6–1. MEASURING TRANSMISSION PRESSURES

Measuring individual clutch pressures helps determine if a transmission malfunction is due to a mechanical or an electrical problem. Proper pressure measurements require transmission and vehicle (or test stand) preparation, recording of data, and comparing recorded data against specifications provided. These instructions are for all 3000 and 4000 Product Family transmissions.

6–2. TRANSMISSION AND VEHICLE PREPARATION

1. Remove the plugs from the pressure tap locations where measurement is desired (Figure 6–1).

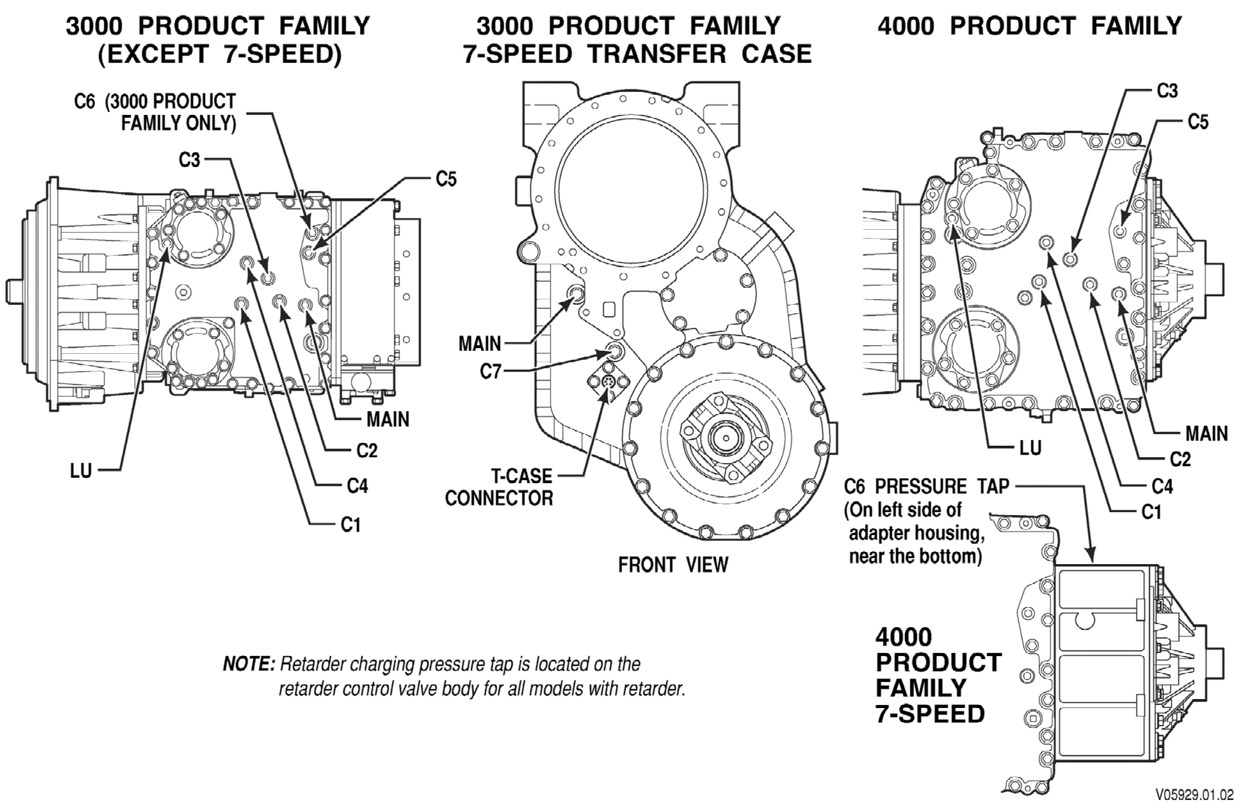

Figure 6–1. Clutch Pressure Check Points

CAUTION: Make sure that the hydraulic fittings have the same thread as the plugs removed (7/16-20 UNF-2A). Also, please note that these fittings must be straight thread, O-ring style. Failure to do this will result in damage to the control module.

2. Install hydraulic fittings suitable for attaching pressure gauges or transducers.
3. Connect pressure gauges or transducers. J-26417-A Pressure Gauge Set is available for this purpose.
4. Make sure that engine speed can be monitored. Allison DOC® may be used for this purpose.
5. Make sure that transmission sump fluid temperature can be measured. Allison DOC® may be used for this purpose.
6. Make sure that the transmission has enough fluid for cold operation until an operating temperature fluid level can be set.

7. Bring the transmission to normal operating temperature of 71-93ºC (160-200ºF). Inspect for fluid leaks in the added pressure gauge/transducer lines. Repair leaks as needed. Make sure that fluid level is correct.

6–3. COMPARING RECORDED DATA TO SPECIFICATIONS

NOTE: Use Allison DOC® to monitor the Main Mod solenoid state while taking main pressure and clutch pressure readings. The pressure specifications (listed in Figure 6–2 and Figure 6–3 for 3000 Product Family Transmissions, and Figure 6–4 for 4000 Product Family Transmissions) and the actual main pressure and clutch pressures on the gauges are dependent on current test conditions. These conditions include range attained, input speed, fluid temperature, and whether the Main Mod solenoid is on or off. Note that the Main Mod solenoid OFF state increases pressures above the Main Mod solenoid ON pressures.

1. If clutch pressures are within specifications, return the transmission and vehicle to their original configuration and proceed with electrical troubleshooting.
2. If clutch pressures are not within specification, take corrective action to replace the internal parts of the transmission necessary to correct the problem.
3. Measure pressure values after the transmission has been repaired.
4. Return the transmission to its original configuration. Remove instrumentation and install any components removed for pressure testing. Pressure tap plugs should be reinstalled and tightened to 10-13 N·m (7-10 lb ft).

6–4. ALLISON DOC® CLUTCH TEST ACTION REQUEST

The Allison DOC® can check individual range clutch pressures with the vehicle stationary. Clutch Test instructions are located in the Action Request section of the Allison DOC® User Guide, GN7281EN, and in the Allison DOC® Technician's Library. Follow instructions to test clutch pressures in individual ranges.

6–5. MAIN MODULATION

NOTE: For Non-Shift Energy Management transmission calibrations, Step Main Mod logic is active during the 1-2 shift. For SEM transmission calibrations, Variable Main Mod logic is active.

Main Pressure Modulation is accomplished via a dedicated solenoid valve located in the solenoid valve body. In TIDA configurations, control main pressure passed to the top of the main regulator valve from the normally low solenoid valve works against main pressure regulator spring force, reducing main pressure. In TIDB configurations, control main pressure passed to the bottom of the main regulator valve via a normally high solenoid valve supplements main pressure regulator spring force, increasing main pressure.

6–6. LOCKUP AND CLUTCH PRESSURES

Lockup clutch pressure can only be measured by driving the vehicle in a range where lockup can be obtained. Record the pressure values at the engine speed and sump fluid temperature values shown in Figure 6–2 and Figure 6–3 for 3000 Product Family Transmissions, and Figure 6–4 for 4000 Product Family Transmissions. The lockup clutch is functioning correctly when engine speed and turbine speed values are equal as shown in the Allison DOC® recorded data, and the lockup pressure meets specification.

Operate the transmission at the conditions shown in Figure 6–2 and Figure 6–3 for 3000 Product Family Transmissions, and Figure 6–4 for 4000 Product Family Transmissions. Record engine speed, transmission sump fluid temperature, Main Mod solenoid state on or off, main hydraulic pressure, and clutch pressures in the ranges where a problem is suspected.

6–7. TORQUE CONVERTER PRESSURE

Occasionally, knowing the approximate torque converter pressure is helpful when troubleshooting symptoms like “transmission will not go to range” and some transmission overheat concerns.

Because torque converter pressure cannot be monitored within the torque converter itself, “torque converter out” pressure is used to approximate torque converter pressure. To measure “torque converter out” pressure, place a pressure gauge in a fitting that has been drilled with a pressure tap into the “To Cooler” line. Take this reading with the transmission in **N** (Neutral) and the engine running above 1400 rpm. Torque converter out pressure should measure between 276-552 kPa (40-80 psi).

6–8. 3000 PRESSURE SPECIFICATIONS

NOTE: Range applied clutch pressure and range applied lockup clutch pressure must not be more than 100kPa (15 psi) below measured main pressure for any range, and must meet the test specifications listed.

Table 6–1. 3000 Product Family Transmissions Idle Check (Input Speed 600 ± 20 rpm

SET			CHECK					
Input rpm	Range	Clutch(es) Applied	Main Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Cooler Flow LPM/(GPM)*	
			Spec	Actual	Spec	Actual	Spec	Actual
580-620	1C Main Mod OFF	C1, C5**	1240-1850 (180-270)		10-40 (1-6)		5-25 (1.3-6.6)	
	1C Main Mod ON		870-1480 (125-215)		10-40 (1-6)		5-25 (1.3-6.6)	
580-620	2C Main Mod OFF	C1, C4	1240-1850 (180-270)		10-40 (1-6)		5-25 (1.3-6.6)	
	2C Main Mod ON		870-1480 125-215		10-40 (1-6)		5-25 (1.3-6.6)	
580-620	Neutral Main Mod OFF	C5**	1510-2150 (220-315)		10-40 (1-6)		5-25 (1.3-6.6)	
	Neutral Main Mod ON		1170-1780 (170-260)		10-40 (1-6)		5-25 (1.3-6.6)	

Table 6–1. 3000 Product Family Transmissions Idle Check (Input Speed 600 ± 20 rpm *(cont'd)*

SET			CHECK					
Input rpm	Range	Clutch(es) Applied	Main Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Cooler Flow LPM/(GPM)*	
580-620	Reverse Main Mod OFF	C3, C5**	1450-2040 (210-295)		10-40 (1-6)		5-25 (1.3-6.6)	
	Reverse Main Mod ON***		1170-1750 (170-255)		10-40 (1-6)		5-25 (1.3-6.6)	

* Conversions not exact
** For software levels C171 and later, C5 Clutch Pressure Limiting Logic is in effect for Neutral and 1st ranges. C5 pressure is commanded lower than full main pressure by the PCS3 solenoid valve. Test C5 hydraulic circuit pressure integrity in Reverse range.
*** Reverse range is not included in Allison DOC® clutch test mode. To check main pressure at idle in reverse, select reverse at the shift selector.

SET			CHECK											
Input rpm	Range	Clutch(s) Applied	Main Pressure kPa/(psi)*		Applied Clutch Pressure kPa/(psi)*		Non-Applied Clutch Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Lockup Pressure kPa/(psi)*		Cooler Flow LPM/GPM*	
			Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual
2080-2120	Reverse	C3 C5 **	1800-2210 (260-325)		1700-2210 (245-325)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
2080-2120	Neutral Main Mod OFF	C5 **	1800-2300 (260-335)		1700-2300 (245-335)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
	Neutral Main Mod ON		1250-1850 (180-270)		1150-1850 (165-270)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
2080-2120	1C	C1 C5 **	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	2C	C1 C4	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	2L	C1 C4	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-270 (20-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	3C	C1 C3	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	3L	C1 C3	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-270 (20-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	4C	C1 C2	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	4L	C1 C2	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		125-270 (18-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	5C	C2 C3	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	5L	C2 C3	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		125-270 (18-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	6C	C2 C4	1345-1970 (195-290)		1240-1970 (180-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	6L	C2 C4	1000-1380 (145-205)		900-1380 (130-205)		0-75 (0-11)		125-270 (18-40)		900-1380 (130-205)		50-95 (13-25)	

* Conversions not exact

** For software levels C171 and later, C5 Clutch Pressure Limiting Logic is in effect for Neutral and 1st ranges. C5 pressure is commanded lower than full main pressure by the PCS3 solenoid valve. Test C5 hydraulic circuit pressure integrity in Reverse range.

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Figure 6–2. 3000 Product Family Transmissions Flow and Pressure Check (Input Speed 2100 ± 20 rpm)

Table 6–2. 3700SP Product Family Transmissions Idle Check (Input Speed 600 ± 20 rpm)

SET			CHECK					
Input rpm	Range	Clutch(es) Applied	Main Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Cooler Flow LPM/(GPM)*	
			Spec	Actual	Spec	Actual	Spec	Actual
580–620	Low C Main Mod OFF	C3, C6	1240–1850 (180–270)		10–40 (1–6)		5-25 (1.3-6.6)	
	Low C Main Mod ON		870-1480 (125-215)		10–40 (1–6)			
580-620	1C Main Mod OFF	C1, C5**	1240-1850 (180-270)		10-40 (1-6)		5-25 (1.3-6.6)	
	1C Main Mod ON		870-1480 (125-215)		10-40 (1-6)		5-25 (1.3-6.6)	
580-620	2C Main Mod OFF	C1, C4	1240-1850 (180-270)		10-40 (1-6)		5-25 (1.3-6.6)	
	2C Main Mod ON		870-1480 (125-215)		10-40 (1-6)		5-25 (1.3-6.6)	
580-620	Neutral Main Mod OFF	C5**	1510-2150 (220-315)		10-40 (1-6)		5-25 (1.3-6.6)	
	Neutral Main Mod ON		1170-1780 (170-260)		10-40 (1-6)		5-25 (1.3-6.6)	
580-620	Reverse Main Mod OFF	C3, C5**	1450-2040 (210-295)		10-40 (1-6)		5-25 (1.3-6.6)	
	Reverse Main Mod ON***		1170-1750 (170-255)		10-40 (1-6)		5-25 (1.3-6.6)	

* Conversions not exact

** For software levels C171 and later, C5 Clutch Pressure Limiting Logic is in effect for Neutral and 1st ranges. C5 pressure is commanded lower than full main pressure by the PCS3 solenoid valve. Test C5 hydraulic circuit pressure integrity in Reverse range.

*** Reverse range is not included in Allison DOC® clutch test mode. To check main pressure at idle in reverse, select reverse at the shift selector.

SET			CHECK											
Input rpm	Range	Clutch(s) Applied	Main Pressure kPa/(psi)*		Applied Clutch Pressure kPa/(psi)*		Non-Applied Clutch Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Lockup Pressure kPa/(psi)*		Cooler Flow LPM/GPM*	
			Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual
2080-2120	Reverse	C3 C5 **	1800-2210 (260-325)		1700-2210 (245-325)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
2080-2120	Neutral Main Mod OFF	C5 **	1800-2300 (260-335)		1700-2300 (245-335)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
	Neutral Main Mod ON		1250-1850 (180-270)		1150-1850 (165-270)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
2080-2120	Low C (7 Speed)	C3 C6	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		160-240 (23-35)		0-75 (0-11)		50-80 (13-21)	
2080-2120	1C	C1 C5 **	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	2C	C1 C4	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	2L	C1 C4	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-270 (20-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	3C	C1 C3	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	3L	C1 C3	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-270 (20-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	4C	C1 C2	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	4L	C1 C2	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		125-270 (18-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	5C	C2 C3	1550-1970 (225-290)		1450-1970 (215-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	5L	C2 C3	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		125-270 (18-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	6C	C2 C4	1345-1970 (195-290)		1240-1970 (180-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	6L	C2 C4	1000-1380 (145-205)		900-1380 (130-205)		0-75 (0-11)		125-270 (18-40)		900-1380 (130-205)		50-95 (13-25)	

* Conversions not exact

** For software levels C171 and later, C5 Clutch Pressure Limiting Logic is in effect for Neutral and 1st ranges. C5 pressure is commanded lower than full main pressure by the PCS3 solenoid valve. Test C5 hydraulic circuit pressure integrity in Reverse range.

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Figure 6–3. 3700 SP Product Family Transmissions Flow and Pressure Check (Input Speed 2100 ± 20 rpm)

6–9. 4000 PRESSURE SPECIFICATIONS

NOTE: Range applied clutch pressure and range applied lockup clutch pressure must not be more than 100kPa (15 psi) below measured main pressure for any range, and must meet the test specifications listed.

Table 6–3. 4000 Product Family Transmissions Idle Check (Input Speed at 600 ± 20 rpm)

SET			CHECK					
Input rpm	Range	Clutch(es) Applied	Main Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Cooler Flow LPM/(GPM)*	
			Spec	Actual	Spec	Actual	Spec	Actual
580-620	1C Main Mod OFF	C1, C5**	1240-1900 (180-275)		10-105 (1-15)		15-35 (4-10)	
	1C Main Mod ON		870-1480 (125-215)		10-105 (1-15)		15-35 (4-10)	
580-620	2C Main Mod OFF	C1, C4	1240-1900 (180-275)		10-105 (1-15)		15-35 (4-10)	
	2C Main Mod ON		870-1480 (125-215)		10-105 (1-15)		15-35 (4-10)	
580-620	Neutral Main Mod OFF	C5**	1515-2200 (220-320)		10-105 (1-15)		15-35 (4-10)	
	Neutral Main Mod ON		1170-1775 (170-260)		10-105 (1-15)		15-35 (4-10)	
580-620	Reverse Main Mod OFF	C3, C5**	1450-2200 (210-320)		10-105 (1-15)		15-35 (4-10)	
	Reverse Main Mod ON***		1170-1750 (170-255)		10-105 (1-15)		15-35 (4-10)	
580-620	Low C (7 Speed) Main Mod OFF	C1, C6	1240-1900 (180-275)		10-105 (1-15)		15-35 (4-10)	
	Low C (7 Speed) Main Mod ON		870-1480 (125-215)					

* Conversions not exact

** For software levels C171 and later, C5 Clutch Pressure Limiting Logic is in effect for Neutral and 1st ranges. C5 pressure is commanded lower than full main pressure by the PCS3 solenoid valve. Test C5 hydraulic circuit pressure integrity in Reverse range.

*** Reverse range is not included in Allison DOC® clutch test mode. To check main pressure at idle in reverse, select reverse at the shift selector.

SET			CHECK											
Input rpm	Range	Clutch(s) Applied	Main Pressurek Pa/(psi)*		Applied Clutch Pressure kPa/(psi)*		Non-Applied Clutch Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Lockup Pressure kPa/(psi)*		Cooler Flow LPM/GPM*	
			Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual
1780-1820	Reverse	C3 C5 **	1800-2300 (260-335)		1670-2300 (245-335)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
1780-1820	Neutral Main Mod OFF	C5 **	1800-2300 (260-335)		1670-2300 (245-335)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
	Neutral Main Mod ON		1250-1850 (180-270)		1150-1850 (165-270)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
1780-1820	Low C (7 Speed)	C1 C6	1550-1970 (225-285)		1450-1970 (210-285)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
1780-1820	1C	C1 C5 **	1550-1970 (225-285)		1450-1970 (210-285)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
1780-1820	2C	C1 C4	1550-1970 (225-285)		1450-1970 (210-285)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
1780-1820	2L	C1 C4	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-255 (20-37)		980-1450 (140-210)		55-105 (14-28)	
1780-1820	3C	C1 C3	1550-1970 (225-285)		1450-1970 (210-285)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
1780-1820	3L	C1 C3	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-255 (20-37)		980-1450 (140-210)		55-105 (14-28)	
1780-1820	4C	C1 C2	1550-1970 (225-285)		1450-1970 (210-285)		0-75 (0-11)		120-215 (17-31)		0-75 (0-11)		55-105 (14-28)	
1780-1820	4L	C1 C2	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		120-215 (17-31)		980-1450 (140-210)		55-105 (14-28)	
1780-1820	5C	C2 C3	1550-1970 (225-285)		1450-1970 (210-285)		0-75 (0-11)		120-215 (17-31)		0-75 (0-11)		55-105 (14-28)	
1780-1820	5L	C2 C3	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		120-215 (17-31)		980-1450 (140-210)		55-105 (14-28)	
1780-1820	6C	C2 C4	1340-1970 (195-285)		1240-1970 (180-285)		0-75 (0-11)		120-215 (17-31)		0-75 (0-11)		55-105 (14-28)	
1780-1820	6L	C2 C4	1000-1400 (145-205)		900-1400 (130-205)		0-75 (0-11)		120-215 (17-31)		900-1400 (130-205)		55-105 (14-28)	

* Conversions not exact

** For software levels C171 and later, C5 Clutch Pressure Limiting Logic is in effect for Neutral and 1st ranges. C5 pressure is commanded lower than full main pressure by the PCS3 solenoid valve. Test C5 hydraulic circuit pressure integrity in Reverse range.

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Figure 6–4. 4000 Product Family Transmissions Flow and Pressure Check (Input Speed 1800 ± 20 rpm)

6–10. RETARDER CHARGE PRESSURE SPECIFICATIONS

1. 3000 Product Family Low Speed/Low Torque Transmission Dyno Test.
   a. 3000 Product Family (except 3500 RDS/EVS/SPS, and MD 3560) Test Conditions:
      - Second Range Lockup, 100 Percent Retarder Apply, Input Speed = 1075-1125 rpm
   b. 3500 RDS/EVS/SPS and MD 3560 Test Conditions:
      - Second Range Lockup, 100 Percent Retarder Apply, Input Speed = 1350-1400 rpm

Table 6–4. 3000 Series Retarder Specifications At Above Test Conditions

Parameter To Determine	High Capacity	Medium Capacity	Low Capacity
Main Pressure-kPa [psi]	1080-1370 (155-200)	1080-1370 (155-200)	1080-1370 (155-200)
Retarder Charge Pressure-kPa [psi]	215-310 (30-45)	215-310 (30-45)	215-310 (30-45)
Cooler In Temperature-C° (F°)	150 (300) Max (Ref)	150 (300) Max (Ref)	150 (300) Max (Ref)

2. 3000 Product Family High Speed Vehicle Road Test Conditions:
   - Fourth Range Lockup, 100 Percent Retarder Apply, Input Speed =1900–2000 rpm

Table 6–5. 3000 Series Retarder Specifications At Above Test Conditions

Parameter To Determine	High Capacity	Medium Capacity	Low Capacity
Main Pressure-kPa [psi]	1080-1450 (155-210)	1080-1450 (155-210)	1080-1450 (155-210)
Retarder Charge Pressure-kPa [psi]	539-608 (75-90)	440-539 (65-78)	380-440 (55–65)
Cooler In Temperature-C° (F°)	150 [300] Max (Ref)	150 [300] Max (Ref)	150 [300] Max (Ref)

3. 4000 Product Family Low Speed/Low Torque Transmission Dyno Test.
   a. 4000 Product Family (except 4500 models) Test Conditions:
      - Second Range Lockup, 100 Percent Retarder Apply, Input Speed = 1025–1075 rpm
   b. 4500 Model Test Conditions:
      - Second Range Lockup, 100 Percent Retarder Apply, Input Speed = 1190–1240 rpm

Table 6–6. 4000 Series Retarder Specifications At Above Test Conditions

Parameter To Determine	High Capacity	Medium Capacity	Low Capacity
Main Pressure–kPa [psi]	1080-1370 (155-200)	1080-1370 (155-200)	1080-1370 (155-200)
Retarder Charge Pressure–kPa [psi]	150-230 (20-35)	150-230 (20-35)	150-230 (20-35)
Cooler In Temperature-C° (F°)	150 [300] Max (Ref)	150 [300] Max (Ref)	150 [300] Max (Ref)

4. 4000 Product Family High Speed Vehicle Road Test Conditions:
   - Fourth Range Lockup, 100 Percent Retarder Apply, Input Speed = 1550–1650 rpm

Table 6–7. 4000 Series Retarder Specifications At Above Test Conditions

Parameter To Determine	High Capacity	Medium Capacity	Low Capacity
Main Pressure–kPa [psi]	1080-1370 (155-200)	1080-1370 (155-200)	1080-1370 (155-200)
Retarder Charge Pressure–kPa [psi]	370-440 (55-65)	320-370 (45-54)	270-320 (35-45)
Cooler In Temperature-C° (F°)	150 [300] Max (Ref)	150 [300] Max (Ref)	150 [300] Max (Ref)

6–11. SOLENOID AND CLUTCH CHART

Table 6–8. Basic Configuration

Range	Solenoid Variable Bleed						Clutches					
	PCS1 N/O	PSC2 N/O	PCS3 N/C	PCS4 N/C	TCC N/C	SS1 On/Off	C1	C2	C3	C4	C5	LU
6	X			X	O			Y		Y		O
5	X		X		O	X		Y	Y			O
4					O	X	Y	Y				O
3		X	X		O	X	Y		Y			O
2		X		X	O	X	Y			Y		O
1		X	X		O		Y				Y	O
N-C5	X	X	X	*						*	Y	
NVL	X	X	X	X						Y	Y	
N-C4	X	X		X						Y		
N-C3	X								Y			
R	X		X						Y		Y	

NOTE: Refer to Table 6–10 for legend.

Table 6–9. 7-Speed Configuration (3000 and 4000 Product Families)

Range	Solenoid Variable Bleed									Clutches							
	PCS1 N/O	PCS2 N/O	PCS3 N/C	PCS4 N/C	TCC N/C	SS1 On/ Off	SS2 On/Off	PCS5 N/L	PCS6 N/L	C1	C2	C3	C4	C5	LU	C6	DIF
6	X			X	O						Y		Y		O		O
5	X		X		O	X					Y	Y			O		O
4					O	X				Y	Y				O		O
3		X	X		O	X				Y		Y			O		O
2		X		X	O	X				Y			Y		O		O
1		X	X		O					Y				Y	O		O
LO-3700	X						X	X	X			Y				Y	O
LO-4700		X					X		X	Y						Y	O
N-C5	X	X	X	*									*	Y			O
NVL	X	X		X									Y	Y			O
N-C4	X	X		X									Y				O
N-C3	X											Y					O
R	X		X									Y		Y			

NOTE: Refer to Table 6–10 for legend.

Table 6–10. Legend

X	Indicates solenoid is electrically ON.
Y	Indicates clutch is hydraulically applied.
Blank	Indicates solenoid is electrically OFF or clutch is not hydraulically applied.
O	Optional ON or OFF.
*	See NVL explanation below.
NVL	**As a diagnostic response:** If turbine speed is below 150 rpm when output speed is below 100 rpm and engine speed is above 400 rpm, Neutral Very Low (NVL) is commanded when N–C5 (Neutral) is the selected range. NVL is achieved by turning PCS4 solenoid on in addition to PCS3 being on, which locks the output. Otherwise, PCS4 solenoid is turned off N1 (Neutral). **As a commanded range when shifting to Fire Truck Pump Mode:** While wire 123 is energized before wire 122 is energized when going into Fire Truck Pump Mode, Neutral Very Low (NVL) will be commanded to lock the output to assist the shifting of the split-shaft PTO transfer case from road mode to pump mode. While wire 123 is de-energized before wire 122 is de-energized when shifting out of Fire Truck Pump Mode, Neutral Very Low (NVL) will be commanded to lock the output to assist the shifting of the split-shaft PTO transfer case from pump mode to road mode.

6–12. DIAGNOSTIC FLOW CHARTS USING CLUTCH TEST

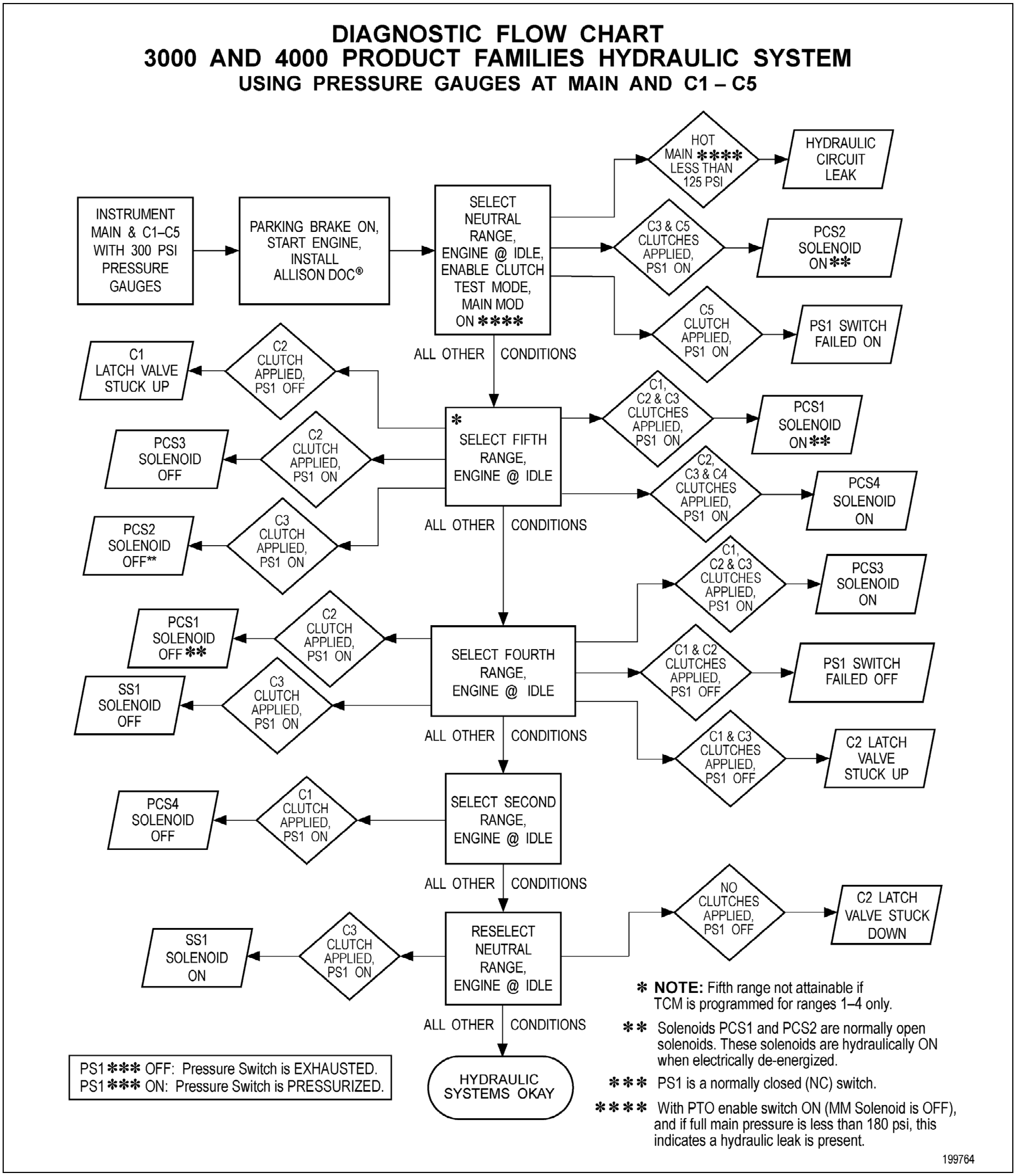


Figure 6–5. Diagnostic Flow Chart—3000 and 4000 Product Families Hydraulic System Using Pressure Gauges At Main and C1–C5

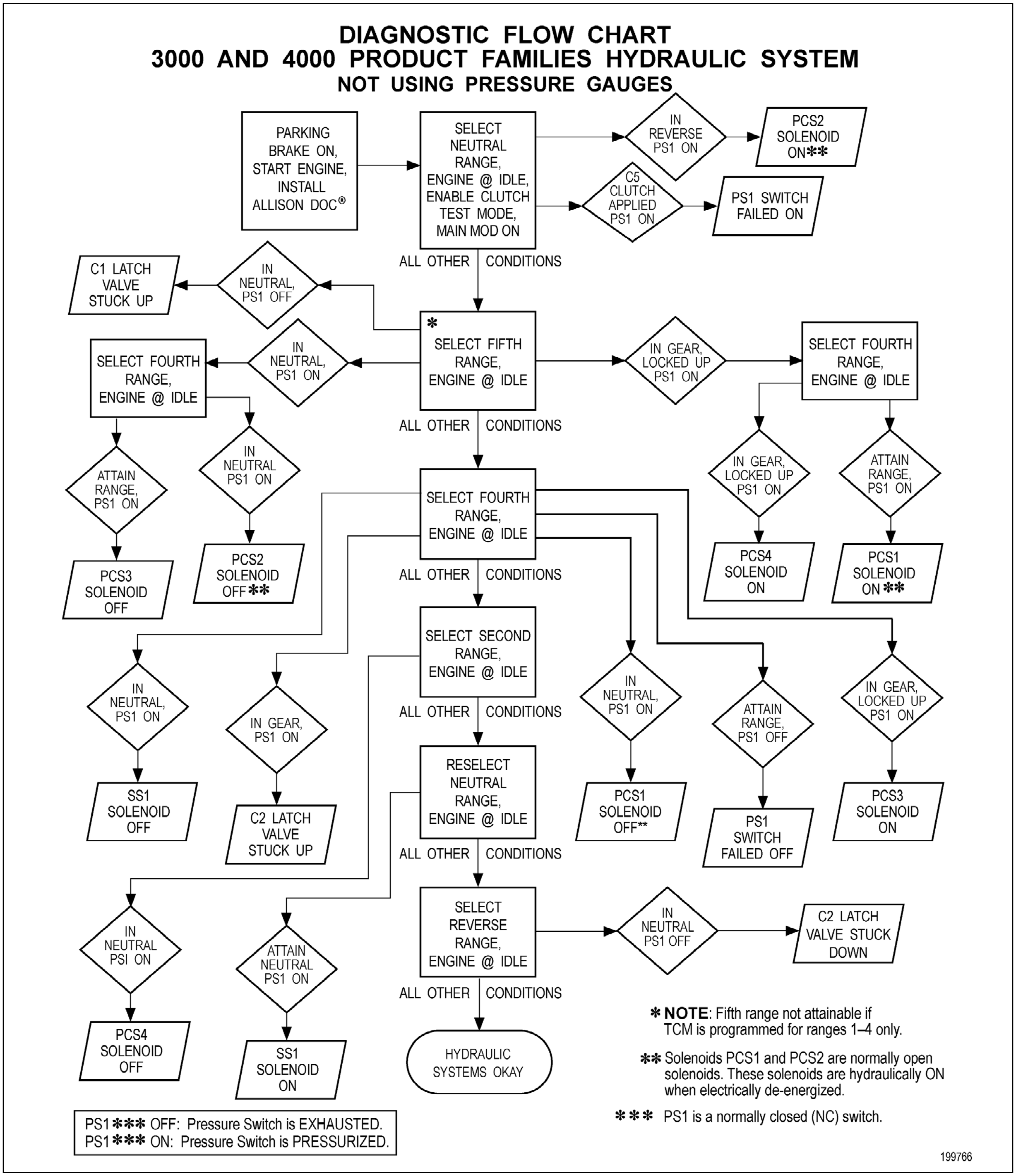


Figure 6–6. Diagnostic Flow Chart—3000 and 4000 Product Families Hydraulic System Without Pressure Gauges

6–13. SPEED SENSOR DATA

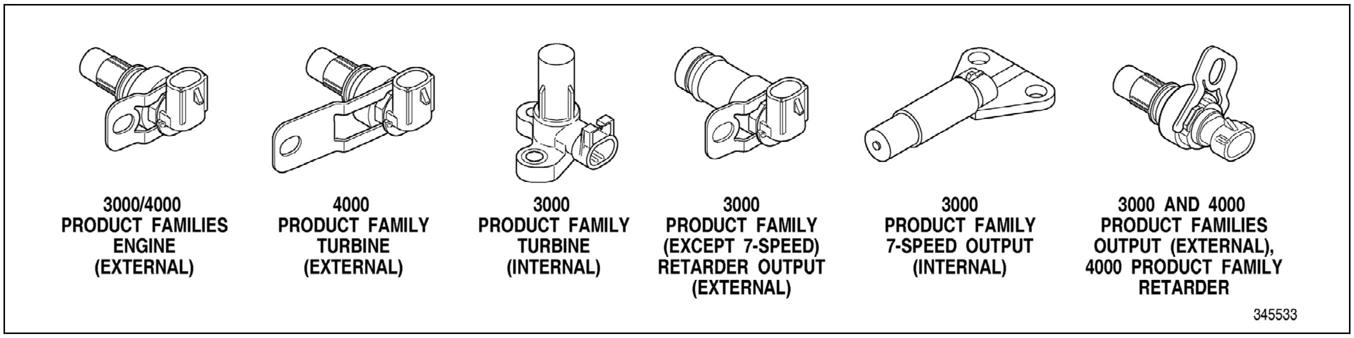


Figure 6–7. Speed Sensors

Table 6–11. Output Shaft Speed Sensor Nominal Resistance vs. Temperature

Nominal* Resistance	Temp °F	Temp °C
250	-40	-40
340	68	20
450	230	110
* Sensors meet specification at ± 25 Ω of nominal value		

6–14. SOLENOID DATA

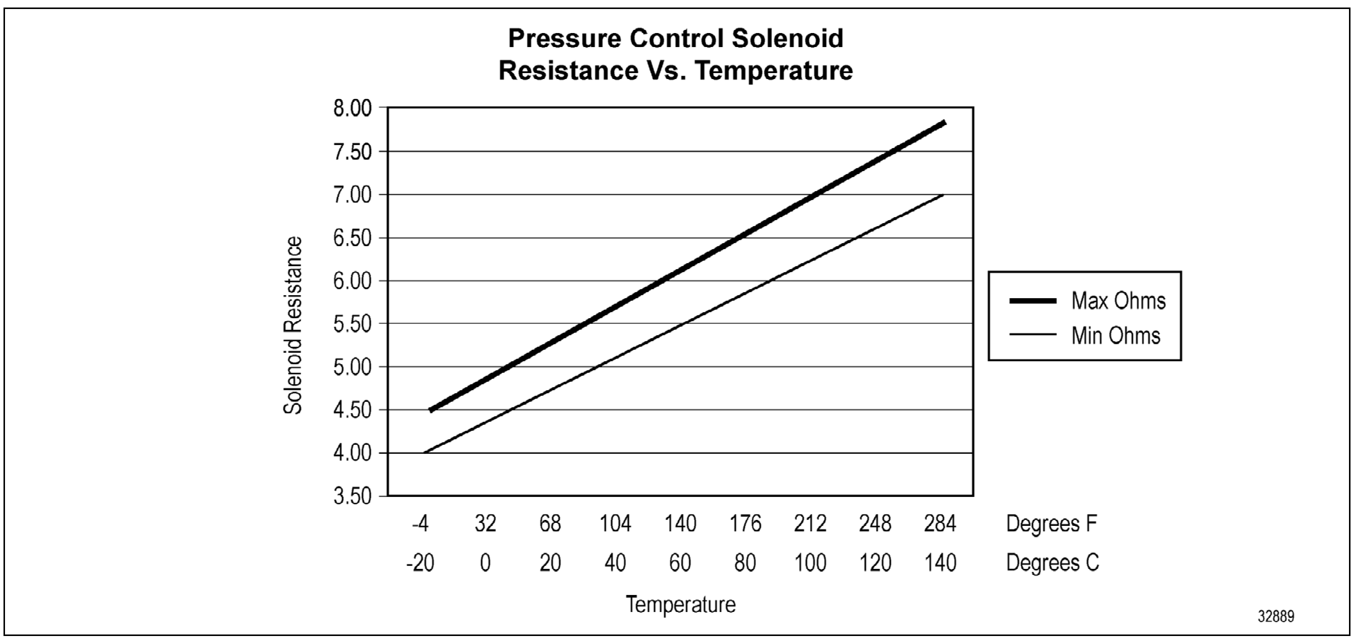


Figure 6–8. Variable Bleed Pressure Control Solenoids—Main Mod, TCC, PCS1-PCS4, PCS5 Retarder Only, PCS6

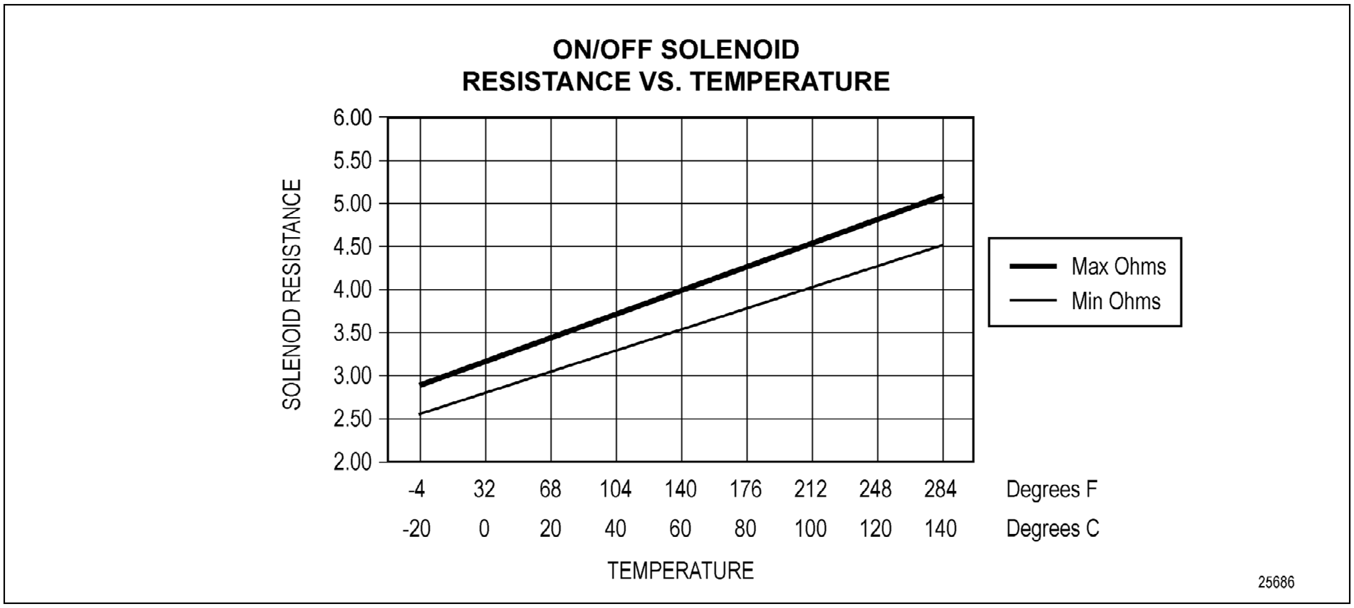


Figure 6–9. ON/OFF Solenoid–SS1, SS2 (7 Speed Only), PCS5 (Differential Lock 3700SP Only)

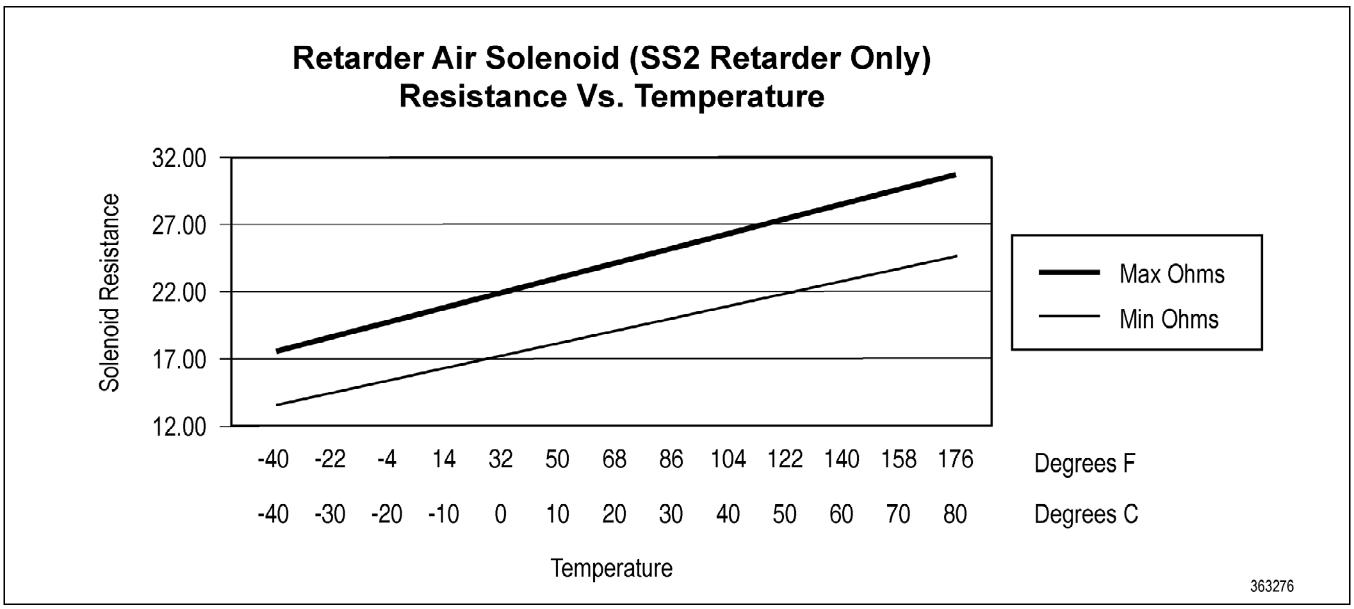


Figure 6–10. Retarder Air Solenoid—SS2 in Retarder Equipped Transmissions

6–15. TRANSMISSION FLUID TEMPERATURE (TFT) SENSORS

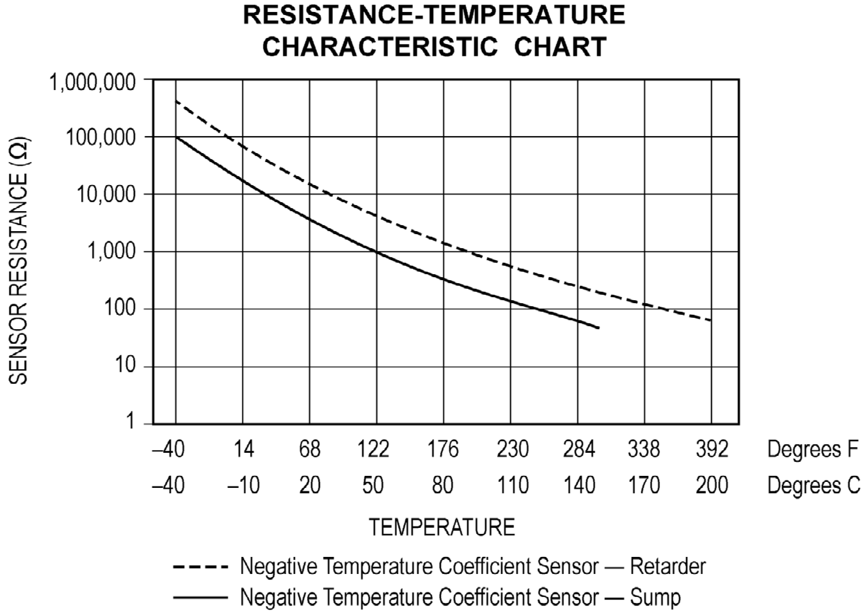


Figure 6–11. Transmission Fluid Temperature Sensors (Sump, Retarder) Characteristics

6–16. PRESSURE SWITCH DATA, PS1 AND PS2

PS1 and PS2 are both Normally Closed (N/C) switches that open with pressure. The switch should not exceed 5 Ω in a normally closed position (exhausted). With the switch open (pressurized), the switch should exceed 20 kΩ.

6–17. RETARDER MODULATION REQUEST (RMR) RESISTANCE MODULE DATA

Table 6–12. RMR Resistance Module Data

	Resistance Test in Resistance Module*		Voltage Signal**		Wiring to Control Device
Description	**Terminals**	**Resistance KΩ ± 5%**	**% Retarder Application**	**Voltage ± 0.2V**	**Device Terminal**
Auto Full On	A to C	12	100	3.6	No Connections
Pressure Switch Full On High	A to C	32	— 0 100	— 1.1 3.6	— A B
3-Step Bendix E-10R™ Pedal	A to C	32	0 32 58 100	1.1 1.9 2.8 3.6	A B C D

Table 6–12. RMR Resistance Module Data *(cont'd)*

	Resistance Test in Resistance Module*		Voltage Signal**		Wiring to Control Device
Description	**Terminals**	**Resistance KΩ ± 5%**	**% Retarder Application**	**Voltage ± 0.2V**	**Device Terminal**
6–Step Hand Lever Off Position 1 Position 2 Position 3 Position 4 Position 5 Position 6	A to C	32	— 0 16 28 48 65 84 100	— 1.1 1.5 1.9 2.3 2.8 3.2 3.6	— + 1 2 3 4 5 6
Auto 1/2 On	A to C	12	50	2.4	No connections
3 Pressure Switches Low Medium High	A to C	32	0 32 68 100	1.1 1.9 2.3 3.6	— A and B A and B A and B
Auto ⅓ On 2 Pressure Switches — Auto Medium High	A to C	21.4	— — — 32 68 100	— — — 1.9 2.8 3.6	— — — A B A and B
Dedicated Pedal	No Tests	Interface not a resistance module	0 100	0.7–1.2 3.4–3.5	A B

* Resistance module must be disconnected from the wiring harness and retarder control devices.
** These voltages may be measured between TCM pins 56 and 58 using J-47275 Harness Adapter.

6–18. THROTTLE POSITION SENSOR (TPS) ADJUSTMENT

1. Description and Operation
   a. To properly communicate throttle position to the TCM, the TPS must convert its mechanical movement to an electrical form the TCM can understand. To accomplish this, contacts move across a resistive strip inside the sensor which translates position into voltage (Figure 6–12).

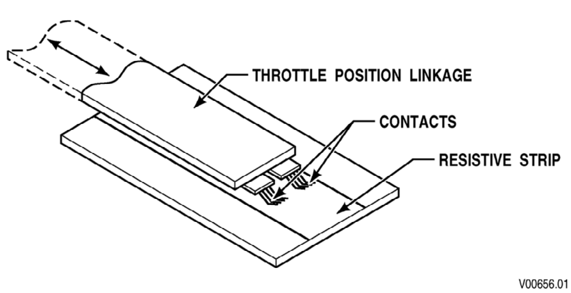


Figure 6–12. Throttle Position to Voltage Conversion

b. Each position gives a different voltage. The TCM then converts this voltage into percent. Each millimeter of travel converts to approximately 0.110 volts. Figure 6–13 diagrams the voltage and throttle movement relationship.

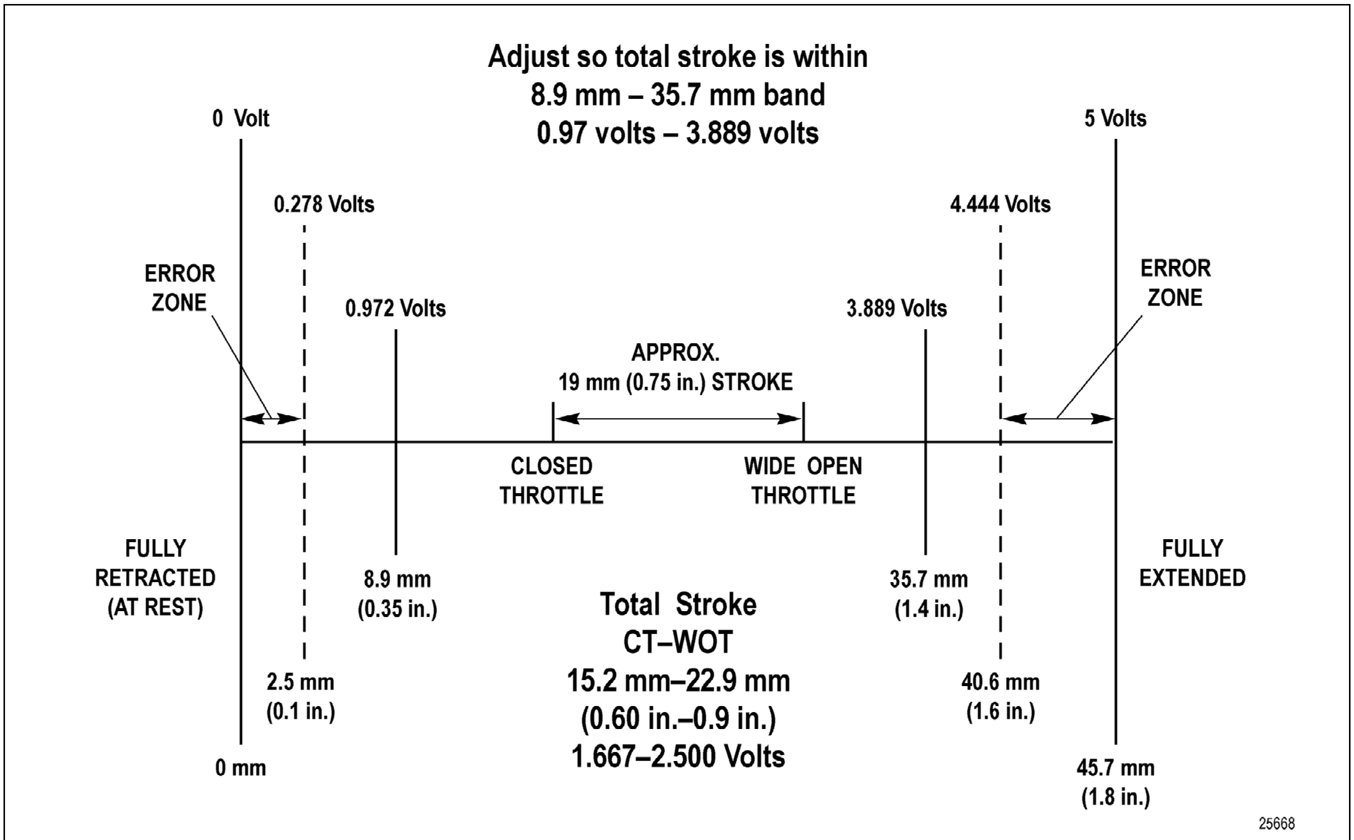


Figure 6–13. Throttle Position Determination Diagram

c. Throttle percent is proportional to the amount of travel of the TPS (Table 6–13). Therefore a small amount of travel corresponds to a low throttle percentage and a large amount of travel corresponds to a high throttle percentage.

d. The TPS is self-calibrating within its normal range of operation. Each time the vehicle is started and the TCM is initialized, the idle position that is stored for closed throttle is increased from its previous lowest reading. Also, the wide open throttle position is reduced from its previous highest reading. Once the new position is read from the TPS, the idle and wide open throttle set points are continuously readjusted to the lowest and highest points, respectively. This compensates for fuel control system wear or previous mechanical adjustment. One area of particular concern is when the throttle sensor extends into the error zone. This indicates a TPS misadjustment to the TCM and 100 percent throttle is assumed until readjustment is performed. Simply clearing the DTC will not resolve the situation; use the Allison DOC® to reset the TPS calibrations after a TPS adjustment.

2. Throttle Position Sensor (TPS) Adjustment

   When properly installed by the equipment manufacturer (Figure 6–14), the TPS should not require adjustment. Confirm that the TPS is installed to manufacturer specifications before adjusting the TPS. The idle position should be approximately 8.9 mm or 0.97 volts or higher, and full throttle position should be approximately 35.7 mm or 3.889 volts or lower. The TPS is self-calibrating, meaning there is no optimum closed position or wide open position. As long as the travel is within the 8.9–35.7 mm range the TPS is set properly. A total stroke of 15.2–22.9 mm must be maintained. Watch the movement of the TPS as the controls move it through its full stroke. Be sure there is no misalignment or obstruction to smooth movement through the full stroke. Make certain the idle and full throttle positions are not in the error zones (Figure 6–13). The error zones occur when the idle position is less than 2.5 mm, or when the full throttle position is more than 40.6 mm. When idle or wide open throttle positions are in the error zones, the TCM logs a code. When a TPS code is logged, the TCM assumes a default throttle setting which will negatively affect shift quality.

NOTE: Use J-41339 TPS/Retarder Harness for measuring voltages.

Table 6–13. Travel of the TPS

mm	Volts	mm	Volts
0	0	24	2.634
1	0.110	25	2.744
2	0.220	26	2.854
3	0.329	27	2.964
4	0.439	28	3.073
5	0.549	29	3.183
6	0.659	30	3.293
7	0.768	31	3.403
8	0.878	32	3.512
9	0.988	33	3.622
10	1.098	34	3.732
11	1.207	35	3.842
12	1.317	36	3.951
13	1.427	37	4.061
14	1.537	38	4.171
15	1.646	39	4.281
16	1.756	40	4.390
17	1.866	41	4.500
18	1.976	42	4.610
19	2.085	43	4.720
20	2.195	44	4.829
21	2.305	45	4.939
22	2.415	46	5.049
23	2.524		

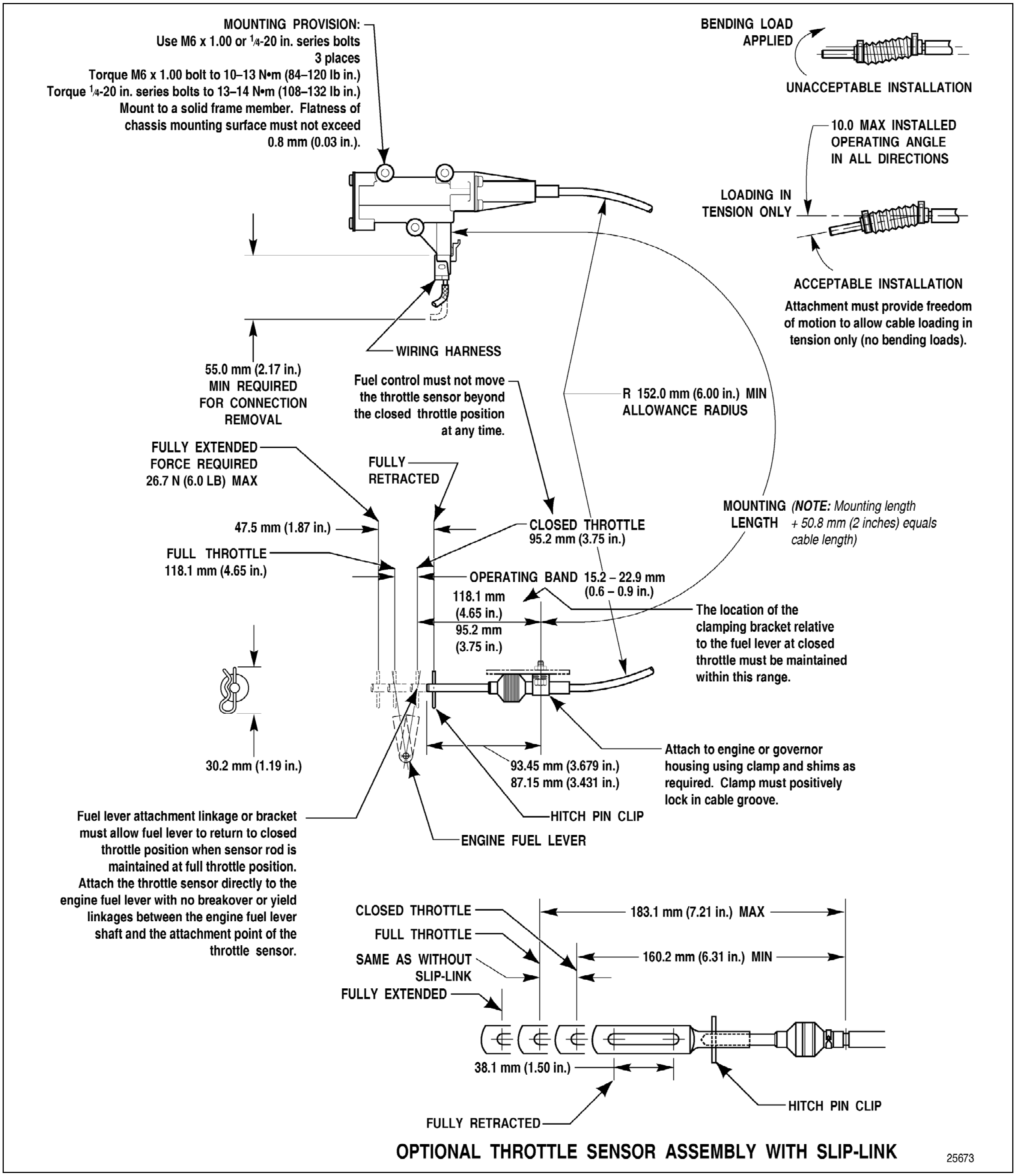


Figure 6–14. Throttle Position Sensor Adjustment

Section 6—CONTROL SYSTEM AND TRANSMISSION SPECIFICATIONS

Allison Transmission only supplies the parts of these assemblies for both service requirements and support equipment requirements to OEMs and DOEMs. Here is the list of parts that are attached to the TPS to achieve the different configurations.

Configuration	Description	Part number	Quality
Chassis-Mounted with Slip-Link	Throttle Position Sensor x length	Various	1
	Slip-Link	29503631	1
Engine-Mounted with Slip-Link	Throttle Position Sensor x length	Various	1
	Slip-Link	29503631	1
	Engine Bracket	29500824	1
	Grommet	29509441	3
	Ferrule	29509442	3
	0.250-20 x 2.250 long; bolt with nylon patch	29544294	3
Transmission-Mounted (Right or Left) with Slip-Link	Throttle Position Sensor x length	Various	1
	Slip-Link	29503631	1
	Engine Bracket	29508371	1
	Grommet	29509441	3
	Ferrule	29509442	3
	0.250-20 x 2.250 long; bolt with nylon patch	2954494	3

NOTE: The bolt for attaching the throttle sensor to the ferrules in engine and transmission brackets is torqued to 8-11 N·m (72-98 lb-in).

NOTES

7–1. GENERAL TROUBLESHOOTING OF PERFORMANCE COMPLAINTS

Table 7–1. Troubleshooting Performance Complaints

Problem	Probable Cause	Suggested Remedy
BATTERIES DEAD, ENGINE NO START, OR ENGINE STARTS AND DIES		
BATTERIES RUNNING DOWN WITH IGNITION OFF, SHIFT SELECTOR DISPLAY IS STAYING ILLUMINATED	Faulty ignition switch circuit	Resolve ignition circuit issue
	Ignition sense input to TCM or selector miswired to unswitched battery power	Correct point to point vehicle wiring
	Voltage backfeeding on GPI3, Wire 143, with ignition off	Turn off switch controlling GPI3 when ignition is off. Check that unswitched power is not backfeeding GPI3, e.g., a short to power on wire 143, etc.
	Output shaft speed detected **NOTE:** TCM will not power down by design when output shaft speed detected.	Resolve cause for false output shaft speed at a stop, e.g., vehicle vibration, electrical noise on speed sensor wiring, tone wheel loose, etc.
BATTERIES RUNNING DOWN SHIFT SELECTOR DISPLAYS ARE NOT ILLUMINATED WITH IGNITION OFF	Current drain not related to transmission controls	Resolve battery drain issue

Problem	Probable Cause	Suggested Remedy
ENGINE STARTS TO CRANK BUT STOPS	Loss of Neutral start signal for the following:	
	Battery voltage dipping below 4.75 volts during engine crank	Resolve battery capacity or battery cable issue
	Vehicle Neutral start circuit component issue, e.g., starter relays, engine TCM, etc.	Resolve Neutral start circuit component issue e.g., starter, starter relays, cables, etc.
	Ignition switch issue	Resolve ignition switch circuit issue, e.g., ignition switch, relays, engine TCM, etc.
	Starter issue	Resolve starter issue
ENGINE WILL NOT CRANK	Neutral start signal not present for the following:	
	For lever shift selector, lever not in **N** (Neutral) position	Select **N** (Neutral)
	Ignition fuse or unswitched battery fuse(s) open	Resolve condition causing fuse to blow, then replace fuse
	Ignition switch is off, miswired, or open	Resolve ignition switch or wiring issue
	Ignition wiring to TCM or shift selector open or miswired	Resolve point-to-point wiring issue
	Vehicle’s master disconnect switch off or switch issue	Turn on master disconnect or resolve switch issue
	Unswitched battery power to shift selector or TCM miswired or open	Resolve point-to-point wiring issue
	Battery voltage below 4.75 volts during engine cranking	Resolve battery capacity issue, or battery cabling, e.g., corrosion, wire gauge, loose powers and grounds, etc.
	Fuse blown in VIM if equipped	Repair cause for blowing fuse and replace fuse
	Neutral start relay issue in VIM, if equipped	Replace neutral start relay in VIM
	TCM issue	Replace TCM **NOTE:** Install original TCM again to verify the complaint only occurs with the original TCM.
ENGINE STARTS AND DIES IN **N** (Neutral)	Non-transmission issues	Consult vehicle or engine OEM service location. This issue not related to transmission controls or transmission

Problem	Probable Cause	Suggested Remedy
ENGINE STARTS AND DIES AFTER A RANGE IS SELECTED	Lock-up clutch hydraulically applied	Measure for high exhaust backfill pressure at an exhausted clutch besides lockup. Measure the lockup clutch pressure in Neutral. Repair control valve module issue causing high exhaust backfill pressure at idle or high lock-up clutch pressure in Neutral at idle, e.g., replace TCC solenoid, etc. Check for turned ground sleeve causing lockup clutch to apply. Replace ground sleeve and front support if turned in front support. Miswired TCM solenoid in vehicle harness. Resolve issue with vehicle wiring
	Lock-up clutch mechanically applied, with no lock up apply pressure present	Repair damaged lockup clutch components
ENGINE CRANKS BUT DOES NOT START	Non-transmission issue	Consult vehicle or engine OEM service location. This issue not related to transmission controls or transmission
	CHECK TRANS LIGHT ISSUES	
CHECK TRANS LIGHT WILL NOT GO OUT AFTER ENGINE STARTS, TRANSMISSION DIAGNOSTIC RESPONSE OCCURS	Active DTC	Troubleshoot DTC
CHECK TRANS LIGHT WILL NOT GO OUT AFTER ENGINE STARTS, TRANSMISSION DIAGNOSTIC RESPONSE DOES NOT OCCUR	**CHECK TRANS** light circuit issue, e.g., wire short	Resolve **CHECK TRANS** light circuit issue. Use action request for **CHECK TRANS** light
	Erroneous datalink message from non-transmission controller	Resolve datalink message issue with vehicle controller. Monitor datalink traffic file duplicating issue with Data Bus Viewer
CHECK TRANS LIGHT FLASHES INTERMITTENTLY	Active DTC	Troubleshoot DTC
	CHECK TRANS light circuit has intermittent connection, e.g., intermittent open	Resolve **CHECK TRANS** light circuit issue. Use action request for **CHECK TRANS** light

Problem	Probable Cause	Suggested Remedy
	Erroneous datalink message from non-transmission controller	Resolve datalink message issue. Monitor using Data Bus Viewer
NO BULB CHECK FOR CHECK TRANS LIGHT AT START-UP	**CHECK TRANS** light circuit issue, e.g., open circuit to light	Resolve **CHECK TRANS** light circuit issue. Use action request for **CHECK TRANS** light.
	Erroneous datalink message from non-transmission controller	Resolve datalink message issue. Monitor using Data Bus Viewer
	CONVERTER STALL SPEED ISSUES	
STALL SPEED EXCEEDS SPECIFICATION MORE THAN 150 RPM **NOTE:** Do not stall transmission more than 30 seconds without returning to **N** (Neutral). Stay in **N** (Neutral) until transmission fluid cools. Transmission damage occurs from maintaining high stall speed conditions for too long	Not in gear	Place in forward range **NOTE:** Some OEM(s) prohibit stall testing in **1** (First Range) to protect the driveline components. In addition, do not stall test in **R** (Reverse) or **7** (Seventh Range) (Low) for 7-speed models. If possible use Allison clutch test and pick 2nd through 6th for stall testing.
	Incorrect fluid level	Correct the fluid level
	Incorrect torque converter or converter components	Replace incorrect components with correct components causing issue e.g., converter pump assembly, stator
	Slipping clutch	See solutions for shift quality issue
	Engine rating mismatched to converter assembly specified by OEM	Resolve engine rating issue
STALL SPEED BELOW SPECIFICATION MORE THAN 150 RPM	Engine is low on power	Resolve engine power issue
	Stator freewheeling **NOTE:** A free-wheeling stator lowers normal stall speed about 33%.	Repair stator components causing free-wheel condition
	Incorrect or misassembled torque converter or converter components	Replace incorrect components with correct components causing issue e.g., converter pump assembly, stator

Problem	Probable Cause	Suggested Remedy
	Low converter pressure	Resolve issue with low converter pressure, e.g., repair any components causing converter flow valve sticking, valve stop pin damage, broken springs, loose bolts, converter assembly leak, cooler leak
	4TH LOCKUP PUMP MODE ISSUES	
4TH LOCKUP PUMP MODE FUNCTION NOT WORKING	Function not enabled	Enable function with Allison DOC®
	Wiring, connector, switch or relay issue	Determine which input wire is open using Allison DOC® Snapshot and Data Monitor. Resolve the issue causing the open input
	Transfer case components worn or damaged	Resolve mechanical issue with transfer case
GRINDING NOISE GOING PUMP MODE TO ROAD MODE	Transfer case components worn or damaged	Resolve transfer case issues
	Transmission output shaft still turning after selecting **N** (Neutral) while trying to enter road mode	Install momentary normally closed trans brake switch in the switch-to-power input for function. Opening switch in **N** (Neutral) enables Trans Brake if less than 175 output rpm
	Trans brake switch does not lock output because output shaft rpm over 175 rpm	Overhaul transmission
AFTER ENTERING PUMP MODE, TRANSMISSION UPSHIFTS FROM 1ST RANGE INSTEAD OF PRESELECTING TO 4TH RANGE	Function inputs are switching after **D** (Drive) selected	Function inputs must transition while in **N** (Neutral). Resolve issue with switch inputs delaying until **D** (Drive)
BUTT-TOOTH CONDITION OCCURRING IN TRANSFER CASE PREVENTING PUMP MODE	Transfer case components worn or damaged	Resolve transfer case issues
	Windup torque preventing engagement	For a CIN starting with 44, update the A40 series TCM calibration to a CIN beginning with 48, then recheck for condition. Update A50 series TCM calibrations to latest 4F CIN and recheck condition

Problem	Probable Cause	Suggested Remedy
	Excessive clutch drag while in N (Neutral)	Overhaul transmission
	FLUID CONDITION ABNORMAL OR DETERIORATED	
FLUID DARK, SMELLS OK	Poor maintenance	Change fluid and filters according to Allison requirements
	Unapproved fluid	Use Allison recommended fluid. Change transmission filters as required
FLUID VERY DARK, HAS STRONG ODOR	Fluid overheated	See Overheat indicated by DTC P0218, P273F, or Fluid Condition
FLUID LOOKS MILKY AND PINK OR BROWN	Coolant in transmission fluid	Resolve coolant leak issue, rebuild transmission
FLUID GELLED OR LIKE MUD	Coolant in transmission fluid	Resolve coolant leak issue, rebuild transmission
	Unapproved fluid	Use Allison recommended fluid. Overhaul transmission
	Fluid overheated	See Overheat indicated by DTC P0218, P273F, or Fluid Condition
FLUID VISCOSITY, TOTAL ACID NUMBER (TAN), OR CONTAMINANT (INCLUDING WATER OR COOLANT PERCENTAGE) EXCEEDS ATI LIMITS	Various	Change fluid and filters. Refer to Technician’s Guide, Automatic Transmission Fluid, Understanding/Analysis SA2055A

Problem	Probable Cause	Suggested Remedy
OIL SAMPLE SHOWS LAST WEAR METAL DATA POINT DEVIATES SHARPLY ABOVE ESTABLISHED TRENDLINE SLOPE. USE AT LEAST 4 SAMPLE POINTS TO ESTABLISH THE TRENDLINE SLOPE **NOTE:** A maximum wear metal specification based solely on absolute value for a specific wear metal from a sample of oil without using trendline analysis is not recommended. Trendline analysis establishes a baseline slope for each transmission installation by plotting at least four oil samples for any specific wear metal. **NOTE:** Cause for action is driven by a significant deviation above a trendline. Other variables influence a deviation value, besides the transmission, like differences in test technique between labs, changes in oil storage and pumping methods between facilities, changes in fluid types, failures in components that contact the transmission fluid etc. **NOTE:** Never base the transmission removal step solely on a single deviated test point. Instead, use the deviated wear metal data point as a reason to perform an in-vehicle inspection and functional check of the transmission.	Various	Perform transmission functional check e.g., shift quality, active DTCs, filter inspection, or control valve module removal to look for debris and suction filter debris. Overhaul transmission only if functional check indicates an issue exists in the transmission. Refer to Technician's Guide, Automatic Transmission Fluid, Understanding/Analysis SA2055A **NOTE:** If the transmission functional checks, such as fluid filter check, visual fluid check, shift quality check, and clutch pressure check are all normal, do not remove the transmission from the vehicle. Instead, continue to monitor the transmission for issues.
	FLUID LEAK ISSUES	
FLUID LEAK FROM BREATHER	Fluid level too high	Correct fluid level
	Loose front support bolts	Tighten and correctly torque front support bolts
	Rotated ground sleeve	Replace ground sleeve and front support

Problem	Probable Cause	Suggested Remedy
	Misassembled or damaged component in rotating hub assembly e.g., rotating hub cracked, rotating drum cracked, snap-ring dislocated, piston seal damaged	Repair or replace any damaged rotating hub component causing fluid to exit breather
LEAK FROM TOP OR BOTTOM OF FILL-TUBE	Fluid level too high	Correct fluid level
	Dipstick loose or top fill tube cap worn or damaged	Replace dipstick or repair dipstick cap or seal
	Breather clogged or damaged	Clear breather of debris or replace breather
	Fill tube seal worn, damaged, or missing	Replace fill tube seal
LEAK FROM MAIN CASE PLUG ASSEMBLY (3000 SERIES ONLY)	Plug not seated	Install plug assembly correctly
	Plug seal worn, damaged, or missing	Replace seal
	Damaged or missing plug	Replace plug and seal
	Shipping plug installed in place of plug assembly	Install plug seal
INPUT SEAL LEAK	Input seal worn or damaged	Replace input seal
	Engine adaptation exceeds specifications, misassembled, worn, or damaged	Resolve issues with engine adaptation
	Debris on seal or converter hub or PTO drive hub	Clean input seal, converter pump assembly hub, and PTO drive hub surfaces
	Converter pump assembly hub or PTO drive hub damaged, worn	Replace converter pump assembly or PTO drive hub
	Worn bushing	Replace bushing
	PTO models, PTO driveline exceeds ATI driveline specifications	Resolve issue with PTO driveline
CONVERTER ASSEMBLY LEAKING	Engine adaptation exceeds specifications, misassembled, worn, or damaged	Resolve issues with engine adaptation
	Seal between converter pump assembly and converter front cover damaged	Replace seal

Problem	Probable Cause	Suggested Remedy
	Torque converter bolts not torqued to specification	Torque bolts to specification
	Missing, or broken torque converter bolts	Replace missing or broken torque converter bolts and torque all bolts to specification
OUTPUT OIL SEAL LEAK	Output seal worn or damaged	Replace output oil seal
	Output flange worn, grooved or damaged	Replace output flange and output oil seal
	Damaged or missing output bolt	Torque output bolt to specification. Run driveline report, inspect driveline and resolve any driveline issues found
	Loose or missing output bolt O-ring	Replace O-ring
	Damaged or missing output retainer plate O-ring	Replace O-ring
	Damaged or missing output retainer plate	Replace retainer plate assembly. Run driveline report, inspect driveline and resolve any driveline issues found
ALL OTHER LEAK AREAS	Various, e.g., loose, missing or damaged bolts at transmission casting split-lines; damaged gaskets at split-lines; loose or damaged transmission cooler lines; loose or damaged fittings; loose or damaged plugs or O-rings; loose or damaged PTO line; cracked or porous casting	Identify cause for leak and correct. Refer to SIL 19-TR-03 for additional information on how to identify leaks
	Non-transmission leak misidentified as transmission fluid leak, engine output oil seal leak, oil-pan leak, hydraulic fluid leak from fan drive, fluid leak from PTO, loose hydraulic fluid lines and fittings, leaking brake system component, leaking engine coolant, insufficiently filtered compressed air system leaking contaminants, water or oil	Identify non-transmission cause and resolve leak issue

Problem	Probable Cause	Suggested Remedy
	INHIBIT ISSUES	
TRANSMISSION STAYS IN **N** (Neutral) WHEN **D** (Drive) OR **R** (Reverse) SELECTED, THE SELECT CHARACTER OF THE SHIFT SELECTOR IS BLINKING, RANGE INHIBIT INDICATOR IS ALSO ON IN ALLISON DOC®	I/O inputs state causing a range inhibit	Use Allison DOC® to snapshot issue. Review all inputs of enabled I/O functions e.g., Direction Change Enable, Auto Neutral functions, Auxiliary Function Range Inhibit, etc. Refer to the Universal Allison DOC® Technician's Library for additional information.
	Datalink message is active or missing causing a range inhibit	Use Data Bus Viewer to log issue. Review all logs to determine cause for inhibit **NOTE:** When using Data Bus Viewer to monitor datalink message issues, typically, it is better to select Reuse Allison DOC® connection. Reusing the existing connection allows all TCM and selector datalink messages to be collected along with outside controller messages.
	Range inhibit caused from exceeding software limits for engine speed, accelerator position percent, output shaft speed, or wheel spin or lock	Use Allison DOC® to determine cause for inhibit and correct issue. Refer to 2–26. SHIFT INHIBIT LOGIC for additional information.
ALLISON DOC® INHIBIT GRID SHOWS TRANSFER CASE INHIBIT ACTIVE	**N** (Neutral) not reselected prior to exiting Allison DOC® action request, e.g., clutch test, full main pressure test	Disregard active inhibit
ALLISON DOC® INHIBIT GRID SHOWS DIAGNOSTIC INHIBIT WITHOUT ACTIVE DTC	Allison DOC® Inhibit grid shows diagnostic inhibit active without an active DTC, history, or failure record	Disregard active inhibit. Engine speeds below 200 rpm e.g., ignition ON engine OFF causes diagnostic inhibit.
	INPUT/OUTPUT (I/O) FUNCTION ISSUES	
I/O FUNCTION NOT WORKING	Function not enabled	Enable function using Allison DOC®
	Wiring or connector issue	Resolve wiring or connector issue
	Switch or relay issue	Resolve switch or relay issue
	Datalink message inhibiting the function	Resolve datalink issue

Problem	Probable Cause	Suggested Remedy
	Required datalink message missing	Resolve datalink issue **NOTE:** When using Data Bus Viewer to monitor datalink message issues, typically, it is better to select Reuse Allison DOC® connection. Reusing the existing connection allows all TCM and selector datalink messages to be collected along with outside controller messages.
	Defective TCM.	Replace TCM
INPUT/OUTPUT FUNCTION WITH MODE BUTTON AS INPUT NOT WORKING	**MODE** button function latched disabled during previous package change	Switch back to the original wire package and enable the **MODE** button. Make the wire package change as needed
INPUT/OUTPUT FUNCTION WORKING INCORRECTLY	Switch or relay logic reversed, e.g., wired to Normal Open side vs. Normal Close	Resolve issue with relay or switch wiring
	CMC set incorrectly	Set CMC(s) correctly using Allison DOC®
	LOW TRANSMISSION FLUID PRESSURES	
MAIN PRESSURE LOW	Low fluid level	Correct fluid level
	Transmission fluid feels gelled	Overhaul transmission
	Faulty pressure gauge	Try different gauge. Install new pressure gauge if old one is faulty
	Main filter full of debris	Replace main and lube filter and recheck
	Suction filter full of debris	Overhaul transmission
	Main pressure regulator valve sticking; main pressure valve spring issue	Repair condition with valve, valve bore, or spring
	Excessive internal control valve module leakage to sump	Repair condition in control valve module causing excessive internal leakage to sump
	Oil pump issue	Repair or replace damaged components causing oil pump issue
	Front support bolts loose	Tighten front support bolts to specifications
	Pump tangs broke on converter or PTO drive hub	Repair or replace damaged components causing pump tang breakage

Problem	Probable Cause	Suggested Remedy
CLUTCH PRESSURE IS LOW **NOTE:** Clutch pressures are considered low if they are 15 psi or more lower than main pressure specifications for the range commanded. Refer to 6–1. MEASURING TRANSMISSION PRESSURES for additional information.	Low fluid level	Correct fluid level
	Faulty pressure gauge	Try a different gauge. Install new pressure gauge if old one is faulty
	Main filter full of debris	Replace main and lube filter and recheck
	Suction filter full of debris	Overhaul transmission
	Sticky trim valve	Repair condition with valve, valve bore, or spring
	Sticky shift solenoid valve	Repair condition with valve, valve bore, or spring
	Trim spring issue	Repair condition with valve, valve bore, or spring
	Excessive internal control valve module leakage to sump	Repair condition in control valve module causing excessive internal leakage to sump
	Clutch piston seal leaking	Replace clutch piston seal
	Oil pump issue	Repair or replace damaged components causing oil pump issue
	Front support bolts loose	Tighten front support bolts to specification
	Pump tangs broke on converter or PTO drive hub	Repair or replace damaged components causing pump tang breakage
	Rotated ground sleeve	Replace front support and ground sleeve
	Damaged or missing seal rings on front support	Replace damaged or missing seal rings
	Damaged or missing seal rings on turbine shaft	Replace damaged or missing seal rings

Problem	Probable Cause	Suggested Remedy
	TCM issue	Replace TCM **NOTE:** Install original TCM again to verify the complaint only occurs with the original TCM.
LUBE PRESSURE IS LOW	Low fluid level	Correct fluid level
	Faulty pressure gauge	Try different gauge. Install new pressure gauge if old one is faulty
	Lube filter full of debris	Replace main and lube filter and recheck
	Transmission fluid gelled	Overhaul transmission
	Oil cooler plugged	Flush or replace cooler
	Cooler lines or cooler leaking or restricted	Reroute, repair, or replace restricted cooler lines and fittings
	Converter regulator valve or lube regulator valve sticking, valve stop pin broken, damaged or broken springs, loose bolts, damaged gaskets	Repair or replace damaged, broken, or misassembled control module component such as valves, valve spring, valve stop pin, valve body, etc. causing low lube pressure
	Worn or missing bushings, and/or seal rings	Replace worn or missing bushings or seal rings
	NOISE OR VIBRATION ISSUES	
BUZZING NOISE FROM TRANSMISSION	Low fluid level	Correct fluid level
	Transmission fluid gelled	Overhaul transmission
	Plugged filters	Analyze TransHealth reports. Inspect for clutch failure by removing control module and suction filter. Overhaul if required, otherwise replace filters and fluid
	Low main pressure	For additional information, refer to Low Transmission Fluid Pressures found is this table
	Aerated fluid	Correct fluid level

Problem	Probable Cause	Suggested Remedy
PTO NOISE AT IDLE WHILE PTO DISENGAGED	Engine torsional vibration causing rattle sound	Increase or decrease idle speed to decrease rattle of PTO assembly gears Remove the PTO and then verify noise is not present. If noise not present, resolve issue with PTO manufacturer, OEM, or the Body-builder who is responsible for PTO issues. If present, go to "Unidentified Noise" problem **NOTE:** Transmission PTO drive gear to the PTO driven gear backlash specification is 0.10-0.66 mm (0.004-0.026 in). Maximum axial movement of transmission PTO drive gear is 3.18 mm (0.125 in)
SPLIT SHAFT PTO NOISE DURING OPERATION	PTO driveline out of specification	Resolve PTO driveline issue
OVERDRIVE WHINE OR HISS IN 5TH OR 6TH RANGE FROM TRANSMISSION	P2 pinions or P3 ring gear	If transmission noise above commercially acceptable level for that vehicle class range, replace P2 pinions and P3 ring gear
DRIVELINE VIBRATION SYMPTOMS AND PROBLEMS: VIBRATION FELT THROUGH THROTTLE PEDAL, STEERING WHEEL, SEAT FRAME, OR FLOOR OF VEHICLE, LOW FREQUENCY NOISE COMPLAINT, OUTPUT BOLT LOOSE OR MISSING, OUTPUT RETAINER PLATE DAMAGED, REPEAT OUTPUT SEAL LEAKS IN SHORT PERIOD, DAMAGED OR PREMATURELY WORN DRIVELINE COMPONENTS, ROTATING DRUM CRACKED, C5 FRICTION PLATE SPLINE WEAR ON BOTH SIDES OF TEETH	Driveline exceeds ATI specification for torsional, inertial, or coast accels	Measure driveline parameters. Run Allison DOC® driveline report. Correct driveline to specification. Rerun driveline report to confirm results

Problem	Probable Cause	Suggested Remedy
	Poor driveline maintenance e.g., U-joints incorrectly installed or worn out, slip-joint spline not greased, ride height is incorrect, carrier bearing worn out	Repair or replace damaged driveline components
	Slip-joint bottoms out in tube	Resolve slip-joint issue
	Driveline out of balance	Resolve balance issue
	Driveline(s) runout exceeds ATI specification 0.381 mm (0.015 inch)	Resolve runout issue with driveline pieces out of specification
	Driveline whip e.g., from undersized tube wall thickness or driveline too long for output shaft speeds attained (critical speed)	Resolve whip issue caused by driveline design. Use IScaan report, Tech Data Critical Speed Charts and Shift Summery Reports to determine if critical speed exceeded for this vehicles driveline configuration
	U-joints out of phase	Resolve U-joint phase issue. Consult with vehicle OEM or bodybuilder who installed driveline to determine phasing requirements
UNIDENTIFIED NOISE PRESENT	Vehicle components in close contact with transmission	Resolve issues with vehicle components in close proximity or in contact with transmission, such as exhaust system components etc. Verify ride height is correct for vehicle.
	Transmission or engine mounts loose or requiring repair	Check engine and transmission mounts. Check that transmission, equipment bolted to transmission, and driveline components are not in contact with other vehicle components, cab, or frame in a manner that is creating the noise.

Problem	Probable Cause	Suggested Remedy
	Internal transmission issue	Use Chassis Ears or stethoscope to determine source or disconnect, if possible, auxiliary equipment such as pumps, transfer cases to isolate source of noise. Remove transmission and install on transmission dyno test stand. Conduct complete clutch test and also check transmission operation at idle and at 2100 rpm in **N** (Neutral) for the noise. If transmission noise is audibly objectionable to unaided human ear, then use chassis ears or stethoscope at various places on the transmission to isolate the location, e.g., front, middle, back, left, right, center, in case transmission must be disassembled and inspected. Do not disassemble and inspect transmissions based solely on chassis ears or stethoscope. Internal noises of transmission are amplified through this device. Always verify the noise exists based on unaided human ear test first.
OVERHEATING INDICATED BY DTC P0218, P273F OR FLUID CONDITION INDICATES OVERHEAT		
TRANSMISSION FLUID OVERHEAT INDICATED BY ACTIVE DTC P0218, P273F OR FLUID CONDITION INDICATES OVERHEAT	Refer to DTC P0218 or DTC P273F	Troubleshoot DTCs
	Incorrect fluid level	Correct fluid level

Problem	Probable Cause	Suggested Remedy
	Oil-to-Water coolers installed on suction side of water pump with thermostats not bypassed	Resolve coolant flow issue due to insufficient bypass on suction side installations **NOTE:** To check for coolant flow inside the cooler with the thermostats closed, install a flow-meter in the water inlet side of the cooler. Alternately, lack of proper coolant flow could be deduced if mechanically blocking the thermostats open-resolves the overheat condition. Do not put the vehicle back in service without a working thermostat, the cooling system will not operate within specification.
	Oil-to-Air cooler's air flow restricted, insufficient in design or installation, air cooling system issue	Resolve air flow issue, e.g., damaged or missing fan shroud, incorrect fan installed, improper or broken fan controls, debris plugging cooler fins, etc.
	Customer abuse, excessive amount of time spent at fast idle with transmission in range **NOTE:** The transmission fluid cooler and components should be designed to handle a normal idle speed of 600-800 rpm while in a forward range at a stop for a minimum of 30 minutes.	Driver education **NOTE:** Cooling systems are designed to allow for extended periods of idle time while in range. They are typically not designed to handle extended stall times above 800 rpm at a stop. Refer to TECH DATA-157 on the extranet for cooling system test requirements at idle.

Problem	Probable Cause	Suggested Remedy
	Excessive pressure drop across cooler causing low cooler flow	Resolve cooler pressure drop issue, e.g., check for plugged cooler; undersized cooler; undersized, restricted, blocked hydraulic lines or fittings; excessive number of fitting bends; cooler incorrectly plumbed **NOTE:** Cooler pressure drop is the difference between the cooler-in pressure-and the cooler-out pressure. The maximum pressure drop across the cooler and corresponding minimum flow specification varies by transmission model and input speed. Refer to Section 6. CONTROL SYSTEM AND TRANSMISSION SPECIFICATIONS for minimum and maximum external hydraulic circuit requirements. Go to Allison DOC® Help Menu, and Allison Calc Program for additional cooling capacity calculators.
	Transmission issue causing low cooler flow	Repair or replace components causing low flow, sticky converter flow valve, spring damage, valve body issue. See Low Transmission Fluid Pressures if pressures are low. **NOTE:** Refer to Section 6. CONTROL SYSTEM AND TRANSMISSION SPECIFICATIONS for minimum and maximum external hydraulic circuit requirements.
	Stuck stator	Repair stator assembly **NOTE:** Stuck stator symptom will not allow fluid to cool down in **N** (Neutral).

