
SECTION 5A

AUTOMATIC TRANSMISSION

TABLE OF CONTENTS

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



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	Description
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



CLUTCH PACK DETAILS

	0574-000001, 0574-000004, 0574-000005	0574-000002
C1 Composition Steel	4 6(2)	5 5(2)
C2 Composition Steel	4 5(2)	5 4(2)
C3 Composition Steel	3 5(2)	4 4(2)
C4 Composition Steel	3 4(1)	3 4(1)
Note : Numbers in brackets indicate number of selective thickness steel plates required to achieve specided clutch pack clearance		



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)

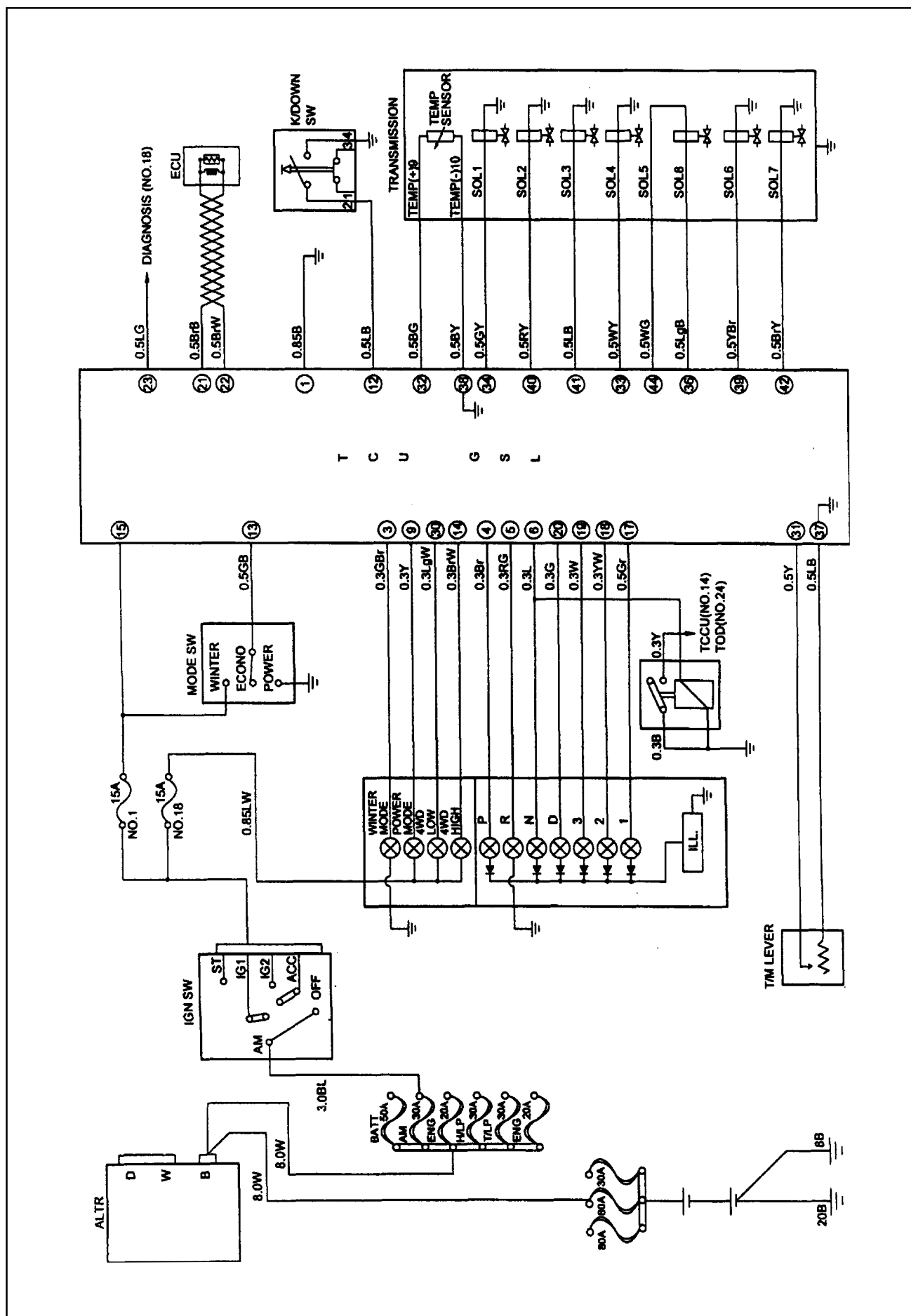


The diagram illustrates the electrical system for a vehicle, featuring a terminal block with pins numbered 10 through 42. The system includes the following components and connections:

- Alternator (ALTR):** Connected to the battery and the terminal block.
- Battery (BATT):** Connected to the terminal block and the ignition switch.
- Ignition Switch (IGN SW):** Controls the engine and other systems.
- Mode Switch (MODE SW):** Selects between WINTER, ECONO, and POWER modes.
- Throttle Position Sensor:** Provides feedback to the engine control system.
- Transmission Temperature Sensor:** Monitors the transmission temperature.
- Engine Speed Sensor (RPM):** Provides RPM feedback to the engine control system.
- Solenoids (SOL1-SOL7):** Control various actuators in the system.
- Kick Down Switch:** Controls the kick down function.
- Cluster (SPDOUT):** Provides speed feedback to the engine control system.
- TCU (DSI):** The Transmission Control Unit, which manages the transmission's operation.

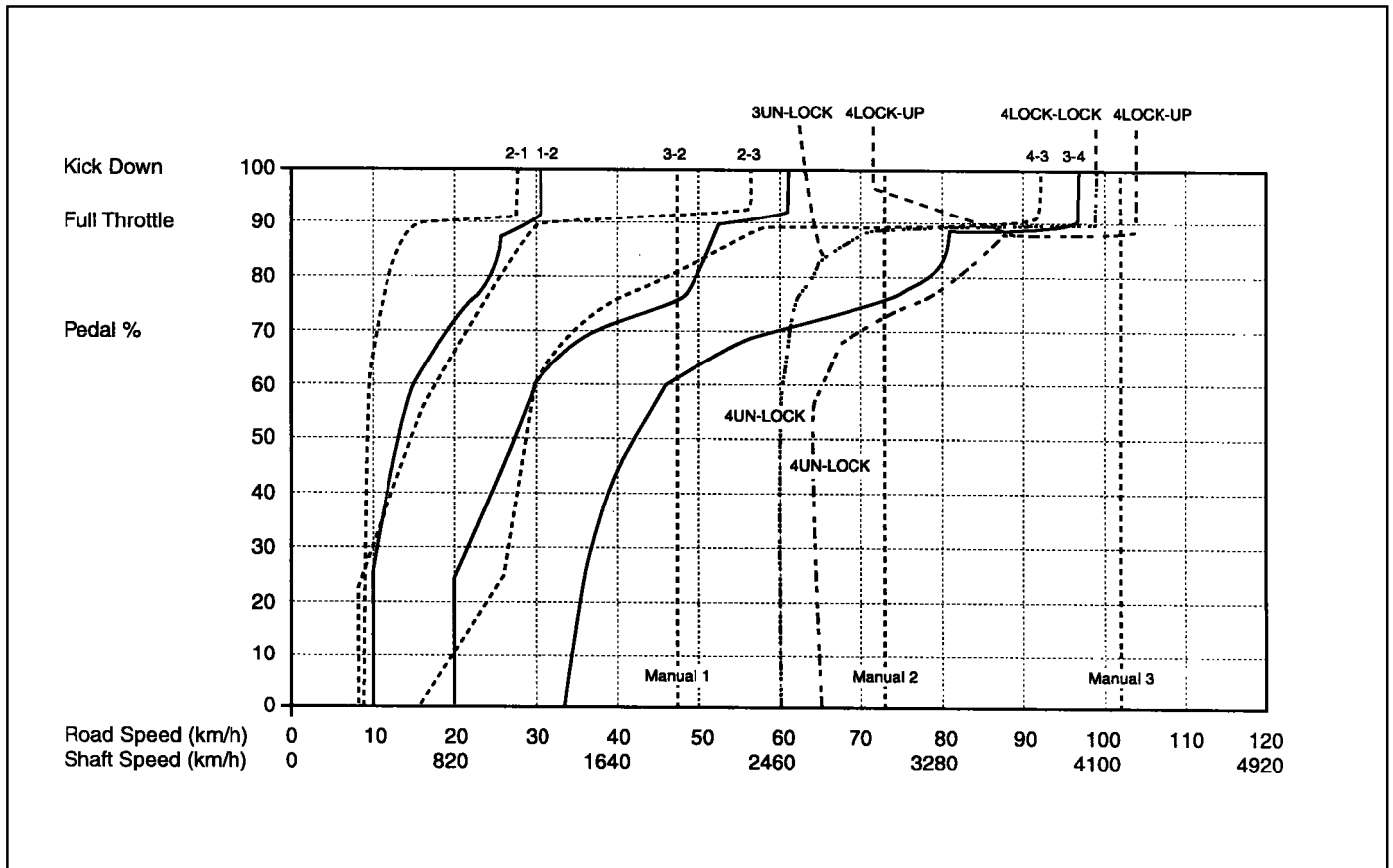
The diagram shows the wiring for these components, including the use of relays and fuses, and the connection to the terminal block. The terminal block pins are labeled with their respective functions and the wire colors used for each connection.

TCU CIRCUIT (4WD-GASOLINE)

