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SECTION 5A

AUTOMATIC TRANSMISSION

TABLE OF CONTENTS

Specifications 5A-2
Model Part Numbers and Applications 5A-2
Model Specifications 5A-2
Clutch Pack Details 5A-3
Special Tools 5A-4
Special Tools Table 5A-4
Schematic and Routing Diagrams 5A-5
TCU Circuit (Diesel) 5A-5
TCU Circuit (Gasoline) 5A-6
Shift Pattern Diagram 5A-7
661LA Normal Mode 5A-7
661LA Power Mode 5A-8
662LA Normal Mode 5A-9
662LA Power Mode 5A-10
662LA Low Mode 5A-11
E32 Power Mode 5A-12
E32 Normal Mode 5A-13
E32 Low Mode 5A-14
E23 Power Mode 5A-15
E23 Normal Mode 5A-16
E23 Low Mode 5A-17
Introduction 5A-18
Operator Interfaces 5A-20
Gear Select Lever Operation 5A-20
Driving Mode Selector 5A-21
Control Systems 5A-22
General 5A-22
Electronic Control System 5A-22
Hydraulic Control System 5A-31
Power Train System 5A-42
Torque Converter 5A-43
Clutch Packs 5A-44
Bands 5A-45
One Way Clutches 5A-45
Planetary Gear Set 5A-45
Parking Mechanism 5A-46
Power Flows 5A-47
Introduction 5A-47
Power Flow - Park and Neutral 5A-48
Power Flow - Reverse 5A-49
Power Flow - Manual 1 . . . . . 5A-50
Power Flow - Drive 1 . . . . . 5A-51
Power Flow - Drive 2 and Manual 2 . . . . . 5A-52
Power Flow - Drive 3 and Manual 3 . . . . . 5A-54
Power Flow - Drive 3 Lock Up and Manual 3 Lock Up 5A-56
Power Flow - Drive 4 (Overdrive) 5A-57
Power Flow - Drive 4 Lock Up 5A-59
Diagnosis 5A-60
Diagnostic System 5A-60
Mechanical Tests 5A-69
Self Diagnosis Test 5A-75
Adjustments 5A-79
Hydraulic System 5A-79
Transmission Fluid Test Procedure 5A-79
Electronic Adjustments 5A-80
Maintenance and Repair 5A-82
On-Vehicle Service 5A-82
Removal and Installation of Transmission . . . 5A-82
Unit Repair 5A-85
Rebuild Warnings 5A-85
Disassembly Procedure 5A-85
Assembly Procedure 5A-94
Front and Rear Band Adjustment 5A-128

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SPECIFICATIONS

MODEL PART NUMBERS AND APPLICATIONS

DWMC P/NO	Transmission	Engine Version	Torque Converter
36100-05420 (1)	0574-000001 (9)	661LA	179K
36100-05430 (1)	0574-000002 (8)	E32	160K
36100-05410 (1)	0574-000004 (10)	662LA(Turbo)	160K
36100-05440 (1)	0574-000005 (7)	E23	179K

MODEL SPECIFICATIONS

Application	Descriprtion
Torque Converter	
Mean diameter of fluid circuit	260
Maximum torque multiplication	2.0 : 1
Stall speed (rpm)	
0574-000001 (D23LA)	2100 - 2250
0574-000002 (E32)	2050 - 2250
0574-000004 (D29LA)	2100 - 2200
0574-000005 (E23)	1800 - 2100
0574-000020	
0574-000021	
Gear Ratios	
First	2.741 : 1
Second	1.508 : 1
Third	1.000 : 1
Fourth	0.708 : 1
Reverse	2.429 : 1
Lubricant	
Type	Castrol TQ95 or other approved fluid
Capacity	
Dry System	9.0 Litres (approx)
Service Refill	4.5 Litres (approx)
Gear Train End Float	0.50 - 0.65 mm
Gear Set Pinion End Float	0.10 - 0.50 mm

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CLUTCH PACK DETAILS

	0574-000001, 0574-000004, 0574-000005	0574-000002
C1		
Composition	4	5
Steel	6(2)	5(2)
C2		
Composition	4	5
Steel	5(2)	4(2)
C3		
Composition	3	4
Steel	5(2)	4(2)
C4		
Composition	3	3
Steel	4(1)	4(1)

Note : Numbers in brackets indicate number of selective thickness steel plates required to achieve specifed clutch pack clearance

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SPECIAL TOOLS

SPECIAL TOOLS TABLE

Part Number	Description
0555 - 332083	Solenoid / Thermistor, Electronic Tester
0555 - 336046	Solenoid, Bench Tester
0555 - 336256	Transmission Bench Cradle
0555 - 336257	Pump Puller
0555 - 336258	Pin Remover / Installer Tool (Cross Shaft / Detent Lever)
0555 - 336259	Clutch Spring Compressor
0555 - 336260	Clutch Pack Clearance Kit
0555 - 336261	Seal Removal Tool (Cross - Shaft)
0555 - 336262	Oil Seal Dolly (Cross - Shaft)
0555 - 336263	Assembly Bullet
0555 - 336264	Seal Compressor
0555 - 336265	Pin Press
0555 - 336266	Seal Dolly
0555 - 336267	Alignment Tool
0555 - 336268	Pump Seal Dolly
0555 - 336269	End Float Adaptor
0555 - 336270	End Float Shaft
0555 - 332895	Locknut Crimping Tool (W-Car Only)

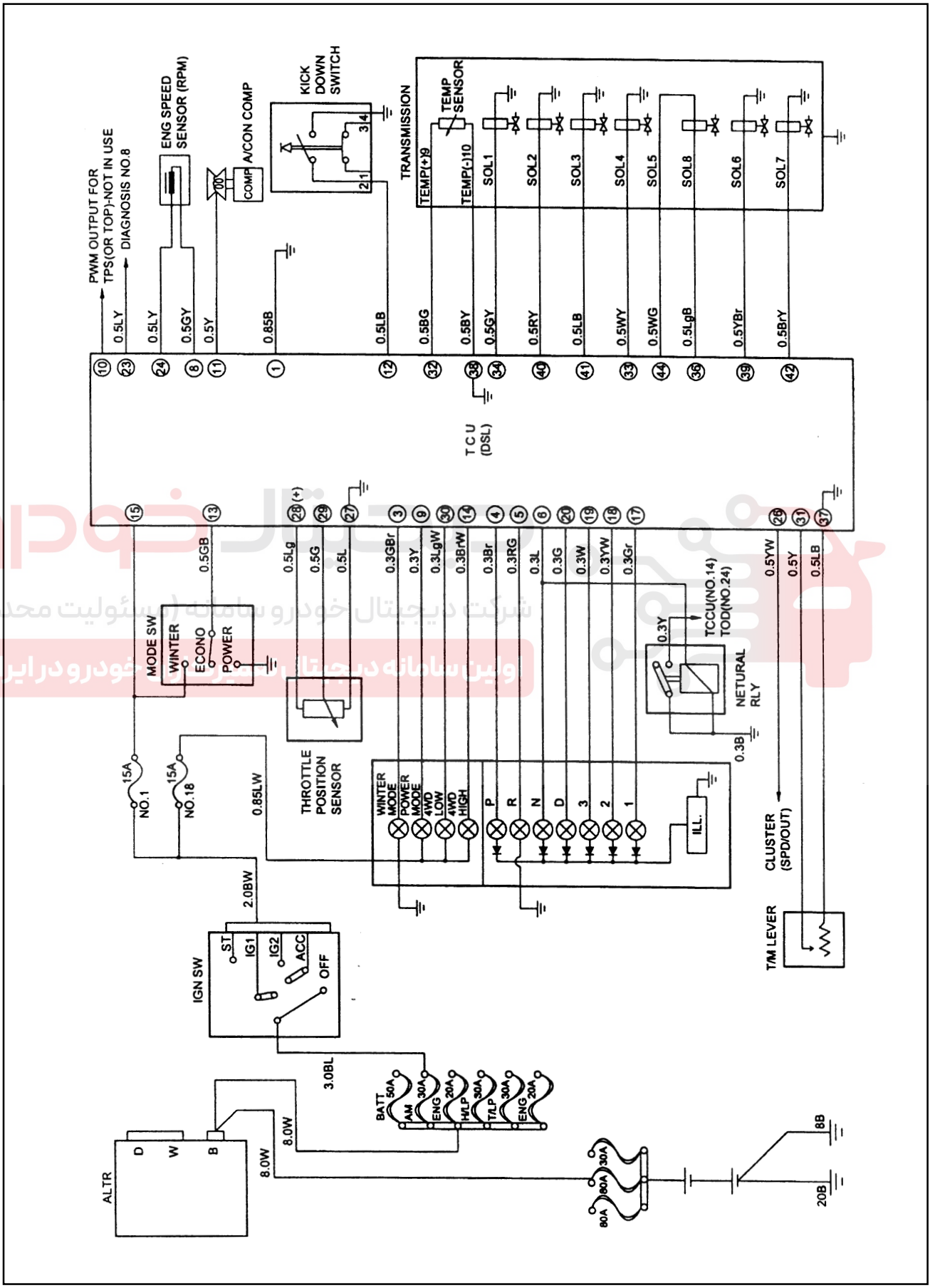
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SCHEMATIC AND ROUTING DIAGRAMS

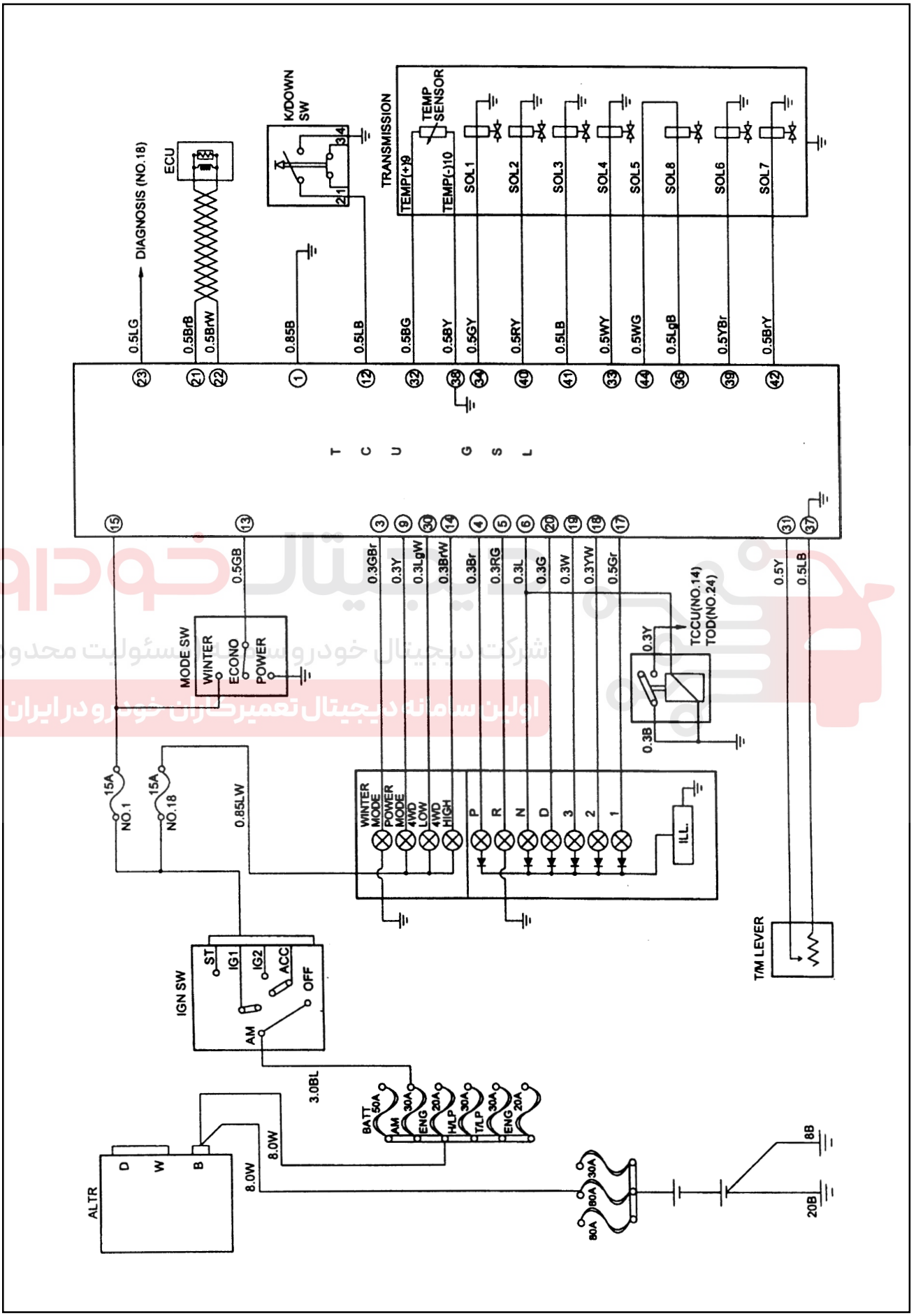
TCU CIRCUIT (4WD-DIESEL)



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TCU CIRCUIT (4WD-GASOLINE)

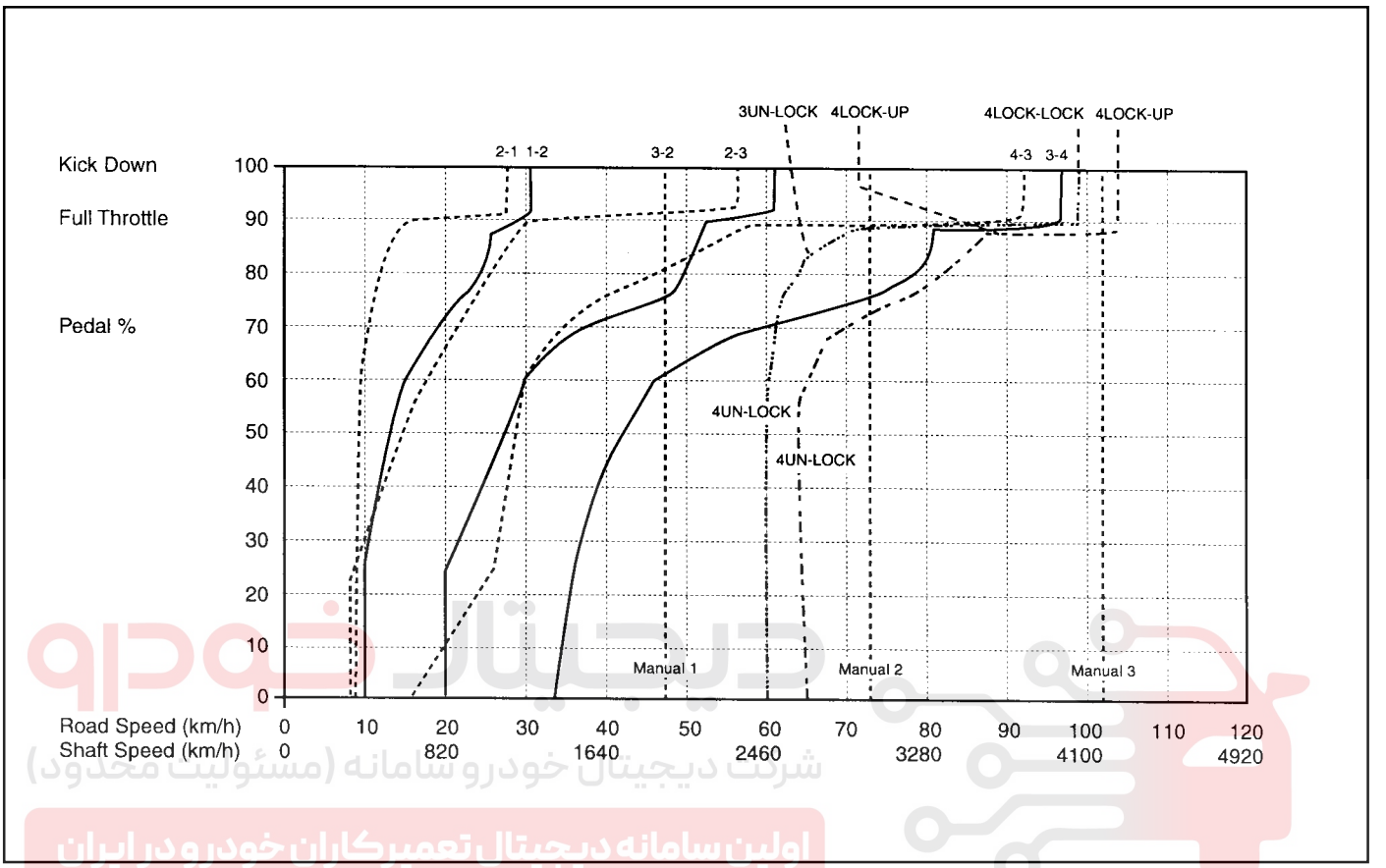


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SHIFT PATTERN DIAGRAM

661LA NORMAL MODE

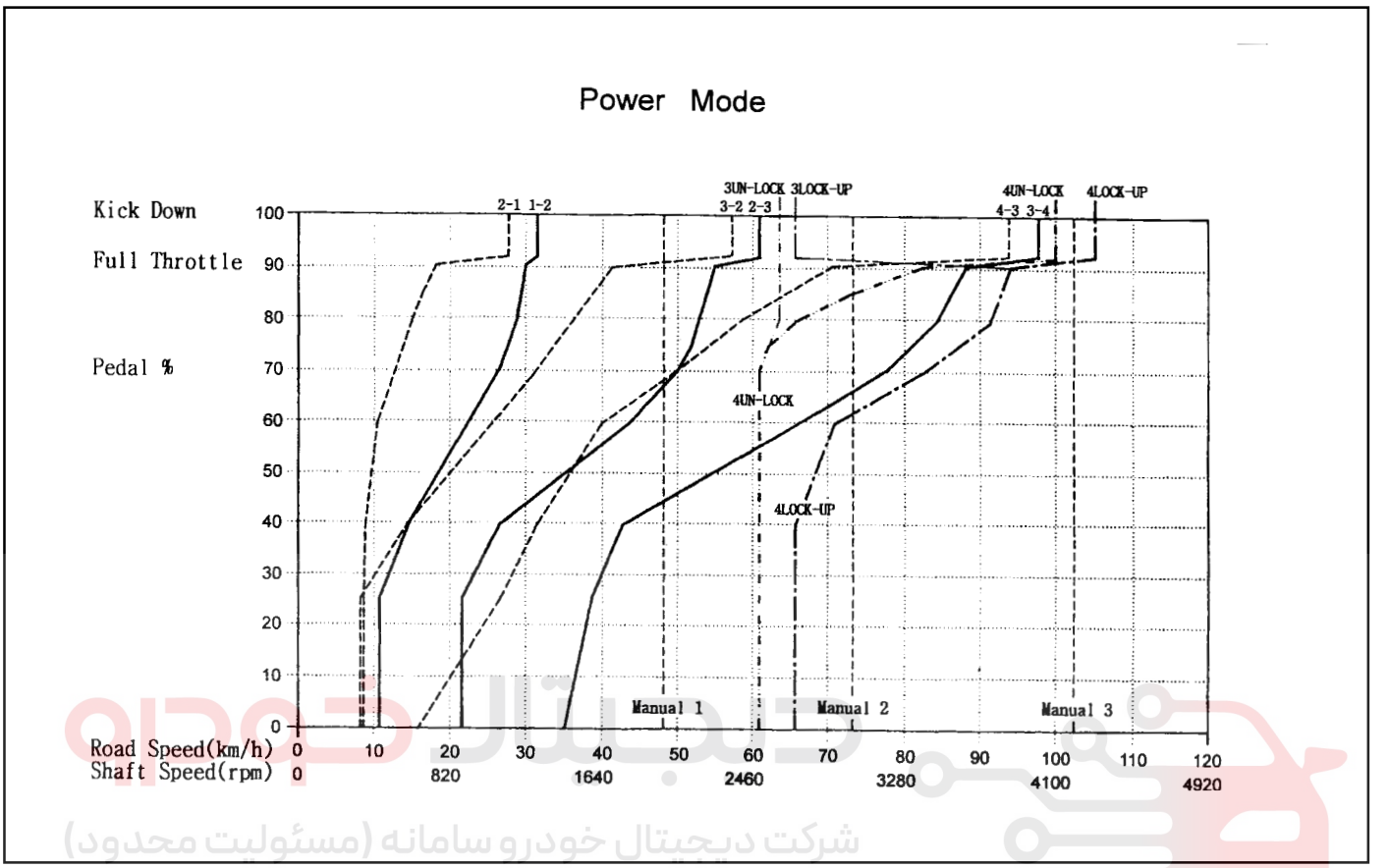


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661LA POWER MODE

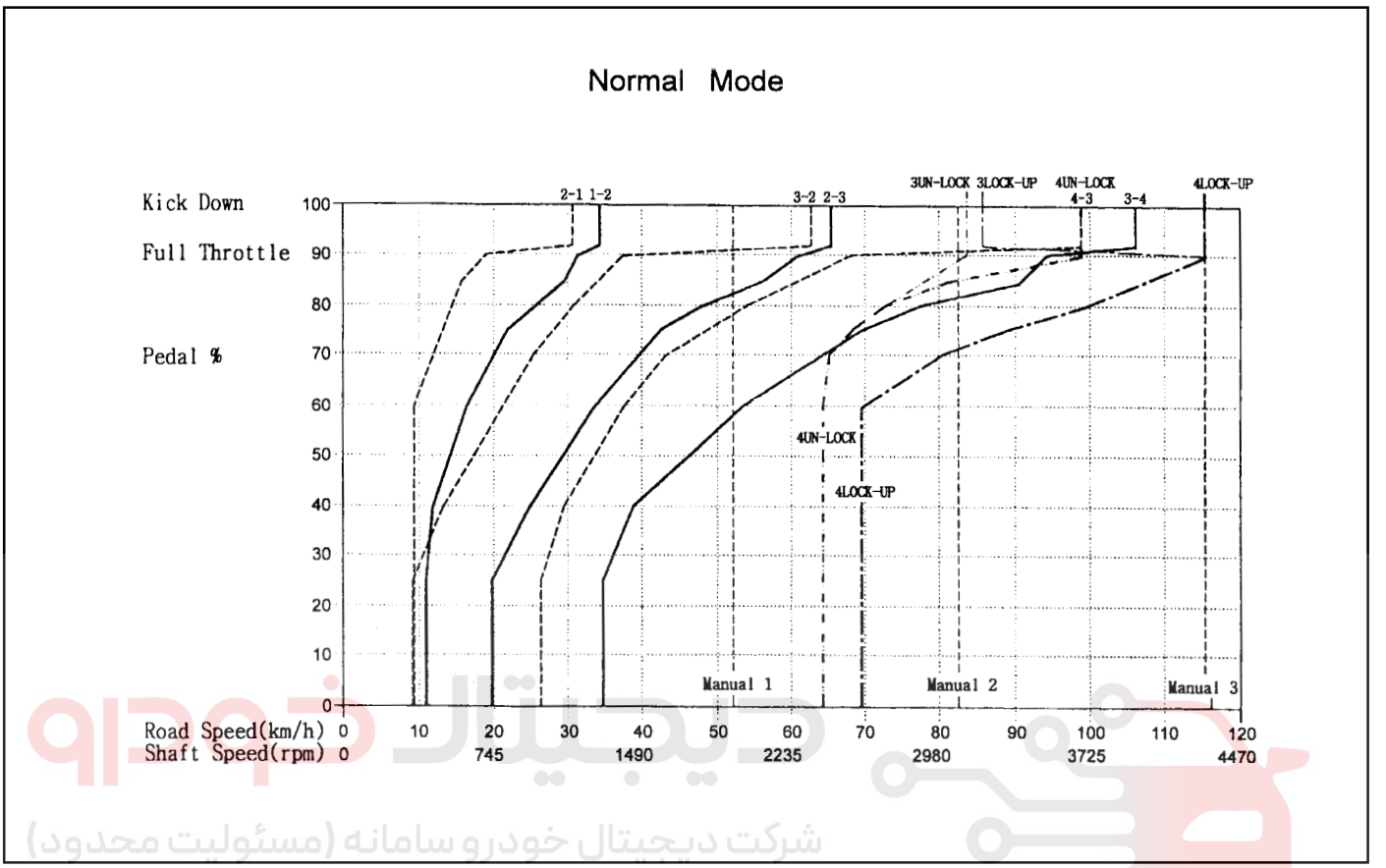


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662LA NORMAL MODE

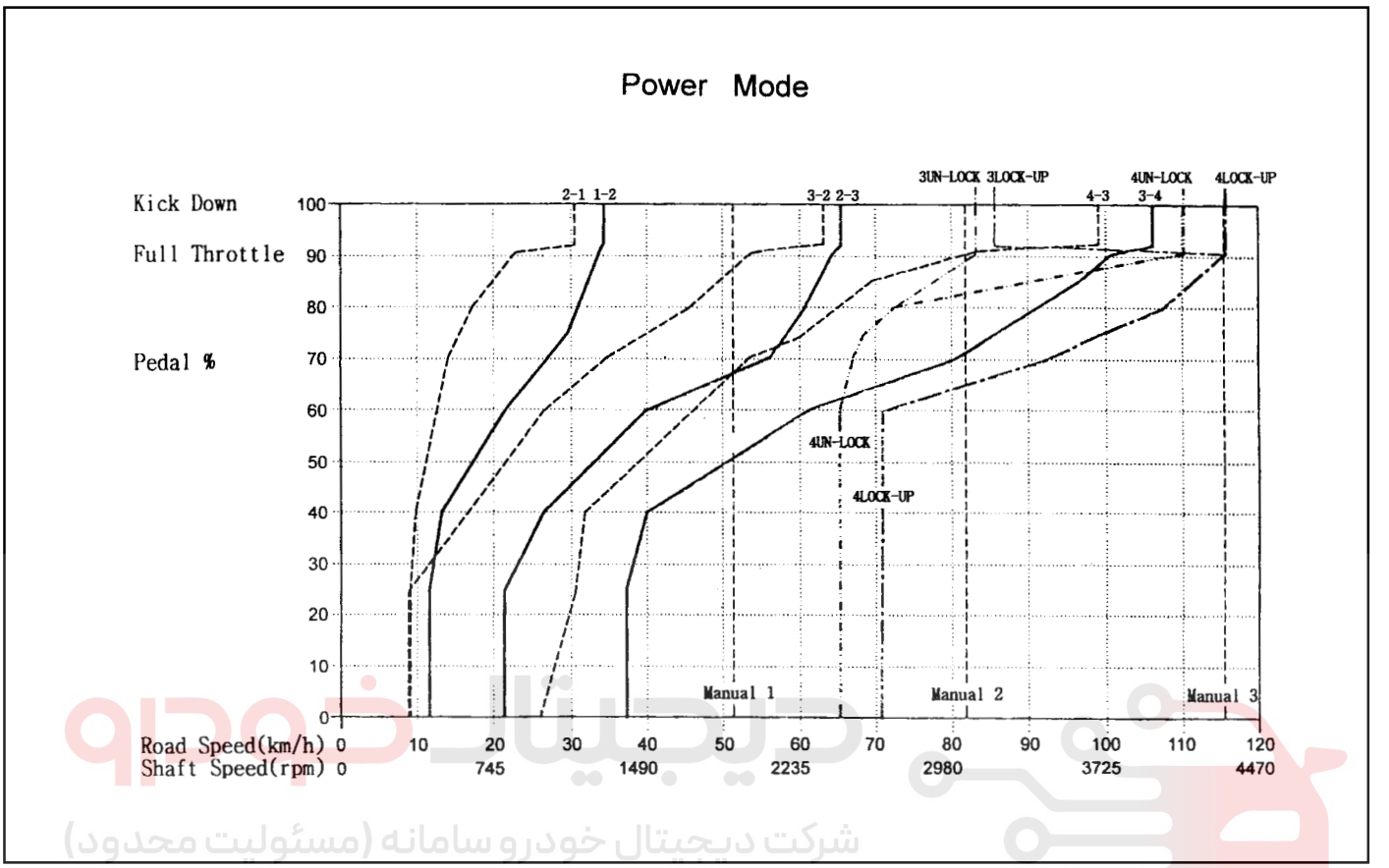


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662LA POWER MODE

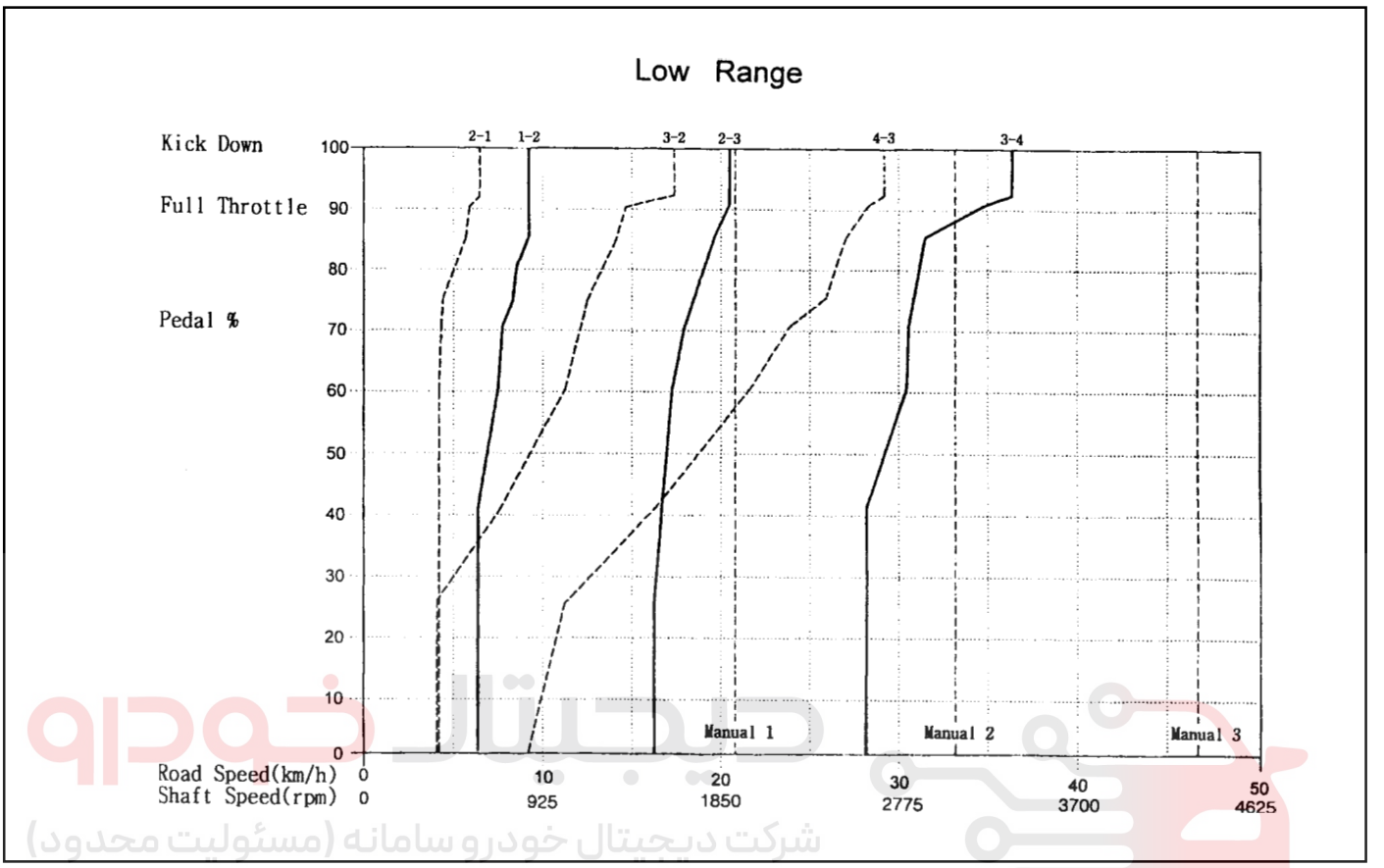


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662LA LOW MODE

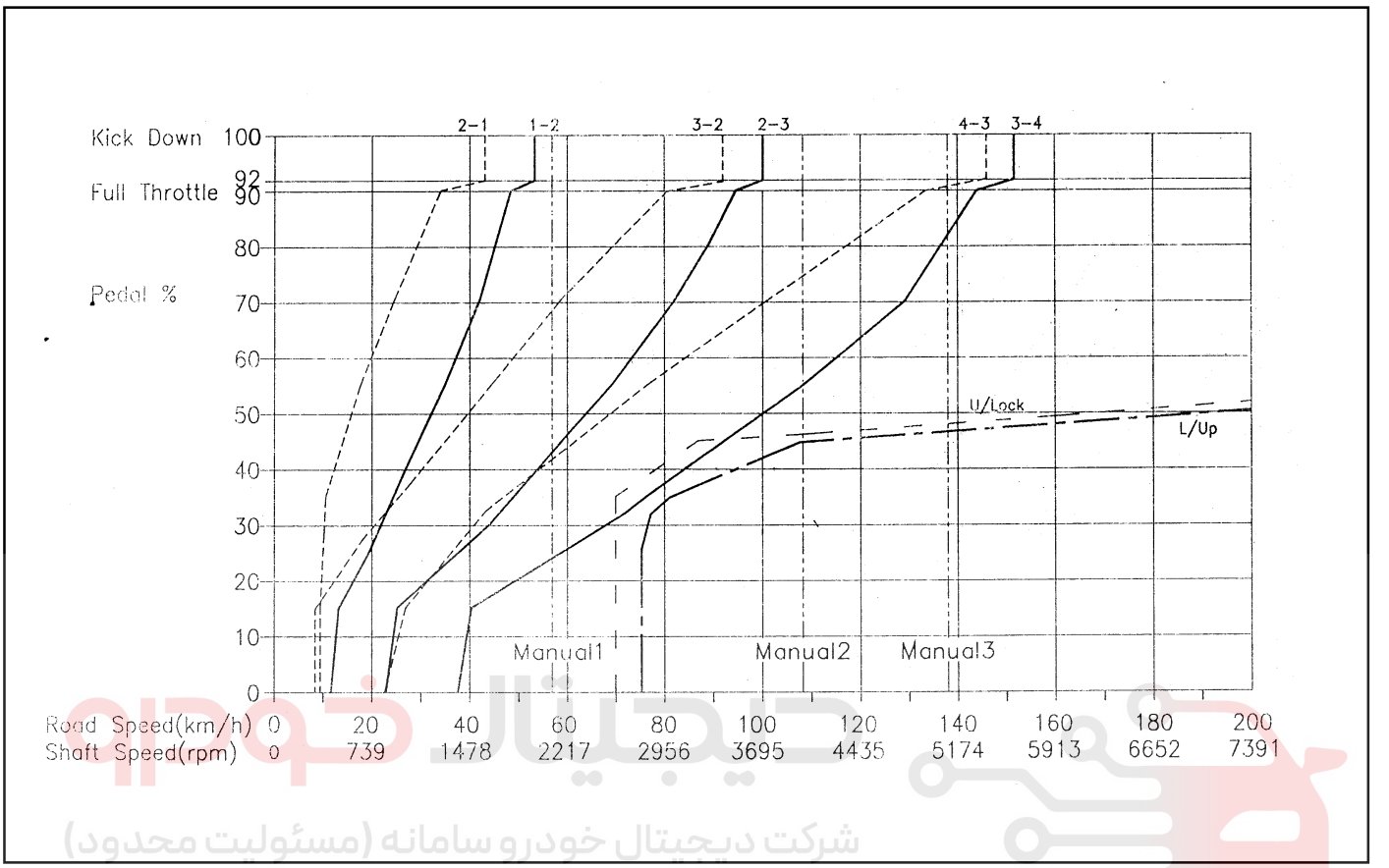


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E32 POWER MODE

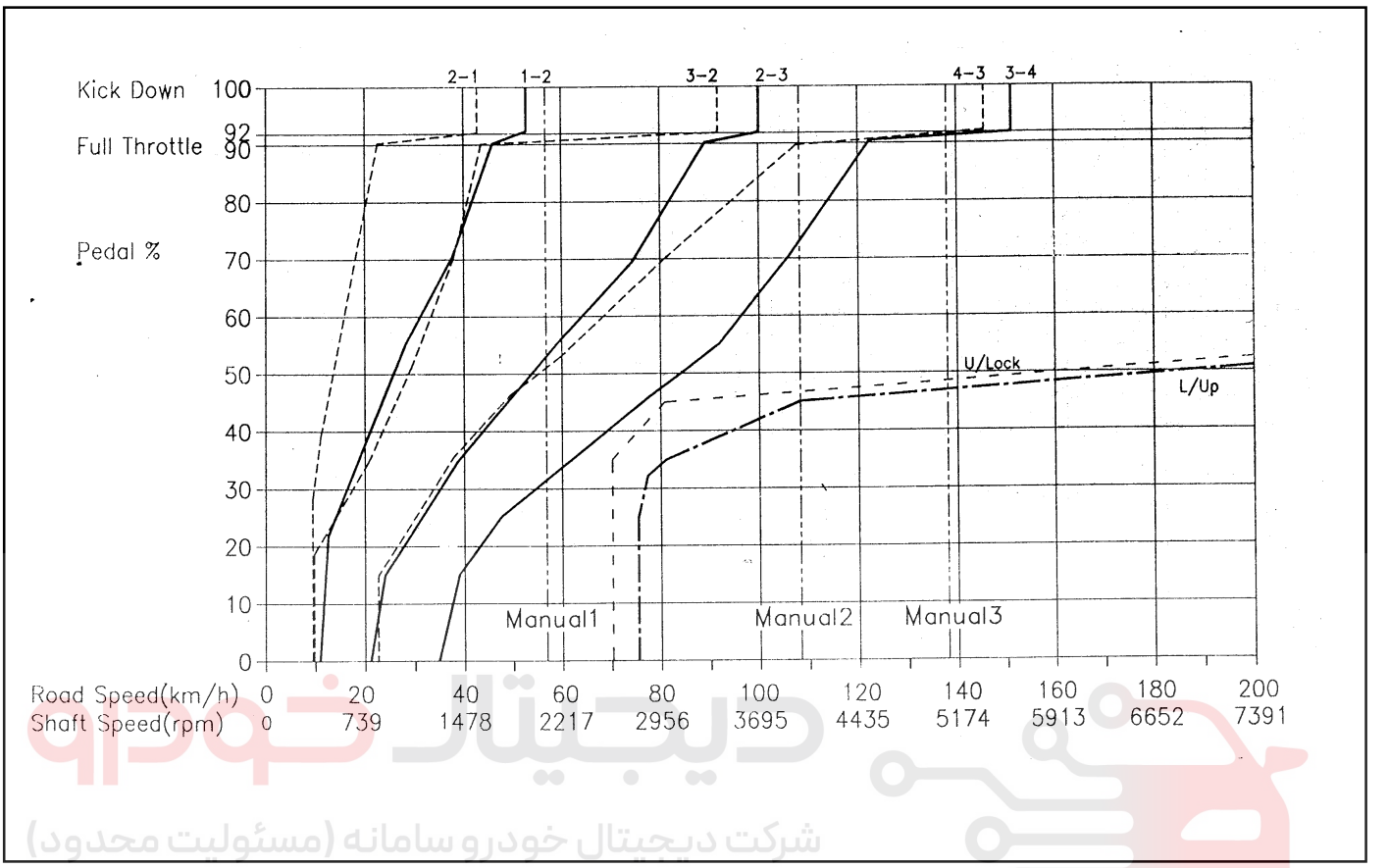


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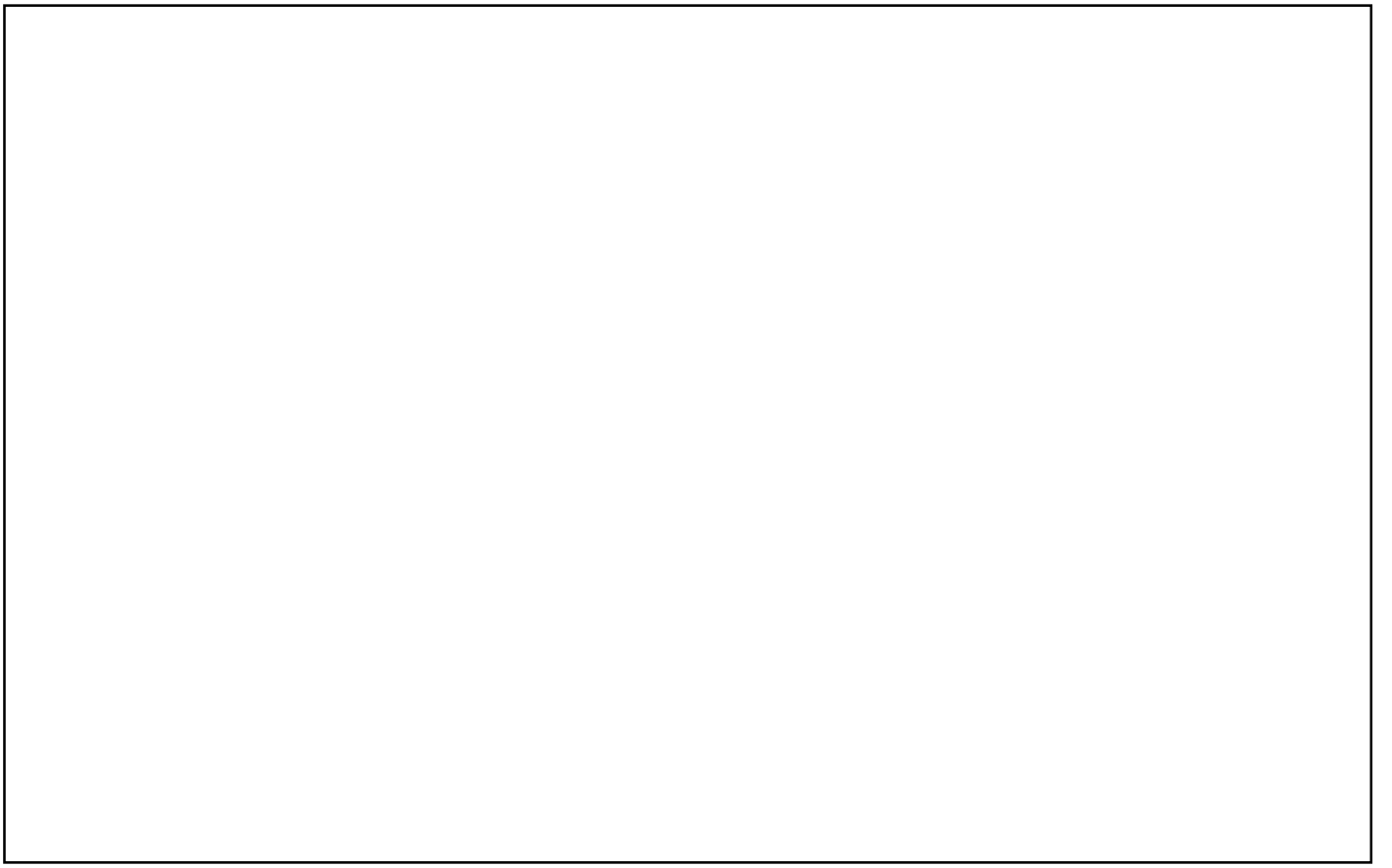
E32 NORMAL MODE



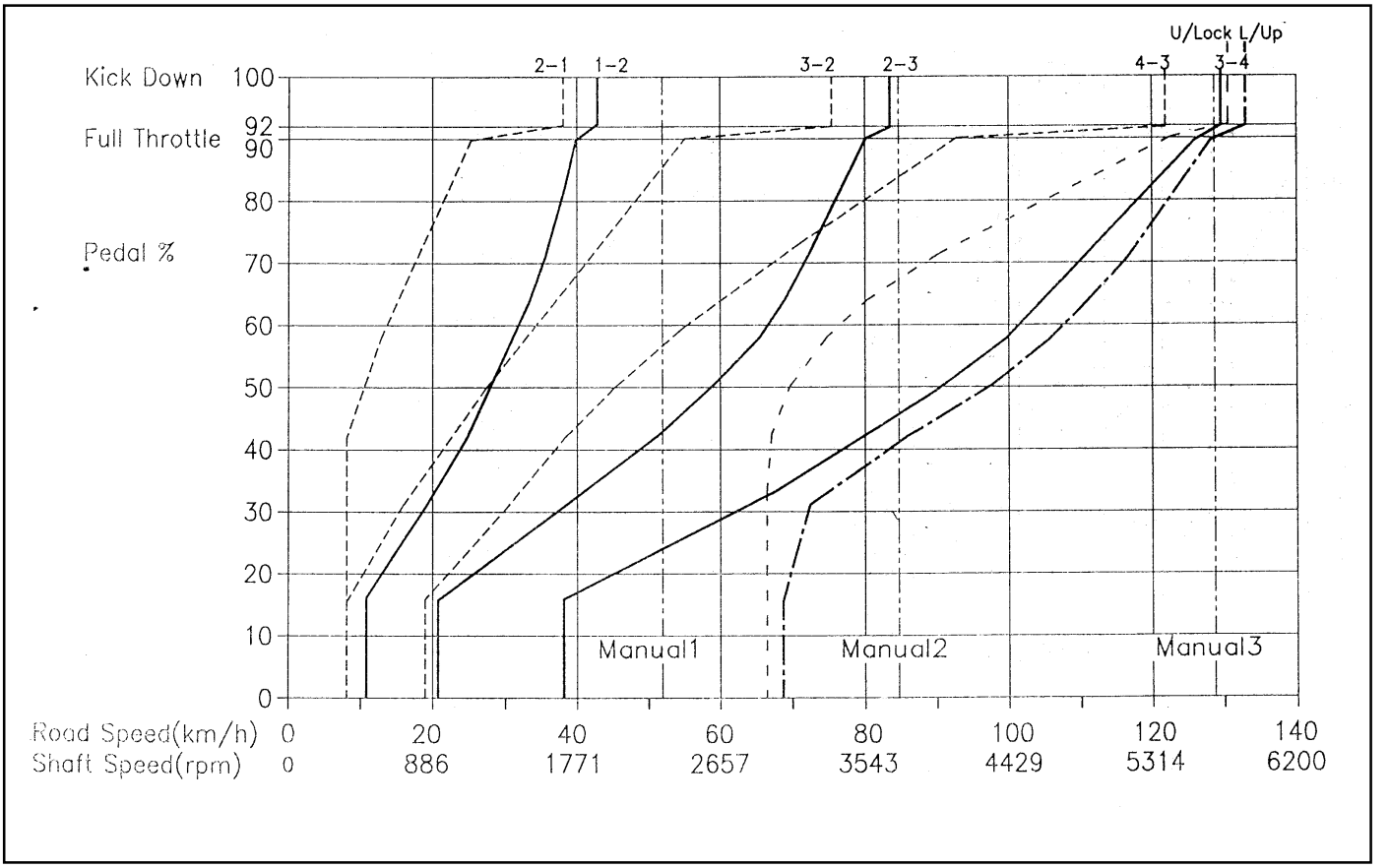
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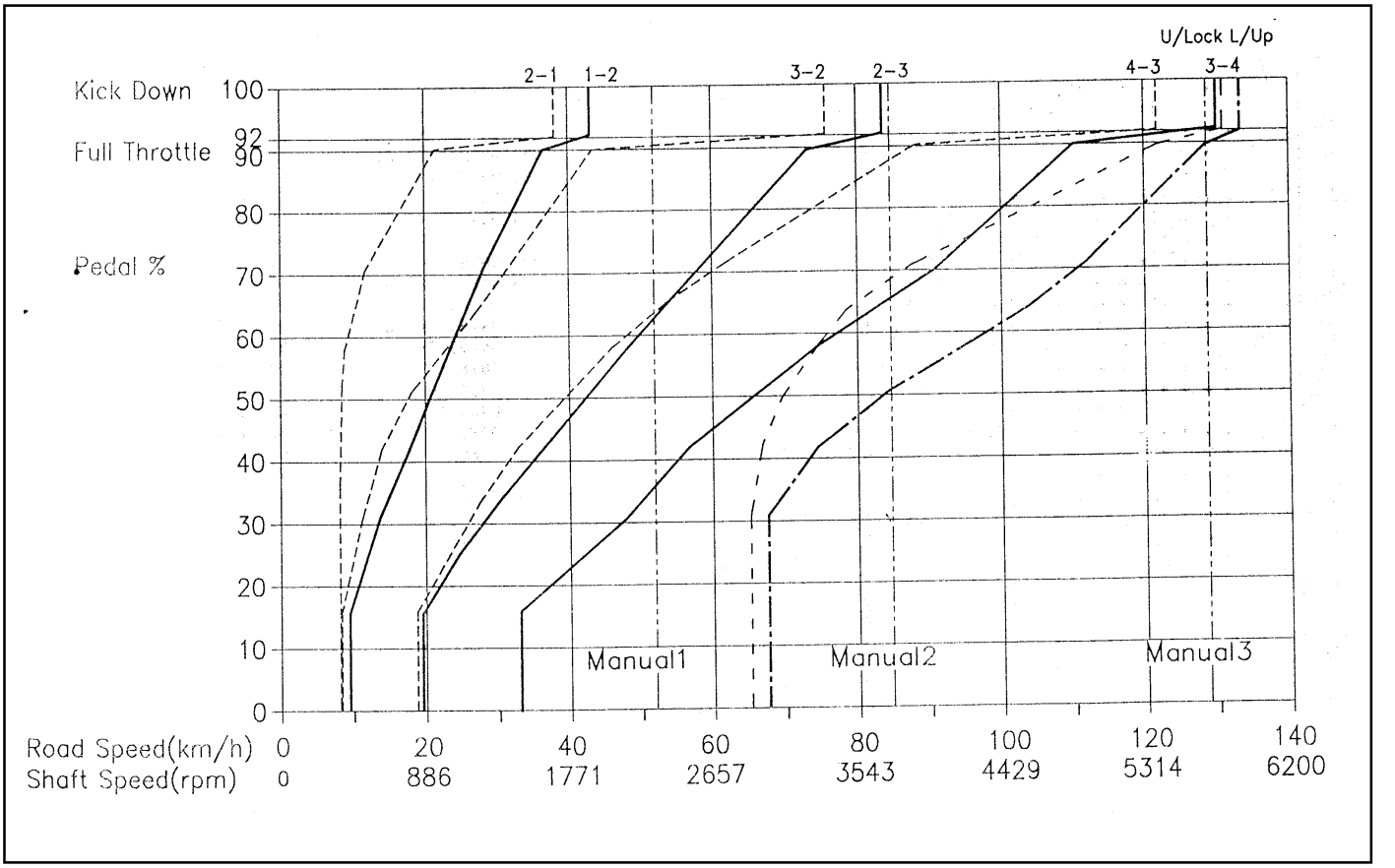
E32 LOW MODE



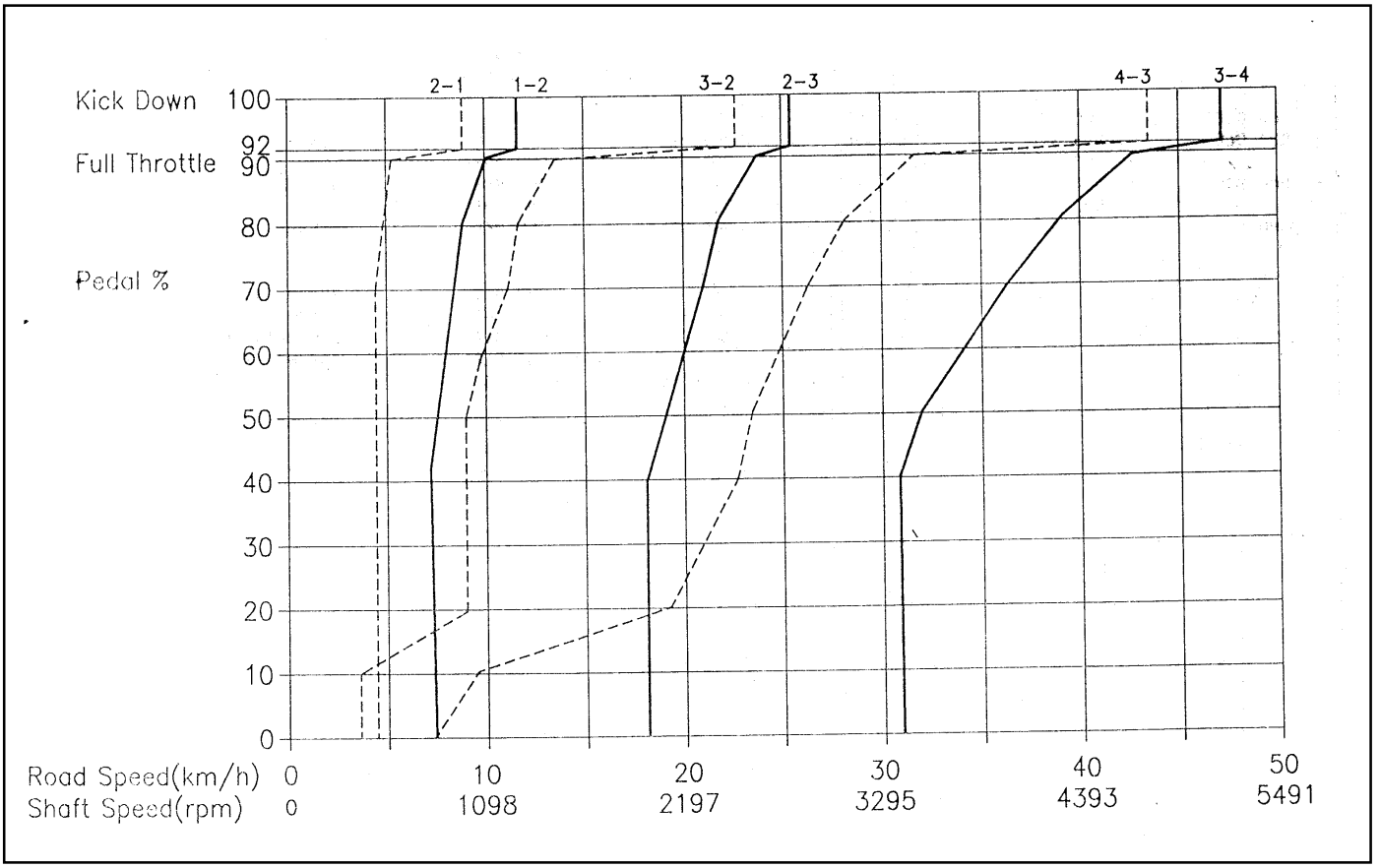
E23 POWER MODE



E23 NORMAL MODE



E23 LOW MODE


2-1
1-2
3-2
2-3
4-3
3-4
Kick Down
Full Throttle
Pedal %
100
92
90
80
70
60
50
40
30
20
10
0
Road Speed(km/h) 0 10 20 30 40 50
Shaft Speed(rpm) 0 1098 2197 3295 4393 5491

INTRODUCTION

The BTR Automotive Model 74 Four Speed Automatic Transmission is an electronically controlled overdrive four speed unit with a lock-up torque converter. The lock-up torque converter results in lower engine speeds at cruise and eliminates unnecessary slippage. These features benefit the customer through improved fuel economy and noise reduction. Refer to table 1.1 for details of power, torque and configuration.

Of primary significance is the transmission control unit (TCU) which is a microprocessor based control system. The TCU utilizes throttle position, rate of throttle opening, engine speed, transmission output speed, transmission sump temperature, gear selector position and mode selector inputs, and in some applications a 'kickdown' switch to control all shift feel and shift schedule aspects.

The TCU drives a single proportional solenoid multiplexed to three regulator valves to control all shift feel aspects. The output pressure of this solenoid is controlled as a function of transmission sump temperature to maintain consistent shift feel throughout the operating range.

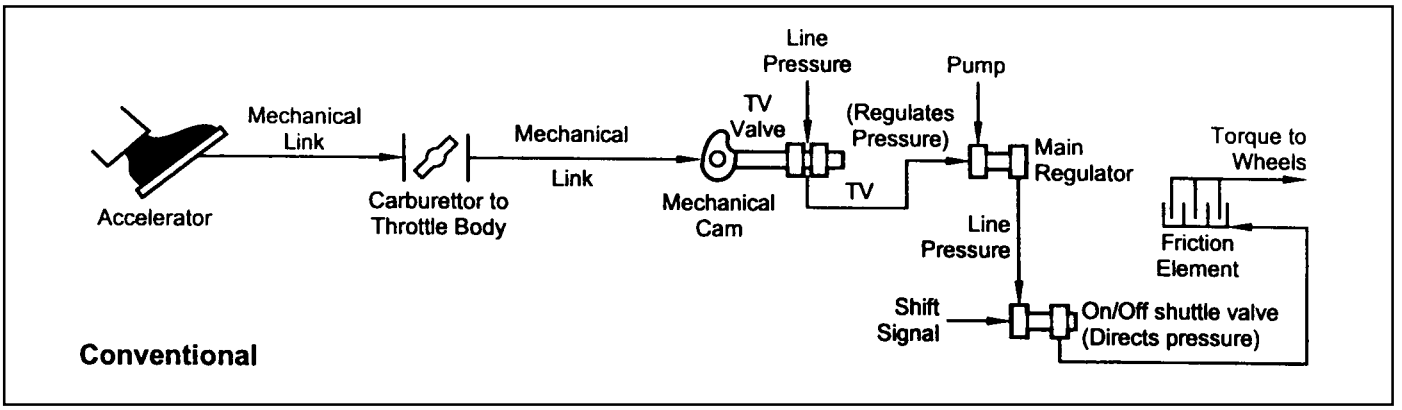
Shift scheduling is highly flexible, and several independent schedules are programmed depending on the vehicle. Typically the 'NORMAL' schedule is used to maximise fuel economy and driveability, and a 'POWER' schedule is used to maximise performance. 'WINTER' schedule is used to facilitate starting at second gear.

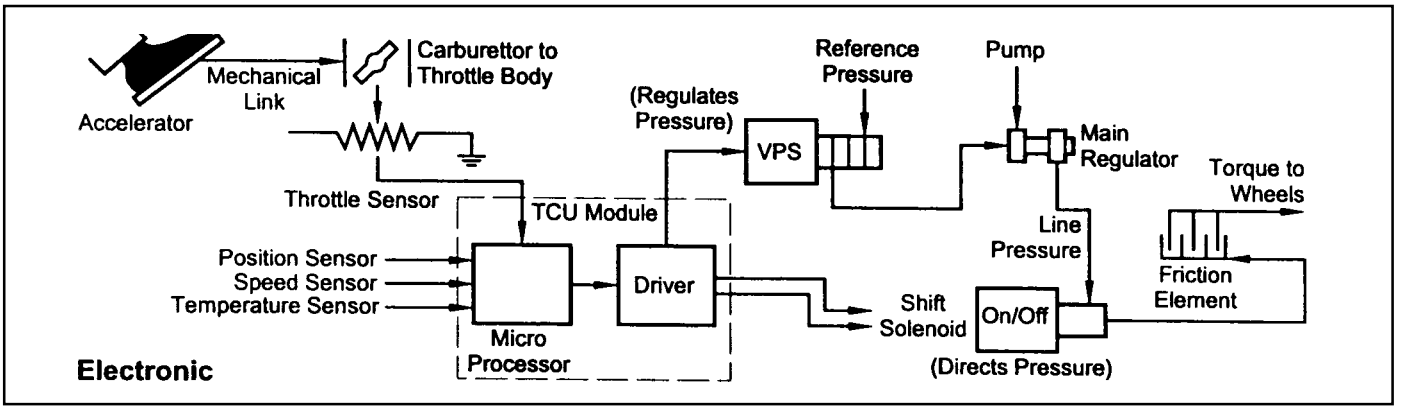
Figure 1.1 details the differences between conventional and electronic transmission control systems.

Table 1.1 - M74 Torque, Power and Configuration

Model	Max Torque (Nm)	Min Torque (Nm)	Configuration
M74 4WD Transmission	320	160	260 mm Torque Converter Wide Ratio Gear Set Splined Output for Transfer Case

Figure 1.1 - Conventional VS Electronic Transmission Control System





OPERATOR INTERFACES

There are three operator interfaces associated with the four speed transmission.

They are:

- The gear select lever
- The driving mode selector
- The indicator light

These operator interfaces are described below.

GEAR SELECT LEVER OPERATION

The transmission uses a conventional selector lever. The selector lever can be moved from one position to another within the staggered configuration of the selector lever gate to positively indicate the gear -selection as shown on figure 2.1. For information about the gear selections available refer to table 2.1.

Figure 2.1 - Typical Gear Selector and Mode Switch

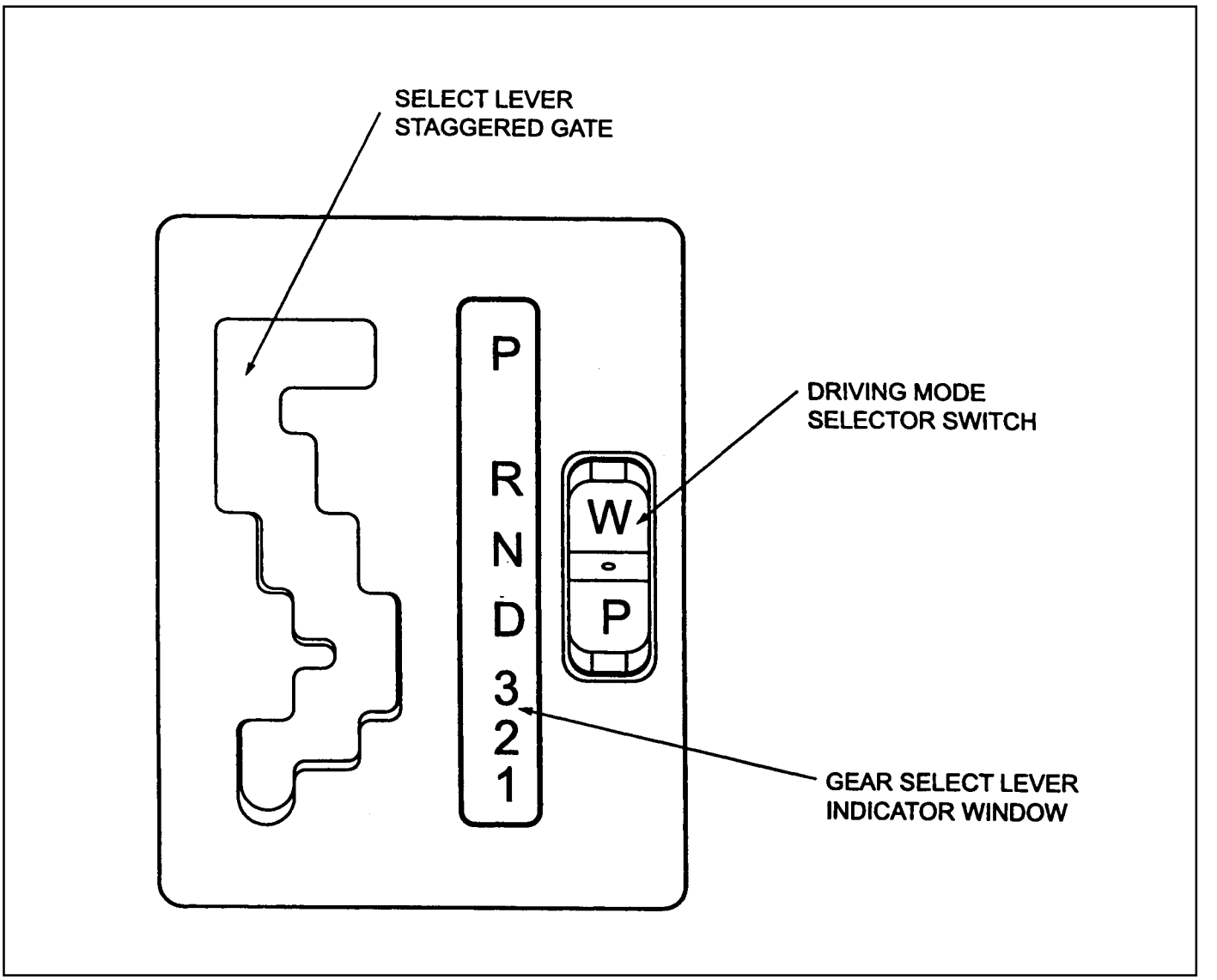


Table 2.1 - Gear Selections

Downshift Type	Inhibited Above
RANGE '1' (MANUAL '1'):	First gear operation only with inhibited engagement as a function of vehicle speed. Engine braking is applied with reduced throttle.
RANGE '2' (MANUAL '2'):	First and second gear operation with inhibited engagement of second gear, as a function of vehicle speed. Engine braking is applied with reduced throttle.
RANGE '3' (MANUAL '3'):	First, second and third gear operation with an inhibited third gear engagement at high vehicle speed. Refer to the vehicle owner's manual.
RANGE 'D' (DRIVE):	Engine braking is applied with reduced throttle. First, second, third and fourth gear operation. First to second (1-2), first to third (1-3), second to third (2-3), second to fourth (2-4), third to fourth (3-4), fourth to third (4-3), fourth to second (4-2), third to second (3-2), third to first (3-1) and second to first (2-1), shifts are all available as a function of vehicle speed, throttle position and the time rate of change of the throttle position (forced downshift). Lockup clutch may be enabled in 3rd and 4th gears depending on vehicle type. Refer to the owner's manual.
RANGE 'N' (NEUTRAL):	Rear band applied only, with inhibited engagement as a function of vehicle speed, engine speed and throttle position. The inhibitor switch allows the engine to start.
RANGE 'R' (REVERSE):	Reverse gear operation, with inhibitor engagement as a function of vehicle speed, engine speed and throttle position. The inhibitor switch enables reverse lamp operation.
RANGE 'P' (PARK):	Rear band applied only, with inhibited engagement as a function of vehicle speed, engine speed and throttle position. The transmission output shaft is locked. The inhibitor switch allows the engine to start.

DRIVING MODE SELECTOR

The driving mode selector consists of a mode selection switch and indicator light. The driving mode selector is located on the centre console. See figure 2,1.

The schedules available to be selected vary with vehicle types. Typically the driver should have the option to select between 'NORMAL' , 'POWER' or 'WINTER' modes.

When 'NORMAL' mode is selected upshifts will occur to maximise fuel economy and the indicator lights remain extinguished. When 'POWER' mode is selected upshifts will occur to give maximum performance and the 'POWER' mode indicator light is switched on. When 'WINTER' mode is selected, starting at second gear is facilitated, the 'WINTER' mode indicator light is switched on and the 'POWER' mode indicator light is switched off.

Refer to the vehicle owner's manual for specific modes for each vehicle type.

CONTROL SYSTEMS

GENERAL

There are two control systems associated with the transmission. The electronic control system monitors vehicle parameters and adjusts the transmission performance. The hydraulic control system implements the electronic control system commands.

ELECTRONIC CONTROL SYSTEM

The electronic control system is comprised of sensors, a TCU and seven solenoids. The TCU reads the inputs, and under software control activates the outputs according to values stored in read only memory (ROM).

The TCU controls the hydraulic control system. This control is via the hydraulic valve body, which contains seven electro-magnetic solenoids. Six of the seven solenoids are used to control the line pressure, operate the shift valves and the torque converter lock-up clutch, and to turn on and off the two regulator valves (The two regulator valves control the shift feel.).

The seventh solenoid is the proportional or variable pressure solenoid (VPS) which works with the two regulator valves to control shift feel.

Figure 3.1 details a typical TCU control system schematic.

The individual component locations, operation and specifications which make up the electronic control subsystem are covered in this section.

Figure 3.1 - Typical TCU Control System Schematic

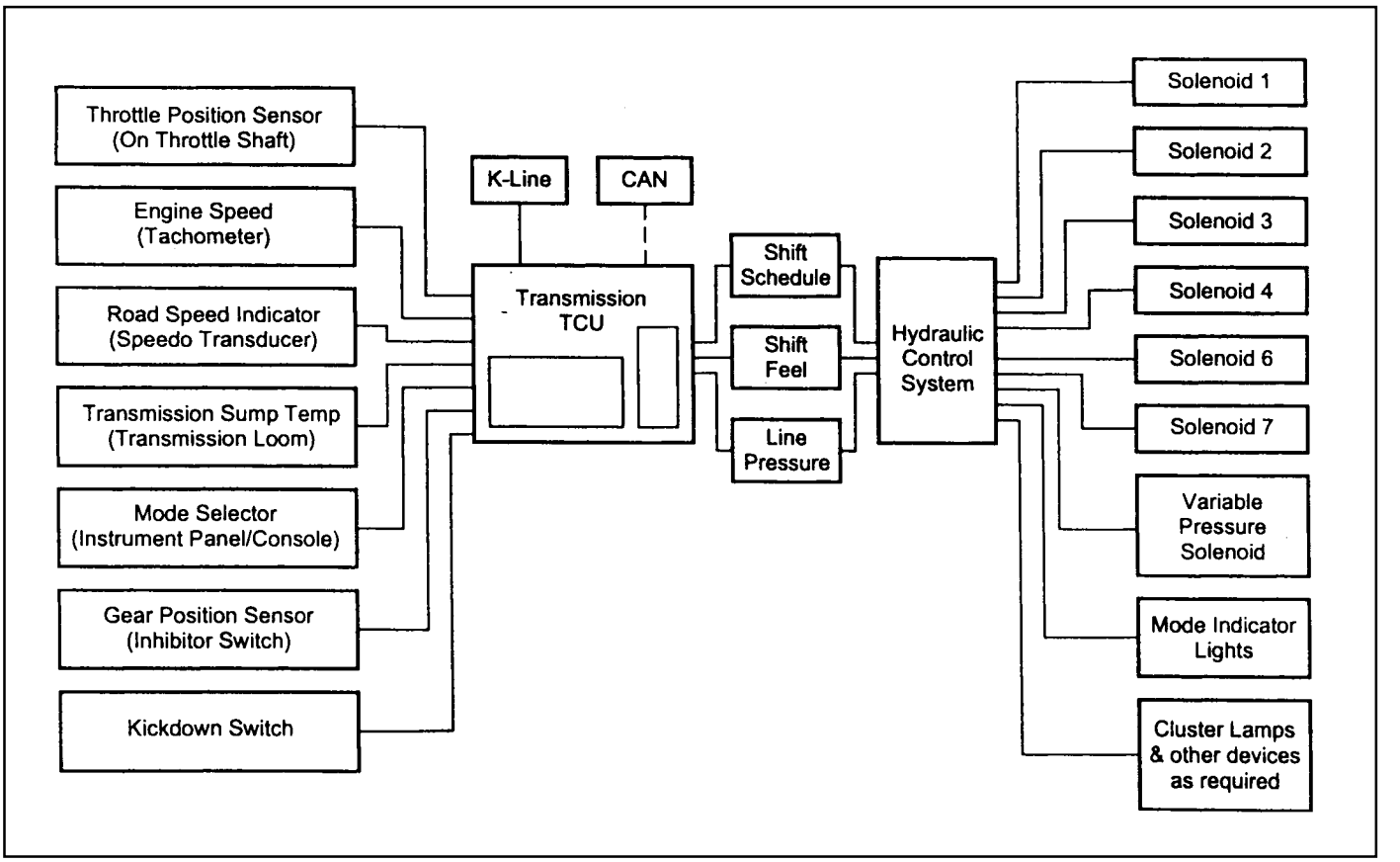
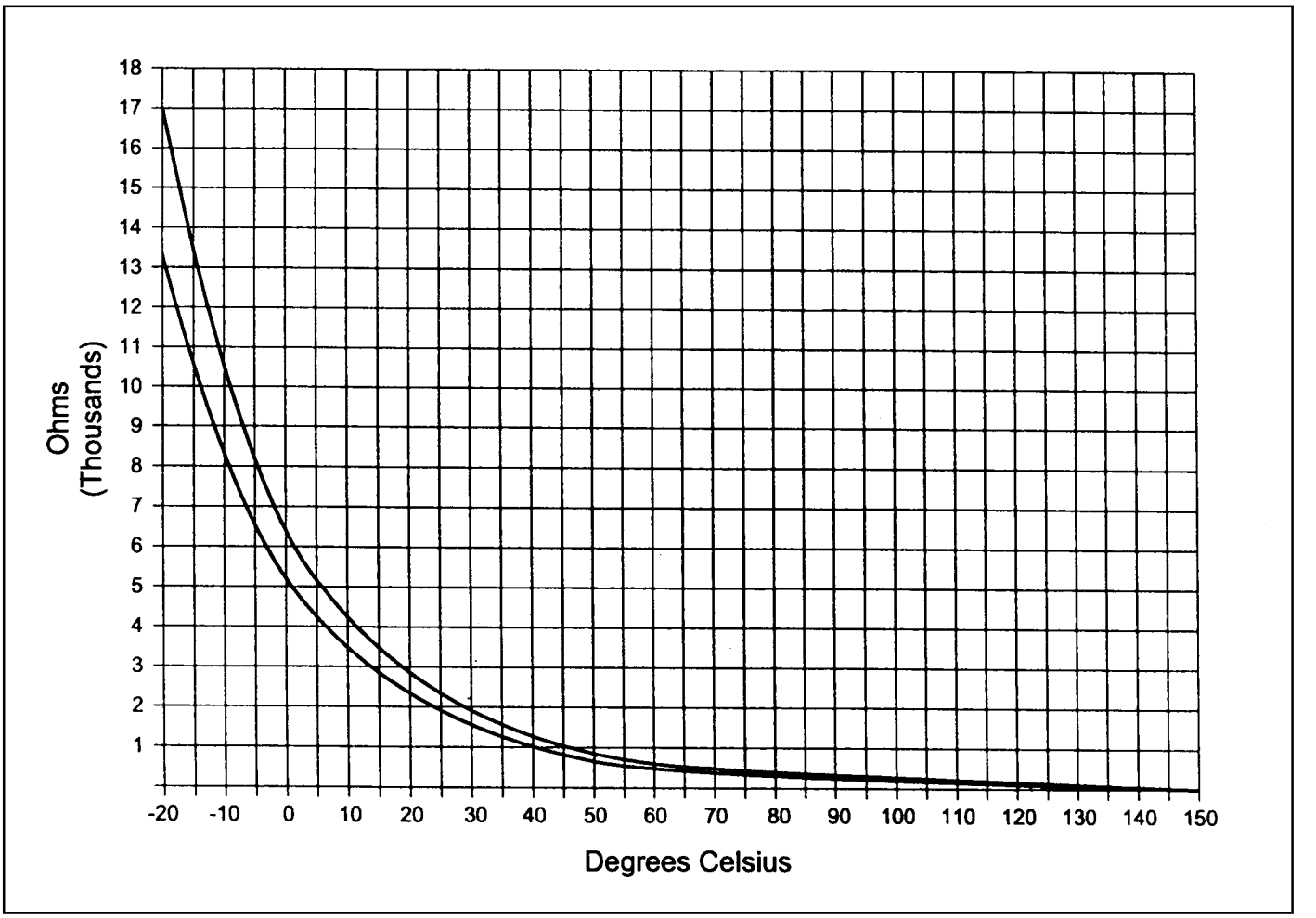


Table 3.1 - Temperature / Resistance Characteristics

Temperature (°C)	Resistance (Ohms)	
	Minimum	Maximum
-20	13,638	17,287
0	5,177	6,616
20	2,278	2,723
100	177	196
135 (Overheat Mode Threshold)	75	85

Figure 3.2 - Temperature / Resistance Characteristics



Transmission Control Unit(TCU)

The TCU is an in-vehicle micro-processor based transmission management system. It is usually mounted in the vehicle cabin, under the instrument panel, under the seat, behind the side kick panels or under the floor in the footwell on the passenger side. Different control units are supplied for different vehicle applications.

The TCU contains:

- Processing logic circuits which include a central microcontroller and a back-up memory system.
- Input circuits.
- Output circuits which control external devices such as the variable pressure solenoid (VPS), on/off solenoid drivers, a diagnostics output and the driving mode indicator light.

The various items which make up the TCU are discussed below.

Processing Logic

Shift schedule and calibration information is stored in an erasable programmable read only memory (EEPROM). Throttle input calibration constants and the diagnostics information are stored in electrically erasable programmable read only memory (EEPROM) that retains the memory even when power to the TCU is disconnected.

In operation the software continuously monitors the input values and uses these, via the shift schedule, to determine the required gear state, At the same time it monitors, via the solenoid outputs, the current gear state. Whenever the input conditions change such that the required gear state is different to the current gear state, the TCU initiates a gear shift to bring the two states back into line.

Once the TCU has determined the type of gear shift required the software accesses the shift logic, estimates the engine torque output, adjusts the variable pressure solenoid ramp pressure then executes the shift.

The TCU continuously monitors every input and output circuit for short or open circuits and operating range. When a failure or abnormal operation is detected the TCU records the condition code in the diagnostics memory and implements a limp mode, The actual limp mode used depends upon the failure detected with the object to maintain maximum driveability without damaging the transmission. In general input failures are handled by providing a default value. Output failures, which are capable of damaging the transmission, result in full limp mode giving only third or fourth gear and reverse. For further details of limp modes and memory retention refer to the Diagnostic Section.

The TCU is designed to operate at ambient temperatures between -40 and 85°C . It is also protected against electrical noise and voltage spikes, however all the usual precautions should be observed, for example when arc welding or jump starting.

TCU Inputs

To function correctly, the TCU requires engine speed, road speed, transmission sump temperature, throttle position and gear position inputs to determine the variable pressure solenoid current ramp and on/off solenoid states. This ensures the correct gear selection and shift feel for all driving conditions.

The inputs required by the TCU are as follows:

- Engine Speed

  The engine speed signal is derived from the tachometer signal line, a dedicated sensor or a Controlled Area Network (CAN).

- Road Speed

  4WD (Diesel) - The shaft speed signal is derived from the speedo sensor located on the transfer case. This signal is transmitted directly to the TCU.

  4WD (Gasoline) - The speedo sensor sends the shaft speed signal to the engine control module (ECM). The information is then transferred to the TCU via the CAN.

- Transmission Sump Temperature

  The transmission sump temperature sensor is a thermistor located in the solenoid wiring loom within the transmission. This sensor is a typical NTC resistor with low temperatures producing a high resistance and high temperatures

producing a low resistance.

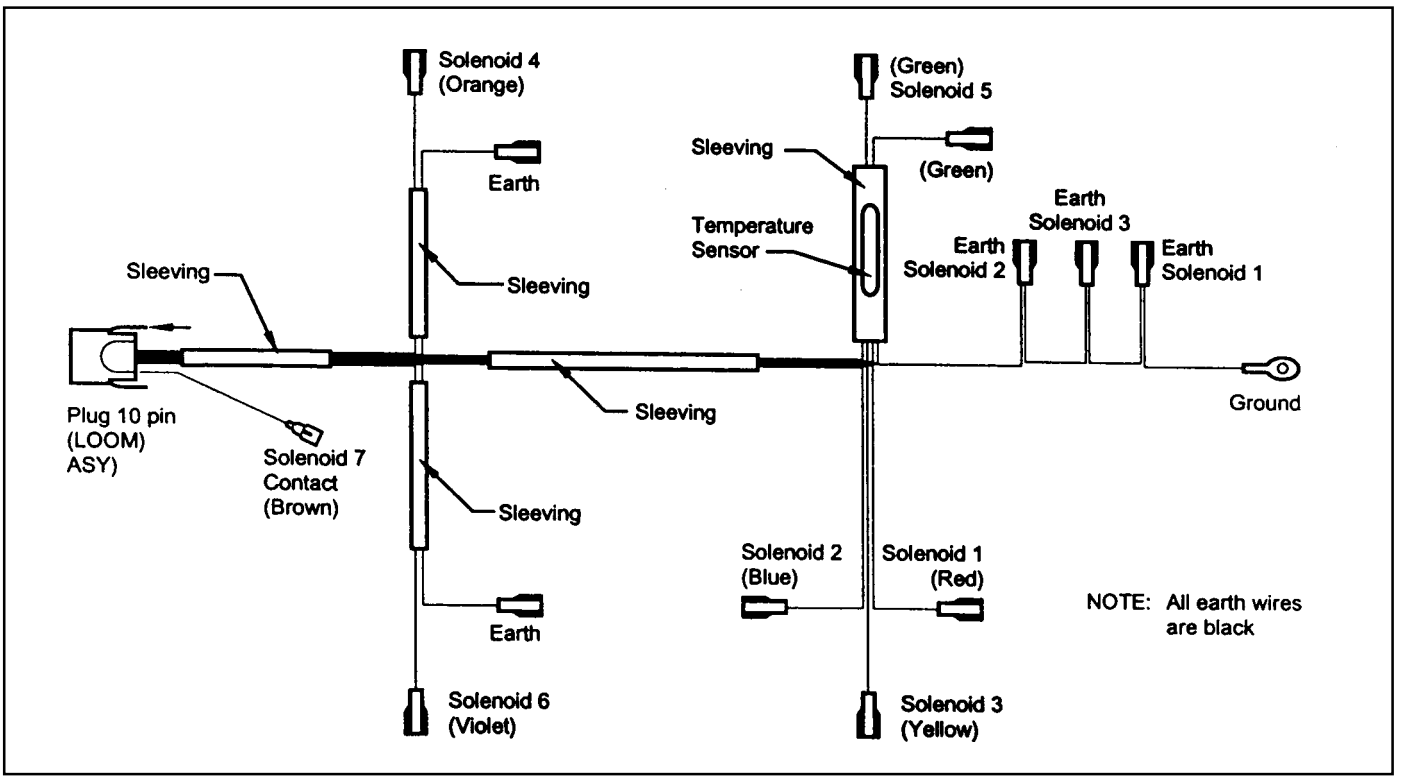
Temperature/Resistance characteristics and location within the solenoid wiring loom are given in tables 3-1 and 3-2, and figures 3.2 and 3.3.

If the transmission sump temperature exceeds 135°C, the TCU will impose converter lock-up at lower vehicle speeds and in some vehicles flashes the mode indicator lamp. This results in maximum oil flow through the external oil cooler and eliminates slippage in the torque converter. Both these actions combine to reduce the oil temperature in the transmission.

Table 3.2 - Pin No. Codes for Temperature Sensor Location In Solenoid Loom

Pin No.	Wire Color	Connects To
1	Red	Solenoid 1
2	Blue	Solenoid 2
3	Yellow	Solenoid 3
4	Orange	Solenoid 4
5	Green	Solenoid 5
6	Violet	Solenoid 6
7	Brown	Solenoid 7
8	Green	Solenoid 5
9	White	Temp Sensor
10	White	Temp Sensor

Figure 3.3 - Temperature Sensor Location in Solenoid Loom



Throttle Position Sensor

The throttle position sensor(TPS) is a resistance potentiometer mounted on the throttle body of the engine.

It transmits a signal to the TCU proportional to the throttle plate opening.

The potentiometer is connected to the TCU by three wires:

5 volts positive supply, earth and variable wiper voltage.

Throttle voltage adjustments are as follows:

- Closed throttle voltage is 0.2V to 1.0V.
- Wide open throttle voltage is 3V -4.7V.

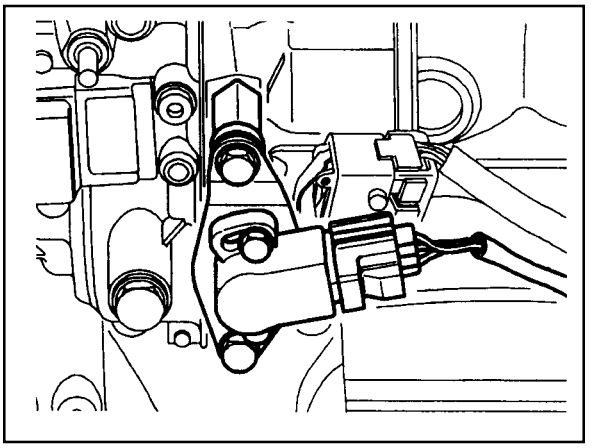
These measurements are taken between pins 29 and 27 of the TCU.

Maintaining good shift feel through the transmission life span is dependant on having an accurate measure of

the engine throttle position. To achieve this the TCU continuously monitors the maximum and minimum throttle

potentiometer voltages and, if a change occurs, stores the new voltage values.

However these limits will be lost and will require relearning should a new TCU be installed, or the throttle calibration data is cleared by the execution of a particular sequence, This last instance depends on the installation, and reference should be made to the Diagnostics Section of this manual. The relearning will happen automatically



Notice

Above figure of T.P.S. is for the diesel engine which is installed on the injection pump.

Gear Position Sensor

The gear position sensor is incorporated in the inhibitor switch mounted on the side of the transmission case.

(Refer to figure 3.5.) The gear position sensor is a multi-function switch providing three functions:

- Inhibit starting of the vehicle when the shift lever is in a position other than Park or Neutral
- Illuminate the reversing lamps when Reverse is selected indicate to the TCU which lever position has been selected by way of a varying resistance (Refer to table 3.3.)

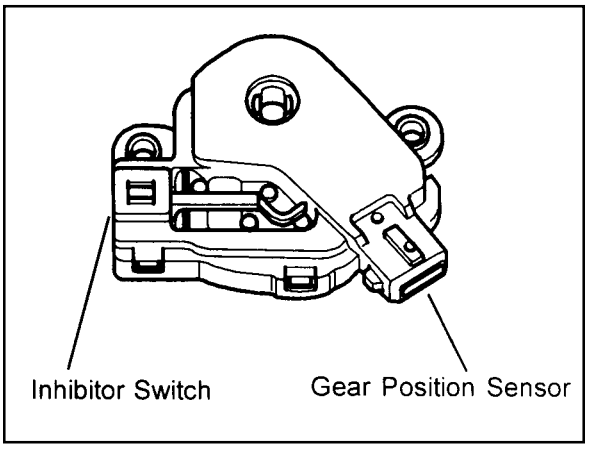


Figure 3.5 - Inhibitor Switch

Table 3.3 - Readings for Resistance/Shift Lever Positions

Shift Lever Position	Resistance (OHMS)
Manual 1	1k - 1.4k
Manual 2	1.8k - 2.2k
Manual 3	3k - 3.4k
Drive	4.5k - 4.9k
Netural	6.8k - 7.2k
Reverse	10.8k - 11.2k
Park	18.6k - 19k

Diagnostics Inputs

The diagnostics control input or K-line is used to initiate the outputting of diagnostics data from the TCU to a diagnostic test instrument. This input may also be used to clear the stored fault history data from the TCU's retentive memory. Connection to the diagnostics input of the TCU is via a connector included in the vehicle's wiring harness or computer interface. Refer to the vehicle manufacturer's manual for the location of the self test connectors.

Battery Voltage Monitoring Input

The battery voltage monitoring input connects to the positive side of the battery. The signal is taken from the main supply to the TCU.

If operating conditions are such that the battery voltage at the TCU falls below 11.3V the transmission will adopt a 'low voltage' mode of operating in which shifts into first gear are inhibited. All other shifts are allowed but may not occur because of the reduced voltage. This condition normally occurs only when the battery is in poor condition.

When system voltage recovers, the TCU will resume normal operation after a 3 second delay period.

TCU Outputs

The outputs from the TCU are supplied to the components described below:

Solenoids

The TCU controls seven solenoids. Solenoids 1 to 6 (S1 to S6) are mounted in the valve body, while Solenoid 7 (S7) is mounted in the pump cover. The normal state (OPEN/CLOSED) and the functions associated with the solenoids are detailed in table 3.4. Table 3.5 details the S1 and S2 logic for static gear states. The logic during gear changes for S1 to S4 and S7 is detailed in table 3.6.

Table 3.4 - Solenoid States and Functions

Solenoids 1 and 2	S1 and S2 are normally open On/off solenoids that set the selected gear. These solenoids determine static gear position by operating the shift valves. Refer to table 3.5. Note that S1 and S2 solenoids also send signal pressure to allow or prohibit rear band engagement.
Solenoids 3 and 4	S3 and S4 are normally open On/off solenoids that combine to control shift quality and sequencing. S3 switches the clutch regulator valve off or on. S4 switches the front band regulator valve off or on.
Solenoid 5	S5 is a variable force solenoid that ramps the pressure during gear changes. This solenoid provides the signal pressure to the clutch and band regulator, thereby controlling the shift pressures.
Solenoid 6	S6 is a normally open On/off solenoid that sets the high/low level of line pressure, Solenoid off gives high pressure.
Solenoid 7	S7 is a normally open On/off solenoid that controls the application of the converter clutch. Solenoid on activates the clutch.

Table 3.5 - Solenoid Logic for Static Gear States

Gear	**S1**	**S2**
1st	ON	ON
2nd	OFF	ON
3rd	OFF	OFF
4th	ON	OFF
Reverse	OFF	OFF
Neutral	OFF	OFF
Park	OFF	OFF

Table 3.6- Solenoid Operation During Gearshifts

Shift	To Initiate Shift	Typical S5 Current Ramp	To Complete Shift
1-2	S1 OFF S4 ON	750mA to 600mA	S4 OFF
1-3	S1 OFF S2 OFF S3 ON S4 ON	850mA to 750mA	S3 OFF S4 OFF
1-4	S2 OFF S3 ON S4 ON	850mA to 750mA	S3 OFF S4 OFF
2-3	S2 OFF S3 ON S4 ON	700mA to 500mA	S3 OFF S4 OFF
3-4	S1 ON S4 ON	750mA to 600mA	S4 OFF
4-3	S4 ON	750mA to 900mA	S1 OFF S4 OFF
4-2	S3 ON	750mA to 950mA	S1 OFF S2 ON S3 OFF
4-1	S3 ON S4 ON	600mA to 1000mA	S2 ON S3 OFF S4 OFF
3-2	S2 ON S4 ON	600mA to 450mA @ 20 kph. 550mA to 400mA @ 60 kph. 800mA to 650mA @ 100 kph.	S4 OFF
3-1	S3 ON S4 ON	700mA to 950mA	S1 ON S2 ON S3 OFF S4 OFF
2-1	S4 ON	800mA to 950mA	S1 ON S4 OFF
Conv. Clutch ON OFF	S7 ON	700mA to 400mA 600mA to 100mA	S7 OFF

Solenoid Valve Symbols (On/off Solenoids)

The solenoid symbol shown adjacent to each solenoid on the hydraulic system schematics indicates the state of the oil flow through the solenoid valve with the power On or 0ff. Refer to figure 3.6 for the On/off operational details of NO solenoid valves.

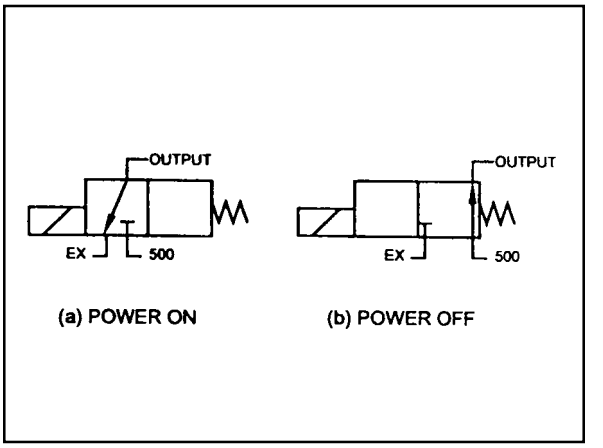


Figure 3.6- Normally Open (NO) Symbols

Normally Open (NO) Solenoid

POWER ON

Line 500 port is closed. The output port is open to exhaust at the solenoid valve.

POWER OFF

The exhaust port is closed. The output port is open to line 500,

Variable Pressure Solenoid Multiplexing System

Friction element shifting pressures are controlled by the variable pressure solenoid (VPS).
Line pressure is completely independent of shift pressure and is a function of throttle position, gear state and engine speed.
S5 is a proportional or variable pressure solenoid that provides the signal pressure to the clutch and band regulator valves thereby controlling shift pressures.
VPS pressure is multiplexed to the clutch regulator valve, the band regulator valve and the converter clutch regulator valve during automatic gearshifts.
A variable pressure solenoid produces a hydraulic pressure inversely proportional to the current applied. During a gearshift the TCU applies a progressively increasing or decreasing (ramped) current to the solenoid. Current applied will vary between a minimum of 200 mA and a maximum of 1000 mA, Increasing current decreases output (55) pressure. Decreasing current increases output (55) pressure.
Line 500 pressure, (approximately 440 to 560 kPa), is the reference pressure for the VPS, and the VPS output pressure is always below line 500 pressure.
When the VPS is at standby, that is no gearshift is taking place, the VPS current is set to 200 mA giving maximum output pressure.
Under steady state conditions the band and clutch regulator valve solenoids are switched off. This applies full Line 500 pressure to the plunger and because Line 500 pressure is always greater than S5 pressure it squeezes the S5 oil out between the regulator valve and the plunger. The friction elements are then fed oil pressure equal to Line 500 multiplied by the amplification ratio.
When a shift is initiated the required On/off solenoid is switched on cutting the supply of Line 500 to the plunger.
At the same time the VPS pressure is reduced to the ramp start value and assumes control of the regulator valve by pushing the plunger away from the valve. The VPS then carries out the required pressure ramp and the timed shift is completed by switching Off the On/off solenoid and returning the VPS to the standby pressure.
This system enables either the band or clutch or both to be electrically controlled for each gearshift.

Mode Indicator Light

Depending on the application, the mode indicator light may be used to indicate the mode that has been selected or if an overheat condition exists. The mode indicator light is usually located on the instrument cluster.

Communication Systems

CAN

The controller area network (CAN) connects various control modules by using a twisted pair of wires, to share common information. This results in a reduction of sensors and wiring. Typical applications include using the engine controller to obtain the actual engine speed and throttle position, and adding these to the network. The ABS controller (if fitted) can be used to obtain the road speed signal. This information is then available to the TCU without any additional sensors.

K-Line

The K-line is typically used for obtaining diagnostic information from the TCU. A computer with a special interface is connected to the TCU and all current faults, stored faults, runtime parameters are then available. The stored fault codes can also be cleared.

The K-line can be used for vehicle coding at the manufacturer's plant or in the workshop. This allows for one TCU design to be used over different vehicle models. The particular code is sent to the microprocessor via the K line and this results in the software selecting the correct shift and VPS ramp parameters.

HYDRAULIC CONTROL SYSTEM

The hydraulic controls are located in the valve body, pump body and main case.

The valve body contains the following:

- Manual valve,
- Three shift valves,
- Sequence valve,
- solenoid supply pressure regulator valve,
- line pressure control valve,
- clutch apply regulator valve,
- band apply regulator valve,
- S1 to S6, and
- Reverse lockout valve.
- The pump body contains the following:
- Primary regulator valve for line pressure,
- converter clutch regulator valve,
- converter clutch control valve,
- S7,and
- C1 bias valve.

The main case contains the following:

- B1R exhaust valve

The hydraulic control system schematic is shown at figure 3.7.

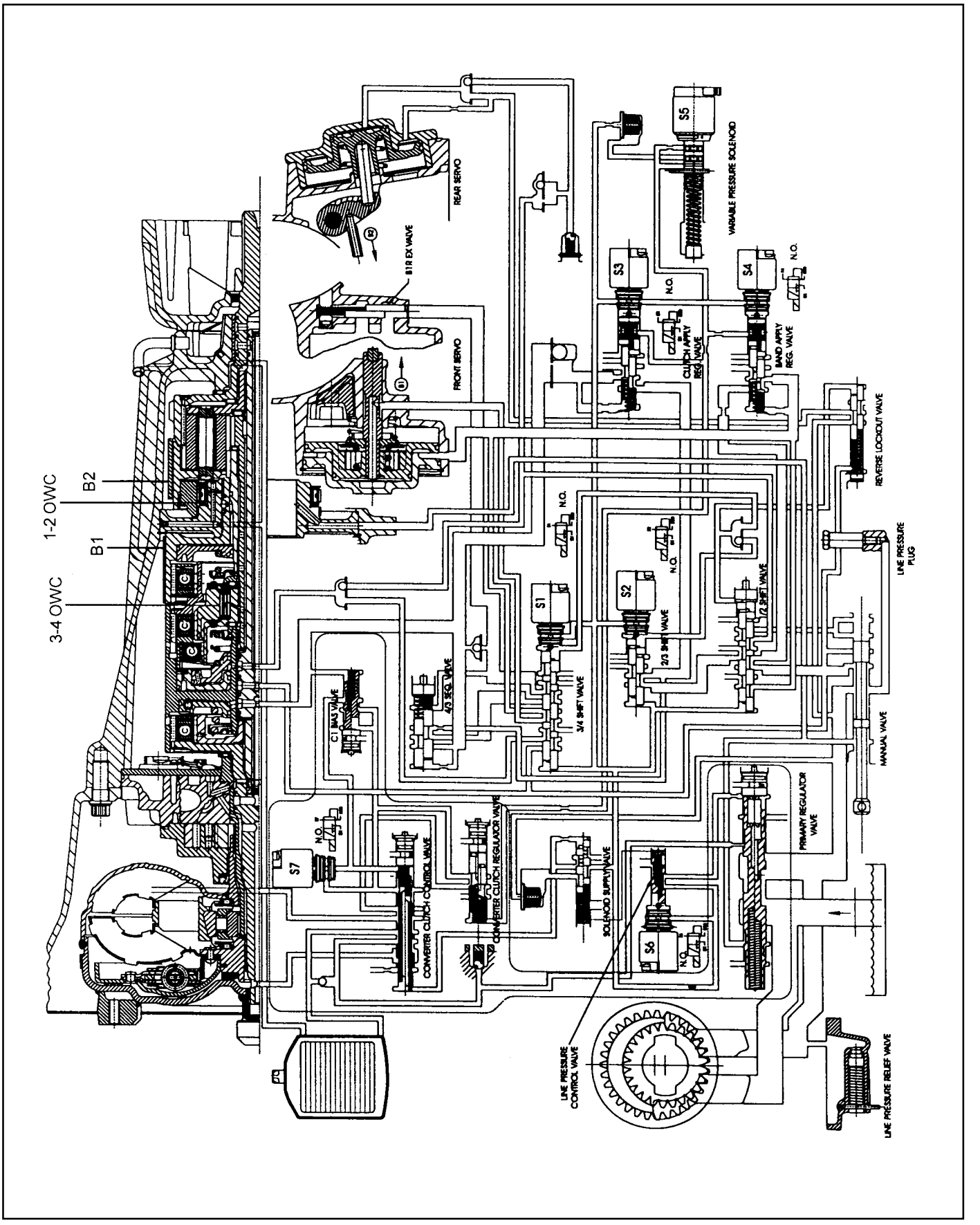
All upshifts are accomplished by simultaneously switching on a shift valve(s), switching VPS pressure to the band and/or clutch regulator valve, and then sending the VPS a ramped current. The shift is completed by switching the regulators off and at the same time causing the VPS to reach maximum . pressure. All downshifts are accomplished by switching VPS pressure to the band and/or clutch regulator valve and sending a ramped current to the VPS. The shift is completed by simultaneously switching the regulators off, switching the shift valves and at the same time causing the VPS to return to stand-by pressure.

The primary regulator valve is located in the pump cover and supplies four line pressures; high and low for forward gears, and high and low for reverse. This pressure has no effect on shift quality and merely provides static clutch capacity during steady state operation. Low pressure can be obtained by activating an On/off solenoid with high line pressure being the default mode.

Torque converter lock-up is initiated by toggling the converter clutch control valve with an On/off solenoid. The actual apply and release of the clutch is regulated by the VPS via the converter clutch regulator valve. As an additional safety feature, the lock-up is hydraulically disabled in first and second gear by the bias valve which only supplies oil to the lock-up solenoid when C1 is applied in third and fourth gears. This prevents the vehicle from being rendered immobile in the unlikely event of S7 becoming stuck.

The solenoid supply valve provides reference pressure for all the solenoids.

Figure 3.7 - Hydraulic Control Circuit



Valve Body

Figure 3.8 depicts the valve body as a unit as viewed from the transmission sump. Figure 3.9 depicts the pump cover.

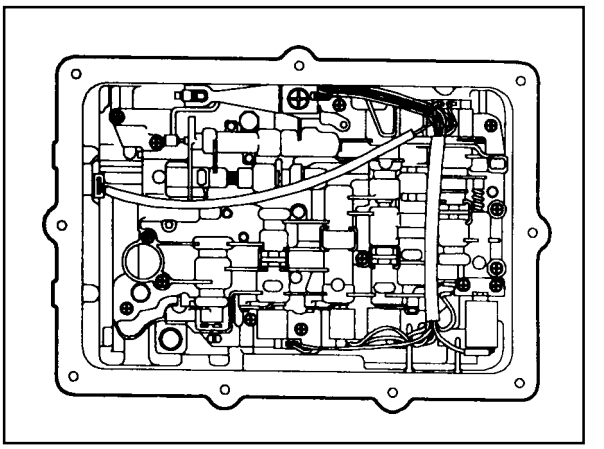


Figure 3.8 - Valve Body

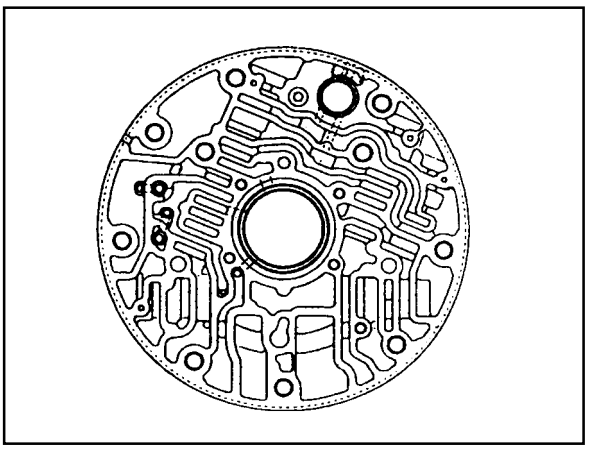
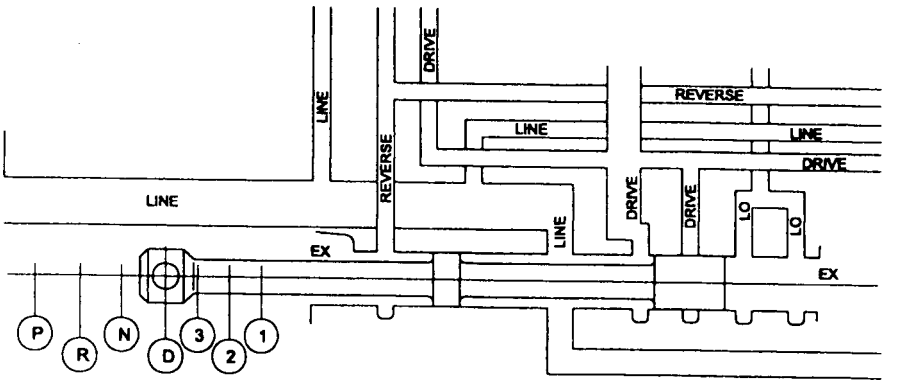


Figure 3.9 - Pump Cover

Manual Valve

The manual valve (refer to figure 3.10) is connected to the vehicle selector mechanism and controls the flow of oil to the forward and reverse circuits. The manual valve function is identical in all forward gear positions except that in the Manual 1 position an additional supply of oil is directed to the 1-2 shift valve for application of the rear band and the C4 overrun clutch.

Figure 3.10 - Manual Valve



1-2 Shift Valve

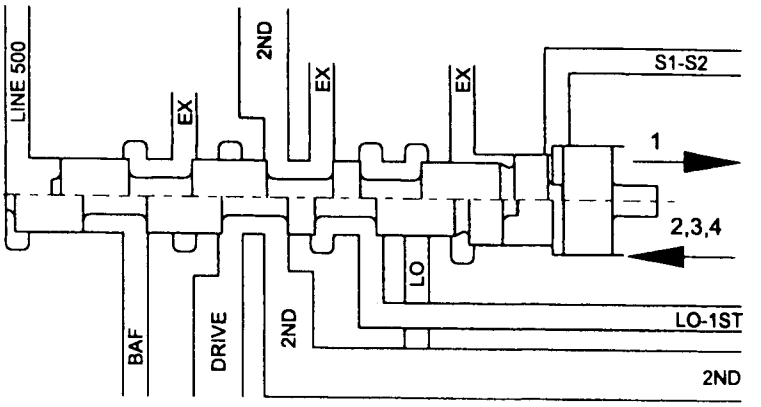
The 1-2 shift valve (refer to figure 3.11) is a two position valve that must be switched to the (2,3,4) position in order to get any forward gear other than first gear. It is used for all 1-2 and 2-1 gearshifts.