Problem	Probable Cause	Suggested Remedy
	Lockup not engaging	Resolve or repair lockup clutch engagement issue. e.g., active transmission DTC code, active ABS event, TCC solenoid issue, TCC, no or low lockup pressure, stuck converter flow valve, broken TCC trim valve
	Incorrect torque converter assembly	Replace incorrect components with correct components causing issue e.g., converter pump assembly, stator
	Slipping clutch	See solutions for shift quality issue
	Cooler lines reversed on oil-to-water cooler	Connect cooler lines correctly **NOTE:** Transmission fluid and engine coolant should be flowing in opposite directions within the cooler.
	Retarder autoflow valve stuck allowing retarder cavity to stay pressurized after retarder commanded off	Repair autoflow valve issue
	Retarder cavity pressurized when retarder is off caused by misassembly, damaged gaskets	Repair or replace issue causing retarder to stay pressurized when retarder is commanded OFF
TEMPERATURE GAUGE OR INDICATOR LAMP, (IF NOT TIED TO OUTPUT FUNCTION B SUMP/RETARDER TEMPERATURE INDICATOR) SHOWING OVERHEATING	Defective or misinstalled sending unit or gauge	Resolve temperature gauge issue

Problem	Probable Cause	Suggested Remedy
	Misidentification as overheat	Overheat from gauge readings and lamps are not exact for showing actual transmission fluid temperature and should not be relied on as an indication that fluid temperature is overheated. The fluid temperature sensed and displayed in Allison DOC® is almost always correct unless there are electrical DTCs for the temperature sensor active or in history. **NOTE:** If in doubt of temperature sensor data integrity, check against other data items like condition and smell of fluid, hand-held temperature device, temperature tape, vehicle gauges, thermocouple and DVOM readout.
	RETARDER ISSUES	
RETARDER DOES NOT APPLY	Retarder function disabled	Reset retarder autodetect
	DTC active that inhibits retarder operation	Troubleshoot DTC
	ABS active	Retarder off is the normal system response to ABS active signal or ABS active datalink message
	Retarder request below 10.2 percent	Check that RMR devices, retarder controls, and retarder datalink messages meet specification. If out of specification, resolve issues with the retarder control component or wiring causing the issue, e.g., pressure switch issue, wiring issues, RMR issues, lever or foot pedal issues, device or system sourcing erroneous datalink message for requested amount
	Accelerator pedal position above 9.8 percent	Resolve pedal position issue if actual versus measured is not valid
	Transmission output rpm below limit for retarder operation	Retarder off is the normal system response to output rpm below limit

Problem	Probable Cause	Suggested Remedy
	Retarder enable circuit issue	Resolve circuit issue e.g., switch issue, wire or connector is open circuit, miswired circuit
	Valve in retarder valve body sticking	Repair sticking condition with valve, valve bore
	Valve spring issue	Repair valve spring
	Autoflow valve sticking	Repair issue with autoflow valve
	Leakage to sump in retarder valve body assembly	Repair issue with valve body assembly, e.g., damaged gaskets, misassembly, etc.
	Leakage to sump in retarder assembly	Repair issue with valve body assembly, e.g., damaged gaskets, damage rotor seal rings, etc.
RETARDER FEELS WEAK	Retarder fluid temperature, sump fluid temperature, or engine coolant temperature measured beyond temperature limit to allow 100 percent retarder	Resolve high transmission fluid temperature or high engine coolant temperature condition causing designed cutback of retarder request Resolve issue for false fluid or coolant temperature value
	Retarder accumulator solenoid not energized	Check accumulator solenoid resistance meets specification Check accumulator solenoid installed, if required for installation Check wiring to accumulator solenoid correct and meets specification, e.g., check for opens, shorts, and pin to pin wiring
	Incorrect transmission fluid level	Correct fluid level
	Incorrect TCM calibration for retarder capacity	Install OEM-approved TCM calibration
	Valve in retarder valve body sticking	Repair condition with valve, valve bore
	Valve spring issue	Repair valve spring
	Autoflow valve sticking	Repair issue with autoflow valve
	Leakage to sump in retarder valve body assembly	Repair issue with valve body assembly, e.g., damaged gaskets, misassembly, etc.

Problem	Probable Cause	Suggested Remedy
	Leakage to sump in retarder assembly	Repair issue with valve body assembly, e.g., damaged gaskets, damage rotor seal rings, etc.
	SHIFT SELECTOR ISSUES	
RANGE SELECT BLANK	Active DTC	Troubleshoot DTC
RANGE SELECT FLASHING	Requested Shift Inhibited	Use Allison DOC® to determine cause for inhibit and correct. Refer to 2–26. SHIFT INHIBIT LOGIC for additional information. If I/O function state is causing range inhibit, refer to the Allison DOC® Technician's Library for additional information.
WRENCH ICON ILLUMINATED	Prognostics service issue	Perform transmission maintenance, reset Prognostics
	Other DTCs not requiring **CHECK TRANS** light	Troubleshoot DTC
DOUBLE CAT-EYES	SAE J1939 failure	Troubleshoot DTC. Refer to the Allison DOC® Technician's Library for additional information.
	No calibration	Calibrate TCM
	Primary/Secondary shift selector incorrectly integrated into vehicle	Wire and integrate Primary/ Secondary shift selector(s) correctly. Refer to the Allison DOC® Technician's Library, and Appendix L. 3000 AND 4000 TCM DIAGRAM
	Input/Output function not integrated correctly	Resolve issue with Input/Output function
ALL SEGMENTS ILLUMINATED FOR TWELVE SECONDS OR MORE **NOTE:** Brief illumination of all segments is normal and indicates TCM initialization occurring.	TCM did not complete initialization	Troubleshoot active or inactive DTC
RANGE SELECT AND MONITOR DISPLAYS BOTH BLANK	Check if Function AQ: Selector Display Blanking is enabled and ON. No battery power or ignition voltage at selector	Troubleshoot for power and ignition voltage at selector
	SAE J1939 failure (Shifter uses PWM directional signal on W134 only to attain range)	Check for blanking function AQ enabled

Problem	Probable Cause	Suggested Remedy
	If followed by cat-eyes, refer to cat-eyes description in this table. If blank display following all segments, refer to all segments description in this table	Troubleshoot for active DTCs. Refer to the Allison DOC® Technician's Library for additional information.
NO SELECTOR BACKLIGHTING WITH THE HEADLIGHTS ON AND DIMMER SWITCH ON	Selector pin 3 not wired to vehicle dimmer circuit	Resolve wiring for dimmer circuit to selector pin
RANGE SELECT AND MONITOR DISPLAYS STAY ON WITH IGNITION OFF	Faulty ignition switch circuit, e.g., bad ignition switch or relay, short to power, etc., causing ignition to stay on while in off position.	Resolve ignition circuit issue
	Ignition sense input to TCM or selector miswired to unswitched battery power	Resolve issue with ignition and battery power wiring to selector and/or TCM
	Output shaft speed sensor falsely detecting output shaft speed while stopped	Determine cause of false output shaft speed, e.g., vehicle vibration, electrical noise on speed sensor wiring, tone wheel loose, etc.
WILL NOT SHIFT FROM **N** (Neutral) WITHOUT RANGE INHIBIT OR DTC ACTIVE	Worn selector buttons or defective shift selector	Replace shift selector **NOTE:** Install original shift selector again to verify the complaint only occurs with the original shift selector.
LEVER SELECTOR IN FORWARD OR REVERSE RANGE BUT ALLOWS ENGINE TO CRANK	Neutral start circuit not wired to neutral start output (wire 141)	Resolve issue with neutral start circuit wiring
	Neutral start circuit wired to range indicator function	Wire to neutral start output (wire 141)
	SHIFT SEQUENCE ISSUES	
TRANSMISSION WILL NOT STAY IN DRIVER'S COMMANDED RANGE	Active DTCs	Troubleshoot DTCs
	Low fluid level	Correct fluid level
	Refer to 2–26. SHIFT INHIBIT LOGIC if select side of shift selector is blinking	Refer to 2–26. SHIFT INHIBIT LOGIC for additional information
STARTS OFF IN 2ND GEAR	Fluid temperature data to TCM is reading –7°C (20°F or less)	Correct issue with fluid temperature sensor circuit if transmission fluid is known to be warmer than –7°C (20°F or less)

Problem	Probable Cause	Suggested Remedy
	2^{nd} gear start is active in shift schedule	Change CIN if 2^{nd} gear start not desired
DOES NOT UPSHIFT PAST A CERTAIN RANGE E.G., 4^{TH} RANGE	Low engine power	Resolve engine power issue
	Transmission fluid temperature above limits and will not allow shifts past 4^{th} gear	Resolve cooler issue or engine thermostat bypass, or engine thermostat issue. Check for hot fluid temperature DTCs
	Maximum available forward ranges reached	Check with OEM to verify driveline design is compatible before updating CIN to one with more forward ranges
	SHIFT QUALITY ISSUES	
LOCKUP CLUTCH NOT COMMANDED DURING SHIFTS	Active transmission DTCs	Troubleshoot DTCs
	ABS event active or ABS controller sending error or DTC message on datalink	Resolve ABS issue
SHIFT FLARE(S) OR SLIPS DURING SHIFT	Active transmission DTCs	Troubleshoot DTCs
	Low fluid or high fluid level	Correct fluid level
	Shift(s) not converged yet	With Allison DOC®, snapshot a test drive duplicating the condition and bookmark the occurrence(s). Next, check Adaptive Shift Summary Report for any shifts that are not converged. Conduct at least 5 shifts each for shifts with complaints until shifts are acceptable. Save files for later review
	Low main pressure, low clutch pressure(s), or low control main pressure	Refer to Low Transmission Fluid Pressures section in this table
	Low main pressure, low clutch pressure(s), or low control main pressure caused from, clogged main filter or suction filter	Main or suction filter replacement

Problem	Probable Cause	Suggested Remedy
	Low main pressure, low clutch pressure(s), or low control main pressure caused from, control valve module issue, e.g., mechanical or electrical solenoid(s) problem, stuck valve, worn main regulator or control main valve springs, etc.	Repair control valve module issue e.g., stuck valves, replace solenoid(s) used during shift, replace worn valve spring(s), etc.
	Internal transmission problem (not in control module) caused from, worn clutches	Analyze TransHealth report for worn clutch. Conduct partial stall test in range indicated as worn in report, to check for clutch slip. If turbine speed increases speed during stall, remove control module and look for clutch debris trapped in filters. Overhaul transmission if needed
	Internal transmission problem (not in control module) caused from, leaking piston seal	Replace piston seal
	Control valve module issue or misassembly e.g., solenoid issue, sticky valves, plugged orifice in separator plate, debris, etc.	Remove, disassemble, inspect, repair, replace item causing shift concern in control module. If nothing is found replace, solenoid(s) used during the shift with the complaint
	Turbine or output shaft speed sensor circuit issue	Resolve turbine or output shaft speed signal circuit issues **NOTE:** A stair-stepped appearance to speed signal data does not indicate a speed signal issue. Use the speed SpeedSignalsIntegrityDataList file with Allison DOC® available at DPID configuration tab or manually configure a DPID list to only collect throttle and speed signals. Refer to the Allison DOC® Technician's Library for additional instructions.
	TCM issue	Replace TCM **NOTE:** Install original TCM again to verify the complaint only occurs with the original TCM.
SLIPS IN RANGE(S)	Active transmission DTCs	Troubleshoot DTCs

Problem	Probable Cause	Suggested Remedy
	Low fluid or high fluid level	Correct fluid level
	Mechanical or electrical solenoid(s) problem	Replace clutch solenoid(s) related to specific slipping in range
	Low main pressure, low clutch pressure(s), or low control main pressure	Refer to Low Transmission Fluid Pressures section in this table
	Low main pressure, low clutch pressure(s), or low control main pressure caused from, clogged main filter or suction filter	Main or suction filter replacement **NOTE:** Check fluid and filter conditions for excessive debris. Remove and repair transmission if fluid or filter condition is full of debris. **NOTE:** Consult with the TAC, regional representative, or service channel support in the distributor/dealer network if there is a question regarding what should be considered excessive debris. Check all clutch pressures in all ranges using Allison DOC® clutch test. Partially stall transmission in range reported to slip e.g., 2^{nd} gear or higher only. Do not stall in lower gears or reverse. Check that turbine speed is returning to 0-1 rpm at 1300-1500 engine rpm stall. If turbine speed is present at 1300-1500 engine rpm in a stall condition, remove transmission and repair.
	Low main pressure, low clutch pressure(s), or low control main pressure caused from, control valve module issue, e.g., mechanical or electrical solenoid(s) problem, stuck valve, worn main regulator or control main valve springs, etc.	Repair control valve module issue e.g., stuck valves, replace solenoid(s) used during shift, replace worn valve spring(s), etc.

Problem	Probable Cause	Suggested Remedy
	Internal transmission problem (not in control module) caused from, worn clutches	Analyze TransHealth report for worn clutch. Conduct partial stall test in range indicated as worn in report, to check for clutch slip. If turbine speed increases speed during stall, remove control module and look for clutch debris trapped in filters. Overhaul transmission if needed
	Internal transmission problem (not in control module) caused from, leaking piston seal	Replace piston seal
	TCM issue	Replace TCM **NOTE:** Install original TCM again to verify the complaint only occurs with the original TCM.
HARSH, HARD SHIFTS	Active transmission DTCs	Troubleshoot DTCs
	Low or high fluid level	Correct fluid level
	Shift(s) not converged yet	With Allison DOC®, snapshot a test drive duplicating the condition and bookmark the occurrence(s). Next, check Adaptive Shift Summary Report for any shifts that are not converged. Conduct at least 5 shifts each for shifts with complaints until shifts are acceptable. Save files for later review
	Engine idle is intermittently below 500 rpm	Resolve engine idle issue **NOTE:** Use the SpeedSignalsDataIntegrityList with Allison DOC® available at DPID configuration tab or manually configure your own DPID list to only collect throttle and speed signals. Engine (Input) speed that drops below 500 rpm at engine idle may need to be captured at a high data transfer rate that is not available if all transmission parameters are collected. Refer to the Allison DOC® Technician's Library for additional information.

Problem	Probable Cause	Suggested Remedy
	Low main pressure, low clutch pressure(s), or low control main pressure	Refer to Low Transmission Fluid Pressures section in this table
	Low main pressure, low clutch pressure(s), or low control main pressure caused from, clogged main filter or suction filter	Main or suction filter replacement
	Low main pressure, low clutch pressure(s), or low control main pressure caused from, control valve module issue, e.g., mechanical or electrical solenoid(s) problem, stuck valve, worn main regulator or control main valve springs, etc.	Repair control valve module issue e.g., stuck valves, replace solenoid(s) used during shift, replace worn valve spring(s), etc.
	Internal transmission problem (not in control module) caused from, worn clutches	Analyze TransHealth report for worn clutch. Conduct partial stall test in range indicated as worn in report, to check for clutch slip. If turbine speed increases speed during stall, remove control module and look for clutch debris trapped in filters. Overhaul transmission if needed
	Internal transmission problem (not in control module) caused from, leaking piston seal	Replace piston seal
	Control valve module issue or misassembly e.g., issue solenoid, sticky valves, plugged orifice in separator plate, debris, etc.	Remove, disassemble, inspect, repair, replace item causing shift concern in control module. If nothing is found, replace solenoid(s) used during the shift with the complaint
	Turbine or output shaft speed sensor circuit issue	Resolve turbine or output shaft speed signal circuit issues **NOTE:** A stair-stepped appearance to speed signal data does not indicate a speed signal issue. Use the SpeedSignalsDataIntegrityList with Allison DOC® available at DPID configuration tab or manually configure a DPID list to only collect throttle and speed signals. Refer to the Allison DOC® Technician's Library for additional information.

Problem	Probable Cause	Suggested Remedy
	Transmission component(s) issue not in control valve module causing hard shift, e.g., issue clutch(es), warped reaction plates, cut piston seal, worn lockup damper, rotated ground sleeve, converter issue, etc.	Check fluid and filter conditions for excessive debris. Remove and repair transmission if fluid or filter condition is full of debris **NOTE:** Consult with the TAC, regional representative, or service channel support in the distributor/dealer network if there is a question regarding what should be considered excessive debris. Check all clutch pressures in all ranges using Allison DOC® clutch test. If low clutch pressure is not related to control valve module issue, remove transmission and repair condition causing low pressure. Refer to Low Transmission Fluid Pressures section in this table Partially stall transmission in range reported to slip e.g., 2nd gear or higher only. Do not stall in lower gears or reverse. Check that turbine speed is returning to 0-1 rpm at 1300-1500 engine rpm stall. If turbine speed is present at 1300-1500 engine rpm in a stall condition, remove transmission and repair
	TCM issue	Replace TCM **NOTE:** Install original TCM again to verify the complaint only occurs with the original TCM.
UPSHIFTS OR DOWNSHIFTS ARE LATE OR TRANSMISSION HESITATES BEFORE MAKING NEXT SHIFT	Low engine power	Resolve low engine power

Problem	Probable Cause	Suggested Remedy
	Wrong engine governor setting programmed in ECM **NOTE:** Typically, the correct governor setting will be an “automotive” style governor, although there are hybrid governor types developed for automatic transmissions from a few engine OEM(s) as well. The engine OEM(s) call their automotive and hybrid style governors by various names. If there is a question which to select, check with the engine or vehicle OEM. Governor types are typically selected from the engine OEM(s) service tool screen, never from Allison DOC®.	Verify engine governor type setting is correct
	Wrong transmission CIN in TCM, or wrong ECM calibration installed e.g., listed CIN governed speed or shift schedule is incorrect for ECM programming.	Calibrate transmission TCM with correct CIN or resolve ECM issue of incorrect calibration, whichever is in error
	Datalink message from vehicle or engine controller for accelerator pedal percentage is erroneous or unavailable	Resolve accelerator pedal issue
	For an analog TPS source to transmission controls, the signal voltage (throttle counts) may be erroneous or TPS may need mechanical adjustment and Allison DOC® action requests TPS calibration	Adjust mechanical TPS as listed in Troubleshooting Manual or Mechanics Tips and also perform Allison DOC® TPS calibration action request. Replace TPS if voltage or counts are intermittent or cannot maintain calibration
	Transmission feature settings not optimized to driver preferences, e.g., LBSS, VAC, shift schedule type, etc.	Resolve issues with driver by modifying settings or by driver education
	Load cycle on engine occurring e.g., cooling fan ON and OFF, etc.	Resolve load cycling issue or resolve issue with driver education

Problem	Probable Cause	Suggested Remedy
UPSHIFTS OR DOWNSHIFTS EARLY	Transmission feature settings not optimized to driver preferences, e.g., LBSS, VAC, shift schedule type, etc.	Resolve issues with driver by modifying settings or by driver education **NOTE:** If a trained technician cannot reproduce complaint, consider taking a snapshot of the driver operating vehicle while duplicating their complaint so the technician can analyze the issue captured.
	Wrong engine governor setting programmed in ECM **NOTE:** Typically, the correct governor setting will be an “automotive” style governor, although there are hybrid governor types developed for automatic transmissions from a few engine OEM(s) as well. The engine OEM(s) call their automotive and hybrid style governors by various names. If there is a question which to select, check with the engine or vehicle OEM. Governor types are typically selected from the engine OEM(s) service tool screen, never from Allison DOC®.	Resolve engine governor type setting
	Wrong transmission CIN in TCM, or wrong ECM calibration installed e.g., listed CIN governed speed or shift schedule is incorrect for ECM programming	Calibrate TCM with correct CIN or resolve ECM issue of incorrect calibration whichever is in error
	Datalink message from vehicle or engine controller for accelerator pedal percentage is erroneous or unavailable	Resolve accelerator pedal issue
	For an analog TPS source to the transmission controls, the signal voltage (and throttle counts) may be incorrect such that the TPS may need mechanical adjustment and Allison DOC® requests TPS calibration or replacement	Adjust mechanical TPS as listed in Troubleshooting Manual or Mechanics Tips and also perform Allison DOC® TPS calibration action request. Replace TPS if voltage or counts are intermittent or cannot maintain calibration
	Dual power curve switching in ECM	Driver education for driving with dual power curve engines

Problem	Probable Cause	Suggested Remedy
	ECM parameters for cruise control or engine governor droops not set correctly	Modify ECM cruise settings and/or governor droop settings Select an alternate shift schedule, e.g., use the mode button on selector or preselect range
	Vehicle speed oscillating due to changes in engine power, terrain, or wind conditions	Increase or decrease vehicle set speed
FEELS LIKE SHIFT-CYCLES OR HAS SHIFT-BUSYNESS WHILE IN CERTAIN SHIFT SCHEDULE(S) OR CERTAIN RANGES, E.G., PRIMARY, SECONDARY, CRUISE CONTROL, 1-2, 2-1, ETC.	Transmission feature settings not optimized to driver preferences, e.g., LBSS, VAC, shift schedule type, etc.	Resolve issues with driver by modifying settings or through driver education
	Wrong engine governor setting programmed in ECM **NOTE:** Typically, the correct governor setting will be an “automotive” style governor, although there are hybrid governor types developed for automatic transmissions from a few engine OEM(s) as well. The engine OEM(s) call their automotive and hybrid style governors by various names. If there is a question which to select, check with the engine or vehicle OEM. Governor types are typically selected from the engine OEM(s) service tool screen, never from Allison DOC®.	Resolve engine governor type setting
	Wrong transmission CIN in TCM, or wrong ECM calibration installed e.g., listed CIN governed speed or shift schedule is incorrect for ECM programming	Calibrate TCM with correct CIN
	Datalink message from vehicle or engine controller for accelerator pedal percentage is erroneous or unavailable	Resolve accelerator pedal issue

Problem	Probable Cause	Suggested Remedy
	For an analog TPS source to the transmission controls, the signal voltage (and throttle counts) may be incorrect such that the TPS may need mechanical adjustment with TPS calibration and adjustment.	Adjust mechanical TPS as listed in Troubleshooting Manual or Mechanics Tips and also perform Allison DOC® TPS calibration action request or replace as needed
	ECM parameters for cruise control or engine governor droops not set correctly	Resolve settings for ECM cruise or engine governor droop settings
	Vehicle speed oscillating due to changes in engine power, terrain, or wind conditions	Select an alternate shift schedule, e.g., use mode button or preselect lower range
	STUCK IN NEUTRAL	
TRANSMISSION WILL NOT SHIFT TO **D** (Drive) OR **R** (Reverse) FROM **N** (Neutral)	Shift Inhibit Active–Indicated by the Range Select character flashing for example, high engine speed, high throttle percent or counts, etc.	Use Allison DOC® to determine cause for inhibit and correct. Refer to 2–26. SHIFT INHIBIT LOGIC for additional information.
	Active DTC **NOTE:** If the Range Select Character is always blank for active codes, the transmission is limited to **N** (Neutral). **NOTE:** Some codes require at least 800 rpm of engine speed before setting active code, e.g. P0894.	Troubleshoot DTC
	Low fluid level	Correct fluid level
	Input function requirement, such as Auxiliary Function Range Inhibit or Direction Change Enable, not met (function requirements vary) e.g., switch state is in wrong state	Resolve Input function issue. Monitor wire-states, function enabled, and Data Bus Viewer messages using Allison DOC® and/or Data Bus Viewer
	Low main pressure, low clutch pressure(s)	Refer to Low Transmission Fluid Pressures section in this table
	Low main pressure, low clutch pressure(s) caused from clogged main filter or suction filter	Main or suction filter replacement
	Control valve module issue, e.g., mechanical or electrical solenoid(s) problem, stuck valve, worn main regulator or control main valve springs, etc.	Repair control valve module issue e.g., stuck valves, replace solenoid(s), replace worn valve spring(s)

Problem	Probable Cause	Suggested Remedy
	Internal transmission problem (not in control module) caused from worn clutch(es)	Analyze TransHealth report for worn clutch. Conduct partial stall test in range indicated as worn in report, to check for clutch slip. If turbine speed increases speed during stall, remove control module and look for clutch debris trapped in filters. Overhaul transmission if needed.
	Internal transmission problem (not in control module) caused from leaking piston seal	Replace piston seal
	Internal transmission problem (not in control module) caused by front support issue e.g., loose front support bolts (fluid out the breather), worn or turned ground sleeve	Repair front support issue
	Internal transmission problem (not in control module) caused by Broken converter pump tangs or PTO drive hub tangs	Replace converter pump or PTO drive hub
	Snap-ring out of carrier assembly	Repair snap-ring issue
	Broken C1 drive hub (no 1st thru 4th range)	Replace C1 drive hub
	Cracked rotating clutch hub	Replace rotating clutch hub if cracked
	Adaptation hardware missing or failed	Check and resolve adaptation issue **NOTE:** If flexplate center ripped than resolve the cause for damage, such as, wrong length flexplate bolts, loose bolts, engine damper failed, internal rotational engine component failed, etc.
	Worn or damaged shift selector	Replace shift selector **NOTE:** Install original shift selector again to verify the complaint only occurs with the original shift selector.
	TCM issue	Replace TCM **NOTE:** Install original TCM again to verify the complaint only occurs with the original TCM.

Problem	Probable Cause	Suggested Remedy
	Low converter pressure **NOTE:** Converter pressure is approximately the cooler in pressure.	Repair control valve module issue causing low converter pressure, e.g., sticky converter flow valve, converter regulator valve. See Low Transmission Fluid Pressures section in this table
DOES NOT SHIFT **N** (Neutral) TO **D** (Drive) BUT SHIFTS **N** (Neutral) TO **R** (Reverse)	SS1 circuit high resistance issue	Resolve any external SS1 electrical circuit such as high resistance wire 151, poor pin crimps, expanded terminals **NOTE:** Intermittent high resistance may or may not cause an SS1 open circuit code.
	SS1 electrically or hydraulically not meeting specifications	Replace SS1
	Internal wire harness issue for SS1	Repair or replace internal harness
	Stuck or sticky C2 latch valve (under SS1)	Repair condition causing sticky valve e.g., C2 latch valve damaged or not to specification, main valve body C2 valve bore damaged, C2 latch valve spring weak, C5 pressure low
	For no or low C1 pressure, possible PCS1 issue, C1 clutch piston seal leaking, broken or damaged PCS1 trim valve or trim spring for PCS1	Repair or replace component causing C1 pressure issue, e.g., PCS1, trim valve, spring or C1 clutch piston seal, etc. See Low Transmission Fluid Pressures section in this table
	For no or low C5 pressure possible PCS3 issue, C5 piston seal leaking, broken or damaged PCS5 trim valve or trim spring	Repair or replace component causing C5 pressure issue, e.g., PCS3, trim valve, spring or C5 clutch piston seal, etc. See Low Transmission Fluid Pressures section in this table
	TCM ISSUES	
TCM STAYS POWERED UP WITH IGNITION OFF	Ignition sense wire 163 is miswired or shorted to unswitched positive battery power wire	Resolve OEM wiring issue
	Ignition switch issue	Resolve ignition switch issue

Problem	Probable Cause	Suggested Remedy
	Output shaft speed detected	Resolve source of output shaft speed signal, e.g., bodybuilder spliced into output shaft speed sensor wiring with another circuit, output shaft speed signal wheel (3000 non-retarder) loose on P3 carrier, electrical noise coupling to speed sensor circuit **NOTE:** With ignition off, Allison DOC® should not turn on when connected to TCM. If Allison DOC® connects, TCM is still powered up.
VEHICLE TRIES TO MOVE AT IDLE IN NEUTRAL		
AT IDLE CONDITION, WITH SERVICE BRAKE OR PARK BRAKE APPLIED, VEHICLE TRIES TO MOVE FORWARD, OR MOVE IN REVERSE WHILE IN **N** (Neutral) **WARNING:** The vehicle service brakes, parking brake, or emergency brake must be applied whenever **N** (Neutral) is selected to prevent unexpected vehicle movement. Selecting **N** (Neutral) does not apply the vehicle brakes unless an auxiliary system to apply the parking brake is installed by the OEM. **WARNING:** To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from **N** (Neutral) to **D** (Drive) or **R** (Reverse) when the throttle is open. The vehicle may lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from **N** (Neutral) to a forward range or **R** (Reverse) only when the throttle is closed and the service brakes are applied.	Vehicle brake system not applied or needs repair	Resolve issue with vehicle brake system or apply brakes

Problem	Probable Cause	Suggested Remedy
	Vehicle parked on incline	Drive vehicle away from incline to flat ground and recheck for symptom
	Engine not at idle speed	Lower to engine idle speed 600-800 rpm
	Exhaust backfill pressure beyond specification	Repair issue in control valve module causing excessive exhaust backfill pressure **NOTE:** Exhaust backfill pressure is the pressure in the exhausted clutch pressures.
	Clutch applied or mechanically dragging that is not requested for the range selected	Clutch solenoids miswired in vehicle harness Clutch plates or reaction plates warped in a clutch pack causing symptom while in **N** (Neutral) **NOTE:** If DTC active, troubleshoot DTC.
	Clutch hydraulically applied for range not selected	Repair issue in control valve module causing applied clutch for range not selected, e.g., replace solenoid for incorrectly applied clutch, etc.
	Rotated ground sleeve	Replace ground sleeve and front support
	Front support hook type seal rings damaged or missing	Replace missing or damaged hook type seal rings
AT IDLE CONDITION, WITH SERVICE BRAKE OR PARK BRAKE APPLIED, VEHICLE TRIES TO PULL FORWARD EXCESSIVELY, OR PULL IN REVERSE EXCESSIVELY AFTER D (DRIVE) OR R (REVERSE) SELECTED	Vehicle body not mounted on frame yet	Recheck for symptom after body installed
	Vehicle brake system needs repair	Resolve issue with vehicle brake system
	Engine not at idle speed	Lower to recommended engine idle speed 600-800 rpm
	Vehicle parked on incline	Drive vehicle away from incline to flat ground and recheck for symptom

Problem	Probable Cause	Suggested Remedy
	Engine idle governor commanding high fueling rate to maintain the set idle speed	Resolve engine issue causing high fuel rate request from idle governor
	Exhaust backfill pressure beyond specification **NOTE:** Excessive exhaust backfill pressure may exhibit symptom of lockup apply, causing engine to die if range selected.	Repair issue in control valve module causing excessive exhaust backfill pressure **NOTE:** Exhaust backfill pressure is the pressure in the exhausted clutch pressures.
	Clutch applied or mechanically dragging for range not selected	Clutch solenoids miswired in vehicle harness Clutch plates or reaction plates warped in a clutch pack causing symptom while in selected range **NOTE:** If DTC active, troubleshoot DTC.

APPENDICES

APPENDICES

NOTES

Appendix A—TOWING, JUMP STARTING, WELDING AND PAINTING

A–1. TOWING, JUMP STARTING, WELDING, AND PAINTING

A. Requirements for Vehicle Towing or Pushing.

CAUTION: Failure to lift the drive wheels off the road, disconnect the driveline or remove the axle shafts before towing or pushing can cause serious transmission damage.

NOTE: The engine cannot be started by pushing or towing.

Before pushing or towing a vehicle with a 3700SP Model, do one of the following:

- Make sure all wheels are on the ground and drivelines are connected, or
- Lift one axle off the ground and disconnect the driveline to the axle contacting the ground

Before pushing or towing a vehicle with a 3000 or 4000 series transmission (unless equipped with 3700SP), do one of the following:

- Lift the drive wheels off the road,
- Disconnect the driveline, or
- Remove the axle shafts

NOTE: When the axle shafts are removed, make sure the wheel openings are covered to prevent loss of lubricant and entry of dust and dirt.

Make sure to deactivate the vehicle parking brake system prior to towing or pushing. An auxiliary air supply is usually required to actuate the vehicle brake system.

B. Requirements for Jump Starting the Vehicle.

Observe the following precautions when jump starting a vehicle:

- Battery positive side fuse rated at 10 to 15 amps in series with pin 10 and pin 70 of TCM is required to protect against reverse polarity
- Ignition fuse is rated at 5 to 15 amps in series with pin 63 of TCM
- Do not connect cables to transmission electronic control components, such as the TCM
- Do not exceed 26.5 volts when jump starting or charging batteries equipped with a 12 volt TCM (A61/A62/A63)
- Do not exceed 36 volts when jump starting or charging batteries equipped with a 12/24 volt TCM (A63)

If jump start voltage is under or over the DTC threshold voltage, DTCs P0882/P0883 may set while jump starting or charging the vehicle. After starting the vehicle, clear the active/inactive DTCs from history.

C. Requirements for Welding on Vehicle.

Observe the following precautions when welding on the vehicle:

- Disconnect the wiring harnesses from the TCM
- Disconnect the TCM power and ground circuits from the battery, and any electronic control ground wires connected to the frame or chassis
- Do not connect welding cables to electronic control components
- Do not weld on electronic control components
- Cover electronic control components and wiring to protect them from hot sparks, heat, etc.

D. Requirements Electrostatic Painting on Vehicle.

If the vehicle chassis or body is painted using an electrostatic painting process, electrical voltage must not be discharged through the TCM. To prevent this possibility, Allison recommends installing the TCM after the electrostatic paint process is complete. If the TCM is installed prior to electrostatic painting, make sure:

- the TCM is not painted, and
- the elements being painted are properly and continuously grounded during the entire painting process.

NOTE: Allison Transmission is not responsible for TCM damage resulting from improper grounding during electrostatic painting of the vehicle.

Appendix B—TRAINING AND REQUIRED SKILLS

B–1. TRAINING AND REQUIRED SKILLS

To service Allison 5th Generation Controls, the technician must understand and be proficient in basic electrical and hydraulic circuit troubleshooting. Allison E-Learn's blended web-based and hands-on training system has been proven to be successful in fulfilling this commitment. Allison E-Learn is for Allison Distributor, Dealer and Product Support professionals. Web-based training is found at *www.allisonelearn.com.*

In addition, various videos are available within Allison DOC®/Advanced Help Menu under the Training Videos tab. Additional training demos are also found under the Help Menu. Before attempting a repair, be sure to understand and complete the relevant training needed. Contact your local distributor for more information about classroom setting training as needed.

The following skills, in addition to complete familiarity with this publication, are needed to troubleshoot symptom(s) and Diagnostic Trouble Codes (DTCs) described within this publication.

A. Electrical Troubleshooting Skills.

Electrical troubleshooting skills require:

- Working knowledge of the differences between normal system response, diagnostic response, and inhibited responses using Allison DOC® snapshots, reports, action requests, and DMM.
- Ability to use the Allison Extranet to find Service SILs, Tech Tips, WATCH, and Original Equipment Manufacturer (OEM) Vehicle Integration Tech Data and Transmission Specifications.
- Accurate use of DMM to make resistance, voltage, and frequency circuit checks. Refer to 1–2. ESSENTIAL TOOLS LIST for additional information.
- Use of approved jumper wires and approved breakout box and harness adapters. Refer to 1–2. ESSENTIAL TOOLS LIST for additional information.
- Ability to measure DMM lead, breakout (box), and adapter harness resistances in order to subtract this value from the measured circuit resistance to determine the actual (true) resistance of the circuit.
- Ability to understand and troubleshoot using TCM mechanization drawings and connector pin-outs for TCM, shift-selectors, and other transmission-related controls and I/O, such as retarder controls, etc.
- Ability to determine electrical over-stress damage to TCM such as electrical load dump due to improper or lack of good vehicle grounds. In this example, vehicle circuits dump excessive current through TCM grounds and cause ground paths to open inside the TCM.
- Ability to read, understand, and troubleshoot vehicle wiring based on vehicle schematics and point-to-point wiring to troubleshoot relay-logic integrated into vehicle.

NOTE: Vehicle relays drawing more than 0.5 Amp are recommended by Tech Data to be suppressed with a resistor or diode.

- Ability to troubleshoot active and intermittent transmission DTCs related to either ATI transmission components or vehicle issues, such as wiring, etc.
- Ability to understand and isolate issues related to data or signal corruption caused by Electro-Magnetic Interference (EMI), or Radio Frequency Interference (RFI). Signal corruption might be caused from the following: unsuppressed relays drawing more than

0.5 Amp through the relay coil, antenna location, routing of radio or video, improper wiring practices, loose or poorly connected vehicle ignition, power or ground issues.

- Working knowledge of Principle of Operations of transmission, including solenoid and speed sensor theory of operation and related system response to these varying signals. Refer to Principles of Operation for additional information.

B. Datalink Troubleshooting Skills.

Datalink troubleshooting skills require:

- Type of physical datalink connection and required components, number and location of termination resistors, stub locations, shielding, twisted pairs, location and integration requirements of shift selectors, etc.
- Communication Protocol, e.g., SAE J1939
- Message and/or Parameters required for proper datalink-based transmission function integration, e.g., I/O, CMC settings
- Allison "Auto-Detection" logic
- TCM models and their unique levels of communication and protocol support

NOTE: Properly terminated datalinks across CAN High and CAN Low wires should measure 60 ohms.

- Working knowledge of difference between normal system response, diagnostic response, and inhibited responses using Allison DOC® snapshots, reports, action requests, and Data Bus Viewer logs.
- Ability to use the Allison Extranet to find Service SILs, Tech Tips, WATCH, and OEM Vehicle Integration Tech Data and Transmission Specifications related to datalink information or updates.

C. Allison DOC® Skills.

Allison DOC® skills require:

- Proficiency with all facets of Allison DOC® for all action requests such as clutch test, solenoid test, and full main pressure checks.
- Complete familiarity with Allison DOC® User’s Guide and Help Menus.
- Ability to program and adjust CMC.
- Ability to use Data Monitor grid, Snapshot feature, and Data Bus Viewer to troubleshoot issues.
- Understanding the difference between range inhibits, such as high engine, throttle, or output speed and a diagnostic response due to an active DTC.
- Knowing when to auto-detect a function, using Allison DOC® to resolve specific issues, such as an active DTC, retarder not available, etc.
- Knowing when to reset adaptive shifts for all shifts or specific shifts using Allison DOC® to resolve a shift quality issue after repair of a transmission, such as solenoid or speed sensor replacement, transmission overhaul, or vehicle chassis dyno testing.

NOTE: This procedure is rarely used solely to resolve a complaint for shift quality without identifying a related cause for resetting adaptive shifts.

- Knowing when and how to use Allison DOC® features for collecting and replay of snapshots, determining when to use the strip-chart feature vs. data monitor grid to review data, knowing when to use the software reconfiguration tool (such as for fast speed signal data review) and what to pay attention to from various Allison DOC® reports and failure records that might be the key to understanding and duplicating specific symptoms and DTCs.
- Working knowledge of differences between normal system response, diagnostic response, and inhibited responses using Allison DOC® snapshots, reports, action requests, and DMM.

D. Hydraulic Circuits Troubleshooting Skills.

Hydraulic circuits troubleshooting skills require:

- Ability to connect and take temperature data in order to compare with ATI specifications.
- Ability to use hydraulic schematics simulation program available in Allison DOC® Help Menu and the hydraulic schematics layouts in the Appendices.
- Ability to use the Allison Extranet to find Service SILs, Tech Tips, WATCH, and OEM Vehicle Integration Tech Data and Transmission Specifications.
- Ability to safely conduct Allison DOC® Action Request for clutch test, conduct stall tests, cooling tests, and retarder performance tests.
- Working knowledge of Principle of Operations of transmission including power flows, applied and exhaust clutches for specific ranges, and all other hydraulic circuit descriptions, measurements, and specifications, including lockup pressure, main mod pressure, lube pressure, control main pressure, exhaust backfill pressure, and converter pressure.
- Working knowledge of differences between normal system response, diagnostic response, and inhibited responses using Allison DOC® Snapshots, Reports, Action Requests and Hydraulic Gauges and Flowmeters.

E. Vehicle Driveline Troubleshooting Skills.

Vehicle driveline troubleshooting skills require:

- Ability to take accurate measurements for the ATI multi-joint driveline program. This program is part of the Allison Calc package within Allison DOC® and is accessible from the Help Menu. Refer to K–1. ANALYZING DRIVELINE DESIGN for additional information.
- Ability to use the Allison Extranet to find Service SILs, Tech Tips, WATCH, and OEM Vehicle Integration Tech Data and Transmission Specifications.

NOTE: Internal transmission damage and poor shift quality are common complaints when driveline issues and suspension issues (such as ride height) are left unattended.

F. Vehicle Cooling System Troubleshooting Skills.

Vehicle cooling system troubleshooting skills require:

- Working knowledge of the Allison Calc package within Allison DOC® which is accessible from the Help Menu. Refer to related DTCs in Section 5. DIAGNOSTIC CODES.

- Ability to use the Allison Extranet to find Service SILs, Tech Tips, WATCH, and OEM Vehicle Integration Tech Data.
- Ability to take measurements for fluid flows and fluid temperatures and compare those to Allison Tech Data specification.
- Ability to run drive idle cooling test and understand requirements of TD-157 which is available from the Allison Extranet.

G. Vehicle Noise and Vibration Troubleshooting Skills.

Vehicle noise and vibration troubleshooting skills require:

- Ability to take accurate measurements using J-38792 EVA and J-38792–A EVA 2 Electronic Vibration Analyzer, or similar tool, to isolate noise or vibration sources.
- Working knowledge of Chassis Ear, or similar tool, to isolate source of noise.
- Ability to make vehicle driveline inspections, take measurements, and run reports.

H. Vehicle Operation Troubleshooting Skills.

Vehicle operation troubleshooting skills require:

- Complete familiarity with the appropriate ATI Operator's Manual for the model year vehicle and vocational model type; for example TC10® TS. Operator's Manuals are available for free download from the ATI public website at *www.allisontransmissionpublications.com* or the ATI extranet site.
- Working knowledge of OEM publications and training related to vehicle or application operation.

Appendix C—FIRST STEPS AND TIPS FOR TROUBLESHOOTING

C–1. FIRST STEPS AND TIPS FOR TROUBLESHOOTING

A. Preparation.

1. Locate the information in this publication that best fits the symptoms or complaint before starting a repair. Other useful resources include Allison Transmission, Inc. Service Manuals, Allison Transmission, Inc. Parts Catalogs, Allison Tech Data, Extranet Tech Tips, Operator's Manuals, warranty history, Field Action (FA) letters, etc.
2. The Technical Assistance Center (TAC) is available for international and domestic service channel support for English speaking callers. Hours of operation are 8AM until 6PM Eastern Standard Time, Monday through Friday. The TAC phone number is 1-800-252-5283. Calls outside those times are received by an answering service. The answering service documents the call, refers the caller to a local Allison distributor or dealer, and forwards a message to TAC. The answering service cannot assist with troubleshooting vehicles or addressing parts questions. Form GN7353EN can be downloaded for free (or purchased as a pad of forms), and can be used by the technician to update/close an existing case or initiate a request for assistance. The form may be faxed to TAC at 317-242-2203 or e-mailed to *allison.tac@allisontransmission.com*.
3. Make sure all tools required to do the job are on site. These tools may include an approved Digital Multimeter (DMM), the Allison Transmission, Inc. breakout box, harness adapters, jumpers, overlays, the latest version of Allison DOC®, a complete and working set of hydraulic gauges (preferably the Allison Transmission, Inc. approved set, with a range up to 2500 kPa (325 psi)), and any other required Allison Transmission, Inc. special tools to complete the repairs.
4. Vehicle or engine issues are the main causes for transmission complaints or DTCs. Seek OEM service channel support as necessary. Allison Transmission, Inc. does not warranty any labor and parts that are non-ATI related unless authorized by a regional factory ATI representative or the ATI warranty department.
5. Refer to the Appendices for transmission specifications, TCM and shift selector diagrams, connector repairs, and Input/Output diagrams.

B. Documentation.

1. Obtain Allison DOC® snapshots that duplicate the event. Be prepared to e-mail files to TAC when requested, such as recorded pressure measurements, snapshots, pictures, and form GN7353EN.
2. Take notes and look for clues such as excessive debris, fluid condition, fluid analysis report, etc. Fill out necessary data sheets with clutch pressures, etc.

C. Transmission Data Acquisition Tips.

1. When a transmission clutch test or transmission dyno test is performed, install as many hydraulic gauges of appropriate range in all the pressure taps available on the transmission as possible. Hydraulic pressure readings can be very important when determining an appropriate repair plan. Pressure readings from clutches that are commanded hydraulically OFF can provide valuable information to diagnose issues. Make sure to snapshot these tests as well.
2. Drive or operate the vehicle normally during a snapshot. Erratic driver action with the throttle, selector buttons, service brake usage, and retarder controls will confuse the analysis.
3. Keep the snapshot as short as possible, but ensure that the event, symptom, or complaint is captured in the snapshot. Also, bookmark the occurrences.

4. Check failure records in the Allison DOC® for any active and inactive codes before clearing codes because the reports are deleted when clearing the DTCs.
5. Use Allison DOC® reports menus for a variety of reports that can be generated to help with determining current status or health of the transmission.
6. Pick the Strip Chart feature or Data Monitor Grids depending on the type of data and nature of the issue when reviewing snapshots. For example, strip chart is a better choice when looking for sensor issues or shift quality issues, and data monitor is a better choice when troubleshooting I/O-related issues.
7. If high resolution (meaning faster data transfer to the service tool) is needed, use either manual DPID configuration or a pre-configured DPID list available from the software configuration tab to limit the amount of data that is extraneous to the actual problem. For example, if speed signal traces are examined for noise or dropouts, then reconfigure the DPIDs at the software tab to collect the speed signals and throttle, and either disable or slow down the other transmission data reaching the service tool. Alternately, certain data is not collected unless the list is enabled at connection time under "Troubleshoot Transmission Problem", such as engine data.
8. Collect Data Bus Viewer logs and ensure that Engine Data collection in Allison DOC® is enabled in case an issue is caused by datalink issues or another controller on the vehicle, such as the engine, TCM, body controllers, or ABS.

D. Troubleshooting With An Active DTC.

1. The DTC trees are designed to identify causes for active DTCs. Following the troubleshooting steps of a DTC tree when the code is inactive rarely reveals the source of the issue causing the DTC unless the code becomes active while following the steps.
2. Always follow the troubleshooting tree steps for an active DTC. If multiple codes are active, troubleshoot the first code in the list.
3. Review DTC tree schematics and all the other information preceding the actual tree steps. This information is useful for troubleshooting and identifying possible causes for active and inactive codes.
4. Try to get a snapshot at ignition key **ON** to capture TCM information, the history of codes, and any failure records associated with that history. The snapshot will preserve the failure records. Note that failure record reports are deleted with a code clear.
5. When the TCM detects an electrical fault, it logs a DTC indicating a faulty circuit. The transmission operation may be altered to prevent or reduce damage, such as a fail-to-range mode of operation.
6. When the TCM detects a non-electrical problem while trying to make a shift, the TCM may attempt that shift a second or third time before setting a DTC. Once that shift has been retried (fault pending logic) and a fault is still detected, the TCM sets a DTC and holds the transmission in a fail-to-range mode of operation.
7. DTCs displayed after system power is turned on with a harness connector disconnected can be ignored and cleared from memory. Refer to Section 5. DIAGNOSTIC CODES for the code clearing procedure.

E. Troubleshooting Without an Active DTC.

1. The DTC trees are designed to identify causes for active codes. Following troubleshooting steps of a DTC tree when the code is inactive rarely reveals the source of the issue causing the DTC.

2. Check the fluid condition and fluid level using the OLS, if available; otherwise, use the dipstick. Correct the fluid level as needed prior to road test or vehicle function check. If fluid condition is poor, do not road test or stall the transmission until the cause for poor fluid condition is identified, functional pressure checks are done, and filters are inspected. The control valve module may need to be removed for a visual inspection of the suction filter contents and signs of clutch or metallic debris on components.
3. If there is no DTC history, then look for the symptom in the problem column of Section 7. GENERAL TROUBLESHOOTING OF PERFORMANCE COMPLAINTS and follow instructions for the symptom.
4. With an inactive history for a DTC, try to reproduce the issue by using the failure records stored in the TCM. This serves as a starting point for the test drive or Allison DOC® Action Request, such as clutch test, solenoid test, etc. Make sure to capture this in a snapshot.
5. If a test drive or operation of the auxiliary function related to the issue will not duplicate the concern, and if no DTC history exists in Allison DOC®, then conduct a customer interview or customer observed test drive to define the customer complaint. Take a snapshot of this test drive.
6. If a DTC or customer issue still cannot be duplicated, then remove filters and review conditions, service tool reports (if needed), and any available failure records. If there are no issues found, return vehicle back to service.
7. Performance issues related to Input/Output (I/O) functions typically do not have DTCs associated with them. Refer to related I/O functions, relevant Tech Data, Datalink Tech Data, vehicle wiring diagrams, and vehicle operator manuals prior to taking a snapshot of the vehicle operation and event.
8. Shift quality issues do not always generate DTCs. Use TCM Reflash to download a complete shift schedule and summary report for review. Compare any snapshot data to the shift schedule specification and the next upshift and downshift points in the data monitor grid. Check for engine DTCs and engine derates. Low power from the engine impacts transmission shift quality. Typically, the output speed acceleration data traced in strip chart will indicate very low acceleration, none, or negative acceleration as turbine speed may climb with a low engine power issue. The transmission shifts may feel prolonged as well. Determine if the correct CIN is installed and that the correct features and shift schedules corresponding to the engine and the vehicle are enabled in the TCM.

F. Allison DOC®.

- For most problems in Section 7. GENERAL TROUBLESHOOTING OF PERFORMANCE COMPLAINTS, an Allison DOC® snapshot reproducing the issue is imperative. Bookmarking the occurrence(s) of the complaint is equally important, particularly if the file is lengthy. Save snapshots in case they are needed for later review. TAC or ATI Service support will almost always ask for them.
- Allison DOC® Data Monitor grid is useful for troubleshooting discrete event data (called ON/OFF data) such as I/O switch states, PS1/PS2 switch state, etc.
- Allison DOC® Strip Chart view and its cursor feature is better suited to troubleshooting variably changing data (called analog data) such as commanded pressures, speed signal values, throttle data, temperature data, etc. The cursor location determines parameter values shown in the strip chart legend. Strip charts are ideal for troubleshooting shift quality issues, overheat complaints, etc.

G. Data Bus Viewer.

- The Data Bus Viewer file is useful for troubleshooting datalink-related I/O functionality issues or datalink-related DTCs (for example DTCs P0703, U0304, etc.). Allison DOC® snapshots and Data Bus Viewer files cannot be collected at the same time. Be sure to reproduce the issue in both the snapshot and the Data Bus Viewer files.
- Many transmission issues can be resolved by analyzing the message(s) on the datalink. The Anti-lock Brake System (ABS) state, retarder requests and status, exhaust brake requests and status, service brake status, engine torque reduction requests and many I/O function inputs are datalink driven.
- When choosing a Data Bus Viewer connection, it is better to select Reuse Allison DOC® connection. Reusing the existing connection allows all TCM and selector datalink messages to be collected with outside controller messages. Selecting New Connection does not capture the TCM and shift selector messages; only messages from the other controllers are collected into the log file.

H. Using Clutch Test to Collect Transmission Pressures.

- Troubleshooting most DTCs or performance issues usually requires measuring transmission pressures. The best method (except when in reverse range or collecting lockup pressure data) is to collect transmission pressures while in Allison DOC® Clutch Test. Command every allowed range and collect all possible transmission pressures for each range. Record main pressure, clutch pressures, exhaust backfill pressures (for all OFF clutches), lube pressure, and Main Mod energized solenoid state (Y\N or ON\OFF).
- An energized Main Mod solenoid reduces main pressure by a variable amount depending on other transmission conditions (like range attained, engine speed, PTO state, throttle amount). A de-energized Main Mod solenoid causes full main pressure. Confusion or an incorrect conclusion that main pressure is below specification can occur when a technician fails to note on the datasheet if the Main Mod solenoid was energized for the ranges tested. In Allison DOC® Data Monitor, a value of 1600 kPa (232 psi) indicates that Main Mod is electrically off, which coincides with a full main pressure schedule. For example, there is no reduction in the main pressure schedule via the Main Mod solenoid at this time.
- Allison DOC® has a new action request for TCM calibrations called Full Main Pressure Test. This action request allows the Main Mod solenoid to be de-energized in **N** (Neutral), **1** (First Range), **2** (Second Range) at idle in order to note the “full” main pressure (and corresponding clutch pressures) without the Main Mod solenoid pressure reduction. Use the Full Main Pressure Test to verify main pressure meets specifications at idle. A PTO enable ON state also commands full main pressure (if enabled in a calibration) where the Full Main Pressure Test is not available, such as TCM calibrations or using Allison DOC®.
- Diagnostic flow charts found in Figure 6–5 and Figure 6–6 are another tool for identifying possible causes of issues based on observable clutch state information with or without using pressure gauges.

I. Clutch Slip Detection with Partial Stall Test.

A clutch slip can be detected by doing a partial stall test (1300-1500 rpm) in any range(s) except **R** (Reverse), **7** (Seventh Range) (Low, 7 speed), **1** (First Range), and **N** (Neutral). The turbine side of the converter and the turbine shaft should be stopped in a stall condition (0 rpm turbine speed). Steady turbine speed or increasing speed while in range at a stop in a partial stall condition usually means a clutch is slipping. Turbine speed should pull down to 0-1 rpm within seconds of starting the stall when range is selected and attained for the stall test. It is common to see turbine rpm increase but pull down quickly, creating a bump in turbine speed (in the speed signal strip chart trace) while changing or just after clutch test ranges.

J. Analyzing Speed Signal Traces.

Intermittent speed signals can be difficult to capture in a snapshot unless they are extremely erratic. A stair-stepped appearance of speed signals while in the strip chart view is typical and is related to data transfer rate constraints between the TCM and Allison DOC®. To see higher resolution speed traces in a strip chart, Allison DOC® includes a pre-configured data packet ID (DPIDDPID) file called SpeedSignalsIntegrityDataList (Figure C–1) that can be loaded and applied prior to connecting to the TCM. User customized DPID files can also be loaded to enhance speed signal data transfer rate, along with any other desired user configured DPIDs needed for troubleshooting, such as throttle, solenoid commanded pressures, etc.

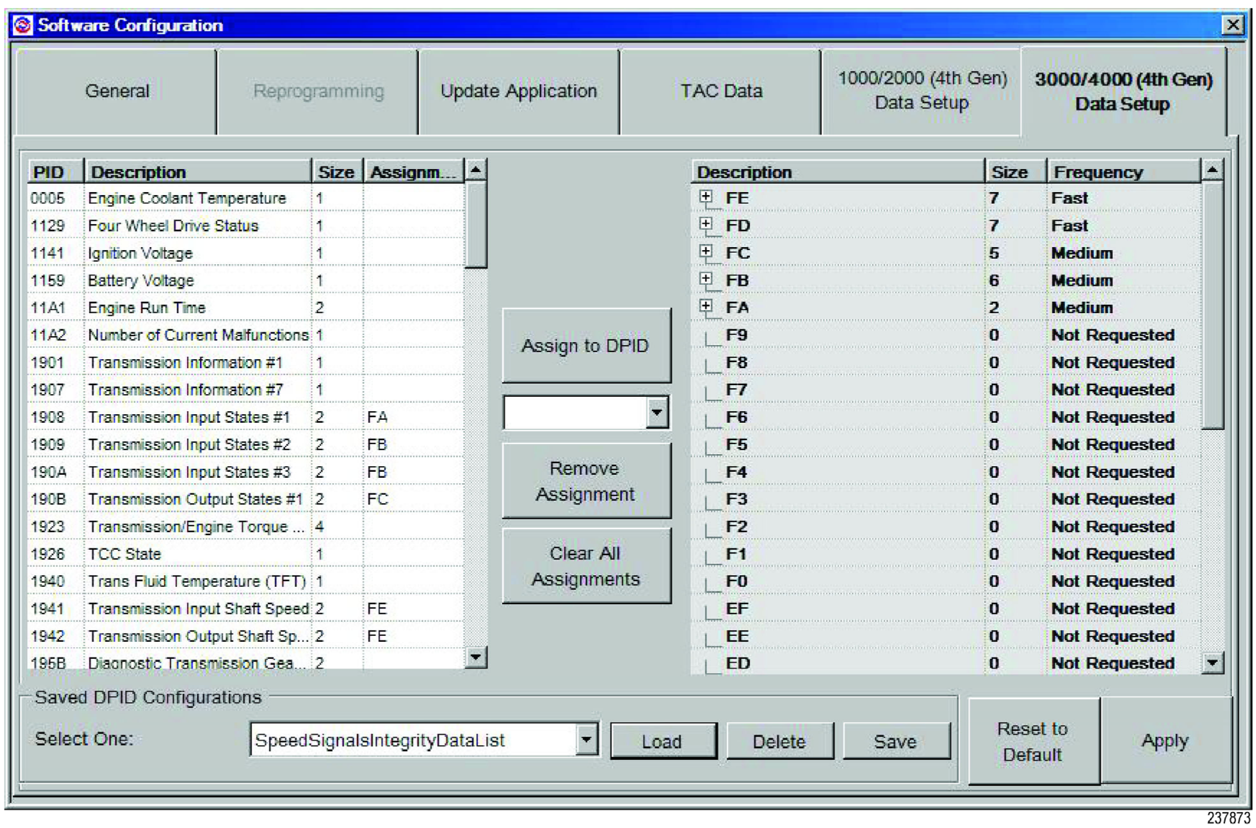


Figure C–1. SpeedSignalsIntegrityDataList

The transfer rate for each DPID is user selectable by picking the transfer rate from a select box next to each DPID, e.g., DPID "FA", "FE", etc.

NOTE: Each DPID has multiple transmission parameters assigned; DPID transmission parameters are also user configurable. Click on the plus sign next to the DPID to see what transmission parameters are assigned to specific DPIDs. Save the configured file using the Save button. Use the Load button to view and set the DPID file; then use the Apply button to implement the changed collection assignments and rates.

Certain transmission data parameters cannot be inhibited from being collected. Pop-up messages during user defined DPID configuration will show which transmission parameters are required by Allison DOC® for collection. The Allison DOC® required parameters which are not needed by the user for a snapshot can be configured to a "slow" data transfer rate to improve resolution for the other data. All uncollected DPIDs (those that the user sets to a transfer rate of "Not Requested") will not be collected from the TCM during that Allison DOC® session and is shown as "Not Available" in the Data Monitor grid.

The Input, Turbine, and Output speed parameters (which are included in DPID "FE") should be set to "Fast" data transfer rate in a user customized file to achieve the best resolution for speed signals. The pre-configured DPID file called SpeedSignalsIntegrityDataList is an easier option than customizing DPIDs manually. Note that this file results in higher resolution speed signals that will no longer appear stair-stepped in strip chart view provided the user loaded and applied the file correctly prior to connecting to the TCM.

Exiting out of the Allison DOC® program resets everything back to the default DPID assignments and transfer rates. If Allison DOC® is not shutdown the current DPID file is still loaded. If another snapshot is needed for specific data defined by a user customized list (or if using the pre-configured SpeedSignalsIntegrityDataList) but the program Exit command was executed, then reload the saved file name for the desired DPID configuration from the software configuration tab, and select the Data Setup Tab (Figure C–1).

Appendix D—TROUBLESHOOTING WITH A DIGITAL MULTIMETER (DMM)

D–1. TROUBLESHOOTING WITH A DIGITAL MULTIMETER (DMM)

WARNING: Prior to working on electrical circuits with potentially hazardous electrically energy, one should be familiar with and understand all safe electrical work practices required to do that work. Do not attempt to work on potentially hazardous electrical circuits if you are not trained to do so.

NOTE: Digital Multimeter (DMM), Digital Volt/Ohm Meter (DVOM), Volt Ohm Meter (VOM), and meter are terms that describe the same tool and are used interchangeably throughout this publication.

A DMM, also called a DVOM, VOM, or meter is a tool used to acquire various electrical measurements of energized or de-energized electrical circuits.

The most common measurements required to troubleshoot transmission-related issues are circuit resistance in ohms (Ω) and voltage (V) values. Sometimes frequency in hertz (Hz) measurements are needed when troubleshooting speedometer speed signals.

The following are some tips for using a meter:

- To avoid meter damage and to get accurate circuit measurements, read and understand the meter manufacturer’s instruction manual prior to making measurements.
- To avoid possible damage to the meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.
- When making electrical connections, connect the lead inserted in the common jack (COM) of the meter before connecting the live test lead. When disconnecting, disconnect the live test lead before disconnecting the lead in the common jack (COM).
- Placing the test leads across a powered circuit when a test lead is plugged into a current terminal of the meter can damage the tested circuit and blow the meter's fuse. This can happen because the resistance through the meter's current terminals is very low and the meter acts like a short circuit.

A. Measuring Resistance.

To measure resistance, refer to Figure D–1. The meter measures resistance by sending a small current through the circuit. Because this current flows through all possible paths between the test leads, the resistance reading represents the total resistance of all paths between the leads. Resistance is measured in ohms.

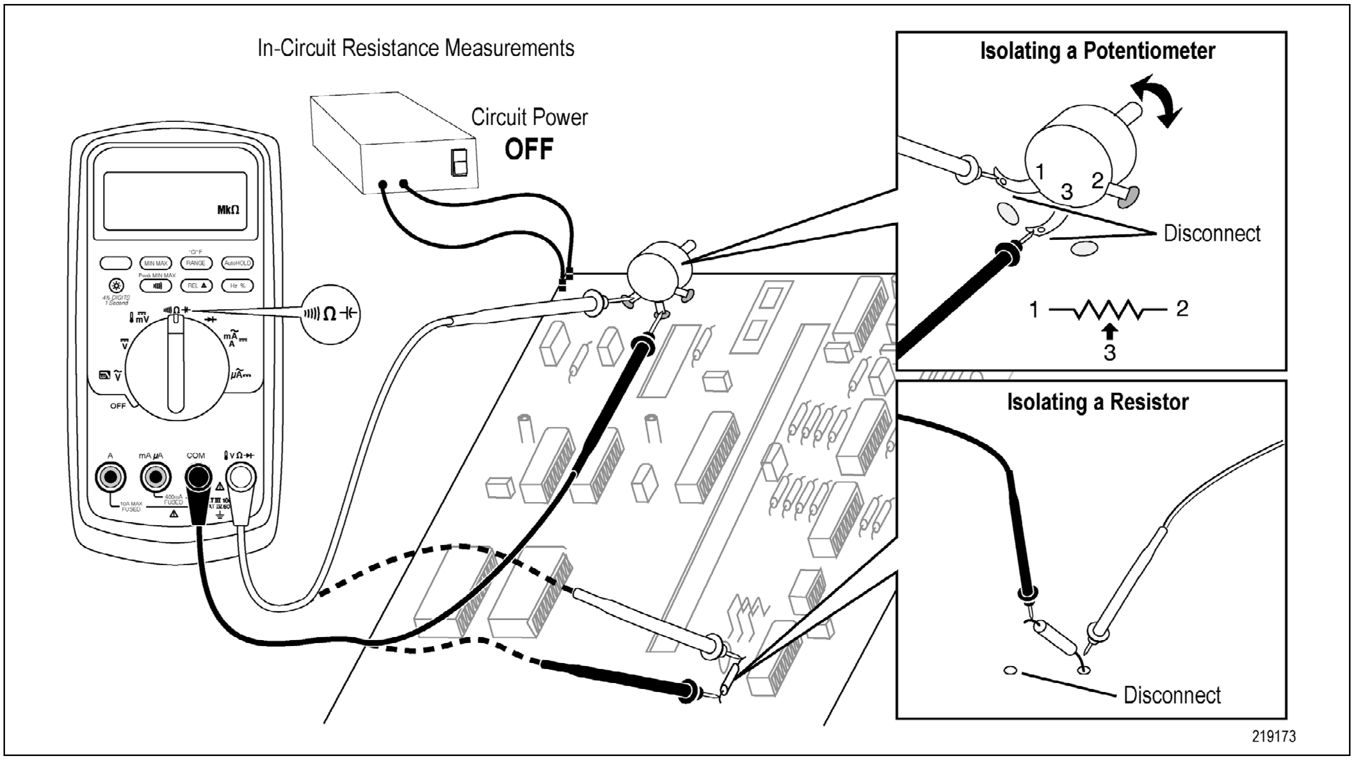


Figure D–1. Resistance Measuring

The following are some tips for measuring resistance:

- The resistance function can produce enough voltage to a forward-bias silicon diode or transistor junctions, causing them to conduct. If this is suspected, press the range button on the meter to apply a lower current in the next higher range. If the resistance value is higher, use the higher range value.
- The measured value of a resistor in a circuit is often different from the resistor's rated value. To avoid possible damage to the meter or the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before testing resistance.

B. Measuring AC and DC Voltage.

To measure AC or DC voltage, refer to Figure D–2. When measuring voltage, the meter acts approximately as a 10 MΩ (10,000,000 Ω) impedance in parallel with the circuit. This loading effect can cause measurement errors in high-impedance circuits. In most cases, the error is negligible (0.1% or less) if the circuit impedance is 10 KΩ (10,000 Ω) or less.

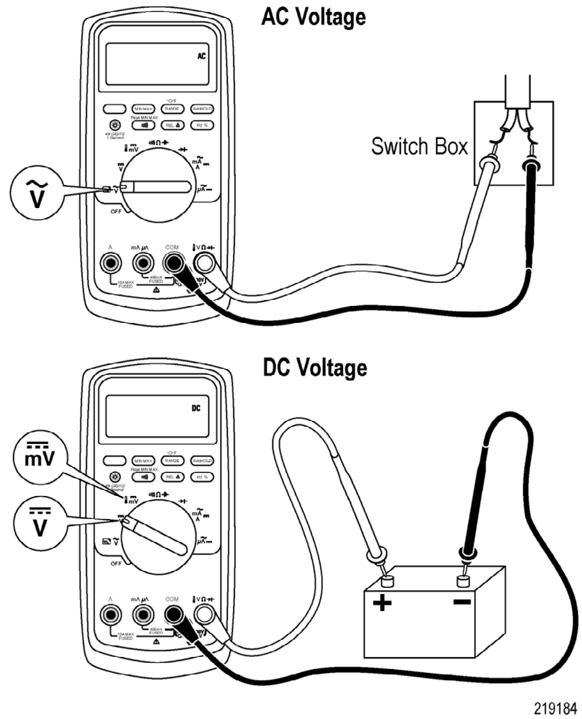


Figure D–2. Measuring AC and DC Voltage

NOTE: For the procedures in this publication, only DC Voltage measurements are needed.

C. Measuring Frequency.

The meter measures the frequency of a voltage or current signal by counting the number of times the signal crosses a threshold level each second. To measure frequency:

1. Connect the meter to the signal source.
2. Press the Hz button.
3. Press the Auto HOLD button to start the counter.

Most meters that have a frequency button will auto-range its frequency ranges.

The following are some tips for measuring frequency:

- If a reading shows 0 Hz or is unstable, either the input signal may be below or near the trigger level, or the vehicle is not moving. Correct the problem by either selecting a lower range on the meter, which increases the sensitivity of the meter, or drive the vehicle to generate output speed.
- If a reading seems to be a multiple of what you expect, the input signal may be distorted. Distortion can cause multiple triggerings of the frequency counter. Selecting a higher voltage range might solve this problem by decreasing the sensitivity of the meter. Try selecting a DC range, which raises the trigger level. In general, the lowest frequency displayed is the correct one.

D. MIN MAX Recording Mode.

The MIN MAX mode records minimum and maximum input values. When the inputs go below the recorded minimum value or above the recorded maximum value, the meter beeps and records the new value. This mode can be used to capture intermittent readings, record maximum readings while you are away, or record readings while you are operating the equipment under test and cannot watch the meter. The response time is the length of time an input must stay at a new value to be recorded. A quality meter has a maximum response time of 100 milliseconds.

NOTE: MIN MAX mode is useful for monitoring voltage dips in ignition signal voltage and battery voltages to the TCM. It is also useful to check for intermittent opens or shorts in wires while making resistance checks in the harness.

During engine starter cranking, the TCM battery voltage supply may typically dip below 5.0 V. This would not be an issue unless the neutral start signal drops out, which may happen below a battery voltage of 4.75 V (refer to Tech Data) during engine starter cranking. The minimum continuous battery voltage to an Allison shift selector and the minimum continuous battery voltage to the TCM are not identical (refer to Tech Data).

E. Testing for Continuity.

Most quality meters have a continuity test that sounds an alert when a circuit is complete. To test for continuity, refer to Figure D–3.

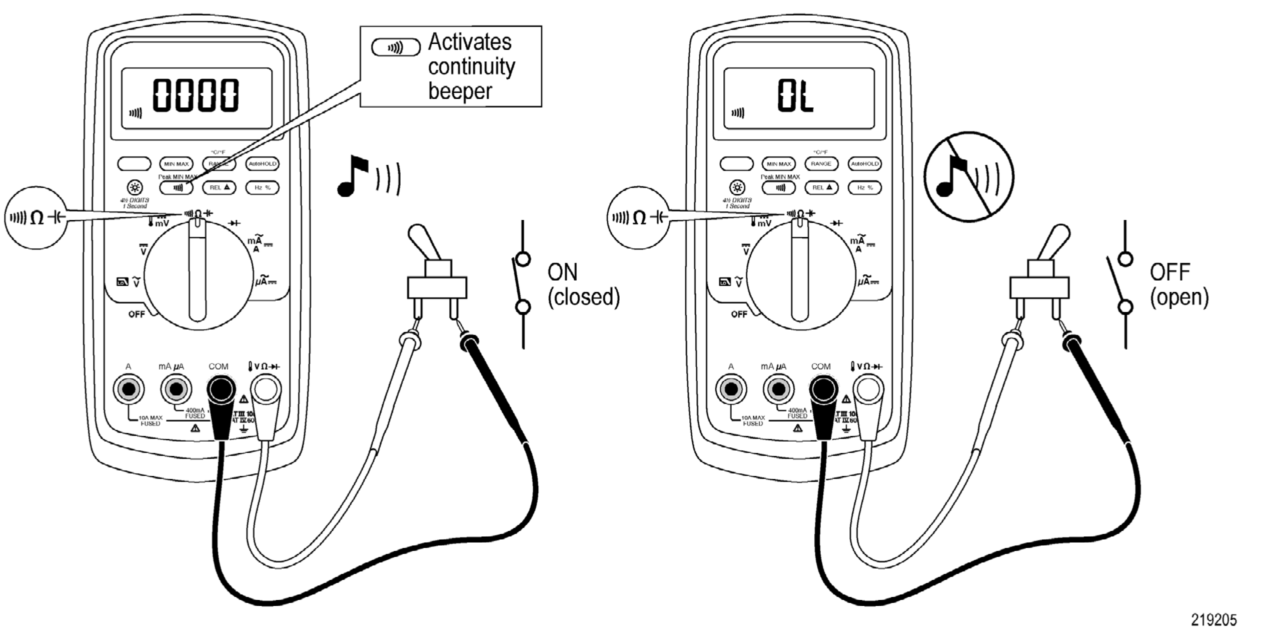


Figure D–3. Testing Continuity

The continuity function can be used to detect intermittent opens and shorts lasting as little as 1 ms. An intermittent short or open condition causes the meter to emit a short alert sound or a burst of short alert sounds as the conditions causing the intermittent issue change. Furthermore, the technician does not have to read a meter display to see the open or short, he can hear it.

NOTE: For the procedures listed in this publication, a DMM resistance measurement in ohms is the most reliable and accurate method to determine whether a circuit meets service specification while checking for opens, shorts, or resistance values. Depending on the continuity alerts as a substitute for measuring circuit resistance in ohms is not recommended for the transmission and related circuit troubleshooting in this publication. DMM continuity mode and dedicated continuity testers can contribute to technician error when pass/fail criteria for a circuit is based only on continuity test results.

A continuity tester, or a DMM set to continuity mode, will typically sound a steady audible alert showing the electrical continuity of the path between the leads. An open circuit between the leads is indicated by the lack of an alert sound.

Some manufacturers of high-quality meters have stated in their specifications for approved field service meters that the threshold of continuity alert can occur at as high as 40 Ω. This value is higher than the maximum allowed service specification for resistance for a closed circuit across a switch with no other components in series (such as a TPS, solenoid, temperature sensor, etc.). Some service specifications in this publication state the maximum ohms must not exceed more than 5 Ω. Use the DMM autorange button to set the correct ohms range for the circuit test.

F. Testing Diodes.

To avoid possible damage to the meter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before testing diodes.

Use the diode test to check diodes. This function tests a semiconductor junction by sending a current through the junction, then measuring the junction's voltage drop. A good silicon junction voltage drop is between 0.5 V and 0.8 V.

To test a diode out of a circuit, refer to Figure D–4. For forward-bias readings on any semiconductor component, place the red test lead on the component's positive terminal and place the black lead on the component's negative terminal.

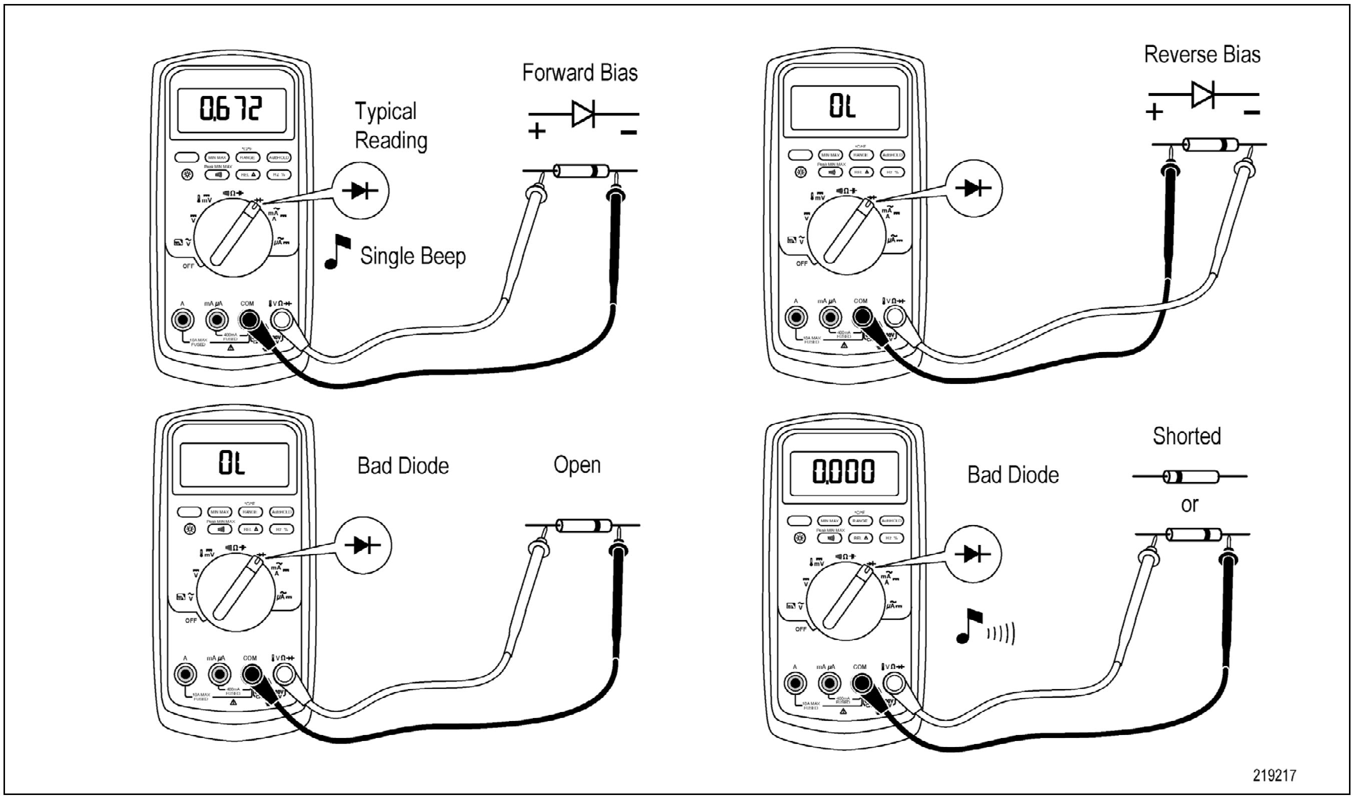


Figure D–4. Testing a Diode

In a circuit, a good diode should produce a forward-bias reading of 0.5 V to 0.8 V; however, the reverse-bias reading can vary depending on the resistance of other pathways between the probe tips.

For most quality meters, a short beep sounds if the diode is good (less than 0.85 V). A continuous beep sounds if the reading is less than 0.100 V. This reading would indicate a short circuit. The display typically shows “OL” if the diode is open on most quality meters.

G. Measuring AC or DC Current.

NOTE: This publication does not contain any diagnostic procedures that require AC or DC current measurement. This information is intended for educational purposes only.

To avoid possible damage to the meter or to the equipment under test:

- Check the meter's fuses before measuring current.
- Use the proper terminals, function, and range for all measurements.
- Never place the test leads across (in parallel with) any circuit or component when the leads are plugged into the current terminals.

To measure current, refer to Figure D–5 and proceed as follows:

1. Turn off power to the circuit. Discharge all high-voltage capacitors.
2. Open the circuit under test, then place the meter in series with the circuit.

3. Insert the black lead into the COM (common) terminal. For currents between 6 mA and 400 mA, insert the red lead into the mA/μA terminal. For currents above 400 mA, insert the red lead into the A terminal.
4. Set the meter's range dial to the correct setting.

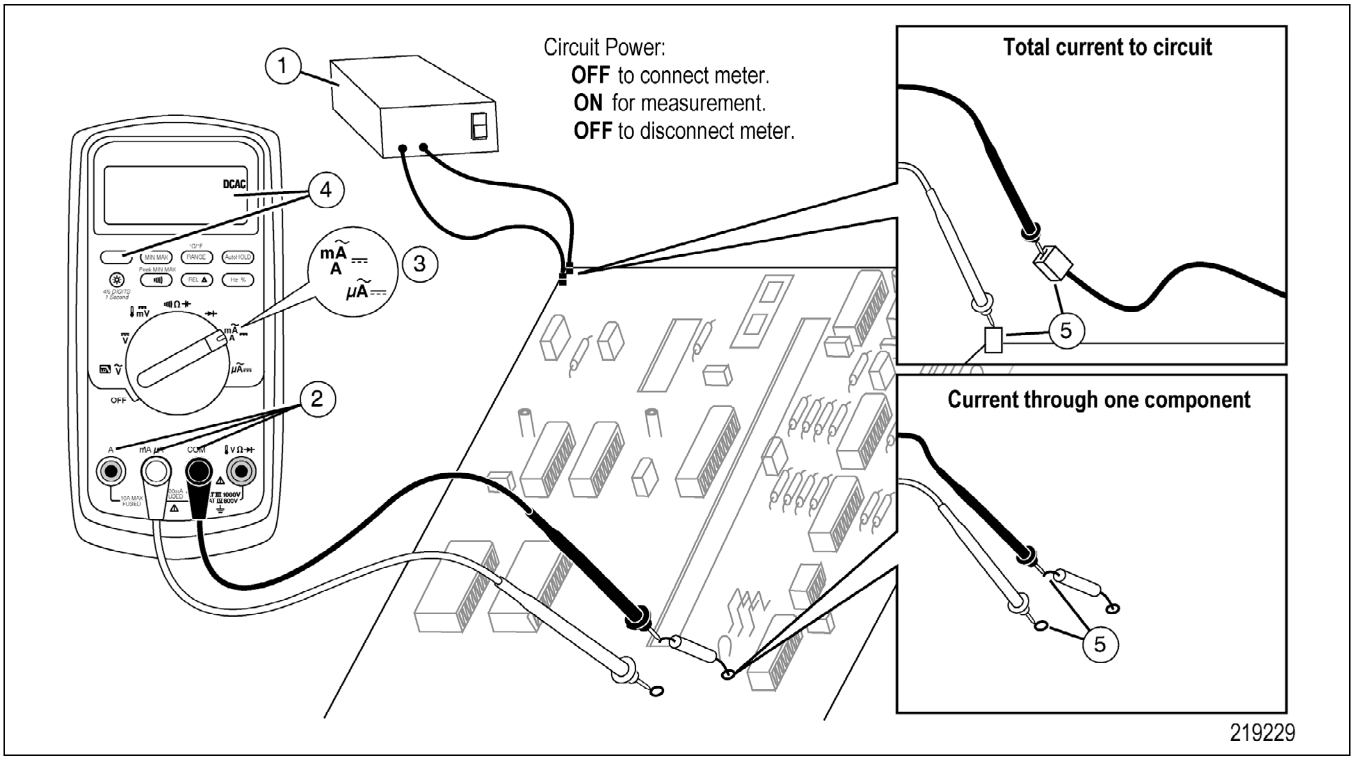


Figure D–5. Measuring Current

NOTE: To avoid blowing the meter's 400 mA fuse, use the mA/μA terminal only if you are sure the current is less than 400 mA continuously or less than 600 mA for 18 hours or less.

The following are some tips for measuring current:

- If the current reading is 0 and you are sure the meter is set up correctly, check the meter's fuses.
- A current meter drops a small voltage across itself, which might affect circuit operation.

NOTES

Appendix E—TROUBLESHOOTING TRANSMISSION AND VEHICLE CIRCUITS

E–1. TROUBLESHOOTING TRANSMISSION AND VEHICLE CIRCUITS

A. Beginning Steps and General Tips.

Before beginning the troubleshooting process, read and understand the following:

- All resistance measurements should be taken with the ignition in the **OFF** position.
- Always disconnect the TCM from the chassis harness before measuring resistance. Electronic components in the TCM will alter the measured resistance significantly and can result in errors.
- Refer to TCM schematic, connector charts, and vehicle schematics while troubleshooting circuits. Compare measured electrical values with electrical specification tables published in this manual.
- Do not measure resistance for the Oil Level Sensor (OLS). The OLS is an active electronic device (Hall Effect) that may be damaged by some Digital Multimeters.
- Allison has recommended that Original Equipment Manufacturers (OEMs) use 3-digit transmission wire numbers using the pin number assignment at the TCM for the second and third digits, (e.g., wire 158 terminates at terminal 58 in the TCM connector).
- Shut off the engine and ignition before any harness connectors are disconnected or connected.
- If the circuit is suspected to be shorted to another wire or ground at that moment, then minimize movement of wiring harnesses. Shorts involve wire-to-wire or wire-to-ground contacts and moving the harnesses may eliminate the problem. If a short circuit is suspected and the circuit is not shorted to another circuit or ground, then wiggle the harnesses to obtain the short circuit condition. Make sure to stop wiggling the harnesses when you duplicate the short condition.
- If an open circuit is suspected, but the circuit is not open, then wiggle connectors, harnesses, and splices to try and create the open circuit. This simulates vehicle movements which occur during actual operation. Be sure to stop wiggling the harnesses when an open is detected.
- When disconnecting a harness connector, be sure the pulling force is applied to the connector and not to the wires extending from the connector.
- Always coordinate with the vehicle OEM service channel when repairing or replacing defective vehicle wiring, connectors, pins, seals, etc. for both parts and service support. OEM's may not use the same methods and tools for connector and wiring repairs as Allison Transmission, Inc. Secondly, ATI does not have the vehicle wiring layout diagrams and schematics needed to diagnose and fix an issue on the vehicle side.

NOTE: Repairs to a chassis harness not provided by Allison Transmission are not covered by Allison Transmission warranty.

- Check for terminal tension (expanded terminals) by inserting its mating connector and slowly withdrawing while checking for evidence of friction or drag in the fit. If there is no perceptible drag, then replace the expanded terminal.
- Check for broken wire strands. These are usually located a short distance from an OEM connector that has inadequate strain relief. Broken strands can be suspected if the wiring feels loose and limp.
- Use proper strain relief techniques on any repair. Check for strain relief issues as part of the inspection process of a repair. Broken wiring and worn insulation can develop if harnesses

are cinched too tightly, harnesses are too loose between harnesses and attachment points, or connectors have inadequate strain relief (too tight or loose).

- Check for connectors that are not locked to seat (twist types) or improperly torqued together such TCM 80-way and OEM 20-way transmission connectors. In addition to intermittent connection issues, weather can affect the connectors. Twist type connectors that use seals to squeeze against the connector face are vulnerable to moisture.
- Check for water intrusion inside mating connectors, especially if located in an environmentally unprotected space. When corrosion is noted, determine the cause. Common causes include missing seal plugs for vacated wire seal holes and connector halves that are not locked to seat or torqued properly. Check for missing or defective connector seals or O-rings.
- Use Data Monitor and Snapshot feature with Allison DOC® while troubleshooting electrical issues for DTC steps that require ignition power ON. The TCM response to wiggling harnesses may identify where to look for an electrical problem. A new feature with Allison DOC®, include new add-on lists for collecting some sensor data at connection that reports in ohms, counts, or volts depending on the data parameter acquired. Adding that list to any snapshot where an electrical issue is intermittent can lead to a solution if DMM troubleshooting cannot isolate the issue.
- Chassis harness wires between the TCM connector and another component typically adds 1 Ω or less of resistance to the measured circuit. This measurement does not include the added J-39700 Universal Breakout Box extra circuit resistance introduced when inserting the J-39700 Universal Breakout Box and harness adapter into the circuit. This resistance must be compensated by either subtracting the value from the measured circuit resistance or using the relative (REL) mode on the meter (if equipped) to cancel out or "zero" the meter prior to measuring circuit resistance.
- Inspect all connector terminals for damage. Terminals may have been bent or lost the necessary tension (expanded open) to maintain firm contact. Check for terminal locks inside the connector which could allow the terminal to push away from its mating terminal; this could cause either an open circuit or a short to another shared circuit inside the connector.
- Clean dirty terminals or connectors with isopropyl alcohol or a non-residue, non-lubricating, contact cleaner such as LPS® Electro Contact Cleaner or LPS® NoFlash Electro Contact Cleaner. Then, with clean dry air, blow any excess contact cleaner out from the connector. Contact cleaner trapped in the connector may affect the connector seal.

  The contact cleaner solvent must not be:

  - Chlorine based
  - Contain petroleum distillates
  - Conduct electricity
- DTCs displayed after system power will become active with a harness connector disconnected, and can be ignored and cleared from memory. Refer to Section 5. DIAGNOSTIC CODES for the DTC clearing procedure. To determine exact conditions for duplicating codes, check the failure records report for the active codes. Do not clear active or inactive codes until acquiring the failure records reports because the reports are deleted after clearing the DTCs. Interview the operator, if possible, to understand when the code or symptom is active.
- Make sure all vehicle ground points are clean and properly tightened. Poor chassis grounds and engine block grounds can loosen or corrode. This could cause vehicle currents to flow

through the easiest pathway to ground which might include the TCM circuit wires that could cause damage to the TCM.

B. Allison Transmission, Inc. (ATI) Unapproved Procedures for Electrical Circuit Troubleshooting.

The following procedures are not approved by Allison Transmission, Inc. service engineering and therefore should not be used as a method to diagnose any transmission DTCs, I/O functions, or shift quality concerns:

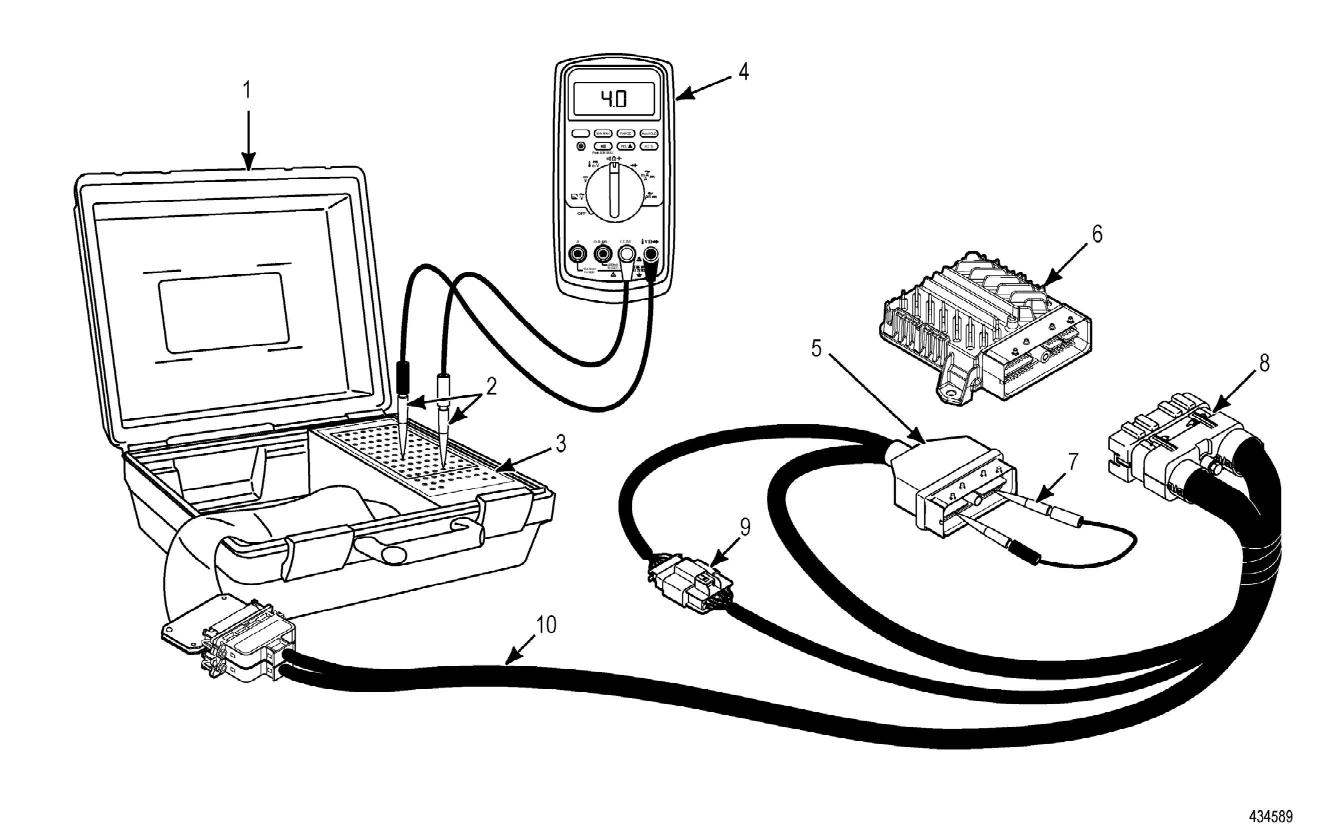
- Back-probing any connectors used for transmission features or functions unless directed to do so within a DTC tree. Back-probing connectors may damage and/or unlock the terminals in the connector which could create permanent or intermittent shorts, and/or open circuits. If possible, use J-39700 Universal Breakout Box, appropriate harness adapters, and appropriate magnetic overlays to troubleshoot the vehicle.
- Do not load-test any transmission-related circuits with outside electrical devices such as vehicle lamps or relays.
- Do not pierce wires to check for voltages, shorts-to-grounds or other wires in the circuit. This creates a leak path for moisture and will damage the wire and insulation.

