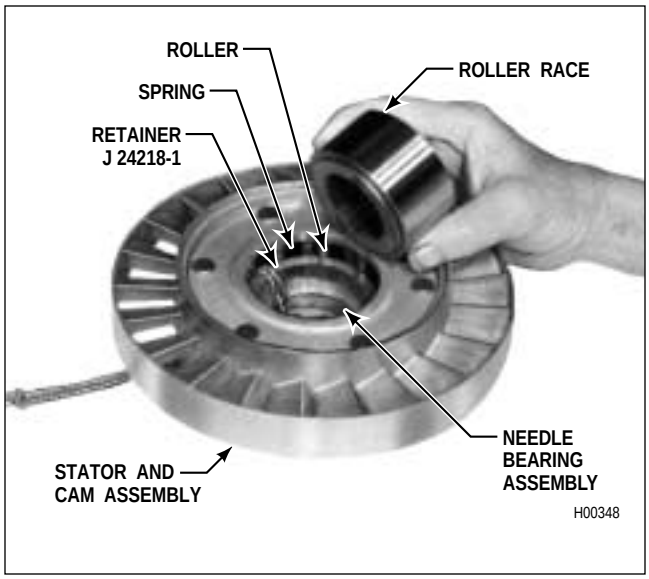


**Figure 6–11. Installing Freewheel Roller Race (AT 543)**

(8) Grasp the stator and cam assembly as shown in Figure 6–7 and install it onto the converter pump hub. Hold the roller race firmly to retain it in position.

(9) Install the converter turbine assembly (Figure 6–6).

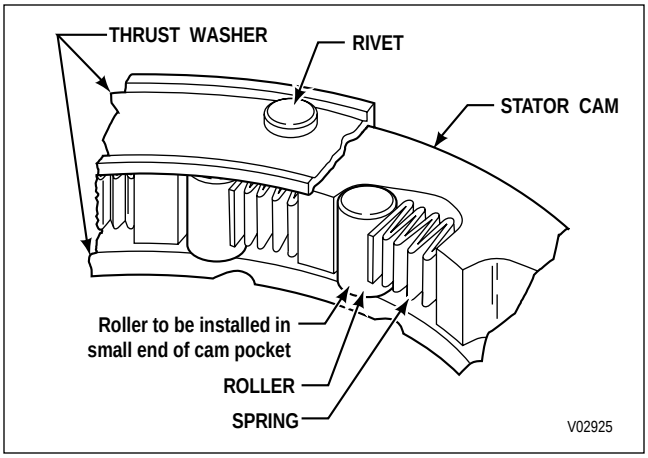


**Figure 6–12. Spring and Roller in Stator Cam (AT 543)**

**NOTE:**

**If no parts were replaced with new parts that affect converter end play (items 5, 11, 15, 25, 30, or 35 in Foldout 7,A) and if the end play recorded in Paragraph 6–4*a* was 0.025 inch (0.64 mm) maximum, proceed with Steps (10) through (17). If any of the listed items were replaced or if the end play recorded in Paragraph 6–4*a* was greater than 0.025 inch (0.64 mm), disregard Steps (10) through (17) and proceed with Steps (18) through (27).**

(10) Install the same color selective thrust bearing spacer as was removed in Paragraph 6–4**b**(4) (Figure 6–5).

(11) Using transmission fluid, lubricate the rear bearing race and install it, flat side first, onto the spacer (Figure 6–5).

(12) Lubricate the thrust bearing, and install it onto the bearing race (Figure 6–5).

(13) Using oil-soluble grease, install the front bearing race, inner lip first, into the hub of converter cover 5 (Foldout 7,A).

(14) Install sealring 34 into the groove in the converter pump (Figure 6–4).

(15) Install the converter cover onto the converter pump (Figure 6–4). The balance marks on the cover and pump must match.

(16) Install twenty-four nuts to retain the converter cover (Figure 6–3). Tighten four of the nuts, at 90 degree intervals, to 10 lb ft (14 N·m). Then, tighten all the nuts to 19–23 lb ft (26–31 N·m).

(17) Install a spacer and a spacer retainer (earlier models) onto each of the six drive studs on the converter cover (Figure 6–3). Recheck end play as outlined in Paragraph 6–3**b**. If end play does not exceed 0.025 inch (0.64 mm), repair is complete. If end play exceeds this limit, perform the steps in Paragraph 6–4**b** (1) through (4) and then proceed to Paragraph 6–4**d**(18).

(18) Install the rear bearing race (Figure 6–5), flat side first, onto the converter turbine (selective spacer is omitted). The race should be dry.

(19) Install the thrust bearing (dry) onto the rear race (Figure 6–5). Install the front bearing race (dry), inner lip upward, onto the thrust bearing.

**NOTE:**

**The measurements made in Steps (20) through (23) require that the gauge bar and blocks used (Figure 6–13 through 6–16) be straight and smooth and have parallel sides. The actual thickness of the bar and height of blocks are immaterial, but the blocks, as pairs, must be of equal height.**

(20) Position a bar and two blocks as shown in Figure 6–13. Using a depth micrometer, measure the distance from the top of the bar to the machined surface of the converter cover hub. Record this Dimension as **A**.

(21) Measure the distance from the top of the bar to the mounting surface of the converter cover (between bolt holes) as shown in Figure 6–14. Record this Dimension as **B**.

(22) Position the bar and two blocks as shown in Figure 6–15. Measure the distance from the top of the bar to the mounting surface of the converter pump (between bolts). Record this Dimension as **C**.

(23) Measure the distance (Figure 6–16) from the top of the bar to the front bearing race installed in Step (19). Record this Dimension as **D**.

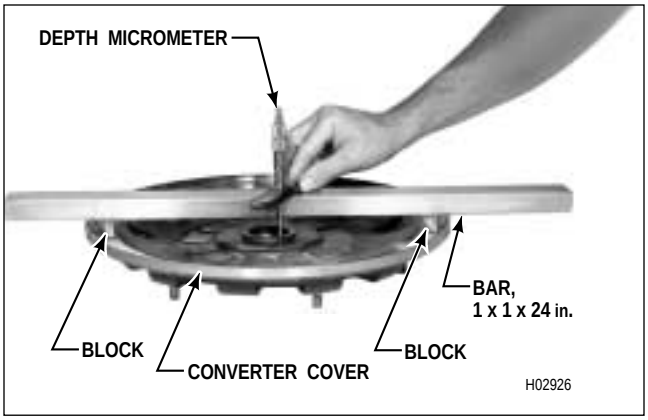


**Figure 6–13. Measuring Dimension A for Selection of Converter Spacer (AT 543)**

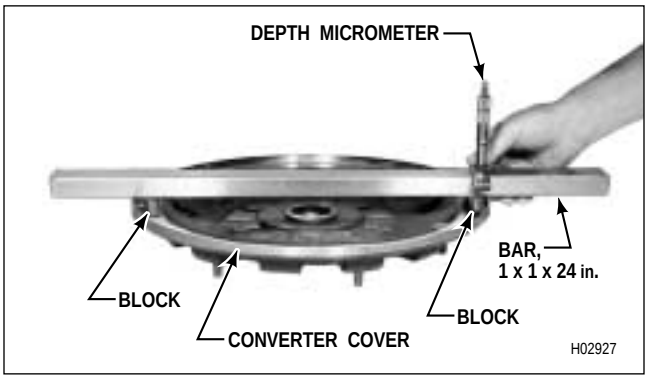


**Figure 6–14. Measuring Dimension B for Selection of Converter Spacer (AT 543)**

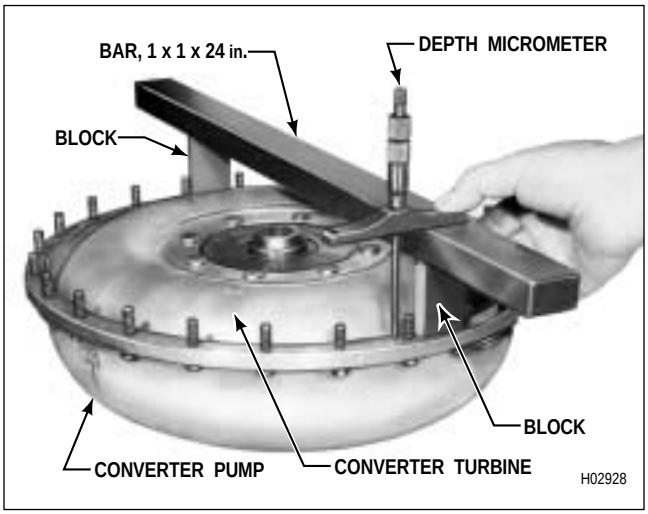


**Figure 6–15. Measuring Dimension C for Selection of Converter Spacer (AT 543)**

(24) Using the dimensions recorded in Steps (20) through (23) in the formula **X = (A–B) – (C–D)**, find **X**.

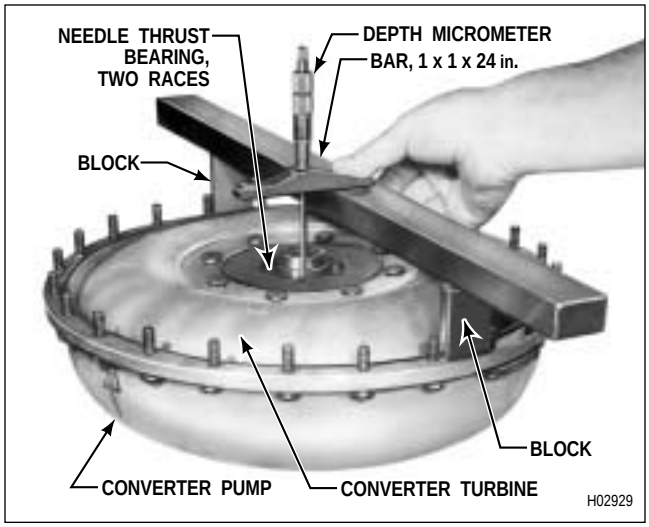


**Figure 6–16. Measuring Dimension D for Selection of Converter Spacer (AT 543)**

(25) From the following table, select the proper spacer.

| X | Use Part No. | Color |
|---|---|---|
| 0.017–0.034 inch (0.44–0.86 mm) | 6837429 | Gold |
| 0.034–0.049 inch (0.86–1.24 mm) | 6837430 | Silver |
| 0.049–0.062 inch (1.24–1.57 mm) | 6837431 | Plain |
| 0.062–0.079 inch (1.57–2.00 mm) | 6837432 | Black |
| 0.079–0.093 inch (2.00–2.36 mm) | 6837433 | Copper |

(26) Remove the two bearing races and bearing installed in Steps (18) and (19). Install the selected spacer onto the torque converter pump hub (Figure 6–5).

(27) Complete the assembly of the torque converter by following Steps (11) through (17).

## *6–5. GOVERNOR*

### a. Disassembly *(Foldout 12,A)*

(1) Governor 18 may be disassembled for cleaning and inspection. Inspect governor driven gear for scuffed, nicked, burred or broken teeth, any damage or wear will require governor assembly replacement. Do not disassemble the governor unless the kit

consisting of two governor weight pins and the cover gasket is available.

(2) Follow the directions furnished with the kit to disassemble the governor.

**b. Assembly** *(Foldout 12,A)*

(1) Assemble the governor as outlined in the directions furnished with the governor service kit.

(2) Check the governor port openings as outlined in the kit instructions. Refer to Figure 6–17.

## *6–6. MAIN CONTROL VALVE BODY*

**a. Disassembly** *(Foldout 11)*

**CAUTION:**

- **Before removing retainer pins 9, 52, 59, 65, and 71, record the positions of adjusting rings 4 or 82, 51, 58, 64, and 70 (Figure 6–18). To retain the original calibration of the valve assembly, the adjusting rings must be reinstalled in the same positions as when removed. Adjusting rings are spring-loaded.**
- **The main control valve body assembly contains springs and other parts, some of which are similar and can be mistakenly interchanged. If parts are not reinstalled in the same locations from which they were removed, the calibration of valve body functions will be lost. Tag each part at removal with its item number in Foldout 11 and utilize valve body parts tray set J 33163 to simplify correct reassembly of the valve body components.**

(1) Remove manual selector valve 53 from control valve body 11.

(2) Remove three bolts 3 from modulator valve body 10. Remove the valve body and separator plate 2.

(3) Remove priority valve 45, spring 44, and valve stop 43 from valve body 11.

(4) Compress adjusting ring 4 or 82 and remove retainer pin 9.

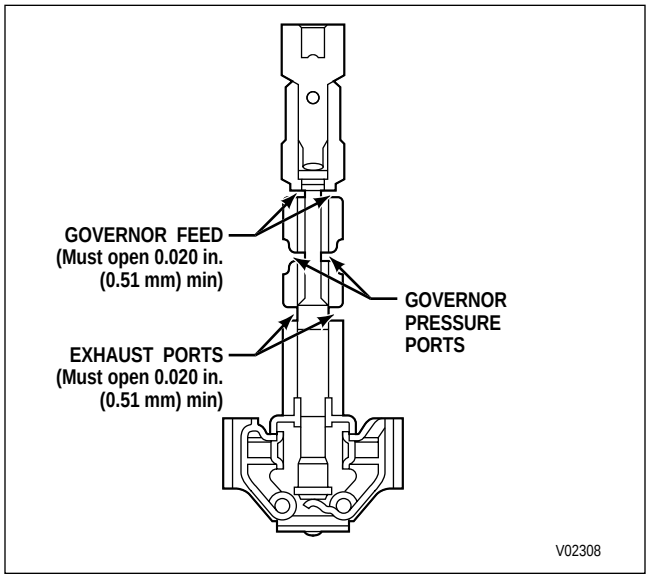


**Figure 6–17. Governor Assembly — Showing Port Openings**

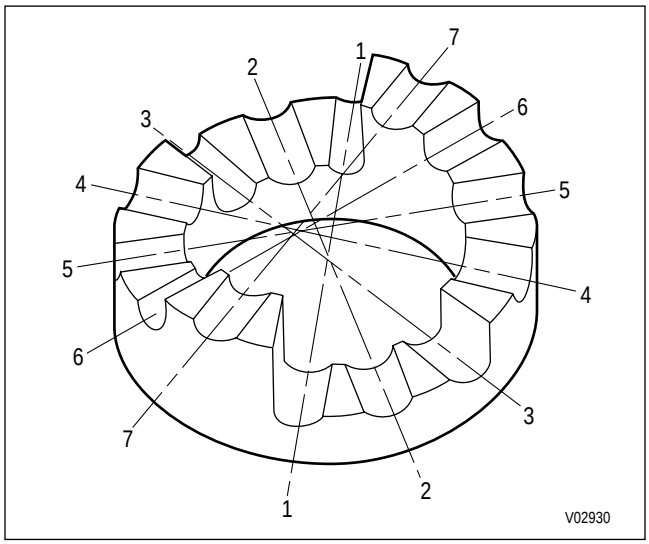


**Figure 6–18. Step Numbers for Recording the Positions of Adjusting Rings**

(5) For some models, remove adjusting ring 82, spring 7, modulator valve 81, and actuating rod 80. For other models, remove adjusting ring 4, stop 5, spring washer 6, spring 7, and modulator valve 8.

(6) Remove nine bolts 35 (eight, some models) from trimmer cover 34. Remove trimmer cover 34.

(7) Remove from the bores in valve body 11, spring 14, stop 15, plug 13, and third clutch trimmer valve 12; springs 18 and 19 (if present), stop 20, plug 17, and first clutch trimmer valve 16; springs 23 and 24 (if present), stop 25, plug 22, and second

clutch trimmer valve 21; and springs 31 and 32 (if present), stop 33, plug 30, and fourth clutch trimmer valve 29. For models that do not have spring 32, discard spring 31 and install new springs 31 and 32.

(8) If present, remove accumulator valve 28, spring 27, and stop 26.

**NOTE:**

- **For AT 545 models, S/N 3210418516 through 3210419140 only, proceed with Step (9).**
- **For all other models, skip Step (9) and proceed with NOTE preceding Step (10).**

(9) For AT 545 models S/N 321041856 through 3210419140 only, check the etched part number on trimmer valves 12, 16, 21, and 29. Replace any incorrect P/N 23016686 trimmer valves at reassembly with the correct P/N 23014097 trimmer valves.

**NOTE:**

**Valve stop 39 and spacer 42 are spring-loaded and must be restrained while retainer pins 36 are being removed. (Valve stop 39 replaces two parts used in earlier models.)**

(10) Remove one retainer pin 36 from control valve body 11. Remove spacer 42, spring 41, and 1–2 relay valve 40.

(11) Examine the interior bore of 1–2 relay valve 40. If the configuration of the valve matches View **A**, Figure 6–19, discard the valve and replace it with a new valve at reassembly.

(12) Remove the other retainer pin 36 from control valve body 11. Remove stop 39, spring 38, and 2–3 relay valve 37.

(13) Compress adjusting ring 51 and remove retainer pin 52. Remove adjusting ring 51, washer 50, plug 49 (if present), valve stop 48, valve spring 47, and hold regulator valve 46 from the bore in control valve body 11.

(14) Compress adjusting ring 58 and remove retainer pin 59. Remove adjusting ring 58, stop 57, spring 56 (if present), 1–2 modulator valve 55, 1–2 shift signal valve 54, and spring 83 (if present).

(15) Compress adjusting ring 64 and remove retainer pin 65. Remove adjusting ring 64, stop 63, spring 62, 2–3 modulator valve 61, and 2–3 shift signal valve 60.

**NOTE:**

**Some units may have been field modified to prevent the 3–4 shift. Take note of the position of retainer pin 71 and stop 69; install parts in the same position as removed.**

(16) Compress adjusting ring 70 and remove retainer pin 71. Remove adjusting ring 70, stop 69, spring 68, 3–4 modulator valve 67, and 3–4 shift signal valve 66.

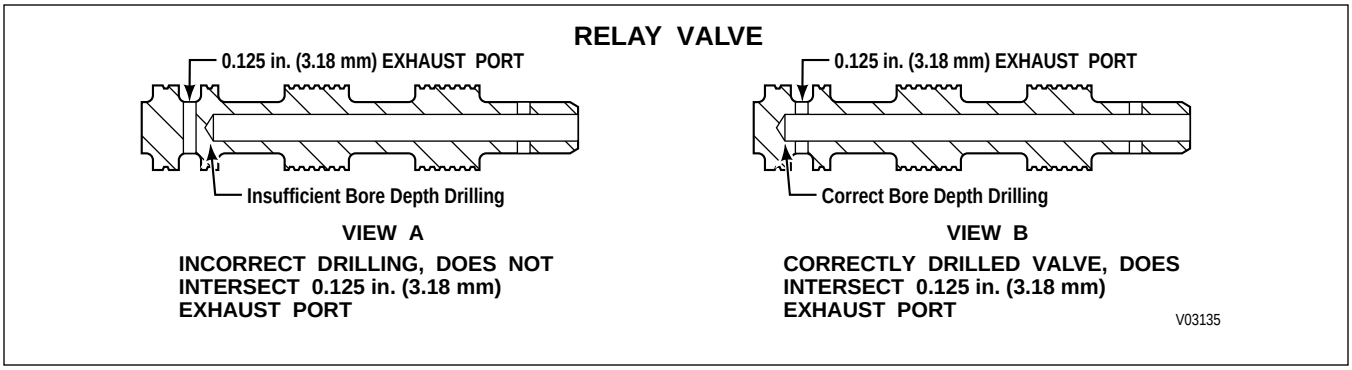


**Figure 6–19. 1–2 Relay Valve**

(17) Restrain stop 74 and remove retainer pin 75. Remove stop 74, spring 73, and 3–4 relay valve 72. Valve stop 74 replaces two parts used in earlier models.

(18) If present, restrain stop 78 and remove retainer pin 79. Remove stop 78, spring 77, and trimmer regulator valve 76.

**b. Assembly** *(Foldout 11)*

---

**NOTE:**

**Check the configuration and position of all components (Figure 6–20). Check the identification of all springs (Paragraph 8–2). All valves, when dry, must move freely by their own weight in their bores.**

---

(1) Install 1–2 relay valve 40 (Foldout 11) into Bore **A** (Figure 6–20). Into the same bore, install spring 41 (Foldout 11) and spacer 42. Compress spacer 42 and install pin 36 through the valve body and at the outside end of spacer 42.

(2) Install 2–3 relay valve 37 into Bore **B** (Figure 6–20). Into the same bore, install spring 38 (Foldout 11) and valve stop 39. Compress stop 39 and install pin 36 through the valve body and at the outside end of stop 39.

(3) Install fourth clutch trimmer valve 29 into Bore **C** (Figure 6–20). Into the same bore, install plug 30 (Foldout 11), springs 31 and 32 (if present), and valve stop 33.

(4) Install second clutch trimmer valve 21 into Bore **D** (Figure 6–20). Into the same bore, install plug 22 (Foldout 11), springs 23 and 24 (if present), and valve stop 25.

(5) Install third clutch trimmer valve 12 into Bore **E** (Figure 6–20). Into the same bore, install plug 13 (Foldout 11), spring 14, and valve stop 15.

(6) Install first clutch trimmer valve 16 into Bore **F** (Figure 6–20). Into the same bore, install plug 17 (Foldout 11), springs 18 and 19 (if present), and valve stop 20.

(7) If removed, install spring 27 into Bore **P** (Figure 6–20). Into the same bore, install stop 26 (Foldout 11) and accumulator valve 28.

(8) Install cover 34. Hold cover against spring force and install nine (or eight, some models) ¼-20 x ¾ inch bolts 35. Using preset torque wrench J 26912, tighten the bolts to 8–12 lb ft (11–16 N·m).

(9) If removed, install trimmer regulator valve 76 into Bore **G** (Figure 6–20). Into the same bore, install spring 77 (Foldout 11) and valve stop 78. Compress stop 78 and install retainer pin 79 through the valve body and through the hole in stop 78.

(10) Install 3–4 relay valve 72 into Bore **H** (Figure 6–20). Into the same bore, install spring 73 (Foldout 11) and valve stop 74. Compress stop 74 and install pin 75 through the valve body and at the outside end of stop 74.

(11) Install 3–4 shift signal valve 66 into Bore **I** (Figure 6–20). Into the same bore, install 3–4 modulator valve 67 (Foldout 11), spring 68, valve stop 69, and adjusting ring 70. Compress adjusting ring 70 and install retainer pin 71 as it was at removal.

(12) Install 2–3 shift signal valve 60 into Bore **J** (Figure 6–20). Into the same bore, install 2–3 modulator valve 61 (Foldout 11), spring 62, valve stop 63, and adjusting ring 64. Compress adjusting ring 64 and install retainer pin 65 through the valve body, across the recorded step of adjusting ring 64, and through the hole in stop 63.

(13) For units with second gear start, install spring 83 into Bore **K** (Figure 6–20). For all models, into Bore **K**, install 1–2 shift signal valve 54 (Foldout 11). Into the same bore install 1–2 modulator valve 55. For units without second gear start, install spring 56. Install valve stop 57 and adjusting ring 58. Compress adjusting ring 58 and install retainer pin 59 through the valve body, across the recorded step of adjusting ring 58, and through the hole in stop 57.

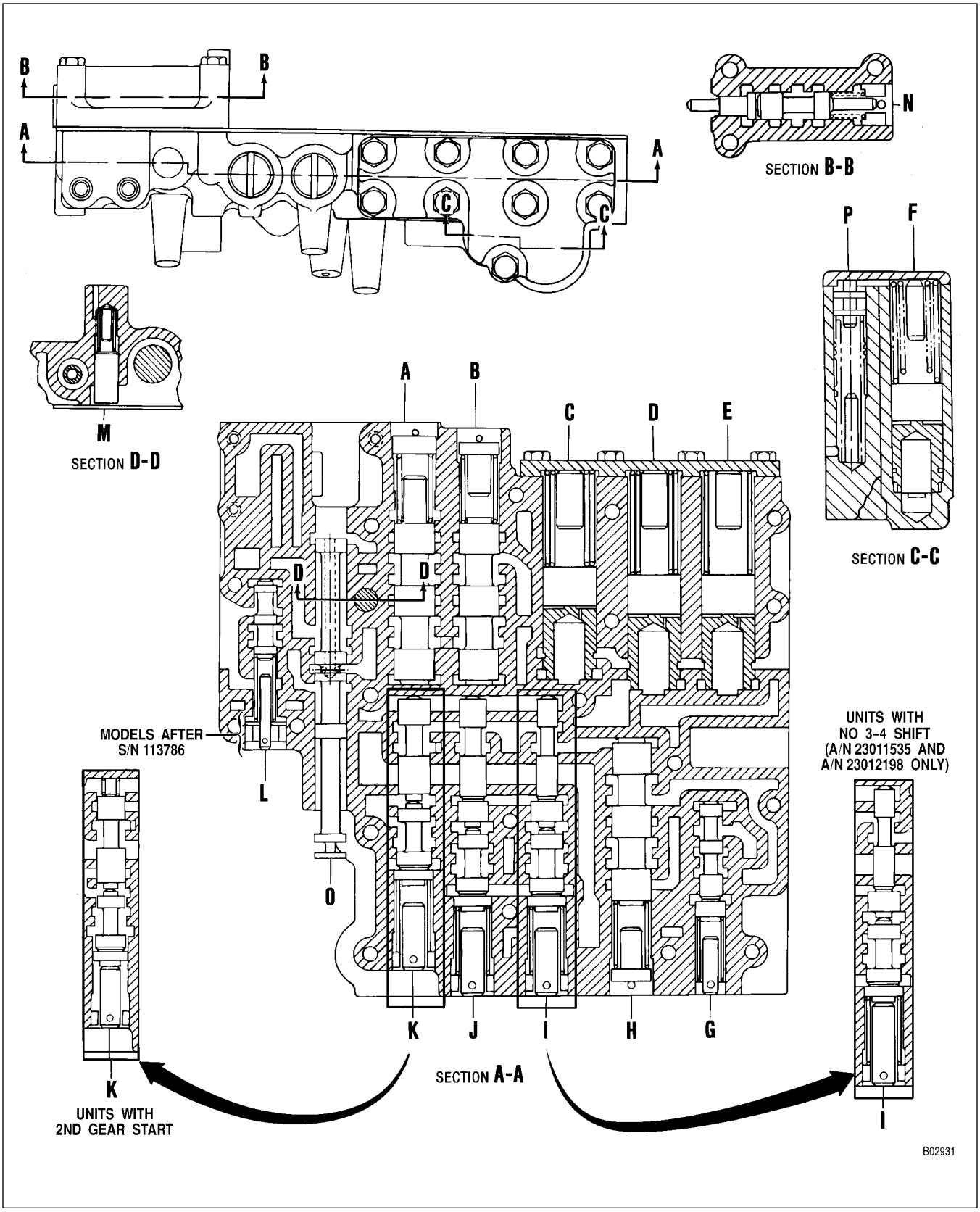


**Figure 6–20. Control Valve Body Assembly — With Components Installed**

(14) Install hold regulator valve 46 into Bore **L** (Figure 6–20). Into the same bore, install spring 47 (Foldout 11) and valve stop 48. Prior to transmission S/N 113786, install valve plug 49. Beginning with transmission S/N 113786, install washer 50 and adjusting ring 51. Compress adjusting ring 51 and install retainer pin 52 through the valve body, across the recorded step of adjusting ring 51, and through the hole in stop 48.

(15) Install valve stop 43 into Bore **M** (Figure 6–20). Into the same bore, install spring 44 (Foldout 11) and priority valve 45.

(16) Into Bore **N** (Figure 6–20), install either modulator valve 8 (Foldout 11), spring 7, washer 6, stop 5, and adjusting ring 4; or, actuating rod 80, modulator valve 81, spring 7, and adjusting ring 82. Compress adjusting ring 4 or 82 and install retainer pin 9 through the valve body, across the recorded step of adjusting ring 4 or 82, and through the hold in stop 5 or at the outside end of valve 81.

(17) Install separator plate 2 onto valve body 11. Install valve body 10 onto separator plate 2.

---

**NOTE:**

**Install six valve body bolts at various points through the separator plate and valve body to align separator plate.**

---

(18) Install three ¼-20 x 1¾ inch bolts 3 to retain valve body 10 and separator plate 2. Tighten the bolts to 8–12 lb ft (11–16 N·m). The assembled valve body is shown in Figure 6–21.

(19) Install selector valve 53 (Foldout 11 into the assembled valve body and retain it with a rubber band, tape, or soft wire to prevent its dropping out during handling.

(20) Use special tool J 24314, recheck the positions of all adjusting rings (Figure 6–21) with the positions recorded before disassembly.

(21) For ease of handling, install valve body lifting tool J 29863 into the drilled boss in the center of the valve body. Put the assembled valve body into a plastic bag or other dirt-proof, lint-free wrapping until ready to install it.

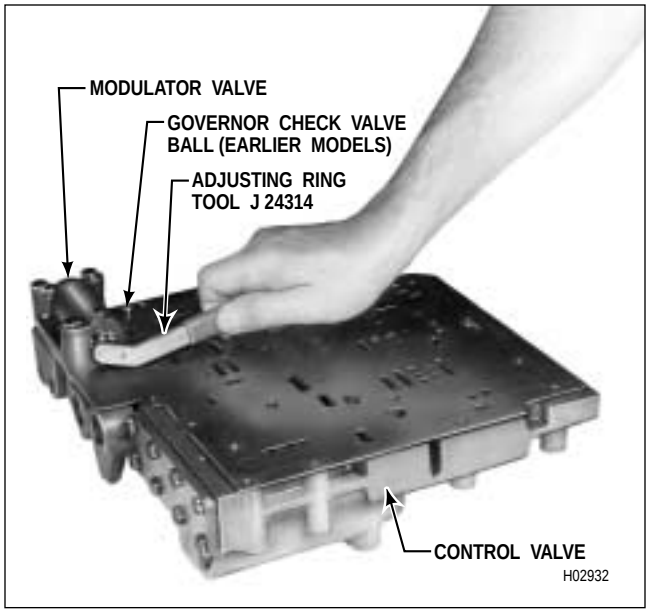


**Figure 6–21. Adjusting Modulator Valve Ring**

## *6–7. RETARDER CONTROL VALVE BODY*

**a. Disassembly** *(Foldout 13)*

**CAUTION:**

**The retarder control valve body assembly contains springs and other parts, some of which are similar and can be mistakenly interchanged. If parts are not reinstalled in the same locations from which they were removed, the calibration of retarder control valve body functions will be lost. Tag each part at removal with its item number in Foldout 13 to simplify correct reassembly of the valve body components.**

**WARNING!**

**Priority valve 20 and plug 19 are spring-loaded and must be restrained while pin 22 is being removed.**

(1) Restrain plug 19 and remove pin 22.

(2) Remove plug 19, priority valve 20, and spring 21.

**WARNING!**

**Regulator valve 24 and plug 27 are spring-loaded and must be restrained while pin 22 is being removed.**

(3) Restrain plug 27 and remove pin 22.

(4) Remove plug 27, capacity pin 26, spring 25, and regulator valve 24.

**WARNING!**

**Autoflow valve plug 30 is spring-loaded and must be restrained while snapring 32 is being removed.**

(5) Restrain plug 30 and remove snapring 32.

(6) Remove plug 30, spring 29, and autoflow valve 28.

(7) Remove O-ring 31 from plug 30.

**b. Assembly**

**NOTE:**

**Check the configuration and position of all components (Foldout 13). Check the identification of all springs (Paragraph 8–2). All valves, when dry, must move freely by their own weight in their bore.**

(1) Install a new O-ring 31 onto plug 30.

(2) Install autoflow valve 28, short-tipped end first, into valve body 23. Into the same bore, install spring 29 and plug 30 (with O-ring 31 in place).

(3) Depress plug 30 and install snapring 32.

(4) Install regulator valve 24, wider diameter first, into valve body 23. Into the same bore, install spring 25, capacity pin 26, and plug 27.

(5) Depress plug 27 and install pin 22.

(6) Install spring 21 into valve body 23. Into the same bore, install priority valve 20, smaller diameter first, and plug 19.

(7) Depress plug 19 and install pin 22.

## *6–8. TRANSFER PLATE ASSEMBLY (Retarder Models) (Foldout 13)*

**a. Disassembly**

(1) Remove snapring 9 from feedthrough seal 10.

(2) Disconnect two connectors 8 from solenoids 7.

(3) Remove the terminals from connectors 8 as follows:

- Using remover tool J 38125-13, depress locktab on terminal (accessible in slot of connector) and push the terminal out front of the connector (Figure 6–22).
- Cut the terminal between the core and the insulation crimp (to minimize wire loss).
- Repeat the process for the remaining terminals.

(4) Remove harness 11 from transfer plate 14.

(5) Remove a pipe plug 12 and a pin 13 for each solenoid 7 and remove the two solenoids.

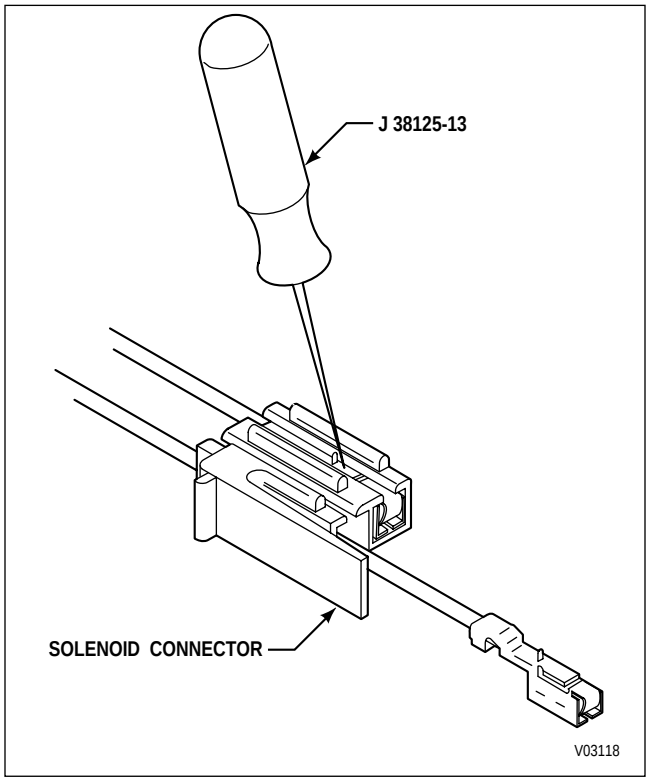


**Figure 6–22. Terminal Removal**

(6) If present, remove pipe plug 15 (at the temperature sending unit location) or, if present, remove the temperature sending unit.

**b. Assembly**

(1) If removed, install ½-14 pipe plug 15. Tighten the plug to 16–20 lb ft (22–27 N·m).

(2) Place solenoids 7 in place in transfer plate 14 and install pins 13. Install 1⁄16 inch pipe plugs 12 to retain pins 13. Tighten plugs 12 to 35–50 lb in. (4–5 N·m).

(3) In preparation for installation of harness 11, carefully strip wire insulation approximately ¼ inch (6 mm) (unless insulation crimp is over tight). Automatic wire stripper J 35615 will remove the insulation and crimp from the old terminal without damaging the wire.

(4) Install harness 11, fitting feedthrough seal 10 into transfer housing 14.

---

**NOTE:**

**Terminals with white wires install in one connector and terminals with red wires install in the other connector.**

---

(5) Install the terminals onto connectors 8 as follows:

- Place core crimp portion of terminal on bed of Anvil **C** on crimping tools J 38125-7 and squeeze the crimper enough to hold the terminal from dropping (Figure 6–23).
- Position the wire core in the terminal and squeeze the crimper tool to complete the core crimp.
- Position the insulation crimp of the terminal on Anvil **D** so that the entire insulation crimp area and a portion of the terminal between the core and insulation crimp areas are supported by the anvil. Complete the insulation crimp.
- Slip the wire through the slot in the connector and pull to fully seat the terminal(s).

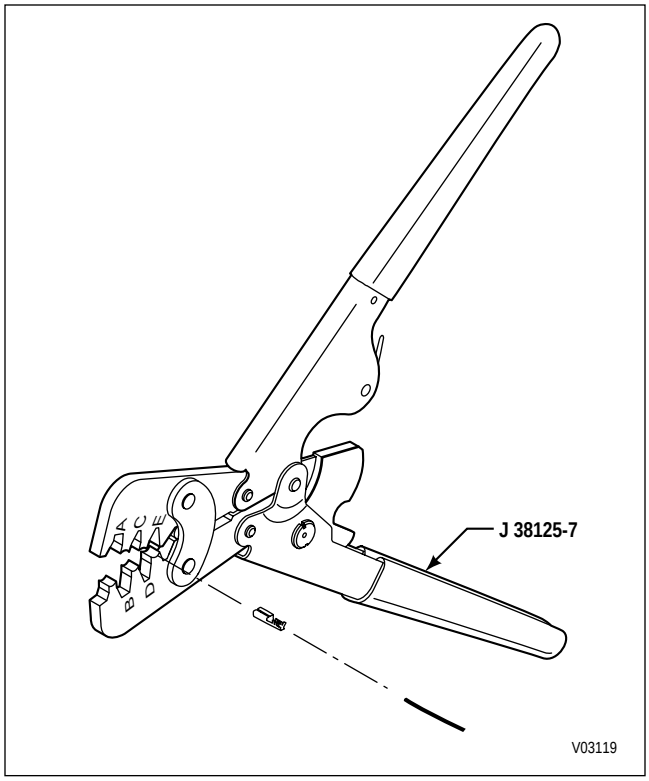


**Figure 6–23. Terminal Installation**

(6) Install snapring 9 to retain the harness.

(7) Connect two connectors 8 until they snap into place on two solenoids 7. The connector with white wires connects to the H (upper) solenoid; the connector with the red wires connects to the F (lower) solenoid.

## *6–9. OIL PUMP AND FRONT SUPPORT ASSEMBLY*

**a. Disassembly** *(Foldout 7,B)*

(1) Remove sealring 13 from front support 16.

(2) Remove six bolts 11 (eight, some models) and washers 12 from the front of pump body 8. Discard the washers.

---

**NOTE:**

**When removing bolts 28 and 29, if the five bolts are of two different lengths, take note of the size and location of the five bolts. The same size bolts will need to be installed as are removed.**

---

(3) Remove five bolts 28 and 29 from front support 16.

(4) Separate pump body and gear assembly 5 from front support 16. Remove pump driven gear 9 and pump drive gear 10 from pump body 8.

(5) Remove sealring 4 from pump body 8.

(6) Remove oil seal 3 and, if parts replacement is necessary, bushing 7.

---

**NOTE:**

- **AT 1500 Series models do not have bushing 18. Therefore, for AT 1500 Series models, skip Step (7) and proceed with Step (8).**
- **For AT 500 Series models, do not remove bushing 18 unless replacement is necessary. Replacement bushing 18 requires machining and a runout check. Refer to Paragraph 6–9*b*(5) through (7).**

---

(7) If replacement is necessary, collapse bushing 18 and remove it from stator shaft 19 using care not to damage the bearing bore in the stator shaft.

(8) If replacement is necessary, remove plugs 20 and 22 and bearing 23 from support 21.

(9) Install main-pressure regulator valve remover tool J 24787 (Figure 6–24). Compress spring stop 25 (Foldout 7,B) and remove snapring 24.

(10) Remove spring stop 25, spring 26, and main-pressure regulator valve assembly 27 from the valve bore of front support 21.

---

**NOTE:**

- **For AT 1500 Series (models with lockup), proceed with Step (11).**
- **For AT 500 Series (models without lockup), skip Step (11) and proceed with Step (12).**

---

(11) Restrain stop 32 (Foldout 7,B) and remove pin 33. Remove spring 31 and lockup valve 30 from the bore of front support 21. Skip Step (12) and proceed with Step (13).

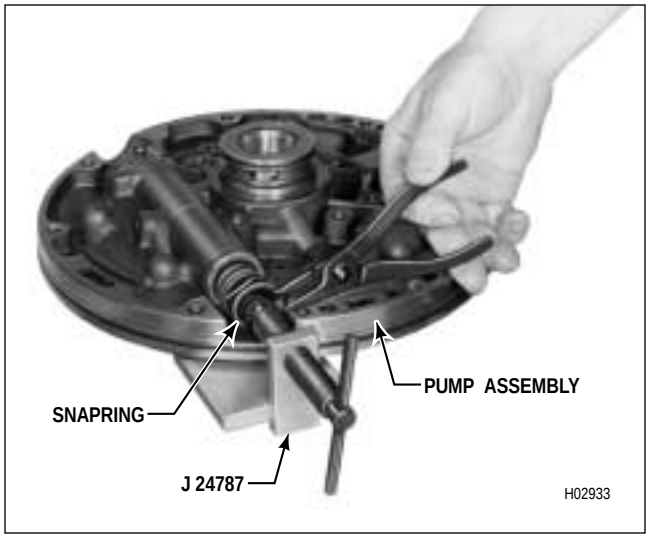


**Figure 6–24. Removing (or Installing) Main-Pressure Regulator Valve**

(12) Turn the front support over. Remove pin 15 (earlier models) from front support 21. Remove valve plug 14 (earlier models) from the smaller end of the main-pressure regulator valve bore.

(13) Insert, but do not force, rotating sealring gauge J 29198-1 into the hub sealring grooves. Rotate the gauge 360 degrees. If the gauge does not go into the groove or will not rotate completely, the groove is damaged and the front support must be replaced.

(14) Examine the splines of stator shaft 19. For some earlier models that have splines that do not show signs of induction hardening process (dark discoloration), if adequate machining capabilities are available, install a new induction-hardened shaft 19. Also, inspect the shaft for cracks between the splines. Inspect the shaft ID for scoring and metal transfer. Replace shaft 19 if there are cracks or excessive scoring.

**CAUTION:**

**Do not attempt this rework procedure unless adequate machining capabilities are available. If these capabilities are not available, replace the entire stator shaft and front support assembly 17.**

**NOTE:**

- **If stator shaft 19 does not require being replaced, skip Step (15) and Paragraph 6–8*b* and proceed with Paragraph 6–8*c*.**
- **If stator shaft 19 is to be replaced, proceed with Step (15).**

(15) Put front support 21 in a press bed, machined face downward, and press shaft 19 from front support 21. Proceed with Paragraph 6–8**b** for shaft and bushing replacement and machining instructions.

**b. Installation of Stator Shaft and Bushing**
*(Foldout 7,B)*

(1) Support the front support in a press with the pump face upward.

(2) Position the stator shaft in the center bore of the front support, aligning the hole in the stator shaft within Angle **K** (Figure 6–25 or 6–26).

(3) Press the stator shaft into the front support to Dimension **M** as measured from Surface **B** to the end of the stator shaft (Surface **L**) (Figure 6–25 or 6–26). Axis **A** is established by Diameter **D** and Surface **B**. When mounted on Diameter **D** and Surface **B**, features shall be within the total runout specified by **H**.

(4) Observe specifications for machining Diameters **E** and **G**.

**NOTE:**

**AT 1500 Series models do not require bushing 18 (Foldout 7,B). Therefore, for AT 1500 Series models, skip Steps (5) through (7).**

**CAUTION:**

**Be sure to use the correct P/N replacement bushing. Refer to Parts Catalog PC1235EN.**

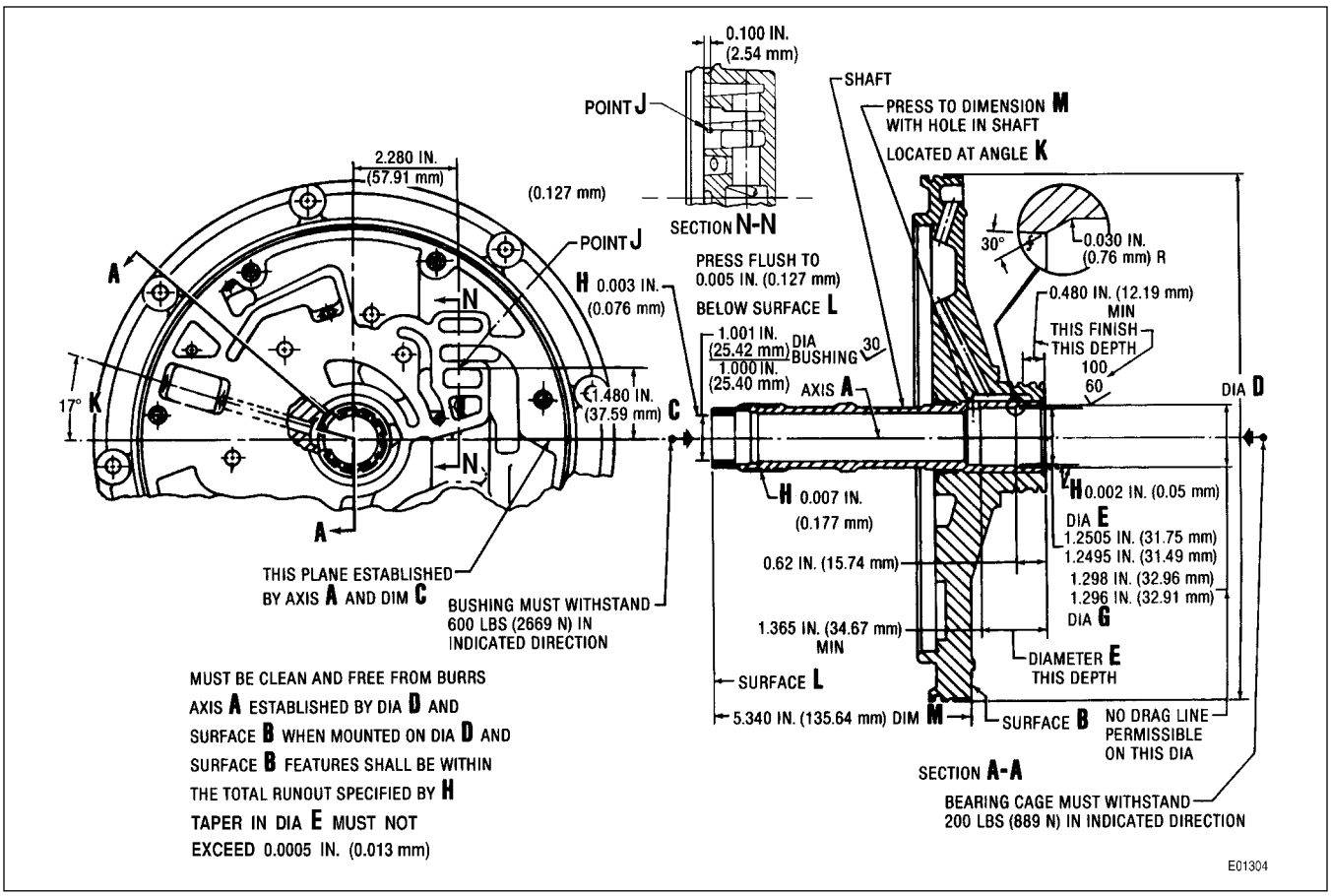


**Figure 6–25. Installation of Stator Shaft, Machining of Bushing and Bearing Bores (AT 500 Series)**

(5) Coat the OD of a new **non-prebored** replacement bushing 18 (Foldout 7,B) with Loctite® 601 sleeve retainer, or equivalent. Install bushing 18 into the stator shaft with J 23614-A to a depth of flush to 0.005 inch (0.127 mm) below the end of the shaft (Figure 6–27). Remove any excess Loctite® from the shaft housing.