The switching of this valve is achieved by using S1 and/or S2.

During a 1-2 gearshift drive oil from the manual valve passes through to the second gear circuit. During a 2-1 gearshift the band apply feed oil is allowed to exhaust via the 1-2 shift valve.

The 1-2 shift valve works in conjunction with the 3-4 shift valve (described below) to disengage the C4 clutch in first gear, and engage C4 in second gear. When Manual 1 is selected the C4 clutch and rear band (B2) are engaged.

Figure 3.11 - 1-2 Shift Valve



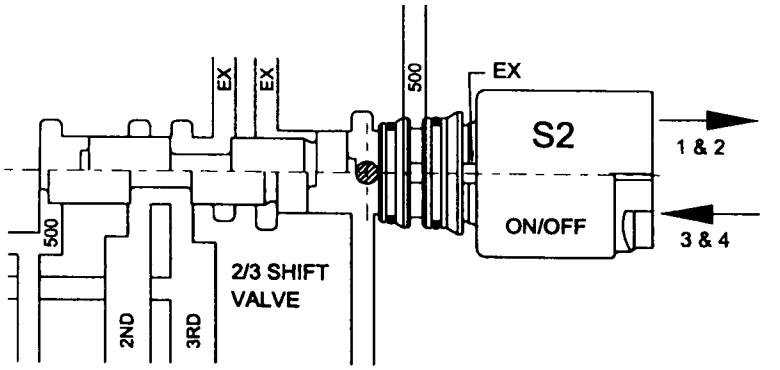
2-3 Shift Valve

The 2-3 shift valve (refer to figure 3.12) is a two position valve. It is used on all 2-3 and 3-2 gearshifts.

The switching of this valve is achieved by S2 which is located at the end of the valve spool.

When in the (1,2) position, second gear oil from the 1-2 shift valve is prevented from entering the third gear circuit. When the valve is moved to the (3,4) position, oil from the second gear circuit is routed to the third gear circuit and the transmission changes to third gear.

Figure 3.12 - 2-3 Shift Valve



3-4 Shift Valve

The 3-4 shift valve (refer to figure 3,13) is a two position valve. It is used for all 3-4 and 4-3 gearshifts.

The switching of this valve is achieved by S1 which is located at the end of the valve spool.

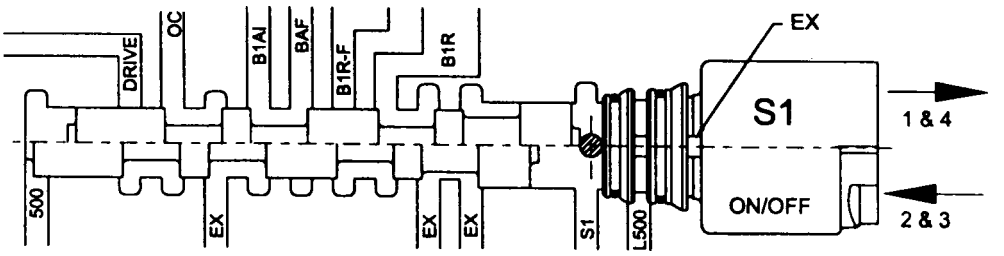
During a 3-4 gearshift the 3-4 shift valve:

- Exhausts the front band release circuit (B 1R) thereby allowing the application of the front band (B1).
- Connects the inner apply area of the front servo (B 1AI) to the band apply feed circuit (BAF) thus allowing greater apply forces to the front band.
- Exhausts the overrun clutch circuit (OC) which allows the C4 clutch to disengage.

During a 4-3 gearshift, the C4 clutch is engaged and the front band (B1) is released. These actions are sequenced by the 4-3 sequence valve (described below).

The 3-4 shift valve also switches during 1-2 and 2-1 gearshifts (see 1-2 shift valve above) where its function is to apply the overrun clutch (C4) in second gear but to release it in first gear. Note that the C4 clutch is applied in Manual 1 by virtue of the manual valve and the 1-2 shift valve (as described in the 1-2 shift valve section).

Figure 3.13 - 3-4 Shift Valve

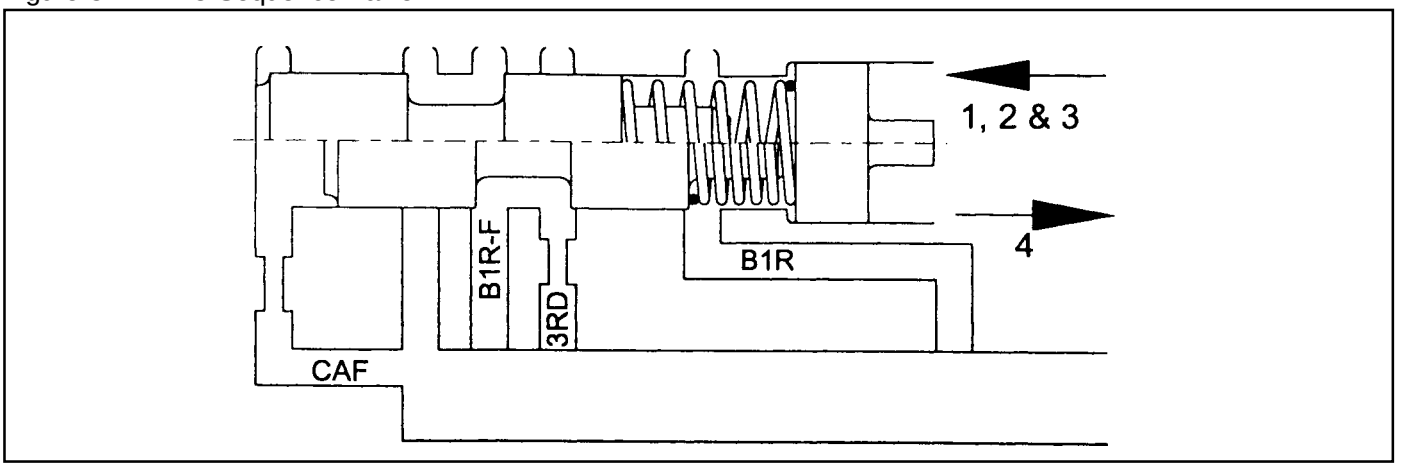


4-3 Sequence Valve

The 4-3 sequence valve (refer figure 3.14) is a two position spring loaded valve. It switches during 3-4 and 4-3 gearshifts although it performs no function during the 3-4 shift.

During the 4-3 shift the 4-3 sequence valve delays the connection of the clutch apply feed circuit (CAF) to the BIR circuit until the BIR circuit has been fully pressurised by using the third gear circuit. This prevents objectionable engine flare on completion of the 4-3 gearshift.

Figure 3.14 - 4-3 Sequence Valve



Solenoid Supply Pressure Regulator Valve

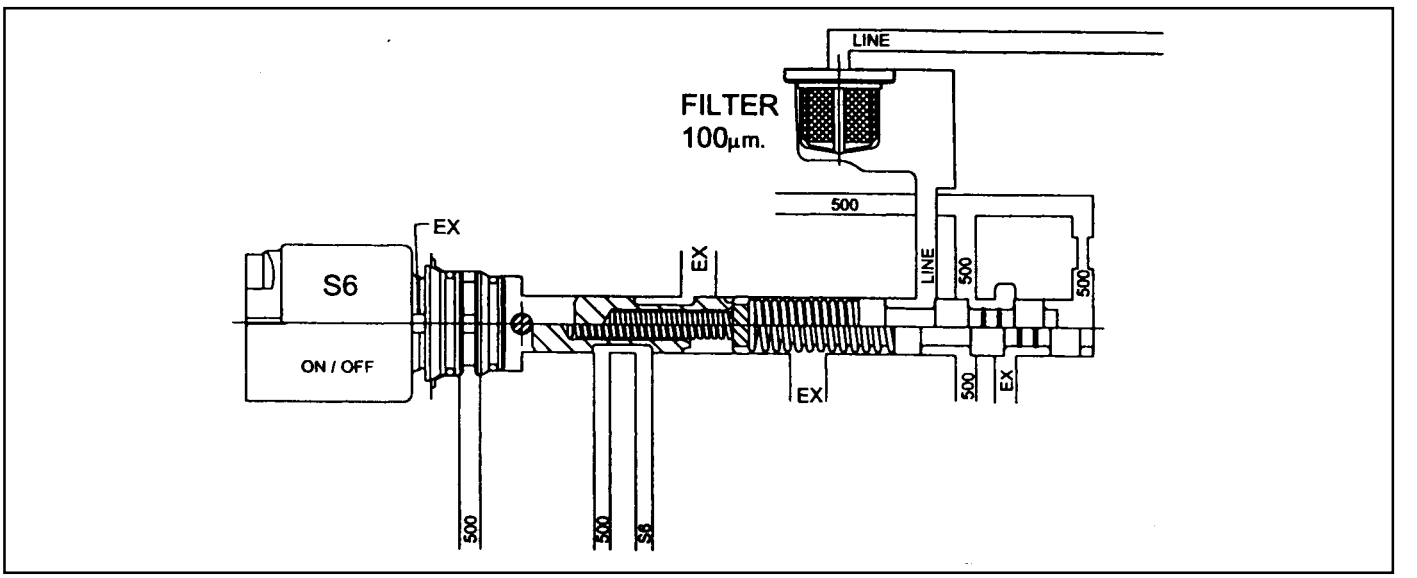
The solenoid supply valve (refer figure 3.15) supplies a constant pressure to all solenoids (51 to 57). Line pressure is used as the feed oil to this regulator and the output is termed line 500.

Line Pressure Boost Valve

Line pressure is controlled by 56, which acts as the line pressure boost valve (refer figure 3.15). When 56 pressure is applied to the end of the PRV it is opposed by spring force and causes LOW line pressure for light throttle application and cruising.

Heavy throttle application causes the normally open 56 to open (switch Off) thus closing line 500 and opening 56 to exhaust. Removal of 56 pressure from the PRV results in HIGH line pressure.

Figure 3.15 - Solenoid Supply Pressure Regulator Valve and Line Pressure Control Valve



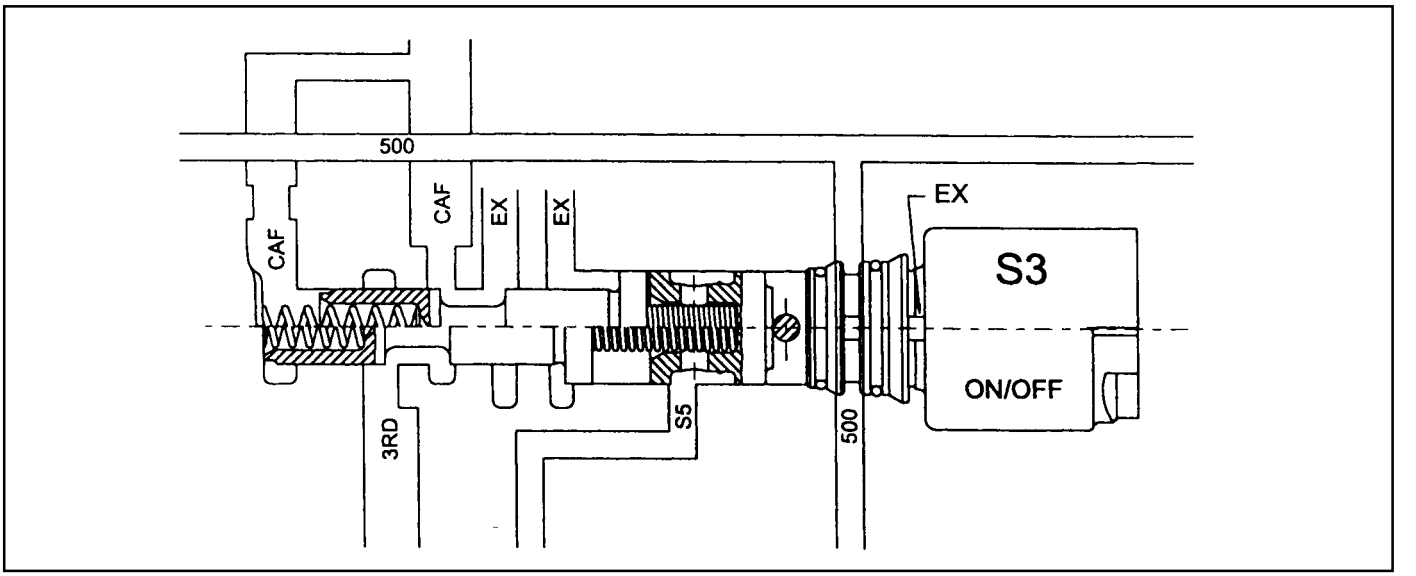
Clutch Apply Regulator Valve

The clutch apply regulator valve (refer figure 3.16) is a fixed ratio valve. This valve provides a regulated pressure to the C1 clutch and controls the rate of change of state of the clutch to give the desired shift quality.

This ratio is 2.25 : 1.

Third gear oil supplied to the valve is regulated to provide an output pressure (CAF) of 2.25 times the S5 signal pressure when S3 is On. When S3 is Off the output pressure is 2.25 times the line 500 pressure.

Figure 3.16 - Clutch Apply Regulator Valve



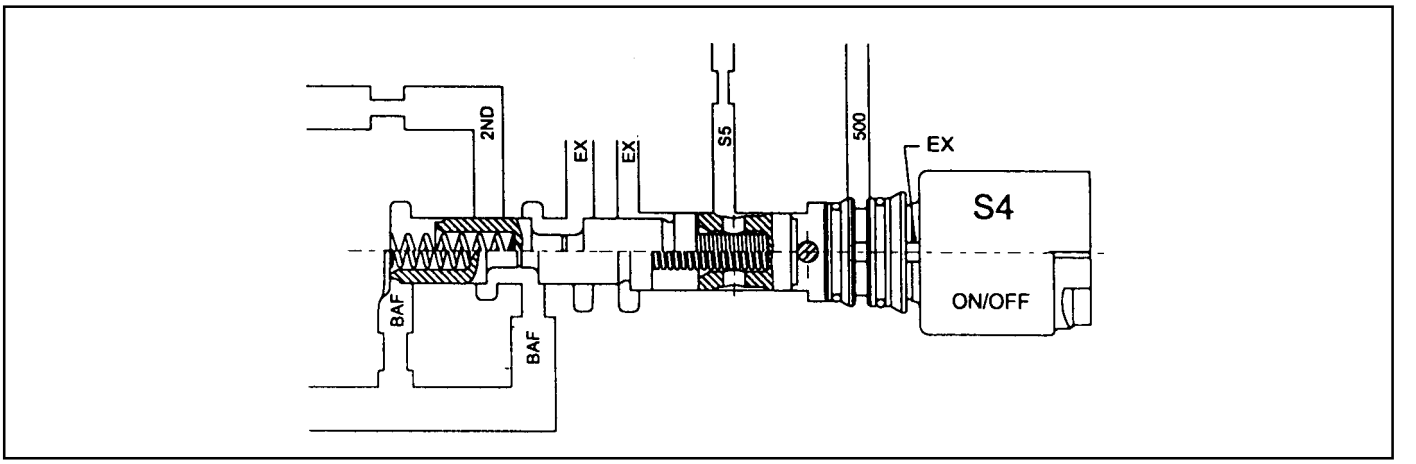
Band Apply regulator Valve

The band apply regulator valve (refer figure 3.17) is a fixed ratio valve. It provides a regulated pressure to the front servo, and controls the rate of change of state of the front band (B1) to give the desired shift quality.

This ratio is 1.4 : 1.

Second gear oil supplied to the valve is regulated to provide an output pressure (BAF) of 1.4 times the S5 signal pressure when S4 is On. When S4 is Off the output pressure is 1.4 times the line 500 pressure.

Figure 3.17 - Band Apply Regulator Valve



Reverse Lockout Valve

The reverse lockout valve (refer figure 3.18) is a two position valve contained in the upper valve body. This valve uses 51-52 pressure as a signal pressure and controls the application of the rear band (B2).

While the manual valve is in D,3,2, or 1 positions, drive oil is applied to the spring end of the valve, overriding any signal pressures and holding the valve in the lockout position. This prevents the application of B2 in any of the forward driving gears.

When the manual valve is in P, R or N positions, drive oil is exhausted and the reverse lockout valve may be toggled by S1-S2 pressure.

B2 is applied in P, R, and N provided that the following conditions are satisfied:

1. In P or N, roadspeed ≤ 3 km/h.
2. In R, road speed ≤ 10 km/h.
3. Engine speed ≤ 1400 rpm.
4. For diesel vehicles, throttle ≤ 25%.
5. For gasoline vehicles, throttle ≤ 12%.

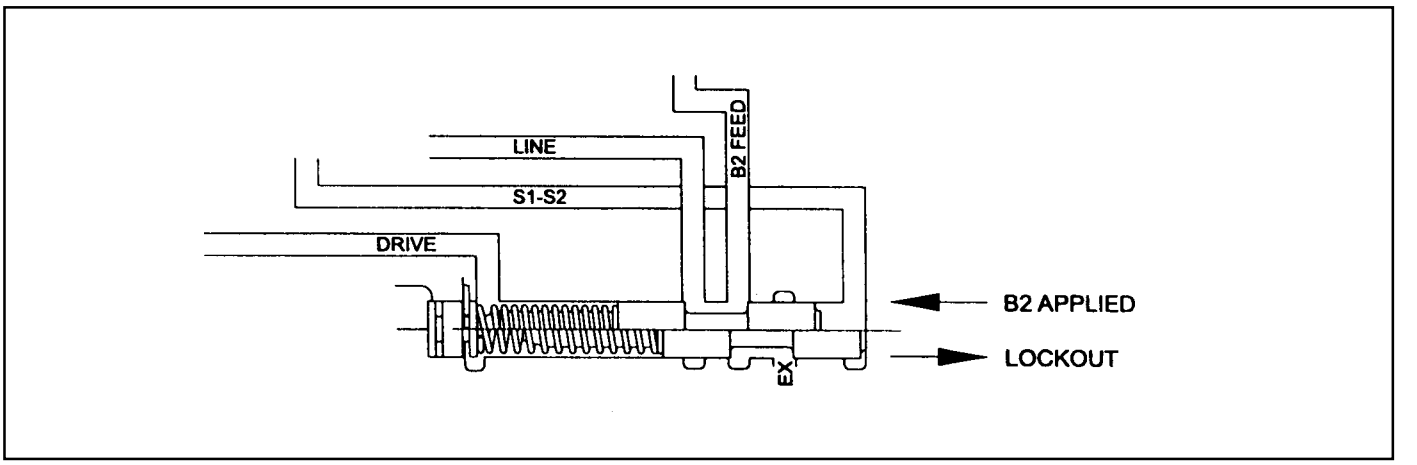
Under these conditions, the TCU switches solenoids S1 and S2 to Off. The reverse lockout valve toggles under the influence of the S1-S2 pressure, to connect the line pressure to the B2 feed. Oil is fed to both the inner and outer apply areas of the rear servo piston, applying B2.

If any of the above conditions are not satisfied, the TCU switches solenoids S1 and S2 to On. S1- S2 pressure is exhausted and the valve is held in the lockout position by the spring. In this position, engagement of B2 is prohibited.

This feature protects the transmission from abuse by preventing the undesirable application of B2 at high speed, and by providing a reverse lockout function.

Note that if the transmission is in failure mode, the rear band will be applied at all times in P, R and N.

Figure 3.18 - Reverse Lockout Valve



Primary Regulator Valve

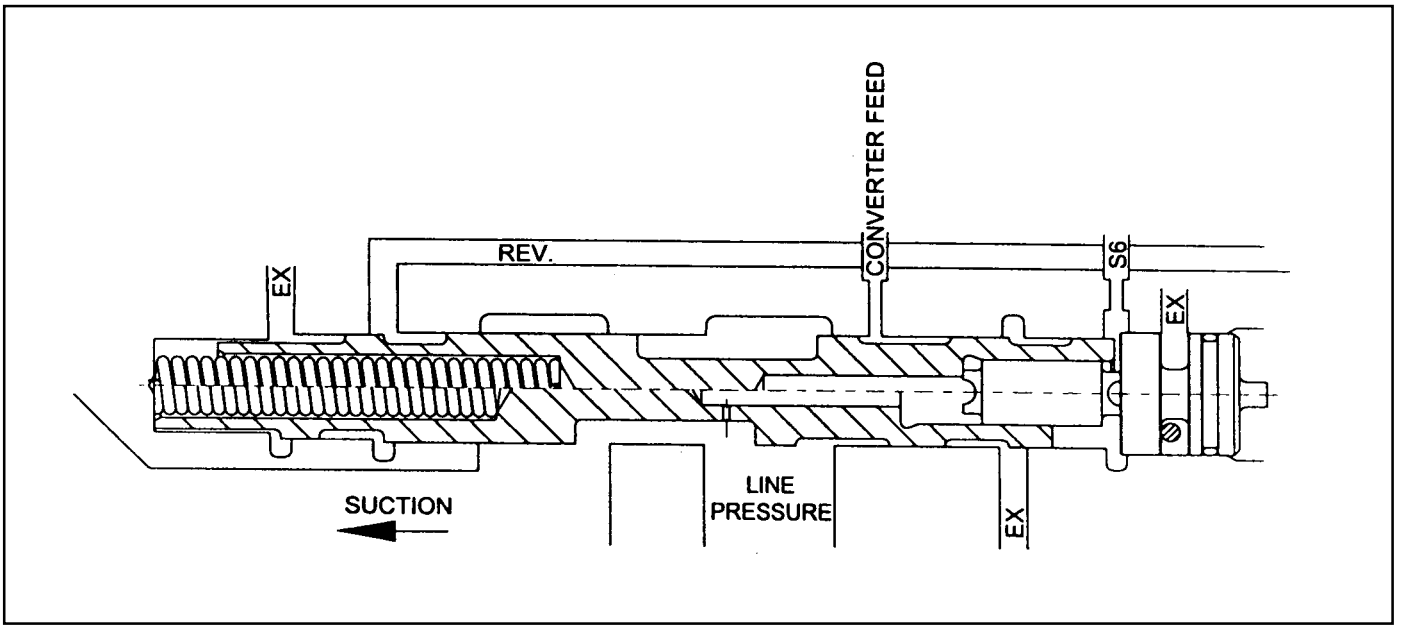
The primary regulator valve (PRV) (refer to figure 3.19) regulates the transmission line pressure (or pump output pressure). This valve gives either high or low line pressure depending on whether S6 is switched Off or On, When S6 is switched On,S6 pressure is applied to the PRV moving it against spring pressure and opening the line pressure circuit to the pump suction port resulting in reduced line pressure. Low line pressure is used during light throttle applications and cruising. Heavy throttle will cause S6 to switch Off and thereby cause high line pressure.

This stepped line pressure control has no detrimental effect on shift feel because all shifting pressures are controlled by separate band and clutch regulator valves, and the output of S5.

When reverse gear is selected, both the low and high line pressure values are boosted to guard against slippage. This is achieved by applying reverse oil line pressure to the PRV to assist the spring load. The other end of the valve contains ports for line pressure feedback and 56 pressure.

The PRV also regulates the supply of oil to the converter via the converter feed port. The cascade effect of the PRV ensures the first priority of the valve is to maintain line pressure at very low engine speeds. When the engine speed increases and the pump supplies an excess of oil the PRV moves to uncover the converter feed port thereby pressurising the converter. If there is an excess of oil for the transmission's needs then the PRV moves further to allow oil to return to the suction port.

Figure 3.19 - Primary Regulator Valve



Converter Clutch Regulator Valve

The converter clutch regulator valve (refer figure 3.20) regulates the pressure of the oil which applies the converter clutch. Input oil from the line 500 circuit is regulated within the valve, with the output pressure being variable according to the signal pressure from the S5 circuit. Converter clutch apply and release application is smoothed by electronically varying the S5 circuit pressure.

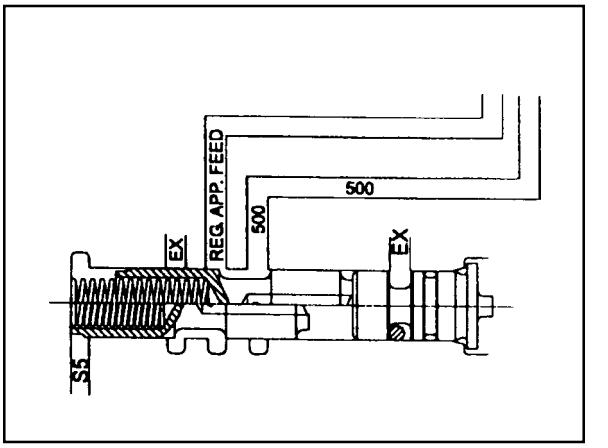


Figure 3.20 - Converter Clutch Regulator Valve

Converter Clutch Control Valve

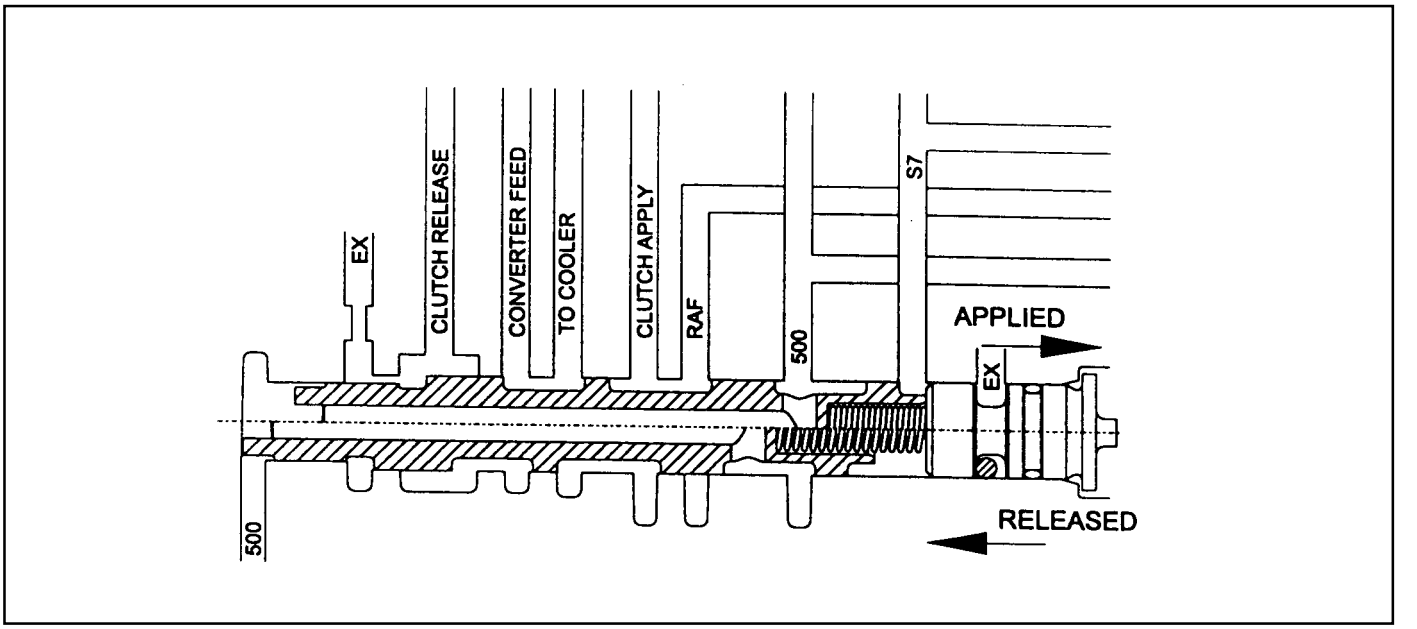
The converter clutch control valve (refer figure 3.21) is a two position valve which applies or releases the converter clutch.

The switching of this valve is governed by the signal pressure from S7.

When the valve is in the off or released position, converter feed oil from the PRV is directed to the release side of the converter clutch. After flowing through the converter, oil returns to the converter clutch control valve and is then directed to the oil cooler.

When the valve is in the on or applied position, regulated oil from the converter clutch regulator valve is directed to the apply side of the converter clutch. This oil remains within the converter because the converter clutch piston is sealed against the flat friction surface of the converter cover. To provide oil flow to the cooler the converter clutch control valve directs converter feed oil from the PRV directly to the cooler circuit.

Figure 3.21- Converter Clutch Control Valve

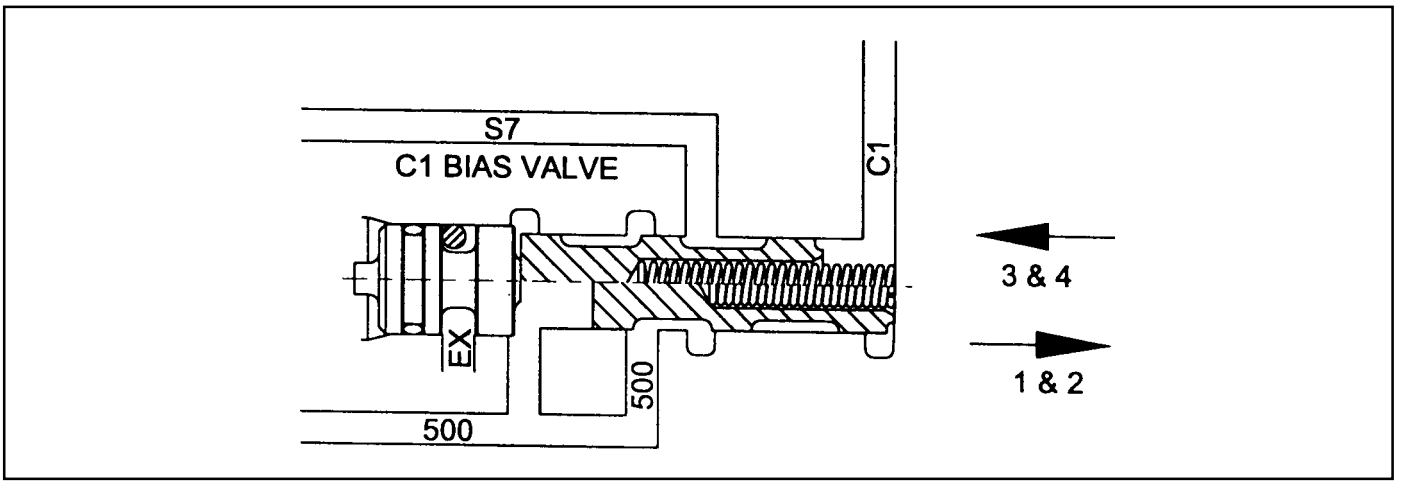


C1 Bias Valve

The C1 bias valve (refer figure 3.22) ensures that the converter lock-up clutch is only applied in third and fourth gears. It uses C1 clutch oil pressure as the switching signal since C1 is only applied in third and fourth gears.

Line to 500 oil is routed through the C1 bias valve to S7. The C1 bias valve therefore acts as a safety feature to ensure drivability in the event of S7 failure.

Figure 3.22- C1 Bias Valve



B1R Exhaust Valve

The B1R exhaust valve (refer figure 3.23) is a two position spring loaded valve located in the transmission case directly adjacent to the front servo. It permits the servo release oil to be rapidly exhausted into the transmission case during application of the front band (B1). This prevents the need to force the oil back from the front servo through the valve body and through the 3-4 shift valve. The spring positions the valve to prevent oil entering the release area of the servo until the B1R circuit oil pressure reaches approximately 100 kPa.

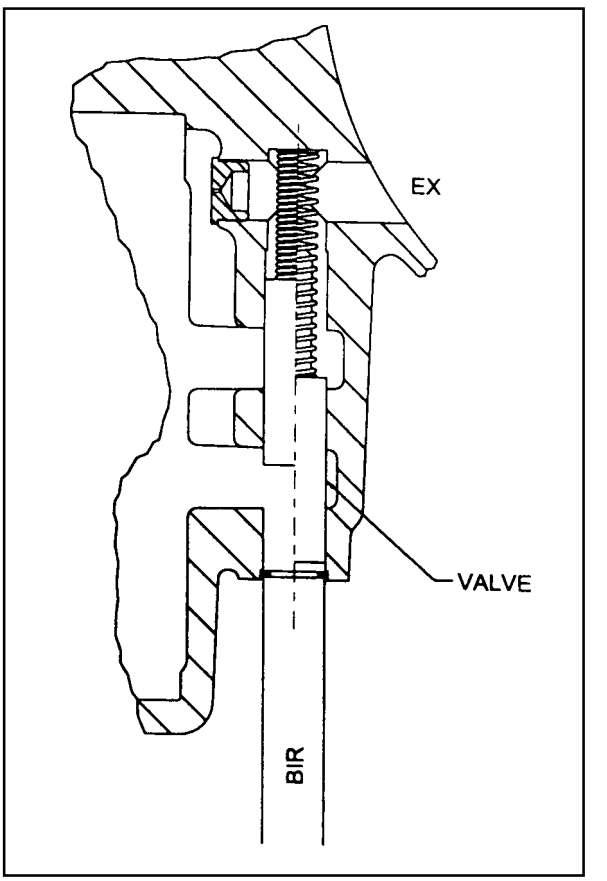


Figure 3.23 - B1R Exhaust Valve

POWER TRAIN SYSTEM

The Power Train System consists of:

- A torque converter with single face lock-up clutch
- Four multi-plate clutch assemblies
- Two brake bands
- Two one-way clutches
- Planetary gearset
- Parking mechanism

A conventional six pinion Ravigneaux compound planetary gearset is used with overdrive (fourth gear) being obtained by driving the carrier.

The cross-sectional arrangement is very modular in nature. Four main sub-assemblies are installed within the case to complete the build. These sub-assemblies are:

- Gearset-sprag-centre support
- C1 -C2-C3-C4 clutch sub-assembly
- Pump assembly
- Valve body assembly

One, or a combination of selective washers are used between the input shaft flange and the number 4 bearing to control the transmission end float. This arrangement allows for extensive subassembly testing and simplistic final assembly during production.

A general description of the operation of the Power Train System is detailed below. Refer to table 4.1 and figure 4.1.

First gear is engaged by applying the C2 clutch and locking the 1-2 One Way Clutch (1-2 OWC). The 1-2 shift is accomplished by applying the B1 band and overrunning the 1-2 OWC. The 2-3 shift is accomplished by applying the C1 clutch and releasing the B1 band. The 3-4 shift is accomplished by re-applying the B1 band and overrunning the 3-4 OWC. Reverse gear is engaged by applying the C3 clutch and the B2 band.

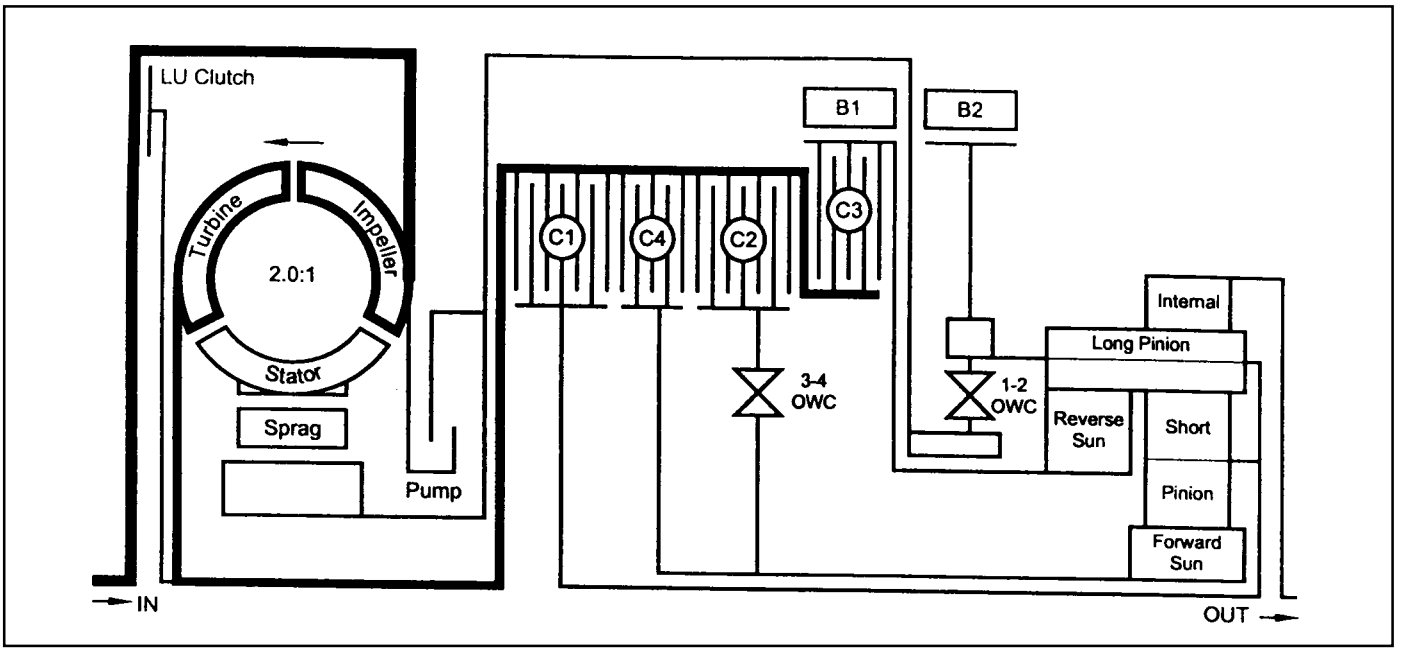
The C4 clutch is applied in the Manual 1,2 and 3 ranges to provide engine braking. In addition, the C4 clutch is also applied in the Drive range for second and third gears to eliminate objectionable freewheel coasting. The B2 band is also applied in the Manual 1 range to accomplish the low-overrun shift.

Both the front and rear servos are dual area designs to allow accurate friction element matching without the need for secondary regulator valves. All the friction elements have been designed to provide low shift energies and high static capacities when used with the new low static co-efficient transmission fluids. Non-asbestos friction materials are used throughout.

Table 4.1 - Engaged Elements vs Gear Ratios

		ELEMENTS ENGAGED								
Gear	**Gear Ratio**	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
First	2.741		X					X	X	
Second	1.508		X			X			X	
Third	1.000	X	X		X	X			X	X*
Fourth	0.708	X	X		X					X
Reverse	2.428			X			X			
Manual 1	2.741		X			X	X			
* For Certain Vehicle Applications, Refer to the Owner's Manual.										

Figure 4.1 - Power Flow Diagram



TORQUE CONVERTER

The torque converter (refer figure 4.2) consists of a turbine, stator pump, impeller and a lock-up damper and piston assembly. As in conventional torque converters, the impeller is attached to the converter cover, the turbine is splined to the input shaft and the stator is mounted on the pump housing via a one way clutch (sprag).

The addition of the damper and piston assembly enables the torque converter to 'lock-up' under favourable conditions. Lock-up is only permitted to occur in third and fourth gears under specified throttle and road speed conditions.

Lock-up is achieved by applying hydraulic pressure to the damper and piston assembly which couples the turbine to the converter cover, locking-up the converter and eliminating unwanted slippage. Whenever lock-up occurs, improved fuel consumption is achieved. Torsional damper springs are provided in the damper and piston assembly to absorb any engine torque fluctuations during lock-up.

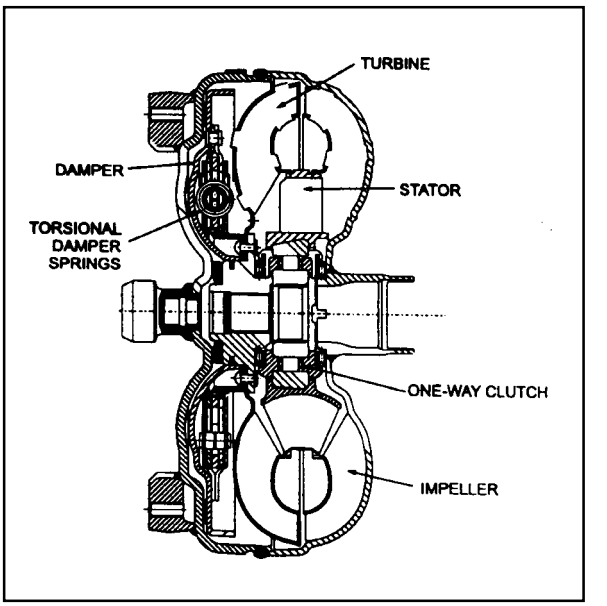


Figure 4.2 - Torque Converter Cross Section

CLUTCH PACKS

There are four clutch packs (refer to figure 4.3). All clutch packs are composed of multiple steel and friction plates.

C1 CLUTCH When applied, this clutch pack allows the input shaft to drive the planet carrier.

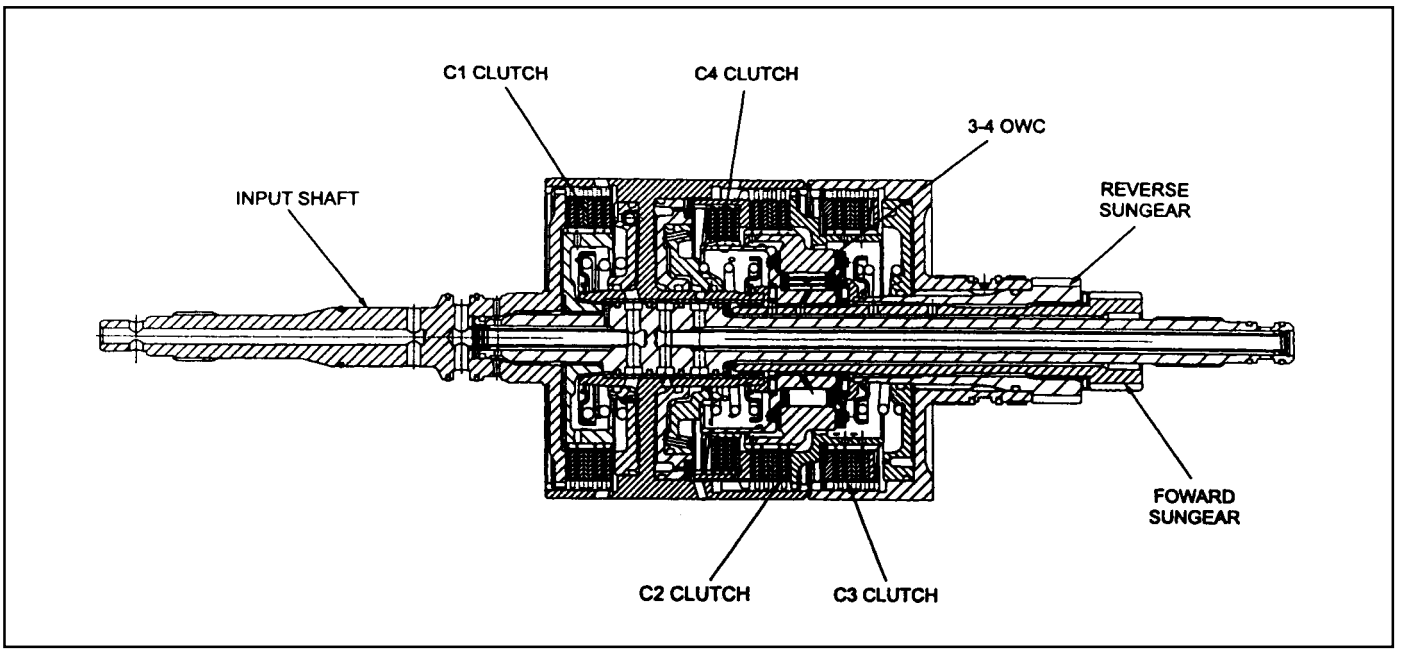
This occurs in third and fourth gears.

C2 CLUTCH When applied this clutch pack allows the input shaft to drive the forward sun gear via the 3-4 OWC. This occurs in all forward gears.

C3 CLUTCH When applied this clutch pack allows the input shaft to drive the reverse sun gear. This only occurs in reverse gear.

C4 CLUTCH When applied this clutch provides engine braking on overrun. This occurs in Manual 1, 2 and 3 and also Drive 2 and Drive 3 to prevent objectionable free wheel coasting.

Figure 4.3 - Clutch Packs



BANDS

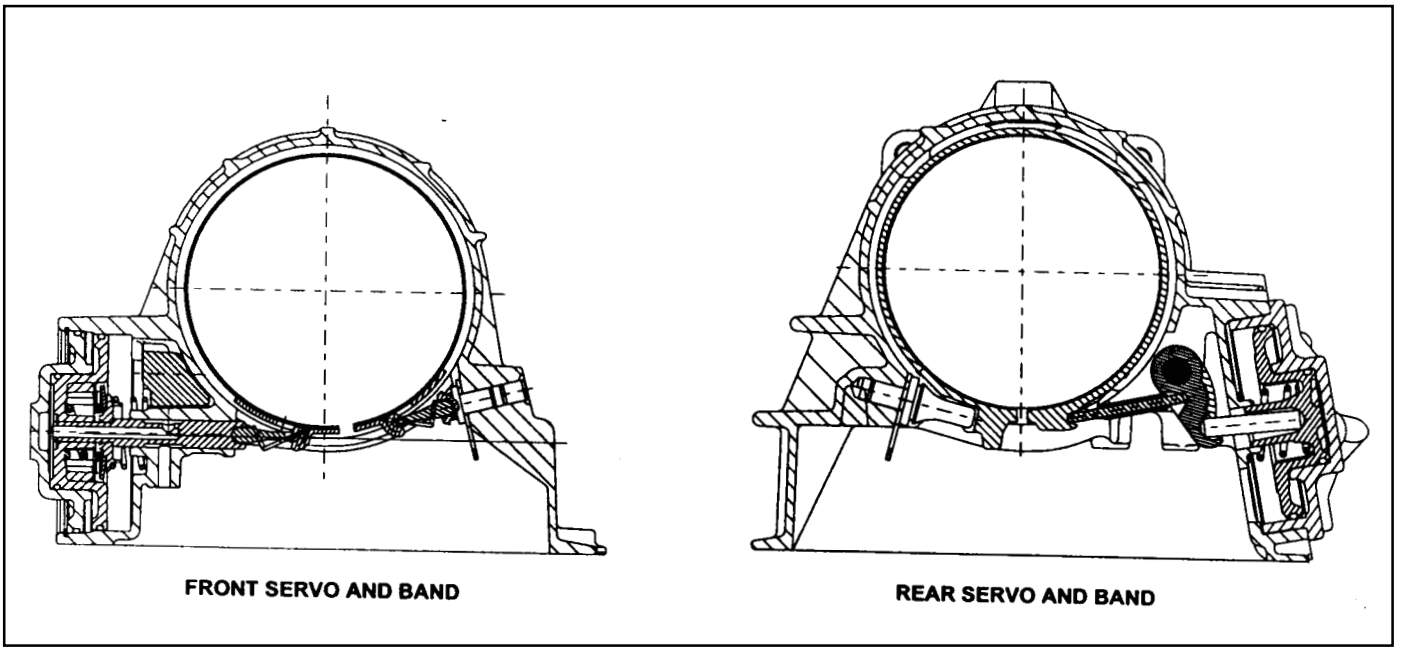
The transmission utilises two bands, the B1 band (sometimes known as the 24 band), and the B2 band (sometimes known as the low-reverse band). Refer to figure 4.4.

The B1 band is a flexible band which is engaged by the front servo piston. B1 is activated in second and fourth gear. When activated B1 prevents the reverse sun gear from rotating by holding the C3 clutch assembly stationary. In second gear only the outer area of the apply piston is utilised. In fourth gear both areas are utilised for greater clamping force.

The B2 band is a solid band which is engaged by the rear servo piston. B2 is activated in Park,

Reverse, Neutral and Manual 1. When activated B2 prevents the planet carrier assembly from rotating. In Manual 1 only the inner area of the apply piston is utilised. In Park, Reverse and Neutral, both areas are utilised for greater clamping force.

Figure 4.4- Bands



ONE WAY CLUTCHES

The transmission uses two OWCs, the 1-2 OWC and the 34 OWC. (Note that a third OWC is located in the torque converter, also known as a sprag.)

The 1-2 OWC is located between the planetary carrier assembly and the centre support. This allows the carrier to rotate around the centre support in one direction only. The one way clutch is engaged only in Drive 1.

The 3-4 OWC is located between the C4 and the C2 clutch assemblies. This allows the C2 clutch to drive the forward sun gear in first, second and third gears but unlocks in fourth gear and during overrun.

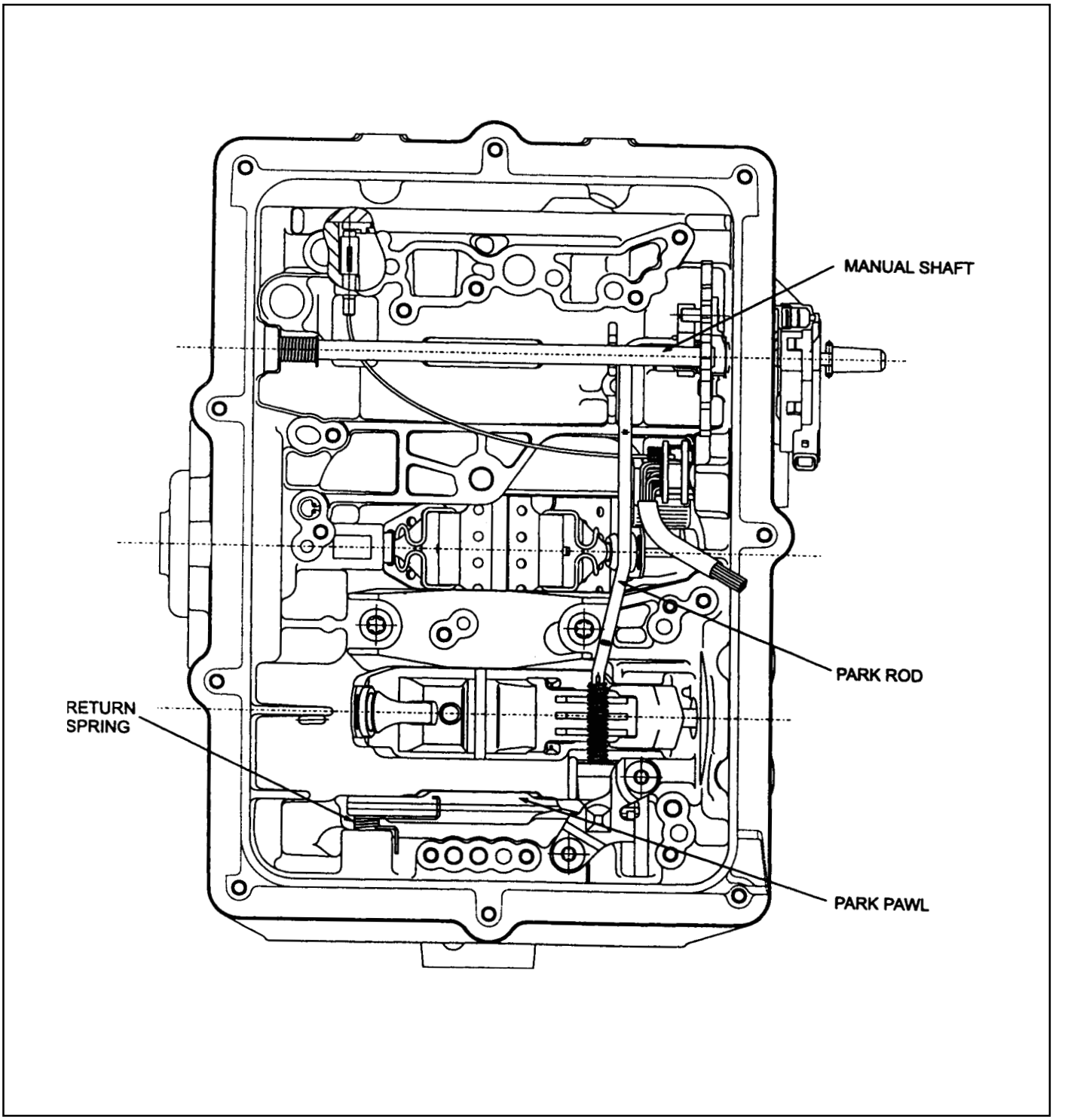
PLANETARY GEAR SET

The planetary gear set used in the transmission is a conventional six pinion Ravigneaux compound gear set.

PARKING MECHANISM

When Park is selected the manual lever extends the park rod rearwards to engage the parking pawl (refer to (figure 4.5). The pawl will engage the external teeth on the ring gear thus locking the output shaft to the transmission case. When Park is not selected a return spring holds the parking pawl clear of the output shaft, preventing accidental engagement of Park.

Figure 4.5 - Park Rod and Cross Shaft



POWER FLOWS

INTRODUCTION

The power flows for the various transmission selections are listed below:

- Power Flow - Neutral and Park
- Power Flow - Reverse
- Power Flow - Manual 1
- Power Flow - Drive 1
- Power Flow - Drive 2
- Power Flow - Drive 3
- Power Flow - Drive 3 Lock Up
- Power Flow - Drive 4 (Overdrive)
- Power Flow - Drive4 Lock Up

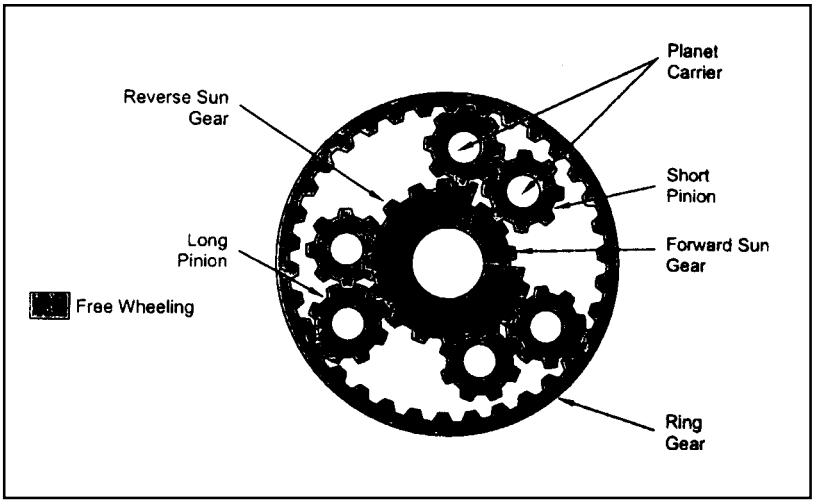
Each power flow is described in the following sections.

Table 5.1 details the engaged elements versus the gear selected for all transmission selections.

Figure 5.1 - Engaged Elements vs Gear Selected

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-
Reverse	-	-	X	-	-	X	-	-	-
Manual 1	-	X	-	X	-	X	-	X	-
Drive 1	-	X	-	-	-	-	X	X	-
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X
Drive 4 Overdrive	X	X	-	-	-	-	-	-	-
Drive 4 Lock Up	X	X	-	-	-	-	-	-	X

Planetary Gear Set



POWER FLOW - PARK AND NEUTRAL

In Park and Neutral, there is no drive to the planetary gear set. The rear band is applied to eliminate 'clunk' on engagement of the reverse gear, and to improve the low range engagement for 4WD applications. No other clutches or bands are applied.

In Park the transmission is mechanically locked by engaging a case mounted pawl with teeth on the output shaft ring gear.

Control

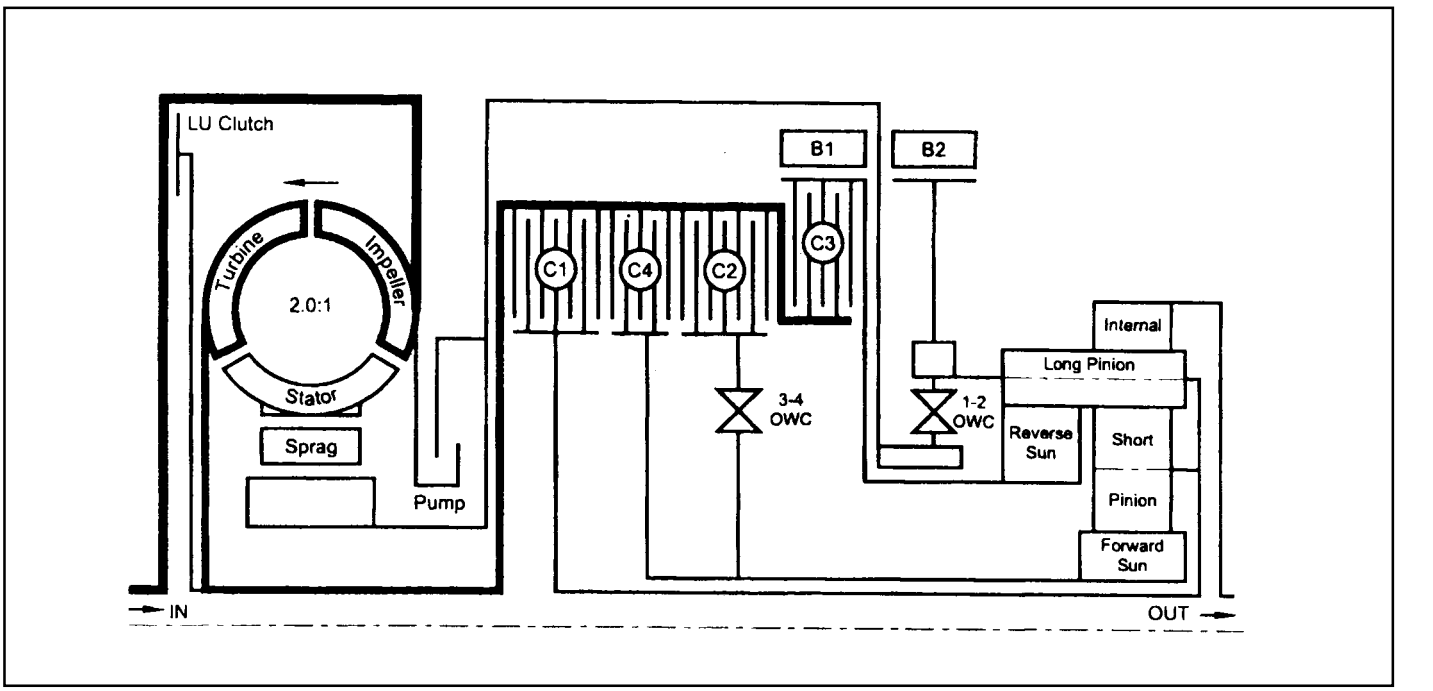
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched off.
- Line (pump) pressure is applied to the primary regulator valve (PRV) and to the solenoid supply valve.
- The converter, oil cooler, and lubrication circuits are charged from the primary regulator valve.
- The line 500 circuit is charged by the solenoid supply valve.
- The S5 circuit is charged by the variable pressure solenoid (S5).
- Line pressure is prevented from entering the drive circuit by the manual valve.
- The B1 circuit and all clutch circuits are open to exhaust.

Refer to figure 5.1 and table 5.2.

Table 5.2 - Engaged Elements - Park arid Neutral

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Park and Neutral	-	-	-	-	-	X	-	-	-



POWER FLOW - REVERSE

In Reverse, transmission drive is via the input shaft and the forward clutch cylinder to the hub of the C3 clutch. The elements of the transmission function as follows :

- The C3 clutch is engaged and drives the reverse sun gear in a clock-wise direction.
- The B2 band is engaged and holds the planetary gear carrier stationary causing the long pinion to rotate anti-clockwise about its axis on the pinion shaft.
- The long pinion drives the internal ring fear in the same direction.
- The internal ring being splined to the output shaft drives it in an anti-clockwise or reverse direction.

Control

To maintain this arrangement in the steady state

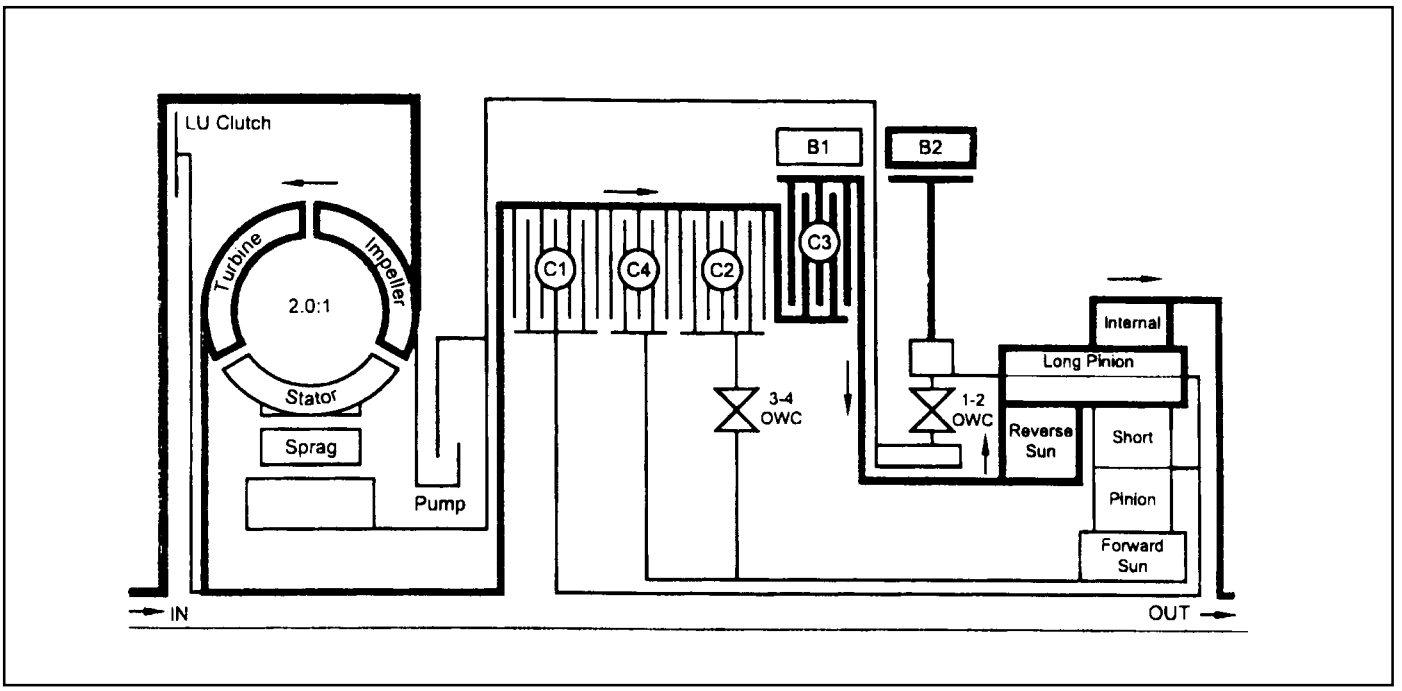
solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched off.
- Line pressure is directed through the reverse lockout valve to both the inner and outer apply areas of the rear servo piston for B2 band application.
- Line pressure feeds the reverse oil circuit via the manual valve.
- Reverse oil is routed from the manual valve to the C3 clutch.
- Reverse oil is also applied to the spring end of the primary regulator valve to assist the spring and to boost the line pressure value.
- All other clutch and band apply circuits are open to exhaust.

Refer to figure 5.2 and table 5.3

Table 5.3 - Engaged Elements - Reverse

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Reverse	-	-	X	-	-	X	-	-	-



POWER FLOW - MANUAL 1

In Manual 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows :

- The C2 clutch is engaged to drive the forward sun gear, via the 3-4 OWC.
- The B2 band is engaged to hold the planetary gear carrier stationary.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The long pinion rotating about its axis drives the internal ring gear and the output shaft in a clockwise or forward direction.
- The C4 clutch provides engine braking through the 3-4 OWC on overrun.

Control

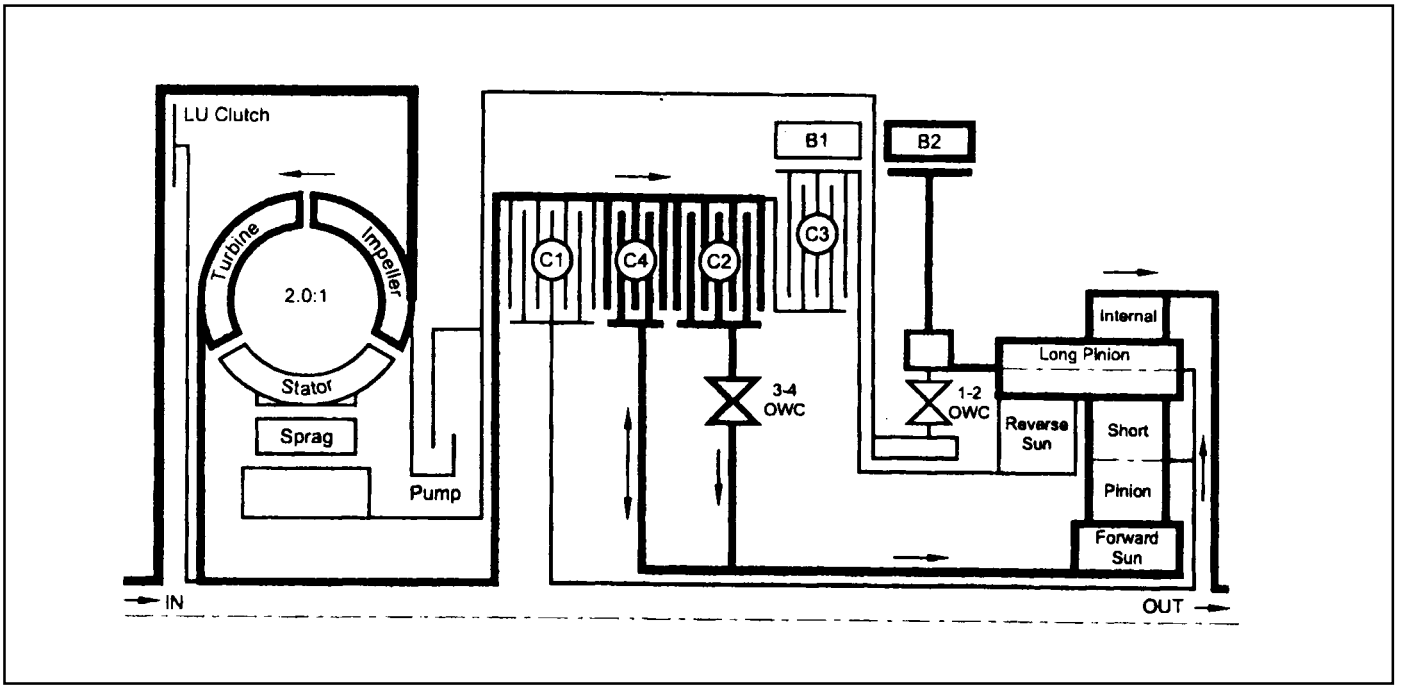
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched ON.
- The 1-2,2-3, and 34 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- Lo-1st (line pressure) oil is routed through the 1-2 shift valve to the C4 clutch, and to the inner apply area of the rear servo piston for B2 band application.

Refer to figure 5.3 and table 5.4.

Table 5.4 - Engaged Elements - Manual 1

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Manual 1	-	X	-	X	-	X	-	X	-



POWER FLOW - DRIVE 1

In Drive 1, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows :

- The C2 clutch is engaged to drive the forward sun gear.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The 1-2 OWC prevents the planetary gear carrier from rotating under reaction force and the long pinion rotates on its axis driving the internal ring gear and output shaft in a clockwise or forward direction.
- There is no engine braking on overrun.

Control

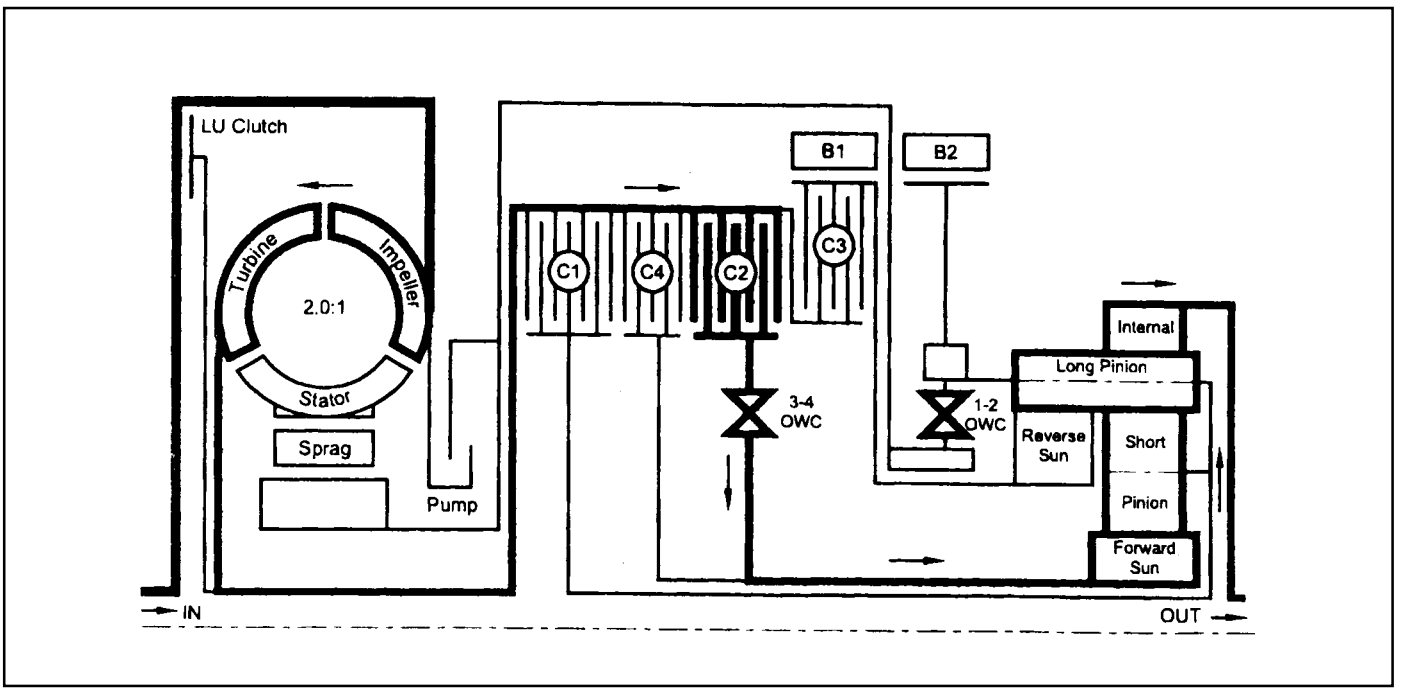
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched On.
- The 1-2, 2-3, and 3-4 shift valves are held in their first gear positions by line 500 pressure.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.

Refer to figure 5.4 and table 5.5

Table 5.5 - Engaged Elements - Drive 1

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 1	-	X	-	-	-	-	X	X	-



POWER FLOW - DRIVE 2 AND MANUAL 2

In Drive 2 and Manual 2, transmission drive is via the input shaft and forward clutch cylinder. The elements of the transmission function as follows :

- The C2 clutch is applied to drive the forward sun gear.
- The forward sun gear drives the short pinion anti-clockwise.
- The short pinion drives the long pinion clockwise.
- The B1 band is applied holding the reverse sun gear stationary therefore the long pinion 'walks' around the reverse sun gear taking the internal ring gear and output shaft with it in a clockwise or forward direction.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

Control

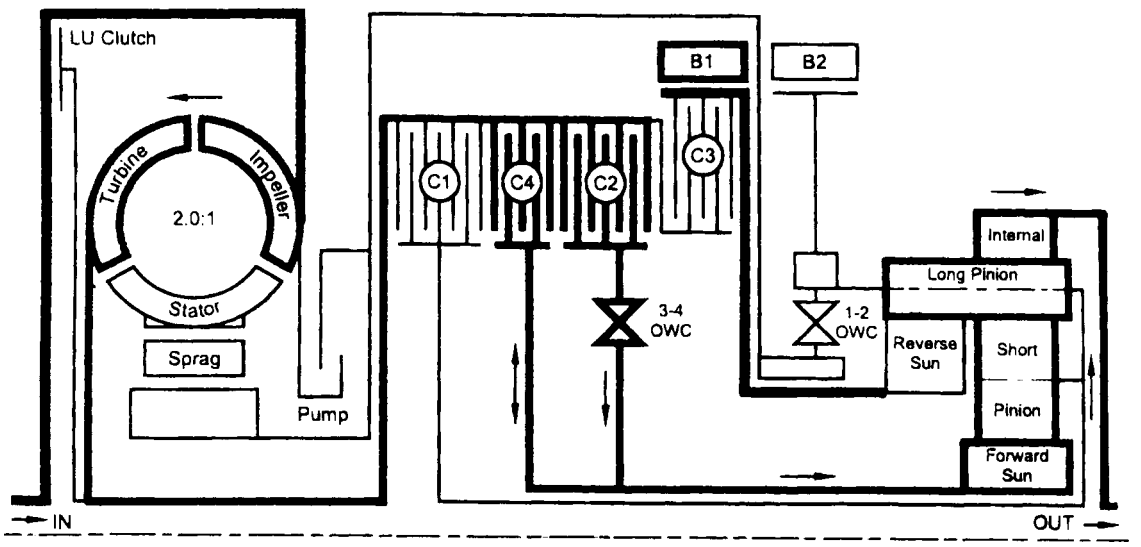
To maintain this arrangement in the steady state solenoids and valves are activated as follows: Solenoid S1 is switched Off. S2 is switched On.

- Solonoid S1 is switched Off. S2 is switched On.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- When S1 switches off , S1 oil pressure, which is derived from line 500 pressure, moves the 3-4 shift valve to the left. At the same time S1 oil is directed to the 1-2 shift valve which moves the valve to the second gear position.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply regulator valve, and to the 2-3 shift valve.
- The band apply regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the band apply feed (BAF) circuit.
- Band apply feed oil is directed to:
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

Refer to figure 5.5 and table 5.6.

Table 5.6 - Engaged Elements - Drive 2 and Manual 2

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 2 and Manual 2	-	X	-	X	X	-	-	X	-


LU Clutch
Turbine
Impeller
2.0:1
Stator
Sprag
Pump
B1
B2
C1
C4
C2
C3
3-4
OWC
1-2
OWC
Internal
Long Pinion
Reverse
Sun
Short
Pinion
Forward
Sun
IN
OUT

POWER FLOW - DRIVE 3 AND MANUAL 3

In Drive 3 and Manual 3, transmission drive is via the input shaft to the forward clutch cylinder. The elements of the transmission function as follows :

- The C2 clutch is engaged to drive the forward sun gear.
- The C1 clutch is engaged to drive the planet carrier.
- The forward sun gear and the planet carrier are driven clockwise at the same speed therefore there is no relative motion between the sun gear and the pinions.
- The ring gear and output shaft are driven in a clockwise or forward direction at input shaft speed.
- The C4 clutch is applied to bypass the 3-4 OWC and provide engine braking on overrun.

Control

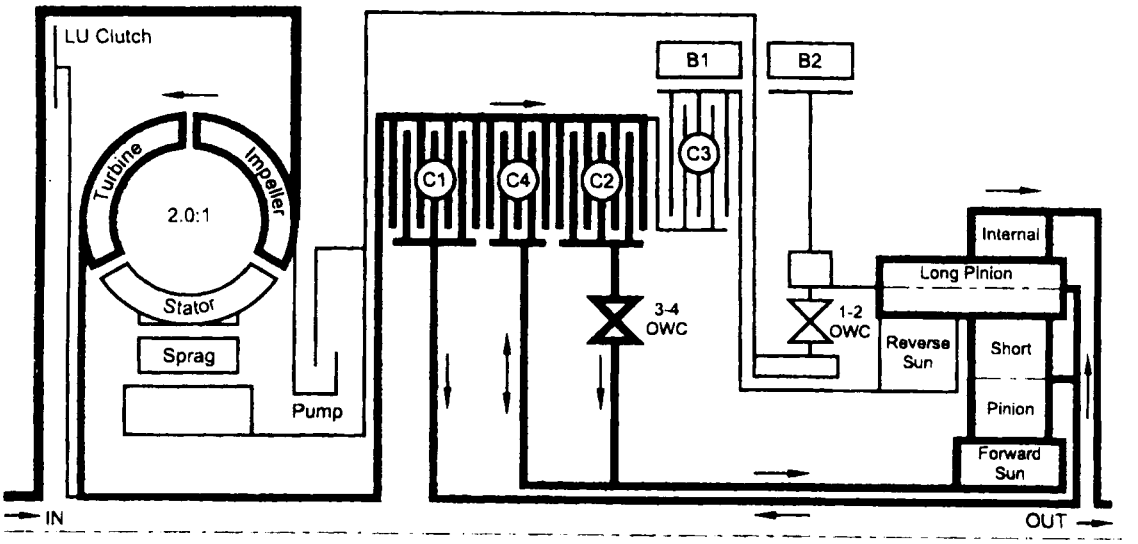
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoid S1 is switched Off. S2 is switched Off.
- With S1 and S2 switched Off, the 2-3 and 3-4 shift valves are held in the third gear position by line 500 pressure.
- The 1-2 shift valve is held in the third gear position by S1-S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply regulator valve. and to the 2-3 shift valve.
- The band apply regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the band apply feed (BAF) circuit.
- Band apply feed oil is directed to:
  - The outer apply area of the front servo
  - The 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
  - The 3-4 shift valve for use when the transmission is shifted into fourth gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 Sequence Valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the clutch apply feed (CAF) circuit.
- The CAF oil is directed to:
  - The C1 clutch
  - The C1 bias valve
  - The 4-3 sequence valve
- At the 4-3 sequence valve the CAF oil becomes band 1 release feed (B1R-F) oil, and is directed through the 3-4 shift valve to the spring end of the 4-3 sequence valve, and to the release side of the front servo piston to hold band 1 off.
- Drive (line pressure) is routed through the 3-4 shift valve to apply the C4 clutch.

Refer to figure 5.6 and table 5.7.

Table 5.7 - Engaged Elements - Drive 3 and Manual 3

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 3 and Manual 3	X	X	-	X	-	-	-	X	-


LU Clutch
Turbine
Impeller
2.0:1
Stator
Sprag
Pump
B1
B2
C1
C4
C2
C3
3-4
OWC
1-2
OWC
Internal
Long Pinion
Reverse
Sun
Short
Pinion
Forward
Sun
IN
OUT

POWER FLOW - DRIVE 3 LOCK UP AND MANUAL 3 LOCK UP

In Drive 3 Lock Up and Manual 3 Lock Up, transmission drive is the same as for Drive 3 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

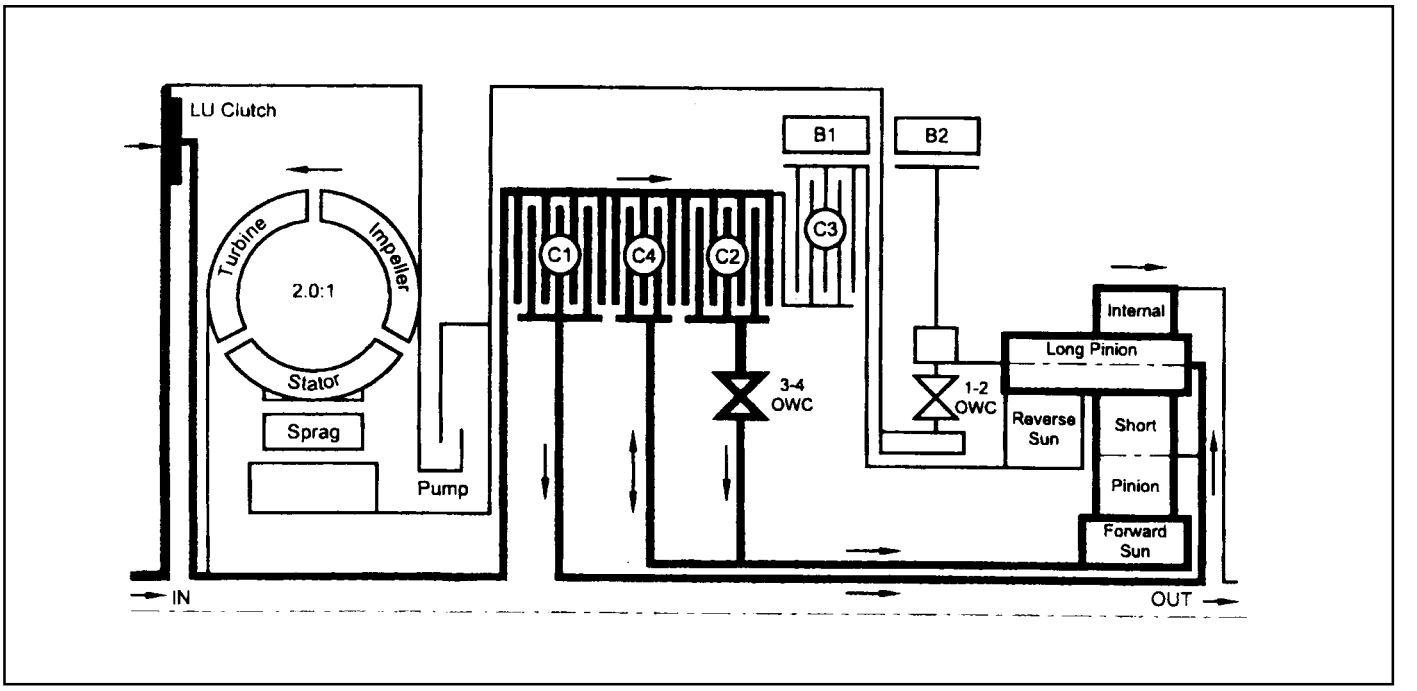
Control for Drive 3 Lock Up and Manual 3 Lock Up is the same as for Drive 3 with the addition of the converter clutch circuit activated by solenoid S7.

- When S7 is switched On, S7 feed oil to the converter clutch control valve is switched off and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, derived from line 500 oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

Refer to figure 5.7and table 5.8.

Table 5.8 - Engaged Elements - Drive 3 Lock Up and Manual 3 Lock Up

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 3 Lock Up and Manual 3 Lock Up	X	X	-	X	-	-	-	X	X



POWER FLOW - DRIVE 4 (OVERDRIVE)

In Drive 4 (Overdrive), transmission drive is via the input shaft to the forward clutch cylinder.

The elements of the transmission function as follows :

- The C1 clutch is applied to drive the planet carrier clockwise.
- The B1 band is applied to hold the reverse sun gear stationary.
- As the planet carrier tuns, the long pinion 'walks' around the stationary reverse sun gear and rotates around its axis driving the internal ring gear and output shaft in a clockwise or forward direction at a speed faster than the input shaft i.e. in overdrive ratio.
- The forward sun gear is also driven faster than the input shaft and overruns the 3-4 OWC.
- The C2 clutch is engaged to reduce the speed differential across the 3-4 OWC.

Control

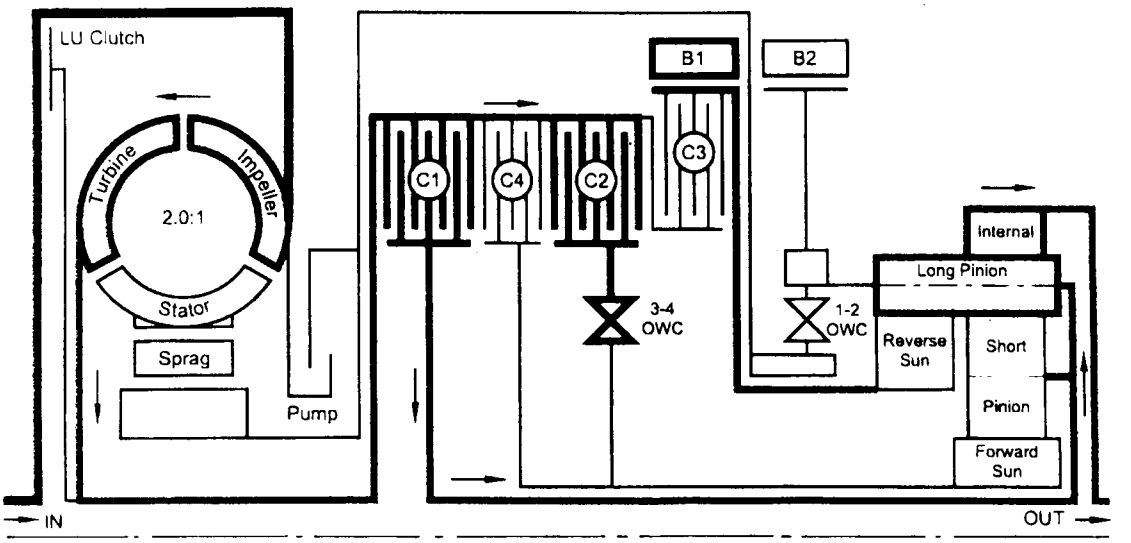
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoid S1 is switched On. S2 is switched Off.
- With S1 switched On the 3-4 shift valve is held in the fourth gear position by line 500 pressure on the small end of the valve.
- With S2 switched Off the 2-3 shift valve is held in the fourth gear position by line 500 pressure on the large end of the valve.
- The 1-2 shift valve is held in the fourth gear position by S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is directed to the band apply regulator valve, and to the 2-3 shift valve.
- The band apply regulator valve supplies 2nd oil (regulated to line pressure multiplied by the valve ratio) to the band apply feed (BAF) circuit.
- Band apply feed oil is directed to:
  - the outer apply area of the front servo
  - the inner apply area of the front servo piston via the 3-4 shift valve
  - the 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear
- 2nd oil at the 2-3 shift valve is directed to the 3rd oil circuit.
- 3rd oil from the 2-3 shift valve is directed to the clutch apply regulator valve, and to the 4-3 Sequence Valve.
- The clutch apply regulator valve supplies oil (regulated to line 500 pressure multiplied by the valve ratio) to the clutch apply feed (CAF) circuit.
- The CAF oil is directed to:
  - the C1 clutch
  - the C1 bias valve
  - the 4-3 sequence valve
- Drive oil (line pressure) from the manual valve engages the C2 clutch

Refer to figure 5.8 and table 5.9.

Table 5.9 - Engaged Elements - Drive 4 (Overdrive)

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 4 (Overdrive)	X	X	-	-	X	-	-	X	-


LU Clutch
Turbine
Impeller
2.0:1
Stator
Sprag
Pump
B1
B2
C1
C4
C2
C3
3-4
OWC
1-2
OWC
Internal
Long Pinion
Reverse
Sun
Short
Pinion
Forward
Sun
IN
OUT

POWER FLOW - DRIVE 4 LOCK UP

In Drive 4 Lock Up, transmission drive is the same as for Drive 4 but with the application of the converter lock up clutch to provide positive no-slip converter drive.

Control

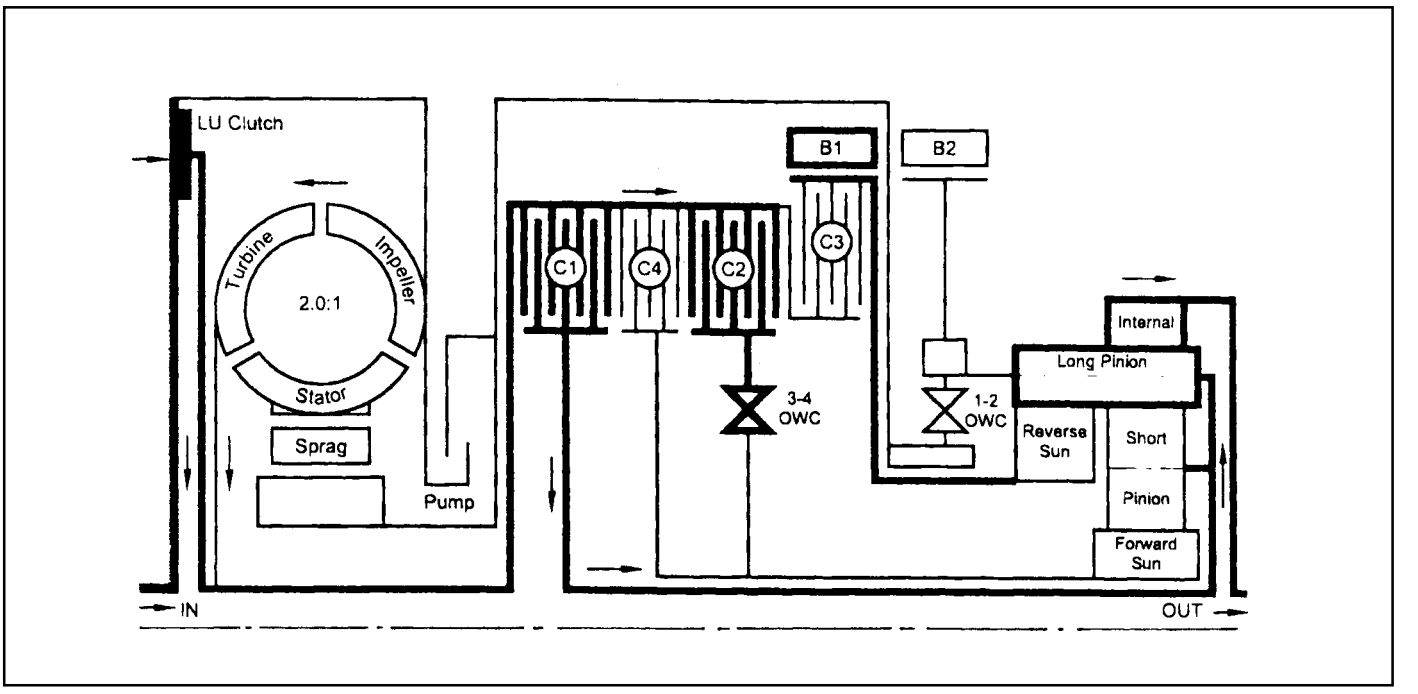
Control for Drive 4 Lock Up is the same as for Drive 4 with the addition of the converter clutch circuit activated by solenoid S7.

- When S7 is switched On, S7 feed oil to the converter clutch control valve is switched off and allowed to exhaust through the S7 solenoid. This allows the valve to move to the clutch engage position.
- Regulated apply feed oil, delved from Line 500 oil at the converter clutch regulator valve, is directed by the converter clutch control valve to the engage side of the converter clutch.
- Converter clutch release oil is exhausted at the converter clutch control valve.
- Converter feed oil is re-routed by the converter clutch control valve directly to the oil cooler and lubrication circuit.

Refer to figure 5.9 arid table 5.10.

Table 5.10 - Engaged Elements - Drive 4 Lock Up

	ELEMENTS ENGAGED								
Gear State	**C1**	**C2**	**C3**	**C4**	**B1**	**B2**	**1-2 OWC**	**3-4 OWC**	**LU CLUTCH**
Drive 4 Lock Up	X	X	-	-	X	-	-	-	X



DIAGNOSIS

DIAGNOSTIC SYSTEM

Recommended Test Equipment and Procedure

The test equipment is designed to be used with the control modules in all vehicles. The components used in the transmission application are:

- Multi Function Tester, and
- Appropriate vehicle for testing.

Multi Function Tester (MFT)

The MFT is programmed with the special vehicle diagnostic software that allows selection of the unit under test.

The program allows the proper communication to the Transmission Control Unit (TCU).

It then requests information from the user via a menu system to select the required set up.

Examples are viewing codes, clearing error codes, and real-time operation. Set up and operation instructions are detailed in the user manual.

This equipment can be used by trained personnel such as technicians and mechanics to diagnose electronic and wiring problems relating to the vehicle transmission. Information that is available includes engine and road (shaft) speed, transmission oil temperature, throttle position, solenoid/gear status and gear lever position. Current and stored faults detected by the electronics are also available.

TCU Pin Description

The TCU pin descriptions are listed in table 6.1.1.

The wiring loom pins are shown in figure 6.1.1

Table 6.1.1 - TCU Pin Description

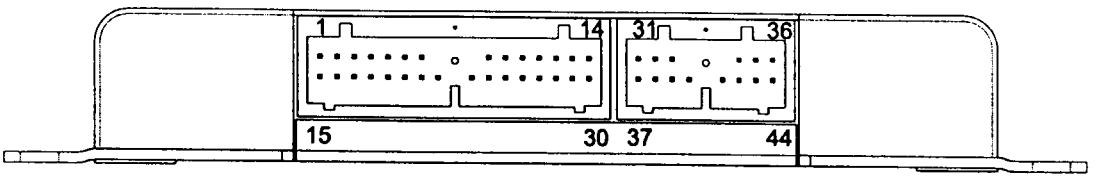
Pin No.	Identification	Type	4WD (Diesel)	4WD (Gas)	Description
1	Common Ground	GND	●	●	Main power ground (or the module. Connects directly to the battery negative terminal.
2	Do not use	-	O	O	
3	Mode Indicator Lamp - 'Winter'	OP	●	●	Indicates 'WINTER' mode shift schedule is selected.
4	Gear Position 'Park' Lamp	OP	●	●	Drives the jewel in the instrument cluster to indicate 'PARK' gear lever position.
5	Gear Position 'Reverse' Lamp	OP	●	●	Drives the jewel in the instrument cluster to indicate 'REVERSE' gear lever position.
6	Gear Position 'Neutral' Lamp	OP	●	●	Drives the jewel in the instrument cluster to indicate 'NEUTRAL' gear lever position.
7	Do not use	-	O	O	
8	Engine Speed Input Sensor (-Ve)	IP	●	O	Flywheel/Ring gear pulses to indicate engine speed.

Pin No.	Identification	Type	4WD (Diesel)	4WD (Gas)	Description
9	Mode Indicator Lamp - 'Power'	OP	●	●	Indicates 'POWER' mode shift schedule is selected.
10	Throttle Position Sensor Output as Pulse Width Modulation for TOD	OP	O	O	Provides an analogue signal of the throttle position for the Torque on Demand (TOD) Control Module.
11	Air Conditioner Input Signal	-	●	O	Input
12	Kickdown Switch	IP	●	●	Switch to indicate when a kickdown is required at high throttle position.
13	Mode Switch	IP	●	●	Switch to select 'NORMAL', 'POWER' or 'WINTER' shift schedule. Voltage varies from OV to 12V.
14	Transfer Case Input (High) -4WD Lamp High	IP	●	●	Switch to indicate 4WD'HIGH RANGE' is selected.
15	Ignition Switch	IP	●	●	Ignition power is used as the main power source to drive the unit and the solenoids.
16	Do not use	-	O	O	
17	Gear Position '1' Lamp/ Gear Position Code 1	OP	●	●	Drives jewel in the instrument cluster to indicate
18	*Gear Position '2' Lamp/ Gear Position Code 2*	OP	●	●	gear leverposition'1'. Drives jewel in the instrument cluster to indicate
19	Gear Position '3' Lamp/ Gear Position Code 3*	OP	●	●	gear lever position'2'. Drives jewel in the instrument cluster to indicate gear lever position'3'.
20	Gear Position 'Drive' Lamp/ Gear Position Code 4*	OP	●	●	Drives jewel in the instrument cluster to indicate 'DRIVE'. gear lever position.
21	CAN (-ve)	I/O	O	●	CAN low side bus communication (CANL).
22	CAN (+ve)	I/O	O	●	CAN high side bus communication (CANH).
23	K-line Communication Link	I/O	●	●	Diagnostic information and vehicle coding.
24	Engine Speed Input Sensor (+ve)	IP	●	O	Flywheel/Ring gear pulses to indicate engine speed.
25	Road Speed Pulses	OP	●	●	Road speed signals derived from shaft speed sensors.
26	Shaft Speed Sensor Signal	IP	●	O	This sensor transmit shaft speed signal to the TCU.
27	Throttle Position Sensor - Ground	GND	●	O	Throttle position sensor ground.
28	Throttle Position Sensor - Reference	REF	●	O	This is the 5V reference voltage supply generated by the unit for the throttle position sensor.
29	Throttle Position Sensor - Input Signal	IP	●	O	This sensor is a resistance potentiometer indicating throttle position. Voltage varies 0V to 5V.
30	Transfer(or Case Input (Low) - 4WD Lamp Low	IP	●	●	Switch to indicate 4WD'LOW RANGE' is selected.

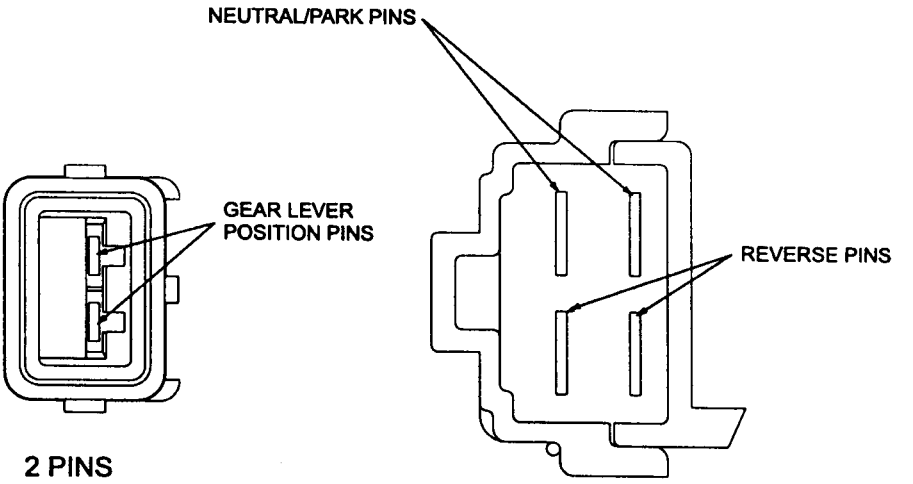
Pin No.	Identification	Type	4WD (Diesel)	4WD (Gas)	Description
31	Gear Lever Position	IP	●	●	This switch has discreet values indicating the positions selected by the gear shift lever (PRNDL). Voltage varies 0V to 5V.
32	Transmission Oil Temperature	IP	●	●	Resistive sensor indicates transmission temperature . High R = low temp Low R = high temp Voltage varies 0V to 5V.
33	Solenoid 4	OP	●	●	On/Off solenoid normally open, combines with other On/off solenoid 3 for shift quality and sequencing.
34	Solenoid 1	OP	●	●	On/off solenoid normally open, combines with other On/off solenoid to set the selected gear.
35	Do not use	-	O	O	
36	Solenoid 5 Return (-ve)	IP	●	●	This ensures the earth path for the VPS and the current in this line is monitored to give feedback control of the VPS.
37	Gear Lever Position - Ground	GND	●	●	PRNDL switch ground.
38	Transmission Oil Temperature - Ground	GND	●	●	Ground reference for temperature sensor input.
39	Solenoid 6	OP	●	●	On/Off solenoid normally open, sets low/high line pressure.
40	Solenoid 2	OP	●	●	On/off solenoid normally open, combines with other On/off solenoid to set the selected gear.
41	Solenoid 3	OP	●	●	On/off solenoid normally open, combines with On/off solenoid 4 for shift quality and sequencing.
42	Solenoid 7	OP	●	●	On/off solenoid normally open, locks up the torque converter to Increase cruising efficiency.
43	Do not use	-	O	O	
44	Solenoid 5 (+ve)	OP	●	●	This is the variable force solenoid which ramps the pressure during gear changes and solenoid switching, to enhance transmission shift quality.

Notice : ● = circuit connected
O = circuit not connected
* = unique
OP = Output
IP = Input
I/O = Input/output
GND = Ground
REF = Reference

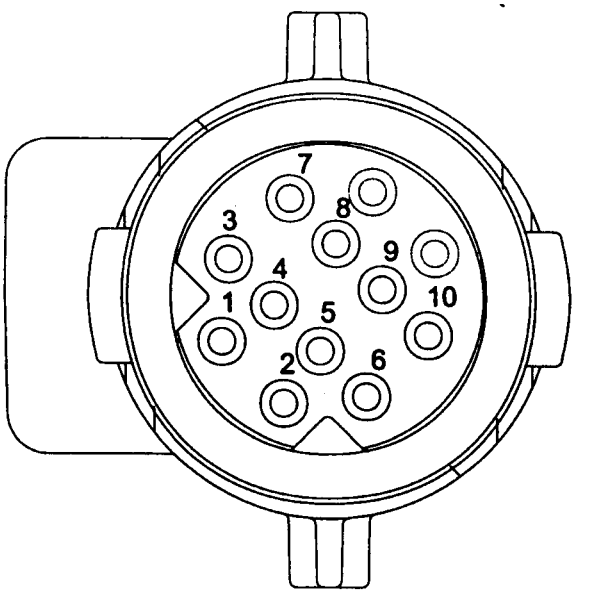
Figure 6.1.1 - Wiring Loom Pins



Transmission Control Unit (TCU) Pin Numbers



Inhibitor Switch Pins



4WD

Ten Pin Plug Pin Numbers

Default Transmission Operating Modes

The TCU relies on accurate information from its inputs and complete control of its outputs to effectively control the transmission. To ensure that it has both valid inputs and functioning outputs, the TCU carries out both hardware and software fault detection routines. The TCU will respond to any faults detected by adopting the operating modes which are detailed below.

The following symptoms of faults are the most obvious results of each fault under 'normal' conditions.

There is always the possibility that a fault may not be detected. If undetected fault conditions are present, the operation of the transmission is difficult to predict.

1 Throttle Fault

- All shifts will occur as if a nominal throttle (approx. 44%) were applied for shift scheduling.
- All shifts will be firm as full throttle and hence high engine torque is assumed.
- The torque converter will be unlocked at all times.
- All downshifts initiated by the shift lever will occur as though they were 'automatic' shifts. That is the engine braking effect will not occur until near the end of the shift.
- Line pressure will always stay high (solenoid 6 OFF) to cope with assumed high throttle/torque.

If a fault is undetected, the percent throttle is most likely to be interpreted as higher than actual, resulting in late upshifts, early downshifts, firm shifting and a harsh 3-1 shift when stopping.

2 Throttle Not Learnt Fault

The transmission operates from default throttle calibration values which results in the evaluation of the throttle being higher (more open) than it is. There(ore at zero throttle settings, the transmission may calculate that sufficient throttle opening is present to justify high line pressure and switch solenoid 6 to OFF.

Other symptoms are:

a. late upshifts and

b. lock-up maintained at zero throttle when the vehicle speed is sufficiently high.

3 Engine Speed Fault

- All shifts will be firm because an engine speed corresponding to peak engine torques is assumed.

If a fault is undetected, the engine speed is likely to be interpreted as stalled resulting in soft shifting possibly with an end of shift bump.

4 Vehicle Speed Sensor Fault

- All shifts will be controlled by the shift lever with skip downshifts disabled and downshifts only allowed if the engine speed is low. Fourth gear will be inhibited.
- The torque converter will be unlocked at all times.

If a fault is undetected, the vehicle is likely to be interpreted as being stationary resulting in first gear operation at all times. Note that speedometer transducer faults are likely to cause the vehicle's speedometer to become inoperative.

5 Gear Lever Fault (Inhibitor/PRNDL Switch)

- The gear lever is assumed to be in the Drive position.
- The transmission is limited to 2nd,3rd, and R gears only.
- The rear band will apply at all times when the lever is shifted to P, R or N. (B2 inhibition and reverse lockout protection is disabled.)
- The torque converter will be unlocked at all times.
- Manually (gear lever) initiated downshifts will not be available.

If a fault is undetected, the gear lever position is likely to be interpreted as being higher than actual. Where Park is the highest position and Manual 1 is the lowest, the result being the availability of higher gears than selected by the gear lever.

If the gear lever is incorrectly adjusted, the transmission may shift gears on bumpy road surfaces.

6 Transmission Oil Temperature Sensing Fault

- All shifts will be firm until the transmission has warmed up, because a high transmission oil temperature is assumed.

If a fault is undetected, the temperature is likely to be evaluated as being lower than actual, resulting in softer shifts with 'end bump' (very firm feel at the end of the shift).

7 Mode Setting Fault

- All shifts will occur as if the mode is set to 'NORMAL'.
- The mode indicator will always be off indicating that 'NORMAL' mode is selected.
- The mode indicator will not respond to changes in switch setting.