C. Compensating for Universal Breakout Box and Lead Resistance Introduced into Circuits.

NOTE: The DMM test leads typically add 0.1 Ω to 0.2 Ω of extra resistance to any test circuit resistance measurement. To measure the test lead resistance, touch the test lead tips together and read the resistance. If desired, use the relative (REL) mode on the meter (if equipped, refer to DMM instruction manual) to compensate for the measured test lead resistance from the circuit automatically. The same technique may be used to compensate for the extra resistance added to the circuit resistance by the J-39700 Universal Breakout Box and the adapter harnesses. This extra resistance must be subtracted from the readings to get an accurate resistance measurement for the circuit. Typically, the universal breakout box and equipment adds an extra 2-4 Ω to the circuit being tested.

To determine the extra resistance of the universal breakout box and equipment that should be compensated out or subtracted off, do the following:

1. Identify two terminals on the male side of the adapter harness being used with J-39700 Universal Breakout Box to jumper together. Use matching socket terminals (J-47277) from the J-39197-A Jumper Wire Kit. Jumper the terminals in the male connector of the J-39700 Adapter Harness. Do not connect the adapter harness to the vehicle for this procedure.
2. Use two additional jumper wires from J-39197-A Jumper Wire Kit and insert one end of each into a DMM. On the other end of the jumpers, install the male terminals from the jumper kit that match the magnetic overlay test points. Then, insert J-39197-A Jumper Wire Kit male terminals into the identical test points on J-47275-1 Magnetic Overlay identified in Step 1.
3. Measure the resistance in ohms (Figure E–1). Use this resistance value to subtract from the test circuit resistance while troubleshooting vehicle circuits with J-39700 Universal Breakout Box and harness. The J-47275 TCM Breakout Harness and J-47279 3k/4k Transmission Harness will probably have different harness resistances. Do not assume your compensation resistance will be the same or remain constant with time. Typically, the value will range between 2-4 Ω.



(1) – J-39700 Universal Breakout Box
(2) – J-39197-A Jumper Wire Kit
(3) – J-47275-1 Magnetic Overlay
(4) – DMM
(5) – 80-Way Connector (for OEM Side)
(6) – TCM
(7) – J-39197-A Jumper Wire Kit
(8) – 80-Way Connector (TCM Side)
(9) – 16-Way Bypass Connector
(10) – J-47275 TCM Breakout Harness

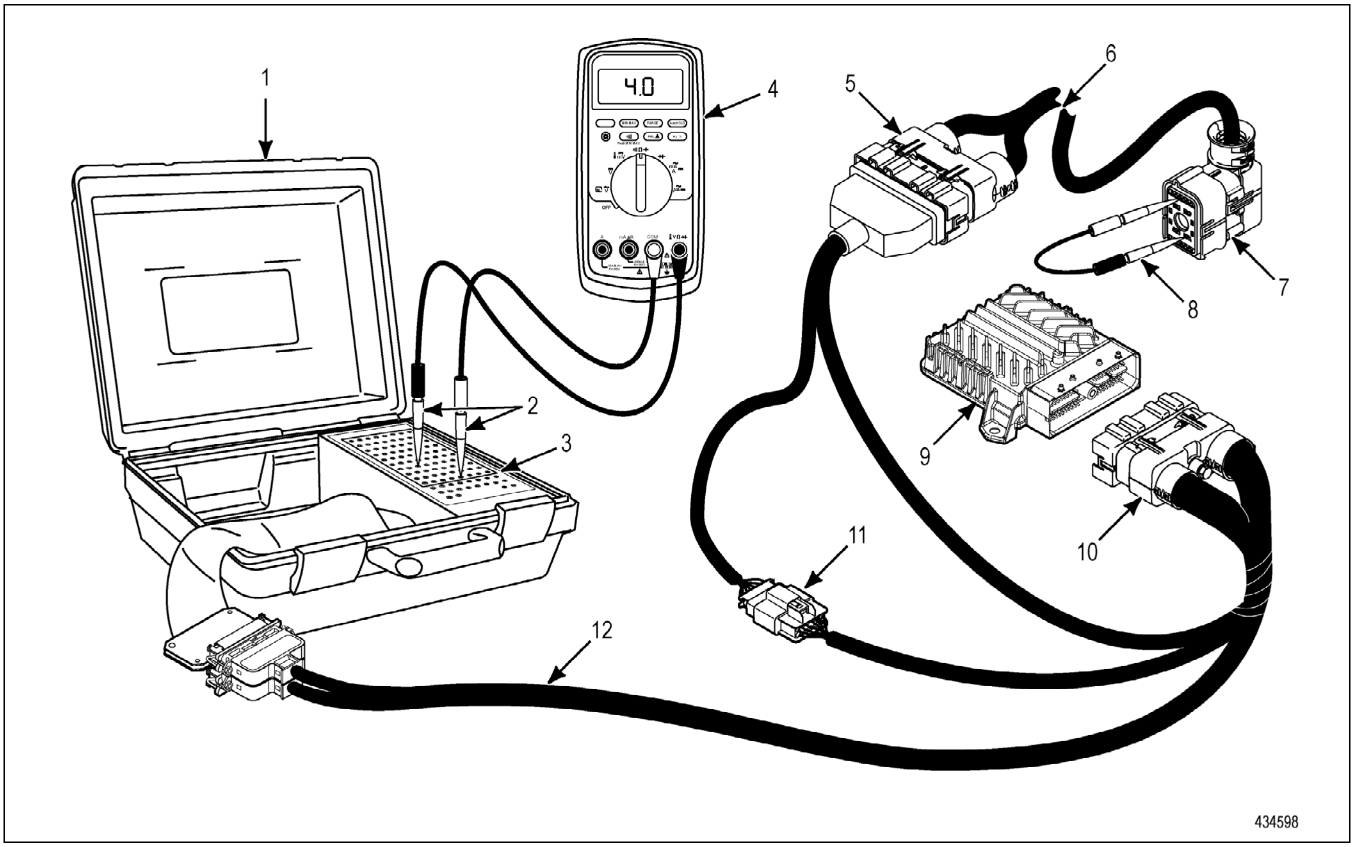
Figure E–1. Compensating for Universal Breakout Box and Lead Resistance

D. Example Steps to Find Open Circuit or High Resistance.

NOTE: The following example provides a procedure to check for an open circuit in the vehicle harness. These steps were copied from the DTC P0843 tree, but are applicable to many circuits between the TCM and the transmission or other component wiring, such as speed sensor wiring, selector wiring, etc.

1. Measure J-39700 Universal Breakout Box and DMM test lead resistance. Use the relative (REL) mode on the meter (if equipped). Refer to DMM instruction manual for instructions on how to cancel the additive resistance effect of the DMM test leads, J-39700 Universal Breakout Box, and J-47275 TCM Breakout Harness during circuit troubleshooting. Zero the DMM or record the extra resistance to subtract from measured circuit resistance.
2. Turn the ignition **OFF**.
3. Connect J-47275 TCM Breakout Harness to J-39700 Universal Breakout Box if disconnected after Step 1.
4. Connect OEM chassis harness 80-way to J-47275 TCM Breakout Harness.
5. Leave TCM side of J-47275 TCM Breakout Harness disconnected from the TCM.
6. Connect 16-way bypass of J-47275 TCM Breakout Harness.

7. Disconnect OEM 20-way transmission connector from transmission.
8. Install jumper from terminal 10 to terminal 3 of OEM 20-way transmission connector.
9. Using a DMM, measure the resistance between terminal 51 and terminal 77 at TCM J-47275-1 Magnetic Overlay (Figure E–2).
10. Does circuit resistance measure 4 Ω or less after tool resistance is subtracted from DMM reading? If not, coordinate with the vehicle OEM to repair or replace defective vehicle wiring, connectors, pins, etc. found to be causing high resistance in wire(s).



(1) – J-39700 Universal Breakout Box
(2) – J-39197-A Jumper Wire Kit
(3) – J-47275-1 Magnetic Overlay
(4) – DMM
(5) – 80-Way Connector (OEM Side)
(6) – OEM Vehicle Harness
(7) – 20-Way Transmission Connector (OEM Side)
(8) – J-39197-A Jumper Wire Kit
(9) – TCM
(10) – 80-Way Connector To TCM
(11) – 16-Pin Bypass Connector
(12) – J-47275 TCM Breakout Harness

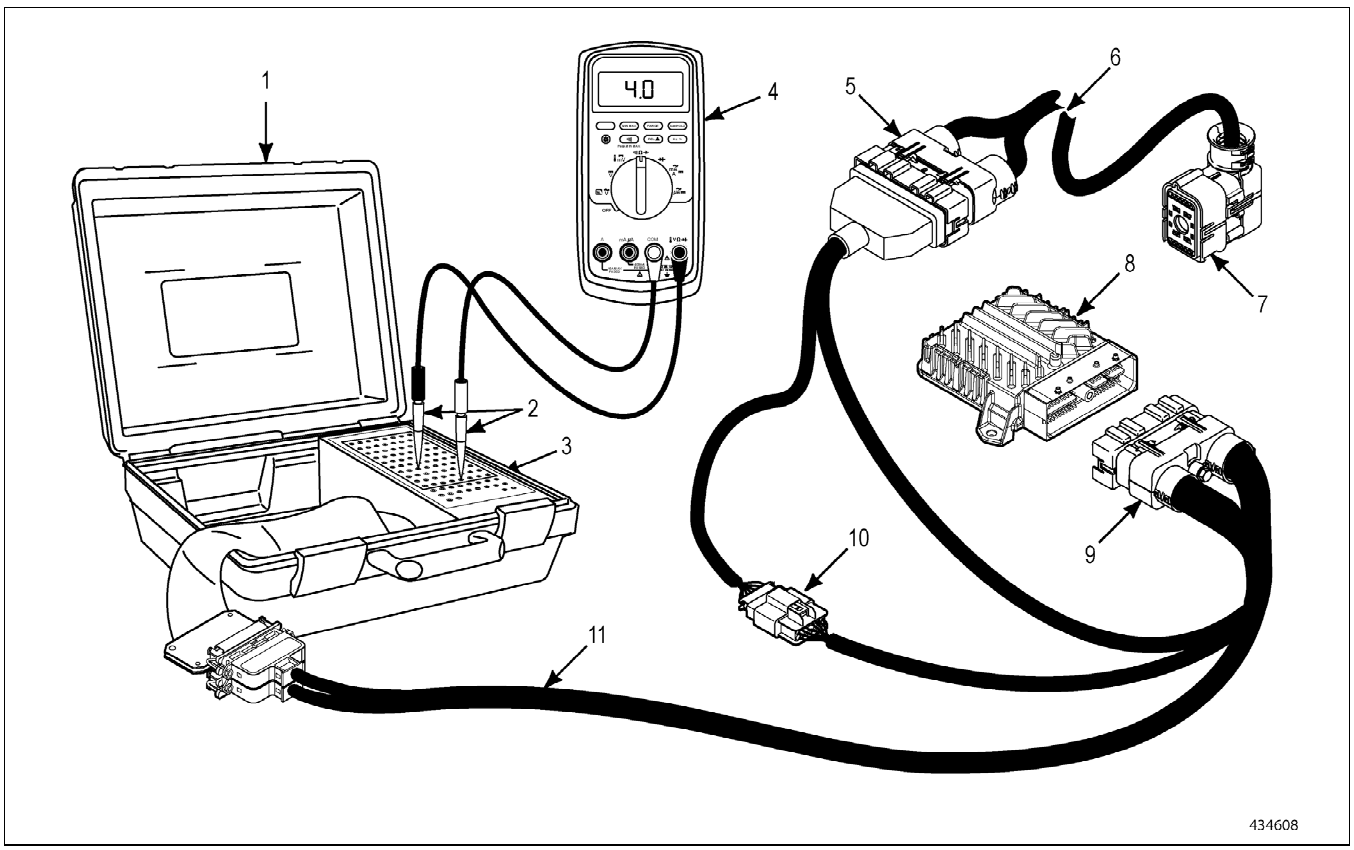
Figure E–2. Checking for Open Circuit or High Resistance

NOTE: Repairs to a chassis harness not provided by Allison Transmission are not covered by Allison Transmission warranty.

E. Example Steps to Find Short Circuit or Low Resistance.

NOTE: The following example provides a procedure to check for short in the OEM vehicle harness. These steps were copied from the P0842 tree, but are applicable to many circuits between the TCM and the transmission or other component wiring, such as speed sensor wiring, selector wiring, etc.

1. Turn the ignition **OFF**.
2. Leave J-47275 TCM Breakout Harness connected to the J-39700 Universal Breakout Box.
3. Leave OEM TCM 80-way connected to the J-47275 TCM Breakout Harness.
4. Leave TCM side of J-47275 TCM Breakout Harness disconnected from TCM.
5. Leave 16-way bypass of J-47275 TCM Breakout Harness connected.
6. Leave OEM 20-way transmission connector disconnected from transmission.
7. Remove jumper installed in OEM 20-way transmission connector.
8. Using DMM, measure resistance between terminal 51 and terminal 77 to all other labeled terminals shown on J-47275-1 Magnetic Overlay (Figure E–3).



(1) – J-39700 Universal Breakout Box
(2) – J-39197-A Jumper Wire Kit
(3) – J-47275-1 Magnetic Overlay
(4) – DMM
(5) – 80-Way Connector (OEM Side)
(6) – OEM Vehicle Harness
(7) – 20-Way Transmission Connector (OEM Side)
(8) – TCM
(9) – 80-Way Connector To TCM
(10) – 16-Way Bypass Connector
(11) – J-47275 TCM Breakout Harness

Figure E–3. Checking for Short Circuit

NOTE: For 7 speed model, also make resistance check at terminal 19 of J-47279-1 Magnetic Overlay.

9. Does resistance measure 20,000 Ω (20 kΩ) or more between terminal 51 and terminal 77 to all other labeled terminals on J-47275-1 Magnetic Overlay? If not, coordinate with the vehicle OEM to repair or replace defective vehicle wiring, connectors, pins, etc. found to be causing low resistance or short circuits to another wire in the harness.

NOTE: When checking for a shorted or low resistance coil in a solenoid, bad pressure switch, or other device with a metal case, also check for a short to the component housing.

NOTE: Repairs to a chassis harness not provided by Allison Transmission are not covered by Allison Transmission warranty.

F. Measuring Voltage Drops.

Using voltage drop to isolate circuit issues is not recommended for transmission and related circuit troubleshooting in this publication (unless described explicitly in a DTC procedure). Voltage drop procedures typically involve unapproved methods. These include back-probing connectors, leaving the TCM connected and powered, or using outside power sources and electrical loads in transmission or vehicle harnesses that may not be designed for the currents generated. This may damage other connected components in the transmission or other related controls, such as solenoids, switches, I/O relays, connector pins, TCM, etc.

G. Identifying the Harness Location of the Problem.

After a circuit issue is noted with the circuit connected end-to-end (using resistance values and the universal breakout box and tools), the next step is to find where the issue resides specifically. The method recommended in this publication is to make the same checks shown in Figure E–2 or Figure E–3, except install jumper wires to mating terminals in the intermediate chassis harness connectors to check for high resistance or an open. Similarly disconnect at an intermediate harness connector when making terminal-to-terminal checks for a short. This isolates the problem to a specific chassis harness segment, if present.

To troubleshoot a sub-assembly or a portion of a chassis harness (e.g., from the OEM bulkhead connector to the OEM TCM connector), remove a jumper from the OEM 20-way transmission connector up to the OEM bulkhead connector. This step will isolate that piece of the harness for troubleshooting. Then, repeat the steps fromFigure E–2 or Figure E–3, modifying terminal identification of the jumper to match the OEM bulkhead connector pin-out. The same approach works for other separate branches of the chassis harness (e.g., shift selector branch, external speed sensor harness branches, I/O wiring branches, retarder controls branches, datalink branches, etc.).

H. Adding and Subtracting Resistance Values When Comparing to Specifications.

Occasionally, resistance specifications will need to be added together and later subtracted or canceled with the REL feature to determine if the circuits under test are within specification. For example, if the technician wants to measure solenoid resistance without removing the control valve module from the transmission, the technician must total other resistances in series with the solenoid and account for (or cancel) those extra resistance values in order to arrive at a true measured solenoid resistance. To arrive at a true measured value for the solenoid that is measured through the universal breakout box, tools and vehicle harness, the technician needs to consider the following:

1. Find the resistance specification for the particular solenoid at the current temperature of the control valve module.

NOTE: Solenoid resistance can vary a few ohms based on temperature of the solenoid at time of the measurement.

2. Measure breakout adapter tool resistance and vehicle harness resistance through the two vehicle harness solenoid wires, its intermediate OEM connectors, and the DMM test lead resistance.
3. Subtract the "additive" resistance from 1-3 or cancel that resistance with the DMM REL function.
4. If solenoid resistance is too low after accounting for these resistances, either the internal harness or solenoid is in a short condition.
5. If solenoid resistance is too high after accounting for these resistances, either the internal harness or solenoid is high resistance or open.

NOTE: The internal harness resistance can be assumed to add less than 0.5 Ω to solenoid resistance in the case of control valve modules that are still on the transmission. Circuits that are below or above specification (listed above in Steps 1-5) require the control valve module to be removed so further checks can be made (as shown in Figure E–5) to determine if the internal harness or solenoid is defective.

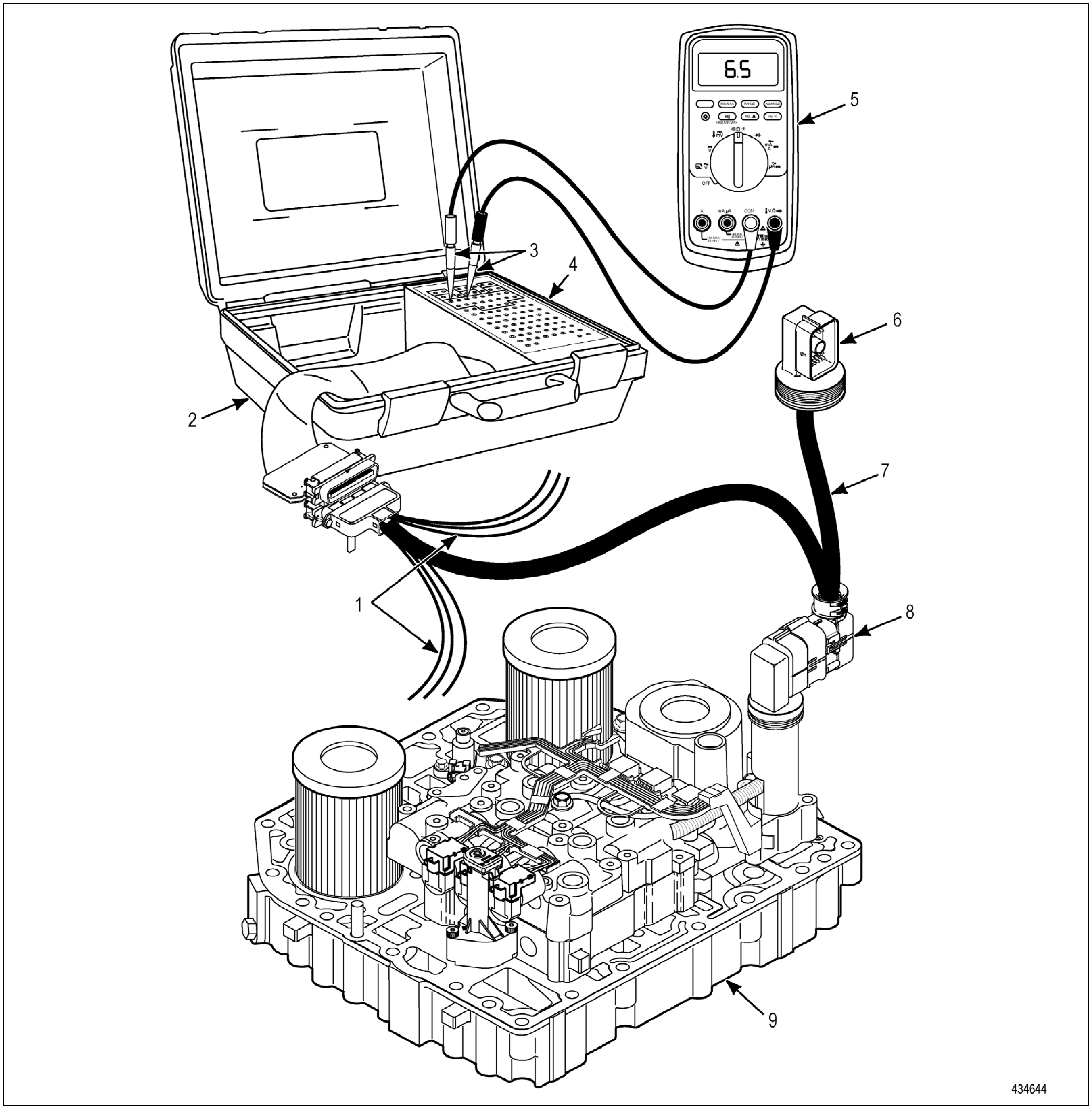
The principles for additive resistance as described above also apply to other control valve module components, such as pressure switches and the internal turbine speed sensor.

I. Use of J-39197-A Jumper Wire Kit.

Jumper wire configurations included in the J-39197-A Jumper Wire Kit should address any transmission component troubleshooting at the TCM 80-way, transmission 20-way, and inside the control valve module. However, when troubleshooting OEM connectors, or OEM-related I/O components, like bulkhead connectors, retarder pressure switches, OEM I/O relays, etc., the jumper wires in the J-39197-A Jumper Wire Kit A may not work. Use the correct jumper wires or find mating terminals, and make your own jumper wires to give yourself the best chance of getting an accurate resistance measurement of the component under test. Forcing test leads into connectors risks damage to the connector. Using alligator clips as test leads in place of proper jumpers with correct mating terminals or inserting anything non-standard into a connector (like a paper clip), runs the risk of inadvertent contact to another circuit, slipping off the intended test point, or damage to the terminals (expanded pins, broken terminal locks etc.). With non-standard methods, a technician may not be aware of an error in a measurement, and may assume that the resistance is valid and risks unnecessary diagnostics or parts replacements.

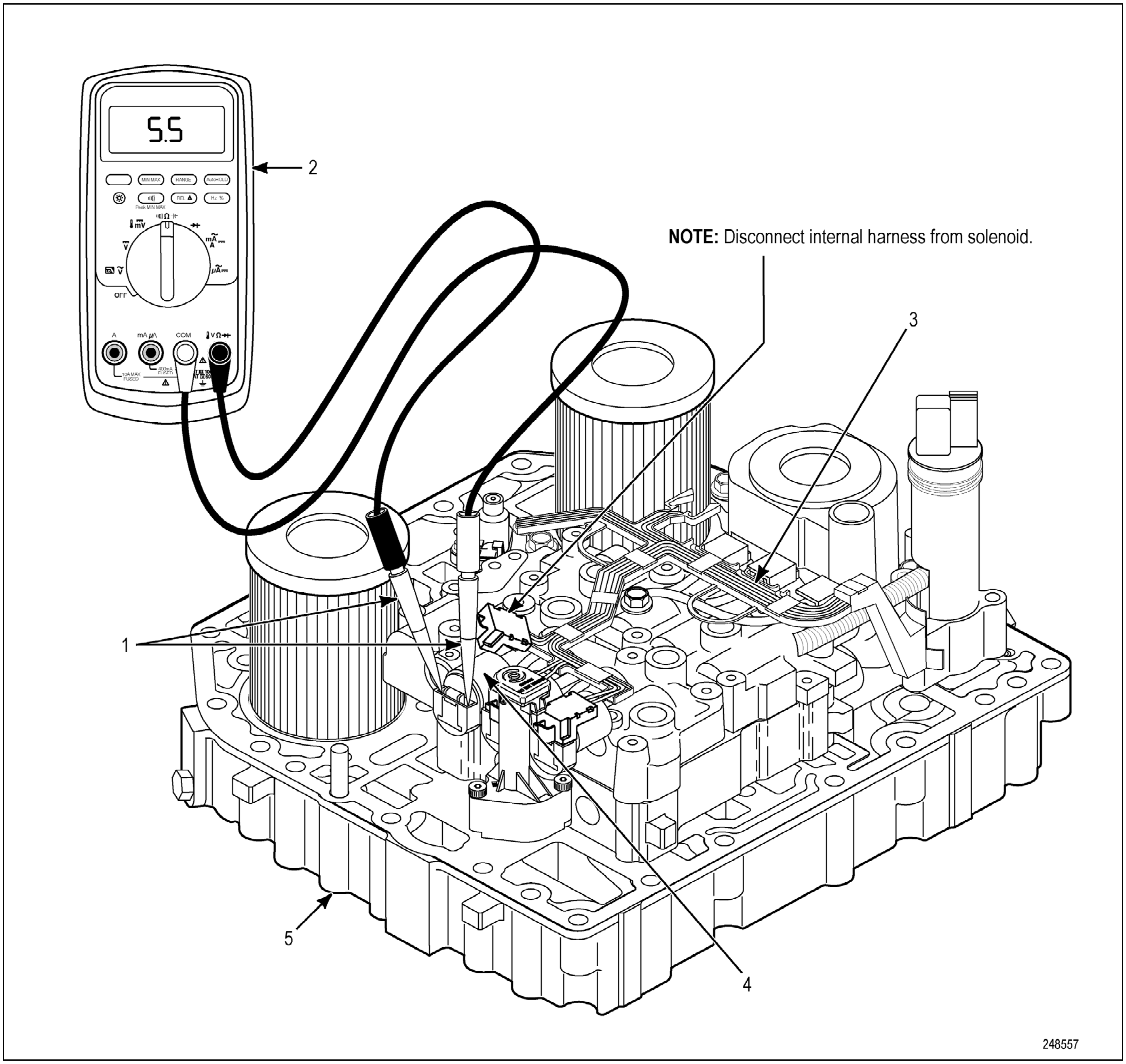
J. When to Use J-47279 3k/4k Transmission Harness.

The J-47279 3k/4k Transmission Harness is used to troubleshoot for opens, shorts, low and high resistance conditions of external sensors, control valve module components, and the transmission internal harness. The J-47279 3k/4k Transmission Harness connects between the OEM 20-way transmission connector and the 20-way transmission connector of the transmission assembly (Figure E–4). Use the mating terminal jumpers in the J-39197-A Jumper Wire Kit for jumpers at the J-47275-1 Magnetic Overlay, and also when jumpers are installed at a sensor or solenoid connector for open or short circuit checks (Figure E–5).



(1) – J-47279 3k/4k Transmission Harness (Sensor and Solenoid Connectors)
(2) – J-39700 Universal Breakout Box
(3) – J-39197-A Jumper Wire Kit
(4) – J-47275-1 Magnetic Overlay
(5) – DMM
(6) – 20-Way For OEM Harness
(7) – J-47279 3k/4k Transmission Harness
(8) – J-47279 3k/4k Transmission Harness 20-Way For Control Valve Module
(9) – Control Valve Module

Figure E–4. Using the J-47279 3k/4k Transmission Harness



(1) – J-39197-A Jumper Wire Kit
(2) – DMM
(3) – Transmission Internal Harness
(4) – Solenoid
(5) – Control Valve Module

Figure E–5. Solenoid Resistance Check

Appendix F—WIRE/CONNECTOR/VIM CHARTS

F–1. WIRE/CONNECTOR CHART

The connector information in this appendix is provided for the convenience of the servicing technician. The connector illustration and pin identifications for connection to Allison Transmission components will be accurate. Allison Transmission components are the TCM, speed sensors, retarder connectors, transmission connectors, and shift selectors. Other kinds of connectors for optional or customer-furnished components are provided based on typical past practice for an Allison-designed system.

Contact St. Clair Technologies, Inc. or your vehicle manufacturer for information on connectors not found in this appendix.

NOTE: The following abbreviation guide should be used to locate connector termination points for wires in the Allison Transmission 5th Generation wiring harness(es).

Table F–1. Abbreviation Guide

Termination Point Abbreviation	Connector Name
ABS	Anti-lock Brake System
ARTN	Analog Return
CAN	Controller Area Network
DDRD	Diagnostic Connector—Deutsch
DDRP	Diagnostic Connector—Packard
FM	Filter Life Monitor
GPI	General Purpose Input
GPO	General Purpose Output
NE	Engine Speed Sensor
NO	Output Shaft Speed Sensor
NT	Turbine Shaft Speed Sensor
OBD-II	Diagnostic Connector—GMC On Board Diagnostics
OLS	Oil Level Sensor
OM	Oil Life Monitor
PCS	Pressure Control Solenoid
PS	Pressure Switch—Control Module
PWM	Pulse Width Modulation
RMR	Retarder Modulation Request Device
RNGTRM	Chassis Ground Ring Terminal
RTEMP	Retarder Temperature—Retarder Housing
SAE J1939	SAE J1939 Datalink From ECU Selector (S) Harness
SCI	Serial Communication Interface
SS	Shift Solenoid
TCASE	3000 Product Family 7-Speed Transfer Case
TM	Transmission Health Monitor
TPS	Throttle Position Sensor

Table F–1. Abbreviation Guide *(cont'd)*

Termination Point Abbreviation	Connector Name
TRANS	Transmission Feed Through Harness
VIM	Vehicle Interface Module

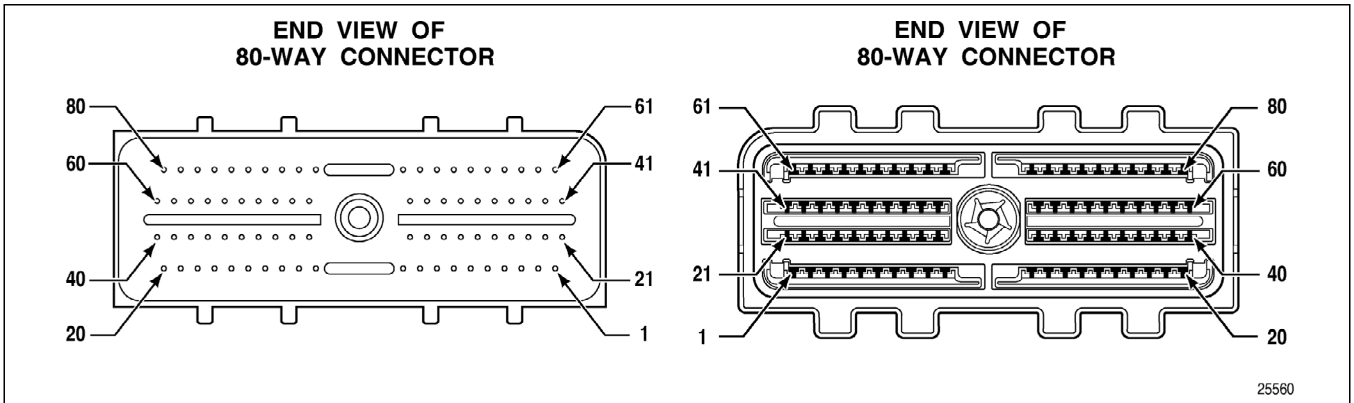


Figure F–1. 80-Way TCM Connector

Table F–2. 80-Way TCM CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
1	Blue	101	GPI 6 (-)	Vehicle System
2	Yellow	102	GPI 2 (+)	Vehicle System
3	Yellow	103	TCM Digital Return	Vehicle System
4	Yellow	104	GPO 2 (-)	Vehicle System or VIM-B1
5	Orange	105	GPO 4 (-)	Vehicle System or VIM-C2
6	Yellow	106	CAN2 High (+)	IESCAN A or H
7	Yellow	107	Internal Terminating Resistor CAN1 (TCM)	Vehicle System
8	Green	108	CAN1 Low (–)	SAE J1939 B or L
9	Gray	109	Battery (-)	Vehicle System or VIM-A2
10	Pink	110	Battery (+)	Vehicle System or VIM-E2
11	Orange	111	High Side Driver Feed (HSD1)	Trans Connector (Pin 1)
			TransID (TIDB Only)	Trans Connector (Pin 6 TIDB Only)
				Unused TransID (Pin 20)
12	Pink	112	Signal Reference 5V	Trans Connector (Pin 16) TPS (Pin C)
13	White	113	GPO 8 (-)	Vehicle System
14	Blue	114	Strip Shift Selector Bit-4	Strip Shift Selector (Pin C)
15	White	115	Pressure Control Solenoid (PCS5)	Retarder Solenoid (Pin A) or T-Case (Pin A)
16	Blue	116	OLS	Trans Connector (Pin 15)
17	Blue	117	GPI 10 (–)	Vehicle System

Table F–2. 80-Way TCM CONNECTOR *(cont'd)*

Terminal No.	Color	Wire No.	Description	Termination Point(s)
18	Yellow	118	PS2	Trans Connector (Pin 17)
19	Blue	119	Shift Solenoid (SS2)	Trans Connector (Pin 17) or Retarder Accumulator Solenoid (Pin A)
20	Blue	120	Turbine Shaft Speed Sensor—Low	NT-B (4000) or Trans Connector (Pin 14) (3000)
21	Green	121	ABS/GPI 8 (–)	Vehicle System
22	Yellow	122	GPI 4 (-)	Vehicle System
23	Green	123	GPI 1 (+)	Vehicle System
24	White	124	GPO 5	Vehicle System
25	Tan	125	Vehicle Speed Signal	Input for Vehicle Speedometer or VIM-B2
26	Yellow	126	Internal Terminating Resistor CAN2 (TCM)	Vehicle System
27	Green	127	CAN2 Low (–)	IESCAN B or L
28	Yellow	128	CAN1 High (+)	SAE J1939 A or H
29	Green	129	CHECK TRANS (-)	Vehicle System
30	White	130	GPO 1 (+)	Vehicle System or VIM-D2
31	Yellow	131	HSD3	Trans Connector (Pin 11), Retarder Accumulator Solenoid (Pin B), and Retarder Solenoid (Pin B) or T-Case (Pin-B)
32	—	—	Not Used	—
33	Yellow	133	PCS3	Trans Connector (Pin 9)
34	No Color	134	Allison-supplied SAE J1939 Shift Selector	Allison SAE J1939 Shift Selector (Pin 11)
35	Blue	135	Engine Water Temperature	Engine Water Temp (Pin A)
36	Orange	136	PCS1	Trans Connector (Pin 4)
37	White	137	TCC Solenoid	Trans Connector (Pin 12)
38	Tan	138	Strip Shift Selector Bit-Parity	Strip Shift Selector (Pin E)
39	Orange	139	Engine Speed Sensor—Low	NE-B
40	Green	140	Output Shaft Speed Sensor—Low	NO-B or T-Case (Pin D)
41	Tan	141	Neutral Start Output (+)	To OEM supplied starter relay or VIM-D1
42	White	142	GPI 5 (-)	Vehicle System
43	Blue	143	GPI 3 (+)	Vehicle System
44	Blue	144	PWM/TPS Input	Vehicle System or TPS (Pin B)
45	Orange	145	GPO 3 (-)	Vehicle System or VIM-F3
46	—	—	Not Used	—
47	—	—	Not Used	—

Table F–2. 80-Way TCM CONNECTOR *(cont'd)*

Terminal No.	Color	Wire No.	Description	Termination Point(s)
48	Yellow	148	CAN1 High	SAE J1939 A or H
49	N/A	149	CAN1 Shield	SAE J1939 C or S
50	Pink	150	GPO 7 (-)	Vehicle System
51	White	151	SS1	Trans Connector (Pin 10)
52	Green	152	PCS2	Trans Connector (Pin 5)
53	Green	153	Strip Shift Selector Bit-2	Strip Shift Selector (Pin B)
54	Tan	154	Sump Temp Sensor	Trans Connector (Pin 18)
55	White	155	PCS4	Trans Connector (Pin 2)
56	Yellow	156	Retarder Request Sensor	RMR (Pin B)
57	White	157	GPI 12 (–)	Vehicle System
58	Green	158	TCM Analog Return	Trans Connector (Pin 19), RMR (Pin A), TPS (Pin A), Engine Water Temp (Pin B), Retarder Temp (Pin B)
59	Tan	159	Engine Speed Sensor—High	NE-A
60	Yellow	160	Output Shaft Speed Sensor—High	NO-A or T-Case (Pin C)
61	Orange	161	GPI 7 (-)	Vehicle System
62	Yellow	162	GPI 9 (-)	Vehicle System or VIM-F1
63	Yellow	163	Ignition Power	Vehicle System or VIM-F1
64	Blue	164	GPO 6 (-)	Vehicle System
65	Tan	165	Reverse Warning	Vehicle System or VIM-F2
66	Yellow	166	CAN2 High	IESCAN A or H
67	N/A	167	CAN2 Shield	IESCAN C or S
68	—	—	Not Used	—
69	Gray	169	Battery (-)	Vehicle System or VIM-A
70	Pink	170	Battery (+)	Vehicle System or VIM-E1
71	Yellow	171	HSD2	Trans Connector (Pin 6)
			TransID (TIDB Only)	Trans Connector (Pin 1 TIDB Only)
72	—	—	Not Used	—
73	Orange	173	Strip Shift Selector Bit-1	Strip Shift Selector (Pin A)
74	Blue	174	MAIN MOD Solenoid	Trans Connector (Pin 8)
75	Orange	175	Retarder Temperature	Retarder Temp (Pin A)
76	Yellow	176	OEM Optional	Unused Obsolete TransID
77	Green	177	PS1	Trans Connector (Pin 3)
78	White	178	PCS6	Trans Connector (Pin 7)
79	Pink	179	GPI 11 (–)	Vehicle System
80	Orange	180	Turbine Shaft Speed Sensor—High	NT-A (4000) or Trans Connector (Pin 13) (3000)

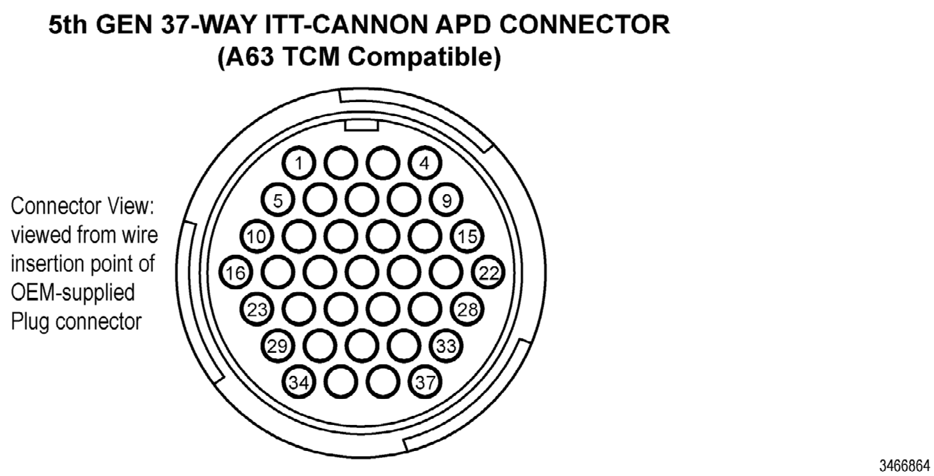


Figure F–2. 37–Way ITT-Cannon APD Connector

Table F–3. 37–Way ITT-Cannon APD Connector

Terminal Number	Color	Wire Number	Description
1	Blue	119	Air Solenoid/SS2
2	Orange	111	HSD1
3	Yellow	133	PCS3
4	White	151	SS1
5	Pink	112	Sensor Supply
6	—	—	Not Used
7	Blue	174	Main Mod
8	White	115	Retarder Solenoid
9	White	178	PCS6
10	Yellow	131	HSD3
11	—	—	Not Used
12	Orange	136	PCS1
13	Yellow	118	PS2
14	White	137	TCC
15	Blue	135	Water Temperature
16	—	—	Not Used
17	Green	152	PCS2
18	—	—	Not Used
19	Yellow	171	HSD2
20	White	155	PCS4
21	Orange	175	Retarder Temperature
22	Green	158	Sensor Ground
23	—	—	Not Used
24	—	—	Not Used

Table F–3. 37–Way ITT-Cannon APD Connector *(cont'd)*

Terminal Number	Color	Wire Number	Description
25	—	—	Not Used
26	Tan	154	Sump Temperature
27	—	—	Not Used
28	Blue	144	EBS
29	Green	140	No-
30	—	—	Not Used
31	Green	177	PS1
32	Blue	116	Oil Level
33	Tan	159	Ne+
34	Yellow	160	No+
35	Orange	180	Nt+
36	Blue	120	Nt-
37	Orange	139	Ne-

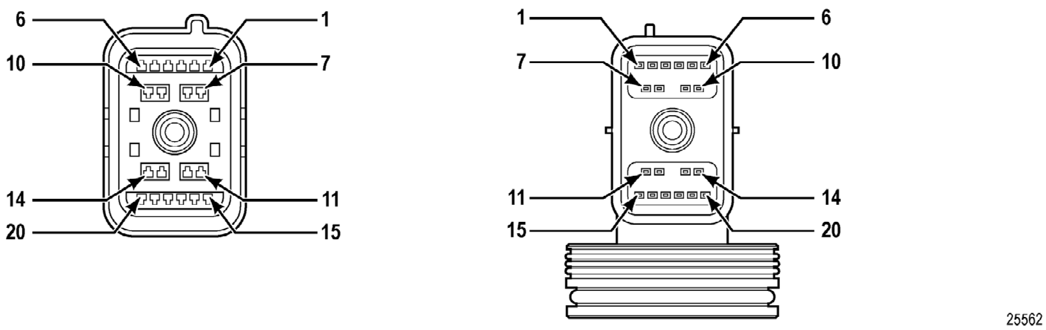


Figure F–3. 20-Way AFL Transmission Connector

Table F–4. 20-Way AFL Transmission Connector

Terminal No.	Color	Wire No.	Description	Termination Point(s)
1	Orange	111	HSD1, Unused TransID, HSD2 (TIDB Only)	TCM-11, MAIN MOD-A, PCS4-A, PCS6-A, Internal WH-20, TCM 76 (OEM Optional), HSD2 (TIDB Only)
2	White	155	PCS4, Low	TCM-55, PCS4-B
3	Green	177	PS1 Input	TCM-77, PS1-A
4	Orange	136	PCS1, Low	TCM-36, PCS1-B
5	Green	152	PCS2, Low	TCM-52, PCS2-B
6	Yellow	171	HSD1, HSD2 (TIDB Only)	TCM-71, PCS1-A, PCS2-A, PCS3-A, SS1-A, HSD2 (TIDB Only)
7	White	178	PCS6, Low (7-speed only)	TCM-78, PCS6-B

Table F–4. 20-Way AFL Transmission Connector *(cont'd)*

Terminal No.	Color	Wire No.	Description	Termination Point(s)
8	Blue	174	MAIN MOD Solenoid, Low	TCM-74, MAIN MOD-B
9	Yellow	133	PCS3, Low	TCM-33, PCS3-B
10	White	151	SS1, Low	TCM-51, SS1-B
11	Yellow	131	HSD3	TCM-31, TCC-A, SS2-A (7-speed only)
12	White	137	TCC Solenoid, Low	TCM-37, TCC-B
13	Orange	180	Turbine Shaft Speed Sensor, High (3000 only)	TCM-80, NT-A
14	Blue	120	Turbine Shaft Speed Sensor, Low (3000 only)	TCM-20. NT-B
15	Blue	116	OLS Input	TCM-16, OLS-B
16	Pink	112	5V Reference Voltage	TCM-12, OLS-C, TPS-C, RMR-C
17	Blue	118	PS2	TCM-18, PS2-A
17	Blue	119	SS2, Low (7-speed only)	TCM-19, SS2-B
18	Tan	154	Sump Temperature Sensor Input	TCM-54 Sump Temp-B
19	Green	158	Analog Return	TCM-58, OLS-A, Sump Temp-A, PS1-B, PS2–B, RMR-A, TPS-A, RTR Temp-B, Engine Water Temp-B
20	Yellow	176	Unused TransID	TCM-76 (OEM Optional), TCM-11, Internal WH-1, HSD1, Main Mod-A, PCS4-A, PCS6-A

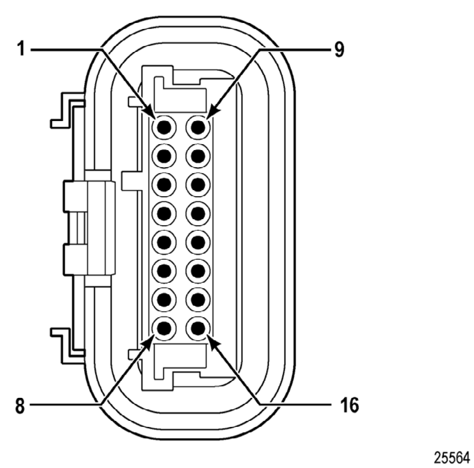


Figure F–4. SAE J1939 Shift Selector (Pushbutton, Bump Lever, Strip) Connector

Table F–5. SAE J1939 Shift Selector (Pushbutton, Bump Lever, Strip)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
1				
2				

Table F–5. SAE J1939 Shift Selector (Pushbutton, Bump Lever, Strip) *(cont'd)*

Terminal No.	Color	Wire No.	Description	Termination Point(s)
3			Dimmer Input	Vehicle System
4				
5			Battery Ground	
6			Shift Selector 2 ID	Battery Ground
7			Internal Termination Resistor Jumper, if used	Shift Selector Pin 16
8			CAN1 or CAN2 High	A or H
9				
10				
11		134	PWM Directional Signal	TCM-34
12			Ignition Sense	Vehicle System
13			Battery Voltage	Vehicle System
14			CAN1 or CAN2 Shield	
15			CAN1 or CAN2 Low	B or L
16			Internal Terminal Resistor Jumper, if used	Shift Selector Pin 7

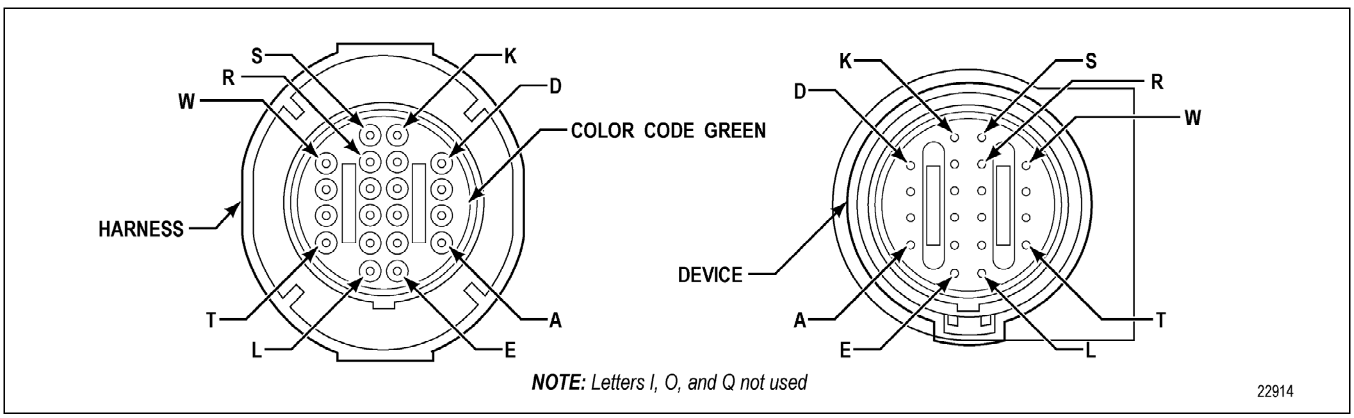


Figure F–5. Analog (PDL) Shift Selector (Non-SAE J1939) Connector

Table F–6. Analog (PDL) Shift Selector (Non-SAE J1939)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Orange	173	Strip Selector, Data Bit 1	TCM-73
B	Green	153	Strip Selector, Data Bit 2	TCM-53
C	Blue	114	Strip Selector, Data Bit 4	TCM-14
D				
E	Tan	138	Strip Selector, Parity	TCM-38
F				

Table F–6. Analog (PDL) Shift Selector (Non-SAE J1939) *(cont'd)*

Terminal No.	Color	Wire No.	Description	Termination Point(s)
G				
H				
J				
K				
L	Tan	150	Lamp Ground	TCM-50
M				
N				
P	Yellow	103	Digital Ground	TCM-3
R			Switch Power	Vehicle System
S				
T				
U				
V				
W				

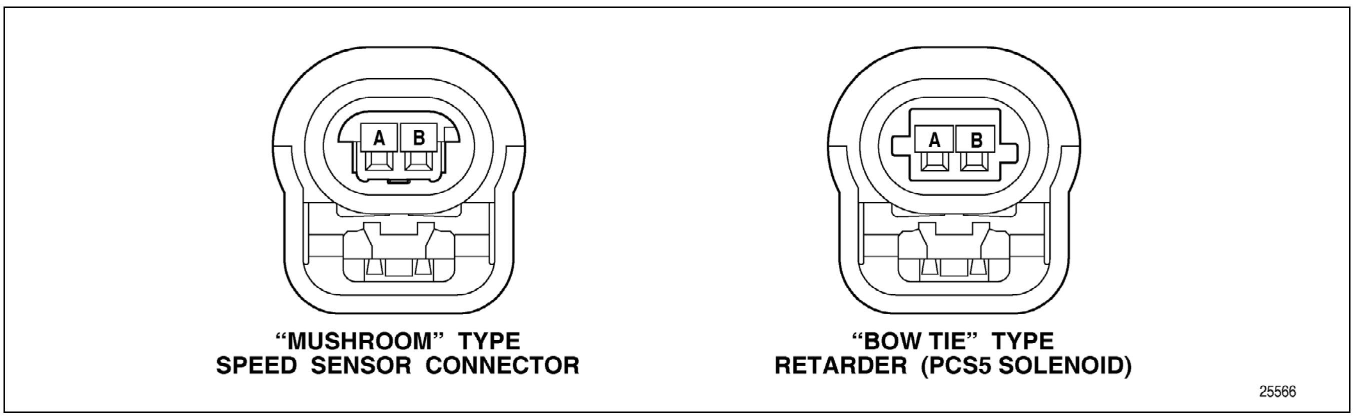


Figure F–6. Delphi-Packard GT150 Speed Sensor and Retarder Connectors

Table F–7. ENGINE SPEED SENSOR CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Tan	159	Engine Speed Sensor High	TCM-59
B	Orange	139	Engine Speed Sensor Low	TCM-39

Table F–8. TURBINE SHAFT SPEED SENSOR CONNECTOR (4000 Product Family Only)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Orange	180	Turbine Shaft Speed Sensor High	TCM-80
B	Blue	120	Turbine Shaft Speed Sensor Low	TCM-20

Table F–9. OUTPUT SHAFT SPEED SENSOR CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Yellow	160	Output Shaft Speed Sensor High	TCM-60
B	Green	140	Output Shaft Speed Sensor Low	TCM-40

Table F–10. Retarder (PCS5 Solenoid)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	White	115	PCS5 Low	TCM-15
B	Yellow	131	PCS5 High	TCM-31, TRANS-11

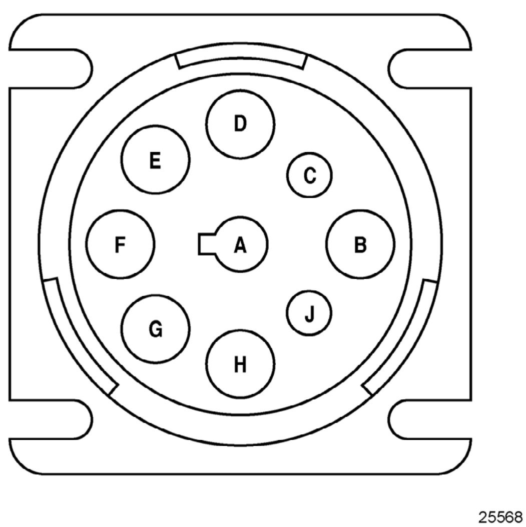


Figure F–7. Deutsch Diagnostic Tool Connector

Table F–11. 9-Pin Diagnostic Tool Connector For CAN1 or CAN2 (Green)

Terminal No.	Wire No.	Description	Termination Point(s)
A	109 or 169	Battery Return (–)	TCM-9 or TCM-69
B	110 or 170	Battery Power (+)	TCM-10 or TCM-70
C	128 or 148	CAN1 High	TCM-28 or TCM-48-A/H
C	106 or 166	CAN2 High	TCM-6 or TCM-66-A/H
D	108 or 168	CAN1 Low	TCM-8 or TCM-68-B/L
D	127 or 147	CAN2 Low	TCM-27 or TCM-47-B/L
E	149	CAN1 Shield/ Ground	TCM-49-C/S
E	167	CAN2 Shield	TCM-67-C/S
F	132	Serial Communication (+)	TCM-32, SSI-A
G	172	Serial Communication (–)	TCM-72, SCI-B

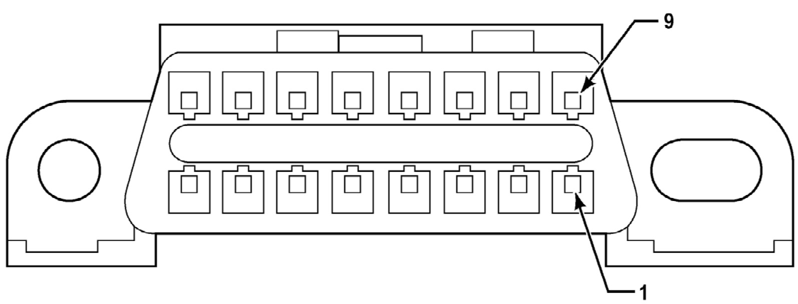


Figure F–8. GMC Connector for OBD II Diagnostic Adapter

Table F–12. Optional OBD II Diagnostic Connector

Terminal No.*	Color	Wire No.	Description	Termination Point(s)*
1				
2				
3				
4				
5	Gray	109 or 169	Battery Return (–)	TCM-9 or TCM-69, VIWS-P, PSS-P, SSS-P
6		106	CAN2 High	
7	White	132	Serial Communication Interface, High	TCM-32, SCI-A

Table F–12. Optional OBD II Diagnostic Connector *(cont'd)*

Terminal No.*	Color	Wire No.	Description	Termination Point(s)*
8				
9				
10				
11				
12				
13				
14		107	CAN2 Low	
15	Blue	172	Serial Communication Interface, Low	TCM-72, SCI-B
16	Yellow	163	Ignition Sense (+)	TCM-63, VIWS-E

*Terminal number and termination points shown only apply when an Allison Transmission recommended harness configuration and bulkhead connector are used.

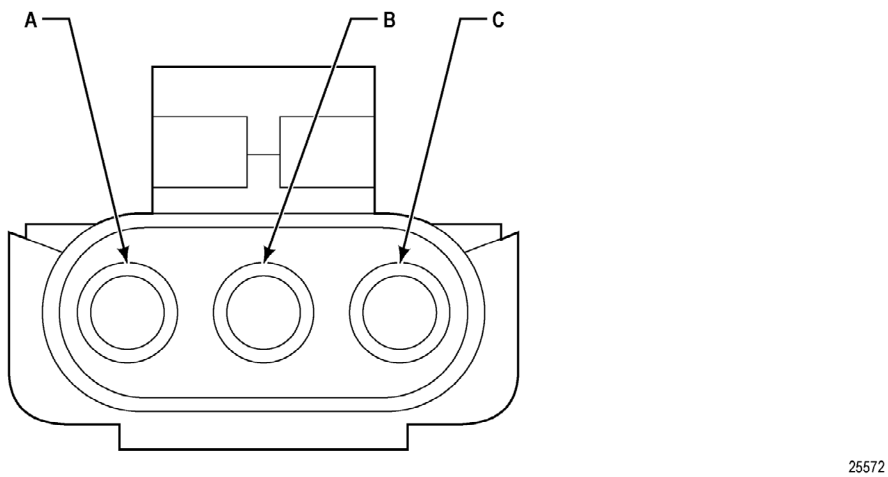


Figure F–9. TPS Connector

Table F–13. TPS CONNECTOR

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Green	158	Analog Return	TCM-58, TRANS-19, RMR-A
B	Blue	144	TPS Signal	TCM-44
C	Pink	112	TPS High	TCM-12, RMR-C, TRANS-16

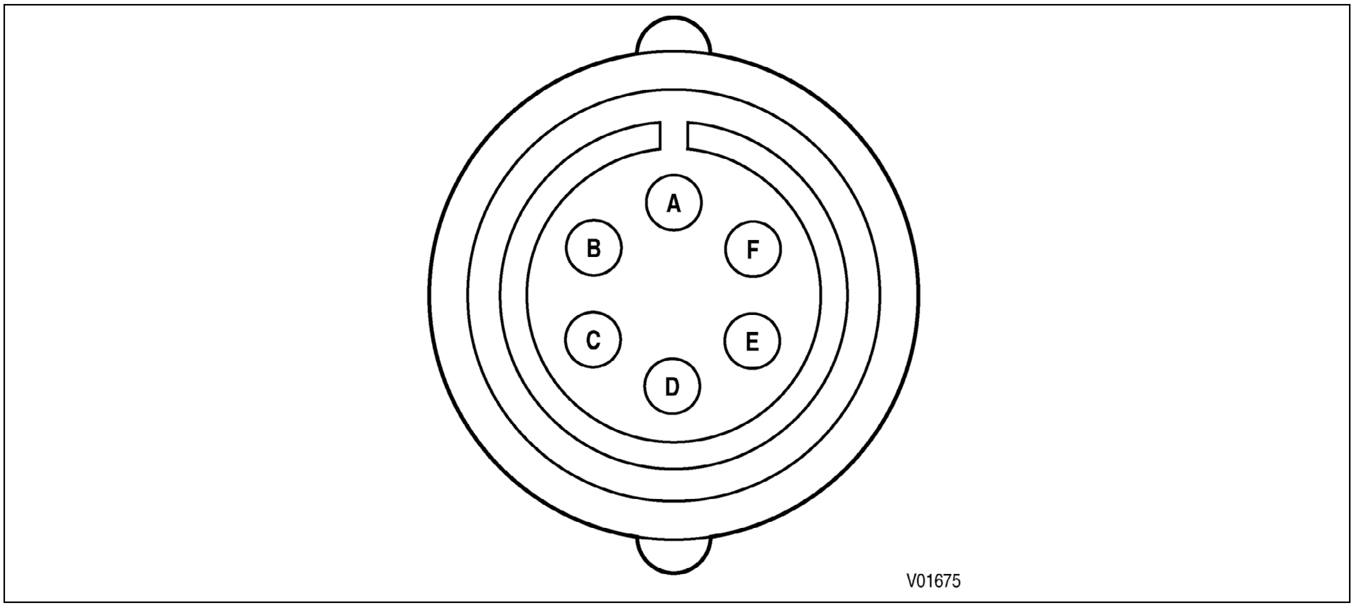


Figure F–10. Transfer Case Connector (3000 Product Family 7-Speed)

Table F–14. Transfer Case Connector (3000 Product Family 7-Speed Only)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	White	115	PCS5 (Diff Lock) Low	TCM-15
B	Yellow	131	PCS5 (Diff Lock) High	TCM-31, TRANS-11
C	Yellow	160	Output Shaft Speed Sensor High	TCM-60
D	Green	140	Output Shaft Speed Sensor Low	TCM-40

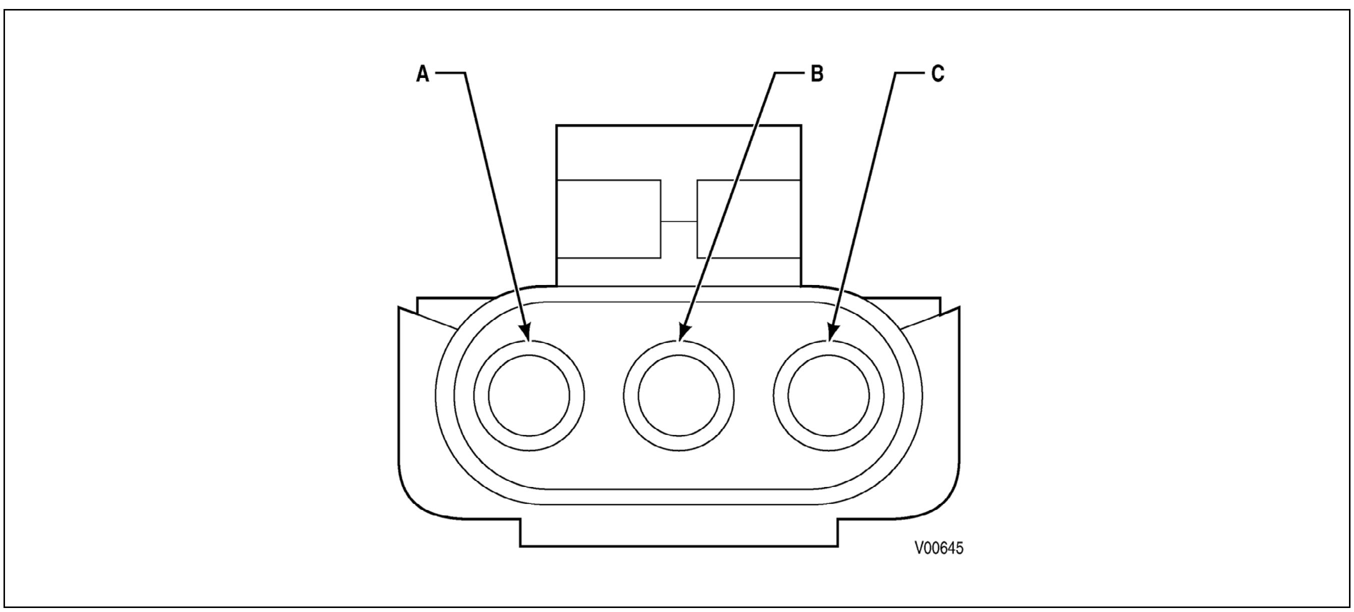


Figure F–11. Retarder Resistance Module/Interface Connector

Table F–15. Retarder Resistance Module/Interface Connector

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Green	158	Analog Return	TCM-58, TRANS-19, TPS-A, Engine Water Temp-B, RMR-A, Retarder Temp-B
B	Yellow	156	Retarder Mod.	TCM-56
C	Pink	112	Retarder Mod. High	TCM-12, TRANS-16, TPS-C

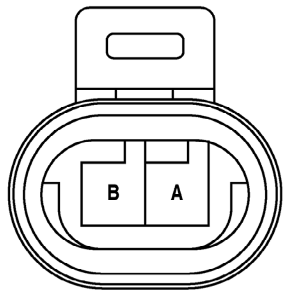


Figure F–12. Retarder Temperature Sensor Connector (3000 and 4000 Product Families)

Table F–16. Retarder Temperature Sensor Connector 3000 and 4000 Product Families

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Orange	175	Retarder Temperature Input	TCM-75
B	Green	158	Analog Return	TCM-58, TRANS-19, RMR-A, TPS-A, Engine Water Temp-B

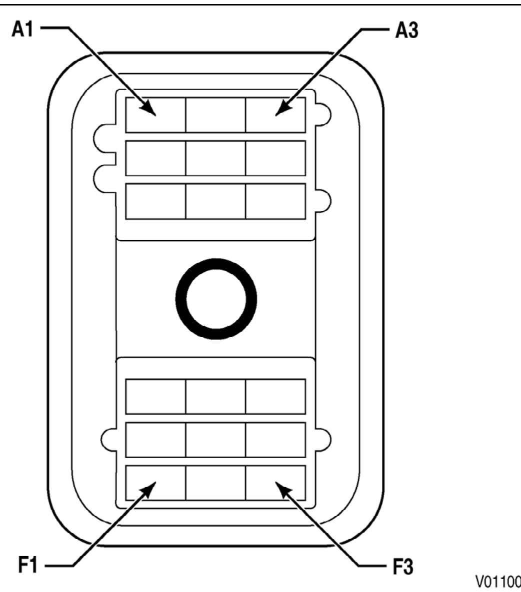


Figure F–13. VIM Connector (Harness)

Table F–17. VIM Connector (Harness)

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A1	Gray	169	Battery Return (–)	TCM-69
A2	Gray	109	Battery Return (–)	TCM-9
A3			Reserved	
B1	Yellow	104	GPO 2	TCM-4
B2	Tan	125	Speedometer Signal	TCM-25
B3			Reserved	
C1			Reserved	
C2	White	124	GPO 4	TCM-24
C3			Reserved	
D1	Tan	141	Neutral Start	TCM-41
D2	Orange	130	GPO 3	TCM-45
D3			Reserved	
E1	Pink	170	Reserved	TCM-70
E2	Pink	110	Battery Power (+)	TCM-10
E3			Reserved	
F1	Yellow	163	Ignition Sense (+)	TCM-63
F2	Tan	165	Reverse Warning	TCM-65
F3	White	145	GPO 1	TCM-30

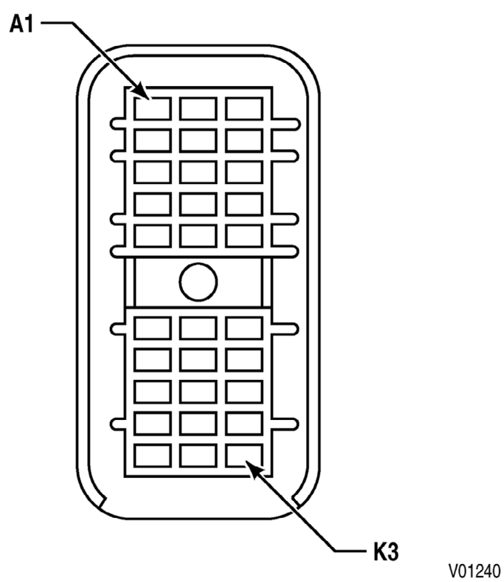


Figure F–14. VIM Connector (Harness)

Table F–18. VIM Connector (Harness 30-Way)

Terminal No.	Color*	Wire No.*	Description	Termination Point(s)*
A1			Reverse Warning Relay—Normally Open	

Table F–18. VIM Connector (Harness 30-Way) *(cont'd)*

Terminal No.	Color*	Wire No.*	Description	Termination Point(s)*
A2			Output Wire 145 Relay—Common	
A3			Output Wire 145 Relay—Normally Open	
B1			Reverse Warning Relay—Common	
B2			Output Wire 145 Relay—Normally Closed	
B3			Reserved	
C1			Ignition Power	
C2			Output Wire 130 Relay—Normally Closed	
C3			Reserved	
D1			Output Wire 124 Relay—Normally Closed	
D2			Output Wire 104 Relay—Normally Closed	
D3			Reserved	
E1			Output Wire 124 Relay—Common	
E2			Output Wire 104 Relay—Common	
E3			Output Wire 104 Relay—Normally Open	
F1			Neutral Start Relay—Normally Open	
F2			Output Wire 130 Relay—Common	
F3			Output Wire 130 Relay—Normally Open	
G1			Neutral Start Relay—Common	
G2			Reserved	
G3			Reserved	
H1			Reserved	
H2			Speedometer—Unfiltered	
H3			Reserved	
J1			Battery Power	
J2			Battery Power	
J3			Reserved	
K1			Battery Return	
K2			Battery Return	
K3			Reserved	

*Colors, wire numbers, and termination points are determined by OEM electrical system design.

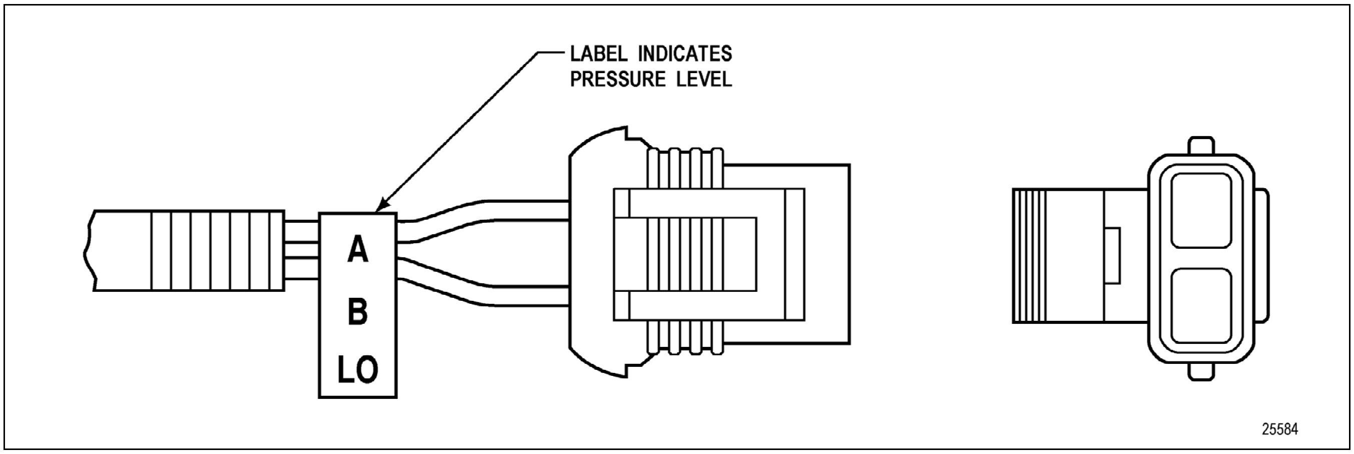


Figure F–15. Resistance Module Type 2–Single Pressure Switch and SCI

Table F–19. Resistance Module Type 2

Terminal No.
A
B

Table F–20. SCI Connector

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	White	132	Serial Communication Interface, High	TCM-32, 9-pin Diagnostic Tool Connector-F
B	Blue	172	Serial Communication Interface, Low	TCM-72, 9-pin Diagnostic Tool Connector-G

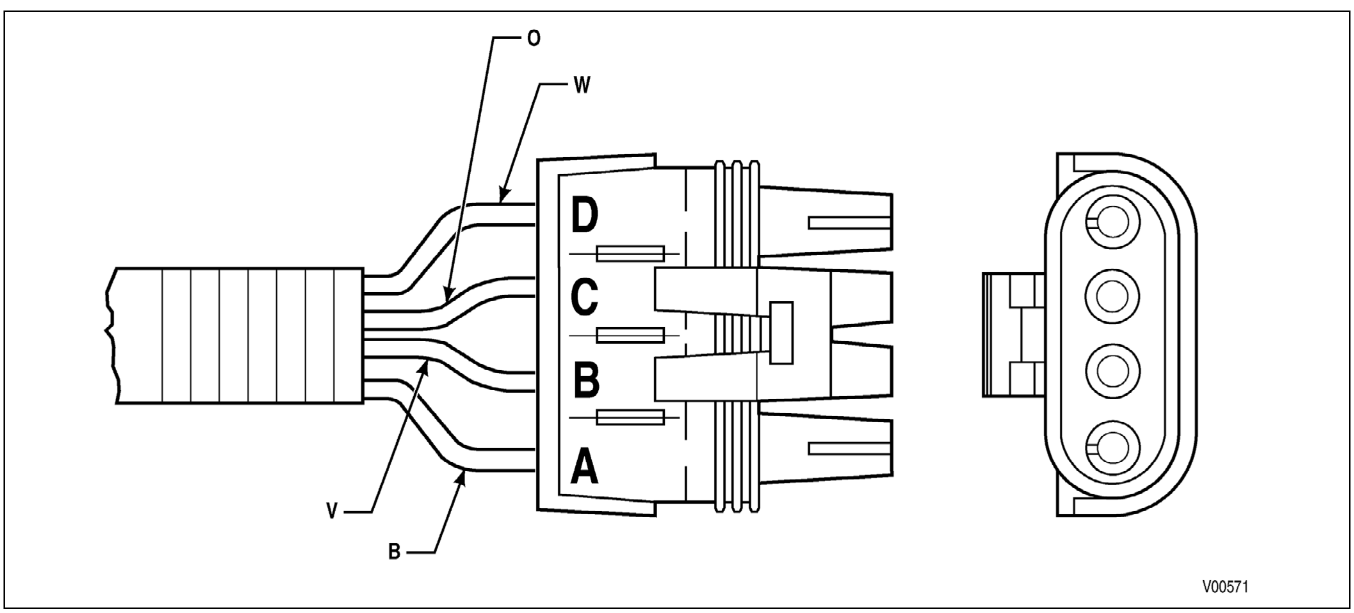


Figure F–16. Resistance Module Type 3–Bendix E-10R Pedal

Table F–21. Resistance Module Type 3

Terminal No.	Wire Color
A	Blue
B	Violet
C	Orange
D	White

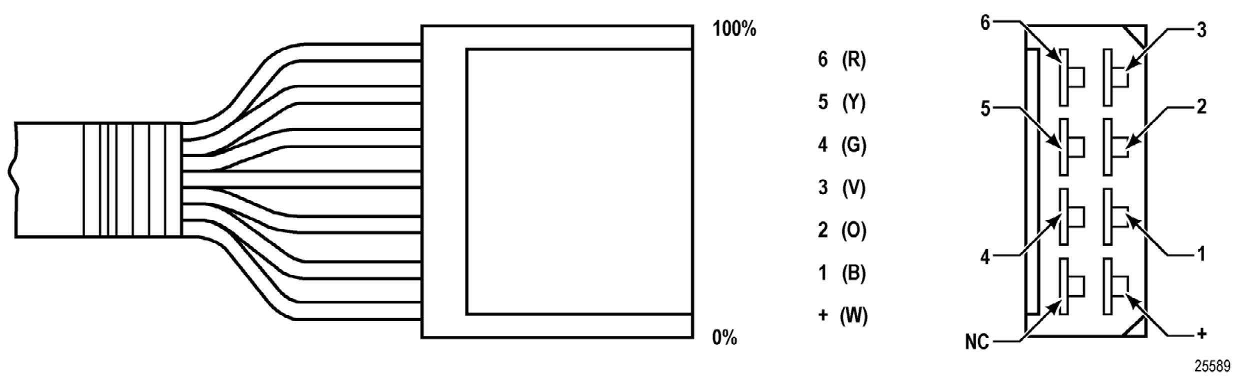


Figure F–17. Resistance Module Type 5–Hand Lever

Table F–22. Resistance Module Type 5

Terminal No.	Wire Color
+	White
1	Blue
2	Orange
3	Violet
4	Green
5	Yellow
6	Red

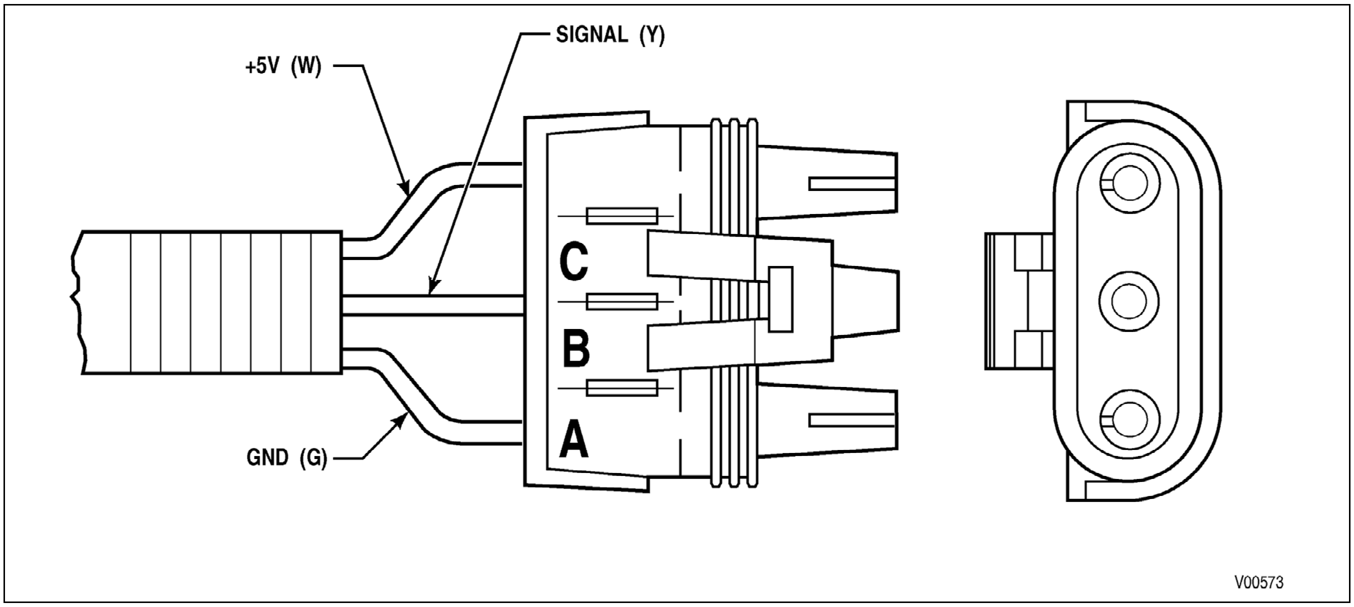


Figure F–18. Resistance Module Type 7–Dedicated Pedal

Table F–23. Resistance Module Type 7

Terminal No.	Wire Color
A	Green
B	Yellow
C	White

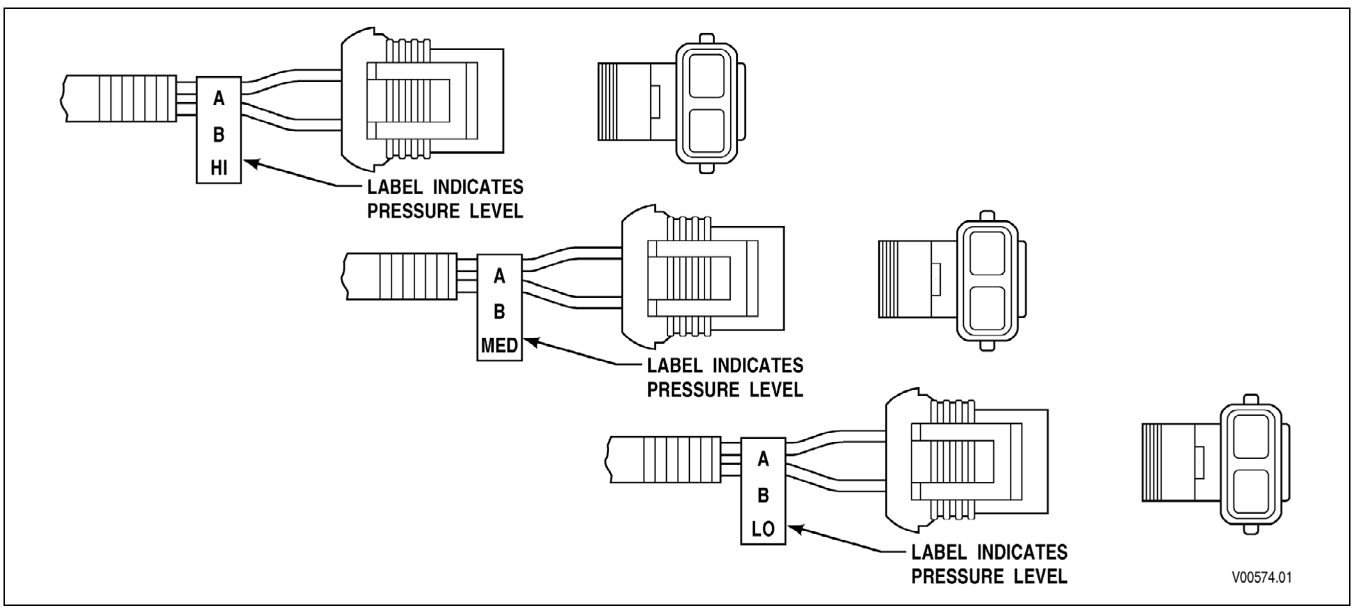


Figure F–19. Resistance Module Type 8–Three Pressure Switch

Table F–24. Resistance Module Type 8

Low Pressure

Terminal No.	Wire Color

Table F–24. Resistance Module Type 8 *(cont'd)*

A	White
B	Blue

Table F–25. Resistance Module Type 8

Medium Pressure

Terminal No.	Wire Color
A	White
B	Orange

Table F–26. Resistance Module Type 8

High Pressure

Terminal No.	Wire Color
A	White
B	Violet

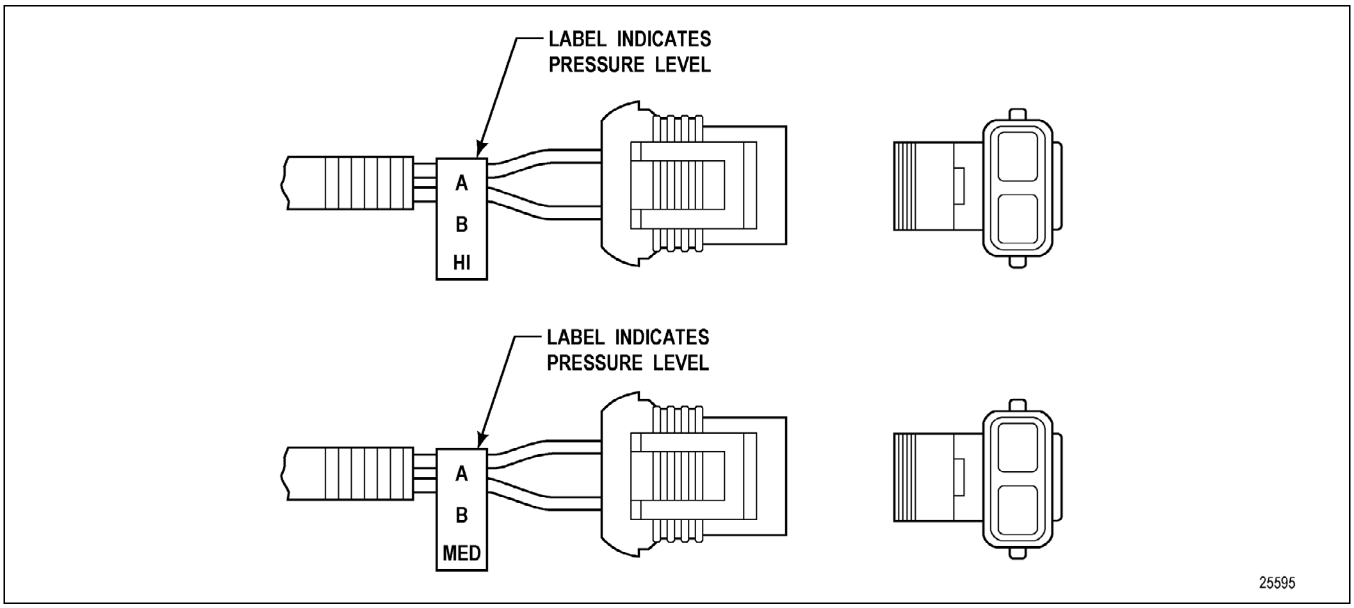


Figure F–20. Resistance Module Type 9–Two Pressure Switch

Table F–27. Resistance Module Type 9

Medium Pressure

Terminal No.	Wire Color
A	White
B	Orange

Table F–28. Resistance Module Type 9

High Pressure

Terminal No.	Wire Color
A	White
B	Violet

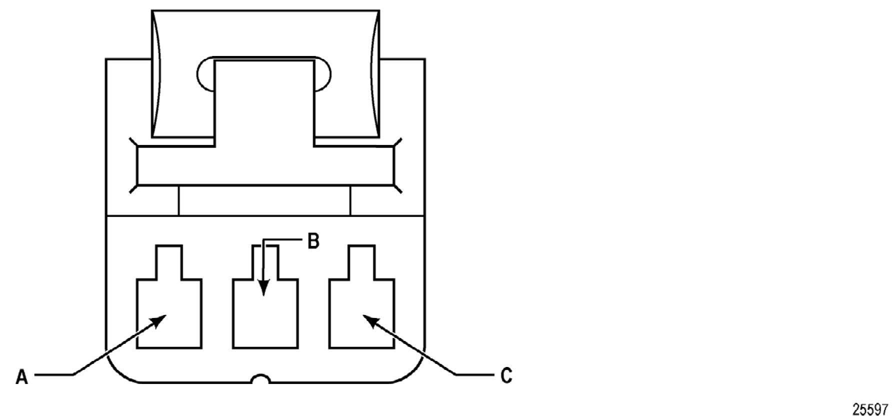


Figure F–21. Oil Level Sensor Plug

Table F–29. 3-Way Connector (Redesigned OLS)

Terminal No.	Color	Wire No.	Description	Termination Point(s) 20-Way Feed Through Harness Connector
A	Black	158	Analog Return	TRANS-19
B	White	116	OLS Input	TRANS-15
C	Red	112	Sensor Power	TRANS-16

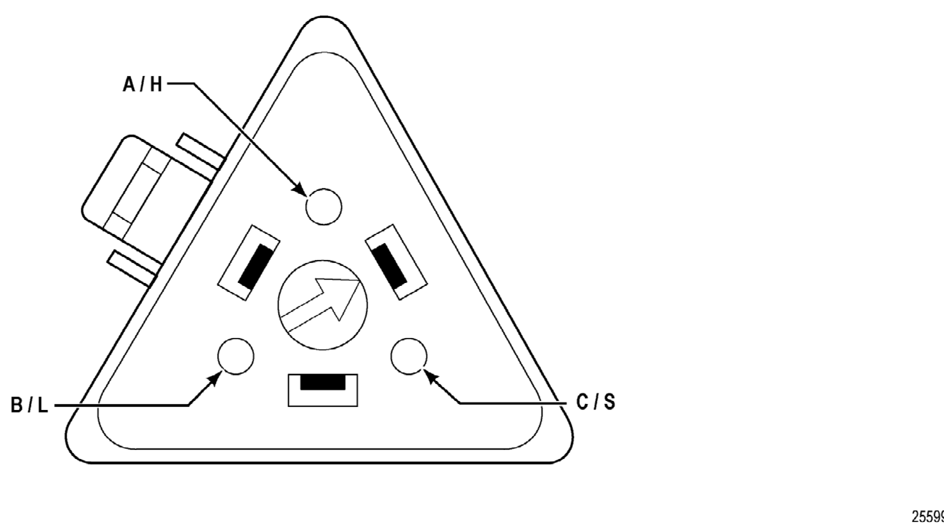


Figure F–22. CAN Interface Connector

Table F–30. SAE J1939 Interface Connector

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A or H	Yellow	128 and/or 148	CAN1 High	TCM-28 and/or TCM-48
A or H	Yellow	106 and/or 166	CAN2 High	TCM-6 and/or TCM-66
B or L	Green	108 and/or 168	CAN1 Low	TCM -8 and/or TCM-68
B or L	Green	127 and/or 147	CAN2 Low	TCM-27 and/or TCM-47
C or S	N/A	149	CAN1 Shield	TCM-49
C or S	N/A	167	CAN2 Shield	TCM-67

Table F–31. IES CAN Interface Connector

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A or H	Yellow	106	CAN Controller #2, High	TCM-6 and/or TCM-66
B or L	Green	127	CAN Controller #2, Low	TCM-27 and/or TCM-47
C or S	N/A	167	CAN Shield #2	TCM-67

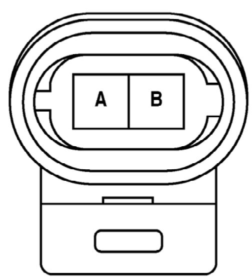


Figure F–23. Retarder Accumulator Solenoid Connector

Table F–32. Accumulator (SS2) Solenoid

Terminal No.	Color	Wire No.	Description	Termination Point(s)
A	Blue	119	SS2 Low	TCM-19
B	Yellow	131	SS2 High	TCM-31, TRANS-11

Appendix G—CONNECTOR PART NUMBERS

G–1. AFL 80F BOLT-ASSIST TRANSMISSION CONTROL MODULE (TCM CONNECTOR)

