SECTION : 307-01a Automatic Transmission

VEHICLE APPLICATION : 2008.0 Falcon

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SPECIFICATIONS

Oil Specification

Description	Specification
Automatic Transmission Fluid	CASTROL TQ-95

NOTE: When adding fluid use only CASTROL TQ-95 ATF. The use of incorrect fluids will cause a reduction in performance and durability of the transmission.

Torque Specifications

Description	Nm
Transmission Assembly Screws	
T. C. housing to case M12 x 32	54-68
Extension housing to case - M93 M12 x 32	54-68
Extension housing to case - M97 M8 x 25	35-40
Rear servo cover to case M8 x 25	30-35
Pan to case M6 x 16	4-6
Cooler connector	40-45
Valve body to case M6 x 26	8-13
Valve body to case M6 x 45	8-13
Detent spring M8 x 16	20-22
Centre support to case M10 x 34	20-27
Cam plate to case M8 x 16	16-22
Position sensorswitch 10-24 x 13	4-6
Shipping strap to converter housing - M93, M8 x 13 OR M8 x 30 (TAPTITE)	11-16
Shipping strap to converter housing - M97, M8 x 13	11-16
Shipping strap to converter housing - M97, M8 x 50	13-18
Shipping cap - cooler connector M16	0.15-0.35
Service fill plug M20	30-35
Pump Cover Assembly Screws	
Pump to pump cover M8 x 55	24-27
Pump to pump cover M8 x 40	24-34
Pump cover to case M8 x 58	24-34
Pump cover plate to pump cover M6 x 16	13-16
Pump cover plate to crescent M6 x 54	13-16
Valve Body Body Assembly Screws	
Upper valve body to lower M6 x 30	11-16
Line pressure plug M6	4-7
Solenoids (ON/OFF & VPS including S7) M6 x 16	8-12

DESCRIPTION AND OPERATION

Automatic Transmission

BTR Model 93LE Automatic transmission general description

The Model 93LE is an electronically controlled four speed transmission with overdrive fourth gear and a torque converter lockup clutch.

Of primary significance is the microprocessor based control system which employs a single proportional solenoid multiplexed to three regulator valves to control all shift feel aspects. This solenoid is controlled as a function of transmission sump temperature to maintain consistent shift feel throughout the operating range.

Transmission gear state is selected by the driver via the position selector. There are two vehicle/transmission position selector mechanism variants available, these are Sequential Sports Shift and Column Shift.

The Sequential Sports Shift variant has the following selection of gear states or modes: Park, Reverse, Neutral, Drive (Adaptive Mode), Performance Mode, '+' and '-' in Sequential Sports Shift Mode. The Column Shift variant has the following selection of gear states or modes, Park, Reverse, Neutral, Drive (Adaptive Mode), Manual '3', Manual '2' and Manual '1'.

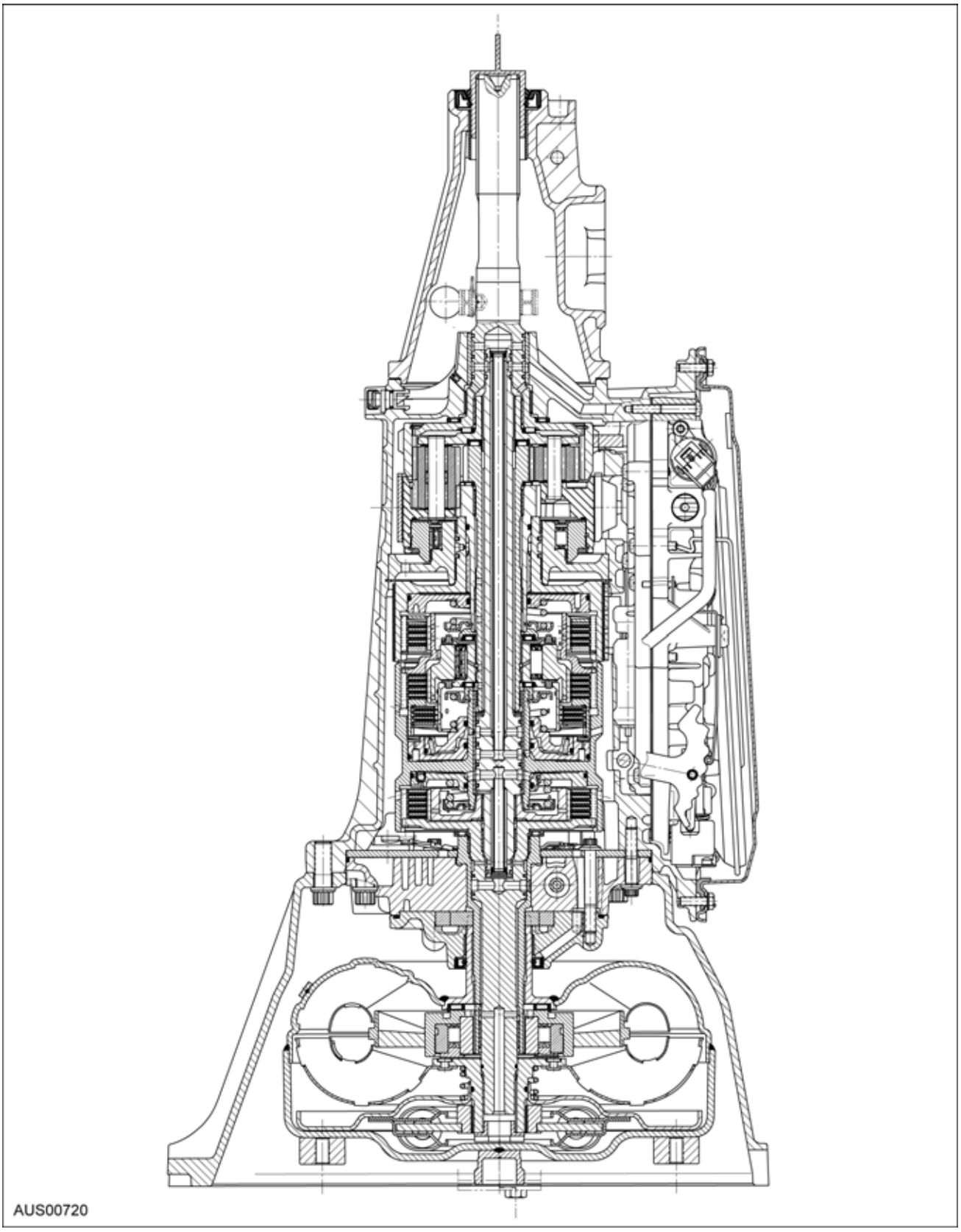
Shift scheduling is controlled by the Adaptive (mode) Shift Schedule or the Performance (mode) Shift Schedule System. The Adaptive mode monitors how the driver uses the throttle and adjusts the shift strategy to meet driving requirements. The Performance mode is optimised to achieve maximum vehicle performance. In certain vehicles this mode is optimised for towing operations instead.

The 93LE transmission is controlled by Powertrain Control Module (PCM). The PCM utilizes throttle position, engine speed, engine torque, transmission range sensor, transmission output speed, transmission sump temperature and communication to the engine controller inputs, to control all shift feel and shift schedule aspects.

A reverse lockout feature is also incorporated into the transmission design. This feature is intended to protect the transmission from being exposed to excessive torque in the event that Reverse gear is engaged at speed.

DESCRIPTION AND OPERATION (Continued)

Model 93LE Automatic Transmission (Non-ABS shown)



DESCRIPTION AND OPERATION (Continued)

Electronic Control

This system is comprised of various input sensors, a PCM and seven solenoids. The PCM simply reads the inputs and activates the outputs as per the software and table values stored in the Read Only Memory (ROM).

The PCM drives the hydraulic valve body via the seven electromagnetic solenoids. Six of the seven solenoids are ON/OFF solenoids used to: boost the line pressure, operate shift valves and turn on and off two regulator valves to control shift feel. The seventh solenoid is the proportional or Variable Pressure Solenoid (VPS).

Hydraulic Control

The hydraulic control system consists of a primary regulator valve for line pressure, a solenoid supply regulator, a lockup clutch regulator valve, a band apply regulator valve, a clutch apply regulator valve, a servo exhaust valve, C1 bias valve for converter lockups, a 4-3 sequence valve, three shift valves, a manual valve and the previously mentioned solenoids.

All upshifts are accomplished by simultaneously switching: a shift valve or valves, the band and/or clutch regulator valve and controlling the VPS output pressure. The event is completed by switching the regulator off concurrent with sending the VPS to maximum pressure.

All downshifts are accomplished by simultaneously switching on one or both of the regulators and controlling the VPS output pressure. The event is completed by concurrently; switching the regulator off, switching the shift valve and sending the VPS to maximum pressure. The exception to this is a downshift to Auto 1st where the VPS is reduced to minimum pressure while switching the shift valve, the regulator remains on while in Auto 1st.

Neutral to ‘D’ shifts while the vehicle speed is below approximately 6 km/hr results in a shift to Garage 1st to improve garage shift quality. Above 6 km/hr the transmission shifts to Auto 1st. Garage 1st is identical to Auto 1st hydraulically except solenoid 1 is energised, this results in the C4 clutch not being supplied with oil.

Downshifts to Manual 1st gear state are accomplished in the same manner as other downshifts, however the gear state is achieved by exhausting the output pressures of solenoids 1, 2 & 3. This results in the 1-2 Shift Valve toggling to the Manual 1st position supplying oil to the C4 clutch and B2 band.

The Reverse gear state is accomplished by the driver positioning the manual valve into the reverse position, the manual valve supplies oil to the C3 clutch and to the reverse lockout valve (RLO). To obtain Reverse gear state either solenoids 1 or 3 supply output pressure to the RLO valve, this biases the valve to the B2 Band applied position where reverse oil is fed to the B2 band.

In the case where Reverse is selected inappropriately, solenoids 1 and 3 both have the supply output pressure exhausted, the RLO spring biases the RLO valve to the B2 band exhausted position, reverse oil is prevented from feeding the B2 band.

Mechanical Arrangement

The mechanical arrangement consists of four clutch assemblies, two bands, two sprag (or one way) clutches and a planetary gear set.

Power Flow

First gear is accomplished by applying the C2 clutch and regulating the front band off, the reaction torque is taken by the 1-2 One Way Clutch (OWC). The C2 clutch is applied in all forward gears.

The 1-2 shift is accomplished by applying the B1 band and overrunning the 1-2 OWC (Only the outer B1 servo apply area is used).

The 2-3 shift is accomplished by applying the C1 clutch concurrent with releasing the B1 band.

The 3-4 shift is accomplished by applying the B1 band and overrunning the 3-4 OWC. (Both inner and outer B1 servo apply areas are used).

The C3 clutch and the B2 band are applied to accomplish Reverse. (Both inner and outer B2 servo apply areas are used).

The C4 clutch is applied in Sequential Sports Shift/manual ranges 3, 2 and 1 to provide engine braking. In addition the C4 clutch is applied in Adaptive and Performance mode for 2nd and 3rd gears to prevent objectionable ‘freewheel’ coasting. Note in Auto 1st the C4 clutch is applied but due to the B2 band not being applied the 1-2 OWC is able to overrun this enables the vehicle to ‘freewheel’.

B2 band is applied in Sequential Sports Shift/manual range 1 to achieve engine braking shift. The servo is a dual area design which allows smooth overrun shifts at high vehicle speeds without the addition of a regulator valve (i.e. servo is applied with line pressure). Only the inner B2 area is used for manual 1st.

The B1 servo is also a dual area design to provide additional clamping force on the B1 band in fourth gear.

The mechanical arrangement utilizes non-asbestos friction materials for all members. These paper composites were selected based upon their performance with a specially formulated Automatic Transmission Fluid.

Converter Lockup Clutch

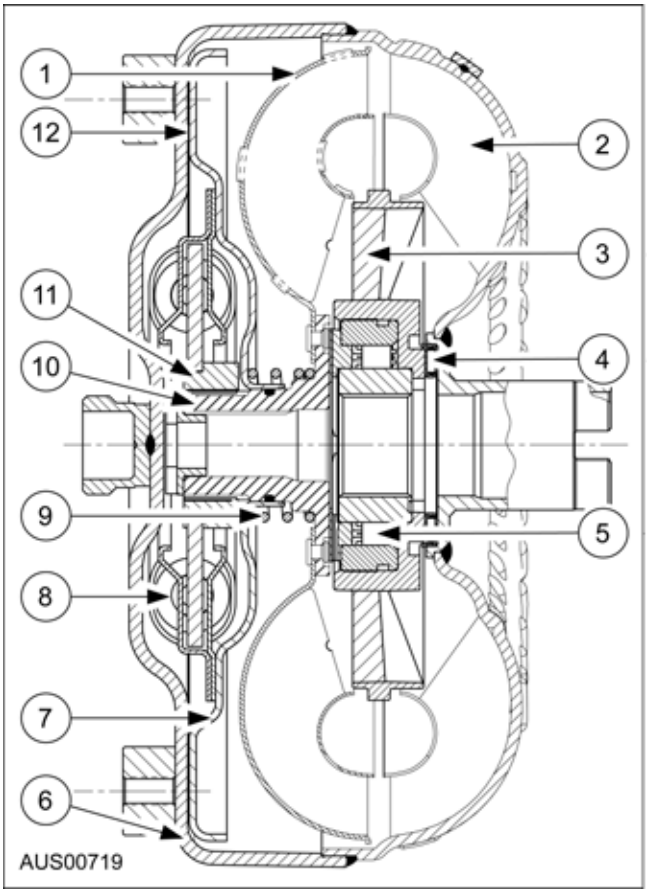
The Converter Lockup Clutch is a conventional clutch with a spring damper arrangement to reduce engine torsional disturbances. Located in the torque converter, its function is to couple the turbine (driven member) to the impeller (drive member) to eliminate slippage. It is generally functional in 3rd gear and 4th

DESCRIPTION AND OPERATION (Continued)

gear. The apply schedule and feel are modulated with throttle position, engine torque and vehicle speed.

To enable lockup at high engine torque, line pressure is supplied to the converter clutch regulator valve.

The Torque Converter - 93LE



Item	Description
1	Turbine
2	Impeller
3	Stator
4	Thrust Bearing
5	Stator One Way Clutch
6	Converter Cover

Item	Description
7	Clutch Plate
8	Torsion Damper Springs
9	Preload Spring
10	Turbine Hub
11	Clutch Hub
12	Friction Surface

DESCRIPTION AND OPERATION (Continued)

Diagnostics

Diagnostic activities of the control module are divided into two categories.

Real-Time Self Check

This is an automatic monitoring of all inputs and outputs for malfunctions during normal operation of the vehicle.

If any INPUTS malfunction, the transmission assumes one of a number of 'temporary limp home' (default) modes until the malfunction ceases, at which time the unit will return to normal operation either while driving or after the module is re-initialised (vehicle turned off and restarted).

If solenoids 1 to 6 OUTPUTS malfunction the transmission assumes a 'permanent limp home' mode. Even if the output malfunction corrects itself, the module must be re-initialised to return to normal operation. The exception to this is a hydraulic solenoid 1 or 3 fault where normal operation is not restored until reverse is successfully engaged at vehicle startup.

If solenoid 7 output malfunctions then this solenoid is disabled resulting in the torque converter always unlocked.

Limp Home Mode

There are now a number of 'Limp Home' modes available depending on the type of fault which has occurred. The target gear state in most cases is third gear, if solenoid 2 is faulty above a certain speed fourth gear is the target gear state. Several Limp Home modes will result in the speed limiting of the vehicle, in the event of a speedo fault the vehicle will be limited to 140 km/hr, a solenoid 1 to 6 fault will limit to 120 km/hr and multiple solenoid 1 to 6 faults will limit to 45 km/hr. These speeds are approximate and depend on the vehicle axle/wheel configuration.

Limp Home modes that noticeably limit driveability also result in the PRNDL display being flashed. Reverse gear is available.

Active Diagnostics

This aspect is dedicated for service technician use. Error codes are displayed by digital output to the diagnostic terminals.

Selector Lever Positions

1. Sequential Sports Shift Selector Lever

A four position detent mechanism is used to select ranges 'D', 'N', 'R', 'P'. In the 'D' position, Adaptive mode is selected. The lever can then be moved to the left to obtain the 'PERF' range, or Performance mode. In this position the lever can be nudged up for '-' or down for '+', this initiates Sequential Sports Shift mode. A spring returns the lever to the central position, the transmission will remain in Sequential Sports Shift mode until the lever is moved back to 'D'.

RANGE 'P' (PARK): No bands or clutches are engaged. The transmission output shaft is locked. The inhibitor switch will allow engine start.

RANGE 'R' (REVERSE): Reverse gear operation, when selected outside appropriate vehicle and engine speed limits reverse is inhibited. Reversing lights on.

RANGE 'N' (NEUTRAL): No bands or clutches are engaged. The inhibitor switch will allow engine start. During a N-D or N-PERF shift and while the vehicle is stationary, a N-Garage 1st-Auto 1st shift will be performed. This feature is to improve garage shift quality.

RANGE 'D' (ADAPTIVE MODE): Auto 1st, 2nd, 3rd and 4th gear operation. 1-2, 2-3, 3-4, 4-3, 4-2, 4-1, 3-2, 3-1 and 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, inhibited upshifts). Lockup clutch available in 3rd and 4th.

RANGE 'PERF' (PERFORMANCE MODE): Auto 1st, 2nd, 3rd and 4th gear operation. 1-2, 2-3, 3-4, 4-3, 4-2, 4-1, 3-2, 3-1, and 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, inhibited upshifts). Lockup clutch available in 3rd and 4th. In some vehicle this mode is replaced with Towing mode.

Range '+' (MANUAL '2', '3', '4'): This position initiates an upshift. Each gear state has a vehicle speed range, if the target gear is outside of this range an upshift is inhibited. Lockup clutch available in third and fourth, application.

RANGE '-' (MANUAL '1', '2', '3'): This position initiates a downshift. Each gear state has a vehicle speed range, if the target gear is outside of this range a downshift is inhibited. Lockup clutch available in 3rd. Manual 1st is only available by this means.

2. Column Shift Selector Lever

A seven position detent mechanism is featured to select ranges '1', '2', '3', 'D', 'N', 'R', 'P'.

Range '1' (MANUAL '1'): Manual 1st gear only with an inhibited engagement as a function of excess vehicle speed. Manual 1st is only available in this range.

RANGE '2' (MANUAL '2'): Auto 1st and 2nd gear operation with an inhibited engagement of second at high vehicle speed.

RANGE '3' (MANUAL '3'): Auto 1st, 2nd and 3rd gear operation with an inhibited 3rd gear engagement at high vehicle speed. Lockup clutch available in 3rd.

RANGE 'D': Auto 1st, 2nd, 3rd and 4th gear operation. 1-2, 2-3, 3-4, 4-3, 4-2, 4-1, 3-2, 3-1, and 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, inhibited upshifts). Lockup clutch available in 3rd and 4th.

DESCRIPTION AND OPERATION (Continued)

RANGE 'N' (NEUTRAL): No bands or clutches are engaged. The inhibitor switch will allow engine start. During a N-D or N-PERF shift and while the vehicle is stationary, a N-Garage 1st-Auto 1st shift will be performed. This feature is to improve garage shift quality.

RANGE 'R' (REVERSE): Reverse gear operation, when selected outside appropriate vehicle and engine speed limits reverse is inhibited.. Reversing lights on.

RANGE 'P' (PARK): No bands or clutches are engaged. The transmission output shaft is locked. The inhibitor switch will allow engine start.

Friction Members

All friction materials are non-asbestos.

'C1' CLUTCH: 3-4 clutch . . . engaged in third and fourth gears.

'C2' CLUTCH: Forward clutch . . . engaged in all forward gears.

'C3' CLUTCH: Reverse clutch . . . engaged in reverse gear only.

'C4' CLUTCH: Overrun clutch . . . primary function is to provide engine braking in manual 1st, 2nd and 3rd. In 2nd and 3rd gears to prevent objectionable 'freewheel coasting'.

'B1' BAND: 2-4 band . . . engaged in second and fourth gears. There are two apply areas on the servo piston. The outer area is applied in second gear. Both areas are applied in fourth gear.

'B2' BAND: Low/reverse band. There are two apply areas on the servo piston. The inner area is applied for manual 1st. Both areas are applied for reverse operation.

The Electronic Control System

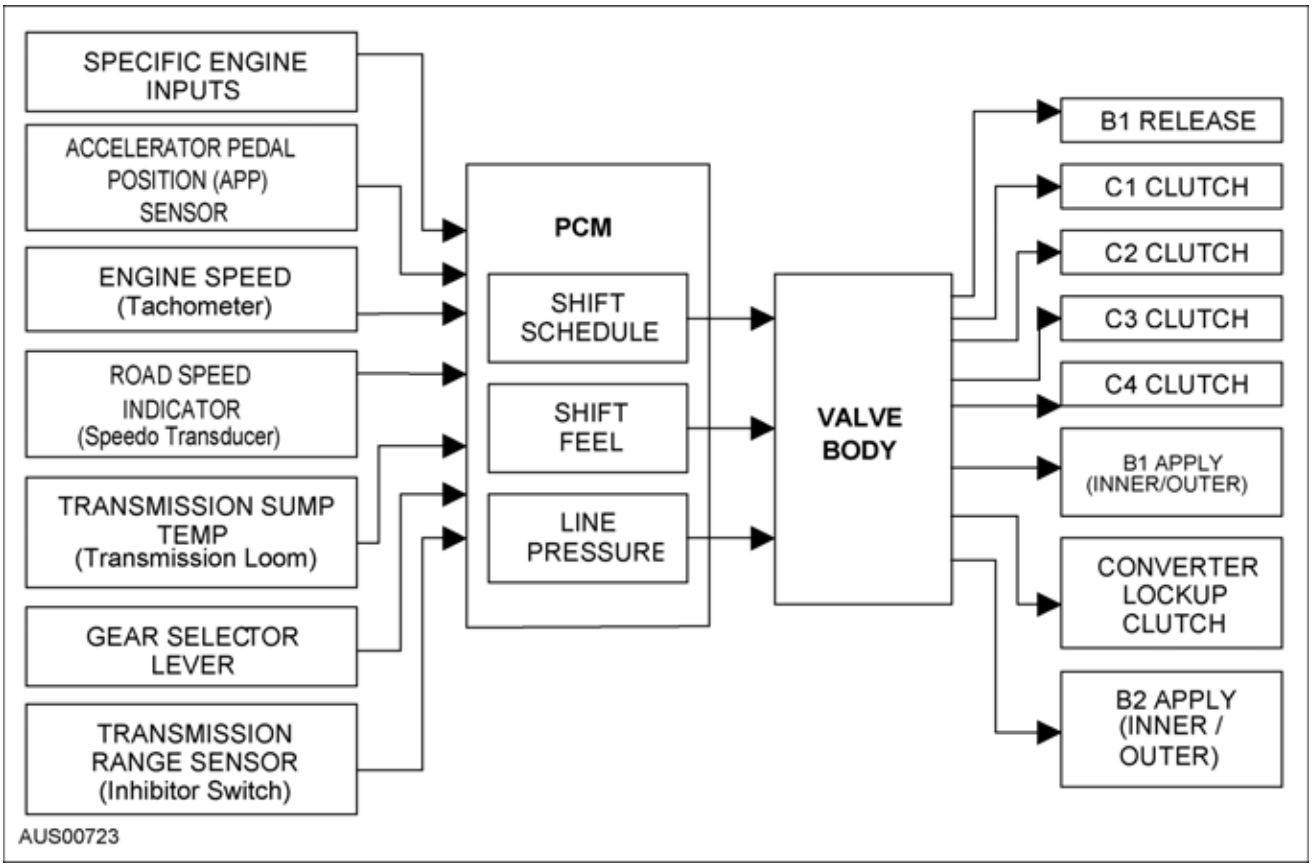
The transmission control unit is combined within the Powertrain Control Unit (PCM).

Input signals received from the pedal position sensor, ignition system, speedometer transducer, range sensor, transmission temperature sensor and the Sequential Sports Shift selector switch are processed by the PCM to provide output signals to control the shift schedule, shift feel and line pressure.

This control is achieved by the use of six ON/OFF solenoids and one proportional or variable pressure solenoid.

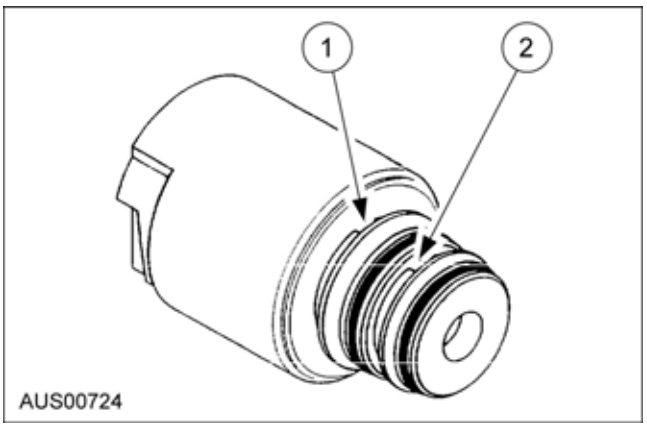
The PCM has a diagnostic 'Self Test' capability whereby any malfunctions are recorded in the memory. The Diagnostic Test Codes (DTC's) codes are displayed by digital output at the diagnostic terminals and may be read by the technician with the Worldwide Diagnostic System (WDS) tester. Refer to chapter 303-14 for PCM diagnostics.

DESCRIPTION AND OPERATION (Continued)



DESCRIPTION AND OPERATION (Continued)

Solenoids



Item	Description
1	Exhaust
2	Line 500

Solenoids Nos. 1 to 6 are mounted in the valve body. Solenoid No. 7 is mounted in the pump cover.

Solenoids 1 and 2 are normally open ON/OFF solenoids that combine with other solenoids to set the selected gear.

Solenoids 3 and 4 are normally open ON/OFF solenoids that combine to control shift quality sequencing. They also combine with other solenoids to obtain certain gear states.

Solenoid 5 is a variable pressure solenoid (VPS) that ramps the pressure during gear changes to control shift quality. It is also used to obtain certain gear states in combination with other solenoids.

Solenoid 6 is a normally open ON/OFF solenoid that sets the high/low level of line pressure.

Solenoid 7 is a normally open ON/OFF solenoid that controls the application of the converter clutch.

Accelerator Pedal Position (APP) Sensor

The APP is part of the Electronic Throttle Control ETC system. ETC provides direct throttle control by eliminating the throttle cable. A spring is contained in the APP to proved pedal resistance. The APP contains three potentiometers: one reverse slope full ratio, one forward slope full-ratio and one forward slope half-ratio. This allows an accurate picture of both the accelerator pedal position and rate of change to be sent to the PCM, while providing a failsafe backup if one of the potentiometers fails. The APP is not serviceable, if faulty replace the APP as an assembly.

Engine Speed

The engine speed signal is taken from the tachometer signal line.

Road Speed

The road speed signal is taken from the speedometer transducer to speedometer line (ABS model only). On non-ABS models, the speed signal is taken from the speedometer transducer on the output shaft.

DESCRIPTION AND OPERATION (Continued)

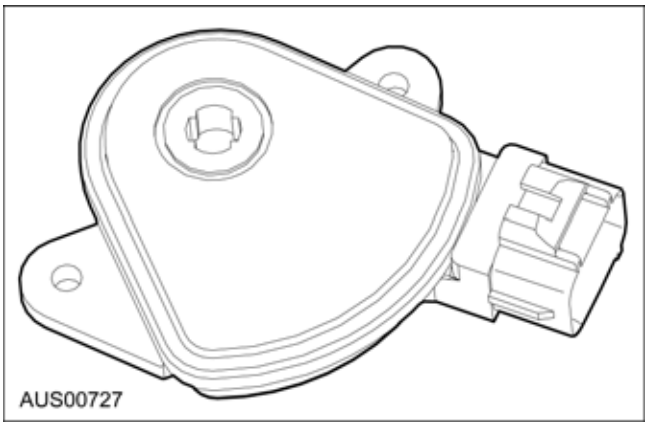
Transmission Sump Temperature

This sensor takes the form of a thermistor located in the solenoid wiring loom within the transmission. Above certain temperatures, overheat strategies are invoked as indicated in the table below.

Temp (°C)	Overheat Strategy
115	• Fan engaged. • No driver alert.
120	• In Adaptive mode, power shift schedule is selected. • Engine temperature jewel will appear. • PRNDL indicator will flash.
125	• Torque converter lock-up invoked in 2nd, 3rd and 4th gears above certain calibratable shaft speed points.
135	• Vehicle restricted to a calibratable constant torque.

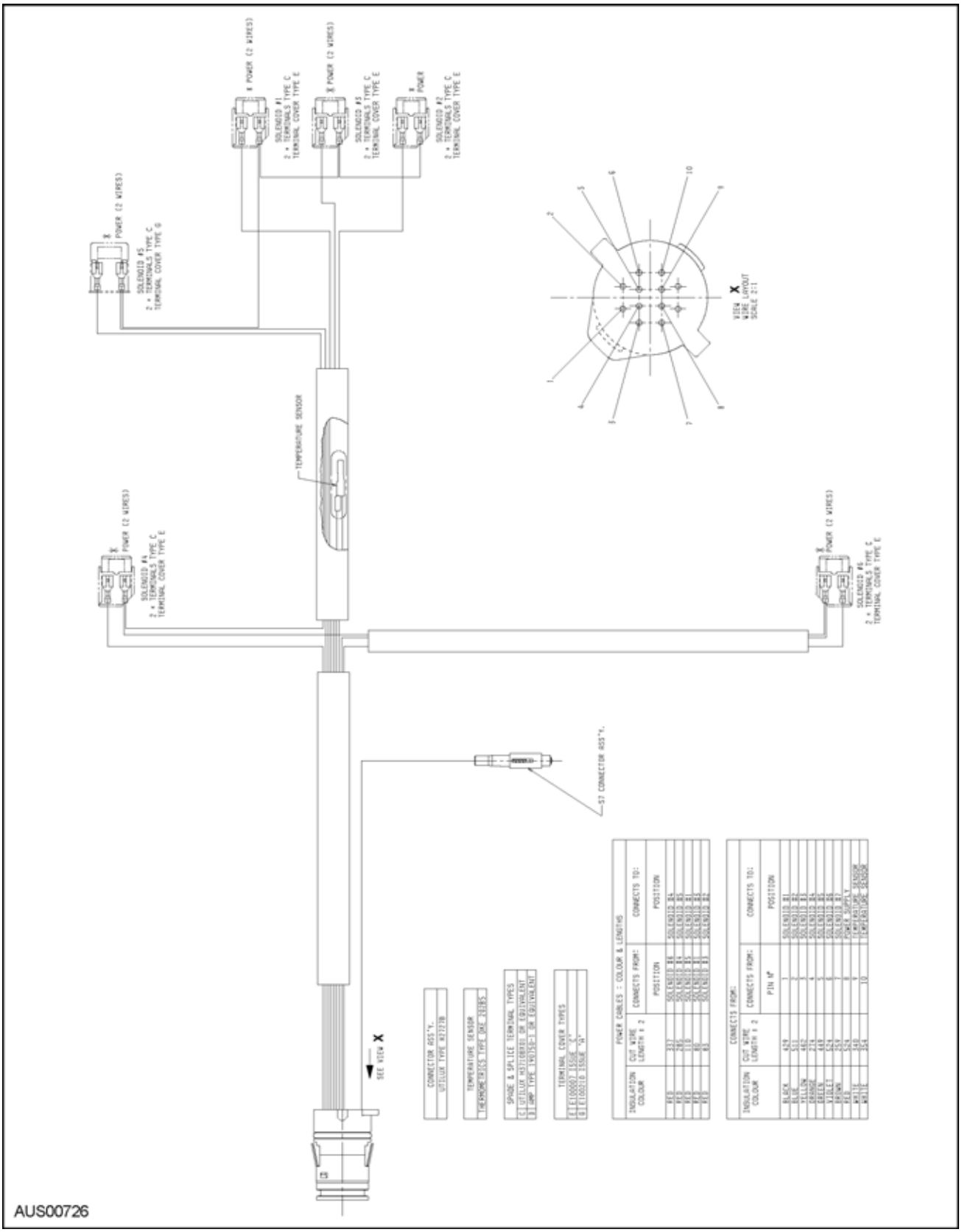
Transmission Range Sensor

The transmission range TR sensor is incorporated in the inhibitor switch mounted on the side of the transmission case and provides discrete resistance values indicating the gear selected by the gear shift lever.



DESCRIPTION AND OPERATION (Continued)

Temperature Sensor Location in Solenoid Loom

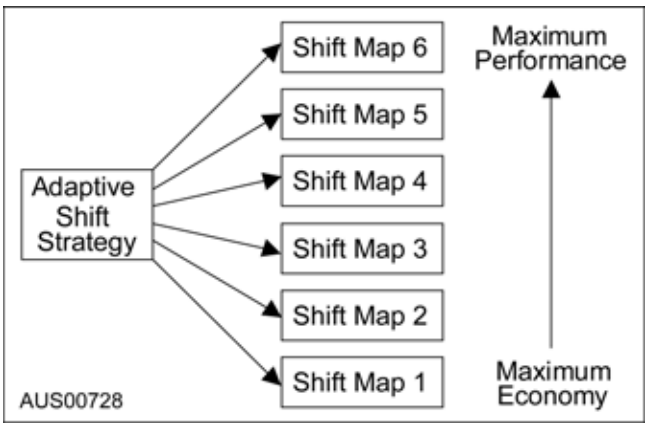


DESCRIPTION AND OPERATION (Continued)

Adaptive Shift Strategy

The PCM features an adaptive shift strategy, which is controlled by the software within the PCM. By continuously monitoring the driver's accelerator inputs (via the Throttle Position Sensor - measuring throttle position and rate of change, and vehicle speed-VSS), the PCM determines the driving style being used and modifies the gearshift points to suit that style.

The PCM selects from 6 graduated shift maps. The maps are selected automatically by the PCM dependent on the driving style being used at the time.



The Shift maps are essentially sets of tables which dictate the speeds at which the transmission will change gear, based on vehicle speed and throttle position.

Operation

The PCM monitors what pedal position is used for upshifts and/or downshifts and compiles a composite score which reflects a particular driver's behaviour. If the composite score is higher than the current "library" score then it will move to the next more aggressive "shift map", or vice versa.

There are two parameters that the adaptive shift routine continuously monitors to determine the best suited "shift map" to suit the driver's driving behaviour.

Parameters monitored are as follows:

1. Shift Scoring

The "Shift Scoring" parameter is used to record and monitor the position of the pedal at the start of a shift. The PCM does this using the APP signal.

2. Launch Scoring

The "Launch Scoring" parameter is used to record and monitor the pedal position each time the vehicle is accelerated from rest. The PCM does this using the pedal position sensor and vehicle speed sensor (APP vs VSS).

Override Function

The adaptive shift strategy allows for an immediate change to maximum performance shifting when the pedal application is greater than 85%. When the pedal falls below 85%, the adaptive shift level will return to the level used prior to the 85% pedal application.

Kickdown Strategy

A 'kickdown', or forced downshift feature, is controlled by the PCM. The PCM reads pedal position, rate of pedal application, engine speed and road speed signals to determine and select the required gear.

Keep alive memory data retention

The 93LE PCM contains a 'Keep Alive Memory' capability. When in Adaptive Mode, this enables the module to maintain a score of various engine/ transmission parameters and optimise the transmission shift points.

The Keep Alive Memory also stores the fault data for service technician use in diagnosis. This data is stored for 40 warm up cycles of the PCM. (Warm = transmission temp. > 50°C)

If the power supply to the PCM is interrupted the PCM may lose the data in the 'Keep Alive Memory'.

The data retention time for the PCM depends on the module temperature during the time that the power supply is interrupted (e.g. battery disconnected).

Engine Idle Up Strategy

To ensure sufficient pump capacity the PCM controls the engine idle at different transmission oil temperatures.

The Shift Pressure Control System

Variable Pressure Solenoid (VPS) Multiplexing System

Friction element shifting pressures are controlled by the variable pressure solenoid No. 5. Line pressure is completely independent of shift pressure.

VPS pressure is supplied continuously to the converter clutch regulator valve and is multiplexed to the clutch and band regulator valves during timed gearshifts.

The multiplexing is carried out by two normally open on/off solenoids. These on/off solenoids act via a plunger to apply either VPS outlet pressure or Line 500 reference pressure to one end of the regulator valve. The other end of the regulator valve is fed with band or clutch feed-back pressure.

Except when in Auto 1st , Manual 1st or RLO gear state, 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 from between the regulator valve and the plunger. The friction elements

DESCRIPTION AND OPERATION (Continued)

are then fed oil pressure equal to Line 500 multiplied by the regulator valve amplification ratio. When a gearshift is not in progress the VPS current is set to 200 mA which gives a pressure of approximately 450 kPa.

When a shift is initiated the required on/off solenoid is switched on cutting the supply of Line 500 oil 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 selected for each gearshift. The multiplexing arrangement also increases transmission reliability since it requires both the VPS and one on/off solenoid to fail before a friction element burn-up can occur.

The converter clutch regulator valve is permanently connected to the VPS but its regulated outlet pressure is only fed to the torque converter when the lock up solenoid LUS S7 is activated.

The VPS has been fitted with nose filters to prevent the ingress of contaminants resulting in solenoid stiction and hence further increase the overall system reliability.

Solenoid Shifting Sequence

Tables 1 and 2 outline the usage of solenoid numbers S1, S2, S3, S4, S5 and S7 in each gear position and during gear shifts.

In brief:

- S1 & S2 - determine static gear position by operating the shift valves.
- S3 - Switches the clutch regulator valve off or on. It is also utilised to obtain Reverse, RLO, Manual 1st, Garage 1st and 2nd No Engine Braking.
- S4 - Switches the band regulator valve off or on. It is also utilised to obtain Auto 1st, Garage 1st and 3rd Limp Home.
- S5 - Variable pressure solenoid VPS provides the signal pressure to the clutch, band regulator and hence controls the shift pressures. It is also utilised to obtain Auto 1st, Garage 1st and 3rd Limp Home.
- S7 - Lock up solenoid LUS switches converter clutch on or off, solenoid on applies the clutch.

Variable Pressure Solenoid (VPS) Operation

Solenoid S5 is a proportional or variable pressure solenoid that provides the signal pressure to the clutch and band regulator valves thereby controlling shift pressures.

A variable pressure solenoid produces an oil pressure inversely proportional to the current applied.

During a gearshift the PCM applies a progressively increasing or decreasing (ramped) current to the solenoid. Current applied will vary between a minimum of 0.2 amps and a maximum of 1.275 amps.

Increasing current decreases output (S5) pressure. Decreasing current increases output (S5) pressure. Line 500 pressure, 480 kPa, is the reference pressure for the VPS.

S5 output pressure has a maximum value of approximately 450 kPa.

When the VPS is on standby (i.e. no gearshift is taking place), the VPS current is set at 0.2 amps giving maximum output pressure. This current may be lower when the lockup clutch is applied in high performance vehicles.

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.

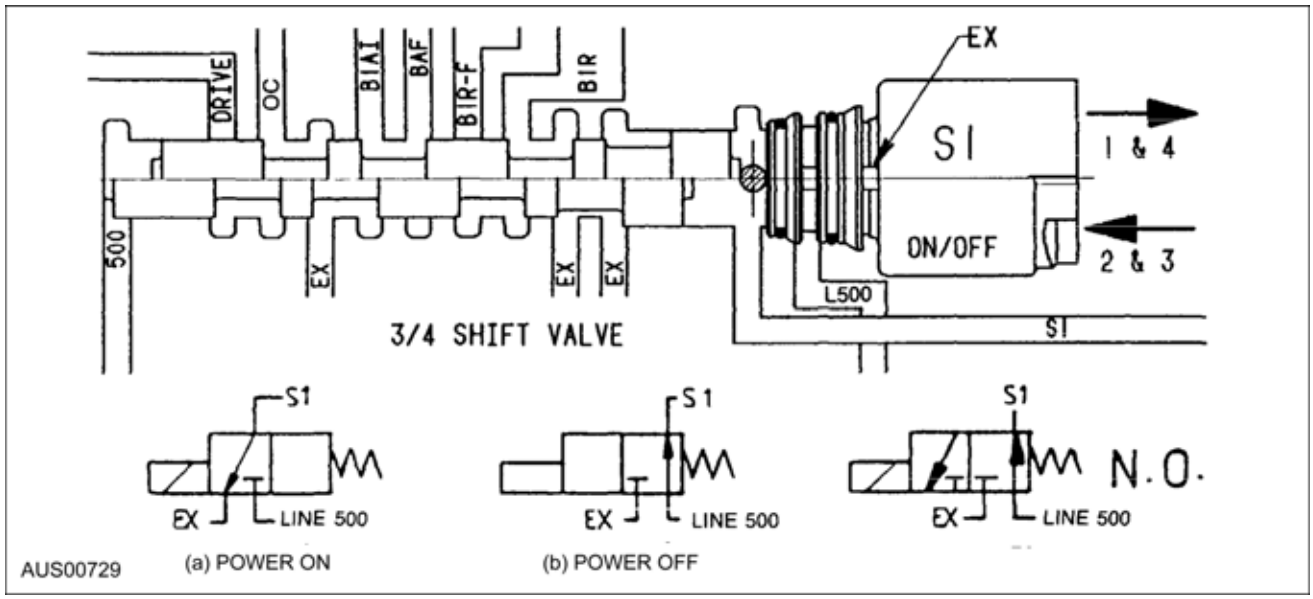
Both halves of the symbol are identical, only the spring end is labeled.

In the example illustrated:

- POWER ON Line 500 port is closed. The S1 port is open to exhaust at the solenoid valve.
- POWER OFF The exhaust port is closed. The S1 port is open to Line 500.

DESCRIPTION AND OPERATION (Continued)

On/Off Solenoid



Solenoid Logic States For Model 93LE

GEAR STATE	ELECTRICAL SHIFT SOLENOID STATES						
	S1	S2	S3	S4	S5	S7	MODE[3]
PARK	ON	OFF	OFF	OFF	X	OFF	NORMAL
REVERSE	ON[2]	OFF	OFF	OFF	X	OFF	NORMAL
REVERSE LIMP HOME	OFF	OFF	OFF	OFF	X	OFF	LIMP HOME
RLO	ON	OFF	ON	OFF	X	OFF	NORMAL
NEUTRAL	ON	OFF	OFF	OFF	X	OFF	NORMAL
MANUAL 1ST	ON	ON	ON	OFF	X	OFF	Sequential Sports Shift/M1
AUTO 1ST	OFF	ON	OFF	ON	1000mA	OFF	NORMAL
GARAGE 1ST	ON	ON	OFF	ON	1000mA	OFF	GARAGE
2ND (ENGINE BRAKING)	OFF	ON	OFF	OFF	X	OFF	NORMAL
2ND LOCKED	OFF	ON	OFF	OFF	STANDBY	ON	LIMP HOME
2ND NO ENGINE BRAKING	ON	ON	OFF	OFF	X	OFF	LIMP HOME
3RD (ENGINE BRAKING)[1]	OFF	OFF	OFF	OFF	X	OFF	NORMAL
3RD LOCKED	OFF	OFF	OFF	OFF	STANDBY	ON	NORMAL
3RD LIMP HOME	OFF	OFF	OFF	ON	1000mA	OFF	LIMP HOME
4TH (ENGINE BRAKING)	ON	OFF	OFF	OFF	X	OFF	NORMAL
4TH LOCKED	ON	OFF	OFF	OFF	STANDBY	ON	NORMAL

[1] Power down gear state.

