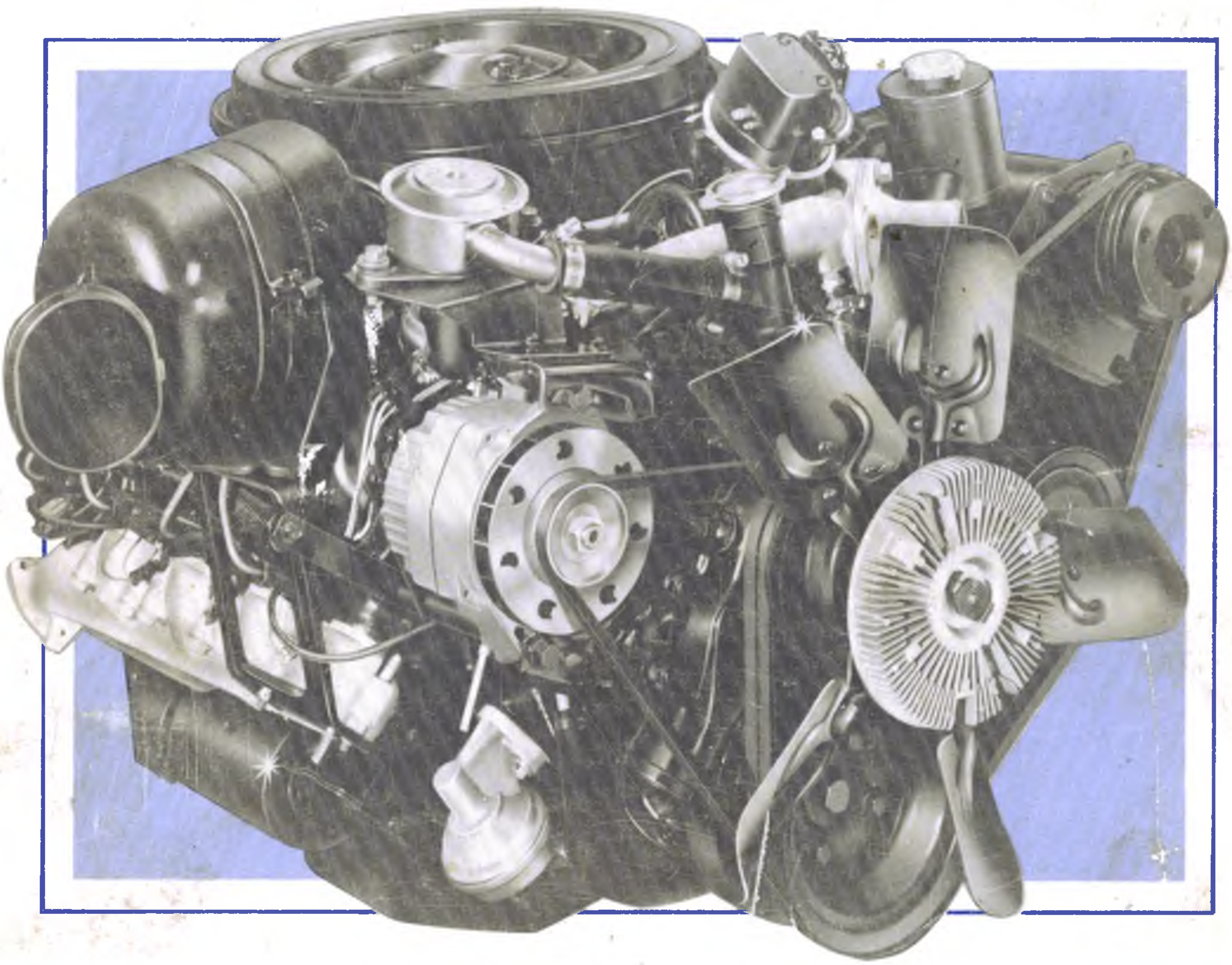
THE 6.2 LITER DIESEL ENGINE



GM

Product
Service
Training

16015.05-1C

6.2 Liter Diesel Engine

Foreword

This booklet is supplied by GM Product Service Training to GM dealer service personnel upon their completion of the subject course conducted at GM Training Centers.

While this booklet will serve as an excellent review of the extensive program presented in the training center session, it is not intended to substitute for the various service manuals normally used on the job. The range of specifications and variation in procedures between carlines and models requires that the division service publications be referred to, as necessary, when performing these operations.

All information contained in this booklet is based on the latest data available at the time of publication approval. The right is reserved to make product or publication changes, at any time, without notice.

Portions of this book were produced using information provided by Detroit Diesel Allison Division, Stanadyne Diesel Systems and Robert Bosch Corporation.

— NOTE —

Many of the words and terms in this section are explained in the "glossary" section at the back of this book. If the meaning of a new or confusing word or term isn't clear, always take the time to look it up.

Table of Contents

1. General Information and Maintenance

General Description

The 6.2L Diesel Engine is a 90° V-8 configuration using conventional push rods. It is a four stroke cycle operation and naturally aspirated; it does not use a turbocharger for air induction.

This is an engine designed, engineered, and tested for demanding light truck applications — with emphasis on fuel efficiency and emissions control see Fig. 1-1.

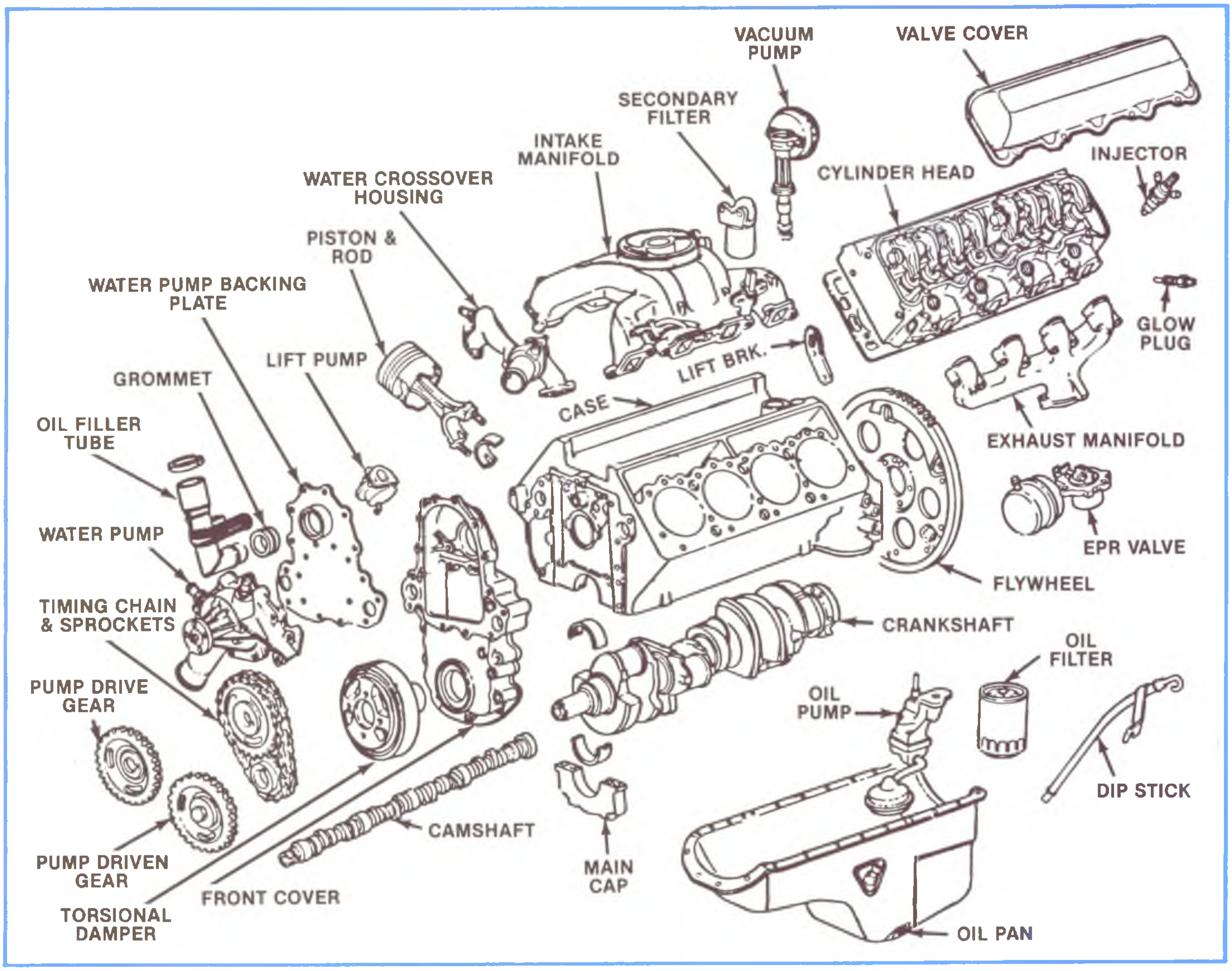


Figure 1-1, 6.2L Major Components

Engine Identification

A. #1 CYLINDER INTAKE RUNNER — A steel stamp placed on the engine part way through the assembly process, is located on the block under the #1 inlet runner. The stamp identifies the broadcast code, which essentially defines the engine configuration, plus the month and date of build. A typical marking would be a broadcast code UHH0311, indicating the engine was built on March 11.

B. THE TRACEABILITY LABEL glued to the engine contains two bar codes. The #1 code would include the number 10, indicating an "engine", plus the broadcast code, which could be 1 of 37 codes presently released (i.e., UHH). The #2 bar code would contain a computer letter, plus component identification, component manufacturing location, Julian date and a serial number. As an example, the first piece of information on the bar code would be a letter "T", which is simply for programming in the computer. The next information would be a number 10 to define the component as being an engine. The next bit of information would be the letter "R" to signify the product was made at the Moraine Engine Plant and the Julian date follows, which for March the 11th, the 70th day of the year, would be 070. After the date the serial number of the engine appears, which is started new for each broadcast code at the beginning of the Model Year. For each of the 36 broadcast codes there will be a separate set of serial numbers starting with #1 for the 1983 M.Y. and continuing until the last product of the current Model Year is manufactured.

BROADCAST CODE	SUFFIX CODES	
UHH 03 11 SUFFIX MONTH DAY	T — 1982 U — 1983 F — 1984	D — 1985 H — 1986 J — 1987

C. ENGINE PLANT IN-PROCESS BAR CODE IDENTIFICATION — Top of left-hand rocker cover consists of numerical codes to identify type of engine and in-plant serial number for internal use only. Cannot be used to reference engine in communication with the engine plant.

D. WATER PUMP — Cast identification on front of water inlet tube, depressed cast numbers. Cast date alpha and 3 numbers. Pattern number alpha and 1 number.

E. CYLINDER HEAD — Drill points on end of head to identify internal machining changes and type of head.

F. INLET MANIFOLD — Cast identification on top of #4 inlet runner (right side—rear). Raised cast numbers. Cast date and shift underneath.

G. CYLINDER CASE — Casting plant pattern identification. Raised cast in clock to show time of casting. Pattern number in valley under inlet manifold.

H. CYLINDER CASE — Cast identification on top of left-hand flywheel housing surface. Raised cast numbers with cast date underneath. Pattern number to right of cast number. (CFD) Central Foundry Defiance.

I. EXHAUST MANIFOLD — Cast identification on outside face. Raised cast numbers. Pattern number and date cast clock casting plant ID.

J. INJECTION PUMP — Printed plate riveted to left side of pump body. Model number and serial number.

K. (TPS) 6 DIGIT IDENTIFIER —
Throttle
Position
Switch

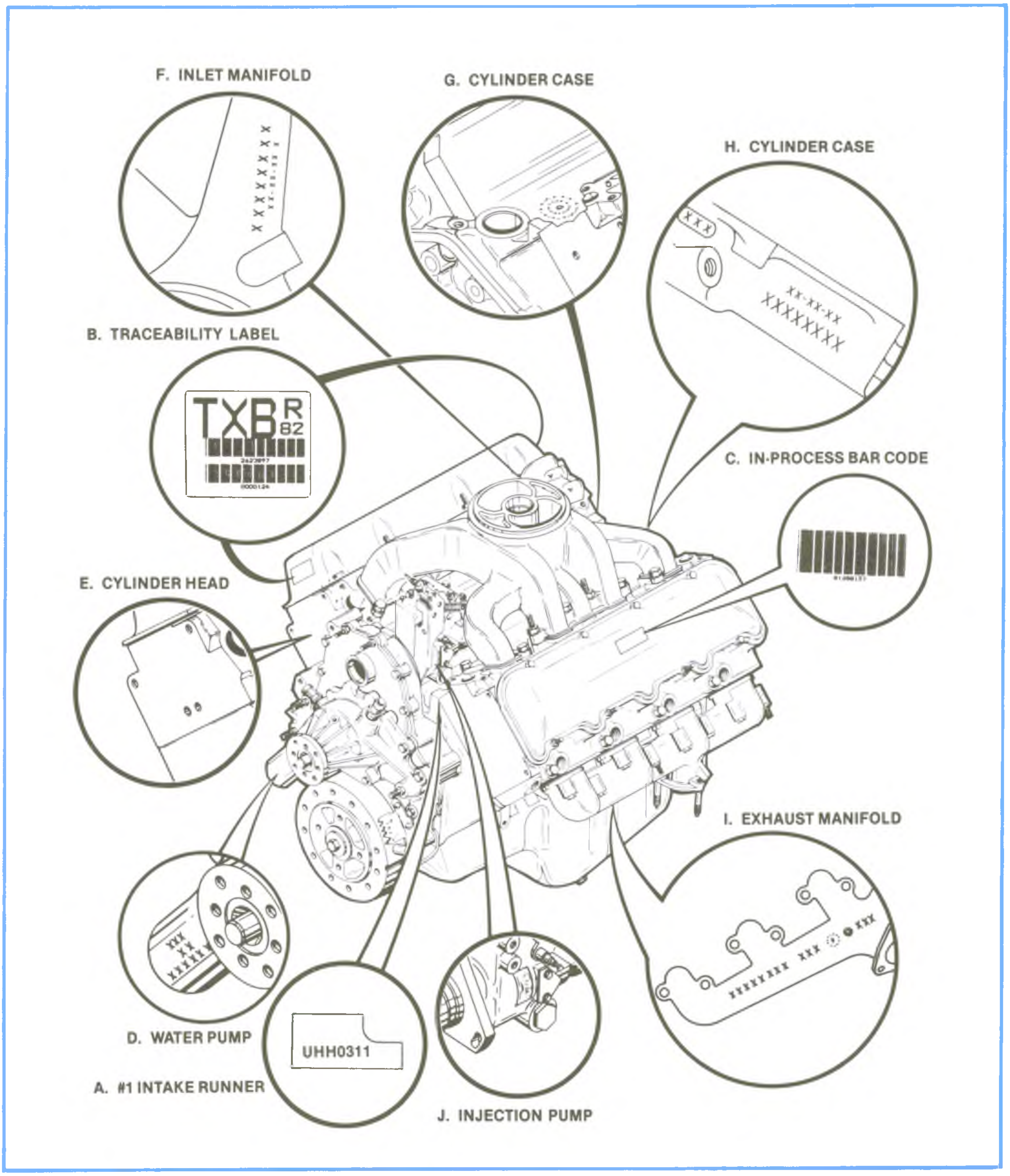


Figure 1-2, Engine Identification.

LH6 (C) Engine Specifications

General Engine Description

- **MODEL** **LH6**
- **REGULAR PRODUCTION OPTION (RPO) CODE < 8500 LBS. GVWR** **LH6**
- **VEHICLE IDENTIFICATION NUMBER (VIN) CODE** . . . . . . **C**
- **ENGINE TYPE** . . . . . . **4-STROKE CYCLE 90° V-8 NORMALLY ASPIRATED**
- **COMBUSTION CHAMBER TYPE** . . . . . . **TURBULENCE SWIRL PRE-CHAMBER (RICARDO COMET V)**

Firing Order	1-8-7-2-6-5-4-3
Cylinder Block	Cast Iron with Combined Cylinders
Valve Timing	Chain and Sprockets (Overhead Valves)
Bore and Stroke	(101mm (3.98″) x 97mm (3.80″)
Displacement	6.2L (6217 cc) (379.4 cu. in.)
Horsepower LH6	130 Net H.P. (97 Kw) @ 3600 RPM
Torque LH6	240 lb. ft. (325.4 N·m) @ 2000 RPM
Volume of Acyl. at BDC	815.4048 cc (49.756 cu. in.)
Volume of Acyl. at TDC	37.8148 (2.3075 cu. in.)
Compression Ratio LH6	21.5 to 1
Dimensions & weight (approx.)	
Length — mm (in.)	750 (29.5)
Width — mm (in.)	692 (27.2)
Height — mm (in.)	696 (27.4)
Weight — kg (lbs.)	318 (701)

Technical Engine Specifications

Injector nozzle	BOSCH DNOSD 248
Bmep — kPa (lb/in.^{2})	579 (83.9)
Fuel consumption — kg/hr (lb/hr)	30.6 (67.6)
Specific fuel cons. — g/kW·hr (lb/bhp·hr)	283.5 (.466)
Fuel pump suction at pump inlet	
Maximum — kPa (in. Hg)	
Clean system	20 (6)
Dirty system	41 (12)
Airflow — m^3/min (ft^3/min)	9.9 (350)
Air intake restriction, max. — kPa (in. H_2O)	
(Dry type air cleaner)	
Full load — dirty	5.0 (20)
clean	2.5 (10)
Exhaust temp. — °C (°F)	657 (1230)
Exhaust flow — m^3/min (ft^3/min)	30.9 (1090)
Exhaust back press., max. — kPa (in. Hg) Full load	9 (2.5)
Coolant flow — litre/min (gal/min)	249 (66)
Max. top tank temp. allowed — °C (°F)	99 (210)
Heat rejection — kW (Btu/min)	123.1 (7000)
Coolant inlet restriction, max. — kPa (in. Hg)	10 (3)
Lubricating oil press., normal — kPa (lb/in.^{2})	275-345 (40-50)
Lubricating oil temp., in-pan — °C (°F)	82-127 (180-260)
Cooling index — Min air to boil	
With 24 km/h (15 mph) maximum ram air — °C (°F)	40 (104)
Deaeration — Air injection capacity (corrected — m^3/min. (cfm)	0.0085 (0.3)
Drawdown — Min requirement or 10% of total cooling system capacity — whichever is larger — litre (qts)	3.8 (4.0)

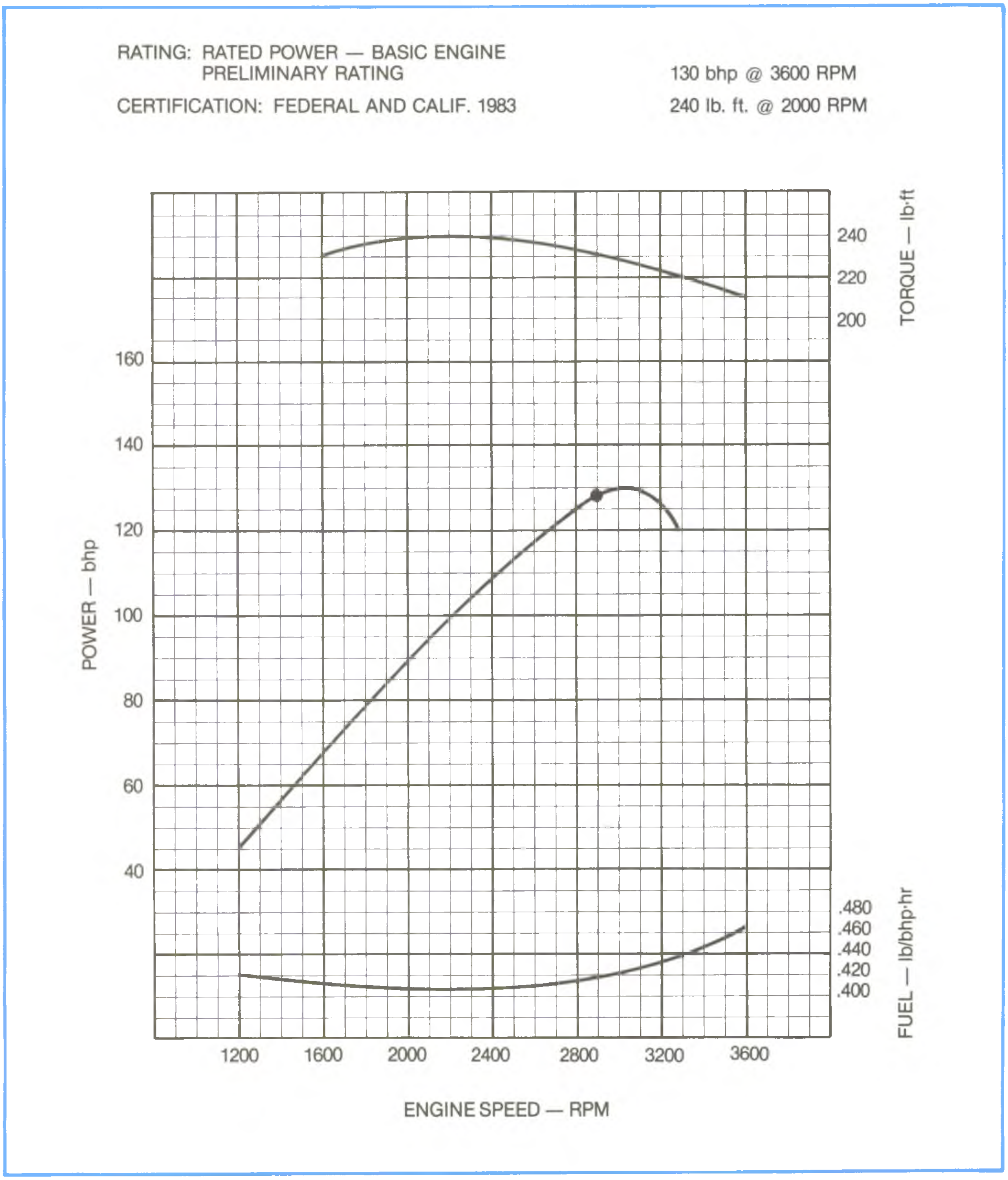


Figure 1-3, **Engine Performance Curve, 6.2L — Light Duty (LH6).**

LL4 (J) Engine Specifications

General Engine Description

- **MODEL** . . . **LL4**
- **REGULAR PRODUCTION OPTION (RPO) CODE > 8500 LBS. GVWR** . . . **LL4**
- **VEHICLE IDENTIFICATION NUMBER (VIN) CODE** . . . **J**
- **ENGINE TYPE** . . . **4-STROKE CYCLE 90° V-8 NORMALLY ASPIRATED**
- **COMBUSTION CHAMBER TYPE** . . . **TURBULENCE SWIRL PRE-CHAMBER (RICARDO COMET V)**

Firing Order	1-8-7-2-6-5-4-3
Cylinder Block	Cast Iron with Combined Cylinders
Valve Timing	Chain and Sprockets (Overhead Valves)
Bore and Stroke	(101mm (3.98") x 97mm (3.80")
Displacement	6.2L (6217 cc) (379.4 cu. in.)
Horsepower 1982-84 LL4	135 Net H.P. (101 Kw) @ 3600 RPM
1983 LL4 Industrial	145 Net H.P. (108 Kw) @ 3600 RPM
1985 LL4	160 Net H.P. (119 Kw) @ 3600 RPM
Torque 1982-84 All LL4	240 Lb. Ft. (325.4 N·m) @ 2000 RPM
1985 LL4	275 Lb. Ft. (373 N·m) @ 2000 RPM
Compression Ratio 1982	20.3 to 1
1982-85	21.3 to 1
Dimensions & weight (approx.)	
Length — mm (in.)	750 (29.5)
Width — mm (in.)	692 (27.2)
Height — mm (in.)	696 (27.4)
Weight — kg (lbs.)	318 (701)

Technical Engine Specifications

Injection pump (timing)	STANADYNE DB2
Injector nozzle	BOSCH DNOSD 248
Engine speed — r/min	3600
Brake horsepower — kW (bhp)	108 (145)
Bmep — kPa (lb/in.^{2})	579 (83.9)
Peak torque — N·m (lb·ft) @ r/min	325.4 (240) @ 2000
Fuel consumption — kg/hr (lb/hr)	30.6 (67.6)
Specific fuel cons. — g/kW·hr (lb/bhp·hr)	283.5 (.466)
Fuel pump suction at pump inlet	
Maximum — kPa (in. Hg)	
Clean system	20 (6)
Dirty system	41 (12)
Airflow — m^3/min (ft^3/min)	9.9 (350)
Air intake restriction, max. — kPa (in. H_2O)	
(Dry type air cleaner)	
Full load — dirty	5.0 (20)
— clean	2.5 (10)
Exhaust temp. — °C (°F)	657 (1230)
Exhaust flow — m^3/min (ft^3/min)	30.9 (1090)
Exhaust back press., max. — kPa (in. Hg) Full load	9 (2.5)
Coolant flow — litre/min (gal/min)	249 (66)
Max. top tank temp. allowed — °C (°F)	99 (210)
Heat rejection — kW (Btu/min)	123.1 (7000)
Coolant inlet restriction, max. — kPa (in. Hg)	10 (3)
Lubricating oil press., normal — kPa (lb/in.^{2})	275-345 (40-50)
Lubricating oil temp., in-pan — °C (°F)	82-127 (180-260)
Cooling index — Min air to boil	
With 24 km/h (15 mph) maximum ram air — °C (°F)	40 (104)
Deaeration — Air injection capacity (corrected — m^3/min. (cfm)	0.0085 (0.3)
Drawdown — Min requirement or 10% of total cooling system capacity — whichever is larger — litre (qts)	3.8 (4.0)

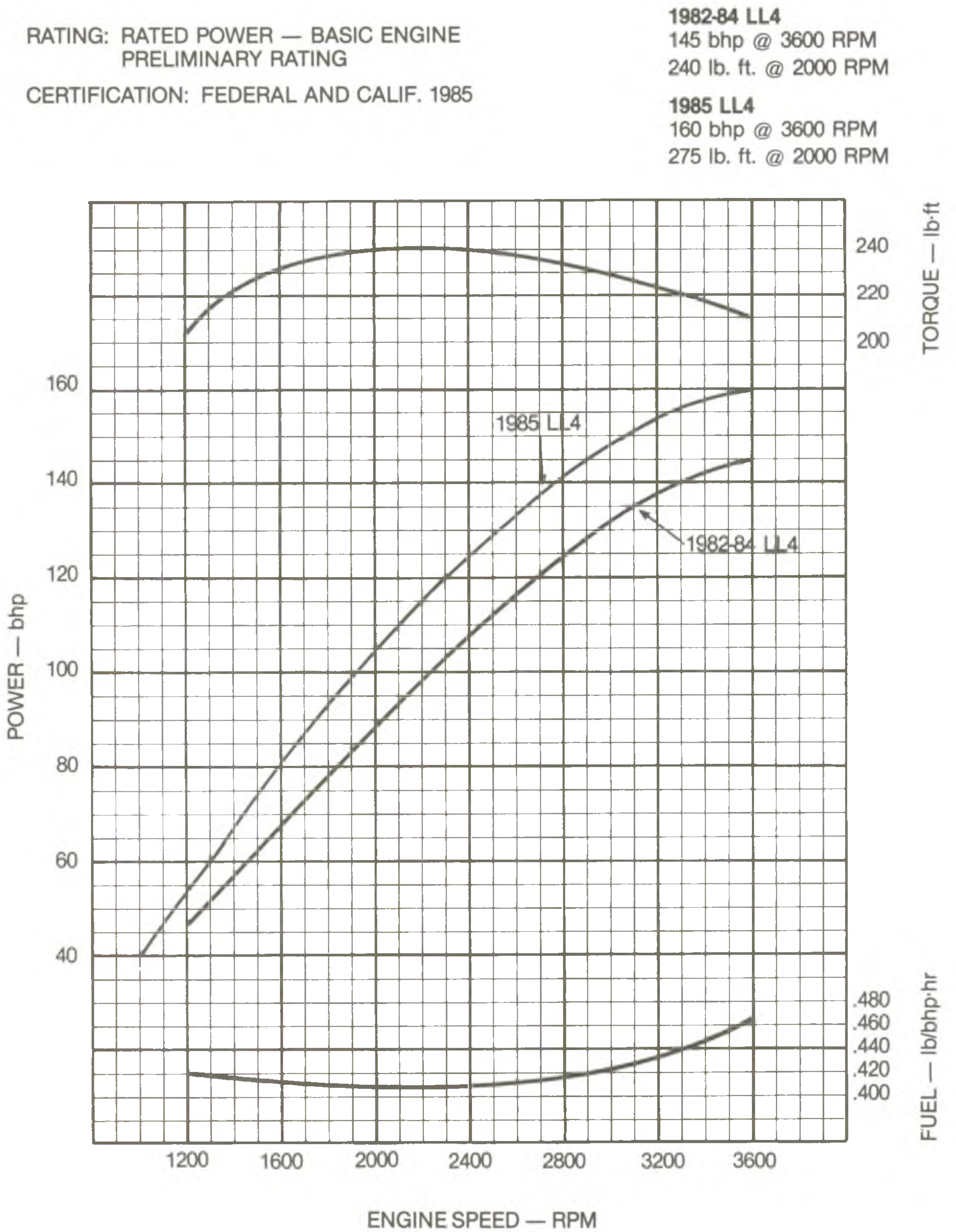


Figure 1-4, Engine Performance Curve, 6.2L — Heavy Duty (LL4)

GENERAL DATA:

Type	90° V8 Diesel
Displacement	6.2 Liter
RPO	LH6, LL4
Bore	101 mm
Stroke	97 mm
Compression Ratio	21.5:1
Firing Order	1-8-7-2-6-5-4-3

CYLINDER BORE:

Diameter	100.987-101.065
Out of Round	.02 Max.
Taper-Thrust Side	.02 Max.

PISTON:

(Bores 1-6)	Clearance *	B	.089-.115
	*	Z	.112-.138

Bores 7 & 8 to be fit .013 Looser
*BOHN PISTONS *ZOLLNER PISTONS

PISTON RING:

Compression	Groove Clearance	Top	.076-.178
		2nd	.039-.080
	Gap	Top	.3-.55
		2nd	.75-1.0
Oil	Groove Clearance		.040-.096
	Gap		0.25-0.51

PISTON PIN:

Diameter	30.9961-31.0039
Clearance	.0101-.0153
Fit in Rod	.0081-.0309

CAMSHAFT:

± Lift .05	In	7.133
	Ex	7.133
Journal Diameter	#1, 2, 3, 4	55.025-54.975
	#5	51.025-50.975
Journal Clearance		.026-.101
Camshaft End Play		.051-.305

CRANKSHAFT:

Main Journal	Diameter	#1, 2, 3, 4	74.917-74.941
		#5	74.912-74.936
	Taper		.005 Max.
	Out Of Round		.005 Max.
Main Bearing Clearance		#1, 2, 3, 4	.045-.083
		#5	.055-.093
Crankshaft End Play			0.10-0.25
Crank-pin	Diameter		60.913-60.939
	Taper		.005 Max.
	Out Of Round		.005 Max.
	Rod Bearing Clearance		.045-.100
	Rod Side Clearance		.17-.63

VALVE SYSTEM:

Lifter			Hydraulic Roller
Rocker Arm Ratio			1.5 to 1
Face Angle (All)			45°
Seat Angle (All)			46°
Seat Runout			.05
Seat Width		In	.89-1.53
		Ex	1.57-2.36
Stem Clearance		In	.026-.069
		Ex	.026-.069
Valve Spring			
	Pressure N @ mm	Closed	356 @ 46.0
		Open	1025 @ 35.3
	Installed Height		46

TIMING CHAIN DEFLECTION:

New Chain	.500″ Max.
Used Chain	.800″ Max.

NOTICE: All dimensions are in millimetres (mm) unless otherwise specified.

Torque Specifications

ENGINE	N·m	FT. LBS.
Baffle to block and stud	34-50	25-37
Bell or clutch housing	34-48	25-35
Camshaft sprocket bolt (pump drive gear)	75-90	55-66
Camshaft thrust bearing	18-27	13-20
Connecting rod nuts	60-70	44-52
Cylinder head bolts	(torque angle method)	
Cylinder head temperature switch	10-12	7-9
Cylinder head water cover plate	34-50	25-37
Exhaust manifold	25-35	18-26
Fast idle support to injection pump	18-27	13-20
Front cover to block	34-50	25-37
Fuel delivery (lift) pump to block	27-40	20-30
Fuel delivery (lift) pump plate to block	6-10	4-7
Fuel injection pump (driven) gear to pump	18-27	13-20
Fuel injection pump to front cover	34-50	25-37
Fuel line bracket to rocker cover studs	18-27	13-20
Fuel lines to brackets	3-4	2-3
Fuel lines to injection pump	20-32	15-24
Fuel lines to nozzle	20-32	15-24
Fuel lines to secondary filter and lift pump	24-26	17-19
Flywheel to crankshaft	80-95	60-70
Glow plugs	11-16	08-12
Glow plugs controller	18-27	13-20
Glow plugs temperature switch	10-12	7-9
HPCA and fast idle temperature switch	10-12	7-9
Intake manifold to head	34-50	25-37
Lifting brackets	45-60	33-44
Main brg. cap bolts inner	141-160	104-118
Main brg. cap bolts outer	126-145	93-107
Nozzle to head	60-80	44-60
Oil fill tube nuts	18-27	13-20
Oil pan bolts (except two rear)	6-14	4-10
Oil pan bolts two rear	18-27	13-20
Oil pump to main brg. cap	80-100	60-74
Pressure plate to flywheel	34-48	25-35
Rocker arm cover bolts	18-35	13-25
Rocker arm shaft	50-60	37-44
Sec. filter adapter to manifold	34-50	25-37
Thermostat to crossover	34-50	25-37
Torsional damper	190-220	140-162
TPS and VRV to injection pump	5-7	4-5
Vacuum pump clamp	34-50	25-37
Valve lifter guide clamp	18-35	13-25
Water outlet crossover	34-50	25-37
Water pump to front cover to block	34-50	25-37
Water pump plate to front cover	18-27	13-20
Water pump plate to water pump	18-27	13-20

SPECIAL TOOLS			
J-6098-10	Camshaft Brg Rem & Inst	J-33043-5	T.P.S. Gage Block
J-26999-10	Compression Gage Adapter	(.751-.773)	LL4 (700R4 Transmission)
J-29134	Piston Pin Retaining Ring	J-7049	Valve Guide Reamer Set
J-29664	Manifold Cover	J-5830	Valve Guide Reamer Set
J-29666	Airline Adapter	J-8037	Piston Ring Compressor
J-29873	Nozzle Socket	J-22102	Front Cover Seal Installer
J-33042	Static Timing Gage	J-23523-D	Harmonic Balancer Remover
J-33153	Rear Main Seal Installer	J-8089	Wire Brush, Combustion Chamber
J-33154	Rear Main Seal Packer	J-8101	Valve Guide Cleaner
J-26513	Valve Spring Compressor	J-8056	Spring Tester
J-6098.01	Camshaft Brg Rem & Inst	J-8062	Valve Spring Compressor
	Used With J-6098-10)	J-29834	Valve Lifter Remover
J-33043-2	T.P.S. And Vacuum	J-6098-11, -12	Camshaft Brg Rem & Inst
(.646-.668)	Regulator Valve Gage Block		(No's. 2, 3, 4, No. 5, No. 1)
J-33043-4	T.P.S. Gage Block	J-34352	Diesel Fuel Hydrometer
(.602-.624)		J-29872	Pump Adjusting Tool
J-33888	G-Van Engine Lifting Fixture	J-29843	Torx Bit Set
J-33300-100	Tach-N-Time	J-34029	DVOM
J-29075B	Diesel Nozzle	J-29125	DVOM
J-29079-125	Adapter Tester Set	J-34520	DVOM With Probes And Sockets
J-29079-95	6.2L Nozzle Adapter Kit	J33081	Advance Piston Hole Plug (Spring Side) Seal Installer
J-34116	Cylinder Balance Rough Idle Test Harness	J-9553-01	Drive Shaft Retaining Ring Remover
J-28552	Pressure Gage and Hose Assy. 0-15 PSI	J-29692-B	Injection Pump Holding Fixture
J-26999-12	Compression Gage	J-33198	Synkut Oil
J-34151	Housing Pressure Adapter	J-29601	Face Cam Setting Tool
J-34750	DECS — DDC Tool	J-29135	Cap Plug Set
J-29745-A	Injection Pump Drive Shaft Seal Protector		

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CYLINDER BORE AND PISTON SKIRT SIZES

METAL STAMP GRADE #	BOHN		ZOLLNER		**CYLINDER BORE	
	METRIC (mm)	ENGLISH (in.)	METRIC (mm)	ENGLISH (in.)	METRIC (mm)	ENGLISH (in.)
A	100.885 100.898	3.9719 3.9724	100.862 100.875	3.9709 3.9719	100.987 101.000	3.97585 3.97635
B	100.898 100.911	3.9724 3.9729	100.875 100.888	3.9719 3.9720	101.000 101.013	3.97635 3.97685
C	100.911 100.924	3.9729 3.9734	100.888 100.901	3.9720 3.9725	101.013 101.026	3.97685 3.97735
D	100.924 100.937	3.9734 3.9739	100.901 100.914	3.9725 3.9730	101.026 101.039	3.97735 3.97785
E	100.937 100.950	3.9739 3.9744	100.914 100.927	3.9730 3.9735	101.039 101.052	3.97785 3.97835
G	100.950 100.963	3.9744 3.9749	100.927 100.940	3.9735 3.9740	101.052 101.065	3.97835 3.97885

**Cylinder bores #7 and #8 are marked one size class smaller than actual size, i.e. a bore measuring "B" class is stamped "A" class.

OVERSIZED PISTONS (PLANT USE ONLY)

SIZE	BOHN		ZOLLNER		**CYLINDER BORE	
	METRIC	ENGLISH	METRIC	ENGLISH	METRIC	ENGLISH
X	101.029 101.041	3.9775 3.9780	101.009 101.022	3.9767 3.9772	101.130 101.143	3.98149 3.98200
Y	101.041 101.054	3.9780 3.9785	101.022 101.035	3.9772 3.9777	101.143 101.156	3.98200 3.98251
Z	101.054 101.067	3.9785 3.9790	101.035 101.048	3.9777 3.9782	101.156 101.169	3.98251 3.98303

— NOTE —

Service replacement pistons are fitted by measuring cylinder bores and honing as outlined in the Service Manual for a piston fit.

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	PISTON TO CYLINDER BORE CLEARANCE (Except Bores #7 & #8)		CLEARANCE CYLINDER BORES (#7 and #8 only)	
	METRIC	ENGLISH		
Bohn	.085mm/.115mm	.0035″/.0045″	.102mm/.128mm	.0040″/.0050″
Zollner	.112mm/.138mm	.0044″/.0054″	.125mm/.151mm	.0049″/.0059″

CASE, CAMSHAFT, AND CAMSHAFT BEARINGS (mm)					
	#1	#2	#3	#4	#5
Camshaft Journal Dia.	55.025/54.975	55.025/54.975	55.025/54.975	55.025/54.975	47.025/46.975
Finished Cam Bearing I.D.	55.088/55.063	55.088/55.063	55.088/55.063	55.088/55.063	47.076/47.051
Camshaft Brg. Clearance	.113/.038	.113/.038	.113/.038	.113/.038	.101/.026
Cam Bore Dia. (Case)	59.17/59.12	58.92/58.87	58.67/58.62	58.42/58.37	50.42/50.37
Cam Bearing O.D.	59.30/59.25	59.05/59.00	58.80/58.75	58.55/58.50	50.55/50.50
Press Fit (Bearing to Case)	.18/.08	.18/.08	.18/.08	.18/.08	.18/.08

FUEL PUMP PUSH ROD			
Pushrod O.D.	12.662/12.649	(.4985″/.4980″)	Clearance .025mm-.064mm
Pushrod Guide	12.713/12.687	(.5005″/.4995″)	(.001″-.0025″)

SURFACE FINISHES			
CRANKSHAFT	SURFACE FINISH MICROMETERS	HEAD	SURFACE FINISH MICROMETERS
Oil Seal Diameter	.40 max.	Mating Face	1.60-2.80
Main Journals	.32 max.	CAMSHAFT	
Pin Journals	.32 max.	Lobes	.50 max.
Thrust Face (front)	.50 max.	Journals	.50 max.
(rear)	.32 max.		
CASE		CONNECTING ROD	
Crank Bores	1.50-3.0	Wrist Pin Bore	.20-.50
Cylinder Bores	.40- .90	Crank Bore	2.00 max.
Deck Face	1.60-2.80	Joint Face (rod & cap)	1.25 max.
		Side Face (both sides)	2.00 max.

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CAMSHAFT BEARINGS			
BEARING #	DELCO MORAINE PART #	GOULD PART #	BEARING COLOR CODE
1	18007491	14028905	Plain (no color)
2	18007492	14028906	Pink
3	18007493	14028907	Yellow
4	18007494	14028908	Green
5	18007495	14028909	Orange

LIFTERS				
	DIAMETER		LIFTER TO CLEARANCE	
Hydraulic Valve Lifter	23.41mm / 23.39mm	.9217″ / .9209″	.040mm / .080mm	.0015″ / .0031″
Case Lifter Bore	23.47mm / 23.45mm	.9240 / .9232		

MAIN BEARINGS						
CYLINDER CASE MAIN BRG. #1-#5	METAL STAMP CODE	UPPER BEARINGS	CRANKSHAFT MAIN BRGS. #1-#4	MAIN BRG. #5	LOWER BRGS.	COLOR CODES FOR CASE, CRANK & ALL BEARINGS
79.850mm / 79.842mm	3	.026 U.S.	74.917mm / 74.925mm	74.912mm / 74.920mm	.026 U.S.	Blue
79.842mm / 79.834mm	2	.013 U.S.	4.925mm / 74.933mm	74.920mm / 74.928mm	.013 U.S.	Red
79.834mm / 79.826mm	1	Std.	74.933mm / 74.941mm	74.928mm / 74.936mm	Std.	White (plain for Std. Bearings)

BEARING CLEARANCES				
MAIN BEARING CLEARANCES	(CALCULATED CLEARANCE)		*(ACTUAL CLEARANCE)	
Bearings #1, 2, 3, & 4	.035mm / .073mm	.0014″ / .0029″	.045mm / .083mm	.0018″ / .0033″
Bearing #5	.040mm / .078mm	.0016″ / .0031″	.055mm / .093mm	.0022″ / .0037″

*Actual clearance is based upon estimated bearing distortion for bearings #1, 2, 3, & 4 (.01mm) and bearing #5 (.015mm).

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6.2L DIESEL ENGINES

CRANKSHAFT PIN JOURNALS AND CON. ROD BEARINGS			
CRANKSHAFT PIN JOURNAL DIA.	CONNECTING ROD BEARINGS	ROD & CAP BEARINGS COLOR CODES	CONNECTING ROD BEARING I.D.
60.913mm / 60.926mm Green	Std. in Rod .026 U.S. in Cap	.026 U.S. (Green)	64.150mm / 64.124mm
60.926mm / 60.939mm Yellow	Std. in Rod Std. in Cap	Std. (Yellow)	

CONNECTING ROD TO CRANKSHAFT JOURNAL BEARING CLEARANCE			
(Calculated Clearance)		*(Actual Clearance)	
.035mm / .090mm	.0014″ / .0035″	.045mm / .100mm	.0018″ / .0039″

*Actual Clearance based upon estimated bearing distortion of 0.01 mm.

PISTON AND ROD PINS						
PISTON PIN BORE SIZES		PISTON PIN O.D.		ROD PIN BUSHING BORE		COLOR CODE
METRIC	ENGLISH	METRIC	ENGLISH	METRIC	ENGLISH	
31.0088 / 31.0114	1.2208 / 1.2209	30.9961 / 30.9987	1.2203 / 1.2204	31.012 / 31.027	1.2209 / 1.2215	Green
31.0114 / 31.0140	1.2209 / 1.2210	30.9987 / 31.0013	1.2204 / 1.2205	31.012 / 31.027	1.2209 / 1.2215	Orange
31.0140 / 31.0166	1.2210 / 1.2211	31.0013 / 31.0039	1.2205 / 1.2206	31.012 / 31.027	1.2209 / 1.2215	Blue

PIN CLEARANCES			
PIN TO PISTON BORE CLEARANCE		*PISTON PIN TO ROD PIN BUSHING CLEARANCE	
METRIC	ENGLISH	METRIC	ENGLISH
.0101mm / .0153mm	.0004″ / .0006″	.0081mm / .0309mm	.0003″ / .0012″

Piston Pin P/N 14025530
Connecting Rod Assembly P/N 14025523

— *NOTE —
No selective assembly for wrist pin to rod bushing.

Reference Information
6.2L DIESEL ENGINES

PRECHAMBER SELECT FIT TO CYLINDER HEAD				
C-BORE DEPTH IN HEAD (mm)	DEPTH OF PRECHAMBER TOP FLANGE (mm)	RELATIONSHIP OF TOP PRECHAMBER TO HEAD MATING FACE (mm)	1982-84 PRECHAMBER PLUG CLASS DESIGNATION	1985
4.989 (.1964″) 5.014 (.1974″)	5.039 (.1984″) 5.014 (.1974″)	−.000 (−.000″) +.050 (+.002″)	M	W
4.963 (.1954″) 4.9988 (.1964″)	5.013 (.1974″) 4.988 (.1964″)	−.000 (−.000″) +.050 (−.002″)	N	X
4.937 (.1944″) 4.962 (.1954″)	4.987 (.1964″) 4.962 (.1954″)	−.000 (−.000″) +.050 (−.002″)	P	Y

C-BORE DIA. IN HEAD	FLANGE DIA. OF PRECHAMBER	PRESS FIT—PRECHAMBER INTO PRECHAMBER BORE
39.675 (1.5620″) 39.650 (1.5610″)	39.701 (1.5630″) 39.676 (1.5620″)	0.051mm (.002″) 0.001mm (.000″)

	VALVE STEM DIA. (mm)		VALVE GUIDE (mm)		CLEARANCE (mm)	
Int.	8.679 8.661	.3417″ .3410″	8.730 3.705	.3437″ .3427″	.026 .069	.0010″ .0027″
Exh.	9.454 9.436	.3722″ .3715″	9.505 9.480	.3742″ .3732″	.026 .069	.0010″ .0027″

Piston Protrusion Above Block	.049″ ± .010″
Valve Protrusion	(max.) Exhaust — .035″, Intake — .045″
Cylinder Head Thickness (Firedeck to rocker cover seat)	3.858″ ± .005″
Cam Lobe Lift	.280″ ± .002″

6.2 Liter Diesel Service Information

Operation In Snow (Diesel Engines)

Driving in a heavy snow storm or in dry loose snow that may swirl around the front of the vehicle, will cause snow to be drawn into the air intake system. Continuing to operate your vehicle under these conditions may cause the air cleaner to plug causing excessive black smoke and loss of power. Should the air cleaner become plugged with snow in extreme conditions the air cleaner element can be removed to allow the vehicle to be driven to a place of safety.

Starting the Diesel Engine

The following procedure is recommended for starting your diesel engine. Please note that a diesel engine starts differently from a gasoline engine.

1. Apply the parking brake.
2. Automatic Transmissions — Shift the transmission to "P" (Park) or "N" (Neutral) ("P" preferred). A starter safety device is designed to keep the starter from operating if the shift lever is in any drive position. (If you need to re-start the engine while the vehicle is moving, move the shift lever to "N").

   Manual Transmission — Press the clutch pedal to the floor and shift the transmission to Neutral. Hold the clutch pedal to the floor while you are starting the engine. A starter safety device is designed to keep the starter from operating if the clutch pedal is not pushed down all the way.
3. Turn the ignition key to "RUN." DO NOT TURN IT TO "START." With the ignition in "Run," the "GLOW PLUGS" light will come on. This tells you that small heating elements, called "glow plugs," are warming part of the engine for improved starting. When the engine is ready to start, the "GLOW PLUGS" light will go out.

   If the engine is warm, the "GLOW PLUGS" light may not come on. This is normal.

   During cranking, and/or after starting, the "GLOW PLUGS" light may cycle on and off a few times. This is normal; however, if the light cycles continuously, you should contact your authorized dealer as soon as practical.
4. With the "GLOW PLUGS" light out, if the temperature is more than 0°C (32°F), press down the accelerator pedal halfway and hold; if the temperature is less than 0°C (32°F), press the accelerator pedal to the floor and hold; then crank the engine by turning the ignition key to "Start." Release the key when the engine starts.

Pumping the accelerator pedal before or during cranking will not aid in starting, and could keep the engine from starting.

If the engine does not start after cranking 10 to 15 seconds, release the ignition key. Wait 10 to 15 seconds; then repeat Step 4. If attempting to start the engine after running out of fuel, refer to the "Notice" under "Fuel Requirements" in this section.

Do NOT use starting "aids" in the air intake system. Such "aids" can cause immediate engine damage.

When the engine is cold, let it run for a few seconds before moving the vehicle. This will allow oil pressure to build up. Increased operating noise and light smoke are normal when the engine is cold.

5. Apply the regular brakes and shift into the proper gear. Release the parking brake and drive off.

NOTICE: Do not leave your vehicle unattended with the engine running. If the engine should overheat, you would not be there to react to the "TEMP" warning light or gage. This could result in costly damage to your vehicle and its contents.

While you are waiting for the "GLOW PLUGS" light to go out, fasten your seat belt and ask your passengers to do the same.

COLD WEATHER STARTING (DIESEL ENGINES)

If you plan ahead for cold weather, starting and driving your vehicle should be no problem. The following tips will help assure good starting in cold weather.

Oil gets thicker as it gets colder, which slows down the engine cranking speed. Your diesel engine runs through the heat of compression (and glow plugs when cold), rather than through the use of spark plugs as in a gasoline engine. So, your engine must crank faster than a gasoline engine before it will start.

To be sure the engine can turn fast enough to start, use the proper viscosity engine oil when prevailing temperatures drop below 0°C (32°F). (See the oil quality and oil viscosity recommendations in this section.) Using the proper viscosity oil will make starting easier down to −18°C (0°F). When prevailing temperatures drop below −18°C (0°F), the engine block heater may be needed for starting.

If you park your vehicle in a garage, you should not need to use the block heater until the GARAGE temperature drops below −18°C (0°F), regardless of outside temperatures.

The engine block heater is designed to warm the block area, which will let the engine turn faster. To use the block heater:

1. Open the hood.
2. Unwrap the electrical cord located in the engine compartment. (After using the block heater, be sure to properly restow the cord, to help keep it away from moving engine parts.)
3. Plug the cord into any three-prong 110 volt outlet (normal household current).

NOTICE: If the cord is too short, use a heavy-duty, three-prong extension cord. Do not use an extension cord such as you would use for a lamp because the cord may overheat.

- Use the block heater in accordance with the chart shown in Figure 1-5.

FIGURE 1-5, ENGINE BLOCK HEATER USAGE*

Viscosity Grade Oil	32° to 0°F (0° to −18°C)	Below 0°F (Below −18°C)
30	2 HOURS MINIMUM	8 HOURS MINIMUM
15W-40	NOT REQUIRED	8 HOURS MINIMUM
10W-30	NOT REQUIRED	8 HOURS MINIMUM

*The times listed are minimum times. It will not harm either the block heater or the vehicle to leave it plugged in longer than the times stated.

In cold weather when the vehicle is to be parked for an extended period of time (overnight), the engine-block heater may be used to reduce the engine warm-up time, and consequently, reduce the heater warm-up time.

At temperatures below −7°C (20°F), Number 2-D diesel fuel may clog the fuel filter. This is normally caused by paraffin in the fuel turning into wax as it gets colder. If the engine starts but stalls out after a short time and will not re-start, the fuel filter may be clogged. For best results in cold weather, use Number 1-D diesel fuel or a "winterized" Number 2-D fuel. (For more information, see "Diesel Fuel Requirements and Fuel System" in Section 4 of this manual.

IF ENGINE FAILS TO START

1. Do NOT use starting "aids," such as ether or gasoline, in the air intake. Such "aids" can cause immediate engine damage.
2. Turn the ignition key to "Run." Check to be sure the "GLOW PLUGS" light is out before turning the ignition key to "Start."
3. If the "GLOW PLUGS" light fails to go out, there may be a system malfunction. If this happens, you can usually still start the engine after waiting a few seconds, but you should contact your authorized dealer as soon as practical for a starting system check.
4. Be sure you have the proper viscosity oil and that you have changed it at the recommended intervals. Using oil of improper viscosity may make starting more difficult.
5. If your batteries do not have enough charge to start the engine, see "Emergency Starting" in this section on page 1-18.
6. If the "GLOW PLUGS" light is out and your batteries are sufficiently charged, but the engine will not start, contact your authorized dealer.

7. If the engine starts, runs a short time, then stops, wax forming in the fuel could be plugging the filter. (This can happen if you use the improper fuel at colder temperatures.) If this happens, contact your authorized dealer. (For more information, see "Diesel Fuel Requirements and Fuel System" in Section 4 of this manual.)

Emergency "Jump Starting"

Vehicles equipped with diesel engines use two 12-volt batteries to provide the electrical energy needed for the glow plugs and the starter. If the batteries become discharged, the diesel engine can be "jump started" using another vehicle. The procedure for "jump starting" is the same as for a vehicle with a single battery. Jumper cables may be connected to either battery. However, it is suggested that the connection be made to the battery on the right side since it is closer to the starter and the resistance is less.

Diesel Maintenance

ENGINE OIL AND OIL FILTER

Oil and filter change intervals depend upon truck usage. Figure 1-6 should assist in determining the proper oil and filter change intervals.

Diesel fuel is really oil, thus it creates a lot of soot when it burns. A considerable amount of this soot goes past the rings into the crankcase. This dirties the lubricating oil. The only way to get rid of it is to change the oil and oil filter at the recommended intervals.

After driving in a dust storm, change oil and filter as soon as you can.

The capacity when changing the oil and filter is 7 quarts.

The oil filter used for both LH6 and LL4 is the AC model PF35.

Diesel engines have an oil cooler which is located in the radiator outlet tank with the transmission cooler.

TYPE OF USE	CHANGE INTERVAL
• FREQUENT LONG RUNS AT HIGH SPEEDS AND HIGH AMBIENT TEMPERATURES. • OPERATING IN DUSTY AREAS. • TOWING A TRAILER. • IDLING FOR EXTENDED PERIODS AND/OR LOW SPEED OPERATION SUCH AS FOUND IN POLICE, TAXI OR DOOR-TO-DOOR DELIVERY SERVICE. • OPERATING WHEN OUTSIDE TEMPERATURES REMAIN BELOW FREEZING AND WHEN MOST TRIPS ARE LESS THAN 4 MILES (6 KILOMETERS).	• CHANGE ENGINE OIL AND FILTER EVERY 2,500 MILES (4,000 KILOMETERS) or 3 MONTHS, WHICHEVER COMES FIRST.
• OPERATING ON A DAILY BASIS, AS A GENERAL RULE, FOR SEVERAL MILES AND WHEN NONE OF THE ABOVE CONDITIONS APPLY.	• CHANGE ENGINE OIL AND FILTER EVERY 5,000 MILES (8,000 KILOMETERS) OR 12 MONTHS WHICHEVER COMES FIRST.

Figure 1-6, Oil Change Interval.

— NOTE —

Always change oil and filter as soon as possible after driving in a dust storm. Also, always use SF/CD or SF/CC quality oils of the proper viscosity.

OIL VISCOSITY

Engine oil viscosity (thickness) has a noticeable effect on fuel economy. Lower viscosity grade engine oils can provide increased fuel economy; however, higher temperature weather conditions require higher viscosity grade engine oils for satisfactory lubrication. The chart shown in Figure 1-4 lists the engine oil viscosities that will provide the best balance of fuel economy, engine life and oil economy.

Engine Oil Additives

— CAUTION —

DO NOT USE ANY SUPPLEMENTAL OIL ADDITIVES. USING OIL ADDITIVES MAY CAUSE ENGINE DAMAGE.

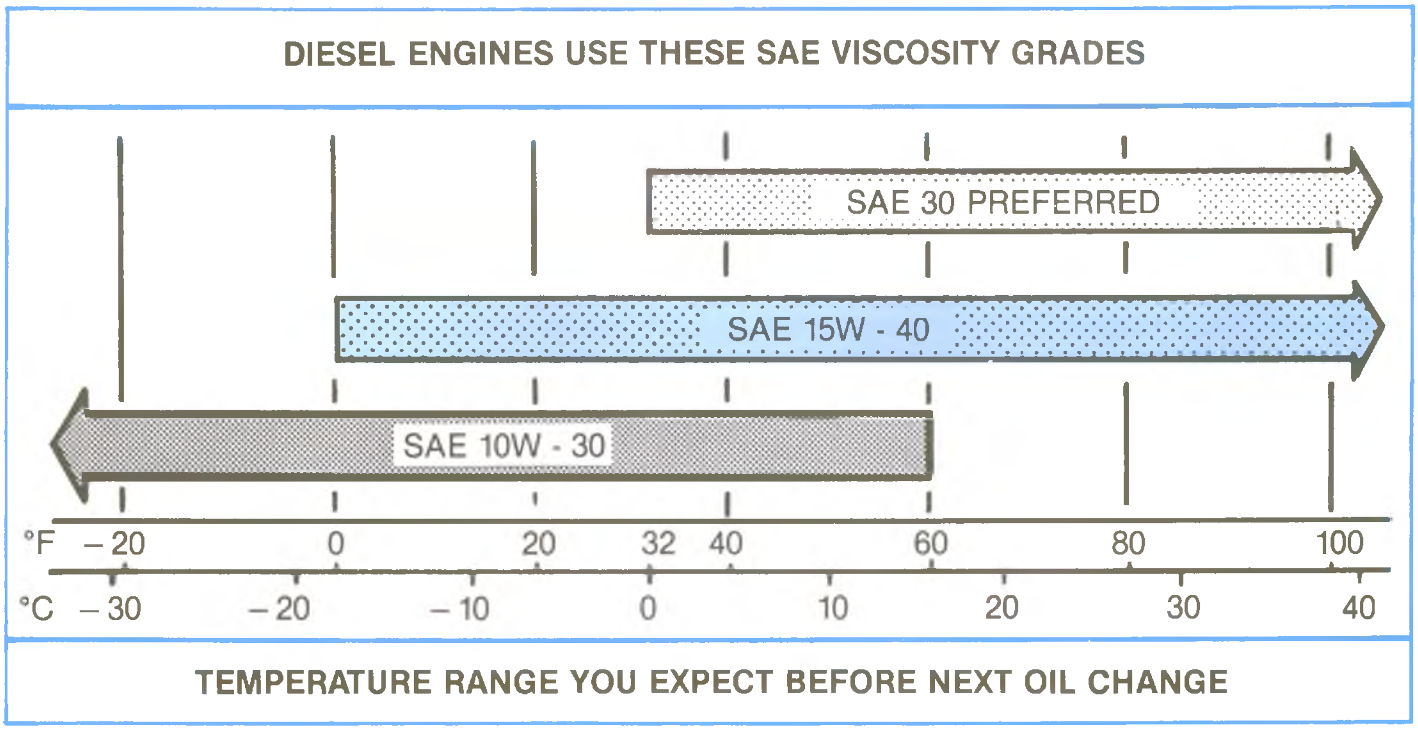


Figure 1-7, Ambient Temperature Range For Engine Oil.

Diesel Engine Oil Usage

A.P.I. OIL CLASSIFICATIONS

A.P.I., the American Petroleum Institute, has devised a service classification system based on ten classes. Gasoline engine oils are described in six and diesel engines are described in four. Generally, the higher the letters in a class, the more an oil is required to do.

A.P.I. service classifications of engine oils refer to the performance characteristics of the oils and types of services they can be used in.

RECOMMENDED OIL

Use engine oils labeled with the A.P.I. (American Petroleum Institute) designations SF/CC and CD. The A.P.I. designations are listed somewhere on the oil can, usually on the top or label.

Several different designations may appear on the can. Be sure the oil has BOTH the SF and the CC or CD designations, regardless of the order in which they appear on the oil can.

SF/CD (best choice) and SF/CC (acceptable) oils combine excellent film strength with the best available additive package to prevent wear and protect against piston ring sticking at higher mileages. DO NOT USE SAE 10W-40 OILS IN THE 6.2L DIESEL ENGINES.

Used Lube Oil Analysis Warning Values

FREQUENCY OF LUBE OIL SAMPLES FOR ANALYSIS

The interval at which used lube oil samples may be obtained for analysis can be scheduled for the same period as when other preventative maintenance is conducted. For example, in highway vehicle applications, a sample may be obtained every 2,500 miles when engines are brought in for fuel and coolant filter replacement.

USED LUB OIL ANALYSIS PROGRAM

A used lube oil analysis program is useful for monitoring the condition of the crankcase oil in all engines.

Primarily, used lube oil analyses indicate the condition of the oil but not necessarily the condition of the engine. Never tear down an engine based solely on the analysis results obtained from a single used oil sample. However, the condition of the engine should be investigated using conventional mechanical and/or electronic diagnostic instruments. Frequently, visual inspections are all that is required to detect problem areas related to engine wear. It is also prudent to obtain another oil sample from the suspected distressed unit for analysis.

Abnormal concentrations of some contaminants such as diesel fuel, coolant, road salt, or airborne dirt cannot be tolerated for prolonged periods. Their presence will be reflected in accelerated engine wear, which can result in less than optimum engine life. The oil should be changed immediately if any contamination is present in concentrations exceeding the warning limits given.

Experience in specific engine applications operating specific model engines is a prerequisite for proper interpretation of laboratory used lube oil sample analysis results. It is imperative to remember, in scrutinizing laboratory used lube oil sample results, that it is the change in value or deviation from baseline data obtained from the new oil (same brand or mixture of brands) that is significant. This is especially important to remember in investigations such as wear metal analysis, total base number and viscosity determinations.

NOTES

2. Engine Systems and Construction

Engine Design Features

The 6.2L Diesel engine features overhead valves & stainless steel swirl pre-chambers. It is an over square design; that is the bore is larger than the stroke. This provides higher RPM for heavy duty usage. The 6.2L is built in 2 versions. The LH6 Lt-duty is for use in 6,000-8,500 GVW Lt. Duty trucks and has 46mm diameter intake valves and 42mm diameter exhaust valves. The LL4 Heavy duty version is for use in trucks in the 8500-10,000 GVW range and has 50mm diameter intake valves and 42mm diameter exhaust valves in 1982 and 1983. The 1984 and later LL4 versions will use 46mm diameter intake valves and 38mm diameter exhaust valves. The 1985 Calif. LH6 uses 46mm intake and 39mm exhaust valves. The firing order is 1-8-7-2-6-5-4-3 and #1 cylinder is left bank forward.

Cylinders #1, 3, 5, 7 are on the left bank and cylinders #2, 4, 6, 8 are on the right bank.

This engine is similar to a V-8 gasoline engine in many ways but major differences occur in the cylinder heads, combustion chamber, fuel distribution system, air intake manifold and the method of ignition. The cylinder case, crankshaft, main bearings, rods, pistons and wrist pins are a heavy duty design, because of the high compression ratio required in the diesel engine to ignite fuel. Ignition of the fuel in a diesel engine occurs because of heat developed in the combustion chamber during the compression stroke. Thus, no spark plugs or high voltage ignition are necessary for a diesel engine.

Intake and exhaust valves in the cylinder heads operate the same as in a gasoline engine but are of special design and material for diesel operation. The special alloy steel pre-chamber inserts in the cylinder head combustion chambers are serviced separately from the head. With the cylinder head removed, they can be pushed out after removing the glow plugs and injection nozzles. Glow plugs and injector nozzles are threaded for assembly into the head. The nozzles are spring loaded and calibrated to open at a specified p.s.i. of fuel pressure.

Because the intake manifold is always open to atmospheric pressure, there is no vacuum supply and a vacuum pump is required to operate accessories such as air conditioning, door diaphragms and cruise control.

The engine is designed with a 101mm (3.98 inch) bore and a 97mm (3.8 inch) stroke, which produces 6217 CC (379.4 cubic inches). The compression ratio is 21.5 to 1. The cylinder head incorporates a 17 bolt head design which locates 5 bolts around each cylinder. This helps gasket durability, by increasing clamping load.

The cylinder head includes a high swirl pre-combustion chamber which mixes fuel and air to provide an efficient fuel burn and low emissions. A glow plug is used to assist in starting this system. A special cavity in the piston top further assists in mixing the combustion products for complete burning.

The main bearing caps all use 4 bolts to provide a rigid support for the crankshaft and minimize stress.

The rolled fillet nodular iron crankshaft utilizes a torsional damper, tuned to reduce vibrations.

This engine uses roller hydraulic valve lifters running on a forged steel camshaft.

The fuel system includes a water sensor, which signals high water levels and a need for service. Additional water separation, and a drain valve is provided at the filter.

A block heater is standard equipment to aid starting in severe weather.

Cylinder Case

The cylinder case is made of one piece cast iron comprised of a special alloy containing carbon, silicon, and chromium. This mixture provides good elasticity, and thermal expansion. The 6.2L is designed to match fit the cylinder bore with the piston. This is done by dividing the total diameter tolerance size range of 100.987-101.065 mm (3.975-3.979) into 6 size ranges. Each of the bore sizes is identified by a code letter A-B-C-D-E-G. This identification is metal stamped on the cylinder case pan rail adjacent to the proper cylinder, "A" size pistons for "A" size cylinder bores etc., by using this select fit method, the clearance is controlled to .089-.138mm (.0035 in.-.005 in.). See Figure 2-2.

There are 5 main bearings numbering 1 through 5 from the front of the engine. There is an arrow on the cap which points toward the front of the engine.

Each main bearing cap is retained with 4 bolts in order to provide a more rigid support for the crankshaft and minimize stress. The caps are made of nodular cast iron, and are torque driven in place on the machine line before boring, just the same as they are finally torque driven at assembly.

The center or number 3 bearing is the thrust bearing.

The main bearings are select-fitted to each of the 5 main bearing bores. The proper size code is stamped on the pan rail at the corresponding main bearing bulk head. The total diameter size range of the main bearing bores #1 through 5 is 79.826 - 79.850mm. The spread of .024mm (.0096″) is divided into 3 sizes. It will be stamped 1-2 or 3 on the pan rail. Each of the sizes is matched to the corresponding size of split bearing insert in the case half only. The split bearing insert for the main cap is match fitted to the crankshaft main journal.

Figure 2-3 shows the plant chart for main bearing installation. This matches the main bearing journal diameter with the case bore to come up with the proper size inserts.

These numbers 1, 2 & 3 are primarily for plant use in selecting the inserts of the standard, .013mm (.0005 in.) U.S., and .026mm (.001 in.) U.S.

These three bearings will be used in the field to obtain proper clearance on a crankshaft.

— NOTE —

All values in Figure 2-3 are metric and the undersize specification refers to the change in running clearance when a pair of bearings are fitted e.g. .001″ U.S. half fitted with a std. half would give a total change in running clearance of .0005″.

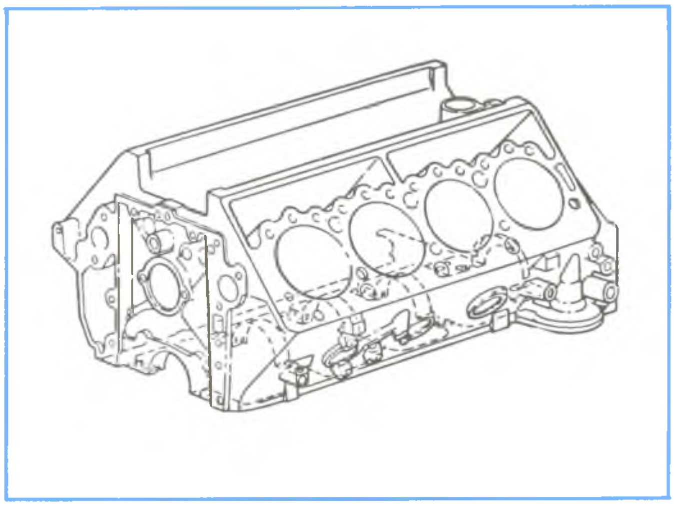


Figure 2-1, **Cylinder Case.**

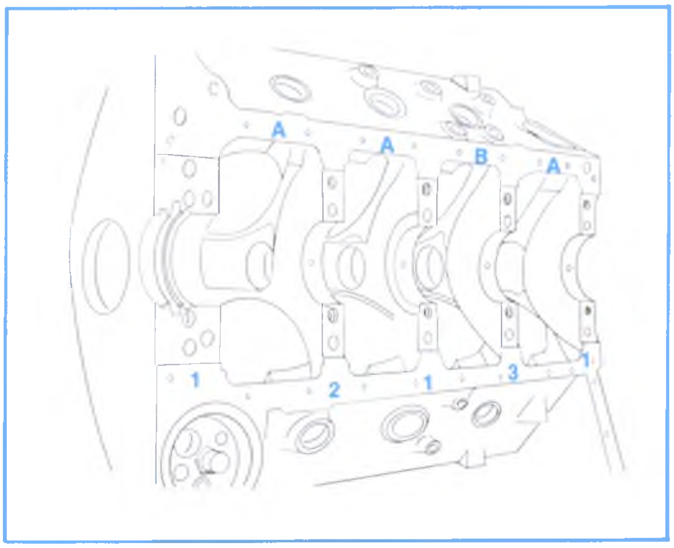


Figure 2-2, **Bottom of Case.**

CRANKSHAFT MAIN JOURNAL DIAMETER		CYLINDER & CASE MAIN BEARING BORE DIAMETER		
		79.850 79.842 (3)	79.842 79.834 (2)	79.834 79.826 (1)
FRONT, FRONT INTERMEDIATE CENTER & REAR INTERMEDIATE MAIN BEARINGS	74.917 74.925 BLUE	1-.026 U.S. IN CASE 1-.026 U.S. IN CAP	1-.013 U.S. IN CASE 1-.026 U.S. IN CAP	1-STD IN CASE 1-.026 U.S. IN CAP
	74.925 74.933 ORANGE	1-.026 U.S. IN CASE 1-.013 U.S. IN CAP	1-.013 U.S. IN CASE 1-.013 U.S. IN CAP	1-STD IN CASE 1-.013 U.S. IN CAP
	74.933 74.941 WHITE	1-.026 U.S. IN CASE 1-STD IN CAP	1-.013 U.S. IN CASE 1-STD IN CAP	1-STD IN CASE 1-STD IN CAP
REAR MAIN BEARING	74.912 74.920 BLUE	1-.026 U.S. IN CASE 1-.026 U.S. IN CAP	1-.013 U.S. IN CASE 1-.026 U.S. IN CAP	1-STD IN CASE 1-.026 U.S. IN CAP
	74.920 74.928 ORANGE	1-.026 U.S. IN CASE 1-.013 U.S. IN CAP	1-.013 U.S. IN CASE 1-.013 U.S. IN CAP	1-STD IN CASE 1-.013 U.S. IN CAP
	74.928 74.936 WHITE	1-.026 U.S. IN CASE 1-STD IN CAP	1-.013 U.S. IN CASE 1-STD IN CAP	1-STD IN CASE 1-STD IN CAP

Figure 2-3, **Bearing Chart.**

Service will continue to selectively fit bearing halves in the field by using plastigage, trying to obtain a clearance of .045-.083mm (.0018-.0032 in.) on #'s 1 thru 4, and .055-.093mm (.002-.0036 in.) on #5. The standard, .013mm (.0005 in.) U.S. and .026mm (.001 in.) U.S., bearings are for dealer service in selecting those clearances.

6.2L Valve Train

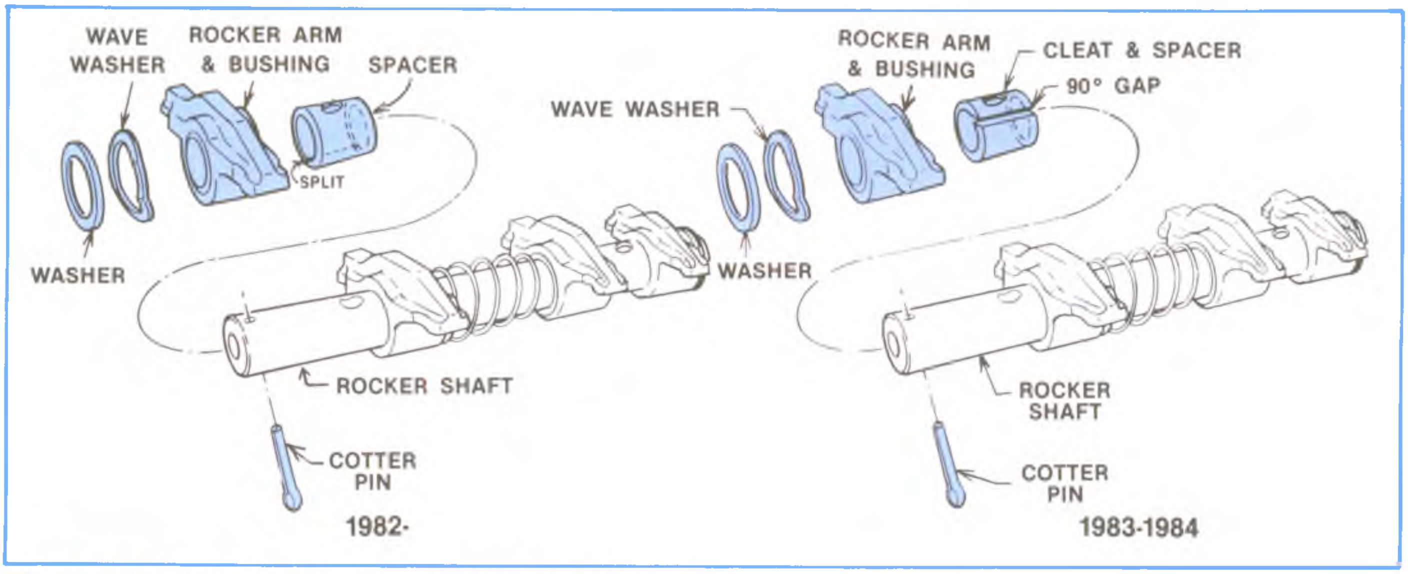


Figure 2-4, 1982-1984 Rocker Arm Assembly.

VALVE TRAIN
1982-1984 ROCKER ARM & SHAFT DESIGN

With the high compression ratio of the pre-chamber diesel, there is minimal valve-to-piston clearance. Because it is important to have a rigid valve train that insures a precise valve train motion through the speed range, a shaft supported valve rocker arm design is used. Nodular iron rocker arms with a steel backed bushing are used. The shafts are bolted to case stanchions on the cylinder head. The design has a steel backed bronze alloy bushing in the rocker arm which is final bored after being press fit into the cast arm. This bushing uses a performed circumferential oil groove and 2 cross oil grooves for directing lubrication to the mating shaft surface. Oil is supplied to the rocker arm via the hollow push rod and the arm in turn has drilled passages that provide a flow path for oil to the bushing.

The 1982 engine used a hardened steel spacer and a metric washer at the rocker shaft attachment. The 1983-84 engine uses an unhardened spacer and a steel cleat. The steel cleat has a large gap 90° to the bolt. This prevents any closure, and the cleat spreads the load.

Spacer part # — New 14057297
— Old 14028990

1983-84 Cleat — 14057296

1983-84 Rocker Arm Assembly 14061505

1985 and Later Rocker Arm Assembly

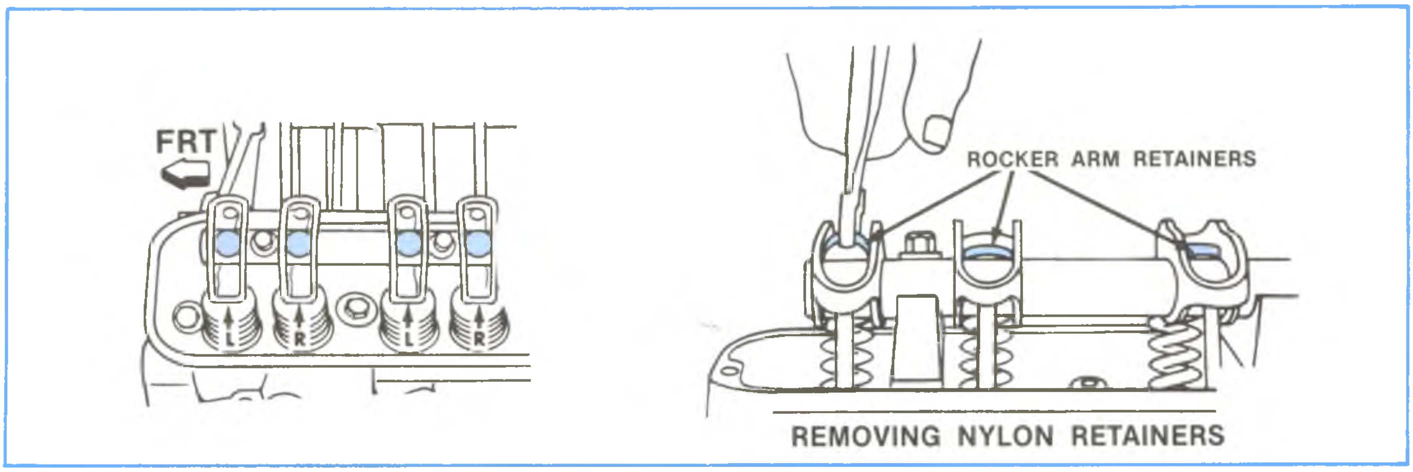


Figure 2-5, **1985 and Later Rocker Arm Assembly.**

- THE 1985 AND LATER ROCKER ARM ASSEMBLY CONSISTS OF:

1. Steel stamped rocker arms.
2. A large diameter steel shaft bolted directly to the cylinder head pedestals.
3. Individual plastic locater buttons for each arm.

The rocker arm is open-topped permitting splash lubrication of the bearing surface.

- TO REMOVE THE ROCKER ARMS IT IS NECESSARY TO DO THE FOLLOWING:

1. Remove rocker arm assembly from the cylinder head.
2. Insert a screwdriver in the bore of the rocker shaft, breaking off the ends of the nylon rocker arm retainers.
3. Using a pair of pliers, pry up on the flat tops of the retainers, removing them.
4. Remove the rocker arms.

- TO INSTALL THE ROCKER ARMS IT IS NECESSARY TO DO THE FOLLOWING:

1. Install the rocker arm or arms on the rocker shaft, lubricating them with engine oil. One common rocker arm (Part #23500073) is used in all locations.
2. Center each arm on the ¼ inch hole in the shaft. Install a **new** nylon rocker arm retainer (Part #23500076) in each ¼ inch hole, using a drift of at least ½ inch diameter.

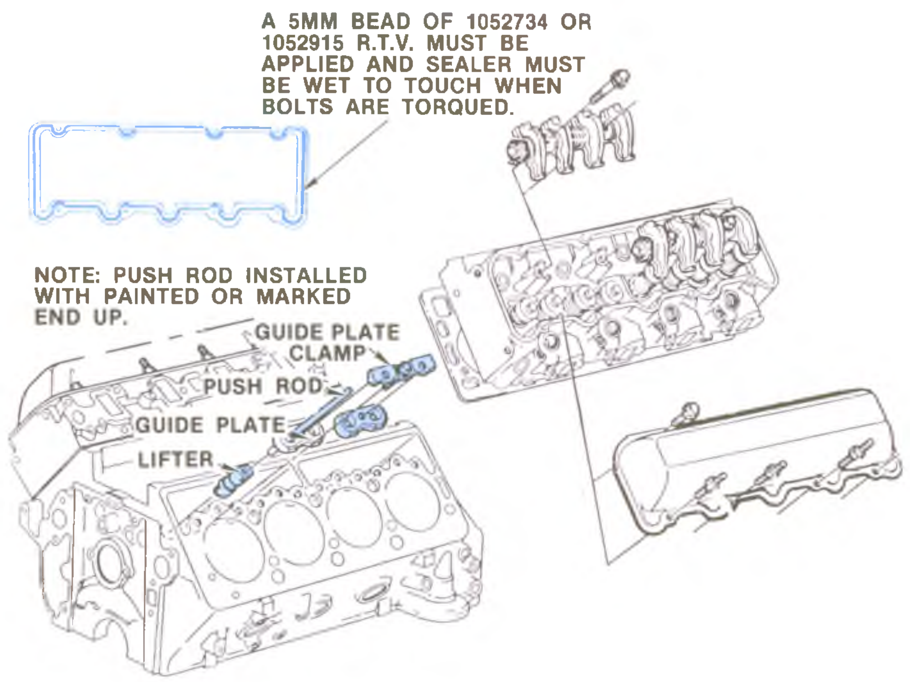


Figure 2-6, Valve Train.

Roller Hydraulic Lifters

Roller hydraulic lifters are used to reduce the amount of friction between the valve lifter and the camshaft lobe. See Figure 2-6. A requirement with the use of a roller lifter is a positive guide device to insure the roller will track consistently. First; the line of action of lifter motion is offset from the camshaft center line, to reduce the skewing motion of the lifter during the cam opening and closing. Second, a lifter guide plate is used, to restrain lifter motion to less than two degrees about its axis. A guide plate clamp holds 2 of the guide plates in position. The clamp is a self-contained bolt attached to a bracket. And there are 4 lifters and 2 guide plates to every guide plate clamp. 1982-1983 guide plates are stamped steel. 1984 and later guide plates are sintered iron.

— NOTE —

It is important that the lifter guide plates and retaining brackets are properly installed to prevent lifter rotation; so it is suggested that after installing the guide plates and retainers, to rotate the crankshaft by hand 720° which will cycle the camshaft 360° or one full revolution. Make sure while doing this, that the lifters move up and down in the guide plate. If the engine will not turn over by hand, then one of the lifters is not free to move up & down in the guide plate.

OPERATION

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the push-rods to the rocker arms. (Figure 2-7)

When the lifter begins to roll up the cam lobe, the ball check is held against its seat in the plunger by the ball check spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise as a unit, opening the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push-rod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rolls down the other side of the cam lobe and reaches the base circle or "valve closed" position, the plunger spring quickly moves the plunger back up to its original position. This movement causes the ball check to open against the ball spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash.

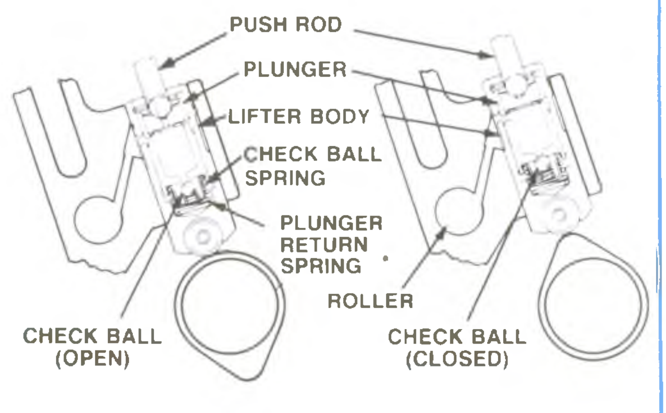


Figure 2-7, Roller Valve Lifter Operation.

VALVE LIFTER SERVICE REMOVAL

Valve lifters and push rods should be kept in order so they can be re-installed in their original position. The push rods must be installed with painted end up. This is necessary as the premium ball is located on the upper end only.

1. Remove rocker arm covers.
2. Remove rocker arms.
3. Remove guide clamps and guide plates. It may be necessary to use mechanical fingers to remove the guide plates.
4. Remove lifters using Tool J-29834 and a magnet through access holes in cylinder head.

• DISASSEMBLY (Figure 2-8)

1. Remove the retainer ring with a small screwdriver.
2. Remove push-rod seat and oil metering valve.
3. Remove plunger and plunger spring.
4. Remove check valve retainer from plunger, then remove valve and spring.

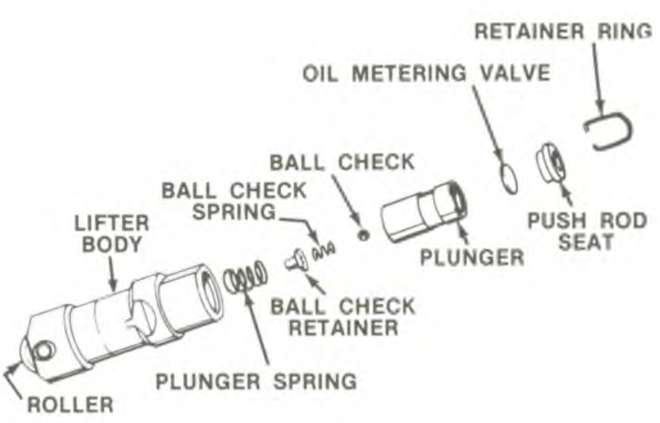


Figure 2-8, Valve Lifter Disassembled.

CLEANING AND INSPECTION

After lifters are disassembled, all parts should be cleaned in clean solvent. A small particle of foreign material under the check valve will cause malfunctioning of the lifter. Close inspection should be made for nicks, burrs or scoring of parts. If either the roller body or plunger is defective, replace with a new lifter assembly.

ROLLER LIFTER INSPECTION

1. Roller should rotate freely, but without excessive play.
2. Check for missing or broken needle bearings.
3. Roller should be free of pits or roughness. If present, check camshaft for similar condition. If pits or roughness are evident replace the lifter and camshaft.

LIFTER ASSEMBLY

1. Assemble ball check spring and retainer into plunger, (Figure 2-6). Make sure retainer flange is pressed tight against bottom of recess in plunger.
2. Install plunger spring over check retainer.
3. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.
4. Assemble oil metering valve and push rod seat and seat retaining ring in groove.

Lifters must be assembled while submerged in kerosene or diesel fuel and leak-down tested before placing into service.

INSTALLATION

Prime new lifters by working lifter plunger while submerged in new kerosene or diesel fuel. Lifter could be damaged if dry when starting engine.

Coat the roller and bearings of lifter with 1052365 lubricant or equivalent.

1. Install the lifters into the original position in the cylinder block.
2. Install valve lifter guide plate.
3. Install guide plate clamp. Crankshaft must be manually rotated 720° after assembly of lifter guide plate clamp to insure free movement of lifters in guide plates.

• PUSHROD

The pushrods have a different degree of hardness at each end. A paint mark at the hard end identifies it.

The reason for the additional hardness on the rocker arm end, is because the lifter no longer rotates and consequently neither does the pushrod increasing wear spots. The pushrods could be installed the wrong way, so mark the top of the pushrods as soon as you remove them from the engine.

ROCKER ARM SHAFT INSTALLATION, 6.2L DIESEL

Rocker arm shafts may break if installed improperly. Uneven torquing causes stress at bolt holes.

The proper method to install rocker shafts is as follows:

1. Set engine balancer timing mark at TDC mark on engine.
2. Rotate engine 3½″ counter clockwise (measured on balancer) or to first lower water pump bolt (See Figure 2-9). This procedure will position the engine so that no valves are close to a piston head. This is 30° BTDC.
3. Before installing bolts through shaft be certain that ring around shaft is installed with "split" at bottom (See Figure 2-10) on 1982 models. On 1983 and later the split is 90° to the right. On 1985 and later no split ring is used.
4. Snug both bolts on each shaft.
5. Tighten bolts evenly to 55 N.m. (40 lb. ft.) torque.

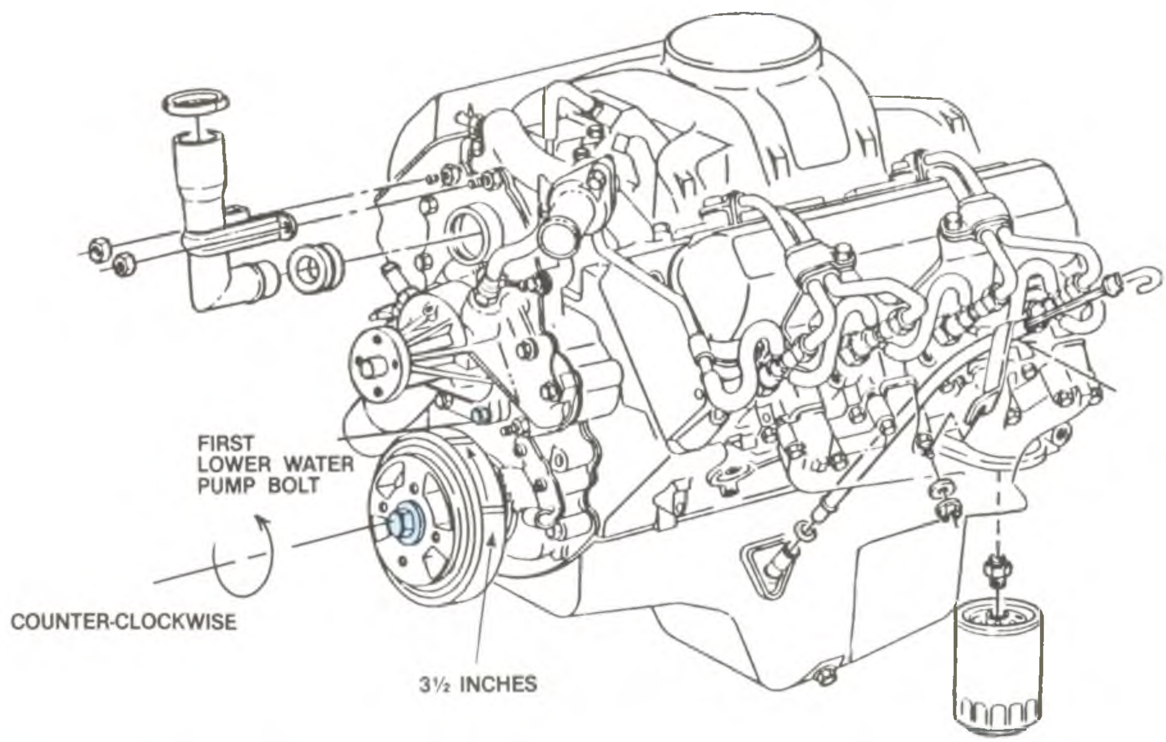


Figure 2-9, Balancer Position.

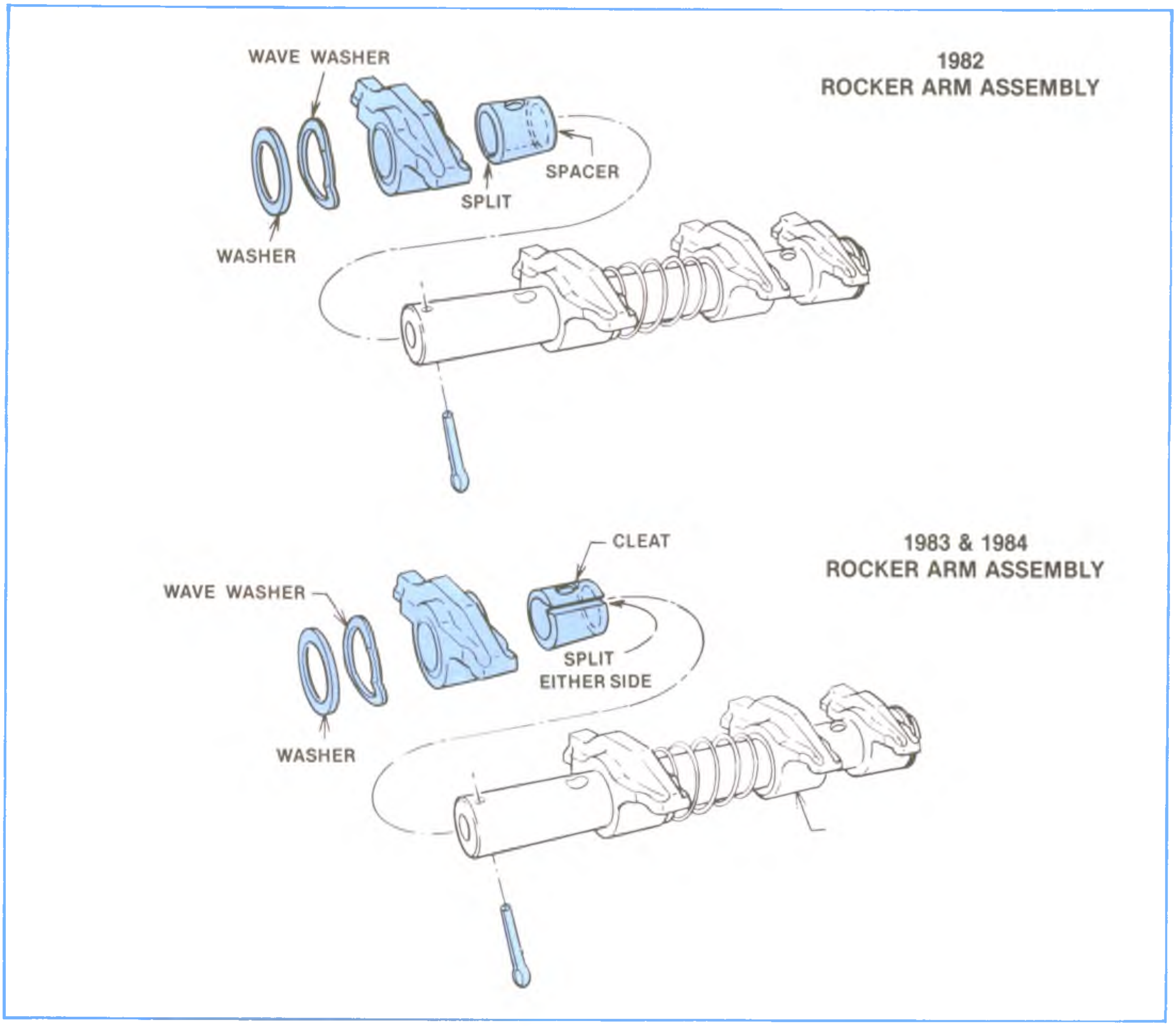


Figure 2-10, 1982-84 Rocker Shafts.

Roller Lifter Wear — Diesel Engines

Roller lifter wear, sticking, or looseness can be caused by high carbon content in the engine oil, which is the product of combustion and can be caused by a malfunctioning EGR and/or EPR system.

When you encounter this type of condition, be sure the EGR and EPR systems are functioning properly and that there are no exhaust leaks in the air inlet system. If the above systems are found to be OK, the operator of the vehicle involved should be questioned about driving conditions and driving habits. Extended idle periods and/or low speed operation will necessitate more frequent oil changes. Refer to the appropriate Owner's Manual for recommended oil change intervals for severe service driving conditions.

Valve Lifter Diagnosis

1. MOMENTARILY NOISY WHEN CAR IS STARTED:

This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifter to fill after the engine is started.

2. INTERMITTENTLY NOISY ON IDLE ONLY, DISAPPEARING WHEN ENGINE SPEED IS INCREASED:

Intermittent clicking may be an indication of a pitted check valve ball, or it may be caused by dirt.

Correction: Clean the lifter and inspect. If check valve ball is defective, replace lifter.

3. NOISY AT SLOW IDLE OR WITH HOT OIL, QUIET WITH COLD OIL OR AS ENGINE SPEED IS INCREASED:

High leak down rate. Replace suspect lifter.

4. NOISY AT HIGH CAR SPEEDS AND QUIET AT LOW SPEEDS:

a. High oil level — Oil level above the "Full" mark allows crankshaft counterweights to churn the oil into foam. When foam is pumped into the lifters, they will become noisy since a solid column of oil is required for proper operation.

   Correction: Drain oil until proper level is obtained. See PERIODIC MAINTENANCE Section.

b. Low oil level — Oil level below the "Add" mark allows the pump to pump air at high speeds which results in noisy lifters.

   Correction: Fill until proper oil level is obtained. See PERIODIC MAINTENANCE Section.

c. Oil pan bent on bottom or pump screen cocked or loose; replace or repair as necessary.

5. NOISY AT IDLE BECOMING LOUDER AS ENGINE SPEED IS INCREASED TO 1500 RPM:

This noise is not connected with lifter malfunction. It becomes most noticeable in the car at 10 to 15 mph "L" range, or 30 to 35 mph "D" range and is best described as a hashy sound. At slow idle, it may be entirely gone or appear as a light ticking noise in one or more valves. It is caused by one or more of the following:

a. Badly worn or scuffed valve tip and rocker arm pad.

b. Excessive valve stem to guide clearance.

c. Excessive valve seat runout.

d. Off square valve spring.

e. Excessive valve face runout.

f. Valve spring damper clicking on rotator.

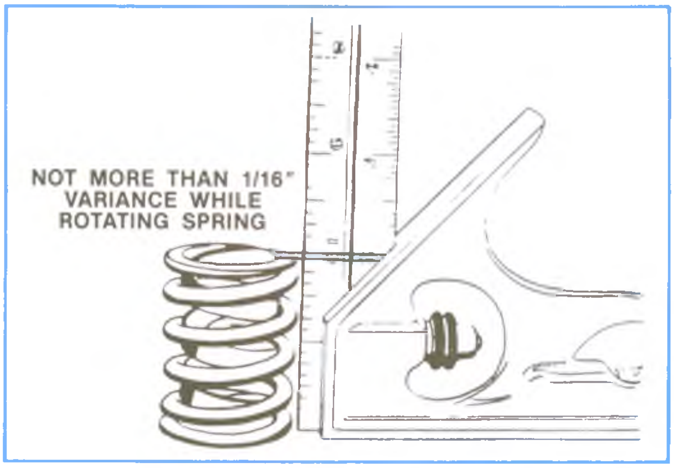


Figure 2-11, Checking Valve Spring.

To check valve spring and valve guide clearance, remove the valve covers:

a. Occasionally this noise can be eliminated by rotating the valve spring and valve. Crank engine until noisy valve is off its seat. Rotate spring. This will also rotate valve. Repeat until valve becomes quiet. If correct is obtained, check for an off square valve spring. If spring is off square more than 1/16″ in free position, replace spring. (Figure 2-11).

b. Check for excessive valve stem to guide clearance. If necessary, correct as required.

6. VALVES NOISY REGARDLESS OF ENGINE SPEED:

This condition can be caused by foreign particles or excessive valve lash.

Check for valve lash by turning the engine so the piston in that cylinder is on top dead center of firing stroke. If valve lash is present, the push-rod can be freely moved up and down a certain amount with rocker arm held against valve. If OK, clean suspected valve lifters.

Valve lash indicates one of the following:

a. Worn push-rod.

b. Worn rocker arm and/or shaft.

c. Lifter plunger stuck in down position due to dirt or carbon.

d. Defective lifter.

Checking of the above four items:

1. Look at the upper end of push-rod. Excessive wear of the spherical surface indicates one of the following conditions.
   a. Improper hardness of the push-rod ball. The push-rod and rocker arm must be replaced.
   b. Improper lubrication of the push-rod. The push-rod and rocker arm must be replaced. The oiling system to the push-rod should be checked.
2. If the push-rod appears in good condition and has been properly lubricated, replace rocker arm and recheck valve lash.
3. If valve lash exists and push-rod and rocker arm are okay, trouble is in the lifter. Lifter should be replaced.

Cylinder Head

The cylinder head (Figure 2-12) is a very heavy design and made of cast gray iron. It is a 17 bolt design that has 5 bolts positioned around each cylinder, to provide a more effective seal, and improve gasket retention.

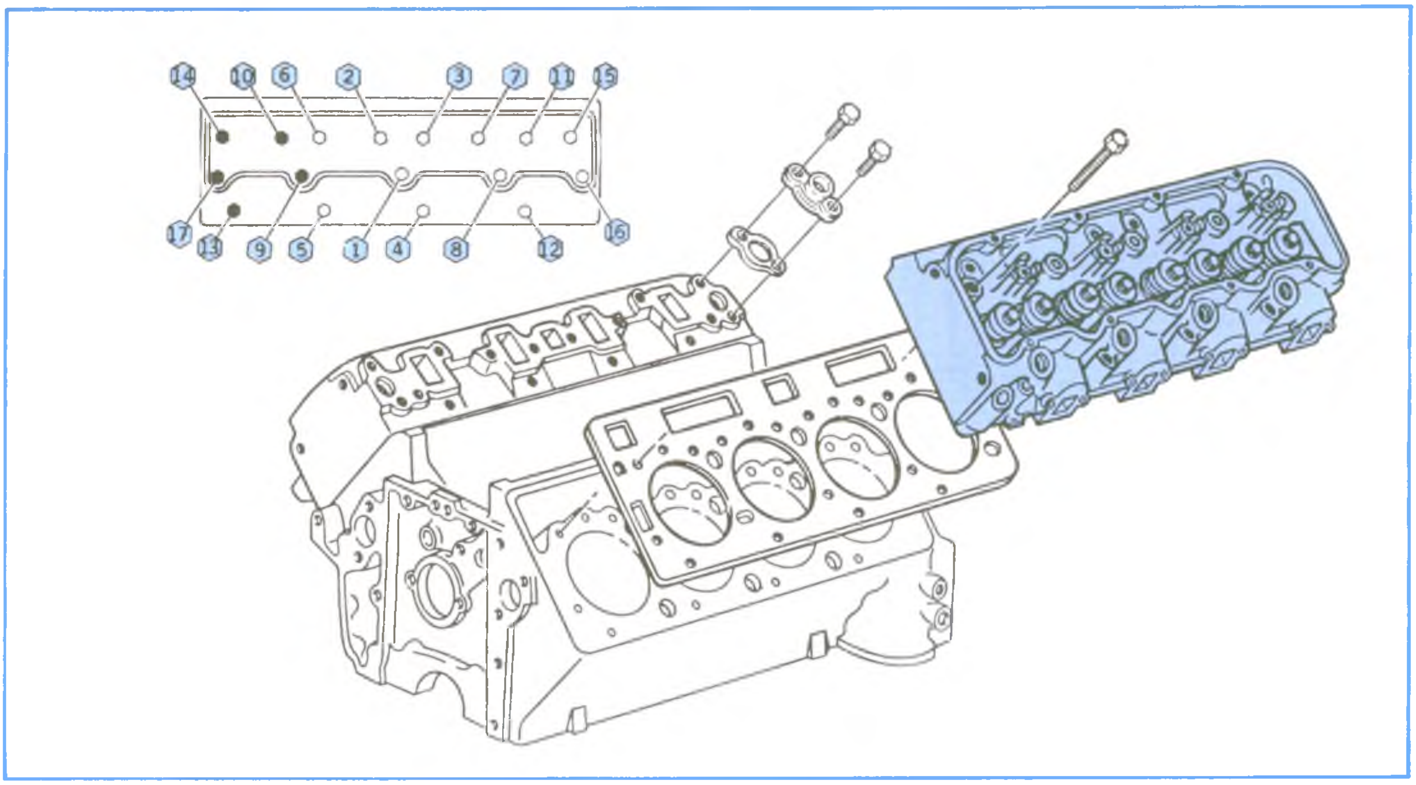


Figure 2-12, **Cylinder Head.**

> **— NOTE —**
>
> **The cylinder heads for the LH6, LL4 and different model years are different. This is because of different; pre-chambers, nozzles, compression ratios, and valve sizes. Consult a G.M. Parts Book or Fiche, to determine the proper cylinder head.**

Cylinder heads for 6.2L engines should be checked to verify the correct part for the application before installation on the block. The following information is provided for determining that the correct part number head has been received.

YEAR	PART #	MODELS	ENGINE CODE	NOZZLE THREAD	INTAKE VALVE	EXHAUST VALVE
1982	14079354	C,K-1,2,3	C	M24x2	46mm	42mm
1982	14079335	C,K,P-2,3	J	M24x2	50mm	42mm
1983-84	14079336	C,K,G-1,2,3	C	M24x1.5	46mm	42mm
1983	14079337	C,K,G,P	J	M24x1.5	50mm	42mm
1984	14079304	C,K,G,P	J	M24x1.5	46mm	38mm

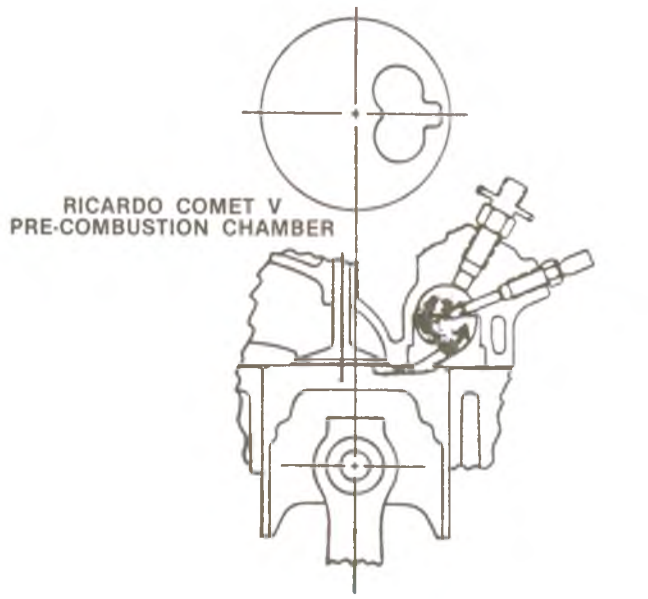


Figure 2-13, Pre-Combustion Chamber.

Pre-Combustion Chambers

A design feature is the Ricardo Comet V pre-combustion chamber which has a spherical chamber which mixes the air and fuel by air swirl (Figure 2-13). This assists in promoting high turbulence. This is an ante-or divided combustion chamber, having the major chamber in the cylinder head and only a small space between the piston and the cylinder head. Close piston clearance produces high turbulence in the ante chamber and promotes rapid combustion. The charge is forced out of the throat area, agitating the entire mixture and resulting in more complete combustion. This design has a broad speed operating range. It also provides low noise and effective emission control. The pre-chamber is installed in the cylinder head flush to +- .050 mm (.002 in.).

Broken Glow Plug Tip

A burned out glow plug tip may bulge then break off and drop into the pre-chamber when the glow plug is removed. When this occurs the nozzle should be removed and the broken tip removed through the nozzle hole. It may be necessary to remove the cylinder head.

Servicing Cylinder Head and Gasket

For removal, see the Service Manual.

V-8 Diesel Head Gasket Leakage

There are various reasons why a cylinder head may not seal, that should be detected before a head gasket is replaced. Some may not be readily apparent to the technician because the theory of sealing is not fully understood.

First get an understanding of what is going on in the engine and what the gasket must accomplish. The pressure within the diesel engine cylinder is much higher than a gasoline engine, 1000 vs 600 psi.

The sealing concept is to use most of the clamping load, about 75%, to seal the compression. This is accomplished by placing a round wire ring inside of a thin metal shield that surrounds the cylinder bore. When the bolts are tightened we literally have line contact around the bore between the cylinder head and the block. Because it is line contact the pressure exerted by the ring to the head and block is extremely high. The clamping load is used to compress the metal ring. The body of the gasket is a few thousands of an inch thinner than the ring after it is crushed. Therefore none of the clamping load is used to crush the body. The colored rings around the various holes in the gasket are a cured RTV sealer. The sealer is about .005 inches in thickness, on each side. It is thick enough so that it gets crushed between the head and block. The sealer keeps the combustion gases from going into the coolant and obviously keeps the coolant from leaking out through the gasket.

The gasket has another feature that needs explanation. The wire ring must cross over the pre-chamber which should be flush with the head. If the pre-chamber is recessed the clamping load in that area will not be as great. If it is exposed, the clamping load beside the pre-chamber will not be as great.

Now it should be better understood that the sealing surface is the wire ring in the gasket where it contacts the block and head. Any damage to these surfaces will result in gasket leaks. Use of the motorized wire brush or grinder could remove a few thousands of metal. The head may then clamp the body of the gasket rather than the sealing ring.

While the cylinder heads are off the engine, they should be carefully inspected for a number of possible conditions, one of which is warpage. If any cylinder head is warped more than .006″ longitudinally, .003″ transversely, it should be replaced; resurfacing is not recommended.

Minor surface cracks in the valve port area of the cylinder head, especially between the intake and exhaust valve ports, are not a normal condition. These surface cracks may affect the function of the cylinder heads and they may require replacement for this condition. The use of magnaflux or dye check is recommended as cracks in the cylinder head that affect performance are not always readily visible to the naked eye, therefore magnafluxing is necessary.

There is an indentation in the block and head surface where the sealing ring contacts both parts. While this appears to be quite deep, actual measurements have shown that the groove is only one or two thousands deep and does not affect sealing. There are gaskets available that are used with .030 inch oversize pistons. Use of these head gaskets will move the sealing bead outboard of the existing groove. These gaskets will be used in the various kits.

Another condition is one that is evident by looking at the gasket once it is located on the dowel pins on the block. The sealing bead is only slightly larger in diameter than the bore. The bead may extend into the chamfer at the top of the cylinder which results in an uneven crush of the wire and after a few miles will result in a leak.