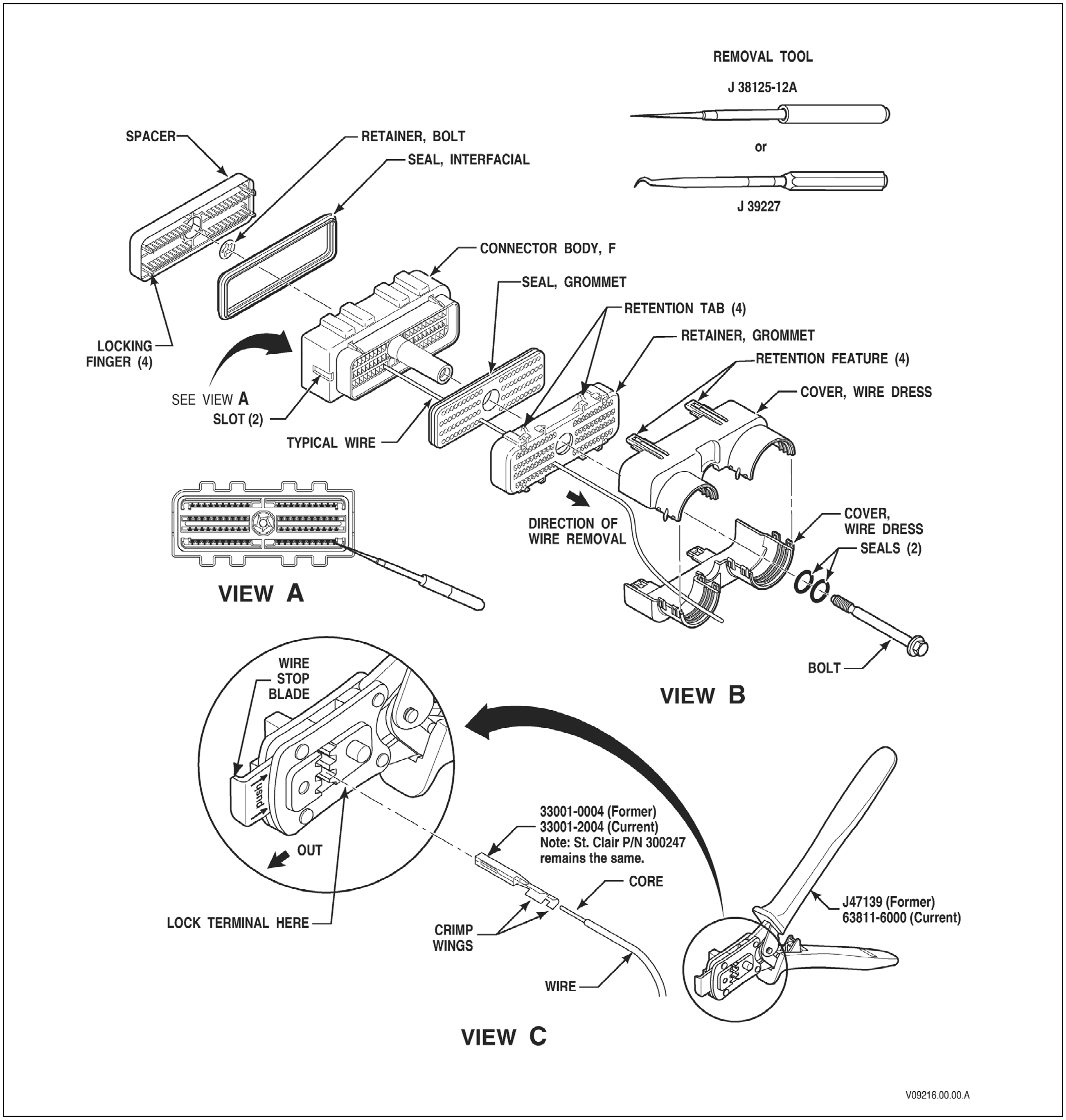


Figure G–1. AFL 80F Bolt-Assist TCM Connector

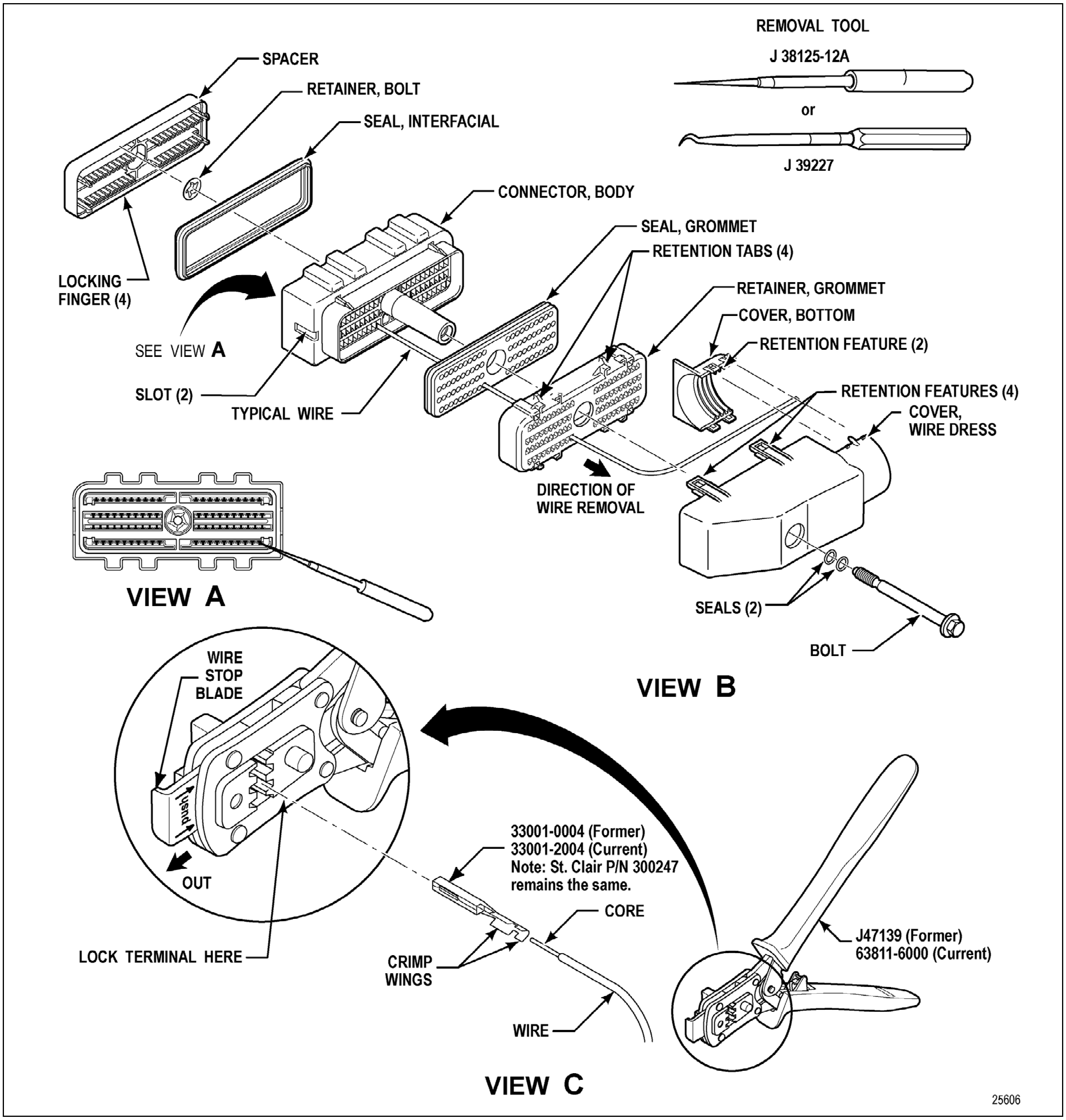


Figure G–2. AFL 80F Bolt-Assist, Direction 'A' 90 Degree TCM Connector

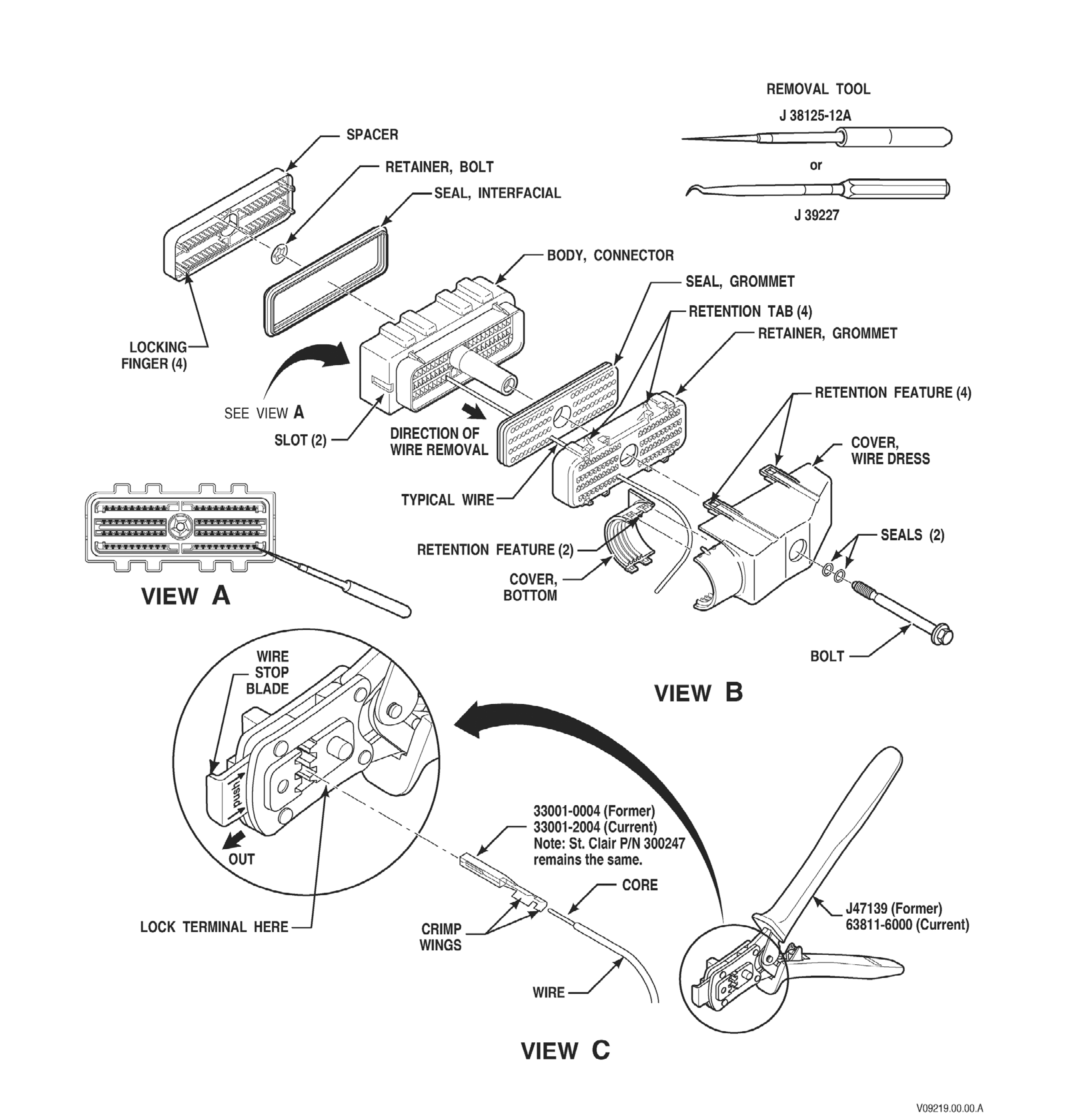


Figure G–3. AFL 80F Bolt-Assist, Direction 'B' 90 Degree TCM Connector

A. AFL 80F Bolt-Assist TCM Connector (Figure G–1).

Required Tools

Crimping Tool	J-47139 (Former), 63811-6000 (Current)
Remover Tool	J-38125-12A

Use	Description	St. Clair P/N	Manufacturers P/N
TCM Connector 80F, Bolt	Kit, Connector Assembly, 80F, Bolt Assist	P/N 300276	
	Connector Assembly, 80F, Bolt	P/N 300243	P/N R-61991-001
	Spacer 80F		P/N E-4540
	Seal, Interfacial		P/N E-4539
	Connector Body, 80F Bolt		P/N E-4538
	Bolt		P/N E-4543-001
	Seal, Bolt		P/N E-4544
	Retainer Bolt		P/N E-4545
	Grommet, Wire Seal		P/N E-4541
	Grommet, Retainer	P/N 300244	P/N E-4542
	Cover A, Wire Dress	P/N 300290	P/N E-4550
	Cover B, Wire Dress	P/N 300291	P/N E-4551
	Terminal, Receptacle	P/N 300247	P/N 33001-2004
	Plug, Cavity Seal	P/N 300008	P/N 12034413
	Wire Cover Kit 80W Bolt	P/N 300235	
	Cover A, Wire Dress	P/N 300245	P/N E-4550
	Cover B, Wire Dress	P/N 300246	P/N E-4551
	Bolt Kit	P/N 300234	
	Bolt		P/N E-4543-001
	Seal, Bolt		P/N E-4544
	Retainer, Bolt		P/N E-4545

B. AFL 80F Bolt-Assist, Direction ‘A’ 90 Degree TCM Connector (Figure G–2).

Required Tools

Crimping Tool	J-47139 (Former), 63811-6000 (Current)
Remover Tool	J-38125-12A

Use	Description	St. Clair P/N	Manufacturers P/N
TCM Connector	Kit, Connector Assembly, 80F, Bolt Assist, 90 Degree, Dir A		
	Connector Assembly, 80F Bolt, 90 Degree, Dir A	P/N 300243	P/N R-61991-001
	Spacer 80F		P/N E-4540
	Seal, Interfacial		P/N E-4539
	Connector Body, 80F Bolt		P/N E-4538
	Bolt		P/N E-4543-001
	Seal, Bolt		P/N E-4544
	Retainer Bolt		P/N E-4545
	Grommet, Wire Seal		P/N E-4541
	Grommet, Retainer	P/N 300244	P/N E-4542
	Cover, Wire Dress, 80F, Dir A		P/N E-6206-002
	Cover, Bottom		P/N E-4555
	Terminal, Receptacle	P/N 300247	P/N 330001-2004
	Plug, Cavity Seal	P/N 300008	P/N 12034413
	Wire Cover Kit 80W Bolt	P/N 300236	
	Cover, Wire Dress, 80F, Dir A		P/N E-6206-001
	Cover, Bottom		P/N E-4555

C. AFL 80F Bolt-Assist, Direction 'B' 90 Degree TCM Connector (Figure G–3).

Required Tools

Crimping Tool	J-47139 (Former), 63811-6000 (Current)
Remover Tool	J-38125-12A

Use	Description	St. Clair P/N	Manufacturers P/N
TCM Connector 80F, Bolt	Kit, Connector Assembly, 80F, Bolt Assist, 90 Degree, Dir B	P/N 300278	
	Connector Assembly, 80F Bolt, 90 Degree, Dir B	P/N 300243	P/N R-61991-001
	Spacer 80F		P/N E-4540
	Seal, Interfacial		P/N E-4539
	Connector Body, 80F Bolt		P/N E-4538
	Bolt		P/N E-4543-001
	Seal, Bolt		P/N E-4544
	Retainer Bolt		P/N E-4545
	Grommet, Wire Seal		P/N E-4541
	Grommet, Retainer	P/N 300244	P/N E-4542
	Cover, Wire Dress, 80F, Dir B		P/N E-6206-001
	Cover, Bottom		P/N E-4555
	Terminal, Receptacle	P/N 300247	P/N 330001-2004
	Plug, Cavity Seal	P/N 300008	P/N 12034413
	Wire Cover Kit 80W Bolt	P/N 300237	
	Cover, Wire Dress, 80F, Dir B		P/N E-6206-002
	Cover, Bottom		P/N E-4555

D. Terminal Removal.

1. Loosen the bolt (refer to Figure G–1, Figure G–2, or Figure G–3, View B) that retains 80-way connector to the TCM.
2. Separate the 80-way connector from the TCM.
3. Refer to the proper Figure for the connector being used:
   a. Refer to Figure G–1, View B. Use a small-bladed screwdriver to gently unlatch the retention features (4) of the wire dress cover and separate the two halves.
   b. Refer to Figure G–2, or Figure G–3, View B. Use a small-bladed screwdriver to gently unlatch the retention features (2) of the wire dress cover and remove it from the backshell wire dress. Gently release the retention features (4) of the backshell wire dress and remove it from the connector body.
4. Insert a small-bladed screwdriver in between the connector body and the grommet retainer (refer to Figure G–1, Figure G–2, or Figure G–3, View B) and carefully pry the grommet retainer away from the connector body. Slide the grommet retainer along the wires away from the connector body. If the grommet seal stayed with the connector body, also slide it away from the connector body and seat it into the grommet retainer, allowing better access to the wires.

5. Insert a small-bladed screwdriver through the slot in the connector body (being careful not to damage the green interfacial seal) and apply upward pressure on the red spacer until it lifts to the pre-stage location on one side (approximately 1⁄8 inch). Repeat this process on the other side so it is removed evenly. Carefully continue to evenly lift the red spacer out of the connector body until the four lock tabs release. Remove the red spacer completely. The red spacer **must be replaced** if any of the four lock tabs are broken during removal.
6. Make a note for reassembly purposes of which wire (number) goes into which terminal cavity in the connector body.
7. Insert the metal blade of J-38125-12A or J-39227 removal tool into the small hole in the front of the connector body above or below the desired terminal/wire lead cavity location (refer to Figure G–1, Figure G–2, or Figure G–3, View A).
8. Remove the selected terminal by gently lifting the locking finger with the removal tool and pulling the wire and terminal rearward out of the connector.

NOTE: Care should be taken not to damage or break the terminal locking fingers during removal. If a locking finger is damaged or broken, proper terminal retention will be lost after reassembly.

E. Terminal Crimping.

1. Carefully strip the insulation from the wire to leave 4.70–5.60 mm (0.185–0.220 inch) of bare wire (core) exposed.
2. Refer to Figure G–1, Figure G–2, or Figure G–3, View C. Pull out the wire stop blade of the crimping tool so it is clear of the terminal crimp area. Place the terminal all the way into the appropriate wire size opening of the J-47139 (former) or 63811-6000 (Molex P/N, current) crimping tool until it contacts the stop and is properly oriented. Squeeze the handle enough to keep the terminal in place in the tool but not enough to compress the crimp wings.
3. Push in the wire stop blade until it touches the terminal. Insert the wire core into the terminal, with the core held against the wire stop blade.
4. Hold the wire and terminal against the stops until the terminal is fully crimped. Squeeze the crimper handle until the ratchet releases
5. Pull out the wire stop blade and remove the crimped terminal and wire.

NOTE: If cavities do not have a terminal/wire lead or grommet cover pin (or if grommet cover pin is damaged) install Cavity Plug P/N 12034413 into corresponding cavity in grommet seal in connector body.

6. Repeat as necessary.
7. Slide the grommet retainer containing the grommet seal along the wires and snap it into place on the connector body.
8. When all terminals have been inserted, be sure the green interfacial seal is properly located on the connector body and not damaged. Install the red spacer into the connector body. Push it into the connector body until it is fully seated against the connector body.

NOTE: If the red spacer will not seat properly on the connector body, be sure all terminals are fully seated.

9. Refer to the proper Figure for the connector being used:
   a. Refer to Figure G–1. Align and press together the two halves of the wire dress cover until they lock. Align the four retention features on the wire dress cover with the four lock tabs on the grommet retainer and press the wire dress cover onto the grommet retainer until all four retention features lock.
   b. Refer to Figure G–2, or Figure G–3. Align the four retention features of the backshell wire dress with the four lock tabs on the grommet retainer and press the backshell wire dress onto the grommet retainer until all four retention features lock. Align the wire dress cover with the backshell wire dress and press into place until it locks on both sides.
10. Reconnect the 80-way connector to the TCM and tighten connector bolt to specified torque value (N·m) shown on the wire dress cover (DO NOT OVER-TORQUE).

G–2. AFL AUTOMOTIVE 80F CAM-ASSIST CONNECTORS (TCM CONNECTOR)

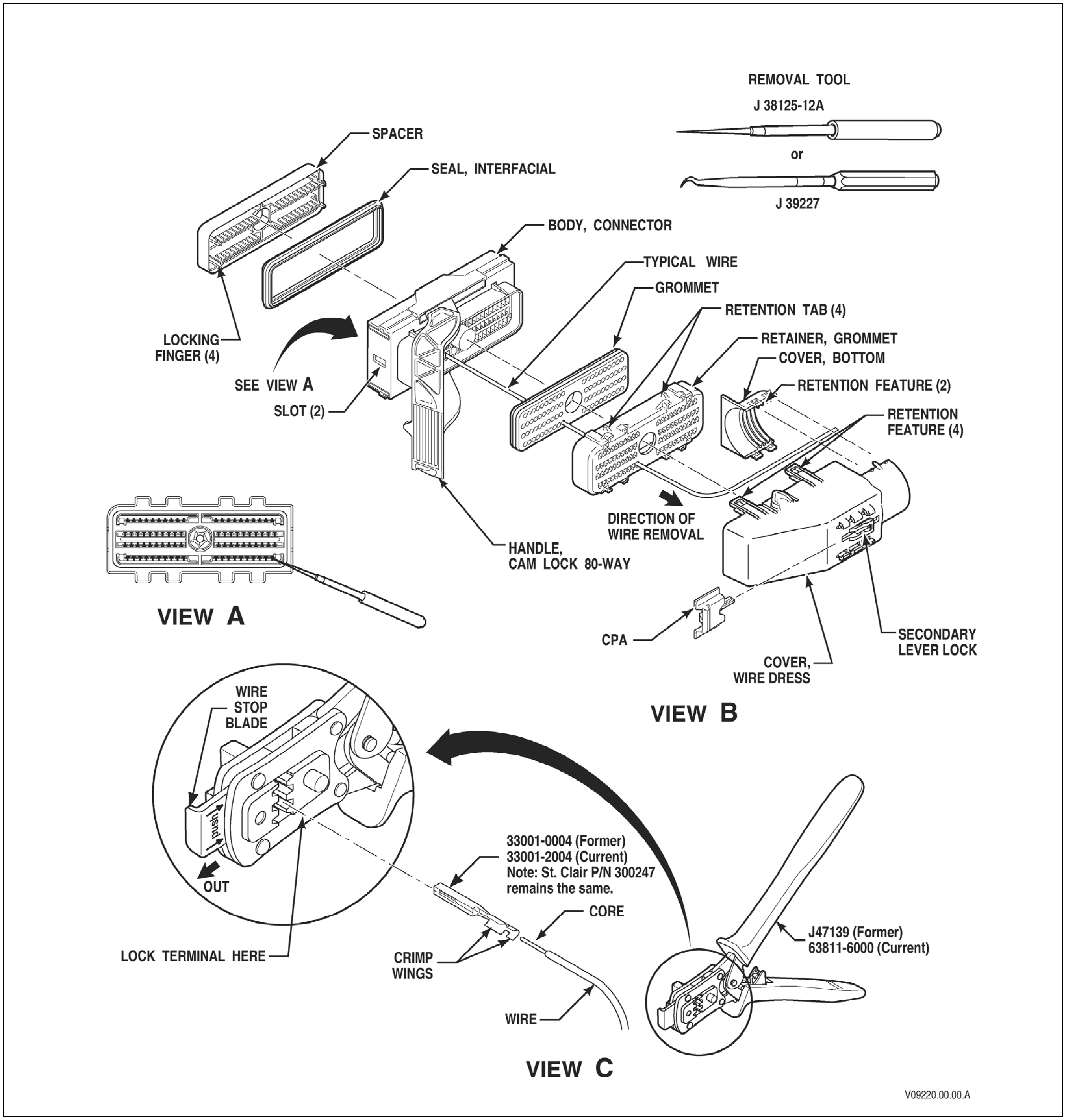


Figure G–4. AFL 80F Cam-Assist, Direction 'A' TCM Connector

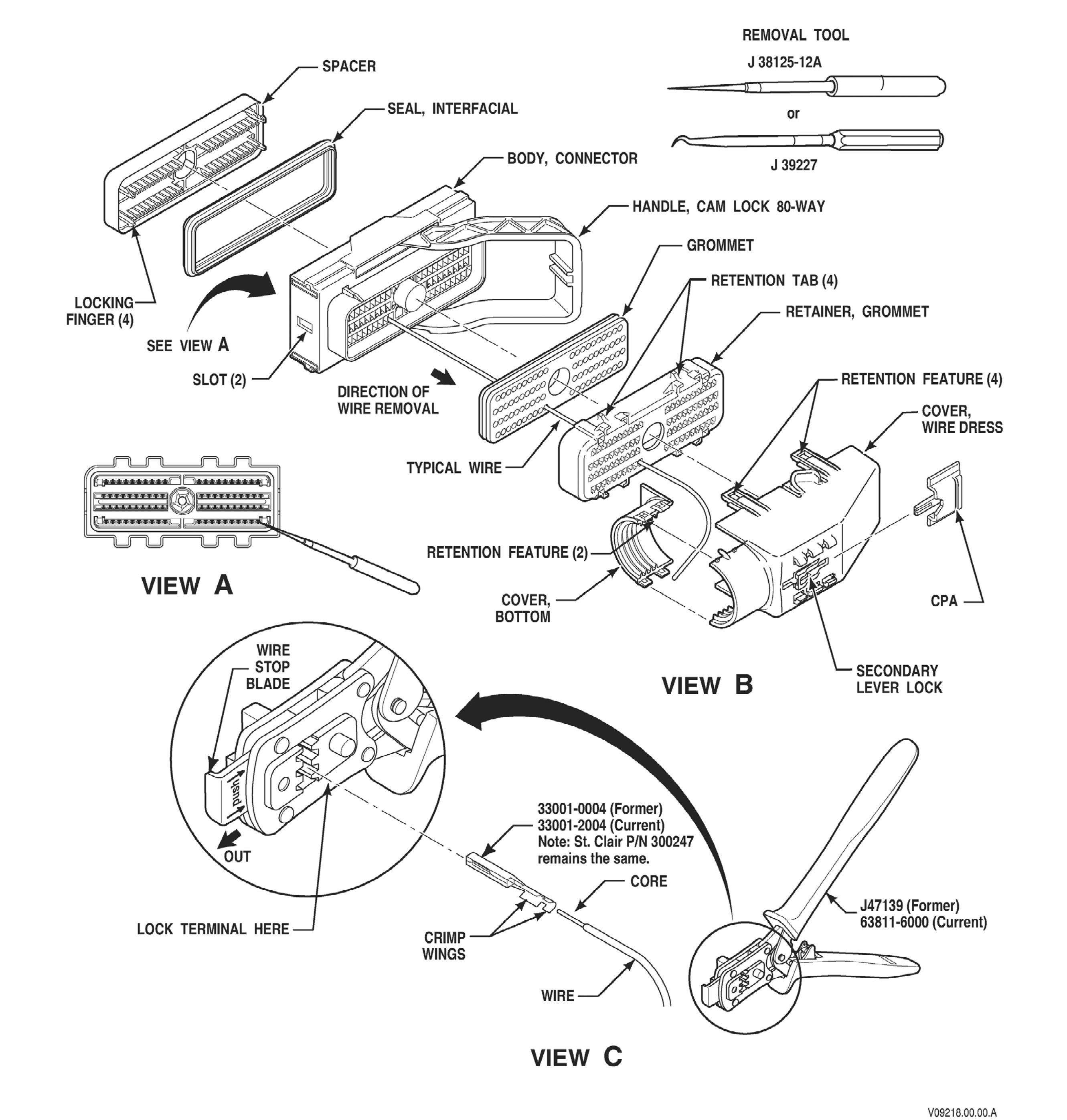


Figure G–5. AFL 80F Cam-Assist, Direction 'B' TCM Connector

A. Connector, Assembly 80F Cam-Assist, 'A' Direction (Figure G–4).

Required Tools

Crimping Tool	J-47139 (Former), 63811-6000 (Current)
Remover Tool	J-38125-12A

Use	Description	St. Clair P/N	Manufacturers P/N
TCM Connector	Kit, Connector Assembly, 80F, Cam-Assist, Dir A		
	Connector Assembly, 80F, Cam-Assist, Dir A		R-62004-001
	Spacer 80F		E-4540
	Seal, Interfacial		E-4539
	Connector Body, 80F, Cam		E-4547
	Cam, Left		E-4554
	Cam, Right		E-4553
	Handle, Cam		E-4548
	Retainer Bolt		E-4545
	Grommet, Wire Seal		E-4541
	Grommet, Retainer	300244	E-4542
	Cover, Wire Dress and CPA		E-4589
	Cover, Bottom		E-4555
	Terminal, Receptacle	300247	33001-2004
	Plug, Cavity Seal	300008	12034413
	Wire Cover Kit 80W Cam, Dir A	300238	
	Cover, Wire Dress and CPA		E-4555
	Cover, Bottom		E-4589

B. Connector, Assembly 80F Cam-Assist, 'B' Direction (Figure G–5).

Required Tools

Crimping Tool	J-47139 (Former), 63811-6000 (Current)
Remover Tool	J-38125-12A

Appendix G—CONNECTOR PART NUMBERS

Use	Description	St. Clair P/N	Manufacturers P/N
TCM Connector	Kit, Connector Assembly, 80F, Cam-Assist, Dir B		
	Connector Assembly, 80F, Cam-Assist, Dir B		R-62004-002
	Spacer 80F		E-4540
	Seal, Interfacial		E-4539
	Connector Body, 80F Cam		E-4547
	Cam, Left		E-4554
	Cam, Right		E-4553
	Handle, Cam		E-4548
	Retainer Bolt		E-4545
	Grommet, Wire Seal		E-4541
	Grommet, Retainer	300244	E-4542
	Cover, Wire Dress and CPA		E-4588
	Cover, Bottom		E-4555
	Terminal, Receptacle	300247	33001-2004
	Plug, Cavity Seal	300008	12034413
	Wire Cover Kit 80W Cam, Dir B	300239	
	Cover, Wire Dress and CPA		E-4555
	Cover, Bottom		E-4588

C. Connector Removal (Figure G–4 or Figure G–5 View B).

1. Remove the CPA from the secondary lever lock and press in on the secondary lever lock while moving the cam lock handle to the unlatched position.
2. Separate connector from TCM.

NOTE: Do not attempt to move CAM lever after it is disengaged from the TCM, doing so can break the internal latching mechanism.

3. Refer to Figure G–4 or Figure G–5, View B. Use a small-bladed screwdriver to gently unlatch the retention features (2) of the wire dress cover and remove it from the backshell wire dress. Gently release the retention features (4) of the backshell wire dress and remove it from the connector body.
4. Insert a small-bladed screwdriver in between the connector body and the grommet retainer (Figure G–4 or Figure G–5, View B) and carefully pry the grommet retainer away from the connector body. Slide the grommet retainer along the wires away from the connector body. If the grommet seal stayed with the connector body, also slide it away from the connector body and seat it into the grommet retainer, allowing better access to the wires.
5. Insert a small-bladed screwdriver through the slot in the connector body (being careful not to damage the blue interfacial seal) and apply upward pressure on the red spacer until it lifts to the pre-stage location on one side (approximately $^1/_8$ inch). Repeat this process on the other side so it is removed evenly. Carefully continue to evenly lift the red spacer out of the

connector body until the four lock tabs release. Remove the red spacer completely. The red spacer must be replaced if any of the four lock tabs are broken during removal.

6. Make a note for reassembly purposes of which wire (number) goes into which terminal cavity in the connector body.
7. Insert the metal blade of J-38125-12A or J-39227 remover tool into the small hole in the front of the connector body above or below the desired terminal/wire lead cavity location (Figure G–4 or Figure G–5, View A).
8. Remove the selected terminal by gently lifting the locking finger with the remover tool and pulling the wire and terminal rearward out of the connector.

NOTE: Care should be taken not to damage or break the terminal locking finger during removal. If the locking finger is damaged or broken, proper terminal retention will be lost after reassembly.

D. Terminal Crimping.

1. Carefully strip the insulation from the wire to leave 4.70–5.60 mm (0.185–0.220 inch) of bare wire (core) exposed.
2. Refer to Figure G–4 or Figure G–5, View C. Pull out the wire stop blade of the crimping tool so it is clear of the terminal crimp area. Place the terminal all the way into the appropriate wire size opening of the J-47139 (former) or 63811-6000 (Molex P/N, current) crimping tool until it contacts the stop and is properly oriented. Squeeze the handle enough to keep the terminal in place in the tool but not enough to compress the crimp wings.
3. Push in the wire stop blade until it touches the terminal. Insert the wire core into the terminal, with the core held against the wire stop blade.
4. Hold the wire and terminal against the stops until the terminal is fully crimped. Squeeze the crimper handle until the ratchet releases.

NOTE: If cavities do not have a terminal/wire lead or grommet cover pin (or if grommet cover pin is damaged) install Cavity Plug P/N 12034413 into corresponding cavity in grommet seal in connector body.

5. Repeat as necessary.
6. Slide the grommet retainer containing the grommet seal along the wires and snap it into place on the connector body.
7. When all terminals have been inserted, be sure the green interfacial seal is properly located on the connector body and is not damaged. Install the red spacer into the connector body. Push it into the connector body until it is fully seated against the connector body.

NOTE: If the red spacer will not seat properly on the connector body, be sure all terminals are fully seated.

8. Refer to Figure G–4 or Figure G–5, View B. Align the four retention features of the backshell wire dress with the four lock tabs on the grommet retainer and press the backshell wire dress onto the grommet retainer until all four retention features lock. Align the wire dress cover with the backshell wire dress and press into place until it locks on both sides.

9. To reconnect the 80-way connector to the TCM:
   a. Bring the connector to TCM “squared up”, not at an angle.
   b. Keeping hands away from the handle, squarely press the connector onto the TCM until the cam lever handle moves of its own accord approximately $^3/_4$ inch.
   c. Gently complete mating the connector to the TCM by moving the cam lever handle to the locked position.
   d. Slide the CPA back toward the secondary lock.

G–3. AFL AUTOMOTIVE 20-WAY BOLT-ASSIST CONNECTORS (TCM CONNECTOR)

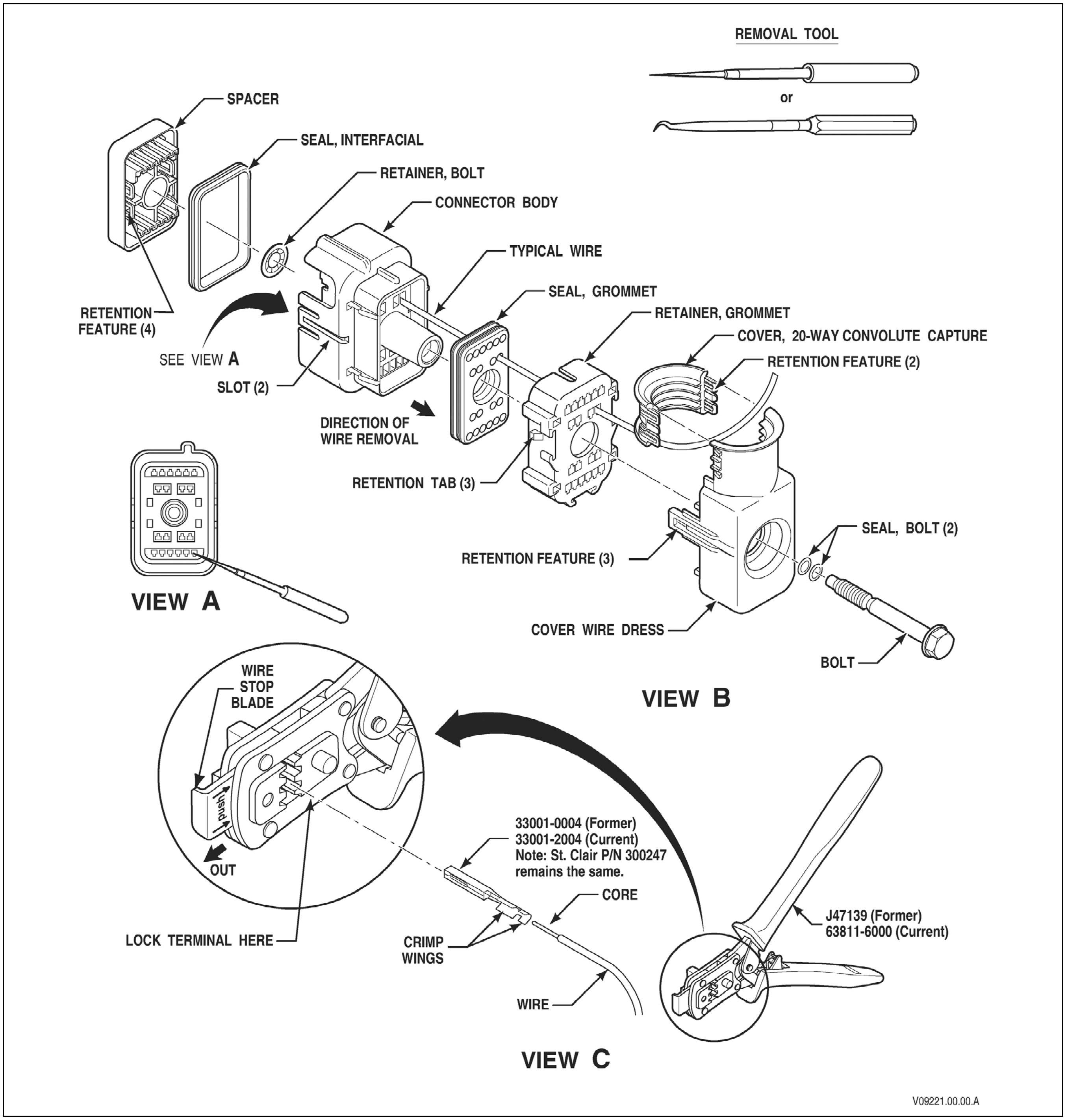


Figure G–6. AFL Automotive 20-Way, Bolt-Assist TCM Connector

A. Connector/Terminal Tools.

Required Tools

Crimping Tool	J-47139 (Former), 63811-6000 (Current)
Remover Tool	J-38125-12A

Use	Description	St. Clair P/N	Manufacturers P/N
TCM Connector (20-way Bolt assist)	Kit, Connector Assembly, 20F, Bolt Assist	300278	
	Connector Assembly, 20F, Bolt Assist	300252	R-62183-001
	Spacer 80F		E-4564
	Seal, Interfacial		E-4542
	Connector Body, 80F, Bolt		E-4561
	Bolt		E-6187-001
	Seal, Bolt		E-4590
	Retainer Bolt		E-4545
	Grommet, Wire Seal		E-4565
	Grommet Cover, 20-Way	300253	E-4566
	Cover, Wire Dress	300254	E-4569
	Clip, Convolute	300251	E-4570
	Terminal, Receptacle	300247	33001-2004
	Plug, Cavity Seal	300008	12034413
	Bolt Kit	300241	
	Bolt		E-6187-001
	Seal, Bolt		E-4590
	Retainer, Bolt		E-4545
	Wire Cover Kit	300242	
	Cover, Wire Dress		E-4569
	Clip, Convolute		E-4570

NOTE: Read disassembly process/procedure thoroughly before beginning disassembly.

1. Loosen the bolt (Figure G–6, View B) that retains 20-way connector to the transmission pass-through connector.
2. Separate the 20-way connector from the transmission pass-through connector.
3. Use a small-bladed screwdriver to gently unlatch the retention features (2) of the wire dress cover and remove it from the backshell wire dress. Gently release the retention features (3) of the backshell wire dress and remove it from the connector body.
4. Insert a small-bladed screwdriver in between the connector body and the grommet retainer (Figure G–1, Figure G–2, or Figure G–3) and carefully pry the grommet retainer away from the connector body. Slide the grommet retainer along the wires away from the connector body. If the grommet seal stayed with the connector body, also slide it away from the connector body and seat it into the grommet retainer, allowing better access to the wires (only required when adding or deleting circuits).

5. Make a note for reassembly purposes of which wire (number) goes into which terminal cavity in the connector body.
6. Insert a small-bladed screwdriver through the slot in the connector body (being careful not to damage the interfacial seal) and apply upward pressure on the spacer until it lifts to the pre-stage location on one side (approximately 1⁄8 inch). Repeat this process on the other side so it is removed evenly. Carefully continue to evenly lift the spacer out of the connector body until the two lock tabs release. Remove the spacer completely. The spacer must be replaced if any one of the four retention features is broken during removal.
7. Insert the metal blade of J-38125-12A or J-39227 remover tool into the small hole in the front of the connector body above or below the desired terminal/wire lead cavity location (Figure G–6, View A).
8. Remove the selected terminal by gently lifting the locking finger with the remover tool and pulling the wire and terminal rearward out of the connector.

NOTE: Care should be taken not to damage or break a terminal locking finger during removal. If a locking finger is damaged or broken, proper terminal retention will be lost after reassembly.

B. Terminal Crimping.

1. Carefully strip the insulation from the wire to leave 4.70–5.60 mm (0.185–0.220 inch) of bare wire (core) exposed.
2. Refer to Figure G–6, View C. Pull out the wire stop blade of the crimping tool so it is clear of the terminal crimp area. Place the terminal all the way into the appropriate wire size opening of the J-47139 (former) or 63811-6000 (Molex P/N, current) crimping tool until it contacts the stop and is properly oriented. Squeeze the handle enough to keep the terminal in place in the tool but not enough to compress the crimp wings.
3. Push in the wire stop blade until it touches the terminal. Insert the wire core into the terminal, with the core held against the wire stop blade.
4. Hold the wire and terminal against the stops until the terminal is fully crimped. Squeeze the crimper handle until the ratchet releases.
5. Pull out the wire stop blade and remove the crimped terminal.

NOTE: If cavities do not have a terminal/wire lead or grommet cover pin (or if grommet cover pin is damaged) install Cavity Plug P/N 12034413 into corresponding cavity in grommet seal in connector body.

6. Repeat as necessary.
7. Slide the grommet retainer containing the grommet seal along the wires and snap it into place on the connector body (only if removed).
8. Be sure the interfacial seal is properly located on the connector body and not damaged. Install the spacer into the connector body. Push it into the connector body until it is fully seated against the connector body.

NOTE: If the spacer will not seat properly on the connector body, be sure all terminals are fully seated.

9. Refer to Figure G–6, View A. Align the three retention features of the backshell wire dress with the three lock tabs on the grommet retainer and press the backshell wire dress onto the grommet retainer until all three retention features lock. Align the wire dress cover with the backshell wire dress and press into place until it locks on both sides.
10. Reconnect the 20-way connector to the transmission pass-through connector and tighten connector bolt to specified torque value (N·m or lb ft) shown on the wire dress cover (DO NOT OVERTORQUE).

G–4. DELPHI-PACKARD MICRO PACK 100W CONNECTORS (CAN AND STRIP SHIFT SELECTORS)

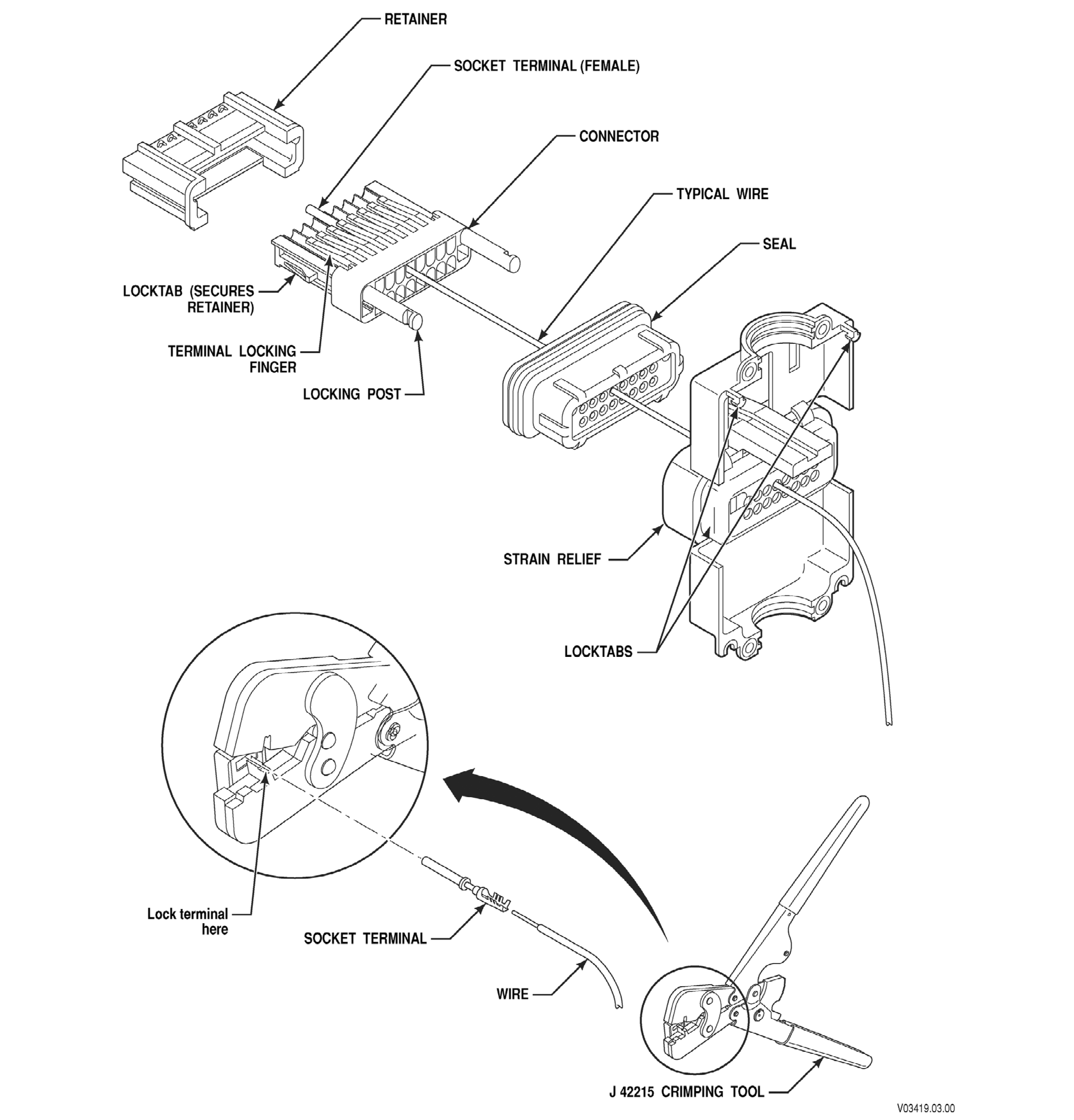


Figure G–7. Delphi-Packard Micro Pack 16-Way 180 Degree Connector

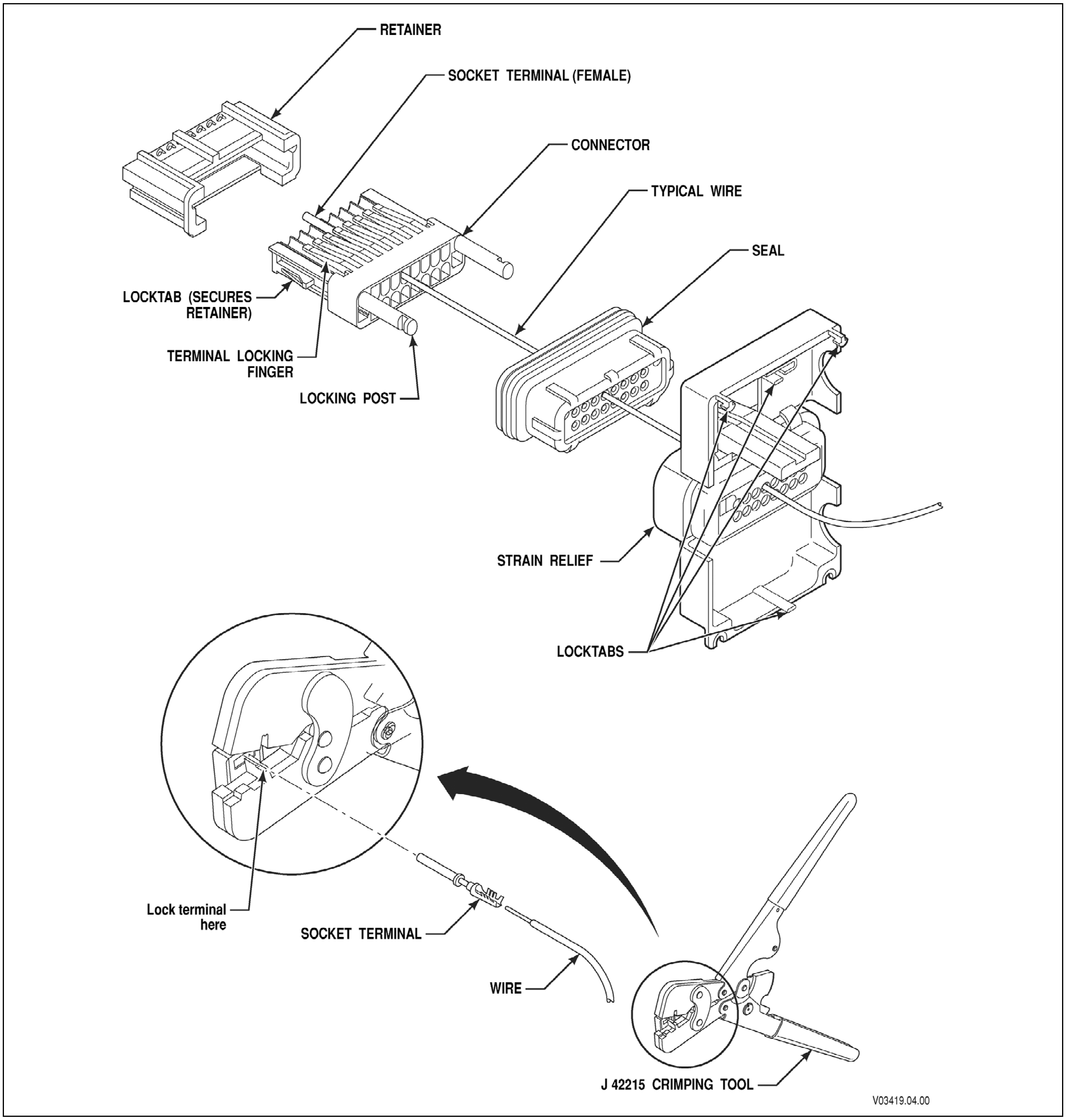


Figure G–8. Delphi-Packard Micro Pack 16-Way 90 Degree Connector

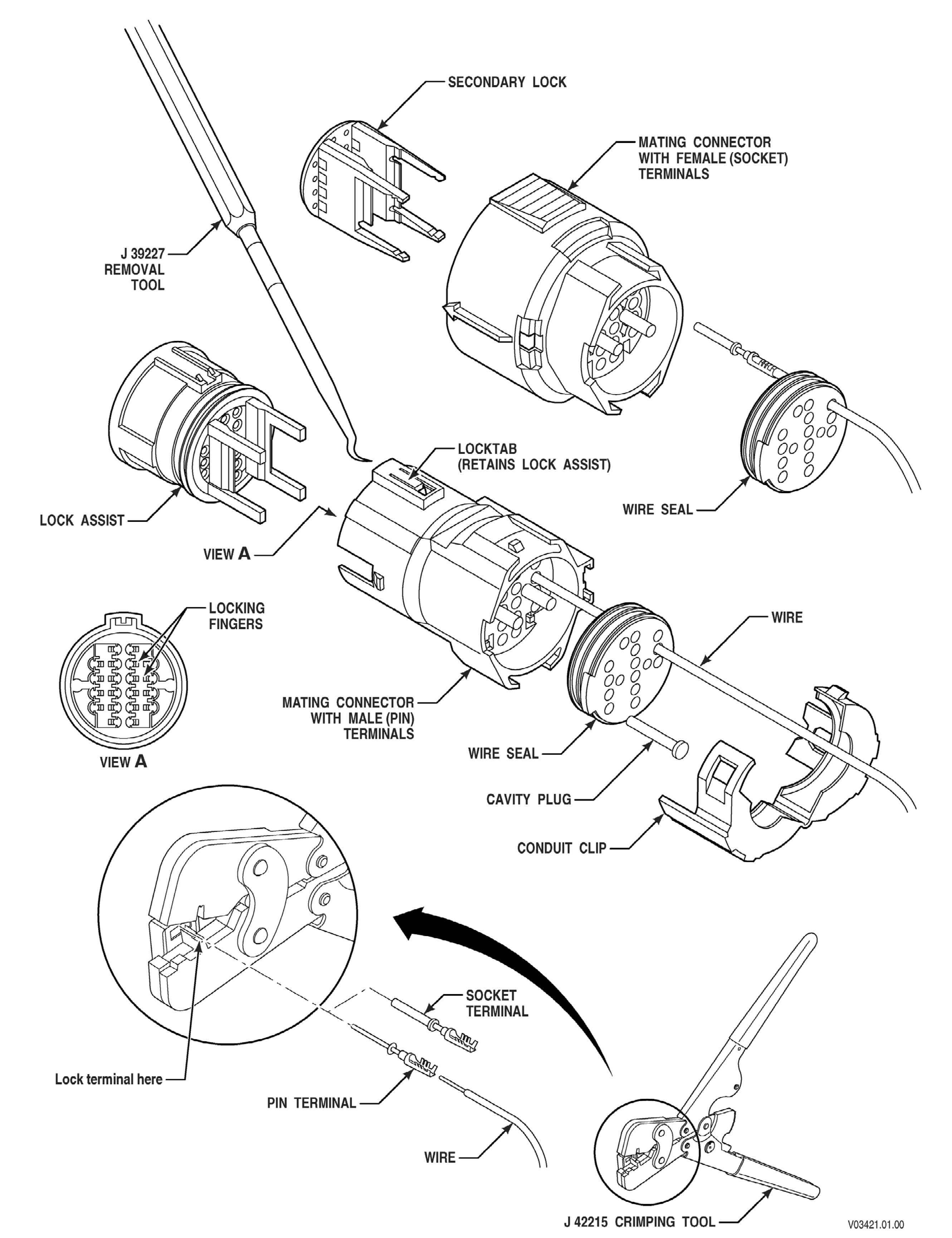


Figure G–9. Delphi-Packard Micro Pack Connector (Strip Shift Selector)

Appendix G—CONNECTOR PART NUMBERS

A. Connector/Terminal Tools.

Required Tools

Crimping Tool	J-42215
Remover Tool	J-39227

Use	Description	St. Clair P/N	Manufacturers P/N
CAN Shift Selector, 90 Degree	Kit, CAN Shift Selector, 90 Degree	P/N 300279	
	Connector, 16F	P/N 300255	P/N 12191065
	Seal, 16-way	P/N 300256	P/N 12191066
	TPA Retainer, 16F	P/N 300257	P/N 12191067
	Strain Relief, 16F, 90 Degree	P/N 300258	P/N 12191068
	Terminal, 0.8 mm Wire	P/N 300087	P/N 12084912
	Cavity Plug	P/N 300105	P/N 12129557
	CPA Lock M/P	P/N 300114	P/N 12177289
CAN Shift Selector, 180 Degree	Kit, CAN Shift Selector, 180 Degree	P/N 300280	
	Connector, 16F	P/N 300255	P/N 12191065
	Seal, 16-way	P/N 300256	P/N 12191066
	TPA Retainer, 16F	P/N 300257	P/N 12191067
	Strain Relief, 16F, 180 Degree	P/N 300259	P/N 15460298
	Terminal, 0.8 mm Wire	P/N 300087	P/N 12084912
	Cavity Plug	P/N 300105	P/N 12129557
	CPA Lock M/P	P/N 300114	P/N 12177289
Strip Shift Selector, Harness	Connector		P/N 12160280
	Wire Seal		P/N 15304882
	Secondary Lock		P/N 12160494
	Terminal, Socket		P/N 12084912
	Cavity Plug		P/N 12129557
	Conduit Clip		P/N 12176394
Strip Shift Selector, Device	Connector, Gray		P/N 12160542
	Wire Seal		P/N 12110693
	Lock Assist/Seal		P/N 12191176
	Terminal, Pin		P/N 12060551
	Cavity Plug		P/N 12129557
	Conduit Clip, Black		P/N 12176394

B. Terminal Removal.

1. CAN Shift Selector Harness Connectors (refer to Figure G–7, Figure G–8, and Figure G–9).

CAUTION: The color code of the strain relief should match the color code of the retainer. However, cases have been reported where this has not occurred. The retainer color code and key configuration ensures the proper wiring harness connector is in the right socket of the TCM. The color code of the strain relief is of secondary importance and may not agree with the retainer. Change the strain relief to match the color code of the retainer (refer to G–1. AFL 80F BOLT-ASSIST TRANSMISSION CONTROL MODULE (TCM CONNECTOR)) when color code mismatch is found.

   a. Use a small-bladed screwdriver to gently release the locktabs at the splitline of the strain relief.
   b. Spread the strain relief open.
   c. Remove the retainer from the connector by using a small-bladed screwdriver to press the locktabs on the side of the connector.
   d. Remove a selected terminal by pushing forward on the wire or by lifting the locking finger and pulling the wire and terminal rearward out of the connector.

2. Strip Shift Selector (Device) Connectors (refer to Figure G–9).
   a. Lift locktab on the side of the connector and remove the lock assist.
   b. Open the conduit clip on the back of the connector after lifting locktabs on each side and sliding clip back to release it from connector.
   c. Use the J-39227 tool to release the locking finger inside the connector and pull the terminal/wire out the rear of the connector.

3. Strip Shift Selector Harness Connectors (refer to Figure G–9).
   a. Carefully insert a small screwdriver blade between the connector body and the secondary lock. Twist/pry to remove the secondary lock from the connector body.
   b. Open the conduit clip on the back of the connector after lifting locktabs on each side and sliding clip back to release it from connector.
   c. Use the J-39227 tool to release the locking finger inside the connector and pull the terminal/wire out the rear of the connector.

C. Terminal Crimping.

1. Carefully strip insulation to leave 5.0 mm ± 0.5 mm (0.20 ± 0.02 inch) of bare wire showing.
2. Insert the new terminal to be crimped in the J-42215 Crimping Tool. There is a spring-loaded terminal positioner at the front of the tool to hold the terminal in place. Squeeze the crimper handles for a few clicks to start the crimping process but leave room to insert the wire end.
3. Insert the bare wire end into the terminal. Squeeze the crimper handles to complete the crimping process and until the crimper handles open when released to remove the terminal/wire from the tool.
4. Complete terminal installation for Strip Shift Selector Connectors as follows: (refer to Figure G–9)
   a. Insert the wire seal in the back of the connector.

b. Push the terminal/wire assembly through the proper hole in the back of the wire seal. Push the wire in until the terminal clicks into position. Gently pull rearward on the wire to be sure that the terminal is fully seated. Install cavity plugs as needed.

c. Install the lock assist or secondary lock into the connector body.

d. Close the conduit clip around the conduit and lock the clip into the rear of the connector body.

5. Complete terminal installation of the CAN Shift Selector Connectors as follows: (refer to Figure G–7, and Figure G–8).

   a. Align the locking posts on the connector with the seal and push the locking posts through the seal into the mating holes in the strain relief (if the connector was removed from the strain relief).

   b. Push the terminal/wire assembly through the proper hole in the back of the seal. Push the wire in until the terminal clicks into position.

NOTE: All terminals must be properly positioned to install the retainer in Step (5c).

   c. Install the retainer on the connector body to lock the terminals in position. Pull rearward on the wire to be sure that the terminal is fully seated. Install cavity plugs as needed.

   d. Position the conduit inside the strain relief and snap the strain relief halves together.

G–5. DELPHI-PACKARD GT150 CONNECTORS—PUSH-TO-SEAT (SPEED SENSOR, ACCUMULATOR SOLENOID, RETARDER SOLENOID)

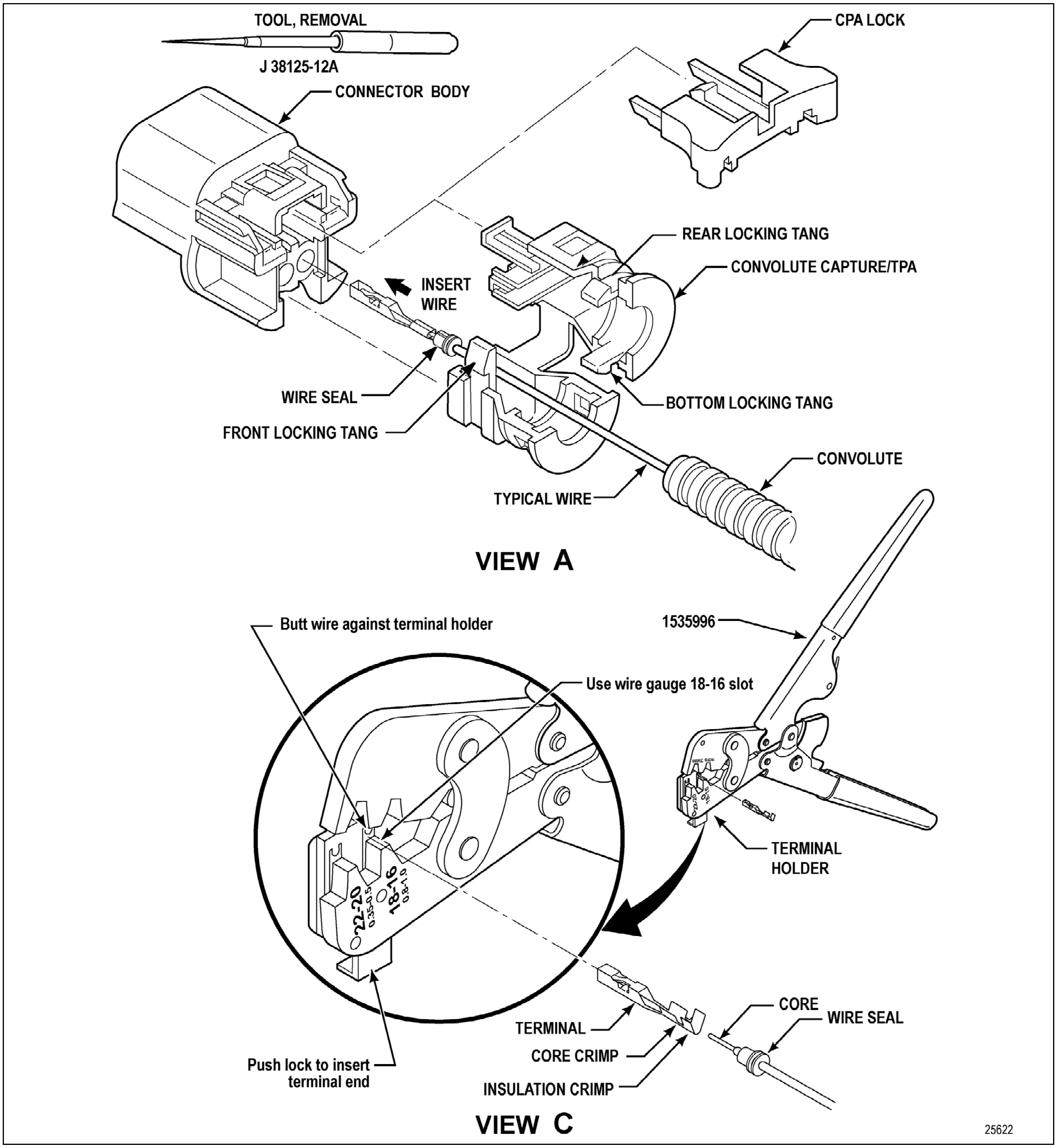


Figure G–10. Delphi-Packard Metri-Pack GT150 Series Connectors—Push-to-Seat (Speed Sensor, Accumulator Solenoid, Retarder Solenoid)

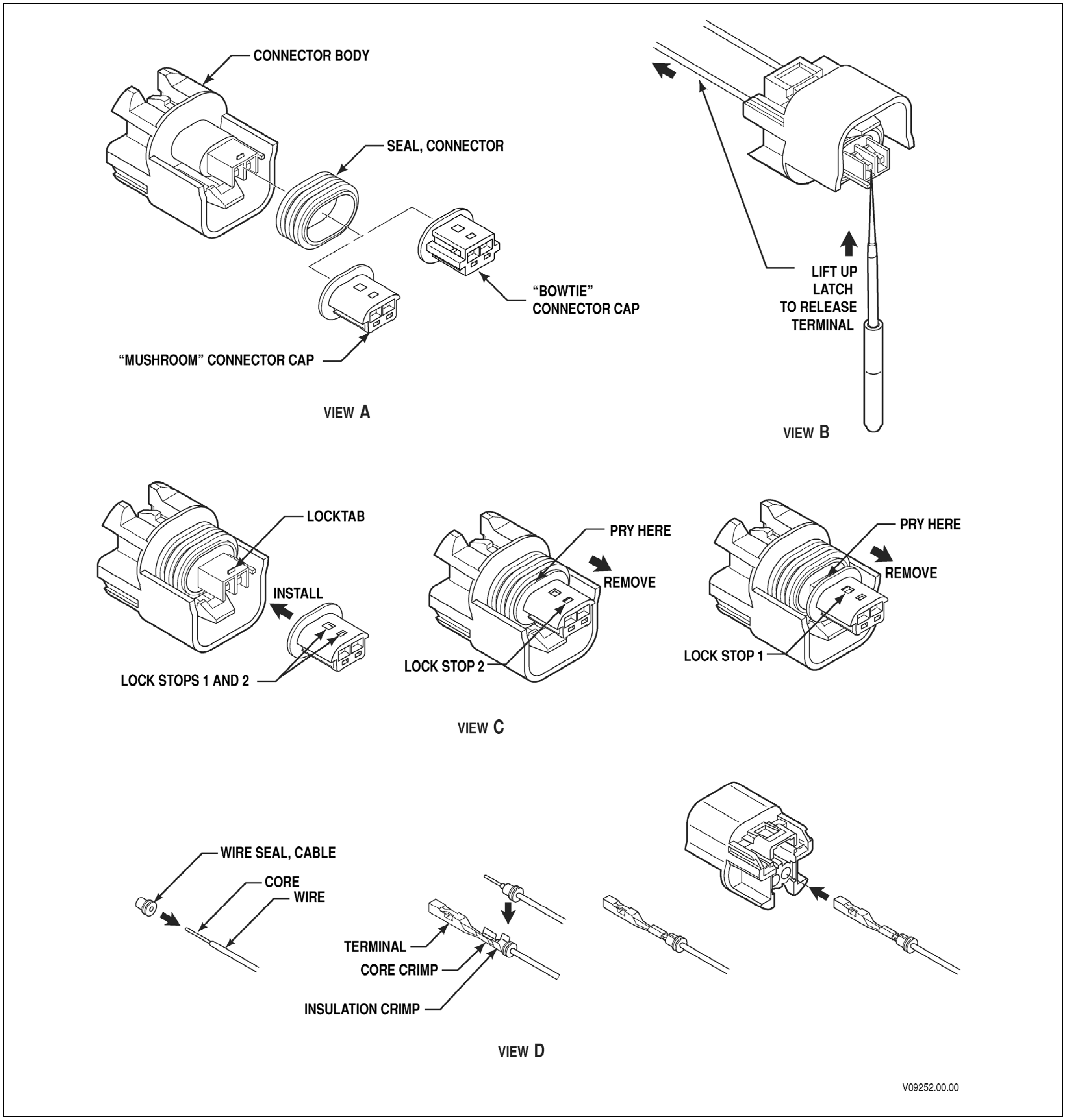


Figure G–11. Delphi-Packard GT150 Series Connectors—Push-to-Seat (Speed Sensor, Accumulator Solenoid, Retarder Solenoid)

A. Connector/Terminal Repair.

Required Tools	
Wire Stripper	J-35615
Crimp Tool	Delphi 1535996
Alternate Crimp Tool	J-38125-6 Anvil “1” J-38125-7 Anvil “E”
Remover Tool	J-38125-12A
Alternate Removal Tool	J-35689-A

Use	Description	St. Clair P/N	Manufacturers P/N (Current)	Manufacturers P/N (Former)
GT Turbine Speed (Nt) Sensor GT Engine/Output (All Models) (Ne/No) Speed Sensor	Kit, GT150, Speed Sensor	P/N 300227		
	Connector Assembly	P/N 300260	P/N 13520101	P/N 15490464
	CPA	P/N 300261	P/N 15496486	
	Terminal	P/N 300262	P/N 15326267	
	Cable Seal	P/N 300269	P/N 15305351	
	Convolute Capture, TPA	P/N 300064	P/N 15358890	
Retarder Solenoid (PCS5)	Connector Assembly		P/N 13523048	P/N 13513314
	CPA		P/N 15496486	
	Terminal		P/N 15326267	
	Cable Seal		P/N 15305351	
	Convolute Capture, TPA		P/N 15358890	
Retarder Accumulator Solenoid	Connector Assembly		P/N 13520104	
	Cable Seal		P/N 15305351	
	Terminal		P/N 15326267	
	CPA		P/N 15496486	
	Convolute Capture, TPA		P/N 15358890	

B. Terminal Removal.

NOTE: Do not solder crimps.

1. The CPA lock has two positions. The fully locked position retains the connector to the mating connector. The second position allows the connector to be released from the mating

connector. To facilitate terminal removal, completely remove the CPA lock by depressing the lock tang and pulling the lock up and away from the connector (refer to Figure G–10, View A).

2. Remove the convolute capture from the rear of the GT150 connector by raising the retainer clip and pulling on the harness.
3. Remove the convolute capture from the convolute by applying pressure with a small-bladed screwdriver inserted into the front locking tang. Repeat the process on the rear locking tang and open the capture. The wires are now loose in the convolute and can be pulled out a short distance to make terminal installation easier.
4. Two different connector caps, “bowtie” or “mushroom”, are used (refer to Figure G–11, View A). Each connector cap has two stops (refer to Figure G–11, View C). The cap must be completely removed from the connector in order to remove and install a wire and terminal. Remove the appropriate connector cap from the connector by carefully prying up on the cap and push it away from the connector past the lock tab, so that it completely clears the connector. Be sure seal is not damaged.
5. Insert the J-38125-12A Removal Tool between the terminal lock finger and the terminal (refer to Figure G–11, View B) and carefully lift the finger while pulling the wire and terminal rearward from the connector body (refer to Figure G–10, View A).
6. If the terminal is to be replaced, cut the terminal between the core and insulation crimp to minimize wire loss.

C. Terminal Crimping—(Delphi 15359996 Crimping Tool).

1. Carefully strip the wire of enough insulation to expose 4.5 mm ± 0.5 mm (0.18 ± 0.02 inch) of bare wire (core).
2. Install a seal onto the wire (refer to Figure G–11, View D).
3. Pull out the wire stop blade of the crimping tool so it is clear of the terminal crimp area (refer to Figure G–10, View C). Place the terminal all the way into the appropriate wire size opening of the J-47139 Crimping Tool until it contacts the stop and is properly oriented. Squeeze the handle just enough to maintain pressure on the terminal so it does not drop out of the tool, but not enough to compress the crimp wings.
4. Push in the wire stop blade until it touches the terminal. Insert the wire core into the terminal, with the core held against the wire stop blade. Position the seal on the wire so the small diameter is in the insulation crimp wing (refer to Figure G–11, View D).
5. Hold the wire and terminal against the stops and be sure the seal is in the insulation crimp wing. Squeeze the crimping tool handle until it releases. Pull out the wire stop blade and remove the wire and terminal from the tool.
6. Lightly pull on the wire while holding the terminal to be sure the crimp is tight.
7. Repeat as needed to crimp another wire.
8. Insert the terminal and sealed wire into the connector (refer to Figure G–11, View D) until it stops. Lightly pull on the wire to be sure it is held in the connector by the terminal lock finger.
9. Install connector cap (refer to Figure G–11, View A) onto front of connector body.
10. Close the convolute capture over the convolute until both locks are engaged.
11. Push the convolute capture into the connector body until both locks are engaged. Install the CPA lock onto the connector body.

D. Terminal Crimping Using Alternate Tool J-38125-6 and J-38125-7.

1. Use J-38125-7 to crimp the wire core. Place core crimp portion of terminal onto bed of anvil "E" and squeeze crimper enough to keep terminal from dropping.
2. Position wire core in terminal and squeeze crimper tool to complete the core crimp. Be sure to orient the terminal so that it is properly aligned with the terminal cavity in the connector. The terminal should be positioned so that the notch on top of the terminal is aligned with the locking finger in the connector cavity.
3. Position the wire seal between the two insulation crimping tabs (refer to Figure G–11, View D).
4. Use J-38125-6 to crimp the insulation over the wire seal. Position insulation crimp of terminal on anvil "1" so that the entire insulation crimp area and a portion of the terminal between the core and insulation crimp areas are supported by the anvil. Complete the insulation crimp.

G–6. DELPHI-PACKARD METRI-PACK 150 SERIES CONNECTORS—PUSH-TO-SEAT (TURBINE SPEED SENSOR, 30-WAY AND 18-WAY VIM, RETARDER TEMPERATURE SENSOR, AND RETARDER ACCUMULATOR SOLENOID)

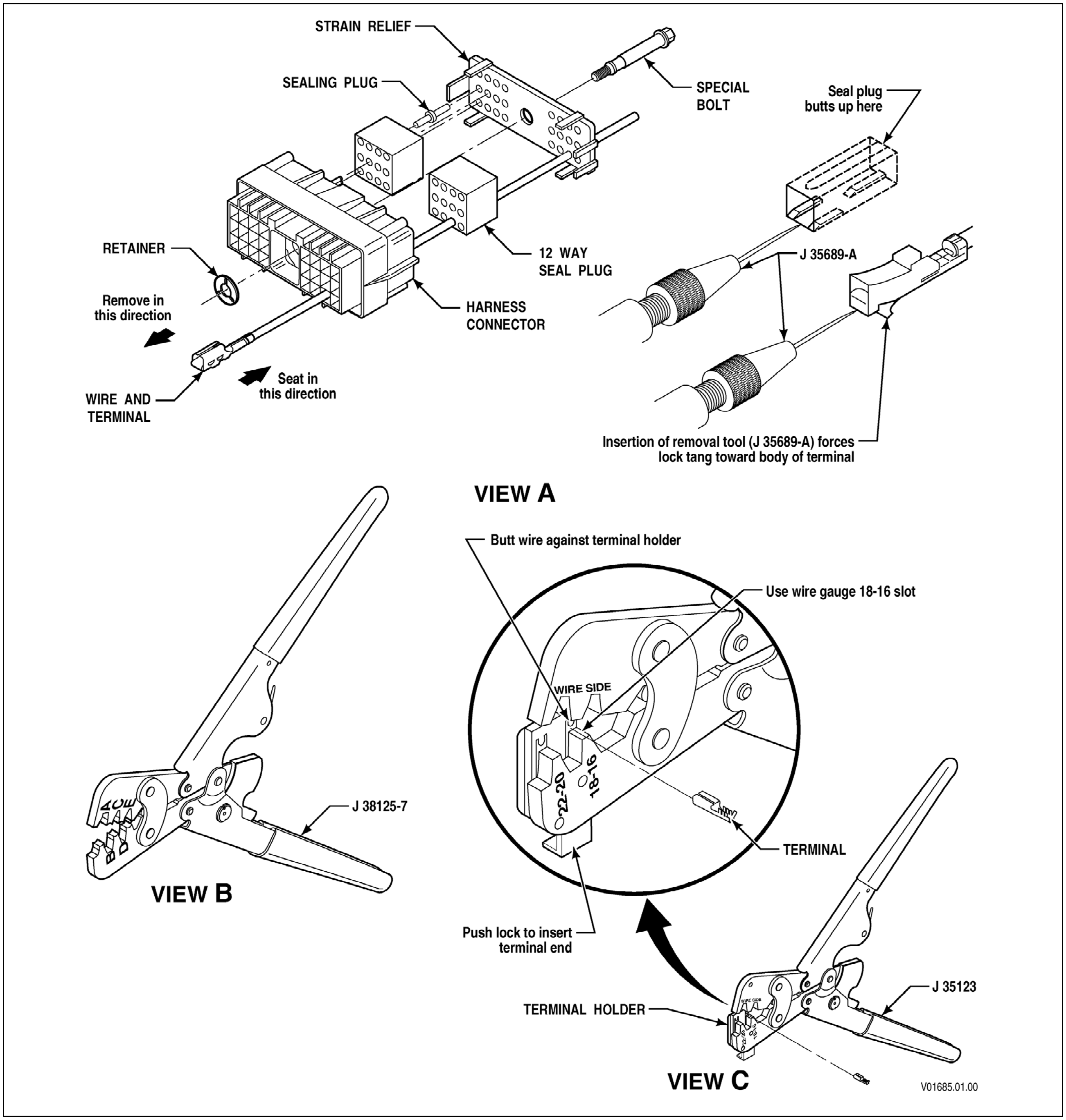


Figure G–12. Delphi-Packard Metri-Pack 150 Series connectors Pull-To-Seat (Turbine Speed Sensor, 30-Way and 18-Way VIM, Retarder Temperature Sensor, and Retarder Accumulator Solenoid)

A. Connector/Terminal Tools.

Required Tools	
Wire Stripper	J-35615
Crimping Tool	J-38125-7
Wire Crimp	J-38125-7 Anvil “E”
Insulation Crimp	J-38125-7 Anvil “C”
Alternate Crimping Tool	J-35123
Remover Tool	J-35689-A

Use	Description	Manufacturers P/N
Turbine Speed (Nt) Sensor	Connector	P/N 15490953
	Terminal	P/N 12110236
VIM	Connector (VIM)	
	Connector Body	P/N 12040920
	9-Way Seal (x2)	P/N 12040936
	30-Way Strain Relief	P/N 12110545
	Special Bolt	P/N 12129426
	Bolt Retainer	P/N 12034236
	Sealing Ring	P/N 12034413
	Terminal	P/N 12103881
VIM	Connector (VIM)	
	Connector Body	P/N 12034397
	15-Way Seal (x2)	P/N 12040879
	18-Way Strain Relief	P/N 12110546
	Special Bolt	P/N 12129426
	Bolt Retainer	P/N 12034236
	Sealing Ring	P/N 12034413
	Terminal	P/N 12103881
VIM	Connector (OEM)	
	Connector Body	P/N 12034397
	15-Way Seal (x2)	P/N 12040879
	30-Way Strain Relief	P/N 12110546
	Special Bolt	P/N 12129426
	Bolt Retainer	P/N 12034236
	Sealing Ring	P/N 12034413
	Terminal	P/N 12103881
Retarder Temperature Sensor	Connector Assembly, 2F M/P 150	P/N 12162852

Use	Description	Manufacturers P/N
	Connector Body, Black	P/N 12162734
	Connector Seal	P/N 12110513
	Cable Seal	P/N 12110514
	Terminal	P/N 12124075
Retarder Accumulator Solenoid	Connector Assembly, 2F M/P 150	P/N 15326143
	Connector Body, Black	P/N 15326141
	Connector Seal	P/N 12110513
	Cable Seal	P/N 12110514
	Terminal	P/N 12124075

B. Terminal Removal.

NOTE: Do not solder crimps.

1. Insert needle end of terminal remover J-35689-A into the small notch between the connector and the terminal to be removed (refer to Figure G–12, View A). Push the lock tang toward the terminal.
2. Push the wire and terminal out of the connector—this is a “pull-to-seat” terminal.
3. Pull terminal as far as necessary from the connector. This will be limited by the number of other wires inserted into the connector and by the distance between the back side of the connector and the beginning of the harness covering.
4. If terminal is to be replaced, cut the terminal between the core and insulation crimp to minimize wire loss.

C. Terminal Crimping—VIM, Speed Sensor, Retarder Temperature Sensor, and Retarder Accumulator Solenoid Terminals (Standard Crimping Tool).

1. If a spare wire is used, the wire should be pushed through the proper hole in the strain relief (if used), through the wire seal, and out the other side of the connector before stripping.
2. Carefully strip insulation 4.5 mm ± 0.5 mm (0.18 ± 0.02 inch). Unless insulation crimp is overtight, J-35615 Automatic Wire Stripper will remove insulation and crimp from old terminal without damaging wire.
3. Place core crimp portion of terminal on bed of anvil “E” and squeeze crimper enough to keep terminal from dropping (refer to Figure G–12, View B).
4. Position wire core in terminal and squeeze crimper tool to complete the core crimp. Be sure to orient the terminal so that it is properly aligned with the terminal cavity in the connector. The terminal should be positioned so that the lock tang is on the side of the cavity which has the notch in the middle (for the remover tool).
5. Position insulation crimp of terminal on anvil “C” so that the entire insulation crimp area and a portion of the terminal between the core and insulation crimp areas are supported by the anvil. Complete the insulation crimp.
6. Be sure lock tang is lifted to allow proper reseating of the terminal.

7. Pull on the wire to pull the terminal completely into the cavity. A click will be heard and the terminal should stay in place if the wire is pushed.

D. Terminal Crimping Using Alternate Tool J-35123.

1. If a spare wire is used, the wire should be pushed through the proper hole in the strain relief (if used) and the wire seal, and out the other side of the connector prior to stripping.
2. Insert remover tool in front side of connector to release locktab and push terminal out front of connector. Pull the terminal and wire out the front of the connector to complete Steps (3) through (7).
3. Push open the terminal holder on the crimper tool J-35123 and insert a terminal into the opening marked 18-16 (refer to Figure G–12, View C) so that the crimp ends point up. Release the terminal holder.
4. Slightly close the crimping tool (close until one click is heard) but do not start to crimp the terminal. Place the terminal on the wire so it is in the same position as it will be when pulled back into the connector. The terminal should be positioned so that the lock tang is on the side of the cavity which has the notch in the middle (for the remover tool).
5. Insert the wire into the terminal until the wire contacts the holder. By doing this, the core and insulation should be properly positioned for the core and insulation crimp wings.
6. Squeeze the crimper fully until it opens when released.
7. Open the terminal holder and remove the wire and terminal from the crimping tool.
8. Pull on the terminal to assure a tight crimp.
9. Be sure lock tang is lifted to allow proper reseating of the terminal.
10. Pull on the wire to pull the terminal completely into the cavity. A click will be heard and the terminal should stay in place if the wire is pushed.

G–7. DELPHI-PACKARD METRI-PACK 150 SERIES CONNECTORS—PUSH-TO-SEAT (OIL LEVEL SENSOR (OLS))

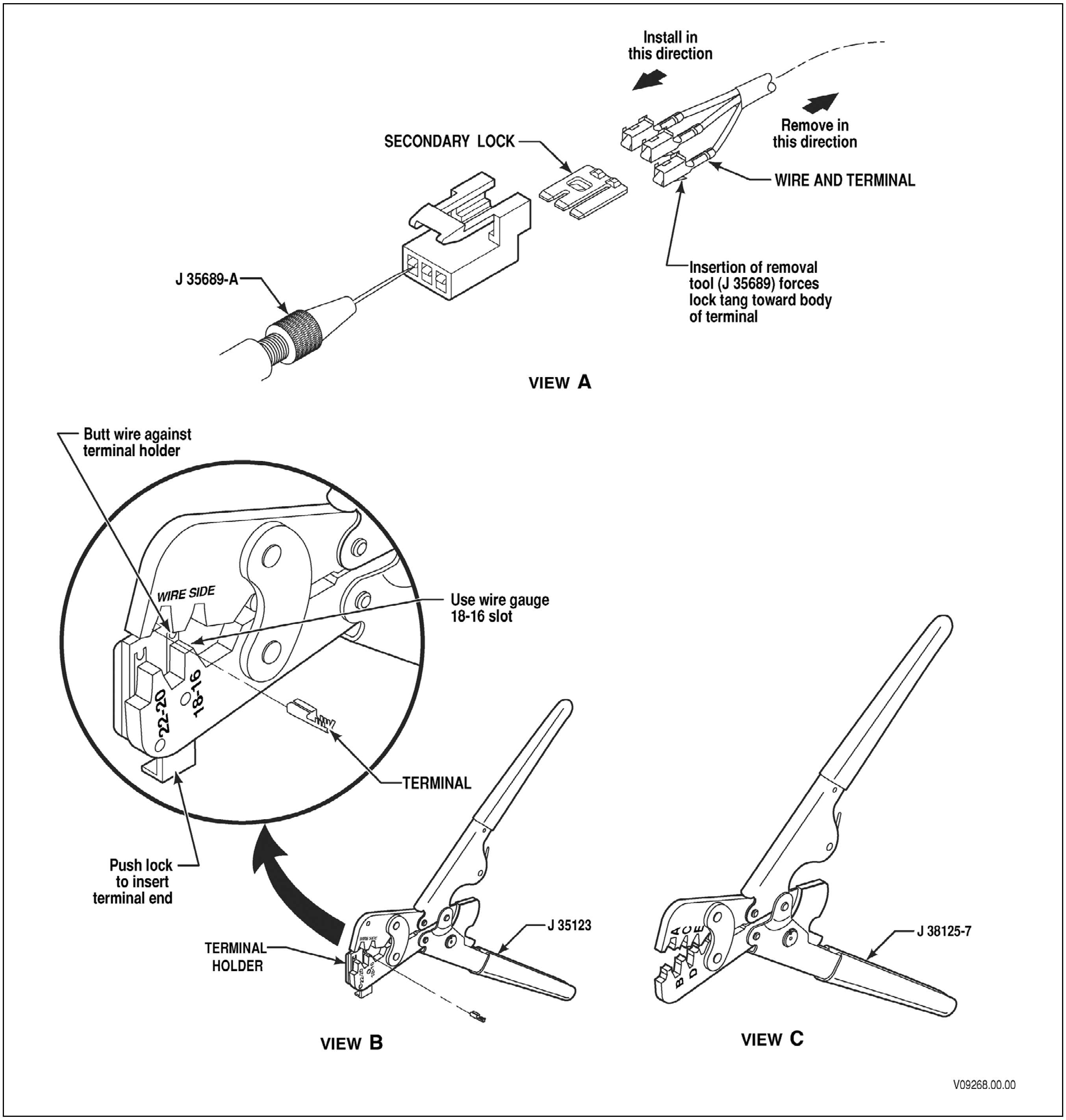


Figure G–13. Delphi-Packard Metri-Pack 150 Series Connectors Push-To-Seat (OLS)

A. Connector/Terminal Tools.

Required Tools

Wire Stripper	J-35615

Required Tools

Crimping Tool	J-38125-7
Wire Crimp	J-38125-7 Anvil “E”
Insulation Crimp	J-38125-7 Anvil “C”
Alternate Crimping Tool	J-35123
Remover Tool	J-35689-A

Use	Description	Manufacturers P/N
Oil Level Sensor (OLS)	3-Pin Plug	12064758
	Terminal (Socket)	12047767
	Secondary Lock, TPA	12047783

B. Terminal Removal.

NOTE: Do not solder crimps.

1. Remove the secondary lock.
2. Insert needle end of terminal remover J-35689-A into the small notch between the connector and the terminal to be removed (Figure G–13, View A). Push the lock tang toward the terminal.
3. Pull the wire and terminal out the rear of the connector—this is a “push-to-seat” terminal.
4. Pull terminal as far as necessary from the connector. This will be limited by the number of other wires inserted into the connector and by the distance between the back side of the connector and the beginning of the harness covering.
5. If terminal is to be replaced, cut the terminal between the core and insulation crimp to minimize wire loss.

C. Terminal Crimping.

1. Carefully strip insulation 4.5 mm ± 0.5 mm (0.18 ± 0.02 inch). Unless insulation crimp is overtight, J-35615 Automatic Wire Stripper will remove insulation and crimp from old terminal without damaging wire.
2. Place core crimp portion of terminal on bed of anvil “E” and squeeze crimper enough to keep terminal from dropping (Figure G–13, View C).
3. Position wire core in terminal and squeeze crimper tool to complete the core crimp. Be sure to orient the terminal so that it is properly aligned with the terminal cavity in the connector. The terminal should be positioned so that the lock tang is on the side of the cavity which has the notch in the middle (for the remover tool).
4. Position insulation crimp of terminal on anvil “C” so that the entire insulation crimp area and a portion of the terminal between the core and insulation crimp areas are supported by the anvil. Complete the insulation crimp.
5. Be sure lock tang is lifted to allow proper reseating of the terminal.
6. Push on the wire until the terminal is completely seated into the cavity. A click will be heard and the terminal should stay in place when the wire is lightly pulled.

D. Terminal Crimping Using Alternate Tool J-35123.

1. Insert remover tool in front side of connector to release locktab and push terminal out front of connector. Pull the terminal and wire out the front of the connector to complete Steps (3) through (7).
2. Push open the terminal holder on the crimper tool J-35123 and insert a terminal into the opening marked 18-16 (Figure G–13, View B) so that the crimp ends point up. Release the terminal holder.
3. Slightly close the crimping tool (close until one click is heard) but do not start to crimp the terminal. Place the terminal on the wire so it is in the same position as it will be when pulled back into the connector. The terminal should be positioned so that the lock tang is on the side of the cavity which has the notch in the middle (for the remover tool).
4. Insert the wire into the terminal until the wire contacts the holder. By doing this, the core and insulation should be properly positioned for the core and insulation crimp wings.
5. Squeeze the crimper fully until it opens when released.
6. Open the terminal holder and remove the wire and terminal from the crimping tool.
7. Pull on the terminal to assure a tight crimp.
8. Be sure the lock tang is lifted to allow proper reseating of the terminal.
9. Push on the wire until the terminal is completely seated into the cavity. A click will be heard and the terminal should stay in place if the wire is lightly pulled.