(6) Machine the bushing to the diameter and microfinish specified (Figure 6–25) while maintaining TIR not to exceed 0.003 inch (0.076 mm).

(7) Thoroughly clean the assembly of any metal chips and dirt, being careful to clean all passages in the front support.

**c. Pump Gear Clearance Check** *(Foldout 7,B)*

**NOTE:**

**Proper end play and side clearance of the oil pump gears must be established before the pump is assembled. Remove all nicks and burrs from the pump and gear surfaces to facilitate accurate dial indicator readings.**

(1) Position oil pump body assembly 6, flat side upward. Install drive gear 10 into pump body assembly 6, so the internal tangs of the gear are facing upward. Install gear 9 into the pump body 6 so that the side of gear 9 marked with a diamond is downward.

(2) Position dial indicator J 26857 on the pump body as shown in Figure 6–28. Zero the dial while the stylus (plunger) is contacting the pump body face.

(3) Without disturbing the dial setting, slide the indicator to the driven gear (Figure 6–29). While holding the indicator in position, record the reading. If the clearance is not within 0.0008–0.0022 inch (0.020–0.056 mm) on a new gear or 0.0008–0.0026 inch (0.020–0.066 mm) on a used gear, replace the gear and repeat Steps (2) and (3).

(4) Slide the indicator to the drive gear (Figure 6–30). While holding the indicator in position, record the reading. If the clearance is not within 0.0008–0.0022 inch (0.020–0.056 mm) on a new gear or 0.0008–0.0026 inch (0.020–0.066 mm) on a used gear, replace the gear and repeat Steps (2) and (4).

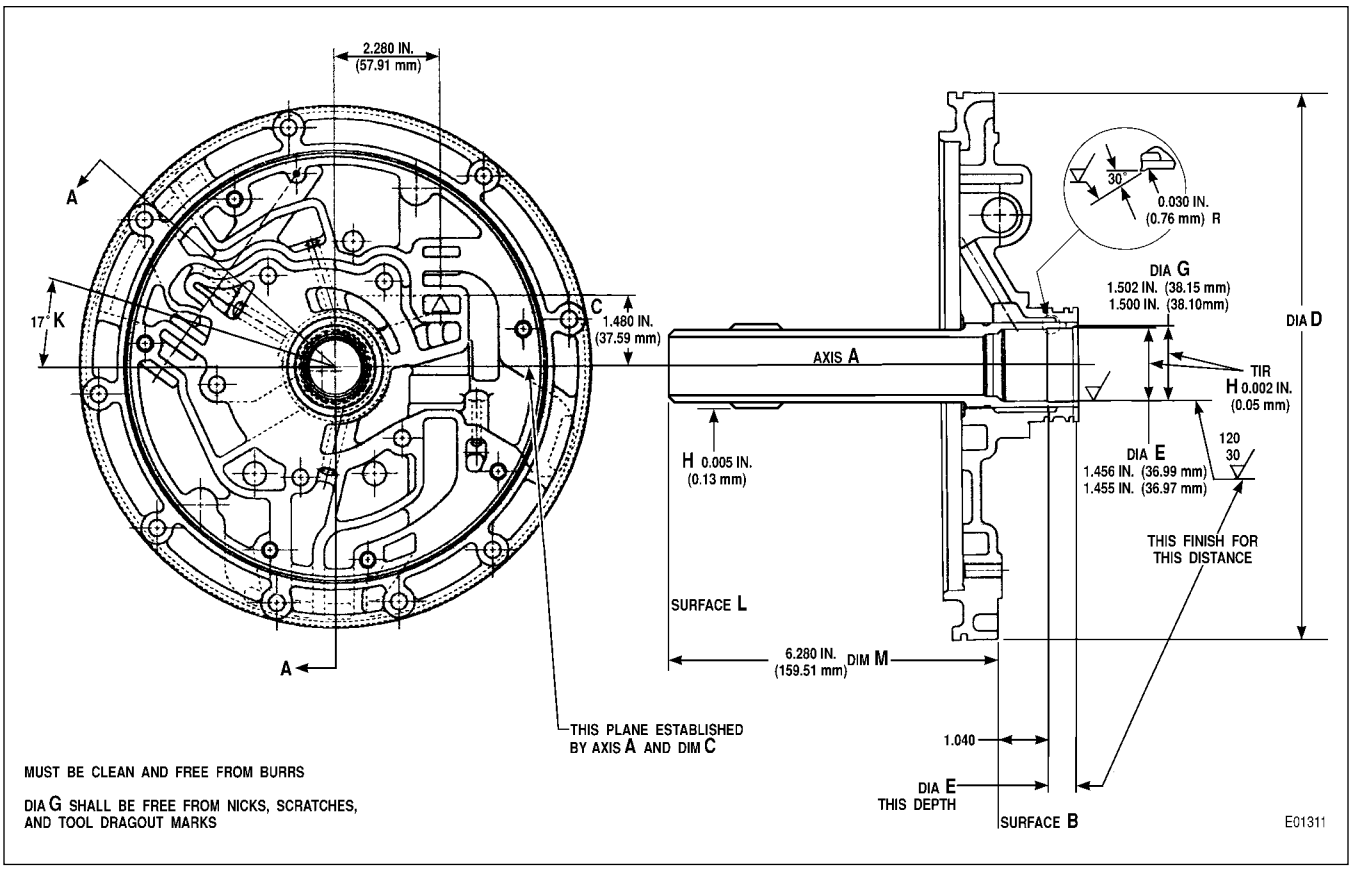


**Figure 6–26. Installation of Stator Shaft (AT 1500 Series)**

(5) Check the driven gear diametrical clearance with a feeler gauge as shown in Figure 6–31. Replace the gear if the clearance is not within 0.0055–0.0085 inch (0.14–0.22 mm) on a new gear or 0.0055–0.0089 inch (0.14–0.23 mm) on a used gear.

**d. Assembly** *(Foldout 7,B)*

**NOTE:**

- **For models without lockup, proceed with Step (1).**
- **For models with lockup, skip Steps (1) and (2) and proceed with Step (3).**

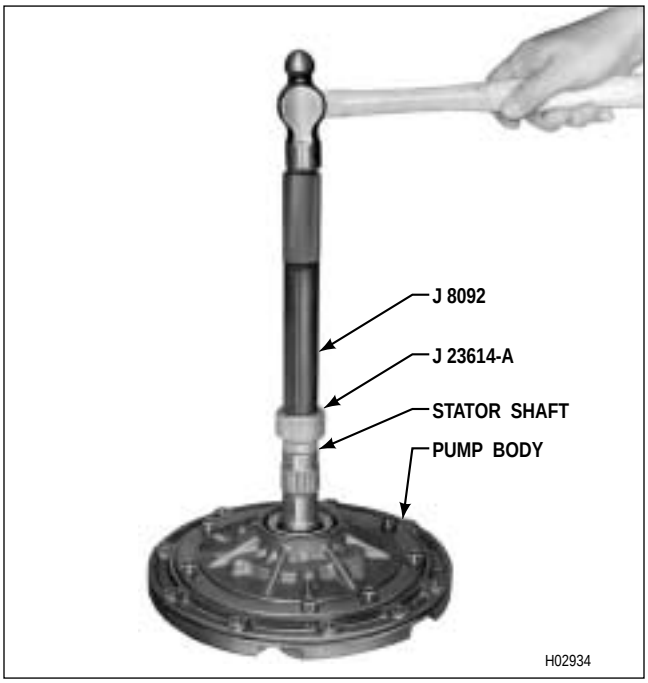


**Figure 6–27. Installing Stator Shaft Front Bushing (AT 500 Series Models)**

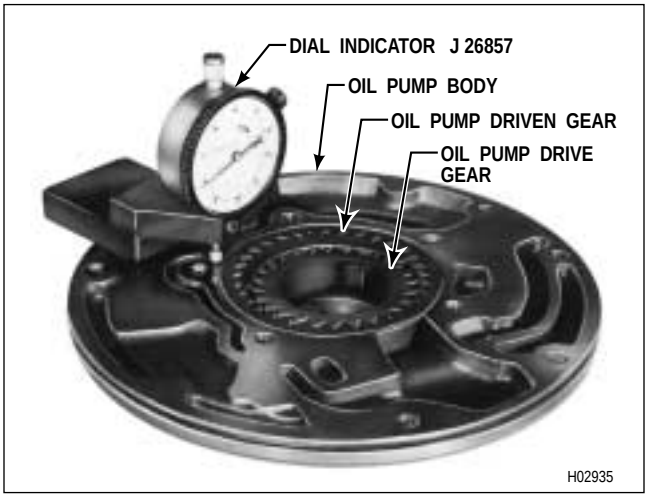


**Figure 6–28. Zero Dial Indicator on Oil Pump Body Surface**

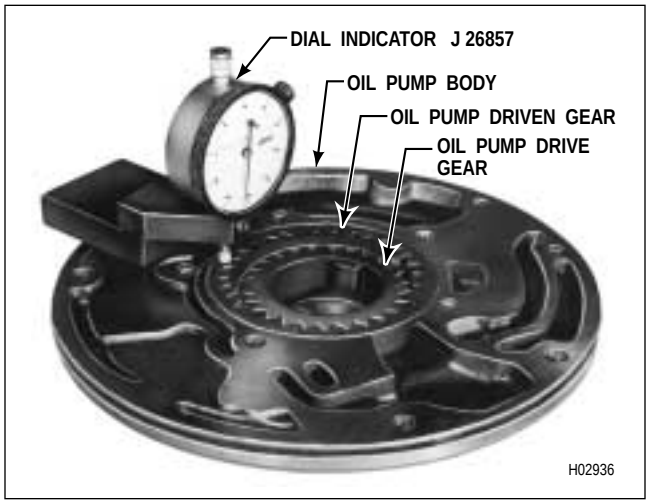


**Figure 6–29. Dial Indicator Check of Oil Pump Driven Gear End Clearance**

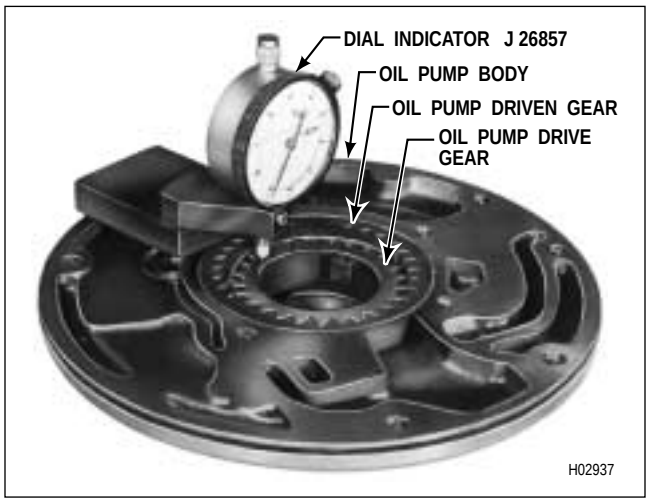


**Figure 6–30. Dial Indicator Check of Oil Pump Drive Gear End Clearance**

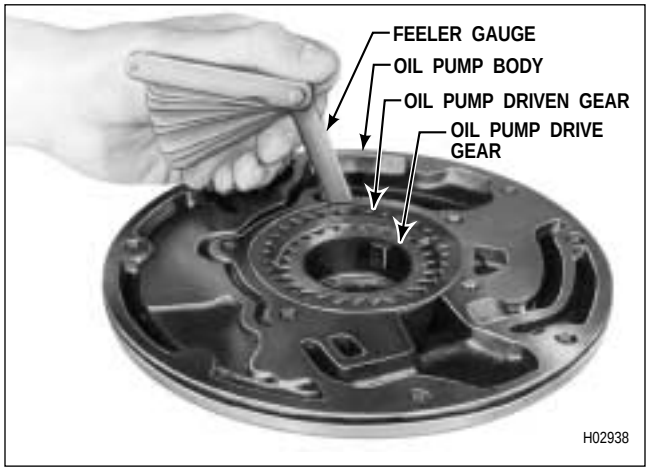


**Figure 6–31. Checking Diametrical Clearance of Oil Pump Driven Gear**

(1) For models without lockup, if roller bearing 23 was removed, using installer J 23615, press on the lettered end of the new bearing to a depth of 0.595–0.615 inch (15.11–15.62 mm) from the end of the shaft (Figure 6–32).

(2) Install valve plug 14 (earlier models) into the main pressure regulator valve bore of front support 21. Install pin 15 (earlier models) into the pump body side of front support 21. Skip Step (3) and proceed with Step (4).

(3) For models with lockup, if roller bearing 23 was removed, using installer J 39794, press on the lettered end of the new bearing to a depth of 0.625–0.635 inch (15.88–16.12 mm) from the end of the shaft.

(4) Install main-pressure regulator valve 27, smaller end first, into its valve bore.

(5) Into the same bore, install valve spring 26 and spring stop 25 (smaller end first).

(6) Install main-pressure regulator valve installer tool J 24787 (Figure 6–24). Restrain spring stop 25 (Foldout 7,B) and install snapring 24, **flat side outward**. Remove the tool from the assembly.

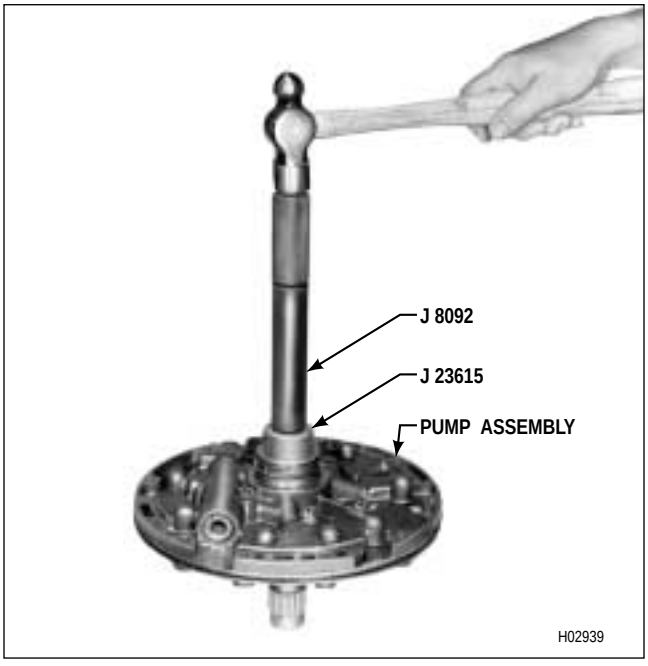


**Figure 6–32. Installing Stator Shaft Rear Bearing (Models without Lockup)**

**NOTE:**
- **For models without lockup, skip Step (7) and proceed with Step (8).**
- **For models with lockup, proceed with Step (7).**

(7) For models with lockup, install lockup valve 30 (Foldout 7,B), smaller end first, into pump assembly 16. Into the same bore install spring 31 and stop 32. Restrain stop 32 and install pin 33 through the machined side of the front support.

(8) If either plug 20 or 22 was removed, install a new plug. Press plug 20 into the support to a depth of flush to 0.010 inch (0.25 mm) below the surface. Press plug 22 to the shoulder in the support.

**NOTE:**
- **For models without lockup, proceed with Step (9).**
- **For models with lockup, skip Steps (9) and (10), and proceed with Step (11).**

(9) For models without lockup, if bushing 7 was removed, install a new bushing. The split in the bushing must be located in an area of the bore that can completely support it. Use installer tool J 25356 to press the bushing into the front of the pump body to a height of 0.010–0.020 inch (0.25–0.51 mm) above the surface.

(10) Using special installer tool J 21359-A, install oil seal 3, with the lip facing inward (Figure 6–33). Skip Steps (11) and (12) and proceed with Step (13).

(11) For models with lockup, if bushing 7 was removed, install a new bushing. The split in the bushing must be located in an area of the bore that can completely support it. Use installer tool J 39739 to press the bushing into the front of the pump body to a depth of flush to 0.398 inch (10.11 mm).

(12) Using special installer tool J 39757, install oil seal 3 with the lip facing inward (Figure 6–33).

(13) Lubricate and install sealring 4 (Foldout 7,B) onto pump body 8. Lubricate and install driven gear 9 and drive gear 10.

(14) Install front support assembly 16 onto pump body assembly 5, aligning the bolt holes.

**CAUTION:**

**Because of transmission fluid leakage, a six-bolt support should never be used with an eight-bolt pump body. However, the six-bolt support may be modified by tapping two additional holes (Figure 6–34). Any other combination of parts (6-hole support with 6-hole body, 8-hole support with 8-hole body, or 8-hole support with 6-hole body) is acceptable without modification.**

(15) Install six (eight, some models) 5/16-18 x 1 inch bolts 11 (Foldout 7,B) and new rubber coated washers 12 into the pump side of the oil pump assembly. Tighten the bolts finger tight.

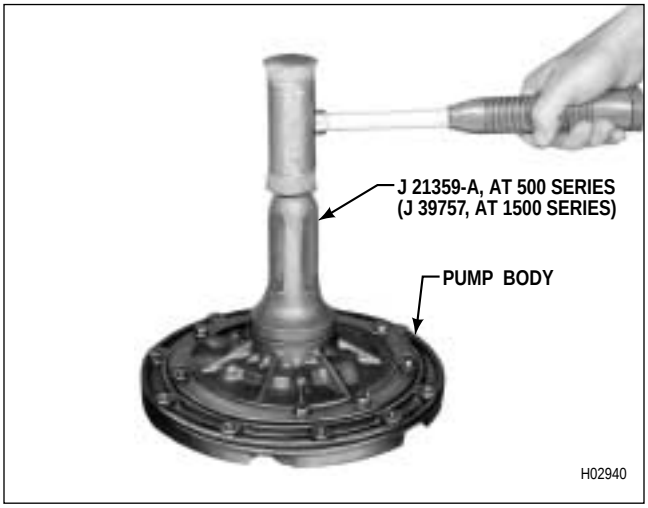


**Figure 6–33. Installing Oil Pump Seal**

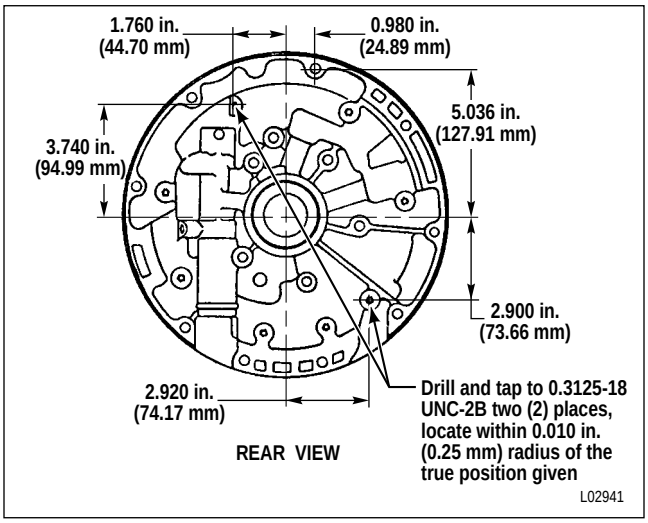


**Figure 6–34. Rework Dimensions for Front Support**

(16) Install bolts 28 and 29 as were removed. (For different models, the length may differ).

(17) Tighten all the 5/16-18 bolts to 15–20 lb ft (20–27 N·m).

(18) Lubricate and install sealring 13 onto the outer diameter of front support 21.

## *6–10. FORWARD CLUTCH AND TURBINE SHAFT ASSEMBLY*

### a. Disassembly

**NOTE:**

- **For earlier models with PTO gear and without retarder, proceed with Step (1).**
- **For later models with PTO gear and without retarder, skip Step (1) and proceed with Step (2)**
- **For models without PTO gear and without retarder, skip Steps (1) through (8) and proceed with Step (9).**
- **For models with retarder, skip Steps (1) through (7) and proceed with Step (8).**

(1) For earlier models with PTO gear and without retarder, place forward clutch and turbine shaft assembly 7 (Foldout 8) on the work table, with the shaft upward. Using a screwdriver, remove snapring 3 that secures PTO drive gear 4 to forward clutch housing 9. Remove gear 4 and snapring 5. Skip Steps (2) through (7) and proceed with Step (8).

(2) For later models with PTO gear and without retarder, locate the snapring gap by looking between the tips of the PTO gear internal splines and the roots of the housing splines. Light can be seen in the gap area.

(3) At the opening (omitted housing spline) closest to the snapring gap, insert a small screwdriver and push the snapring toward the housing until a 5/64 x 0.020 inch (2 x 0.5 mm) steel strip, 2 to 3 inches (50–75 mm) long can be inserted in the root of the housing spline nearest the snapring gap (Figure 6–35).

(4) Repeat Step (3) at the opposite side of the snapring gap.

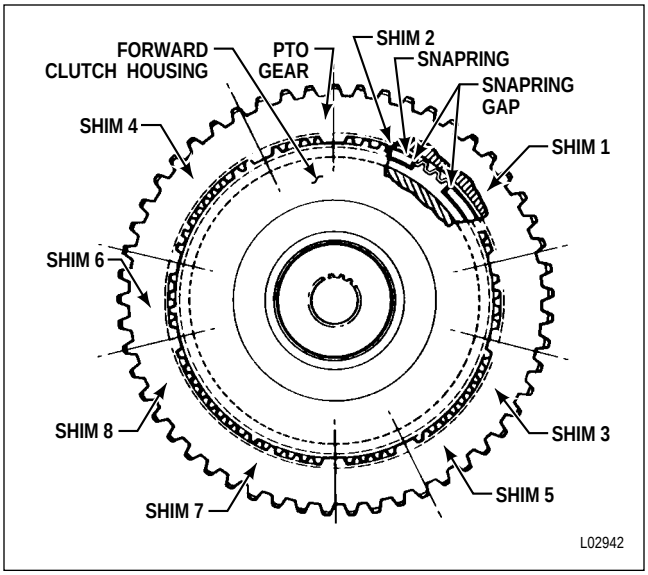


**Figure 6–35. Removing PTO Gear From Forward Clutch Housing (Later Models Without Retarder)**

(5) Using the screwdriver in the openings (omitted splines) as required to depress the snapring, place steel strips in housing spline roots as necessary to hold the snapring inward. Work from the strips first installed to a point opposite the gap.

(6) Use as many strips as required (8 should be sufficient) and place them at positions that will hold the snapring entirely clear of the PTO gear splines.

(7) When the snapring clears the PTO gear splines, light can be seen through all spaces (except those holding steel strips) between PTO gear spline tips and housing spline roots. Remove the gear.

(8) For models with retarder, remove two hook-type sealrings 12 (Foldout 8) from forward clutch housing 14.

(9) Remove hook-type sealring 2 (Foldout 8) from the turbine shaft. Turn the assembly over.

(10) Using a screwdriver, remove snapring 30 from the forward clutch housing. Remove fourth clutch drive hub 29 from the housing.

(11) Remove forward clutch hub 26 from the housing.

(12) Inspect forward clutch hub 26 closely on high mileage transmission units down for overhaul. Over an extended period of operation, a wear pattern at the internal spline of the hub may occur. This wear ring, the result of contact with the transmission main shaft, is so uniform in shape that it is often overlooked. Replace this hub where this condition exists. In most instances, wear of adjacent thrust washers should alert you to inspect the forward clutch hub for abnormal wear. Although the transmission may be functioning properly prior to overhaul, the clutch hub should be replaced when wear exists. Reuse of a distressed hub with new washers will accelerate washer wear and will not duplicate the original durability and service life.

(13) Remove thrust bearing race 25, thrust needle bearing 24, and thrust bearing race 23 from the hub of the forward clutch housing.

(14) Remove five external-tanged clutch plates 27 and five internal-splined clutch plates 28 from the clutch housing.

---

**NOTE:**

- **Later models have a wave plate in the forward clutch next to piston 19 (Foldout 8) which improves the neutral-to-range shift quality. A kit is available that contains parts required to make this change. Be sure to confirm all interchangeability factors by referring to Parts Catalog SA1235 or SA2126. Both forward- and fourth-clutch assemblies have various part numbers affected by this upgrade. Refer also to the latest version of Service Information Letter 3-TR-93.**
- **Models that have the wave plate in the forward clutch assembly use a clutch housing marked with an identification groove (Figure 6–36).**

---

(15) Place the forward clutch assembly in a press with the spring retainer upward (Figure 6–37).

**CAUTION:**

**When removing the forward clutch snapring, do not allow the spring retainer to catch in the snapring groove.**

(16) Place compressor tool J 23616 on the spring retainer (Figure 6–37). Compress the retainer until the snapring is free. Using snapring pliers, remove the snapring. Release the press and remove the assembly.

(17) Remove spring retainer 21 (Foldout 8) and sixteen clutch springs 20.

(18) Remove forward clutch piston 19 from the clutch housing. If necessary, turn the clutch housing over and "bump" the piston from the housing.

(19) Remove piston outer sealring 18 and piston inner sealring 17. Inspect ball 10 or 15 to make sure it moves freely in the housing. If the piston is being replaced, be sure the new piston has the same letter identification (**A**, **B**, **C**, **EF**, **E**, or **DE**) that was stamped on the old piston.

(20) Refer to Paragraph 4–5**p** and Figure 6–40 for housing check ball specifications. Remove ball 10 or 15 (Foldout 8) from the forward clutch housing only if replacement is necessary. If necessary, clear the bore of staked metal and remove the ball.

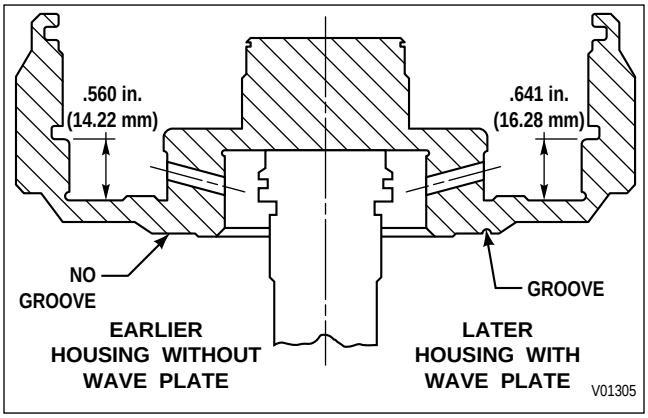


**Figure 6–36. Forward Clutch Housing Identification**

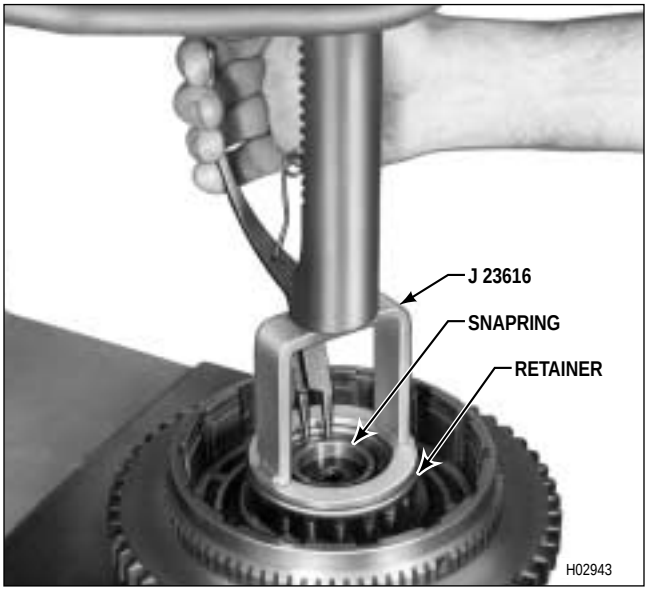


**Figure 6–37. Removing (or Installing) Forward Clutch Spring Retainer Snapring**

**b. Checking Clutch Pack Clearance**
*(Models Without Wave Plate)*

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**NOTE:**

**Two methods of establishing proper clutch clearance are explained and illustrated. The first method, Steps (1) through (6), is by direct measurement using a go/no-go gauge and is only to be used for checking the forward clutch in models NOT equipped with a wave plate next to piston 19 (Foldout 8). The second method is by stack dimension computation (Paragraph 6–16). This method may be more convenient when assembly line overhaul practices are used. THE STACK DIMENSION METHOD MUST ALSO BE USED FOR CHECKING THE FORWARD CLUTCH IN MODELS EQUIPPED WITH A WAVE PLATE NEXT TO PISTON 19.**

---

(1) Install the piston, without sealrings, into forward clutch housing 8 (Foldout 6,A) until the piston bottoms against the housing.

(2) Beginning with an external-tanged plate, alternately install five external-tanged clutch plates 27 and five internal-splined clutch plates 28 into the forward clutch housing assembly.

---

**NOTE:**

**Before installing the fourth clutch drive hub, refer to Paragraph 6–9*b* and to Figure 6–38.**

---

(3) Install the fourth clutch drive hub (Figure 6–38) into the housing assembly, engaging the tangs in the slots. Install snapring 30 (Foldout 8) into the housing assembly.

(4) While holding clutch drive hub 29 firmly against snapring 30, use clearance gauge J 23619-01 to measure the clutch running clearance (Figure 6–39). The smaller end of the gauge must insert between the hub and the first plate. The larger end must not.

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**NOTE:**

**If the J 23619-01 gauge is not available, measure the clearance between the hub and the first plate (Figure 6–40).**

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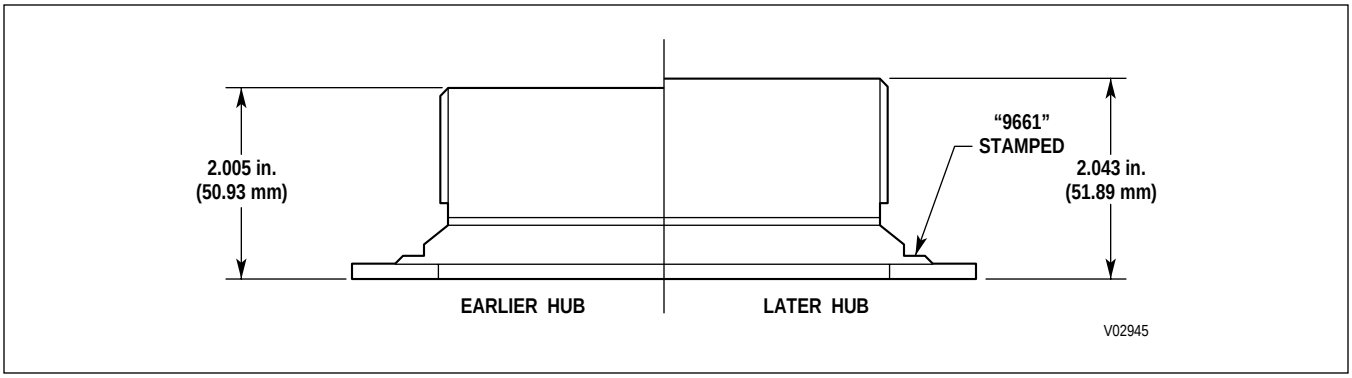


**Figure 6–38. Fourth Clutch Drive Hub Identification**

(5) If the clutch running clearance is not within the specified limits, remove snapring 30, fourth clutch drive hub 29, and clutch plates 27 and 28. Replace clutch plates 27 and 28 with new plates or new piston, as required, to obtain the desired running clearance. Refer to wear limits, Section 8, to determine the plates which should be replaced.

(6) Repeat Steps (2), (3), (4), and (5). When the running clearance is within 0.0765–0.1265 inch (1.944–3.213 mm), remove snapring 30, drive hub 29, clutch plates 27 and 28, and piston 19. Keep the clutch plates together as a package until required.

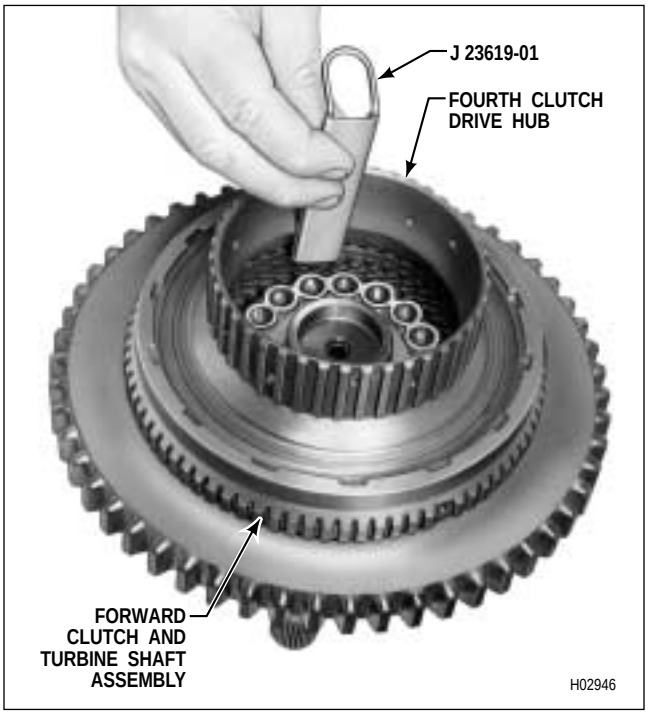


**Figure 6–39. Checking Forward Clutch Clearance (Models Without Wave Plate)**

**c. Assembly** *(Foldout 8)*

(1) If ball 10 or 15 was removed, place the new ball into the bore. Stake the bore at three equally spaced locations. The bore is properly staked when the ball has the minimum axial movement specified in Figure 6–40 and when the ball is retained by the staking when a 30 lb (133 N) load is applied against the ball.

(2) Install sixteen return springs 20 (Foldout 8) into their pockets in the piston (Figure 6–41). Install the spring retainer, recess side first, onto the springs.

(3) Place the clutch assembly in a press, spring retainer upward. Lay snapring 22 (Foldout 8) in its approximate installed position on spring retainer 21.

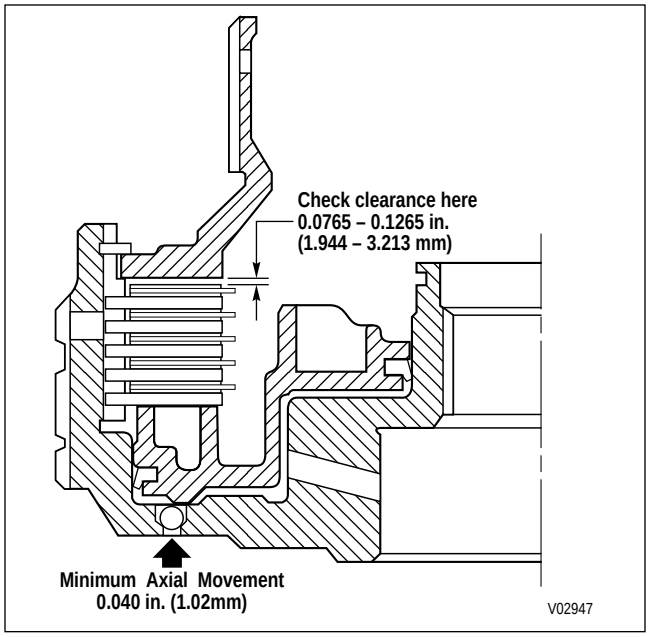


**Figure 6–40. Forward Clutch Clearance Check Point (Models Without Wave Plate)**

**CAUTION:**

**When installing the forward clutch snapring, do not allow the spring retainer to catch in the snapring groove.**

(4) Using compressor tool J 23616, compress the spring retainer until it clears the snapring groove in the housing hub (Figure 6–37). Install snapring 22 (Foldout 8) into the groove in the hub in the clutch housing assembly. Release the press and remove the clutch housing assembly.

(5) Install the flat bearing race onto the hub of the forward clutch housing (Figure 6–41). Install the thrust needle bearing and the lipped bearing race so that it encloses the bearing. Retain the bearing and races with oil-soluble grease.

(6) Install the forward clutch hub into the clutch housing (Figure 6–42).

**NOTE:**

- **For models with a wave plate next to piston 19 (Foldout 8), proceed with Step (7).**
- **For models not equipped with a wave plate next to piston 19, skip Step (7) and proceed with Step (8).**

(7) Install the clutch pack established in Paragraph 6–17**b**(3). Begin by placing the wave plate next to piston 19 (Foldout 8). Then alternately install five internal-splined and the remaining four external-tanged clutch plates into the forward clutch housing assembly. Skip Step (8) and proceed with Step (9).

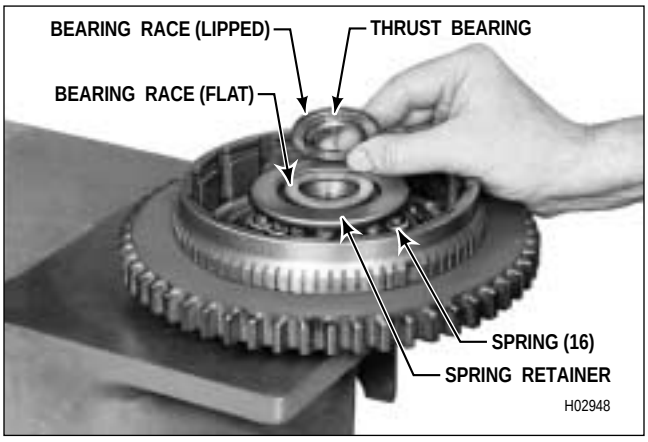


**Figure 6–41. Installing Forward Clutch Thrust Bearing**

(8) Beginning with an external-tanged clutch plate, install the clutch pack established in Paragraph 6–9**c**(6) or 6–17**b**(3) (Figure 6–42).

(9) Install the fourth clutch drive hub (Figure 6–39) into the housing assembly and secure the hub with snapring 30 (Foldout 8).

**NOTE:**

- **For assembly of the PTO gear for later models do Steps (10) through (13) and Step (17).**
- **For assembly of the PTO gear for earlier models, skip Steps (10) through (13), and do Steps (14) through (17).**
- **For non-retarder models that do not include a PTO gear, skip Steps (10) through (16) and do Step (17) only.**
- **For retarder models, skip Steps (10) through (16) and do Steps (17) and (18).**

(10) For later models, place forward clutch housing and turbine assembly 7 (Foldout 8) on the work table, shaft downward.

(11) Install snapring 31 into the snapring groove in forward clutch housing 9.

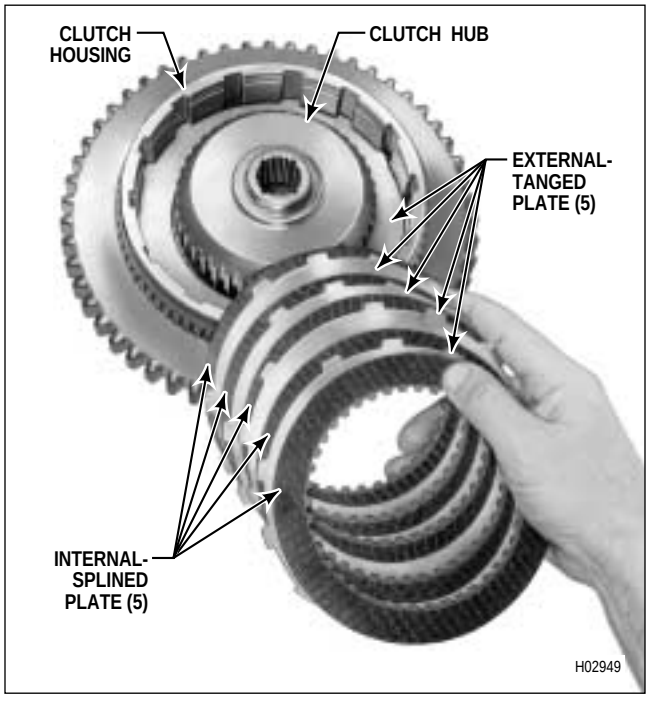


**Figure 6–42. Installing Forward Clutch Plates (Models Without Wave Plate)**

(12) Place PTO gear 32 onto the forward clutch housing. Be sure the chamfer on the inside diameter of the PTO gear is facing downward.

(13) Compress snapring 31 into the clutch housing and install the PTO gear. Be sure the gear is positioned so that the snapring expands into the gear. Proceed to Step (17).

(14) For earlier models, install wave-type snapring 5 (Foldout 8) onto forward clutch housing 9. Be sure the tips of the snapring face the PTO gear.

(15) Install PTO drive gear 4 (flat side toward front of transmission), from the turbine shaft side, until it is firmly seated against snapring 5.

(16) Install snapring 3 onto housing 9 to secure gear 4.

(17) Install hook-type sealring 2 onto the turbine shaft.

(18) For models with retarder, install two hook-type sealrings 12 onto forward clutch housing 14.

## *6–11. RETARDER HOUSING ASSEMBLY*

### a. Disassembly

(1) Place retarder housing assembly 34 (Foldout 8) on the work table with the screw side facing upward.

(2) Remove four screws 37.

(3) Separate rear stator 35 from retarder housing 36.

(4) Visually inspect that all fluid passage holes are clean and free of debris.

### b. Assembly

(1) Place rear stator 35 in place in retarder housing 36, aligning the bolt holes. Start one screw 37 to establish alignment.

(2) Install the remaining three screws 37. Tighten all four screws to 10–12 lb ft (14–16 N·m).

## *6–12. FOURTH CLUTCH ASSEMBLY*

### a. Disassembly *(Foldout 9,A)*

(1) Place the fourth clutch on the work table, with snapring 1 upward. Remove snapring 1, backplate 2, five internal-splined clutch plates 3, and five external-tanged clutch plates 4.

(2) Place fourth clutch housing assembly 11 in a press (Figure 6–43).

**CAUTION:**

**When removing the fourth clutch snapring, do not allow the spring retainer to catch in the snapring groove.**

(3) Using spring compressor J 23616, compress piston return spring retainer 6 and remove snapring 5 and spring retainer 6.

(4) Remove sixteen piston return springs 7 and remove fourth clutch piston 8.

(5) Remove sealring 9 from the OD of piston 8. Remove sealring 10 from the ID of piston 8. Check the sealring groove thoroughly for burrs and rough spots.

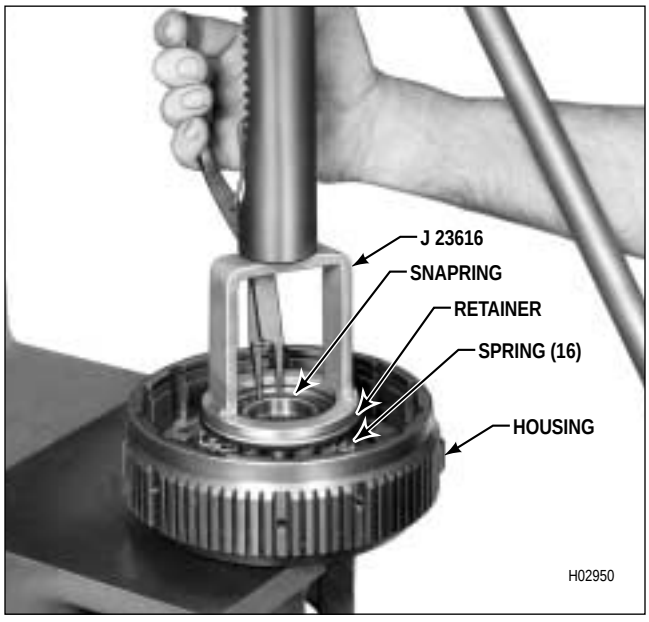


**Figure 6–43. Removing (or Installing) Fourth Clutch Spring Retainer Snapring**

**NOTE:**

**Earlier model transmissions use a piston seal on fourth clutch housing 13. If present, discard the housing seal. A fourth clutch housing seal *should not* be used during assembly. Use only the two seals on the piston.**

(6) Refer to Paragraph 4–5**p** and Figure 6–45 for housing check ball specifications. Remove the ball from the fourth clutch housing only if replacement is necessary. If necessary, clear the bore of the staked metal and remove the ball.

### b. Checking Clutch Pack Clearance

**NOTE:**

- **Two methods of establishing proper clutch clearance are explained and illustrated. The first method, Steps (1) through (6), is by direct measurement using a go/no-go gauge. The second method is by stack dimension computation (Paragraph 6–17). This method may be more convenient when assembly line overhaul practices are used.**
- **If piston 8 must be replaced, be sure that the identification (A, B, C, EF, E, or DE) on the new piston is the same as that on the old piston.**

(1) Install the piston, without sealrings, into the clutch housing assembly until the piston bottoms against the housing.

(2) Beginning with an external-tanged plate, alternately install five external-tanged clutch plates 4 (Foldout 9,A) and five internal-splined clutch plates 3 onto piston 8.

(3) Install clutch backplate 2, flat side first, onto the last clutch plate 3 installed. Install snapring 1 into housing 13.

(4) While holding backplate 2 firmly against snapring 1, use clutch clearance gauge J 23619-01 to measure the clearance between the backplate and the clutch plate (Figure 6–44). The smaller end of the gauge must insert between the backplate and the first clutch plate. The larger end must not.

**NOTE:**

**If the J 23619-01 gauge is not available, measure the clearance between the backplate and the first clutch plate (Figure 6–45).**

(5) If the clutch running clearance is not within the specified limits, remove snapring 1, backplate 2, and clutch plates 3 and 4. Replace clutch plates 3 and 4 with new plates or replace piston, as required, to establish the proper running clearance. Refer to wear limits, Section 8, to determine the plates which should be replaced.

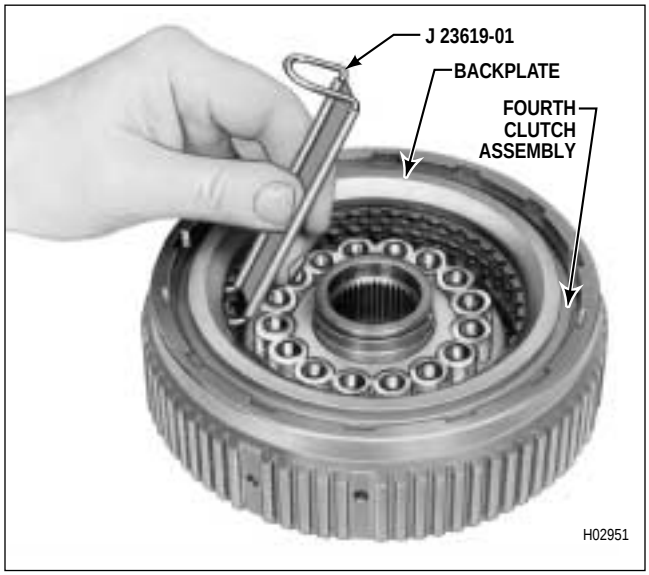


**Figure 6–44. Checking Fourth Clutch Clearance**

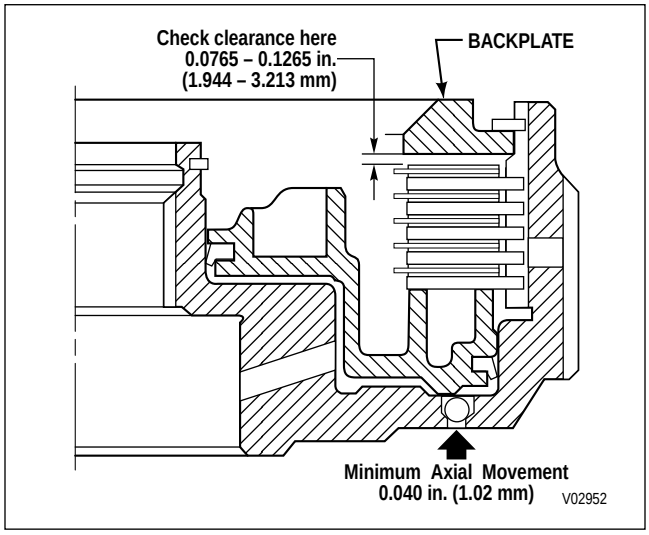


**Figure 6–45. Fourth Clutch Clearance Check Point**

(6) Repeat Steps (2), (3), (4), and (5). When the running clearance is within 0.0765–0.1265 inch (1.944–3.213 mm), remove snapring 1, clutch backplate 2, clutch plates 3 and 4, and piston. Keep the clutch plates together as a package until required.