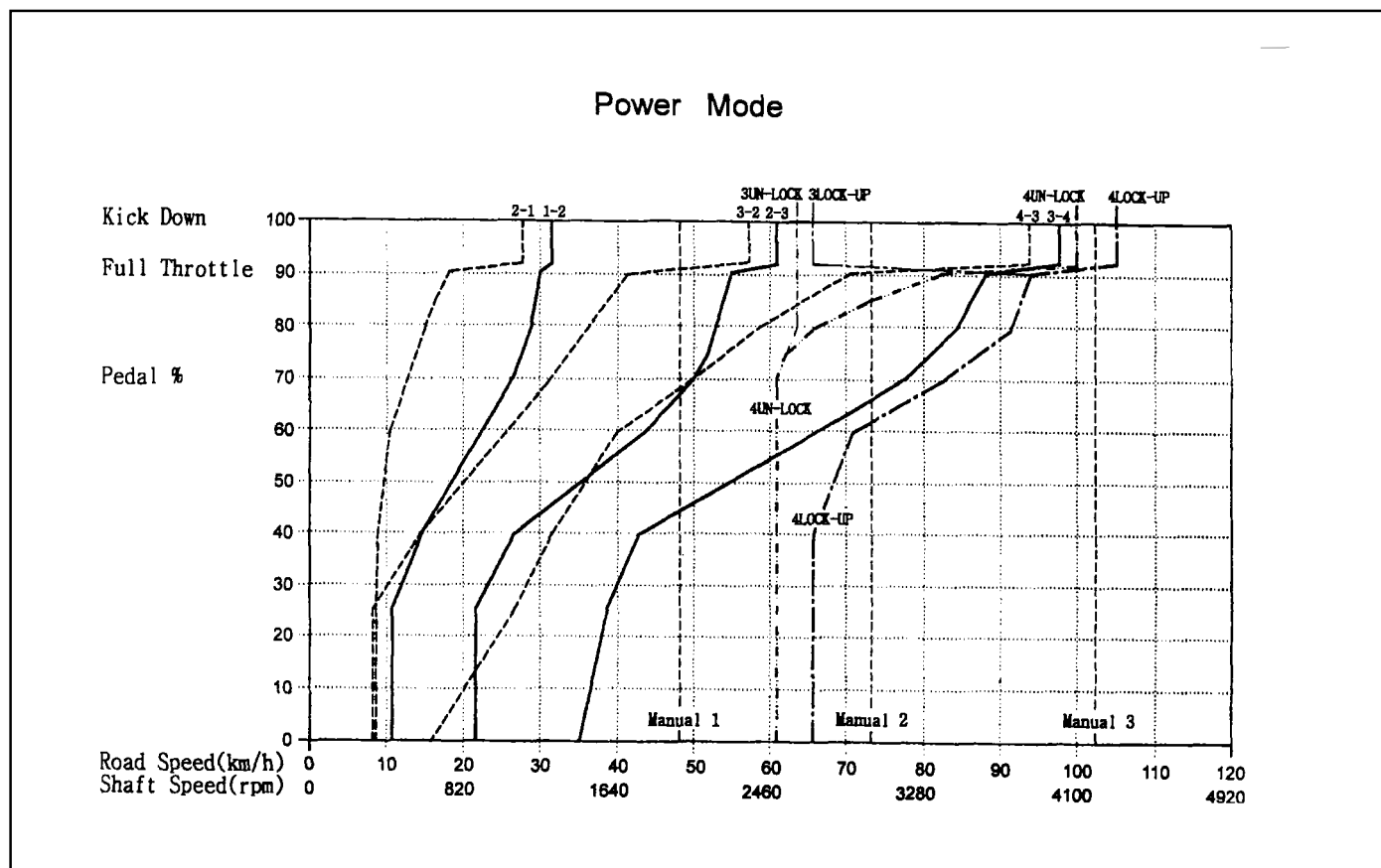


SHIFT PATTERN DIAGRAM

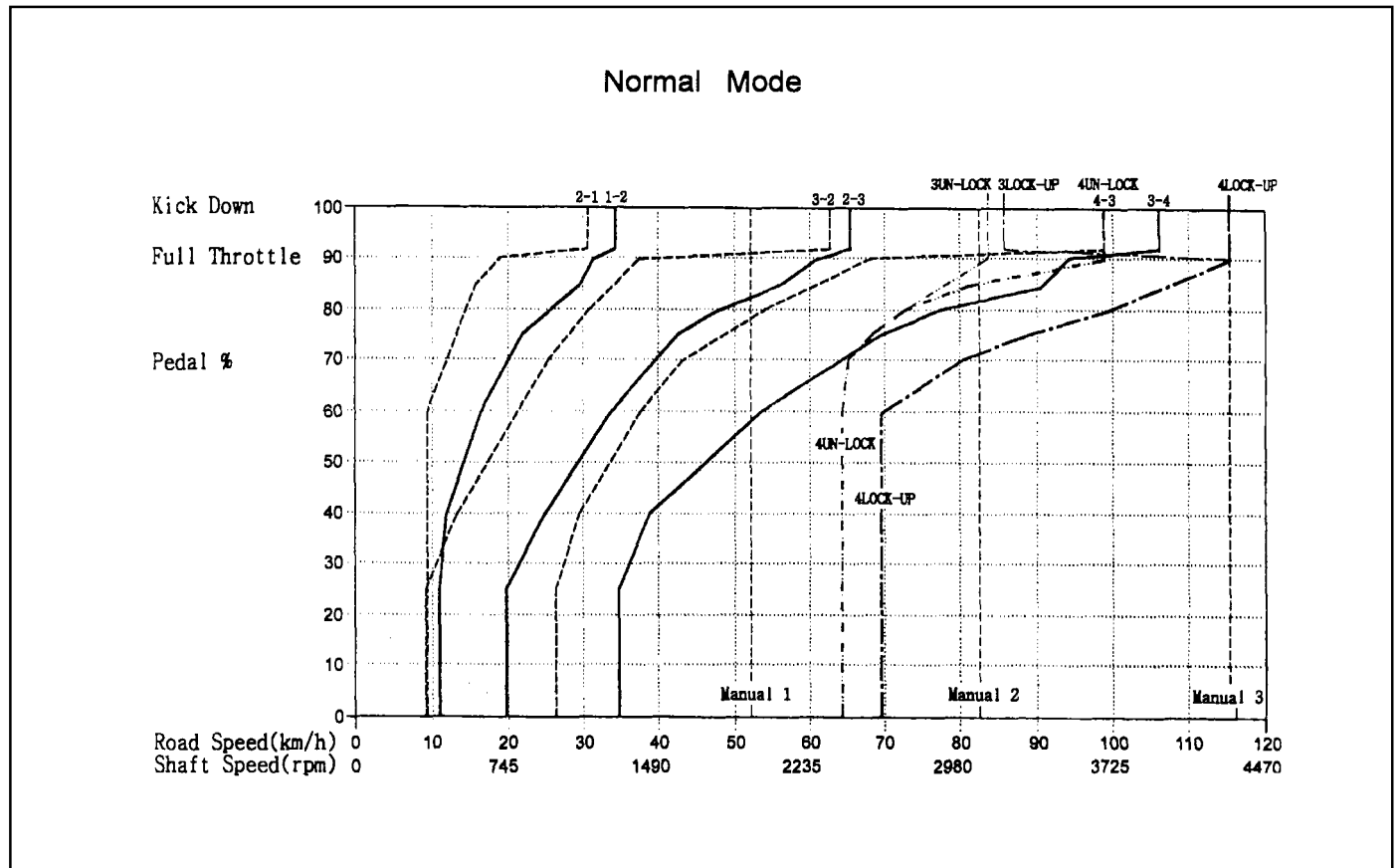
661LA NORMAL MODE



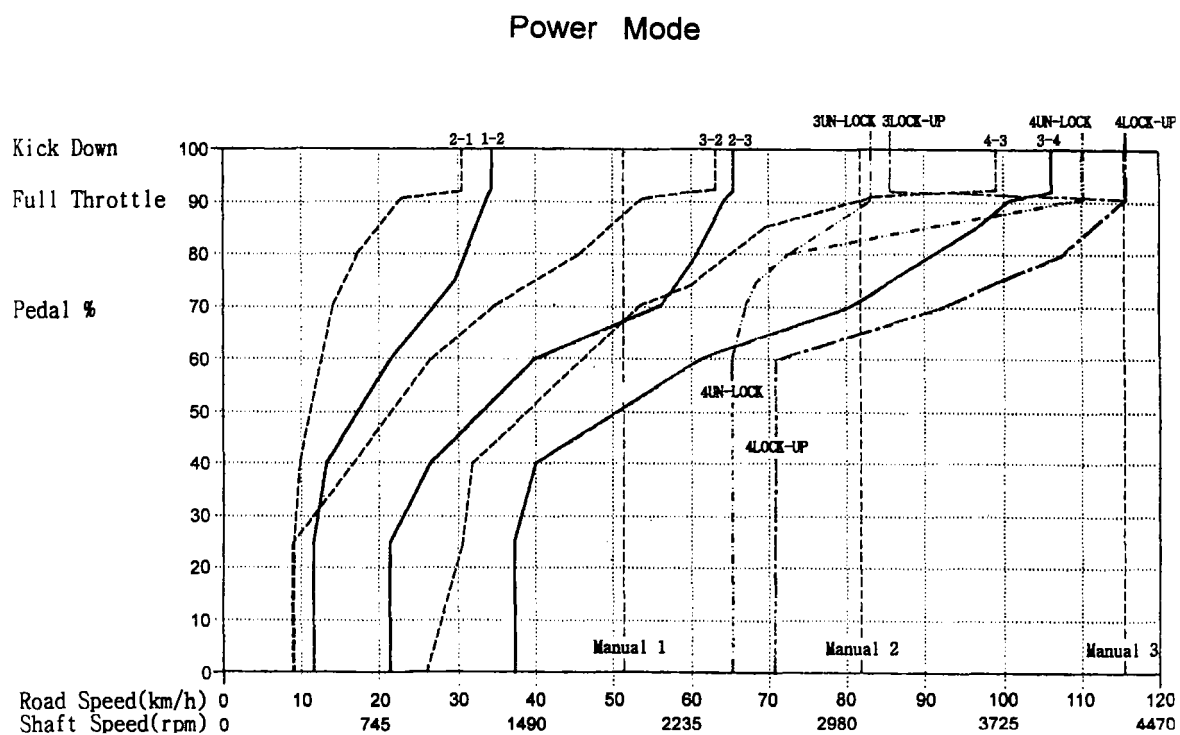
661LA POWER MODE

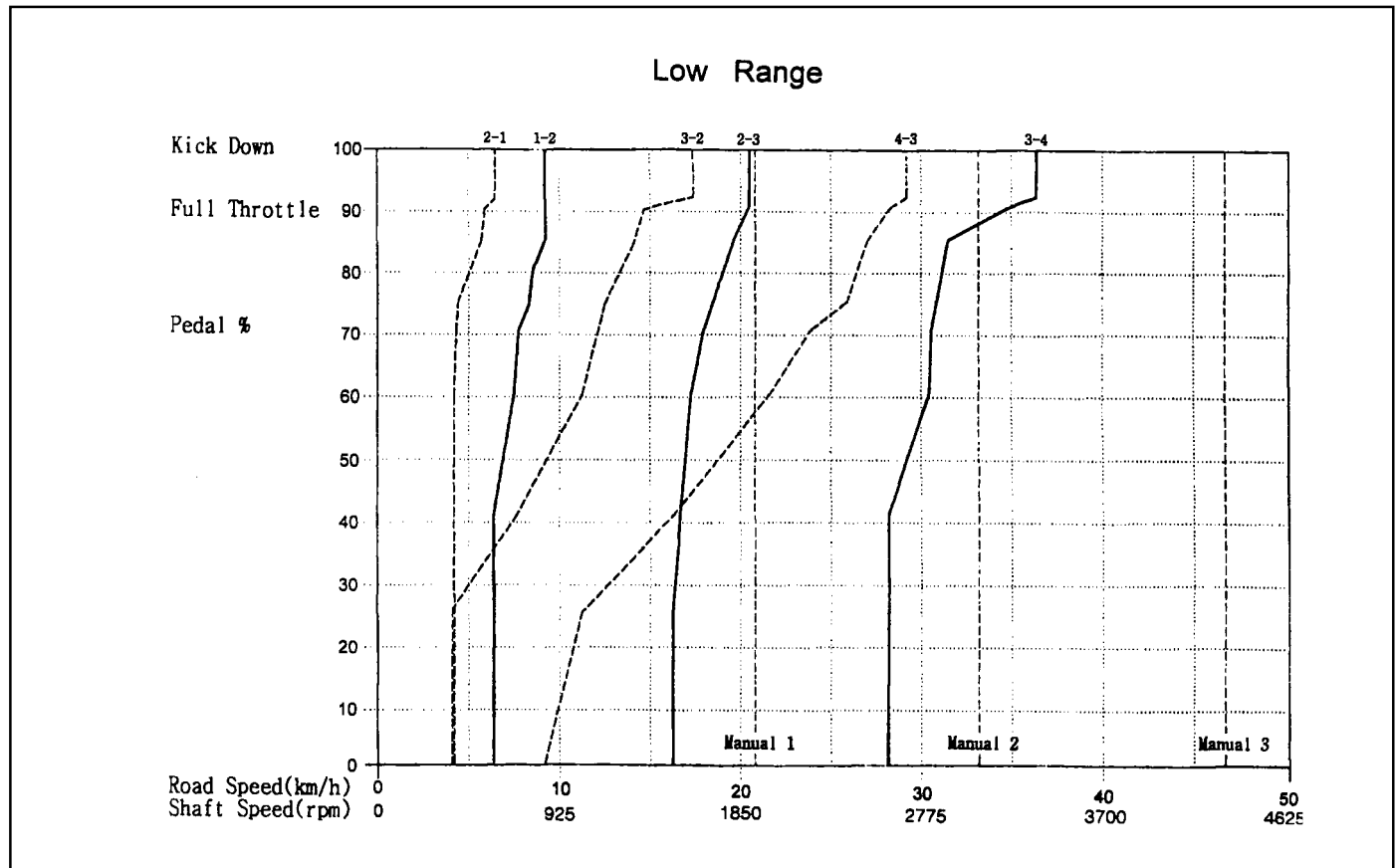


662LA NORMAL MODE

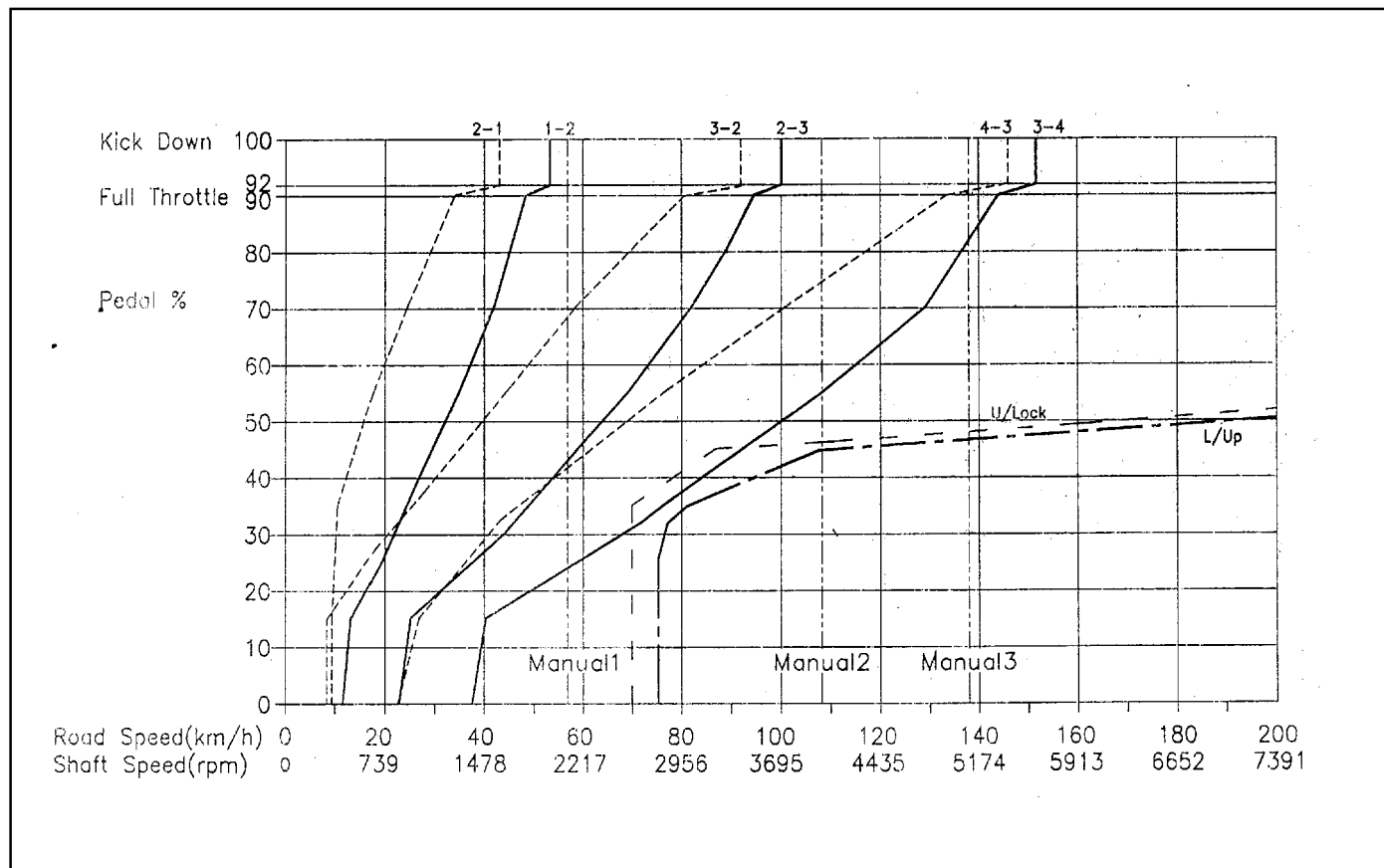


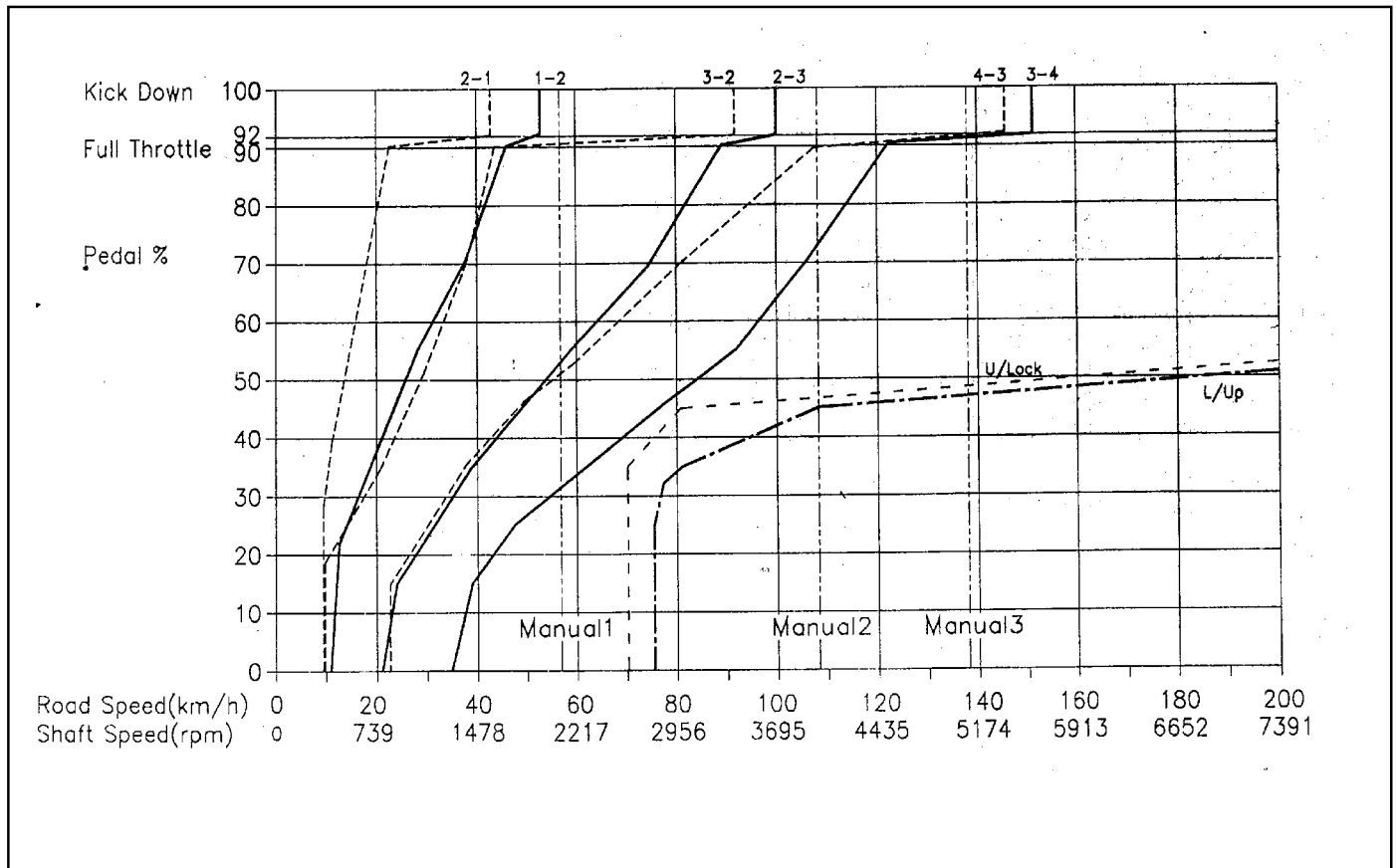
662LA POWER MODE



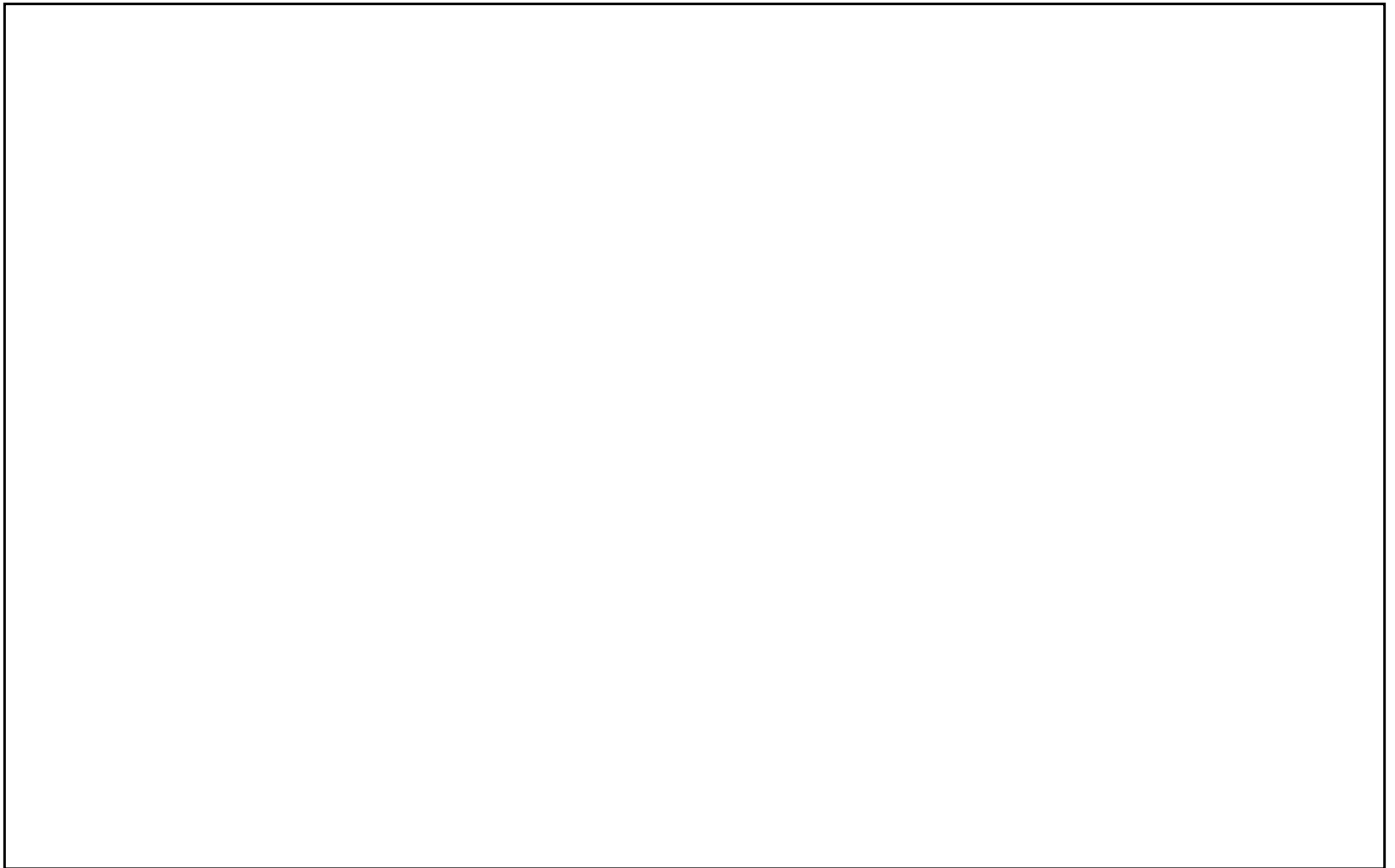
662LA LOW MODE

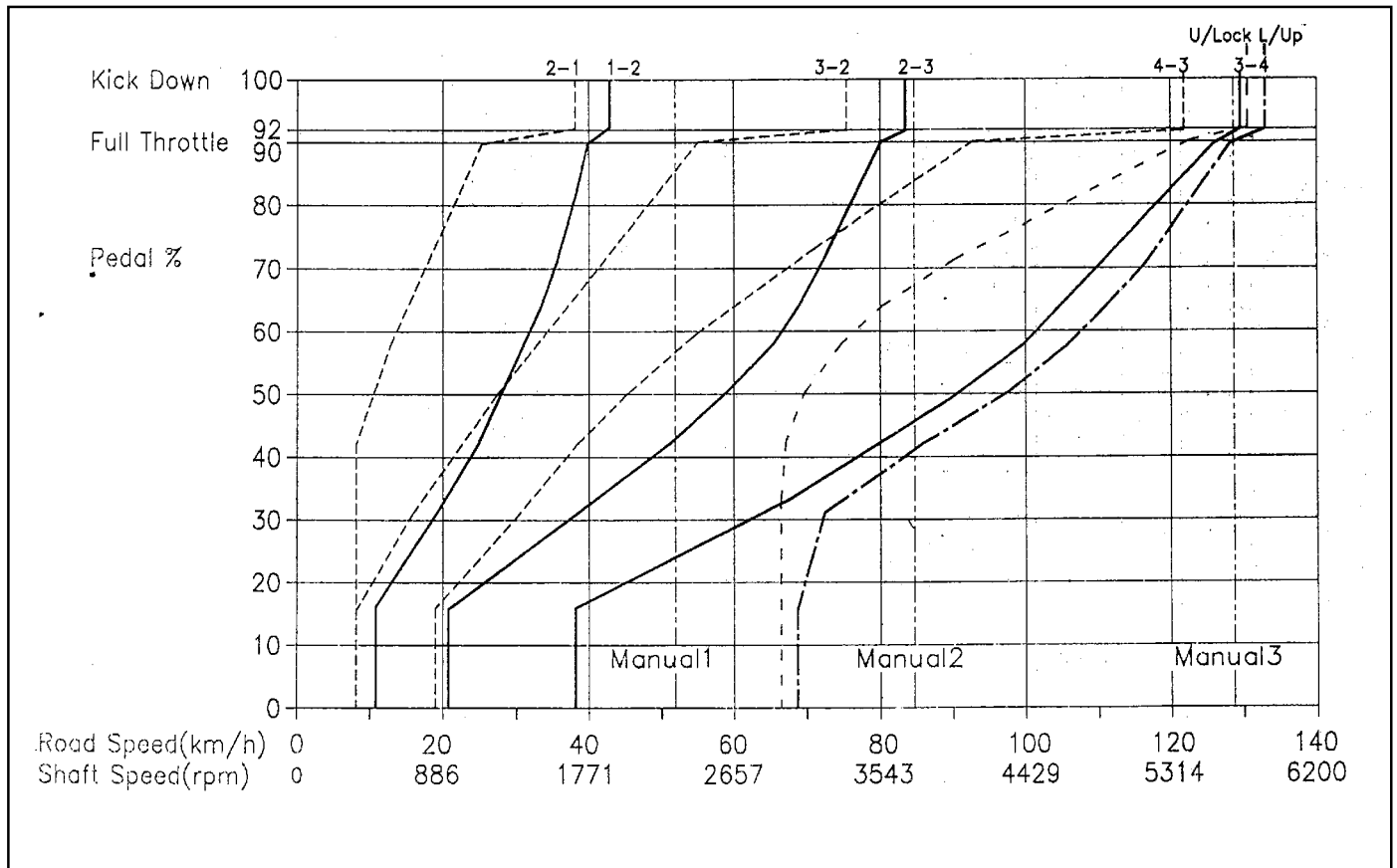
E32 POWER MODE



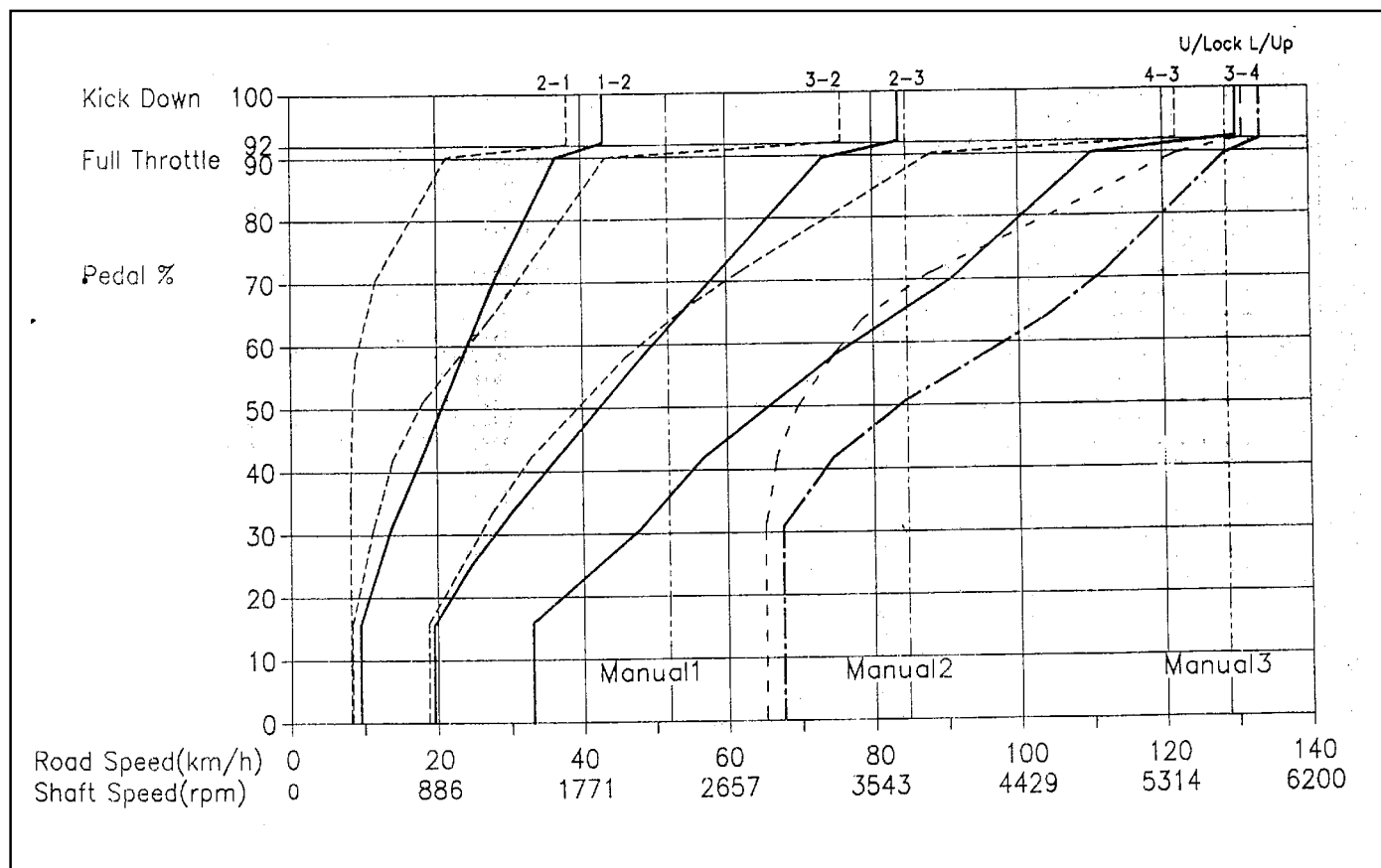
E32 NORMAL MODE

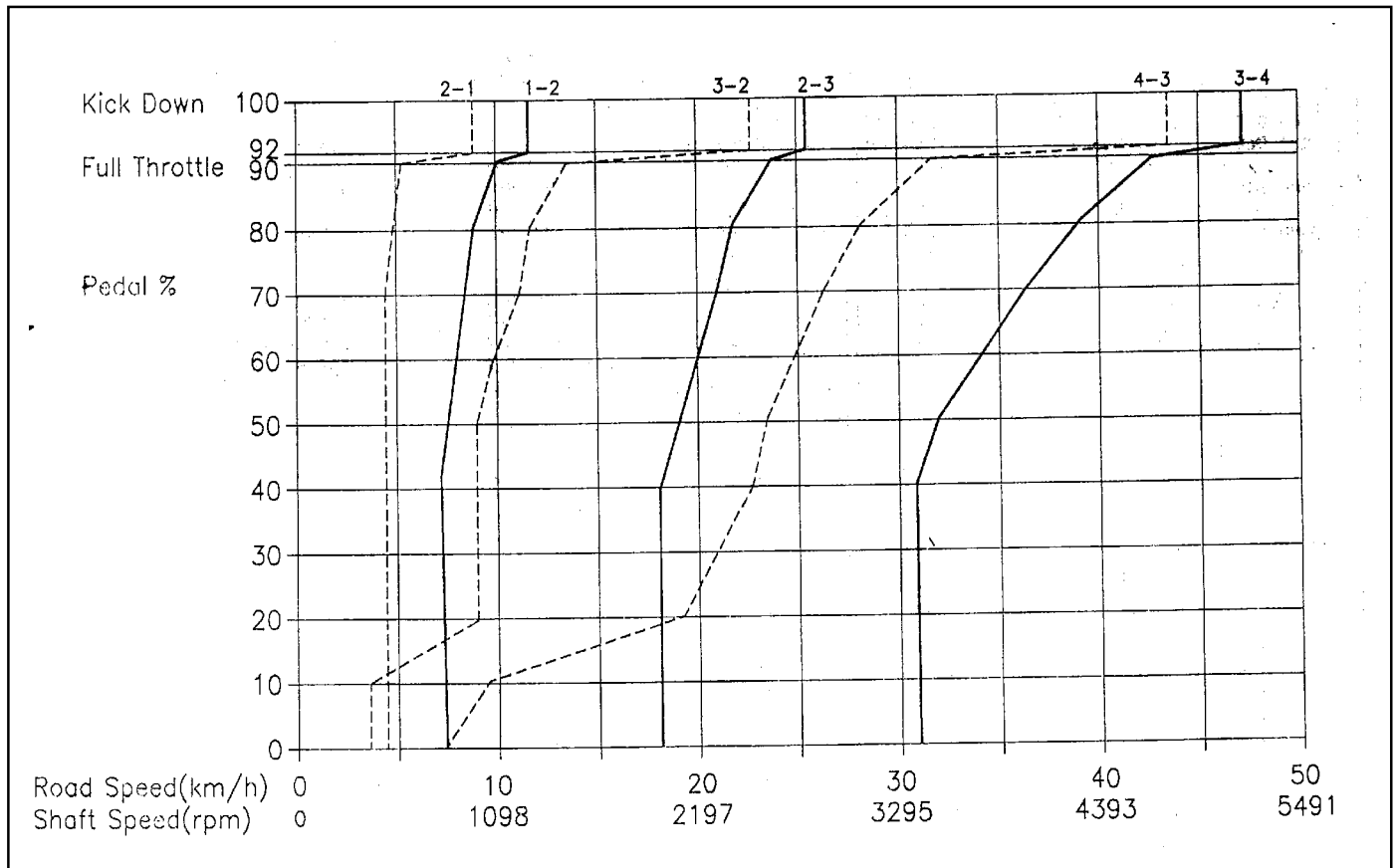
E32 LOW MODE



E23 POWER MODE

E23 NORMAL MODE



E23 LOW MODE

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.

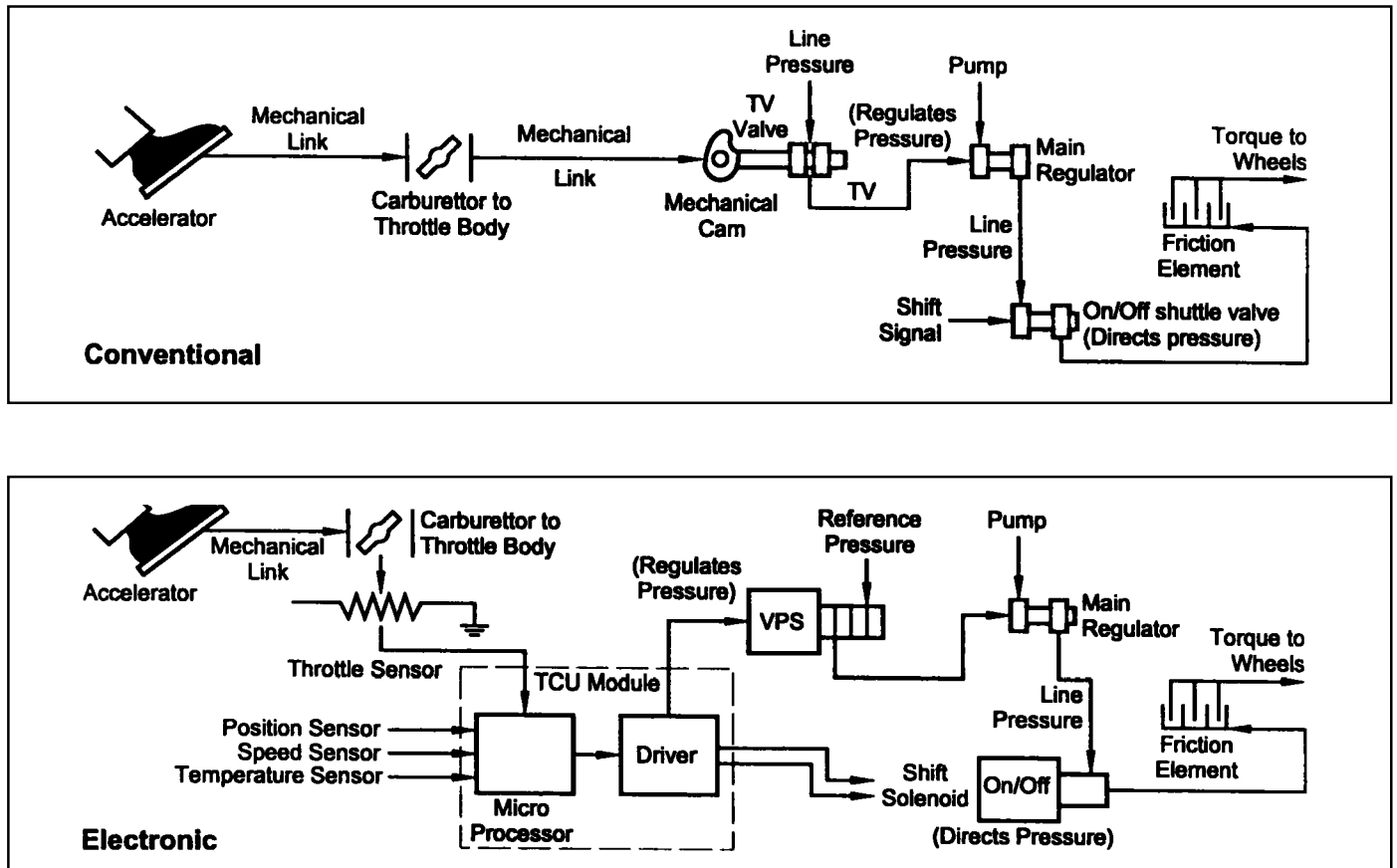
Figure 1.1 details the differences between conventional and electronic transmission control systems.

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

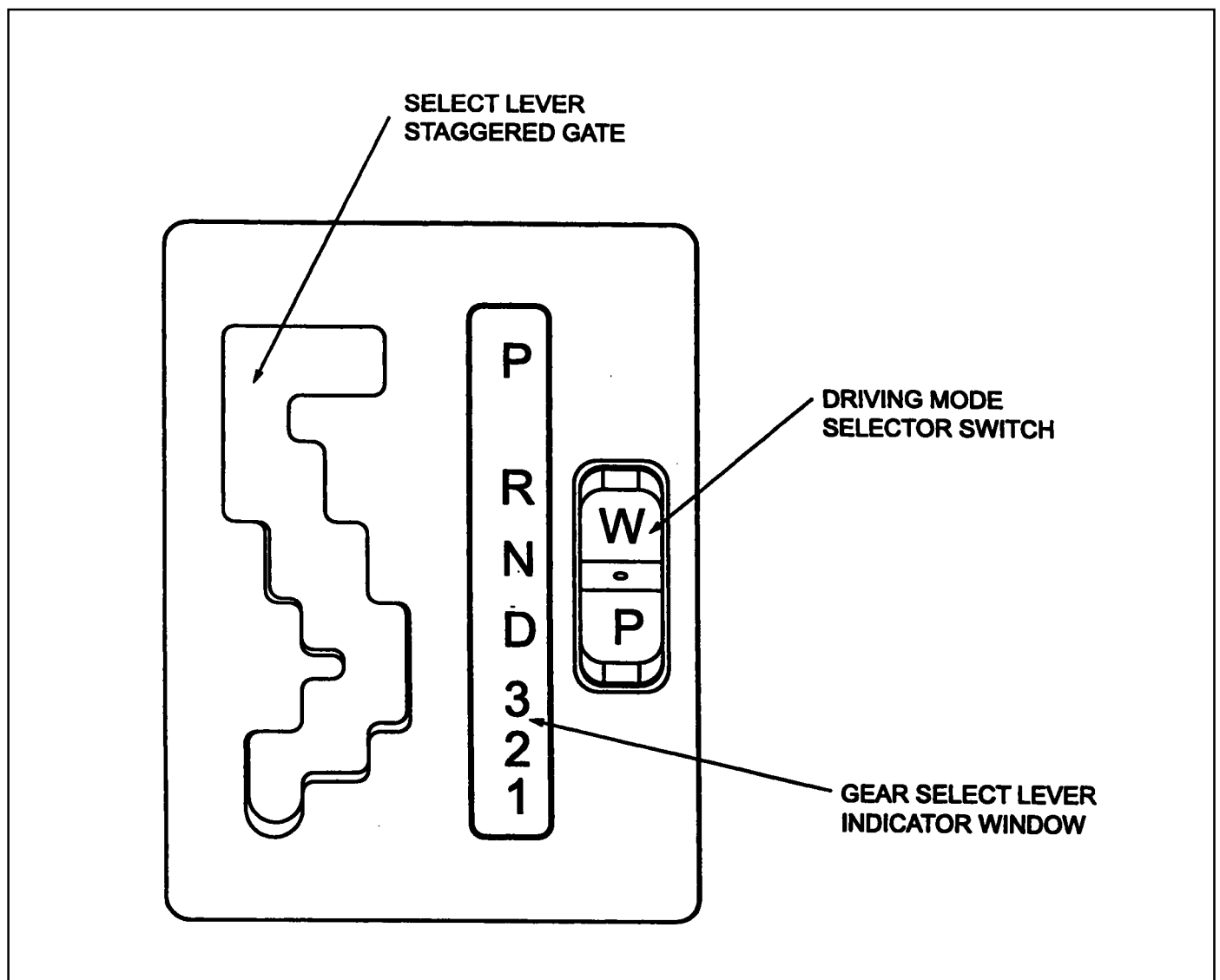


Table 2.1 - Gear Selections

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

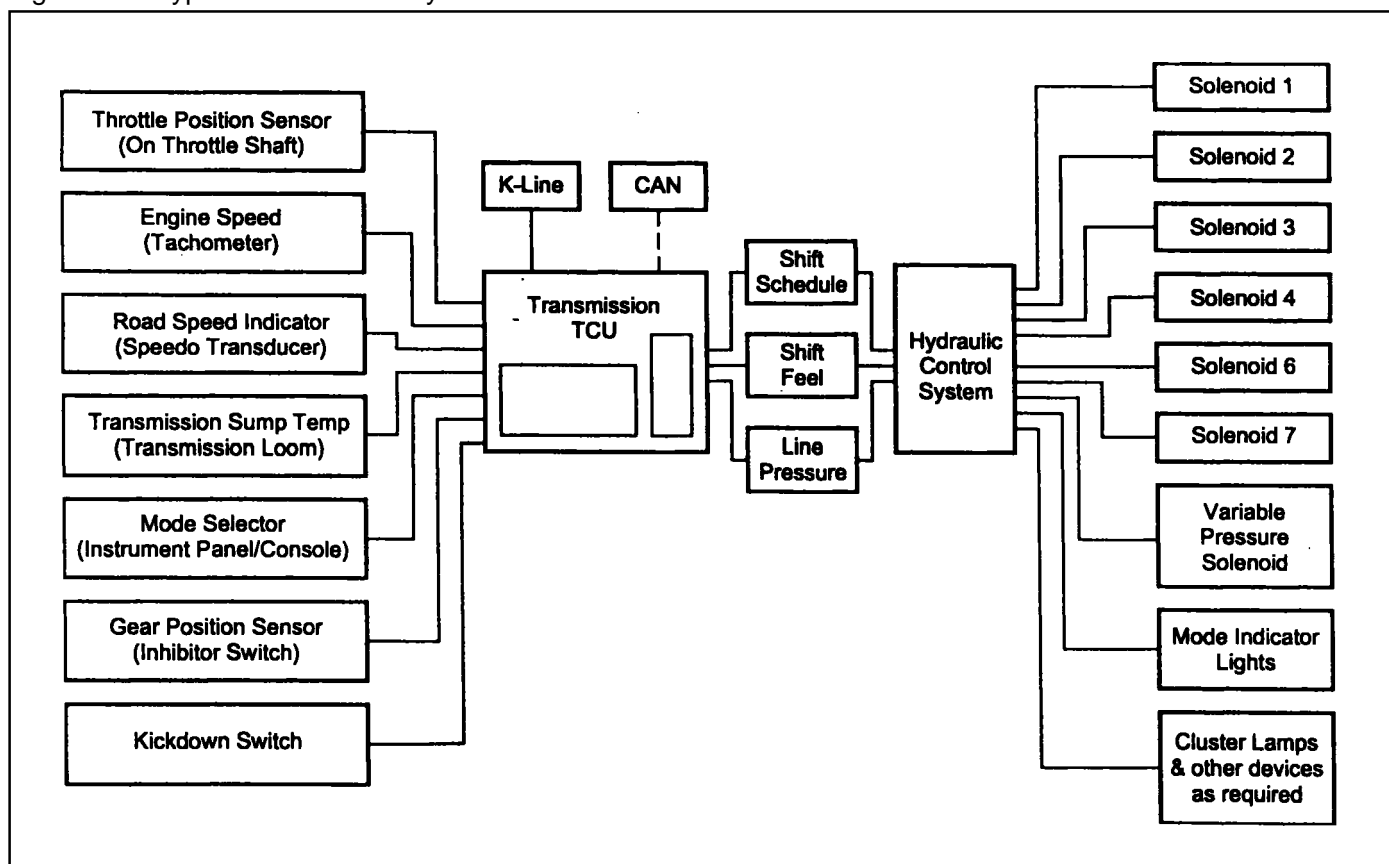
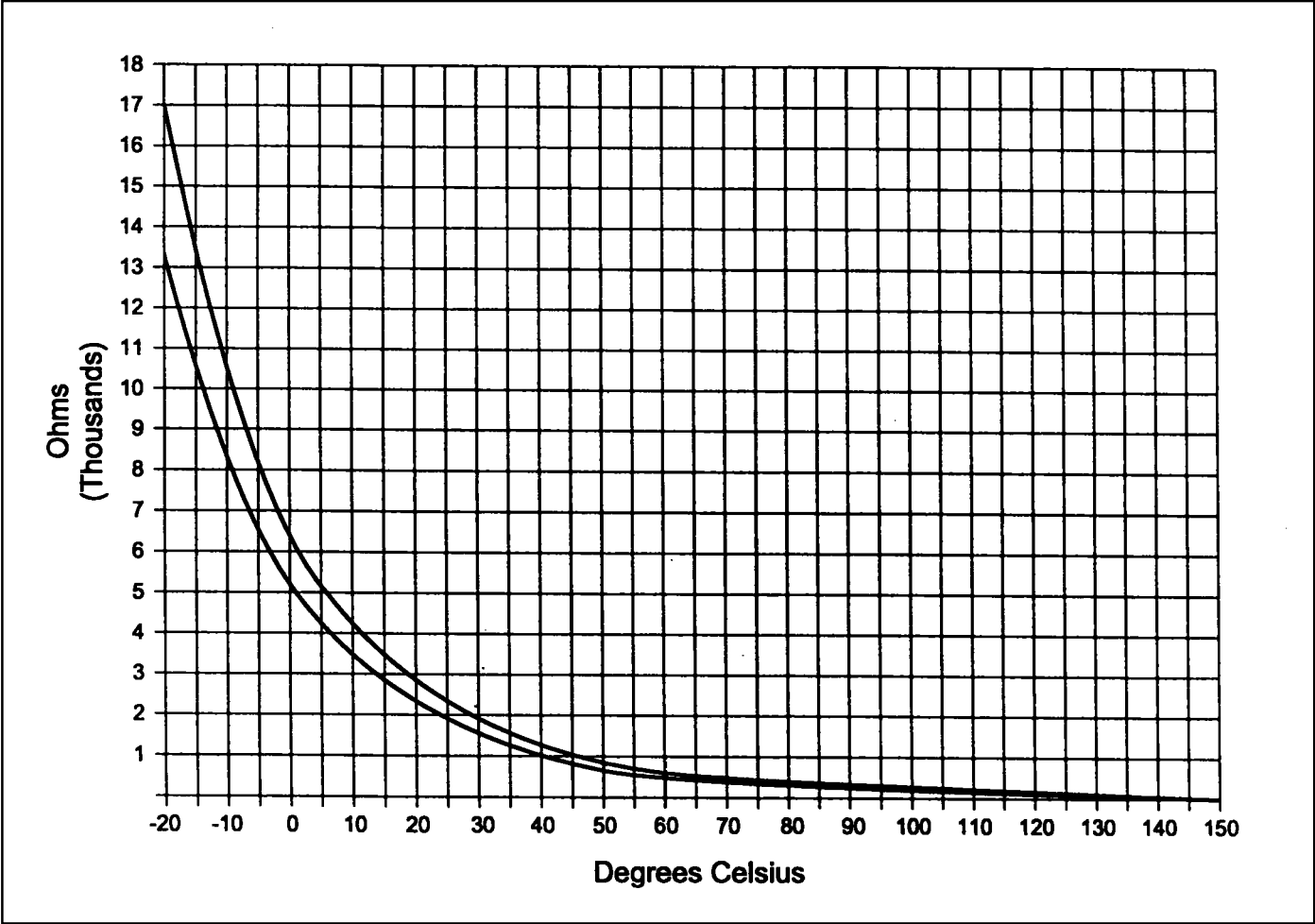


Table 3.1 - Temperature / Resistance Characteristics

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.

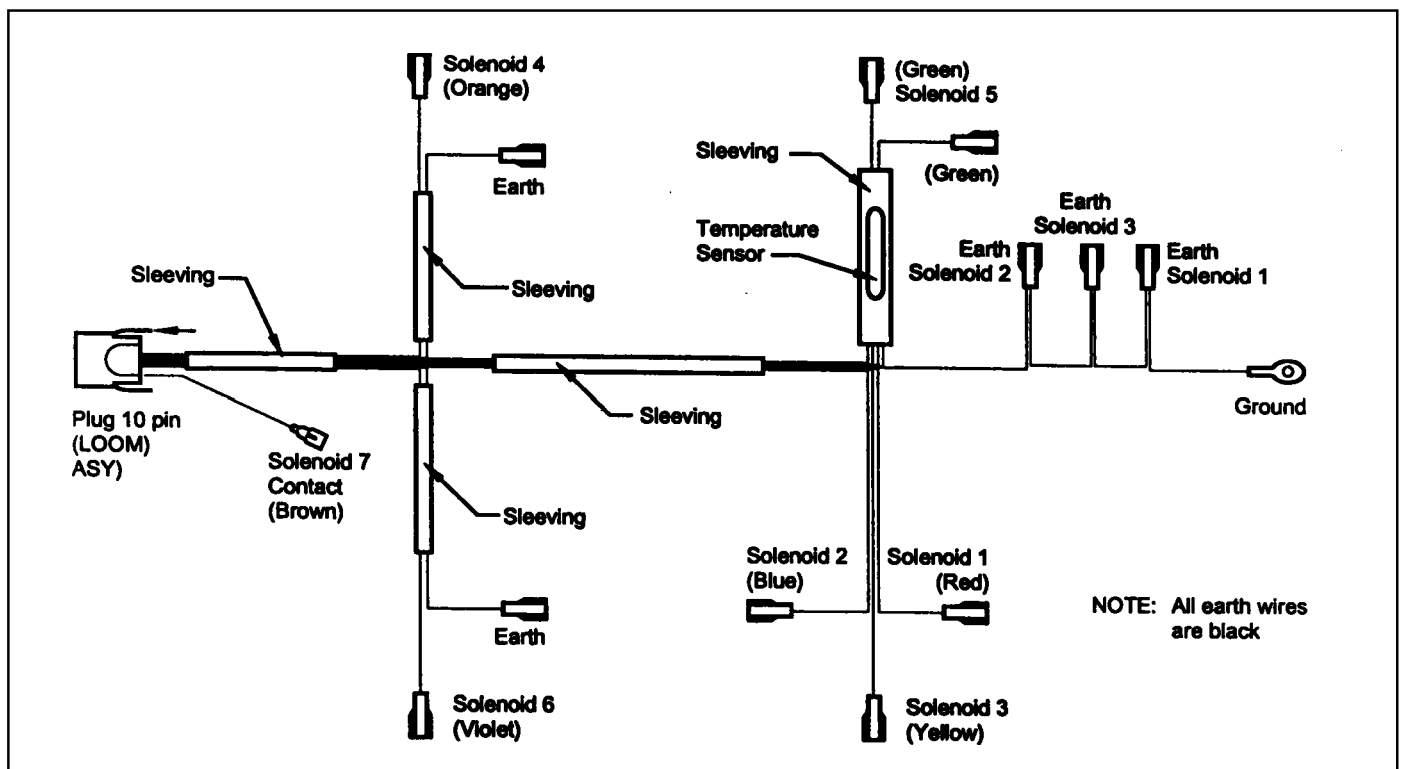
Temperature/Resistance characteristics and location within the solenoid wiring loom are given in tables 3-1 and 3-2, and figures 3.2 and 3.3.

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.

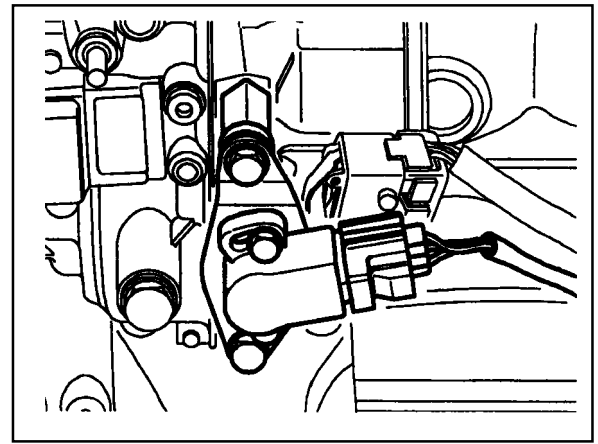
Throttle voltage adjustments are as follows:

- 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.)

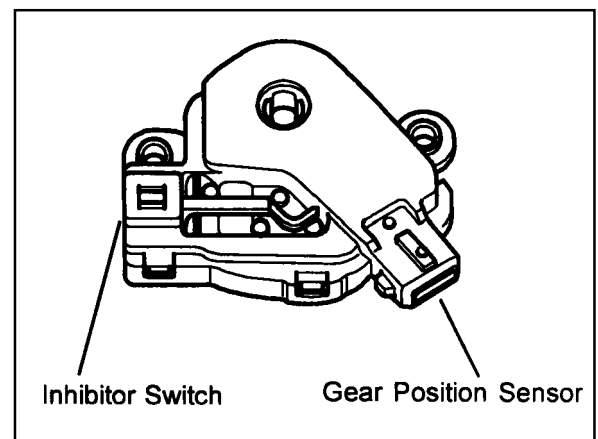


Figure 3.5 - Inhibitor Switch

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.



5A-28 AUTOMATIC TRANSMISSION

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



5A-30 AUTOMATIC TRANSMISSION

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 Off. Refer to figure 3.6 for the On/off operational details of NO solenoid valves.

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,

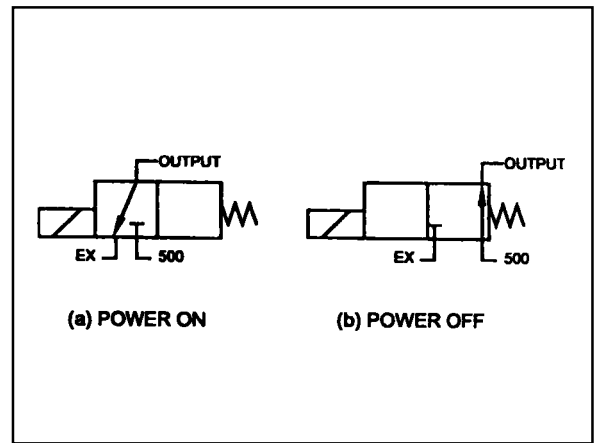


Figure 3.6- Normally Open (NO) Symbols

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.

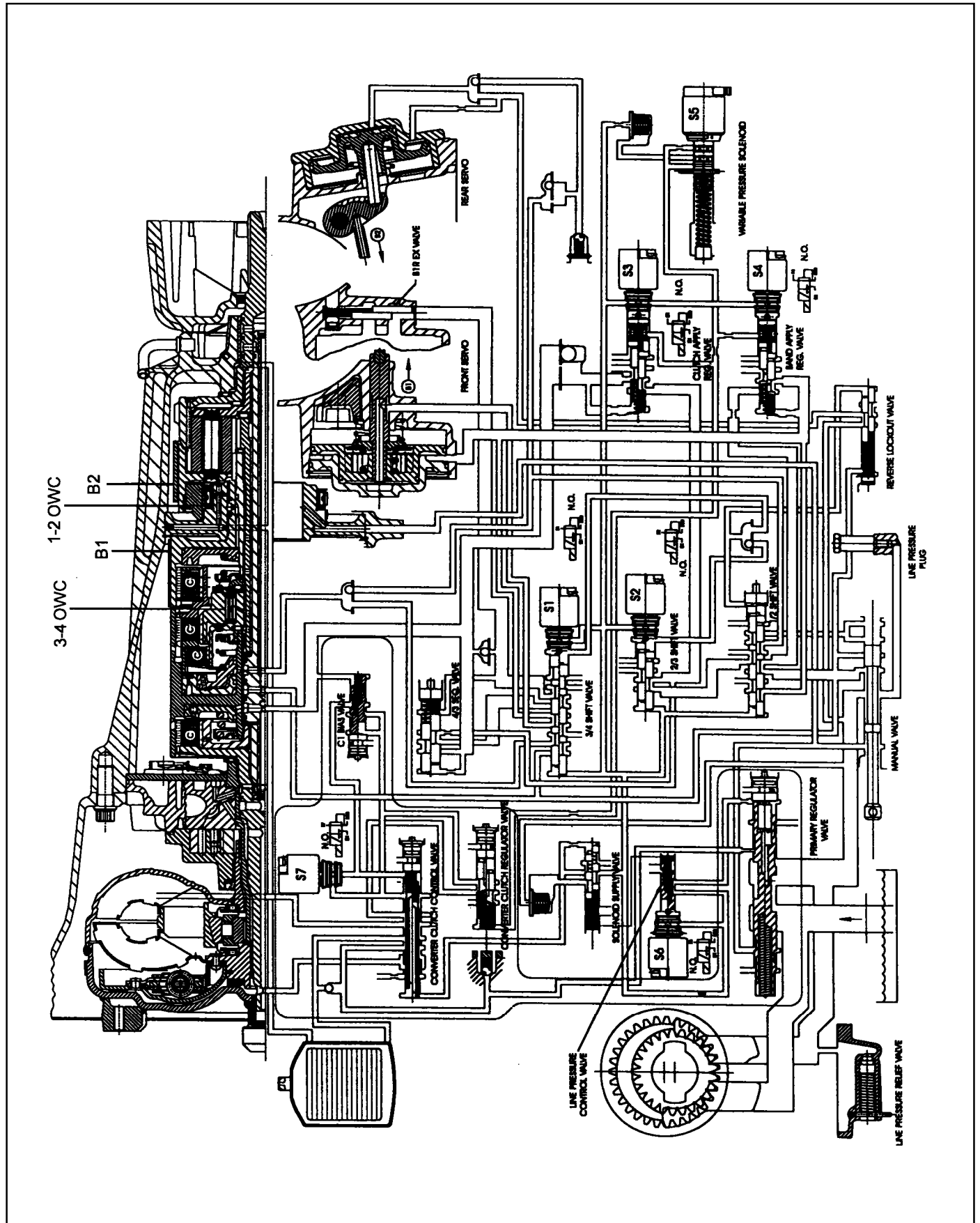
Torque converter lock-up is initiated by toggling the converter clutch control valve with an On/off solenoid. The actual apply and release of the clutch is regulated by the VPS via the converter clutch regulator valve. As an additional safety feature, the lock-up is hydraulically disabled in first and 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.