[2] In Reverse S1 and S3 states are inverted each engagement into Reverse, solenoid status needs to be recorded into history so that it is not reset at key off.

[3] Mode is broken down into four modes, normal which refers to the normal state which the driver selects using either the T-Bar or Column Shift Selector Lever. This covers all normal driving modes. Sequential Sports Shift (T-Bar) or M1 (Column Shift) modes are the specific modes where Manual 1st is selected. Garage mode is a transient mode used when shifting from N to D and the vehicle is stationary. Limp Home mode refers to the situation where a system or sub-system has been detected as being faulty and the transmission software has been put into this mode for protection.

DESCRIPTION AND OPERATION (Continued)

Solenoid Operation During Gearshifts 93LE			
Shift	To Initiate Shift	Typical S5 Current Ramp	To Complete Shift
1-2	S1 OFF S4 ON	700 mA to 550 mA	S4 OFF
1-3	S1 OFF S2 OFF S3 ON S4 ON	500 mA to 350 mA	S3 OFF S4 OFF
1-4	S2 OFF S3 ON S4 OFF	900 mA to 700 mA	S3 OFF S4 OFF
2-3	S2 OFF S3 ON S4 ON	500 mA to 400 mA	S3 OFF S4 OFF
3-4	S1 ON S4 ON	600 mA to 450 mA	S4 OFF
3L-4L	S1 ON S4 ON	600 mA to 450 mA	S4 OFF
4-3 KD	S4 ON S4 OFF	750 mA to 950 mA	S1 OFF
4-2 KD	S3 ON	600 mA to 900 mA	S1 OFF S2 ON S3 OFF
4-1 KD	S3 ON S4 ON	400 mA to 900 mA	S2 ON S3 OFF S4 OFF
3-2 KD @20 kph @60 kph @100 kph	 S2 ON S4 ON	 500 mA to 300 mA 600 mA to 500 mA 700 mA to 600 mA	S4 OFF
3-1 KD	S3 ON S4 ON	700 mA to 900 mA	S1 ON S2 ON S3 OFF S4 OFF
2-1 KD	S4 ON	700 mA to 900 mA	S1 ON S4 OFF
CONV. CLUTCH ON OFF	S7 ON	 700 mA to 500 mA 700 mA to 900 mA	S7 OFF
3L-4	S1 ON S4 ON	600 mA to 450 mA	S4 OFF S7 OFF

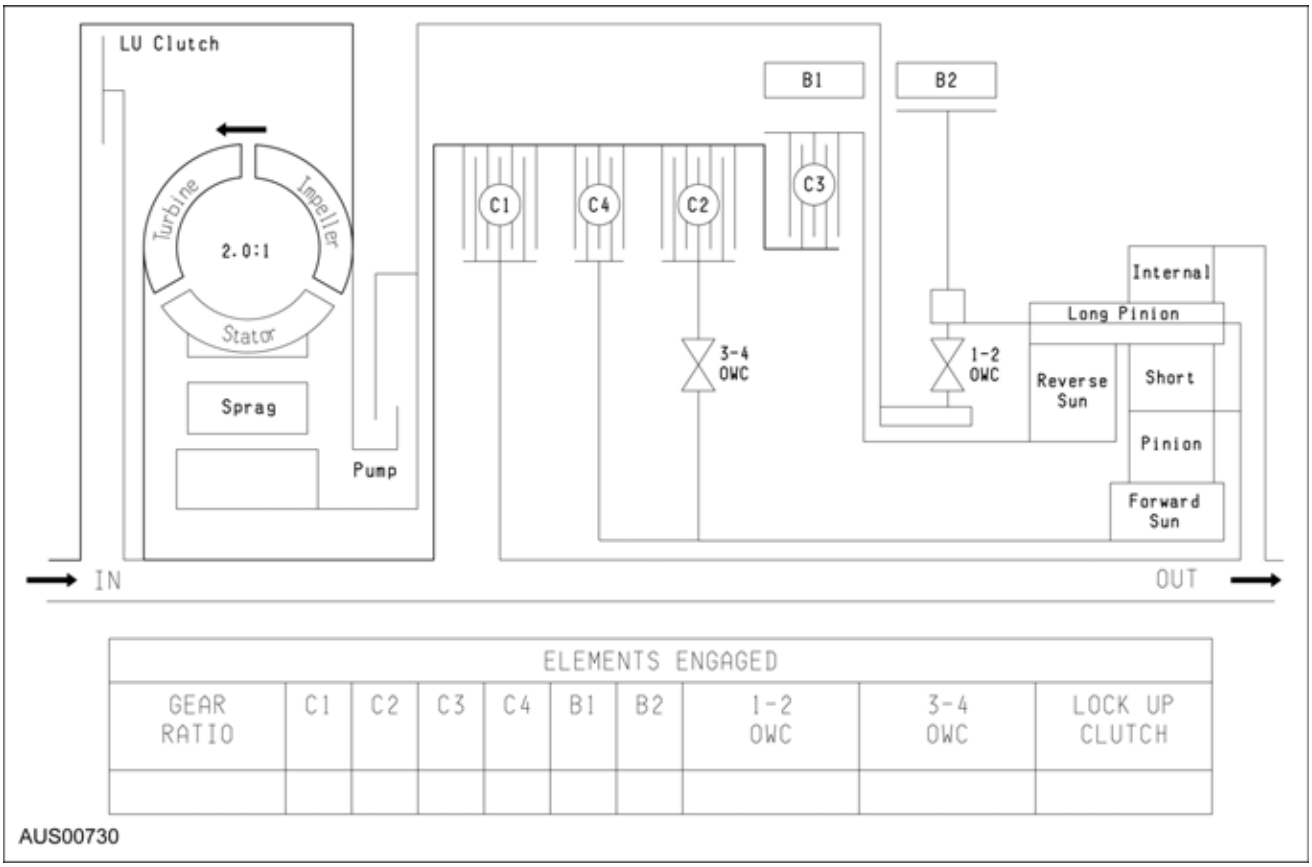
KD .... Power on Kickdown Shift

L ..... Locked

Power Flow and Hydraulic Systems Schematics

Power Flow - Neutral and Park

DESCRIPTION AND OPERATION (Continued)



No clutches or bands are engaged in Neutral or Park therefore there is no drive input to the planetary gear set.

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

Control

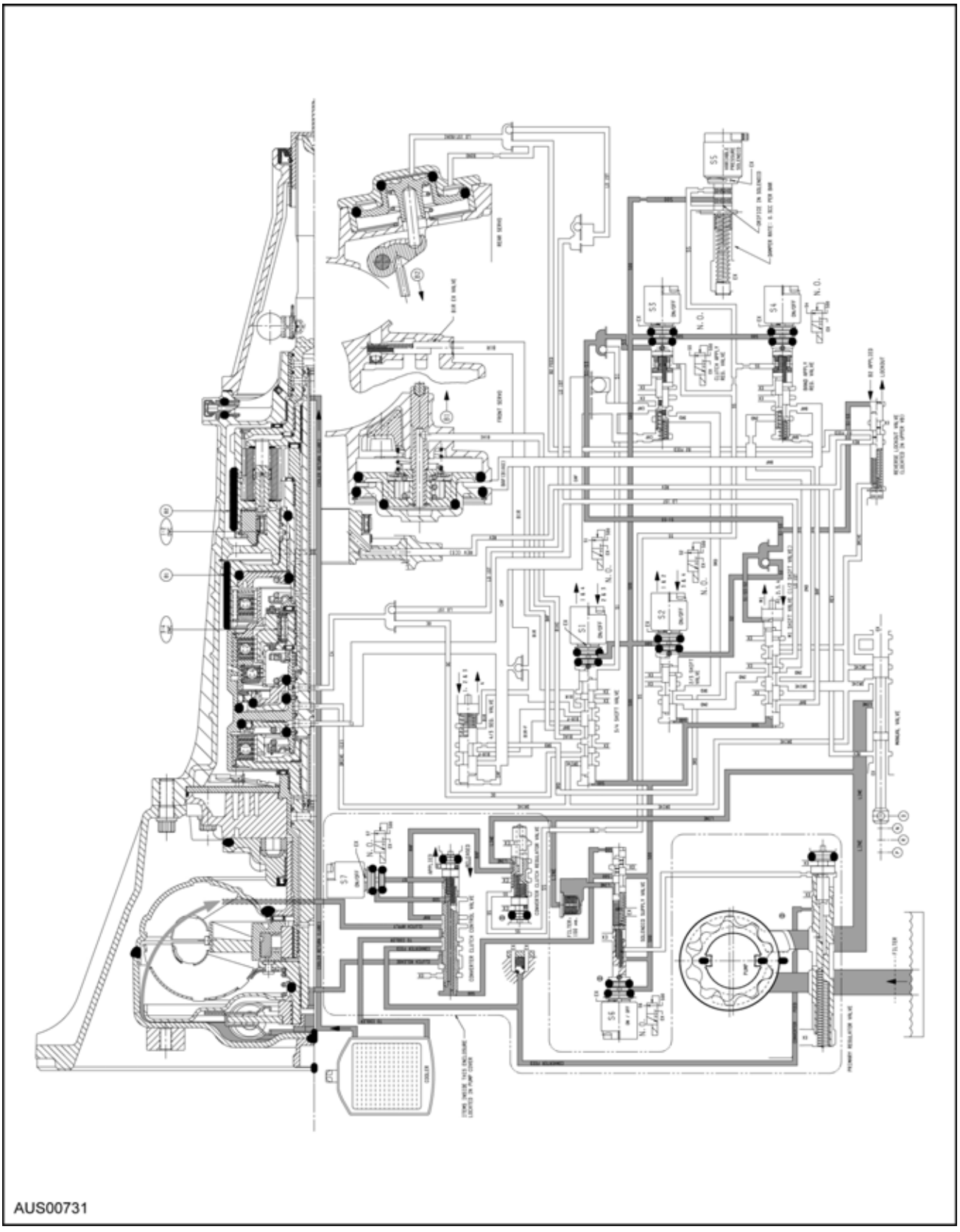
Solenoid 1 is switched ON, solenoid 2 is switched OFF. Line (pump) pressure is applied to the Primary Regulator Valve and to the Solenoid Supply Valve. The Converter, Oil Cooler and lubrication circuits are charged from the Primary Regulator Valve.

The Line 500 circuit is charged from 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.

All Clutch and Band circuits are open to exhaust.

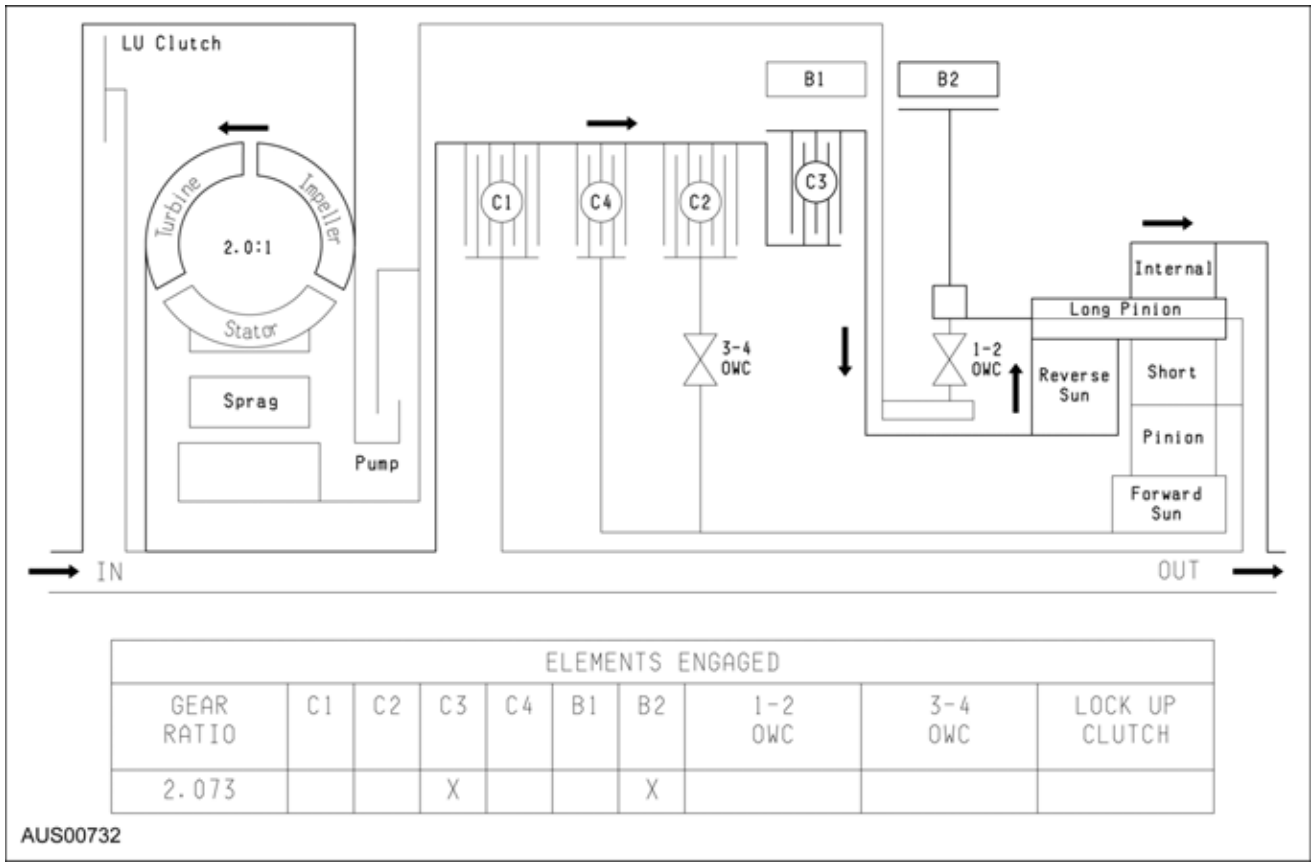
DESCRIPTION AND OPERATION (Continued)

Hydraulic System - Neutral and Park



DESCRIPTION AND OPERATION (Continued)

Power Flow — Reverse



ELEMENTS ENGAGED									
GEAR RATIO	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LOCK UP CLUTCH
2.073			X			X			

AUS00732

Drive is via the input shaft and the forward clutch cylinder to the hub of the C3 clutch. 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 anticlockwise 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

Solenoid 2 is switched OFF.

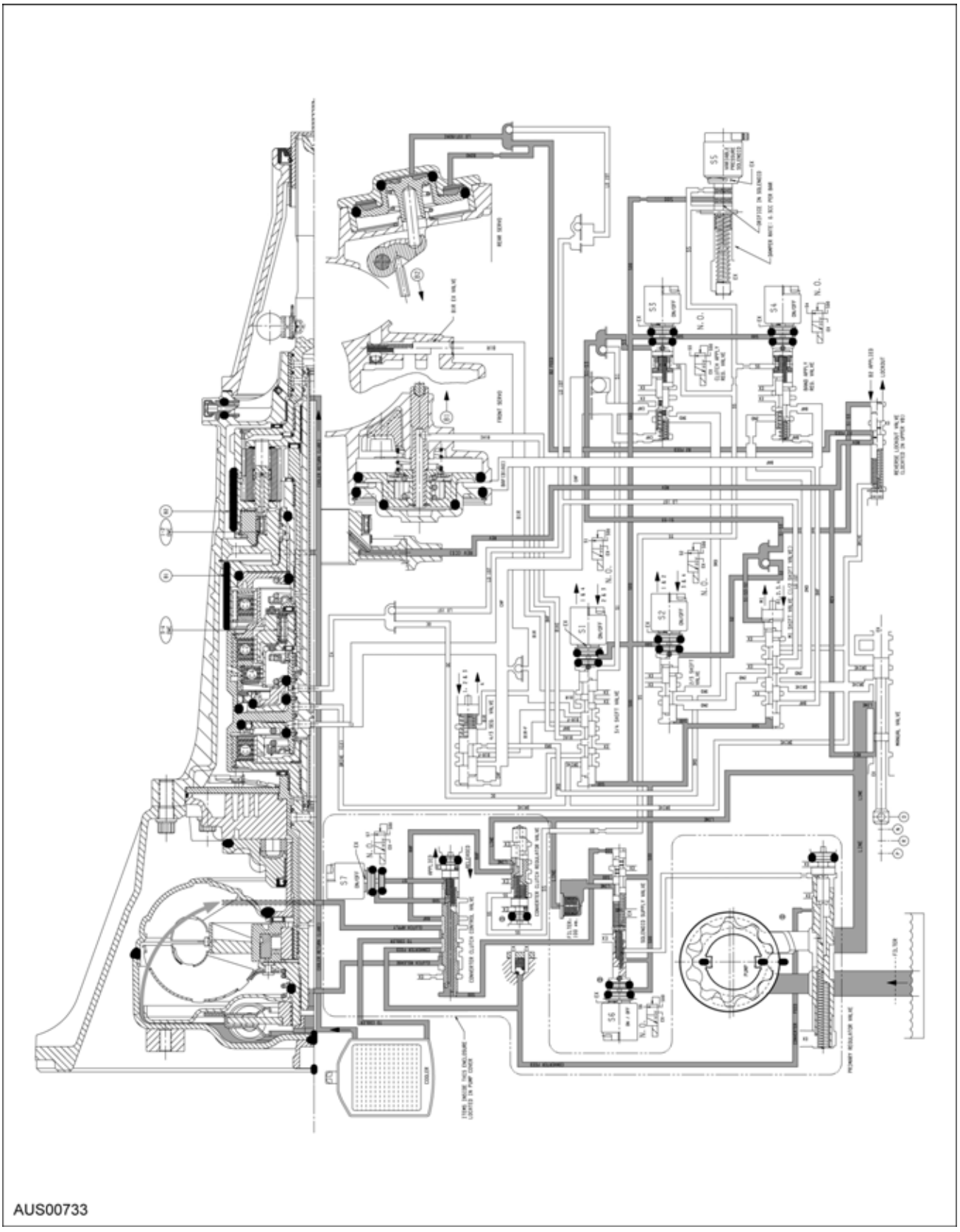
In any given reverse engagement S1 and S3 have opposite states (for example S1 ON, S3 OFF). Each subsequent reverse engagement changes the ON/OFF state of S1 and S3 (eg S1 OFF, S3 ON). Thus oil pressure from EITHER S1 OR S3 pilots the Reverse Lockout (RLO) valve into the B2 band applied position.

Reverse (Line) pressure oil is routed from the Manual valve direct to the C3 clutch and through the RLO valve to both the inner and outer apply areas of the rear servo piston for B2 band application. All other clutch and band apply circuits are open to exhaust.

To obtain the RLO state, solenoids 1 and 3 are switched ON to exhaust tracks S1 and S3. The RLO spring biases the RLO valve to the lockout position preventing reverse pressure from applying the B2 band.

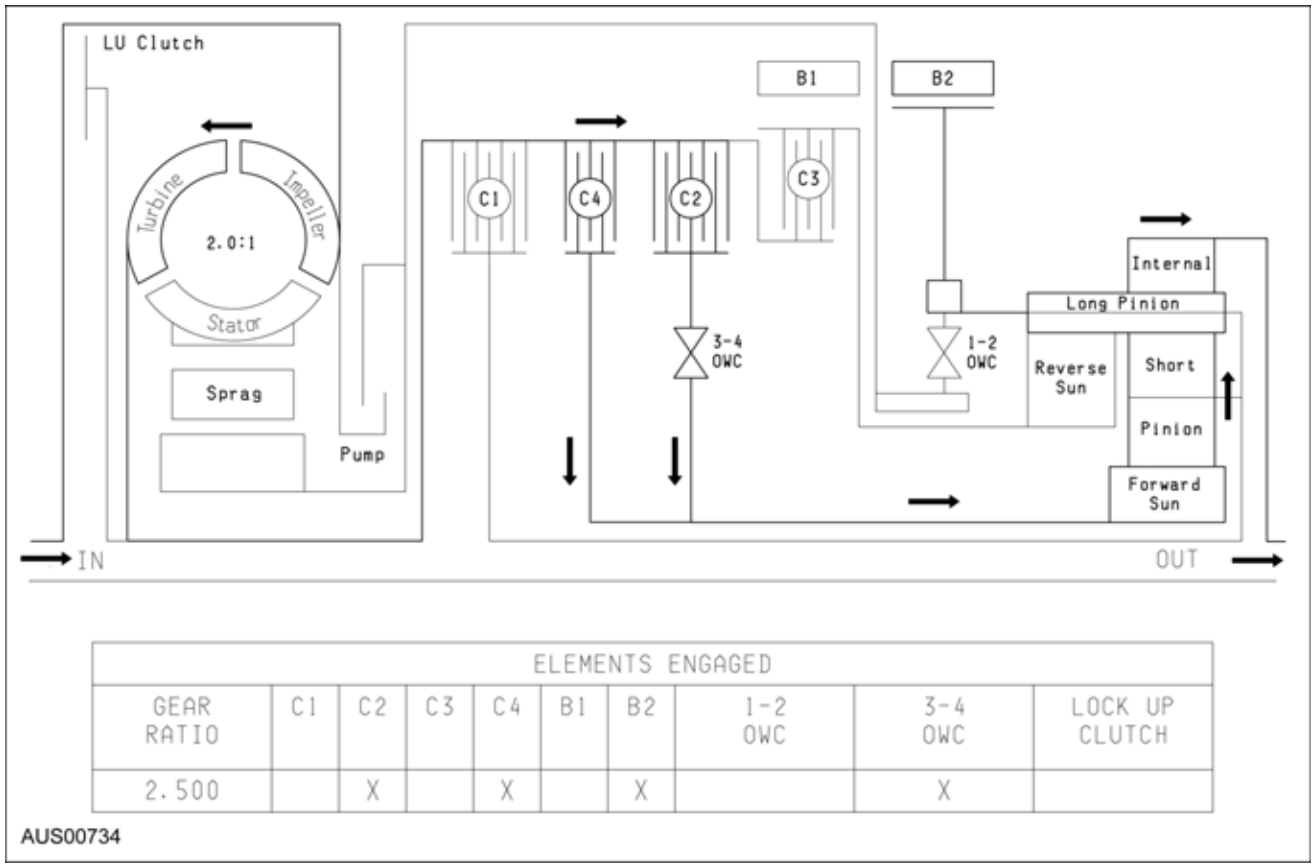
DESCRIPTION AND OPERATION (Continued)

Hydraulic System - Reverse



DESCRIPTION AND OPERATION (Continued)

Power Flow — Sequential Sport Shift 1 / Manual 1



ELEMENTS ENGAGED									
GEAR RATIO	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LOCK UP CLUTCH
2.500		X		X		X		X	

AUS00734

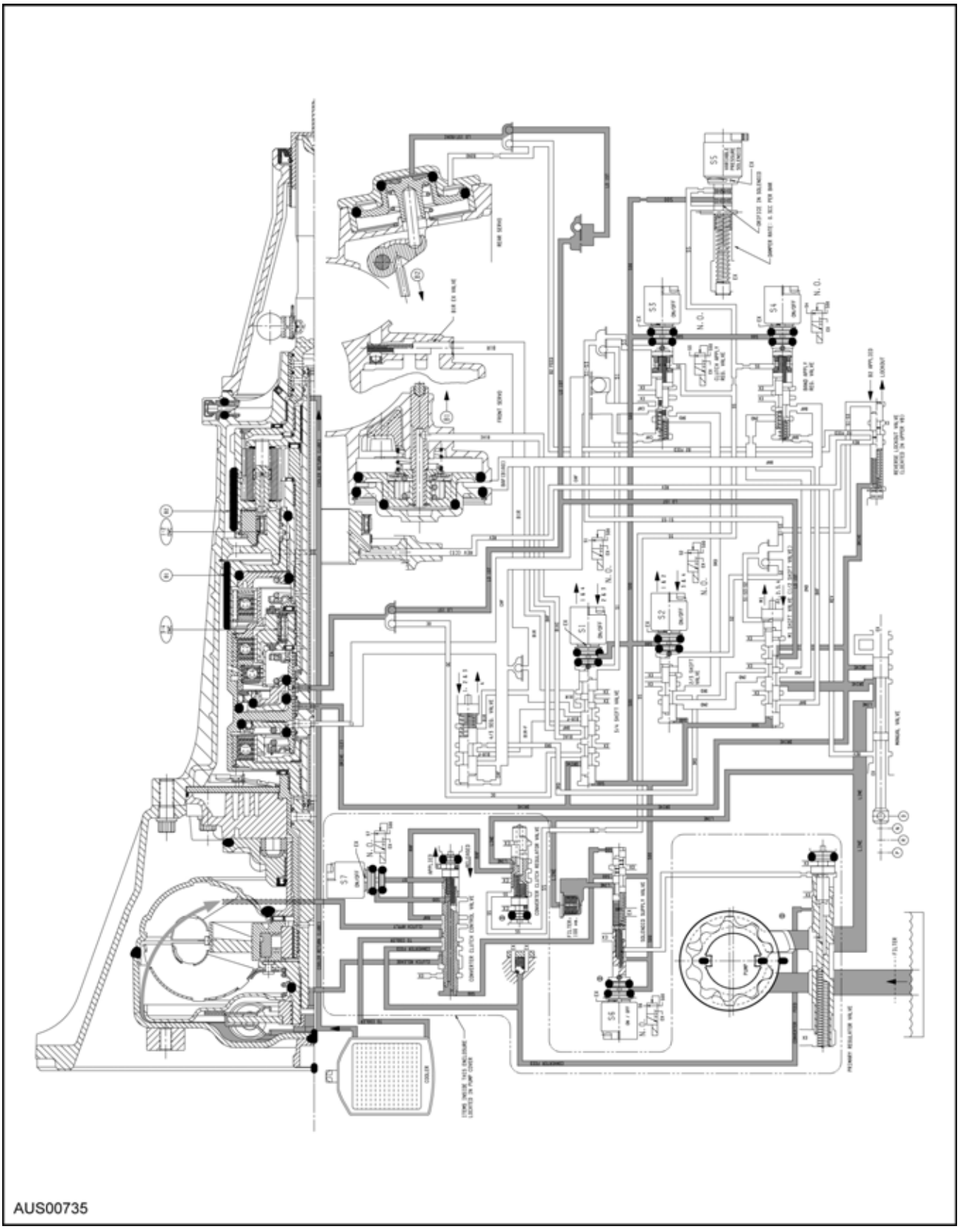
Drive is via the input shaft to the forward clutch cylinder. The C2 clutch is engaged to drive the forward sun gear via the 3-4 OWC. The B2 band and the 1-2 OWC are engaged to hold the planetary gear carrier stationary. The forward sun gear drives the short pinion anti-clockwise. The short pinion drives 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 by by-passing the 3-4 OWC on overrun.

Control

Solenoids 1, 2 and 3 are switched ON. The 1-2, 2-3, 3-4 shift valves are held in their first gear positions by Line 500 pressure. Drive (Line pressure) oil from the Manual valve applies 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.

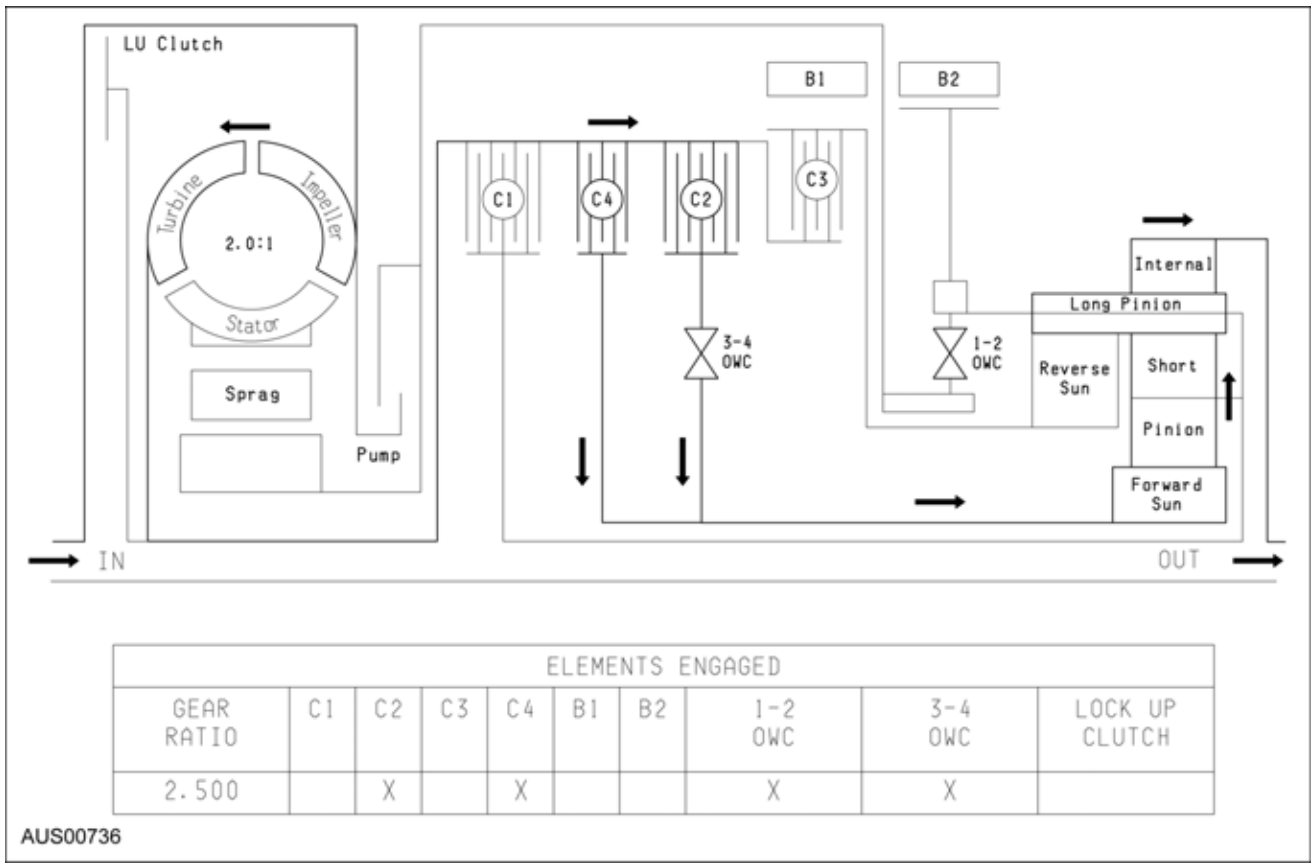
DESCRIPTION AND OPERATION (Continued)

Hydraulic System - Sequential Sports Shift 1 / Manual 1



DESCRIPTION AND OPERATION (Continued)

Power Flow — Auto 1



ELEMENTS ENGAGED									
GEAR RATIO	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LOCK UP CLUTCH
2.500		X		X			X	X	

AUS00736

Drive is via the input shaft to the forward clutch cylinder. The C2 clutch is engaged to drive the forward sun gear via the 3-4 OWC. 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

Solenoids 1 and 3 are switched OFF. Solenoids 2 and 4 are switched ON. VPS is set to minimum pressure (approximately 0 kPa). Drive (Line pressure) oil from the Manual valve applies the C2 clutch.

When solenoid S1 switches OFF, S1 oil pressure, derived from Line 500 moves the 3-4 shift valve to the left. At the same time S1 and S3 oil is directed to the 1-2 shift valve moving it to its second gear position.

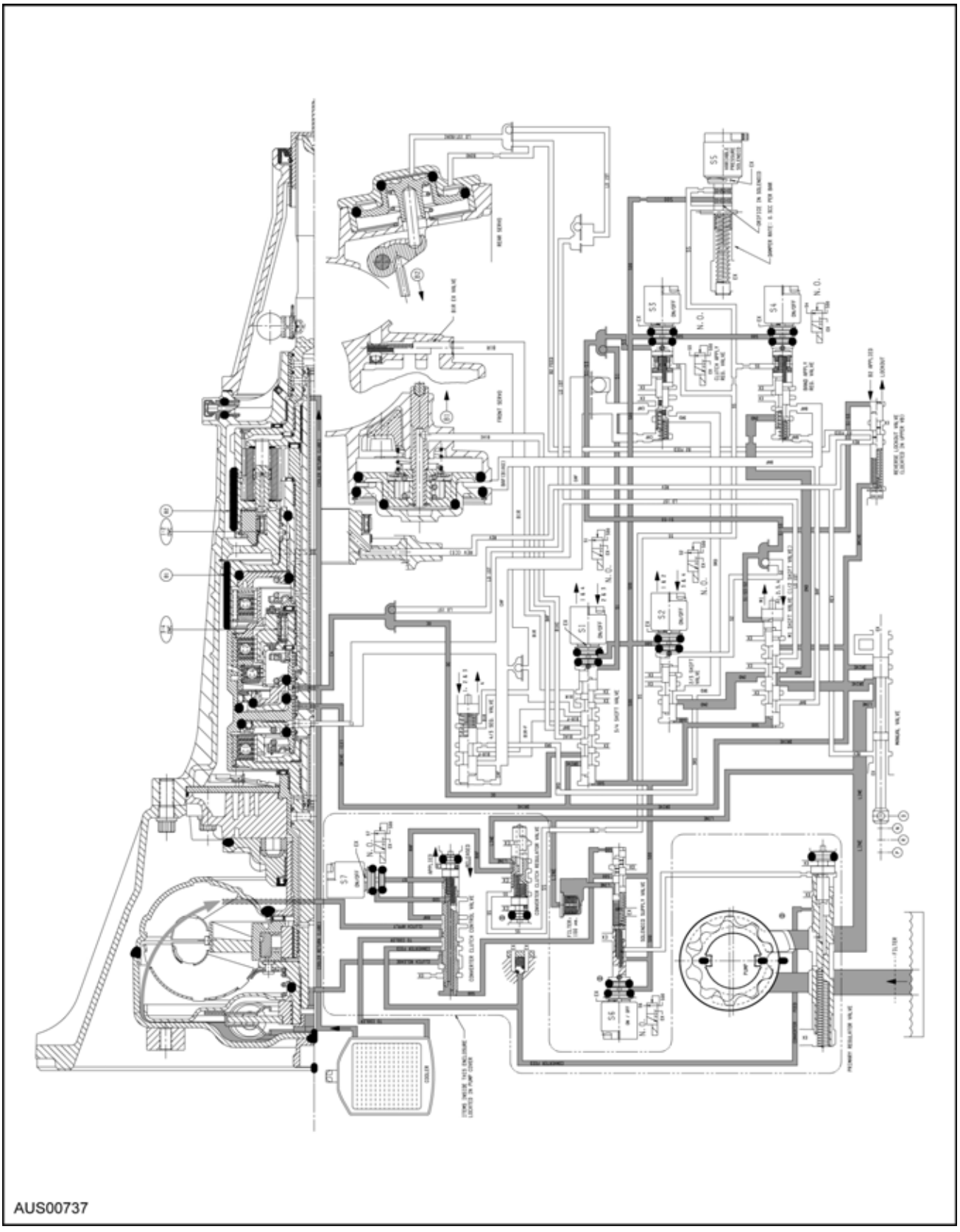
2nd oil (Line pressure) from the 1-2 shift valve is directed to the Band Apply Regulator (BAR) valve and to the 2-3 shift valve.

When solenoid S4 switches ON, the pressure behind the BAR piston is exhausted, S5 pressure is minimum allows the BAR spring to bias the BAR valve to the exhaust position. In this position the BAR valve deadheads 2nd oil and the Band Apply Feed (BAF) circuit is exhausted.

Drive (Line pressure) is routed through the 3-4 shift valve to apply to C4 clutch.

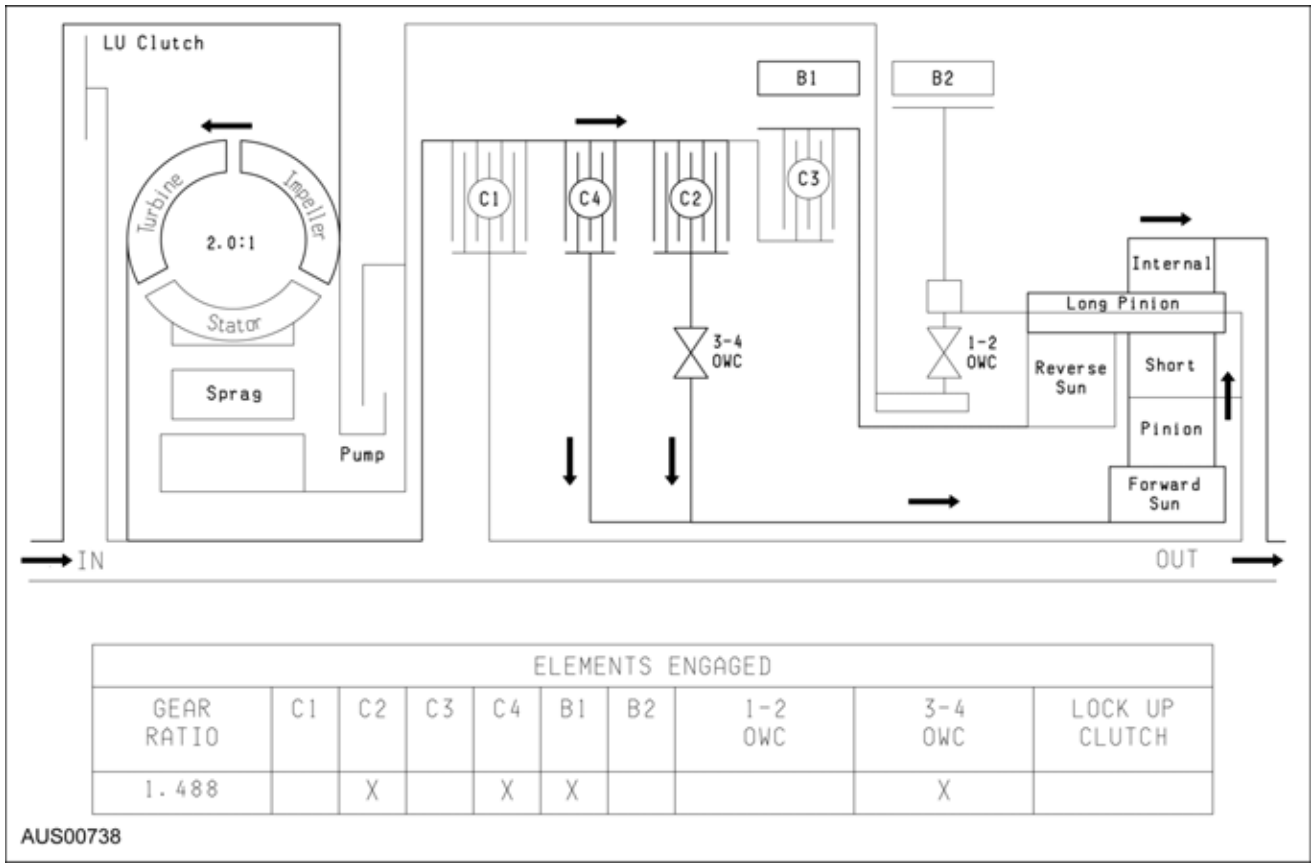
DESCRIPTION AND OPERATION (Continued)

Hydraulic System - Auto 1st



DESCRIPTION AND OPERATION (Continued)

Power Flow — D2 and Sequential Sport Shift 2/Manual 2



ELEMENTS ENGAGED									
GEAR RATIO	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LOCK UP CLUTCH
1.488		X		X	X			X	

AUS00738

Drive is via the input shaft and forward clutch cylinder, Clutch C2 is applied to drive the forward sun gear via the 3-4 OWC. 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 by-pass the 3-4 OWC and provide engine braking on overrun.

Control

Solenoids 1, 3 and 4 are switched OFF. Solenoid 2 is switched ON. Drive (Line pressure) oil from the Manual valve applies the C2 clutch.

When solenoid S1 switches OFF, S1 oil pressure, derived from Line 500 moves the 3-4 shift valve to the left. At the same time S1 and S3 oils are directed to the 1-2 shift valve moving it to its 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 a pressure 1.8 times Line 500 pressure less 191 kPa for the BAR spring (724 kPa) to the Band Apply Feed (BAF) circuit.

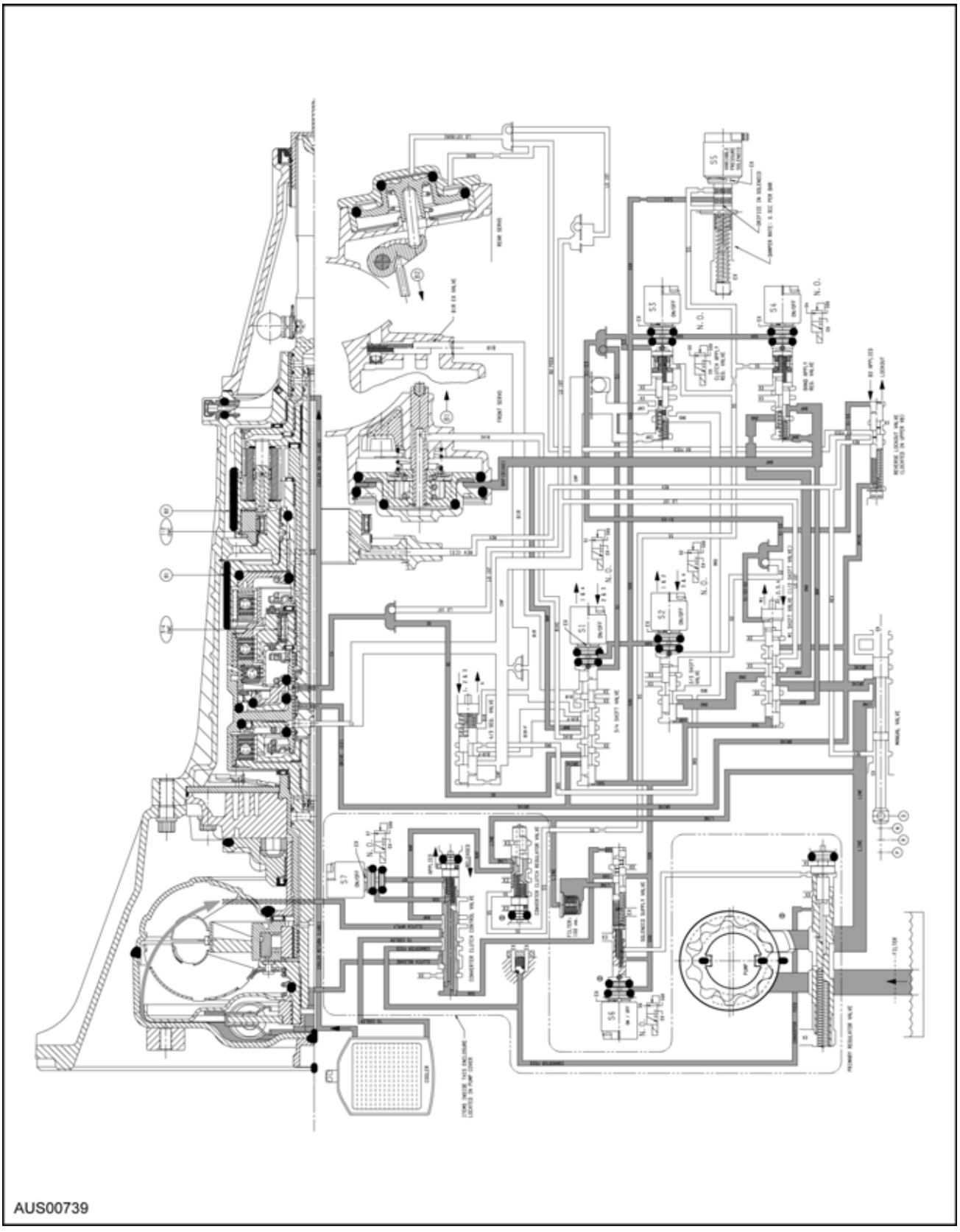
Band Apply Feed oil is directed to:

- the outer apply area of the front servo piston
- the 3-4 shift valve for use when the transmission is shifted to fourth gear
- the 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear.
- the 1-2 shift valve to provide an exhaust port when the transmission is shifted to first gear.