If a fault is undetected, the mode as indicated by the mode indicator is not likely to respond to the mode switch.

8 Battery Voltage Sensing Fault

If the battery voltage is low then shifts to first gear are inhibited.9 the battery voltage is high (>16.5V) then the transmission goes into limp home (LHM) mode.

If a fault is undetected, the transmission is likely to incorrectly evaluate an ON/OFF solenoid fault resulting in limp home mode (LHM) operation.

9 ON/OFF Solenoid Fault (Solenoids 1,2,3 and 4)

The transmission adopts its limp home mode (LHM) operation, described above. However, if solenoid 1 is faulty then the fourth gear LHM strategy will be adopted independent of vehicle speed.

If a fault is undetected, the operation of the transmission is dependent on which solenoid is actually faulty. The characteristics for different solenoid fault conditions are listed in table 6.1.2.

10 ON/OFF Solenoid Fault (Solenoids 6,7)

If solenoid 6 is found faulty it is always disabled resulting in high line pressure being applied continuously.

If solenoid 7 is found faulty it is disabled resulting in the transmission being locked always.

The transmission does not go into LHM.

11 Variable Pressure Solenoid Fault

The transmission adopts its LHM operation.

If a fault is undetected, the transmission shift feel is likely to be poor for all shifts.

12 Software Fault

The transmission adopts the third gear LHM strategy of operation, independent of vehicle speed. The operation of the TCU under this condition is difficult to predict. Its operation may be erratic.

If a fault is undetected, the operation of the TCU is likely to be erratic.

13 Power Supply Fault

The transmission adopts the third gear LHM strategy of operation, independent of vehicle speed. If there is an intermittent power supply connection, the TCU will power-up in fourth gear and then shift to the appropriate gear to satisfy the conditions present. The power supply is not monitored for fault evaluation.

All faults except for solenoid faults can be recovered without having to turn the TCU off and back on. However, in general the recovery requires that no faults are present for a period of time (approx. 3 or 30 seconds). Recovery from a fault will not clear the fault from the keep alive memory

14 Transmission Sump Temperature Exceeding 135°C

- The converter lockup clutch will be applied at lower speeds, causing a shudder through the vehicle.
- The mode indicator will flash in some vehicles.

These faults can be due to the transmission oil overheating or due to an incorrect signal received from the temperature sensor.

Diagnostic Trouble Messages

The diagnostic trouble messages generated by the TCU and their possible causes are listed in table 6.1.3.

Table 6.1.2 - Transmission Operations for On/Off Solenoid Faults

Solenoid	Condition	Transmission Operation
1	Always ON	First gear instead of second and fourth gear instead of third. This results in a 1® 4 shift as the vehicle accelerates from rest.
	Always OFF	Second gear instead of first and third gear instead of fourth. This results in second gear starts.
2	Always OFF	Fourth gear instead of first and third gear instead of second. This results in fourth gear starts.
	Always ON	Second gear instead of third and first gear instead of fourth. This results in a 1® 2 then 2® 1 (overrun) downshift as the vehicle accelerates from rest.
3	Always OFF	The following shifts become poor: 1® 3, 1® 4, 2® 1 2® 3, 2® 4, 4® 2, 4® 1.
	Always ON	The following shifts become poor: 3® 4, 4® 3, 3® 2. There may be slippage in the gears during torque converter locking.
4	Always OFF	The following shifts become poor: 1® 2, 1® 3, 1® 4, 2® 3, 2® 4, 3® 1, 3® 2 (All Including Manual), 3® 4, 4® 1,4® 3.
	Always ON	The following shifts become poor: 2® 4, 3® 2. There may be slippage in the gears during torque converter locking.
6	Always OFF	Line pressure always high.
	Always ON	Line pressure always low thus resulting in risk of slippage in gears.
7	Always OFF	Torque converter always unlocked.
	Always ON	Torque converter always locked in 3rd and 4th gears, causing the vehicle to shudder at lower speeds,

Table 6.1.3 - Diagnostic Trouble Messages

Solenoid	Condition	Description / Cause
1	Test Pass	There have been no faults recorded since the TCU was last cleared. If the fault history has never been cleared, then there have been no faults recorded since the TCU was originally powered up.
2	Transmission Control Module Fault	There is an internal fault within the TCU.
3	Battery Voltage Input Fault	The voltage measured by the TCU corresponding to the battery supply voltage has been outside the range of the maximum operating voltage of 16.5 volts. The minimum operating voltage depends on the transmission temperature but is typically between 8-9 V for a warm transmission.
4	Throttle Input Fault	The voltage measured by the TCU from the throttle potentiometer has been outside acceptable levels. This would typically indicate a loose connection in the wiring to, or within, the throttle sensor which has caused the signal at the TCU to read 0V or 5V.
5	Temperature Input Fault	The voltage measured by the TCU across the temperature Input terminals has been outside acceptable levels. This would typically be caused by a loose connection or short to ground in the wiring to, or within, the temperature sensor which has caused the signal at the TCU to read 0V or 5V.
6	Shift Lever Position Input Fault (Inhibitor/PRNDL Switch)	The voltage measured by the TCU across the shift lever input terminals has been outside acceptable levels for a significant length of time. This would typically be caused by a loose connection or short to ground in the wiring to, or within, the inhibitor switch which has caused the signal at the TCU to read 0V or 5V.
7	Engine Speed Sensor Fault	The signal from the ignition, of ignition pulses, has either been non-existent or has been unreliable. There are two reasons this fault could occur. The first is due to a lack of ignition pulses when other TCU inputs would indicate that the engine is running, that is the gear lever is in a driving position, the throttle is applied and vehicle speed increasing. The second cause of this (aunt is the frequency of the pulses of the ignition pulse input to the TCU indicate an unachievable engine speed.
8	Shaft Speed Sensor Fault (Speedo Sensor)	The pulses from the shaft speed sensor have either been non-existent or have been unreliable. There are three reasons this fault could occur. The first is due to a sudden loss of speedometer pulses at a time when they were fre quent, thus indicating an unachievable degree of deceleration of the drive line. The second cause of this fault is that the frequency of the pulses on the shaft speed sensor input to the TCU indicate an unachievable propeller shaft speed. The third is the presence of a high engine speed in a driving gear with no speedometer pulses.

Solenoid	Condition	Description / Cause
9	Mode Switch Input Fault (Power/Economy Mode)	The signal from the mode switch is unreliable. This fault is caused by too many changes in the mode input signal over a period of time. Typical causes would be an intermittent connec tion in the switch or wiring or an intermittent short to ground in the wiring.
10	Data Output Link Fault	The data link between the TCU and the engine management module is found to be unreliable because the checksum, or the data received, did not match the correct checksum. This could be caused by an open circuit, short circuit to ground or a loose connection in the link wire itself.
11	On/off Solenoid Fault (Solenoid 1,2,3,4,6,7)	Each solenoid in turn is switched off if it was energised, or switched on if it was not energised by a very small 100 ms pulse. This pulse is too short for the solenoid to react so transmission operation is not af fected. The solenoid feedback voltage is measured before the 100 ms pulse and again during the pulse. If the difference is outside the acceptable limits the relevant fault messages are set. Typical causes would be an open circuit in the wiring to or within the solenoid, or a short circuit to ground in the wiring to, from or within the solenoid in question. If several of these fault codes are presents check the wiring or connectors that are common to the selected solenoids, especially the earth connections. The state of the solenoid feedback voltage is outside acceptable limits but the faulty solenoid could not be isolated.
12	Solenoid 5 Fault (Variable Pressure Solenoid)	The current to solenoid 5 was outside acceptable limits. This fault results from a mismatch between the current set point for solenoid 5 and the current measured by the feedback within the TCU. Typical causes would be an open circuit or short circuit to ground in the wiring to, from or within the solenoid. It is also possible that there has been a fault in the solenoid output circuit. If this is the case however, the fault should be continually present.
13	Throttle Not Learnt	The closed throttle position has not been learnt. This fault may be caused by the transmission not having reached normal operating temperature or the engine idle speed being incorrect. The TCU will learn the closed throttle position automatically when the transmission is brought to normal operating temperature and the engine is allowed to idle in Drive with the 'base idle' correctly set and the air conditioner (if fitted) switched off.

MECHANICAL TESTS

In Vehicle Transmission Checks

Carry out the following tests before removing the transmission.

- See Checking Transmission Fluid Level, Section 7.2.1.
- Check that the transmission oil is not burnt (colour and smell are correct).
- Ensure that the transmission is not in limp home mode (LHM).
- Check that the battery terminals and the earth connections are not corroded or loose.
- Check the engine stall speed is within the handbook value.
- Check that the cooler flow is not restricted.
- Check that all electrical plug connections are tight.
- Carry out a road test to confirm the symptoms, if necessary.
- Inspect the oil, ensure that there are no metal or other contaminants in the oil pan.

Diagnosing Oil Leaks

Determine the source of oil leaks by firstly cleaning down the affected area, then driving the vehicle.
Inspect the seals to confirm the source of the leak.

- To determine the source of a rear servo oil leak, raise the vehicle on a hoist, then carry out a reverse stall.
- To determine the source of a front servo leak, raise the vehicle on a hoist, then run the vehicle in second gear.

Troubleshooting Charts

The troubleshooting charts are set out as follows:

- Table 6.2.1 Drive Faults,
- Table 6.2.2 Faulty Shift Patterns.
- Table 6.2.3 Shift Quality Faults.
- Table 6.2.4 After Teardown Faults.

Table 6.2.1 - Drive Faults

Symptom	Possible Cause	Action
No Drive in D	Insufficient auto transmission fluid.	Check the fluid level. Top up as necessary.
	Blocked feed in C1/C2 cylinder.	Inspect and clean C1/C2 feed.
	'Z' link displaced.	Reinstall/renew the 'z' link.
	Primal regulator valve (PRV) jammed open.	Remove, clean and re-install the PRV.
	Overdrive shaft or input shaft seal rings failed.	Inspect and replace as necessary.
	3-4 or 1-2 one way clutch (OWC) installed backwards or failed.	Inspect and replace as necessary.
	C2 piston broken or cracked.	Inspect and replace as necessary.
No Drive in Reverse		
No engine braking in Manual 1	Rear band or servo faulty.	Check servo adjustment or replace rear band as necessary.
Engine braking in Manual 1 is OK	Failure in C3, C3 hub or C1/C2 cylinder.	Check for failure in C3, C3 hub or C1/C2 cylinder. Repair as necessary.
No drive in Drive and Reverse	Jammed primary regulator valve (PRV).	Inspect and clean PRV.
	Damaged/broken pump gears.	Inspect and replace pump gears as necessary.
	Dislodged output shaft snap ring.	Inspect and repair as necessary.

Symptom	Possible Cause	Action
2-3 shift only (no 4th or 1st)	S1 always OFF.	Inspect S1. Repair or replace as necessary. Check for 12 Volts applied to S1 at all times or for wiring fault.
1-4 shift only 1-3-4 (Delayed 1-2shift)	S1 always ON.	Inspect S1. Repair or replace as necessary. Check for 12 Volts applied to S1 at all times or for wiring fault.
4-3 shift only	S2 always OFF.	Inspect S2. Repair or replace as necessary. Check for open circuit or wiring fault.
1-2-Neutral (1st over run)	S2 always ON.	Inspect S2. Repair or replace as necessary. Check for open circuit or wiring fault.
1-3 shift only	B1 failed. Loose band adjustment. Front servo piston or seal failed. S1/S2 ball misplaced,	 Inspect and adjust as necessary. Inspect and repair as necessary. Inspect and replace or refit as necessary.
1-3-4 only	Smaller'0'ring on front servo piston failed or missing. 2-3 shift valve jammed.	Inspect 'O' ring. Refit or replace as necessary. Inspect the 2-3 shift valve. Repair or replace as necessary.
1-2-1 only	C1 clutch failed or slipping in 3rd and 4th. (Gives 1st in 3rd and 2nd in 4th.)	Inspect C1 clutch. Repair or replace as necessary.
No manual 4-3,3-2 or 2-1	Over-run clutch (OC)/low ball misplaced. C4 failed or C4 wave plate broken.	Inspect ball. Refit or replace as necessary. Inspect C4. Repair C4 or replace C4 wave plate as necessary.
No manual 1st	Rear band slipping when hot. Reverse/Low-1st ball misplaced. Rear servo inner 'O' ring missing. C4 failed or C4 wave plate broken.	Inspect rear band adjustment. Adjust as necessary. Inspect ball- Refit or replace as necessary. Inspect'0'ring. Refit or replace as necessary. Inspect C4 and C4 wave plate. Repair or replace as necessary.
1st gear only or 2nd,3rd, and 4th only	Inhibitor switch faulty. 1-2 shift valve jammed.	Inspect inhibitor switch. Repair or replace as necessary. Inspect the 1-2 shift valve. Repair or replace as necessary
1st and 2nd only or 1st, 3rd and 4th only	Inhibitor switch fault, 1-2 only. 2-3 shift valve jammed.	Inspect inhibitor switch. Repair or replace as necessary. Inspect the 2-3 shift valve. Repair or replace as necessary.

Table 6.2.2 - Faulty Shift Patterns

Symptom	Possible Cause	Action
1st,2nd and 4th only or 1st,2nd, and 3rd (tied up in 3rd)	Inhibitor switch fault, 1-2-3 only.	Inspect inhibitor switch. Repair or replace as necessary.
	3-4 shift valve jammed.	Inspect the 3-4 shift valve. Repair or replace as necessary.
Harsh 2-3 shift	Jammed band 1 release valve.	Inspect the release valve. Repair or replace as necessary.
	Faulty S3 or S2 solenoid.	Inspect S3 or S2. Repair or replace as necessary.
	Faulty clutch apply regulator valve.	Inspect the regulator valve. Repair or replace as necessary.
	Missing or damaged clutch apply feed ball.	Inspect the ball. Refit or replace as necessary.
	Damaged input shaft sealing rings.	Inspect the sealing rings. Refit or replace as necessary.
	Damaged C1 piston 'O' rings.	Inspect the 'O' rings. Refit or replace as necessary.
	Damaged or dislodged C1 piston bleed ball.	Inspect the bleed ball. Refit or replace as necessary.
	Faulty S1 or S4 solenoid.	Inspect S1 or S4. Repair or replace as necessary.
Harsh 3-4 shift	Jammed band 1 release valve.	Inspect the release valve. Repair or replace as necessary.
	Incorrect front band adjustment.	Inspect the band. Adjust as necessary.
	Damaged front servo piston 'O' rings.	Inspect the 'O' rings. Refit or replace as necessary.
	Faulty or damaged variable pressure solenoid (S5).	Inspect S5. Repair or replace as necessary.
	Faulty band apply regulator valve.	Inspect the regulator valve. Repair or replace as necessary.

Symptom	Possible Cause	Action
All Shifts Firm	Incorrect auto transmission fluid (ATF). S5 faulty won, or incorrectly fitted. Band apply and clutch apply regulator springs misplaced.	Drain and fill with specified ATF. Check that S5 is fitted correctly, or replace S5. Inspect band apply and clutch apply regulator springs. Refit or replace as necessary.
Manual 4-3-2-1 is soft delayed or missing	Over-run clutch (OC)/Low-1st ball misplaced. C4 clutch worn or burnt. C4 wave plate not lined up with the holes in the piston. C4 wave plate failed.	Inspect the ball. Refit or replace as necessary. Inspect C4 clutch. Replace or repair as necessary. Check the alignment.]Realign as necessary. Inspect wave plate. Replace as necessary.
Firm 1-2 Hot	S5 worn. S5 damper spring broken. Front servo belleville spring broken.	Inspect S5 and replace as necessary. Inspect the damper spring and replace as necessary. Replace spring as necessary.
4th Tied up	Incorrect C4 pack clearance. Damaged C4 clutch. Cracked C2 piston (leaking into C4).	Check the clearance and adjust as necessary. Inspect C4. Repair or replace as necessary. Inspect piston. Repair or replace as necessary.
Tied up on 2-3	Incorrect band adjustment Front servo plastic plug missing B1R spring broken.	Inspect and adjust band as necessary. Replace the plug. Replace the spring.
Flare on 2-3	B1R spring/plug left out. C1/B1R ball misplaced. C1 clutch damaged. Restriction in C1 feed. C1 piston check ball jammed. Overdrive or input shaft sealing rings damaged.	Replace the spring/plug. Refit the ball. Inspect the clutch. Repair the clutch as necessary. Inspect and clean C1 feed. Replace the piston. Inspect and replace the sealing rings and/or shaft as necessary.
Slips in 4th	C1/B1R ball misplaced. Overdrive or input shaft sealing rings damaged. C1 clutch damaged.	Inspect and replace the ball. Inspect and replace the sealing rings and/or shaft as necessary. Inspect and repair the C1 clutch as necessary.
Flare on 4-3, Flare on 3-2	4-3 sequence valve in backwards.	Refit the valve.
Firm Manual low shift-high line press.	Low-1st check ball misplaced.	Replace the ball.

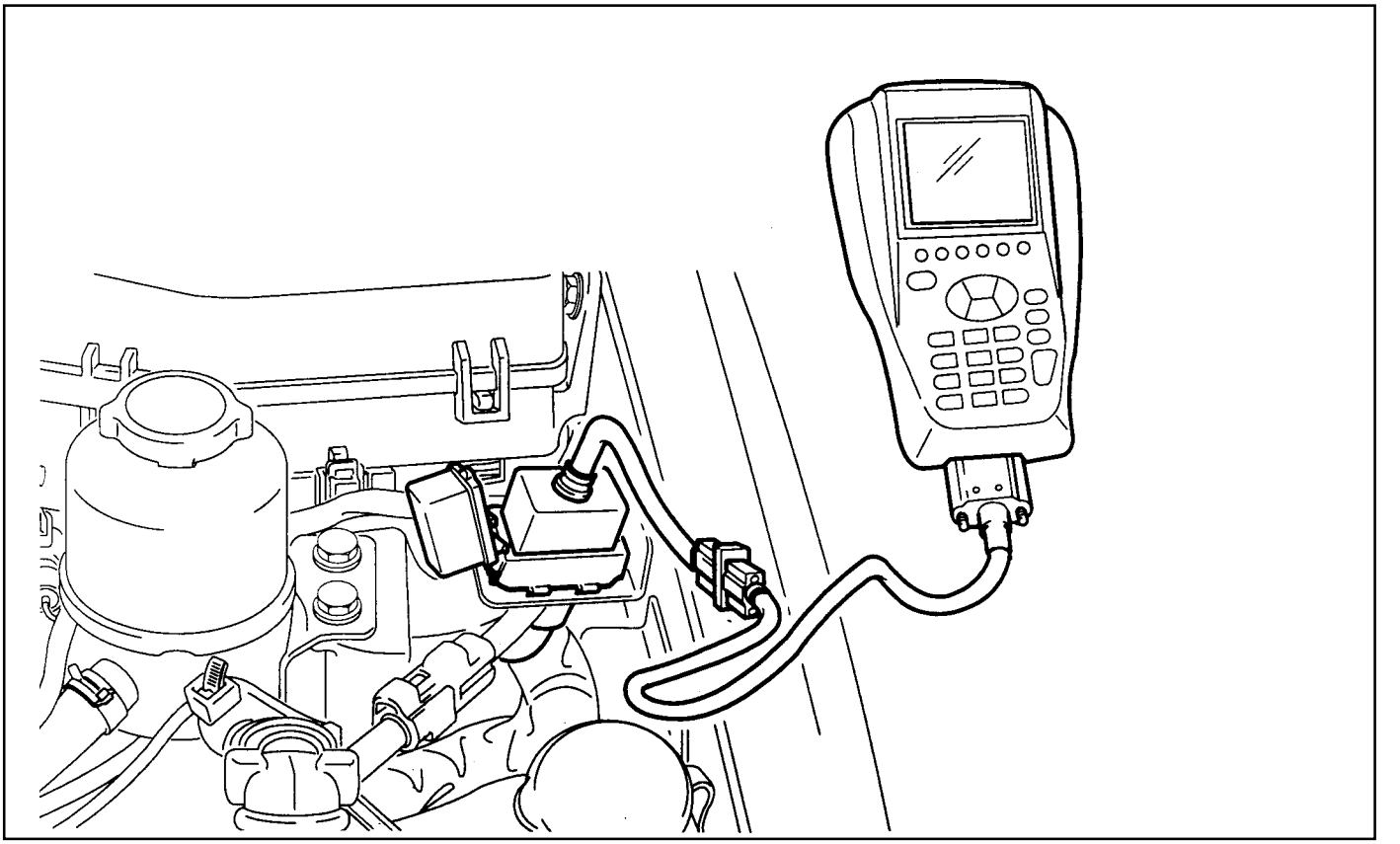
Table 6.2.3 - Shift Quality Faults

Symptom	Possible Cause	Action
Harsh 1-2 shift	Faulty inhibitor switch.	Check the resistance. Replace the inhibitor switch as necessary.
	Faulty throttle position sensor.	Inspect and replace the sensor as necessary.
	Incorrect front band adjustment.	Inspect and adjust the band as necessary.
	Damaged front servo piston'0'rings.	Inspect and replace the'0'rings as necessary.
	Faulty or damaged variable pressure solenoid (S5).	Inspect, repair or replace S5 as necessary.
	Faulty S1 or S4 solenoid.	Inspect, repair or replace S1 or S4 as necessary.
	Faulty band apply regulator valve (BAR).	Inspect, repair or replace the BAR as necessary.
	Misassembled front servo return spring.	Inspect and repair as necessary.
stalls when Drive or Reverse	Jammed converter clutch control valve (CCCV).	Inspect and clean CCCV.
selected Shudder on Rolldown	Faulty solenoid 7.	Inspect, repair or replace as necessary.

Table 6.2.4 - After Teardown Faults

Symptom	Possible Cause	Action
C2 burnt	T-bar linkage out of adjustment.	Inspect, repair C2 and adjust the linkage as necessary.
	56 foiled - stuck low.	Repair C2. Inspect, repair or replace S6 as necessary.
	Overdrive/output shaft sealing rings damaged.	Repair C2. Inspect, replace the sealing rings and/or shaft as necessary.
	C2 piston cracked.	Repair C2. Inspect, repair or replace the C2 piston as necessary.
C4 burnt	Incorrect C4 pack clearance.	Inspect C4 and repair as necessary. Inspect and adjust the C4 pack clearance as necessary.
	C4 wave plate broken.	Repair C4. Inspect and replace the wave plate as necessary.
	C4 wave plate not lined up properly.	Repair C4. Inspect and realign the wave plate as necessary.
	Overdrive or output shaft sealing rings damaged.	Repair C4. Inspect and realign the sealing rings and/or shaft as necessary.
	3-4 one way clutch (OWC) in backwards.	Repair C4. Inspect and refit the OWC as necessary.
	C2 piston cracked.	Repair C4. Inspect and replace the C2 piston as necessary.
	Over-run clutch (OC)/low-1st ball misplaced.	Repair C4. Inspect and refit the ball as necessary.
B1 burnt	B1R spring broken.	Inspect and repair B1 and replace the spring as necessary.
	Input shaft sealing ring cut.	Replace sealing ring.
	C1/B1R ball misplaced.	Repair B1. Refit the ball as necessary.
C1 burnt	B1R spring left out.	Inspect and repair C1 and replace the spring.
	Overdrive or input shaft sealing rings damaged.	Repair C1. Inspect and replace the sealing tongs and/or shaft as necessary.
	C1 piston cracked.	Repair C1. Inspect and replace the C1 piston as necessary.
	Ball capsule jammed.	Repair C1. Inspect and refit the capsule as necessary.
	4-3 sequence valve in backwards.	Repair C1. Inspect and refit the valve as necessary.
	Clutch apply feed (CAF)/B1R ball left out.	Repair C1. Inspect and replace the ball as necessary.
Slips in reverse - no manual 1st	Rear band incorrectly adjusted or damaged.	Inspect and adjust the band as necessary.
	Reverse-low/first ball misplaced.	Inspect and refit the ball as necessary.
Firm converter lock or unlock	Input shaft 'O' ring missing or damaged.	Inspect and replace the 'O' ring as necessary.
	Converter clutch regulator valve in backwards.	Inspect and refit the valve as necessary.
No lock up at light throttle	Input shaft 'O' ring missing or damaged.	Inspect and replace the 'O' ring as necessary.
	C1 bias valve in backwards.	Inspect and refit the valve as necessary.

SELF DIAGNOSIS TEST



1. Turn the ignition switch to “OFF” position.
2. Connect the scanner harness connector to the engine compartment diagnosis socket.
3. Turn the ignition switch to “ON” position.
4. Select “Electronics control vehicle diagnosis” from the function selection display and press “Enter”.
5. Select “Musso(98 face lift)” from the vehicle model selection model selection display and press “Enter”.
6. Select “Transmission control unit(TCU)” from the control system selection and press “Enter”.
7. Select “Self-diagnosis” from diagnosis items.

   Notice

   Check sensor output value displays if necessary.
8. Determine the fault code and check the detective Items.

   Notice

   Refer to sefadf3fnosfs list.

Self-diagnosis List

Symptom	Possible Cause	Action
P1702	Throttle position sensor	● Check cable for open / short. ● Check connection of other connectors. ● Check voltage between terminal 27 and 29 of TCU, - Standard value : 0.2 - 4.7V ● Check TPS.
P1703	Engine RPM	● Check cable for open / short. ● Check connection of other connectors. ● Check engine speed sensor. ● Check resistance between terminal 8 and 24 of TCU (when the connector is disconnected). - Standard value : 1 .9 - 0.2 kw
P1704	Vehicle speed	● Check cable for open / short. ● Check connection of other connectors. ● Check vehicle speed sensor.
P4705	Shift lever	● Check cable for open / short. ● Check connection of other connectors. ● Check engine speed sensor. ● Check inhibitor switch resistance between terminal 34 and 37 of TCU(when the connector is disconnected). - Standard value : 1st gear - 4 - 4.4 kw 2nd gear - 4,8 - 2.2 kw 3rd gear - 3 - 3.4 kw D gear - 4.5 - 4.g kw N gear - 6.8 - 7.2 kw R gear - 10.8 -11.2 kw P gear - 18.6 - 19 kw ● Check voltage between terminal 31 and 37 of TCU. - Standard value : 0-5V(P,R,N,D,L)
P1706	W, E, P mode switch	● Check cable for open / short. ● Check connection of other connectors. ● Check mode switch. ● Check condition between terminal 1 and 13 of TCU. Winter mode :12V, Normal mode : Open status, Power mode : 0V
P1707	T/M oil temperature	● Check cable for open / short. ● Check connection of other connectors. ● Check voltage between terminal 32 and 38 of TCU. - Standard value : 0-5V ● Check oil temperature sensor.
P1708	Battery voltage	● Check cable for open / short. ● Check connection of other connectors. ● Check battery condition. ● Check alternator.

Symptom	Possible Cause	Action
P1710	Air conditioner switch	● Check cable for open / short. ● Check connection of other connectors. ● Check voltage between terminal 4 and 11 of TCU. - Standard value : when the A/C compressor is ON : 12V when the A/C compressor is OFF : 0V
P1712	Kick down switch	● Check cable for open / short, ● Check connection of other connectors. ● Check voltage between terminal 1 and 12 of TCU. - Standard value : when the kick down switch is ON : 12V when the kick down switch is OFF : 0V
P1713	Pedal	
P1714	Vehicle ID	
P1715	VPS offset	
P1716	Throttle position sensor initialization	● Fully depress accelerator pedal for 5 seconds(ignition key is ON). ● Release accelerator pedal. ● Depress brake pedal and start the engine in 'P' position. ● Depress brake pedal and idle the engine for 5 seconds in 'D' position. ● Shift into 'D' position and determine fault code for throttle initialization. ● Complete the initialization.
P1733	Solenoid 1	● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 34 of TCU(when the connector is disconnected). - Standard value : 26 - 30Ω ● Check solenoid.
P1734	Solenoid 2	● Check cable for open / short. ● Check connection of other connectors, ● Check resistance between terminal 1 and 40 of TCU (when the connector is disconnected). - Standard value : 26 - 30Ω ● Check solenoid.
P1735	Solenoid 3	● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 41 of TCU (when the connector is disconnected). - Standard value : 26 - 30Ω ● Check solenoid.
P1736	Solenoid 4	● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 33 of TCU (when the connector is disconnected), - Standard value : 26 - 30Ω

Symptom	Possible Cause	Action
		● Check solenoid.
P1737	Solenoid 5	● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 36 and 44 of TCU (when the connector is disconnected). - Standard value : 3.6 - 4.2w ● Check solenoid.
P1738	Solenoid 6	● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 39 of TCU (when the connector is disconnected). - Standard value : 26 - 30w ● Check solenoid.
P1739	Solenoid 7	● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 42 of TCU (when the connector is disconnected). - Standard value : 26 - 30w ● Check solenoid.
P1741	Short of solenoid 1	● Check cable for short. ● Check connection of other connectors, ● Check solenoid.
P1742	Short of solenoid 2	● Check cable for short. ● Check connection of other connectors. ● Check solenoid.
P1743	Short of solenoid 3	● Check cable for short. ● Check connection of other connectors. ● Check solenoid.
P1744	Short of solenoid 4	● Check cable for short. ● Check connection of other connectors. ● Check solenoid.
P1745	Short of solenoid 5	● Check cable for short. ● Check connection of other connectors. ● Check solenoid.
P1746	Short of solenoid 6	● Check cable for short. ● Check connection of other connectors, ● Check solenoid.
P1747	Short of solenoid 7	● Check cable for short. ● Check connection of other connectors. ● Check solenoid.

ADJUSTMENTS

HYDRAULIC SYSTEM

The procedures detailed below should be followed in the event that the self test procedure detailed in section 6, or a defect symptom, indicates that there is a fault in the hydraulic system.

When making adjustments to the transmission, select the appropriate procedures from the following preliminary checks.

- Conduct a transmission fluid test procedure, refer to section 7.2.
- Check the manual linkage adjustment (refer to the vehicle workshop manual).
- Check engine idle speed (refer to Section 7.3).
- Conduct a stall test (it is outside the scope of this publication to detail this procedure)
- conduct a road test (it is outside the scope of this publication to detail this procedure).

TRANSMISSION FLUID TEST PROCEDURE

Checking Transmission Fluid Level

This procedure is to be used when checking a concern with the fluid level in a vehicle. A low fluid level will result in gearshift loss or delay if driven when the vehicle is cold.

The vehicle is first checked for transmission diagnostic messages (refer to section 6). If the vehicle has a speedo fault it is possible for the oil level to be low.

The vehicle is to be test driven to determine if there is an abnormal delay when selecting drive or reverse, or loss of drive. One symptom of low oil level is a momentary loss of drive when driving the vehicle around a comer. Also when the transmission fluid level is low, a loss of drive may occur when the transmission oil temperature is low.
If there is no loss of drive when the vehicle is driven warm and a speedo fault is registered, then fluid should be added to the transmission.

Checking, Adding Fluid and Filling

When adding or changing transmission oil use only Castrol TQ 95 automatic transmission fluid (ATF) or other approved fluids. The use of incorrect oil will cause the performance and durability of the transmission to be severely degraded. Do not underfill the transmission. Incorrect tilling may cause damage to the transmission. The fluid level setting procedure is detailed below.

Notice

When a transmission is at operating temperature hot transmission fluid may come out of the case if the fill plug is removed. 9 the transmission is at operating temperature allow two hours for cooling prior to removing the plug.

1. If the vehicle is at operating temperature allow the vehicle to cool down for two, but no greater than four hours before adding transmission fluid (this will allow the transmission to be within the correct temperature range).

   While hot the ATF level is higher and removing the plug may result in oil being expelled from the filler hole. This will result in the level being low.
2. The transmission selector is to be in Park.

   Switch the engine off.
3. Raise the vehicle on a hoist (or leave over a service pit).
4. Clean all dirt from around the service fill plug prior to removing the plug. Remove the oil service fill plug. Clean the fill plug and check that there is no damage to the ‘O’ ring.

   Install the filler pump into the filler hole.
5. Lower the vehicle with the filler pump still connected and partially fill the transmission.

   Start the vehicle in Park with the Parking brake and foot brake applied with the engine idling, cycle the transmission gear selector through all positions, adding ATF until gear application is felt.

6. Switch off the engine and raise the vehicle on the hoist, if applicable, ensuring that the vehicle is level.
7. Three minutes after the engine has stopped, but no longer than one hour, remove the filler pump, The correct level is reached when ATF is aligned with the bottom of the filler hole. If the correct level is not reached, then add a small quantity of ATF to the correct level.
8. Replace the transmission filler plug and clean all remnants of ATF on the transmission and vehicle.
9. Tighten the transmission filler plug to specification.

Checking, Adding Fluid and Filling - Drained or Dry Transmission

To set the correct fluid level proceed as follows.

1. Set the transmission selector to Park and switch the engine off.
2. Raise the vehicle on a hoist (or leave over a service pit).
3. Clean all dirt from around the service fill plug prior to removing the plug, Remove the oil service fill plug. Clean the fill plug and check that there is no damage to the 'O' ring. Install the filler pump into the filler hole.
4. Lower the vehicle with the filler pump still connected and partially fill the transmission. This typically requires approximately :
   a. If the transmission torque converter is empty:
      9.0 litres - 4WD
      9.0 litres - RWD
   b. If the transmission torque converter is full:
      4.5 litres - 4WD
      4.5 litres - RWD
5. Start the vehicle in Park with the Parking brake and foot brake applied with the engine idling, cycle the transmission gear selector through all positions, adding ATF until gear application is felt.
6. Then add an additional 0.5 litres of ATF.
7. Switch off the engine and raise the vehicle on the hoist. Remove the filler pump and replace the filler plug. The plug shall be tightened to specification.
8. The vehicle is then to be driven between 3.5 and 4.5 kilometers at light throttle so that the engine does not exceed 2500 rpm. This should result in the transmission temperature being in the range 50 to 60°C.
9. With the engine idling, cycle the transmission selector through all gear positions with the brake applied.
10. Stop the engine. Raise the vehicle on the hoist, if applicable ensuring the vehicle is level.
11. Three minutes after the engine has stopped, but no longer than one hour, remove the filler plug. The correct level is reached when ATF is aligned with the bottom of the filler hole. If the correct level is not reached, then add a small quantity of ATP to the correct level.
12. Replace the transmission filler plug and clean all remnants of ATF on the transmission and vehicle. Tighten the transmission Filler plug to specification.

ELECTRONIC ADJUSTMENTS

Idle Speed Adjustment

Carry out the adjustments to the idle speed as detailed in the workshop manual.

Throttle Position Calibration

Should the throttle position data stored in the TCU be lost or be out of specification, as indicated by a diagnostic trouble message, it may be re-established by the following procedure.

- Check that the hot engine idle speed is within specification.
- Allow the engine to idle in 'Drive' for 60 seconds with the air conditioner (if fitted) turned off. The closed throttle reference point in the TCU has now been set.

Switch the engine off but leave the ignition on. Hold the accelerator pedal on the floor for 60 seconds. The wide open throttle reference point in the TCU has now been set.

Throttle Clearing

The leant throttle clearing routine uses the mode switch and gear lever. Carry out the following steps to complete the automated throttle clearing procedure:

1. Switch ignition ‘ON’ with handbrake applied and engine ‘OFF’.
2. Select ‘M1’ and ‘WINTER’ mode.
3. Move the T-bar to ‘M2’ and then select ‘NORMAL’ or ‘POWER’ mode.
4. Move the T-bar to ‘M3’ and then select ‘WINTER’ mode.

Vehicle Coding

The vehicle coding is integrated as part of the diagnostic software. The coding applies to the following vehicle models:

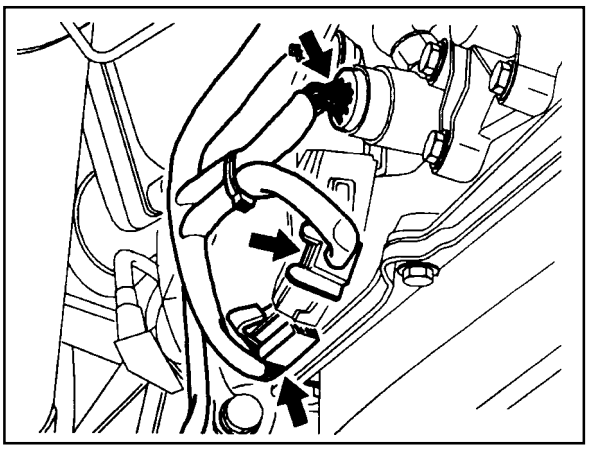
1. 4WD Gasoline E32.
2. 4WD Gasoline 523
3. 4WD Gasoline 520.
4. 4WD Diesel D29NA.
5. 4WD Diesel D29LA.
6. 4WD Diesel D23LA.
7. RWD E20.
8. RWD E23.

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

REMOVAL & INSTALLATION OF TRANSMISSION

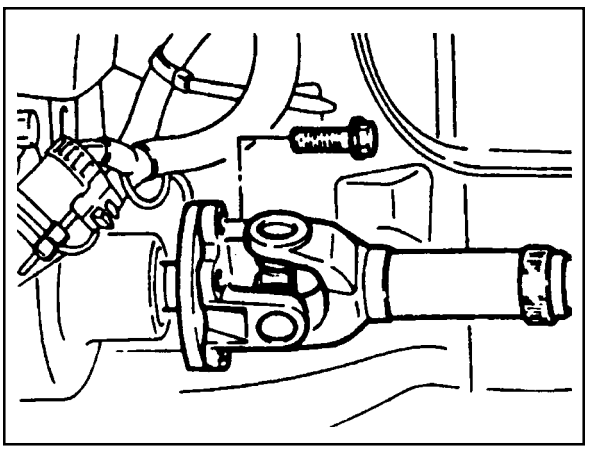
1. Disconnect the negative battery cable.
2. Disconnect the connectors from transfer case.
3. Disconnect the speedometer connector from transfer case.
4. Disconnect the inhibitor and Sear position sensor connector.



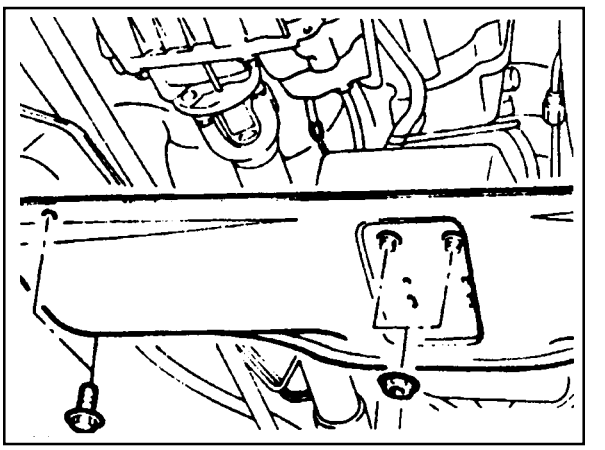
5. Remove the rear propeller shaft .

Installation Notice

Tightening Torque	70 - 80 Nm



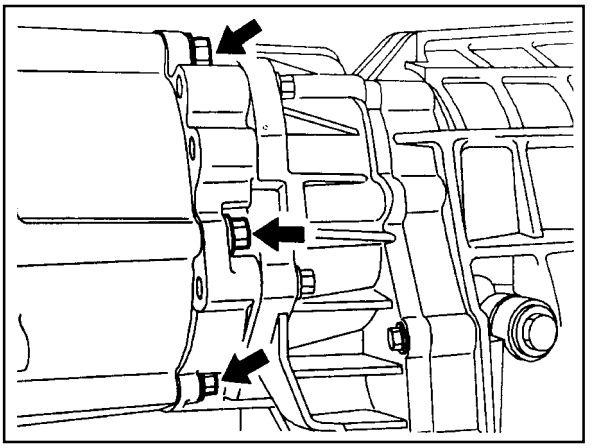
6. Unscrew the eight bolts and two nuts, and remove the cross member.



7. Remove the rear propeller shaft.

Installation Notice

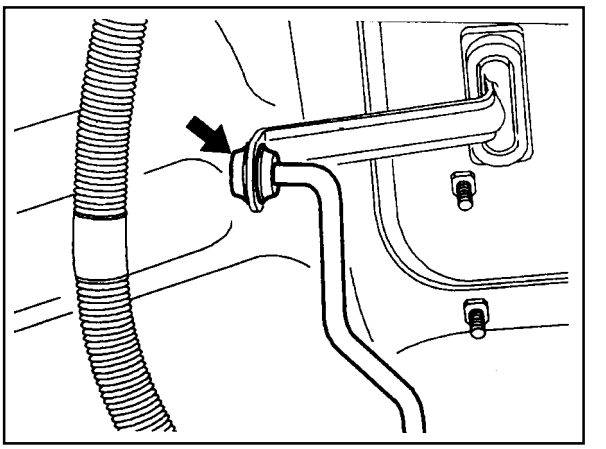
Tightening Torque	70 - 80 Nm



8. Unscrew the five bolts and remove the transfer case.
9. Disconnect the 10-Pins Plug connector from transmission.
10. Separate the locking clip on shift lever and remove the shift rod.

Notice

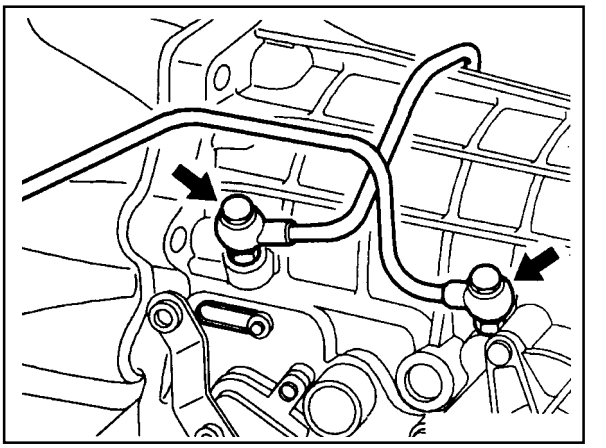
Removal and installation performed when the shift procedure should be lever is in “D” range.



11. Remove the two pipes for oil cooler.

Installation Notice

Tightening Torque	24.5 - 34.3 Nm

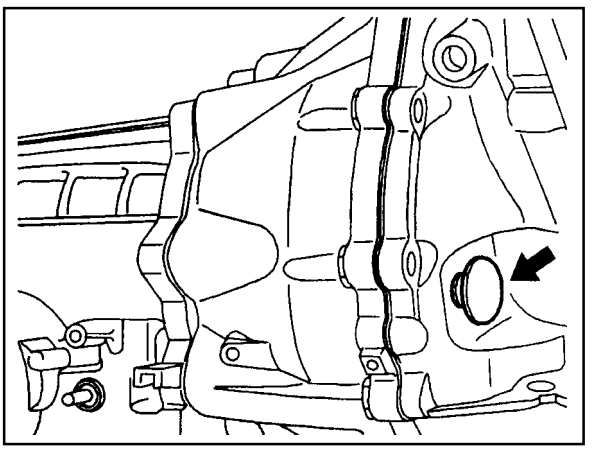


12. Remove the service hall cover on torque converter.
13. Put the alignment mark for installation, and unscrew the six mounting bolts for torque converter from drive plate through the service hole (arrow) by rotating the engine and remove the torque converter.

Installation Notice

Tightening Torque	42 Nm

Screw the six bolts mounting the torque converter through the service hole by using a mirror and rotating the engine.



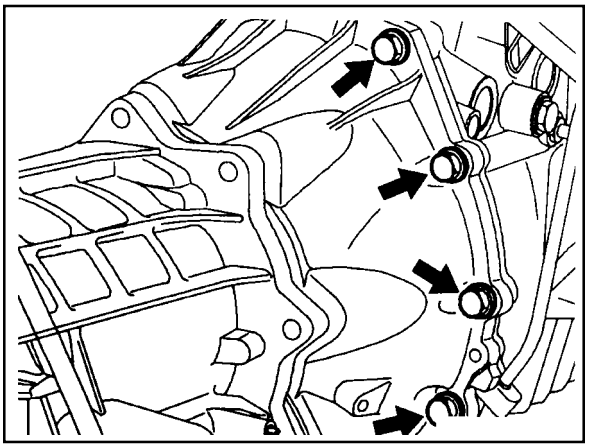
14. Remover the starter.
15. Unscrew the eight transmission housing bolts and remove the transmission assembly.

    Installation Notice

Tightening Torque	55 - 65 Nm

    Be careful not to drop the torque converter while removing the transmission.

16. Installation should follow the removal procedure in the reverse order.



UNIT REPAIR

REBUILD WARNINGS

Prior to rebuilding a transmission system, the following warnings are to be noted.

- Ensure that, before replacing a transmission the cooler lines are flushed out to remove any debris. This can be done by applying compressed air to the rear cooler line forcing oil and any contaminants out of the front cooler line.
- The cooler flow should be checked after the transmission has been fitted. With the front cooler line connected and the rear line run into a suitable container, measure the flow over 15 seconds with the vehicle idling in park.
- The flow rate should exceed 1 liter in 15 seconds.
- Be wary of any situation where water enters the transmission. This may result in fluid foaming and leaking through the breather.
- Ensure that both earth straps (one at the batted terminal and one on the vehicle body) are connected in the vehicle before connecting the positive side of the battery.
- Follow the throttle position calibration procedure in section 7 of this manual if the powertrain control module transmission control unit (PCM/TCU) is swapped.

DISASSEMBLY PROCEDURE

Transmission

Notice

Remove the inhibitor switch before washing the transmission in solvent or hot wash.

It is assumed that the transmission fluid has been drained when the transmission was removed from the

vehicle and that the ‘special tools’ quoted are available.

The transmission is dismantled in a modular fashion, and the details of disassembly for each module are given under the appropriate subject. Refer to table 9.10 in section 9.6 for details of all special tools required when performing disassembly procedures.

Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30, 40 and 50, and an 8 mm,10 mm and 12 mm double hex socket.

To disassemble the transmission, proceed as follows:

1. Remove the converter and the converter housing.
2. Mount the transmission on the bench cradle No.0555-331895.
3. Remove the sump and the sump seal.

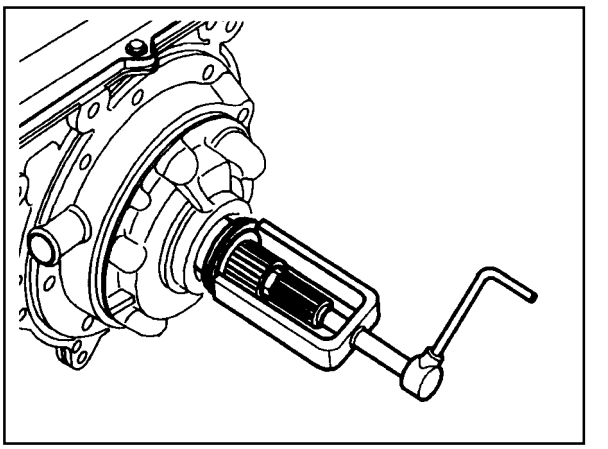
4. Detach each end of the filter retaining clip from the valve body and remove the filter.
5. Detach the wires from each solenoid and lay the wiring to one side.
6. Remove the valve body securing screws and remove the valve body from the case.
7. Remove the front servo cover circlip.

   Remove the cover and piston.

   Notice

   The plastic servo block is retained by the piston return spring only.
8. Where fitted, remove the flange yoke, and then remove the extension housing (RWD model).

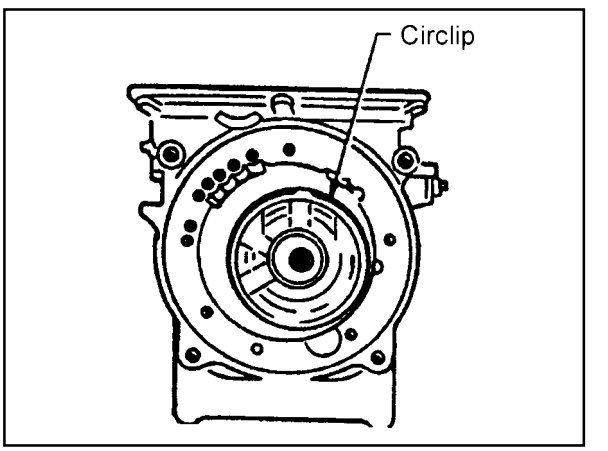
   Remove the adaptor housing (4WD model).
9. Remove the pump to case bolts using a multi-hex 8 mm spanner.
10. Using the pump puller No. 0555-332941, remove the pump.



11. Remove the input shaft, forward clutch cylinder, and the overdrive shaft as an assembly, withdrawing them through the front of the case.
12. Remove the C3 clutch cylinder and sun gears.
13. Remove the fronts band struts. Remove the front band.
14. Remove the two centre support retaining bolts using a T50 Torx bit.
15. Remove the centre support retaining circlip.

    Notice

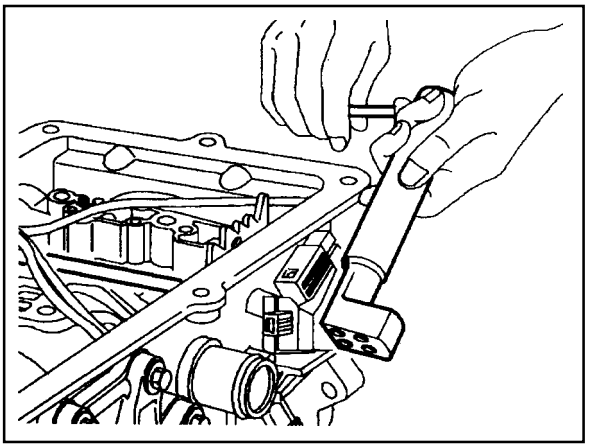
    Do not hammer the output shaft to remove the centre support as this will cause permanent damage to the thrust bearing surfaces.
16. Remove the centre support, 1-2 one way clutch, planetary gear set and output shaft as an assembly.
17. Remove the parking rod cam plate. (T40 Torx bit).
18. Remove the rear band struts and remove the band.



Transmission Case

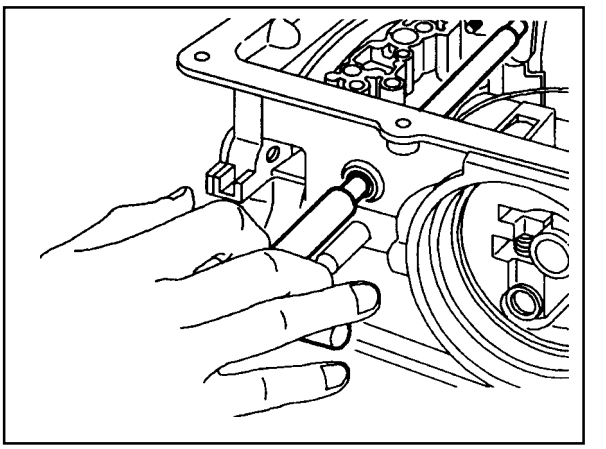
To teardown the transmission case, proceed as follows:

1. Remove the pin from the cross shaft inhibitor switch side (4WD models) using tool No.0555-332942.



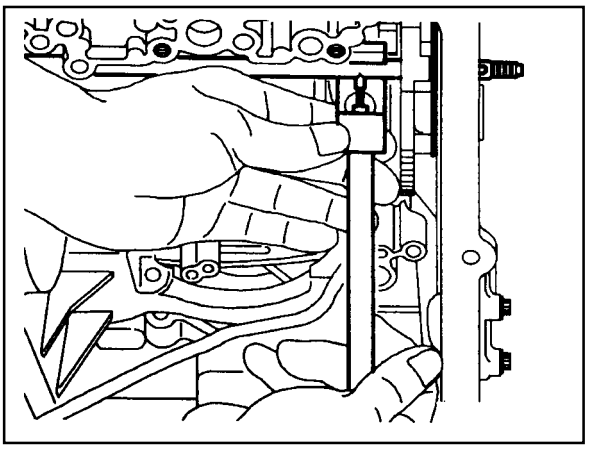
2. Remove the inhibitor switch from the case.

   Remove the cross shaft seals with special tool No.0555-331893.



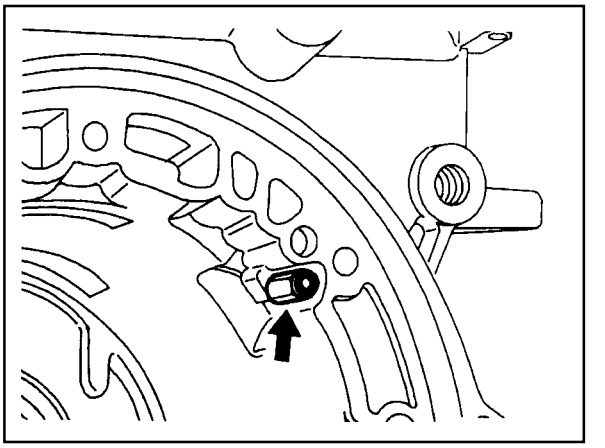
3. Remove the circlip from the cross-shaft. Pull the shaft to release the drive pin from the selector quadrant.

4. Using tool No. 0555-331897, press the pin from the cross-shaft and withdraw the shaft from the case. Retrieve the spring and pin



5. Remove the manual valve lever and the park rod.
6. Remove the 10 pin plug from the wiring loom bracket adjacent to the inhibitor switch(RWD models),
7. Depress the tangs and withdraw the 10 pin connector from the case. Remove the loom assembly.

8. Detach the No.7 solenoid wire from the front of the case.

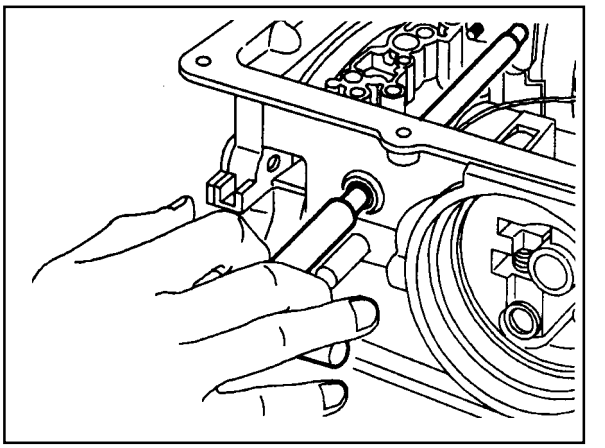


9. Remove the parking pawl pivot pin and the pawl and spring from the case.
10. Remove the shaft and the rear servo lever.
11. Remove the rear servo cover and piston assembly.
12. Remove the B1R circlip, valve and spring.
13. Remove both band adjustment shims.
14. Inspect the output shaft bushing in the case and replace if necessary.
15. Inspect cooler line fittings and replace as necessary.
16. Inspect the case for damage.

17. To remove the park rod lever: Remove the circlip from the inner end of the pivot shaft and tap the outer end of the shaft until it moves free from the case, then using a wide shallow tapered drift as a wedge, drive the pin out from the inside of the case and remove the lever and spring.

    Notice

    Do not remove the park rod lever unless absolutely necessary.



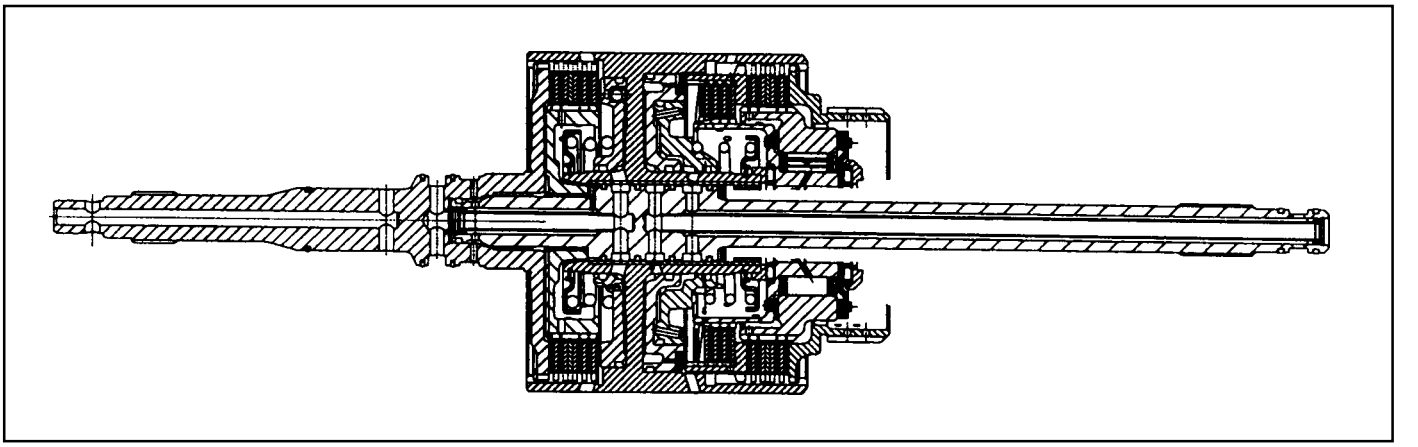


Figure 8.4 - Forward Clutch Cylinder Assembly

Forward Clutch Cylinder

To remove the forward clutch cylinder, refer to figure 8.4, proceed as follows.

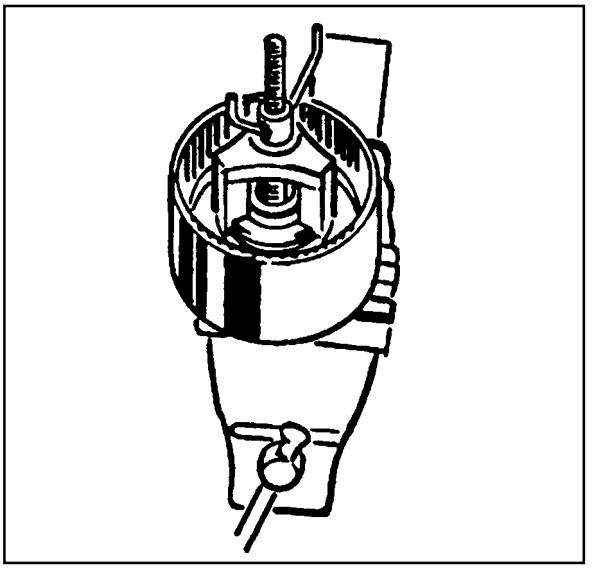
1. Place the assembly in a horizontal position.
2. Remove the thrust bearing and adjustment shims from the input shaft.
3. Remove the circlip from the front of the clutch cylinder and remove the input shaft.
4. Remove the overdrive shaft and the C1 clutch hub assembly from the clutch cylinder.
5. Remove the C1 clutch plates from the cylinder.
6. Remove the circlip retaining the C3 clutch hub in the rear of the clutch cylinder and remove the hub.
7. Remove the C2/C4 clutch hub assembly and remove the thrust bearing from the C4 hub.
8. Remove the C2 clutch plates.
9. Invert the clutch cylinder and remove the C4 clutch sleeve, clutch plates and the two wave washers. The 3-4 one way clutch is located between the C2 and C4 clutch hubs, and the hubs may be separated by rotating one hub clockwise and withdrawing it from the other.

10. Remove the thrust block from the C4 clutch cylinder hub.

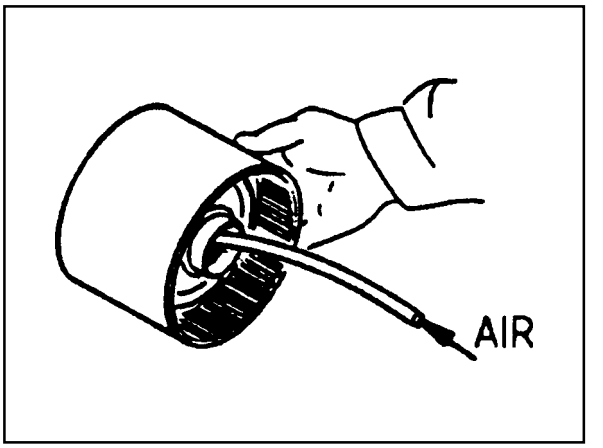
    Notice

    Make sure that the spring keeper is not caught in the circlip groove, and that all the spring pressure is released, before removing the tool.

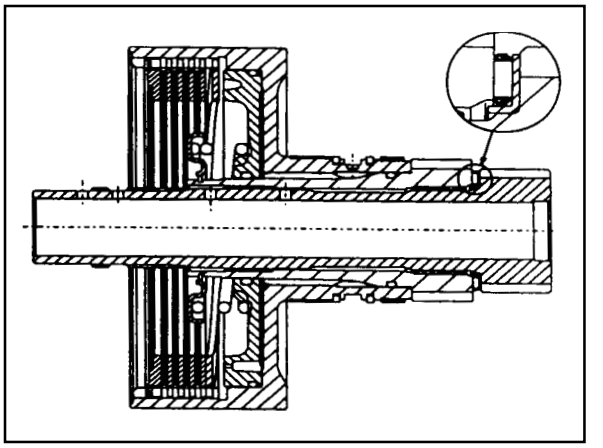
11. Mount the clutch cylinder on tool No.0555-331899 with the C2/C4 end uppermost and compress the piston return spring. Remove the spring retaining circlip. Release the tool and remove the circlip, keeper and spring.
12. Invert the clutch cylinder on the compressor tool and remove the C1 clutch piston return spring in a similar manner.



13. To remove the clutch pistons from the clutch cylinder, apply air pressure to the apply ports in the bore of the cylinder.



C3 Clutch Cylinder



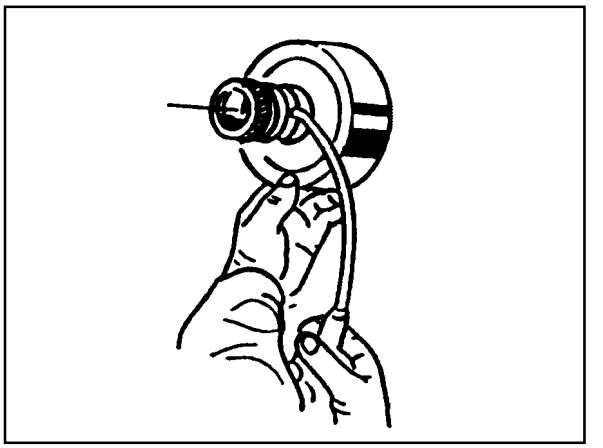
To remove the C3 clutch cylinder, proceed as follows:

1. Remove the forward sun gear and thrust bearing from the C3 clutch cylinder.
2. Remove the nylon thrust bearing, bearing support, needle thrust bearing and thrust block from the clutch cylinder hub.
3. Mount the clutch assembly on tool No.0555-331899 and compress the piston return spring.

   Remove the circlip and release the spring.

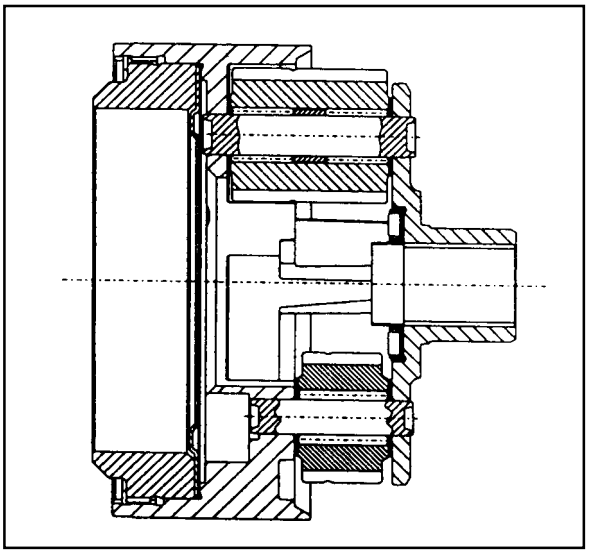
   Notice

   Make sure that the spring keeper has not been caught in the circlip groove, and that all spring pressure has been released, before removing the tool.
4. Remove the tool, circlip, keeper and spring.
5. Remove the sealing rings from the C3 clutch cylinder.
6. Remove the clutch plate retaining circlip and remove the clutch plates.



7. To remove the clutch piston from the clutch cylinder, apply air pressure to the port between the iron sealing rings on the bearing journals of the cylinder.
8. Remove the reverse sun gear from the cylinder.

Planet Carrier and Centre Support



To remove the planet carrier and centre support, proceed as follows.

1. Separate the planet carrier and centre support from the output shaft. Remove the thrust bearings from the output shaft and the planet carrier.
2. Separate the centre support from the planet carrier by rotating it anti-clockwise.
3. Lift the one way clutch from the planet carrier.
4. Remove the circlip retaining the one way clutch outer race in the planet carrier and remove the race.
5. Remove the one way clutch retainer from the planet carrier.

Pump

Note that the following valves are housed in the pump cover:

- Solenoid 7
- C1 bias valve
- Converter clutch control valve
- Converter clutch regulator valve
- Primary regulator valve

To remove the pump, proceed as follows.

1. Remove the wiring loom retainer plate and remove solenoid 7 with a T30 Torx bit.
2. Remove the five washer head bolts from the cover plate using a multi-point 8 mm socket.
3. Remove the five Torx head screws from the cover plate (Torx bit No. 30). Note that the odd screw holds the pump body to the pump body cover.

   Notice

   Do not strike the converter support tube to loosen the pump body.
4. Separate the pump body from the pump cover.
5. Lift the cover plate from the cover.
6. Remove the two ball check valves and one spring from the pump cover.

   Notice

   Some of the valves and plugs are preloaded by springs and may unexpectedly fall out of the cover when the pins are removed.
7. Depress the plug inward and remove the retaining pin for each of the four valves.
8. Remove the four valves, plugs and springs.
9. Remove the pump gears from the pump body.
10. Remove the lip seal from the front of the pump body.

Valve Body

To disassemble the valve body, proceed as follows.

1. Remove the detent spring and retainer plate using a T40 Torx bit.

   Notice

   Be aware that the manual valve will fall out of the valve body.
2. Take note of the angular relationship of the solenoid terminals to the valve body, then slide the manual valve out of the lower valve body.
3. Remove the solenoid and valve assembly as follows:
   - solenoid 1
   - solenoid 2
   - solenoid 3
   - solenoid 4
   - solenoid 5
   - solenoid 6
4. Place the valve body assembly on the bench with the upper body uppermost.
5. Remove the 24 clamping screws with a No. 30 Ton bit. Separate the upper and lower valve bodies by lifting the upper body and the separator plate together.
6. Upper body over and place it on the bench with the separator plate uppermost.
7. Lift the separator plate and gaskets from the upper valve body.
8. Remove the five nylon check balls exposed in the valve body.
9. Remove the retainer plate, plug, spring and reverse lockout valve.
10. Remove the two filters (and the large nylon check ball) from the lower valve body.

    Notice

    Once the pins are removed, the plates are loose in the valve body and will drop out when the valve body is turned over.
11. Remove the keeper plates and pins from the 1-2,2-3,3-4, BAR and CAR valves. The pins can be removed with a magnet.
12. Remove the 1-2,2-3 and 3-4 shift valves.

    Notice

    The plug is preloaded by the spring and may unexpectedly fall out of the valve body.
13. Depress the 4-3 sequence valve plug and remove the keeper plate.
14. Remove the plug, valve and spring.
15. Depress the solenoid 5 valve. Remove the keeper pin and remove the valve and spring.

    Notice

    The valve is preloaded by the spring and may unexpectedly fall out of the valve body.
16. Depress the line pressure release valve, remove the keeper pin, disc (if fitted), spring and valve.
17. Drive out the roll pin and remove the spring and ball check valve adjacent to the BAR valve.

ASSEMBLY PROCEDURE

The transmission is assembled in modular fashion and details of assembly for each module are given under the appropriate subject. Refer to table 8.1 (at the end of Section 8.3) for the torque specifications to be applied, and to table 9.10 in section 9.6 for details of all special tools required, when performing assembly procedures. Technicians overhauling these transmissions will also require a selection of good quality Torx bit sockets, in particular numbers 30,40 and 50, and an 8 mm,10 mm and 12 mm double hex socket.

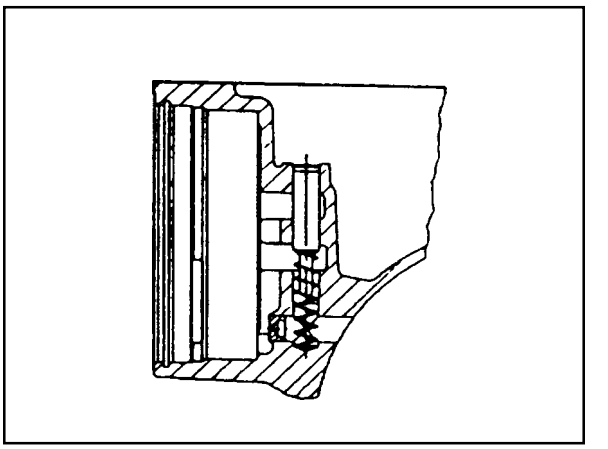
Transmission

Notice

1. Ensure that the B1R circlip is fitted to the case. (If this is not fitted, the valve will peen its way into and through the separator plate.)
2. Ensure that the 'E' clip is fitted to the cross shaft.
3. Ensure that all aspects of the parking mechanism are working.

To assemble the transmission, proceed as follows:

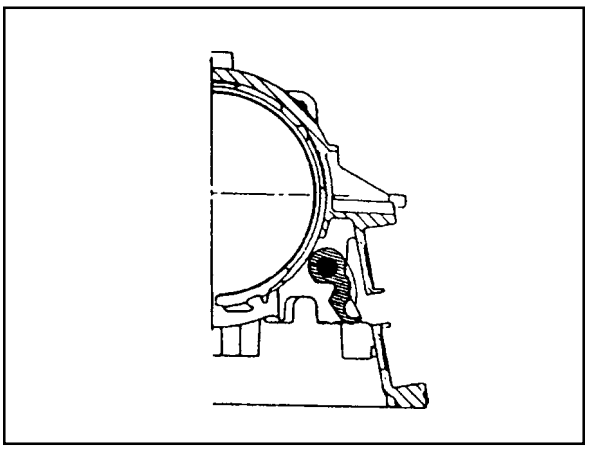
1. Turn the transmission case upside down on the bench and mount it to the transmission cradle No.0555-331895.
2. Install all fittings, plugs and the breather, applying a sealant where applicable, Tighten the fittings to specifications. Ensure that the breather is clear, and check that the lube fitting in the rear of the case is fitted and clear of obstruction.
3. Assemble the B1R valve and spring, and secure with the irclip. Refer to Ensure that the circlip is completely seated in its groove.



4. Install the rear servo lever and pivot pin.

   Notice

   The lever must pivot freely on its pin.



Notice

Care must be taken when applying sealant to ensure that it is not applied between the pin and the lever.

5. Assemble the park rod lever, complete with the return spring and pivot pin, applying a small amount of sealant to the outer end of the pivot pin.

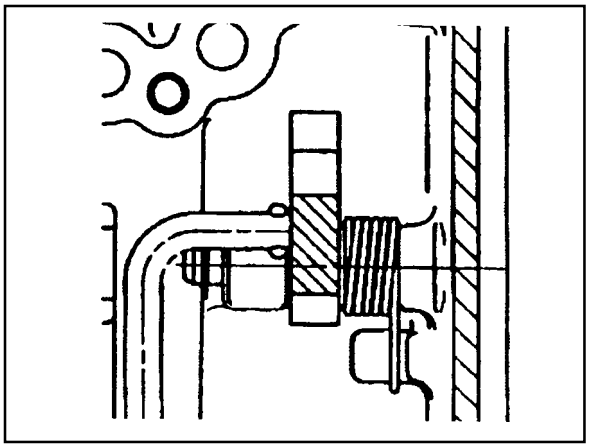
   Notice

   That the lever must pivot freely on its pin and the spring must return the park rod lever to its correct location.

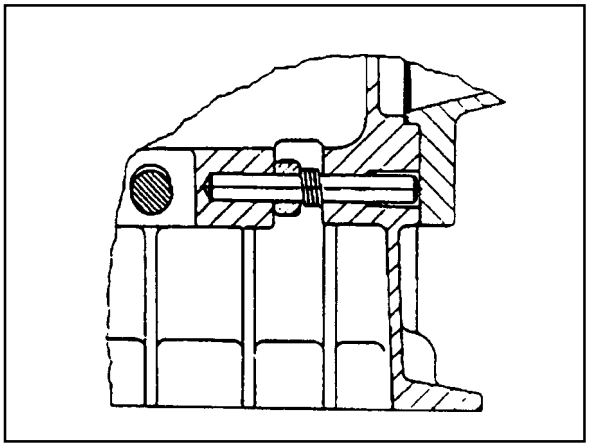
6. Secure the pivot pin with the circlip.

   Notice

   The pawl must pivot freely on its pin.

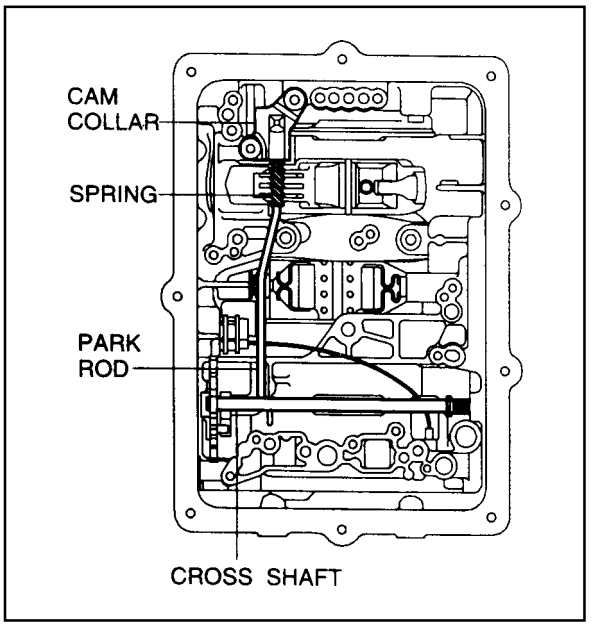


7. Install the parking pawl pivot pin and spring.

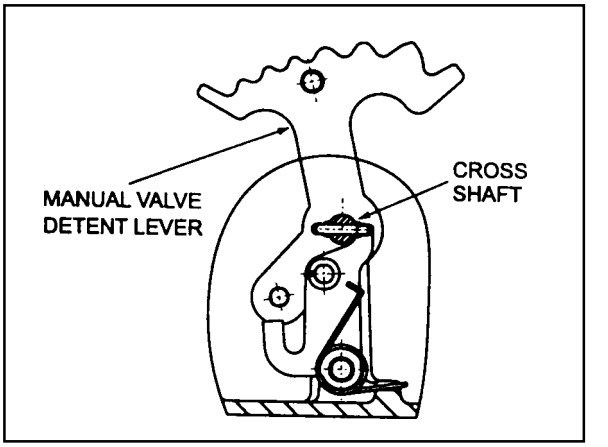


8. Connect the park rod to the manual valve detent lever.

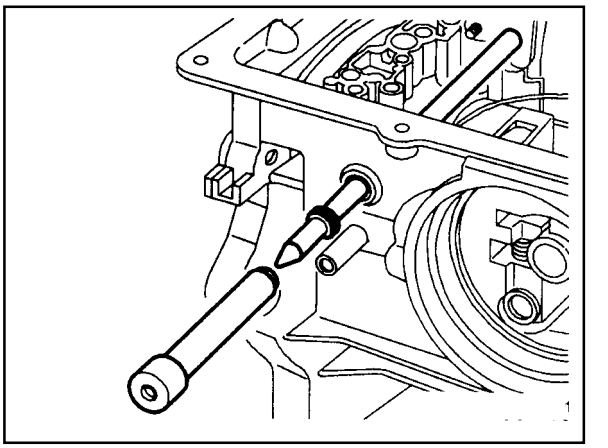
   Ensure the spring and cam collar is firmly installed on the rod.



9. Check that the cam collar slides freely on the rod.
10. Insert the cross shaft into the case, from the side opposite to the inhibitor switch, then install the anti-rattle spring on the shaft.
11. Position the manual valve detent lever, aligning it with the cross-shaft bore in the case.
12. Push the shaft through the detent lever until it starts in the detent lever side of the case.
13. Install the detent lever drive pin in the shaft using tool No. 0555-331897 with the adaptor over the pin.
14. Press the pin into the shaft until the tool bottoms.
15. Remove the tool and fit the spring retaining circlip to the shaft.

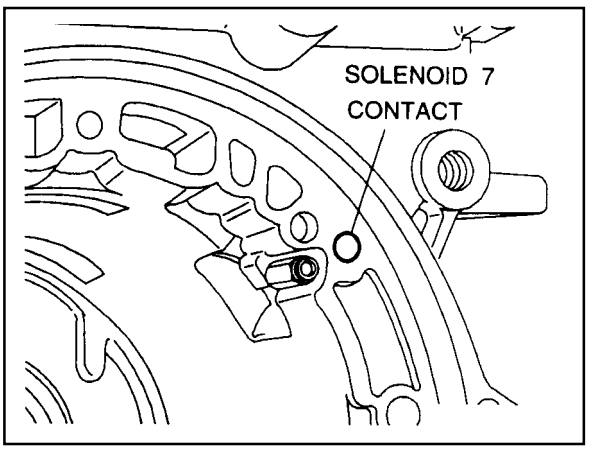


16. Install the new cross shaft seals using tool No. 0555-331894.

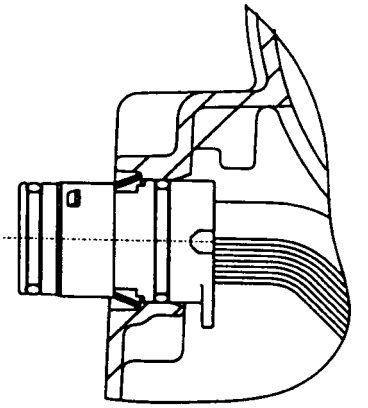


17. Install the inhibitor switch on the case. Torque the screws as per specifications. Press the pin into the shaft until the tool bottoms (4WD models) using tool No.0555-332942.
18. Thoroughly check the terminal wiring loom for condition and continuity.

19. Position the loom and locate the solenoid 7 contact and terminal in the pump mounting flange at the front of the case. The solenoid 7 wire is routed under the park rod and cross shaft in the case.



20. Install the ten pin connector in the case engaging the tangs on the connector in the notches in case.



4WD MODELS ONLY

21. Route the portion of the wiring loom coming out of the case down between the inhibitor switch and the case. Position the ten pin plug on the wiring loom bracket .

Rear Band Assembly

To assemble the rear band assembly proceed as follows:

1. Check the rear band for any cracks or damage along the lining and metal backing.
2. Install the reaction anchor strut into the main case, without shims.

   Notice

   If fitting a new band, soak the new band in automatic transmission fluid (or a minimum of five minutes prior to assembly.
3. Carefully install the rear band into the transmission case and ensure that it is properly fitted in the case.
4. Position the apply strut on the rear band then engage the apply strut in the servo lever.
5. Install the cam plate and tighten the screws to specification.

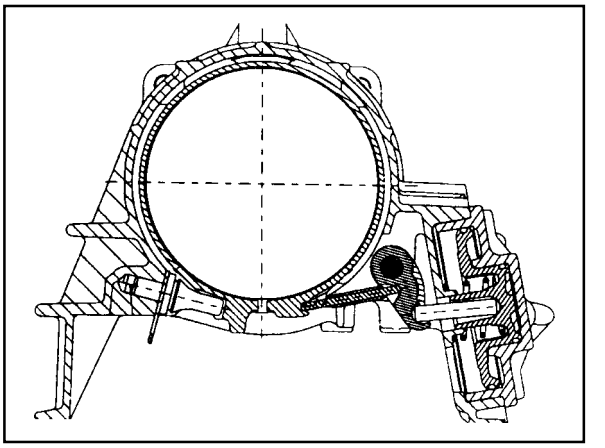
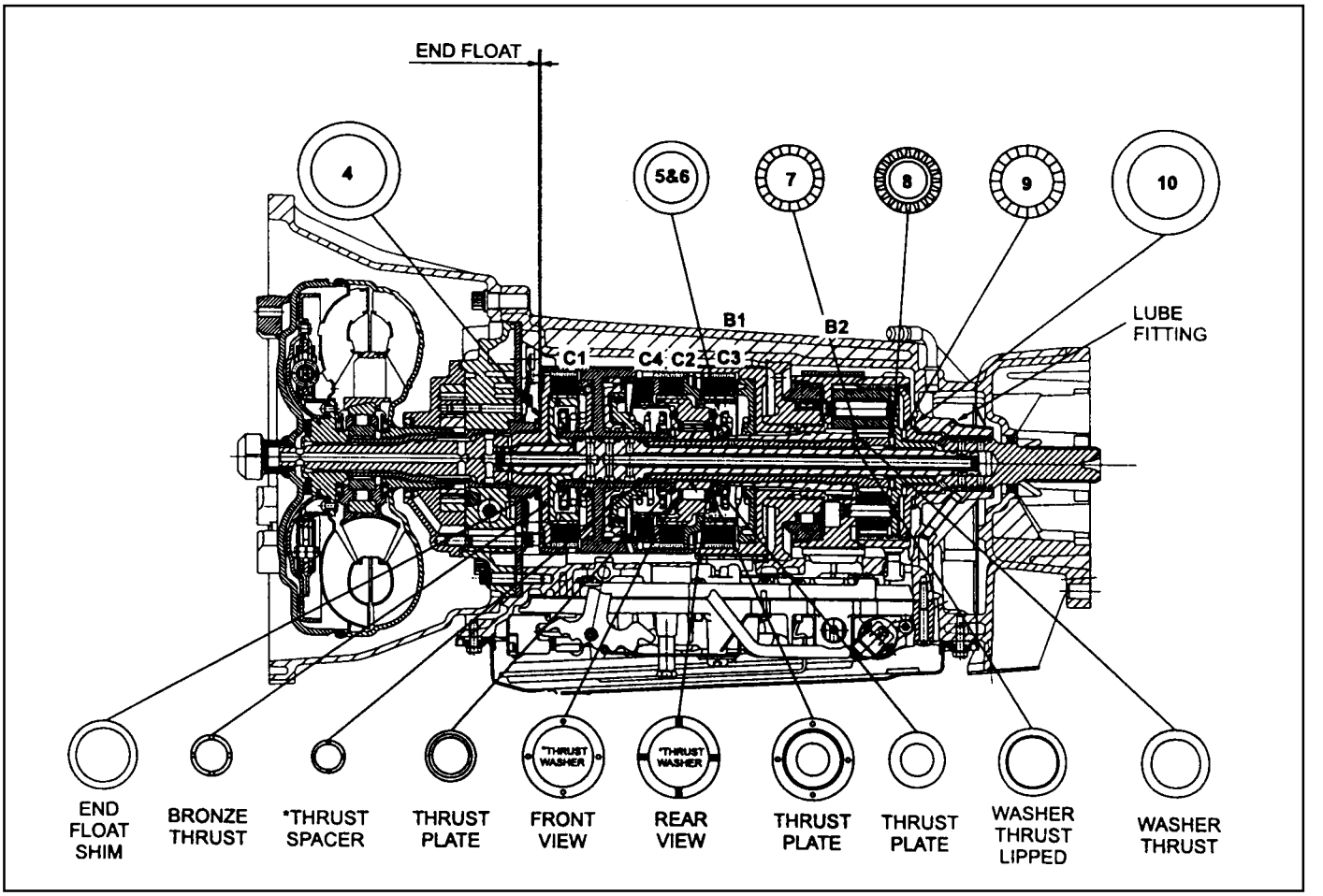


Figure 8.18 - Rear Servo and Band

Figure 8.19 - Thrust Bearing and Washer Locations



Output Shaft and Gear Assembly

To assemble the output shaft and gear assembly (refer to (figure 8.19), proceed as follows:

1. Check that the output shaft bush is not won or damaged. Replace if necessary.
2. Check for damage to parking pawl teeth on the ring gear. Replace if necessary.
3. Check that the sealing ring grooves have not been damaged.
4. Lubricate the sealing rings with automatic transmission fluid.
5. Assemble the sealing rings to the output shaft with the scat cut uppermost.
6. If previously dismantled, assemble the ring gear to the output shaft and secure with circlip. Ensure that the circlip is firmly seated in its groove.
7. Fit the thrust bearing assembly No. 10 onto the output shaft using petroleum jelly.
8. Carefully install the output shaft assembly in the case to prevent damage to the sealing rings.

Rear Servo Assembly

To assemble the rear servo assembly (refer to figure 8.18), proceed as follows.

1. Check the servo piston 'O' rings and gasket for any damage.
2. Lubricate the servo piston 'O' rings with automatic transmission fluid, and fit the 'O' rings to the piston grooves.
3. Assemble the piston to the cover, ensuring that 'O' ring compression is adequate but not excessive.
4. Align the spring on the piston spigot, then position the rear servo rod into the spigot.

   Notice

   Do not use petroleum jelly on the gasket.
5. Assemble the gasket to the cover and fit the assembly to the case.
6. Apply Loctite 567 sealant to the bolts. Install the bolts and tighten to specification.

Planet Carrier Assembly and Centre Support

To assemble the planet carrier assembly and centre support, proceed as follows.

1. Check the carrier and planet assembly for any damage or irregularity and ensure that all pinions rotate freely and that the pinion end float is within the tolerance stated in section 9.2.
2. Install the one way clutch (OWC) retainer to the planet carrier with the inner edge pointing downwards. Inspect the OWC race and the sprag assembly for wear or damage. Replace if necessary.
3. Install the outer race in the drum. Press the race to the bottom of the drum and install the retaining circlip. Ensure the circlip is firmly seated in its groove.

   Refer to figure 8.21.
4. Install the OWC into the outer race with the lip edge uppermost. Lubricate the sprags with automatic transmission fluid. Refer to figure 8.20.
5. Check that the plugs are fitted to the centre support, then assemble the centre support into the OWC, ensuring that the support will rotate in an anti-clockwise direction only. Refer to figure 8.21.

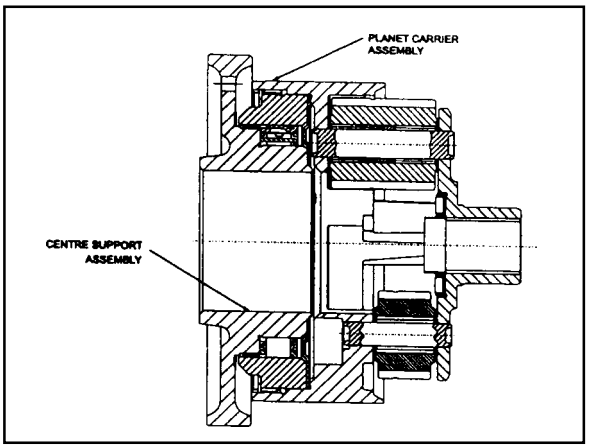


Figure 8.20 - Planet Carrier Assembly and Centre Support

6. Lubricate the No.9 needle thrust bearing and the thrust washer with petroleum jelly and fit them to the rear face of the planet carrier. Refer to figure 8.19.
7. Install the planet assembly and the centre support into the case, and align the centre support mounting bolt holes.
8. Install the centre support bolts finger tight.
9. Install the circlip retainer ensuring that the circlip is completely seated in the groove of the case.
10. Remove the centre support bolts and apply Loctite 222 or equivalent to the threads. Install the bolts and torque to specifications.

Extension Housing Assembly

To assemble the extension housing assembly, proceed as follows.

1. Check the condition of the extension housing roller bearing. Replace if necessary (RWD models). Install the new bearing from rear of extension housing. Press on the branded face of bearing only.
2. Install a new seal to the extension housing or adaptor housing. Refer to figure 8.21.

   Notice

   Do not use petroleum jelly to hold the gasket in position.
3. Position a new gasket onto the extension housing or adaptor housing.

   Notice

   See section 8.3.17 for the procedure to assemble the output flange assembly - RWD models.
4. Install the extension housing (RWD) or adaptor housing (4WD) and torque the bolts to specification.

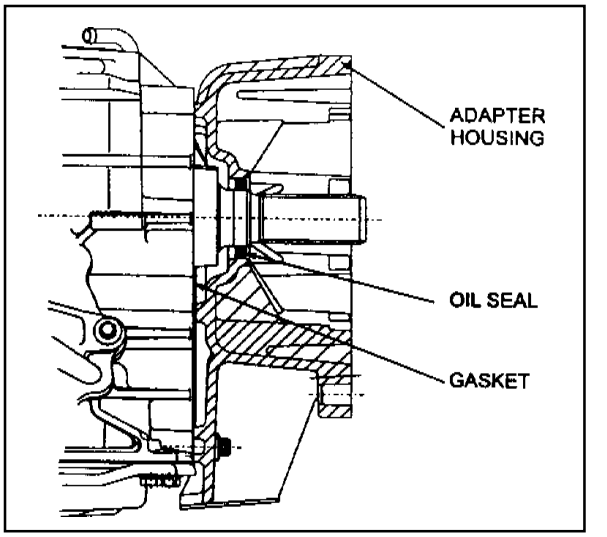


Figure 8.21 - Extension Housing

Front Servo Assembly

NOTICE

Ensure that the front servo snap ring is installed correctly. Orient the circlip with the gap at the bottom, near the pan rail. Refer to figure 8.22.

To assemble the front servo assembly (refer to figure 8.22), proceed as follows.

1. Lubricate the cover 'O' ring with automatic transmission fluid and fit to the cover.
2. Lubricate the piston 'O' rings with automatic transmission fluid and fit to the piston.
3. Assemble the piston, push rod, spring, belleville washer, seat and retaining ring.
4. Fit the piston push rod assembly into the front servo cover.
5. Install the front servo block and spring into the case.
6. Install the front servo assembly into the case.
7. Compress the servo cover and fit the servo cover retaining circlip, aligning the gap with the pan rail, and ensuring that it is completely seated in its groove.

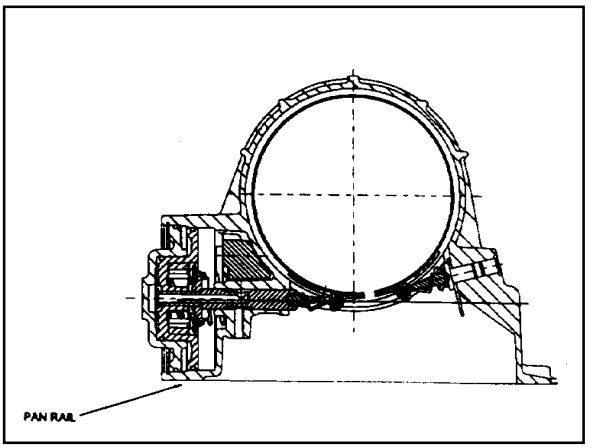


Figure 8.22 - Front Servo and Band

Front Band Assembly

To assemble the front band assembly, proceed as follows.

1. Install the reaction anchor strut to the case.
2. Check the band for ally cracks or damage along its lining and metal backing.
3. Position the strut retainers on the band (refer to figure 8.23).

   NOTICE

   If fitting a new band, soak the band in automatic transmission fluid for a minimum of 5 minutes prior to assembly.
4. Install the front band into the transmission case, ensuring that it is properly seated in place.
5. Position the reaction strut in its retaining clip and engage it with the band and anchor strut.

   Position the apply strut in its retaining clip and engage it with the band and the servo piston rod.

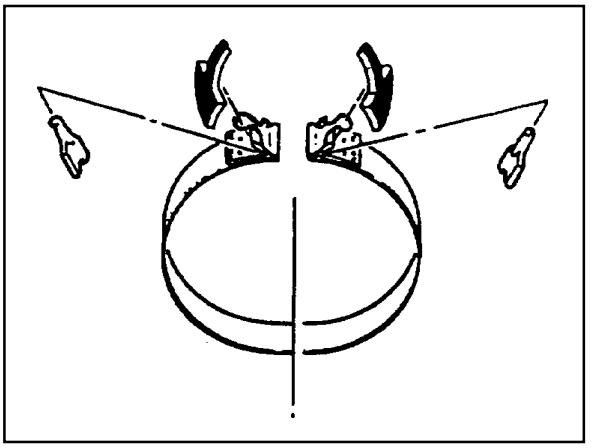


Figure 8.23 - Front Band Strut Installation

C2/C4 Clutch Assembly

Notice

1. Check pistons for cracks.
2. Do not mix the clutch piston return springs.
3. Ensure that the snap rings are fitted correctly.

To assemble the C2/C4 clutch assembly (refer to figure 8.24), proceed as follows.

1. Check the feed orifices in the cylinder bore are clear of obstructions.
2. Check the C2 piston bleed orifices are clear of obstructions.
3. Lubricate the ‘O’ rings with automatic transmission fluid.

   Notice

   ‘O’ rings must not be twisted in the grooves.
4. Fit the small ‘O’ ring onto the inner groove, and the large ‘O’ ring onto the outer groove of the piston.
5. Check the C4 piston bleed orifices are clear of obstructions.
6. Lubricate the ‘O’ rings with automatic transmission fluid.
7. Fit the small ‘O’ rings onto the inner groove and the large ‘O’ rings onto the outer groove of the piston.
8. Position the clutch cylinder with the C2/C4 cavity facing upwards.
9. Fit the C4 piston into the C2 piston with the bleed orifices in alignment.
10. Install the C2/C4 piston assembly into the cylinder, with the piston bleed orifices aligned with the holes on the outside of the cylinder, until the outer diameter of the C2 piston enters the inner diameter of the cylinder.

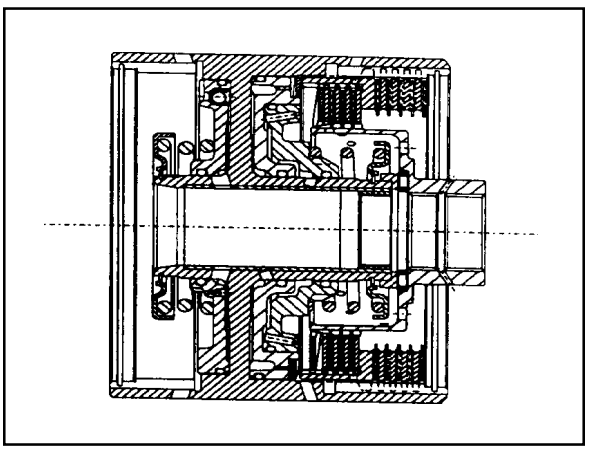


Figure 8.24 - Typical C2/C4 Clutch Assembly

11. Assemble the piston return spring to the piston, and fit the spring retainer over the spring.

    Notice

    The wire diameter of this spring is 4.3 mm.

12. Using special tool No. 0555-331899, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.
13. Check the C1 piston check valves are not damaged and are free to move, and that the cylinder feed orifices are clear of obstructions.
14. Lubricate the'0'rings with automatic transmission fluid and fit them to their respective grooves.

    Notice

    'O' rings must not be twisted in the grooves.

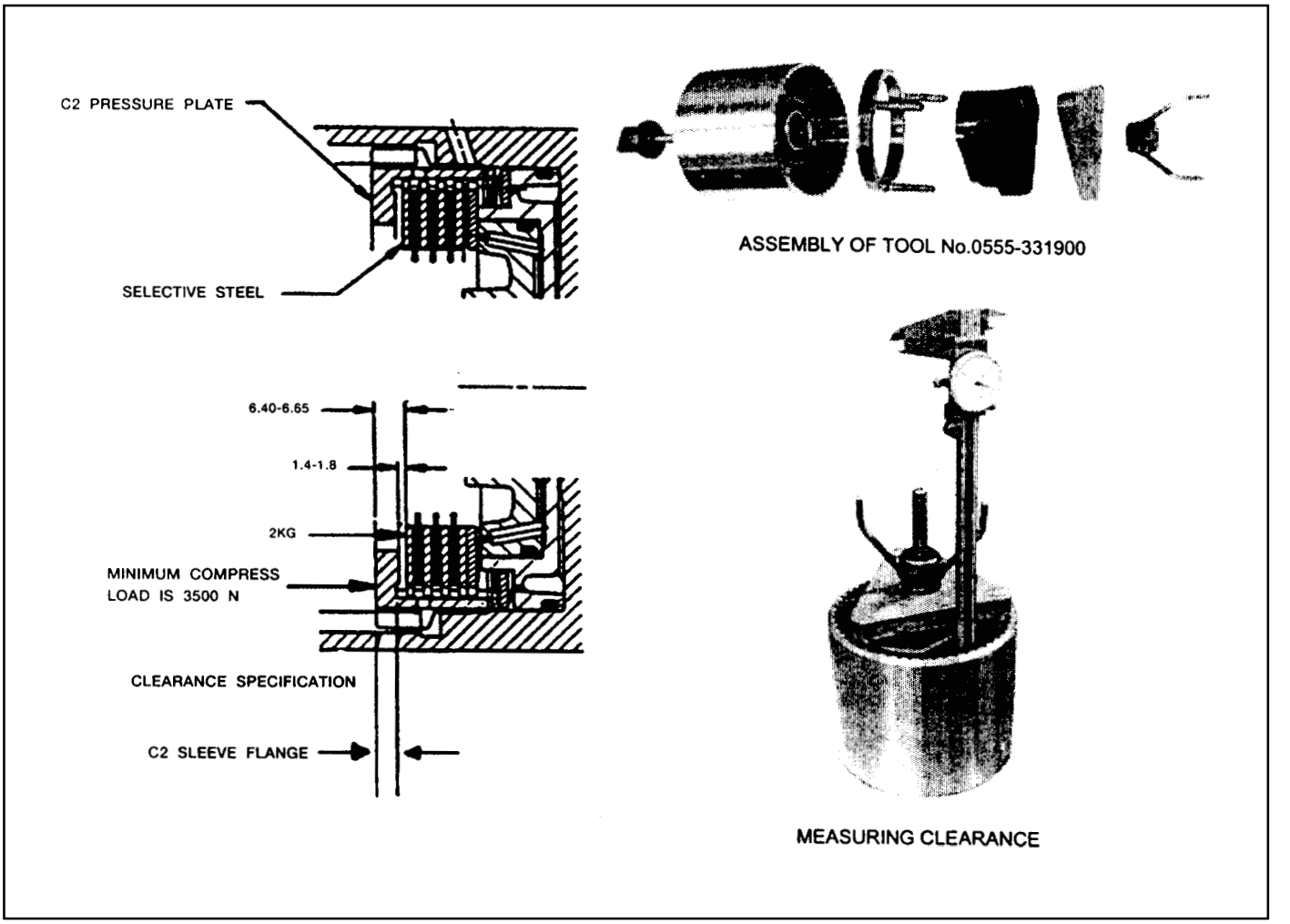
15. Position the cylinder with the C1 cavity upwards. Install the piston into the cylinder until the outer diameter of the piston enters the inner diameter of the cylinder.
16. Install the spring and spring retainer onto the piston.

    Notice

    The wire diameter of this spring is 5.26 mm.

17. Using special tool No. 0555-331899, compress the spring sufficiently to enable the installation of the retaining circlip ensuring that the circlip is firmly seated in its groove, then remove the tool.
18. Install the C2 wave washer into the cylinder with the crest of one wave covering one of the bleed orifices in the C2 piston.
19. Measure and record the thickness of the flange of the C2 sleeve. Refer to figure 8.25.
20. Install the C4 clutch plates and wave washer into the C2 actuating sleeve, with the rounded edge of the steel plates down, in the following sequence:
    - Steel plate (selective)
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Wave washer

Figure 8.25 - C4 Clutch Pack Clearance



21. Holding the cylinder horizontal, install the sleeve and clutch plate assembly into the cylinder, with the crest of one wave of the washer In line with one of the holes in the outside of the cylinder, until the sleeve contacts the C2 wave washer.
22. Check the C4 clutch pack clearance using special tool No. 0555-331900. Refer to figure 8.25.

    Notice

    With the C2 wave spring compressed, and the clutch Pack supporting a 2 k9 weight, the dimension from the underside of the C2 pressure plate to the selective steel is to be between 1.4- 1.8 mm. If the clutch is to be gauged from the top of the pressure plate, then the dimension is to be the actual thickness of the pressure plate plus 1.4-1.8 mm.
23. Use selective plates to achieve the correct specification. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

    Notice

    The clutch pack clearance must be taken before the elements are soaked in Automatic Transmission Fluid (ATF).
24. Reassemble the sleeve and clutch pack into the cylinder. Observe the alignment of the wave washer to the hole in the cylinder.
25. Install the C2 clutch plates in the cylinder in the following sequence:
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate - 0574-000001, 0574-000003, 0574-000004, 0574-000005, 0574-000020, 0574-000021, or friction disc -0574-000002
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc

26. Check the clutch pack clearance using only the weight from tool No.0555-331900. Refer to figure 8.26.

    Notice

    With the clutch pack supporting a 2 kg weight, the dimension from the C3 clutch hub locating step to the friction plate is to be between 0.80-1.05 mm.

27. Use selective plates to achieve the correct specification. If new friction plates are being fitted, remove the clutch pack and soak the friction plates in ATF for a minimum of 5 minutes prior to reassembly.

    Notice

    The clutch pack clearance must be taken before the elements are soaked in ATF.

28. Lubricate and fit the 3-4 OWC and end caps to the C2 hub.

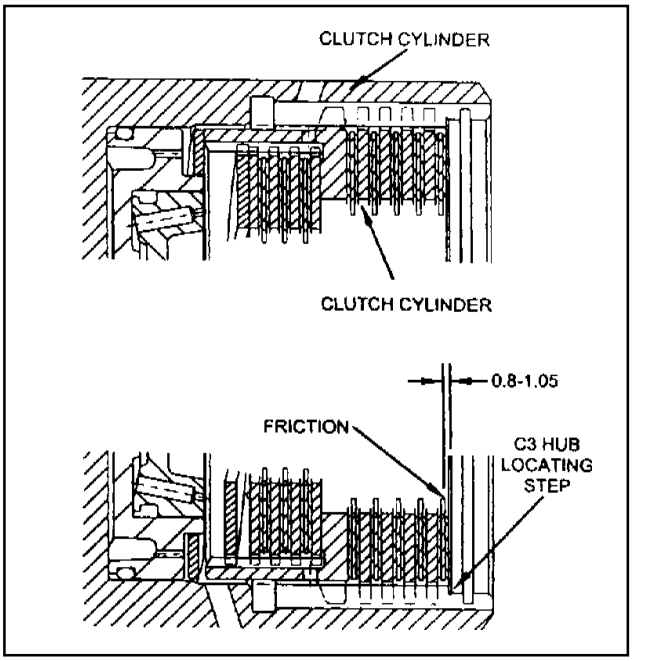


Figure 8.26 - Typical C2 Clutch Pack Clearance

29. Align the tangs and fit the nylon thrust washer onto the C4 hub. Refer to figure 8.27.
30. Align and fit the C4 hub to the C2 clutch and the OWC assembly.
31. Check the rotation of the C2 hub. While holding the C4 hub, the C2 hub should rotate in the clockwise direction and lockup in the anti-clockwise direction when viewed from the C2 hub. Refer to figure 8.27.

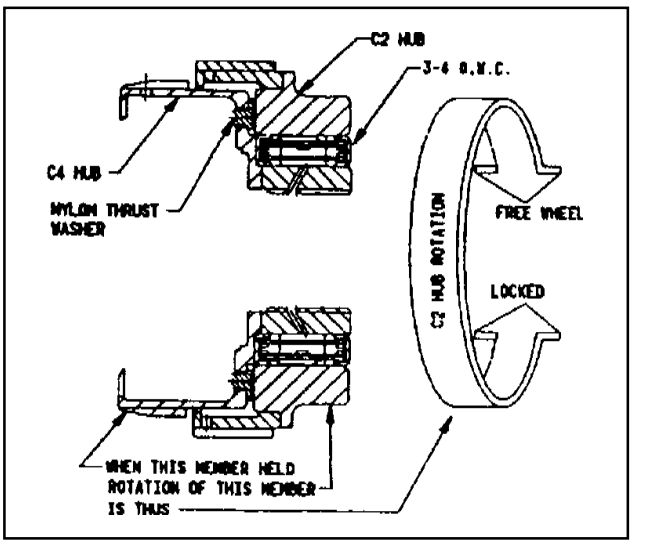


Figure 8.27 - C2 - Hub Rotation

32. Apply petroleum jelly to the No. 5 thrust bearing and fit it to the C4 hub. Refer to figure 8.19.
33. Remove the C2 clutch plates from the clutch cylinder.
34. Fit the thrust plate over the cylinder inner hub. Refer to figures 8.24 and 8.19.
35. Engage the C2/C4 clutch hub assembly in the C4 clutch plates.
36. Install the C2 clutch plates.
37. Install the C3 hub and secure it with the circlip, ensuring that the circlip is firmly seated in its groove.