To check for this lay the old gasket on the block. Look at each cylinder, the gasket should be concentric with the bore. It may help to pull the metal ring out of the gasket so the block is more readily visible.

Make sure that the bolt holes in the cylinder block are drilled and tapped deep enough. The head should be placed on the block without a head gasket. Then run a .005 feeler gage around the edge of the head. There should be no clearance, this indicates that dowel pins are not holding the head off the block. Then by hand, screw each of the bolts in. The bolts should screw in far enough to contact the head. This will indicate that the holes are drilled deep enough.

The bolt threads should be wire brushed to clean them and then coated with a sealant lubricant (1052080). This should be on the threads and under the heads of the bolts. This is critical so that the friction on the bolt is reduced during installation. Do not put the oil in the bolt hole, an excessive amount of oil could cause a hydraulic lock and prevent the bolt from tightening up. Do not paint the head gasket with a sealant. Sealants will sometimes attack the RTV sealer which results in a leak.

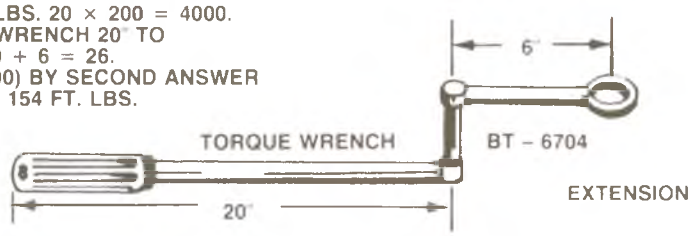
V-8 Diesel Head Gasket Installation Checklist

- Wire brush head bolts to clean threads.
- Apply P/N 1052080 sealant to bolt threads.
- Oil underneath head of bolts.
- Dowel pins hold head off block.
- Dowel pins off location.
- No dowel pins.
- Cylinder heads warped more than .006 inches longitudinally and .003″ transversely.
- Pre-chamber +.002″ inches from head (.004″ maximum)
- No damage in sealing ring area.
- No stamps in seal area around water passage.
- Water passage seal surrounds all water passages.
- No chips in bolt holes.
- Bolt holes in cylinder block drilled and tapped deep enough.
- Follow torque sequence and installation torque procedure.

USING TORQUE WRENCH WITH ADAPTER

When using a torque wrench with an adapter, the reading on the torque wrench will not reflect the actual torque of the bolt due to the extra length of the combined torque wrench and adapter. To obtain the correct torque readings in these cases use the following formula: Multiply the length of the torque wrench by the number of pounds of the desired torque. Then add the length of the torque wrench to the length of the adapter. Divide the first answer by the second answer and the result will be the correct torque reading. (Figure 2-14)

EXAMPLE:
1. MULTIPLY LENGTH OF TORQUE WRENCH 20" BY DESIRED TORQUE 200 FT. LBS. 20 × 200 = 4000.
2. ADD LENGTH OF TORQUE WRENCH 20" TO LENGTH OF ADAPTER 6" 20 + 6 = 26.
3. DIVIDE FIRST ANSWER (4000) BY SECOND ANSWER (26). 4000 ÷ 26 = APPROX. 154 FT. LBS.



154 FT. LBS. WILL BE THE READING ON THE TORQUE WRENCH WHEN THE DESIRED TORQUE OF 200 FT. LBS. IS ACHIEVED AT THE NUT.

TORQUE WRENCH IS MEASURED FROM CENTER OF SOCKET END TO PIVOT POINT IN HANDLE OR IF SOLID TO END OF HANDLE.

TORQUE WRENCH AND ADAPTER MUST BE USED ONLY IN A STRAIGHT LINE.

Figure 2-14, Computing Actual Torque With Adapter.

Leaking Cylinder Head Gasket

Pre-chambers **must not** be recessed into the cylinder head or protrude out of the cylinder head by more than .004" or a head gasket leak may result.

This measurement should be made at two or more points on the pre-chamber where the pre-chamber seats on the head gasket heat shield and sealing ring. Using a straight edge and a thickness gage or dial indicator, measure the difference between the flat of the pre-chamber and the flat surface of the cylinder head. A slight variance from one side of the pre-chamber to the other provided both sides are within the tolerance will result in a good seal.

* New head bolts are being used on 1984 6.2L engines in production. The bolt is available from WDDGM as P/N 14077193. Whenever a head is removed from a 1982-83 engine, replace the head bolts with this new bolt. The new bolt provides an increased and more even clamp load. Install bolts according to the below procedure, using the "torque-and-turn" method. Also be sure to use a sealing compound, such as P/N 1052080 or equivalent, on the bolt threads. New bolts have approximately 1 ¾" of thread.

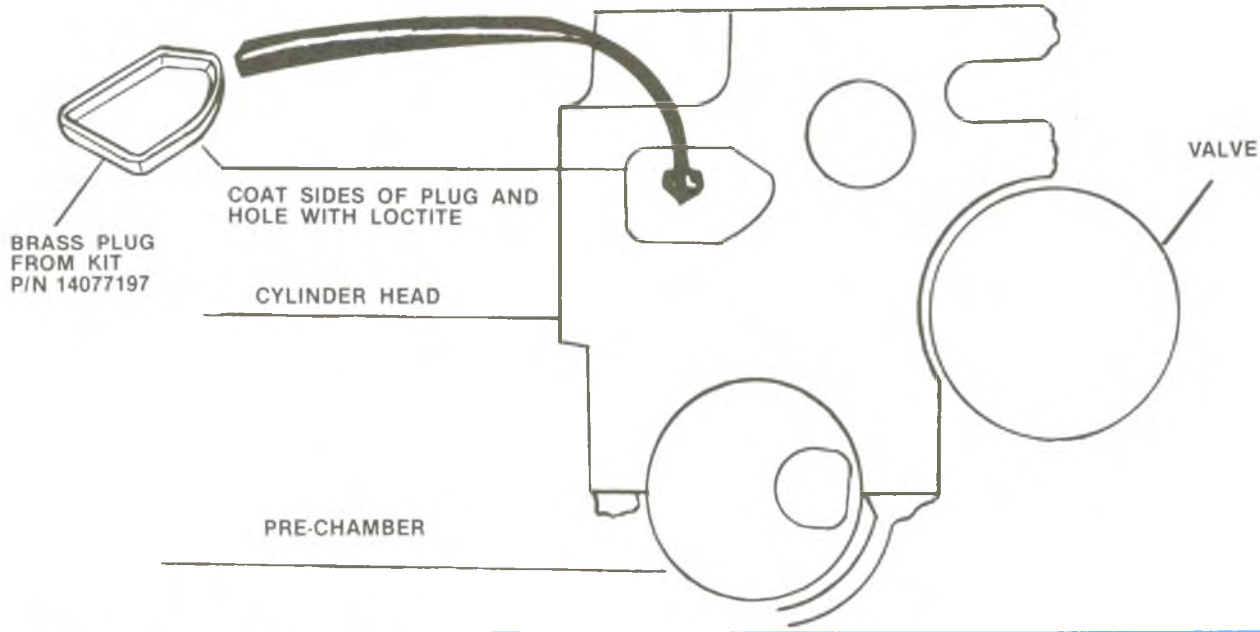


Figure 2-15, Installing Brass Plug.

External engine coolant loss on the 6.2L Diesel has generally been from the rear lower corner on the left hand cylinder head and the front lower corner on the right hand cylinder head. This coolant loss condition is the result of inadequate sealing around the core cleanout hole in the cylinder head. (Figure 2-15)

A contour shaped brass plug, P/N 14079353, has been developed to seal this core hole. In 1983 mid-year, the core cleanout hole will be machined and a plug installed in production. 1985 and later units will have this hole eliminated.

To reduce cylinder head gasket coolant leakage conditions, the following procedure should be adhered to whenever a cylinder head is removed for service:

TORQUE AND ANGLE TURN CONTROL TORQUING PROCEDURE FOR CYLINDER BOLTS.

This new torquing procedure is to be used on all 6.2L Diesel engines. It is to correct external and internal leak conditions.

1. After the removal of the cylinder head and gasket, all cylinder head bolts and bolts holes must be cleaned of all sealer (e.g. wire brush).
2. Check head and block for warpage overall .006 in. (.15mm) or .003 in. (.075mm) within 6 inches and .003" transversely.
3. Wipe all surfaces clean.
4. Install new head gasket, either use: Victor (green) 14066260 (internal combustion leaks) or, Fel-Pro (red) 14066246 (external coolant leaks). Install the gasket over the dowel pins. The pre-chamber shields must be up.
5. **INSTALLATION OF BRASS PLUG IN CYLINDER HEAD COOLANT CORE HOLE. (See Figure 2-15).**
   a. Check if a plug has been previously installed. If a plug is present, visually check condition. If plug appears questionable, remove and replace.
   b. Check cored hole for excessive roughness or casting irregularities. Use a file to remove burrs and break sharp edges. Clean with a wire brush and wash with solvent.
   c. Coat the sides of brass plug and the hole with Loctite 620; or 271, (GM #1052624 kit).

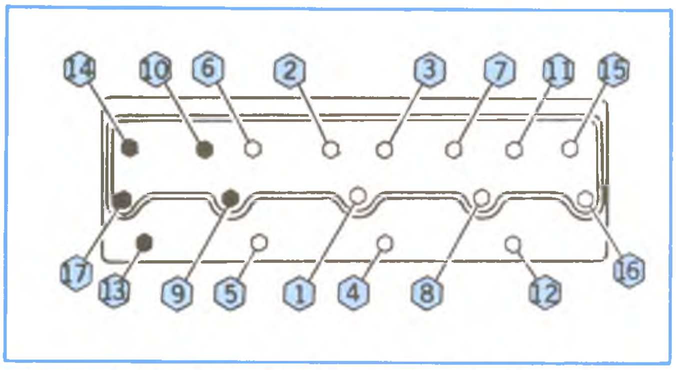


Figure 2-16, Cylinder Head Bolt Tightening Sequence.

Using an Arbor Press or vice, slowly press brass plug into the hole using a flat steel plate or the plastic installation tool from kit #14077197 to squarely load the plug. Press in until plug is flush with head surface. Do not use a hammer as plug may be damaged. Allow Loctite to set 30 minites.

— NOTE —

If the plastic installation tool is available, you may use a hammer along with the plastic tool. Install the plug until it is flush.

6. **REPLACE ALL HEAD BOLTS WITH PART #14077193.**
7. Due to clearance on C-K vehicles, the left rear cylinder head bolt must be installed into the head prior to installation. (Refer to Step 9 for sealing of bolt).
8. Carefully guide the cylinder head into place.
9. Coat the thread and bottom of the bolt head of the cylinder head bolts with sealing compound 1052080 or equivalent, and install bolts finger tight.
10. In sequence, torque all bolts to 25 N.m. (20 ft. lb.). (Figure 2-16).
11. In sequence, re-torque all bolts to 65 N.m. (50 ft. lb.). (Figure 2-16).
12. In sequence, turn each bolt an additional 90 degrees (¼ turn). This is to assure a more uniform bolt tension. (Figure 2-16).

— NOTE —

All four steps (10, 11, and 12) must be done in sequence each time.

— NOTE —

There is a new head bolt released. Part #14077193. It has more threads. This was done to improve bolt stretch for improved clamp load retension. The above procedure can be done with either the old or the new bolt. But the new bolt (14077193) is preferred.

— NOTE —

Part #14077197 is a brass plug kit. It contains the following:
2 - 14079353 brass plugs
1 - plastic driver installation tool

Valve Stem Clearance

NOTICE: Excessive valve stem to bore clearance will cause excessive oil combustion and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.

1. Measure valve stem clearance as follows:
   a. Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail.
   b. Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide.
   c. Drop the valve head about 1/16″ (1.6mm) off the valve seat.
   d. Move the stem of the valve from side to side using light pressure to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves as outlined.

Valve Spring Tension

1. Check valve spring tension with Tool J-8056 spring tester. Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not with 44 N (10 lbs.) of the specified load (without dampers).

Inspection (Timing Chain)

The timing chain on the 6.2L engine will have slack or deflection. It can be measured whenever the front cover is removed from the engine. This is done by using a dial indicator mounted to the front of the cylinder block with the plunger contacting the timing chain between the two sprockets. The chain can be deflected outward a maximum amount with finger pressure on the internal side of the chain. The dial indicator can then be set at zero. The chain can then be deflected inward using finger pressure on the external side of the chain. The total indicator travel can be noted. On a used engine, the deflection cannot exceed .800″. If it does, the sprockets and chain must be examined for wear and replaced as necessary. The timing chain deflection with new parts cannot exceed .500″.

Valve Guide Bores

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves use Tool Set J-7049.

Valve Seats

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valves seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of what type of equipment is used, however, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in the guide.

— NOTE —

Valve seats are induction hardened. Excessive stock removal could cause damage to the seat.

Valves

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32″ (.80mm) thick after grinding, replace the valve. Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

ASSEMBLY

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:
   a. Install valve spring shim on valve spring seat then install a new valve stem oil seal.

Valve Stem Oil Seal/Or Valve Spring

To replace a worn or broken valve spring without removing the cylinder head proceed as follows:

REMOVAL

1. Remove rocker arm assemblies.
2. Rotate engine so piston is at top dead center for each cylinder, or install air line adapter to glow plug port and apply compressed air to hold valves in place.
3. Install Tool J-5892-1 or J-26513 and compress the valve spring until valve keys are accessible; then remove keys, valve cap or rotator, springs and seals. If valve spring does not compress, tap tool with a mallet to break bind at rotator and keys.

INSTALLATION

1. Install seal, valve spring and cap rotator. Using Tool J-5892-1 or J-26513, compress the valve spring until the valve keys can be installed.
2. Install rocker arm assemblies.

Piston Construction (Figure 2-17)

Pistons (See Figure 2-17) are cast aluminum with:

- A ni-resist full top ring groove.
- 2-piece oil control ring.
- "Full floating piston pin".

The full ni-resist insert-molded cast iron full groove protector is for high temperature strength and improved fatigue life. Ni-resist is a metallurgical term describing a cast iron consisting of graphite in a matrix of austenite. Austenite is a non-magnetic solid solution of carbon in gamma-iron. This version contains significant amounts of nickel and chromium. It has high resistance to growth, oxidation and corrosion. It has a high bonding ability to aluminum, and thermal ability (high dissipation rate of aluminum).

The "full-floating" piston pin concept is used to eliminate pin-to-boss scuffing and to promote uniform pin loading through pin rotation. This happens by using the film thickness of the oil, that the pin is suspended by, and rotating in to increase loading and surface area. The film thickness is also used to absorb some of the downward thrust.

PISTON RINGS

The top ring (See Figure 2-18) is a compression ring made of keystone high strength iron with a molybdenum face.

It is a keystone design, which is a tapered ring fitting into the tapered land of the Ni-resist insert-molded cast iron full groove insert.

The second ring is also a compression ring; cast iron construction and chrome faced. Two rings are used to reduce the pressure drop across each ring. The third ring is an oil control ring and two types are utilized depending on emissions application: Lt. duty (under 8,500 lbs. GVWR) uses a 3-piece. Heavy duty (over 8,500 lbs. GVWR) uses a 2-piece. The 3-piece design is made up of 2 segment rails which wipe the cylinder wall and one expander which controls the 2 segment rails.

In 1983 and later both Lt. and Heavy duty will use the two 2-piece. This improves high mileage durability.

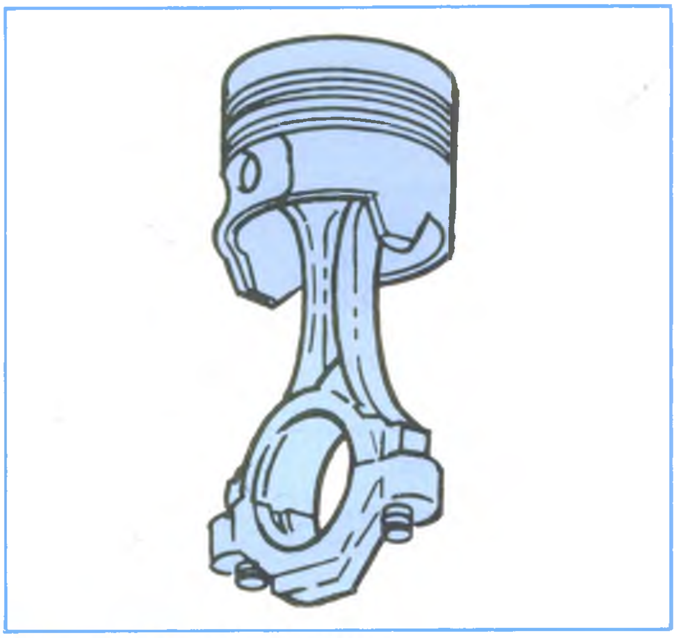


Figure 2-17, 6.2L Piston.

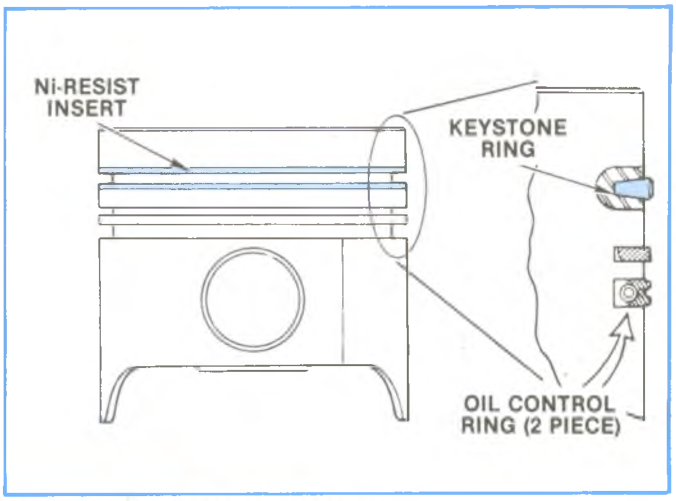


Figure 2-18, Piston Rings.

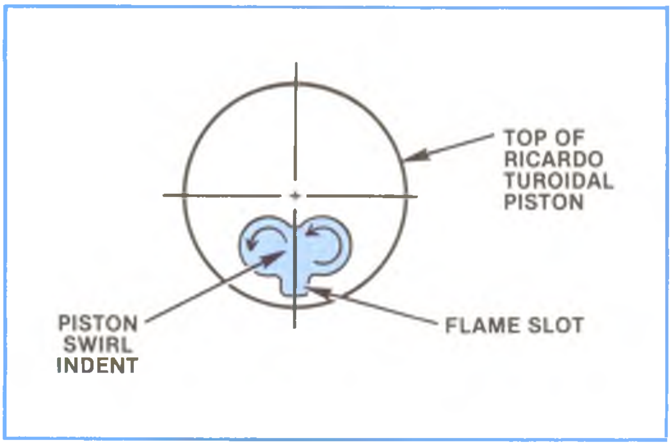


Figure 2-19, Piston Top.

This piston has a half-clover shaped identation on the piston face, which at T.D.C. outlets to the pre-chamber, Figure 2-19. As the piston rises during the compression stroke, the air swirl begins in these two indentations. When the piston reaches the pre-chamber opening, the air swirl is increased in the spherical pre-chamber. This is a Ricardo Turoidal Piston design and is used with the Ricardo COMET V Pre-Chamber for more complete mixing of the air and fuel.

The 6.2L piston is match fitted to each cylinder bore of the engine. This is accomplished by measuring the internal diameter of the cylinder bore and stamping the corresponding size code on the pan rail of the case. The piston outside diameter is measured and the size code stamped on the piston face. When the piston is assembled to the cylinder case, these size codes are matched to insure that proper fit and clearance between the cylinder and piston is maintained. There are six matching cylinder bore sizes. Size codes A, B, C, D, E, G are used to match the piston and cylinder bore. "A" size pistons are assembled to "A" size cylinder bores, "B" size pistons to "B" size cylinder bores and so forth.

Piston Selection

A. The size codes (A, B, C, D, E, G) are stamped on the cylinder case pan rail and beside the proper cylinder.

B. Service pistons will be available in std., high limit std., and .030 in. (.75mm) O.S. An "S6" or "S7" will be stamped on the piston face.

C.

Stamped Size	Part #
S6-100.914-100.940mm	14053377 Standard
S7-100.914-100.965mm	14053378 High Limit Standard
.030 in. (.75mm) O.S.	14053379 Oversize

— NOTE —

Pistons in cylinders number 7 and 8 are fit .013mm (.0005 in.) looser.
This is done because #7 and #8 run hotter, and piston scuff may occur.

1. Check USED piston to cylinder bore clearance as follows:
   a. Measure the "Cylinder Bore Diameter" with a telescope gage 2½" (64mm) from the top of cylinder bore.
   b. Measure the "Piston Diameter" (at skirt across center line of piston pin). (Fig. 2-10).
   c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".
   d. For Bohn Pistons #1 thru 6 .089-.115mm (.0035-.0045 in.)
   For Zollner Pistons #1 thru 6 .112-.138mm (.004-.005 in.)
   For Bohn Pistons #7 and 8 .102-.128mm (.004-.005 in.)
   For Zollner Pistons #7 and 8 .125-.151mm (.0049-.0059 in.)
2. If used piston is not acceptable, determine if a new piston can fit cylinder bore.
3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance.
4. Mark the piston to identify the cylinder for which it was fitted.

There will be two different suppliers of pistons used in the 6.2L; and you may encounter either one, they differ in finish on the exterior of the piston, so there are two different piston to bore clearance values. **Bohn Pistons** identified by the word "Bohnna Lite" near the pin boss, will have a clearance of .089-.115mm (.0035-.0045 in.).

Zollner Pistons identified by the letter Z with a circle around it, also near the pin boss. It carries a clearance of .112-.138mm (.004-.005 in.)

Piston Inspection

Clean the varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, corroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance.

PISTON PINS

The piston pin is a free floating piston pin. It is important that the piston and rod pin hole be clean and free of oil when checking pin fit.

Whenever the replacement of a piston pin is necessary, remove the ring retaining the pin. Then remove pin. Using tool J-29134 install piston pin retaining ring.

It is very important that after installing the piston pin retaining rings, that the rings be rotated to make sure they are fully seated in their grooves.

RING GAP

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is treated with molybdenum for maximum life.

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about ¼" (6.5mm) (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage.
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.
7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is caused by ring groove, correct by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.

RING INSTALLATION

For service ring specifications and detailed installation instructions, refer to the instructions furnished with the parts package.

Piston Related Cylinder Case Operations

CLEANING AND INSPECTION

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
2. Remove oil gallery plugs and clean all oil passages.
3. Clean and inspect water passages in the cylinder block.
4. Inspect the cylinder block for cracks in the cylinder walls, water jacket, valve lifter bores and main bearing webs.
5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about ¼″ (6.5mm) to enter gage in cylinder bore. Center gage in cylinder and turn dial to "0". Carefully work gage up and down cylinder to determine taper, and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

CONDITIONING

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005″ taper or wear, they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less than .005″ wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005″ taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

BORING

If boring is necessary, an oversize gasket will be required.

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important. If not checked, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.
3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

HONING

1. When cylinders are to be honed, follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.
3. When finished honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks, in a cross-hatch pattern of approximately 45° to 65° included angle. The finish marks should be clean but not sharp, free from imbedded particles, and torn or folded metal.
4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

— NOTE —

Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.

5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed and then wiped with a clean dry cloth. The cylinder should not be cleaned with a kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Rod and Piston

INSTALLATION

1. Install the connecting rod bolt guide hose over rod bolt threads.
2. Lightly coat pistons, rings and cylinder walls with light engine oil. Depression on top of piston to be assembled toward outside of engine.
3. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft. Use Tool J-8037 to compress the rings. Guide the connecting rod into place on the crankshaft journal. Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.
4. Install the bearing caps and torque nuts to specifications 65 N.m. (45 ft. lbs.). Be sure to install new pistons in the cylinders for which they were fitted and used pistons in the cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3, 5 and 7 in the left bank and, 2, 4, 6 and 8 in the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Crankshaft

The 6.2L crankshaft (Figure 2-20) is made of nodular iron with deep rolled fillets. Nodular iron, also called ductile iron, is one of three common types of cast iron. The others are grey iron and malleable iron.

Nodular iron is made by treating a low-sulfur, grey-iron-like alloy with magnesium. Addition of the magnesium forms the free carbon into the spheroids — or nodules — which give nodular iron the best combination of ductility and strength of the three common cast irons. Depending on the application, nodular iron castings can be used as cast (without heat treatment), annealed for greater ductility as required or heat-treated to higher hardness for greater strength and wear resistance.

It has 5 main bearing journals. These main bearing journals are classed by O.D. into 3 classes so that the main bearing can be matched to the proper size bearing insert in the main bearing cap. The diameter of the main journals is controlled to the following total range #1 through 4 — 74.917/74.941 mm and #5 — 74.912/74.936 mm. Each of these ranges is divided into 3 sizes. The pin journal diameter range is 60.913/60.939 mm. This range is divided into 2 sizes.

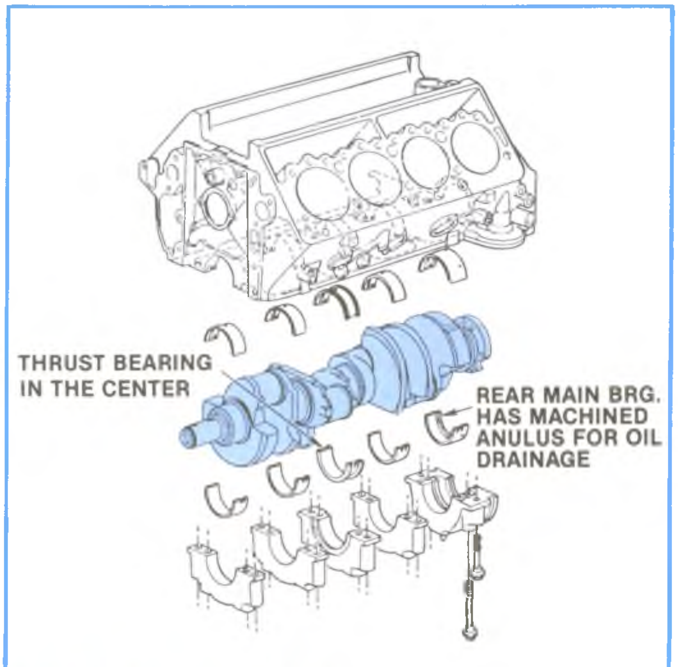


Figure 2-20, **Crankshaft.**

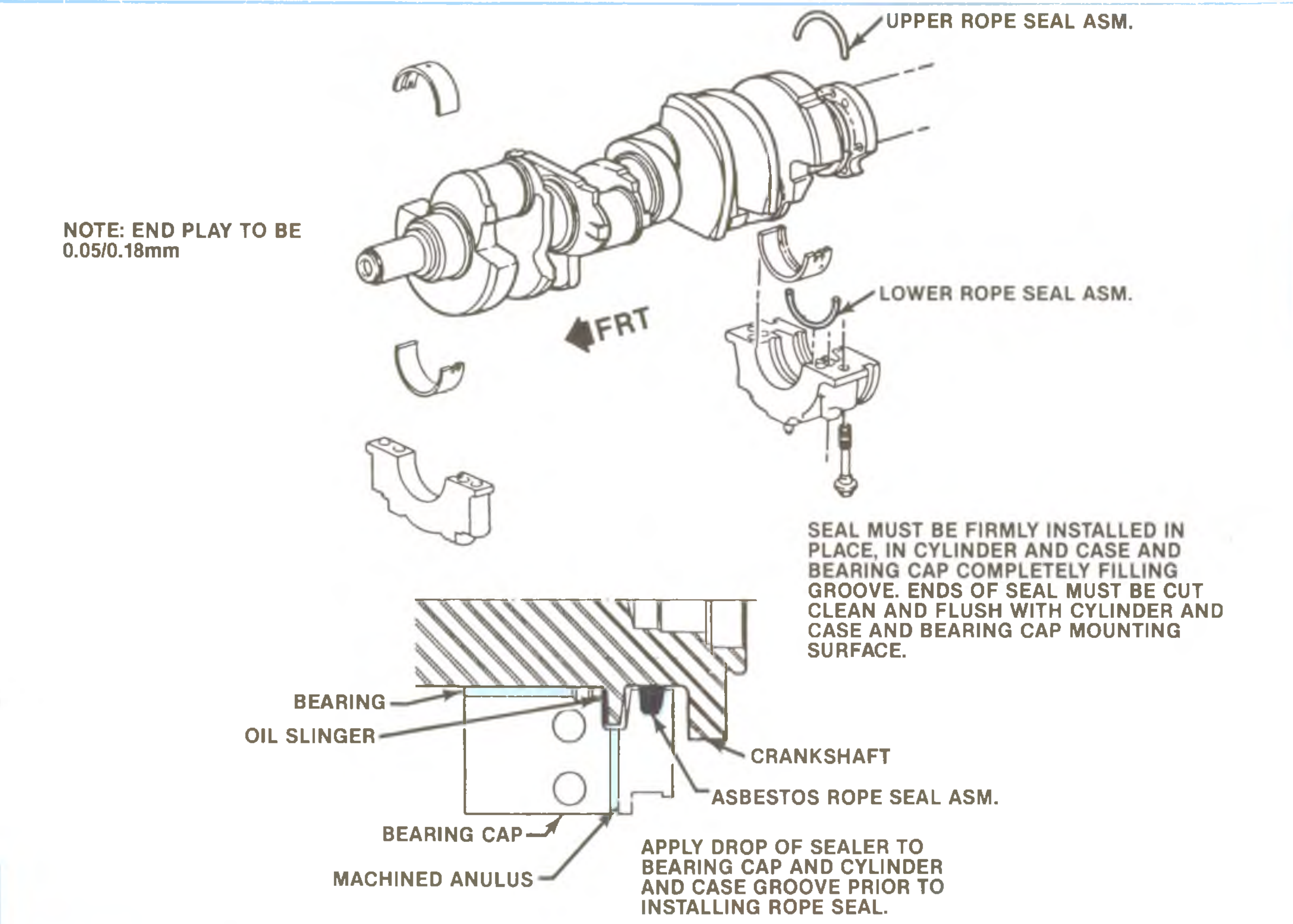


Figure 2-21, **Rear Mainseal.**

Crankshaft Rear Main Seal

The crankshaft rear main seal is an asbestos "rope" seal. A slot is machined the bearing at the rear which bleeds off excess oil. An oil slinger is part of the crankshaft. It prevents excessive oil from going past this area. (Figure 2-21).

Immediately behind the slinger is a knurled surface which is positioned in a way to push oil away from the rope seal during engine rotation. The rope seal is at the rear of the sealing system.

Upper Rear Main Seal Repair

Tools are available to provide a means of correcting engine rear main bearing upper seal leaks without the necessity of removing the crankshaft. The procedure for seal leak correction is listed below.

1. Drain oil and remove oil pan and rear main bearing cap.
2. Insert Packing Tool J33154-2 against one end of seal in cylinder block and drive the old seal gently into the groove until it is packed tight. This varies from ¼″ to ¾″, depending on the amount of pack required. (Figure 2-22).
3. Repeat this on the other end of the seal in the cylinder block.
4. Measure the amount the seal was driven up on one side; add 1/16″, then cut this length from the old seal removed from the main bearing cap with a single edge razor blade. Measure the amount the seal was driven up on the other side. Add 1/16″ and cut another length from old seal. Use main bearing cap as a holding fixture when cutting seal as shown in Figure 2-23.
5. Place a drop of 1052621 sealer or equivalent on each end of seal and cap as indicated.

   (Equivalents are Loctite 414 or Fel-Pro 361.)

— IMPORTANT —

Install the seal pieces within one minute, as this material sets up very quickly.

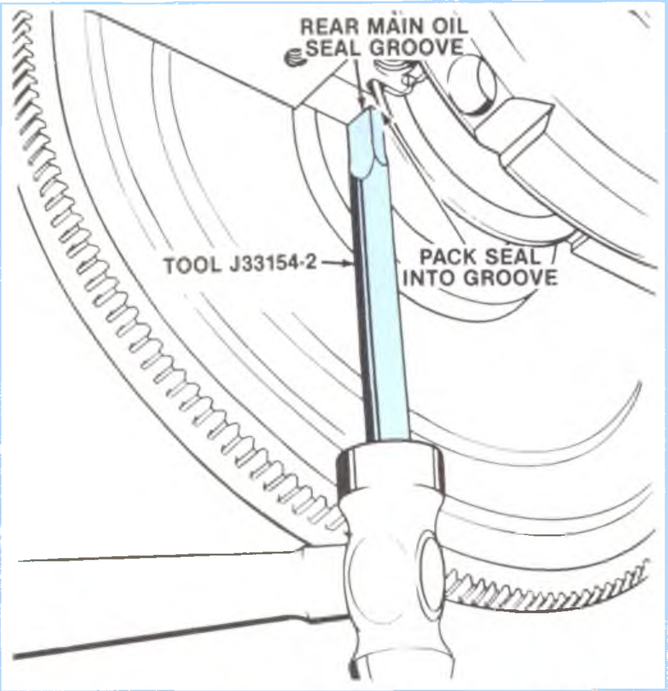


Figure 2-22, **Packing Rear Main Upper Seal.**

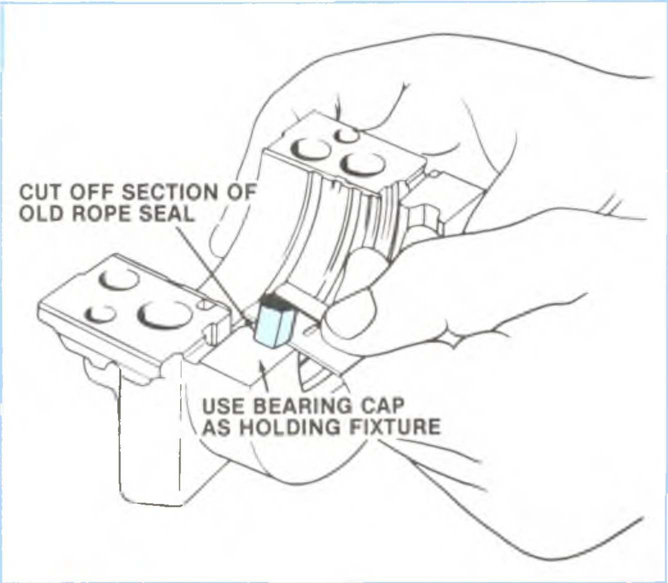


Figure 2-23, **Cutting Section of Rope Seal.**

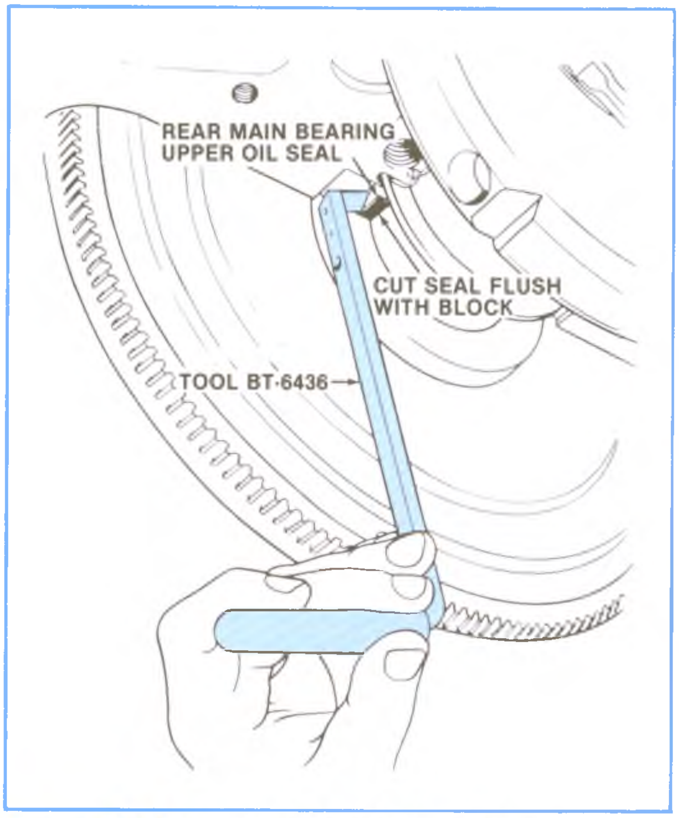


Figure 2-24, Cutting Seal In-Vehicle.

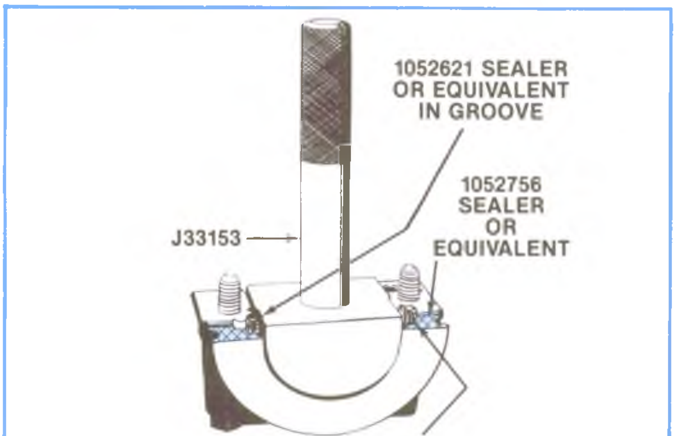


Figure 2-25, Installing Rear Main Lower Oil Seal.

6. Work these two pieces of seal into the cylinder block (one piece on each side) with two small screwdrivers. Using Packing Tool, pack these short pieces up into the block. Use Seal Trimming Tool BT-6436 or sharp blade to trim seal flush with block as shown in Figure 2-24.

   Place a piece of shim stock between seal and crankshaft to protect bearing surface before trimming.
7. Form a new rope seal in the rear main bearing cap.

— NOTE —

In order to prevent the possibility of cylinder block and/or main bearing cap damage, the main bearing caps are to be tapped into their cylinder block cavity using a brass or leather mallet before attaching bolts are installed. Do not use attaching bolts to pull main bearing caps into their seats. Failure to observe this information may damage a cylinder block or bearing cap.

8. Lubricate the cap bolts with engine oil.
9. Assemble the cap to the block and torque to specifications.

Lower Rear Main Oil Seal Replacement

REMOVAL

1. Remove oil pan.
2. Remove the rear main bearing cap.
3. Remove rear main bearing insert and old seal.
4. Clean bearing cap and seal grooves and inspect for cracks.

INSTALLATION

1. Coat seal groove with 1052621 sealer or equivalent (Loctite 414 or Fel-Pro 361).
2. Within one minute, install seal into bearing cap, packing by hand. Using seal installer J33153, drive seal into groove. (Figure 2-25).

   To check if seal is fully seated in the bearing cap, slide the tool away from seal. With tool fully seated in the bearing cap, slide tool against the seal. If undercut area of tool slides over the seal, the seal is fully seated. If tool butts against the seal, the seal must be driven further into the seal groove. Rotate tool before cutting off excess seal packing.
3. With tool slightly rotated, cut seal flush with mating surface. With screwdriver, pack seal end fibers towards center, away from edges. Rotate seal installer when cutting seal to avoid damage to tool.
4. Clean bearing insert and install in bearing cap.
5. Place a piece of plastic gaging material on the rear main journal. Install the rear main bearing cap and torque to 95 N·m (70 ft. lbs.).
6. Remove the rear cap and check the plastigage for bearing clearance (.0022″-.0037″). If it is out of specification, recheck the ends of the seal for fraying, that may be preventing the cap from fully seating.
7. Clean crankshaft bearing journal and seal contact. Install sealer 1052756 or equivalent on cap as shown in Figure 2-25.

— NOTE —

In order to prevent the possibility of cylinder block and/or main bearing cap damage, the main bearing caps are to be tapped into their cylinder block cavity using a brass or leather mallet before attaching bolts are installed. Do not use attaching bolts to pull main bearing caps into their seats. Failure to observe this information may damage a cylinder block or bearing cap.

8. Install bearing caps, lubricate bolt threads with engine oil and install. Torque bolts to inner 135 N·m (100 Ft. Lbs.), outer 150 N·m (110 Ft. Lbs.).
9. Install pan with new gaskets.
10. Install flywheel lower cover.

Main Bearings

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing for both the upper and lower halves, will be required. Service bearings are available in standard size, .013mm (.0005 in.) U.S. and .026mm (.001 in.) U.S.

Selective fitting of main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .001″ (.026mm) undersize insert which will decrease the clearance .0005″ (.013mm) from using a full standard bearing.

INSPECTION

In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

CHECKING CLEARANCE

To obtain the most accurate results with "Plastigage" (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed.

If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove the clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal. Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.
3. Install the bearing cap and evenly torque the retaining bolts to specifications. Bearing cap MUST be torqued to specifications in order to assure proper reading. Variations in torque affect the compression of the plastic gage.
4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.
5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope. Normally main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round (.001″ max.), be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter and the journal is out-of-round .001″, interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001″ difference.
6. If the bearing clearance is within specifications #1, 2, 3, 4 (.0018″-.0032″) and #5 (.0022″-.0037″), the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.
7. A standard, .013mm (.0005″), or .026mm (.001″) undersize bearing may produce the proper clearance. If not, the crankshaft may be ground up to .010″. But bearings in that size range are not available at this writing.
8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag. When checking #1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.
9. Measure crankshaft end play (.05-.18mm) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage.
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

REPLACEMENT

Main bearings may be replaced with or without removing the crankshaft.

— NOTE —

Main bearing cap bolt torque instruction: With crankshaft, bearing and bearing caps installed and bolts started, thrust crankshaft rearward to set and align bearing caps. Then thrust crankshaft forward to align rear faces of center main bearings. Torque bolts as specified. The above procedure is mandatory.

Connecting Rod Bearings

The connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT INTERCHANGE RODS OR ROD CAPS. If clearances are found excessive a new bearing will be required.

Service bearings are available in standard size and .013mm (.0005″) and .026mm (.001″) under size for use with new and used standard size crankshafts.

INSPECTION AND REPLACEMENT

1. With oil pan and oil pump removed, remove connecting rod cap and bearing. Before removing connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.
2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.
4. Measure the crankpin for out-of-round or taper with micrometer. If not within specifications replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.
5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent. If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001″ interference between the bearing and crankpin will result in rapid bearing failure.
   a. Place a piece of gaging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface.

      Plastic gage should be positioned in the middle of upper or lower bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere.)

   b. Install the bearing in the connecting rod and cap.

      Install the bearing cap and evenly torque nuts to specifications. Do not turn the crankshaft with the gaging plastic installed.

      Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point.
6. If the clearance exceeds specification (.0018″-.0039″), select a new, correct size, bearing and remeasure the clearance. Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.
7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications 65 N·m (45 ft. lbs.).
8. When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (.063-.17mm) between connecting rod caps.

Rod Assembly

If a rod is twisted or bent, a new rod must be installed. NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN CONNECTING RODS.

The connecting rods are forged heat-treated steel. They are balanced to within ± 10 grams to avoid engine imbalance.

The connecting rod wrist pin bronze bushing is not serviced. If the clearance between the wrist pin bushing and the wrist pin exceeds .030mm (.0012″) the rod must be replaced.

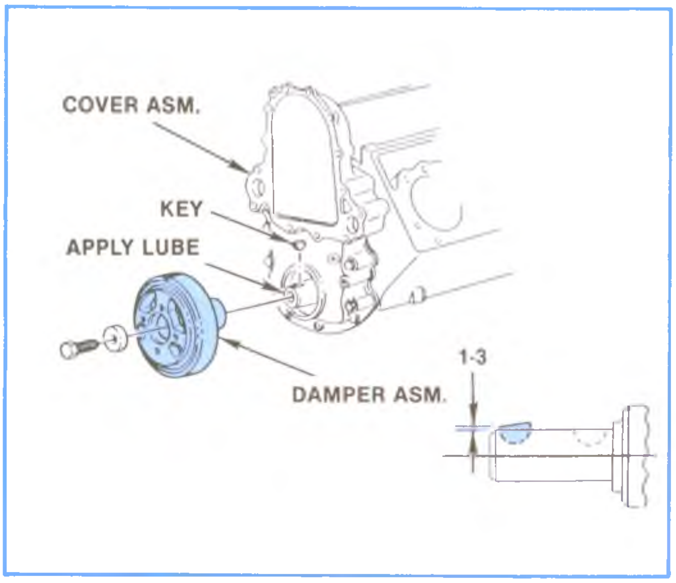


Figure 2-26, Torsional Damper.

Torsional Damper 6.2L

The 6.2L damper is made of nodular iron. It is press-fit assembled to the front end of the crankshaft and bolted on. (Figure 2-26).

The function of the torsional damper is to counteract the twisting or torsional vibration caused by force variations on the piston and thus on the crankshaft. Torsional vibration is an oscillation which occurs within every power stroke. The application of force and its removal a split second later causes the crankshaft to be alternately twisted out of alignment and snapped back in place. If a preventive measure is not taken against this action, the engine will run rough and the crankshaft may break.

The damper consists of two parts: A small inertia inner ring, or damper flywheel, and an outer ring. These are bonded together by a rubber insert that is approximately seven mm thick. It is mounted to the front end of the crankshaft. As the engine tends to speed up or slow down, it acts much like a flywheel by imposing a dragging effect due to its inertia. This effect slightly flexes the rubber insert and tends to hold the crankshaft at a constant speed. Thus, it tends to check the twist, untwist or torsional vibration of the crankshaft. This twist might be as much as 10 tons and without a damper, the crankshaft could break.

The vibration damper, like the crankshaft and flywheel, must be properly balanced prior to assembly to the engine.

Since torsional vibration differs with engine design, vibration dampers are designed to suit specific engines.

Also on the outer diameter is a timing groove. We use this groove to statically time the diesel engine during assembly. This groove can also be used with a mag-tach to measure RPM's during engine operation. Remove torsional damper using tool J-23523 and suitable pilot. Install damper using a mallet. Assemble key as shown in Figure 2-26. Tap damper far enough on crankshaft so attaching bolt may be installed. Torque bolt to specifications 205 N·m (150 ft. lbs.).

Camshaft

The 6.2L has a forged steel carburized camshaft for durability. (Figure 2-27). There are 5 bearing journals which position and support the camshaft. The camshaft has 16 lobes. There is an eccentric lobe immediately rear of the number one journal. This eccentric changes rotary motion of the camshaft to linear motion of the fuel pump push rod, thus the mechanical fuel pump is operated through a push rod off the camshaft.

There is also a helical gear at the rear of the camshaft, this gear mates with another gear which drives the vacuum pump and the oil pump.

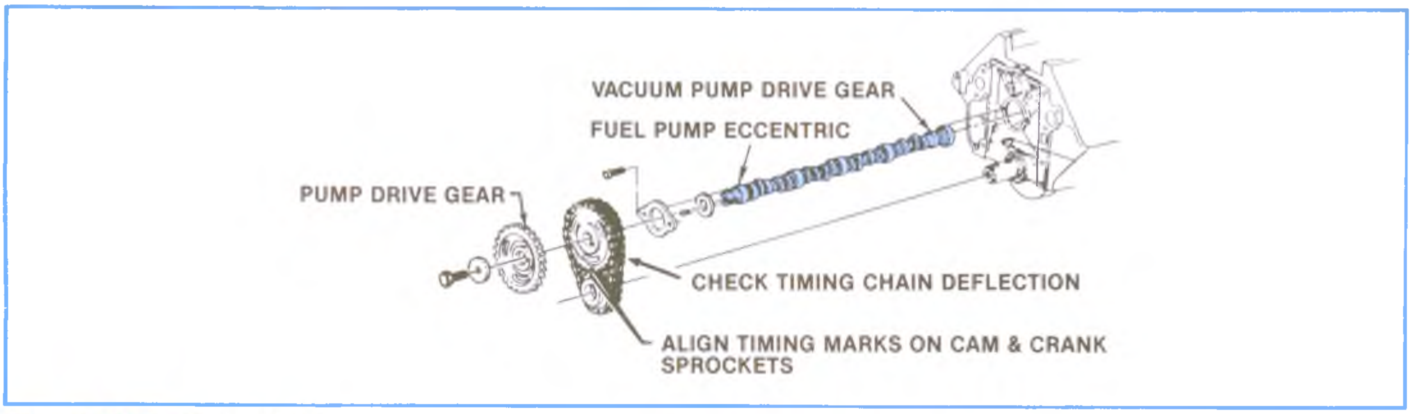


Figure 2-27, Camshaft.

Camshaft Bearings

CK TRUCK, G VAN

- **REMOVAL (FIGURE 2-28)**

Camshaft bearings can be replaced while engine is disassembled for overhaul.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.
2. Using Tool J-6098 with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Install remover and installer tool J-6098-11 for #2, 3, 4 bearing with shoulder toward bearing, making sure a sufficient amount of threads are engaged.
4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw (Figure 2-28).
5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
6. Assemble remover and installer tool J-6098-11 for #1 and J-6098-12 for #5 bearing on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block (Figure 2-29).

- **INSTALLATION**

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block.
2. Using Tool Set J-6098 with nut then thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Index camshaft bearing in bore (with oil hole aligned as outlined below), then install remover and installer tool on puller screw with shoulder toward bearing.

All five bearings must have an oil hole at the approximate 4 o'clock position when viewed from the front with the block in an upright position.

The seam in the bearing must always be located in the upper half of the block face.

The front bearing has an additional oil hole which will be located between the 12 and 1 o'clock position. This bearing also has a notch which must be positioned towards the front of the block.

This procedure will ensure that the oil supply to the bearings will enter prior to the high load zone which is near the bottom of the bore.

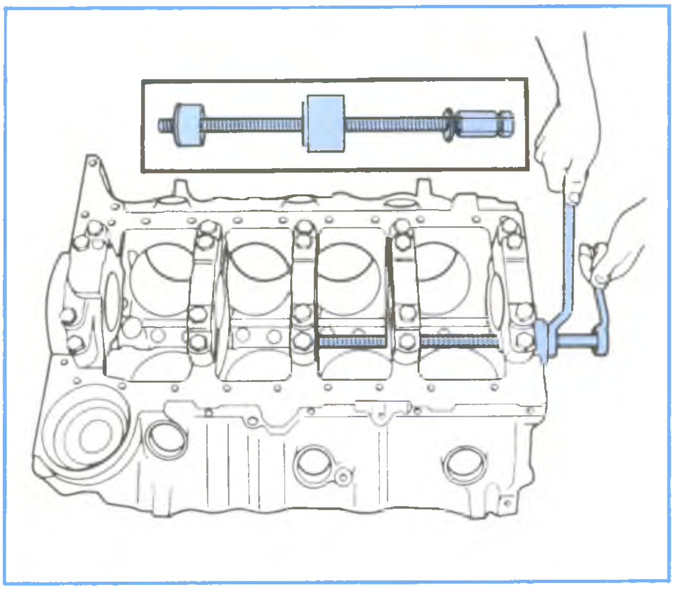


Figure 2-28, **Removing or Replacing Camshaft Bearings**

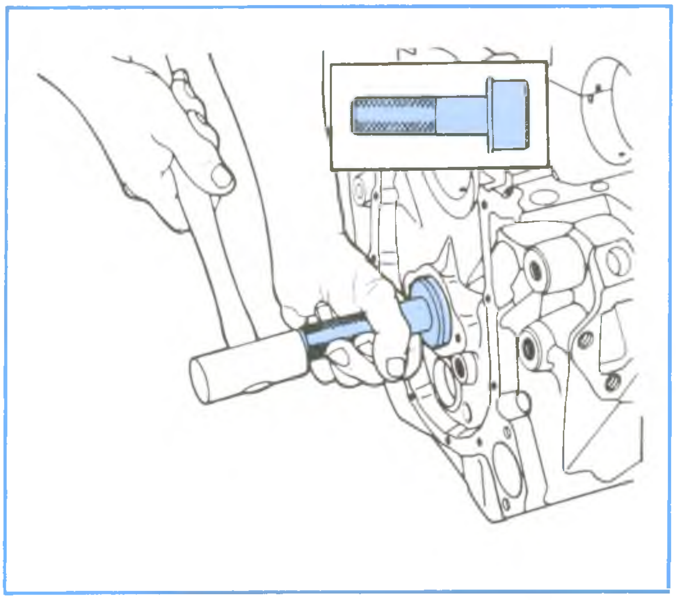


Figure 2-29, **Replacing Camshaft Front Bearing**

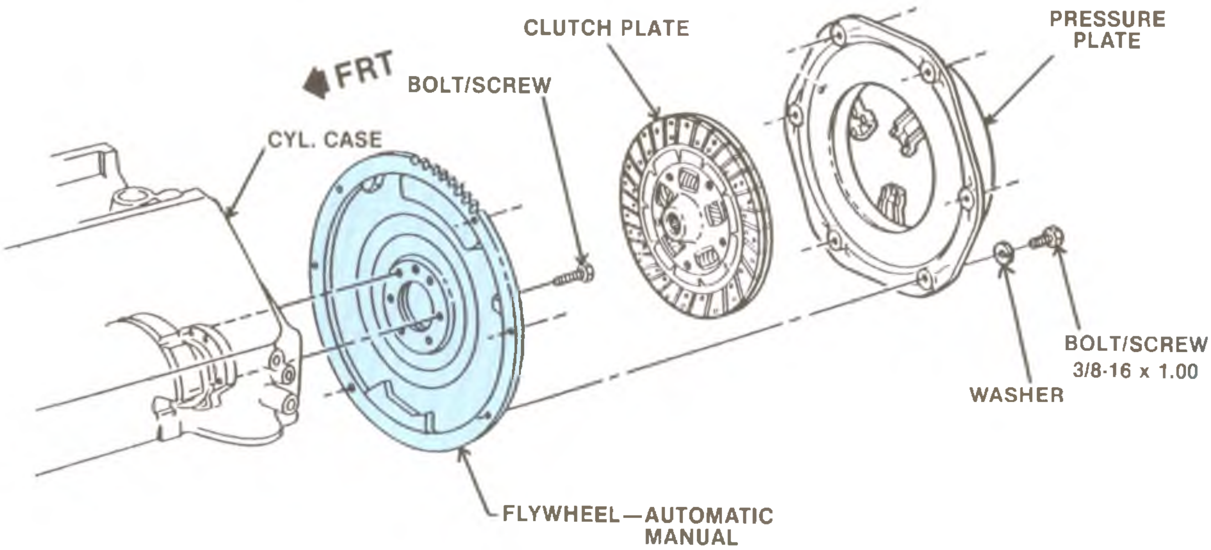


Figure 2-30, **Flywheel.**

Flywheel

The 6.2L diesel engine has 2 flywheels, one to be used for automatic transmissions and one for manual transmissions. The automatic flywheel is made of a heavy steel stamping and the manual flywheel is made of cast iron. See Figure 2-30.

It reduces vibration by smoothing out the power strokes of multi-cylinder engines. Each cylinder delivers power only every fourth stroke. It is absorbing power the other 3 strokes. During the other 3 strokes, the engine tends to slow down. The flywheel resists any effort of the engine to change its speed of rotation because of its inertia. Thus, the flywheel minimizes the effect of the engine trying to slow down or to speed up by absorbing power during the power stroke and then gives it back to the engine during the outer 3 strokes. Thus, the flyweel acts to smooth out the peaks and valleys of power from the engine.

The automatic flywheel (flex plate) should be examined for any signs of cracking. And the ring gear should be checked for worn or broken teeth.

Front Cover

See Figure 2-31. The 6.2L diesel engine front cover is a die cast of aluminum. This compares with the metal stamped front covers of most gasoline engines. This front cover:

- Covers timing gears and chain.
- Retains front crankshaft seal.
- Covers injection pump drive and driven gears.
- Provides mounting for injection pump and drive components.
- Mounts T.D.C. timing pointer.
- Sealed to cylinder case with anaerobic sealant to prevent oil leaks. Pt. #1052357 or 1052756
- Provides mounting for water pump and backing plate.

There is a baffle in the upper half of the timing cover, and the purpose of baffle is, to keep the oil in the bottom of the cover area and not allow too large a quantity to accumulate in the gear and chain area. This prevents oil aeration. Also the upper half of the cover contains the oil fill pipe where venting blow-by gases go to the CDR valve. This area must have a baffle to prevent oil from being drawn into the CDR valve.

It is necessary to maintain .040 in clearance between the baffle and the pump drive gear, or noise could result.

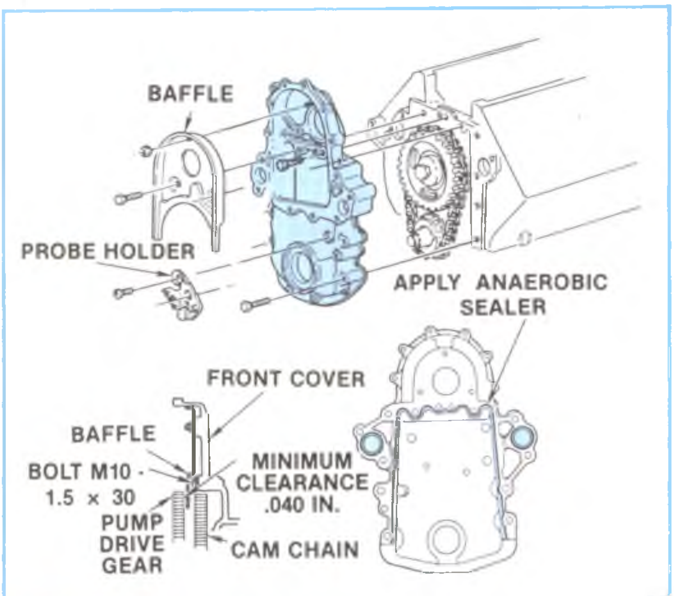


Figure 2-31, **Front Cover.**

Exhaust Manifolds

The 6.2L diesel has 2 exhaust manifolds made of nodular cast iron, Figure 2-32. Exhaust gases are forced out when a lobe on the camshaft causes the exhaust valve to open and the piston forces the exhaust gases through this opening to the exhaust manifold. Using dual exhaust improves efficiency of the engine by allowing freer exhaust of gases, thus leaving less burned gases for the cylinder at the beginning of the intake stroke.

The mounting flanges are machined to seal the exhaust ports to the cylinder head. It is extremely important that these surfaces be flat, since no gasket is used.

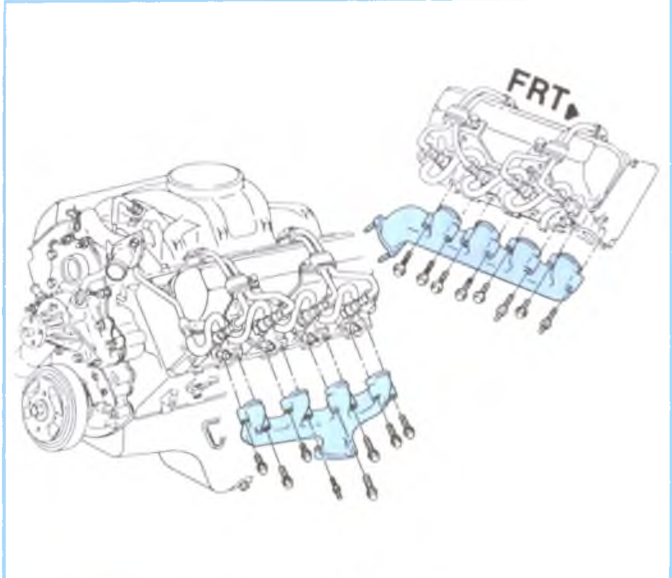


Figure 2-32, **Exhaust Manifolds.**

Lubrication System

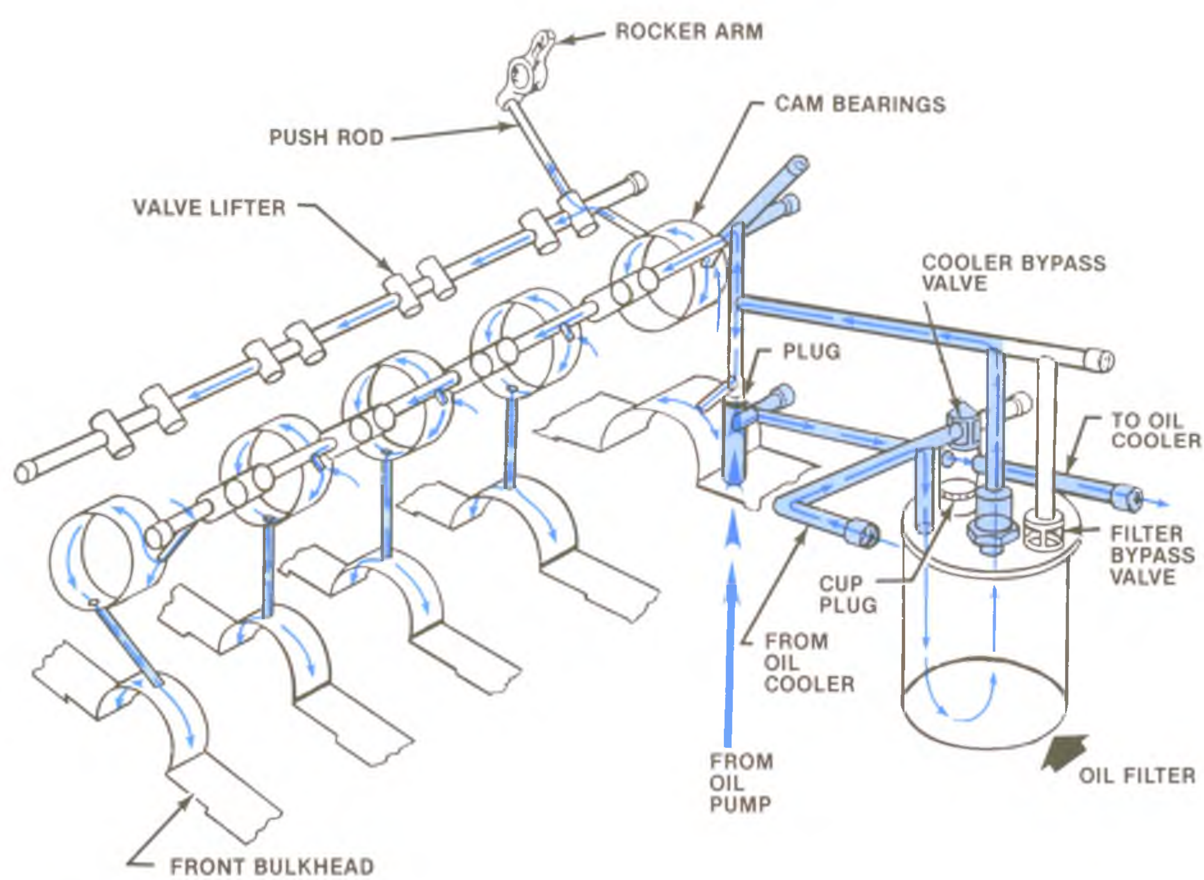


Figure 2-33, **Lubrication System.**

Lubrication System

See Figure 2-33. The lubrication system of the 6.2L diesel engine is composed of:

- Oil pan reservoir
- Filter
- Pump
- Galleries

Seven quarts of oil are required for this engine. The oil pan acts as a reservoir for holding the oil waiting to be circulated through the engine. The oil pan is attached to the bottom side or pan rail of the engine.

The lubricating system of this engine is a pressure feed type which means that a pump forces oil through the galleries to the necessary parts. The pump is mounted to the bottom side of the number five main bearing cap. Extending down from the pump and into the oil is a pick-up tube with a screen cover to filter out foreign material. Oil is picked up by this tube and pumped through the oil pump. The pump is a gear type which uses 2 meshing gears. As these gears rotate in opposite directions, the spaces between the gear teeth and the housing fill with oil from the inlet side of the pump. Then as the teeth mesh, the oil is forced out through the outlet tube. The pump is driven from the engine camshaft by means of an intermediate shaft. The oil is next pumped through a cooler located in the radiator (Figure 2-34) which cools the oil and thus helps to remove engine heat.

From the cooler the oil passes through a filter. This filter is a cartridge type and all oil going to the engine should pass through this filter. The cartridge is made of materials that trap foreign materials to prevent it getting to engine components. The filter used in this engine is called a full flow filter, because all engine oil normally flows through it. If this full flow filter becomes clogged, the engine is equipped with a by-pass valve which is spring loaded. This valve protects the engine from oil starvation by opening when increased pump pressure tries to pump oil through a clogged filter. When the pressure causes the by-pass valve to open, the oil by-passes the filter and the engine continues to receive lubrication. Replacement of the filter periodically will prevent damage to the engine due to a clogged filter.

From the filter the oil is pumped through the drilled galleries in the crankcase to the various moving metal parts in the engine. The rear crankshaft bearing is fed by a hole drilled from the rear main bearing bore to main gallery from filter to cylinder case. Oil is pumped further through the main gallery to a drilled oil gallery which has been drilled the full length of the left side of the case. Oil from this gallery feeds the camshaft babbit bearings and another gallery which runs the full length of the right side of the case. All other engine components are provided lubrication by these 2 oil galleries. Holes are drilled from camshaft bore to provide oil for main bearings #1 through #4. Lifters on the right side receive oil from the right side main oil gallery and lifters on the left side receive oil from the left side oil gallery. The lifters contain a check ball which meters oil through the hollow push rods and to the rocket arm and valve stem in the cylinder head. After a small accumulation of oil is in the head, it begins to drain back to the crank case. As mentioned before, the first four main bearings receive oil from vertical holes drilled from the cam bores to crank bores. This oil flows onto the crankshaft main bearings and provides lubrication for the crankshaft to rotate freely in its bearings. This oil also flows around the groove in each bearing to holes drilled in the crankshaft to the crankpin journals to provide lubrication there, to allow the crankpins to rotate freely in the connecting rod bearings. As the crankshaft rotates, it slings oil off the crankpins to cover cylinder walls, pistons, piston pin and piston rings. Oil drains off these parts and back to the engine.

There is also one other by-pass valve which has not yet been discussed. This is the oil cooler by-pass valve. It works much the same as the oil filter by-pass valve and opens to allow an alternate route for the oil if the cooler should become clogged.

There is an oil pressure switch which is assembled to the top rear of the cylinder case to sense oil pressure in the oil cavity.

OIL PRESSURE
Hot idle 10 PSI
Max. Cold Start 80 PSI
Average Pressure at stable
Conditions 40-45 PSI @ 2000 RPM

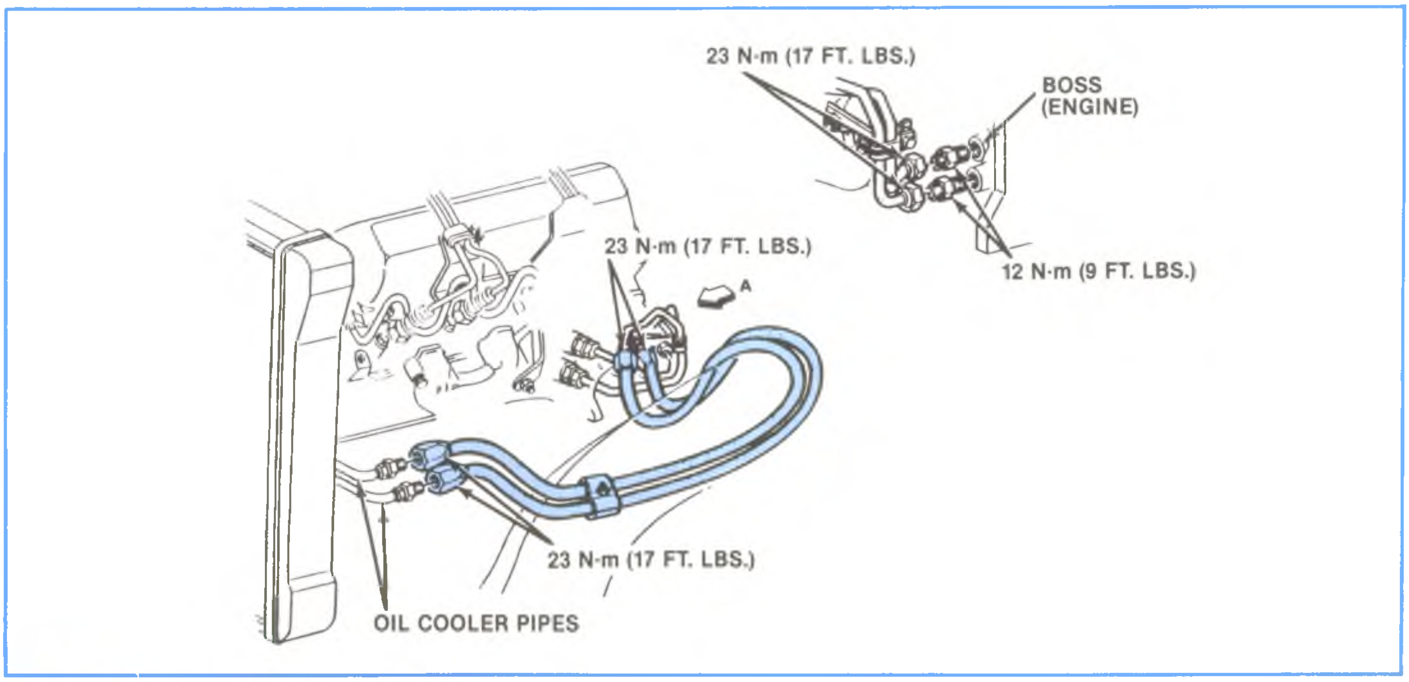


Figure 2-34, 6.2L Oil Cooler Lines.

Engine and Transmission Oil Cooler Diagnosis, All Models

When radiator oil coolers are suspected of leaking, they should be thoroughly checked before the radiator is removed for repair. This can be done by testing the cooler with air pressure while the radiator is still in the vehicle. BT-8316-A or J-34111 are available tools that can be used to test the oil coolers.

TESTING

1. Allow the engine to cool down.
2. Disconnect the negative battery cable(s).
3. Remove the radiator cap. Check coolant level in the radiator and add as necessary.

— CAUTION —

Never remove the radiator cap on a warm engine. Removing the cap immediately lowers the boiling point of the liquid and can cause violent overflow. The result could be a large coolant loss and possible personal injury.

4. Place a drain pan under the vehicle to catch lost oil.
5. Disconnect the lower pipe or hose from the oil cooler to be tested. Install the correct plug from the Tool Kit into the open radiator fitting.
6. Disconnect the upper pipe or hose from the oil cooler. Install the correct adapter from the Tool Kit into the radiator oil cooler fitting.
7. Apply 345 kPa (50 psi) adapter valve.
8. Watch for bubbles in the coolant. If bubbles appear, remove radiator for repair.
9. If no bubbles, increase the air pressure to 690 kPa (100 psi) and watch for bubbles. If still no bubbles, increase the air pressure to 1,034 kPa (150 psi) and again watch for bubbles.

   If no bubbles appeared, the oil cooler is not leaking. If bubbles did appear, remove the radiator for repair.
10. Reconnect the cooler lines (or hoses using new “O” rings) and torque to specifications.
11. Connect the negative battery cable(s).
12. Start the engine and check for leaks.
13. Check and add coolant, engine oil, or transmission fluid as necessary.

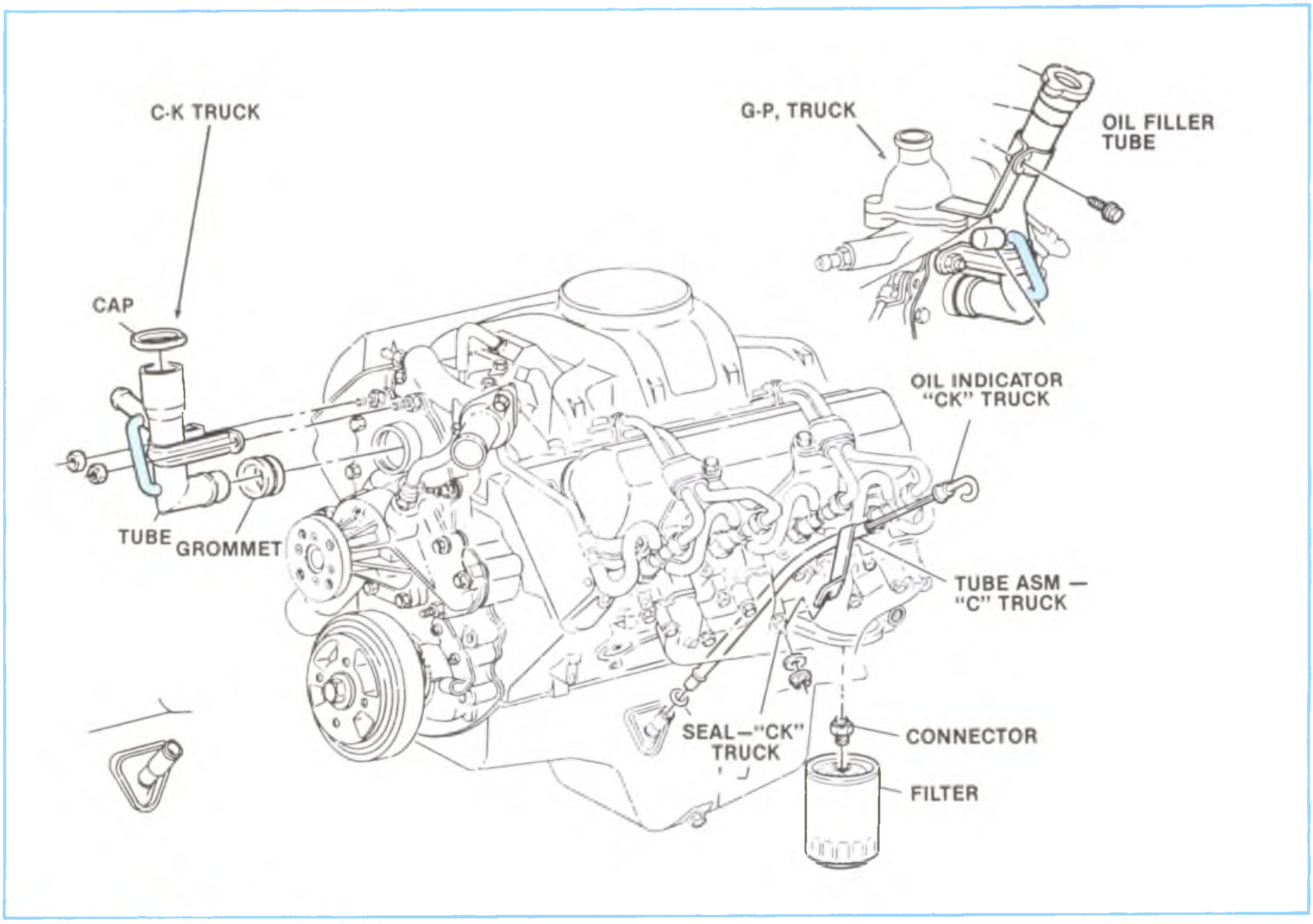


Figure 2-35, **Oil Filler Tube.**

Oil Filler Tube (Figure 2-35)

During late 1983 Model Year production, a vented oil fill tube (14071059) replaced the non-vented tube (Figure 2-35).

The vented tube will prevent the possibility of some oil entering the air intake system during oil additions. This vented oil fill tube is available through service as P/N 14071059.

Oil which has entered the intake manifold can cause damage if the amount is sufficient to cause hydraulic lock-up of a piston.

The vented tube should **always** be used in service when replacing the tube for any reason.

When replacing the fill tube on vehicles equipped with air-conditioning, a clearance modification must be made to the A/C hose support bracket (or use new P/N 14074317).

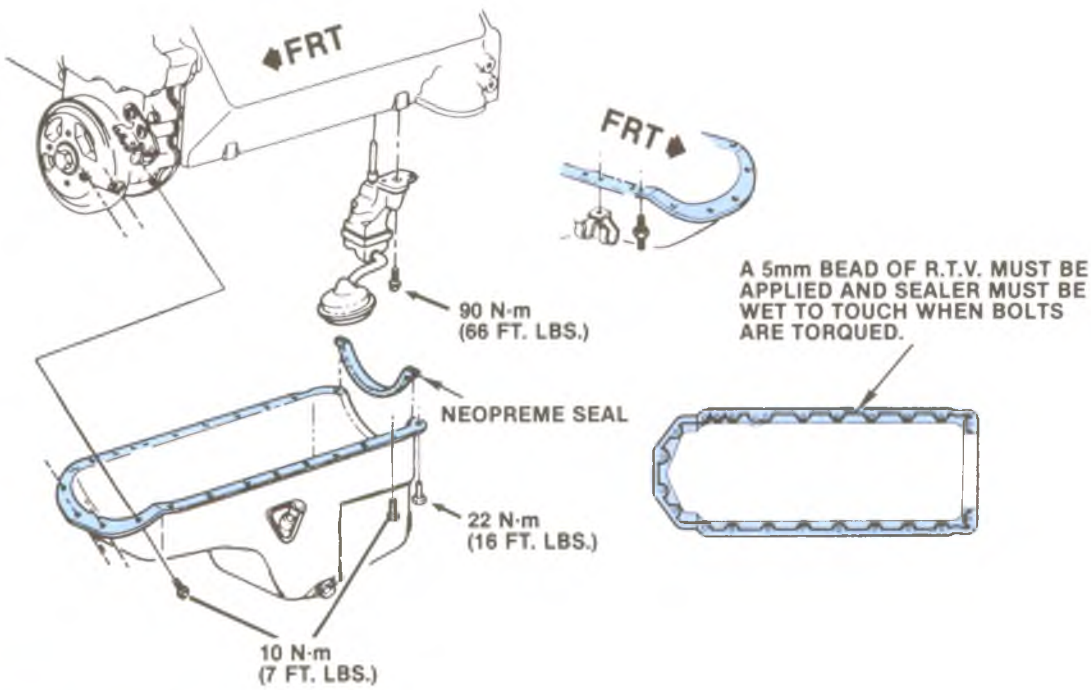


Figure 2-36, Oil Pan Seal.

OIL PAN SEAL

6.2L diesel uses R.T.V. around most of the perimeter of the pan, except at the rear, where a neoprene seal is used. See Figure 2-36.

RTV part #1052734, 1052914, or 1052915.

DIRECTIONS FOR RTV APPLICATION

1. Surface must be clean and dry. Remove all traces of oil and old gasket material. Clean with a chlorinated solvent such as carburetor spray cleaner. Don't use petroleum cleaners such as mineral spirits. They leave a film which R.T.V. won't stick to.
2. Cut the tube extension to approximately 1/8″.
3. Apply R.T.V. (1052734 or 1052915) to one of the clean surfaces. Circle all bolt holes.
4. Assemble while R.T.V. is still wet. Don't wait for R.T.V. to skin over (within 3 minutes).
5. Torque bolts to 10 N·m (7 Ft. Lbs.) except the 2 rear bolts (2 rear bolts 22 N·m 16 Ft. Lbs.). Don't over torque.
6. R.T.V. will skin over in 15 minutes, which is sufficient to allow for testing and operation of vehicle. No need to wait for the R.T.V. to cure.

Vacuum Pump

The vacuum pump (Figure 2-37) is required because the diesel engine does not develop vacuum in the unrestricted air intake manifold.

Since the air crossover and intake manifold are unrestricted, no vacuum source is available as found in gasoline engines. To provide vacuum, a vacuum pump is mounted in the location occupied by the distributor in the gasoline engine. This vacuum pump supplies the air conditioning servos, cruise control servo, and transmission vacuum modulator where required.

It is a diaphragm pump which needs no periodic maintenance. It is driven by a cam inside the drive assembly to which it mounts. The pump's diaphragm moves back and forth causing air to flow into the inlet tube, through the pump, and exhaust out the rear port.

The drive housing assembly has a drive gear on the lower end which meshes with the camshaft gear in the engine. This drive gear causes the cam in the drive housing to rotate. The drive gear also powers the engine oil lubricating pump.

Figure 2-38 illustrates the vacuum pump in sectional view. Lubrication of the vacuum pump is via a passage from the rear of the right lifter oil gallery.

See Figure 2-39 for removal and installation of the assembly and Figure 2-40 for general diagnosis.

— NOTE —

The engine will run without the vacuum pump installed, but in that case, there would be no oil circulation in the engine since the oil pump shaft has no gear to the camshaft. So, you should never run the engine without the vacuum pump installed.

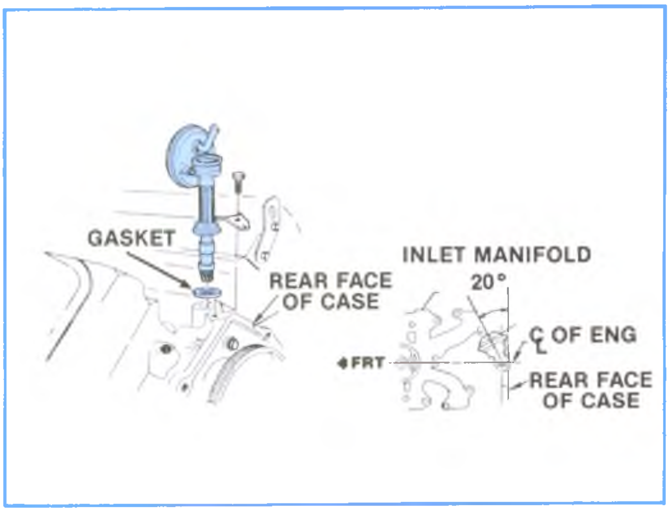


Figure 2-37, **Vacuum Pump.**

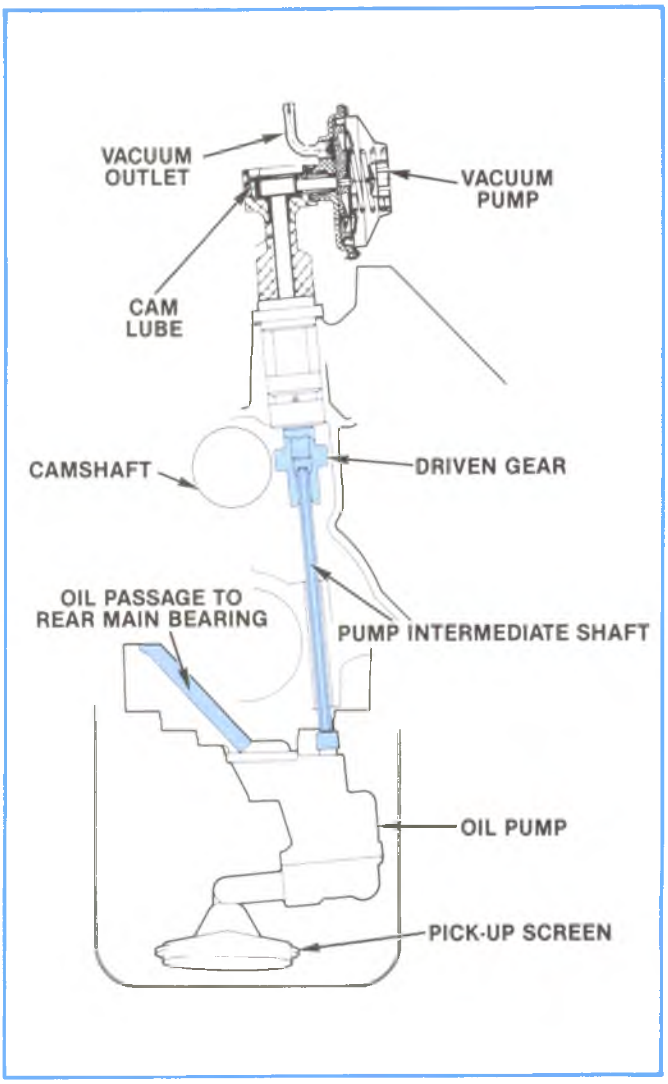


Figure 2-38, **Vacuum Pump Drive.**

1. REMOVE AND INSTALL

REMOVE

1. Remove hose from pump inlet.
2. Remove bolt and bracket holding pump to engine block.
3. Remove pump.

INSTALL

1. Insert pump in engine, making sure the gears on the pump mesh with the gears on the engine camshaft.
2. Rotate the pump into position so the bracket and bolt can be installed.
3. Install vacuum hose.

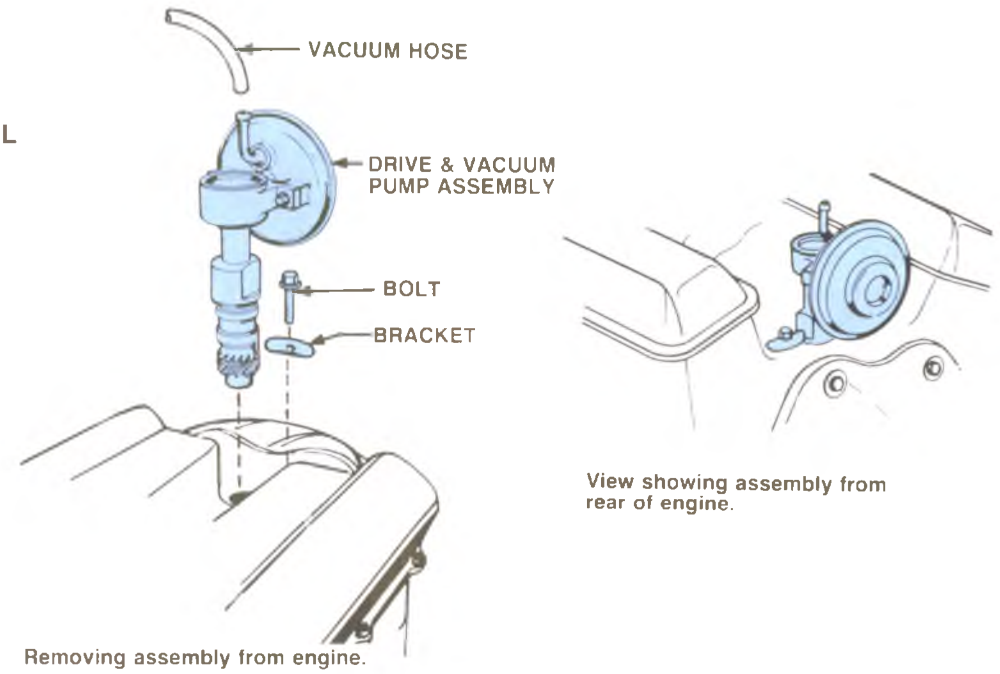


Figure 2-39, Repair Procedures.

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive noise or clattering noise.	1. Loose screws between pump assy. and drive assy. 2. Loose tube on pump assy.	1. A – Tighten screws to spec. B – Replace pump assy. 2. Replace pump assy.
Hooting noise.	Valves not functioning properly.	Replace pump assy.
Pump assy. loose on drive assy.	Stripped threads	Replace pump assy.
Oil around end plug.	Loose plug.	1. Seat plug. 2. Replace drive assy.
Oil leaking out crimp.	Bad crimp.	Replace pump assy.
Install hose and vacuum gage to pump, engine running, gage should have reading of 20 inches vacuum minimum. With engine off, vacuum level loss should not drop from 20 inches to 19 inches in less than 1½ seconds.	1. Defective valves. 2. Defective diaphragm. 3. Worn push rod seal. 4. Loose tube.	Replace pump assy.

Figure 2-40, Vacuum Pump Diagnosis.

EXCESSIVE BRAKE PEDAL EFFORT, BRAKE WARNING LIGHT ON (BRAKES WITH VACUUM ASSIST).

AUTOMATIC TRANSMISSION (VACUUM MODULATED) WILL NOT SHIFT OUT OF FIRST (LOW) GEAR

STEP 1

CONNECT VACUUM GAGE TO VACUUM PUMP INLET. AT ENGINE IDLE, VACUUM SHOULD REACH 70 kPA (21″ Hg) MINIMUM AT SEA LEVEL WITHIN 30 SECONDS (SEE GRAPH FOR VACUUM AT OTHER ELEVATIONS).

CHECKS OKAY. LEAK IN SYSTEM OTHER THAN VACUUM PUMP

GO TO STEP 2

LOW VACUUM OR FLUCTUATING GAGE READING

1. CHECK GAGE AND CONNECTIONS FOR LEAKS.
2. IF BELT DRIVEN, CHECK BELT TENSION AND PULLEY FIT TO SHAFT.
3. CHECK IDLE RPM.

RECHECK VACUUM GAGE

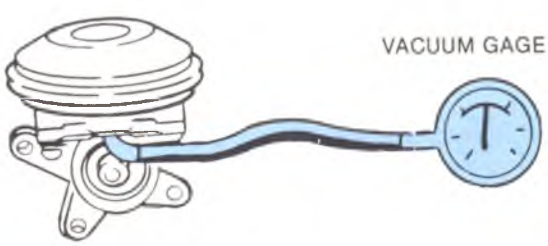
VACUUM O.K.

GO TO STEP 2

LOW VACUUM REPLACE PUMP

GO TO STEP 1

VACUUM PUMP DIAGNOSIS



VACUUM PUMP, NO-LEAK VACUUM MINIMUM ACCEPTABLE vs. ALTITUDE

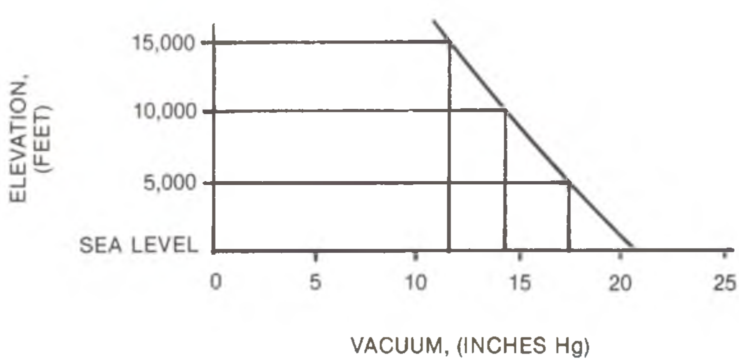


Figure 2-40, **Vacuum Pump Diagnosis.**

STEP 2

RECONNECT VEHICLE VACUUM HOSE TO PUMP WITH A TEE AND A VACUUM GAGE LOCATED NEAR PUMP INLET AS SHOWN BELOW. AT ENGINE IDLE, VACUUM CAN BE 3″ Hg MAXIMUM LOWER THAN MEASURED IN STEP 1 AFTER 1 MINUTE.

- CHECKS OKAY. ANY REMAINING PROBLEMS ARE NOT WITH VACUUM SYSTEM.
- LOW VACUUM — UNACCEPTABLE.
  - CHECK ALL ATTACHING HOSES FOR LEAKS — REPAIR AS REQUIRED.
  - IF STILL LOW VACUUM, CHECK ALL VACUUM ACCESSORIES FOR OUT OF SPECIFICATION LEAKS. REPAIR OR REPLACE AS REQUIRED.

VEHICLE VACUUM SYSTEM DIAGNOSIS

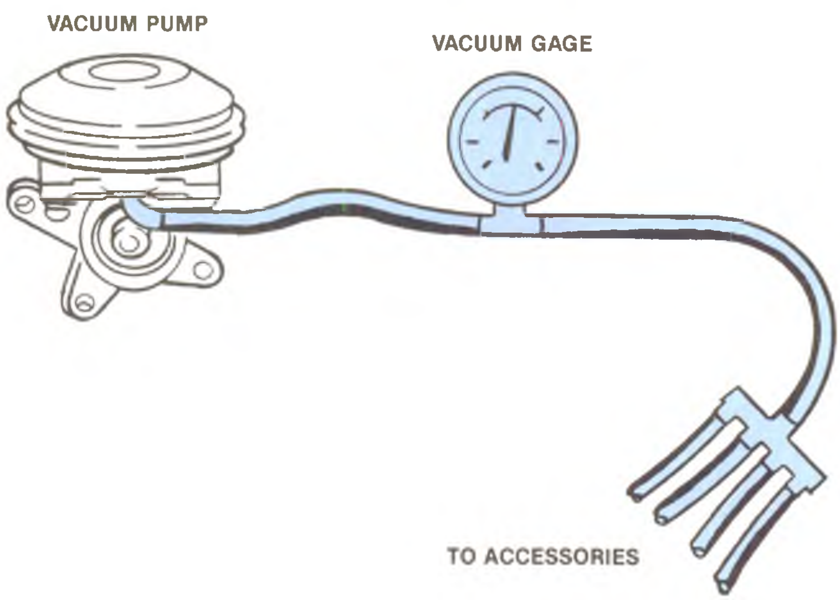


Figure 2-40 Cont'd, Vacuum Pump Diagnosis.

On applications with an engine mounted Model 80 fuel filter, a belt driven vacuum pump is used. This appears on 1984 and later units. See Figure 2-41.

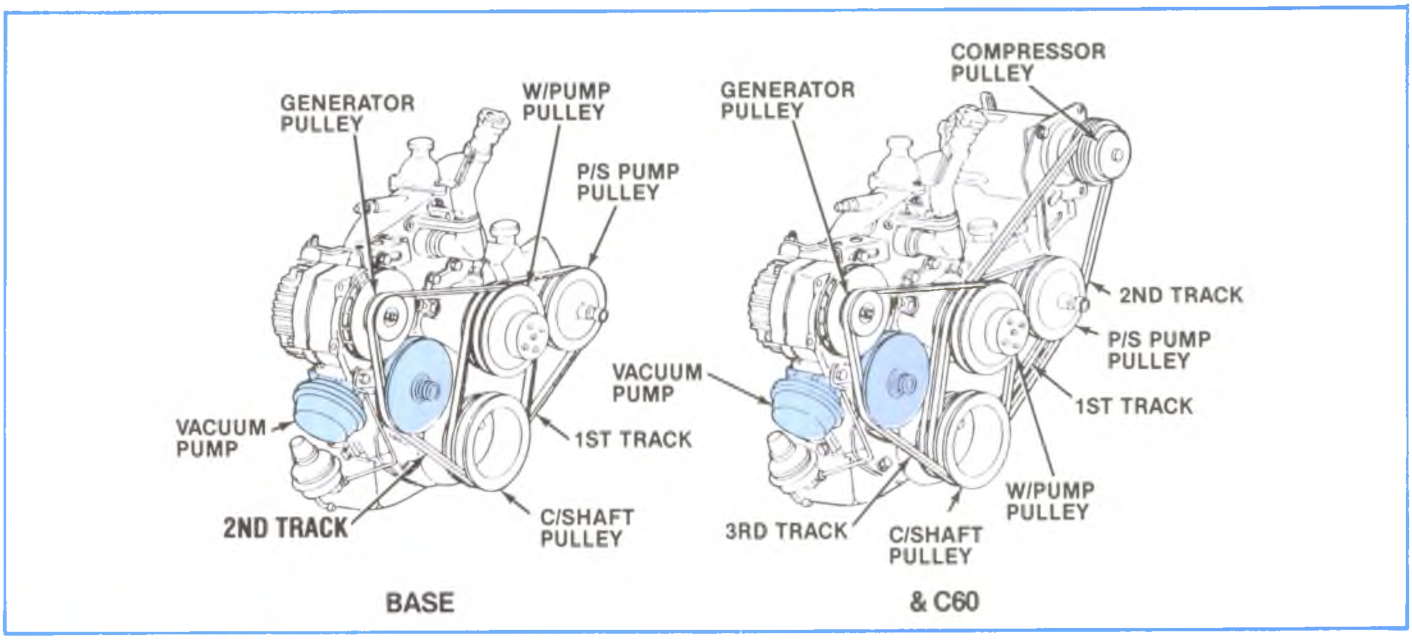


Figure 2-41, **Belt Driven Vacuum Pump.**

Units with belt driven vacuum pump use an oil pump drive in place of the gear driven vacuum pump. See Figure 2-42.

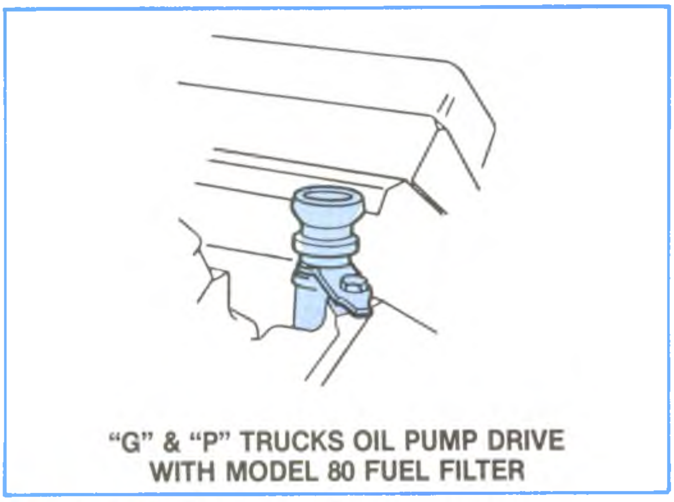


Figure 2-42, **Oil Pump Drive.**

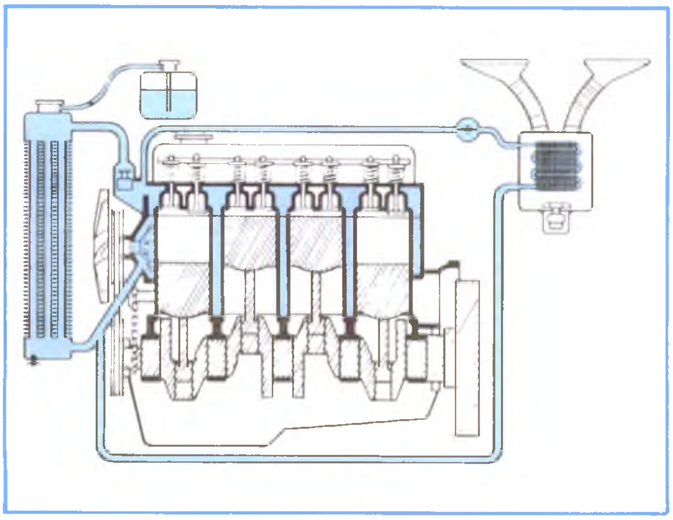


Figure 2-43, **Cooling System.**

Cooling System

The engine cooling system is similar to that used in a gasoline engine, except that it is larger capacity. (See Figure 2-43).

The purpose of the cooling system is to dissipate heat arising from combustion and to keep the engine at its most efficient operating temperature at all engine speeds and all driving conditions. During combustion of the air fuel mixture in engine cylinder, the burning gases may reach temperature as high as 4,000 °F. Some of this heat is absorbed by the wall of the cylinder, the heads and the pistons. These parts must be cooled so that they are not damaged from excessive temperature.

While it is critical that the engine not overheat, it is desirable that the engine operate as close as possible to the limits. This is because the engine is less efficient when it is cold. Therefore, the cooling system includes devices that prevent normal cooling action during warm-up of the engine. These devices are called thermostats and only allow flow of the coolant after the engine reaches normal operating temperature.

The cooling system in most all automobile and truck applications is a liquid coolant system. The liquid coolant system is made up of water jackets in both the cylinder head and in the cylinder case, a pump, an engine fan and a radiator.

GM 1825 M Spec. Coolant is used in the 6.2L Diesel. It is a new specification with modified formulations to lessen aluminum transport deposition (cavitation erosion). When engines with aluminum components are used with coolants not formulated for aluminum, plugging of radiators and engine overheating has been observed. Aluminum compounds in the radiator tubes caused the plugging.

Both service and owners manuals call for GM 1825 M Spec. Coolant. The new coolant (1052753) conforms to GM 1825 M.

Cooling System Diagnosis

A. PROBLEMS NOT REQUIRING DISASSEMBLY OF COOLING SYSTEM —

1. LARGE OBSTRUCTIONS BLOCKING RADIATOR OR CONDENSER
   - a. AUXILIARY OIL COOLERS
   - b. LICENSE PLATES — RELOCATE
   - c. SPARE TIRES
   - d. ICE, MUD OR SNOW OBSTRUCTING GRILLE — REMOVE
2. ENGINE OIL OVERFILL — CHECK ENGINE OIL DIPSTICK
3. WRONG RADIATOR FOR APPLICATION
4. LOOSE, DAMAGED OR MISSING AIR SEALS
5. MISSING OR DAMAGED LOWER AIR BAFFLE
6. WRONG TIMING

B. PROBLEMS REQUIRING DISASSEMBLY OF COOLING SYSTEM —

1. INCORRECT OR DAMAGED FAN
2. PRESSURE CHECK COOLING SYSTEM
3. DEFECTIVE WATER PUMP
   - a. ERODED OR BROKEN IMPELLER VANES
   - b. FAILED BEARING OR SEAL — CHECK FOR SHAFT OR BEARING PLAY
4. PLUGGED RADIATOR TUBES — SEND TO RADIATOR REPAIR SHOP FOR FLOW CHECK
5. INTERNAL SYSTEM LEAKS
   - a. HEAD GASKET
   - b. CRACKED BLOCK
   - c. TIMING CHAIN COVER
6. PLUGGED COOLANT PASSAGES IN CYLINDER HEADS — REMOVE HEADS AND CHECK VISUALLY

Figure 2-44, Cooling System Diagnosis Check List.

VISCOUS FAN DRIVE

The 6.2L Coolant Fan is not directly driven. The engine fan is mounted on the water pump shaft and is driven by the same belt that drives the pump. The purpose of this fan is to provide a flow of air thru the radiator. It incorporates a thermostatically operated fluid clutch in the fan hub. This allows the fan to turn less slowly when the engine is cold or when down-the-road driving supplies enough cooling air to control coolant temperature. As coolant temperature rises, the hot air passing through the radiator causes the bimetallic spring at the front of the hub to expand. The spring moves a plate, allowing the working fluid to pass into the working chamber. The fluid resists the free rotation of the fan hub and the fan turns faster. See Figure 2-45.

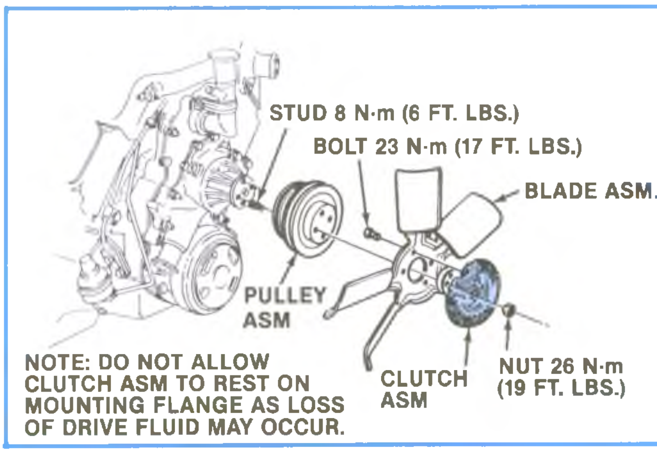


Figure 2-45, Viscous Fan Drive.

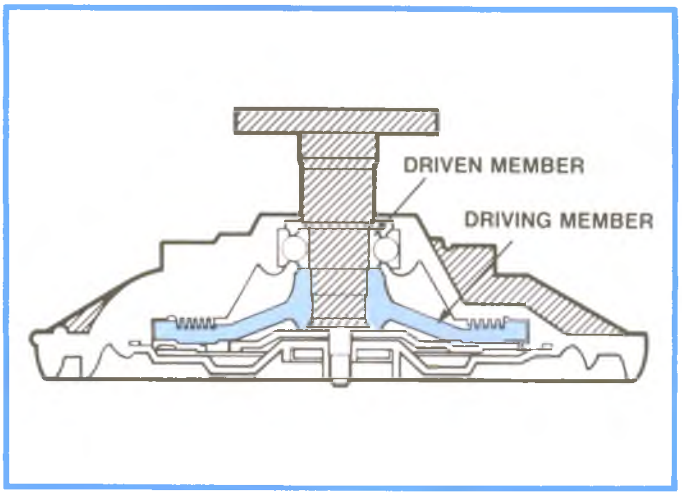


Figure 2-46, Fan Drive Members.

DRIVING AND DRIVEN MEMBERS

There are two viscous clutch members (Figure 2-46). The clutch plate is splined to the pulley shaft and becomes the driving member.

The driven member is integral with the drive housing, which is bolted to the fan. Both members have circular grooves that are closely mated.

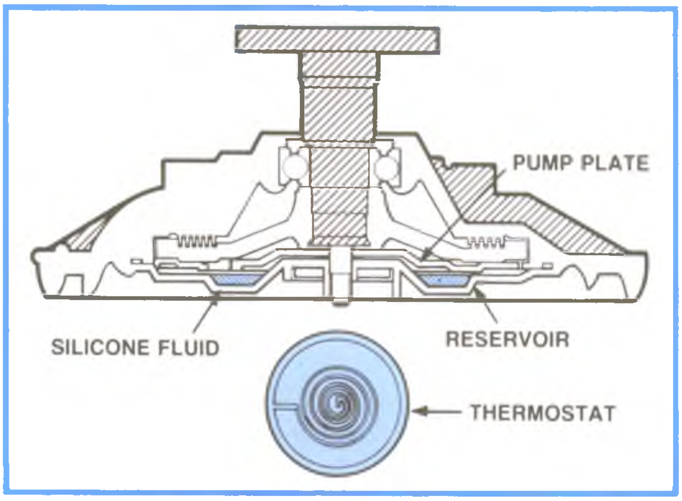


Figure 2-47, Fluid Reservoir and Thermostat.

SILICONE FLUID

The viscous drive medium is silicone fluid, which is stored in a reservoir chamber in front of the pump plate (Figure 2-47). A bi-metallic coil or thermostat controls the fluid flow.

BI-METAL CONTROL

The bi-metallic coil senses the air temperature directly behind the radiator to engage or disengage the drive as required.

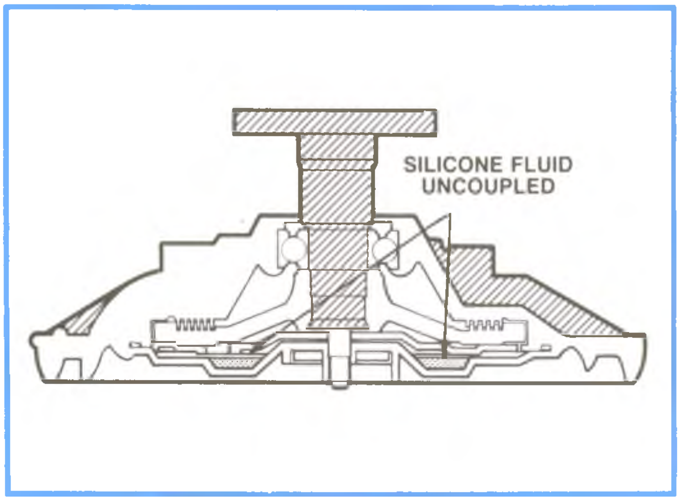


Figure 2-48, Drive Uncoupled.

DRIVE UNCOUPLED

When the radiator air stream is cold, the silicone fluid remains trapped in the reservoir. With little or no fluid in the working chamber, the clutch members are uncoupled, and there is little or no fan rotation (Figure 2-48).

DRIVE COUPLED

As the bi-metallic coil gets hot (around 165 degrees), it moves an arm to uncover an opening in the pump plate and let the fluid flow into the working chamber.

The fluid viscosity causes the members to couple and drive the fan, whenever there is enough fluid to fill the spaces between the grooves.

When the drive is in the coupling phase, the fluid continually circulates between the reservoir and the working chamber. It is again trapped in the reservoir when the bi-metallic coil cools and the fan is uncoupled. See Figure 2-49.

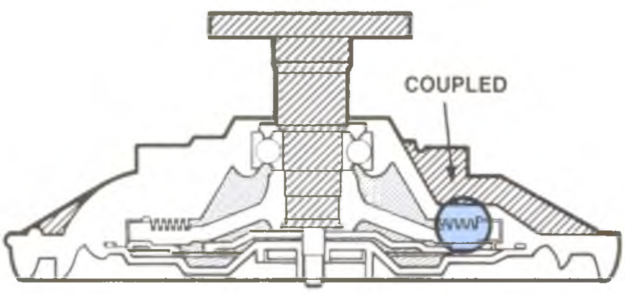


Figure 2-49, **Drive Coupled.**

Fan Clutch Diagnosis

1. NOISE

Fan noise is sometimes evident under the following normal conditions:

a. When clutch is engaged for maximum cooling.

b. During first few minutes after start-up until the clutch can re-distribute the silicone fluid back to its normal disengaged operating condition.

2. LOOSENESS

Under various temperature conditions, there is a visible lateral movement that can be observed at the tip of the fan blade. This is a normal condition due to the type of bearing used. Approximately 1/4″ maximum lateral movement measured at the fan tip is allowable. This is not cause for replacement.

3. SILICONE FLUID LEAK

The operation of the unit is generally not affected by small fluid leaks which may occur in the area around the bearing assembly. However, if the degree of leakage appears excessive, proceed to item 4.