**c. Assembly** *(Foldout 9,A)*

(1) If check ball 12 was removed, place the new ball into the bore. Stake the bore at three equally spaced locations. The bore is properly staked when the ball has the minimum axial movement specified in Figure 6–45 and when the ball is retained by the staking when a 30 lb (133 N) load is applied against the ball.

(2) Install sixteen return springs 7 (Foldout 9,A) into their pockets in piston 8. Install spring retainer 6, recess side first, onto the springs.

(3) Place the clutch assembly in a press, spring retainer upward. Lay snapring 5 in its approximate installed position, on spring retainer 6.

**CAUTION:**

**When installing the fourth clutch snapring, do not allow the spring retainer to catch in the snapring groove.**

(4) Using compressor J 23616, compress the spring retainer until it clears the snapring groove in the housing hub (Figure 6–43). Install snapring 5 (Foldout 9,A) into the groove in the hub in clutch housing assembly 11. Release the press and remove the clutch assembly.

(5) Beginning with an external-tanged clutch plate, install the clutch pack removed in Paragraph 6–12**b**(6) or that which was determined in Paragraph 6–17**c**.

(6) Install backplate 2, flat side first, onto the clutch plates. Install snapring 1 to retain the backplate.

## *6–13. CENTER SUPPORT ASSEMBLY*

**a. Disassembly** *(Foldout 9,B)*

(1) Remove pistons 9 and 18 with attached parts, from center support assembly 13

**CAUTION:**

**When removing piston retainer washers, cut the retainer washers carefully to prevent damaging the piston projections.**

(2) Remove eight retainer washers 6 and 21, (Figure 6–46).

(3) Remove spring retainers 7 and 20 (Foldout 9,B). Remove twenty-four piston return springs 8 and 19.

(4) Remove piston sealrings 10 and 11 from piston 9.

(5) Remove piston sealrings 16 and 17 from piston 18.

(6) Remove the two hook-type sealrings 12 from center support and bushing assembly 13.

(7) Insert, but do not force, rotating sealring gauge J 29198-1 into the hub sealring grooves. Rotate the gauge 360 degrees. If the gauge will not rotate freely, the front support must be replaced.

**CAUTION:**

**When removing the center support bushing be careful not to damage the bushing bore.**

(8) If bushing replacement is necessary, place support and bushing assembly 13 in a press, sealring grooves side upward. Press bushing 14 out of the support.

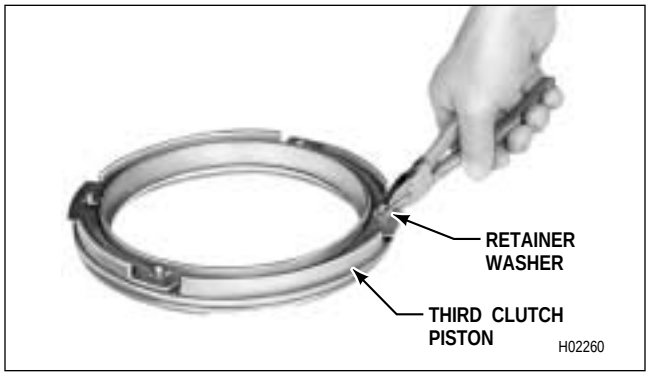


**Figure 6–46. Removing Self-Locking Retainer Washers**

**b. Rework of Center Support Piston Retainer Locating Notches** *(Foldout 9,B)*

**NOTE:**

**Do not attempt this rework procedure unless adequate machining capabilities are available.**

If the notch broke away to let the retainer ride upward, rework as shown in Figure 6–47.

**c. Assembly** *(Foldout 9,B)*

(1) Place center support 15 in a press, sealring grooves side upward. To ensure proper alignment of the oil hole in bushing 14 with the notch in support 15, the identifying notch of the bushing must lie in the area indicated (Figure 6–48). Using bushing tool J 24778 (for models without lockup) or J 39735 (for models with lockup), install bushing 14 (Foldout 9,B) as shown in Figure 6–49.

(2) If a special bushing tool is not available, press bushing 14 flush to 0.010 inch (0.25 mm) below the surface adjacent to the bore. The bushing must withstand 500 pounds (2224 N) of end load as specified in the direction of Arrow **A** in Figure 6–48 after assembly.

(3) Place piston 9 (Foldout 9,B) in its bore without the piston sealrings in place, with the four ejector pin bosses upward. Install piston return springs 8 in the twelve holes in third clutch piston 9.

(4) Place spring retainer 7 on piston 9, aligning the four holes in the piston. Using tool J 24453, install four new self-locking retainer washers 6 onto the eight ejector pin bosses (Figure 6–50).

(5) Remove piston 9 from the support assembly.

(6) Repeat steps (3) through (5) for piston 18.

(7) Install sealrings 10 and 17 into the inside diameter groove of pistons 9 and 18. Install sealrings 11 and 16 into the outside diameter grooves of pistons 9 and 18. Be sure the lips of the sealrings and the flat side of the piston face the same direction. Special care is required to prevent distortion, cutting, or stretching of the sealrings. Apply oil-soluble grease to the sealrings.

(8) Install two hook-type sealrings 12 onto the hub of center support 15.

**NOTE:**

**Do not install the piston assemblies until the second clutch stack check is made (Paragraph 6–17*e*).**

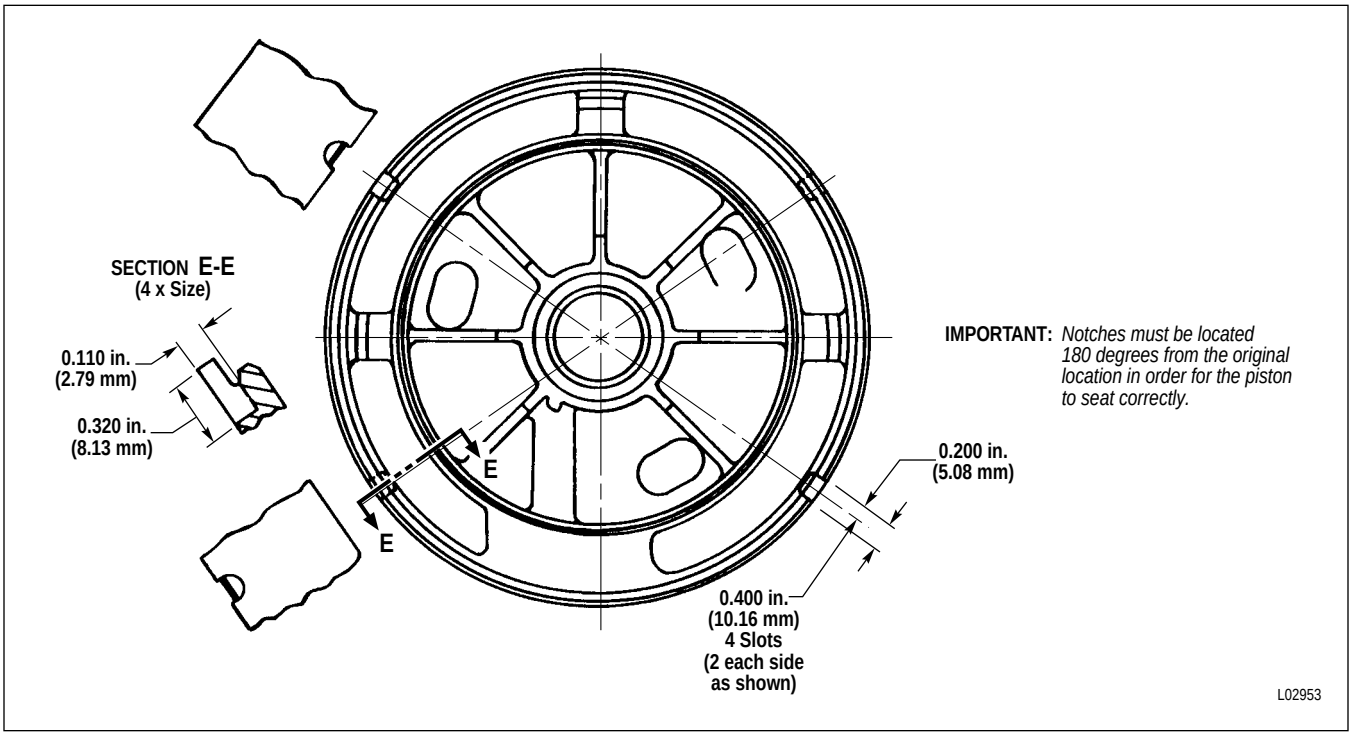


**Figure 6–47. Rework of Center Support Piston Retainer Locating Notches**

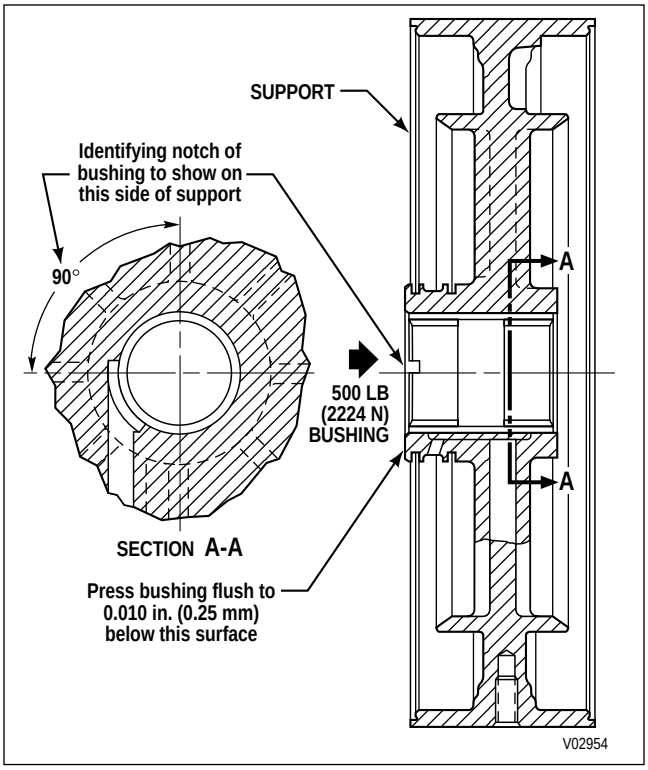


**Figure 6–48. Center Support Assembly**

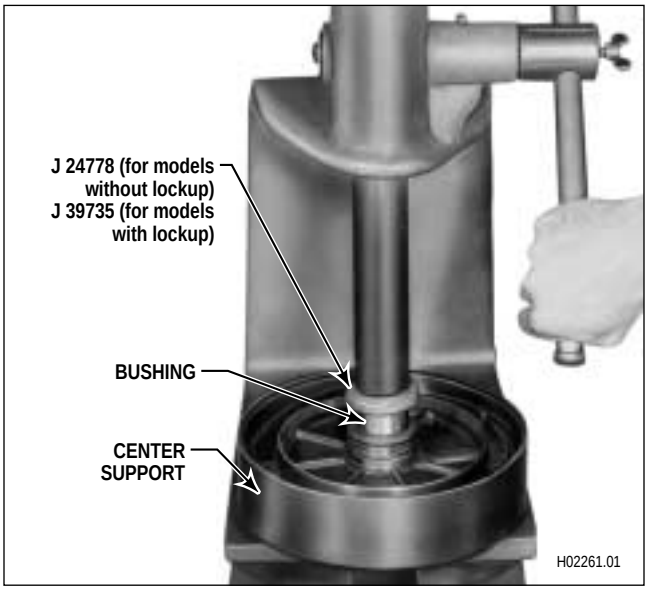


**Figure 6–49. Installing Center Support Bushing**

## *6–14. PLANETARY GEAR UNIT*

**a. Disassembly** *(Foldout 10,A)*

**NOTE:**

**If available, support the planetary vertically in an engine cylinder liner or through a hole in the work bench.**

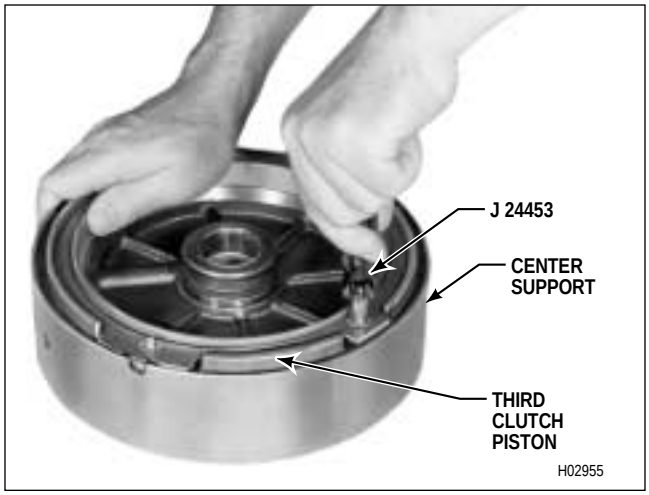


**Figure 6–50. Installing Self-Locking Retainer Washer**

(1) Remove front planetary sun gear 6.

(2) Lift front planetary carrier assembly 8 from ring gear 18.

(3) Remove thrust washer 7 from front planetary carrier assembly 8, and thrust washer 16 from center planetary carrier assembly 20. Refer to Paragraph 6–16 for rebuild of the front planetary carrier assembly.

(4) Remove center planetary sun gear 19 and thrust washer 27.

(5) Remove snapring 17 that retains front planetary ring gear 18 to planetary connecting drum 28. Remove ring gear 18 and center planetary carrier assembly 20 from drum 28. Refer to Paragraph 6–16 for rebuild of the center planetary carrier assembly.

(6) Remove main shaft assembly 4. Remove snapring 29, center ring gear 30, spiral retaining ring 34, and rear sun gear 31.

(7) Remove snapring 43 that holds rear planetary carrier assembly 36 to planetary connecting drum 28.

(8) Remove output shaft assembly 45.

**NOTE:**

**Be sure to inspect the output shaft for raised metal at the front end. If damage is found, remove the raised metal with a soft honing stone. If damage cannot be removed, replace the output shaft. Replace the adjacent bearing and race, and carefully inspect the rear sun gear for damage.**

(9) Remove needle bearing assembly 32 and bearing race 33 located between output shaft 45 and rear sun gear 31.

(10) Place the output shaft on a work bench in a vertical position (rear planetary carrier upward). If necessary, force the planetary carrier downward until snapring 35 is clear of the carrier. Remove the snapring and bearing 44.

(11) Remove rear carrier assembly 36 from the output shaft.

(12) On models before S/N 5071, remove the spiral retainer ring 51 and thrust washer 52 that retain rear planetary ring gear 53 to carrier assembly 36. Remove ring gear 53 and thrust washer 54. On models after S/N 5070, the ring gear is not included in the planetary gear unit. Refer to Paragraph 6–16 for rebuild of the rear planetary carrier assembly.

(13) Remove spring pin 50. If bushing or plug replacement is necessary, remove bushing 47 and orifice plug 49 from output shaft 48.

(14) If bushing replacement is necessary, remove two bushings 2 from sun gear shaft 3.

**b. Assembly** *(Foldout 10,A)*

(1) If orifice plug 49 was removed from output shaft 48, install a new plug. Press the plug clear of the chamfer.

(2) If bushing 47 was removed, install a new bushing into output shaft 48, following the specifications in Figure 6–51. Bushing installer tool J 24451 can be used along with driven handle J 8092 (Figure 6–52).

**NOTE:**

**Do not use or reuse a sun gear shaft 3 that is drilled for staked bushings.**

(3) If bushings 2 were removed from sun gear shaft 3, install new bushings, following the specifications in Figure 6–53. Bushing installer tool J 23614-A (for models without lockup) or J 39737 (for models with lockup) can be used (Figure 6–54).

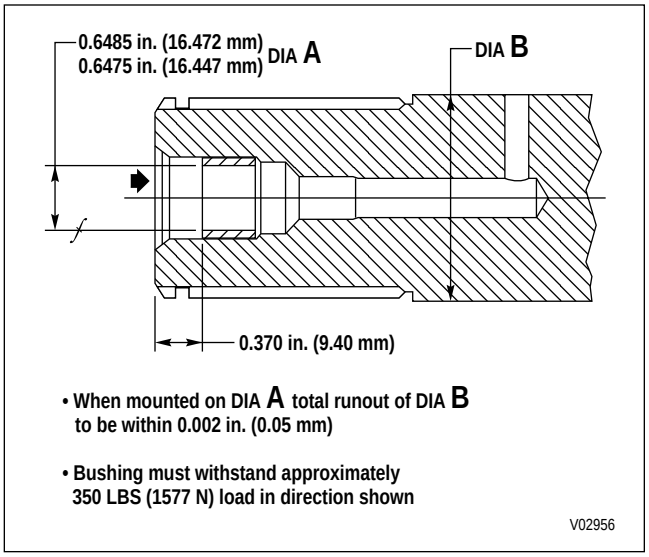


**Figure 6–51. Output Shaft Assembly**

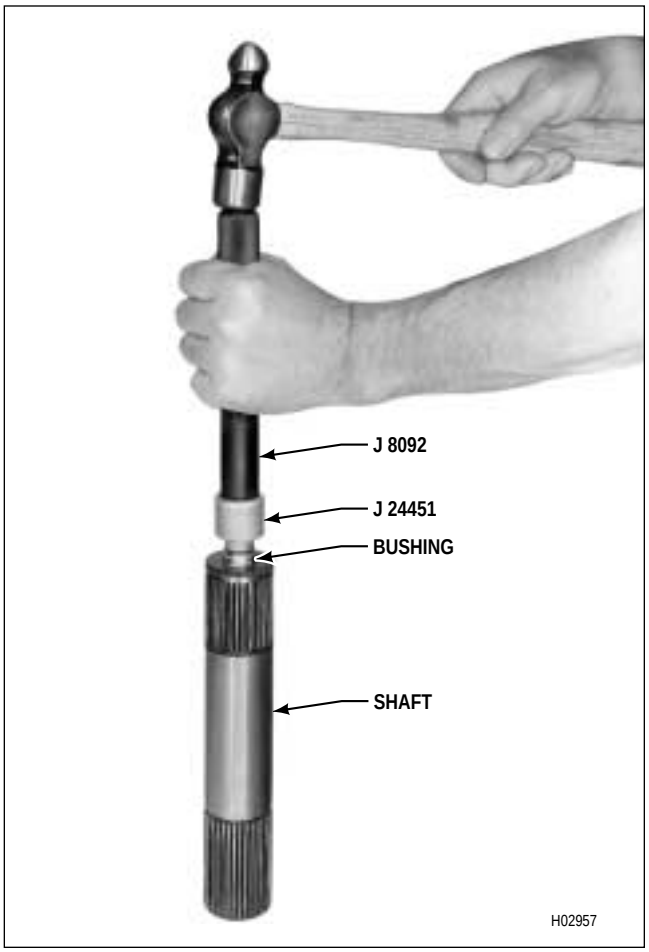


**Figure 6–52. Installing Output Shaft Bushing**

(4) If bushing 15 was damaged or distorted, refer to Paragraph 6–16**c** for machining instructions.

(5) If the transmission being rebuilt has a governor drive gear with a large V slot (Figure 6–55), install a spring pin 50 (Foldout 10,A) into the output shaft to a height of 0.150–0.170 inch (3.81–4.31 mm). If the transmission being rebuilt has a governor drive gear with a dead-end slot (Figure 6–55), install a spring pin 50 (Foldout 10,A) to a height of 0.066–0.076 inch (1.68–1.93 mm).

(6) Install rear planetary sun gear 31 onto main shaft 4, smaller end first. Secure the sun gear to the main shaft with spiral retaining ring 34.

(7) Install center ring gear 30, concave side forward, onto the rear sun gear and secure it with snapring 29.

(8) Install rear planetary carrier assembly 36 into planetary carrier connecting drum 28 aligning the broad groove in the drum OD away from the carrier. Secure the carrier with snapring 43.

**NOTE:**

- **For models after S/N 5070, skip Steps (9) and (10) and proceed with Step (11).**
- **For models before S/N 5071, proceed with Step (9).**

(9) Install spacer washer 54 and rear planetary ring gear 53 onto the hub of rear planetary carrier 36.

(10) Install spacer washer 52 and spiral retainer ring 51 to secure the rear planetary ring gear.

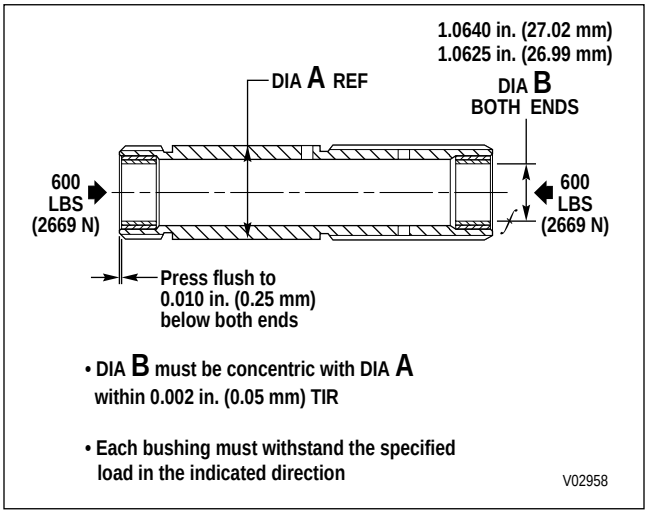


**Figure 6–53. Sun Gear Shaft and Bushings**

(11) Install ball bearing assembly 44 over the snapring groove end of output shaft 45. Install output shaft 45 (snapring groove first) into rear planetary carrier assembly 36. Secure it with snapring 35.

(12) Lubricate race 33 and bearing assembly 32 with oil-soluble grease. Install the race and bearing onto the output shaft adjacent to the rear sun gear.

(13) Install main shaft assembly 4 into rear planetary carrier 36. Index sun gear 31 with the pinions of the rear planetary carrier.

(14) Install thrust washer 27 against the front side of the rear sun gear.

(15) Install center planetary carrier assembly 20, smaller diameter end first, into planetary connecting drum 28. Index the carrier splines with the splines in the connecting drum.

(16) Install center sun gear 19, larger end first against thrust washer 27.

(17) Install front planetary ring gear 18, larger diameter end first, into planetary connecting drum 28 and secure it with snapring 17.

(18) Lubricate and install thrust washer 16 onto the hub of front planetary carrier 8.

(19) Install front planetary carrier assembly 8 onto center sun gear 19.

(20) Lubricate and install thrust washer 7 onto center sun gear 19.

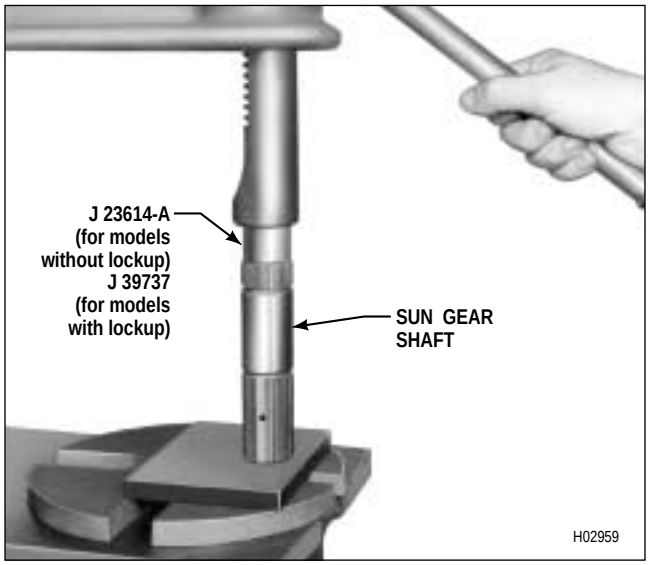


**Figure 6–54. Installing Sun Gear Shaft Bushing**

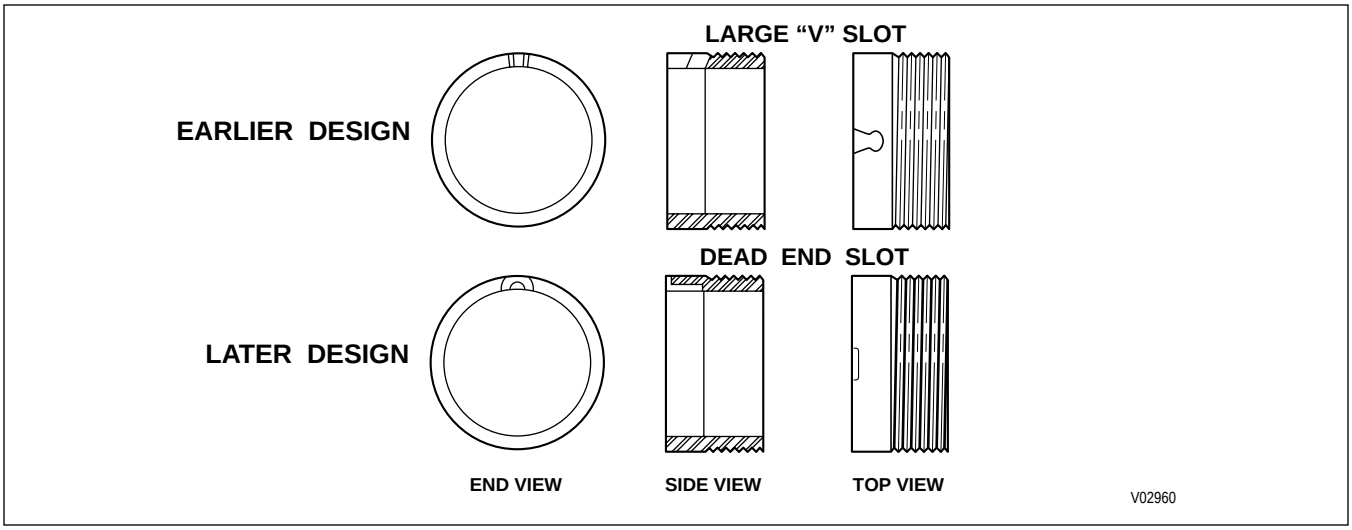


**Figure 6–55. Governor Drive Gear Configurations**

(21) Install front planetary sun gear 6, **ID spline chamfer (if present) downward**, into the front planetary carrier assembly. Later models do not have a chamfer of the ID splines.

**NOTE:**

**Thrust washer 5 and sun gear shaft assembly 1 will be installed after the gear unit is installed into the transmission.**

## *6–15. TRANSMISSION MAIN HOUSING ASSEMBLY*

### a. Disassembly

(1) Remove seal 61 (Foldout 12,B) from the transmission housing using seal remover tool J 26401.

(2) To remove the manual shift lever, remove the retainer pin and locknut (Figure 6–56). Begin to pull the selector shaft out of the housing enough to remove the selector lever. **The selector lever may have burred the end of the selector shaft; remove the burr with a small file before removing the shaft from the transmission housing.**

(3) Do not remove snapring 9 (Foldout 12,A) unless replacement is necessary.

(4) Do not remove the breather from transmission housing 11 unless replacement is necessary. It is press fit and should be cleaned while in the housing.

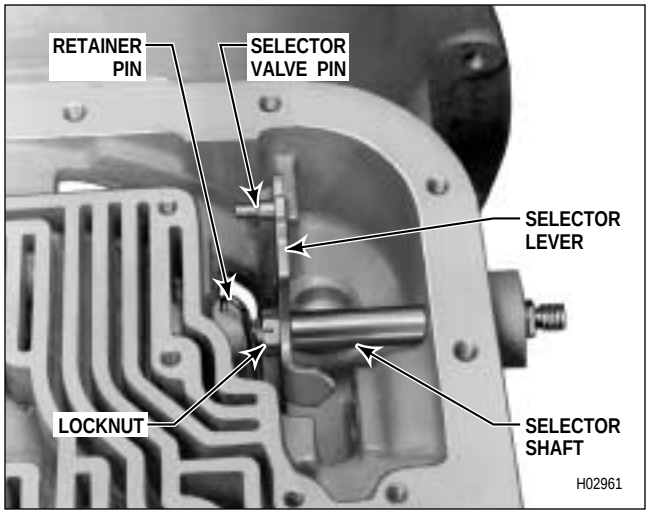


**Figure 6–56. Selector Shaft Components**

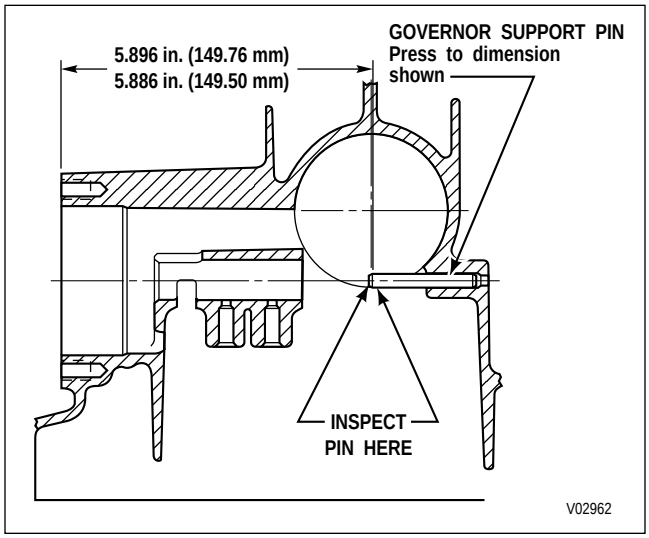


**Figure 6–57. Governor Support Pin Location**

(5) Inspect governor support pin 12 for evidence of wear. If any wear is noted on the end or on the OD of the pin, remove the pin using pin remover tool J 28708 (Figure 6–57).

(6) Inspect test plugs 8 and 13 (Foldout 12,A). Replace if damaged.

(7) If it is necessary to replace a damaged nameplate 5, remove one drive screw 4.

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**NOTE:**

**For accurate ordering of replacement parts, the information on the new nameplate must be *identical* to the information that was stamped on the damaged nameplate.**

---

**b. Assembly**

(1) If snapring 9 (Foldout 12,A) was removed, install a new snapring. Be sure to inspect the bore into which bearing 4 (Foldout 12,B) fits for damage.

(2) Coat the ID of lip-type oil seal 61 (Foldout 12,B) with oil-soluble grease. Install the seal, lip first, into the transmission case (Figure 6–58), using special installer J 26282.

**CAUTION:**

**Manual selector shafts that are center drilled at their outer ends require an M10 x 1.5-6G nut (metric thread). Shafts that are undrilled require a ⅜-16 nut (standard inch series). Use of the wrong nut will damage both the shaft and nut. Torque for either nut is 15–20 lb ft (20–27 N·m).**

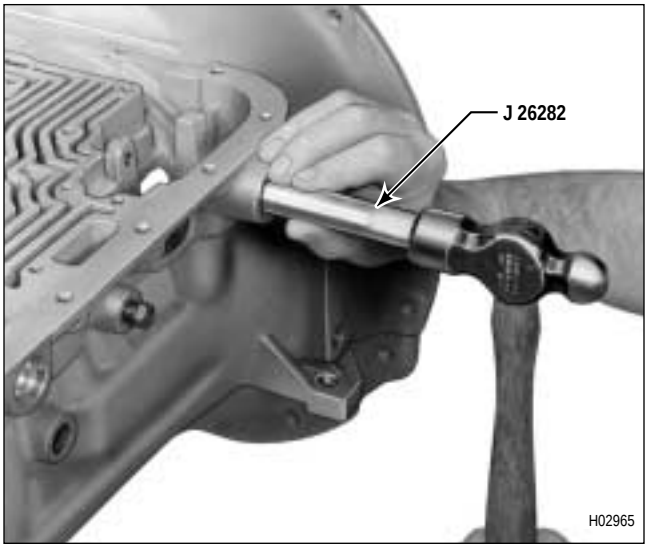


**Figure 6–58. Installing Selector Shaft Oil Seal**

(3) Hold selector lever 54 or 55 (Foldout 12,B) so the selector valve pin is facing the inside of the case. Slide selector shaft 60 through the opening in the transmission housing, oil seal, and into the slot in selector lever 54 or 55. Attach locknut 59 and retainer pin 57 (Figure 6–56). Tighten the locknut to 15–20 lb ft (20–27 N·m).

(4) If removed, press new breather 7 (Foldout 12,A) into the housing.

**CAUTION:**

**The alignment of the governor pin with the governor bore in the transmission housing is critical. The governor must rotate freely, without interference with either the case bore or the pin. Any interference will result in damage to the governor body, the bore in the housing, and/or the governor driven gear.**

(5) If governor support pin 12 was removed, install a new pin using tool J 28684. If the tool is not available, install the pin to dimensions shown in Figure 6–57.

(6) Install ⅛ inch test plugs 8 and 13 (Foldout 12,A) into housing 11. Tighten the plugs to 48–60 lb in. (5.5–6.7 N·m).

## *6–16. PLANETARY CARRIER ASSEMBLIES*

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**NOTE:**

- **The disassembly and assembly procedures for all the planetary carrier assemblies in the AT Series transmissions differ only in the proper tool selection for the specific carrier assembly. Refer to the tool chart and Figure 6–59 for specific use and identity of the carrier (front, center, rear) and tools involved. If the tool is common to all the planetary carrier assemblies, its number will be listed in the text. If the tool is not common, the text will refer to the chart. For planetary carrier detailed information, refer to the exploded views at the back of this manual.**
- **The hydraulic press, used with J 25587-01 Planetary Rebuilding Set, must have a five-ton (45 kN) capacity, an adjustable press bed of 25 inch (635 mm) minimum opening, and a pressure gauge to assist in determining proper installation and staking of the pinion pins.**

---

**a. Inspection**

(1) Visually inspect the planetary carrier assembly for evidence of excessive wear, indications of overheating, damage, or heavy metal contamination.

(2) Check the end play of the planetary carrier pinions. With the washer held flat, insert a feeler gauge between the carrier and thrust washer. End play must be within 0.008–0.031 inch (0.20–0.79 mm).

**NOTE:**

- **Do not disassemble the carrier assembly unless parts replacement is necessary. Failure of one pinion requires replacement of the entire matched pinion gear set, pinion pins, and bearings.**
- **Depending upon the amount of labor (machining the bushing), time, part replacement, and extent of rework, complete replacement of the assembly may be more practical.**

**Planetary Carrier Assembly Rebuild Tool Chart**

Note — All tools in this chart have a basic number (J 25587) and a suffix. Only the suffix is shown below.
The figures in parentheses are quantities required.

| Planetary Carrier Assembly | Support Block | Pin Remover | Pin Remover and Installer Adapter | Pin Remover and Installer Spacer | Loading Pin | Guide Pin | Pin Installer | Swaging Tool Holder | Swaging Tool |
|---|---|---|---|---|---|---|---|---|---|
| Front | –4 | –16 | | | –22 (4) | –50 (4) | –14 | –17 | –27 (2) |
| Center | –1 | –16 | | | –20 (4) | –49 (4) | –10 | –17 | –25 (2) |
| Rear | –3 | –16 | –2 | –6 | –20 (4) | –49 (4) | –10 | –17 | –25 (2) |

Tools in the chart above are components of Planetary Rebuilding Kit J 25587-01. Refer to Paragraph 4–2**b.**

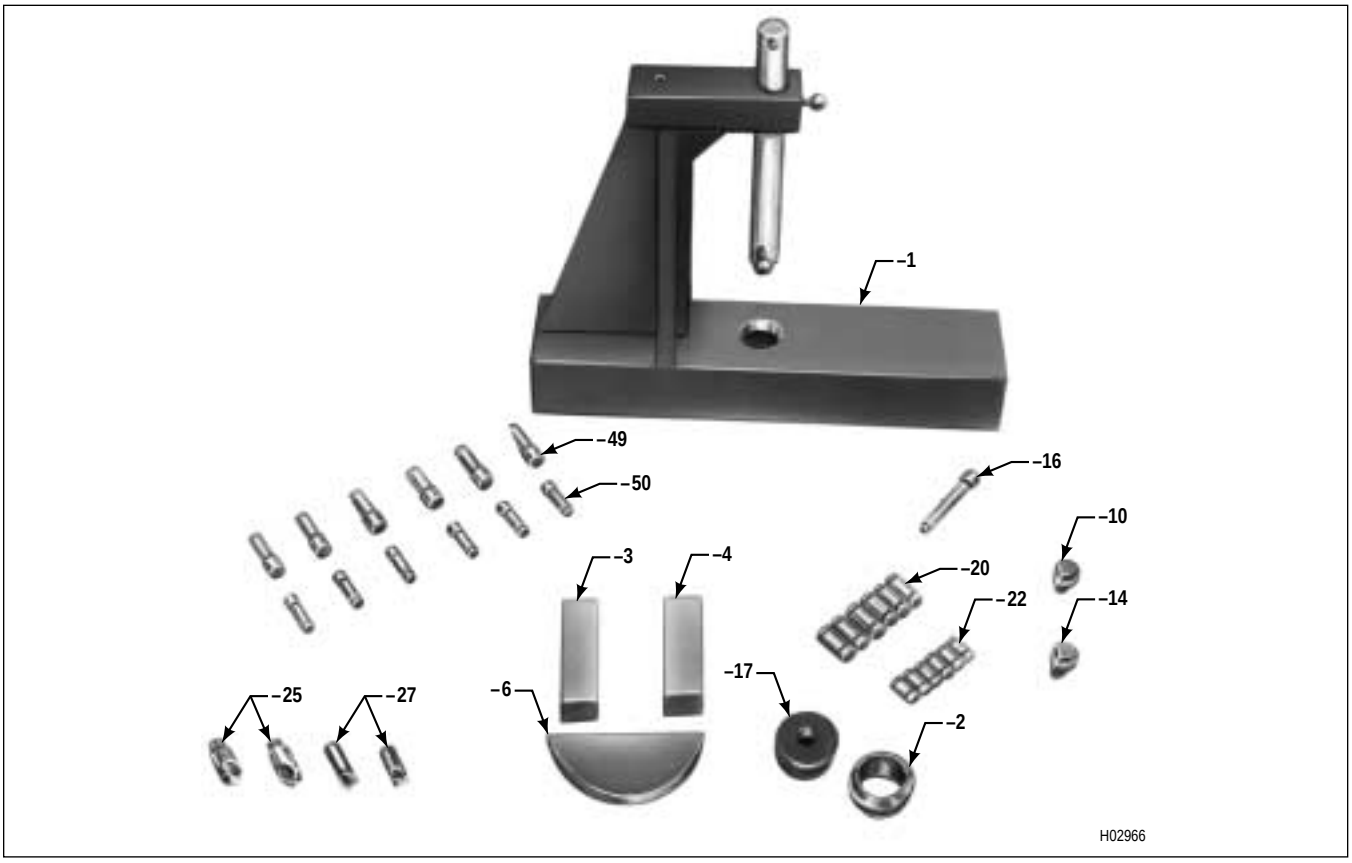



**Figure 6–59. Planetary Rebuild Tool Identification**

**b. Removal of Pinion Components**

(1) Using a drill that is slightly smaller than the pinion pin diameter, drill into the swaged end on the pins (only one end required). Do not drill into the carrier. The rear ends of all pinion pins except those in the center carrier assembly will be drilled. Drill the front ends of the center assembly pins.

(2) Place press fixture J 25587-1 in a hydraulic press. Select the proper spacer and adapter, if required, from the tool chart and Figure 6–59. Position these parts (if used) to support the carrier assembly (drilled ends of pinion pins upward) solidly on the press fixture.

(3) Install pin remover J 25587-16 into the ram of the press fixture. Press the pinion pins from the carrier assembly.

(4) Remove the pinion groups, consisting of pinions, bearings, and thrust washers.

**c. Replacing Bushing in Front Planetary Carrier**

(1) Fabricate four dummy pins to the dimensions shown in Figure 6–60.

(2) Place the front carrier on a work table, rear downward.

(3) Press the bushing from the carrier. Do not scratch or score the bushing bore. (Refer to Paragraph 4–5**f**(1).)

(4) Place the carrier in a press, rear downward.

(5) Apply Loctite® Sleeve Retainer No. 601 (or equivalent) to the OD of the new bushing. Install the bushing using tool J 28501. Press the bushing flush to 0.010 inch (0.25 mm) below its adjacent surface (Figure 6–60). Remove excess Loctite® from the carrier.

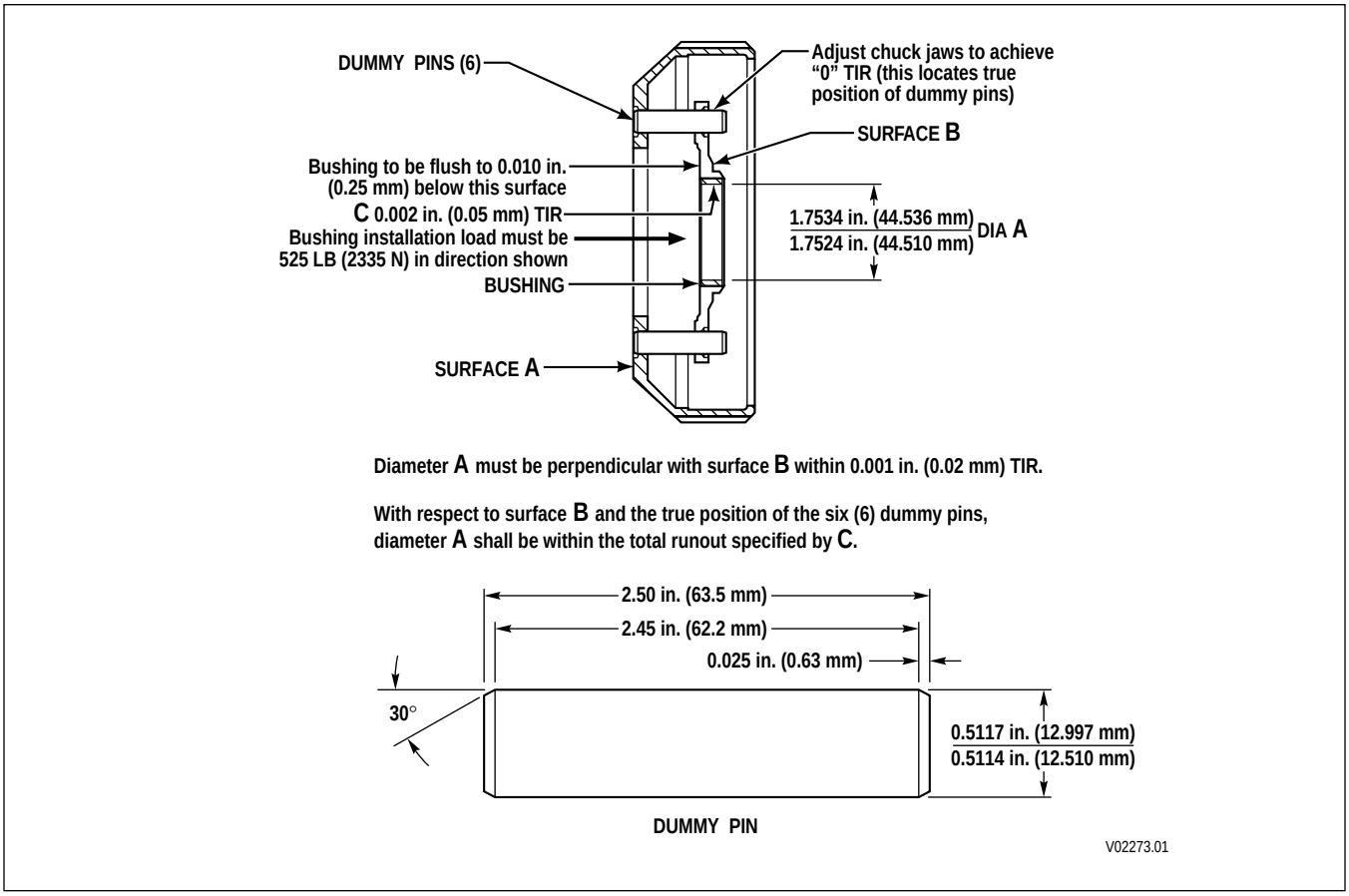



**Figure 6–60. Front Carrier Assembly Bushing Installation**

(6) Using a lathe with a four jaw chuck, mount the carrier with Surface **A** facing the chuck. Insert the four fabricated dummy pins (Figure 6–60) into the pinion pin holes. Adjust the chuck, centering the carrier based on Surface **B** and the runout of the dummy pins.

(7) Total runout of bushing after boring must not exceed 0.010 inch (0.25 mm). Use Figure 6–60 as a guide.

**d. Installation of Pinion Components**

**NOTE:**

**Lubricate needle rollers and thrust washers before assembling the pinion groups.**

(1) Assemble all the pinion groups for the carrier assembly. Each group is assembled by inserting the proper loading pin into the bore of the pinion, installing the needle roller bearings around the loading pin, installing a steel thrust washer at each end of the pinion, and installing a bronze thrust washer onto each steel thrust washer.

(2) Position the carrier assembly, rear upward (center carrier, front upward). Install all the pinion groups into the planetary carrier, aligning the loading pins with the pin bores in the carrier.

(3) Install the proper pinion guide pins (Tool Chart and Figure 6–59), larger diameters first, into the pinion pin bores. Push the guide pins through the carrier until the loading pins drop out.

(4) Position the carrier assembly on the press fixture, using pin remover and installer adapter J 25587-2 (if required).

(5) Select the proper pin installer, and install it into the press fixture ram.

**NOTE:**

**Pin installers are shaped to avoid interference with bosses on the carrier assemblies. They must be installed in the ram so that the cutaway portion of the installer will clear the bosses when the pinion pin is pressed in.**

**CAUTION:**

**Do not put pressure on the carrier. Distortion of the carrier will damage it.**

(6) Place a pinion pin onto the pilot end of the pin guide located below the press fixture ram. Press the pinion pin into the carrier until the installer contacts the carrier.

(7) Install the remaining pinion pins as instructed in Step (6).