    Refer to figure 8.32.

C3 Clutch and Reverse Sun Gear Assembly

To assemble the C3 clutch and reverse sun gear assembly (refer to figure 8.28), proceed as follows.

1. Check the orifices in the cylinder are clear of obstructions.
2. Check the C3 cylinder bush outside diameter and the centre support inside diameter are in good condition and not damaged. Coat the sealing rings with automatic transmission fluid and fit into the C3 cylinder grooves.
3. Check the reverse sun gear splines, grooves and thrust face for condition. Coat the 'O' ring with automatic transmission fluid and fit it to the groove of the reverse sun gear.
4. Install the reverse sun gear in the C3 cylinder, ensuring that the 'O' ring compression is adequate but not excessive.

   Notice

   'O' rings must not be twisted in the grooves.
5. Coat the C3 piston 'O' rings with automatic transmission fluid and fat the small 'O' ring onto the inner ring and the large 'O' ring onto the outer ring of the C3 piston.
6. Check that the bleed orifices of the piston are clean and clear of obstructions.
7. Install the C3 piston in the cylinder until the outside diameter of the piston enters the inside diameter of the cylinder.

   Notice

   Take care not to cut the 'O' ring.
8. Assemble the spring and spring retainer on the piston. Using tool No. 0555-331899 compress the spring sufficiently to enable the installation of the retaining circlip, ensuring that the circlip is firmly seated in the groove, and remove the tool.
9. Fit the C3 wave plate to the C3 piston face, ensuring that one crest of the wave plate of the C3 piston face is aligned over one of the piston orifices.
10. Assemble the clutch plates and discs into the cylinder in the following sequence :
    - Steel plate
    - Friction disc
    - Steel plate
    - Steel plate - 0574-000001, 0574-000003, 0574-000004,0574-000005,0574-000020, 0574-000021, or friction disc -0574-000002
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc
11. Align and fit the pressure plate with the counterbore facing away from the clutch plates.

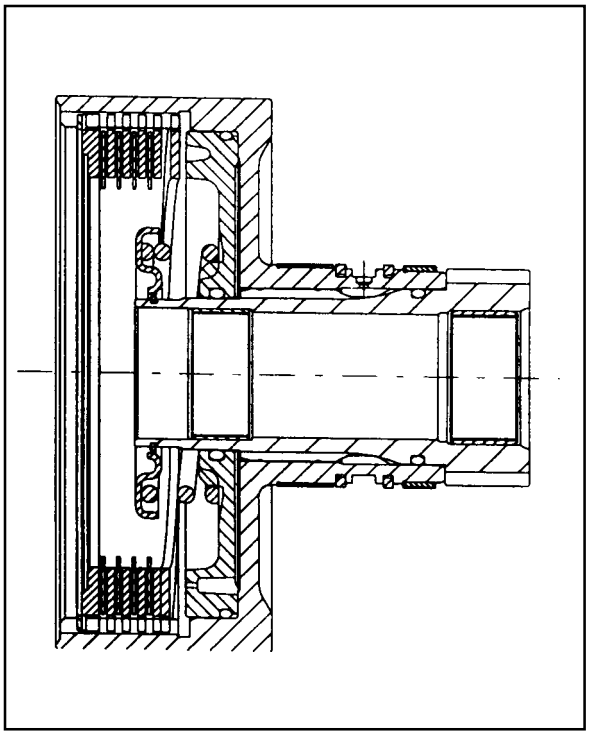


Figure 8.28 - C3 Clutch and Reverse Sun Gear

12. Install the circlip.
13. Check the C3 clutch clearance (refer to figure 8.29) using special tool No.0555-331900 in the following manner (weight only).
    a. Place the weight on the pressure plate and measure the distance from the end of the cylinder to the top of the pressure plate.
    b. Record this figure.
    c. Remove the weight.
    d. Lift the pressure plate up against the circlip and measure the distance from the end of

       the cylinder to the top of the pressure plate.
    e. Record this figure.
    f. Subtract the second reading from the first reading to obtain the clutch pack clearance.

    Notice

    With the clutch pack supporting a weight of 2 kg, the clearance between the snap ring and the top of the pressure plate is to be between 1.20-1.45 mm.
14. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in automatic transmission fluid for a minimum of five minutes prior to reassembly.

    Notice

    The clutch pack clearance must be taken before the elements are soaked in automatic transmission fluid.

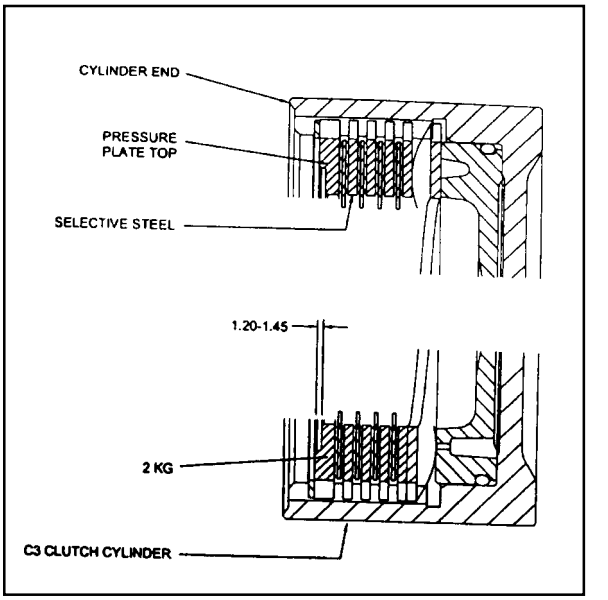


Figure 8.29 - Typical C3 Clutch Assembly Clearance

Forward Sun Gear and C3 Clutch Pack Assembly

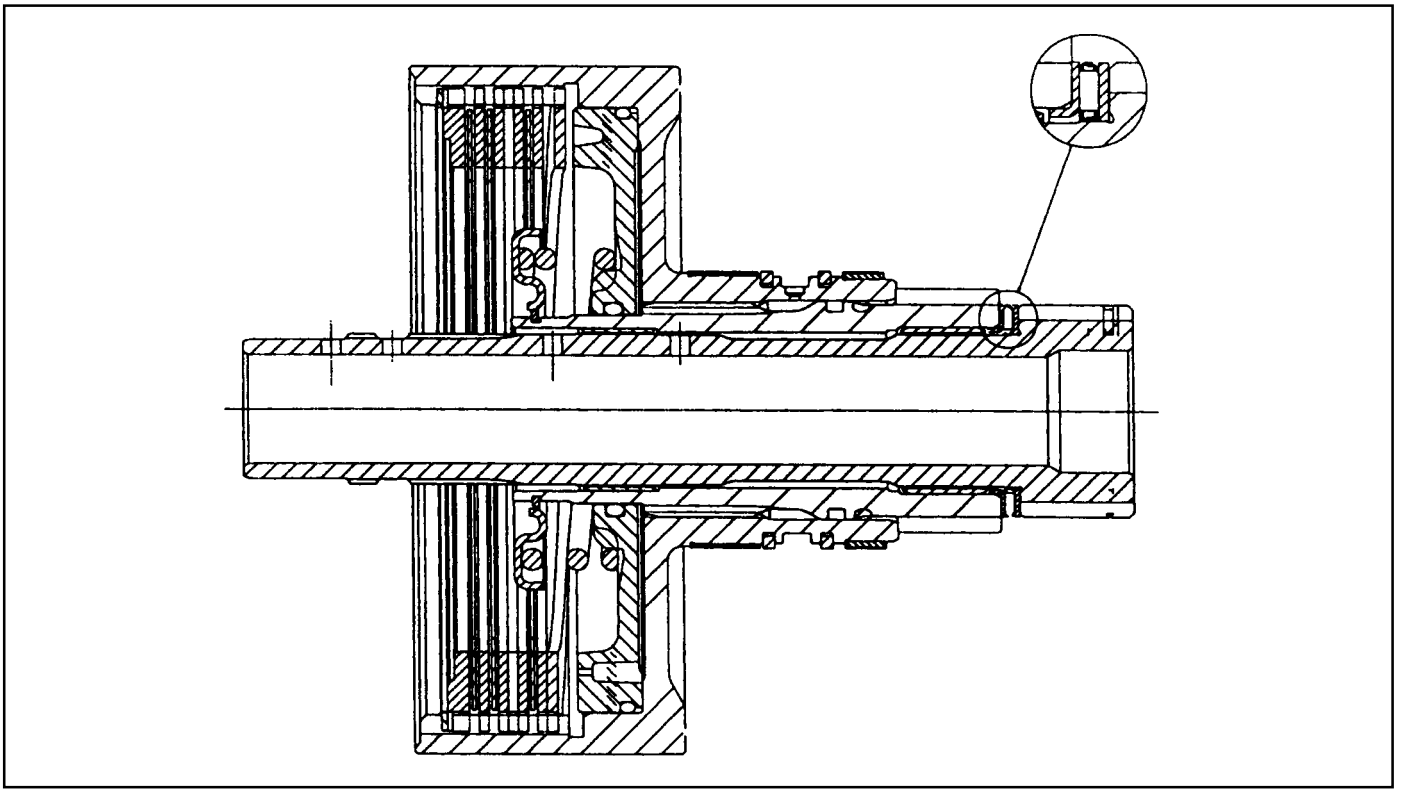


Figure 8.30 - Typical forward Sun Gear add C3 Clutch Assembly

To assemble the forward sun gear and C3 clutch pack assembly (Refer to figure 8.30), proceed as follows:

1. Fit the No. 7 needle thrust bearing assembly over the forward sun gear, ensuring that the thrust washer is between the bearing and the sun gear.
2. Lubricate the thrust plate with petroleum jelly and fit the thrust plate onto the reverse sun gear.

   Refer to figure 8.33.
3. Align and fit the C3 clutch assembly over the forward sun gear.
4. Lubricate the No. 6 needle thrust bearing with petroleum jelly and fit it to the thrust plate. Ensure the lugs on the outside diameter of the bearing fit in the thrust plate counterbore.

   Refer to figure 8.19.
5. Align and fit the plastic thrust washer to the thrust plate with petroleum jelly.

   Refer to to figures 8.19.
6. Install the assembly over the forward sun gear shaft against the No.6 thrust bearing.

   Refer to figure 8.19.
7. Place the assembly to one side.

C1 Clutch Overdrive Shaft and Input Shaft Assembly

Notice

1. Ensure that the snap rings are fitted correctly.
2. Check pistons for cracks, especially the C1 piston.
3. Do not mix clutch piston return springs.
4. If the C1/C2 clutch packs separate from the C3 clutch pack, make sure the No. 6 bearing doesn't drop out of the bearing retainer.

To assemble the C1 clutch overdrive shaft and input shaft assembly, proceed as follows:

1. Check the overdrive shaft grooves for any defect.
2. Coat the sealing rings, large and small, with petroleum jelly and fit them to the overdrive shaft. The sealing rings may be held in place with a small amount of petroleum jelly.
3. Assemble the clutch plate and disc into the cylinder in the following sequence:
   - steel plate
   - friction disc
   - steel plate
   - friction disc
   - steel plate
   - steel plate - 0574-GOOGOl, 0574-000003, 0574-000004, 0574-000005, 0574-000020, 0574-000021, or friction disc -0574-000002
   - steel plate (selective)
   - friction disc
   - steel plate (selective)
   - friction disc
4. Check the clutch pack clearance using special tool No.0555-331900. Refer to figure 8.31.

   Use selective plates to achieve the correct specification.

   Notice

   The clutch pack supporting a 2 kg weight, the dimension from the input shaft locating stop to the friction disc must be 0.70-0.90 mm.
5. If new friction plates are being fitted, remove the clutch pack and soak the friction elements in automatic transmission fluid for a minimum of five minutes prior to assembly.

   Notice

   The clutch pack clearance must be taken before elements are soaked in automatic transmission fluid.
6. Check the fit of the C1 clutch hub on the overdrive shaft. If it is loose, the hub and shaft assembly must be replaced.

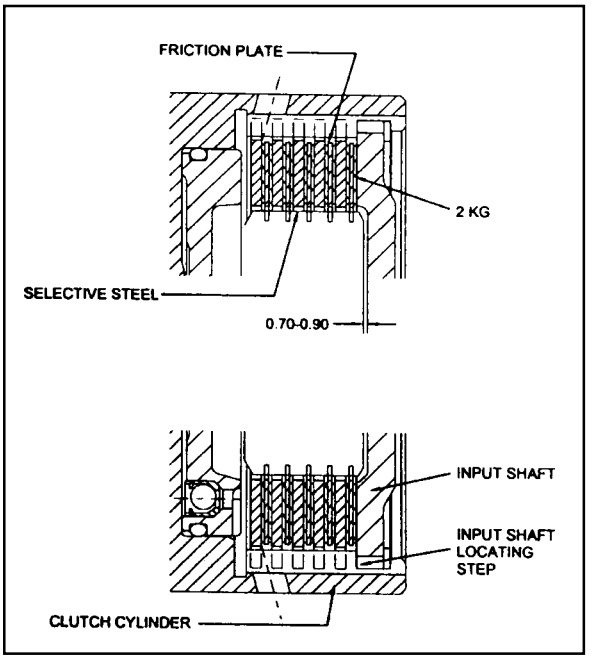


Figure 8.31 - Typical C1 Clutch Assembly Clearance

7. Coat the small nylon thrust spacer with petroleum jelly and install it over the overdrive shaft. Refer to figure 8.19.
8. Carefully fit the overdrive shaft into the C1 cylinder so as not to damage the sealing ring.
9. Fit the small bronze C1 hub thrust washer in place with petroleum jelly. Refer to figure 8.19.
10. Check the input shaft for any defect. Fit the input shaft into the cylinder and secure it with the circlip, ensuring that the circlip is completely seated in the groove.
11. Coat the sealing rings with petroleum jelly and fit onto the input shaft.
12. Assemble the C1/C2/C4 clutch assembly to the C3 clutch and sun gear assembly. Refer to figures 8.32 and 8.33.
13. Install this assembly in the transmission case.

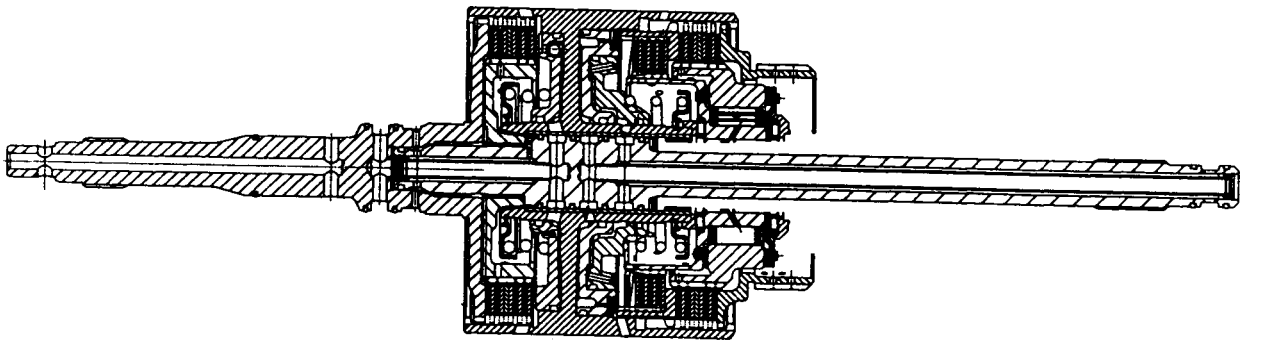


Figure 8.32 - C1, C4 and C2 Clutch

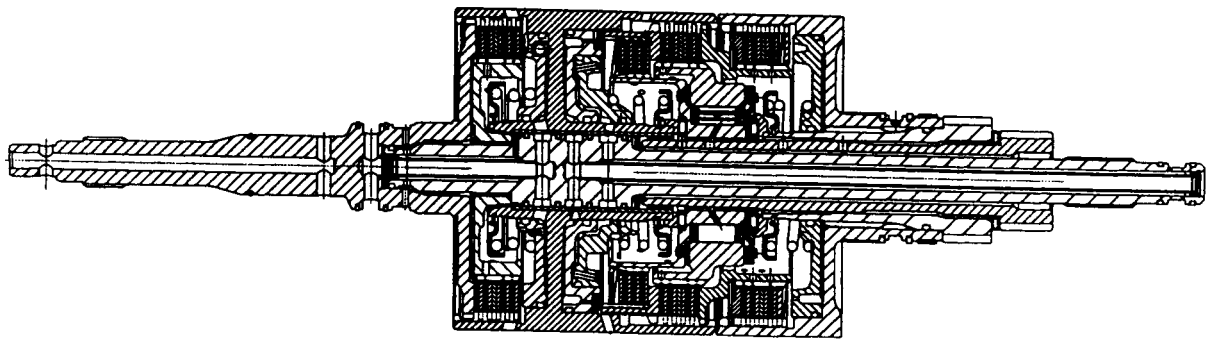


Figure 8.33 - C1, C4, C2 and C3 Clutch

Pump Cover and Converter Support

Notice

1. Do not wash the nose of solenoids in solvent.
2. Ensure that the correct 'O' ring is fitted for the application.
3. Do not mix up the low first blow-off and the torque converter blow-off ball springs.
4. Be careful not to damage the needle bearings on the assembly. Avoid any axial impact loads during assembly.
5. Check the transmission end float. This will help to detect any missing parts or incorrect assembly.

Notice

Figure 8.35 shows the orientation of the cross- sections for figures 8.36 to 8.42.

To assemble the pump cover and converter support (refer to figures 8.34 and 8.35), proceed as follows.

1. Check the pump body for any damage, chips or irregularity. Check that the bush is firmly staked in the drive gear.
2. Install the seal flush with the front face of the pump body.
3. Lubricate the pump bush, and the drive and driven gears, with automatic transmission fluid.
4. Install the pump driven gear and the pump drive gear into the pump body.
5. Using a straight edge and thickness gauge, check that the clearance between pump face and gears is 0.04 - 0.018 mm.
6. Lubricate the pump body 'O' ring with automatic transmission fluid and fit it to the pump body. Put the pump body to one side.
7. Ensure that the pump cover cavities, ports and holes are clean and free of any obstruction.
8. Lubricate all loose parts with automatic transmission fluid prior to assembly.

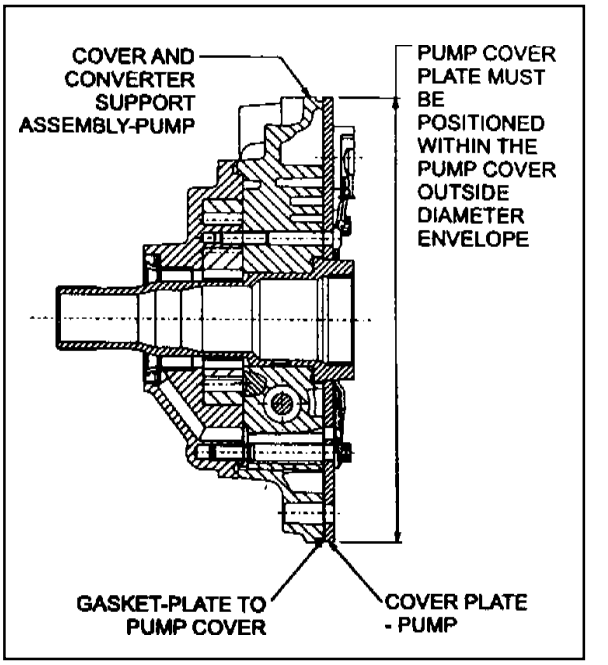


Figure 8.34 - Pump, Cover and Converter Support

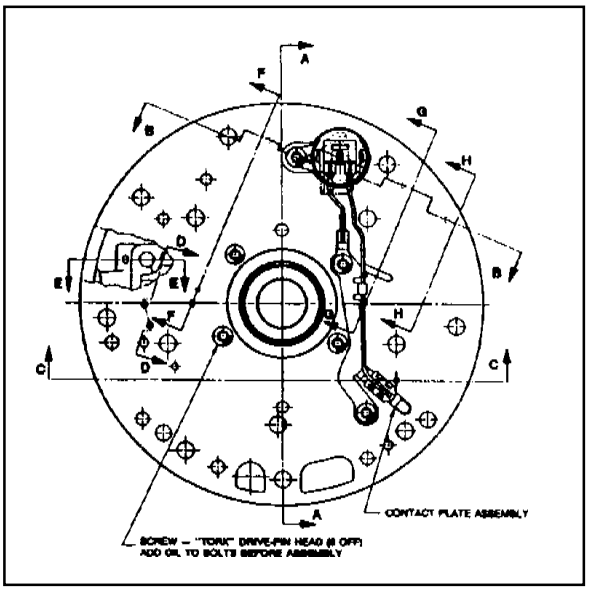
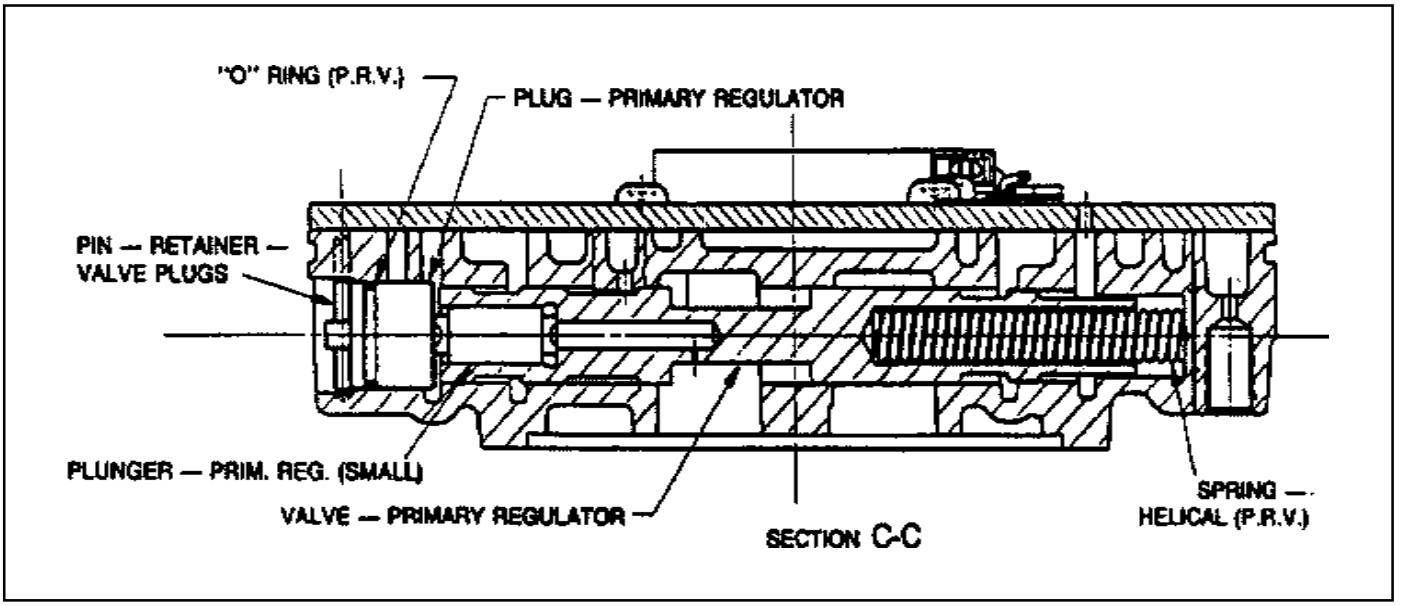


Figure 8.35 - Pump Cover Assembly

9. Assemble the primary regulator valve and plunger (refer to figure 8.36) to the pump cover, ensuring that the regulator valve slides freely, then fit the regulator valve plug and 'O' ring.

Figure 8.36 - Primary Regulator Valve



10. Install the retaining pin.

11. Install the converter clutch regulator valve (refer to figure 8.37), plug, and 'O' ring.

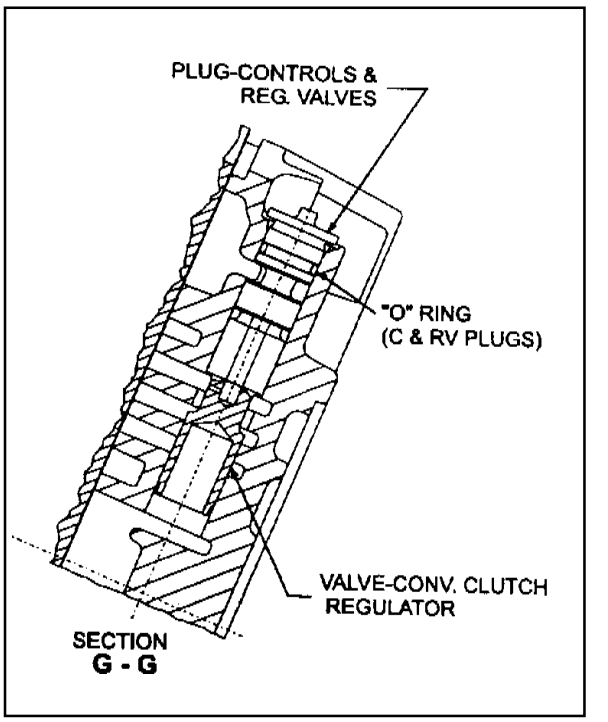
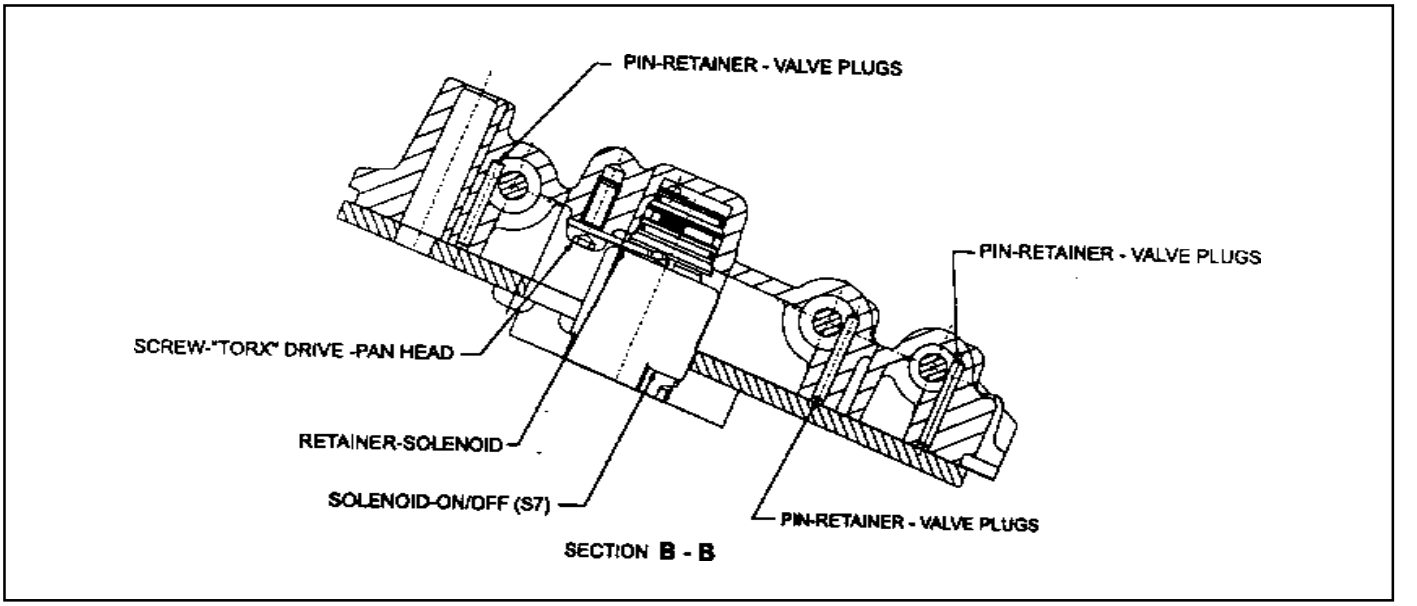


Figure 8.37 - Converter Clutch Regulator Valve

12. Install the retaining pin. Refer to figure 8.39.

Figure 8.39 - Valve Retaining Plugs and Pins



13. Install the converter clutch control valve (refer to figure 8.38), spring, plug, and 'O' ring.

14. Install the retaining pin. Refer to figure 8.39.

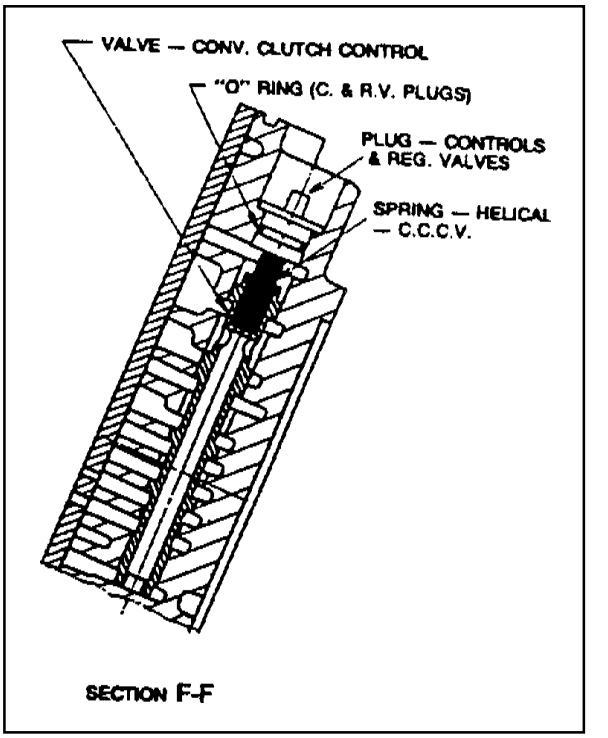


Figure 8.38 - Converter Clutch Control Valve

15. Install the C1 bias valve spring, valve, plug and 'O' ring. Refer to figure 8.40.
16. Install the retaining pin. Refer to figure 8.39.

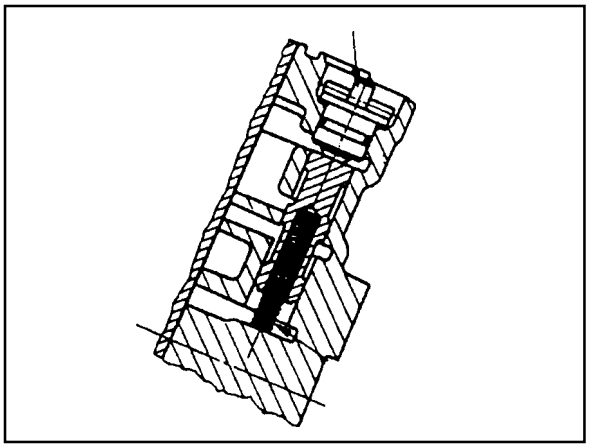


Figure 8.40 - C1 Bias Valve

17. Install the converter release check ball and spring and the feed ball. Refer to figures 8.41, 8.42 and 8.43.

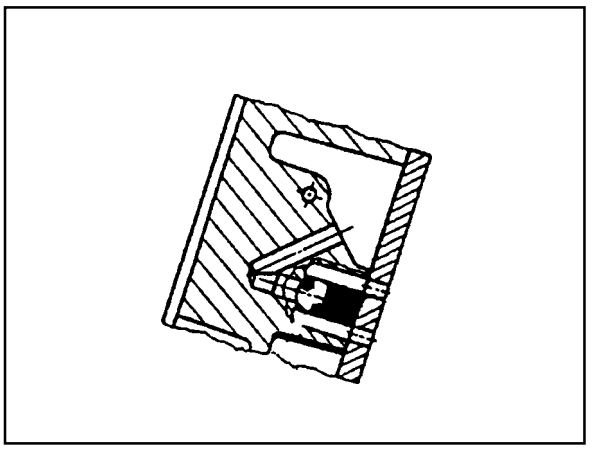


Figure 8.41 - Converter Relief Ball and Spring

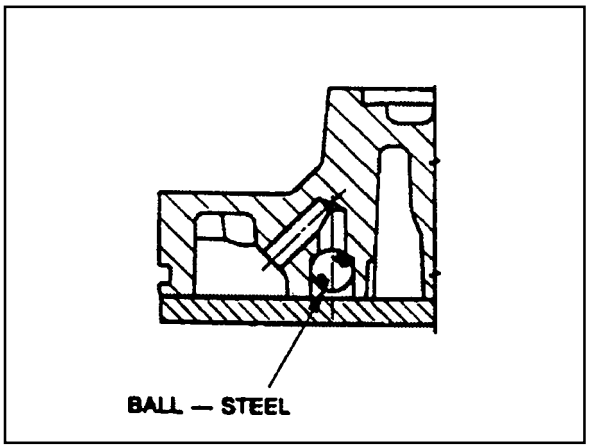


Figure 8.42 - Peed Ball

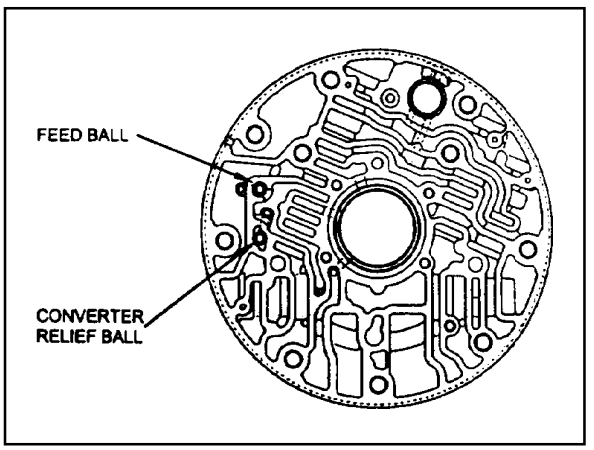


Figure 8.42 - Feed Ball

18. Install the gasket on the pump cover.
19. Install the cover plate, solenoid 7 with the retainer and the solenoid wiring retainer to the pump cover, ensuring that the periphery of the cover plate is flush with the periphery of the pump cover. Refer to figure 8.34.

    Tighten the screws to specification in the order (1-5), shown in figure 8.44.

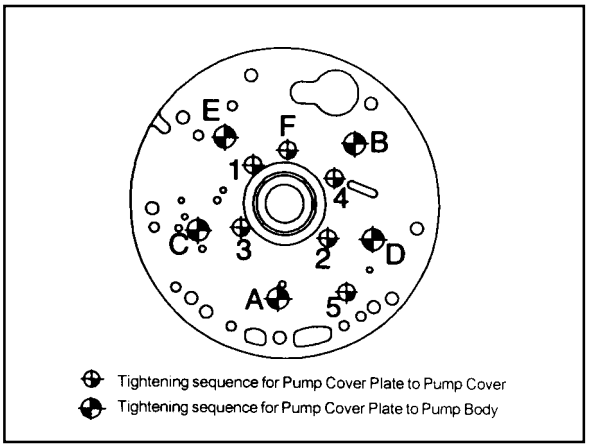


Figure 8.44 - Pump Bolt Tightening Sequence

20. Tighten the solenoid 7 screw. Refer to figure 8.39.

    Notice

    Check that neither the wiring nor the connector protrudes excessively, in order that at assembly neither the wiring and the connector contacts or rubs on the input shaft or the C1/C2 clutch cylinder.
21. Assemble the pump to the pump cover.

    Tighten all bolts and the crescent screw finger tight, ensuring that the pump is flush against the pump cover. Tighten the bolts and the screw to specification in the order (A - F), shown in figure 8.44.
22. Install the pump to transmission case gasket onto the case.
23. Fit the 'O' ring to the pump cover outer diameter.

24. Install the pump and cover assembly over the input shaft being careful not to damage the sealing rings. Tighten the pump cover to case bolts to specification. Refer to figure 8.45.

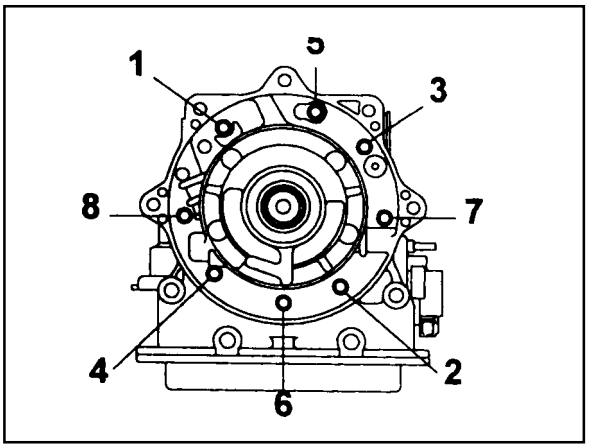
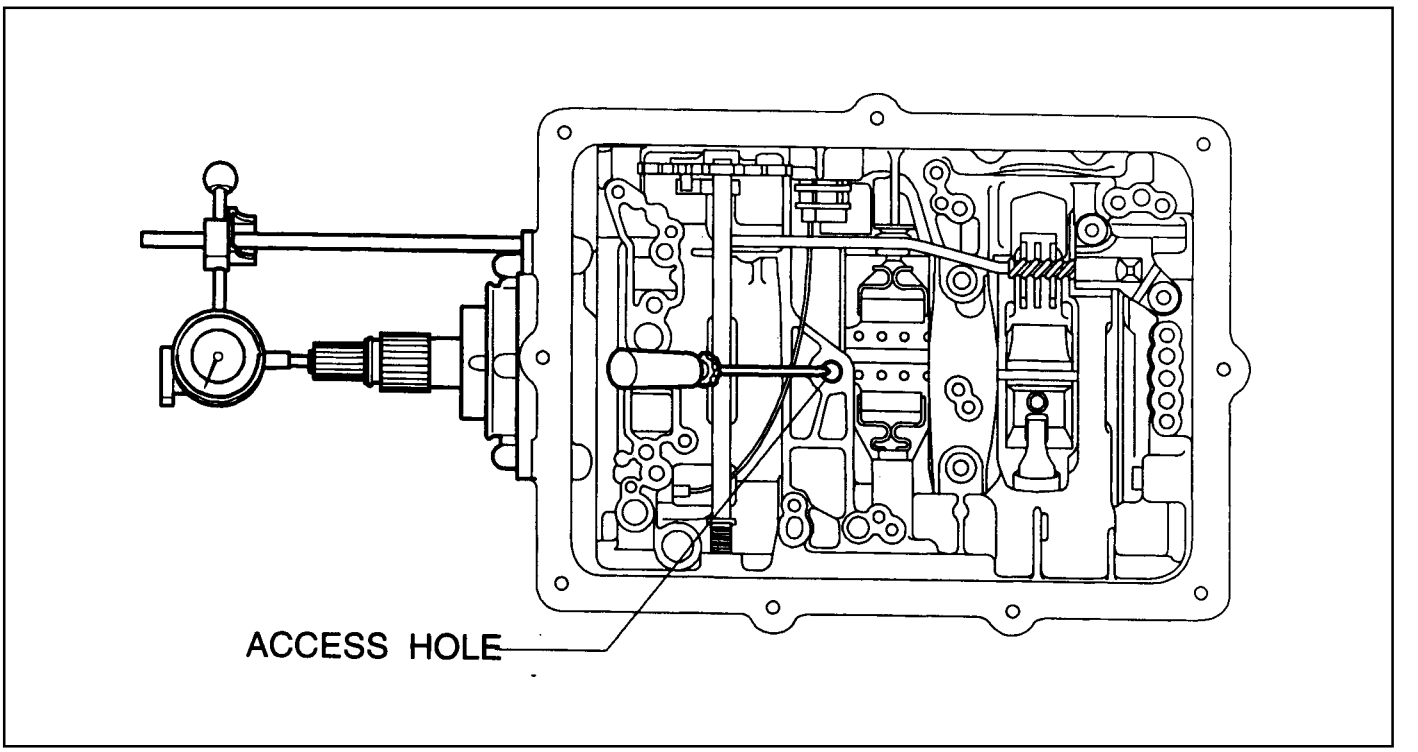


Figure 8.45 - Tightening Sequence Pump to Case

25. Check that the transmission end float is set to the tolerance stated in section 9.2. Refer to figure 8.46. If the unshimmed end float clearance is greater than specification, shims are to be placed between the No. 4 bearing and the input shaft bearing surface. Refer to figure 8.19. If the end float clearance is less than 0.5 mm then the transmission has been assembled incorrectly or the parts are out of specification.
26. Perform the following steps to check the end float :
    a. Attach a dial indicator to the front of the transmission case with the stylus resting on the end of the input shaft.
    b. Apply a force of approximately 250 newtons or 25 kg to the input shaft.
    c. Zero the dial indicator.
    d. Place a small lever behind the forward clutch cylinder and lever the cylinder forward.
    e. The measurement recorded on the dial indicator is the transmission end float or clearance between the No.4 bearing and the converter support tube.
27. On completion of this procedure, adjust the front and rear bands to specifications detailed in section 8.4.

Figure 8.46 - Gear Train End Float Check



Valve Bodies

Notice

1. Do not wash the nose of solenoids in solvent.
2. Be aware of ball positions in the upper valve body.
3. Be aware of 1-2 and 3-4 shift valve positions, they can be swapped.
4. Check the 4-3 sequence valve and spring orientation.
5. Check that the 12 mm ball is in the lower body.
6. Do not mix up the low first blow-off and the torque converter blow-off ball springs.
7. Check the line pressure relief valve for swarf, and be aware of replacing the shims.
8. The orifices in the valve body are for stability and safeguard; do not drill them any larger.
9. When servicing the transmission, ensure that the solenoid 5 damper spring is not broken.
10. Locate the detent spring central to the detent lever.

To assemble the valve bodies, proceed as follows.

1. Wash the upper and lower valve bodies (refer to figures 8.47 and 8.48) thoroughly with cleansing solvent and blow dry.
2. Check the valve body cavities, ports and holes for damage or obstructions.
3. Install the detent lever locating pin.
4. Thoroughly wash all loose components.
5. Check that all valves slide freely in their location.

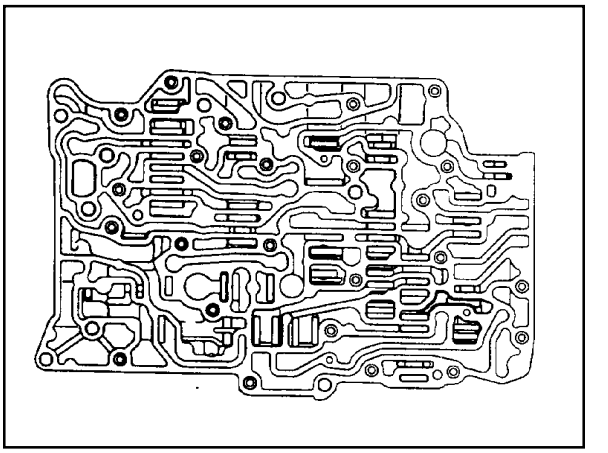


Figure 8.47 - Lower Valve Body

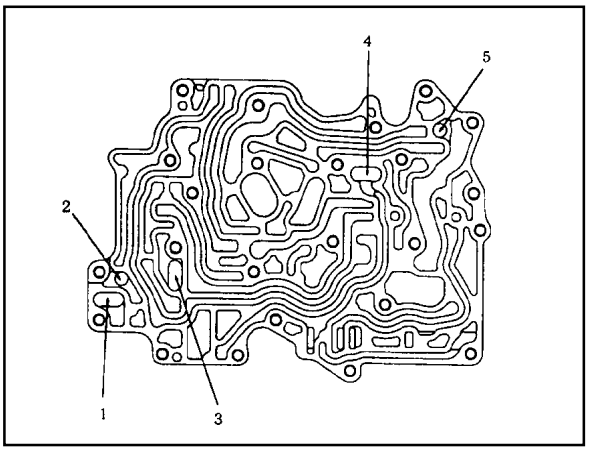
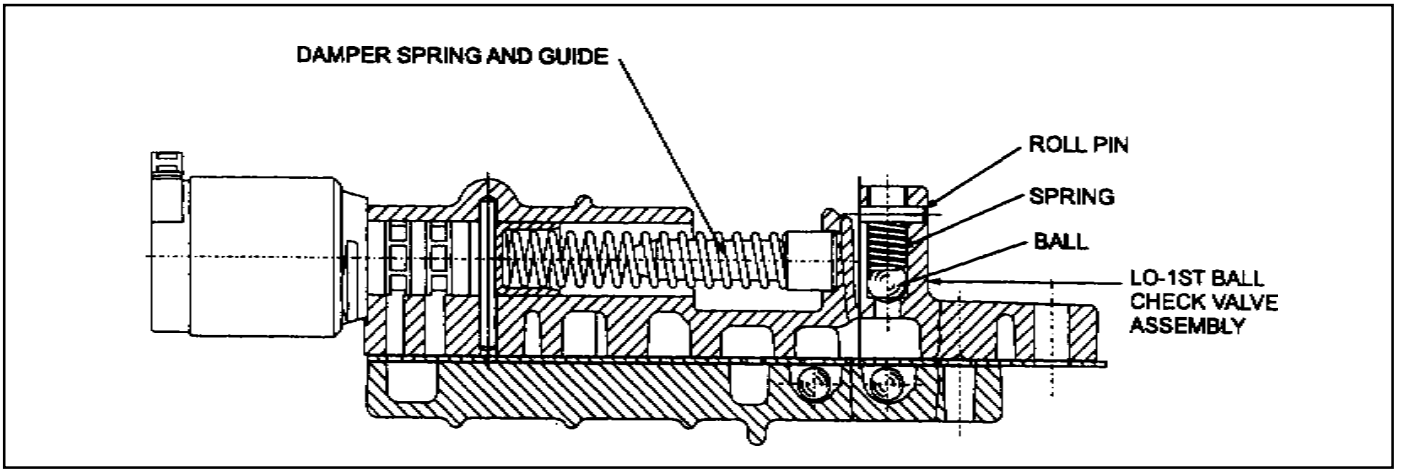


Figure8.48 - Upper Valve Body Showing Check Ball Locations

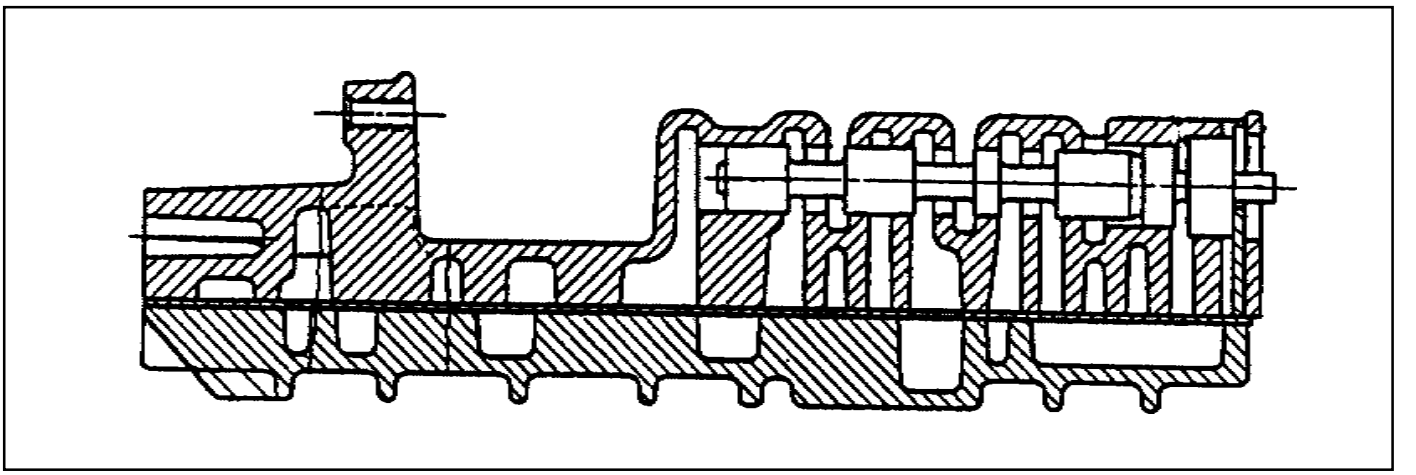
6. Install the lo-1st spring, ball check valve and roll pin. Refer to figure 8.49.
7. Install the solenoid 5 damper guide spring, piston and retaining pin. Refer to figure 8.49.

Figure 8.49 - Solenoid 5 and Damper, Lo-1st Check Valve Assemblies



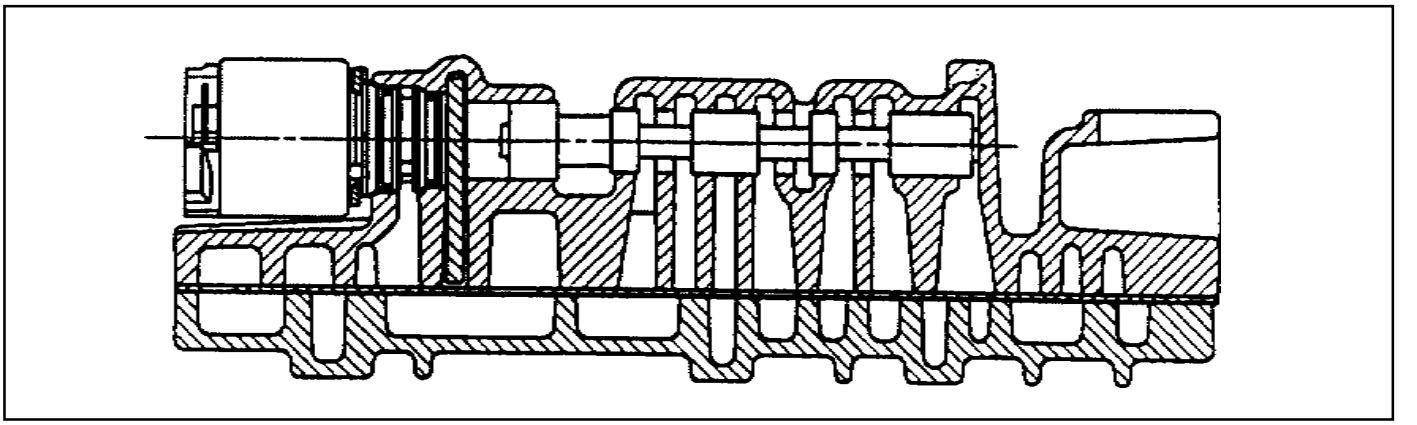
8. Install the 1-2 shift valve, plug and retaining pin. Refer to figure 8.50.

Figure 8.50 - 1-2 Shift Valve



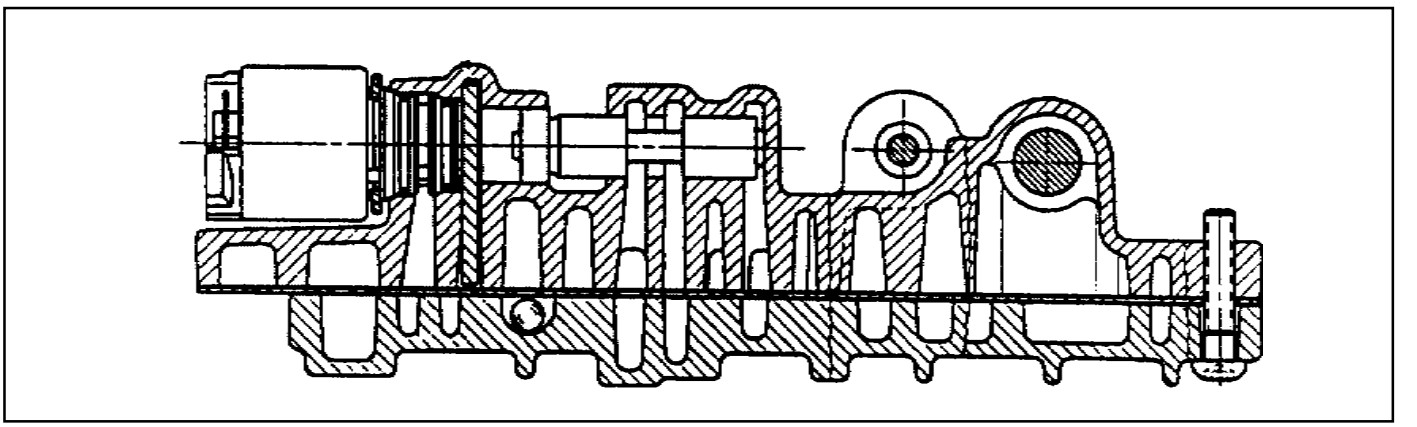
9. Install the 3-4 shift valve and retaining pin. Refer to figure 8.51.

Figure 8.51 - 3-4 Shift Valve



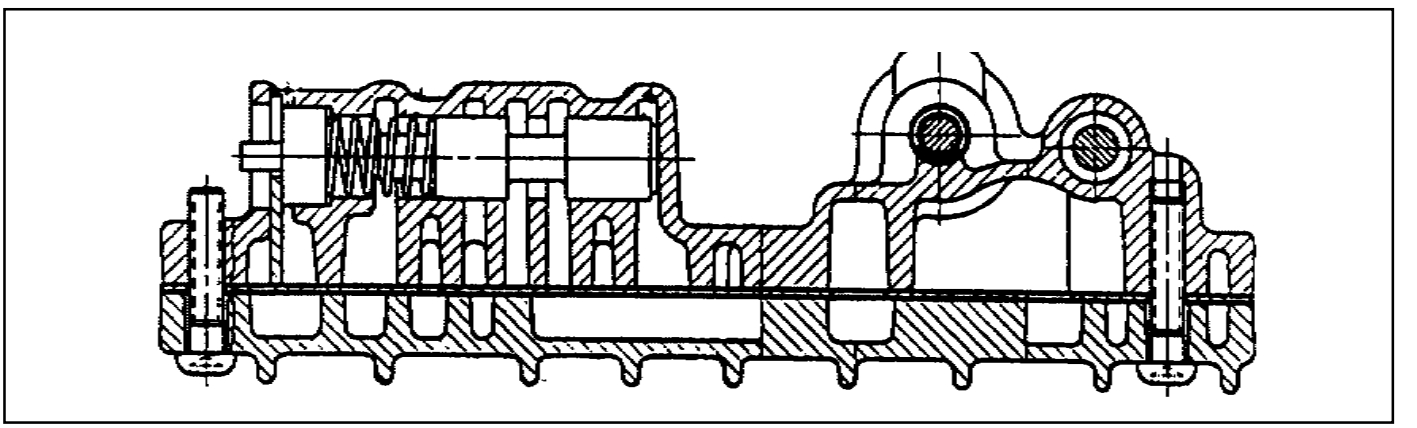
10. Install the 2-3 shift valve and retaining pin. Refer to figure 8.52.

Figure 8.52 - Solenoid 2 and 2-3 Shift Valve



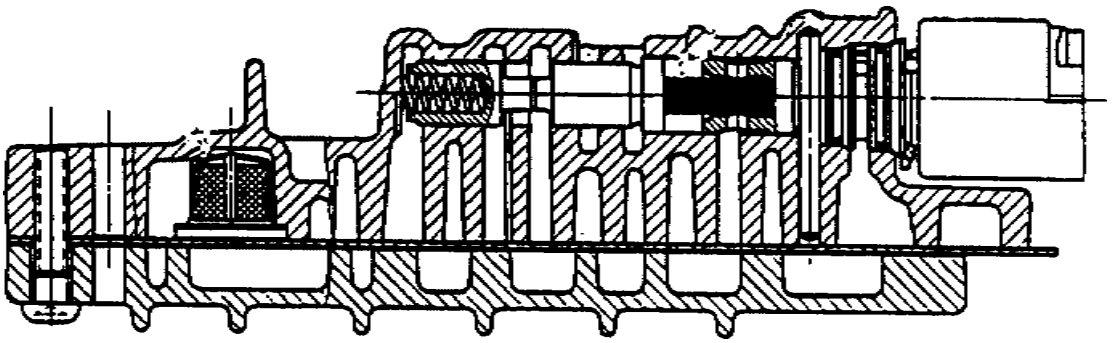
11. Install the 4-3 sequence valve, spring, plug and retaining plate. Refer to figure 8.53.

Figure 8.53 - 4-3 Sequence Valve



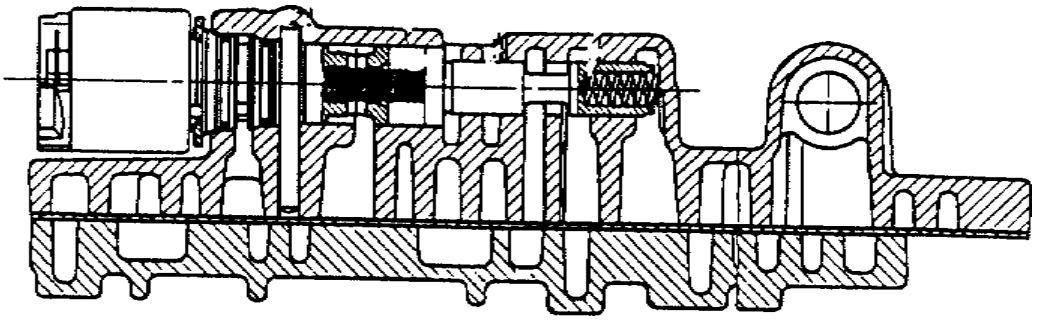
12. Install the band apply regulator (BAR) valve (refer to figure 8.54), springs, plunger and retainer pin.

Figure 8.54 - Band Apply Regulator Valve and Solenoid 4



13. Install the clutch apply regulator (CAR) valve (refer to figure 8.55), springs, plunger and retainer pin.

Figure 8.55 - Clutch Apply Regulator Valve and solenoid 3

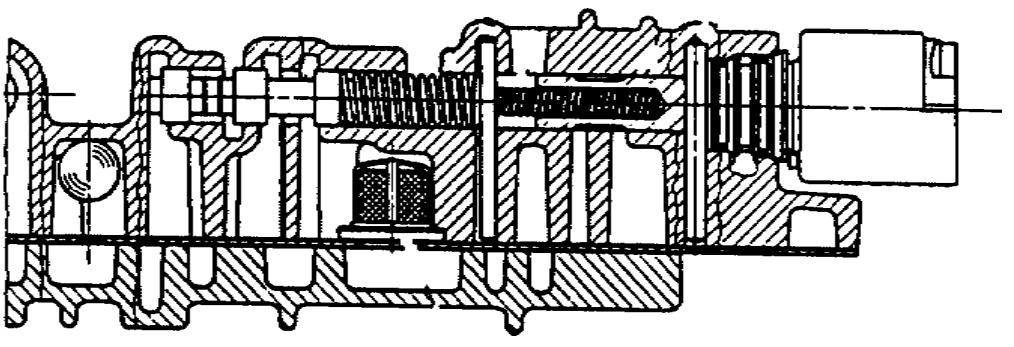


14. Install the solenoid supply valve, spring and retainer plate. Refer to figure 8.56.

Notice

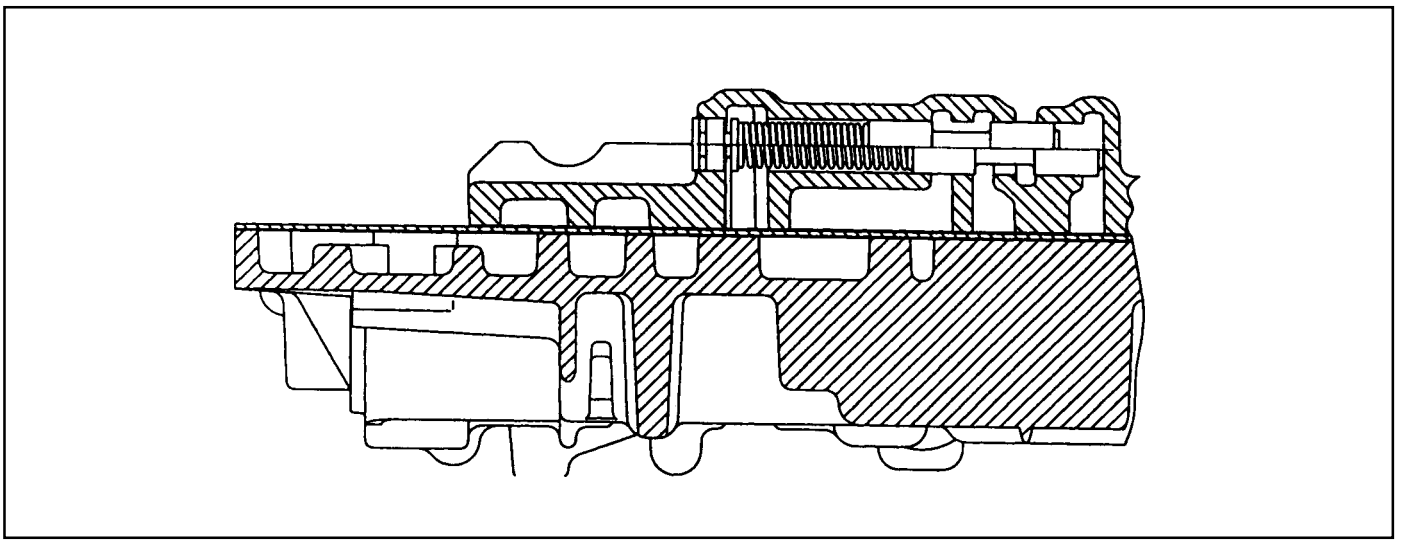
This aluminum valve is easily damaged.

Figure 8.56 - Solenoid Supply Valve and Solenoid 6



15. Install solenoid 6 plunger, spring and retaining pin.
16. Position the third feed ball (large nylon) in the valve body and install the solenoid 5 filter and the solenoid 6 filter. Refer to figures 8.5 and 8.56.
17. Check the separator plate for burrs and damage. Repair or replace the separator plate as necessary.
18. Check the upper and lower valve body gaskets for damage. Replace the gaskets as necessary.
19. Install the lower valve body gasket on the lower valve body.
20. Install the reverse lockout valve, spring, plug and retainer plate. Ensure that the valve is correctly oriented. Refer to figure 8.57.

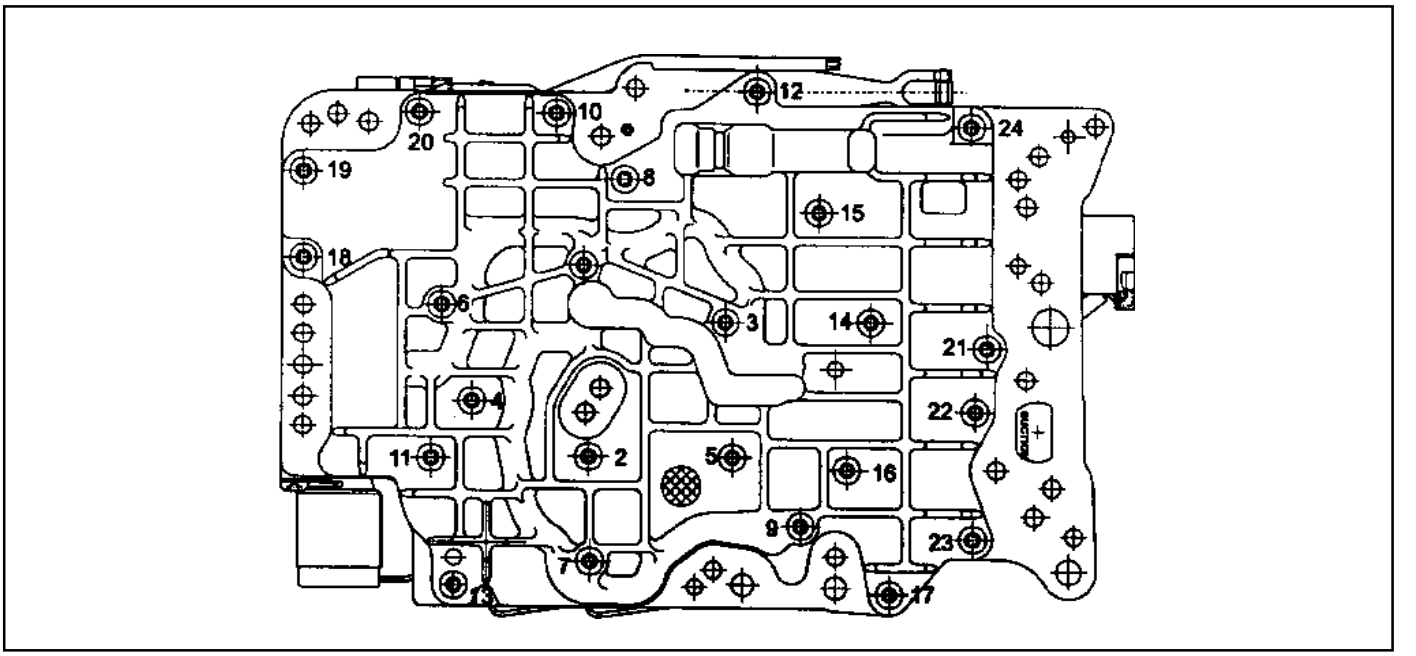
Figure 8.57 - Reverse Lockout Valve



21. Position the five nylon ball checks in the upper valve body. Refer to figure 8.48.
22. Fit the upper valve body gasket. Install the separator plate over the upper valve body.

23. Holding the separator plate to the upper valve body to prevent the check balls from falling out, install the upper valve body on the lower valve body. Install all screws finger tight then tighten the screws to specification in the prescribed sequence. Refer to figure 8.58.

Figure 8.58 - Tightening Sequence Upper to Lower Valve Body



24. Install solenoids 1,2,3,4 and 6. Ensure the solenoid is firmly secured by the retainer and that the screw is tightened to specification.
25. Install solenoid 5. Ensure that the solenoid is pushed firmly into the valve body by the retainer.

    Notice

    The wiring loom ground wire eyelet terminal is secured beneath the solenoid retainer.
26. Install the line pressure relief valve, tapered end first, (refer to figure 8.59), and the spring and disc. Secure with the retaining pin.

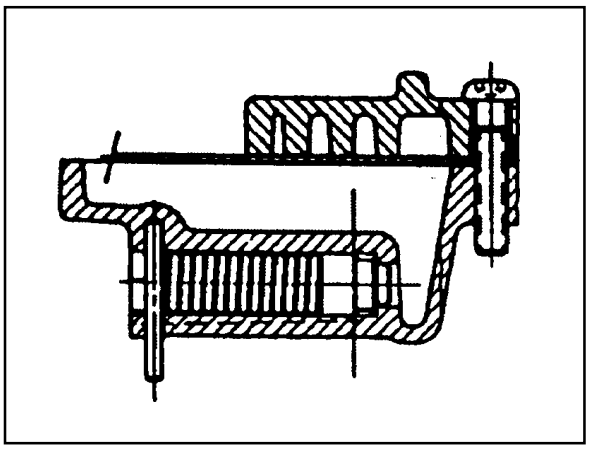
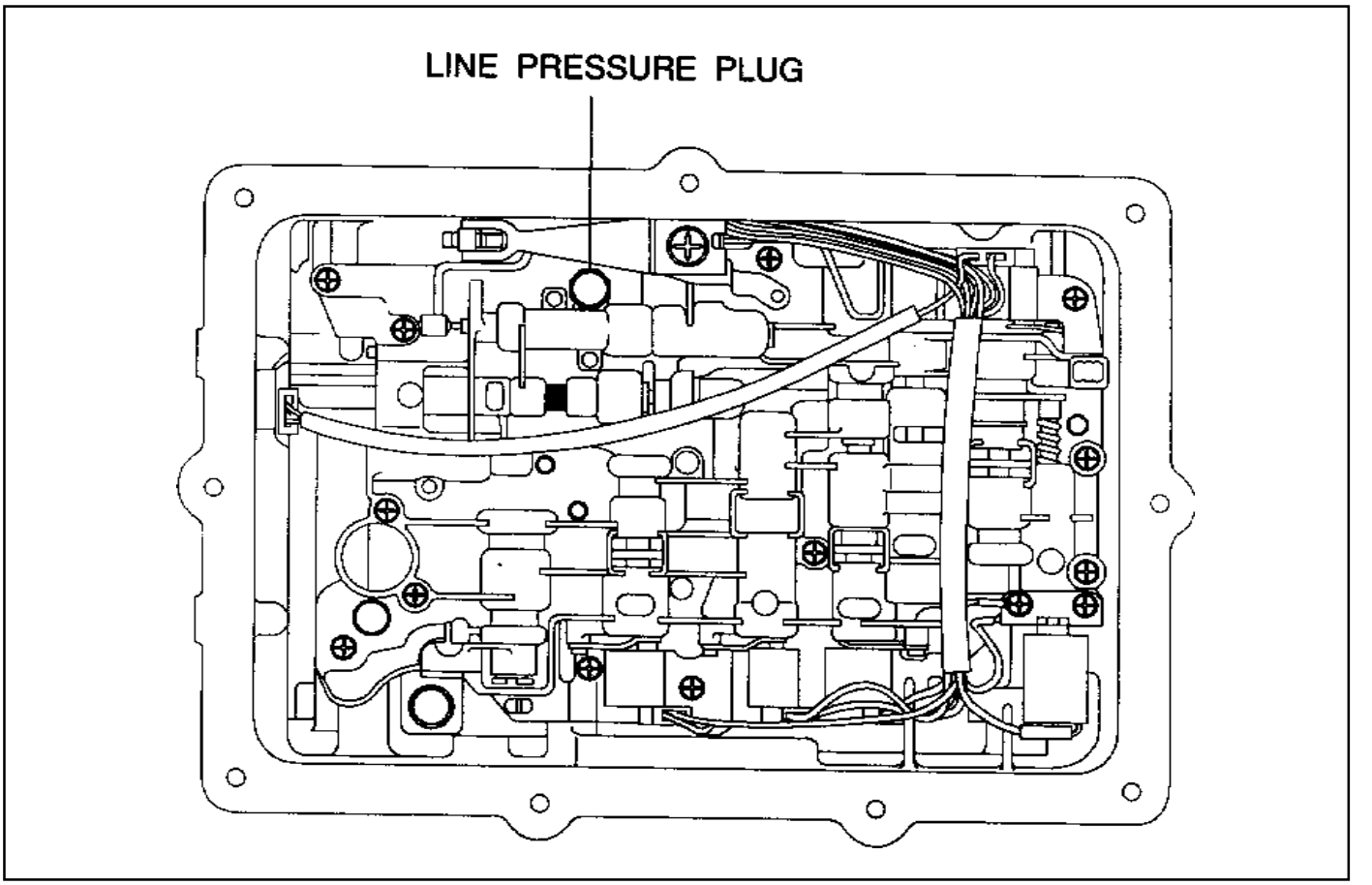


Figure 8.59 - Line Pressure Relief Valve

27. Install the line pressure plug and tighten to specification. Refer to figure 8.62.

Figure 8.62 - Wiring Installation



28. Install the detent spring assembly (spring, support plate and screw), ensuring that the screw is tightened to specification. Check the spring for wear or damage.
29. Install the manual shift valve. Refer to figure 8.60.

    Notice

    Be aware that the manual valve will fall out of the valve body.

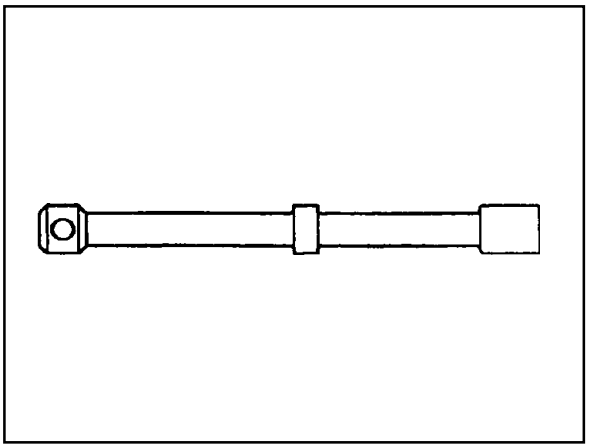
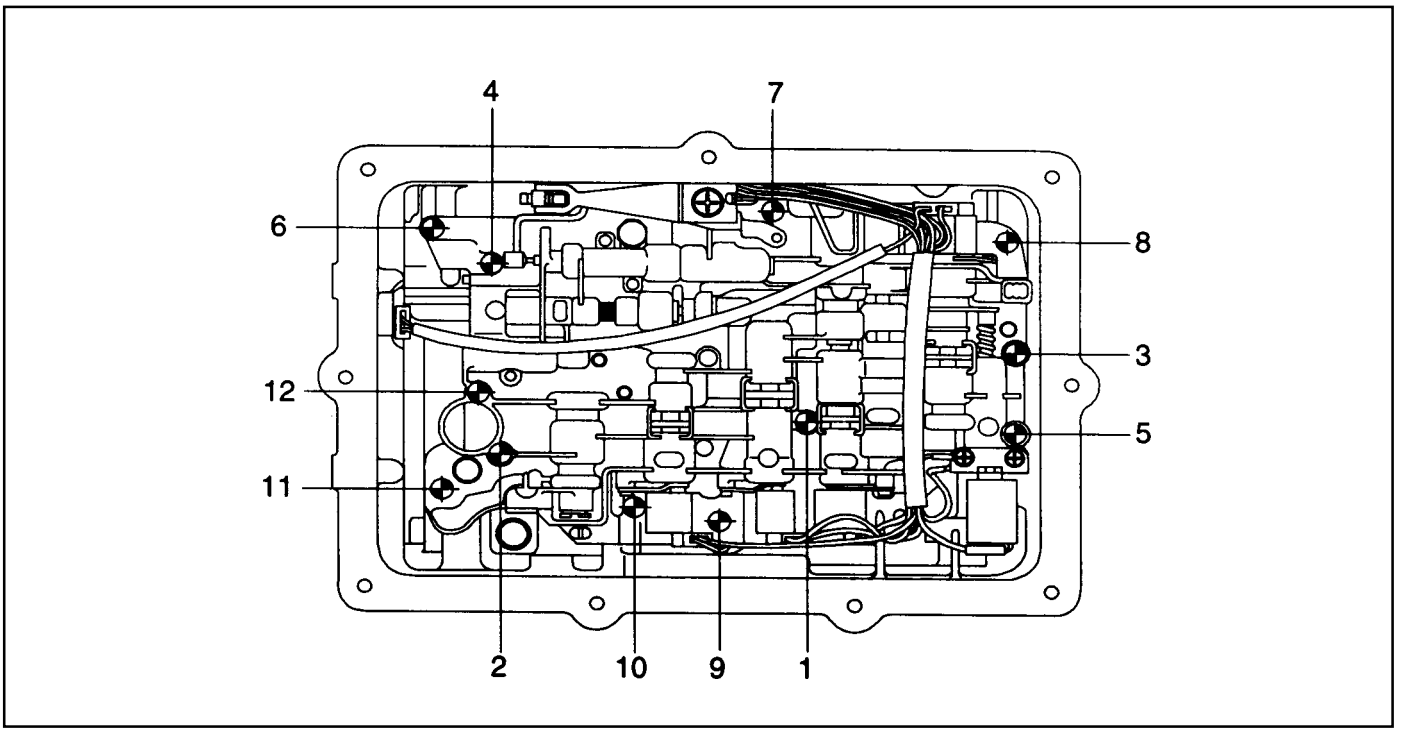


Figure 8.60 - Manual Shift Valve

30. Align the valve body assembly on the transmission case and install the manual valve lever to manual valve link. Fit the long end of the link to the manual valve first. Install the securing bolts and tighten to specification in the specified sequence. Refer to figure 8.61.

Figure 8.61 - Tightening Sequence Valve Body to Case



31. Check the alignment of the detent roller and the manual lever quadrant.
32. Connect the solenoid wiring as detailed below:
    - Solenoid 1 - red
    - Solenoid 2 - blue
    - Solenoid 3 - yellow
    - Solenoid 4 - orange
    - Solenoid 5 - green
    - Solenoid 6 - violet (Refer to figure 8.62.)

    Notice

    All hardware must be correctly installed and torqued to specification.

Oil Filter and Pan Assembly

Notice

1. Replace the filter whenever rebuilding a transmission where a significant amount of mechanical damage has occurred.
2. To aid the assembly of the pan gasket, use a small amount of Vaseline at the pan/gasket interface. This ensures that the gasket remains on the pan ridge. Do not over torque pan bolts as this may distort the pan and cause leaks.
3. Ensure that the internal line pressure plus in the valve body is fitted.

To assemble the oil filter and pan assembly (refer to figures 8.63 and 8.64), proceed as follows.

1. Lubricate the oil filter sealing ring with automatic transmission fluid.
2. Carefully assemble the oil filter to the valve body. The spigot must not lean on one side while being fitted. Refer to figure 8.63.
3. Secure the oil falter assembly with the retainer.
4. Check that the magnet is located in the dimple in the comer of the oil pan.
5. Assemble the gasket on the pan lip. The gasket must be free of any distortion when installed.
6. Fit the oil pan assembly to the transmission case and tighten the securing bolts to specification and sequence (refer to figure 8.65). Do not over torque.

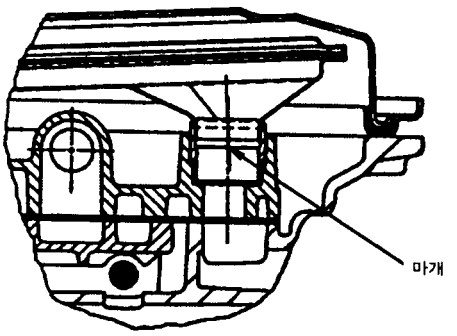


Figure 8.63 - Oil Filter Spigot

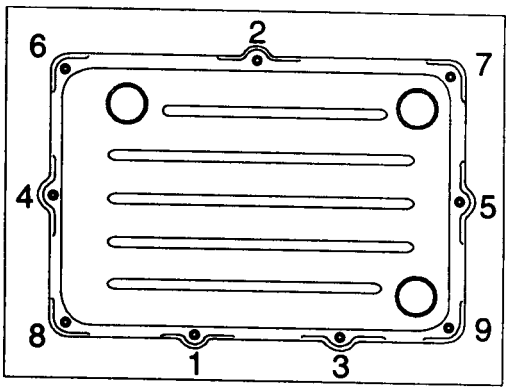


Figure 8.65 - Oil Pan Tightening Sequence

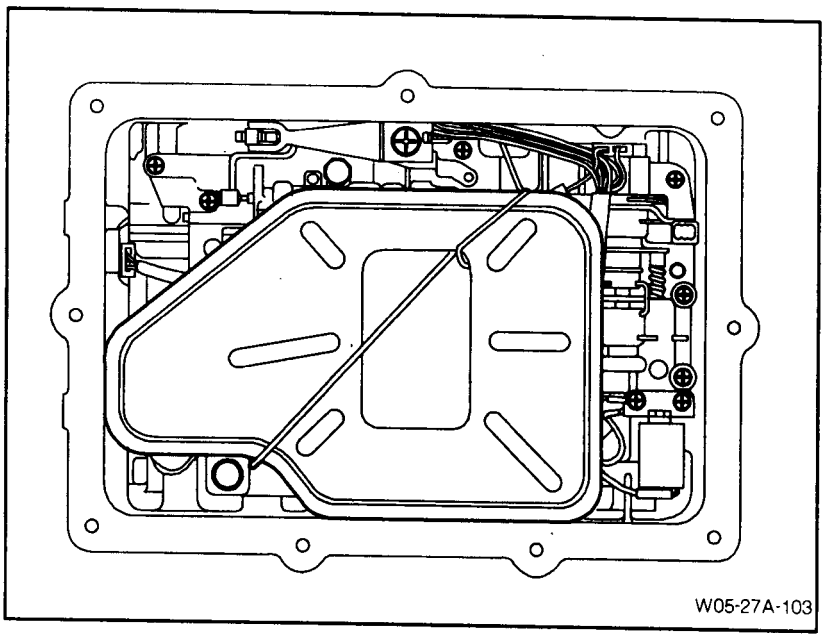


Figure 8.64 - Oil Filter Installation

Torque Converter and Housing Assembly

To assemble the torque converter and housing assembly, proceed as follows.

1. Locate the torque converter housing on the transmission main case.
2. Install and tighten the securing bolts to specification.

   Notice

   All the hardware must be correctly installed and torqued to specification.
3. Fit the converter ensuring that the tangs are engaged in the pump gear. Ensure that the tangs do not contact the pump seal.

Figure 8.1 - Torque Specifications

Torque Specifications	N●m
Torque converter housing to case	54 - 68
Extension housing to case	54 - 68
Rear servo cover	25 - 35
Pan to case	4 - 6
Inhibitor switch to case	2.3 - 3.4
Cooler connectors	30 - 35
Transmission filler plug	30 - 35
Output flange lock nut (RWD models)	100 - 110
Centre support to case	20 - 27
Cam plate to case (parking pawl)	16 - 22
Valve body to case	8 - 13
Upper valve body to lower valve body	11 - 16
ON/OFF solenoid retainers	8 - 12
Variable pressure solenoid retainer	8 - 12
Line pressure plug	4 - 7
Detent spring	20 - 22
Pump cover to case	24 - 34
Pump cover plate to pump cover	13 - 16
Pump to pump adaptor	24 - 27
Pump cover plate to crescent	13 - 16
Adaptor to case	25 - 35

FRONT AND REAR BAND ADJUSTMENT

Front Band Setting Procedure

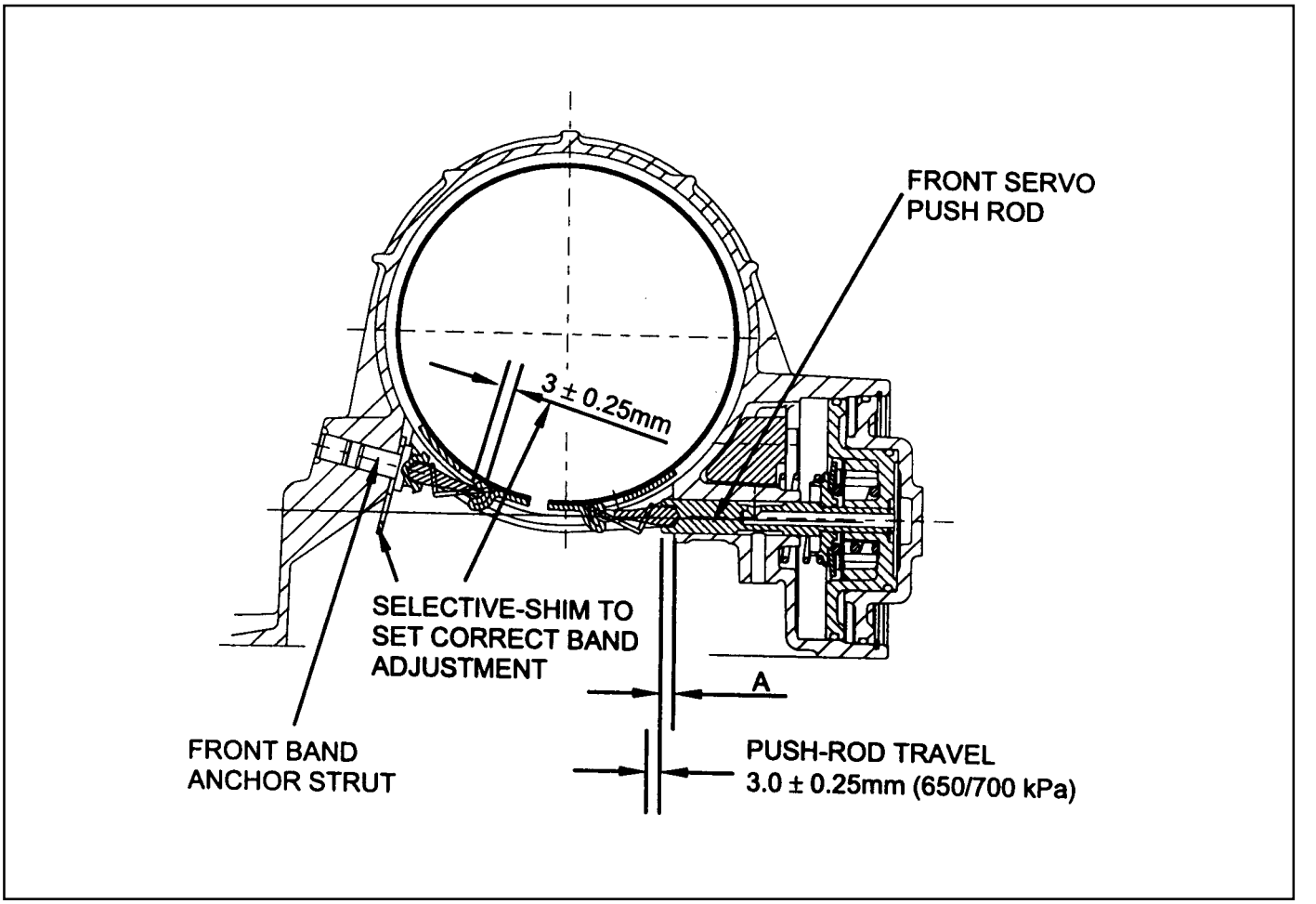
To set the front band, proceed as follows.

1. Measure the projection of the front servo push rod from the transmission case. Refer to figure 8.66, dimension A.
   a. Apply air at 650/700 kPa to the front servo apply area (B1 outer). (Refer to figure 8.67.)
   b. Measure the travel of the push rod and subtract 3 mm to find the shim size required.
   c. Release the air.

   Notice

   A minimum of one shim is required at all times - minimum shim size is 1 mm. The thicknesses of available shims are listed in table 8.2.
2. Fit the selected shim(s) to the shank of the anchor strut as follows:
   a. Inspect the shim(s) for damage, wear or corrosion. Replace as necessary.
   b. The shim(s) are to be installed between the case abutment face and the anchor strut flange. Refer to figure 8.66.
   c. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced.
   d. Shim(s) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the push rod travel is 3 mm ± 0.25 mm.

Figure 8.66 - Front Band Settings



Rear Band Setting Procedure

To set the rear band, proceed as follows.

1. Measure distance 'A' from the rear servo piston to the inner face of the transmission case using vernier calipers. Refer to figure 8.68.
   a. Apply air at 650/700 kPa to the rear servo apply area (B2 outer). Refer to figure 8.67.
   b. Measure the travel of the piston, subtract 3.75 mm and divide the remainder by 2.5 to find shim size.
   c. Release the air.

   Notice

   A minimum of one shim is required at all times - minimum shim size is 1 mm. The thickness of available shims are listed in table 8.2.
2. Fit the selected shim(s) to the shank of the anchor strut as follows.
   a. Inspect the shim(s) for damage, wear or corrosion and replace as necessary. The shim(s) are to be installed between the case abutment face and the anchor strut flange. Refer to figure 8.68.
   c. The shim(s) are to be fitted by hand and under no circumstances to be hammered or forced.
   d. The shim(5) are to be pressed on by hand until an audible click is heard. The click indicates that the shim is clipped home correctly.
3. Re-check that the piston travel is 3.75 mm ± 0.625 mm.

Figure 8.68 - Rear Band Settings

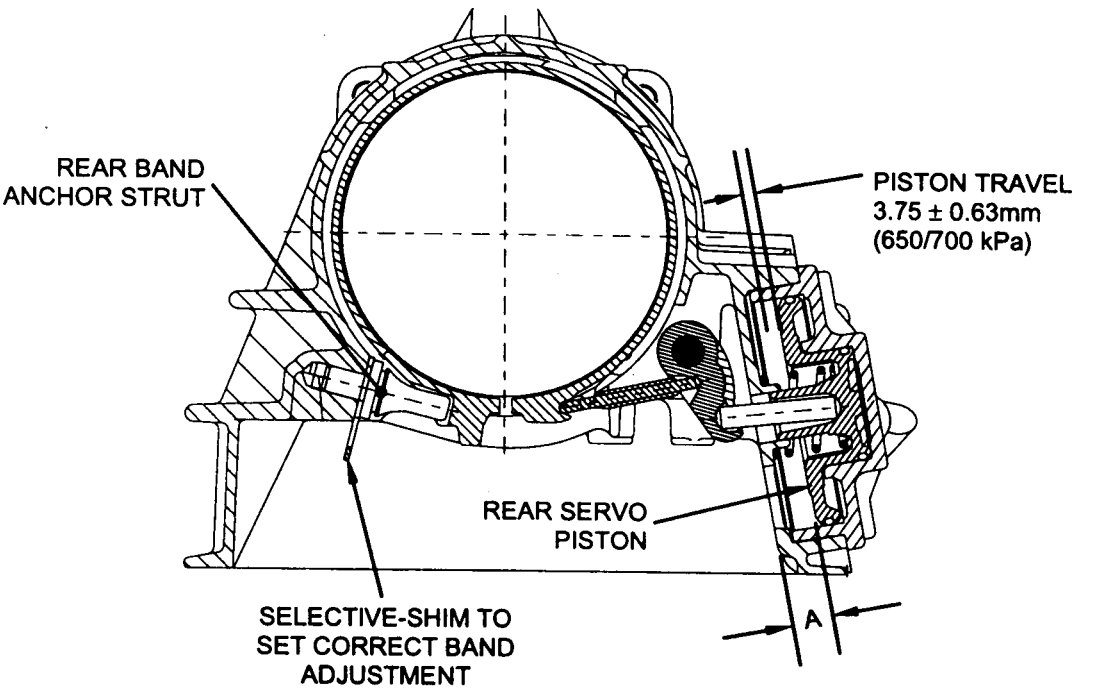
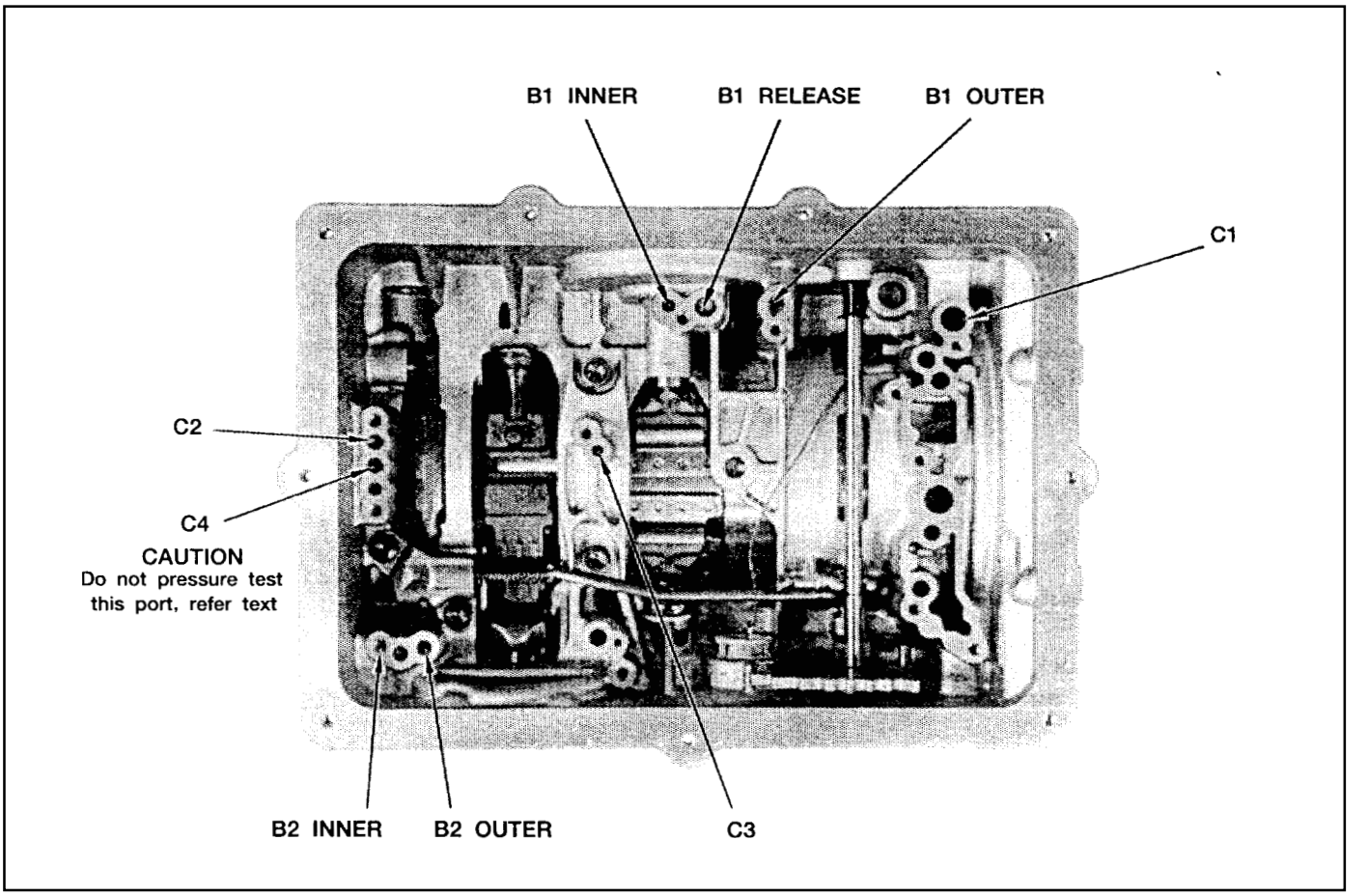


Table 8.2 - Thickness of Available Shims

Thickness	Part Number	Thickness	Part Number
0.95/1.05	0574-037017	1.93/2.07	0574-037021
1.15/1.25	0574-037018	2.12/2.28	0574-037022
1.44/1.56	0574-037019	2.42/2.58	0574-037023
1.73/1.87	0574-037020	2.61/2.79	0574-037024

Figure 8.68 - Thickness of Available Shims



SECTION 5B

MANUAL TRANSMISSION

TABLE OF CONTENTS

Specifications 5B-1
General Specifications 5B-1
Fastener Tightening Specifications 5B-2
External View 5B-3
Gear Train 5B-3
Power Flow 5B-4
Diagnosis 5B-5
Will not Shift (Control Lever Moves) 5B-5
Hard Shift or Control Lever Will not Move Into Gear 5B-5
Gears Crash When Shifting 5B-5
Transmission Jumps Out 5B-6
Transmission Locked in One Gear 5B-6
Transmission Noise 5B-6
Transmission Leakage 5B-7
Diagnosis Table 5B-8
Component Locator 5B-9
Maintenance and Repair 5B-11
On-Vehicle Service 5B-11
Shift Control Cable 5B-11
Transmission 5B-14
Unit Repair 5B-17
Major Unit 5B-17
Main Shaft 5B-27
Input Shaft 5B-32
Counter Shaft 5B-34
Extension Housing 5B-35
Shift Cover 5B-36
Inspection of Components 5B-40
Pre-Installation Checks 5B-45

SPECIFICATIONS

GENERAL SPECIFICATIONS

Application		Description
Model		T5WC
Type		Floor Change
Gear Ratio	1st	3.97 : 1
	2nd	2.34 : 1
	3rd	1.46 : 1
	4th	1.00 : 1
	5th	0.85 :1
	Reverse	3.71 : 1
Oil	Specification	ATF DEXRON II / III
	Capacity(litre)	3.4 L
	Change Interval	Check : Every 15,000km, Replace : Every 50,000km
Weight (Dry)		33kg

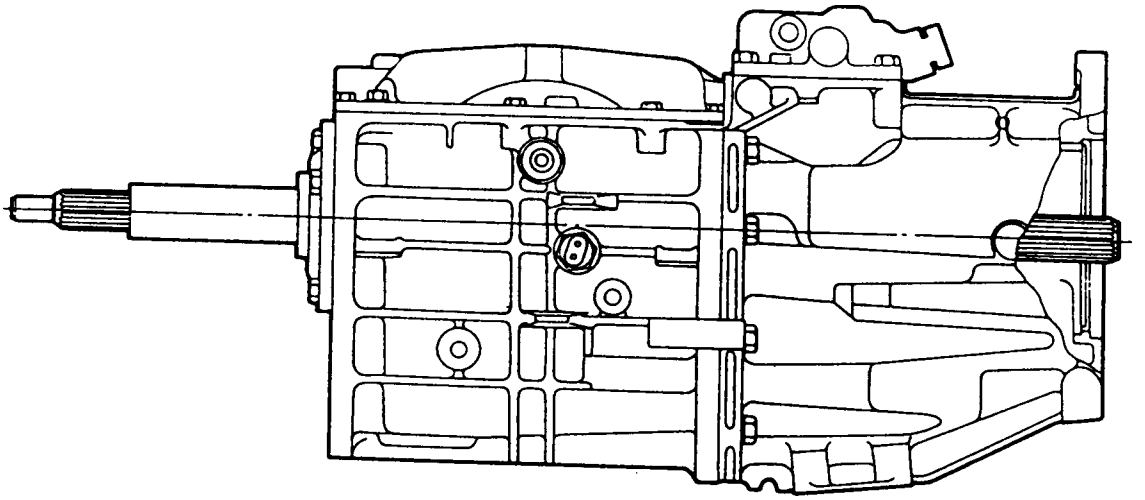
Notice

Add LUBRIZOL (280cc) in oil after overhauling.

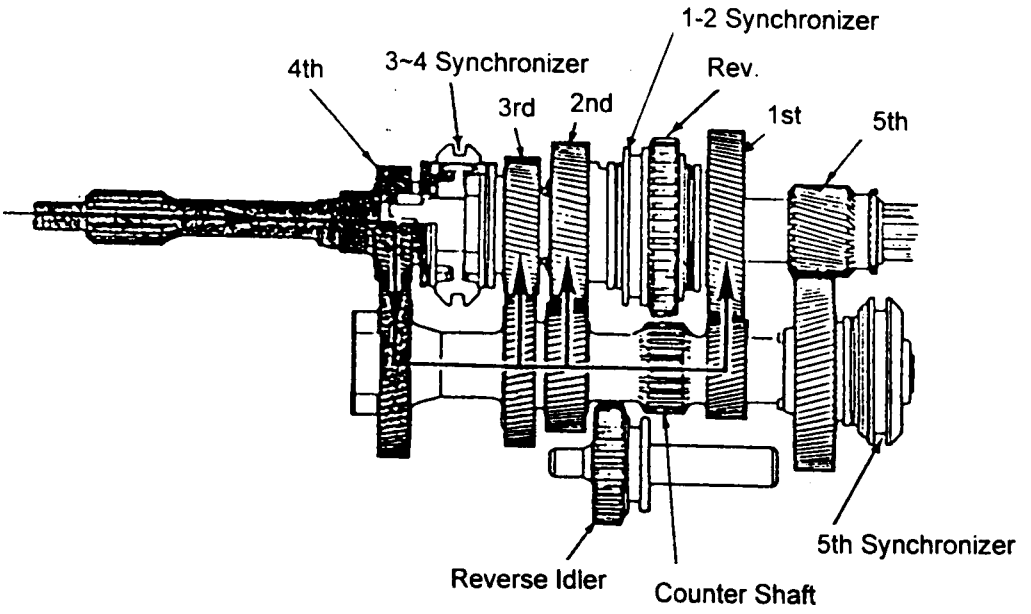
FASTENER TIGHTENING SPECIFICATIONS

Application	N●m
Transmission	
Oil Filler Plug	25
Transmission Mounting Bolt (Housing)	77 - 87
Oil Drain Plug	25
Front Propeller Shaft (T/C)	81 - 89
Rear Propeller Shaft (T/C)	70 - 90
Cross Member Bolt (Center)	21 - 35
Cross Member Bolt (Side)	62 - 93
Control Cable	
Shift Lever Bolt	20 - 30

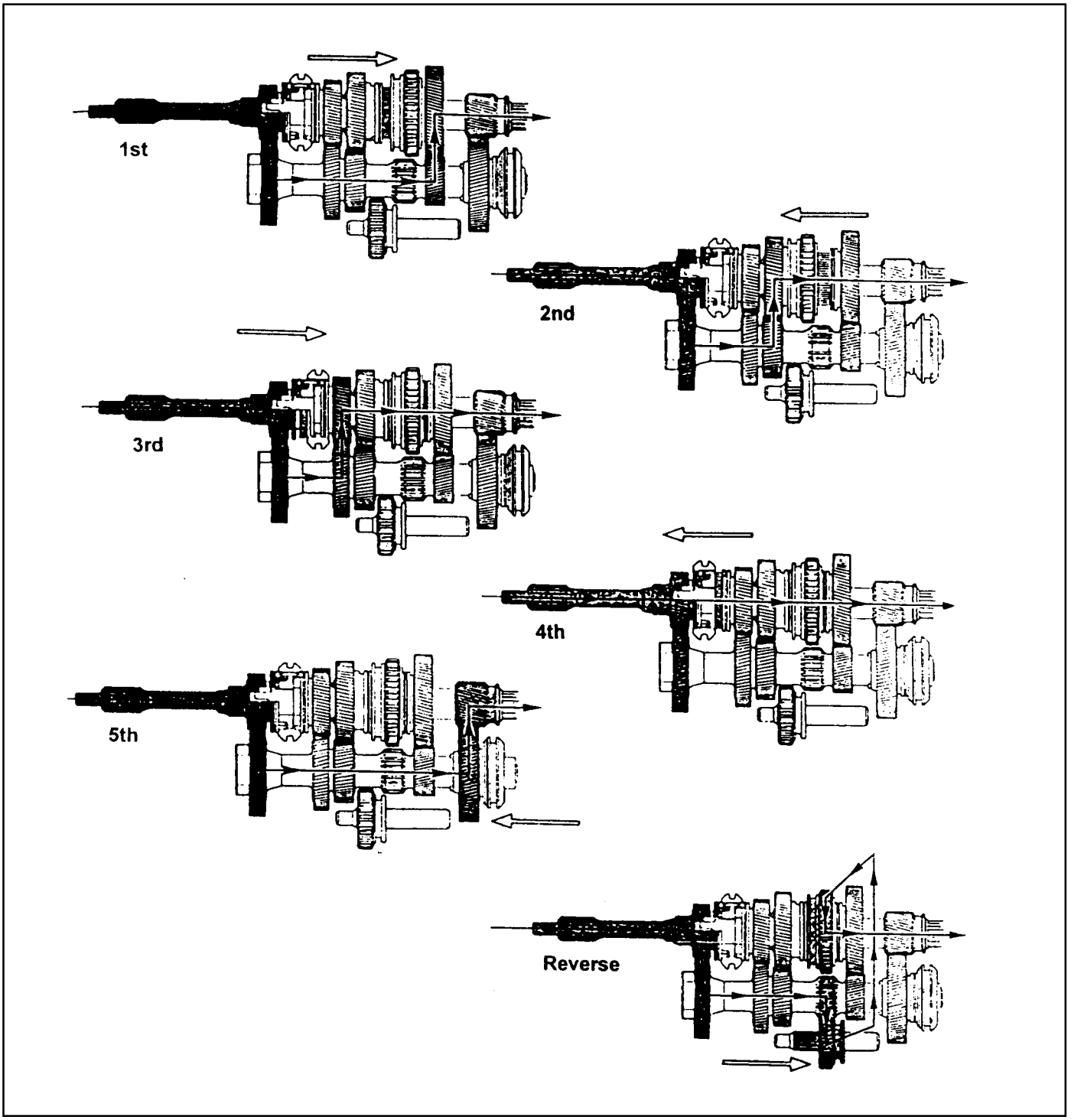
EXTERNAL VIEW



GEAR TRAIN



POWER FLOW



DIAGNOSIS

WILL NOT SHIFT(CONTROL LEVER MOVES)

Check	Action
Control lever assembly broken or damaged.	Replace control lever and housing assembly.
Damaged offset lever, shift fork, selector place or selector arm.	Remove extension, adapter or case cover. Check or replace damaged parts.

HARD SHIFT OR CONTROL LEVER WILL NOT MOVE INTO GEAR

Check	Action
Clutch not releasing.	Adjust or replace clutch.
Improper or low transmission oil.	Add or replace with specified oil.
Shift or shift rail binding.	Remove extension, adapter or case cover. Check or replace damaged parts.
Binding of sliding synchronizers or gears.	Remove extension, adapter or case cover. Check synchronizers and gears and replace damaged parts.
If reverse only, faulty backup switch.	Check or replace backup switch.
Worn or damaged flywheel pilot bushing.	Replace pilot bushing.