4. ENGINE OVERHEATING

a. Start with a cool engine to insure complete fan clutch disengagement.

b. If the fan and clutch assembly free-wheels with no drag (revolves over 5 times when spun by hand), the clutch should be replaced. If clutch performs properly with a slight drag go to Step C.

Testing a fan clutch by holding the small hub with one hand and rotating the aluminum housing in a clockwise/counterclockwise motion will cause the clutch to free-wheel, which is a normal condition when operated in this manner. This should not be considered a test by which replacement is determined.

c. Position thermometer so that it is located between the fan blades and radiator. This can be achieved by inserting the sensor through one of the existing holes in the fan shroud or fan guard, or by placing between the radiator and the shroud. On some models, it may be necessary to drill a 3/16″ hole in the fan shroud to insert thermometer.

— NOTE —

Check for adequate clearance between fan blades and thermometer sensor before starting engine, to prevent damage to thermometer, fan or radiator.

d. with thermometer in position, cover radiator grille sufficiently to induce a high engine temperature. Start engine and turn on A/C if equipped, operate at 2,000 rpm.

e. Observe thermometer reading when clutch engages. It will take approximately 5 to 10 minutes for the temperature to become high enough to allow engagement of the fan clutch. This will be indicated by an increase or roar in fan air noise and by a drop in the thermometer reading of approximately 5-15 °F (3-9 °C). If the clutch did not engage between 150-195 °F (66-91 °C) the unit should be replaced. Be sure fan clutch was disengaged at beginning of test.

   If no sharp increase in fan noise or temperature drop was observed and the fan noise level was constantly high from start of test to 190 °F (88 °C), the unit should be replaced.

f. As soon as the clutch engages, remove the radiator grille cover and turn off the A/C to assist in engine cooling. The engine should be run at approximately 1500 rpm.

g. After several minutes the fan clutch should disengage, as indicated by a reduction in fan speed and roar.

   If the fan clutch fails to function as described, it should be replaced.

— CAUTION —

If a fan blade is bent or damaged in any way, no attempt should be made to repair and reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new assembly.

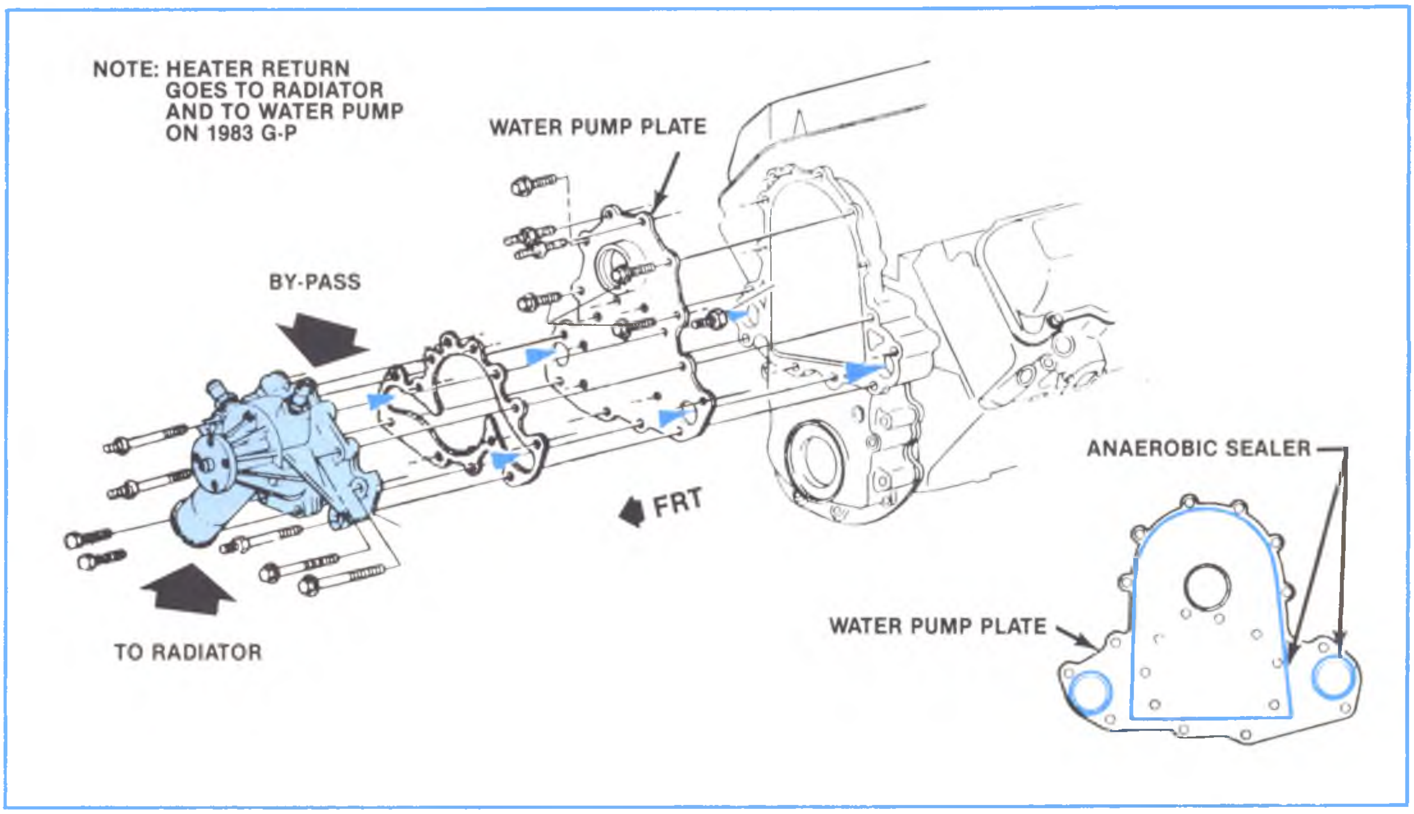


Figure 2-50, Water Pump.

Water Pump

The water pump (Figure 2-50) is mounted at the front end of the engine between the block and the radiator. The pump consists of a housing, with a water inlet and water outlet. Internally there is an impeller which rotates, forcing the coolant through the pump. The inlet of the pump is connected by a hose to the bottom of the radiator and coolant from the radiator is drawn thru the pump. The impeller shaft is supported on bearings and a ceramic type seal prevents coolant from leaking out around the bearing. The pump is driven by a belt on the drive pulley mounted on the front end of the end of the engine crankshaft.

The water pump discharge (flow) rate is 70 G.P.M. and the average coolant capacity is 6.2 gallons with 3.2 gallons in the engine.

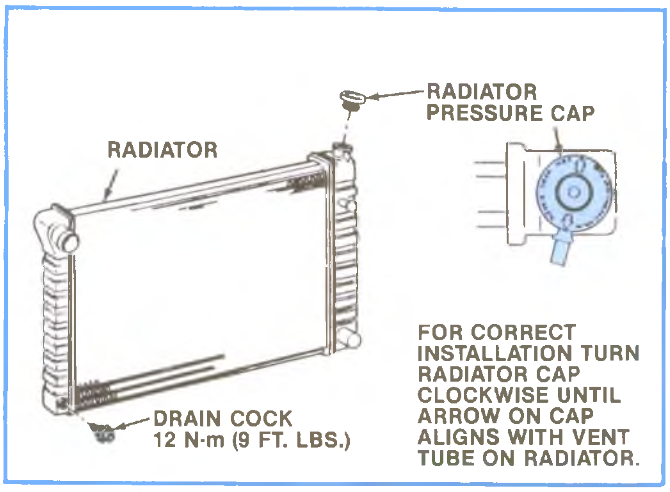


Figure 2-51.

Radiator

See Figure 2-51. The radiator holds a large volume of coolant in close contact with flowing air. This allows the radiator to transfer heat from the coolant to outside air. Many cooling systems today have a separate expansion tank outside the radiator. The expansion tank is partly filled with coolant and is connected to the radiator cap. The coolant expands in the engine as it heats up. This sends part of the coolant into the expansion tank. Then when the engine reaches operating temperature a valve in the radiator cap closes which seals the coolant system. The pressure in the cooling system increases and thus prevents boiling. This increased pressure allows a higher coolant temperature and thus a more efficient cooling system.

RADIATOR CAP

A pressure-vent cap is used on the cross-flow radiator to allow a buildup of 103 kPa (15 psi) in the cooling system. This pressure raises the boiling point of coolant to approximately 125°C (262°F) at sea level.

DO NOT REMOVE RADIATOR CAP TO CHECK ENGINE COOLANT LEVEL; CHECK COOLANT VISUALLY AT THE SEE-THROUGH COOLANT RESERVOIR. COOLANT SHOULD BE ADDED ONLY TO THE RESERVOIR.

The pressure-type radiator filler cap contains a blow off or pressure valve (Figure 2-52) and a vacuum or atmospheric valve (Figure 2-53).

The pressure valve is held against its seat by a spring of pre-determined strength which protects the radiator by relieving the pressure if an extreme case of internal pressure should exceed that for which the cooling system is designed.

A vacuum valve is used which permits opening of the valve to relieve vacuum created in the system when it cools off and which otherwise might cause the radiator to collapse. It also permits transfer of coolant from the reservoir.

The design of the radiator cap is to discourage inadvertent removal. The finger grips have been removed so the cap is round in shape. It must be pushed downward before it can be removed. A rubber asbestos gasket is added to the diaphragm spring at the top of the cap. Also, embossed on the cap is a caution against its being opened, and arrows indicating the proper closed position.

TEMPERATURE SWITCH

A temperature switch (Figure 2-54) activates a warning lamp in the instrument cluster should excessive coolant temperatures prevail in the engine. With optional instrumentation, a temperature gage replaces the warning lamp and the temperature switch is replaced with a transducer.

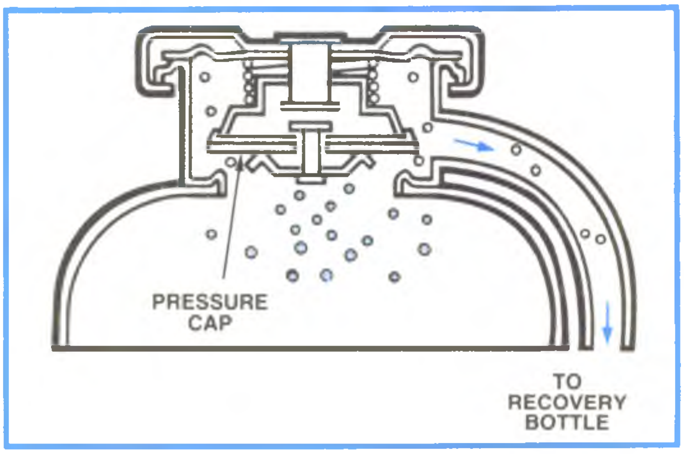


Figure 2-52, **Radiator Cap With Pressure Valve Open.**

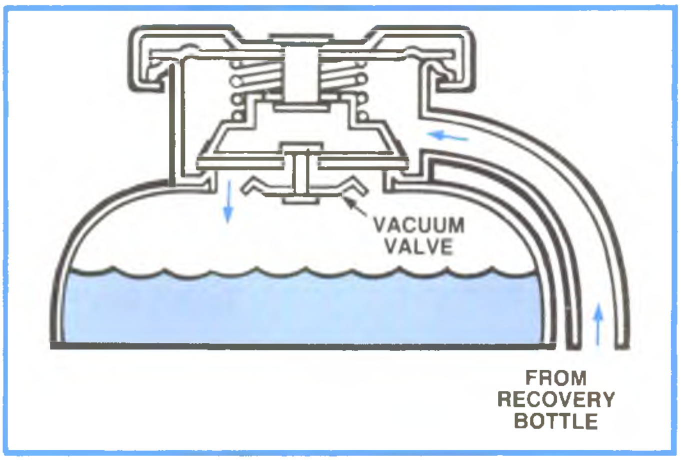


Figure 2-53, **Radiator Cap With Vacuum Valve Open.**

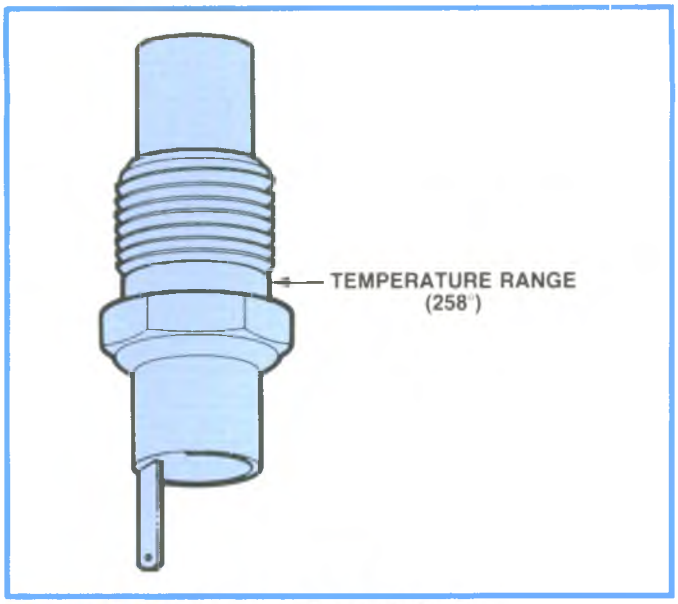


Figure 2-54, **Temperature Switch.**

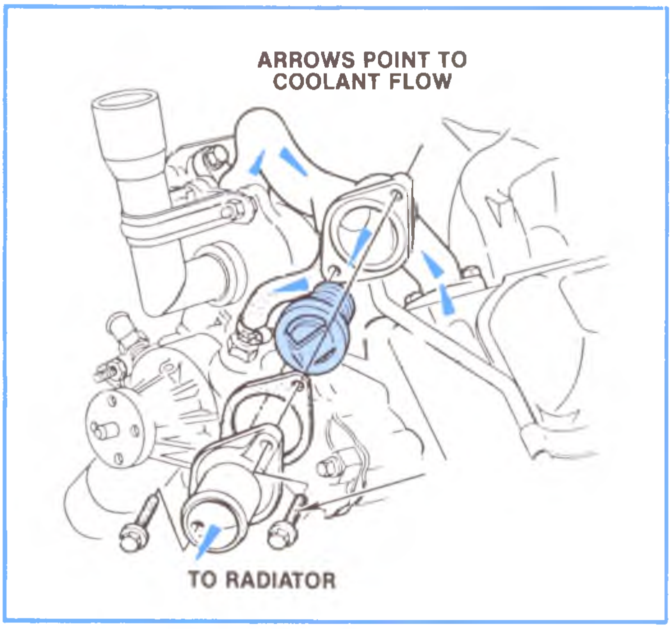


Figure 2-55, Thermostat.

THERMOSTAT

The thermostat Figure 2-55 is placed in the coolant passage between the cylinder head and the top of the radiator. Its purpose is to close off this passage when the engine is cold so that coolant circulation is restricted. This allows the engine to reach normal operating temperature more rapidly. The thermostat is designed to open at a specific temperature (180°F). When the engine is cold and the thermostat is closed and coolant recirculates thru the cylinder head and case. When the thermostat opens, the coolant circulates through the radiator.

1982 - Early 1983 Engines 180°

1983 and Later 190°

THERMOSTAT RANGE CHART		
190°F Stat.	Temperature Range 187°F to 194°F	Fully Open @212°F
180°F Stat.	Temperature Range 175°F to 182°F	Fully Open @202°F

THERMOSTAT OPERATION

A pellet-type thermostat (Figure 2-56) is used in the coolant outlet passage to control the flow of engine coolant, to provide fast engine warm-up and to regulate coolant temperatures. A wax pellet element in the thermostat expands when heated and contracts when cooled. The pellet is connected through a piston to a valve. When the pellet is heated, pressure is exerted against a rubber diaphragm which forces the valve to open. As the pellet is cooled, the contraction allows a spring to close the valve. Thus, the valve remains closed while the coolant is cold, preventing circulation of coolant through the radiator. At this point, coolant is allowed to circulate only throughout the engine to warm it quickly and evenly.

As the engine warms, the pellet expands and the thermostat valve opens, permitting coolant to flow through the radiator where heat is passed through the radiator walls. This opening and closing of the thermostat permits enough coolant to enter the radiator to keep the engine within operating limits.

See Figure 2-57 for thermostat diagnosis and Figure 2-61 for general cooling system diagnosis.

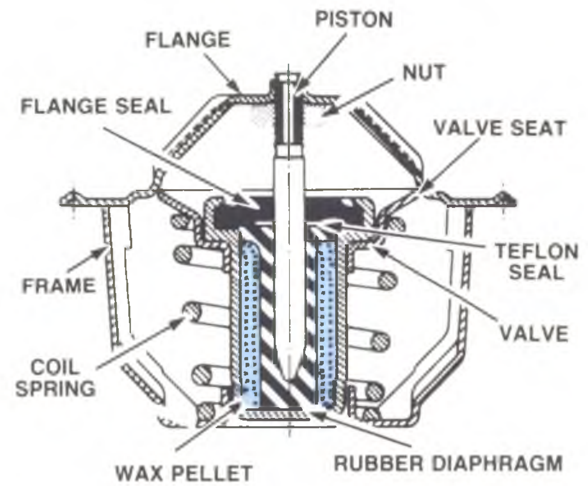
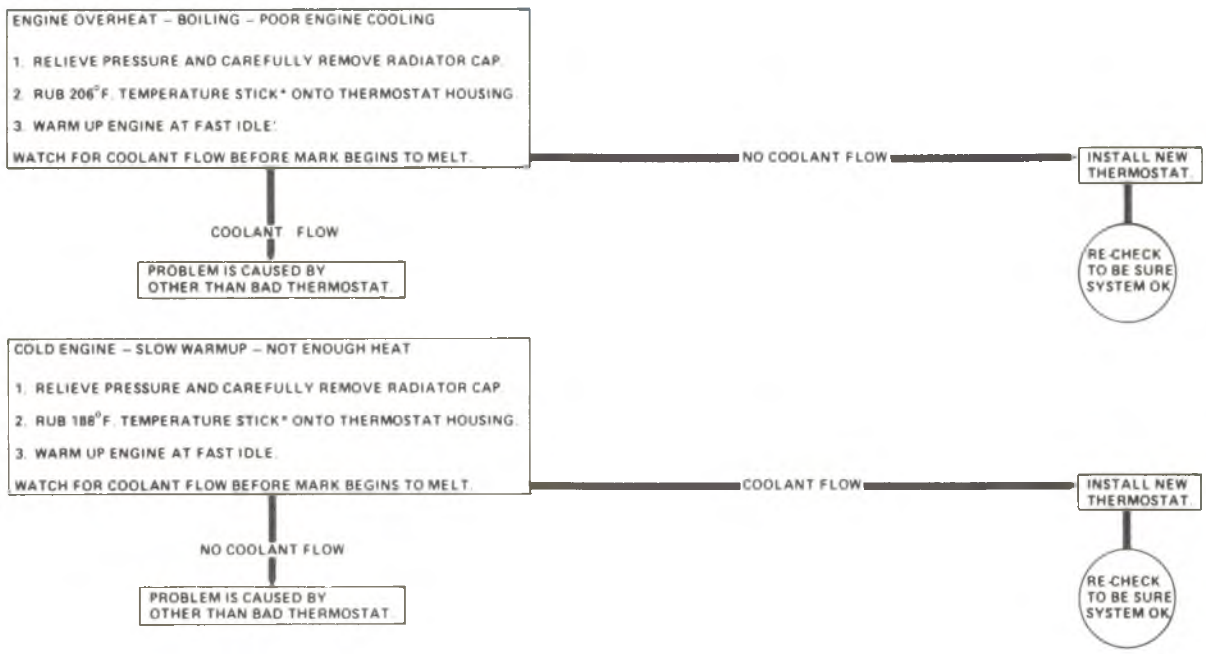


Figure 2-56, Thermostat Construction.



*NOTE: THE TEMPERATURE STICK IS A PENCIL LIKE DEVICE WHICH HAS A WAX MATERIAL CONTAINING CERTAIN CHEMICALS WHICH MELT AT A GIVEN TEMPERATURE. THEMPERATURE STICKS CAN BE USED TO DETERMINE A THERMOSTAT'S OPERATING TEMPERATURE BY RUBBING 188°F. AND 206°F. STICKS ON THE THERMOSTAT HOUSING. THE MARKS MADE BY THE STICKS SHOULD MELT WHEN COOLANT TEMPERATURES OF 188°F. AND 206°F. ARE REACHED, RESPECTIVELY. THESE TEMPERATURES ARE THE NORMAL OPERATING RANGE OF THE THERMOSTAT, THEREFORE, IF THE COOLANT FLOWS AS INDICATED ON THE DIAGNOSIS CHART, THE THERMOSTAT MAY BE DEFECTIVE.

Figure 2-57, Thermostat Diagnosis.

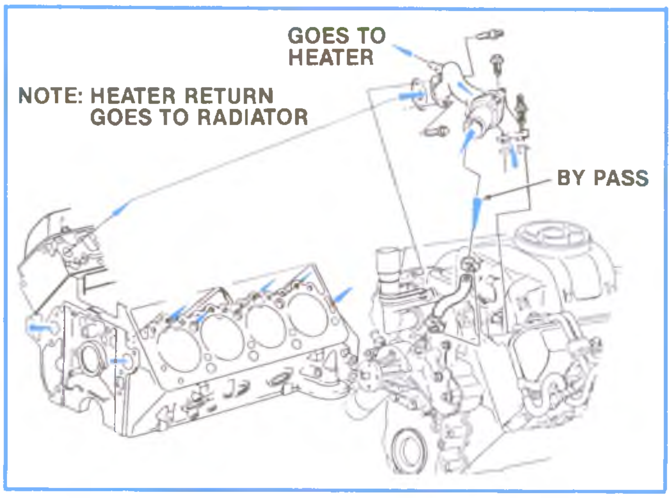


Figure 2-58, **Cooling System Flow.**

Cooling System Schematic

- **COOLANT FLOW**

A. Coolant is drawn from the radiator by the water pump.

B. The pump pushes the coolant into both sides of the block.

C. Coolant flows around the cylinders and up into:

D. The heads where it circulates around the exhaust passages and fire deck areas of the head and flows out the front into:

E. The thermostat housing which stops the main flow when the temperature is below about 180°F directing a small portion (bypass) back to the pump. When the thermostat is open the coolant flows to the top tank of the radiator to be cooled.

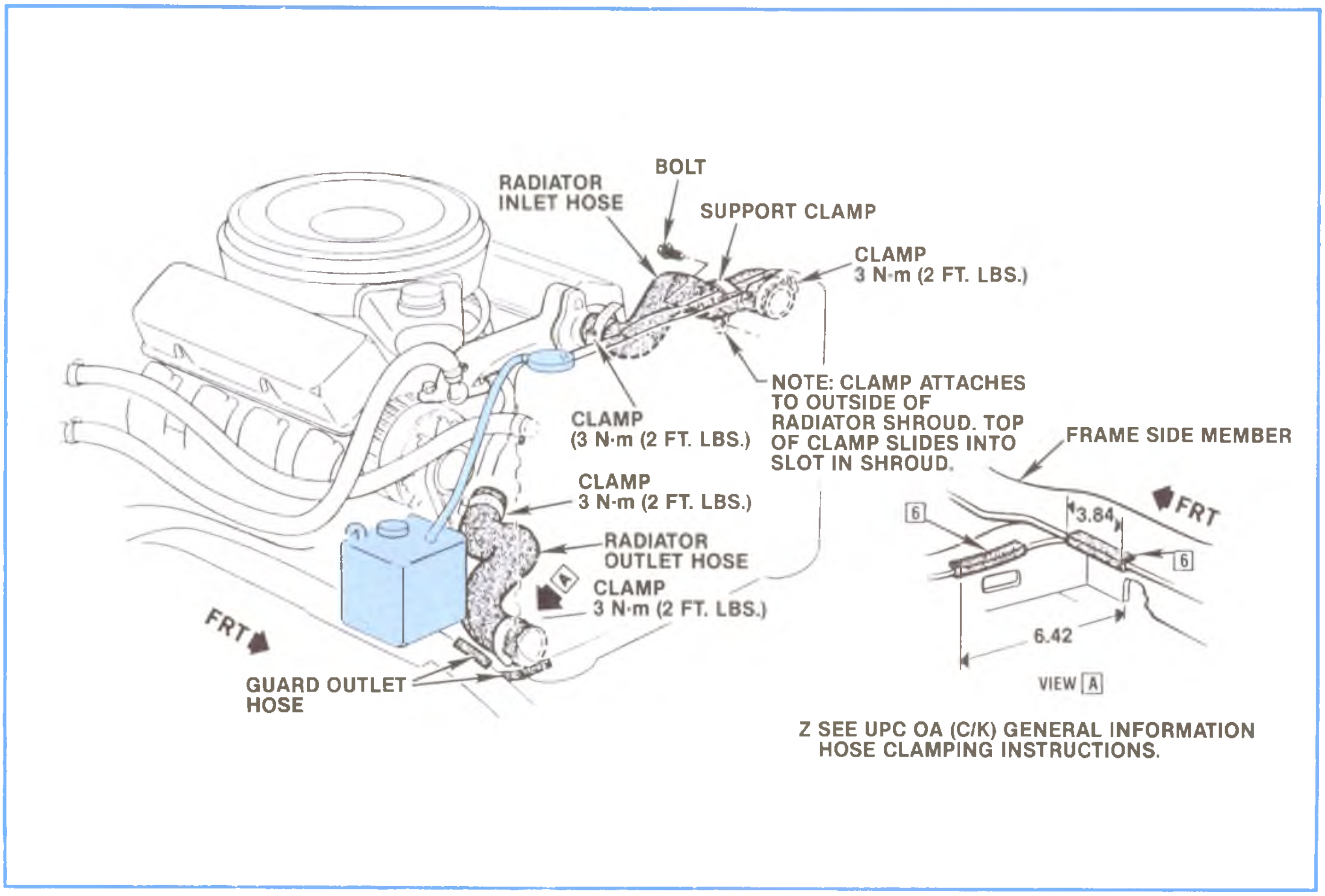


Figure 2-59, **Pressure Coolant Recovery Tank (Bottle).**

1985 Cooling System

- The 1985 6.2L cooling system has a pressurized coolant recovery tank.

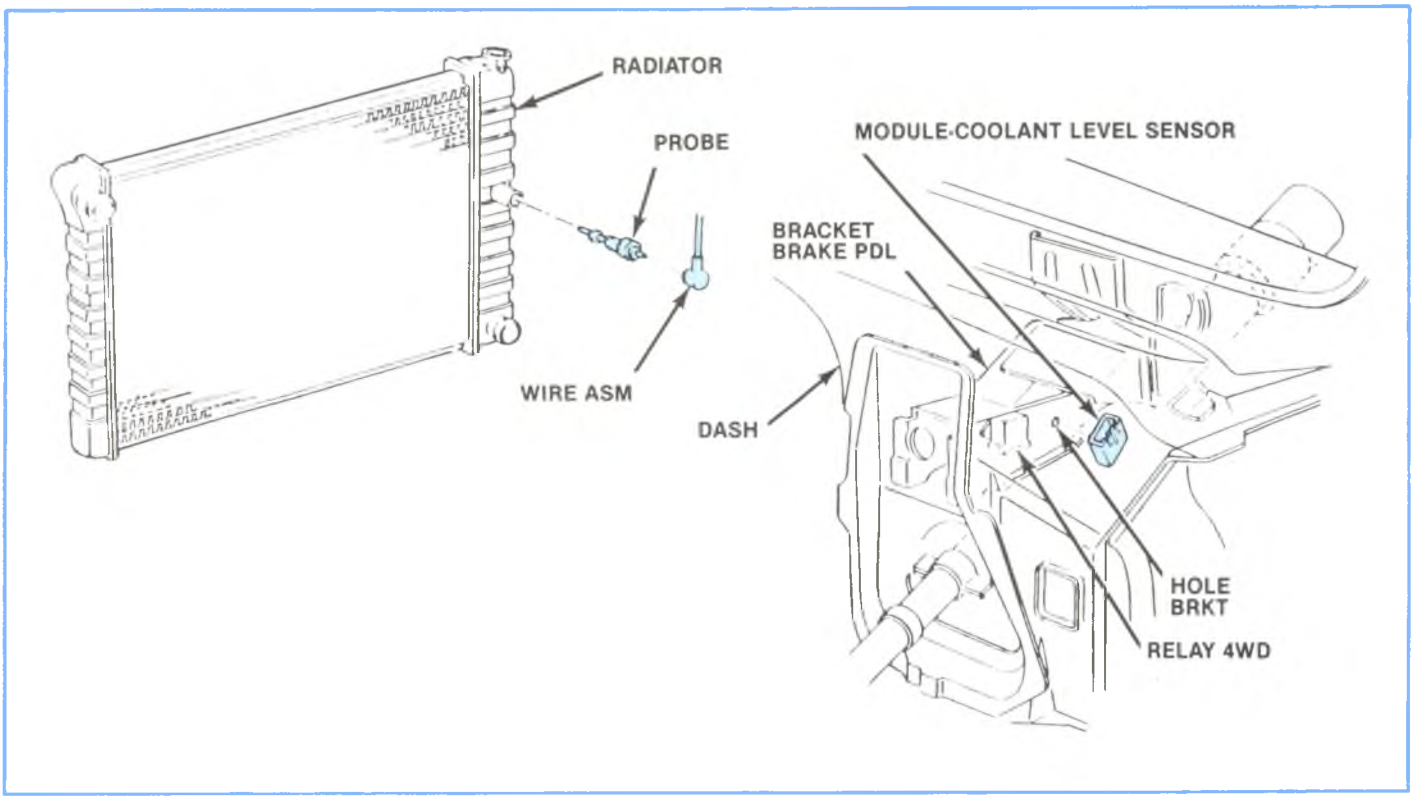


Figure 2-60.

LOW COOLANT INDICATOR

A low coolant indicator system is used in 6.2L applications. See Figure 2-60. This system consists of a:

- Module
- Probe
- Low coolant dash light
- Related wiring

There is an electronic module located in the cab. It will turn on a light in the I.P. when the coolant drops below a specified level. The probe which signals low coolant level is located in the right side of the radiator. The module is located on the upper left side of the pedal bracket.

Low Coolant Lamp Inoperative

NO TEST AT KEY ON OR DOES NOT INDICATE LOW COOLANT

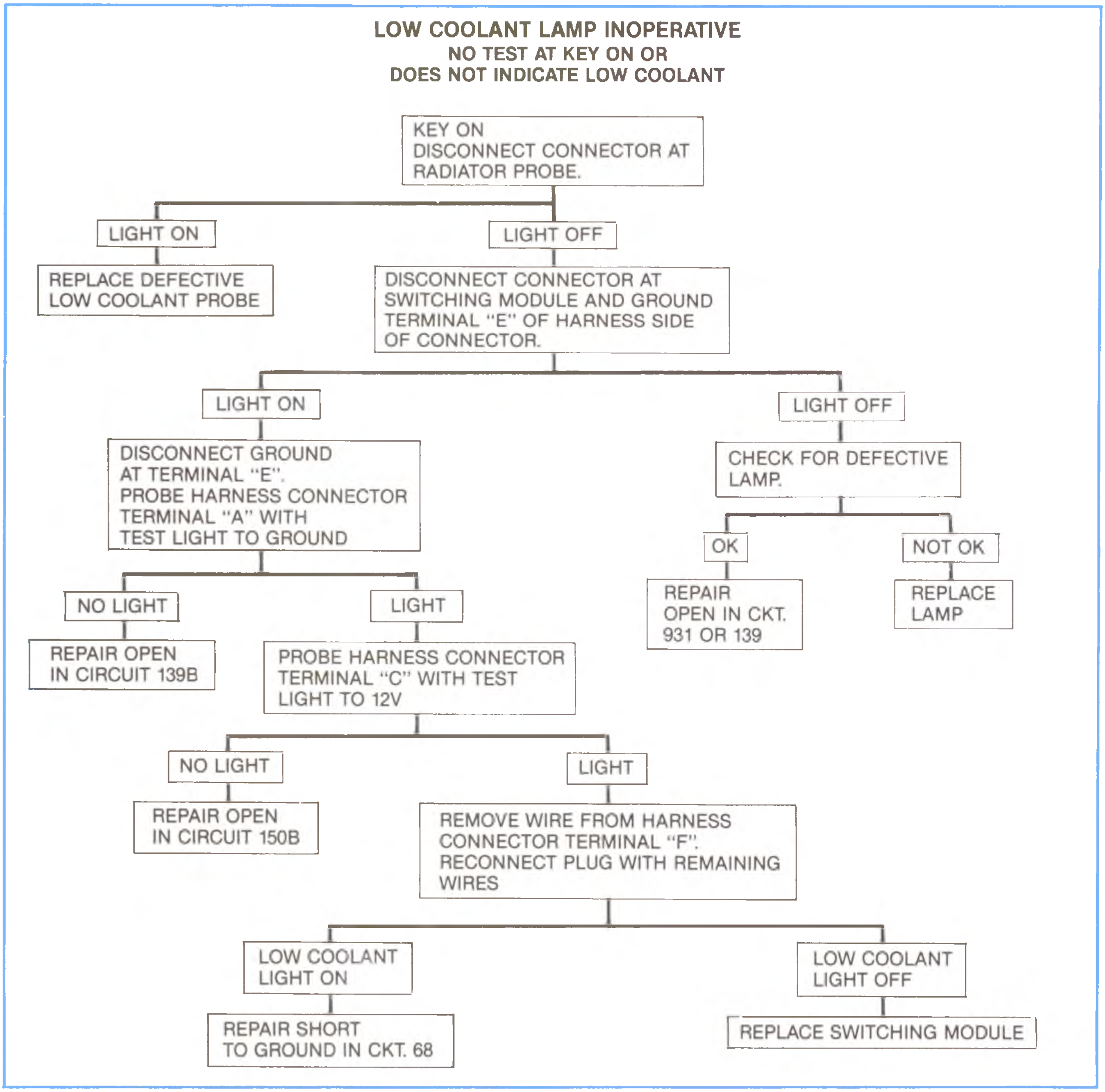


Figure 2-61, Low Coolant Lamp Inoperative.

Low Coolant Lamp "On" All the Time

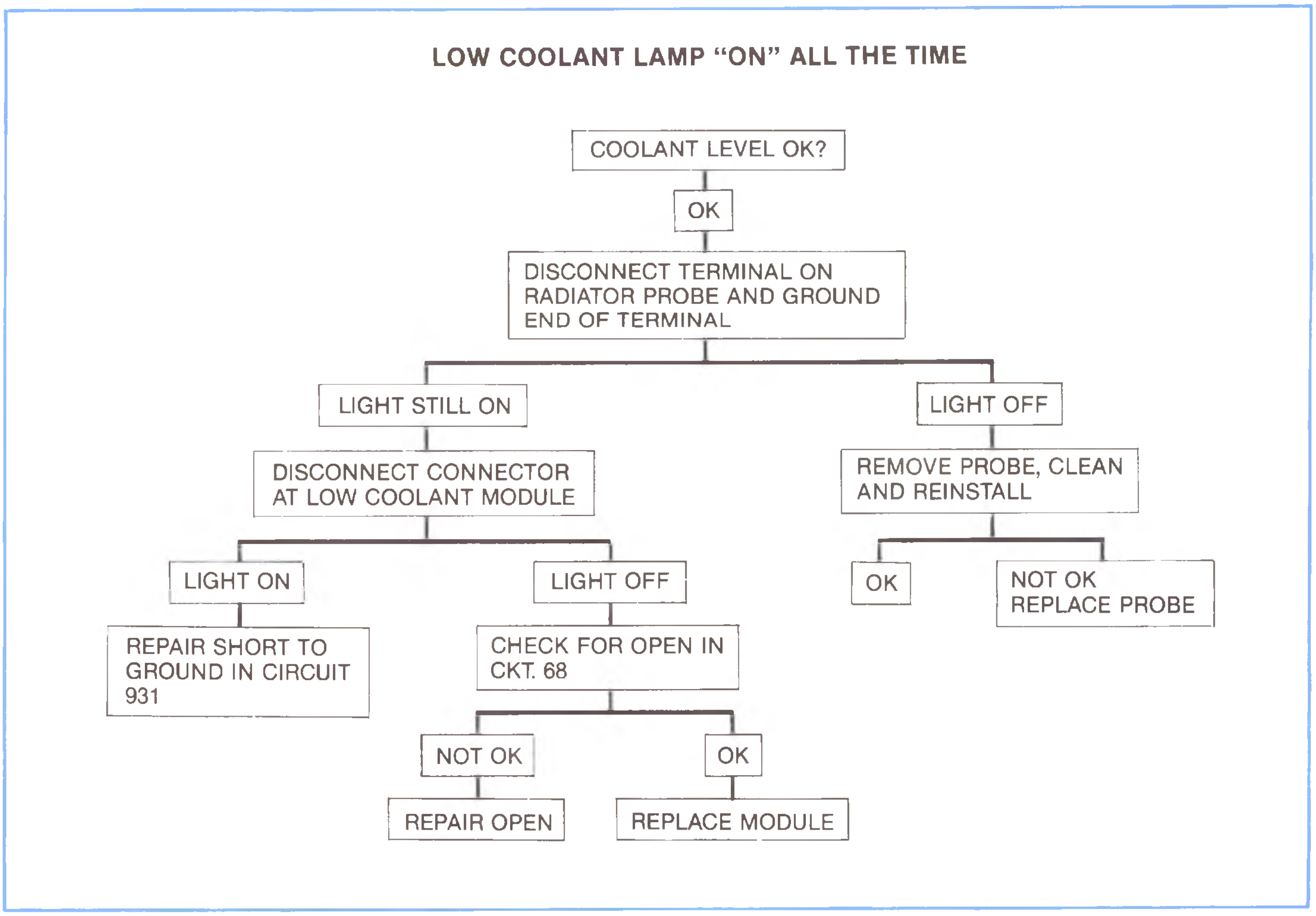


Figure 2-62, **Low Coolant Lamp Remains "On".**

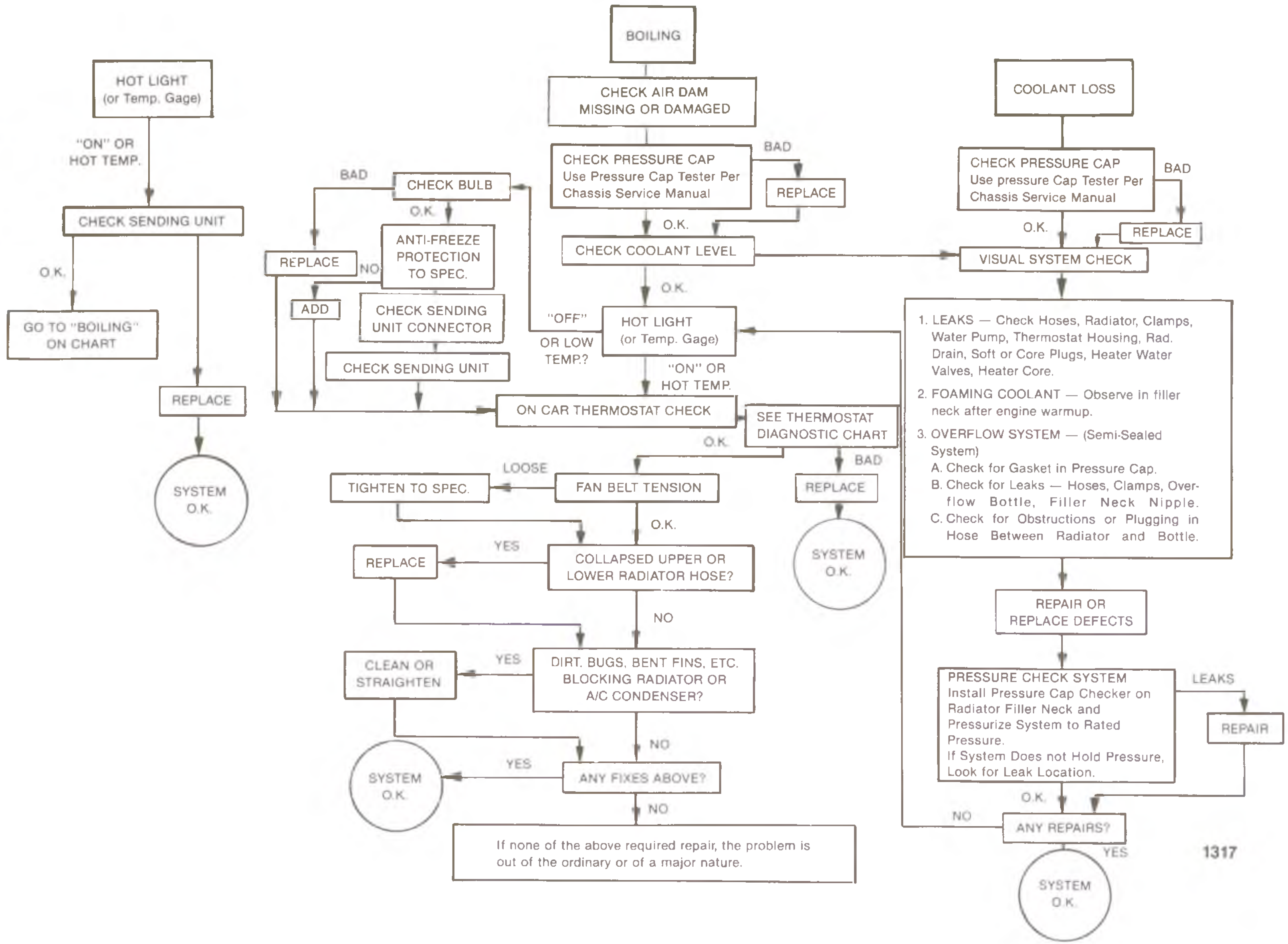


Figure 2-63, Cooling System Diagnosis Chart.

Base Engine Troubleshooting

COMPRESSION TEST — DIESEL ENGINES

To determine if the valves or rings are the cause of low compression, a test should be made to determine the cylinder compression pressure.

When checking compression, the cranking speed must be at least 180 RPM and the engine fully warmed-up (Engine Oil Hot). The lowest reading should not be less than 80% of the highest and no cylinder reading should be less than 2622 KPA (380 PSI)

1. Remove air cleaner then install intake manifold cover J29664-1.
2. Disconnect the wire from the fuel solenoid terminal of the injection pump.
3. Disconnect wires from glow plugs then remove all glow plugs.
4. Screw the compression gage J-26999-10 into the glow plug hole of the cylinder that is being checked.
5. Crank engine.

   Allow six "puffs" per cylinder.

   NORMAL — Compression builds up quickly and evenly to specified compression on each cylinder.
   LEAKING — Compression low on first stroke tends to build up on following strokes but does not reach normal.

— NOTE —

Do not add oil to any cylinder during a compression test as extensive engine damage can result.

— NOTE —

6.2L V-8 Diesel compression should be in the 380-400 PSI Range.

DIESEL ENGINE NOISE

A noise is possible in diesel engines that is throttle conscious. It is most noticeable when the engine is warm. The cause of the noise may be a worn wrist pin pushing in the connecting rod.

DIESEL ENGINE WITH STUCK PISTON RINGS

If you encounter a diesel engine that exhibits excessive oil consumption, low compression or excessive blowby and you suspect stuck piston rings as the cause, the following procedure may be an effective correction:

1. Remove the glow plugs from all 8 cylinders.
2. Equally divide the contents of one can of top engine cleaner, part number 1050002, into each cylinder. (Allow the engine to soak for 24 hours).
3. Crank the engine with the glow plugs removed to expell the top engine cleaner.
4. Reinstall the glow plugs and start the engine.

DIESEL ENGINE HOT HARD START

Diesel engines may exhibit hard starting characteristics when they are shut down for some period of time after being fully warmed up. The cause is almost always lack of fuel or lack of heat to ignite the fuel.

The first step is to determine if it is a heat related condition or a fuel related condition. Normally this can be determined by looking at the exhaust when the engine is being cranked.

Large quantities of white or light blue smoke coming out the exhaust is fuel vapor that did not ignite. If you see lots of fuel vapor, the condition is most likely insufficient heat. If there is little or no white or black smoke, there is insufficient fuel.

The Service Manuals contain information regarding the diagnosis of diesel engines that are hard to start. Review the appropriate manual for diagnosis information. The following are items that are the most often overlooked. This listing is by no means a comprehensive list of all items that affect starting.

• INSUFFICIENT HEAT

The following items affect the heat and must be correct. Refer to the Service Manual for procedures:

1. Cranking speed is extremely critical for a diesel to start, either hot or cold. Some tachometers may not be accurate at cranking speeds. A way to determine cranking speed and check tachometer accuracy is to perform the following procedures:
   a. Install J-26999-10 compression gage into any cylinder.
   b. Disconnect the injection pump fuel shut off solenoid lead at the injection pump or harness connector.
   c. Install a tachometer.
   d. Depress the pressure release valve on the compression gage.
   e. With the aid of an assistant, crank the engine for two or three (2 or 3) seconds to get the starter up to speed, then without stopping, count the number of "puffs" at the compression gage that occur in the next 10 seconds. Multiply the number of "puffs" in the 10 second period by 12 and that will be the cranking RPM (speed).

   Example — 10 seconds = 1/6 of a minute
   1 "puff" = 2 RPM
   RPM = (x) "puffs" × 2 × 6 or
   RPM = (x) "puffs" × 12

   Tests conducted show that diesel engines start hot at around 180 RPM which is below the 240 specified in the Service Manual.
2. Dynamic Timing — If time is retarded beyond specifications, hard starting may be experienced.
3. Compression — Low compression may be experienced as a result of stuck rings. Stuck rings can be freed up with the use of a top engine cleaner. Refer to "Diesel Engine With Stuck Piston Rings".

• INSUFFICIENT FUEL

1. Cranking speed — If it cranks too slowly, high injection pressures will not be reached.

ENGINE OIL CONDITIONS TROUBLESHOOTING

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive oil loss.	A. External oil leaks.	1. Tighten bolts and/or replace gaskets and seals as necessary.
	B. Improper reading of dipstick.	1. Check oil with car on a level surface and allow adequate drain down time.
	C. Improper oil viscosity.	1. Use recommended S.A.E. viscosity for prevailing temperatures.
	D. Continuous high speed driving and/or severe usage such as trailer hauling.	1. Continuous high speed operation and/or severe usage will normally cause decreased oil mileage.
	E. Crankcase ventilation.	1. Service as necessary.
	F. Valve guides and/or valve stem seals worn, or seals omitted.	1. Ream guides and install oversize service valves and/or new valve stem seals.
	G. Piston rings not seated, broken or worn.	1. Allow adequate time for rings to seat. 2. Replace broken or worn rings as necessary.
	H. Piston improperly installed or misfitted.	1. Replace piston or repair as necessary.

ENGINE OIL CONDITIONS TROUBLESHOOTING (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
Low oil pressure.	A. Slow idle speed.	1. Set idle speed to specs.
	B. Incorrect or malfunctioning oil pressure switch.	1. Replace with proper switch.
	C. Incorrect or malfunctioning oil pressure gage.	1. Replace with proper gage.
	D. Improper oil viscosity or diluted oil.	1. Install oil of proper viscosity for expected temperature. 2. Install new oil if diluted with moisture or unburned fuel mixtures.
	E. Oil pump worn or dirty.	1. Clean pump and replace worn parts as necessary.
	F. Plugged oil filter.	1. Replace filter and oil.
	G. Oil pickup screen loose or plugged.	1. Clean or replace screen as necessary.
	H. Hole in oil pickup tube.	1. Replace tube.
	I. Excessive bearing clearance.	1. Replace as necessary.
	J. Cracked, porous or plugged oil galleys.	1. Repair or replace block.
	K. Galley plugs missing or misinstalled.	1. Install plugs or repair as necessary.
	L. Excessive valve lifter to bore clearance caused by wear. Wear is in the upper end of the bore, and towards the center line of the engine.	1. Measure the lifter in 2 spots, where it contacts the bore parallel with the roller and 90° to the roller. 2. Wear in the area of .005-.008" can cause low oil pressure. The lifter should be replaced. 3. Measure the lifter bore in the block. Any wear not exceeding .003" should be satisfactory. If necessary to replace lifters, stone the sharp edges on the bearing shoulder area of the new lifters.

NOISE TROUBLESHOOTING

CONDITION	POSSIBLE CAUSE	CORRECTION
Valve train noise.	A. Low oil pressure.	1. Repair as necessary. (See diagnosis for low oil pressure.)
	B. Loose rocker arm shaft attachments.	1. Inspect and repair as necessary.
	C. Worn rocker arm and/or pushrod.	1. Replace as necessary.
	D. Broken valve spring.	1. Replace spring.
	E. Sticking valves.	1. Free valves.
	F. Lifters worn, dirty or defective.	1. Clean, inspect, test and replace as necessary.
	G. Camshaft worn or poor machining.	1. Replace camshaft
	H. Worn valve guides.	1. Repair as necessary.
Engine knocks on initial start up but only lasts a few seconds.	A. Fuel pump.	1. Replace pump.
	B. Improper oil viscosity.	1. Install proper oil viscosity for expected temperatures.
	C. Hydraulic lifter bleed down.	1. Clean, test and replace as necessary.
	D. Excessive crankshaft end clearance.	1. Replace crankshaft thrust bearing.
	E. Excessive main bearing clearance.	1. Replace worn parts.

NOISE TROUBLESHOOTING (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine knocks cold and continues for two to three minutes. Knock increases with torque.	A. Flywheel contacting splash shield.	1. Reposition splash shield.
	B. Loose or broken balancer or drive pulleys.	1. Tighten or replace as necessary.
	C. Overfueling.	1. With the engine off to assist in the diagnosis, retard the injection pump timing as far as the slot in the pump flange will allow. This will quiet down a combustion knock. If the knocking is not substantially reduced, the noise is most likely a mechanical problem.
	D. Improper timing.	1. Adjust pump timing.
	E. No fuel.	1. See Section 4, Fuel System.
	F. Air leak.	1. See Section 4, Fuel System.
	G. Excessive piston to bore clearance.	1. Replace piston.
	H. Bent connecting rod.	1. Replace bent connecting rod.

NOISE TROUBLESHOOTING (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine has heavy knock hot with torque applied.	A. Broken balancer or pulley hub.	1. Replace parts as necessary.
	B. Loose torque converter bolts.	1. Tighten bolts.
	C. Accessory belts too tight or nicked.	1. Replace and/or tension to specs as necessary.
	D. Exhaust system grounded.	1. Reposition as necessary.
	E. Flywheel cracked.	1. Replace flywheel.
	F. Excessive main bearing clearance.	1. Replace as necessary.
	G. Excessive rod bearing clearance.	1. Replace as necessary.
Engine has light knock hot in light load conditions.	A. Air leak.	1. See Section 4.
	B. Improper timing.	1. Check engine timing.
	C. Loose torque converter bolts.	1. Tighten bolts.
	D. Exhaust leak at manifold.	1. Tighten bolts and/or replace gasket.
	E. Excessive rod bearing clearance.	1. Replace bearings as necessary.

NOISE TROUBLESHOOTING (CONT'D)

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine knocks at idle hot.	A. Loose or worn drive belts.	1. Tension and/or replace as necessary.
	B. Compressor or generator bearing.	1. Replace as necessary.
	C. Fuel Pump.	1. Replace pump.
	D. Valve train.	1. Replace parts as necessary.
	E. Improper oil viscosity.	1. Install proper viscosity oil for expected temperature.
	F. Excessive piston pin clearance.	1. Replace as necessary.
	G. Connecting rod alignment.	1. Check and replace rods as necessary.
	H. Insufficient piston to bore clearance.	1. Hone and fit new piston.
	I. Loose crankshaft balancer.	1. Torque any or replace worn parts.

3. Charge Air System

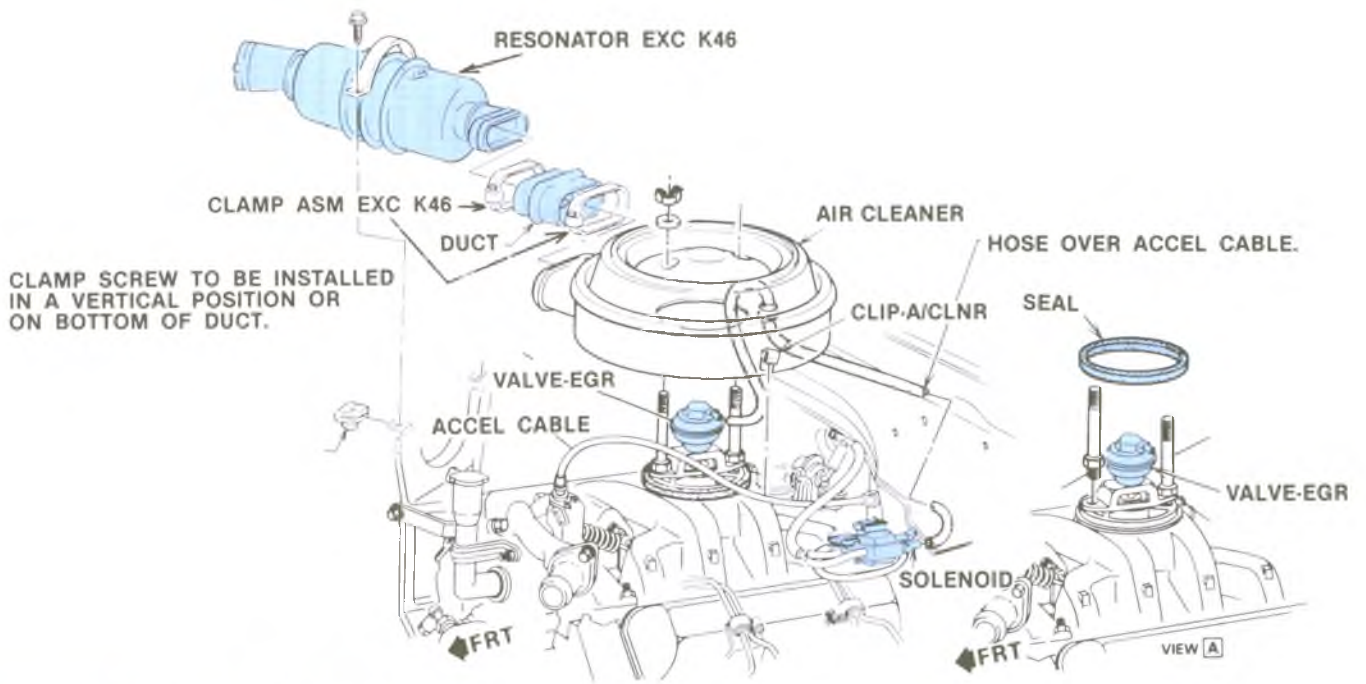


Figure 3-1, LH6 Air Intake System With EGR Valve

Air Flow To Combustion Chamber

Air moves without restriction through the air cleaner and intake manifold (Figure 3-1 and 3-2) to the combustion chamber. The chamber is filled with air, then the air is compressed to a temperature that will ignite the diesel fuel when it is injected.

The intake manifold provides a mount for the air cleaner and EGR valve. Since the intake "bridges" the injection pump, it must be removed when the injection pump requires removal.

The air cleaner assembly has a tuning chamber on the air inlet snorkel, called a resonator. It reduces air intake noise.

Figure 3-3 shows the available option K46 pre-cleaner chamber.

— NOTE —

Whenever the air cleaner assembly is removed, manifold cover J29664-1 should be installed. Manifold covers J29664-2 should be installed when the intake manifold is removed.

Figure 3-4 shows the air cleaner arrangement on the G-Van.

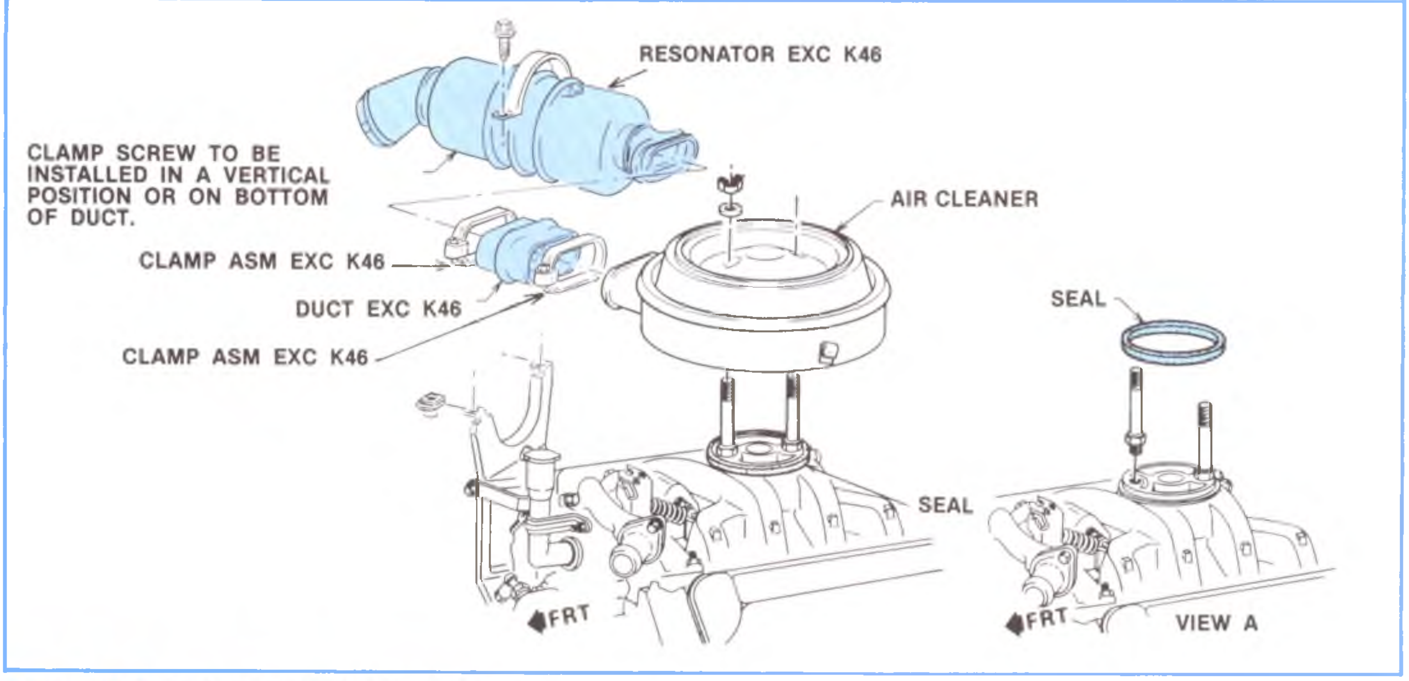


Figure 3-2. LL4 Air Intake System.

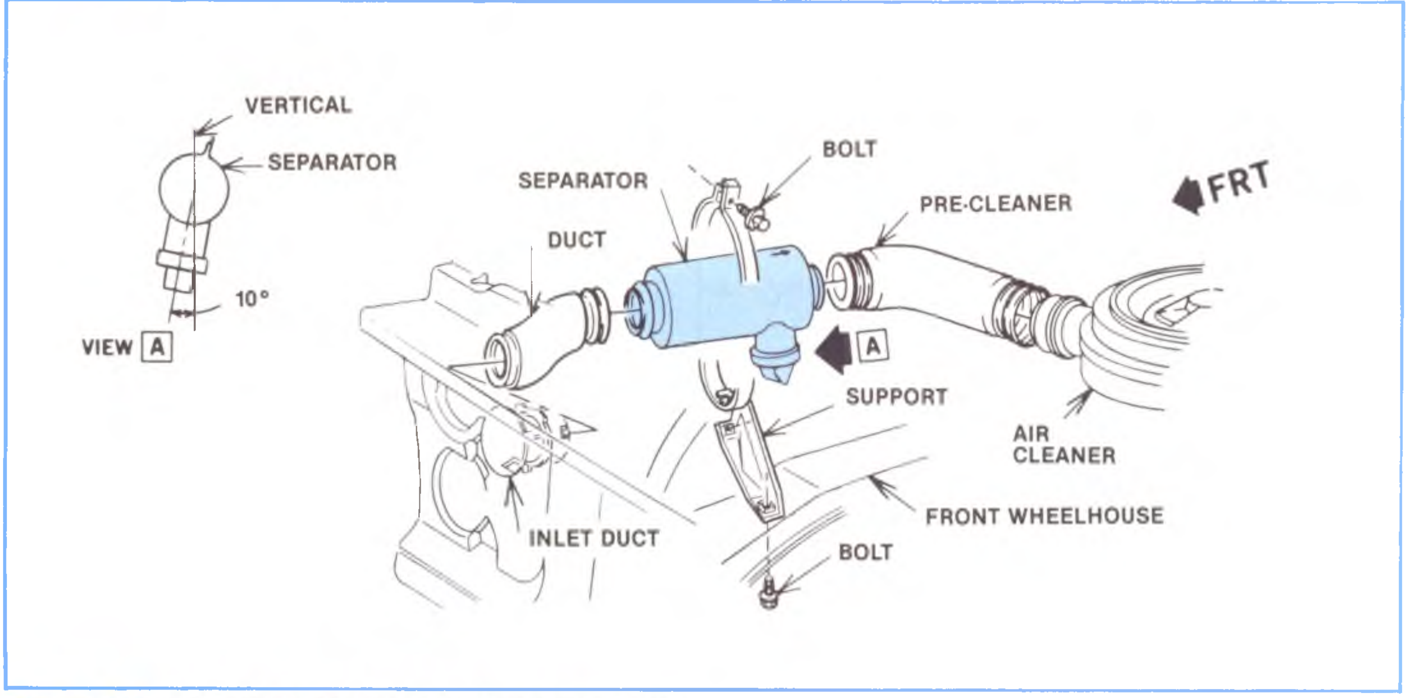


Figure 3-3. RPO K46 Air Pre-Cleaner Chamber.

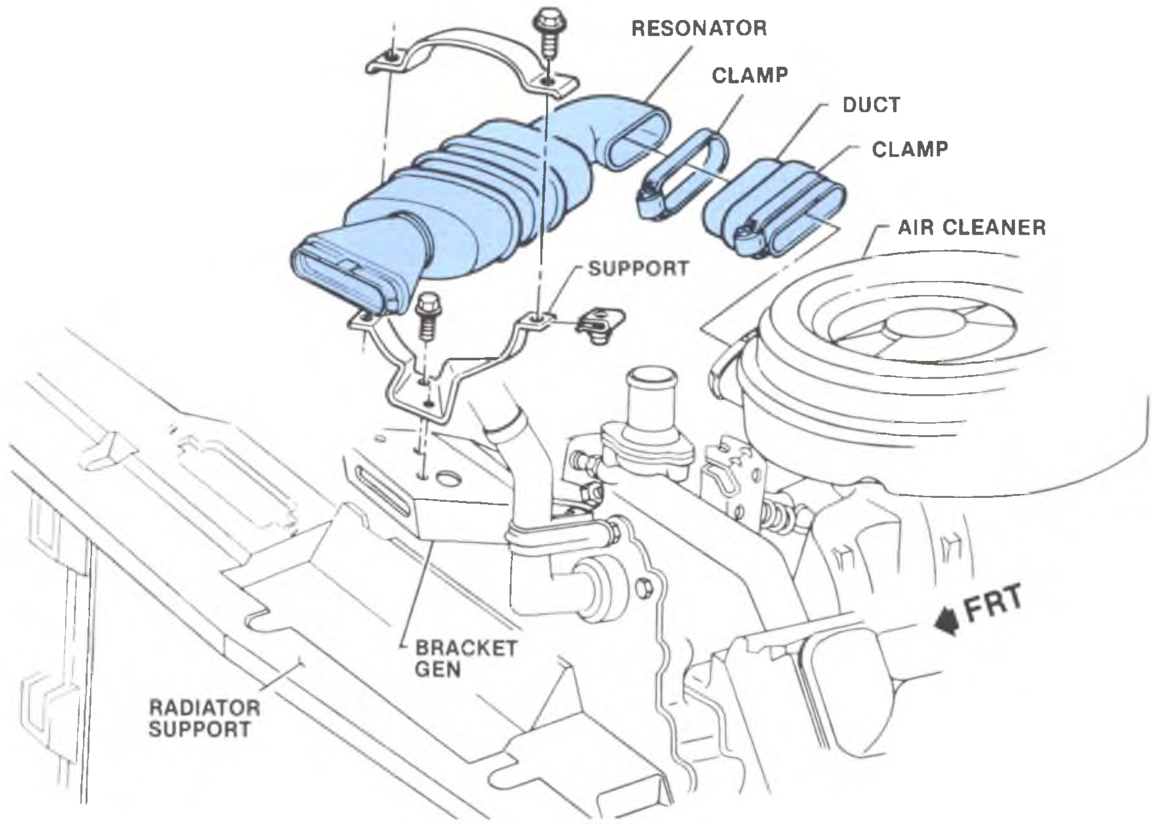


Figure 3-4, G-Van Air Cleaner LH6/LL4.

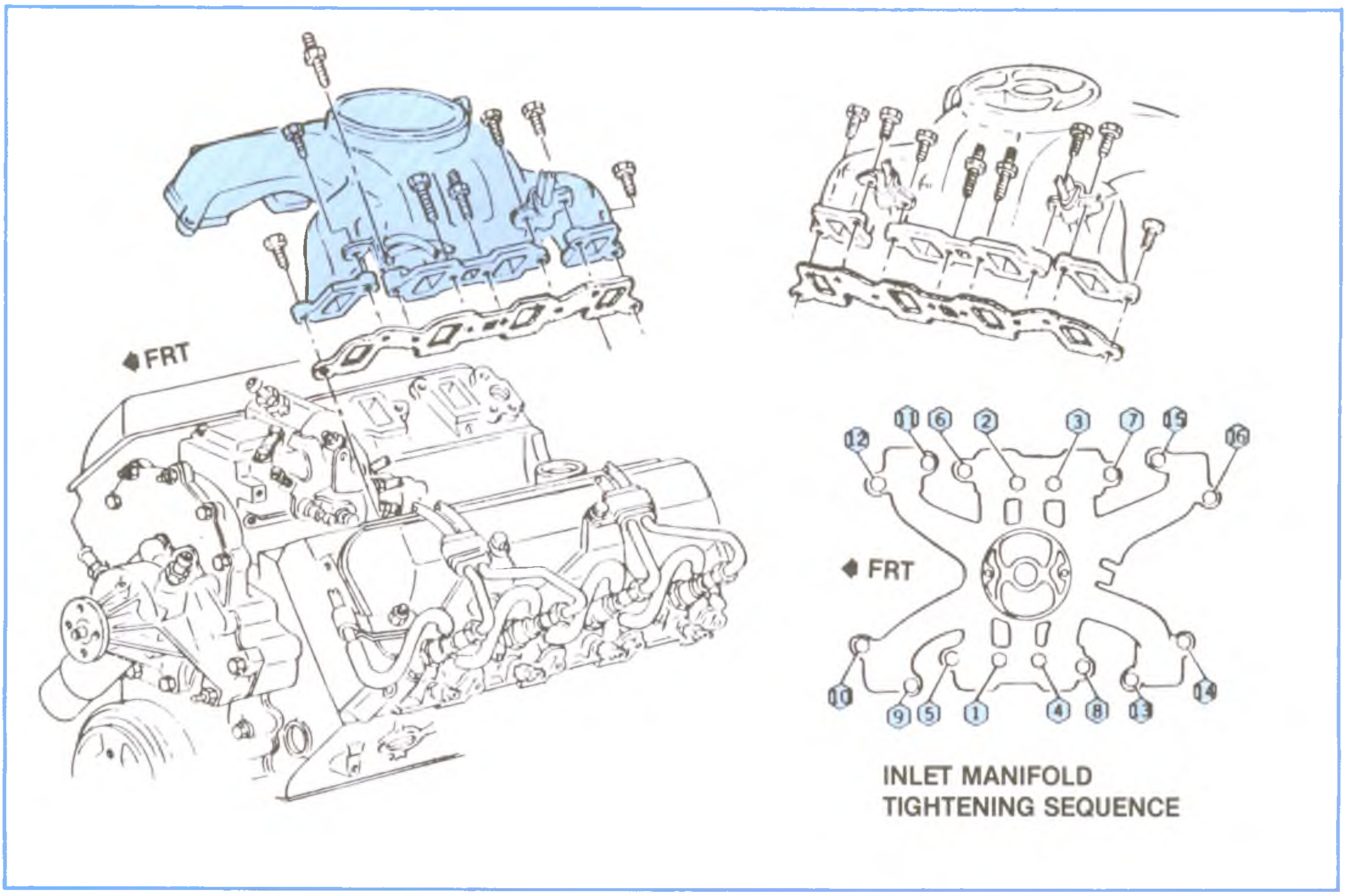


Figure 3-5, 6.2L Intake Manifold.

INTAKE MANIFOLD

See Figure 3-5. A combination intake manifold and cross over is used. It is a splider air plenum type which allows it to be completely separated from the coolant system. This permits removing the intake manifold without disturbing the coolant system.

The intake manifold is symmetrical, meaning it is proportionally the same, either from the front or the rear, so it is possible to install the intake manifold backwards. The engine would run, however the mounting boss for the secondary fuel filter would be in the wrong location for filter installation. The secondary fuel filter is at the rear of the intake manifold at the cowl.

This manifold is free standing and doesn't see any oil splash or heat from the crankcase. Also it contains no coolant passages. This feature adds 5 to 10 lb. ft. of torque to the performance.

PRE-COMBUSTION CHAMBERS

See Figure 3-6. A design feature is the Ricardo Comet V pre-combustion chamber which has a spherical chamber which mixes the air and fuel by air swirl. This assists in promoting high turbulence. This is an ante-or divided combustion chamber, having the major chamber in the cylinder head and only a small space between the piston and the cylinder head. Close piston clearance produces high turbulence in the ante chamber and promotes rapid combustion. The charge is forced out of the throat area, agitating the entire mixture and resulting in more complete combustion. This design has a broad speed operating range. It also provides low noise and effective emission control. The pre-chamber is installed in the cylinder head flush to +.050mm (.002 in.).

See Figure 3-7. The 1982-1984 LH6 and LL4 pre-chamber was cast from nichol base (nimonic 80 alloy) stainless steel and is nonmagnetic and marked M, N, P. The late 1984 and 1985 LH6 pre-chamber is cast from iron base high carbon alloy and is magnetic and marked W, X, Y on the outer area.

The 1985 LL4 pre-chamber is a reversed throat type, with a different locating notch.

The pre-chamber is pressed into the cylinder head. Orientation is provided by a locating tab on the pre-chamber and a mating slot in the cylinder head. Figure 3-7 provides a detailed view of the pre-chamber.

BROKEN GLOW PLUG TIP

A burned out glow plug tip may bulge then break off and drop into the pre-chamber when the glow plug is removed. When this occurs the nozzle should be removed, and the broken tip removed through the nozzle hole. In some cases, it may be necessary to remove the cylinder head.

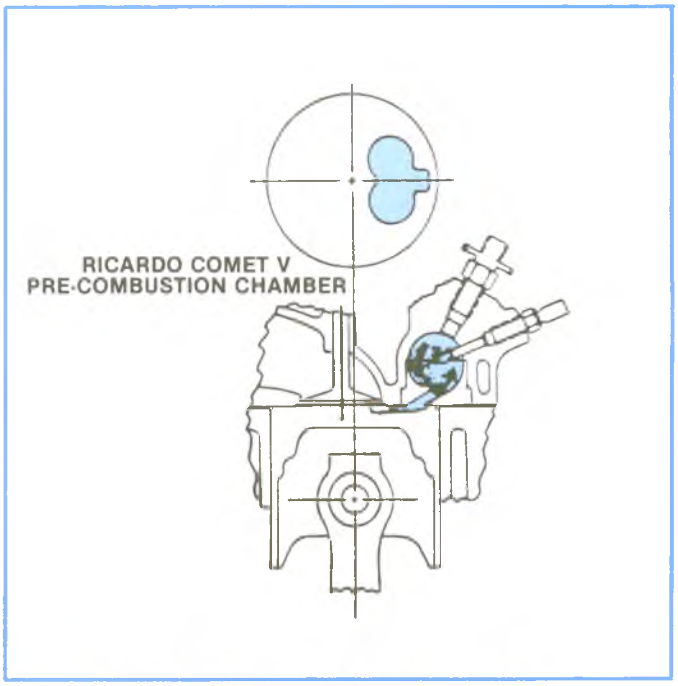


Figure 3-6, **Pre-Combustion Chamber.**

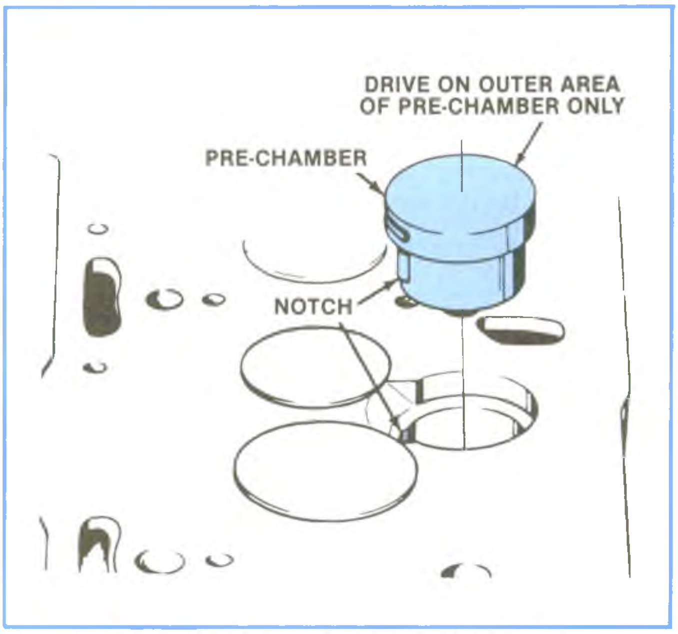


Figure 3-7, **Pre-Chamber Installation in Cylinder Head.**

PRE-CHAMBER CRACKS

During the service of 6.2L diesel cylinder heads, the observance of hairline cracks may be noted in the pre-chamber area.

Cracks on the face of the pre-chamber start at the edge of the fire slot. From the edge, the cracks proceed toward the circular impression of the head gasket bead.

These cracks are a form of stress relief and are completely harmless up to a length of 5mm (3/16″). Cracks longer than this are approaching the head gasket sealing bead and should be replaced with the proper part number.

See Figure 3-8. This illustration of a pre-chamber displays both acceptable and nonacceptable cracks.

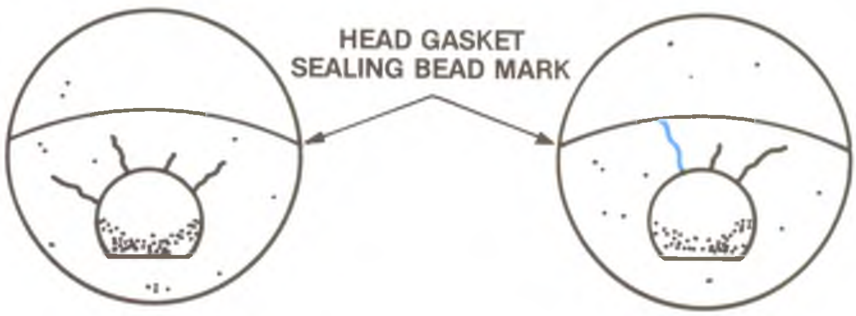


Figure 3-8, **Pre-Chamber Cracks.**

SERVICE PRE-CHAMBERS

Service pre-chambers are available for the 6.2L diesel engine. If replacement pre-chambers are required, the correct pre-chamber for the specific application should be procured per the following parts information:

Application	Standard	.010 Over-Size O.D.
1982 Light Duty LH6-Vin Code C	14067526	14069540
1982 Heavy Duty LL4-Vin Code J	14067527	14069541
1983-84 All 62L	14067526	14069540
1984-85 LH6-Vin Code C	23500082	
1985 LL4 Vin Code J Reverse Throat	23500250	

— NOTE —

Oversize pre-chambers are stamped "OS".

It should be noted that all 1983 and 1984 6.2L diesel engines, both light duty and heavy duty emission, use a common pre-chamber which is the same part number used in the 1982 light duty application.

EGR VALVE

Build up of soot (carbon) or contamination of the air filter element is a result of exhaust gases emitted from the EGR valve.

During normal operation of the EGR valve, some soot will occur in the intake manifold below the EGR valve. A soot deposit will also occur on the inner surface of the air cleaner element and housing. This is normal. The air filter element air flow will not be affected, and should last the specified change interval.

Should soot build-up be excessive, and/or evidence of filter deterioration occurring, the following may have occurred:

1. Malfunction of the EGR system (evidenced by excessive black exhaust).
2. Malfunction or setting of the TPS (throttle position switch). Refer to Section 4B.
3. Mode of vehicle operation. If the vehicle is idled for long periods, or long downhill operation with closed throttle, the build-up may be excessive.

To direct the EGR exhaust gas directly into the intake manifold, a baffle, P/N 25042774, has been released for service. The installation of this baffle will prevent the sooting of the filter element. Malfunctions or improper settings of the EGR/TPS system will still cause excessive black smoke and poor performance. Conditions in these areas should be corrected promptly.

To install this baffle, refer to Figure 3-9 below and use the following steps:

1. Remove air filter housing from engine. (Disconnect EGR hose at EGR valve and at solenoid.
2. Clean housing and cover.
3. Inspect air cleaner gasket on manifold. If it is torn or missing, install a new gasket.
4. Install air cleaner housing.
5. Replace element if required.
6. Install baffle and element. Assure proper seating of both. (Attach vacuum hose to EGR valve and solenoid.)
7. Install cover and tighten wing nuts.

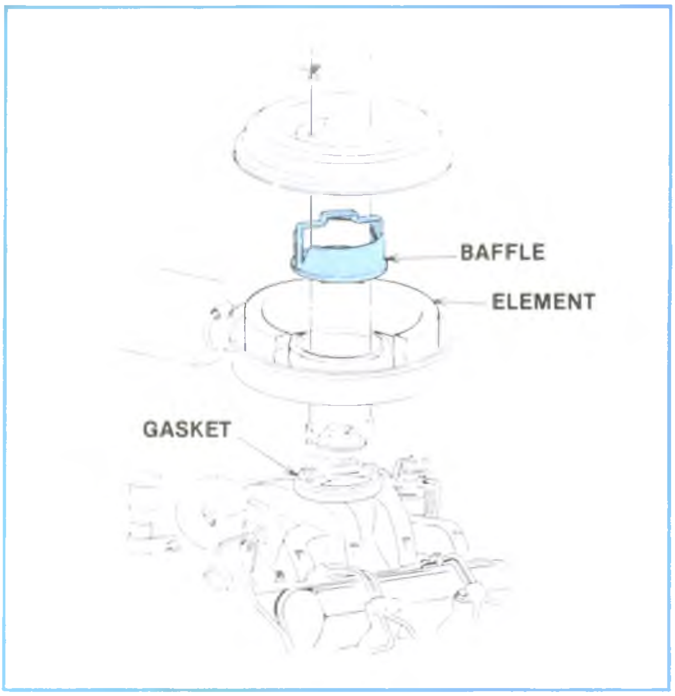


Figure 3-9, **Baffle.**

NOTES

4. Fuel System

4A. Low Pressure Fuel Delivery System
4B. High Pressure Fuel Delivery System

Fuel System Components

The diesel fuel system (see Figure 4-1) consists of the following components:

- Low Pressure: Fuel tank, fuel (lift) pump, fuel filter or filters, fuel lines.

A. Low Pressure Fuel Delivery System.
The system consists of:

- Tank filter sock.
- Mechanical lift pump.
- 1982-83 Primary fuel filter.
- Fuel Line Heater.
- 1982-83 Secondary fuel filter.
- 1983 G-P Truck Secondary fuel filter.
- 1984 Model 80 fuel filter (1984).

B. High Pressure Fuel Delivery System.
The system consists of:

- Fuel injection pump.
- High pressure lines.
- Nozzles.

Fuel is pulled from the fuel tank by the Mechanical pump which is located on the right side of the engine. It is driven by an eccentric lobe on the camshaft through a push rod. Fuel is pulled through the primary filter (1982-83 only), by the Mechanical pump. Fuel is then pumped through the secondary or model 80 filter mounted on the inlet manifold. Both filters remove foreign material which could damage the injection pump or clog the injector nozzle. From the filter, the fuel is pumped to the injection pump.

Fuel Return System

A fuel return system routes excess fuel from the injection pump and leak-off type nozzles.

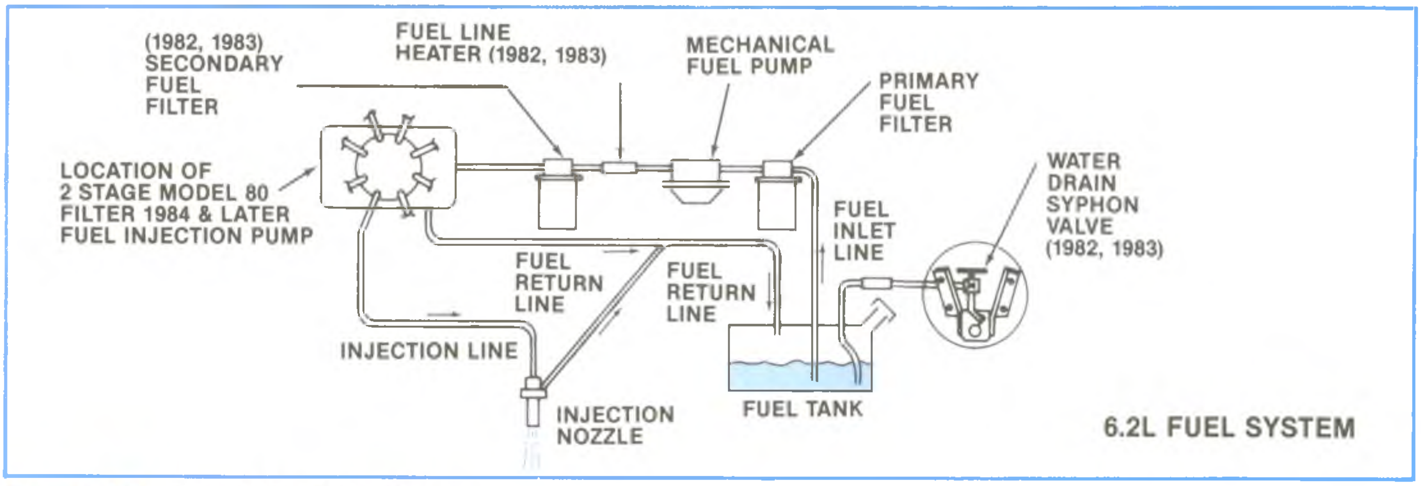


Figure 4-1, **Diesel Fuel System.**

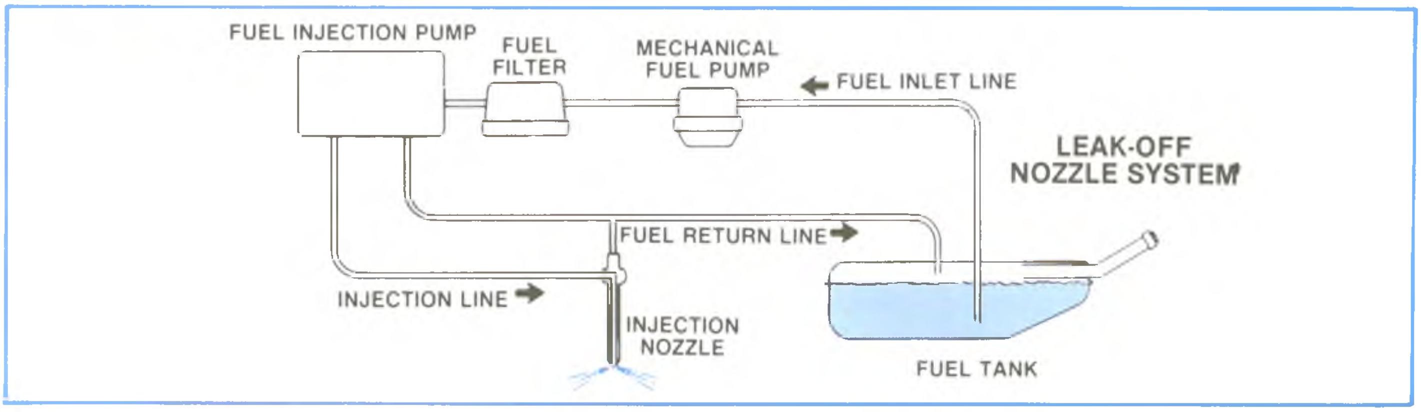


Figure 4-2, **Fuel Return Systems.**

Fuel Recommendations

General Motors Corporation recommends that owners of 1985 and subsequent Model Year diesel engine vehicles use Number 2-D diesel fuel above 20 °F (-7 °C) ambient temperature. If the ambient temperature is expected to be below 20 °F, Number 1-D diesel fuel is recommended. (Figure 4-3). A "winterized" blend of Number 2-D and Number 1-D fuels may be used if Number 1-D is unavailable.

General Motors will not recommend the use of Number 2-D diesel fuel below 20 °F unless it is "winterized". Temperatures below 20 °F will cause the "non-winterized" fuel to thicken which may keep the engine from running.

FUEL AND ENGINE OIL RECOMMENDATION

- FUEL TYPE — ABOVE 20 °F (-7 °C) USE NO. 2-D FUEL. BELOW 20 °F (-7 °C) USE NO. 1-D (OR WINTERIZED NO. 2-D) FUEL.
- OIL CHANGE INTERVAL AND OIL TYPE — EXTREMELY IMPORTANT
  - CHANGE OIL AND FILTER EVERY 5000 MILES (8000 km)
  - USE ONLY ENGINE OILS LABELED SF/CD (PREFERRED) OR SF/CC.
- OIL VISCOSITY — SELECT THE SAE GRADE OIL BASED ON THE EXPECTED TEMPERATURE RANGE BEFORE NEXT OIL CHANGE.
  - USE SAE 30 GRADE WHENEVER POSSIBLE.
  - DO NOT USE SAE 10W-40 GRADE OIL, OR ANY OTHER GRADE NOT RECOMMENDED.
  - USE SAE 10W-30 or 15W-40 FOR COLD OPERATION ONLY.

Figure 4-3, Fuel Recommendation On Visor.

The colder temperatures will cause number 2 diesel fuel to thicken or cause a wax build-up. This wax build-up could plug the fuel filter and keep the engine from running. However, if the car is towed in and sets in a warm garage, the wax will disappear. On no start complaints in cold weather, ask which grade of diesel fuel is in the tank.

For the best fuel economy, use Number 2-D fuel whenever temperatures will permit.

— NOTE —

Do not try to use home heating oil or gasoline in the diesel engine. Heating oil may cause engine damage. Gasoline may cause engine damage and may keep the engine from running.

— NOTE —

The fuel injection pump, injection nozzles or other parts of the fuel system and engine can be damaged if you use any fuel or fuel additive other than those specifically recommended by DDAD. To help avoid fuel system or engine damage, please heed the following:

- **Some service stations mix used engine oil with diesel fuel. Some manufacturers of large diesel engines allow this; however, for your diesel engine, DO NOT USE DIESEL FUEL WHICH HAS BEEN CONTAMINATED WITH ENGINE OILS. Besides causing engine damage, such fuel will also affect emission control. Before using ANY diesel fuel, check with the service station operator to see if the fuel has been mixed with engine oil.**
- **Do not use any fuel additive (other than as recommended under "Biocide" in this section). At the time this manual was printed, no other fuel additive was recommended.**
- **Take care to not run out of diesel fuel. If you do run out of fuel, you may need to crank the engine longer to re-start it after fuel has been added. To protect the cranking motor (starter), do not crank the engine for more than 10-15 seconds at a time. Allow a one minute cooling off period between crankings. This will allow the cranking motor to cool and any trapped air in the fuel system to bleed off. However, if air is TRAPPED in the system and the engine does not re-start after a total of 30 seconds of cranking air must be purged from the system. See "Fuel Exhaustion" information in this section.**

COLD WEATHER OPERATION (DIESEL ENGINES)

Diesel fuel is sensitive to temperature. All diesel fuel has a certain amount of heavy paraffin-like components, which are high in energy value and help improve fuel economy. But, when temperatures are less than about −7°C (20°F), these heavy paraffin components begin turning into wax flakes. If temperatures are low enough, these flakes can build up on the fuel tank filter or the engine fuel filter and stop fuel from reaching the engine.

At low temperatures, wax flakes are more likely to form in Number 2-D fuel than Number 1-D (or a "winterized" 2-D) fuel. For best operation at temperatures below −7°C (20°F) use Number 1-D, or Number 2-D which has been blended with Number 1-D for winter use.

If you are driving in temperatures less than −18°C (0°F) and do not have Number 1-D or "winterized" Number 2-D fuel in the fuel tank, kerosene can be added to reduce waxing. Kerosene should be added at a ratio of one gallon of kerosene to two gallons of diesel fuel. Because of the lower energy value of kerosene (and reduced fuel economy) it should be added only when anticipated temperatures are less than −18°C (0°F). Once kerosene has been added the engine should be run for several minutes to mix the fuel.

The addition of kerosene will not unplug a filter plugged with wax. Warming a "waxed" filter 0°C to 10°C (32°F to 50°F) will return the wax to solution. Filter replacement is not normally required.

To improve cold weather operation, an engine block heater and fuel heater are on your diesel engine. (See "Cold Weather Starting" under "Starting the Diesel Engine" in Section 1 of this manual for information on the block heater.) The fuel heater is designed to come on when the fuel temperature is less than 4°C (40°F). It warms the fuel and helps stop wax flakes from building up in the fuel filter.

Fuel Tank Components

FILLER CAP

The filler cap contains a 2-way check valve. This will allow air to escape during the day when the tank heats up. In the event of a rollover, the valve will prevent spillage. Under pressure, no greater than 2 psi will exist. The valve must also allow air to enter the tank to replace the fuel used by the engine. A vacuum of no more than about one inch of mercury can accumulate in the tank and a slight hissing sound when removing the cap is normal. The fuel system is calibrated with the cap in place and any alterations will effect performance. Diesel fuel tank caps are specific to Diesels. Gasoline tank caps may fit in the diesel tank filler neck but should not be used.

FUEL PICKUP AND SENDING UNIT

See Figure 4-4. The fuel pick up, commonly known as the "sock" has three functions:

1. Strain out large solids.
2. Act as a strainer to prevent entry of water.
3. Act as a wick to drain fuel down to the bottom of the tank since all pickup pipes do not reach the very bottom of the tank.

The tank filter is a Saran (Polyvinylidene Chloride) sock and is fastened to the fuel inlet line of the in-tank fuel filter and fuel pick-up assembly.

The fuel tank filter sock has a bypass valve which opens when the filter is covered with wax allowing fuel to flow to the fuel heater.

Without this sock fuel line heater would be ineffective because the fuel would be trapped in the tank. Since the bypass valve is located at the upper end of the sock, fuel will only be drawn into the waxed sock if the tank contains more than approximately 4 gallons of fuel. Therefore, it is important to maintain a minimum of 1/4 tank of fuel when temperatures are below 20 degrees F.

The Saran sock material has a nominal pore size of 130 microns. In addition to acting as a particle filter for the mechanical lift pump, the Saran tank filter acts as a wick to pick up fuel from the bottom of the tank and as a water filter; water is excluded on the basis of the difference in surface tension between the water and the sock material on the one hand and the fuel and the sock material on the other.

4A. Low Pressure Fuel Delivery System

By law in many states, water in fuel should be no more than 1/2 of 1%. That quantity of water will be absorbed by the fuel. Periodically, station operators check for water by putting a special gel on the dip stick. If it turns color, then water is present and it can be pumped out. Unfortunately, not all station operators are responsible and this prompted the use of the Saran sock.

The fuel pickup tube doesn't reach the bottom of the tank. However, since the sock acts as a "wick" the fuel level can actually be lower than the level of the tube and fuel will be drawn out right down to empty. Also, with this design, the level of water in the tank can be much higher before water enters the fuel system. This is about five gallons. Water that gets into the tank will eventually be absorbed by good fuel and will pass harmlessly through the fuel system. Water will be absorbed at a rate of about one gallon per 1000 miles.

— IMPORTANT —

The 6.2L diesel fuel tank sending unit is a 3-pipe assembly (main fuel, fuel syphon, and fuel return). The 4.3L V-6 and 5.7L diesel sending unit is a 2 pipe (main fuel and return). The gasoline fuel tank sending unit is a two pipe assembly (main fuel and canister). The canister pipe has a .055″ orifice in the end of the pipe. It is important that these two units not be interchanged. If the gas unit is installed on a diesel, it will cause intermittent problems with idle and power loss. If the diesel unit is installed on a gas car, the fuel vapors to the canister will be uncontrolled.

The ground wire on a diesel sending unit is a different color than on a gas unit for identification purposes. The tubes are also different sizes: main fuel 3/8 inch, gasoline fuel tank sending unit canister tube is 5/16 inch and the diesel sending unit return tube is 1/4 inch.

WATER IN FUEL WARNING SYSTEM

The 1982-83 units used a tank unit mounted water in fuel (W.I.F.) warning-system. It will detect the presence of water when it reaches the 1-2 gallon level. The water is detected by a capacitive probe. An electronic module provides a ground through a wire to a light in the instrument cluster that reads "water in fuel". The W.I.F. also contains a bulb check. When the ignition is turned on, the bulb will glow from two to five seconds and then fade away.

Owners with water in fuel lights have been instructed to drain the water from the tank if the light comes on immediately after filling. There could be enough water in the system to get into the fuel system and shut the engine down after driving for a short distance. If however it comes on during a cornering or braking maneuver, there is less than a gallon and a shut down will not occur, however, the water should be removed within one or two days. This system will not detect bacteria contained in the water. Figure 4-5 contains diagnostic information on the tank sending unit mounted W.I.F.

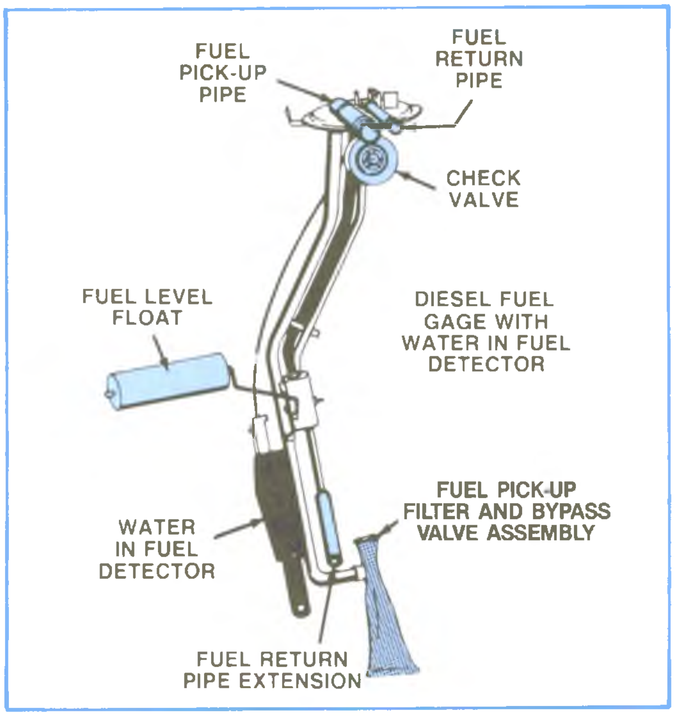


Figure 4-4, Fuel Pickup/Sending Unit With Water-in-Fuel Warning.

A check valve is provided at the upper end of the return pipe to allow fuel to return in the event that frozen water plugs the end of the pipe.

All vehicles using diesel engines have a sock with a bypass valve in the top end. This bypass valve is designed to open up in the event that high cloud point fuels are used in cold weather and the sock gets plugged with wax crystals. The fuel level should be kept at a 1/4 tank, to make sure you do not run out of fuel.

The W.I.F. detector can be serviced separately from the tank unit assembly when it requires replacement. It can be bench checked by using the test setup shown in Figure 4-6.

The module in the detector probe must remain submerged in water for approximately a 15 to 20 second delay period. The indicator lamp will then come on and stay on until the 12V signal is removed. This feature will accommodate large amounts of water.

In 1983, the water in fuel sensitivity was increased to trigger at 1 to 3 liters (.26 to .80 gals.). The time delay was changed from 15-20 seconds to 3-6 seconds.

WATER IN FUEL DETECTOR DIAGNOSIS

OPERATION

The Diesel "Water in Fuel" system uses an electronic water detector mounted inside the fuel tank on the fuel gage sender. The detector will warn the driver when 1 - 2½ gallons of water are present in the fuel tank by lighting a "Water in Fuel" light on the instrument panel. The light will also come on for 2-5 seconds each time the ignition is turned on. This bulb check assures the driver the light is working.

When water is detected it can be drained through the fuel return line without removing the fuel tank.

*TORONADO HAS A 3 WIRE CONNECTOR.

WATER IN FUEL LIGHT ON AT ALL TIMES

With ignition on disconnect 2 wire (yel/blk-pink) connector* at rear of fuel tank and check water in fuel light.

- **LIGHT ON** → Locate and repair short to ground in yel/blk wire from 2 wire connector to IP water in fuel lamp.
- **LIGHT OFF** → Purge fuel tank per purging instructions. Connect 2 wire connector* and check water in fuel light.
  - **LIGHT ON** → Remove tank unit. Check wires for short circuits. If OK, replace detector.
  - **LIGHT OFF** → Normal – fuel had water in it.

WATER IN FUEL LIGHT DOES NOT COME ON DURING BULB CHECK

With ignition on disconnect 2 wire (yel/blk-pink) connector* at rear of fuel tank and ground the yel/blk wire in the body harness. Check water in fuel light.

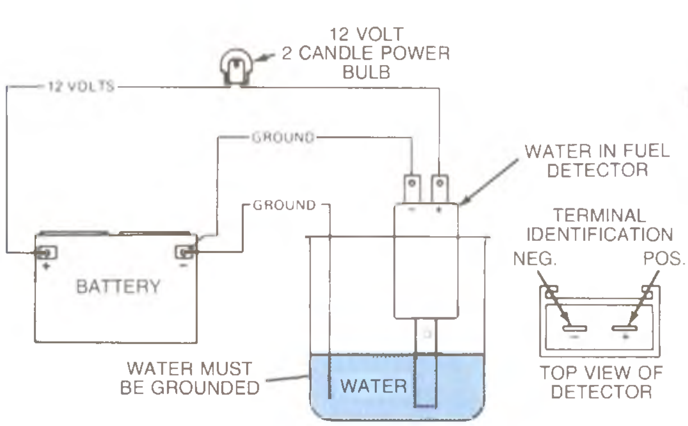
- **LIGHT ON** → Remove fuel gage tank unit and check yel/blk wire for opens. Check connections to water in fuel detector and mounting screw-must be tight. If OK, replace water in fuel detector.
- **LIGHT OFF** → Check water in fuel bulb. If OK, check for open circuit in yel/blk wire from 2 wire connector at rear of tank to IP water in fuel lamp socket.

FUEL TANK PURGE PROCEDURE

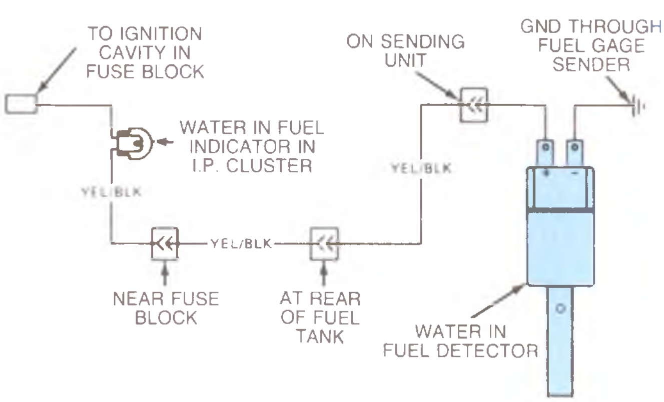
Cars which have a "Water in Fuel" light may have the water removed from the fuel tank with a pump or by siphoning. The pump or siphon hose should be hooked up to the 1/4 inch fuel return hose (smaller of the two fuel hoses) above the rear axle or under the hood near the fuel pump. Siphoning should continue until all water is removed from the fuel tank. Use a clear plastic line or observe filter bowl on draining equipment to determine when clear fuel begins to flow. Be sure to remove the cap on fuel tank while using this purge procedure. Replace the cap when finished. The same precautions for handling gasoline should be observed when purging diesel fuel tanks.

TESTING WATER IN FUEL DETECTOR

Connect water in fuel detector as shown using a 12 V 2 C.P. bulb. There must be a ground circuit to the water for the detector to work. The light will turn on for 2-5 seconds then dim out. It will then turn back on (after 15-20 second delay) when about 3/8" of the detector probe is in the water. Refer to illustration for test set-up.



TEST SET-UP



WATER IN FUEL DETECTOR CIRCUIT

Figure 4-5, Water In Fuel Detector Diagnosis: 1982-1983.

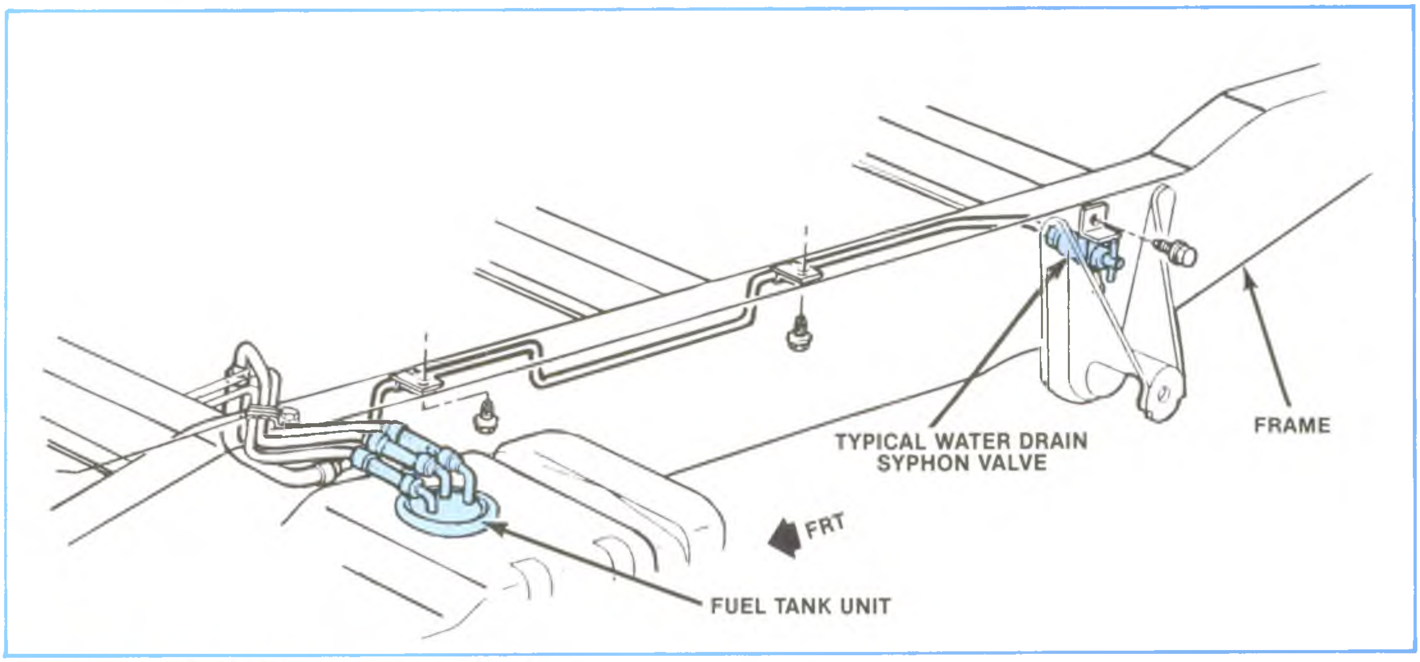


Figure 4-6, **Typical Fuel Syphon Valve.**

1982-1983 Water Drain Syphon Valve (Figure 4-5)

A siphoning system starting at the tank and going to the rear spring hanger, (on some models) and at the midway point of the right frame rail on other models, permits the user to attach a hose at the shut-off and siphon out the water.

— NOTE —

This system was deleted after 1983.

Diesel Fuel Contamination

Various malfunctions in diesel engines often lead to injection pump replacement. Before replacing the injection pump, determine if water or an excessive amount of gasoline is the cause of the malfunction. If water or gasoline is found to be the cause of the malfunction, injection pump and injection nozzle replacement may not be necessary. The following procedure should help to eliminate unnecessary pump and nozzle replacement in the event of fuel contamination.

- First, remove the engine fuel filter and inspect the contents for the presence of water or gasoline. If water or gasoline is found, flush the system as outlined on the following page.
- Fuel contamination should be expected if the car stalls, performance is poor or in the case of gasoline, the engine will knock loudly.
- If gasoline is suspected, remove the fuel fill cap and check for the presence of gasoline fumes.
- Gasoline will not harm the injection system. Flush the gasoline out of the system as outlined. Do not remove any injection equipment unless engine operation is unsatisfactory after the system has been flushed.
- For water, remove the engine fuel filter and inspect the contents for the presence of water. If water is found, remove the injection pump cover. If the pump is full of water, flush as outlined on the next page.
- Small quantities of surface rust in the injection pump will not create a problem. If the vehicle stalls as a result of contamination, remove the metering valve and polish it lightly with 600 grit paper to remove the contaminant. If the advance piston is stuck as evident by poor performance, smoke or noise, it may be necessary to remove the pump to free it up.
- Occasionally contamination may enter the system that becomes so severe that physical damage has occurred to the springs and linkage in the pump. These pumps that require part replacement should be returned to a Stanadyne shop for repair.

BIOCIDES

In warm or humid weather, fungi and/or bacteria may form in diesel fuel if there is water in the fuel. Fungi or bacteria can cause fuel system damage by plugging the fuel lines, fuel filters or injection nozzles. They can also cause fuel system corrosion.

If fungi or bacteria have caused your fuel system problems, have your authorized dealer correct these problems. Then, use a diesel fuel biocide to sterilize the fuel system (follow the biocide manufacturer's instructions). Biocides are available from your dealer, service stations, parts stores and other such places. See your authorized dealer for advice on using biocides in your area, and for recommendations on which biocides to use.

DIESEL FUEL QUALITY TEST

The diesel fuel hydrometer J34352 can be used to measure specific gravity of fuel at a nominal temperature (75°F to 95°F). Fuel specific gravity is an indication of the cetane number, and thus, the quality of a fuel. A poor quality fuel can impair diesel engine performance. The following procedure outline how to measure diesel fuel quality:

1. Fill a clean container ¾ full of diesel fuel.
2. Fill the glass hydrometer container with fuel until the hydrometer floats.
3. Gently spin the tool to break the surface tension.
4. Read the scale where the fuel level contacts the hydrometer float.

Scale Code	Approx. Cetane Range	Possible Fuel Quality
Green	46-50 plus	High quality fuel
Yellow	41-45	Medium quality fuel
Red	38-40	Low quality fuel

— NOTE —

The glass hydrometer, including float portion, is very delicate, thus extreme care must be utilized when using this tool.

— NOTE —

You should remove the fuel tank for cleaning when water is detected, because of the current understanding that a small amount of water or slurry is potentially damaging to the fuel system. The syphon does not remove it all.

Diesel Fuel System Cleaning Procedure

— CAUTION —

Never drain or store diesel fuel in an open container due to possibility of fire or explosion.

CLEANING PROCEDURE: WATER IN FUEL SYSTEM

1. Drain the fuel tank.
2. Remove the tank gage unit.
3. Thoroughly clean the fuel tank. If the tank is rusted internally, it should be replaced. Clean or replace the fuel pickup filter and check valve assembly.
4. Re-install the fuel tank but leave the lines disconnected at fuel tank area (above the rear axle).
5. Disconnect the main fuel hose at the fuel pump. Using low air pressure, blow out line towards rear of vehicle. Disconnect the return fuel line at the injection pump, with low air pressure, blow out the line towards the rear of the vehicle.

— NOTE —

If rust is present in these pipes, they must be replaced.