5A-32 AUTOMATIC TRANSMISSION

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.

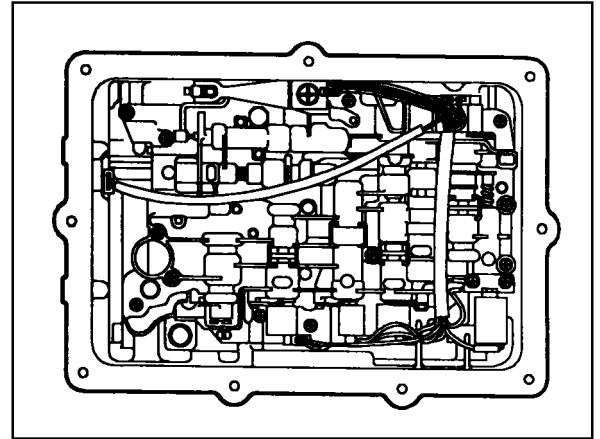


Figure 3.8 - Valve Body

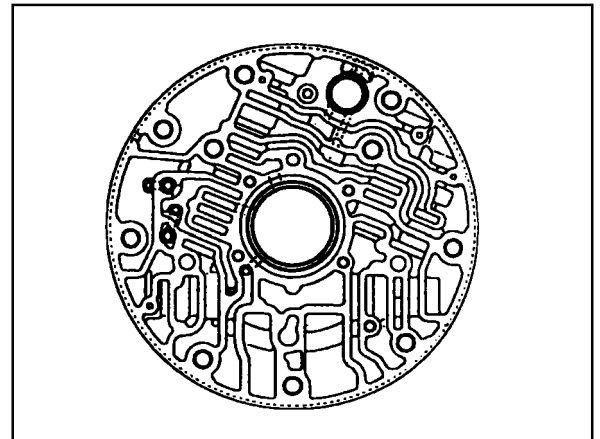
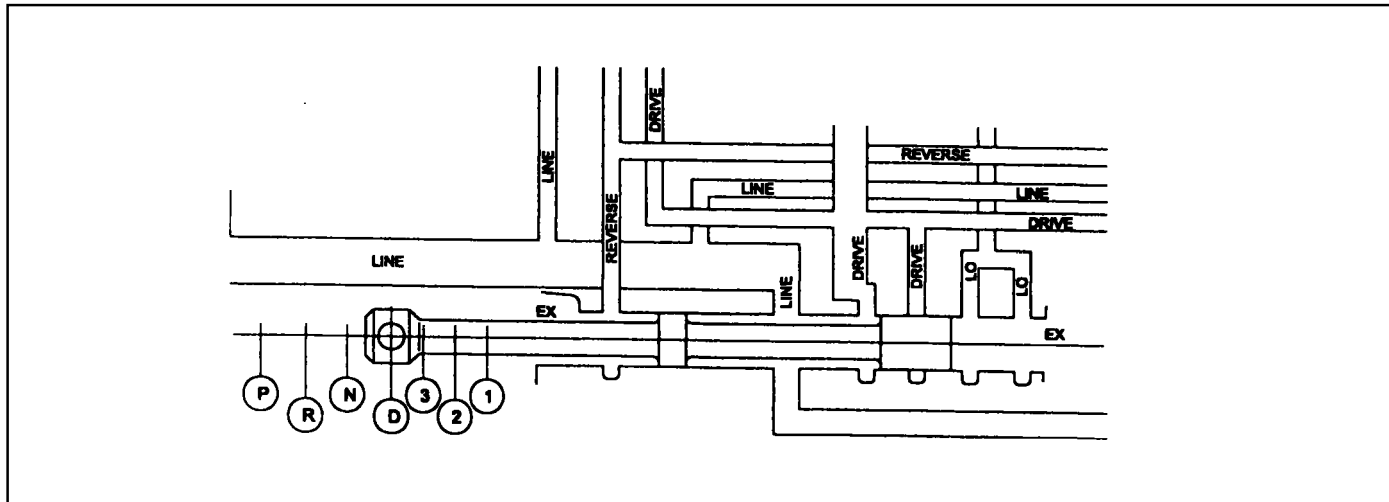


Figure 3.9 - Pump Cover

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

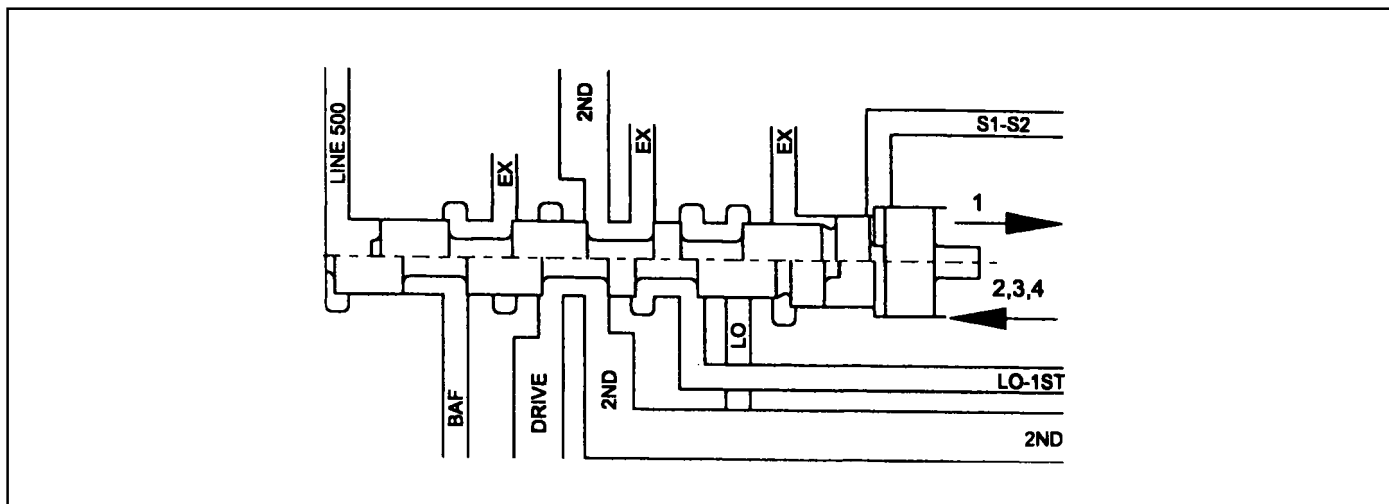
The 1-2 shift valve (refer to figure 3.11) is a two position valve that must be switched to the (2,3,4) position in order to get any forward gear other than first gear. It is used for all 1-2 and 2-1 gearshifts.

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



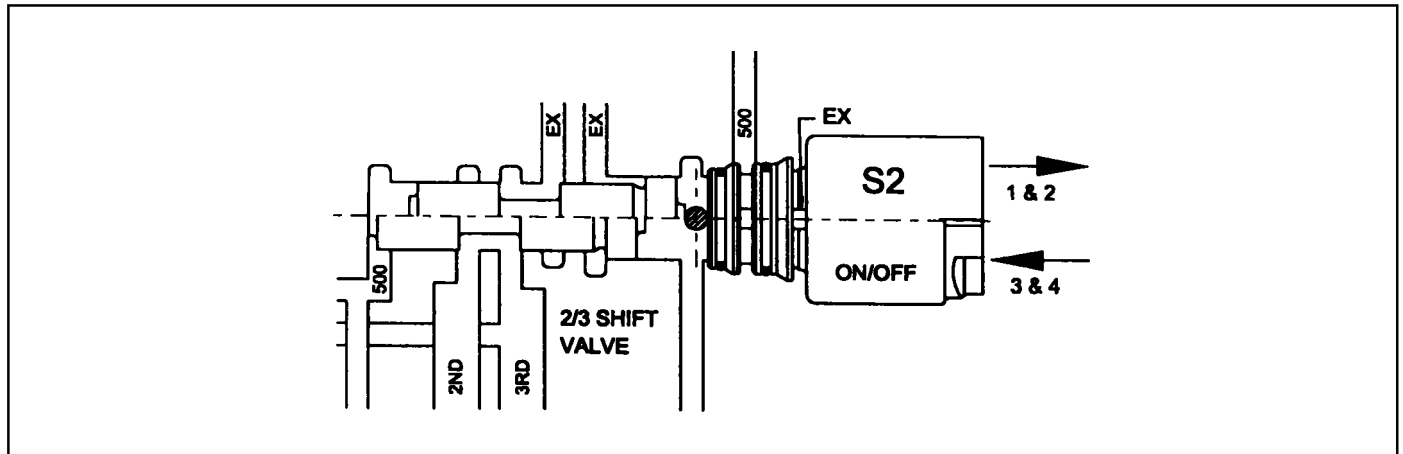
2-3 Shift Valve

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.

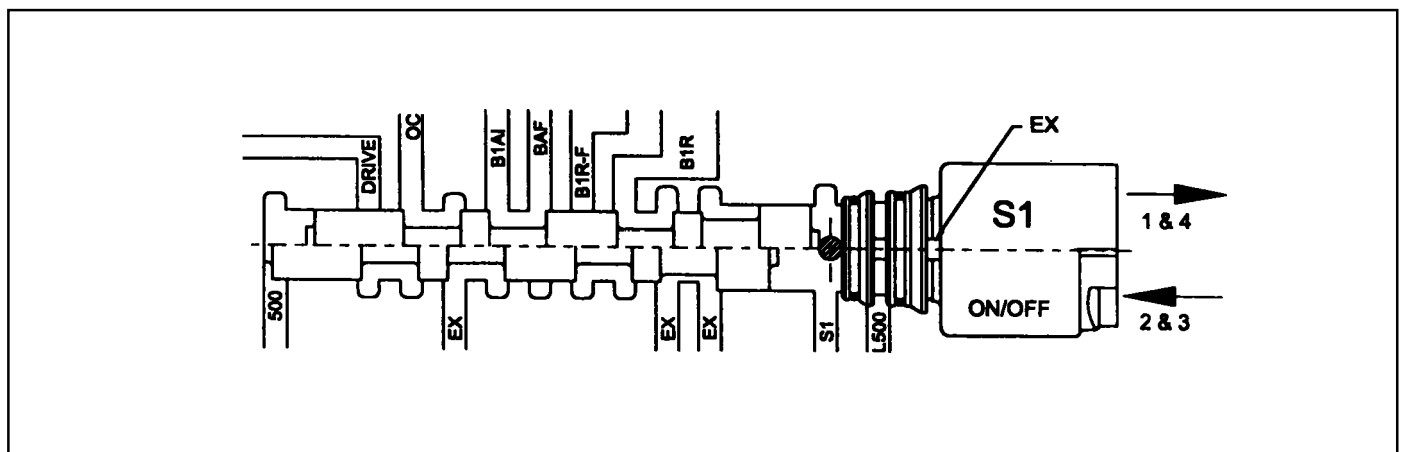
During a 3-4 gearshift the 3-4 shift valve:

- 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

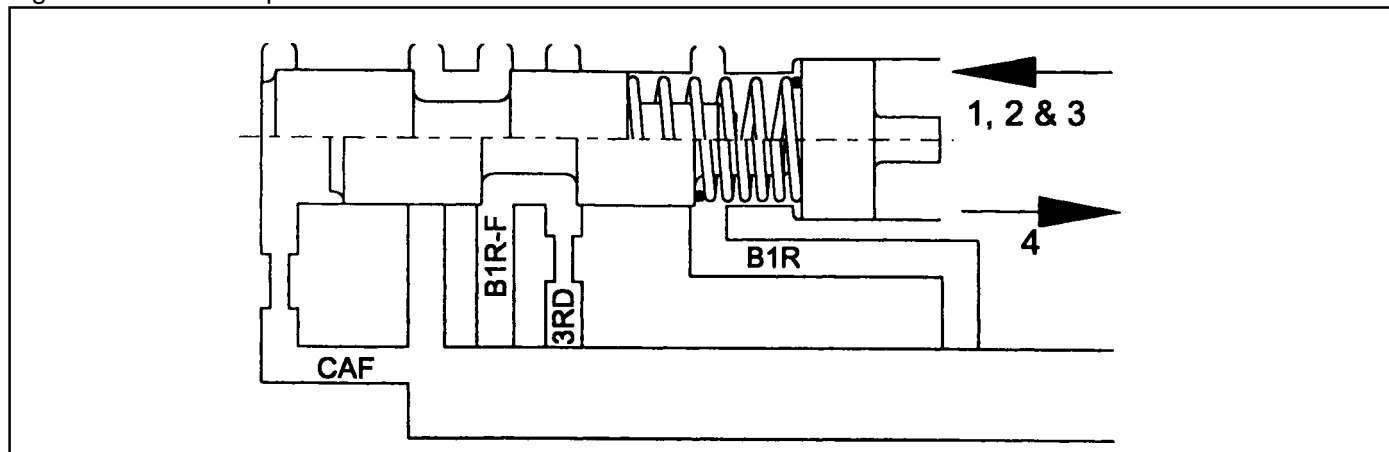


4-3 Sequence Valve

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 B1R circuit until the B1R 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

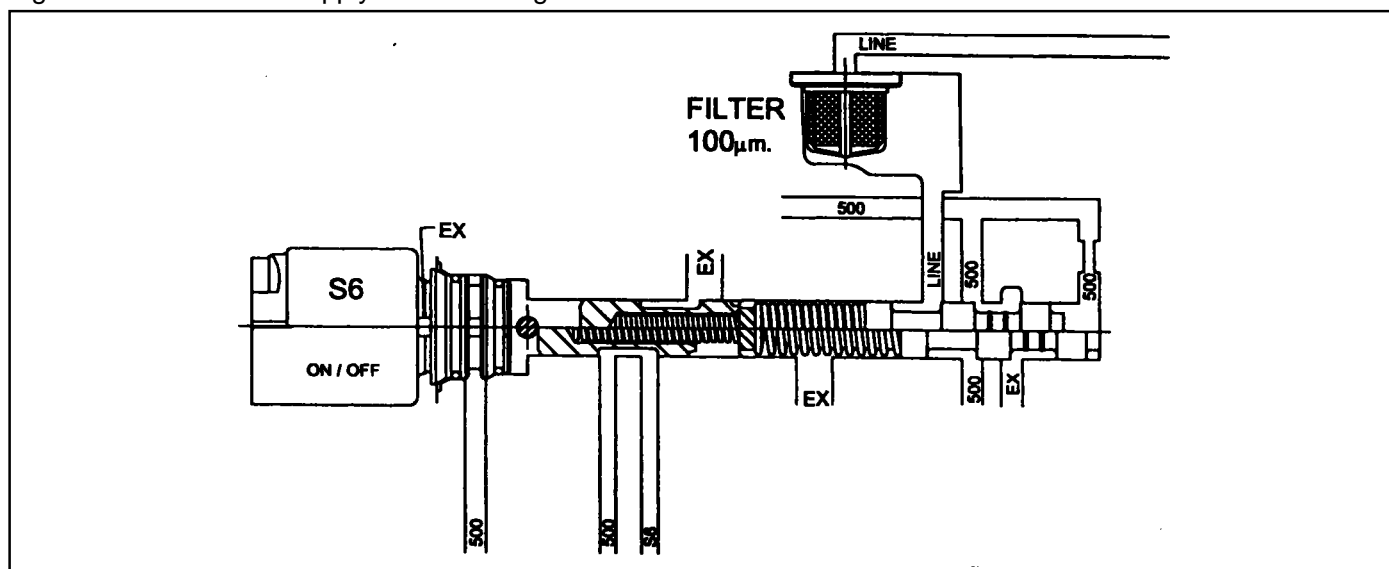
The solenoid supply valve (refer figure 3.15) supplies a constant pressure to all solenoids (51 to 57). Line pressure is used as the feed oil to this regulator and the output is termed line 500.

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



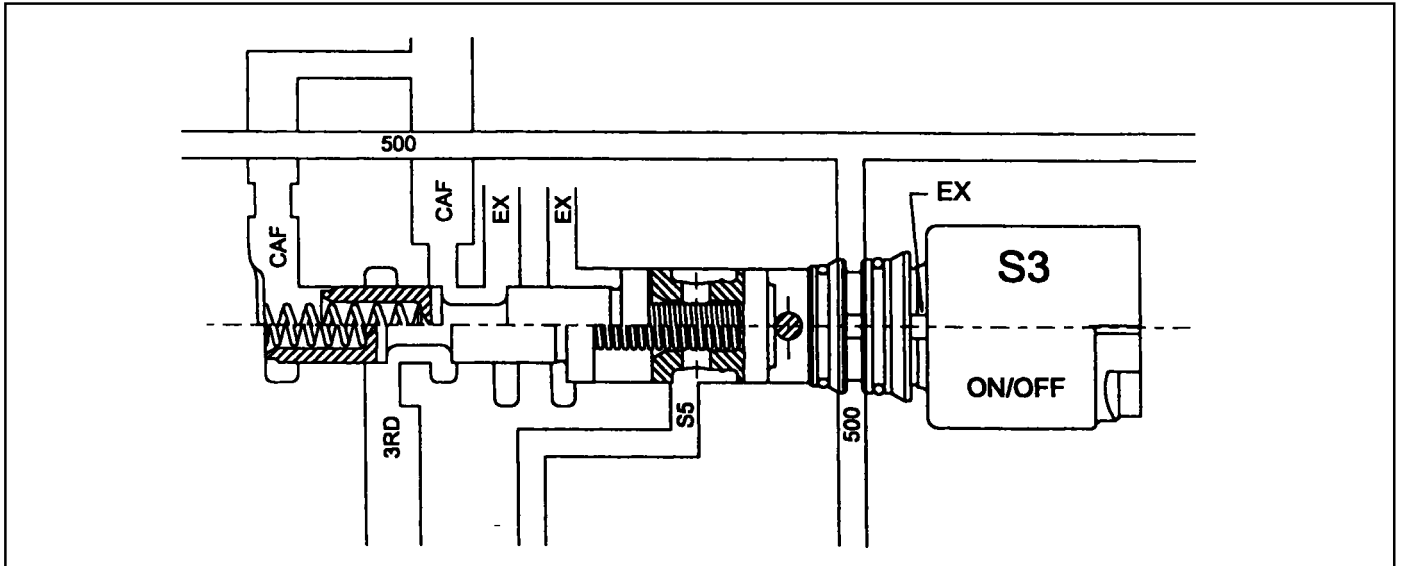
Clutch Apply Regulator Valve

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



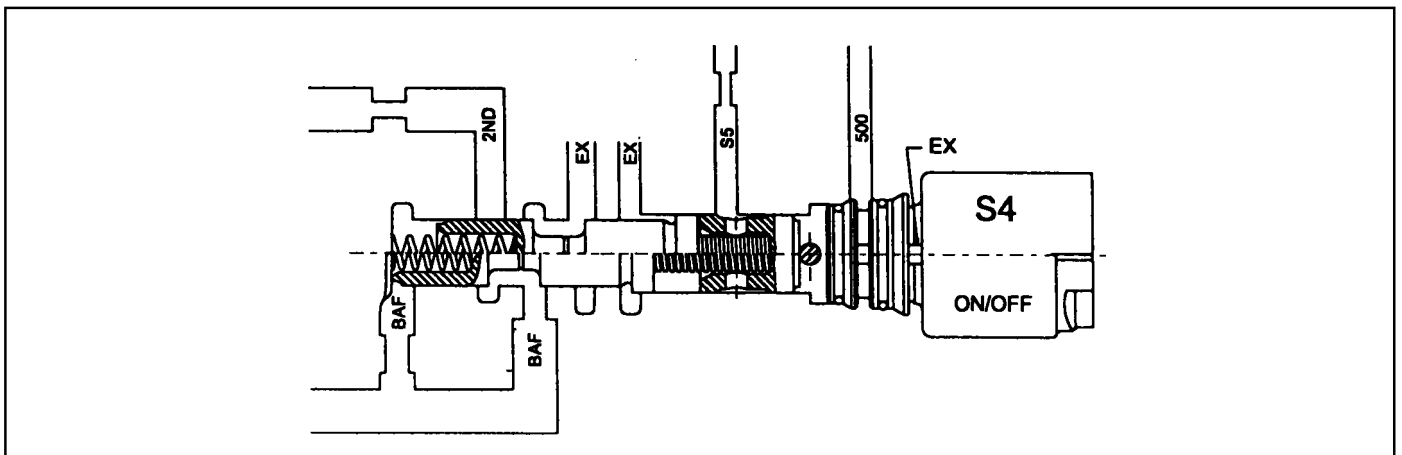
Band Apply regulator Valve

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, road speed ≤ 3 km/h.
2. In R, road speed ≤ 10 km/h.
3. Engine speed ≤ 1400 rpm.
4. For diesel vehicles, throttle $\leq 25\%$.
5. For gasoline vehicles, throttle $\leq 12\%$.

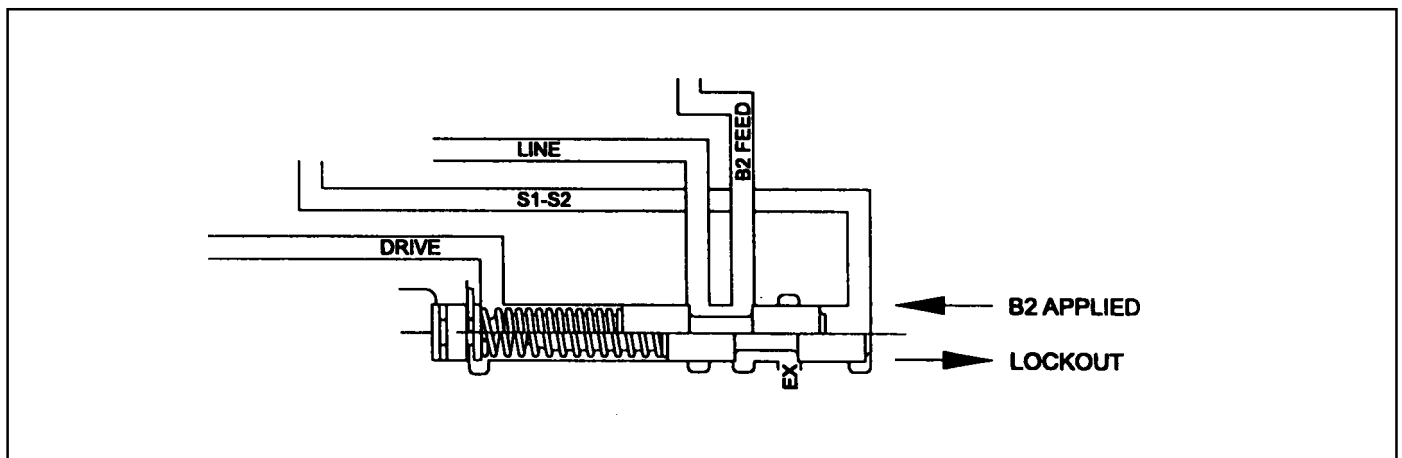
Under these conditions, the TCU switches solenoids S1 and S2 to Off. The reverse lockout valve toggles under the influence of the S1-S2 pressure, to connect the line pressure to the B2 feed. Oil is fed to both the inner and outer apply areas of the rear servo piston, applying B2.

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

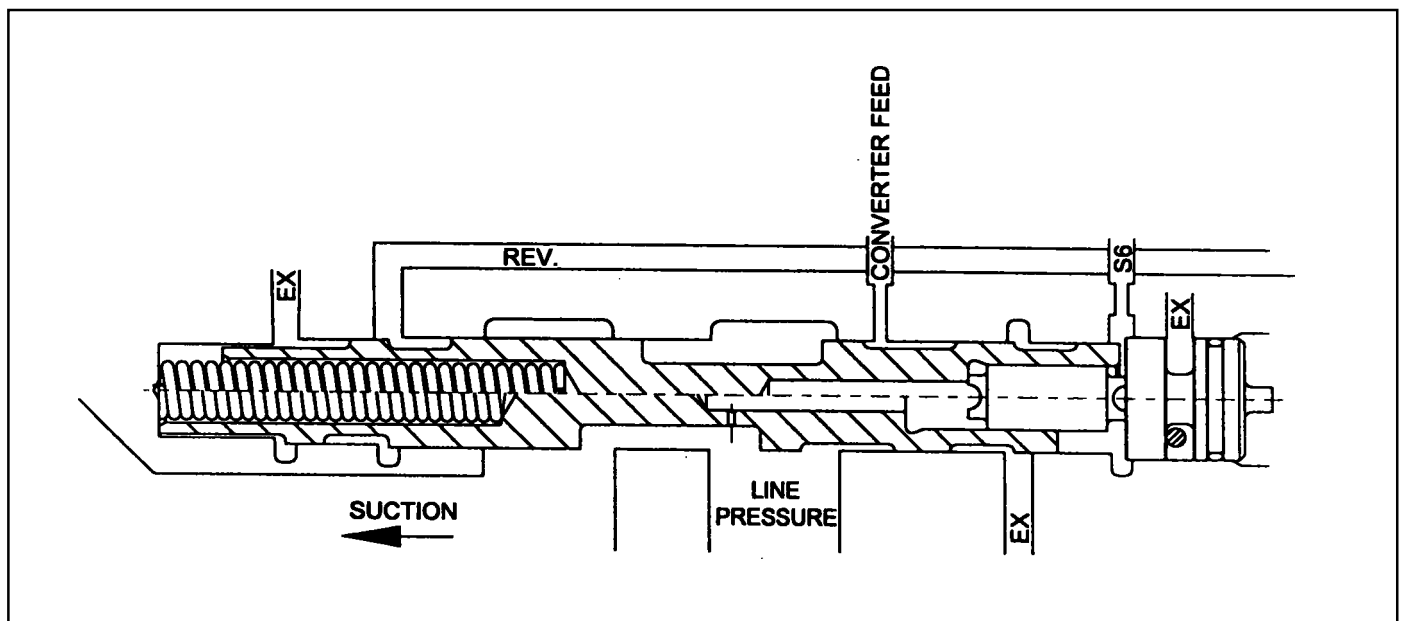
The primary regulator valve (PRV) (refer to figure 3.19) regulates the transmission line pressure (or pump output pressure). This valve gives either high or low line pressure depending on whether S6 is switched Off or On. When S6 is switched On, S6 pressure is applied to the PRV moving it against spring 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 S6 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.

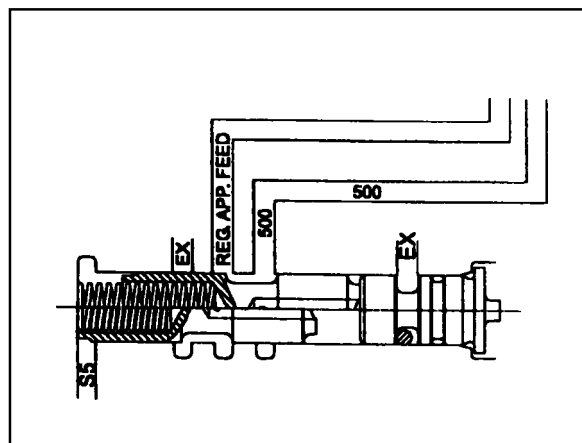


Figure 3.20 - Converter Clutch Regulator Valve

Converter Clutch Control Valve

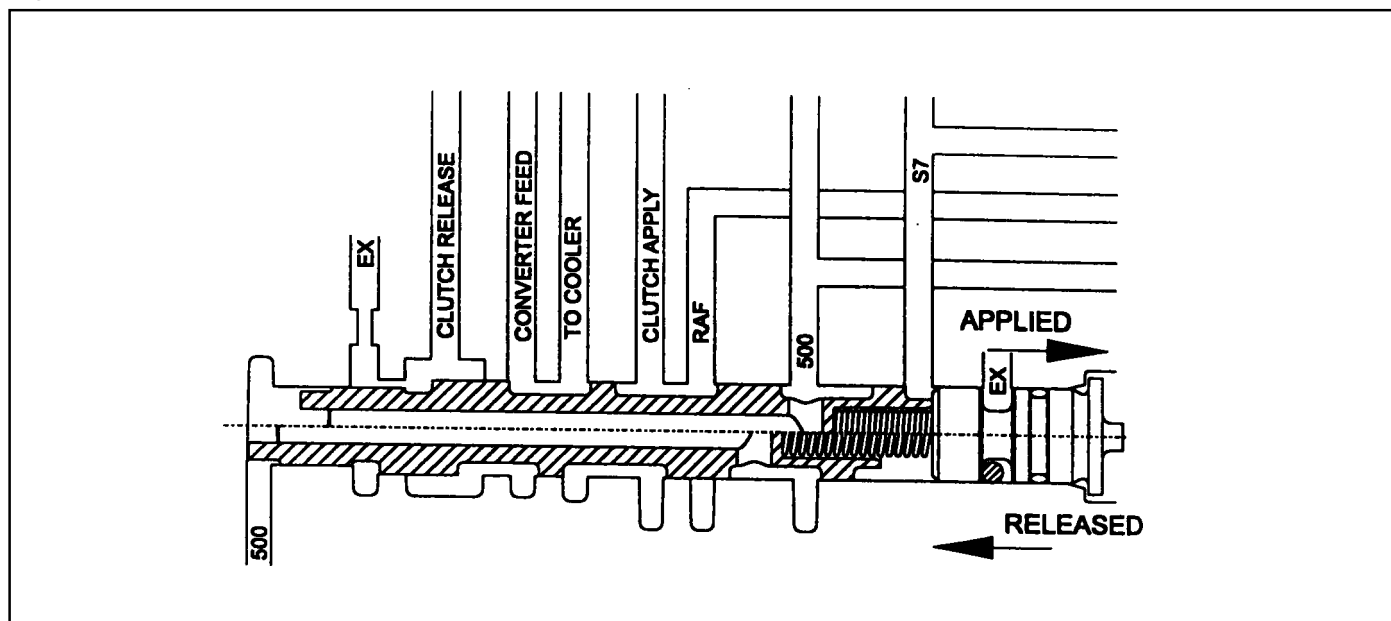
The converter clutch control valve (refer figure 3.21) is a two position valve which applies or releases the converter clutch.

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

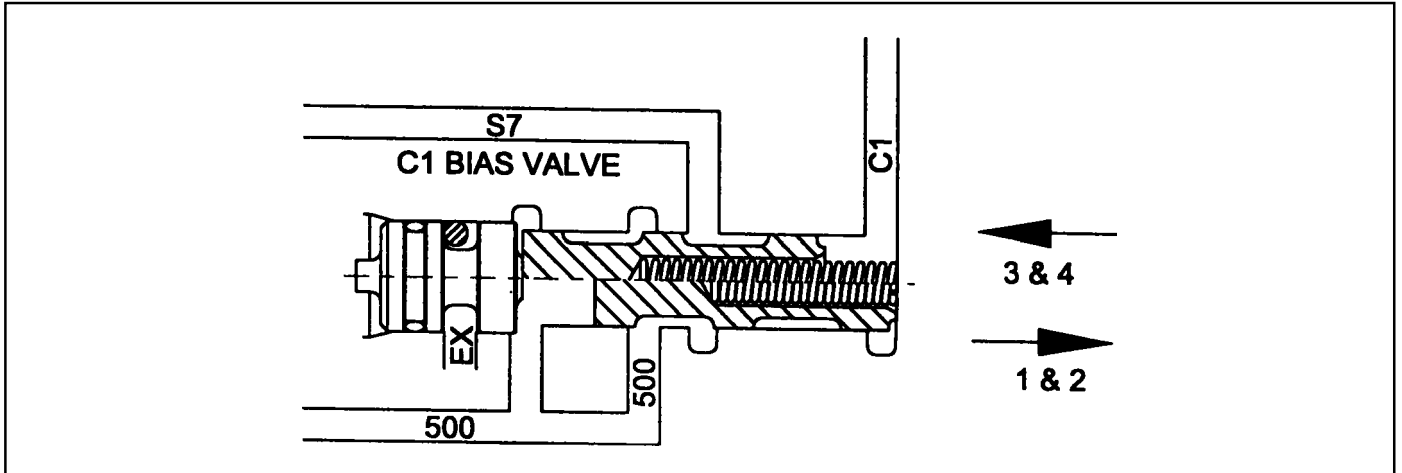


C1 Bias Valve

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.

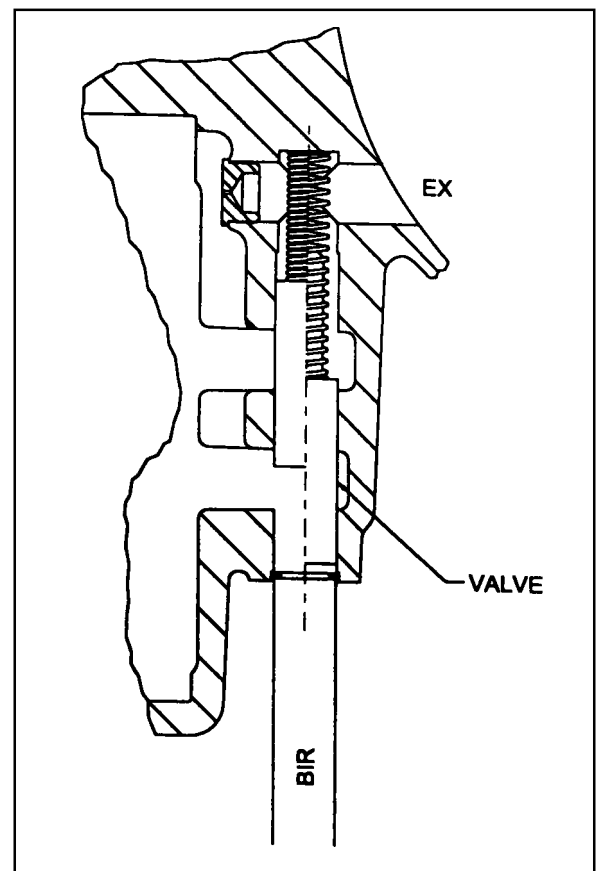


Figure 3.23 - B1R Exhaust Valve

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.