Drive (Line pressure) is routed through the 3-4 shift valve to apply to C4 clutch.

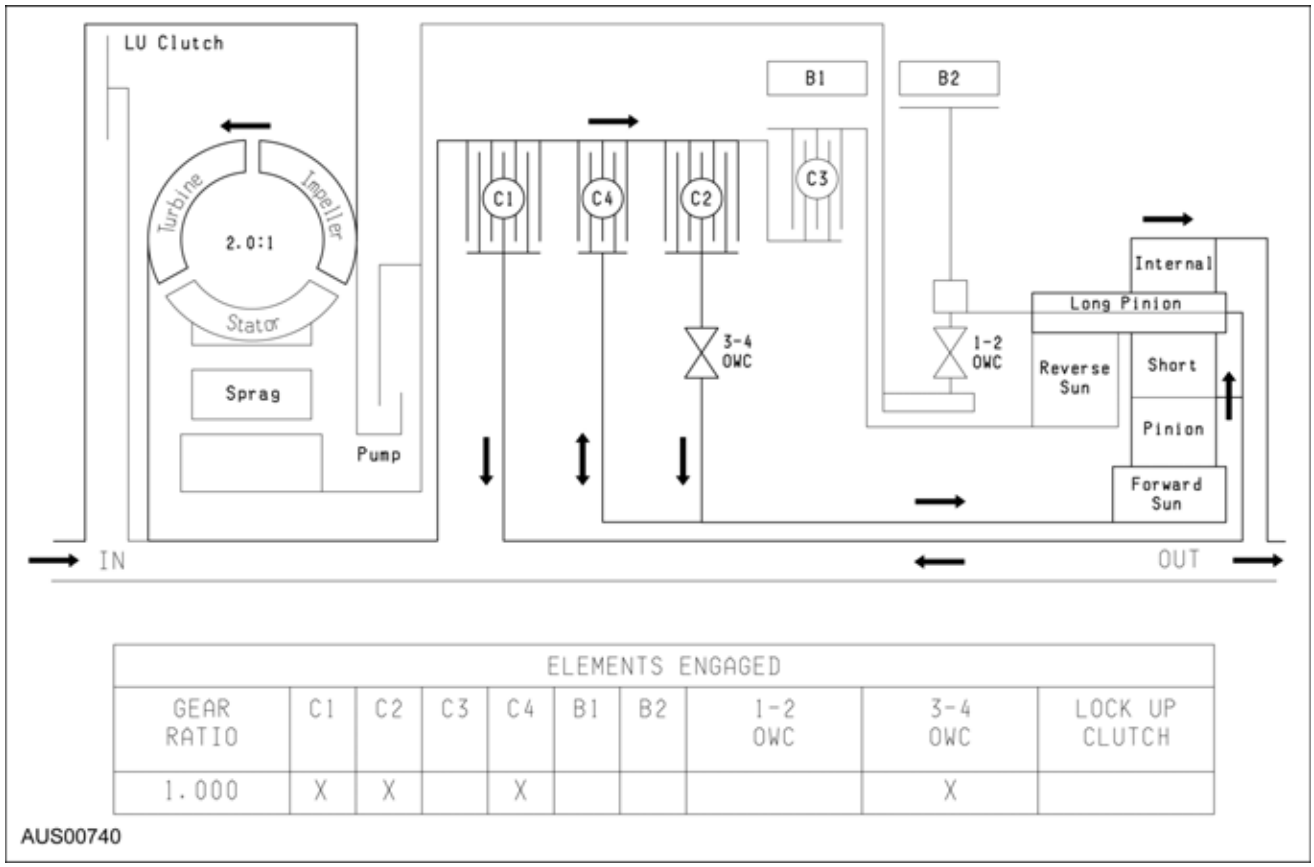
DESCRIPTION AND OPERATION (Continued)

Hydraulic System - D2 and Sequential Sports Shift / Manual 2



DESCRIPTION AND OPERATION (Continued)

Power Flow — D3 and Sequential Sport Shift 3/Manual 3



ELEMENTS ENGAGED									
GEAR RATIO	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LOCK UP CLUTCH
1.000	X	X		X				X	

AUS00740

Drive is via the input shaft to the forward clutch cylinder. Clutch C2 is engaged to drive the forward sun gear via the 3-4 OWC. Clutch C1 is engaged to drive the planet carrier. Because the forward sun gear and the planet carrier are driven clockwise at the same speed 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 by-pass the 3-4 OWC and provide engine braking on overrun.

Control

Solenoids S1, S2, S3 and S4 are switched OFF. With solenoids 1 and 2 switched OFF the 2-3 and 3-4 shift valves are held in third gear position by Line 500 pressure. The 1-2 shift valve is held in third gear position by S1-S2-S3 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 a pressure 1.8 times Line 500 pressure less 191 kPa for the BAR spring (724 kPa) 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 to 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.

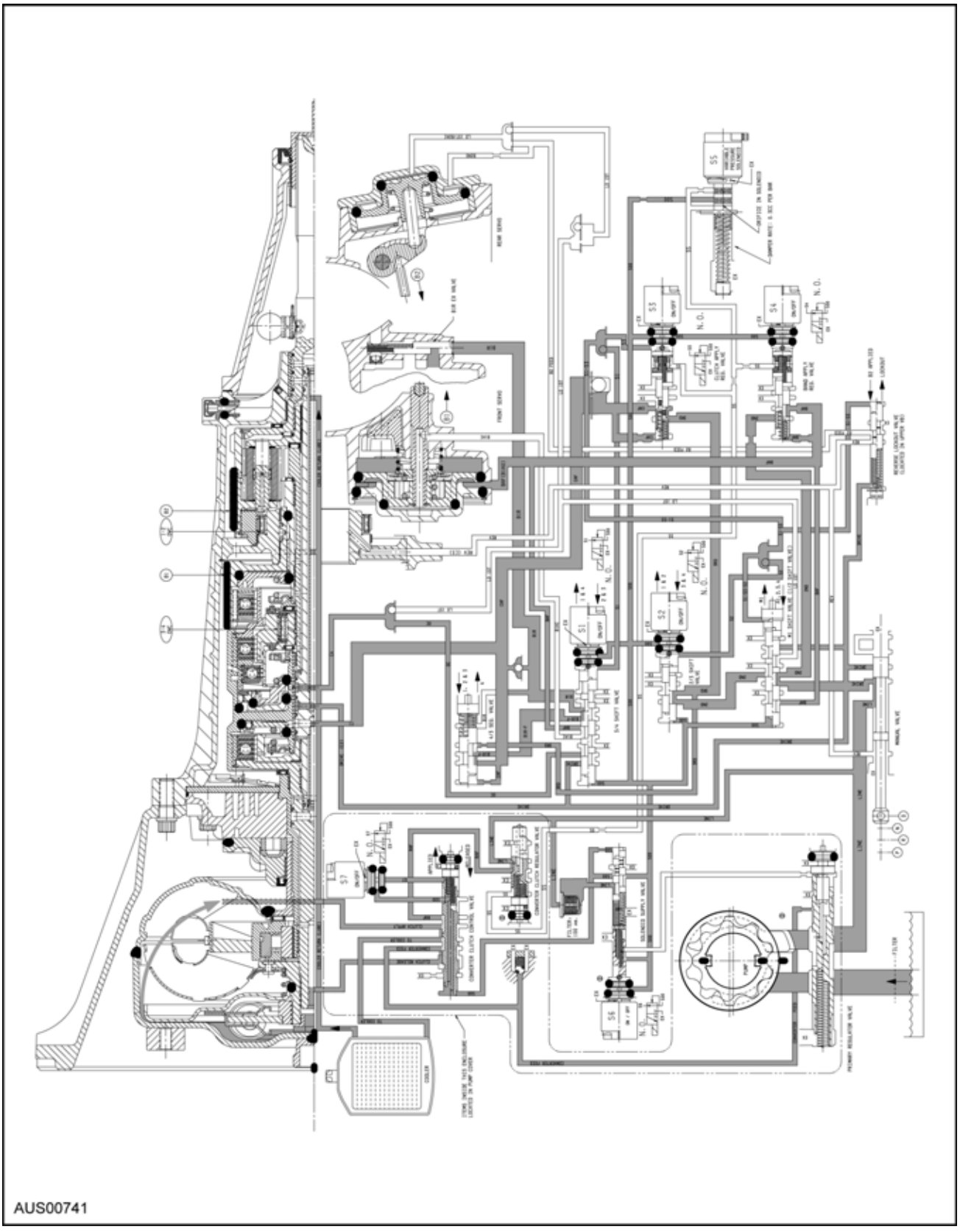
Clutch Apply Feed oil is directed to:

- the C1 clutch
- the 4-3 sequence valve

At the 4-3 sequence valve the CAF oil is directed, as Band 1 Release Feed (B1R-F) oil, 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 oil (Line pressure) from the 3-4 shift valve applies the C4 clutch.

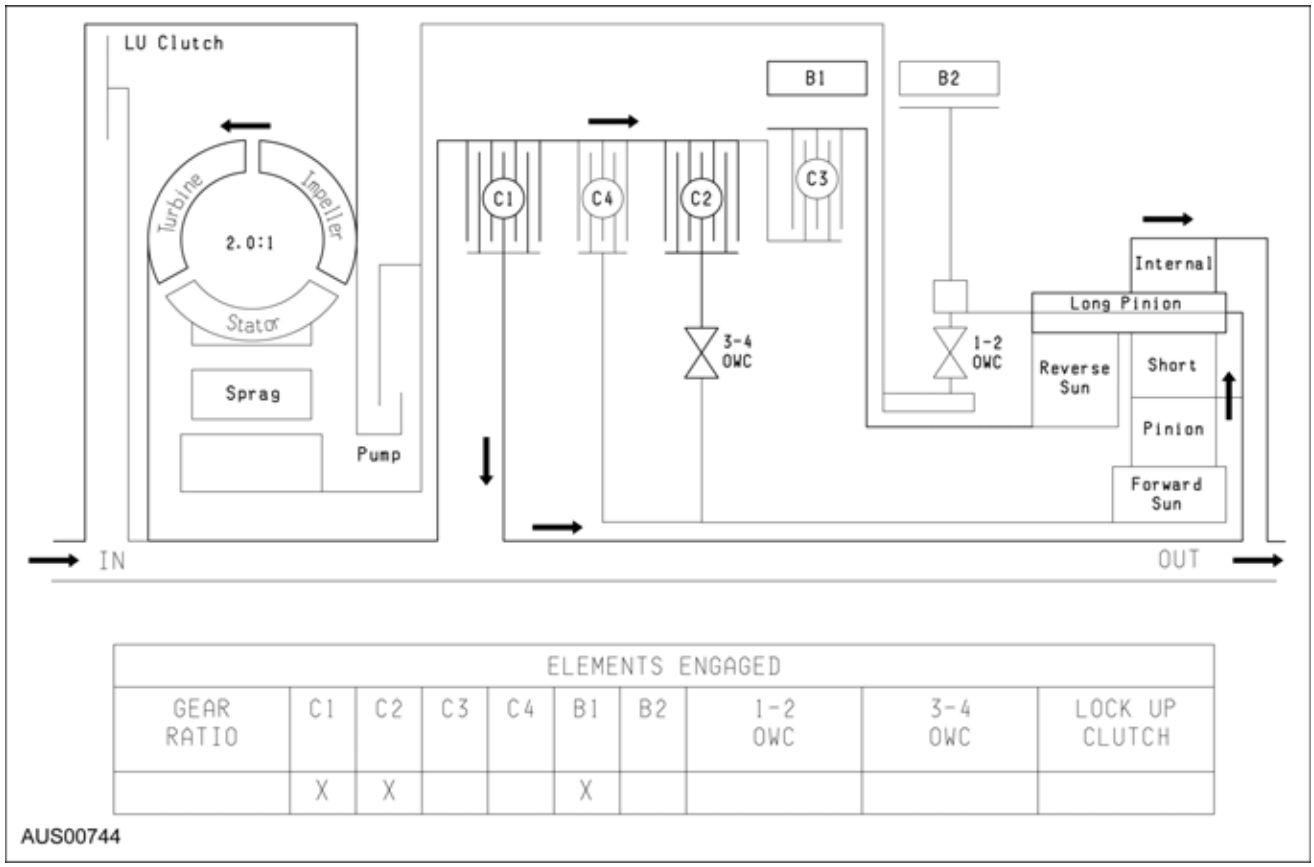
DESCRIPTION AND OPERATION (Continued)

Hydraulic System - D3 and Sequential Sports Shift 3 / Manaul 3



DESCRIPTION AND OPERATION (Continued)

Power Flow — D4 and Sequential Sports Shift 4/Manual 4



ELEMENTS ENGAGED									
GEAR RATIO	C1	C2	C3	C4	B1	B2	1-2 OWC	3-4 OWC	LOCK UP CLUTCH
	X	X			X				

Drive is via the input shaft to the forward clutch cylinder. 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

Solenoid S1 is switched ON.

Solenoid S2 is switched OFF.

With solenoid S1 switched ON the 3-4 shift valve is held in fourth gear position by Line 500 pressure on the small end of the valve. With solenoid S2 switched OFF the 2-3 shift valve is held in fourth gear position by Line 500 pressure on the large end of the valve. The 1-2 shift valve is held in 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 a pressure 1.8 times Line 500 pressure less 191 kPa for the BAR spring (724 kPa) or for XR8 only 2.32 times Line 500 pressure less 237 kPa (946 kPa), to the Band Apply Feed (BAF) circuit.

Band Apply Feed oil is directed to:

- the outer apply area of the front servo piston.
- 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 a pressure 2.25 times Line 500 pressure (1100 kPa) to the Clutch Apply Feed (CAF) circuit.

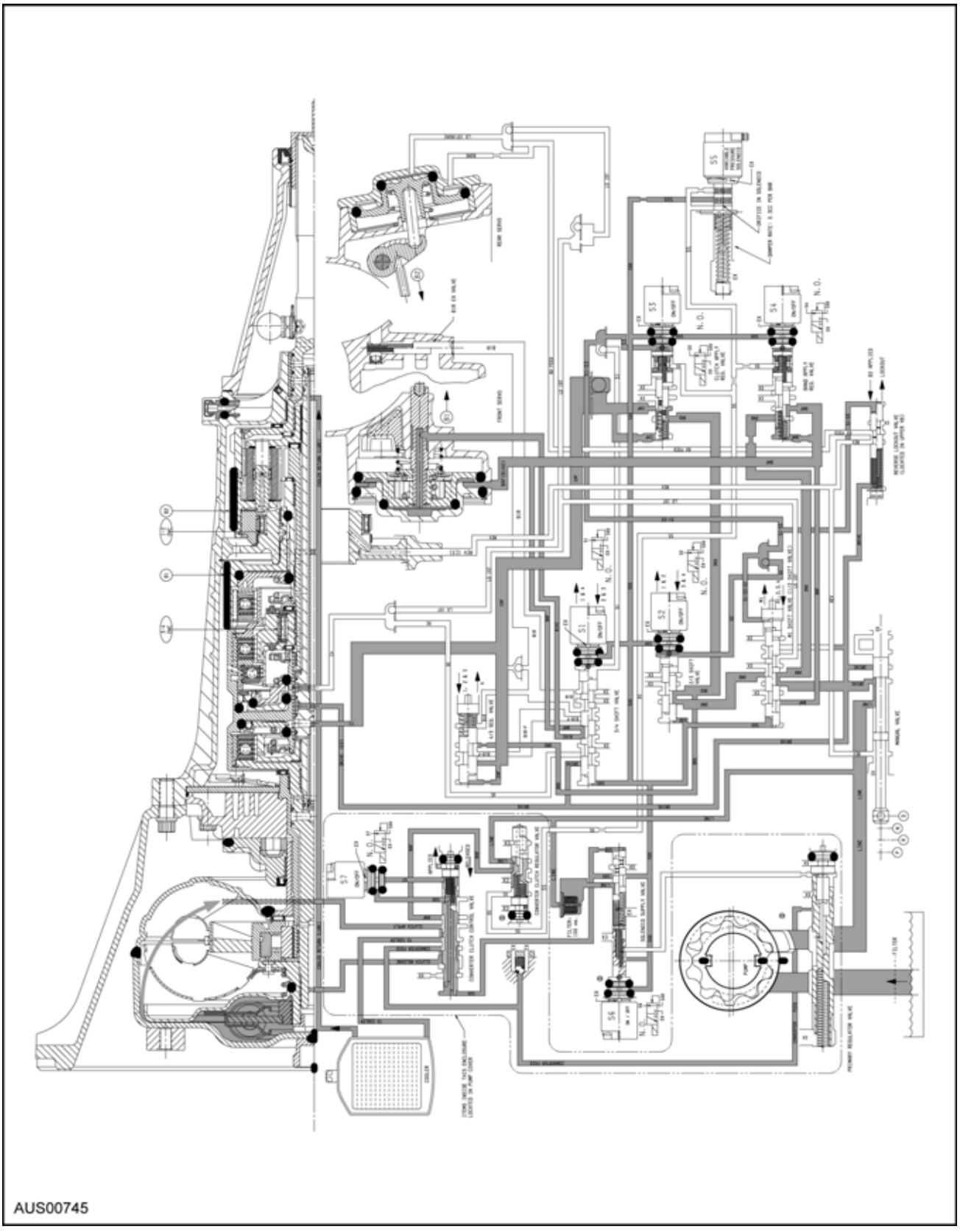
Clutch Apply Feed oil is directed to:

- the 4-3 Sequence valve
- the C1 clutch

The C2 clutch is applied by Drive oil (Line pressure) from the Manual valve.

DESCRIPTION AND OPERATION (Continued)

Hyadraulic System - D4 and Sequential Sports Shift 4 / Manual 4



DESCRIPTION AND OPERATION (Continued)

Power Flow — D2, D3 and D4 Lockup

Drive in this range is the same as for D2, D3 or D4 with the application of the converter Lockup clutch to provide positive no-slip converter drive.

NOTE: D2 Lockup is only used as an overheat reduction strategy when in failure mode.

Control

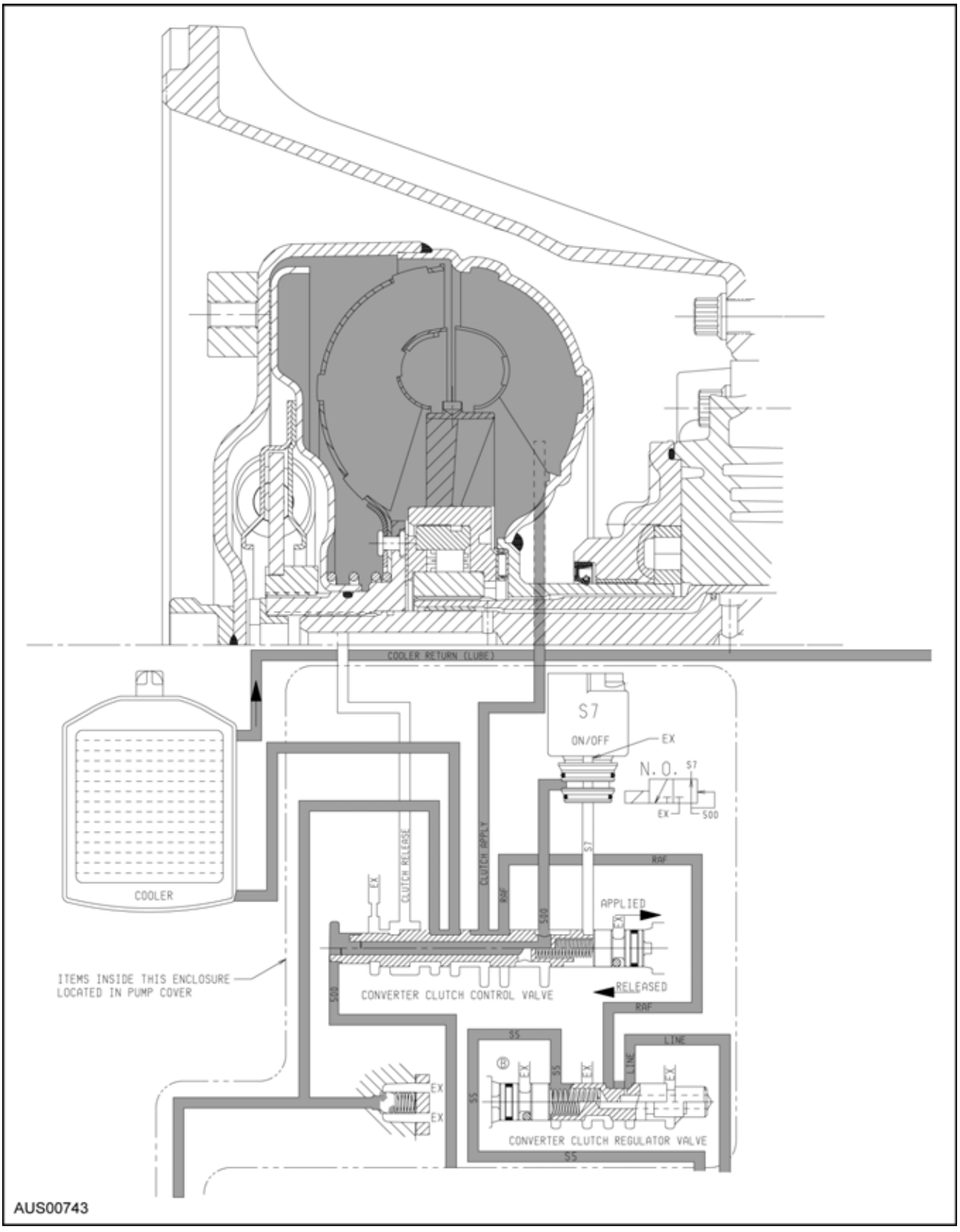
Control for this range is the same as for D2, D3 or D4 with the addition of the converter clutch circuit activated by solenoid S7, as illustrated. When solenoid S7 is switched ON, S7 feeds oil to the Converter Clutch Control Valve (CCCV) is switched off and allowed to exhaust through the S7 solenoid, allowing the valve to move to the clutch applied position.

The Converter Clutch Regulator Valve (CCRV) supplies Line oil, regulated to a pressure 1.48 times S5 pressure plus 138 kPa (875 kPa), to the Regulated Apply Feed (BAF) circuit. This is directed by the CCCV to the apply side of the converter clutch.

Converter clutch release oil is exhausted at the CCCV. Converter Feed oil is re-routed by the CCCV to the oil cooler and lubrication circuit.

DESCRIPTION AND OPERATION (Continued)

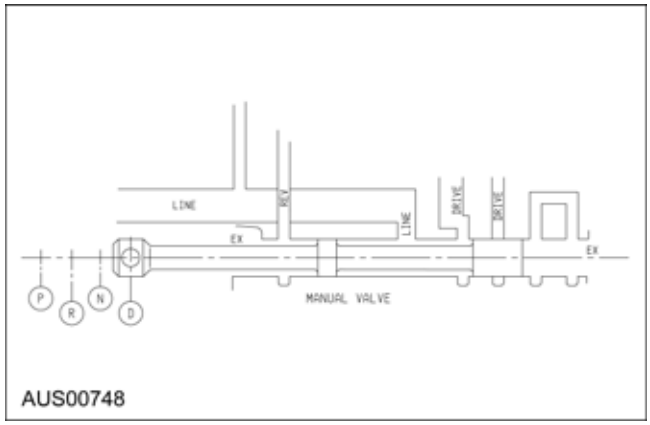
Hydraulic System - D2, D3 and D4 Lockup



DESCRIPTION AND OPERATION (Continued)

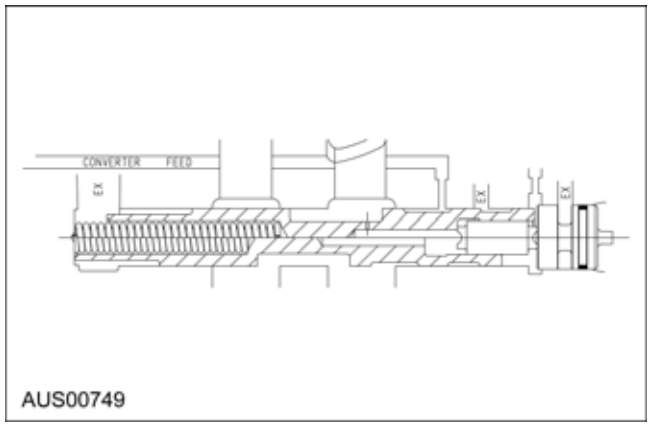
Hydraulic Valves

Manual Valve



The manual valve 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. Oil is prevented from entering the forward and reverse circuits when the manual valve is in the park or neutral position.

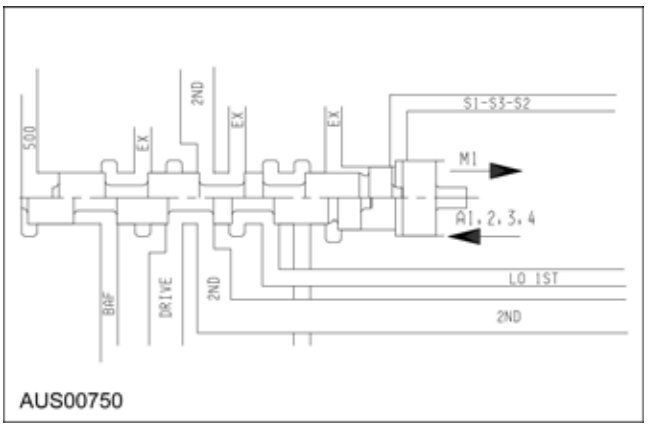
Primary Regulator Valve



The function of this valve is to regulate the transmission line pressure (pump outlet pressure). This valve gives either low, or high, line pressure depending on whether solenoid #6 is switched ON, or OFF. When the #6 solenoid 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 application will cause solenoid #6 to switch ‘OFF’ allowing the PRV to close off increasing line pressure. This stepped line pressure control does not have a detrimental effect on shift quality because all shifting pressures are controlled by separate band and clutch regulator valves and the output of solenoid #5.

The PRV also regulates the supply of oil to the torque converter via the converter feed port. The lands on the PRV are designed such that priority is given to maintaining line pressure at very low engine speeds. When engine speed increases and the pump provides an excess of oil the PRV moves to uncover the converter feed port thereby pressurising the converter. As engine speed increases further the excess oil supplied by the pump is diverted back to the pump suction port as the PRV opens further against spring force.

1-2 Shift Valve (Manual 1st Shift Valve)



This is a two position valve that must be switched to the 2, 3 or 4 position in order to get any forward gear other than Manual 1st. It is used on every Manual 1st-2 and 2-Manual 1st gearshift hence its name. Drive oil from the manual valve is allowed to pass through to the 2nd circuit during a Manual 1st-2 gearshift. During a 2-Manual 1st shift the band apply feed oil is allowed to exhaust via this valve. It also routes oil to the C4 clutch and the rear band servo.

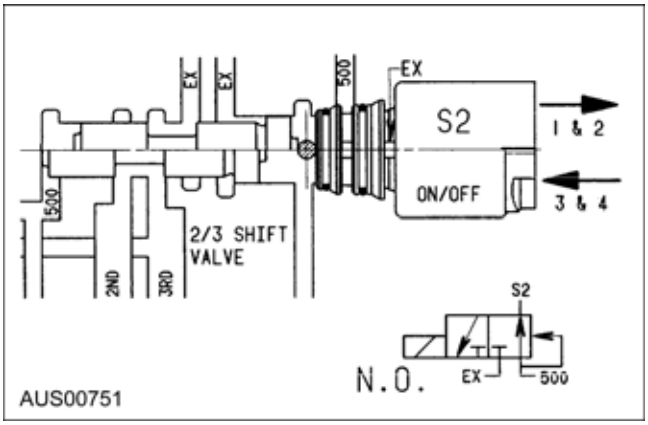
The switching of this valve is achieved by supplying pressure from solenoid 1, 2 and/or 3, or exhausting pressure through solenoid 1, 2 and 3.

2-3 Shift Valve

This valve is used on 2-3 and 3-2 shifts. The switching of this valve is done directly by solenoid 2 which is located at the end of the 2-3 shift valve. When in the 1 and 2 position 2nd oil from the 1-2 shift valve is prevented from entering the 3rd circuit. When the valve is shifted to the 3 and 4 position the 3rd circuit is fed from the 2nd circuit and the transmission will shift to 3rd gear.

DESCRIPTION AND OPERATION (Continued)

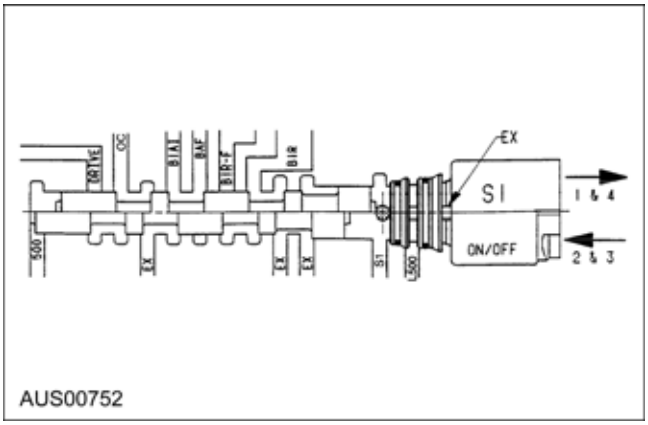
2-3 Shift Valve



3-4 Shift Valve

This valve is used for 3-4 and 4-3 shifts. Switching of this valve is done directly by solenoid 1 which is located at the end of the valve. The function of the valve during a 3-4 shift is as follows:

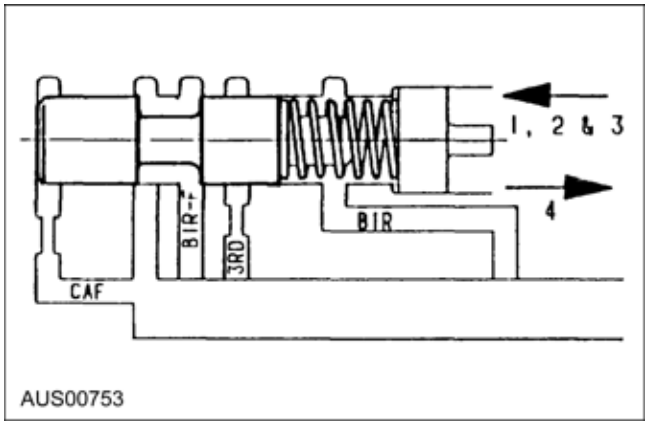
3-4 Shift Valve



- exhausts the front band release circuit (B1R) thereby allowing the application of the band.
- connects the inner apply area of the front servo (B1AI) to the band apply feed circuit (BAF) thus allowing greater apply forces to the front band.
- exhausts the overrun clutch circuit (O.C.) which will allow the C4 clutch to release.

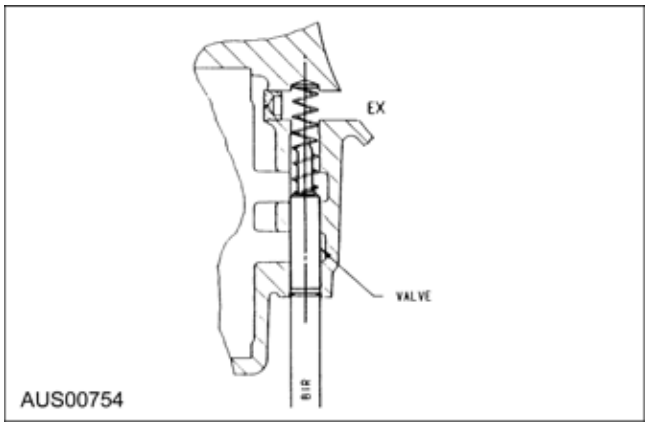
The exact opposite of the above functions will occur on a 4-3 downshift. This valve also switches during Manual 1st-2 and 2-Manual 1st gearshifts where it's function is to apply the overrun clutch (C4) in 2nd gear but to release it in Manual 1st gear. Note that the C4 clutch is applied in Manual 1st by the 1-2 shift valve.

4-3 Sequence Valve



This valve switches during 3-4 and 4-3 gearshifts although it performs no function during the 3-4 shift. It's sole purpose during the 4-3 shift is to delay the connection of the clutch apply feed circuit (CAF) to the B1R circuit until the B1R circuit has been fully pressurised by using the 3rd circuit. It prevents objectionable engine flare at the completion of the 4-3 gearshift.

B1R Exhaust Valve

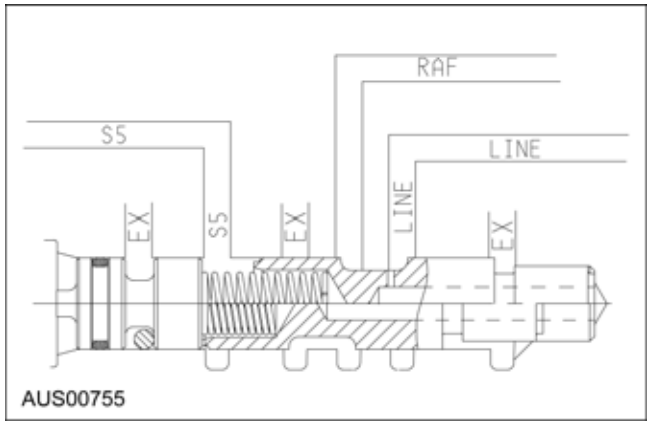


This valve is located in the case directly adjacent to the front servo. Its function is to allow the servo release oil to be rapidly exhausted into the transmission case during application of the front band rather than forcing the oil back into the valve body and through the 3-4 shift valve. In addition the spring on one end prevents oil entering the release area of the servo until the circuit pressure reaches approximately 70 kPa.

This valve also ensures that C1 pressure has reached 70 kPa on a 2-3 shift before B1 is allowed to begin releasing, thus preventing unwanted engine flare at the commencement of the gearshift.

DESCRIPTION AND OPERATION (Continued)

Converter Clutch Regulator Valve (CCRV)

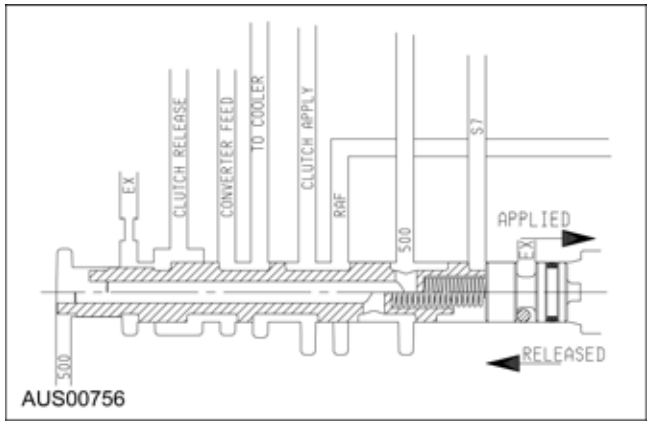


This valve regulates the pressure of the oil which applies the converter clutch. Input oil to this valve is from the Line Pressure and the output pressure is variable according to the signal pressure from the solenoid 5 circuit (S5). Converter clutch apply and release feel is made smooth by electronically varying the S5 pressure.

The spring on the S5 end of this valve allows the CCRV to boost its regulator apply feed pressure to a level above S5 pressure during 3rd locked to 4th unlocked gearshifts to prevent torque converter clutch slippage during these shifts.

The load of this spring results in an additional 140 kPa output from this valve during gear changes.

Converter Clutch Control Valve



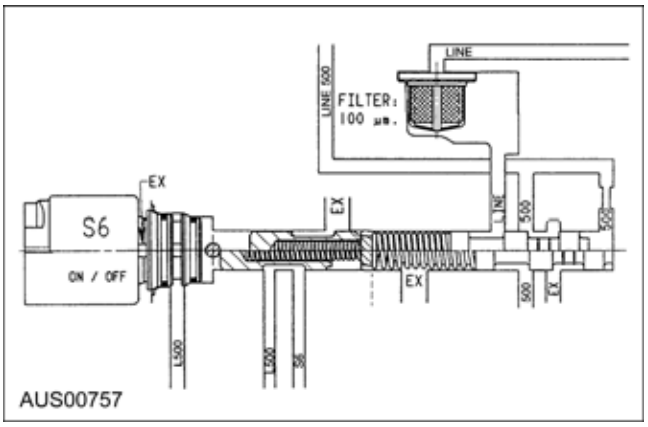
The two positions of this valve cause the converter clutch to be either off or on. The switching of this valve is governed by the signal pressure from solenoid 7.

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

When the valve is in the applied position, regulated oil from the converter clutch regulator valve is directed to the apply side of the converter. This oil does not return from the converter because the converter clutch piston will be sealed against the flat friction surface of the converter cover. To provide cooler flow the converter clutch control valve will now direct converter feed oil from the PRV directly to the cooler circuit.

The spring on the plug end of this valve ensures that the valve will remain in the released condition during engine shutdown, thus limiting the amount of torque converter draindown that can occur over long periods of non use.

Solenoid Supply Valve



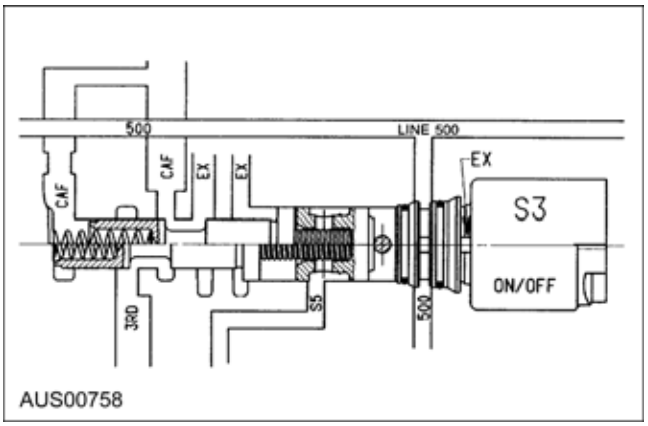
A constant pressure is supplied to all the solenoids by this valve. Line pressure is used as the feed oil to this regulator and the output is termed Line 500 due to its approximate 500 kPa pressure value.

Line Pressure Boost Valve

S6 pressure applied to the end of the PRV opposes spring force and causes LOW line pressure for light throttle application and cruising.

Heavy throttle application causes the normally open S6 solenoid to switch OFF closing Line 500 and opening S6 to exhaust. Removal of S6 pressure from the PRV results in HIGH line pressure.

Clutch Apply Regulator Valve

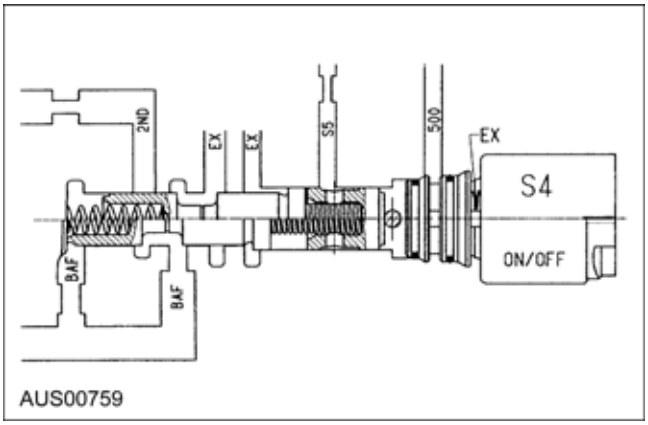


The clutch apply regulator (CAR) valve is a 2.25:1 ratio valve. This valve provides a regulated pressure to the C1 clutch and controls the rate of change of

DESCRIPTION AND OPERATION (Continued)

state of the clutch to give the desired shift quality. 3rd oil fed to the valve is regulated to provide an output pressure (CAF) of 2.25 times the S5 signal pressure or 2.25 times the Line 500 pressure depending on the ON/OFF condition of the S3 solenoid.

Band Apply Regulator Valve



The band apply regulator (BAR) valve is a 1.8:1 ratio valve. This valve 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. The BAR spring retained in the bore of the BAR valve enables the output pressure (BAF) to be regulated to zero to fully release the front band. This feature is used in Auto 1st, Garage 1st and 3rd limp home gear states.

2nd oil fed to the valve is regulated to provide a BAF pressure of 1.8 times the S5 signal pressure or the Line 500 pressure less 191 kPa depending on the ON/OFF condition of the solenoid S4.