G–8. DELPHI-PACKARD METRI-PACK 150 SERIES CONNECTOR—PUSH-TO-SEAT (ALL MODELS, SUMP TEMPERATURE THERMISTOR)

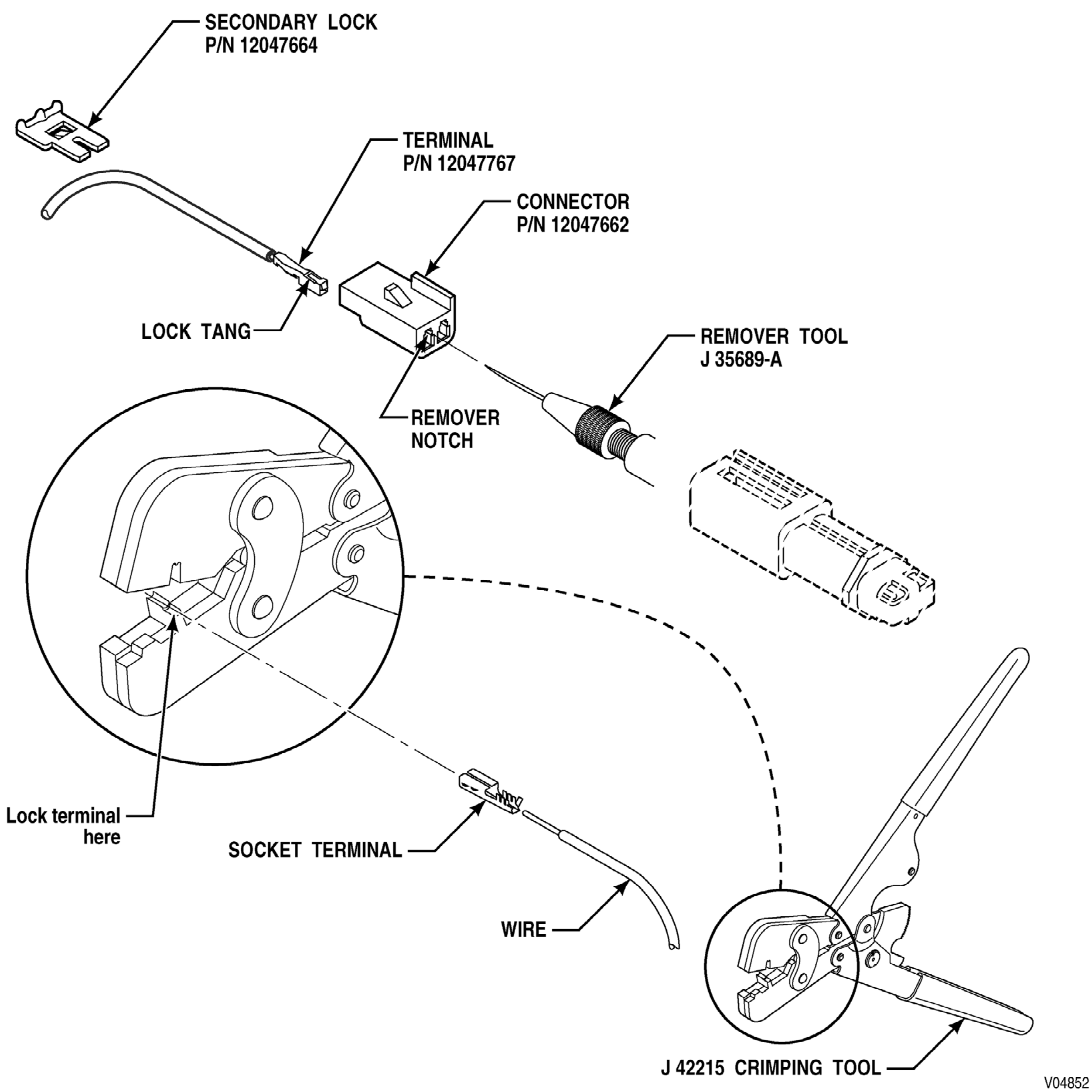


Figure G–14. Delphi-Packard Metri-Pack 150 Series Connector—Push-To-Seat (All Models, Sump Temperature Thermistor)

Appendix G—CONNECTOR PART NUMBERS

A. Connector/Terminal Repairs.

Required Tools

Crimping Tool	J-42215 (with terminal positioner removed)
Remover Tool	J-35689-A

Use	Description	Manufacturers P/N
Sump Temperature Thermistor	Sump Temperature Sensor	P/N 12129691
	Connector, Black	P/N 12047662
	Terminal	P/N 12047767
	Secondary Lock	P/N 12047664

B. Terminal Removal.

1. Remove the secondary lock from the connector.
2. Insert needle end of J-35689-A Remover Tool into the small notch in the front of the connector cavity of the terminal to be removed (refer to Figure G–14).
3. Push the lock tang toward the terminal.
4. Pull the wire and terminal out of the connector.
5. Cut the terminal between the core and insulation crimp to minimize wire loss.

C. Terminal Crimping.

1. Strip insulation approximately 0.18 inch (4.5 mm).
2. Remove the spring-loaded terminal positioner from the J-42215 Crimping Tool.
3. Insert the new terminal to be crimped in the J-42215 Crimping Tool. Squeeze the crimper handles a couple clicks to start the crimping process but leave room to insert the wire end.
4. Insert the bare wire end into the terminal. Squeeze the crimper handles to complete the crimping process and until the crimper handles open when released to remove the terminal/wire from the tool.
5. Be sure the lock tang is positioned to allow proper retention of the terminal in the connector.
6. Push the terminal completely into the cavity. A click will be heard and the terminal should stay in place if the wire is pulled.
7. Install the secondary lock in the connector.

G–9. DELPHI-PACKARD METRI-PACK 280 SERIES CONNECTORS—PULL-TO-SEAT (INTERNAL HARNESS ON/OFF SOLENOID AND PS1 PRESSURE SWITCH)

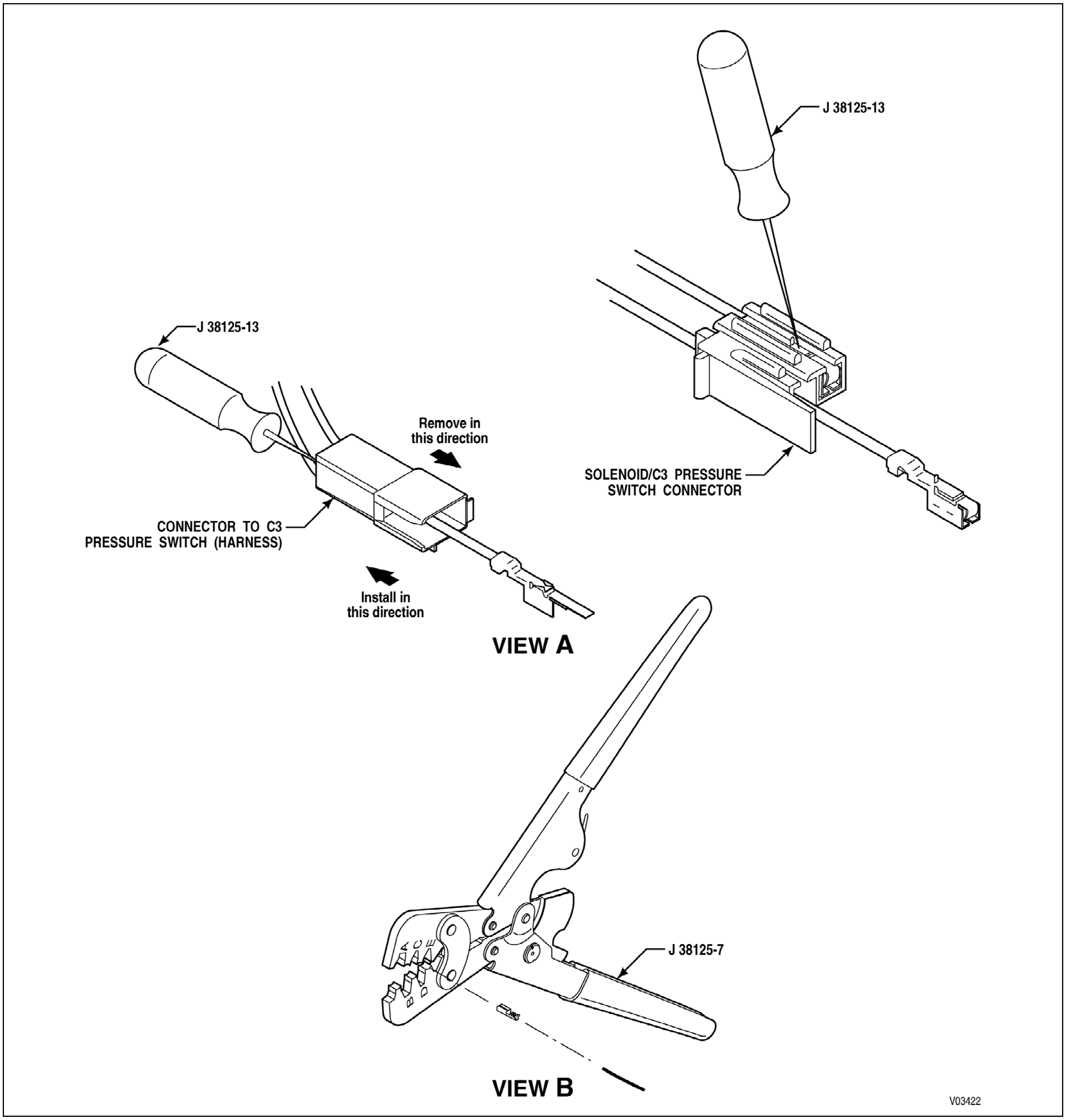


Figure G–15. Delphi-Packard Metri-Pack 280 Series Connectors—Pull-to-Seat (Internal Harness On/Off Solenoid and PS1 Pressure Switch)

A. Connector/Terminal Repairs.

Required Tools

Wire Stripper	J-35615
Crimping Tool	J-38125-7
Remover Tool	J-38125-13

NOTE: Crimping anvils will be listed following the terminal part numbers for the various connectors in this section. The anvil for the core crimp is always listed first.

Use	Description	Manufacturers P/N
Shift Solenoid/PS1 Pressure Switch (Switch)	Connector	P/N 29541590
PS1 Pressure Switch (Harness)	Connector	P/N 12110139
Shift Solenoid/PS1 Pressure Switch (Switch)	Terminal (Use crimping anvils “C” and “D”)	P/N 12124639
PS1 Pressure Switch (Harness)	Terminal (Use crimping anvils “C” and “D”)	P/N 12066337

B. Terminal Removal.

1. Depress locktab on terminal (accessible in slot of connector) and push terminal out front of connector (refer to Figure G–15, View A).
2. If replacing terminal, cut terminal between core and insulation crimp (to minimize wire loss).

C. Terminal Crimping.

1. Carefully strip insulation 6.0 ± 0.25 mm (0.24 ± 0.01 inch). Unless insulation crimp is overtight, J-35615 Automatic Wire Stripper removes insulation and crimp from old terminal without damaging wire.
2. Place core crimp portion of terminal on bed of anvil indicated and squeeze crimper enough to hold terminal from dropping (refer to Figure G–15, View B).
3. Position wire core in terminal and squeeze crimper tool to complete the core crimp. Be sure to orient the terminal so that it is properly aligned with the terminal cavity in the connector.
4. Position insulation crimp of terminal on anvil indicated so that the entire insulation crimp area and a portion of the terminal between the core and insulation crimp areas are supported by the anvil. Complete the insulation crimp.
5. Slip the wire through the slot in the connector and pull to fully seat the terminal(s).

G–10. DELPHI-PACKARD WEATHERPACK CONNECTORS (TPS, 3-WAY RMR SENSOR, 3-WAY RMR DEVICE (DEDICATED PEDAL))

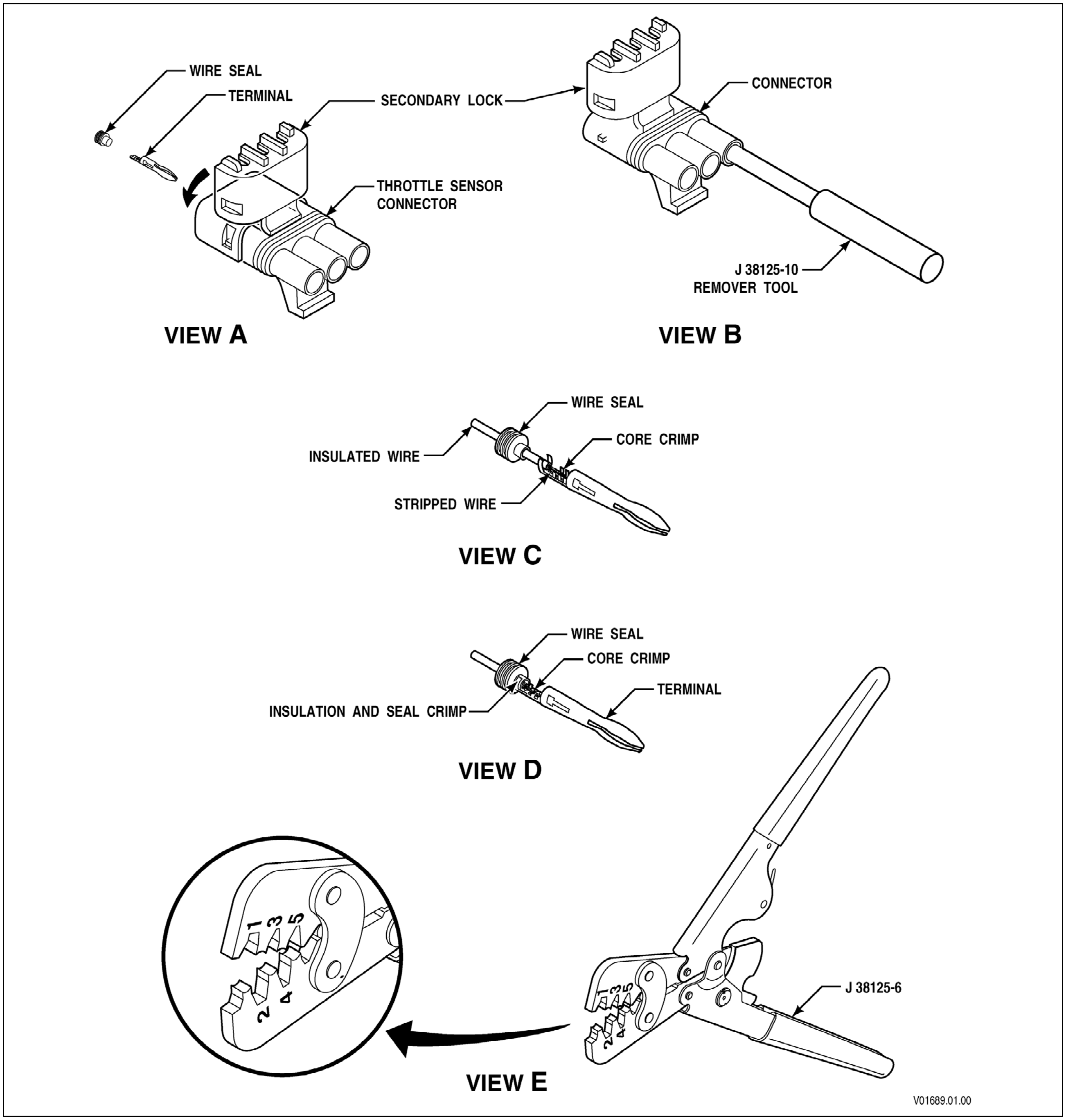


Figure G–16. Delphi-Packard WeatherPack Connectors (TPS, 3-Way RMR Sensor, 3-Way RMR Device (Dedicated Pedal))

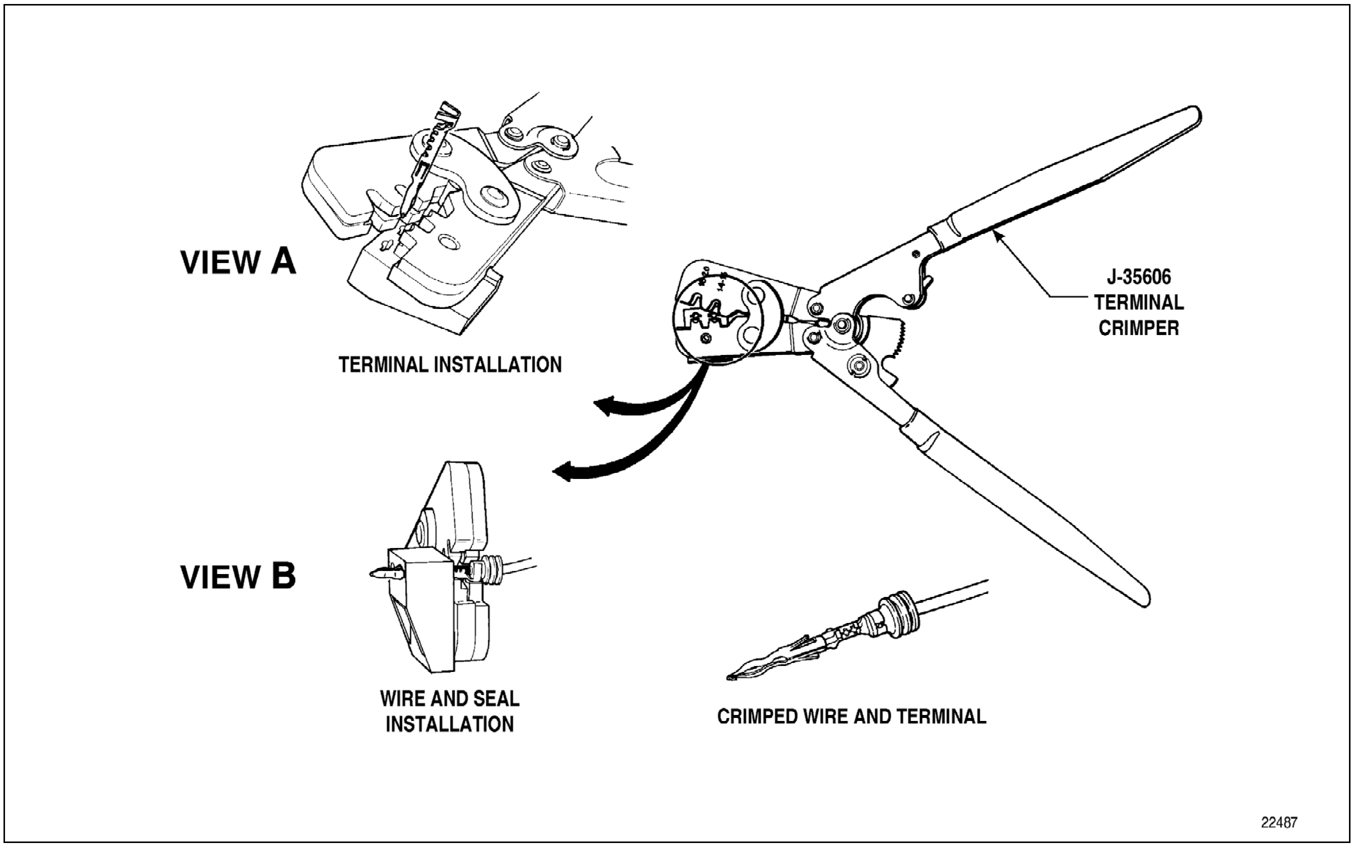


Figure G–17. Terminal Crimping With Tool J-35606

A. Connector/Terminal Repairs.

Table G–1. Connector/Terminal Repairs (Figure G–16)

Required Tools	
Crimping Tool	J-38125-6
Wire Crimp	J-38125-6 Anvil “2”
Insulation Crimp	J-38125-6 Anvil “5”
Alternate Crimping Tool	J-35606 or J-38852
Removal Tool	J-38125-10

Use	Description	Manufacturers P/N
TPS	Connector	P/N 12015793
	Terminal	P/N 12089040
	Wire Seal	P/N 12089444
RMR Device	Connector	P/N 12015795
	Terminal	P/N 12089040
	Wire Seal	P/N 12089444
Retarder Temperature Sensor	Connector	P/N 12010973
	Terminal	P/N 12089188
	Wire Seal	P/N 12089444

B. Terminal Removal.

1. Unlatch and open the secondary lock on the connector (refer to Figure G–16, View A).
2. From the front of the connector, insert J-38125-10 Removal Tool over the terminal. Push the tool over the terminal and pull the terminal out the back of the connector (refer to Figure G–16, View B).
3. If a terminal is to be replaced, cut the terminal between the core and the insulation crimp to minimize wire loss.

NOTE: Two special tools are available for this operation: Tool J-38125-6 (Paragraph C); Tool J-35606 Figure G–17 or J-38852 (Paragraph D).

C. Terminal Crimping Using Crimping Tool J-38125-6.

1. Place the wire seal onto the wire before stripping the wire (refer to Figure G–16, View C).
2. Strip 6.0 ±0.25 mm (0.24 ±0.01 inch) of insulation from the end of the wire.
3. Place the terminal onto crimping tool J-38125-6 Crimping Tool (refer to Figure G–16, View E), Anvil “2.”
4. Slightly close the crimping tool to hold the terminal steady.
5. Insert the wire so that the stripped portion of the wire is in the core crimp area and the insulated portion of the wire is in the insulation crimping area (refer to Figure G–16, View C).
6. Crimp the stripped section of the wire.

7. Remove the terminal from the crimping tool.
8. Push the wire seal onto the terminal (refer to Figure G–16, View D). The second crimp will wrap around the wire seal. This will seal the insulated area of the wire.
9. Use a pair of needle nose pliers, if necessary, to squeeze the terminal wings together to fit in Anvil “5.”
10. Crimp the wire seal in Anvil “5.”
11. Tug on the terminal to be sure the crimp is tight.
12. Insert the terminal into the connector. The terminal will click into place and should not pull out.
13. Secure the secondary lock. Both sides of the connector must be latched.

D. Terminal Crimping Using Alternate Crimper Pliers J-35606 or J-38852.

1. Place the wire seal onto the wire before stripping the wire (refer to Figure G–16, View C).
2. Strip 6.0 ±0.25 mm (0.24 ±0.01 inch) of insulation from the end of the wire.
3. Insert terminal into J-35606 or J-38852 Crimping Tool (refer to Figure G–17, View A), opening marked 18-20.
4. Position the terminal so the crimp wings are pointing up from the bottom jaw of the crimper and are properly positioned.
5. Slightly close the crimping tool to hold the terminal steady.
6. Slide the wire seal to the edge of the insulation and insert the wire and seal into the terminal (refer to Figure G–16, View A and View B).
7. Position the wire and seal and squeeze the crimping tool until it opens when released.
8. Tug on the terminal to be sure the crimp is tight.
9. Insert the terminal into the connector. The terminal will click into place and should not pull out.
10. Secure the secondary lock. Both sides of the connector must be latched.

G–11. AMP PRODUCTS CONNECTORS—8-WAY RMR DEVICE (HAND LEVER)

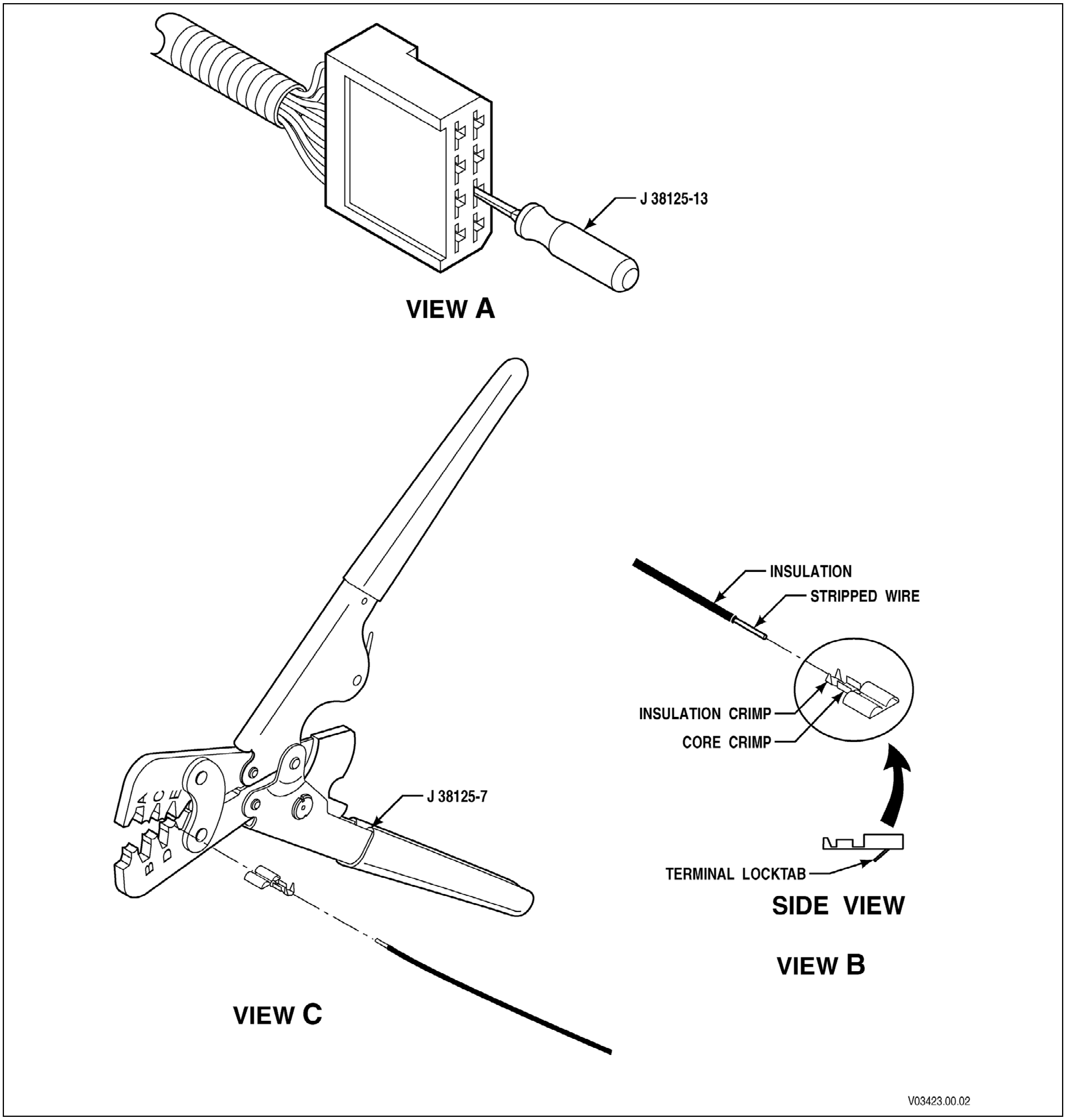


Figure G–18. Amp Products Connectors (8-Way RMR Device (Hand Lever))

A. Connector/Terminal Repairs.

Required Tools	
Crimping Tool	J-38125-7
Wire Crimp	Anvil “E”

Required Tools

Insulation Crimp	Anvil “A”
Remover Tool	J-38125-13

Use	Description	Manufacturers P/N
8-Way RMR Device (Hand Lever	8-Way Receptacle	163007-0
	Terminal (Socket)	42100-2

B. Terminal Removal.

1. Insert J-38125-13 Removal Tool into the small notch at the front of the connector to release the terminal locktab (Figure G–18, View A).
2. Pull the terminal and wire out the back of the connector.
3. If replacing terminal, cut terminal between core and insulation crimp (this minimizes wire loss).

C. Terminal Crimping.

1. Strip wire to approximately 4.0 ± 0.25 mm (0.16 ± 0.01 inch) (Figure G–18, View B).
2. Place new terminal onto J-38125-7, anvil “E” Crimping Tool (Figure G–18, View C).
3. Slightly close the crimping tool to hold the terminal steady.
4. Insert the wire so that the stripped portion of the wire is in the core crimp area and the insulated portion of the wire is in the insulation crimping area.
5. Crimp the stripped section of the wire (Figure G–18, View B).
6. Remove the terminal from the crimping tool.
7. Use a pair of needle nose pliers, if necessary, to start the bend on the insulation crimp wings.
8. Crimp the insulated section of the wire using anvil “A” of the crimpers (Figure G–18, View C).
9. Remove the terminal from the crimping tool.
10. Tug on the terminal to make sure the crimp is tight.
11. Insert the terminal into the connector. The terminal will “click” into place and should not pull out.

G–12. DEUTSCH IPD/ECD CONNECTORS (SAE J1939 DIAGNOSTIC DATA LINK 9-WAY DIAGNOSTIC TOOL CONNECTOR)

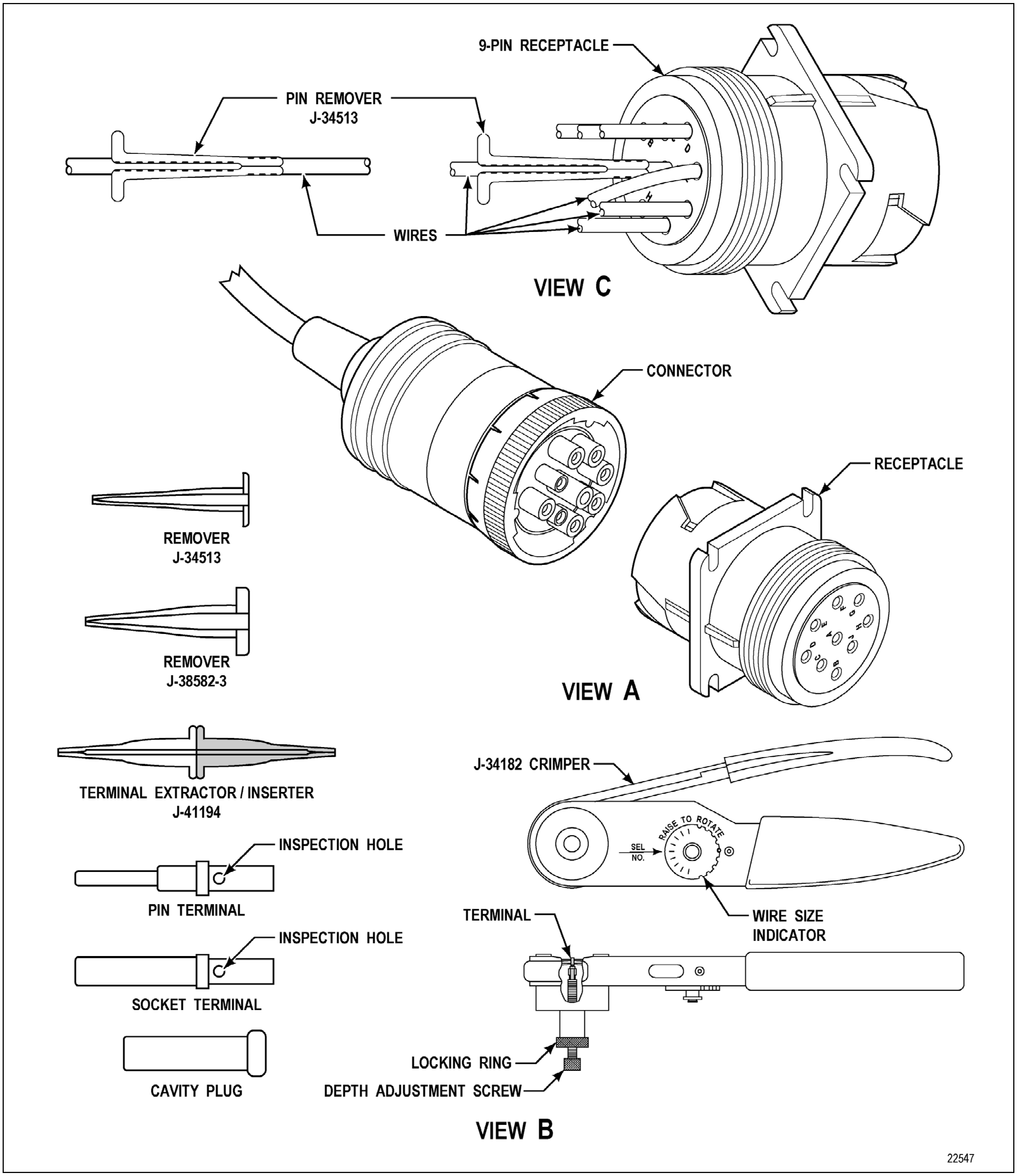


Figure G–19. Deutsch IPD/ECD Connectors (9-Way Optional Diagnostic Tool Connector)

A. Connector/Terminal Repairs.

Required Tools

Crimping Tool	J-34182
Extractor/Inserter Tool	J-41194 (18 GA ECD Bulkhead)
Remover Tool Set	J-34513
Remover Tool (Diagnostic Tool Connector)	J-38582-3 (12-14 GA)

Use	Description	St. Clair P/N	Manufacturers P/N
SAE J1939 Diag Link (9–Way Diagnostic Tool Connector)	Kit, J-1939 9-Way Diagnostic Link Receptacle	P/N 300217	
	Connector, 9–Way	P/N 300267	P/N HD10-9-1939P
	Contact, Pin	P/N 300007	P/N 0460-202-1631
	Contact, Pin Extract	P/N 300273	P/N 0460-247-1631
	Seal Plug	P/N 300000	P/N 114017
	Strain Relief	P/N 300269	P/N HD18
	Cap, Connector	P/N 300268	P/N HDC16-6

NOTE: If difficulty is encountered in removing or installing the plug backshell, insert the plug into the receptacle, do not lock it into place, and loosen the backshell.

B. Terminal Removal (Figure G–19, View A).

NOTE: When using J-41194 Extraction/Inserter Tool, take care not to break the tip of the tool. Lay the wire in the widest part of the wire slot and work toward the tool tip.

1. Loosen and slide the backshell along the convolute conduit.
2. Remove the convolute conduit from the base of the backshell follower. Peel enough conduit from the harness to allow working access.
3. Slide the backshell follower clear of the connector housing.
4. Remove as much tape wrap as necessary to allow working access.
5. Fully insert the proper remover/extractor tool into the back of the connector until it releases the terminal.
6. Pull the terminal, wire, and tool out the back of the connector.
7. If replacing a terminal, cut the wire through the middle of the terminal crimp to minimize wire loss.

C. Terminal Crimping (Figure G–19, View B).

1. Strip approximately 6-8 mm (0.236-0.315 inch) of insulation from the end of the wire.
2. Set the crimping tool wire size to number 12. To set the wire size, remove the retainer pin. Lift and rotate the indicator until the number 12 is aligned with the SEL NO. arrow. Reinstall the retainer pin.

3. Insert the contact end of the terminal into J-34182 Crimping Tool. To adjust the crimping tool depth, loosen the locking ring until the depth adjusting screw is free. Turn the adjusting screw until the top of the terminal is just above flush with the top of the crimping hole (the crimp jaws will contact the middle of the terminal barrel). Tighten the locking ring to retain the adjustment.
4. Fully insert the wire into the terminal so the stripped portion of the wire is in the crimp area. A small section (0.5-1.0 mm (0.02-0.04 inch)) of wire is visible above the terminal barrel.
5. Squeeze the crimping tool handle until it releases. The terminal is now crimped onto the wire.
6. Remove the terminal and wire from the crimping tool.
7. Tug on the terminal to be sure the crimp is tight.
8. Install a 25 mm (1 inch) long piece of heat shrink tubing over the wire insulation just behind the terminal. Apply heat to shrink and lock the tubing to the insulation.

D. Terminal Insertion (ECD Bulkhead).

1. Insert the terminal and attached wire through the proper hole in the grommet.
2. Push on the terminal and wire until the terminal clicks into position. Gently pull on the wire to be sure the terminal is fully seated.

G–13. ITT CANNON CONNECTORS—CRIMPED (BULKHEAD, 6-WAY TRANSFER CASE)

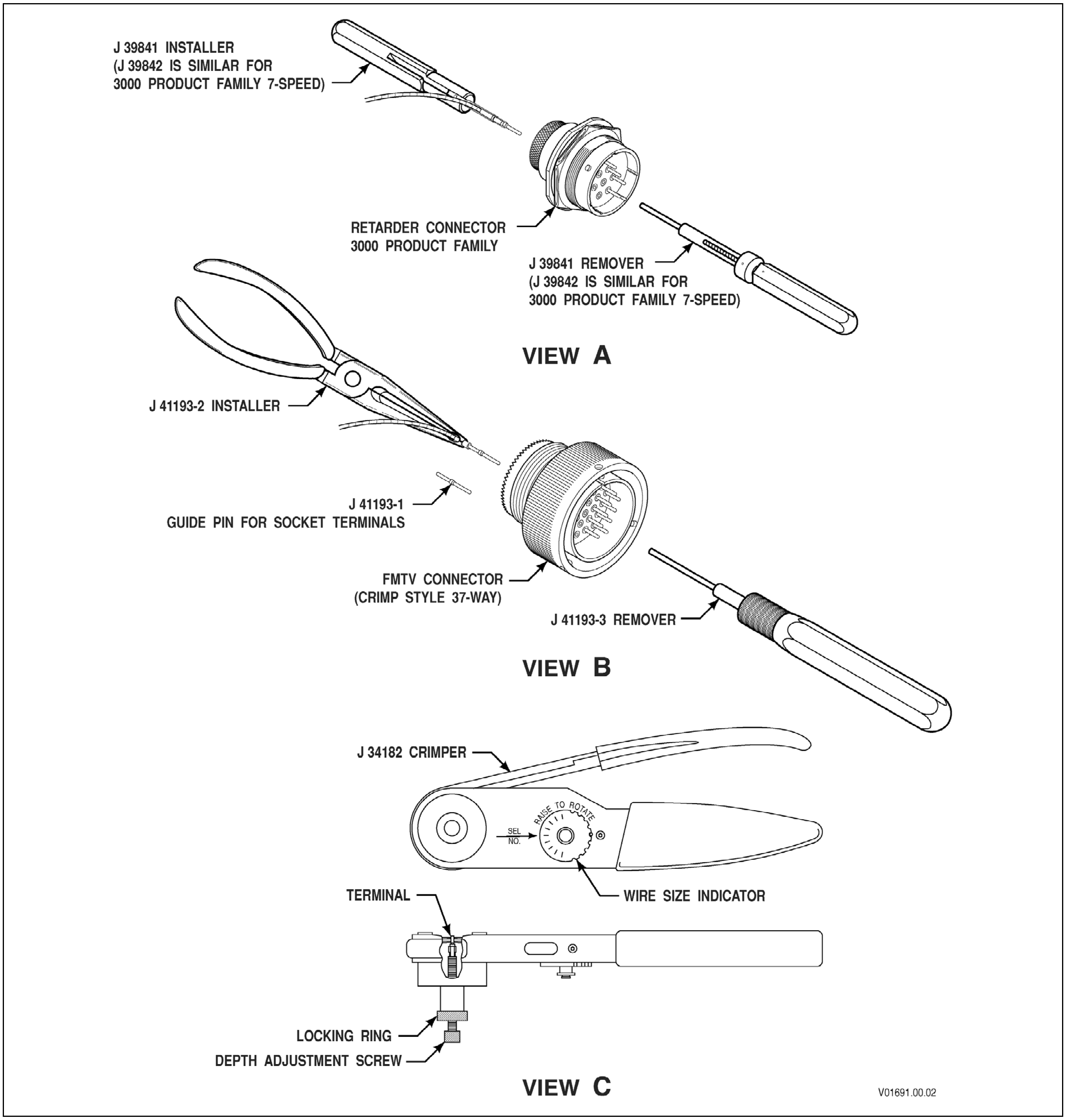


Figure G–20. ITT Cannon Connectors–Crimped (Bulkhead, 6-Way Transfer Case)

A. Connector/Terminal Repairs.

Required Tools

Crimping Tool

Connector Repair Kit (FMTV)	J-34182

Required Tools

Guide Pin	J-41193-1
Insertion Tool	J-41193-2
Terminal Remover	J-41193-3
Terminal Remover/Installer (3000 7-Speed T-Case Connector)	J-39842

Use	Description	Manufacturers P/N
3000 Product Family FMTV	37-Way Plug Assembly	CA3106E28-21P-B
	37-Way Receptacle Assembly	CA3100E28-21S-B
3000 Product Family Transfer Case	6-Way Plug Assembly	KPSE06E10-6S
	Terminal (Socket)	031-9174-004
	Cavity Plug	225-0070-000
	6-Way Receptacle Assembly	KPSE07E10-6P
	Terminal (Pin)	030-9173-006
	Cavity Plug	225-0070-000

B. Terminal Removal (Figure G–20, View A and B).

1. Select the remover tool for the plug or receptacle that is being repaired.
2. For the FMTV connector, choose either the pin or socket terminal remover tip and lock it into the handle.
3. Place the tip of the remover tool over the pin or into the socket and push the contact/terminal out the rear of the connector using slow, even pressure.
4. Pull the wire and terminal out the back of the connector.
5. If replacing the terminal, cut the wire through the middle of the terminal crimp to minimize wire loss.

C. Terminal Crimping (Figure G–20, View C).

1. Strip approximately 6-8 mm (0.24-0.31 inch) of insulation from the wire.
2. Set the crimping tool wire size to number 18. To set the wire size, remove the retainer pin. Lift and rotate the indicator until 18 is aligned with the SEL NO. arrow. Reinstall the retainer pin.
3. Insert the contact end of the terminal down into J-34182 Crimping Tool. Adjust the crimping tool depth by loosening the locking ring until the depth adjusting screw is free and turning the adjusting screw until the wire end of the terminal is just above flush with the top of the crimping hole. The crimp jaws will now contact the middle of the terminal barrel. Tighten the lock ring to retain the adjustment.
4. Fully insert the wire into the terminal so that the stripped portion of the wire is in the crimp area. A small section (0.5-1.0 mm (0.020-0.040 inch)) of wire will be visible above the terminal barrel.
5. Squeeze the crimping tool handle until it releases. The terminal is now crimped onto the wire.
6. Remove the terminal and wire from the crimping tool.
7. Tug on the terminal to ensure the crimp is tight.

D. Terminal Insertion.

1. Select the proper insertion tool for the connector or receptacle that is being reassembled.
2. Place the terminal and wire in the insertion tool (Figure G–20, View A and B).

NOTE: When installing a socket terminal for the FMTV plug, use the J-41193-1 guide pin.

3. Insert the terminal through the correct hole in the back of the connector and push until the terminal is seated. Remove the insertion tool. Check to see that the terminal is at the same height as other terminals. Tug on the wire at the rear of the connector to ensure that the terminal is locked in place.
4. Insert cavity plugs into all unused cavities.

5th GEN 37-WAY ITT-CANNON APD CONNECTOR
(A63 TCM Compatible)

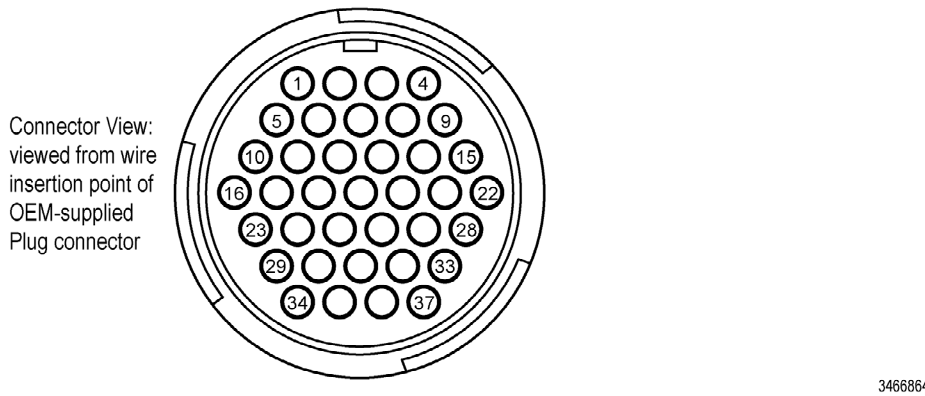


Figure G–21. 37–Way ITT-Cannon APD Connector

Table G–2. 37–Way ITT-Cannon APD Connector

Description	Manufacturer	Part Name	Part Number	Quantity	Remarks
Transmission Companion Harness Connector	ITT-Cannon	Flange Receptacle, 37–Way	248-8653-026	1	
		End Bell	044-8597-000	1	
		Pin Crimp Contact	121668-0267	A/R	Gold Plated
		Wire Seal	121667-0023	A/R	
		Wire Filler	121667-0025	A/R	
		Alignment Disc	052-8509-004	1	
		Dust Cap	ATE Supplied	1	Protection during Transmission transportation
	Harnessflex	Straight Adapter	AB25-PG21	1	For LCT T-Comp Harness P/N 2954221 Only
		90° Adapter	AB25-PG21-90°	1	For all other T-Comp harnesses
Transmission Companion Harness OEM Mating Connector	ITT-Cannon	37–Way Plug	121583-0058	1	
		End Bell	044-8597-000	1	
		Socket Crimp Contact	121668-0268	A/R	Gold Plated
		Wire Seal	121667-0023	A/R	
		Wire Filler	121667-0025	A/R	
	Harnessflex	Straight Adapter	AB25-PG21	1	Choose One- OEM uses different convolute capture solutions that adapt to PG21 thread
		90° Adapter	AB25-PG21-90°	1	Choose One- OEM uses different convolute capture solutions that adapt to PG21 thread
	Schlemmer	SEM PG21/ NW22 sw	3800-21-1	1	Choose One- OEM uses different convolute capture solutions that adapt to PG21 thread

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FAX: 0049 (0) 8121 804 113
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G–14. DEUTSCH DT SERIES CONNECTORS (3-WAY SAE J1939 INTERFACE)

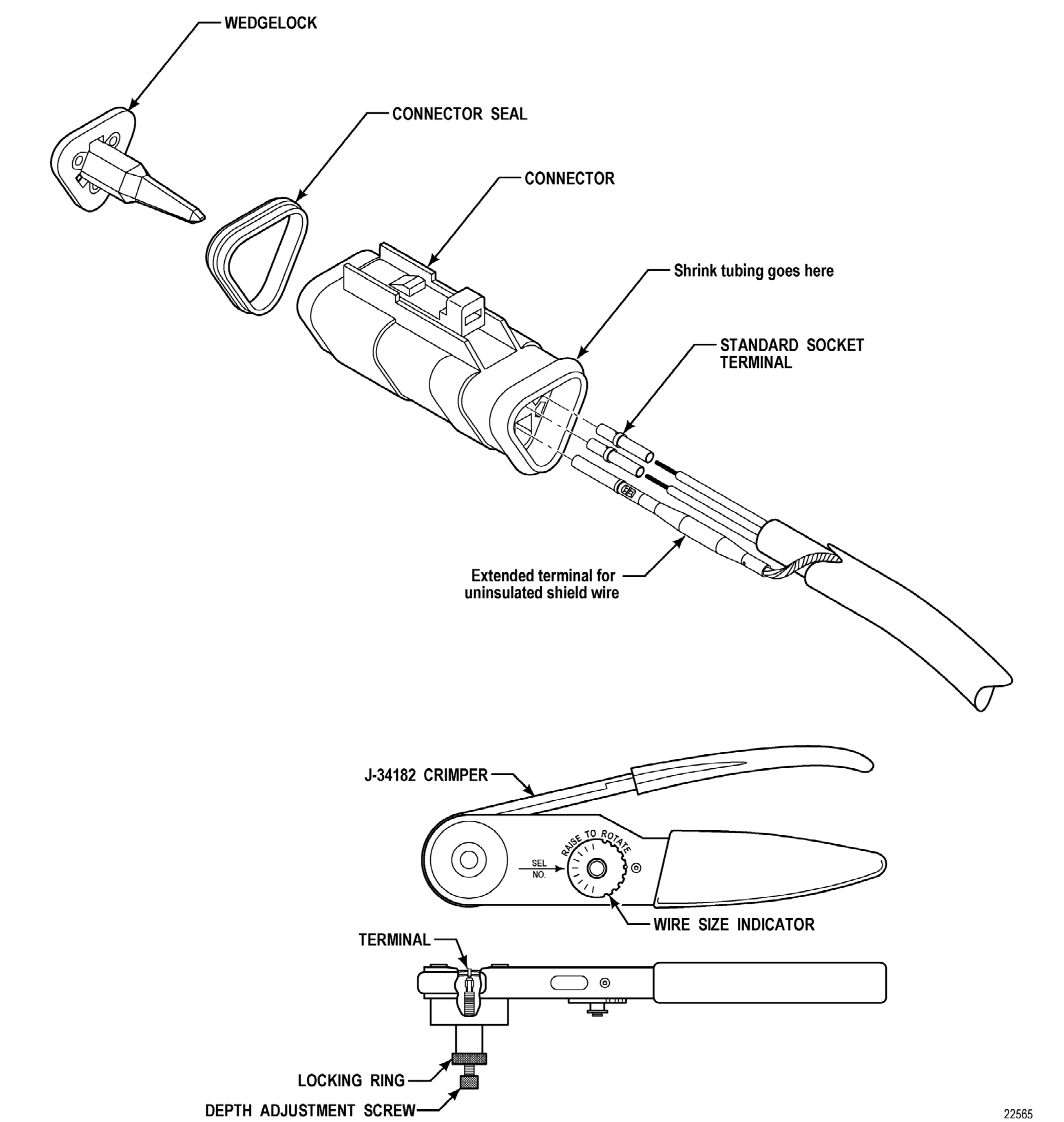

Figure G–22. Deutsch DT Series Connector (3-Way SAE J1939 Interface)

A. Connector/Terminal Repair.

Required Tools

Crimping Tool	J-34182

Use	Description	St. Clair P/N	Manufacturers P/N
SAE J1939 Interface, Plug (Typically on backbone side)	Kit, SAE J1939, 3-way Plug	P/N 300283	
	Connector, Plug, 3-way	P/N 300206	P/N DT06-3S-EP11
	Wedgelock, Plug	P/N 300275	P/N W3S-P012
	Contact, Socket #16	P/N 300005	P/N 0462-201-1631
	Contact, Extended Socket	P/N 300035	P/N 0462-221-1631
	Heat Shrink	P/N 300274	P/N ATUM-3⁄4-0
SAE J1939 Interface, Receptacle (Typically on module side)	Kit, SAE J1939, 3-way Receptacle	P/N 300282	
	Connector, Recpt, 3-way	P/N 300270	P/N DT06-3P-EE01
	Wedgelock, Receptacle	P/N 300271	P/N W3P
	Contact, Pin #16	P/N 300007	P/N 0462-202-1631
	Contact, Extended Pin	P/N 300273	P/N 0462-247-1631
	Heat Shrink	P/N 300274	P/N ATUM-3⁄4-0
	Resistor (optional)	P/N 300272	P/N DT06-3S-P006

B. Terminal Removal (Figure G–22).

1. Use a small-bladed screwdriver to remove the wedgelock that holds the terminals in place.
2. Use a sharp knife to carefully remove the shrink tubing from the rear of the connector plug.
3. Use a small screwdriver to release the locking lever for all of the terminals. Pull the wire and terminal out of the rear of the connector.
4. Slide a new piece of shrink tubing over the removed terminals and onto the cable.
5. If replacing a terminal, cut the wire through the middle of the terminal crimp to minimize wire loss.

C. Terminal Crimping (Figure G–22).

1. Strip approximately 6-8 mm (0.24-0.31 inch) of insulation from the end of the wire. (There is no insulation on the shield wire.)
2. Set the crimping tool wire size to number 18. To set the wire size, remove the retainer pin. Lift and rotate the indicator until the number 18 is aligned with the SEL NO. arrow. Reinstall the retainer pin.
3. Insert the contact end of the terminal down into J-34182 Crimping Tool. To adjust the crimping tool depth, loosen the locking ring until the depth adjusting screw is free. Turn the adjusting screw until the wire end of the terminal is just above flush with the top of the crimping hole. The depth adjustment screw will need to be backed out a large amount to accept the extended shield terminal. The crimp jaws will now contact the middle of the terminal barrel. Tighten the locking ring to retain the adjustment.

4. Fully insert the wire into the terminal so that the stripped portion of the wire is in the crimp area. A small section (0.5-1.0 mm (0.02-0.04 inch)) of wire will be visible above the terminal barrel.
5. Squeeze the crimping tool handle until it releases. The terminal is now crimped onto the wire.
6. Remove the terminal and wire from the crimping tool.
7. Tug on the terminal to be sure the crimp is tight.

D. Terminal Insertion.

1. Slide the wire with crimped terminal attached into the rear of the connector.
2. Push the terminal and wire into the connector until it locks into position (refer to Figure G–22). Check the front of the connector to see that the terminal is at the same height as other terminals. Tug on the wire at the rear of the connector to be sure the terminal is locked in place.
3. Insert the wedge lock to hold the terminals in place. Slide the sealing plug back into place at the rear of the connector.
4. Slide the shrink tubing over the raised area at the rear of the connector. Use a heat gun to shrink the tubing into position over the connector and cable.

G–15. REPAIR OF A BROKEN WIRE WITH IN-LINE BUTT SPLICE

A. Connector Check Before Repair.

NOTE: Before repairing or replacing wiring harness, sensor, solenoid, switch, or TCM as indicated for a diagnosed problem, follow the procedure below:

1. Disconnect the connector or connectors associated with the problem and inspect for:
   - Bent terminals
   - Broken terminals
   - Dirty terminals
   - Pushed back terminals
   - Missing terminals
   - Condition of mating tabs
   - Condition of mating terminals

   Make sure the terminals are secure in the connector. Clean, straighten, or replace parts as required.
2. Reconnect all previous unmated connectors. Ensure connectors are fully inserted or twisted until they lock in place. Connectors with locking tabs make an audible click when the lock is engaged.
3. If the trouble recurs after starting the vehicle, follow the repair procedures for the trouble code or complaint.
4. If the trouble does not recur, or if the appropriate repairs and/or replacements have been made, the problem should be corrected.

B. Special Tools.

- J-25070 Heat Gun or equivalent
- J-38125-8 Crimping Tool for Pre-insulated Crimp (refer to Figure G–23)

NOTE: Use crimping Anvils “F” and “G.”

- J-35615 Wire Strippers
- Splices P/N 23046604 14-16 AWG
- Splices P/N 23046605 18-22 AWG

NOTE: Each splice must be properly crimped and then heated to shrink the covering to protect and insulate the splice. Insulation-piercing splice clips should not be used.

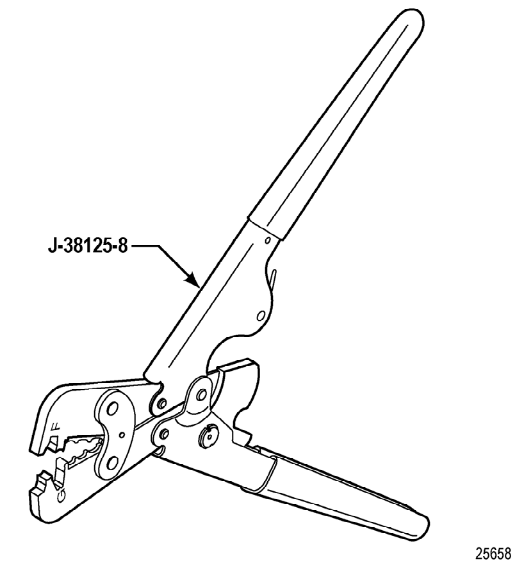

Figure G–23. J-38125-8 Crimping Tool

C. Straight Lead Repair Procedure.

1. Locate the damaged wire.
2. Remove 8.0 mm (0.3 inch) of insulation from the end of each segment of the damaged wire.
3. Insert the stripped end of one wire into the crimp barrel of the splice, and crimp.
4. Insert the stripped and of the other wire into the other end of the crimp barrel, and crimp.
5. Pull on the connection to be sure of crimping integrity.
6. Heat the splice with a heat gun until the covering shrinks and adhesive flows from under the covering.
7. The splice is now sealed and insulated. Electrical tape is not necessary and should not be used.

G–16. AFL AUTOMOTIVE 2-WAY, 90 DEGREE SOLENOID CONNECTOR

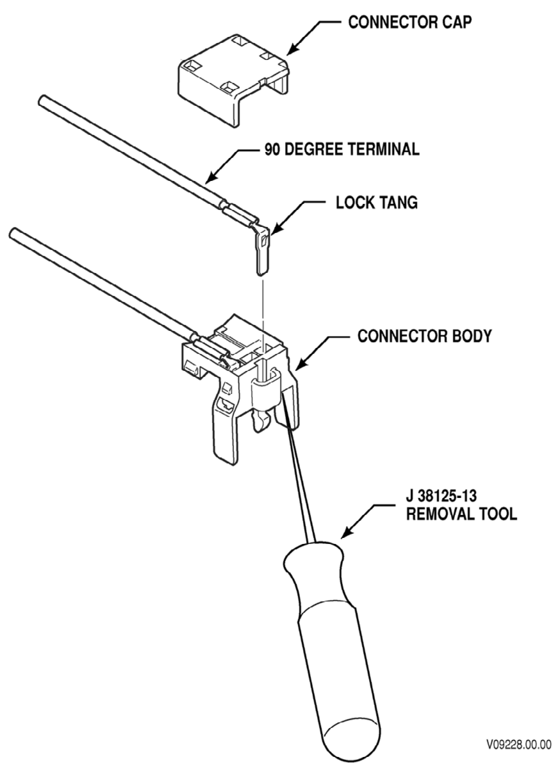

Figure G–24. AFL Automotive 2-Way, 90 Degree Solenoid Connector

A. Connector/Terminal Repairs.

Required Tools	
Crimping Tool	J-38125-8
Terminal Remover	J-38125-13A

Use	Description	Manufacturers P/N
PCS Solenoid Connector	Connector, 2-Way	R-61992-001
	Cap, Connector	R-62189-001
	Terminal with 0.5 m (20 inches) wire	R-61970-001
	In-Line Splice Connector	23046605

Read disassembly process/procedure thoroughly before beginning disassembly.

B. Terminal Removal.

1. Separate the 2-way connector from the solenoid (Figure G–24).
2. Remove the connector cap from the connector body.
3. Make a note for reassembly purposes of which wire (number) goes into which terminal cavity in the connector body.

4. Insert the metal blade of J-38125-13A Terminal Remover into the bottom of the connector where terminal blade protrudes from the connector body.
5. Apply pressure to the terminal blade. Lift selected terminal from connector body when lock tang releases.
6. Repeat steps 4 and 5 for the remaining terminal leads.

C. Terminal Crimping.

Crimping of AFL 2-way, 90 degree terminals is not permitted. Perform repairs using a precrimped, 90 degree terminal and wire assembly. New terminal/wire leads are serviced as follows:

1. Locate damaged wire in terminal wiring harness.
2. Identify a location to cut the damaged wire where the butt splice connector(s) will not interfere with re-assembly and re-installation of the hydraulic control module.
3. Cut wire and strip 8.0 mm (0.3 inch) of insulation from the end. Be careful not to nick or cut wire strands.
4. Insert the stripped end of the wire into the crimp barrel and crimp.
5. Cut the 90 degree terminal and wire assembly to an appropriate length that will allow the crimped wire to securely fit into the plastic channel of the internal wiring harness. Strip 8.0 mm (0.3 inch) of installation from the end of wire, being careful not to nick or cut wire strands.
6. Insert the stripped end of the wire into the other end of the crimp barrel and crimp using J-38125-8 Crimping Tool.
7. Pull on connector to be sure crimp is tight.
8. Heat splice with heat gun until covering shrinks and adhesive flows from under the covering.
9. The splice is now sealed and insulated. Electrical tape **should not be used** and is not necessary.
10. Complete terminal installation of the 2-way connector as follows:
    a. Position proper terminal into the correct location in connector body. Push terminal and wire into connector until it locks in place. Push lightly on the terminal blade to be sure the terminal is seated.
    b. After both terminals have been inserted, install connector cap onto connector body and push lightly on cap until it locks in place.
    c. Reconnect the solenoid connector to the appropriate solenoid.

CONNECTOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
TCM, 80-Way, Bolt Assist	R-61991-001	Spacer, 80F	300243	300276	AFL Automotive	1-PC/TCM			TCM Header
		Seal, Industrial							
		Connector Body, 80F Bolt							
		Bolt							
		Seal, Bolt							
		Retainer, Bolt							
		Grommet, Wire Seal							
	E-4542	Grommet, Retainer	300244						
	E-4550	Cover A, Wire Dress	300245						
	E-4551	Cover B, Wire Dress	300246						
	33001-2004	Terminal	300247		Molex				
	12034413	Plug, Cavity Seal	300008		Delphi				

CONNECTOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
TCM, 80-Way, Bolt-Assist, Dir “A” 90 Degree Wire Dress	R-61991-001	Spacer, 80F	300243	300276	AFL Automotive	1-PC/TCM			TCM Header
		Seal, Industrial							
		Connector Body, 80F Bolt							
		Bolt							
		Seal, Bolt							
		Retainer, Bolt							
		Grommet, Wire Seal							
	E-4542	Grommet, Retainer	300244						
	E-6206-002	Cover, Wire Dress, Dir A							
	E-4555	Cover, Bottom							
	33001-2004	Terminal	300247		Molex				
	12034413	Plug, Cavity Seal	300008		Delphi				

CONNEC-TOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
TCM, 80-Way, Bolt-Assist, Dir “B” 90 Degree Wire Dress	R-61991-001	Spacer, 80F	300243	300276	AFL Automotive	1-PC/TCM			TCM Header
		Seal, Industrial							
		Connector Body, 80F Bolt							
		Bolt							
		Seal, Bolt							
		Retainer, Bolt							
		Grommet, Wire Seal							
	E-4542	Grommet, Retainer	300244						
	E-6206-001	Cover, Wire Dress, Dir B							
	E-4555	Cover, Bottom							
	33001-2004	Terminal	300247		Molex				
	12034413	Plug, Cavity Seal	300008		Delphi				
TCM, 80-Way, Cam-Assist “A” Dir	R-62004-001	Spacer, 80F			AFL Automotive	1-PC/TCM			TCM Header
		Seal, Industrial							
		Connector Body, 80F Bolt							
		Cam, Left							
		Cam, Right							
		Handle, Cam							
		Grommet, Wire Seal							
	E-4542	Grommet, Retainer	300244						
	E-4555	Cover, Bottom							
	E-4588	Cover, Wire Dress							
		CPA							

CONNEC-TOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
TCM, 80-Way, Cam-Assist "B" Dir	R-62004-002	Spacer, 80F			AFL Automotive	1-PC/TCM			TCM Header
		Seal, Industrial							
		Connector Body, 80F Bolt							
		Cam, Left							
		Cam, Right							
		Handle, Cam							
		Grommet, Wire Seal							
	E-4542	Grommet, Retainer	300244						
	E-4555	Cover, Bottom							
	E-4588	Cover, Wire Dress							
		CPA							
TCM, 80-Way, 80W, All	E-4540	Spacer, 80F			St. Clair	1-PC/TCM			TCM Header
	E-4539	Seal, Interfacial							
Bolt Kit, TCM, 80W, All		Bolt	300234	300234	St. Clair	1-PC/TCM			TCM Header
		Seal, Bolt							
		Retainer, Bolt							
Wire Cover Kit, 80W Bolt		Cover A, Wire Dress	300235	300235	St. Clair	1-PC/TCM			TCM Header
		Cover B, Wire Dress							
Wire Cover Kit, 80W Bolt, Dir "A" 90 Degree		Cover, Wire Dress, Dir A	300236	300236	St. Clair	1-PC/TCM			TCM Header
		Cover, Bottom							
Wire Cover Kit, 80W Bolt, Dir "A" Dir		Cover, Wire Dress, Dir A	300237	300237	St. Clair	1-PC/TCM			TCM Header
		Cover, Bottom							

CONNECTOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
Wire Cover Kit, 80W CAM “A” Dir		Cover, Bottom	300238	300238	St. Clair	1-PC/TCM			TCM Header
		Cover, Wire Dress							
		CPA							
Wire Cover Kit, 80W Cam “B” Dir		Cover, Bottom	300239	300239	St. Clair	1-PC/TCM			
		Cover, Wire Dress							
		CPA							
TRANS, 20F, Bolt-Assist	R-62183-001	Spacer, 20F	300252	300278	AFL Automotive	1-PC/TCM	R-62000-001-D	R-62000-001-D	Connector Assy, 20M, Pass-Thru
		Seal, Industrial							
		Connector Body, 20F							
		Bolt							
		Seal, Bolt							
		Retainer, Bolt							
		Grommet, Wire Seal							
	E-4542	Grommet, Retainer	300253						
	E-4555	Cover, Wire Dress	300254						
	E-4588	Clip, Convolute	300251						
TRANS, 20F, Bolt-Assist	E-4564	Spacer, 20F			St. Clair	1-PC/TCM			Connector Assy, 20M, Pass-Thru
	E-4562	Seal, Interfacial							
Bolt Kit, TRANS, 20W		Bolt		300241	St. Clair	1-PC/TCM			Connector Assy, 20M, Pass-Thru
		Seal, Bolt							
		Retainer, Bolt							
Wire Cover Kit, 20W		Cover, Wire Dress		300242	St. Clair	1-PC/TCM			Connector Assy, 20M, Pass-Thru
		Clip, Convolute							

CONNECTOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
NE, NO, NT	15490464	Connector Assy, GT150, Half Shroud	300260	300227	Delphi	1-PC/ COMP			Speed Sensors Engine, Turbine, Output
	15496486	CPA Lock, Beige/Natural	300261						
	15326267	Terminal, F GT150	300262						
	15305351	Seal Assy, Cable 1-Way, Yellow	300263						
	15358890	Convolute Capture/TPA Lock, Black							
TPS	12015793	Connector, 3-Way			Delphi	1-PC/TCM			TCM Header
	12089040	Terminal, Pin							
	12089444	Seal- Wire Type, Silicone							
CAN Shift Sel, 90-Degree	12191065	Connector, 16F	300255	300278	Delphi	1-PC/ COMP			TCM Header
	12191066	Seal, 16-Way Connector, Orange	300256						
	12191067	TPA Retainer, 16F	300257						
	12191068	Strain Relief, 16F 90-Degree	300258						
	12084912	Terminal, 0.8mm Wire	300087						
	12129557	Cavity Plug	300105						
	12177289	CPA Lock M/P, Red	300114						

CONNECTOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
CAN Shift Sel, 180-Degree	12191065	Connector, 16F	300255	300280	Delphi	1-PC/ COMP			TCM Header
	12191066	Seal, 16-Way Connector, Orange	300256						
	12191067	TPA Retainer, 16F	300257						
	15460298	Strain Relief, 16F 180-Degree	300259						
	12084912	Terminal, 0.8mm Wire	300087						
	12129557	Cavity Plug	300105						
	12177289	CPA Lock M/P, Red	300114						
Strip SS	12160280	Conn 20F Mic/P 100W Gray			Delphi	1-PC/ COMP	12160542	12160542	Conn 20M Mic/P 100W Gray
	15304882	Cable Seal, 14F Gray					12110693	12110693	Cable Assist/ Seal, 20M Green
	12160494	Lock, Secondary 20F Green					12191176	12191176	Lock Assist/ Seal, 20M Green
	12084912	Terminal, Socket 100W					12060551	12060551	Terminal, Pin 100W
	12129557	Cavity Plug, 100W					12129557	12129557	Cavity Plug, 100W
	12176394	Conduit Clip, 13mm Black					12176394	12176394	Conduit Clip, 13mm Black

CONNEC-TOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
DTC, 9-Pin	HD10-9-1939P	Connector, Rec., 9-Way	300267	300217	Delphi	1-PC/ COMP			Diagnostic Tool
	0460-202-1631	Contact, Pin	300007						
	0460-247-1631	Contact, Pin Extended	300273						
	114017	Sealing Plug	300000						
	HD18	Strain Relief	300269						
	HDC16-6	Cap, Connector	300268						
SAE J1939	0462-201-1631	Contact, Socket #16	300005	300283	Deutsch IPD	1-PC// COMP	29511369	0460-202-1631	Contact, Pin #18
	0462-221-1631	Contact, Extended Socket	300035					0460-247-1631	Contact, Pin Extended
	23-000-13	Cable, SAE J1939 Data Bus							
	DT06-3S-EP11	Connector, Plug, 3-Way	300206		Deutsch IPD			DT04-3P-EE01	Connector, Rec., 3-Way
	W3S-P012	Wedgelock, Plug (Green)	300275					W3P	Wedgelock, Receptacle
RFT	135133141	Connector Assy, 2F GT150 Half Shroud			Delphi	1-PC/ COMP	29542490	R-62184-001-A	Retarder Solenoid
	15326267	Terminal, F GT150	300262						
	154964863	CPA Lock, Beige/Natural	300261						
	15305351	Seal Assy, Cable 1-Way Yellow	300263						
	15358890	Convolute Capture/TPA Lock, Black	300264						

CONNECTOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
RMR	12015795	Connector, 3-Way			Delphi	1-PC/ COMP	12015092	12015092	Connector, Shroud 3-Way
	12089040	Terminal, Pin					12089188	12089188	Terminal, Socket
	12089444	Seal- Wire Type, Silicone					12089444	12089444	Seal, Wire Type, Silicone
RMRX	12015092	Connector, Shroud 3-Way			Delphi	Resist Mod	12015795	12015795	Connector, 3-Way
	12089188	Terminal, Pin					12089040	12089040	Terminal, Pin
	12089444	Seal- Wire Type, Silicone					12089444	12089444	Seal, Wire Type, Silicone
RTEMP	12162852	Connector, 2F M/P 150.2, Black			Delphi	1-PC/ COMP	12015792	12015792	Retarder Temp Sensor
	12124075	Terminal, F M/P 150.2							
RTDR Air Sol	15326143	Connector Assy, 2F M/P 150.2, Black			Delphi	1-PC/ COMP	12084669		Accumulator Solenoid
	12124075	Terminal, F GT160							
STANDOFF					AFL Automotive	Internal			Control Module
	19134000	Seal, Interfacial			Minnesota				
	12092125	O-ring Seal			Parker Seal				
PCS Sol	R-61992-001	Connector, 2F			AFL Automotive	Internal			PCS Solenoid
	R-62189-001	Cap, Connector							
Connector Assembly, 2M, 90 Sol Kit	29544184	Connector, 2F			Allison Transmission PDC	Internal			PCS Solenoid
		Cap, Connector							
		Terminal with 0.5 meter wire							
		In-line Splice connection							

CONNEC-TOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
SS1 Sol	29541590	Connector, 2W Solenoid			Delphi	Internal			Solenoid SS1
	121246391	Terminal, 280 Series Socket							
SS2 Sol, 7-Speed	29541590	Connector, 2W Solenoid			Delphi	Internal			Solenoid SS2, 7-Speed
	121246391	Terminal, 280 Series Pin							
PS1	12110139	Connector, 2-Way, PS1			Delphi	Internal			Pressure Switch PS1
	12066337	Terminal, 280 Series Pin							
OLS	12064758	3-Pin Plug			Delphi	Internal			Oil Level Sensor
	12047767	Terminal, Socket							
	12047783	Secondary Lock, TPA							
NT1	15490953	Connector, 2-Way			Delphi	Internal			Turbine Speed Sensor (3000)
	12110236	Terminal, 150F							
OILT	12129691	Sump Temp Sensor			Phillips	Internal			Sump Temp Connector
TEMP	12047662	Connector, 2-Way			Delphi	Internal			Sensor, Temperature, Sump
	12047664	Lock, Secondary 20F Green							
	12047767	Terminal, Socket							

CONNEC-TOR	MFG. P/N	PART NAME	SCT P/N	SCT Kit #	MFR	CONFIG	MATING P/N	MFG. P/N	MATING PART NAME
VIM, 18 Way	12040920	Connector Body, 18-Way			Delphi	1-PC/ COMP			VIM Header Assy
	12040936	Seal, 15-Way							
	12110545	Strain Relief, 308-Way							
	12129426	Bolt, 7mm Head Ext.							
	12034236	Retainer Clip, Bolt							
	12103881	Terminal, 150F							
	12034413	Cavity Plug, Metri-pack							
VIM, 30-Way	12034397	Connector Body, 30-Way			Delphi	1-PC/ COMP			VIM Header Assy
	12040879	Seal, 9-Way							
	12110546	Strain Relief, 18-Way							
	12129426	Bolt, 7mm Head Ext.							
	12034236	Retainer Clip, Bolt							
	12103881	Terminal, 150F							
	12034413	Cavity Plug, Metri-pack							
XFER	KPSE06E10-6S	Connector Assy, Metri-Pack			ITT Cannon	1-PC/ COMP		KPSE07E10–6P	Transfer Case

Appendix H—TRANSMISSION STALL TEST

H–1. TRANSMISSION STALL TEST

A. **Purpose.** Stall testing is performed to determine if a vehicle performance complaint is due to an engine or transmission malfunction. Stall testing is a troubleshooting procedure only—never perform a stall test as a general check or during routine maintenance.

Transmission stall speed is the maximum engine rpm attainable when the engine is at full throttle and the torque converter turbine is not moving, or “stalled.” After a transmission stall test, compare the actual full throttle engine speed at torque converter turbine stall with specifications established by the vehicle manufacturer.

NOTE: Engine speed data can be obtained from the engine manufacturer or from the equipment dealer or distributor. Some engine manufacturers provide a programmable parameter to limit engine speed when the transmission output speed is 0 rpm, such as at a stop. This parameter should be set to a higher value than the expected transmission stall speed before performing the stall test.

B. **Stall Testing Preparation.** If a transmission stall test is to be performed, make sure the following preparations have been made before conducting the transmission stall test:

1. The manufacturer concurs with performing a full-throttle transmission stall test.
2. The engine programmable parameter for 0 rpm transmission output speed is set higher than the value expected at transmission stall speed.
3. The vehicle is in an area in which a transmission stall test can be safely performed.
4. Make sure the fuel control linkage goes to full throttle and does not stick when released.
5. Make sure the engine air induction system and exhaust system have no restrictions.
6. Perform a cold check of the transmission fluid level and adjust as necessary.
7. Connect Allison DOC® to the vehicle diagnostic data connector.
8. Install a temperature gauge with the probe in the transmission converter-out (to cooler) line. Allison DOC® displays sump temperature only.
9. Install wheel chocks.
10. A driver is in the driver's position.
11. The vehicle's brakes are fully locked.

WARNING: To help avoid personal injury, such as burns, from hot transmission fluid and/or to help avoid equipment damage, do not stall the torque converter for more than ten seconds maximum and monitor transmission fluid temperature. Immediately return the engine to idle if converter out (to cooler) temperature exceeds 150°C (300°F). Operating the transmission at high engine power at transmission stall or near stall conditions causes a rapid rise in the transmission fluid temperature. The fluid in the transmission torque converter is absorbing all of the engine power and the vehicle cooling system cannot dissipate the excessive heat load. Extended operation under high heat load conditions causes transmission and cooling system damage, and can lead to hydraulic line failure and high temperature fluid leakage.

WARNING: To help avoid personal injury and equipment damage while conducting a transmission stall test, the vehicle must be prevented from moving. Apply the parking brake, the service brake, and chock the wheels securely. Warn personnel to keep clear of the vehicle and its travel path.

C. Performing a Transmission Stall Test.

1. Start the engine. While in **N** (Neutral) allow the transmission to warm to normal operating temperature:
   - Sump temperature 71–93°C (160–200°F)
   - Converter out temperature 82–104°C (180–220°F)
2. Perform a hot check of the transmission fluid level and adjust as necessary.
3. Turn all engine accessories **OFF**.
4. To place Allison DOC® in clutch test mode, select **D** (Drive) on the shift selector, then select **4** (Fourth Range) on the Range Panel.

CAUTION: To help avoid transmission or driveline damage, full throttle stall tests **must not be performed** in **R** (Reverse) range, all models, or low ranges, 7-speed models.

5. Notify personnel in the area to keep clear of the vehicle.
6. Slowly increase engine rpm until engine speed stabilizes.
7. Record engine speed.

CAUTION: The transmission stall test procedure causes a rapid rise in transmission fluid temperature that can damage the transmission. **Never** maintain a stall condition once engine speed stabilizes or converter out (to cooler) temperature exceeds 150°C (300°F). During a stall condition, converter out temperature rises much faster than the internal (sump) temperature. **Never** use sump fluid temperature to determine the length of the stall condition. If the stall test is repeated, **do not let** the engine overheat.

8. Record converter out (to cooler) temperature.
9. Reduce the engine speed to idle and shift the transmission to **N** (Neutral).
10. Raise engine speed to 1200–1500 rpm for 2 minutes to cool transmission fluid.
11. At the end of two minutes, record converter out (to cooler) temperature.
12. Proceed to G. Neutral Cool-Down Check Procedure.

D. Driving Transmission Stall Test.

NOTE: If the vehicle's engine acceleration at a stop is controlled or limited, the following stall test procedure can be used.

WARNING: To help avoid personal injury and/or equipment damage, a driving transmission stall test **MUST BE PERFORMED** by a trained driver and a qualified technician.

E. Driving Transmission Stall Test Preparation.

If a driving transmission stall test is to be performed, make sure the following preparations have been made before conducting the test.

1. The manufacturer concurs with performing a full-throttle transmission stall test.
2. The engine programmable parameter for 0 rpm transmission output speed is set higher than the value expected at transmission stall speed.
3. The vehicle is in an area in which the transmission stall test can be safely performed.
4. Make sure the fuel control linkage goes to full throttle and does not stick when released.
5. Inspect the engine air induction system and exhaust system to make sure there are no restrictions.
6. Perform a cold check of the transmission fluid level and adjust as necessary.
7. Connect Allison DOC® to the vehicle diagnostic data connector.
8. Install an accurate tachometer (do not rely on the vehicle tachometer).
9. Install a temperature gauge with the probe in the transmission converter-out (to cooler) hose. Allison DOC® displays sump temperature only.

F. Performing A Driving Transmission Stall Test.

CAUTION: The transmission stall test procedure causes a rapid rise in transmission fluid temperature that can damage the transmission. **Never** maintain a stall condition once engine speed stabilizes or converter out (to cooler) temperature exceeds 150°C (300°F). During a stall condition, converter out temperature rises much faster than the internal (sump) temperature. **Never** use sump fluid temperature to determine the length of the stall condition. If the stall test is repeated, **do not let** the engine overheat.

1. Start the engine. While in **N** (Neutral) allow the transmission to warm normal operating temperature:
   - Sump temperature 71–93°C (160–200°F)
   - Converter out temperature 82–104°C (180–220°F)
2. Perform a hot check of the transmission fluid level and adjust as necessary.
3. Turn all engine accessories **OFF**.
4. While located in an isolated area, begin the driving transmission stall test.
5. Select a hold range that will limit road speed (usually 2nd range or 3rd range). Never perform a driving stall test in **R** (Reverse) or Low range (7-speed models).
6. Operate the engine at 100 percent full throttle, maximum governed speed.
7. With the engine at maximum governed speed, begin gradually applying the vehicle service breaks while maintaining 100 percent full throttle. When the vehicle comes to a complete stop, record engine speed.
8. Record converter out (to cooler) temperature.
9. Reduce the engine speed to idle and shift the transmission to **N** (Neutral).
10. Raise engine speed to 1200–1500 rpm for 2 minutes to cool transmission fluid.
11. At the end of two minutes, record converter out (to cooler) temperature.

12. Proceed to G. Neutral Cool-Down Check Procedure.

G. Neutral Cool-Down Check Procedure.

1. At the end of two minutes the converter out (to cooler) fluid temperature should return to within normal operating temperature range.
2. If the transmission fluid does not cool within two minutes, the cause could be a stuck torque converter stator or an issue with the transmission cooler, lines or fittings.

H. Transmission Stall Test Results.

NOTE: Environmental conditions, such as ambient temperature, altitude, engine accessory loss variations, etc., affect the power input to the converter. Due to such conditions, stall speed can vary from specification by ±150 rpm and still be accepted as within published stall speed.

- If engine speed with the transmission stalled is more than 150 rpm below the stall speed specification, an engine issue is indicated.
- If engine stall speed is more than 150 rpm above specification, a transmission issue is indicated.
- Conditions that can exist to cause stall speed to 150 rpm above specification could be:
  - Transmission fluid cavitation or aeration. Verify proper fluid level using the oil level sensor, if equipped or dipstick.
  - Slipping clutch.
  - Torque converter malfunction.
  - Sticking or damaged torque converter valve.
- A low stall speed (at least 33 percent lower than published stall speed) could indicate an engine issue or a freewheeling stator in the torque converter.

Appendix I—ENGINE/TRANSMISSION ADAPTATION REQUIREMENTS

I–1. ENGINE/TRANSMISSION ADAPTATION REQUIREMENTS

A. Adaptation Requirements Checksheet.

Transmission performance may be adversely affected by improper tolerances existing between engine-to-transmission mating components. Vibration, converter section oil leaks, a worn front bushing or bearing, and/or a worn engine crankshaft thrust bearing are frequently the result of exceeding recommended tolerances in engine-to-transmission mating components. When these conditions are encountered, check certain important measurements before installing a repaired or new transmission. These measurements are summarized and detailed below. Figure I–1, Adaptation Requirements Checksheet, specifies the tolerance by transmission model.

RO Number ________________ **Technician Name/Number** ______________________________

THE ADAPTATION REQUIREMENTS CHECKSHEET

	H 40/50 EP™	1000/2000 Series SAE No. 2 Housing	1000/2000 Series SAE No. 3 Housing	3000 Series	TC10 4000 Series	Ref. Fig.	Record Reading
FLYWHEEL HOUSING: BORE DIAMETER	17.625 $^{+0.005}_{-0.000}$ in. (447.68 $^{+0.13}_{-0.00}$ mm)	17.625 $^{+0.005}_{-0.000}$ in. (447.68 $^{+0.13}_{-0.00}$ mm)	16.125 $^{+0.005}_{-0.000}$ in. (409.58 $^{+0.13}_{-0.00}$ mm)	17.625 $^{+0.005}_{-0.000}$ in. (447.68 $^{+0.13}_{-0.00}$ mm)	20.125 $^{+0.005}_{-0.000}$ in. (511.18 $^{+0.13}_{-0.00}$ mm)	2	________
BORE ECCENTRICITY (Limits are for installed engines.)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	3	________
FACE SQUARENESS (Limits are for installed engines.)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	4	________
CRANKSHAFT HUB AND/OR ADAPTOR:							
CONVERTER PILOT DIAMETER	2.006-2.008 in. (50.94-50.99 mm)	1.703-1.705 in. (43.26-43.31 mm)	1.703-1.705 in. (43.26-43.31 mm)	2.006-2.008 in. (50.94-50.99 mm)	2.006-2.008 in. (50.94-50.99 mm)	5 & 6	________
FACE SQUARENESS (T.I.R. per inch of diameter or T.I.R. per 25 mm of diameter)	0.005 in. (0.13 mm)	0.005 in. (0.13 mm)	0.005 in. (0.13 mm)	0.005 in. (0.13 mm)	0.005 in. (0.13 mm)	7	________
PILOT ECCENTRICITY (With respect to crankshaft center of rotation)	0.005 in. T.I.R. (0.13 mm)	0.010 in. T.I.R. (0.25 mm)	0.010 in. T.I.R. (0.25 mm)	0.005 in. T.I.R. (0.13 mm)	0.005 in. T.I.R. (0.13 mm)	8	________
FLEXPLATE:							
CHECK FOR RADIAL CRACKS	For all models						
CHECK FOR ELONGATED MOUNTING HOLES	For all models						
CHECK FOR ANY SIGNS OF DISTRESS OR WEAR	For all models						
MOUNTED FLEXPLATE:							
INPUT DAMPER AXIIAL LOCATION (AED™)	1.98-2.09 in. (50.36-53.06 mm)	N/A	N/A	N/A	N/A		
CONVERTER AXIAL LOCATION (EXCEPT AED™)	N/A	1.201-1.361 in. (30.50-34.56 mm)	1.581-1.741 in. (40.15-44.21 mm)	1.943-1.983 in. (49.36-50.38 mm)	1.732-1.842 in. (44.0-46.8 mm)	10	________
FLATNESS (Area adjacent to each converter mounting hole)	N/A	0.030 in. T.I.R. (0.076 mm)*	0.030 in. T.I.R. (0.076 mm)*	N/A	N/A	9	________

* When measured at 11.5 inch (292 mm) diameter.

NOTE: This form is to be completed and retained with the Repair Order records when performing Allison Transmission Warrenty, ETC or Policy repairs.

2769531

Figure I–1. Adaptation Requirements Checksheet

B. Measuring Equipment.

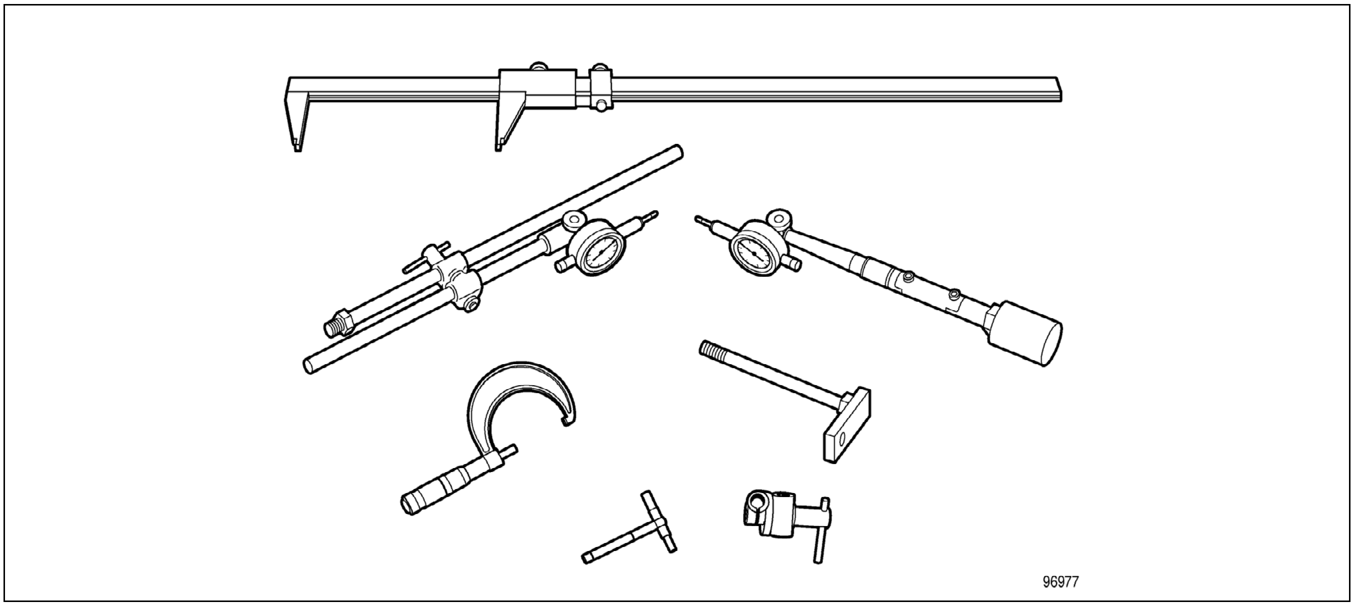

Figure I–2. Typical Set Of Tools Used To Determine The Adaptation Requirements Of An Automatic Transmission

C. Flywheel Housing Pilot Bore Diameter.

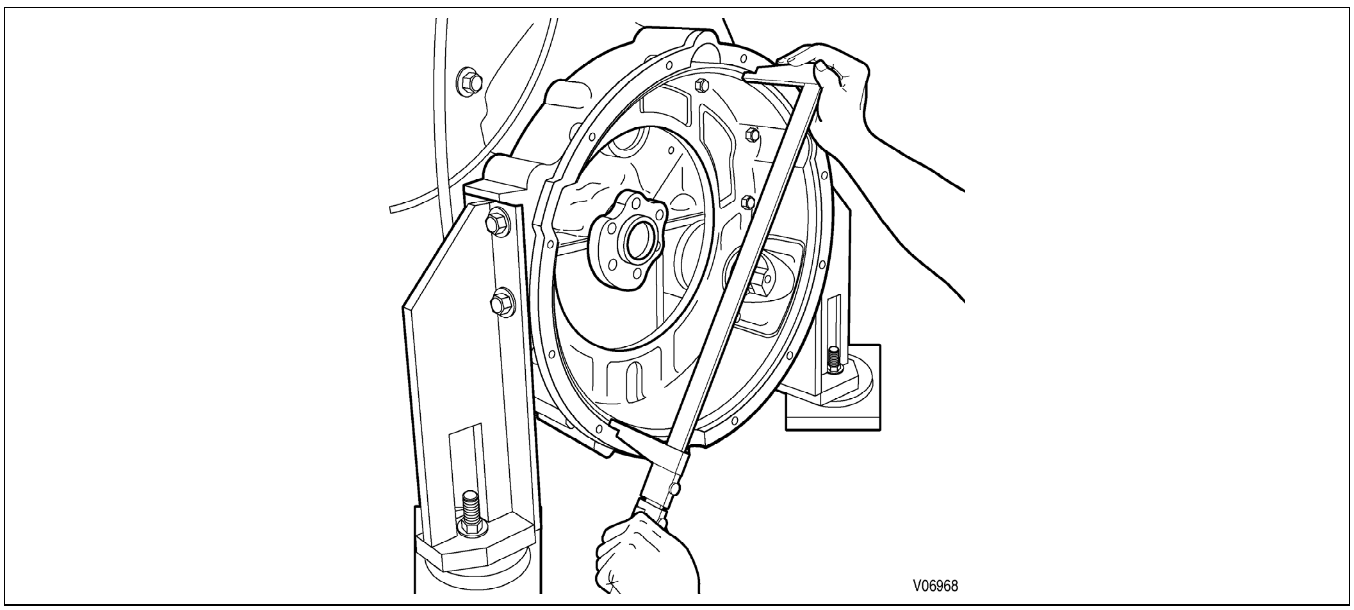

Figure I–3. Measuring Flywheel Housing Bore Diameter — Inside Caliper Method

D. Flywheel Housing Bore Runout.

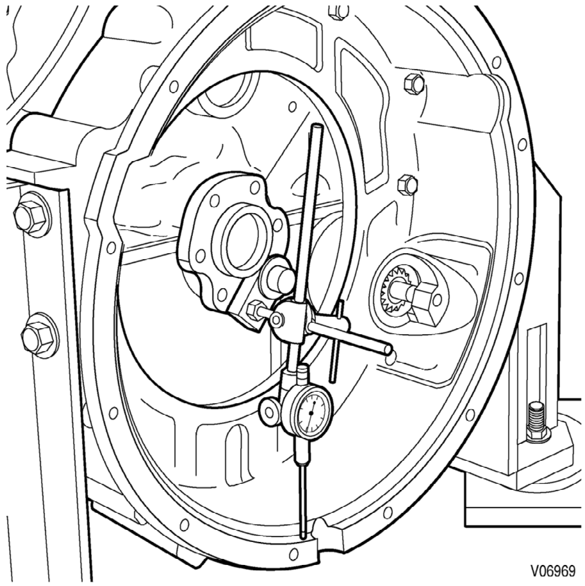

Figure I–4. Measuring Flywheel Housing Bore Eccentricity Of The Flywheel Housing Bore

Refer to Figure I–4 and measure the flywheel housing bore using a dial indicator as follows:

- Securely fasten the base of the dial indicator support extension to the crankshaft hub.
- Rotate the crankshaft so the dial indicator sweeps the entire flywheel housing bore.
- Record the maximum and minimum readings. The difference in these readings should not be greater than the tolerances specified in Figure I–1.