GEARS CRASH WHEN SHIFTING

Check	Action
Engine idle speed too high.	Adjust idle speed to specified speed.
Damaged or faulty clutch.	Adjust or replace clutch.
Pilot bearing between input shaft and output shaft binding.	Replace or check roller bearings.
Damaged synchronizer.	Check or replace synchronizer parts.
Bell housing misaligned.	Align bell housing and bore.
Damaged gear(s).	Check or replace gear(s).
Worn or damaged flywheel pilot bushing.	Replace pilot bushing.

TRANSMISSION JUMPS OUT

Check	Action
Loosened transmission or flywheel housing bolts, improper alignment.	Tighten bolts to specified value. Realign if necessary.
Synchronizer damaged or excessively worn.	Check or replace synchronizer parts.
Blocking ring damaged, worn index slots or friction surfaces worn or damaged.	Check or replace blocking ring.
Excessive countershaft end play.	Check worn or damaged parts. Adjust shim thickness using roller bearings if necessary.
Worn or damaged fork due to loosened shaft, rail or shifting fork.	Check for wear or damaged. Replace worn or damaged parts.

TRANSMISSION LOCKED IN ONE GEAR

Check	Action
Fork or offset lever loose on shaft or rail.	Replace extension, adapter or case cover. Check or replace loose parts on shaft or rail. Replace roll pin(s).
Worn or damaged forks, offset lever, shaft or rail.	Remove extension, adapter or case cover. Check for wear or damaged. Replace damaged parts.
Worn or damaged synchronizer.	Check worn or damaged synchronizer parts and replace if necessary.
Worn or damaged gears.	Check worn or damaged gears and replace if necessary.

TRANSMISSION NOISE

Check	Action
Improper or low transmission oil.	Add or drain and replace with proper oil.
Loose bolts or other attaching parts.	Tighten as specified.
Improper flywheel housing to engine crankshaft alignment.	Realign correctly.
Noisy transmission bearing.	Check bearings, bearing rollers and parts for wear or damage. Replace if necessary.
Noisy gears.	Check for worn or damaged gears (including speedometer gear). Replace if necessary.

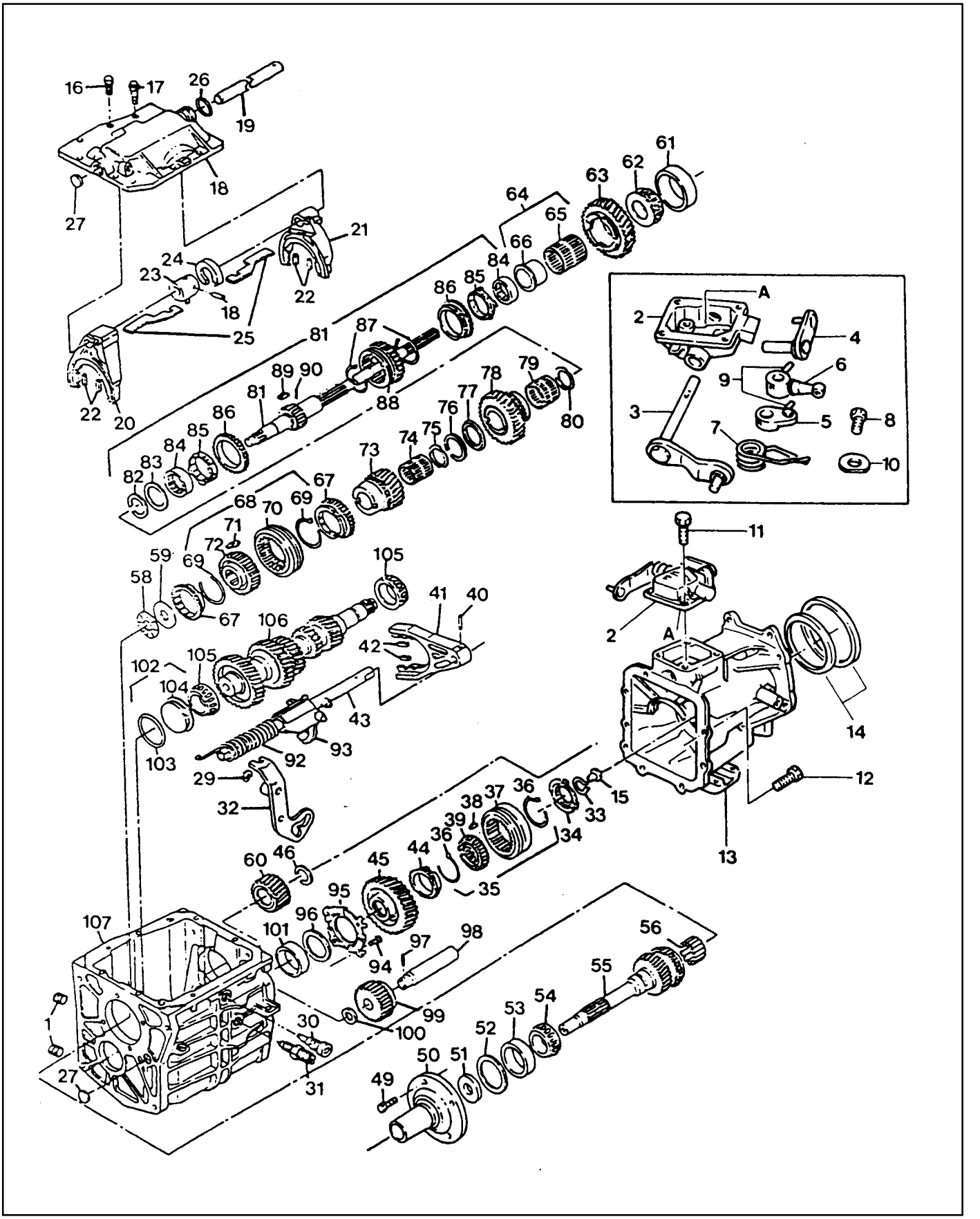
TRANSMISSION LEAKAGE

Check	Action
Leakage from transmission.	Clean all exposed surfaces, then check for leaks.
Vent or breather clogged.	Clean or replace vent or breather.
Too much oil.	Check oil level.
Loose bolts at sealing faces.	Tighten as specified.
Improperly applied sealant.	Clean leaking surfaces. Reapply sealant.
Worn or damaged oil seal.	Replace oil seal.

DIAGNOSIS TABLE

Condition 1 Shift Hop-out 2 Shift Gear Crash 3 Shift Block-out 4 Hard Shift 5 Noise in Reverse Gear 6 Noise in 5th Gear 7 Noise in 4th Gear 8 Noise in 3rd Gear 9 Noise in 2nd Gear 10 Noise in 1st Gear 11 Noise in All Speeds 12 Leak at Transmission Rear Part 13 Leak at Transmission Center Part 14 Leak at Transmission Front	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Possible Faulty Part														
Transmission Case													●	●
Extension Housing												●	●	
Shift Cover / Shift Shift	●			●									●	●
Shift Control Lever	●			●										
Input Bearing Retainer				●										●
Input Gear Set											●			
3rd Speed Gear Set	●							●			●			
2nd Speed Gear Set	●								●		●			
Reverse Speed Gear Set					●									
1st Speed Gear Set	●									●	●			
5th Speed Gear Set	●										●			
Clutch Housing and Release Derive				●							●			
Crankshaft Pilot Bushing and Release Bearing				●							●			
Input Bearing											●			
Main Shaft Input Bearing											●			
Main Shaft Thrust Bearing	●										●			
3rd Speed Gear Bearing								●			●			
2nd Speed Gear Bearing									●		●			
1st Speed Gear Bearing										●	●			
Reverse Idler Gear Bushing					●									
Counter Shaft Front Bearing											●			
Counter Shaft Rear Bearing											●			
Counter Shaft Thrust Bearing	●		●								●			
5th Speed Drive Gear Bearing						●					●			
Slip Yoke Bushing														
Slip Yoke Seal														
Speedometer Drive / Driven Gears												●		
Speedometer Driven Gear Housing												●		
Input Shaft Seal														●
1 - 2 Synchronizer Assembly	●	●	●						●	●	●			
3 - 4 Synchronizer Assembly	●	●	●				●	●			●			
5th Synchronizer Assembly	●	●	●				●				●			
Ring Oil Seal												●		
T/C Front Face												●		

COMPONENT LOCATOR

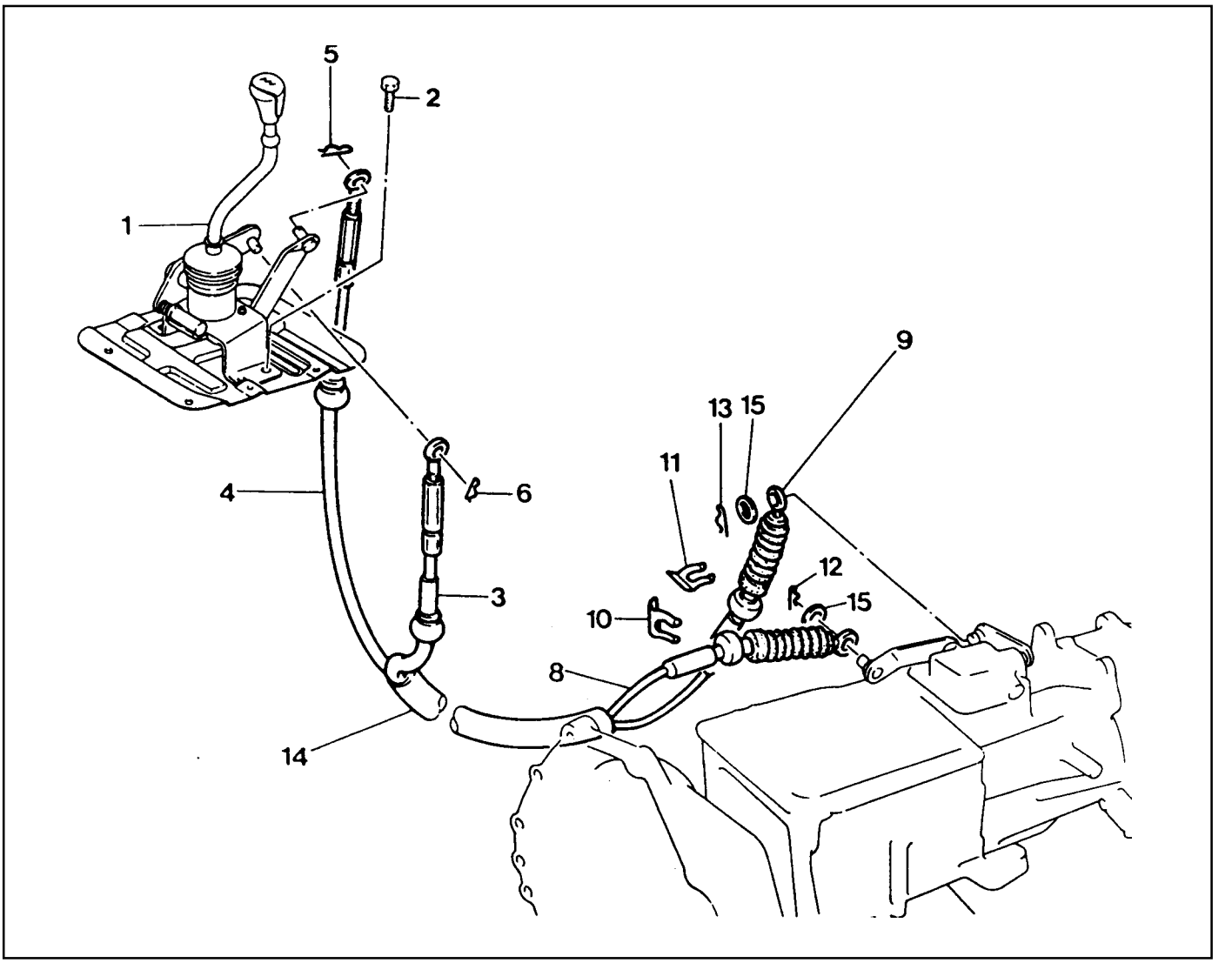


1 Filler/Drain Plug
2 Shift Mechanism Cover
3 Shift Shaft Lever
4 Outer Select Lever
5 Inner Select Lever
6 Offset Control Lever
7 Bias Spring
8 Bolt
9 Pin
10 Washer
11 Bolt
12 Bolt
13 Extension and Plate Assembly
14 O-Ring & Steel Ring
15 Oiling Funnel
16 Bolt
17 Alignment Bolt
18 Pin
19 Shift Shaft
20 3/4 Shift Fork
21 1/2 Shift Fork
22 Insert
23 Selector Arm Assembly
24 Interlock Plate Assembly
25 Selector Plate
26 O-ring
27 Plug
28 Case Cover
29 Retaining Ring
30 Pivot Pin
31 Back-up Switch
32 5/Reverse Shift Lever
33 Snap Ring
34 5th Synchronizer Retainer
35 5th Synchronizer Assembly
36 Synchronizer Spring
37 Synchronizer Assembly
38 Insert
39 Synchronizer Hub
40 Roll Pin
41 5th Shift Fork
42 Insert
43 Shift Rail Assembly
44 Blocking Ring
45 5th Speed Drive Gear
46 Snap Ring
47 Speed Gear
48 Speed Gear Clip
49 Bolt
50 Input Bearing Retainer
51 Oil Seal
52 Shim
53 Bearing Cup
54 Bearing Cone
55 Input Shaft
56 Roller Bearing
57 Spacer
58 Thrust Bearing
59 Thrust Bearing Race
60 5th Speed Driven Gear
61 Bearing Cup
62 Bearing Cone
63 1st Speed Gear
64 Bearing Sleeve Assembly
65 A. Bearing
65 B. Bearing
65 C. Spacer
66 Sleeve
67 Blocking Ring Assembly
68 3/4 synchronizer Assembly
69 Synchronizer Spring
70 Synchronizer Sleeve
71 Insert
72 Synchronizer Sleeve
73 3rd Speed Gear
74 Needle Bearing
75 Spacer
76 Snap Ring
77 Thrust Washer
78 2nd Speed Gear
79 2nd Speed Gear Bearing
80 Spacer
81 Output Shaft Assembly
82 Retaining Ring
83 Thrust Washer
84 Inner Cone
85 Outer Cone Race
86 1/2 Blocking Ring
87 Spring Gear
88 Reverse Sliding Gear
89 Insert Gear
90 Pin
91 Shaft and Hub Assembly
92 Spring
93 Pin Fork and Reverse Roller Assembly
94 Bolt
95 Rear Bearing Retainer
96 Shim
97 Roll Pin
98 Reverse Idler Shaft
99 Reverse Idler Gear Assembly
100 O-ring
101 Bearing Cup
102 Bearing Cup Assembly
103 O-ring
104 Bearing Cup
105 Bearing Cone
106 Counter Shaft Gear
107 Transmission Case Assembly

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

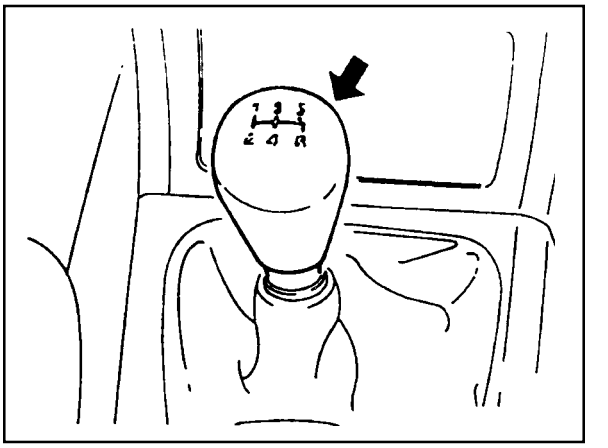
SHIFT CONTROL CABLE



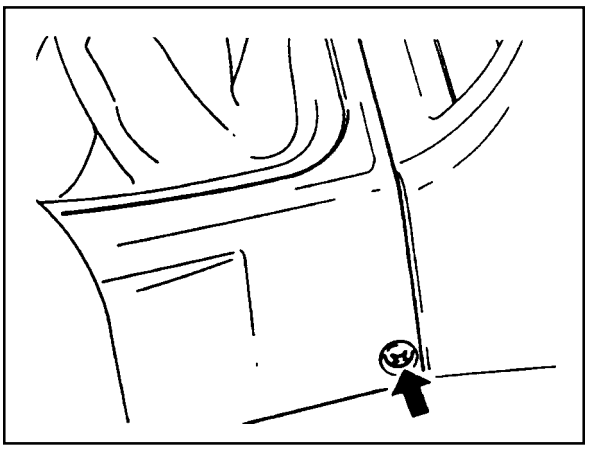
1 Shift Lever Assembly
2 Bolt ..... 20-30 Nm
3 Select Cable
4 Shift Cable
5 Snap Pin
6 Snap Pin
7 Transmission
8 Shift Cable
9 Select Cable
10 Clip
11 Clip
12 Snap Pin
13 Snap Pin
14 Protector
15 Washer

Removal & Installation Procedure

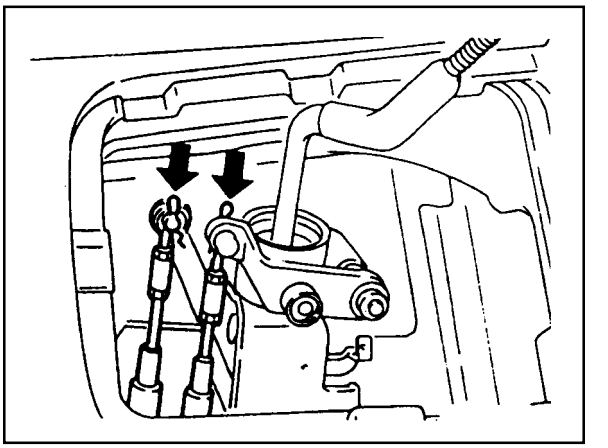
1. Position the shift lever in neutral and remove the knob.

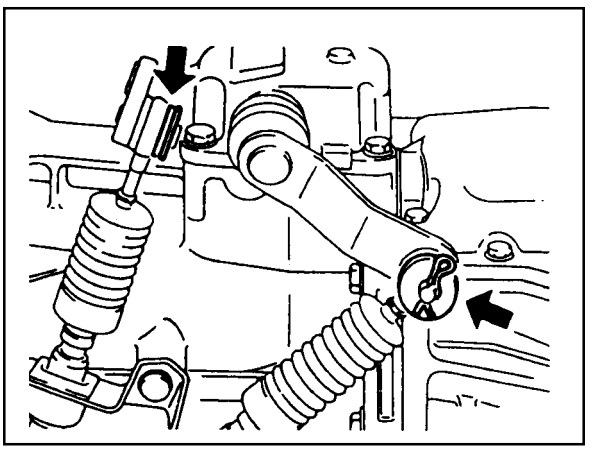


2. Remove the screw from the console box side and remove the shift lever cover.

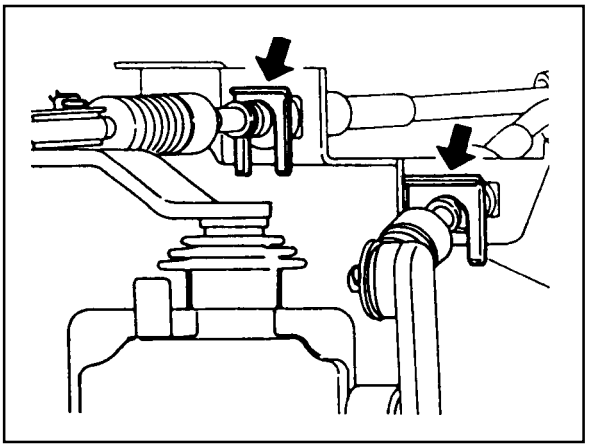


3. Disconnect the cables by removing the snap pins from the control cable connections to the select lever and shift lever.
4. Remove the shift lever an cable mounting snap pin and washer of the select lever.





5. Pull out the clip from the bracket and remove the shift cable and select cable.
6. Installation is reverse order of the removal.



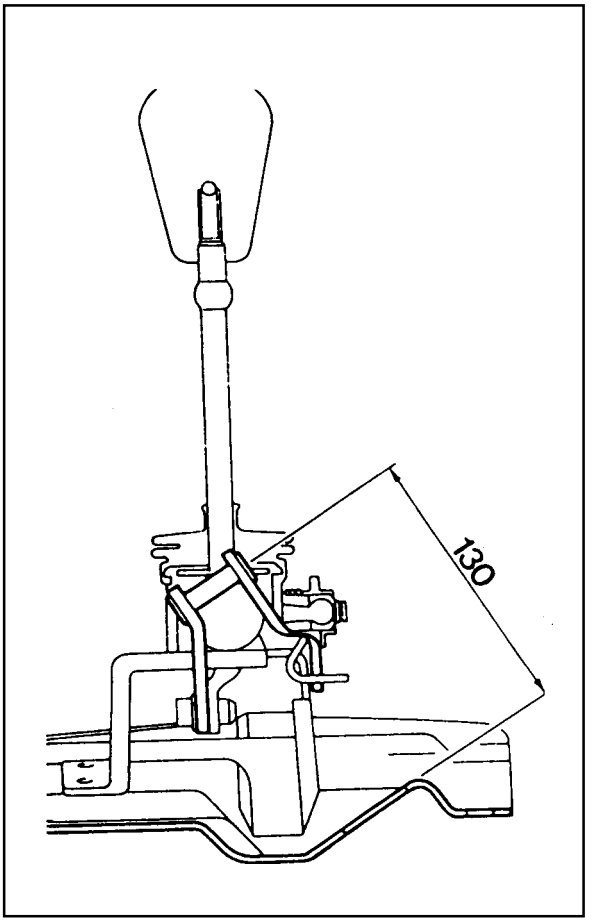
Inspection Procedure

1. The shift lever should be positioned in neutral.
2. Apply liquid gasket on the cable contact surface.
3. Keep 130 mm between the center of the cable end-eye and floor.

Standard	130 mm

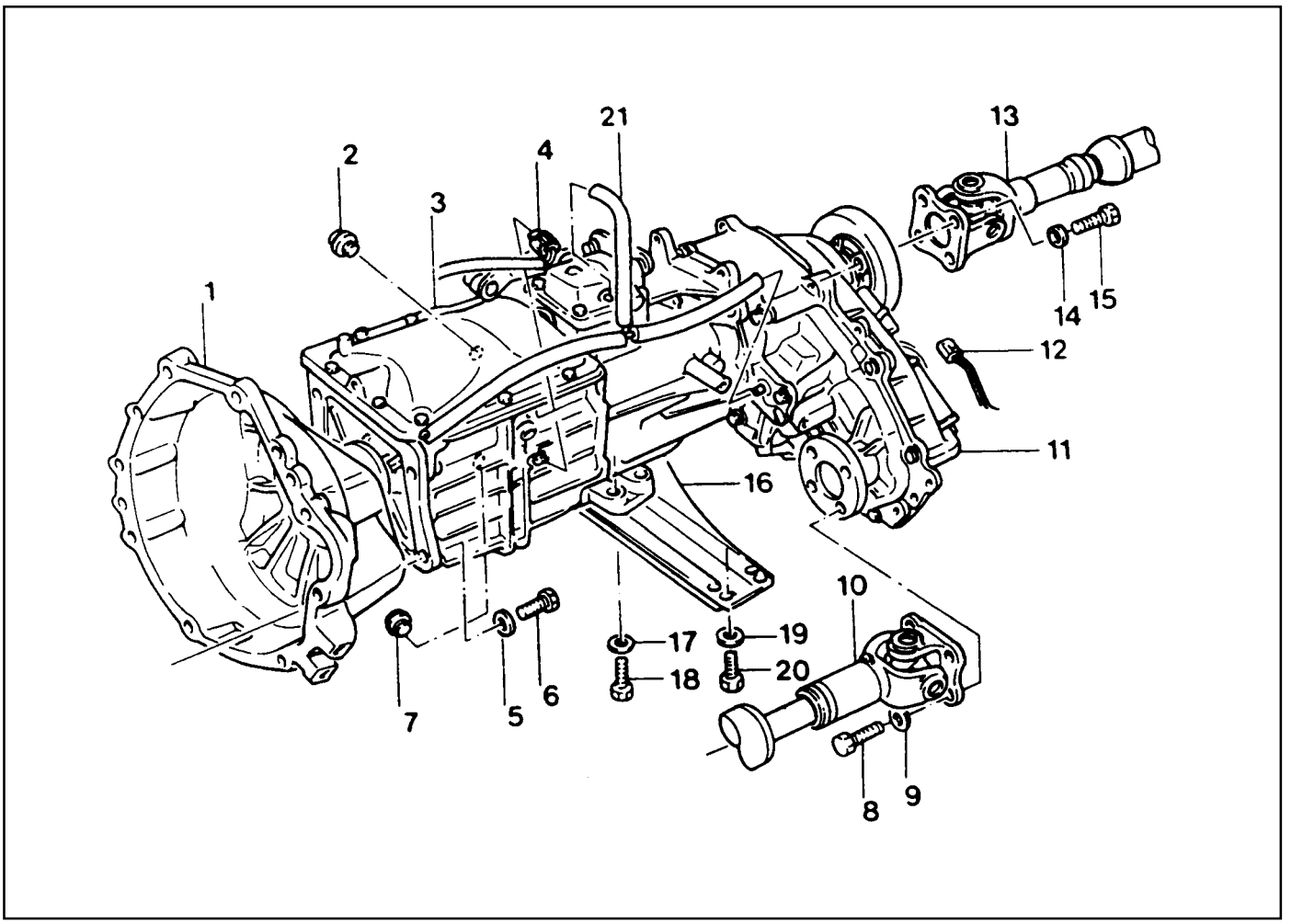
Notice

If necessary, adjust the adjust nut.



TRANSMISSION

Preceding Work : Removal of the shift control cable



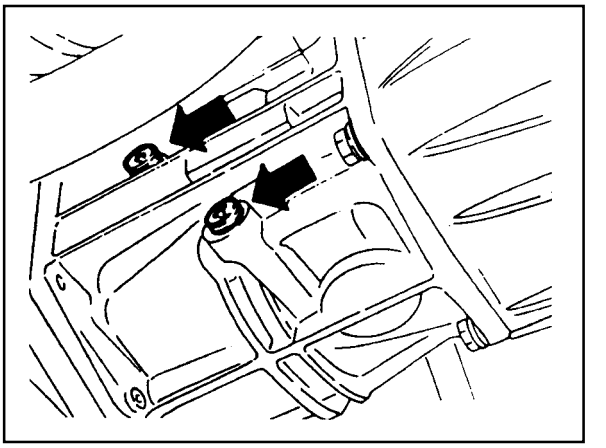
1 Clutch Housing
2 Oil Filler Plug ..... 25 Nm
3 Transmission Assembly
4 Back-up Switch
5 Washer
6 Bolt ..... 77-87 Nm
7 Oil Drain Plug ..... 25 Nm
8 Bolt ..... 81-89 Nm
9 Washer
10 Front Propeller Shaft
11 Transfer Case Assembly
12 Speedometer Cable
13 Rear Propeller Shaft
14 Washer
15 Bolt ..... 70-80 Nm
16 Cross Member
17 Washer
18 Bolt ..... 21-35 Nm
19 Washer
20 Bolt ..... 62-93 Nm
21 Breather Hose

Removal & Installation Procedure

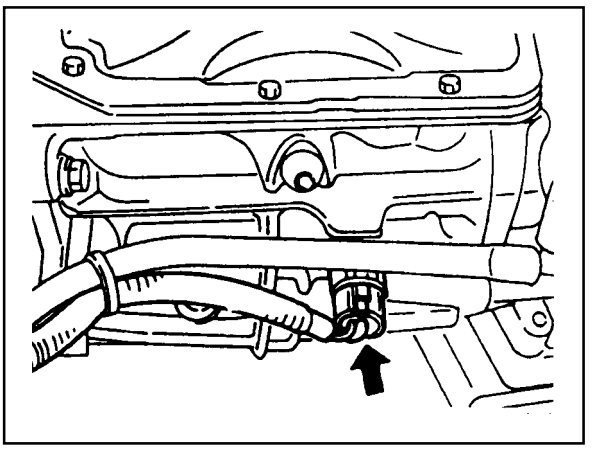
1. Disconnect the negative terminal from the battery.
2. Lift up the vehicle and fix it safely.
3. Remove the drain plug from the transmission housing and drain the oil. Reinstall the drain plug.

Installation Notice

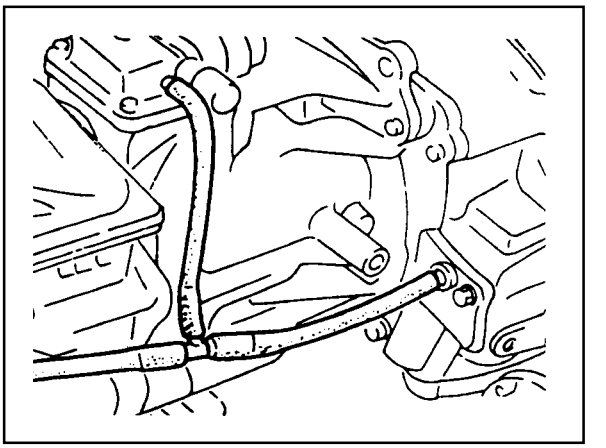
Tightening Torque	25 Nm



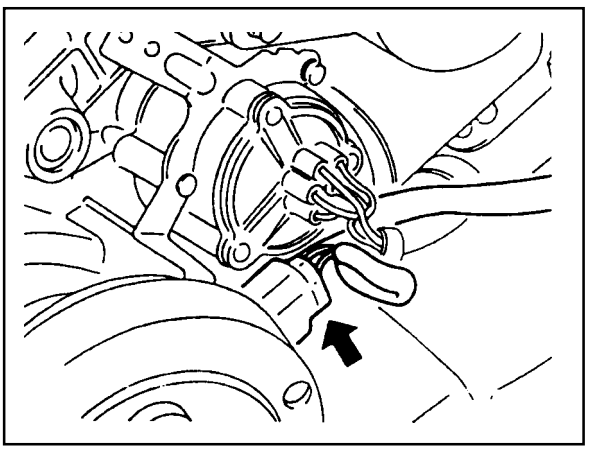
4. Disconnect the back-up switch connector.



5. Remove the breather hose.



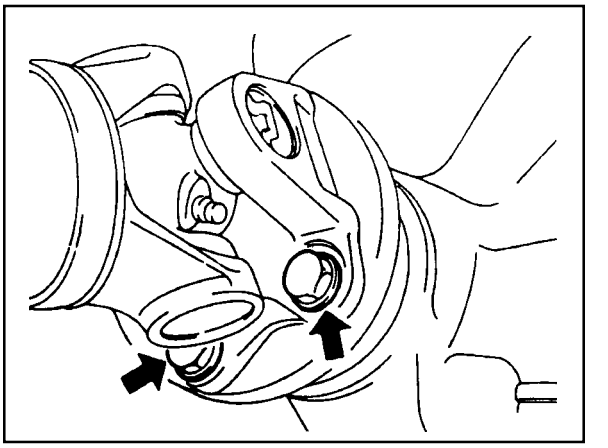
6. Remove the speedometer connector and other wiring harnesses and connectors.



7. Remove the front and rear propeller shafts from the transfercase.

Installation Notice

Tightening Torque	Front	81 - 89 Nm
	Rear	70 - 90 Nm

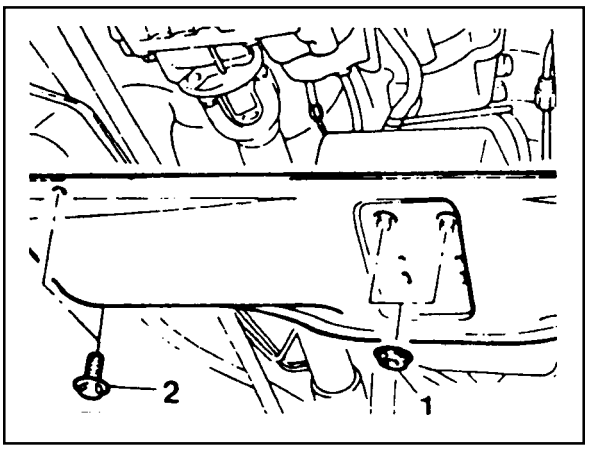


8. Support the transmission on an suitable jack.

Unscrew the center mounting nuts and each sides mounting bolts and remove the cross member.

Installation Notice

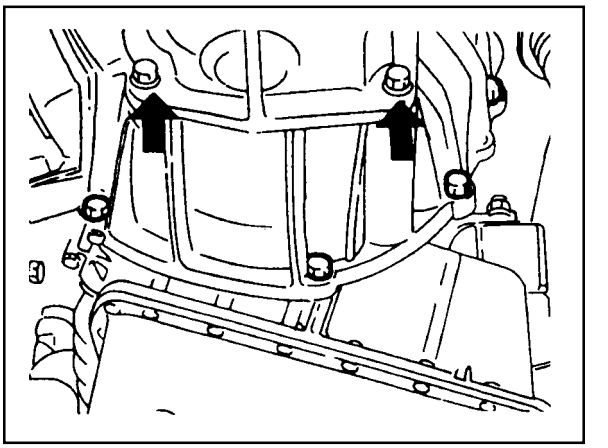
Tightening Torque (1)	21 - 35 Nm
Tightening Torque (2)	62 - 93 Nm



9. Remove the transmission mounting bolts.

Installation Notice

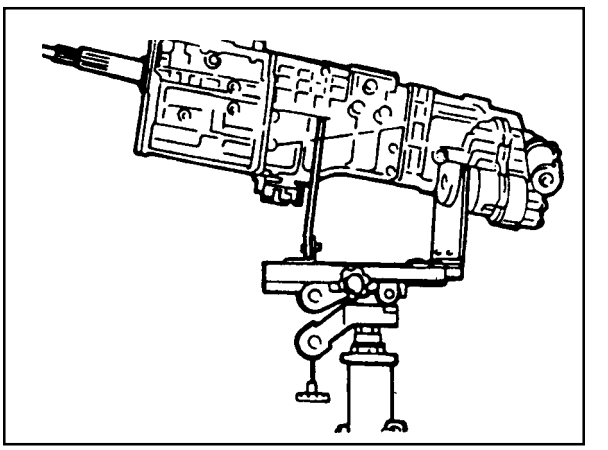
Tightening Torque	77 - 87 Nm



10. Move the transmission jack backward careful and disengage the transmission input shaft from the engine.

Remove the transmission.

11. Installation should follow the removal procedure in the reverse order.



UNIT REPAIR

MAJOR UNIT

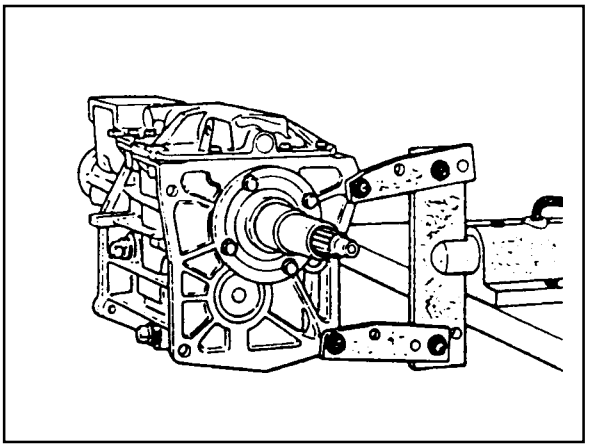
Preceding Work : Removal of the transmission
Removal of the transfer case

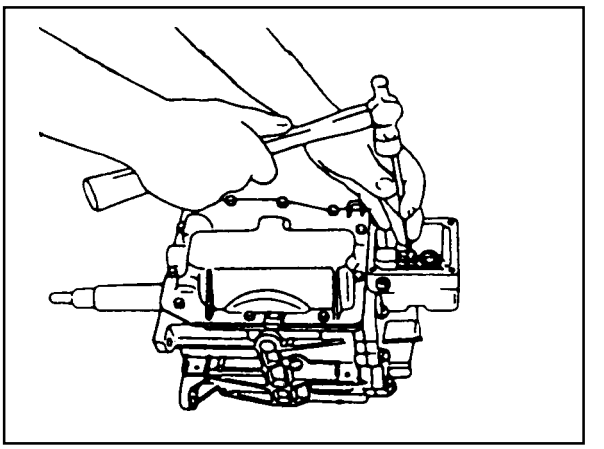
Disassembly Procedure

1. Install the removed transmission into a fixture.
2. Remove the drain plug and drain the oil. Using a 13 mm wrench, remove the clamp bolt and position the offset lever in the 3-4 position of neutral.

   Notice

   Removal of the offset lever in a position other than 3-4 of neutral will be difficult.
3. Using a pin punch and a hammer, remove the roll pin to remove the shift lever from the offset lever.
4. Using a 15 mm wrench, remove the 8 bolts from the extension housing.



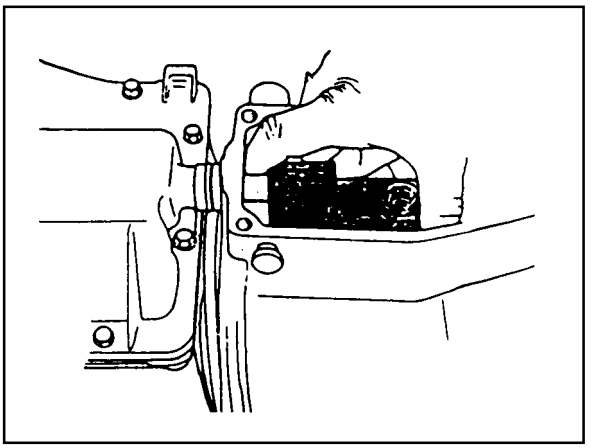


5. Separate the extension housing from the case and shift cover.

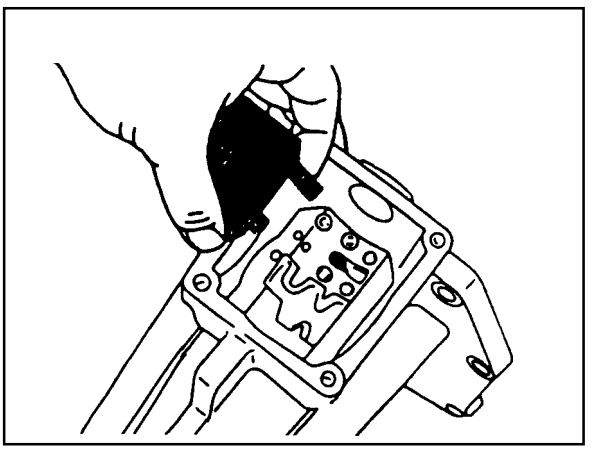
   Separate the offset lever from the shift.

   Notice

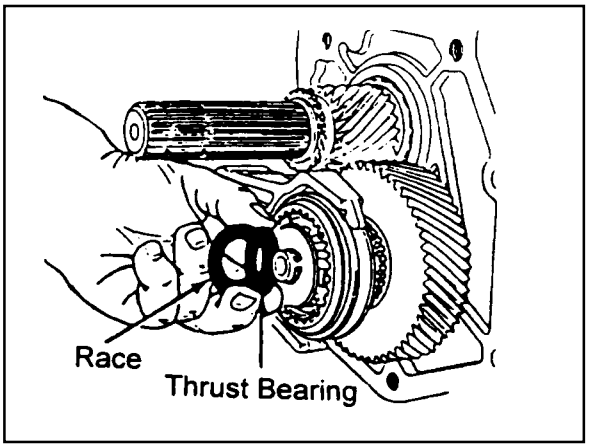
   Do not remove the offset lever while the extension housing is still assembled to the case.



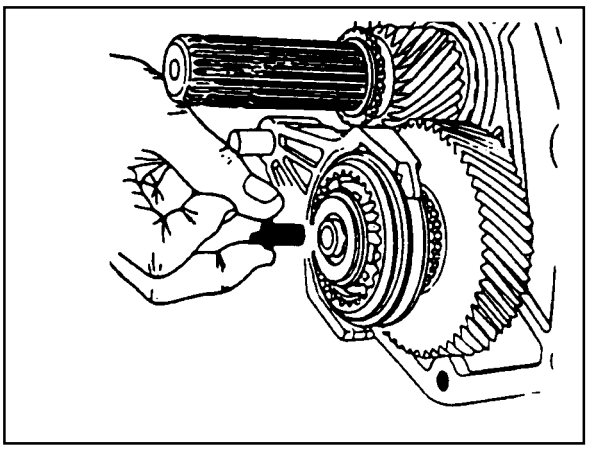
6. Remove the offset lever from the extension housing with the detent ball and spring.
7. Remove the roll pin from either the offset lever or extension housing.



8. Remove the counter shaft thrust race and bearing.



9. Carefully remove the oiling funnel from the end of the counter shaft.

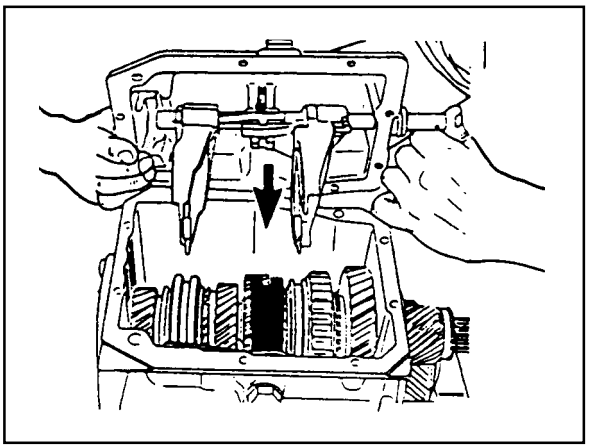


10. Using a 10 mm wrench, remove the 10 bolts from the shift cover.

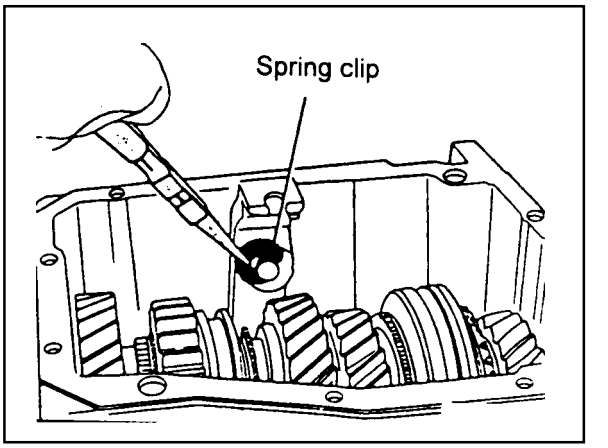
    Notice

    For assembly, note the location of the two bolts.

11. Lift up the shift cover after sliding it toward the drain plug about 3 cm. At this time remove sealer bond.



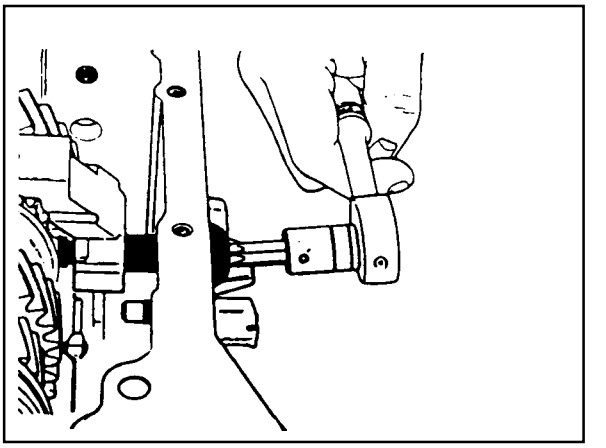
12. Using a needle nose pliers, remove the 5-R lever clip.



13. Using a 21 mm wrench or a T-50 bit, remove the 5-R lever pivot bolt.

    Notice

    Apply sealer bond to this bolt during assembly.

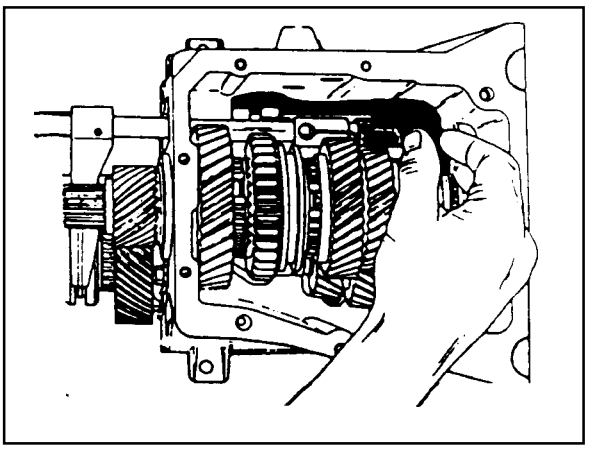


14. Using a 22 mm wrench, remove the back-up lamp switch from the 5-R lever side.

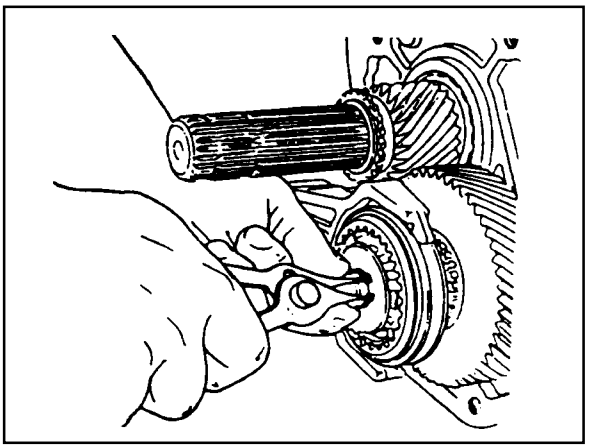
    Notice

    Apply sealer to the threads.

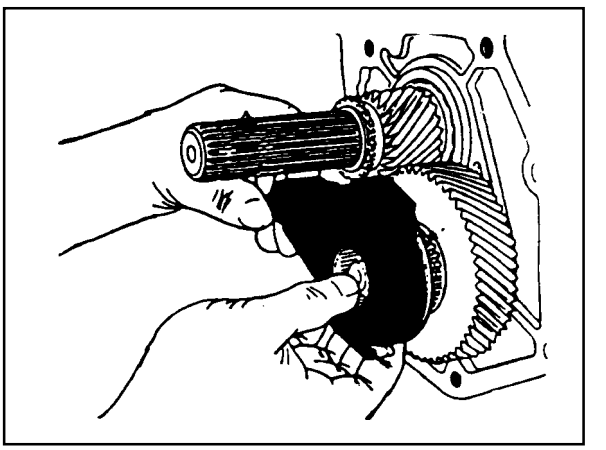
15. Pull out the 5-R lever out of the transmission.



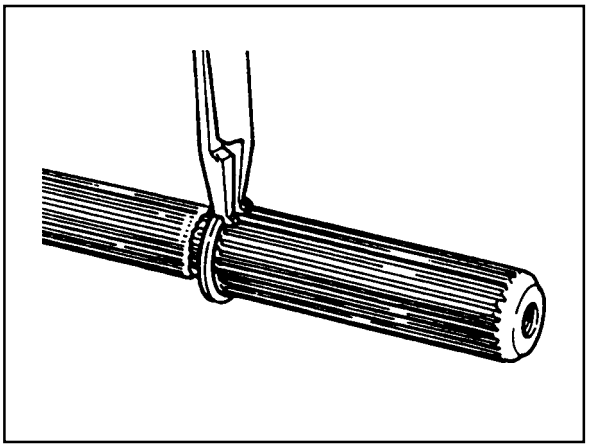
16. Using a snap ring pliers, remove the 5th synchronizer snap ring from the end of the counter shaft.



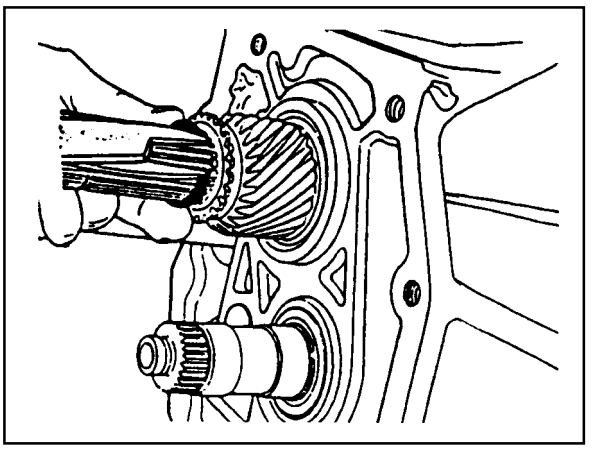
17. Remove the 5th synchronizer assembly with its fork and rail assembly from the counter shaft.



18. Remove the slip yoke snap ring from the main shaft.



19. Remove the 5th speed drive gear snap ring from the main shaft.

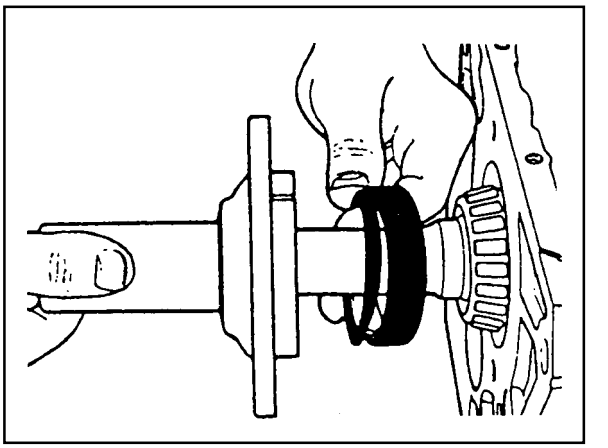


20. Make alignment marks on the case and input bearing retainer and remove the 4 input shaft bearing retainer bolts, using a 13 mm wrench.

    Notice

    Apply sealer on these bolts during assembly.

    Remove the input bearing retainer with the bearing outer race and shim.

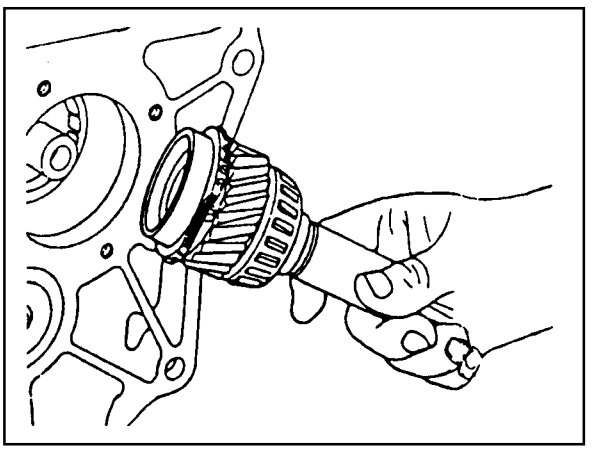


21. Remove the input shaft from the case by rotating it until the flat surface appears.

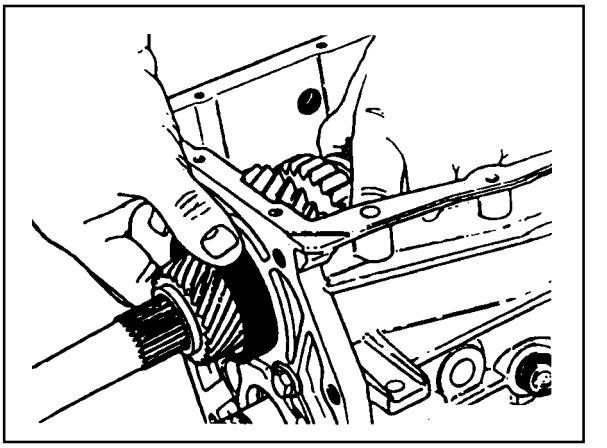
22. Remove the following parts from the input shaft.
    - 4th speed gear blocking ring.
    - Main shaft thrust race and bearing.
    - Main shaft pilot bearing rollers (15 rollers).

    Notice

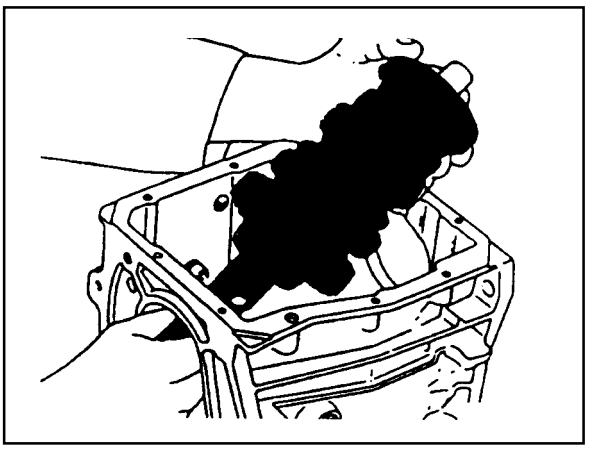
    Be careful not to dissipate the pilot bearing rollers.



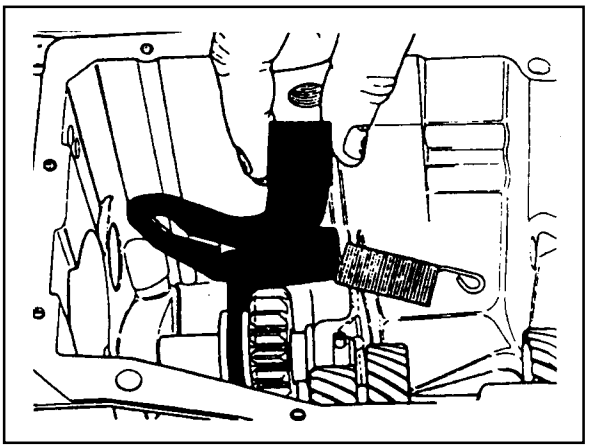
23. Remove the main shaft in 2 steps.
    - To remove the rear bearing outer race, push the main shaft rearward.



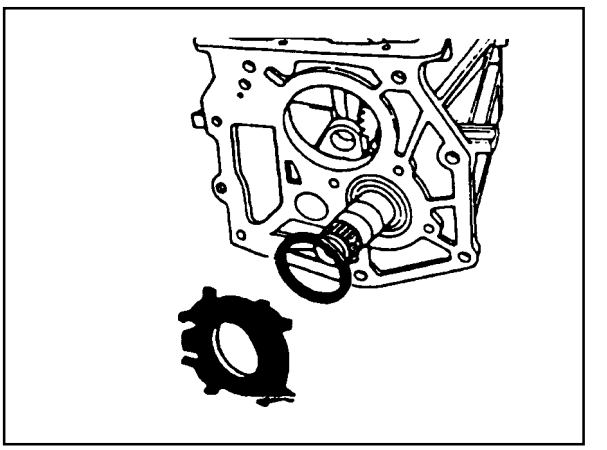
    - Tilt and lift the main shaft from the case.



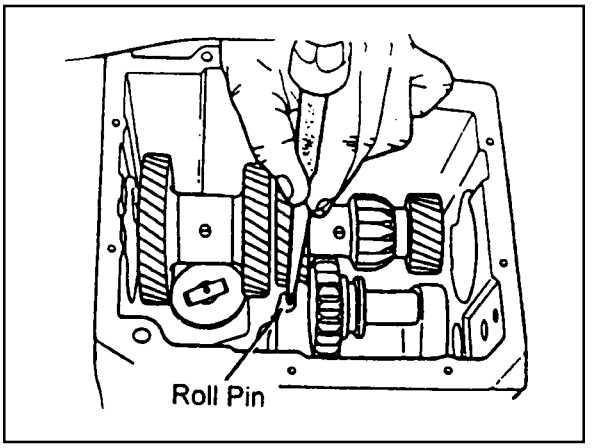
24. Remove the reverse fork and spring from the case.



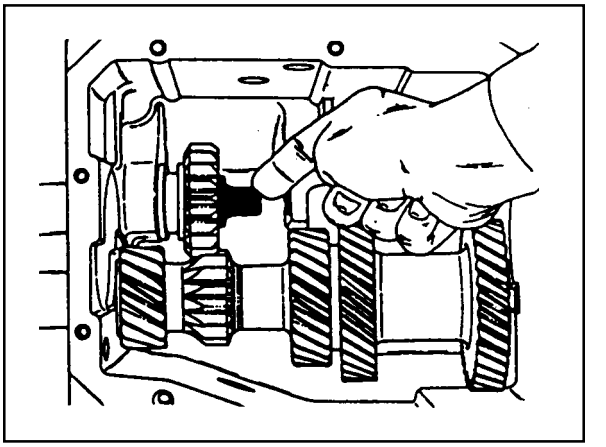
25. Remove the counter shaft as follows:
    - Using a punch and hammer, pry up the lock tabs.
    - Using a 13 mm wrench or T-40 bit, remove the 4 bolts.
    - Remove the retainer and shim from the case.
    - Push the counter shaft rearward to remove the rear bearing outer race.



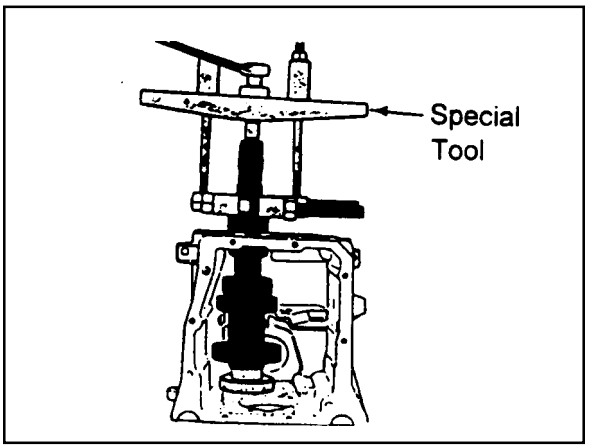
26. Using a pin punch and a hammer, remove the roll pin fixed on the reverse idler shaft.



27. By pushing the reverse idler shaft rearward and out of the case, remove the reverse idler gear and O-ring.

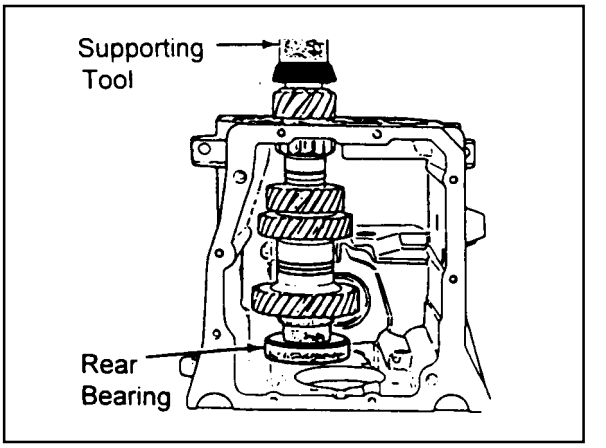


28. Using a puller, remove the rear bearing assembly from the counter shaft.



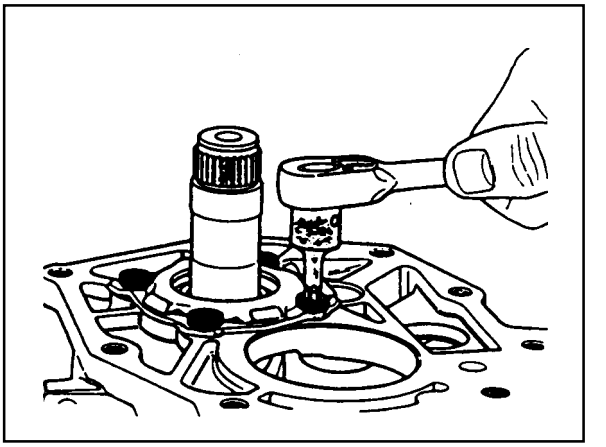
Assembly Procedure

1. Using a hydraulic press and a supporting tool, press the counter shaft rear bearing into the case. Be sure that the supporting tool inside of the case should support the counter shaft.

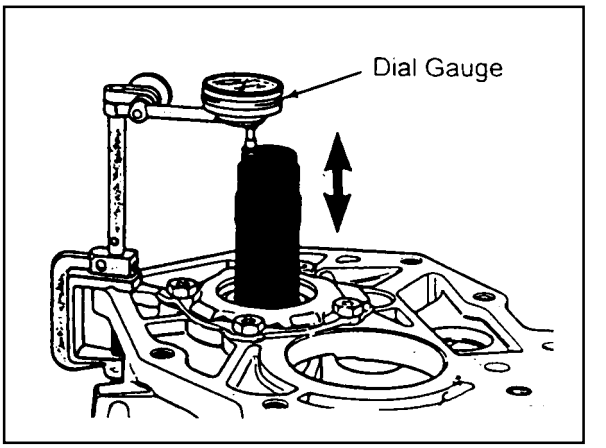


2. Without the shim, install the retainer and counter shaft rear bearing outer race. Tighten the 4 retainer bolts.

Tightening Torque	20 Nm



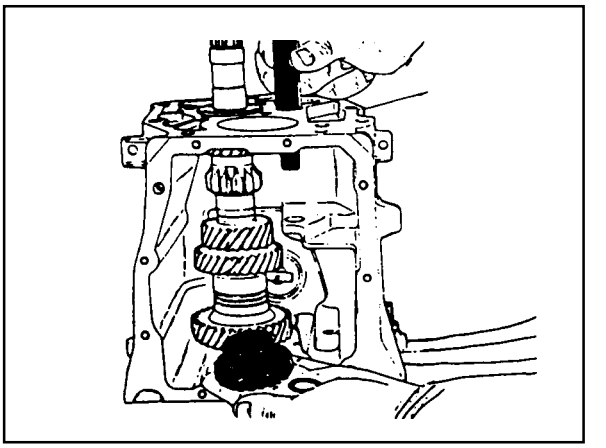
3. Place a dial indicator on the case and measure counter shaft end play by moving up and down.



4. Select a shim which is the same thickness as the indicator rearing (up to 0.004 inch) and assemble it.

5. When the end play is correctly adjusted, remove the counter shaft rear bearing retainer and outer race.

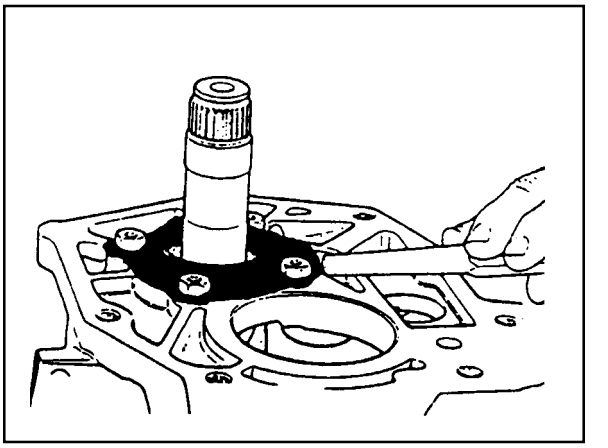
6. Using a pin punch and rubber hammer, install the reverse idler shaft, gear and O-ring.



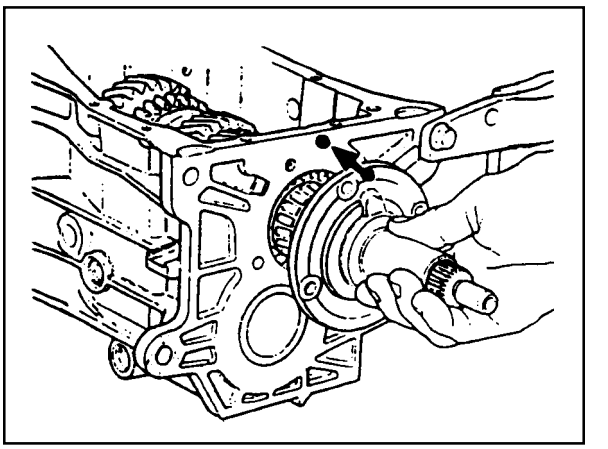
7. Install the counter shaft rear bearing outer race, shim and retainer.

Tightening Torque	39 - 52 Nm

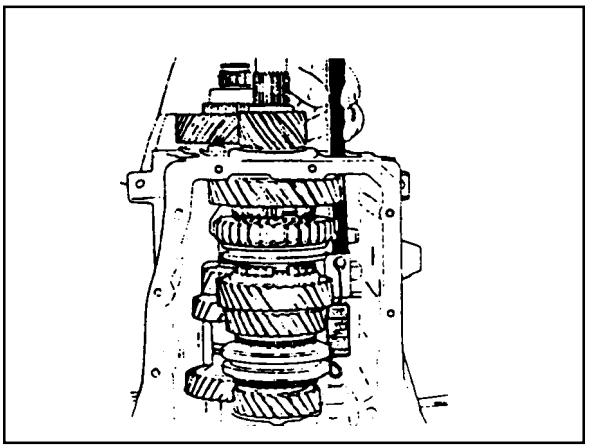
- Using a punch and hammer, bend the lock tabs on the retainer.



8. Install the following parts :
   - Install the main shaft into case.
   - Install the main shaft rear bearing outer race into the rear of the case.
   - Install the 4th speed blocking ring onto the front of the main shaft.
   - Install the input shaft onto the front of the main shaft.
   - Install the input bearing retainer without shim onto the front of the case.
   - Using a torque wrench, tighten the 4 bolts.



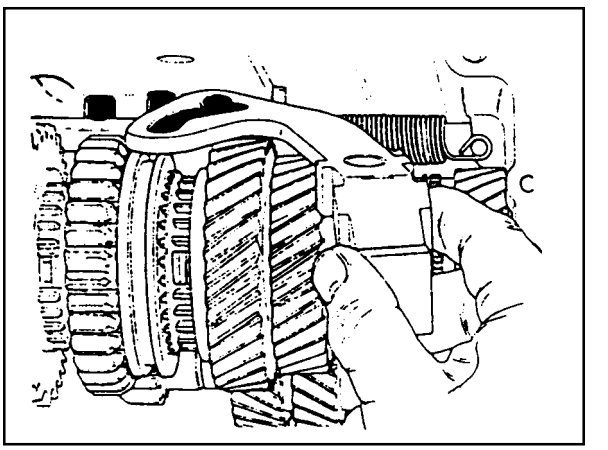
9. Install the 5th speed drive gear and blocking ring on the counter shaft.
10. Install the 5th synchronizer and rail/fork.
11. Install the 5th synchronizer snap ring and oiling funnel.



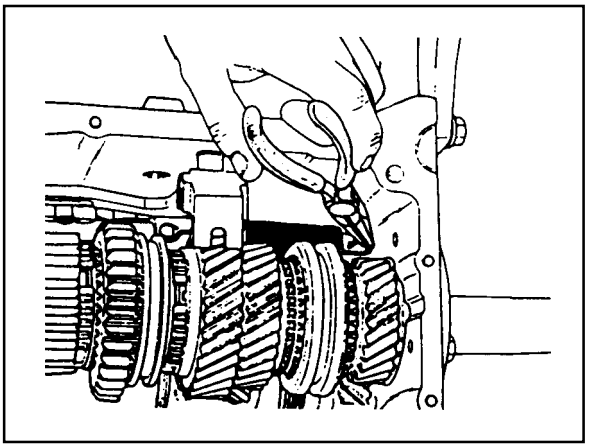
12. Align the slots of the lever with the rollers of the reverse fork and 5th shift rail. Apply sealer on the 5-R lever pivot bolt and install it into the case.

Tightening Torque	28 Nm

13. Using a needle nose pliers, install the 5-R lever clip.

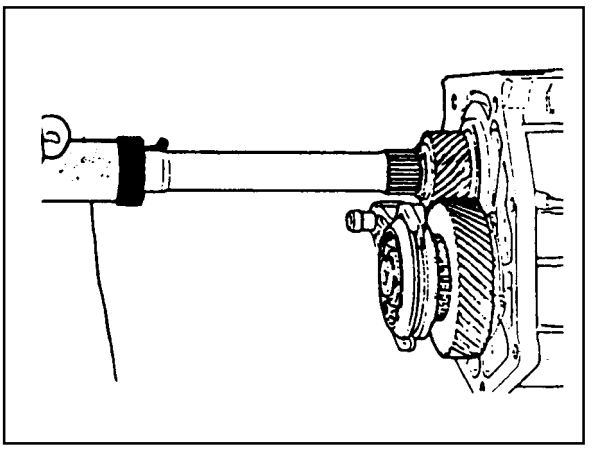


14. Using a needle nose pliers, install the reverse fork spring to its pin inside the case. Check the operation of the 5-R shift mechanism at this time.



15. Using a snap ring piers, install the slip yoke snap ring onto the end of the main shaft.

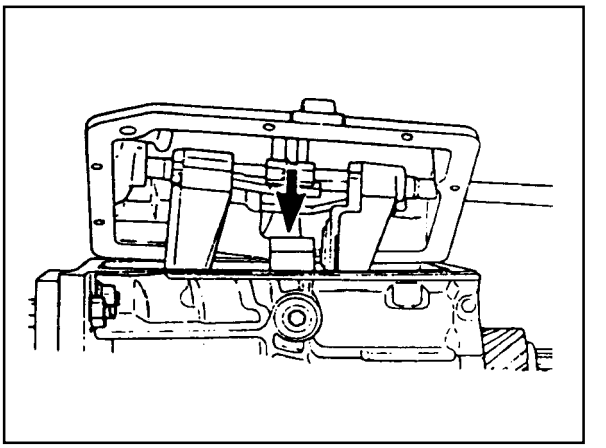
16. Make sure that the 1-2 and 3-4 synchronizer sleeves and 5-R shift lever are in neutral position.



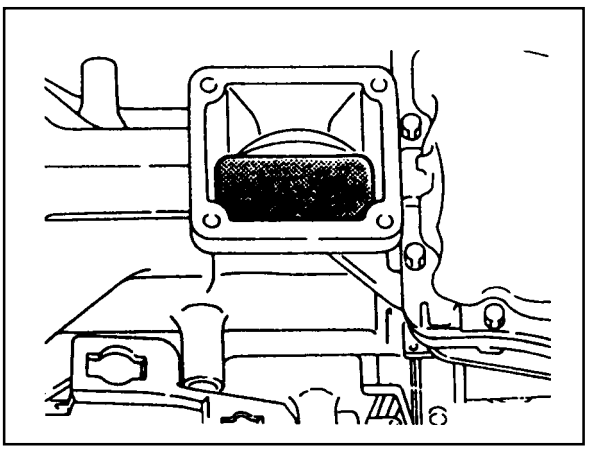
17. Align the holes the case and cover with alignment-type bolts. Tighten the 10 bolts.

18. Apply 'RTV' sealant on the sealing surface of the extension housing.

19. Apply grease on the detent/guide plate in the extension housing. Install the detent ball in the 3-4 position.



20. Place the detent spring and offset lever in the extension housing and push the extension against the case and shift cover.



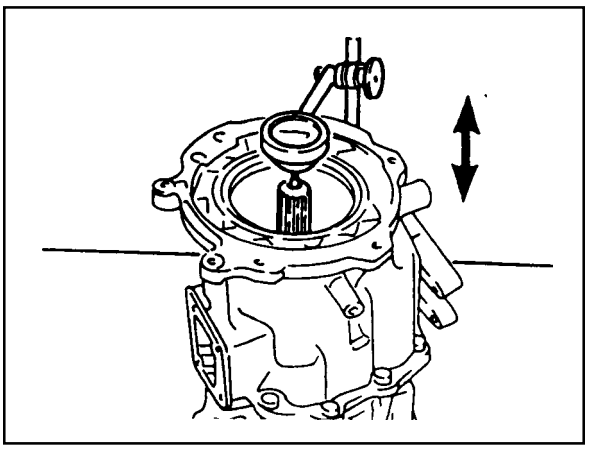
21. Completely compress the detent spring.

22. To install the extension housing to the case, apply sealer to the top two bolts and tighten them and tighten the 6 bolts.

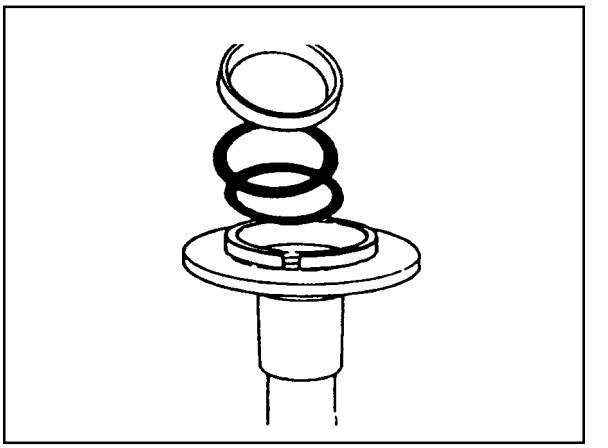
23. Apply sealer to the back-up lamp switch and drain plug and tighten them.

24. Using a hammer, install the offset lever-to-shift roll pin.

25. Turn the transmission case reversely and place a dial indicator on the extension housing. Move the input and main shift up and down and measure end play. Select a shim which is the same thickness as the measurement (± 0.001 inch). After shim installation, the end play should be '0'.



26. Remove the input bearing retainer and do the following :
    - Install the adjusting shim behind the input bearing outer race in the retainer and if 2 shims are used, install the thinner one in first.
    - Install the retainer to the case and tighten the bolts.
    - If end play is not '0'change the shim again.
    - Apply RTV sealant to the sealing surface of the retainer.
    - Apply sealer to the 4 retainer bolts and tighten them.



27. Remove the fill plug.

28. Remove the transmission from the holding fixture and install it to the vehicle.

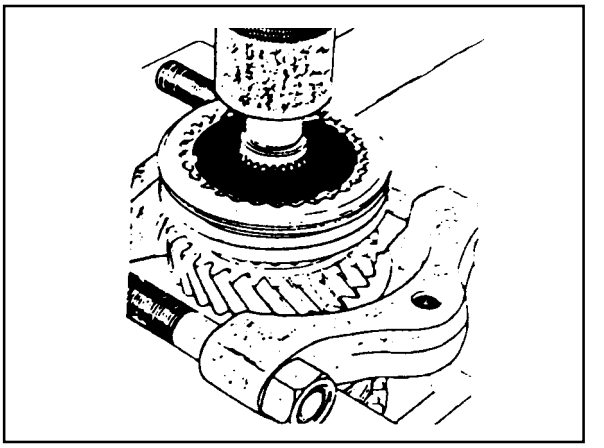
29. Clean the sealing surface of the shift control lever.

30. Install the control cables to the shift lever.

MAIN SHAFT

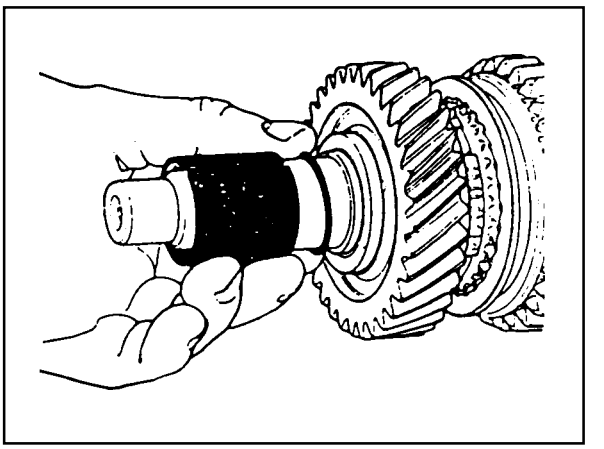
Disassembly Procedure

1. For correct reassemble, place an alignment mark on the 3-4 Synchronizer hub and sleeve.



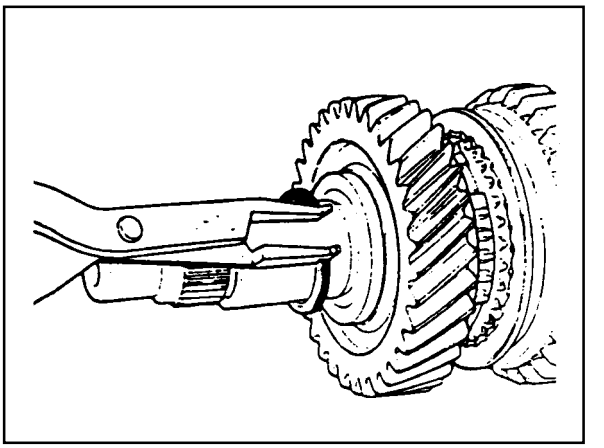
2. Using a hydraulic press and puller plate, remove the 3-4 Synchronizer assembly and the 3rd speed gear.

3. Remove the 3rd speed gear bearing and spacer.

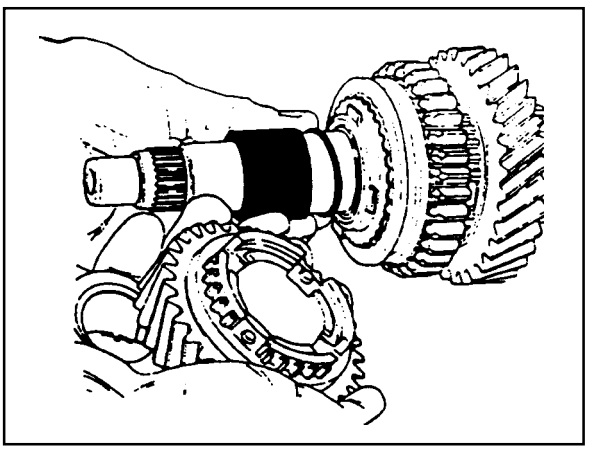


4. Using a snap ring pliers, remove the 2nd speed gear snap ring.

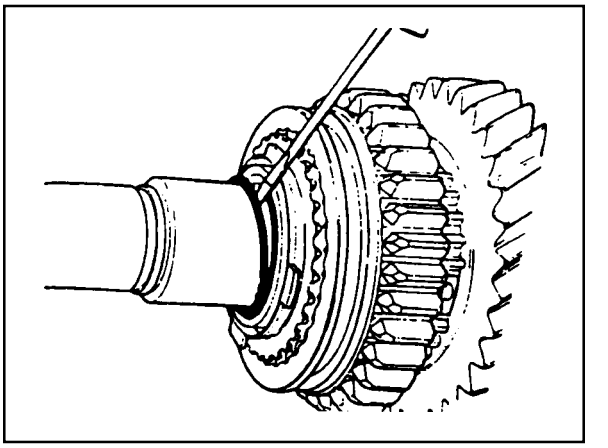
5. Remove the 2nd speed gear thrust washer.



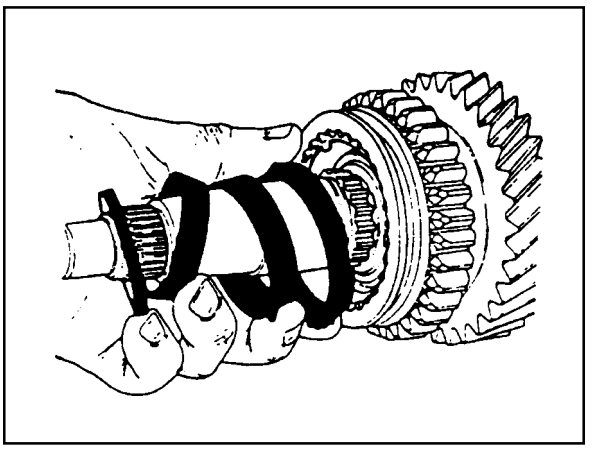
6. Remove the 2nd speed gear, bearing and spacer.



7. Using a screwdriver, remove the spiral retaining ring.

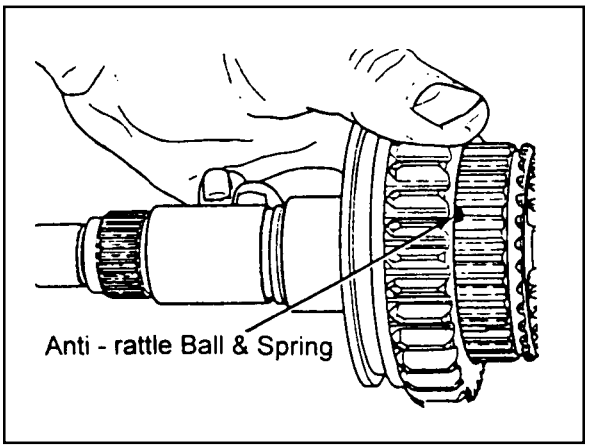


8. Remove the thrust washer and three-piece 2nd speed blocking ring assembly.

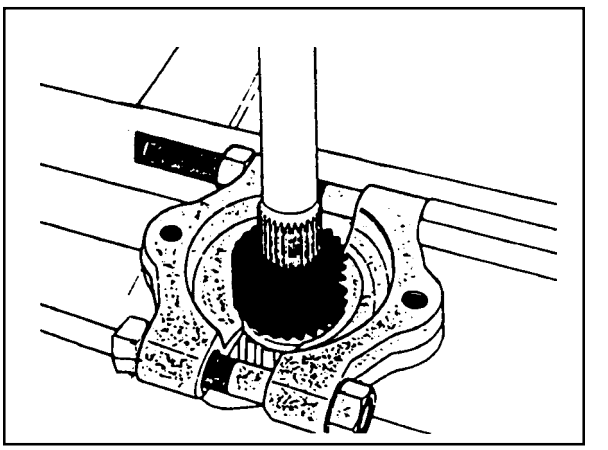


9. For correct reassembly, place an alignment mark on the 1-2 synchronizer hub and sleeve.

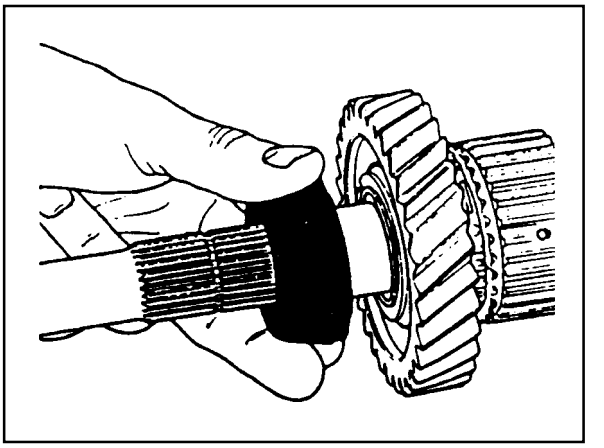
10. Remove the 1-2 synchronizer sleeve from the hub with following parts :
    - The anti-rattle ball and spring.
    - The three keys.
    - One of the 3 springs.



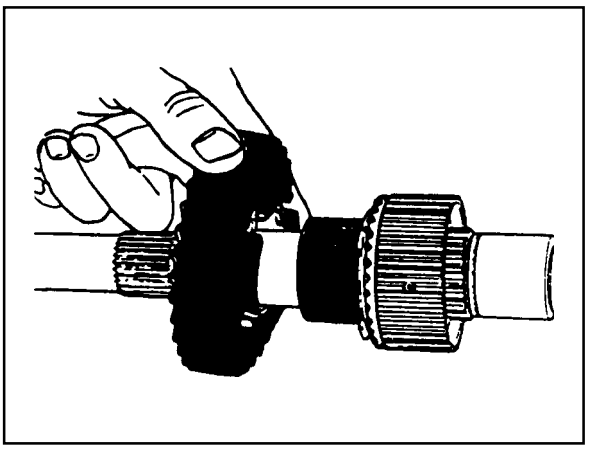
11. Using a hydraulic press and puller plate, remove the 5th speed driven gear from the main shaft.



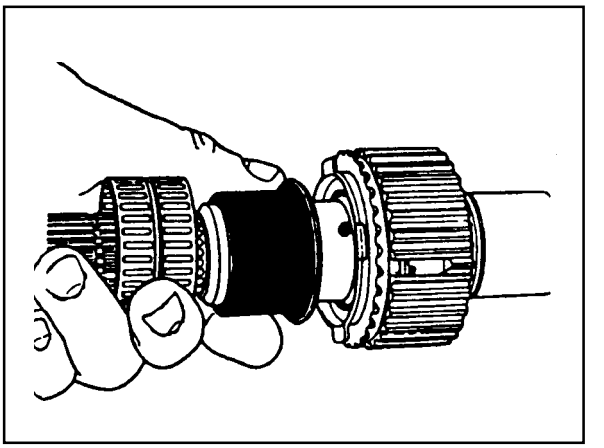
12. Remove the main shaft rear bearing assembly from the shaft.



13. Remove the 1st speed gear and bearing.

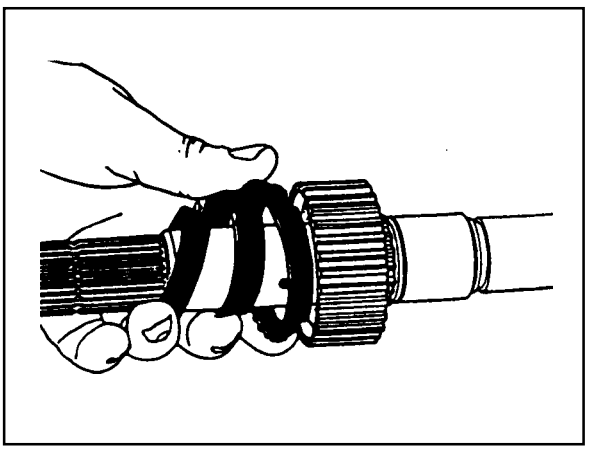


14. Remove the inner race.



15. Remove the tree-piece 1st speed blocking ring assembly and remaining synchronizer spring.

16. Check and clean all removed parts and replace if necessary.

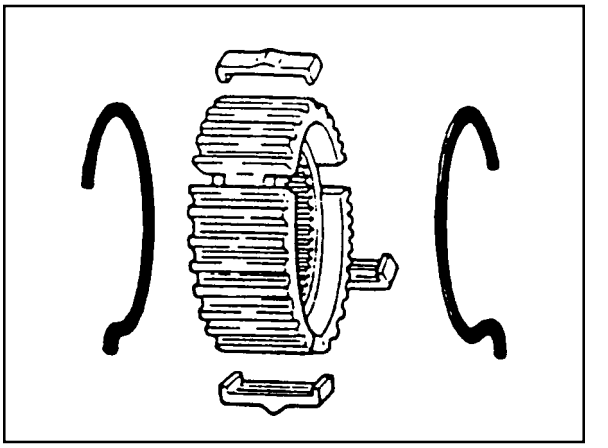


Assembly Procedure

1. When assemble the synchronizer, make sure that the hubs and sleeves are matched and the 3 keys are installed properly. Also align blocking rings with keys during installation.

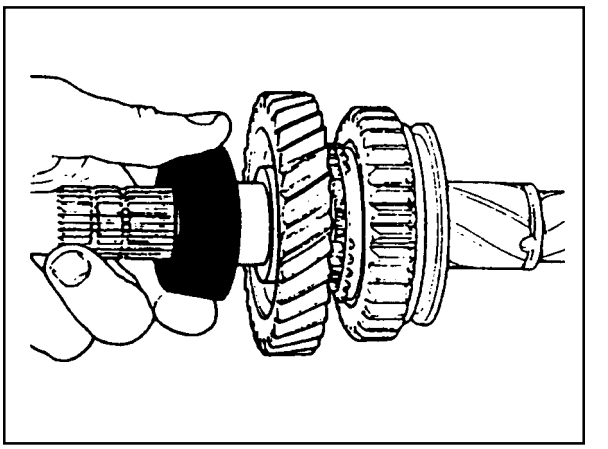
   Notice

   Before assembly, coat all parts with lubricant. In case of the paper-lined blocking rings, soak them in DexronⅡ/Ⅲ before installation.

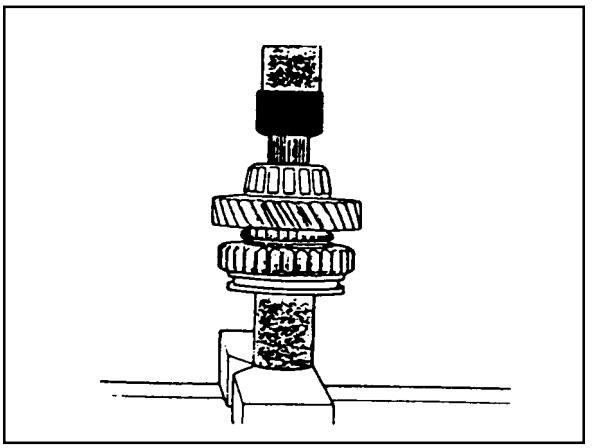


2. Assemble the following parts :
   - 1st speed blocking ring.
   - Alignment pin and 1st speed gear bearing race.
   - 1st speed gear and its bearing.

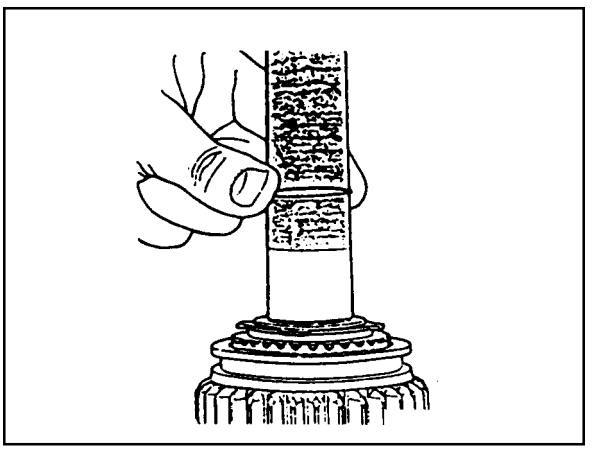
3. Install the rear bearing assembly to the main shaft.



4. Using a hydraulic press and installer, press the 5th driven gear onto the main shaft. While the main shaft is still on the press bed, install the 5th driven gear snap ring. If the snap ring does not fit completely, continue pressing the 5th driven gear.



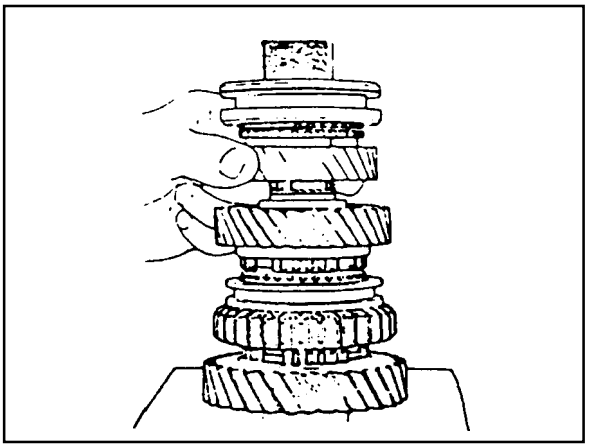
5. Install the following parts :
   - 2nd speed blocking ring assembly.
   - Thrust washer for the blocking ring inner cone.
   - Spiral retaining ring (Use special tools).
   - 2nd speed gear spacer, bearing and gear.
   - 2nd gear thrust washer and snap ring.
   - 3rd speed gear spacer, bearing and gear.
   - 3rd speed blocking ring.



6. Using a hydraulic press and installer, install the 3-4 synchronizer hub onto the main shaft.

   Notice

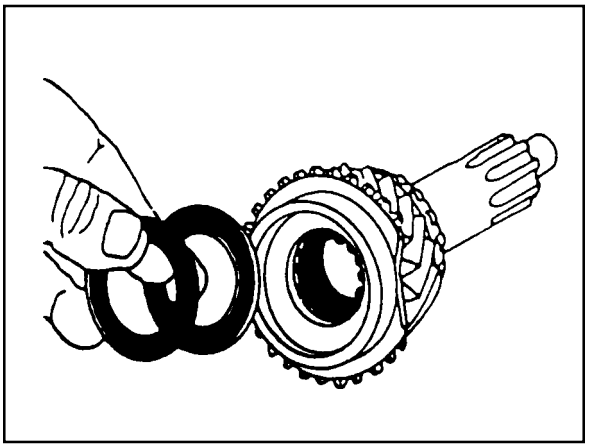
   Align the blocking ring with the synchronizer keys while installing the hub.



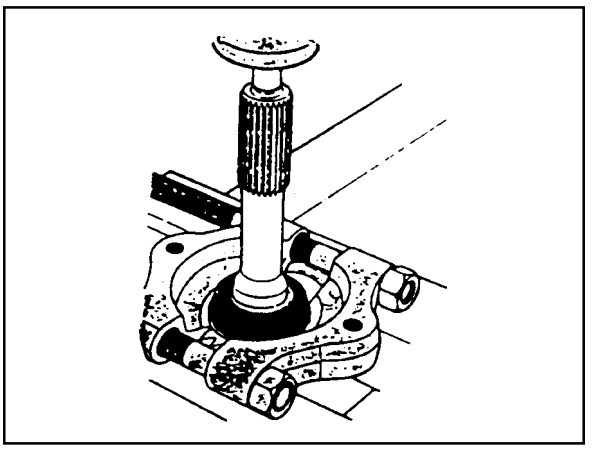
INPUT SHAFT

Disassembly Procedure

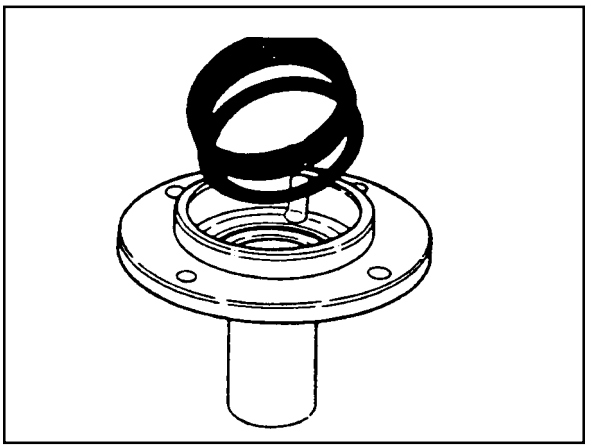
1. Remove the following parts from the input shaft :
   - Main shaft thrust race and bearing.
   - Main shaft pilot bearing rollers (15 rollers).



2. Using a hydraulic press and puller plate, remove the input shaft bearing assembly from the shaft.

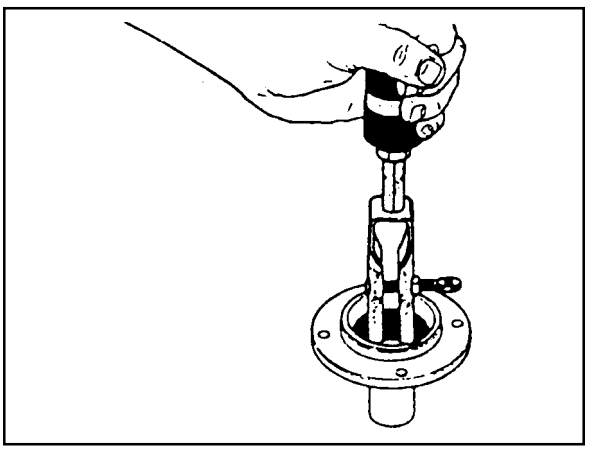


3. Remove the input bearing.



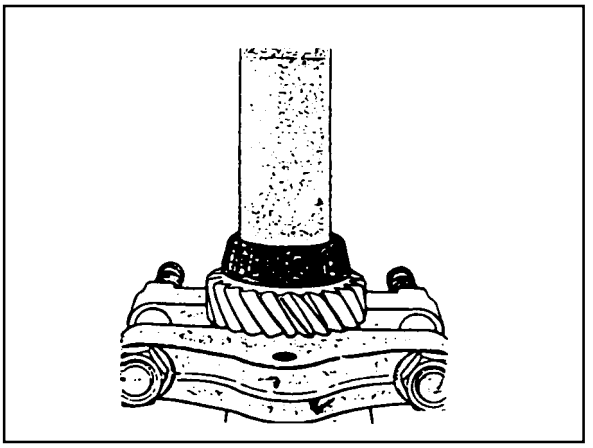
4. Remove the input shaft seal.

5. Check and clean all removed parts and replace if necessary.



Assembly Procedure

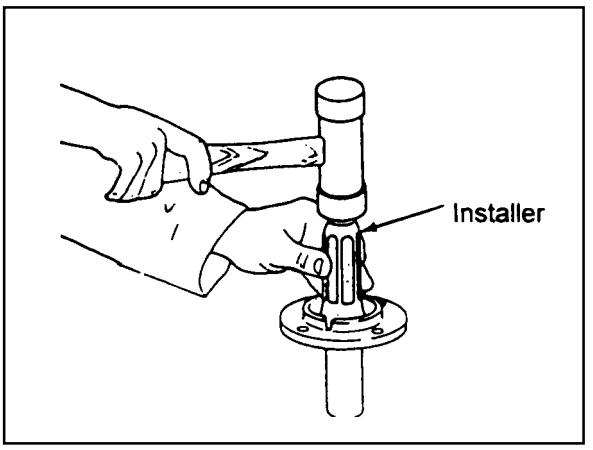
1. Using a hydraulic press and installer, press the input shaft bearing onto the input shaft.



2. Apply grease to the thrust bearing inner roller (15 rollers) and install the main shaft thrust bearing and its race in the rear of the input shaft.

3. Using a rubber hammer and installer, install the input bearing retainer and input shaft seal after applying grease.

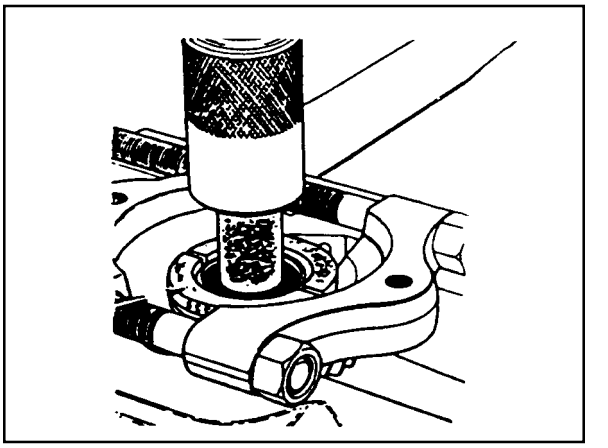
4. Install the bearing outer race to the retainer without end play adjusting shim.



COUNTER SHAFT

Disassembly Procedure

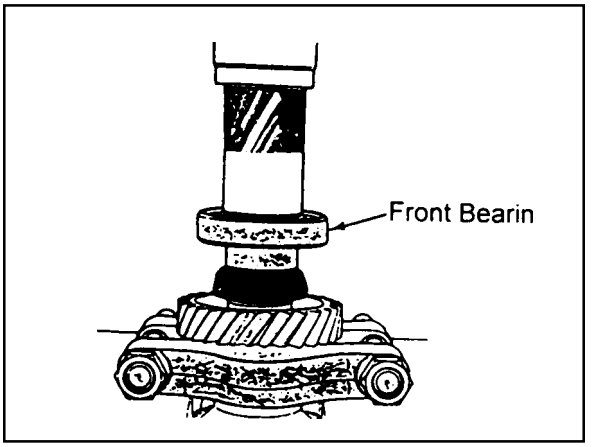
1. Using a hydraulic press and special tool, remove the front bearing assembly from the counter shaft.



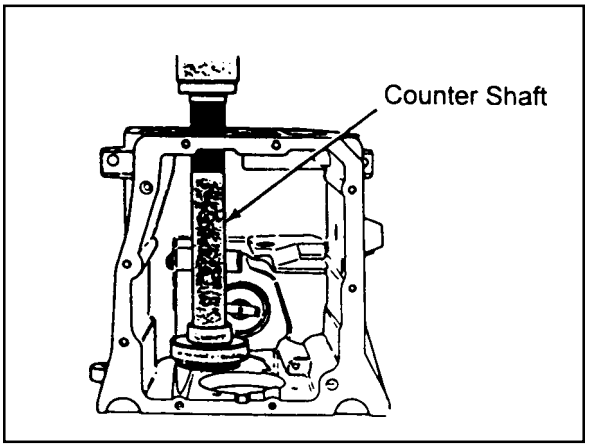
2. Check and clean all removed parts and replace if necessary.

Assembly Procedure

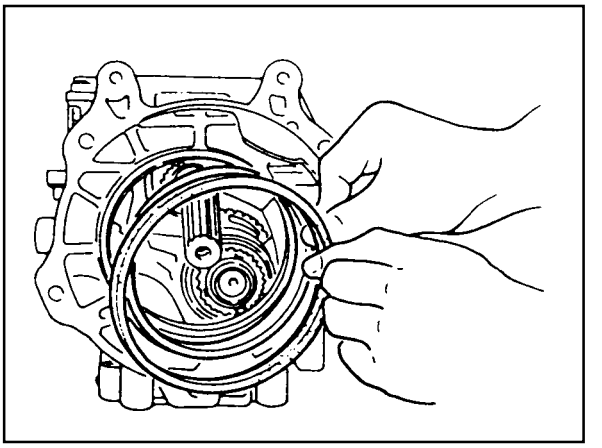
1. Using a hydraulic press and installer, press the front bearing assembly onto the counter shaft.



2. Install is as follows :
   - Install a new O-ring on the counter shaft outer race and lubricate it.
   - Using a installer, lightly tap the race into its bore until the O-ring is compressed.
   - Install the race to be fully seated on the inside of the case.



EXTENSION HOUSING



Disassembly Procedure

1. Remove the vent from the extension housing.
2. Remove the O-ring and steel ring from the rear of the extension housing.
3. Check and clean all removed parts and replace if necessary.

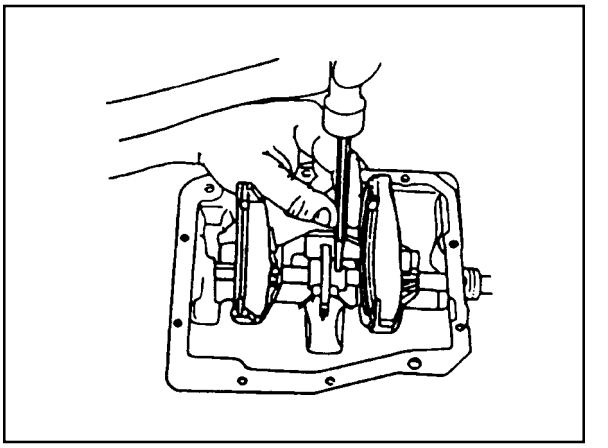
Assembly Procedure

1. Install the O-ring and steel ring to the rear of the extension housing.
2. Install the vent to the extension housing.

SHIFT COVER

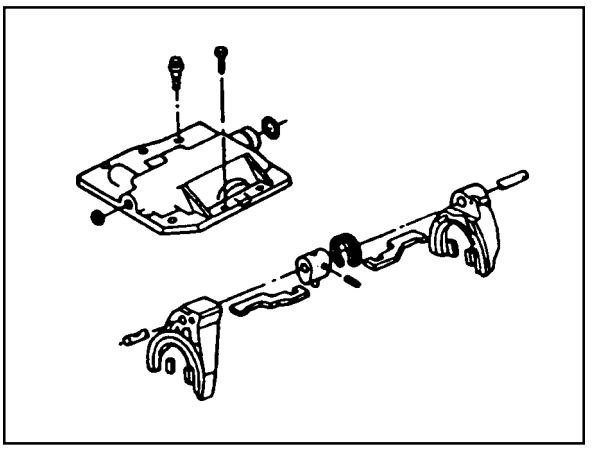
Disassembly Procedure

1. Using a hammer and a pin punch (3/16) remove the selector arm roll pin.



2. Before removal, note the correct position of the interlock plate and selector arm and remove the shift shaft.

3. Check and clean all removed parts and replace if necessary.



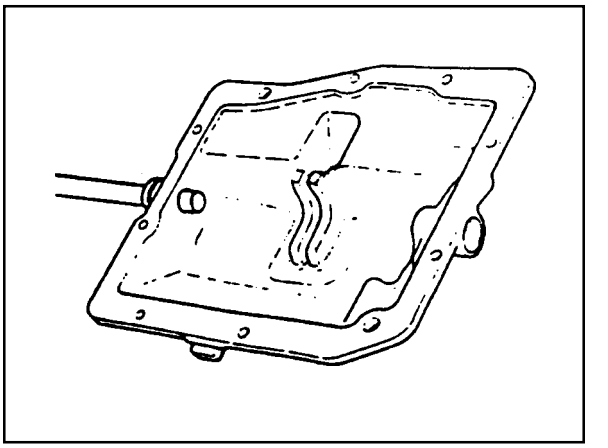
Assembly Procedure

1. If the shaft cup plug was removed, apply plug outer surface with sealer and install it into the cover.

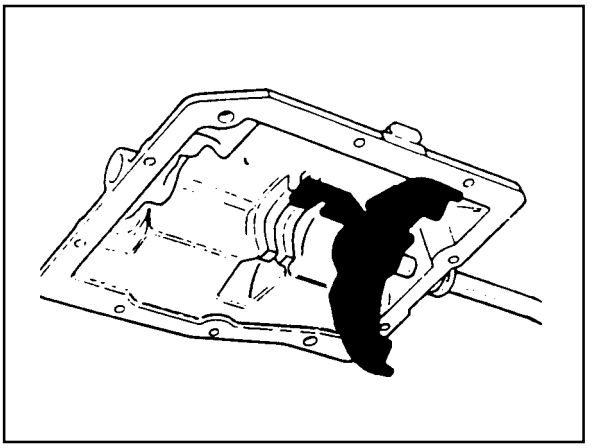
2. Install the fork pads and selector plates onto the 1-2 and 3-4 shift forks.