DIAGNOSIS AND TESTING

Automatic Transmission

Electronic Control System

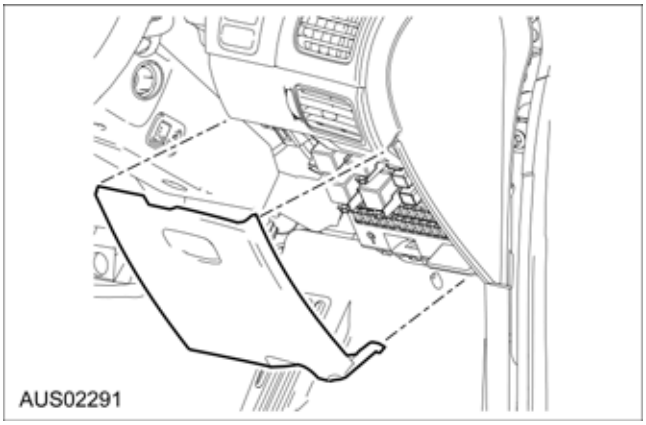
Diagnosis and Testing of the Automatic Transmission electronic control system is covered in Section 303-14 as part of the Powertrain Control Module Diagnosis and Testing. The Worldwide Diagnostic System (WDS) is connected to the vehicle using the Diagnostic Link Connector (DLC). The WDS retrieves Diagnostic Trouble Codes (DTC's), initiate self-testing diagnostics, review Parameter Identification (PID) values or reset the Keep Alive Memory (KAM) or adaptive values.

Component description, maintenance and diagnosis, (including DTCs and PIDs) for the following components is found in Section 303-14:

- Vehicle Speed Sensor VSS
- Transmission Fluid Temperature Sensor TFT
- Transmission Range Sensor TR
- Shift Solenoid 1 SS1
- Shift Solenoid 2 SS2
- Shift Solenoid 3 SS3
- Shift Solenoid 4 SS4
- Variable Pressure Solenoid 5 VPS
- Power Control Solenoid 6 PCS
- Lock Up Solenoid 7 LUS

Solenoid 5 has a resistance range of 3.8 to 6.2 ohms depending on its temperature. All other solenoids have a resistance range from 23 to 45 ohms depending on their temperature. Should a circuit register a reading outside the above limits the COMPLETE CIRCUIT including the solenoid and all its associated wiring and connectors should be thoroughly checked to determine the source of the fault.

Diagnostic Connector Location



Symptom Chart

Default Transmission Operating Modes

The PCM 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 PCM carries out both hardware and software fault detection routines. The PCM 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.

DIAGNOSIS AND TESTING (Continued)

Default Transmission Operating Modes

Fault Condition	Default Operation
• Pedal Fault	• The default pedal position in the event of a pedal sensor fault is 9%. The transmission software will respond normally as if the pedal is held at 9%.
• Engine Speed Fault	• All shifts will be firm as 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.
• Vehicle Speed Sensor Fault	• The PRNDL display will flash, Performance and Sequential Sports Shift modes will be inhibited and the torque converter will be unlocked at all times. • If the transmission is in 4th gear at high engine speed it will stay in 4th gear, otherwise it will shift to 3rd Limp Home gear state. • The vehicle will be speed limited to approximately 140 km/hr. • The reverse lockout feature will only operate above engine speeds of 3000 ERPM. • In the event of a loss of speed signal the engine speed is used to estimate vehicle speed. **NOTE:** Speedo transducer faults are likely to cause the vehicle's speedometer to become inoperative.
• Gear Lever Fault (Inhibitor/PRNDL switch)	• The gear lever is assumed to be in the Drive position, Sequential Sports Shift and performance modes will be inhibited. • The torque converter will be unlocked at all times.
• Transmission Oil Temperature Sensing FaultTransmission Oil Temperature Sensing Fault	• All shifts will be firm until the transmission has warmed up, as 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).
• Sequential Sports Shift/Performance Mode Setting Fault	• All shifts will occur as if the mode is set to Adaptive in the instance of the Performance mode switch a being faulty.v • All shifts will occur as if the mode is set to Performance in the instance of the Sequential Sports Shift mode switches being faulty. • The mode indicator will not respond to changes in the mode switch setting. If a fault is undetected, the mode as indicated by the mode indicator is likely to not respond to the mode switch.

DIAGNOSIS AND TESTING (Continued)

Fault Condition	Default Operation

• Battery Voltage Sensing Fault	• If the battery voltage is too low then:If the battery voltage is too low then:
	  • Shifts into 1st gear prohibited.
	  • Transmission uses High Line.
	• If the battery voltage is too high or faulty then:If the battery voltage is too high or faulty then:
	  • Standby S5 current is set to 0 mA for all gears except Auto 1st.v

• ON/OFF Solenoid Electrical Fault (Solenoid 1, 3, 4, 5 & 6)	• If a fault is detected in the electrical circuit of solenoid 1, 3, 4, 5 or 6 the Fault Detection Strategy puts the transmission into a Limp Home Mode where: If a fault is detected in the electrical circuit of solenoid 1, 3, 4, 5 or 6 the Fault Detection Strategy puts the transmission into a Limp Home Mode where:
	  • The PRNDL display will flash.
	  • The transmission will shift to 3rd Limp Home gear state
	  • The torque converter will be unlocked at all times.
	  • Performance and Sequential Sports Shift modes will be inhibited.
	  • No shift ramps will be available.
	  • Above approximately 90 km/hr the solenoid 6 is switched ON supplying Low Line Pressure to the transmission to soften high speed gear shift engagement.
	  • In the case of a single solenoid fault the vehicle will be speed limited to approximately 120 km/hr, if multiple faults are present then the vehicle is limited to approximately 45 km/hr.
	  • Engine torque is limited to protect the transmission from stall starts in 4th.
	  • The reverse lockout feature will not operate in the event of a solenoid 1 or 3 fault.

• ON/OFF Solenoid Electrical Fault (Solenoid 2)	• If a fault is detected in the electrical circuit of solenoid 2 the Fault Detection Strategy puts the transmission into a Limp Home Mode where:
	  • The PRNDL display will flash.
	  • The transmission will shift to 3rd Limp Home gear state if below 90 km/hr or S3 fault is present, otherwise a shift to 4th gear will be attempted.
	  • The torque converter will be unlocked at all times.
	  • Performance and Sequential Sports Shift modes will be inhibited.
	  • No shift ramps will be available.
	  • Above approximately 90 km/hr the solenoid 6 is switched ON supplying Low Line Pressure to the transmission to soften high speed gear shift engagement.
	  • In the case of a single solenoid fault the vehicle will be speed limited to approximately 120 km/hr, if multiple faults are present then the vehicle is limited to approximately 45 km/hr.
	  • Engine torque is limited to protect the transmission from stall starts in 4th.
	  • The reverse lockout feature will be available.

• ON/OFF Solenoid Electrical Fault (Solenoid 7)	• If Solenoid 7 is found faulty it is disabled resulting in transmission always unlocked. The transmission does not go into LOS.

DIAGNOSIS AND TESTING (Continued)

Fault Condition	Default Operation
• ON/OFF Solenoid Hydraulic Fault (Solenoid 1 & 3)	• When Reverse is selected solenoid 1 is switched OFF while solenoid 3 is switched ON, once a speed signal has been recognised the solenoid switching state is inverted next time Reverse is selected. A hydraulic solenoid 1or 3 fault is detected when Reverse is selected and the engine exceeds the stall speed while the vehicle is stationary, that is the transmission is neutralised. The Fault Detection Strategy puts the transmission into Limp Home Mode as if it had a solenoid 1 or 3 electric circuit fault as in 9A.
• ON/OFF Solenoid Hydraulic Fault (Solenoid 2)	• Whenever the transmission is in 3rd or 4th gear and is not in the process of a gear shift the engine speed is monitored to confirm that it is in a valid vehicle speed range for 3rd and 4th gear states. In the event that it is not, the Fault Detection Strategy puts the transmission into Limp Home Mode as if it had a solenoid 2 electric circuit fault as in 9B.
• Software Fault	• The transmission adopts its Limited Operation Strategy of operation. i.e. 3rd gear, unlocked and high line pressure. • The operation of the PCM under this condition is difficult to predict. Its operation may be erratic. If a fault is undetected, the operation of the PCM is likely to be erratic.
• Power Supply Fault	• The transmission adopts its Limited Operation Strategy of operation. i.e. 3rd gear, unlocked and high line pressure. • If there is an intermittent power supply connection, the PCM 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.

If a fault is undetected, the operation of the transmission is dependent of which solenoid is actually faulty. The following is a list of characteristics for different solenoid fault conditions.

DIAGNOSIS AND TESTING (Continued)

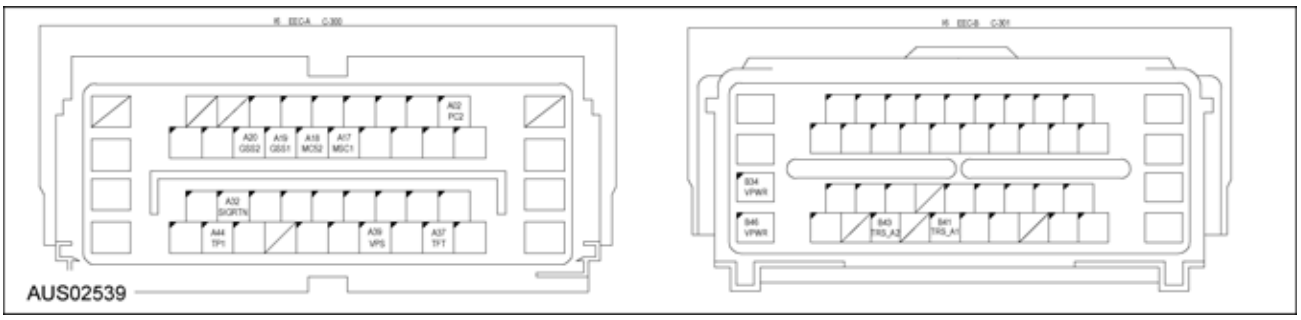
Solenoid Fault Transmission Response (when fault undetected)

Solenoid	Condition	Transmission Operation
1	Always OFF	Auto 1st gear instead of Garage 1st 3rd gear instead of 4th. Manual 1st unavailable. Reverse Lockout feature not available. This results in delayed N-D engagement.
	Always ON	Garage 1st gear instead of Auto 1st. 4th gear instead of 3rd. Loss of engine braking in 2nd gear. Loss of Reverse every second reverse engagement. This results in a 1 -> 2->4->4 shifts as the vehicle accelerates from rest.
2	Always OFF	3rd gear instead of Garage 1st, Auto 1st and 2nd. Manual 1st unavailable. This results in 3 -> 3 -> 3 -> 4 shifts as the vehicle accelerates from rest.
	Always ON	2nd gear instead of 3rd. Garage 1st gear instead of 4th. This results in a 1 -> 2 -> 2 -> I (overrun) downshift as the vehicle accelerates from rest.
3	Always OFF	Manual 1st gear unavailable. Reverse Lockout feature not available. The following shifts become poor:1 -> 3, 1 -> 4, 2 -> 1, 2 -> 3, 4 -> 2, 4 -> 1.
	Always ON	Manual 1st gear instead of Garage 1st. Loss of Reverse every second reverse engagement.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	2nd gear instead of Garage 1st and Auto 1st. This results in a 2 -> 2->3->4 shifts as the vehicle accelerates from rest. The following shifts become poor:2 -> 3, 3 -> 2, 3 -> 4, 4 -> 3.
	Always ON	2nd gear instead of Garage 1st and Auto 1st. This results in a 2 -> 2->3->4 shifts as the vehicle accelerates from rest. The following shifts become poor:2 -> 3, 3 -> 2, 3 -> 4, 4 -> 3.
5	Output Pressure High	Garage 1st gear and Auto 1st not available. All shifts become poor.
	Output Pressure Low	Torque converter slips during lockup. All shifts become poor.
6	Always OFF	Line pressure always high. Torque Converter Blow off valve noise may be audible at low speeds and throttle.
	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, engine stall at low speed.

DIAGNOSIS AND TESTING (Continued)

Connector Circuit Reference

Automatic Transmission Connector Switch



Pin	Condition	Measurable Value	Min	Max
B34 VPWR	A	Voltage to GND B1	10V	14V
B46 VPWR	A	Voltage to GND B1	10V	14V
A43 LUS	B	Resistance to GND B1	23 Ohm	45 Ohm
A2 PCS	B	Resistance to pin B46 VPWR	23 Ohm	45 Ohm
B41 PRNDL	A	Voltage to pin A32, M1*	0.90V	1.10 V
B41 PRNDL	A	Voltage to pin A32, M2*	1.40V	1.60V
B41 PRNDL	A	Voltage to pin A32, M3*	1.90V	2.10V
B41 PRNDL	A	Voltage to pin A32, D	2.40V	2.60V
B41 PRNDL	A	Voltage to pin A32, N	2.90V	3.10V
B41 PRNDL	A	Voltage to pin A32, R	3.40V	3.60V
B41 PRNDL	A	Voltage to pin A32, P	3.9V	4.10V
B41 PRNDL	B	Resistance to pin A32, M1*	1.0 kOhm	1.4 kOhm
B41 PRNDL	B	Resistance to pin A32, M2*	1.8 kOhm	2.2 kOhm
B41 PRNDL	B	Resistance to pin A32, M3*	3.0 kOhm	3.4 kOhm
B41 PRNDL	B	Resistance to pin A32, D	4.5 kOhm	4.9 kOhm
B41 PRNDL	B	Resistance to pin A32, N	6.8 kOhm	7.2 kOhm
B41 PRNDL	B	Resistance to pin A32, R	10.6 kOhm	11.2 kOhm
B41 PRNDL	B	Resistance to pin A32, P	18.6 kOhm	19.0 kOhm
A17 MSC1	B	Resistance to pin B46 VPWR	23.0 Ohm	45.0 Ohm
A39 VPS	B	Resistance to pin B46 VPWR	3.1 Ohm	5.0 Ohm
A37 TFT	A	Voltage to pin A32 SGRTN	0.25V	4.8V
A37 TFT	B	Resistance to pin A32 SGRTN	57.0 Ohm	15.5 kOhm
A32 SIGRTN	C	Resistance to GND B	1 0.0V	1.0V
A19 GSS1	B	Resistance to pin B46 VPWR	23.0 Ohm	45 Ohm
A20 GSS2	B	Resistance to pin B46 VPWR	23.0 Ohm	45 Ohm
A18 MCS2	B	Resistance to pin B46 VPWR	23.0 Ohm	45 Ohm
B43 TRSA_2	A	Voltage to pin B33, D	3.94V	
B43 TRSA_2	A	Voltage to pin B33, S	2.88V	
B43 TRSA_2	A	Voltage to pin B33, UP	1.83V	
B43 TRSA_2	A	Voltage to pin B33, DOWN	0.83V	

DIAGNOSIS AND TESTING (Continued)

*Reading only applicable to column shift.

Conditions

A	PCM connected to vehicle wiring harness. Ignition turned on. Measurement at pin of vehicle wiring harness.
B	PCM disconnected from vehicle wiring harness. Measurement at pin of vehicle wiring harness.
C	PCM disconnected from vehicle wiring harness. Measurement at pin of PCM.

GENERAL PROCEDURES

Hydraulic System

Preliminary inspection

When diagnosing transmission problems, first refer to the diagnosis guide for detailed information of the items that could be causing the problem. The following preliminary checks should be made in the order listed.

1. Check the fluid level. Check the fluid for a burnt clutch plate odour.
2. Check the manual linkage adjustment.
3. Check engine idle speed.
4. Check electrical connections.
5. Check that the transmission is not in failure mode.
6. Check front and rear band adjustment.

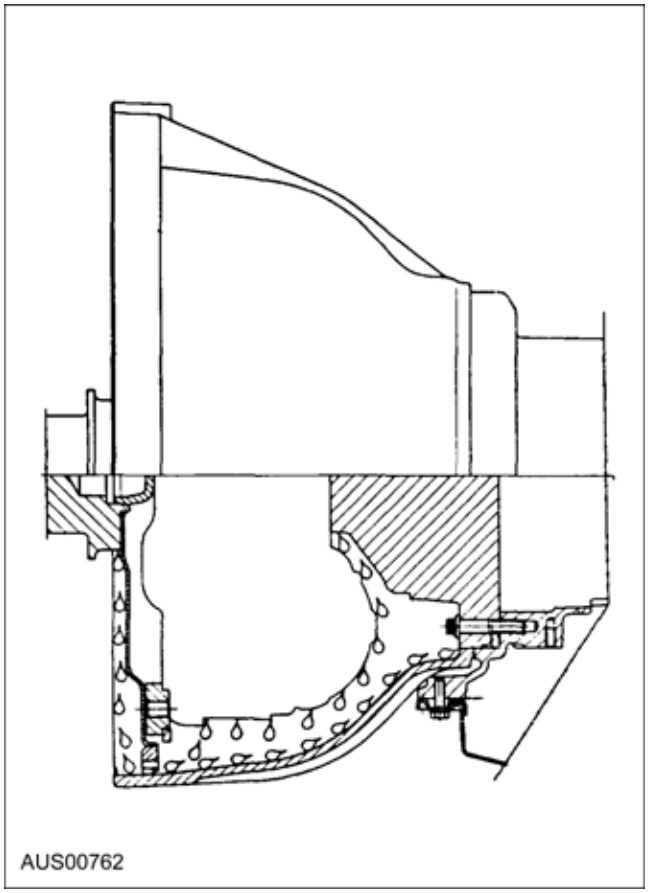
Fluid Level

A fluid level that is too high will cause the fluid to become aerated. Aerated fluid will cause low line pressure, and the aerated fluid may be forced out the vent. Low fluid level can effect the operation of the transmission and may indicate fluid leaks that could cause transmission damage.

Fluid leakage checks

1. Check the speedometer transducer installation at the transmission (if fitted).
2. Leakage at the oil pan seal often can be stopped by tightening the attaching bolts to the proper torque.
3. If necessary, replace the seal.
4. Check the fluid plug. If the plug O-ring seal is leaking, replace the seal.
5. The transmission fluid is water cooled; check the fluid lines and fittings between the transmission and the cooler in the radiator tank for looseness, wear, or damage.
   If leakage cannot be stopped by tightening a fitting, replace the defective parts.
6. Check the engine coolant in the radiator. If transmission fluid is present in the coolant, the cooler in the radiator tank is probably leaking.
7. The cooler can be further checked for leaks by disconnecting the lines at the cooler fittings and applying 500 kPa maximum air pressure to the fittings. The radiator cap must be removed when making this check to relieve the pressure on the exterior side of the cooler.
   If the cooler is leaking and will not hold this pressure the radiator must be replaced. The cooler cannot be replaced separately.
8. Leakage in the extension housing area may be caused by a worn extension housing bush, seal, drive shaft yoke, the housing to case gasket or the speedo transducer (if fitted).
9. If leakage is found at the manual lever shaft, replace seals that are leaking.
10. Check the front and rear servo covers.
11. Fluid leakage from the converter housing may be caused by engine oil leaking past the rear main bearing or from oil gallery plugs. Be sure to determine the exact cause of the leak.

Converter Area Leakage



Fluid Leakage Converter Area

In diagnosing and correcting fluid leaks in the front pump and converter area, use the following procedures to facilitate locating the exact cause of the leakage. Leakage at the front of the transmission, as evidenced by fluid around the converter housing, may have several sources. By careful observation, it is possible, in many instances, to pinpoint the source of the leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the converter housing are as shown.

1. Fluid leaking from the front pump seal lip will tend to move along the drive hub and onto the back of the impeller housing. In the case of a total seal failure, fluid leakage past the lip of the seal will be deposited on the inside of the converter housing only, near the outside diameter of the housing.

GENERAL PROCEDURES (Continued)

2. Fluid leakage from the outside diameter of the seal and front pump body will follow the same path as leaks from the front pump seal or may run down the face of the front pump.
3. Fluid that leaks by front pump to case bolts will be deposited on the inside of the converter housing only. Fluid will not be deposited on the back of the converter.
4. Leakage by the front pump to case and O-ring seal may cause fluid to be deposited on the inside lower part of the converter housing. Engine oil leaks are sometimes improperly diagnosed as front pump seal leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the problem:
   - Leakage at the rocker arm cover may allow oil to flow over the converter housing or seep down between the converter housing and cylinder block causing oil to be present in or at the bottom of the converter housing.
   - Oil gallery plug leaks will allow oil to flow down the rear face of the block to the bottom of the converter housing.
   - Leakage from the crank shaft seal will work back to the flywheel, and then into the converter housing.

Fluid leakage from other areas, forward of the transmission could cause fluid to be present around the converter housing due to blow-back or road draft. The following procedure should be used to determine the cause of leakage before any repairs are made:

5. Remove the transmission plug and note the colour of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. Since road draft may cause leaking rocker cover oil to be present on the transmission, this leakage, if present, should be eliminated before performing work on the transmission.
6. Remove the converter lower housing cover. Clean off any fluid from the top and bottom of the converter housing, front of the transmission case, and rear face of the engine and engine oil pan. Clean the converter area by washing with suitable non-flammable solvent, and blow dry with compressed air.
7. Wash out the converter housing and the front of the flywheel. Blow all washed areas dry with compressed air.
8. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the block and top of the converter housing for evidence of fluid leakage. Raise the car on a hoist and run the engine at fast idle, then at engine idle, occasionally shifting to the drive and reverse ranges to increase pressures within the transmission. Observe the front of the flywheel, back of the block (in as far as possible), and inside the converter housing. Run the engine until fluid leakage is evident and the probable source of leakage can be determined.

Gear shift Cable check

Correct cable adjustment is necessary to position the manual valve for proper fluid pressure direction to the different transmission components. Improper adjustment may cause subsequent transmission failure. Refer to Gear Shift Cable Adjustment for detailed adjustment procedures.

Initial Engagement check

Initial engagement checks are made to determine if initial band and clutch engagements are smooth. Run the engine until its normal operating temperature is reached. With the engine at kerb idle speed, shift the selector lever from N to D and R. Observe the initial band and clutch engagements. Band and clutch engagements should be smooth in all positions. Rough initial engagements are caused by high engine idle speed or high line pressures.

Transmission operation checks - Test preparation

When testing the transmission, the transmission and engine must be at normal operating temperature.

1. Check the transmission fluid level.
2. Check the gear shift cable adjustment.
3. Attach a tachometer to the engine.
4. Firmly apply the parking brake and start the engine.

Stall test, Engine speed

Ensure that the park and service brakes are firmly applied during these tests and the A/C is off. The stall test is made in D and R at full throttle, speeds should agree with the specifications shown in the Converter Stall Speed table. While making this test, do not hold the throttle open for more than five seconds at a time. Then move the selector lever to Neutral and run engine at 1000 rpm for about 15 seconds to cool the converter before making the next test. If the engine speed recorded by the tachometer exceeds the maximum limits specified in the Converter Stall Speed table, release the accelerator immediately because clutch or band slippage is indicated.

Type	Stall Speed
6 Cyl	2000-2200 rpm
8 Cyl	2000-2400 rpm

Stall speed too high

A higher stall speed than that specified indicates that the converter is not receiving its required fluid supply or that slip is occurring. Excessive engine speed in ‘D’

GENERAL PROCEDURES (Continued)

indicates C2 clutch slippage or gear train one way clutch slippage. Excessive engine speed in ‘R’ indicates C3 clutch or B2 band slippage.

Stall speed too low

When the stall test speeds are low and the engine is properly tuned, converter stator clutch problems are indicated. A road test must be performed to determine the exact cause of the trouble. If the stall test speeds are 300 to 400 rpm below the specified values, and the car cruises properly but has very poor acceleration, the converter stator clutch is slipping. If the stall test speeds are 300 to 400 rpm below the specified values, and the car drags at cruising speeds and acceleration is poor, the stator clutch could have been installed backwards. Remove the converter and check the stator clutch by replacing with a converter known to be operating correctly and retesting. Below standard acceleration in top gear above 50 km/h combined with a substantially reduced maximum speed, indicates that the stator one-way clutch has locked in the engaged condition. This condition will also be indicated by the transmission overheating, although the stall speed will remain as specified. Renew the converter.

NOTE: The torque converter is a sealed unit without a drain plug. The unit must not be dismantled. If a converter is unsatisfactory in any way then it must be replaced.

Green Transmission Strategy (Retraining for new Automatic Transmission)

Where a new automatic transmission has been installed, or any of the transmission bands or clutches have been replaced, the Powertrain Control Module (PCM) must be reset for "green" transmission strategy.

This strategy ensures that the line pressure is regulated to correspond with the lower friction coefficient of new clutch material. The strategy remains in effect for 1,500km.

Instructions to activate the "green" transmission strategy

This procedure is now independent of the WDS. It is a T-Bar sequence that will only work on the first key-on cycle after the battery has been disconnected

NOTE: This reset procedure (Steps 5-9) must be complete within sixty (60) seconds from the first Key-On in Step 5.

1. Ensure the ignition is off.
2. Disconnect the battery for approximately one minute.
3. Reconnect the battery.
4. Place the T-bar in the "D" position.
5. Turn the key to the "RUN" position (Key On Engine Off);
6. Leave the T-bar in "D" for at least ten (10) seconds after key-on.
7. Move the T-bar to the "Park" position for at least ten (10) seconds.
8. Move the T-bar to "Neutral" position.
9. Ten (10) seconds later, the PRNDL display will fast flash "N" on the display to confirm that the "green" strategy has been activated.
10. The operation is complete and it is safe to either key through to start the vehicle, or key off.

To check whether "green" transmission strategy is active

If this procedure is performed when the battery has not been disconnected, or on a key-on cycle other than the first after battery is disconnected, it will not reset the "green" transmission strategy. Instead it will fast flash "N" to indicate if the "green" transmission strategy is still active, or "N" will remain steady if the strategy has expired (i.e. 1500km/1600km has elapsed since vehicle or transmission was new).

Line Pressure Boost Check

This test requires that the vehicle be driven on the road or on a dynamometer whilst monitoring PID EPCDC with the WDS tester. There should be a sharp rise in line pressure when solenoid No. 6 switches off as the vehicle is gently accelerated in Drive or Reverse. This should occur at approximately 8% of throttle opening in Drive or 5% of throttle opening in Reverse.

Lack of pressure boost: This may be caused by a sticking primary regulator valve, a sticking line pressure boost valve, faulty No. 6 solenoid or faulty connections or wiring.

Road testing

NOTE: A road test, using the WDS tester, will determine if the ECU, transmission and converter are functioning correctly. The WDS tester incorporates:

- a Parameter Identification PID to monitor the state of each ON/OFF solenoid (1, 2, 3, 4, 6 and 7): SS1-4, EPC and TCC.
- a PID to monitor transmission gear state: GEAR.
- a PID to monitor the current ramp of the Variable Pressure Solenoid (S5): EPCD

Diagnosis Guide

C1 Clutch Failure	• Slip or no drive in 3rd or 4th gear • Will drive in 1st instead of 3rd, and 2nd instead of 4th • Normal drive in 1st, 2nd and reverse.
C2 Clutch Failure	• Slip or no forward drive. • Normal reverse.

GENERAL PROCEDURES (Continued)

C3 Clutch Failure	• Slip or no reverse drive. • Normal forward drive.
C4 Clutch Failure	• No engine braking in Manual 1, D2 or D3.
B1 Band Failure	• No 2nd or 4th gear. • Will operation in 1st instead of 2nd, and 3rd instead of 4th
B2 Band Failure	• No reverse drive. • Manual 1 will not have engine braking.
1-2 OWC Slip	• No drive in D1. • Drive in Manual 1.
1-2 OWC Seized	• D1 will have engine braking. • Transmission will lock up in other forward gears with probable gear or friction element damage. • Reverse will function normally.
3-4 OWC Slip	• No drive in D1. • Probable loss of drive in Manual 1 because of C4 clutch burn out.
3-4 OWC Seized	• Transmission lock up in 4th gear causing probable damage of C1/C2 clutch or B1 band burn out.

Road Test

1. Check that the engine will only start in Neutral and Park.
2. Drive the vehicle normally.
   - Do solenoids 1, 2, 3, 4 & 5 operate in the correct sequence?

   Gear Solenoid States

Gear	S1	S2
Auto 1	OFF	ON
2	OFF	ON
3	OFF	OFF
4	ON	OFF

   - Do solenoids 3 and 4 operate during gearshifts?
   - Does solenoid 5 current ramp during gearshifts and return to 0.2 amps when shift is completed (except in Garage 1& Auto 1)?
   - Is solenoid 6 ON at light throttle and OFF at heavy throttle?
   - Does solenoid 7 indicate converter clutch lock-up in 3 and in Drive?
3. Drive the vehicle at minimum throttle and check shift speeds in both adaptive and performance modes.
4. Drive the vehicle at 40% throttle opening and check shift speeds in both adaptive and performance modes.
5. Where safe, and legally permissible, drive the vehicle at wide open throttle and check shift speeds in both adaptive and performance modes.
6. Where safe, and legally permissible, check the Sequential Sports Shift / Manual Downshift and Kickdown shift speeds. During the road test take note of the shift quality, abnormal noise and any evidence of slip or shudder for further investigation.

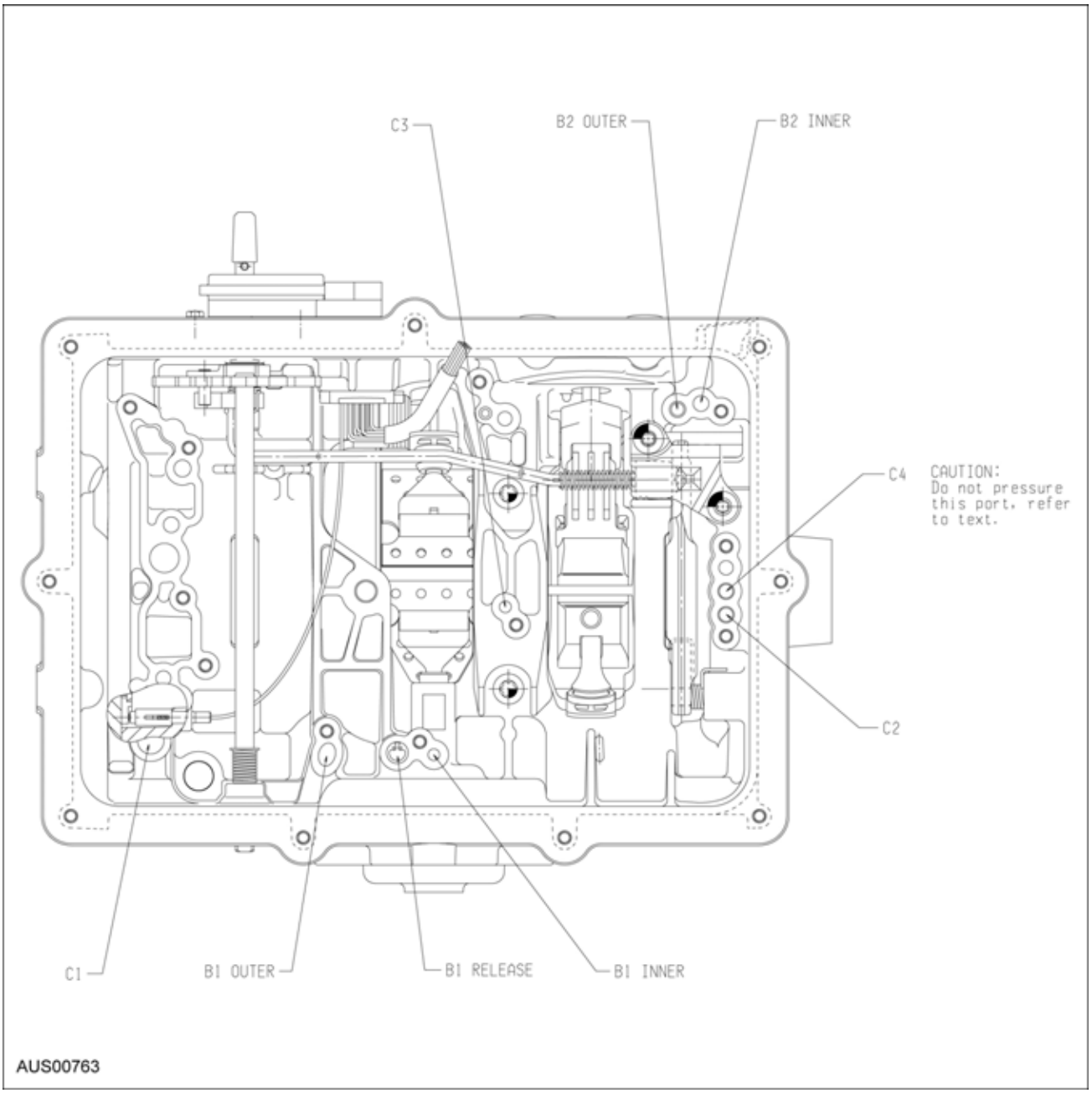
Air Pressure checks

A ‘NO DRIVE’ condition can exist even with correct transmission fluid pressure, because of inoperative clutches or bands. Inoperative bands can be located through a series of checks by substituting air pressure for the fluid pressure to determine the location of the malfunction. To make the air pressure checks, drain the transmission fluid and then remove the oil pan and control valve body. The inoperative units can be located by introducing air pressure into the transmission passages leading to the bands.

CAUTION: Do not apply air pressure to the C4 clutch passage as this may dislodge the piston ‘O’ ring.

GENERAL PROCEDURES (Continued)

Pressure Apply Ports



Servos

Apply air pressure to the inner passage of each servo. The band will be seen to tighten around the drum if the servo is operating. Apply air pressure to the outer passage of each servo. Again the band will be seen to tighten around the drum if the servo is operating. While holding air pressure to the outer passage of the front servo apply air pressure to the release passage of the front servo. The air pressure in the release passage, aided by the return spring, should release the front band against the apply pressure.

GENERAL PROCEDURES (Continued)

Transmission fluid level adjustment

WARNING: Do not touch a hot exhaust pipe with your hands or allow transmission fluid to contact the exhaust pipe.

NOTE: The transmission is sealed from the factory, oil level and oil condition checks should only be required when fluid leakage from the transmission or reduced transmission performance has occurred.

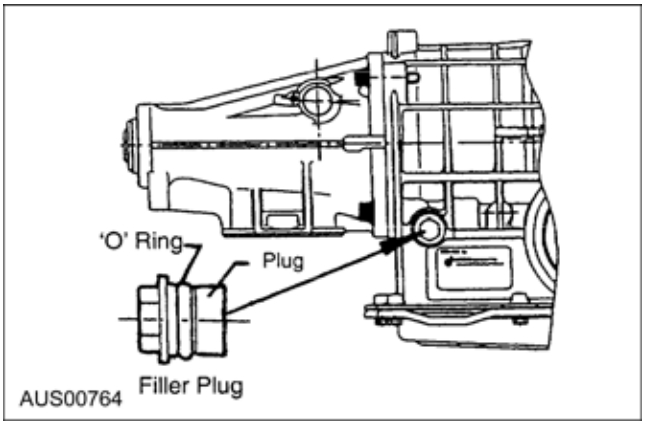
To determine the correct fluid level, proceed as follows:

1. Place the transmission selector in 'PARK' - Engine switched OFF.
2. Raise the vehicle on a hoist or place on a service pit.
3. The transmission sump should be warm to touch (this indicates that the transmission is at the correct temperature for checking oil level).
   - If the vehicle is at operating temperature - allow the vehicle to cool down for two, but no greater than four hours (while hot, the ATF level is higher and removing the filler plug may result in oil being expelled from the filler hole, this will result in low ATF level).
   - If the engine is cold - the vehicle should be driven between 3.5 and 4.5 kilometres at light throttle so engine does not exceed 2500RPM.
4. Clean all dirt from around the service plug prior to removing. Allow approx. 3 minutes for transmission oil drainback. Remove the filler plug and check the O-ring for damage (replace as necessary).
5. The correct fluid level is reached when the ATF is level with the bottom of the filler hole, if the level is low install the filler pump and add oil to the correct level. When the level is correct, refit and tighten the filler plug to 30 - 35 Nm.

Filling a drained/dry transmission and convertor to determine the correct fluid level

1. Place the transmission selector in 'PARK' - Engine switched OFF.
2. Raise the vehicle on a hoist, or place on a pit (if the vehicle is placed on stands, it should be kept level).
3. Clean all dirt from around the service fill plug prior to removing the plug. Remove the oil service fill plug, clean the plug and replace the O-ring as necessary. Install the oil filler tube into the transmission filler hole.
4. Partially fill the transmission (if the vehicle is on a hoist, it should be lowered). Ensure the park-brake is applied and the selector lever is in the 'PARK' position. Start the engine and allow to idle, cycle the transmission selector through all positions while adding transmission fluid until gear application is felt.

Filler Plug Location



   - **NOTE :** Approx. 9 litres if converter is empty (dry transmission). Approx. 4 litres if converter is full (Service refill). An additional 0.5 litres when gear application is felt as above.

     CAUTION: Be careful not to spill oil during the filling procedure.
5. Switch off the engine, remove the oil filler tube and refit the filler plug (raise the vehicle on the hoist if required). The plug is to be tightened to 30-35Nm.
6. The vehicle should be driven on light throttle so theengine does not exceed 2500RPM for approx. 3.5 to 4.5 kilometres.
7. While the engine is idling and with the brake applied, cycle the transmission selector through all gear positions.
8. Stop the engine and raise the vehicle ensuring the vehicle is level.
9. Allow the vehicle to sit for 3 minutes after the engine has been turned off. The transmission sump should be warm to touch. Remove the filler plug, the correct level is reached when the transmission fluid is aligned with the bottom of the filler hole. If the level is low, add a small quantity of transmission fluid and recheck.
10. Refit the transmission filler plug and tighten to 30-35 Nm. Clean all transmission fluid from the transmission.

GENERAL PROCEDURES (Continued)

Gear shift cable adjustment

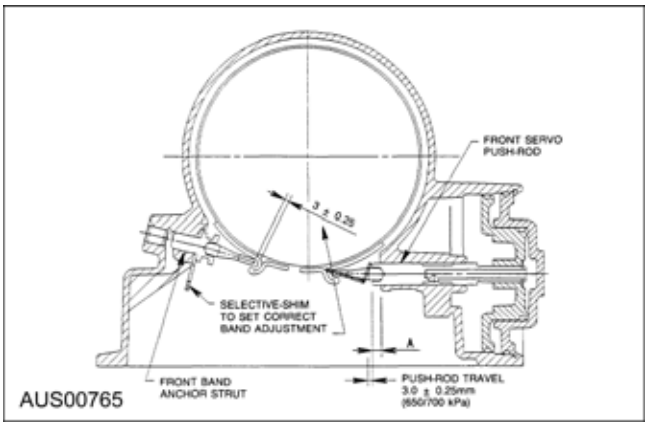
For more information, refer to Section 307-05.

Band adjustment

Front band

1. Measure projection of Front Servo Push Rod from Transmission Case.
   1. Apply air at 650/700 kPa to the Front Servo apply area (B1 outer)
   2. Measure travel of Push Rod and subtract 3mm to find Shim size.
   3. Release Air.
   4. Fit Shim as per 2 below and re-check Push Rod travel is 3 mm ± 0.25mm.
      NOTE: A minimum of one Shim is required at all times - minimum Shim size is 1 mm.
2. Fit the Shim(s) selected to the shank of the Anchor Strut as follows:
   1. Inspect Shims for damage, wear or corrosion and replace as necessary.
   2. Shims are to be installed between the Case abutment face and the Anchor Strut flange.
   3. Shim(s) are to be fitted by hand and under no circumstances to be hammered or forced.
   4. 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. The Shim thickness available are listed below:
   1. 1 mm ± 0.05, 2.0mm ± 0.07
   2. 1.2mm ± 0.05, 2.2mm ± 0.08
   3. 1.5mm ± 0.06, 2.4mm ± 0.08
   4. 1.8mm ± 0.07, 2.7mm ± 0.09

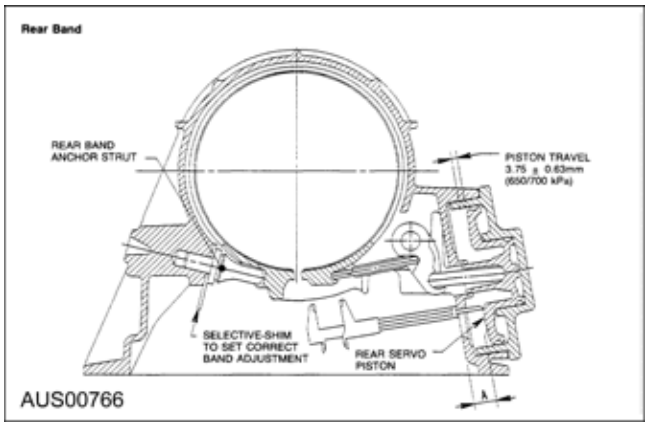
Front Band Adjustment



Rear Band

1. Measure distance 'A' from the Rear Servo Piston to the inner face of the Transmission Case using vernier calipers.
   1. Apply air at 650/700 kPa to the Rear Servo apply area (B2 outer).
   2. Measure travel of the Piston, subtract 3.75mm and divide the remainder by 2.5 to find Shim size.
   3. Release Air.
   4. Fit Shim as per 2 below and re-check Piston travel is 3.75mm ± 0.625mm.
      NOTE: A minimum of one Shim is required at all times - minimum Shim size is 1mm.
2. Fit the Shim(s) selected to the shank of the Anchor Strut as follows:
   1. Inspect Shims for damage, wear or corrosion and replace as necessary.
   2. Shims are to be installed between the Case abutment face and the Anchor Strut flange.
   3. Shim(s) are to be fitted by hand and under no circumstances to be hammered or forced.
   4. 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. The Shim thickness available are:
   1. 1 mm ± 0.05, 2.0mm ± 0.07
   2. 1.2mm ± 0.05, 2.2mm ± 0.08
   3. 1.5mm ± 0.06, 2.4mm ± 0.08
   4. 1.8mm ± 0.07, 2.7mm ± 0.09
      NOTE: All hardware must be correctly installed and torqued to specification.

Rear Band Adjustment

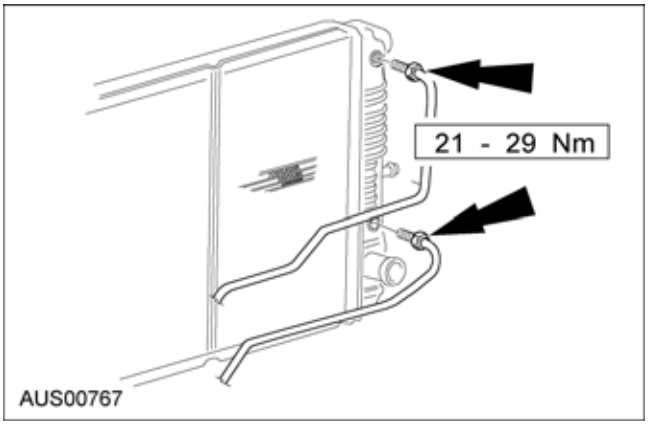


GENERAL PROCEDURES (Continued)

Oil cooler flushing

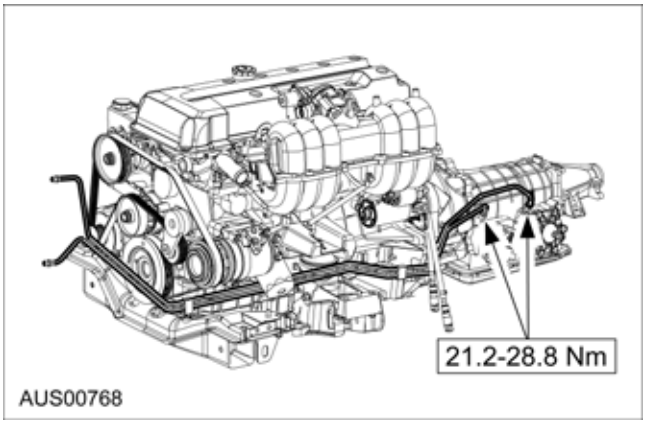
When a clutch or band failure or other internal trouble has occurred in the transmission, any metal particles or clutch plate or band material that may have been carried into the cooler should be removed from the system by flushing the cooler and lines before the transmission is put back into service. In no case should an automatic transmission having a clutch or band failure or other internal trouble resulting in fluid contamination, be put back into service without first flushing the transmission oil cooler.