(8) Remove the carrier assembly from the press fixture. Install swaging tool holder J 25587-17 into the opening of the press fixture bed. Install a swaging tool into the holder. Install another swaging tool into the press fixture ram. Lubricate both ends of the pinion pins with oil-soluble grease.

(9) Position the carrier assembly, rear upward (center carrier, front upward) on the press fixture. Use the proper support block to level the carrier while the lower swaging tool is supporting the lower end of one pinion pin.

(10) Apply sufficient pressure to the press fixture ram to firmly swage the ends of the pinion pin against the metal of the carrier. Figure 6–61 illustrates a typical swage pattern.

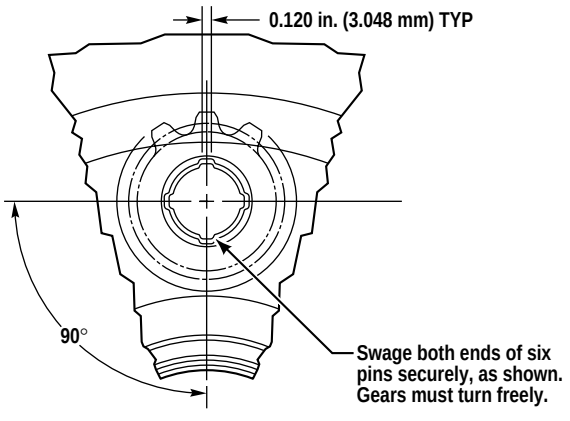



**Figure 6–61. Typical Swaging Pattern on Pinion Pin**

**NOTE:**

**Swaging pressure varies with the size of the pinion pins (approximately two tons for front carriers; three tons for center and rear carriers). While applying pressure, rotate the pinions and feel for reduction of end play. The pinions must rotate freely and have 0.008–0.031 inch (0.20–0.79 mm) end play after swaging the pins.**

(11) Swage the remaining pinion pin ends as instructed in Step (10).

## *6–17. CLUTCH STACK MEASUREMENT*

### a. Assembly Line

(1) When mass production overhaul practices are used, the stack measurement procedure may be more convenient.

(2) The stack dimension method is the only method available for determining running clearance for:

- Forward clutch assemblies using a wave plate (models with an identification groove in the clutch housing)
- Second clutch (all models)

(3) To obtain accurate dimensions, the stack to be measured must have new clutch plates, and the applied load must be evenly distributed.

### b. Forward Clutch

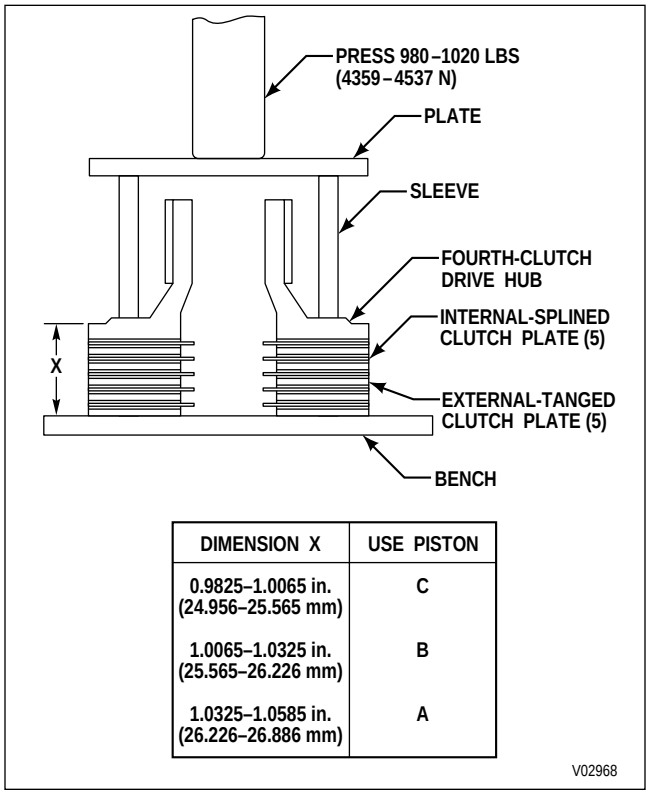
(1) Stack the forward clutch plates and fourth clutch hub as shown in Figure 6–62 or 6–63.

(2) Apply the specified load, and measure Dimension **X**.

(3) From the applicable table in Figure 6–62 or 6–63, select the forward clutch piston. Use the parts measured, and the selected piston, in the forward clutch assembly (Paragraph 6–10**a**).

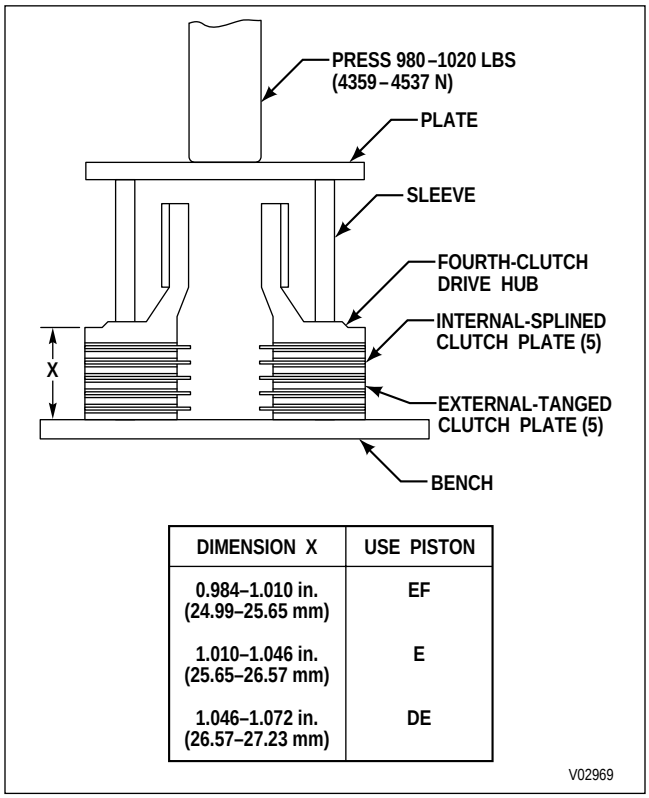
### c. Fourth Clutch

(1) Stack the fourth clutch plates and backplate as shown in Figure 6–64.




| DIMENSION X | USE PISTON |
|---|---|
| 0.9825–1.0065 in. (24.956–25.565 mm) | C |
| 1.0065–1.0325 in. (25.565–26.226 mm) | B |
| 1.0325–1.0585 in. (26.226–26.886 mm) | A |

**Figure 6–62. Determining Forward Clutch Piston Thickness (Models Not Using a Wave Plate)**




| DIMENSION X | USE PISTON |
|---|---|
| 0.984–1.010 in. (24.99–25.65 mm) | EF |
| 1.010–1.046 in. (25.65–26.57 mm) | E |
| 1.046–1.072 in. (26.57–27.23 mm) | DE |

**Figure 6–63. Determining Forward Clutch Piston Thickness (Models Using a Wave Plate)**

(2) Apply the specified load, and measure Dimension **X**.

(3) From the table in Figure 6–64, select the fourth clutch piston. Use the parts measured, and the selected piston, in the fourth clutch assembly (Paragraph 6–12**c**).

**d. Third Clutch.** Refer to Paragraph 7–7**a** for clutch clearance.

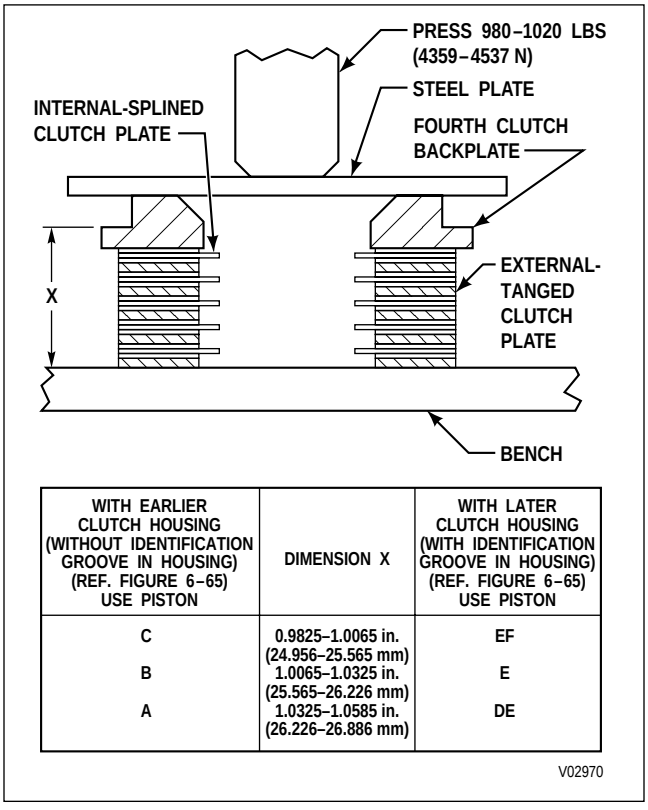
**e. Second Clutch**

(1) Stack the second clutch plates and piston as shown in Figure 6–66.

(2) Apply the specified load, and measure Dimension **X**.

**NOTE:**

**Replace used plates, within specifications, as needed with new to produce Dimension X. *Second clutch does not have selective backplates.***




| WITH EARLIER CLUTCH HOUSING (WITHOUT IDENTIFICATION GROOVE IN HOUSING) (REF. FIGURE 6–65) USE PISTON | DIMENSION X | WITH LATER CLUTCH HOUSING (WITH IDENTIFICATION GROOVE IN HOUSING) (REF. FIGURE 6–65) USE PISTON |
|---|---|---|
| C | 0.9825–1.0065 in. (24.956–25.565 mm) | EF |
| B | 1.0065–1.0325 in. (25.565–26.226 mm) | E |
| A | 1.0325–1.0585 in. (26.226–26.886 mm) | DE |

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**Figure 6–64. Determining Fourth Clutch Piston Thickness**

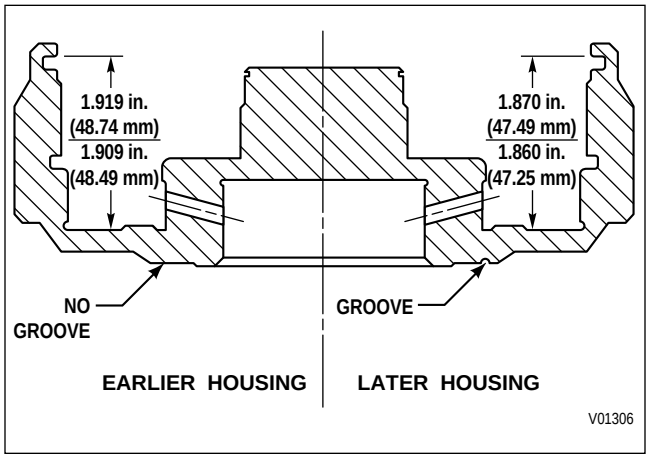



**Figure 6–65. Fourth Clutch Housing Identification**

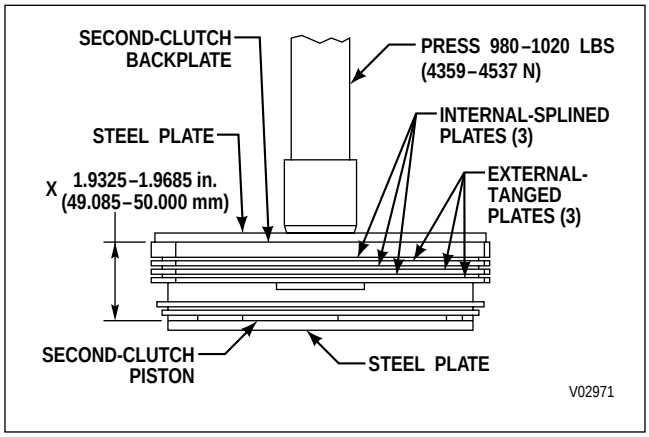
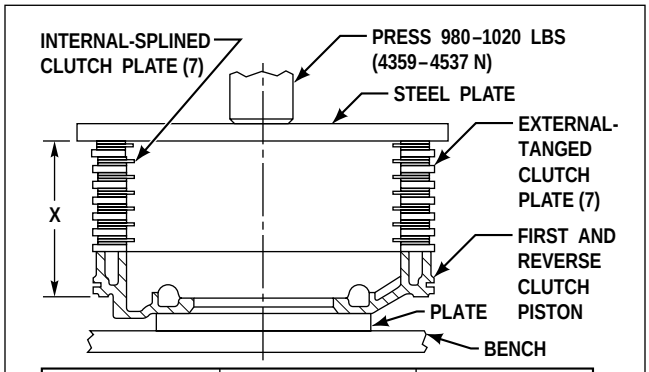



**Figure 6–66. Checking Second Clutch Plate Running Clearance**




| EARLIER MODELS USE BACKPLATE | DIMENSION X | LATER MODELS USE BACKPLATE |
|---|---|---|
| 1 | 2.2875–2.3235 in. (58.103–59.016 mm) | 4 |
| 2 | 2.3236–2.3595 in. (59.017–59.931 mm) | 5 (or no mark) |
| 3 | 2.3596–2.3955 in. (59.932–60.846 mm) | 6 |

V02972

**Figure 6–67. Determining First Clutch Backplate Thickness**

(3) The clutch running clearance will be within limits when the stack thickness measurement is from 1.93–1.97 inch (49–50 mm).

(4) Use the parts measured when the transmission is assembled (Paragraph 7–5**a**).

**f. First Clutch**

(1) Stack the first clutch plates and piston as shown in Figure 6–67.

(2) Apply the specified load, and measure Dimension **X**.

(3) From the table in Figure 6–67, select the first clutch backplate. Use the parts measured, and the selected backplate, when the transmission is assembled (Paragraph 7–4**a**).

**NOTES**

# Section 7 – ASSEMBLY OF TRANSMISSION

## *7–1. SCOPE*

This section covers assembly of transmission from subassemblies and parts. Procedures that differ in the various models, or procedures that apply to only one model, are identified. Procedures common to all models have no model identification.

## *7–2. GENERAL INFORMATION FOR FINAL ASSEMBLY*

Refer to Sections 4 and 8 for assembly information as follows:

| Paragraph | Description |
|---|---|
| 4–2 | Tools and Equipment |
| 4–3 | Replacement Parts |
| 4–4 | Careful Handling |
| 4–6 | Assembly Procedures |
| 4–10 | Torque Specifications |
| 8–1 | Wear Limits Data |
| 8–2 | Spring Data |

## *7–3. SELECTIVE COMPONENTS*

### a. Establish Clearances

(1) Certain components are available in graduated lengths or thicknesses to provide the proper running clearances. These components are selected by taking measurements at certain stages in the assembly of the transmission.

(2) The components which are selected during assembly of the transmission are tabulated below. Refer to Parts Catalog SA1235 or SA2126 for specific part numbers.

| Component | Item | Illustration |
|---|---|---|
| Thrust washer | 37 | (Foldout 7,B) |
| Snapring | 5 | (Foldout 9,B) |
| First clutch backplate | 2 | (Foldout 10,B) |
| Spacer | 3 | (Foldout 12,B) |

### b. Clutch Plate Stack Measurements

(1) First clutch clearance can be determined by direct measurement (Paragraph 7–4) or by stack dimension measurement (Paragraph 6–7**f**). Refer to Paragraph 6–17**e** for stack dimension measurement to establish clutch clearance for second clutch. The clearance for third clutch is established by direct measurement in this section (Paragraph 7–7).

(2) An initial clutch plate running clearance check may be in excess of the required dimension. Do not install a thicker backplate if excess clearance can be eliminated by installing new clutch plates.

## *7–4. INSTALLATION OF FIRST CLUTCH AND GEARING*

### a. First Clutch *(Foldout 10,B)*

(1) Place the transmission housing assembly into the holding fixture, converter housing upward.

(2) Place inner seal protector tool J 24216-01 over the hub in the transmission housing (Figure 7–1).

(3) Install the inner and outer lip-type sealrings into the grooves in the first clutch piston. A color-coded, outer lip-type sealring (blue) is used on the piston after S/N 3210201937. The lips of both sealrings must face toward the rear of the transmission when the piston is installed. (Refer to sealring cross-sections on Foldout 10,B.) Lightly lubricate the surface of the piston bore and protector J 24216-01 with transmission fluid before installation.

(4) Install the piston and sealrings into the transmission housing rear bore, engaging the piston tang into the slot in the housing (Figure 7–1). Be sure the lip of the sealring on the outside diameter of the piston is not distorted. Remove the protector tool.

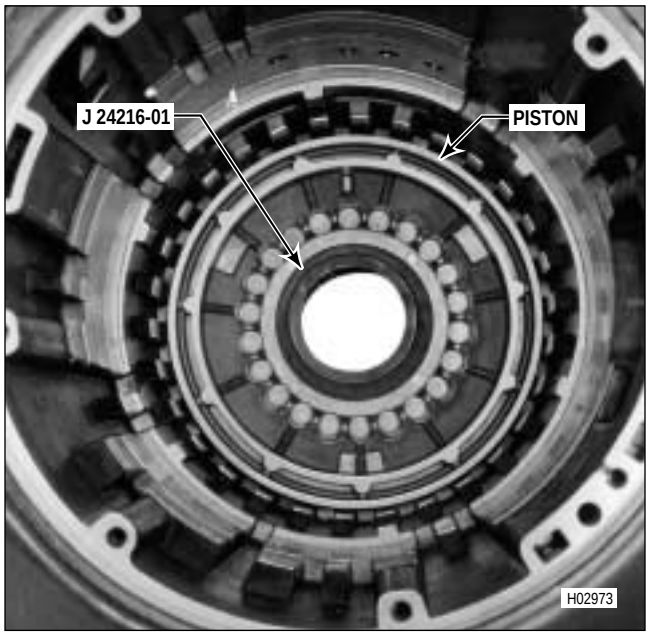



**Figure 7–1. Installing First Clutch Piston**

(5) Install twenty-two springs into the recesses in the piston. Install the spring retainer onto the springs (Figure 7–2).

(6) Lay the spring retainer snapring on the spring retainer (Figure 7–2).

(7) Install spring compressor assembly J 23630-02 into the rear bearing bore of the transmission housing (Figure 7–2). Check the springs for proper alignment.

**CAUTION:**

**When installing the first clutch snapring, do not allow the spring retainer to catch in the snapring groove.**

(8) Tighten the wing-nut on the spring compressor until the spring retainer clears the snapring groove in the housing hub. Install the snapring into its groove. Remove the spring compressor.

**NOTE:**

**For models before S/N 5071, proceed with Step (9). For models after S/N 5070, skip Steps (9) and (10) and proceed with Step (11).**

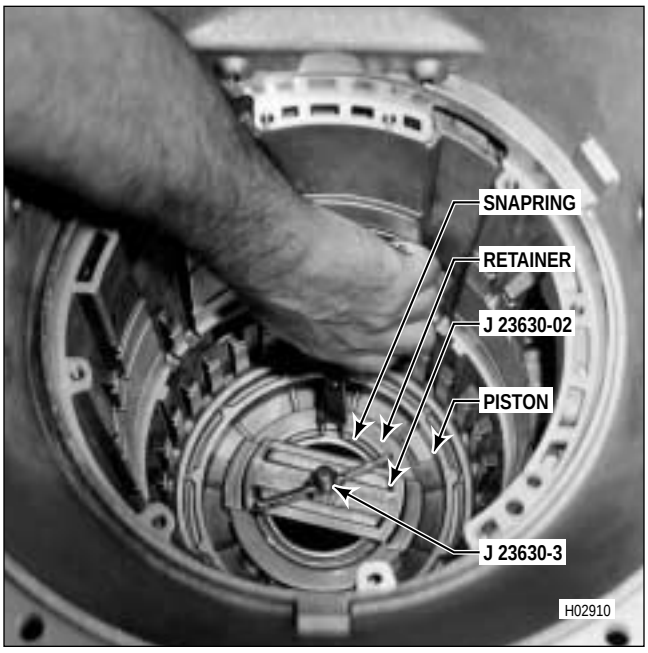



**Figure 7–2. Installing First Clutch Spring Retainer Snapring**

(9) For models before S/N 5071, install all fourteen first clutch plates into the transmission as follows. Beginning with an external-tanged plate, alternately install seven external-tanged plates 4 (Foldout 10,B) and seven internal-splined clutch plates 3.

(10) Install the clutch backplate (wide surface down) and secure it with a snapring. The first clutch snapring must be installed with the snapring gap at the 12 o'clock position (at the top of the transmission housing) and must be fully seated in its groove. Proceed to Paragraph 7–4**b** and continue rebuild.

(11) After S/N 5070, place ring gear 5 (Foldout 10,B) on a work table, extended teeth downward. Beginning with an internal-splined plate, alternately install six internal-splined and six external-tanged clutch plates onto the rear ring gear (Figure 7–3).

**NOTE:**

**Assemble ring gear 5 (Foldout 10,B) with extended teeth *upward* in housing.**

(12) Pick up the ring gear and assembled first clutch plates. Invert the assembly. Align the tangs of the external clutch plates on the ring gear and install the gear and plates into the transmission as a package. Be sure the extended teeth on the ring gear are at the **top** of the gear after installation.

(13) Install the two remaining clutch plates, external-tanged plate first. Install the clutch backplate (Figure 7–4) (wide surface down) and secure it with a snapring (Figure 7–5). The first clutch backplate snapring must be installed with the snapring gap at the 12 o'clock position (at the top of the transmission housing) and must be fully seated in its groove.

**b. First Clutch Running Clearance**
*(Foldout 10,B)*

(1) Using clutch clearance gauge J 23715, check the clearance between the snapring and the backplate (Figure 7–5). The smaller end of the gauge should go into the clearance while the larger end should not. The running clearance is satisfactory when the dimension is 0.040–0.100 inch (1.02–2.54 mm).

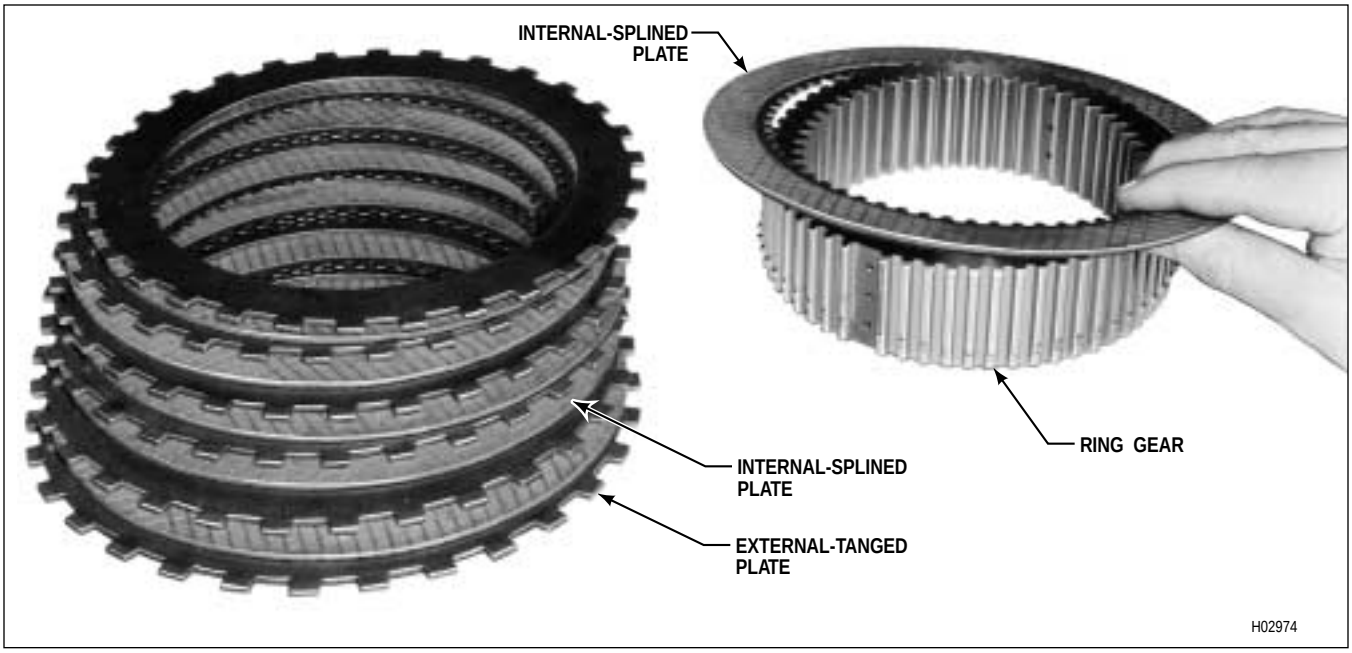



**Figure 7–3. Installing First Clutch Plates Onto Rear Planetary Ring Gear**

(2) If the clearance is excessive (larger end of gauge will pass between the snapring and the backplate), new plates may be installed to reduce the clearance. If the clearance is still excessive after new internal-splined and external-tanged clutch plates are installed, a thicker backplate is required.

(3) If the clearance is insufficient (small end of gauge will not enter), a thinner backplate is required.

(4) Backplates are stamped with identifying numbers (1, 2, 3, 4, 5 (or no mark), or 6). Thicknesses are as follows:

| | |
|---|---|
| Identification 1, 4 | 0.683 to 0.693 inch (17.35 to 17.60 mm) |
| 2, 5, or No Stamp Identification | 0.647 to 0.657 inch (16.43 to 16.69 mm) |
| Identification 3, 6 | 0.611 to 0.621 inch (15.52 to 15.77 mm) |

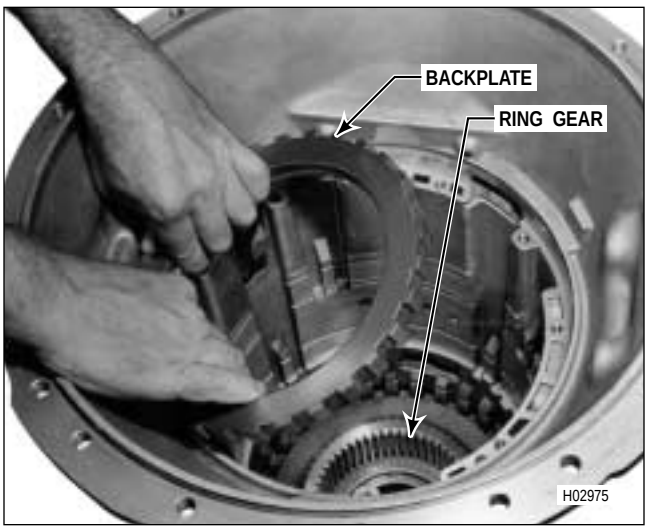



**Figure 7–4. Installing First Clutch Backplate**

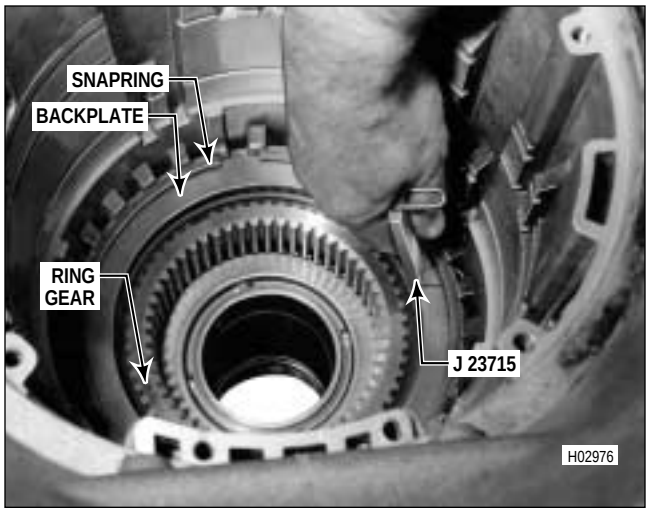



**Figure 7–5. Checking First Clutch Running Clearance**

**c. Planetary Gear Unit**

**NOTE:**

- **Models before S/N 5071 include the rear planetary ring gear as part of the planetary gear unit. Proceed with Steps (1) and (2).**
- **For models after S/N 5070, skip Steps (1) and (2) and proceed with Steps (3) and (4).**

(1) Align the internal splines on the first clutch pack, just installed in the main housing. Apply air pressure to first clutch feed (refer to Figure 4–5). Grasp the gear unit (as assembled in Paragraph 6–14) by the main shaft, and install it into the transmission housing.

(2) Make sure all the first clutch plate internal splines are engaged with rear planetary ring gear 53 (Foldout 10,A). Apply air pressure to the first clutch feed, located just below the valve body oil tracks (refer to Figure 4–5). Air pressure will lift the ring gear and gear pack slightly if all the splined plates are not engaged. Proceed to Paragraph 7–5 and continue rebuild.

(3) On models after S/N 5070, grasp the planetary gear unit by the main shaft and lower the unit into the transmission (Figure 7–6). Mesh the internal teeth of the previously installed rear ring gear (Paragraph 7–4**a**(11) through (13)) with the rear planetary carrier pinion teeth. Be sure the unit bottoms.

(4) Install the sun gear shaft assembly (long splines first) and the front sun gear thrust washer (Figure 7–7).

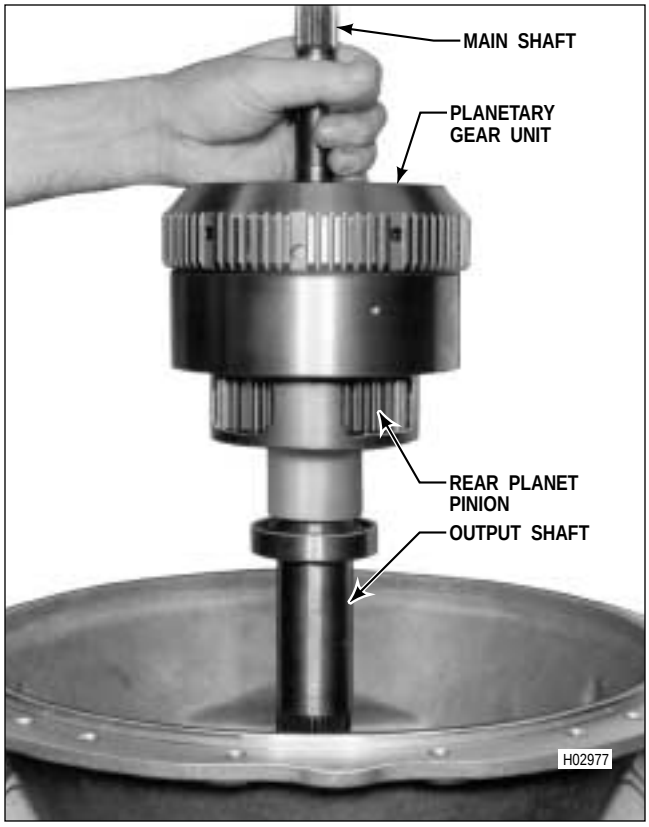



**Figure 7–6. Installing Planetary Gear Unit**

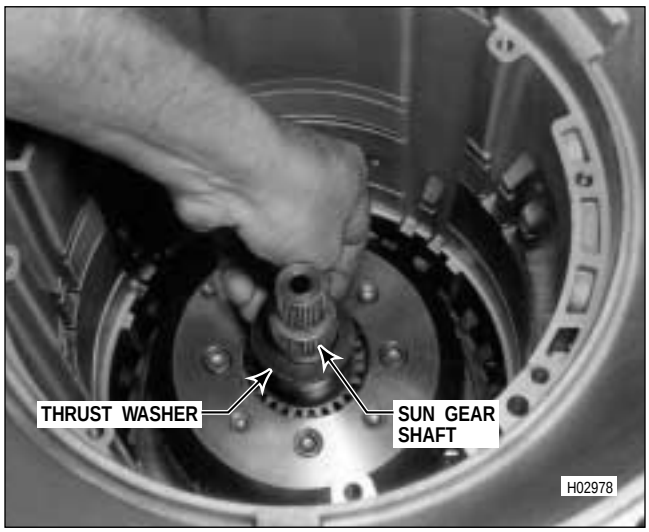



**Figure 7–7. Installing Sun Gear Shaft Assembly and Thrust Washer**

## *7–5. INSTALLATION OF SECOND CLUTCH AND CENTER SUPPORT*

**a. Second Clutch Pack** *(Foldout 9,B)*

(1) Refer to Paragraph 6–17**e** for second clutch running clearance specifications. **The stack dimension procedure is the only method available for determining proper second clutch running clearance**.

(2) Install the second clutch backplate (Figure 7–8). Note the location of the single tang in the single slot in the transmission housing.

(3) Beginning with an internal-splined plate, alternately install three internal-splined and three external-tanged second clutch plates (Figure 7–8). The single tangs of the clutch plates must align with the single tang of the backplate.

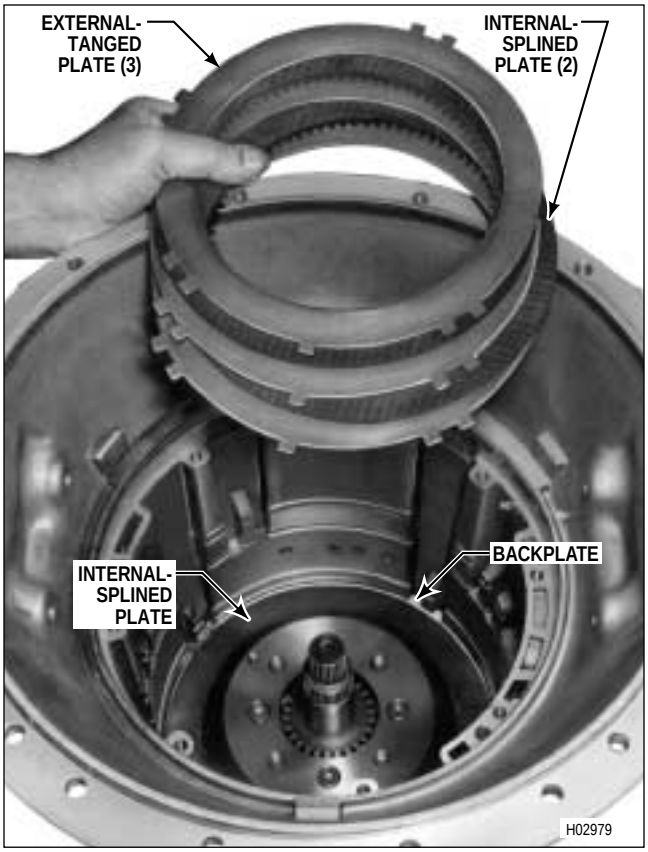



**Figure 7–8. Installing Second Clutch Plates**

**CAUTION:**

**When installing the second clutch snapring, do not allow the snapring to drag across the machined surface (surface with four holes through it). Dragging the snapring may result in leaks between the passages and/or leaks to the sump.**

(4) Install the 0.155–0.157 inch (3.94–3.99 mm) thick green snapring that retains the second clutch plates (Figure 7–9). The snapring gap must be located at the 12 o'clock position (at the top of the transmission housing), and must be fully seated in its groove.

**b. Center Support and Pistons** *(Foldout 9,B)*

(1) Place center support assembly 13 on a work table and clean the piston bores of all foreign matter.

**CAUTION:**

**Both the second and third pistons have been preset in Paragraph 6–13*c*, (3) through (6). Do not disturb the piston spring retainer lockrings when installing the pistons into the piston bores in the center support.**

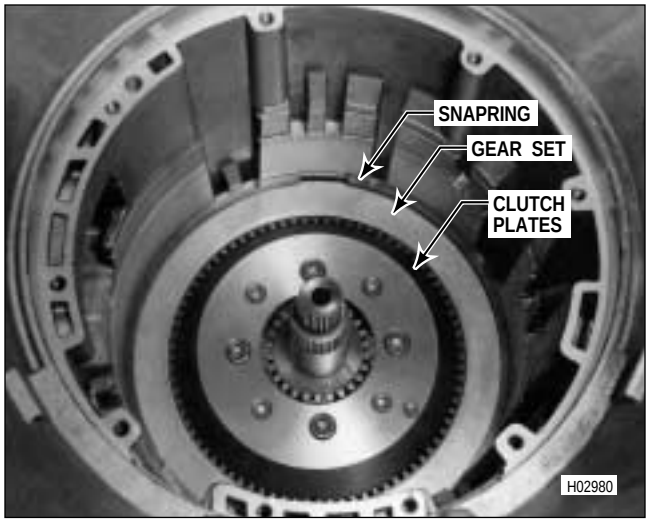



**Figure 7–9. Second Clutch Snapring Installed**

(2) Be sure the lips of the sealrings of both pistons each face (what will be after installation) the bottom of the respective piston cavity in the center support. (Refer to sealring cross-sections on Foldout 9,B.)

(3) Lubricate the sealrings of the second and third clutch pistons. Lubricate the piston bores in the center support.

(4) Install the third clutch piston and its attached parts in the front bore of the center supports, engaging the small lug on the third clutch spring retainer with the slot in the center support.

(5) Install the second clutch piston and its attached parts in the rear bore of the center support, engaging the small lug on the second clutch spring retainer with the slot in the center support.

**CAUTION:**

**Some models use a 3⁄8-16 center support anchor bolt; some use a 7⁄16-20 bolt. Take care to install the same size bolt as was removed.**

(6) Attach center support lifting bracket J 23643 to the center support and carefully lower the support into the transmission case. During installation, align the threaded anchor bolt hole in the support with the hole in the bottom of the transmission housing. Install the plain washer and a new anchor bolt into the support. Tighten the bolt finger tight.

(7) Install center support compressor J 23717-C (Figure 7–10). Use two of the 5⁄16-18 x 1¾ inch oil pump assembly retaining bolts to retain the compressor.

(8) Tighten the compressor bolt to 5 lb ft (7 N·m) (Figure 7–10).

(9) Using snapring gauge J 34127, measure the snapring groove clearance (Figure 7–11). The gauge has four lugs of different thicknesses, with each lug thickness stamped on the tool shaft. Try all four lugs in the groove. The thickest lug which will enter the groove indicates the thickness of the snapring required.

(10) Select a snapring from the list.

| Gauge Lug | Snapring Color Code | Snapring Thickness |
|---|---|---|
| 0.149 inch (3.78 mm) | Blue | 0.148–0.150 inch (3.76–3.81 mm) |
| 0.153 inch (3.88 mm) | Yellow | 0.152–0.154 inch (3.86–3.91 mm) |
| 0.156 inch (3.96 mm) | Green | 0.155–0.157 inch (3.94–3.99 mm) |
| 0.159 inch (4.04 mm) | Red | 0.158–0.160 inch (4.01–4.06 mm) |

(11) Install the snapring selected in Step (10). The snapring gap must be located at the 12 o'clock position (at the top of the transmission housing), and must be fully seated in its groove.

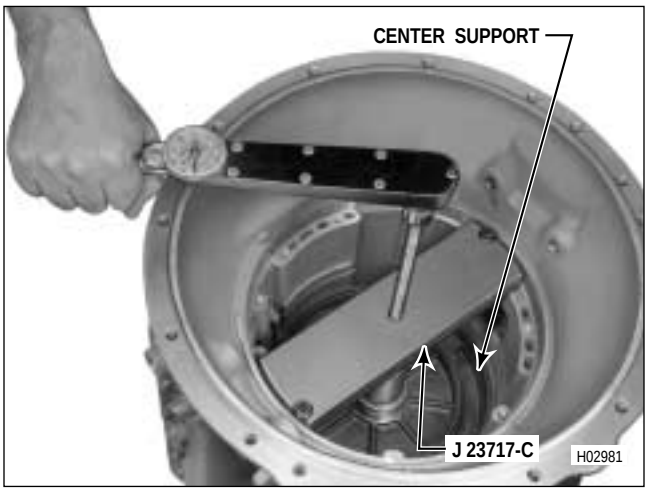



**Figure 7–10. Compressing Center Support For Snapring Measurement**

(12) Remove the center support compressor.

(13) Install two new hook-type sealrings 12 (Foldout 9,B) onto the hub of center support assembly 13.

## *7–6. INSTALLATION OF REAR BEARING SPACER AND FOURTH CLUTCH*

### a. Selecting, Installing Rear Bearing Spacer *(Foldout 12,B)*

(1) Install the sun gear shaft retainer J 24352 for AT 500 Series or J 39736-01 for AT 1500 Series onto the transmission main shaft (Figure 7–12). Be sure retainer sleeve is seated on the sun gear shaft while tightening the thumb screw.

(2) Position the transmission, rear end upward. Install the governor drive gear, engaging its slot with the pin in the output shaft (Figure 7–13).

(3) Install speedometer drive gear 2 (Foldout 12,B) or speed sensor wheel 9 onto the output shaft.

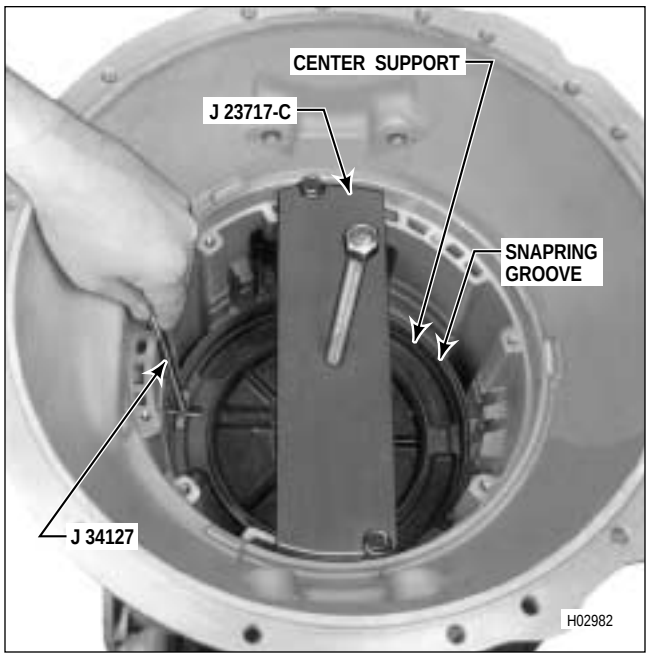



**Figure 7–11. Measuring For Selection of Center Support Snapring**

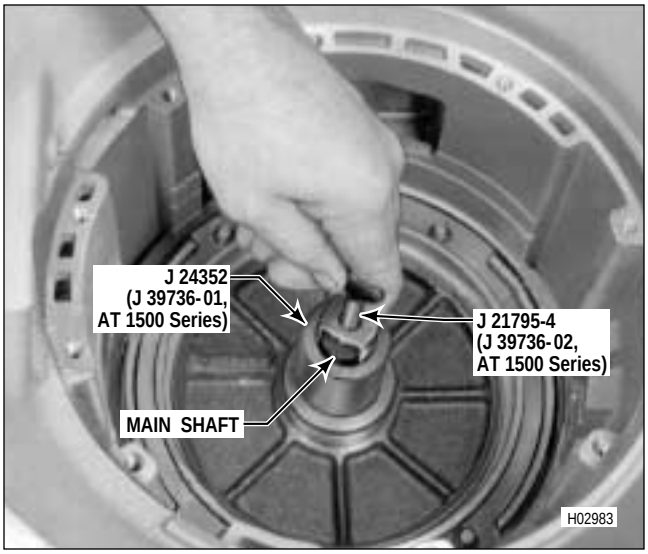



**Figure 7–12. Installing Sun Gear Shaft Retainer**

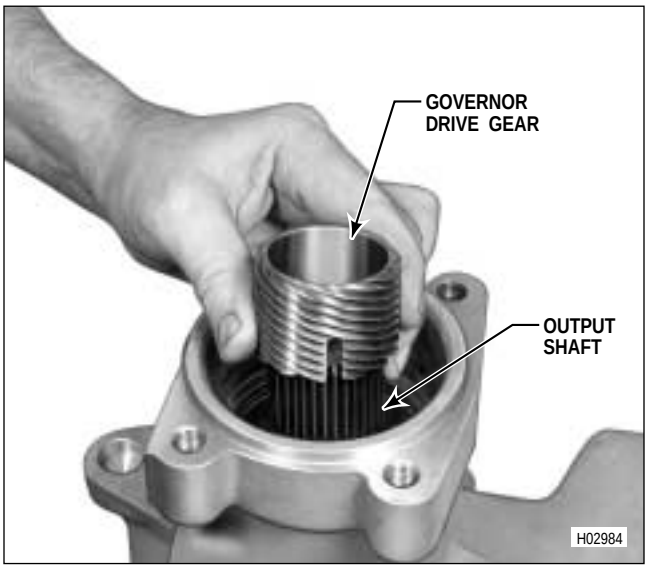



**Figure 7–13. Installing Governor Drive Gear**

(4) Using a soft drift, tap against the speedometer drive gear or speed sensor wheel to seat all the installed components.

(5) Loosen the thumbscrew on spacer selection gauge J 23632-01 and position the gauge against the output shaft (Figure 7–14). Push the straight member of the gauge against the rear of the speedometer drive gear. Push the lipped member against the rear bearing front snapring. It may be necessary to extend the slot on the gauge to obtain this measurement. When the gauge is in firm contact with these parts, and the concave side of the straight member is firmly against the output shaft, tighten the thumbscrew.

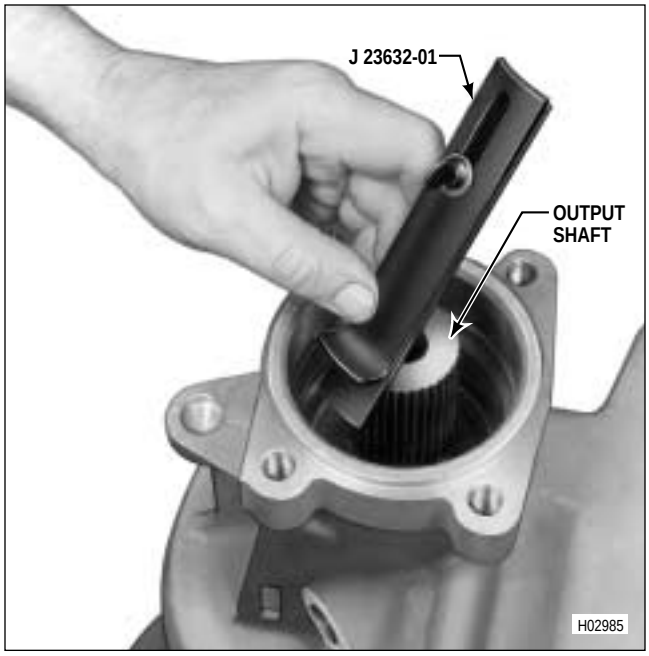



**Figure 7–14. Measuring For Selection of Rear Bearing Spacer**

(6) Remove the gauge, and using a depth micrometer, measure the distance from the end of the straight member to the lip of the curved member. Use this dimension to select the proper rear spacer, as listed in the following chart. Install the spacer.

| Dimension* | | Use | |
|---|---|---|---|
| **From** | **To** | **Spacer** | **Marked** |
| 1.0003 (25.408) | 1.0138 (25.750) | 23017123 | 1 Groove |
| 1.0138 (25.750) | 1.0273 (26.093) | 23017124 | 2 Grooves |
| 1.0273 (26.093) | 1.0408 (26.436) | 23017125 (See SIL 20-TR-92) | 0 or 3 Grooves |
| 1.0408 (26.436) | 1.0543 (26.779) | 23017126 | 4 Grooves |
| 1.0543 (26.779) | 1.0678 (27.122) | 23017127 | 5 Grooves |
| 1.0678 (27.122) | 1.0813 (27.465) | 23017128 | 6 Grooves |

*Dimension in inches (millimeters)

(7) Using bearing installer tool J 24446, install rear bearing 4 (Foldout 12,B) numbered side out, as shown in Figure 7–15. Install beveled snapring 5 (Foldout 9,B), flat side down.