3. Assemble the sift cover parts as follows :

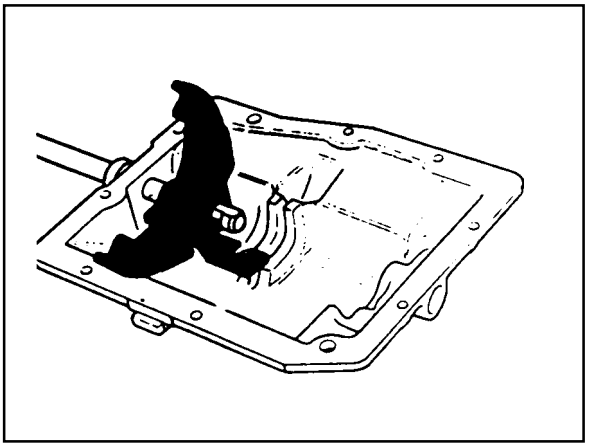
   Push the shift shaft into the cover until the front of the shaft is at the inside of the cover.



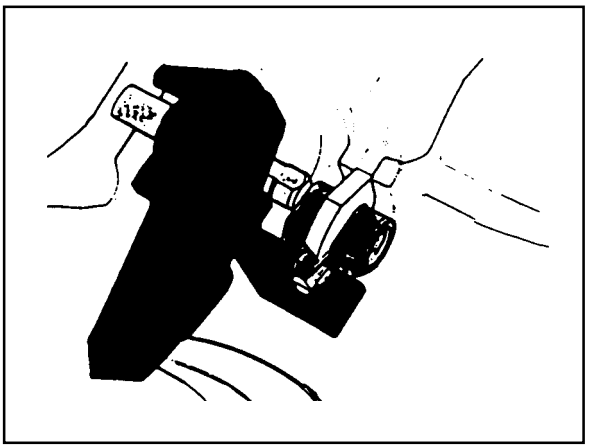
- Install the 1-2 shift fork and its selector plate.



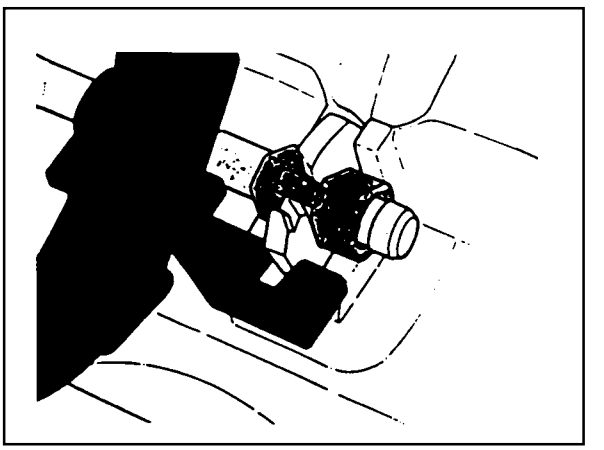
- Push the shift shaft through the 1-2 shift fork.



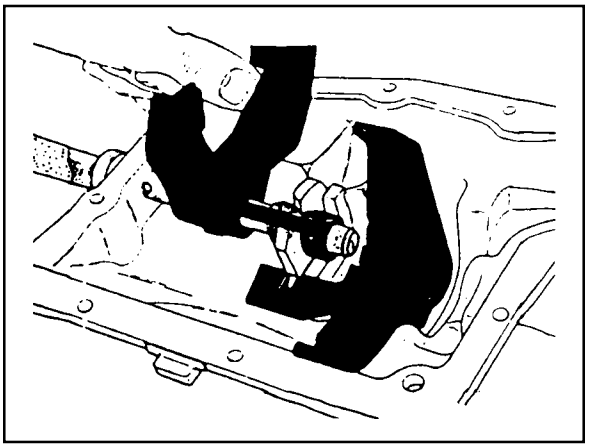
- Place the selector arm and interlock plate in the cover Note the position of the interlock plate and selector arm.



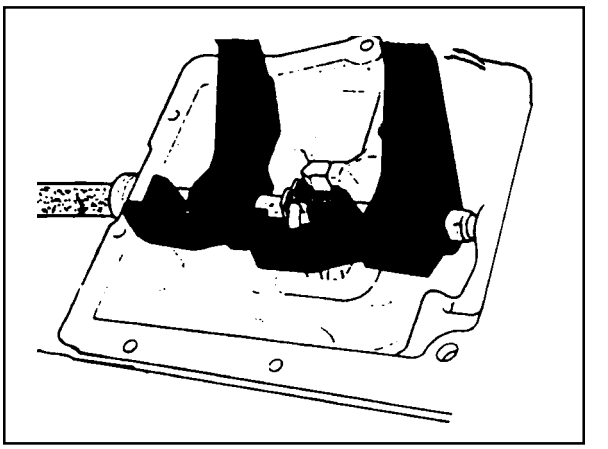
- Push the shift shaft through the 3-4 shift fork.



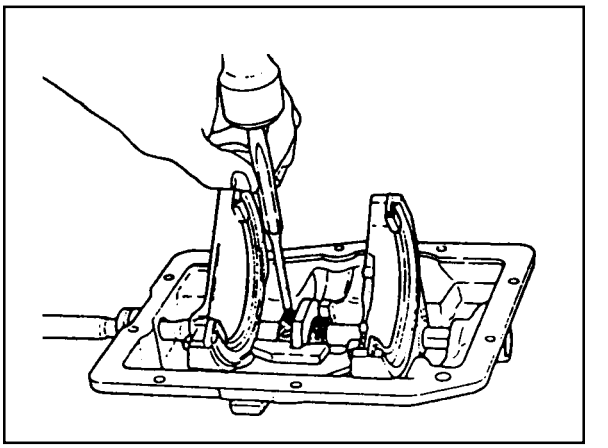
- Install the 3-4 shift fork and its selector plate.



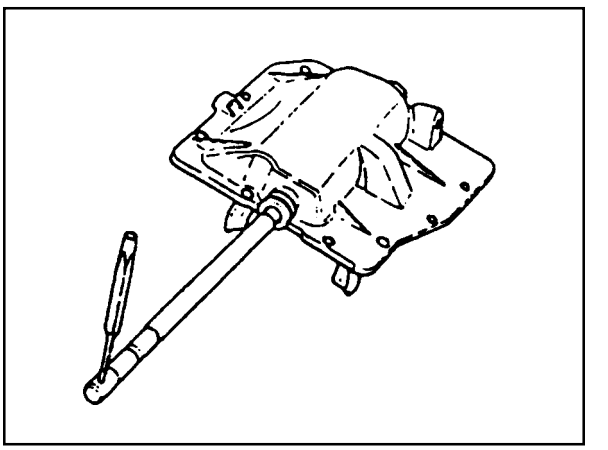
- Push the shift shaft through the 3-4 shift fork.



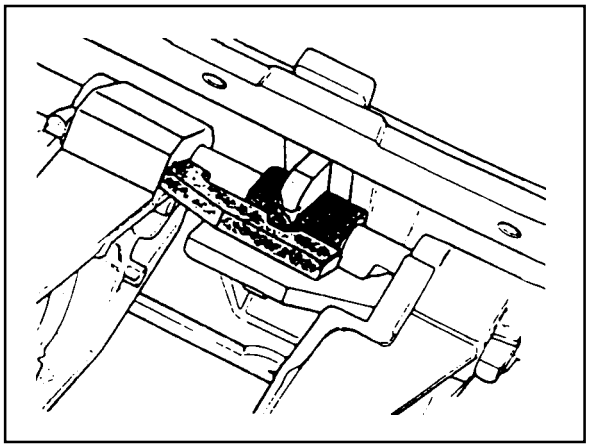
- Install the roll pin that fixes the selector arm to the shift shaft.



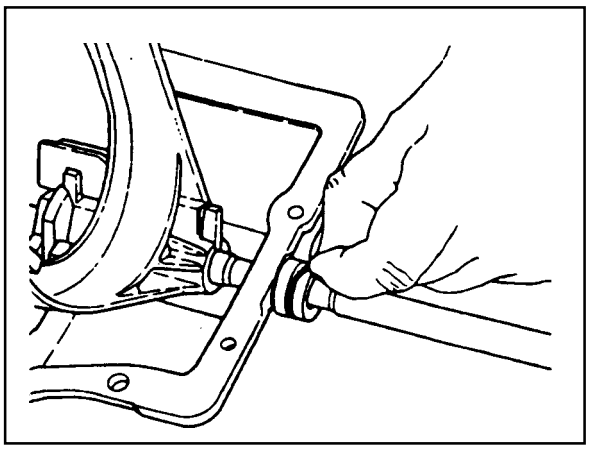
4. Check the shift cover parts for proper assembly as follows :
   - Insert a pin punch (3/16) into the offset lever hole of the shift shaft.
   - Place the shift cover to the flat ground and rotate the shift shaft so that the punch is vertical.



- Selector arm should be aligned with the 3/4 shift fork selector plate.



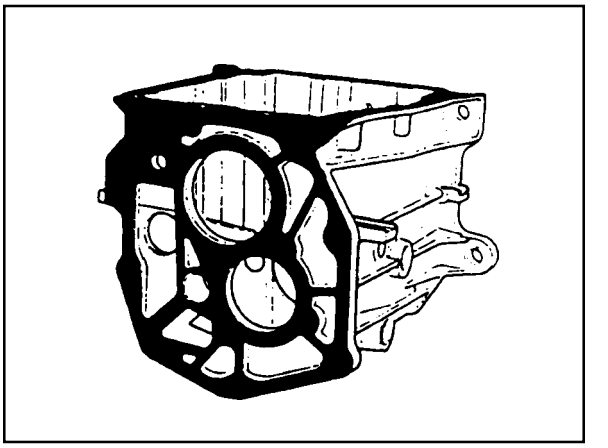
5. Lubricate and install the O-ring on the rear of the shift cover.



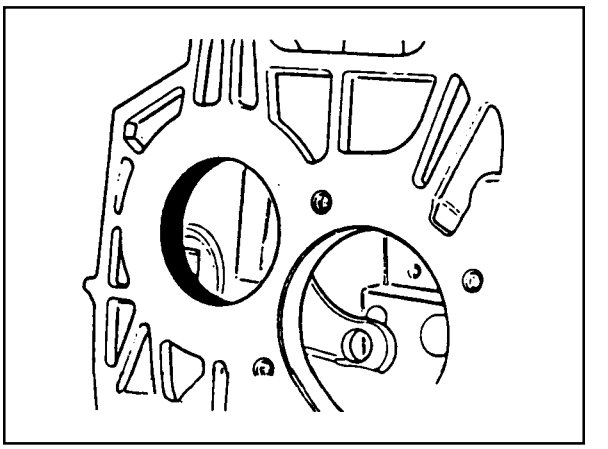
INSPECTION OF COMPONENTS

Inspection Procedure

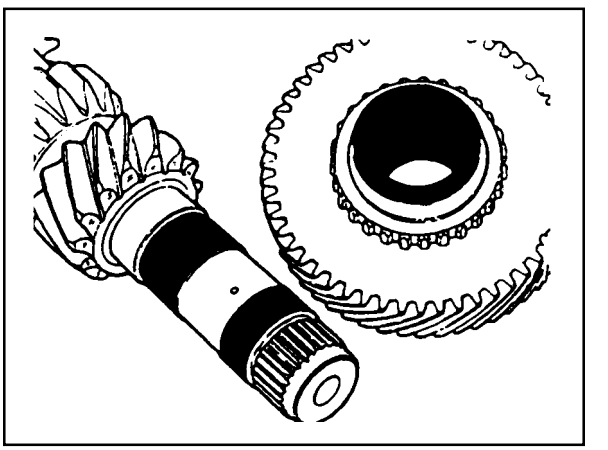
1. Clean all parts with solvent and dry them with compressed air. Check the following parts for cracks and damaged sealing surfaces.
   - Case
   - Extension housing
   - Shift Cover
   - Input bearing retainer
   - Counter shaft rear bearing retainer



2. Check the parts which support bearings and shafts for excessive wear and replace them if necessary.



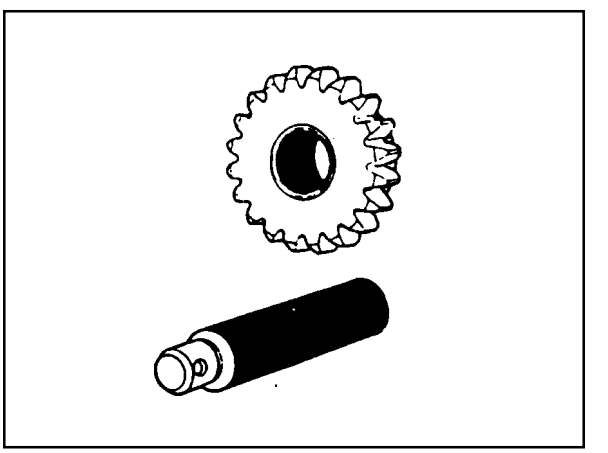
3. Check the bearing surfaces of the following parts ;
   - Input shaft
   - Main shaft and its gears
   - Counter shaft and 5th drive gear



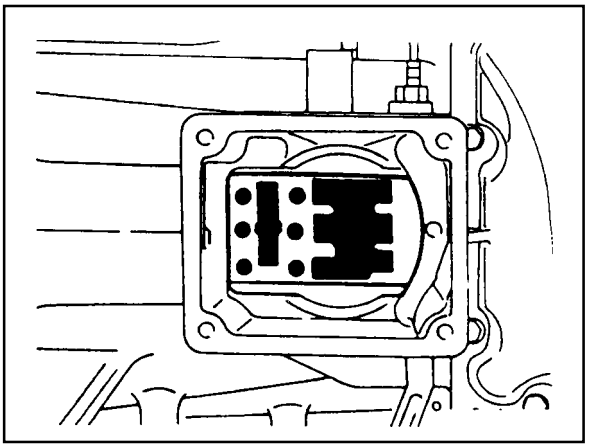
4. Check the reverse idler shaft and its gears.

   Notice

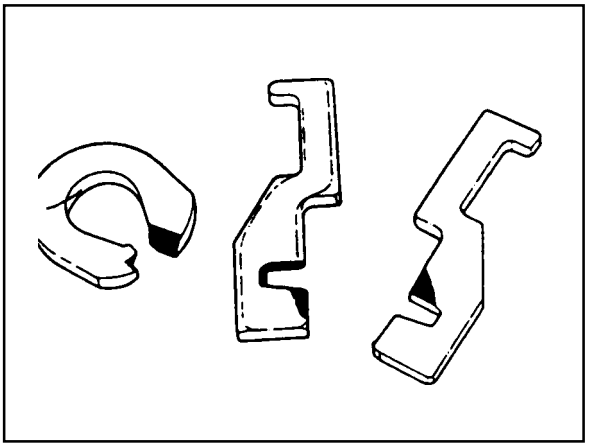
   Replace excessive wear parts and do not file on the hardened surface and precision ground.



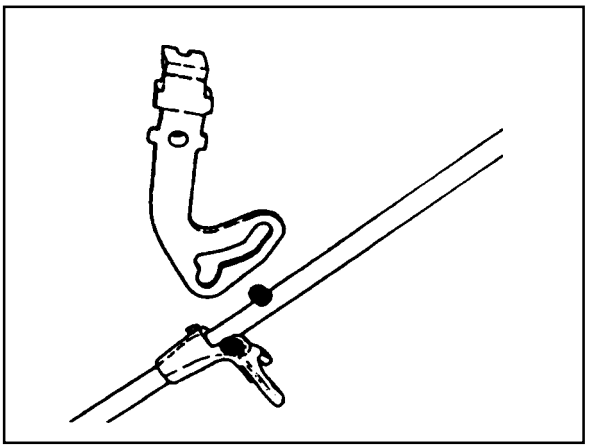
5. Check the shift mechanism parts as follows :
   - Wear of the shift shaft.
   - Wear of the detent/guide plate and offset lever.



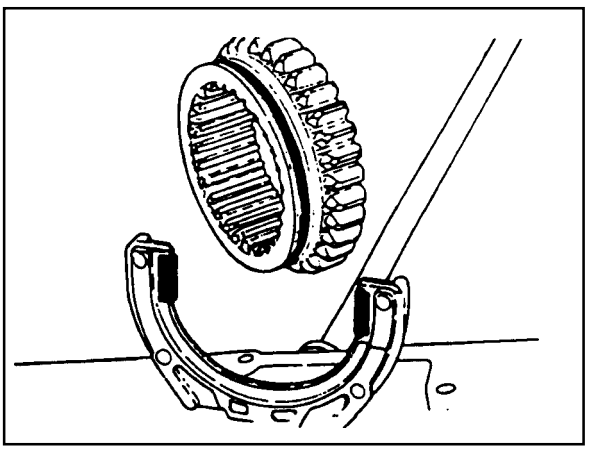
   - Check worn edges on the following parts :
     - Selector arm.
     - Interlock plate.
     - Selector plates for the 1-2 and 3-4 shift forks.



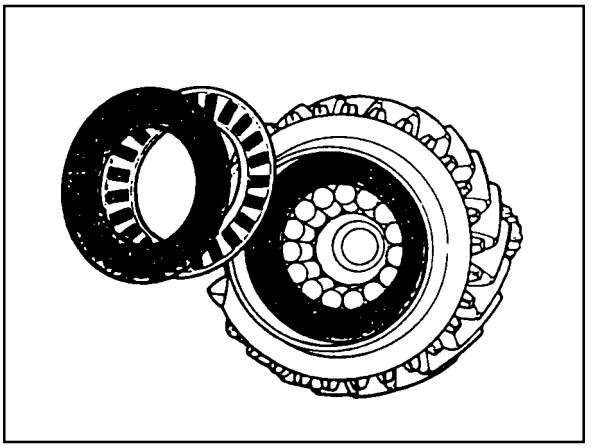
     - 5-R shift lever and the rollers on the reverse fork and the 5th shift rail/fork.



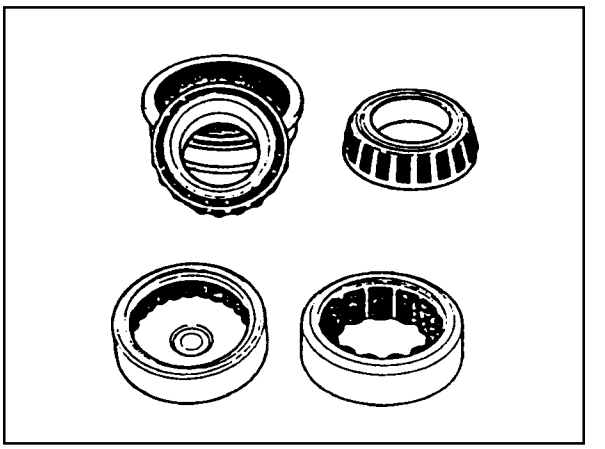
   - Check worn mating surfaces on the following parts :
     - 1-2 shift fork, pads and synchronizer sleeve.
     - 3-4 shift fork, pads and synchronizer sleeve.
     - 5th shift rail/fork pads and synchronizer sleeve.
     - Reverse fork and reverse idler gear sleeve.



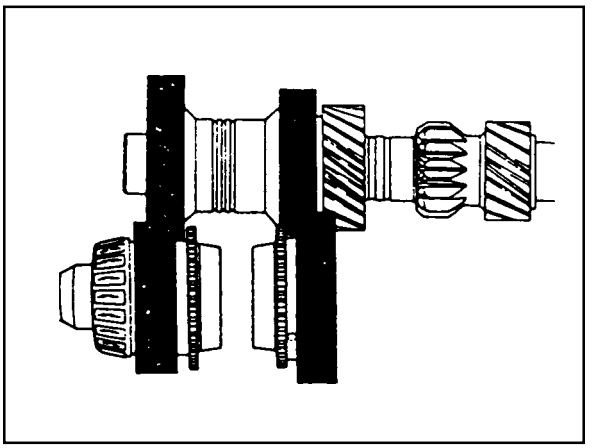
6. Check the following Bearing for excessive war:
   - Crankshaft pilot bushing for the front of the input shaft.
   - Clutch release bearing.
   - Input shaft bearing.
   - Main shaft pilot bearing rollers.
   - Main shaft thrust Bearing and its surfaces.



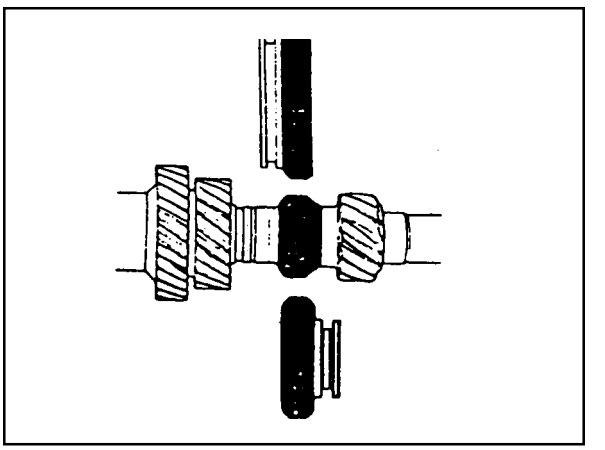
   - Speed gear roller bearing on the main shaft.
   - Main shaft rear bearing.
   - Counter shaft front and rear bearings.



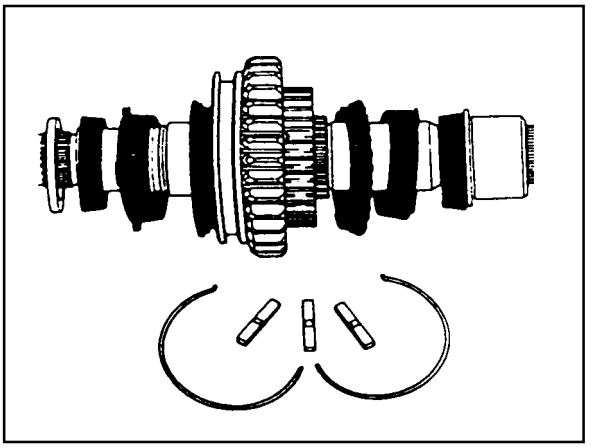
7. Check the gear tooth surfaces of all gear sets.



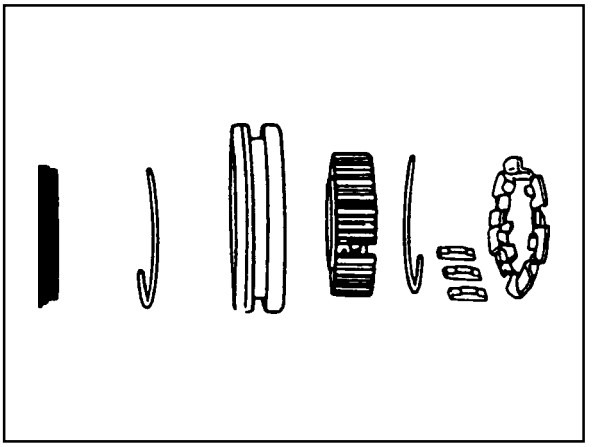
8. Check the reverse gear set surfaces. Check the surfaces of gear teeth for excessive wear, pitting, scoring and spalling and replace if necessary.



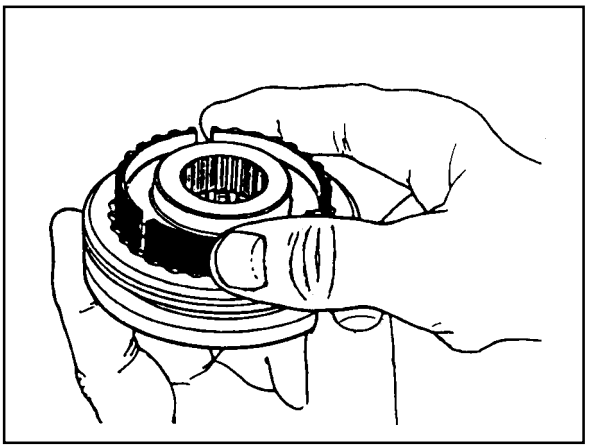
9. Take apart the three synchronizer assemblies and check :
   - The 1-2 synchronizer.



   - The 5th blocking ring.



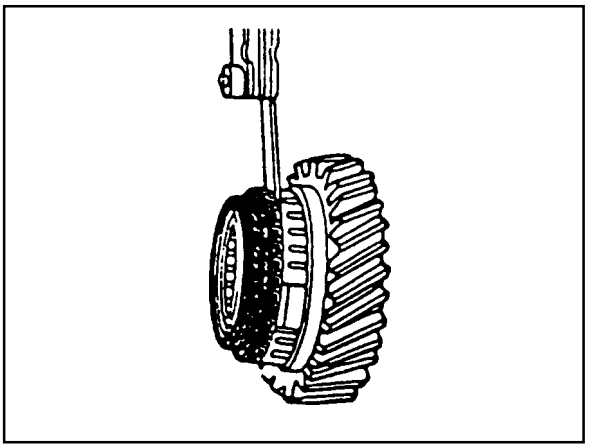
10. Check the fit between the hub and sleeve of each synchronizer
    - Excessively tight or loose hub-to-sleeve fit.
    - Wear of the cone clutch surfaces of brass blocking rings and gears.



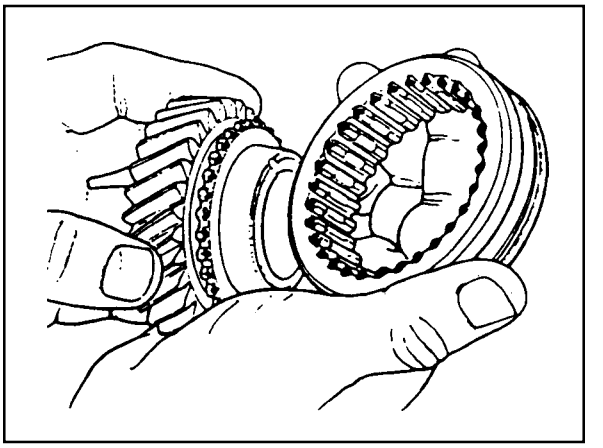
11. Measure the clearance between the blocking ring and the speed gear
    - New 1-2 blocking ring : 0.87-1.4mm
    - New 3-4 blocking ring : 0.88-1.5mm

    Notice

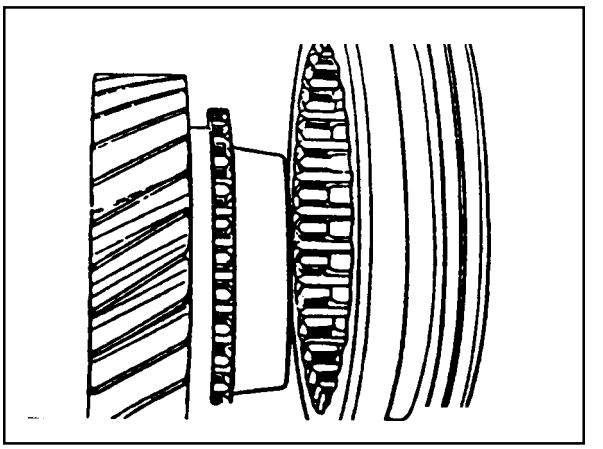
    Excessive wear of the blocking ring or the speed gear cone surface will cause shift block-out gear clash.



12. Check for gear clash on the synchronizer sleeve teeth or the clutch teeth on the speed gear.



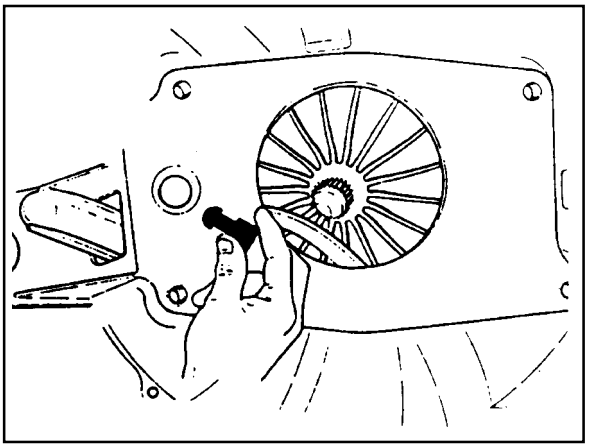
13. Check the synchronizer sleeve and gear clutch tooth for hop-out.



PRE-INSTALLATION CHECKS

Checking Procedure

1. Separate the clutch release fork from the pivot and remove the pivot from the clutch housing.

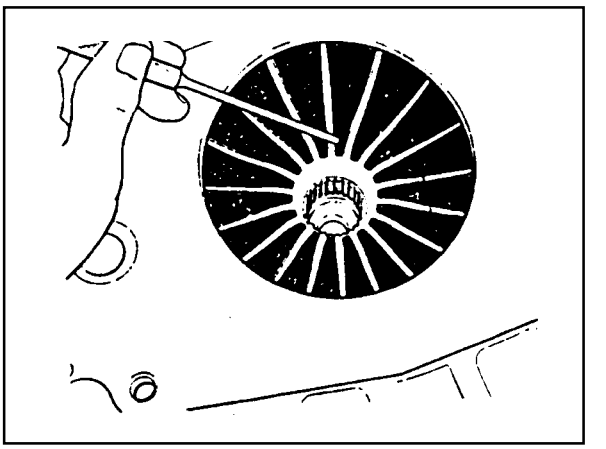


2. Check the pivot. Fork and release bearing.

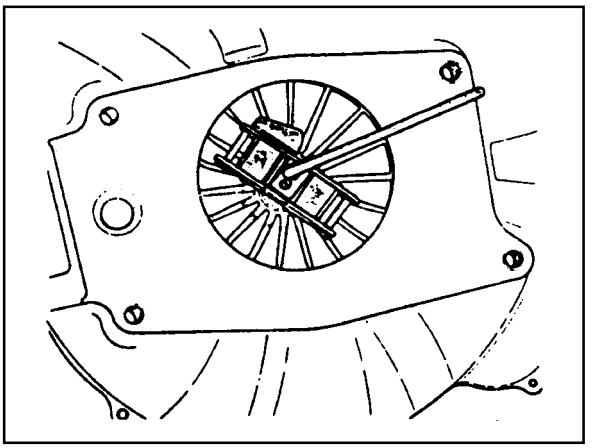
3. Check the pressure plate spring.

   Notice

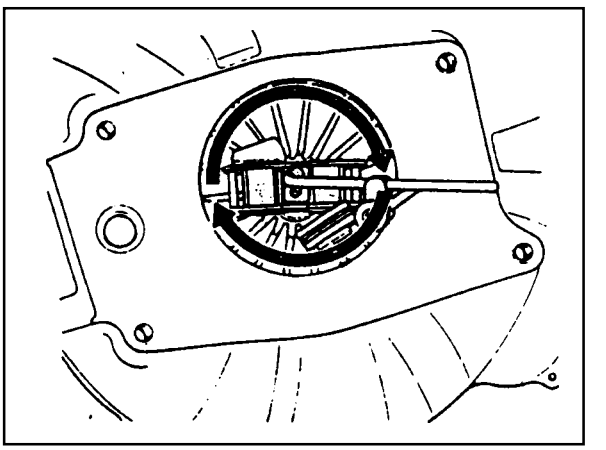
   Inspect each parts and replace the excessively worn parts.



4. Check the clutch housing alignment as follows :
   - Place the magnetic base on the pressure plate spring.



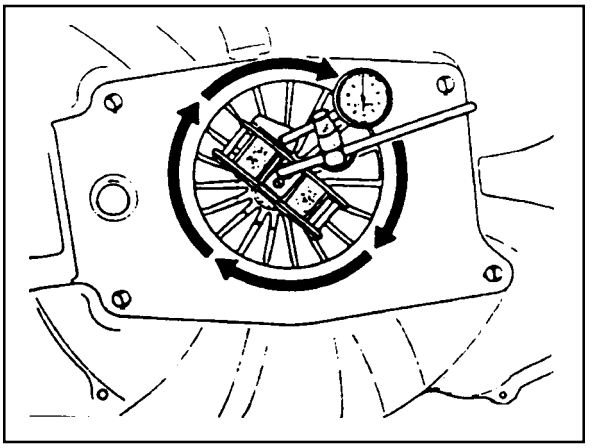
   - Check the housing bore alignment.
     - Place the dial indicator on the bore.
     - By rotating the crankshaft one revolution, record the dial indicator reading.



- Check the housing face alignment.
  - Place the dial indicator on the housing face.
  - By rotating the crankshaft one revolution, record the dial indicator reading.

Notice

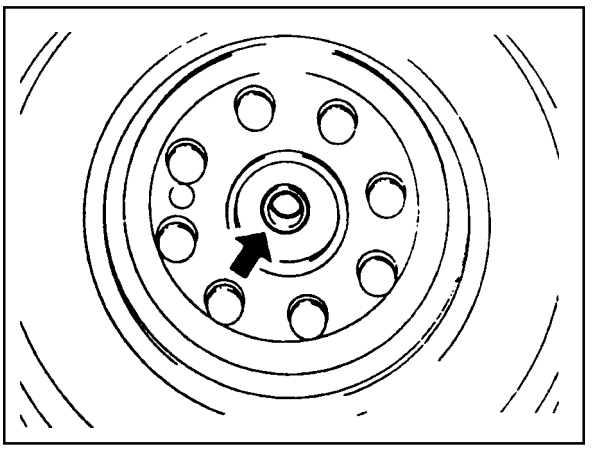
If the reading is greater than 0.010 inch, insert the shim between the engine and clutch housing and adjust the alignment.



5. Check the following parts :
   - Pressure plate spring assembly
   - Disc
   - Flywheel
   - Input shaft pilot bearing

Notice

Replace the excessively worn parts.



6. Lubricate the clutch release bearing bore, fork pivot head during assembly.

SECTION 5C

CLUTCH

Caution: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 5C-1
General Specifications 5C-1
Fastener Tightening Specifications 5C-2
Special Tools 5C-3
Special Tools Table 5C-3
Diagnosis 5C-4
Clutch Slips 5C-4
Poor Disengagement 5C-4
Hard to Shift or Will not Shift 5C-4
Clutch Chatters When Starting 5C-4
Difficult Pedal Operation 5C-5
Clutch Noisy 5C-5
Component Locator 5C-6
Clutch Assembly 5C-6
Pedal and Master Cylinder 5C-7
Maintenance and Repair 5C-8
On-Vehicle Service 5C-8
Bleeding of Clutch System 5C-8
Clutch Disc 5C-9
Master Cylinder 5C-13
Clutch Pedal 5C-15
Clutch Oil Chamber 5C-17

SPECIFICATIONS

GENERAL SPECIFICATIONS

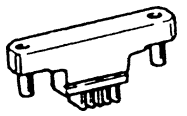
Application			Description
Type			Hydraulic
Clutch Pedal	Type		Suspended
	Max. Pedal Stroke		158 mm
	Pedal Free Play		5 - 10 mm
Clutch Disc	Type		Single Dry Diaphragm
	Thickness of Disc	Free	9.85 - 10.2 mm
		With Load	9.2 mm
Clutch Master Cylinder	Stroke		19.8 mm
	Inner Diameter		f15.87 mm
Clutch Release Cylinder	Stroke		14.0 mm
	Inner Diameter		f17.46 mm
Clutch Fluid			SAE J1703 / DOT3

FASTENER TIGHTENING SPECIFICATIONS

Application		N·m
Clutch Cover Bolt		37
Clutch Housing Bolt		47
Clutch Release Cylinder		30 - 40
Master Cylinder Nut		8 - 18
Clutch Tube Nut		15 - 18
Pedal Push Rod Nut		16 - 22
Pedal Mounting	Bracket Bolt	8 - 18
	Stopper Bolt	21 - 25

SPECIAL TOOLS

SPECIAL TOOLS TABLE

	**602 589 00 40 00** **Engine Lock**
	**661 589 00 15 00** **Centering Pin**

DIAGNOSIS

CLUTCH SLIPS

Checks	Action
Excessive Wear of Facing	Replace
Hard or Oily Facing	Repair or Replace
Damaged Pressure Plate or Flywheel	Replace
Damaged or Burnt Diaphragm Spring	Replace
Clutch Pedal Free play Insufficient	Adjust
Faulty Operation of Clutch Pedal	Repair or Replace
Worn or Damaged Clutch Disc	Replace

POOR DISENGAGEMENT

Checks	Action
Vibration or Excessive Run-out of Disc	Replace
Rust or Wear of Disc Spline	Repair or Replace
Oily Facing	Repair or Replace
Damaged Diaphragm Spring	Replace
Excessive Clutch Pedal Free play	Adjust

HARD TO SHIFT OR WILL NOT SHIFT

Checks	Action
Excessive Clutch Pedal Free play	Adjust Pedal Freeplay
Faulty Clutch Release Cylinder	Repair Release Cylinder
Worn Disc, Excessive Run-out, Damaged Lining	Repair or Replace
Dirty or Burred Splines on Input Shaft or Clutch Disc	Repair as Necessary
Damaged Clutch Pressure Plate	Replace

CLUTCH CHATTERS WHEN STARTING

Checks	Action
Oily Facing	Repair or Replace
Hard or Faulty Facing	Replace
Burnt Torsion Spring	Replace
Faulty Pressure Plate	Replace
Bent Clutch Diaphragm Spring	Replace
Hard or Bent Flywheel	Repair or Replace
Engine Mounts Loose or Burnt Lever	Tighten or Replace

DIFFICULT PEDAL OPERATION

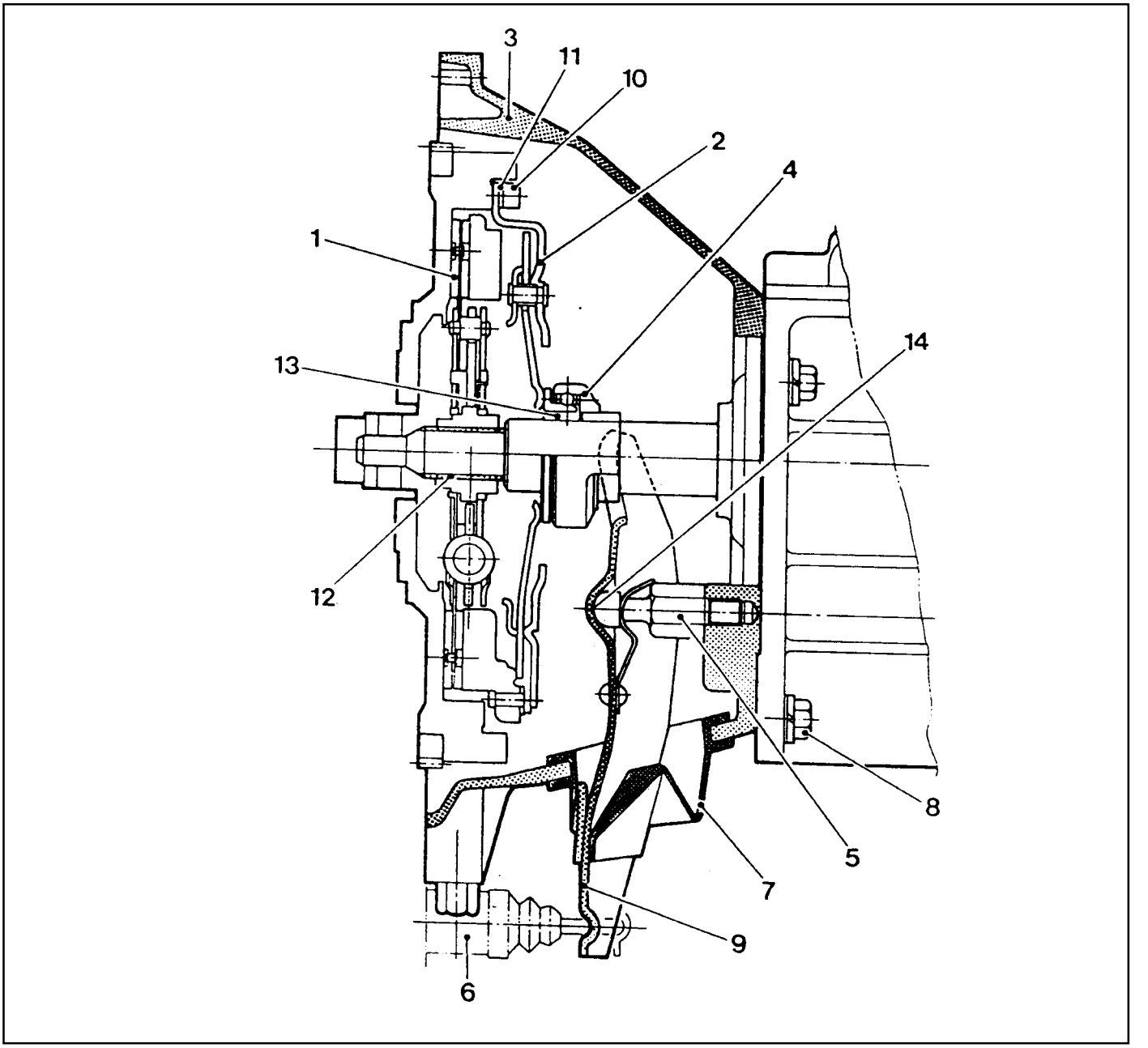
Checks	Action
Poor Lubrication on Clutch Cable	Lubricate or Replace
Poor Lubrication on Pedal Shaft	Lubricate or Replace
Poor Lubrication on Clutch Pedal	Repair

CLUTCH NOISY

Checks		Action
Not Using the Clutch	Insufficient Clutch Pedal Free play	Adjust
	Excessive Wear of Facing	Replace
After Disengagement	Worn or Damaged Release Bearing	Replace
When Disengaging	Poor Lubrication Contact Surface of Bearing	Replace
	Faulty Installation of Clutch Assembly or Bearing	Repair
Clutch Pedal is Partially Depressed and Vehicle Speed is Reduced	Damaged Pilot Bushing	Replace

COMPONENT LOCATOR

CLUTCH ASSEMBLY

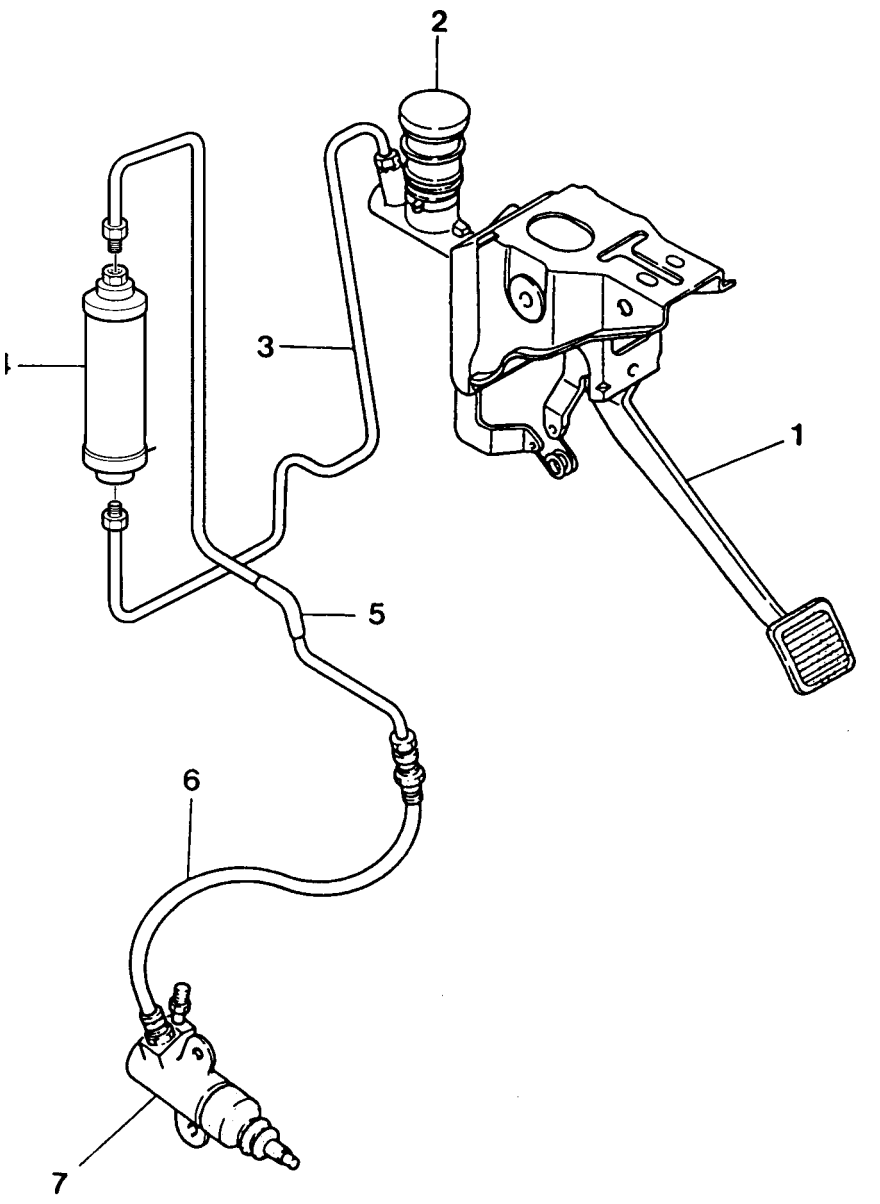


1 Clutch Disc
2 Clutch Cover
3 Clutch Housing
4 Release Bearing
5 Release Fork Pivot
6 Release Cylinder
7 Release Fork Boot
8 Bolt
9 Release Fork
10 Bolt
11 Spring Lock Washer
12 Transmission Input Spline
13 Release Bearing Contacting Surface
14 Contacting Point of Release Fork and Pivot

Notice

Apply the long-term grease (DBL 6811.00) to No.12,13 and 14.

PEDAL AND MASTER CYLINDER



1 Clutch Pedal
2 Clutch Master Cylinder
3 Clutch Tube
4 Clutch Oil Chamber
5 Clutch Tube
6 Clutch Hose
7 Clutch Release Cylinder

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

BLEEDING OF CLUTCH SYSTEM

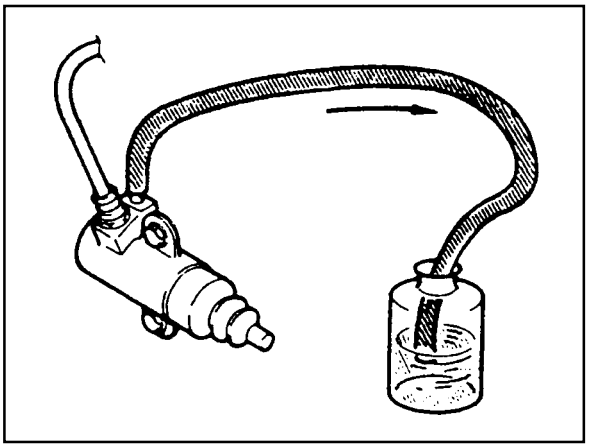
Bleeding procedure

Notice

Keep the fluid level over 'MAX' in reservoir during bleeding operation.

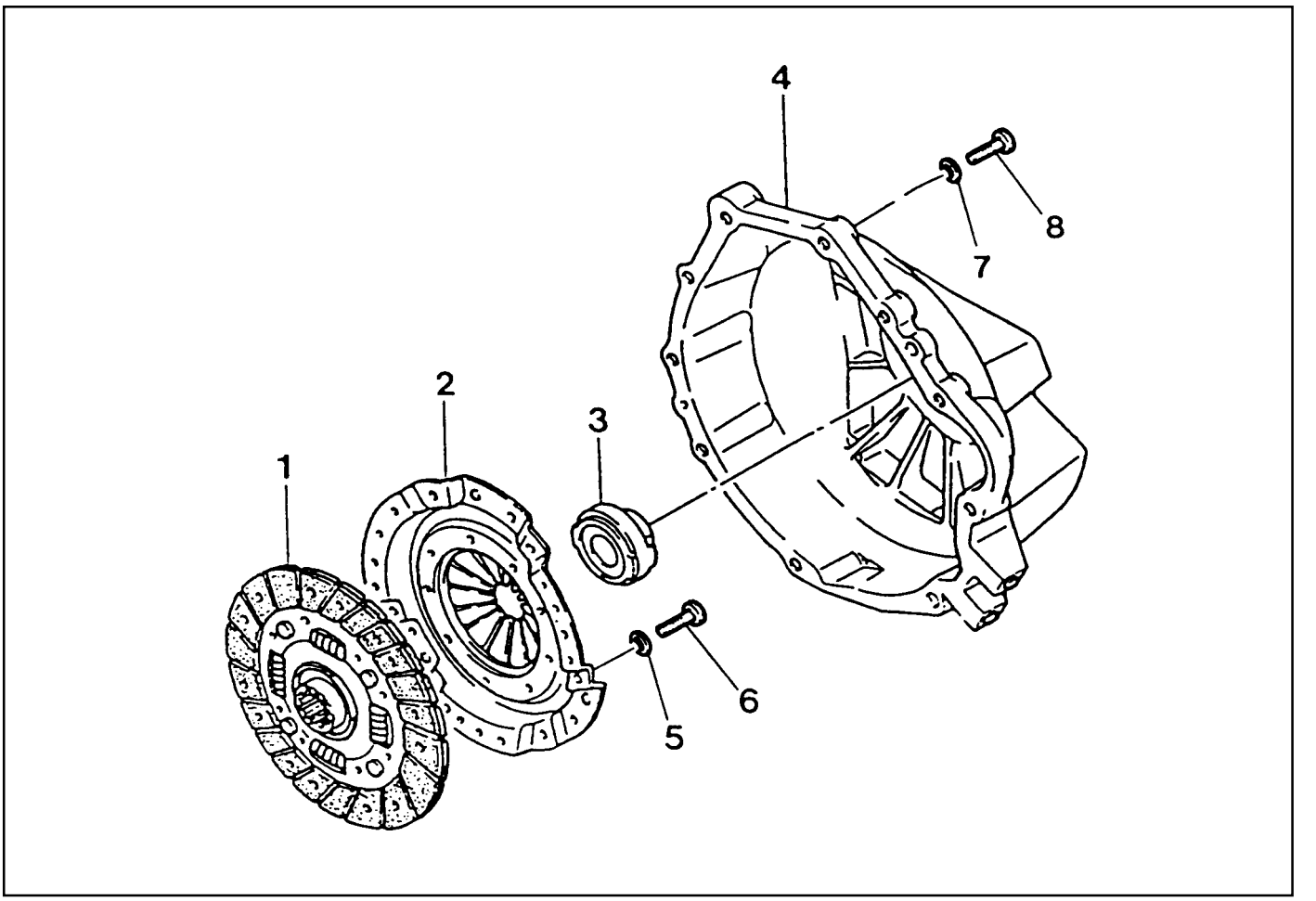
Do not let fluid contact a painted surface.

1. Remove the air bolt cap of the release cylinder.
   Connect a vinyl tube to the bolt.
2. Insert the other end of the tube in a vacant container.
3. Slowly depress the clutch pedal several times.
4. With clutch pedal fully depressed, open the air bolt and release air rind fluid in the fluid line,
5. Repeat this procedure until there are no more air bubbles in the fluid flows.



CLUTCH DISC

Preceding Work : Removal of the transmission



1 Clutch Disc
2 Clutch Cover Assembly
3 Release Bearing
4 Clutch Housing
5 Washer
6 Bolt ..... 23 Nm
7 Washer
8 Bolt ..... 44 Nm

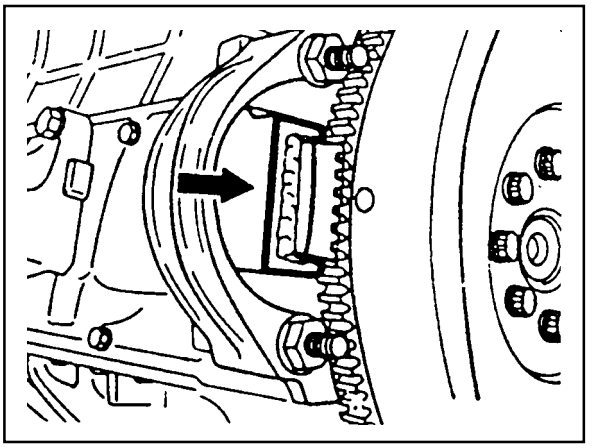
Tools

602 589 00 40 00 Engine Lock
661 589 00 15 00 Centering Pin

Removal & Installation Procedure

1. Remove the starter motor. Install the special tool to the flywheel through the starter motor mounting holes.

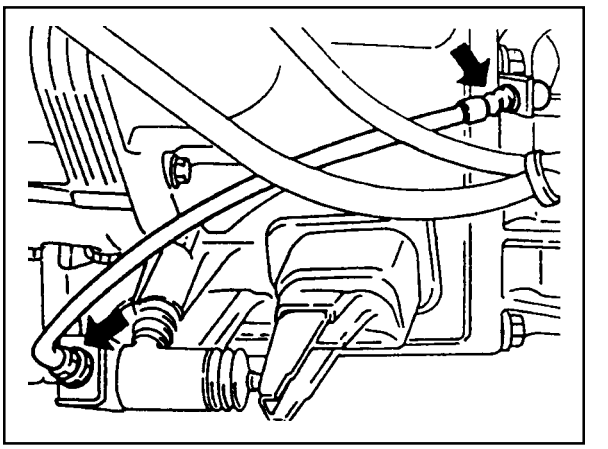
Engine Lock 602 589 00 40 00



2. Unscren the release cylinder mounting bolts and remove the release cylinder.

Installation Notice

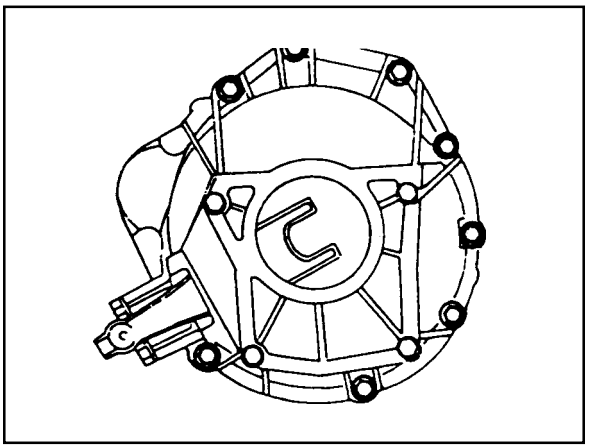
Tightening Torque	30 - 40 Nm



3. Unscrew the clutch housing bolts and remove the clutch housing, release fork and release bearing.

Installation Notice

Tightening Torque	47 Nm



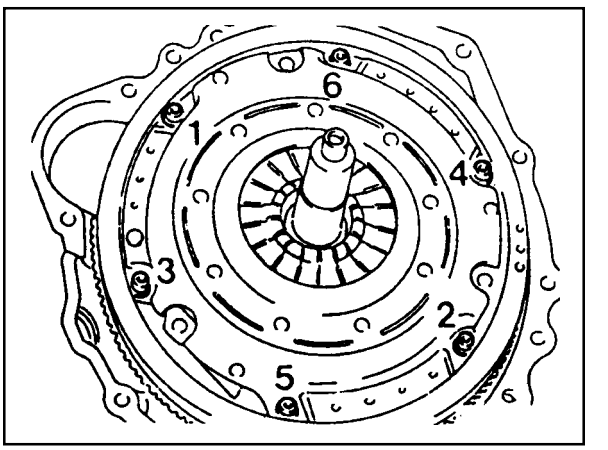
4. Insert the centering pin into the clutch spline.

   Loosen the clutch cover bolts 1/2 turn in crisscross sequence until the spring tension is released.

   Notice

   Do not remove the bolts at a time, or clutchcover can be damaged or deformed.

Centering Pin 661 589 00 15 00



5. Unscrew the bolts and remove the clutch cover, pressure plate and clutch disc.

   Notice

   Be careful not to drop the pressure plate and clutch disc.

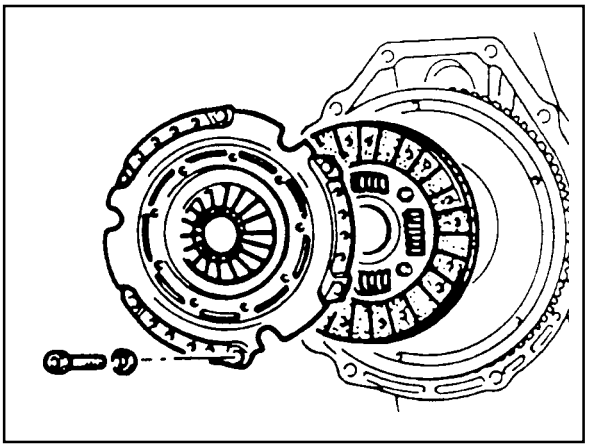
   Installation Notice

Tightening Torque	21 - 27 Nm

6. Installation should follow the removal procedure in the reverse order.

   Notice

   - Before installation, clean oil and grease on the flywheel surface.
   - Do not clean the clutch disc and release bearing in solvent.

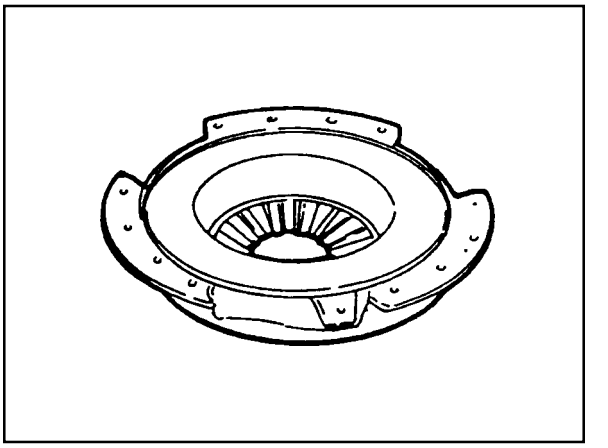


Inspection Procedure

1. Clutch Cover
   - Check the diaphragm spring tip for wear and height unevenness.

Unevenness Limit	0.8 mm

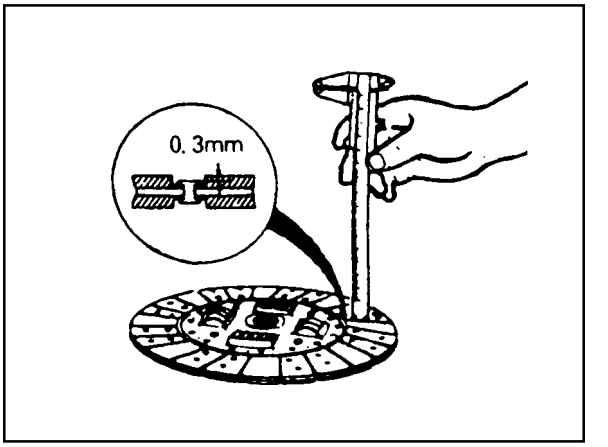
   - Check the pressure plate surface for wear, crack and discoloration.
   - Check the strap plate rivet for looseness and replace the clutch cover if loosened.



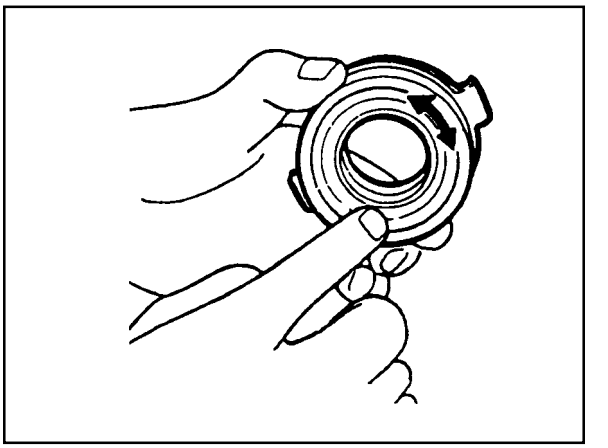
2. Clutch Disc
   - Check the facing for rivet looseness, excessive runout, sticks, oil and grease.
   - Measure the rivet head depth.

     If out limit, replace the disc.

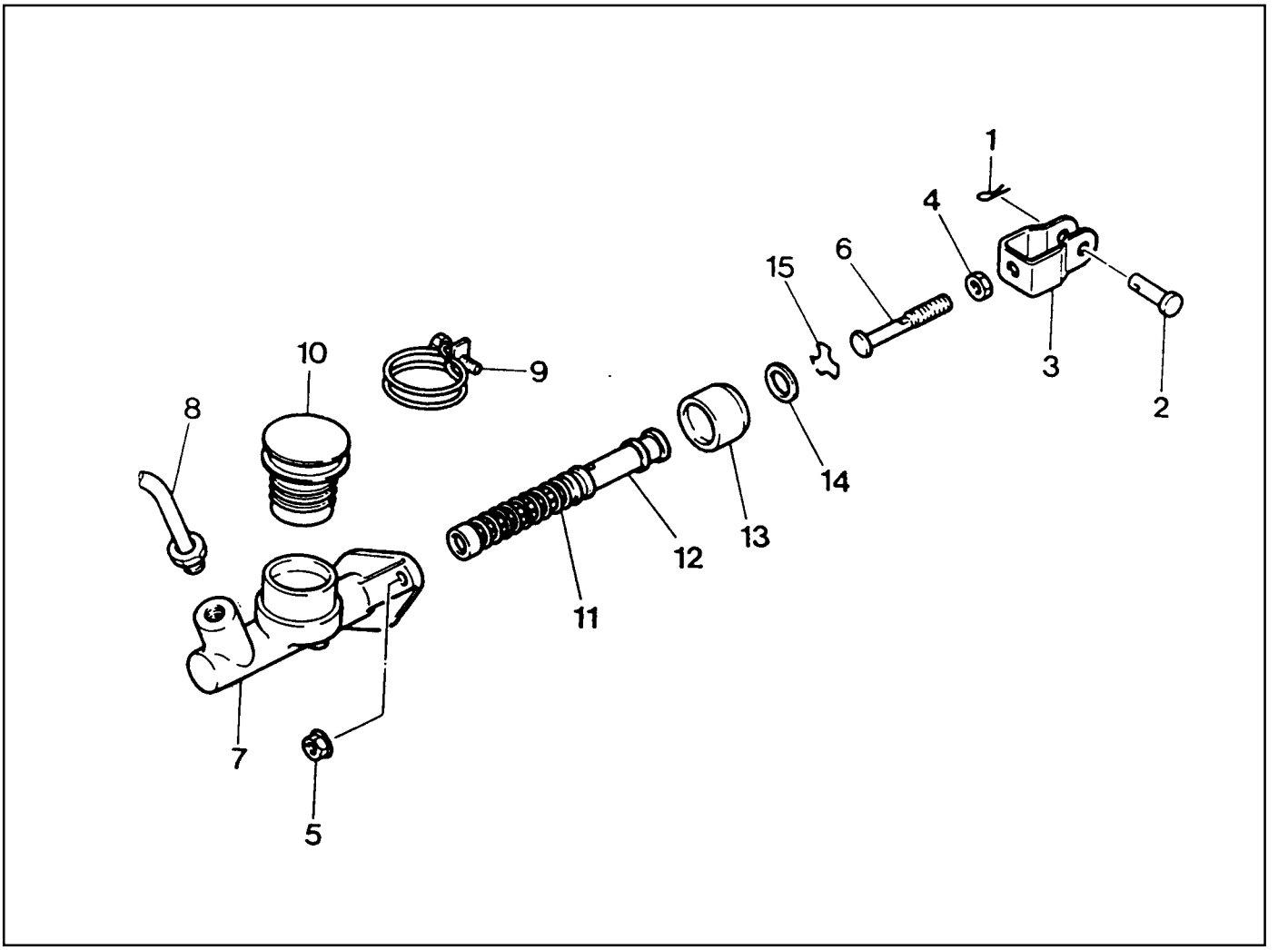
Wear Limit	0.3 mm



3. Clutch Release Bearing
   - The release bearing is permanently lubricated and requires no cleaning.
   - Check the bearing for sticks, damage, abnormal noise, turning drag and wear.
4. Release Fork
   - If there is abnormal wear in contact point with bearing, replace the release fork.



MASTER CYLINDER

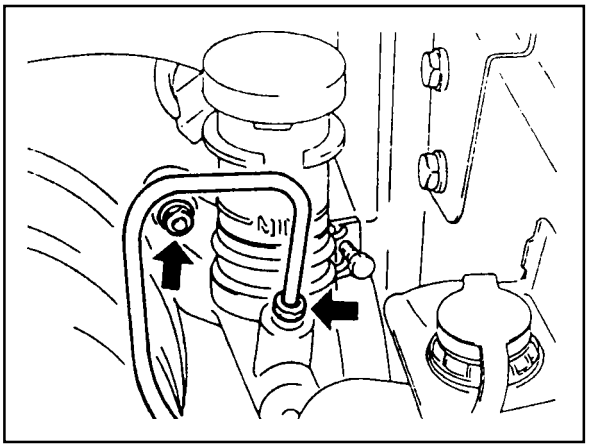


1 Snap Pin
2 Clevis Pin
3 Clevis
4 Lock Nut
5 Flange Nut ..... 30-40 Nm
6 Push Rod
7 Cylinder Body
8 Oil Pipe ..... 15-18 Nm
9 Clamp
10 Reservoir
11 Spring
12 Piston Assembly
13 Boot
14 Plate
15 Snap Ring

Notice

Do not disassemble the No.12.

Removal & Installation Procedure



1. Draw out the fluid.
2. Pull out the snap pin and clevis pin from the clutch pedal connection.
3. Remove the clutch tube.

   Installation Notice

Tightening Torque	15 - 18 Nm

   Notice

   Be careful not the fluid contact a painted surface.

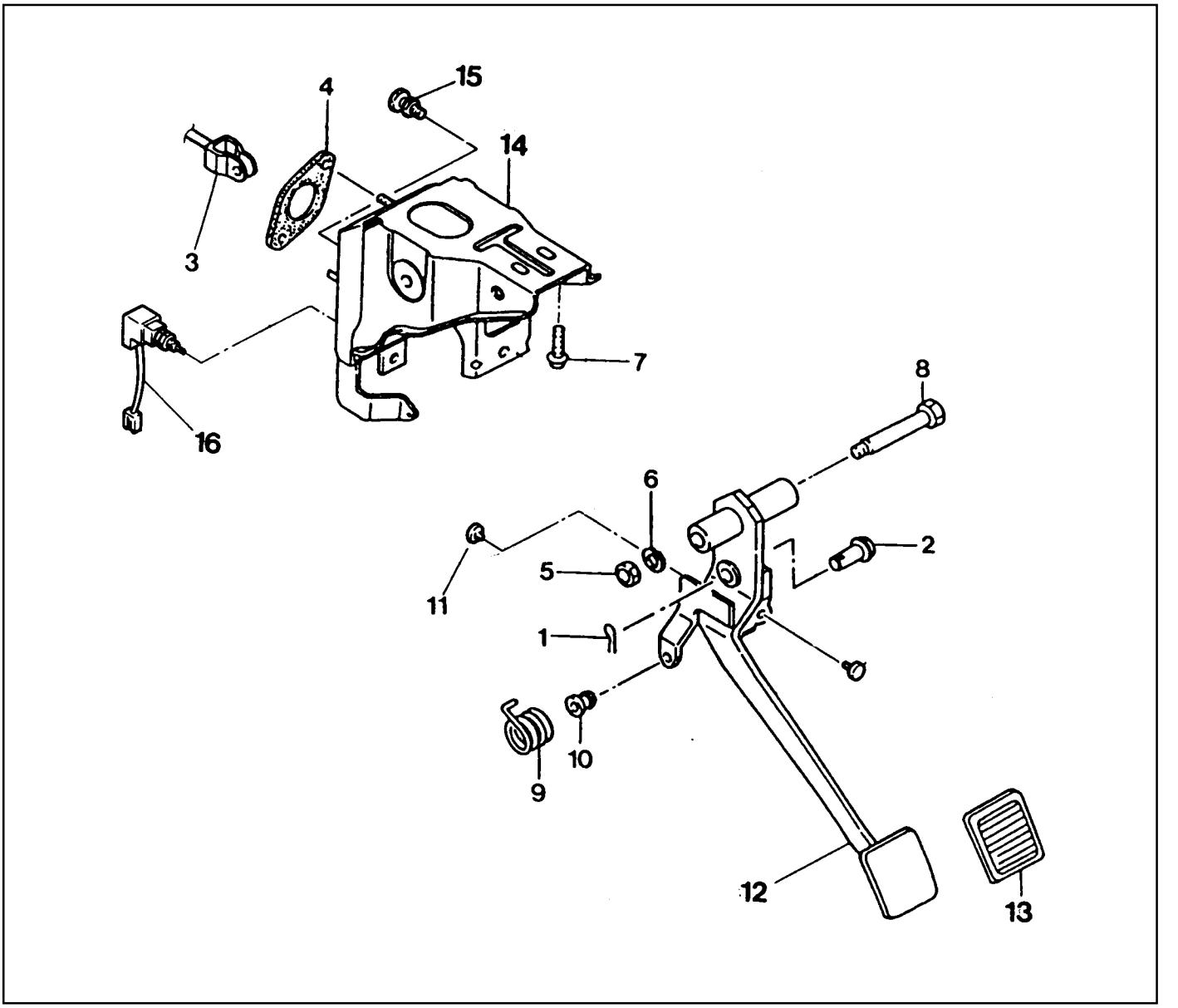
4. Remove the master cylinder mounting nuts and pull off the master cylinder.

   Installation Notice

Tightening Torque	8 - 18 Nm

5. Check the clutch pedal operation.
6. Bleed the clutch system.

CLUTCH PEDAL



1 Snap Pin ..... Replace
2 Clevis Pin ..... Apply Grease
3 Master Cylinder Push Rod
4 Gasket
5 Nut ..... 16-22 Nm
6 Spring washer
7 Bolt ..... 8-18 Nm
8 Fulcrum Pin
9 Turn Over Spring ..... Apply Grease
10 Bushing ..... Replace, Apply Grease
11 Full Stroke Stopper Contact Pad
12 Clutch Pedal
13 Pedal Pad
14 Pedal Mounting Bracket
15 Stopper Bolt 21-25Nm
16 Clutch Interlock Switch

Notice

Assembly should follow the disassembly procedure in the reverse order.

Grease specification : Long - term grease (T/Mn DBL6611.00)

Inspection Procedure

1. Pedal Stroke (A).

Max. Stroke	158 mm

Notice

To adjust the pedal stroke, loosen the lock nut (H) of the interlock switch (G) and turn the two lock auto until the stroke is correct.

2. Pedal Height (B).

Height (From the Floor Carpet)	147 - 187 mm

Notice

To adjust the pedal height, loosen the lock nut (C) of the stopper bolt(D) and turn the stopper bolt until the height is correct.

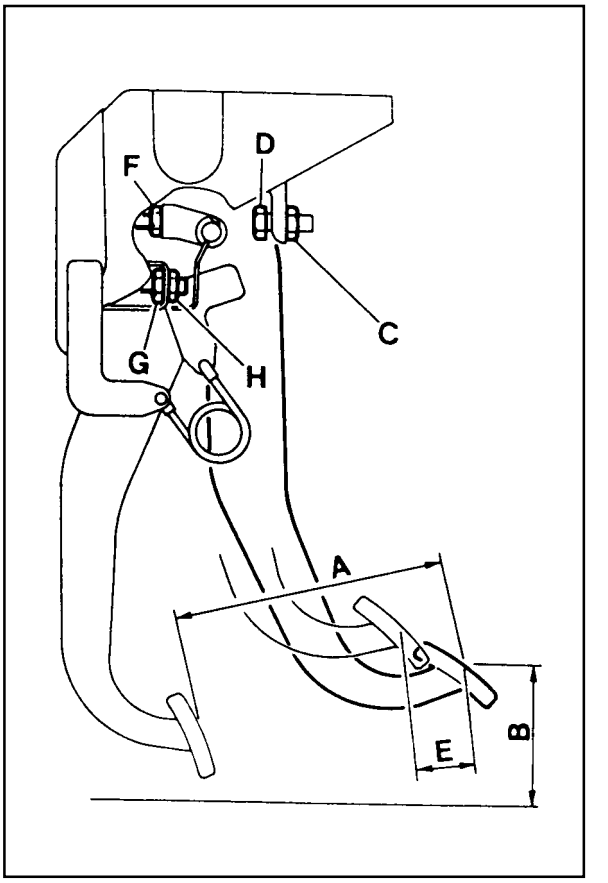
3. Pedal Free Play (E).

Free Play	5 - 10 Nm

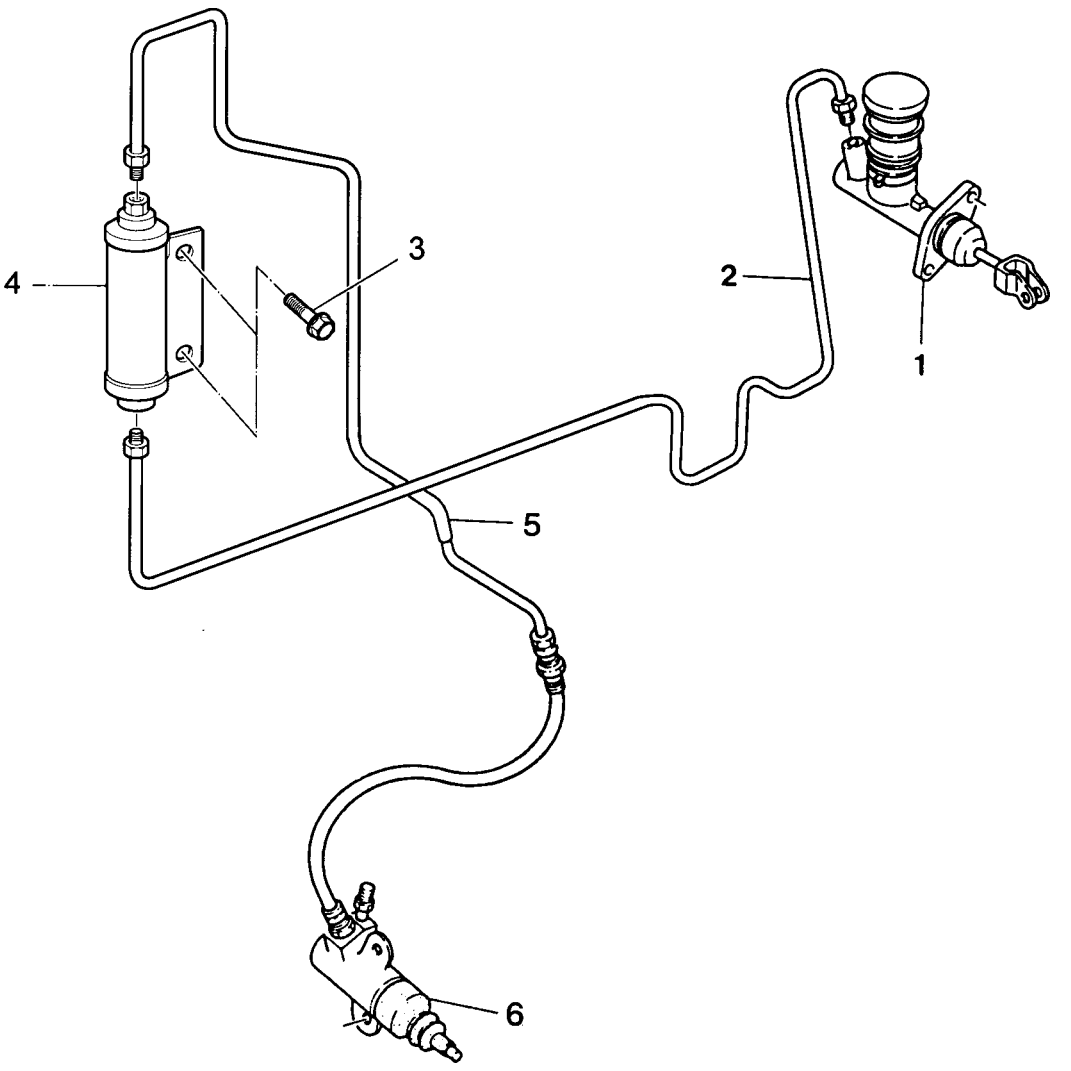
Notice

To adjust the pedal free play, loosen the lock nut (F) of the master cylinder and turn the push rod until the free play is correct.

4. Check the fulcrum pin and the bushing for wear, the pedal for bending and the spring for damage.



CLUTCH OIL CHAMBER



1 Clutch Master Cylinder
2 Hydraulic Tube
3 Bolt
4 Clutch Oil Chamber
5 Hydraulic Tube
6 Clutch Release Cylinder

Notice

- Installation should follow the removal procedure in the reverse order.
- When installing, perform the bleeding procedures from chamber cylinder and release cylinder.

SECTION 5D1

TRANSFER CASE (PART TIME 4408)

Caution: Disconnect the negative battery cable before removing or installing any electrical unit or when a tool or equipment could easily come in contact with exposed electrical terminals. Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

TABLE OF CONTENTS

Specifications 5D1-1
General Specifications 5D1-1
Schematic and Routing Diagram 5D1-2
Part Time Transfer Case - 4408 . . . . . 5D1-2
Diagnosis 5D1-3
Self-Diagnosis 5D1-4
System Description 5D1-4
Self-Diagnosis Test 5D1-8
Diagnostic Diagram 5D1-9
Maintenance and Repair 5D1-10
On-Vehicle Service 5D1-10
Maintenance of Transfer Case Lubricant . . 5D1-10
Transfer Case 5D1-11
Unit Repair 5D1-14
Transfer Case 5D1-14
Transfer Case Control Unit (TCCU) 5D1-36

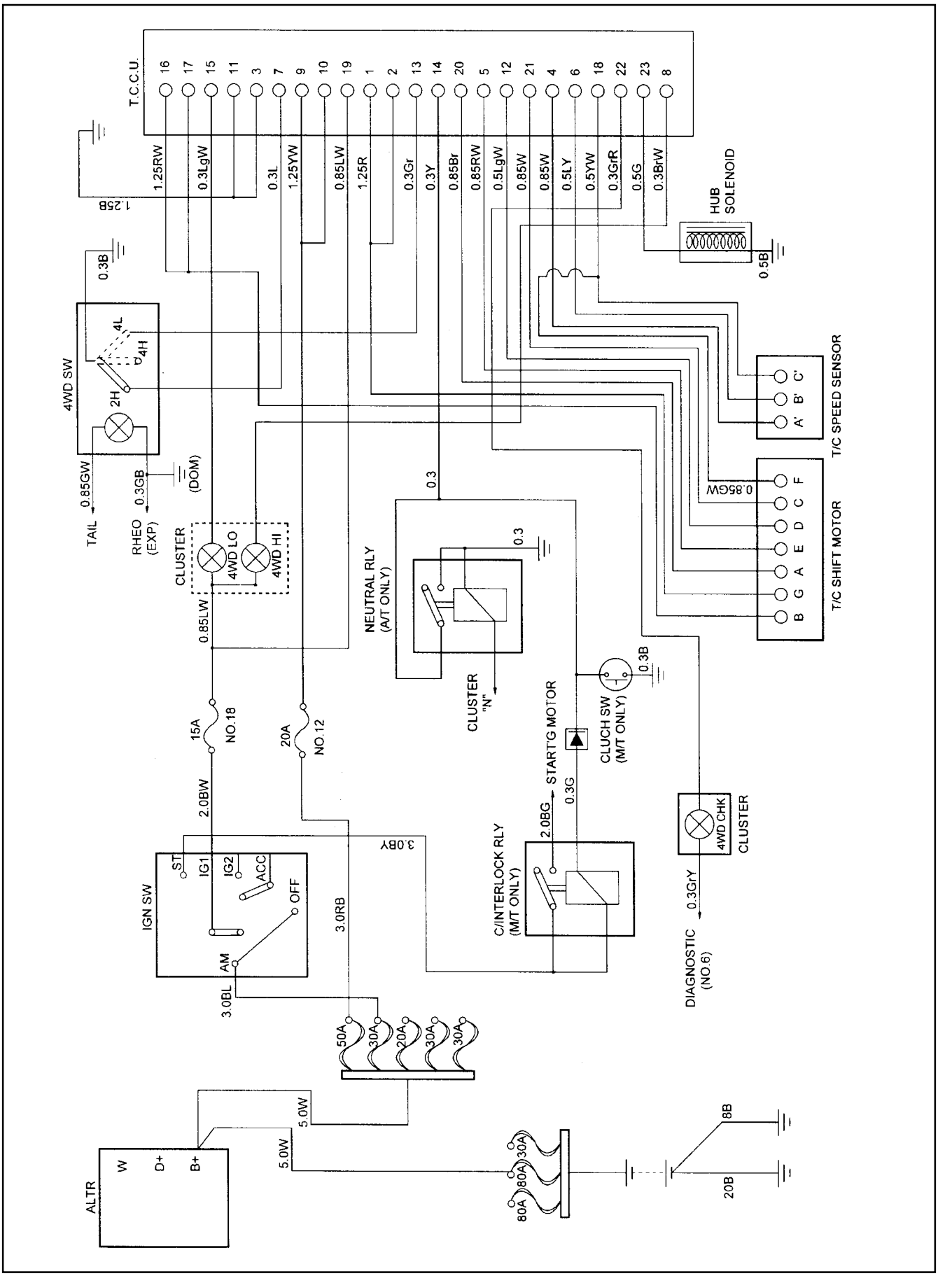
SPECIFICATIONS

GENERAL SPECIFICATIONS

Application		Description
Model		Part-Time 4408 (E)
Type		E.S.O.F. Type
Gear Ratio	High	1 : 1
	Low	2.48 : 1
Oil	Specification	ATF S-3, S-4 or DEXRON II, III
	Capacity	1.2 L
	Lubrication	Check : Every 15,000 km Replace : Every 50,000 km
Manufacturer		Borg Warner
Weight		30 kg

SCHEMATIC AND ROUTING DIAGRAM

PART TIME TRANSFER CASE - 4408



DIAGNOSIS

Electric Shift Problems

Checks	Action
Faulty or Damaged TCCU, Speed Sensor, Motor, Clutch or Internal Wirings	Overhaul and check, replace if necessary.
Damaged or Worn Shift Cam, Hub, Fork and Rail Shift	Overhaul and check for wear and damage. Replace if necessary.
Binding Shift Fork, Hub Collar or Gear	Check sliding parts, replace if necessary.

Cannot Front Wheel Drive when Shifted 4H,4L

Checks	Action
Broken Drive Chain	Check sliding parts, replace if necessary.

Noise in 4WD Operation

Checks	Action
Improper or low oil	Drain and replace with specified oil.
Loosened bolts or mounted parts	Retighten as specified.
Noisy T/C bearing	Disassemble bearings and parts and check for wear or damage. Replace if necessary.
Noisy gears	Check for wear and damage including speedometer gear, replace if necessary.

Noise in 4H or 4L

Checks	Action
Worn or Damaged Sprockets or Drive Chain	Disassemble and check for wear and damage, replace if necessary.
Incorrect Tire Pressure	Adjust tire pressure.

Transfer Case Oil Leakage

Checks	Action
Cracked Transfer Case	Replace the case.
Leakage from Other Parts	Clean case and parts and check for leakage.
Breather Clogging	Remove breather hose and clean, replace if necessary.
Improper or too much Oil	Use specified oil and adjust oil level.
Loosened Sealing Bolts	Retighten
Improperly Applied Sealant	Use specified sealant and retighten.
Worn or Damaged Oil Seal	Replace

SELF-DIAGNOSIS

SYSTEM DESCRIPTION

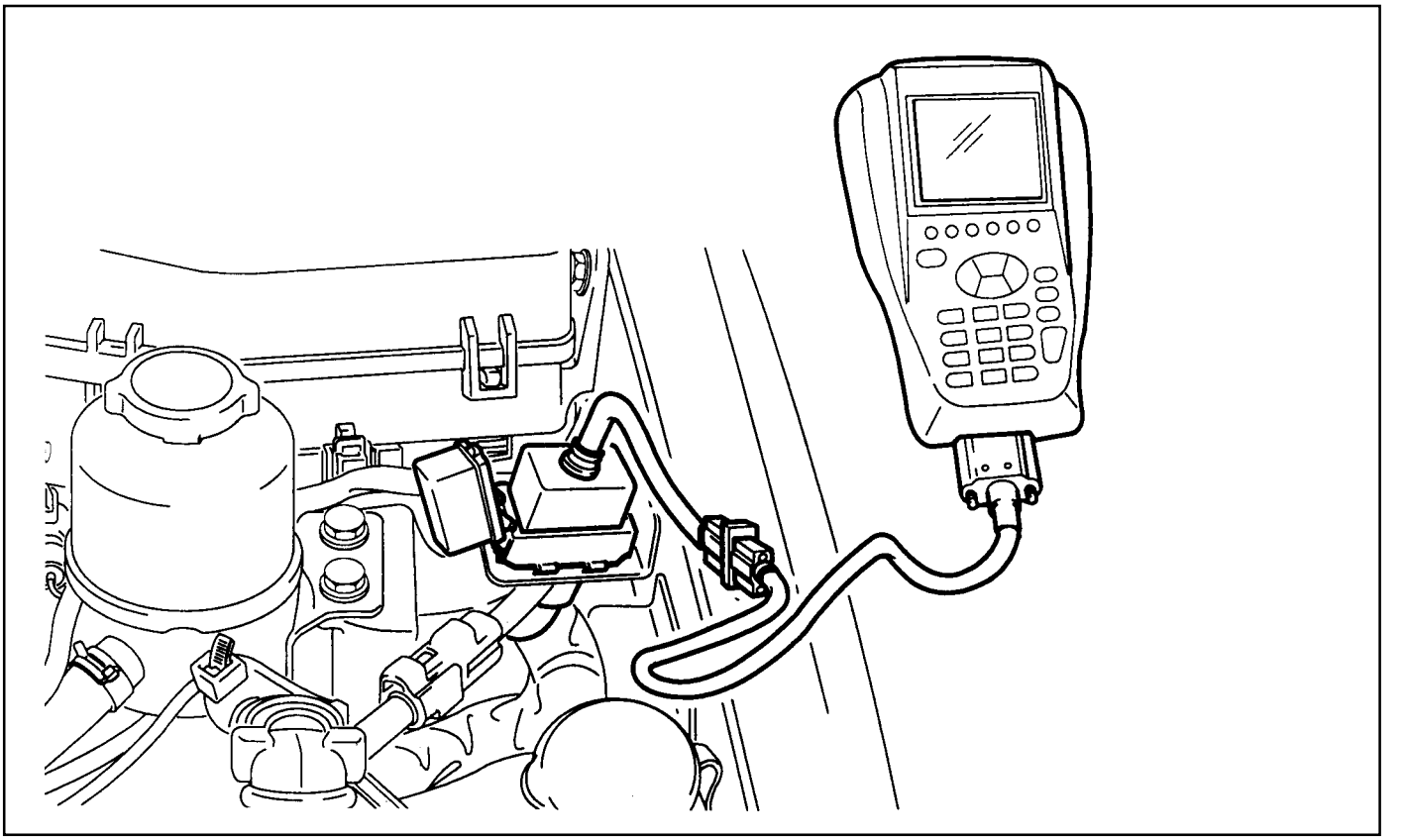
1. TCCU detects transfer case system malfunctions and indicates malfunctioning part(s) through flashing 4H,4L indicator lights.

   Using a service connector, connect it to the diagnosis box in the engine room and read the flashing of the ‘4WD CHECK’ indicator light.

   The flashing indicator light will show you defective code(s).
2. Identify 7 defective codes after reading the flashing indicator light.
   - TCCU
   - Shift motor
   - Magnetic synchronizer clutch
   - Speed sensor
   - Hub solenoid
   - Selector switch
   - Motor position sensor
3. Transfer case system is malfunctioning when:
   - 4H ,4L indicator lights are remain on after 0.6 second when turning the ignition switch ‘ON’
   - 4H,4L indicator lights are continuously come on during driving.
4. If only 1 part is malfunctioning, ‘4WD CHECK’ indicator light will display defective code 3 times continuously.
5. If more then 2 part is malfunctioning, the first malfunctioning part will be displayed 3 times and following malfunctioning parts will be displayed .
6. To read defective code, connect the service connector and turn the ignition switch 'ON'.
7. After repairing, eliminate the defective code stored in the TCCU.

   Notice

   Before replacing the malfunction parts with defective code, check the wires and connectors for proper condition.



Defective Code Reading

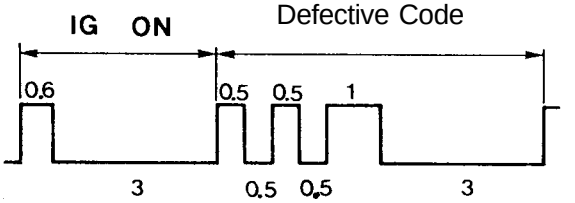
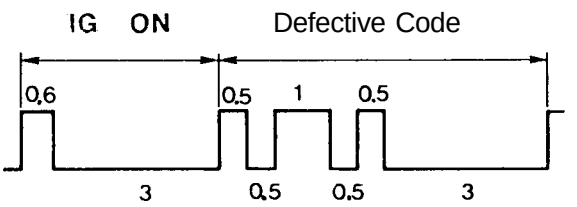
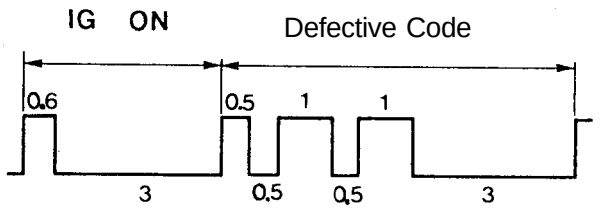
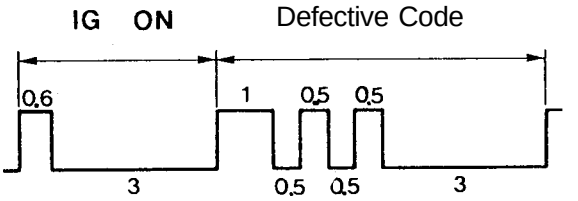
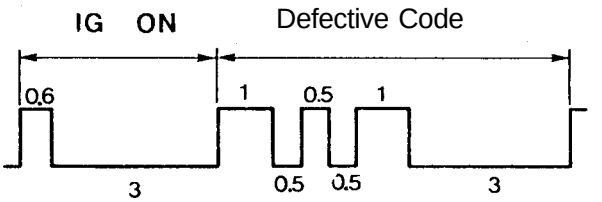
1. Position the ignition switch to ‘OFF’
2. Using a service connector, connect the No.2 pin (Ignition) and No.6 pin (TCCU) of the diagnosis socket in the engine room.
3. Position the ignition switch to 'ON'.
4. Read the flashing ‘4WD CHECK’ indicator light and identify the malfunctioning part.

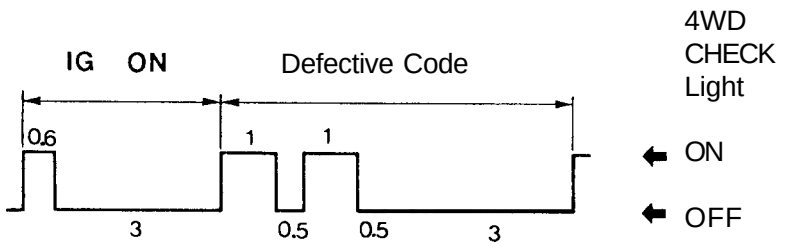
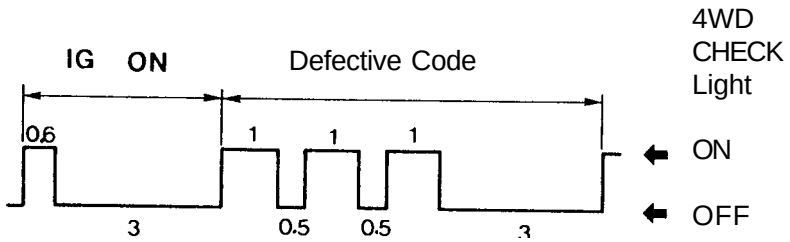
How to Eliminate the Falut Code

1. Position the ignition switch to ‘OFF’
2. Using a service connector, connect the No.2 pin (GND) and No.6 pin (TCCU) of the diagnosis socket in the engine room.
3. Position the ignition switch to ‘ON’ over 5 seconds.
4. Do defective code reading and make sure that all defective codes are eliminated.

Diagnostic Table

Connect a service connector. If turn the ignition switch 'ON' '4WD CHECK' indicator light will come on for 0.6 second and turn off for 3 seconds and then display a defective code 3 times continuously.

No.	Defective Code	Malfunctioning Part
1		TCCU
2		Shift Motor
3		Synchronizer Clutch
4		Speed Sensor
5		Hub Solenoid

No.	Defective Code	Malfunctioning Part
6		Selector Switch
7		Motor Positon Sensor

SELF-DIAGNOSIS TEST

Test Procedure

1. Connect the scanner harness connector to the engine compartment diagnosis socket.
2. Turn the ignition switch to "ON" position.
3. Select "Electronic control vehicle diagnosis" from the function selection display and press "Enter".
4. Select "Musso" from vehicle model selection display and press "Enter".
5. Select "TCCU" from control system selection display and press "Enter".
6. Select "TCCU Part Time" from TCCU diagnosis selection display.

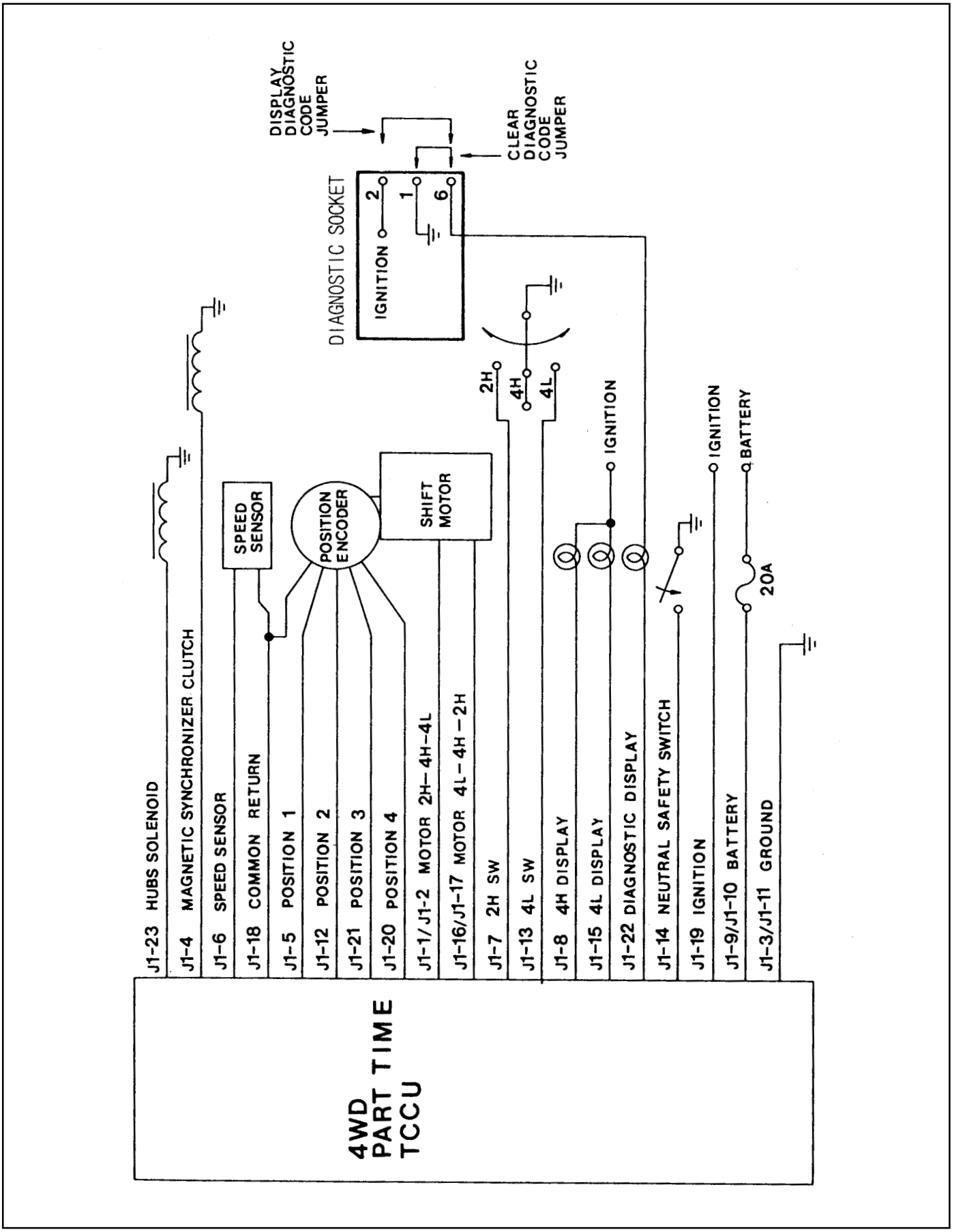
   Notice

   Check sensor valve output display if necessary.
7. Select "Self-diagnosis" from diagnosis items selection display.
8. Turn the ignition switch to "OFF" position and press "ENTER". Turn the ignition swtich to "ON" position again and press "ENTER".
9. Determine fault code and check the defective component.

   Notice

   Refer to self-diagnosis list.

DIAGNOSTIC DIAGRAM



MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

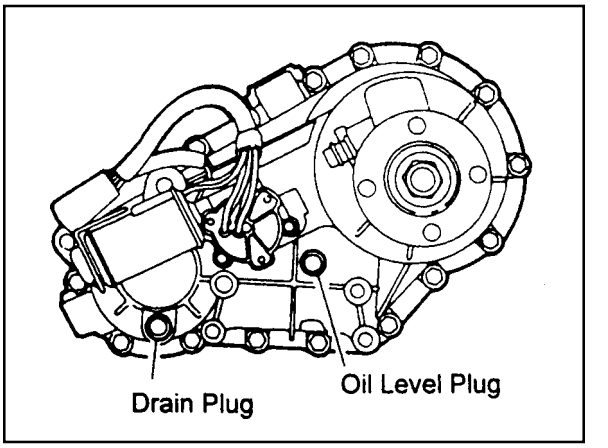
MAINTENANCE OF TRANSFER CASE LUBRICANT

Oil Level Check

- Clean the oil level plug and surrounding area.
- Remove the oil level plug and check whether oil is drip out or not.

Tightening Torque	20 - 30 Nm

- Tighten the oil level plug.



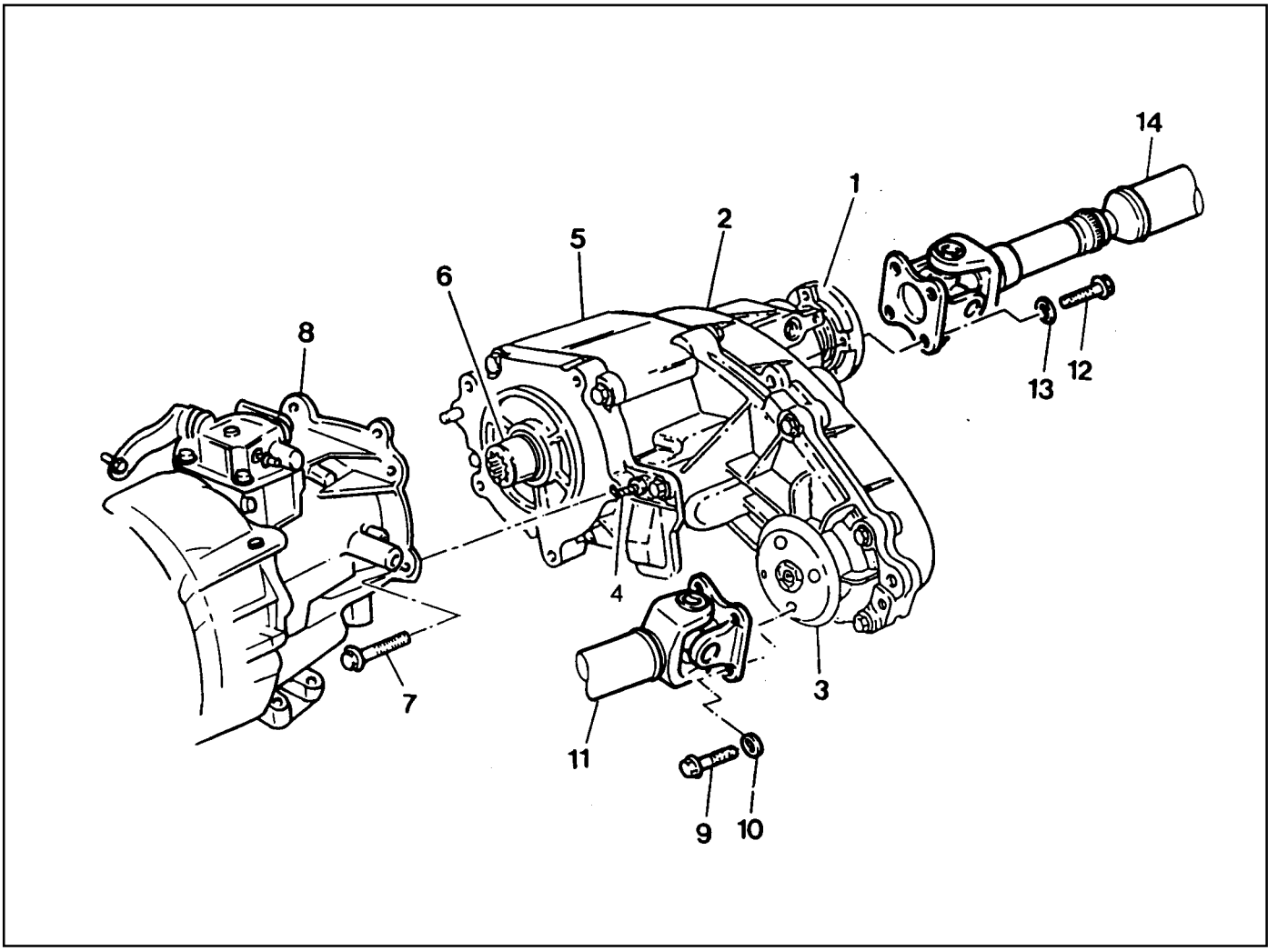
Oil Change

- Clean the oil level plug and surrounding area
- Place a suitable container under the transfer case.
- Remove the oil and tighten the drain plug.
- Fill the oil through the oil level plug until oil begins to drip out.
- Tighten the oil level plug.

Cautions for oil level check and plugs tightening

- Do not use an impact wrench to remove or tighten the oil level plug or drain plug since this will damage the threads in the transfer case.