1. After installing a new or rebuilt automatic transmission and converter assembly in the vehicle, do not connect the cooler lines to the transmission.



2. Place a pan under the cooler lines.
3. Using an air pressure of 100 kPa and a cleaning gun charged with clean transmission fluid, flush the cooler and lines until the fluid from the return line runs clean.
4. Connect the cooler lines to the transmission.

I6 Auto transmission cooling lines



5. Fill the transmission with the specified Automatic Transmission Fluid following the procedure detailed under FILLING A DRY TRANSMISSION AND CONVERTER in the ADJUSTMENTS SECTION.
6. Check the system for leaks.

REMOVAL AND INSTALLATION

Inhibitor Switch

Special Tool(s)	
 SST307-467	Selector shift pin Remover/Installer

Removal

1. Raise the vehicle.
2. Disconnect the wiring connector.
   NOTE: Be careful not to lose the silicone seal contained within the two-pin connector.
3. Remove the external cross-shaft pin using pin remover tool 307-467.

   CAUTION: When using a pin punch to remove/install the external cross shaft pin, be sure to support the cross shaft to ensure that it is not damaged.
4. Remove the two screws securing the switch and remove the switch.

Installation

1. Engage the switch with the transmission cross shaft and install the two screws.
2. Install a new external cross-shaft pin using tool 307-467.

   CAUTION: When using a pin punch to remove/install the external cross shaft pin, be sure to support the cross shaft to ensure that it is not damaged.
3. Install the wiring connector. Check that the 2 pin plug has the red silicon gasket in place.
4. Lower the vehicle.

Radiator Oil Cooler

When fluid leakage is found at the radiator oil cooler the radiator must be replaced. The oil cooler cannot be separated from the radiator for servicing.

Oil Cooler Tube

WARNING: Tubing and fittings must be free of any kinks or restrictions i.e. flattened areas.

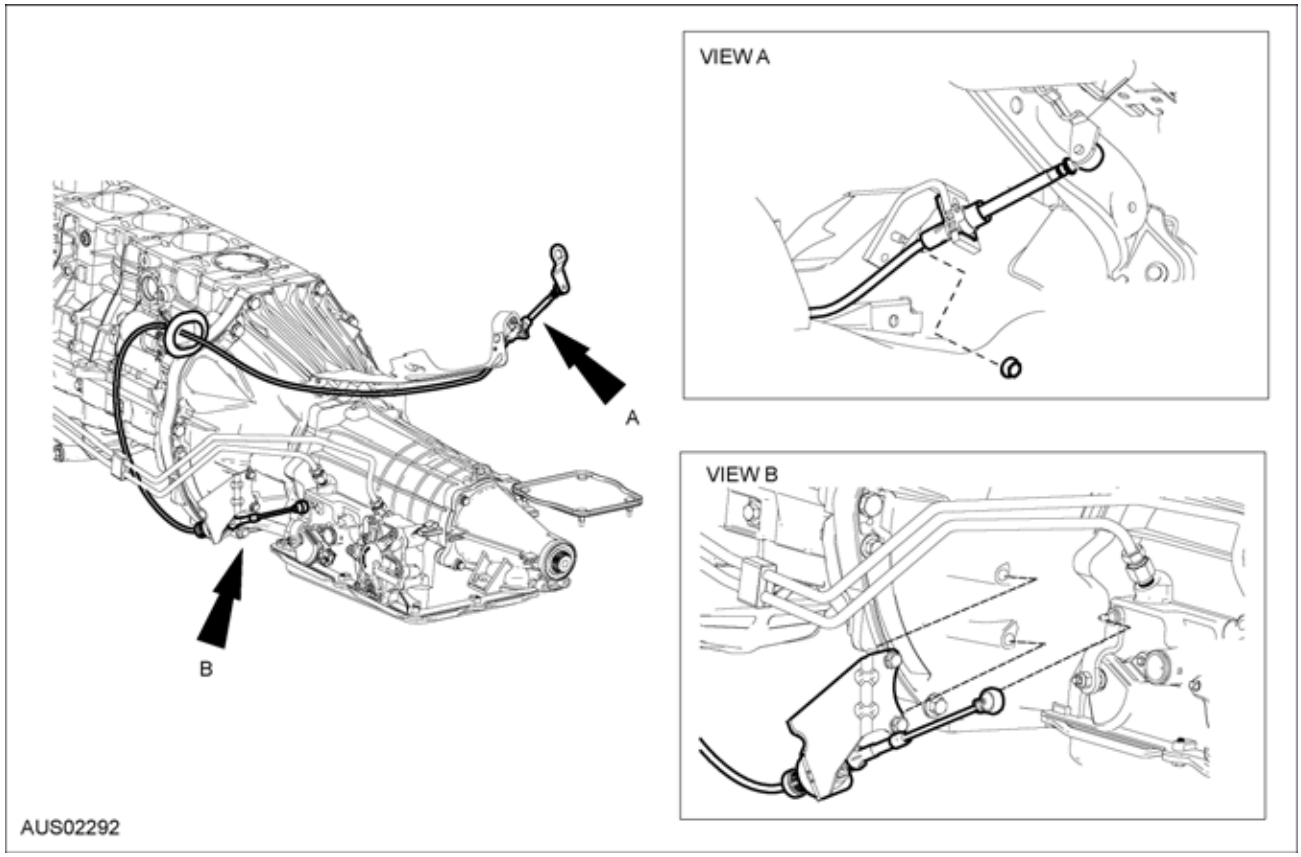
When a fluid cooler steel tube must be replaced, the replacement tube must be fabricated from the same size steel tubing as the original line. Using the old tube as a guide, bend the new tube as required. Add the necessary fittings and install the tube. After the fittings have been tightened, add fluid as needed and check for leaks. (Replacement tubing must be new and clean, oxidised tubing is not acceptable).

REMOVAL AND INSTALLATION (Continued)

Gear Shift — Column Shift

1. For steering column components, refer to Section 211-04.

I6 Steering column components



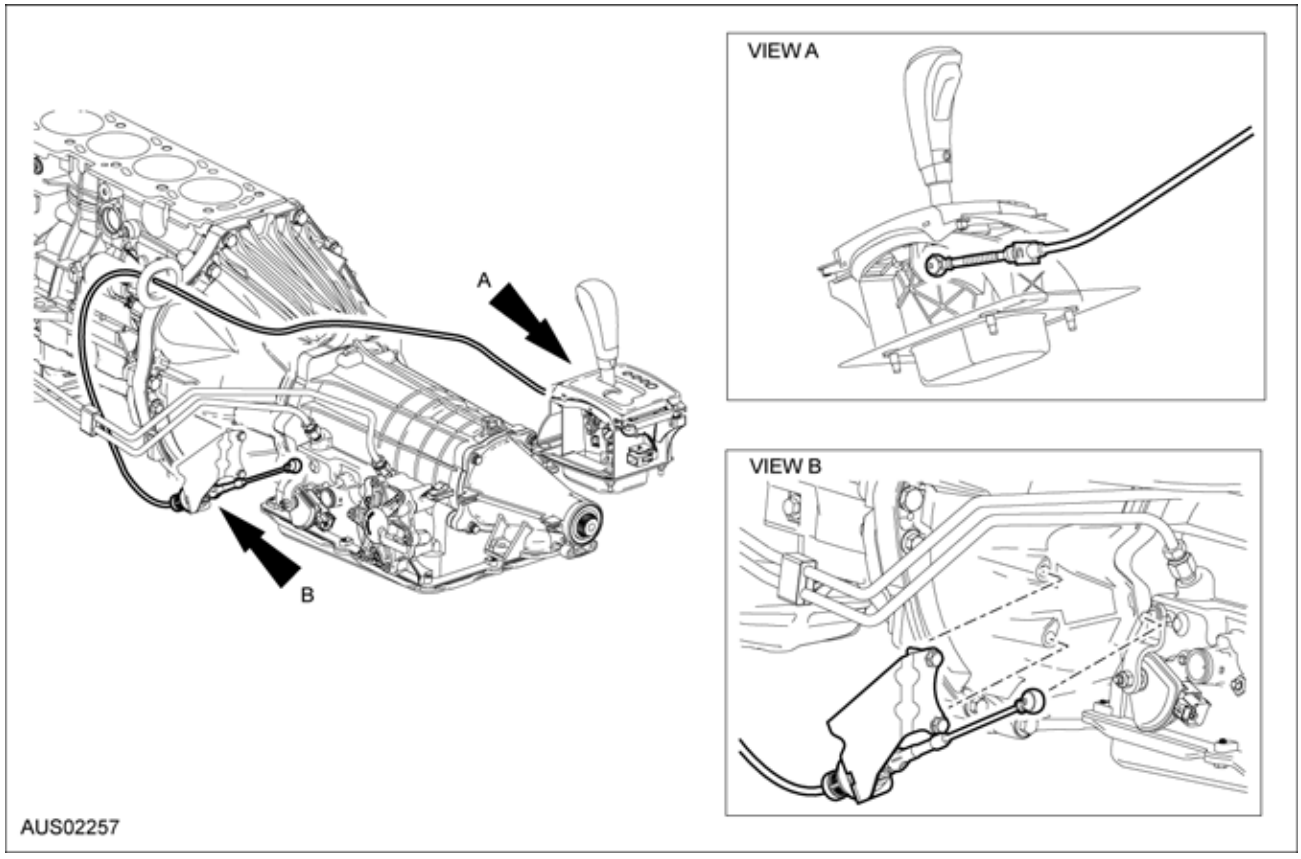
REMOVAL AND INSTALLATION (Continued)

Gear Shift — Floor Mounted

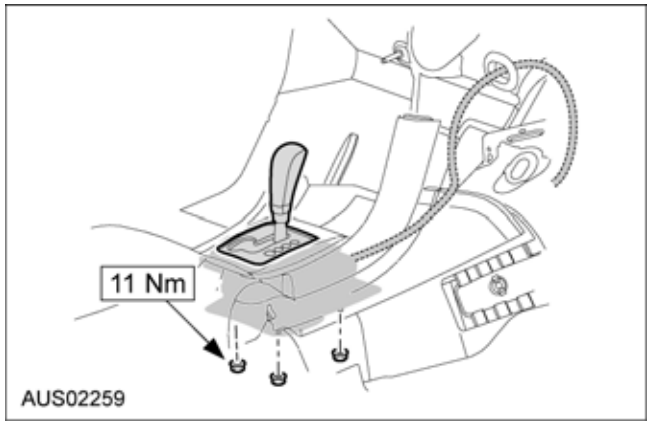
Removal

1. Raise the vehicle and disconnect the transmission shift cable from the lower selector lever.

Floor mount shift components



2. Disconnect the four nuts that attach the housing to the floorpan.



3. Lower the vehicle.
4. Remove the centre console (Refer to section 307-05).
5. Detach the back light bulb/wiring.
6. Remove the whole floor shift housing by lifting vertically

Installation

1. To install the floor shift housing to the floorpan reverse the above instructions in order 6, 5, 4.
2. Place the selector lever in the ‘P’ position.
3. Raise the vehicle.
4. Reconnect the four nuts that attach the housing to the floorpan.
5. Install the shift cable back onto the lower selector lever.
6. Tighten the lock nut to the required torque to 28 Nm.
7. Lower the vehicle and check transmission operation in each selector lever detent position.
8. Check that the mode light functions correctly. For further information, refer to Section 307-05.

REMOVAL AND INSTALLATION (Continued)

Cross Shaft Seals

Special Tool(s)	
 SST307-467	Selector shift pin remover and installer
 SST307-365	Manual selector shaft seal remover
 SST307-366	Manual selector shaft seal installer

Removal

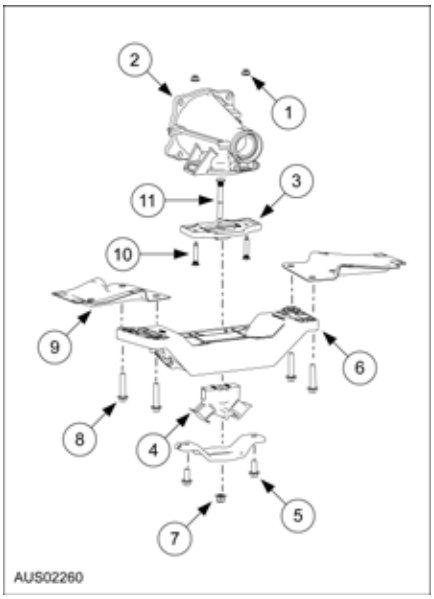
1. Raise the vehicle.
2. Detach the transmission lever and/or the inhibitor switch from the cross shaft. For 93LE only the external cross shaft pin must be removed using tool 307-467 prior to removing the inhibitor switch.
3. Carefully remove the seal/s from the case using special tool 307-365.

Installation

1. Cover the shaft with plastic tape to prevent damage to the seal and using special tool 307-366 drive the new seal into the case until it is flush with the boss. Remove the tape.
2. Install the transmission lever and/or inhibitor switch. For 93LE only install the external cross shaft pin using tool 307-467 prior to installing the transmission lever.
3. Lower the vehicle.

Mass Damper / Extension Housing

93 LE (I6)



Item	Description
1	Nut M8
2	I6 AutomaticTransmission Extension Housing
3	Extension Housing adapter
4	Support Bracket
5	Bolt M10x25
6	Transmission Support
7	Lock Nut M10
8	Bolt M10x50
9	Cross Member
10	Bolt M8X46
11	Bolt M10x89

Removal

1. Raise the vehicle.
2. Support the transmission with a jack.
3. Remove the transmission cross member.
4. Remove the insulator from the extension housing.
5. Remove the bolt/s securing the mass damper to the rear of the extension housing one bolt securing the mass damper bracket on the side of the extension housing. Remove the damper.
6. If the extension housing is to be removed mark the driveshaft and pinion flange alignment and remove the driveshaft.

   NOTE: When disconnecting or removing the driveshaft it is essential that the position of the slip yoke relative to the output shaft and position of the companion flange hardware be identified as illustrated. Failure to return all parts to their original position may induce driveline vibration.

REMOVAL AND INSTALLATION (Continued)

7. Separate the park brake cable at the cable joiner.
8. Remove the speedometer transducer (non-ABS vehicles only).
9. Loosen the extension housing bolts to drain the fluid.
10. Remove the extension housing bolts and withdraw the extension housing. Discard the gasket.

Installation

1. Install a new gasket on the extension housing.
2. Install the extension housing.
3. Install the speedometer transducer (non-ABS vehicles only).
4. Position the mass damper and insulator assembly.
5. Install the insulator bolts then the mass damper bolts.
6. Install the cross member.
7. Remove the transmission jack.
8. Install the drive shaft aligning the mating marks.
9. Connect the park brake cable joiner.
10. Lower the vehicle.
11. Check the transmission fluid level.
    NOTE: All hardware must be correctly installed and torqued to specification.

Speedometer drive gear (Non-ABS vehicles only)

Removal

1. Remove the extension housing.
2. The speedometer drive gear is retained to the output shaft by a spring clip. Depress the tang of the clip and slide the gear from the shaft.

Installation

1. Position the retaining clip on the shaft with the flanged end towards the case.
2. Slide the gear over the clip. Ensure that the retaining leg of the clip prevents the gear from moving rearwards.
3. Install the extension housing with a new gasket.
4. Check the fluid level.

Extension housing seal

Removal

1. Raise the vehicle.
    1. Mark the driveshaft and pinion flange alignment and remove the drive shaft.
    2. Prise the seal from the housing.

Installation

1. Using the seal replacing tool, drive the seal until the seal seats.
2. Lubricate the seal and the driveshaft yoke with MIC75B grease and install the driveshaft aligning the marks on the shaft and pinion flange.
3. Lower the vehicle.

Extension housing bush

Removal

1. Remove the extension housing.
2. Prise the seal from the housing.
3. Using the bush removing tool press the bush from the housing.

Installation

1. Place a new gasket on the extension housing and install the housing.
2. Align the lubrication hole in the bush with the rib along the upper inner surface of the housing.
3. Using the bush replacing tool, drive the bush into the housing until it is flush with the inner edge of the seal recess. Lubricate the bush.
4. Drive the seal into the housing with the seal replacing tool.
5. Lubricate the seal and the driveshaft yoke with MIC75B grease and install the driveshaft.

Oil Pan and Filter

Removal

1. Raise the vehicle.
2. Place a drain pan under the transmission. Remove the screws at the rear of the oil pan. Loosen the remaining screws and allow the fluid to drain.

   CAUTION: The fluid will be very hot if the transmission has just been operated.
3. Remove the remaining screws and lower the pan carefully, it will still contain a quantity of fluid. Discard this fluid and the oil pan seal.
4. Unclip the oil filter assembly. Remove the filter.

Installation

1. Thoroughly clean the oil pan, filter assembly and the seal face of the transmission.
2. Check the condition of the ‘O’ ring seal on the oil filter spigot and replace if necessary.
3. Position the filter assembly on the valve body and install the retaining clip.
4. Check the location of the oil pan magnet.
5. Place a new seal on the oil pan and install the pan. Torque to 4.5 Nm.
6. Fill the transmission with approved fluid.
7. Lower the vehicle.
8. Check for leaks.

REMOVAL AND INSTALLATION (Continued)

Valve Body Assembly

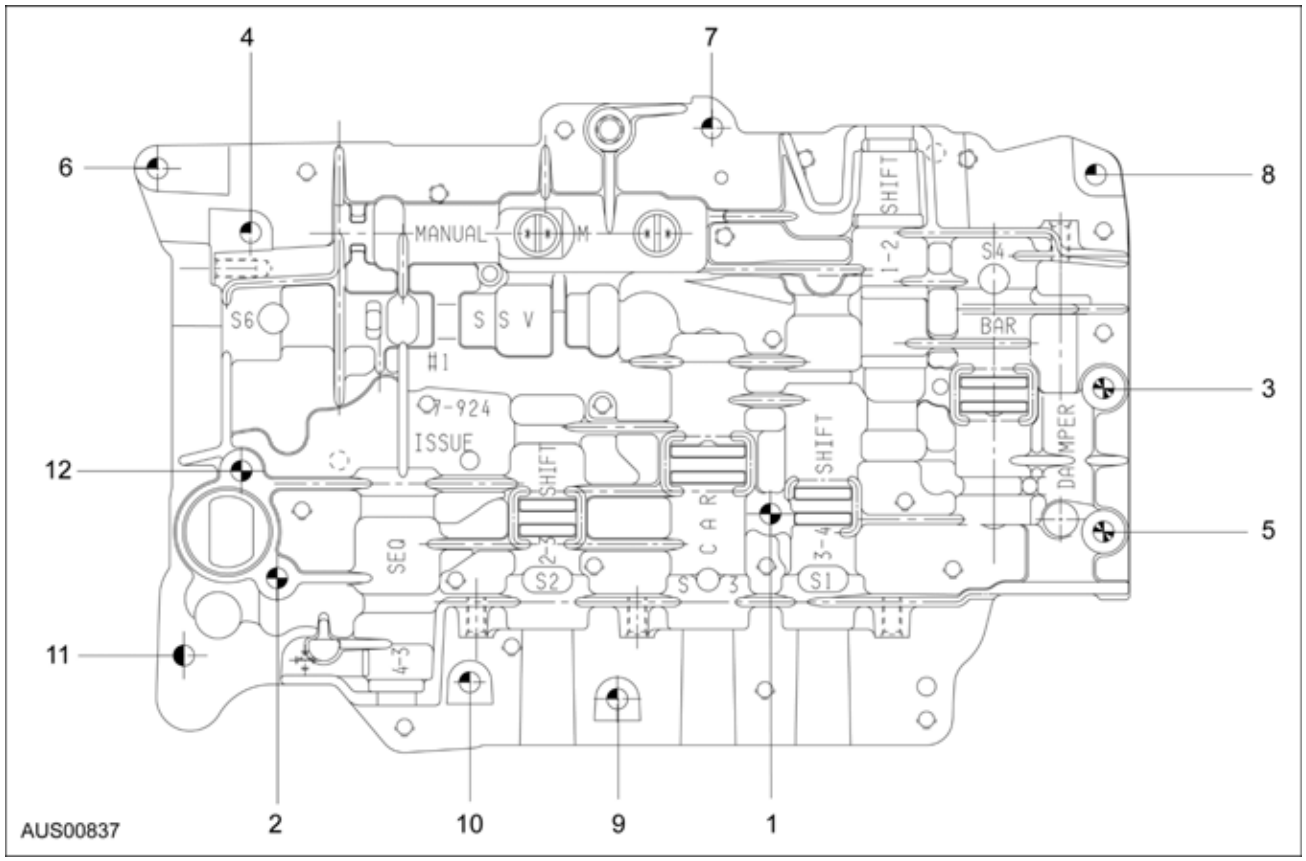
Removal

1. Raise the vehicle and remove the oil pan.
2. Remove the filter assembly.
3. Disconnect the solenoid wiring at the solenoids.
4. Remove the manual valve lever to manual valve link.
5. Remove the screws securing the valve body assembly to the case and lower the valve body.

Installation

1. Ensure that the locating pin is correctly positioned. Offer the valve body assembly to the case. Ensure the z-link is connected to the manual valve and detent lever. Fit the long end of the link to the manual valve first.
2. Install the screws. Torque the screws in the specified sequence.

Tightening Sequence Valve Body to Case



NOTE: All hardware must be correctly installed and torqued to specification.

3. Check the alignment of the detent roller in the manual lever detent quadrant.
4. Connect the solenoid wiring.
5. Lubricate the ‘O’ ring seal on the filter spigot and carefully install the filter assembly on the valve body. The spigot must not lean on one side while being fitted. Install the retaining clip.
6. Clean the oil pan and install a new seal on the pan.
7. Install the oil pan. Torque to 4.5 Nm.

REMOVAL AND INSTALLATION (Continued)

8. Fill the transmission with approved transmission fluid.
9. Lower the vehicle.
10. Check for leaks.

Front Servo

Removal

1. Raise the vehicle.
2. Remove oil pan, filter and valve body as previously described.
3. Remove the servo cover retaining circlip.
4. Remove the servo piston by pushing carefully on front servo pushrod.

Installation

1. Check the condition of the piston, push rod and cover 'O' ring seals and replace if necessary.
2. Lubricate the 'O' rings with automatic transmission fluid and install the servo piston in the case. Ensure that Band struts are correctly seated and located in push rod and anchor strut and that shim is correctly retained.
3. Install the retaining circlip.
4. Adjust the band with correct shims.
5. Install valve body, filter and oil pan.
6. Lower the vehicle.
7. Check the fluid level, top up as necessary.
8. Check for leaks.

Rear Servo

Removal

1. Raise the vehicle. Remove the oil pan, filter and valve body as previously described.
2. Remove the cover bolts and remove the assembly with the spring and rod.
3. Remove the gasket.

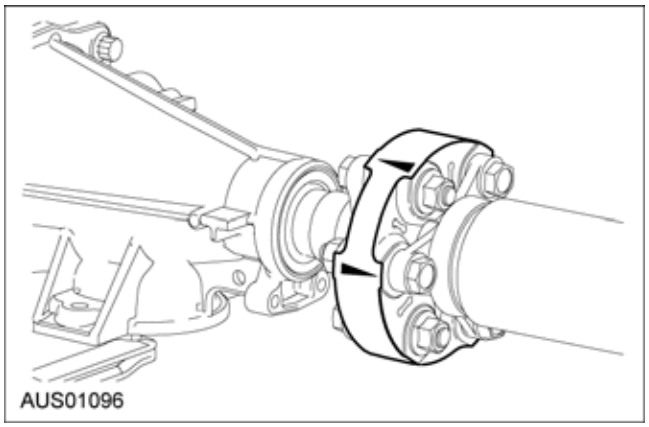
Installation

1. Lubricate the piston 'O' rings with A.T.F. and fit to the piston. Assemble the piston to the cover. Position the spring over the piston spigot and the servo rod in the piston spigot.
2. Assemble gasket to cover and assemble in case.
   NOTE: Do not use petroleum jelly on gasket.
3. Apply 'Loctite 567' sealant to the bolt threads. Install the bolts and tighten.
4. Check that the band struts are correctly located. Check band adjustment.
5. Install valve body, filter and oil pan as previously described.
6. Lower the vehicle.
7. Check the fluid level and top up as necessary.
8. Run the engine and check for leaks at the cover in Reverse and Manual 1.

Transmission

Removal

1. Disconnect the battery.
2. Raise the vehicle. If work is to be carried out on the transmission or torque converter when removed from the vehicle, drain the transmission fluid.
3. Mark the driveshaft and pinion flange alignment and remove the driveshaft. Install the extension housing seal tool in the extension housing.
   NOTE: When disconnecting or removing the driveshaft it is essential that the position of the slip yoke relative to the output shaft and position of the companion flange hardware be identified as illustrated. Failure to return all parts to their original position may induce driveline vibration. For more information, refer to Section 205-01
4. Remove the catalytic converter assembly by disconnecting it from the exhaust manifold, muffler inlet pipe and bracket.
5. Remove the cover plate from the front of the converter housing and remove the converter to flywheel bolts.

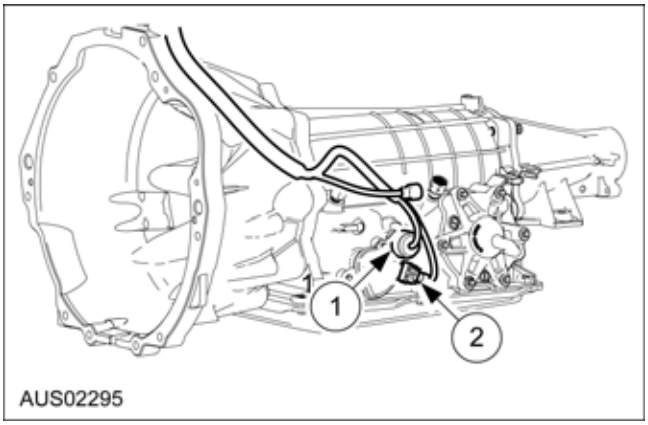


6. Disconnect the inhibitor switch, speedometer transducer (where fitted) and solenoid wiring connectors from the side of the transmission.

REMOVAL AND INSTALLATION (Continued)

7.

Transmission - 93LE

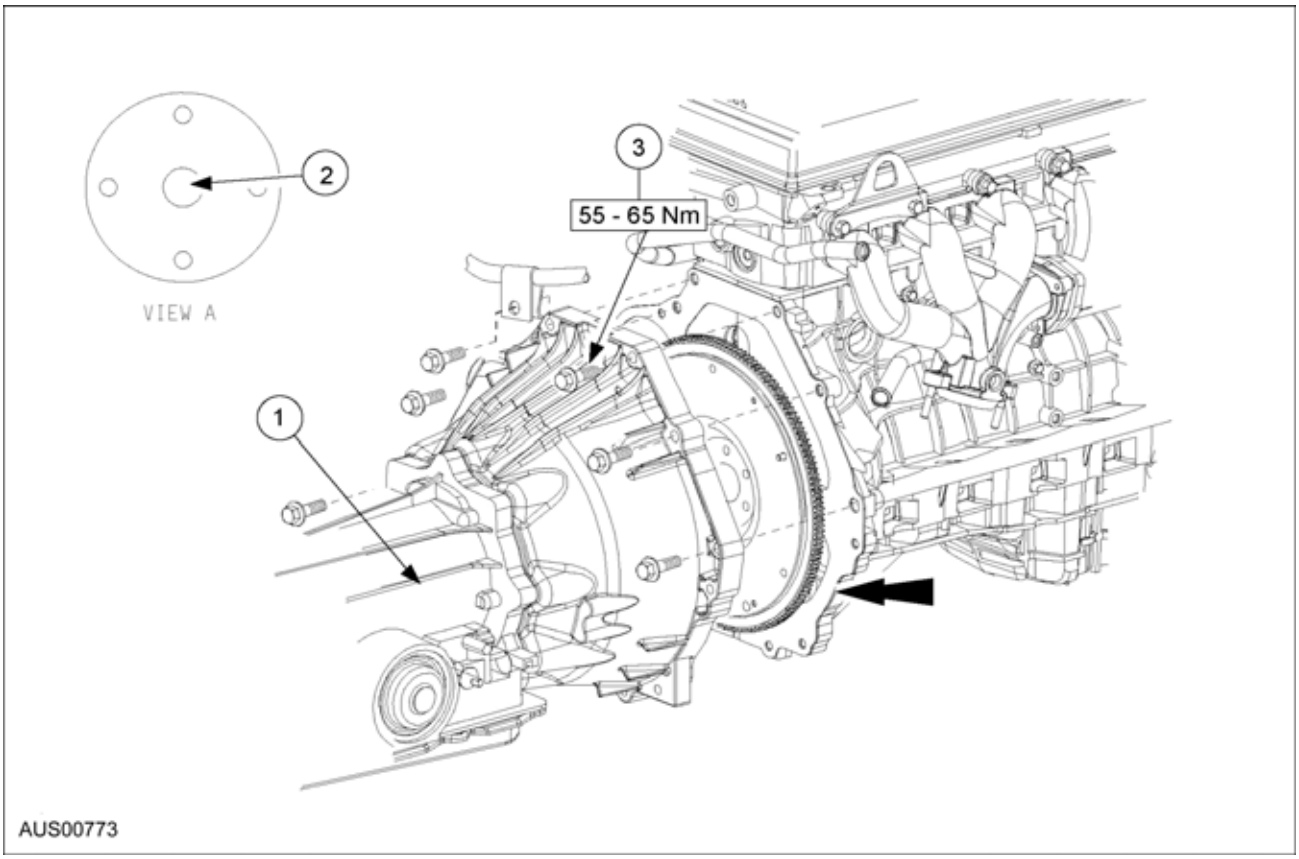


Item	Description
1	Transmission wiring loom connector
2	Inhibitor switch connector

8. Remove the starter motor mounting bolts and position the starter motor to one side.
9. Disconnect the fluid cooler lines. Plug the lines.
10. Support the transmission with a transmission jack. Install the safety chain.
11. Remove the transmission crossmember.
12. Remove the mass damper and insulator from the extension housing.
13. Lower the transmission jack until it is just supporting the transmission.
14. Remove the transmission control lever from the transmission cross shaft.
15. Remove the converter housing to cylinder block bolts.
16. Hold the converter firmly against the transmission, move the transmission rearward and lower. Secure the converter to the transmission and remove the assembly from under the vehicle. Installation

REMOVAL AND INSTALLATION (Continued)

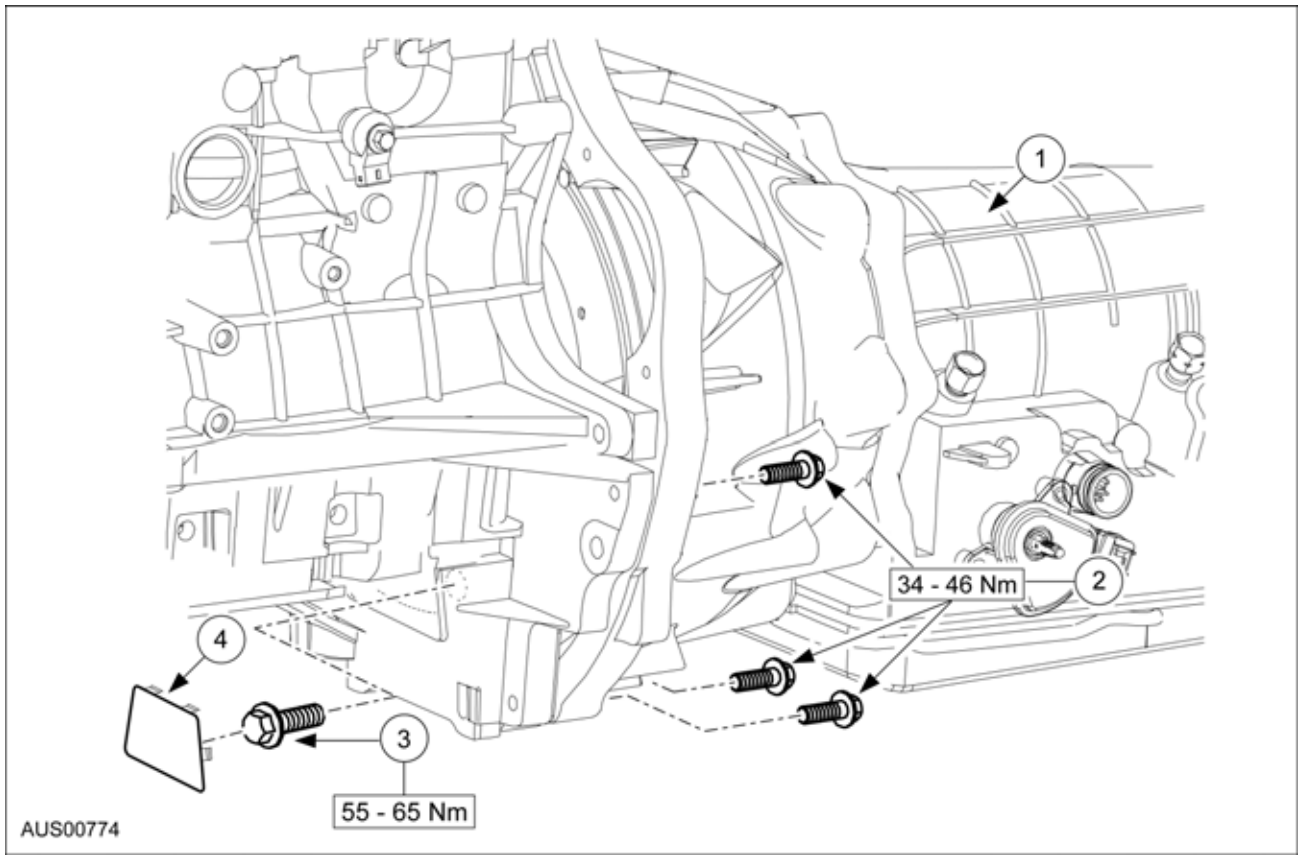
Installing Transmission - 93LE



Item	Description
1	Transmission case
2	Lubricant ESA-MK-75B
3	Bolt M12x55

REMOVAL AND INSTALLATION (Continued)

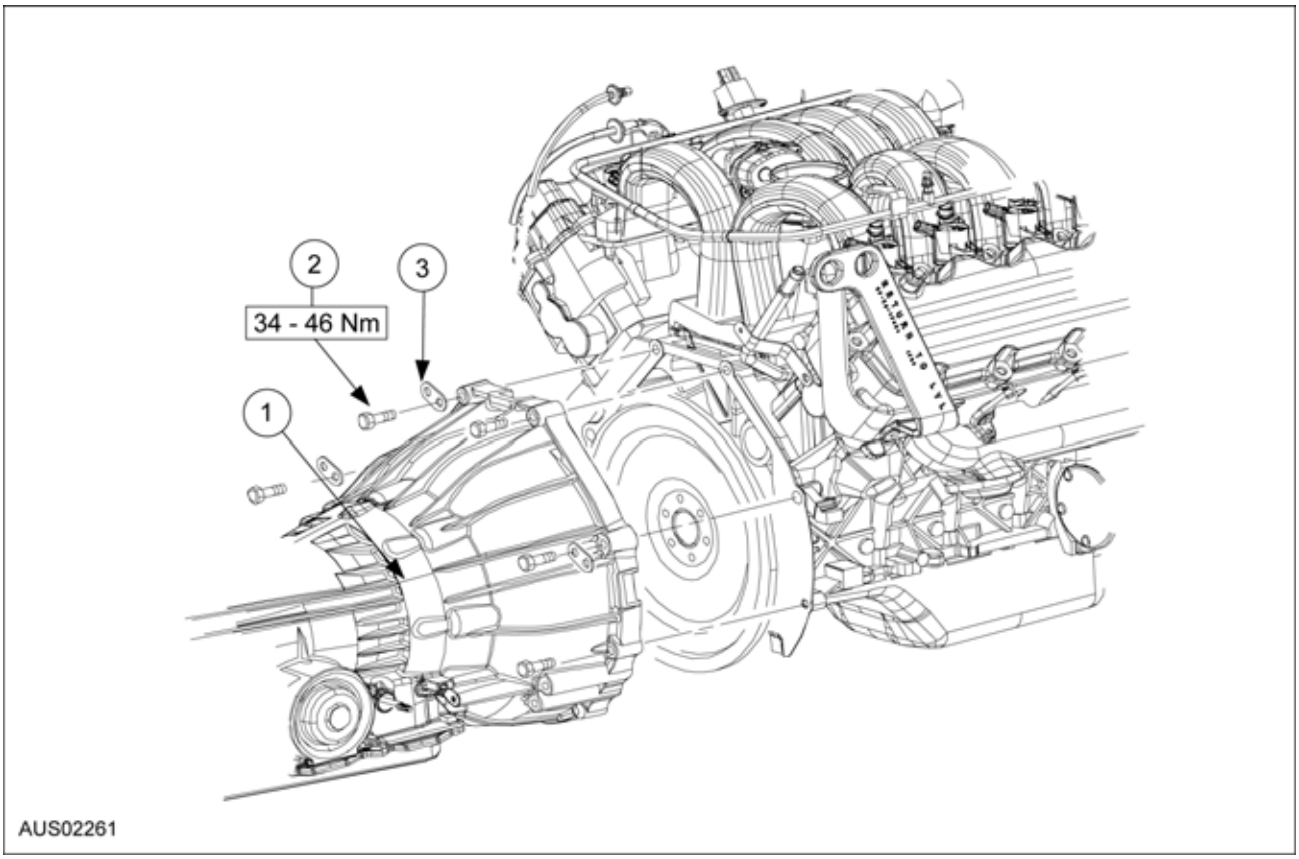
Installing Transmission - 93LE



Item	Description
1	Transmission case
2	Bolt M10x50
3	Bolt M10x18
4	Cover flywheel

REMOVAL AND INSTALLATION (Continued)

Installing Transmission - 97LE



Item	Description
1	Transmission case
2	Bolt M12x55
3	Wiring retainer

Installation

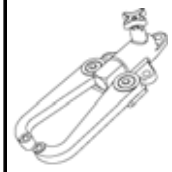
1. With the converter properly installed on the transmission, place it on the jack and install the safety chain.
2. Raise the transmission into position.
3. Install the transmission to engine attaching bolts.
4. Install the converter to flywheel bolts. Install the converter housing cover and engine to body earth cable.
5. Install the starter motor.
6. Loosely connect the transmission cooler pipes.
7. Install the mass damper and rear mount on the extension housing.
8. Detach the safety chain, raise the transmission and install the transmission cross member.
9. Remove the jack.
10. Tighten the cooler line unions.
11. Install the control lever on the transmission cross shaft.
12. Check the gear shift cable adjustment (refer section 307-05).
13. Connect the inhibitor switch, speedometer transducer (if fitted) and solenoid wiring. Ensure that the inhibitor switch 2 pin plug and breather tube are sealed. Attach the inhibitor switch shield.
14. Install the drive shaft. Match the alignment marks and secure the flange bolts.
    NOTE: When disconnecting or removing the driveshaft it is essential that the position of the slip yoke relative to the output shaft and position of the companion flange hardware be identified as illustrated. Failure to return all parts to their original position may induce driveline vibration.
15. Install the catalytic converter assembly.
16. Connect the park brake cable.
17. Lower the vehicle.
18. Connect the battery.
19. Check the fluid level and top up with approved fluid as required (see Transmission Fluid Level Check).
20. Check the operation of the transmission controls.
21. Carry out the 'Throttle Learn' procedure.

REMOVAL AND INSTALLATION (Continued)

22. If a new transmission has been installed the PCM must be configured using an WDS tester and the Service Card:
    - Enter SERVICE BAY FUNCTIONS
    - Select PCM
    - Select TRANSMISSION CONFIGURE (1)
      This procedure ensures that the line pressure is regulated to correspond with a green/new transmission.

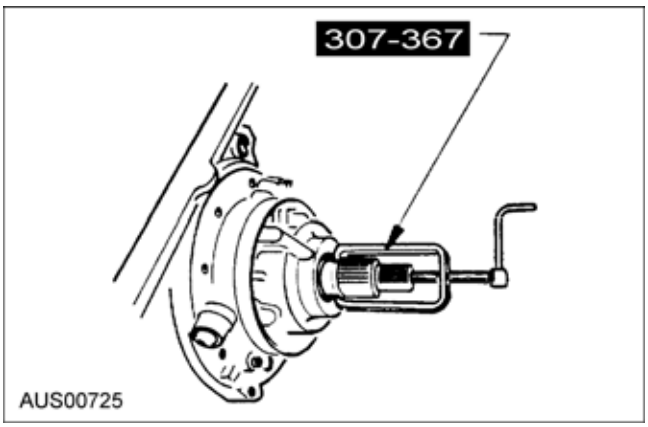
DISASSEMBLY

Transmission

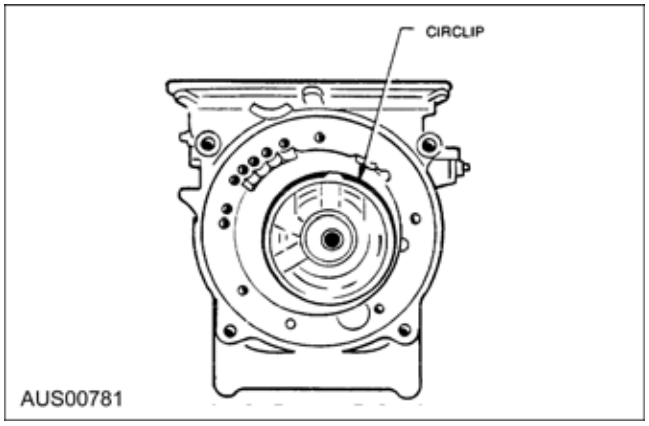
Special Tool(s)	
 SST307-003	Transmission bench cradle
 SST307-367	Pump housing aligner

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 is given under the appropriate subject.