(8) Check the end play of the transmission output shaft as follows.

(9) Place the first clutch spring compressor base J 23630-2, flange side down on the output shaft (Figure 7–16). Secure the base to the output shaft with a ½-20 x 1¼ inch bolt. Tighten the bolt to 15 lb ft (20 N·m).

(10) Lift the output shaft with a screwdriver (Figure 7–16) and measure the distance from the top of the flange to the rear of the transmission. Release the output shaft and repeat the measurement. The allowable clearance with the proper spacer is 0.013–0.031 inch (0.33–0.79 mm). **A different size spacer must be used if this clearance is not obtained**.

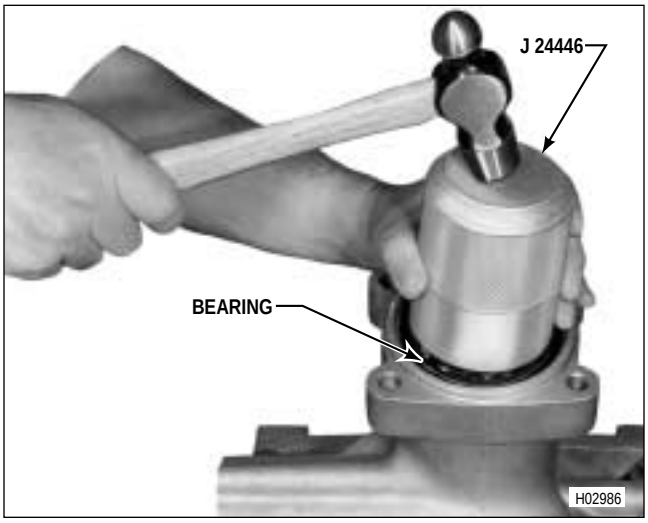



**Figure 7–15. Installing Rear Output Shaft Bearing**

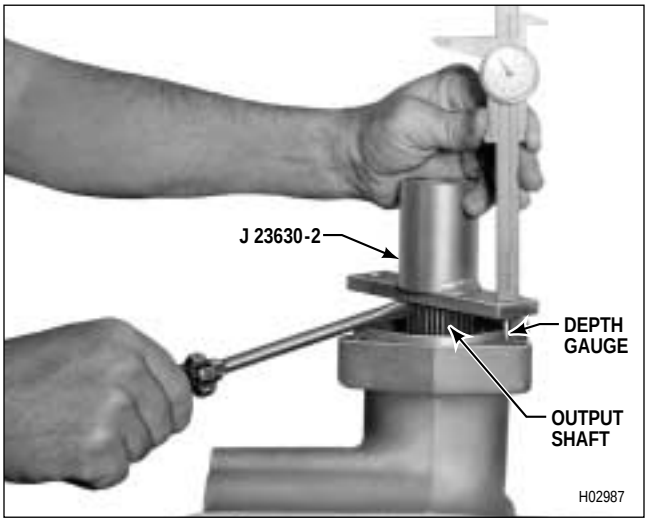



**Figure 7–16. Checking End Play of Output Shaft**

(11) Install spring compressor assembly J 23630-2. Tighten the ½-20 x 1¼ inch center bolt to 15 lb ft (20 N·m). Align the spring compressor base with the two parking brake mounting holes in the transmission housing (Figure 7–17). Install two ½-13 bolts through the base and into the case. Tighten these bolts evenly to 5–8 lb ft (7–11 N·m). This positions the gear pack and all components for an accurate selective thrust washer measurement in Paragraph 7–8.

**b. Fourth Clutch** *(Foldout 9,A)*

(1) Reposition the transmission, front upward. Carefully remove sun gear shaft retainer J 24352 or J 39736-01 (Figure 7–12) without moving the sun gear shaft.

**CAUTION:**

- **The sun gear shaft assembly must be properly seated to establish an accurate clearance between the forward clutch housing and the front support and bearing assembly. Refer to Paragraph 7–8.**
- ***Do not remove* the sun gear shaft assembly before checking the required clearance shown on Figure 7–18. If the clearance is less than ⅛ inch (3.18 mm), proceed with Step (2). Otherwise, skip Step (2) and proceed with Step (3).**

(2) If the sun gear shaft assembly is properly seated, there should be approximately ⅛ inch (3.18 mm) distance from the end of the sun gear shaft assembly to the shoulder on the main shaft shown in Figure 7–18. If the shaft is not properly seated, a slow rotation with a slight up and down motion may seat it. If not, remove the shaft (noting its relative position to the main shaft) and center the front sun gear thrust washer so the sun gear shaft will bottom. Recheck the clearance (Figure 7–18).

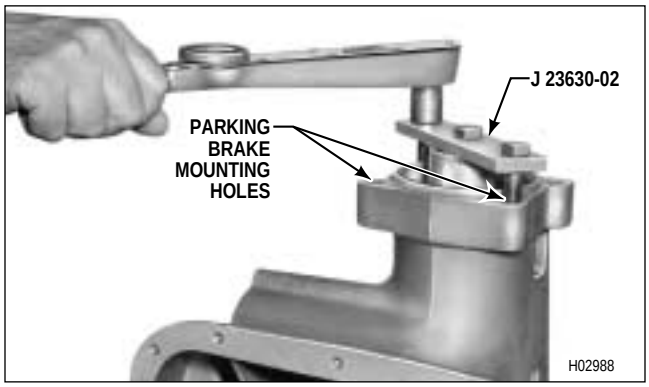



**Figure 7–17. Positioning Components For Front Thrust Washer Measurements**

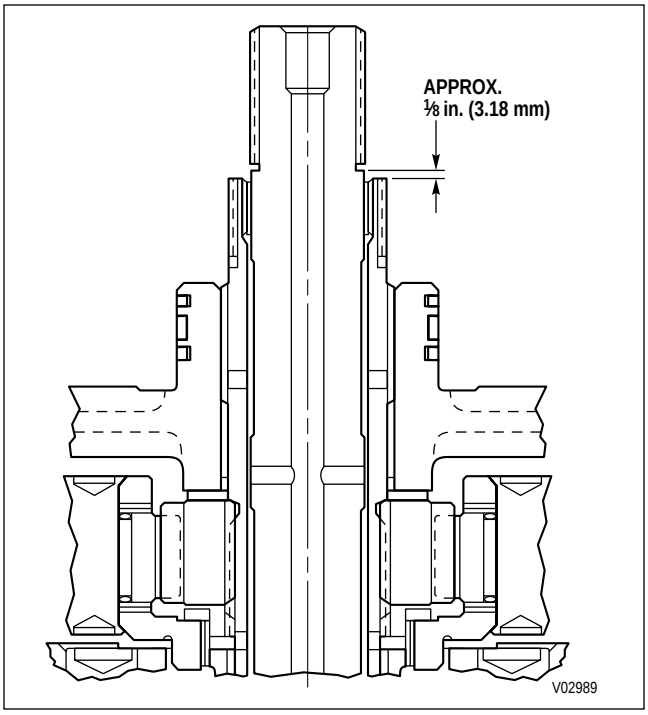



**Figure 7–18. Sun Gear Shaft Clearance**

(3) Install the fourth clutch assembly (as rebuilt in Paragraph 6–12) onto the splines of the sun gear shaft.

## *7–7. INSTALLATION OF THIRD AND FORWARD CLUTCHES*

**a. Third Clutch** *(Foldout 9,B)*

---

**NOTE:**

**Establishing clutch clearance for the third clutch pack by stack dimension is not necessary. The running clearance for this clutch is such that it will accept all internal and external plates within their required wear limit. (Refer to Section 8.) However, especially for models with retarder, it is critical that the wear limits measurements are taken and that the third-clutch plates are within the wear limits listed in Section 8. The retarder housing serves as a backplate for the third clutch pack, making the pack inaccessible for a running clearance check when the third clutch pack is first installed. Third clutch running clearance for models with retarder is not checked until the transmission is removed from the overhaul stand. Refer to Paragraph 7–12*b*.**

---

(1) Beginning with an external-tanged clutch plate, alternately install three (models without retarder) or four (models with retarder) external-tanged and three internal-splined plates (Figure 7–19). Note the location of the three pairs of tangs and a single tang in relation to paired slots and a single slot. The plate will have minimal rotational movement when properly installed.

---

**NOTE:**

- **For models without retarder, proceed with Step (2).**
- **For models with retarder, skip Steps (2) through (5) and proceed with Paragraph 7–7*b*.**

---

(2) Install the third clutch backplate, aligning its tangs with those of the three clutch plates (Figure 7–20). For models prior to S/N 3210668026, this plate is identified by the Mark **4**. For later models, there is a square stamped on a single external tang.

(3) Install the snapring that retains the backplate (Figure 7–20). The snapring is identified by a green mark and is 0.155–0.157 inch (3.94–3.99 mm) thick. The snapring gap must be at the 12 o'clock position (viewed from the front of the transmission housing), and must be fully seated in its groove.

(4) Using third clutch clearance gauge J 23716 (Figure 7–20), check the clutch running clearance. The thin end of the gauge should pass between the snapring and the backplate; the thick end should not. The running clearance is correct with a dimension of 0.028–0.119 inch (0.74–3.02 mm).

(5) If clearance is excessive (larger end of gauge enters plates), new clutch plates should replace worn plates. Refer to the wear limits in Section 8 for clutch plate dimensions.

(6) Skip Paragraph 7–7**b** and proceed with Paragraph 7–7**c**.

**b. Retarder Housing Assembly.** Install the retarder housing assembly, stator blades upward, aligning the oil jumper tube holes with the PTO opening in the transmission housing (Figure 7–21).

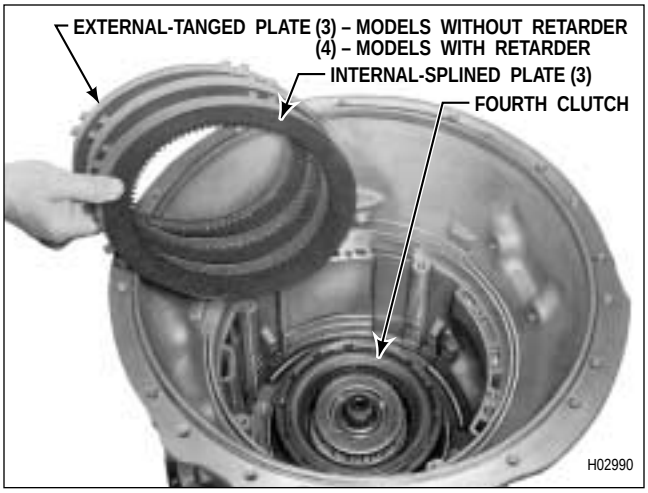



**Figure 7–19. Installing Third Clutch Plates**

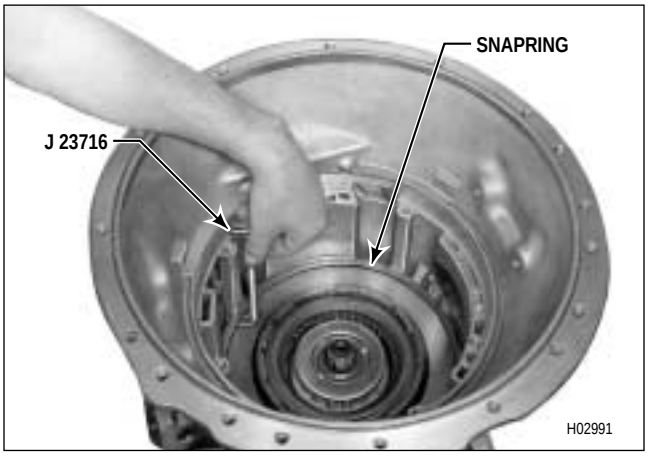



**Figure 7–20. Checking Third Clutch Running Clearance (Models Without Retarder)**

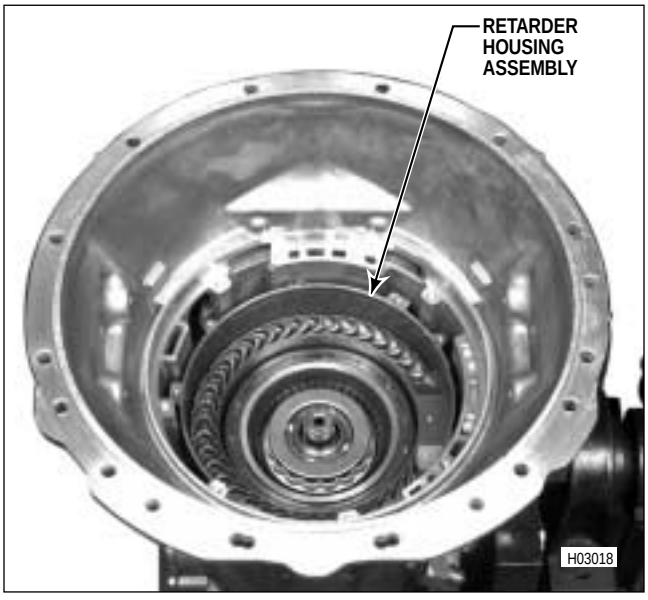



**Figure 7–21. Installing Retarder Housing Assembly (Models With Retarder)**

**c. Forward Clutch and Turbine Shaft Assembly** *(Foldout 8)*

(1) Install the thrust washer onto the hub of the forward clutch assembly, retaining it with oil-soluble grease (Figure 7–22).

(2) Install forward clutch and turbine shaft assembly. The hub splines engage the transmission main shaft. The splines on the fourth clutch drive hub engage the internal splined plates of the fourth clutch.

(3) Rotate the forward clutch assembly one or two revolutions, while pushing it downward. Make sure all the fourth clutch internal-splined plates are engaged.

---

**NOTE:**

- **For models with retarder, proceed with Step (4).**
- **For models without retarder, skip Step (4) and proceed with Paragraph 7–8.**

---

(4) For models with retarder, install two M6-1 x 80 mm guide bolts into the retarder housing assembly (Figure 7–23). Install the front stator, stator blades first, aligning the holes in the stator with the holes in the retarder housing assembly (Figure 7–24).

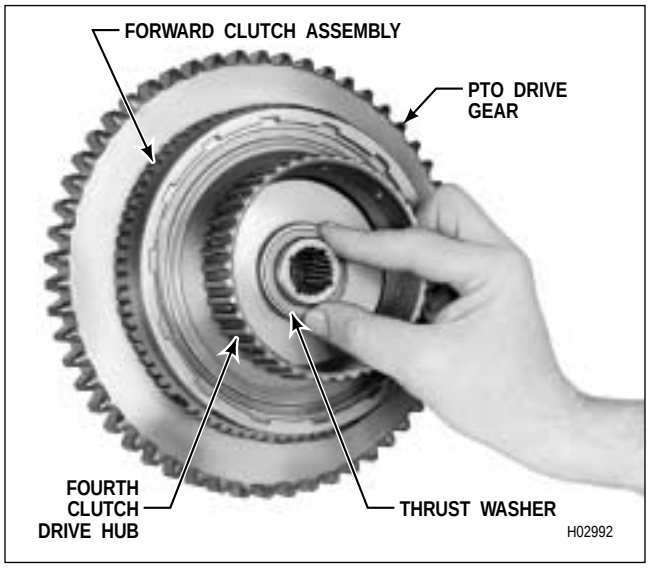



**Figure 7–22. Installing Thrust Washer at Rear of Forward Clutch Hub**

## *7–8. INSTALLATION OF OIL PUMP ASSEMBLY*

### a. Selection of Front Thrust Washer *(Foldout 7,B)*

(1) Lay thrust washer selection gauge bar J 23633 in the transmission housing (Figure 7–25). Place the depth micrometer so that its stem passes through the center hole in the gauge bar.

(2) Align the gauge bar so that the micrometer stem is above the thrust washer surface of the forward clutch housing (Figure 7–25).

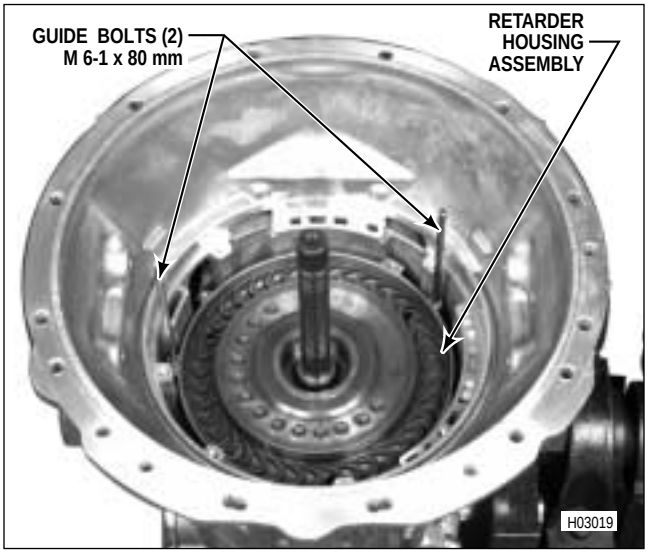



**Figure 7–23. Installing Retarder Housing Assembly Guide Pins (Models With Retarder)**

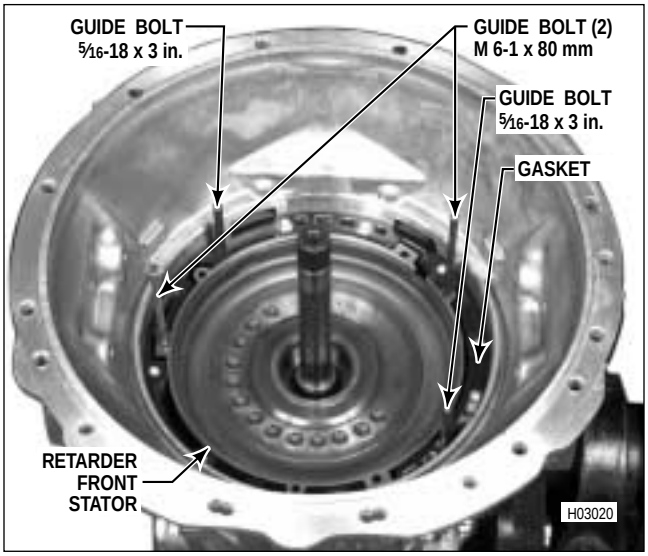



**Figure 7–24. Installing Retarder Front Stator (Models With Retarder)**

(3) Measure the distance from the top of the gauge bar to the thrust surface of the clutch housing (Figure 7–25). Subtract 1.00 inch (25.4 mm) or the thickness of the gauge bar and record the difference. Select the proper thrust washer from the following table.

| Dimension* | | Thrust Washer | |
|---|---|---|---|
| From | To | Number | Marked |
| 0.732 (18.61) | 0.749 (19.03) | 6831620 Black | 0 |
| 0.749 (19.03) | 0.765 (19.44) | 6831621 Red | 1 |
| 0.765 (19.44) | 0.782 (19.86) | 6831622 Blue | 2 |
| 0.782 (19.86) | 0.798 (20.27) | 6831623 Green | 3 |
| 0.798 (20.27) | 0.814 (20.69) | 6831624 Black | 4 |
| 0.814 (20.69) | 0.831 (21.11) | 6831625 Black | 5 |

*Dimension in inches (millimeters)

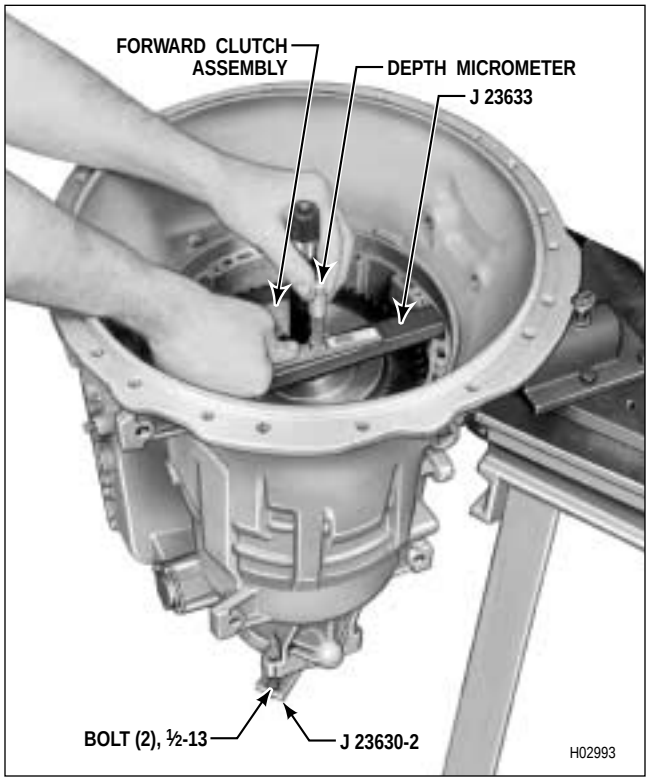



**Figure 7–25. Measuring For Selection of Front Thrust Washer**

**b. Pump Assembly** *(Foldout 7,B)*

(1) Using oil-soluble grease, install the thrust washer selected in Paragraph 7–8**a**(3), onto the oil pump assembly (Figure 7–26). The tab on the washer must engage the cast recess in the front support.

(2) Install two hook-type sealrings onto the hub of the front support (Figure 7–26).

(3) Lubricate the sealrings and thrust washer with oil-soluble grease.

(4) Install the front support gasket, aligning the bolt holes in the gasket with those in the transmission housing (Figure 7–24 or 7–27).

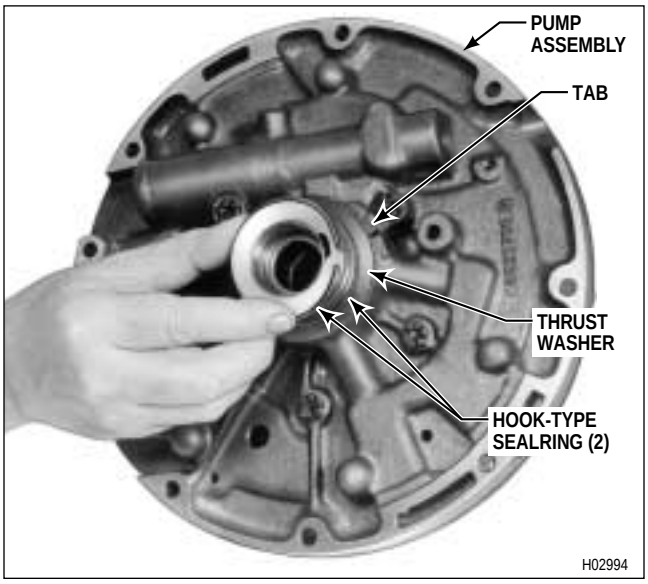



**Figure 7–26. Installing Hook-Type Sealrings Onto Oil Pump Assembly**

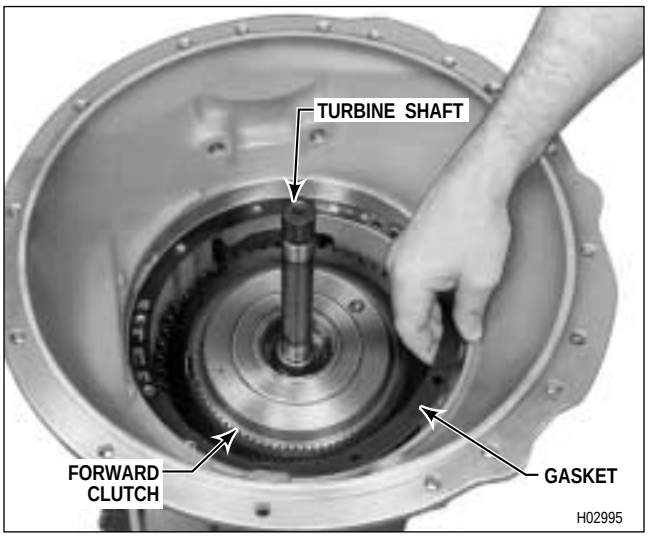



**Figure 7–27. Installing Front Support Gasket (Models Without Retarder)**

(5) Install two 5⁄16-18 headless guide bolts into two opposite holes in the gasket and transmission housing (Figure 7–24 or 7–28).

(6) Grasp the oil pump assembly by the stator shaft and lower it into the transmission housing (Figure 7–28 or 7–29). Be sure the support bottoms. Remove the guide bolts.

(7) Install nine 5⁄16-18 x 1¾ inch self-locking bolts, with nine new rubber coated washers, into the front support and transmission housing. Tighten the bolts to 13–16 lb ft (17–22 N·m).

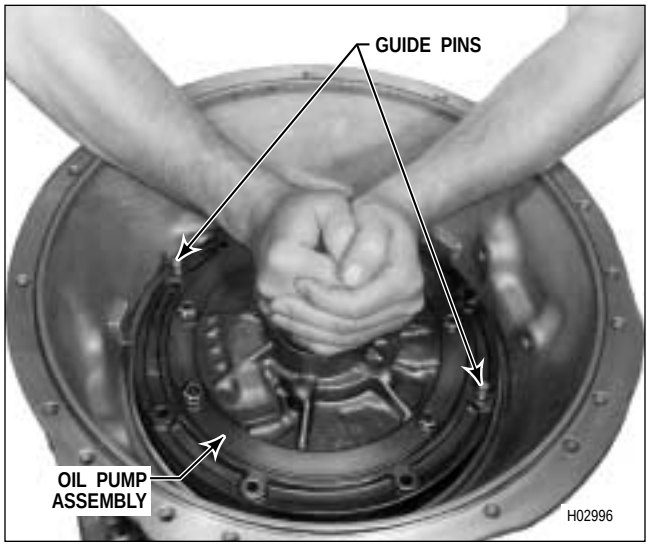



**Figure 7–28. Installing Oil Pump Assembly (Models Without Retarder)**

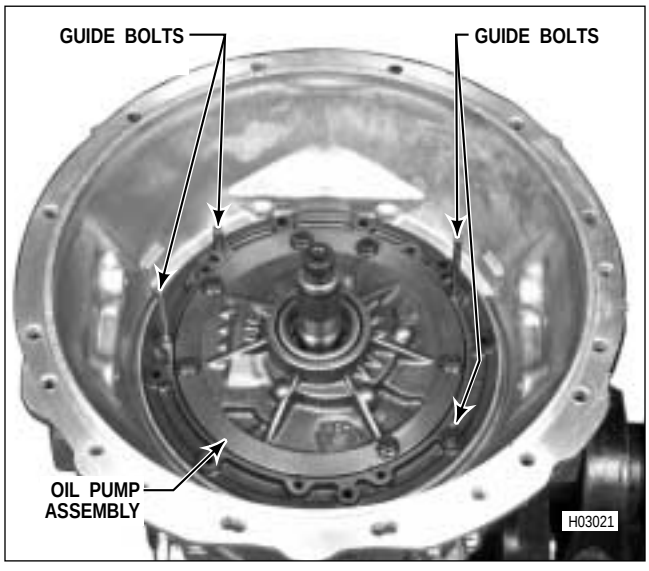



**Figure 7–29. Installing Oil Pump Assembly (Models With Retarder)**

**NOTE:**

- **For models with retarder, proceed with Step (8).**
- **For models without retarder, skip Step (8) and proceed with Step (9).**

(8) For models with retarder, install six M6-1 bolts 39 (Foldout 7,B). Tighten bolts 39 to 9–10 lb ft (12–14 N·m).

(9) To check the turbine shaft end play, mount a vernier dial caliper on the turbine shaft. Raise the shaft, extending the depth gauge to bear upon the stator shaft and record the dial reading (Figure 7–30).

(10) Release the shaft and record the dial reading. If the dial reading does not fall within the desired end play range of 0.005–0.034 inch (0.13–0.85 mm), the thickness of the selective thrust washer must be recalculated.

(11) Remove the compressor base, J 23630-2, installed in Paragraph 7–6**a**, from the transmission housing and output shaft.

## *7–9. INSTALLATION OF OUTPUT SHAFT OIL SEAL (Foldout 12,B)*

(1) Refer to Paragraph 4–6**e**. Coat the lip of oil seal 6 with high temperature grease.

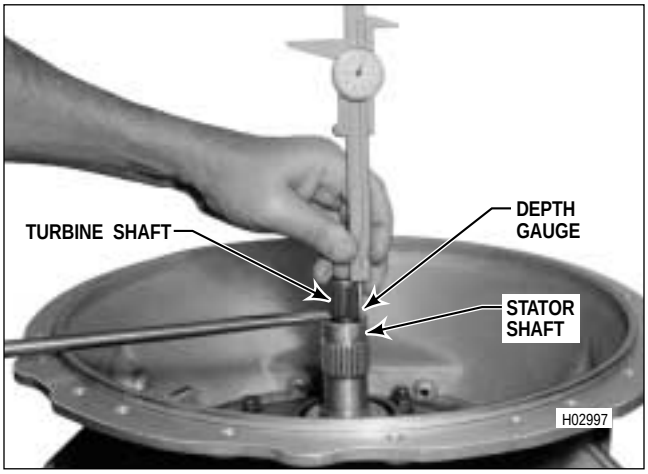



**Figure 7–30. Measuring Turbine Shaft End Play**

(2) Start the oil seal, lip first, squarely into the rear bore of the transmission housing.

(3) Using installer tool J 23631, drive the oil seal into the housing until the installer seats against the housing (Figure 7–31). The rear of the oil seal will be 0.51–0.55 inch (13.0–14.0 mm) forward of the brake mounting surface of the transmission housing when properly installed.

(4) Refer to Paragraph 3–16**h** for the installation of the output flange and retaining bolt and washer.

## *7–10. INSTALLATION OF MAIN CONTROL VALVE BODY, OIL FILTER, AND OIL PAN*

### a. Main Control Valve Body

**NOTE:**

**If the control valve body assembly was replaced, it will perform properly only if it is functionally compatible with the main housing channeling. Refer to Parts Catalog SA1235 for part numbers and serial number application.**

(1) Position the transmission housing bottom side upward.

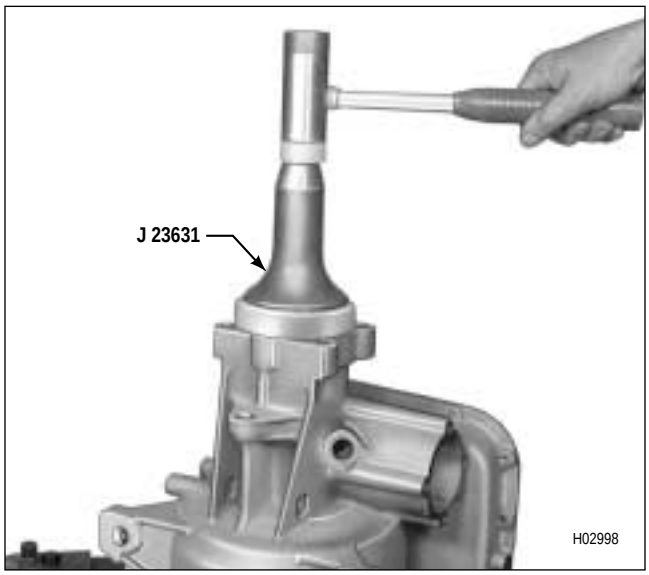



**Figure 7–31. Installing Output Shaft Oil Seal**

(2) If the anchor bolt is 3/8-16, tighten it to 39–46 lb ft (53–62 N·m); if the anchor bolt is 7/16-20, tighten it to 67–80 lb ft (91–108 N·m) (Figure 7–32).

(3) For earlier models, install the governor check valve ball into the channel in the transmission housing (Figure 7–32).

**CAUTION:**

**Do not allow the selector valve to fall out during handling of the main control valve assembly.**

**NOTE:**

**If it is necessary to install the main control valve assembly from under a vehicle, apply oil-soluble grease to the governor check valve ball to locate it on the separator plate of the assembled control valve body.**

(4) Position the main control valve body on the transmission housing in its approximate installed position (Figure 7–33)

**CAUTION:**

**If the governor feed and pressure tubes are installed, rear end first, they will not align properly when the main control valve is installed. They may appear to align until installation of the main control valve body is attempted.**

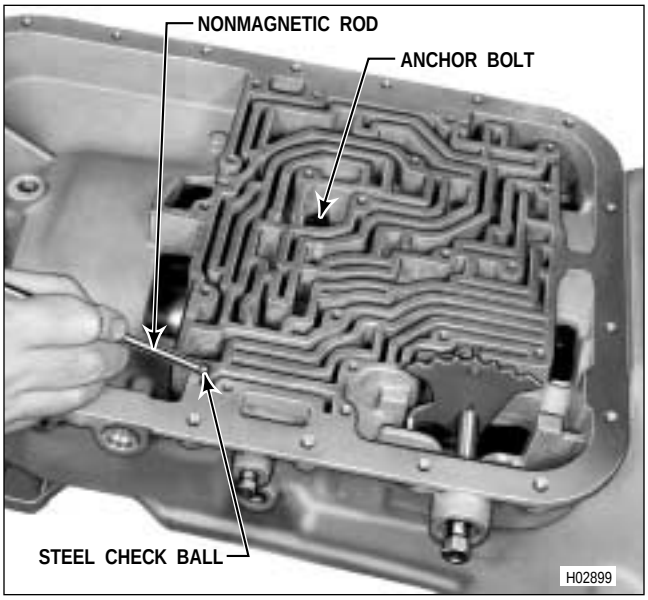



**Figure 7–32. Installing Governor Check Ball (Earlier Models)**

(5) Install governor circuit screen 12 (Foldout 12,B) closed end first, into the valve body, at the governor feed tube opening (Figure 7–33). Install the governor feed tube.

**NOTE:**

**Inspect both ends of the governor feed tube. Earlier models contained a plastic screen located where the governor feed tube unites with the housing. This screen must be replaced with a wire screen and relocated in the governor feed tube bore (Figure 7–33).**

(6) Install the governor pressure tube (Figure 7–33).

(7) For earlier models, install the short, non-braced, first clutch feed tube.

(8) Lift the main control valve body and swing the three tubes into proper position to enter their holes in the transmission case.

(9) Lower the main control valve body onto the case, while engaging the rear ends of the tubes in the case, and the selector valve on the selector lever (Figure 7–33). Remove valve body lifter tool J 29863.

(10) For later models, install the long-braced first clutch feed tube (Figure 7–33).

(11) Install the detent spring, with its roller over the selector lever, and its rear tab in the hole immediately behind the bolt hole (Figure 7–33).

(12) Install a 1/4-20 x 1 3/4 inch bolt into the detent spring and valve body.

(13) For later models, install sixteen valve body retaining bolts. Earlier models use one 1/4-20 x 2 3/4 inch bolt and seventeen 1/4-20 x 2 1/4 inch bolts or eighteen 1/4-20 x 2 1/4 inch bolts (Figure 7–33).

(14) On models equipped with a deep oil pan, install filter spacer 41 or 49 (Foldout 12,B). Use 1/4-20 x 3 inch valve body retaining bolts to retain the spacer.

(15) Shake the valve body slightly, and the ends of the bolts will start into the tapped holes in the transmission case.

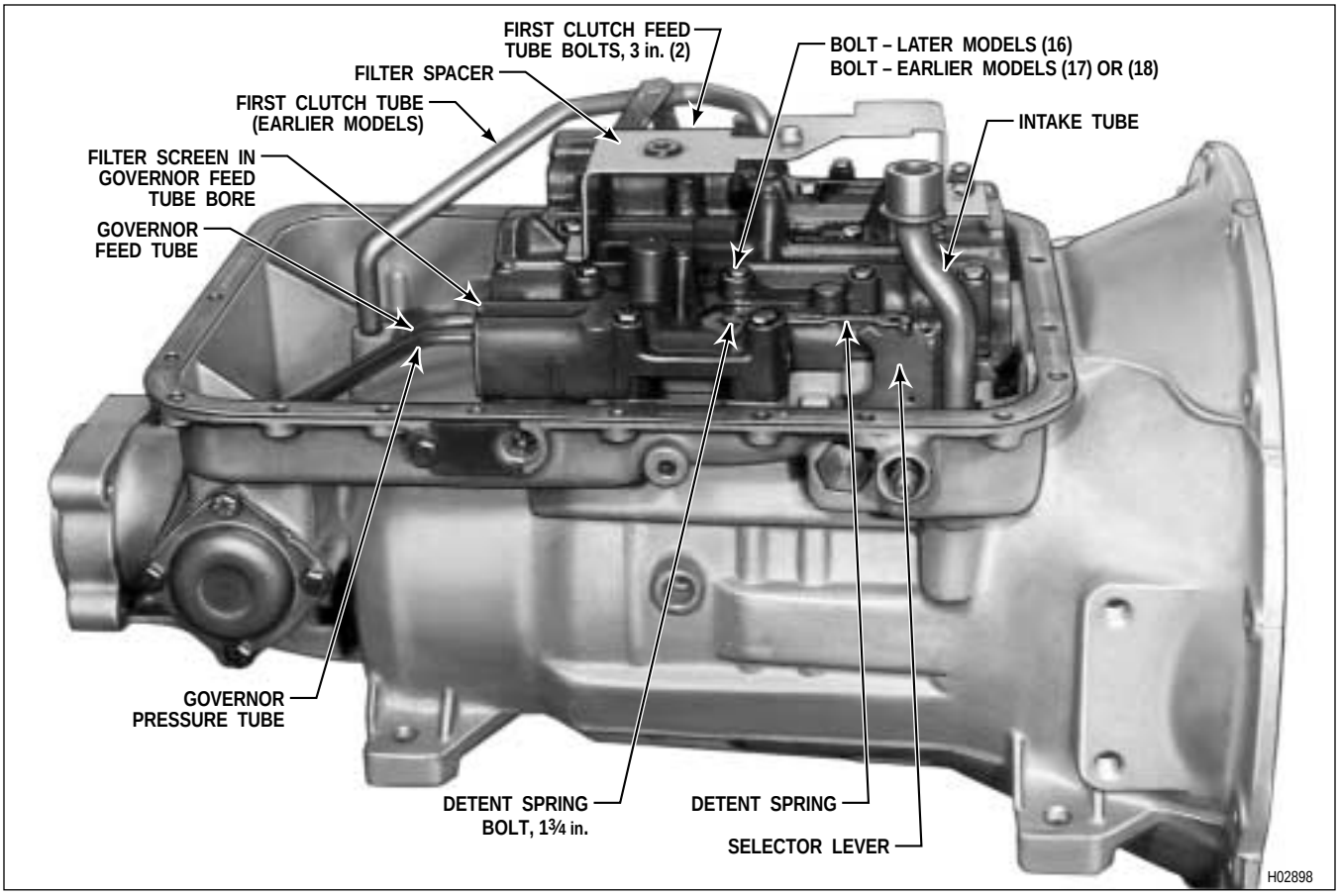



**Figure 7–33. Installing Valve Body and Sump Components**

**NOTE:**

**The detent spring must be held in alignment over the selector lever while the 1¾ inch bolt is tightened.**

(16) Using preset torque wrench J 29612, tighten the bolts evenly to 8–12 lb ft (11–16 N·m).

**b. Filter**

(1) Install the sealring onto the straighter end of the intake tube. Lubricate the sealring with transmission fluid.

**CAUTION:**

**Avoid twisting the intake tube or filter when installing the filter, intake tube, and sealring. The sealring may become pinched, cut, or deformed. An airtight seal must be maintained.**

(2) Install the intake tube and sealring (Figure 7–34).

(3) Install the filter onto the intake tube, making sure the grommet in the filter fits the intake pipe snugly (Figure 7–34).

**NOTE:**

**Turn the intake tube until it enters the grommet squarely.**

(4) Retain the filter with bolt 35 (Foldout 12,B) or bolt 42 and washer 43 for the deep pan or bolt 23 for the shallow pan configuration. Tighten the bolt to 10–15 lb ft (14–20 N·m).

**c. Oil Pan**

(1) Position the pan gasket on the transmission housing, aligning its bolt holes with those in the housing (Figure 7–35).

(2) Position the oil pan on the transmission housing.

(3) Refer to Paragraph 3–10**b** for oil pan installation and torque requirements.

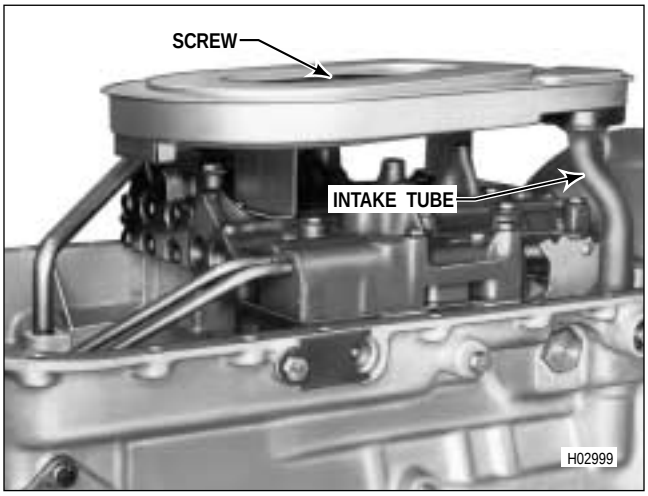



**Figure 7–34. Installing Oil Filter Screw and Washer (Models Prior to S/N 3210622842)**

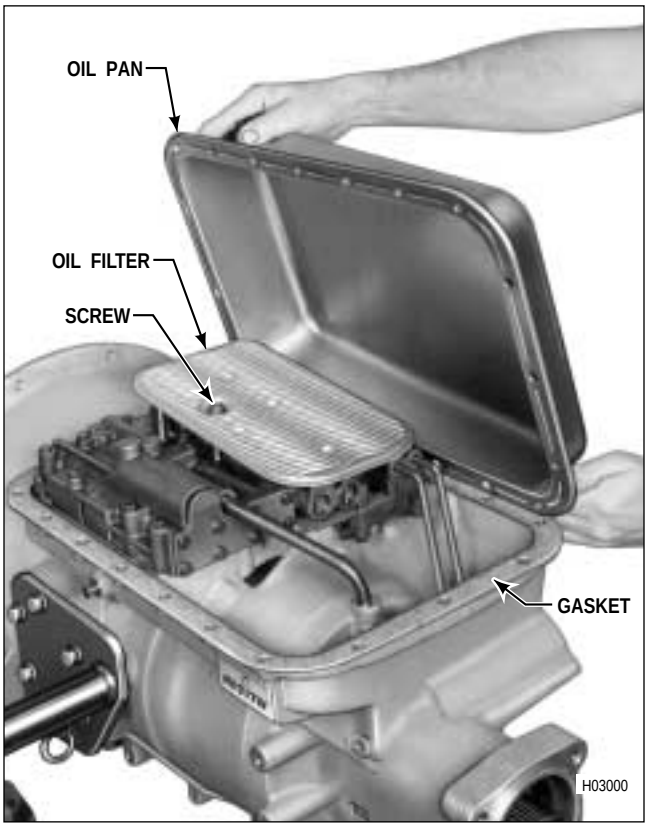



**Figure 7–35. Installing Transmission Oil Pan (Shallow Pan Models)**

## *7–11. INSTALLATION OF GOVERNOR, MODULATOR, AND TORQUE CONVERTER*

### a. Governor

(1) Install the governor cover gasket onto the transmission housing, using oil-soluble grease to retain it (Figure 7–36).

(2) Install the governor assembly by pushing it inward with a slight rotation (Figure 7–36).

(3) Install the governor cover and retain it with four 5⁄16-18 x 9⁄16 inch bolts (Figure 7–37). Tighten the bolts to 15–20 lb ft (20–27 N·m).

### b. Vacuum Modulator

(1) For earlier models, install the vacuum modulator valve actuating rod, larger diameter end first (Figure 7–37). On diesel units (before S/N 22700) where a mechanical actuator is used, actuator pin 28 (Foldout 12,A) is one diameter. After S/N 22699, rod 28 (with two diameters) is used.

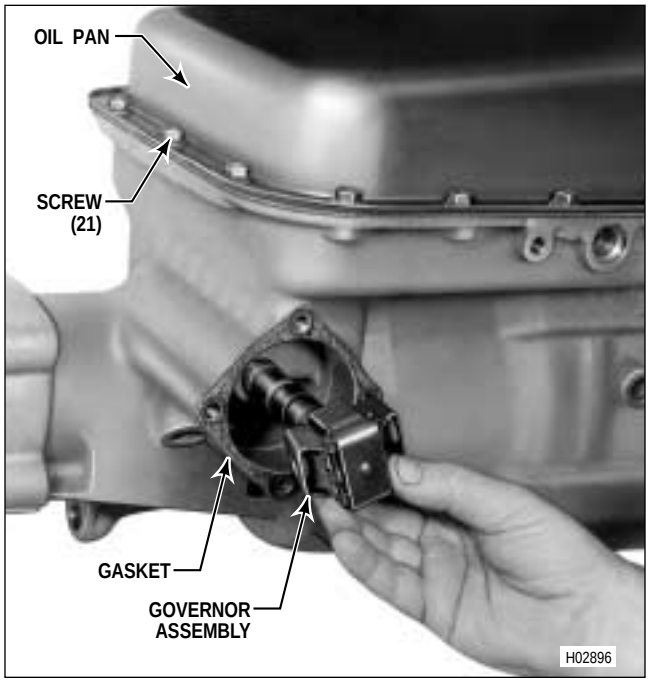



**Figure 7–36. Installing Governor Assembly**

(2) Install the sealring onto the vacuum modulator (Figure 7–37). Lubricate the sealring with oil-soluble grease. Install the vacuum modulator.

(3) Rotate the vacuum modulator until the hose nipple faces ten degrees downward (toward bottom of transmission) and directly forward (Figure 7–38).

(4) Install the modulator retainer, bent tabs toward transmission, and secure it with a 5⁄16-18 x 3⁄4 inch bolt (Figure 7–38). Tighten the bolt to 10–16 lb ft (14–22 N·m).