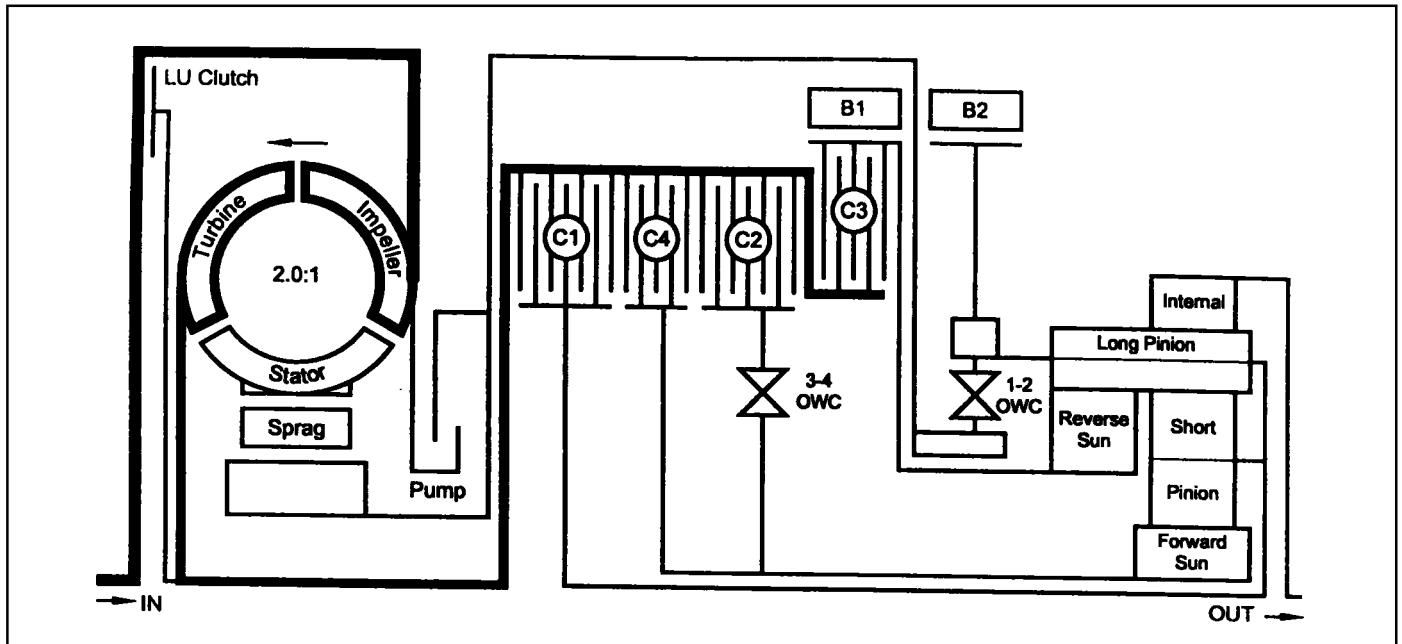
Table 4.1 - Engaged Elements vs Gear Ratios

Gear	Gear Ratio	ELEMENTS ENGAGED								
		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.

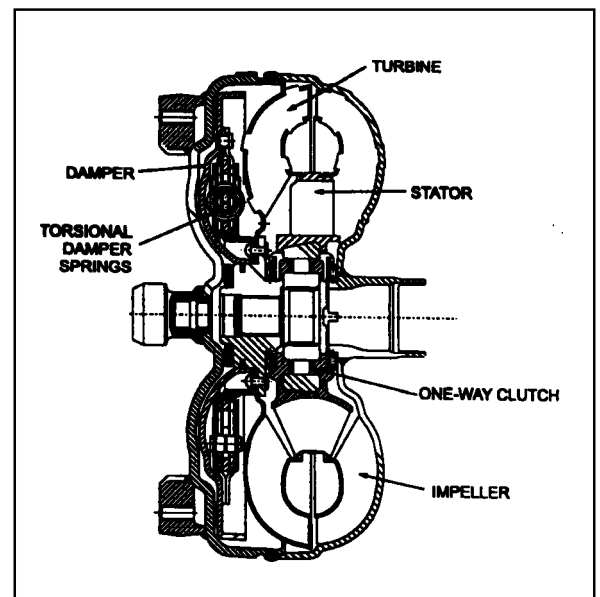


Figure 4.2 - Torque Converter Cross Section

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.

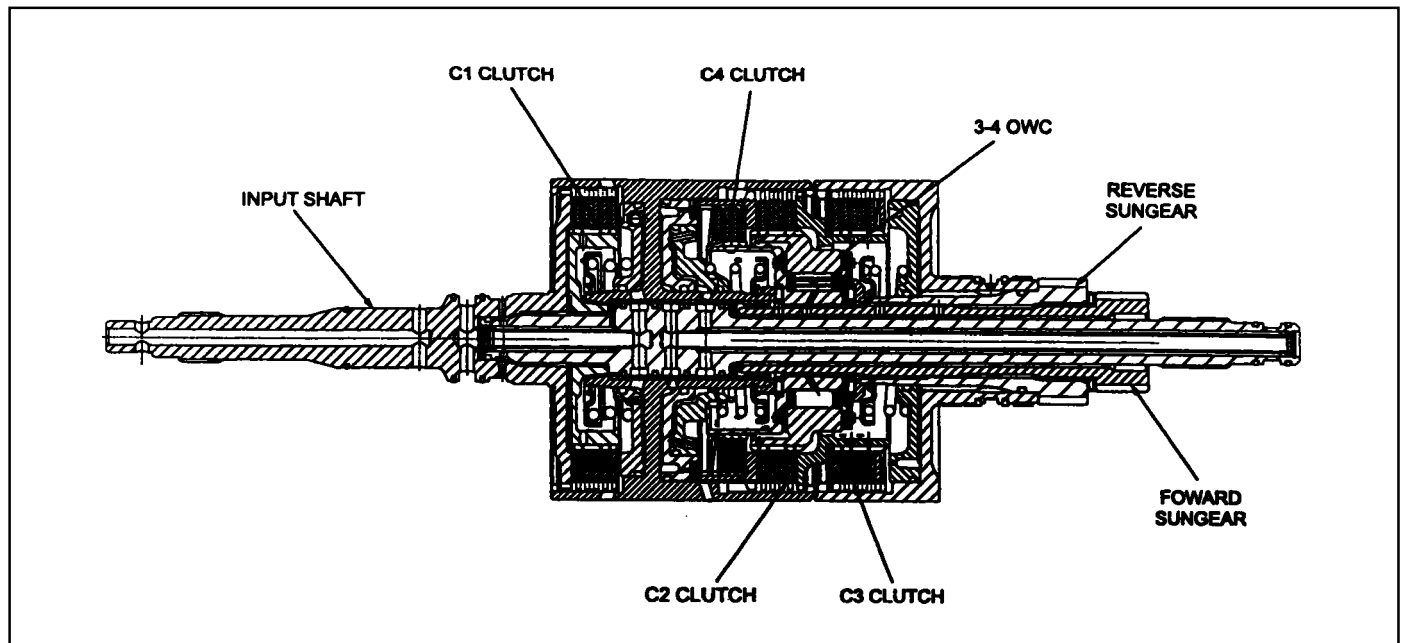
This occurs in third and fourth gears.

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



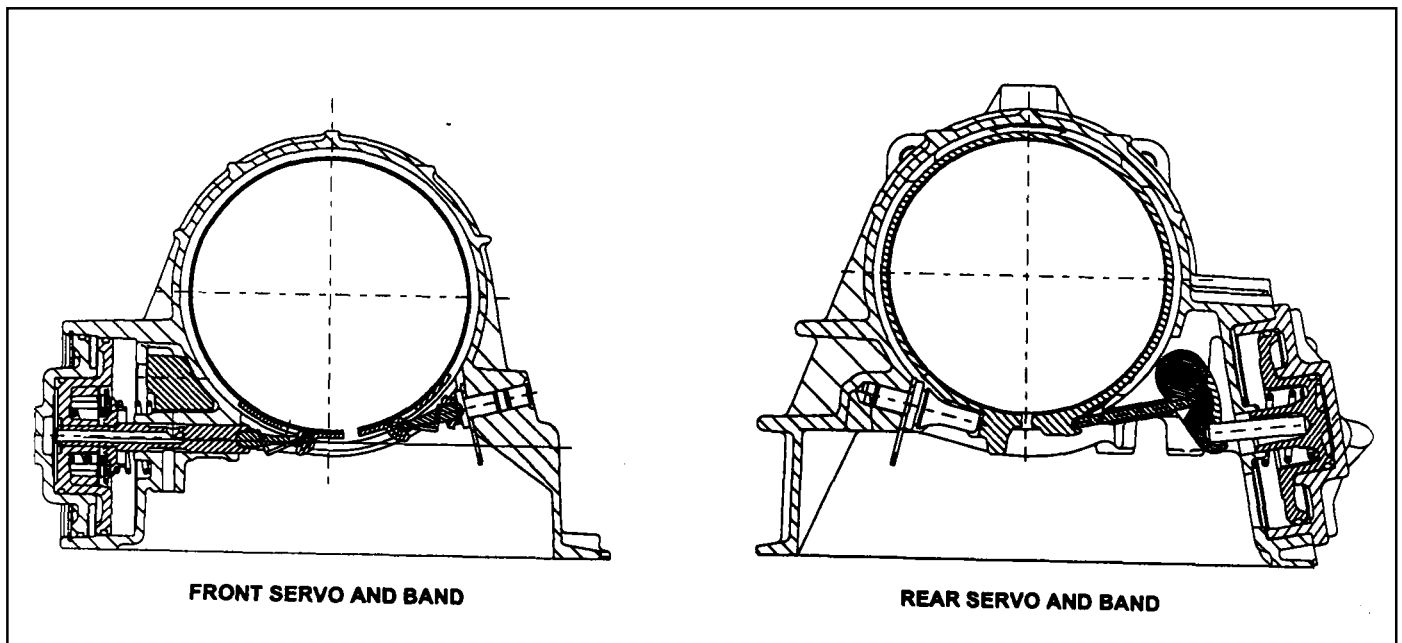
BANDS

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 3-4 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

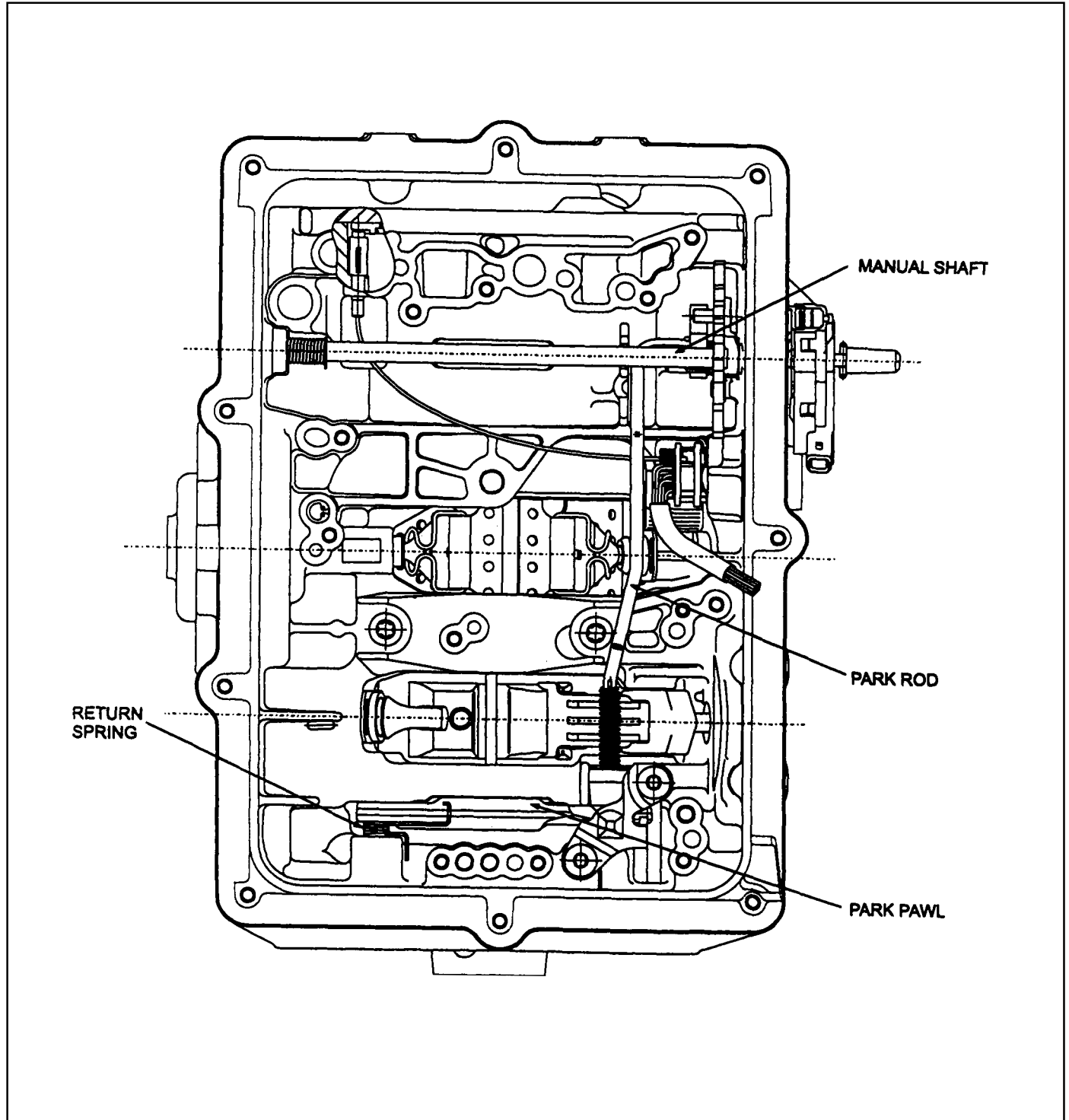
The planetary gear set used in the transmission is a conventional six pinion Ravigneaux compound gear set.



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

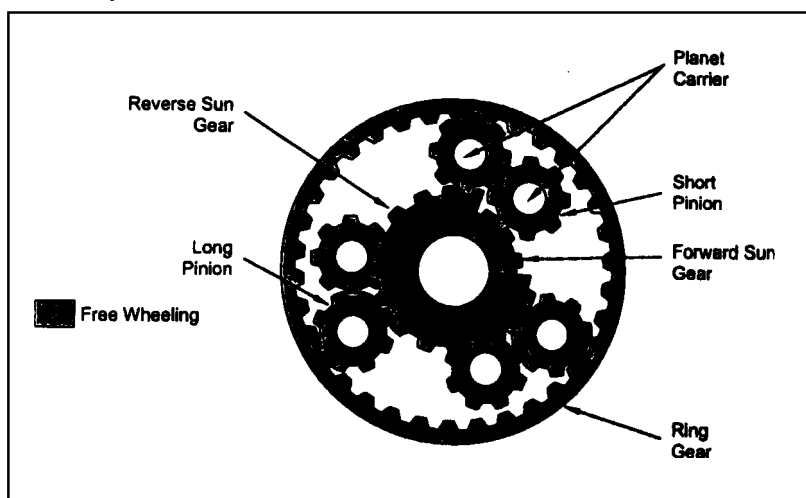
Each power flow is described in the following sections.

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

Figure 5.1 - Engaged Elements vs Gear Selected

Gear State	ELEMENTS ENGAGED								
	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

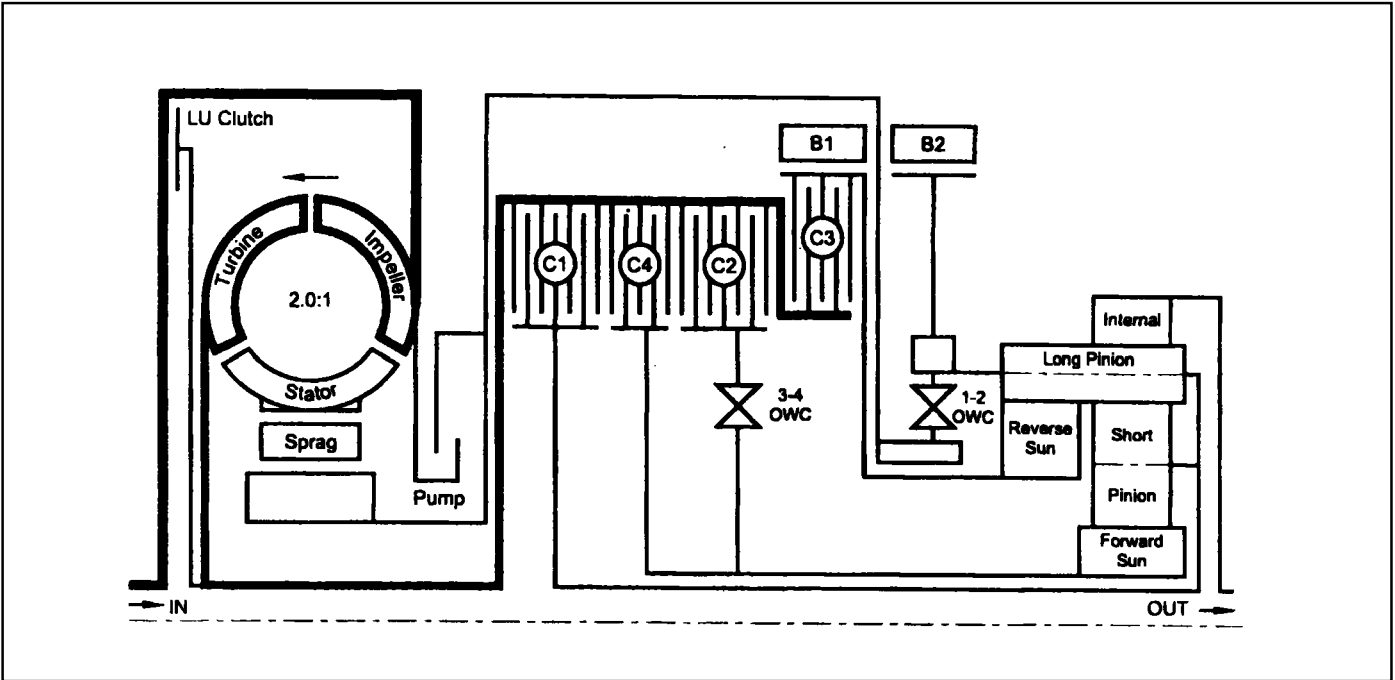
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- 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 and Neutral

Gear State	ELEMENTS ENGAGED								
	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 gear 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

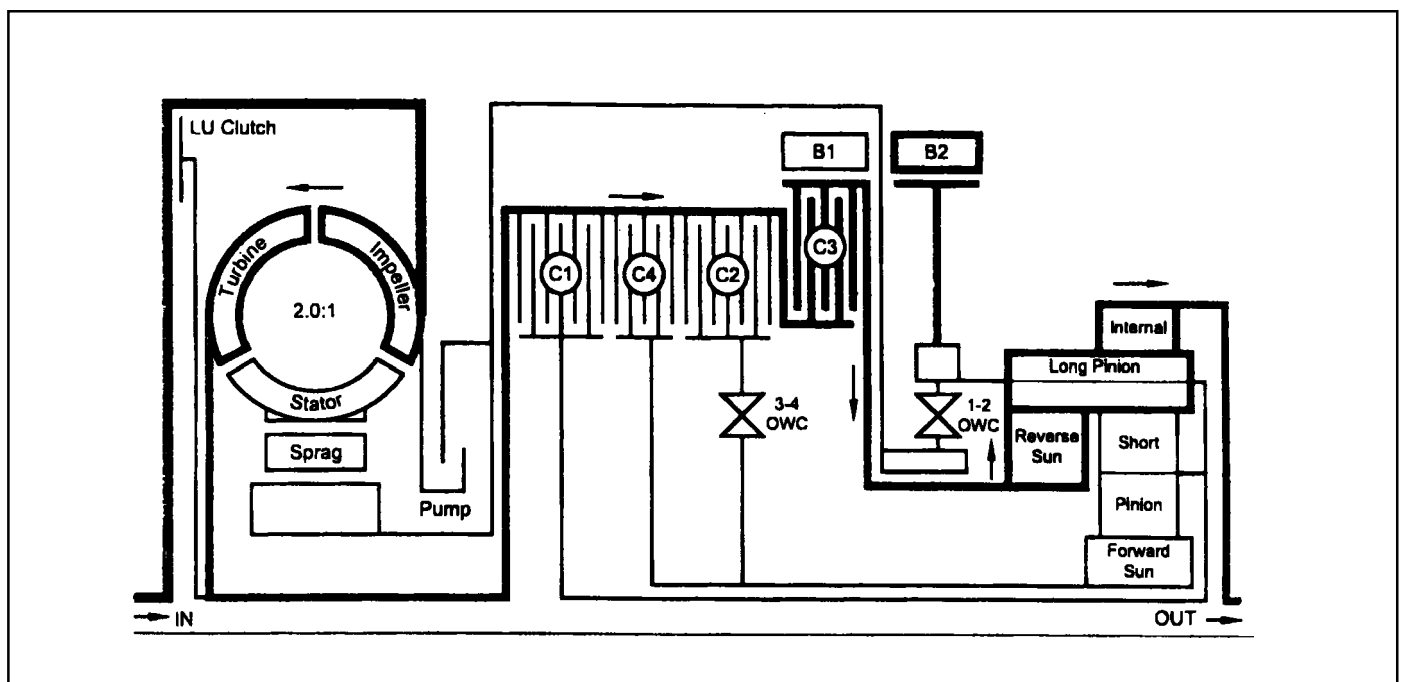
solenoids and valves are activated as follows:

- 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

Gear State	ELEMENTS ENGAGED								
	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

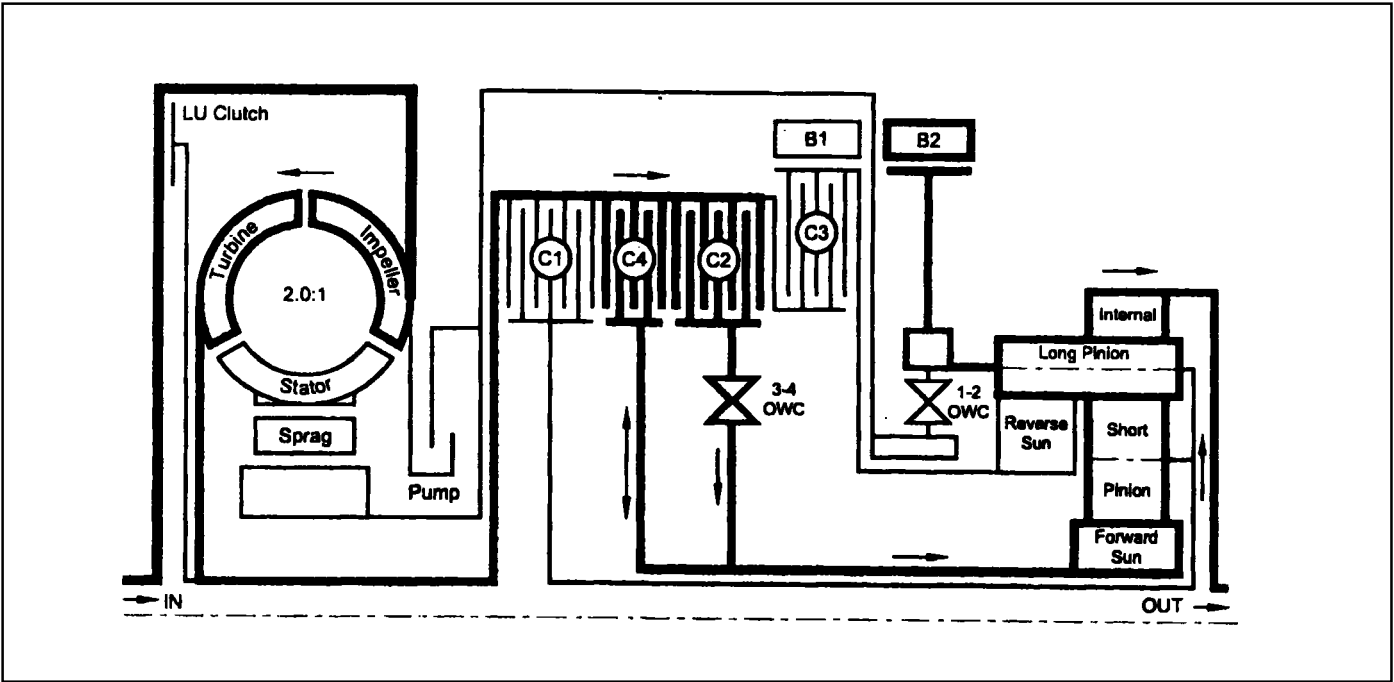
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- Solenoids S1 and S2 are switched ON.
- The 1-2,2-3, and 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.
- 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

Gear State	ELEMENTS ENGAGED								
	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

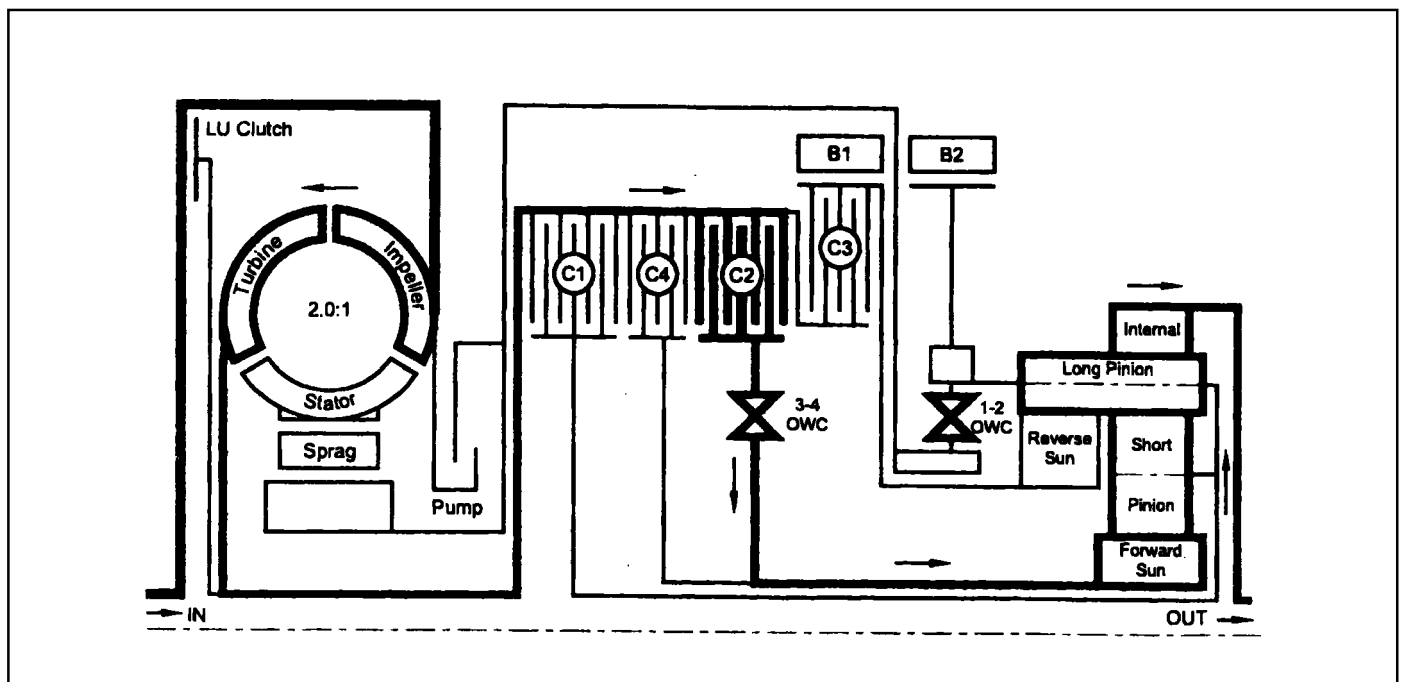
To maintain this arrangement in the steady state solenoids and valves are activated as follows:

- 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

Gear State	ELEMENTS ENGAGED								
	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.

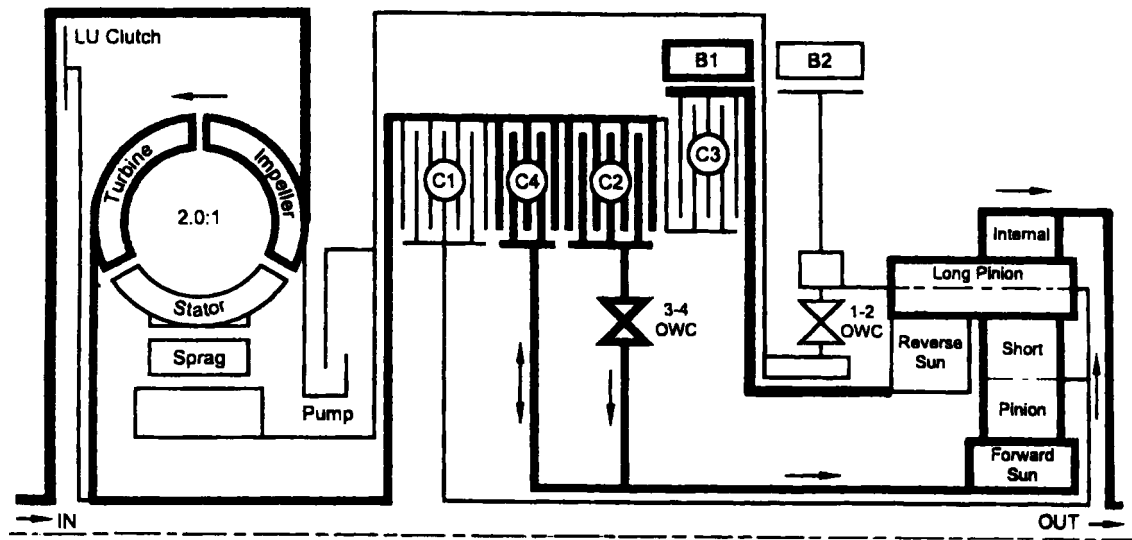
- Solenoid S1 is switched Off. S2 is switched On.
- Drive (line pressure) oil from the manual valve engages the C2 clutch.
- When S1 switches off , S1 oil pressure, which is derived from line 500 pressure, moves the 3-4 shift valve to the left. At the same time S1 oil is directed to the 1-2 shift valve 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

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





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:

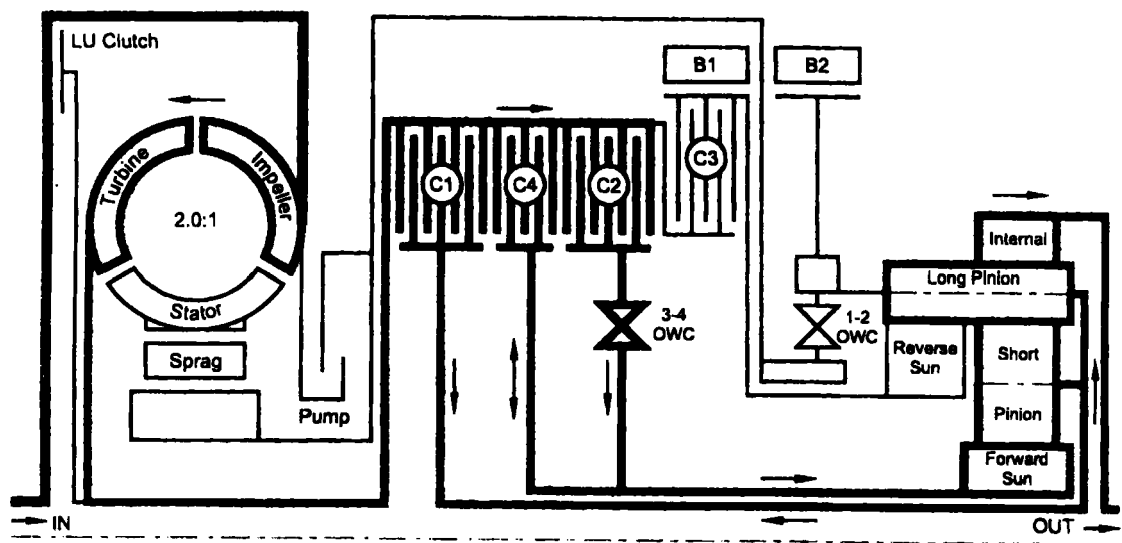
- Solenoid S1 is switched Off. S2 is switched Off.
- With S1 and S2 switched Off, the 2-3 and 3-4 shift valves are held in the third gear position by line 500 pressure.
- The 1-2 shift valve is held in the third gear position by S1-S2 oil pressure.
- 2nd oil (line pressure) from the 1-2 shift valve is 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

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





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

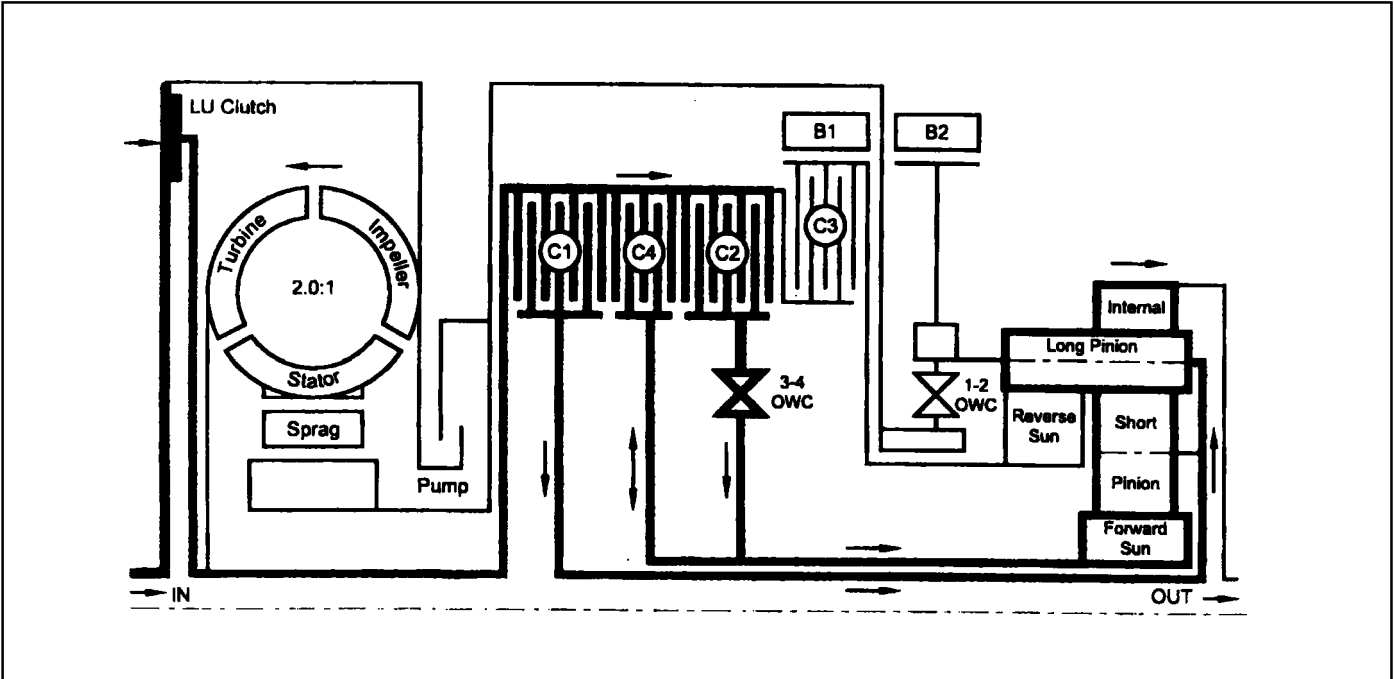
Control for Drive 3 Lock Up and Manual 3 Lock Up is the same as for Drive 3 with the addition of the converter clutch circuit activated by solenoid S7.