1. Remove the converter and the converter housing.
2. Mount the transmission on the bench cradle No. 307-003.
3. Remove the oil pan and the oil pan seal.
4. Detach each end of the filter retaining clip from the valve body and remove the filter.
5. Detach the wires from each solenoid and lay the wiring to one side.
6. Remove the valve body securing screws and remove the valve body from the case.
7. Remove the front servo cover circlip. Remove the cover and piston.
   NOTE: Plastic Servo block is retained by piston return spring only.
8. Remove the extension housing and the speedometer drive gear (if fitted).
9. Remove the pump bolts using a multihex 8mm spanner.
10. Remove the 'O' ring from the input shaft.
11. Using puller No. 307-003, remove the pump.



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



17. Remove the centre support, 1-2 one way clutch, planetary gearset and output shaft as an assembly.
    CAUTION: On no account hammer the output shaft to remove the centre support as this will cause permanent damage to the thrust bearing surfaces.
18. Remove the parking rod cam plate. (T40 Torx bit).
19. Remove the rear band struts and remove the band.

Transmission Case

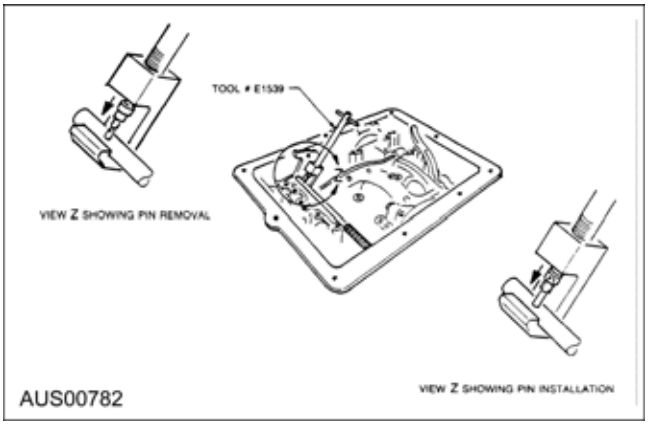
Special Tool(s)	
 SST307-365	Manual selector shaft seal remover
 SST307-467	Cross pin remover installer

DISASSEMBLY (Continued)

Disassembly

1. Remove the external cross shaft pin using tool 307-467 (93LE only). Remove the inhibitor switch from the case. Remove the cross shaft seals with special tool 307-365.
2. Remove the circlips from the cross-shaft. Pull the shaft to release the drivepin from the selector quadrant.
3. Using tool 307-467 press the cross shaft pin from the cross-shaft and withdraw the shaft from the case. Retrieve the spring and pin.

Removing and Installing the Cross Shaft Pin



4. Remove the manual valve lever and the park rod.
5. Depress the tangs on the wiring loom plug and detach it from the connector in the case. Detach the No. 7 solenoid wire from the front of the case.
6. Remove the wiring connector retainer and withdraw the connector from the case. Remove the loom assembly.
7. Remove the parking pawl pivot and the pawl and spring from the case.
8. Remove the rear servo lever and shaft.
9. Remove the rear servo cover and piston assembly.
10. Remove the front servo release exhaust valve.
11. Remove both band adjustment shims.
12. Inspect the output shaft bushing in the case and replace if necessary.
13. Inspect cooler line fittings and replace as necessary.
14. Inspect the case for damage.
15. Do not remove the park rod lever unless absolutely necessary.

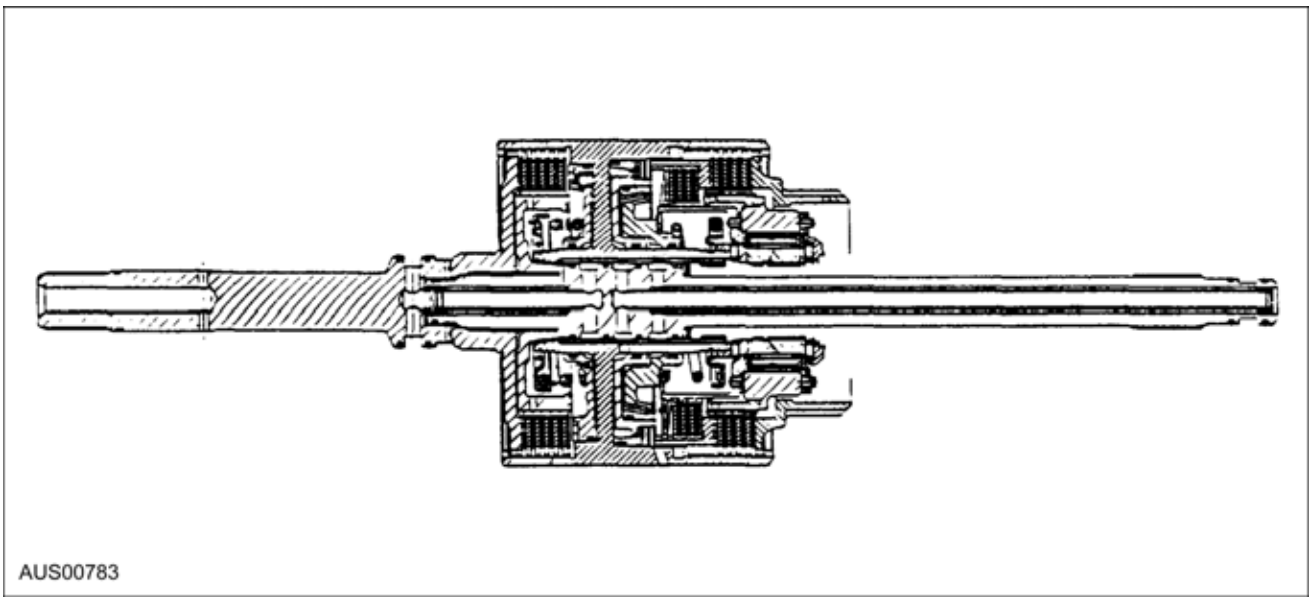
NOTE: To Remove: Tap the outer end of the shaft until it moves to break the grip in the case. Using a wide shallow tapered drift as a wedge, drive the pin out from the inside of the case and remove the lever and spring.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Forward Clutch Cylinder

Special Tool(s)	
 SST307-369	Clutch compression kit.

Disassembly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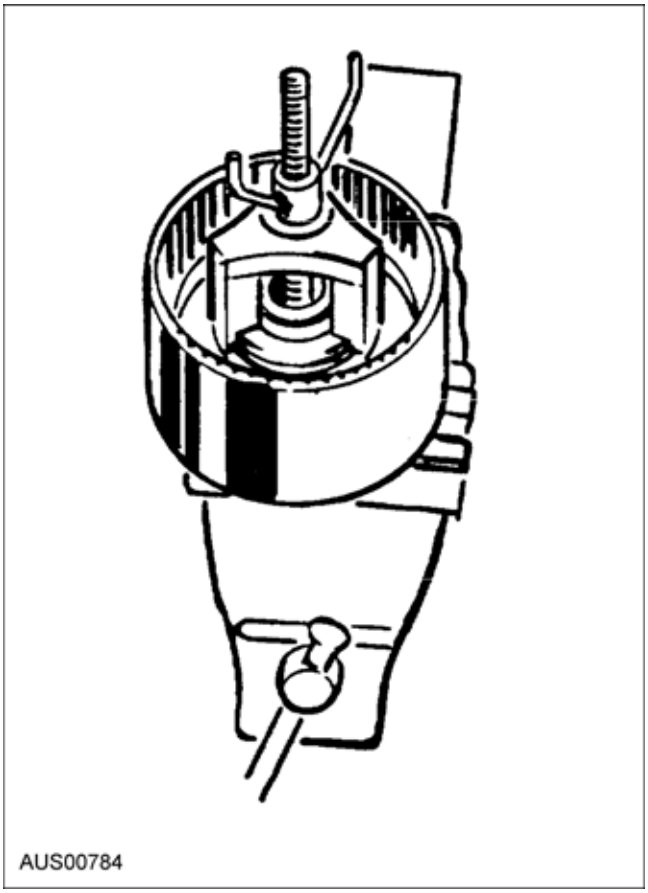
1. Place the assembly in a horizontal position.
2. Remove the thrust bearing and adjustment shims from the input shaft.
3. Remove the circlip from the front of the clutch cylinder and remove the input shaft.
4. Remove the overdrive shaft and the C1 clutch hub assembly from the clutch cylinder.
5. Remove the C1 clutch plates from the cylinder.
6. Remove the circlip retaining the C3 clutch hub in the rear of the clutch cylinder and remove the hub.
7. Remove the C2/C4 clutch hub assembly and remove the thrust bearing from the C4 hub.
8. Remove the C2 clutch plates.
9. Invert the clutch cylinder and remove the C4 clutch sleeve, clutch plates and the two wave washers. The 3-4 one way clutch is located between the C2 and C4 clutch hubs and the hubs may be separated by rotating one hub clockwise and withdrawing it from the other.
10. Remove the thrust block from the C4 clutch cylinder hub.
11. Mount the clutch cylinder on tool 307-369 with 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.

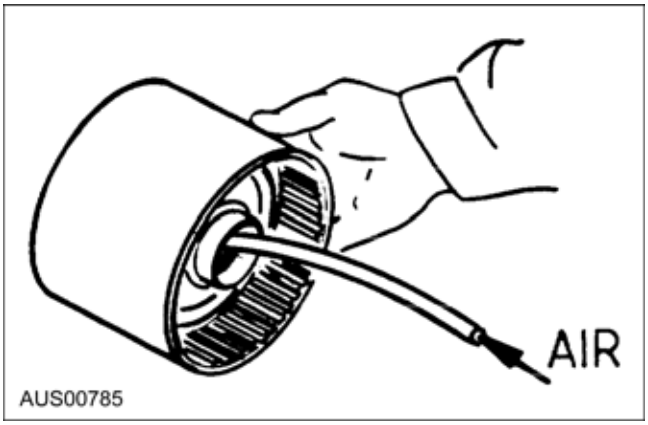
⚠ CAUTION: When removing the spring compressor, make sure that the spring keeper has not been trapped in the circlip groove and that all spring pressure has been released before removing the tool.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

Compressing the Clutch Return 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.

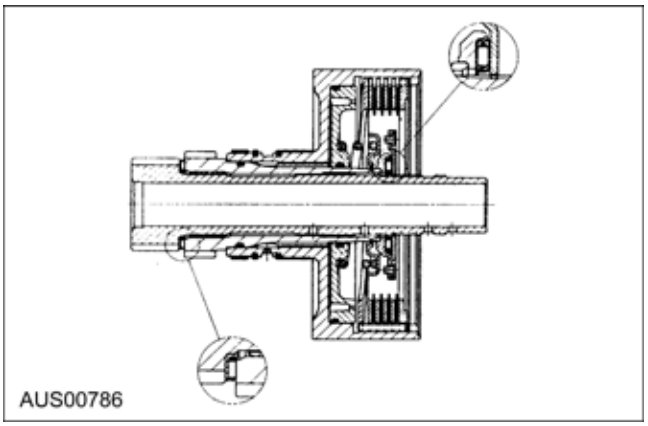


C3 Clutch Cylinder

Special Tool(s)	
 SST307-369	Clutch compression kit.

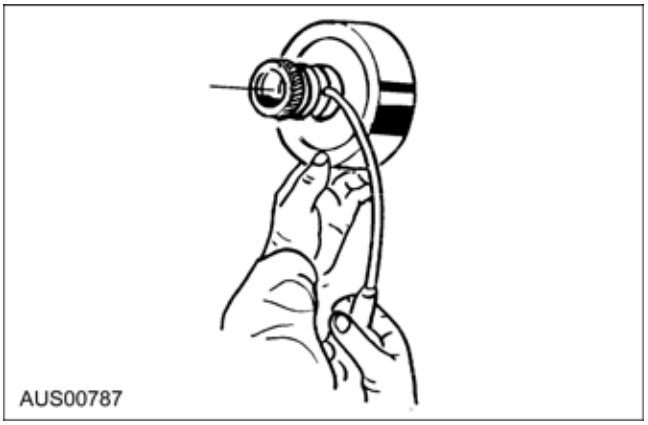
Disassembly

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 307-369 and compress the piston return spring. Remove the circlip and release the spring.

⚠ CAUTION: Make sure that the spring keeper has not been caught in the circlip groove. Ensure all spring pressure has been released before removing tool.



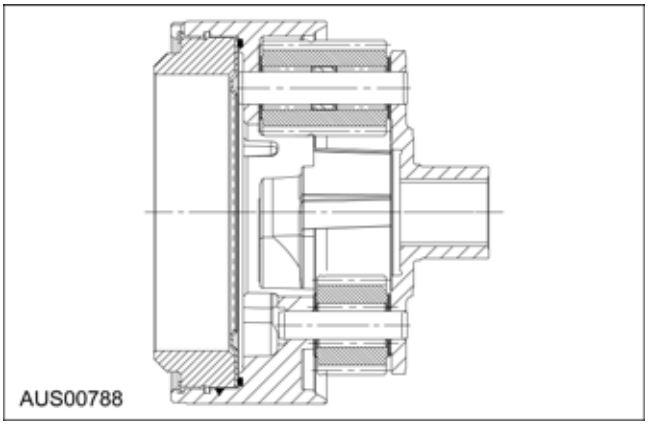
4. Remove the tool, circlip, keeper and spring. Remove the reverse sun gear ‘O’ ring.
5. Remove the clutch plate retaining circlip and remove the clutch plates.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

6. 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.
7. Remove the reverse sun gear from the cylinder.

Planet Carrier & Centre Support

Disassembly



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 and o-ring from the planet carrier.

Pump

Disassembly

NOTE: The following valves are housed in the pump cover:

- No. 7 solenoid.
- Converter clutch control valve.
- Converter clutch regulator valve.
- Primary regulator valve.

1. Remove the wiring loom retainer plate and remove the No. 7 solenoid with a T30 Torx bit.
2. Remove the 5 washer head bolts from the cover plate using a multipoint 8 mm socket. Separate the pump assembly from the pump cover assembly.
   NOTE: The pump assembly should be supported as the bolts are removed. If the pump assembly does not come away freely from the pump cover do not strike the converter support tube to free the pump assembly.
3. Remove the 4 Torx head screws from the cover plate (Torx bit No. 30).
4. Lift the cover plate from the cover. Remove the ball check valves and spring from the pump cover.
5. The retaining pins for the 3 valves are loose in the cover, remove the pins. This may be done by pushing the sealing plugs in slightly and allowing the pins to fall out or by withdrawing the pins with a magnet. Remove the 3 sealing plugs.
6. Remove the 3 valves.
7. Remove the ‘O’ ring seal from the periphery of the pump cover.
8. Remove the pump gears from the pump body.
9. Remove the ‘O’ ring seal from the pump body.
10. Remove the lip seal from the front of the pump body.
    NOTE: Do not remove the seal unless replacement is required.

Valve Body

Disassembly

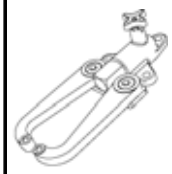
1. Remove the detent spring and retainer plate using a T40 Torx bit.
2. Slide the manual valve out of the lower valve body.
3. Take note of the angular relationship of the solenoid terminals to the valve body. Remove the solenoid and valve assembly as follows:
   - No. 1 solenoid.
   - No. 2 solenoid.
   - No. 3 solenoid.
   - No. 4 solenoid.
   - No. 5 solenoid.
   - No. 6 solenoid.
4. Place the valve body assembly on the bench with the upper body uppermost. 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. Turn the upper body over the place on the bench with the separator plate uppermost.
5. Lift the separator plate and gaskets from the upper valve body, remove the 3 nylon (white) and 3 PIA (olive) check balls exposed in the valve body. Remove the keeper plate from the reverse lockout valve, spring and plug will drop out when the upper valve body is tipped on its end.
6. Remove the 1 filter and the one large nylon check ball from the lower valve body.
7. Remove the keeper plates and pins from the 1-2, 2-3, 3- 4, bar and car valves. The plates are loose in the valve body and will drop out when the valve body is turned over. Pins can be removed with a magnet.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

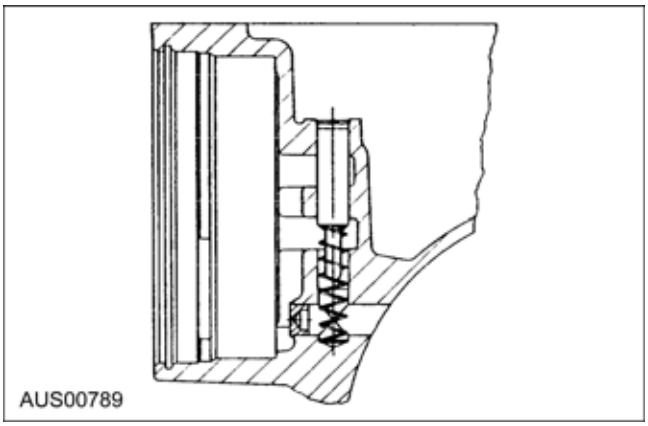
8. Remove the 1-2, 2-3 and 3-4 shift valves.
9. Depress the 4-3 sequence valve plug and remove the keeper plate. Remove the plug, valve and spring.
10. Depress the damper valve. Remove the keeper pin and remove the valve and spring.
11. Drive out the roll pin and remove the spring and ball check valve adjacent to the BAR valve.
    NOTE: All hardware must be correctly installed and torqued to specification.

ASSEMBLY

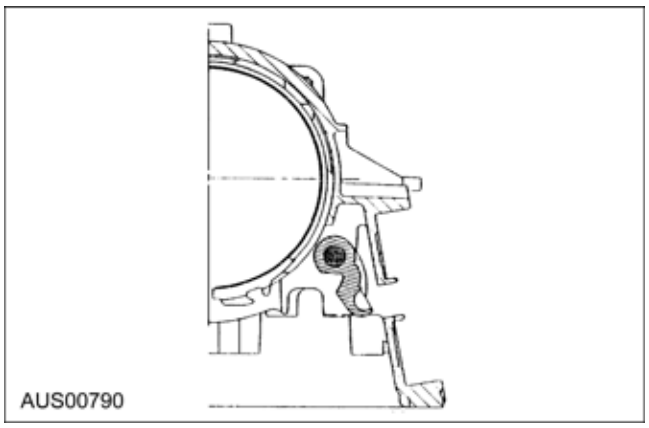
Transmission

Special Tool(s)	
 SST307-366	Manual selector shaft shift seal remover
 SST307-467	Selector shaft pin remover and installer
 SST307-003	Transmission bench cradle

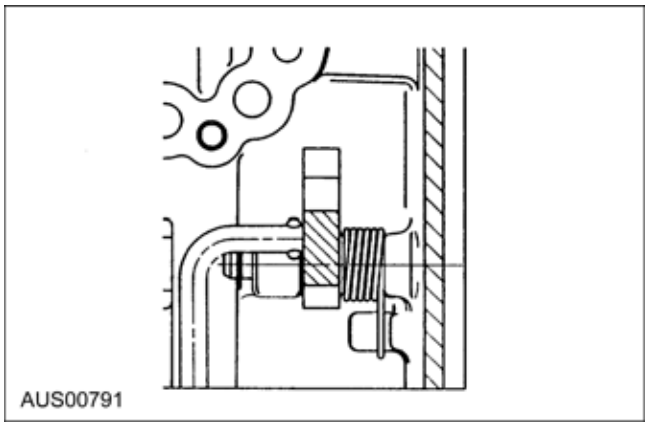
1. Turn the transmission case upside down on the bench and mount it to the transmission cradle 307-003.
2. Install all fittings, plugs and the breather. Apply sealant where applicable. Ensure that the breather is clear. Check that the tube fitting in the rear of the case is filled and clear of obstruction.
3. Assemble the BIR valve and spring and secure with the circlip. Ensure the circlip is completely seated in its groove.



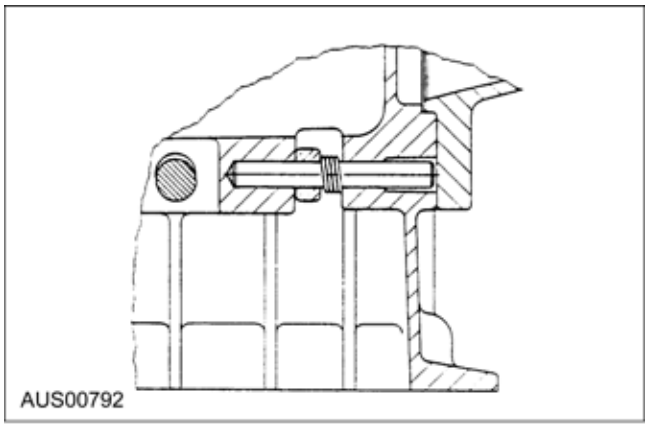
4. Install the rear servo lever and pivot pin. The lever must pivot freely on its pin.



5. Assemble the park rod lever complete with return spring and pivot pin. Apply a small amount of sealer to the outer end of the pivot pin. No sealant allowed between pin and lever. The lever must pivot freely on its pin and the spring must return the park rod lever.



6. Install the parking pawl with its spring and install the pivot pin. The pawl must pivot freely on its pin.

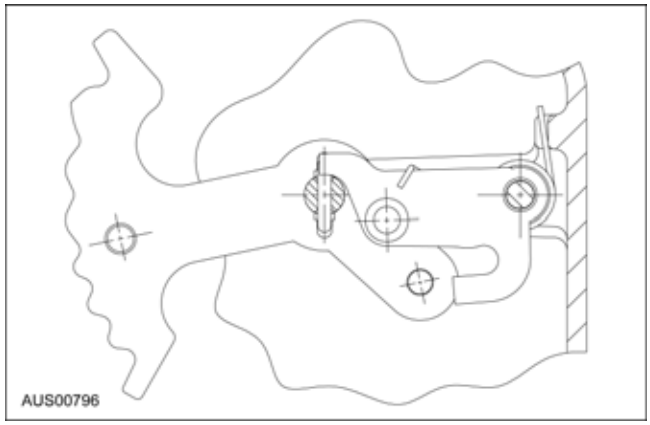


7. Connect the park rod to lever. Ensure the spring and cam collar is firmly installed on the rod. Check that the cam collar slides freely on the rod.

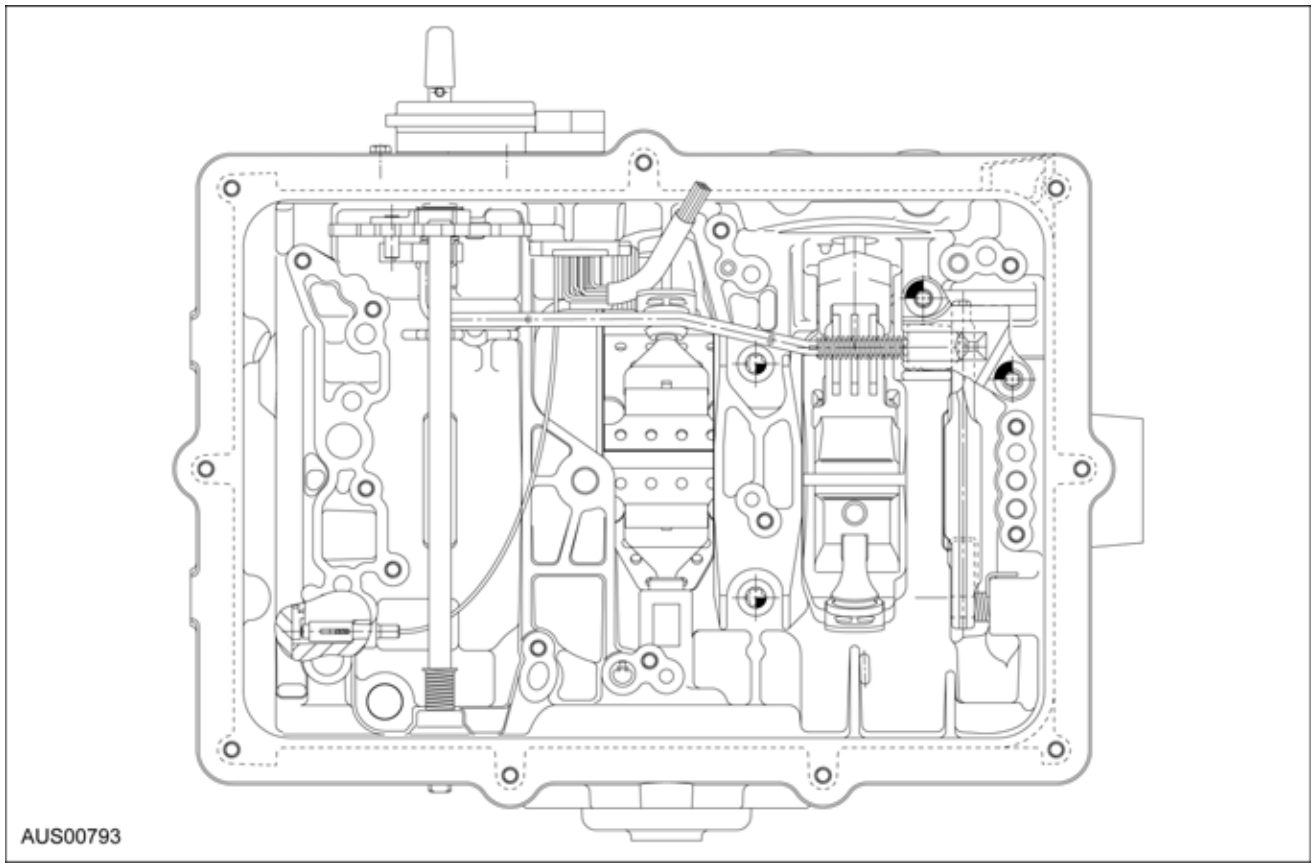
ASSEMBLY (Continued)

8. Start the cross shaft into the case from the cable side of the case, inhibitor switch end first, and install the antirattle spring on the shaft. Position the manual valve detent lever, aligning it with the cross-shaft bore in the case. Push the shaft through the detent lever until it starts in the detent lever side of the case. Install the detent lever drive pin in the shaft using tool 307-467 with the adaptor over the pin. Press the pin into the shaft until the tool bottoms. Remove the tool. Fit the spring retaining circlip.

Manual Valve Detent Lever



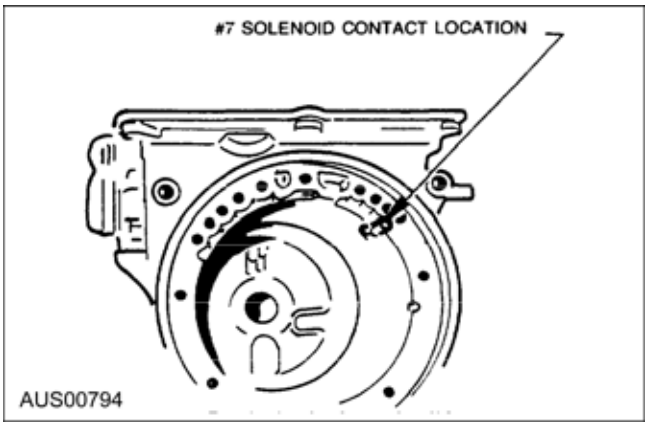
Manual Valve Detent Lever



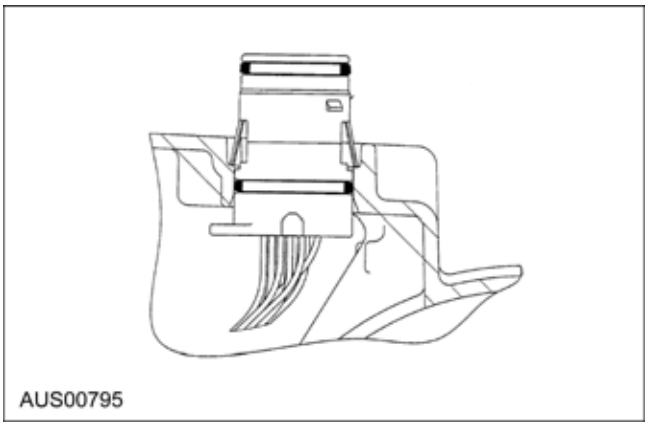
ASSEMBLY (Continued)

9. Install new cross shaft seals using tool 307-366.
10. Install the inhibitor switch on the case.
    NOTE: All hardware must be correctly installed and torqued to specification.
11. Thoroughly check the internal wiring loom for condition and continuity. Install a new external cross shaft pin using tool 307-467. Press the pin into the shaft until the tool bottoms.
12. Thoroughly check the internal wiring loom, position the loom and locate the S7 solenoid terminal in the pump mounting flange at the front of the case. The S7 solenoid wire is routed under the park rod and cross shaft in the case.

10 Pin connector and installation

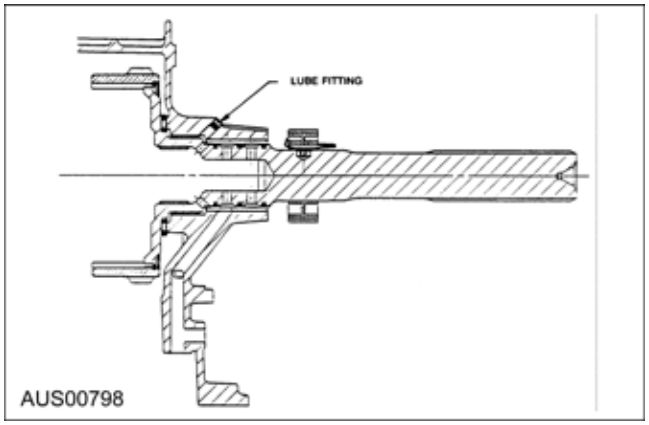


13. Install the ten pin connector in the case engaging the tangs into the notches in the case. It is important that both tangs fully engage. This can be checked visually on the outside of the case.



Output Shaft & Gear Assembly

93LE (Non-ABS shown)

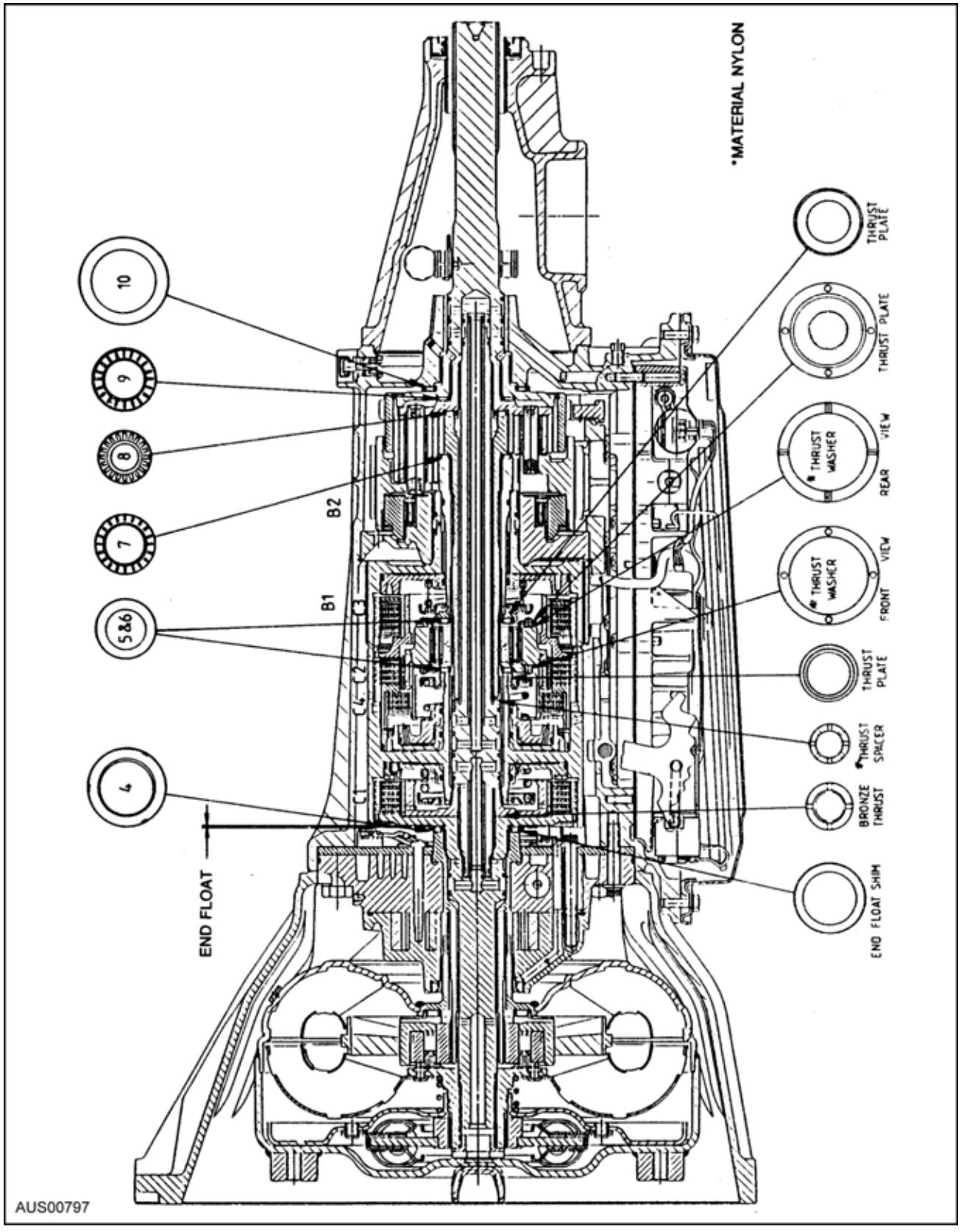


Assembly

1. Check that the output shaft bush is not worn or damaged. Replace if necessary.
2. Check for damage to parking pawl teeth on ring gear. Replace if necessary.
3. Check that the sealing ring grooves have not been damaged.
4. Lubricate the sealing ring with automatic transmission fluid.
5. Assemble the sealing rings to the output shaft with the scarf 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 on the output shaft using petroleum jelly.
8. Install the output shaft assembly in the case carefully to prevent damage to the sealing rings. Lubricate the case bush with petroleum jelly.
9. Install the speedo drive gear (non-ABS models only).

ASSEMBLY (Continued)

Thrust Bearing Location



ASSEMBLY (Continued)

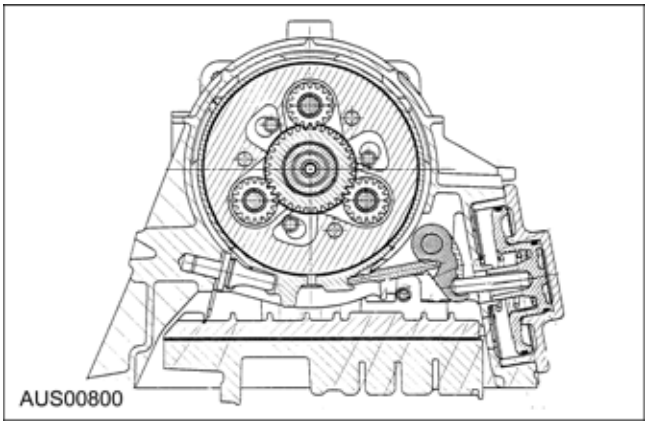
Rear Band

Assembly

1. Check the band for any cracks or damage along the lining and metal backing.
2. Soak a new band in automatic transmission fluid for a minimum of five minutes prior to assembly.
3. Install reaction anchor strut into maincase without shims.
4. Install the rear band carefully into the transmission case and ensure that it is properly fitted in the case.
5. Position the apply strut on the rear band.
6. Engage the apply strut in the servo lever.
7. Band adjustment is to be left backed off to allow easy installation of the planet carrier assembly into transmission.
8. Install the cam plate and tighten screws to specification.
   NOTE: AII hardware must be correctly installed and torqued to specification.

Rear Servo

Assembly

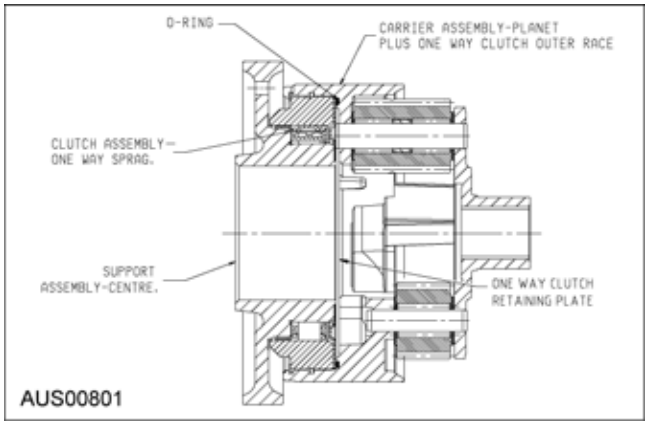


1. Check the servo piston ‘O’ ring and gasket for any damage.
2. Lubricate the servo piston ‘O’ rings with automatic transmission fluid and fit the ‘O’ rings to the piston grooves.
3. Assemble the piston to the cover. Ensure that ‘O’ ring compression is adequate but not excessive.
4. Align the spring on the piston spigot. Position the rear servo rod in the spigot.
5. Assemble the gasket to the cover and fit the assembly to the case.
   NOTE: Do not use petroleum jelly on gasket.
6. Apply Loctite 567 sealant to the bolts. Install the bolts and tighten to specification. Fit the wiring loom clip to hold the wiring vertical.

Planet Carrier and Centre Support

Assembly

Planet Carrier Assembly and Centre Support (93LE Shown)



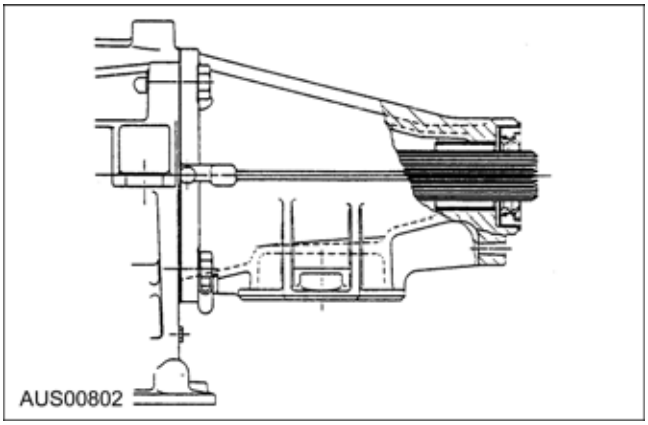
1. Check the carrier and planet assembly for any damage or irregularity and ensure that all pinions rotate freely and that pinion and float is within 0.1 to 0.5 mm.
2. Install the o-ring into the planet carrier o-ring groove.
3. Install the one way clutch retainer to the planet carrier with the inner edge pointing downwards. Inspect the one way clutch race and the sprag assembly for wear or damage. Replace if necessary.
4. Install the outer race in the drum. Press the race to the bottom of the drum and install the retaining circlip, as illustrated. Ensure the circlip is firmly seated in its groove.
5. Install the one way clutch into the outer race with the lip edge uppermost, as illustrated. Lubricate the sprags with automatic transmission fluid.
6. Check that the plugs are fitted to the centre support and assemble the centre support into the one way clutch, as illustrated. Ensure that the support will rotate in an anti-clockwise direction only.
7. Lubricate the needle thrust bearing No. 9 with petroleum jelly and fit it to the rear face of the planet carrier.
8. Install the planet assembly and the centre support into the case and align the centre support mounting bolt holes. Install the centre support bolts finger tight. Install the circlip retainer ensuring that circlip is completely seated in the groove of the case.
9. Remove the centre support bolts and apply Loctite 222 or equivalent to the threads. Install the bolts and torque to specifications.
10. Adjust the rear band to specifications.

ASSEMBLY (Continued)

Extension Housing

Assembly

Extension Housing



1. Check the condition of the extension housing bush, replace if necessary.
2. Install a new seal to the extension housing.
3. Position a new gasket to the extension housing.
   NOTE: Do not use petroleum jelly to hold gasket in position.
4. Install the extension housing and torque the bolts to specification.

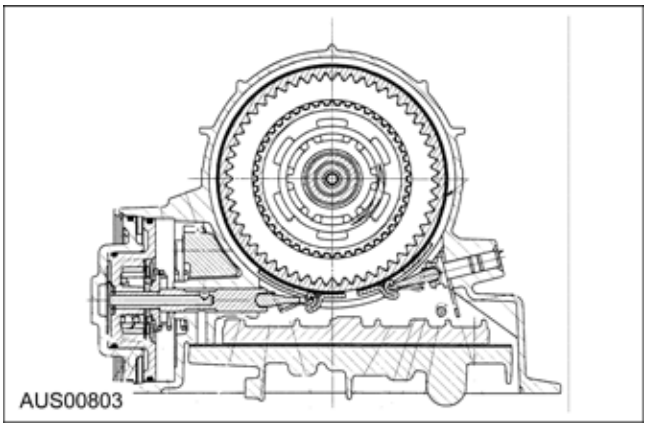
Front Servo

Assembly

1. Lubricate the cover ‘O’ ring with automatic transmission fluid and assemble to the cover.
2. Lubricate the piston ‘O’ rings with automatic transmission fluid and assemble to the piston.
3. Fit the piston push rod assembly into the front servo cover ensuring that the ‘O’ ring compression is adequate but not excessive.
4. Install the front servo assembly into the case. Ensure that the cover ‘O’ ring compression is adequate but not excessive.
5. Compress the servo cover and fit the servo cover retaining circlip and ensure that it is completely seated in its groove.

Front Band

Assembly



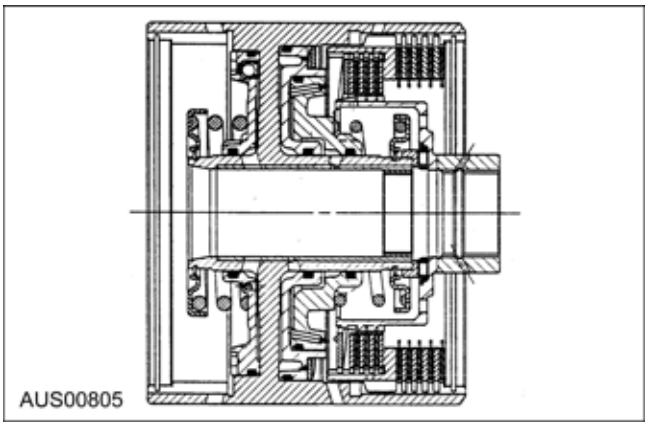
1. Install the reaction anchor strut to the case.
2. Check the band for any cracks or damage along its lining and metal backing.
3. If fitting a new band, soak the band in automatic transmission fluid for a minimum of 5 minutes prior to assembly.
4. Install the front band into the transmission case and ensure 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.
6. Band adjustment is to be backed off to aid installation of the clutch cylinder.