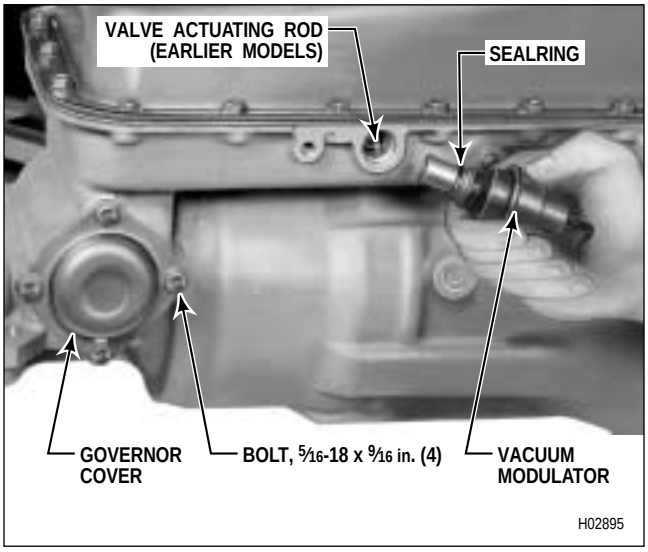



**Figure 7–37. Installing Vacuum Modulator**

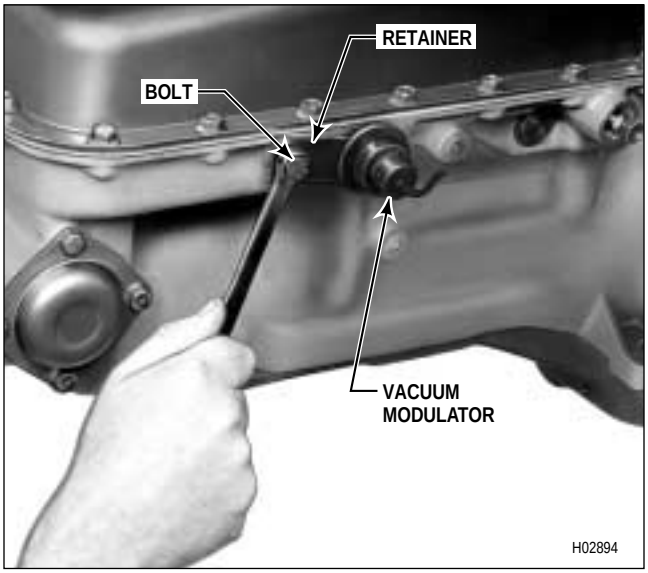



**Figure 7–38. Installing Vacuum Modulator Retainer Bolt**

**c. Torque Converter Assembly**
*(Foldout 7,A or B)*

**CAUTION:**

**Allison Transmission Division GM recommends only genuine Allison torque converters for use with any AT 500, 1500 Series Allison transmissions. Any transmission damage that may occur as a result of using a converter other than a new Allison converter or a genuine Allison replacement is the responsibility of the owner and will not be covered by Allison warranty.**

(1) Position the transmission housing front end upward. Install the torque converter assembly into the transmission housing (Figure 7–39). Be sure the splines on the converter turbine shaft engage the splines in the converter turbine hub, and the tangs on the converter pump hub engage the input pump drive gear. (Refer to Foldout 1, 2, or 3.)

(2) Install the torque converter retaining strap before removing the transmission from the holding fixture.

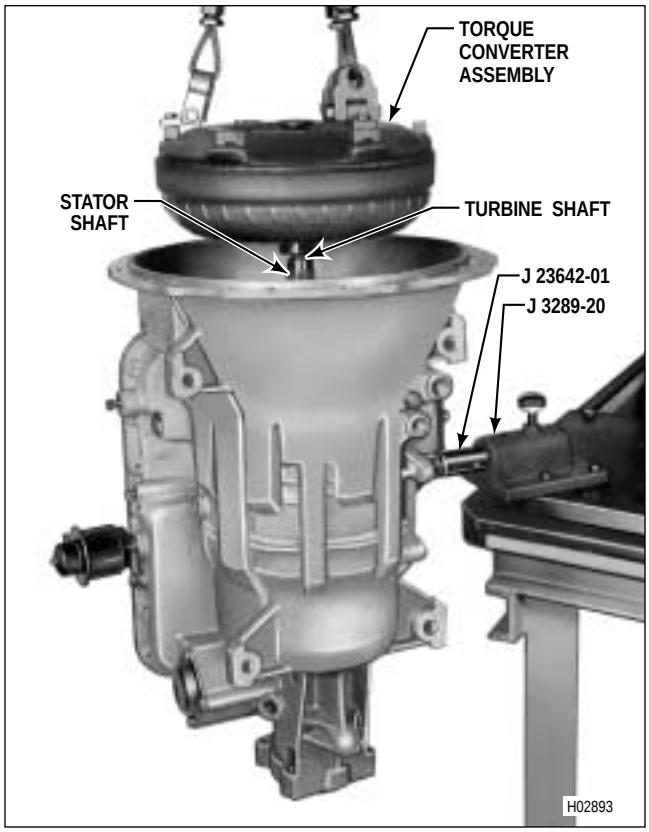



**Figure 7–39. Installing Torque Converter Assembly**

## *7–12. REMOVAL OF TRANSMISSION FROM OVERHAUL STAND AND INSTALLATION OF EXTERNAL COMPONENTS*

### a. Supporting Transmission

(1) Attach a sling to the transmission. Support the transmission and remove it from the holding fixture.

(2) Remove adapter J 23642-01 (Figure 7–39). Lower the transmission to a supporting surface, and remove the sling.

---

**NOTE:**

- **For models with retarder, proceed with Paragraphs 7–12*b* and 7–12*c*.**
- **For models without retarder, skip Paragraphs 7–12*b* and 7–12*c*, and proceed with Paragraph 7–12*d*.**

---

### b. Determining Third Clutch Clearance

(1) Using third clutch clearance gauge J 23716, enter through the retarder valve body (PTO pad) opening to access the third clutch pack, and check the running clearance. The thin end of the gauge should pass between the retarder housing and the first clutch plate; the thick end should not. The running clearance is correct with a dimension of 0.028–0.119 inch (0.74–3.02 mm).

(2) If clearance is excessive (larger end of gauge enters plates), rebuild the transmission to the area of the third clutch and replace worn plates with new plates. Refer to the wear limits in Section 8 for clutch plate dimensions.

(3) When third clutch clearance is proper, proceed with Paragraph 7–12**c**.

### c. Installing Retarder Valve Body

(1) Lay retarder control valve assembly 18 (Foldout 13) on the work table, outside surface downward.

(2) Put one gasket 16, separator plate 17, and a second gasket 16 in place on retarder control valve assembly 18.

(3) Put transfer plate assembly 6 in place on gasket 24 and carefully install four ¼-20 x 1¼ inch bolts 4 and flat washers 5, aligning the parts. Using preset torque wrench J 29612, tighten bolts 4 to 8–12 lb ft (10–16 N·m).

(4) Through the retarder valve body (PTO) pad opening, install two jumper tubes 2 into their bores in the retarder housing.

(5) Install gasket 1 and complete retarder valve body assembly 3, retaining them with four ⅜-16 x 4¼ inch bolts 36. Tighten the bolts to 26–32 lb ft (36–43 N·m).

(6) Skip Paragraph 7–12**d** and proceed with Paragraph 7–12**e**.

### d. Installing PTO Cover *(Foldout 12,A)*

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**NOTE:**
**If the PTO is to be installed right away, skip Steps (1) and (2) and proceed with Paragraph 7–12*e*.**

---

(1) Install gasket 1 and cover 2.

(2) Retain the cover with six ⅜-16 x ¾ inch bolts 3. Tighten bolts 3 to 15–20 lb ft (20–27 N·m).

### e. Installing Neutral Start Switch, Speedometer Components

(1) If not previously installed, install neutral start switch or plug with socket wrench J 33410 using partial turns of the wrench. Tighten the switch to 50–60 lb ft (68–81 N·m) or, tighten the plug to 24–45 lb ft (33–60 N·m). Make sure the tool is not contacting the transmission housing when verifying final torque reading.

(2) Install speedometer driven gear assembly or plug, as required. Tighten locking nut or plug to 45–50 lb ft (61–68 N·m).

**f. Shift Lever Installation.** Refer to Paragraph 3–12 for installation specifications.

## *7–13. CHECKING AND ADJUSTING SHIFT POINTS*

Refer to Paragraph 3–13 for shift point checks and adjustments.

## *7–14. POWER TAKEOFF COMPONENTS (Models Without Retarder)*

**a. Existing Installation**

(1) Unless space limitations prevent, install the PTO components before the transmission is installed in the vehicle.

**CAUTION:**

**Cork or other soft gasket material cannot be used to mount the PTO. Use only the shims or gaskets recommended by the PTO manufacturer.**

(2) Use the proper shims or gaskets to establish satisfactory gear backlash 0.006–0.029 inch (0.15–0.73 mm) or as specified by the PTO manufacturer.

**b. Determining Turbine-Driven PTO Backlash**

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**NOTE:**

**A PTO that whines in operation usually has too little backlash (too tight); a clatter indicates too much backlash (too loose).**

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(1) Position tool J 34814 (Figure 7–40) onto PTO pad with plunger engagement between two drive gear teeth.

(2) Tighten the two hold-down bolts.

(3) Measure the height between the gauge pin and base plate (Figure 7–40) with a feeler gauge and refer to the chart.

(4) Install the two headless guide bolts, one into the top and one into the bottom of the PTO mounting pad. Place the required shims or gasket on the guide bolts.

**CAUTION:**

**The transmission and PTO can be damaged if the PTO is installed with its drive gear to the front of the PTO drive gear.**

(5) If the PTO has a manual disconnect, be sure that the disconnect lever is in the disconnect position. When the PTO is installed on the mounting pad, the PTO driven gear must be to the rear of the PTO drive gear in the transmission.

(6) Install the PTO on the mounting pad.

(7) Connect the lubrication line (if used).

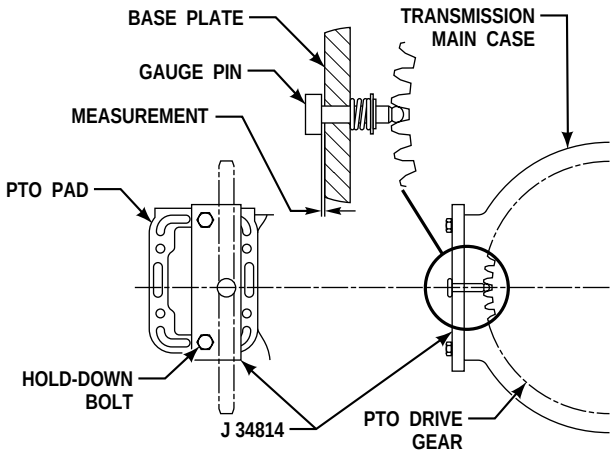
**c. New Installation**

(1) Contact Allison Transmission Division of General Motors for approval of planned installation, or for recommendations.

(2) Speeds, type of duty, power requirements, and other factors must be considered when adding a PTO to a transmission. If the job requirements of the PTO cannot be fully met by the transmission, the installation will not be satisfactory. Also, the transmission could be damaged.

(3) Follow all of the recommendations in Paragraph 7–14**a** and 7–14**b**.

(4) If a lubrication source is required, the return line from-cooler-to-transmission may be tapped. Provide a 0.032 inch (0.81 mm) restriction in the lubrication circuit (usually already provided in the PTO assembly).




| MEASUREMENT | | CORRECTION |
|---|---|---|
| 0.011–0.046 inch (0.27–1.16 mm) | Correct Height | One 0.030 inch Gasket (One 0.76 mm Gasket) |
| 0.047–0.070 inch (1.19–1.78 mm) | Correct Height | Two 0.030 inch Gaskets (Two 0.76 mm Gaskets) |

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**Figure 7–40. Measuring Turbine-Driven PTO Backlash (Models Without Retarder)**

# Section 8 – WEAR LIMITS AND SPRING DATA

## *8–1. WEAR LIMIT DATA*

**NOTE:**

**For detailed inspection criteria, refer to SA1948, AT Technician's Guide.**

(1) Wear limit information in this section shows the maximum wear at which components are expected to function satisfactorily. Table 8–1 lists the wear limits data and is referenced to the exploded views (Foldouts 7 through 13) in the back of this manual.

(2) Parts must be clean to permit effective inspection for wear or damage. Refer to Paragraph 4–5.

## *8–2. SPRING DATA*

(1) Springs must be clean to permit effective inspection. Replace springs if there are signs of overheating, wear due to rubbing adjacent parts, or permanent set. Discard springs which do not meet the load height specifications in the spring chart.

(2) Inspection criteria (load vs height) and identification characteristics of the springs are presented in Table 8–2. The spring data are keyed to the exploded views (Foldouts 7 through 13) in the back of this manual.

**NOTE:**

**Where more than one spring part number is listed for the same location, refer to the Parts Catalog SA1235 or SA2126 to determine which spring is used in your specific assembly number.**

**Table 8–1. Wear Limits**

| Illustration | Description | Wear Limit inch | Wear Limit (mm) |
|---|---|---|---|
| Foldout 7,A | TORQUE CONVERTER ASSEMBLY | | |
| 16 | Converter stator | | |
| 17, 22 | Max inside diameter of side plates | 2.857 | 72.56 |
| 17, 24 | Converter stator | | |
| | Min thickness of front side plate plus installed bearing | 0.435 | 11.05 |
| 25 | Freewheel roller race — min outside diameter | No scoring permitted. | |
| Foldout 7,B | TORQUE CONVERTER, OIL PUMP ASSEMBLIES | | |
| 1, 7 | Torque converter hub — max clearance in bushing | 0.005 | 0.12 |
| 1 | Torque converter assembly — max turbine end play (except AT 543) | 0.037 | 0.93 |
| 8, 9 | Pump driven gear 9 | | |
| | Max diametral clearance in body 8 | 0.0089 | 0.226 |
| 9, 10 | Pump drive and driven gear — max side clearance | 0.0026 | 0.066 |
| 18 | Stator shaft bushing | | |
| | Max clearance on turbine shaft 9 or 14 (Foldout 8) | 0.004 | 0.10 |
| Foldout 8 | FORWARD CLUTCH AND TURBINE SHAFT | | |
| 7 or 11 | Turbine shaft | | |
| | Max clearance in bushing 18 (Foldout 17,B) | 0.004 | 0.10 |

**Table 8–1. Wear Limits *(Cont'd)***

| Illustration | Description | Wear Limit inch | Wear Limit (mm) |
|---|---|---|---|
| Foldout 8 | FORWARD CLUTCH AND TURBINE SHAFT *(cont'd)* | | |
| 27, 28 | External-tanged clutch plate | | |
| | Min thickness | No visible wear or scoring permitted. | |
| | Max cone | 0.004 | 0.10 |
| 29 | Internal-splined clutch plate — min thickness | 0.071 | 1.80 |
| | Min depth of oil grooves | 0.008 | 0.21 |
| 30 | Fourth clutch drive hub | | |
| | Min thickness at friction face | No visible wear or scoring permitted. | |
| Foldout 9,A | FOURTH CLUTCH | | |
| 2 | Clutch backplate — min thickness | No visible wear or scoring permitted. | |
| 3 | Internal-splined clutch plate — min thickness | 0.071 | 1.80 |
| | Min depth of oil grooves | 0.008 | 0.21 |
| 4 | External-tanged clutch plate | | |
| | Min thickness | No visible wear or scoring permitted. | |
| | Max cone | 0.004 | 0.10 |
| Foldout 9,B | SECOND CLUTCH, THIRD CLUTCH, CENTER SUPPORT | | |
| 2 | Third clutch backplate — min thickness | No visible wear or scoring permitted. | |
| 3, 24 | Internal-splined clutch plate — min thickness | 0.090 | 2.29 |
| | Min depth of oil grooves | 0.008 | 0.21 |
| 4, 23 | External-tanged clutch plate | | |
| | Min thickness | No visible wear or scoring permitted. | |
| | Max cone | 0.010 | 0.25 |
| 14 | Center support bushing | | |
| | Max clearance on shaft 3 (Foldout 10,A) | 0.005 | 0.12 |
| 25 | Second-clutch backplate — min thickness | No visible wear or scoring permitted. | |
| Foldout 10,A | PLANETARY GEAR UNIT | | |
| 2 | Sun gear shaft bushing — max clearance on shaft 4 | 0.0045 | 0.114 |
| 3 | Sun gear shaft | | |
| | Max clearance in bushing 14 (Foldout 9,B) | 0.005 | 0.12 |

**Table 8–1. Wear Limits *(Cont'd)***

| Illustration | Description | Wear Limit inch | Wear Limit (mm) |
|---|---|---|---|
| Foldout 10,A | PLANETARY GEAR UNIT *(cont'd)* | | |
| 4 | Transmission main shaft — max clearance in bushing 2 | 0.0045 | 0.114 |
| 15 | Front planetary carrier bushing | | |
| | Max clearance on sun gear 19 | 0.005 | 0.12 |
| 47 | Output shaft bushing — max clearance on shaft 4 | 0.0065 | 0.165 |
| Foldout 10,B | FIRST CLUTCH | | |
| 2 | Backplate (ident 1, 2, 3, 4, 5, 6) — min thickness | No visible wear or scoring permitted. | |
| 3 | Internal-splined clutch plate — min thickness | 0.090 | 2.29 |
| | Min depth of oil grooves | 0.008 | 0.21 |
| 4 | External-tanged clutch plate | | |
| | Min thickness | No visible wear or scoring permitted. | |
| | Max cone | 0.010 | 0.25 |
| Foldout 12,A | TRANSMISSION HOUSING, GOVERNOR | | |
| 11 | Transmission housing | | |
| | Max clearance of governor bore on governor 18 | 0.0035 | 0.088 |

## Table 8–2. Spring Data

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 7,A | 27 | Stator | 6774966 | No color code | Convoluted Spring | | | 0.64 (16.3) | 0.30 (7.6) | 0.15–0.33 (0.7–1.5) |
| 7,B | 26 | Main pressure regulator valve | 6833294 | Solid orange | 14 | 0.125 (3.18) | 1.06 (26.9) | 4.19 (106.4) | 2.01 (51.1) | 74.16–78.76 (329.9–350.3) |
| 7,B | 31 | Lockup valve | 29501072 | Solid purple | 14 | 0.125 (3.18) | 1.06 (26.9) | 4.27 (108.5) | 2.01 (51.1) | 77.2–81.8 (343–363) |
| | | | 29505835 | No color | 18.7 | .098 (2.49) | 0.648 (16.46) | 3.11 (79.0) | 2.51 (63.8) | 25.83–31.57 (114.9–140.4) |
| 8 | 20 | Forward clutch piston release | 8624073 | Solid red | 10.5 | 0.055 (1.40) | 0.45 (11.4) | 1.31 (33.3) | 0.88 (22.4) | 8.50–12.22 (37.8–54.4) |
| | | | 23045233 | Solid red | 10.5 | 0.056 (1.42) | 0.45 (11.4) | 1.28 (32.5) | 0.88 (22.4) | 10.00–12.00 (44.5–53.4) |
| | | | 29505884 | Dark blue | 9.5 | .055 (1.40) | .0455 (11.56) | 1.30 (33.0) | 0.88 (22.3) | 10.0–12.0 (44.5–53.4) |
| 9,A | 7 | Fourth clutch piston release | 8624073 | Solid red | 10.5 | 0.055 (1.40) | 0.45 (11.4) | 1.31 (33.3) | 0.88 (22.4) | 8.50–12.22 (37.8–54.4) |
| | | | 23045233 | Solid red | 10.5 | 0.056 (1.42) | 0.45 (11.4) | 1.28 (32.5) | 0.88 (22.4) | 10.00–12.00 (44.5–53.4) |
| | | | 29505884 | Dark blue | 9.5 | .055 (1.40) | 0.455 (11.56) | 1.30 (33.0) | 0.88 (22.3) | 10.0–12.0 (44.5–53.4) |
| 9,B | 8 | Third clutch piston release | 6831656 | Solid green | 11.5 | 0.041 (1.04) | 0.38 (9.7) | 1.29 (32.8) | 0.82 (20.8) | 4.30–5.95 (19.1–26.5) |
| 9,B | 19 | Second clutch piston release | 6831656 | Solid green | 11.5 | 0.041 (1.04) | 0.38 (9.7) | 1.29 (32.8) | 0.82 (20.8) | 4.30–5.95 (19.1–26.5) |
| 10,B | 8 | First clutch piston release | 6831702 | Solid yellow | 11.5 | 0.044 (1.12) | 0.45 (11.4) | 1.53 (38.9) | 1.01 (25.7) | 3.59–4.81 (16.0–21.4) |
| | | | 6880251 | Solid orange, yellow stripe | 10 | 0.063 (1.60) | 0.45 (11.4) | 1.28 (32.5) | 0.95 (24.1) | 13.60–16.40 (60.5–73.0) |

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 7 | Modulator valve | 6833934 | Solid white, orange stripe | 10 | 0.054 (1.37) | 0.49 (12.4) | 1.47 (37.3) | 0.80 (20.3) | 11.90—13.10 (52.9—58.3) |
| | | | 6838077 | Solid yellow | 10 | 0.054 (1.37) | 0.49 (12.4) | 1.15 (29.2) | 0.80 (20.3) | 6.01—7.15 (26.7—31.8) |
| | | | 6880980 | Solid light blue, red stripe | 10 | 0.054 (1.37) | 0.49 (12.4) | 1.36 (34.5) | 0.80 (20.3) | 9.88—10.92 (43.9—48.6) |
| | | | 23012937 | Solid white | 9 | 0.99 (2.52) | 0.95 (24.1) | 2.27 (57.7) | 1.94 (49.3) | 9.40—11.40 (41.8—50.7) |
| | | | 23012948 | Solid white, orange stripe | 10 | 0.054 (1.37) | 0.49 (12.4) | 1.47 (37.3) | 0.80 (20.3) | 11.90—13.10 (52.9—58.3) |
| 11 | 14 | Third clutch trimmer valve | 6833938 | Solid yellow | 12.5 | 0.080 (2.03) | 0.94 (23.9) | 2.96 (75.2) | 1.10 (27.9) | 15.95—17.65 (70.9—78.5) |
| | | | 6833945 | Solid light blue | 7.4 | 0.092 (2.34) | 0.93 (23.6) | 2.27 (57.7) | 1.94 (49.3) | 9.40—11.40 (41.8—50.7) |
| | | | 6880045 | Solid orange | 10 | 0.099 (2.51) | 0.94 (23.9) | 2.18 (55.4) | 1.94 (49.3) | 6.20—7.40 (27.6—32.9) |
| | | | 23012937 | Solid white | 9 | 0.099 (2.51) | 0.95 (24.1) | 2.27 (57.7) | 1.10 (27.9) | 34.80—38.80 (154.8—172.6) |
| | | | 23017086 | Solid white, black stripe | 8.5 | 0.105 (2.67) | 0.95 (24.1) | 2.21 (56.1) | 1.94 (49.3) | 11.0—13.4 (48.9—59.6) |
| | | | 23018733 | One end orange | 11.3 | 0.078 (1.98) | 0.94 (23.9) | 2.98 (75.7) | 1.94 (49.3) | 8.30—10.30 (36.9—45.8) |
| 11 | NI* | Third clutch trimmer valve (inner) (earlier models) (inner spring no longer used) | 6885166 | Orange, white stripe | 9.6 | 0.092 (2.34) | 0.69 (17.53) | 1.69 (42.9) | 1.10 (27.9) | 32.60—39.80 (145.0—177.0) |
| | | | 23011987 | Solid red, orange stripe | 11 | 0.072 (1.83) | 0.68 (17.3) | 1.52 (38.6) | 1.10 (27.9) | 7.20—8.80 (32.0—39.1) |

*NI — Not Illustrated

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 18 | First clutch trimmer valve (outer) | 6833945 | Solid light blue | 7.4 | 0.092 (2.34) | 0.93 (23.6) | 2.27 (57.7) | 1.94 (49.3) | 9.40—11.40 (41.8—50.7) |
| | | | 6838839 | Solid purple, orange stripe | 8 | 0.092 (2.34) | 0.93 (23.6) | 1.95 (49.5) | 1.10 (27.9) | 22.4—26.4 (99.6—117.4) |
| | | | 6839271 | Solid white, yellow stripe | 10 | 0.102 (2.59) | 0.94 (23.9) | 2.56 (65.0) | 1.94 (49.3) | 20.00—22.00 (89.0—97.9) |
| | | | 6880045 | Solid orange | 10 | 0.099 (2.51) | 0.94 (23.9) | 2.18 (55.4) | 1.94 (49.3) | 6.20—7.40 (27.6—32.9) |
| | | | 23012937 | Solid white | 9 | 0.099 (2.51) | 0.95 (24.1) | 2.27 (57.7) | 1.10 (27.9) | 34.80—38.80 (154.8—172.6) |
| 11 | 19 | Second clutch trimmer valve (inner) | 6839102 | Solid red | 8.5 | 0.092 (2.34) | 0.72 (18.3) | 1.68 (42.7) | 1.10 (27.9) | 32.60—39.80 (145.0—177.0) |
| | | | 6880118 | Blue, white stripe | 8.5 | 0.091 (2.31) | 0.69 (17.53) | 1.45 (36.8) | 1.10 (27.9) | 21.70—25.30 (96.5—112.5) |
| | | | 6880274 | Solid yellow, blue stripe | 9.6 | 0.092 (2.34) | 0.69 (17.5) | 1.69 (42.9) | 1.10 (27.9) | 32.60—39.80 (145.0—177.0) |
| | | | 6884701 | Solid orange | 9.6 | 0.092 (2.34) | 0.69 (17.5) | 1.69 (42.9) | 1.10 (27.9) | 32.60—39.80 (145.0—177.0) |
| | | | 6885166 | Solid orange, white stripe | 9.6 | 0.091 (2.31) | 0.72 (18.3) | 1.69 (42.9) | 1.10 (27.9) | 32.60—39.80 (145.0—177.0) |
| 11 | 23 | Second clutch trimmer valve (outer) | 6833940 | Solid orange, yellow stripe | 8.5 | 0.121 (3.07) | 0.95 (24.1) | 2.38 (60.5) | 1.94 (49.3) | 29.00—35.00 (129.0—155.7) |
| | | | 6837692 | Yellow | 9.5 | 0.101 (2.57) | 0.94 (23.88) | 2.33 (59.2) | 1.20 (30.5) | 37.80—41.88 (168.1—185.9) |
| | | | 6838532 | Solid white | 8.5 | 0.121 (3.07) | 0.95 (24.1) | 2.10 (53.3) | 1.94 (49.3) | 10.50—15.50 (46.7—68.9) |
| | | | 6839102 | Solid red | 8.5 | 0.092 (2.34) | 0.72 (18.3) | 1.68 (42.7) | 1.10 (27.9) | 32.60—39.80 (145.0—177.0) |
| | | | 6839271 | Solid white, yellow stripe | 10 | 0.102 (2.59) | 0.94 (23.9) | 2.56 (65.0) | 1.94 (49.3) | 20.00–22.00 (89.0–97.9) |

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 23 | Second clutch trimmer valve (outer) *(cont'd)* | 6883300 | Solid light green, white | 10 | 0.082 (2.08) | 0.69 (17.5) | 1.95 (49.5) | 1.10 (27.9) | 31.20–37.20 (138.8–165.5) |
| | | | 6885047 | Solid light green | 10 | 0.098 (2.49) | 0.94 (23.9) | 2.57 (65.3) | 1.94 (49.3) | 16.10–19.70 (71.6–87.6) |
| | | | 6885164 | Solid white, orange stripe | 8.5 | 0.121 (3.07) | 0.95 (24.1) | 2.10 (53.3) | 1.94 (49.3) | 10.50–15.50 (46.7–68.9) |
| | | | 23011988 | Solid yellow, orange stripe | 8.5 | 0.092 (2.34) | 0.94 (23.88) | 2.31 (58.7) | 1.10 (27.9) | 29.0–32.2 (129.0–143.2) |
| | | | 23012937 | Solid white | 9 | 0.099 (2.51) | 0.95 (24.1) | 2.27 (57.7) | 1.10 (27.9) | 34.80–38.80 (154.8–172.6) |
| | | | 23017086 | Solid white, black stripe | 8.5 | 0.105 (2.67) | 0.95 (24.1) | 2.21 (56.1) | 1.94 (49.3) | 11.00–13.40 (48.9–59.6) |
| 11 | 24 | Second clutch trimmer valve (inner) | 6839102 | Solid red | 8.5 | 0.092 (2.34) | 0.72 (18.3) | 1.68 (42.7) | 1.10 (27.9) | 32.60–39.80 (145.0–177.0) |
| | | | 6880045 | Orange | 10 | 0.099 (2.51) | 0.94 (23.88) | 2.18 (55.4) | 1.94 (49.3) | 6.20–7.40 (27.6–32.9) |
| | | | 6883300 | Solid lt. green, white stripe | 10 | 0.082 (2.08) | 0.69 (17.5) | 1.95 (49.5) | 1.10 (27.9) | 31.20–37.20 (138.8–165.5) |
| | | | 6885166 | Solid orange, white stripe | 9.6 | 0.091 (2.31) | 0.72 (18.3) | 1.69 (42.9) | 1.10 (27.9) | 32.60–39.80 (145.0–177.0) |
| | | | 23013908 | Solid white | 10 | 0.080 (2.03) | 0.69 (17.53) | 1.80 (45.7) | 1.10 (27.9) | 21.50–23.70 (95.5–105.5) |
| 11 | 27 | Trim boost accumulator valve | 23013744 | Solid light blue, white stripe | 13 | 0.060 (1.52) | 0.62 (15.7) | 2.61 (66.3) | 0.95 (24.1) | 15.50–17.10 (68.9–76.1) |
| | | | 23013054 | Solid orange, light blue stripe | 15 | 0.054 (1.37) | 0.62 (15.7) | 2.72 (69.1) | 0.90 (22.9) | 8.70–10.70 (38.7–47.6) |
| 11 | 31 | Fourth clutch trimmer valve (outer) | 6837692 | Yellow | 9.5 | 0.101 (2.57) | 0.94 (23.88) | 2.33 (59.2) | 1.20 (30.5) | 37.80–41.80 (168.1–185.9) |
| | | | 6839271 | Solid white, yellow stripe | 10 | 0.102 (2.59) | 0.94 (23.9) | 2.56 (65.0) | 1.94 (49.3) | 20.00–22.00 (89.0–97.9) |

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 31 | Fourth clutch trimmer valve (outer) *(cont'd)* | 6880045 | Orange | 10 | 0.099 (2.51) | 0.94 (23.88) | 2.18 (55.4) | 1.94 (49.3) | 6.20–7.40 (27.6–32.9) |
| | | | 23012937 | Solid white | 9 | 0.099 (2.52) | 0.95 (24.1) | 2.27 (57.7) | 1.94 (49.3) | 9.40–11.40 (41.8–50.7) |
| 11 | 32 | Fourth clutch trimmer valve (inner) | 6880118 | Solid light blue, white stripe | 8.5 | 0.091 (2.31) | 0.69 (17.5) | 1.42 (36.1) | 1.10 (27.9) | 20.70–25.30 (92.1–112.5) |
| 11 | 38 | 2–3 relay valve | 6832462 | Solid red | 11 | 0.072 (1.83) | 0.69 (17.5) | 2.18 (55.4) | 1.20 (30.5) | 16.20–19.80 (72.1–88.1) |
| 11 | 41 | 1–2 relay valve | 6834528 | Solid light blue, yellow stripe | 11 | 0.072 (1.83) | 0.68 (17.3) | 1.52 (38.6) | 1.10 (27.9) | 7.20–8.80 (32.0–39.1) |
| 11 | 44 | Priority valve | 6835729 | Solid white, yellow stripe | 11 | 0.054 (1.37) | 0.38 (9.7) | 1.17 (29.7) | 0.94 (23.9) | 8.15–9.15 (36.3–40.7) |
| 11 | 47 | Hold regulator valve | 6836784 | Solid yellow | 13 | 0.041 (1.04) | 0.40 (10.2) | 1.90 (48.3) | 1.15 (29.2) | 5.93–6.17 (26.4–27.4) |
| | | | 6836785 | Solid white | 14 | 0.041 (1.04) | 0.40 (10.2) | 2.01 (51.1) | 1.15 (29.2) | 6.22–6.48 (27.7–28.8) |
| | | | 6836976 | Solid white, yellow stripe | 14 | 0.044 (1.12) | 0.40 (10.2) | 1.85 (47.0) | 1.15 (29.2) | 6.91–7.19 (30.7–32.0) |
| | | | 6836977 | Orange | 16 | 0.047 (1.19) | 0.40 (10.16) | 1.85 (47.0) | 1.15 (29.2) | 7.79–8.11 (34.7–36.1) |
| | | | 6837539 | Solid light blue, white stripe | 11 | 0.041 (1.04) | 0.40 (10.2) | 1.72 (43.7) | 1.15 (29.2) | 5.44–5.66 (24.2–25.2) |
| | | | 6837541 | Solid yellow, light blue stripe | 14 | 0.044 (1.12) | 0.40 (10.2) | 1.82 (46.2) | 1.15 (29.2) | 6.61–6.89 (29.4–30.6) |
| | | | 6837952 | Solid light green | 14 | 0.044 (1.12) | 0.40 (10.2) | 1.87 (47.5) | 1.15 (29.2) | 7.10–7.40 (31.6–32.9) |
| | | | 6837953 | Solid light blue | 14 | 0.044 (1.12) | 0.40 (10.2) | 1.91 (48.5) | 1.15 (29.2) | 7.46–7.76 (33.2–34.5) |

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 56 | 1–2 shift valve | 6833935 | Solid blue | 9 | 0.054 (1.37) | 0.64 (16.3) | 2.17 (55.1) | 1.15 (29.2) | 8.60–9.10 (38.3–40.5) |
| | | | 6833941 | Solid blue, white stripe | 13.5 | 0.062 (1.57) | 0.64 (16.3) | 2.15 (54.6) | 1.15 (29.2) | 9.35–9.85 (41.6–43.8) |
| | | | 6833942 | Solid white | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.50 (63.5) | 1.15 (29.2) | 7.85–8.35 (34.9–37.1) |
| | | | 6834576 | Solid orange, yellow stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.39 (60.7) | 1.15 (29.2) | 7.18–7.68 (31.9–34.2) |
| | | | 6837454 | Solid yellow | 9 | 0.056 (1.42) | 0.64 (16.3) | 1.98 (50.3) | 1.15 (29.2) | 8.22–8.72 (36.6–38.8) |
| | | | 6837882 | No color code | 8.5 | 0.054 (1.37) | 0.73 (18.5) | 1.74 (44.2) | 0.81 (20.6) | 5.02–6.14 (22.3–27.3) |
| | | | 6881061 | Solid light blue, orange stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.55 (64.8) | 1.15 (29.2) | 8.10–8.70 (36.0–38.7) |
| | | | 23012946 | Solid orange, yellow stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.39 (60.7) | 1.15 (29.2) | 7.18–7.68 (31.9–34.2) |
| | | | 23017028 | Solid yellow, black stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.65 (67.3) | 1.15 (29.2) | 8.65–9.35 (38.5–41.6) |
| | | | 23017031 | Solid orange, black stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.36 (59.9) | 1.15 (29.2) | 6.95–7.55 (30.9–33.6) |
| | | | 23017045 | Solid light blue, purple stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.40 (61.0) | 1.15 (29.2) | 7.20–7.80 (32.0–34.7) |
| | | | 23017047 | Solid orange, purple stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.48 (63.0) | 1.15 (29.2) | 7.70–8.30 (34.3–36.9) |
| | | | 23017048 | Solid white, purple stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.61 (66.3) | 1.15 (29.2) | 8.45–9.05 (37.6–40.3) |
| | | | 23018388 | Solid white, one end red | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.53 (64.3) | 1.15 (29.2) | 7.95–8.55 (35.4–38.0) |

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 62 | 2–3 shift valve | 6833935 | Solid blue | 9 | 0.054 (1.37) | 0.64 (16.3) | 2.17 (55.1) | 1.15 (29.2) | 8.60–9.10 (38.3–40.5) |
| | | | 6833941 | Solid blue, white stripe | 13.5 | 0.062 (1.57) | 0.64 (16.3) | 2.15 (54.6) | 1.15 (29.2) | 9.35–9.85 (41.6–43.8) |
| | | | 6833942 | Solid white | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.50 (63.5) | 1.15 (29.2) | 7.85–8.35 (34.9–37.1) |
| | | | 6834902 | Solid orange | 13 | 0.059 (1.50) | 0.64 (16.3) | 2.41 (61.2) | 1.15 (29.2) | 9.95–10.45 (44.3–46.5) |
| | | | 6835310 | Solid green | 13 | 0.059 (1.50) | 0.64 (16.3) | 2.51 (63.8) | 1.15 (29.2) | 10.75–11.25 (47.8–50.0) |
| | | | 6837454 | Solid yellow | 9 | 0.056 (1.42) | 0.64 (16.3) | 1.98 (50.3) | 1.15 (29.2) | 8.22–8.72 (36.6–38.8) |
| | | | 6880991 | Solid light blue, red stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.75 (69.9) | 1.15 (29.2) | 9.25–9.95 (41.1–44.3) |
| | | | 6880992 | Solid white, red stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.85 (72.4) | 1.15 (29.2) | 9.85–10.55 (43.8–46.9) |
| | | | 6881061 | Solid light blue, orange stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.55 (64.8) | 1.15 (29.2) | 8.10–8.70 36.0–38.7) |
| | | | 6883665 | Solid white, green stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.82 (71.6) | 1.15 (29.2) | 9.65–10.35 (42.9–46.0) |
| | | | 23012950 | Solid white, blue stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.90 (73.7) | 1.15 (29.2) | 10.15–10.85 (45.1–48.3) |
| | | | 23012951 | Solid orange, green stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.98 (75.7) | 1.15 (29.2) | 10.60–11.40 (47.2–50.7) |
| | | | 23012952 | Solid orange, red stripe | 9 | 0.054 (1.37) | 0.64 (16.3) | 2.17 (55.1) | 1.15 (29.2) | 8.60–9.10 (38.3–40.5) |
| | | | 23012954 | Solid yellow, green stripe | 13 | 0.059 (1.50) | 0.64 (16.3) | 2.51 (63.8) | 1.15 (29.2) | 10.75–11.25 (47.8–50.0) |

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 62 | 2–3 shift valve *(cont'd)* | 23012955 | Solid green, blue stripe | 13.5 | 0.062 (1.57) | 0.64 (16.3) | 2.15 (54.6) | 1.15 (29.2) | 9.35–9.85 (41.6–43.8) |
| | | | 23012956 | Solid red, blue stripe | 13 | 0.059 (1.50) | 0.64 (16.3) | 2.41 (61.2) | 1.15 (29.2) | 9.95–10.45 (44.3–46.5) |
| | | | 23013271 | Blue, yellow stripe | 12 | 0.054 (1.37) | 0.64 (16.26) | 2.73 (69.3) | 1.15 (29.2) | 9.15–9.85 (40.7–43.8) |
| | | | 23013273 | Solid orange, yellow stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.65 (67.3) | 1.15 (29.2) | 8.65–9.35 (38.5–41.6) |
| | | | 23017028 | Solid yellow, black stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.65 (67.3) | 1.15 (29.2) | 8.65–9.35 (38.5–41.6) |
| | | | 23045295 | Solid orange, one end white | 13.8 | 0.056 (1.42) | 0.64 (16.3) | 2.98 (75.7) | 1.15 (29.2) | 10.60–11.40 (47.2–50.7) |
| | | | 29503530 | Gray | 12 | 0.054 (1.37) | 0.64 (16.26) | 2.48 (63.0) | 1.15 (29.2) | 7.9–8.3 (35.1–36.9) |
| 11 | 68 | 3–4 shift valve | 6833935 | Solid blue | 9 | 0.054 (1.37) | 0.64 (16.3) | 2.17 (55.1) | 1.15 (29.2) | 8.60–9.10 (38.3–40.5) |
| | | | 6833941 | Solid blue, white stripe | 13.5 | 0.062 (1.57) | 0.64 (16.3) | 2.15 (54.6) | 1.15 (29.2) | 9.35–9.85 (41.6–43.8) |
| | | | 6833942 | Solid white | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.50 (63.5) | 1.15 (29.2) | 7.85–8.35 (34.9–37.1) |
| | | | 6834576 | Solid orange, yellow stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.39 (60.7) | 1.15 (29.2) | 7.18–7.68 (31.9–34.2) |
| | | | 6834902 | Solid orange | 13 | 0.059 (1.50) | 0.64 (16.3) | 2.41 (61.2) | 1.15 (29.2) | 9.95–10.45 (44.3–46.5) |
| | | | 6837454 | Solid yellow | 9 | 0.056 (1.42) | 0.64 (16.3) | 1.98 (50.3) | 1.15 (29.2) | 8.22–8.72 (36.6–38.8) |
| | | | 6880991 | Solid light blue, red stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.75 (69.9) | 1.15 (29.2) | 9.25–9.95 (41.1–44.3) |
| | | | 6880992 | Solid white, red stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.85 (72.4) | 1.15 (29.2) | 9.85–10.55 (43.8–46.9) |

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 68 | 3–4 shift valve *(cont'd)* | 6881061 | Solid light blue, orange stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.55 (64.8) | 1.15 (29.2) | 8.10–8.70 (36.0–38.7) |
| | | | 6884947 | No color | 12 | 0.054 (1.37) | 0.64 (16.26) | 2.86 (72.6) | 1.15 (29.2) | 9.90–10.60 (44.0–47.2) |
| | | | 23012946 | Solid orange, yellow stripe | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.39 (60.7) | 1.15 (29.2) | 7.18–7.68 (31.9–34.2) |
| | | | 23012952 | Solid orange, red stripe | 9 | 0.054 (1.37) | 0.64 (16.3) | 2.17 (55.1) | 1.15 (29.2) | 8.60–9.10 (38.3–40.5) |
| | | | 23012955 | Solid green, blue stripe | 13.5 | 0.062 (1.57) | 0.64 (16.3) | 2.15 (54.6) | 1.15 (29.2) | 9.35–9.85 (41.6–43.8) |
| | | | 23012956 | Solid red, blue stripe | 13 | 0.059 (1.50) | 0.64 (16.3) | 2.41 (61.2) | 1.15 (29.2) | 9.95–10.45 (44.3–46.5) |
| | | | 23013267 | Solid yellow | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.57 (65.3) | 1.15 (29.2) | 8.20–8.80 (36.5–39.1) |
| | | | 23013269 | Solid orange | 12 | 0.054 (1.37) | 0.64 (16.3) | 2.69 (68.3) | 1.15 (29.2) | 8.90–9.60 (39.6–42.7) |
| | | | 23013271 | Blue, yellow stripe | 12 | 0.054 (1.37) | 0.64 (16.26) | 2.36 (59.9) | 1.15 (29.2) | 6.95–7.55 (30.9–33.6) |
| | | | 23017047 | Solid orange, purple stripe | 12 | 0.054 (1.37) | 0.64 (16.26) | 2.48 (63.0) | 1.15 (29.2) | 7.70–8.30 (34.3–36.9) |
| | | | 29503530 | Gray | 12 | 0.054 (1.37) | 0.64 (16.26) | 2.48 (63.0) | 1.15 (29.2) | 7.9–8.3 (35.1–36.9) |
| 11 | 73 | 3–4 relay valve | 6832462 | Solid red | 11 | 0.072 (1.83) | 0.69 (17.5) | 2.18 (55.4) | 1.20 (30.5) | 16.20–19.80 (72.1–88.1) |
| 11 | 77 | Trimmer regulator valve | 6834527 | Solid light blue, red stripe | 14 | 0.047 (1.19) | 0.50 (12.7) | 1.87 (47.5) | 1.14 (29.0) | 4.25–4.75 (18.9–21.1) |
| | | | 6880246 | Solid light blue | 13 | 0.041 (1.04) | 0.46 (11.7) | 1.81 (46.0) | 0.89 (22.6) | 4.25–4.75 (18.9–21.1) |

**Table 8–2. Spring Data *(Cont'd)***

| Foldout | Ref | Spring | Part No. | Color Code | No. Coils | Wire dia in. (mm) | Spring OD in. (mm) | Free Length in. (mm) | Length Under Load | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | in. (mm) | lb (N) |
| 11 | 77 | Trimmer regulator valve *(cont'd)* | 23018423 | Solid lightblue, one end lt. green | 12.5 | 0.041 (1.04) | 0.46 (11.7) | 1.33 (33.8) | 0.86 (21.8) | 2.30–2.54 (10.2–11.3) |
| | | | 23018424 | Solid light blue, one end red | 13 | 0.045 (1.14) | 0.50 (12.7) | 1.86 (47.2) | 1.11 (28.2) | 4.06–4.48 (18.1–19.9) |
| 11 | 83 | 1–2 shift valve assist | 6834536 | Solid yellow, one end white | 15 | 0.020 (0.51) | 0.33 (8.4) | 1.25 (31.8) | 0.94 (23.9) | 0.17–0.21 (0.8–0.9) |
| 13 | 21 | Retarder priority valve | 29524421 | Yellow end | 9 | 0.053 (1.35) | 0.484 (12.29) | 1.26 (32.0) | 0.665 (16.89) | 11.75–12.45 (52.3–55.3) |
| 13 | 25 | Retarder regulator valve | 29524379 | No color | 9 | 0.043 (1.09) | 0.450 (11.43) | 1.25 (31.8) | 0.681 (17.30) | 5.70–6.30 (25.4–27.9) |
| 13 | 29 | Retarder auto flow valve | 23011981 | Solid red, white stripe | 8 | 0.080 (2.03) | 0.931 (23.65) | 2.52 (64.0) | 1.94 (49.3) | 8.8–9.8 (39.2–43.5) |

**NOTES**

# Section 9 – CUSTOMER SERVICE

## *9–1. OWNER ASSISTANCE*

The satisfaction and goodwill of the owners of Allison transmissions are of primary concern to Allison Transmission Division (ATD), its distributors, and their dealers.

As an owner of an Allison transmission, you have service locations throughout the world eager to meet your parts and service needs with:

- Expert service by trained personnel
- Emergency service 24 hours a day in many areas
- Complete parts support
- Sales teams to help determine your transmission requirements
- Product information and literature

Refer to a current North American Parts and Service Directory SA2229 or the International Parts and Service Directory SA2338 for a listing of Allison Transmission authorized distributors and service dealers.

Normally, any situation that arises in connection with the sale, operation, or service of your transmission will be handled by the distributor or dealer in your area. (Check the telephone directory for the Allison Transmission service outlet nearest you.)

We recognize, however, that despite t–he best intentions of all concerned, misunderstandings may occur. To further assure your complete satisfaction, we have developed the following three-step procedure in the event you have a problem that has not been handled satisfactorily.

**Step One — Discuss your problem with a member of management from the distributorship or dealership.** Complaints are frequently the result of a breakdown in communication and can be quickly resolved by a member of management. If you have already discussed the problem with the Sales or Service Manager, contact the General Manager. All ATD dealers are associated with an ATD distributor. If your problems originate with a dealer, explain the matter to a distributorship member of management with whom the dealer has his service agreement. The dealer will provide his ATD distributor's name, address, and telephone number on request.

**Step Two —** If your problem cannot be readily resolved at the distributor level without additional assistance, **contact the Allison Transmission Regional Office responsible for your local distributor** (see maps in Warranty Manual). You will be assisted by a member of the Regional Service Manager's staff.