6. Re-connect the main fuel and return line hoses at the tank. Fill the tank at least 1/4 full with clean diesel fuel. Re-install fuel tank cap.
7. Remove and discard the fuel filter.
8. Connect the fuel hose to the fuel pump.
9. Re-connect both battery cables.
10. Purge the fuel pump and pump to filter line by cranking the engine until clean fuel is pumped out, catching the fuel in a closed metal container.
11. Install a new fuel filter.
12. Install a hose from the fuel return line (from the injection pump) to a closed metal container with a capacity of at least two gallons.
13. If the engine temperature is above 125 degrees F (52 degrees C), activate the Injection Pump Housing Pressure Cold Advance (H.P.C.A.). This can be done by disconnecting the two lead connectors at the engine temperature switch (located at the rear of the right cylinder head), and bridging the connector with a jumper.

14. Crank the engine until clean fuel appears at the return line. Do not crank the engine for more than 30 seconds at one time. Repeat cranking if necessary with 3 minute intervals between crankings.
15. Remove the jumper from the engine temperature switch connector and reconnect the connector to the switch.
16. Crack open each high pressure line at the nozzles using two wrenches to prevent nozzle damage.
17. Disconnect the lead to the H.P.C.A. solenoid (on the injection pump).
18. Crank the engine until clean fuel appears at each nozzle. Do not crank for more than 30 seconds at one time. Repeat cranking if necessary, with 3 minute intervals between crankings.

CLEANING PROCEDURE: GASOLINE IN FUEL SYSTEM

1. Drain fuel tank and fill with diesel fuel.
2. Remove fuel line between fuel filter and injection pump.
3. Connect a short pipe and hose to the fuel filter outlet and run it to a closed metal container.
4. Crank the engine to purge gasoline out of the fuel pump and fuel filter. Do not crank engine more than 30 seconds with two minutes between cranking intervals.
5. Remove the short pipe and hose and install fuel line between fuel filter and injection pump.
6. Attempt to start engine. If it does not start, purge the injection pump.
7. Purge the injection pump and lines by cranking the engine with accelerator held to the floor, crank until the gasoline is purged and clear diesel fuel leaks out of the fittings. Tighten fittings. Limit cranking to 30 seconds with two minutes between cranking intervals.
8. Start engine and run at idle for 15 minutes.

— NOTE —

If gasoline is inadvertently pumped into the tank, there will be no damage to the fuel system or the engine. The engine will not run on gasoline. Gasoline has a feature called Octane which defined is the ability of the fuel to resist ignition under high temperatures. Gasoline is a fuel that has high Octane and it resists ignition under high heat, it will only ignite by a spark. Gasoline in the fuel at small percentages, 0-30%, will not be noticeable to the driver. At greater percentages the engine noise will become louder. Gasoline at any percentage will make the engine hard to start hot. In the summer time, this could be a cause of a hot start problem.

Fuel Lines and Lift Pump

Although the injection pump has capabilities to pull fuel from the tank, an engine mounted fuel pump is included in this system as an additional assist in the event of air in the lines such as running out of fuel, fuel line air leaks or air from occasional fuel tank service. (Figure 4-7).

The fuel pump's main job is to supply 5½ lbs. to 6½ lbs. of pressure through the fuel filter to the Injection pump.

Fuel is drawn from the fuel tank through the tank filter by the fuel pump. The fuel pump is driven by an eccentric on the crankshaft. The injection pump drive system uses the end of the camshaft where the fuel pump eccentric is usually located in a gasoline engine.

See figure 4-8. The diesel fuel pump is located on the right side of the engine between the fuel tank and fuel filter. The design of this pump is quite similar to the gasoline engine pump: however, the two components are not interchangeable.

All 1982 and later models will be equipped with GM SPEC. 6031 hoses which are made of "Viton" and contain a non-permeable tube inside.

The hoses will include a yellow stripe and the words "Fluro Elastomer" on the outside. Their purpose is to reduce emissions when hydro-carbons pass through the hose material.

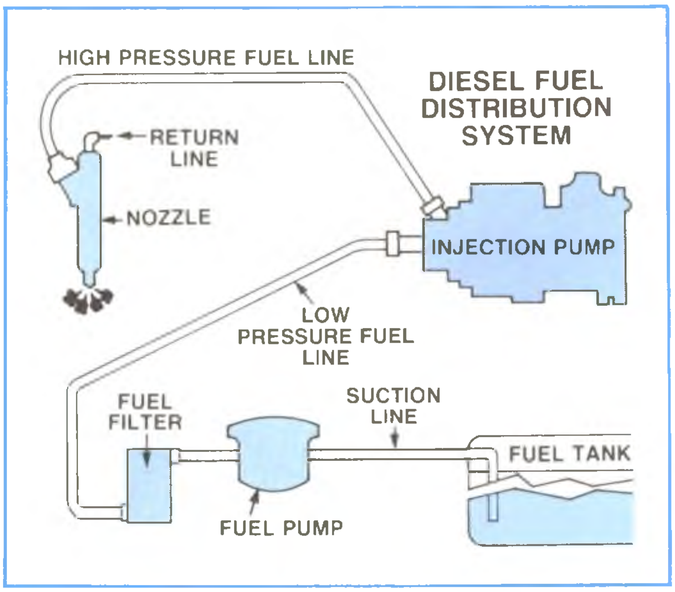


Figure 4-7, Mechanical Lift Pump and Fuel Lines.

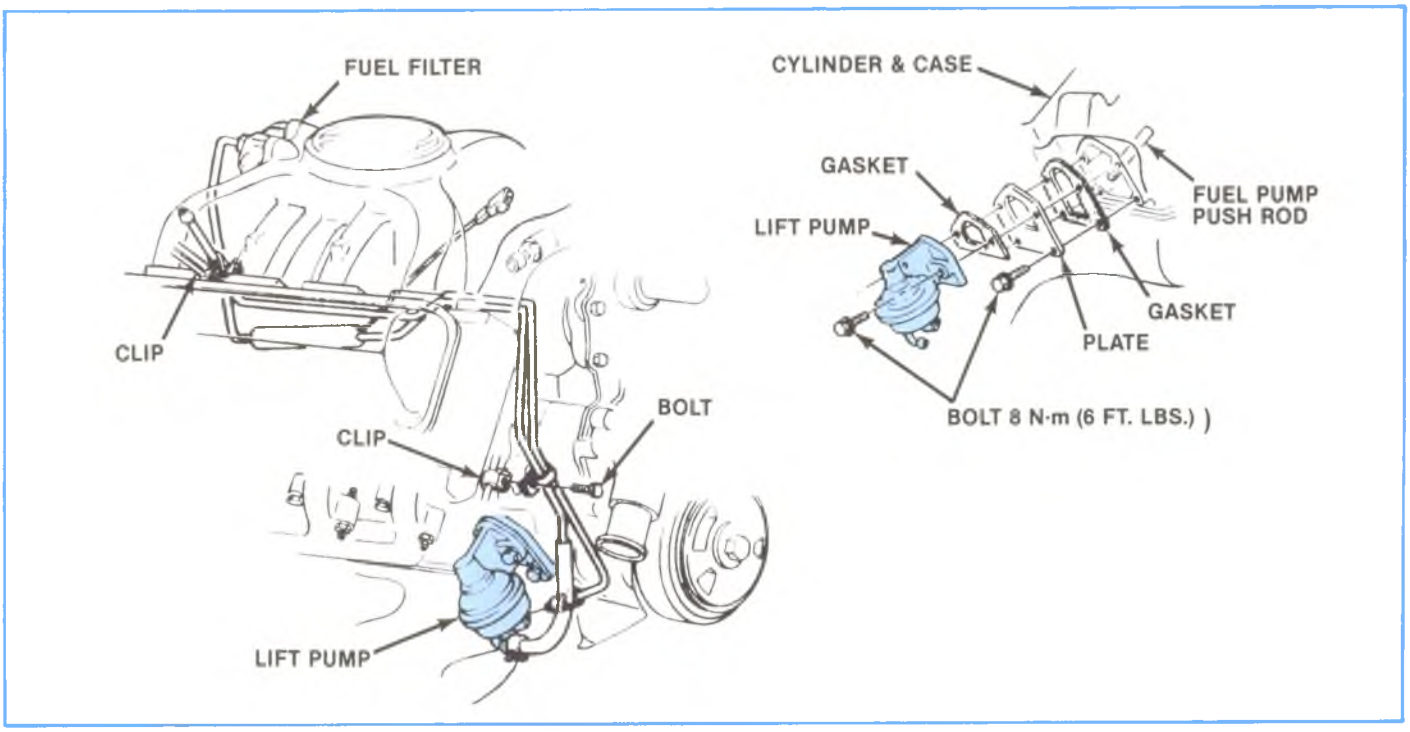


Figure 4-8, Mechanical Lift Pump Location.

Mechanical Fuel Pumps

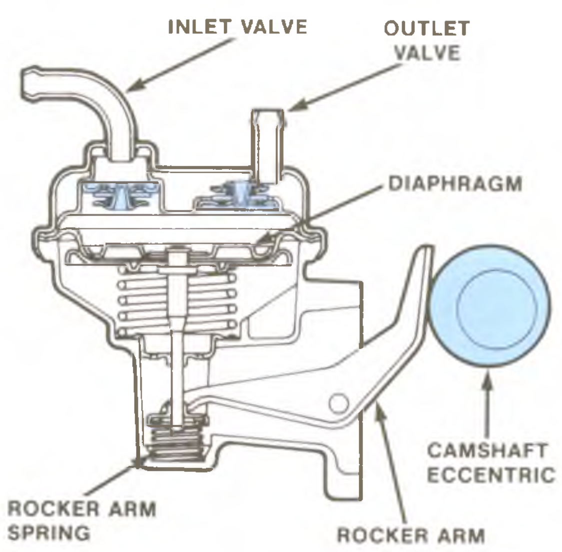


Figure 4-9, **Typical Mechanical Fuel Pump.**

How the Mechanical Fuel Pump Works

A mechanical fuel pump is mechanically actuated by a rocker arm or push rod without electrical assistance. Figure 4-9 shows a typical mechanical fuel pump.

The rocker arm spring holds the rocker arm in constant contact with the camshaft or eccentric.

As the end of the rocker arm moves upward, the other end of the arm pulls the fuel diaphragm downward. The vacuum action of the diaphragm enlarges the fuel chamber drawing fuel from the fuel tank through the inlet valve and into the fuel chamber.

The return stroke starting at the high point of the cam releases the compressed diaphragm spring, expelling fuel through the outlet valve.

When the immediate fuel needs of the engine are satisfied, pressure builds in the fuel line and pump chamber. This pressure forces the diaphragm/piston to make shorter and shorter strokes, until more fuel is needed in the engine.

Fuel Pump Service

Mechanical Fuel Pump Tests

PRELIMINARY INSPECTION

— NOTE —

Perform following tests or inspections before removing pump.

Step 1 Check fittings and connections to insure tightness. If insufficiently tight, leaks of air and/or fuel may occur.

Step 2 Check for fuel line bends or kinks in hoses.

Step 3 With engine idling look for:

a. Leaks at pressure (outlet) side of the pump.

b. A leak on suction (inlet) side will reduce the volume of fuel on the pressure side of the pump and suck in air.

c. Also check for leaks at diaphragm, flange, and at breather holes in pump casting.

d. Check fuel pump steel cover and its fittings for leaks. Tighten or replace fittings as necessary. If fuel pump leaks (diaphragm, flange, steel cover, or pump casting breathing holes), replace pump.

FUEL FLOW TEST

Step 1 Disconnect fuel line at the filter inlet.

Step 2 Disconnect pink wire at the fuel injection pump electric shut-off (ESO) solenoid.

Place a suitable container at end of pipe and crank engine a few revolutions (Figure 4-10). If little or no fuel flows from open end of pipe, then fuel pipe is clogged or pump is inoperative.

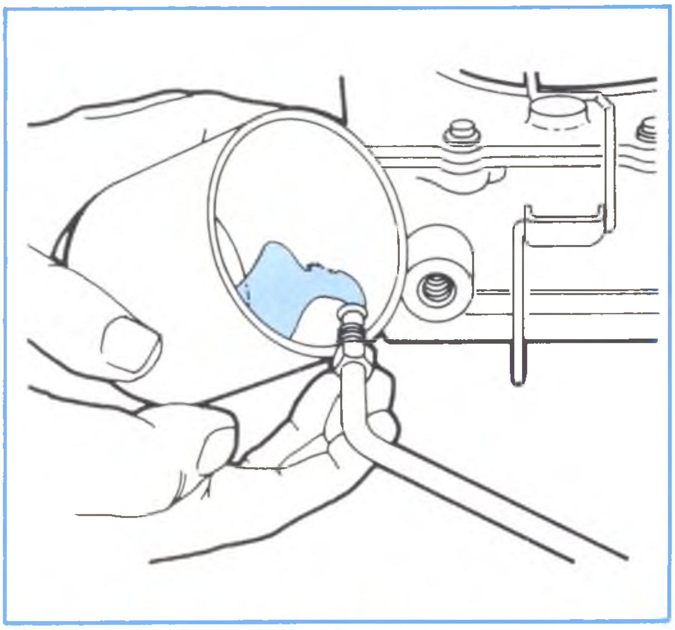


Figure 4-10, **Fuel Flow Test.**

Step 3 Before removing fuel pump, disconnect fuel line at tank and blow through it with air hose. Do not blow through fuel line without disconnecting it becasue it is possible to blow strainer off tank unit or to rupture it. Then reconnect fuel lines to pump and tank. Also, reconnect fuel lines at filter. Start engine and check for leaks.

If fuel flows in a good volume from pipe at filter 1 pint @ 30-45 seconds, fuel delivery pressure may be checked. This test is necessary because a weak pump can still produce an adequate volume of fuel when it is not under pressure. Fuel pressure should be in the 5.5 to 6.5 psi range.

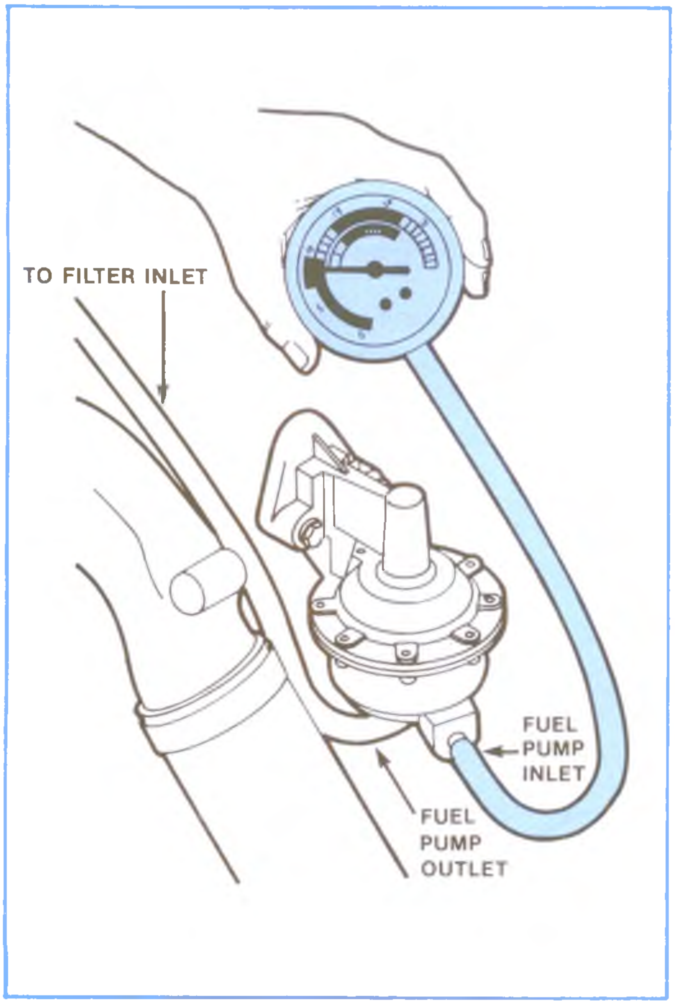


Figure 4-11, Fuel Pump Vacuum Test.

VACUUM TEST, FUEL PUMP INLET (DEAD HEAD)

Low vacuum or complete loss of vacuum provides insufficient fuel to the injection pump to operate the engine throughout normal speed range. The vacuum test will determine if the pump has the ability to pump fuel and is the best indication of the quality performance of the pump (Figure 4-11).

Step 1 Disconnect hose from fuel tank to fuel pump at fuel pump. Plug or position hose to insure no fuel leakage.

Step 2 Connect one end of a short hose to fuel pump inlet and attach a vacuum gage to the other end.

Step 3 Start engine. With engine idling (using fuel in the filter assembly), check vacuum gage. If vacuum is less than 12 inches Hg (2.98 kPa) replace fuel pump.

Avoiding Air Intake

An important function of all hoses, lines and fittings is to carry fuel with maximum absence of air.

When the fuel tank cap is in place and the injection pump and fuel pump are drawing fuel through the lines a low vacuum of 0-1 lb. mercury is created. This occurs because the fuel which the engine uses must be replaced by air. During this vacuum condition, the slightest leak, which may not leak fuel externally, could draw air into the system and depending on the volume of air, a wide variety of engine malfunctions are possible. These may show up as M.P.G. complaints, smoke complaints, performance complaints and hard starting or not starting conditions.

For example, suppose the inlet fitting was slightly loose at the engine fuel filter. This would probably have an external leak and be a complaint of fuel leak or smell of diesel fuel accompanied by a "starts but then dies and can't re-start" complaint. It is possible that when the engine is shut down the fuel could syphon out of the lines and fuel pump and back into the tank. It is then replaced by air which entered at the loose fitting. The fuel system is now empty and as a result the engine must be cranked until the lines are full again.

Diagnosing Air In Fuel Lines

Shop manual diagnosis charts should be referred to when diagnosing for air problems to determine the presence of air. First install a short clear plastic hose into the return line at the top of the injection pump (Figure 4-12). Start the engine and observe for air bubbles or foam in the line. If foam or bubbles are present, proceed as follows:

1. Raise vehicle and disconnect both fuel lines at the tank unit.
2. Plug the smaller disconnected return line.
3. Attach a low pressure (preferably hand operated pump) air pressure source to the larger 3/8 fuel hose and apply 8-12 P.S.I.
   a. Diagnosing trucks equipped with dual tanks will require a check of the right fuel lines with the dash switch in the right tank position and a check of the left fuel lines with the dash switch in the left tank position. The switching valve could be a source.
4. Observe the pressure pump reading of 8-10 P.S.I. A decrease in pressure will indicate the presence of a leak. The pressure will push fuel out at the leak point indicating the location of the leak.
5. Repair as necessary.

In checking for air problems, the proper size clamps on all hoses should be checked. Also, a burr on the edge of a pipe could rip the inside of a line and create air ingestion. Particular attention should be given to improper installation or defective auxiliary filters or water separators.

Since operation of the hydraulic advance mechanism is dependent on transfer pump pressure and pump housing pressure, any deviation from pre-set tolerances can affect the advance mechanism and therefore, the injection timing. Fuel pump delivery less than 5½ lbs. to 6½ lbs. pressure, for example, will reduce total advance directly proportional to pressure loss. Leaks, plugged filters, air ingestion restriced lines etc. will all reduce pressure delivery. Return line restriction can raise housing pressure to as high as transfer pump pressure depending on the degree of restriction and eventually stall the engine by upsetting the balance of transfer pump and housing pressures.

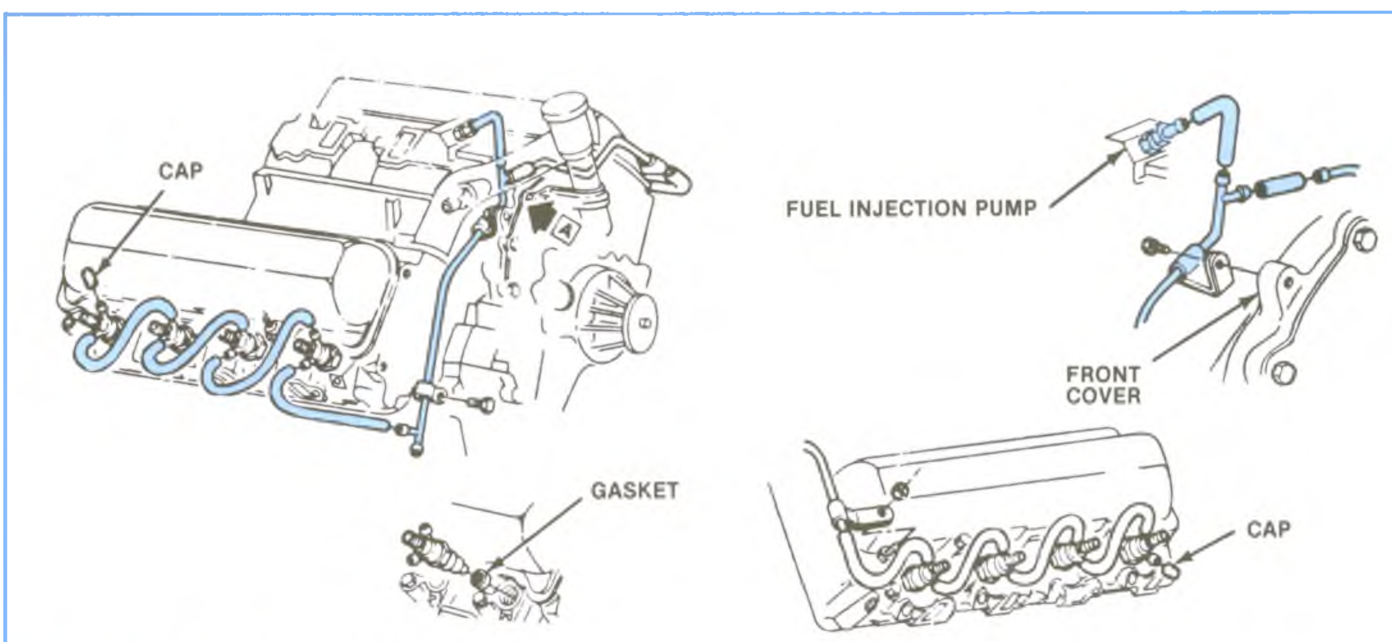


Figure 4-12, Fuel Return Lines.

1982-83 Primary Fuel Filter

The primary fuel filter is mounted on the bulkhead in the engine compartment. It is the same type of filter that is used on larger trucks. (Figure 4-13).

At the bottom of the filter, a water drain valve permits draining water that is caught by the filter. This filter is an AC fibrous depth element of the spin-on type. The filter case includes the drain petcock.

PRIMARY FUEL FILTER-WATER DRAIN

See Figure 4-13. If it should become necessary to drain water from the fuel tank, also check the primary fuel filter for water. This can be done as follows:

1. Open the petcock on the top of the primary filter housing.
2. Place a drain pan below the filter and open the petcock on the bottom of the drain assembly. (A length of hose is attached to the petcock to direct drained fluid below the frame.)
3. When all water is drained from the filter, close the petcock lightly.

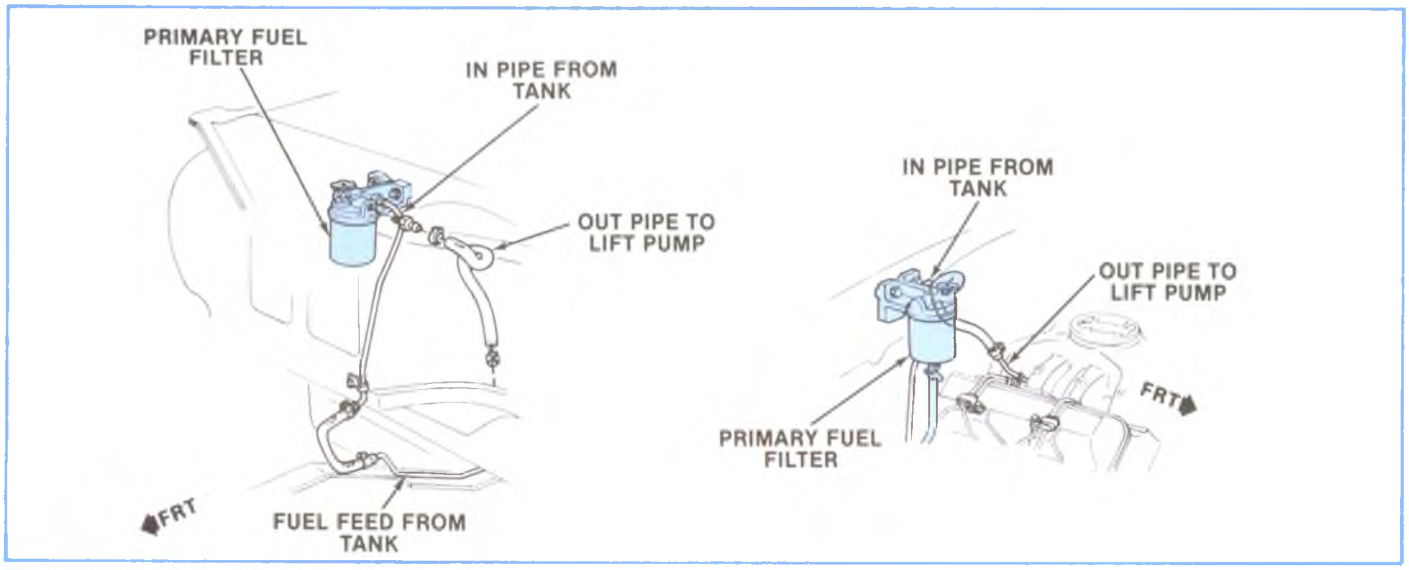


Figure 4-13, **Primary Fuel Filter.**

— NOTE —

If filter is completely drained, remove filter and refill with clean fuel to prevent engine stalling.

4. Close upper petcock tightly.
5. Start the engine and let it run briefly. The engine may run roughly for a short time until the air is purged from the system.
6. If engine continues to run roughly, check that both petcocks at the primary filter are closed tightly.

The primary filter was used in 1982-83 only.

Line Heater

A Diesel cold weather package is used. This package consists of an in-line diesel fuel heater and the engine block heater. (Figure 4-14).

The purpose of the heater is to heat the fuel so that the filter does not plug with paraffin wax crystals. This allows the use of more efficient #2 Diesel fuel at temperatures substantially below its cloud point.

The heater is electrically powered from the ignition circuit and is placed on the fuel filter inlet line a short distance up stream from the filter.

Following are some of the qualities designed into this system:

The heater is in-line, and in fact, a component of fuel pipe assembly between fuel lift pump and filter. It does not have any additional seals or joints that increase the possibility of fuel leaks.

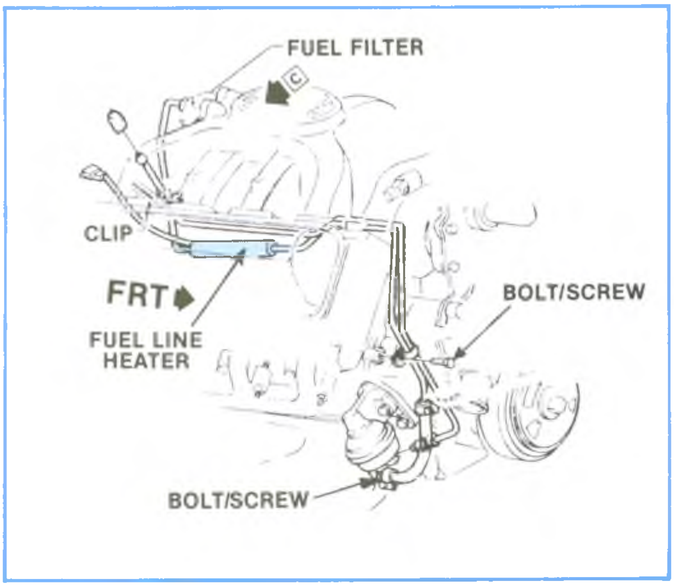


Figure 4-14, Fuel Line Heater Installation.

The heater is thermostatically controlled to work when waxing of the fuel is expected. Thermal feedback from the heating element to the bimetal actuator protects the element from burning out if for any reason fuel is not flowing through the fuel heater.

OPERATION

The device can be divided into two major functional components, the heater and the power control assemblies. (Figure 4-15).

The heater is 7/8 inches in diameter and approximately 5½ inches long and consists of an electric resistance strip spiral wound and bonded around the fuel pipe. To minimize the heat loss to the environment, heating element is surrounded by an insulating fiber.

The power control assembly senses fuel temperature and responds by closing an electrical circuit to the heater. The sensing element is a bimetal switch. The internal bimetal switch turns on at 20 degrees F. and shuts off at 50 degrees F. Power consumption is 100 watts. The heat will only be on until the under hood temperature gets hot enough to warm the fuel.

The fuel tank filter sock has a bypass valve which opens when the filter is covered with wax allowing fuel to flow to the heater. Without this bypass valve fuel line heater would be ineffective because the fuel would be trapped in the tank. Since the bypass valve is located at the upper end of the sock, fuel will only be drawn into the waxed sock if the tank contains more than approximately 4 gallons of fuel. Therefore it is important to maintain a minimum level of 1/4 tank of fuel when temperatures are below 20°F.

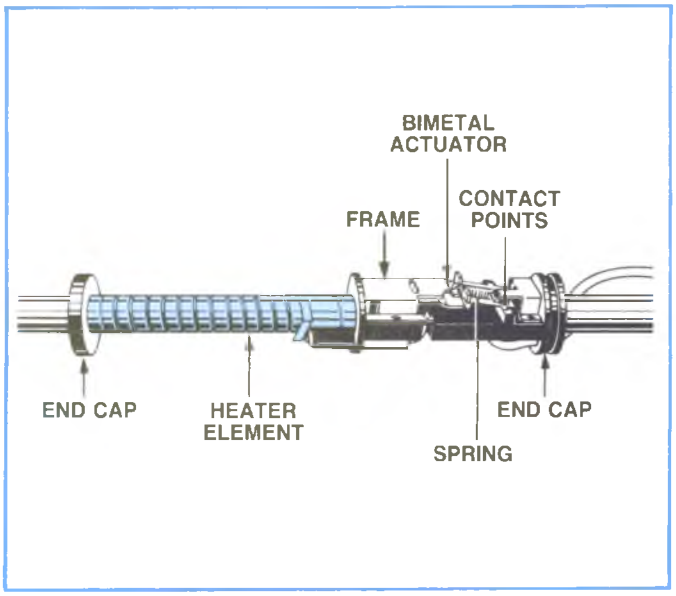


Figure 4-15, Diesel Fuel Heater Components.

HEATER SERVICEABILITY/DIAGNOSIS

The heater cannot be serviced. However, it can be checked by using an ammeter connected in series. Checking must take place below 20° ambient temperature. Proper operation will draw approximately 7 amps.

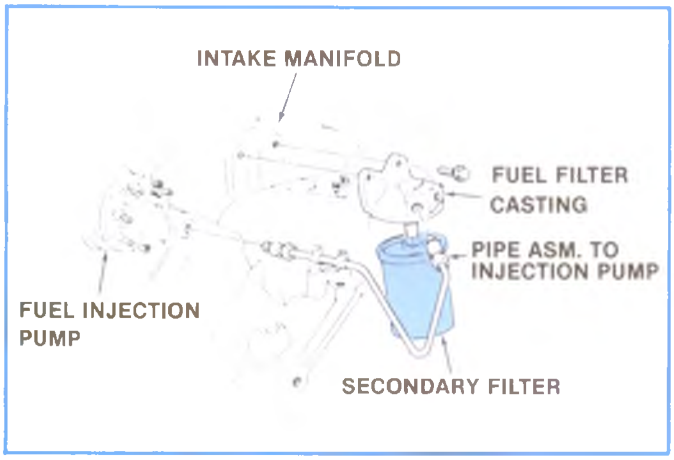


Figure 4-15a, Secondary Fuel Filter (C-K Series).

Secondary Fuel Filters

The 1982 C, K & P, and the 1983 C, K trucks use an intake manifold mounted secondary fuel filter, before the fuel enters the pump. This filter is an AC 10 micron paper replaceable element of the spin-on type. It is mounted to the rear of the intake manifold. See Figure 4-15.

SECONDARY FUEL FILTER C-K SERIES

REMOVAL:

1. Remove fuel filter lines from adapter.
2. Remove fuel filter.
3. Remove filter.

INSTALLATION:

1. Install filter to adapter, tighten 2/3 turn after contacting gasket.
2. Install adapter to intake manifold.
3. Install the fuel filter **inlet line only.**

Anytime the secondary filter is removed or replaced, air must be purged from the filter to prevent engine stalling or excessive cranking time to restart.

4. With the secondary fuel line disconnected, disconnect the pink electrical wire from the fuel injection pump to prevent the engine from starting.
5. Place an absorbent towel under the filter outlet.
6. Crank engine (for 10 seconds max.) until fuel is observed at the outlet port.
7. If fuel is not observed after 10 seconds, wait 15 seconds, repeat Step 6.
8. When fuel is observed at the outlet port, install the outlet line.
9. Reconnect pink wire at injection pump, and reinstall air cleaner.
10. Start engine and allow to idle for several minutes to purge remaining air.
11. Check all fittings and filter for leakage; remove absorbent towel.

1983 G-P TRUCK MODEL 75 FILTER

The G-P series uses a Stanadyne Model 75 secondary fuel filter in 1983. See Figure 4-16. It is fastened using two bail clips. It is particularly important to place absorbent towels under the filter when changing it to improve cylinder and case valley drain and prevent fuel oil contamination of the clutch driven disc.

The Model 75 filter is a two-stage pleated paper type filter. (Figure 4-16). The first stage consists of approximately 400 sq. inches of filtering area and will remove 94% of particles 10 microns and larger. The second stage is made of the same paper material and consists of approximately 200 sq. inches of filtering surface. The second stage is 98% effective in filtering the fuel already filtered by the first stage.

Particles which are larger than 10 microns may damage the pump's internal components. Figure 4-17 will compare various micron sizes and will ultimately show the filter's effectiveness.

1983 G-P TRUCK SECONDARY FUEL FILTER

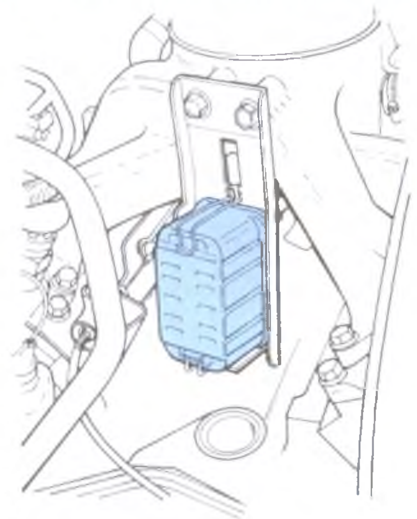


Figure 4-16, G-P Model 75 Secondary Fuel Filter.

SECONDARY FUEL FILTER G-P SERIES

REMOVAL:

1. Engine must be turned off.
2. Remove engine cover.
3. Remove air cleaner.
4. Place absorbent cloth or towel under filter.
5. Unstrap the lower bail first to relieve fuel pressure in the filter.
6. Unstrap the upper bail and remove filter.

INSTALLATION:

1. Insure that both filter mounting plate fittings are free of dirt.
2. Install new filter; snap on the **upper bail clamp only.**

   Anytime the secondary filter is removed or replaced, air must be purged from the filter to prevent engine stalling or excessive cranking time to restart.
3. Disconnect the pink electrical wire from the injection pump to prevent the engine from starting.
4. Crank engine (for 10 seconds max.) until fuel is observed at the lower filter fitting.
5. If fuel is not observed after 10 seconds, wait 15 seconds, repeat Step 4.
6. When fuel is observed at the lower fitting, connect the lower bail clamp.
7. Reconnect the pink wire on injection pump — and install air cleaner.
8. Start engine and allow to idle for several minutes to purge remaining air, — check for fuel leaks.
9. Remove absorbent towel from filter area — reinstall engine cover.

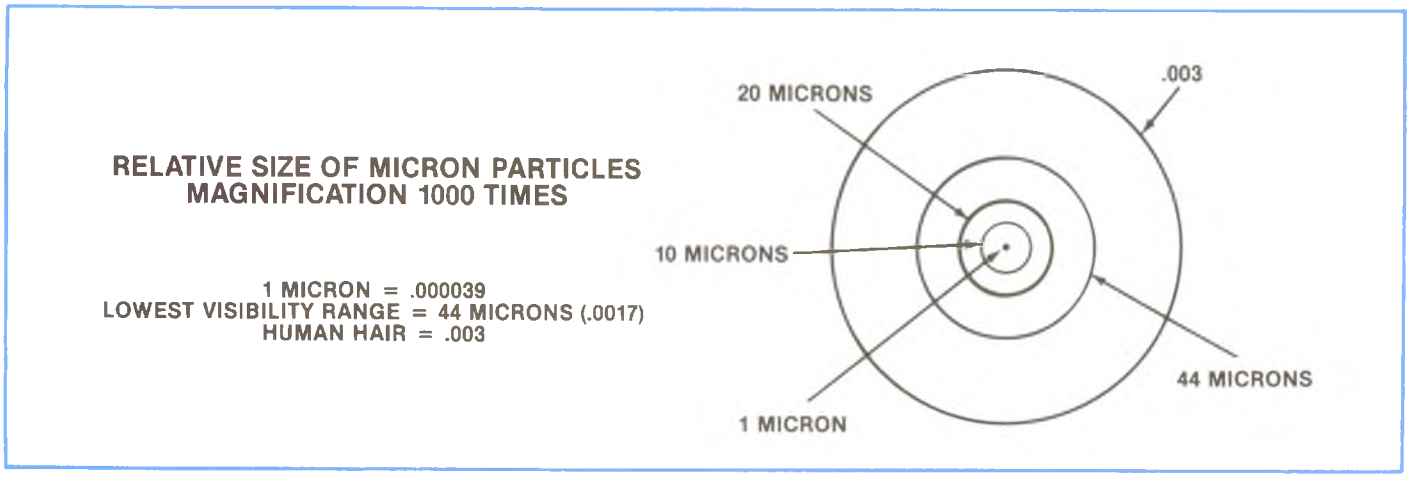


Figure 4-17, Relative Size of Micron Particles.

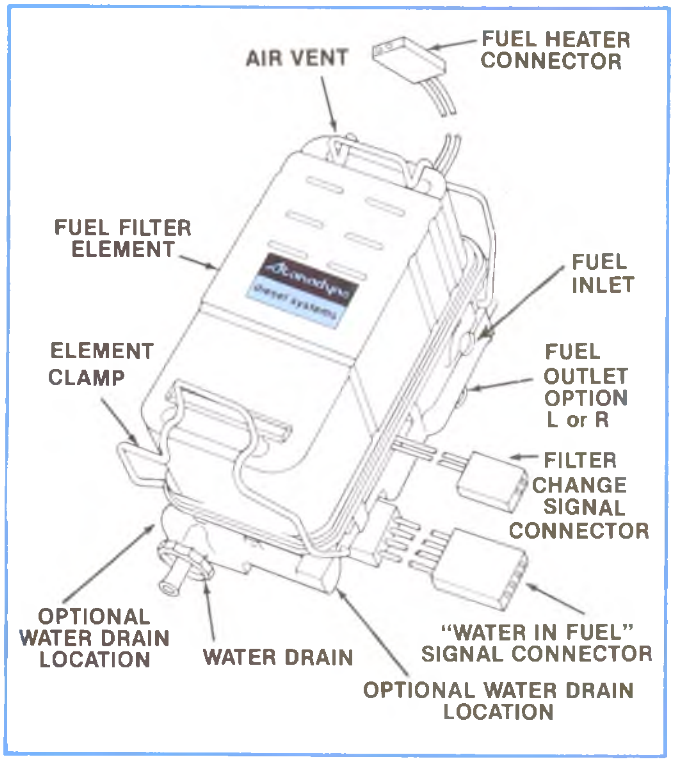


Figure 4-18, Model 80 Fuel Filter and Base Assembly.

1984 & LATER MODEL 80 FUEL SENTRY FILTER SYSTEM (FIGURE 4-18)

Combination Fuel Heater
- Fuel Filter
- Water Separator
- Water Sensor
- Filter Change Signal

• FUEL HEATER

See Figure 4-19. The purpose of the heater is to heat fuel, so that the filter does not plug with parafin wax crystals. This will allow the use of fuels at temperatures substantially below the cloud point of the fuel.

The heater is electrically powered from the ignition circuit 39. It is placed in the filter inlet passage in the filter base.

The heater is thermostatically controlled to work when waxing of the fuel is expected. It is self-protected (by thermal feedback from the heating element to the bi-metal actuator) against overheating resulting from the lack of fuel flow. Because it is located within the filter base, it is 50% more heat efficient than a line heater.

The device can be divided into two major functional components, the heater and the power control assemblies.

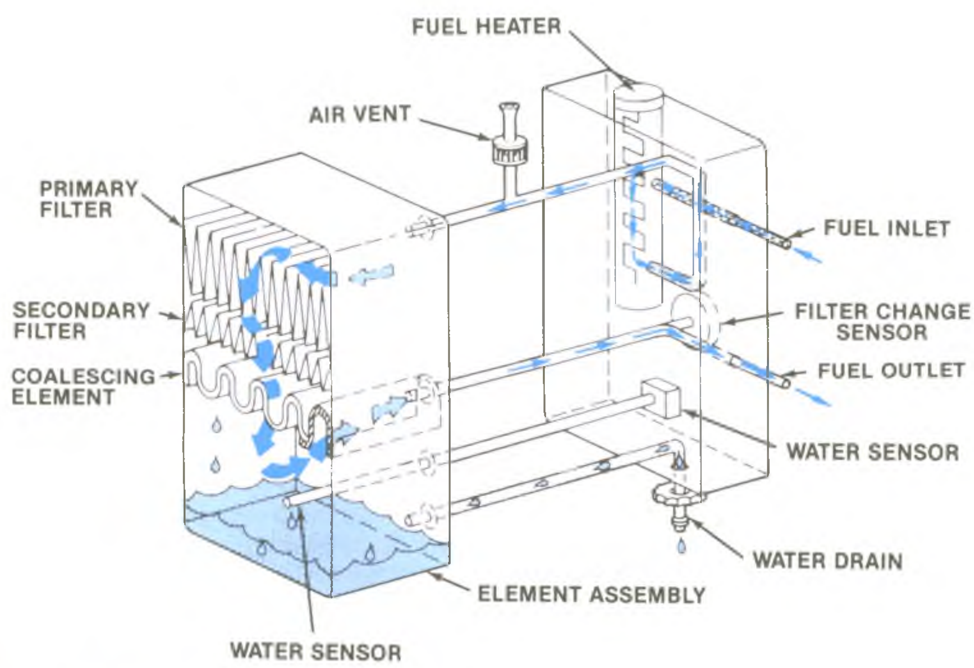


Figure 4-19, **Filter and Base Flow Schematic.**

The heater is 7/8 inches in diameter and consists of an electric resistance strip spiral wound.

The power control assembly senses fuel temperature and responds by closing an electrical circuit to the heater. The sensing element is a bimetal switch. The internal bimetal switch turns on at 20 degrees F and shuts off at 46 degrees F. Power consumption is 110 watts @ 14 volts D.C. The heat will only be on until the under hood temperature gets hot enough to warm the fuel.

The heater can be serviced. However, it is retained in the filter base by the vent valve and an "0" ring. To remove it;

1. Remove the vent valve.
2. Disconnect the electrical connector.
3. Grasp the heater and remove it.

It can be checked by using an ammeter connected in series. Checking must take place below 20 degrees ambient temperature. Proper operation will draw approximately 8.6 amps.

Fuel Filter

The engine fuel filter is a two-stage pleated paper type filter (Figure 4-20). The first stage consists of approximately 350 sq. inches of filtering area and will remove 96% of particles 5-6 microns and larger. The second stage is made of the same paper material with glass particles and consists of approximately 100 sq. inches of filtering surface.

The second stage is 98% effective in filtering the fuel already filtered by the first stage. Particles which are larger than 10 microns may damage pump's internal components. The rectangular design of this filter allows the use of these 2 different elements.

Figure 4-17 compares various micron sizes and will ultimately show the effectiveness of the filter.

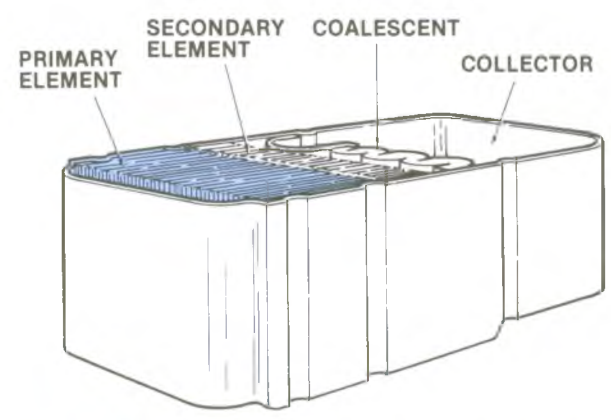


Figure 4-20, **Model 80 Filter Cross-Section.**

WATER SEPARATOR

The bottom of the filter is a hollow water collector. (See Figure 4-19). Because of the greater density of the water, the water droplets will separate from the fuel oil. It will hold approximately 260 cubic centimeters of water (approx. 3-10%).

A nylon fiberglass coalescent is used to blend the small water droplets into larger ones.

"One micron" water droplets collect in the coalescent fibers, and when the droplets get large and heavy enough they drop into the filter bottom.

The coalescing increases the water concentration from 20-30 ppm to 100 ppm. This allows for more efficient water collection.

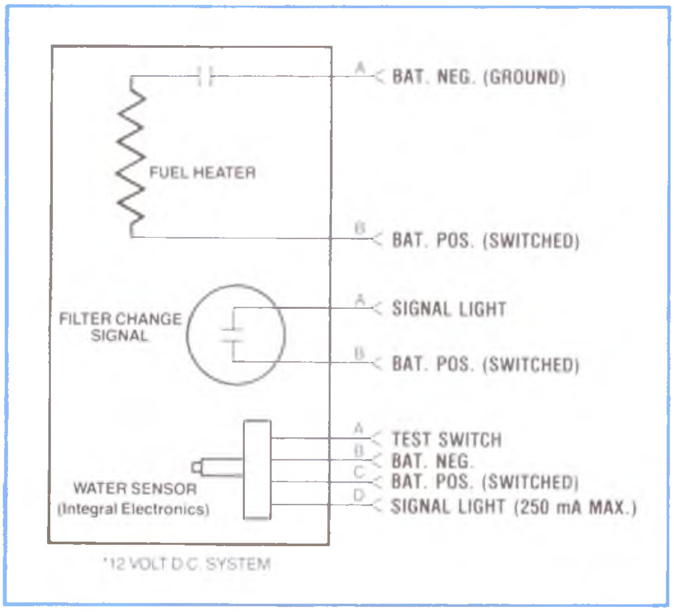


Figure 4-21, 1984 Filter Base Wiring.

WATER SENSOR

The 6.2L uses a water in fuel warning system, which allows the user to guard against water in the fuel.

The water is detected by a capacitive probe located in the filter base. Electronics within the probe will connect a ground (circuit 150) to the ground side of the water in fuel lamp (circuit 508). This lamp is in the center of the instrument panel next to the glow plug lamp. In 1984 (4 wire water sensor module) a bulb check was made any time the ignition switch was in the start position. A B+ signal on the purple wire at the "A" test switch (Figure 4-21) causes pin "D" to pull low, grounding the "water-in-fuel" bulb. In 1984½ and 1985 (3 wire water sensor module) when the ignition is turned on, the lamp will glow from 2 to 5 seconds, and fade away. This is done as a bulb check.

The probe material is iron ferrite, which is not subject to electrolysis. The sensor will turn on at a 50cc level.

— NOTE —

The 1984 water sensor is an IC chip, 4 wire, 4 wire male connector voltage transient module. The 1984½ water sensor has discrete components, 3 wire module, 4 wire male connector. The 1985 and later water sensor has discrete components, 3 wire module and a 3 wire "female" connector.

PRESSURE SWITCH

A pressure will be incorporated in the filter base. It will be used to indicate filter blockage. The pressure differential value is set at 14 in. Hg. ± 2 in.

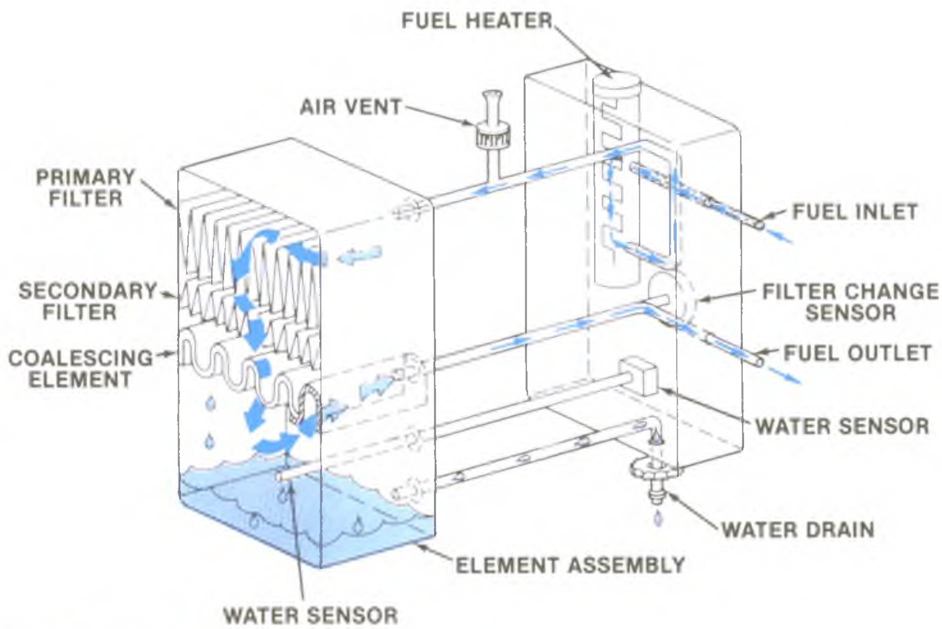


Figure 4-22, Filter and Base Flow Schematic.

Fuel Flow

See Figure 4-22. Fuel enters at top right inlet and flows into heating chamber. Heater is activated at 8 degrees C (46 degrees F) and below. Heated fuel enters element at top and flows down thru the two stage fuel filter media pack. While passing through the third stage, water coalesces out and drops to a sump holding area. Clean fuel returns to the base and exits to the fuel injection pump. An electrical signal is obtained from the filter change sensor located in the return path.

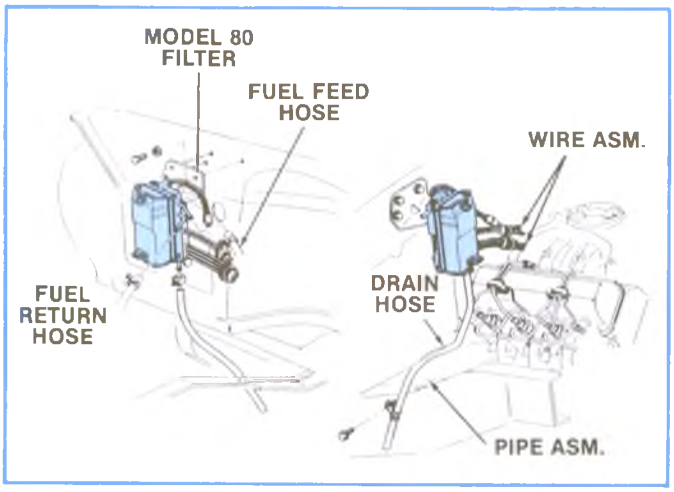


Figure 4-23, C-K Model 80 Mounting.

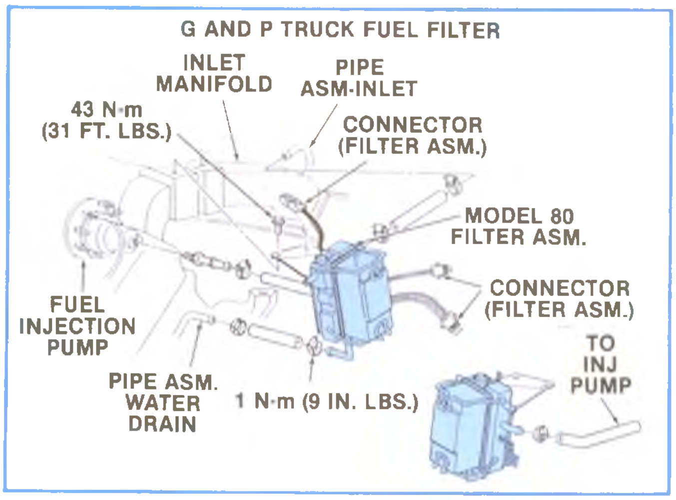


Figure 4-24, G-P Model 80 Mounting.

FUEL FILTER MOUNTING

The Model 80 is cowl mounted on the C-K. See Figure 4-23.

It is mounted at the rear of the intake manifold on a G or P Truck. Also because of space the G & P will use a belt driven vacuum pump. See Figure 4-24.

Water in Fuel

During refueling, it is possible for water to be pumped into your fuel tank along with the diesel fuel. Your vehicle has a water separation system in the fuel filter. It also has a "WATER IN FUEL" light in the instrument cluster which is designed to come on if water has accumulated in the fuel filter and if the fuel filter becomes plugged (a low pressure sensor will activate the light). (The "WATER IN FUEL" light is also designed to come on during engine starting to let you know the bulb is working. If the light does not come on, check the fuse and the bulb.)

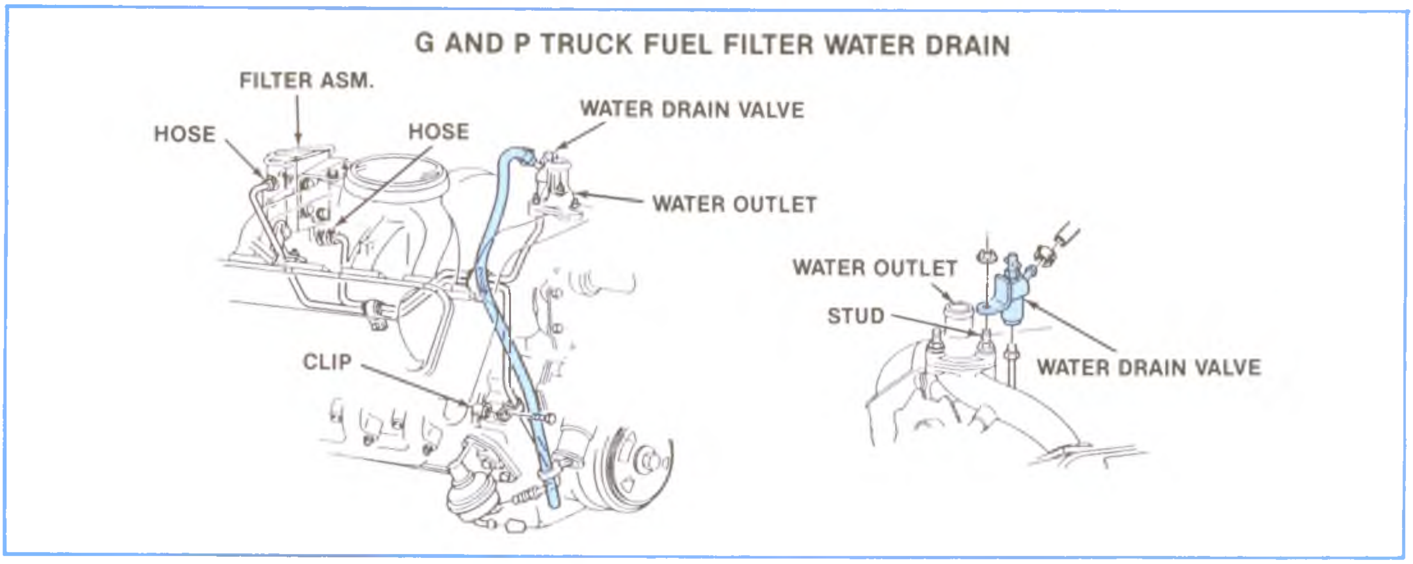


Figure 4-25, G-P Truck Remote Fuel Filter Water Drain.

The G & P Truck have a remote mounted water drain valve near the water outlet.

FUEL FILTER — WATER DRAIN (FIGURE 4-23, 4-24 OR 4-25)

The diesel equipped truck has a multifunction filter for solid contaminants and water. The filter is mounted on the front of the dash.

To drain water:

1. Remove the vehicle fuel tank cap.
2. Place a container below the filter drain hose located below the filter.
3. With the engine off open water drain valve 2-3 turns.
4. Start engine — allow it to idle for about 1-2 minutes or until clear fuel is observed.
5. Stop engine and close water drain valve.
6. Install fuel tank cap.

If the "WATER IN FUEL" light comes on again after driving a short distance or the engine runs rough or stalls — a large amount of water has probably been pumped into the fuel tank. The fuel tank should be purged.

FUEL TANK PURGE PROCEDURE

An authorized dealer can remove (purge) water from the fuel tank. However, you can purge the fuel tank by using the following procedure.

— CAUTION —

If you choose to purge the fuel tank yourself, use caution when working on or near the fuel tank or other parts of the fuel system. Use the same safety precautions you would normally use with gasoline when handling and disposing of the purged mixture. (To dispose of purged fuel, contact a waste oil facility, your dealer or a service station.)

Remember that improper or incomplete service could lead to the vehicle itself not working properly, which may result in personal injury or damage to the vehicle or its equipment. If you have any questions about carrying out this service, have the service done by a skilled technician.

TO PURGE THE FUEL TANK:

1. Park vehicle in a level position. The fuel pick up is in the approximate center of the tank.
2. Place a large container under the filter drain hose. Open the drain 3-4 turns.
3. Disconnect fuel return hose at injection pump.
4. With the fuel tank cap properly installed, apply a low pressure 20.6-34.4 kPa (3-5 psi) maximum air through the fuel return hose. The fuel tank cap is designed to retain 20.6-34.4 kPa (3-5 psi) pressure, allowing water to be forced out of the tank via the filter drain hose.
5. Continue to drain until only clear fuel is observed — the complete contents of the tank may have to be drained.
6. Close drain valve tightly. Reinstall the fuel return hose.

FUEL EXHAUSTION — ENGINE STOPS

Care should be taken not to run out of fuel; however, if the engine stalls and you suspect fuel exhaustion the following procedure will facilitate restarting.

First, determine if engine stall is due to fuel exhaustion. Open the filter air bleed valve — if air is present then the vehicle is probably out of fuel.

To restart the engine:

1. Add at least 2 gallons of fuel if the vehicle is parked on a level surface; as much as 5 gallons may be required if the vehicle is parked on a slope.
2. Disconnect the fuel injection pump shut off solenoid wire (pink wire). (See illustration).

3. With the air bleed open crank the engine 10 to 15 seconds. **Wait one minute for the starter to cool.** Repeat until clear fuel is observed at the air bleed.
4. Close air bleed and reconnect injection pump solenoid wire.
5. Repeat cranking **10-15 seconds** until engine starts.

FUEL FILTER — REPLACEMENT (FIGURE 4-23, 4-24 OR 4-25)

The fuel filter is easily removed and installed with the use of a screwdriver. To prevent fuel spillage — drain fuel from the filter by opening both the air bleed and water drain valve allowing fuel to drain out — into an appropriate container.

To remove the filter:

1. Remove fuel tank cap. This releases any pressure or vacuum in the tank.
2. Disengage both bail wires with a screwdriver.
3. Remove the filter.
4. Clean any dirt off the fuel port sealing surface of the filter adapter and the new filter.
5. Install the new filter — snap into position with bail wires.
6. Close the water drain valve — and open the air bleed. Connect a 1/8″ I.D. hose to the air bleed port and place the other end into a suitable container.
7. Disconnect fuel injection pump shut off solenoid wire. (See illustration).
8. Crank engine for 10-15 seconds and then **wait one minute** for the starter motor to cool. Repeat until clear fuel is observed coming from the air bleed.
9. Close the air bleed, reconnect the injection pump solenoid wire and replace fuel tank cap.
10. Start engine and allow it to idle for 5 minutes.
11. Check fuel filter for leaks.

If the "WATER IN FUEL" light illuminates the following chart (Figure 4-26) may help pinpoint a specific problem.

"WATER IN FUEL" LIGHT CHART

PROBLEM	RECOMMENDED ACTION
• Light comes on intermittently.	Drain water from fuel filter.
• Light stays on — engine running	
1) Temperatures above freezing.	Drain fuel filter immediately. If no water is drained and light stays on — replace fuel filter.
2) Temperatures below freezing.	Drain fuel filter immediately. If no water can be drained — water may be frozen. Open air bleed to check for fuel pressure. If no fuel pressure replace filter.
• Light comes on at high speed or heavy accelerations.	Fuel filter plugged — replace.
• Light stays on continuously — engine stalls, will not restart.	
1) After initial start-up.	Fuel filter or fuel lines may be plugged. See your dealer.
2) Immediately after refueling — Large amounts of water probably pumped into the tank.	Fuel tank purging required. See "Fuel Tank Purge" procedure found in Section 4 of this manual.

Figure 4-26, "W.I.F." Light Chart.

Model 80 Fuel Filter Seal Leakage

Leakage of fuel and/or air past the drain and/or vent seal(s) can occur in the base of a Model 80 fuel filter. The two Model 80 assemblies involved are part numbers 14071933 and 14071064. The specific symptoms of this leakage are:

1. External fuel leakage from the vent or drain plugs.
2. A hard starting problem where the engine starts normally, then stalls, and is difficult to re-start.

A new seal (P/N 15529641) has been released to repair fuel and/or air leakage. The new seal has a slightly smaller outside diameter, enabling it to bottom in the bore and seal properly.

Seal replacement can be accomplished with the filter assembly removed from the vehicle as outlined in the following steps:

1. Remove the air vent plug located at the top of the filter base.
2. Loosen the drain plug on C/K model trucks and drain the fuel from the filter. On G and P models, open the remote drain valve to drain the filter.

— NOTE —

G and P model trucks do not have a filter drain plug or seal, and only the air vent plug seal will require replacement.

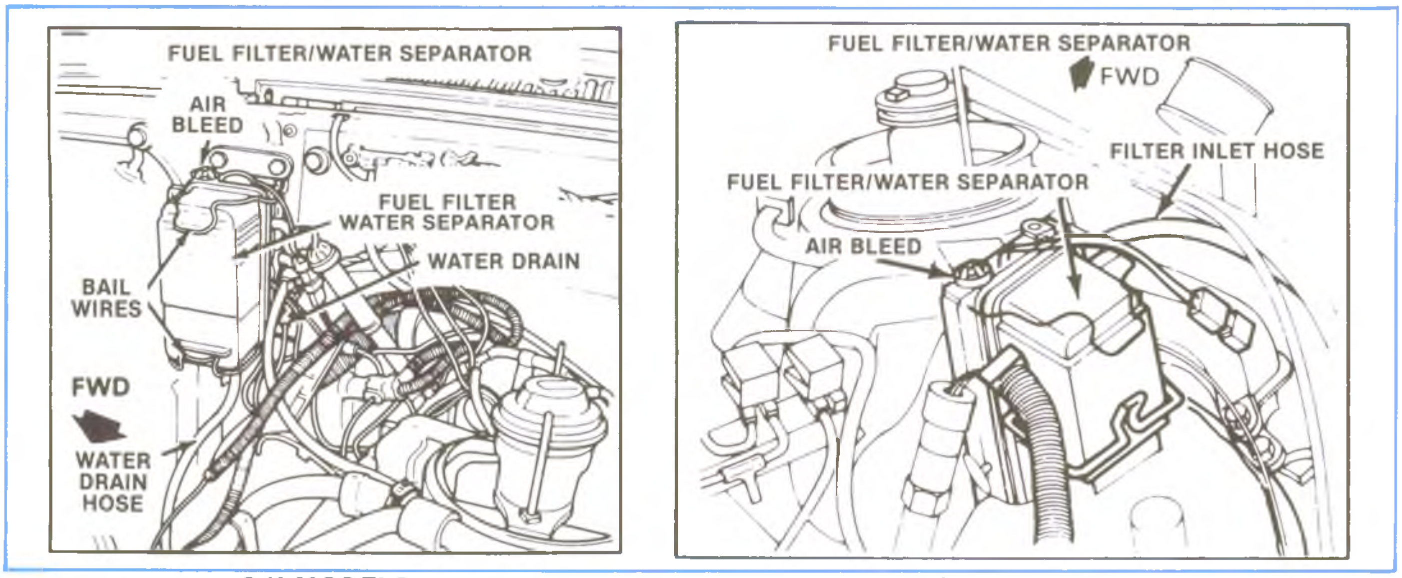
3. Disconnect fuel hoses and wire connections from the filter assembly. Remove the assembly from the vehicle.
4. Unclip and remove the filter/separator element from the base.
5. A paper clip or short length of mechanic's wire can be formed into a tool for seal removal. Using the tool, remove the air vent and drain plug seal (if applicable) from the filter base.
6. Visually inspect the bore(s) for evidence of seal particles. If particles are present, compressed air can be blown into the filter base outlet to remove small particles in the bore(s).
7. A short length of 1/4" bar stock or equivalent with square ends can be used to install the new seals in the base. Apply a small amount of Synkut lubricant or equivalent, such as STP, to one end of the rod. Attach a new seal (P/N 15529641) to the rod's end. Insert the seal into the air vent plug bore until it seats firmly in the bottom of the bore. Visually inspect the seal to ensure it is squarely bottomed. Install the air vent plug.
8. Repeat the above procedure to install a new seal in the drain plug bore, but do not install the drain plug.
9. Prior to installing the drain plug, measure the length of the drain plug bore boss. If the boss is 1/4" long, install the drain plug and tighten until it bottoms. If the boss is 1/8" long, install plain washer (P/N 561890) on the drain plug and then thread the plug in until it bottoms. The drain plug washer prevents threading the drain plug in too far and damaging the seal.
10. Attach the element to the base.
11. The filter assembly can be pressure checked with air by plugging the fuel inlet, outlet, and drain outlet (if applicable). Using a maximum of 10 psi air pressure, open and close the air vent and drain plug (if equipped) several times to ensure the valve(s) are sealing.
12. Reinstall filter assembly on vehicle and attach all fuel hoses and wire connections.
13. Vent and prime the fuel system as outlined in the Service Manual or Owner's and Driver's Guide.

Fuel Filter/Water Separator

SERVICE INSTRUCTIONS TO CORRECT A "WATER IN FUEL" LIGHT INDICATED PROBLEM

When a problem is indicated by the "WATER IN FUEL" signal light, first follow the diagnostic procedure outlined in the vehicle service manual. If this procedure fails to locate the problem and the light continues to stay on, the fault may be in the fuel filter/water separator assembly electrical sensors.

To determine which sensor may be at fault, first disconnect the vacuum sensor. To distinguish the electrical leads, refer to Figure 4-27. The vacuum sensor has two wire leads with a black connector. (The "WATER IN FUEL" sensor has four wire leads with a black connector, and the fuel heater has two wire leads with a white connector.)



C,K MODELS G,P MODELS

Figure 4-27, Electrical Connections, Fuel Filter/Water Separator.

If the indicator light goes off, then the vacuum sensor is probably defective and should be replaced according to the following instructions.

1) Prior to removal of the defective vacuum sensor, obtain a new vacuum sensor and connect to the wire leads in the vehicle. The light should remain off. This is to ensure the new sensor has not been damaged during shipment.
2) Drain the fuel filter/water separator assembly into a container according to the instructions in the vehicle service manual, then disconnect and remove the entire assembly from the vehicle.
3) Remove the filter/separator element from the base assembly.
4) Using a small screwdriver, pry the vacuum sensor retaining clip from the base (Reference Figure 4-27). Take care to prevent damage to the bore. It is suggested that initially prying the clip upwards at the wire lead protective tab will cause the least amount of scoring to the base bore.
5) Remove the vacuum sensor by pulling up on the sensor wire leads and by simultaneously prying under the sensor opposite the leads using a small screwdriver.
6) After the sensor is removed, check the bore by running your finger around the inside of the bore and visually inspect for sharp edges or raised metal burrs caused by removal of the retaining clip.
7) If burrs are present, use a fine (300) grit paper or round stone to remove any sharp metal burrs or scratches in the bore. This is to prevent harm to the sensor "0" ring seal during installation. Take care to prevent debris from entering the hole at the bottom of the bore when performing this service.

— CAUTION —

Do not sand or scratch the lower machined "0" ring sealing surface while deburring.

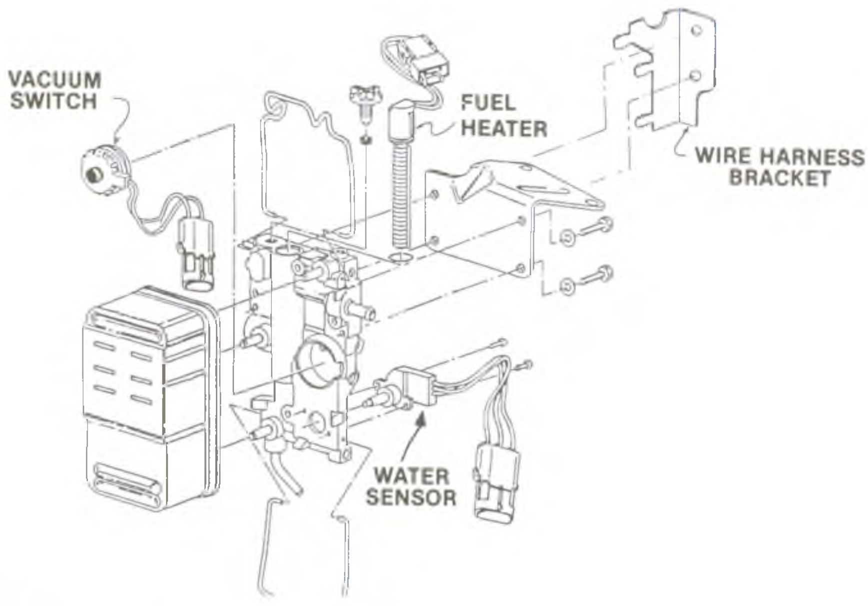


Figure 4-28, **1985 Model 80 Filter, Exploded View.**

8) Using a lint-free cloth and solvent, wipe off any debris from the bore area that may have been generated during the deburring process, then blow off the area with compressed air.
9) Remove the sensor retaining clip from the new sensor using a knife blade or screwdriver to pry the clip upward at the wire lead area.
10) Apply a liberal amount of vaseline, grease or STP to the sensor "0" ring seal. Also apply a small amount of lubricant to the base sensor bore.
11) See Figure 4-28 for proper vacuum sensor installation. To prevent cutting of the "0" ring seal, insert the sensor into the bore at an angle with wire lead portion inserted first. Insert the new sensor (less the retaining clip) into the base, using finger pressure until it is seated or nearly seated at the bottom of the bore.
12) Assure the cellular air filter is in place atop the sensor, then place the sensor retaining clip in position with the protective tab over the wire lead. Holding the retaining clip in position with one finger placed at the center of the clip, work the retainer into place by forcing each tab downward uniformly and in small increments using a screwdriver. The retainer will be in proper position when no further downward movement is felt and the top of the retainer is approximately flush with the lip of the bore.

— NOTE —

Current versions of the vacuum sensor have a rubber button at the center of the retaining clip. This button should be in place prior to installation of the sensor retaining clip to the base and prior to installation of the filter/separator element.

13) Install filter/separator element to the base assembly.
14) Reinstall fuel filter/water separator assembly to the vehicle. Connect all electrical leads and the fuel inlet line. Leave the fuel outlet line (smaller) disconnected.
15) Follow the engine startup procedure outlined in the vehicle service manual under "Fuel Filter — Replacement (Diesel Engine)". When clear fuel is observed coming from the outlet fitting, connect the outlet fuel line and complete the engine startup procedure.

Modifications To Model 80 Fuel Sentry For DDA (G & P) Applications

*SDS #	TITLE	DESCRIPTION
		1984
27108	Water Sensor	IC chip, 4 wire, 4 wire male connector, voltage transient module
24831	Vacuum Switch	2 wire male connector
24270	Fuel Heater	2 wire female connector
		1984½
27284	Water Sensor	Discrete components, 3 wire, 4 wire male connector
24831	Vacuum Switch	Same as 1984
24270	Fuel Heater	Same as 1984
		1985
27285	Water Sensor	Discrete components, 3 wire, 3 wire female connector
24290	Vacuum Switch	2 wire female connector
27530	Fuel Heater	2 wire female connector
27517	Wire Harness Bracket	All connectors are attached to this bracket at final assembly

*SDS — Stanadyne Diesel Systems

Functional Difference:

Discrete circuit (1984½ & 1985) water sensor will lamp test for approximately 2-5 seconds each time the key is turned on.

1984 unit lamp tests only during cranking.

14071933 ASSEMBLY C-K TRUCK MODEL 80 PARTS LIST		
DESCRIPTION	**GM PART NUMBER**	**STANADYNE NUMBER**
Bracket, Wiring Harness	15593335	24838
Clip, Vacuum Switch Retainer	15593306	24835
Seal, "0" Ring (Vacuum Switch)	15596608	24275
Switch, Vacuum	15593308	24831
Seal, Drain Plug	15596611	24266
Seal, "0" Ring (Fuel Heater)	15596600	15349
Plug, Vent	15596612	24267
Screw, Thd Forming ½-20	15596607	24437
Bracket, Mtg.	15593336	34522
Clamp, Filter	15596613	24265
Heater Assembly, Fuel	15593337	24870
Screw, Thd Forming	15596603	24322
Sensor, Water	15596610	24269
Base Assembly	15593338	24521
*Element, Filter	14075347	24262

*Part of Filter Element

14071064 ASSEMBLY G-P TRUCK MODEL 80 PARTS LIST		
DESCRIPTION	**GM PART NUMBER**	**STANADYNE NUMBER**
Bumper, Vacuum Switch	15593305	27129
Clip, Vacuum Switch Retainer	15593306	24835
Seal, "0" Ring Vacuum Switch	15593307	24834
Switch, Vacuum	15593308	24831
Screw Thd Forming (¼-20)	15596607	24437
Clamp, Filter	15596613	24265
Bracket, Filter Mtg.	15593309	24527
Seal, Drain Plug	15596611	24266
Plug, Vent	15596612	24267
Seal, "0" Ring	15596600	15349
Heater Assembly, Fuel	15596609	24270
Screw, Thd Forming (8-32)	15596603	24322
Sensor, Water	15593310	27108
*Element, Filter	14075347	24262

*Part of Filter Element

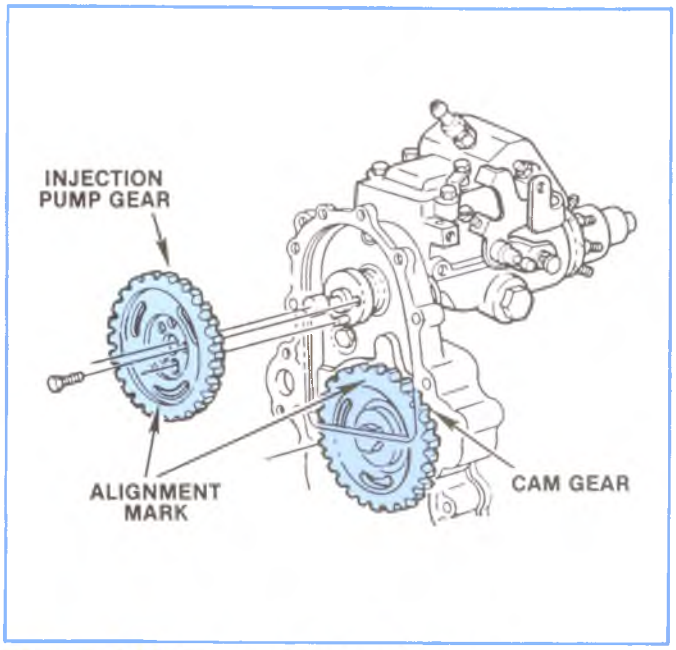


Figure 4-29, **Pump Timing Gears.**

High Pressure Fuel Delivery System

- Injection distributor pump.
- High pressure lines.
- Fuel injection nozzles.

The 6.2 liter injection pump is mounted on top of the engine under the intake manifold. It is gear driven by 2 gears — one attached to the front end of the camshaft which drives the second gear that is attached to the end of the injection pump shaft. These 2 gears are the same size and have the same number of teeth; thus, the injection pump shaft turns at the same rate as the camshaft and one-half the speed of the crankshaft. The pump will turn in the opposite direction to that of the camshaft and crankshaft. See Figure 4-29.

The Injection pump is a high pressure rotary type pump that directs a metered pressurized fuel through the high pressure tubes to the eight injector nozzles.

The eight high pressure lines are all the same length although their shape may be different. This prevents any difference in timing, cylinder to cylinder. See Figure 4-30.

The lines are all 600mm long. The I.D. is 2.5mm, and the O.D. is 6.3mm on C, K, and P series. The G-van I.D. is 2mm and the O.D. is 6mm.

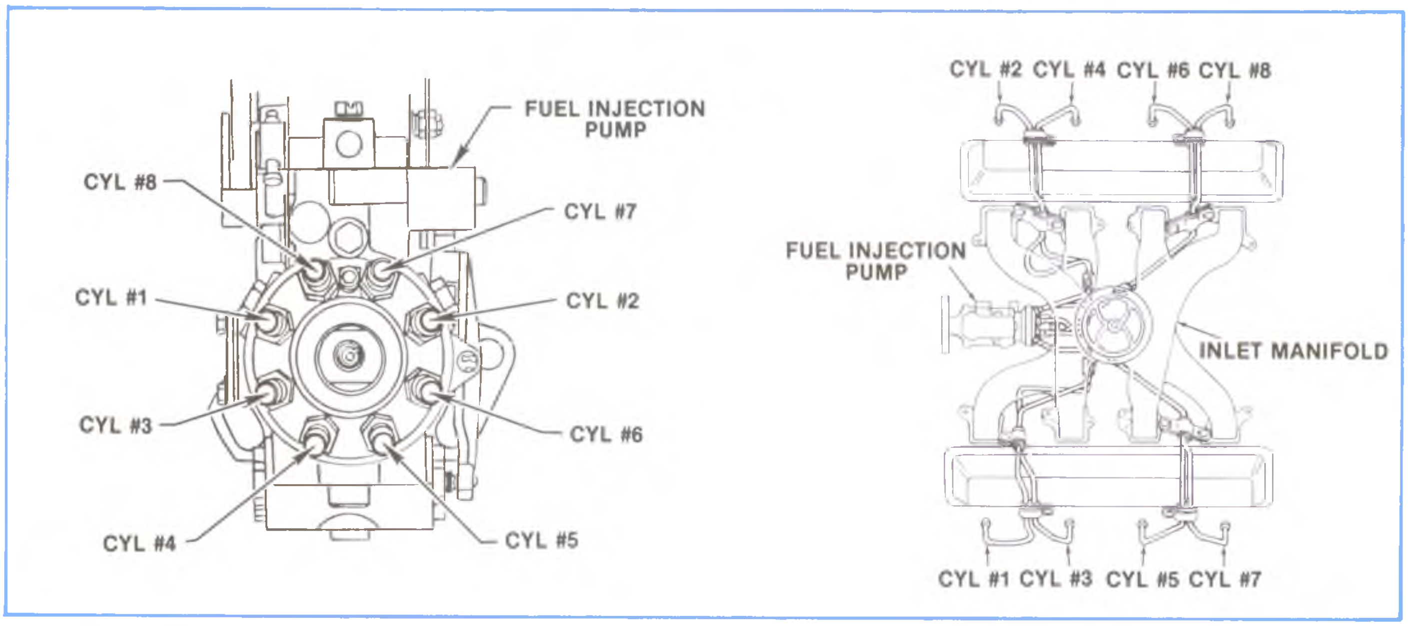


Figure 4-30, **High Pressure Lines.**

Fuel Injection Pump

The 6.2L diesel engine uses the Stanadyne DB2, distributor-type, fuel injection pump (Figure 4-31).

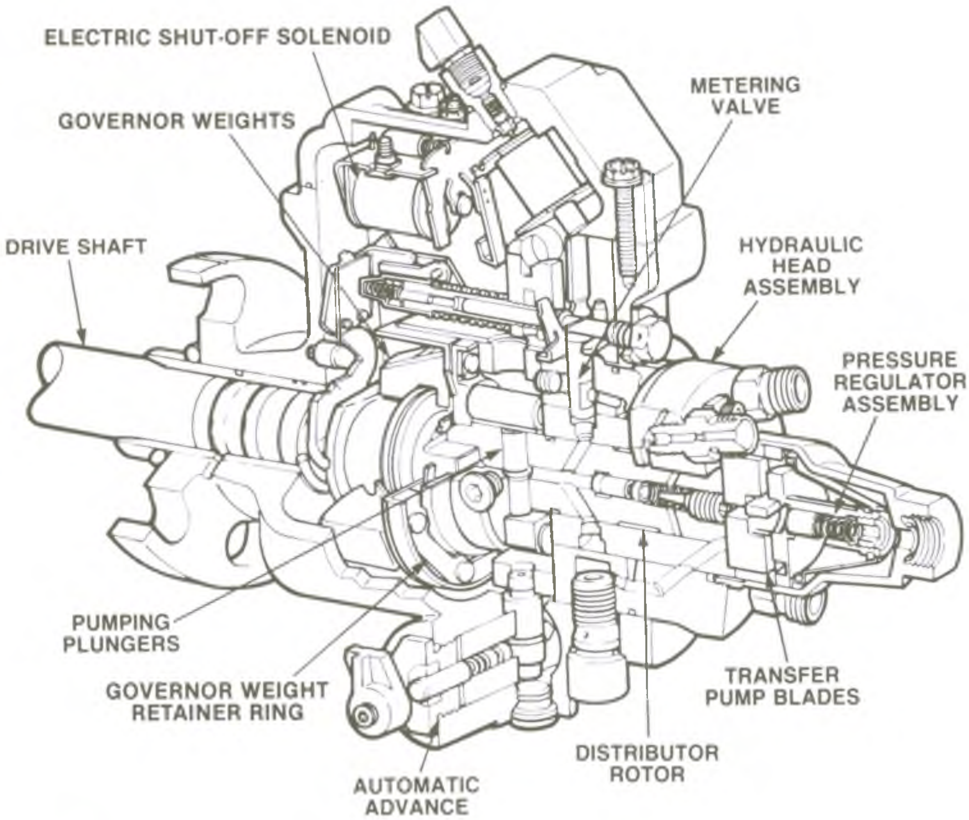


Figure 4-31, **DB2 Distributor-Type Injection Pump Cutaway.**

The function of the fuel injection pump is to meter the fuel according to engine power requirements and to inject it at high pressure through nozzles into the combustion chambers of the engine at the correct timing intervals. The metering calls for careful design and construction, as it has to be carried out at a high speed and with great precision, in order to ensure even fuel distribution with smooth running, and sensitive response to power control. The timing of the injections must also be done with perfect precision, or high efficiency is impossible to achieve, and since the operating pressure may be as high as 6,000 PSI, the pump itself must be constructed with the utmost care, employing high-grade materials and the finest of working tolerances for the pump elements.

The employment of a separate pumping element for each cylinder, together with suitable means of output control, has been the general practice of fuel injection pump manufacture for some time. The idea of using one pump barrel and a set of plungers to supply all cylinders in turn is a natural one, as it offers obvious savings; the pumping element operates more often (according to the number of cylinders), and is provided with a distributor or means of connecting the pump delivery to each of the injectors in turn.

The distributor type pump is thus an attractive proposition, since the number of pumping elements is reduced to one in all cases.

Injection Pump Description

The main rotating components (Figure 4-32) are the drive shaft, the distributor rotor, the transfer pump blades and the governor.

The drive shaft engages the distributor rotor in the hydraulic head. The drive end of the rotor incorporates two pumping plungers.

The plungers are actuated toward each other simultaneously by an internal cam ring through rollers and shoes which are carried in slots at the drive end of the rotor. The number of cam lobes equals the number of engine cylinders.

The hydraulic head contains the bore in which the rotor revolves, the metering valve bore, the charging ports and the head discharge fittings. The high pressure injection lines to the nozzles are fastened to these discharge fittings.

The DB2 Pump is an inlet metering pump. That is, it has a pumping period with a variable beginning, and a constant ending.

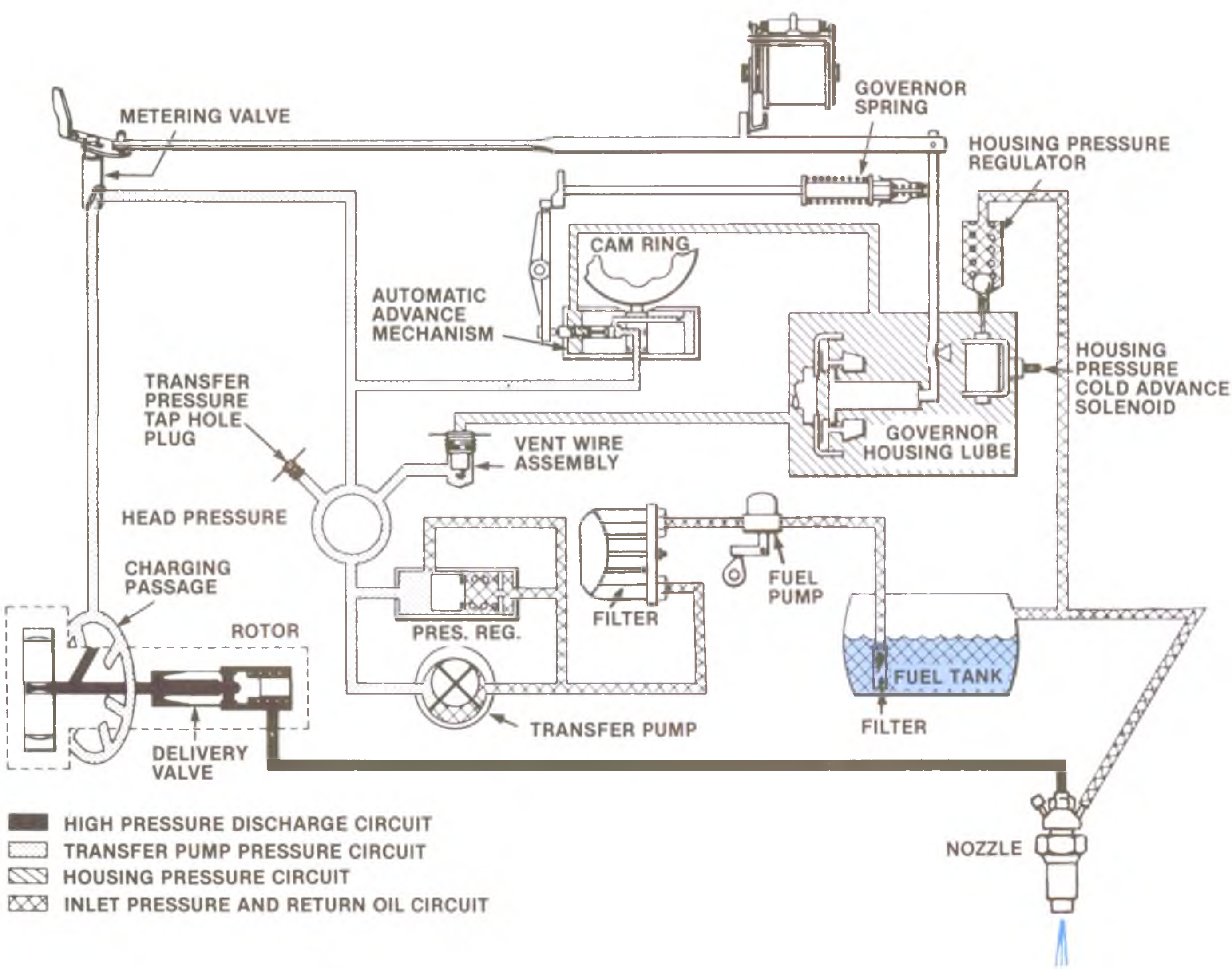


Figure 4-32, **Pump Schematic.**

Injection Pump Operation

The general operating principal of the pump may be easily understood by following the fuel circuit through the pump.

FUEL FLOW

First, the fuel is drawn into the pump inlet, and through the inlet filter screen by the transfer pump. Excess fuel is bypassed through the pressure regulator assembly, and back through the suction side. The fuel, which is under transfer pump pressure, flows through the rotor and head. (Figure 4-33).

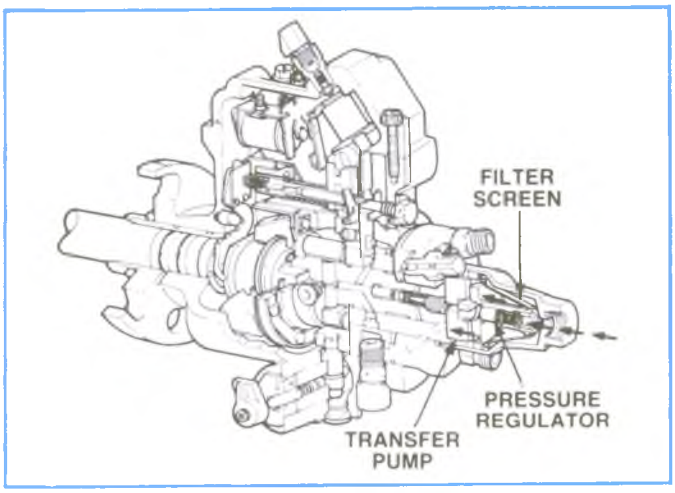


Figure 4-33, **Fuel Intake.**

From here, the fuel is routed in a number of different directions. Some of the fuel is sent through the head locating screw to the automatic advance. The majority of the fuel is sent into a connecting annulus to the top of the hydraulic head. (Figure 4-34).

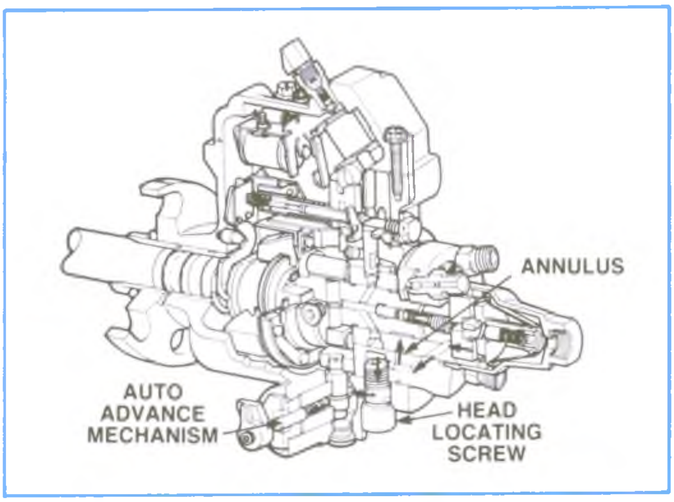


Figure 4-34, **Fuel Flow To Hydraulic Head.**

From this point fuel is sent to the transfer pump test tap and the vent wire assembly. The remaining fuel is sent through a connecting passage to the metering valve. (Figure 4-35).

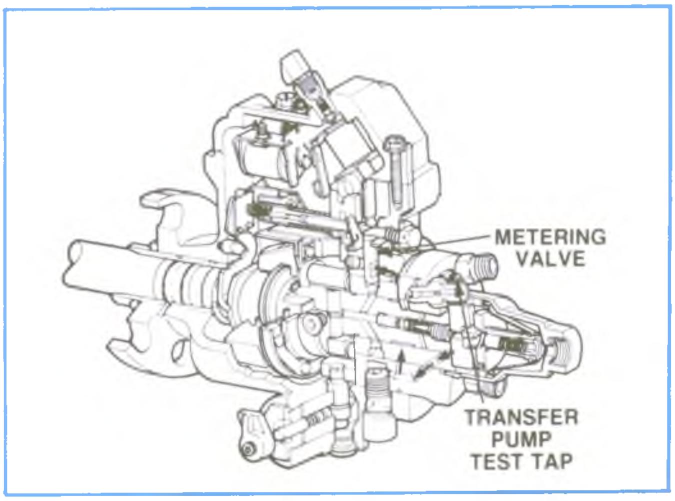


Figure 4-35, **Fuel Flow To Transfer Pump and Metering Valve.**

METERING VALVE

The metering valve, which is controlled by the governor, regulates fuel flow into the head charging ports. (Figure 4-36). It is the equivalent of a throttle plate in a carburetor. It controls the flow area to the pumping plungers. Figure 4-37 shows minimum flow area, and Figure 4-38 shows maximum flow area.

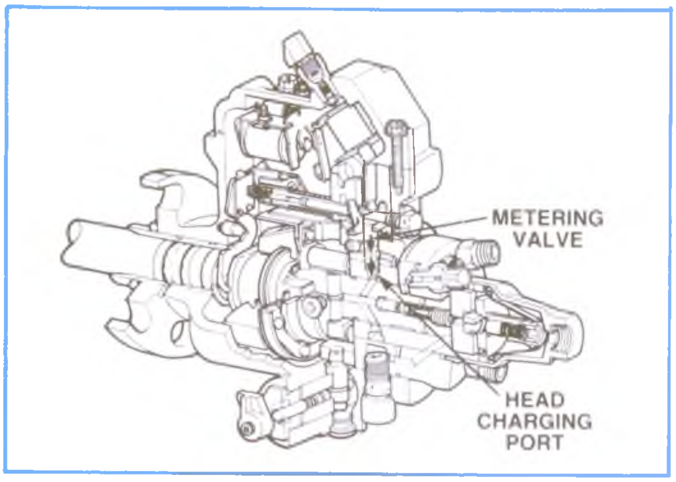


Figure 4-36, Metering Valve.

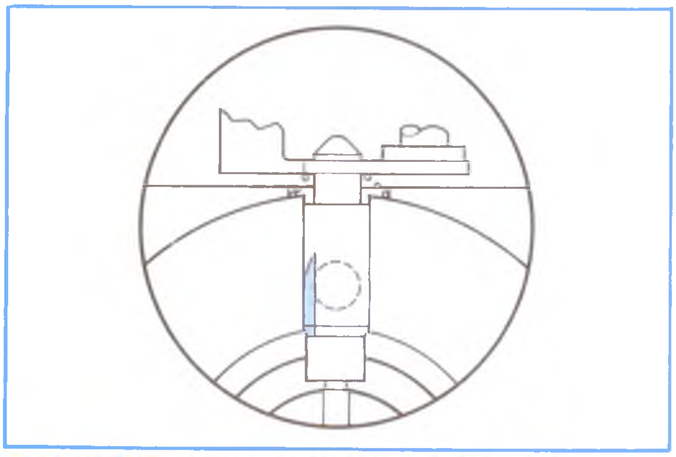


Figure 4-37, Metering Valve Light Load.

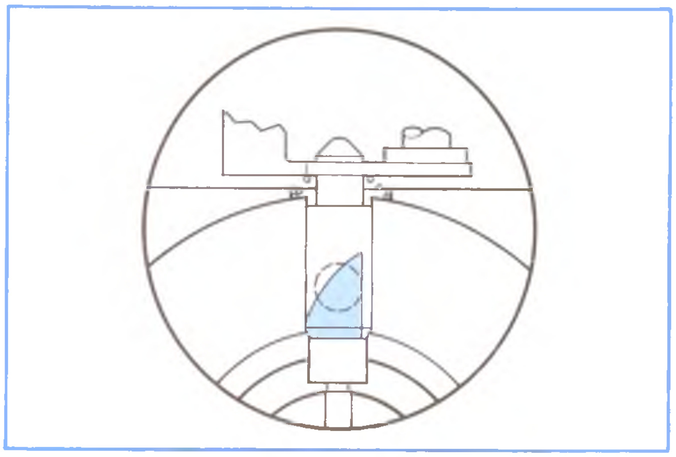


Figure 4-38, Metering Valve Full Load.

Figure 4-39 shows the vertical straight edge and hole type metering valves. The 6.2L uses the vertical straight edge type.

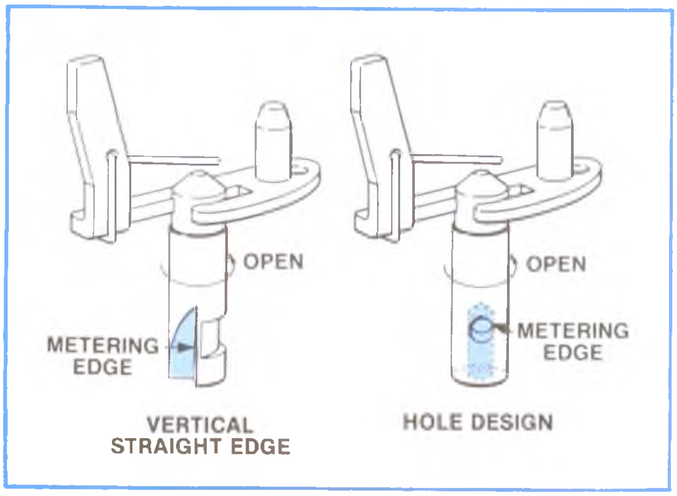


Figure 4-39, Metering Valve Designs.

PUMPING MECHANISM

As the rotor revolves, the two rotor inlet passages register with charging ports in the hydraulic head. (Figure 4-40).

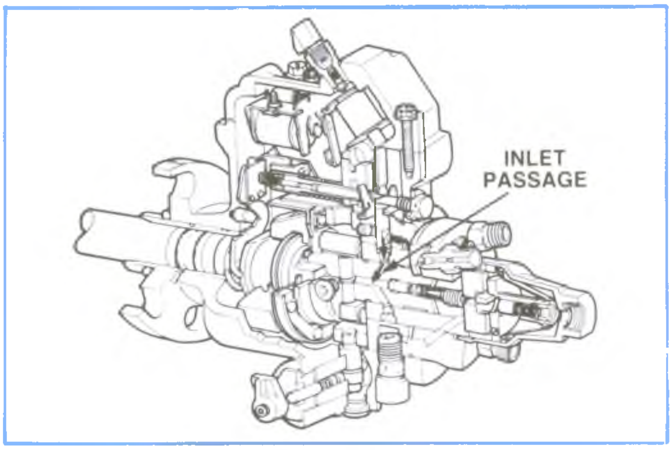


Figure 4-40, **Charging Ports.**

This allows fuel to flow into the pumping chamber. (Figure 4-41). For improved roller retention, the 6.2L engine will use a new roller shoe. It will provide increased shoe wrap-around by positioning the roller deeper into the shoe. Due to the lower profile of these shoes and rollers, the part number of their companion leaf spring has been changed. The shoes are identified by a –10 marking.

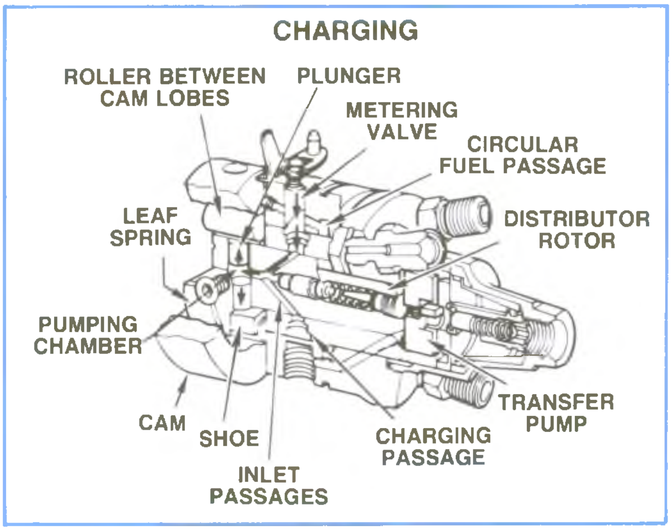


Figure 4-41, **Pumping Chamber.**

As the rotor continues to revolve, the inlet passages move out of registry, ending charging. Discharge begins when the discharge port of the rotor registers with one of the head discharge outlets. (Figure 4-42).

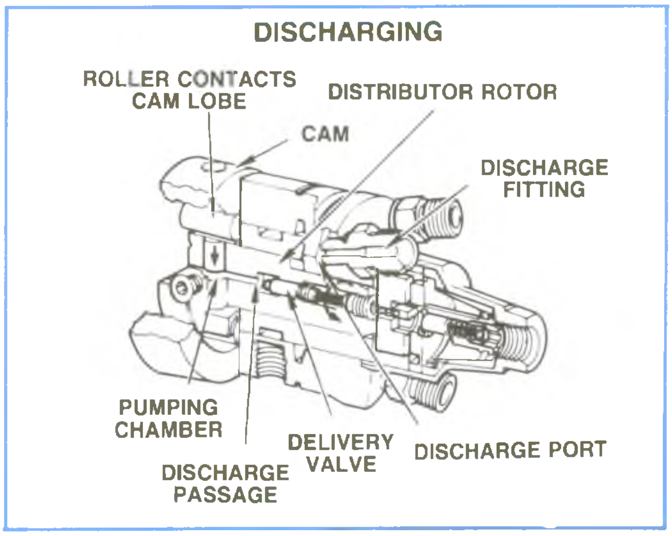


Figure 4-42, **Fuel Discharge.**

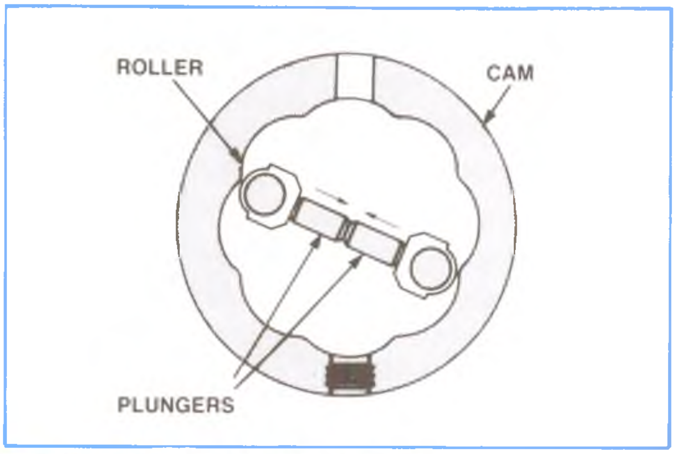


Figure 4-43, Pressurizing Fuel.

PUMPING UNDER PRESSURE TO NOZZLE

While the discharge port is open, the movement of the rotor causes the rollers to contact the cam lobes, forcing the plungers together. The fuel is thus pressurized until the rollers pass over the top of the injection cam, when the pressure starts to drop. (Figure 4-43).

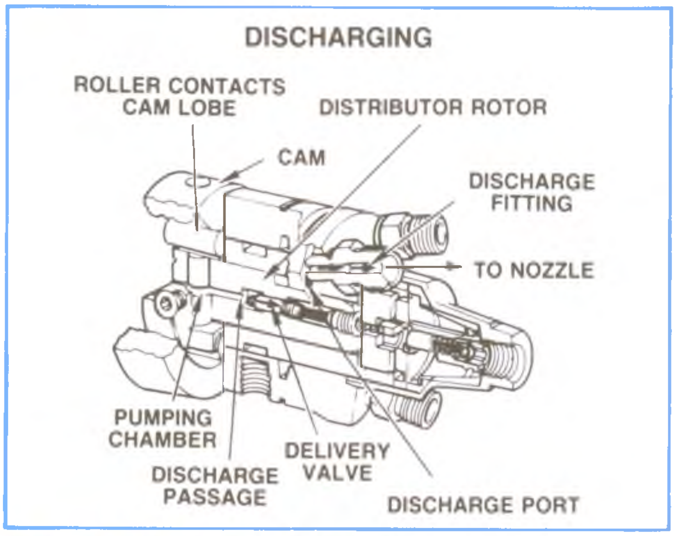


Figure 4-44, Flow To Nozzle.

The fuel then flows through the discharge outlet and discharge port to the injection nozzle. (Figure 4-44).

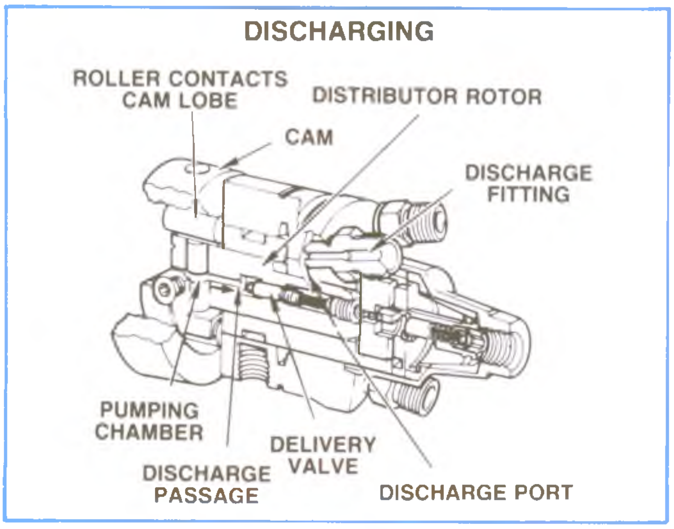


Figure 4-45, Delivery Valve Control.

The magnitude of this pressure drop is controlled by the delivery valve which retains a definite residual pressure in the discharge circuit. This pressure is low enough to assure prompt nozzle closing yet high enough to prevent cavitation of the fuel between injections. (Figure 4-45).

TRANSFER PUMP

Now for a closer look at some of the systems and components mentioned earlier in the program. Where model year design differences exist they will also be pointed out.

Let's begin with the component that supplies and pressurizes the fuel: The Transfer Pump.

The positive displacement vane type transfer pump consists of a stationary liner and four spring loaded blades. Since the inside diameter of the liner is eccentric to the rotor axis, inlet and discharge cavities are formed by the blades as they rotate. (Figure 4-46).

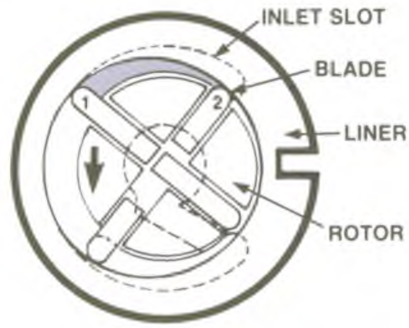


Figure 4-46, Transfer Pump Construction.

— NOTE —

A positive displacement pump discharges a certain amount of liquid for each revolution of the rotating element.

As a blade passes over the inlet slot it enlarges the inlet volume, creating suction. The cavity between this and the second blade fills with fuel until the second blade passes the end of the inlet slot. (Figure 4-47). This volume of fuel is carried around until the leading blade uncovers the end of the discharge slot as shown in the next illustration.

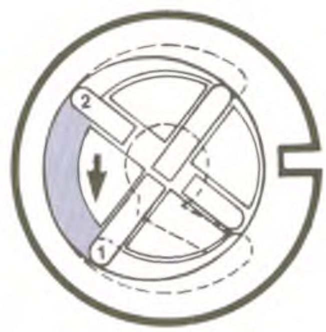


Figure 4-47, Transfer Pump In Mid Position.

As the leading blade continues to pass over the discharge slot it is followed by the second blade which pushes the captive volume of fuel ahead of it. Since the blades are moving into a decreasing volume in the liner, the captive fuel is squeezed out through the discharge slot by the following blade as shown in Figure 4-48.

This sequence takes place four times every revolution of the rotor, producing a continuous discharge.

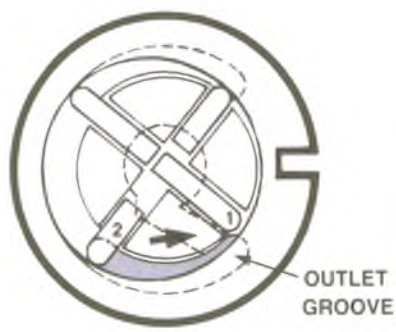


Figure 4-48, Transfer Pump In Lower Position.

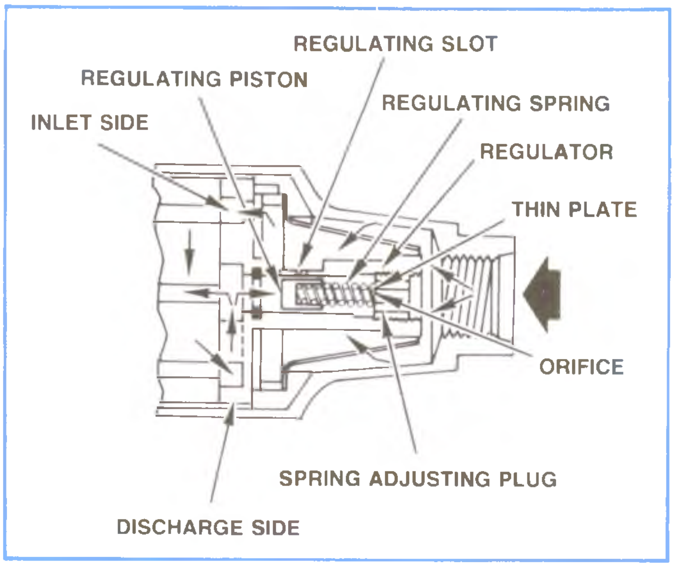


Figure 4-49, Regulator Assembly.