- 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 turns, 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

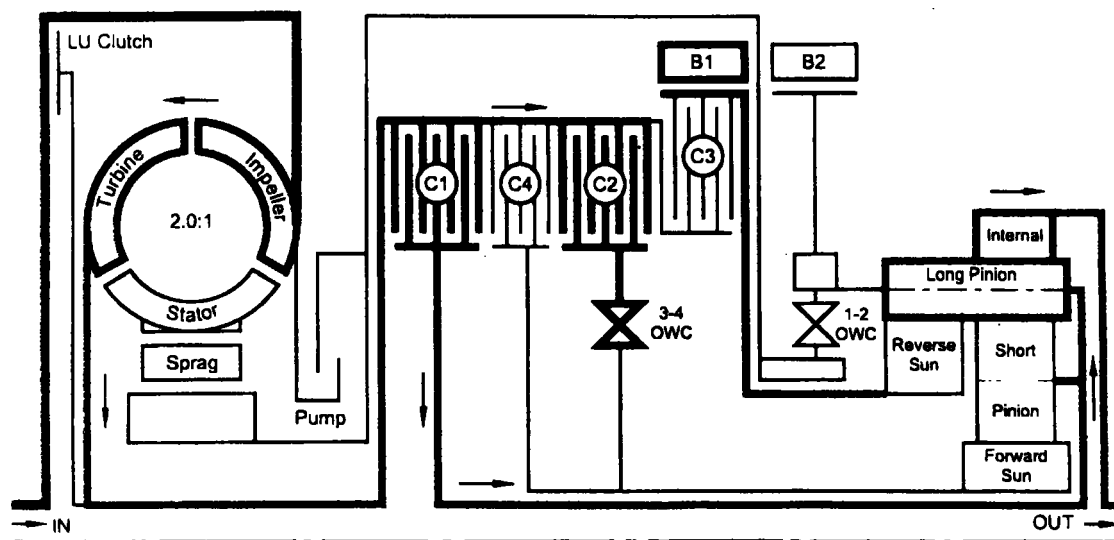
Refer to figure 5.8 and table 5.9.

Table 5.9 - Engaged Elements - Drive 4 (Overdrive)

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



5A-58 AUTOMATIC TRANSMISSION



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

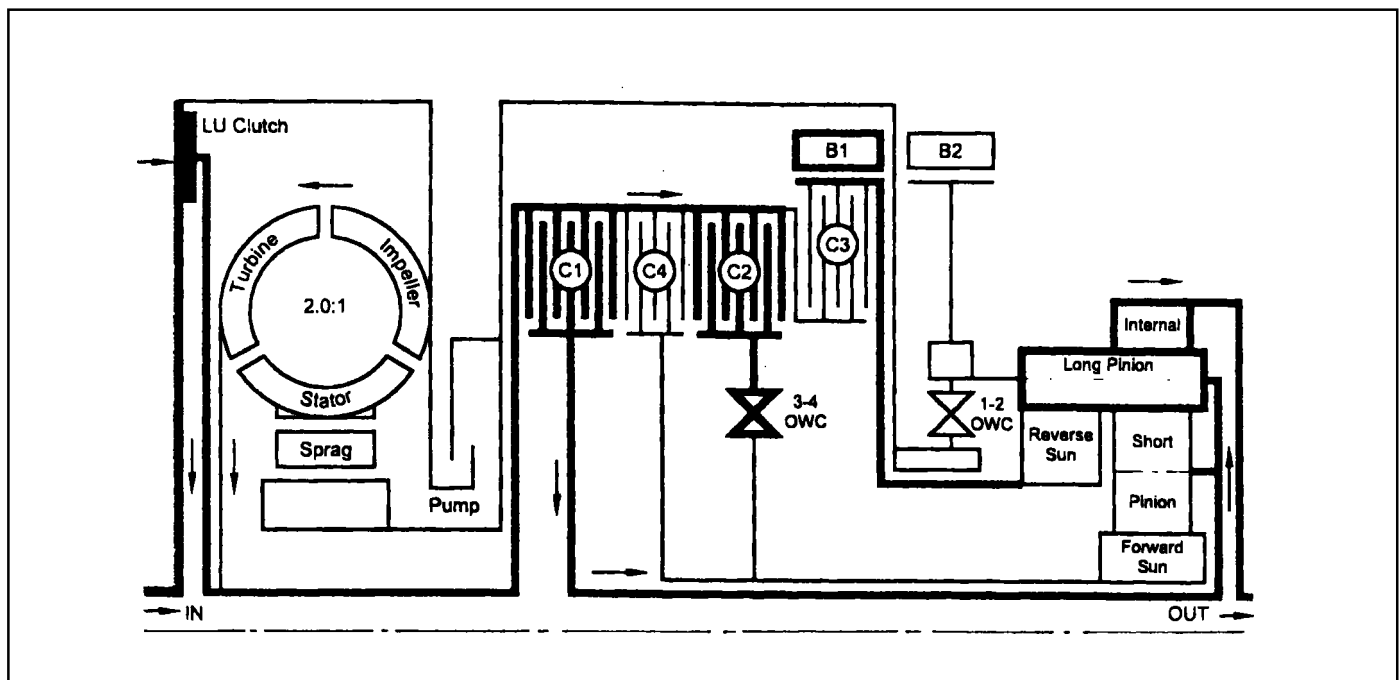
Control for Drive 4 Lock Up is the same as for Drive 4 with the addition of the converter clutch circuit activated by solenoid S7.

- 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 and table 5.10.

Table 5.10 - Engaged Elements - Drive 4 Lock Up

Gear State	ELEMENTS ENGAGED								
	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	-	○	○	
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	-	○	○	
8	Engine Speed Input Sensor (-Ve)	IP	●	○	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	○	○	Provides an analogue signal of the throttle position for the Torque on Demand (TOD) Control Module.
11	Air Conditioner Input Signal	-	●	○	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 0V 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	-	○	○	
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 lever position '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	○	●	CAN low side bus communication (CANL).
22	CAN (+ve)	I/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	●	○	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	●	○	This sensor transmit shaft speed signal to the TCU.
27	Throttle Position Sensor - Ground	GND	●	○	Throttle position sensor ground.
28	Throttle Position Sensor - Reference	REF	●	○	This is the 5V reference voltage supply generated by the unit for the throttle position sensor.
29	Throttle Position Sensor - Input Signal	IP	●	○	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.



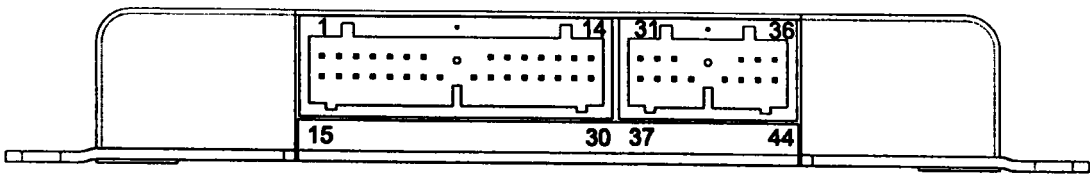
5A-62 AUTOMATIC TRANSMISSION

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.

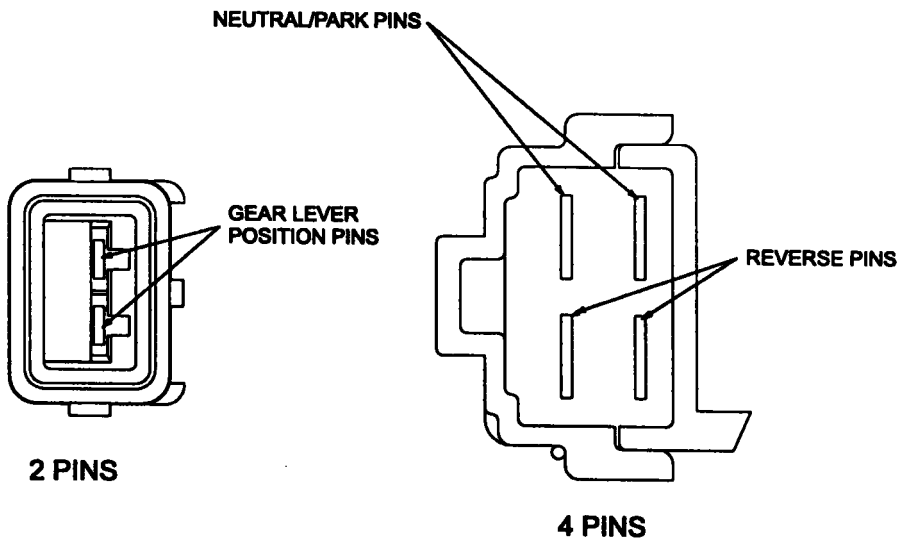
Notice : ● = circuit connected
 O = circuit not connected
 * = unique
 OP = Output
 IP = Input
 I/O = Input/output
 GND = Ground
 REF = Reference



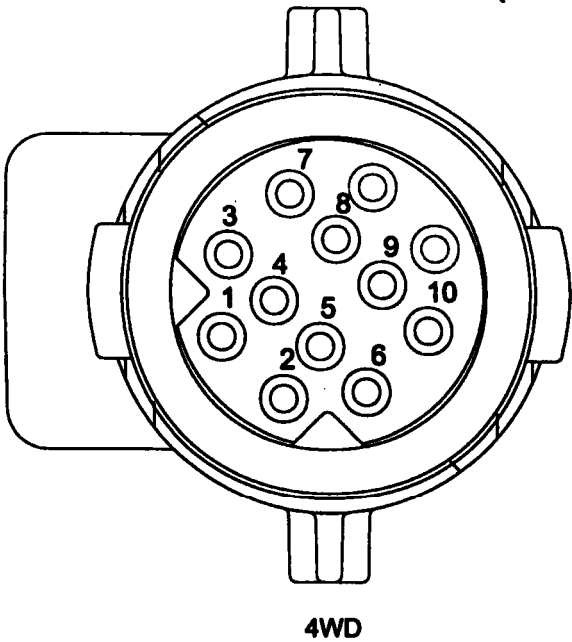
Figure 6.1.1 - Wiring Loom Pins



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. If 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 frequent, 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.



5A-68 AUTOMATIC TRANSMISSION

Solenoid	Condition	Description / Cause
9	Mode Switch Input Fault (Power/Economy Mode)	<p>The signal from the mode switch is unreliable.</p> <p>This fault is caused by too many changes in the mode input signal over a period of time. Typical causes would be an intermittent connection in the switch or wiring or an intermittent short to ground in the wiring.</p>
10	Data Output Link Fault	<p>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.</p> <p>This could be caused by an open circuit, short circuit to ground or a loose connection in the link wire itself.</p>
11	On/off Solenoid Fault (Solenoid 1,2,3,4,6,7)	<p>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 affected.</p> <p>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.</p> <p>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.</p> <p>If several of these fault codes are presents check the wiring or connectors that are common to the selected solenoids, especially the earth connections.</p> <p>The state of the solenoid feedback voltage is outside acceptable limits but the faulty solenoid could not be isolated.</p>
12	Solenoid 5 Fault (Variable Pressure Solenoid)	<p>The current to solenoid 5 was outside acceptable limits.</p> <p>This fault results from a mismatch between the current set point for solenoid 5 and the current measured by the feedback within the TCU.</p> <p>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.</p>
13	Throttle Not Learnt	<p>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.</p> <p>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.</p>



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



5A-70 AUTOMATIC TRANSMISSION

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 'O' 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 'O' 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. 3-4 shift valve jammed.	Inspect inhibitor switch. Repair or replace as necessary. Inspect the 3-4 shift valve. Repair or replace as necessary.
Harsh 2-3 shift	Jammed band 1 release valve. Faulty S3 or S2 solenoid. Faulty clutch apply regulator valve. Missing or damaged clutch apply feed ball. Damaged input shaft sealing rings. Damaged C1 piston 'O' rings. Damaged or dislodged C1 piston bleed ball. Faulty S1 or S4 solenoid.	Inspect the release valve. Repair or replace as necessary. Inspect S3 or S2. Repair or replace as necessary. Inspect the regulator valve. Repair or replace as necessary. Inspect the ball. Refit or replace as necessary. Inspect the sealing rings. Refit or replace as necessary. Inspect the 'O' rings. Refit or replace as necessary. Inspect the bleed ball. Refit or replace as necessary. Inspect S1 or S4. Repair or replace as necessary.
Harsh 3-4 shift	Jammed band 1 release valve. Incorrect front band adjustment. Damaged front servo piston 'O' rings. Faulty or damaged variable pressure solenoid (S5). Faulty band apply regulator valve.	Inspect the release valve. Repair or replace as necessary. Inspect the band. Adjust as necessary. Inspect the 'O' rings. Refit or replace as necessary. Inspect S5. Repair or replace as necessary. Inspect the regulator valve. Repair or replace as necessary.



5A-72 AUTOMATIC TRANSMISSION

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. Faulty throttle position sensor. Incorrect front band adjustment. Damaged front servo piston O-rings. Faulty or damaged variable pressure solenoid (S5). Faulty S1 or S4 solenoid. Faulty band apply regulator valve (BAR). Misassembled front servo return spring.	Check the resistance. Replace the inhibitor switch as necessary. Inspect and replace the sensor as necessary. Inspect and adjust the band as necessary. Inspect and replace the O-rings as necessary. Inspect, repair or replace S5 as necessary. Inspect, repair or replace S1 or S4 as necessary. Inspect, repair or replace the BAR as necessary. 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.

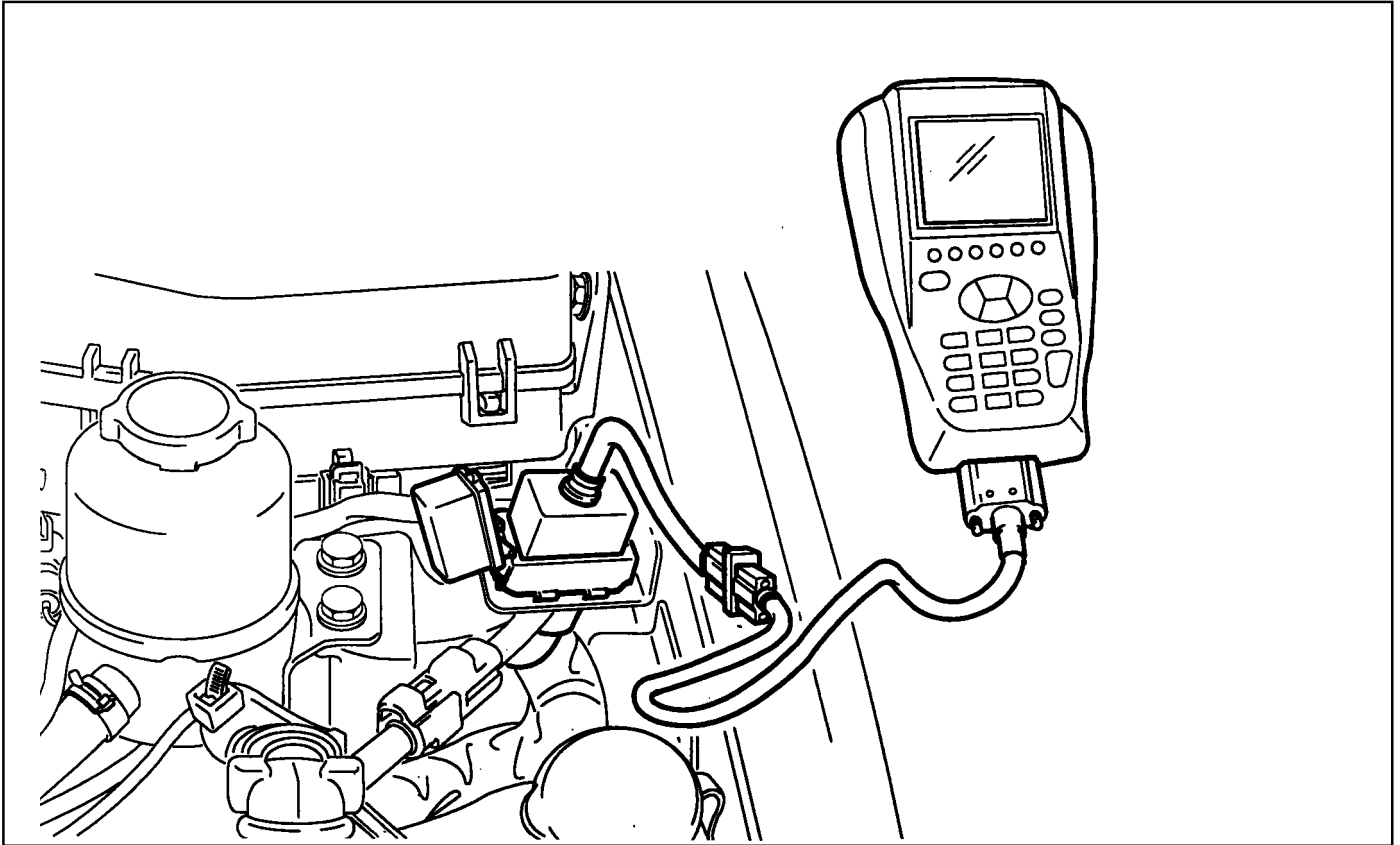
5A-74 AUTOMATIC TRANSMISSION

Table 6.2.4 - After Teardown Faults

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

Self-diagnosis List

Symptom	Possible Cause	Action
P1702	Throttle position sensor	<ul style="list-style-type: none"> ● 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	<ul style="list-style-type: none"> ● 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 kΩ
P1704	Vehicle speed	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check vehicle speed sensor.
P4705	Shift lever	<ul style="list-style-type: none"> ● 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 kΩ 2nd gear - 4,8 - 2.2 kΩ 3rd gear - 3 - 3.4 kΩ D gear - 4.5 - 4.g kΩ N gear - 6.8 - 7.2 kΩ R gear - 10.8 -11.2 kΩ P gear - 18.6 - 19 kΩ ● Check voltage between terminal 31 and 37 of TCU. - Standard value : 0-5V(P,R,N,D,L)
P1706	W, E, P mode switch	<ul style="list-style-type: none"> ● 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	<ul style="list-style-type: none"> ● 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	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check battery condition. ● Check alternator.

Symptom	Possible Cause	Action
P1710	Air conditioner switch	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check voltage between terminal 4 and 11 of TCU. <ul style="list-style-type: none"> - Standard value : when the A/C compressor is ON : 12V when the A/C compressor is OFF : 0V
P1712	Kick down switch	<ul style="list-style-type: none"> ● Check cable for open / short, ● Check connection of other connectors. ● Check voltage between terminal 1 and 12 of TCU. <ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> ● 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	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 34 of TCU(when the connector is disconnected). <ul style="list-style-type: none"> - Standard value : 26 - 30Ω ● Check solenoid.
P1734	Solenoid 2	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors, ● Check resistance between terminal 1 and 40 of TCU (when the connector is disconnected). <ul style="list-style-type: none"> - Standard value : 26 - 30Ω ● Check solenoid.
P1735	Solenoid 3	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 41 of TCU (when the connector is disconnected). <ul style="list-style-type: none"> - Standard value : 26 - 30Ω ● Check solenoid.
P1736	Solenoid 4	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 33 of TCU (when the connector is disconnected), <ul style="list-style-type: none"> - Standard value : 26 - 30Ω



5A-78 AUTOMATIC TRANSMISSION

Symptom	Possible Cause	Action
		<ul style="list-style-type: none"> ● Check solenoid.
P1737	Solenoid 5	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 36 and 44 of TCU (when the connector is disconnected). <ul style="list-style-type: none"> - Standard value : 3.6 - 4.2Ω ● Check solenoid.
P1738	Solenoid 6	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 39 of TCU (when the connector is disconnected). <ul style="list-style-type: none"> - Standard value : 26 - 30Ω ● Check solenoid.
P1739	Solenoid 7	<ul style="list-style-type: none"> ● Check cable for open / short. ● Check connection of other connectors. ● Check resistance between terminal 1 and 42 of TCU (when the connector is disconnected). <ul style="list-style-type: none"> - Standard value : 26 - 30Ω ● Check solenoid.
P1741	Short of solenoid 1	<ul style="list-style-type: none"> ● Check cable for short. ● Check connection of other connectors, ● Check solenoid.
P1742	Short of solenoid 2	<ul style="list-style-type: none"> ● Check cable for short. ● Check connection of other connectors. ● Check solenoid.
P1743	Short of solenoid 3	<ul style="list-style-type: none"> ● Check cable for short. ● Check connection of other connectors. ● Check solenoid.
P1744	Short of solenoid 4	<ul style="list-style-type: none"> ● Check cable for short. ● Check connection of other connectors. ● Check solenoid.
P1745	Short of solenoid 5	<ul style="list-style-type: none"> ● Check cable for short. ● Check connection of other connectors. ● Check solenoid.
P1746	Short of solenoid 6	<ul style="list-style-type: none"> ● Check cable for short. ● Check connection of other connectors, ● Check solenoid.
P1747	Short of solenoid 7	<ul style="list-style-type: none"> ● 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 corner. 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 filling 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. If 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.



5A-80 AUTOMATIC TRANSMISSION

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 ATF 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 learnt 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.

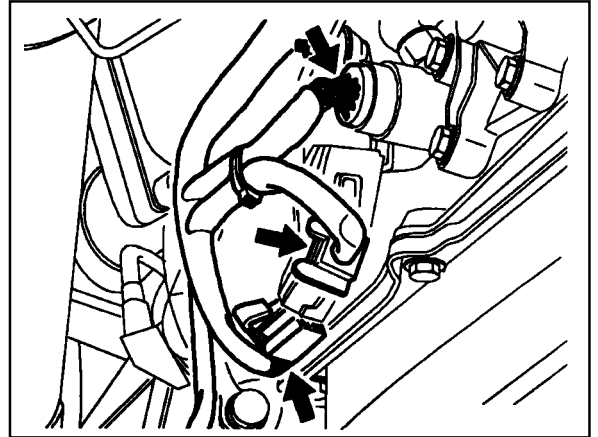


MAINTENANCE AND REPAIR

ON-VEHICLE SERVICE

REMOVAL & INSTALLATION OF TRANSMISSION

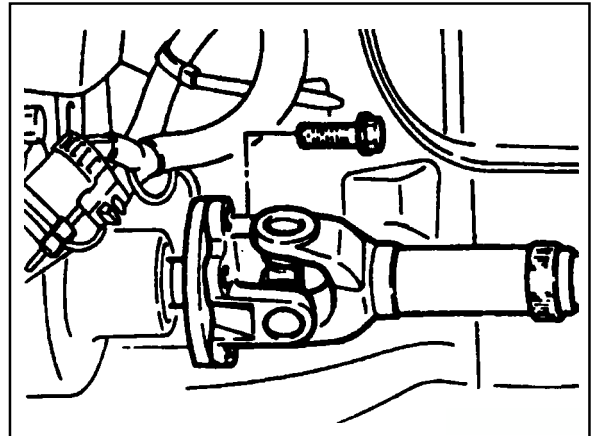
1. Disconnect the negative battery cable.
2. Disconnect the connectors from transfer case.
3. Disconnect the speedometer connector from transfer case.
4. Disconnect the inhibitor and Sear position sensor connector.



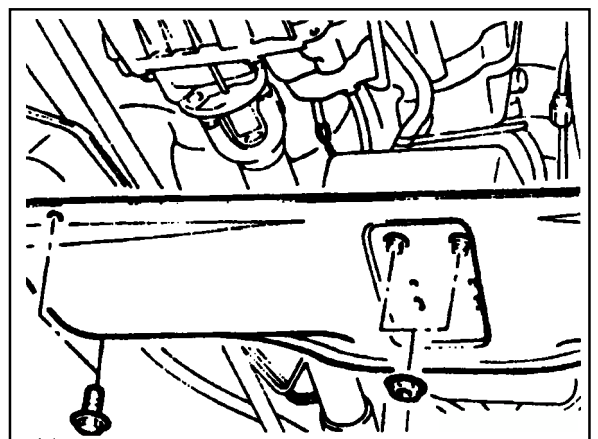
5. Remove the rear propeller shaft .

Installation Notice

Tightening Torque	70 - 80 Nm
-------------------	------------



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

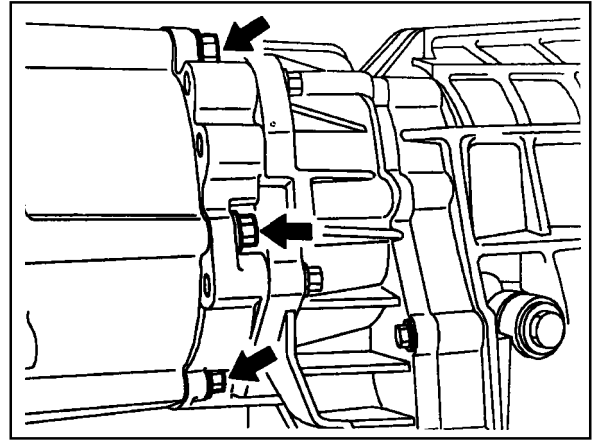


7. Remove the rear propeller shaft.

Installation Notice

Tightening Torque	70 - 80 Nm
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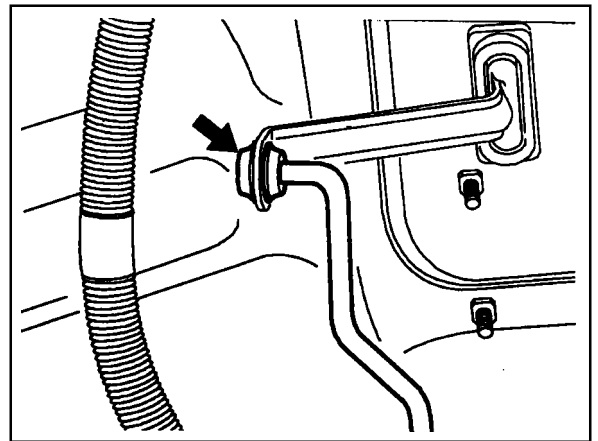
8. Unscrew the five bolts and remove the transfer case.
9. Disconnect the 10-Pins Plug connector from transmission.



10. Separate the locking clip on shift lever and remove the shift rod.

Notice

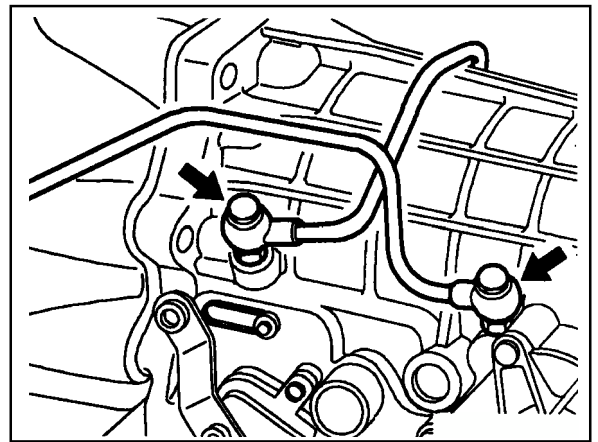
Removal and installation performed when the shift procedure should be lever is in "D" range.



11. Remove the two pipes for oil cooler.

Installation Notice

Tightening Torque	24.5 - 34.3 Nm
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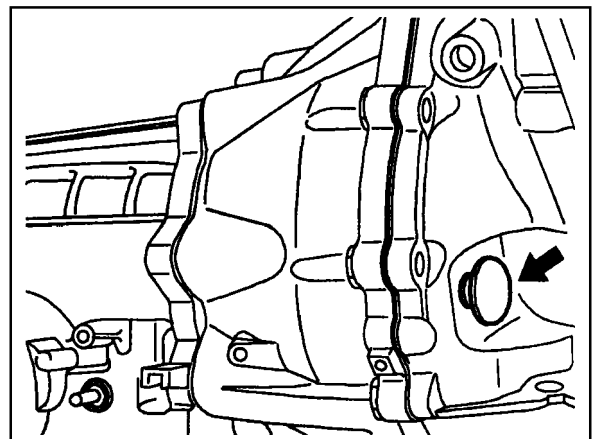


12. Remove the service hall cover on torque converter.
13. Put the alignment mark for installation, and unscrew the six mounting bolts for torque converter from drive plate through the service hole (arrow) by rotating the engine and remove the torque converter.

Installation Notice

Tightening Torque	42 Nm
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Screw the six bolts mounting the torque converter through the service hole by using a mirror and rotating the engine.



5A-84 AUTOMATIC TRANSMISSION

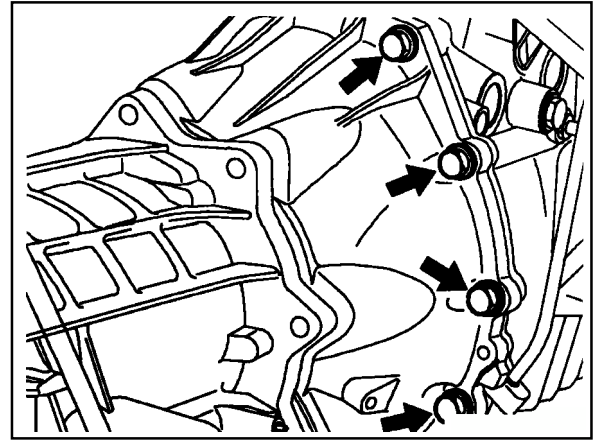
14. Remove the starter.
15. Unscrew the eight transmission housing bolts and remove the transmission assembly.

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.



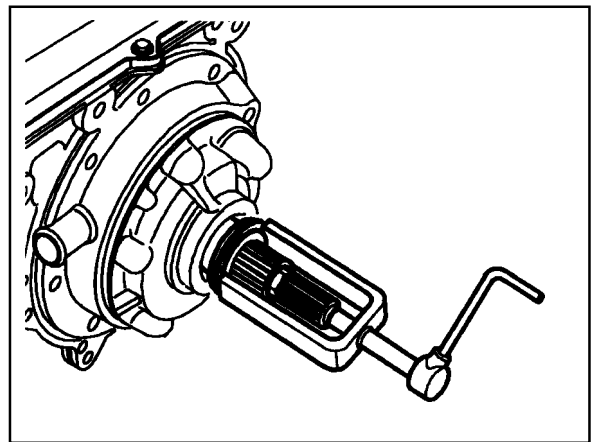
5A-86 AUTOMATIC TRANSMISSION

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.



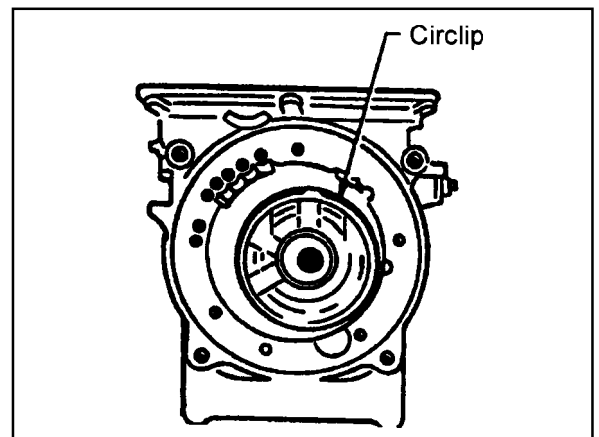
11. Remove the input shaft, forward clutch cylinder, and the overdrive shaft as an assembly, withdrawing them through the front of the case.
12. Remove the C3 clutch cylinder and sun gears.
13. Remove the front band struts. Remove the front band.
14. Remove the two centre support retaining bolts using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

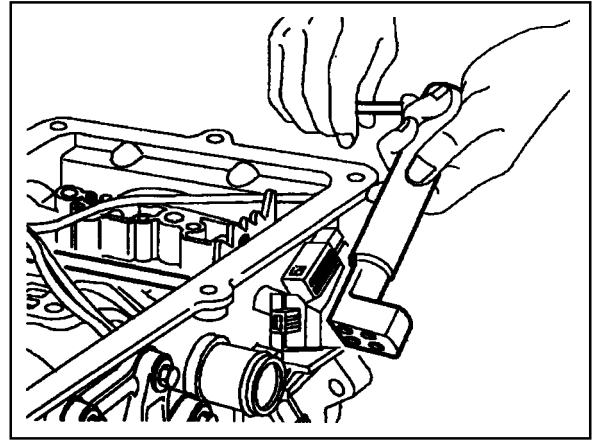
16. Remove the centre support, 1-2 one way clutch, planetary gear set and output shaft as an assembly.
17. Remove the parking rod cam plate. (T40 Torx bit).
18. Remove the rear band struts and remove the band.



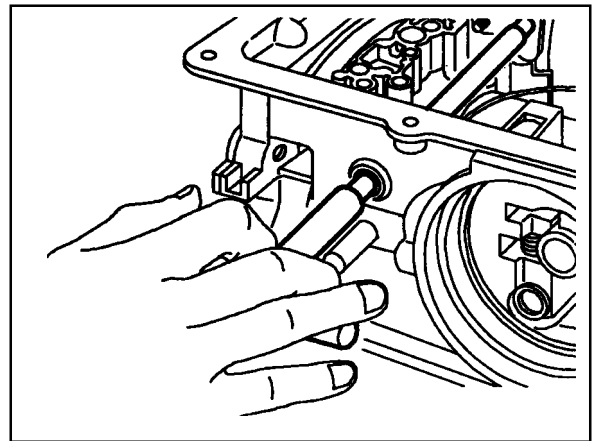
Transmission Case

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.

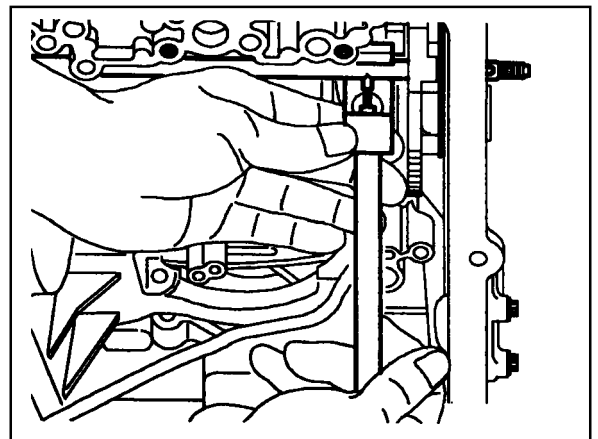


2. Remove the inhibitor switch from the case.
Remove the cross shaft seals with special tool No.0555-331893.



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

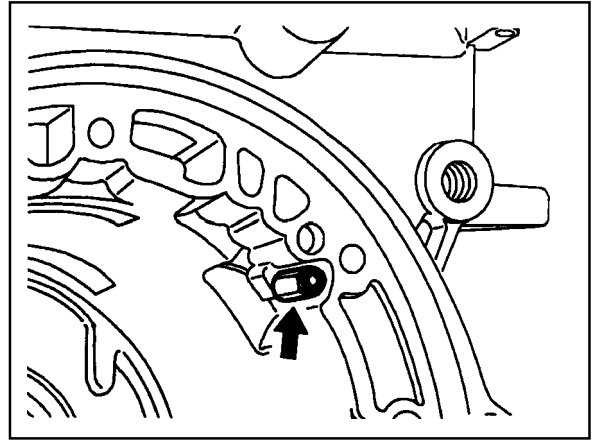
4. Using tool No. 0555-331897, press the pin from the cross-shaft and withdraw the shaft from the case. Retrieve the spring and pin



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.

5A-88 AUTOMATIC TRANSMISSION

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

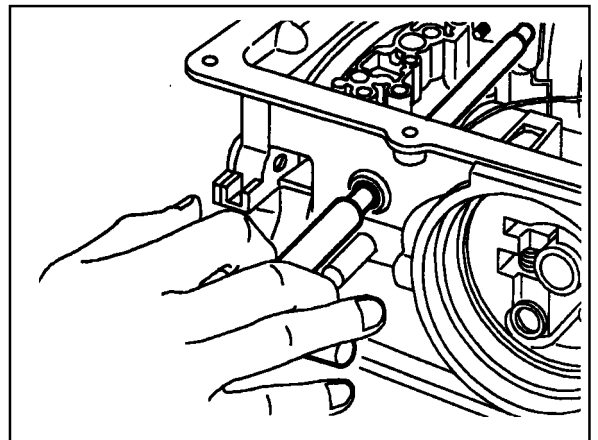


9. Remove the parking pawl pivot pin and the pawl and spring from the case.
10. Remove the shaft and the rear servo lever.
11. Remove the rear servo cover and piston assembly.
12. Remove the B1R circlip, valve and spring.
13. Remove both band adjustment shims.
14. Inspect the output shaft bushing in 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.