C2/C4 Clutch

Special Tool(s)	
	Clutch compression kit
	Clutch measuring kit 307-370

ASSEMBLY (Continued)

Assembly



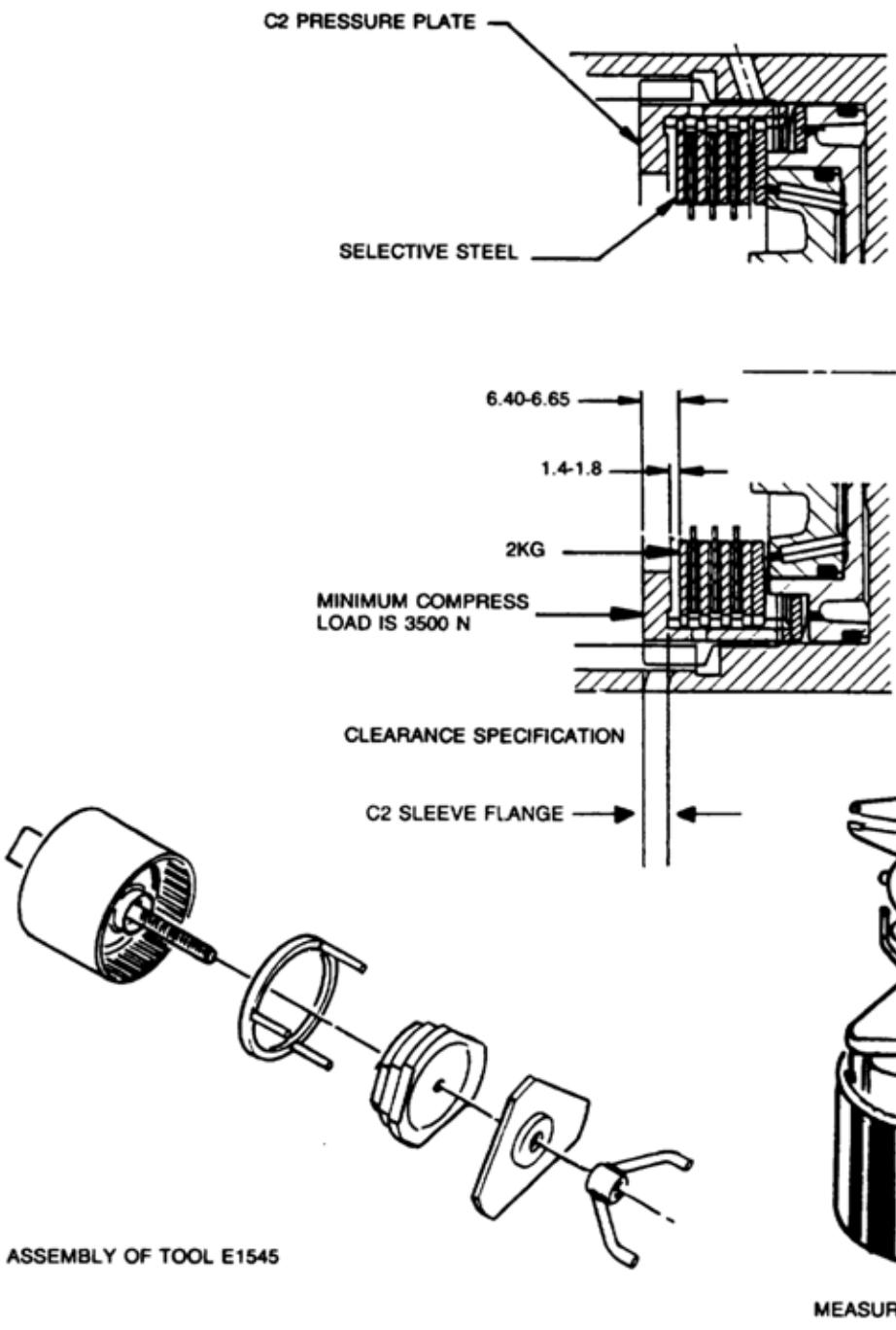
1. Check the C2 piston bleed orifices for obstruction. Check the feed orifices in the cylinder bore.
2. Lubricate the ‘O’ rings with automatic transmission fluid. Fit the small ‘O’ ring on the inner groove and the large ‘O’ ring on the outer groove of the piston. ‘O’ rings must not be twisted.
3. Check the C4 piston bleed orifices for obstruction. Check the feed orifices in the cylinder bore.
4. Lubricate the ‘O’ rings with automatic transmission fluid and fit the small ‘O’ rings to the inner groove and the large ‘O’ rings to the outer groove of the piston.
5. Position the clutch cylinder with the C2/C4 cavity facing upwards.
6. Fit the C4 piston into the C2 piston with the bleed orifices in alignment. Ensure that the C4 piston outer ‘O’ ring compression is adequate but not excessive.
7. 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 OD of the C2 piston enters the inner diameter of the cylinder. Ensure the C2 piston outer ‘O’ ring compression is adequate not excessive.
8. Assemble the piston return spring to the piston and fit the spring retainer over the spring. The wire diameter of this spring is 4.3 mm.
9. Using special tool 307-369 compress the spring sufficiently to enable the installation of the retaining circlip. Ensure that the circlip is firmly seated in its groove and remove the tool.
10. Check the C1 piston check valves for correct function and the cylinder feed orifices for obstructions. Lubricate the ‘O’ rings with petroleum jelly and fit to their respective grooves. The ‘O’ rings must not be twisted in the grooves.
11. Position the cylinder with the C1 cavity upwards. Install the piston into the cylinder until the OD of the piston enters the inner diameter of the cylinder.
12. Install the spring and spring retainer on the piston. Using Tool 307-369 compress the spring until the retaining circlip can be installed. Ensure that the circlip is firmly seated in its groove and remove the tool. The wire diameter of this spring is 5.26 mm.
13. Install the C2 wave washer in the cylinder with the crest of one wave covering one of the bleed orifices in the C2 piston.
14. Measure and record the thickness of the flange of the C2 sleeve.
15. 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
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate (selective)
    - Wave washer

NOTE: Hold the cylinder horizontal and 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.

16. Check the C4 clutch pack clearance using special tool 307-370 as illustrated. 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. Clutch pack clearance must be taken before the elements are soaked in ATF. Reassemble the sleeve and clutch pack into the cylinder.

ASSEMBLY (Continued)

C4 Clutch Pack Clearance

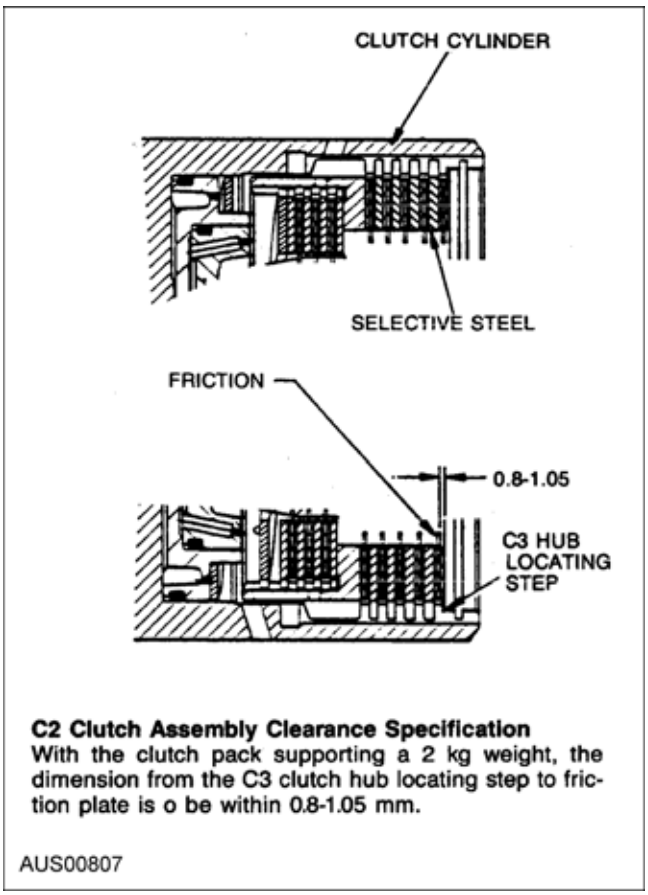


C4 Clutch Pack Assembly Clearance Specification
The pack clearance on this clutch to be set with the C2 wave spring compressed.
With C2 wave spring compressed and the clutch pack supporting a 2 kg weight, the dimension from the underside of the C2 pressure plate to the selective steel to be between 1.4-1.8 mm. If clutch pack is to be gauged from top of pressure plate then the dimension is to be the actual thickness of the pressure plate plus 1.4-1.8 mm.

AUS00806

ASSEMBLY (Continued)

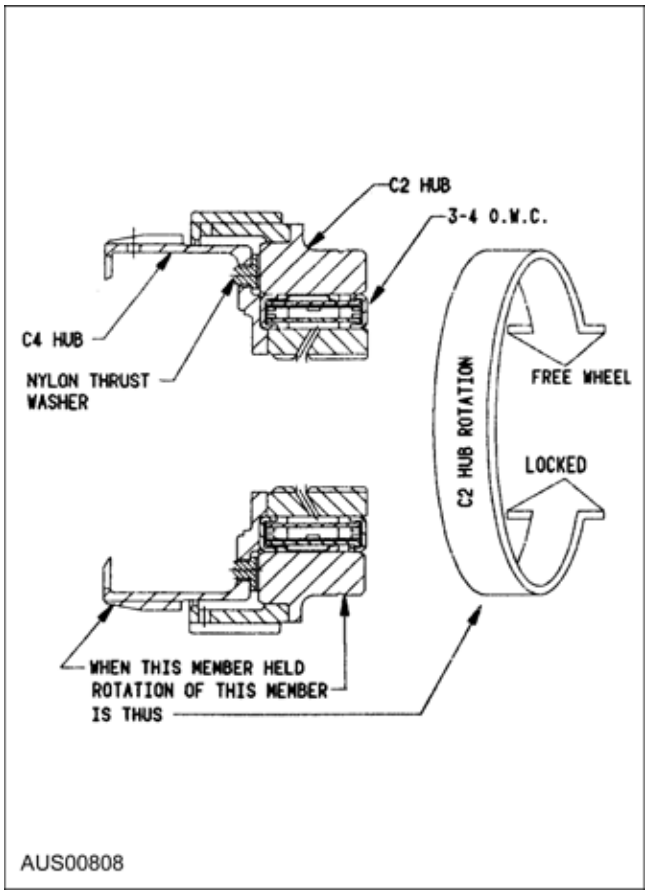
C2 Clutch Pack Clearance



C2 Clutch Assembly Clearance Specification
With the clutch pack supporting a 2 kg weight, the dimension from the C3 clutch hub locating step to friction plate is o be within 0.8-1.05 mm.

AUS00807

17. Fit the thrust plate over the inner hub.
18. Install the C2 clutch plates in the cylinder in the following sequence.
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate
    - Friction disc
    - Steel plate (selective)
    - Friction disc
    - Steel plate (selective)
    - Friction disc
19. Check the clutch pack clearance using the weight only from tool 307-370 as illustrated. Use selective plate 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. Clutch pack clearance must be taken before the elements are soaked in ATF.
20. Lubricate and fit the 3-4 OWC. Lubricate and fit the C2 OWC and end caps to the C2 hub.
21. Align the tangs and fit the nylon thrust washer onto the C4 hub as illustrated.
22. Align and fit the C4 hub to the C2 clutch and OWC assembly. 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.



AUS00808

23. Apply petroleum jelly to thrust bearing No. 5 and fit it to the C4 hub.
24. Remove the C2 clutch plates from the clutch cylinder.
25. Engage the C2/C4 clutch hub assembly in the C4 clutch plates.
26. Install the C2 clutch plates.
27. Install the C3 hub and secure it with the circlip. Ensure that the circlip is firmly seated in its groove.

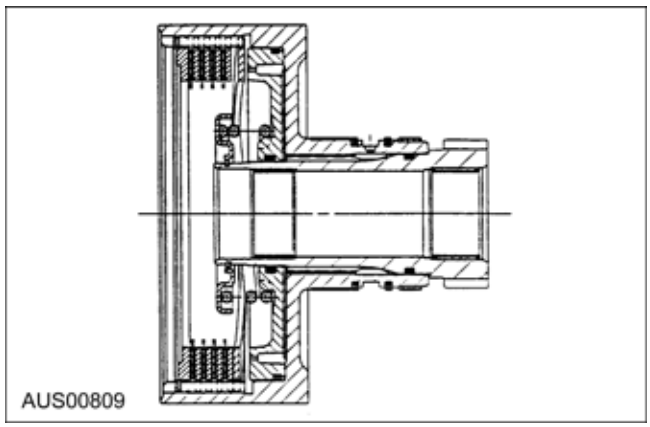
ASSEMBLY (Continued)

C3 Clutch, Reverse Sun Gear & Forward Sun Gear Assembly

Special Tool(s)	
 SST307-369	Clutch Compression Kit
 SST307-370	Clutch Measuring Kit

Assembly

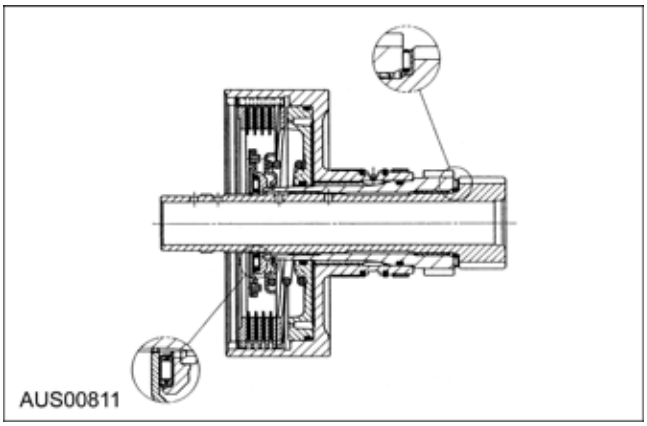
C3 Clutch and Reverse Sun Gear



1. Check the orifices in the cylinder are clear. Check the C3 cylinder bush outside diameter against the centre support inside diameter. Coat the sealing rings with automatic transmission fluid and fit into the C3 cylinder grooves.
2. 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 and the reverse sun gear.
3. Install the reverse sun gear in the C3 cylinder. Ensure that the 'O' ring compression is adequate but not excessive.
4. Coat the C3 piston 'O' rings with automatic transmission fluid and fit the small 'O' ring to the inner ring and the large 'O' ring to the outer ring of the C3 piston. 'O' rings must not be twisted in grooves. Check that the bleed orifices of the piston are clear.
5. Align the C3 piston in the cylinder until the OD of the piston enters the inside diameter of the cylinder. Ensure that the piston 'O' ring compression is adequate but not excessive. Assemble the spring and spring retainer on the piston. Using tool 307-369 compress the spring sufficiently to enable the installation of the retaining circlip. Ensure that the circlip is firmly seated in the groove and remove the tool.
   Fit the C3 wave plate to the C3 piston face with one crest of the wave plate directly over one of the piston orifices. Assemble the clutch plates and discs into the cylinder in the following sequence:
   1. Steel plate outer.
   2. Friction disc inner.
   3. Steel plate outer.
   4. Friction disc inner.
   5. Steel plate outer.
   6. Friction disc inner.
   7. Steel plate outer.
   8. Friction disc inner.

   Align and fit the pressure plate with the counterbore facing away from the clutch plates. Install the circlip.
6. Check the clutch clearance using special tool 307-370 in the following manner:

Forward sun gear and C3 clutch assembly



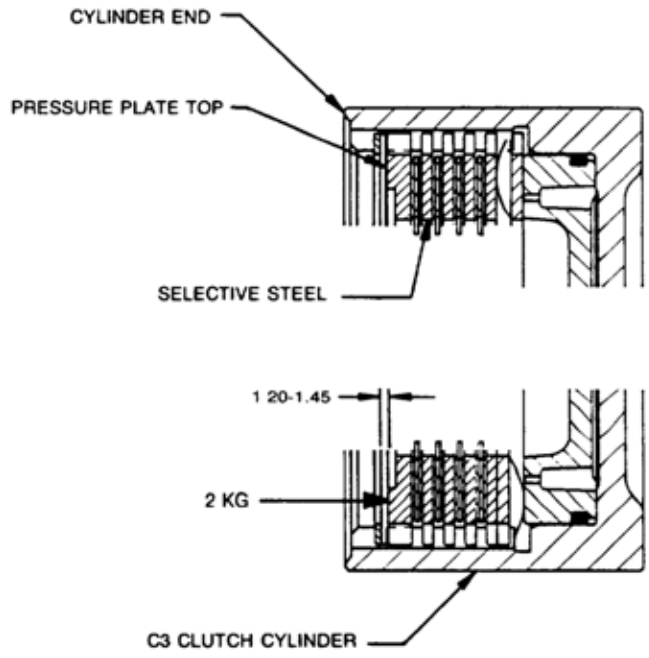
1. (weight only) Place the weight on the pressure plate and measure the distance from the end of the cylinder to the top of the pressure plate. Record this figure.
2. Remove the weight.
3. Lift the pressure plate up against the circlip and measure the distance from the end of the cylinder to the top of the pressure plate. Record this figure.
4. Subtract the second reading from the first reading to obtain the clutch pack clearance.
5. If new friction plates are being fitted, remove the clutch pack and soak the friction elements

ASSEMBLY (Continued)

in automatic transmission fluid for a minimum of five minutes prior to reassembly.

6. Clutch pack clearance must be taken before the elements are soaked in automatic transmission fluid.
7. Lubricate the needle thrust bearing assembly No. 7 with petroleum jelly and fit the bearing over the forward sun gear, thrust washer face to gear.
8. Align and fit the C3 clutch assembly over the forward sun gear.
9. Fit the thrust plate securely over the reverse sun gear.
10. Lubricate the needle thrust bearing No. 6 with petroleum jelly and fit it to the thrust plate. Ensure the lugs on the OD of the bearing fit in the thrust plate counterbore.
11. Align and fit the plastic thrust washer to the thrust plate with petroleum jelly as illustrated. Install the assembly over the foward sun gear shaft against the No. 6 thrust bearing.
12. Place assembly to one side.

C3 Clutch Assembly Clearance



C3 Clutch Pack Assembly Clearance Specification
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 1.2-1.45 mm.

AUS00810

ASSEMBLY (Continued)

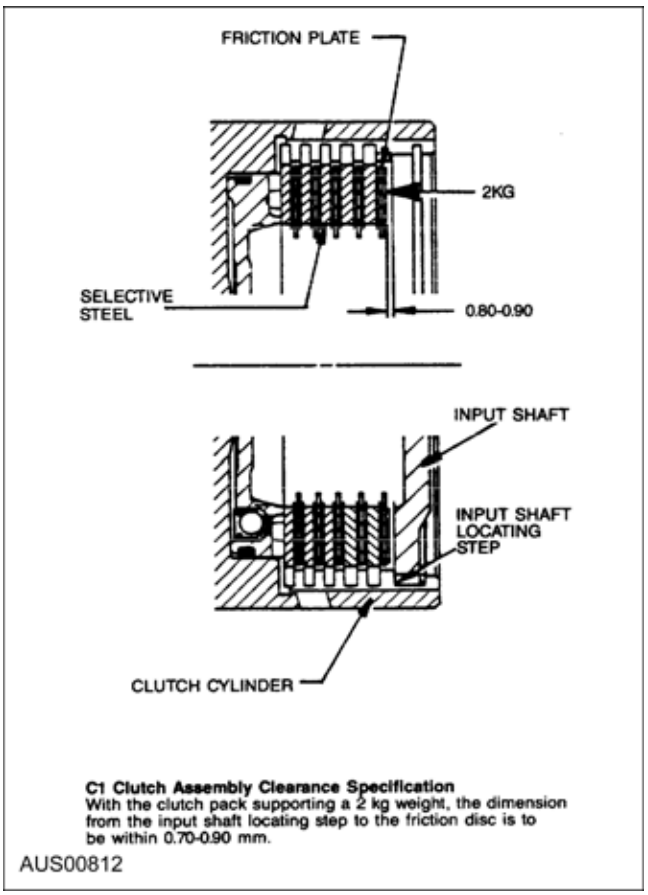
C1 Clutch Overdrive Shaft & Input Shaft

Special Tool(s)	
 SST307-370	Clutch Measuring Kit

Assembly

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:
   1. Steel plate outer.
   2. Friction disc inner.
   3. Steel plate outer.
   4. Friction disc inner.
   5. Steel plate outer.
   6. Friction disc inner.
   7. Steel plate outer (selective).
   8. Friction disc inner.
   9. Steel plate outer (selective).
   10. Friction disc inner.
4. Check the clutch pack clearance using special tool 307-370. Use selective plates to achieve the correct specification. 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. Clutch pack clearance must be taken before elements are soaked in automatic transmission fluid.

C1 Clutch Assembly Clearance

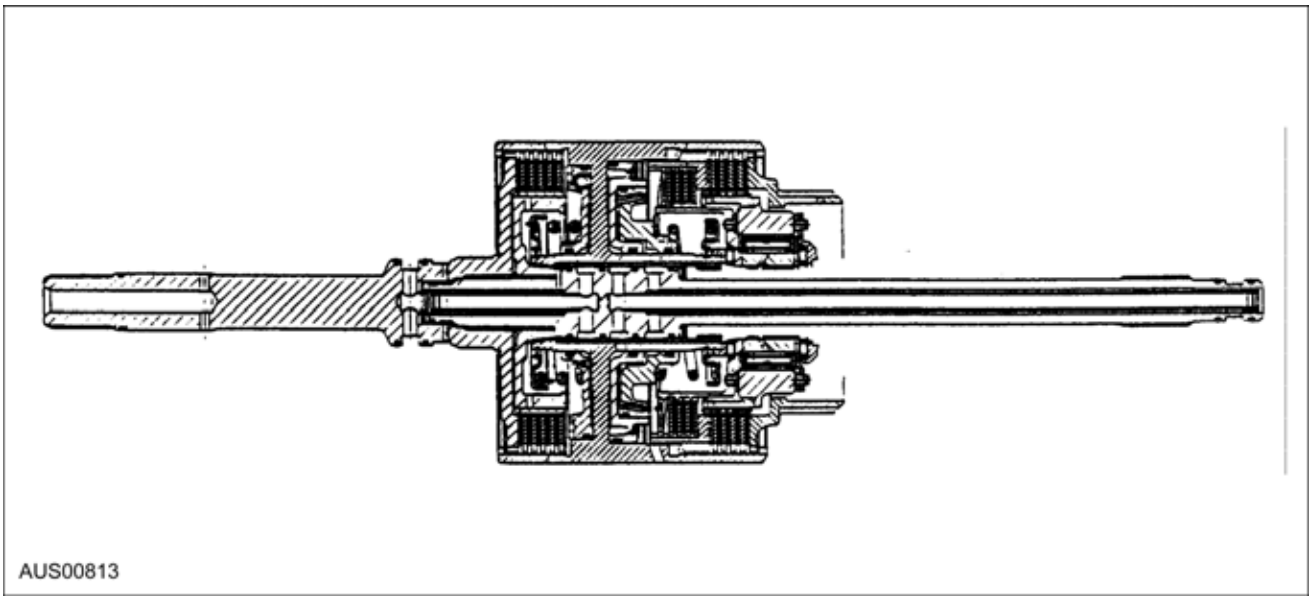


5. Check the fit of the C1 clutch hub on the overdrive shaft. If it is loose, the hub and shaft assembly must be replaced.
6. Coat the small nylon thrust spacer with petroleum jelly and install it into the cylinder hub.
7. Carefully fit the overdrive shaft into the C1 cylinder so as not to damage the sealing ring.
8. Fit the small bronze C1 hub thrust washer in place with petroleum jelly.
9. Check the input shaft for any defect. Fit the input shaft into the cylinder and secure it with the circlip. Ensure the circlip is completely seated in the groove
10. Coat the front and rear sealing rings and the outer ‘O’ ring with petroleum jelly and fit the input shaft.
11. Assemble the C1/C2/C4 clutch assembly to the C3 clutch and sun gear assembly.
12. Install thrust bearing No. 8 onto the overdrive shaft with spigot into the forward sun gear.
13. Install this assembly in the transmission case.

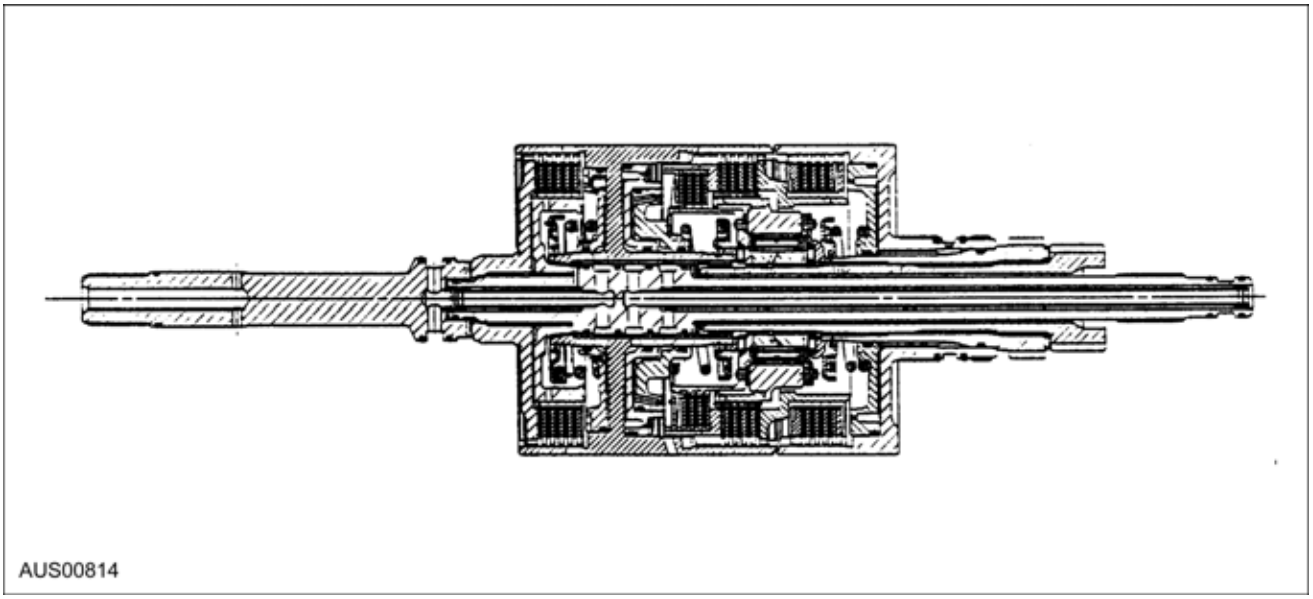
ASSEMBLY (Continued)

Clutch

C1, C4, C2 Clutch



C1, C4, C2, C3 Clutch



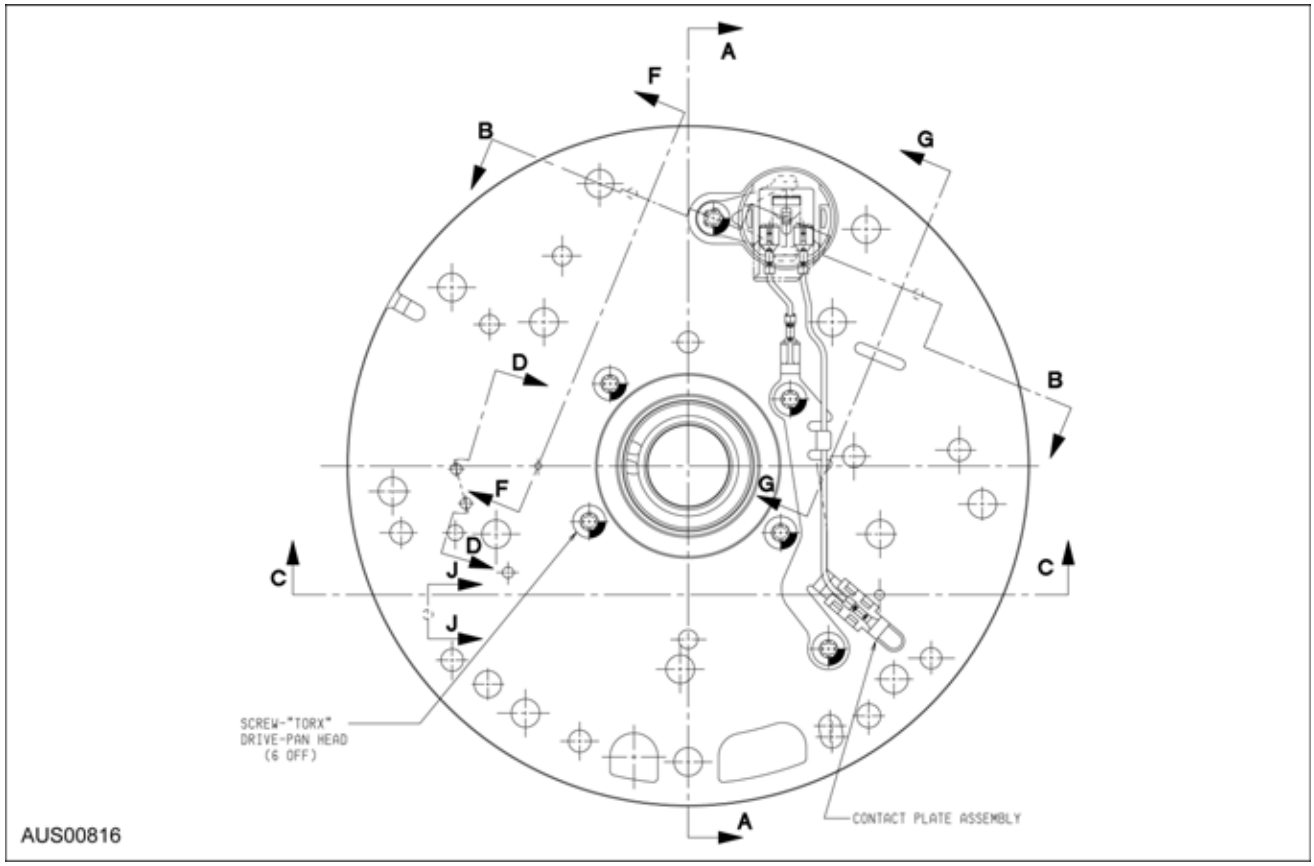
ASSEMBLY (Continued)

Pump Cover & Converter Support

Special Tool(s)	
 SST307-363	Pump Aligner

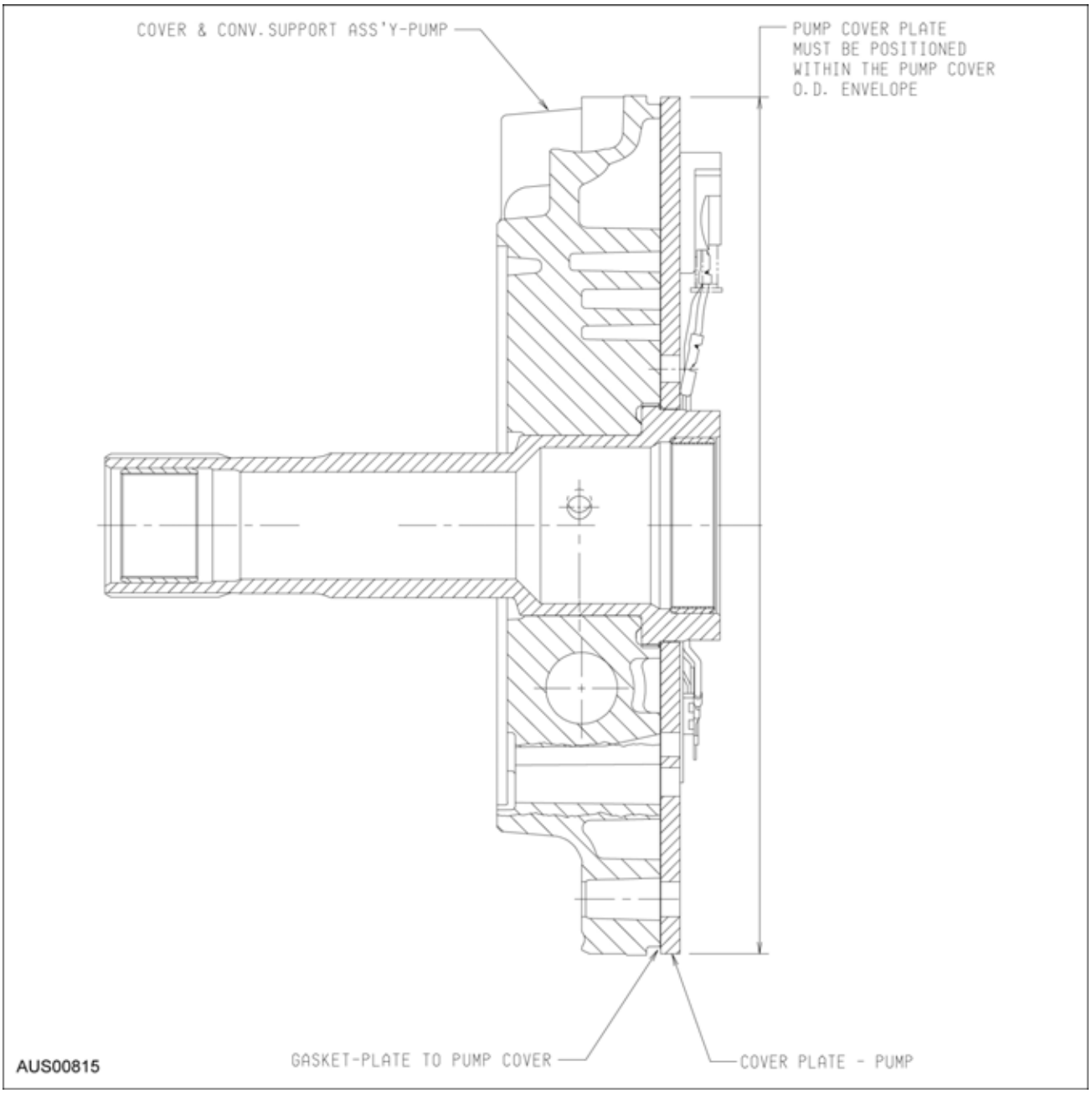
Assembly

Pump Cover



ASSEMBLY (Continued)

Pump, Cover and Converter Support

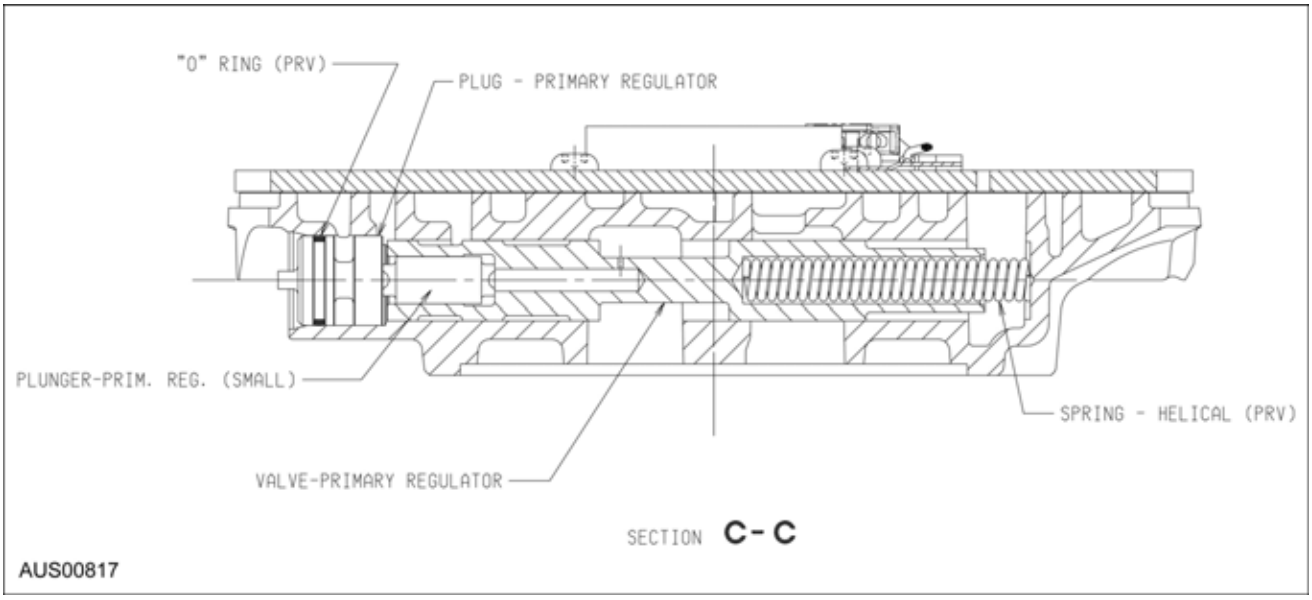


1. Check the pump body for any damage, scoring or similar in the pump gear recess. Check the pump bush for wear or damage.
2. Thoroughly clean the pump body gear recess, pump body flange and the pump gears. Install the gears in the pump body and check the pump end clearance using a depth micrometer or similar. The end clearance should be 0.020 - 0.040 mm.
3. Remove the gears from the pump body and install the seal flush with the front face of the pump body if this was removed previously.
4. Lubricate the pump bush and the drive and driven gears with automatic transmission fluid. Install the pump driven gear and the pump drive gear to the pump body.
5. Lubricate the pump body 'O' ring with automatic transmission fluid and fit to the pump body. Put the pump body to one side.
6. Ensure that the pump cover cavities, ports, holes etc. are clean and free of any obstruction.
7. Lubricate all loose parts with automatic transmission fluid prior to assembly.

ASSEMBLY (Continued)

8. Assemble the Primary Regulator valve to the pump cover. Ensure that the regulator valve slides freely and that the regulator valve plug ‘O’ ring compression is adequate but not excessive. Install the retaining pin.

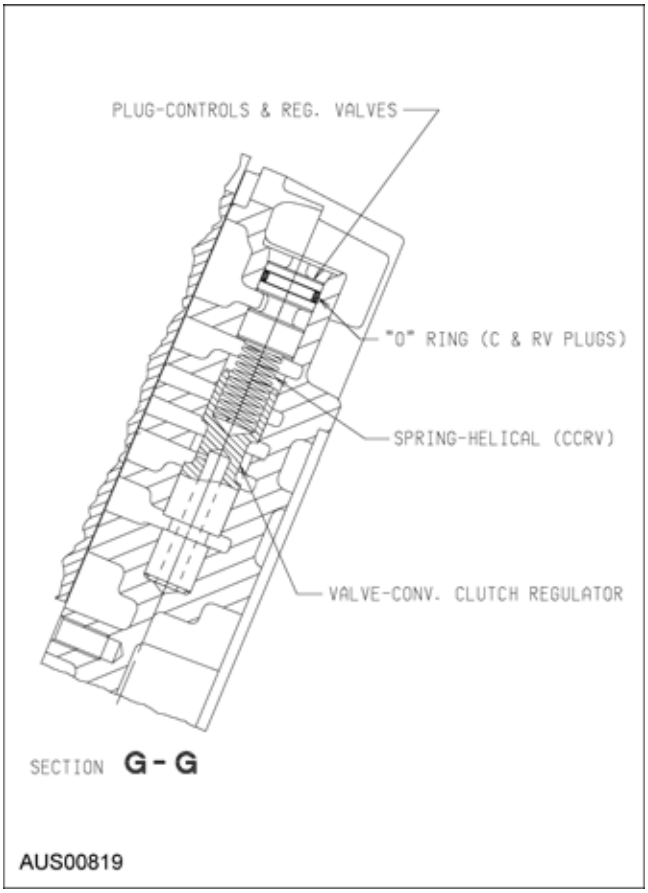
Primary Regulator Valve



ASSEMBLY (Continued)

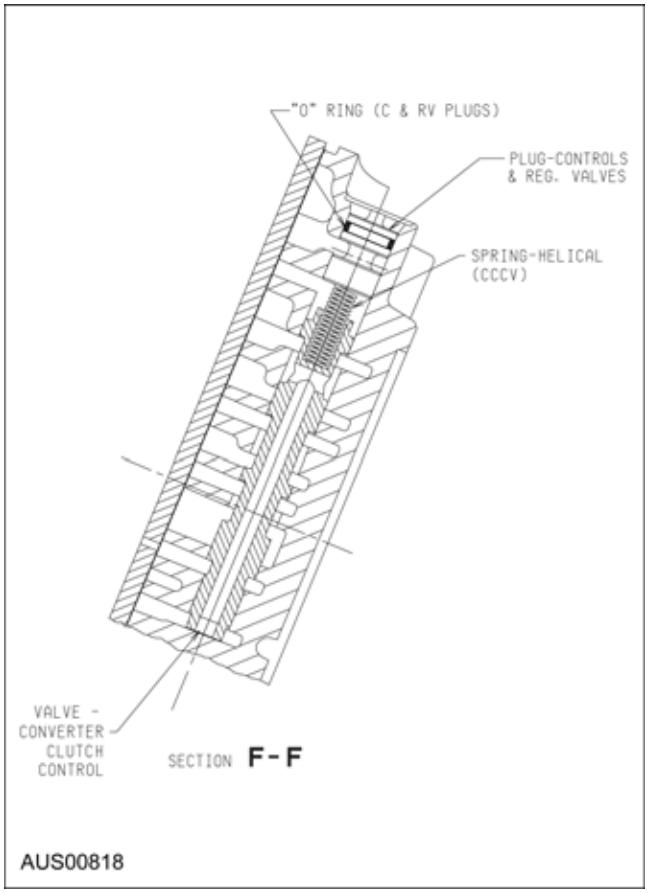
9. Install the converter clutch regulator valve and plug. The compression of the plug ‘O’ ring must be adequate but not excessive. Install the retaining pin.