REGULATOR ASSEMBLY OPERATION

In order to understand how designed fuel pressures are maintained over a broad range of conditions we'll now take a closer look at regulator assembly operation.

This illustration shows the operation of the pressure regulator assembly while the pump is running. Fuel output from the discharge side of transfer pump forces the piston in the regulator assembly against the regulating spring. (Figure 4-49).

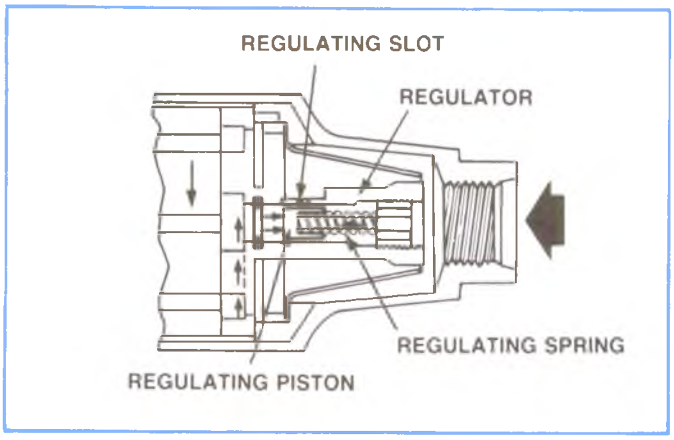


Figure 4-50, Regulator Control.

Since the fuel pressure on the piston is opposed by the regulating spring, the pressure curve of the transfer pump is controlled by the spring rate and the size of the regulating slot. This results in pressure being increased as engine speed increases. (Figure 4-50).

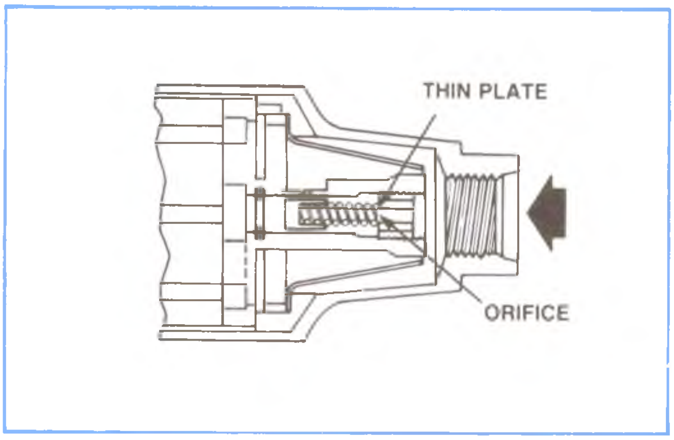


Figure 4-51, Viscosity Compensating Device.

VISCOSITY COMPENSATING DEVICE

Another unique and very simple feature of the DB2 automotive pump is a viscosity compensating device. This component ensures proper transfer pump pressure regardless of the ambient temperature or grade of fuel used. (Figure 4-51).

When fuel "thins" out due to heat, pressure loss will occur. The thin fuel, however, permits increased leakage past a loose fit at the regulating piston causing an increase of pressure in the spring cavity. This aids the spring and moves the piston to restrict spill, thus correcting the pressure. (Figure 4-52).

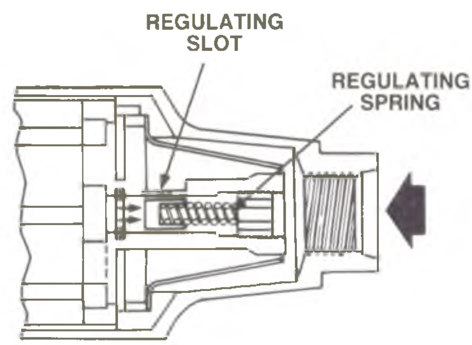


Figure 4-52, **Thin Fuel Correction.**

When fuel is cold it "thickens," and due to the better sealing this affords: fuel pressure increases. Also due to better sealing, leaking past the regulating piston diminishes. This causes a reduction of spring cavity pressure allowing transfer pump pressure to move the regulating piston outward. This increases spill and corrects the pressure. (Figure 4-53).

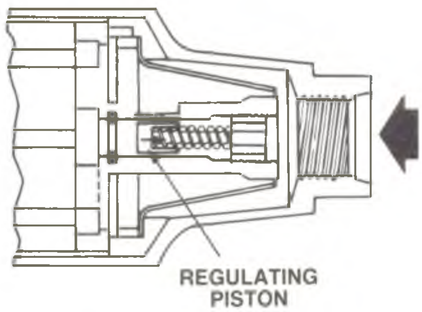


Figure 4-53, **Thick Fuel Correction.**

A short sharp edged orifice in the adjusting plug controls the leakage from the spring cavity.

This orifice is not sensitive to viscosity variation. Consequently, as input to the spring cavity, past the piston, varies with viscosity, pressure in this cavity will also change. This biases the position of the regulating piston over the spill slot and maintains the correct transfer pump pressure. (Figure 4-54).

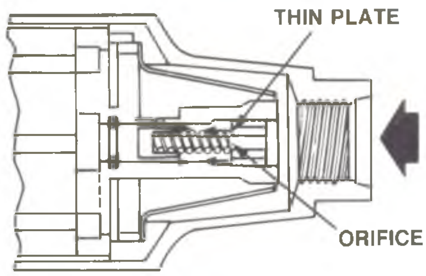


Figure 4-54, **Orifice Control.**

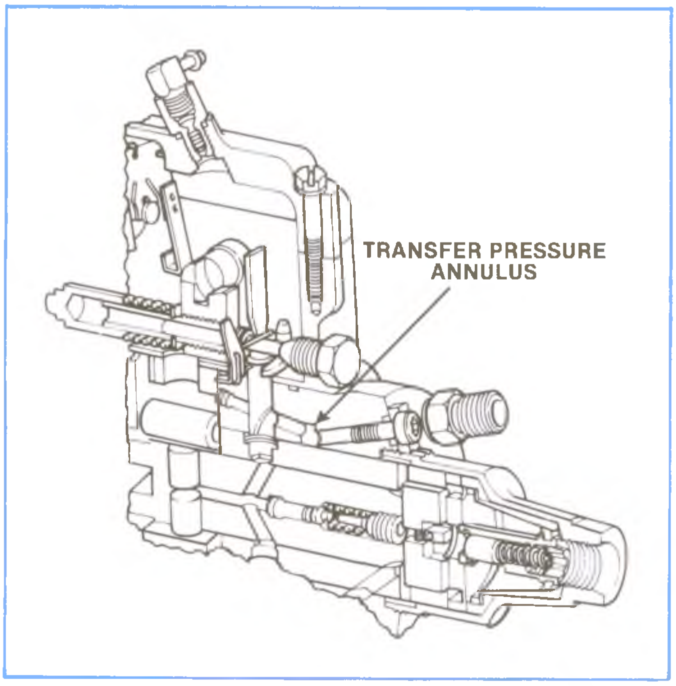


Figure 4-55, Return Oil System.

RETURN OIL SYSTEM

The return oil system (Figure 4-55) performs the following functions. 1.) A controlled flow through the housing maintains stable conditions for the internal parts. 2.) The fuel flow cools and lubricates the pump. 3.) It provides automatic air venting of the system.

The return oil vent passage is fed, from the transfer pressure annulus.

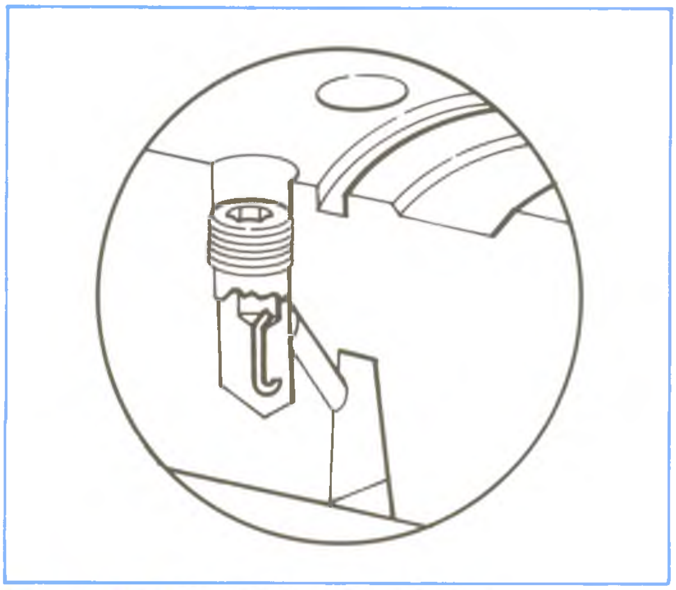


Figure 4-56, Vent Wire Restriction.

Fuel under transfer pump pressure is discharged from the transfer pressure annulus into a vent passage in the hydraulic head (Figure 4-56). Flow through the passage is restricted by a vent wire assembly to prevent excessive return oil and undue pressure loss.

The assembly is made of a hollow screw, into which a "J" wire is installed.

The amount of return oil is controlled by the size of wire used in the vent wire assembly, i.e., the smaller the wire the greater the flow and vice versa. The vent wire assembly is available in several sizes in order to meet the return oil quantities called for on the specification.

Note that this assembly is accessible by removing only the governor cover. The vent passage is located behind the metering valve bore and connects with a short vertical passage containing the vent wire assembly and leads to the governor compartment.

Should a small quantity of air enter the transfer pump, it immediately passes to the vent passage as shown. Air and a small quantity of fuel then flow from the housing to the fuel tank and via the return line.

Housing pressure is maintained by a spring loaded ballcheck return fitting in the governor cover of the pump.

ELECTRIC SHUTOFF SOLENOID

All Stanadyne Diesel Systems DB2 Automotive pumps are equipped with electrical shut-off solenoids. (Figure 4-57).

Illustrated here is an energized to run solenoid. When this is de-energized, an arm on the solenoid is moved out by spring force and physically closes the metering valve. This action interrupts injection, and stops the engine.

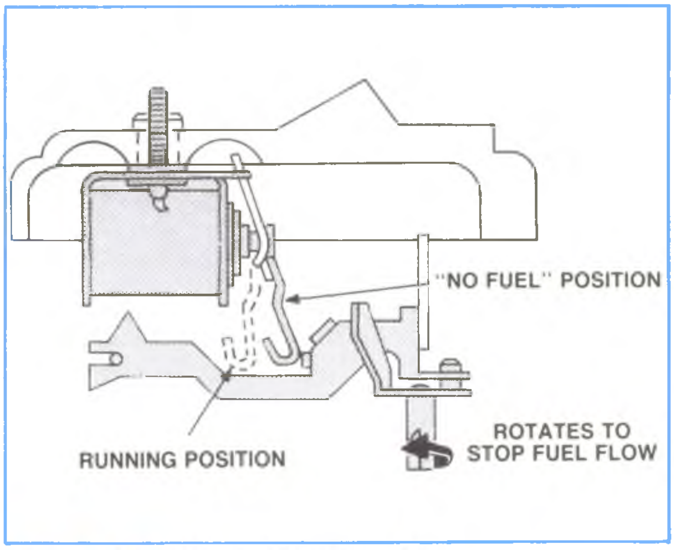


Figure 4-57, **Shutoff Solenoid.**

AUTOMATIC ADVANCE SYSTEMS

The speed advance device (Figure 4-58) is used to achieve best engine performance through the operating speed range of the engine. Timing advance is needed to compensate for the two delay periods: 1) the injection pressure wave traveling the length of the injection line, 2) the ignition delay period.

The injection timing advance system controls the start of injection proportional to pump speed. This is done by moving the cam ring opposite the direction of rotor rotation. The plunger rollers will then come in contact with the lobes on the cam ring earlier in the cycle.

The power advance piston engages the cam ring through the cam advance pin and moves the cam. Fuel under transfer pump pressure is fed through a passage in the hydraulic head, through the cam advance pin to the servo advance piston valve chamber. As transfer pump pressure is increased the servo advance piston valve uncovers a port which is connected to the advance piston, which advance the cam ring.

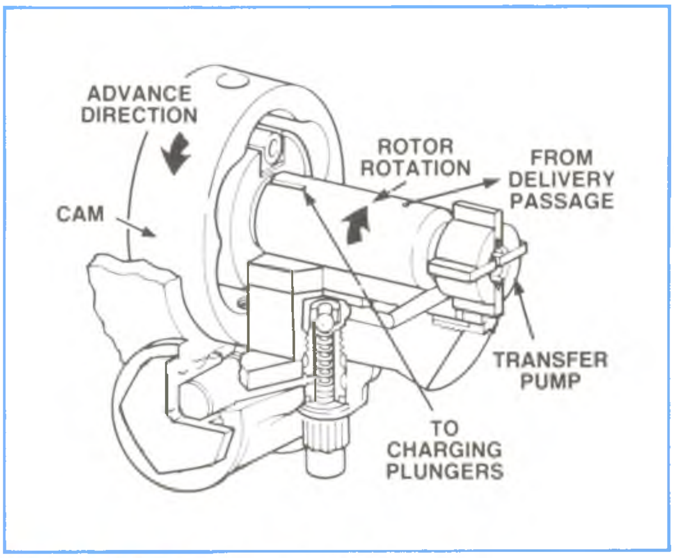


Figure 4-58, **Automatic Advance.**

Secondary control of the cam ring advance is by a mechanical connection from the throttle shaft thru a face cam and rocker lever to the servo advance piston valve spring seat. This secondary timing control results in injection timing better suited to engine demand.

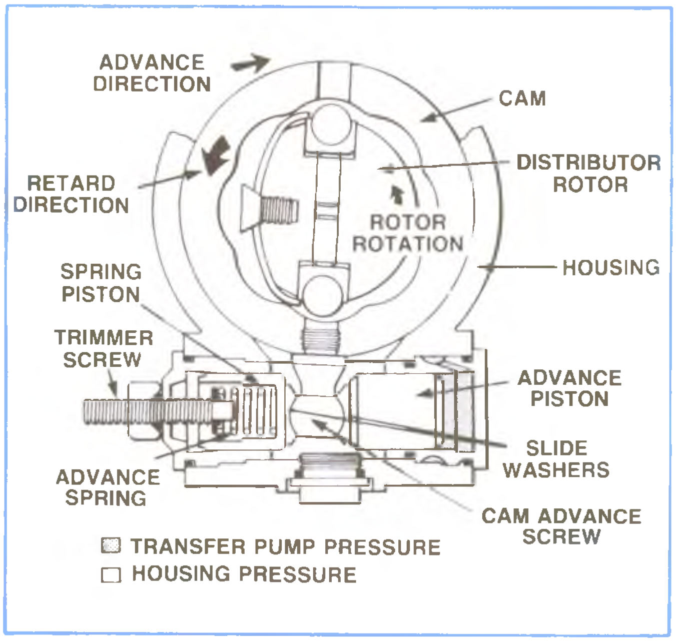


Figure 4-59, Power Side Forces.

AUTOMATIC ADVANCE LOADING FORCES

When the pump is operating, the force required to displace the plungers inward plus the momentum of the rotor assembly transmitted by the rollers, produces the cam loading force. This tends to turn the cam in the direction of rotor rotation. (Figure 4-59). This movement retards the pump's timing.

This cam loading plus spring force is transmitted to and opposes the power side forces. The combination of forces positions the advance mechanism at a definite point for each **full load speed.** At part load the reactive forces diminish and are not as effective in opposing power side forces. As a result the cam assumes a more advanced position.

LIGHT LOAD (PART THROTTLE) TIMING

The inlet metered DB2 pump (Figure 4-60) has a pumping period with a variable beginning and a constant ending. That is, at minimum throttle positions the metering valve is only open a small amount, so the plungers only move a small amount. And the rollers have to ride a great distance up the cam ramp before they can cause the plungers to pressurize the fuel. This causes retarded injection timing as compared to wide open throttle position (maximum metering valve opening). Because at WOT; plunger pressurization begins as the rollers start up the cam ramp, and peaks at the lobe. Therefore, timing must be advanced at light loads (part throttle) to compensate for this injection timing lag. The amount of light load retard is compensated by an inherent light load advance obtained from the mechanical light load advance.

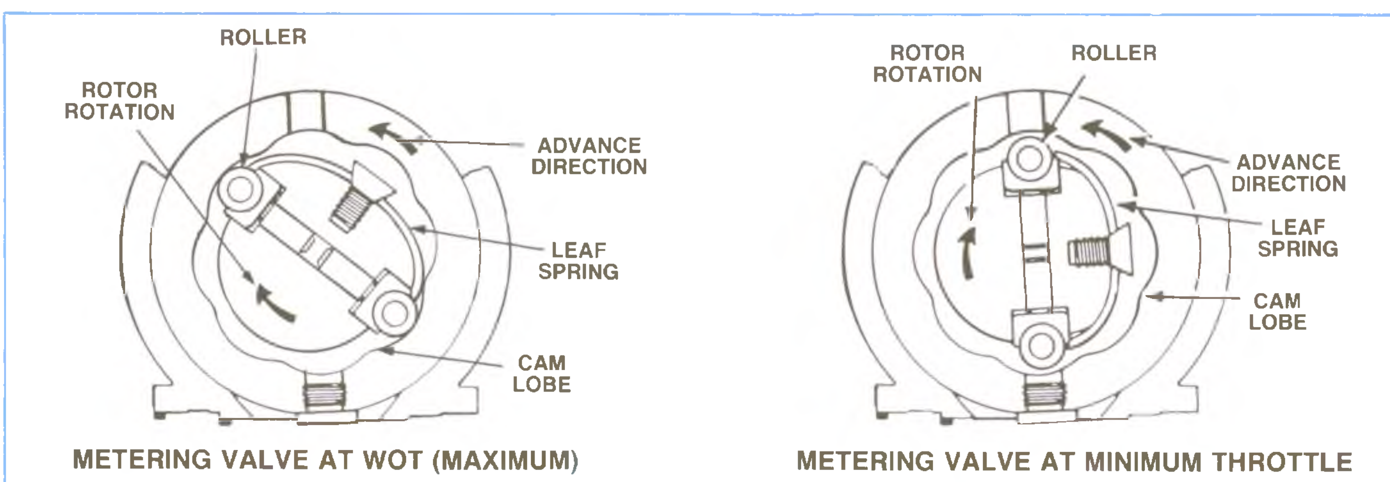


Figure 4-60, Cam Positioning.

SPEED AND LIGHT LOAD ADVANCE SYSTEMS

As noted previously, inlet metered pumps characteristically retard the start of pumping at light loads.

To correct this condition, several forms of light load advance have been developed, two of which are described below.

- The first of these, used in speed advance (used only in the 78-81 5.7L diesel), uses a smaller diameter advance piston to retard the full throttle advance curve with respect to the light load advance curve. The actual advance position at full throttle depends on the difference between the flow into the power piston chamber between pumping events and the reverse flow through the bleed orifice during the pumping event. The smaller diameter advance piston raises advance chamber pressure during the pumping event because of its small area. The flow rate through the bleed orifice is therefore increased. The smaller piston area also increases the advance motion for a given orifice flow change.

MECHANICAL LIGHT LOAD ADVANCE SYSTEM, 6.2L DIESEL

A second light load advance system, shown in Figure 4-61, is available for automotive applications that use min-max governing. In addition to the normal speed advance, light load advance is furnished as a function of throttle angle.

The mechanical light load advance system is used on automotive pumps. It relies on two systems to provide advance. The first system is a servo advance mechanism that is operated by transfer pump pressure and which positions the cam ring in response to throttle setting and engine load.

The second system is composed of a mechanical link between the throttle shaft and the servo plunger. This link is composed of a face cam connected to the end of the throttle shaft and a rocker lever assembly connected to the side of the pump housing by a pivot pin. A roller is attached to the upper end of the lever and rides on the surface of the face cam. The lower end of the lever contacts the protruding end of the servo advance plunger.

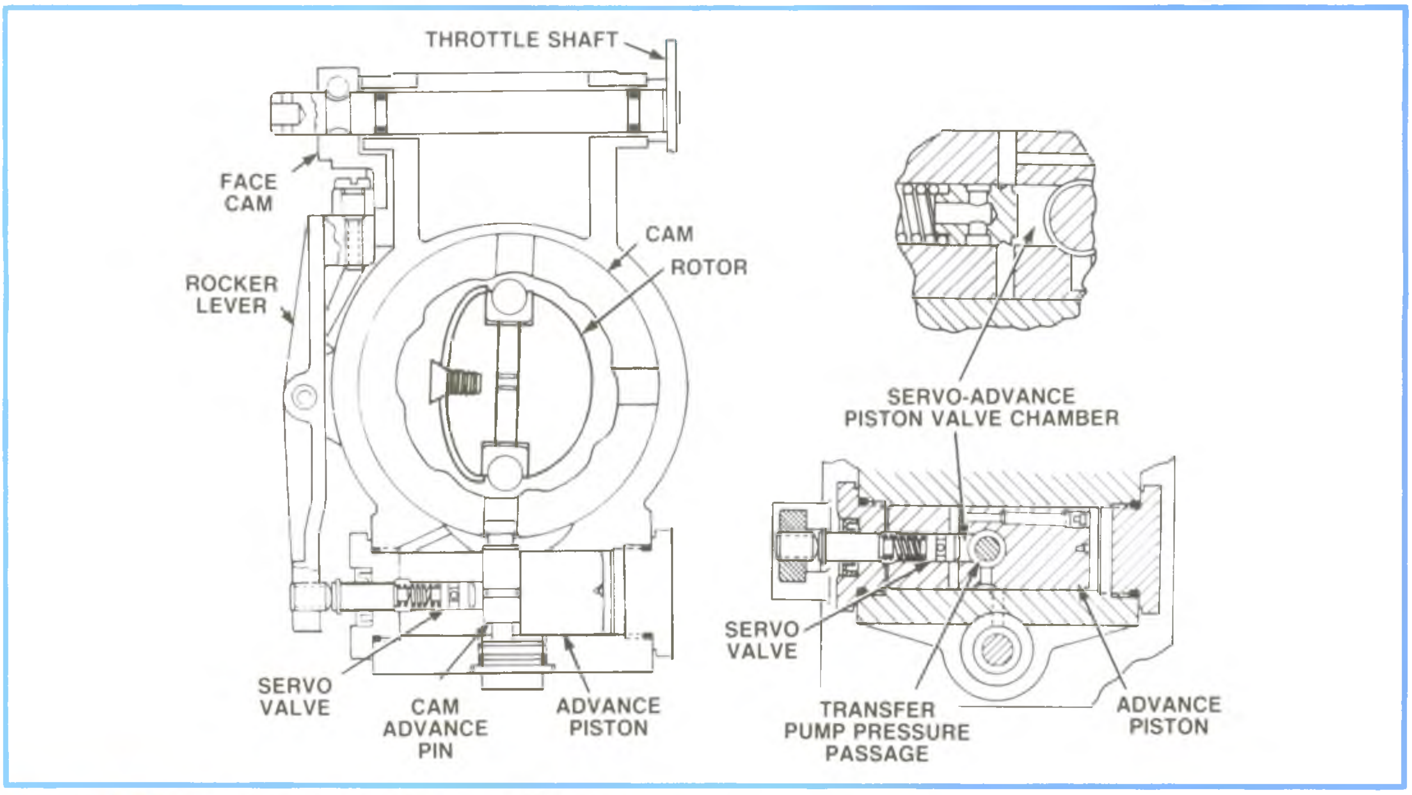


Figure 4-61, Mechanical Light Load Advance.

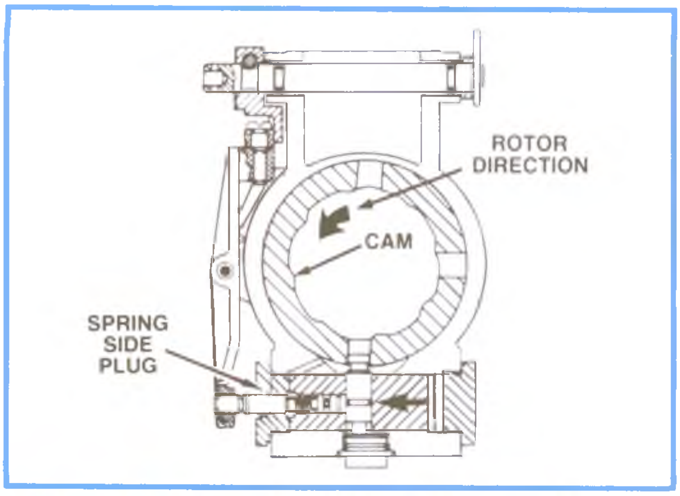


Figure 4-62, **Cam and Rotor Movement.**

MECHANICAL LIGHT LOAD ADVANCE OPERATION

As with the previous advance system, the rotor's force is transferred to the cam ring during injection. This force continually urges the piston toward the retard position. However, an opposing force is supplied by transfer pump pressure acting on one end of the servo advance piston. (Figure 4-62).

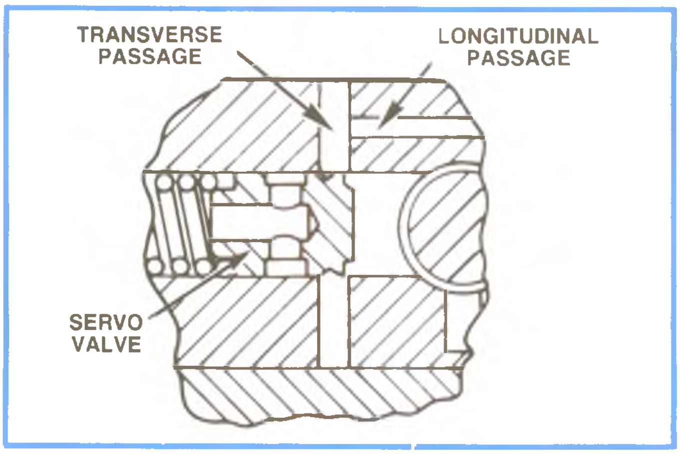


Figure 4-63, **Servo Valve Movement.**

The position of the servo valve in the advance piston bore regulates this force, and determines the degree of advance achieved at any throttle setting or load. (Figure 4-63).

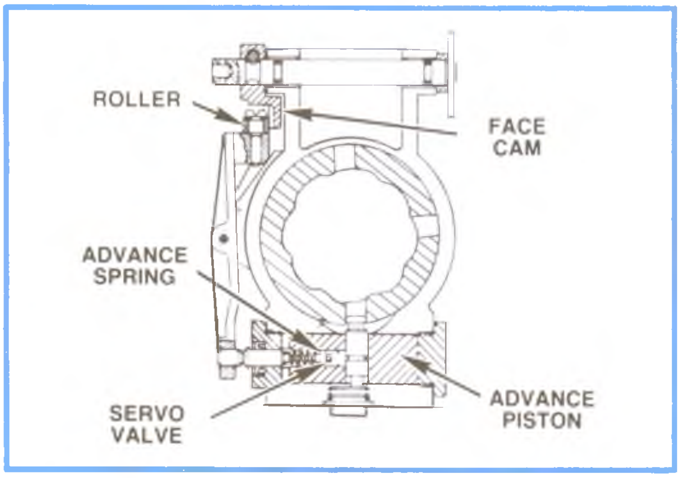


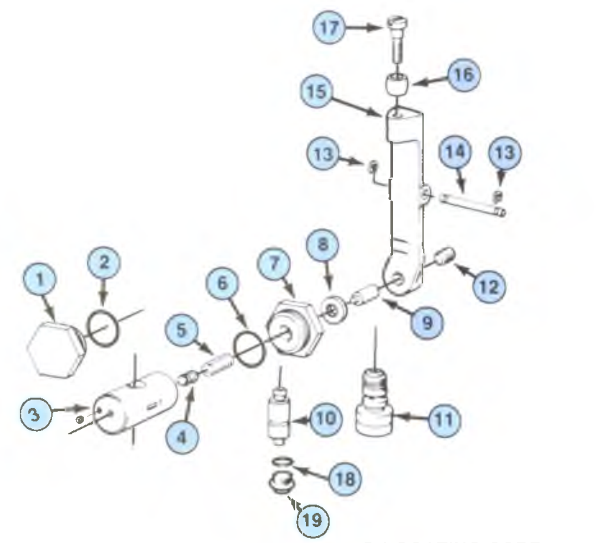
Figure 4-64, **Face Cam To Rocker Lever Action.**

Additional advance at low throttle settings is provided by the face cam to rocker lever action which changes the reference point of the spring. (Figure 4-64).

This allows the servo-advance valve to open further and provide a greater degree of advance at low throttle settings. The end result of both of these advance mechanisms is a vast improvement in the driveability of diesel equipped vehicles.

INTEGRAL ORIFICE ADVANCE PISTON

See Figure 4-65. The advance piston orifice screw has been eliminated, and the orifice is now machined into the piston. The orifice size in 1984 and later is .030 in. 1982-83 orifice size was a .040 in. orifice screw. Stanadyne part #24433 (2443405).



1. POWER SIDE PLUG
2. "O" RING SEAL
3. PISTON ASSEMBLY
4. SERVO ADVANCE VALVE
5. MECHANICAL LIGHT LOAD
6. "O" RING SEAL
7. SPRING SIDE PLUG
8. WASHER
9. SERVO ADVANCE PLUNGER
10. CAM ADVANCE PIN
11. HEAD LOCATING SCREW AND FILTER
12. SERVO ADVANCE ADJUSTING SCREW (DO NOT ADJUST)
13. RETAINING RING
14. ROCKER LEVER PIN
15. ROCKER LEVER
16. ROLLER
17. SCREW
18. "O" RING
19. CAM ADVANCE PIN HOLE PLUG

Figure 4-65, Advance Piston.

HEAD LOCATING SCREW AND FILTER ASSEMBLY

A new head locating screw (#24566) with nylon filter has been introduced to prevent contaminants from reaching the advance piston area. See Figure 4-66. The filter is installed into the body of the screw, the end of which is crimped over. The screw is only available as an assembly, as shown on the right, and is identified by a groove around the head of the screw. Suitable for use in all mechanical light load advance-type pumps.

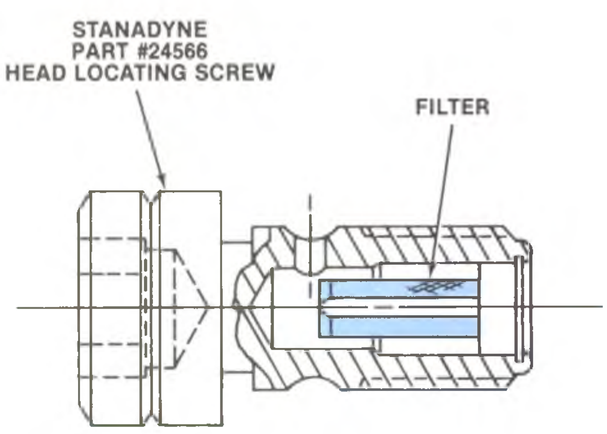


Figure 4-66, Head Locating Screw With Filter.

HOUSING PRESSURE COLD ADVANCE (H.P.C.A.)

All pumps are equipped with a Housing Pressure Cold Advance solenoid. (Figure 4-67).

This component has been designed to allow more advance during engine warm-up. It consists of a solenoid assembly and a ball check return connector, both in a redesigned governor cover. The electrical signal which controls the operation of the solenoid is generated by a sensing unit mounted on the rear of the right cylinder head.

1984 and later H.P.C.A. is controlled by a cold advance circuit (C.A.C.) relay.

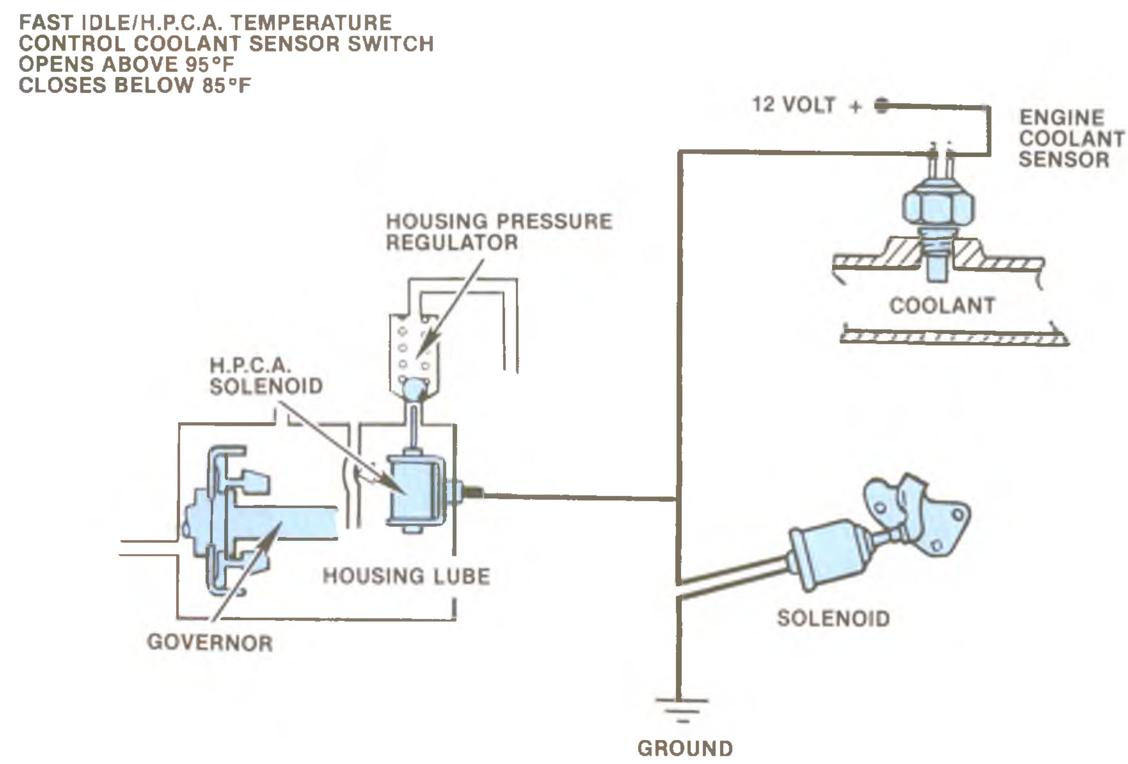


Figure 4-67, H.P.C.A. Solenoid Installation.

The switch is calibrated to open the circuit at 95°F for 83 and later (115° on 1982). Below the switching point, housing pressure is decreased from 8-12 psi to zero which advances the timing 3°. Above, the switch opens de-energizing the solenoid and the housing pressure is returned to 8-12 psi. The fast idle solenoid is energized by the same switch. The switch again closes when the temperature falls below 85°F (95°F on 1982).

PURPOSE:

1. Emission Control device.
2. Better cold starts.
3. Improves idle, reduces white smoke and noise when cold.

H.P.C.A. OPERATION

During cold warm-up conditions, the plunger moves up and the rod contacts the return connector ball. (Figure 4-68). When the ball is moved off of its seat, the housing pressure is reduced due to an increased flow through the connector. Because of lowered housing pressure, the resistance to the advance piston movement is less, and thus the piston can move further in the advance direction.

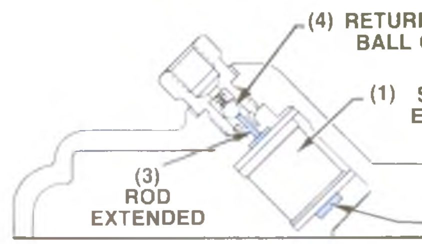


Figure 4-68, Solenoid Energized.

When the engine reaches normal operating temperature the electrical signal to the solenoid ceases, and the plunger is returned to its initial position. (Figure 4-69).

1984 H.P.C.A. Terminal will be changed (24669) because of 84 California System.

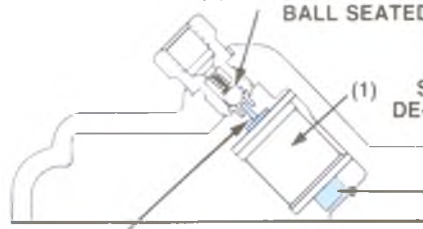


Figure 4-69, Solenoid De-Energized.

— NOTE —

When changing the fuel filter, injection pump or when the car has run out of fuel, disconnect the connector from the temperature switch and jumper connector terminals. This will aid in purging air from the pump by allowing more fuel to pass to the return line. (This procedure is necessary only on a hot engine, as the circuit will always be closed when the engine is cold.)

MIN-MAX GOVERNOR

Now for a look at the operation of the assembly that controls the engine speed at low idle and high speed. The Min-Max governor.

Illustrated here (Figure 4-70) are the main components of the governor. They are the governor weights, the governor arm, the low idle spring, the idle spring guide, the main governor spring, the main governor spring guide and the guide stud.

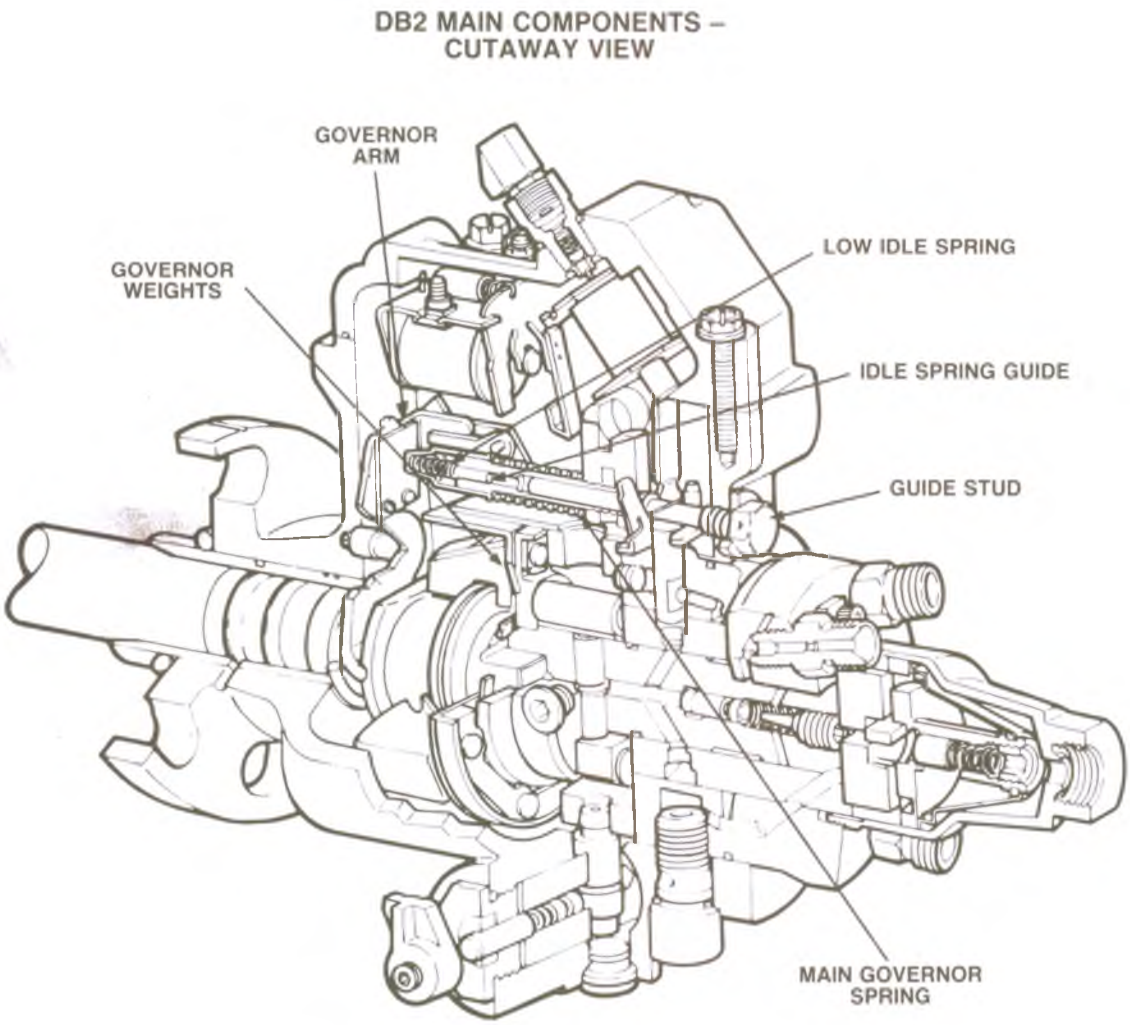


Figure 4-70, Governor Components.

Low Idle

Figure 4-71 shows the relationship of the parts when the pump is running at low idle. The low force developed by the governor weights is balanced by the low idle spring. Thus, only a small amount of fuel is delivered by the metering valve.

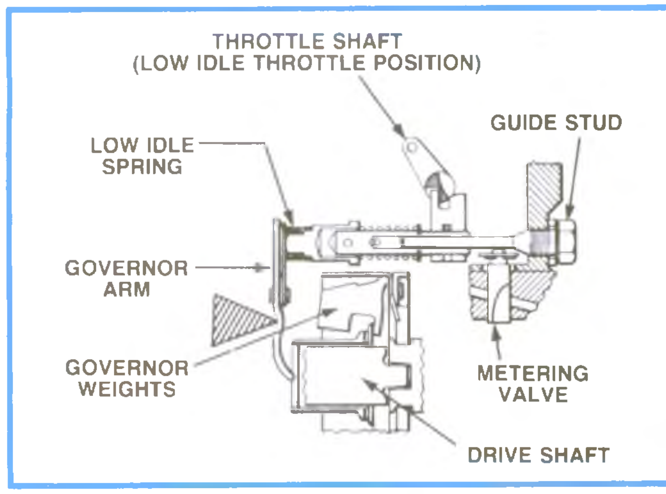


Figure 4-71, Governor at Low Idle.

Mid-Range

In Figure 4-72, the throttle is in a mid-range position. The idle spring is fully collapsed, and the governor weights have moved out partially. The main governor spring is designed such that the governor weight force cannot overcome the spring's preload until the engine reaches the maximum rated speed. Thus, at partial throttle, the assembly acts as a solid link against the governor arm. This permits the driver to control the metering valve position with the throttle over the entire mid-range speed.

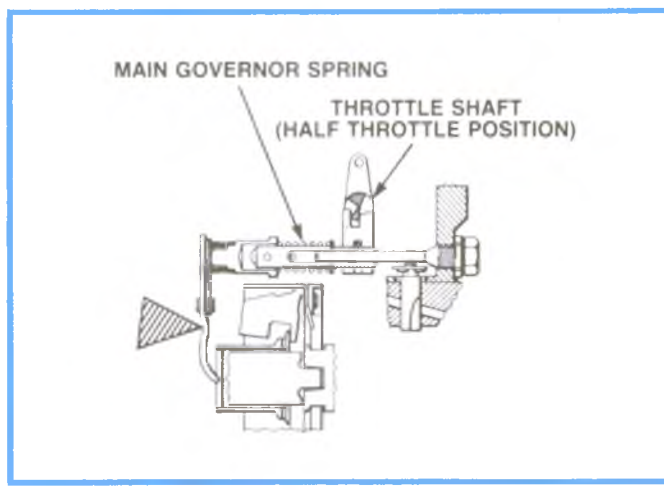


Figure 4-72, Governor at Mid-Range Throttle.

Full Load

With the throttle in the full load position, the engine speed and the pump speed increase until the governor weights have generated enough force to deflect the main governor spring. This movement turns the metering valve to the shut-off position, thereby preventing an engine overspeed condition. (Figure 4-73).

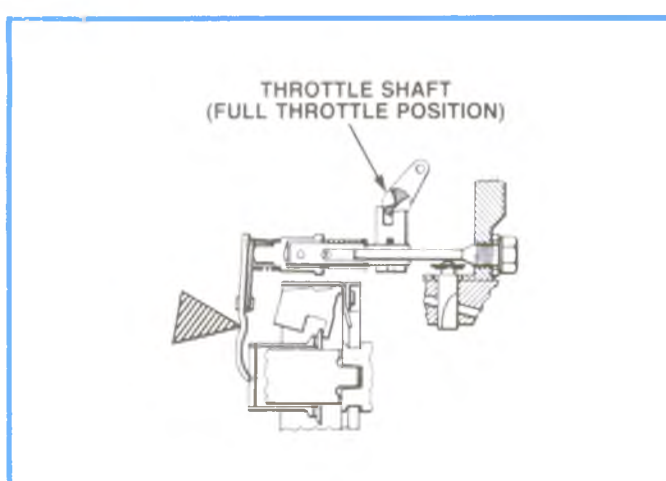


Figure 4-73, Governor at Full Load.

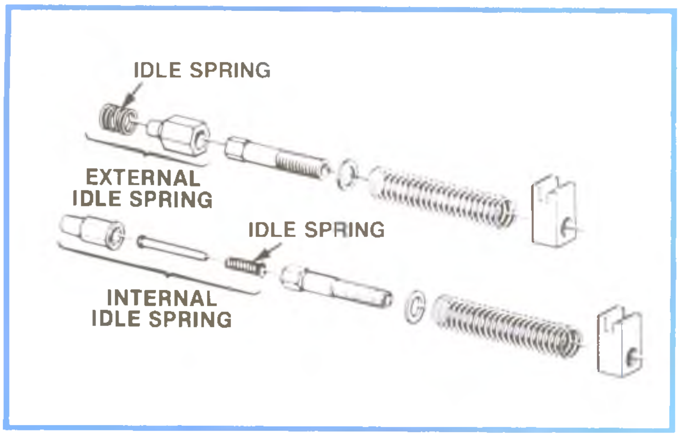


Figure 4-74, Internal Idle Spring Design.

INTERNAL IDLE SPRING

The 1984 and later 6.2L California applications use an internal idle spring, which controls the gap between the sleeve and the washer. (Figure 4-74). The close tolerance will result in a more accurate input to the engine throttle position sensor, which regulates the exhaust gas recirculation and exhaust pressure regulator functions.

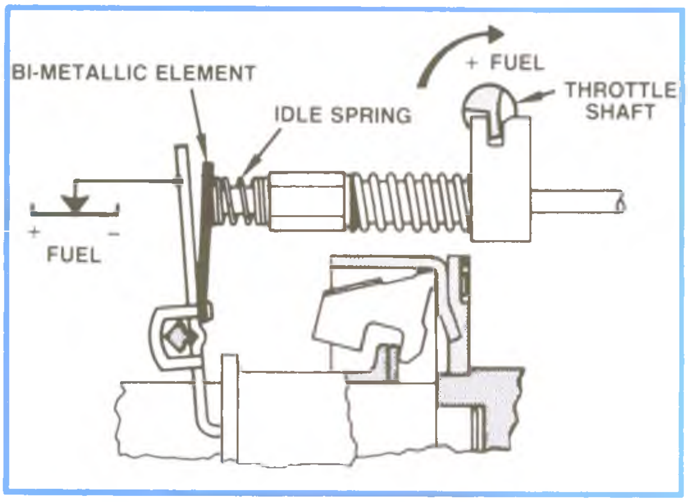


Figure 4-75, Bi-Metal Operation.

HOT FUEL IDLE SPEED DROP

When idle speed drops due to hot fuel, a bi-metal strip on the governor arm deflects. This creates a "spring load" on the governor arm causing it to rotate slightly, thus repositioning the metering valve to pass more fuel and increase speed slightly. (Figure 4-75).

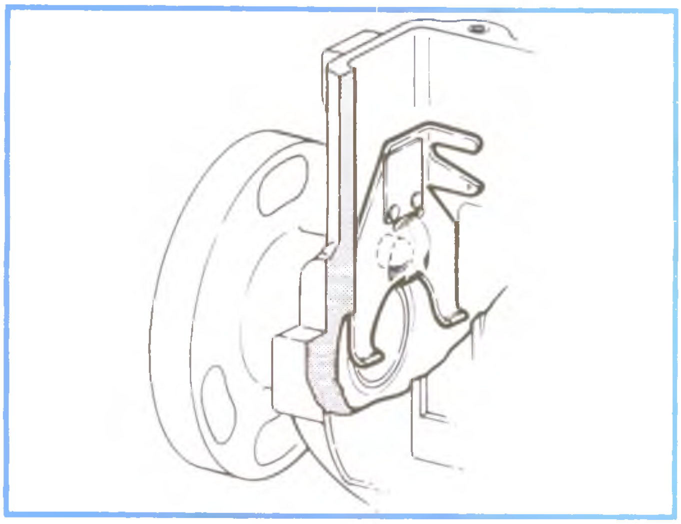


Figure 4-76, Ball Pivot Governor Arm.

GOVERNOR ARM 1982-84

See Figure 4-76. The 6.2L uses a ball-pivot governor arm which has a slot below the bi-metal strip. This prevents interference with the ball pivot conical extrusion. All governor arms of this style now have a tab at the bottom of the conical extrusion, for better retention. The bi-metal strip is covered by a .012″ thick back-up leaf for wear resistance.

Injection Pump Rotor

The final component that we will examine is the heart of the diesel injection pump; the rotor. (Figure 4-77).

Due to the extremely close tolerances of the rotor and head assemblies, a thermal relief groove has been incorporated into the rotor design. Thermal shock can cause a head assembly to contract, resulting in the seizure of the head and rotor. To lessen the possibility of this happening, a reduction in the rotor diameter at the area between the ports has been added.

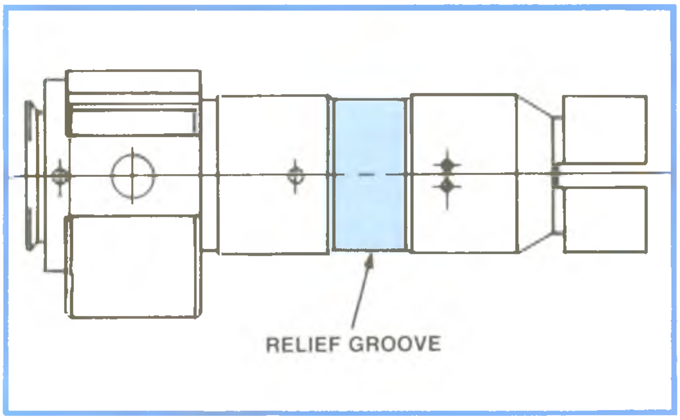


Figure 4-77, **Rotor.**

The rotor in 1980 through 1984 pumps incorporates residual pressure balancing ports. These small vent ports operate by simultaneously registering with the head discharge outlets shortly after each injection. This operation allows a balance of the residual pressures between injection lines and helps smooth out the operation and the sound of the engine.

ROTOR SEIZURES

A rotor seizure can be due to a loss of clearance between the hydraulic head and rotor during the transient (or warm-up) condition. Heat generated by shearing the oil film at the hydraulic head to rotor interface causes heating of the hydraulic head and rotor. Because the mass of the rotor is less than that of the hydraulic head, it heats and expands at a faster rate. The clearance at the interface of the hydraulic head and rotor is thereby reduced and the possibility of rotor seizure is introduced.

The rotor seizures in a test series occurred at the midpoint of the rotor length indicating that the maximum rotor heating and expansion occurred at the midpoint. Therefore, a relief groove was added to the diameter of the rotor, as shown in Figure 4-77 to minimize the potential for rotor seizure following a cold, high speed acceleration.

DELIVERY VALVE

The delivery valve rapidly decreases injection line pressure after injection to a predetermined value lower than that of the nozzle closing pressure. This reduction in pressure permits the nozzle's valve to return rapidly to its seat, achieving sharp delivery cutoff and preventing improperly atomized fuel from entering the combustion chamber.

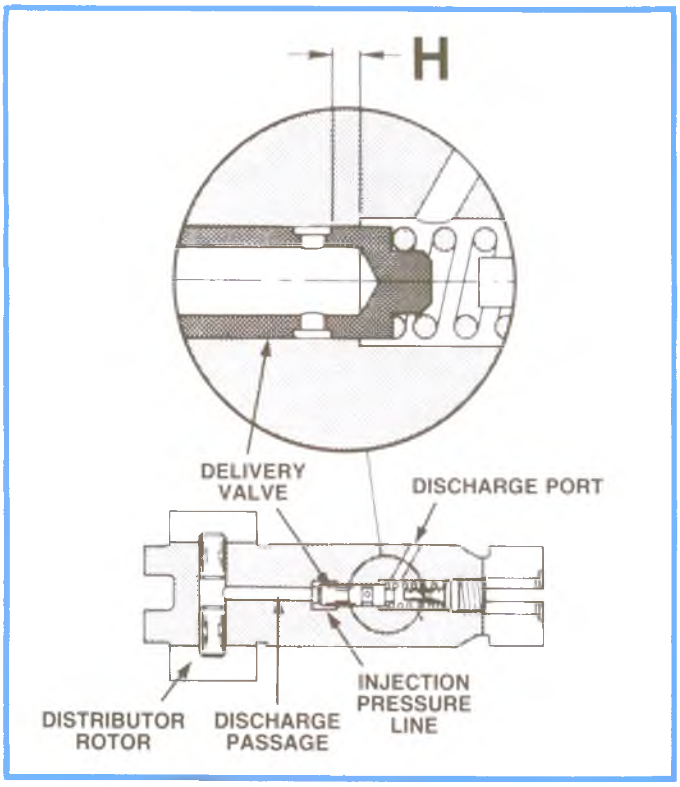


Figure 4-78, Delivery Valve.

DELIVERY VALVE OPERATION

A single, spring loaded, delivery valve (Figure 4-78) is located in the center of the DB2 pump rotor. It serves as a one way check valve to seal the pumping chamber from the injection line and also controls residual line pressure by providing volume unloading.

At the beginning of pumping, the delivery valve is displaced into its spring chamber until, at a valve lift equal to the dimension "H", fuel flows from the plungers to the discharge port. At the end of the pumping cycle, the plungers travel outward allowing the delivery valve to move toward its seat. As the valve closes and the retraction volume (Valve Area H) is removed from the delivery valve spring chamber, a negative pressure wave is propagated toward the nozzle. The negative pressure wave lowers the injection line pressure to allow rapid nozzle closure and prevents secondary injection.

The delivery valve operates in a bore in the center of the distributor rotor. The valve requires no seat — only a stop to limit travel. Sealing is accomplished by the close clearance between the valve and bore into which it fits. Since the same delivery valve performs the function of retraction for each injection line, the result is a smooth running engine at all loads and speed.

When injection starts, fuel pressure moves the delivery valve slightly out of its bore and adds the volume of its displacement to the delivery valve spring chamber. Since the discharge port is already opened to a head outlet, the retraction volume and plunger displacement volume are delivered under high pressure to the nozzle. Delivery ends when the pressure on the plunger side of the delivery valve is quickly reduced, due to the cam rollers passing the highest point on the cam lobe.

Following this, the rotor discharge port closes completely and a residual injection line pressure is maintained. Note that the delivery valve is only required to seal while the discharge port is opened. Once the port is closed, residual line pressures are maintained by the seal of the close fitting head and rotor. It is possible that the residual pressure may vary between injection lines.

TRAILING PORT SNUBBER

A damper orifice is located after the delivery valve. This damper is called a trailing port snubber (Figure 4-79).

The trailing port snubber is used to prevent secondary injections and cavitation errosion of the high pressure system by weakening reflected pressure waves. This port trails the discharge port radially and resonates the fuel back into the delivery valve cavity.

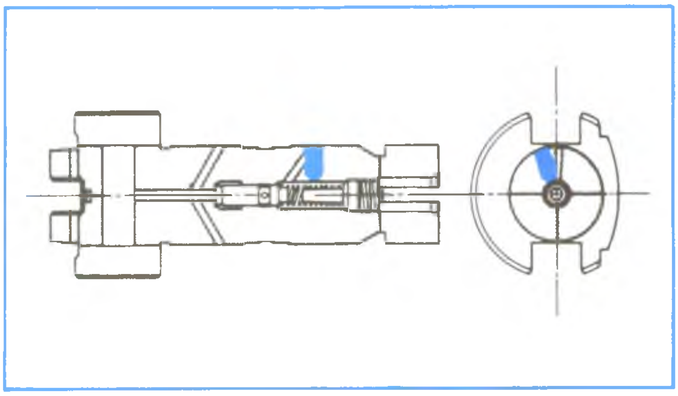


Figure 4-79, Trailing Port Snubber.

The snubber is drilled directly into the rotor bore and is reduced to .018″ in diameter at the bottom of the hole. Since it is located radially behind the discharge port, reflected pressure waves will re-enter the rotor after each injection. The flow rate into the delivery valve bore is then restricted by the .018″ orifice.

Phasing of the rotor snubber port in relation to the other port sequences must be carefully designed. This is especially true for an eight cylinder distributor pump where rotor angular space is at a premium.

The discharge cycle at each port is about 20 degrees. At the 15 degree point in the injection the snubbing begins for approximately 22 degrees.

In the oscilloscope traces (Figure 4-80) the reflected waves cause a needle lift in a system with a standard rotor. With an .018″ snubber port rotor, the pressure waves are reduced and the nozzle valve remains seated between injection.

This reduces the cavitation erosion potential. In addition, pressure waves reflected from the nozzle are partially, rather than totally, reflected as they pass through the snubber orifice.

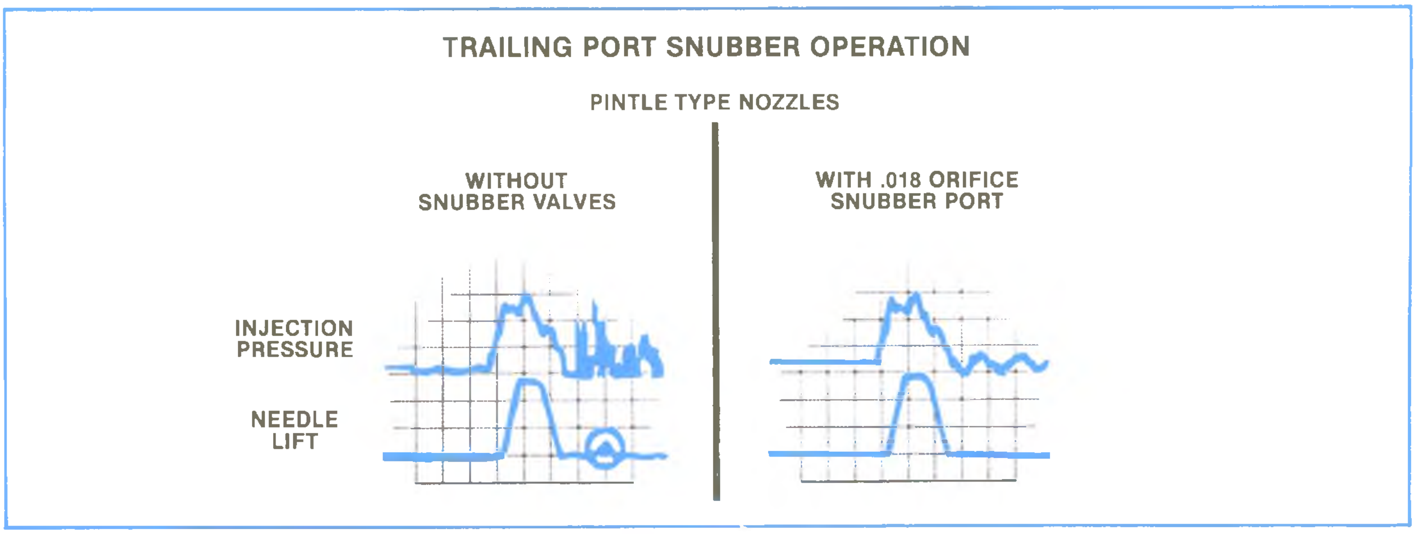


Figure 4-80, Trailing Port Snubber Graph.

Injection Pump Repairs

— NOTE —

The following procedure is not intended as a guide for complete overhaul. It does not include repairs which would involve calibration on a test stand. For operations which require re-calibration, the pump must be sent to an authorized Stanadyne agency.

Figure 4-81 shows a typical test stand installation. The test stand incorporates a 2 to 15 H.P. electric motor, depending on the particular model used, which drives the injection pump. The stand's motor simulates the automotive engine with the rpm controlled on the machine by the operator and not by the throttle opening. Various tests and adjustments are performed. Some are: Electric solenoid pull-in voltage, housing pressure cold advance solenoid operation, face cam position, min-max governor, return oil volume, housing pressure, transfer pump pressure and automatic advance adjustments. Actual calibration of fuel delivery is not adjustable within the head and rotor assembly but is affected directly by some of the above adjustments. Various rpm ranges and throttle openings are used to check output of the pump.

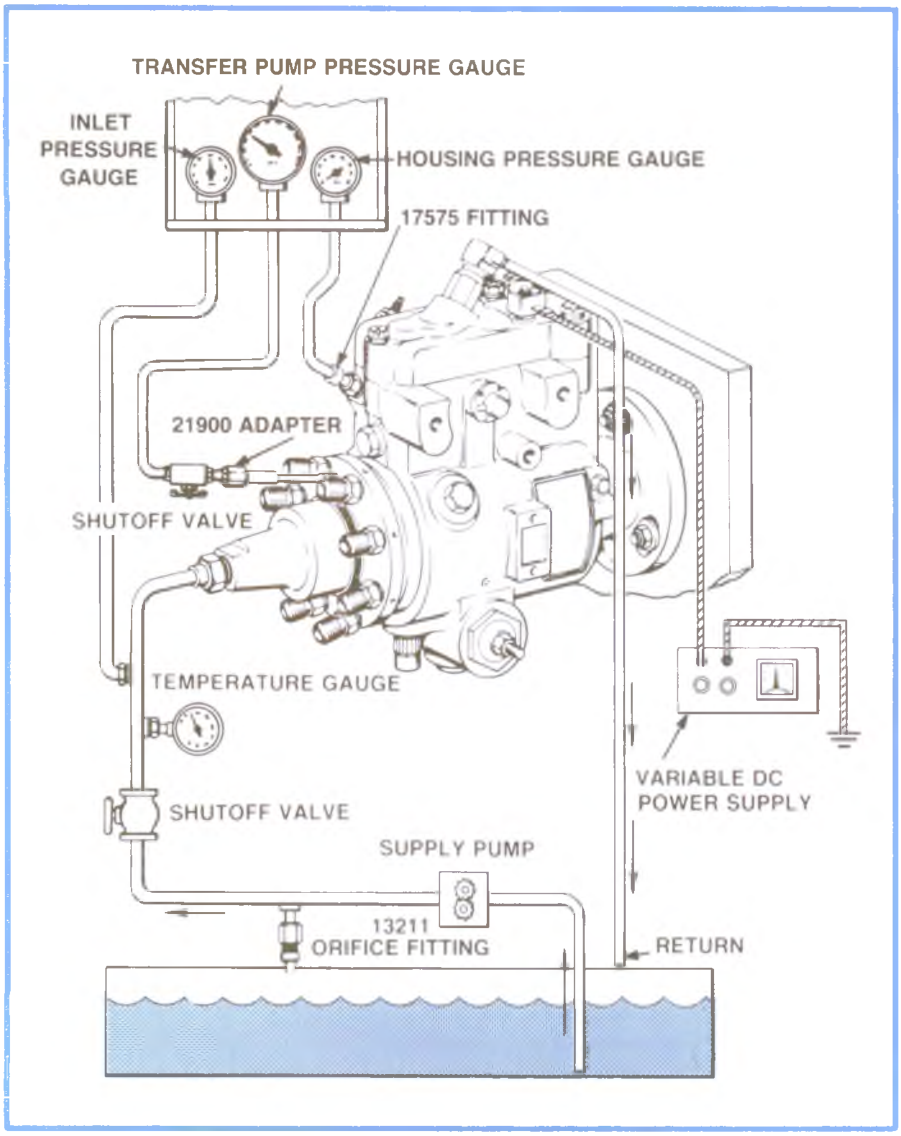


Figure 4-81, Typical Test Stand Installation.

— IMPORTANT —

It should be understood that the injection pump is designed to deliver a metered amount of fuel at the proper time and is therefore incapable of delivering a rich or lean mixture. It should also be understood that other than a failure of the governor weight retainer ring or the correction of the min-max governor, the injection pump will have very little to do with a rough idle condition and therefore generally should not be sent to the local Roosa Master shop for rough idle.

GOVERNOR WEIGHT RETAINER RING FAILURES

Background information of failed governor weight retainer ring: diesel fuel that is contaminated with excessive water or the presence of alcohols found in some additives not normally present in recommended diesel fuels may accelerate failure of the Poly-urethane (Pellethane) governor weight retainer ring in the injection pump. Failure of the ring is heat related and will most likely result in a rough idle condition and, in some instances, the engine may not run. A failed ring will break apart into small black particles plugging the fuel return check valve. Remove the check valve if small particles are observed. Confirm the findings by removing the pump cover and rotating the governor weight retainer in both directions (Figure 4-82) using a suitable tool or screwdriver. If the retainer moves more than 1/16″ and does not return, the retainer ring has failed. Normally a failed ring will allow 1/4″ free movement.

If a failed ring is found, the pump will require removal from the engine. Follow the procedures listed in this manual for replacement.

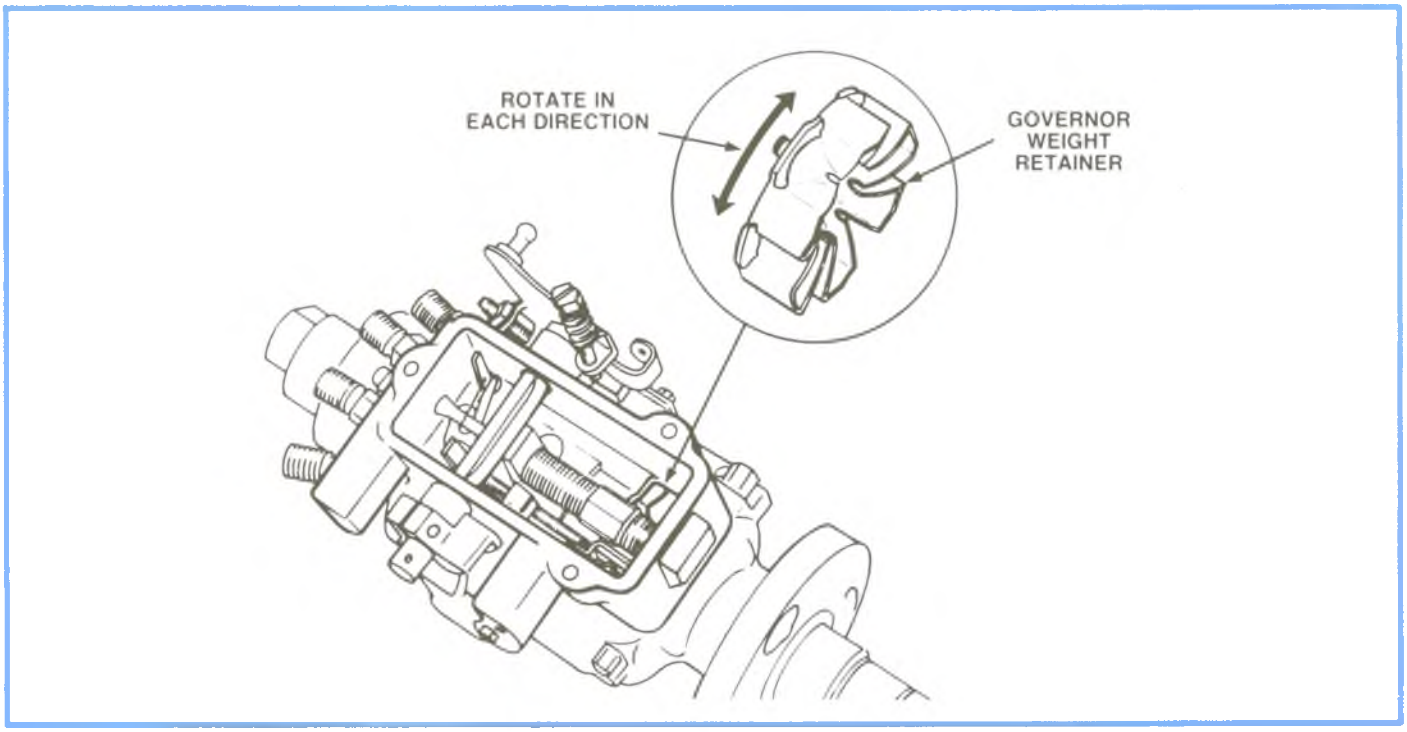


Figure 4-82, **Failed Governor Weight Retainer Ring Checking Procedure.**

SERVICE OPERATIONS ON-VEHICLE

Operations which can be performed individually without removing the pump from the engine are as follows:

- Cover seal replacements
- Guide stud seal replacements
- Throttle shaft seal replacements
- Governor weight retainer ring checking procedure
- Min-Max governor service

The procedure that follows include disassembly, various seal replacements, installation of the pellethane governor weight retainer ring, and a bench leak test.

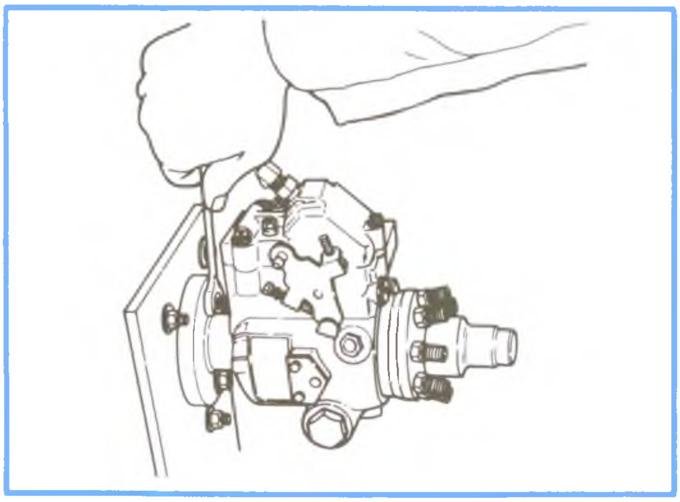


Figure 4-83, Mounting Pump in Fixture.

Mounting in Holding Fixture

Mount the pump in the holding fixture, Tool #J-29692B (BT 8046). Always use the fixture to avoid damage to the pump. NEVER MOUNT THE PUMP DIRECTLY IN A VISE. (Figure 4-83).

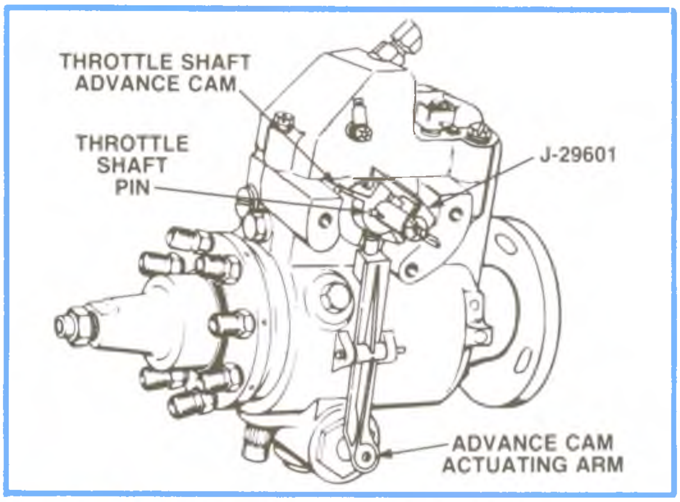


Figure 4-84, Face Cam Tool J-29601.

See Figure 4-84. Rotate the throttle lever to the low idle position and install Tool J-29601 over the throttle shaft with slots of tool engaging pin. Put the spring clip over the throttle shaft advance cam and tighten the wing nut. Without loosening the wing nut, pull the tool off the shaft. (This provides the proper alignment on reassembly).

GOVERNOR COVER

Unscrew the three governor cover hold down screws and remove the governor control cover and cover gasket. (Figure 4-85).

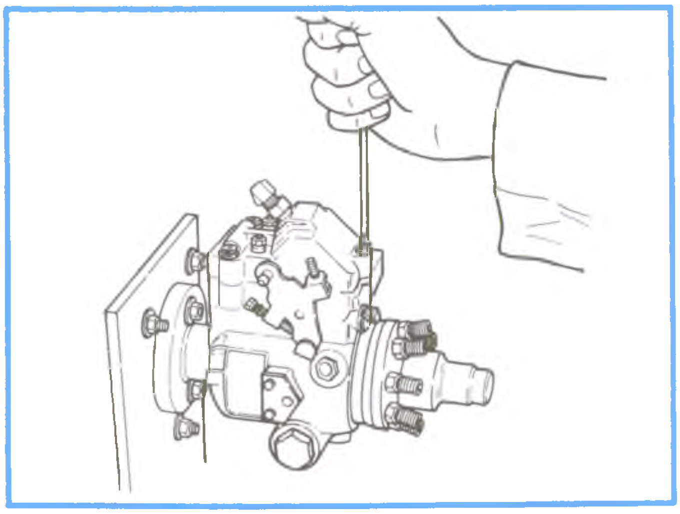


Figure 4-85, **Removing Governor Cover.**

SOLENOIDS

Examine the electric shut off solenoids (Figure 4-86) and the housing pressure cold advance solenoid if so equipped, for damage or debris. Clean the solenoids with compressed air. Solenoid plungers should move freely in their bores.

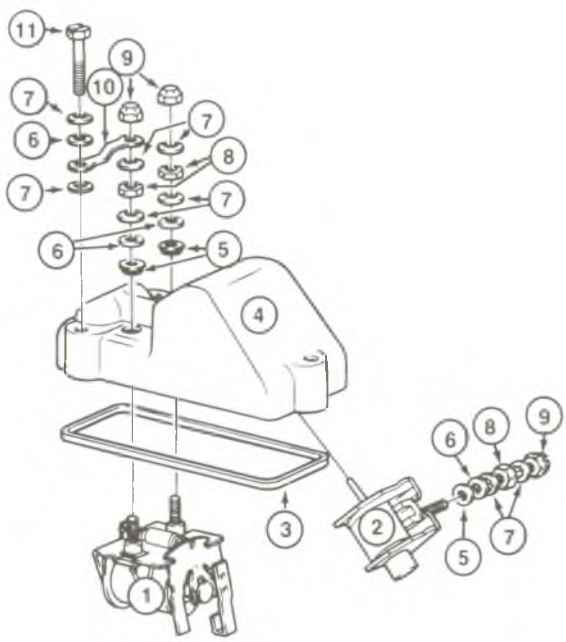


Figure 4-86, **Solenoids.**

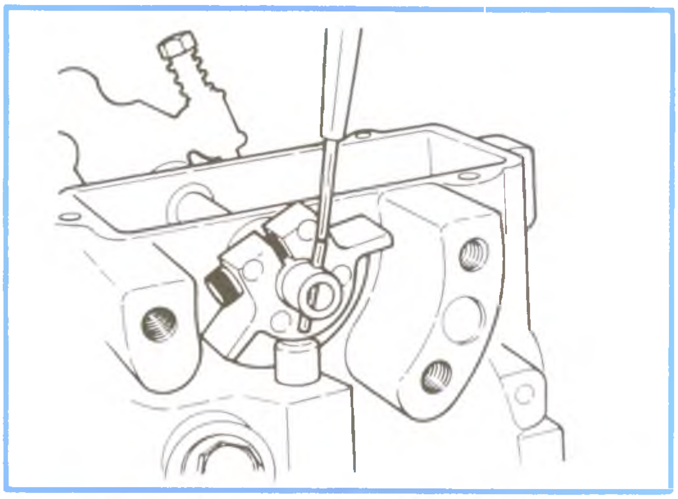


Figure 4-87, Removing Pin From Shaft.

Remove the drive pin from the throttle shaft using the appropriate drift punch. (Figure 4-87).

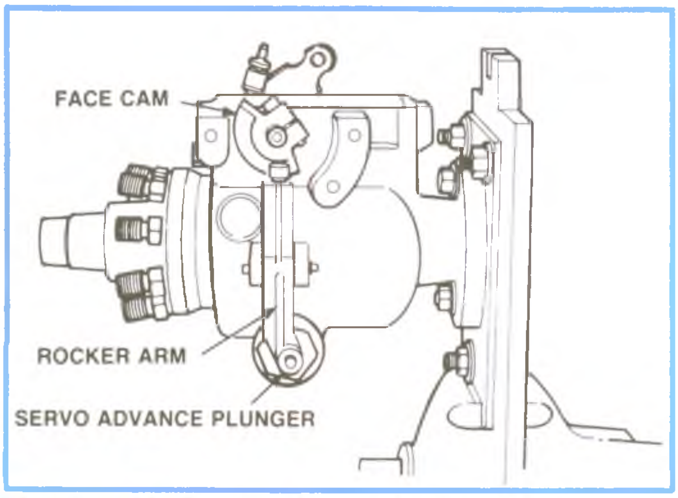


Figure 4-88, Rocker Arm and Face Cam.

LIGHT LOAD ADVANCE ROCKER ARM AND FACE CAM

All mechanical light load advance pumps are equipped with a rocker arm, which contact the servo advance plunger at one end and a face cam which is located on the throttle shaft at the other end. (Figure 4-88).

Pry off the retaining rings from the rocker lever pin and discard the rings. (Figure 4-89).

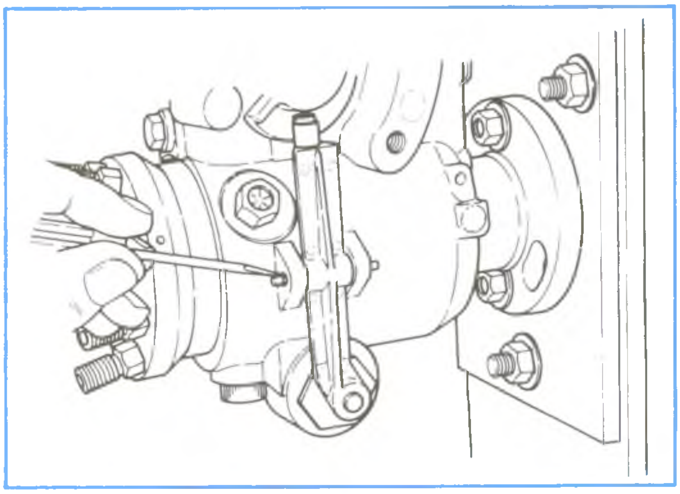


Figure 4-89, Removing Retaining Rings.

Push out the pin and remove the lever assembly. (Figure 4-90).

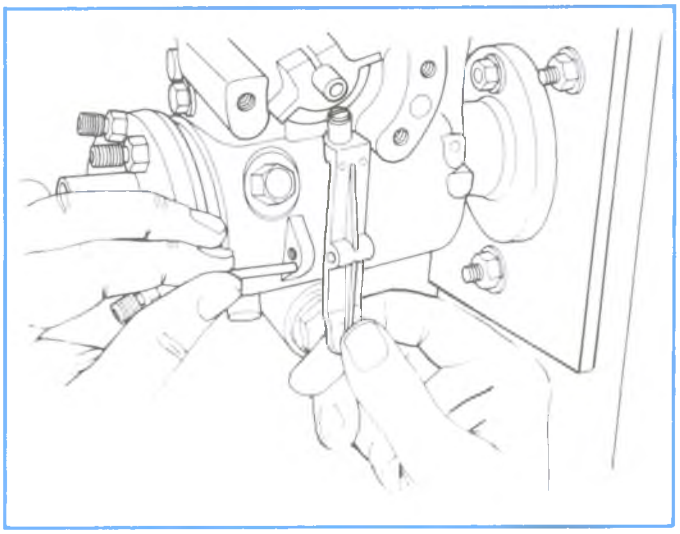


Figure 4-90, Removing Lever Assembly.

Face Cam Removal

Loosen the face cam screw, using a 5/32″ hex bit, or #27 Torx bit. The screw must be fully withdrawn to allow for removal of the face cam. (Figure 4-91).

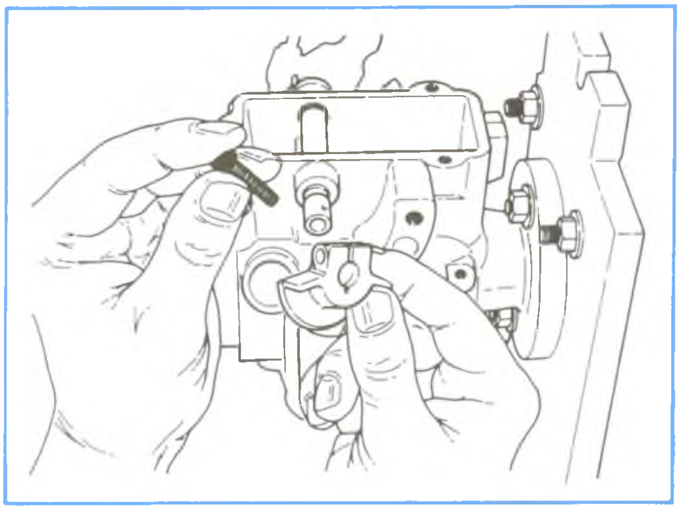


Figure 4-91, Removing Face Cam.

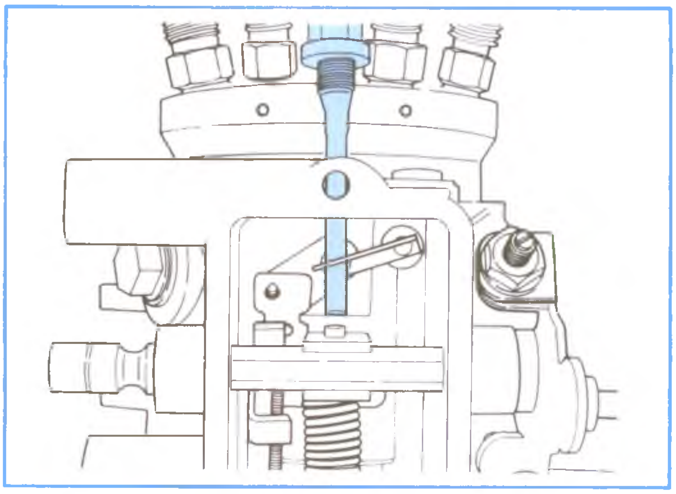


Figure 4-92, Loosening Guide Stud.

Guide Stud

Using a 7/16″ open end wrench or a ¼″ Allen, loosen and withdraw the guide stud. (Figure 4-92).

Observe position of metering valve spring over the top of the guide stud. This position must be exactly duplicated during reassembly. Remove guide stud and washer.

— NOTE —

Two types of guide stud and washer combinations are in use:

- **The current combination is a guide stud with a 1/4 inch internal hex and utilizes a steel washer with trapped elastomer.**
- **The other combination has a 7/16 inch external hex and an aluminum washer. This type of washer must be replaced during reassembly. The correct guide stud and washer combination must be used to prevent fuel leakage.**

Governor Spring Components

While holding the Min-Max assembly between the thumb and forefinger, rotate the throttle and lift out the governor spring components. (Figure 4-93).

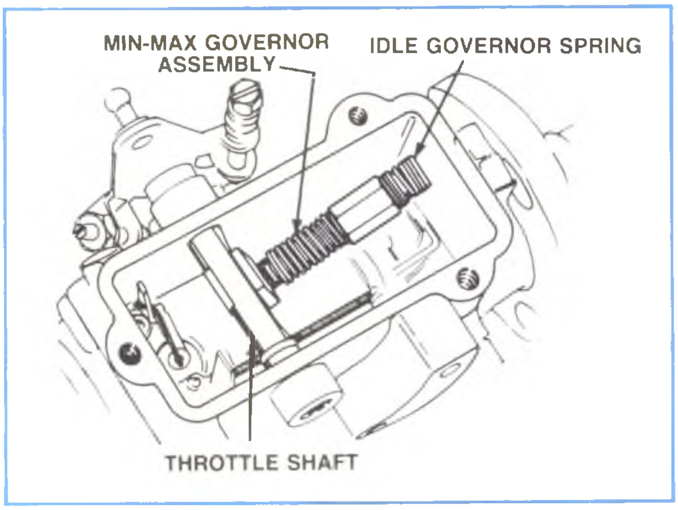


Figure 4-93, Removing Governor Spring.

Throttle Assembly

Now, simply pull the throttle shaft assembly through the housing. Remove the mylar washer and O ring seals from the throttle shaft. (Figure 4-94).

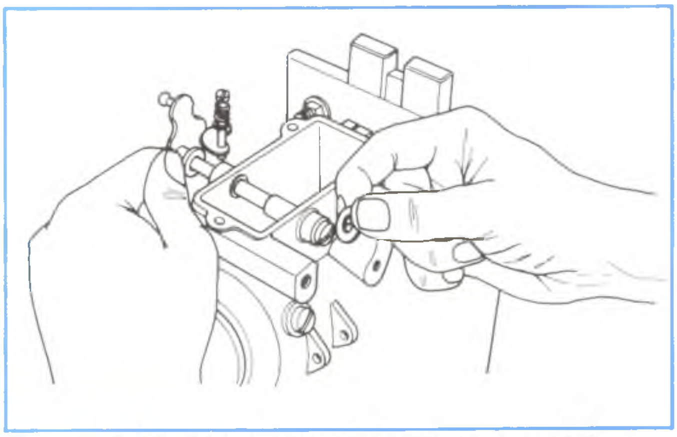


Figure 4-94, Removing Throttle Assembly.

Linkage Hook

While depressing the metering valve assembly raise the linkage hook from the metering valve arm. (Figure 4-95).

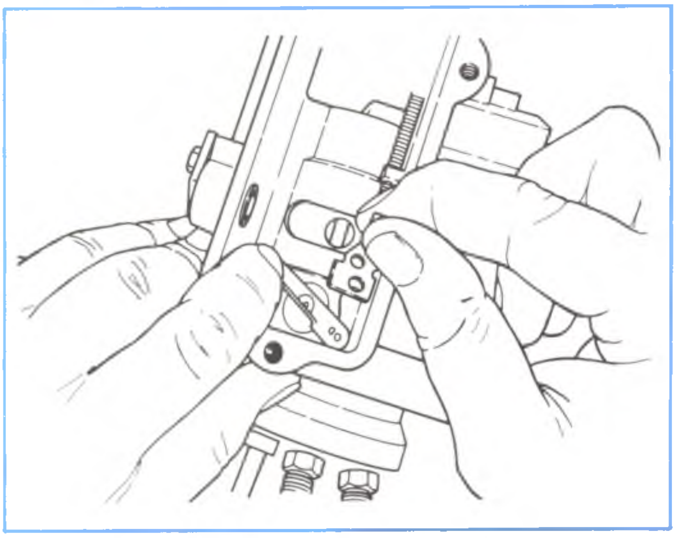


Figure 4-95, Disengaging Linkage Hook.

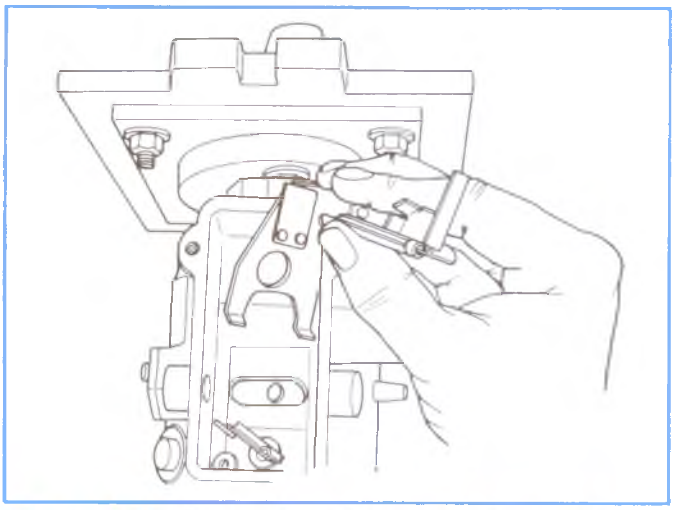


Figure 4-96, **Removing Governor Arm and Linkage (Late Model).**

Governor Arm and Linkage (Late Model)

The governor arm and linkage assembly may be removed as a single unit. (Figure 4-96).

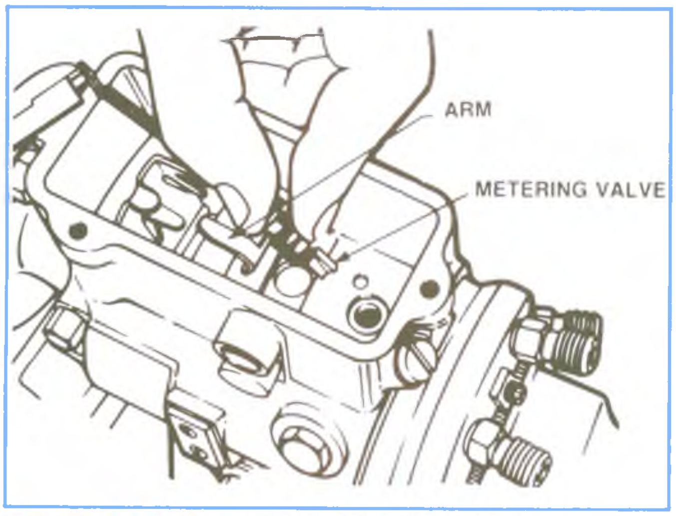


Figure 4-97, **Removing Metering Valve.**

Metering Valve

Remove the metering valve assembly. (Figure 4-97).

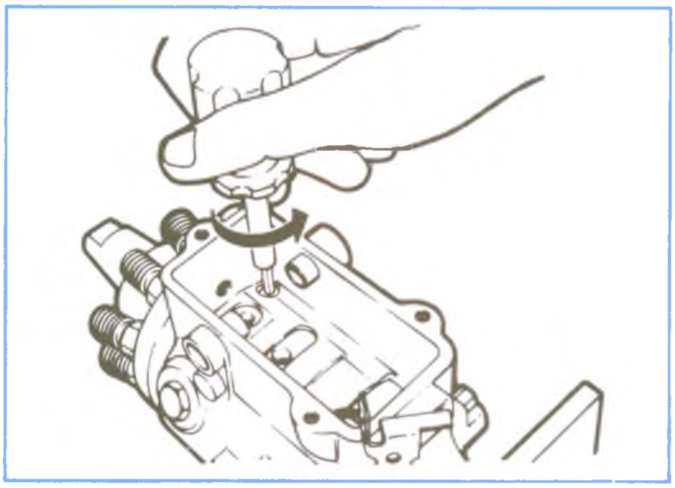


Figure 4-98, **Removing Vent Wire Assembly.**

Vent Wire Assembly

Remove the vent wire screw assembly, using a 1/8″ Allen wrench. (Figure 4-98).

End Cap Locking Screw

Loosen and remove the transfer pump end cap locking screw, plate and seal from the hydraulic head. (Figure 4-99).

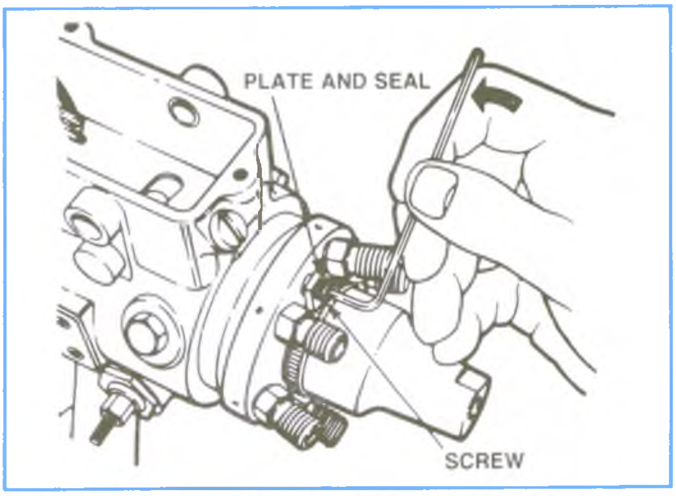


Figure 4-99, Removing End Cap Locking Screw.

— NOTE —

The following 4 procedures are optional, and are used to replace the end cap seal, if it is found to be leaking.

Transfer Pump End Cap

In a counterclockwise direction, loosen and remove the transfer pump end cap assembly, using the appropriate end wrench. (Stanadyne Tool #20548, Figure 4-100).

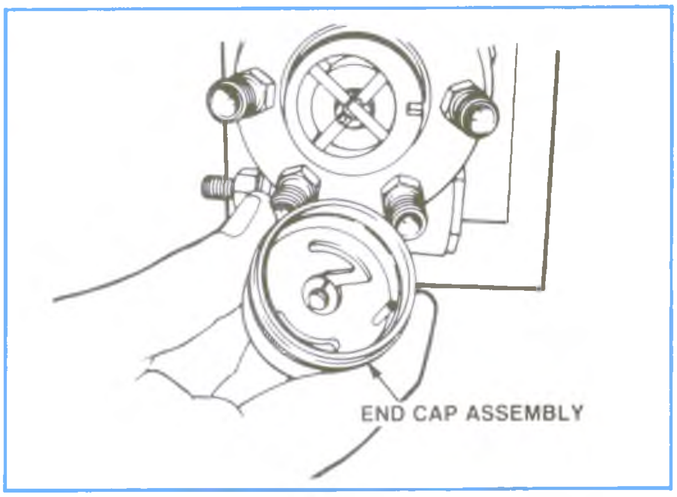


Figure 4-100, Removing End Cap.

Regulator Assembly

See Figure 4-101. With the end cap assembly removed, remove the transfer pump regulator assembly.

— NOTE —

Do not remove the transfer pump blades and liner, unless they fall out.

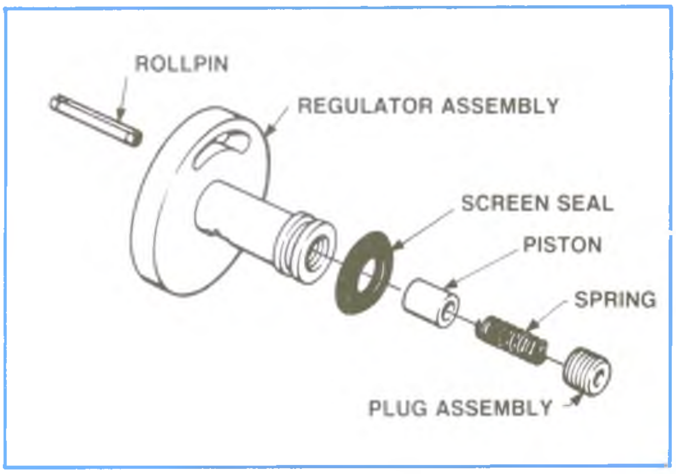


Figure 4-101, Regulator Components.

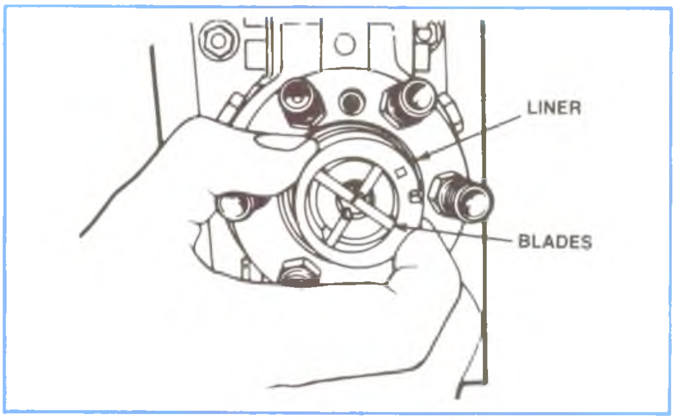


Figure 4-102, **Removing Transfer Pump Blades and Liner.**

Transfer Pump Blades and Liner

See Figure 4-102. If the liner and blades fall out, note on which side the "potmark" is located on the liner.

Also identify which slots in the rotor each blade comes from and mark them with Dykem stain, Stanadyne Part #18836.

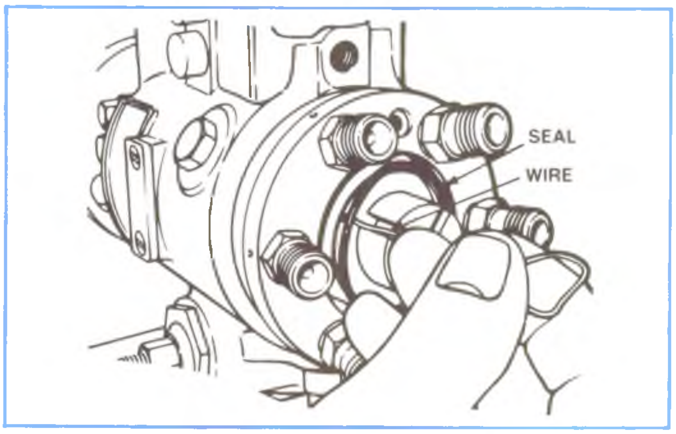


Figure 4-103, **Removing Seal.**

End Cap Seal

Remove the transfer pump end cap seal. (Figure 4-103).

Head Screws

Loosen the head locking screws and remove one screw. (Figure 4-104, left).

Carefully invert the pump and holding fixture in the vise, and remove the head locating screw. (Figure 4-104, right).

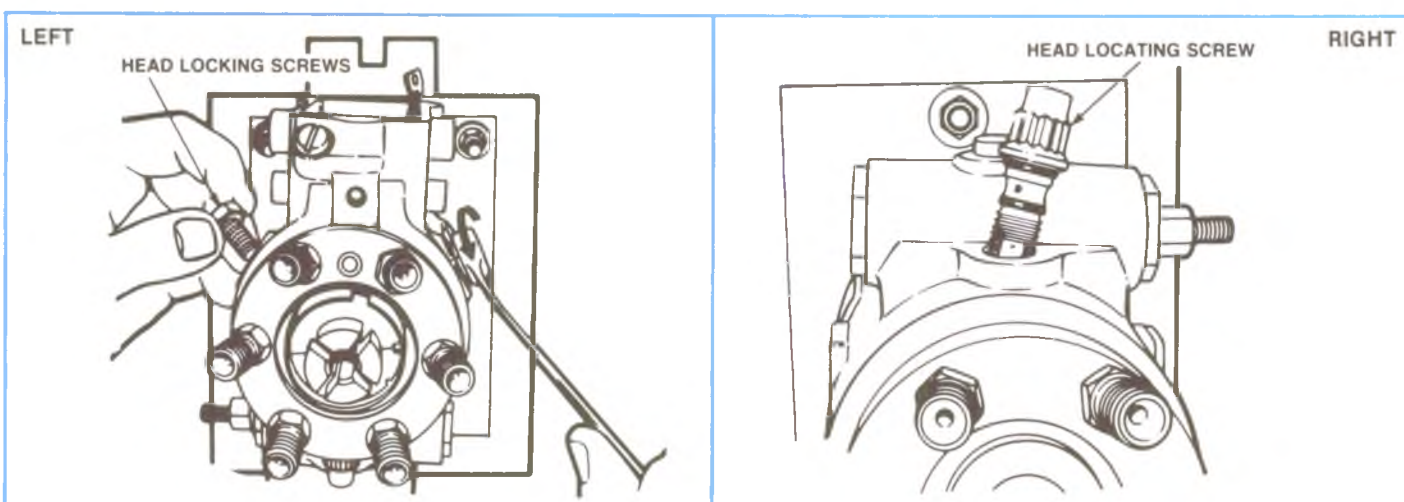


Figure 4-104, **Removing Head Screws.**

Servo Advance Plunger and Piston — Mechanical Light Load Advance

Remove the servo advance plunger. (Figure 4-105, Left).

Using a one inch socket and breaker bar, loosen and remove the spring side piston hole plug. (Figure 4-105, Right).

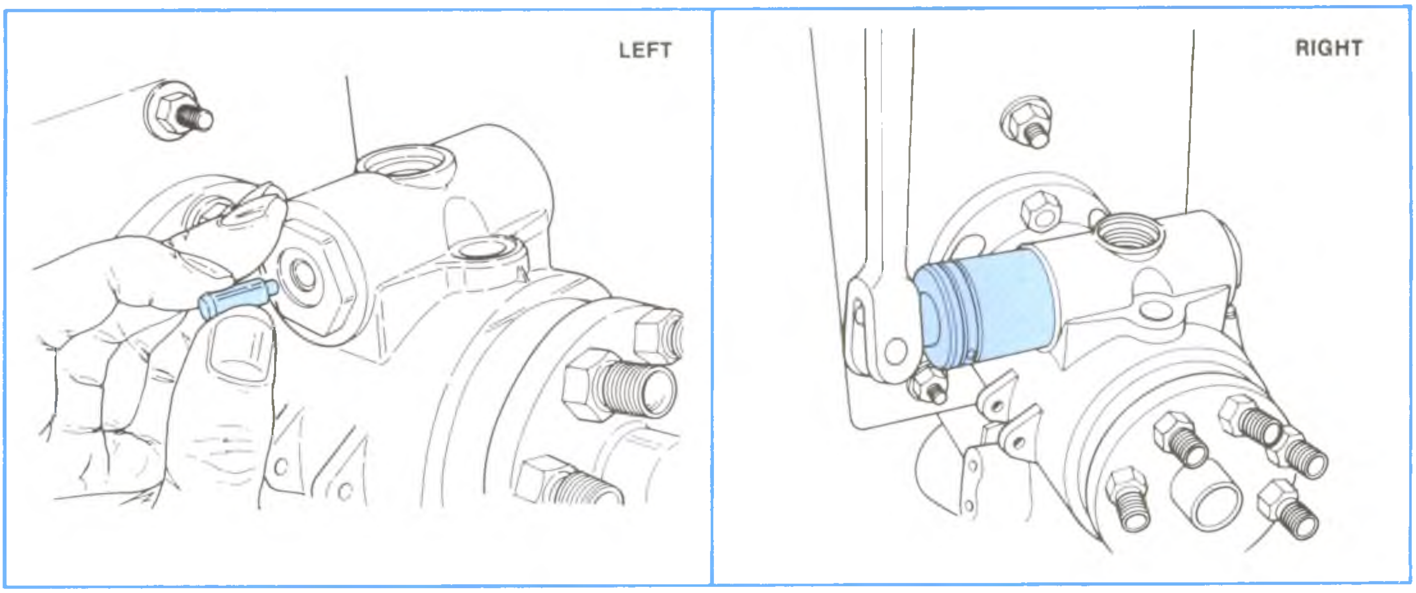


Figure 4-105, Removing Servo Advance Plunger and Piston Hole Plug.

Remove the mechanical light load advance spring and servo advance valve from the advance piston. (Figure 4-106, Left).

Next, remove the power side advance piston hole plug. (Figure 4-106, Right).

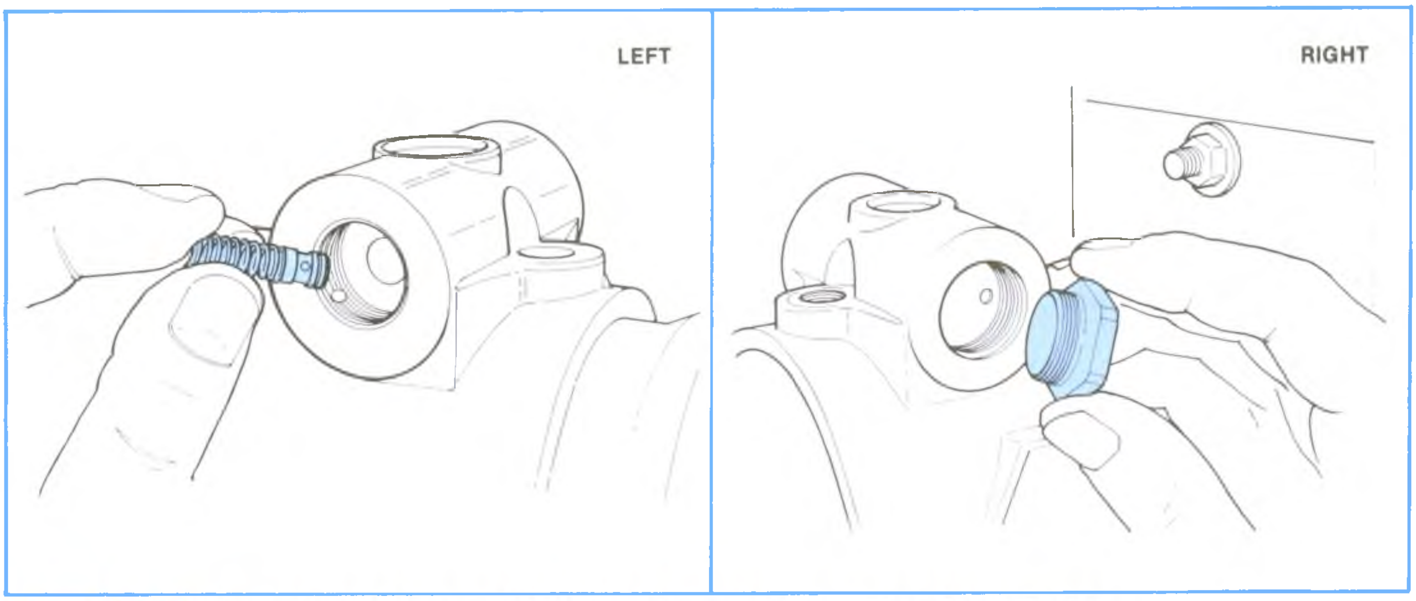


Figure 4-106, Removing Spring and Valve (Left) and Power Side Plug (Right).

Using needle nose pliers, carefully remove the cam advance pin from the advance piston. (Figure 4-107, Left). Now remove the advance piston from its housing bore. (Figure 4-107, Right).

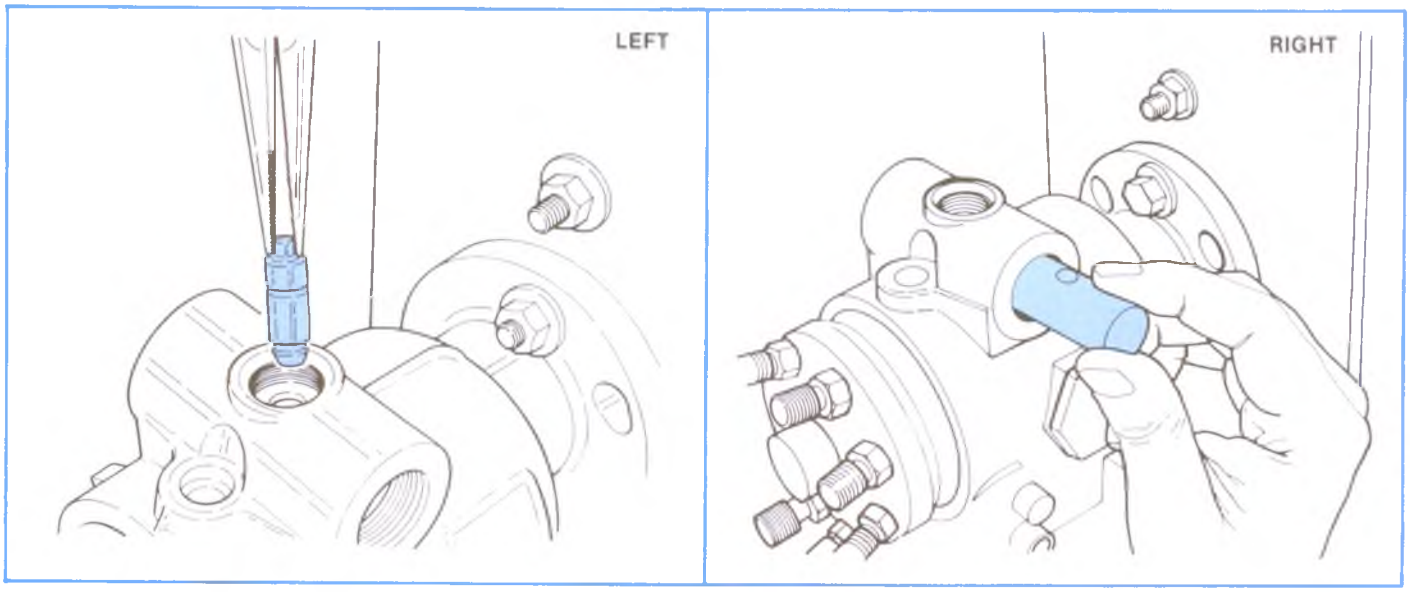


Figure 4-107, Removing Cam Advance Pin and Advance Piston.