E. Flywheel Housing Face Squareness.

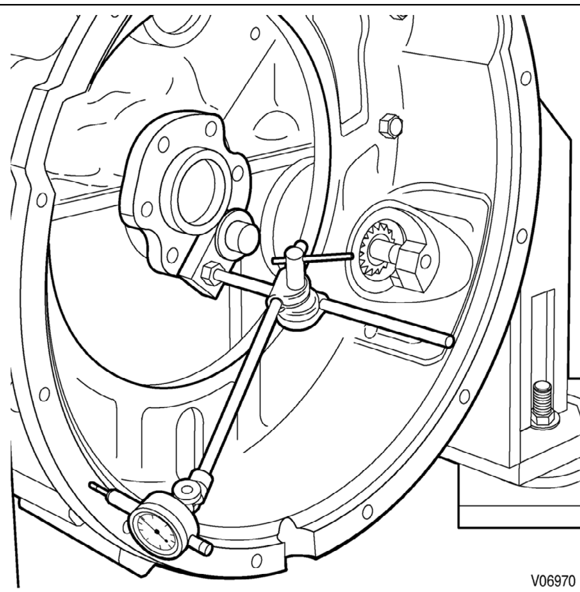

Figure I–5. Measuring Flywheel Housing Face Squareness

Refer to Figure I–5 and measure the squareness of the flywheel housing face using a dial indicator as follows:

- Securely fasten the dial indicator to the crankshaft hub.
- While pressing the crankshaft rearward to remove all crankshaft end play, rotate the crankshaft so the dial indicator sweeps the entire surface of the flywheel housing face.
- Record the maximum and minimum readings. The difference in these two readings should not be greater than the tolerance specified in Figure I–1.

F. Crankshaft Hub Pilot or Adapter Diameter.

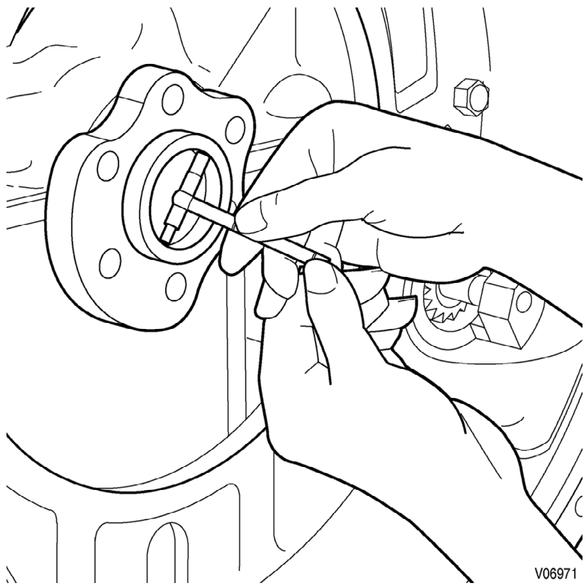

Figure I–6. Measuring Converter Hub Pilot Diameter - Inside Micrometer Method

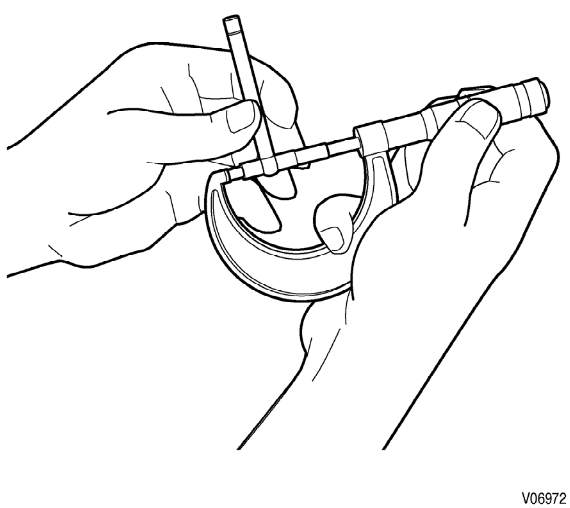

Figure I–7. Measuring Converter Hub Pilot Diameter - Inside Micrometer Method

G. Crankshaft Hub or Adapter Squareness.

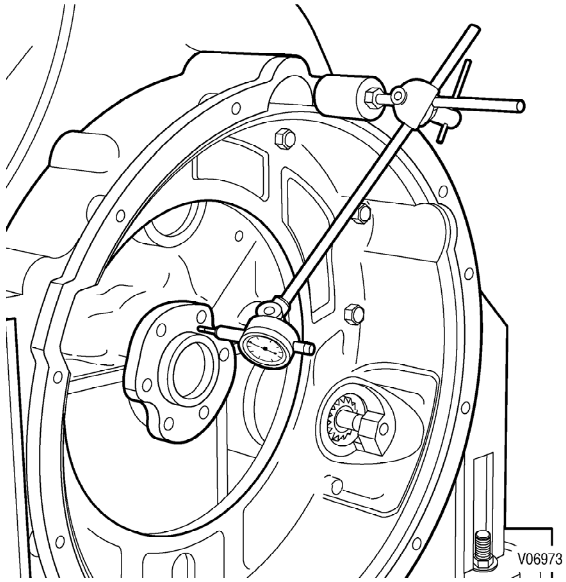

Figure I–8. Measuring Crankshaft Hub Face Squareness

Refer to Figure I–8 and measure the squareness of the crankshaft hub face as follows:

- Securely fasten the base of the dial indicator to the flywheel housing and adjust the indicator to measure the outer edge of the crankshaft hub face.
- While pressing the crankshaft rearward to remove all crankshaft end play, rotate the crankshaft so the dial indicator sweeps the entire diameter of the crankshaft hub face.
- Record the maximum and minimum readings. The difference in these two readings should not be greater than the tolerance specified in Figure I–1.

NOTE: This tolerance is given as Total Indicator Runout (TIR) per inch of diameter or TIR per 25 mm (0.98 inch) of diameter. Multiply the tolerance from the checksheet by the diameter at which the reading is taken.

H. Crankshaft Hub or Adapter Eccentricity.

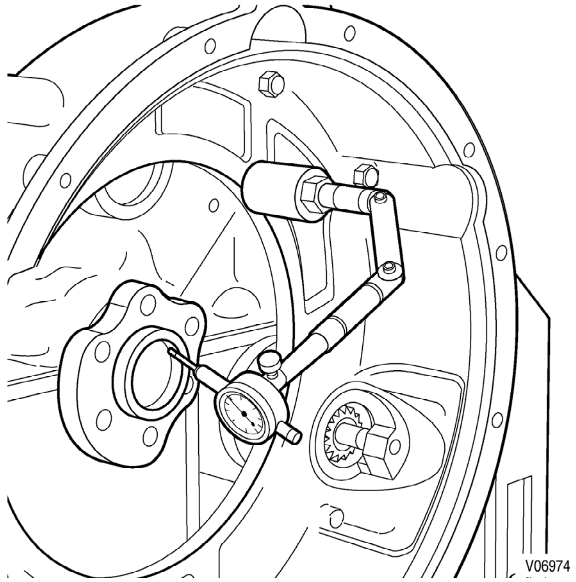

Figure I–9. Measuring Crankshaft Hub Eccentricity

Refer to Figure I–9 and measure the crankshaft hub eccentricity as follows:

- With the dial indicator fastened to the flywheel housing, rotate the crankshaft so the indicator sweeps the entire inside diameter of the crankshaft hub.
- Note the maximum and minimum readings. The difference of these readings should not be greater than the tolerance specified in Figure I–1.

I. Flexplate Flatness.

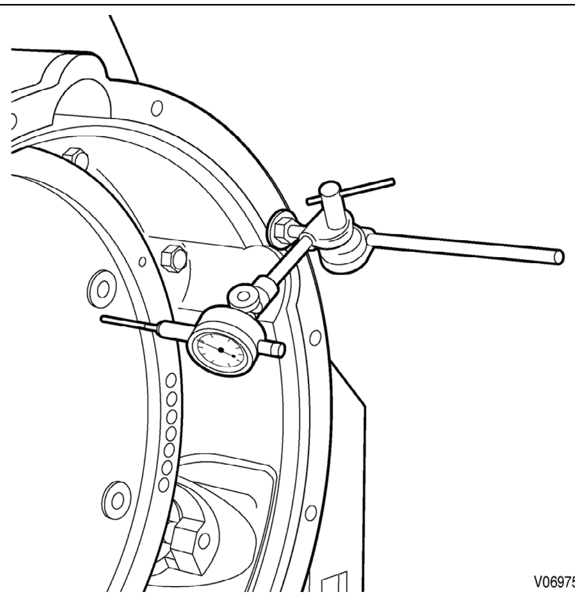

Figure I–10. Measuring Flexplate Flatness

Refer to Figure I–10 and measure the flexplate flatness as follows:

- Fasten the dial indicator to the flywheel housing and measure only in an area adjacent to each converter mounting hole in the flexplate.
- If a two-piece flexplate is being checked, bolt both pieces together on the engine. Refer to Figure I–1 for tolerance.

J. Torque Converter Axial Location.

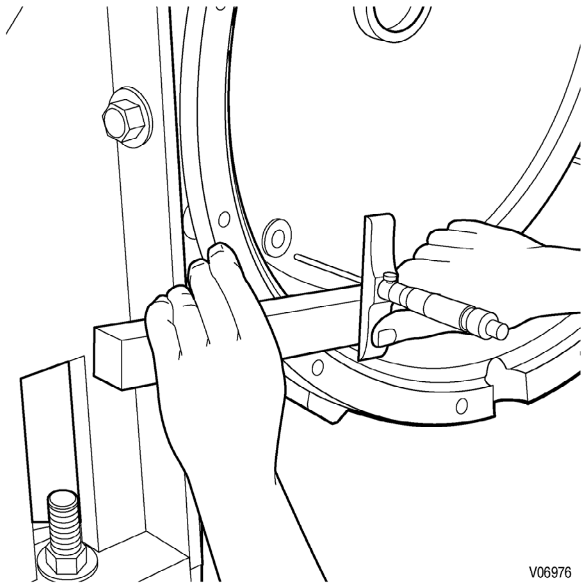

Figure I–11. Measuring Converter Axial Location

Refer to Figure I–11 for converter axial location measurement as follows:

- While pressing the crankshaft rearward to remove all crankshaft end play, measure from the rear face of the flywheel housing to the rear face of the flexplate, adjacent to the converter mounting holes.
- The measurement should be within the tolerance specified in the adaptation checksheet. Refer to Figure I–1 for tolerances.

Appendix J—TROUBLESHOOTING NOISE AND VIBRATION

J–1. TROUBLESHOOTING NOISE AND VIBRATION

NOTE: Most noise and vibration complaints are not usually transmission related.

A. Isolating Vibrations and Noises.

The first step in isolating driveline vibration is to ask questions. These questions include:

- Is the vibration new, or an old vibration getting worse?
- Where is the vibration felt?
- What does it sound/feel like?
- Is it a constant sound or does it change?
- At what speed does it occur?
- Is the vibration/noise vehicle speed dependent?
- Is the vibration/noise engine rpm dependent?
- Does the vibration/noise occur under load or high torque conditions?
- Does the vibration/noise occur during acceleration/deceleration?

Have the driver recreate the complaint condition during a road test. Record the following when complaint is reproduced:

- Road speed
- Engine rpm
- Transmission range(s)
- Under acceleration, coast, steady state
- Loaded or unloaded

Two types of vibrations that drivers will most commonly report are listed below:

Table J–1. Types of Vibrations

Type	Indication	Cause
Low Frequency	Shimmying or Shaking	A component turning at road speed: such as wheels, tires, brake drums, axle shafts, and wheel bearings
High Frequency	Buzz or Hum	Driveline problem, engine resonance

B. Pinpointing The Vibration.

Specific ways to pinpoint the exact cause of the vibration are referred to in Table J–1.

Engine Test (rpm)

This test is performed with the vehicle stationary, parking brake set, and the transmission in **N** (Neutral).

Start the engine and gradually increase the engine rpm.

If abnormal vibration occurs, the problem could be misfire, engine and/or torque converter out of balance, powertrain mounting problems or engine resonance.

Powertrain Test (Road Speed)

Drive the vehicle along a smooth road in a high range (**4** (Fourth Range) or higher). Is vibration engine speed or road speed related?

Determine if vibration is impacted by the amount of engine load. If vibration increases with an increase in the amount of throttle and engine rpm, the problem could be engine misfire or powertrain mounting systems problems.

Driveline Test (Coast)

WARNING: The Driveline Test is a troubleshooting procedure only and should not be done during normal vehicle operation. This test cannot be performed on public highways and must be performed on flat, level ground.

The Driveline Test reveals vibrations caused by the driveline. Driveline vibrations usually show up within a specific speed range.

To perform a Driveline Test, accelerate in a high range (**4** (Fourth Range) or higher) past the speed range where the vibration occurs, shift into **N** (Neutral), and coast back through the vibration range. If the vibration is still evident and frequency decays with decreasing speed, the potential cause is probably driveline orientated. Possible causes:

- Worn universal joint bearings, universal joints and/or intermediate support bearings
- Worn slip splines
- Loose output yoke/flange retaining hardware
- Loose driveshaft bolts
- Driveshaft not phased correctly
- Driveshaft not balanced correctly, missing balance weights, or damaged driveshaft
- Driveshaft total run-out beyond manufacture's specifications
- Universal joints operating angles beyond Allison Transmission limits
- Driveshaft length, diameter, and/or wall thickness not correct for maximum operational speeds
- Wheel/tire assembly out of balance (wheel speed frequency)
- Axle problems

Vibration Diagnostics

NOTE: Use factory service manuals and procedures, and refer to all applicable safety precautions when servicing vehicle.

Table J–2 may be used to help troubleshoot vehicle vibration complaints. Flow chart (Figure J–1) is intended to assist with driveline diagnosis. It does not guarantee an immediate solution nor does it guarantee warranty responsibility or reimbursement.

Table J–2. Vibration Isolation

Test	Isolation
Driveline Test (Coast)	Vibrations caused by the driveline
Powertrain Test (Road Speed)	Wheel, tire, and/or brake drum balance problems, engine misfire, or powertrain mounting system problems
Engine Test (rpm)	Vibration could be caused by the engine misfire, engine and/or torque out of balance, or powertrain mounting problems

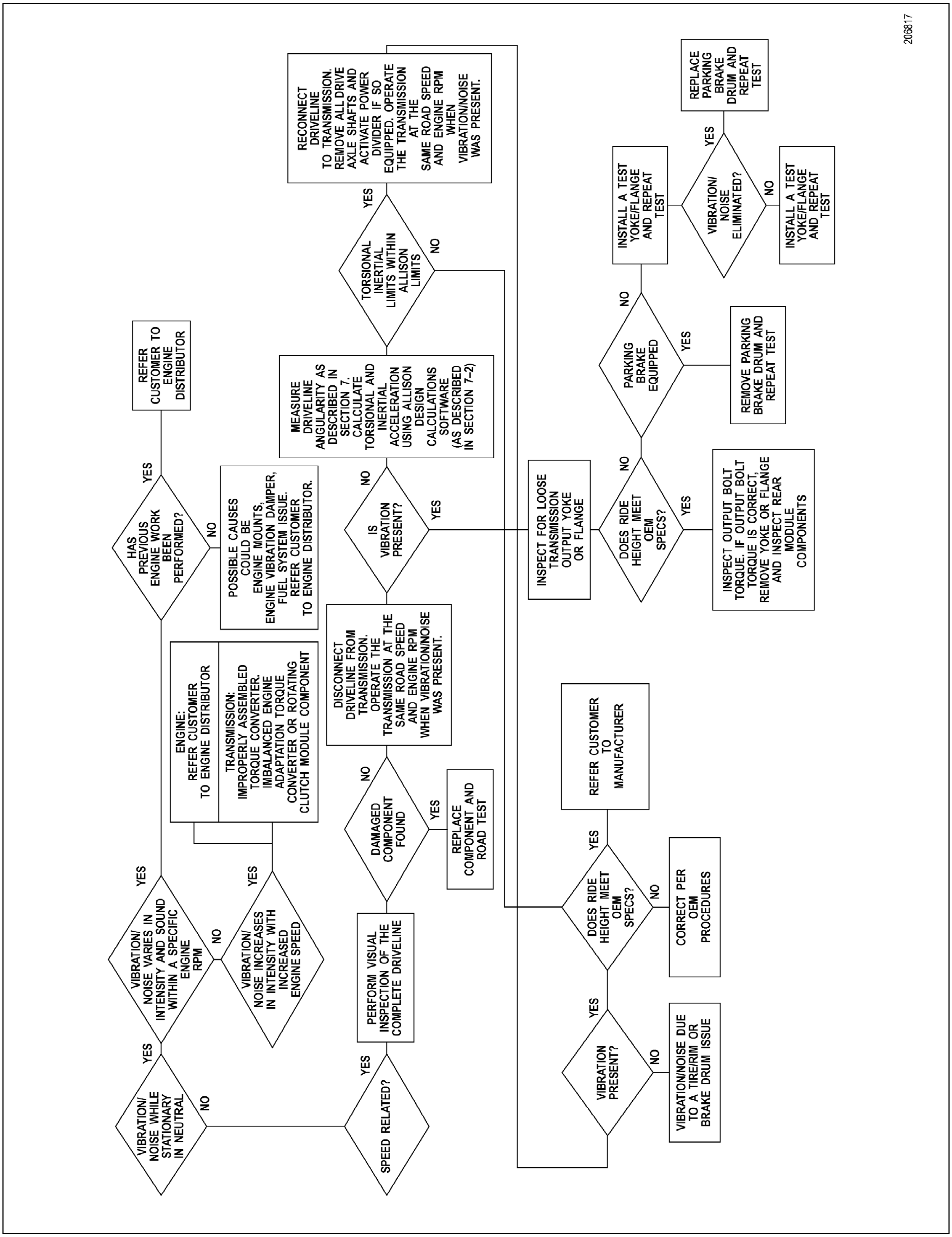

Figure J–1. Vibration Diagnostic Flow Chart

Electronic Vibration Analyzers (EVA)

The J-38792 Electronic Vibration Analyzers (EVA) and the J-38792-A Electronic Vibration Analyzers (EVA 2) are low-cost, electronic diagnostic tools that use sophisticated software programs designed to help diagnose unacceptable, low-frequency vibrations.

Software Description

The EVA software program is designed to perform targeted frequency calculations on a suspected vibration source. The tire size, axle ratio, number of cylinders, vehicle speed and engine rpm are factored into a calculation that determines the predominant vibration frequency, amplitude, and the suspected vehicle system producing the vibration. The following table helps the user to understand the EVA software and hardware that may be in use.

Table J–3. EVA Software

Software Version	Tool Version	Programs Available	Strobe Filters Available	Notes
J-38792-10 EVA	J-38792 EVA	Normal Mode	Full (6-250 Hz) Low (35-45 Hz) High (45-55 Hz)	
J-38792-50 Smart EVA	J-38792 EVA J-38792-A EVA 2	Auto Mode Smart Mode	Full (6-250 Hz) Low (35-45 Hz) High (45-55 Hz)	It may be necessary to do a Phase Shift Calibration (refer to EVA Instruction Manual) if the software is used with the J-38792 EVA tool and the J-38792-A EVA 2 tool
J-38792-60 EVA 2	J-38792 EVA J-38792-A EVA 2	Auto Mode Normal Mode Smart Mode	Low (35-45 Hz) Medium (45-55 Hz) High (55-65 Hz)	High (55-65 Hz) strobe filter is not available if software is used with a J-38792 EVA tool

Design

The EVA tool is similar to a scan tool, but easier to use. Only one connection is necessary. Power is supplied by a 12 volt cigarette lighter feed. The unit is hand-held, and the vibration sensor can be mounted anywhere.

Function

The EVA 2 Auto Mode function speeds up diagnosis by displaying the three most prominent vibration frequencies in cycles per second (Hz) or revolutions per minute (rpm), source of the vibration, and amplitude that shows the relative strength of each vibration being displayed.

For additional information on the EVA tool, refer to the Electronic Vibration Analyzer Instruction Manual. The EVA tool is available for purchase from Bosch Automotive Service Solutions LLC, 28635 Mound Road, Warren, Michigan 48092.

NOTES

K–1. ANALYZING DRIVELINE DESIGN

When working with a new or modified vehicle, you must first consider the driveline design before any further troubleshooting can be done. For information about this procedure, refer to the appropriate Tech Data Book. It is listed in Technical Document 111 (available on the Allison Extranet at *www.allisontransmission.com*).

A. Inspect Driveline Components.

General inspection of the driveline includes:

- Look for an uneven buildup of paint, undercoating, or mud
- Inspect for missing shaft balance weights (Figure K–1)

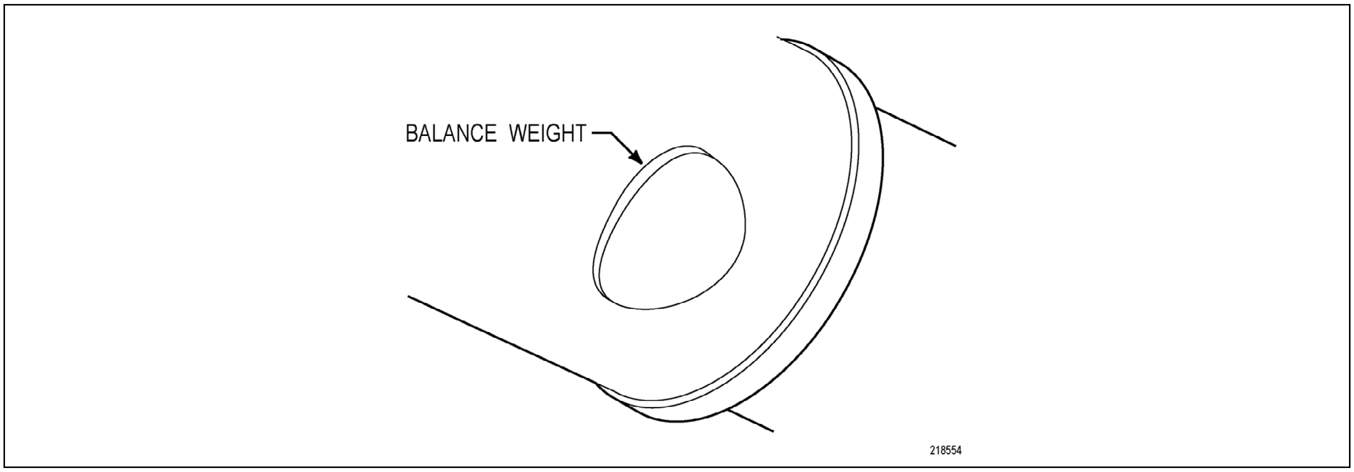

Figure K–1. Inspect Driveshaft for Missing Shaft Weights

- Inspect the transmission yoke or flange bolts to be sure they are tight
- Inspect the engine and transmission mounts to be sure the engine/transmission power package is still at the proper angle

Inspect Driveline Intermediate Support Bearings

Inspect the intermediate support bearings to be sure they are not damaged and will not allow the shaft to travel in an elliptical pattern (Figure K–2).

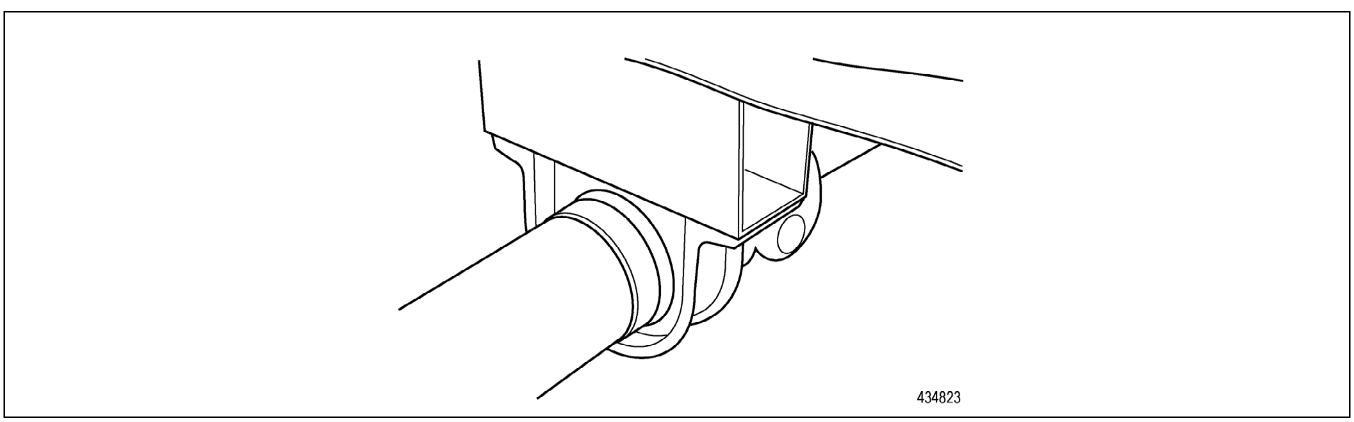

Figure K–2. Inspect Driveline Intermediate Support Bearing

Inspect Driveline Slip Joint

Inspect the driveline slip joint to make sure that it can move freely and has the proper amount of travel (Figure K–3).

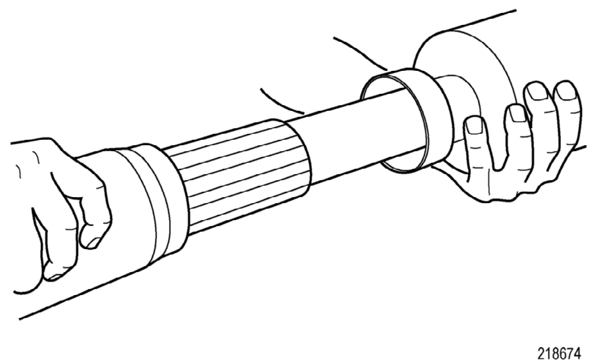

Figure K–3. Inspect Driveshaft Slip Joint

Before disassembling the slip joint, look for marks (if present) that indicate the correct assembly alignment (Figure K–4). If no marks exist, be sure to mark both parts of the slip joint before disassembling it. Be sure the marks are aligned properly when the slip joint is reassembled.

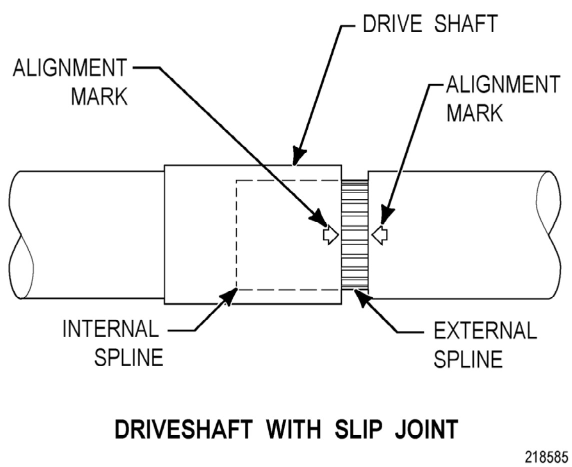

Figure K–4. Alignment Markings on Driveshaft Slip Joint

Inspect Axle Mounts and Rear Springs

Inspect axle mounts, torque rods, and rear springs to make sure they are not loose, bent, or broken (Figure K–5).

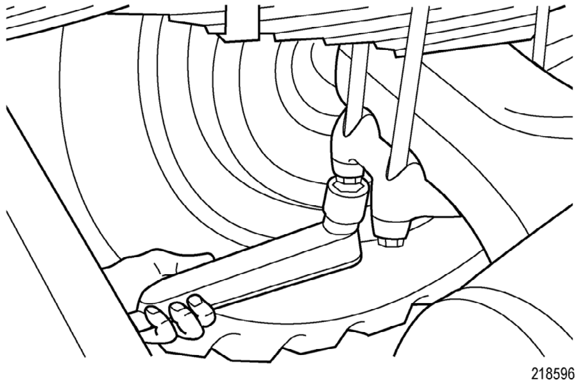

Figure K–5. Inspect Axle Mounts and Rear Springs

Inspect U-joints

Inspect the U-joints and replace any that are damaged or worn (Figure K–6).

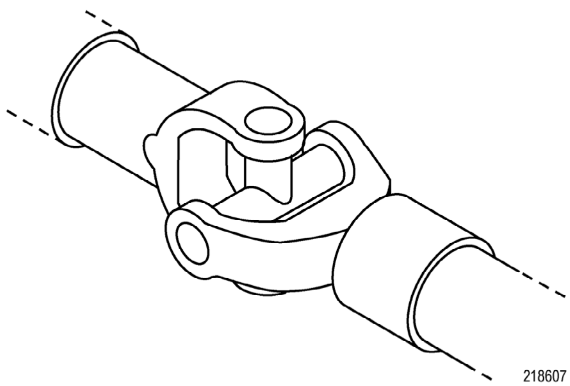

Figure K–6. Inspect Universal Joints

Transmission Output

Inspect transmission output flange or yoke bolts for looseness.

Axle Yoke/Flange

Inspect axle pinion yoke or flange retaining hardware for looseness.

Inspect Driveshaft Runout

Inspect the shaft runout or position of the shaft around its operating centerline. Visually inspect the shafts for dents or anything that might be out of position (Figure K–7).

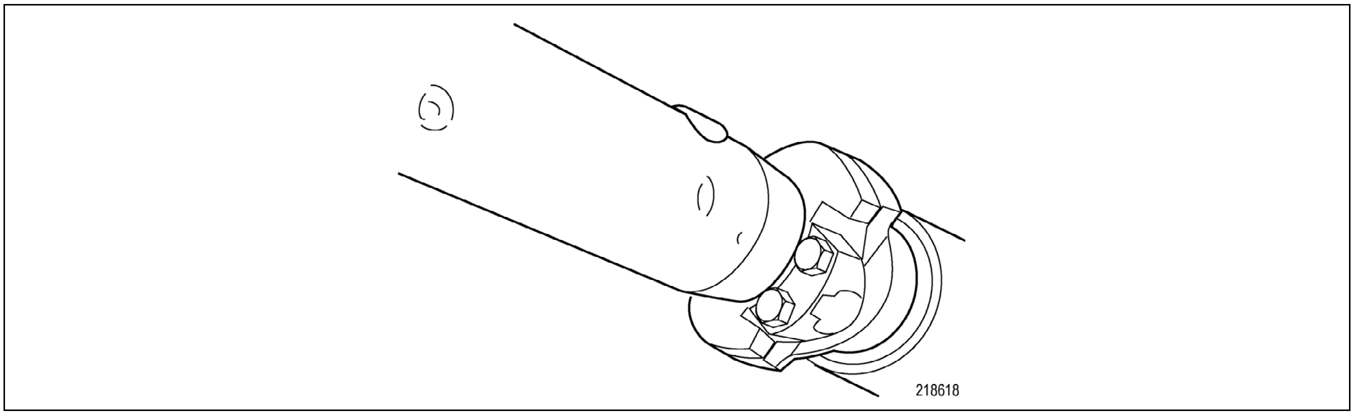

Figure K–7. Inspect Driveshaft Runout

Use Dial Indicator to Measure Shaft Runout

Be sure that the shaft runout complies with the shaft manufacturer's specifications. Use a dial indicator (Figure K–8) to measure the runout in three positions along each shaft (Figure K–9). Clean the area to be measured with mineral spirits. Also be sure the area being measured is not damaged during measurement.

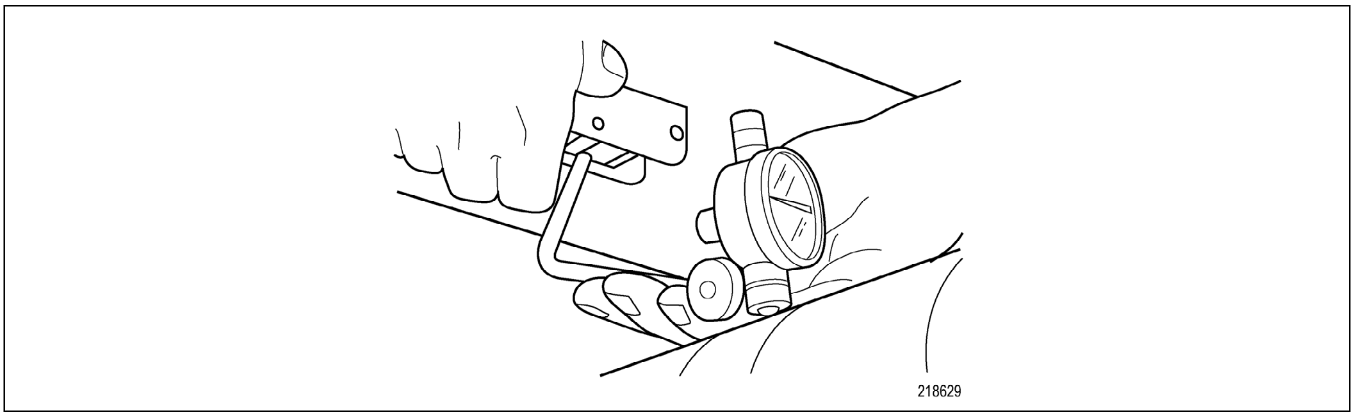

Figure K–8. Using a Dial Indicator to Measure Shaft Runout

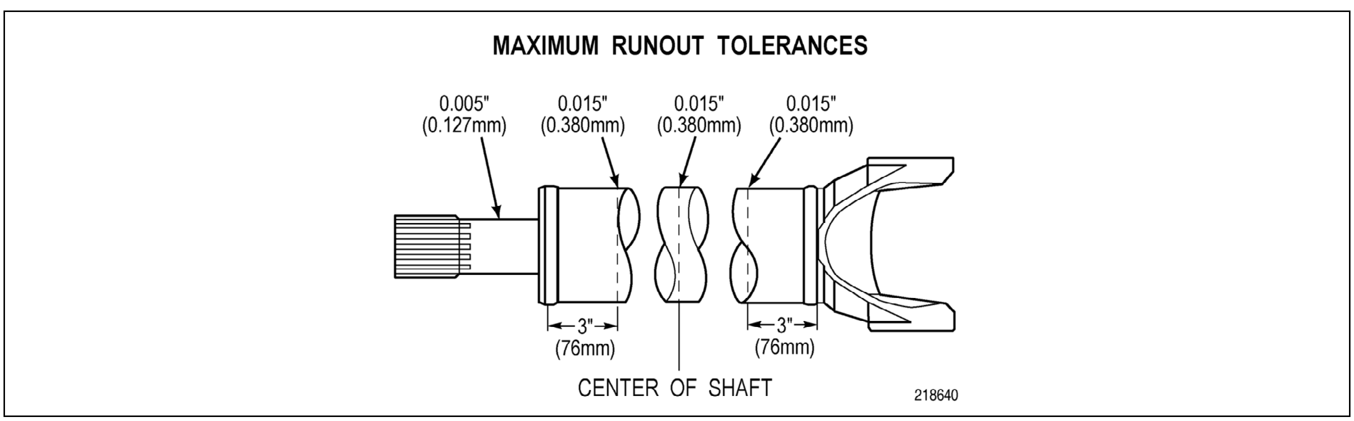

Figure K–9. Runout Measurement Location

When a potential runout problem is discovered, look for the following:

- Worn driveline intermediate support bearing

- Worn universal joint
- Defective shaft.

K–2. U-JOINT PHASING

Phasing Definition

A driveline is intended to have a constant speed input and a constant speed output with fluctuating speeds in the center sections of the driveline. Therefore, it is an inherent design condition that causes each universal joint to speed-up and slow-down twice during each revolution of the shaft. If the yokes on each of the driveline elements are not in phase or parallel with each other (Figure K–10), the result is a fluctuation in the output speed of the driveline. This can result in driveline vibration. At times, a vehicle manufacturer will intentionally misphase driveshafts. When phasing is in question, contact the vehicle manufacturer for determination of proper phasing.

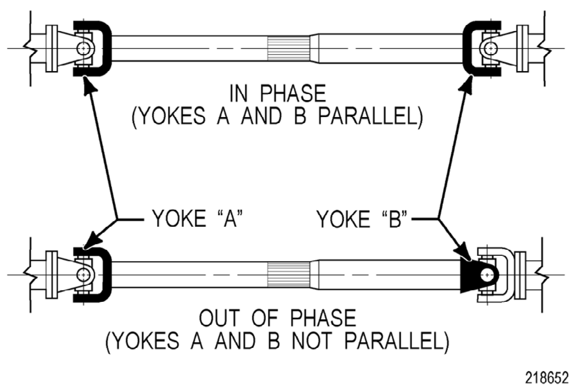

Figure K–10. In Phase (A) and Out of Phase (B) Driveshafts

However, even if the yokes are in-phase, the angles of each universal joint must be within a specified tolerance for a given, maximum speed. If they are not, a vibration can occur that can damage the transmission, driveline, and axle.

A. Determining Driveline Phasing.

The following steps describe how to determine driveline phasing:

1. Begin with a visual inspection of the yokes to see if they are parallel.
2. Prepare the yoke for measurement by cleaning off a flat surface of each yoke.
3. To measure the angle, place an inclinometer on the prepared, flat surface of one universal joint, and read the angle (Figure K–11). Then, place the inclinometer on the prepared, flat surface of the corresponding universal joint and compare the two readings.

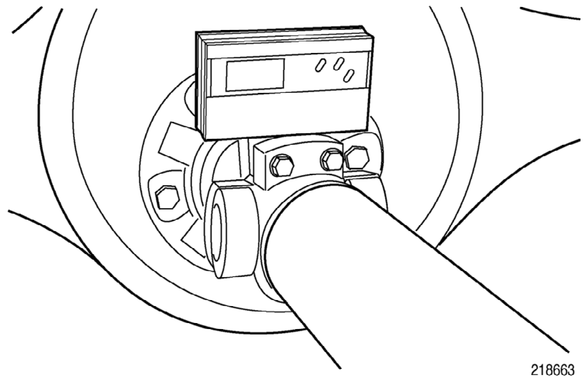

Figure K–11. Determining Yoke Phasing

4. Normal phasing tolerance is a range of 5°. If the readings vary more than 5°, consult the manufacturer's specifications to see if the difference is within tolerance.

B. Correcting Phasing.

To correct a phasing problem, disconnect the universal joint and separate the shaft from the slip joint. Then, realign the shaft so the universal joint yokes are in phase or parallel. Make sure to take a second set of readings to make certain you have corrected the problem.

K–3. DEFINING ANGULARITY

A. Operating Angle Definition.

The operating angle of a universal joint is the angle of one universal joint yoke or shaft in relation to the other yoke or shaft.

Imagine two lines perpendicular to each yoke (Figure K–12). The angle formed where the two lines intersect is the operating angle of the universal joint.

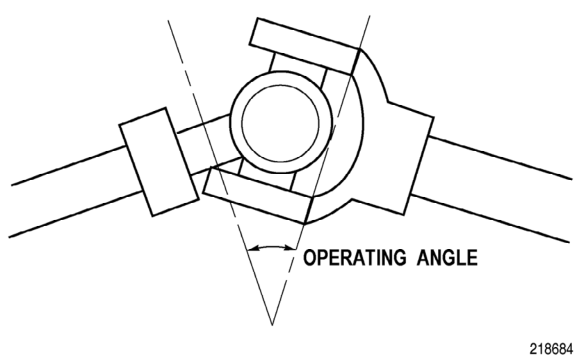

Figure K–12. Operating Angle of a U-Joint

B. Installed Angle Definition.

The installed angle of a driveline is the angle at which each driveline element is installed (Figure K–13). The installed angle of each driveline element is used to determine the operating angle of each universal joint.

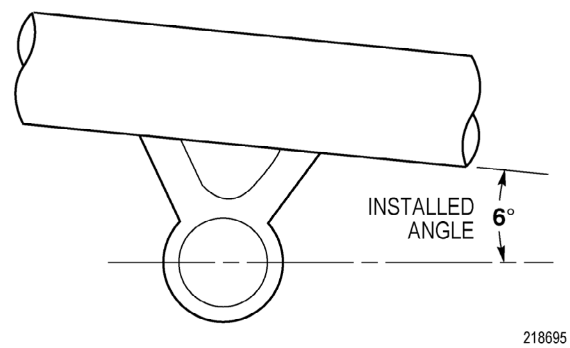

Figure K–13. Definition of Installed (Mounting) Angle

C. Single vs. Compound Angles.

Single operating angles exist when there is no horizontal offset of the driveline between the transmission and axle.

If the centerlines of the transmission output shaft and axle pinion are the same, driveline offset is not present (Figure K–14). The following examples explain how to calculate the operating angle when a single angle exists.

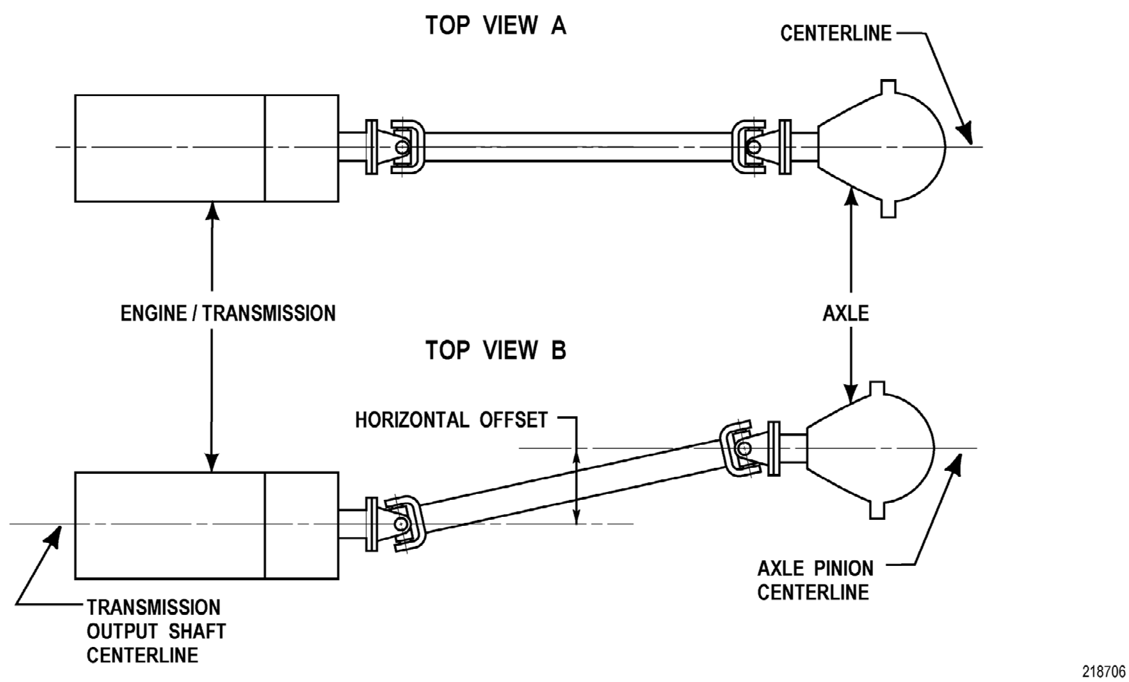

Figure K–14. No Driveline Offset (A), Driveline Offset (B).

D. Measuring Angularity.

Before taking each reading, clean off spots on each element to be sure the readings are accurate. Begin by measuring the installed angle of the transmission using an inclinometer (Figure K–15). Then, measure the angle of each driveline element, working back to the axle pinion angle. Write down each reading.

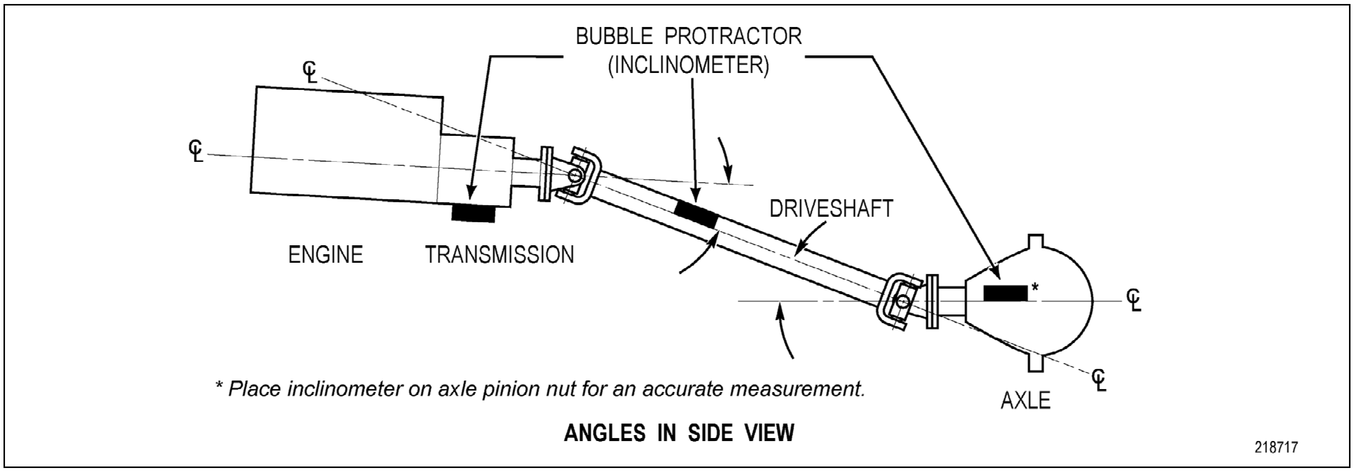

Figure K–15. Using Inclinometer to Measure Mounting Angles

When you have measured the installed angle of each driveline element, draw a line to represent each element, and write down the appropriate reading. Designate each angle as either positive or negative (Figure K–16), depending upon its position. SIL 10–TR-86 contains a blank form to aid with the recording of measurements.

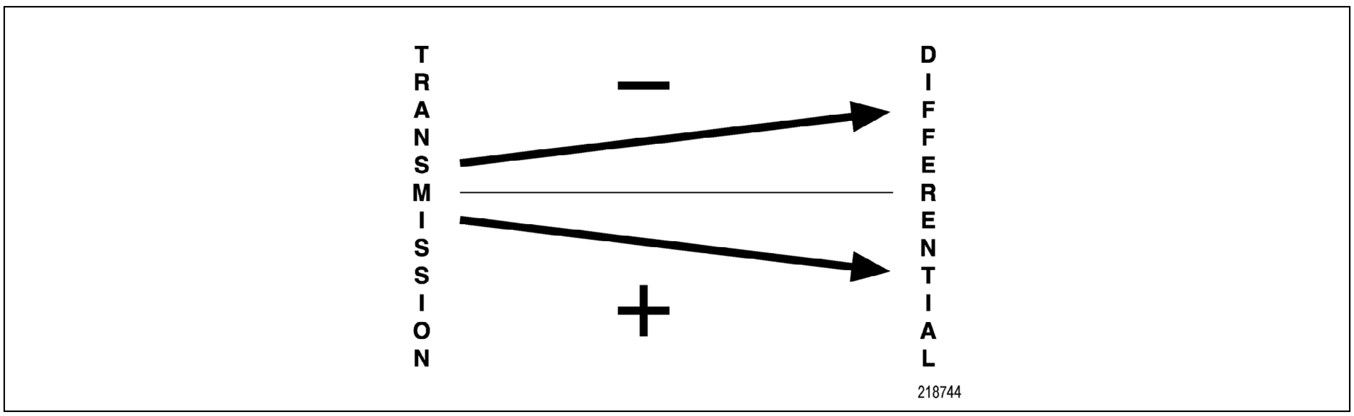

Figure K–16. Determining if Driveline Elements are Positive or Negative

NOTE: If a driveline element points down, it is positive. If it points up, it is negative (Figure K–16).

K–4. CALCULATING ANGULARITY

To compute the operating angles of the driveline, add or subtract the element readings depending on the sign. If the signs are the same, subtract the smaller from the larger. If the signs are different, add the two numbers (Figure K–17).

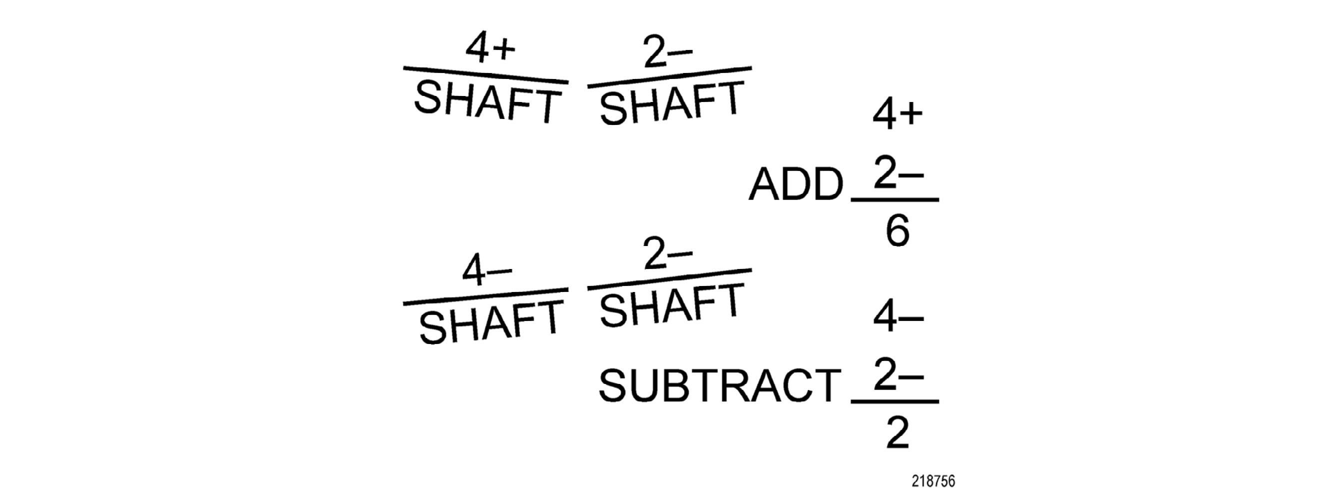

Figure K–17. Calculating Single Angles

The examples given in Figure K–18 and Figure K–19 are for a driveline without offset. When the centerline of the axle pinion does not share the same centerline as the transmission output shaft, offset is present. To determine the operating angle of an offset driveline, use the Allison Transmission Calc under the help menu in Allison DOC®.

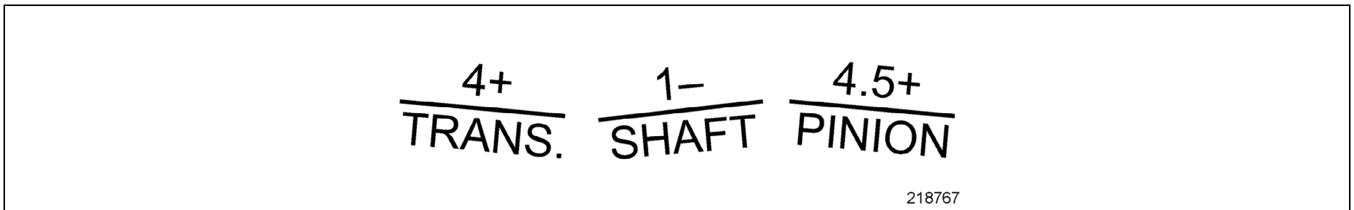

Figure K–18. Single Angle Calculation

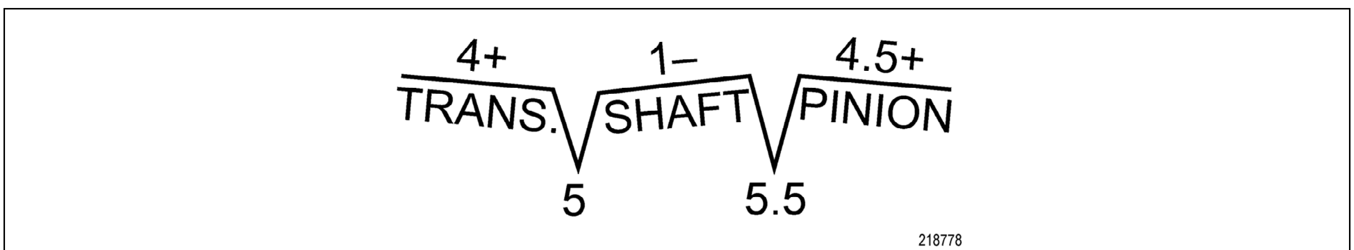

Figure K–19. Single Angle Answer

A. Maximum Allowable Operating Angles.

The maximum allowable operating angle of a U-joint is determined by maximum transmission output rpm. Table K–1 lists typical maximum operating angles for specific rpm ranges.

Table K–1. Typical Maximum U-Joint Allowable Operating Angle vs. Shaft rpm

rpm	Max. Angle
5000	3°15'
4500	3°40'
4000	4°15'

Table K–1. Typical Maximum U-Joint Allowable Operating Angle vs. Shaft rpm *(cont'd)*

rpm	Max. Angle
3500	5°0'
3000	5°50'
2500	7°0'
2000	8°40'
1500	11°30'

B. Solving Angularity Problems.

When an angularity problem is discovered, refer the problem to the vehicle manufacturer or a driveline specialist. They will be able to recommend the proper corrective procedures. Once the problem has been solved, take a second set of readings to make sure the angles are within acceptable tolerances.

NOTE: Some driveline components may be offset. In most cases, the offset should not exceed 51-76 mm (2-3 in) of deviation from the centerline. If these limits are exceeded, it may be a special driveline arrangement. If driveline problems are suspected and cannot otherwise be corrected, advise the customer to contact the OEM dealer.

C. Repair Follow–Up.

Take the following steps to be sure driveline vibration has been eliminated:

1. When all necessary corrections to the driveline have been made, take a second set of readings to be sure the phasing and angularity fall within tolerances.
2. Road Speed Test the vehicle to be sure the vibration has been eliminated.

If all of the corrections were made properly, the vibration should be eliminated.

K–5. DRIVELINE AND RIDE HEIGHT ISSUES

An incorrectly designed and/or installed driveline can create driveability complaints and cause transmission damage and/or failure. Frequently, driveline induced transmission damage/failure is incorrectly diagnosed as the transmission being the root cause.

A. Understanding Driveline Accelerations.

Torsional

When the input and the output shafts of a three shaft transmission system (output shaft, driveshaft, axle pinion) are not parallel (or the universal joints are not indexed correctly), torsional accelerations are present. The resultant effect is that the two shafts at the end of the system (transmission output/axle pinion) do not rotate at a constant velocity relative to each other.

Inertial

When an angle is present between two shafts connected by a Carden-type universal joint, there is cyclic acceleration/deceleration twice per revolution of one of the shafts if the other shaft is rotated at a constant speed. The effect of a three shaft operating system at an angle is shown in Figure K–20.

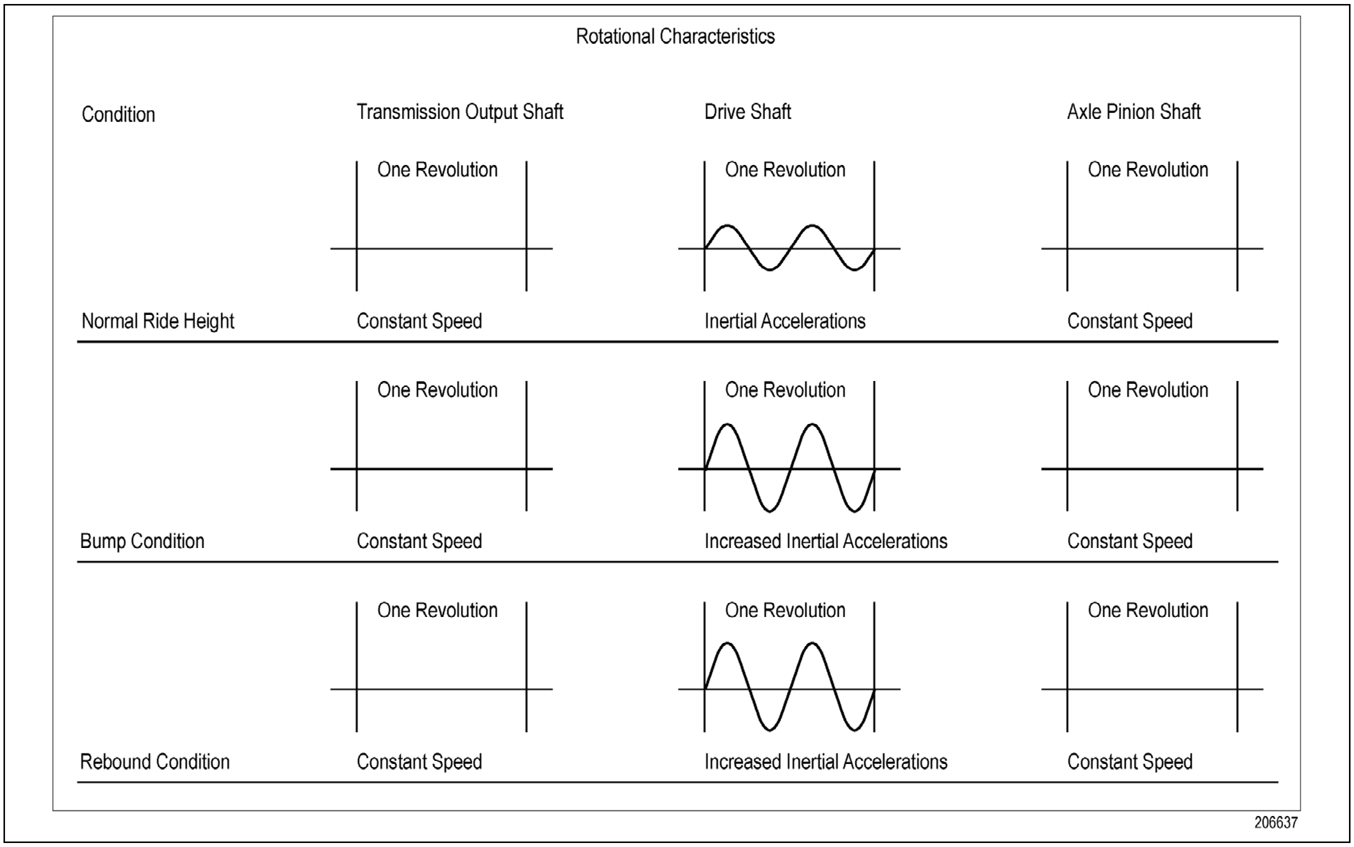

Figure K–20. Parallel Offset Shaft Configuration

When the two universal joint operating angles are equal, the one shaft that experiences the effect of cyclic acceleration/deceleration is the driveshaft. The transmission output shaft is the input to the system and rotates at a constant velocity. When universal joint operating angles create acceleration in excess of Allison limits, the following condition exists as shown in Figure K–21.

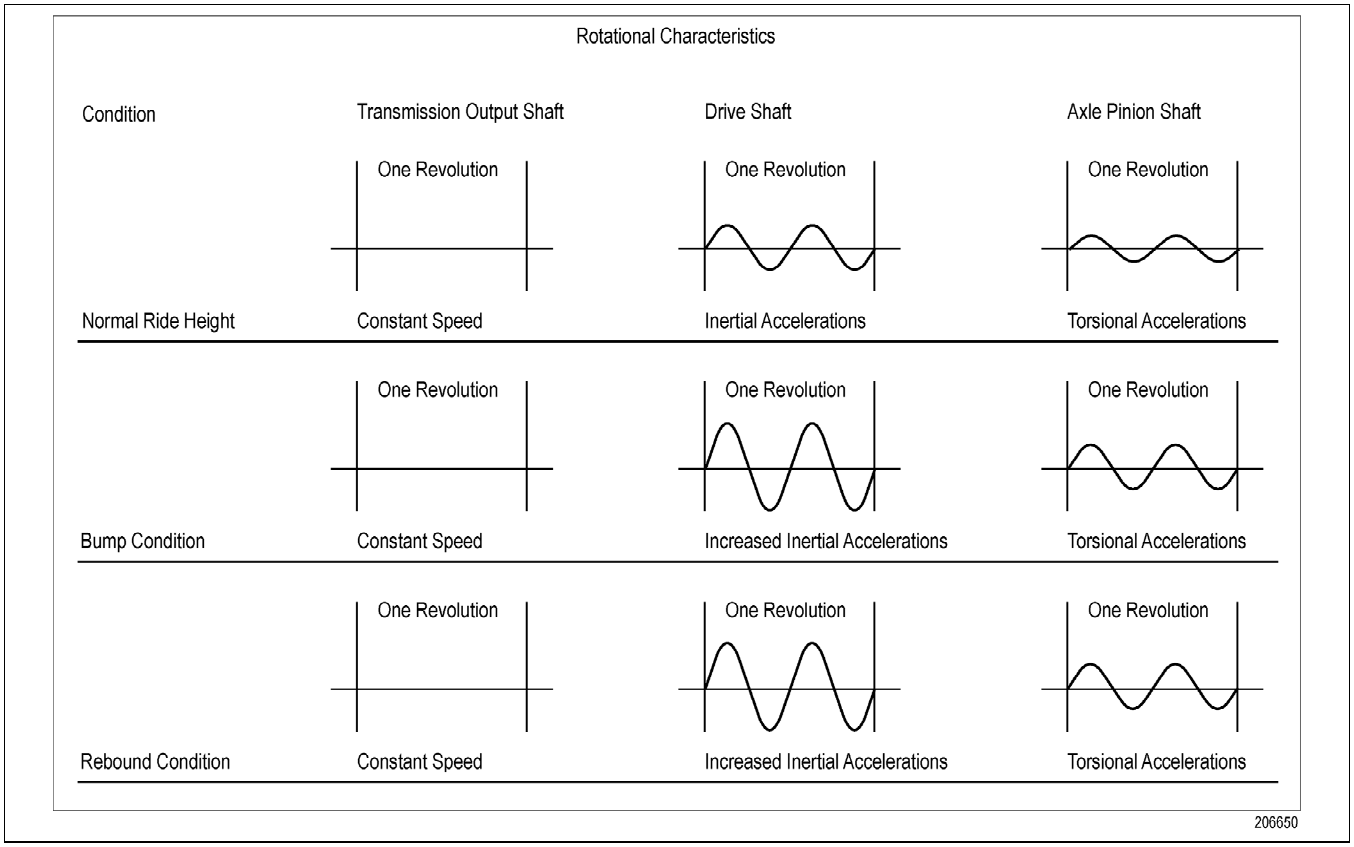

Figure K–21. Incorrectly Aligned Suspension/Axle

The axle receives the effects of the variation in rotational speed. In reality, the transmission is commonly the component affected by this variation in rotational speed. This is due to the vehicle end of the system (axle pinion) connected to a larger flywheel. Since the mass of the vehicle is far greater than the mass of the transmission rotating components, the variation in acceleration is imposed on the transmission output shaft (Figure K–22).

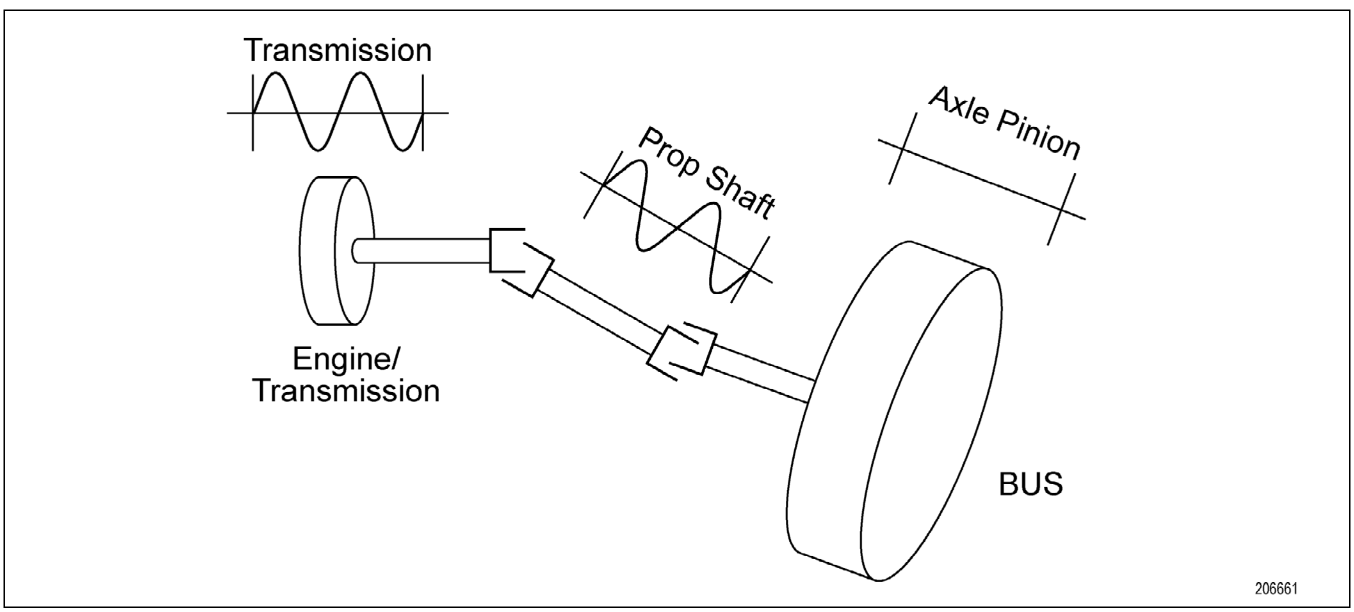

Figure K–22. Axle Receives Effect of the Vibration in Rotational Speed

B. Driveline Measurements.

Driveline Analysis Software Program GN2236EN provides a complete and exact method of analyzing a driveline. To use the software, you must perform the measurements that are outlined in the following paragraphs.

When the measurements have been completed, they may be entered into the software program. The software provides step-by-step instructions by asking a series of questions. When all of the data has been entered, the computer will summarize the information and calculate the specifics of the driveline being analyzed.

Complete instructions and explanations of terms are contained in the User Guide that is included with the software program. These calculations include:

- Torsional acceleration
- Drive universal joint inertial acceleration
- Coast universal joint inertial acceleration

The software responds to each of these factors with an OK if the driveline components are within tolerance or ‘XXX’ if they are outside acceptable tolerance ranges.

This software program is recommended because it can alert the analyzer to certain circumstances involving drivelines that are designed to be operated slightly out of phase.

C. Driveshaft Measurement.

Measure the length of the driveshaft (Figure K–23, measurement A). The measurement must be taken from the center of one universal joint to the center of the other universal joint.

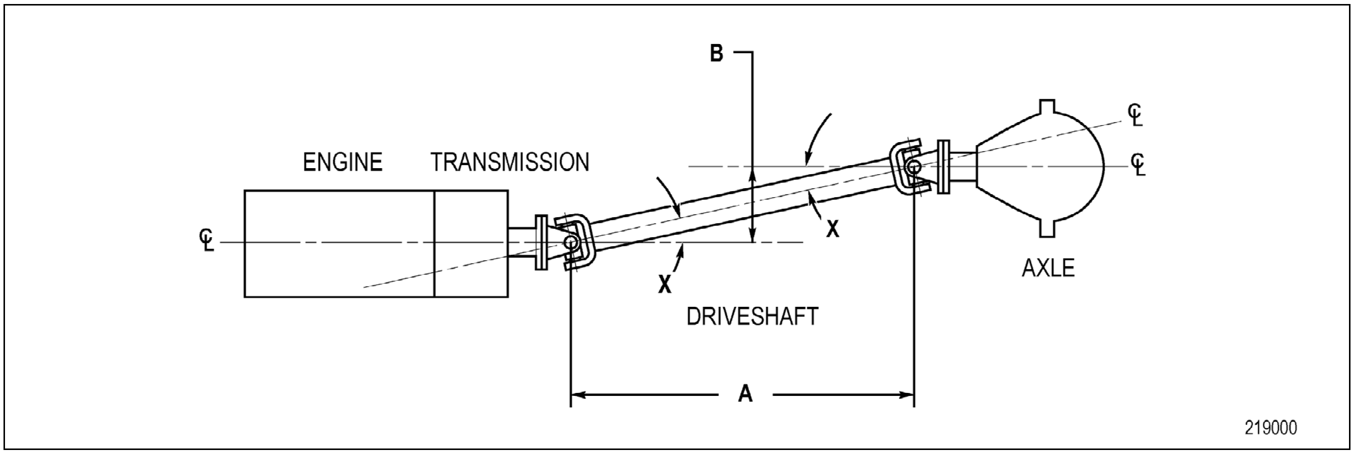

Figure K–23. Driveshaft Length Measurement

D. Phasing.

Refer to K–2. U-JOINT PHASING for additional information on driveline and U-Joint phasing.

E. Measuring Installed Angle of Power Pack and Axle.

NOTE: If the vehicle has to be raised to make the measurements, a wheel lift, not a frame lift, must be used so that the driveline is in the normal position and not hanging from the frame.

Use a bubble-type protractor or electronic leveling tool (inclinometer) such as SmartTool^{TM} or J-38460-A Digital Protractor to measure the slope of the power pack driveshaft and drive axle (Figure K–24). Be sure the bubble-type protractor or electronic leveling tool is placed on the power pack and drive axle at a location that is parallel with the centerline of the transmission and drive axle. Remove all grease and paint before measuring the angles.

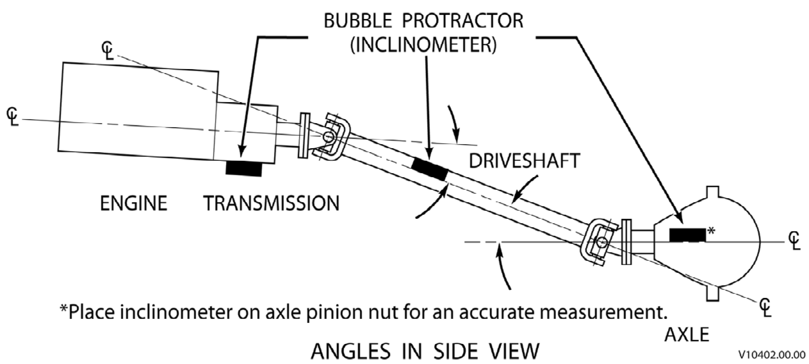

Figure K–24. Measuring Installed Angles

F. Measuring Horizontal Offset.

1. Hang a weighted string from the frame rail.
2. Measure the distance from the first universal joint to the string (Figure K–25).

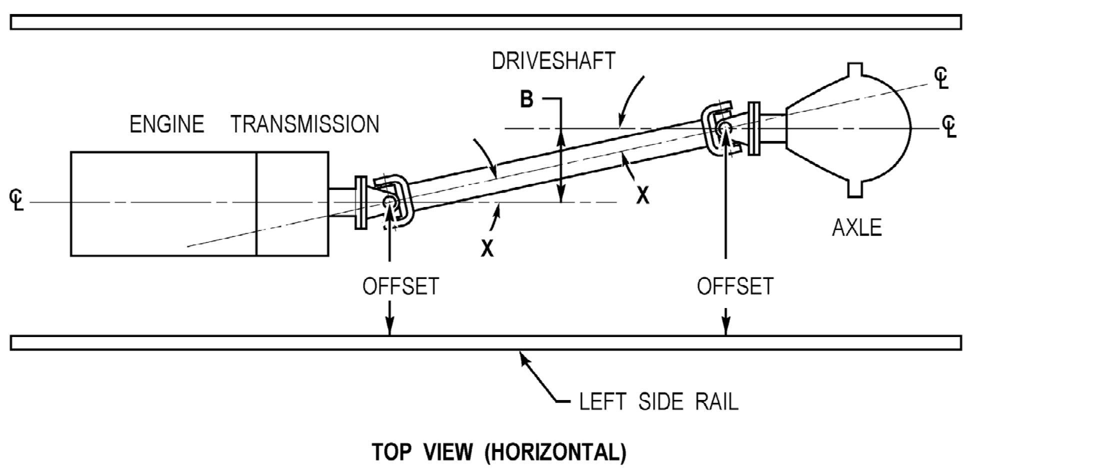

Figure K–25. Horizontal Offset

3. Measure the distance from the second universal joint to the string.
4. Save these measurements.

NOTE: When measuring horizontal offset, all measurements must be taken from the same frame rail. Vehicle frame rail must be straight with no bends in the area of the universal joints for an accurate measurement. If a bend or curve is present in an area to be measured, use the procedure outlined in the next section.

G. Measuring Horizontal Offset With A Laser Beam.

The following procedures should be used to set up a laser beam.

NOTE: If the vehicle has to be raised to make the measurements, a wheel lift, not a frame lift, must be used so that the driveline is in a normal position and not hanging from the frame.

1. Locate and mark the center of the engine crankshaft (Figure K–26) and hang a weighted string from it long enough to intersect the laser beam that will be set up in step 3.

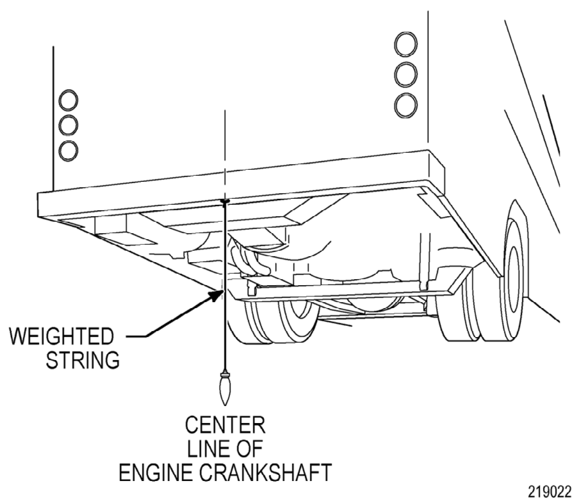

Figure K–26. Locating and Marking the Center of the Engine Crankshaft

2. Locate and mark the center of the first universal joint connected to the transmission output yoke/flange. Hang a second weighted string from it long enough to intersect the laser beam that will be set up in step 3 (Figure K–27). Be sure the universal joints are rotated so that the yokes on the driveshaft are vertical.

NOTE: It is very important to accurately set up the laser projector in step 3. If it is not set up properly on the center of the powerpack represented by the weighted strings, the measurements will be inaccurate.

3. Set up a laser projector and adjust the laser until the beam is aligned with the two weighted strings (Figure K–27).

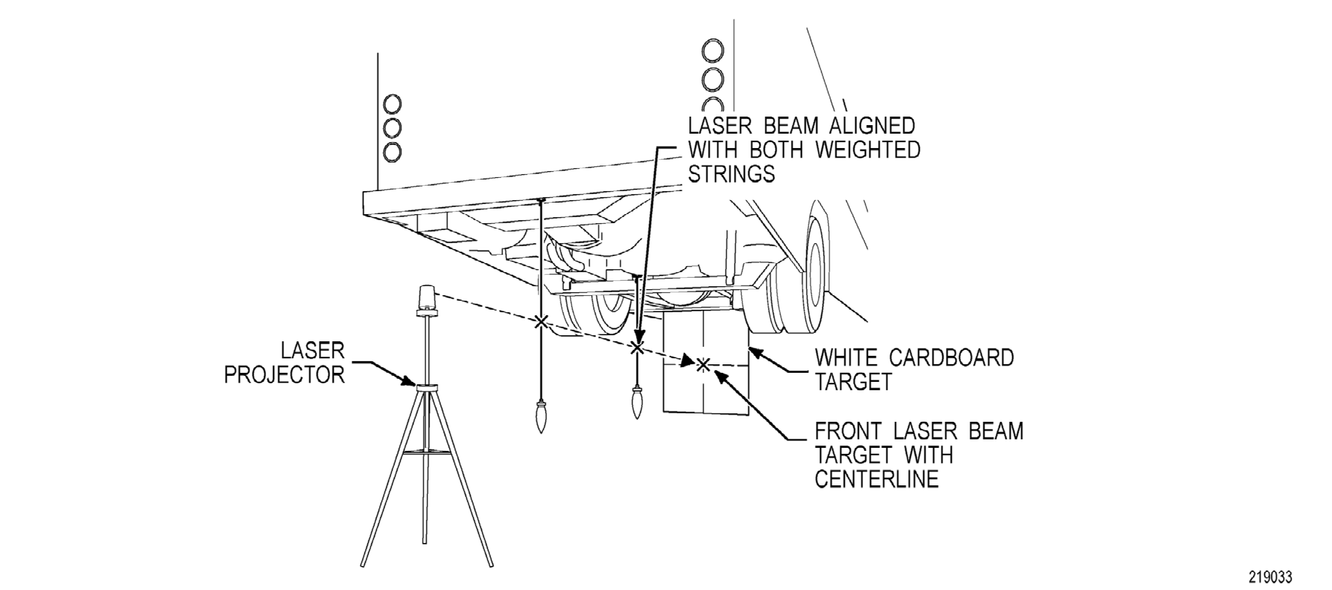

Figure K–27. Positioning and Alignment of Laser Projector and Cardboard

4. Using an appropriately sized white cardboard as a target (Figure K–27), place the target by each universal joint. Measure from the center of the universal joint to the beam projected on the target.

H. Defining Offsets.

Refer to Figure K–28 for a representation of vertical and horizontal offsets.

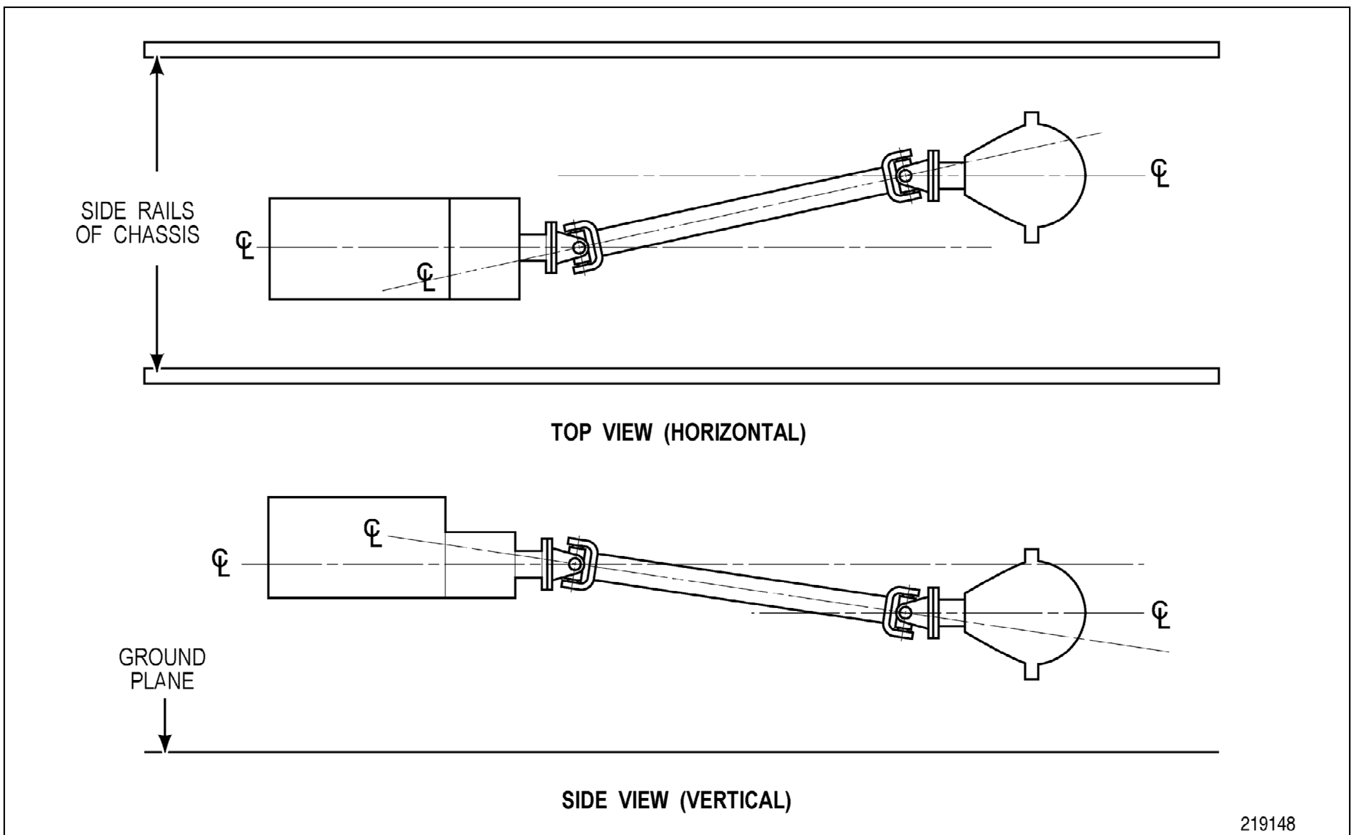

Figure K–28. Measuring Vertical and Horizontal Offsets

The horizontal offset is the distance that the centerlines of the power pack (engine/transmission) and axle pinion are offset from each other when viewed from the top and measured from a side rail.

The vertical offset is the distance that the centerlines of the power pack and axle are offset from each other when viewed from the side.

I. Driveline Analysis Data Entry Screen.

When the measurements have been completed, they can be input into the software program. The software program provides step-by-step instructions by asking a series of questions. When all of the data has been entered, the software will summarize the information and calculate the specifics of the driveline.

The program requests all the information required to determine the acceptability of any driveline configuration. The program can calculate the effect of offsets and non-standard yoke phasing.

The required data will be entered as requested by the program. A driveline form is attached to help organize this data. The questions are as follows:

1. **Type of Driveline**—Output with or without a driveline mounted retarder or an input.
2. **Vehicle Driveline Description**—General information for future reference.
3. **Number of Joints**—Enter the number of universal joints (2–8).
4. **Maximum Operating Speed (rpm)**—Maximum driveline speed in rpm is needed. Enter the engine no load speed except in cases where overdrives are being used. 1000, 2000, 3000, and 4000 Product Family's transmissions are examples of transmissions with overdrives. These cases require that the engine no load speed be divided by the overdrive values to obtain the maximum output speed.
5. **Transmission Vertical Slope**—Enter in the degrees of the vertical slope of the transmission. If the input is higher than the output, the slope is positive.
6. **Axle Vertical Slope**—Enter in the degrees of the vertical slope of the axle. If the input is higher than the output, the slope is positive.
7. **Horizontal Transmission Slope**—The angle in degrees formed by the centerline of the transmission (viewed from above) and the centerline of the frame/frame rail (assuming frame rails are parallel). If the centerlines are parallel, zeros (0) are entered. This measurement is used in cases where the transmission is not “square” in the frame.
8. **Horizontal Axle Slope**—Same as Horizontal Transmission Slope but measurement of the angle in degrees formed by the centerline of the differential pinion and the centerline of the frame/frame rail.
9. **Shaft Vertical Slope**—Enter the degrees of the vertical slope of the shaft(s). If the input is higher than the output, the slope is positive.
10. **Horizontal Joint Offset**—The distance from the center of the universal joint(s) to a given frame rail. This assumes the frame rails are parallel and do not have any offsets along the length from which the offsets are measured. The offset is measured from the same frame rail if the joint phasing is not zero. Begin with the joint closest to the transmission. You will be asked if the measurements are in inches or millimeters.
11. **Shaft Length**—The length of the shaft from center to center of the yokes at each end. This question will be repeated for each shaft.
12. **Yoke Phases**—This is a measurement of the position of each yoke. The drive yoke (yoke closest to the transmission output) of each joint should be measured. Enter the position of

the first yoke as zero (0) and each subsequent yoke is described in terms of its difference in degrees from the first yoke. Each drive yoke should be 90 degrees from the one in front or behind it. This means that the yokes at each end of a shaft should be parallel. If all universal joints meet this description, enter zeros (0) for each joint. Measure differences in the same direction down the driveline. Refer to K–2. U-JOINT PHASING for additional information.

Outputs are given for the torsional angle and acceleration, and inertial angle and acceleration for drive and coast conditions. Acceleration is given in radians/second^2. All acceleration values are qualified as acceptable or not acceptable.

Type of Drivelines

The program has the capability of reviewing:

- A standard multiple universal joint driveline
- A driveline with a driveline mounted retarder
- An input driveline

J. Driveline with Transfer Case, Split Shaft PTO, Auxiliary Transmission or Inter-Axle Drive Shaft.

When determining universal joint torsional and inertial accelerations with vehicles equipped with inter-axle drive shafts or transfer case, each driveline must be analyzed as a separate system. In the example of the vehicle equipped with a transfer case and tandem drive axles, each drive shaft in this system would be measured and analyzed separately (Figure K–29).

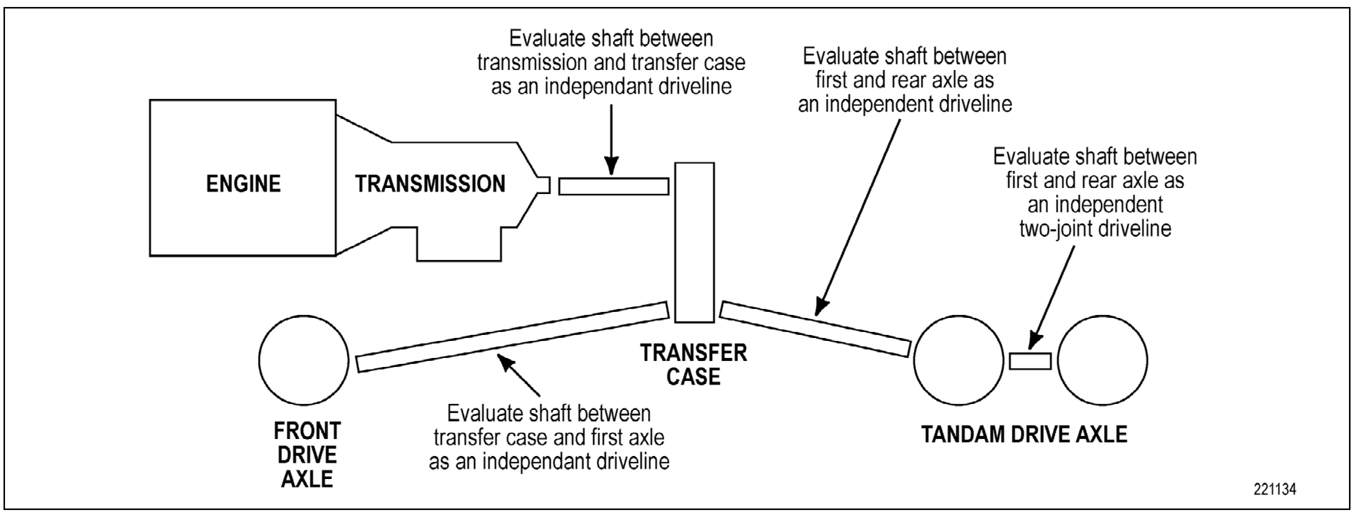

Figure K–29. Driveline with Transfer Case, Split Shaft PTO, Auxiliary Transmission or Inter-Axle Drive Shaft

Driveline Configuration	Limits (radians/sec^2)		
	Torsional	Inertial (Drive)	Inertial (Coast)
Output, no driveline retarder	500	1200	1200
Output, with driveline retarder	–	–	–
– Overall Driveline	500	1200	1200
– Transmission to Retarder	100	*	*
– Retarder to Axle	100	*	*
Input, between engine and transmission	–	–	–
– 3000 rpm and above	100	500	500
– Below 3000 rpm	100	**	**

* Not applicable to tranmission-retarder and retarder-to-axle sections.
** Inertia acceleration limits below 3000 rpm are based on a maximum recomended angle of 4 degrees. A limit is calculated using a 4 degree angle and the driveline speed and thus varies with speed.

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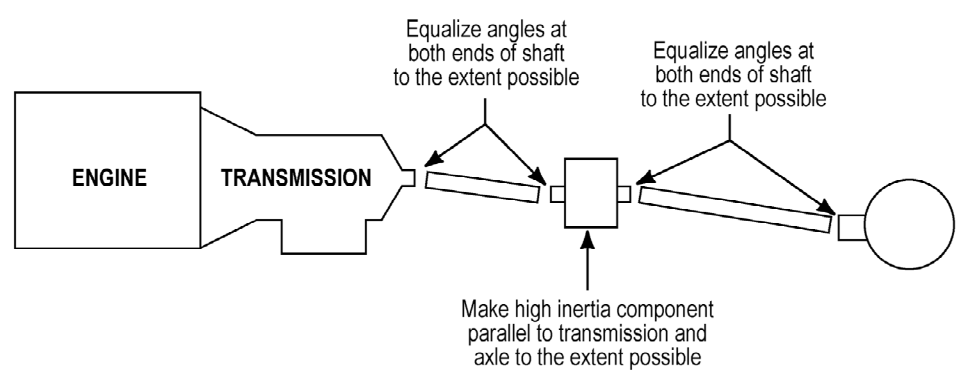
Figure K–30. Torsional and Inertial Acceleration Limits

K. Driveline With A High Inertia Component.

When determining universal joint torsional and inertial accelerations with vehicles equipped with a large inertia component, the driveline is analyzed as 3 systems:

- Drive shaft(s) between the transmission and the high inertia component is measured and analyzed as a separate system.
- Drive shaft(s) between the high inertia component and the drive axle is measured and analyzed as a separate system.
- The total driveline is measured and analyzed as a complete system. The high inertia component is considered as a drive shaft during measurements.



The following maximum torsional and inertial accelerations apply to drivelines equipped with a high inertia component:

CHARACTERISTIC	MAXIMUM ACCEPTABLE (Radians / Sec^2)
Torsional Accelerations	
Input driveline - remote mount	100 max.
Inertia Accelerations	
Design requirements - 3000 rpm & above:	
Drive mode	500 max.
Coast mode	500 max.
Design requirements - below 3000 rpm:	
Inertia acceleration limits below 3000 rpm are based on a maximum recomended angle of 4 degrees. A limit is calculated using a 4 degree angle and the driveline speed and thus varies with speed.	

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L. Input Driveline.

Input drivelines have specific requirements:

- Must be a two joint, one shaft system
- Yoke angles must be parallel
- Universal joint angularity must not exceed Allison Tech Data requirements

The following maximum torsional and inertial accelerations apply to input drivelines:

CHARACTERISTIC	MAXIMUM ACCEPTABLE (Radians / Sec^2)
Torsional Accelerations	
Design and Measured in Vehicle:	
Entire driveline	500 max.
Transmission to the high inerti component	100 max.
High inertia component to axle	100 max.
Inertia Accelerations	
Design requirements - 3000 rpm & above:	
Drive mode	1000 max.
Coast mode	1000 max.
As Measured in Vehicle:	
Drive mode	1200 max.
Coast mode	1200 max.

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The calculations include Torsional Acceleration, Drive U-Joint Inertial Acceleration, and Coast U-Joint Acceleration. The software responds to each of these factors with an OK if the driveline components are within tolerance, or XXX if they are outside of the acceptable tolerance range.