For prompt assistance, please have the following information available.

- Name and location of authorized distributor or dealer
- Type and make of equipment
- Transmission model number, serial number, and assembly number — if equipped with electronic controls, also provide the ECU assembly number
- Transmission delivery date and accumulated miles and/or hours of operation
- Nature of problem
- Chronological summary of unit's history

**Step Three —** If you contacted a regional office and you are still not satisfied, **present the entire matter in writing or by phone to the Home Office:**

Manager Warranty Administration — PF9
Allison Transmission
P. O. Box 894
Indianapolis, Indiana 46206-0894
Phone: (317) 242–3538

The inclusion of all pertinent information will assist the Home Office in expediting the matter. If an additional review by the Home Office of all the facts involved indicates that some further action can be taken, the Regional Office will be advised.

When contacting the Regional or Home Office, please keep in mind that ultimately your problem will likely be resolved at the distributorship or dealership — using their facilities, equipment, and personnel. Therefore, we suggest you follow the above steps, in sequence, when experiencing a problem.

Your purchase of an Allison Transmission product is greatly appreciated, and it is our sincere desire to assure complete satisfaction.

## *9–2. SERVICE LITERATURE*

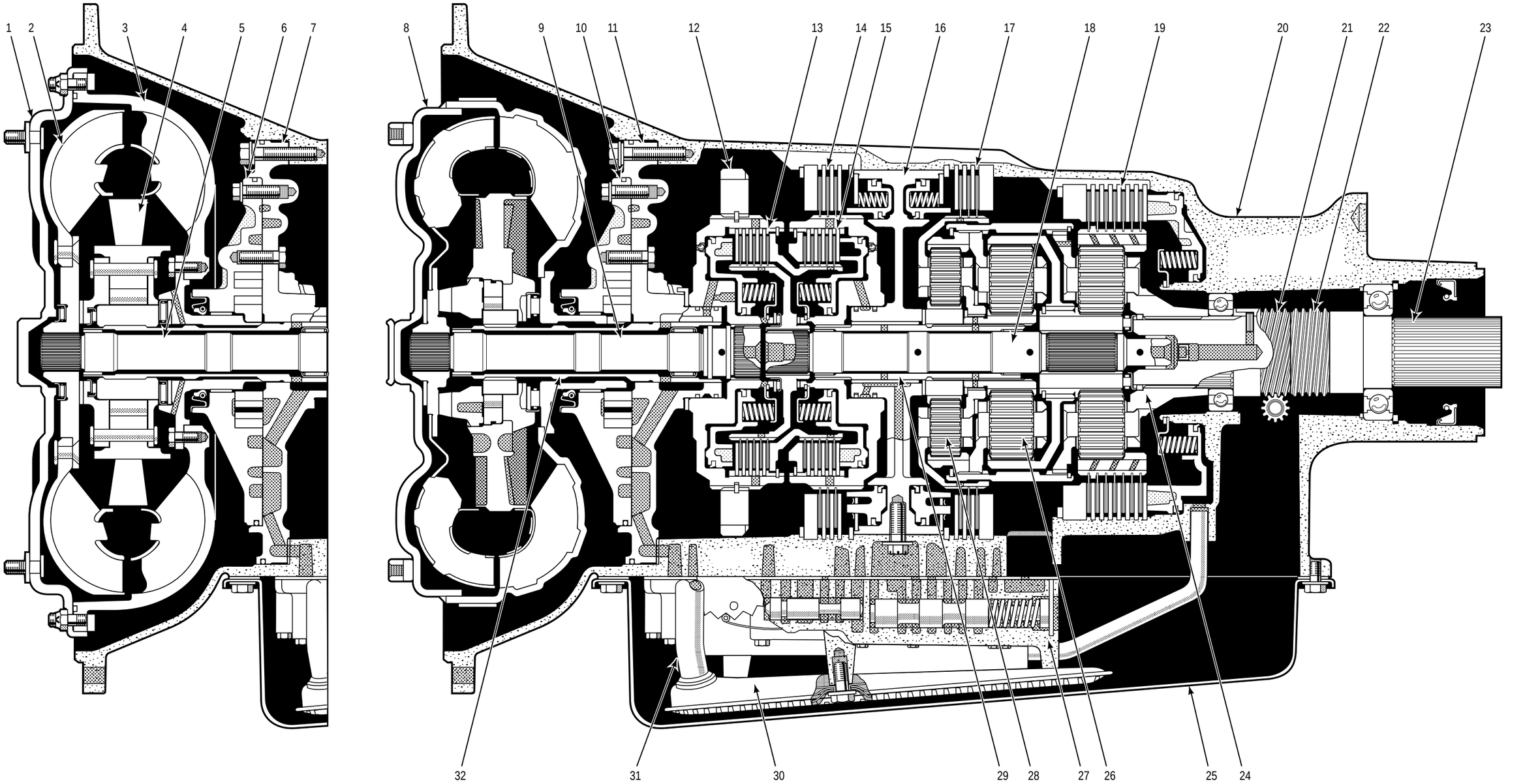
Additional service literature is available. This service literature provides fully illustrated instructions for operation, maintenance, service, overhaul, and parts support for your transmission. To ensure that you get maximum performance and service life from your transmission, see your dealer or distributor for the following publications. (Check the telephone directory for the Allison Transmission service outlet nearest you.)

**Table 9–1. Service Literature**

| Literature Title | AT 500, 1500 Series |
|---|---|
| Operator's Manual | OM1334EN |
| Mechanic's Tips | MT1321EN |
| Parts Catalog | PC1235EN |
| Troubleshooting Manual | TS1838EN |
| Inspection/Analysis Technician's Guide | GN1948EN |
| Automatic Transmission Fluids Technician's Guide | GN2055EN |
| Principles of Operation | PO2123EN |
| Service Manual | SM1241EN |

**Legend for Foldout 1**

1 – Torque converter front cover (AT 543)
2 – Torque converter turbine (AT 543)
3 – Torque converter pump (AT 543)
4 – Torque converter stator (AT 543)
5 – Turbine shaft
6 – Oil pump assembly
7 – Front support
8 – Torque converter assembly (AT 540, 542)
9 – Turbine shaft
10 – Oil pump assembly
11 – Front support
12 – PTO drive gear
13 – Forward clutch
14 – Third clutch
15 – Fourth clutch
16 – Center support
17 – Second clutch
18 – Main shaft
19 – First clutch
20 – Transmission housing
21 – Governor drive gear
22 – Speedometer drive gear
23 – Output shaft
24 – Rear planetary gear set
25 – Oil pan
26 – Center planetary gear set
27 – Control valve body assembly
28 – Front planetary gear set
29 – Sun gear shaft
30 – Oil filter
31 – Intake tube
32 – Stator shaft




**Foldout 1. Model AT 540, 542, 543 Transmission — Cross Section View**

**Legend for Foldout 2**

1 – Torque converter with lockup clutch assembly (AT 1500 Series)

2 – Turbine shaft

3 – Oil pump assembly

4 – Front support

5 – PTO drive gear

6 – Forward clutch

7 – Third clutch

8 – Fourth clutch

9 – Center support

10 – Second clutch

11 – Main shaft

12 – First clutch

13 – Transmission housing

14 – Governor drive gear

15 – Speedometer drive gear

16 – Output shaft

17 – Rear planetary gear set

18 – Oil pan

19 – Center planetary gear set

20 – Control valve body assembly

21 – Front planetary gear set

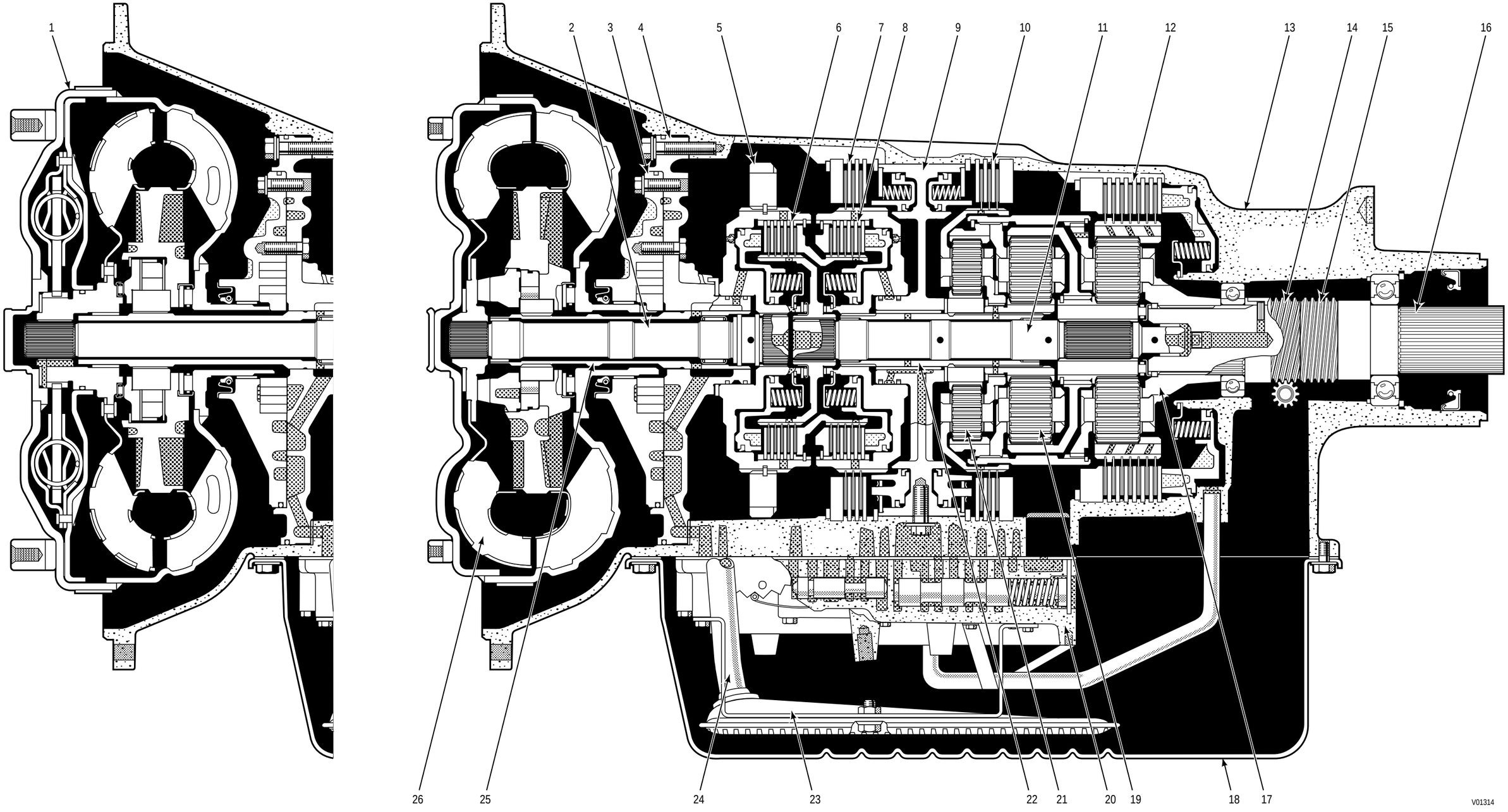
22 – Sun gear shaft

23 – Oil filter

24 – Intake tube

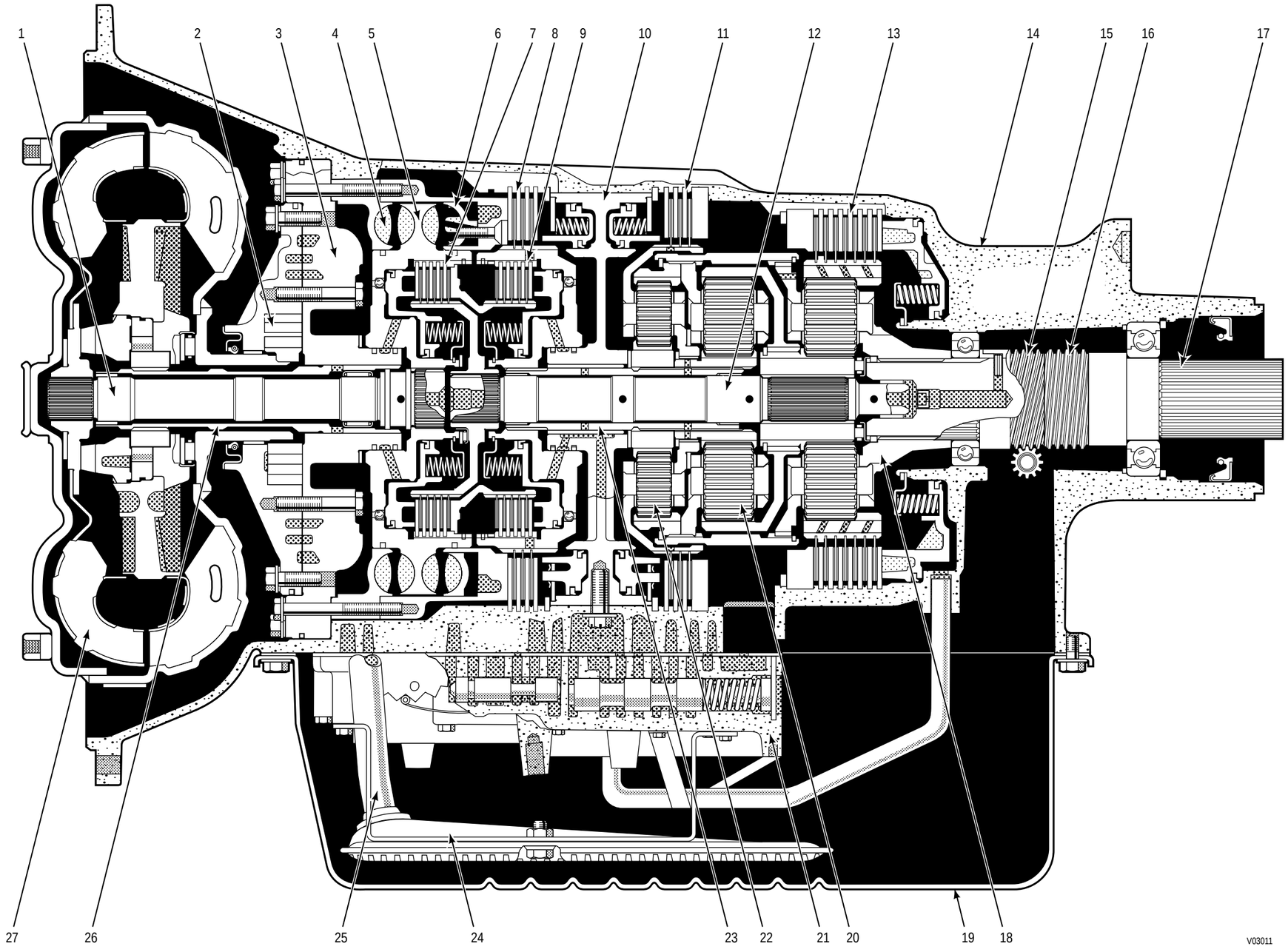
25 – Stator shaft

26 – Torque converter assembly



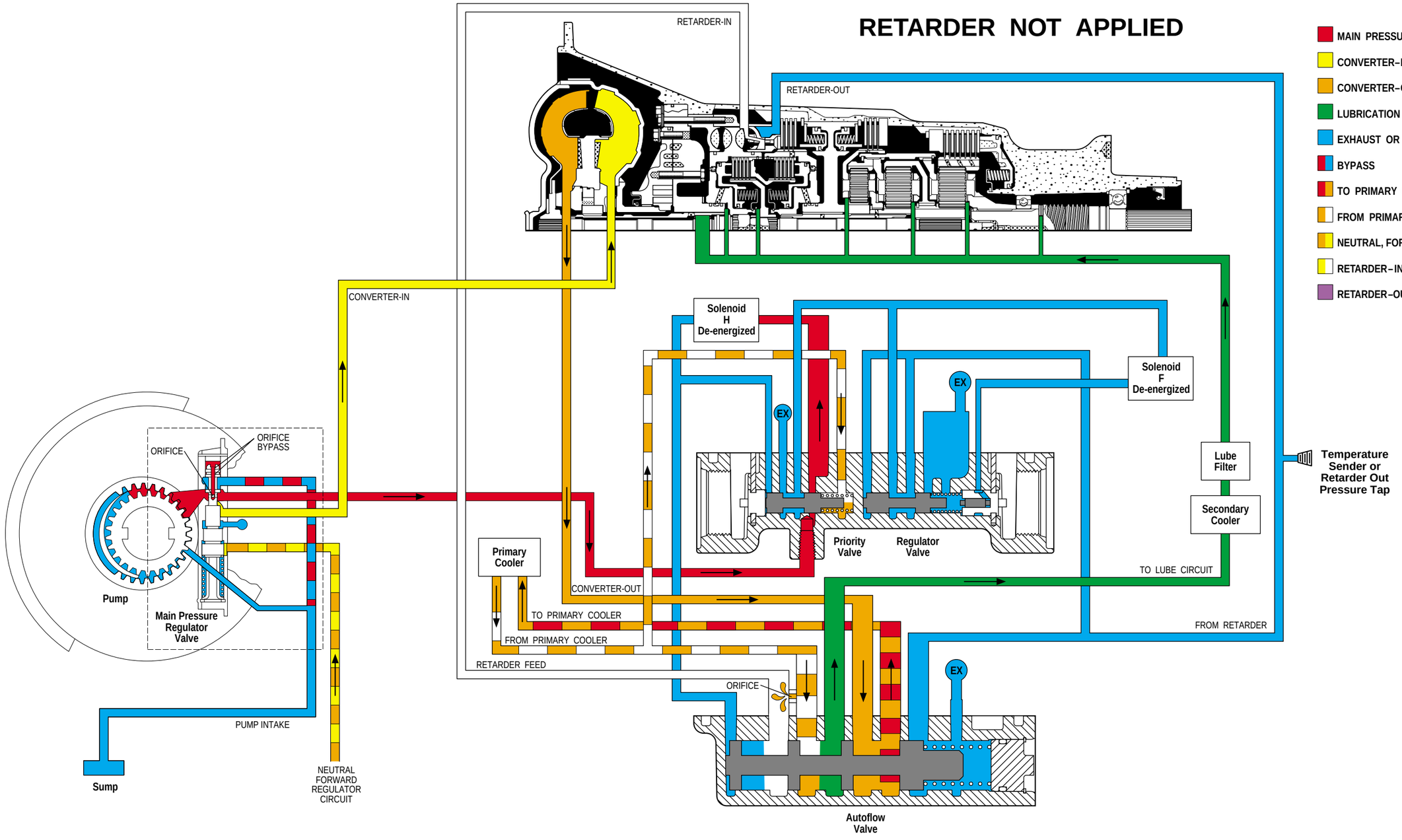

**Foldout 2. Model AT 545, 1545 Transmission — Cross Section View**

1 – Turbine shaft
2 – Oil pump assembly
3 – Front support
4 – Retarder front stator
5 – Retarder rotor
6 – Retarder rear stator
7 – Forward clutch
8 – Third clutch
9 – Fourth clutch
10 – Center support
11 – Second clutch
12 – Main shaft
13 – First clutch
14 – Transmission housing
15 – Governor drive gear
16 – Speedometer drive gear
17 – Output shaft
18 – Rear planetary gear set
19 – Oil pan
20 – Center planetary gear set
21 – Main control valve body assembly
22 – Front planetary gear set
23 – Sun gear shaft
24 – Oil filter
25 – Intake tube
26 – Stator shaft
27 – Torque converter assembly




**Foldout 3. AT Transmissions With Retarder**

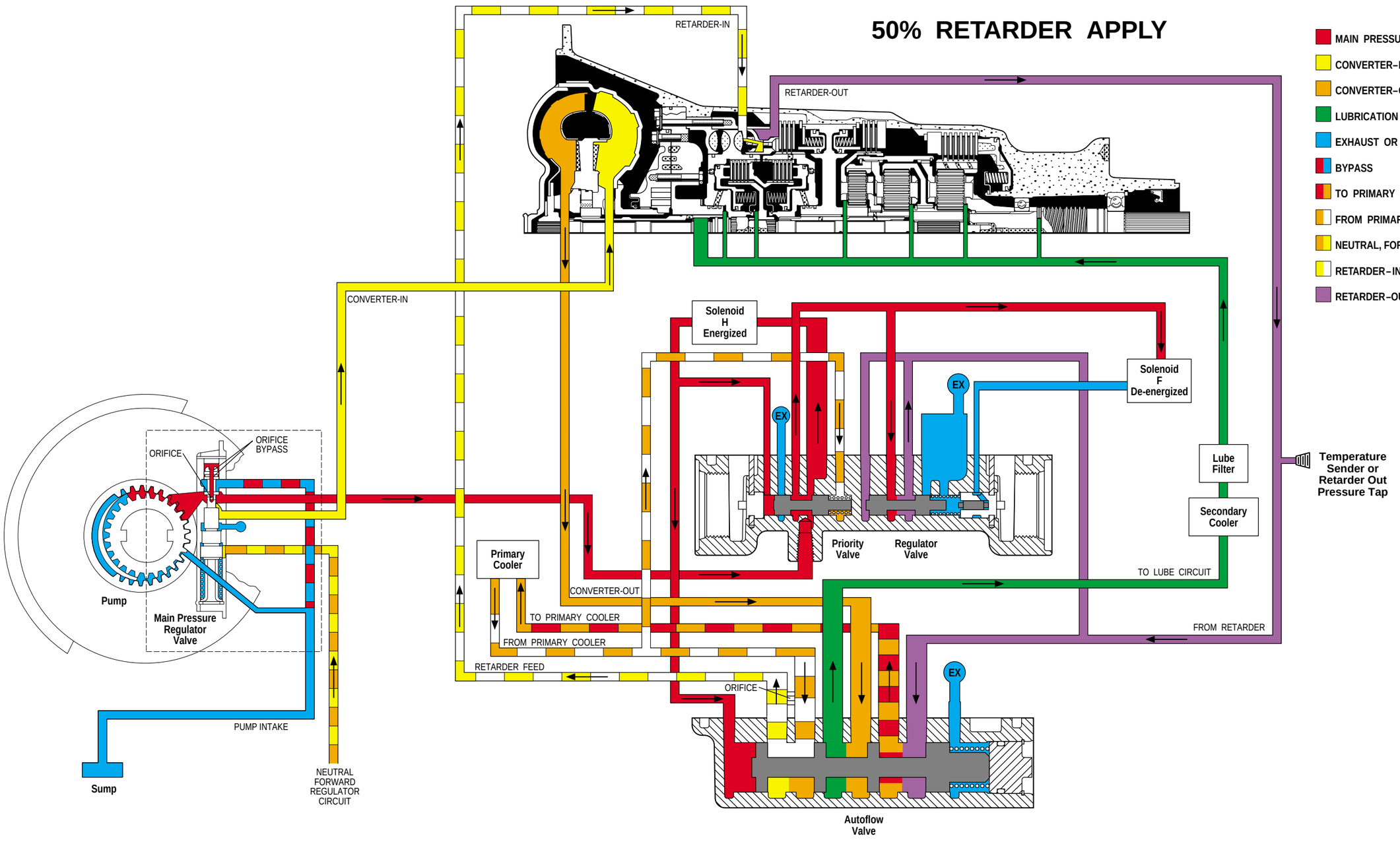
# RETARDER NOT APPLIED



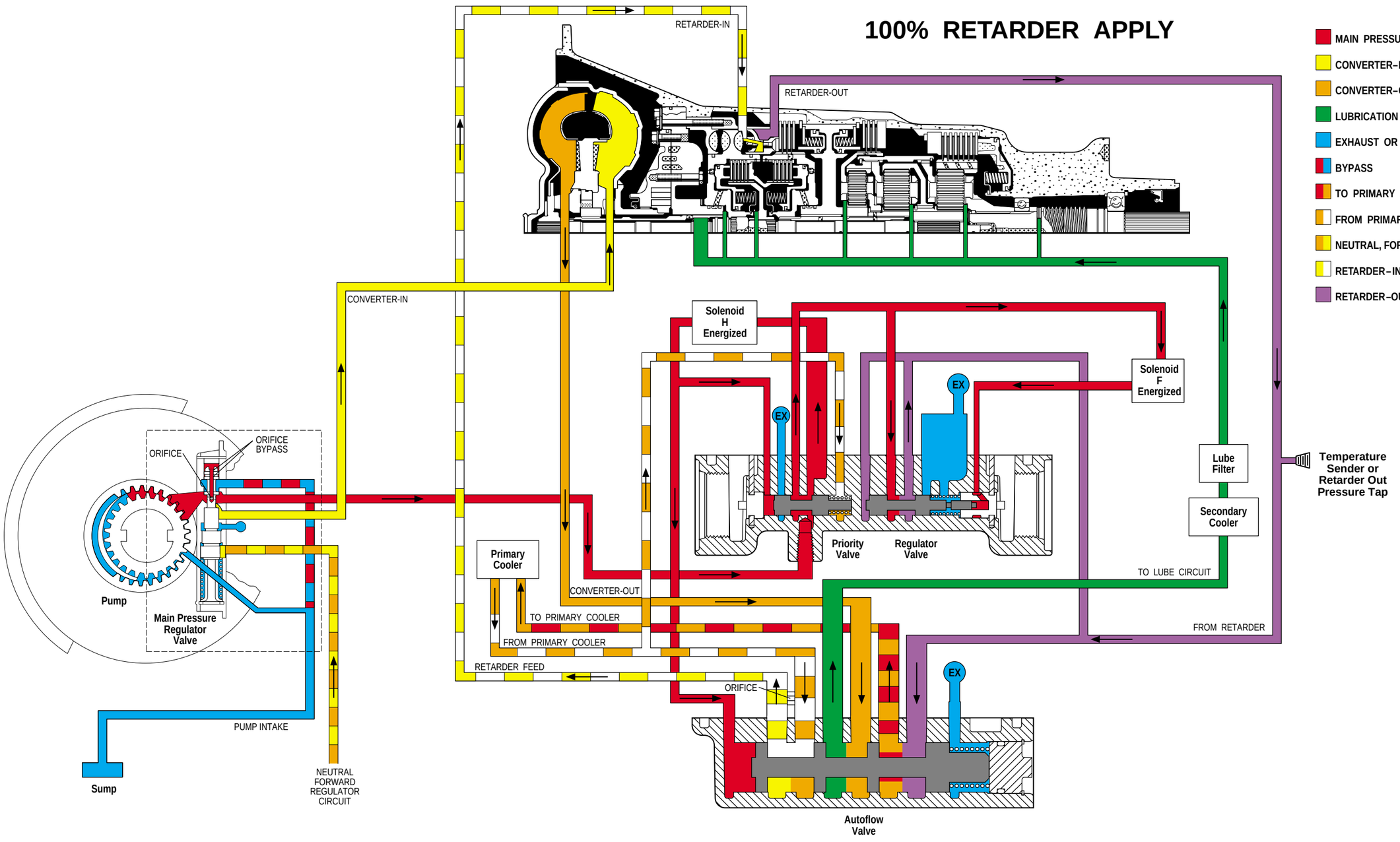

- MAIN PRESSURE
- CONVERTER–IN
- CONVERTER–OUT
- LUBRICATION
- EXHAUST OR SUMP
- BYPASS
- TO PRIMARY COOLER
- FROM PRIMARY COOLER
- NEUTRAL, FORWARD REGULATOR
- RETARDER–IN
- RETARDER–OUT

V03012

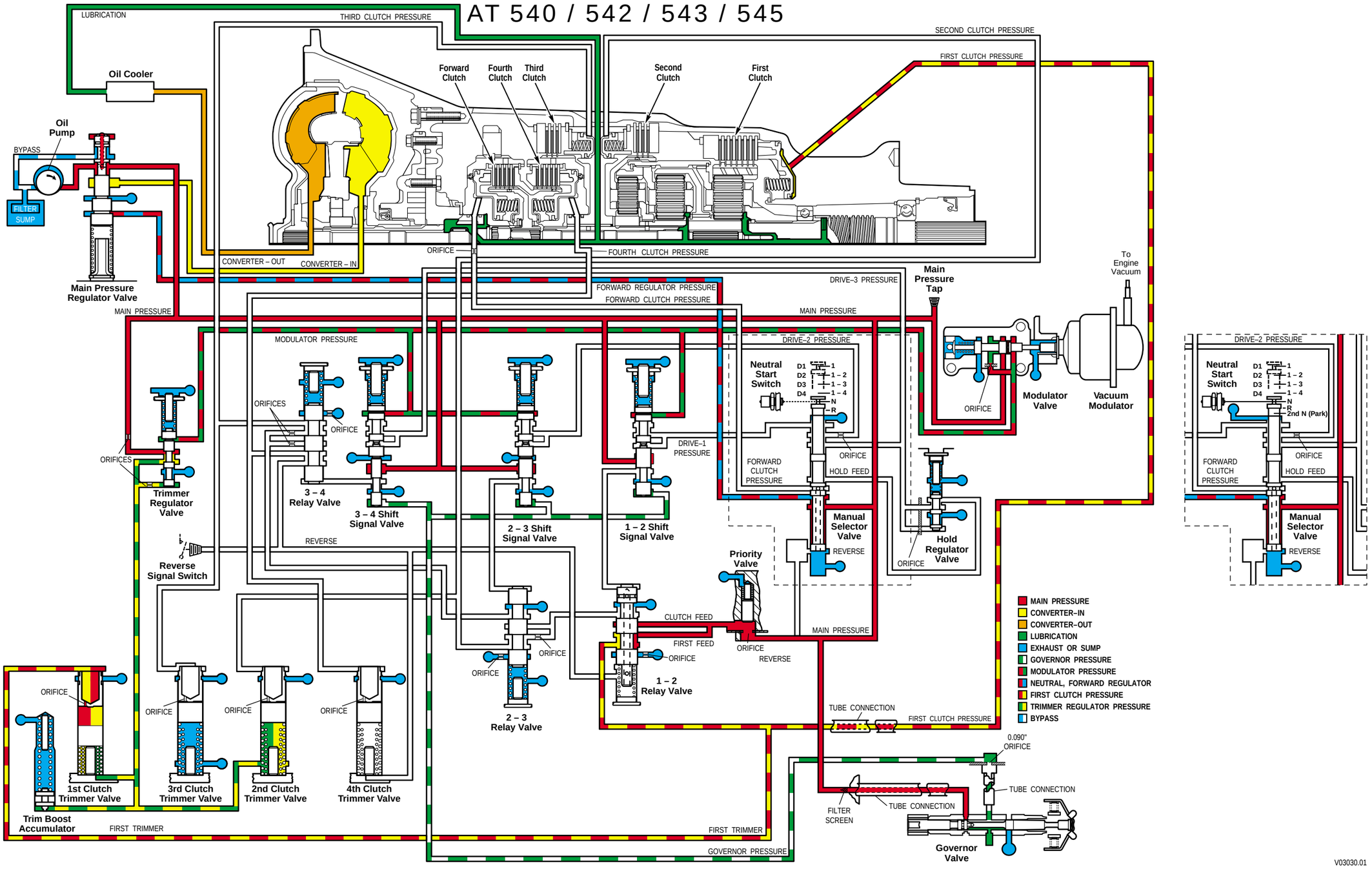
**Foldout 4,A. Input Retarder — Hydraulic Schematic — OFF**



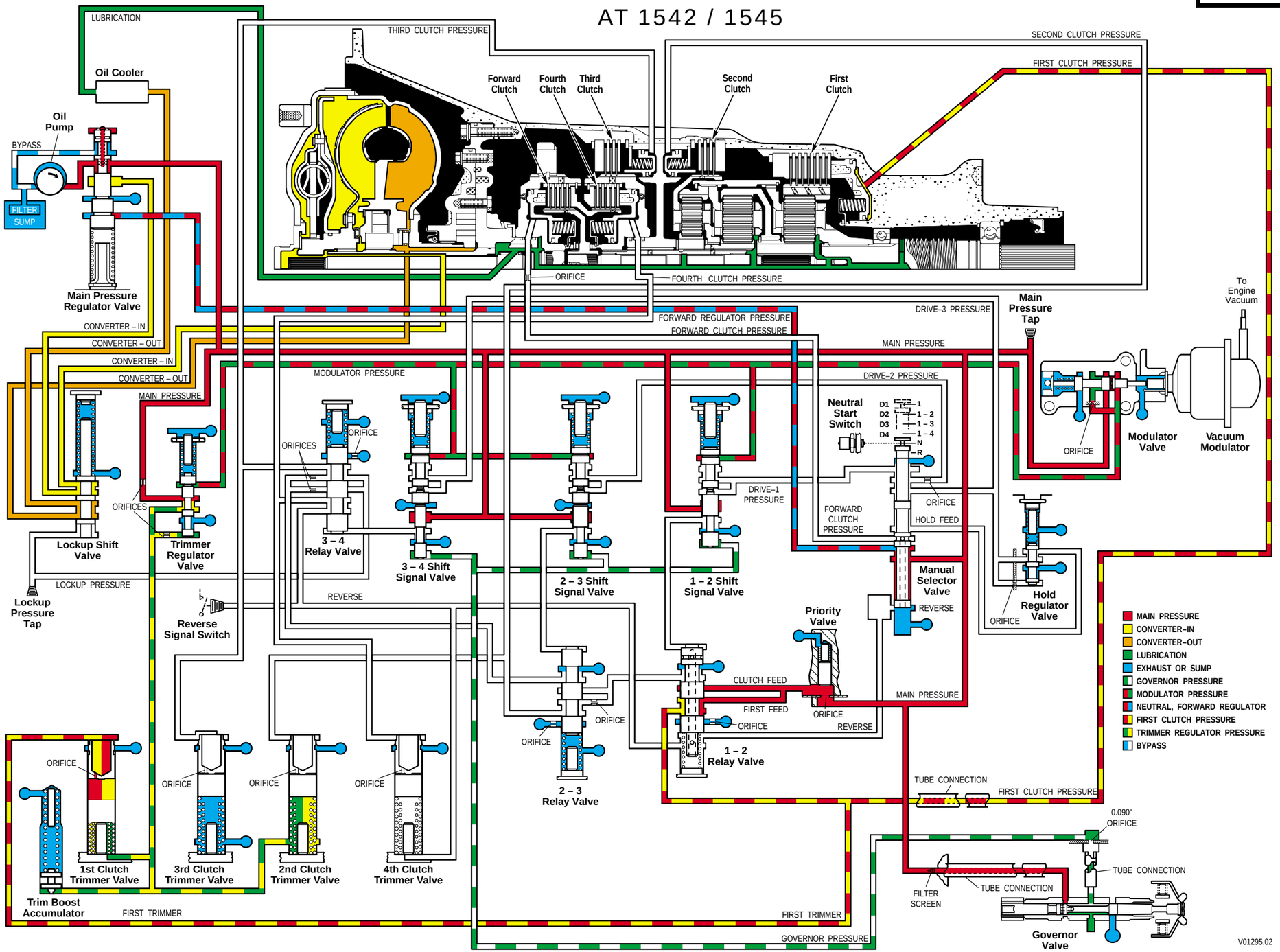

**Foldout 4,B. Input Retarder — Hydraulic Schematic — 50% Capacity**




**Foldout 4,C. Input Retarder — Hydraulic Schematic — 100% Capacity**




**Foldout 5. AT 500 Series Transmissions — Hydraulic Schematic**




**Foldout 6. AT 1500 Series Transmissions — Hydraulic Schematic**

**Legend for Foldout 7**

## *A*

1 – Nut, 3/8-24 (6) **A**
2 – Torque converter assembly (AT 543)
3 – Spacer retainer (6) (earlier models)
4 – Spacer (6)
5 – Torque converter cover assembly
6 – Self-locking nut, 5/16-24 (24) **B**
7 – Bearing race
8 – Thrust bearing assembly
9 – Bearing race
10 – Thrust bearing spacer (selective)
11 – Converter turbine assembly
12 – Rivet
13 – Torque converter turbine
14 – Torque converter turbine hub
15 – Torque converter stator and bearing assembly
16 – Torque converter stator assembly
17 – Stator front side plate
18 – Stator cam washer
19 – Stator
20 – Cam
21 – Stator cam washer
22 – Stator rear side plate
23 – Flat head rivet (6)
24 – Needle bearing assembly
25 – Freewheel roller race
26 – Freewheel roller (10)
27 – Freewheel roller spring (10)
28 – Bolt, 1/4-20 x 5/8 inch (8) **C**
29 – Lockstrip (4)
30 – Torque converter pump hub
31 – Gasket
32 – Needle bearing assembly
33 – Bearing race
34 – Sealring
35 – Torque converter pump assembly
36 – Special bolt, 5/16-24 x 1.36 inch (24)

| Torque | lb ft | N·m |
|---|---|---|
| **A** | 34–40 | 46–54 |
| **B** | 19–23 | 26–31 |
| **C** | 9–11 | 12–15 |

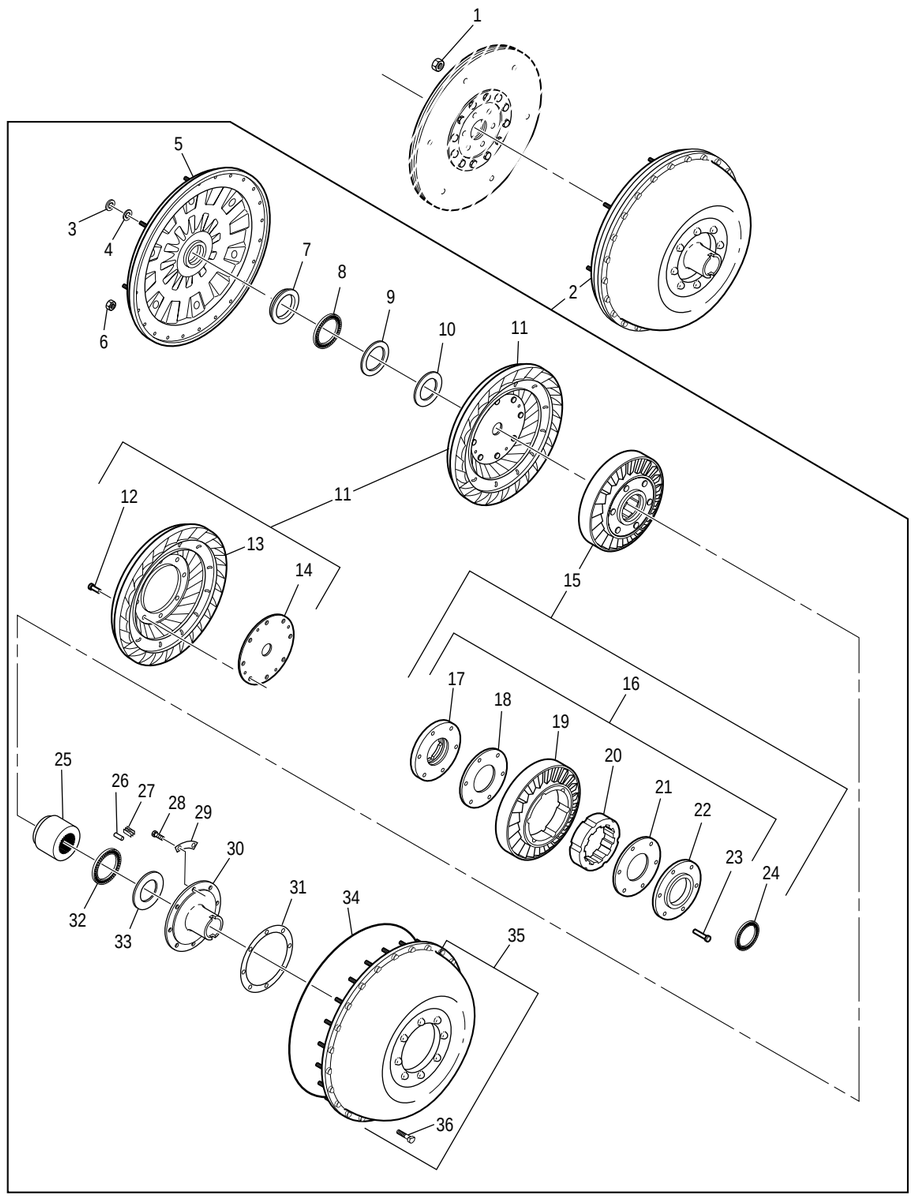
## *B*

1 – Torque converter assembly (AT 540, 542, 545, 1542, 1545)
2 – Oil pump and front support assembly
3 – Front oil seal
4 – Sealring
5 – Pump body and gear assembly
6 – Pump body assembly
7 – Bushing (prebored) (for service only)
8 – Pump body
9 – Pump driven gear
10 – Pump drive gear
11 – Bolt, 5/16-18 x 1 inch (6) (8 on earlier models) **A**
12 – Rubber coated washer (6) (8 on earlier models)
13 – Sealring
14 – Valve plug (earlier models)
15 – Pin (earlier models)
16 – Front support and bearing assembly
17 – Front support assembly
18 – Ground sleeve bushing*
19 – Ground sleeve
20 – Tapered expansion plug
21 – Front support
22 – Tapered expansion plug
23 – Roller bearing
24 – Snapring
25 – Spring stop
26 – Valve spring
27 – Main-pressure regulator valve
28 – Self-locking bolt, 5/16-18 x 1 3/4 inch (3)** **A**
29 – Self-locking bolt, 5/16-18 x 1 inch (2)** **A**
30 – Lockup valve (AT 1500 Series)
31 – Lockup valve spring (AT 1500 Series)
32 – Stop (AT 1500 Series)
33 – Pin (AT 1500 Series)
34 – Self-locking bolt, 5/16-18 x 1 3/4 inch (9) **B**
35 – Rubber coated washer (9)
36 – Gasket
37 – Thrust washer (selective)
38 – Hook-type sealring (2)
39 – Self-locking bolt, M6-1 (6) **C*****
40 – Rubber-coated flat washer (6)

| Torque | lb ft | N·m |
|---|---|---|
| **A** | 15–20 | 20–27 |
| **B** | 13–16 | 18–22 |
| **C** | 9–10 | 12–14 |

* Not present on AT 1500 Series models
** For later models, all five 5/16-18 bolts are 1 3/4 inch long
*** Retarder models only

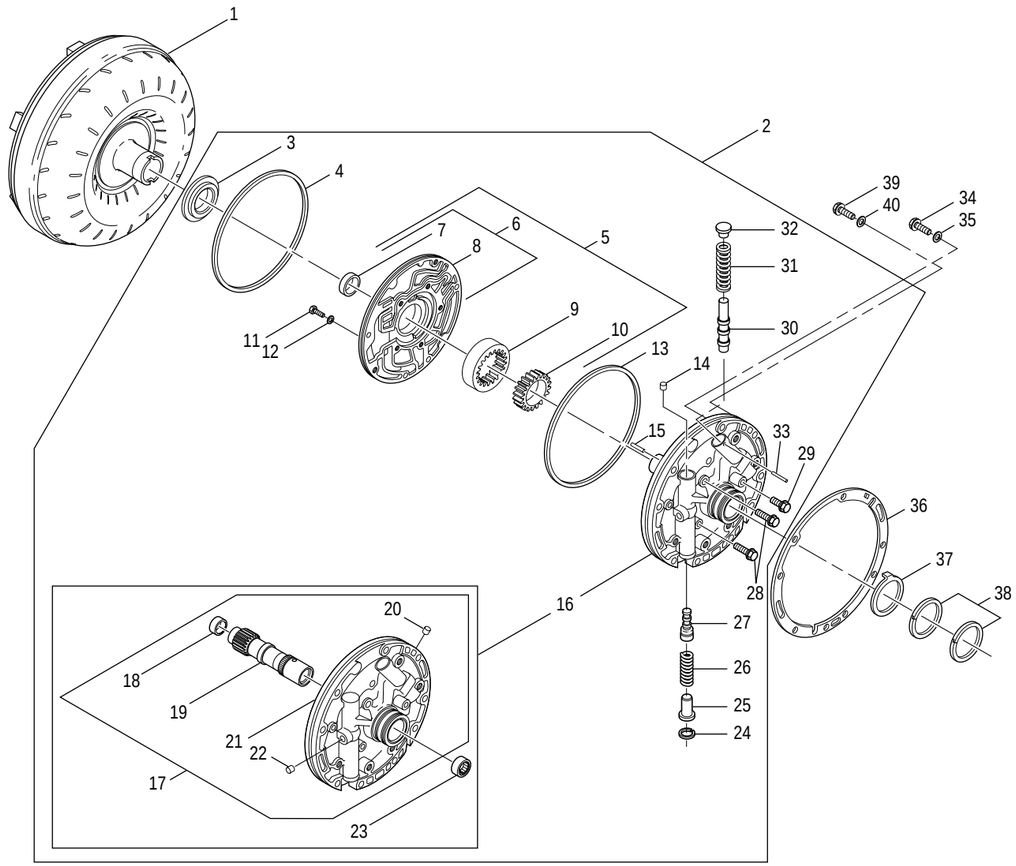
*A*




V03024

**Foldout 7,A. Torque Converter Assembly (AT 543) — Exploded View**

*B*




V03023

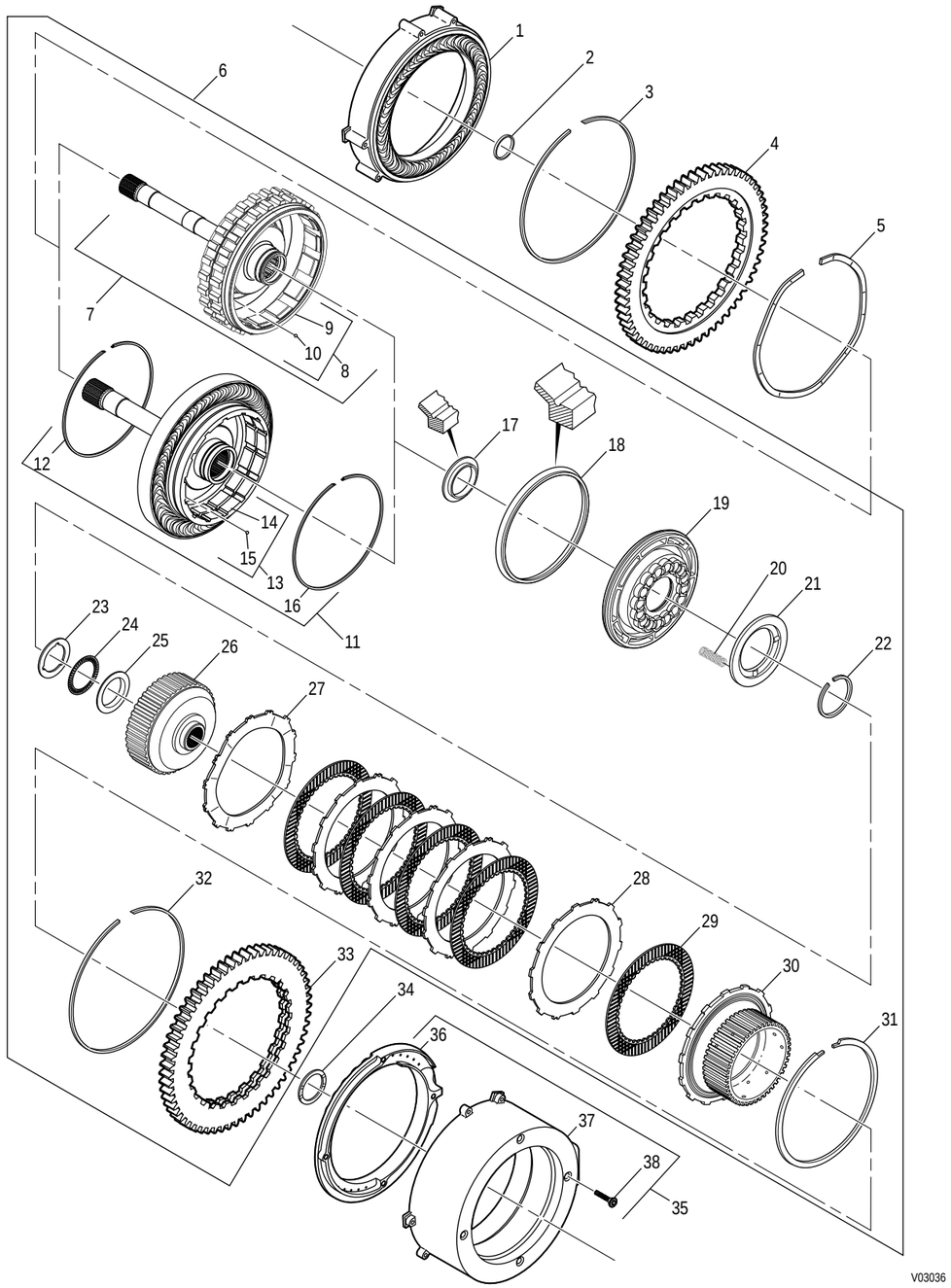
**Foldout 7,B. Torque Converter and Oil Pump Assemblies — Exploded View**