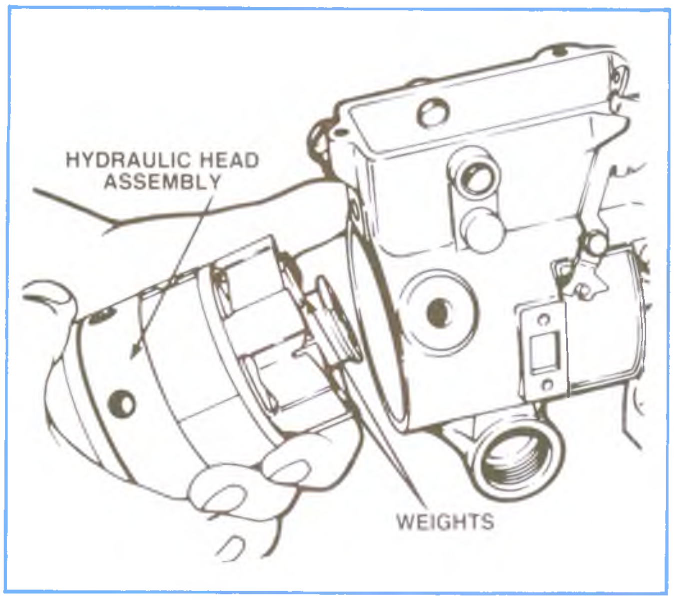


Figure 4-108, Removing Hydraulic Head Assembly.

Hydraulic Head Assembly

Return the pump and holding fixture to its initial position with the rear of the hydraulic head tilted slightly downward, and remove the remaining head locking screw. Remove the hydraulic head assembly by grasping with both hands and withdrawing with a slight rotary motion. (Figure 4-108).

Governor Weights

To disassemble the governor, simply invert the hydraulic head and let the weights, governor thrust sleeve and washer fall into your hand. (Figure 4-109).

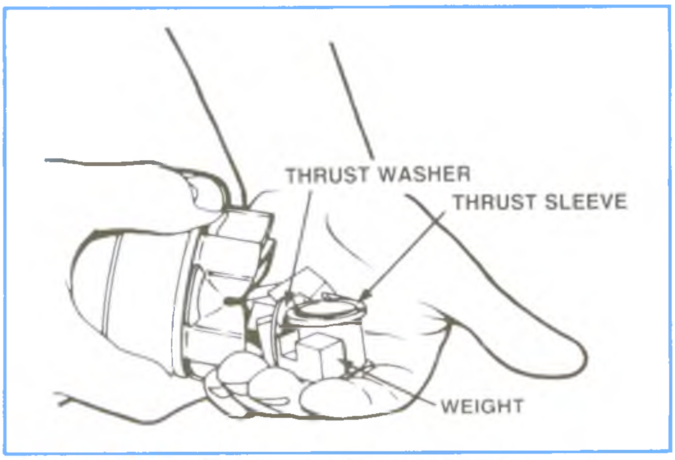


Figure 4-109, Governor Disassembly.

Weight Retainer

Carefully invert the head and rotor assembly, supporting it on the discharge fittings. Use care to avoid dropping the rotor from the hydraulic head. Using Stanadyne tool #13337 07 Tru-Arc Snap Ring Pliers, remove the snap ring holding the retainer assembly to the rotor. (Figure 4-110, Left).

Then remove the weight retainer assembly from the rotor. (Figure 4-110, Right).

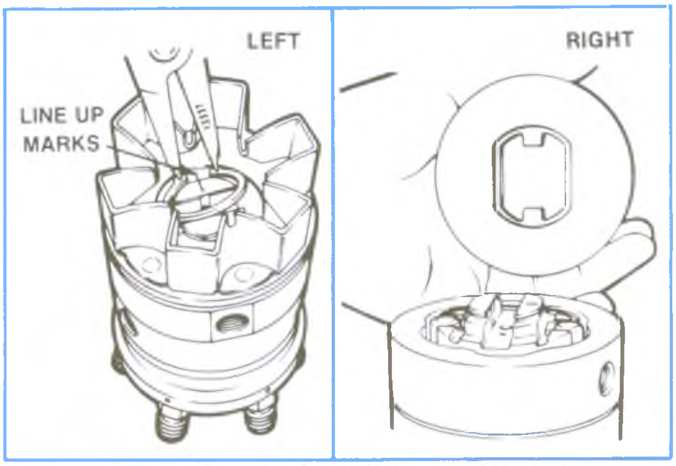


Figure 4-110, Removing Weight Retainer.

— NOTE —

The pump drive shaft is retained with either an "O" ring or a retaining clip (ring). Drive shafts with "O" rings, on late 1984 and later, use a rotating motion and pull out the shaft. Make certain that no pieces of the "O" ring have broken off and still remain in the pump. Remove and discard all drive shaft seals.

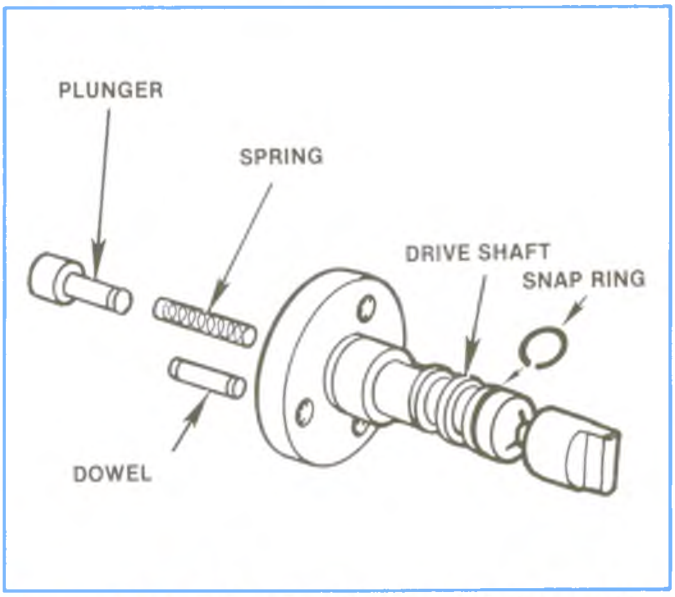


Figure 4-111, Drive Shaft With Retaining Clip.

— NOTE —

The pump drive shaft is retained with either an "O" ring or a retaining clip (ring). Drive shafts with "O" rings, on late 1984 and later, use a rotating motion and pull out the shaft. Make certain that no pieces of the "O" ring have broken off and still remain in the pump. Remove and discard all drive shaft seals.

1982, 1983 And Early 1984 Drive Shafts With A Retaining Clip (Ring).

Rotate drive shaft until one of the raised portions of the retaining ring (immediately below the ball pivot stud), is accessible.

Use a long, thin hook-shaped tool, such as a dental tool, or bent wire, or a snap-on GA467. Reach into the housing through the governor arm opening, hook the ring, and pull it slightly to the rear. Grasp the ring with needle nose pliers and pull it straight up and out of the housing. Discard the ring, it cannot be used again.

— NOTE —

The early drive shaft Stanadyne Part # is 23098. The late drive shaft Part # is 24623. The O-Ring Part # is 22937. The retaining clip (ring) Stanadyne Part # is 23209.

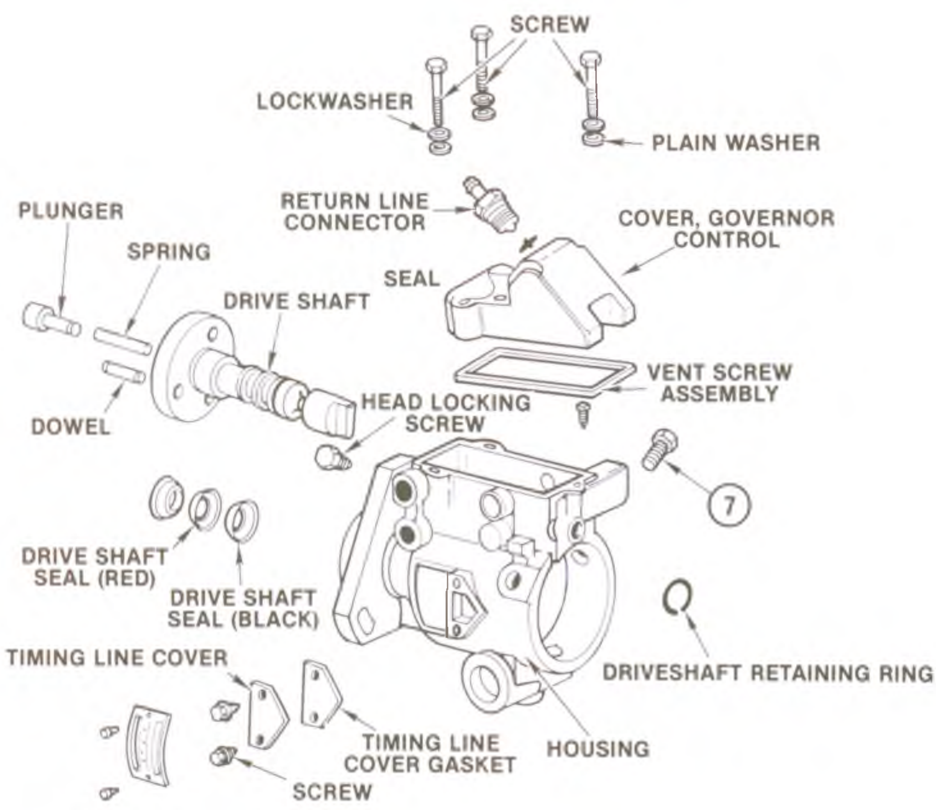


Figure 4-111A, Drive Shaft With Retaining Clip.

INSPECTION OF PUMP COMPONENTS

Remember, keep the work area clean. Dirt is the major enemy of the diesel fuel injection pump.

- Discard all "O" rings, seals and gaskets. Replace gaskets and "O" rings during re-assembly.
- Check all springs that you have removed for fretting, wear, corrosion or breakage.
- Check all bores, grooves and seal seats for damage, wear or obstructions of any kind.
- Inspect all components for excessive wear, rust, nicks or scratches.

Drive Shaft Inspection

Measure the distance across the flats of the drive tang. The measurement must not be less than .305″ or 7.75 mm. The drive shaft seal area must be free of nicks and scratches. (Figure 4-112).

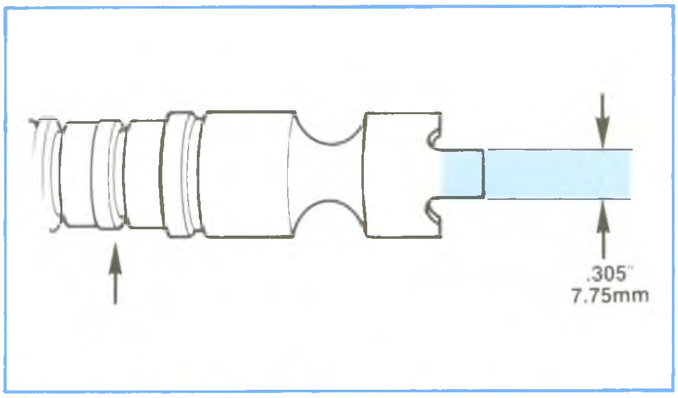


Figure 4-112, Drive Shaft Inspection.

Vent Wire Inspection

Next, check the vent wire assembly for freedom of movement. If the vent wire is sticking or damaged, replace the assembly with the same number vent wire. (Figure 4-113).

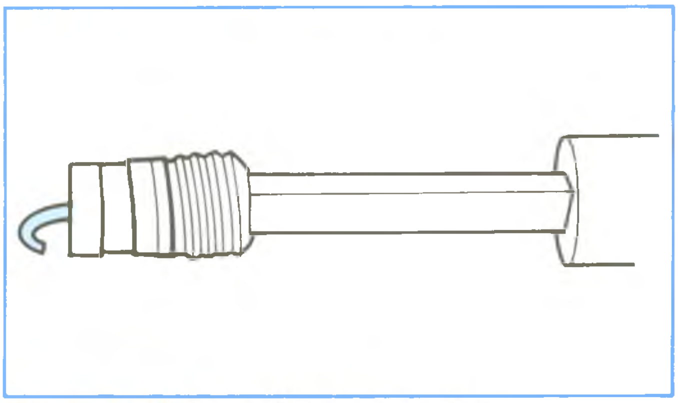


Figure 4-113, Vent Wire Inspection.

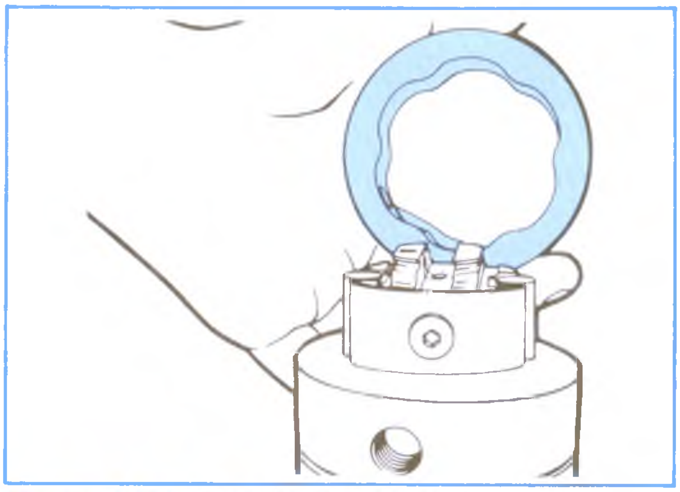


Figure 4-114, Cam Installation.

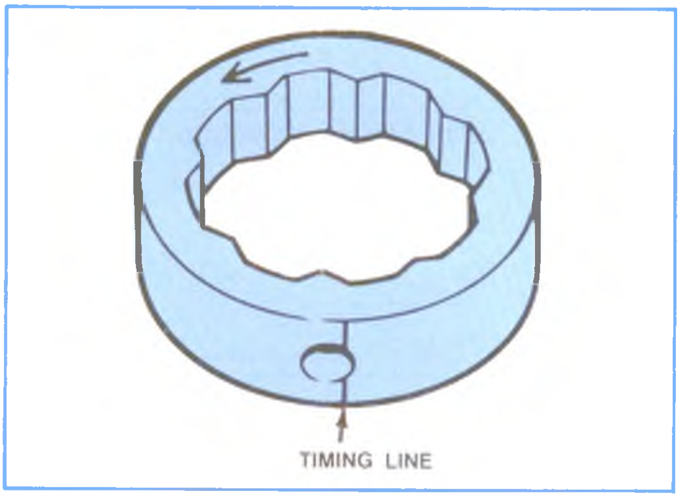


Figure 4-115, Cam Ring Timing Line.

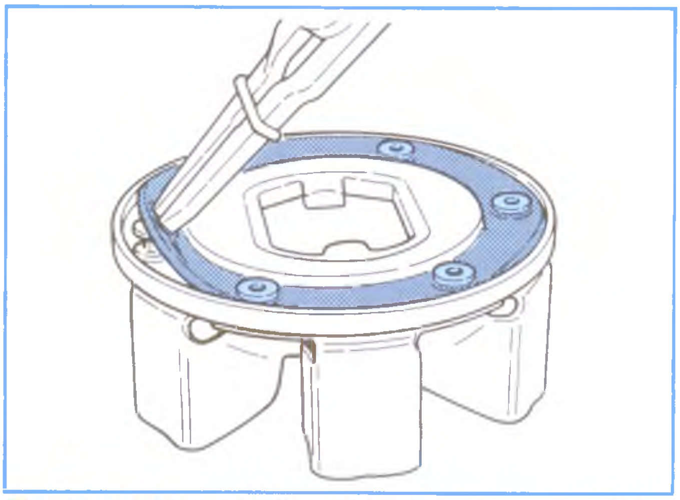


Figure 4-116, Installing Weight Retainer Ring With "Tru-Arcs".

PUMP REPAIR PROCEDURE — ASSEMBLY

Head Seal

Install a new seal onto the hydraulic head.

Cam Ring

If the cam ring was removed, place the cam ring onto the head and rotor assembly, with the arrow indicating the direction of pump rotation showing. (Figure 4-114). Pump rotation is expressed as viewed from the drive end.

Checking Proper Direction of Rotation

If you are servicing a pump in these series, place the cam ring on a table in the same position as Figure 4-115. (Note the hold in relation to the timing line.) Check to be sure the arrow is pointing in the same direction as shown in the illustration.

Weight Retainer Ring (Using Tru-Arc Snap Ring Pliers)

Install a **new** flexible retaining ring onto the weight retainer. Use number 13337 Snap Ring Pliers as shown in Figure 4-116, or use the following procedure with tool BT-8209-A.

Installing Weight Retainer Ring — Using the BT 8209-A

See Figure 4-117.

1. Slide seal over tapered locating pin and into groove on small sleeve.
2. Place indexer ring on bench and insert end of tapered locating pin into hole in top of seal retaining post.
3. Position tool vertically and push down firmly in one continuous motion until it bottoms out.
4. Repeat above operation for all locations.

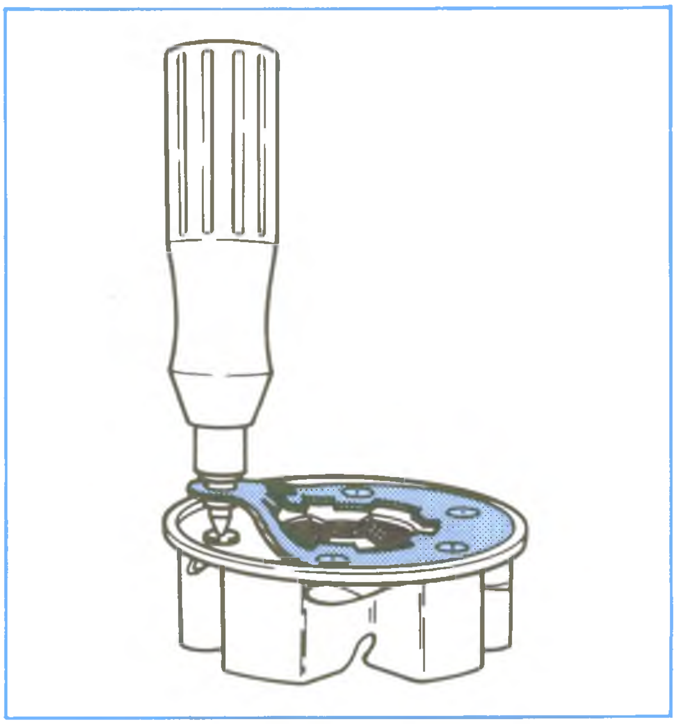


Figure 4-117, Installing Ring With Tool BT 8209-A.

Weight Retainer to Rotor

Assemble the weight retainer onto the rotor. (Figure 4-118).

Next, assemble the snap ring to it's groove using Stanadyne #13337 Pliers 07 Tru-Arc #22 Pliers.

Carefully hold the assembly so the rotor will not fall out. Invert the entire assembly so that it rests on the weight retainer.

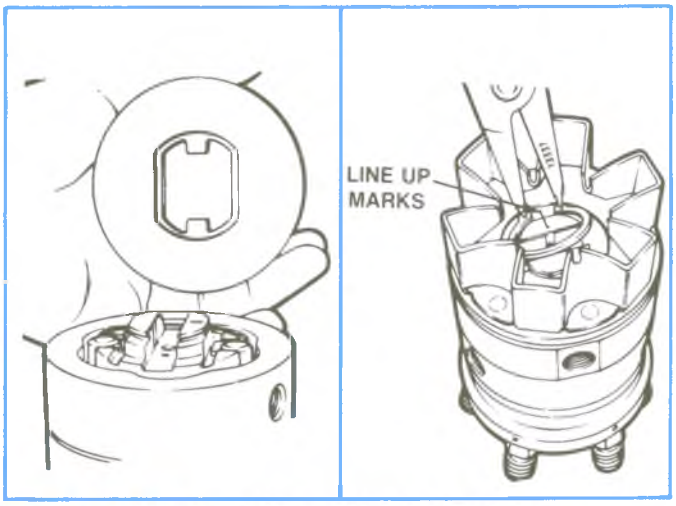


Figure 4-118, Installing Weight Retainer.

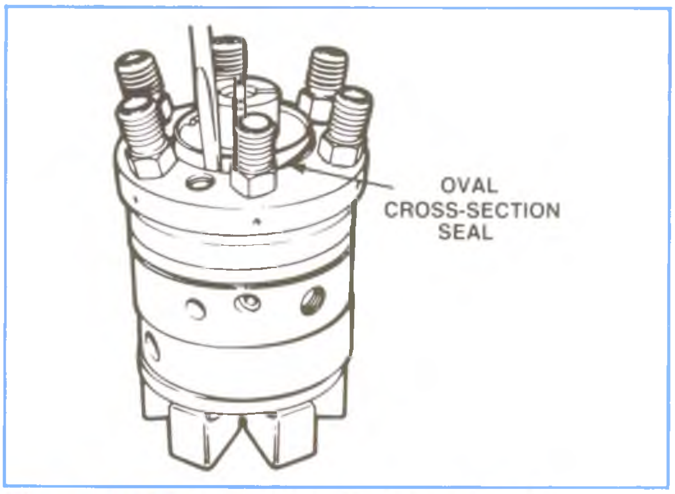


Figure 4-119, Installing End Cap Seal.

Transfer Pump End Cap Seal

Install a new transfer pump end cap seal into it's groove in the hydraulic head. This seal has an oval cross section, and can be identified by rolling it between your fingers. (Figure 4-119).

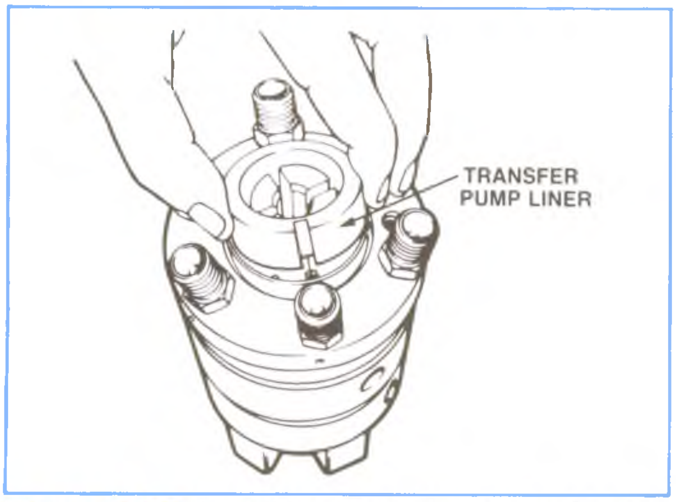


Figure 4-120, Installing Transfer Pump Liner.

Transfer Pump Liner

Insert the transfer pump liner with the slot in line with the hole that the regulator roll pin enters. (Figure 4-120).

— NOTE —

Utmost cleanliness is required during this operation.

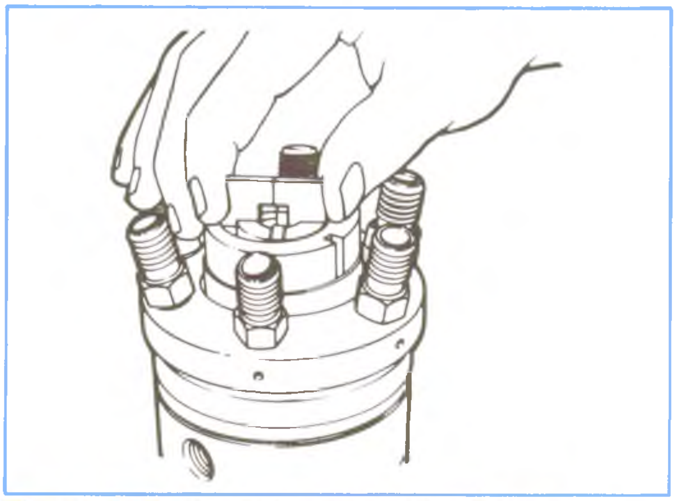


Figure 4-121, Installing Transfer Pump Blades.

Transfer Pump Blades

Assemble the springs to the transfer pump blades and install the blade sets in their rotor slots. The blades must be fully compressed, and care must be exercised that the sharp edge of the liner does not score the blade ends. (Figure 4-121).

— NOTE —

Put the blades in the exact rotor slots, you removed them from, which were marked during disassembly.

Transfer Pump Regulator

Now, install the transfer pump regulator assembly, beginning with the filter screen seal. (Figure 4-122).

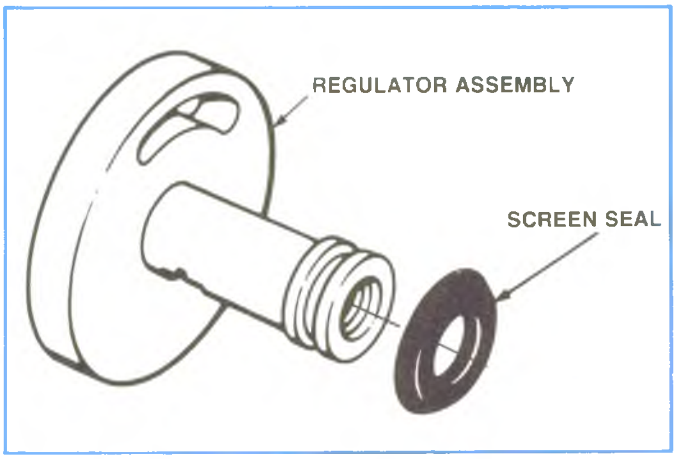


Figure 4-122, Installing Filter Screen Seal.

Piston Free Movement Check

Check the movement of the regulating piston by inserting a brass rod through the unthreaded end of the regulator assembly and applying a moderate amount of pressure to the rod. The piston should move in it's bore. (Figure 4-123). If it does not, the pump must be sent to an authorized pump repair station.

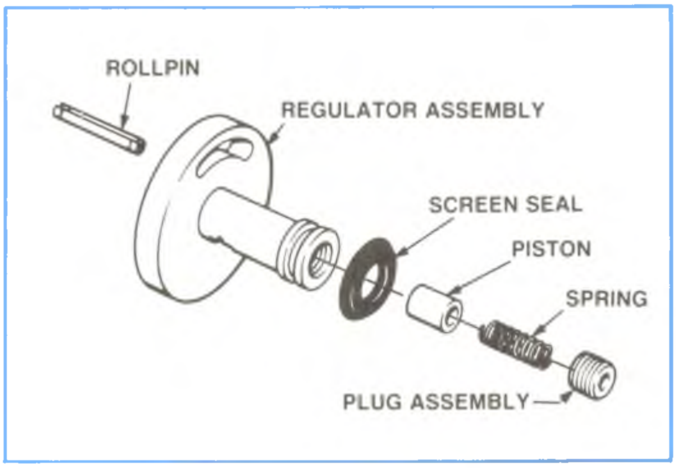


Figure 4-123, Checking Piston Movement.

Regulator, Pressure Plate and Screen

Assemble the regulator to the liner. Make certain that the locating pin is in the correct position for proper pump rotation. (Figure 4-124, Left).

Install the assembled pressure plate and screen onto the transfer pump regulator assembly. (Figure 4-124, Right).

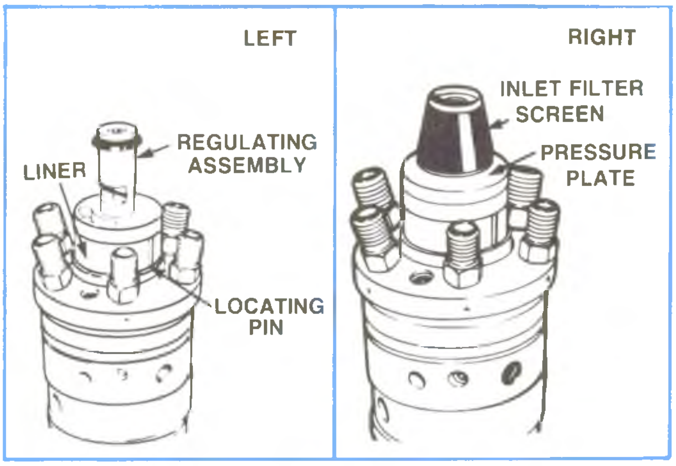


Figure 4-124, Installing Regulator and Pressure Plate/Screen.

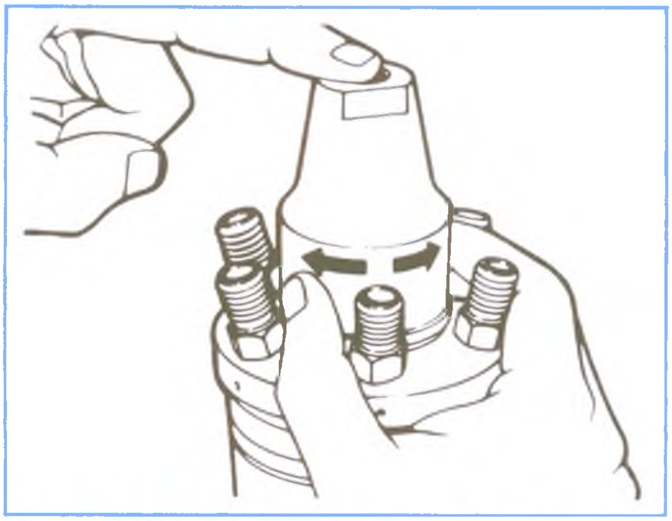


Figure 4-125, **Installing Transfer Pump End Cap.**

Transfer Pump End Cap

Coat the beveled surface of the pressure plate and the threads on the outside diameter of the end cap with lubriplate or equivalent. (Figure 4-125).

Install the transfer pump end cap by applying slight pressure on the top of the cap. Rotate the cap counter-clockwise until a slight click is heard. Now, turn the cap clockwise by hand until it is tight.

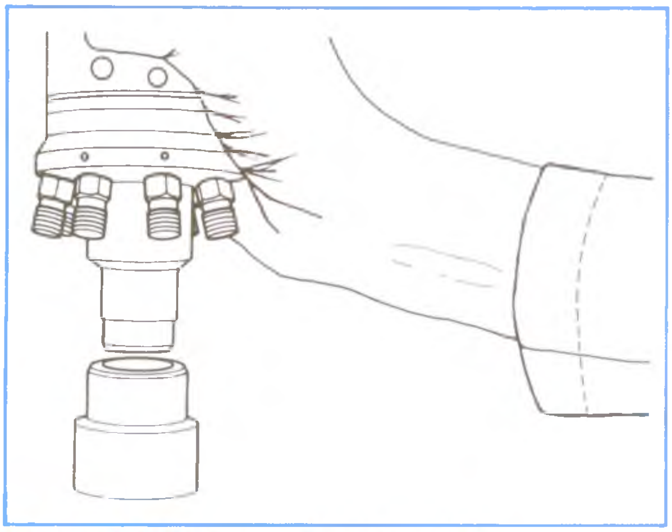


Figure 4-126, **Supporting Head For Assembly.**

Hydraulic Head and Rotor

Support the head and rotor in Stanadyne Tool #18332 or a used T.H.M. 350 Transmission Sun Gear and Shell. (Figure 4-126).

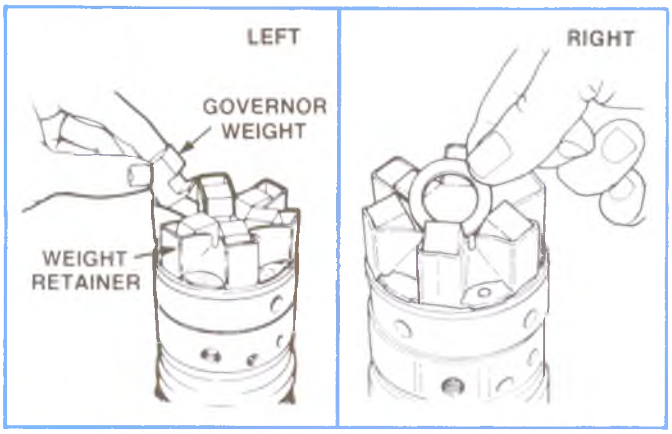


Figure 4-127, **Installing Weights and Washer.**

GOVERNOR WEIGHTS AND THRUST WASHER

Install the governor weights into the governor weight retainer. (Figure 4-127, Left).

1982 and later pumps do not have a chamfered thrust washer. The washer may be installed either side up. (Figure 4-127, Right).

On 1978-1981 pumps, install the thrust washer with the chamfered side up.

GOVERNOR THRUST SLEEVE

Next, insert the governor thrust sleeve into the lower slots of the governor weights. (Figure 4-128).

Sight across the tops of the assembled weights. All weights should be level and collapsed against the thrust sleeve.

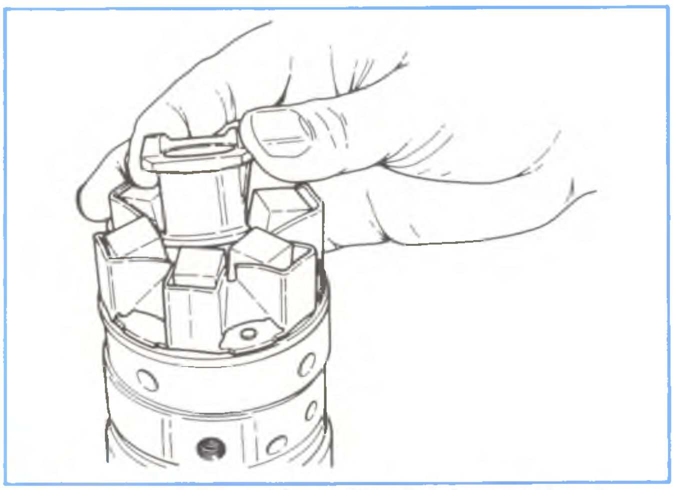


Figure 4-128, **Installing Thrust Sleeve and Checking Weights.**

LUBE HEAD AND HOUSING

The hydraulic head and rotor assembly are now ready to be placed into the housing. First, apply grease onto the hydraulic head, and apply a light film of Synkut (J-33198) lubricant around the inside edge of the housing. In order to aid assembly, tilt the housing slightly downward. (Figure 4-129).

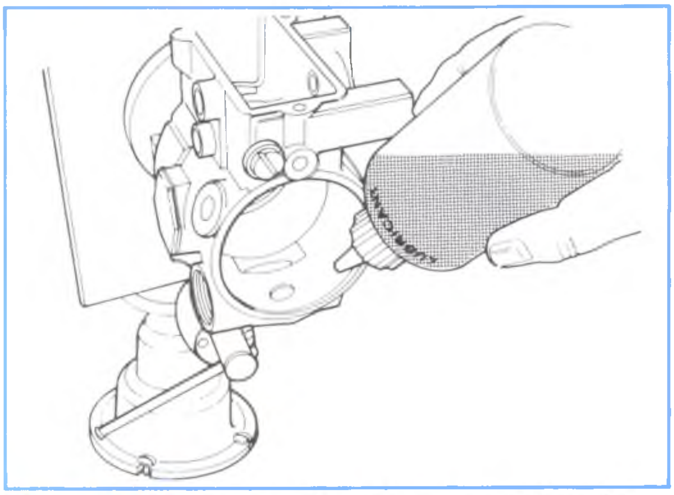


Figure 4-129, **Lubricating Head and Housing.**

CAM POSITIONING

See Figure 4-130. Rotate the cam ring so that the honed hole in the cam is 180 degrees opposite the metering valve bore. This will ensure proper positioning of the cam ring. The smallest hole in the cam ring should be at the bottom. To determine which hole is the smallest, use a head locking screw. The screw will enter the large holes, but not the small one. Position the governor thrust sleeve with the flat edge and two lugs up, and round edge down.

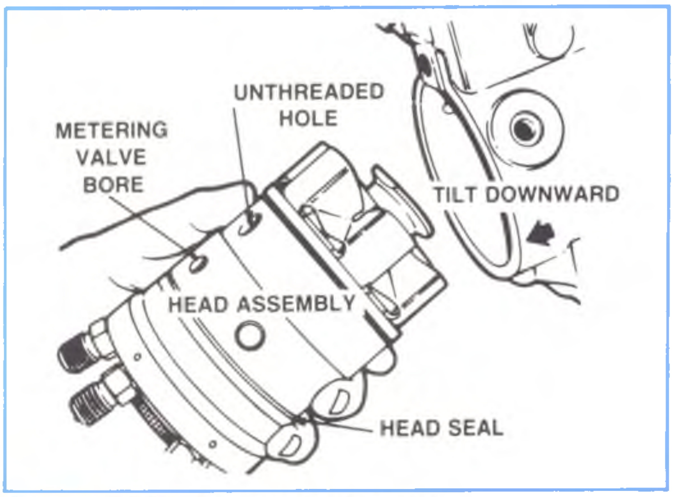


Figure 4-130, **Cam Positioning.**

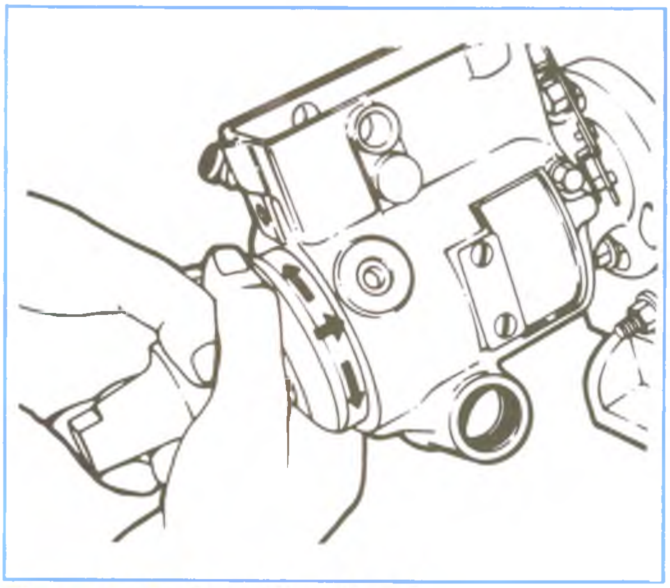


Figure 4-131, Installing Head.

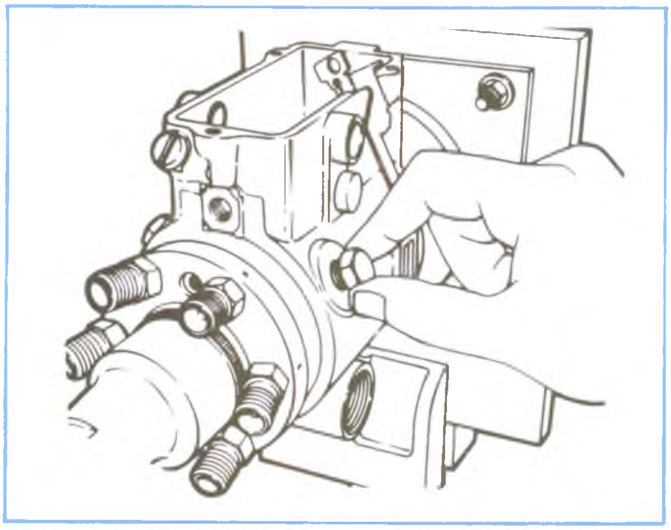


Figure 4-132, Hand Tightening Head Locking Screw.

HEAD INTO BORE

Grasp the hydraulic head firmly in both hands and insert it into the housing bore using a slight rotary motion. (Figure 4-131).

— CAUTION —

Do not force: If the assembly should jam during insertion, withdraw and start over.

— NOTICE —

Be careful not to insert the head assembly too far into the housing. Pushing the head too far will cause the seal to tear in the vent wire opening. It will damage the seal on the hydraulic head and cause leakage.

Rotate the head assembly until the head locking screw holes line up with their corresponding holes in the housing. Insert the two head locking screws, finger tight. (Figure 4-132).

DRIVE SHAFT AND SEALS

Lubricate the seal installer tool. Polish seal tools with #400 grit paper before first use. This will aid installation of seals.

To prevent the governor weights from becoming dislodged from the retainer, the drive shaft should be installed. Begin by installing new seals onto the drive shaft using seal installation tool part #22727 or J-29745A. Apply a liberal coating of Synkut lubricant, part #22204, or J-33198 to the seals and the surface of the tool, to facilitate assembly.

— CAUTION —

Excessive stretching of the center drive shaft seal may cause it to tear. (Figure 4-133)

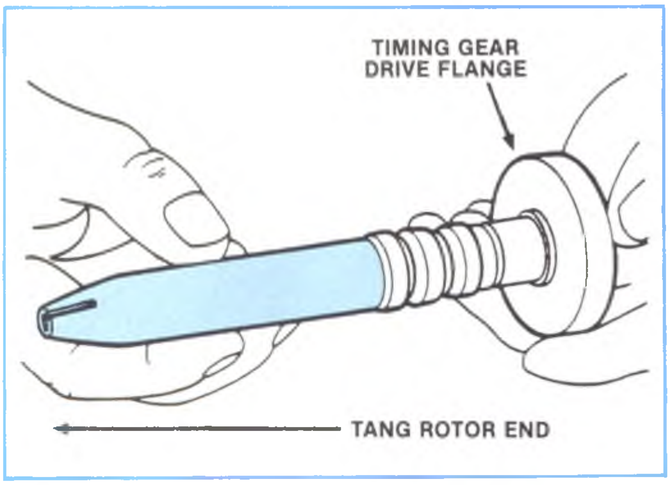


Figure 4-133, **Drive Shaft Seal Installation Tool.**

Install one black seal, cup towards timing gear drive flange.

Relubricate the seal installation tool, and install the red seal, cup towards the tang rotor end.

Install the last black seal, cup towards the tang rotor end.

O-ring retained drive shafts require installation of the O-ring or wire retaining ring onto the shaft at this point. Or install new retaining ring on drive shaft (if so equipped).

— CAUTION —

Do not spread ring far enough so that it becomes loose in the drive shaft retaining slot.

Install the drive shaft to the pump so that the timing spot on the drive shaft tang registers with the timing spot in the rotor tang slot. (Figure 4-134).

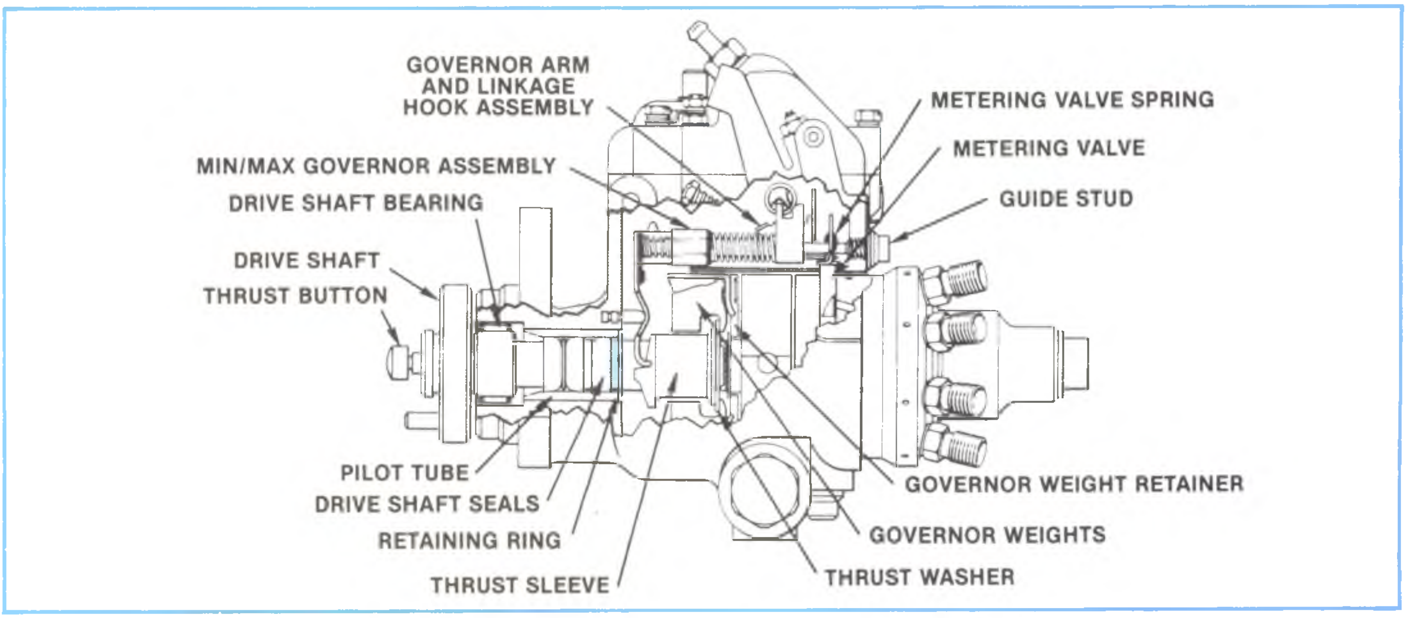


Figure 4-134, **Installing Shaft in Pump.**

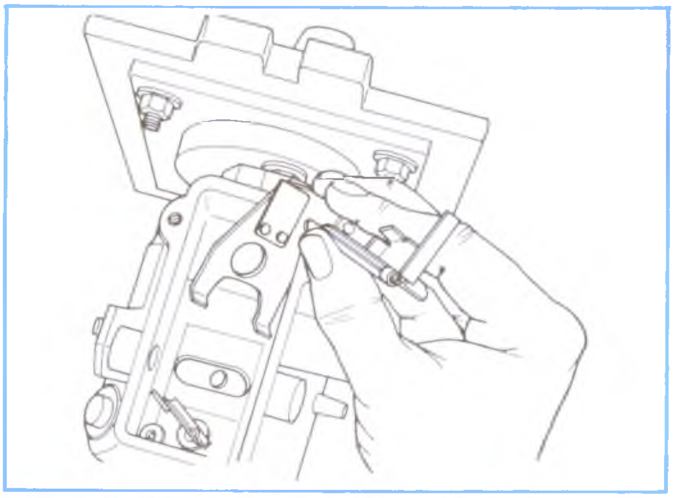


Figure 4-135, Installing Governor Arm.

Governor Arm: Late Pump

Next, place the governor arm in position in the housing. In later model pumps, the arm simply rests on a rounded pin cast into the pump housing. Let the linkage hang over the side. (Figure 4-135).


Figure 4-136, Installing Vent Wire Assembly.

Vent Wire Assembly

Now, install the vent wire screw assembly (Figure 4-136). 2.8-3.4 N·m (25-30 in. lbs.).

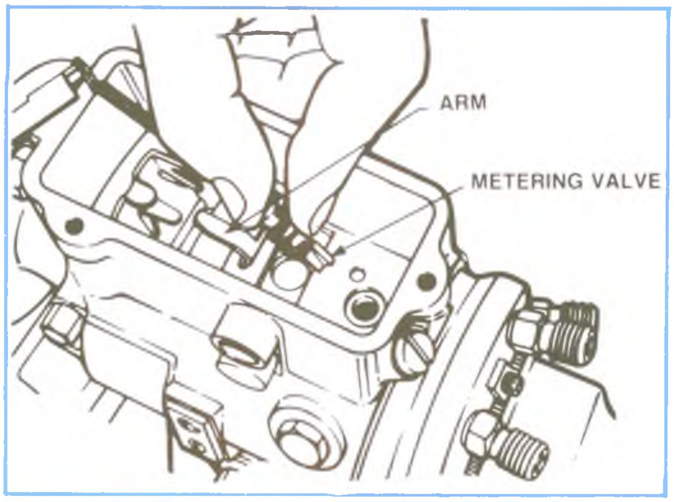


Figure 4-137, Lubricating Metering Valve.

Metering Valve

Place the metering valve assembly into it's bore and depress and rotate the valve several times to ensure freedom of movement. If the valve sticks, rinse it off with clean calibrating oil. (Figure 4-137). Never use an abrasive or the specially treated surface will be damaged. However, it may be polished with 600 grid sand paper, but only five turns.

It is possible for the metering valve arm on some injection pumps to contact and bind on the housing after the head and rotor have been removed and reinstalled. If this condition is encountered when checking for metering valve free movement, rotate the head to provide clearance for the metering valve arm.

Then position the opposite end of the linkage assembly onto the metering valve arm, making certain that the spring is not twisted. Remember to check all governor parts for freedom of movement. (Figure 4-138).

> **— NOTE —**
>
> **All throttle shaft seals (1984 and later) are made from an improved Viton material, and identified by a green color. This was done to lessen the effects of cold temperatures on the sealing area.**

Throttle Shaft (and Clip on Speed Advance Pump)

1. Install the throttle shaft, with throttle shaft spacer, new seals and mylar washer. (Figure 4-139 Left).
   A. Install throttle shaft spacer (22900 if removed).
   B. Install new seals on the throttle shaft.
   C. Install the throttle shaft.
   D. Install mylar washer.

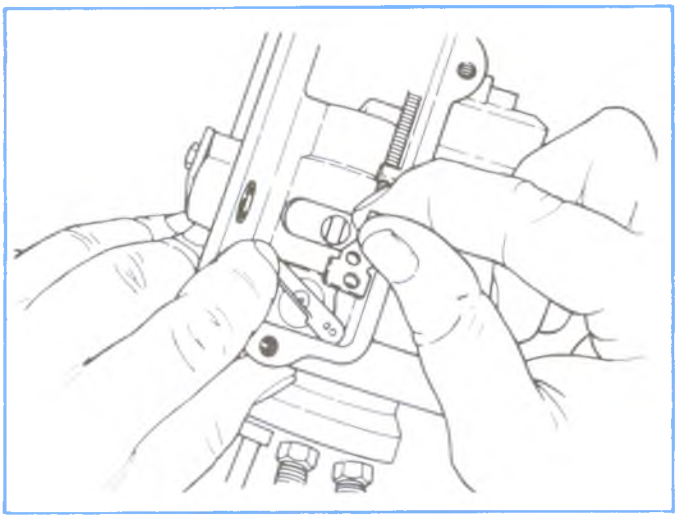


Figure 4-138, Linkage To Metering Valve Arm.

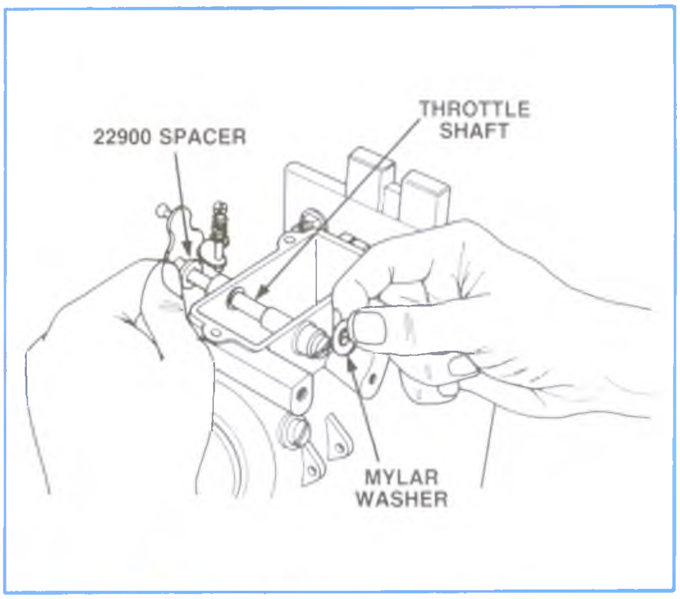


Figure 4-139, Installing Throttle Shaft and Clip.

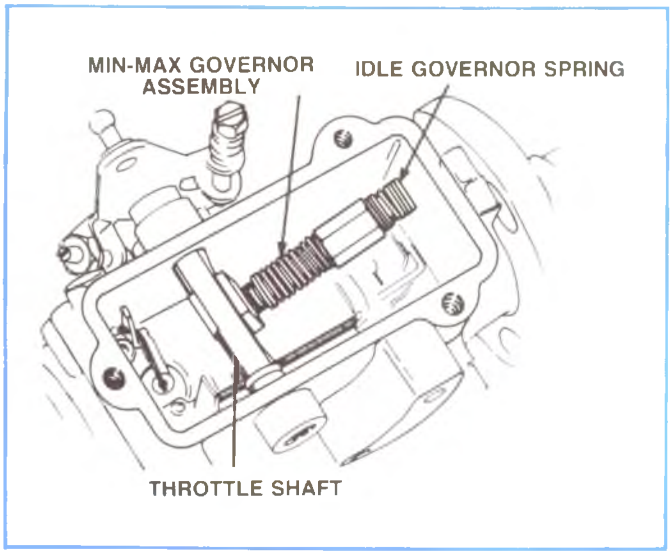


Figure 4-140, Installing Governor Assembly.

Governor Assembly

Rotate the throttle to the wide open throttle position, and holding the entire assembly between the thumb and forefinger, fit the block onto the throttle shaft. Hold the assembly in place and rotate the throttle back to the low idle position until the other end of the governor assembly bears against the governor arm. (Figure 4-140).

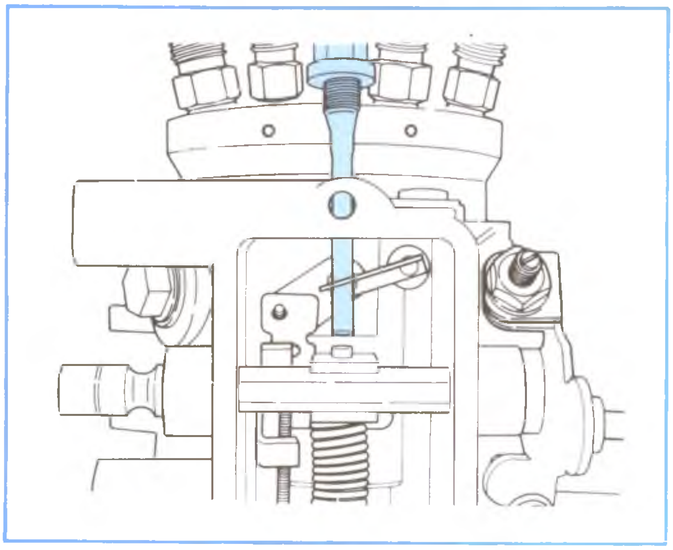


Figure 4-141, Installing Guide Stud.

Install the guide stud, with a new guide stud washer into the housing. (Figure 4-141). The guide stud must be installed beneath the metering valve spring, and engage the min-max assembly without binding. Torque the guide stud to 9-10 N·m (80-90 in.-lbs.).

Check the governor components for proper installation by rotating the throttle shaft assembly to the rear. This should cause compression of the min-max assembly. There should be no evidence of binding.

Head Locating Screw

See Figure 4-142. Invert the pump in the vise, and assemble the seal onto the head locating screw. Apply a light film of grease to the head locating screw. Insert the screw and tighten hand tight. Then using a 5/16″ hex socket, torque to 20-25 N·m (180-220 in.-lbs.).

Make sure that the seal is not sheared during tightening.

— NOTE —

The head locating screw will contain a filter to reduce advance piston sticking caused by contamination. WDDGM part #14067415 — Stanadyne part #24566.

Head Locking Screws

See Figure 4-143. At this time, torque the two head locking screws to 20-25 N·m (180-220 in.-lbs.).

Automatic Advance

Begin the automatic advance assembly of mechanical light load equipped pumps by installing the advance piston. Make certain that the transfer pump pressure port is facing the head locating screw, and that the servo-valve bore faces the rocker arm side of the pump. (Figure 4-144).

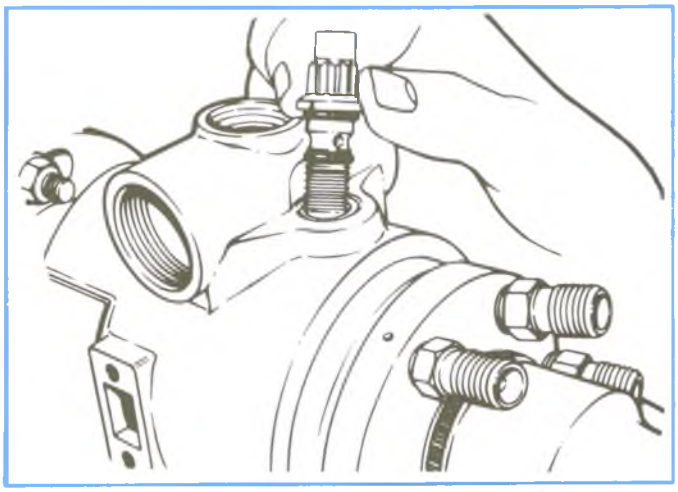


Figure 4-142, Installing Head Locating Screw.

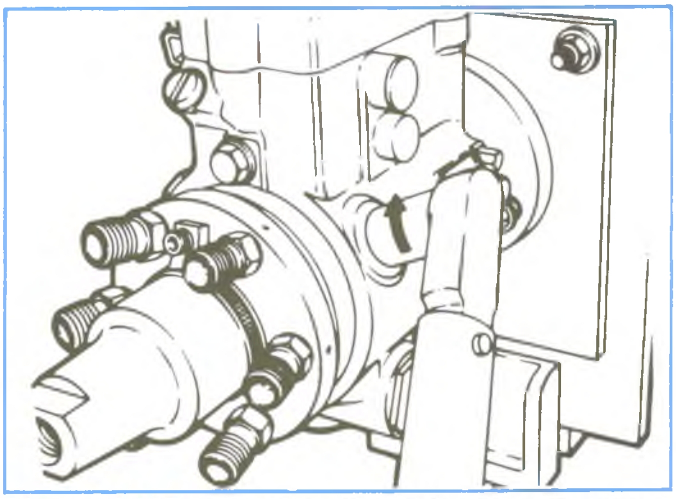


Figure 4-143, Torquing Head Locking Screws.

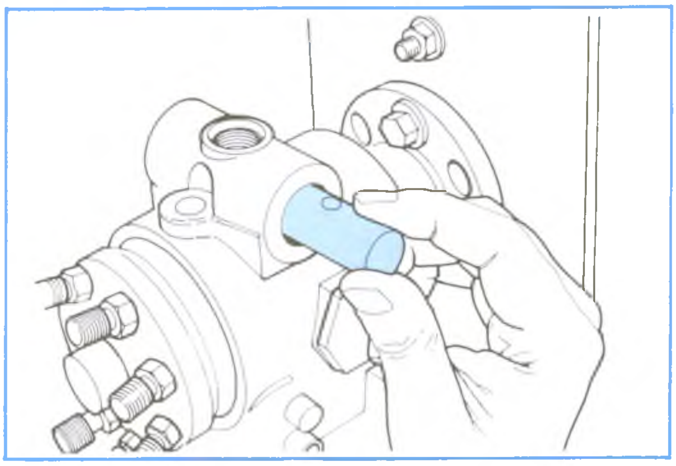


Figure 4-144, Installing the Advance Piston on Mechanical Light Load Pump.

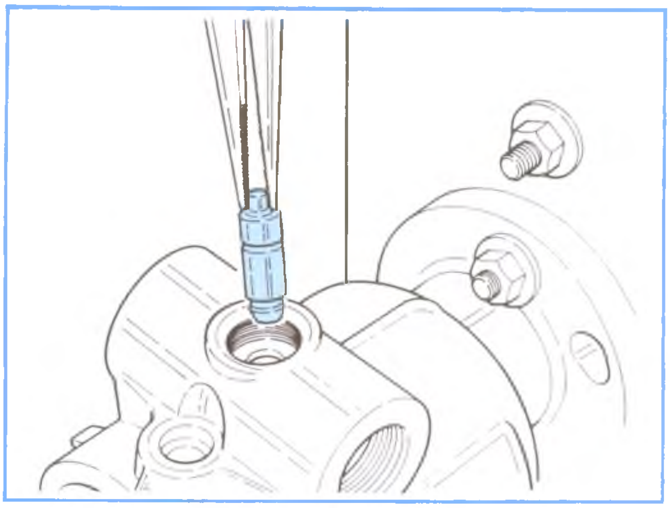


Figure 4-145, **Inserting Cam Pin.**

Then, insert the cam advance pin into its bore, making certain that it properly engages the cam ring. (Figure 4-145).

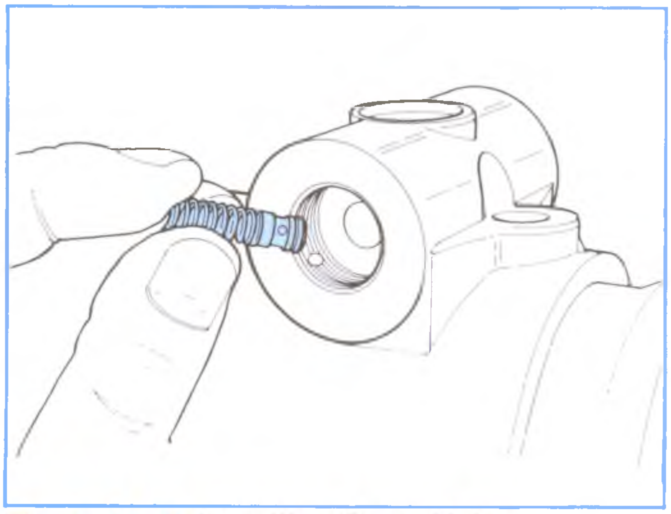


Figure 4-146, **Installing Servo Valve.**

Install the servo valve and spring into the advance piston. (Figure 4-146).

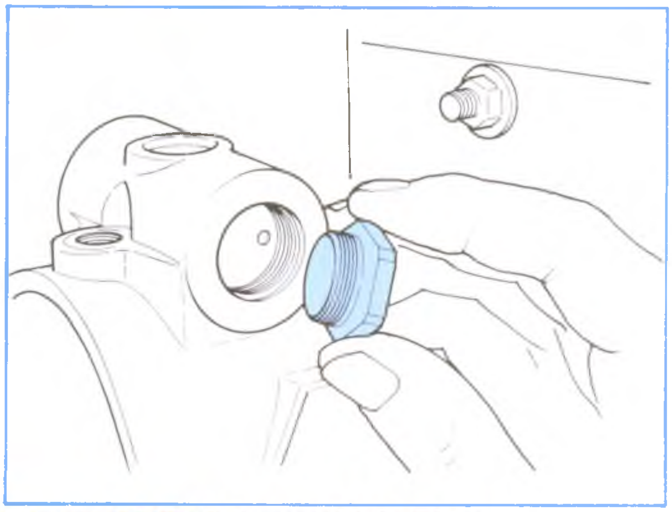


Figure 4-147, **Advance Hole Plugs.**

Install the advance hole plugs. (Figure 4-147).

Now, torque both piston hole plugs to 34.7-42.4 N·m (307-375 in.-lbs.). (Figure 4-148).

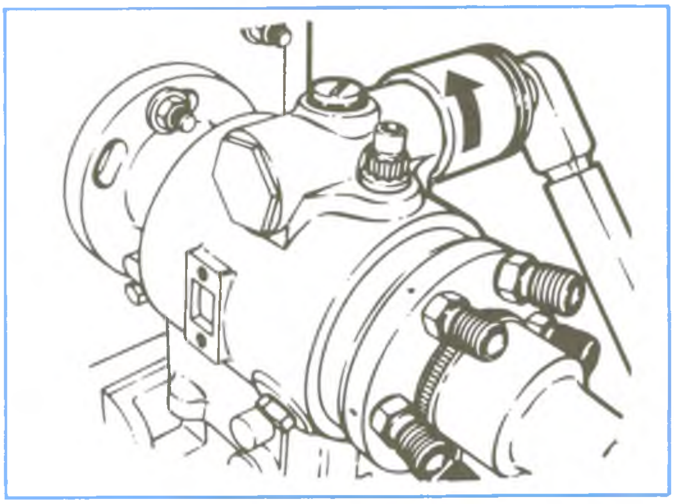


Figure 4-148, **Tightening Piston Hole Plug.**

Complete the assembly of the auto advance mechanism by fitting the advance boss plug with a new seal, and torque to 8.5-11.3 N·m (75-100 in.-lbs.) using a ¼ inch hex socket. (Figure 4-149).

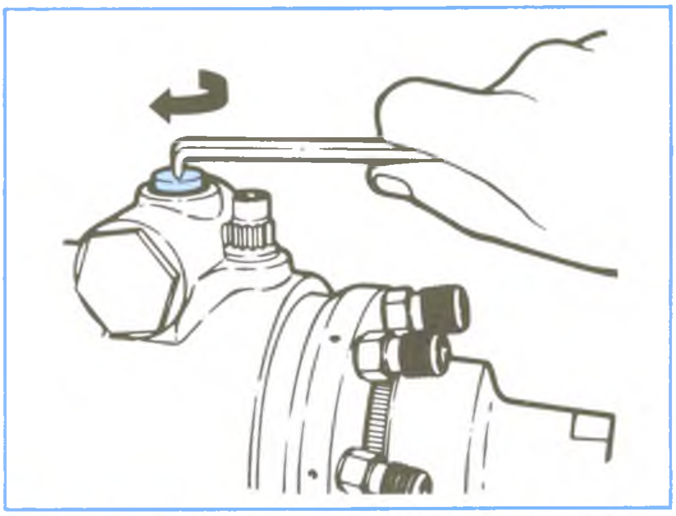


Figure 4-149, **Installing Advance Boss Plug.**

Servo Advance Plunger

In mechanical light load advance pumps, you should now install the servo advance plunger. (Figure 4-150). Then, invert the pump in the vise.

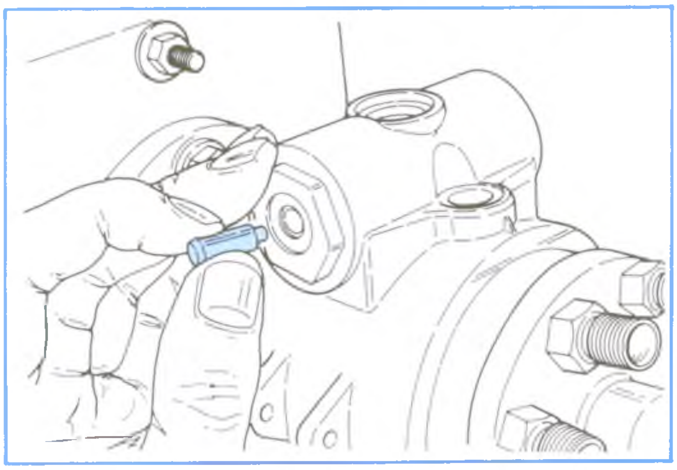


Figure 4-150, **Installing Servo Advance Plunger.**

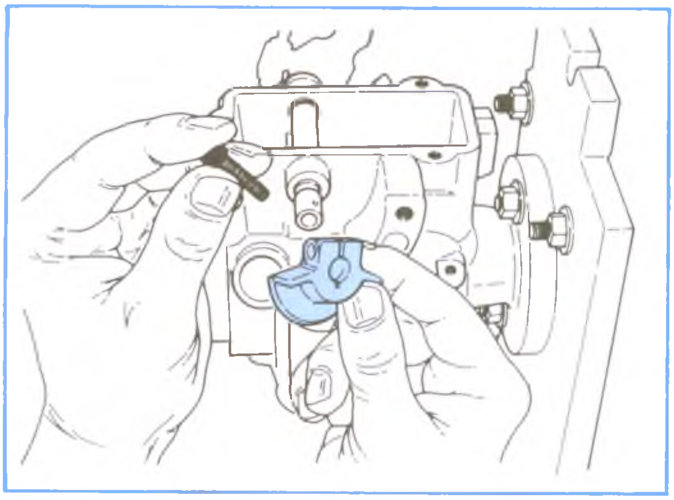


Figure 4-151, **Installing Face Cam Screw.**

Face Cam

Next, install the face cam and a new mylar washer onto the throttle shaft. (Figure 4-151). Secure it by tightening the face cam screw hand tight. Install a new vacuum module drive pin.

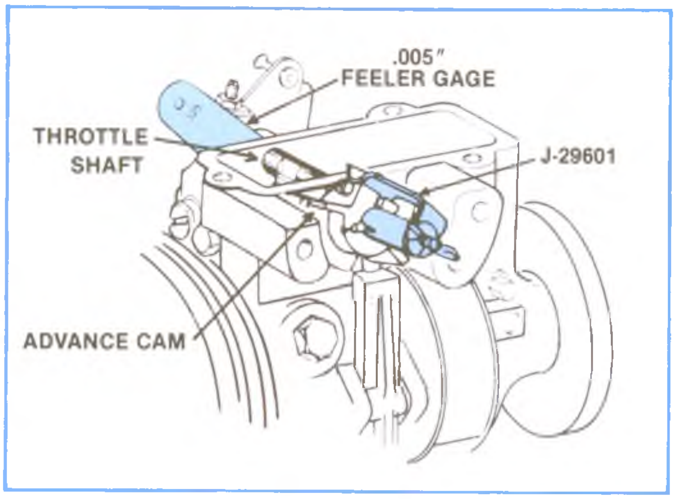


Figure 4-152, **Feeler Gage to Position Cam.**

Install tool J-29601 to position face cam and insert a .005″ feeler gage between throttle shaft washer and housing. (Figure 4-152). Push throttle shaft into housing and squeeze the advance cam to remove clearance. Torque face cam screw to 3-4 N·m (28-32 in.-lbs.).

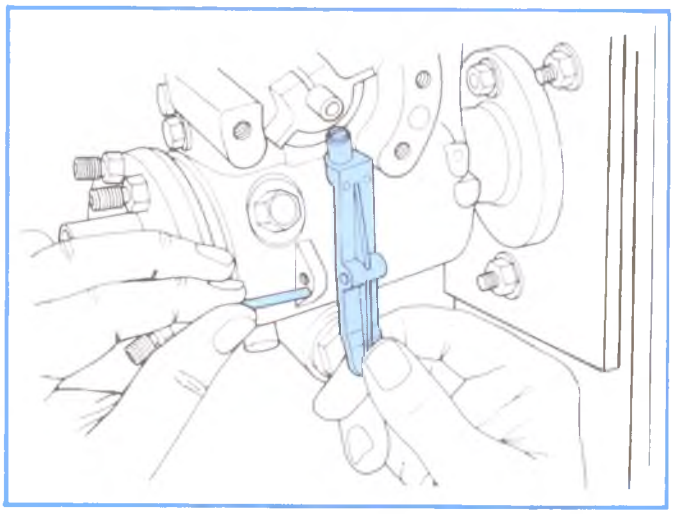


Figure 4-153, **Installing Rocker Arm Pin.**

Rocker Arm

Then, assemble the rocker arm to the housing by installing the rocker arm pin. Secure with the rocker arm pin clips. (Figure 4-153).

Governor Cover Gasket

Complete the governor assembly by placing a new gasket on the governor cover. (Figure 4-154)...

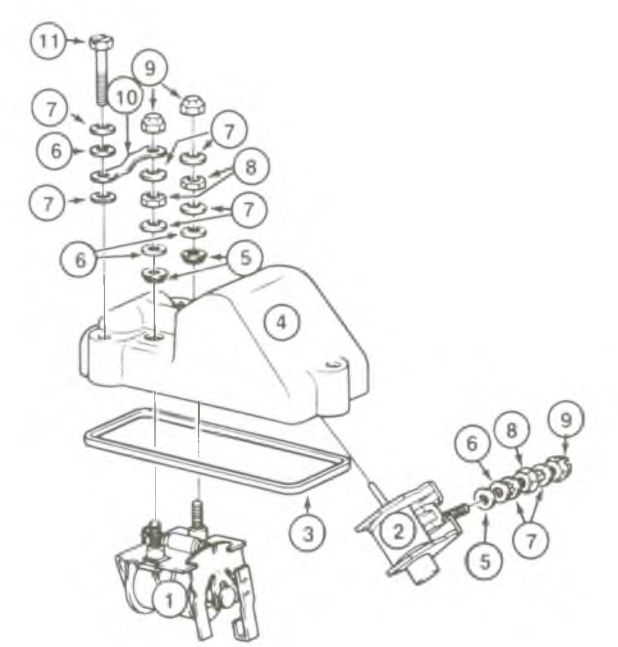


Figure 4-154, Gasket on Governor Cover.

Governor Cover

...and placing the governor cover slightly to the rear of its correct mounting position. (Figure 4-155). Now, slide the cover forward. This prevents the electric shut off solenoid arm from accidently locking the linkage in the run position.

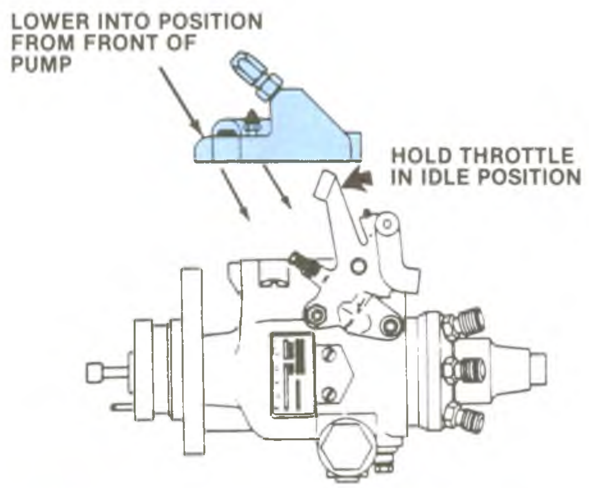


Figure 4-155, Installing Governor Cover.

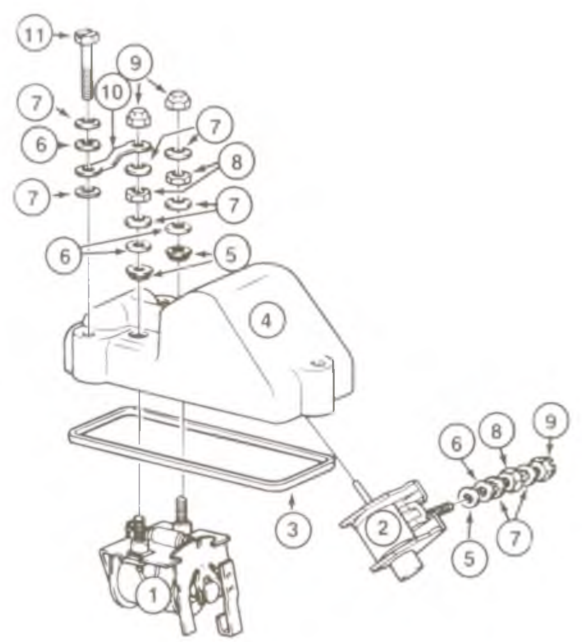


Figure 4-156, installing Governor Cover Screws.

Governor Cover Screws

Install the flat washers, and lock washers onto the cover screws, and torque to 4-5 N·m (35-45 in.-lbs.). (Figure 4-156).

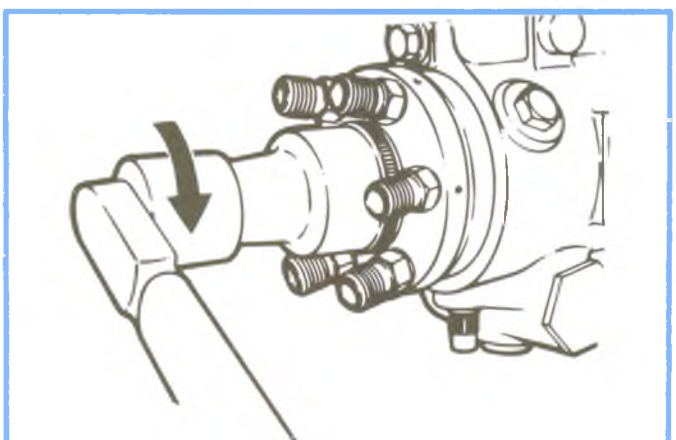


Figure 4-157, Installing the End Cap.

Transfer Pump End Gap

Tighten the transfer pump end cap to 41-50 N·m (360-440 in.-lbs.). (Use Stanadyne Tool #20548, Figure 4-157).

End Cap Locking Plate

Assemble the end cap locking plate, seal and screw to the head and tighten to 8-9 N·m (70-80 in.-lbs.). (Figure 4-158).

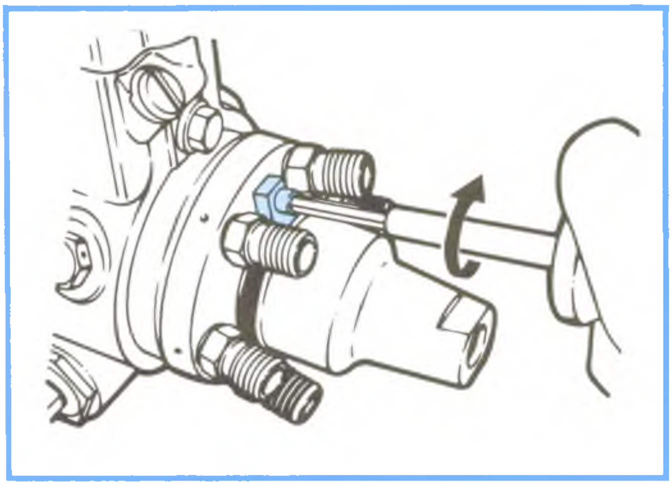


Figure 4-158, **Installing End Cap Locking Plate, Seal and Screw.**

Pressure Testing Of Fuel Injection Pump On the Bench

1. Drain all fuel from the pump.
2. Connect an air line to the pump inlet connection. Be certain that the air supply is clean and dry.
3. Seal off the return line fitting and completely immerse the pump in a bath of clean test oil.
4. Raise the air pressure in the pump to 137.9 kPa (20 PSI). Leave the pump immersed in the oil, to allow any trapped air to escape.
5. Watch for leaks. If the pump is not leaking, reduce the air pressure to 13.8 kPa (2 PSI) for 30 seconds. If there is still no leak, increase the pressure to 137.9 kPa (20 PSI). If still no leaks are seen, the pump is ready for use.

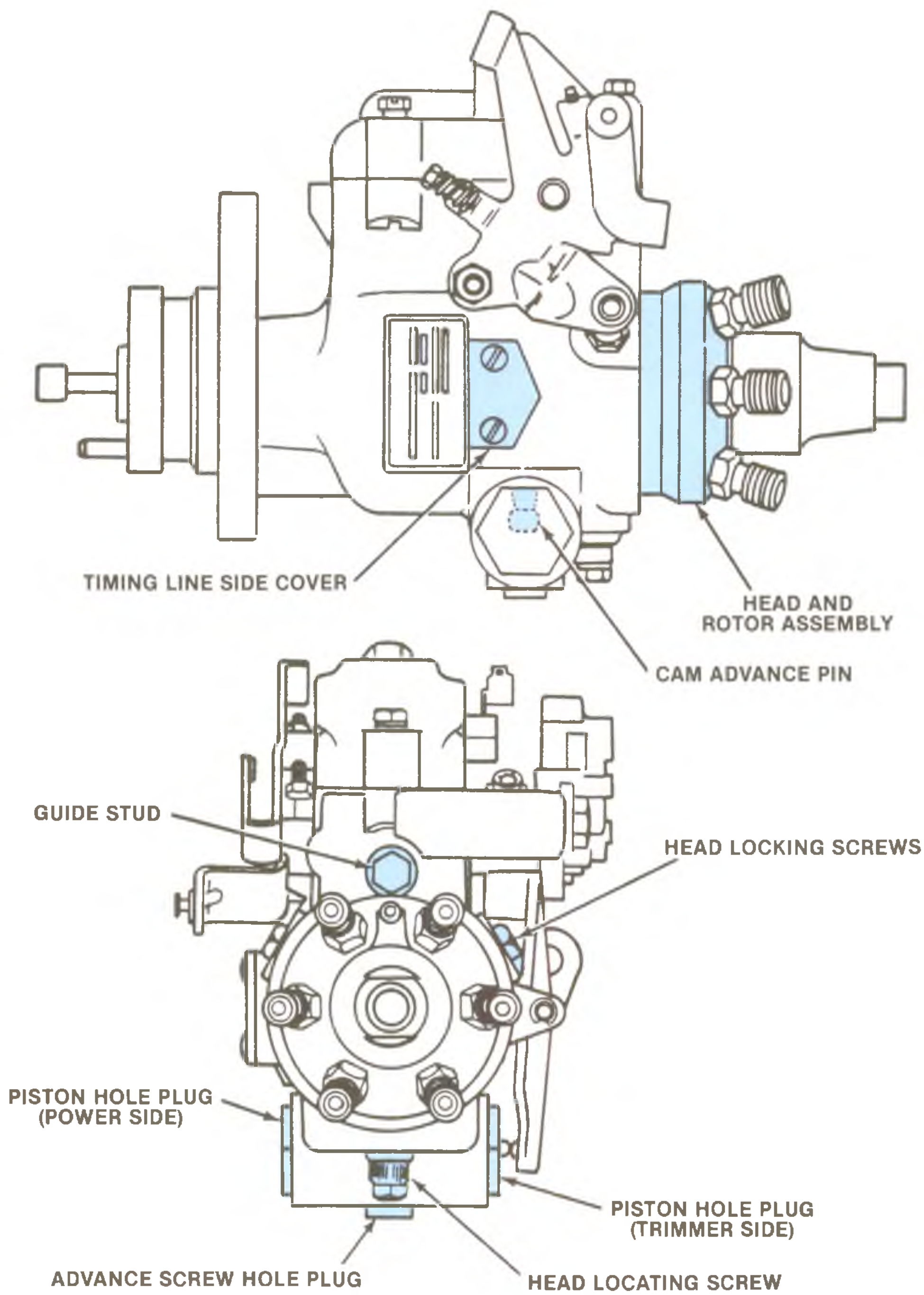


Figure 4-159, Injection Pump Components Location.

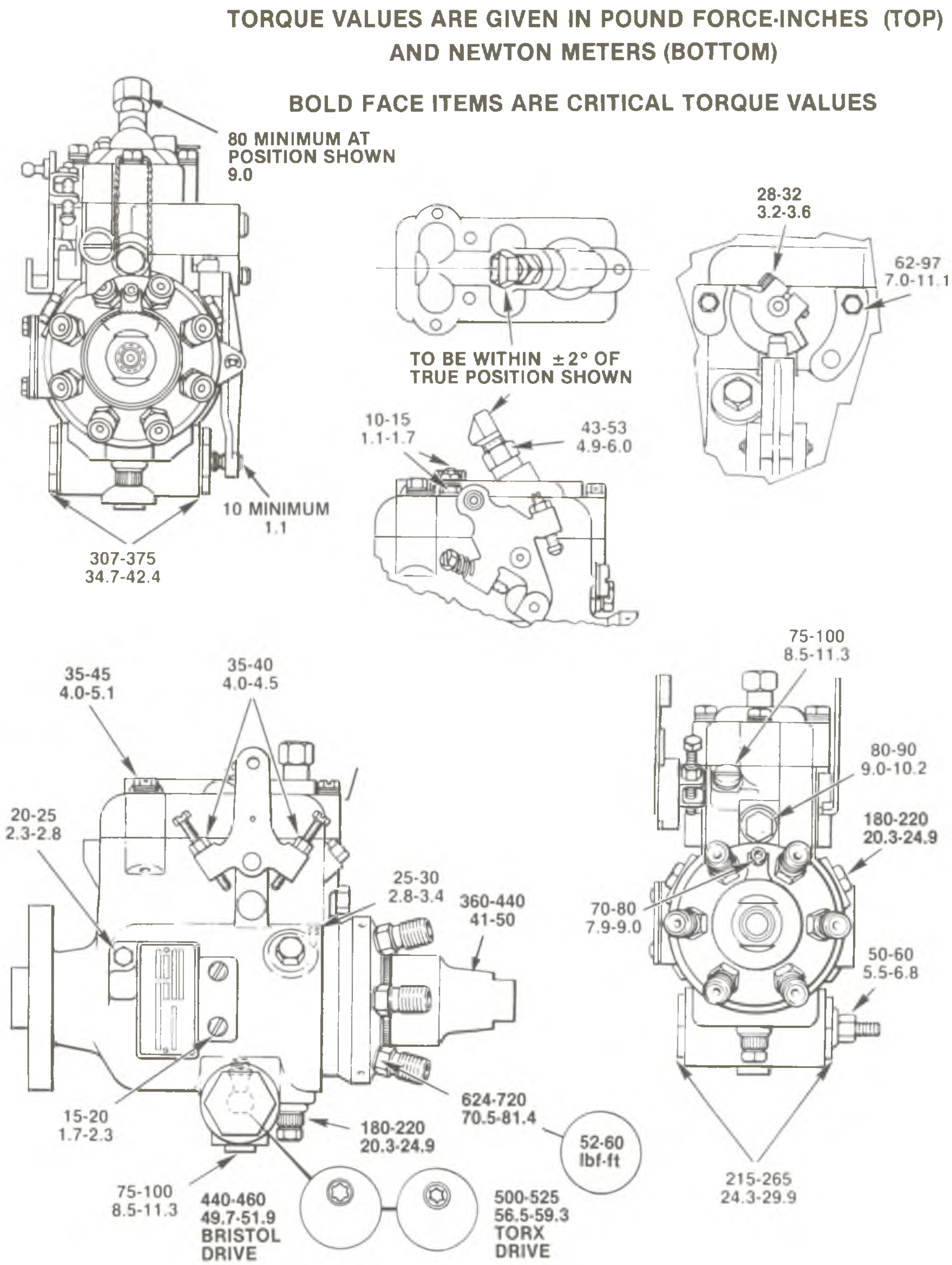


Figure 4-160, Torque Values.

High Altitude Adjustment, 1982 "C-K" Trucks With 6.2L Diesel Engine and LH6 (Light Duty Emissions)

These adjustments are considered altitude performance adjustments and apply only to in-use vehicles. They should not be used to modify vehicles prior to sale.

1982 trucks equipped with the 6.2L diesel engine for low altitude operation may be modified if operation is changed to high altitude for an extended period or permanently. Dealers in high altitude areas should encourage owners who have moved to high altitude counties to purchase the service adjustment procedure outlined below, which is considered an owner maintenance expense. High altitude is defined as 4,000 feet and above. Vehicles designed for principal use at low altitude can be identified by P/N 14050587, injection pump, on light duty emission (LH6) vehicles.

Operation of the 6.2L diesel at high altitudes without modification can result in excessive emission of black exhaust smoke due to low air density. Modification involves the recalibration of the fuel injection pump to a different fuel rate which will compensate for the lower air density at high altitudes.

The injection pump cannot be modified on the vehicle. The following procedure should be used:

1. Remove the injection pump per service manual procedures. Be sure to note the relationship of the timing marks on the pump and front housing. The pump must be reinstalled to its exact previous position.
2. Send the pump to an ADS (Association of Diesel Specialists) Service Center for the altitude performance adjustment. The ADS service centers will be advised by Stanadyne Corporation Bulletin as to injection pump recalibration procedures.
3. Reinstall the pump per service manual procedure. The pump must be installed to its original timing setting. If the original timing relationship was not retained, refer to Bulletin number 82-B-59 detailing the timing procedure.

ALTITUDE ADJUSTMENT LABEL

When LOW ALTITUDE vehicles are adjusted for high altitude operation, a SUPPLEMENTAL emission control information label must be placed **next** to the existing underhood emission control information label. Wash off the area with soap and water, dry thoroughly, and apply the new label, P/N 14057201.

The label should be ordered as regular parts and accessories through the General Motors Warehousing and Distribution Division system. When ordering these labels via rapid entry, use order type CSD. Orders also may be placed on a PC 66 and mailed directly to GMWDD, 6060 West Bristol Road, Flint, Michigan 48554, attention Ship Direct Department.

After performing these adjustments, dealers **should advise** customers that, IF THE VEHICLE IS RETURNED TO CONTINUOUS, LOW ALTITUDE OPERATION, THE PUMP MAY BE RECALIBRATED TO **LOW ALTITUDE** SPECIFICATION PER THE ABOVE PROCEDURE AND THE SUPPLEMENTAL LABEL REMOVED.

Vehicles designed for principal use at high altitude (RPO NA6 — fuel injection pump, P/N 14050526, LH6 engine) perform satisfactorily at low altitude without excessive smoke levels and need not be adjusted for extended operation at low altitude.

HEAVY DUTY DIESEL ENGINE (LL4)

No adjustments are applicable. Engine performs satisfactorily at low and high altitudes.

High Altitude Adjustment, 1983 and Later "C-K-P-G" Trucks With 6.2L Diesel Engine and LL4 (Heavy Duty) or LH6 (Light Duty Emissions)

These adjustments are considered altitude performance adjustments and apply only to in-use vehicles. They should not be used to modify vehicles prior to sale.

1983 trucks equipped with the 6.2L diesel engine for low altitude operation may be modified if operation is changed to high altitude for an extended period or permanently. Dealers in high altitude areas should encourage owners who have moved to high altitude counties to purchase the service adjustment procedure outlined below, which is considered an owner maintenance expense. High altitude is defined as 4,000 feet and above. Vehicles designed for principal use at **high** altitude are identified by option number NA6 on Service Parts Identification label. All other vehicles are designed for principal at **low** altitude.

Operation of the 6.2L diesel at high altitudes without modification can result in excessive emission of black exhaust smoke due to low air density. Modification involves the recalibration of the fuel injection pump to a different fuel rate which will compensate for the lower air density at high altitudes.

The injection pump cannot be modified on the vehicle. The following procedure should be used:

1. Remove the injection pump per Service Manual procedures. Be sure to note the relationship of the timing marks on the pump and front housing. The pump must be reinstalled to its exact previous position.
2. Send the pump to an ADS (Association of Diesel Specialists) Service Center for the altitude performance adjustment. The ADS Service Centers will be advised by Stanadyne Corporation Bulletin as to injection pump recalibration procedures.
3. Reinstall the pump per Service Manual procedure. The pump must be installed to its original timing setting. If the original timing relationship was not retained, refer to bulletins detailing the timing procedure to follow.

ALTITUDE ADJUSTMENT LABEL

When LOW ALTITUDE vehicles are adjusted for high altitude operation, a SUPPLEMENTAL emission control information label must be placed **next** to the existing underhood emission control information label. Wash off the area with soap and water, dry thoroughly, and apply the new label, (P/N 14057201).

The label should be ordered as regular parts and accessories through the General Motors Warehousing and Distribution Division system. When ordering these labels via rapid entry, use order type CSD. Orders also may be placed on a PC 66 and mailed directly to GMWDD, 6060 West Bristol Road, Flint, Michigan 48554, attention Ship Direct Department.

After performing these adjustments, dealers **should advise** customers that, IF THE VEHICLE IS RETURNED TO CONTINUOUS, LOW ALTITUDE OPERATION, THE PUMP MAY BE RECALIBRATED TO **LOW ALTITUDE** SPECIFICATION PER THE ABOVE PROCEDURE AND THE SUPPLEMENTAL LABEL REMOVED.

Vehicles designed for principal use at high altitude (RPO NA6 — fuel injection pump, P/N 14050526, LH6 engine) perform satisfactorily at low altitude without excessive smoke levels and need not be adjusted for extended operation at low altitude.

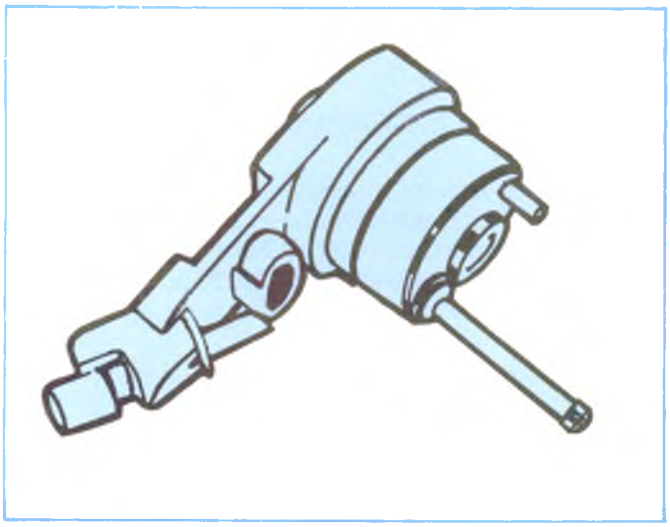


Figure 4-161, Tool #J33042.

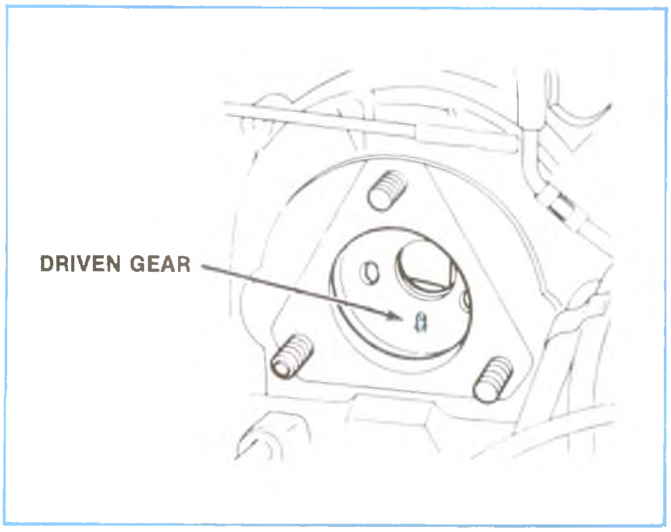


Figure 4-162, Slot of F.I. Pump Gear.

Static Timing

FUEL SYSTEM ADJUSTMENT "MARKING TDC" ON FRONT HOUSING 6.2L DIESEL ENGINE:

1. Turn engine to TDC #1 cylinder (firing).
2. Install timing fixture (J-33042) in F.I. pump location (Figure 4-161). Do not use gasket.
3. Slot of F.I. pump gear to be in vertical 6 o'clock position — (if not, remove fixture and rotate engine crankshaft 360 degrees). The timing marks on gears will be aligned. See Figure 4-162.
4. Fasten gear fixture with one 8mm bolt, and tighten.
5. Install on 10mm nut to housing **upper** stud to hold fixture flange nut to be "finger" tight.
6. Torque large bolt (18mm head) counterclockwise (towards left bank) to 50 ft. lbs. Tighten 10mm nut.
7. Insure crankshaft has not rotated (and fixture did not bind on 10mm nut).
8. Strike scriber with mallet to mark "TDC" on front housing.
9. Remove timing fixture.
10. Install fuel injection pump **with** gasket.
11. Install on 8mm bolt to attach gear to pump hub and tighten to specifications.
12. Align timing mark on F.I. pump to front housing mark. Tighten to specification (3) 10mm attachment nuts.
13. Rotate engine and install remaining (2) pump gear attaching bolt and tighten to specifications.

Checking Probe Holder Alignment For Timing Accuracy

ENGINES DISASSEMBLED

1. Balance #3 and #5 piston positions to establish T.D.C. #1 cylinder firing (Figure 4-163).

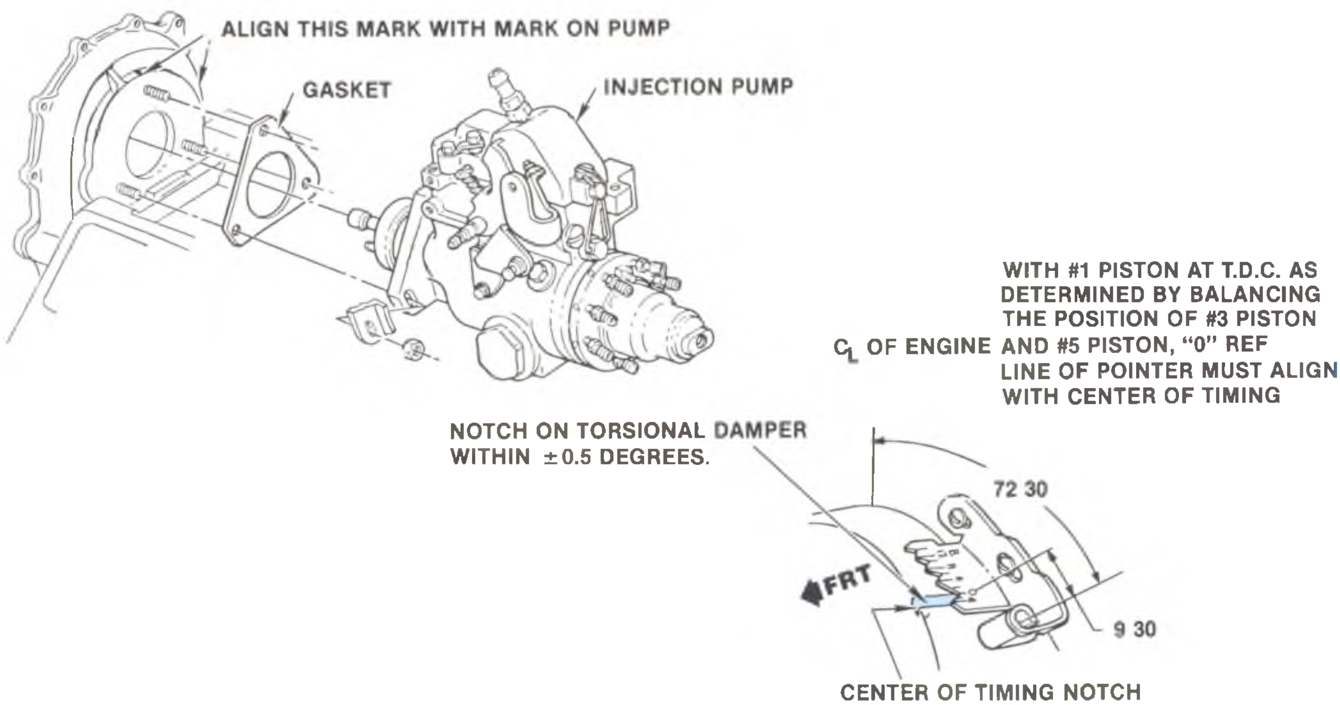


Figure 4-163, T.D.C. Mark.

2. With crankshaft fixed (locked) at T.D.C. #1 cylinder firing:
   A. Install timing pointer at 0 position with respect to mark on torsional damper.
   B. Install timing gear fixture and housing marking fixture. Apply a torque to 50 ft. lbs. to fixture gear in clockwise direction (looking at front of engine, i.e., toward #1 cylinder). Mark timing line on housing. Remove fixtures.
3. Position reference pin on fuel injection pump hub with respect to timing line on pump.
4. Install fuel injection pump through rear of front housing. Align housing and pump timing marks, tighten fasteners.

— NOTE —

Determining cylinder #1 TDC position on an assembled engine for probe holder alignment.

- Remove valve rocker cover.
- Rotate crankshaft until desired cylinder is at or near TDC.
- Remove valve spring retainers, cap, and spring from the inlet valve and allow valve to drop on to head of piston.
- Set up a dial indicator to record the displacement of the valve tip as the crankshaft is rotated.
- Attach a degree wheel to the front of the crankshaft or attach a piece of "calibrated" tape on the damper circumference (.070 inches per degree for an 8 inch diameter damper) to provide accurate reading of at least ±10 degree crankshaft rotation from an assumed TDC reference on a stationary pointer.
- Turn the crankshaft in the direction opposite normal rotation such that the damper mark is approximately 18 degrees BTDC.
- Turn crankshaft in the direction of rotation to 10 degrees BTDC. (To remove any gear/chain lash in timing system). Record dial indicator reading.
- Continue to rotate crankshaft in 2 degree increments and take dial indicator readings thru 10 degrees ATDC.
- Plot the data on a graph. If the assumed TDC was correct, the plot will be symmetrical about that point, i.e., a given valve tip displacement will occur at the same number of degrees before and/or after TDC.
- An alternative to a graph would be to record the number of degrees before TDC and after TDC that a given valve tip displacement occurs; then average those 2 numbers. The resulting number will be the number of degrees thru TDC is from the selected valve tip displacement.

Checking Or Adjusting Pump Timing (Static)

For the engine to be properly timed, the marks on top of the engine front cover and the injection pump flange must be aligned.

— NOTE —

The engine must be off when the timing is reset.

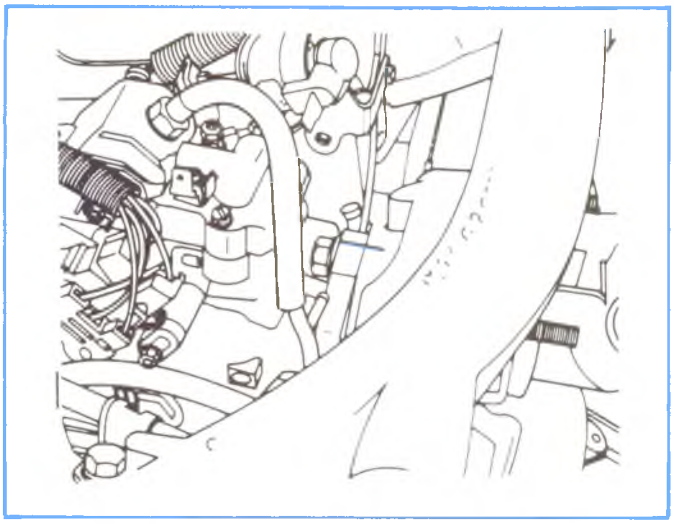


Figure 4-164, Aligned Timing Marks.

ADJUSTING

If marks are not aligned, adjustment is necessary. See Figure 4-164.

1. Loosen the 3-pump retaining nuts **(ENGINE MUST BE OFF).**
2. Align mark on injection pump with mark on front cover and tighten nuts to 40 N·m (30 ft. lbs.). Use Tool J-29872 to aid in rotating the pump to align the marks.

Pump Timing Mark Location And White Smoke At Idle

A condition of white exhaust smoke at idle when the engine is at normal operating temperature may be due to slightly retarded injection timing. The following steps must be adhered to in order to properly diagnose the condition and take corrective action.

1. Determine if retarded timing is the cause of white smoke.
   A. Engine should have a minimum of two hundred (200) miles.
   B. Operate engine to normal temperature (thermostat open).
   C. Check engine RPM and set if required to six hundred and fifty (650) RPM in park (auto) or neutral (manual). Also set fast idle speed to 800 RPM.
   D. With engine at proper idle speed, check for emission of white smoke.
   E. If white smoke is evident, connect a lead from battery plus (+) terminal to the cold advance solenoid terminal on the injection pump (Figure No. 1). A noticeable change in engine sound will be evident. Activating the cold advance solenoid increases the timing approximately three (3) degrees.
   F. Check for white smoke. If no white smoke is evident or has reduced considerably, a change in timing setting is required. If the smoke does not diminish, check for other causes of white smoke. (Assure each cylinder is firing — start with a compression check.)
2. Adjustment of Timing. See Figure 4-165A.
   A. The pump/engine flanges may or may not have a white alignment tape attached, which was used on some early production engines for timing adjustment.
   B. Obtain locally a piece of white tape and draw a 1mm offset line as shown in Figure 4-165B.
   C. To correct the white smoke condition on this engine, add a new tape with a 1mm offset over the old tape (or bare flange(s) if tape is missing). Cut the tape between the flanges. Loosen the three (3) pump attaching bolts and rotate the pump to line up the offset lines. The pump must be rotated clockwise as viewed from the front of the vehicle. Do not exceed 1mm of pump movement. Retighten the three (3) pump attaching nuts to a torque of 25-37 ft. lb. (34-50 N·m).
   D. NOTICE: Do not make timing adjustment with engine running. Do not start engine until pump attaching nuts are torqued securely.

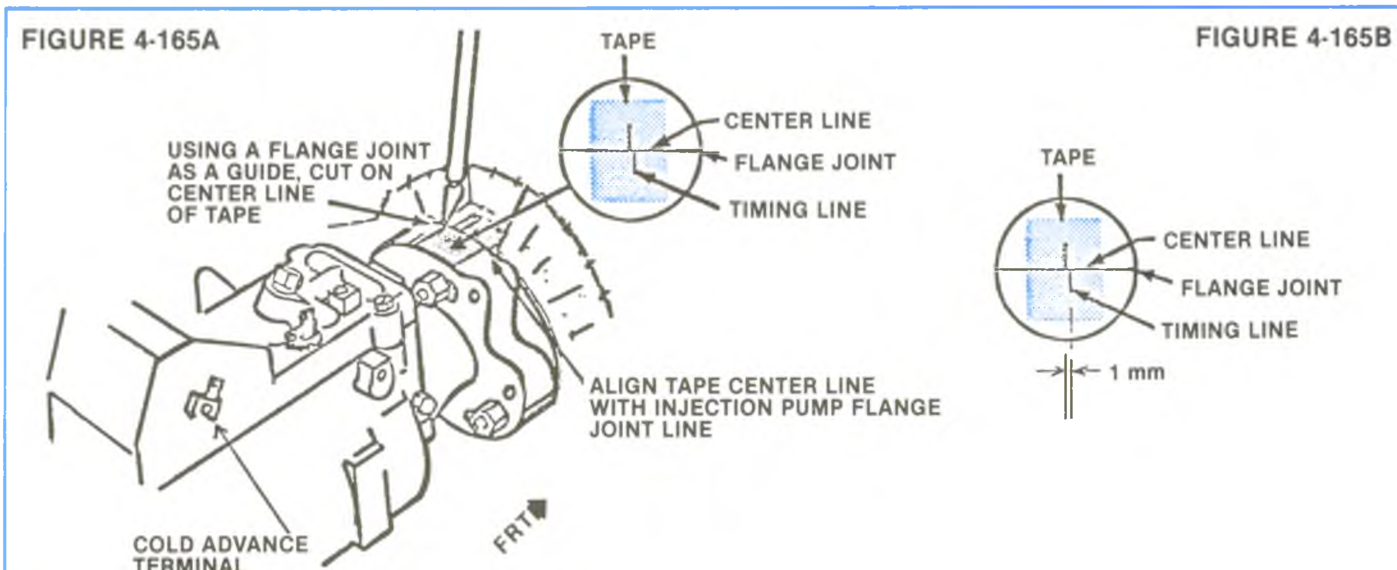


Figure 4-165A-B, Injection Pump Static Timing.

TIMING ADJUSTMENT PROCEDURE

1. Obtain white tape approximately one (1) inch wide by one (1) inch long.
2. Draw a center line.
3. Draw a perpendicular line downward from the center line.
4. Measure from this line 1mm to the left along the center line.
5. Draw a perpendicular line from this point in the other direction.
6. Remove tape backing.
7. Install on pump/flange interface with center line on joint.
8. Cut tape.
9. Loosen pump attaching nuts, move pump to align the offset lines.
10. Retighten pump attaching nuts.

SERVICE INJECTION PUMP STATIC TIMING SETTING

See Figure 4-166. Any service on the 6.2L Diesel engine which requires replacement of the injection pump requires the static timing mark to be at the correct setting.

During the 1982 model year a change to the procedure for marking the pump was made. Injection pumps built during the first half of the 1982 model prior to the change, required the pump timing mark to be offset from the housing flange mark. To facilitate these settings a piece of tape was used which had offset lines. By lining up the tape lines the correct setting was achieved. White tape was used on light duty engines and yellow on heavy duty.

Since service pumps may be of a different vintage than the removed pump, the following must be adhered to for correct timing setting whenever installing a replacement injection pump:

1. All injection pumps have a model identification plate which is attached to the pump housing just below the throttle linkage. The plate includes the (1) model number, (2) serial number and (3) the part number — (Figure 4-166).
2. Remove and install injection pump per service manual procedure.
3. Refer to Figure 4-116 which displays the location of the timing marks which are stamped into the injection pump flange and the front housing.
4. Remove any timing tape that is over the stamped marks.
5. Refer to the model identification plate on the pump that is being installed. Use the following chart to determine the timing mark alignment setting:

MODEL NUMBER	ENGINE/RPO	PUMP PART NUMBER	TIMING MARK OFFSET
DB2-4090	Light Duty (LH6)	14050587	1.5mm (.059″)
DB2-4091	Heavy Duty (LL4)	14050588	2.5mm (.098″)
DB2-4126	Light Duty (LH6)	14050587	Aligned
DB2-4153	Heavy Duty (LL4)	14050588	Aligned

6. If the pump is DB2-4090 or 4091 always have the mark on the pump toward the left side (driver's) of the mark on the housing. This is the advance direction.
7. If an injection pump is to be removed and then reinstalled, it should be first paint marked at the pump to housing flange to allow reinstallation at the original setting.
8. Do not make timing adjustment with the engine running. Do not start engine until pump attaching nuts are torqued securely.