After all information has been entered into the program, there are two sources of vibration to consider.

- **Torsional.** Torsional refers to the non-uniform motion which exists at the input shaft of the differential if the transmission rotates uniformly or vice versa. Torsional acceleration can be caused by the transmission vertical slope and the axle vertical slope being at different angles. Torsional acceleration may also occur as a result of offsets. The torsional acceleration limits are listed in Figure K–30.

- **Inertial.** Inertial refers to the maximum acceleration of each driveline caused by the angles of the universal joint. Inertial is divided into two categories—Drive and Coast.
  - Inertial Drive accelerations occur when the transmission is supplying power to the driveline.
  - Inertial Coast accelerations occur when the axle is supplying the power to the driveline.

Inertial acceleration limits are listed in Figure K–30.

The acceleration values are compared to the limits and noted if they are acceptable (OK) or not acceptable (XXX). If the values exceed the limits, the driveline system will have to be modified.

The other information contained in the results is the effective angle. The effective angle means that a single joint operating at the given angle produces the same output motion (accelerations) as the multiple joint driveline.

M. What the Allison Driveline Program Does Not Calculate.

The driveline program calculates torsional and inertial accelerations based upon the operating angle of the universal joint, but it does not take into account the forces created from imbalance. Imbalance can be created from three conditions:

- Driveshaft within manufacturer's specification for eccentricity, but not balanced to manufacturer's or SAE/ISO specification.
- Driveshaft eccentricity exceeds manufacturer's maximum limits.
- Driveshaft length exceeds critical speed requirements.

Any of these conditions can result in vibration complaints from the driver and/or physical damage to the transmission.

Imbalance imparts a force on the components supporting the shaft(s) once per revolution. In a simplified way, this can be viewed as a "bending" force once per revolution. This imbalance force imparts bending on the transmission output shaft. This force is transmitted to the output shaft/planetary gearing and the transmission housings.

Universal joint torsional and inertial accelerations can be within Allison guidelines, but this does not eliminate the possibility that a driveshaft with excessive imbalance is present.

Refer to the Driveline Design Requirement section of the appropriate Allison Tech Data book for design requirements. Shaft length is discussed as well as balance requirements and shaft critical speed requirements.

NOTES

L–1. 3000 AND 4000 PRODUCT FAMILIES WIRING SCHEMATICS

NOTES

FOLDOUT 1

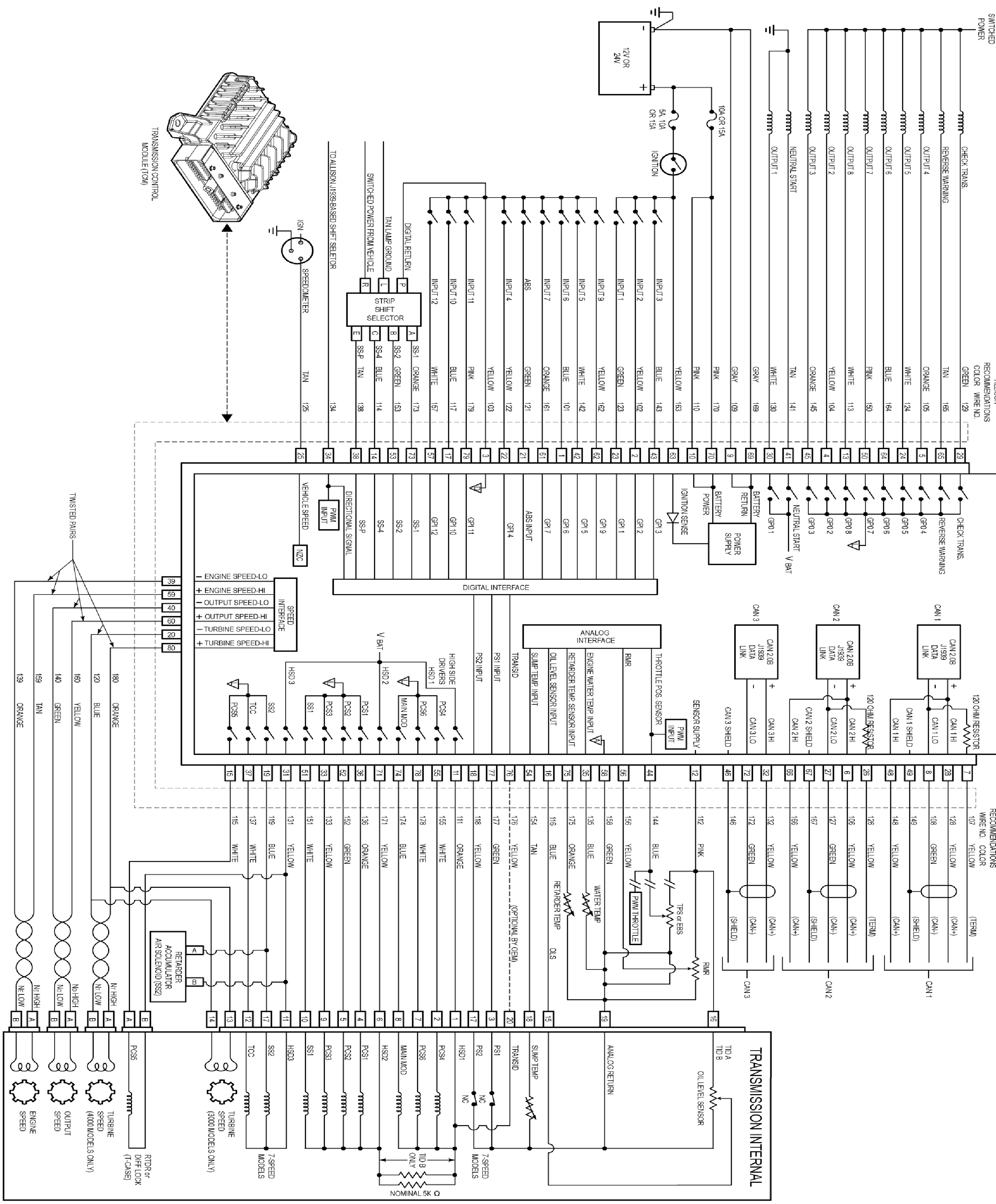

Figure L–1. 3000 and 4000 Product Families Connector Diagram—TCM 5th Generation Controls

410415

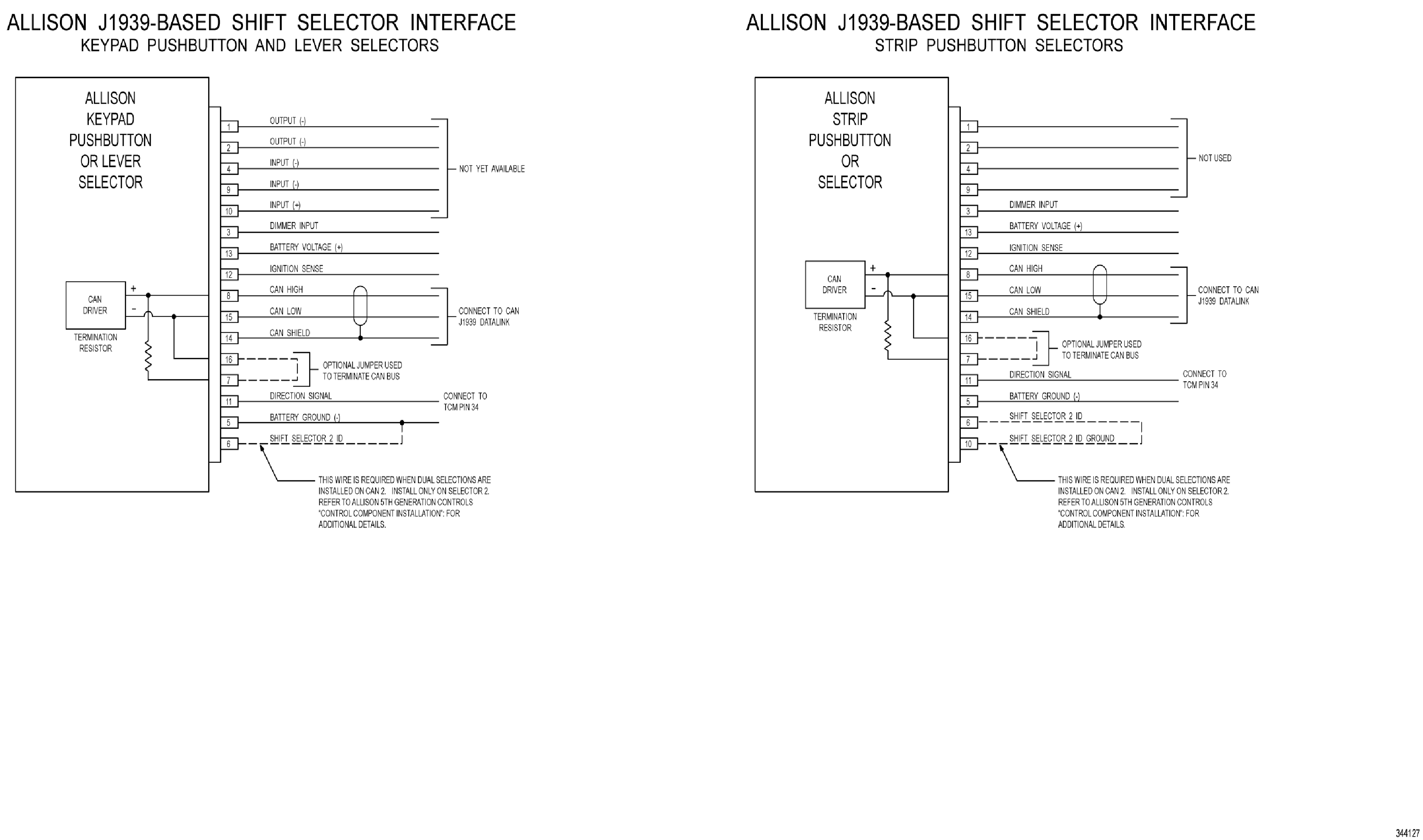

Figure L–2. 3000 and 4000 Product Families Connector Diagram—Shift Selectors 5th Generation Controls

Appendix M—HYDRAULIC SCHEMATICS

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Appendix M—HYDRAULIC SCHEMATICS

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M–2. HYDRAULIC SCHEMATICS.

NOTES

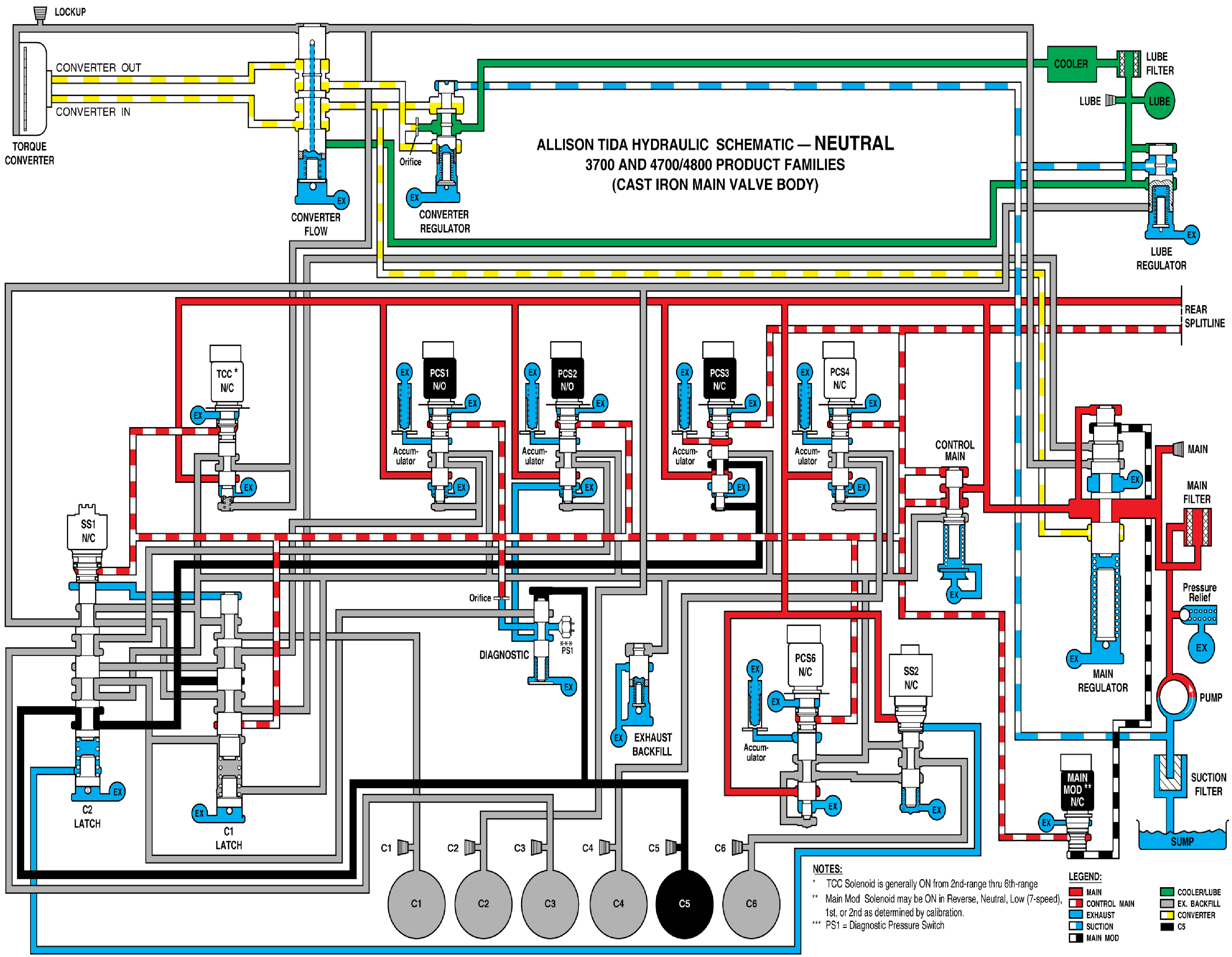


Figure M–1. Allison TIDA Hydraulic Schematic–Neutral 3700 and 4700/4800 Product Families (Cast Iron Main Valve Body)

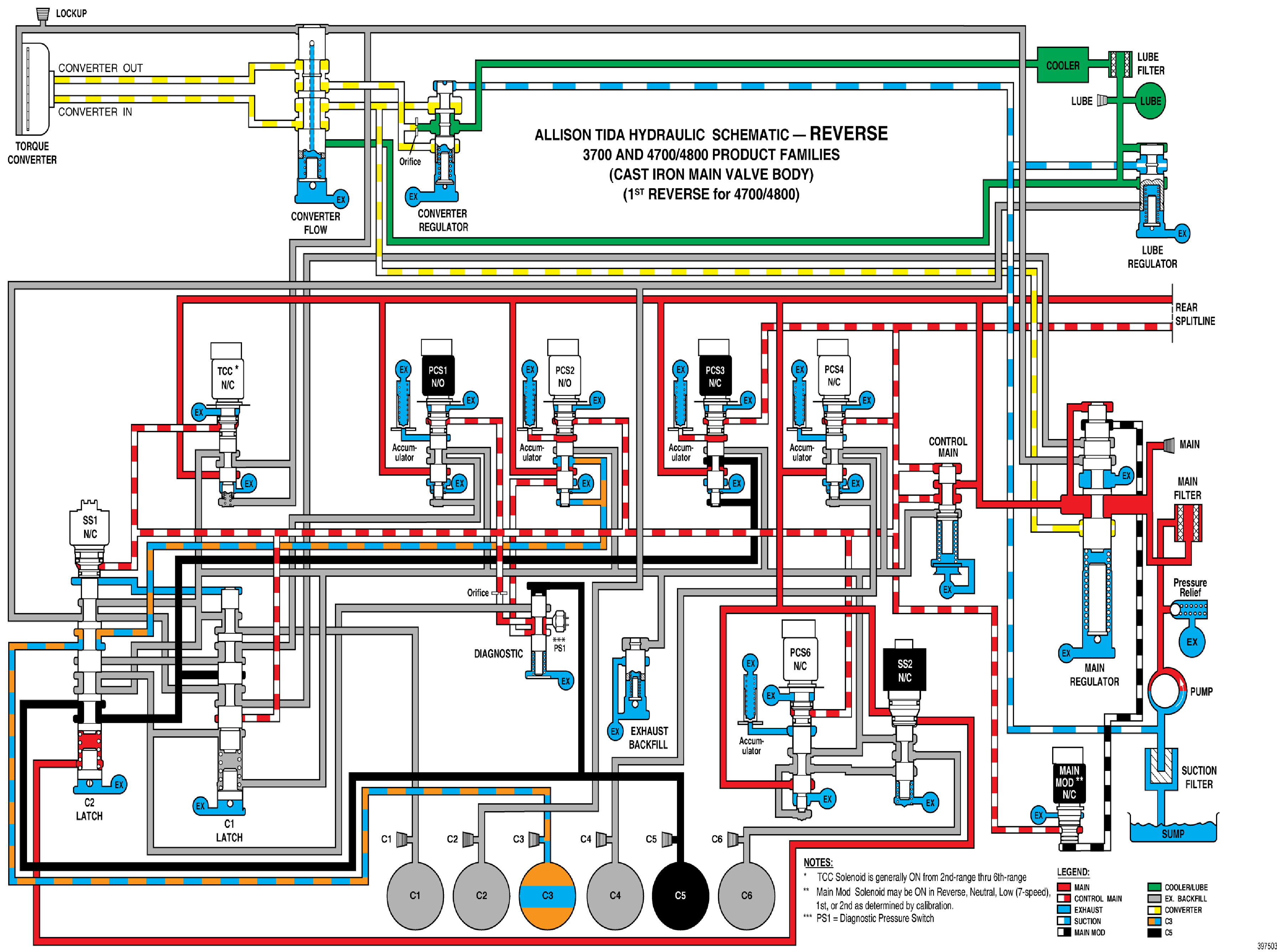


Figure M–2. Allison TIDA Hydraulic Schematic–Reverse 3700 and 4700/4800 Product Families (Standard Reverse for 4700/4800) (Cast Iron Main Valve Body)

FOLDOUT 5

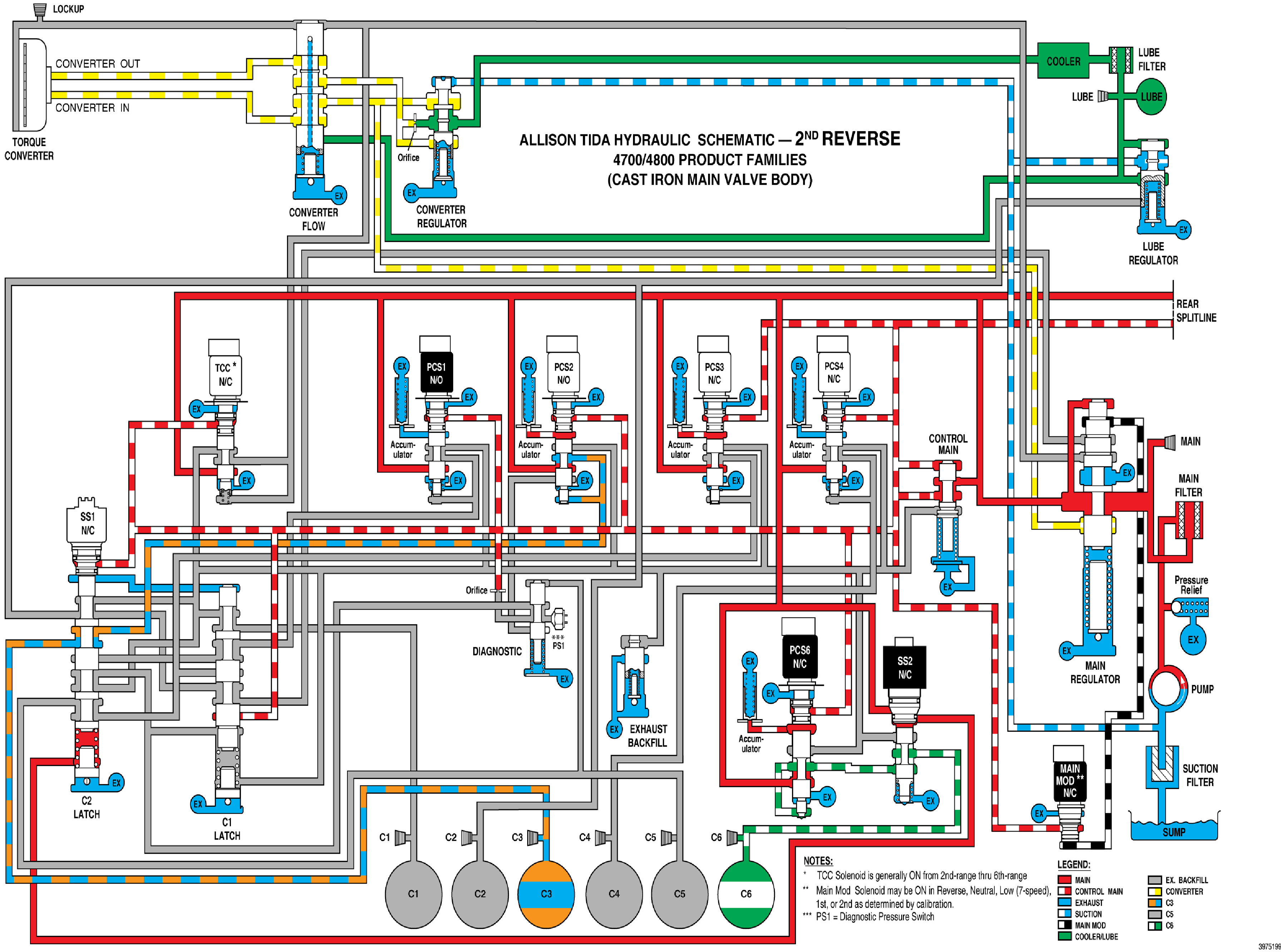


Figure M–3. Allison TIDA Hydraulic Schematic–Deep Reverse 4700/4800 Product Families (Cast Iron Main Valve Body)

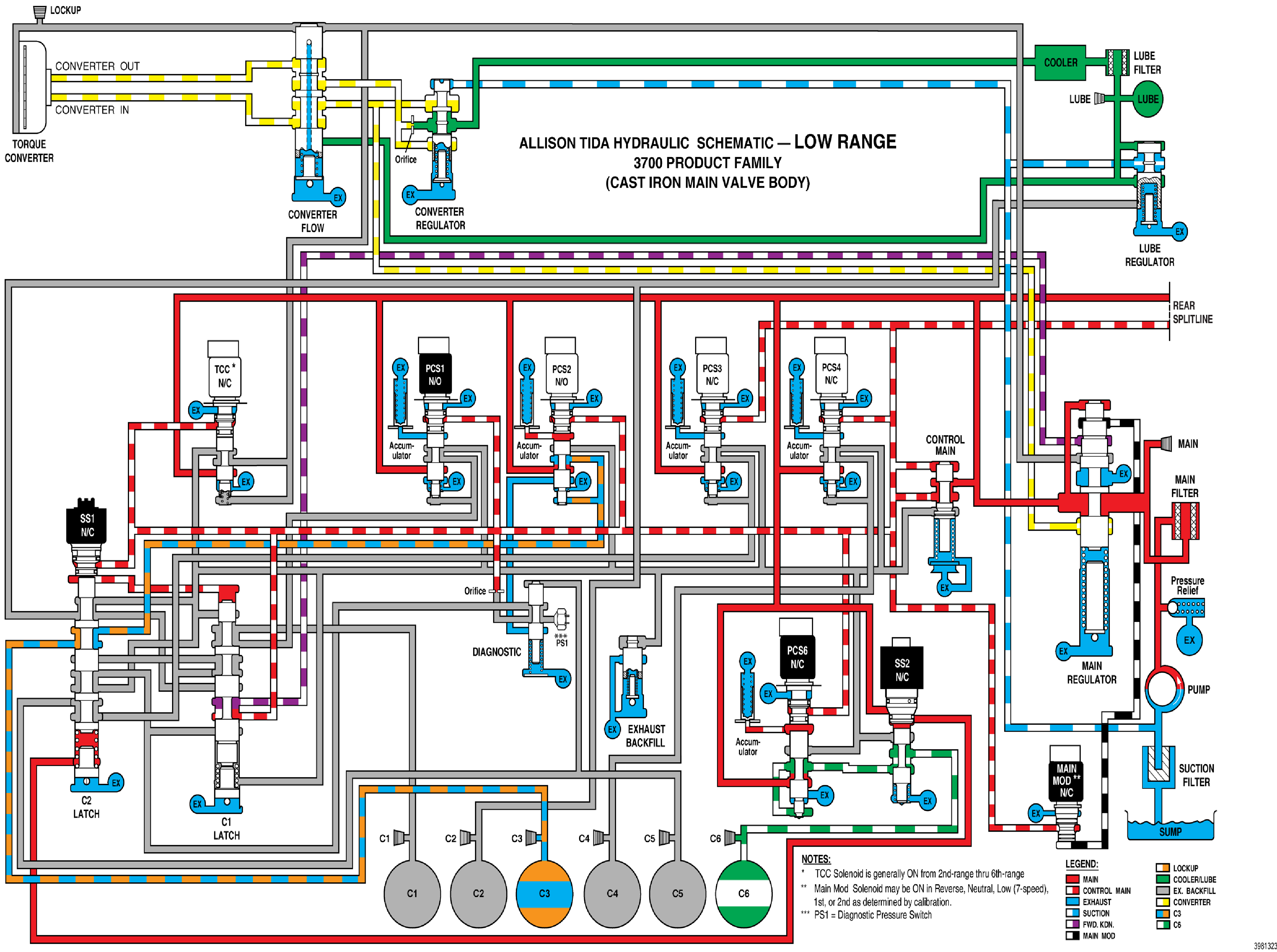


Figure M–4. Allison TIDA Hydraulic Schematic–Low Range 3700 Product Families (Cast Iron Main Valve Body)

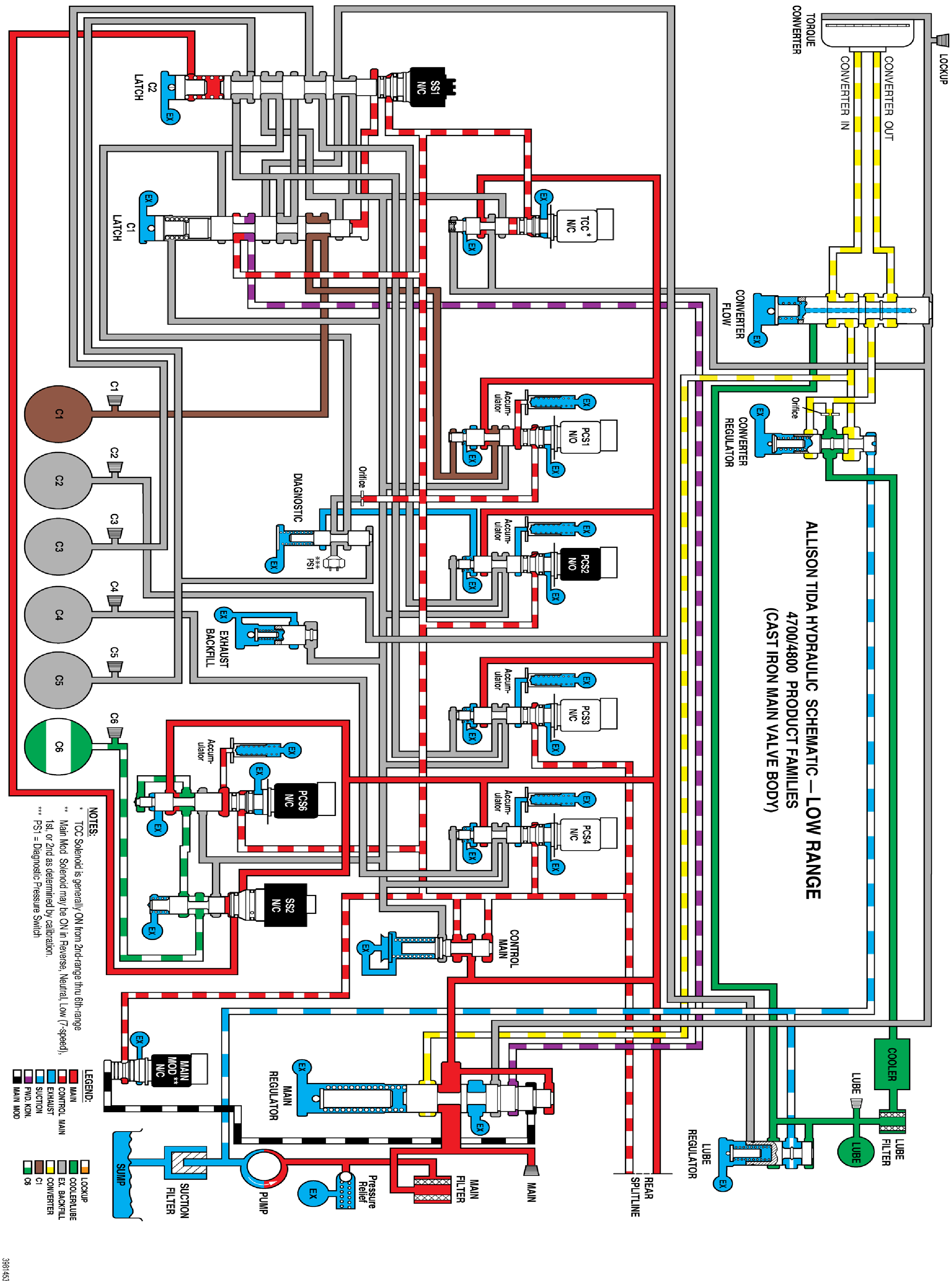


Figure M–5. Allison TIDA Hydraulic Schematic—Low Range 4700/4800 Product Families (Cast Iron Main Valve Body)

FOLDOUT 7

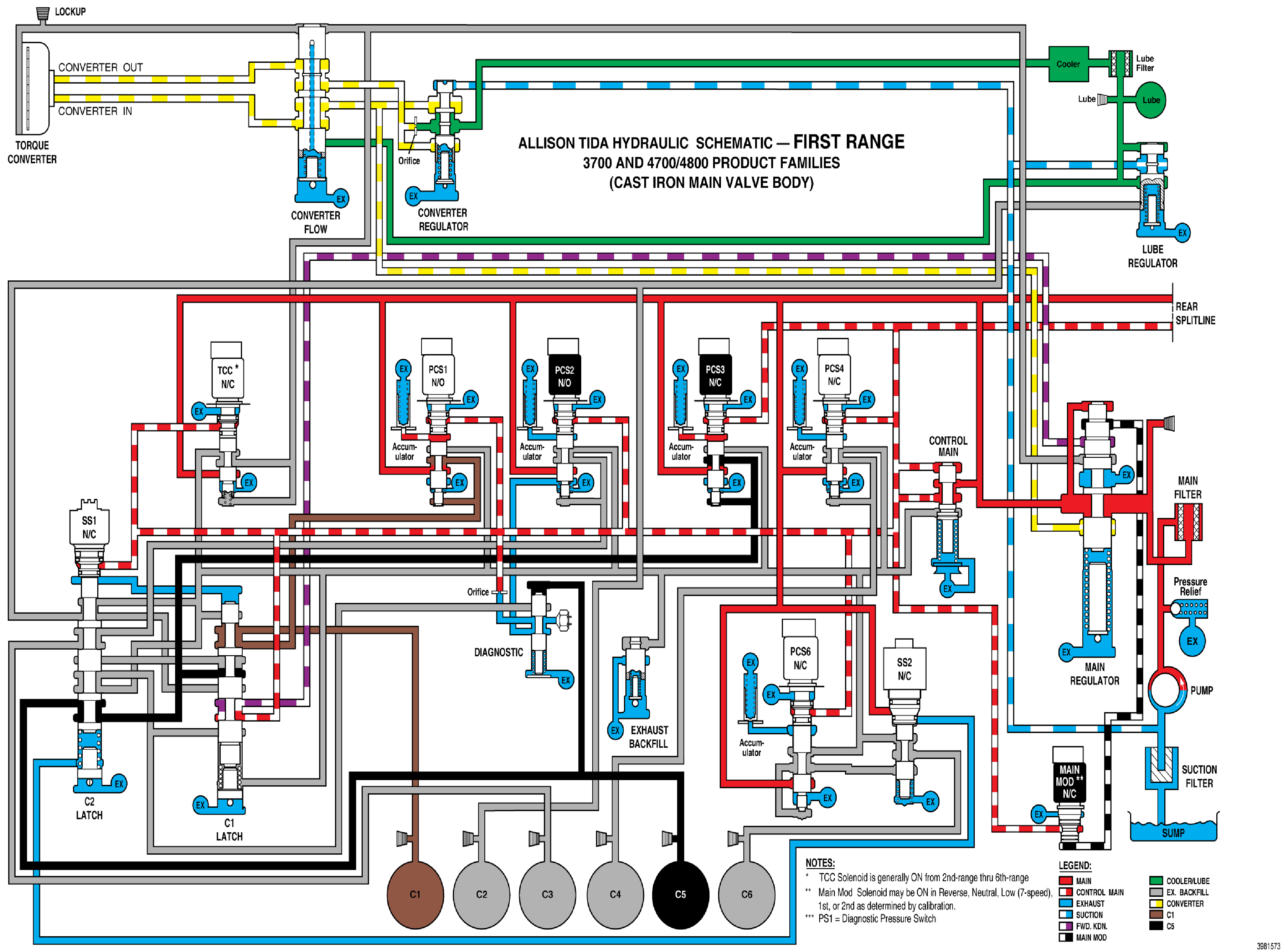


Figure M–6. Allison TIDA Hydraulic Schematic–First Range 3700 and 4700/4800 Product Families (Cast Iron Main Valve Body)

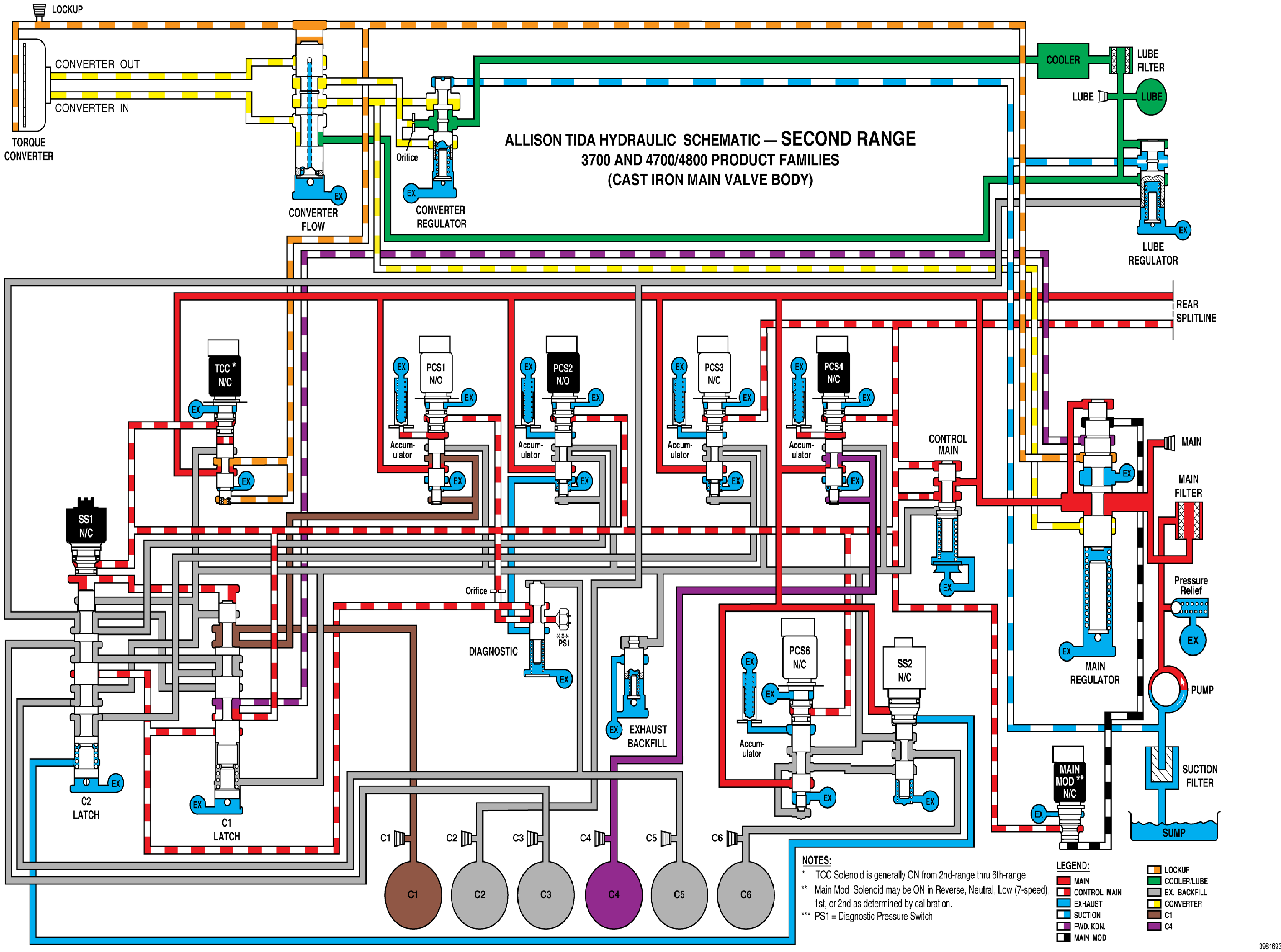


Figure M–7. Allison TIDA Hydraulic Schematic–Second Range 3700 and 4700/4800 Product Families (Cast Iron Main Valve Body)

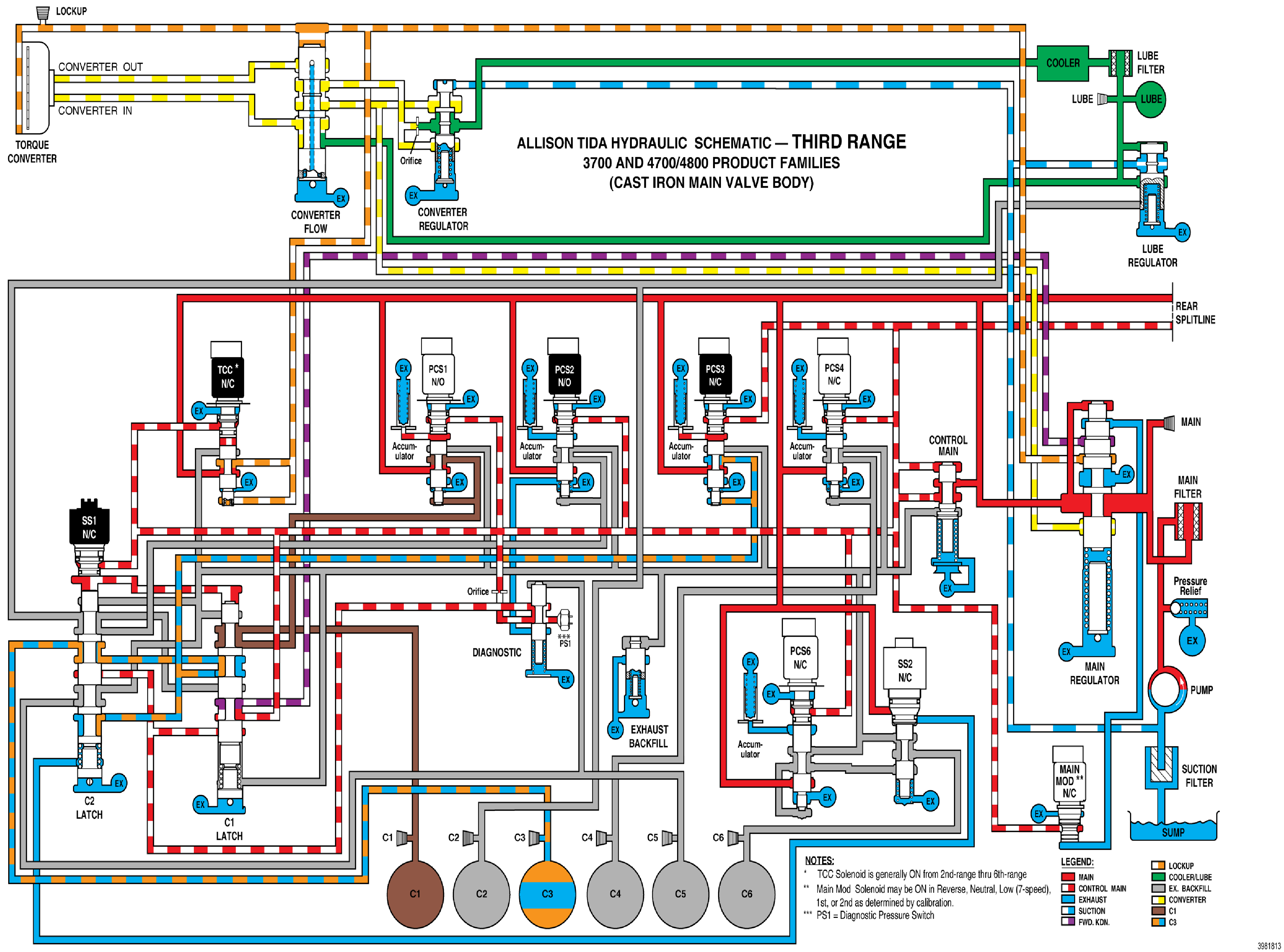


Figure M–8. Allison TIDA Hydraulic Schematic–Third Range 3700 and 4700/4800 Product Families (Cast Iron Main Valve Body)

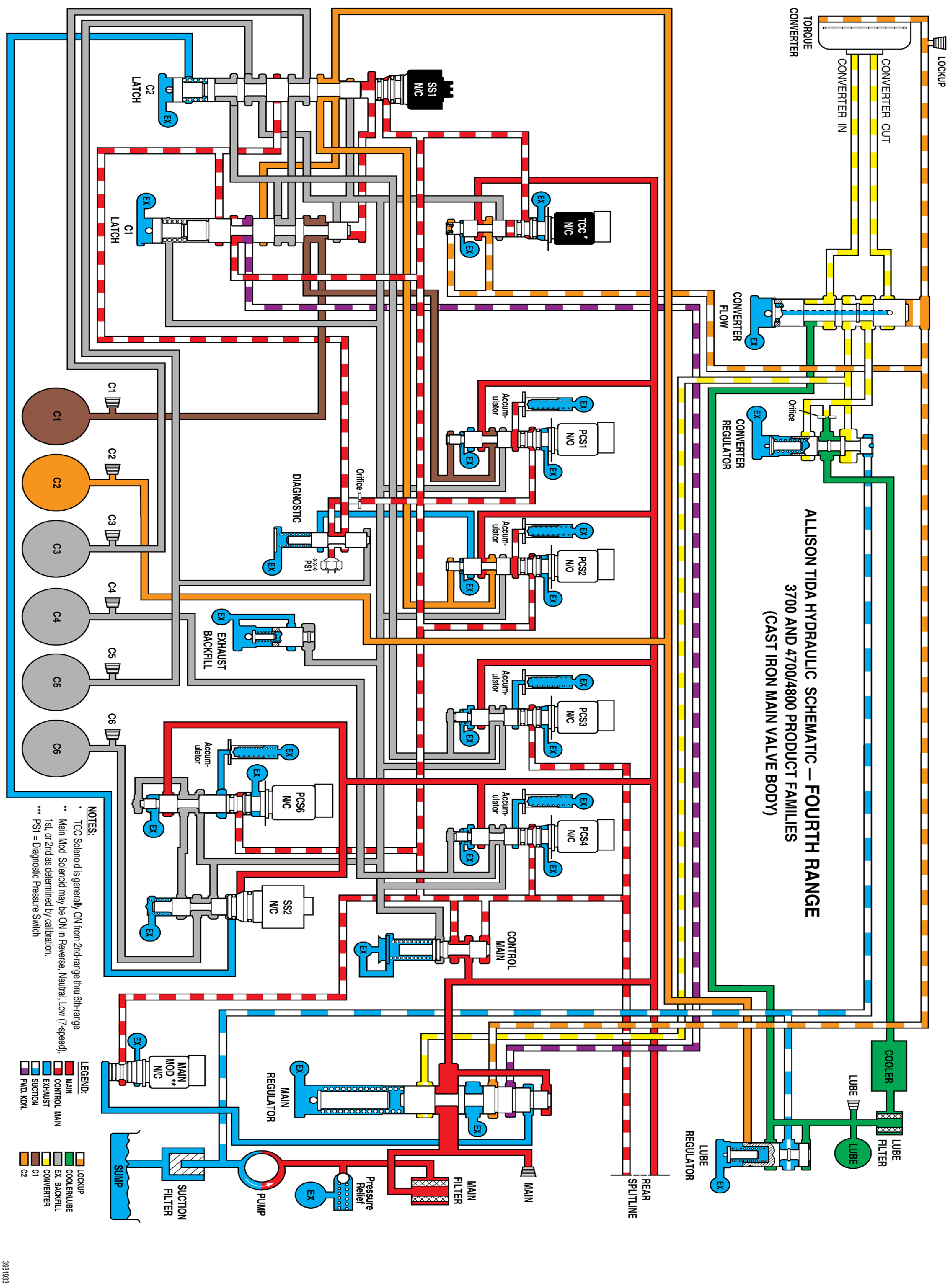
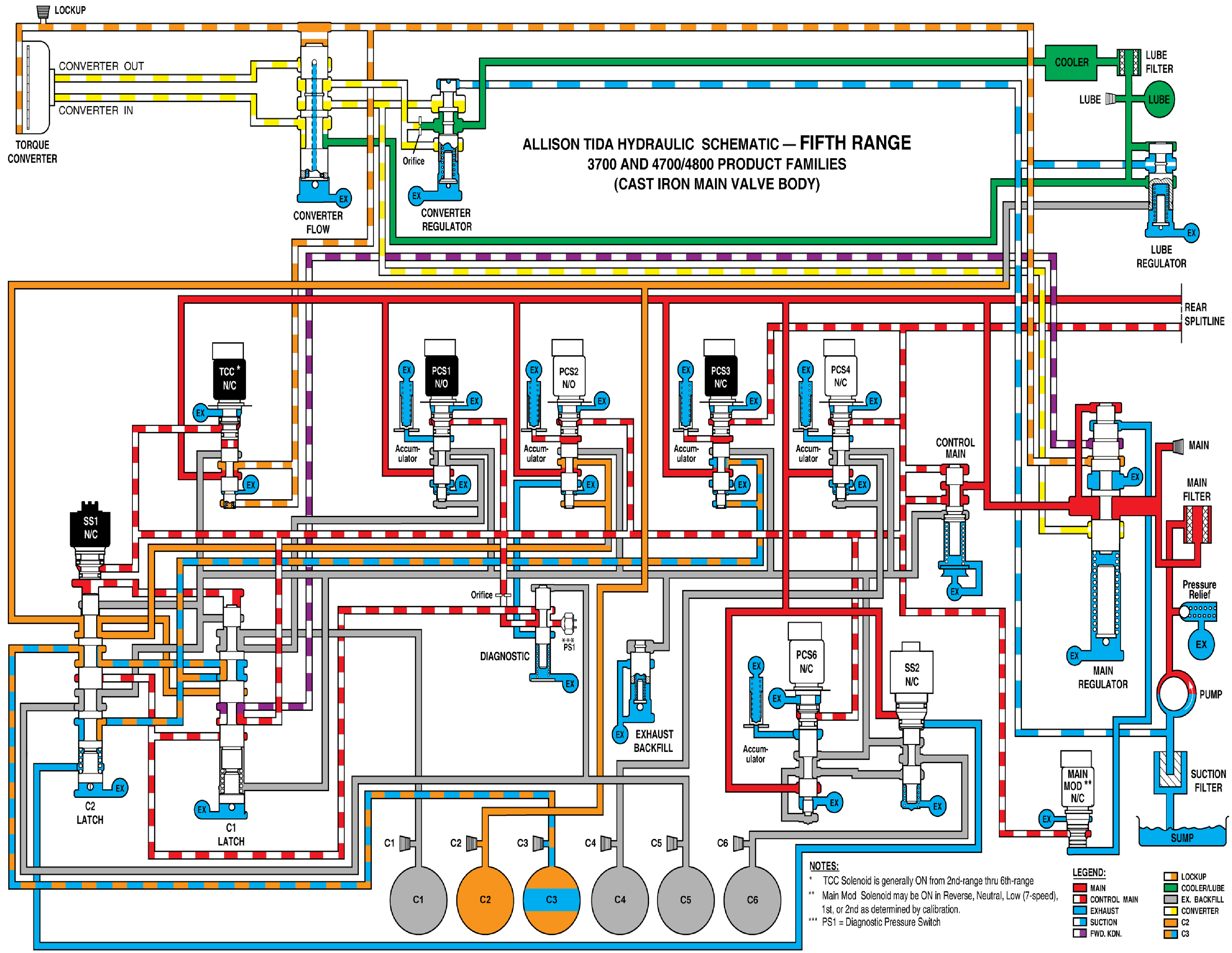


Figure M–9. Allison TIDA Hydraulic Schematic–Fourth Range 3700 and 4700/4800 Product Families (Cast Iron Main Valve Body)



NOTES:

* TCC Solenoid is generally ON from 2nd-range thru 6th-range

** Main Mod Solenoid may be ON in Reverse, Neutral, Low (7-speed), 1st, or 2nd as determined by calibration.

*** PS1 = Diagnostic Pressure Switch

LEGEND:

- MAIN
- CONTROL MAIN
- EXHAUST
- SUCTION
- FWD. KDN.
- LOCKUP
- COOLER/LUBE
- EX. BACKFILL
- CONVERTER
- C2
- C3

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Figure M–10. Allison TIDA Hydraulic Schematic–Fifth Range 3700 and 4700/4800 Product Families (Cast Iron Main Valve Body)

FOLDOUT 13

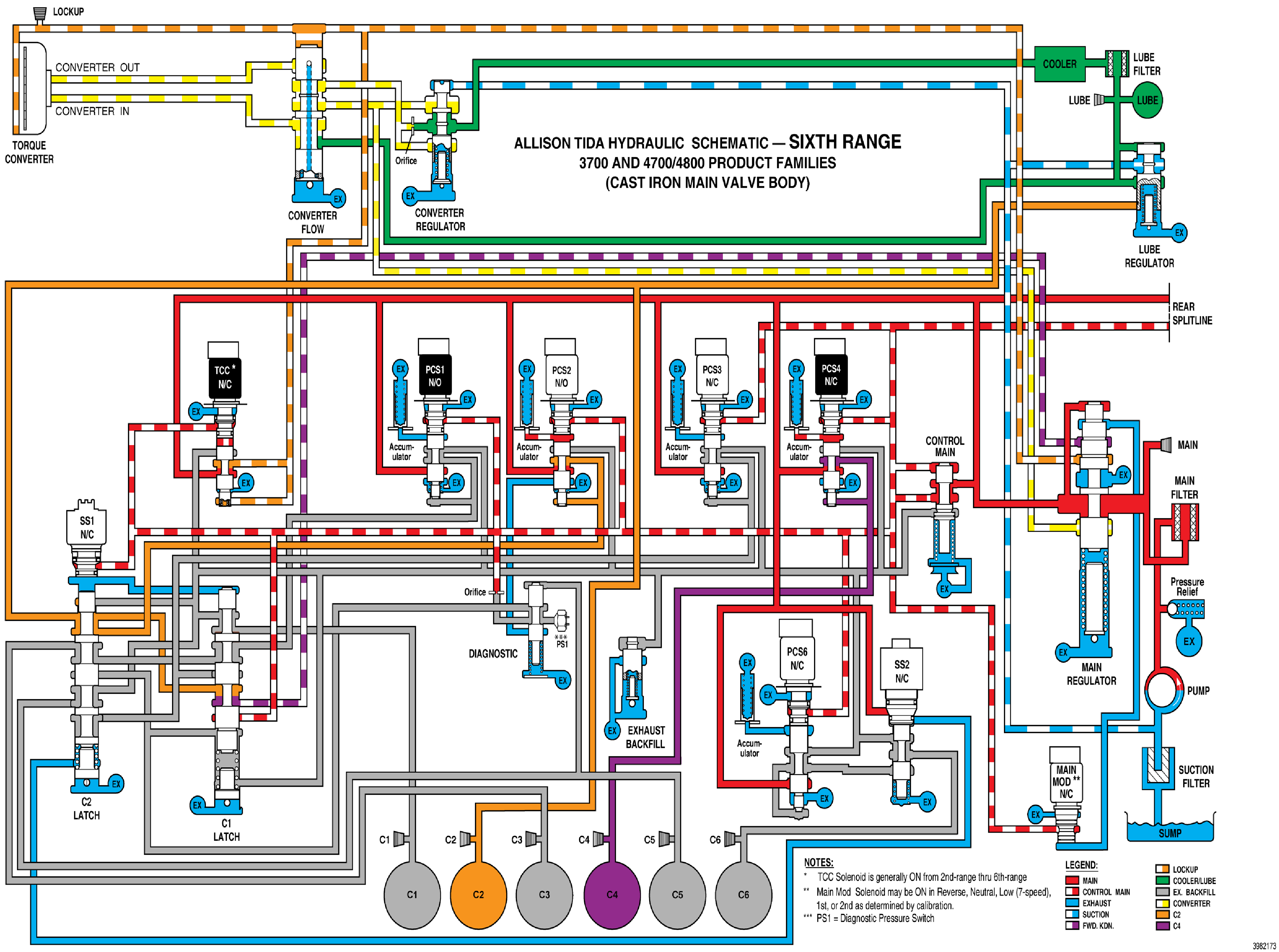


Figure M–11. Allison TIDA Hydraulic Schematic–Sixth Range 3700 and 4700/4800 Product Families (Cast Iron Main Valve Body)

3000 PRODUCT FAMILY RETARDER HYDRAULIC SCHEMATIC – RETARDER OFF

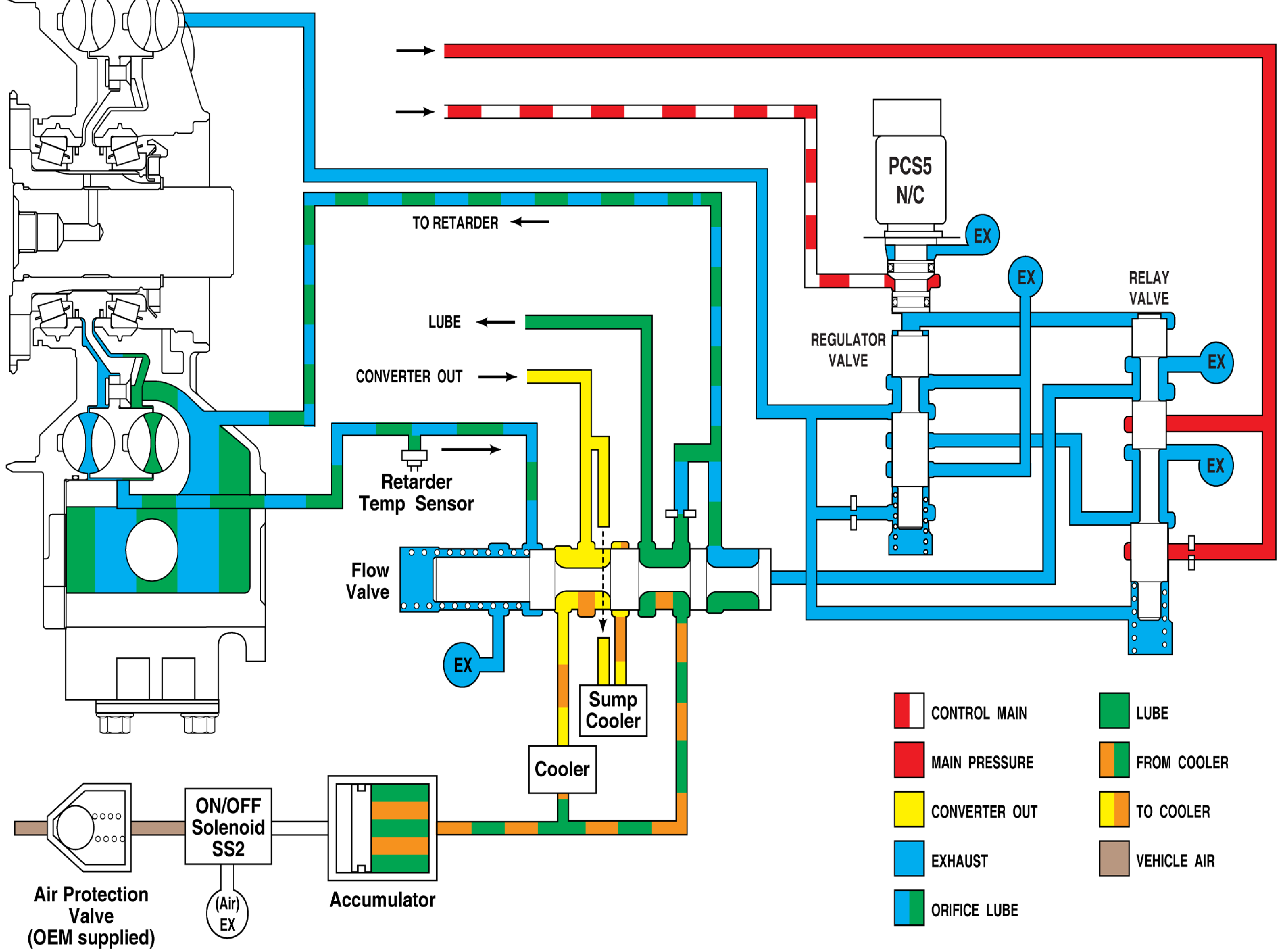


Figure M–12. Allison Hydraulic Schematic–Retarder OFF 3000 Product Family

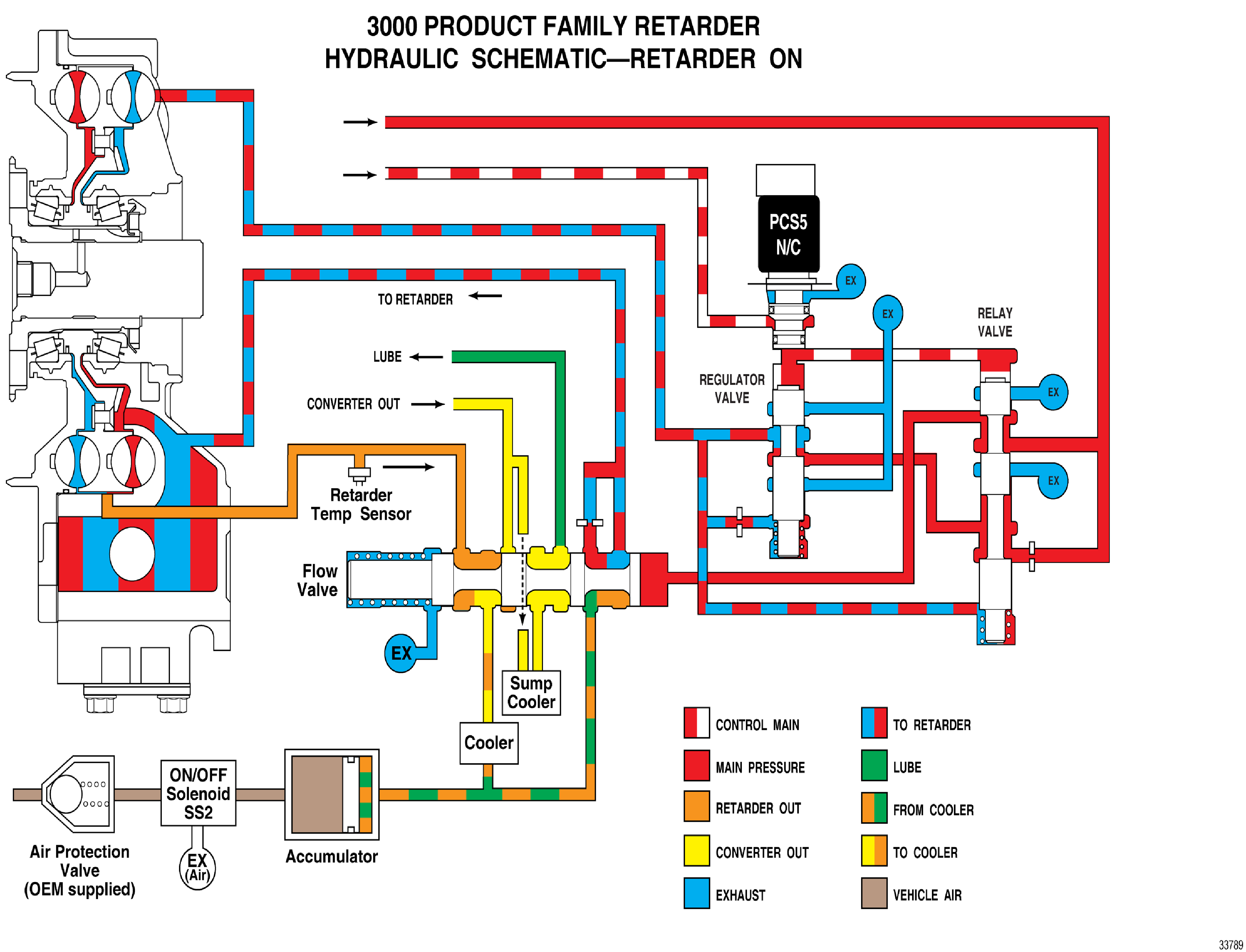


Figure M–13. Allison Hydraulic Schematic–Retarder ON 3000 Product Family

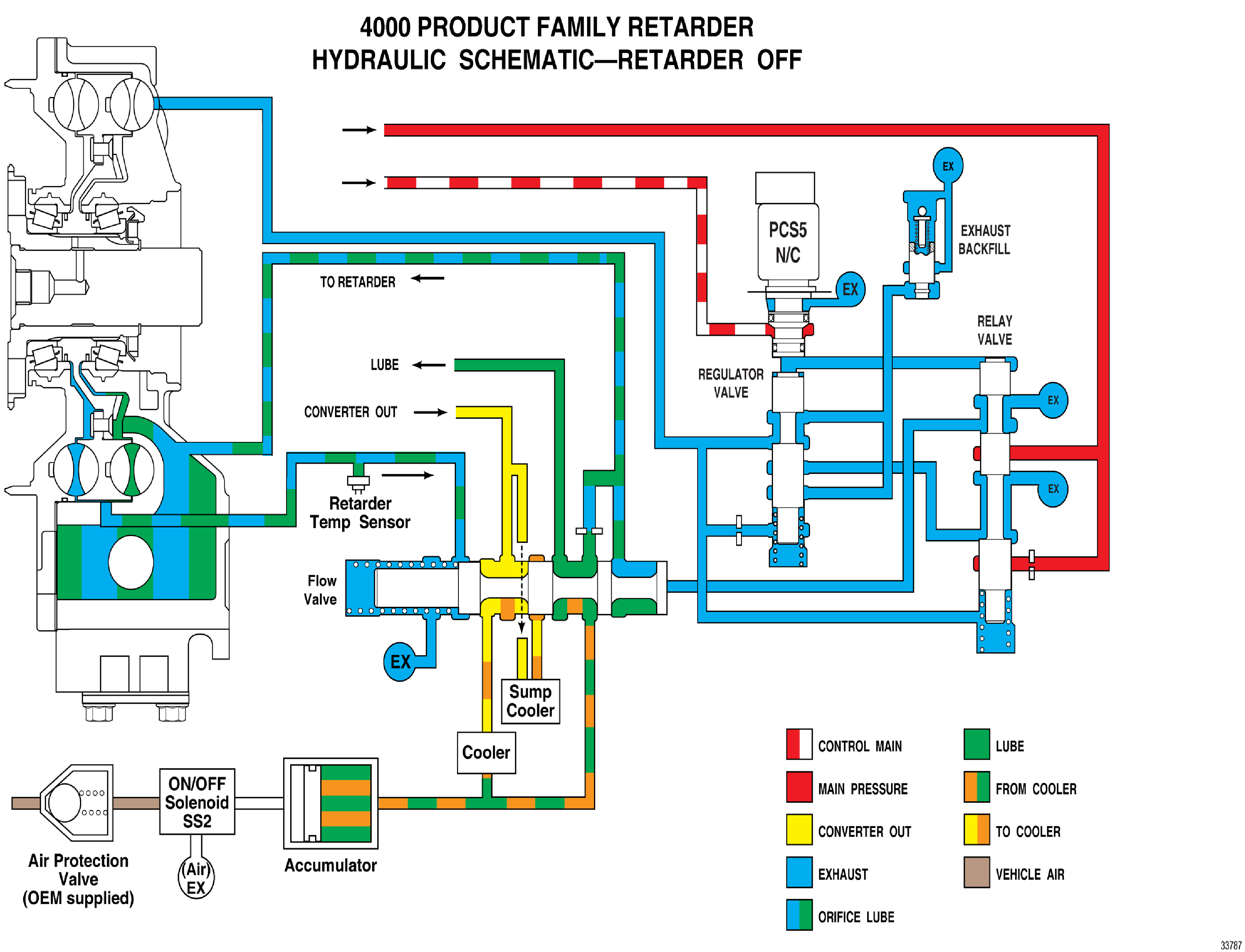


Figure M–14. Allison Hydraulic Schematic–Retarder OFF 4000 Product Family

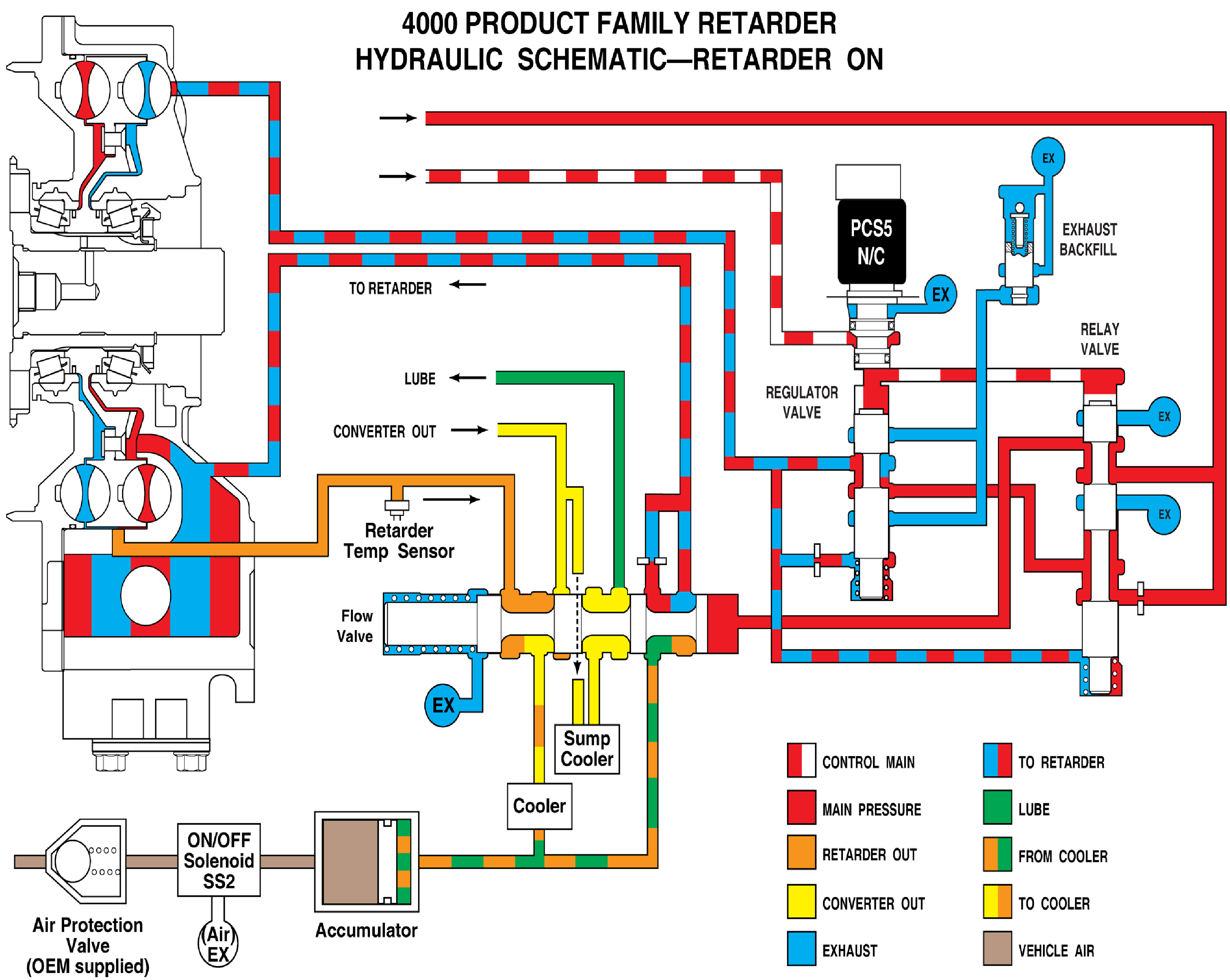
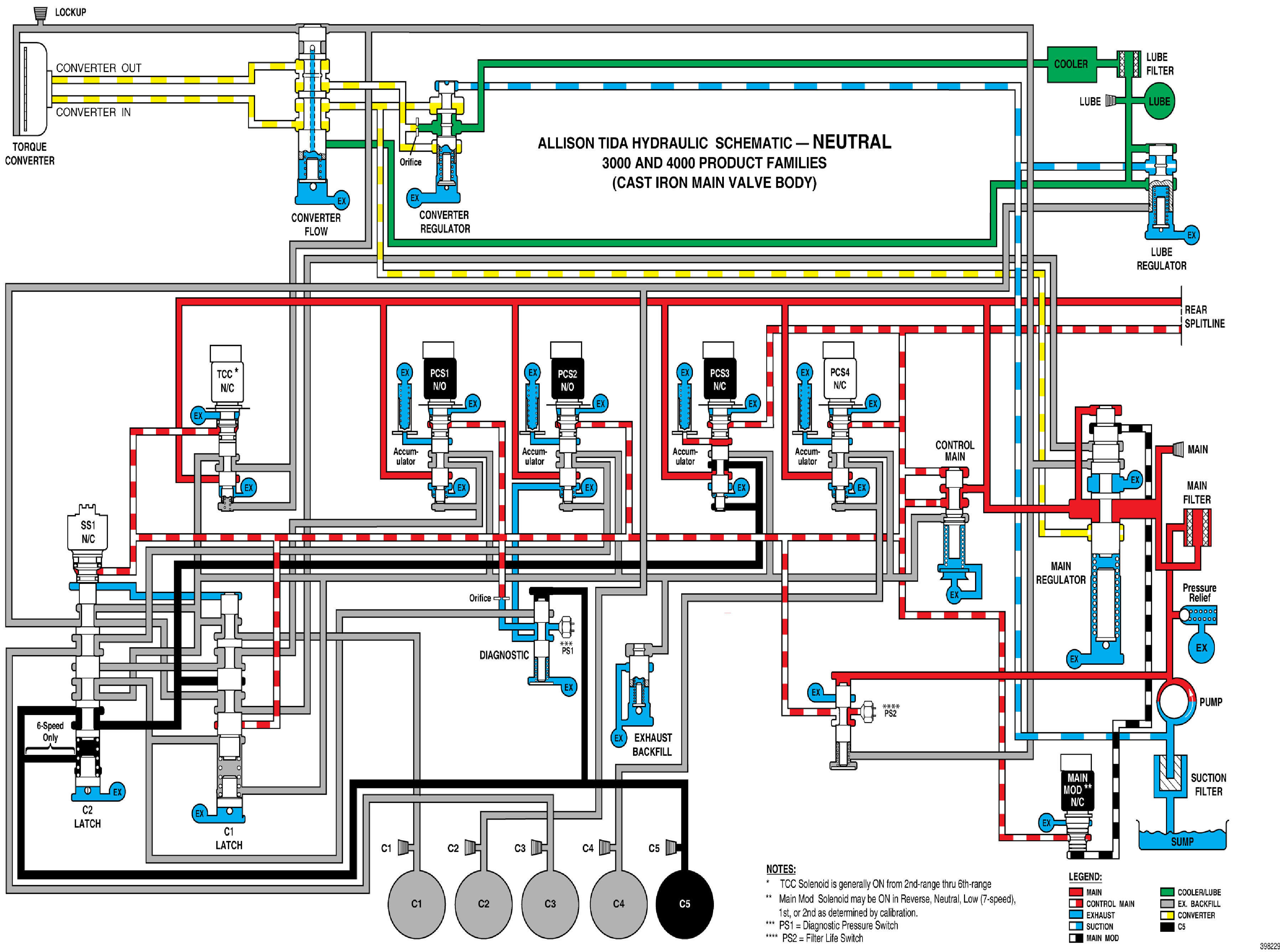


Figure M–15. Allison Hydraulic Schematic–Retarder ON 4000 Product Family



NOTES:

* TCC Solenoid is generally ON from 2nd-range thru 6th-range

** Main Mod Solenoid may be ON in Reverse, Neutral, Low (7-speed), 1st, or 2nd as determined by calibration.

*** PS1 = Diagnostic Pressure Switch

**** PS2 = Filter Life Switch

Figure M–16. Allison TIDA Hydraulic Schematic–Neutral With Prognostics 3000 and 4000 Product Families (Cast Iron Main Valve Body)

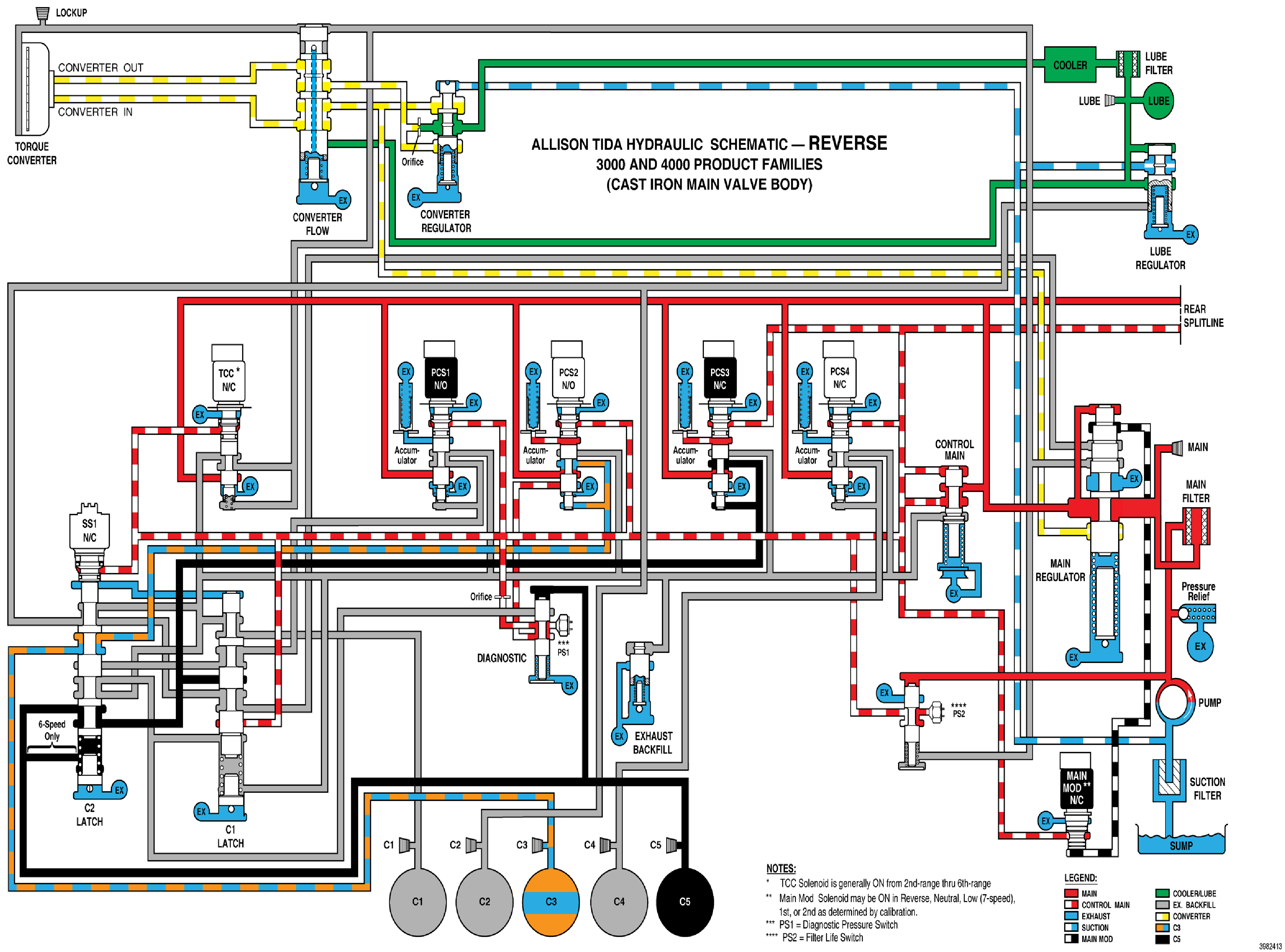
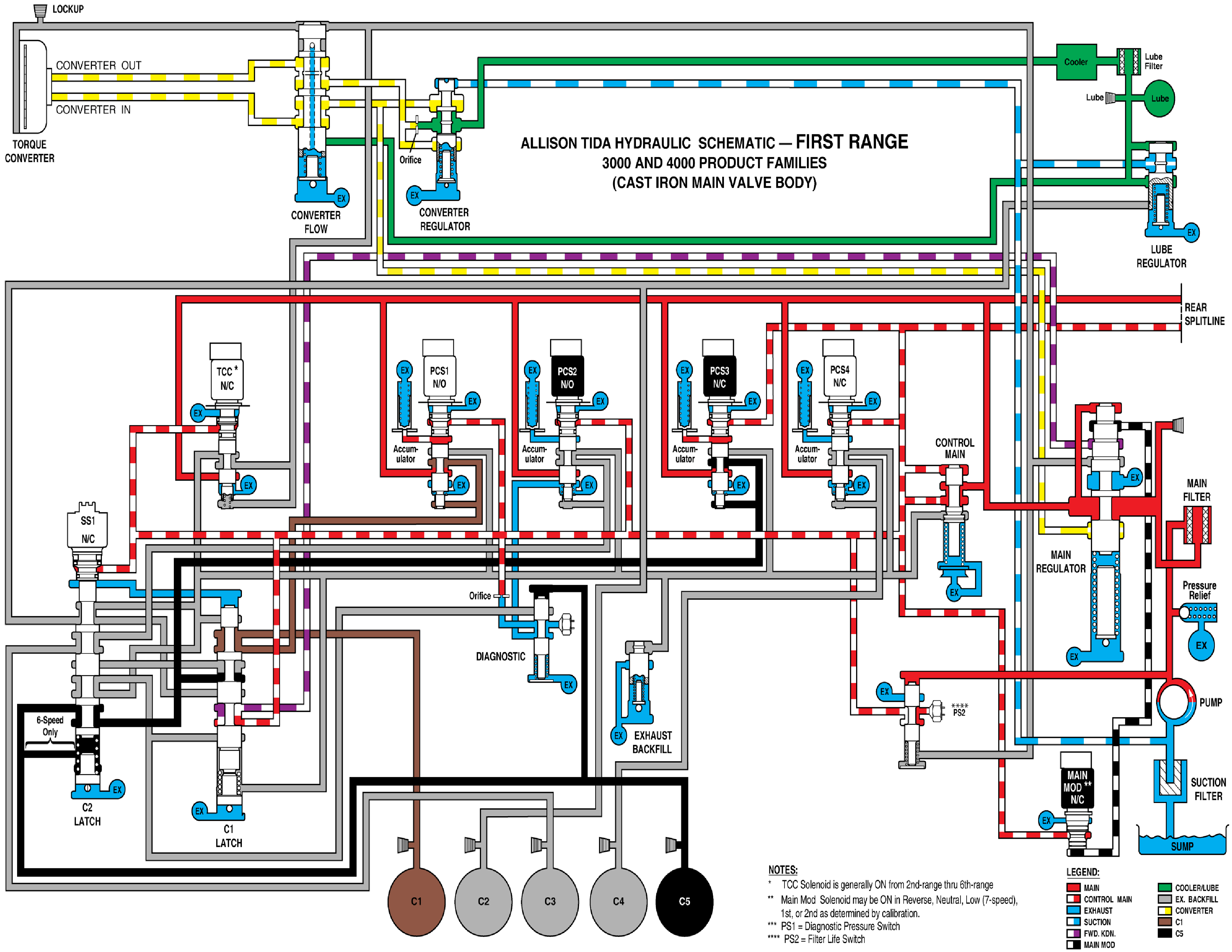


Figure M–17. Allison TIDA Hydraulic Schematic–Reverse With Prognostics 3000 and 4000 Product Families (Cast Iron Main Valve Body)



NOTES:

* TCC Solenoid is generally ON from 2nd-range thru 6th-range

** Main Mod Solenoid may be ON in Reverse, Neutral, Low (7-speed), 1st, or 2nd as determined by calibration.

*** PS1 = Diagnostic Pressure Switch

**** PS2 = Filter Life Switch

LEGEND:

MAIN	COOLER/LUBE
CONTROL MAIN	EX. BACKFILL
EXHAUST	CONVERTER
SUCTION	C1
FWD. KDN.	C5
MAIN MOD	

Figure M–18. Allison TIDA Hydraulic Schematic–First Range With Prognostics 3000 and 4000 Product Families (Cast Iron Main Valve Body)

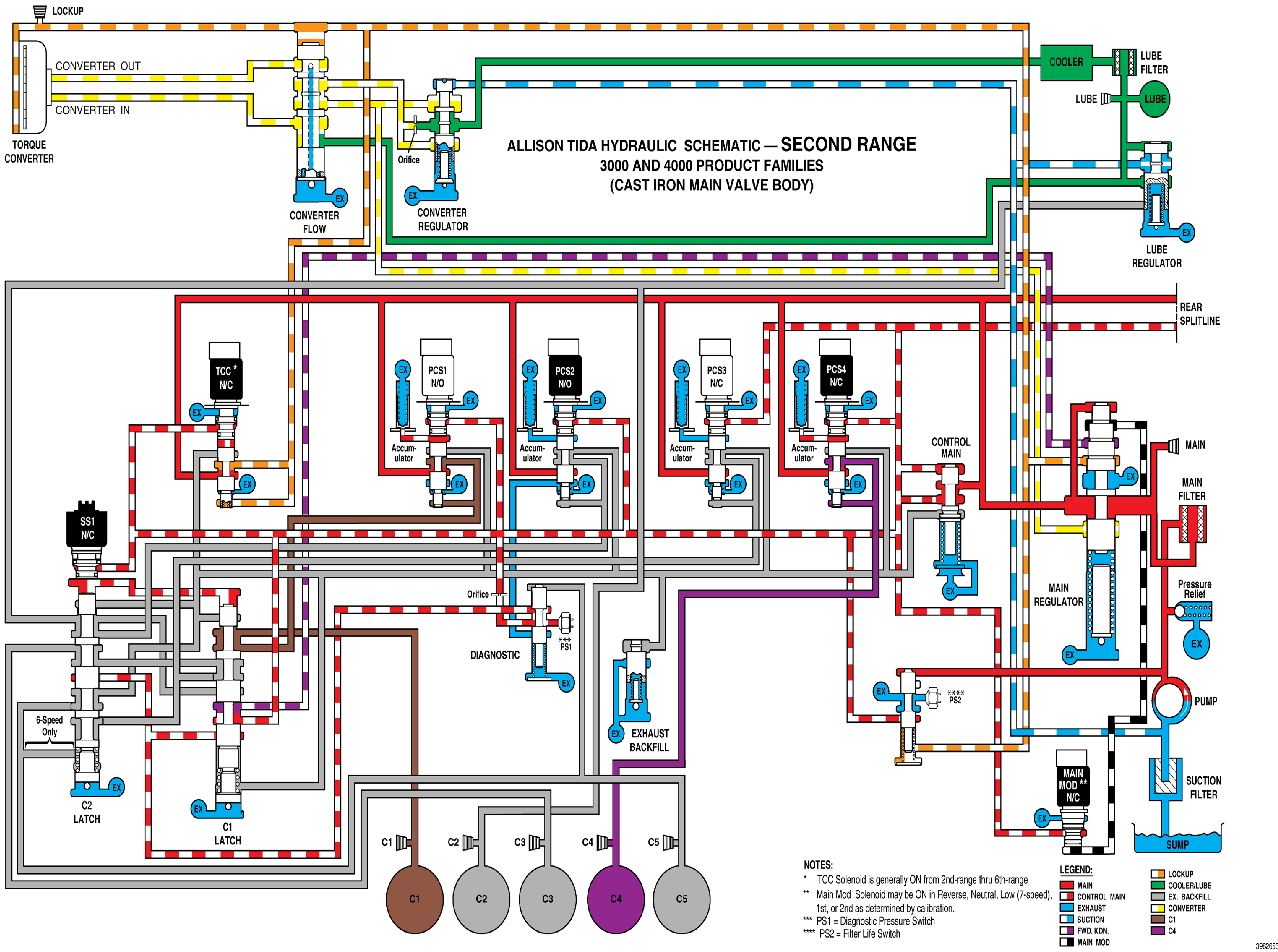
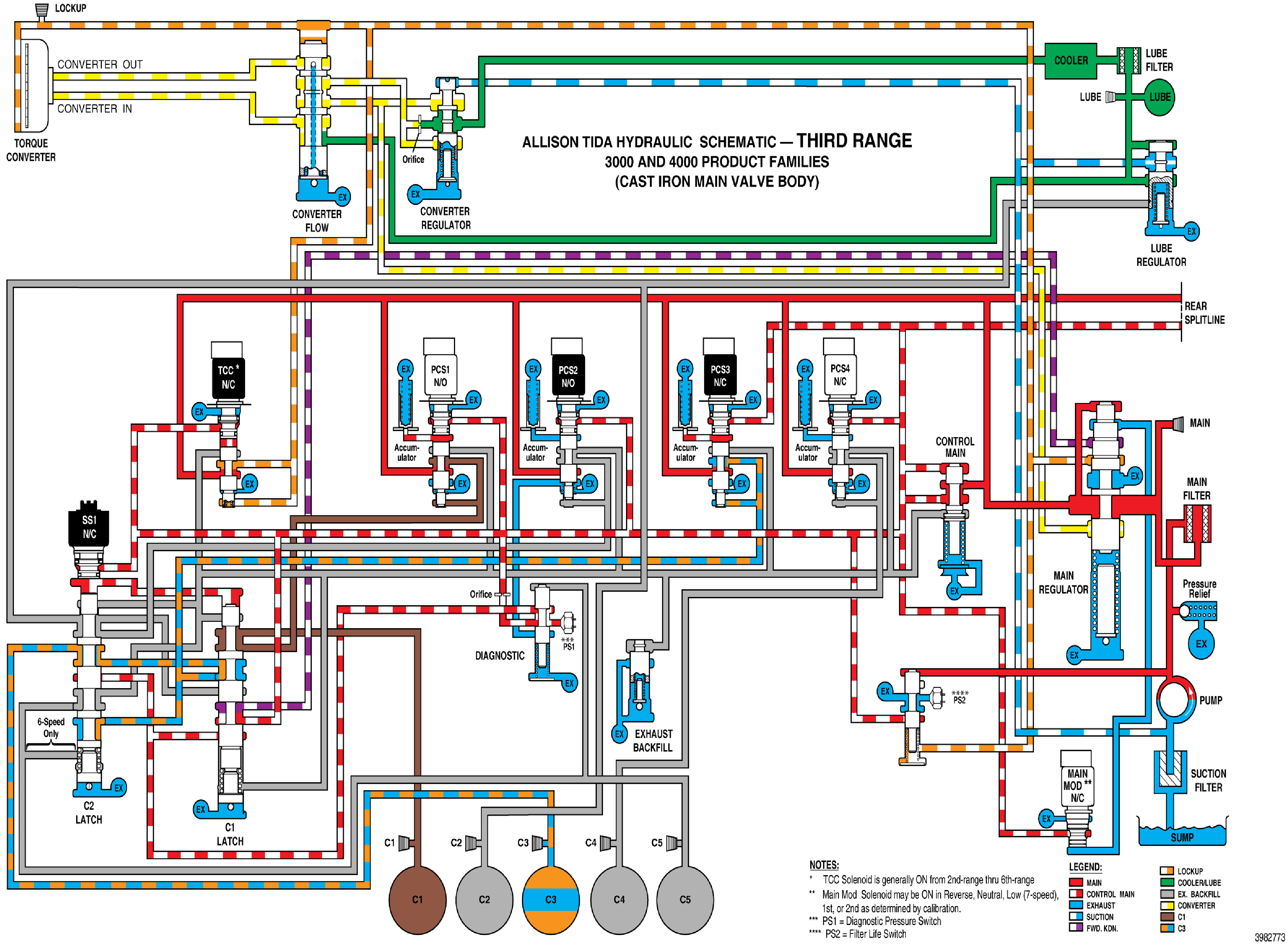


Figure M–19. Allison TIDA Hydraulic Schematic–Second Range With Prognostics 3000 and 4000 Product Families (Cast Iron Main Valve Body)



NOTES:
* TCC Solenoid is generally ON from 2nd-range thru 6th-range
** Main Mod Solenoid may be ON in Reverse, Neutral, Low (7-speed), 1st, or 2nd as determined by calibration.
*** PS1 = Diagnostic Pressure Switch
**** PS2 = Filter Life Switch

LEGEND:
MAIN
CONTROL MAIN
EXHAUST
SUCTION
FWD. KDN.
LOCKUP
COOLER/LUBE
EX. BACKFILL
CONVERTER
C1
C3

Figure M–20. Allison TIDA Hydraulic Schematic–Third Range With Prognostics 3000 and 4000 Product Families (Cast Iron Main Valve Body)