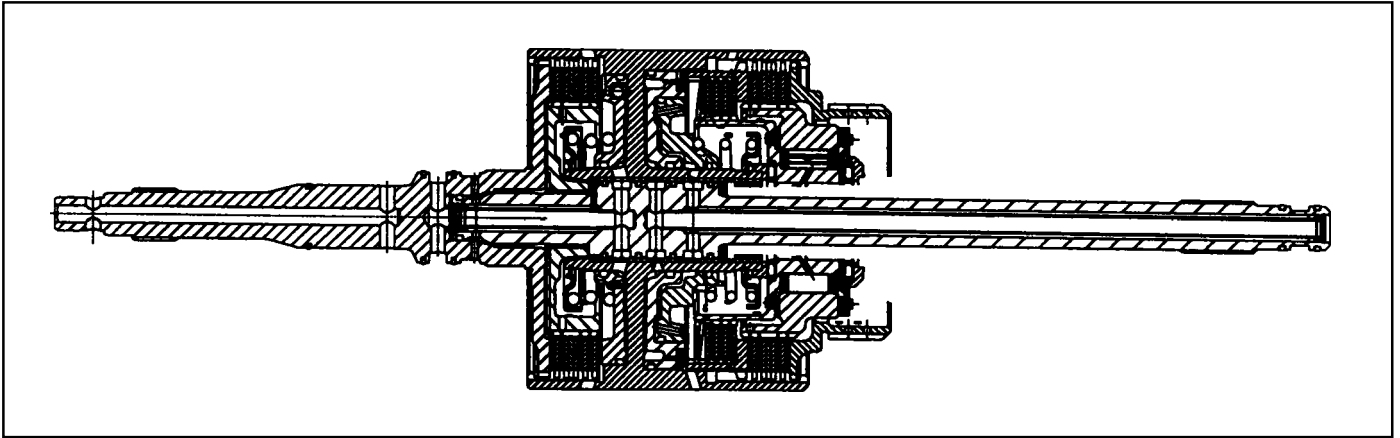


Figure 8.4 - Forward Clutch Cylinder Assembly

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.



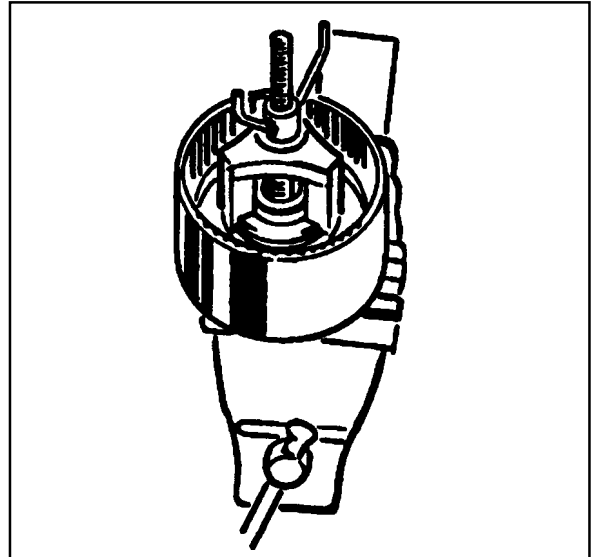
5A-90 AUTOMATIC TRANSMISSION

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

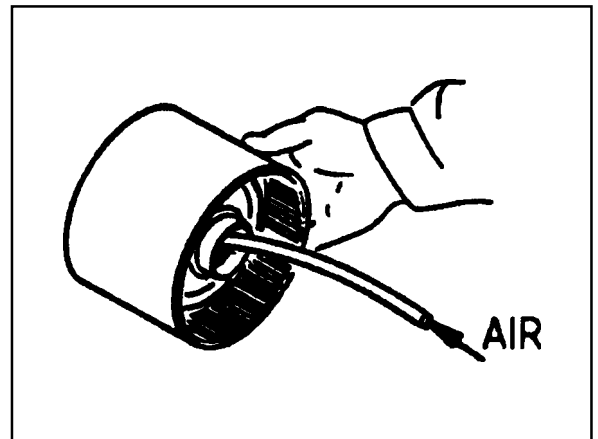
Notice

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.



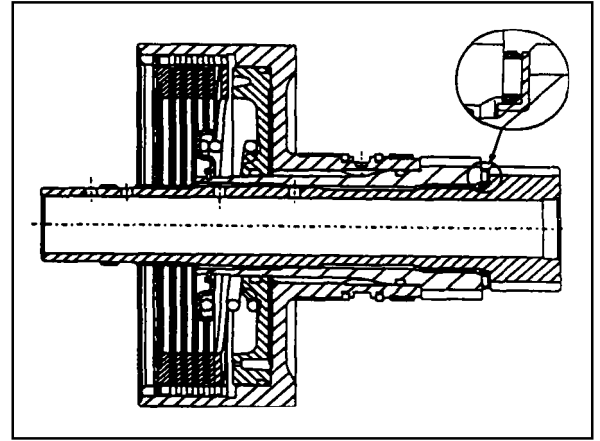
13. To remove the clutch pistons from the clutch cylinder, apply air pressure to the apply ports in the bore of the cylinder.



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.

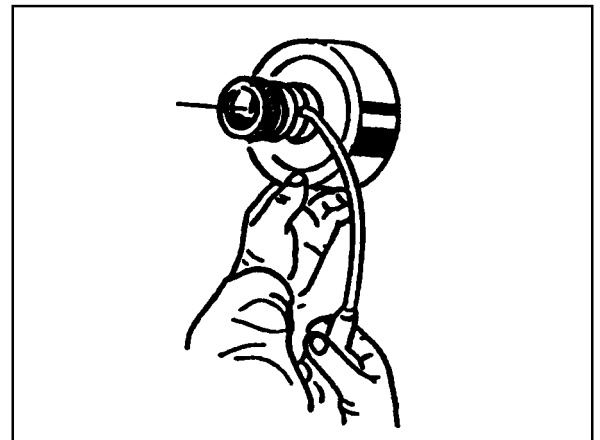
Remove the circlip and release the spring.

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.

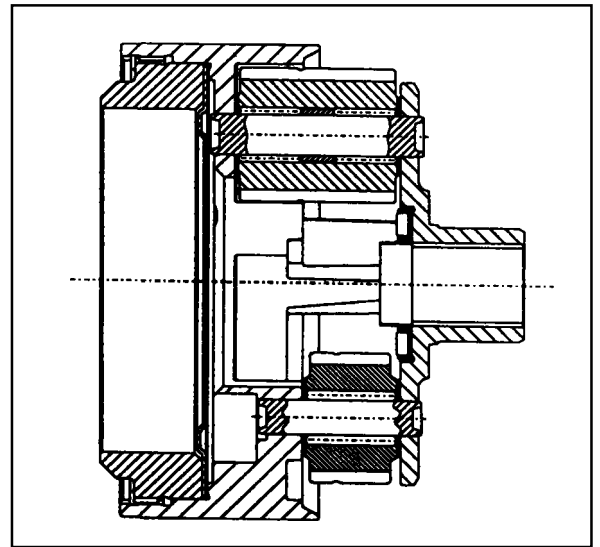


8. Remove the reverse sun gear from the cylinder.

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 Torx 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.

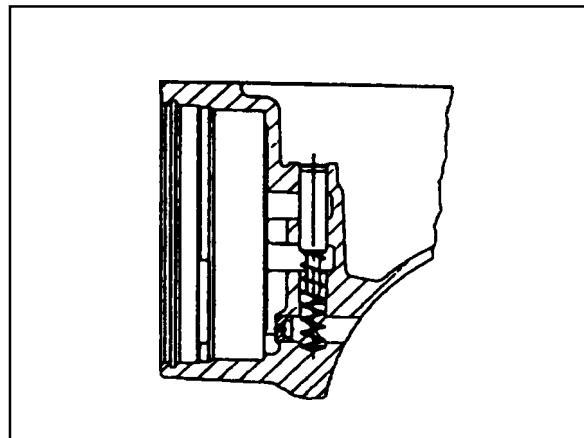
Transmission

Notice

1. Ensure that the B1R circlip is fitted to the case. (If this is not fitted, the valve willpeen 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:

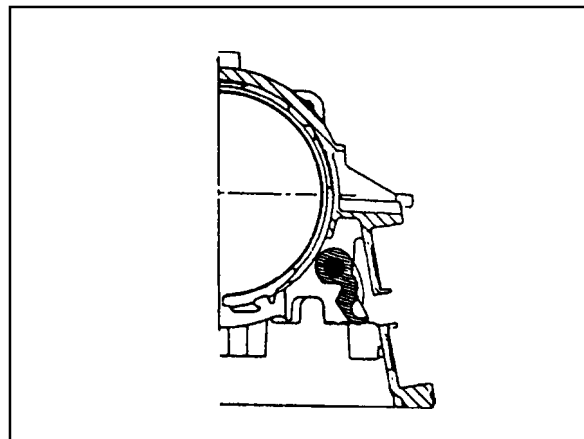
1. Turn the transmission case upside down on the bench and mount it to the transmission cradle No.0555-331895.
2. Install all fittings, plugs and the breather, applying a sealant where applicable, Tighten the fittings to specifications. Ensure that the breather is clear, and check that the lube fitting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

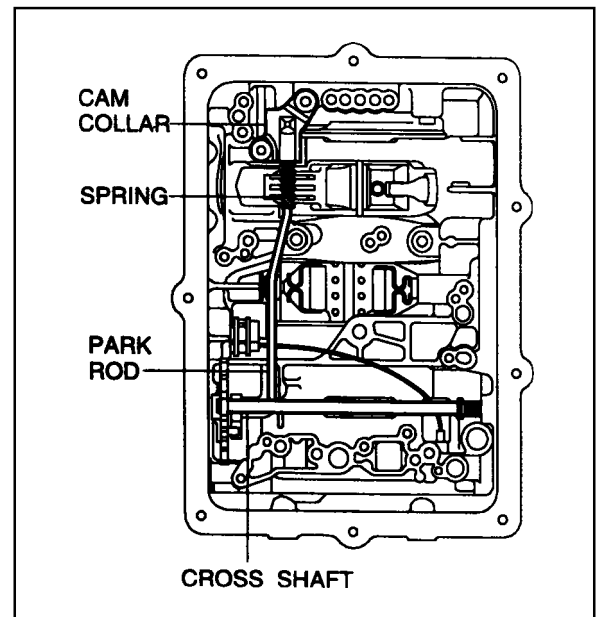
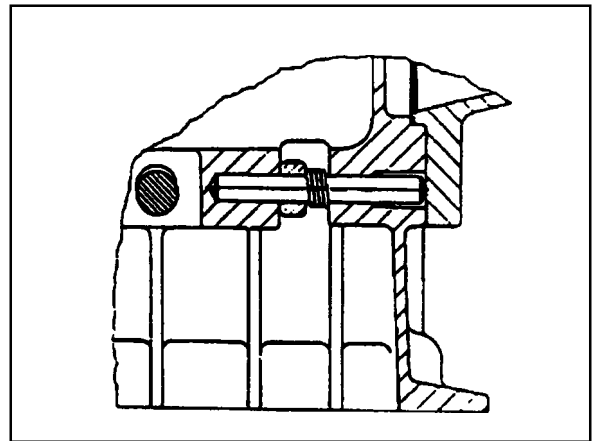
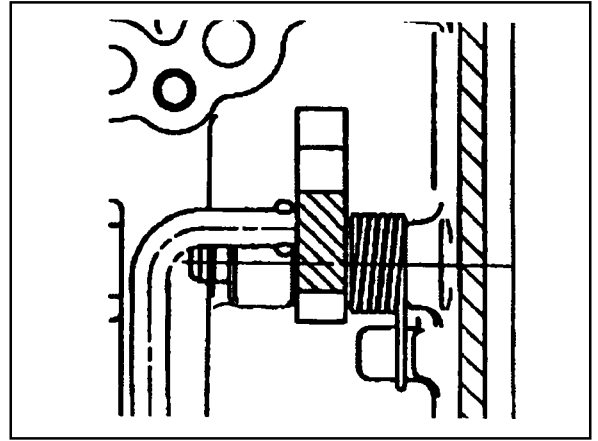
6. Secure the pivot pin with the circlip.

Notice

The pawl must pivot freely on its pin.

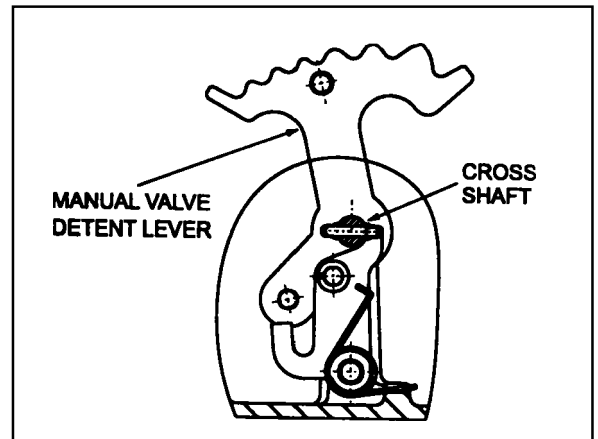
7. Install the parking pawl pivot pin and spring.

8. Connect the park rod to the manual valve detent lever. Ensure the spring and cam collar is firmly installed on the rod.

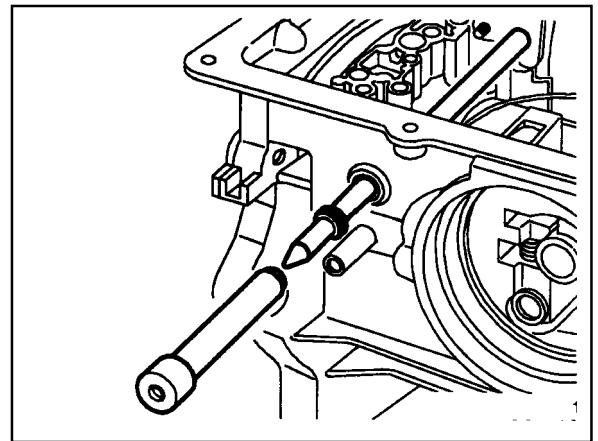


5A-96 AUTOMATIC TRANSMISSION

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.

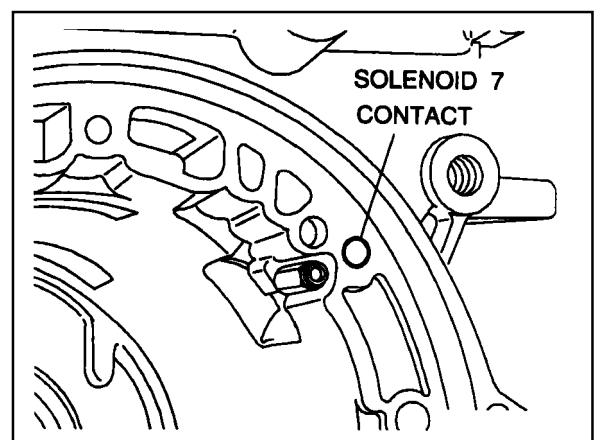


16. Install the new cross shaft seals using tool No. 0555-331894.

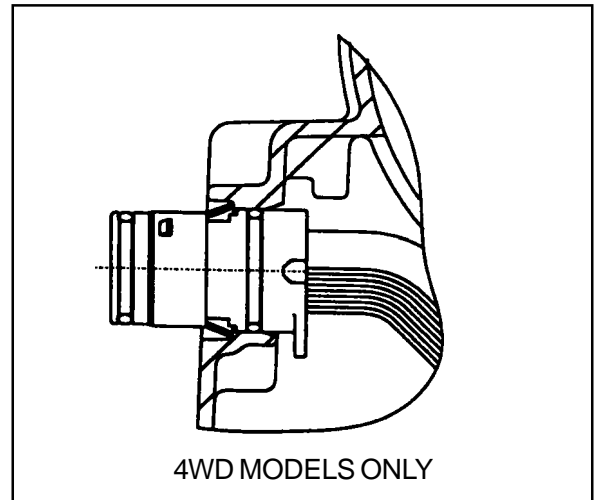


17. Install the inhibitor switch on the case. Torque the screws as per specifications. Press the pin into the shaft until the tool bottoms (4WD models) using tool No.0555-332942.
18. Thoroughly check the terminal wiring loom for condition and continuity.

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.



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.

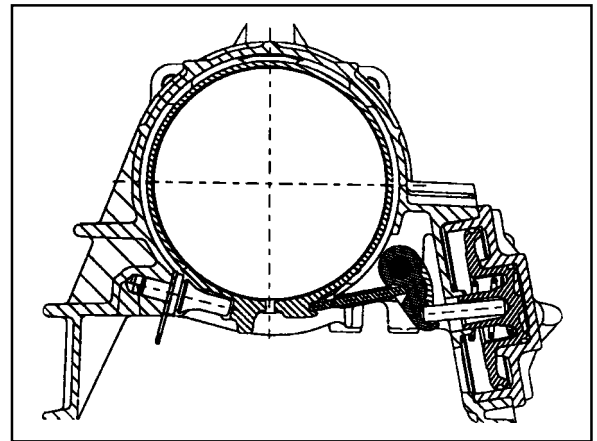
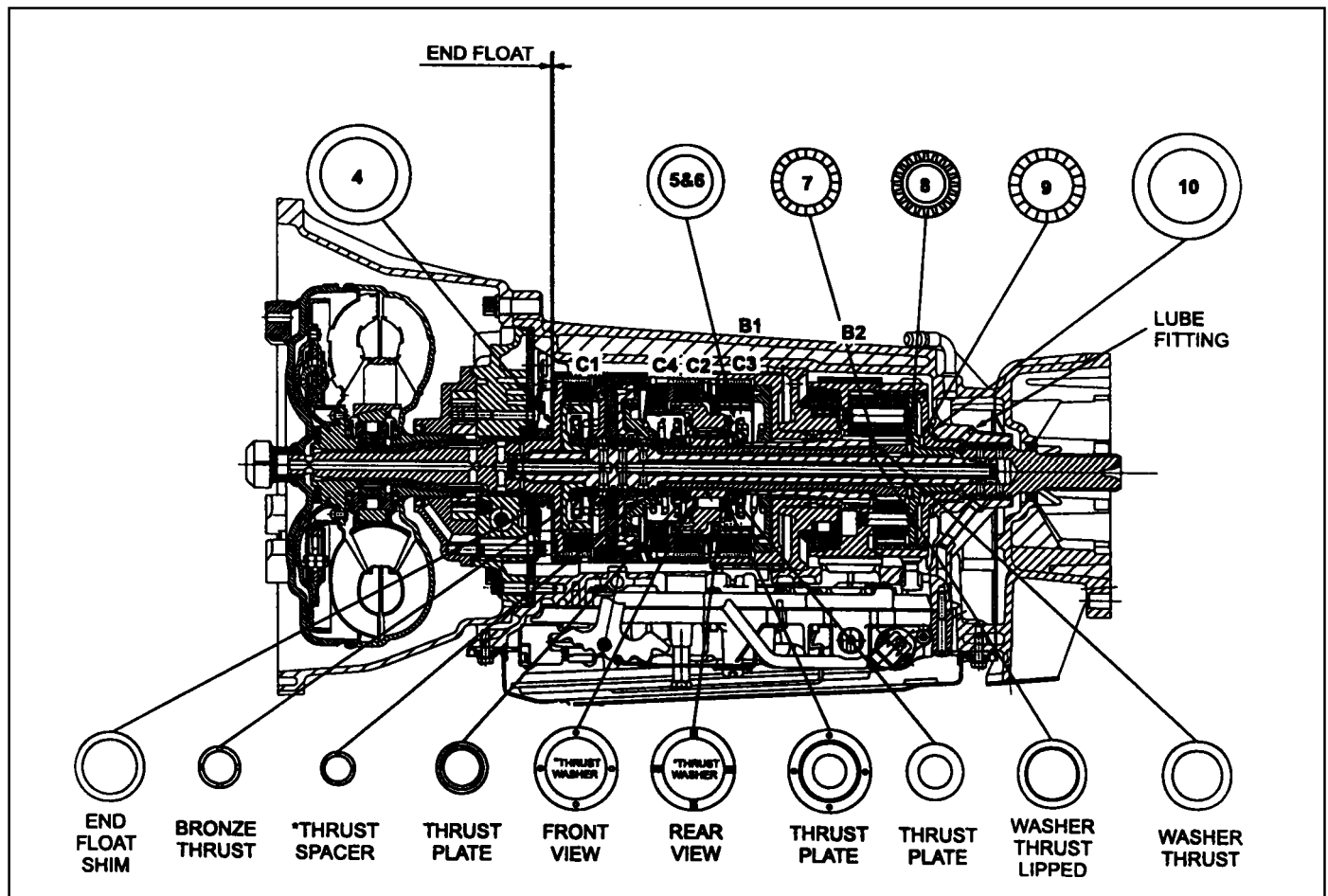


Figure 8.18 - Rear Servo and Band

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 worn 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.

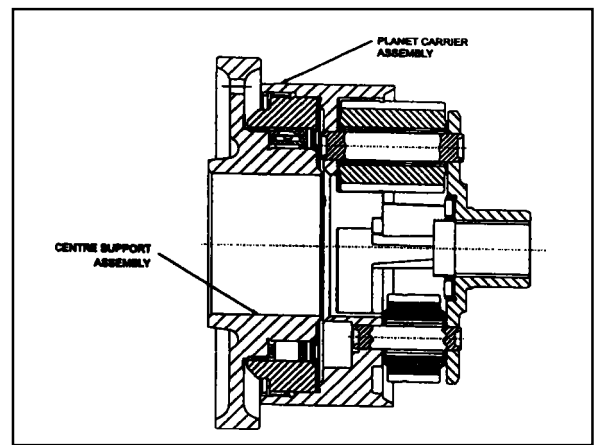


Figure 8.20 - Planet Carrier Assembly and Centre Support

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.

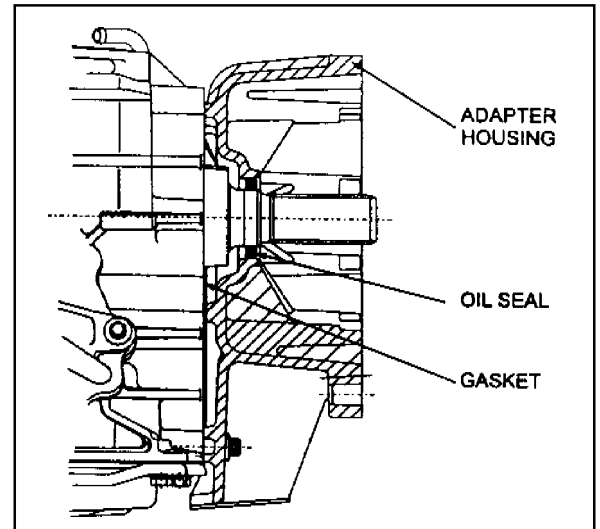


Figure 8.21 - Extension Housing

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.

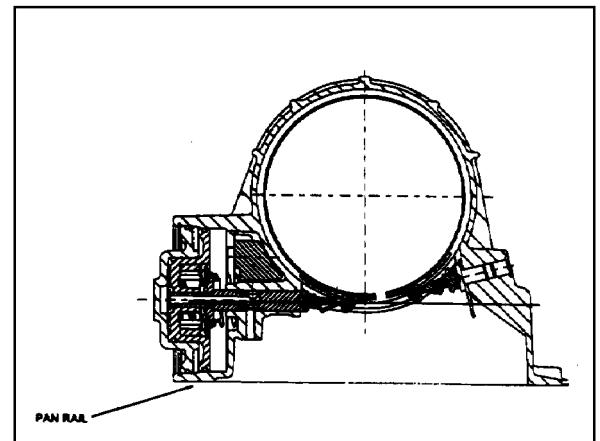


Figure 8.22 - Front Servo and Band



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 any 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.

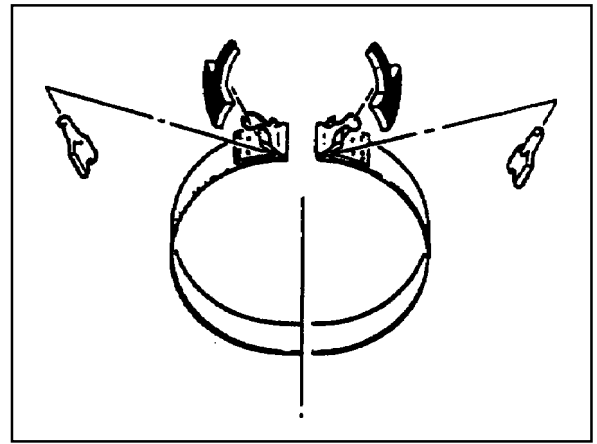


Figure 8.23 - Front Band Strut Installation

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.

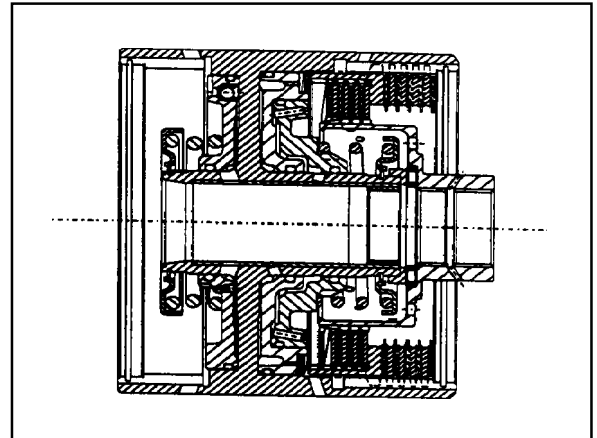


Figure 8.24 - Typical C2/C4 Clutch Assembly

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 O-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

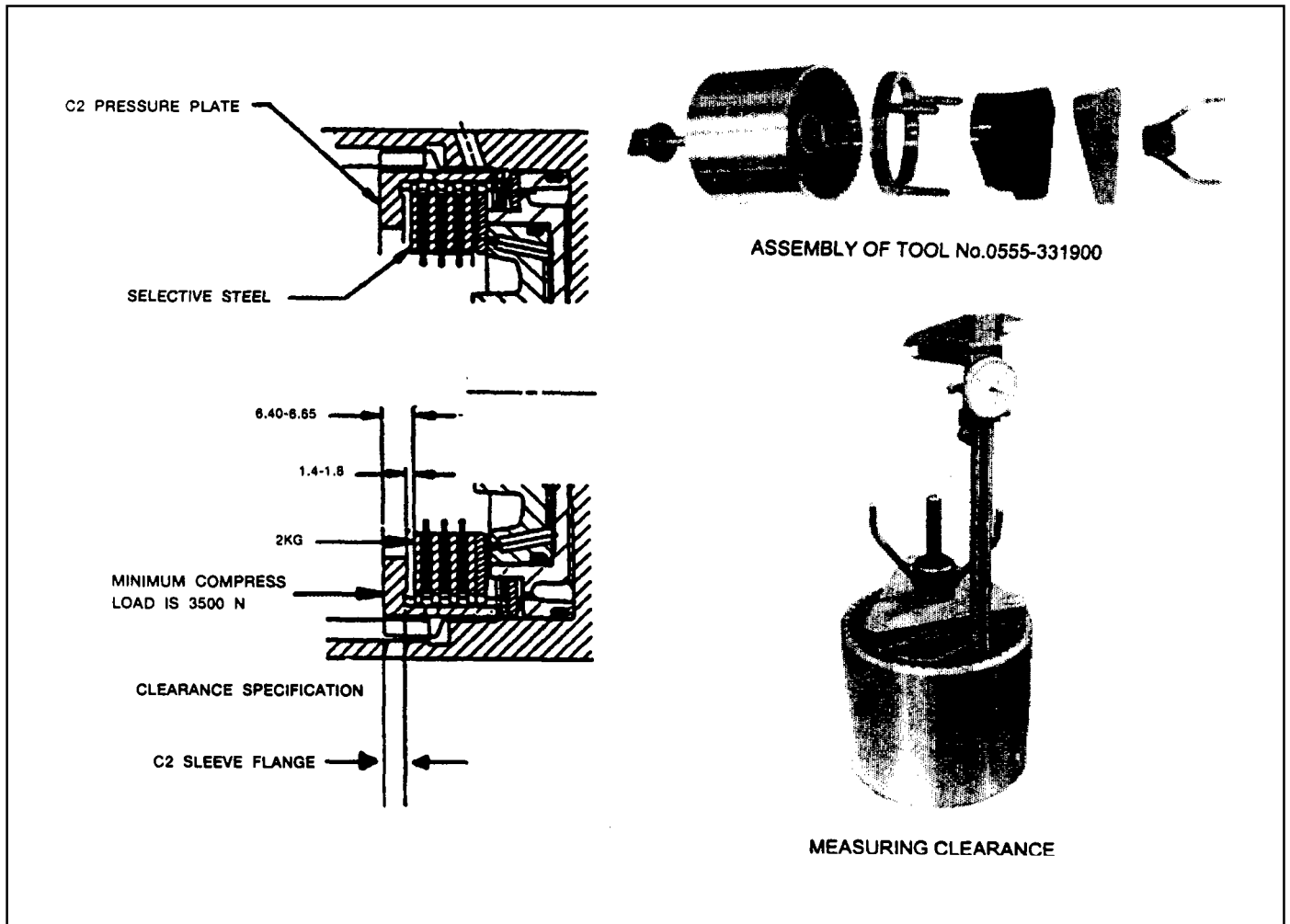
The wire diameter of this spring is 5.26 mm.

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



5A-104 AUTOMATIC TRANSMISSION

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 kg 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



5A-106 AUTOMATIC TRANSMISSION

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.

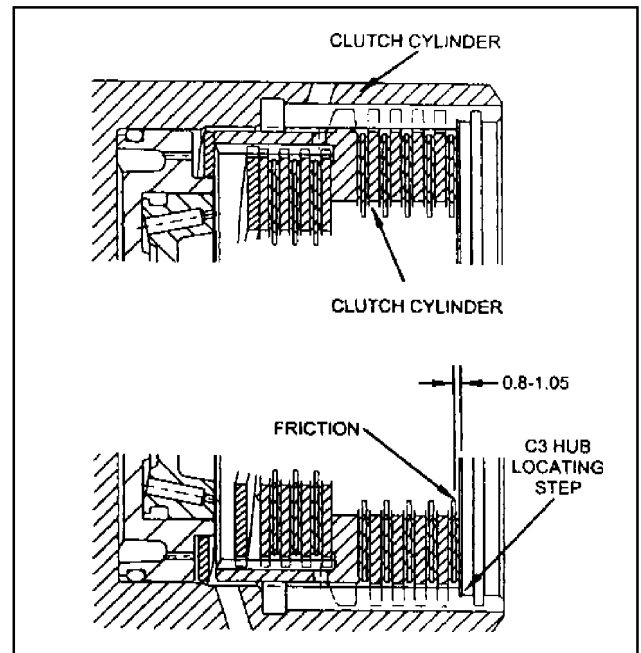


Figure 8.26 - Typical C2 Clutch Pack Clearance

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.

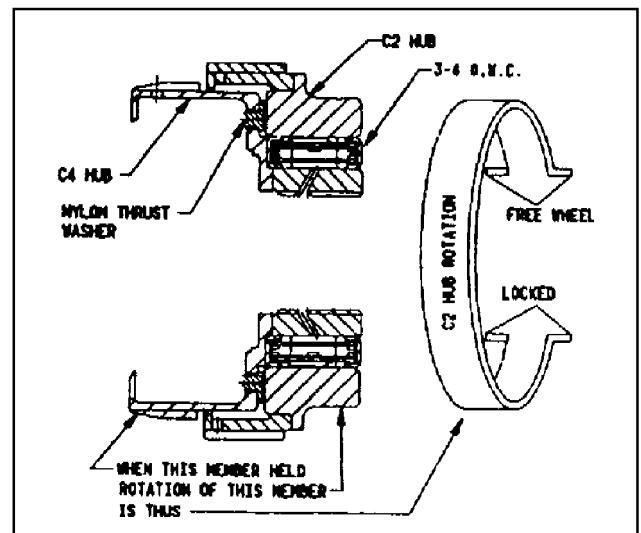


Figure 8.27 - C2 - Hub Rotation

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 fit 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.

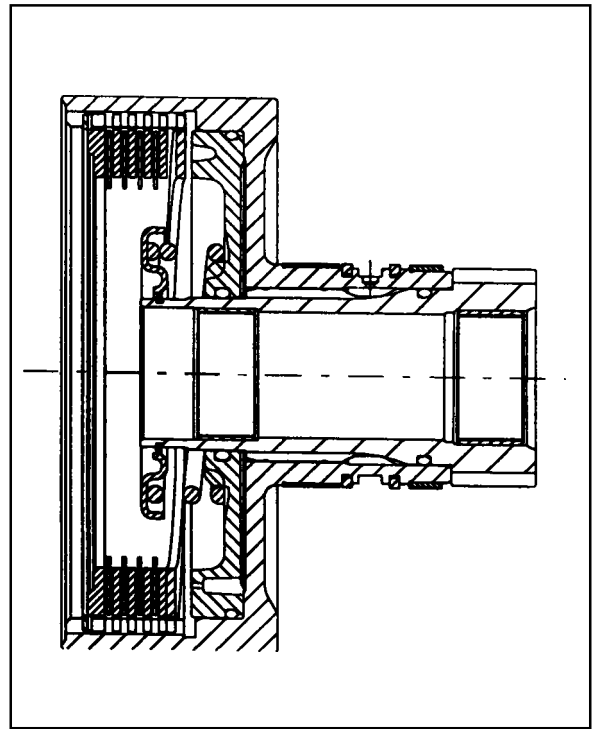


Figure 8.28 - C3 Clutch and Reverse Sun Gear

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.