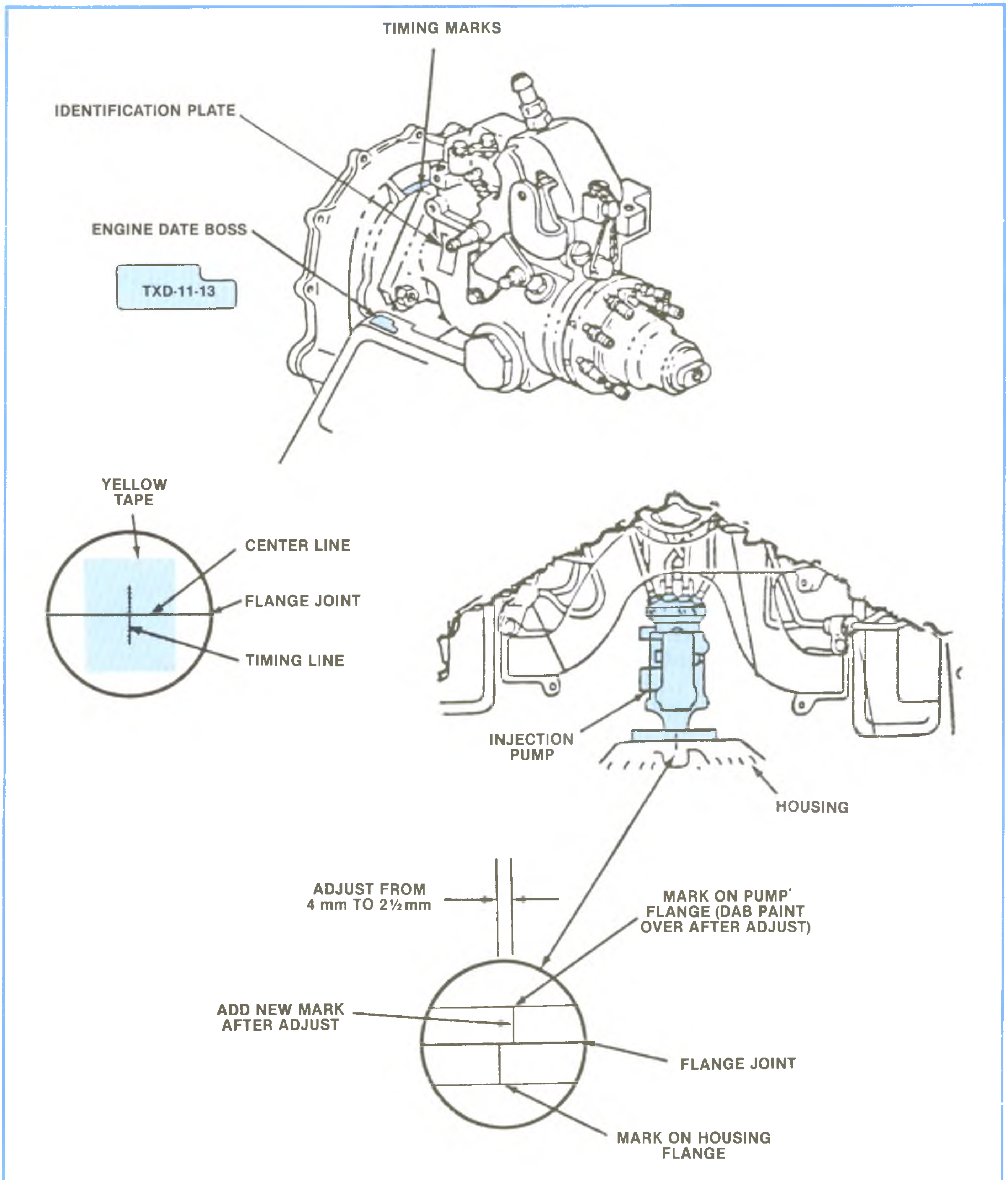


Figure 4-166, Timing Adjustment, Heavy Duty 6.2L Diesel Engine.

6.2L Diesel California Engine Timing "C-K" With YF5 California Emissions Light Duty 6.2L Diesel

Any service on the 6.2L light duty diesel engine (built to California specifications) which necessitates removal or replacement of the injection pump, requires a different static timing procedure.

Light duty engines built to California specifications have been timed with a microwave process. After timing with the microwave, an additional mark "O" is stamped over the pump flange/housing interface.

When viewing the California timed engine, the two (2) timing marks (as on Federal engines) will be visible. These may or may not be lined up. In addition, an "O" will be visible, stamped on the flange interface. The "O" should be round. Any deviation of the timing will result in two (2) half circles not matching.

If the pump is removed for service and is replaced on the same engine, be sure to match the "O" for correct timing setting.

If a new pump or a pump that was not previously on the engine is installed, do not use any "O" marks. Instead, use the normal timing marks and align according to the information previously detailed.

Timing Meters

Diesel engine timing meters have the capability of checking engine timing and RPM. These meters can be used to perform diagnostic checks on the 6.2 liter diesel engine. The 6.2 liter engine's injection pump timing **must be** set to static specifications outlined in this manual.

TIMING METERS AND DIAGNOSTIC PROCEDURES

The timing meter's timing capability and tachometer can be used to check the injection pump's housing pressure cold advance and rocker arm mechanical light load advance functions for operation. These checks may indicate if the pump's advance solenoid, advance piston assembly and cam ring are functioning and not binding or seized.

PROCEDURE

1. Place the transmission selector in park, apply the parking brake and block the wheels.
2. Start the engine and let idle until fully warmed up. Then shut off engine.
3. Clean any dirt from the engine probe holder (RPM counter) and crankshaft balancer rim.
4. Using a snap-on MT95 (bracket qualifier) qualify the timing indicator.
5. Attach the timing meter, following manufacturer's instructions.
6. Start engine and adjust idle to 650 RPM. Note engine timing and RPM readings.

HOUSING PRESSURE COLD ADVANCE CHECK

Disconnect advance solenoid's terminal wire at the injection pump. Attach a jumper wire to the battery positive terminal and touch injection pump's advance solenoid terminal. Note engine timing and RPM readings.

When the advance is functioning properly, the engine's timing will **advance** approximately 3 to 5 degrees and RPM will **increase** when the solenoid is energized.

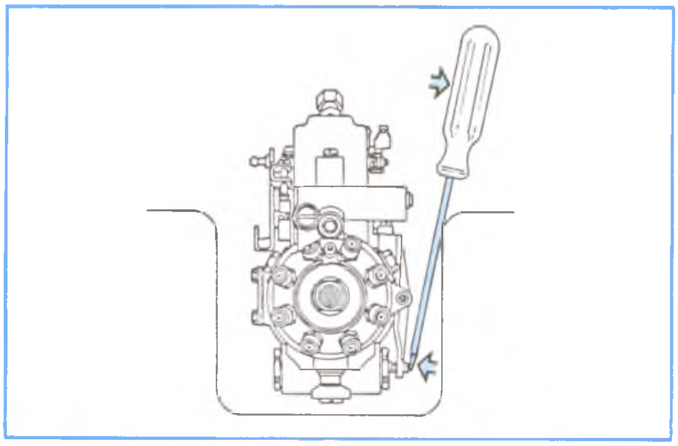


Figure 4-167, Depressing Rocker Lever.

ROCKER ARM MECHANICAL LIGHT LOAD ADVANCE CHECK

See Figure 4-167. Using a ten-inch long screwdriver, push the injection pump's rocker arm (at lower end) towards injection pump. Note engine timing and RPM readings.

When the rocker arm mechanical light load advance is functioning properly, the engine's timing will **retard** approximately 3 to 5 degrees and RPM will **decrease.**

Injection pump removal is normally required to repair the pump's internal mechanical advance.

Engine RPM may require readjustment to emission label specifications when diagnostic procedures are completed.

Injection Nozzles

6.2L NOZZLE AND HIGH PRESSURE FUEL LINES

See Figure 4-168. The fuel from the injection pump is directed through the 8 high pressure lines to the fuel injection nozzles. To a large degree, the successful operation of the engine depends on these eight injection nozzles.

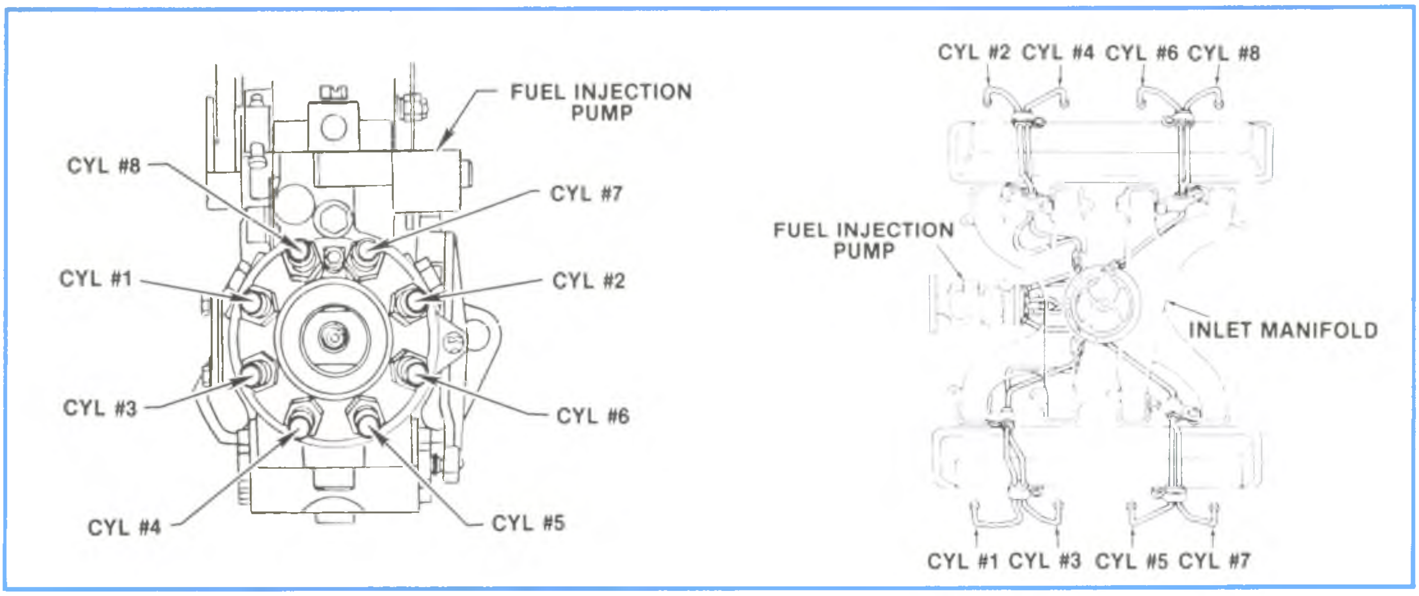


Figure 4-168, **6.2L High Pressure Fuel Lines.**

Metered fuel, under pressure from the injection pump, enters the nozzle and pressurizes the nozzle body (Figure 4-169).

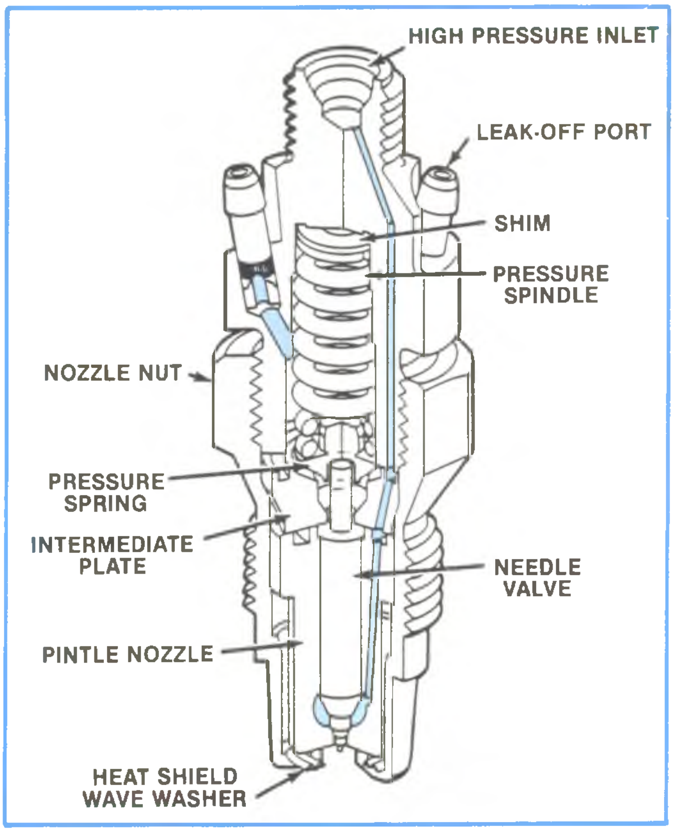


Figure 4-169, **6.2L Nozzle.**

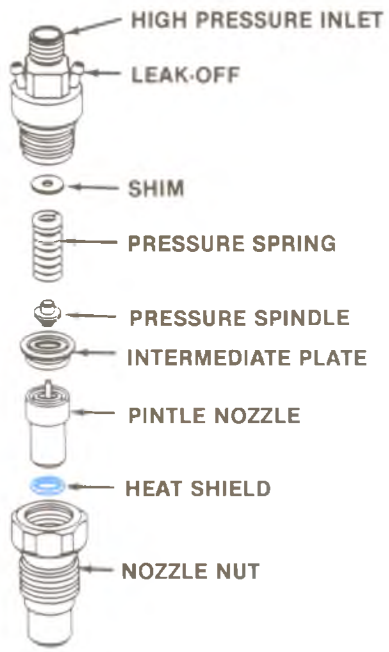


Figure 4-170, **Nozzle Holder Assembly, Exploded View.**

When the pressure in the nozzle body overcomes the spring force, the valve lifts off its seat allowing fuel to spray into the pre-chamber.

During injection a small amount of fuel leaks through the clearance of the valve guide. This fuel flows through the fuel drain back nipple at the top of the nozzle and is returned to the fuel tank through the fuel return line.

The nozzle also has a bleed back path for bleeding excess fuel back to the gas tank. The nozzle allows only the amount of fuel to pass that is needed for engine operation.

Model #KCA18450
Bosch #DNOSD193

See Figure 4-170. The nozzle is a pintle type #DNOSD248 having an initial rota-flow value of 680 cm^3/minute at 0.1mm lift, and overlap length of 0.7mm and a maximum lift of 97mm. The nominal opening pressure is 130 bars (1885 psi).

A pintle nozzle has a special type of a needle valve where in an integral tip from the lower end of the needle is so formed as to influence the flow rate and/or spray. It is a tiny projection at the end of the valve (pintle) which extends through the single large orifice.

The main purpose of the nozzle is to direct and to atomize the metered fuel into the pre-combustion chamber. Fuel from the injection pump enters and pressurizes the supply passages in the injector. When the force on the lift area is greater than the spring pressure on the needle valve spindle, the needle valve is lifted off its seat and rests with its upper shoulder against a stop.

Fuel is forced out into the pre-combustion chamber while the needle valve is lifted. The pressure required to open this injector needle valve is approximately 1700 psi.

As the fuel sprays into the pre-combustion chamber, the pump continues to turn and instantaneously closes off fuel to the nozzle. This action causes a rapid drop in fuel line pressure and spring pressure forces the needle valve to close and seat again, sealing off fuel from the pre-combustion chamber.

The injector nozzle injects fuel once for every 2 revolutions of the crankshaft. This means that under normal driving conditions it will open and close about 1,000 times for every mile driven. In a 10-mile drive to and from work each day, each injector nozzle would open and close approximately 10,000 times. In relation to time if you are driving 60 MPH, each injector nozzle will open and close 1,000 times/minute.

Tool J-29873, a 30mm socket, is used for R & R. There is a copper washer used to seal the outside from the combustion area.

It must be replaced anytime the injector is removed. Maximum pop-off is 135 bars (1960 psi), minimum pop-off 125 bars (1810 psi), leakage 105 bars (1520 psi).

Opening pressure used nozzle; should not fall below 105 bars (1500 psi) on used nozzles.

- Thread size — M24 x 1/5mm fin.
- Length — 84mm
- Needle valve diameter — 6mm
- Line O.D. — 6.3mm
- Line I.D. — 2.5mm
- Line length — 600mm

The G-series has a nozzle which is 10mm shorter than the C-K-P model (Figure 4-171).

Changes in fuel injection nozzle design in the 6.2L diesel from the 1982 to the 1983 and later models require that correct replacement nozzles are used in service.

Attempts to use the incorrect nozzle will damage the cylinder head and nozzle threads. The nozzle used in 1983 and later is similar in appearance to the 1982 nozzle except for a different thread pitch size for the C-K-P Truck only.

When replacing nozzles, reference should be made to the nozzle part number (stamped on the side of the nozzle).

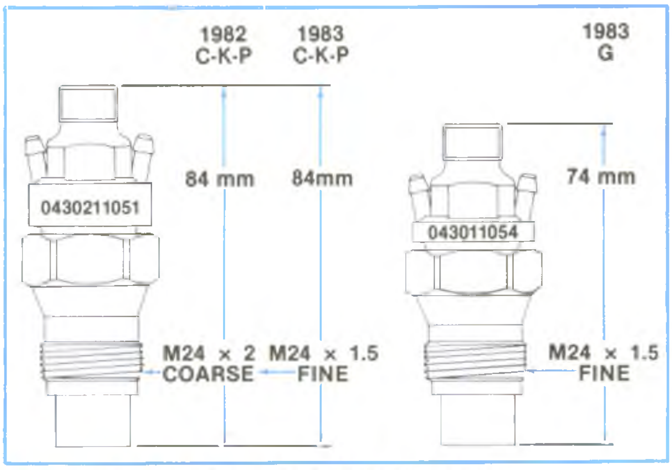


Figure 4-171, **G and C-K-P Nozzle Comparison.**

— NOTE —

When installing nozzle threads, use Anti-Seize Compound #1052771.

The following chart displays the nozzle applications for 1982 and later models:

	1982			1983 AND LATER		
USAGE	**NOZZLE**	**THREAD**	**LENGTH**	**NOZZLE**	**THREAD**	**LENGTH**
C-K-P	0430211051*	M24 x 2 (coarse)	84mm	0430211058*	M24 x 1.5 (fine)	84mm
G	—	—	—	—	M24 x 1.5 (fine)	74mm

— *NOTE —

The nozzle part numbers shown are vendor part numbers and should not be used for ordering. Use GM part numbers for ordering.

The G-series nozzle also has a 5mm needle valve diameter. The I.D. of the G-series lines are 2mm. The C-K-P needle valve O.D. is 6mm and line I.D. is 2.5mm. Both lines are 600mm in length.

Nozzle Testing

Test is comprised of the following checks:

- Nozzle Opening Pressure
- Chatter
- Leakage
- Spray Pattern

— NOTE —

Each test should be considered a unique test, i.e., when checking opening pressure; do not check for leakage.

If all the above tests are satisfied, the nozzle holder assembly can be again installed in the engine without any changes. If any one of the tests is not satisfied, the complete nozzle holder assembly must be replaced or repaired. Use the following steps.

1. Test Lines — 6 x 2 x 400mm (1.5mm bore).
2. Test fluid per ISO 4113 (example Sheel V1399, Viscor 1487c).
3. Kinetic Viscosity at 40 degrees C per ISO 3104: 2.45-2.75mm 2/second.
4. Test oil temperature during test: 20-25 degrees C (room temperature).
5. Refer to the equipment manufacturers instructions for exact test procedures.

— CAUTION —

When testing nozzles, DO NOT place your hands or arms near the tip of the nozzle. This high pressure atomized fuel spray from a nozzle has sufficient penetration power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle, preferably transparent, to contain the spray.

TEST SEQUENCE

- **PREPARATION**

1. Connect the nozzle holder assembly to the test line.
2. Install two clear plastic lines (approximately 1 to 1.5 in. long) over the leak-off connections.
3. Close the shutoff valve to the pressure gauge.
4. **Fill and flush the nozzle holder assembly with test oil by activating the lever repeatedly and briskly. This will apply test oil to all functionally important areas of the nozzle and purge it of air.**

• OBTAINING PRESSURE CHECK

1. Open shutoff valve at pressure ¼ turn.
2. Depress lever of tester slowly. Note at what pressure the needle of the pressure gauge stopped, indicating an increase in pressure (nozzle does not chatter) or at which pressure the pressure dropped substantially (nozzle chatter). The maximum observed pressure is the opening pressure. Some nozzles may drip slightly before they fully open. This is not to be considered a leakage fault, because this is not a leakage test.
3. The opening pressure should not fall below the lower limit of 105 bar (1500 psi) on used nozzles.
4. Replace or adjust nozzles which fall below the lower limit.
5. Adjust the pressure by changing the adjustment shim. The opening pressure is increased by increasing shim thickness and decreased by decreasing shim thickness. It can be changed at the rate of 5 bar (68 psi) for every .04mm (.0016 in.) thickness change.

• LEAKAGE TEST

1. Further open shutoff valve at pressure gauge (½-1½ turns).
2. Blow-dry nozzle tip.
3. Depress lever of manual test stand slowly until gauge reads a pressure of 95 bar (1400 psi). Observe tip of nozzle. A drop may form but not drop off within a period of 10 seconds.
4. Replace the nozzle holder assembly if a droplet drops off the nozzle bottom within the 10 seconds.

• CHATTER TEST

When testing for chatter, it should be noted that the sound (chatter) for new or used nozzles may vary.

On used nozzles, carbonized fuel oil deposited on the pintle and on the nozzle tip produces different sound (chatter) between new and used nozzles on the hand test stand.

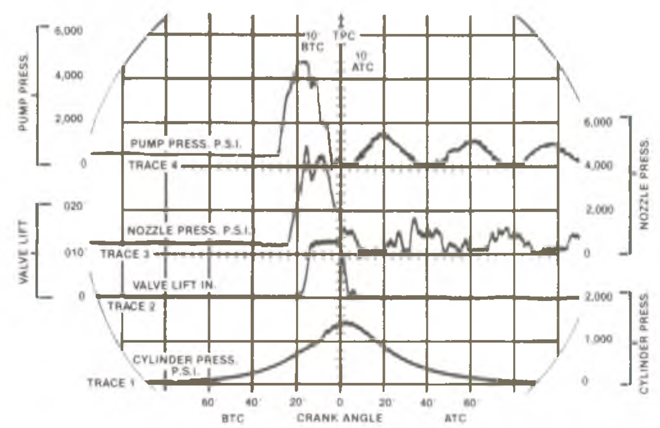
With some used nozzles, the chatter is difficult to detect during slow actuation of the hand test stand lever. As long as there is chatter, the nozzle is acceptable. Use the following steps:

1. Close shutoff lever at pressure gauge.
2. Depress lever of manual test stand slowing noting whether chatter noises can be heard.
3. If no chatter is heard; **increase the speed of lever movement until it reaches a point where the nozzle chatters.**
4. The chatter indicates that the nozzle seat, guide, as well as the pintle, have no mechanical defects.
5. Replace nozzles which do not chatter.

• SPRAY PATTERN

This nozzle features a longer nozzle overlap, greater pintle to body clearance, and greater needle to body clearance. This assembly also features an internal wave washer between the nozzle nut and nozzle. Because of these features, objective testing in the field is difficult. A pop tester will not deliver fuel with the velocity necessary to obtain proper spray pattern analysis.

1. Close shutoff valve at pressure gauge.
2. Depress lever of manual test stand downward abruptly and quickly. The spray should have a tight, evenly shaped conical pattern which is well atomized. This pattern should be concentric to the nozzle axis. Stream-like injections indicate a defect.



TYPICAL OSCILLOSCOPE READING

Figure 4-172, **Oscilloscope Pattern.**

Oscilloscope Pattern, Fuel Injection Pump

Shown in Figure 4-172 is a typical, unretouched, four channel oscilloscope photograph of a Stanadyne fuel injection pump operating at full speed and full load on a 219CID turbocharged diesel engine.

Trace No. 1 represents the cylinder pressure, in pounds per square inch, which reaches approximately 1400 psi during combustion. The preignition pressure of 1000 psi results from the added turbocharger boost which raises the effective compression ratio.

Trace No. 2 represents the nozzle valve lift of .0135 inches (.34mm).

Trace No. 3 shows the nozzle pressure, in pounds per square inch, at the nozzle fitting. A delay in pressure rise occurs around 20° BTDC (engine timing) due to the unseating of the nozzle valve at the preset pressure of 2500 psi. The pressure continues to rise to a peak of approximately 5000 psi after the valve lifts off its seat. This is a result of the resistance generated when the fuel is forced through the tiny spray orifices in the nozzle tip. Note that a small pressure rise, or bounce, occurs after the valve strikes its seat upon closing.

Trace No. 4 represents the injection pump output pressure in pounds per square inch. The peak pressure is approximately the same as nozzle pressure (5000 psi).

The misalignment of traces 3 and 4 indicates the time (lag) it takes for the pump discharge pressure wave to pass through the fuel injection lines and reach the nozzle.

The pump discharge begins at 28° BTDC engine timing. This is 14° pump timing. The advance mechanism was adjusted to produce an 8° pump speed advance (16° engine) with a 12° BTDC static engine timing.

Notice the reflected pressure waves (or afterwaves) which occur after the nozzle is closed. Fluid flow at the nozzle is stopped abruptly when the nozzle closes, but the fuel in the line continues to flow and generates the pressure waves seen in the oscilloscope trace. The pressure waves "echo" back and forth between the nozzle and the pump until they are completely dissipated by fluid friction prior to the next injection cycle. In order to prevent after-injection, the peak pressure of the reflected waves is kept below the nozzle opening pressure.

Also notice that a residual line pressure of approximately 500-600 psi occurs on the left side of the pressure peaks. This pressure is required in order to prevent the valleys of the reflected pressure waves from dropping below atmospheric pressure which could cause cavitation erosion in the pump, fuel line and nozzle.

Cavitation

The injection line is susceptible to a particular kind of corrosion known as cavitation. Cavitation is short of cavitation-erosion-corrosion, indicating the states of the process. First cavitation, second erosion, third corrosion.

The action of the pump creates vapor bubbles in a confined space. These bubbles burst and create shock waves. The shock waves attach nearby metal surfaces, causing them to crumble, or erode. The eroded surface is open to attach by corrosion, which allows the erosion to continue.

Cavitation erosion is actually damage from these pressure waves "echoing" back and forth between the nozzle and pump. It can be compared to the noise or jerk in water pipes which occurs when water is shut off very rapidly.

Fast (Cold) Idle Speed System

See Figure 4-173. The fast idle speed control system consists of a throttle solenoid, engine coolant temperature switch and related control.

During a cold start when the engine coolant temperature is below a prescribed value, the control circuitry energizes (extends) the solenoid and maintains a high engine idle speed by holding the throttle off the low idle stop.

When the engine coolant temperature reaches the prescribed value, the control circuitry de-energizes the solenoid, allowing the throttle to return to the low idle stop.

The fast idle systems work together with the housing pressure cold advance, except on 1984 and later California LH6 systems.

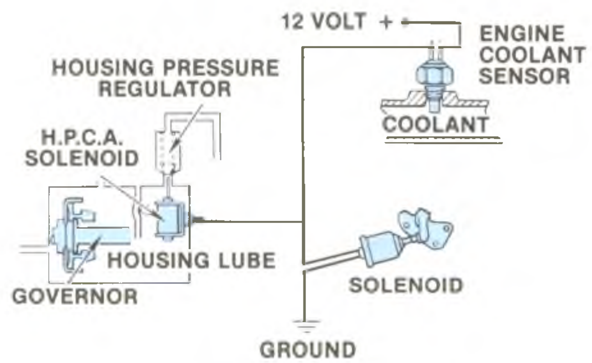


Figure 4-173, **H.P.C.A./Idle Circuit.**

6.2L DIESEL IDLE SPEED SETTING PROCEDURE

1. All idle speeds are to be set within ±25 RPM of specified value.
2. Set parking brake and block drive wheels.
3. Engine must be at normal operating temperature. Air cleaner should be on and all accessories should be turned off.
4. Install a Kent-Moore J-26925 Diesel Tachometer or equivalent per manufacturer's instructions.
5. Adjust low idle speed screw on fuel injection pump to an engine speed of 650 RPM in Neutral for automatic transmissions and 650 RPM in Neutral for manual transmissions.

- **ADJUST FAST IDLE SPEED AS FOLLOWS:**

1. Remove connector from fast idle solenoid. Use an insulated jumper wire from a 12 volt terminal to energize solenoid.

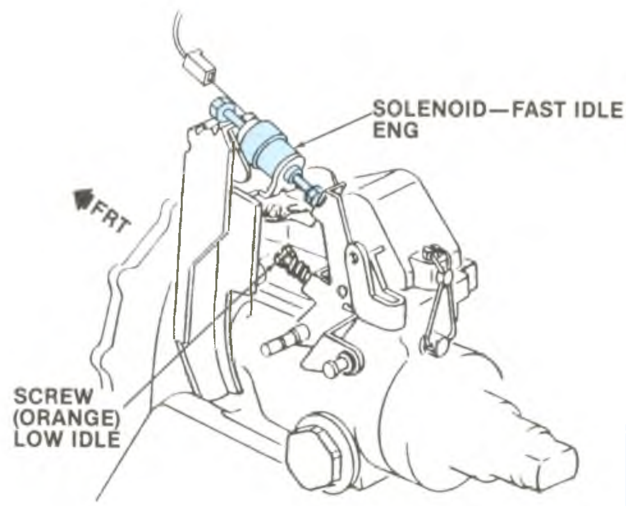


Figure 4-174, **Idle Adjustment.**

— NOTE —

All fast idle solenoids will have the plunger extending through the rear, with a screw head on it. This is for easy access to adjust from the front of the engine.

2. Open throttle momentarily to ensure that the fast idle solenoid plunger is energized and fully extended.
3. Adjust the extended plunger by turning the hex head to an engine fast idle speed of 800 RPM in Neutral.
4. Remove jumper wire and re-install connector to fast idle solenoid.

- **REMOVE TACHOMETER.**

NOTES

5. Emission Systems

5A. General Emission Systems
5B. California Diesel Electronic Control System (DECS)

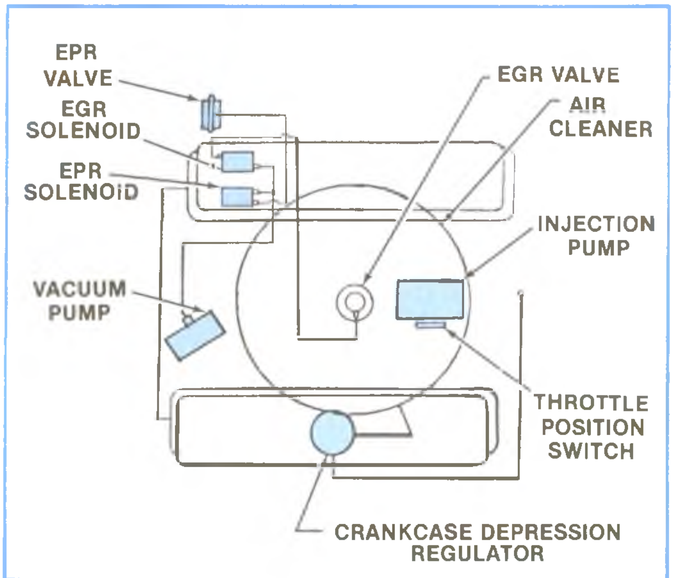


Figure 5-1, Emission Systems.

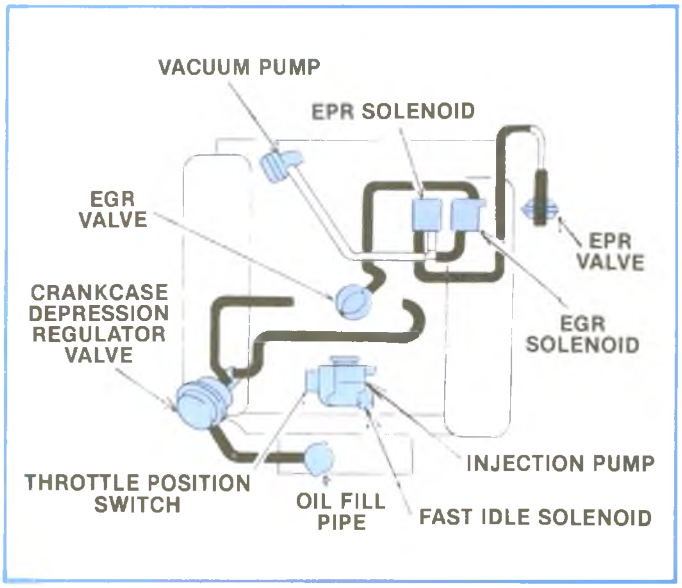


Figure 5-2, Emission Systems — Federal CK (LH6 Engine).

5A. General Emission Systems

See Figure 5-1.

1. Crankcase ventilation system (crankcase depression regulator — CDR) LH6 and LL4.
2. Exhaust gas recirculation (EGR) LH6 only.
3. Exhaust pressure regulator (EPR) LH6 only.
4. (LH6) Throttle position switch/(LL4) Vacuum regulator valve.

- Figures 5-2, 5-3 and 5-4 are the Federal Emission schematics for various vehicle applications:

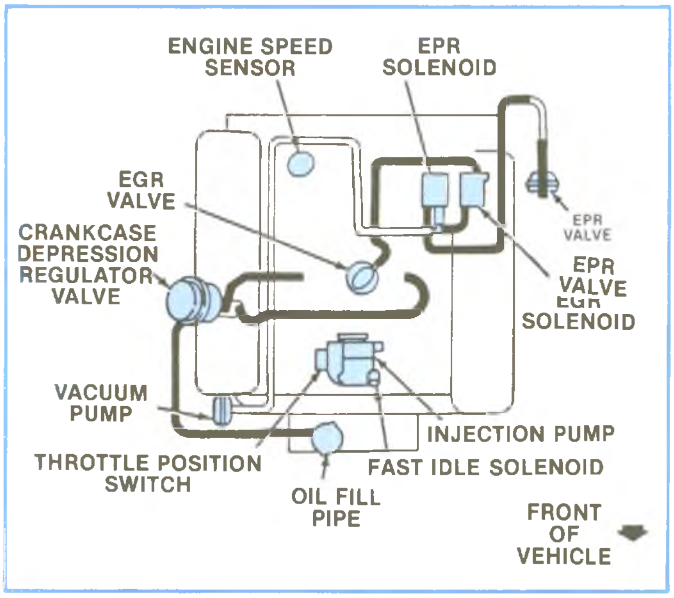


Figure 5-3, Emission Systems — Federal G (LH6 Engine).

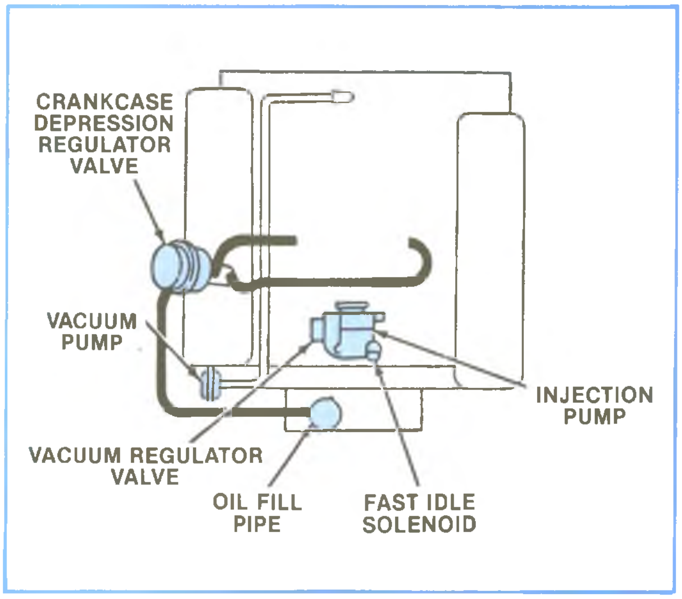


Figure 5-4, Emission System — LL4 Engine.

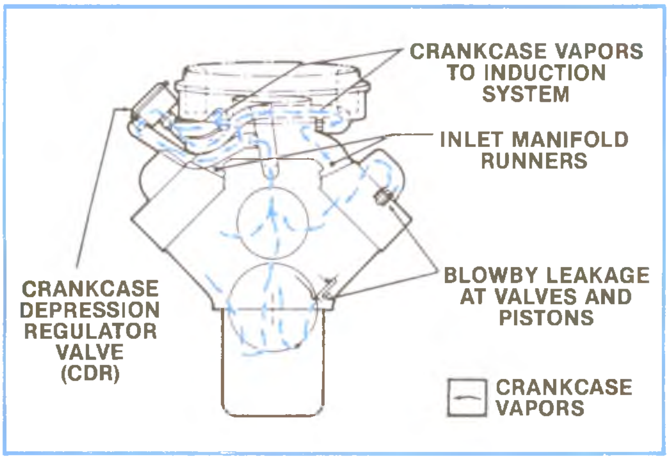


Figure 5-5, Crankcase Ventilation System.

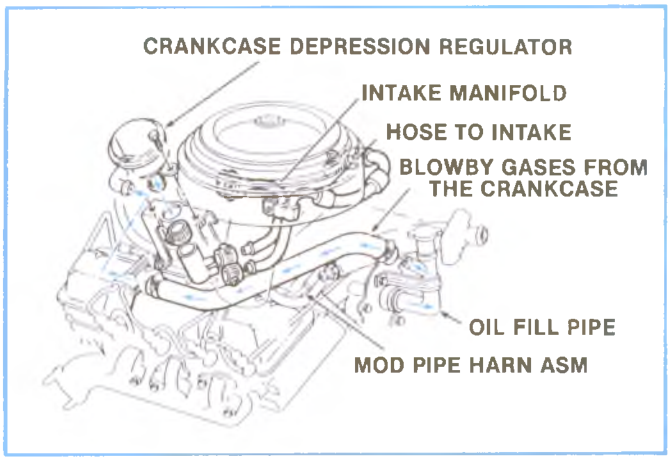


Figure 5-6, CDR Valve Installation.

Crankcase Ventilation System

The 6.2L crankcase ventilation system is designed to reduce crankcase pressure at idle (Figure 5-5). It consequently reduces the possibility of engine oil leaks. Crankcase pressure has been highest at idle and, subsequently, the engines have been more susceptible to oil leaks at idle. The regulator is located at the front of the right cylinder head. This, along with the use of large ventilation system tubing will lower crankcase pressure. Crankcase gases now enter the air crossover on each side of the intake manifold.

Crankcase Depression Regulator, CDR

The major component in the ventilation system is the CDR, crankcase depression regulator valve (Figure 5-6). CDR limits crankcase vacuum to a maximum of 3 to 4 inches water. This is done as the gases (blow-by and fresh air) are drawn from the oil fill pipe through the CDR valve and into the intake manifold. 1985 and later CDR plumbing incorporates plastic snap clamp (10019739) for hose retention.

Intake vacuum acts against a spring loaded diaphragm (Figure 5-7) to control the flow of crankcase gases. Higher intake vacuum levels pull the diaphragm closer to the top of the outlet tube. This reduces the amount of gases being drawn from the crankcase and decreases the vacuum level in the crankcase. As the intake vacuum decreases the spring pushes the diaphragm away from the top of the outlet tube allowing more gases to flow to the intake valve.

A diesel engine has little vacuum at idle, because at slow speed there is more time to leak past the rings. And with higher compression the crankcase can be pressurized by blowby.

The purpose of the CDR valve is to maintain 3-4 inches of water (vacuum in the crankcase). Too little vacuum will tend to force oil leaks. Too much vacuum will pull oil into the air crossover.

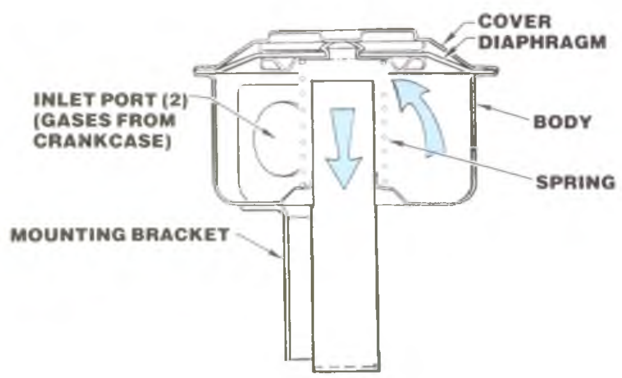


Figure 5-7, **CDR Valve Operation.**

CDR VALVE TEST

The CDR valve is checked with a water manometer (Figure 5-8). The U-tube manometer is a primary measuring device indicating pressure or vacuum by the difference in the height of two columns of fluid. The CDR valve can also be checked with a magnehelic gauge (see Section 7).

Connect one end of the manometer to the oil dipstick hole . . . the other end is vented to the atmosphere. The air cleaner must be installed . . . then run the engine at idle.

•CDR SPECIFICATIONS

1 inch water pressure @ idle to approximately 3-4 inches water vacuum at full load.

NOTE:
Too little vacuum will tend to force oil leaks . . . too much pulls oil into the air crossover.

NOTE:
Add amount column travels up, to amount column travels down, to obtain total. Psi/Vac.

EXAMPLE:
1/2″ + 1/2″ Vac. Reading shown on the manometer is for this **example only.**

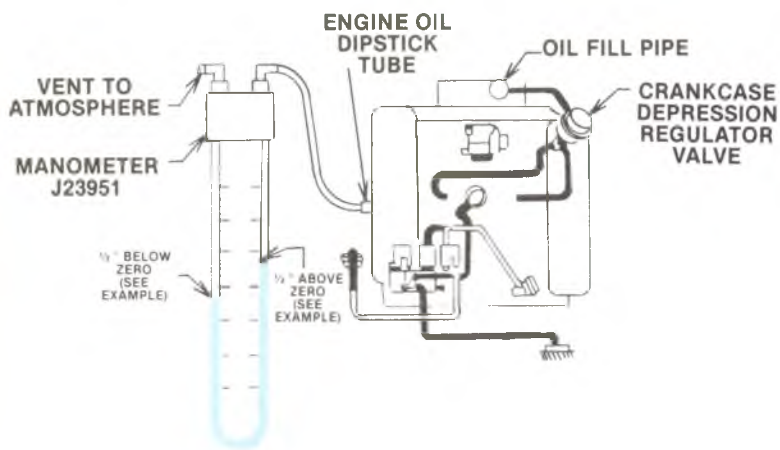


Figure 5-8, **CDR Valve Test with Manometer.**

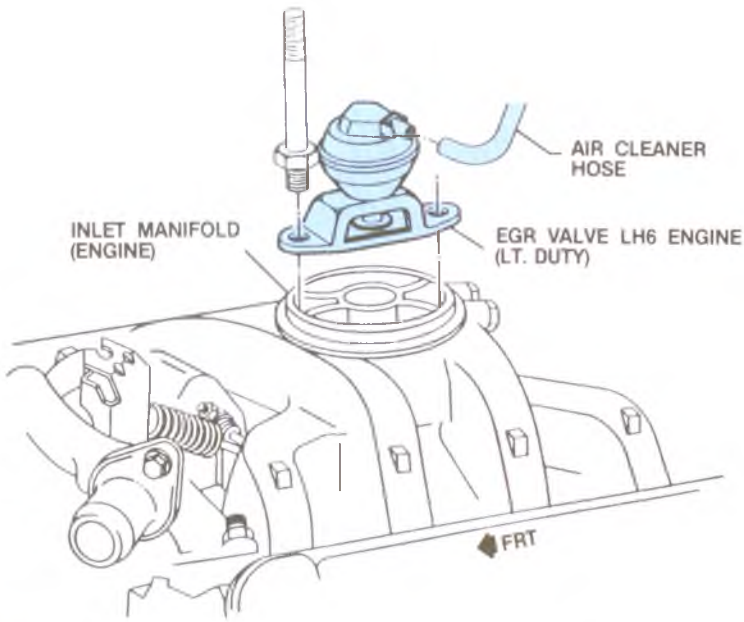


Figure 5-9, **EGR Valve.**

Exhaust Gas Recirculation, EGR

EGR PRINCIPLE

When a vehicle operates for a substantial part of its time at part load — which is the normal condition in town traffic — emissions can be reduced by the use of Exhaust Gas Recirculation. Mixing some of the exhaust gas with the inlet air at part load reduces the concentration of oxygen and lessens the opportunity to produce NO_X. Reduction in NO_X of some 40% can be obtained without increasing HC, CO or specific fuel consumption.

The increase in the temperature and NO_X formation in the main chamber depend upon the amount of incompletely burned compounds discharged from the pre-chamber, the oxygen concentration, and the timing of the discharge.

EGR is designed to control (Oxides of Nitrogen) NO_X. This is done by blending the fuel-air with exhaust gases to reduce the peak temperatures and oxygen concentration. The lack of oxygen lowers the possibility of nitrogen combining with oxygen to form NO_X.

The effect of increasing the EGR on the pollutants shows that as EGR is increased NO_X decreases, while both HC and CO increase. The gradual decrease in NO_X continues as EGR increases but the characteristics of HC and CO change significantly above a value of EGR which varies with speed and load. It is possible to establish an amount of EGR as a function of speed and load. Above 90% fuel no EGR is used. Also since during normal driving in town, very little time is spent above 75% maximum speed, the use of EGR at high speed would have little effect on the pollutants.

Spent gas is run through an EGR valve to the manifold, and then is part of the air intake (Figure 5-9). This is introduced into the combustion chamber. It takes up some of the volume of the incoming charge of air. When ignition takes place, the spent exhaust gases cannot partake in the combustion process, since they have already been used previously, so they add nothing. During the period of "rapid" combustion, the temperature increases quite rapidly. The temperature rise causes the gases to expand. The temperature in the chamber is much higher than the exhaust gases. The spent gases now take part in the process. They cannot add to the process because of lack of oxygen. So the spent or inert gas acts as a sponge and pulls heat into itself causing it to expand. As it does it absorbs heat of combustion and drops the temperature approximately 500°F. Carbon monoxide is not a significant emission factor with diesels. Hydrocarbons are controlled by the injection nozzles, pump timing and combustion chamber design. The EGR valve is used on the LH6 (C) engine only.

VACUUM SWITCHED EGR (FEDERAL EMISSIONS)

With vacuum switched EGR, either full flow or no flow of exhaust gas is admitted to the intake manifold, Figure 5-10. At closed throttle the EGR valve is opened. The EGR valve remains fully open to a calibrated throttle position at which point it closes. The throttle position is sensed by a throttle position switch (TPS) mounted on the throttle shaft. With a TPS, as the throttle is opened, the switch closes at the calibration point and de-energizes a solenoid which shuts the vacuum signal to the EGR valve allowing the valve to close.

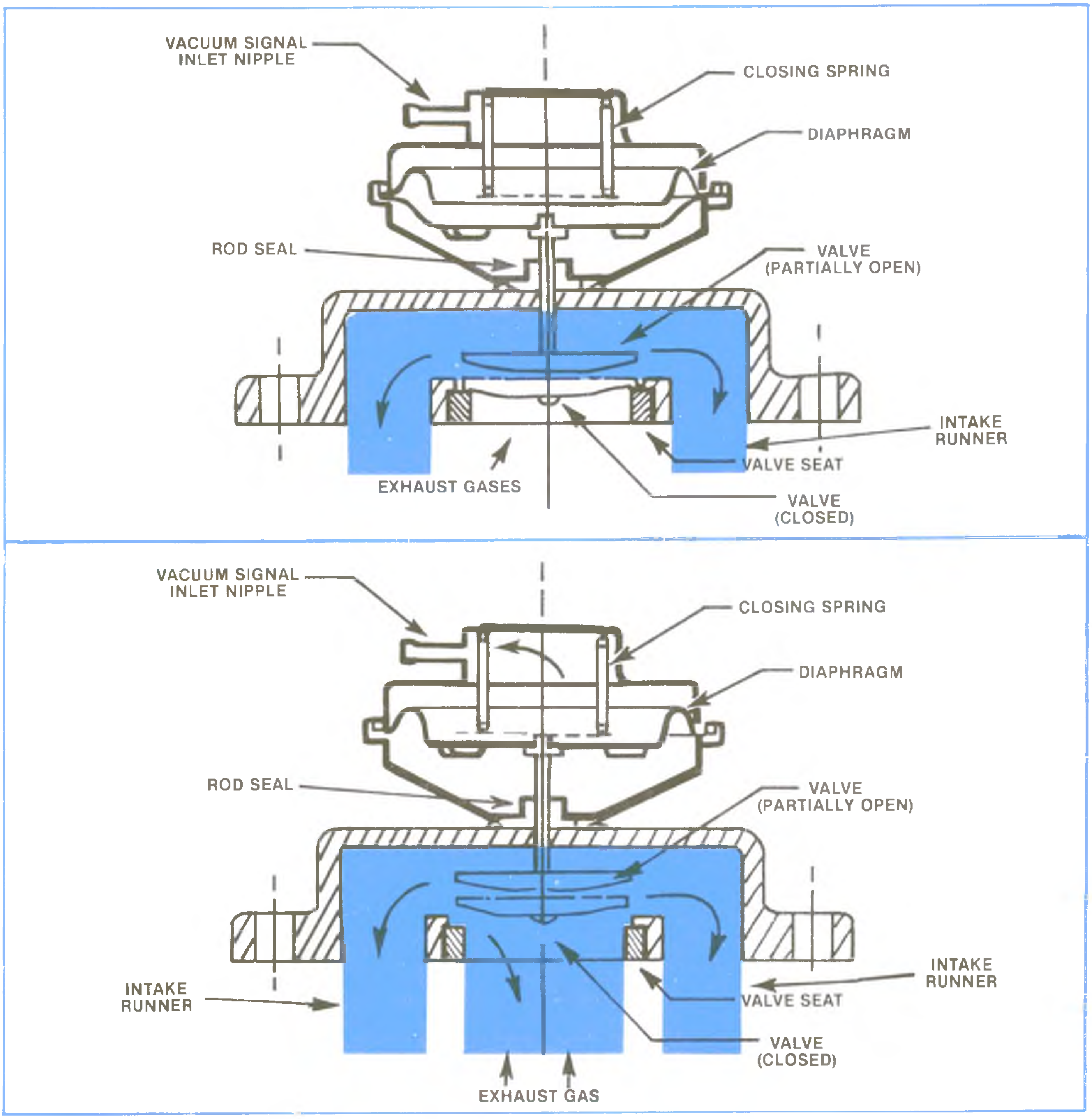


Figure 5-10, Single Diaphragm EGR Valve.

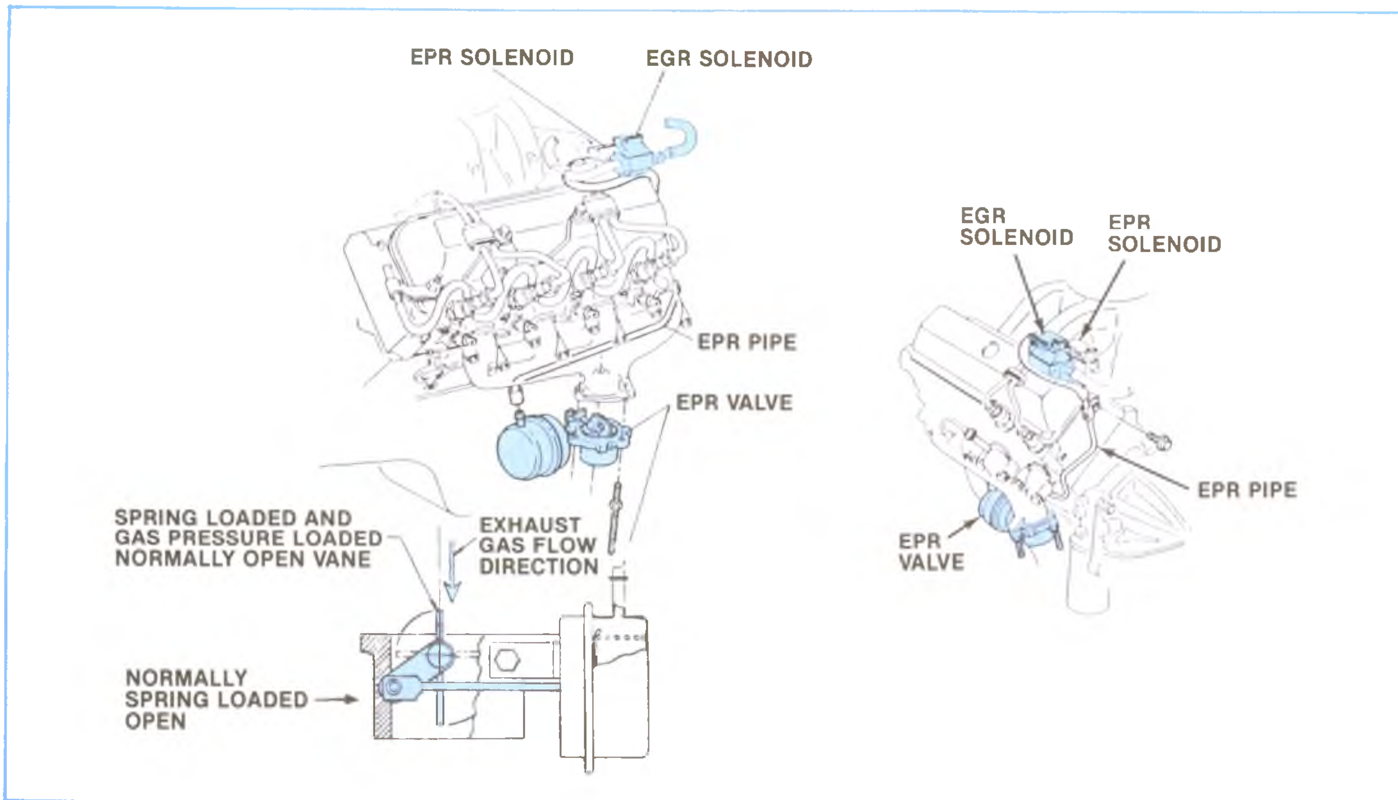


Figure 5-11, EPR Valve and Solenoid Location.

EXHAUST PRESSURE REGULATOR EPR VALVE

An Exhaust Pressure Regulator (EPR) valve is used in the exhaust system to restrict the flow and increase exhaust gas back pressure. (Figure 5-11). This EPR valve is used in conjunction with the vacuum switched EGR valve at the intake manifold. When the throttle is closed, the EPR valve is closed increasing the recirculation of exhaust gas. As the throttle is opened the valve would also open decreasing the amount of exhaust back pressure. The throttle position is sensed by a throttle position switch mounted on the throttle shaft on the injection pump. The throttle position switch de-energizes the EPR solenoid at a calibrated throttle angle.

EPR/EGR Solenoids

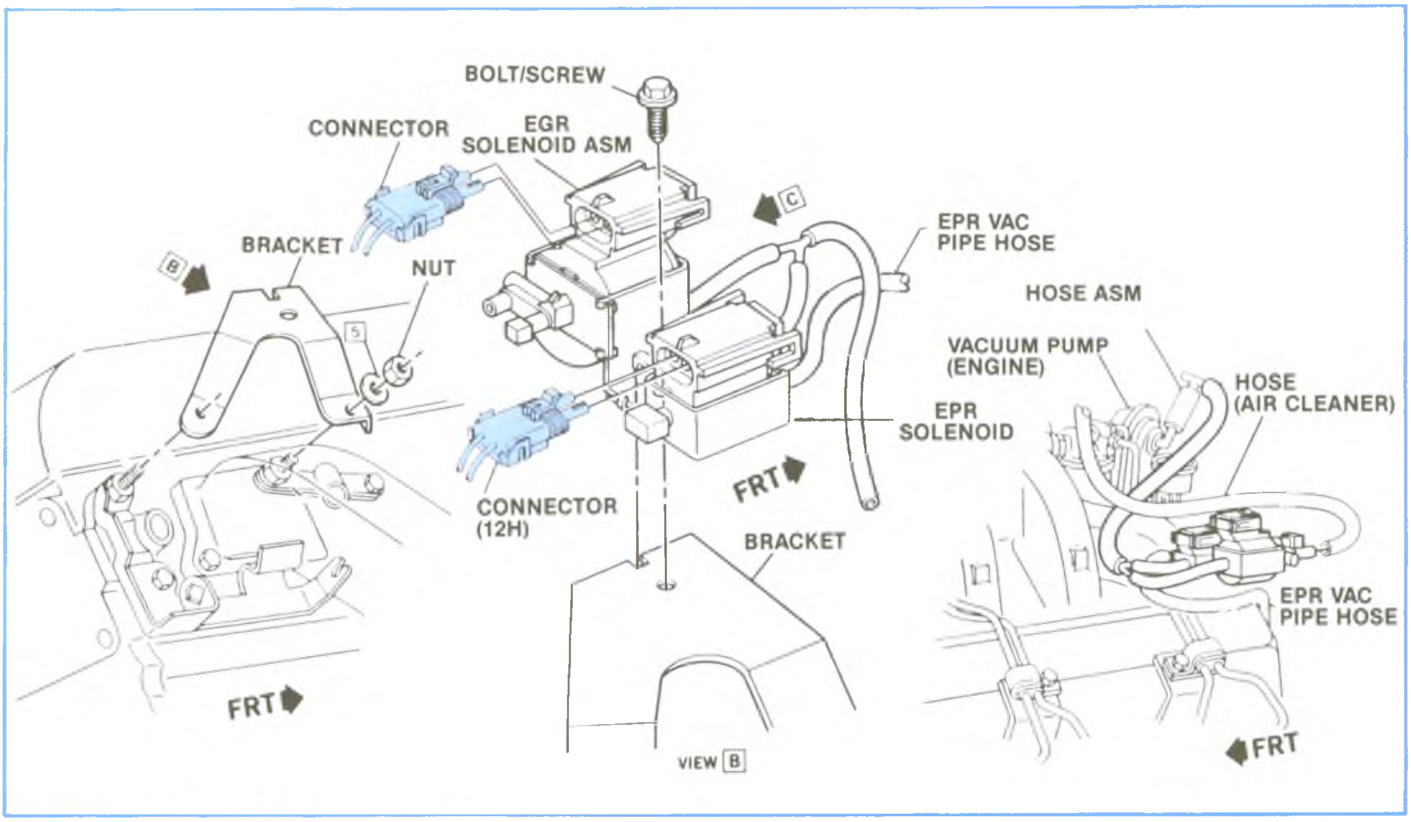


Figure 5-12, **EPR/EGR Solenoids.**

VACUUM SWITCHED EPR

See Figure 5-12. The EPR solenoid is normally closed. When energized by (B+) from the TPS it is open allowing vacuum to the EPR, closing it. This occurs at idle. As the throttle is opened, at a calibrated throttle angle the TPS de-energizes the EPR solenoid, cutting off vacuum to the EPR valve and opening it.

VACUUM SWITCHED EGR

See Figure 5-12. The EGR solenoid is normally open. With vacuum switched EGR, either full flow or no flow of exhaust gas is admitted to the intake manifold. At closed throttle the EGR valve is opened. The EGR valve remains fully open to a calibrated throttle position at which point it closes. The throttle position is sensed by a throttle position switch (TPS) mounted on the throttle shaft on the injection pump.

With TPS, as the throttle is opened the switch closes at the calibration point. It energizes a solenoid which is normally open. This cuts off the vacuum signal to the EGR valve, allowing the valve to close.

— NOTE —

The EPR solenoid is de-energized before, or at the same time, the EGR solenoid is energized.

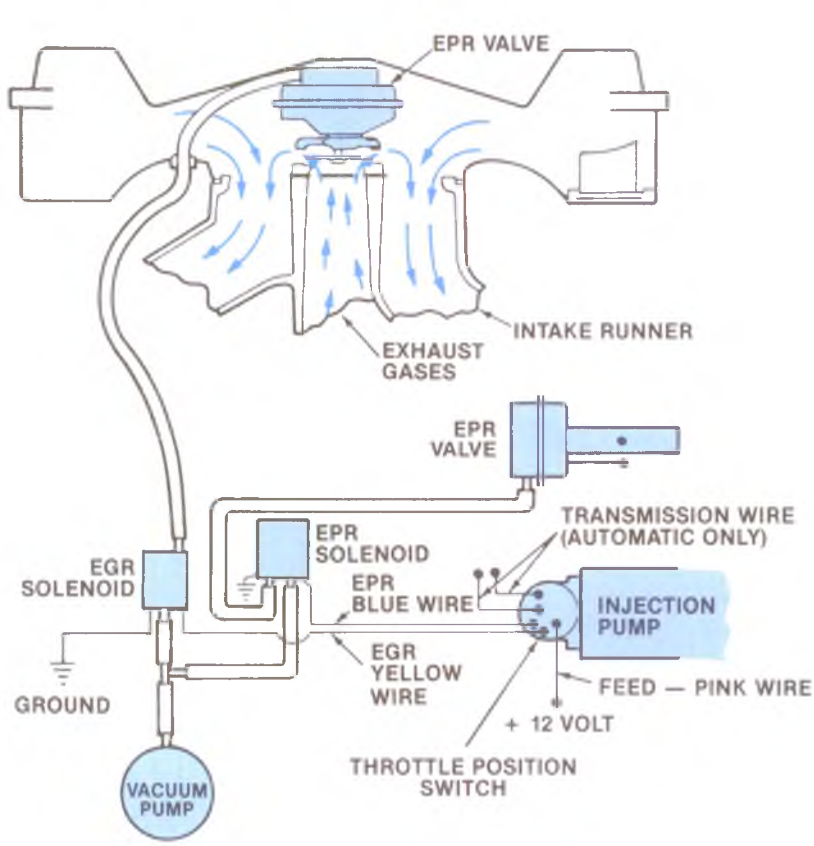


Figure 5-13, Federal EPR/EGR Schematic

Federal EPR/EGR System Operation

Exhaust gas is recycled through the combustion cycle by admitting exhaust gases into the intake manifold. Exhaust gases are routed from both cylinder heads through internal passages in the manifold to the EGR valve (Figure 5-13). Exhaust gas flow is a function of the pressure differential between the exhaust system and the intake manifold. The EGR valve controls the exhaust flow at the point of discharge into the intake manifold.

The EGR valve is operated by vacuum furnished from a mechanically driven vacuum pump (Figure 5-13). The vacuum source signal is routed through an electrically operated open/close solenoid to the EGR valve. EGR is admitted into the intake manifold at idle, and light load fueling rates. The EGR valve remains fully open through a calibrated throttle lever motion. Throttle position is sensed by an electrical switch mounted directly to the R.H. side of the injection pump. As the throttle is opened, the throttle position switch (TPS) electrically closes at the calibration point, energizes the solenoid, and shuts off the vacuum signal, allowing the EGR valve to close.

To increase flow EGR rates an exhaust pressure regulator (EPR) valve is used at the left hand exhaust manifold to increase exhaust back pressure. At closed throttle the EPR valve is closed. With increasing throttle position the throttle position switch electrically opens causing the EPR valve to open by shutting off vacuum to the valve. The EPR valve is controlled by its own switch point within the throttle position switch assembly and its own open/close solenoid. With automatic transmission vehicles, the throttle position switch has an additional function of applying and releasing the transmission converter clutch (TCC), when the throttle is operated to a calibrated point.

THROTTLE POSITION SWITCH

The throttle position switch just has 2 contacts inside it: One to send (B+) at idle on a blue or purple wire to the EPR solenoid which is N.C. and this opens the solenoid valve and vacuum closes the EPR valve. The other contact will send (B+) on a yellow wire to the EGR solenoid, at a specified throttle angle. The EGR solenoid is N.O. This current energizes the EGR solenoid closing it, which cuts off vacuum, closing the EGR valve. There is a delay on some switches in the time when the EPR opens and the EGR closes. There are three different cams used to change EPR/EGR switch points:

- Blue Cam 0° Difference
- Black Cam 5° Difference
- Red Cam 10° Difference

— NOTE —

When DEACTIVATED; the EGR solenoid is normally OPEN, which would allow vacuum to open the EGR valve; and the EPR solenoid is normally CLOSED, cutting off vacuum to the EPR valve, opening it.

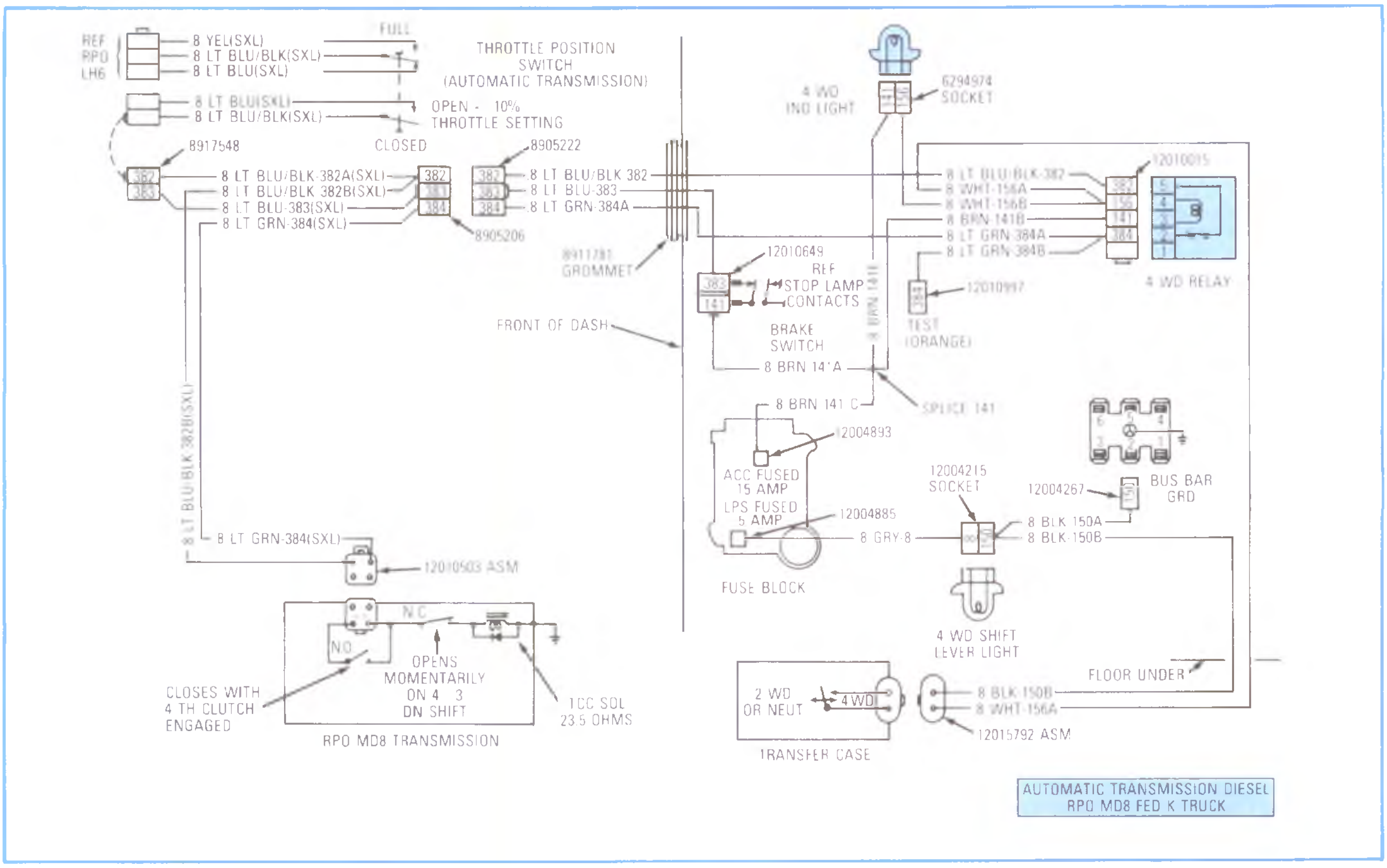


Figure 5-14, Wiring Diagram T.C.C. MD-8 K Truck.

The third switch incorporated in the throttle position switch is used to operate the transmission converter clutch (TCC), in the 700-R4 Transmission (MD8). This switch disengages the converter clutch at a throttle angle of less than 8 degrees.

— NOTE —

The 1982 models disengaged the converter clutch below, have a 16 degree throttle angle.

See Figure 5-14, wiring schematic. This switch controls (B+) coming from the brake switch to the T.C.C. solenoid. It prevents converter clutch operation below 8 degrees of throttle opening.

On a 4-wheel drive (Figure 5-14), Diesel Truck, there is a N.C. relay in the parallel path of current to the T.C.C. solenoid, at pin B of the connector at the transmission. It is energized by grounding at pin 4 of the relay.

Pin 4 is grounded through the 4 wheel drive indicator switch in the transfer case. It is grounded in either 4 high or 4 low. When the relay is grounded the N.C. relay is switched to open interrupting the B+ path to pin B of the transmission connector. The only way to have converter clutch operation in 4 wheel drive is, to close the 4th gear switch in the transmission allowing B+ from the other parallel path at pin A to pass through the now closed contacts of the 4th gear switch to the TC.C. solenoid.

Figure 5-15 summarizes the EGR/EPR valve and solenoid operations.

— NOTE —

Heavy black exhaust smoke upon acceleration generally indicates a malfunction in the EGR system.

ENGINE SPEED	EGR VALVE	EGR SOL.	EPR VALVE	EPR SOL.
Idle to 15° Throttle	Open	Not Energized (Vacuum to Valve)	Closed	Energized (Vacuum to Valve)
15° to 20° Throttle	Open	Not Energized (Vacuum to Valve)	Open	Not Energized (No Vacuum to Valve)
20° to Full Throttle	Closed	Energized (No Vacuum to Valve)	Open	Not Energized (No Vacuum to Valve)

Figure 5-15, **EGR Summary.**

EGR/EPR Problem Diagnosis

1. Start engine and operate to open thermostat temperature.
2. Remove air cleaner cover to observe operation of EGR valve.
3. With engine at idle the EGR valve should be open. (Observe valve head in up position and noticeable exhaust noise intake.) If not, check and correct any electrical and hose connection which may be loose and/or disconnected.
4. Remove vacuum hose from EGR valve. The valve head should drop with a noticeable reduction in noise. Reconnect hose.
5. At idle the hose to the EGR valve should have approximately 20 inches of vacuum. If vacuum is not present, check output of the vacuum pump at the pump. The pump should produce a minimum of 20 inches of vacuum.
6. If vacuum is present at the EGR valve but the valve does not open and close as the hose is put on and taken off, the EGR valve is stuck and should be checked and replaced if necessary.
7. Manually operate the throttle lever at the injection pump through approximately 15° to 20° of travel. The EGR valve should close when the TPS reaches the calibrated point.
8. Check the pink wire to the TPS for 12 volts (key on.) If 12 volts is not present, check for any loose connections, open wire, and a blown 20 amp gauge idle fuse.
9. Correct any loose wire connections and change fuse if required. With key on, the blue wire from the TPS switch should also have 12 volts. This blue wire feeds the EPR solenoid. At idle if the pink wire has 12 volts but the blue one doesn't, the TPS is inoperative and should be changed as shown in Section 6CG of the Light Duty Truck Service Manual.
10. With engine off but key on, operate the throttle through 20° travel. At approximately 15°, the TPS will cut out the 12 volts to the blue wire (EPR). At approximately 20°, the TPS will cut in 12 volts to the yellow wire (EGR). If not, the TPS is inoperative.
11. Check to see that the electrical connections are made at the EGR-EPR solenoid assembly and that the hoses are routed correctly and connected to the solenoids.
12. If vacuum is present at the solenoid assembly and the solenoids are receiving an electrical signal as previously mentioned and operation of the TPS through the calibrated points does not operate the EGR and/or EPR valves, the solenoid assembly is inoperative and should be replaced.

DIODE CAUSING EGR SYSTEM (1982 ONLY) MALFUNCTION

A condition exists whereby an excessive electrical feedback load can cause a diode in the EGR and/or EPR solenoids to short. The diodes are for radio noise suppression only. When the diode shorts it usually will blow the 20 amp gauge fuse. A blown fuse will result in no engine electrical accessory feed such as no glow plug operation or light, no cold advance or fast idle, and the EGR system will not operate. When the EGR system becomes inoperative, full vacuum is supplied to the EGR valve at all speeds resulting in heavy black exhaust smoke and low power.

To prevent the diodes from shorting due to heavy feedback loads, a jumper harness unit #14048052 is being made available to install in the EGR-EPR electrical feed circuit at the TPS. This jumper harness has a built in diode to reduce the feedback load.

If a comment of heavy black exhaust smoke is received and the condition can be traced to the EGR/EPR solenoid assembly diode, the following outlines the procedure to follow to install the jumper harness unit.

1. Have engine stopped and key in off position.
2. Disconnect vacuum and electrical connections to the EGR/EPR solenoid assembly.
3. Remove bolt holding assembly, remove and install new assembly.
4. Reconnect vacuum hose and electrical connections.
5. Disconnect (3) wire connector to TPS and install jumper harness between connectors. (NOTE — The wire colors blue, pink and yellow should line up.)
6. Install a new 20 amp gauge idle fuse.

LL4 Model — Vacuum Regulator Valve (VRV)

When using the M40 THM 400 Transmission, with an LL4-Model, a vacuum regulator valve is used (Figure 5-16). This valve supplies an engine load vacuum signal to the transmission vacuum modulator, which is proportional to throttle travel (e.g. at idle maximum vacuum, at W.O.T. minimum or "0" vacuum). This allows the vacuum modulator to regulate transmission shift points and line pressure.

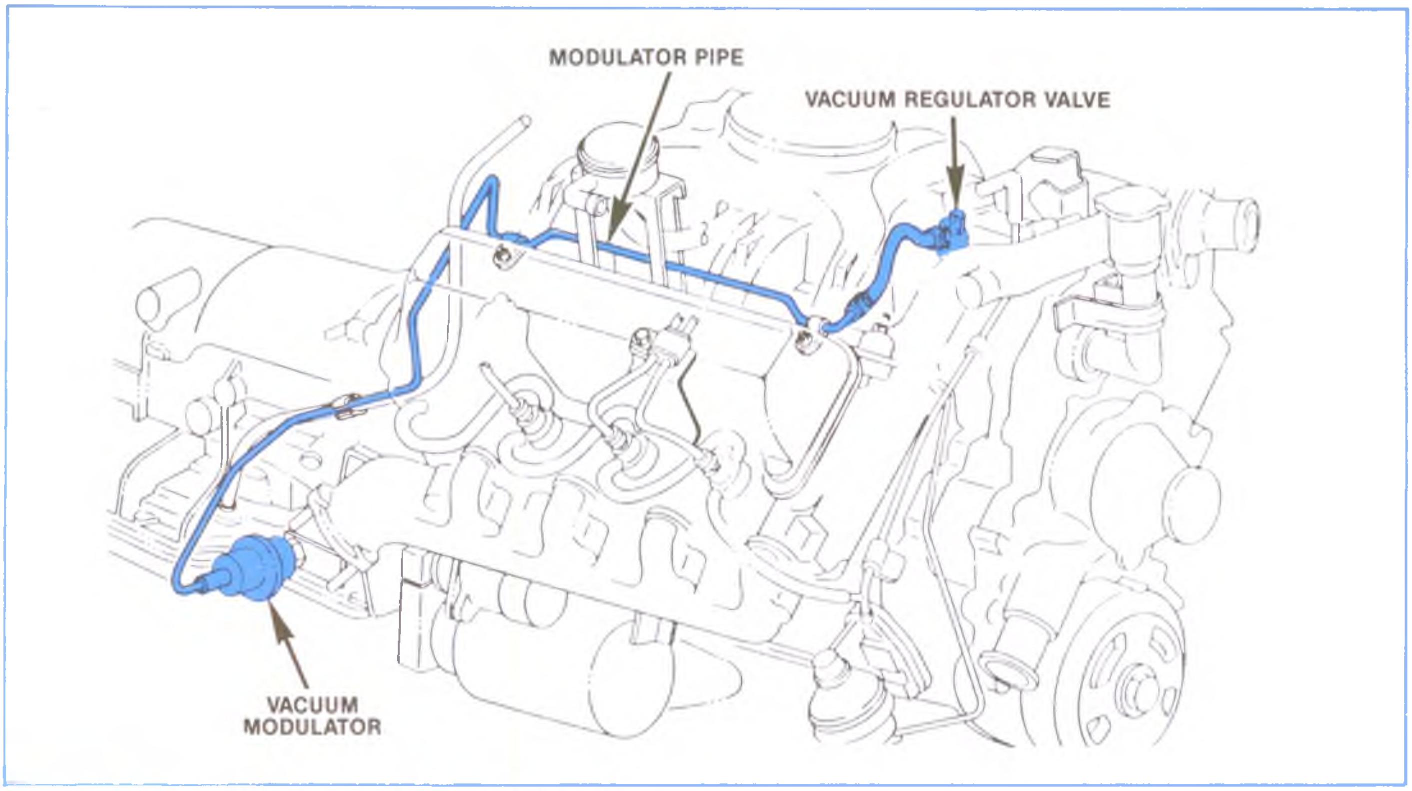


Figure 5-16, **Vacuum Regulator Valve (VRV).**

— NOTE —

The 1983 and later LL4-Model is also available with the 700-R4 4 speed automatic transmission. This application uses a different throttle position switch, which has only one set of contacts for transmission converter clutch operation. Also a specific adjusting gage bar J33043-5 is necessary.

Throttle Position Switch Adjustment Tool

- **J33043 THROTTLE POSITION SWITCH GAGE BLOCK (6.2L)**

The throttle position switch (Figure 5-16A) is properly adjusted on the throttle shaft using this go-no-go gage and a powered test light or ohmmeter, J33043 enables the technician to check and adjust the throttle position switch on the injection pump.

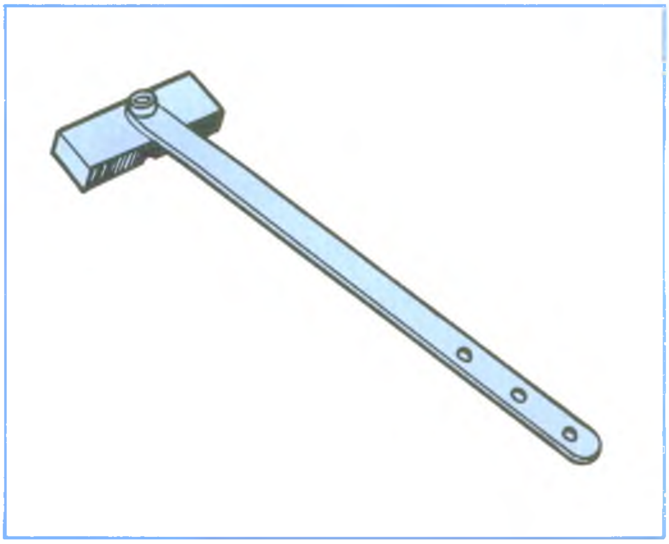


Figure 5-16A, J33043 Throttle Position Switch Gage Block (6.2L).

- **THROTTLE POSITION SWITCH GAGE BLOCKS**

New applications for this engine may require new throttle position switch specifications. New gage blocks (Figure 5-16B) can be installed on the handle (J33043-1) of the original gage block:

J33043-2	.646-.668 inch
J33043-4	.602-.624 inch
J33043-5	.771-.773 inch

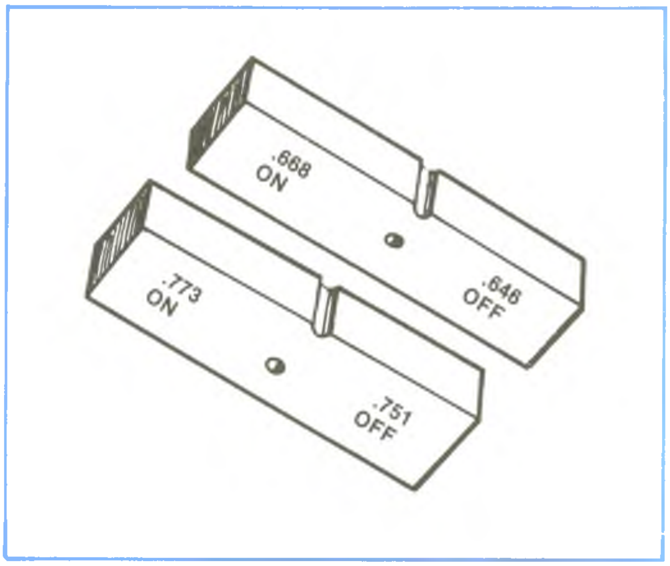


Figure 5-16B, Throttle Position Switch Gage Blocks

1982 LH6-MODEL TPS CHART							
					GAGE BAR		
USAGE	ALTITUDE	TRANS.	MODELS	THROTTLE POSITION SWITCH P/N	SWITCH CLOSED	SWITCH OPEN	GAGE TOOL NUMBER
Nationwide	All	Manual	All	14050405	0.646″	0.668″	J-33043-2
Federal	All	Auto.	All	14033943	0.646″	0.668″	J-33043-2
Calif.	All	Auto.	C/K	14033943	0.646″	0.668″	J-33047-2
Calif.	All	Auto.	C/K	14050408	0.602″	0.624″	J-33043-4

1983 LH6-MODEL TPS CHART					
			GAGE BAR		
ENGINE ASM PART #	BROADCAST B/C CODE	THROTTLE POSITION SWITCH P/N	SWITCH CLOSED	SWITCH OPEN	GAGE TOOL NUMBER
14061529	UHB	14050405	.646	.668	J33043-2
14061531	UHC	14050405	.646	.668	J33043-2
14061545	UHD	14050405	.602	.624	J33043-4
14061549	UHF	14050405	.646	.668	J33043-2
14061550	UHH	14066239	.646	.668	J33043-2
14061552	UHJ	14066238	.602	.624	J33043-4
14061560	UHN	14066239	.646	.668	J33043-2
14050581	UHA	14050405	.646	.668	J33043-2
14061573	UHS	14050405	.646	.668	J33043-2
14066299	UHZ	14050405	.602	.624	J33043-4
14061571	UHR	14050405	.646	.668	J33043-2
14061576	UHT	14066239	.646	.668	J33043-2
14061578	UHU	14066238	.602	.624	J33043-4
14061580	UHW	14066239	.646	.668	J33043-2

1984 LH6 TPS CHART					
			GAGE BAR		
ENGINE ASM PART #	BROADCAST B/C CODE	THROTTLE POSITION SWITCH P/N	SWITCH CLOSED	SWITCH OPEN	GAGE TOOL NUMBER
14071011	FHB	14050405	.602	.624	J33043-4
14071019	FHF	14050405	.602	.624	J33043-4
14071018	FHD	14066239	.646	.668	J33043-2
14071022	FHJ	14066239	.646	.668	J33043-2
14071025	FHK	14050405	.602	.624	J33043-4
14071029	FHN	14050405	.602	.624	J33043-4
14071038	FHW	14066239	.646	.668	J33043-2
14071042	FHY	14066239	.646	.668	J33043-2

— NOTE —

The gage block dimensions were not on the emission label until the 1983 model year. See gage block tool J33043 chart on page 5-14.

1983 & LATER LL4 TPS CHART			
THROTTLE POSITION SWITCH PART NUMBER	GAGE BAR		GAGE TOOL #
	SWITCH CLOSED	SWITCH OPEN	
14066207	.751	.773	J33043-5

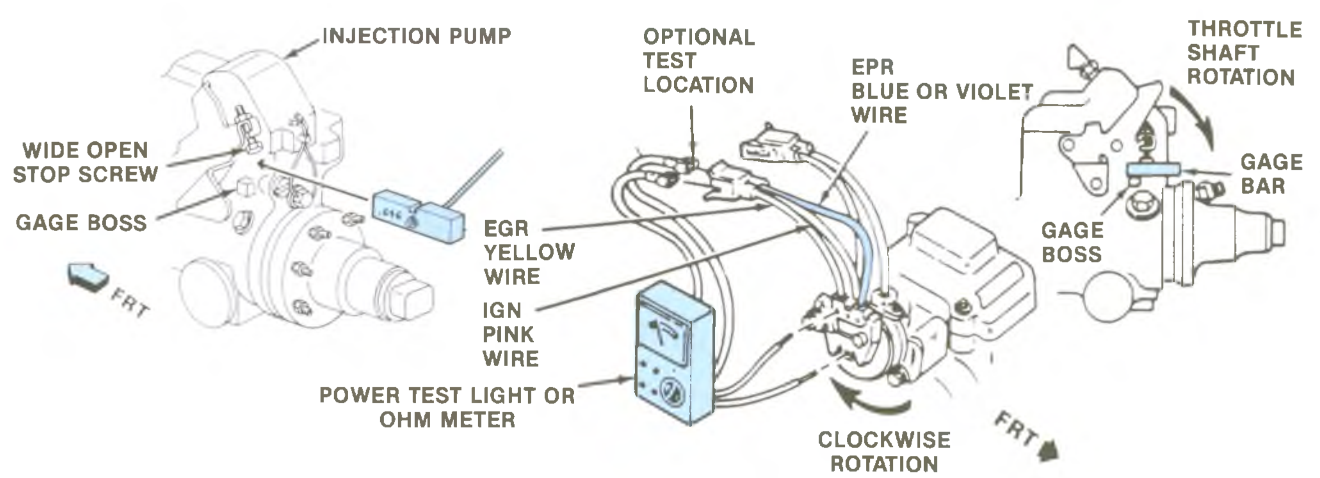


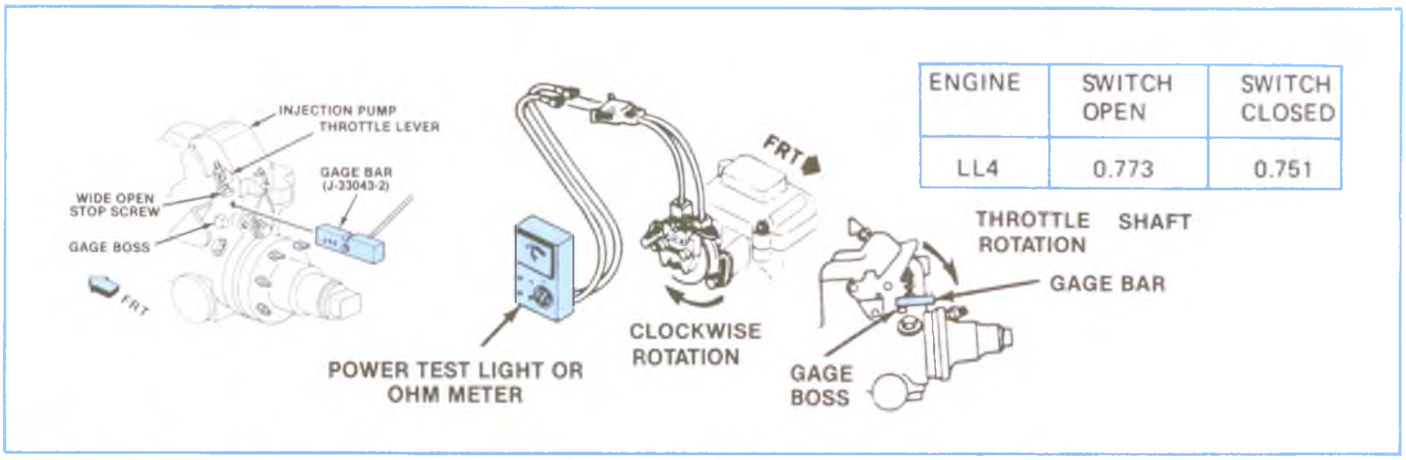
Figure 5-17, TPS Adjustment LH6-Model.

DIESEL ENGINE THROTTLE POSITION SWITCH SETTING PROCEDURE

See Figures 5-17 and 5-18.

1. Loose assemble throttle position switch to fuel injection pump with throttle lever in closed position.
2. Attach an ohmmeter or powered test light across the IGN (pink) and EGR (yellow) terminals or wires. (Or on an LL4/710 R4 across the connector terminals.)
3. Insert the proper "switch-on" gage block between the gage boss on the injection pump and the wide open stop screw on the throttle shaft. (Gage block dimension listed on emission label).
4. Rotate and hold the throttle lever against the gage block.
5. Rotate the throttle switch clockwise (facing throttle switch) until continuity pivot occurs (low meter reading) across the IGN and EGR terminals or wires. Hold switch body at this position and tighten mounting screws to 5-7 N·m (4-5 ft. lbs.).
6. Release throttle lever and allow it to return to idle position. Remove the "switch-on" gage bar and insert the "switch-off" gage bar. Rotate throttle lever against "switch-off" gage bar. There should no continuity (meter reads resistance infinity) across the IGN and EGR terminals or wires. If no continuity exists, switch is set properly. However, if there is continuity, then the switch must be reset by returning to Step 1 and repeating the entire procedure.

— NOTE —
The gage block dimensions were not on the emission label until the 1983 model year. See gage block tool J33043 chart on page 5-12.



ENGINE	SWITCH OPEN	SWITCH CLOSED
LL4	0.773	0.751

Figure 5-18, **TPS Adjustment LL4-Model With 700-R4 (MD8) Transmission.**

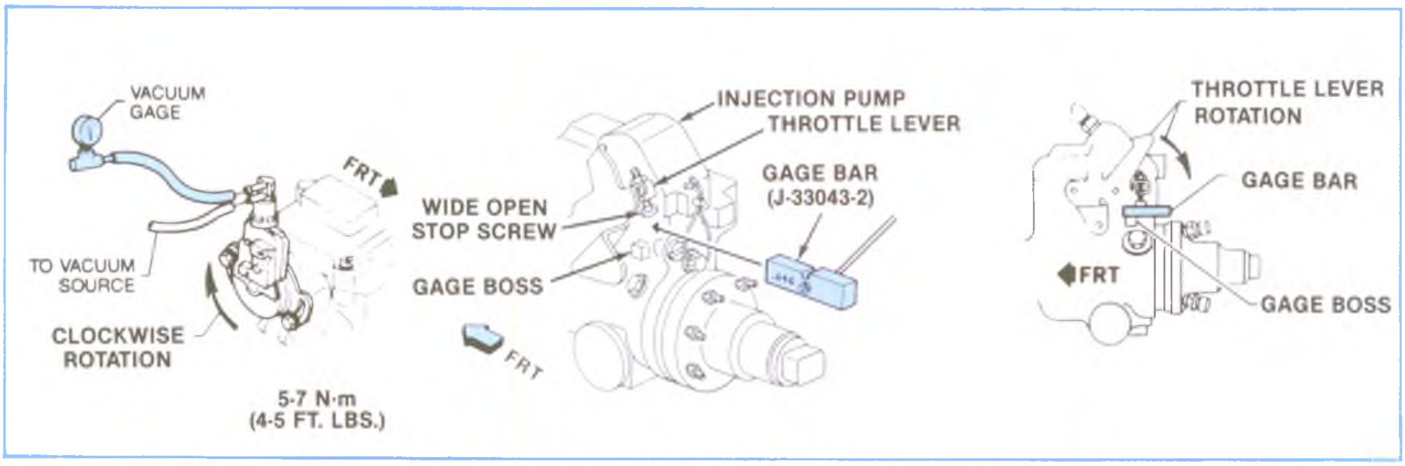


Figure 5-19, **VRV Adjustment LL4-Model With THM 400 (M40) Transmission.**

Transmission Vacuum Regulator Valve Adjustment (LL4)

See Figure 5-19.

1. Attach the vacuum regulator valve snugly, but loosely to the fuel injection pump. The switch body must be free to rotate on the pump.
2. Attach vacuum source of 67 ± 5 kpa (20″ Hg.) to inboard vacuum nipple. Attach vacuum gage to outboard vacuum nipple.
3. Insert vacuum regulator valve gage bar J33043-2 between the gage boss on the injection pump and the wide open stop screw on the throttle lever. (Switch on position).
4. Rotate and hold the throttle shaft against the gage bar.
5. Slowly rotate the vacuum regulator valve body clockwise (facing valve) until vacuum gage reads 27 kpa ± 2 kpa (8″ Hg). Hold valve body at this position and tighten mounting screws to 5-7 N·m (4-5 ft. lbs.).

— NOTE —

Valve must be set while rotating valve body in clockwise direction only.

6. Check by releasing the throttle shaft allowing it to return to the idle stop position. Then rotate throttle shaft back against the gage bar to determine if vacuum gage reads within 27 kpa ± 2 (8″ Hg.). If vacuum is outside limits, reset valve.

VACUUM REGULATOR VALVE, 1982 "C-K-P" WITH 6.2L AND 400 AUTOMATIC TRANSMISSION

Comments regarding high or late upshifts in 1982 "C-K-P" trucks equipped with 6.2L diesel engines and THM 400 automatic transmissions may be the result of the vacuum regulator valve (VRV) calibration. This condition may be corrected by replacing the valve with a new valve, P/N 14057219.

The new valve entered production at the assembly plants in March, 1982.

The VRV should be verified as the cause of this condition using the following procedure:

1. Identify which valve (old or new) is on the engine.
   a. Old valve — rotating CAM is green color. P/N 14033982 is cast into the valve.
   b. New valve — rotating CAM is orange color. P/N 14057219 is white lettered on face of valve.
2. If the valve has a green rotating CAM, remove the valve. If the rotating CAM is orange, go to Step 5.
3. Install a new valve. P/N 14057219.
4. Adjust the new valve, as described on Page 5-16 to 27 kpa (8″ Hg.).
5. If the valve has an orange rotating CAM (P/N 14057219), check for a correct setting of 27 KPA.

— NOTE —

When diagnosing high or late transmission upshifts, be sure to check for a proper vacuum output of approximately 70 kpa (21″ Hg.). Check for the correct modulator pipe. The pipe part #14054204 should be 5/32″ I.D. and be approximately 5″ long.

5B. California (NB2) Diesel Electronic Control System (DECS)

1984-1985 DDAD 6.2L DECS

The 6.2L, LH6 diesel engine will use an electronic controlled EGR emission system for California applications. It is a limited function system, controlling EGR, EPR T.C.C. and system diagnosis.

The 1985 6.2L LH6 DECS is similar, with the addition of on-vehicle self-diagnostics (10 trouble codes) and a vehicle speed sensor.

1984-1985 "California only" (RPO NB2) LH6 Engine less than 8500 lbs. GVWR.

ABBREVIATIONS USED IN THIS SECTION

- DEC—
  Diesel Electronic Control System
- DVM—
  Digital Volt — OHM Meter With 10 MEG-OHM Impedence
- CEL—
  Check Engine Light
- ECM—
  Electronic Control Module—Diesel
- MAP—
  Manifold Absolute Pressure Sensor
- EGR—
  Exhaust Gas Recirculation
- EPR—
  Exhaust Pressure Regulator
- TCC—
  Transmission Convertor Clutch
- RPM—
  Revolutions Per Minute
- IP—
  Instrument Panel
- TPS—
  Throttle Position Sensor
- V-REF—
  ECM Reference Voltage (Approximately 5.3V)
- WOT—
  Wide Open Throttle
- PWM—
  Pulse Width Modulated
- CKT—
  Circuit
- DDC—
  Diesel Diagnostic Check Tool
- ALDL—
  Assembly Line Diagnostic Link
  or
- ALCL—
  Assembly Line Communications Link

1985 DIAGNOSTIC CHARTS

- Diesel system diagnostic check
- DDC tool check
- Code 12
- Code 21
- Code 22
- Code 24
- Code 31
- Code 32
- Code 33
- Code 51
- Code 52
- Code 53
- TCC check
- ECM check (no code 12)
- TPS check

1984 DIAGNOSTIC CHARTS

- Diesel system diagnostic check
- DDC tool check
- ECM check
- Map sensor check
- EGR/EGR vent check
- Engine speed sensor check
- EPR electrical check
- EPR vacuum check
- TPS check
- Transmission convertor clutch (TCC) check

Electronic Vacuum Modulated EGR LH6 6.2L California Diesel

Electronic vacuum modulated EGR is a modulated EGR control system involving digital electronics.

In addition to controlling EGR vacuum signal by throttle position as in a mechanical system, the electronic system also makes use of engine speed and closed loop feedback of EGR control vacuum.

The electronic vacuum modulated EGR system is shown schematically in Figure 5-20. It consists of an electronic control module receiving inputs from throttle position, engine speed and absolute pressure sensors. In 1985 from vehicle speed sensor (VSS).

The electronic control module sends out a pulsed signal which drives a solenoid to control the signal vacuum on the EGR valve, and an "ON/OFF" signal to a solenoid to control vacuum on an exhaust pressure regulator (EPR) valve.

In operation, engine speed and throttle angle define the desired amount of EGR. The electronic control module sends out a pulsed signal to the EGR vacuum control solenoid indicating the vacuum level desired on the EGR valve.

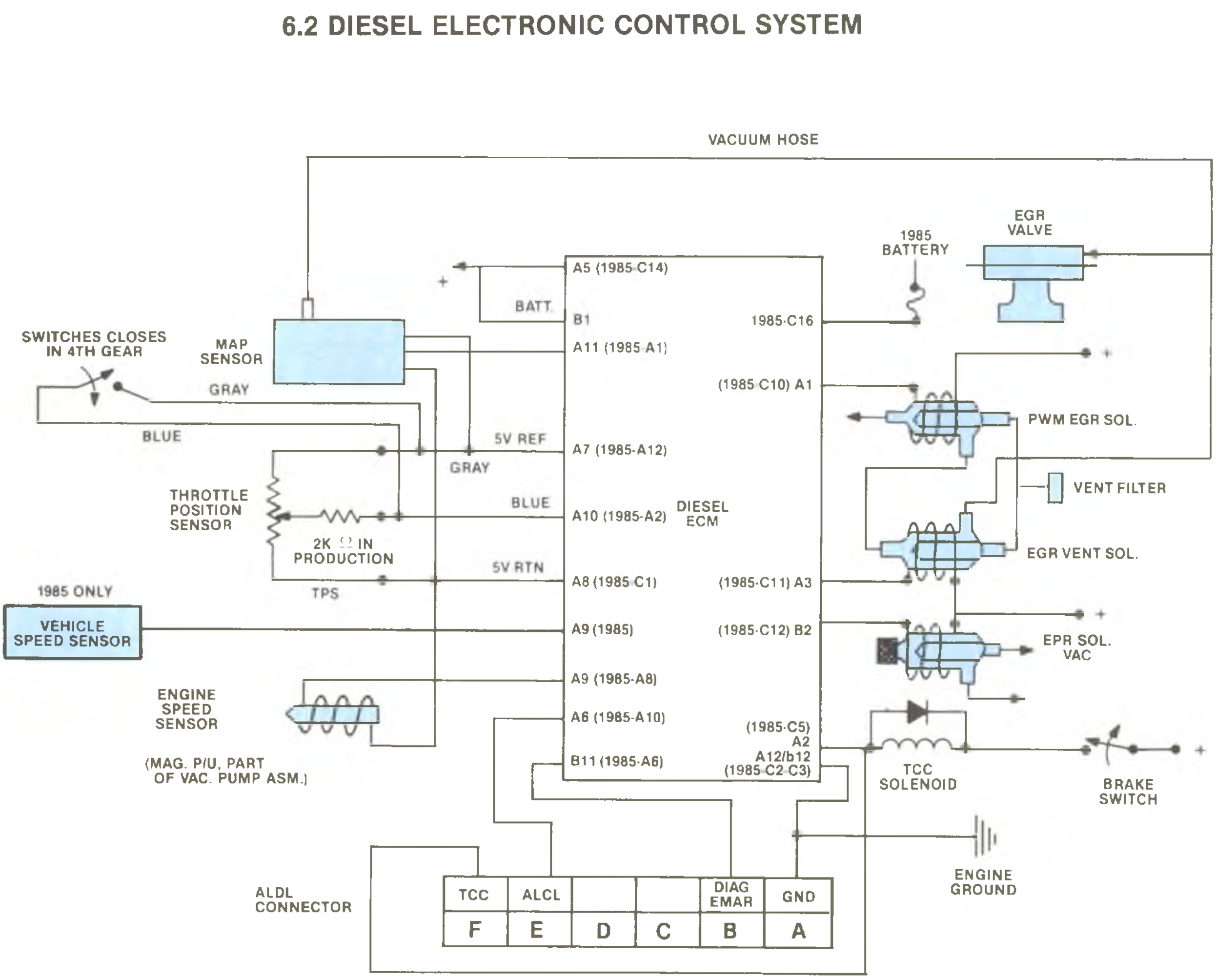


Figure 5-20, Digital Diesel System Schematic.

NOTES

An absolute pressure sensor monitors the vacuum on the EGR valve and feeds this information back to the electronic control module. The electronic control module compares the measured vacuum to the desired vacuum (as defined by throttle angle, engine speed and in 1985 vehicle speed), and then trims the vacuum control solenoid to provide the desired vacuum on the EGR valve. A vacuum control bleed (vent) valve solenoid is also included to quickly relieve vacuum on the EGR valve during accelerations.

In addition, an EPR system is used and the EPR valve is either open or closed. The EPR valve switch point is determined by the electronic control module and is a function of throttle angle and engine speed.

Since the vehicles which use the 6.2L engines are not equipped with a "Check Engine" light, a Diesel Diagnostic Check (DDC Tool J34750) is used whenever the need for service diagnostics (Figure 5-21). This tool J34750 has 4 switch or diagnostic mode positions:

- Normal — Open or resistance infinity to ALCL Pin B.

> **— NOTE —**
> **In this mode of operation all of the ECM outputs are in control of the ECM.**

- ALCL 1 — A 10K ohm resistor to ground from ALCL Pin B.
- ALCL 2 — A 3.9K ohm resistor to ground from ALCL Pin B.
- Diagnostic — 0 ohms resistance to ground from ALCL Pin B.

This allows the ability to quickly recognize that a driveability problem is due to the ECM being in default by either the CEL being "ON" or one of the selectable diagnostic modes indicating a fault is present.

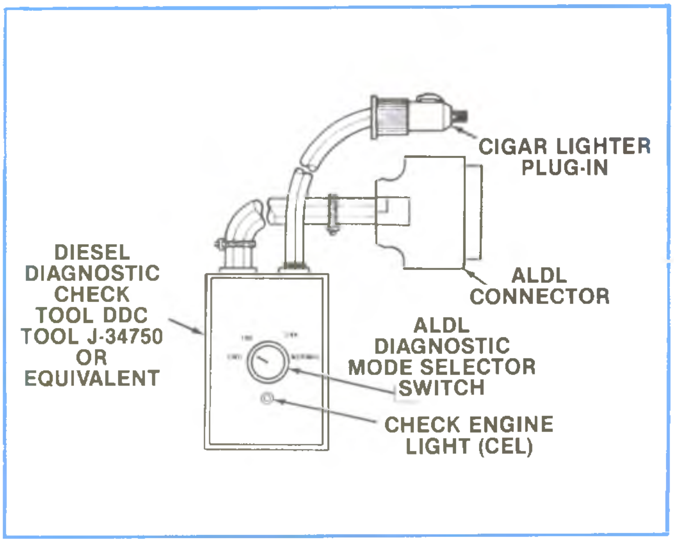


Figure 5-21, DDC Tool #J34750.

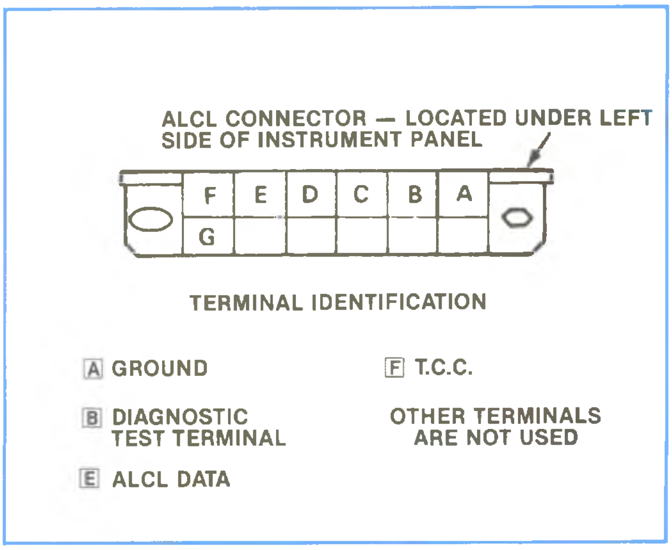


Figure 5-22, ALCL Connector (CK Series).

ALCL CONNECTOR

Under the instrument panel on a series CK or under the driver's seat on a series GP is an Assembly Line Communications Link (ALCL) that is used by the assembly plant for a computerized check-out of the system. This connector is also used in service to help diagnose the EGR system and TCC. See Figure 5-22.

5B. California Diesel Electronic Control System (DECS)

1984 6.2L DIAGNOSTIC MODE CHART						
MODE SELECT	ENGINE SPEED	CHECK ENGINE LIGHT	TCC OUTPUT	EPR OUTPUT	EGR OUTPUT	DUMP SOLENOID OUTPUT
Normal No resistor or infinite resistance	N/A	Normal	Normal	Normal	Normal	Normal
ALCL 1	> 600 RPM	Send ALCL Data	Normal	Normal	Normal	Normal
10k to GRD	> 375 RPM < 800 RPM	Send ALCL Data	On	On	10″ Vacuum	Normal
	< 375 RPM	Send ALCL Data	Off	Off	Off	Off
ALCL 2	> 800 RPM	Send ALCL Data	Normal	Normal	Normal	Normal
3.9k to GRD	> 375 RPM < 800 RPM	Send ALCL Data	Off	Off	Off	On
	< 375 RPM	Send ALCL Data	Off	Off	Off	Off
Diagnostic	> 375 RPM	Normal	On	On	10″ Vacuum	Normal
0Ω to GRD	< 375 RPM	Normal	On	On	50% DC	On

ALCL — Assembly Line Communications Link
GRD — Ground
> — Greater Than
< — Less Than
DDC — Diesel Diagnostic Check

— NOTE —

1984 Diagnostic Modes

ALCL 1 Mode is whenever the ALCL Pin B or ECM Pin B11 is grounded by a 10k Ohm resistor.

ALCL 2 Mode is whenever the ALCL Pin B or ECM Pin or ECM Pin B11 is grounded by a 3.9k Ohm resistor.

Diagnostic Mode is whenever the ALCL Pin B or ECM Pin B11 is grounded 0 Ohms resistance.

SPECIAL SOLENOID CONTROL CONDITIONS (1984 DECS SYSTEM)

Under certain conditions the EGR solenoid, the vent solenoid, and the EPR solenoid are controlled independently of the EGR control programming in the ECM.

These conditions include ECM reset, engine not running, engine at idle, engine above idle, diagnostic mode selection, ALCL 1 mode selection and ALCL 2 mode selection.

Engine not running is defined such that engine speed is less than 375 RPM. Engine at idle is defined such that engine speed is greater than 375 RPM but less than 800 RPM. Engine above idle is defined such that engine speed is greater than 800 RPM.

NORMAL MODE

The control functions are operating according to ECM programming.

RESET

The EGR solenoid is de-energized (EGR valve fully open) when the ECM is reset.

The EPR solenoid is de-energized (EPR valve open) when the ECM is reset.

The vent solenoid is de-energized (EGR vent disabled) when the ECM is reset.

ALCL 1 MODE OR ALCL 2 MODE/ENGINE NOT RUNNING

The EGR solenoid is de-energized (EGR valve fully open) if the engine is not running and either ALCL Mode is selected.

The EPR solenoid is de-energized (EPR valve open) if the engine is not running and either ALCL Mode is selected.

The vent solenoid is de-energized (EGR vent disabled) if the engine is not running and either ALCL Mode is selected.

ALCL 1 MODE/ENGINE AT IDLE

The EGR solenoid is controlled by the ECM to deliver a calibrated amount (kPa) of vacuum to the EGR valve whenever the ECM is in the ALCL 1 Mode and the engine is at idle.

The EPR solenoid is energized (EPR valve closed) whenever the ALCL 1 Mode is selected and the engine is at idle.

The vent solenoid is controlled according to the vent determination logic in the ECM whenever the ALCL 1 Mode is selected and the engine is at idle.

ALCL 2 MODE/ENGINE AT IDLE

The EGR solenoid is de-energized (EGR valve fully open) if the ALCL 2 Mode is selected and the engine is at idle.

The EPR solenoid is de-energized (EPR valve open) if the ALCL 2 Mode is selected and the engine is at idle.

The vent solenoid is energized (EGR vent enabled) if the ALCL 2 Mode is selected and the engine is at idle.

DIAGNOSTIC MODE/ENGINE RUNNING

The EGR solenoid is controlled by the ECM to deliver a calibrated amount (kPa) of vacuum to the EGR valve whenever the ECM is in the Diagnostic Mode and the engine is running. In this way, the EGR control can be checked out using a vacuum gauge or a dwell meter test.

The EPR solenoid is energized (EPR valve closed) whenever the Diagnostic Mode is selected and the engine is running.

The vent solenoid is controlled according to the vent determination logic whenever the Diagnostic Mode is selected and the engine is running.

DIAGNOSTIC MODE/ENGINE NOT RUNNING

The EGR solenoid is pulsed at a 50% duty cycle level if the Diagnostic Mode is selected and the engine is not running.

The EPR solenoid is energized (EPR valve closed) if the Diagnostic Mode is selected and the engine is not running.

The vent solenoid is energized (EGR vent enabled) if the Diagnostic Mode is selected and the engine is not running.