FOLDOUT 23

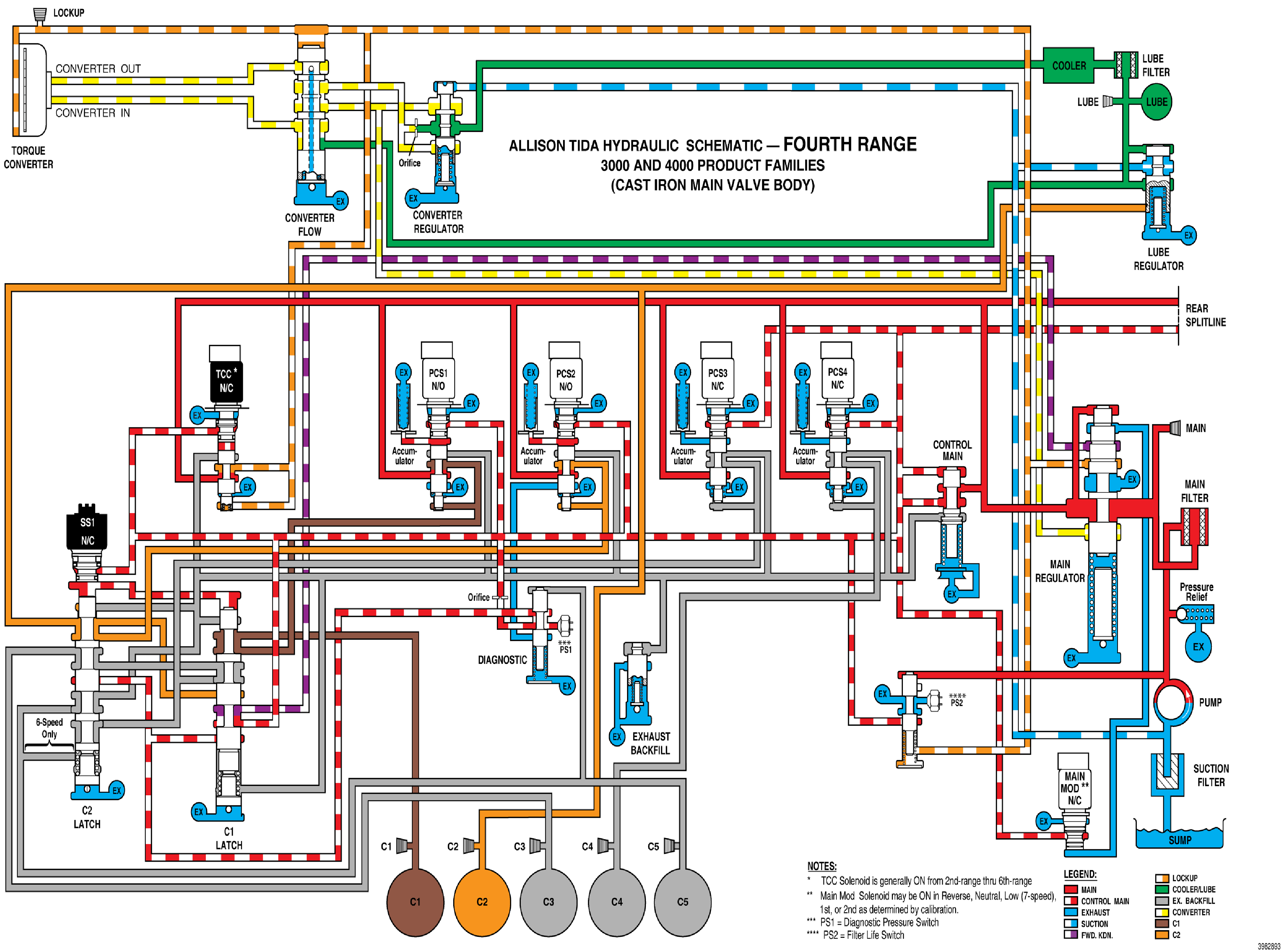


Figure M–21. Allison TIDA Hydraulic Schematic–Fourth Range With Prognostics 3000 and 4000 Product Families (Cast Iron Main Valve Body)

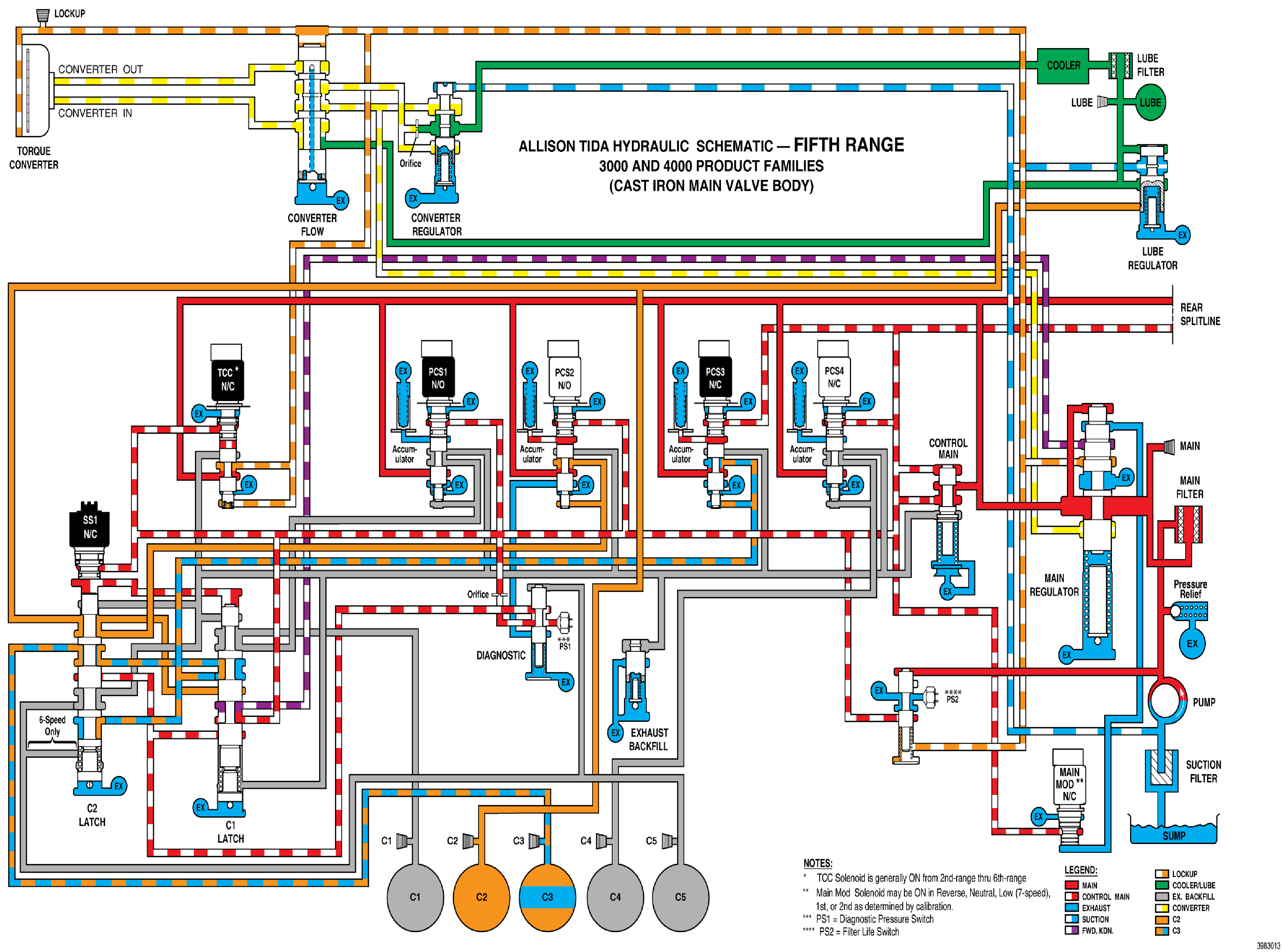


Figure M–22. Allison TIDA Hydraulic Schematic–Fifth Range With Prognostics 3000 and 4000 Product Families (Cast Iron Main Valve Body)

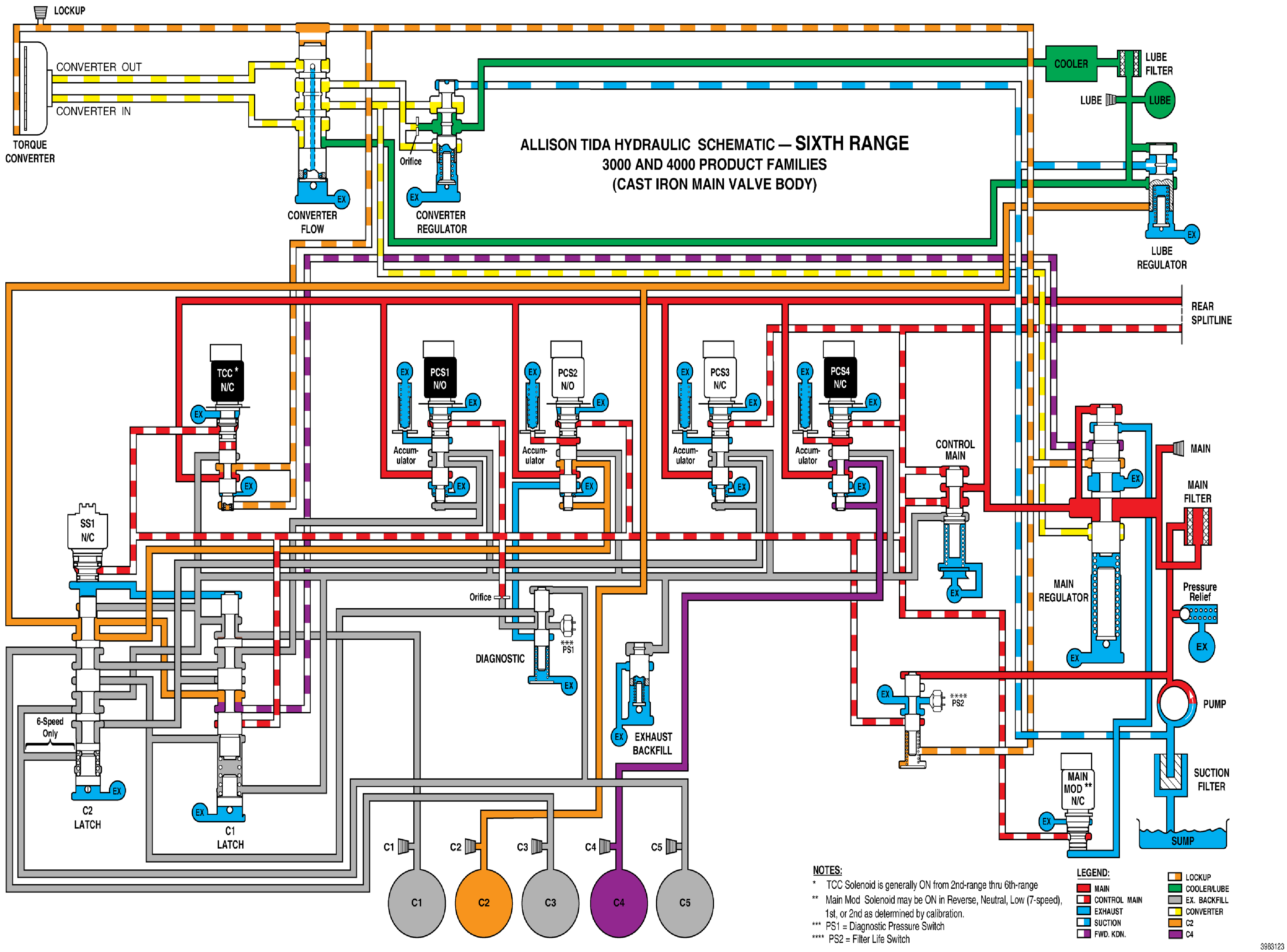


Figure M–23. Allison TIDA Hydraulic Schematic–Sixth Range With Prognostics 3000 and 4000 Product Families (Cast Iron Main Valve Body)

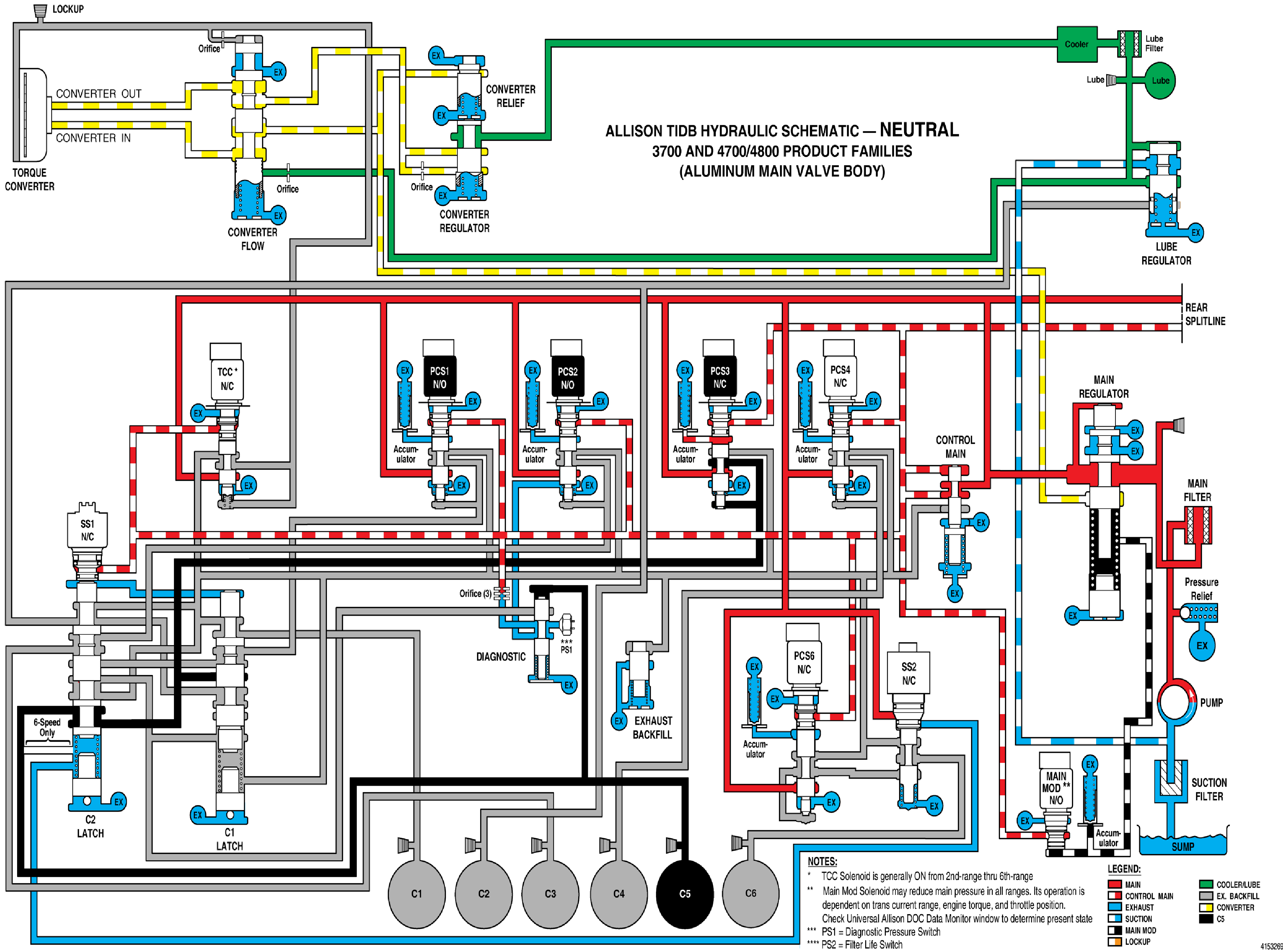


Figure M–24. Allison TIDB Hydraulic Schematic–Neutral Range 3700 and 4700/4800 Product Families (Aluminum Main Valve Body)

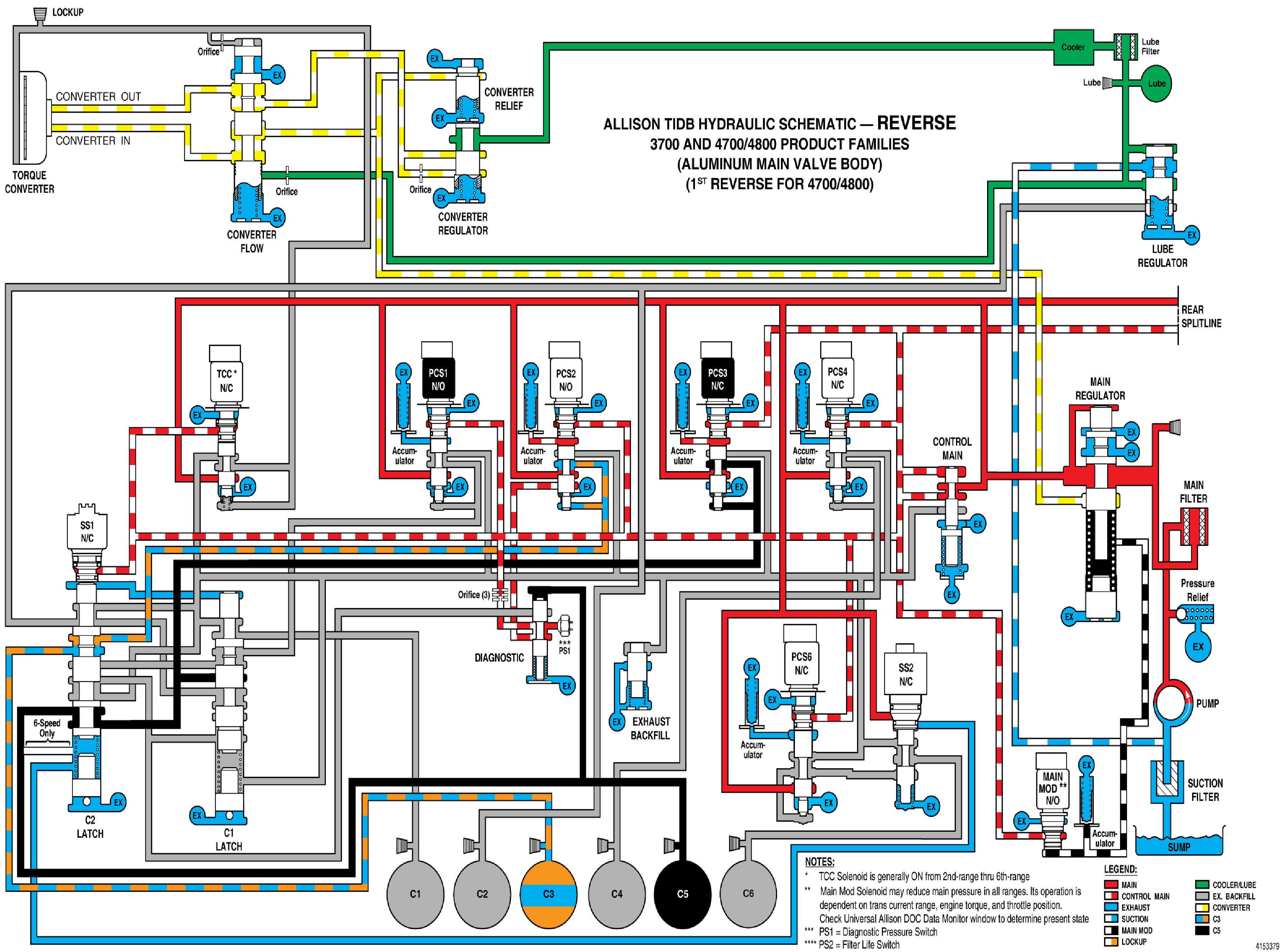


Figure M–25. Allison TIDB Hydraulic Schematic–Reverse Range (Standard Reverse for 4700/4800) 3700 and 4700/4800 Product Families (Aluminum Main Valve Body)

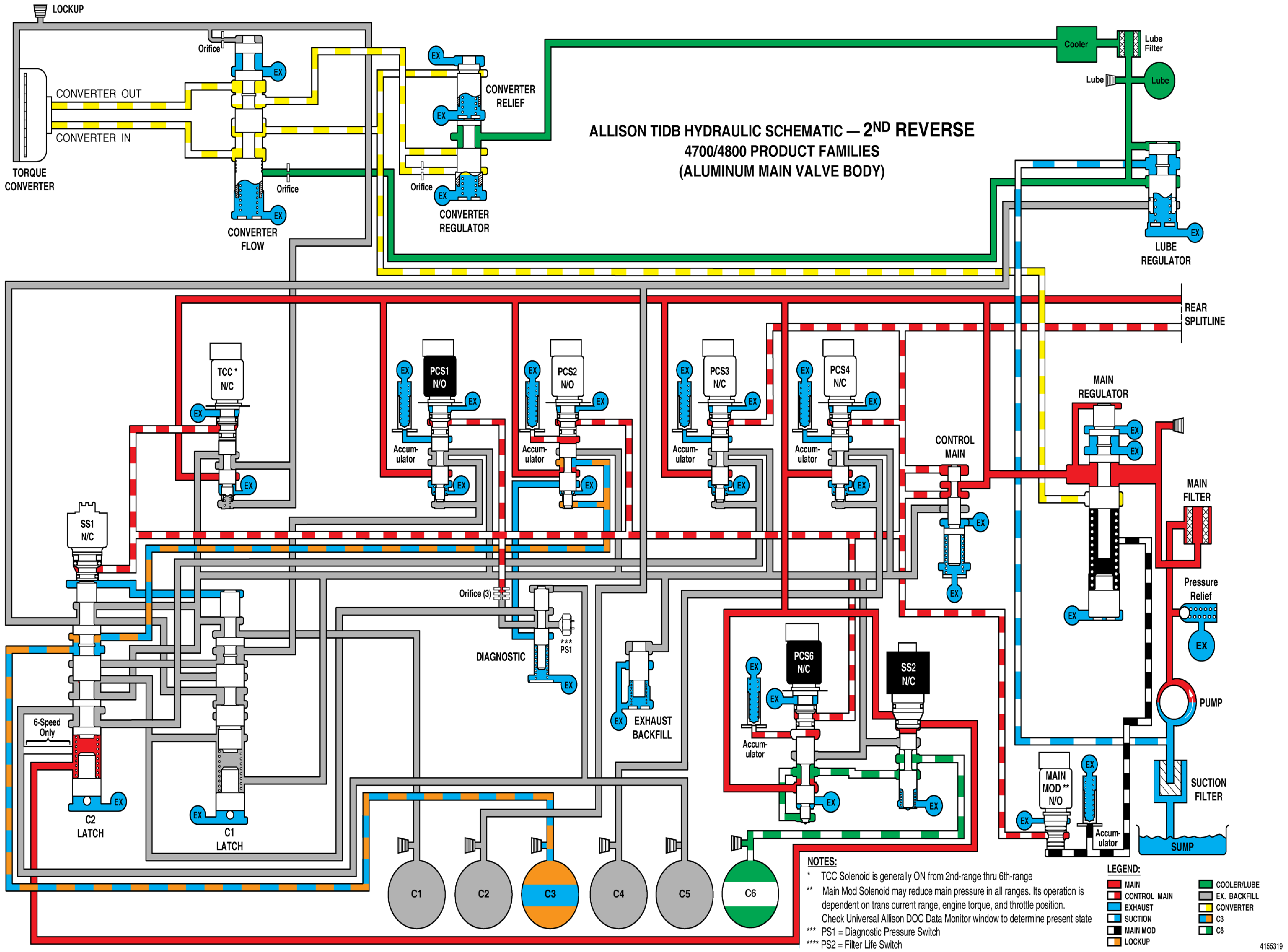


Figure M–26. Allison TID B Hydraulic Schematic–Deep Reverse 4700/4800 Product Families (Aluminum Main Valve Body)

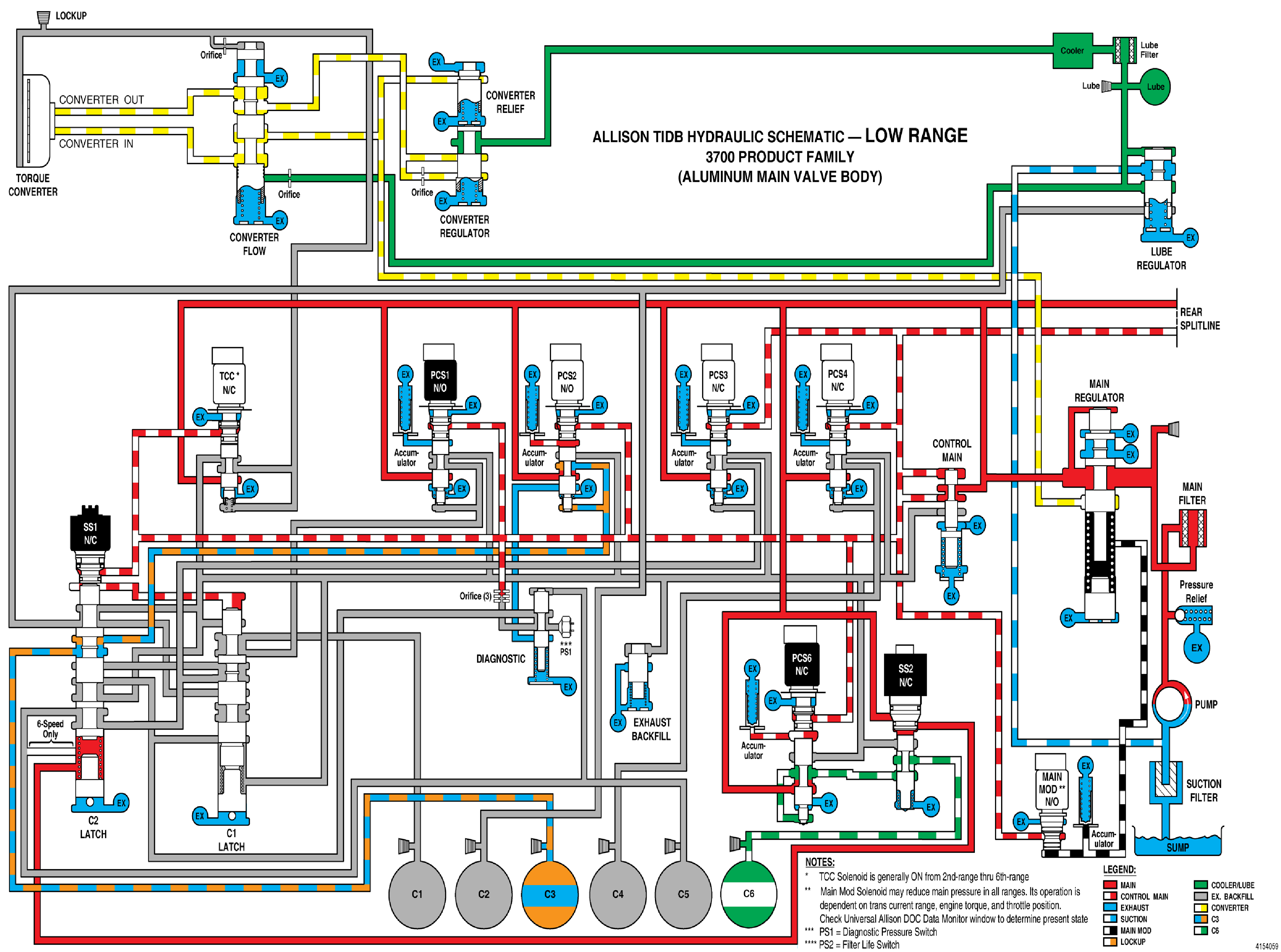


Figure M–27. Allison TIDB Hydraulic Schematic–Low Range 3700 Product Families (Aluminum Main Valve Body)

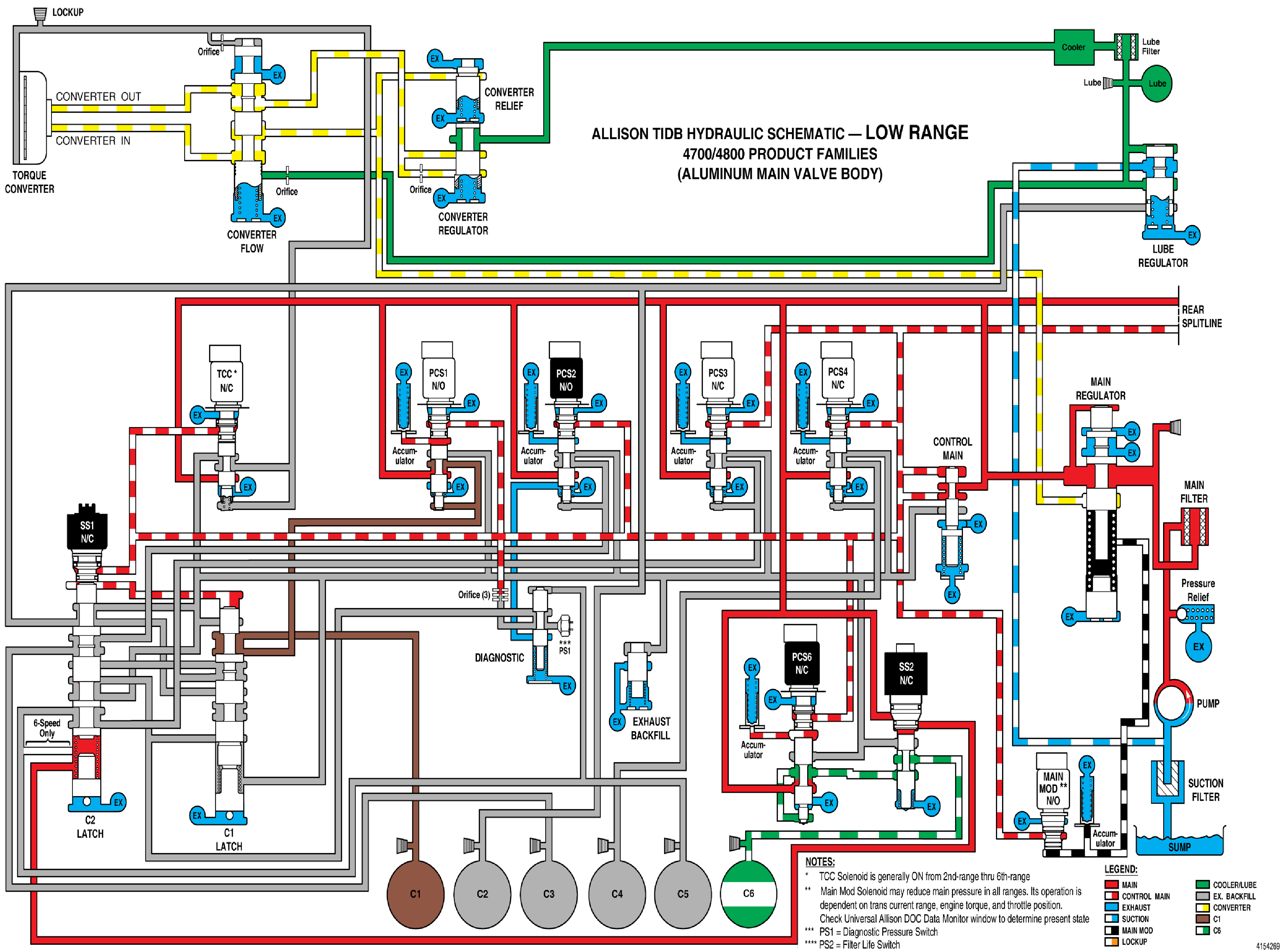


Figure M–28. Allison TIDB Hydraulic Schematic–Low Range 4700/4800 Product Families (Aluminum Main Valve Body)

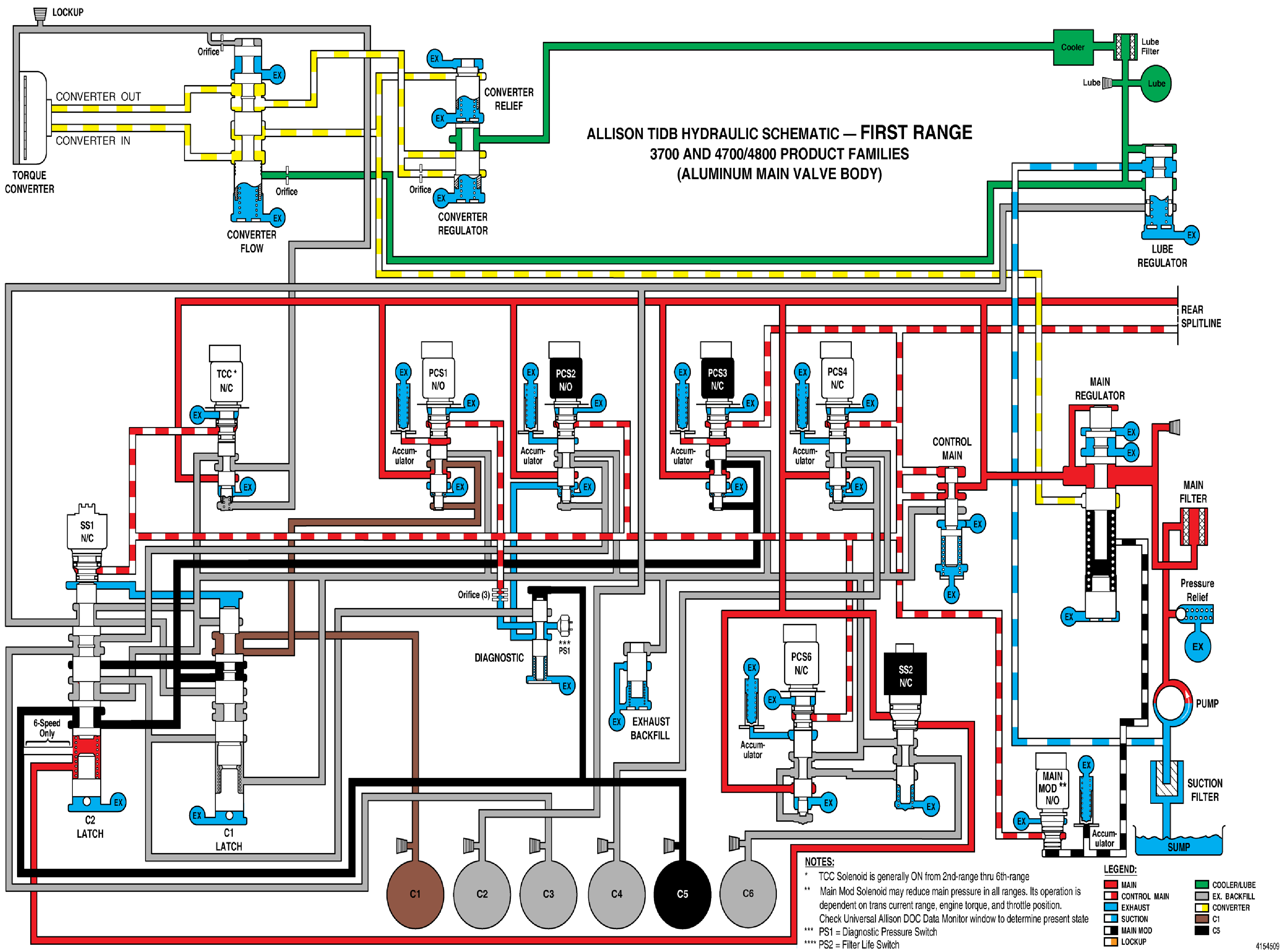


Figure M–29. Allison TIDB Hydraulic Schematic–First Range 3700 and 4700/4800 Product Families (Aluminum Main Valve Body)

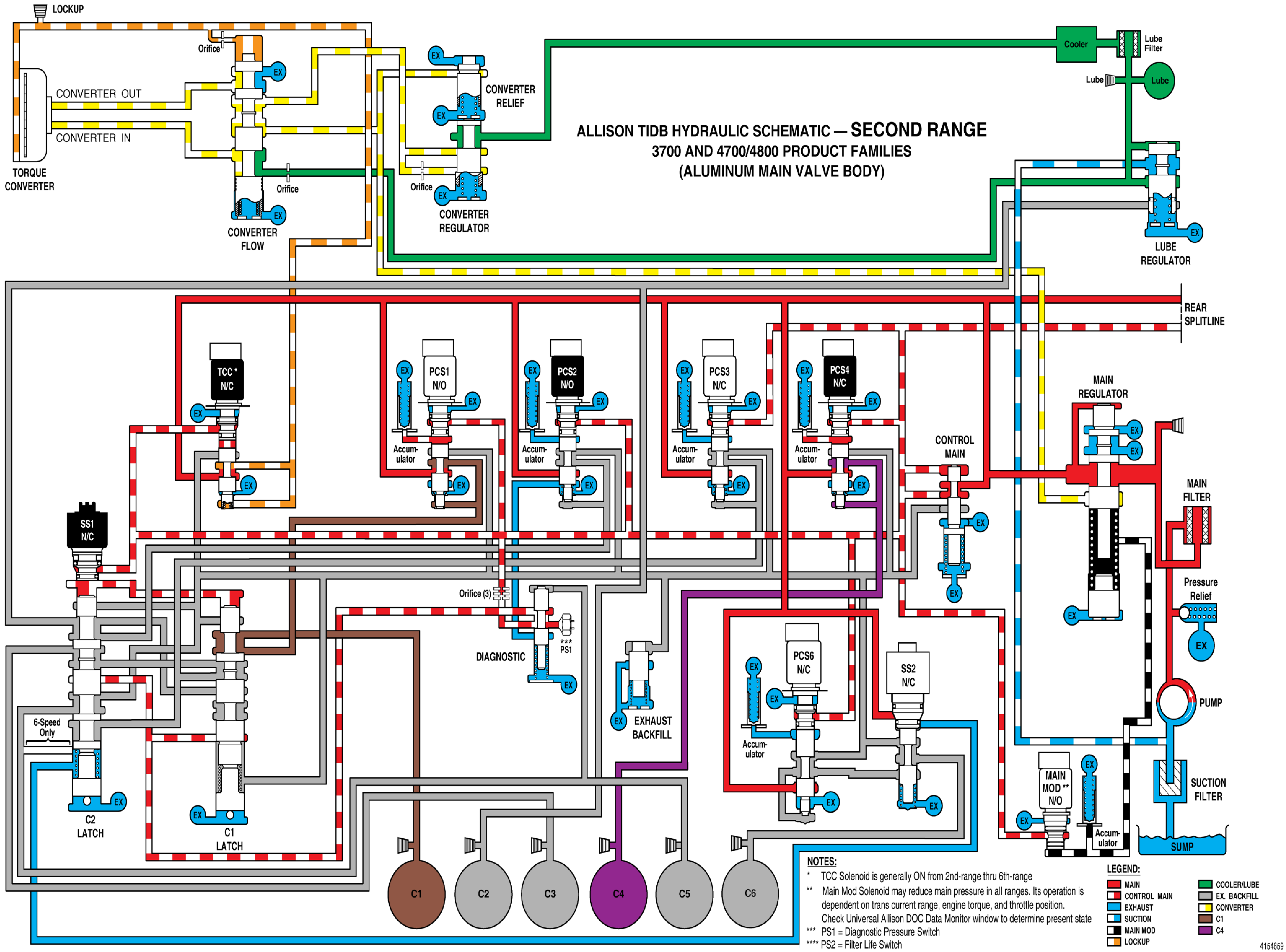


Figure M–30. Allison TIDB Hydraulic Schematic–Second Range 3700 and 4700/4800 Product Families (Aluminum Main Valve Body)

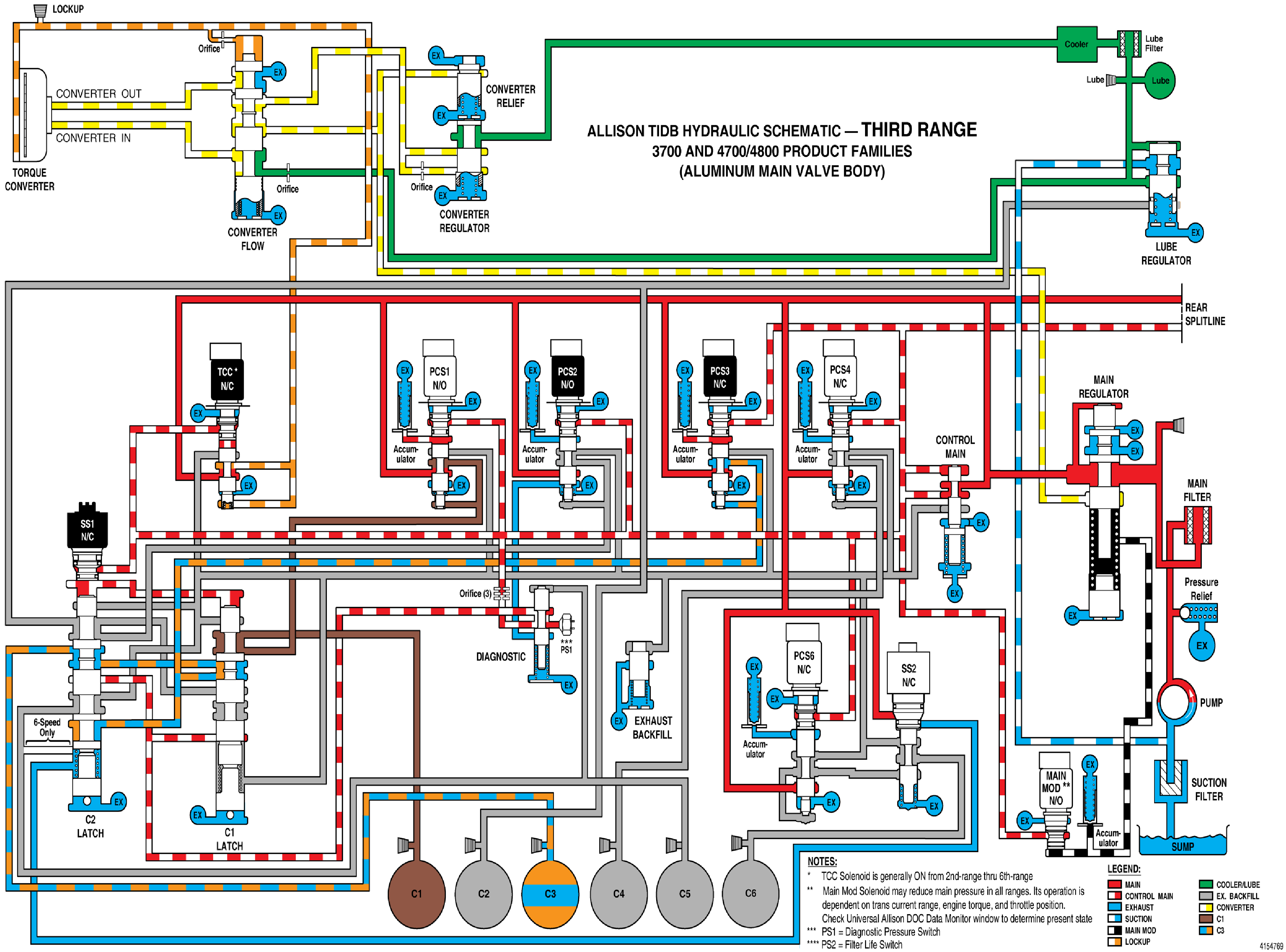


Figure M–31. Allison TIDB Hydraulic Schematic–Third Range 3700 and 4700/4800 Product Families (Aluminum Main Valve Body)

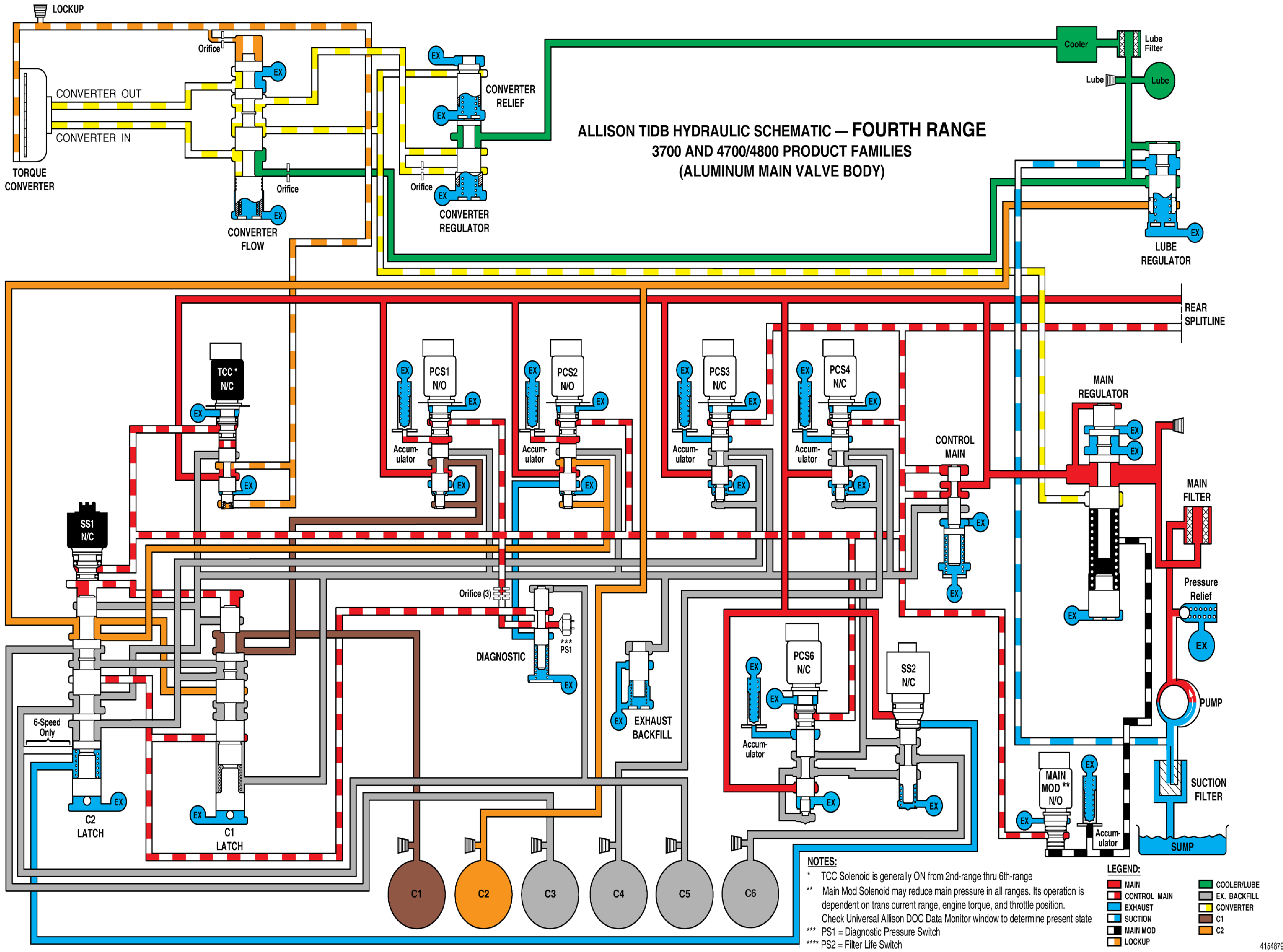


Figure M–32. Allison TIDB Hydraulic Schematic–Fourth Range 3700 and 4700/4800 Product Families (Aluminum Main Valve Body)

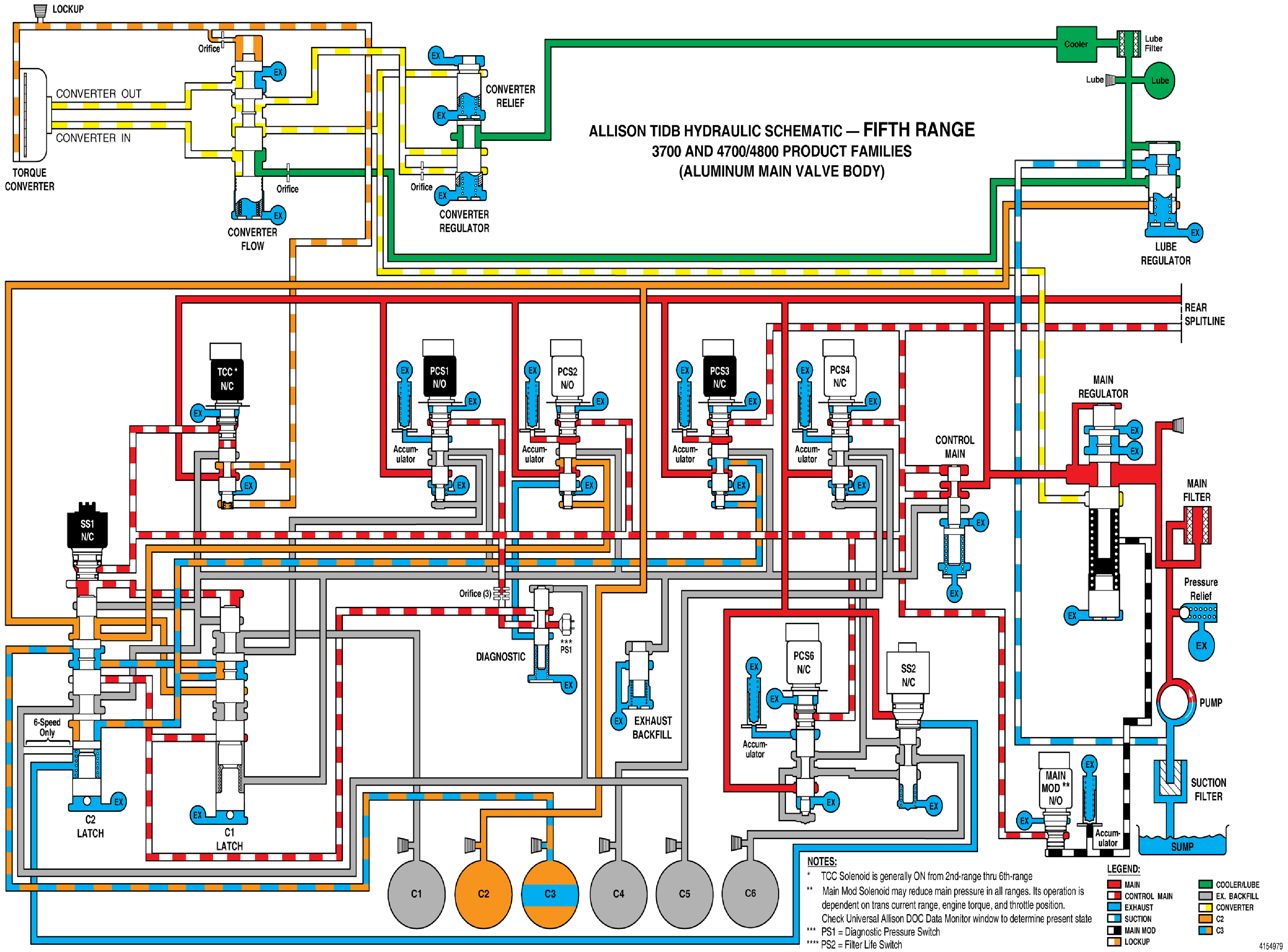


Figure M–33. Allison TIDB Hydraulic Schematic–Fifth Range 3700 and 4700/4800 Product Families (Aluminum Main Valve Body)

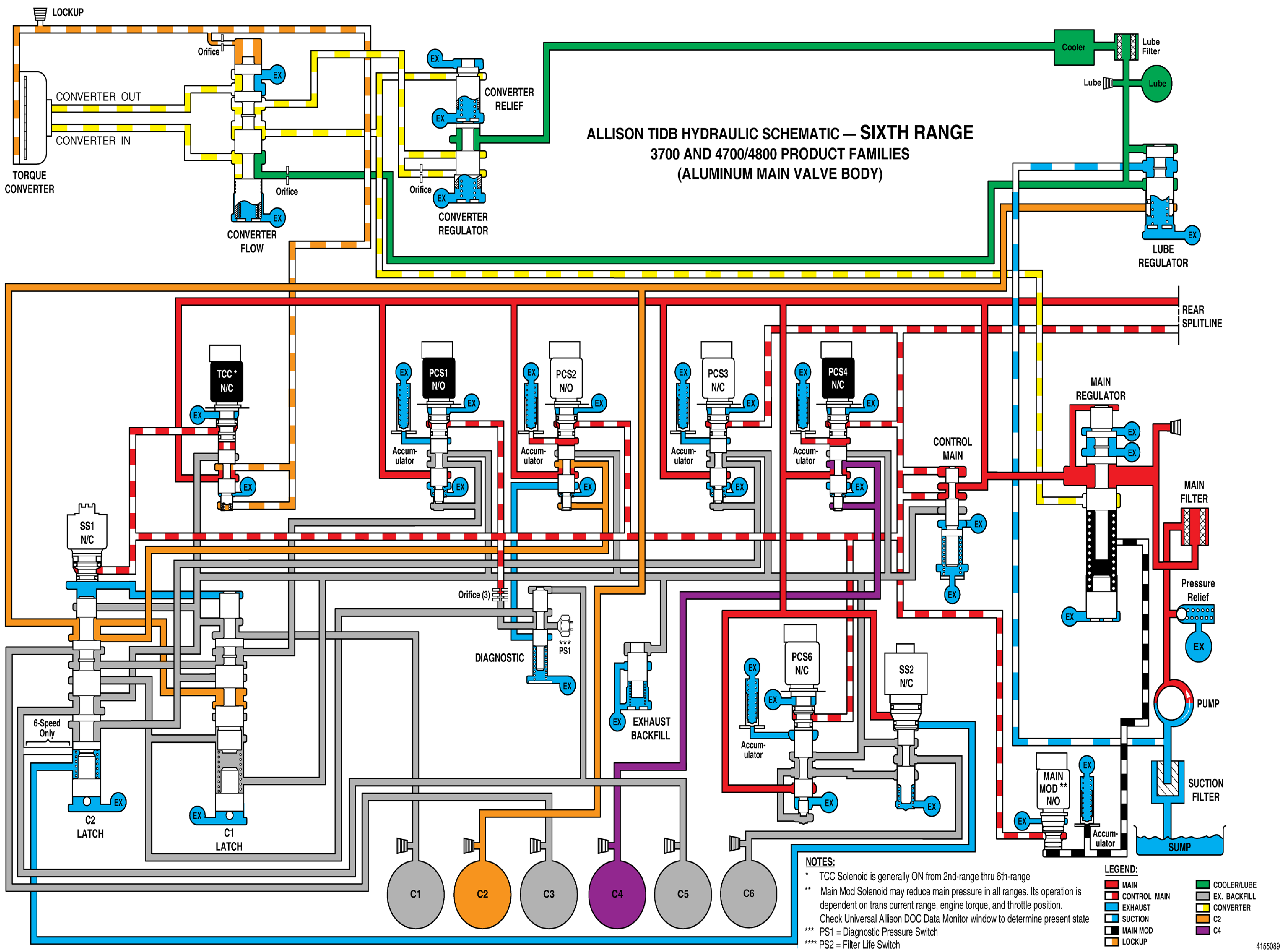


Figure M–34. Allison TIDB Hydraulic Schematic–Sixth Range 3700 and 4700/4800 Product Families (Aluminum Main Valve Body)

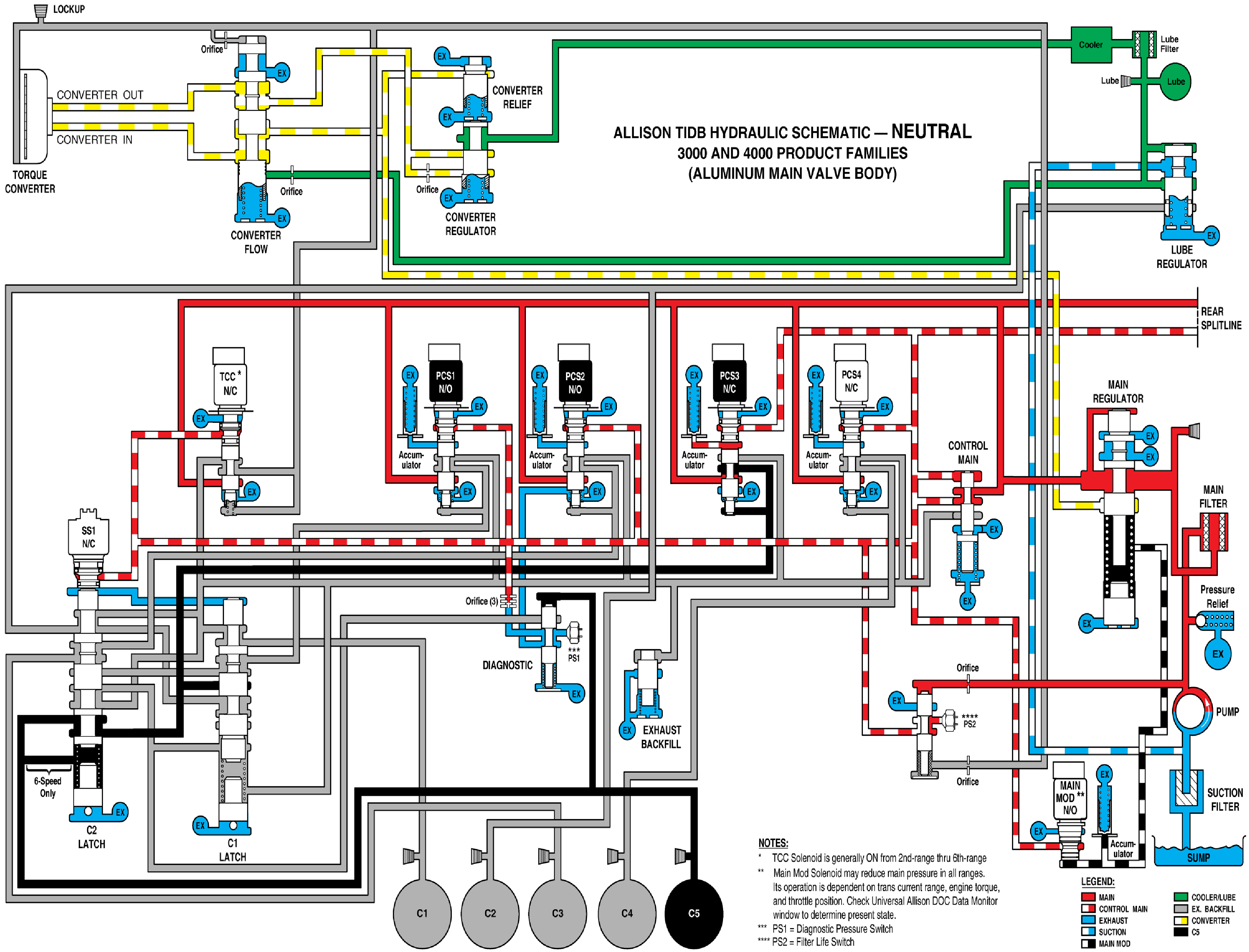


Figure M–35. Allison TIDB Hydraulic Schematic–Neutral With Prognostics 3000 and 4000 Product Families (Aluminum Main Valve Body)

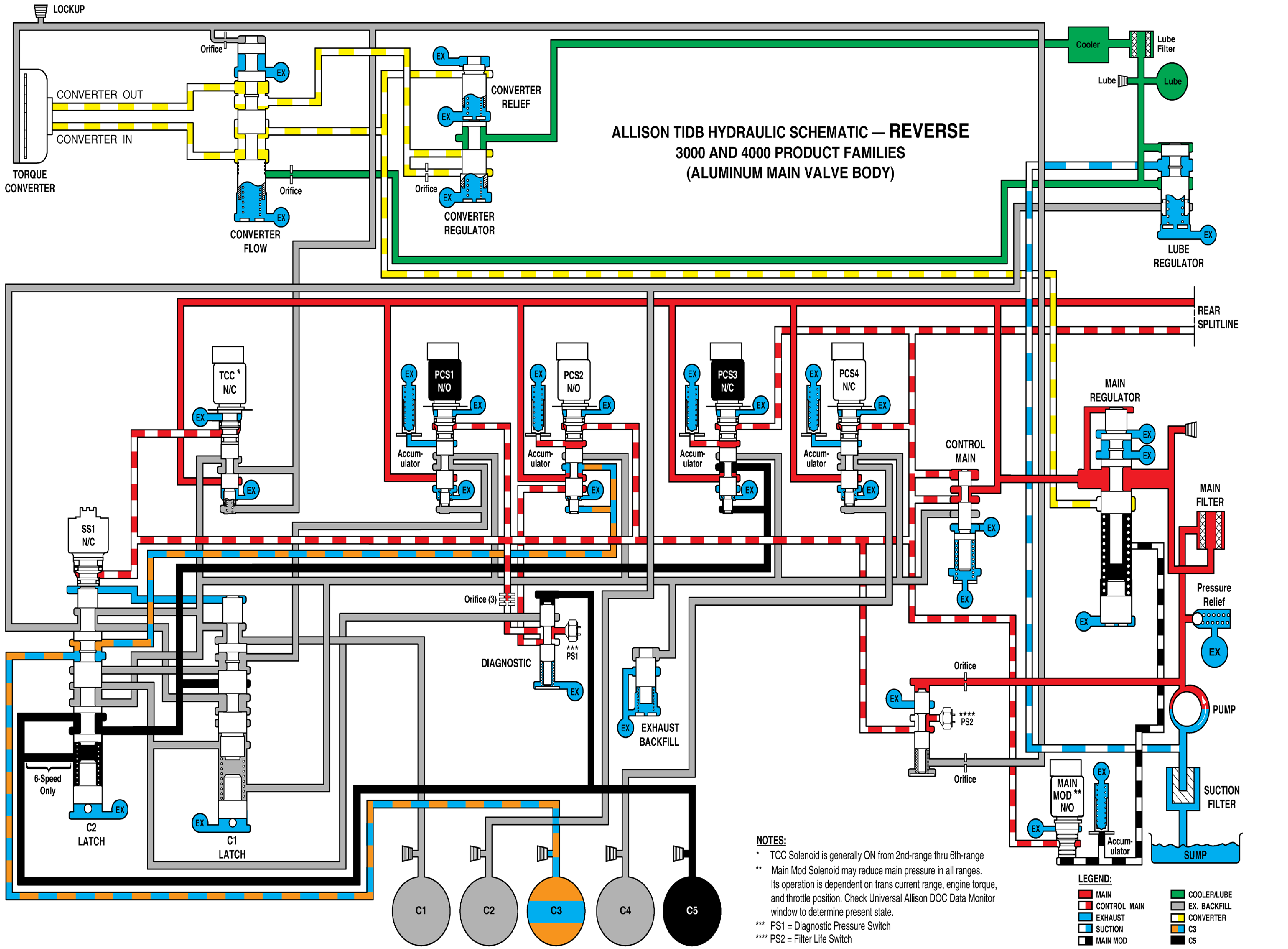


Figure M–36. Allison TIDB Hydraulic Schematic–Reverse With Prognostics 3000 and 4000 Product Families (Aluminum Main Valve Body)

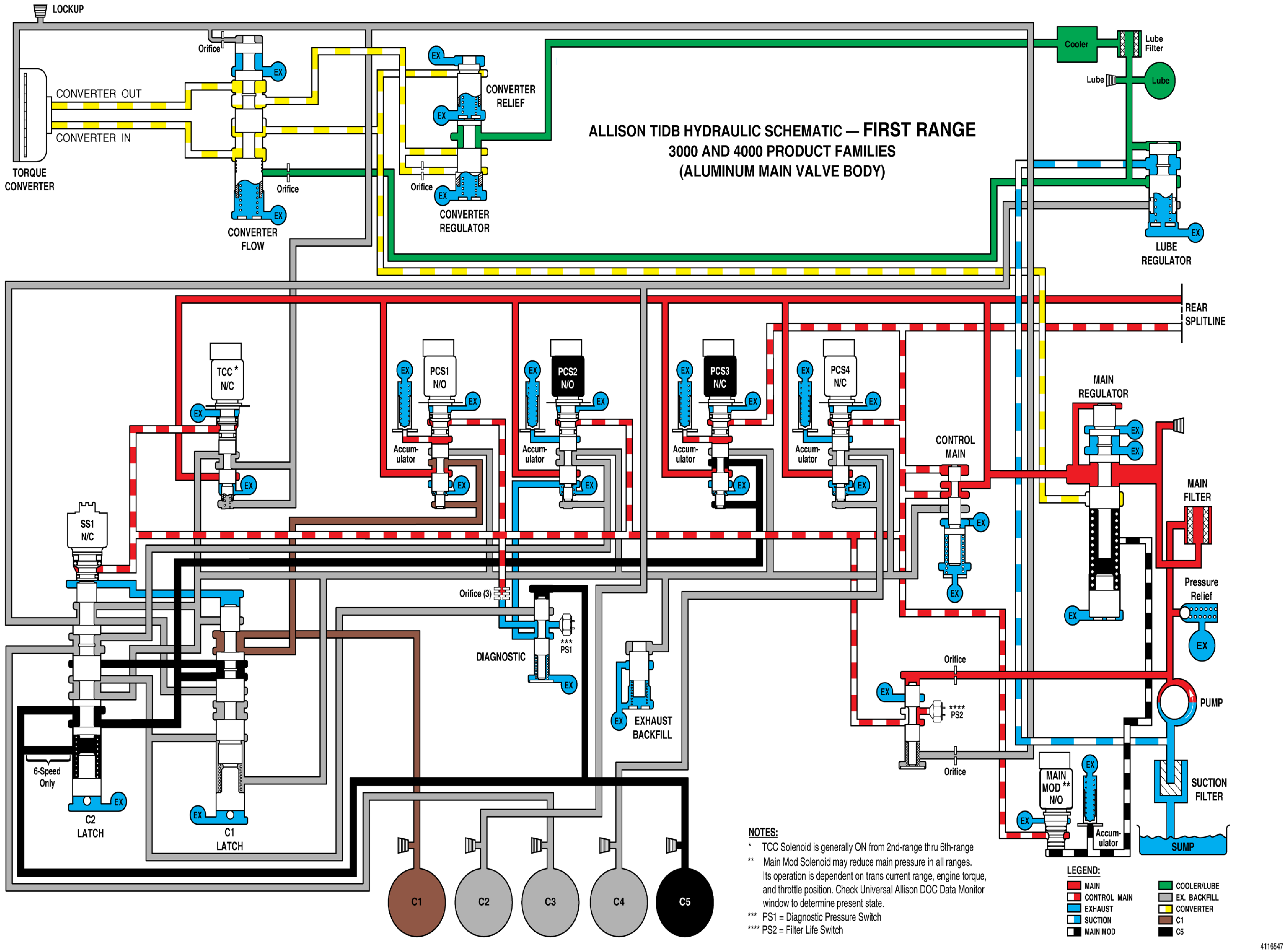
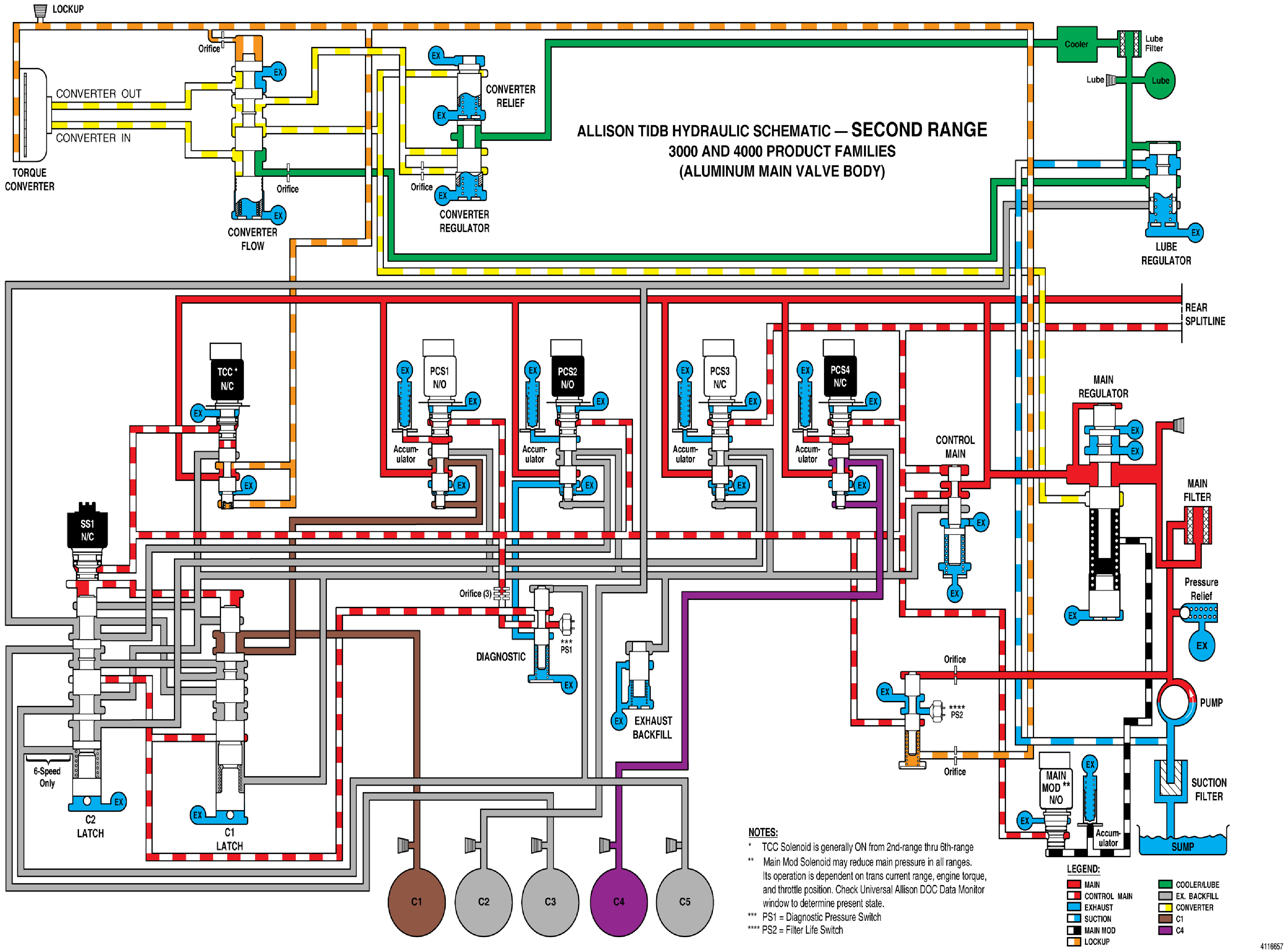


Figure M–37. Allison TIDB Hydraulic Schematic–First Range With Prognostics 3000 and 4000 Product Families (Aluminum Main Valve Body)

FOLDOUT 40



NOTES:

* TCC Solenoid is generally ON from 2nd-range thru 6th-range

** Main Mod Solenoid may reduce main pressure in all ranges. Its operation is dependent on trans current range, engine torque, and throttle position. Check Universal Allison DOC Data Monitor window to determine present state.

*** PS1 = Diagnostic Pressure Switch

**** PS2 = Filter Life Switch

Figure M–38. Allison TIDB Hydraulic Schematic—Second Range With Prognostics 3000 and 4000 Product Families (Aluminum Main Valve Body)

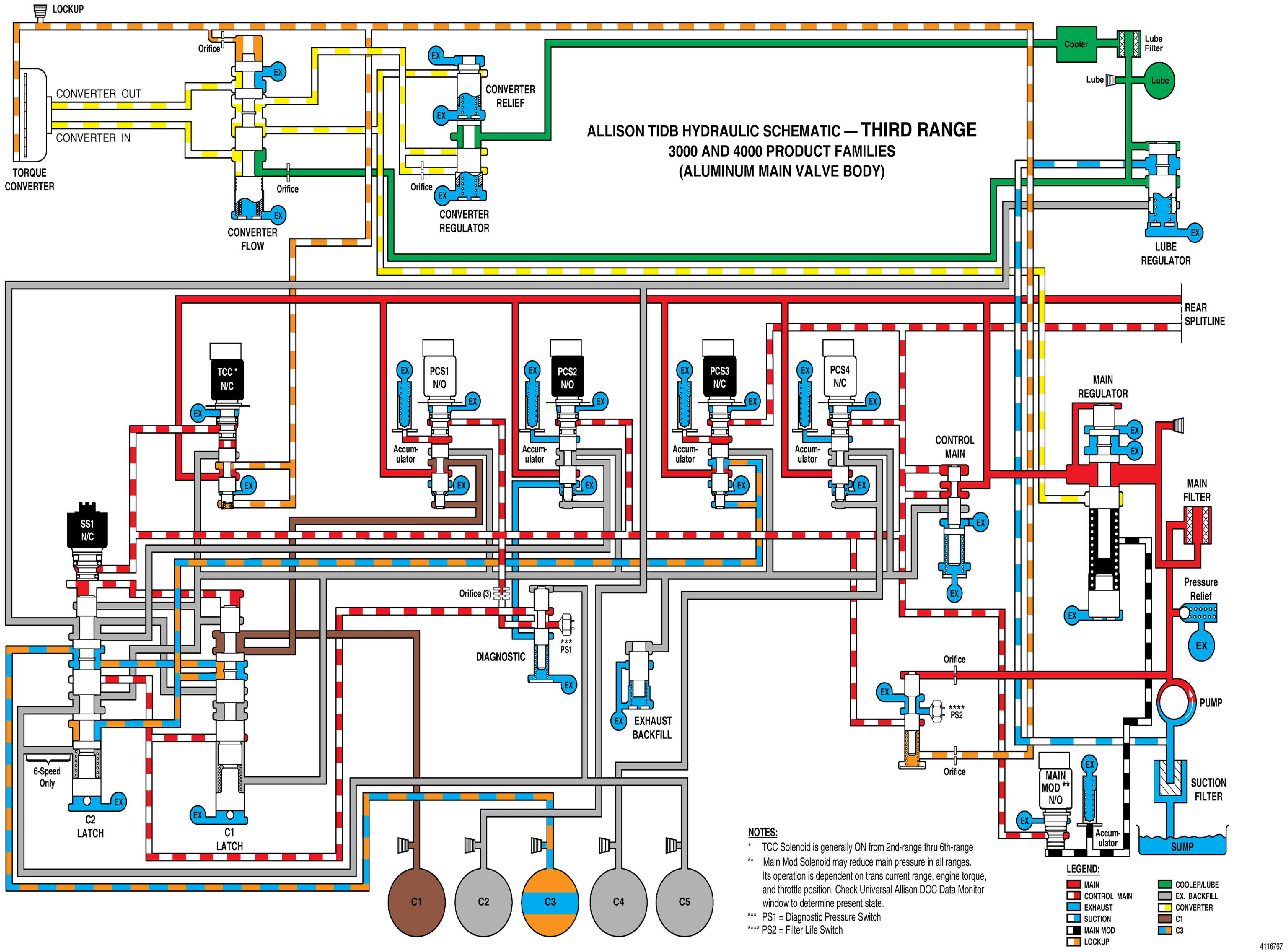


Figure M–39. Allison TIDB Hydraulic Schematic—Third Range With Prognostics 3000 and 4000 Product Families (Aluminum Main Valve Body)

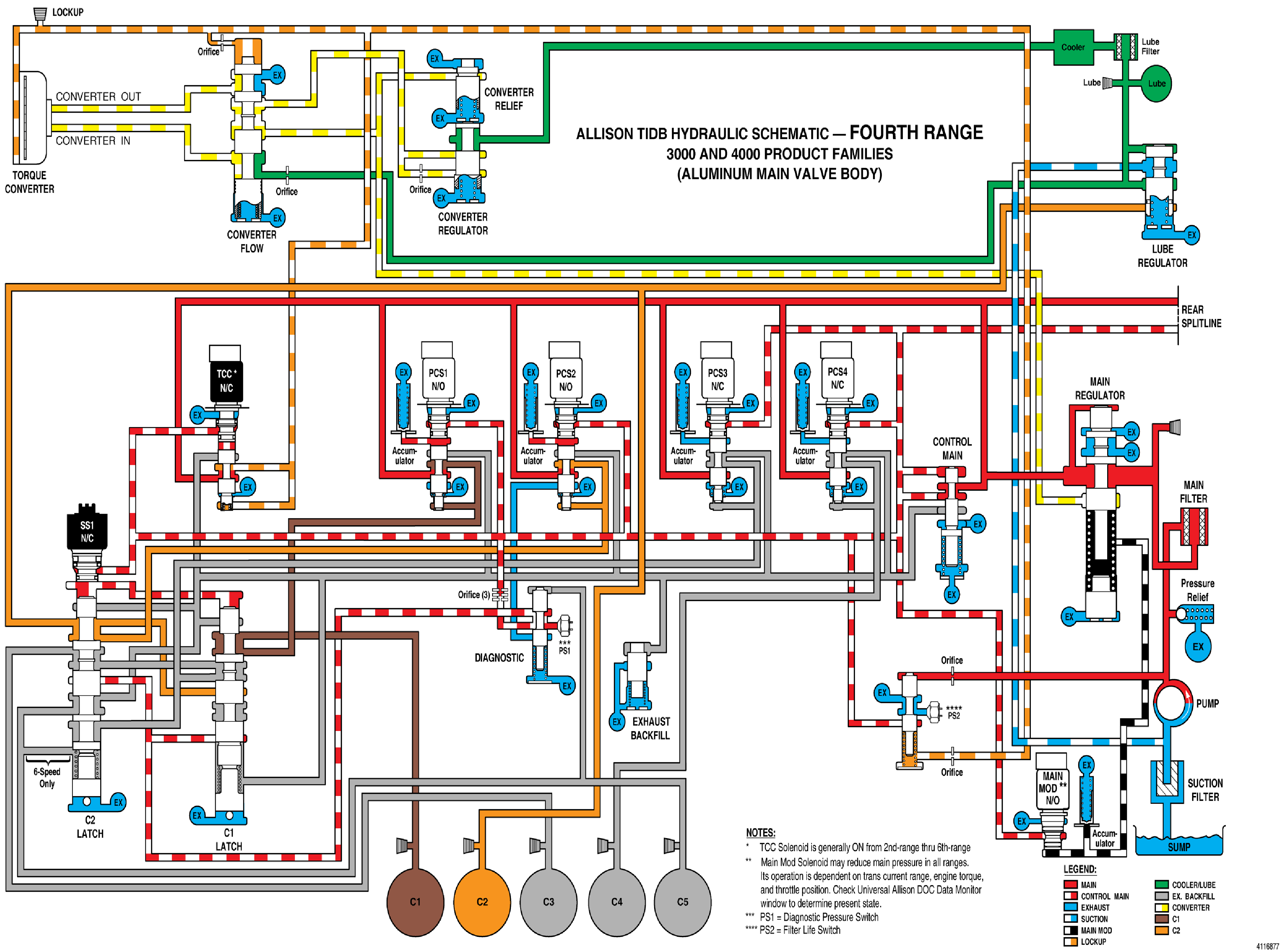


Figure M–40. Allison TIDB Hydraulic Schematic—Fourth Range With Prognostics 3000 and 4000 Product Families (Aluminum Main Valve Body)

FOLDOUT 43

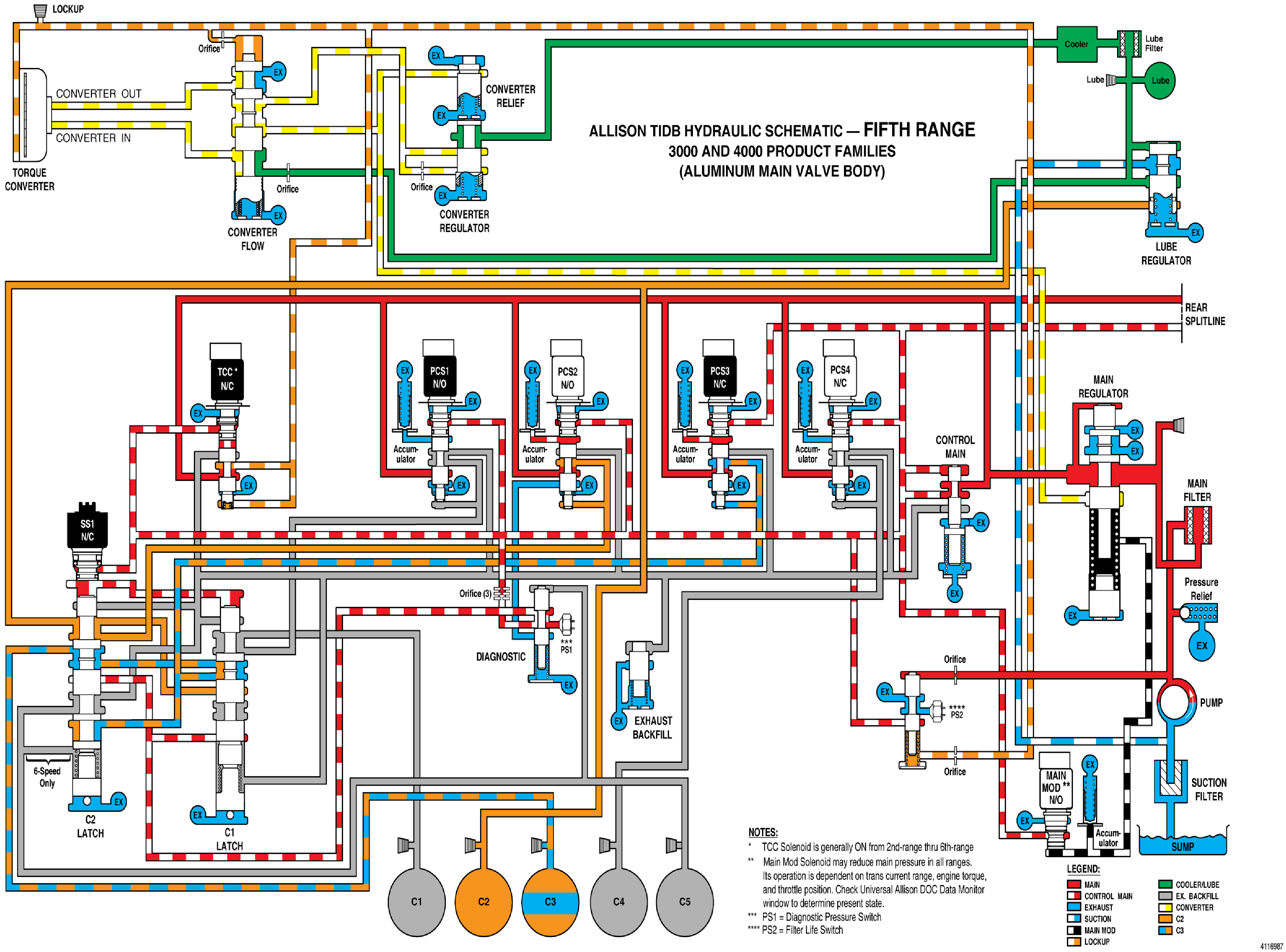


Figure M–41. Allison TIDB Hydraulic Schematic—Fifth Range With Prognostics 3000 and 4000 Product Families (Aluminum Main Valve Body)

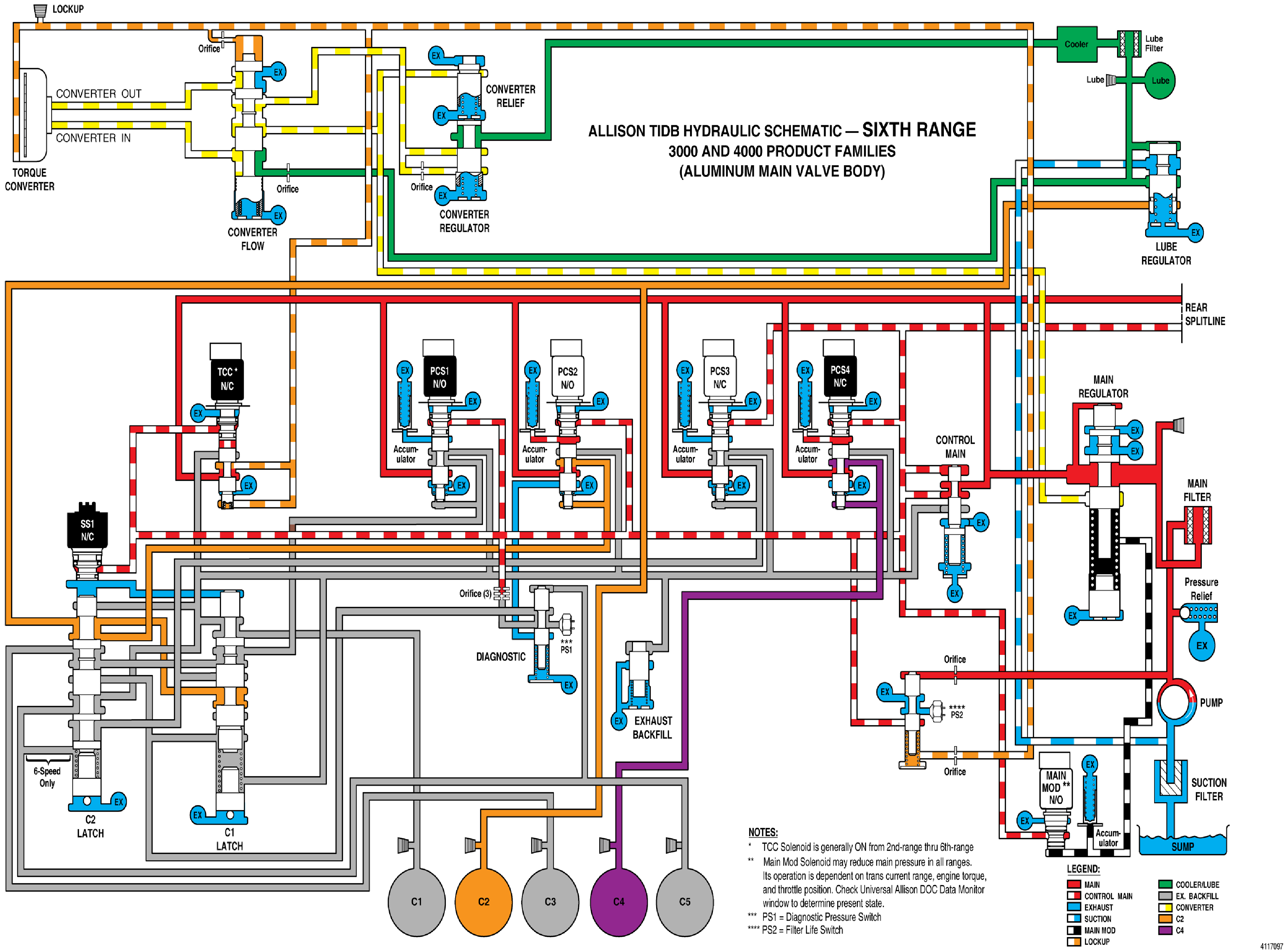


Figure M–42. Allison TIDB Hydraulic Schematic—Sixth Range With Prognostics 3000 and 4000 Product Families (Aluminum Main Valve Body)

Appendix N—REVISION HISTORY

This revision history includes a summary of changes made to the following topics between 2017/09 and 2018/08.

2-6. CONTROL VALVE MODULE (ELECTROHYDRAULIC)

2018/08 Added Converter Relief Valve and Main Mod Accumulator (TIDB Only) in Section A
Added to reduce main pressure in Section D last sentence first paragraph
Changed PCS1 to PCS2 in first bullet point in Section G

2-7. WIRE HARNESSES

2018/08 Added web site for St. Clair Technologies, Inc.
Changed address and Fax number for St. Clair Technologies

2-9. AUTO-DETECT LOGIC

2018/08 Added TIDB Content to Section A paragraphs 1, 2 and 3 were changed
Added new Section F
Updated DOC User Guide Number in Section C

2-11. Shift Schedules

2018/08 Changed the 2nd bullet point in Section A added DynActive

2-23. DYNACTIVE® SHIFTING

2018/08 New Section DynActive® Shifting

2-26. SHIFT INHIBIT LOGIC

2018/08 Added Hill Hold Inhibit for Section D

DTC P0600 Internal Serial Peripheral Interface (SPI) Diagnostics

2018/05 Change Test Descriptions
Change Step 3

DTC P0610 Transmission Control Hardware Incompatible

2018/08 New DTC P0610

DTC P0702 Transmission Control Hardware Not Determined

2018/08 New DTC P0702

DTC P0703 Brake Switch Circuit

2018/05 Updated DTC steps and information to Circuit Description

DTC P071A Neutral at Stop Input Failed On

2018/05 Updated DTC steps and information to Circuit Description

DTC P07CE Neutral At Stop Not Functioning

2018/05 New DTC

DTC P088A Transmission Filter Maintenance Alert

2018/08 Revised DTC, added graphics, and added steps

DTC P088B Transmission Filter Maintenance Required

2018/08 Revised DTC, added graphic, and added steps

6-5. MAIN MODULATION

2018/08 New Paragraph for TIDA and TIDB configurations

6-8. 3000 PRESSURE SPECIFICATIONS

2018/08 Added footnote to all C5 clutches in Clutch Applied Column

6-9. 4000 PRESSURE SPECIFICATIONS

2018/08 Added footnote to C5 clutch in Clutch(es) Applied Column

F-1. WIRE/CONNECTOR CHART

2018/08 Table 2 changed content on Terminal 11, 71, 76
Table 4 changed content on Terminal 1, 6, 20

L-1. 3000 AND 4000 PRODUCT FAMILIES WIRING SCHEMATICS

2018/08 Revised Foldout 1

M-1. Table of Contents

2018/08 New Table of Contents for TIDA and TIDB Hydraulic Schematics

M-2. HYDRAULIC SCHEMATICS.

2018/08 New Hydraulic Schematics for Aluminum Valve Body TIDB

Fix circuit between the Converter Flow and Converter Regulator Valves All Schematics