1 – Front stator (models with retarder)
2 – Hook-type sealring
3 – Snapring (earlier models)
4 – PTO drive gear (earlier models)
5 – Wave-type snapring (earlier models)
6 – Forward clutch and turbine shaft assembly (with PTO)
7 – Housing and shaft assembly
8 – Forward clutch housing assembly
9 – Forward clutch housing
10 – Ball
11 – Forward clutch assembly (models with retarder)
12 – Hook-type sealring (models with retarder)
13 – Forward clutch housing and turbine shaft assembly (models with retarder)
14 – Forward clutch housing assembly (models with retarder)
15 – Ball, 3⁄16 inch diameter (models with retarder)
16 – Hook-type sealring (models with retarder)
17 – Piston inner sealring
18 – Piston outer sealring
19 – Forward clutch piston (selective)

| | |
|---|---|
| Piston **A*** | 0.700–0.710 inch (17.78–18.03 mm) |
| Piston **B*** | 0.726–0.736 inch (18.44–18.69 mm) |
| Piston **C*** | 0.752–0.762 inch (19.10–19.36 mm) |
| Piston **EF**** | 0.984–1.010 inch (25.00–25.65 mm) |
| Piston **E**** | 1.010–1.046 inch (25.66–26.56 mm) |
| Piston **DE**** | 1.046–1.072 inch (26.57–27.22 mm) |

20 – Clutch return spring (16)
21 – Spring retainer
22 – Snapring
23 – Thrust bearing race
24 – Thrust needle bearing
25 – Thrust bearing race
26 – Forward clutch hub
27 – External-tanged wave clutch plate (later models)
28 – External-tanged clutch plate (4)*
29 – Internal-splined clutch plate (5)
30 – Fourth clutch drive hub
31 – Snapring
32 – Snapring (later models)
33 – PTO drive gear (later models)
34 – Thrust washer
35 – Retarder housing assembly (models with retarder)
36 – Rear stator (models with retarder)
37 – Retarder housing (models with retarder)
38 – Screw (4) 10–12 lb ft (14–16 N·m) (models with retarder)

* earlier models
** later models




**Foldout 8. Forward Clutch and Turbine Shaft — Exploded View**

**Legend for Foldout 9**

## *A*

1 – Snapring (models without retarder)
2 – Clutch backplate (models without retarder)
3 – Internal-splined clutch plate (5)
4 – External-tanged clutch plate (5)
5 – Snapring
6 – Spring retainer
7 – Piston return spring (16)
8 – Fourth clutch piston (selective)
Piston **A*** 0.700–0.710 inch (17.78–18.03 mm)
Piston **B*** 0.726–0.736 inch (18.44–18.69 mm)
Piston **C*** 0.752–0.762 inch (19.10–19.36 mm)
Piston **EF**** 0.984–1.010 inch (25.00–25.65 mm)
Piston **E**** 1.010–1.046 inch (25.66–26.56 mm)
Piston **DE**** 1.046–1.072 inch (26.57–27.22 mm)
9 – Piston outer sealring
10 – Piston housing inner sealring
11 – Fourth clutch housing assembly
12 – Ball
13 – Fourth clutch housing

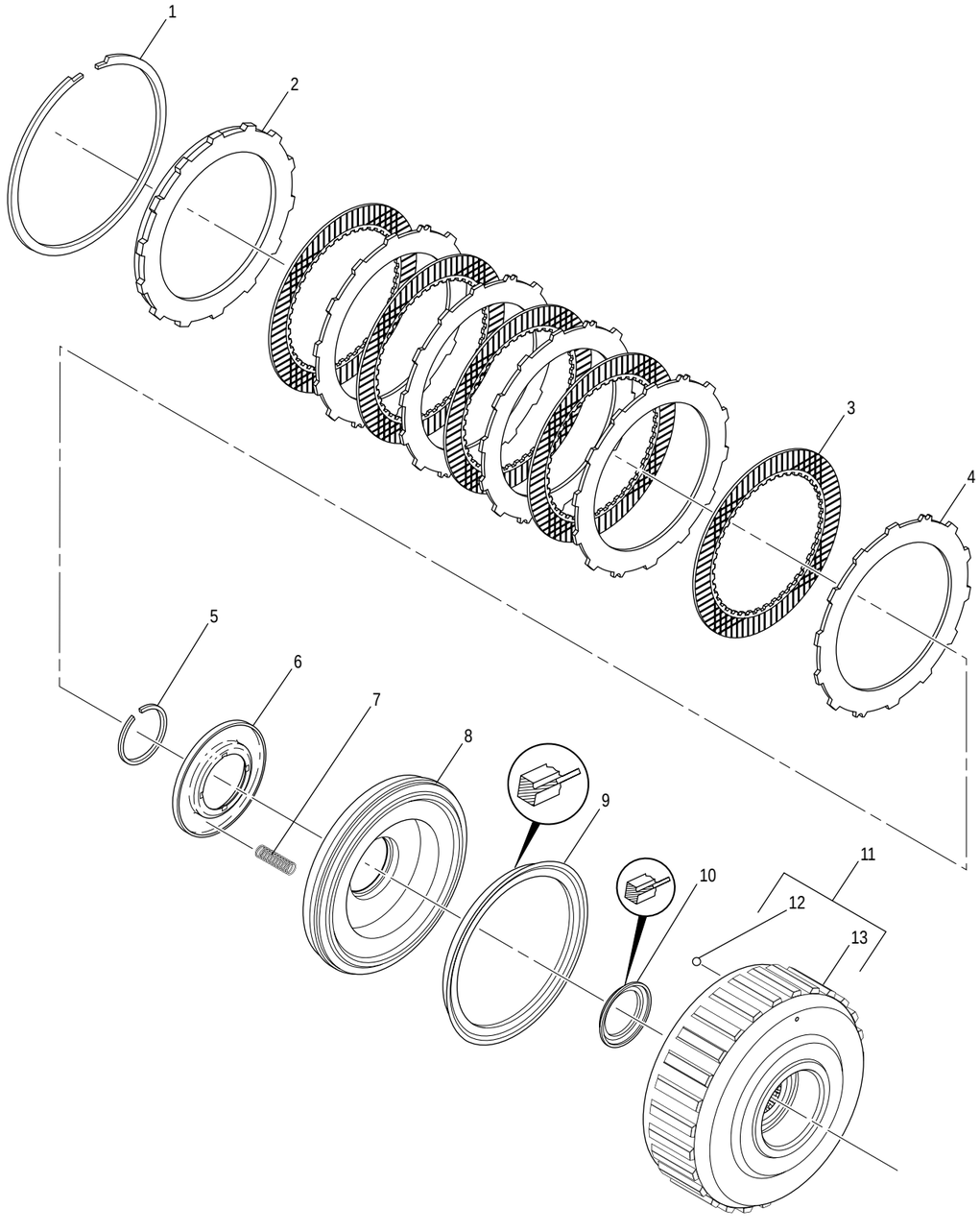
* earlier models
** later models

## *B*

1 – Snapring
2 – Third clutch backplate
(Ident. 4)* 0.416–0.426 inch (10.57–10.82 mm)
(Ident. ❑) 0.419–0.429 inch (10.64–10.90 mm)
3 – Internal-splined clutch plate (3)
4 – External-tanged clutch plate (3)
5 – Snapring
Color code white 0.148–0.150 inch (3.75–3.81 mm)
Color code yellow 0.152–0.154 inch (3.86–3.91 mm)
Color code green 0.155–0.157 inch (3.93–3.98 mm)
Color code red 0.158–0.160 inch (4.01–4.06 mm)
6 – Self-locking retainer washer (4)
7 – Spring retainer
8 – Piston return spring (12)
9 – Third clutch piston
10 – Piston inner sealring
11 – Piston outer sealring
12 – Hook-type sealring (2)
13 – Center support and bushing assembly
14 – Bushing
15 – Center support
16 – Piston outer sealring
17 – Piston inner sealring
18 – Second clutch piston
19 – Piston return spring (12)
20 – Spring retainer
21 – Self-locking retainer washer (4)
22 – Snapring
23 – External-tanged clutch plate (3)
24 – Internal-splined clutch plate (3)
25 – Second clutch backplate
(Ident. 5)* 0.429–0.439 inch (10.90–11.15 mm)
(Ident. ❑) 0.419–0.429 inch (10.64–10.90 mm)

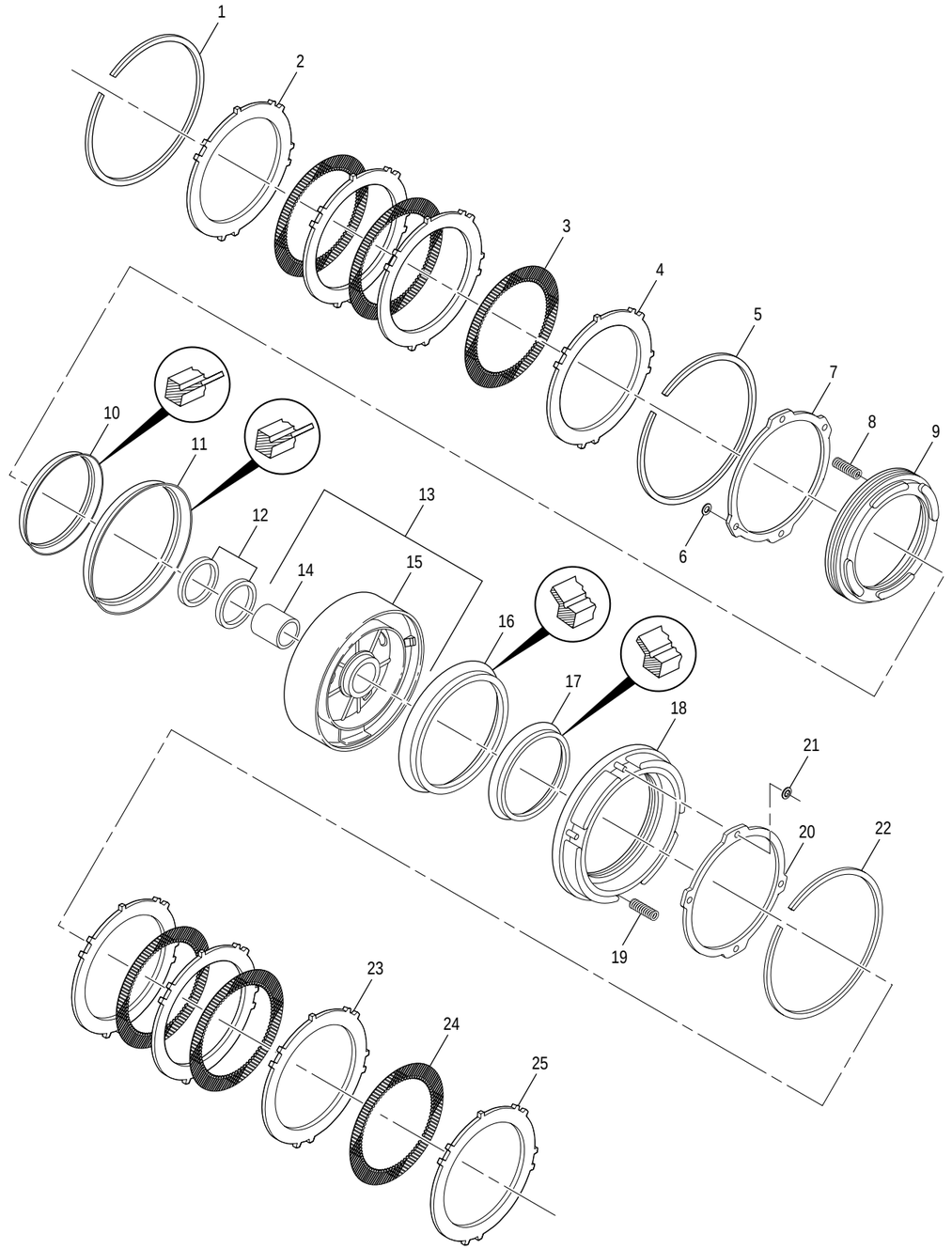
* For models prior to S/N 3210668026

*A*




**Foldout 9,A. Fourth Clutch — Exploded View**

*B*




**Foldout 9,B. Third Clutch, Second Clutch, and Center Support — Exploded View**

**Legend for Foldout 10**

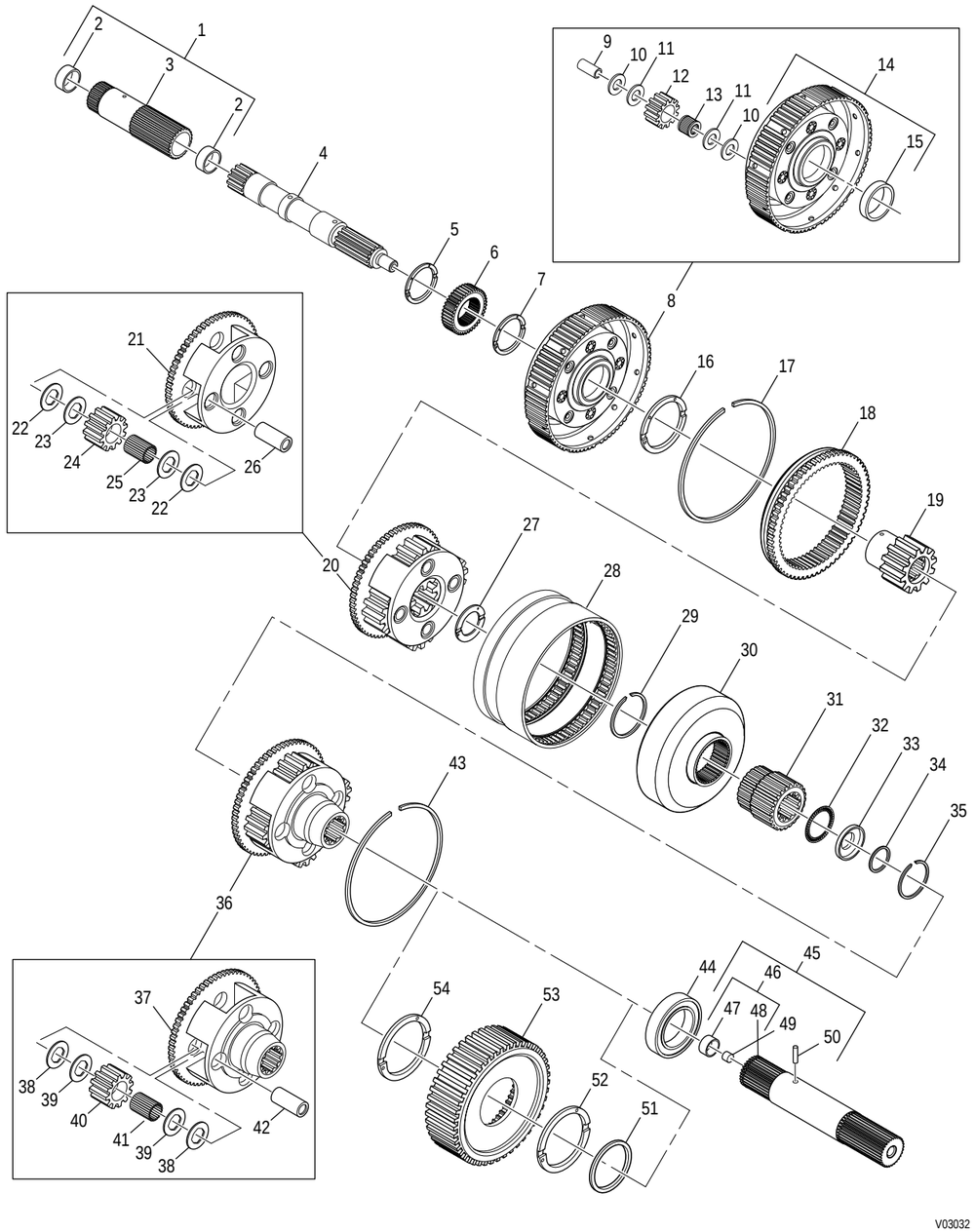
## *A*

1 – Sun gear shaft assembly
2 – Bushing (2) (service only)
3 – Sun gear shaft
4 – Transmission main shaft
5 – Thrust washer
6 – Front planetary sun gear
7 – Thrust washer
8 – Front planetary carrier assembly
9 – Pinion pin (4)
10 – Bronze thrust washer (8)
11 – Steel thrust washer (8)
12 – Pinion (matched set of 4)
13 – Needle roller bearing (80)
14 – Carrier and bushing assembly
15 – Bushing
16 – Thrust washer
17 – Snapring
18 – Front planetary ring gear
19 – Center sun gear
20 – Center planetary carrier assembly
21 – Center planetary carrier
22 – Bronze thrust washer (8)
23 – Steel thrust washer (8)
24 – Pinion (matched set of 4)
25 – Needle roller bearing (76)
26 – Pinion pin (4)
27 – Thrust washer
28 – Planetary connecting drum
29 – Snapring
30 – Center planetary ring gear
31 – Rear planetary sun gear
32 – Needle thrust bearing
33 – Thrust bearing race
34 – Spiral retainer ring
35 – Snapring
36 – Rear planetary carrier assembly
37 – Rear planetary carrier
38 – Bronze thrust washer (8)
39 – Steel thrust washer (8)
40 – Pinion (matched set of 4)
41 – Needle roller bearing (76)
42 – Pinion pin (4)
43 – Snapring
44 – Ball bearing
45 – Output shaft assembly
46 – Shaft and bushing assembly
47 – Bushing
48 – Output shaft
49 – Lube orifice plug
50 – Governor drive spring pin
51 – Spiral retainer ring (prior to S/N 5071)
52 – Spacer washer (prior to S/N 5071)
53 – Rear planetary ring gear (prior to S/N 5071)
54 – Spacer washer (prior to S/N 5071)

## *B*

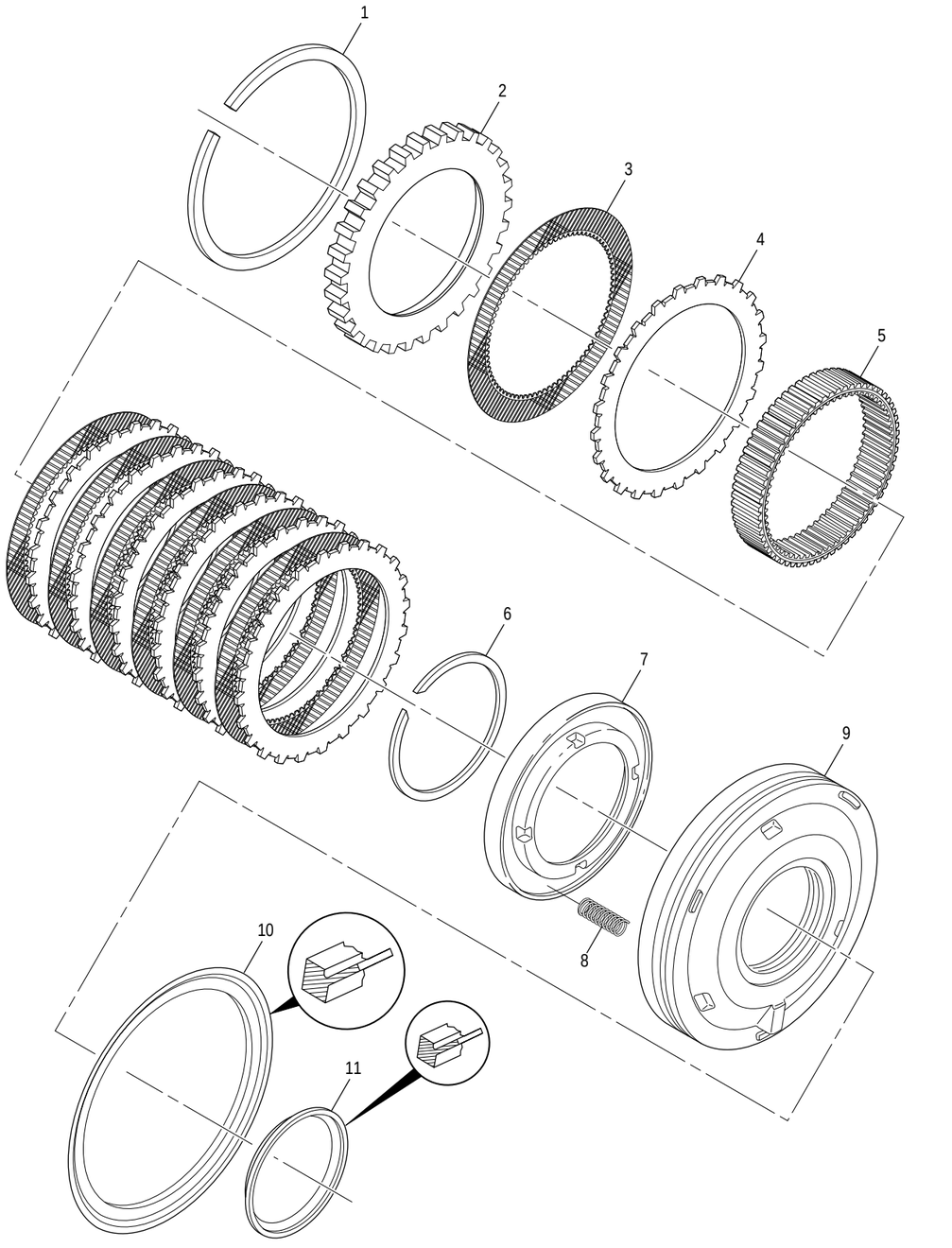
1 – Snapring
2 – Backplate (selective)
(Ident. 1, 4) 0.683–0.693 inch (17.34–17.60 mm)
(Ident. 2, 5, or no stamp) 0.647–0.657 inch (16.43–16.68 mm)
(Ident. 3, 6) 0.611–0.621 inch (15.51–15.77 mm)
3 – Internal-splined clutch plate (7)
4 – External-tanged clutch plate (7)
5 – Rear planetary ring gear
6 – Snapring
7 – Spring retainer
8 – Piston return spring (22)
9 – First clutch piston
10 – Piston outer sealring
11 – Piston inner sealring

*A*




**Foldout 10,A. Planetary Gear Unit — Exploded View**

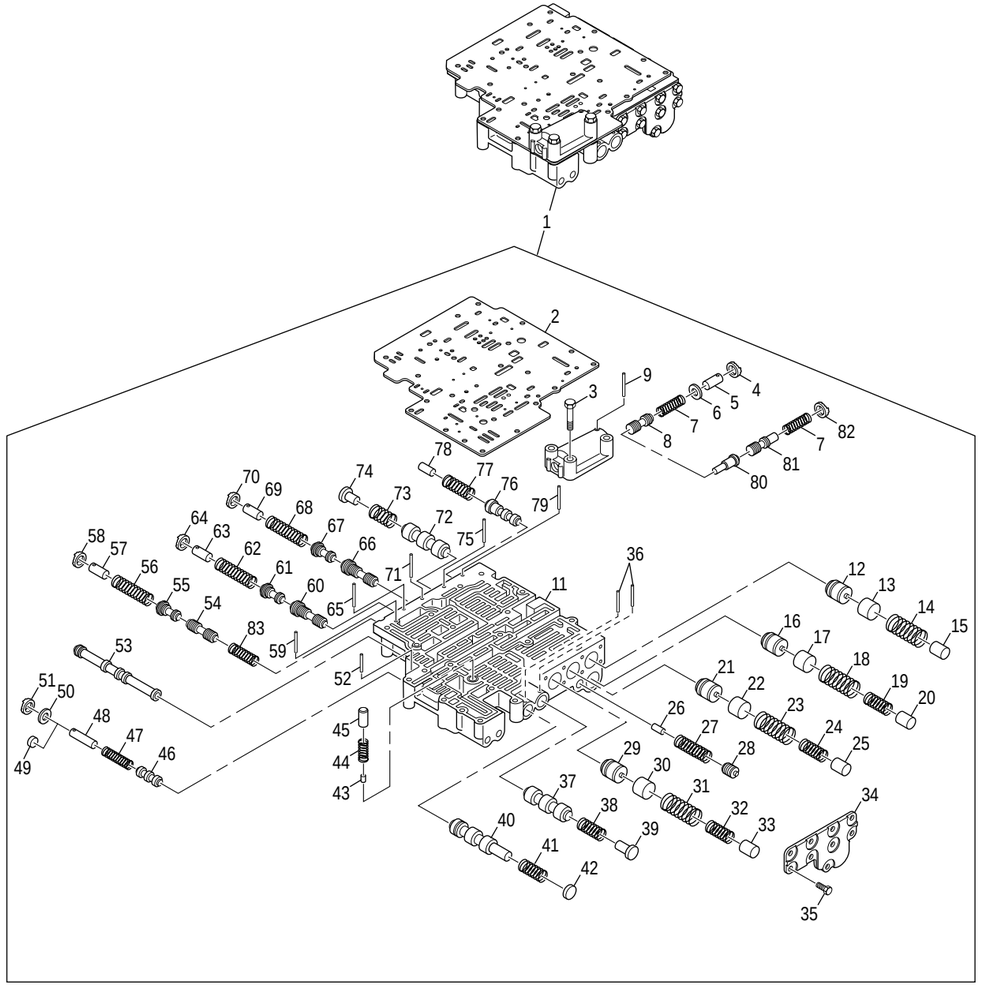
*B*




**Foldout 10,B. First Clutch — Exploded View**

1 – Control valve body assembly
2 – Separator plate
3 – Bolt, ¼-20 x 1¾ (3) **A**
4 – Adjusting ring (earlier models)
5 – Valve stop (earlier models)
6 – Washer (earlier models)
7 – Valve spring
8 – Modulator valve (earlier models)
9 – Retainer pin
10 – Modulator valve body
11 – Control valve body
12 – Third clutch trimmer valve
13 – Trimmer plug
14 – Trimmer spring
15 – Valve stop
16 – First clutch trimmer valve
17 – Trimmer plug
18 – Trimmer outer spring
19 – Trimmer inner spring (after S/N 34500)
20 – Valve stop
21 – Second clutch trimmer valve
22 – Trimmer plug
23 – Trimmer spring
24 – Trimmer inner spring
25 – Valve stop
26 – Valve stop (after S/N 3210274681)
27 – Spring (after S/N 3210274681)
28 – Trim Boost accumulator valve (after S/N 3210274681)
29 – Fourth clutch trimmer valve
30 – Trimmer plug
31 – Trimmer outer spring
32 – Trimmer inner spring (after S/N 34500)
33 – Valve stop
34 – Trimmer cover
35 – Bolt, ¼-20 x ¾ (9) (8, earlier models) **A**
36 – Retainer pin
37 – 2–3 relay valve
38 – Relay valve spring
39 – Valve stop
40 – 1–2 relay valve
41 – Relay valve spring
42 – Spacer
43 – Valve stop
44 – Priority valve spring
45 – Priority valve
46 – Hold regulator valve
47 – Valve spring
48 – Valve stop
49 – Valve plug (earlier models)
50 – Washer
51 – Adjusting ring
52 – Retainer pin
53 – Selector valve
54 – 1–2 shift signal valve
55 – 1–2 modulator valve
56 – Valve spring
57 – Valve stop
58 – Adjusting ring
59 – Retainer pin
60 – 2–3 shift signal valve
61 – 2–3 modulator valve
62 – Valve spring
63 – Valve stop
64 – Adjusting ring
65 – Retainer pin
66 – 3–4 shift signal valve
67 – 3–4 modulator valve
68 – Valve spring
69 – Valve stop
70 – Adjusting ring
71 – Retainer pin
72 – 3–4 relay valve
73 – Relay valve spring
74 – Valve stop
75 – Retainer pin
76 – Trimmer regulator valve
77 – Valve spring
78 – Valve stop
79 – Retainer pin
80 – Retained modulator actuator rod
81 – Modulator valve
82 – Adjusting ring
83 – Valve assist spring (assemblies with 2nd gear start provision)

| Torque | lb ft | N·m |
|---|---|---|
| **A** | 8–12 | 10–16 |




V03033

**Foldout 11. Main Control Valve Body Assembly — Exploded View**

**Legend for Foldout 12**

## *A*

1 – Gasket
2 – Power takeoff cover
3 – Bolt, 3/8-16 x 3/4 (6) **A**
4 – Drive screw
5 – Nameplate
6 – Transmission housing assembly
7 – Vent assembly
8 – Pipe plug, 1/8 inch **B**
9 – Internal snapring
10 – Transmission housing and pin assembly
11 – Transmission housing
12 – Governor support pin
13 – Pipe plug, 1/8 inch **B**
14 – Neutral start switch plug, 3/4 **C**
15 – Washer
16 – Coil insert (4) (AT 543)
17 – Neoprene breather shroud
18 – Governor assembly
19 – Governor service kit
20 – Governor weight pin (2)
21 – Cover gasket
22 – Governor cover
23 – Bolt, 5/16-18 x 9/16 (4) **A**
24 – Bolt, 5/16-18 x 9/16 **D**
25 – Modulator retainer
26 – Vacuum modulator
27 – Modulator sealring
28 – Modulator valve actuating rod (later models)

| Torque | lb ft | N·m |
|---|---|---|
| **A** | 15–20 | 20–27 |
| **B** | * | 5.5–6.7 |
| **C** | 25–45 | 33–60 |
| **D** | 10–16 | 14–22 |

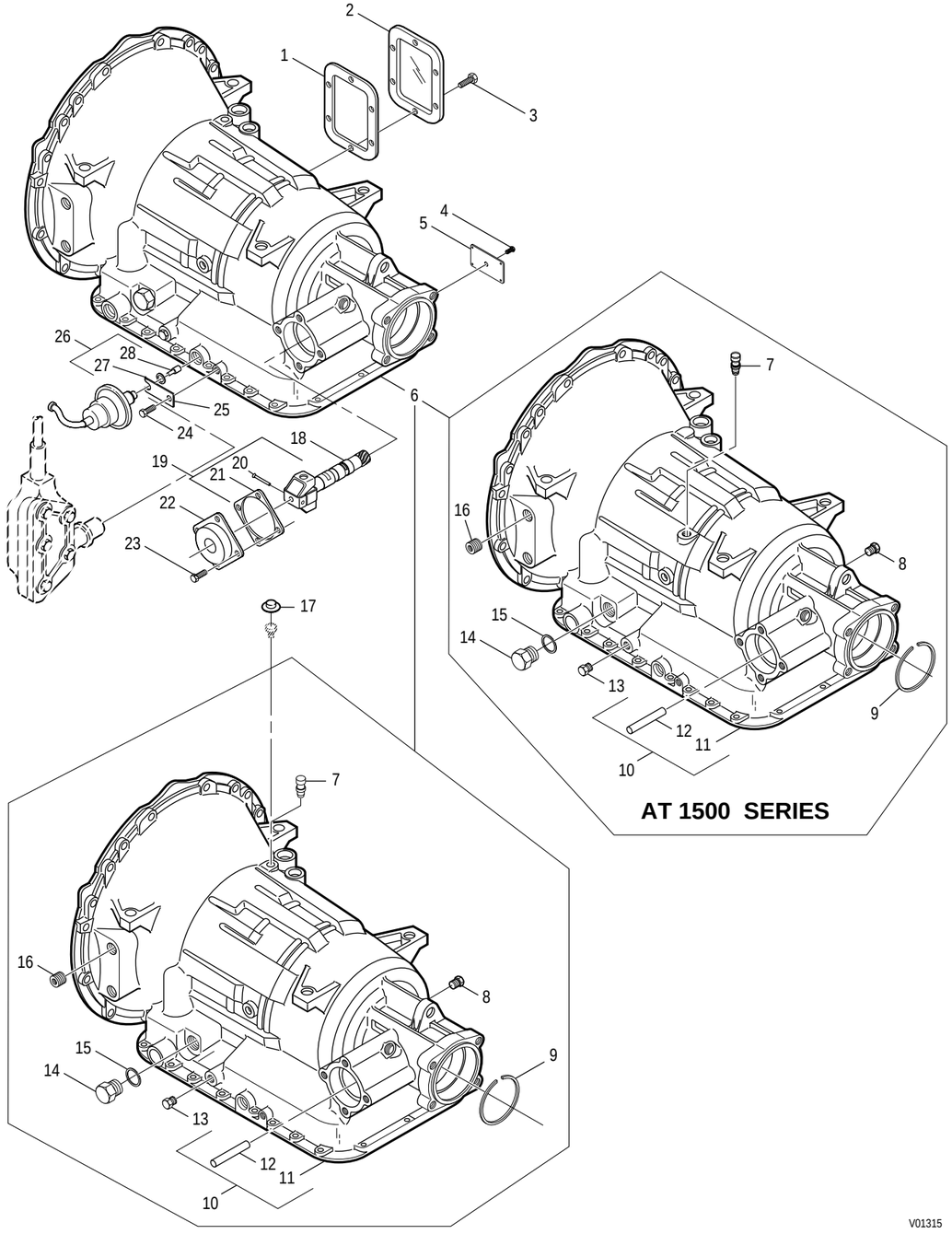
* 48–60 lb in.

## *B*

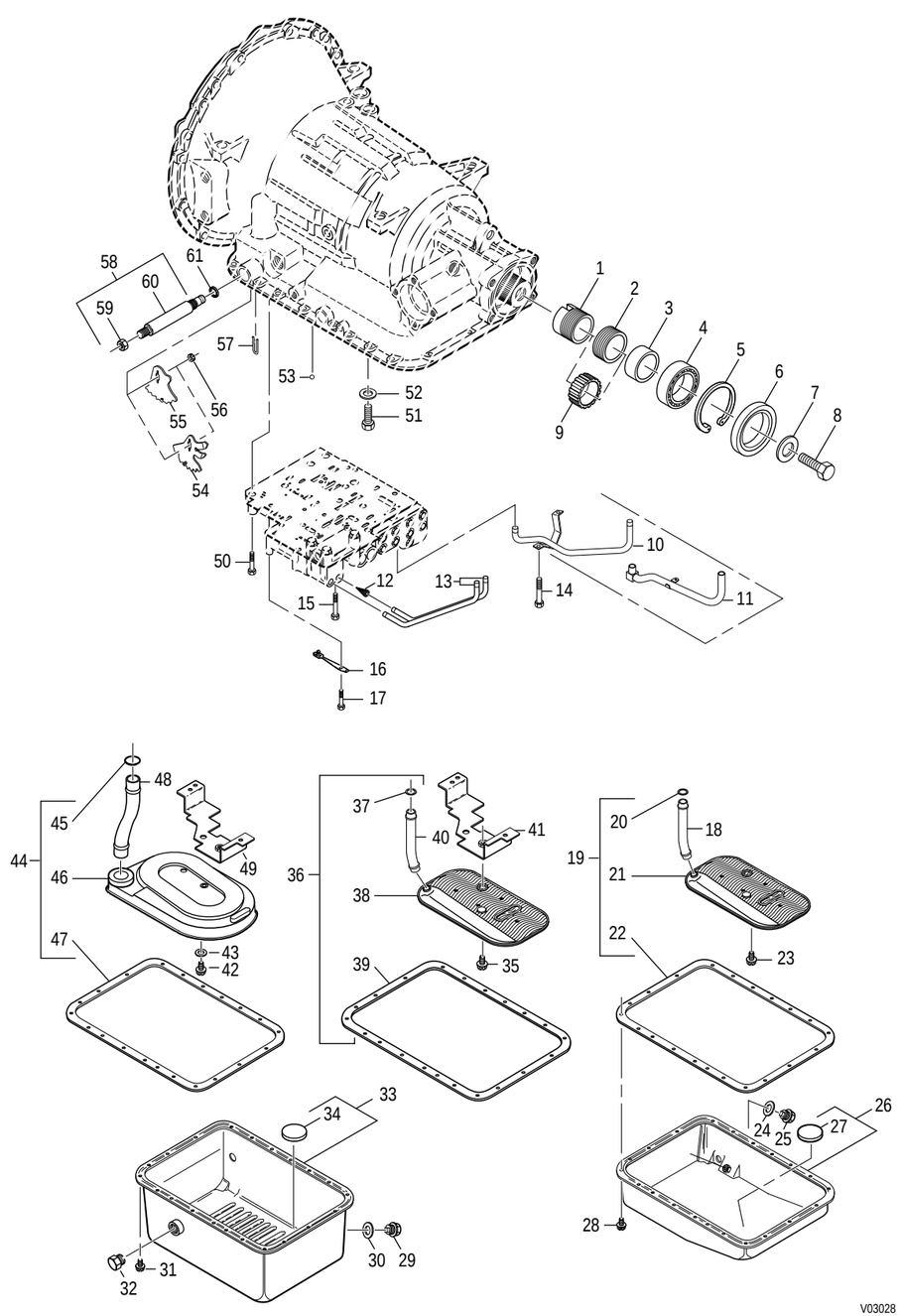
1 – Governor drive gear
2 – Speedometer drive gear
3 – Spacer (selective)
4 – Ball bearing
5 – Snapring
6 – Oil seal
7 – Output flange washer
8 – Bolt, Type BH Place,1/2-20 x 1 1/2 **A**
9 – Speed sensor wheel (for applications using electronic speedometer)
10 – First clutch tube (use with pan 33)
11 – First clutch tube (use with pan 26)
12 – Governor circuit screen
13 – Governor feed tube (2)
14 – Bolt, 1/4-20 x 3 (2) **B**
15 – Bolt, 1/4-20 x 2 3/4 (earlier models) **B**
16 – Detent roller and spring
17 – Bolt, 1/4-20 x 1 3/4 **B**
18 – Intake tube (fitting **C**)
19 – Filter kit
20 – Sealring
21 – Filter assembly
22 – Pan gasket
23 – Washer-head screw, 5/16-18 x 5/8 **D**
24 – Drain plug washer
25 – Drain plug **E**
26 – Shallow oil pan and magnet assembly
27 – Magnet
28 – Washer-head screw, 5/16-18 x 5/8 (21) **D***
29 – Drain plug **E**
30 – Drain plug washer
31 – Washer-head screw, 5/16-18 x 5/8 (21) **D***
32 – Tube plug
33 – Deep oil pan and magnet assembly
34 – Magnet
35 – Washer-head screw, 5/16-18 x 5/8 **D**
36 – Filter kit
37 – Sealring
38 – Filter assembly
39 – Pan gasket
40 – Intake tube (fitting **C**)
41 – Filter spacer
42 – Washer-head screw, 5/16-18 x 5/8 **D** or Bolt, 5/16-18 x 2 1/4 (earlier models) **D**
43 – Plain washer, 5/16 inch (earlier models)
44 – Filter kit
45 – Sealring
46 – Filter assembly
47 – Pan gasket
48 – Intake tube (fitting **C**)
49 – Filter spacer
50 – Bolt, 1/4-20 x 2 1/4 (16) **B** (earlier models use (18) or (17)) **B**
51 – Bolt, center support, 3/8-16 **F**, 7/16-20**G**
52 – Plain washer
53 – Governor pressure check ball (earlier models)
54 – Selector lever detent (models with **P**ark position)
55 – Selector lever detent (models without **P**ark position)
56 – Locknut, 3/8-24 **H**
57 – Selector shaft retainer pin
58 – Selector shaft kit
59 – Selector shaft nut (Refer to **Caution,** Paragraph 3–12**a**) **E**
60 – Selector shaft
61 – Seal

| Torque | lb ft | N·m |
|---|---|---|
| **A** | 102–121 | 138–164 |
| **B** | 8–12 | 10–16 |
| **C** | 90–100 | 122–136 |
| **D** | 10–15 | 14–20 |
| **E** | 15–20 | 20–27 |
| **F** | 39–46 | 53–62 |
| **G** | 67–80 | 91–108 |
| **H** | 15–25 | 20–34 |

* Must maintain a minimum of 5 lb ft (7 N·m) of torque after the pan gasket has taken a set.




**Foldout 12,A. Transmission Housing, Governor, and Vacuum Modulator — Exploded View**



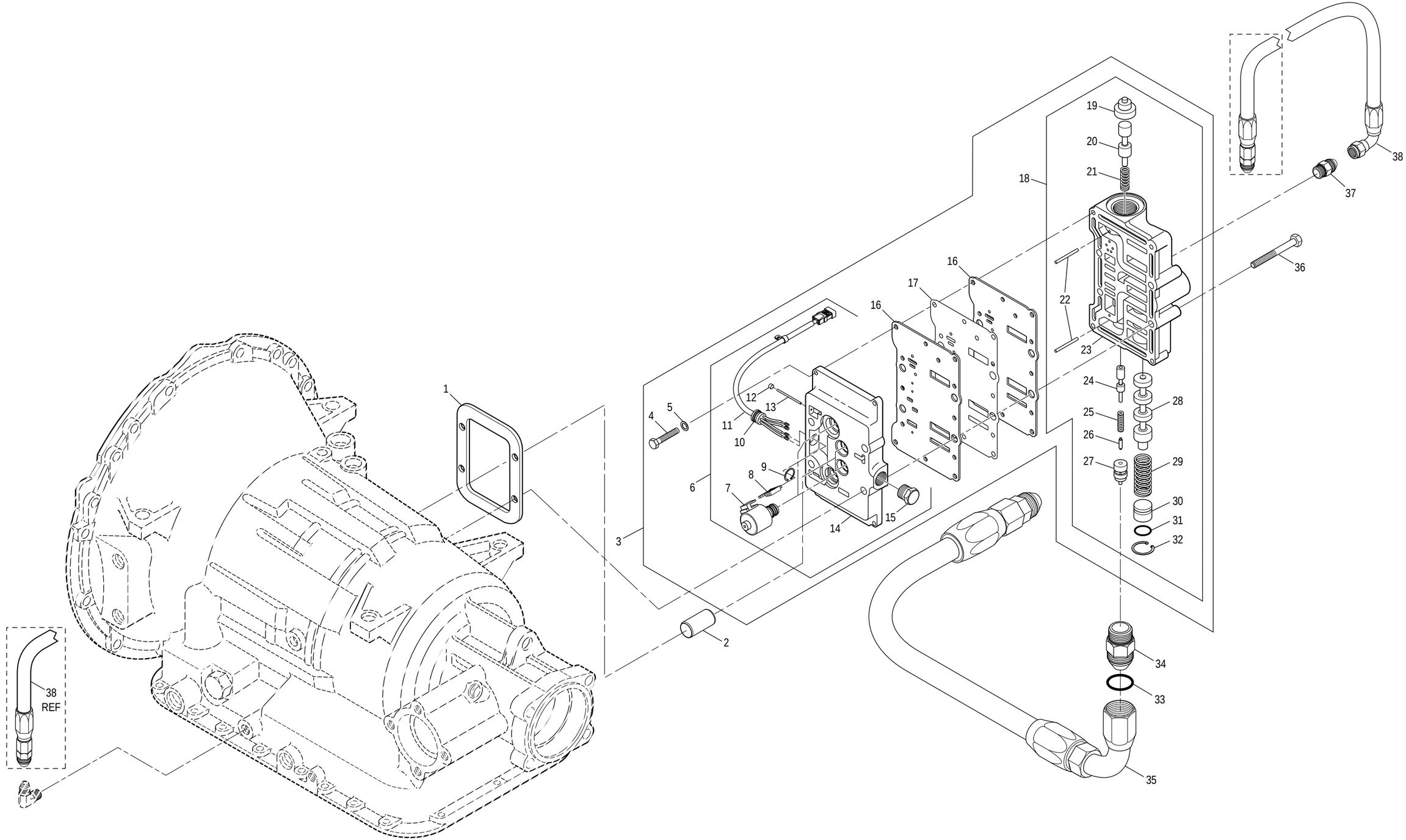

**Foldout 12,B. Oil Pan, Filter, Governor, and Speedometer Drives — Exploded View**

**Legend for Foldout 13**

1 – Gasket
2 – Jumper tube (2)
3 – Complete retarder control assembly
4 – Bolt, ¼-20 x 1¼ inch (4) **A**
5 – Flat washer, ¼ inch (4)
6 – Transfer plate assembly
7 – Solenoid (2)
8 – Solenoid connector (2)
9 – Snapring
10 – Wire feedthrough seal
11 – Retarder wiring harness
12 – Pipe plug, 1⁄16 inch (2) **B**
13 – Retaining pin (2)
14 – Transfer plate
15 – Pipe plug, ½-14 **C**
16 – Gasket (2)
17 – Separator plate
18 – Retarder control valve body assembly
19 – Plug
20 – Retarder priority valve
21 – Spring
22 – Pin (2)
23 – Retarder control valve body
24 – Retarder regulator valve
25 – Spring
26 – Capacity pin
27 – Plug
28 – Retarder autoflow valve
29 – Spring
30 – Plug
31 – O-ring
32 – Snapring
33 – O-ring
34 – To-cooler adapter
35 – To-cooler hose assembly
36 – Bolt, ⅜-16 x 4¼ inch (4) **D**
37 – Main feed adapter
38 – Main feed hose assembly

| Torque | lb ft | N·m |
|---|---|---|
| **A** | 8–12 | 10–16 |
| **B** | * | 4–5 |
| **C** | 16–20 | 22–27 |
| **D** | 26–32 | 36–43 |

* 35–50 lb in.




V03027

**Foldout 13. Retarder Control Components**