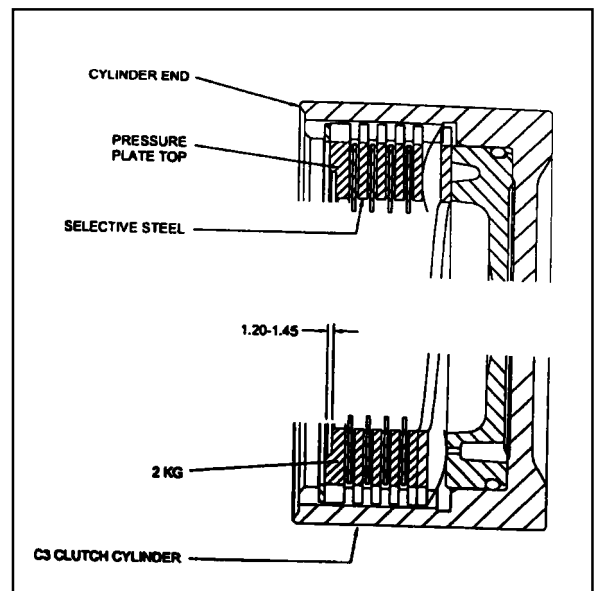


Figure 8.29 - Typical C3 Clutch Assembly Clearance

Forward Sun Gear and C3 Clutch Pack Assembly

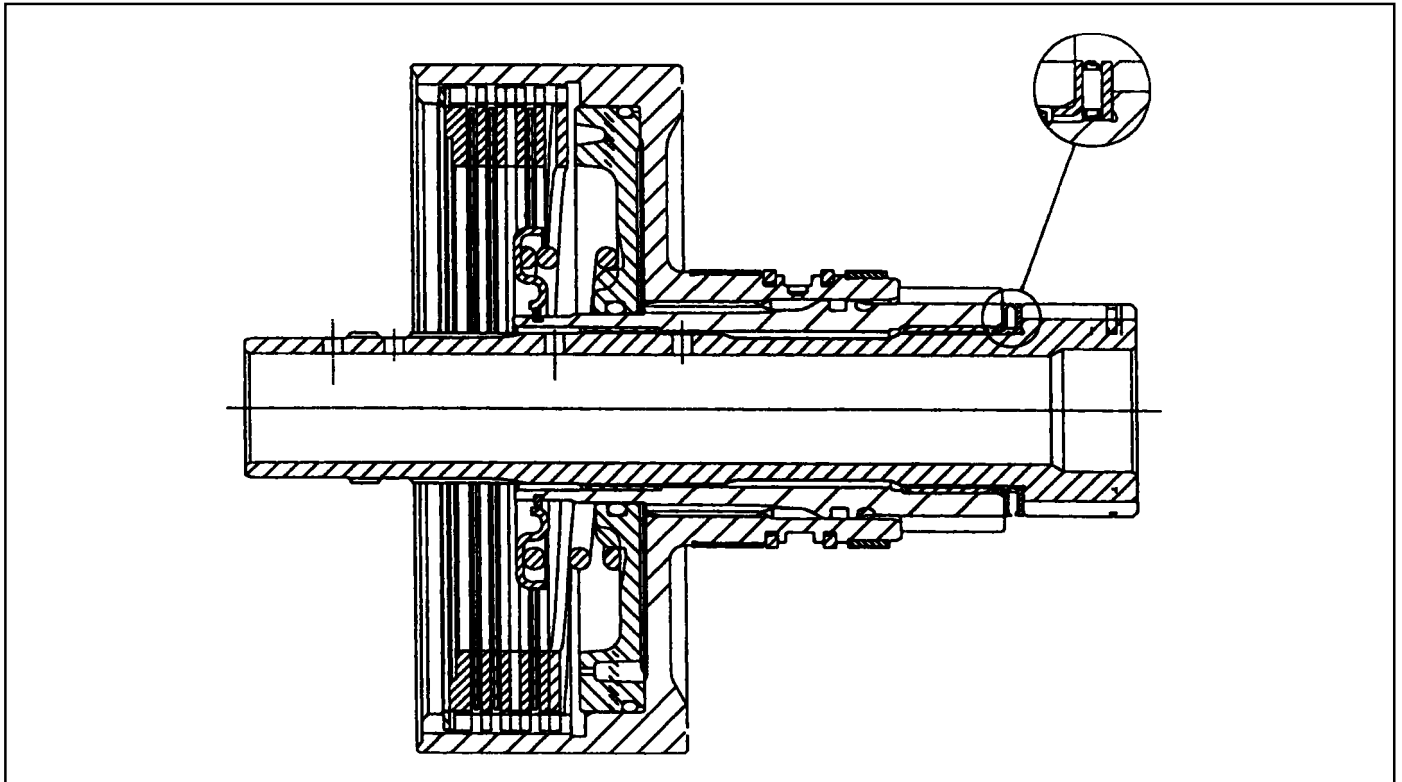


Figure 8.30 - Typical forward Sun Gear add C3 Clutch Assembly

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 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-GOOGOI, 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.

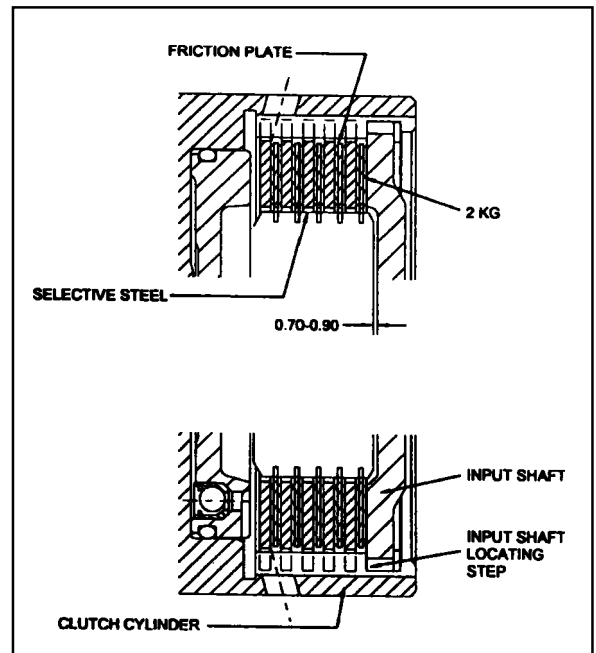


Figure 8.31 - Typical C1 Clutch Assembly Clearance

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.

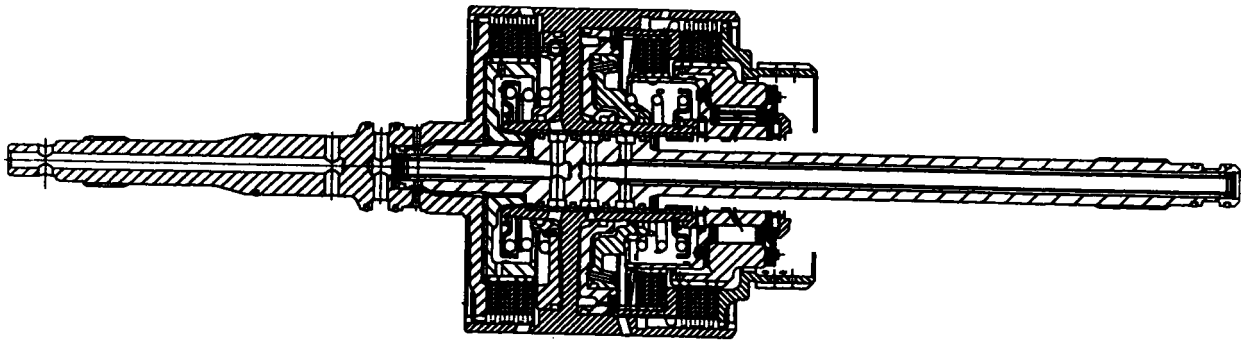


Figure 8.32 - C1, C4 and C2 Clutch

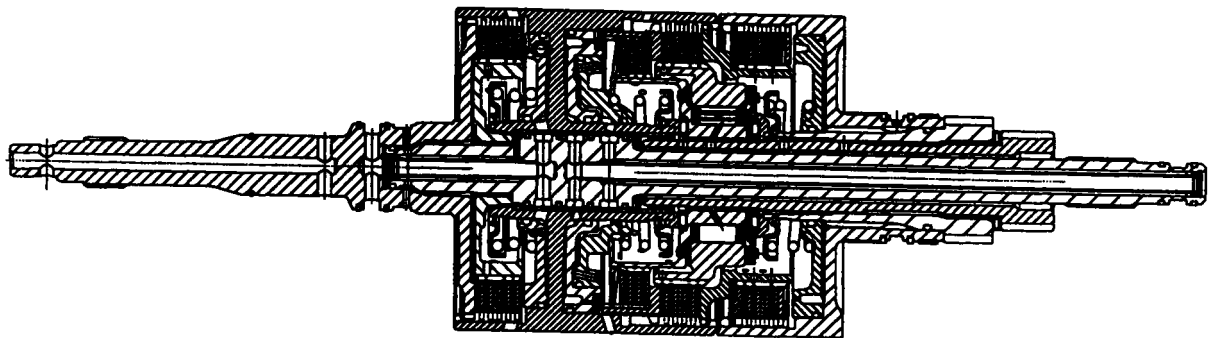


Figure 8.33 - C1, C4, C2 and C3 Clutch

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.

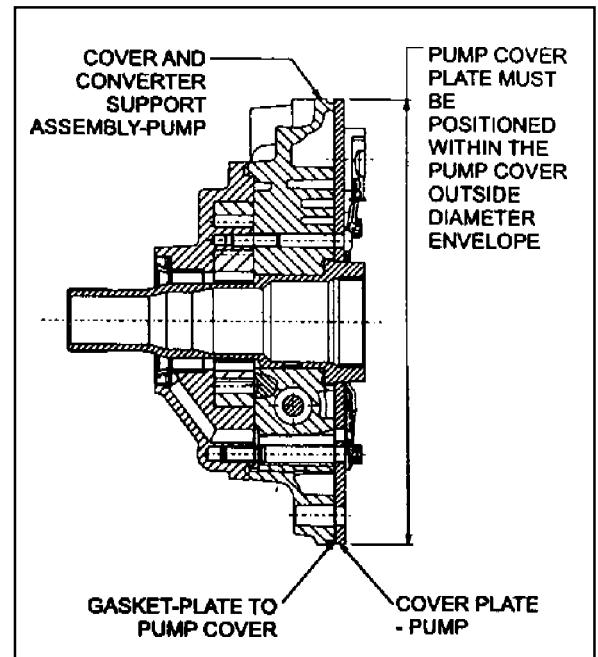


Figure 8.34 - Pump, Cover and Converter Support

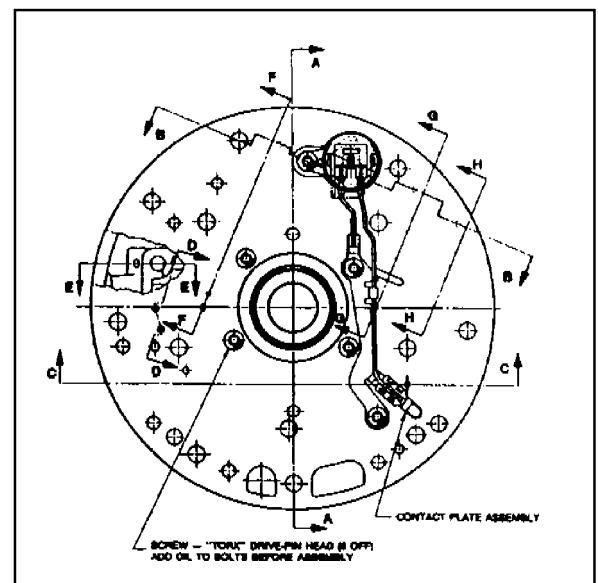
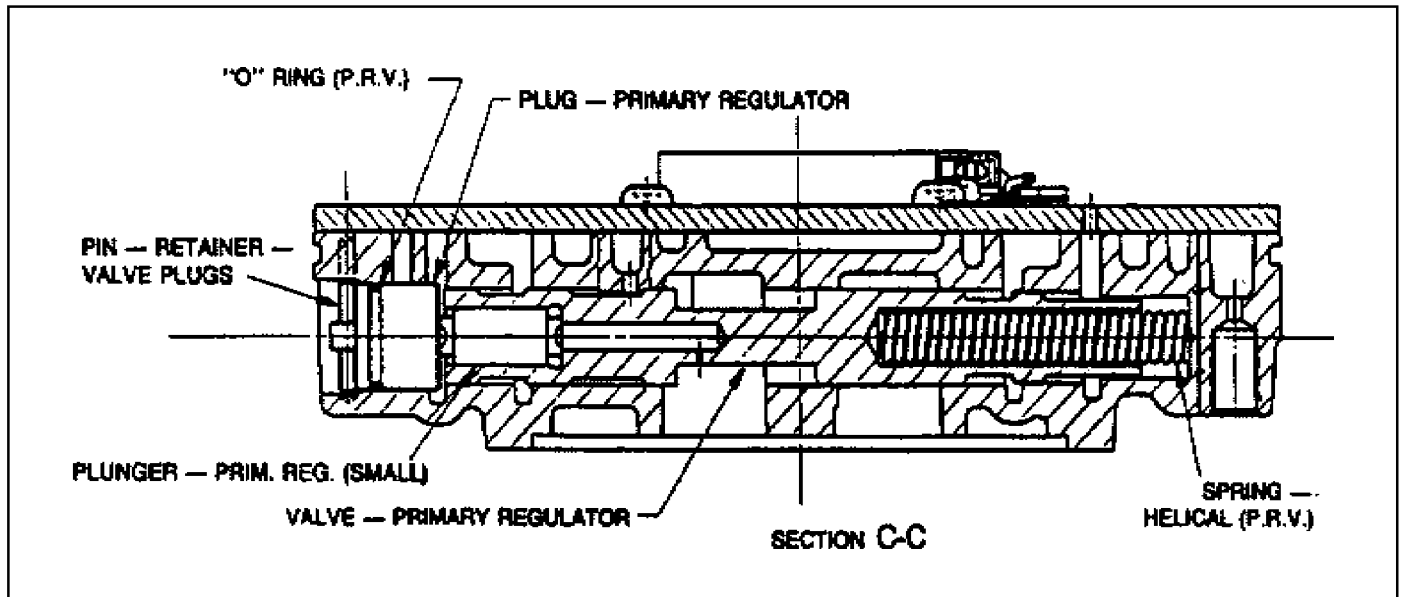


Figure 8.35 - Pump Cover Assembly

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.

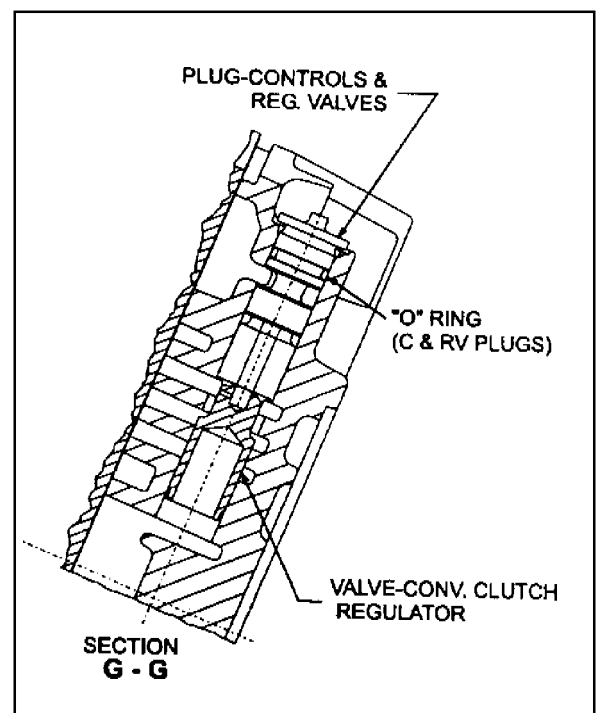
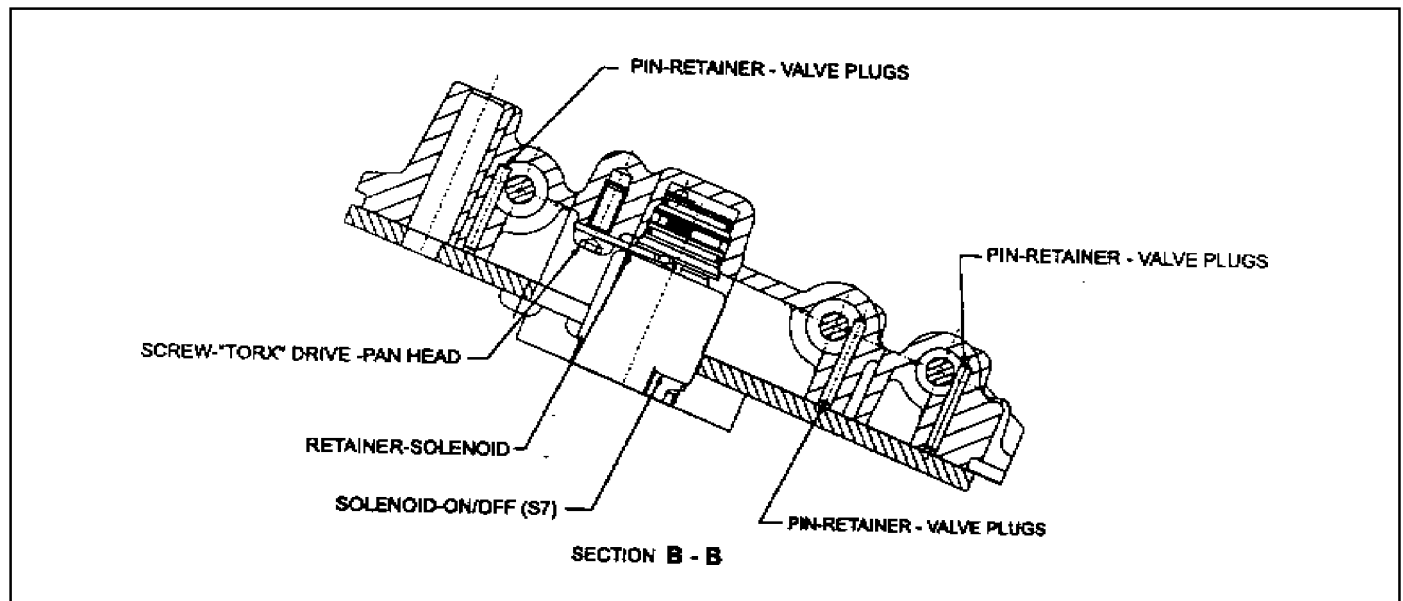


Figure 8.37 - Converter Clutch Regulator Valve

5A-114 AUTOMATIC TRANSMISSION

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.

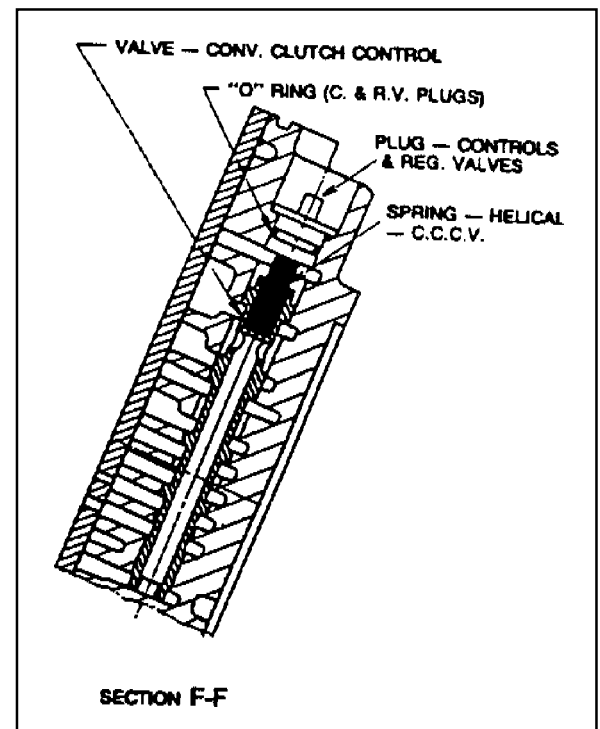
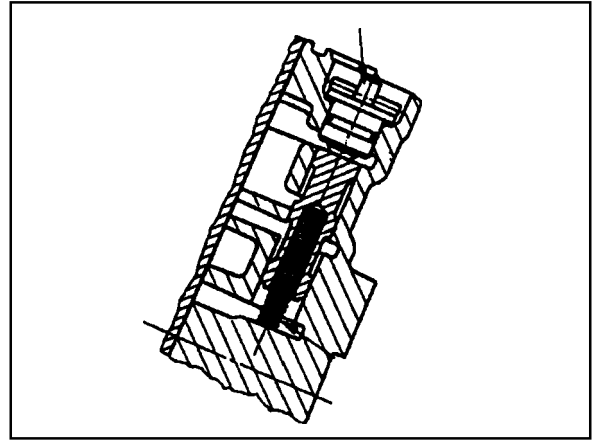


Figure 8.38 - Converter Clutch Control Valve

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

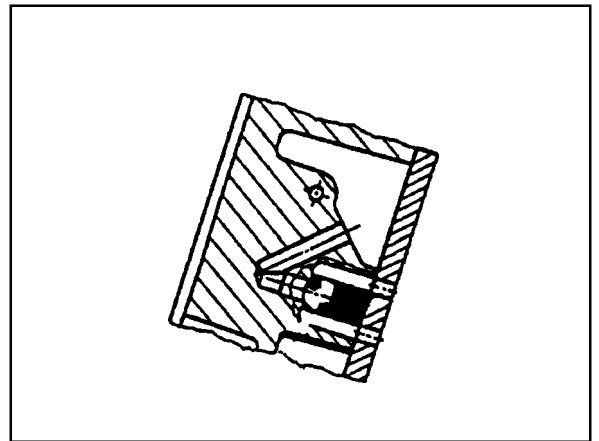


Figure 8.42 - Feed Ball

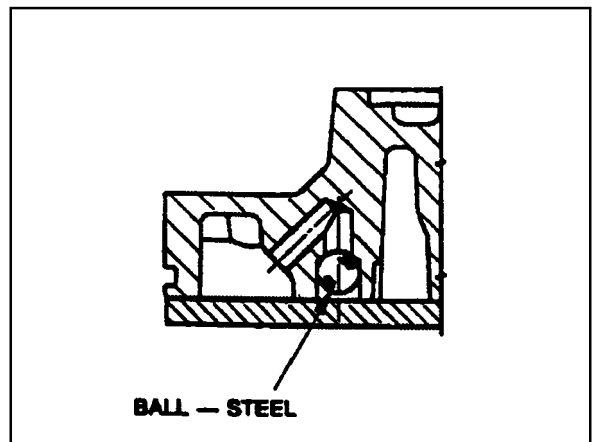
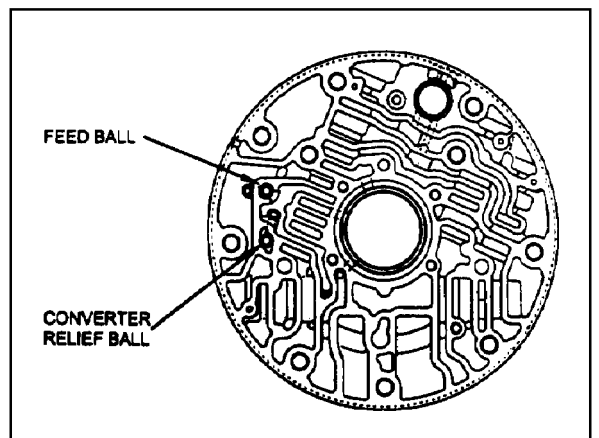


Figure 8.42 - Feed Ball



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.

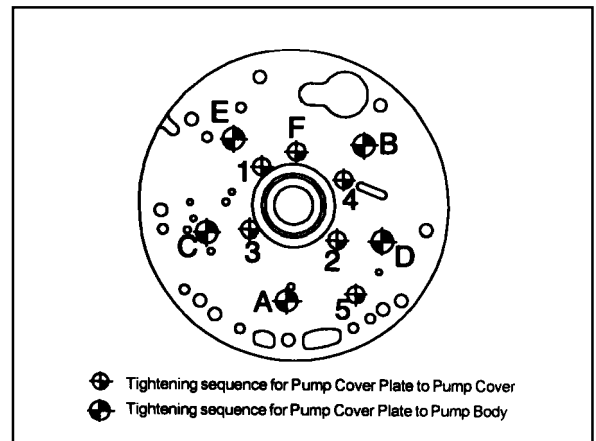


Figure 8.44 - Pump Bolt Tightening Sequence

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.

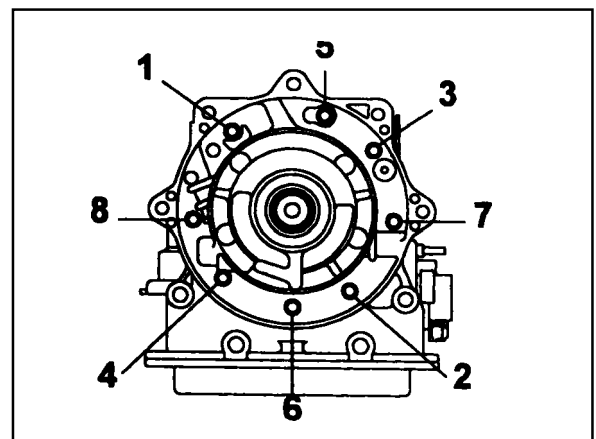
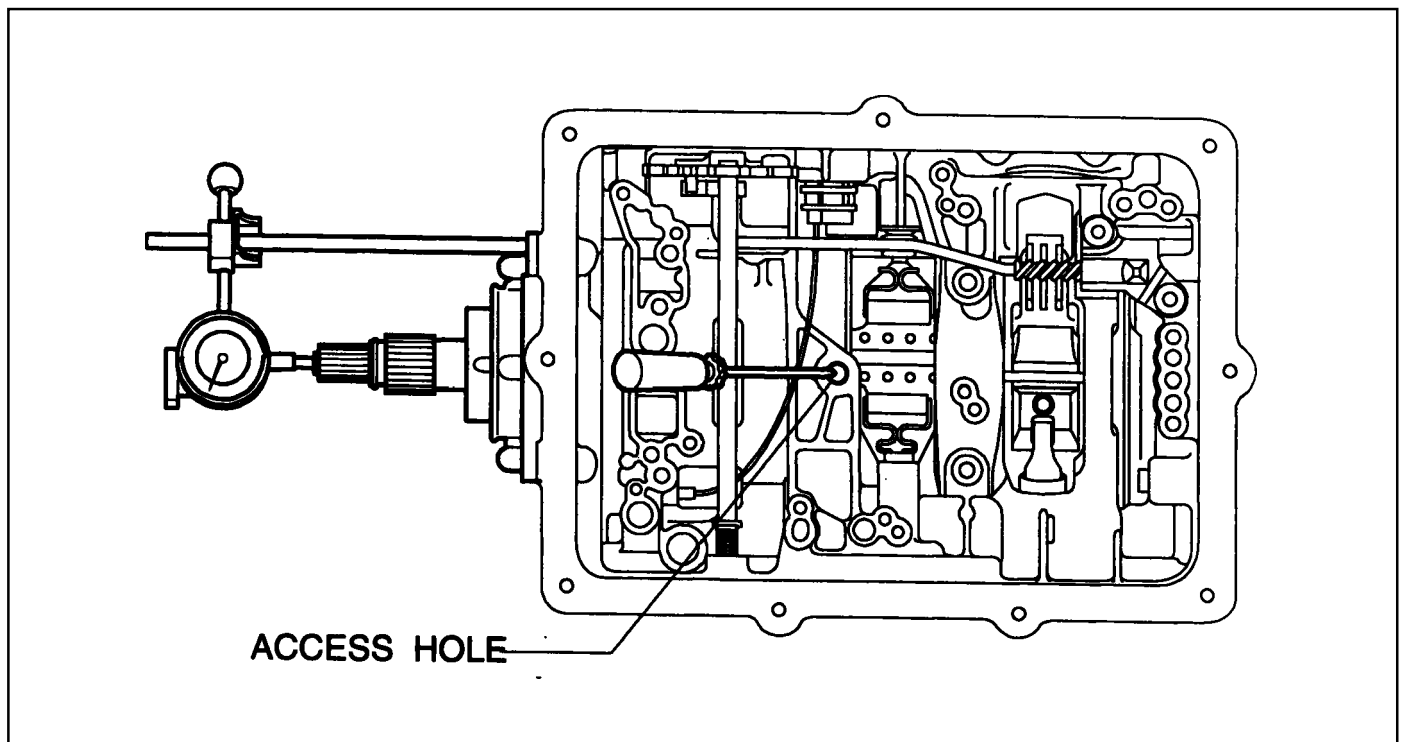


Figure 8.45 - Tightening Sequence Pump to Case

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 :
- Attach a dial indicator to the front of the transmission case with the stylus resting on the end of the input shaft.
 - Apply a force of approximately 250 newtons or 25 kg to the input shaft.
 - Zero the dial indicator.
 - Place a small lever behind the forward clutch cylinder and lever the cylinder forward.
 - 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.

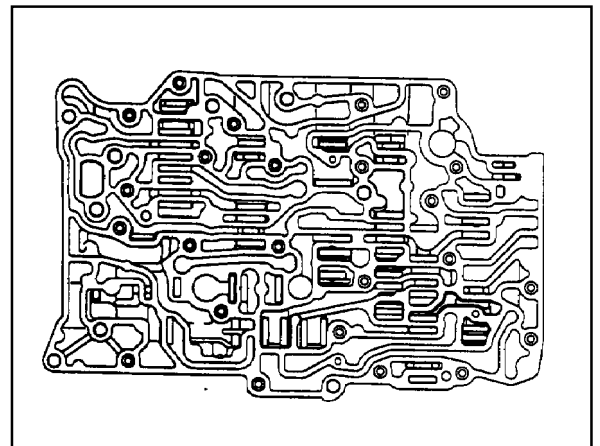


Figure 8.47 - Lower Valve Body

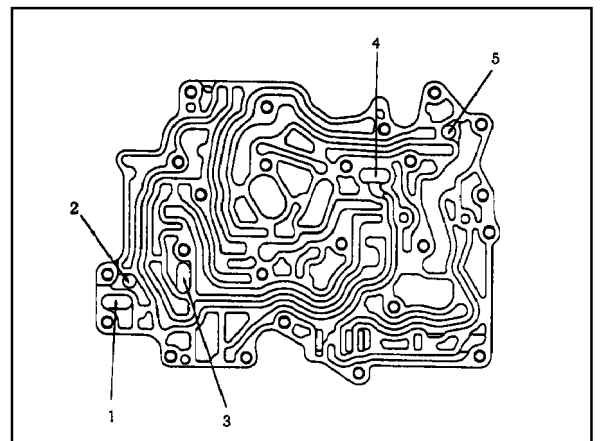
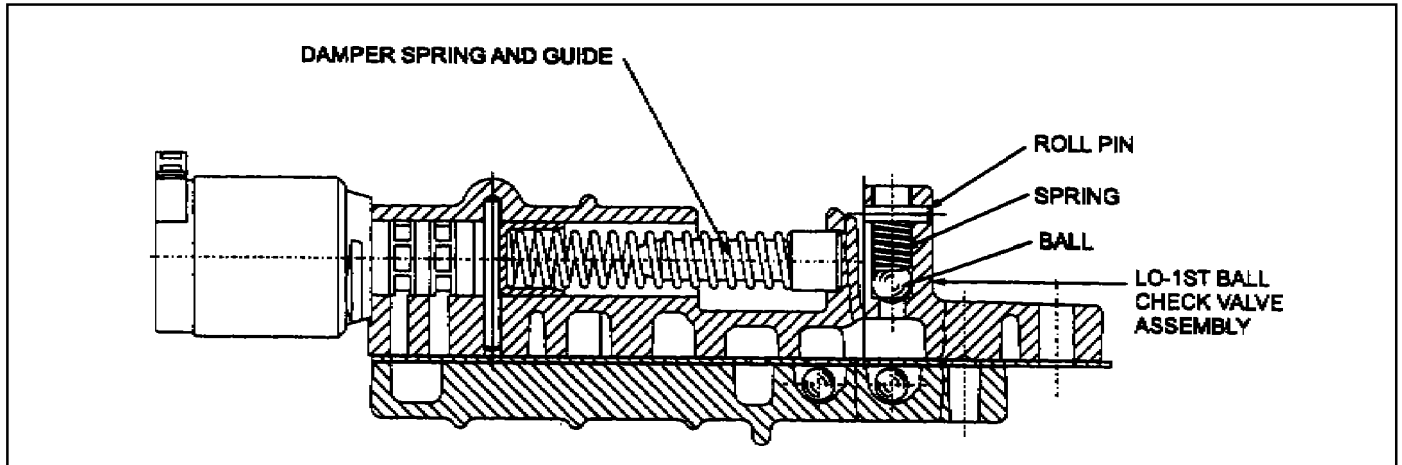


Figure8.48 - Upper Valve Body Showing Check Ball Locations

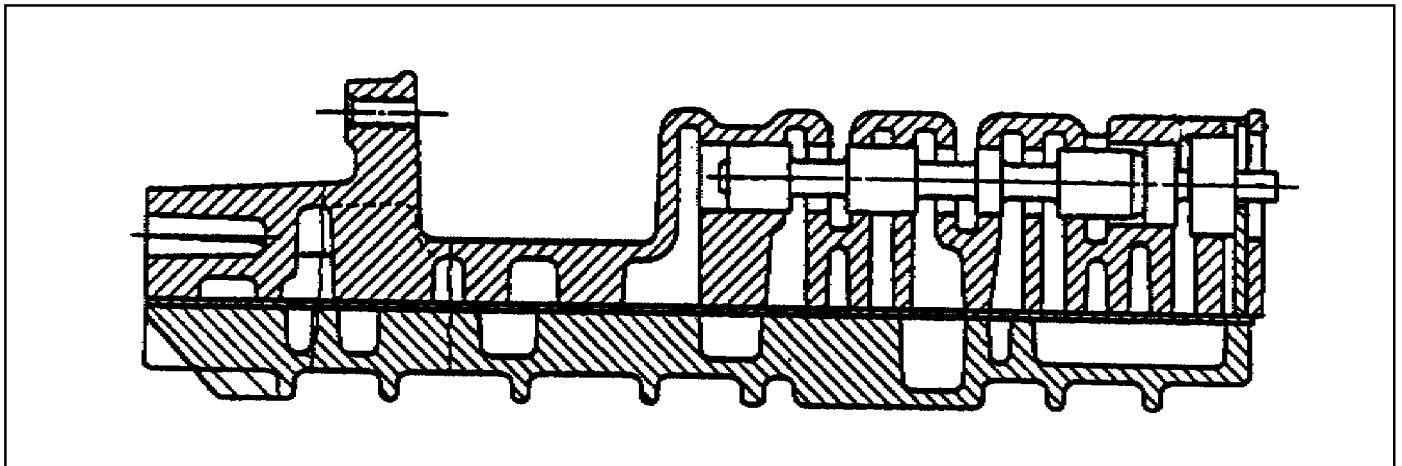
6. Install the lo-1st spring, ball check valve and roll pin. Refer to figure 8.49.
7. Install the solenoid 5 damper guide spring, piston and retaining pin. Refer to figure 8.49.

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.

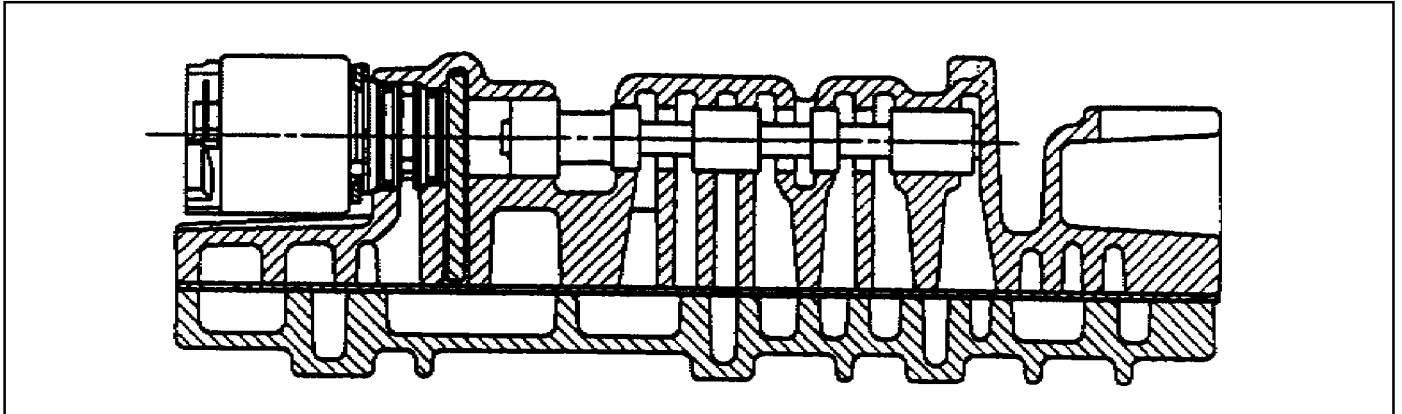
Figure 8.50 - 1-2 Shift Valve



5A-120 AUTOMATIC TRANSMISSION

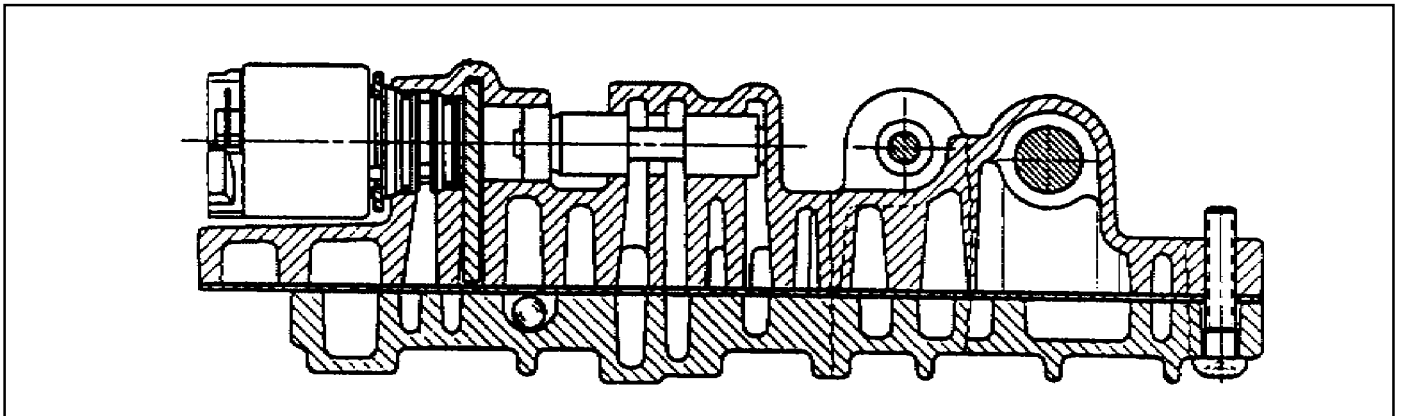
9. Install the 3-4 shift valve and retaining pin. Refer to figure 8.51.