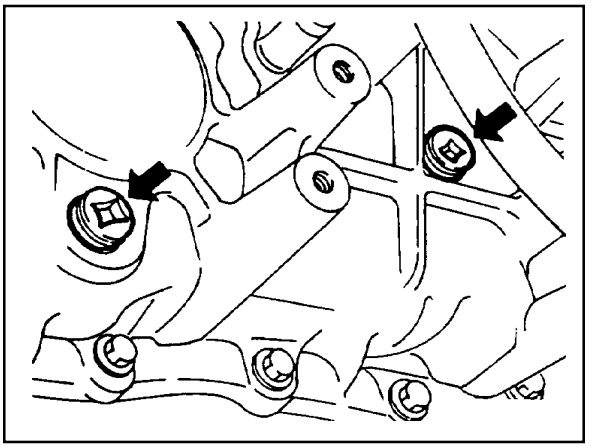
TRANSFER CASE



1 Rear Companion Flange
2 Cover
3 Front Companion Flange
4 Breather Plug
5 Case
6 Input Shaft
7 Mounting Bolt ..... 38-52 Nm
8 Transmission Adapter
9 Bolt ..... 81-59 Nm
10 Washer
11 Front Propeller Shaft
12 Bolt ..... 81-89 Nm
13 Washer
14 Rear Propeller Shaft

Removal & Installation Procedure

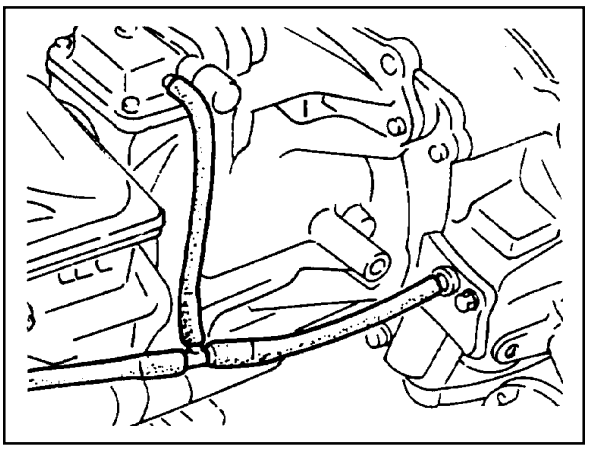
1. Disconnect the negative terminal from the battery.
2. Lift up the vehicle and fix it safely.
3. Remove the drain plug and drain the oil.
   Reinstall the drain plug.
   * If planar damper is installed, unscrew 4 bolts and remove the planar damper.



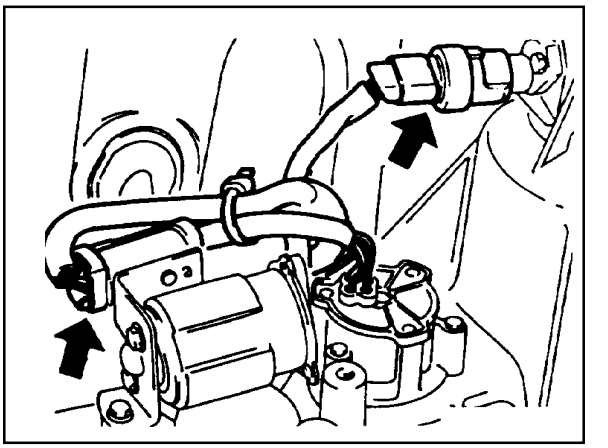
Installation Notice

Tightening Torque	19 - 30 Nm

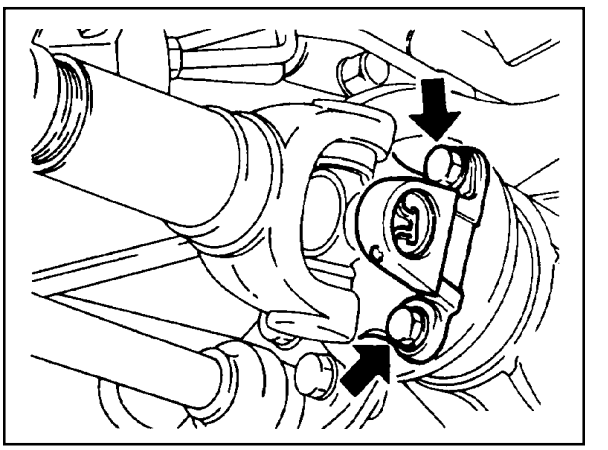
4. Remove the breather hose.



5. Disconnect the speedometer cable connector and other cable connectors and wiring harnesses.



6. Support the transfer case with jack and remove the front and rear propeller shafts from the transfer case.



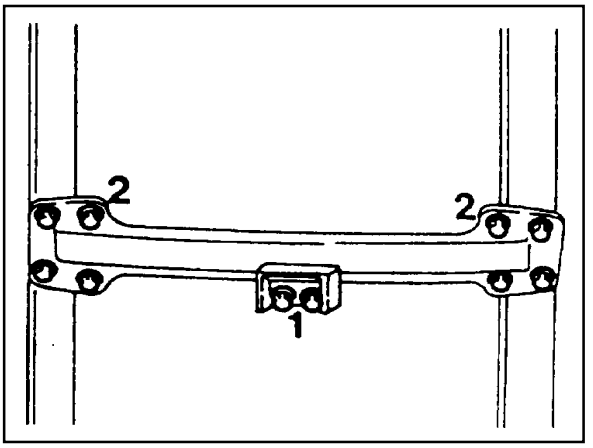
Installation Notice

Tightening Torque	Front	81 - 89 Nm
	Rear	70 - 80 Nm

7. Remove the center mounting nuts and end sides mounting bolts of the cross member and then remove the cross member.

Installation Notice

Tightening Torque(1)	21 - 35 Nm
Tightening Torque(2)	62 - 93 Nm



8. Remove the transfer case by removing the bolts attaching the transfer case to the transmission.

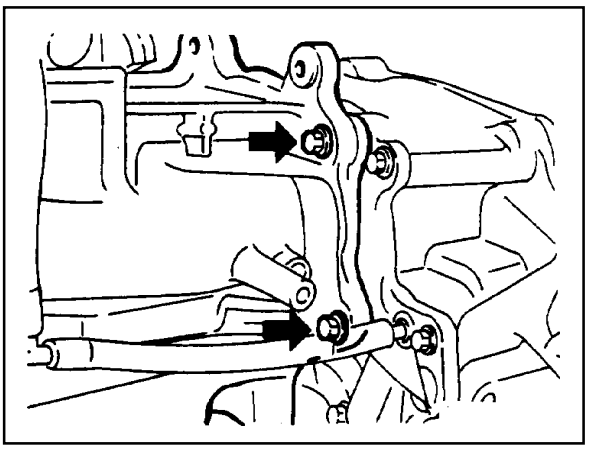
Installation Notice

Tightening Torque	38 - 51 Nm

Notice

Apply long-term grease to the inner spline of the transfer case input shaft.

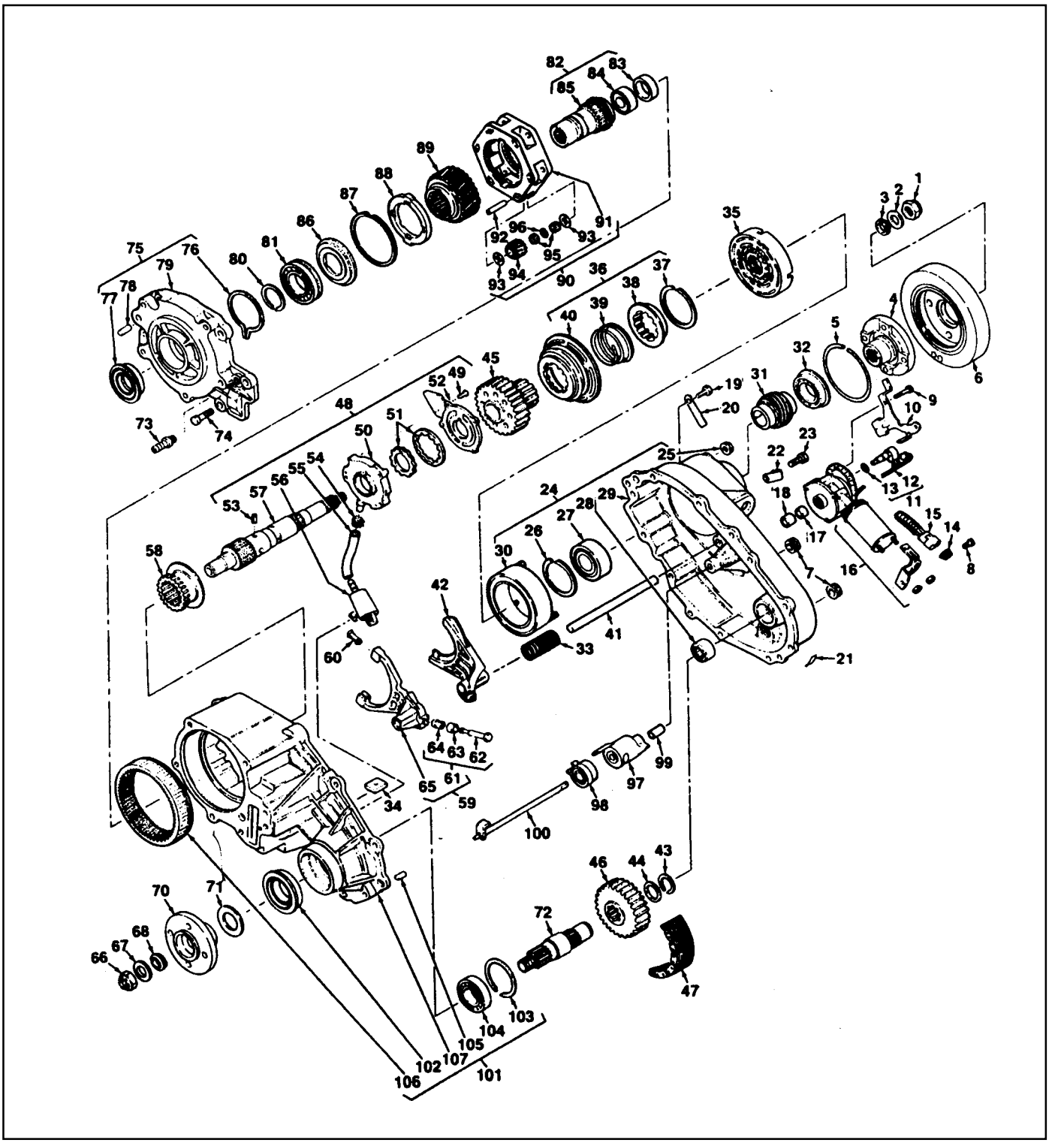
9. Installation should follow the removal procedure in the reverse order.



UNIT REPAIR

TRANSFER CASE

Preceding Work : Removal of the transfer case

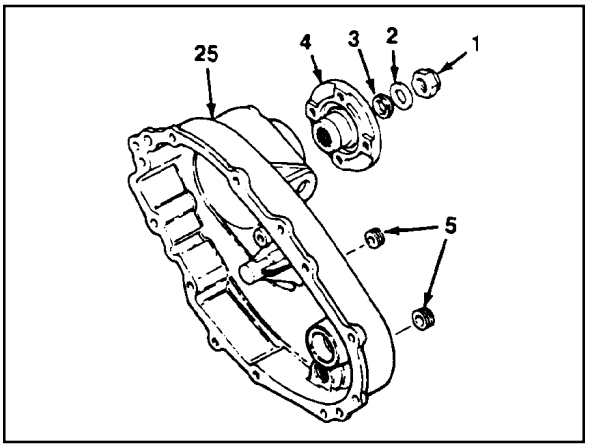


1 Nut
2 Spring Washer
3 Oil Seal
4 Companion Flange
5 Snap Ring
6 Torsional Damper
7 Pipe Plug
8 Bolt
9 Bolt
10 Speed Sensor and Harness Bracket
11 Speed Sensor Assembly
12 Speed Sensor
13 O-Ring
14 Locking Clip
15 Connector
16 Motor Assembly
17 Oil Seal
18 Bearing
19 Bolt
20 Tag
21 Decal
22 Wiring Harness Clip
23 Bolt
24 Cover Assembly
25 Nut
26 Snap Ring
27 Bearing
28 Needle Bearing
29 Cover
30 Clutch Coil Assembly
31 Speed Gear
32 Oil Seal
33 Return Spring
34 Magnet
35 Clutch Housing
36 Lock-up Assembly
37 Snap Ring
38 Lock-up Hub
39 Sleeve Return Spring
40 Lock-up Collar
41 Rail Shaft
42 Lock-up Fork
43 Snap ring
44 Spacer
45 Driven Sprocket
46 Driven Sprocket
47 Drive Chain
48 Shaft and Pump Assembly
49 Screw
50 Pump Housing
51 Pump Gear Set
52 Pump Cover
53 Spring Pin
54 Hose Clamp
55 Hose Coupling
56 Oil Strainer
57 Output Shaft
58 Reduction Hub
59 Shift Fork Assembly
60 Shift Fork Facing
61 Pin, Roller and Retainer
62 Pin
63 Cam Roller
64 Retainer
65 Reduction Shift Fork
66 Nut
67 Plane Washer
68 Oil Seal
70 Companion Flange
71 Spacer
72 Front Output Assembly
73 Breather Hose
74 Bolt
75 Front Adapter Assembly
76 Snap Ring
77 Oil Seal
78 Spiral Pin
79 Front Adapter
80 Snap Ring
81 Bearing
82 Input Shaft Assembly
83 Sleeve Assembly
84 Needle Bearing
85 Input Shaft
86 Thrust Washer
87 Retaining Ring
88 Thrust Plate
89 Sun Gear
90 Gear Carrier Assembly
91 Planet Carrier
92 Pinion Shaft
93 Thrust Washer
94 Pinion Gear
95 Needle Roller Bearing
96 Pinion Needle Spacer
97 Electric Shift Cam
98 Torsion Spring
99 Spacer
100 Shift Shaft
101 Case Assembly
102 Oil Seal
103 Snap Ring
104 Bearing
105 Dowel Pin
106 Ring Gear
107 Case

Disassembly Procedure

<Companion Flange>

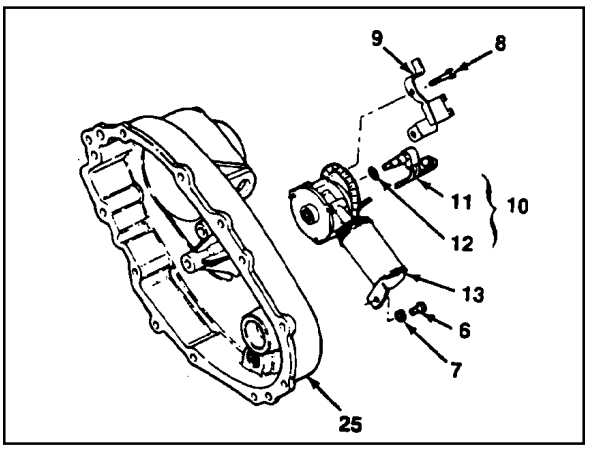
1. Holding the companion flange, remove the nut and washer and then remove the companion flange and oil seal.
2. Remove the 2 plugs from the cover.



1 Nut
2 Washer
3 Oil Seal
4 Companion Flange
5 Plug
25 Cover

<Extension Electric Shift>

1. Remove the bolt, washer,3 bolts and harness bracket.
2. Remove the sensor assembly and remove the O-ring from the speed sensor.
3. Remove the motor assembly.



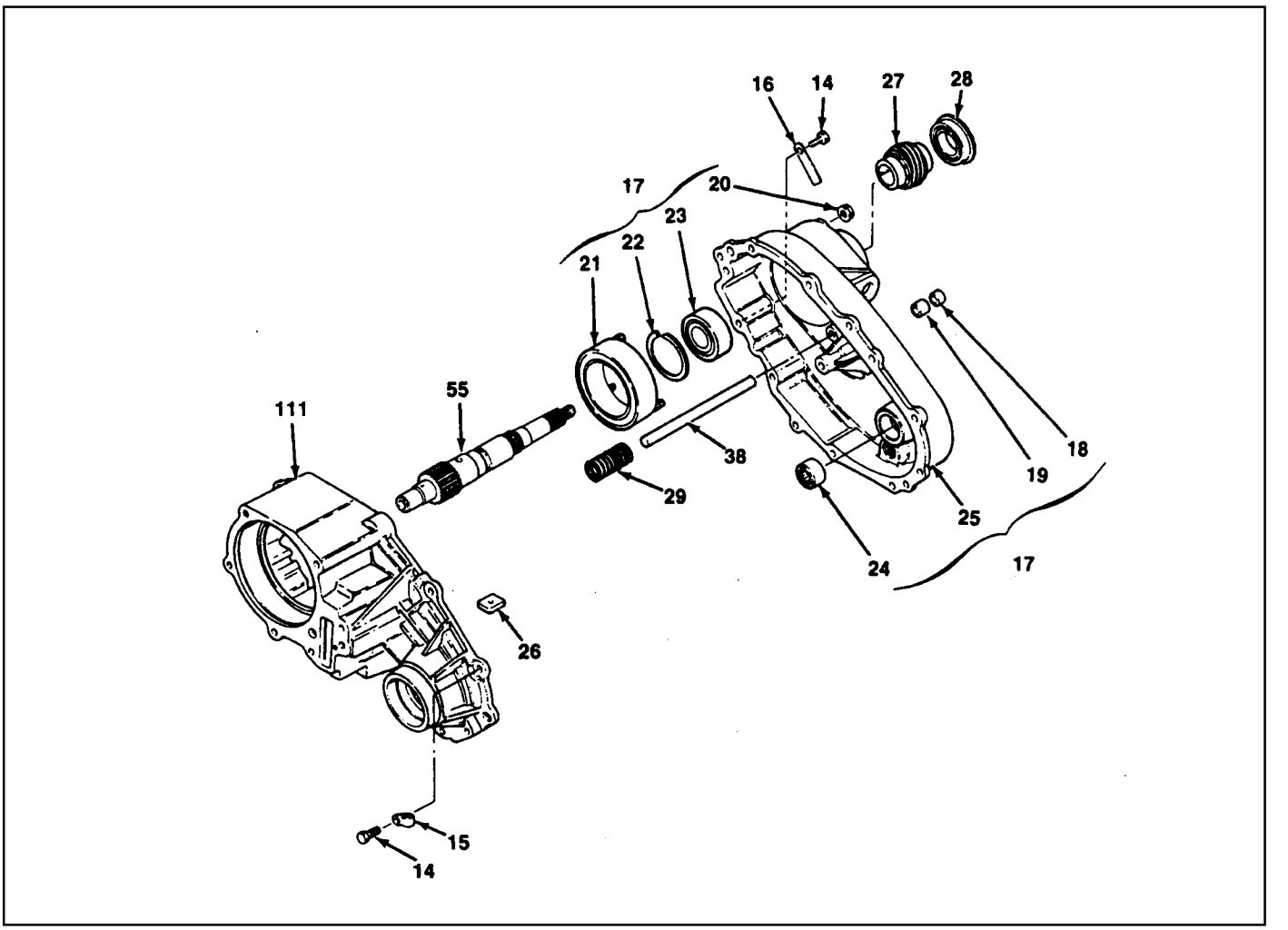
6 Bolt
7 Washer
8 Bolt
9 Sensor and Harness Bracket
10 Sensor Assembly
11 Speed Sensor
12 O-ring
13 Motor Assembly
25 Cover

<Cover Assembly>

1. Remove the 9 bolts, wiring harness clip and identification tag.

   Notice

   Identification tag has information required for ordering replacement parts, so be careful not to lose it.
2. Using a '-' driver, pry and disconnect the sealant bond of the cover and required case.
3. Remove the oil seal, bearing, 3 nuts and clutch coil assembly of the electric shift unit.
4. Remove the snap ring and pull out the ball bearing from the cover to remove the speed gear.
5. Pull out the needle bearing from the cover.
6. Pull out the oil seal from the slot in cover.
7. Remove the magnet form the slot in case.
8. Remove the return spring from the rail shaft.
9. Be careful not to damage the metal surface when removing the sealant of the cover and case.

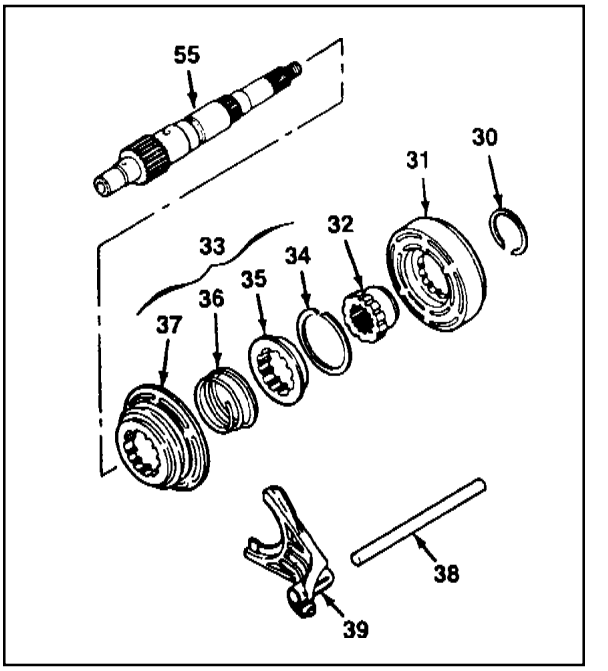


14 Bolt
15 Wiring Clip
16 Identification Tag
17 Cover Assembly
18 Oil Seal
19 Bearing
20 Nut
21 Clutch Coil Assembly
22 Snap Ring
23 Ball Bearing
24 Needle Bearing
25 Cover
26 Magnet
27 Speed Gear
28 Oil Seal
29 Return Spring
38 Rail Shaft
55 Output Shaft
111 Transfer Case

<Lock-up Shift Parts>

1. Remove the retaining ring and clutch housing from the shift collar hub.
2. Remove the shift collar hub from the output shaft.
3. Separate the 2WD - 4WD lock-up assembly and lock-up fork from the output shaft and remove the rail shaft.
4. To remove the 2WD - 4WD lock-up assembly, separate the return spring, lock-up hub and snap ring from the lock-up collar.

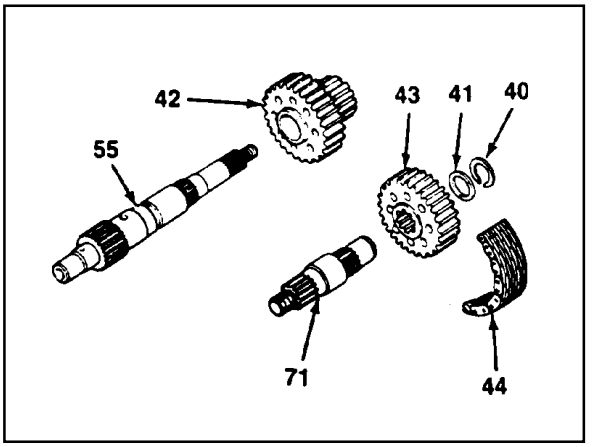
30 Retaining Ring
31 Clutch Housing
32 Shift Collar Housing
33 2WD/4WD Lock-up Assembly
34 Snap Ring
35 Lock-up Hub
36 Return Spring
37 Lock-up Collar
38 Rail Shaft
39 Lock-up Fork
55 Output Shaft



<Drive Chains>

1. Remove the snap ring and spacer from the output shaft.
2. Remove the drive chain, driven sprocket and drive sprocket from the output shaft.
3. Separate the chain and sprocket when removing the assembly.

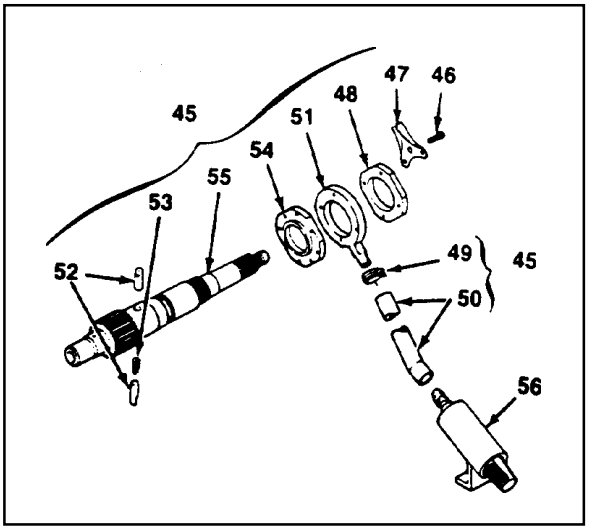
40 Snap Ring
41 Spacer
42 Drive Sprocket
43 Driven Sprocket
44 Drive Chain
55 Output Shaft(Rear)
71 Output Shaft(Front)



<Pump Parts>

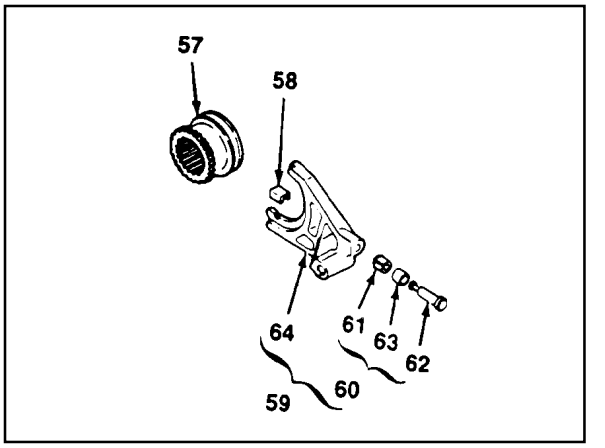
1. Remove the 4 bolts and retainer and separate the output shaft and rear pump cover.
2. Loosen the hose clamp and remove the hose coupling from the pump housing.
3. Remove the hose clamp, hose coupling and strainer.
4. Remove 2 pump pins and spring from the output shaft.
5. Separate the front pump and remove the output shaft.

45 Shaft and Pump Assembly
46 Bolt
47 Pump Retainer
48 Rear Pump Cover
49 Hose Clamp
50 Hose Coupling
51 Pump Housing
52 Pump Pin
53 Spring
54 Front Pump Cover
55 Output Shaft
56 Strainer



<Reduction Shift Parts>

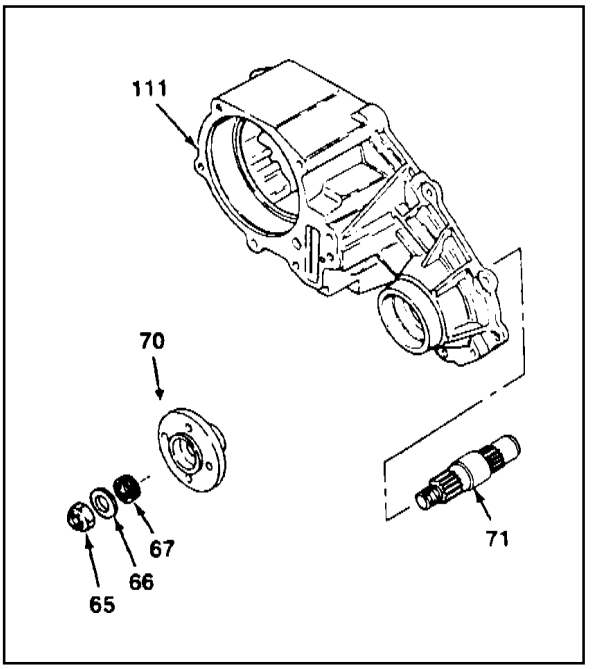
1. Remove the reduction hub and reduction shift fork assembly from the case.
2. Remove the 2 shill fork facings from the shift fork assembly.
3. To remove the roller cam and pin, cut elf the plastic retainer when disassembling the fork assembly.



57 Reduction Hub
58 Shift Fork Facing
59 Reduction Shift Fork Assembly
60 Roller Pin and Retainer Assembly
61 Retainer
62 Pin
63 Roller Cam
64 Reduction Shift Fork

<Front Output Assembly>

1. Holding the companion flange, remove the nut and washer and then remove the companion flange and oil seal.
2. Remove the output shaft.



65 Nut
66 Washer
67 Oil Seal
70 Companion Flange
71 Output Shaft (front)
111 Case

<Adapter, Input Shaft and Carrier Gear>

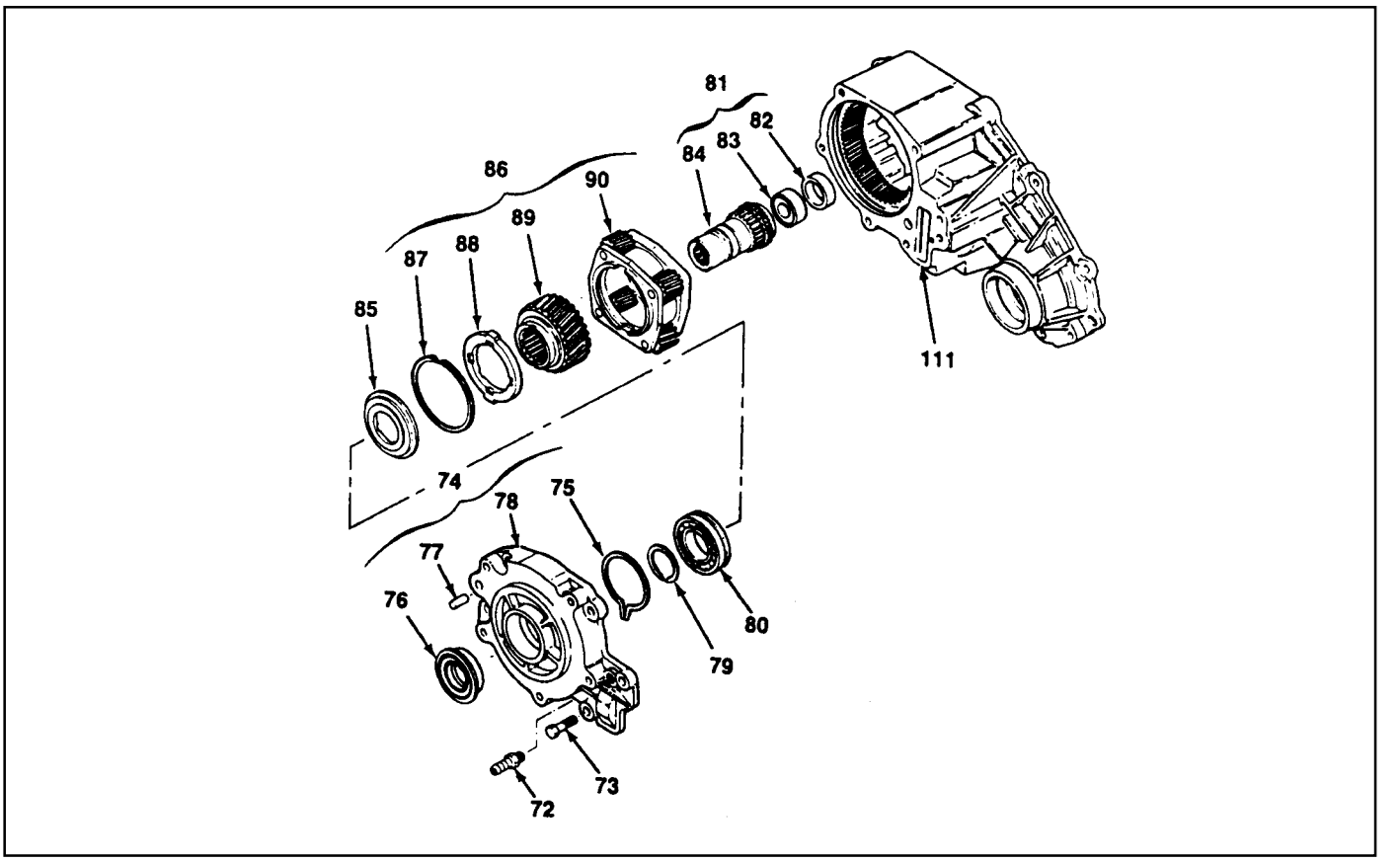
1. Remove the breather.
2. After removing 6 bolts, remove the front adopter by separating the adapter sealer bond from the case using a screw driver.

   Notice

   Be careful not to damage the contacting surface of the case and adapter.
3. Remove the adapter assembly, input shaft assembly and carrier gear assembly.
4. Remove the snap ring and oil seal from the front adapter.
5. After removing snap ring, pull out the bearing and thrust washer from the input shaft assembly and separate the input shaft assembly from the carrier gear assembly.
6. Remove the needle bearing and sleeve bearing from the input shaft assembly.
7. Remove the retaining ring, thrust plate rind sun gear from the planet carrier assembly.

   Notice

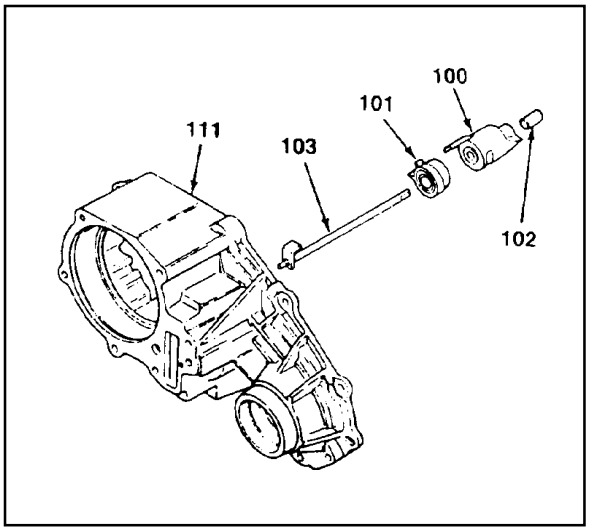
   Do not disassemble the planet carrier assembly.



72 Breather
73 Bolt
74 Adapter Assembly
75 Snap Ring
76 Oil Seal
77 Spiral Pin
78 Front Adapter
79 Retaining Ring
80 Bearing
81 Input Shaft Assembly
82 Sleeve Bearing
83 Needle Bearing
84 Input Shaft
85 Thrust Bearing
86 Carrier Gear Assembly
87 Retaining Ring
88 Thrust Plate
89 Sun Gear
90 Planet Carrier Assembly
111 Case

<Electric Shifts Cam Parts>

1. Remove the electric shift cam parts from the case assembly.
2. Separate the electric shift cam from the shift shaft.
3. Holding the shift shaft in a vise, remove the torsion spring and spacer from the shift shaft using a screw driver.



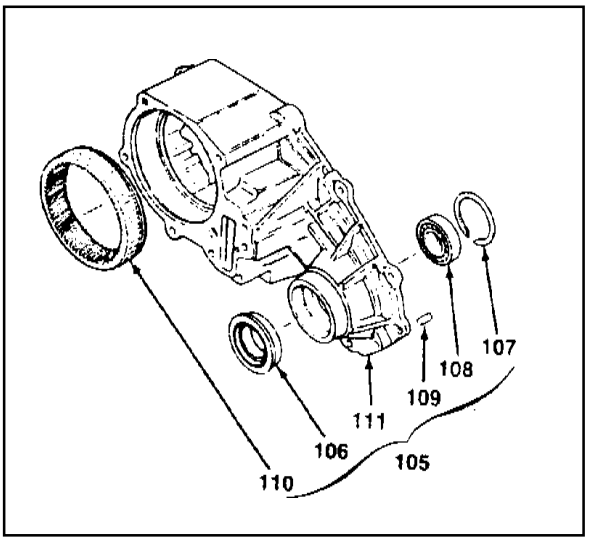
100	Electric Shift Cam
101	Torsion Spring
102	Spacer
103	Shift Shaft
111	Case

<Case Assembly>

1. Remove the oil seal.
2. Remove the retaining ring and bearing.
3. Remove the pin from the transfer case.

   Notice

   Be careful not to damage the pin.
4. Using a press, remove the ring gear from the case.



105	Transfer Case Assembly
106	Oil Seal
107	Retaining Ring
108	Ball Bearing
119	Pin
110	Ring Gear
111	Case

Cleaning Procedure

Notice

Before cleaning, check the magnet for the presence of metal particles which indicate internal chipping of the transfer case.

1. Using cleaning solvent, clean the residual oil and dirt deposits.

   Notice

   During cleaning, be careful not to damage the metal surfaces.
2. After cleaning, dry the parts with low pressure (Max. 20 psi) compressed air.
3. Lubricate the ball bearings and needle bearings with transfer case oil after cleaning.

   Notice

   Protect the lubricated bearings from dust.

Inspection Procedure

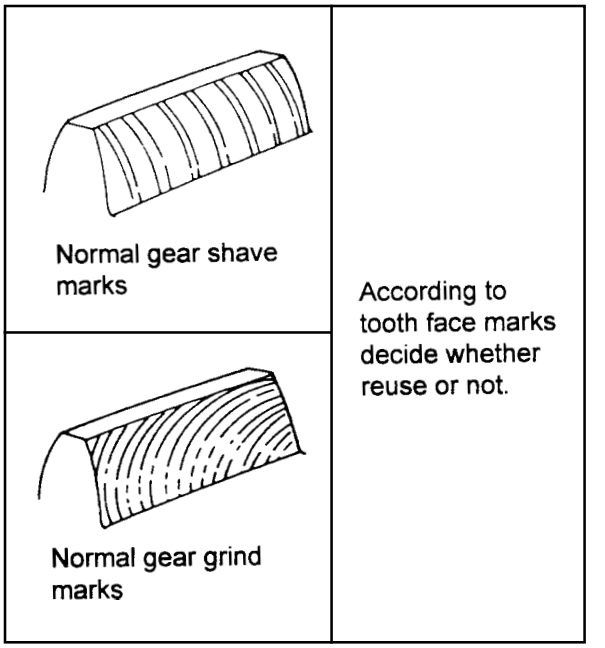
1. Visually check the all removed parts.

   Notice

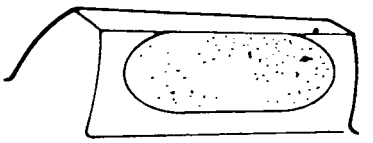
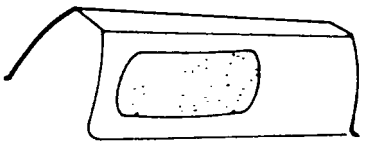
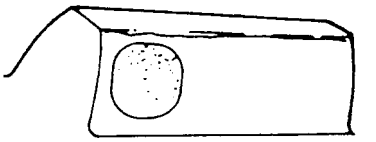
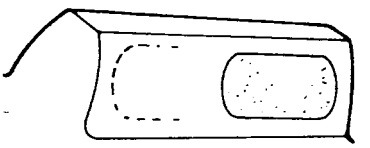
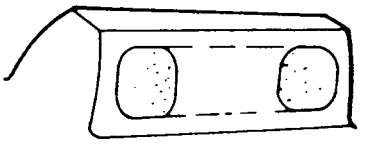
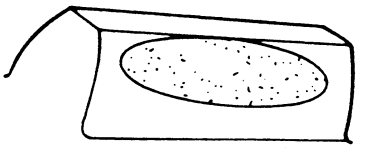
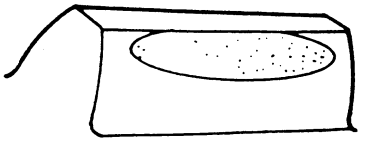
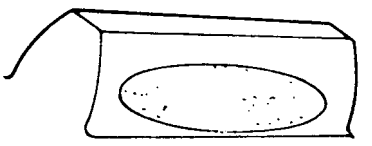
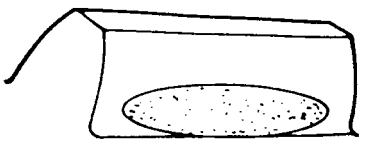
   Always replace the hose coupling, O-ring and oil seal with new parts.
2. Inspection Terms
   - Burr : Local rise of material forming protruding sharp edge
   - Chip : An area from which a small fragment has been broken off or cut
   - Crack : Surface break of line nature indicating partial or complete separation of material.
   - Excessive wear : Heavy or obvious wear beyond expectations considering conditions of operation.
   - Indentation : Displacement of material caused by localized heavy contact.
   - Galling : Breakdown of metal surface due to excessive friction between parts. Particles of the softer material are torn loose and welded to the harder material.
   - Nick : Local break or notch, usually displacement of material rather than loss.
   - Scoring : Tear or break in metal surface from contact under abnormal pressure.
   - Step wear : Heavy wear that produces a step that can be seen or felt between adjacent contact and noncontact surfaces.
   - Uneven wear : Condition of localized, unevenly distributed wear Includes hollows, shiny spots, uneven polish and other visual indications.

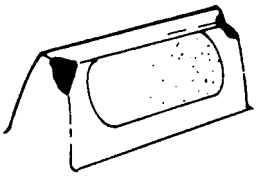
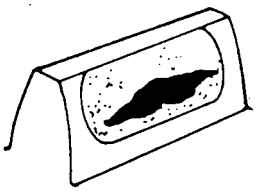
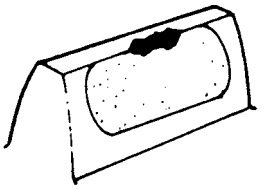
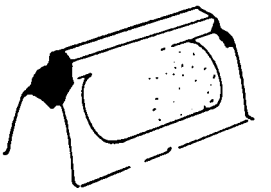
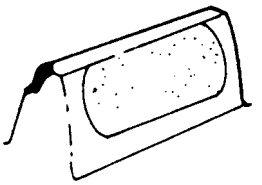
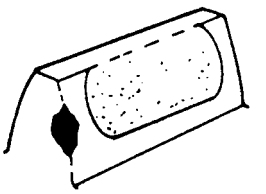
3. Specific Inspection
   - Referring to normal gear tooth face, specifically inspect the uneven wear and chips of gear tooth.

     Replace or repair if necessary.



4. Inspection of Contact Patterns

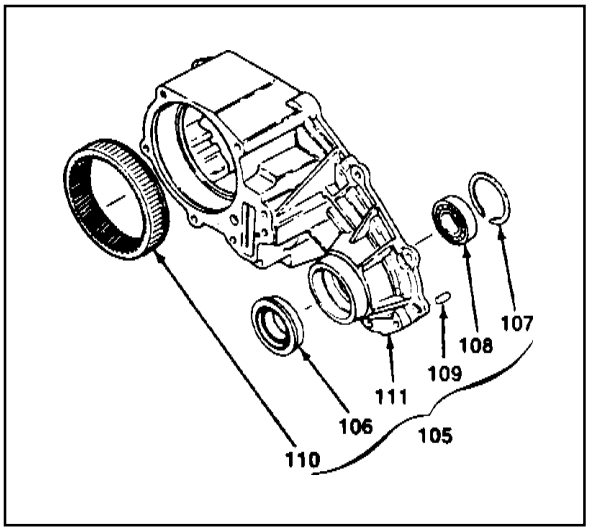
Description	Normal	Abnormal
Normal Wear		
End Face Wear		
Traveling Face Wear		
Upper Face Wear		
Lower Face Wear		

Description	Repair	Description	Repair
Corner chip at drive face		Chip within contact pattern	
Edge chip at drive face		Chip completely through tooth	
Corner chip at coast face		Side edge chip at drive face	

Assembly Procedure

General Information

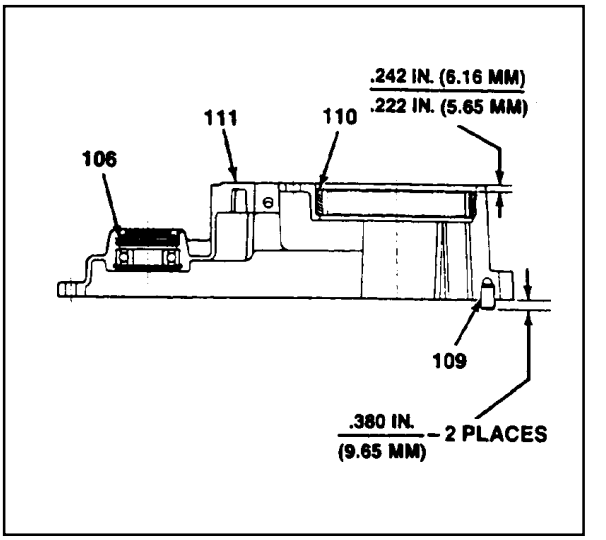
1. Use special tools during assembly of oil seals and bearings.
2. Lubricate bearings, oil seals and bushings before assembly.



105	Case Assembly
106	Oil Seal
107	Retaining Ring
108	Ball Bearing
109	Pin
110	Ring Gear
111	Case

Transfer Case

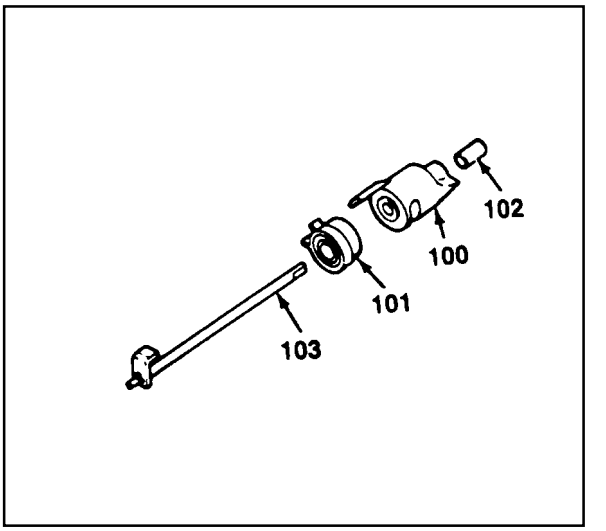
1. If the ring gear was removed, align the outer diameter of the new replaced ring gear with transfer case and assemble it.
2. Insert the pin.
3. Insert the ball bearing to the case and install the retaining ring.
4. Install the new oil seal by pressing into the case.
5. Make sure that all parts are correctly and firmly installed into the case.



106	Oil Seal
109	Pin
110	Ring Gear
111	Case

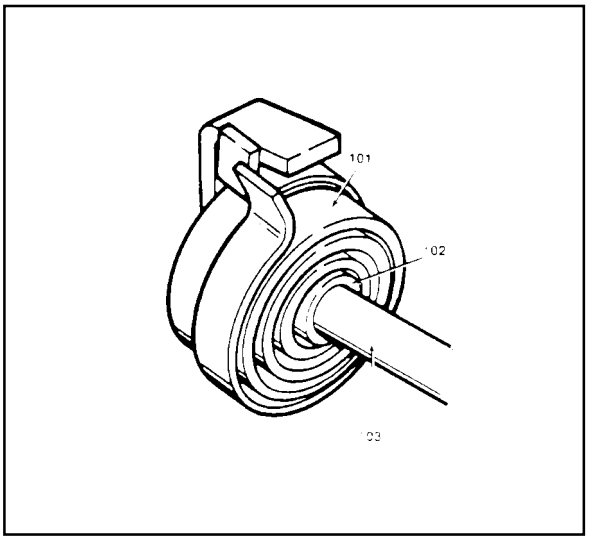
Electric Shift Cam Parts

1. Insert the spacer into torsion spring.
2. Insert the end of the shift shaft into the spacer smoothly.



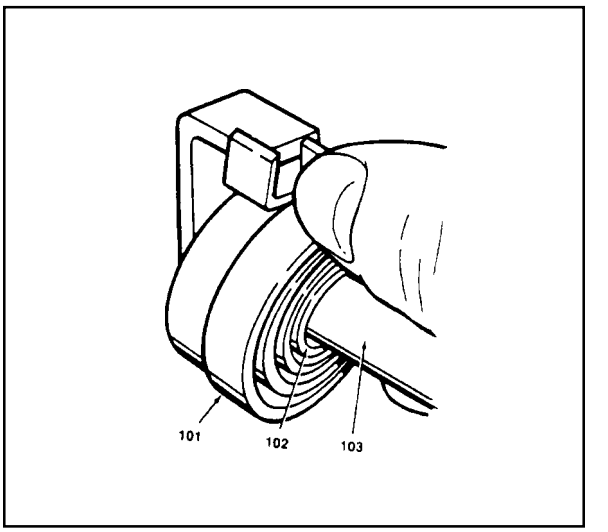
100	Electric Shift Cam
101	Torsion Spring
102	Spacer
103	Shift Shaft

3. Slide the torsion spring and spacer to the left of the shift shaft and position the end of the first spring to fix on the drive tang.



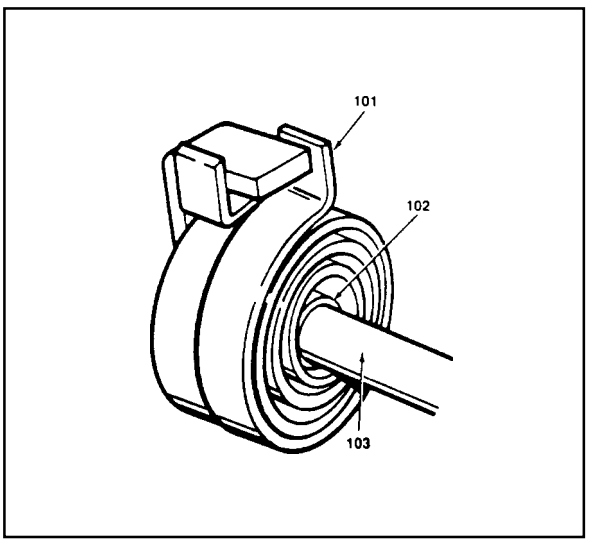
101 Torsion Spring
102 Spacer
103 Shift Shaft

4. Push the end of the second spring to right and fix it on the drive tang.



101 Torsion Spring
102 Spacer
103 Shift Shaft

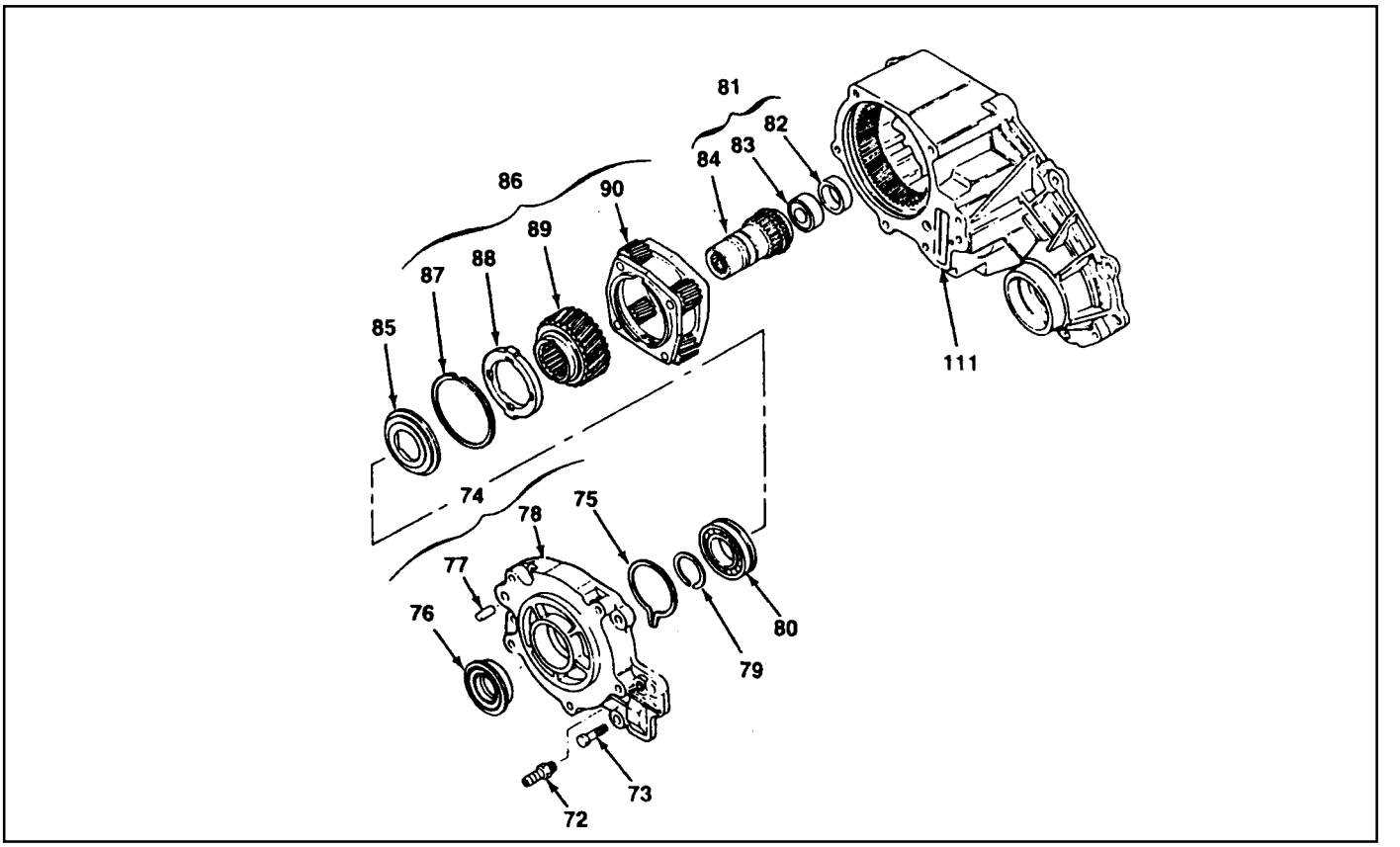
5. Push the torsion spring and spacer together back them completely.
6. Slide the electric shift cam onto the shift shaft.
7. Install the electric shift cam assembly into the transfer case after installation of the shift fork.



101 Torsion spring
102 Spacer
103 Shift Shaft

Adapter, Input Shaft and Carrier

1. Place the planet carrier assembly on work bench to be the retaining ring mounting groove upward.
2. Install the sun gear with the hub end up into the planet carrier assembly and rotate the sun gear to make sure that gears are fully engaged.
3. Align the tabs and install the thrust plate into the planet carrier assembly.
4. Install the retaining ring to the planet carrier assembly.
5. Press the needle bearing into the input shaft and press the new sleeve bearing into the input shaft assembly.



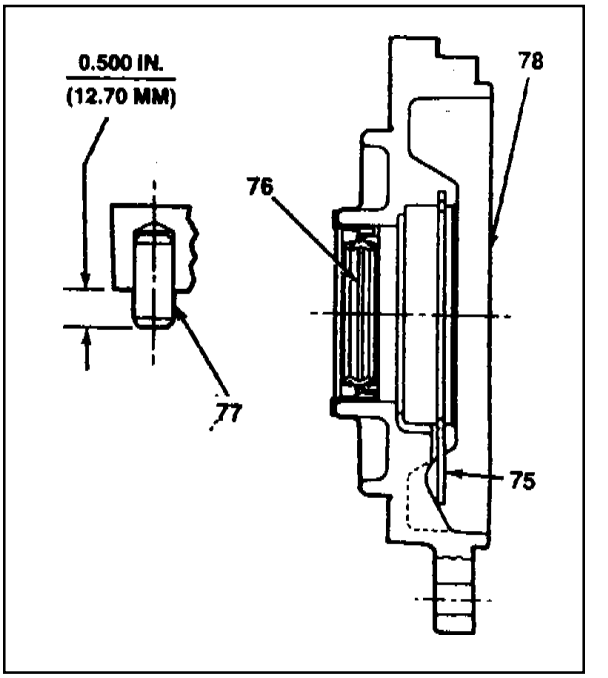
72 Breather
73 Bolt
74 Adapter Assembly
75 Snap Ring
76 Oil Seal
77 Spiral Pin
78 Front Adapter
79 Retaining Ring
80 Bearing
81 Input Shaft Assembly
82 Sleeve Bearing
83 Needle Bearing
84 Input Shaft
85 Thrust Washer
86 Carrier Gear Assembly
87 Retaining Ring
88 Thrust Plate
89 Sun Gear
90 Planet Carrier Assembly
111 Case

6. Install the planet carrier assembly onto the input shaft and install the thrust washer. Press the bearing over input shaft.
7. After pressing the bearing, install the retaining ring.
8. Press the pin into the front adapter.
9. Slowly press the oil seal into the front adapter.
10. Install the front adapter assembly.

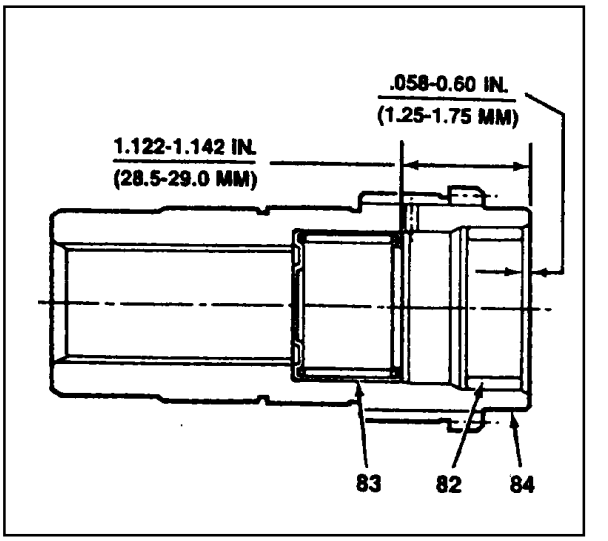
    Notice

    After installation, make sure that snap ring is correctly installed into the groove.
11. Position the input shaft assembly over front cover and engage into the bearing groove by expanding the ends of snap ring.
12. Apply 1.6mm bead of sealant on the mounting face for the transfer case and tighten the 6 bolts.
13. Install the breather.

Item	Tightening Torque
6 Bolts	28 - 48 Nm
Breather	8 - 20 Nm



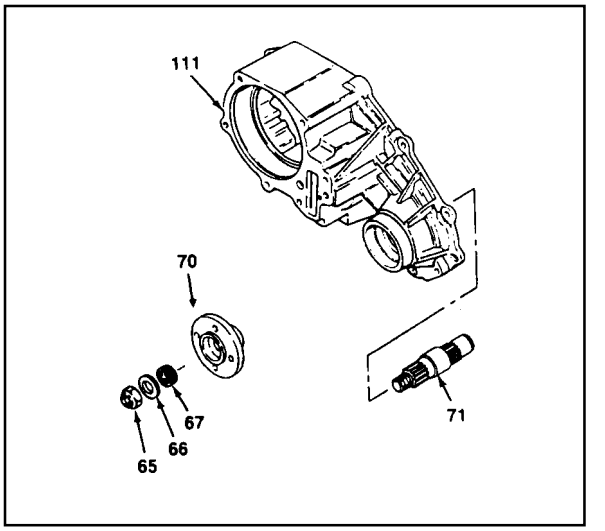
75 Snap Ring
76 Oil Seal
77 Spiral Pin
78 Front Adapter



82 Sleeve Bearing
83 Needle Bearing
84 Input Shaft

Front Output Shaft

1. Position the output shaft in transfer case and install the companion flange assembly, oil seal, washer and nut.
2. Holding the companion flange, tighten the nut.



65 Nut
66 Washer
67 Oil Seal
70 Companion Flange
71 Output Shaft (Front)
111 Case

Reduction Shift Parts

1. Install the new pin, roller and retainer into the reduction shift fork.
2. Press the pin, roller and retainer into the reduction spilt fork bore completely.

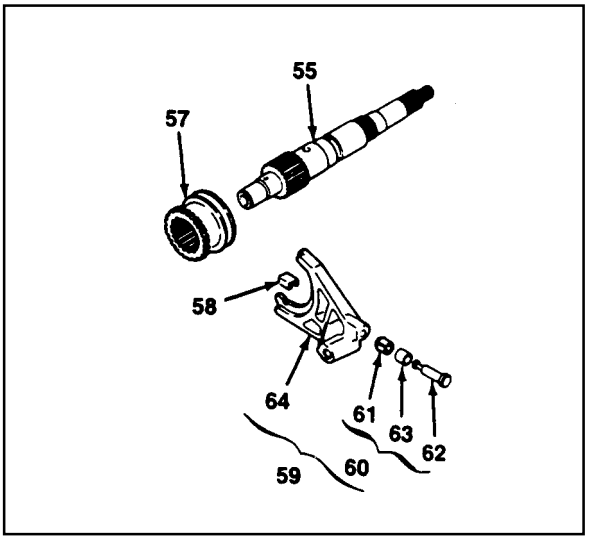
   Notice

   Make sure that the cam roller turns freely.
3. Install the 2 fork facing on the reduction shift fork assembly.
4. Install the reduction shift fork onto the previously installed reduction hub in the transfer case.
5. Install the output shaft spline into the reduction hub and engage the output shaft end with input shaft bearing.

   Notice

   For installation of the output shaft, assemble

   the oil pump temporarily.



55 Output Shaft
57 Reduction Hub
58 Shift Fork Facing
59 Reduction Shift Fork Assembly
60 Roller, Pin and Retainer Assembly
61 Retainer
62 Pin
63 Roller Cam
64 Reduction Shift Fork

Oil Pump

1. Install the pump front cover to be the ‘TOP’ mark down and turn the cover to be the ‘TOP’ mark up when installed in vehicle.

2. Install the 2 pump pins and spring to the output shaft.

   Notice

   Flat surface of the pins must point out and align the center line of pins and spring.

3. Connect the hose coupling to the strainer coupling and install the strainer foot into the transfer case slot.

   Notice

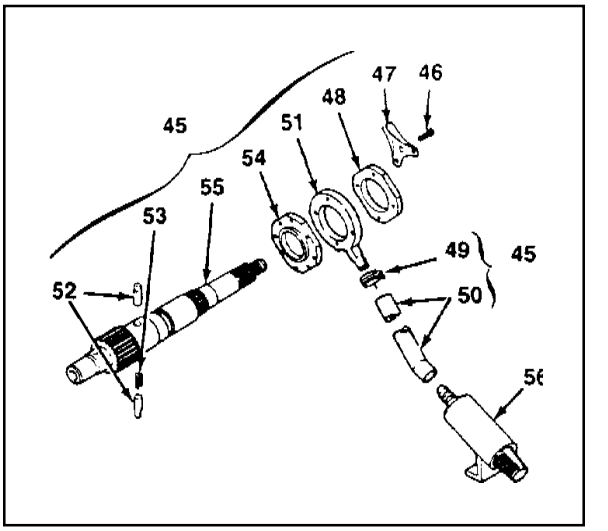
   The hose coupling must face the pump assembly.

4. Install the pump housing to be the 'REAR' mark up and seat the 2 pump pins inside of the pump housing by moving pump pins inward and compressing the spring.

5. Tighten the hose to pump housing by hose clamp.

6. Position the pump rear cover to be the ‘TOP REAR’ mark up and located at the top of transfer case when installed in vehicle. Position the pump retainer on the cover so that tab on the retainer is in notch in the transfer case. Apply Loctite to the bolts and tighten the bolts with turning the output shaft by hand to make the pump pins move freely.

Tightening Torque	4 - 8.5 Nm



45 Shaft and Pump Assembly
46 Bolt
47 Pump Retainer
48 Rear Pump Cover
49 Hose Clamp
50 Hose Coupling
54 Pump Housing
52 Pump Pin
53 Spring
54 Front Pump Cover
55 Output Shaft
56 Strainer

Drive Chain

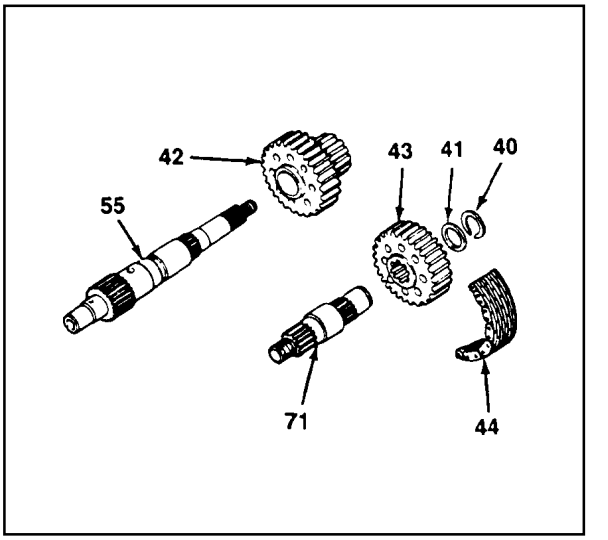
1. Position the drive sprocket to the rear output shaft end and driven sprocket to the front output shaft end.

2. Install the drive chain onto the sprocket.

3. Holding each sprocket to be the drive chain tight and parallel with transfer case, install the drive chain assembly to the output shafts.

4. Rotate the driven sprocket slightly to engage splines on the front output shaft.

5. Install the spacer to the front output shaft and insert the snap ring into the shaft groove over spacer.

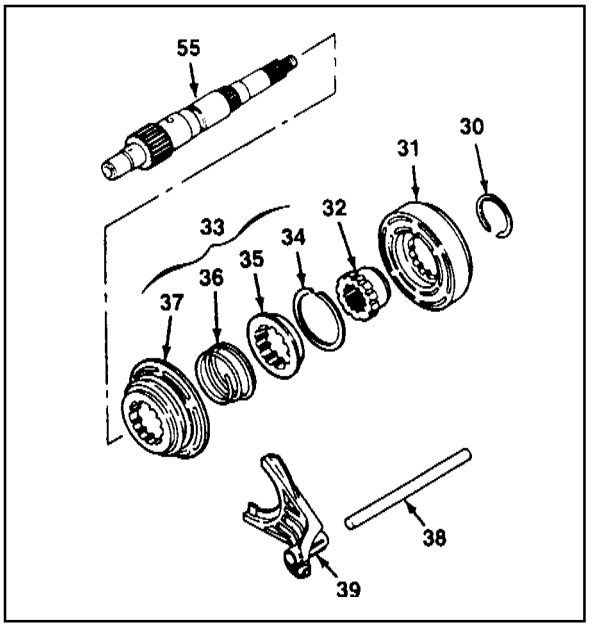


40 Snap Ring
41 Spacer
42 Drive Sprocket
43 Driven Sprocket
44 Drive Chain
55 Output Shaft (Rear)
71 Output Shaft (Front)

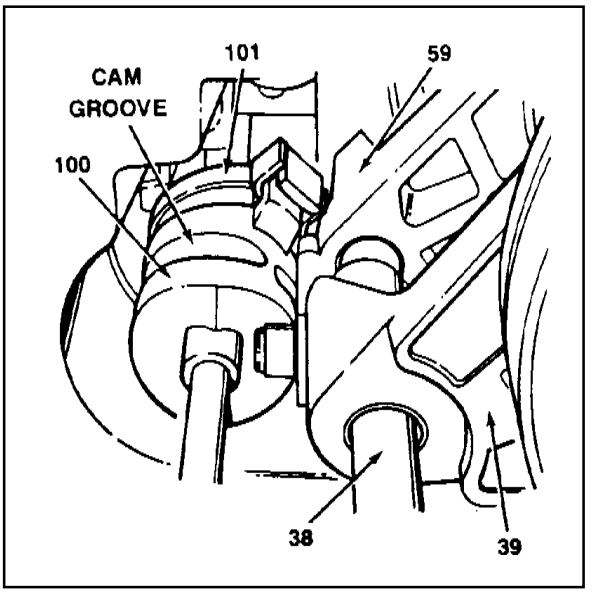
Lockup Shift

1. Install the lockup hub and return spring to the lockup collar and insert the snap ring.
2. Install the rail shaft through reduction shift fork assembly previously installed and into the blind hole in case.
3. Engage the lockup fork into the 2WD/4WD groove and check operation.
4. Install the shift collar hub to the output shaft spline.
5. Install the previously assembled electric shift cam and assemble the clutch housing as follows.
   - Rotate the shift cam assembly to right so that the end of the torsion spring contacts with reduction shift fork side.
   - Holding the rail shaft, lift up the fork assembly slightly.

     Adjust electric shift cam assembly so that the roller on reduction shift fork assembly is in groove in shift cam and button on lockup fork is on cam end.
   - Install the clutch housing over shift collar hub and insert the retaining ring into the clutch collar hub groove.



30	Retaining Ring	35	Lockup Hub
31	Clutch Housing	36	Return Spring
32	Shift Collar Housing	37	Lockup Collar
33	2WD/4WD Lockup Assembly	38	Rail Shaft
		39	Lockup Fork
34	Snap Ring	55	Output Shaft



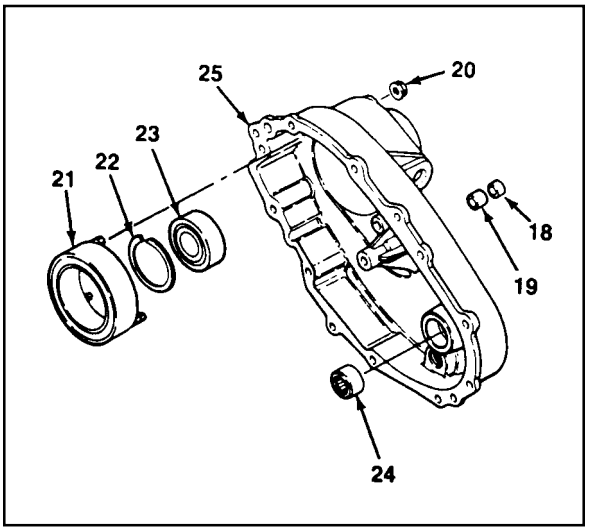
38	Rail Shaft
39	Lockup Fork
59	Reduction Shift Fork Assembly
100	Electric Shift Cam
101	Torsion Spring

Cover

1. Position the cover to be the open end up on the work table.
2. Position the end of needle bearing to be identification mark up and press into the cover until upper end of bearing is 40.47 - 40.97mm below cover face that contacts with transfer case.
3. Press the ball bearing into the cover and install the snap ring .
4. Install remaining parts as follows.
   - Install the 4 O-rings on the stud bolts of the clutch coil assembly.
   - Install the clutch coil assembly inside the cover and tighten 3 nuts.

Tightening Torque	8 - 11 Nm

   - Install the bearing and motor bearing into the cover.



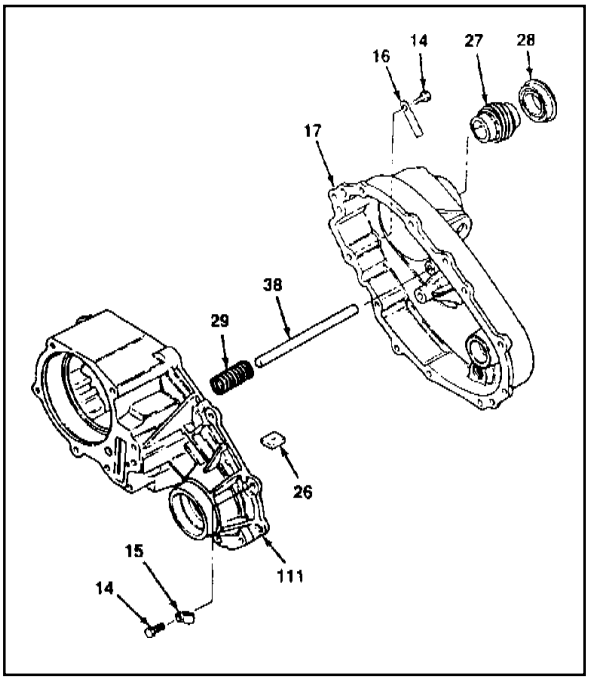
18 Oil Seal
19 Bushing
20 Nut
21 Clutch Coil Assembly
22 Snap Ring
23 Ball Bearing
24 Needle Bearing
25 Cover

Cover Assembly

1. Install the return spring over rail shaft in the transfer case.
2. Insert the magnet into the transfer case slot.
3. Apply 1.6mm bead of Loctite RTV 598 to the transfer case mounting surface.

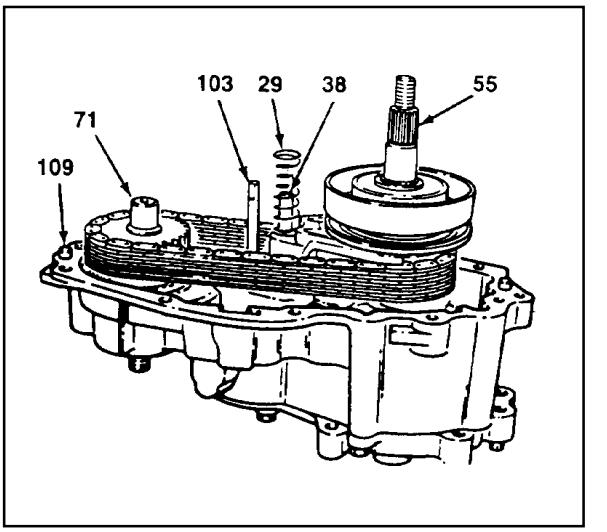
   Notice

   For installation of cover, align the transfer case with cover not to use excessive force.



14	Bolt
15	Wiring Clip
16	Identification Tag
17	Cover Assembly
26	Magnet
27	Speed Gear
28	Oil Seal
29	Return Spring
38	Rail Shaft
111	Case

4. Install the cover onto the transfer case as follows :
   - Align the cover bores with transfer case pins.
   - Align the cover bearings with output shafts.
   - Align the cover blind hole with rail shaft and make sure that return spring is not cocked.

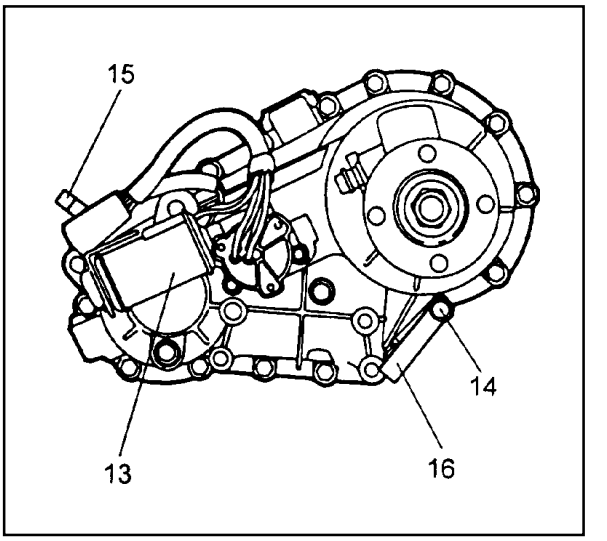


29	Return Spring
38	Rail Shaft
55	Output Shaft
71	Front Output Shaft
103	Shift Shaft
109	Dowel Pin

5. Tighten 9 bolts positioning identification tag and wiring clip.

Tightening Torque	28 - 48 Nm

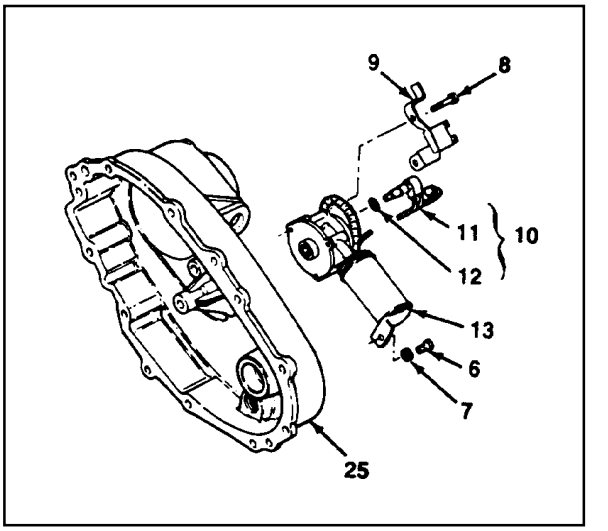
6. Install the speed gear over output shaft spline in the cover assembly.
7. Press the new oil seal into the cover assembly.



13	Motor Assembly
14	Bolt
15	Wiring Clip
16	Identification Tag

External Electric Shift

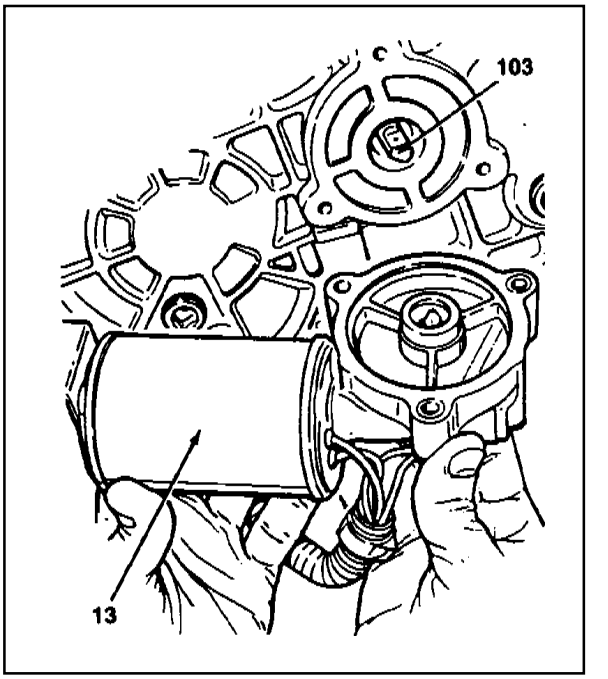
1. Align the motor with shift shaft and position the motor assembly onto the cover.
2. Install the motor to the shift shaft and contact cover androtate the motor clockwise direction to check correctengagement.



6	Bolt
7	Washer
8	Bolt
9	Sensor and Harness Bracket
10	Sensor Assembly
14	Speed Sensor
12	O-ring
13	Motor Assembly
25	Cover

3. Insert the 0-ring on the speed sensor speed sensor assembly to the cover.
4. Install the bracket to the motor assembly and tighten 3bolts.

Tightening Torque	8 -11 Nm



13	Motor Assembly
103	Shift Shaft

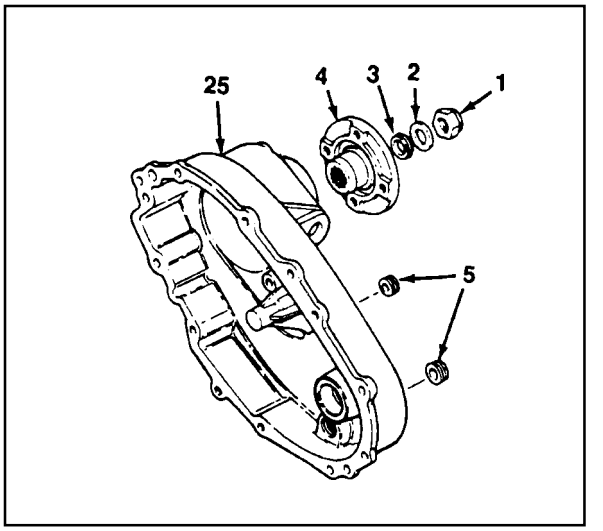
Companion Flange

1. Install the 2 plugs to the cover.
2. Install the companion flange, oil seal and washer.
3. Holding the companion flange, tighten the nut.

Tightening Torque	346 - 380 Nm

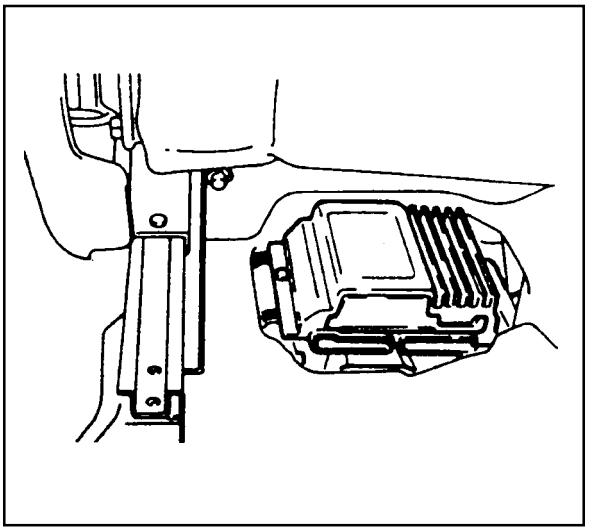
Notice

Apply Loctite 262 to nut before installation.



1 Nut
2 Washer
3 Oil Seal
4 Companion Flange
5 Plug
25 Cover

TRANSFER CASE CONTROL UNIT (TCCU)



System Description

TCCU is located under the front left handed seat and permits the vehicle to shift from two-wheel drive to four-wheel drive (and back shift) according to driver's switch operation during driving (For the shifting between 4WD HIGH and 4WD LOW, stop the vehicle).

1. Shifting from 2H to 4H
   - Position the transfer case switch from '2H' to '4H'.
   - Shifting is possible during driving.
   - '4WD Hl' indicator light will turn on.

2. Shifting from 4H to 2H
   - Position the transfer case switch from '4H' to '2H'.
   - Shifting is possible during driving.
   - '4WD Hl' indicator light will turn off.

3. Shifting between 4H and 4L
   - Shifting is possible when the vehicle is almost stopped (below approx. 2 km/h), so it would be better stop the vehicle.
   - In case of manual transmission equipped vehicle, apply clutch pedal.
   - In case of auto transmission equipped vehicle, put the lever position into 'N'.
   - Position the transfer case switch '4H' to '4L' or '4L' to '4H'.
   - According to the shifted position, indicator light will turn on.

   Notice

   If there are malfunctions during shifting,'4H' or '4L' indicator light will blink.

Inspection and Repair

1. 4H and 4L indicator light inspection
   - When turn the ignition switch to "ON" position, 4H and 4L indicator light will turn on for 0.6 second and will turn off immediately.

   Notice

   If indicator light does not turn on, check bulb, wiring harness and TCCU.
2. TCCU inspection

Pin No.	Operation Condition	Voltage(V)
J1 - 7	4H or 4L	4.75 - 5.35
	2H	0 - 0.50
J1 - 8	4H indicator light ON	< 1.00
	4H indicator light OFF	> 11.00
J1 - 13	2H or 4H	4.75 - 5.35
	4L	0 - 0.50
J1 - 14	Clutch pedal applied	< 0.50
	Clutch pedal released	> 11.00
J1 - 15	4L indicator light ON	< 1.00
	4L indicator light OFF	> 11.00
J1 - 16	Motor OFF	< 1.00
	Motor ON	> 11.00
J1 - 17	Motor OFF	< 1.00
	Motor ON	> 11.00
J1 - 23	Auto locking hub ON	> 11.00
	Auto locking hub OFF	< 1.00

Notice

- DC 12V for the TCCU operation should be maintained.
- In case of J1-8 and J1-15, indicator light will turn on for 0.6 second when turn the ignition switch ON.
- If 4H and 4L indicator lights remain turned on when turn the ignition switch on or during driving, perform the TCCU diagnosis.

SECTION 5D2

TRANSFER CASE (TOD)

TABLE OF CONTENTS

Specifications 5D2-1
General Specifications 5D2-1
Schematic and Routing Diagrams 5D2-2
TOD 5D2-2
T.C.C.U 5D2-3
Function Description 5D2-4
TOD Control Unit 5D2-12
Control Unit Diagram 5D2-14
TOD Control Unit 5D2-14
Diagnosis 5D2-15
Diagnostic Tests 5D2-15
Diagnostic Trouble Codes (DTC's) 5D2-17
Coding 5D2-18
Eliminate the Memorized Fault Code 5D2-20
Diagnosis 5D2-21
Maintenance and Repair 5D2-33
On-Vehicle Service 5D2-33
TOD Control Unit 5D2-33
Transfer Case (TOD) 5D2-34
Speed Sensor in Front and Rear Propeller Shaft 5D2-38
Replacement of Oil 5D2-40
Unit Repair 5D2-41
Transfer Case 5D2-41

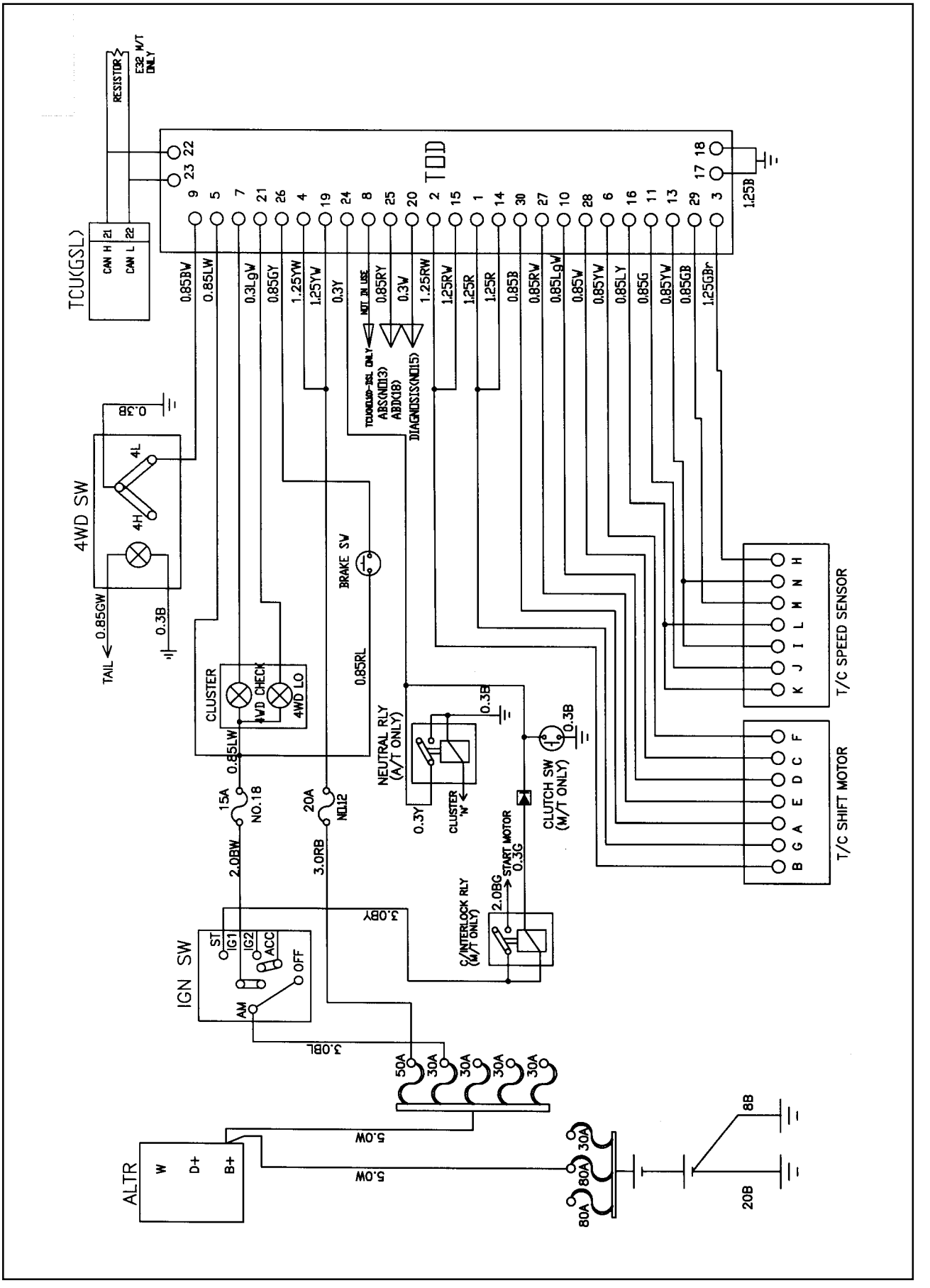
SPECIFICATIONS

GENERAL SPECIFICATIONS

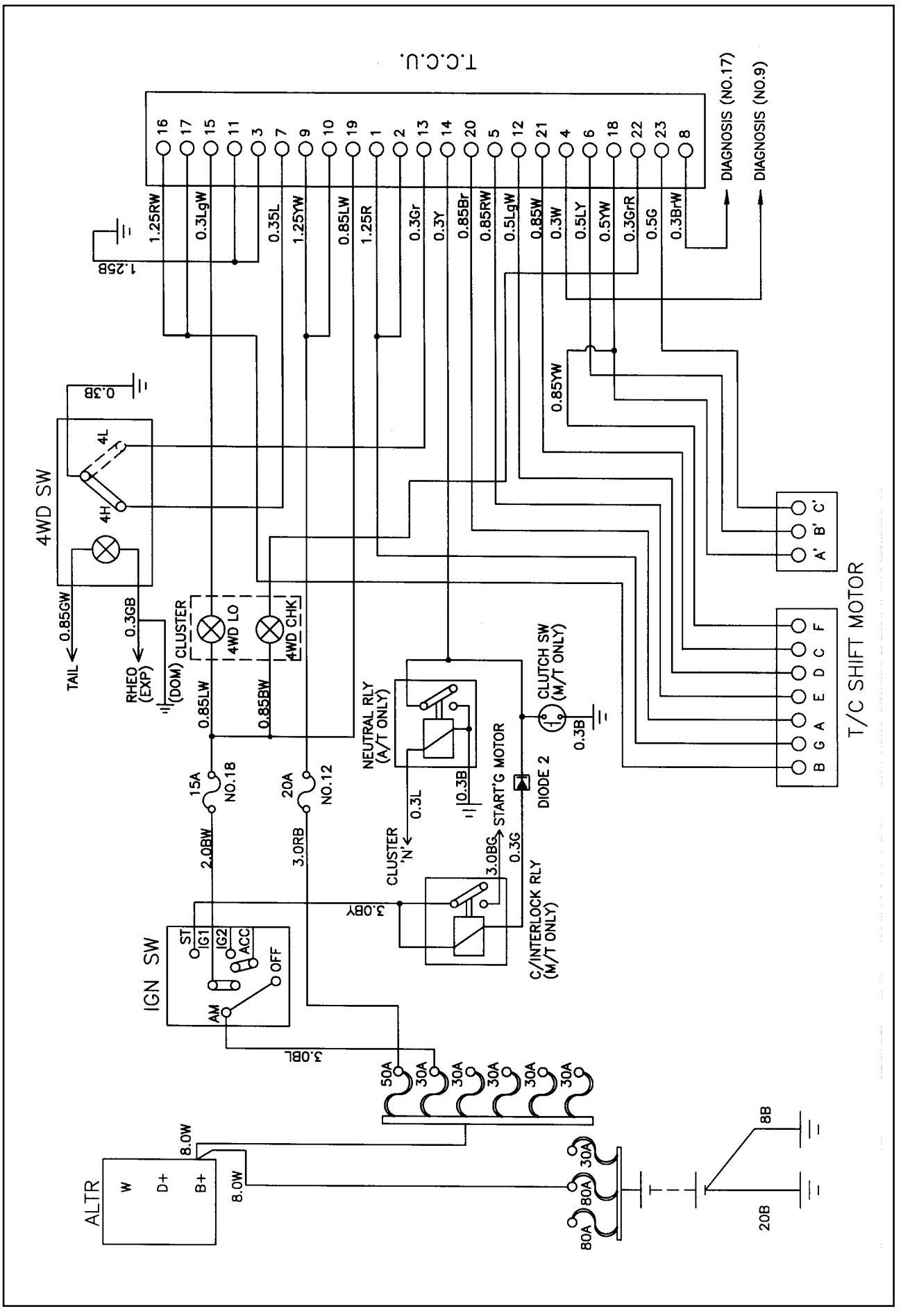
Application		Description
Model		TOD(Torque On Demand) Transfer Case (4423E)
Length (mm)		343.0
Weight (kg)		36.6
Shift Mode		4H and 4L
Gear Ratio	High	1 : 1
	Low	2.48 : 1
Oil	Specification	ATF S-3, S-4 or Dexron II, III
	Capacity	≒ 1.4 L
	Interval	Inspect Every 15,000km, Replace Every 50,000km
Max. Torque		550 lb·ft (≒ 76kg·m)

SCHEMATIC AND ROUTING DIAGRAMS

TOD



T.C.C.U


T.C.C.U.
DIAGNOSIS (NO.17)
DIAGNOSIS (NO.9)
1.25RW
0.3LgW
0.35L
1.25YW
0.85LW
1.25R
0.3Gr
0.3Y
0.85Br
0.85RW
0.5LgW
0.85W
0.3W
0.5LY
0.5YW
0.3GrR
0.5G
0.3BrW
0.85YW
1.25B
0.3B
4WD SW
4L
4H
TAIL
0.85GW
RHEO (EXP)
0.3GB
(DOM)
CLUSTER
4WD LO
4WD CHK
0.85LW
0.85BW
15A
NO.18
20A
NO.12
2.0BW
3.0RB
NEUTRAL RLY (A/T ONLY)
0.3L
0.3B
CLUTCH SW (M/T ONLY)
0.3B
DIODE 2
START'G MOTOR
3.0BG
0.3G
CLUSTER 'N'
3.0BY
C/INTERLOCK RLY (M/T ONLY)
IGN SW
ST
IG1
IG2
ACC
OFF
AM
3.0BL
50A
30A
30A
30A
30A
30A
8.0W
8.0W
ALTR
W
D+
B+
80A
80A
30A
8B
20B
T/C SHIFT MOTOR
A' B' C'
B G A E D C F

FUNCTION DESCRIPTION

- **TOD System Select Mode (4H and 4L)**

  4H is the mode when drive normally of which gear ratio is 1:1 and 4L mode distributes power to front and rear wheels 50:50 of which gear ratio is 2.48:1.

- **TOD System Function (select 4H mode)**

  TOD system controls clutch mechanism to comply with rotation in front and rear propeller shaft and if its difference exceeds the permissible range, corresponding power is distributed into front wheel through EMC (Electro-Magnetic Clutch).

  Hall effect sensor signals speed on front and rear propeller shafts going through with TOD control unit.

  Transfercase clutch coil is activated by variable current on exceeding difference of speed in front and rear propeller shafts.

- **Function of 4L Mode**

  When select 4L mode, EMC is locked to apply maximum torque into front and rear propeller shafts. Shift motor rotates also 4L position by rotation of cam thus propeller shaft torque changes from 1:1 to 2.48:1 by planetary gear set.

- **Shift Motor**

  It locates backside transfer case, which drives rotary helical cam.

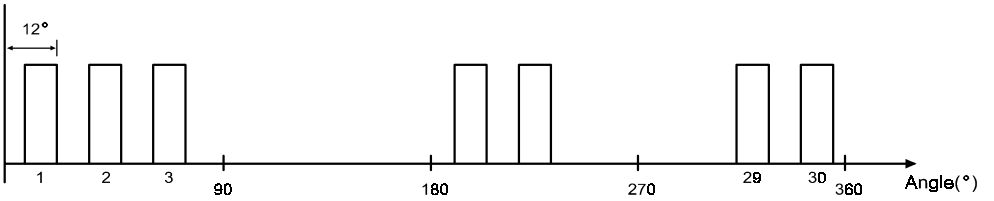
  When mode select switch changes to 4L, shift fork is on position for 2.48:1 by rotation of helical cam.

- **Transfer Case**

  TOD transfer case distributes power into front and rear axle by operation of 4H/4L switch and shift motor.

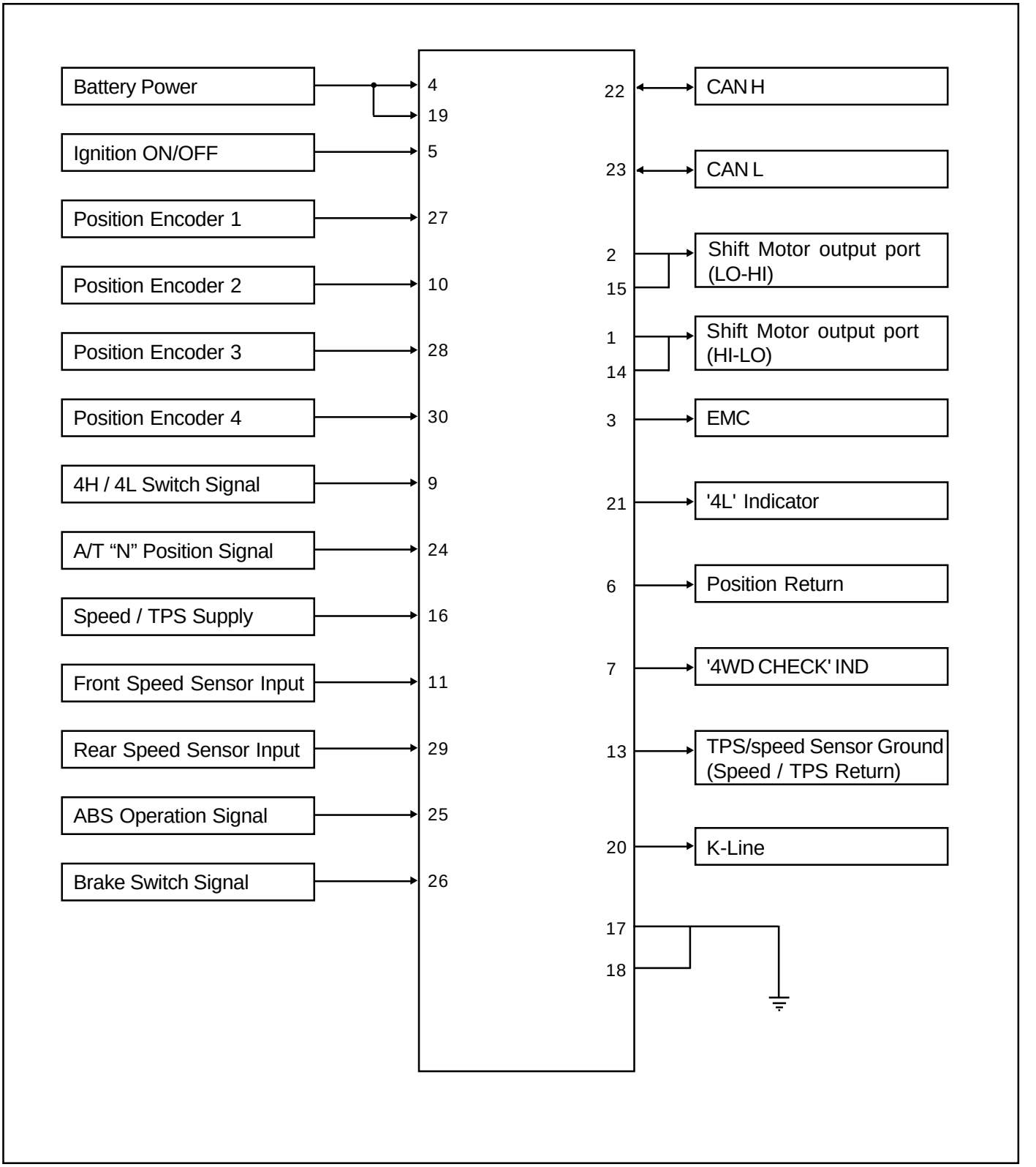
  Shifting 4H to 4L, is performed towards reducing HI-LO collar by means for connection HI-LO shift fork with output shaft in order to join with planetary gear. Torque transmits input shaft then sun gear rotating front planetary gear. Front planetary gear join with output shaft and drives LO position.

Definitions

Rear Speed Sensor	A Hall Effect speed sensor which produces a square wave. 0-5Vdc signal in response to a rotating 30 tooth wheel coupled to the rear propshaft inside the Transfer Case. Each rotation of the rear propshaft will result in 30 speed sensor pulse. 
Front Speed Sensor	A Hall Effect speed sensor which produces a square wave. 0-5Vdc signal in response to a rotating 30 tooth wheel coupled to the front propshaft inside the Transfer Case. Each rotation of the front propshaft will result in 30 speed sensor pulse.
EMC	An Electromagnetic clutch used to control the amount of torque applied to the front propshaft.
TOD™	Torque on Demand™.
Duty Cycle	Duty Cycle is the time the EMC is on divided by the period in which it is being modulated.
Touch-off	A minimum amount of duty cycle applied to the EMC.
Front Overrun	A condition where the front propshaft is turning at a rate which is faster than the rear propshaft.
Rear Overrun	A condition where the rear propshaft is turning at a rate which is faster than the front propshaft.
High Range	The highest (numerically lowest = 1 :1) gear ratio between the input and outputs of the Transfer Case.
Low Range	The lowest (numerically highest = 2.48:1) gear ratio between the input and outputs of the Transfer Case.
4H/4L Switch	A switch which selects the desired gear ratio.
Shift Motor	Electric motor which changes the Transfer Case range.
Position Encoder	A set of 4 Gray code switches which provide feedback to the TCCU indicating the position of the Shift Motor.
Clutch Interlock Switch	A switch on vehicles equipped with a manual transmission which indicates that the clutch pedal is depressed.
Neutral Safety Switch	A switch on vehicles equipped with an automatic transmission which indicates that the transmission is in neutral.
Shift Inhibit Speed	The vehicle speed above which Transfer Case shifts are disallowed. Vehicle speed is indicated by propshaft speed measurement.

Input/Output diagram

TOD control unit and main wiring harness is linked by 30 pin connector. Each pin joins with switche and actuator whose details refer to the below diagram.



Classification of Pin No.

Classification	Pin No.	Pin Name	Description
Power Supply	17,18	Ground	TOD control unit ground
	4,19	Battery	TOD control unit battery supply : (Fuse No 13,20A)
Signal Input	5	Ignition	Ignition ON / OFF
	27	Position 1	Position encoder 1 : check of shift motor position
	10	Position 2	Position encoder 2 : check of shift motor position
	28	Position 3	Position encoder 3 : check of shift motor position
	30	Position 4	Position encoder 4 : check of shift motor position
	9	4H/4L Switch	Transfer case mode input
	24	Auto T/M Neutral	Check of neutral gear position in Auto T/M
	16	Speed	5V supply (TPS / speed sensor)
	11	Front Speed	Front speed sensor signal input
	29	Rear Speed	Rear speed sensor signal input
	25	ABS Operation	ABS ON / OFF
	6	Position Return	Position encoder ground
	13	Speed / TPS Return	Ground for speed sensor / TPS
	22	CAN-L	CAN bus low line
	23	CAN-H	CAN bus high line
Signal Output	2,15	Motor LO-HI	Motor output port - LO to HI : join with battery - HI to LO (or motor brake) : join with ground
	1,14	Motor HI-LO	Motor output port - HI to LO : join with battery - LO to HI (or motor brake) : join with ground
	3	EMC	TOD output
	21	4L Illumination	Illuminates “4L” indicator
	7	Diagnosis Display	4WD check lamp illuminator - Upon defect ; Ground circuit
	20	K-LINE[1)]	Diagnosis

1. K-LINE : Communication line for coding and diagnosis with SCANNER.

Initial Operation of TOD Control Unit

When ignition “ON”, “4L” and "4WD check" lamps illuminates for 0.6second to check bulb in instrument panel, then perform diagnosis of system.

Position Encoder

The Position Encoder is used by the TCCU to determine the position of the Shift Motor. Each motor position is identified by a position code as shown.

Position Code 1/2/3/4	Motor Position	Position Code 1/2/3/4	Motor Position
1110	Left Stop	1001	Neutral
1010	Left of High	0001	Zone 2
0010	High	0101	Low
0000	Right of High	0100	Right Stop
1110	Zone 1		

Notice

1. All other position codes are invalid
2. Position Input Open Circuit (> 4.5V) = 1
3. Position Input shorted to Speed/Position Return (< 0.5V) = 0

Position Sensor Interpretation

1. When the module powers up, it will read the position sensor and the 4H/4L switch input and respond to the possible codes as follows

4H/4L Switch Input	Motor Position	Action
4H	Left Stop	No action required. 4L bulb off.
4H	Left of High	No action required. 4L bulb off.
4H	High	No action required. 4L bulb off.
4H	Right of High	Blink 4L bulb. After the shift conditions are met, attempt a shift to 4H under conditions of below 87 rpm in front and rear propshaft and “Neutral” position. After succesfully shifting into 4H, stop blinking 4L bulb.
4H	Zone 1	Same as above
4H	Neutral	Same as above
4H	Zone 2	Same as above
4H	Low	Same as above
4H	Right Stop	Same as above
4L	Left Stop	Blink 4L bulb. After the shift conditions are met, attempt a shift to 4L. After succesfully shifting into 4L, stop blinking 4L bulb.
4L	Left of High	Same as above
4L	High	Same as above
4L	Right of High	Same as above
4L	Zone 1	Same as above
4L	Neutral	Same as above
4L	Zone 2	Same as above
4L	Low	No action required. 4L bulb on.
4L	Right Stop	No action required. 4L bulb on.

2. A command to shift will only be acted upon if the TCCU is reading a valid code at the time the command to shift is made.
3. After a shift has started, the TCCU will power the shift motor until the code for the requested position is read. If an invalid code is read, the TCCU will go into a default mode.
4. During a shift attempt, the shift motor will be energized for a maximum of 5 seconds.

Electric Shift System Operation

The Electric Shift System is responsible for changing the Transfer Case gear ratio by controlling the electric shift motor. The TCCU monitors the 4H/4L switch, neutral switch, speed sensors, position encoder, and ignition switch.

A range change is initiated when

1. The 4H/4L Switch is changed from 4H to 4L or from 4L to 4H.
2. The motor position (as indicated by the position encoder) does not match the 4H/4L Switch immediately after the ignition is turned on.