Converter Clutch Regulator Valve



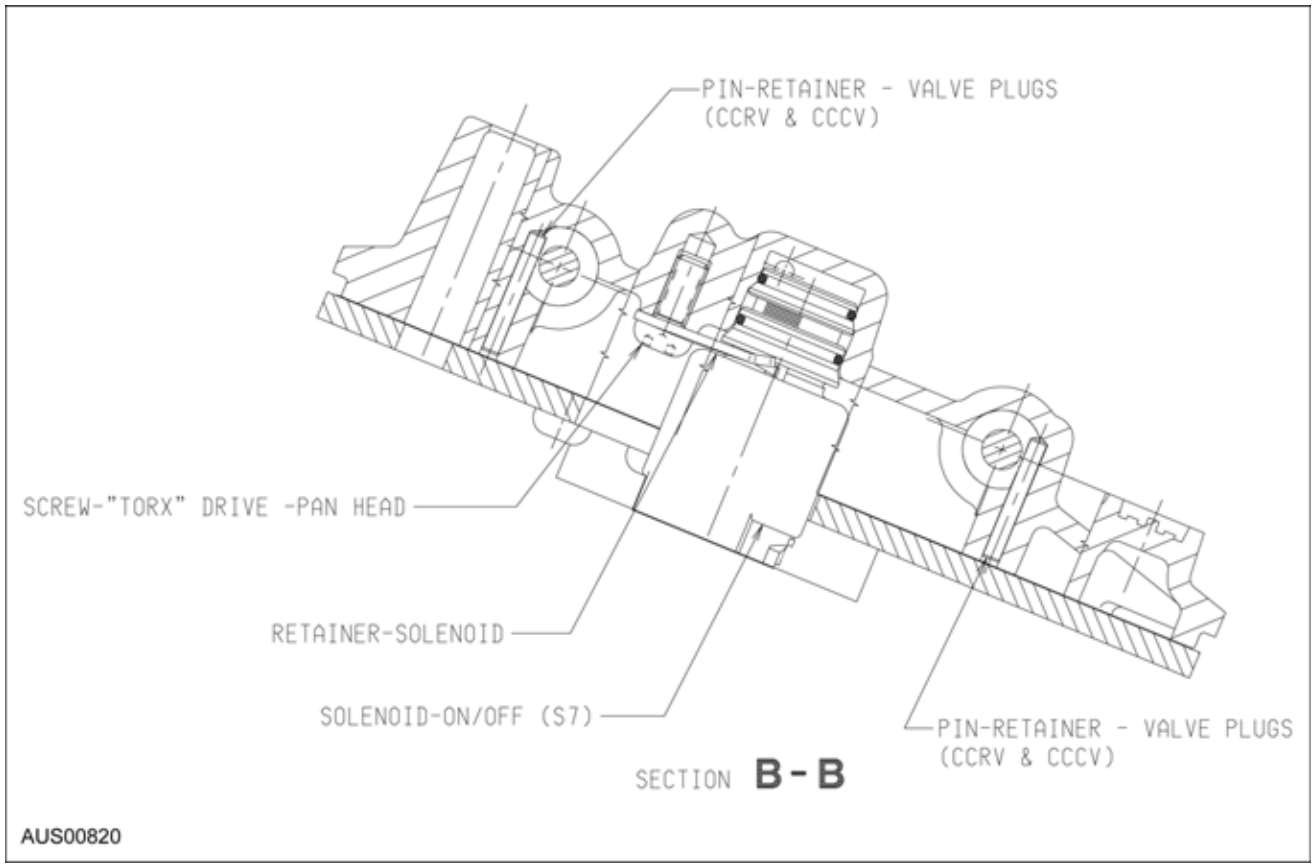
10. Install the converter clutch control valve, spring and plug. Plug ‘O’ ring compression must be adequate but not excessive. Install the retaining pin.

Converter Clutch Control Valve

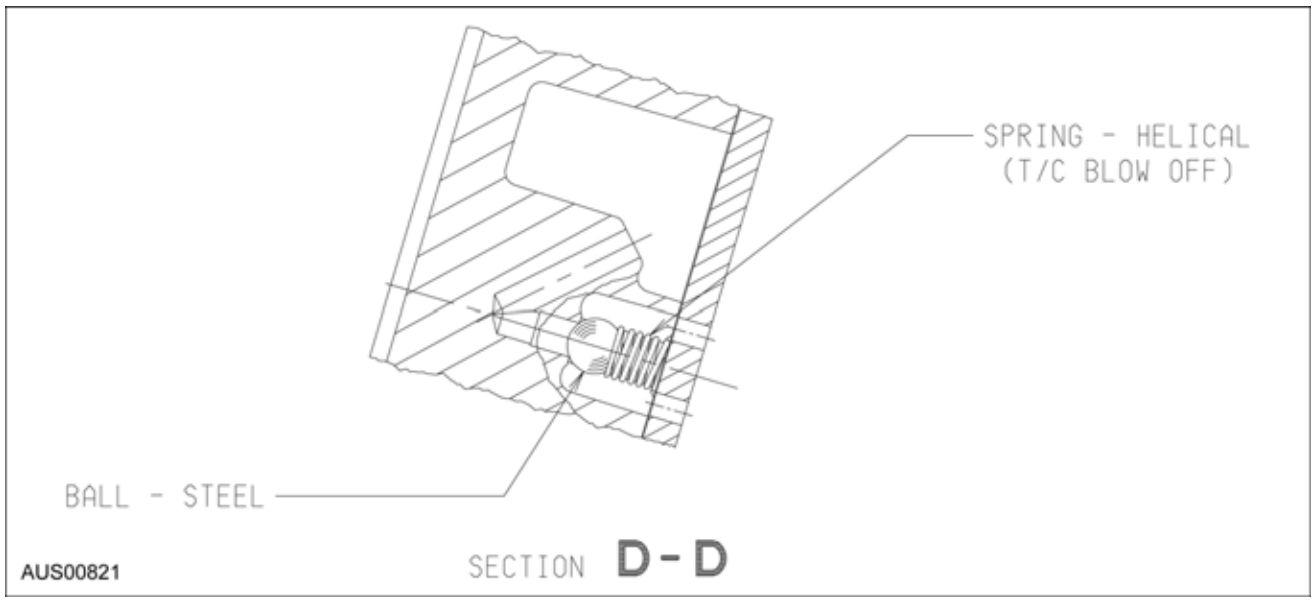


ASSEMBLY (Continued)

Valve Retaining Plugs



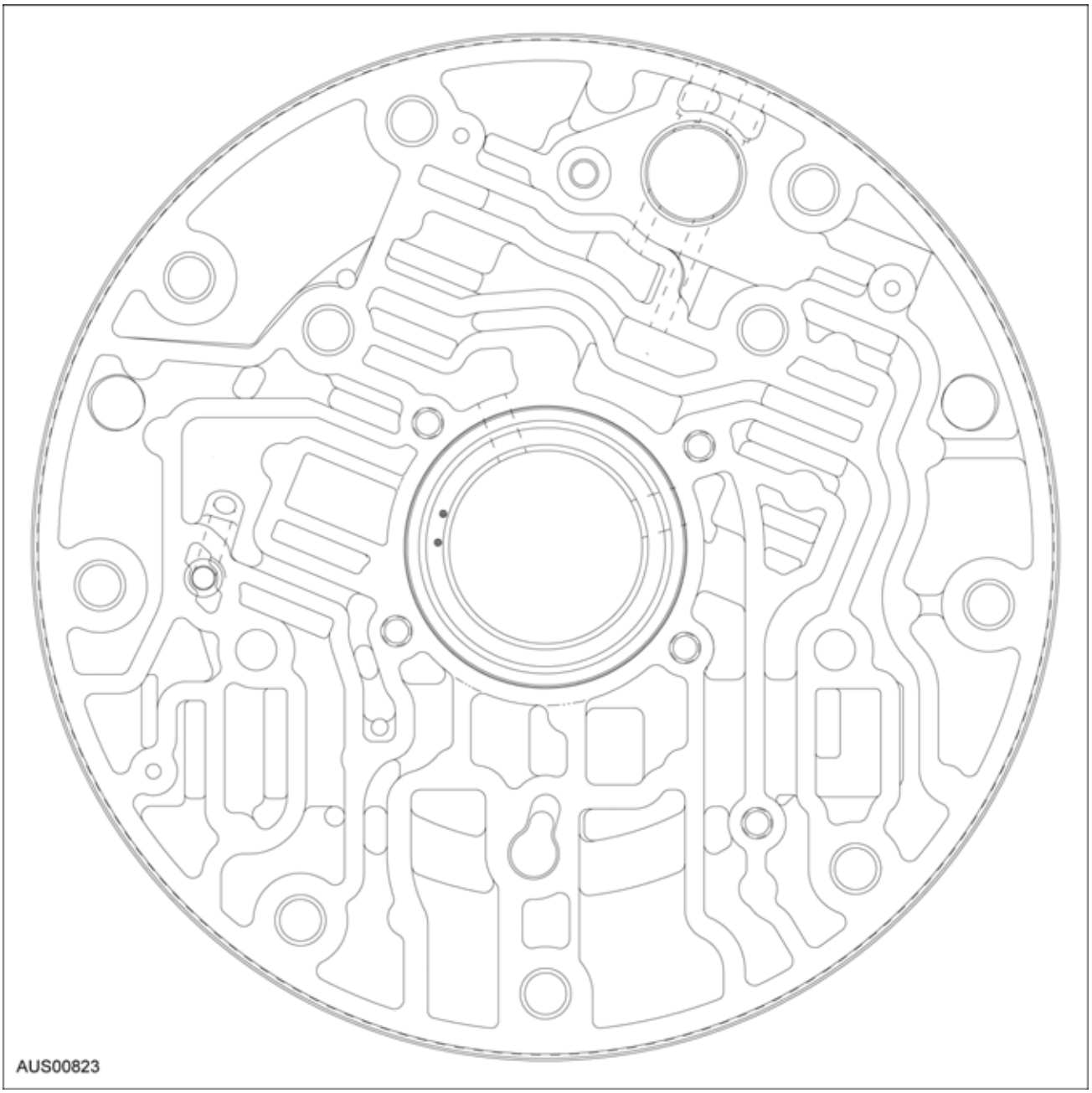
Converter Relief Valve



11. Install the converter feed check ball and spring.

ASSEMBLY (Continued)

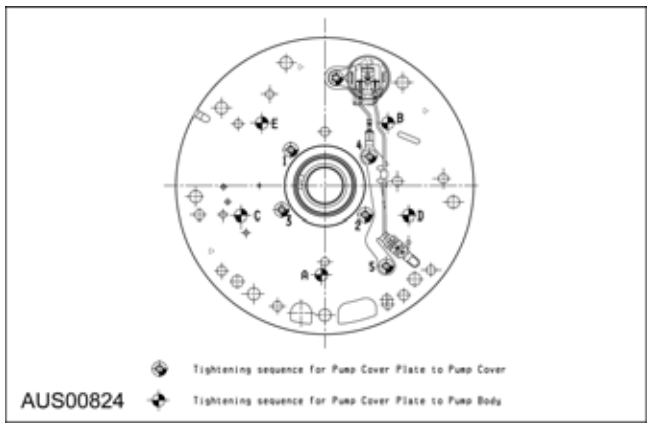
Check Ball Location



12. Install the gasket on the pump cover with petroleum jelly.
13. Install the cover plate and the solenoid wiring retainer to the pump cover. Ensure that the periphery of the cover plate is flush with the periphery of the pump cover. Tighten screws to specification.
14. Fit No. 7 solenoid and secure it with the retainer and screw. Check that wiring or connector does not rub on the input shaft or the C1/C2 clutch cylinder.
15. Assemble the pump to the pump cover using alignment tool 307-363. Tighten all bolts finger tight ensuring that the pump is flush against the pump cover. Check that the alignment tool can still be rotated. Tighten the bolts and the screw to 14 Nm in the order shown. Check that the alignment tool can still be rotated. Tighten bolts to 27 Nm in the order shown. Check that the alignment tool can be rotated.

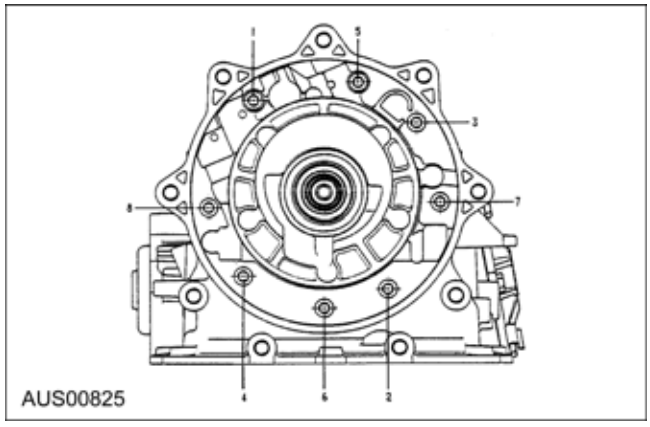
ASSEMBLY (Continued)

Pump bolt tightening sequence



16. Install the pump to transmission case gasket on the case with petroleum jelly. 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.

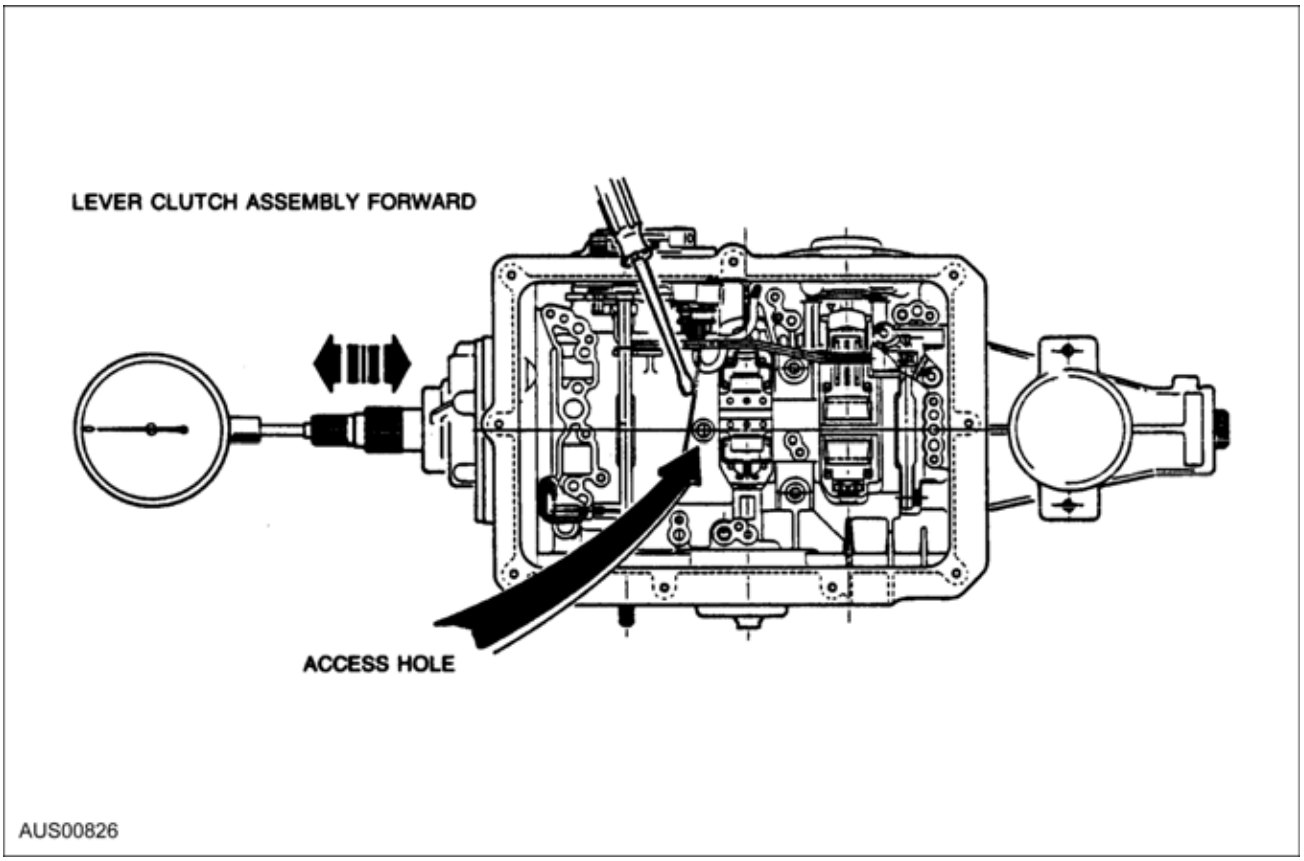
Tightening sequence pump to case



17. Check the transmission end float. Set to 0.5-0.65mm. 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 25kgs 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.
    If unshimmed end float is greater than specification, shims are to be placed between the No. 4 bearing and the input shaft bearing surface.
    If end float is less than 0.5 or greater than 0.65mm then the transmission has been assembled incorrectly or the parts are out of specification.
18. Adjust the front band to specifications.

ASSEMBLY (Continued)

Gear Train End Float Check

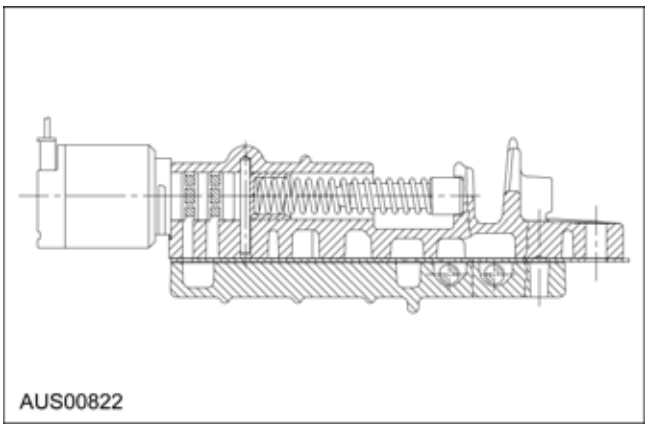


Valve Bodies

Assembly

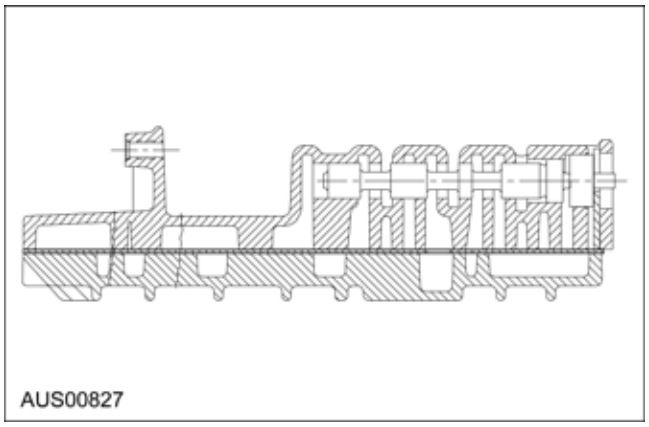
1. Wash the upper and lower valve bodies thoroughly with cleansing solvent and blow dry.
2. Check the valve body cavities, ports and holes for impurities or obstructions.
3. Install the detent lever locating pin.
4. Thoroughly wash all loose components.
5. Check that all valves slide freely in their location.
6. Install the S5 damper spring, piston and retaining pin.

S5 Solenoid and Damper



7. Install the 1-2 shift valve, plug and retaining plate.

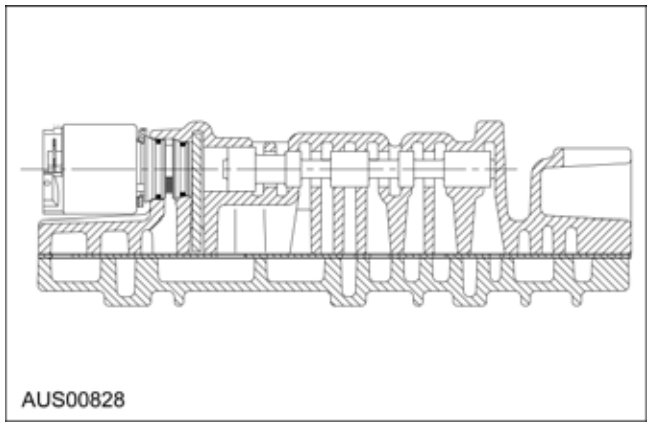
1-2 Shift Valve



ASSEMBLY (Continued)

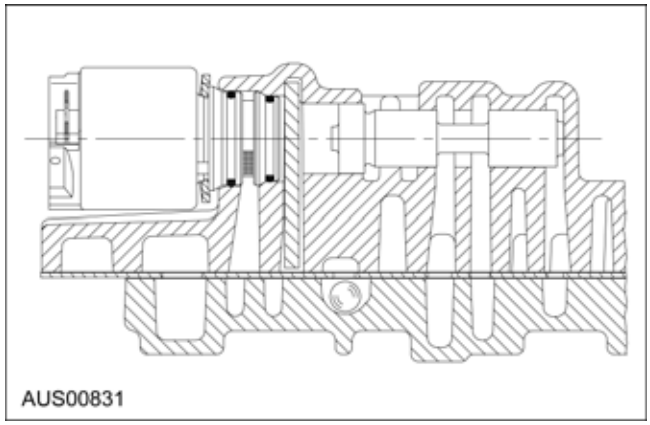
8. Install the 3-4 shift valve and retaining plate.

S1 Solenoid and 3-4 Shift Valve



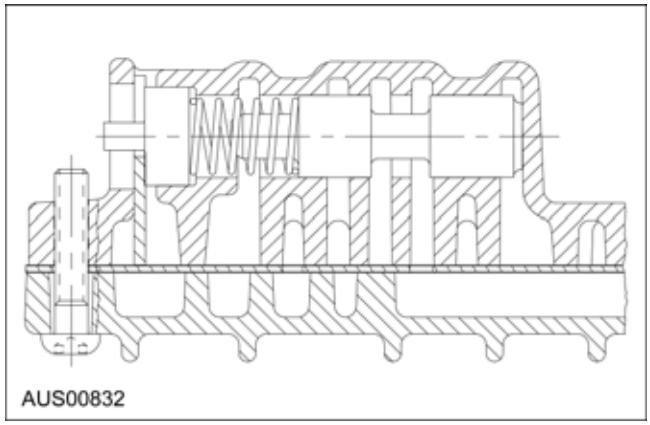
9. Install the 2-3 shift valve and retaining pin.

S2 Solenoid and 2-3 Shift Valve



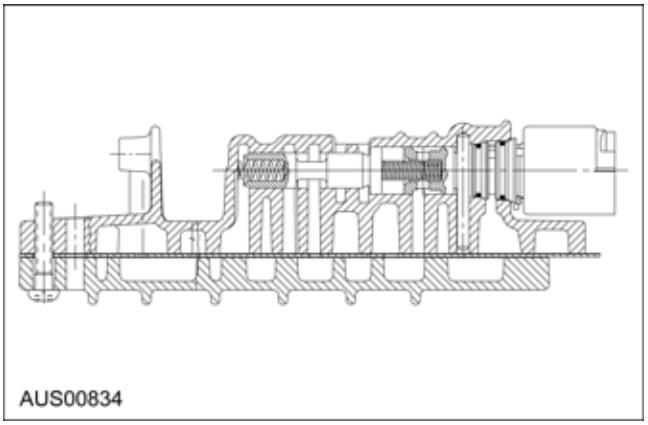
10. Install the 4-3 sequence valve, spring, plug and retaining plate.

4-3 Sequence Valve



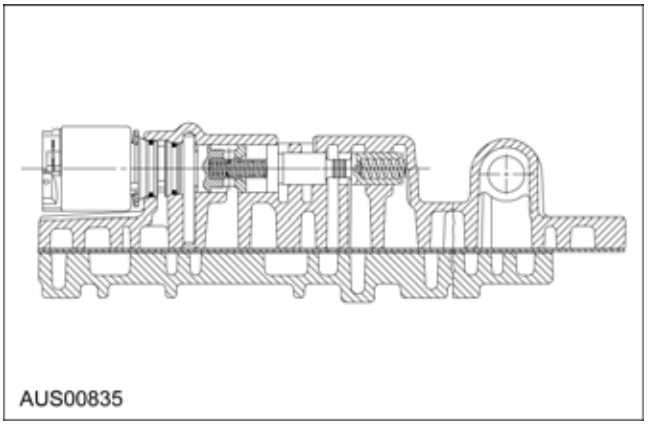
11. Install the bar valve, springs, plunger and retainer pin.

Band Apply Regulator Valve and S4 Solenoid



12. Install the car valve, springs, plunger and retainer pin.

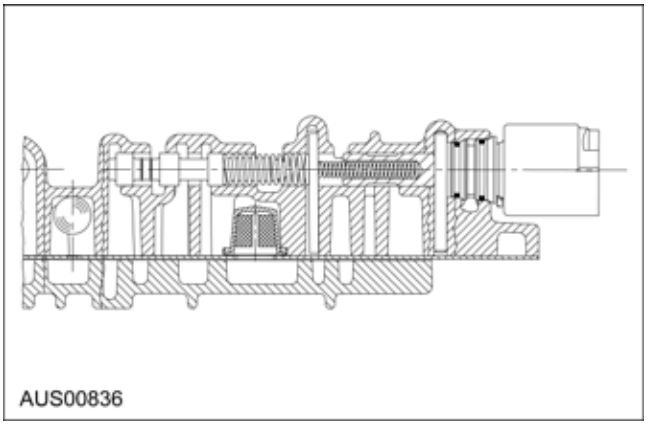
Clutch Apply Regulator Valve and S3 Solenoid



13. Install the solenoid supply valve, spring and retainer plate.

CAUTION: This aluminium valve is easily damaged.

Solenoid Supply Valve and S6 Solenoid

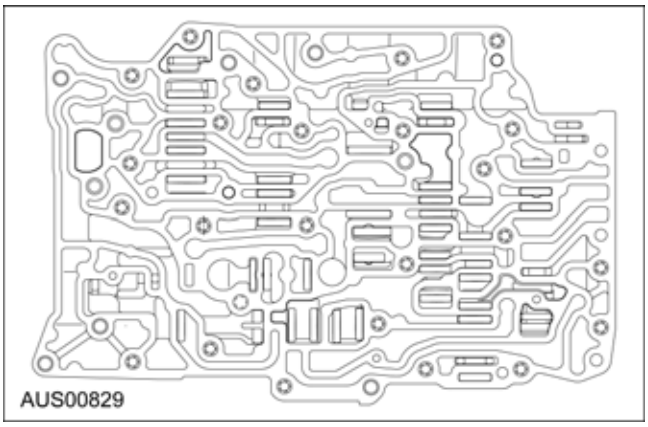


14. Install S6 plunger, spring and retaining pin.

ASSEMBLY (Continued)

15. Position the third feed ball (large nylon) in the valve body and install the S5 and S6 solenoid filters.
16. Check the separator plate for burrs etc.
17. Check the upper and lower valve body gaskets.
18. Install the lower valve body gasket on the lower valve body.

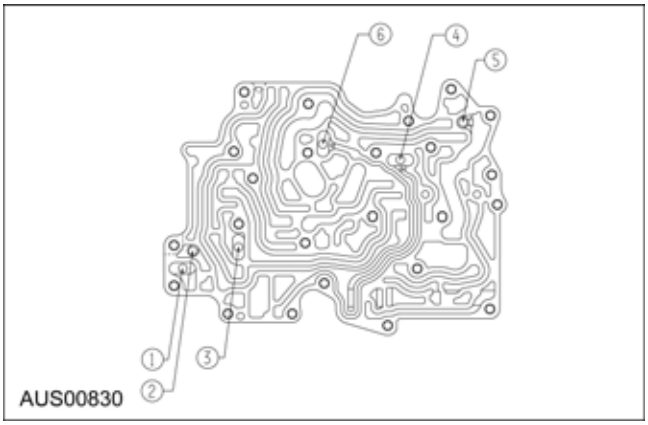
Lower valve body



19. Install the Reverse Lockout valve, spring, plug and retaining plate. Position the 6 PIA (olive) ball checks in the upper valve body.

    CAUTION: On separating the valve body all 6 ball checks need to be replaced with new PIA (olive) balls, using worn or incorrect ball material may lead to reduced transmission durability or erratic gear shifts.
20. Fit the upper valve body gasket. Install the separator plate over the upper valve body.
21. Holding the separator plate to the upper valve body to prevent the check ball from falling out, install the upper valve body on the lower valve body.

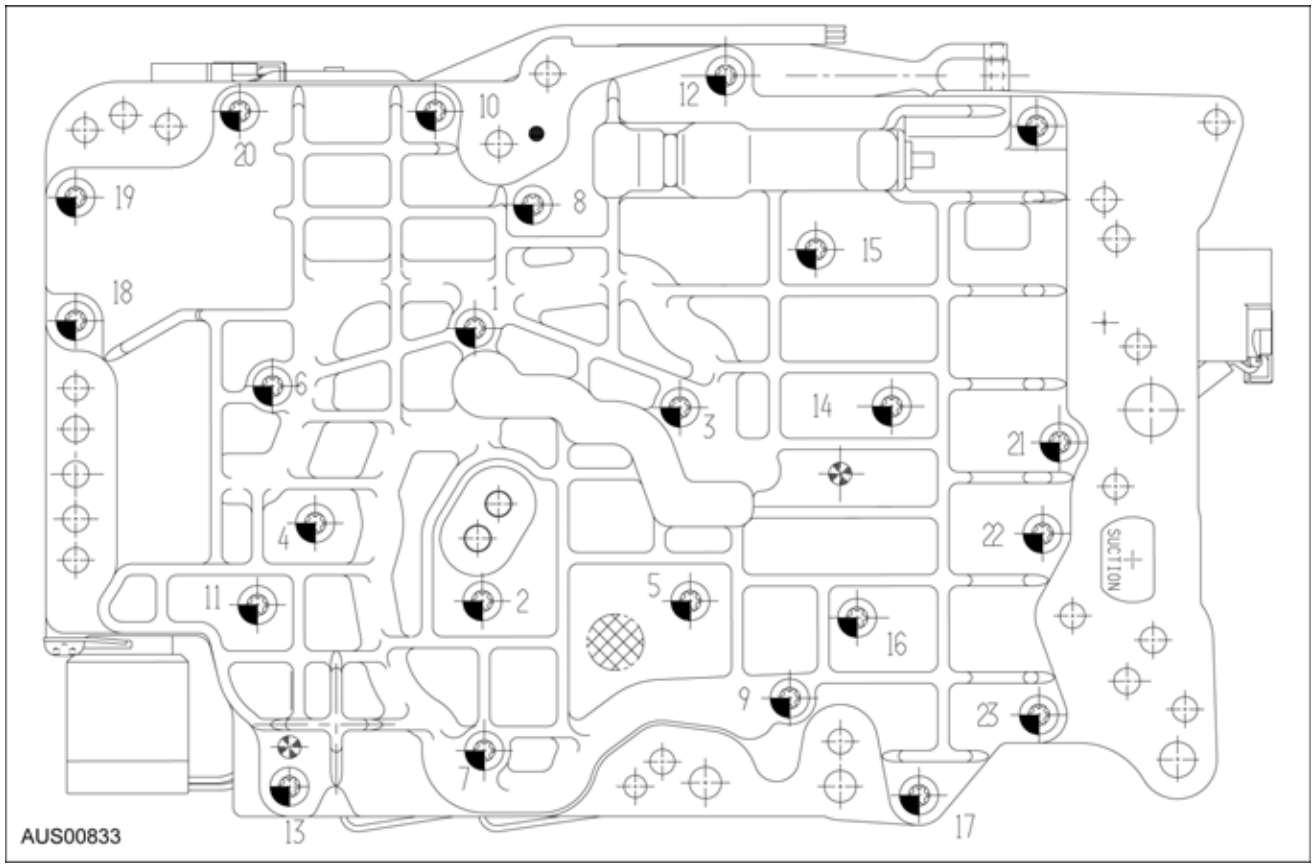
Upper valve body with checkball locations



22. Install all screws finger tight then tighten the screws to specification in the prescribed sequence.

ASSEMBLY (Continued)

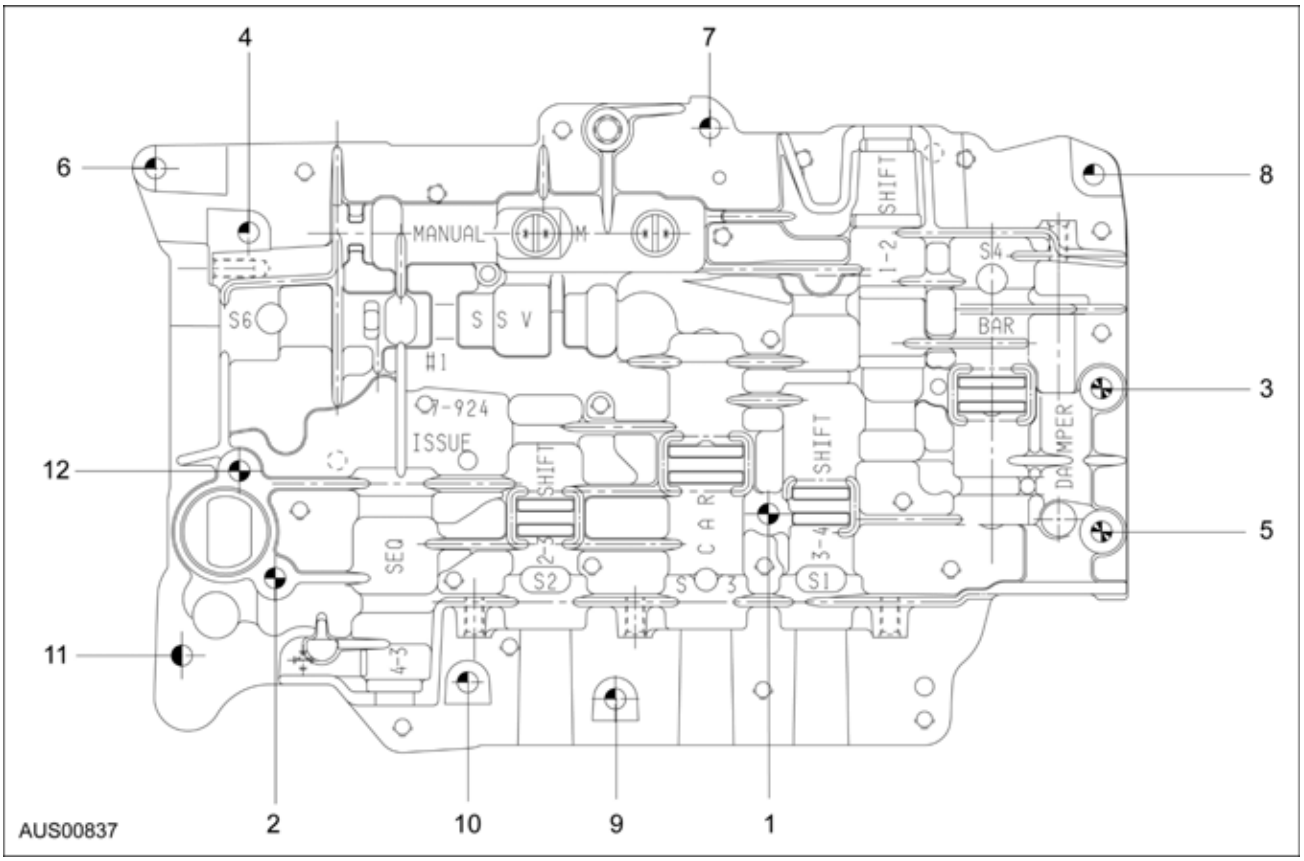
Tightening Sequence Upper to Lower Valve Body



23. Install the No. 4 solenoid. Ensure the solenoid is firmly secured by the retainer and that the screw is tightened to specification.
24. Install the No. 3 solenoid. Ensure the solenoid is firmly secured by the retainer and that the screw is tightened to specification.
25. Install the S6 solenoid assembly.
26. Install the 2-3 shift valve solenoid S2.
27. Install the 3-4 shift valve solenoid S1.
28. Install the S5 solenoid. Ensure that the solenoid is pushed firmly into the valve body by the clamping plate.
29. Install manual feed ball and spring (on lower face adjacent to the BAR valve) and secure with the retaining pin.
30. Install the manual shift valve.
31. Install the detent spring assembly (spring, shims, support plate and screw). Ensure the screw is tightened to specification. Check the spring for wear or damage.
32. 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.

ASSEMBLY (Continued)

Tightening Sequence Valve Body to Case



33. Check the alignment of the detent roller and the manual lever quadrant.
34. Connect the solenoid wiring.
    - S1 - Red
    - S2 - Blue
    - S3 - Yellow
    - S4 - Orange
    - S5 - Green
    - S6 - Violet
35. Check that the cross-shaft torque is within specification. To do this, rotate the cross shaft to the "P" position. Rotate the output shaft until the parking mechanism locks. Measure the torque required to rotate the cross-shaft from P-R (with the output shaft unloaded). This torque must be 2.5-3.5 Nm. Add or remove shims from under the detent spring as necessary to ensure correct torque.

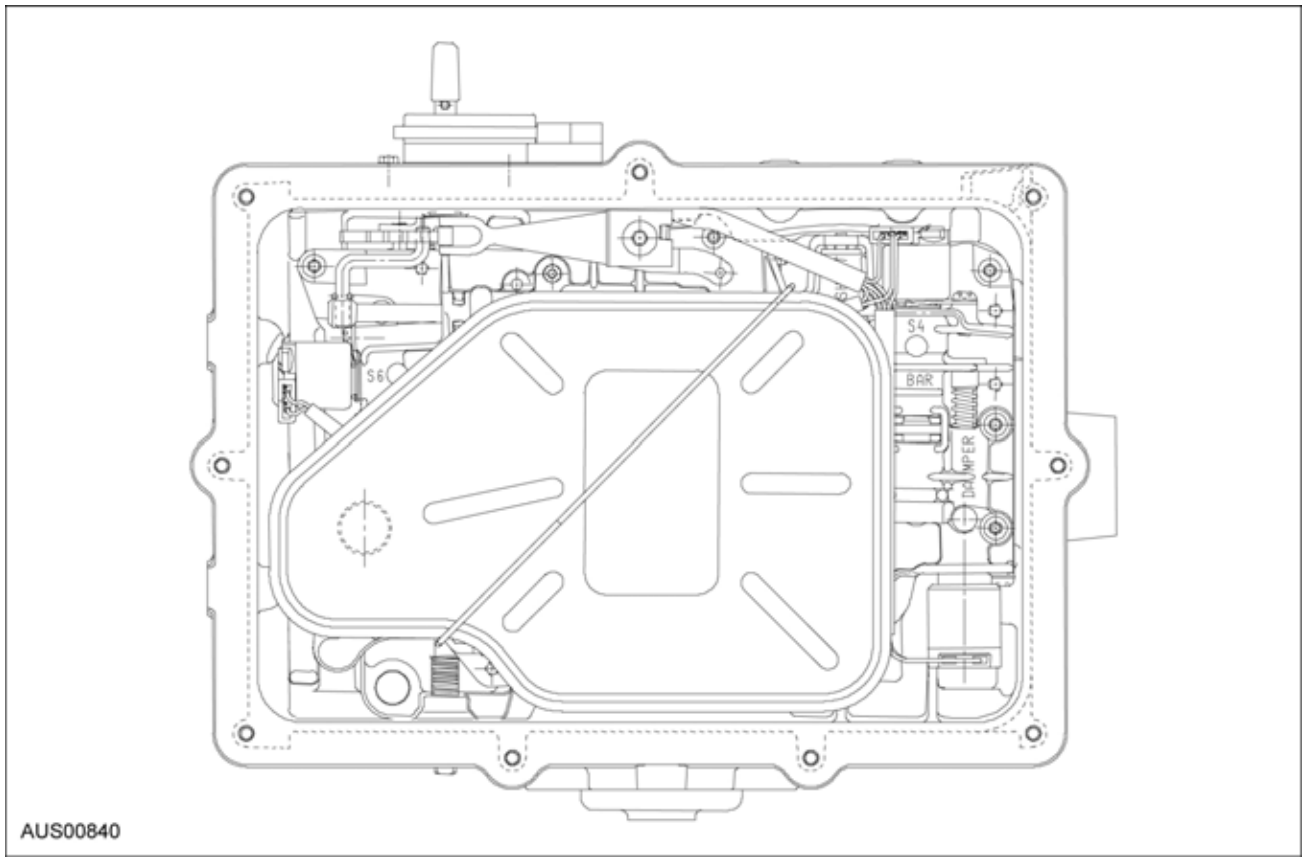
    NOTE: All hardware must be correctly installed and torqued to specification.

ASSEMBLY (Continued)

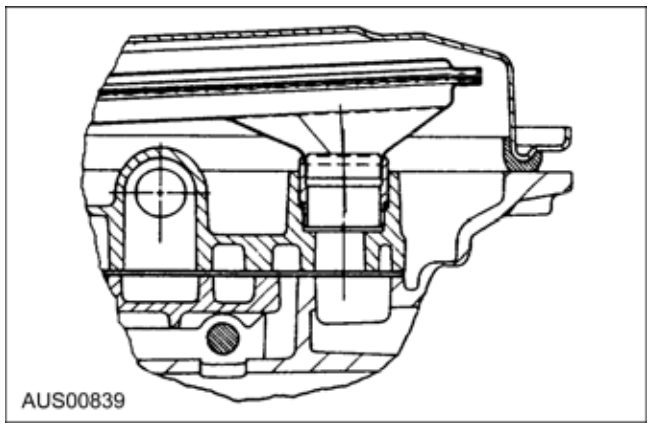
Oil Filter and Pan Assembly

Assembly

Oil Filter Installation



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.

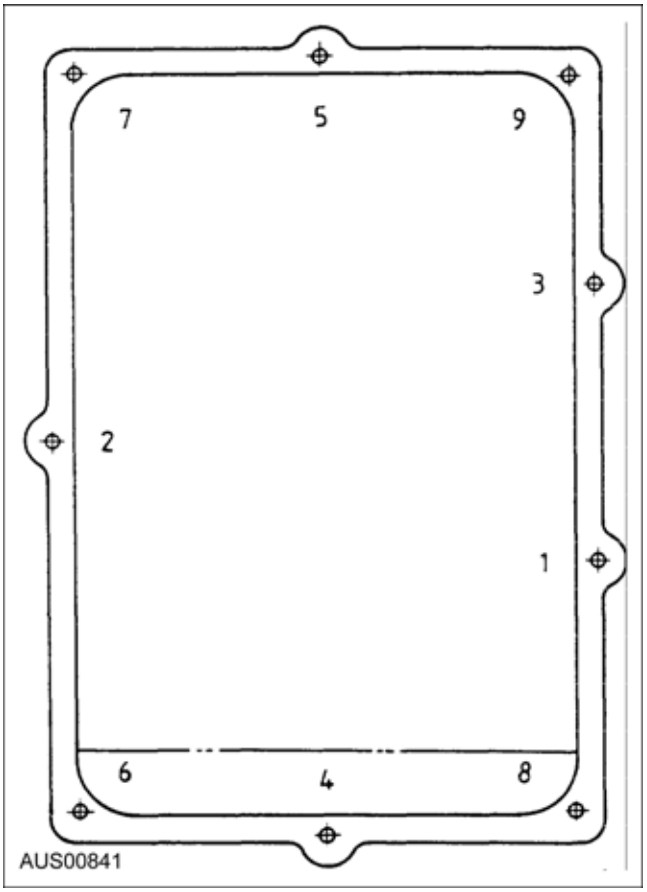


3. Secure the oil filter assembly with the retainer. Engage the long leg of the retainer first.
4. Check that magnet is located in the dimple in the corner of the oil pan.
5. Assemble the gasket on the pan lip. The gasket must be free of any distortion when installed.

ASSEMBLY (Continued)

6. Fit the oil pan assembly to the transmission case and tighten the securing bolts to specification. Do not over torque.

Oil Pan Tightening Sequence



Torque Converter & Housing

Assembly

1. Fit the "O" ring seal to the input shaft.
2. Locate the torque converter housing on the transmission main case. Install and tighten the securing bolts.
3. Fit the torque converter by pushing it fully back and turning the converter until it engages the pump drive dogs.
4. The converter is correctly installed when the torque converter pilot hub is 4mm in from the front face of the torque converter housing.
   NOTE: All hardware must be correctly installed and torqued to specification.