Figure 8.51 - 3-4 Shift Valve



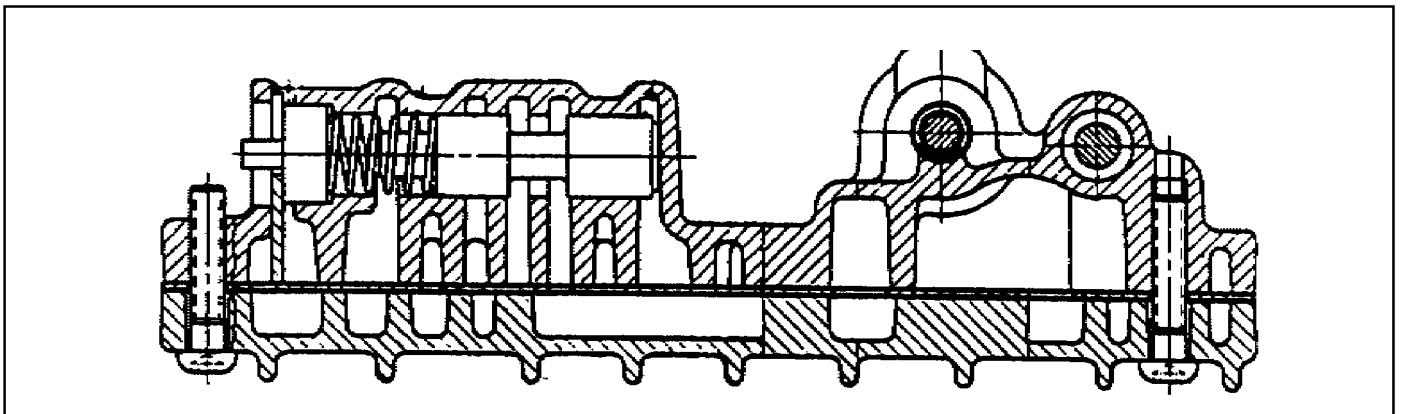
10. Install the 2-3 shift valve and retaining pin. Refer to figure 8.52.

Figure 8.52 - Solenoid 2 and 2-3 Shift Valve



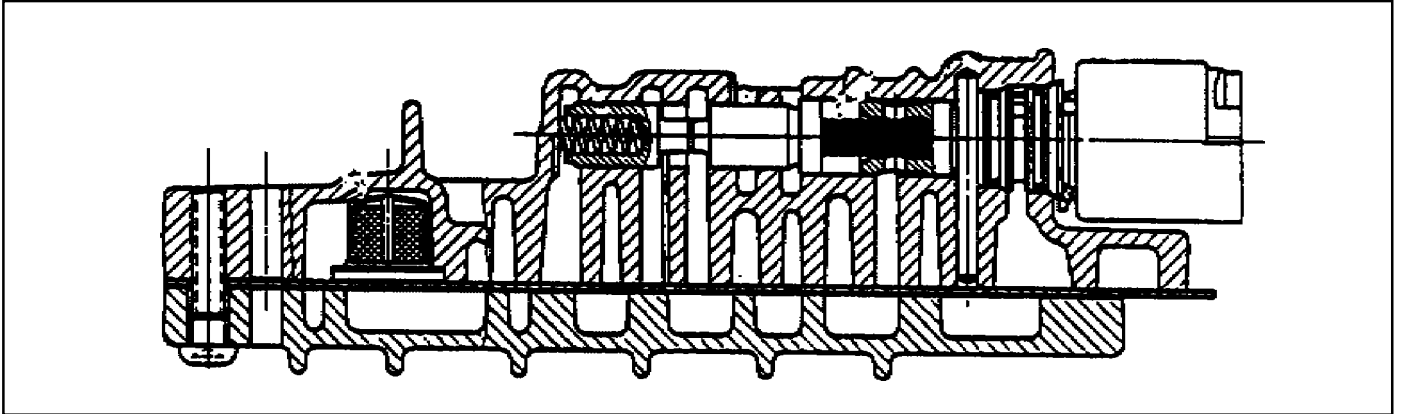
11. Install the 4-3 sequence valve, spring, plug and retaining plate. Refer to figure 8.53.

Figure 8.53 - 4-3 Sequence Valve



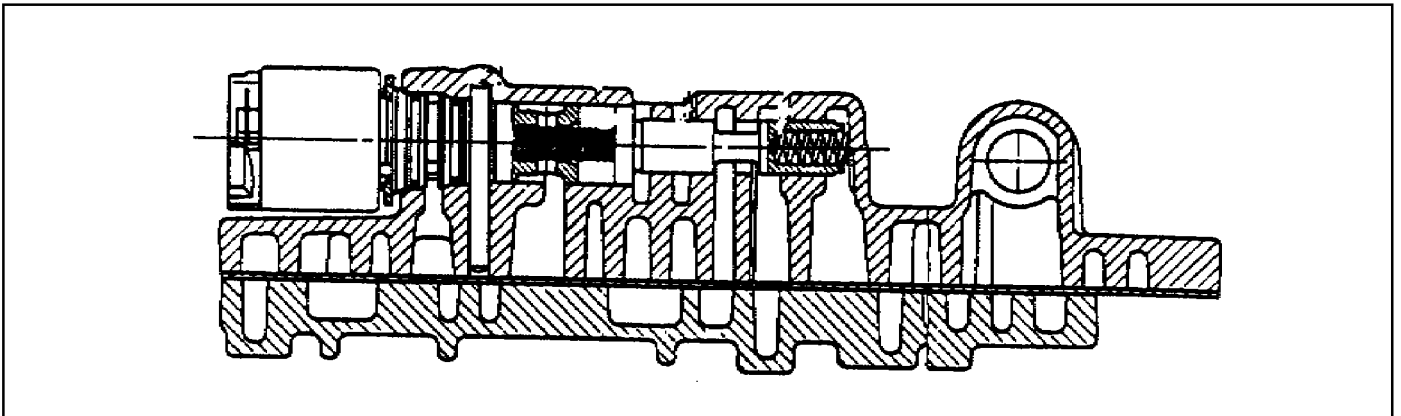
12. Install the band apply regulator (BAR) valve (refer to figure 8.54), springs, plunger and retainer pin.

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

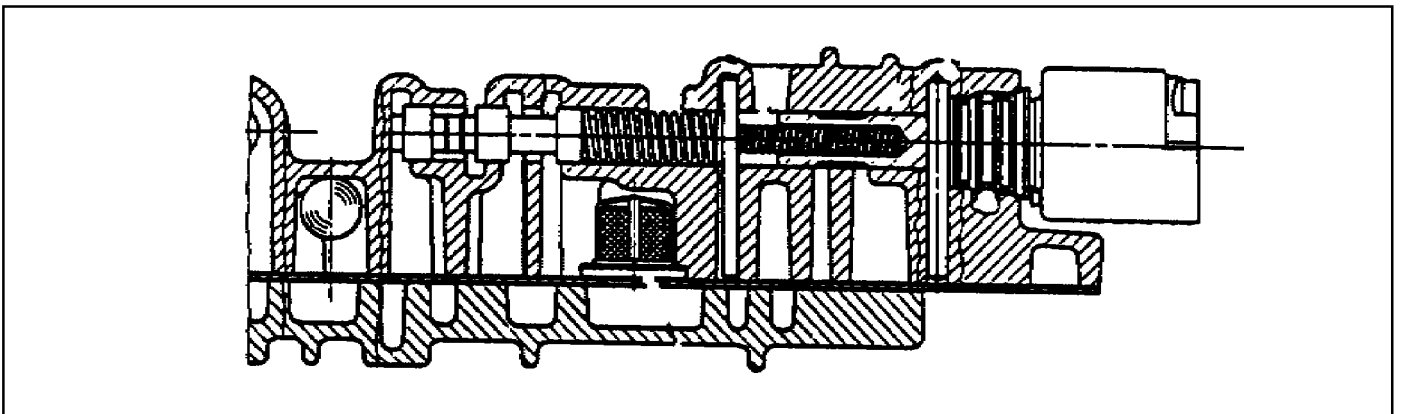


14. Install the solenoid supply valve, spring and retainer plate. Refer to figure 8.56.

Notice

This aluminum valve is easily damaged.

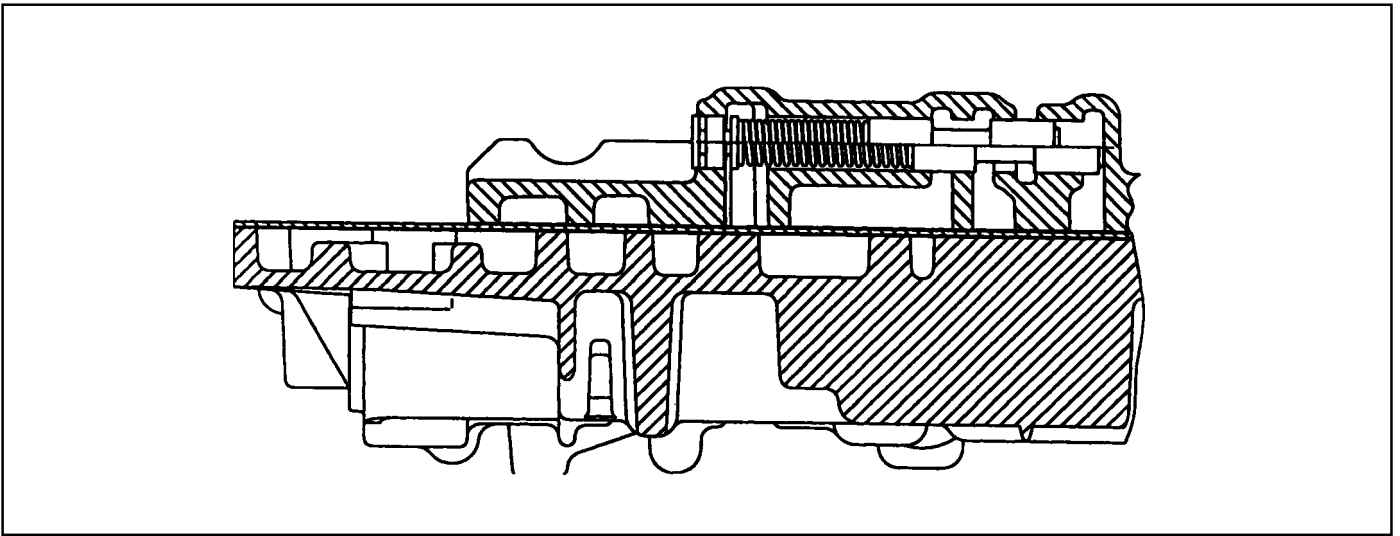
Figure 8.56 - Solenoid Supply Valve and Solenoid 6



5A-122 AUTOMATIC TRANSMISSION

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.

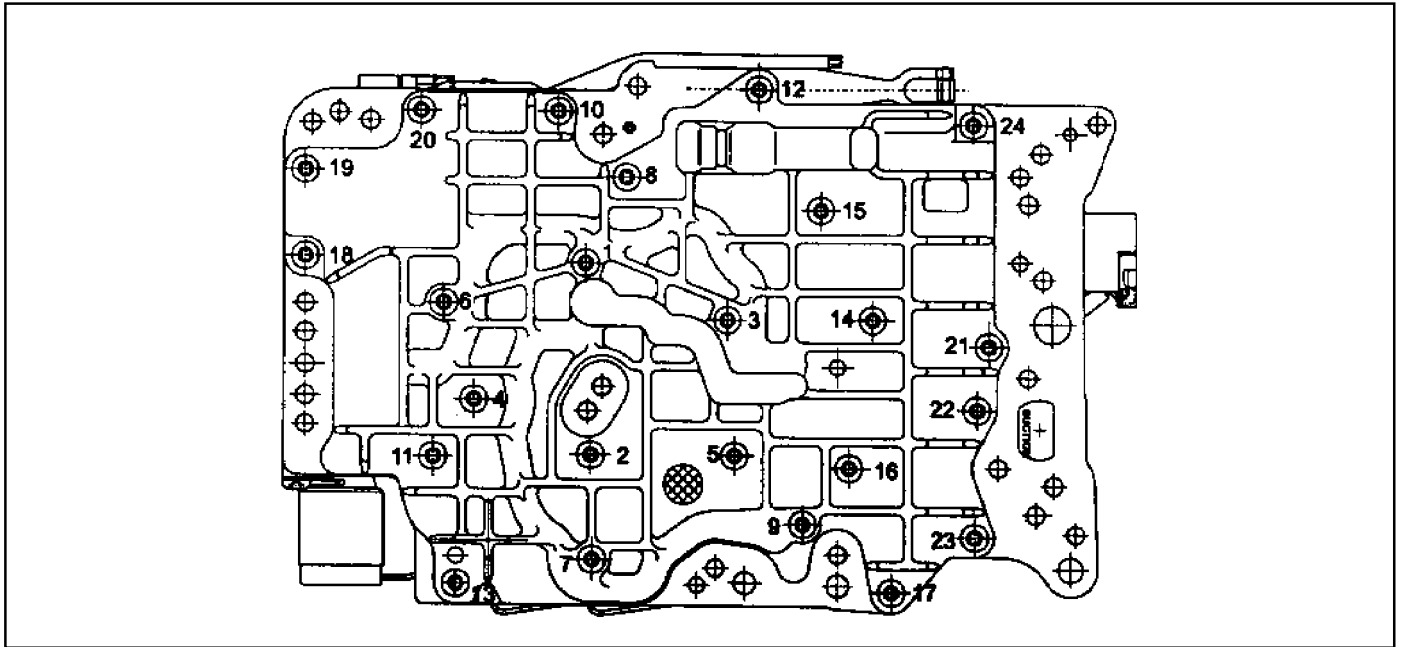
Figure 8.57 - Reverse Lockout Valve



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.

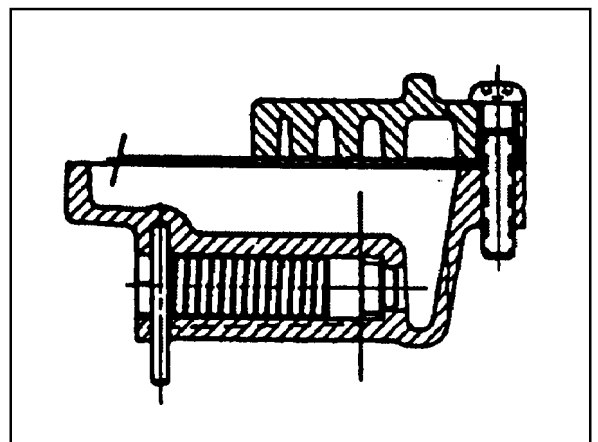
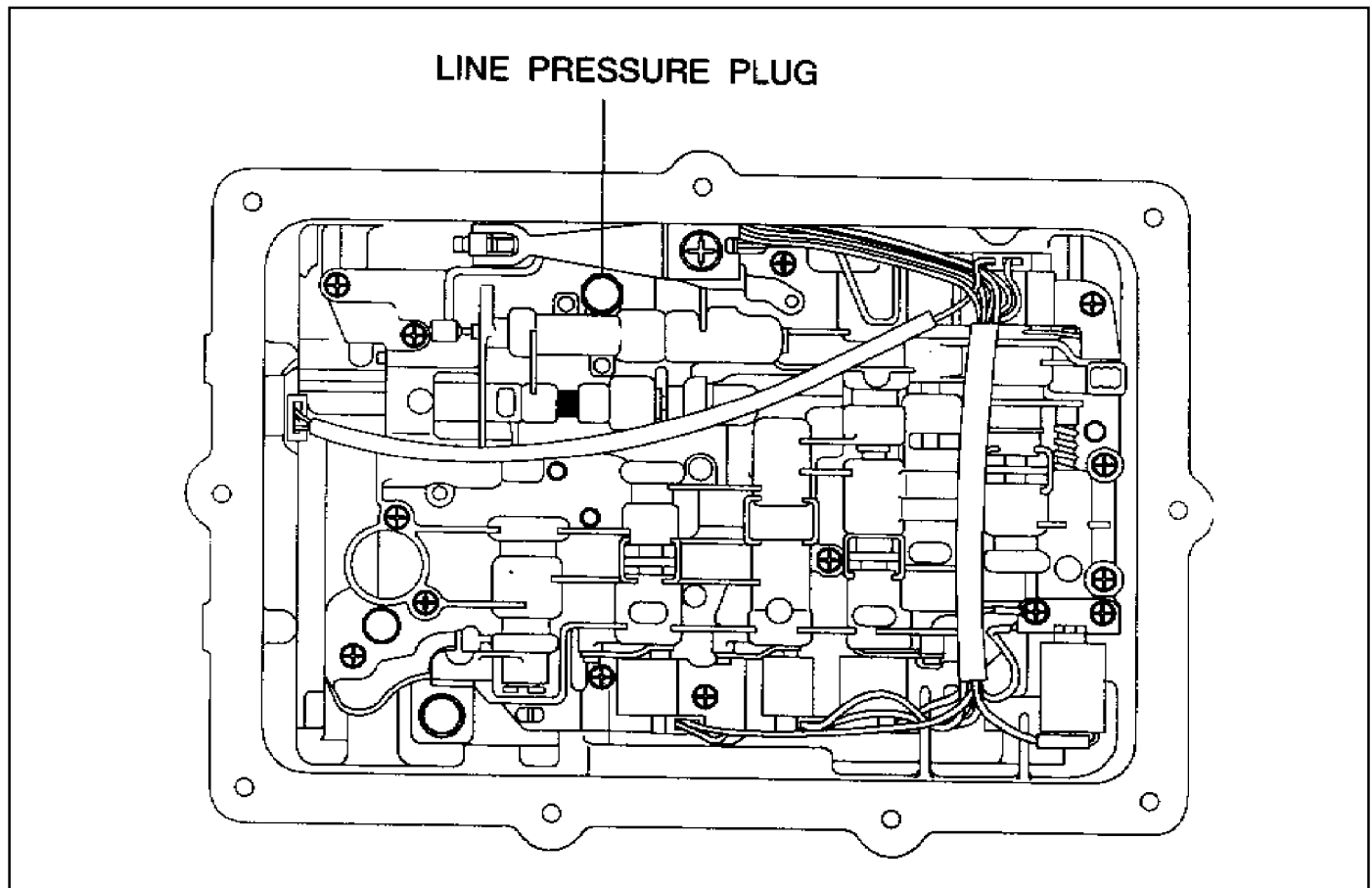


Figure 8.59 - Line Pressure Relief Valve

5A-124 AUTOMATIC TRANSMISSION

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.

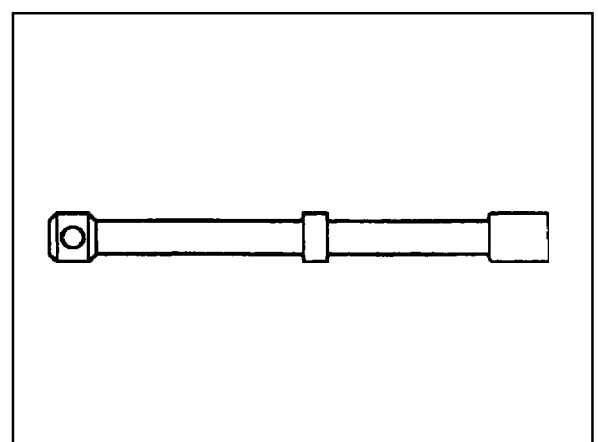
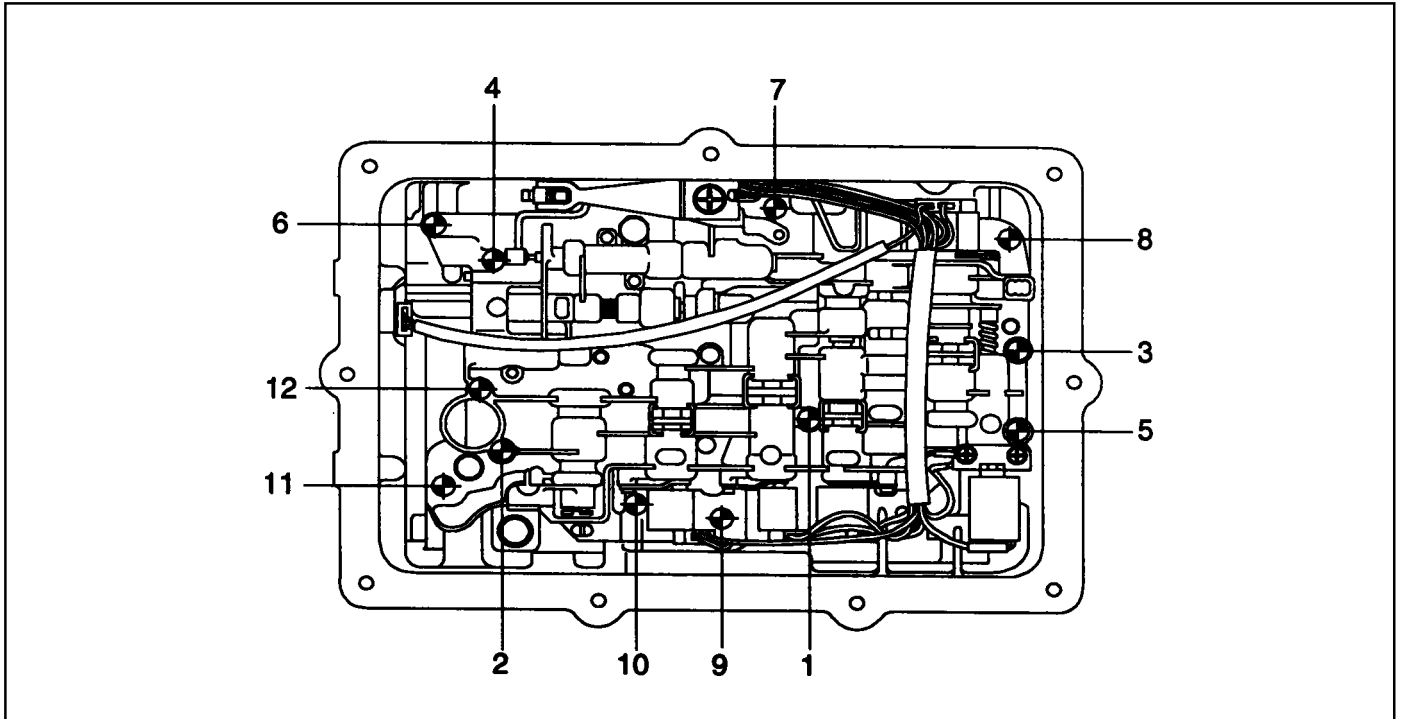


Figure 8.60 - Manual Shift Valve

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 filter assembly with the retainer.
4. Check that the magnet is located in the dimple in the corner 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.

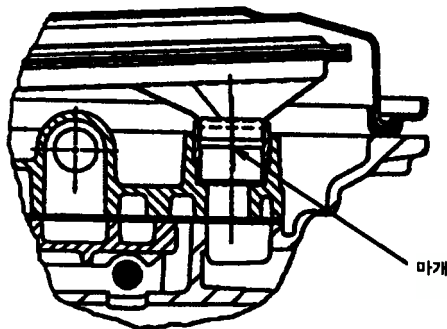


Figure 8.63 - Oil Filter Spigot

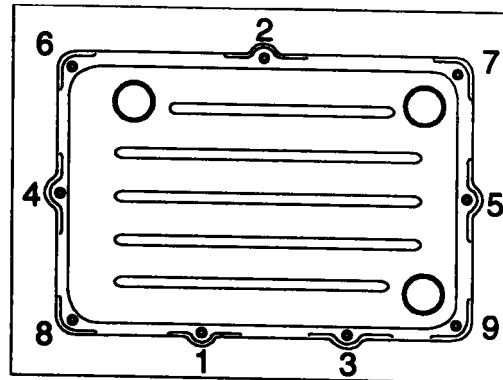
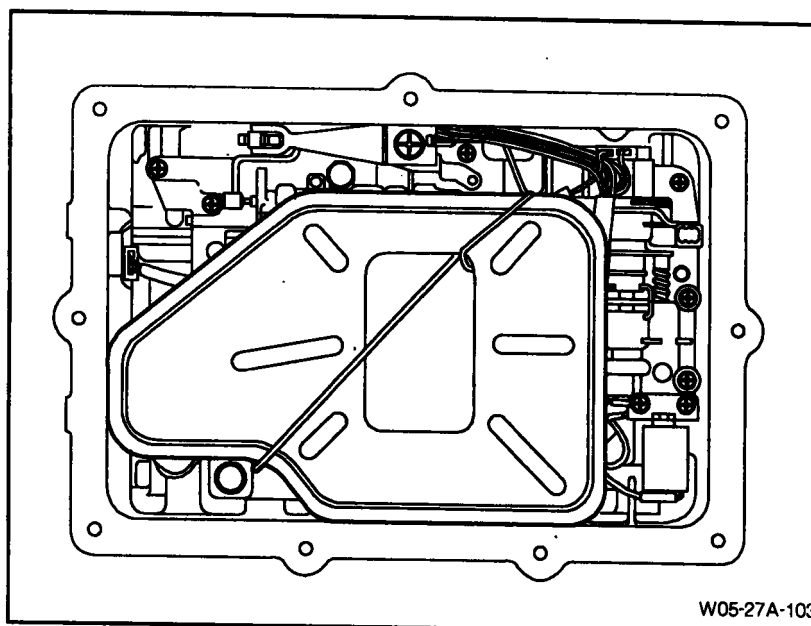


Figure 8.65 - Oil Pan Tightening Sequence



W05-27A-103

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.

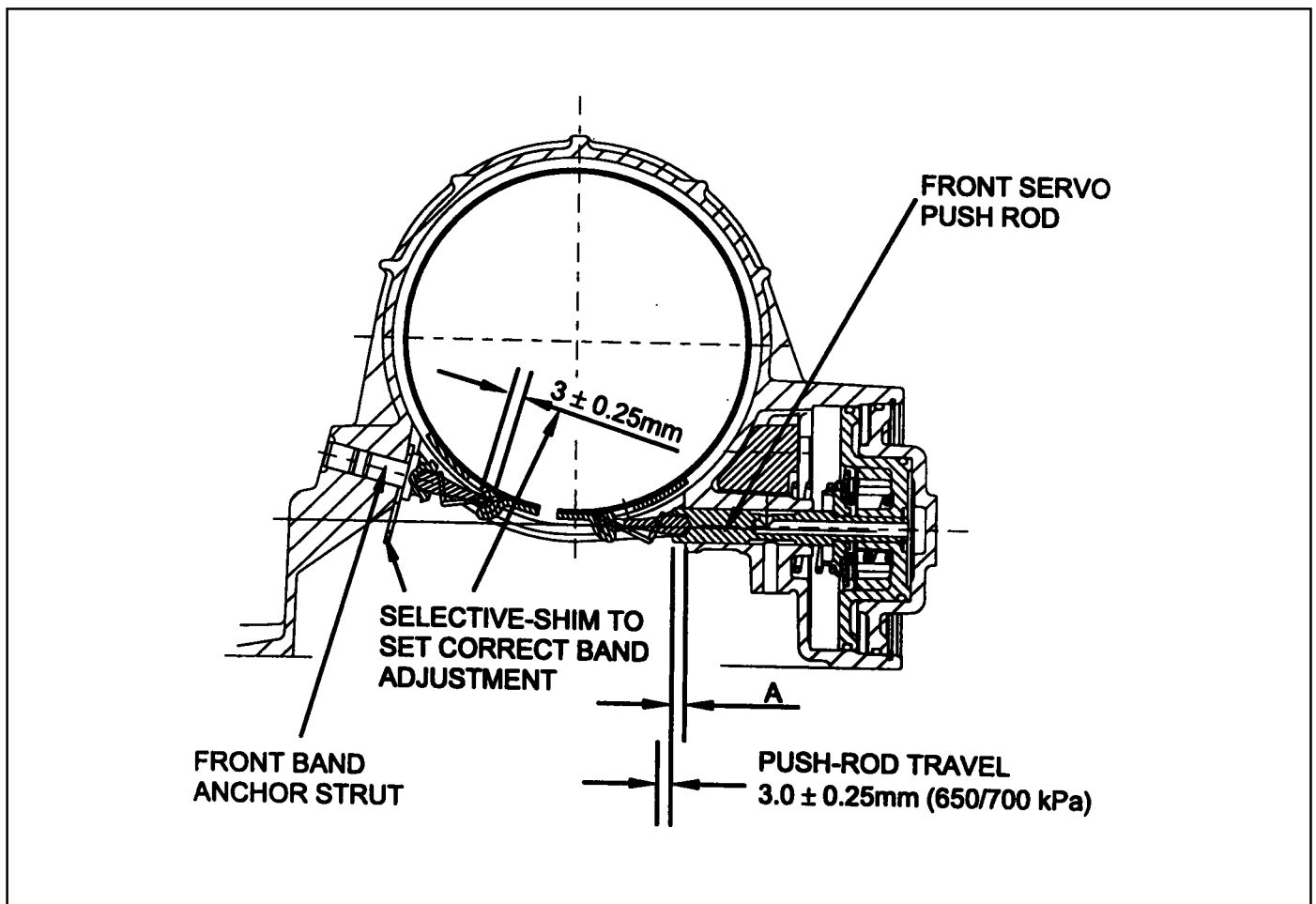
1. Measure the projection of the front servo push rod from the transmission case. Refer to figure 8.66, dimension A.
 - a. Apply air at 650/700 kPa to the front servo apply area (B1 outer). (Refer to figure 8.67.)
 - b. Measure the travel of the push rod and subtract 3 mm to find the shim size required.
 - 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 $3 \text{ mm} \pm 0.25 \text{ mm}$.

Figure 8.66 - Front Band Settings



Rear Band Setting Procedure

To set the rear band, proceed as follows.

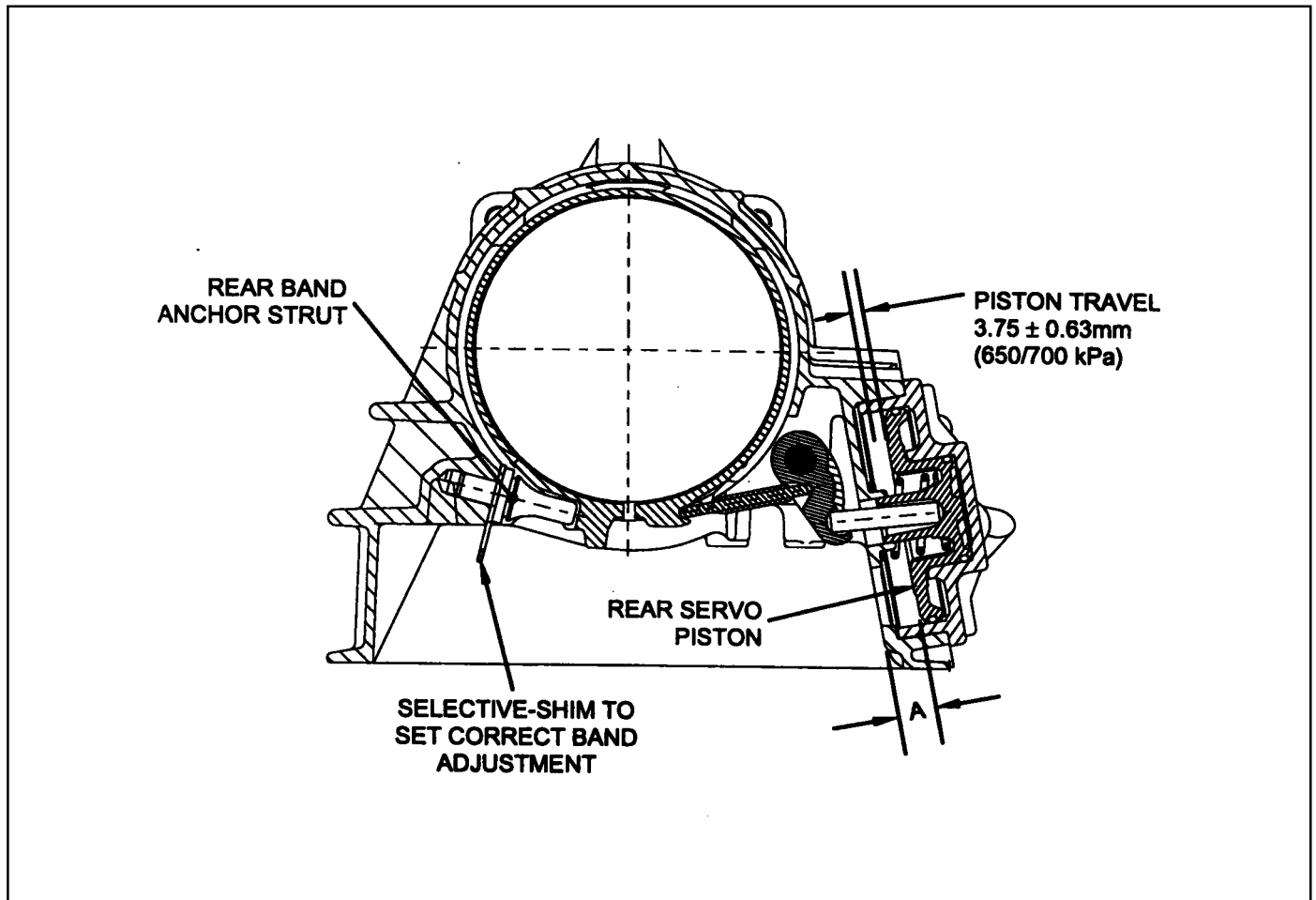
1. Measure distance 'A' from the rear servo piston to the inner face of the transmission case using vernier calipers. Refer to figure 8.68.
 - a. Apply air at 650/700 kPa to the rear servo apply area (B2 outer). Refer to figure 8.67.
 - b. Measure the travel of the piston, subtract 3.75 mm and divide 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(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 piston travel is $3.75 \text{ mm} \pm 0.625 \text{ mm}$.

Figure 8.68 - Rear Band Settings



5A-130 AUTOMATIC TRANSMISSION

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