1. Shift Criteria

When a range change is initiated a Diagnostic Test will be completed on the motor, speed sensors, and position encoder. If the Diagnostic Test fails, the shift will not be attempted. If all components are operating properly, the TCCU will attempt a range change after the following shift criteria are met:

a. The transmission is in neutral for 2 seconds after the shift is requested.

b. Both propshaft speeds are below 87 rpm (2580 pulses/minute).

If the transmission is taken out of neutral before 2 seconds has elapsed, or either propshaft speed increases above the limit, the shift will be suspended and the 4L Indicator will continue to blink until the criteria are met again or the 4H/4L Switch is returned to the original position.

2. Range Change

When the shift criteria are met, the motor is rotated in the appropriate direction (as determined by the selector switch) until one of the following occurs:

a. The motor reaches its destination.

b. The motor is on for 5 seconds without reaching its destination. The shift has failed and the TCCU will respond as default mode.

c. A fault occurs with either the motor or position encoder. Refer to the diagnosis requirement.

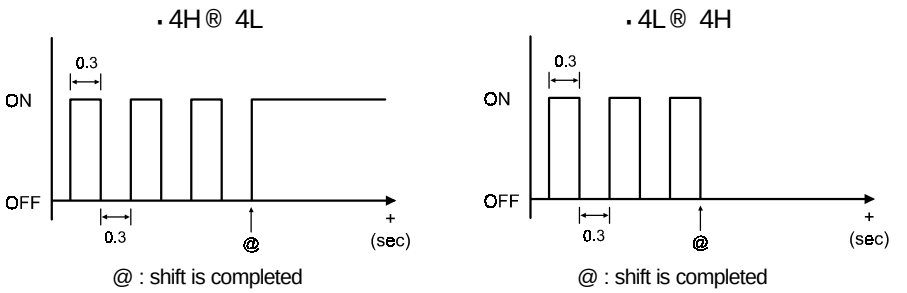
When the motor is energized, the Ignition, 4H/4L Switch, propshaft speeds, and transmission neutral inputs are ignored.

3. Indicator Function

Once a range change has been initiated the 4L Indicator will begin to blink at a rate of 0.3 seconds on, 0.3 seconds off until the shift is completed or canceled.

If a successful shift has been completed, the 4L Indicator will be illuminated if the motor is in Low and it will be turned off if the motor is in High.

4L Indicator illuminates as below figure.



4. Electric Shift Default Mode

If the motor fails to reach its destination, the TCCU will attempt the following (in order):

a. The TCCU will wait 3 seconds then attempt the shift again.

b. If the second attempt to reach the destination fails the TCCU will wait 3 seconds then attempt to rotate the motor back to the original position. If successful, all future shifts will be inhibited until the Ignition is cycled.

c. If the attempt to return to the original position fails, the TCCU will wait 3 seconds then attempt to rotate the motor to the original position again. If the second attempt to return to the original position is successful, the "4WD CHECK" lamp will be illuminated, and all future shifts will be inhibited until the Ignition is cycled.

d. If the second attempt to return to the original position fails the motor will be turned off, the "4WD CHECK" lamp will be illuminated, and all future shifts will be inhibited until the Ignition is cycled.

TOD™ System Operation

The TOD™ System is responsible for distributing torque between the front and rear axles. The TCCU monitors the propshaft speeds, operating range (High/Low), and ABS activity and then applies a calculated amount of torque to the front axle by Pulse Width Modulating the current applied to the EMC.

1. Touch-off Torque

The minimum EMC Duty Cycle is based on the vehicle speed and throttle position

The TCCU receives the TPS signal from the following sources:

On vehicles equipped with CAN, the TCCU receives the TPS signal from the CAN bus.

2. When Slip Detection

The TCCU continuously monitors the front and rear propshaft speeds to detect wheel slip.

3. Wheel Slip Control

When wheel slip is detected the TCCU controls the EMC duty cycle as necessary until the wheel slip is reduced below the allowable limit. The EMC Duty Cycle will then be reduced to the Touch-Off value.

4. Brake/ABS Strategy

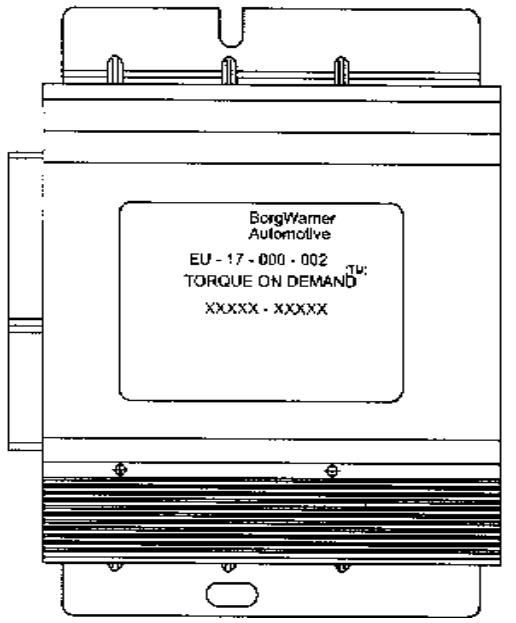
When the ABS System is active, the EMC Duty Cycle is set to a fixed duty cycle (30%) to aid in braking without counteracting the ABS System.

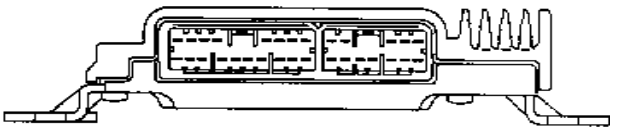
5. 4L Strategy

When the system is operating in 4L, the TCCU continues TOD™ (operation provided that the propshaft speed is below 175 rpm (5220 pulses/minute)). When the speed increases above 175 rpm, the EMC Duty Cycle is set to the maximum value (88%) which applies the maximum available torque to the front axle.

TOD CONTROL UNIT

Shape and function of TOD Control Unit



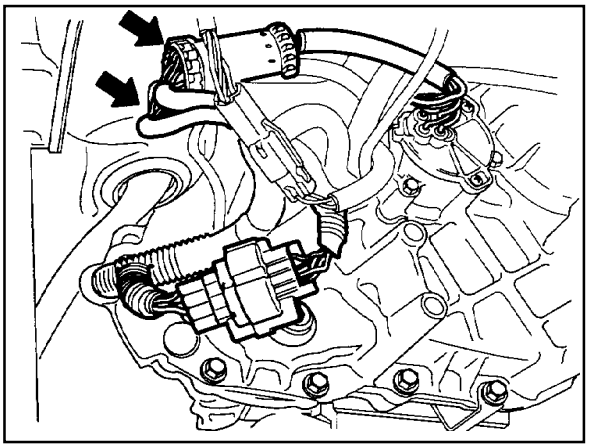


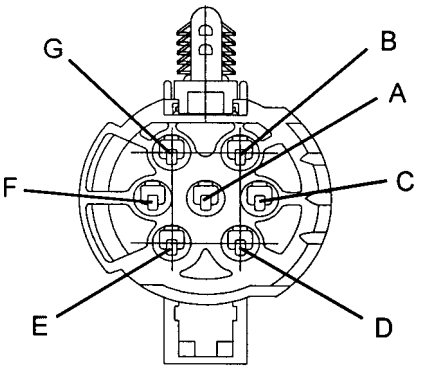
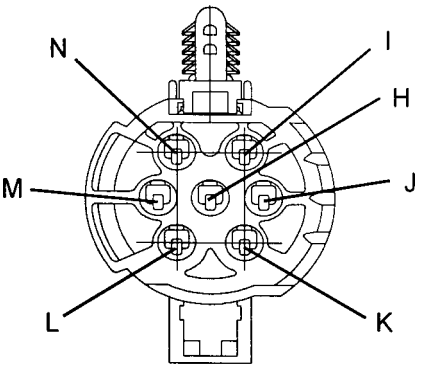
Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	Motor HI-LO	9	HI / LO Switch	17	Ground	25	ABS Input
2	Motor LO-HI	10	Position 2	18	Ground	26	Brake Switch
3	EMC	11	Front Speed	19	Battery (+)	27	Position 1
4	Battery (+)	12	TPS Supply (Diesel)	20	K-LINE	28	Position 3
5	Ignition	13	Speed/TPS Return	21	4L Illumination	29	Rear Speed
6	Position Return	14	Motor HI-LO	22	CAN-H	30	Position 4
7	Diagnosis Display	15	Motor LO-HI	23	CAN-L	-	-
8	-	16	Speed Reference	24	Auto T/M, Neutral	-	-

Speed Sensor/Clutch Coil and Motor Connector

Speed senso /clutch coil and shift motor connector locate upper backside transfer case (upper part of shift motor).

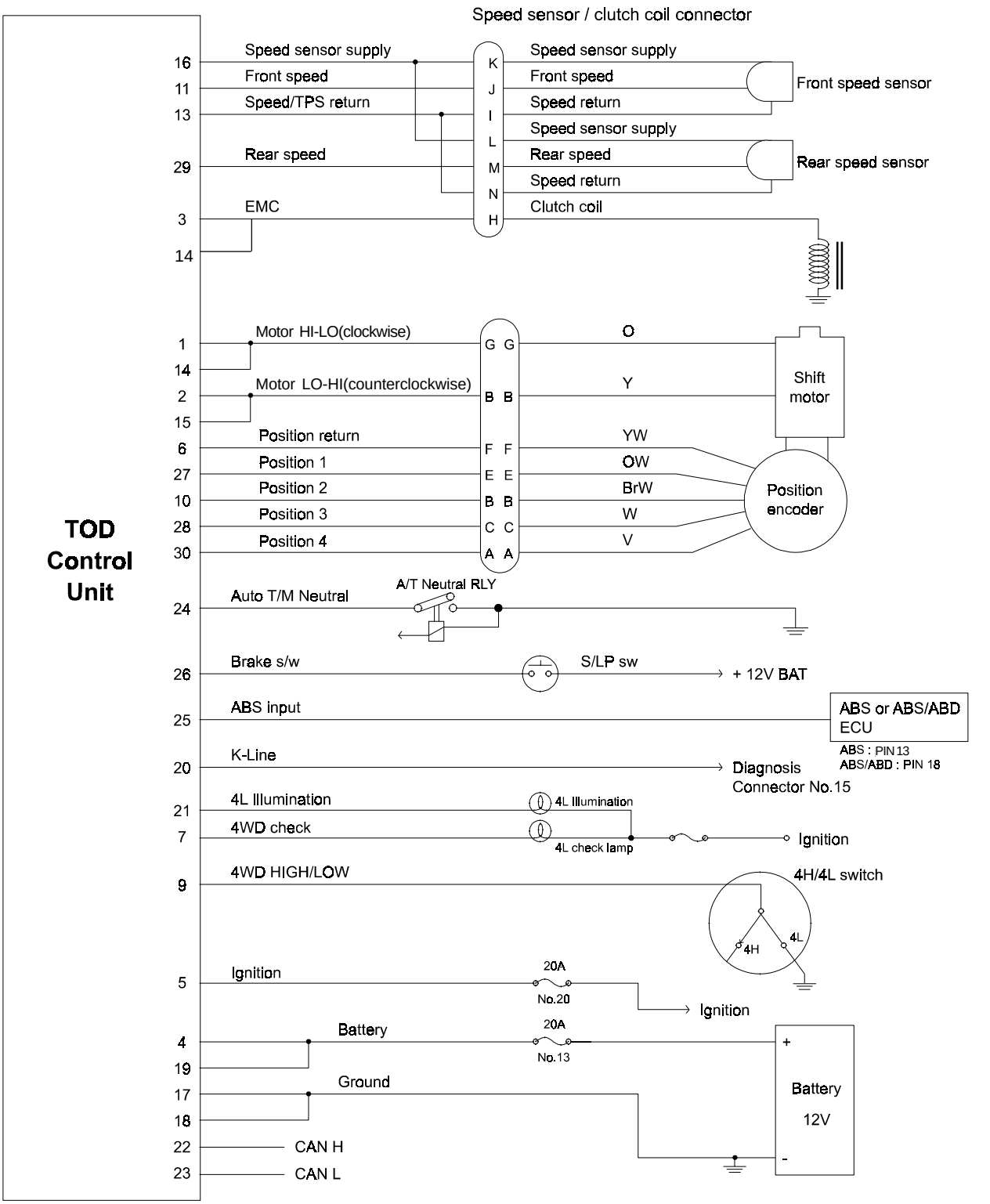
- Shift motor connector : Black
- Speed sensor and clutch coil connector : White



Shift Mtor Connector		Speed Sensor/Clutch Coil Connector	
 Rear View for Connector		 Rear View for Connector	
Pin	**Function**	**Pin**	**Function**
A	Position 4	H	Clutch Coil (EMC)
B	Motor (Counter-Clockwise)	I	Front Speed Return
C	Position 3	J	Front Speed
D	Position 2	K	Front Speed Sensor Supply
E	Position 1	L	Rear Speed Sensor Supply
F	Position Retum	M	Rear Speed
G	Motor (Clockwise)	N	Rear Speed Return

CONTROL UNIT DIAGRAM

TOD CONTROL UNIT



DIAGNOSIS

While the TCCU is active it periodically monitors its inputs and outputs. If a fault is detected the “4WD CHECK” lamp is illuminated and a fault code is stored in the TCCU memory.

When requested, fault codes are downloaded to a diagnostic connector (K-line) serial communications using SCAN-100.

DIAGNOSTIC TESTS

1.TCCU Internal Function

When the Ignition is turned on the TCCU tests its ROM and RAM. If there is a fault, the TCCU immediately resets itself and re-tests the ROM and RAM. If the fault persists the TCCU continues to reset and re-test until the fault is corrected or the ignition is turned off. All TCCU functions are inhibited until the fault is corrected. The “4WD CHECK” lamp is not illuminated if there is a ROM or RAM fault.

If the ROM/RAM passes the EEPROM memory is tested. If there is a fault the “4WD CHECK” lamp is illuminated and the TCCU continues to operate using the default calibration data stored in ROM. Fault codes are not stored when there is an EEPROM fault.

An EEPROM fault can only be cleared by cycling ignition off-on.

2.Shift Motor Assembly Test

If the TCCU detects a shift motor or position encoder fault continuously for one second the ‘4WD CHECK” lamp is turned on and the appropriate fault code is stored in memory.

a. A shift motor fault when the motor is off is defined as follows:
   Motor H-L shorted to Ground
   Motor L-H shorted to Ground
   Motor open circuit

b. A shift motor fault when the motor is energized is defined as follows:
   Motor H-L shorted to Ground
   Motor L-H shorted to Ground
   Motor H-L shorted to Motor L-H
   Motor open circuit

c. A position encoder fault is defined as follows:
   Any position code which does not correspond to the valid 9 codes.
   A short to ground on any of the encoder lines.

d. If no shifts are in progress when a failure occurs the TCCU will not respond to any shift commands.

e. If a shift command has been received, but not acted upon when a failure occurs the TCCU will cancel the command and not respond to any subsequent shift commands.

f. If a shift command is in progress when an invalid position code is confirmed it will be halted and the TCCU will turn the motor toward the high position. Afterwards the TCCU will not respond to any shift commands.

g. If the shift motor/position encoder assembly failure (other than a motor failure which occurs when the motor is energized) recovers continuously for one second the TCCU will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.

h. A motor failure (i.e. open or short circuit) which occurs when the motor is energized can only be cleared by cycling the ignition off-on.

3. Front Speed Sensor Test

If a Front Speed Sensor fault is detected continuously for 0.5 second the “4WD CHECK” lamp is illuminated. The TCCU then responds as follows:

a. If the system is in High Range the TCCU uses the Rear Speed Sensor to determine the EMC Touch Off level and wheel slip control is suspended.

b. If the system is in Low Range, the EMC Duty Cycle is set to maximum (independent of vehicle speed) until the system is shifted out of 4L.

c. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If the Front Speed Sensor recovers continuously for O.5 second the TCCU will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.

4. Rear Speed Sensor Test

If a Rear Speed Sensor fault is detected continuously for 0.5 second the “4WD CHECK” lamp is illuminated. The TCCU then responds as follows:

a. If the system is in High Range the TCCU uses the Front Speed Sensor to determine the EMC Touch Off level and wheel slip control is suspended.

b. If the system is in Low Range, the EMC Duty Cycle is set to maximum (independent of vehicle speed) until the system is shifted out of 4L.

c. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If the Rear Speed Sensor recovers continuously for 0.5 second the TCCU will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.

5. Both Speed Sensor Faulty

If both the Front and Rear Speed Sensors are faulty continuously for 0.5 seconds the “4WD CHECK” lamp is illuminated. The TCCU then responds as follows:

a. If the system is in High Range the TCCU sets the EMC Touch Off level based on a vehicle speed of 0 and wheel slip control is suspended.

b. If the system is in Low Range, the EMC Duty Cycle is set to maximum until the system is shifted out of 4L.

c. All Electric Shift activity is halted until the Ignition is cycled. If a shift is in progress it will be completed.

If both Speed Sensors recover continuously for 0.5 second the TCCU will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.

6. EMC Test

The EMC is tested for open circuit or short circuit to ground. If a fault is detected continuously for 0.8 second the “4WD CHECK” lamp is turned on and all TOD™ activity is halted.

If the EMC recovers continuously for 0.8 second the TCCU will function normally. The “4WD CHECK” lamp is turned off but the fault code will remain in memory.

DIAGNOSTIC TROUBLE CODES (DTC'S)

1. Diagnostic Trouble Code Retention

The first time a fault is detected a DTC is stored in the TCCU's Non-Volatile memory. This DTC will remain in memory until the TCCU is instructed to erase DTC's by SCAN-100. DTC's will not be erased by disconnecting power to the TCCU.

2. Diagnostic Trouble Code Assignments

Classification	Code	Description
TCCU	1714	EEPROM Checksum Fault
	1715	TPS Loss of Signal
	1716	TPS Out of Range
EMC	1721	EMC Open / Short to Battery
	1722	EMC Short to ground
Speed Sensor	1731	Front Speed Sensor Voltage Low
	1732	Front Speed Sensor Voltage High
	1733	Rear Speed Sensor Voltage Low
	1734	Rear Speed Sensor Voltage High
	1735	Speed Sensor Reference Voltage Low
	1736	Speed Sensor Reference Voltage High
Shift Motor	1741	Motor Open / Shorted to Battery
	1742	Motor Output Shorted to Ground
	1743	Shift System Timeout
Position Encoder	1750	General Position Encoder Fault (Invalid Code)
	1751	Position 1 Shorted to Ground
	1752	Position 2 Shorted to Ground
	1753	Position 3 Shorted to Ground
	1754	Position 4 Shorted to Ground

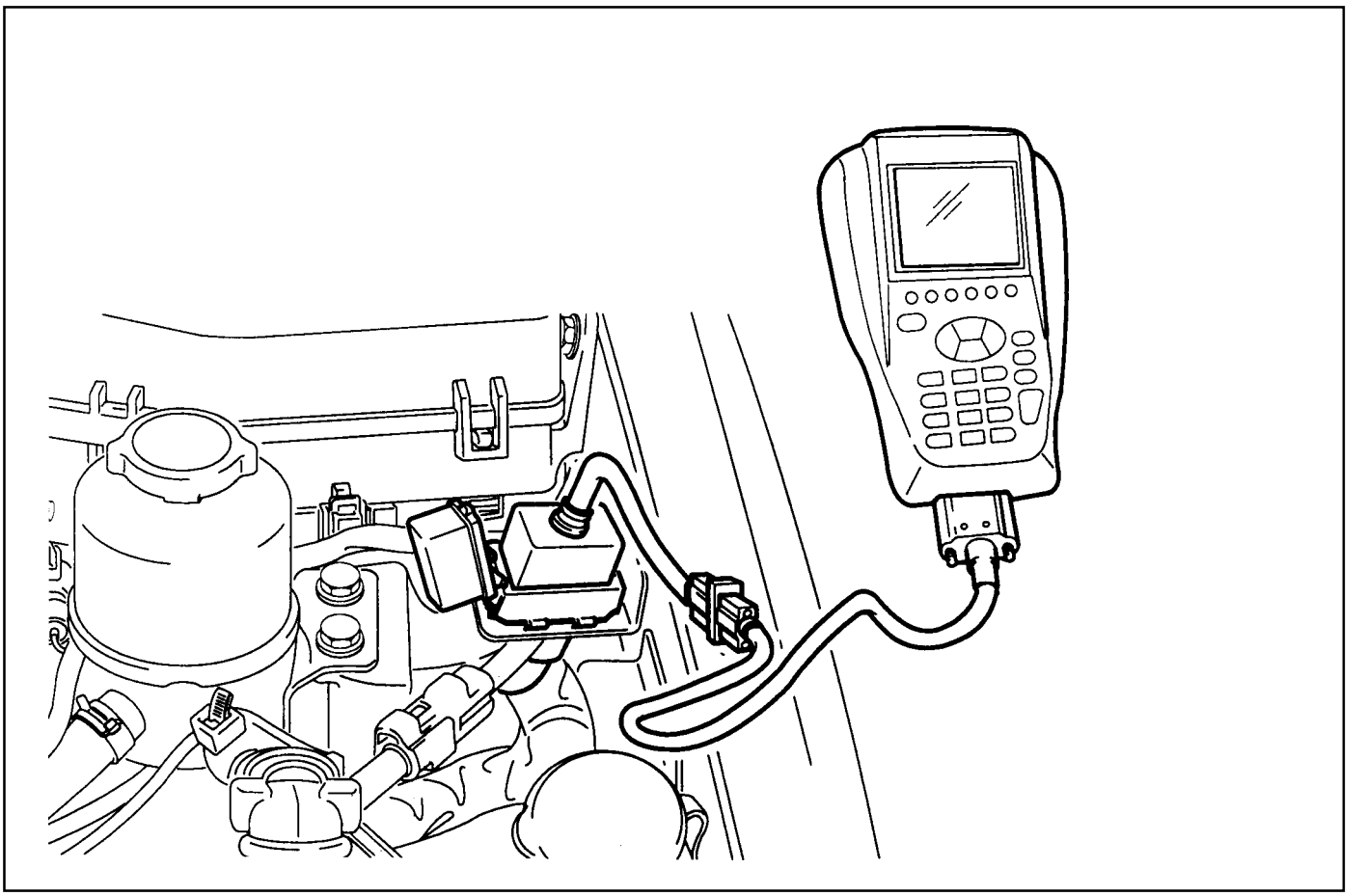
CODING

Coding Tool

SCANNER

Connection of Coding Tool

Construct SCANNER into diagnosis connector (20 pins) near fuse box in engine room as below figure.



1 Diagnosis Connector
2 SCANNER

Notice

Coding ; An input activity of data for the proper performance by matching specification, devices and system with control unit.

Coding Required

1. Replacement of TOD control unit.
2. Adjustment by input error.
3. Change of tire specification.

Coding items

Classification	Items
Engine Type	Gasoline Engine (E32)
	661 Diesel Engine
	661LA Diesel Turbo Engine
	662 Diesel Engine
	662LA Diesel Turbo Engine
Transmission/Vehicle Type	Manual Transmission
	Automatic Transmission
	MUSSO
	KORANDO
Axle Ratio	3.73
	4.55
	4.89
	5.38
	5.86
Tire Size	P215
	P235
	P255
	P275

Coding Method

1. Check and record engine type, axle ratio and tire size.
2. Ignition “OFF”.
3. Connect SCANNER with diagnosis connector in engine room.
4. Ignition “ON”.
5. Read the current memorized specification in TOD control unit.
6. Compare memorized specification with the checked record. If not matched, perform a coding.
7. Read again memorized coding specification in TOD control unit for confirmation of coding.
8. Check coding specification whether it matches with vehicle or not. If not, perform a coding again.

ELIMINATE THE MEMORIZED FAULT CODE

When diagnose by SCANNER, it is required that you make adequate service on defects against all fault codes. And then you should delete the memorized fault codes in TOD control unit using SCANNER as follows;

1. Connect SCANNER with diagnosis connector.
2. Select “trouble code clear” in SCANNER.
3. In “trouble code clear” screen, press “enter” key to erase the fault code.
4. Confirm deletion of fault code and, if not, repeat 2.-3. process.

DIAGNOSIS

Malfunction interior TOD control unit ; fault code 1714

- Phenomenon
  1. When ignition “ON”, “4WD CHECK” lamp illuminates continuously.
  2. On diagnosis by SCAN-100, it displays fault code “1714”.
- Cause ; Error of EEPROM checksum in TOD control unit

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
A1	Check power supply for TOD control unit.		
	1. Disconnect 30 pin connector from TOD control unit. 2. Ignition “ON”. 3. Using multi-tester, measure voltage between pin 5(+) and 17/18 (-). - Specified value - Measured value is within specified range ?	11-14 Vdc Yes No	 Perform A2 stage Perform A3 stage
A2	Check connection status in TOD control unit connector.		
	1. Check connection status. - Is it connected exactly? 2. In case of mal-connection, connect tightly then perform the follows. a. Delete fault code using Scan-100. b. Ignition “OFF”. c. Ignition “ON”. d. Diagnose by Scan-100. - Does it display fault code “1714”?	Yes No Yes No	Perform A3 stage Perform A2 stage Perform A3 stage Normal system
A3	Check short of 10A fuse (fuse No.20).		
	1. Detach No.20 fuse from engine room fuse box. 2. Check the existence of short. - Is fuse normal?	Yes No	Perform A4 stage Replace fuse, then perform A1 stage
A4	Check ground of TOD control unit.		
	1. Ignition “ON”. 2. Check voltage between 4/19 (+) pin and 17/18 (-) using multi-tester (keep connection status). - Specified value (battery is good) - Measured value 3. Check short between 17/18 pin and body after disconnect 30 pin connector. - Is resistance "¥"?	12Vdc (battery voltage) Yes No Yes No	 Perform A4-3 stage Replace TOD control unit Repair ground wiring Ground is O.K., perform A5 stage

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
A5	Check function of TOD control unit. 1. Even A1, A2, A3 and A4 test, if you could not find defect, it is required to replace TOD control unit on basis of below phenomena. a. ”4WD CHECK” lamp illuminates continuously when ignition “ON”. b. Shift is not possible even 4H/4L switch operation. c. Upon diagnosis by Scan-100, it displays on “impossible communication with TOD control unit” or fault code “1714, 1715, 1716”. - Do occur the above defects?	Yes No	Replace TOD control unit Normal system

Error of signal in engine throttle position ; fault code 1715, 1716

- **Phenomenon**
  1. Upon diagnosis by SCAN-100, it display on 1715, 1716 codes.
- **Cause**
  1. Bad communication line between E/G ECU and CAN.
  2. Defect of TOD control unit.
  3. Defect of E/G ECU.

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
B1	Check connection status of connector through CAN communication line.		
	1. Check connection of connector. - Does connector connect correctly between TOD control unit and E/G ECU? 2. In case of bad connection, connect correctly then perform the follows ; a. Delete the memorized fault code using SCANNER. b. Ignition “OFF”. c. Ignition “ON”. d. Diagnose by SCANNER. - Does it display fault codes “1715” or “1716”.	Yes No Yes No	Perform B2 stage Perform B1-2 stage Perform B2 stage Normal system
B2	Check connection status of CAN communication line towards E/G ECU.		
	1. Ignition “OFF”. 2. Disconnect 30 pin connector towards TOD control unit. 3. Measure resistance between pin No.22 and 23 in wiring connector using multi-tester. - Specified value - Measured value is within specified range?	115-125W Yes No	Perform B3 STAGE Perform B4 stage, check and replace E/G ECU
B3	Check connection status of CAN communication line towards TOD control unit.		
	1. Ignition “OFF”. 2. Disconnect coupling of E/G ECU (gray, 1-60 pin). 3. Measure resistance between pin No.37 and 38 in coupling using multi-tester. - Specified value - Measured value is within specified range?	115-125W Yes No	Perform B5 STAGE Replace TOD control unit

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
B4	Check CAN communication line by diagnosis of E/G ECU. 1. Diagnose E/G ECU with SCANNER. 2. Does it display on fault code “27” ?	 Yes No	 Perform B1, B2, B3 stages Perform B5 stage
B5	Check power supply and signal output on throttle valve position sensor (potentiometer) 1,2. 1. Diagnose E/G ECU with SCANNER. - Fault codes : 104, 105, 108, 109, 119, 185 Does it display on above code ?	 Yes No	 Perform B6 stage Replace TOD control unit or perform A1-A5 stages
B6	Check power supply (5V) of throttle valve position sensor. 1. Ignition “ON” 2. Measure voltage between pin 112(+) and 84(-) keeping coupling connection status using multi - tester. - Specified value - Measured value is within specified range ?	 4.75-5.25Vdc Yes No	 Perform B7 stage Replace E/G ECU or perform B1-2 stage after checking cable.
B7	Check output signal from throttle position sensor 1 and 2. 1. Keep E/G idle status. 2. Measure output voltage between pin 87 (+) and 84 (-) keeping E/G ECU coupling connection status using multi-tester. (potentiometer 1) - Specified value min. acc. Pedal max. acc. Pedal - Measured value is within specified range ? 3. Measure output voltage between pin 85 (+) and 84 (-) keeping E/G ECU coupling connection status using multi-tester. (potentiometer 2) - Specified value min. acc. Pedal max. acc. Pedal - Measured value is within specified range ?	 0.3-0.9Vdc 4.6-4.9Vdc Yes No 4.6-4.9Vdc 0.3-0.9Vdc Yes No	 Perform B7-3 stage Replace throttle body actuator or check cable. Replace TOD control unit Replace throttle body actuator or check cable

Error in electro - magnetic clutch : fault code "1721", "1722"

- **Phenomenon**
  1. Upon diagnosis by SCAN-100, it displays on fault codes "1721,1722".
- **Cause**
  1. Defect in electro - magnetic clutch
  2. Defect in connector or wiring
     - Open or short from EMC to the supply : 1721
     - Short EMC to ground : 1722

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
C1	Check relevant connector connection status.		
	1. Check relevant connector connection status with TOD control unit. - Does it connect correctly ?	Yes No	Perform C1-2 stage Perform C1-3 stage
	2. Check connection status of speed sensor and clutch coil connector (7 pin) in transfer case. - Does it connect correctly ?	Yes No	Perform C2 stage Perform C1-3 stage
	3. In case of bad connection, connect it correctly then perform the follows : a. Delete the memorized fault code in control unit with Scan - 100. b. Ignition "OFF". c. Ignition "ON". d. Diagnose by SCAN-100 - Does it display on fault codes "1721,1722" ?	Yes No	Perform C2 stage Normal system
C2	Check supply voltage into electro-magnetic clutch.		
	1. Ignition "ON" 2. Measure voltage between pin 4/19(+) and 17/18(-) in TOD control unit connector. - Specified value - Measured value is within specified range ?	11-15Vdc Yes No	Perform C3 stage Perform C2-3 stage
	3. If the specified value would not be measured, perform the follows : a. Check battery voltage (charging condition) b. Check open circuit on No.13 fuse (20A) c. Check relevant wires. - Is the above 3a, 3b, 3c normal ?	Yes No	Perform C3 stage ● Charging/ Replace battery ● Replace fuse ● Repair wires

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
C3	Check resistance of electro-magnetic clutch. 1. Disconnect 30 pin connector from TOD control unit. 2. Measure resistance between pin 3 and 7 in wiring connector using multi-tester. - Specified value - Measured value is within specified range?	 2.5W Yes No	 Perform C4 stage ● 0W : short ● ¥W : open
C4	Check operational voltage of elector-magnetic clutch. 1. Ignition "ON" 2. Measure voltge between pin 3(+) and 17(-)in TOD control unit connector. - Specified value 4WD high 4WD low - Measure value is within specified range ?	 0Vdc 11 - 15Vdc Yes No	 Replace TOD control unit Replace wire

Defect in speed sensor : fault code 1731, 1732, 1733, 1734, 1735,1736

- **Phenomenon**
  1. Upon diagnosis by SCANNER, it displays on fault code 1731, 1732, 1733, 1734, 1735 and 1736.
  2. “4WD CHECK” lamp illuminates continuously when ignition “ON”.
- **Cause**
  1. Defect of speed sensor (front, rear).
  2. Defect of power supply.

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
D1	Check power supply of speed sensor. 1. Ignition “ON” or driving mode 2. Measure supply voltage between pin 16 (+) and 13 (-) in TOD control unit connector using digital multi-tester. - Specified value - Measured value is within specified range ?	4.75-5.25Vdc Yes No	Perform D3 stage Perform D2 stage
D2	Check connection status of connector. 1. Check connection status of speed sensor/clutch coil connector and TOD control unit connector. - Does it connect correctly ? 2. In case of bad connection, connect it correctly then perform the follows: a. Delete the memorized fault code in control unit by SCANNER. b. Ignition “OFF”. c. Ignition “ON”. d. Diagnose by SCANNER. - It does not display fault code. - It displays one or more fault code among 1731 to 1736.	Yes No Yes Yes	Perform D3 stage Perform D2-2 stage Normal system Perform D3 stage
D3	Check output wave of front and rear speed sensor. 1. Upon driving mode. 2. Check output wave of each speed sensor by SCANNER. 3. Is it normal on output wave ?	Yes No	Perform D4 stage Replace speed sensor then perform D2-2 stage

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
D4	Check output voltage of front and rear speed sensor. 1. Upon driving mode 2. Measure output voltage of front and rear speed sensor by multi-tester. Check voltage whether it varies within specified range. - Specified value • Front speed sensor : Pin 11(+), 13(-) in TOD control unit connector • Rear speed sensor : Pin 29(+), 13(-) in TOD control unit connector - Measure value is within specified range ?	Yes No	Check function of control unit. It necessary, replace then delete fault codes and re-diagnose . Perform D5 stage
D5	Check short/open in cable. 1. Ignition"OFF" 2. Disconnect TOD control unit connector 3. Make a test for open circuit between pin 11 and 13, 16 and 13, 29 and 13 in wiring connector by multi-tester. - Is there a resistance of " ¥ " ? 4. Make a test for short between pin 11 and ground 13 and ground, 29 and ground by multi-tester. - Is there a resistance of " ¥ W " ?	Yes No Yes No	Repair wire Perform D5-4 stge Wiring short, repair Perform D3 stage, then delete fault codes with rediagnosis

Shift motor malfunction : Fault code ® 1741, 1742, 1743

- **Phenomenon**
  1. When change the 4H/4L switch from 4H to 4L, '4L' indicator lamp turn off after blinking for a time and then '4WD CHECK' indicator lamp turn on.
  2. Fault codes display by diagnosis of SCAN-100 : 1741, 1742, 1743
  3. The shifting operation is not occurred when 4H / 4L switch, is operating.
- **Cause**

  Defect in shift motor, improper voltage provided, incorrect connection in connector, short of wiring.

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
E1	Check the input voltage of shift motor.		
	1. Turn the ignition switch to "ON" position. 2. Measure the Hi/Low voltage of motor which is located between No.1/No.14 and No.2/No.15 connector of TOD control unit with digital Multi-tester or which is located between No.G connector and body after detaching T/C motor connector. - The specified value (When operates 4H/4L switch)	11-14 V (Battery voltage)	
	- Measured value is within specified range ?	Yes	Perform E1-3 stage
		No	Perform E2 stage
	3. Measure the Hi/Low voltage of motor which is located between No.2/No.5 and No.1/No.14 connector or which is located No.B connector and body after detaching T/C motor connector - The specified value (When operates 4H/4L switch)	11-14 V (Battery voltage)	
	- Measured value is within specified range ?	Yes	Perform E4 stage
		No	Perform E2 stage
E2	Check the fault condition of the relevant connector.		
	1. Check the installation condition of TOD control unit 30pin connector and T/C shift motor connector. - Is it installed properly ?	Yes	Perform E3 stage
		No	Perform E2-2 stage
	2. If the connector installation is improper, install properly and then perform follows : a. Delete the fault code of control unit by scan scope b. Turn off the ignition switch c. Turn on the ignition switch d. Re-diagnosis of system It displays one or more fault code among 1741 to 1743.	Yes	Perform E3 stage
		No	Normal system

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
E3	Check the wiring of shift motor whether it is shorted or not.		
	1. Turn off the ignition switch. 2. Detach the 30pin connector from TOD control unit 3. Perform short test between the wiring connector No.1/ No.14 and No.2/No.5. - Is there resistance of 0W ?	Yes	Hi-Low motor and Lo-Hi wiring are shorted each other. Repair or replace.
		No	Perform E3-4 stage.
	4. Perform the short test between No.1/No.14 Connector and body, No2/No.15 connector and body. - Is there resistance of 0W ?	Yes	Related wiring is shorted with ground. Repair or replace.
		No	Perform E3-5 stage.
	5. Execute E1 stage to check whether wiring is shorted between Hi-Low motor and LOW-HI motor. - Is the provided voltage proper ?	Yes	Perform E4 stage.
		No	Wiring is shorted. Repair or replace.
E4	Check the resistance of shift motor		
	1. Turn off the ignition switch. 2. Measure the resistance between No.1/No.14 and No.2/ No.15 connector after detaching 30pin connector of TOD control unit Or, check the resistance between No.G and No.B after detaching motor connector of T/C side. - Specified value - Measured value is within specified range ?	Yes	The defective T/C or perform E5 stage.
		No	Replace the shift motor.
E5	Execute the test after detaching shift motor, when the fault is not solved after executing E1~E4 stage.		
	1. Detach the motor connector from T/C. 2. Remove the shift motor. 3. Connect motor connector with the removed shift motor. 4. Operate the 4H/4L switch. - Does motor rotate ?	Yes	Check and fix due to the defective T/C ass'y.
		No	Replace the motor or delete fault code and rediagnosis system.

Position incoder and position 1,2,3,4 malfunction :Fault code®1750,1751,1752,1753, 1754

- **Phenomenon**

  The '4WD check' lamp can not go out when the ignition switch positioned to 'ON'.

  The fault code display 1750, 1751, 1752, 1753, 1754 by diagnosis of SCAN-100.

- **Cause**

  The portion of position incoder malfunction, each wiring is shorted with ground.

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
F1	Check the installation condition of connector.		
	1. Check the installation condition between 30 pin connector of TOD control unit and motor connector of T/C portion. - Is it installed properly ?	Yes No	Perform F2 stage Perform F1-2 stage
	2. If the connector installation is improper, install properly and then execute follow procedure. a. Delete the all fault code from memory by scan scope. b. Turn off ignition switch. c.Turn on ignition switch. d. Rediagnosis the system. - Does the fault codes display one or more among 1750 ~ 1754.	Yes No	Perform F2 stage Normal system
F2	Check the each wiring whether it is shorted or not.		
	1. Turn off the ignition switch 2. Detach the 30 pin connector of TOD control unit. 3. Perform short test each connector, No.27 (Position 1), No.10 (Position 2), No.28 (Position 3),No.30 (Position 4), No.6 with body. - Is there resistance of 0W ?	Yes No	Repair or replace due to wiring short 1. Replace the motor Ass'y due the defective position incoder portion. 2. And then, perform F1-2 stage.

- **Phenomenon**

  “4L” lamp on cluster continuous blinking and can not go off, when operated 4H/4L switch as 4L« 4H.

- **Cause**

  Shifting failure.

Test Stage / Contents		Result	Countermeasure
Stage	**Test Contents and Procedure**	**Specified Value /Yes/No**	
G1	1. Stop the vehicle 2. Return the 4H/4L switch to first position (before operating). - The blinking of 4L indicator lamp is stopped.	Yes No	Perform 2 stage Diagnose TOD control unit
	Note **If the first position before switch operating is ‘4L’, lamp goes on after stopping blink, otherwise it is ‘4H’ lamp goes off.**		
	3. Reoperate 4H/4L switch to 4H« 4L on the below condition. • Positioned Auto T/M to neutral. • At this time, keep the neutral position for 2 second. • Stop the vehicle (The R.P.M of front & Rear propeller shaft is below 80). 4. ‘4L’ lamp blinks based on 0.3 second. 5. When the shifting is engaged, the blinking of ‘4L’ lamp is stopped.		
	- 4H® 4L : goes on ‘4L’ lamp - 4L® 4H : goes on ‘4L’ lamp	Yes No	Normal system Perform system test Auto T/N positioned to neutral Check/Replace the relay
	6. When the ‘4L’ indicator lamp continuous blinking, repositioned to first position and diagnose the system and then fix it.		

MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

TOD CONTROL UNIT

TOD Electric Characteristics

Voltage	Normal Operation Range	9 - 16 Vdc
	CAN communication Operation Range	6 - 16 Vdc
Parasitic Current (Under max. operation Voltage)	Ignition “OFF”	2 mA
	Ignition “ON”	1 A
Max. Operation Current (Under max. operation Voltage)	Motor “OFF”	7 A
	Motor “ON”	20 A

Removal & Installation Procedure

1. Turn the ignition switch to "OFF" position.
2. Remove 30 pin connector from TOD control unit.
3. Unscrew 2 bolts (1).

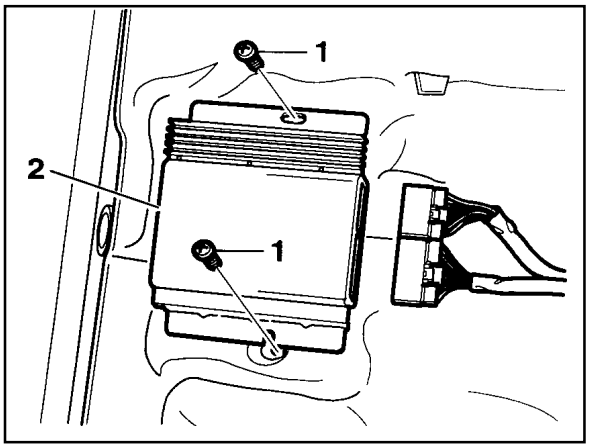
   Installation Notice

Tightening Torque	9 - 11 Nm

4. Installation should follow the removal procedure in the reverse order.

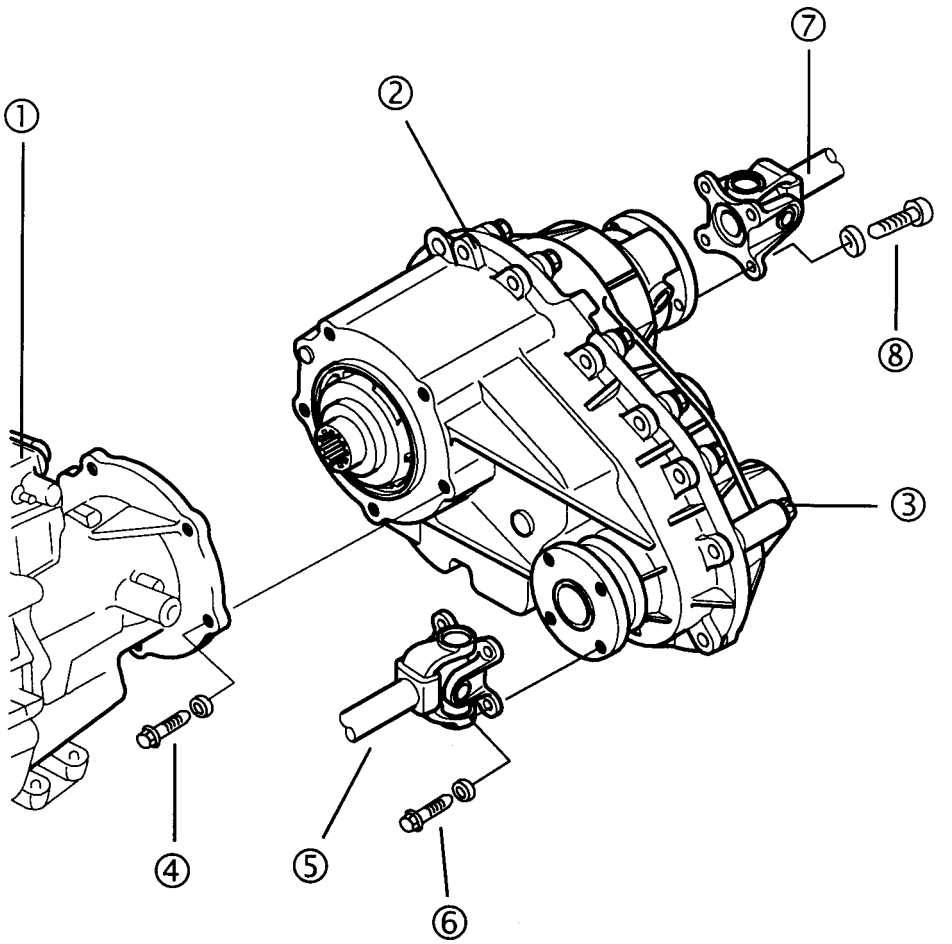
   Notice

   When replace TOD control unit, it is required to make a coding correspondent with vehicle specification.



1 Bolt (M6 x 16, 2pieces) ..... 9-11 Nm
2 TOD control unit

TRANSFER CASE (TOD)



1 Transmission
2 TOD Transfer Case
3 Extension Housing
4 Bolt 35-60Nm
5 Front Propeller Shaft
6 Bolt 81-89Nm
7 Rear Propeller Shaft
8 Bolt 81-89Nm

Removal & Installation Procedure

1. Disconnect (-) cable from battery.
2. Lift on vehicle and make sure on safety.

   Notice

   Be careful for catalytic converter due to high temperature after driving or engine running.
3. Prepare a vessel to drain transfer case and manual transmission oil.
4. Release drain plug and drain transfer case and manual transmission oil.

   If planar damper is installed, unscrew 4 bolts and remove the planar damper.

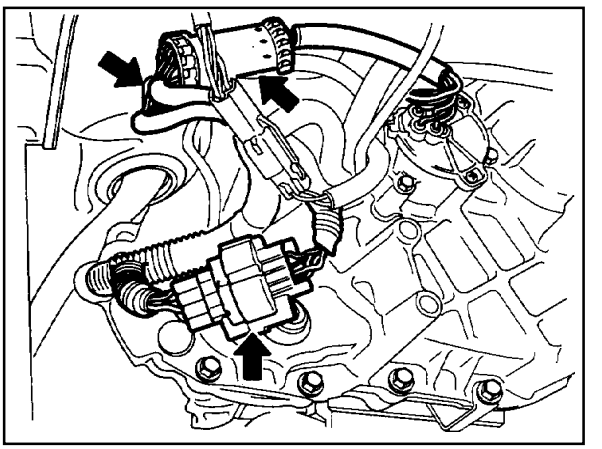
   Notice

   Oil drain should be along with whole transfer case disassembly and assembly.

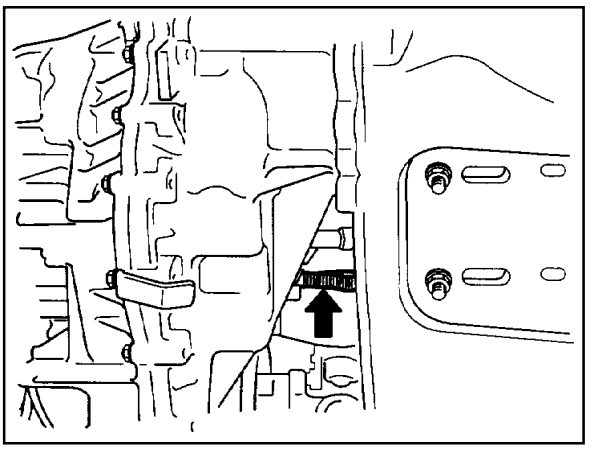
5. Disconnect transmission extension wiring connector back side transfer case.

   Notice

   When disconnect connector, make sure on direction of locking tab towards inside.
6. Disconnect shift motor/clutch coil connect (Black 7 pin) connector upper backside.
7. Disconnect front and rear speed sensor connector (white 7 pin).
8. Disconnect speedometer sensor connector right upper side.



9. Disconnect breather tube front upper side transfer case (upper connecting point of transfer case and front propeller).

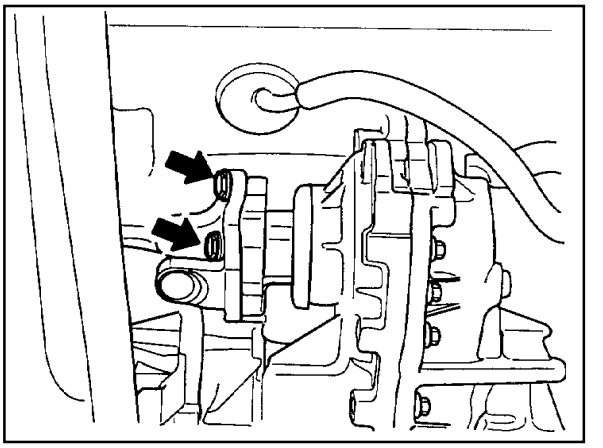


10. Prepare hydraulic jack and support transfer case assembly.

11. Unscrew 4 units of M12 bolts from case flange then disconnect front propeller shaft from transfer case.

Installation Notice

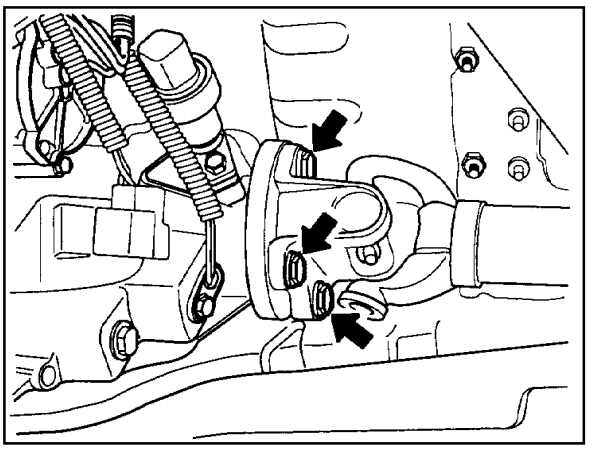
Tightening Torque	81 - 89 Nm



12. Unscrew 4 units of M12 bolts from case flange then disconnect rear propeller shaft from transfer case.

Installation Notice

Tightening Torque	81 - 89 Nm



13. Unscrew 5 units of mounting bolt (M12) from extension housing in transmission.

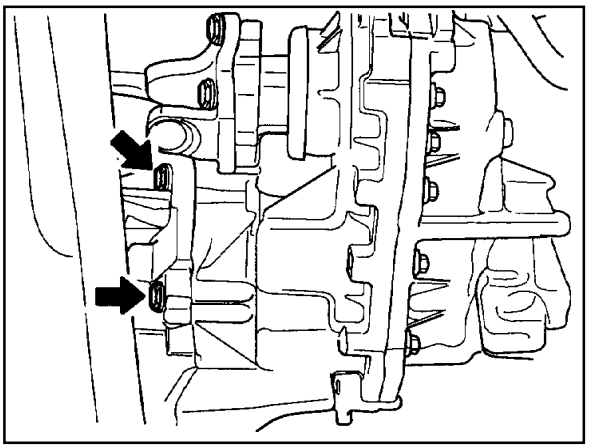
Installation Notice

Tightening Torque	35 - 60 Nm

Notice

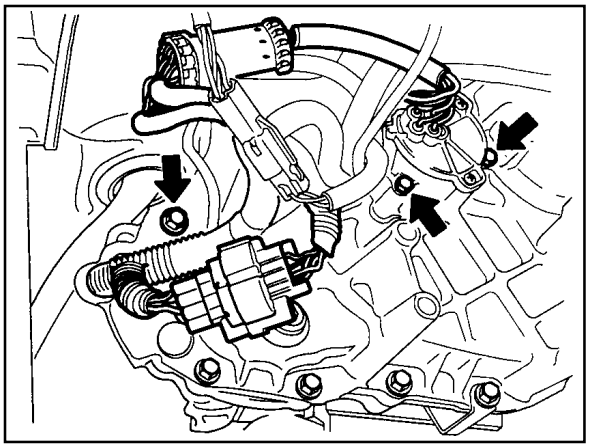
Make sure the connecting surface is clean.

Applying long-life grease spline inside transfer case input shaft.



14. Installation should follow the removal procedure in the reverse order.

Replacement of Shift Motor



1. Disconnect (-) cable from battery.
2. Disconnect shift motor/clutch coil connector (black pin7) upper backside.
3. Unscrew 3 units of shift motor mounting bolts (M10).
4. Unscrew 1unit of bracket mounting bolt (M10).

   Installation Notice

Tightening Torque	9 - 11 Nm

   Notice

   When disconnecting shift motor and mounting bracket, it is required to unscrew 2 units of adjusting bolts (M10) form motor and bracket.

5. Keep shift motor even then pull rearward.
6. Clean connection surface of transfer case and shift motor.
7. If necessary, make a test by SCANNER with shift motor assembly.

   Notice

   Do not disassemble shift motor. If necessary, replace by shift motor assembly unit.

8. Applying sealant into connecting surface for new shift motor.
9. Installation should follow the removal procedure in the reverse order. Before installation, make sure that motor position match with mode of 4H/4L switch.

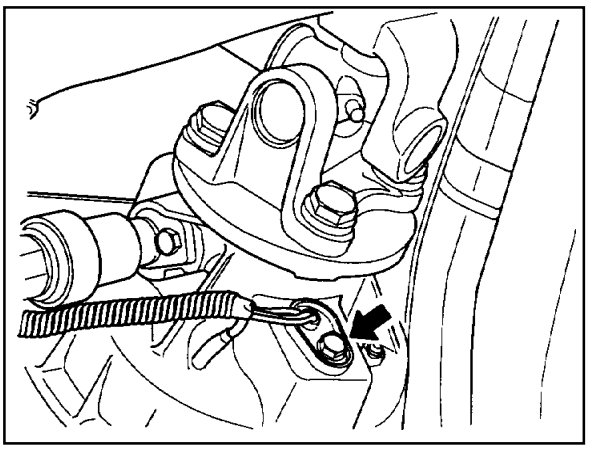
   Reference

   When accord position of motor with 4H/4L switch and transfer case match position of the disconnected motor and new one.

SPEED SENSOR IN FRONT AND REAR PROPELLER SHAFT

Replacement Procedure

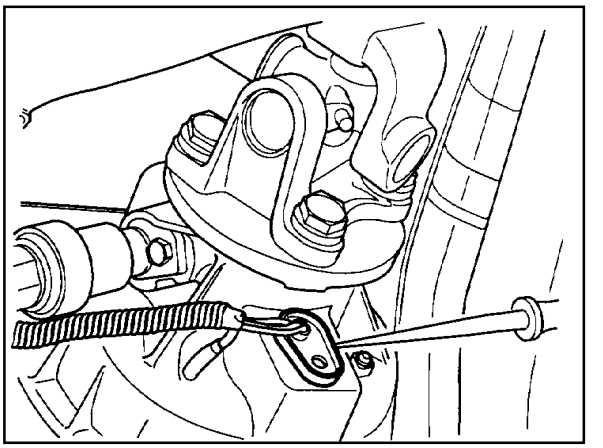
1. Disconnect (-) cable from battery.
2. Detach shift motor assembly.
3. Disconnect front and rear speed sensor connector (white 3 pin) upper backside transfer case.
4. Disconnect speed sensor connect from locking sleeve by pushing.
5. Disconnect wire stick cap from the detached connector.
6. Unscrew rear speed sensor mounting bolt (M10) from upper side of rear case flange.



7. Detach sensor from transfer case by lifting up using tool.

   Notice

   When disconnect sensor, make sure on adequate pressure due to sensitiveness with shock.

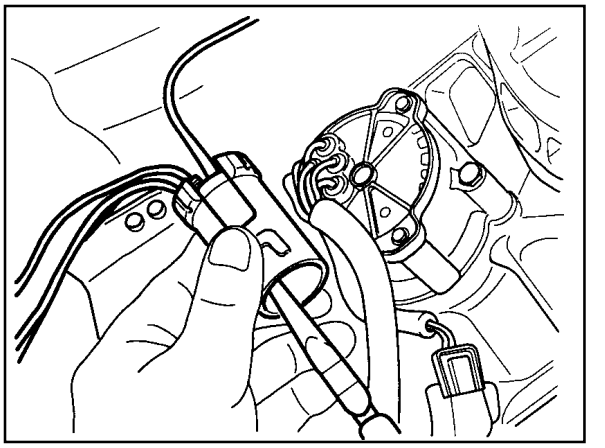


8. Disconnect taping from both protection tube ends that wrap 3 wires of speed sensor and 1 wire of clutch coil.
9. Disconnect tube.

10. Disconnect pin and wire from speed sensor connector by pulling sticking long-nose plier into “L” pin in connector.
11. On the same way, disconnect pin and wire “M” and “N” from connector.

    Notice

    Do not touch the wires related with EMC.



12. Prepare new speed sensor.
13. Connect 3 pins with wires of speed sensor to coincide with each connection position.
14. Using long-nose plier, connect tightly by pulling pins.
15. Apply rubber cap into connector using long-nose plier not to detach.
16. Connect protection tube with wire.
17. Tape both ends of tube.
18. Putting rear speed sensor into hole, connect exactly pushing both ends.
19. Screw 1 unit of bolt (M10).

    Installation Notice

Tightening Torque	9 - 11 Nm

20. Connect speed sensor connector, then locking sleeve.

    Reference

    Front propeller shaft should be premised by removal of shift motor.

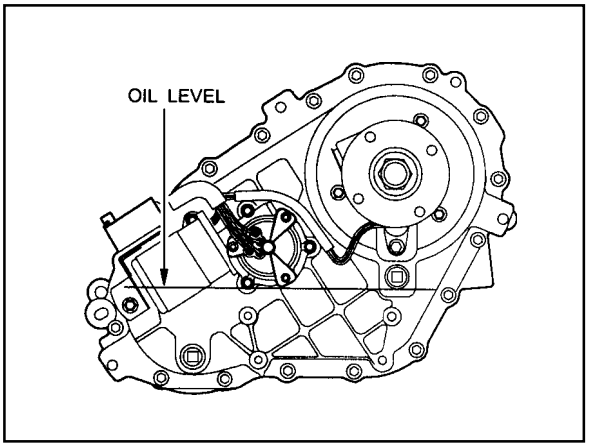
    After disconnecting shift motor, procedure of replacement on sensor assembly of accords with one of rear speed sensor.

REPLACEMENT OF OIL

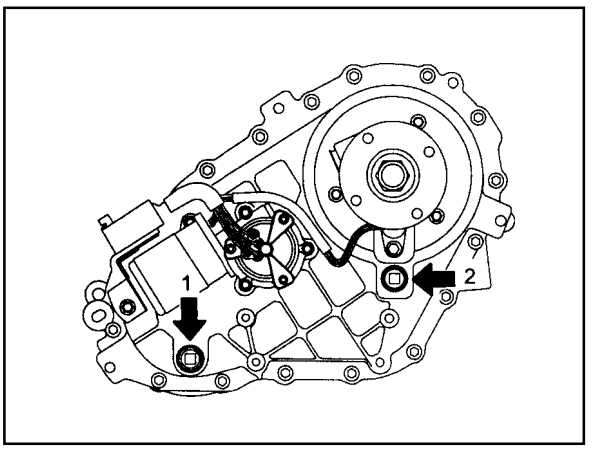
Oil Specification

Specification	Standard	A.T.F S-3, S-4 or Dexron II, III
	Capacity	≒1.4 Litre
	Service	Inspection every 15,000km, Replacement every 50,000km

Specified Oil Level



Oil Replacement



1. Lift on vehicle then make sure on safety.
2. Prepare a vessel to drain transfer case oil.
3. Release filler plug.
4. Drain oil completely.
5. Wash drain plug and than tighten.

   Installation Notice

Tightening Torque	19 - 30 Nm

6. Replenish standardized oil by specified level through filler plug hole.
7. Tighten filler plug after washing.

   Installation Notice

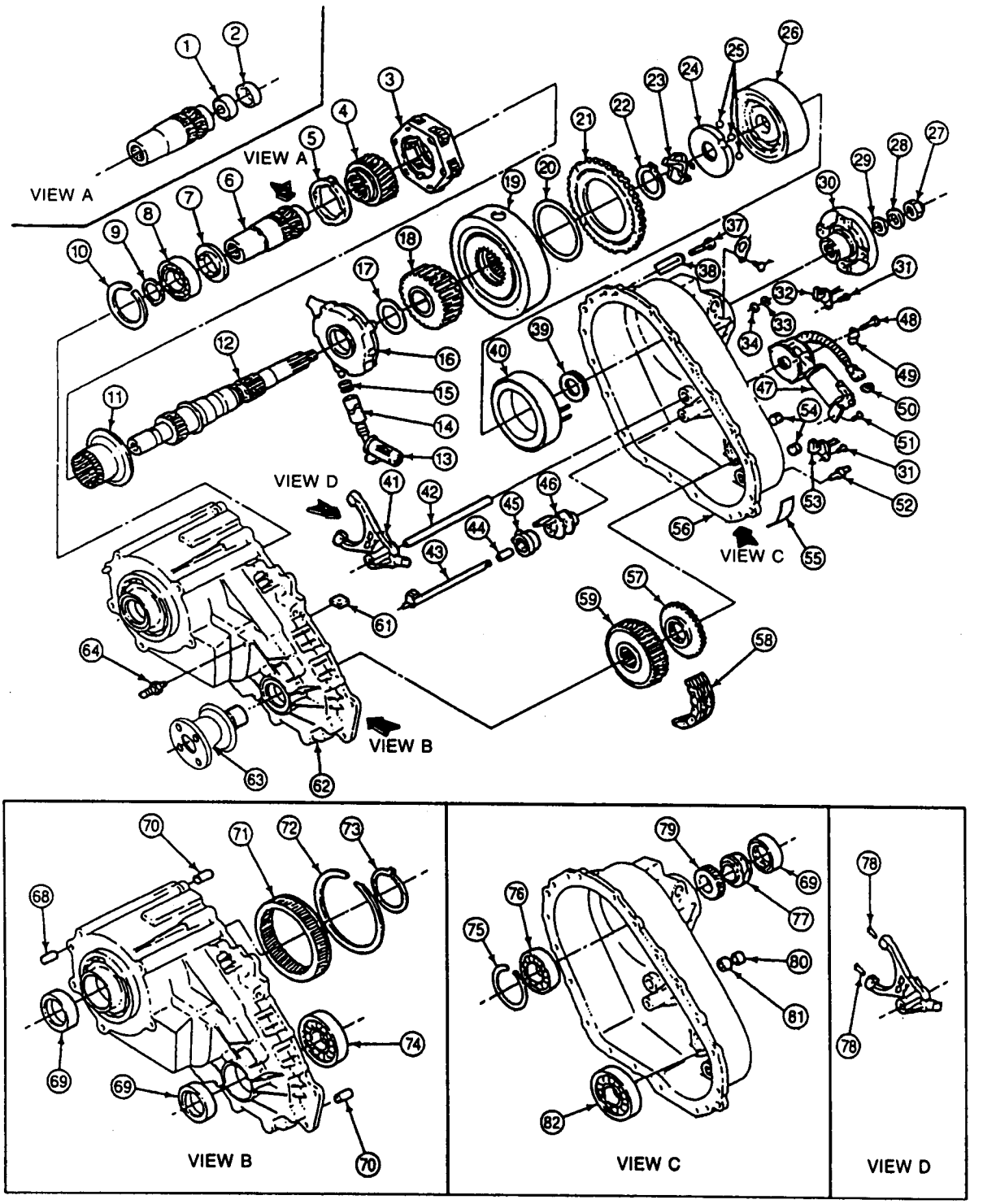
Tightening Torque	19 - 30 Nm

8. Check oil leakage.

UNIT REPAIR

TRANSFER CASE

Transfer Case, Diassembled View



1 Bearing
2 Bushing
3 Carrier Assembly
4 Sun Gear
5 Thrust Plate
6 Input Shaft
7 Output Shaft Thrust Washer
8 Bearing
9 Retaining Ring
10 Snap Ring
11 High-low Collar
12 Rear Output Shaft
13 Oil Strainer
14 Coupling Hose
15 Hose Clamp
16 Pump Assembly
17 Thrust Washer
18 Sprocket, Drive (24T)
19 Clutch Pack Assembly
20 Insulator Washer
21 Armature
22 Snap Ring
23 Wave Washer
24 Apply Cam
25 Ball
26 Cam and Coil Assembly
27 Nut, Metric
28 Output Shaft Yoke Washer
29 Oil Seal
30 Case Flange
31 Bolt
32 Upper Speed Sensor (Rear)
33 Nut
34 Washer
37 Bolt
38 Tag, Identification
39 Thrust Bearing
40 Clutch Coil Assembly
41 Fork, Reduction Shift
42 Shift Rail
43 Shaft, Shift
44 Spacer
45 Torsion Spring
46 Shift Cam
47 Transfer Case Shift Motor
48 Bolt
49 J-clip
50 Connector Retainer
51 Bolt
52 Support Stud
53 Lower Speed Sensor (Front)
54 Plug
55 Identification Decal
56 Cover
57 Tone Wheel, Lower
58 Chain, Drive
59 Sprocket, Driven (24T)
61 Magnet
62 Case
63 Case Flange and Output Shaft
64 Barb, Breather
68 Spiral Pin
69 Oil Seal
70 Pin, Dowel
71 Ring Gear
72 Retaining Ring
73 Snap Ring
74 Bearing
75 Snap Ring
76 Bearing
77 Speedometer Drive Gear
78 Facing, Shift Fork
79 Upper Tone Wheel
80 Oil Seal
81 Bearing Sleeve
82 Bearing

Disassembly Procedure

1. Disconnect transfer case from vehicle
2. Using a 30mm thin-wall socket, first remove the rear output nut, output shaft yoke washer, oil seal then the case flange.

   Installation Notice

Tightening Torque	137 - 196 Nm

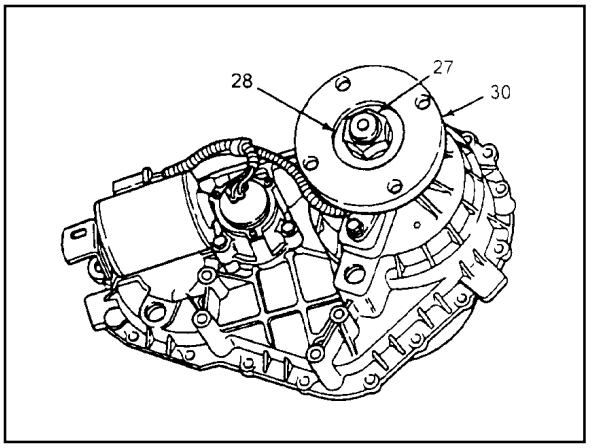
3. Disconnect shift motor/clutch coil connector and speed sensor connector from upper bracket of transfer case.

   Notice

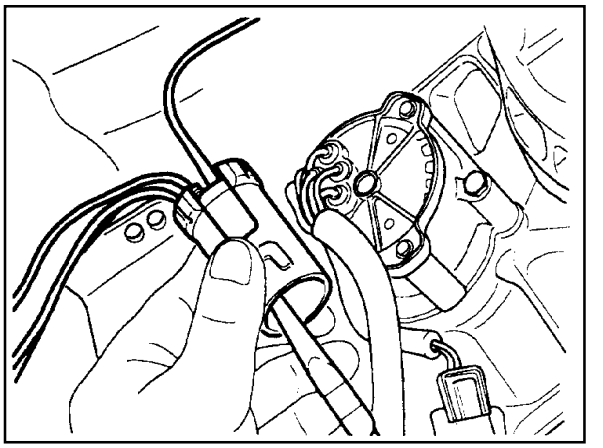
   When disconnect connector, pull forwards grasping connector housing.
4. Remove outer tube on speed sensor connector.
5. Remove wire supporting cape back side of speed sensor connector.
6. Disconnect pin of clutch coil wire (yellow) from speed sensor connector (white 7 pin) using long-nose plier.
7. Remove shift motor.

   Notice

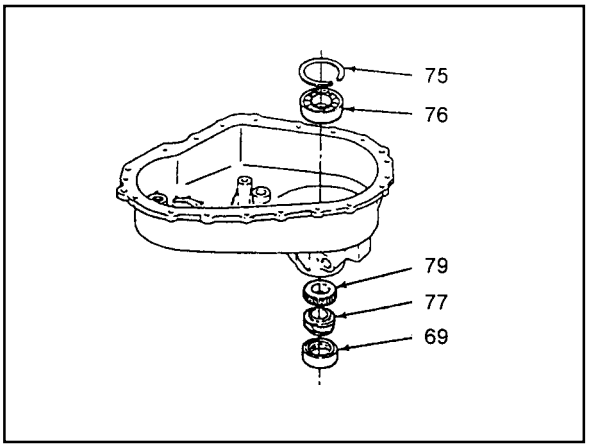
   When remove shift motor, pay attention to the location of triangular slot and shaft in transfer case inside motor.
8. Disconnect front and rear speed sensor.



27 Nut
28 Washer
30 Case Flange

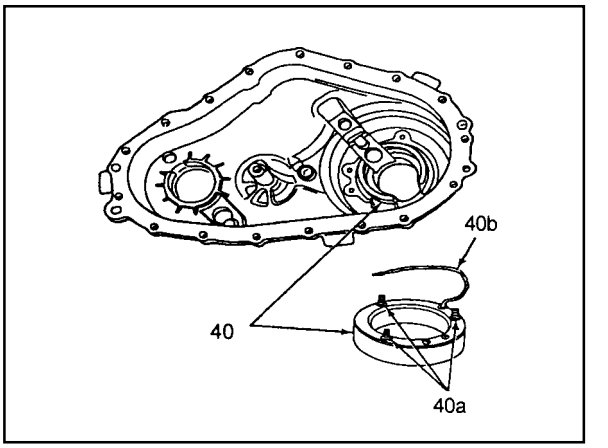


9. Remove the bolts that retain the front case to the rear case. Make sure that the front case is facing downward so that the rear cover is facing upwards. Pry on the bosses and separate the front case from the rear case. Remove all traces of gasket sealant from the mating surfaces of the front case and rear case.
10. If the speedometer drive gear is to be replaced, first remove the flange seal by prying and pulling the curved-up lip of the flange seal. Do not damage the bearing, bearing cage or case. Remove and discard the flange seal. Remove the speedometer drive gear and upper tone wheel.



69 Yoke to Flange Seal
75 Snap Ring
76 Bearing
77 Speedometer Drive Gear
79 Upper Tone Wheel

11. If the rear output shaft bearing requires replacing, remove the internal snap ring that retains the bearing in the bore. From the outside of the case, drive out the bearing.
12. Remove the three nuts and washers retaining the clutch coil assembly to the rear case. Pull the assembly, along with the O-ring and wire, from the case.



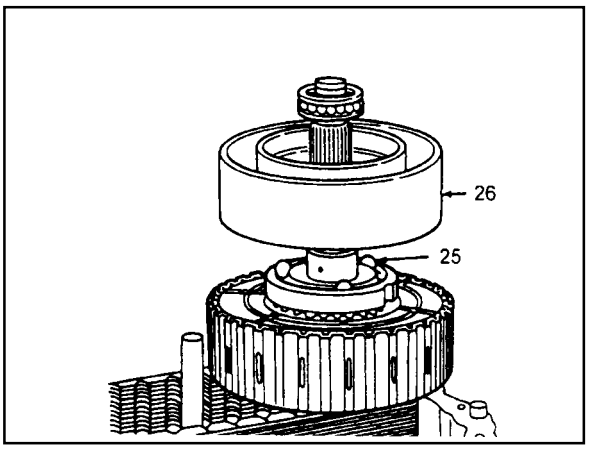
40 Clutch Coil
40a Clutch Coil Retaining Bolts
40b Wire

13. Remove bearing assembly from output shaft.

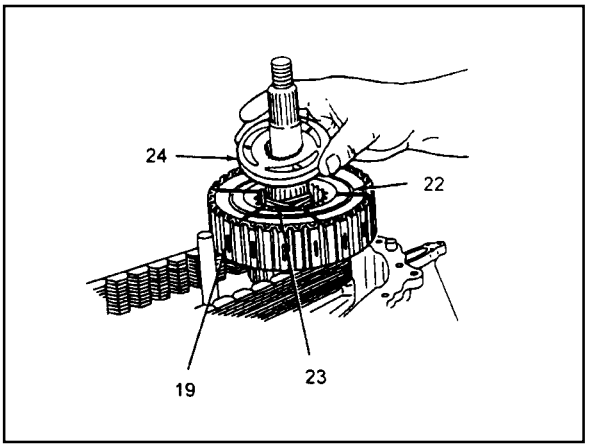
    Remove the clutch housing from the output shaft.

    Remove the balls and apply cam and wave washer from the output shaft.

    Remove snap ring from output shaft. Remove clutch pack assembly from output shaft.



25 Ball
26 Cam and Coil Assembly

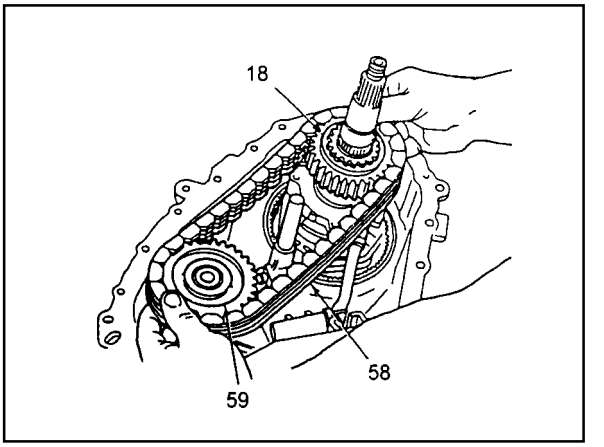


19 Clutch Pack Assembly
22 Snap Ring
23 Wave Washer
24 Apply Cam

14. Remove the chain, driven sprocket and drive sprocket as an assembly.
15. Remove thrust washer from output shaft.
16. Remove the magnet from the slot in the front of the case bottom. Remove the output shaft and oil pump as an assembly.

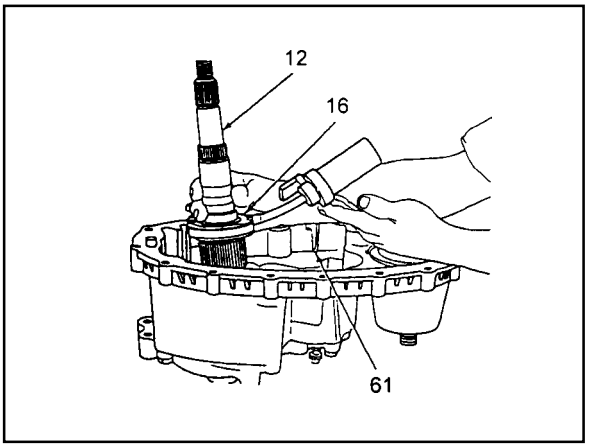
    Notice

    If there is removal resistance, do not pound or use force to disassemble the pump.
17. If required, to remove the pump from the output shaft, rotate the pump to align.
18. Pull out the shift rail.



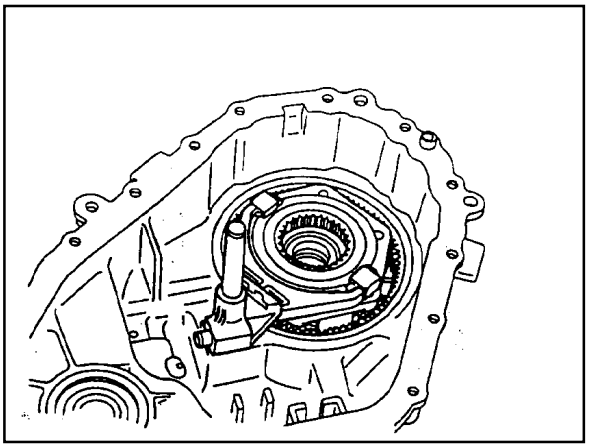
18 Drive Sprocket
58 Drive Chain
59 Driven Sprocket

19. Remove the helical cam from the front case. If required, remove the helical cam, torsion spring and sleeve from the shaft.
20. Remove the high-low range shift fork and collar as an assembly.
21. Expand the tangs of the large snap ring in the case. With the input shaft against a bench, push the case down and slide the main drive gear bearing retainer off the bearing. Lift the input shaft and front planet from the case.
22. If required, remove the oil seal from the case by prying and pulling on the curved-up lip of the oil seal. Do not damage the bearing, bearing cage or case.



12 Rear Output Shaft
16 Oil Pump
61 Magnet

23. Remove the internal snap ring from the planetary carrier and separate the front planet from the input shaft.

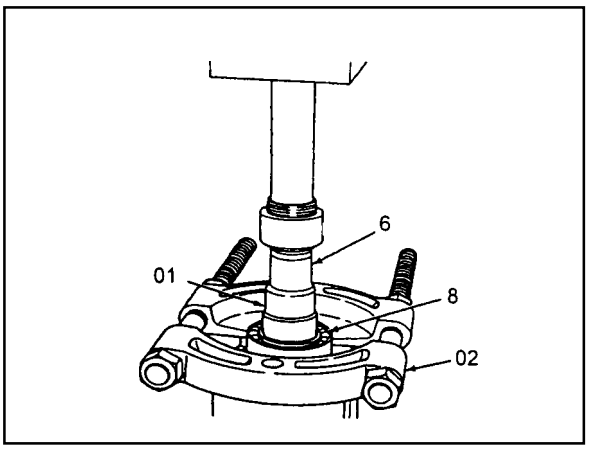


24. Remove the external snap ring from the input shaft. Place the input shaft in a vise and remove the bearing. Remove the thrust washer, thrust plate and the sun gear off the input shaft.
25. Inspect the bushing and needle bearing in the end of the input shaft for wear or damage.

    Notice

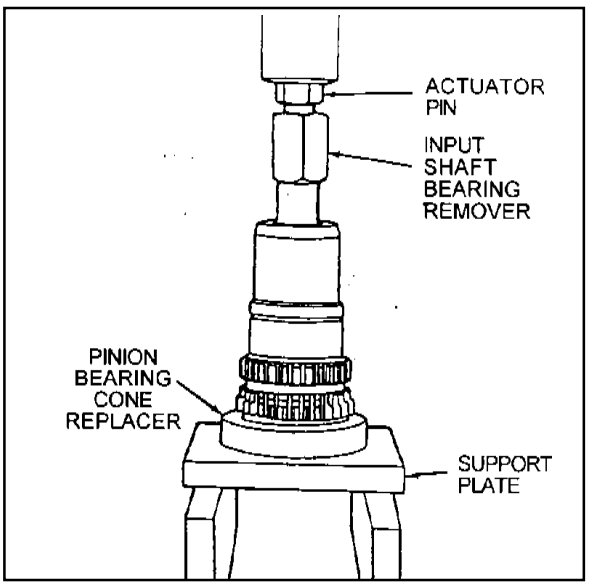
    Under normal use, the needle bearing and bushing should not require replacement. If replacement is required, the bushing and needle bearing must be replaced as a set.

26. If replacement of the needle bearing and bushing is required, press the bearing and bushing is required, press the bearing and bushing out as follows:
    a. Position the input shaft on Axle Bearing/Seal plate,and using Pinion Bearing Cone Replacer as a spacer.
    b. Insert Input Shaft Bearing Remover into the input shaft so it is resting on top of the bearing cage.
    c. Tighten the actuator pin until it stops, then press the bearing and bushing out together.



6 Input Shaft
8 Bearig
01 Pinion Bearing Cone Remover
02 Compress the Dowel

27. If required, remove the front yoke to flange seal by prying and pulling on the curved-up lip of the yoke to flange seal. Do not damage the bearing, bearing cage or case.
28. If required, remove the internal snap ring retaining the front output shaft ball bearing and remove the bearing.

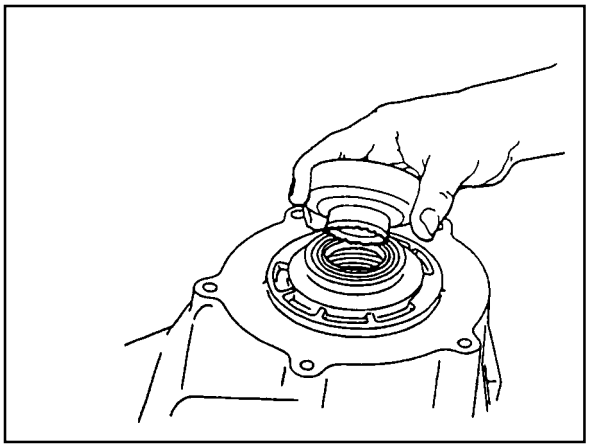


Assembly Procedure

Assembly

Before assembly, lubricate all parts with Automatic Transmission Fluid or equivalent.

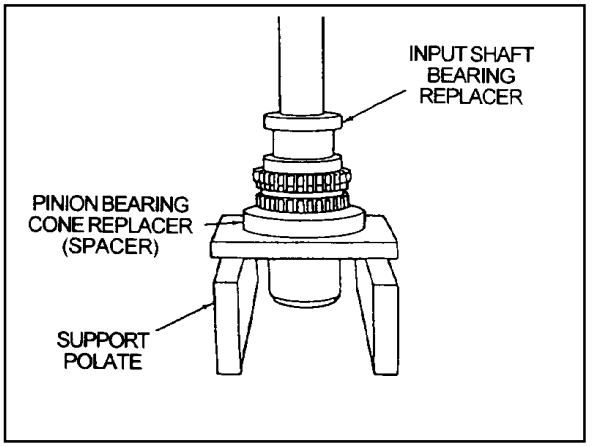
1. If removed, drive the bearing into the front output case bore. Drive the bearing in staight, making sure it is not cocked in the bore. Install the internal snap ring that retains the bearing to the front case.
2. If removed, install the front yoke to flange seal in the front case bore.
3. If removed, install the yoke to flange seal into the mounting adapter bore.



4. If the input shaft needle bearing and bushing were removed, install a new bearing and bushing as detailed in the following steps:

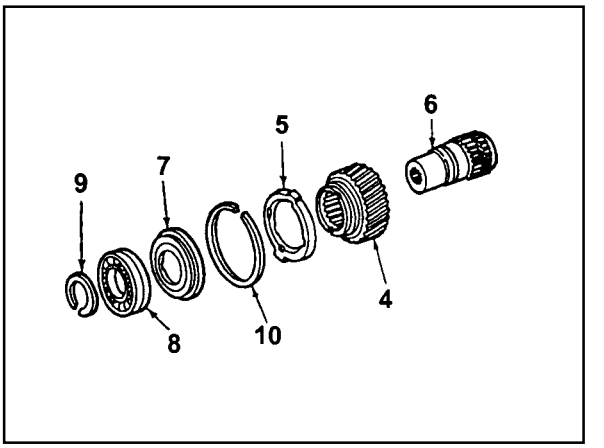
   Press a new needle bearing, then a new bushing in the input shaft as follows:

   a. Position the input shaft on Axle Bearing/Seal Plate or equivalent, and Pinion Bearing Cone Replacer as a spacer.
   b. Press a new needle bearing into the end of the input shaft until it seats in the input shaft.
   c. Press in a new bushing.



5. The recessed face of the sun gear and the snap ring groove on the bearing outer race should be toward the rear of the transfer case. The stepped face of the thrust washer should face toward the bearing.

   Slide the sun gear, thrust plate and thrust washer into position on the input shaft. Press the bearing over the input shaft. Install the external snap ring to the input shaft.

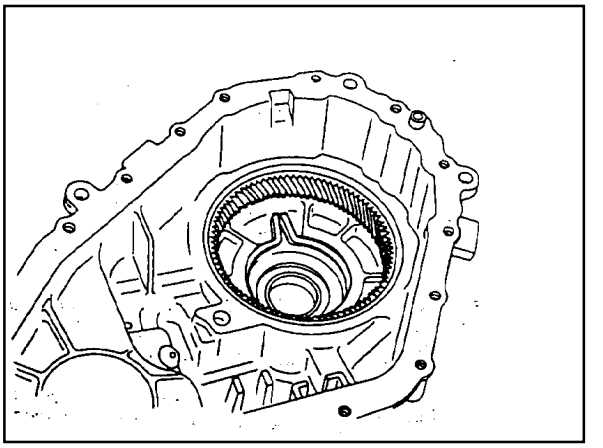


4 Sun Gear
5 Thrust Plate
6 Input Shaft
7 Thrust Washer
8 Bearing
9 External Snap Ring
10 Internal Snap Ring

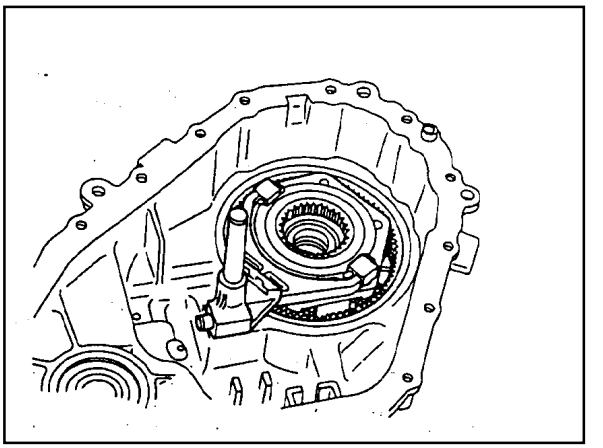
6. Install the front planet to the sun gear and input shaft. Install the internal snap ring to the planetary carrier.
7. Place the tanged snap ring in the case. Expand snap ring with snap ring pliers and install planetary carrier assembly. Check installation by holding the case and carefully tapping the face of the input shaft against a wooden block to make sure the snap ring is installed.
8. Remove all traces of gasket sealant from the front case and mounting adapter mating surfaces. Install a bead of gasket sealant on the surface of the front case.
9. Install the high-low shift fork and high-low collar as an assembly into the front planet.

   Notice

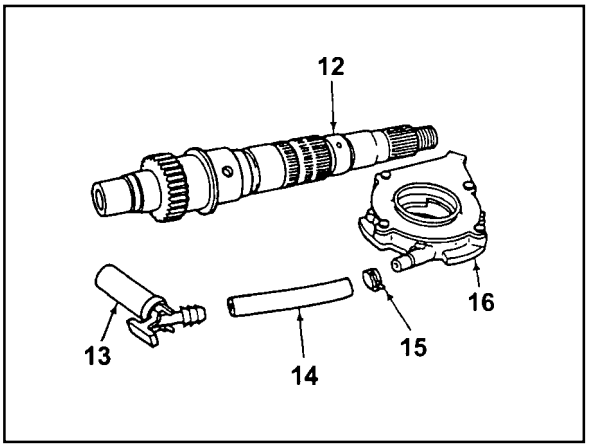
   Make sure that the nylon wear pads are installed on the shift fork and snapped securely into place.



10. If new pump is used, align the flat of the output shaft and the flat of the pump. Slide the pump onto the output shaft.
    - Do not disassemble oil pump. It is serviced only as an assembly. Check the pump to make sure the pump rotates freely.
    - Do not remove the plastic insert from the bore of the new pump. Discard it after it slides out during pump installation to the rear output shaft.
    - While turning the output shaft, prime the pump through the oil filter pickup tube or housing inlet hole with clean Automatic Transmission Fluid or equivalent.

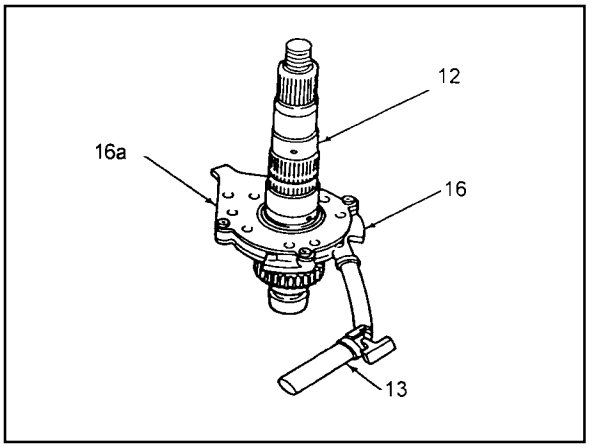


11. Inspect the outside surfaces and bore of the oil pump. If there is no discoloration in the pump housing, gear or cover, and the pump bore and the lube holes of the output shaft show evidence of oil, the pump is working.



12 Rear Output Shaft
13 Oil Strainer
14 Coupling Hose
15 Hose Clamp
16 Pump Body

12. Install the output shaft and oil pump in the input shaft. Make sure that the internal splines of the ouput shaft engage the internal splines of the high-low shift collar. Make sure that the oil pump retainer arm and oil filter leg are in the groove and slot of the front case.

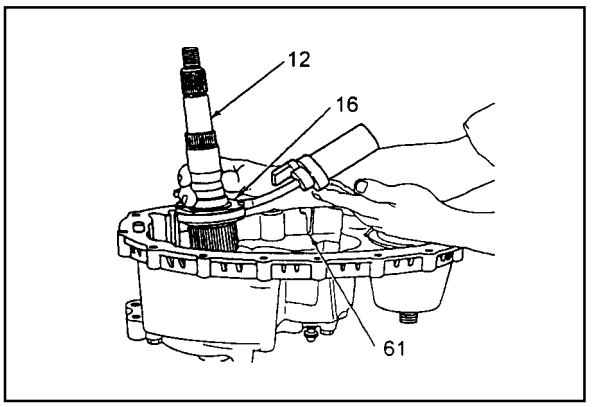


12 Rear Output Shaft
13 Oil Strainer
16 Oil Pump
16a Pump Retainer

13. Install the magnet in the slot in the front case just above the oil filter leg.
14. Install the front output shaft in the front case.
15. Install the thrust washer on the rear output shaft. Install the chain, drive sprocket and driven sprocket as an assembly over the output shaft.

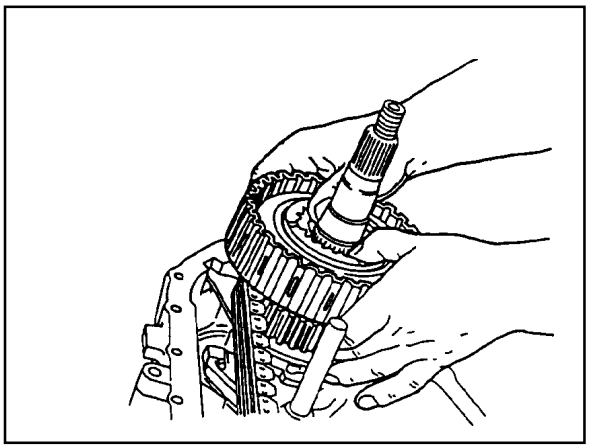
Notice

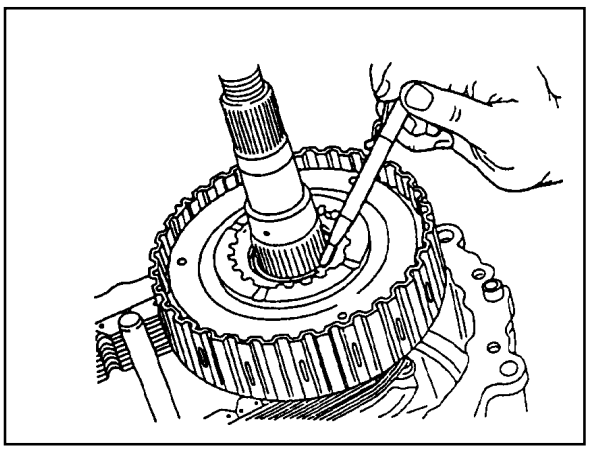
- The driven sprocket (on the front output shaft) must be installed with the marking REAR facing toward the rear case, if so marked.
- Drive sprocket has a bushing pressed into it.



12 Rear Output Shaft
16 Oil Pump
61 Magnet

16. Install tone wheel onto the front output shaft. Make sure the spline on the tone wheel engages the spline on the front output shaft.
17. Install clutch pack assembly onto the rear output shaft. Make sure the spline of the clutch pack engages to the spline of the sprocket.
18. Install snap ring onto the rear output shaft. Start the snap ring over the spline and use the wave spring to seat the snap ring in the snap ring groove. If the snap ring will not install, the thrust washer inside the clutch pack may not be seated properly.

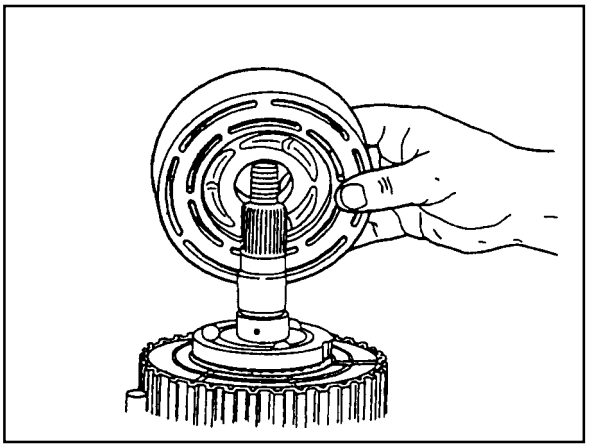




19. Install wave spring, insulator washer and armature. (Three offset slots must align with housing to be installed)

    Notice

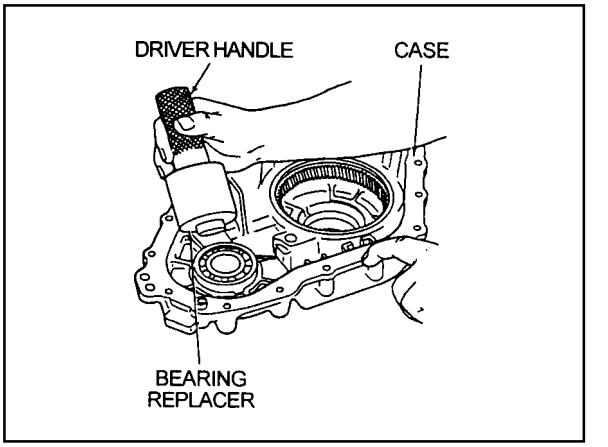
    Three slots on the thrust washer must be aligned with the three tabs on the clutch pack housing.



20. Install apply cam onto the rear output shaft, install three balls into the apply cam, install cam and coil housing assembly onto rear output shaft. Install thrust bearing assembly onto output shaft.

21. If removed, drive the front output shaft ball bearing into the rear cover bore with Front Shaft Needle Bearing Replacer and Driver Handle.

22. If removed, install the rear output bearing in the rear case bore. Drive the bearing into the rear case bore with Output Shaft Bearing Replacer and Driver Handle. Make sure that the bearing is not cocked in the bore. Install the internal snap ring that retains the bearing to the rear case.

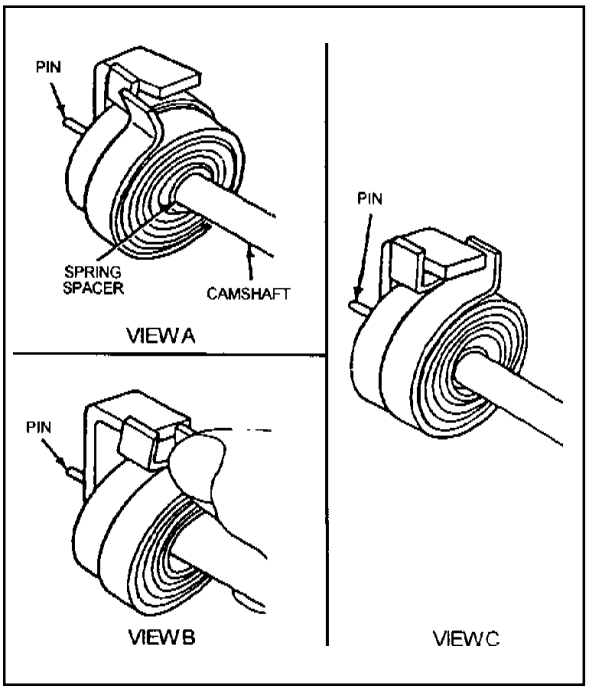


23. Install the clutch coil from inside the rear case until the wire and studs extend through the cover. Install the washers and nuts and tighten.

    CAUTION

    Do not kink or trap the wire while seating the clutch coil to the case.

24. Slide the spring spacer on the camshaft and position it beneath the drive tang. Place the torsion spring on the camshaft. Position the first spring tang to the left of the camshaft drive tang(View A). Wind the second spring tang clockwise past the drive tang(View B). Push the torsion spring and sleeve in as far as it will go (View C). This will seat the second spring tang on the right side of the drive tang. Install the helical cam and slide the drive tang between the torsion spring tangs as far as it will go.

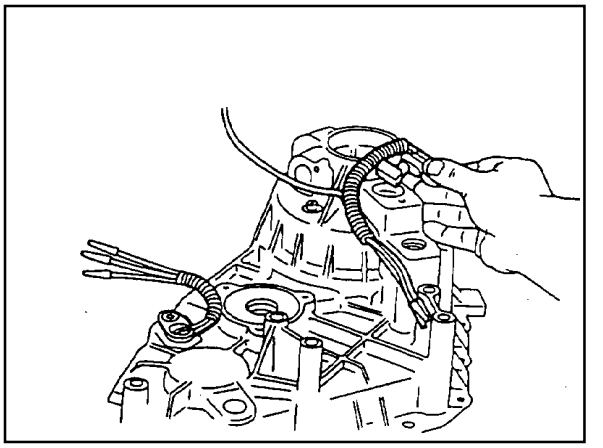


25. Install the pin on the tang end of the helical cam into the hole in the front case. Position the torsion spring tangs so that they are pointing toward the top side of the transfer case and just touching the high-low shift fork.

    CAUTION

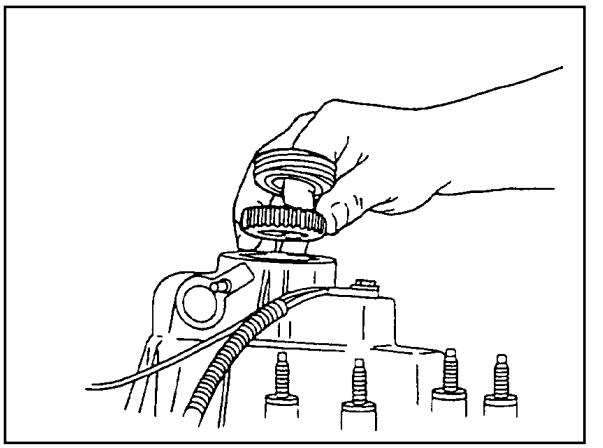
    Do not bend the helical cam during installation to the front case because of possible damage to the pin at the tang end of the motor shaft.

26. Install the shift rail through the high-low shift fork and make sure that the reverse gear shift rail is seated in the front case bore.
27. Install upper and lower speed sensors into the cover. Feed the coil wire through the upper speed sensor wire shield.



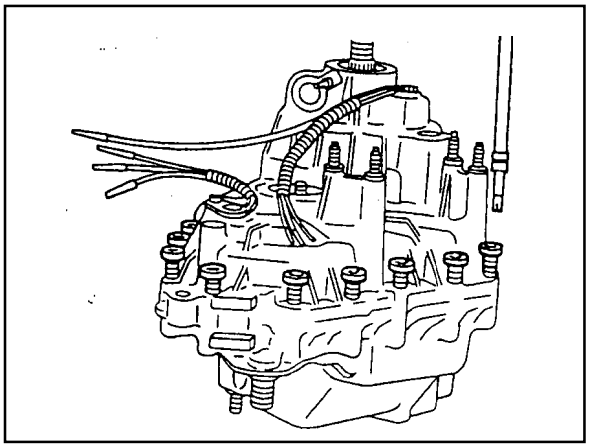
28. Install upper tone wheel, speedometer gear and rear output seal. Use Output Shaft Seal Replacer and Driver or equivalent to install seal.
29. Coat the mating surface of the front case with a bead of Black Non-Acid Cure Silicone Rubber or equivalent.
30. The following procedure must be followed prior to installing the rear case onto the front case half:
    a. Align the output shaft with the rear case output shaft bore.
    b. Align the helical cam with the rear case motor bore.

    If difficulty is encountered with seating the rear case, tap the rear output shaft with a sharp blow using a rubber mallet in a direction away from the triangular shaft while pushing down on the rear case.

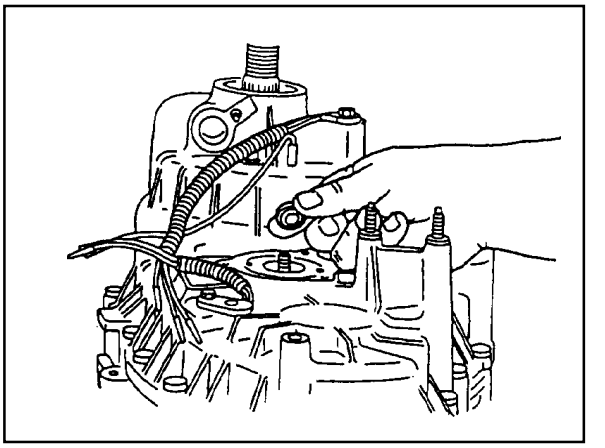


31. Install the bolts retaining the case halves and tighten.

Tightening Torque	25 - 37 Nm



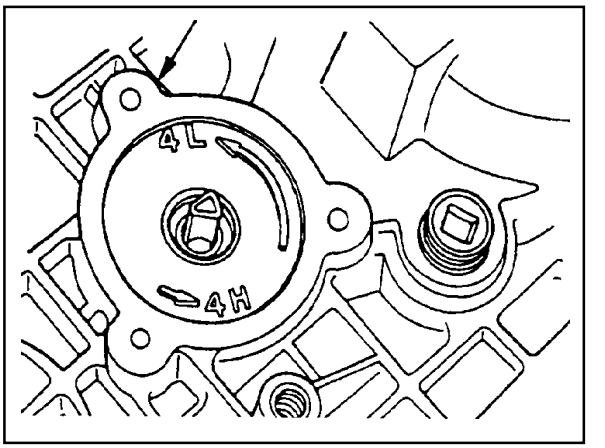
32. Install shift shaft oil seal if it is not installed.
33. Using pliers equipped with soft jaws, rotate the triangular shaft so it is aligned with the triangular slot in the transfer case shift motor. If triangular shaft will not rotate, rotate the rear output shaft.

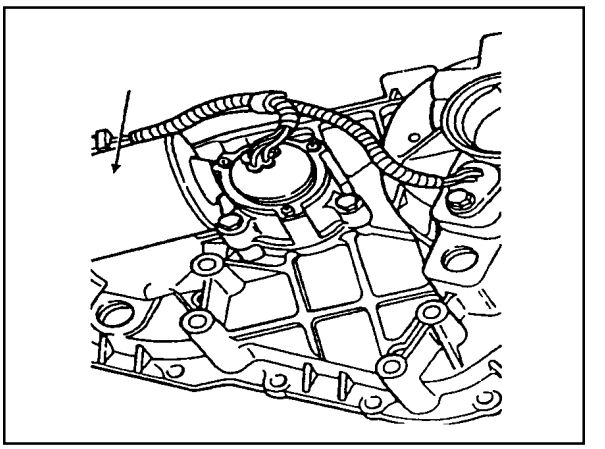


34. Slightly loosen the two nuts that attach the slotted support bracket to the end of the motor house.
35. Apply Black Non-Acid Cure Silicone Rubber or equivalent to motor housing base and install on transfer case.
36. Install the transfer case shift motor and three bolts along with speed sensor wire harness bracket and tighten.

    Notice

    The wire harness must be routed as shown to provide clearance and to prevent the wire harness from grounding the damper.
37. Holding the slotted support bracket tight against the motor housing end, secure the bracket to the transfer case, tightening the bolt with lockwasher to 8-11 Nm (72-96 lb-in).
38. Retighten the two nuts that attach the slotted support bracket to the end of the motor.
39. Install the clutch coil wire terminal and sensor wires.





40. Install the rear case flange on the output shaft. Install the rubber seal, output shaft yoke washer and nut. Tighten the nut.

Tightening Torque	137 - 196 Nm

41. Install the drainplug and tighten.

Tightening Torque	19 - 30 Nm

42. Fill the transfer case with 1.4 liters of Automatic Transmission Fluid or equivalent.

Notice

Fluid level should be just below the filler plug hole.

43. Install the fill pulg and tighten.

Tightening Torque	19 - 30 Nm

44. Install the transfer case as outlined in removal and Installation, transfer case in the section.

Notice

Make sure proper drain and fill plugs are installed if case is replaced.