1985 6.2L DIAGNOSTIC MODE CHART USING DDC TOOL						
MODE SELECTION	ENGINE SPEED	CHECK ENGINE LIGHT	TCC OUTPUT	EPR OUTPUT	EGR OUTPUT	VENT SOLENOID OUTPUT
Normal ∞ Ω	N/A	Normal	Normal	Normal	Normal	Normal
ALCL 1 10k	> 800 RPM	Send Data	Normal	Normal	Normal	Normal
	> 375 RPM < 800 RPM	Send Data	On	On	10″ Vacuum	Normal
GMAD Test Mode	≥ 375 RPM	Send Data	Off	Off	Off	Off
ALCL 2 3.9k	> 800 RPM	Send Data	Normal	Normal	Normal	Normal
	≥ 375 RPM < 800 RPM	Send Data	Off	Off	Off	On
GMAD Test Mode	> 375 RPM	Send Data	Off	Off	Off	Off
ALCL 3 30k	> 800 RPM	Send Data	Normal	Normal	Normal	Normal
	> 375 RPM < 800 RPM	Send Data	Normal	Normal	Normal	Normal
Diagnostic 0 Ω	> 375 RPM	Send Codes	On	On	10″ Vacuum	Normal
Dealer Test Mode	> 375 RPM	Send Codes	On	On	50% DC	On

PWM — Pulse width modulation
∞ — Resistance infinity
D.C. — Duty cycle

DDC — Diesel Diagnostic Check
> Greater Than
< Less Than

≥ Greater Than or Equal To
≤ Less Than or Equal To

Figure 5-23

1985 Diagnostic Modes

• **NORMAL** ALCL Line Open (Infinite Resistance)

In this mode of operation all of the outputs are in control of the ECM. The diagnostics which have been enabled are operational and can log a malfunction if it occurs and issue a remedial action if appropriate.

• **ALCL 1** ALCL Line Grounded Thru a 10k Ohm Resistor

In this mode of operation, the ALCL data is transmitted via the check engine light output. This list is intended for usage by the GMAD assembly plants.

Additionally, the ECM functions are altered depending upon what engine speed is input to the controller. The ALCL list transmission is not altered by engine speed but the data transmitted is.

• **ENGINE SPEED GREATER THAN 800 RPM**

When the engine is operated at greater than 800 RPM, the ECM functions as it would in the normal mode.

— NOTE —

1985 Diagnostic Modes

ALCL 1 Mode is whenever ALCL Pin B or ECM Pin A6 is grounded by a 10k Ohm resistor.

ALCL 2 Mode is whenever ALCL Pin B or ECM Pin A6 is grounded by a 3.9k Ohm resistor.

ALCL 3 Mode is used only by Delco Electronics during manufacture.

Diagnostic Dealer Test Mode is whenever ALCL Pin B or ECM Pin A6 is grounded with 0 Ohms resistance.

ENGINE SPEED @ IDLE

When the engine speed is between the ECM run decision RPM which is between 375 and 800 RPM, the TCC and EPR outputs are turned on all the time. Also, the EGR loop is forced to run at a constant vacuum, by setting the desired (KPA) vacuum amount equal to the 10″ Hg. EGR vacuum in the diagnostic mode. If this diagnostic mode EGR vacuum of 10 in. Hg. is less than the value in the ECM memory, the vent solenoid will be de-energized. This operation helps verify that the MAP transducer, vacuum plumbing and EGR solenoid are installed and operating properly. The TCC solenoid operation is also checked in this mode.

• **ENGINE NOT RUNNING**

When the engine is not running, all ECM outputs are de-energized.

• **ALCL 2** ALCL Line Grounded Thru 3.9k ohm

In this mode of operation the ECM behaves the same as in the ALCL 1 mode except at engine idle.

• **ENGINE SPEED AT IDLE**

When the engine speed is between 375 and 800 RPM, the TCC, EPR and EGR outputs are de-energized. The vent solenoid output is energized. This state helps verify that the vent solenoid is installed and operating properly.

• **ALCL 3** ALCL Line Grounded Thru 30k ohm

This test mode is intended for usage by Delco Electronics during ECM manufacturing.

• **ENGINE SPEED AT IDLE OR ABOVE**

When the engine speed is above 375 RPM, the ECM functions as if it were in the normal mode.

• **DIAGNOSTIC MODE** ALCL Line Grounded (ALCL Pin B or ECM Pin A6)

This mode is intended to aid field service of the vehicle system. While in this mode the ECM will output diagnostic codes on the check engine light in the typical flash-out three times format. In addition ECM operation will be modified as follows.

1. **ENGINE RUNNING**

   The TCC and EPR outputs will be energized and the EGR loop will be forced to run at 10″ vacuum. The vent solenoid will be de-energized if the calibrated value of 10″ is less than the current value of the EPR switchpoint table. If ALCL Pin B or ECM Pin A6 is grounded with the engine running the system will display any stored trouble codes by flashing the "CHECK ENGINE" light. Each code will be flashed three times. The ignition switch is then turned off, engine is re-started and run to see if the code is a "hard" or "intermittent" failure. If it is a "hard" failure, a Diagnostic Code Chart is used to find the problem. If it is an "intermittent" failure, the charts are not used. A physical inspection of the applicable system is made.

2. **ENGINE NOT RUNNING**

   When the engine is not running, all outputs except the EGR output are energized. The EGR output is forced to run at a 50% duty cycle. If ALCL Pin B or ECM Pin A6 is grounded, with the ignition "ON" and the engine stopped, the system will display a code "12" by flashing the "CHECK ENGINE" light (indicating the system is operating). A code "12" consists of one flash, followed by a short pause, then two flashes in quick succession. Code 12 will continue to flash until the "Test" terminal is ungrounded.

3. **SYSTEM RESET**

   During normal operations the system will only be in reset for the first few milliseconds of operation. During this time the ECM will not process any data flow and all four outputs will be energized.

— NOTE —

All diagnosis should start with the Diesel Diagnostic Circuit Check.

DDC Tool Check 6.2L LH6

See Figures 5-24, 5-25 and 5-26. The Diesel Diagnostic Check (DDC) Tool is a combination "Check Engine" Light (CEL), and diagnostic mode selector. The tool allows a check on the ECM's ability to detect a fault and set a CEL. The mode selector assists diagnostics if a fault is present, even if there was no CEL.

— NOTE —

Prior to any diagnostics, it must be verified that the DDC tool is functioning.

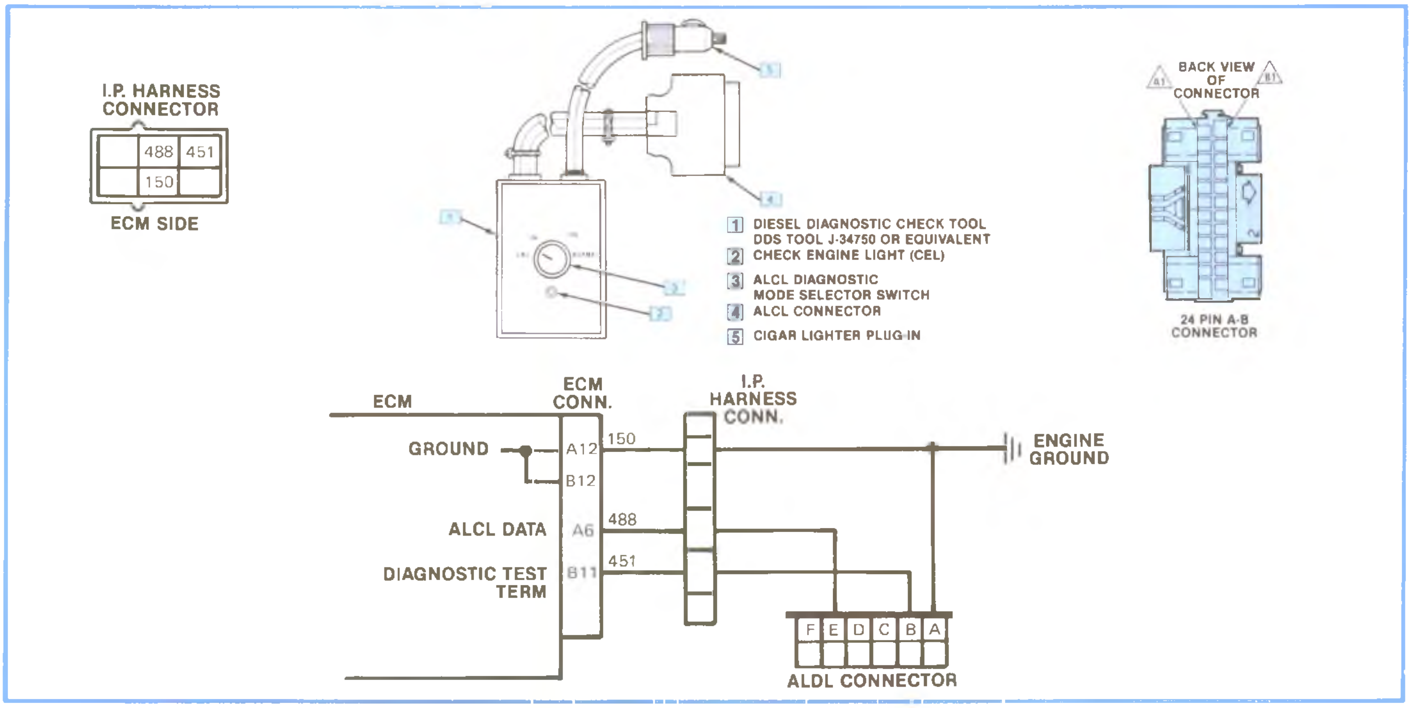


Figure 5-24, 1984 DDC Tool Check Schematic.

1. Check to see if the DDC tool is supplied with 12 volts. Light should be "ON" with only the power cord installed. See Figures 5-24 and 5-25.
2. Check to see if ALCL circuit is grounded or faulty. Normally when connection is made to ALCL, the CEL should remain "ON".
3. When ignition is turned "ON", the CEL should remain "ON". If CEL goes "OFF", ECM may be shorted internally.

— NOTE —

When using the DDC Tool in any of the diagnostic modes (3.9k or 10k), the CEL will flicker. This is normal. Also, when going from any diagnostic mode to either normal or ground, the CEL will come on SOLID for 10 seconds then go "OFF". This is the normal ECM reset.

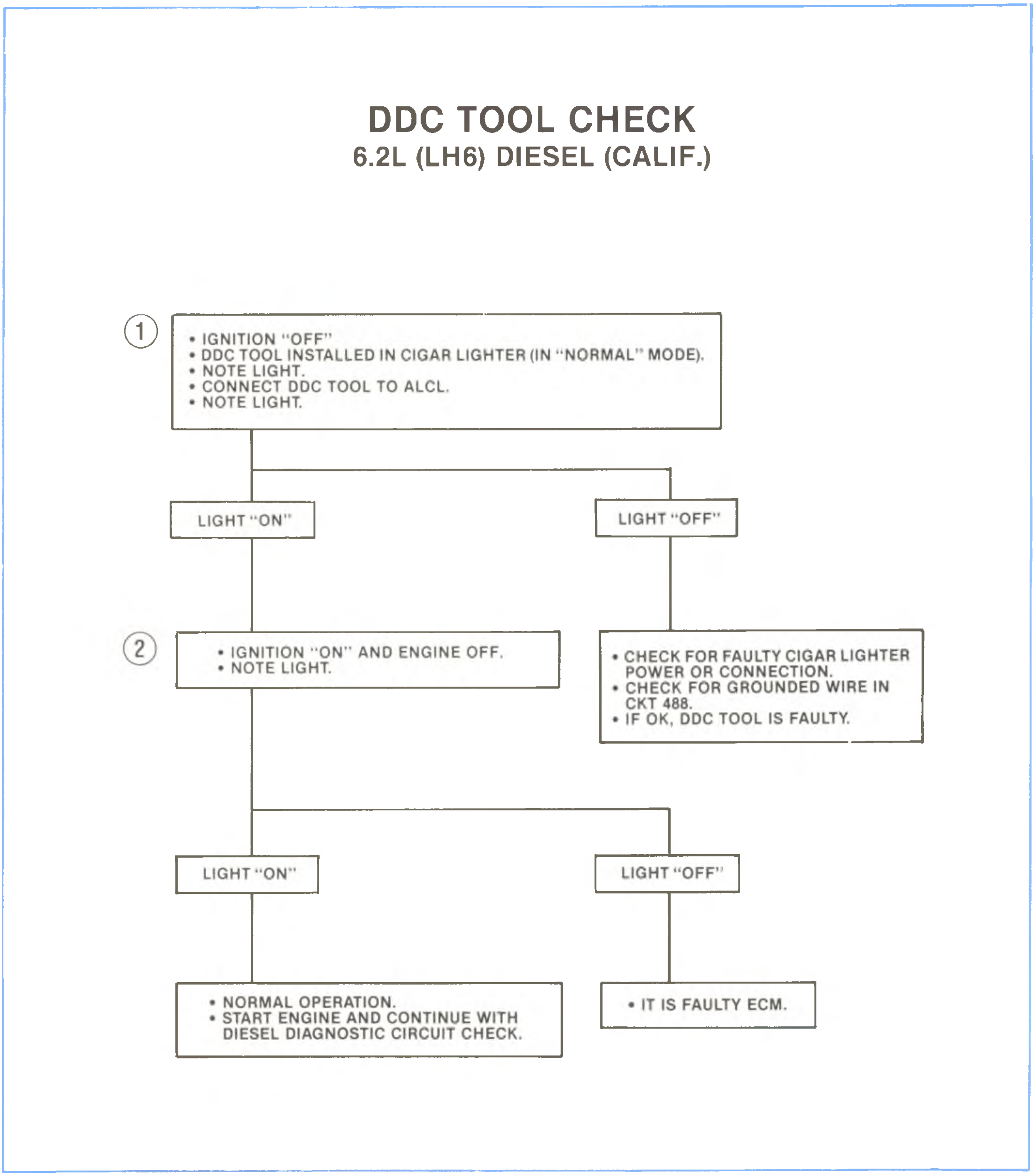


Figure 5-25, DDC Tool Check 1984-85.

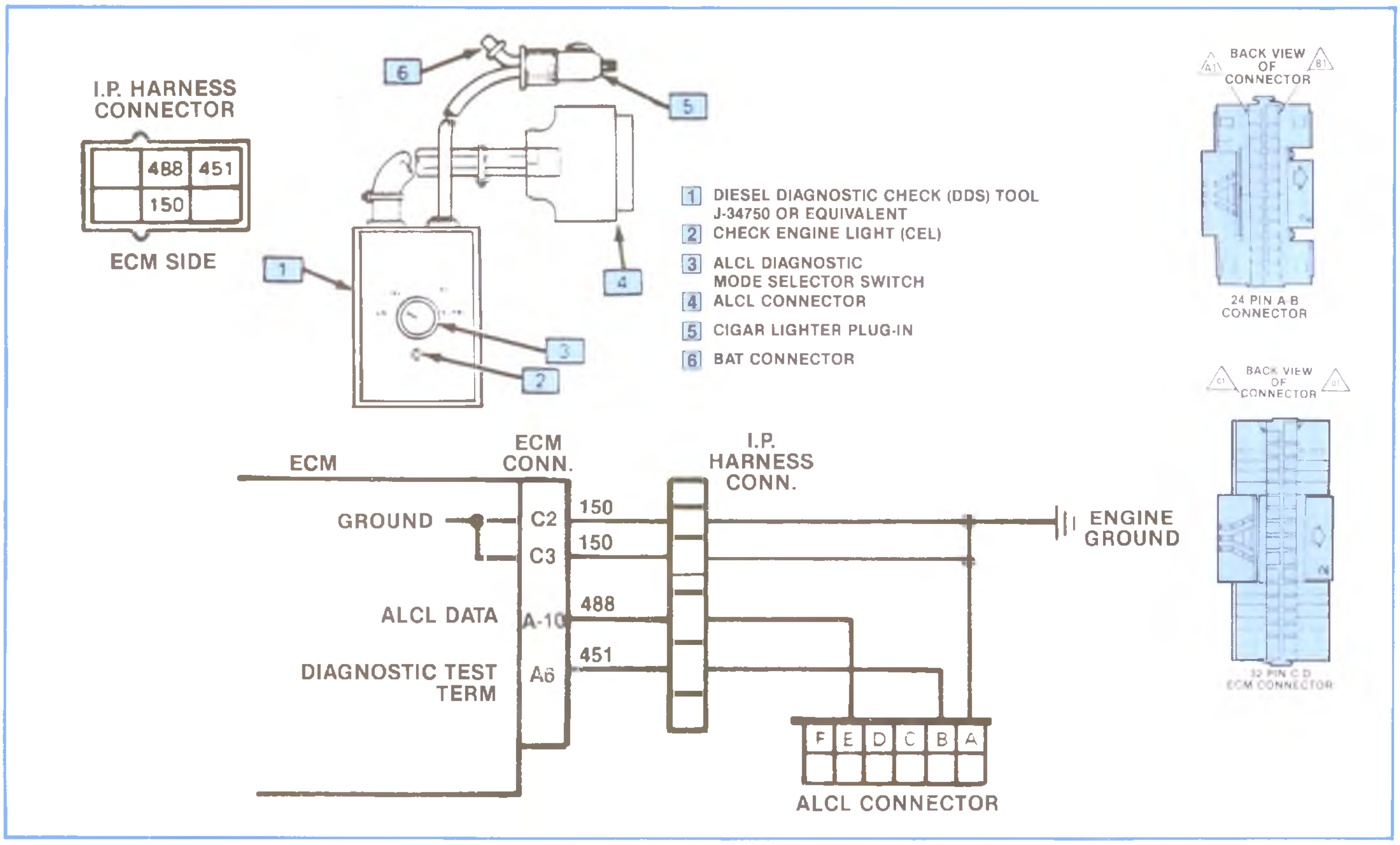


Figure 5-26 **1985 DDC Tool Check Schematic.**

Pin Condition	Terminal	CEL/Code	Condition	Codes
A10 OPN	ALCL	No CEL	OK	No Light — No Code
A10 GND	ALCL	No CEL	OK	No Light — No Code
A10 OPN	EGR Vent	No CEL	OK	Normal — except vacuum for EGR doesn't go to 0.
A10 GND	Sensor GND	No CEL — No Code	OK	System Normal

1984 Diesel Diagnostic Circuit Check

See Figure 5-27.

The ECM provides the diagnostic logic to detect faults in the systems the ECM monitors or controls. In 1984 the ECM, when it recognizes a fault, has the capability of turning a "Check Engine" Light (CEL) "ON" but does not store or flash a trouble code. Furthermore, if the condition corrects itself, the CEL signal will be turned "OFF" immediately following the correction.

The ECM recognizes errors in Engine Speed, Vacuum errors in the EGR vacuum loop via the MAP sensor, and electrical faults involving the 5-volt reference circuit.

1985 DECS with On-Vehicle Self Diagnostics

PURPOSE

The purpose of the system self diagnostics is to detect faults which may occur and then alert the operator. The self diagnostics also assist service personnel in diagnosing system faults.

The Electronic Control Module (ECM) monitors its own performance and certain system input and output signals to determine if a system fault has occurred.

TROUBLE CODES

Ten "2 digit" trouble codes are used to indicate various system faults.

If the DDC tool J34750 is in the diagnostic mode, that is ALCL Pin B or ECM Pin A6 grounded, with the ignition "ON" and the engine stopped, the system will display a code "12" by flashing the "CHECK ENGINE" light (indicating the system is operating). A code "12" consists of one flash, followed by a short pause, then two flashes in quick succession. Code 12 will continue to flash until the ALCL line (ALCL Pin B or ECM Pin A6) is ungrounded.

If the ALCL line (ALCL Pin B or ECM Pin A6) is grounded with the engine running the system will display any stored trouble codes by flashing the "CHECK ENGINE" light. Each code will be flashed three times. The ignition switch is then turned off, engine is re-started and run to see if the code is a "hard" or "intermittent" failure. If it is a "hard" failure, a Diagnostic Code Chart is used to find the problem. If it is an "intermittent" failure, the charts are not used. A physical inspection of the applicable system is made.

Each trouble code has its own set of conditions that must be met for that code to be detected. Once a code is detected, it will cause the "CHECK ENGINE" light to turn on, and a code may be logged in the nonvolatile memory after meeting the trouble code logging requirements.

The purpose of the trouble code logging requirements is three-fold:

1. To prevent false codes from being logged.
2. To insure that the "CHECK ENGINE" light when illuminated, will remain illuminated for a period of time sufficient to be seen by the technician.
3. To prevent an intermittent code from "flashing" the "CHECK ENGINE" light.

1984 DECS
6.2L (LH6)
DIESEL DIAGNOSTIC CIRCUIT CHECK

- Make physical inspection of engine compartment.
- Make certain all electrical components are correctly attached.
- Check all vacuum lines for hoses off, pinched or burned through.
- Check EGR valve for vacuum leak and free movement.
- Check for plugged EGR vent filter.

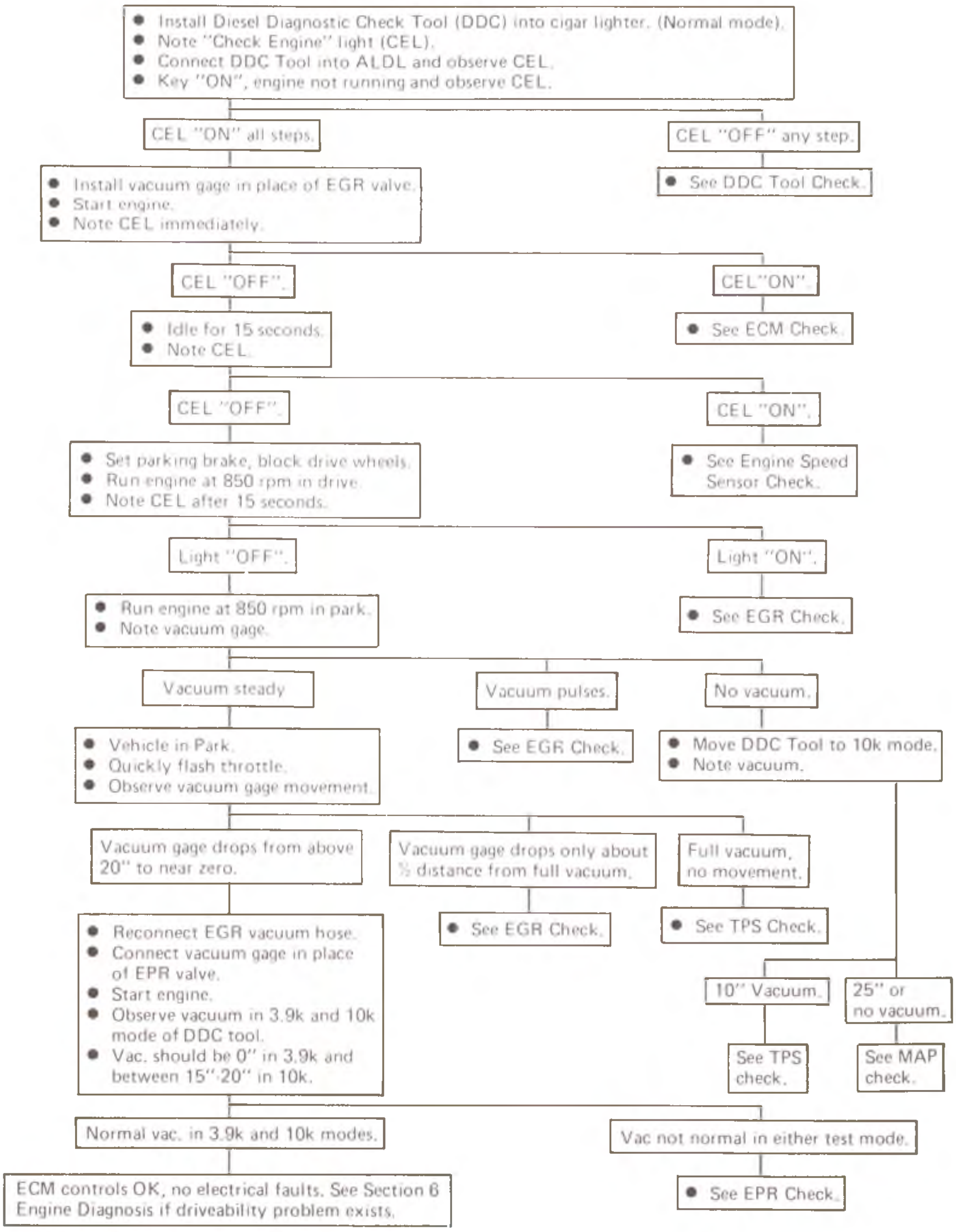


Figure 5-27, 1984 Diagnostic Circuit Check.

The codes are stored in a non-volatile memory, whose storage data is retained if the ignition switch power is turned off. This is commonly known as a long term memory. The trouble codes can be erased by:

1. Disconnecting the large (32 pin) connector for 10 seconds.
2. Disconnecting the battery for 10 seconds.
3. Cycling the ignition switch off and on 50 times.

THE TROUBLE CODES INDICATE FAULTS AS FOLLOWS:

CODE 12	No Engine RPM Reference Pulses. This code is not stored in the memory and will only flash while the fault is present. A normal code with the ignition "ON" engine not running.
CODE 21	Throttle Position Sensor (TPS) circuit 417 sensor signal voltage high on ECM Pin A-2 (open circuit or misadjusted TPS). The engine must run for 2 minutes to set this code.
CODE 22	Throttle Position Sensor (TPS) circuit 417 sensor signal voltage low on ECM A-2 (grounded circuit). The engine must run at 1250 RPM or above before this code will set.
CODE 24	Vehicle Speed Sensor (VSS) is detected when the engine is running. RPM and throttle position indicate the vehicle should be in motion, with inadequate VSS signal (open or grounded circuit). The vehicle must be operating at road speed for 10 seconds before this code will set.
CODE 31	MAP sensor signal voltage too low. Engine must run at idle for 10 seconds before this code will set.
CODE 32	EGR vacuum circuit has seen improper EGR vacuum (closed loop error). The vehicle must be running at a road speed of approximately 30 mph (48 Km/h) for 10 seconds before this code will set.
CODE 33	MAP sensor signal voltage too high. Possible vacuum leak — check for a poor connection at the sensor hose. The engine must run at idle for 10 seconds before this code will set.
CODE 51	PROM fault — (incorrectly installed in socket). It takes 10 seconds to set this code.
CODE 52	ECM fault analog to digital converter fault. It takes 10 seconds to set this code.
CODE 53	5 Volt Reference (V-REF) circuit overloaded (grounded circuit). It takes 10 seconds before this code will set.

1985 Diagnostic Circuit Check

The Diagnostic Circuit Check is the starting point for the diagnostic procedure to be used.

The diagnostic charts are related to the ECM and will determine if the ECM is working properly. This section diagnoses the emissions system controlled by the ECM and has charts to diagnose a circuit when the ECM has displayed a trouble code.

The way to approach a problem is to follow three basic steps:

1. ARE THE ON-VEHICLE DIAGNOSTICS WORKING? — We find this out by performing the "Diagnostic Circuit Check". Since this is the starting point for the diagnostic procedure, always begin here. If the On-Vehicle Diagnostics aren't working, the "Diagnostic Circuit Check" will lead you to a chart to correct the On-Vehicle Diagnostics. If the vehicle will not start, see "Engine Cranks Normally Will Not Start" in Section 7. If the On-Vehicle Diagnostics are OK, the next step is:
2. IS THERE A TROUBLE CODE STORED? If a trouble code is stored, go directly to the numbered code chart. If no trouble code is stored, the third step is:
3. WHAT IS THE DRIVEABILITY SYMPTOM? Section 7 lists various driveability symptoms which may be found, and suggests checks of related components, many of which are found in Section 7.

   This procedure, which takes only a short time, will help lead you to repair the problem in the least amount of time.

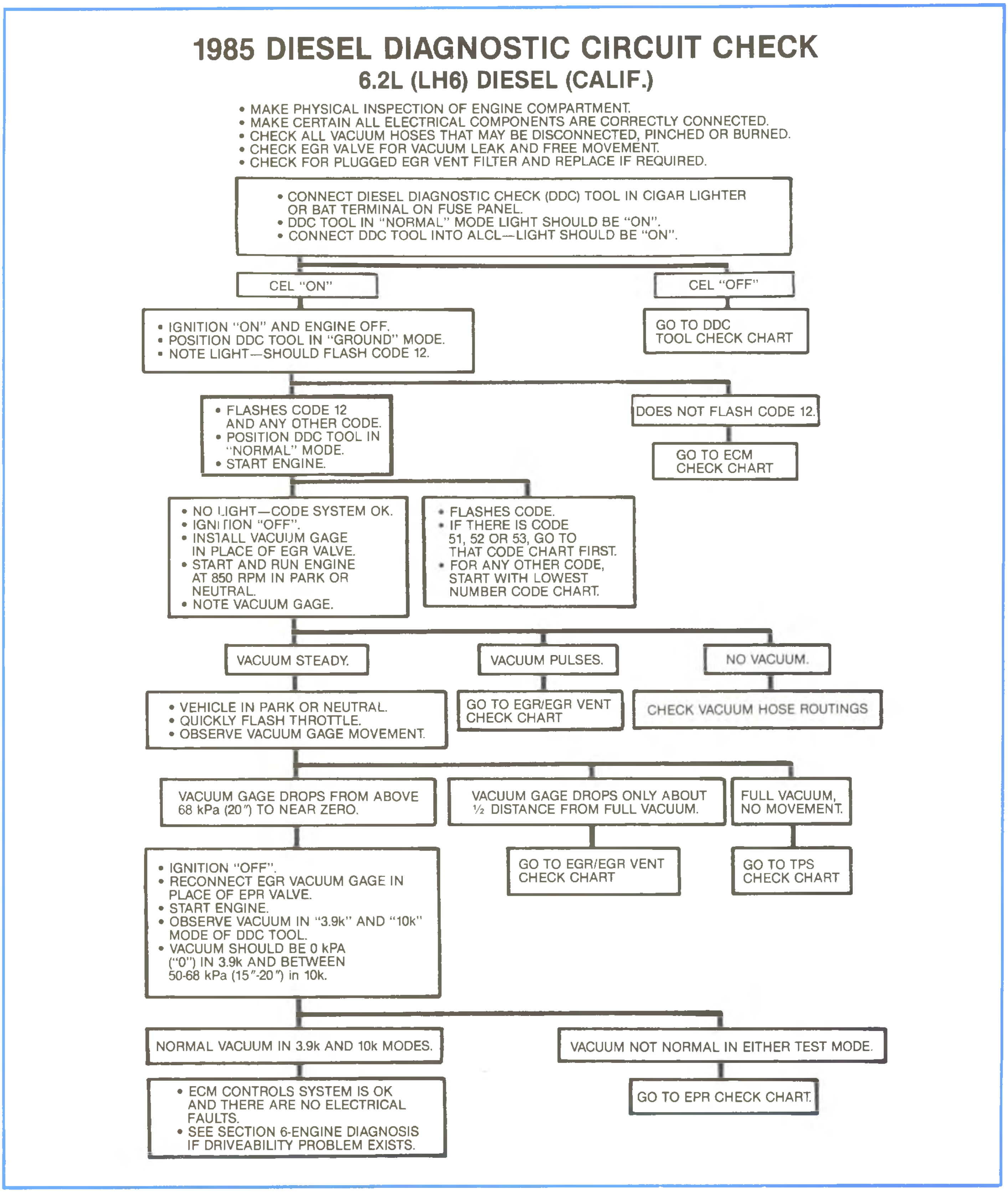


Figure 5-28, 1985 Diesel Diagnostic Circuit Check.

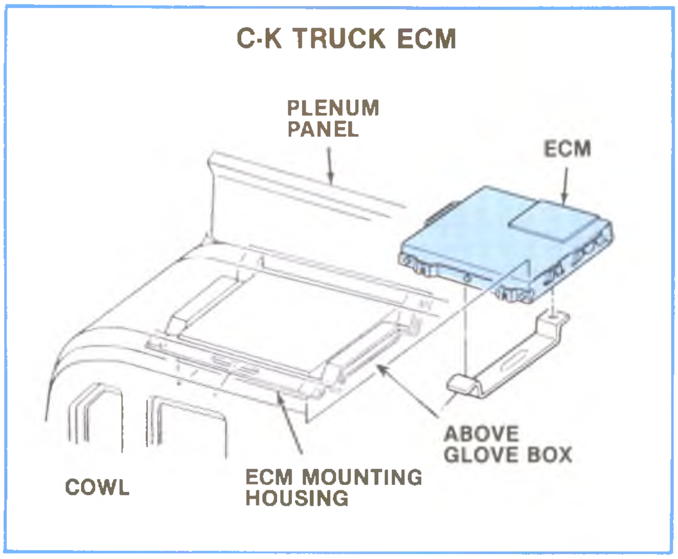


Figure 5-29, C-K Truck ECM Location.

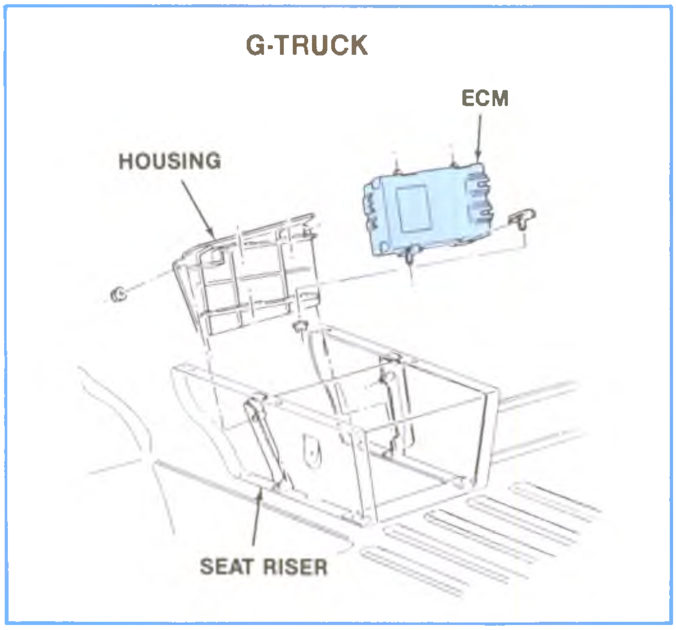


Figure 5-30, G-Truck ECM Location.

Electronic Control Module (ECM)

The system electronic control module (ECM) controls the EGR vacuum signal by modulating a square wave electrical signal to the EGR solenoid.

The solenoid behaves like an "ON/OFF" device responding to the de-energized/energized portion of the square wave. By modulating the de-energized/energized portion of the square wave, the EGR vacuum signal can be controlled. A bleed portion of the solenoid improves the EGR modulation response by bleeding EGR vacuum to atmosphere whenever the solenoid closes the source vacuum port.

THE ECM CONTROLS THE FOLLOWING OUTPUTS:

- Exhaust Gas Recirculation (EGR).
- Exhaust Pressure Regulation Control (EPR).
- Transmission Convertor Clutch Control (TCC).
- System Diagnosis.

THE ECM MONITORS THE FOLLOWING INPUTS:

- Engine RPM.
- Absolute Pressure (MAP) used to monitor EGR vacuum circuit.
- Throttle Position Sensor (TPS).
- 4th Gear Input (1984 only).
- Vehicle Speed via VSS, 1985 and Later.

The ECM is serviced the same as the Delco ECM in gas engine vehicles. In 1984 there is only one service ECM, and 4 different E-PROMS. In 1985, there is one service ECM and 6 different E-PROMS. During service replace either the PROM, ECM or both.

The broadcast code (e.g., BRL) on the E-PROM matches the broadcast code on the ECM.

There is a 4 digit E-PROM code on it for identification, and this code is the last 4 digits in the PROM part number.

E.G. PROM CODE 9564 BRM
PROM part #10039564
Broadcast code — "BRM" will match "BRM" code on the ECM label.

1984 California 6.2L Diesel ECM Usage

- **SERVICE ECM P/N — 1226465**
  - VEHICLE USAGE — C10 Suburban
K10 Blazer
C10-20 Pick-up
  - CALIB. — S8H5M
  - BROADCAST CODE — BRL
  - PROM PART #16040980

- **SERVICE ECM P/N — 1226465**
  - VEHICLE USAGE — K10 Suburban
G20 (Van) Manual Trans.
  - CALIB. — S8H7
  - BROADCAST CODE — BRM
  - PROM PART #16039564

- **SERVICE ECM P/N — 1226465**
  - VEHICLE USAGE — K10 Pick-up
  - CALIB. — S8B14
  - BROADCAST CODE — BRN
  - PROM PART #16039569

- **SERVICE ECM P/N — 1226465**
  - VEHICLE USAGE — G20 (VAN) AUTO TRANS.
  - CALIB. — S8H14
  - BROADCAST CODE — BRR
  - PROM PART #16039580

1985 California 6.2L Diesel ECM Usage

SERVICE ECM PART #1226645 (ALL SERIES)

VEHICLE USAGE

- C-Truck Automatic
- Broadcast Code — DWC
- PROM Part #16044575

- C-Truck Manual
- Broadcast Code — DWD
- PROM Part #16044585

- K-Truck Automatic
- Broadcast Code — DWF
- PROM Part #160144595

- K-Truck Manual
- Broadcast Code — DWH
- PROM Part #16044605

- G-Van Automatic
- Broadcast Code — DWJ
- PROM Part #16044615

- G-Van Manual
- Broadcast Code — DWK
- PROM Part #16044625

ECM REPLACEMENT

— NOTE —

When replacing a production ECM with a service controller, transfer the Production Broadcast Code and Production ECM Number to the service controller label. Do not record on the removable cover. This provides identification of the ECM throughout the service life of the vehicle.

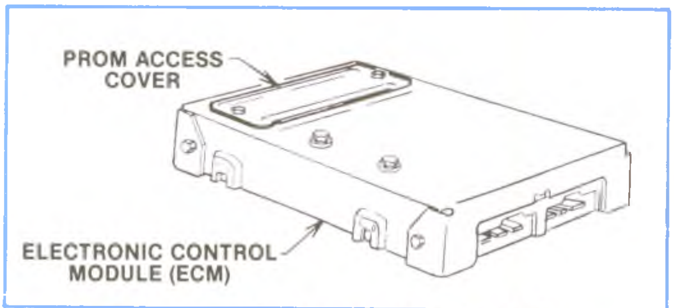


Figure 5-31, **Electronic Control Module.**

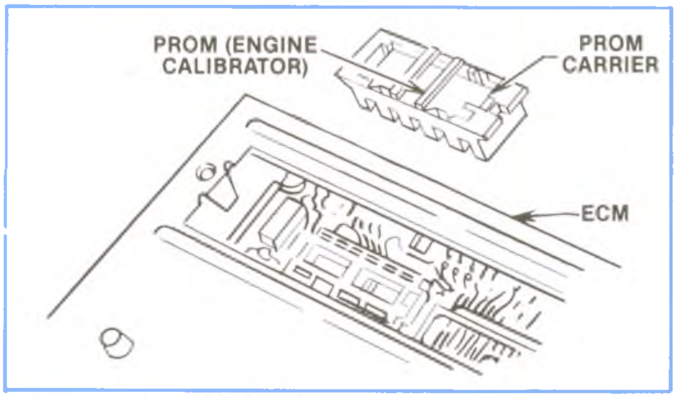


Figure 5-32, **Calibrator.**

• REMOVE OR DISCONNECT

— NOTE —

To prevent internal ECM damage, the ignition must be off when disconnecting or reconnecting the ECM connector.

See Figure 5-31 and 5-32.

1. ECM mounting hardware.
2. Connector from ECM.
3. ECM
4. Calibrator access cover.
5. Calibrator. Grasp the calibrator carrier and gently rock from side to side and upward.

• INSTALL OR CONNECT

Record Production Broadcast Code and Production ECM Number from removed ECM to service controller. Any time a calibrator is installed backwards and the ignition is turned on, the calibrator will be destroyed.

1. Calibrator removed from previous ECM. Position carrier squarely over the socket and press down firmly on the top of the carrier. While pressing down on carrier, use a narrow blunt tool and alternately pressing down on either end of the calibrator body to seat into socket.
2. Access cover.
3. Connector to ECM.
4. ECM with mounting hardware.

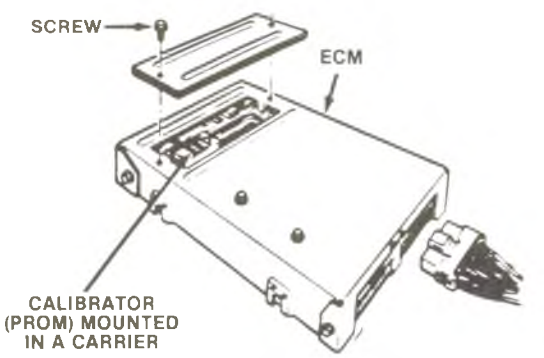
• PART INFORMATION

PART NAME — GROUP
Controller, ECM — 3.670
Calibrator, PROM — 3.670

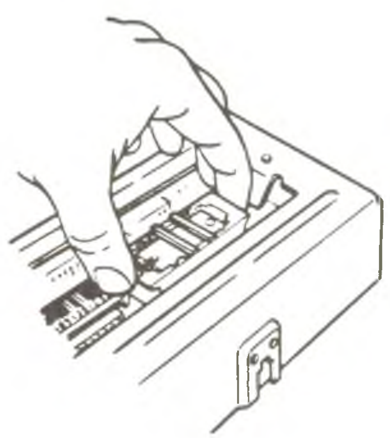
— NOTE —

To prevent internal damage, the ignition must be off when disconnecting or reconnecting the ECM connector.

1. Remove ECM mounting hardware.
2. Disconnect the connector from the ECM.
3. Remove ECM.
4. Remove calibrator access cover.

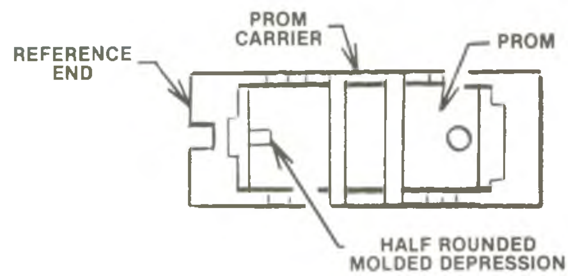


5. Remove calibrator. Grasp the calibrator carrier and gently rock from side to side and upward.



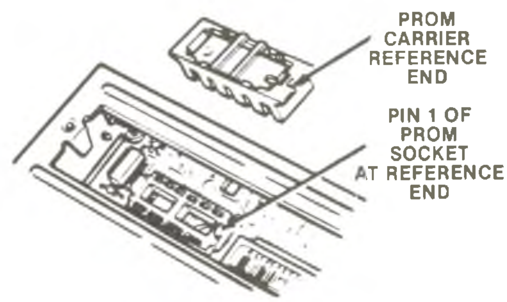
- Replacement ECM (called controller) is supplied without a PROM. Care should be taken when removing a PROM from and ECM that is being replaced as this PROM will be used in a service controller.

6. A correct PROM in a carrier is where the squared off symmetrical end of the carrier is at the same end as the half-rounded molded depression on the PROM. If a new PROM is to be installed, check to see that the installation of the PROM to-carrier is correct. Check for correct PROM part number.

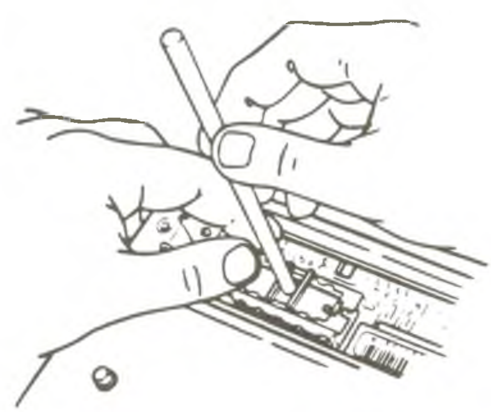


7. If a service controller is to be installed, check the service part number to make sure that it is the correct controller for the replaced ECM.
8. Position the carrier squarely over the PROM socket with the squared off symmetrical end of the carrier aligned with the small notch in the socket at the pin 1 end.

ANYTIME THE PROM IS INSTALLED BACKWARDS AND THE IGNITION SWITCH IS TURNED ON, THE PROM IS DESTROYED.



9. Press down firmly on the top of the carrier.
10. While firmly pressing down on the carrier, take a narrow blunt tool and press down on the body of the PROM. Try to seat the PROM in the socket squarely by alternately pressing on either end of it.



11. Install access cover.
12. Install mounting hardware.
13. Install ECM and connect the connector.

Figure 5-33, Calibrator Replacement.

1984 ECM Check 6.2L (LH6)

See Figures 5-34 and 5-35. The ECM check is made to determine why the "Check Engine" light remains "ON" after the engine is started. Normally, the ECM will not recognize a fault for at least 10 seconds after start-up. If the CEL remains "ON", the ECM has lost power, ground or the signal that turns the CEL "OFF" has been lost. Since the CEL is remote from the ECM, it can recognize faulty ECM power or ECM.

1. Check for proper CEL signal at ALCL. It should normally be about battery voltage until the vehicle is started.
2. Check for 12 volts to ECM ignition feed terminals. Battery voltage should normally be present at both terminals.
3. Check for good ECM ground. Light should normally be "ON". If ECM power and ground terminals are OK, check for good ECM to connector terminal contact.
4. When the vehicle is started, the ECM turns the CEL "OFF" and voltage at ALCL should normally drop under 6 volts.

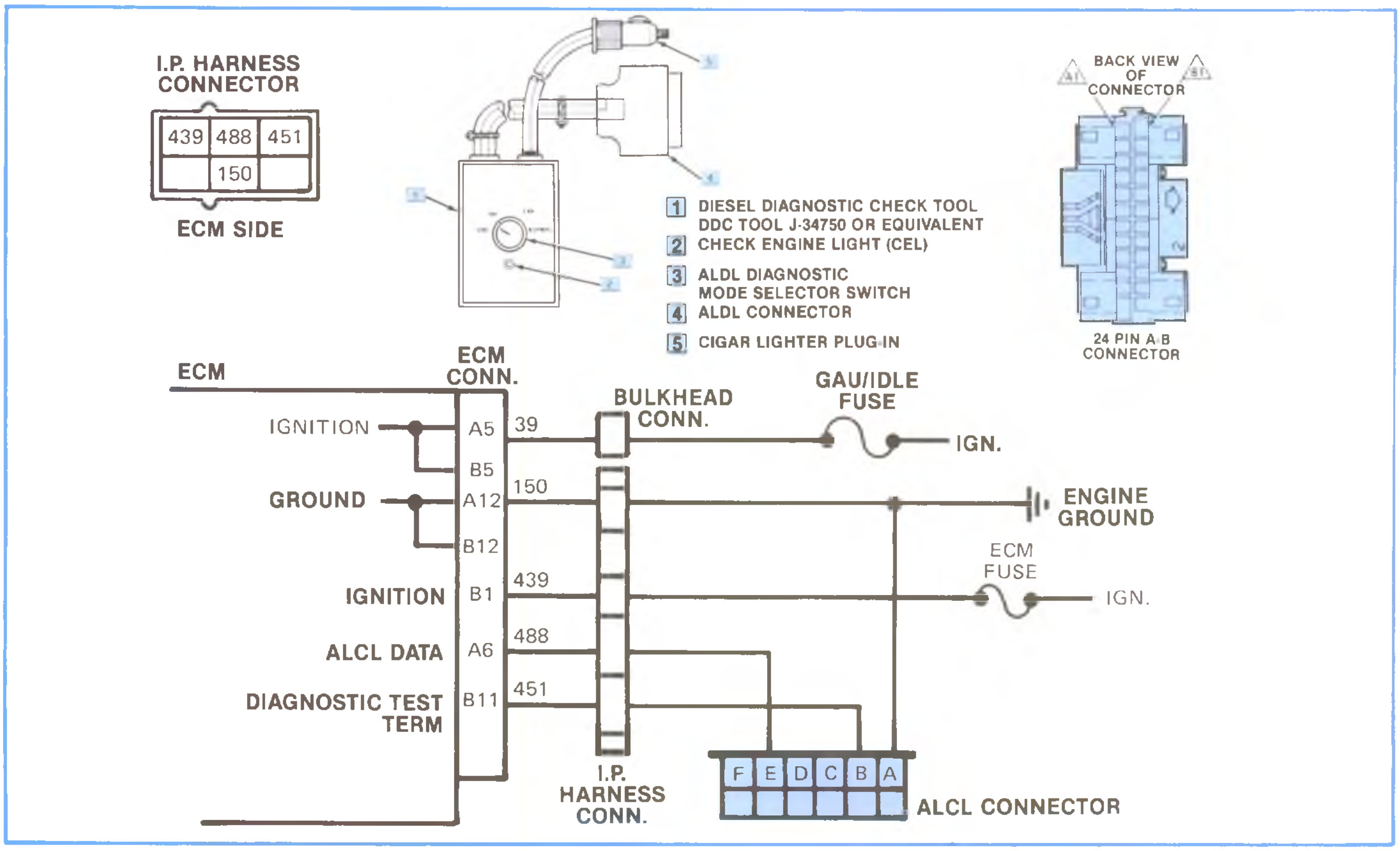


Figure 5-34, 1984 ECM Check Schematic.

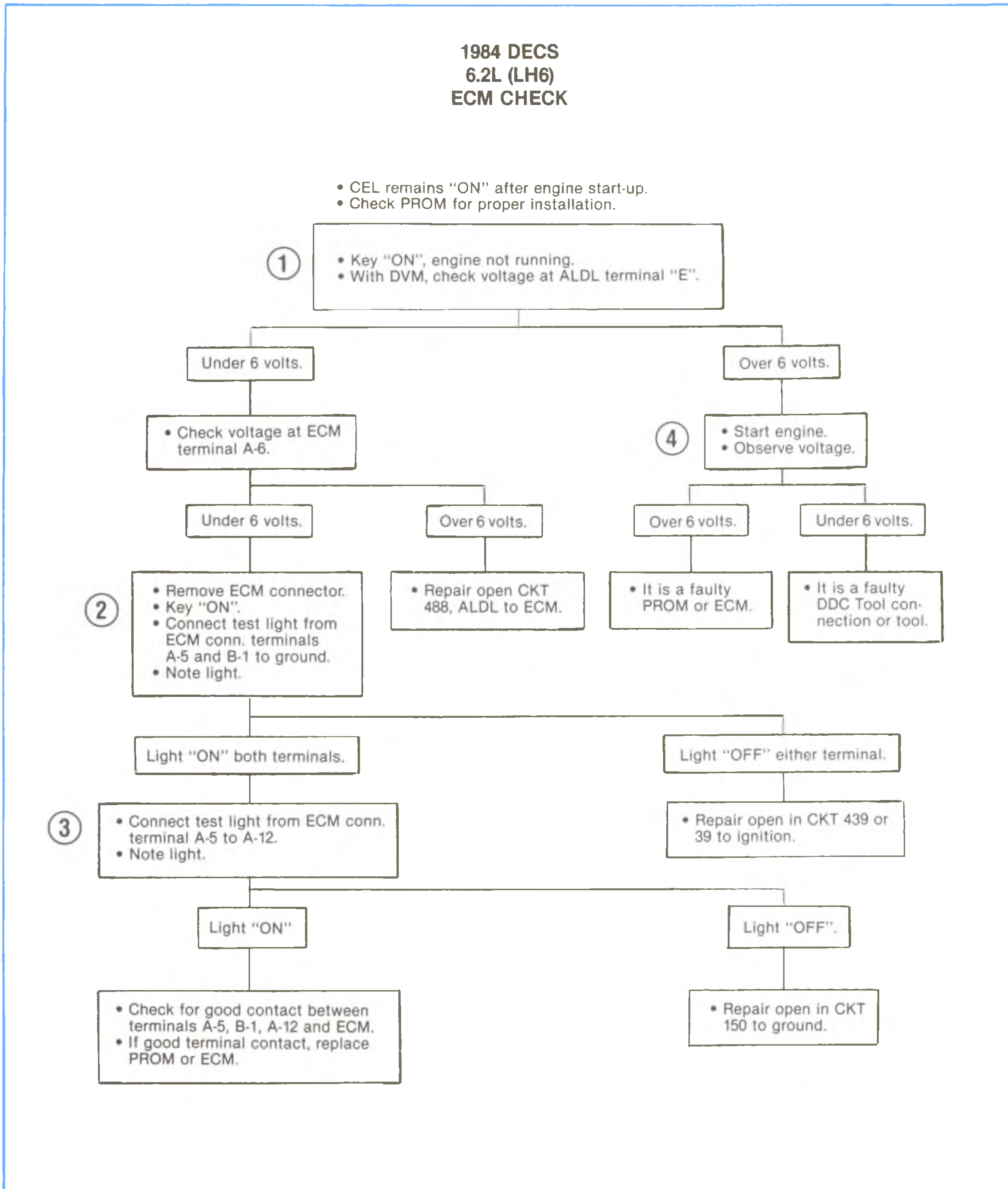


Figure 5-35, ECM Check.

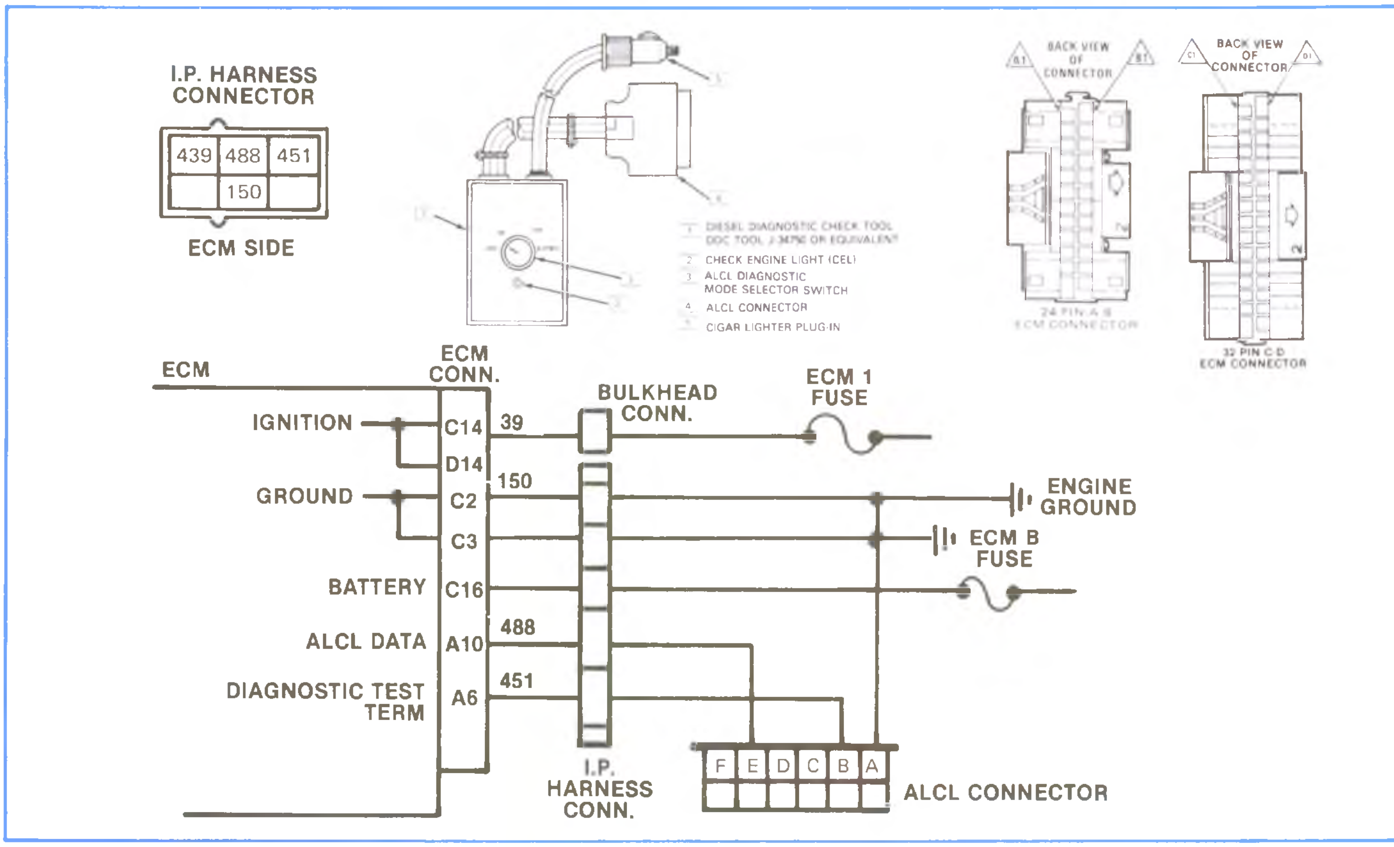


Figure 5-36, 1985 ECM Check Schematic.

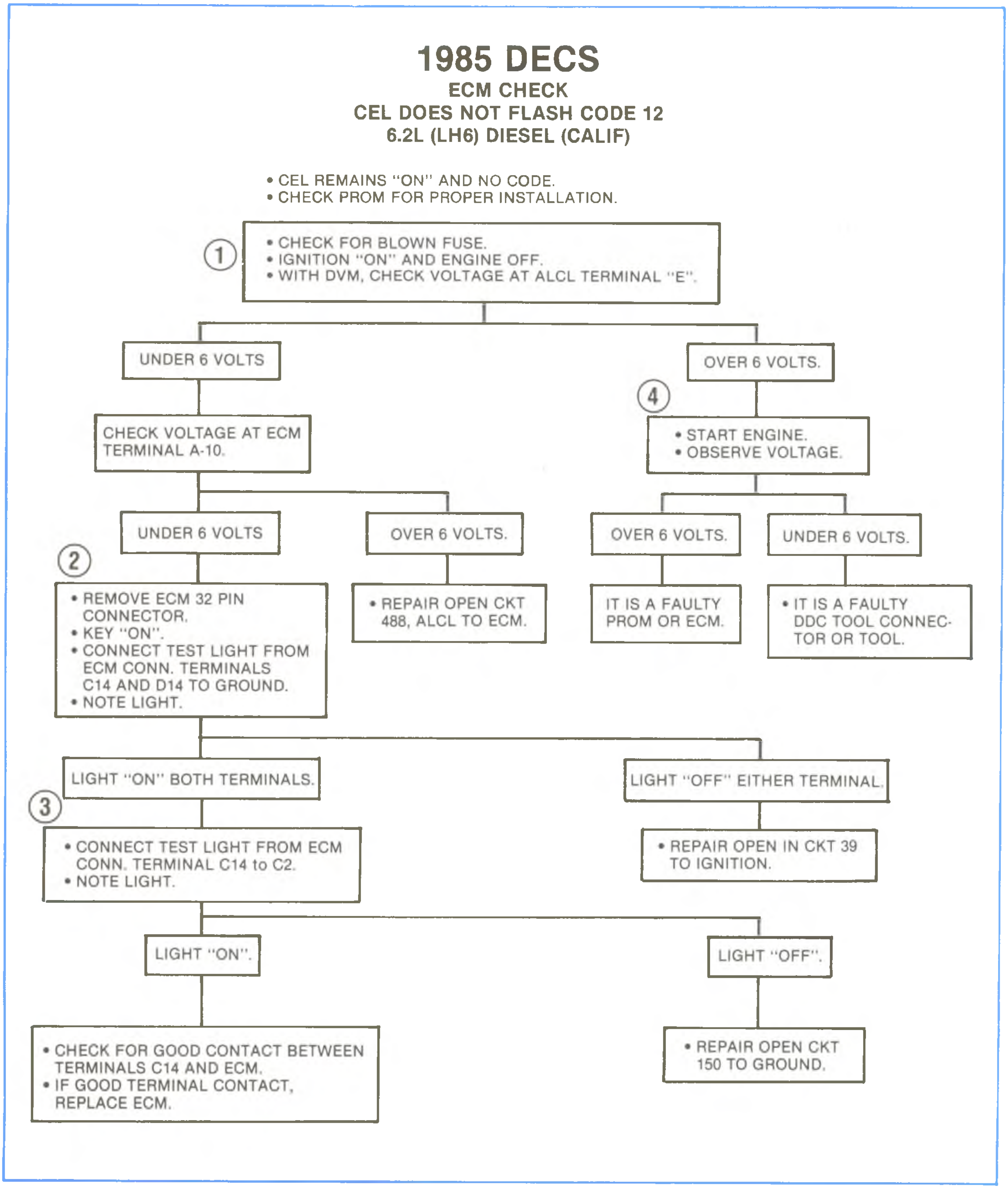


Figure 5-37, 1985 ECM Check Chart.

CODE 51
PROM PROBLEM
6.2L (LH6) DIESEL (CALIF.)

- CHECK THAT ALL PINS ARE FULLY INSERTED IN SOCKET.
- IF OK, REPLACE PROM AND RECHECK.
- IF PROBLEM NOT CORRECTED, REPLACE ECM.

THE IGNITION SHOULD ALWAYS BE OFF WHEN INSTALLING OR REMOVING THE ECM CONNECTORS

Remove or Disconnect (Figures 1 and 2)

1. Connectors from ECM
2. ECM mounting hardware.

Important

ELECTRONIC CONTROL MODULE (ECM) MOUNTING HARDWARE NOT ILLUSTRATED.

3. ECM from passenger compartment
4. ECM Access cover

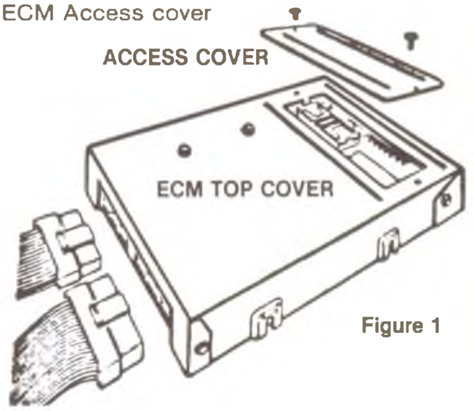


Figure 1

5. PROM removal

Important

Using the rocker-type PROM Removal tool, engage one end of the PROM carrier with the hook end of the tool. Press on the vertical bar end of the tool and rock the engaged end of the PROM Carrier up as far as possible. Engage the opposite end of the PROM Carrier in the same manner and rock this end up as far as possible. Repeat this process until the PROM Carrier and PROM are free of the PROM Socket. The PROM Carrier with PROM in it should lift off the PROM socket easily. PROM Carrier should only be removed by using the pictured PROM removal tool (Figure 2). Other methods could cause damage to the PROM or PROM socket.

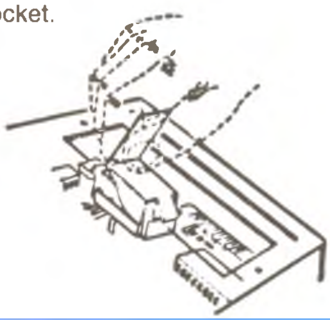


Figure 2

Inspect (Figure 3)

For correct indexing of reference end of the PROM Carrier and carefully set aside. Do not remove PROM from carrier to confirm PROM correctness.

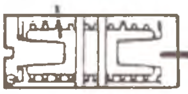


Figure 3

Important (Before installing new PROM)

ANYTIME THE PROM IS INSTALLED BACKWARDS AND THE IGNITION SWITCH IS TURNED ON, THE PROM IS DESTROYED.

Install or Connect (Figures 1 and 3)

1. PROM in PROM socket.

Important

DO NOT press on PROM — ONLY CARRIER.

Small notch of carrier should be aligned with small notch in socket. Press on PROM carrier until it is firmly seated in the socket. Do not press on PROM; only the carrier.

2. Access cover on ECM.
3. ECM in passenger compartment.
4. Connectors to ECM.

Functional Check

1. Turn ignition on
2. Enter diagnostics
   A. Code 12 should flash four times. (No other codes present.) This indicates the PROM is installed properly.
   B. If trouble code 51 occurs or if the check engine light is on constantly with no codes, the PROM is not fully seated. Installed backwards, has bent pins or is faulty.

Figure 5-38, Code 51.

CODE 52
6.2L (LH6) DIESEL (CALIF.)

- CHECK THAT ECM CONNECTOR ARE FULLY INSERTED.
- CLEAR MEMORY.
- DDC TOOL CONNECTED AND IN "NORMAL" MODE.
- START ENGINE AND CHECK FOR LIGHT.
- IF LIGHT REAPPEARS AND DDC TOOL INDICATES CODE 52, REPLACE ECM.
- CLEAR MEMORY AFTER REPAIR TO CONFIRM NO "CEL".

Figure 5-39, Code 52.

CODE 53
Y REF OVERLOAD

- IGNITION "OFF". CLEAR CODES.
- DDC TOOL CONNECTED AND IN "NORMAL" MODE.
- START ENGINE AND RUN FOR 1 MINUTE OR UNTIL "CHECK ENGINE" LIGHT COMES ON.
- POSITION DDC TOOL IN "GROUND" MODE.

CODE 53

CHECK FOR A GROUND AT PIN A12, CKT 416.

NO GROUND AT PIN A12, REPLACE ECM.

NO CODES STORED. PROBLEM IS INTERMITTENT.

Figure 5-40, Code 53.

Engine Speed Sensor (RPM)

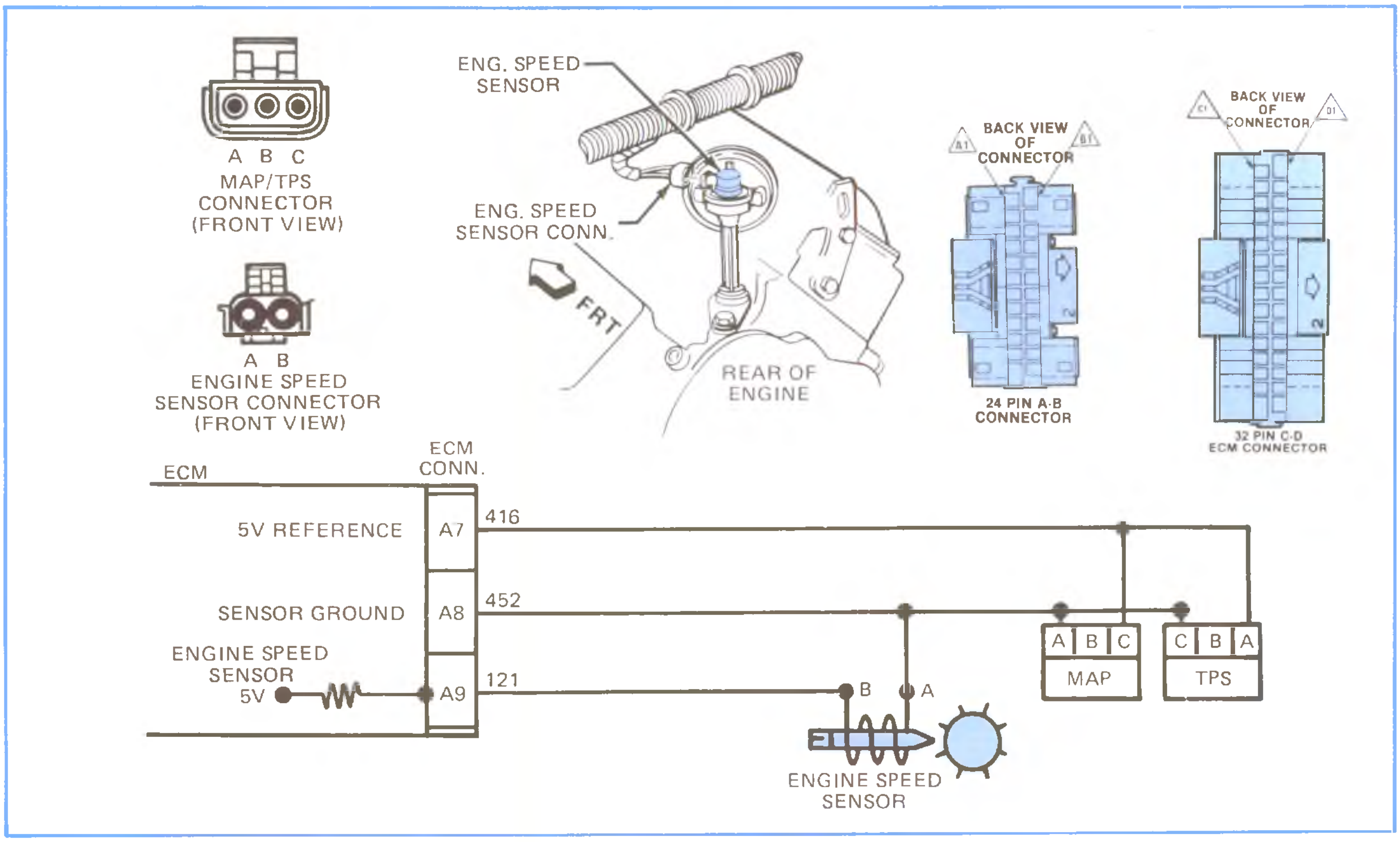


Figure 5-41, 1984 Engine Speed Sensor Check Schematic.

See Figure 5-41.

The ECM monitors engine RPM through a permanent magnet (P.M.) generator. It is located in the top of the vacuum pump, or oil pump drive. Engine RPM is one of the inputs to the ECM to calculate the duty cycle of the EGR. It is 500 milli-volt peak to peak. There are 4 reference pulses per revolution.

1984 ENGINE SPEED SENSOR CHECK

The Engine Speed Sensor is a camshaft driven pick-up mounted at the center rear of the engine.

It is sourced by 5 V-reference and allows the ECM to measure engine RPM by the number of times the voltage is pulsed. The Engine Speed Sensor pulses 4 times per revolution.

See Figure 5-42:

1. Checks for a good 5 V-reference. Normally, the ECM should be at about 5 volts for fully charged batteries.
2. Checks for proper ECM voltage to the Engine Speed Sensor. If the circuit to the ECM is complete, normal voltage will be about 5 volts with the harness disconnected from the sensor.
3. Checks for a good sensor ground circuit (CKT 452) from sensor to ECM. Since Step 2 indicated an open, the results of this step indicates whether the open is in the wire or at the ECM.

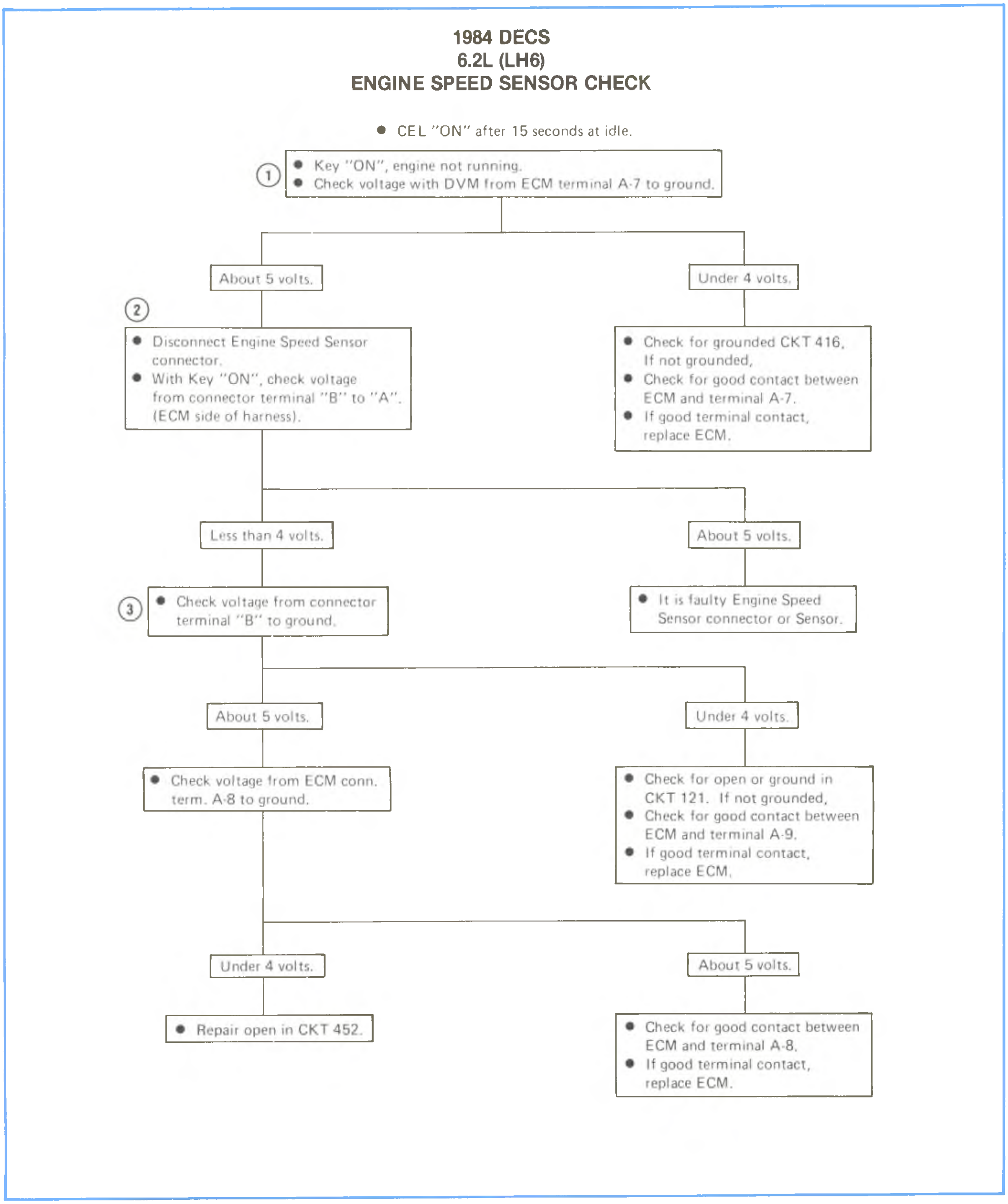


Figure 5-42, 1984 Engine Speed Sensor Chart.

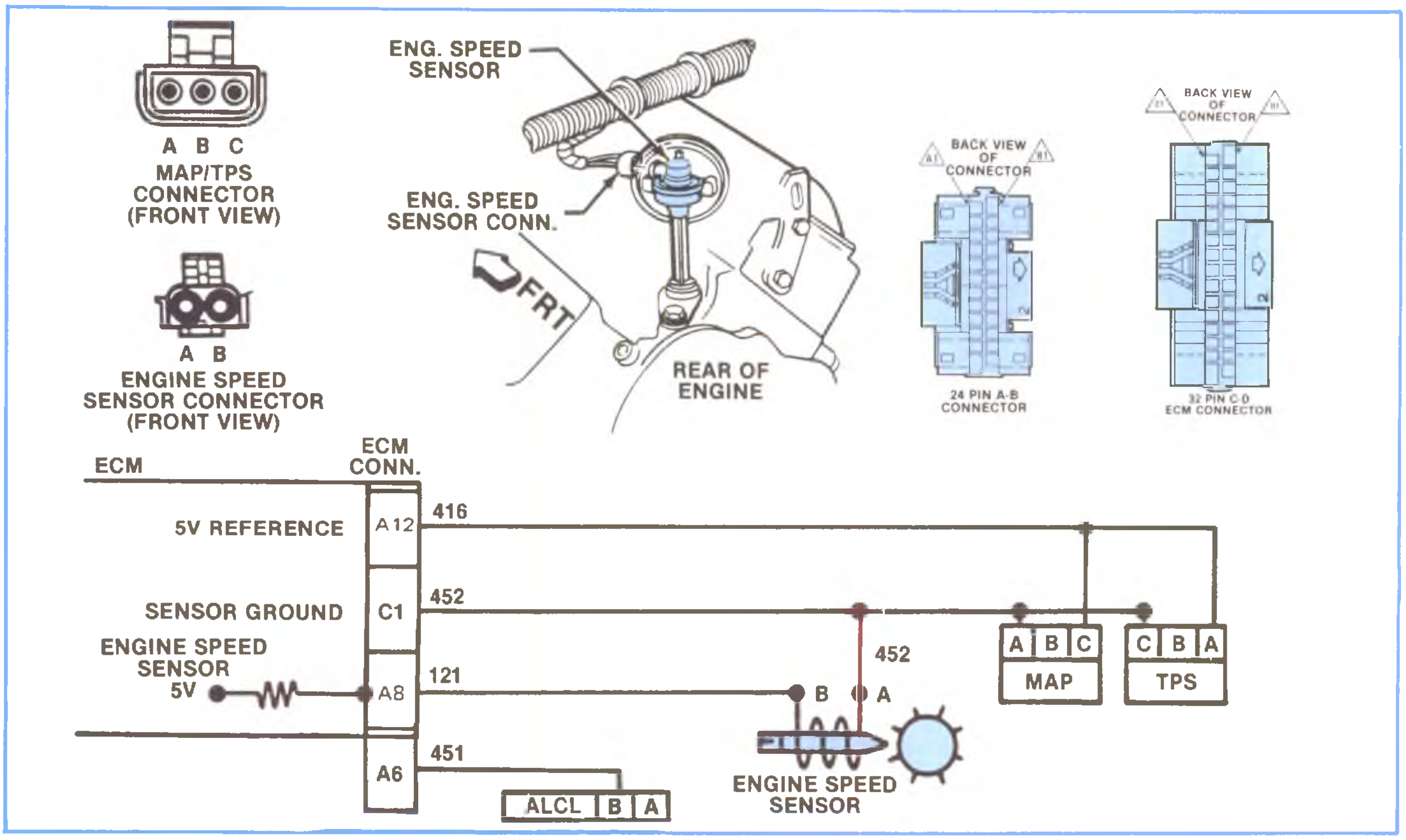


Figure 5-43, 1985 Engine Speed Sensor Schematic.

CODE 12, NO REF PULSE

Malf Code 12 is detected when the ECM detects an "engine not running" condition.

Code is not to be stored in nonvolatile memory. Operation is the same as the gas controller.

Pin Condition	Terminal Name	CEL/CODE	Vacuum Condition	Codes
A6 GND	Diag. Term.	Yes — 12	10″/Full (Flutters)	Code 12 at all times
A8 OPN	RPM	Solid CEL — 12	NO/NO	Code 12 immediate
A8 GND	RPM	Solid CEL — 12	NO/NO	Code 12 immediate
C1 OPN	Sensor GND	Solid CEL — 12	NO/NO	
Engine Speed Sensor	—	Immed. CEL — 12	None/None	

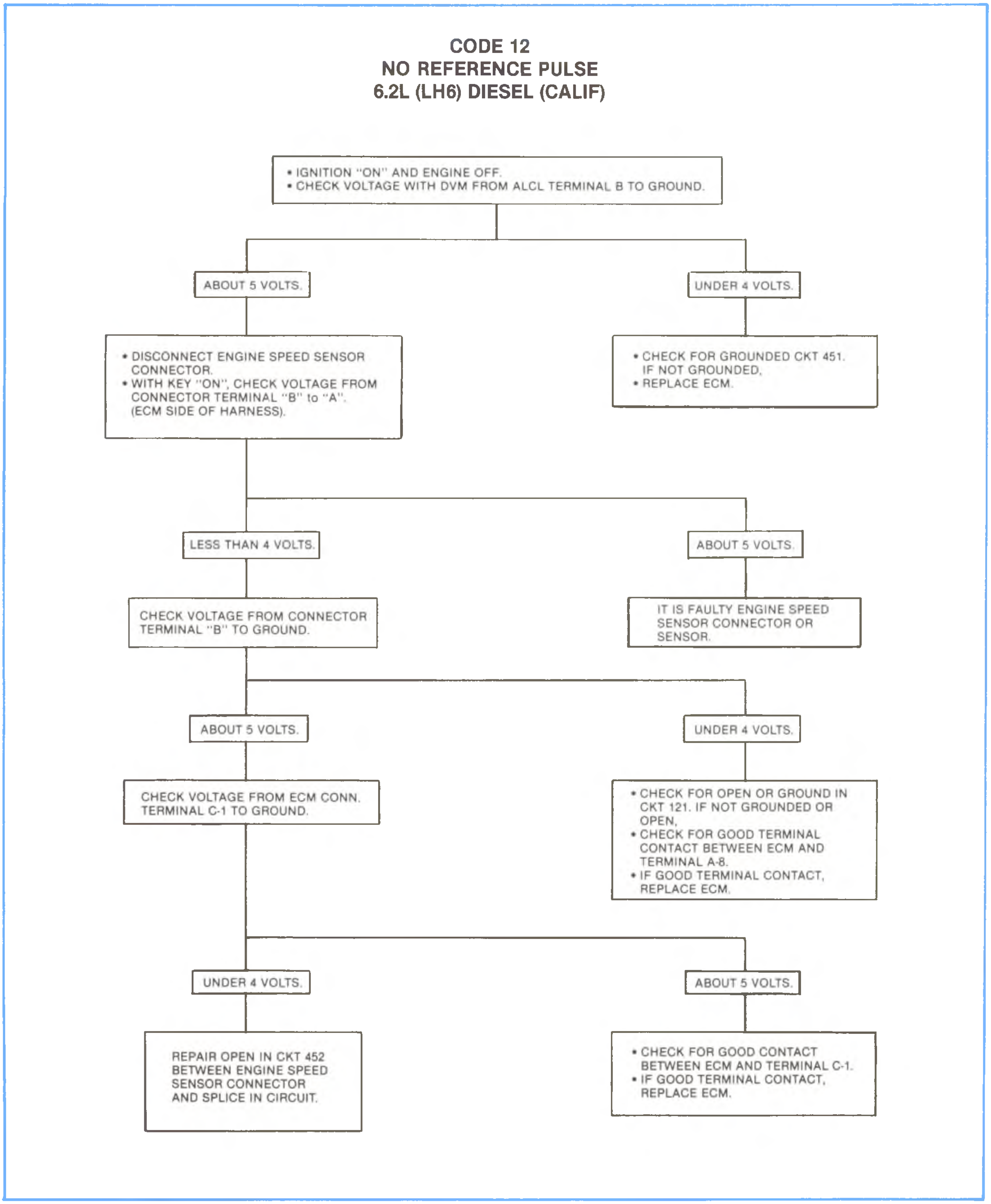


Figure 5-43A, Code 12.

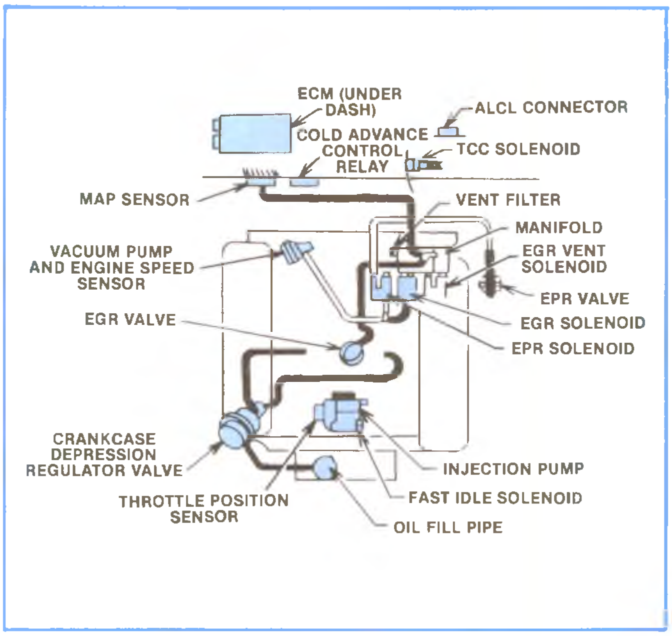


Figure 5-44, Emission Systems — California CK (LH6 Engine).

Exhaust Gas Recirculation Control (EGR)

See Figure 5-44.

The exhaust gas recirculation system provides a means to direct exhaust gases from the exhaust manifold to the intake manifold.

This is accomplished using a vacuum powered EGR valve. The opening of this valve, and therefore the amount of exhaust gas flow, is increased as the amount of vacuum routed to the EGR valve is increased. The amount of vacuum regulated to the EGR valve is controlled by an electrically operated solenoid valve which is supplied with a relatively constant amount of vacuum. The solenoid valve then controls the amount of vacuum to the EGR valve by means of oscilating on and off at a frequency of 25 Hz, with a variable pulse width, controlled by the ECM. The EGR MAP sensor monitors the regulated vacuum to the EGR valve as the feedback parameter of the control function.

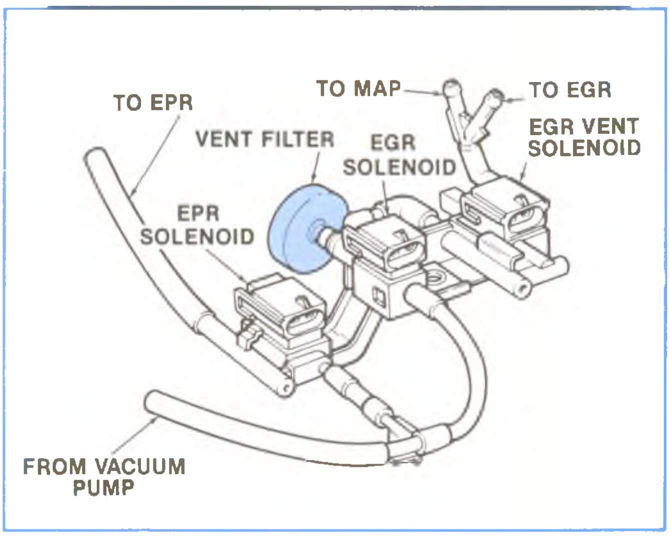


Figure 5-45, EGR, EPR, Vent Solenoid Assembly.

PULSE WIDTH MODULATED EGR VACUUM CONTROL SOLENOID — 6.2L (CALIFORNIA) DIESEL

See Figure 5-45.

A pulse width modulated solenoid (pulsed solenoid) controls the vacuum signal to the EGR valve in the electronic vacuum modulated EGR system. This vacuum control is via an electronic pneumatic servo loop based primarily on load (throttle angle) engine RPM inputs and vehicle speed.

Vacuum is supplied at #8 from the vacuum pump and the vacuum is modulated between #2 (vent to atmosphere) and #4 (vacuum output to EGR valve) as a result of a pulsed electrical signal from the controller.

At 0% duty cycle, the output vacuum signal is 0″ hg. At 100% duty cycle, the output vacuum signal is equal to the input vacuum from the supply pump.

In 1984 the solenoid is grounded at ECM Pin B2 on Circuit 538. In 1985 it is grounded at ECM Pin C10 on Circuit 435.

The duration (time) of the pulses (pulses per second) of the duty cycle (0-100%) for the EGR solenoid is determined by engine parameters such as RPM and the Throttle Position Sensor.

- **DUTY CYCLE IS DETERMINED BY:**

$$\text{DUTY CYCLE} = \frac{\text{t-time on}}{\text{T-time off}}$$

$$\text{D.C.} = \frac{10 \text{ m sec.}}{40 \text{ m sec.}} = 25\%$$

It would only be on 25% of the time.

Frequency 25Hz (25 × @ sec.) 25-40 m sec. time periods.

OUTPUT VACUUM SIGNAL		
ABS. PRESS kPa	ABS. PRESS IN HG.	VAC. IN HG.
0	0	29.92
5	1.48	28.44
10	2.96	26.96
15	4.44	25.48
20	5.92	24.00
25	7.40	22.52
30	8.88	21.04
35	10.36	19.56
40	11.84	18.08
45	13.32	16.60
50	14.80	15.12
55	16.28	13.64
60	17.76	12.16
65	19.25	10.67
70	20.72	9.20
75	22.20	7.72
80	23.68	6.24
85	25.16	4.76
90	26.65	3.27
95	28.12	1.80
100	29.61	.31
101	29.92	—
105	30.09	—

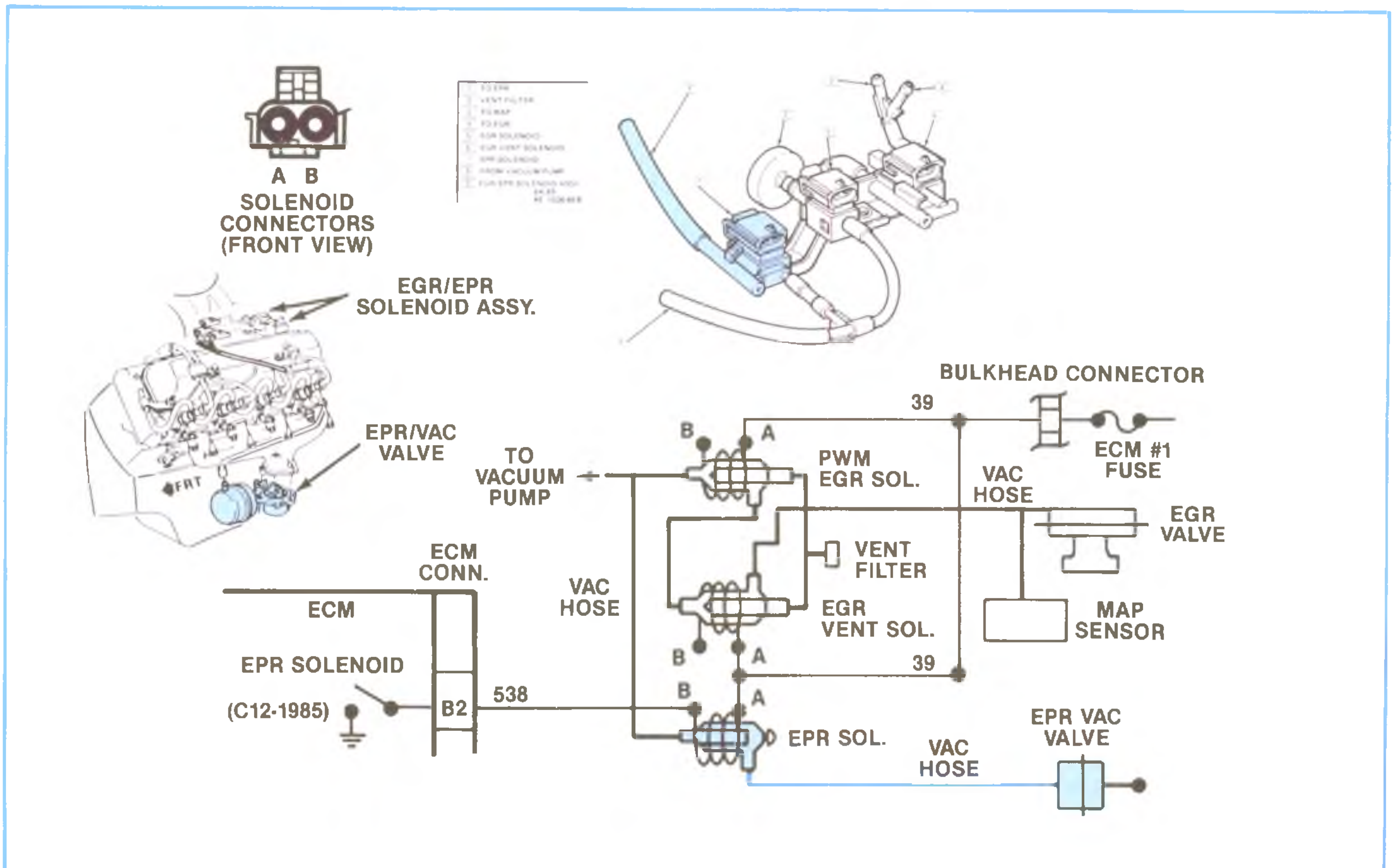


Figure 5-46, **EPR Valve Circuit (1984 & 1985).**

EPR Valve

The system also incorporates an exhaust pressure regulator (EPR) valve, which is closed by control of the ECM whenever the ECM control logic determines that the EGR valve is open. (Figure 5-46).

When the EPR valve is closed, it simply makes a restriction in the exhaust system which causes the pressure inside of the exhaust manifold to rise, thereby increasing the exhaust gas flow through the EGR valve. The EPR valve is also a vacuum actuated valve, which is either supplied vacuum or not, as directed by the EPR solenoid, which is energized or de-energized by the ECM.

An EGR vent solenoid valve is also used in the system. This solenoid valve is controlled by the ECM and upon request of the EGR vent control logic, the vent solenoid valve allows the regulated vacuum supply to the EGR valve to be vented to barometric pressure. This very fast rise in EGR pressure allows the EGR valve to close much more quickly than is attainable with the normal EGR feedback control.

Desired EGR Pressure Calculation

The amount of controlled EGR flow is determined by the calculated value of the desired EGR valve pressure. The desired EGR pressure is calculated in the following manner:

The desired EGR pressure is calculated by summing the required amount of EGR pressure value obtained from one of the desired kPa ECM memory tables, altitude compensated pressure value is obtained from the Table for EGR Altitude Compensation and vehicle speed modification value, unless one of the following conditions exist:

- If the ECM is in either the Diagnostic Mode or the ALCL 1 Mode, the desired EGR pressure value is calculated to be the difference of the barometric pressure value minus the calibration constant value of 10 in. Hg.
- If the initialization routine is forcing the barometric pressure value to be updated, the desired EGR pressure value is set equal to the calibration parameter.
- If the successive calculated values of desired EGR pressure have been increasing and the value is presently greater than the EPR switchpoint value obtained from table, the desired EGR pressure value is set equal to the calibration constant.
- If the calculated values of desired EGR pressure have been decreasing and this value is presently greater than or equal to the EPR switchpoint value minus the calibration constant, the desired EGR pressure value is set equal to the calibration value.

— NOTE —

The EGR vacuum (low pressure kPa) look-up tables are in the read only memory (ROM) of the E PROM. They are for designated EGR pressure (vacuum to EGR), and are based upon known engine RPM and throttle position values.

The 1st table is used to determine the required amount of EGR when engine RPM is between 551 and 1349 RPM.

The 2nd kPa table is used to determine the required amount of EGR when the engine speed is between 1350 and 2650 RPM.

If the engine speed is less than or equal to 550 RPM and greater than or equal to the "Low RPM threshold for no EGR", the required EGR is set equal to a table value corresponding to the minimum RPM value (550 RPM).

If the RPM is less than the "Low RPM for no EGR", the required EGR is set equal to a calibrated value, which will fully close the EGR valve.

When the engine speed is greater than 2650 RPM, the required amount of desired EGR pressure is set equal to the value in the table corresponding to the maximum RPM value (2650 RPM).

ALTITUDE COMPENSATION

There is a look-up table for Altitude Compensation which is based upon barometric pressure values.

VEHICLE SPEED MODIFICATION

The EGR amount is modified with respect to vehicle speed. The EGR amount will be reduced upon reaching a calibrated vehicle speed.

EPR VALVE CONTROL

This portion of the EGR logic determines whether the EPR valve should be open or closed as controlled by the ECM.

EGR SWITCHPOINT TABLE

This is a two dimensional table used for determining what pressure value is to be used for the EPR switchpoint, based upon the present atmospheric pressure value. This table contains 12 look-up values.

EPR OUTPUT DETERMINATION

The EPR solenoid will be de-energized (EPR valve open) if the desired EGR pressure value exceeds the EPR switchpoint value obtained from the table.

If the desired EGR pressure value is less than or equal to the EPR switchpoint value, then the EPR solenoid will be energized (EPR valve closed).

EGR VENT CONTROL

This portion of the EGR logic determines if the EGR vent solenoid should be controlled to allow the EGR pressure to quickly reach a maximum value, equal to atmospheric pressure.

EGR VENT DETERMINATION

The EGR vent function will be enabled, (vent valve open) if the desired EGR pressure value exceeds the EPR switchpoint value obtained from the table.

EGR PULSE WIDTH MODIFICATIONS

Two terms are calculated and used to modify the EGR output pulse width, which controls the EGR solenoid duty cycle. One term is called the integral gain and the other term is called the proportional gain. These values are used to calculate an EGR pressure error, which is the difference between desired EGR pressure, minus the actual EGR pressure.

In 1984 a 4th gear switch is located in the 700-R4 4th gear pressure circuit, and a mechanical switch on the shifter linkage of manual transmissions. When these switches close, this input to the ECM cuts off EGR at all throttle angles.

NOTES

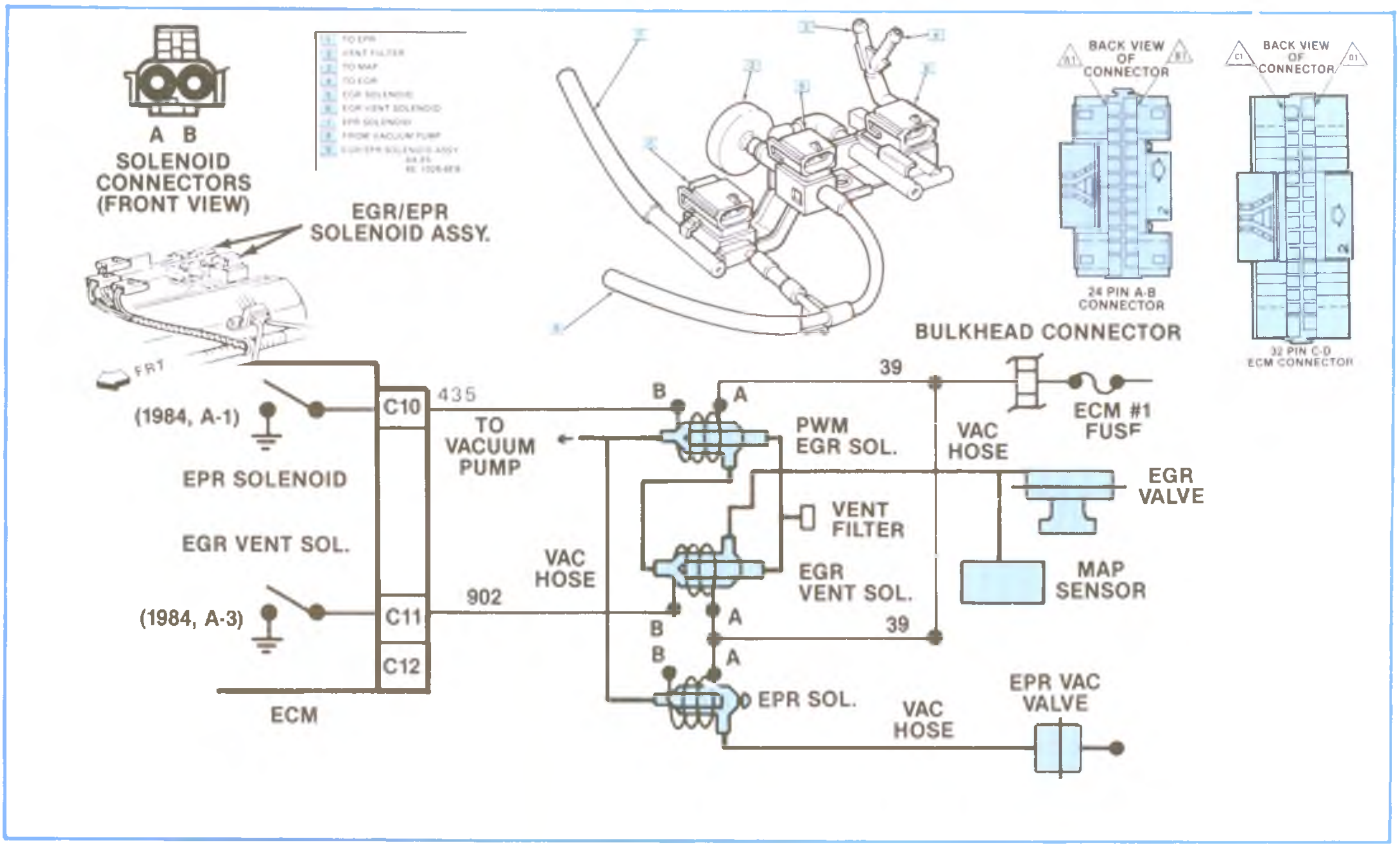


Figure 5-47, EGR/EGR Vent Schematic (1984 & 1985).

EGR/EGR VENT CHECK (1984 & 1985)

The EGR solenoid controls the amount of vacuum to the EGR valve. The signal from the ECM is Pulse Width Modulated (PWM) which varies the cycle ("ON" time) from 0% to 100%.

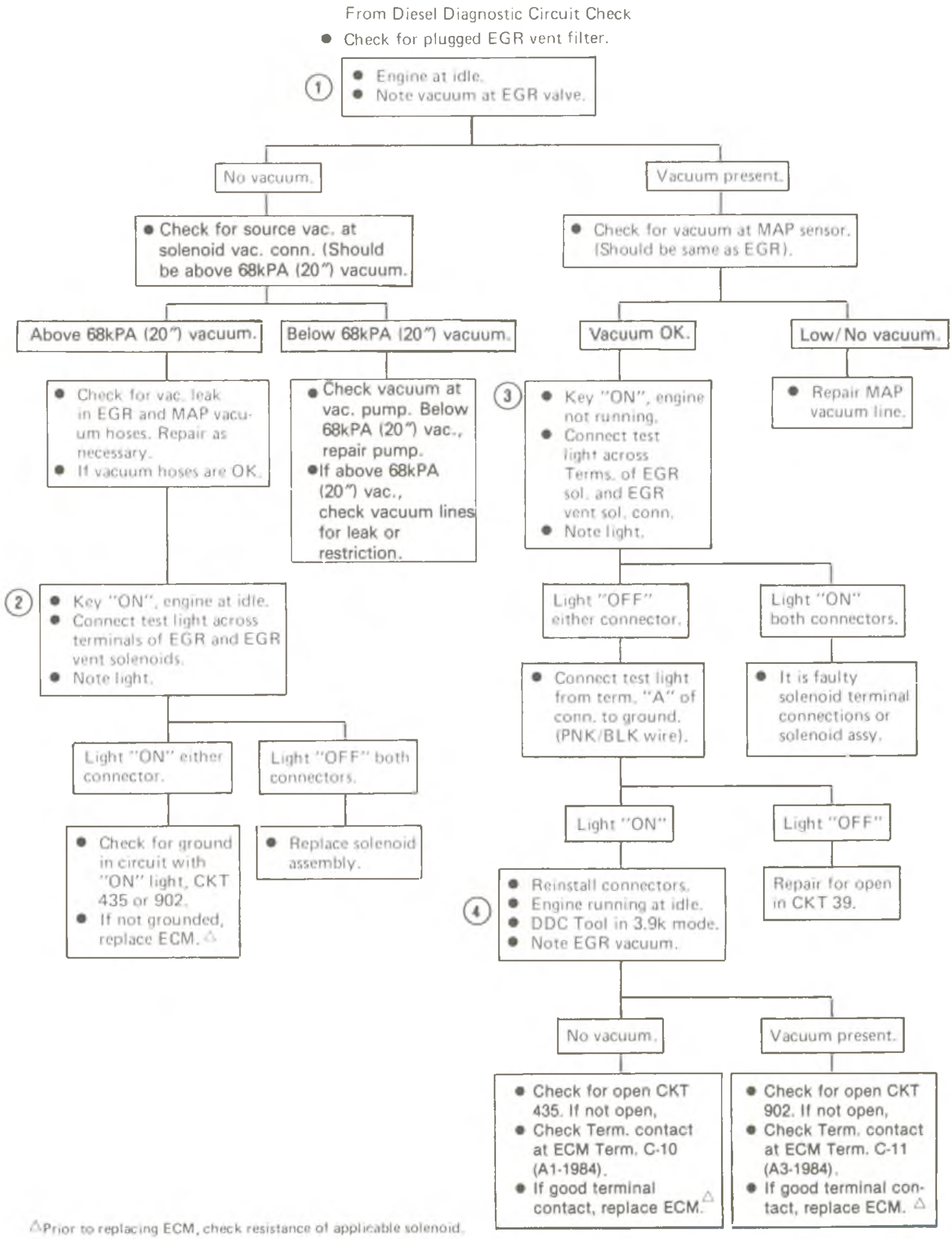
As the EGR solenoid cycles, vacuum to the EGR valve is controlled. When the EGR solenoid is "ON", there is no EGR vacuum.

The EGR Vent Solenoid operates to allow rapid venting of EGR vacuum to improve driveability and performance when the ECM recognizes the operating range for no EGR. When the solenoid is "ON", EGR vacuum is vented.

Both solenoids operate on 12 volts supplied by ignition. The ECM supplies the ground to turn the solenoids "ON". See Figure 5-47.

- Checks for EGR vacuum at idle. Normally, there should be full EGR vacuum at idle (above 68 kPa/20″ vacuum).
- Checks for a ground in the circuit that would energize either solenoid. At idle, neither solenoid should be "ON". A test light "ON" indicates a faulty ground in the circuit.
- Checks for complete circuits to both solenoids. The test light should be "ON" normally.
- Using the DDC tool in the 3.9k mode should turn the vacuum "OFF" to the EGR valve by ECM activation of the EGR vent solenoid. If vacuum is present, the ECM was not able to energize the EGR vent solenoid.

1984 & 1985 DECS
EGR/EGR VENT CHECK
6.2L (LH6) DIESEL (CALIF.)



△ Prior to replacing ECM, check resistance of applicable solenoid. If less than 20 ohms, replace solenoid also.

Figure 5-48, EGR/EGR Vent Check, 1984-1985.

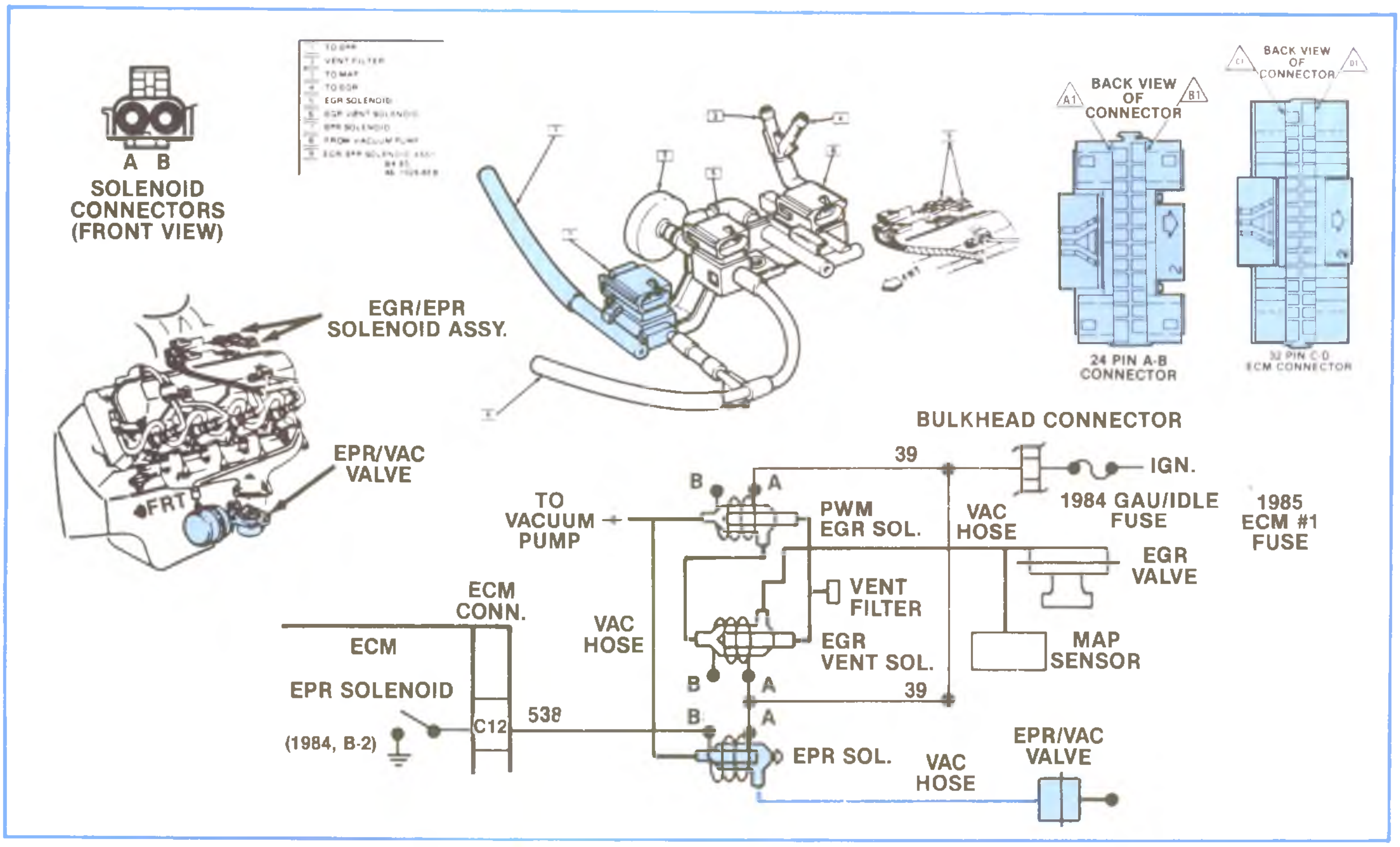


Figure 5-49, EPR Solenoid Schematic (1984 & 1985).

EPR Solenoid Electrical Check (1984 & 1985)

The EPR solenoid controls vacuum to the EPR valve. The EPR solenoid, when energized, allows vacuum pump vacuum to close the EPR valve and increase exhaust back pressure for proper EGR operation. The solenoid is supplied 12 volts by the ignition and the ECM completes the ground to energize the solenoid and turn EPR "ON". See Figure 5-49.

- Checks for a short to ground or a faulty ECM signal to EPR solenoid. Test light should normally be "OFF".
- Checks for signal to energize EPR solenoid with engine at idle. If the test light is "ON", electrical circuits to the solenoid are OK.

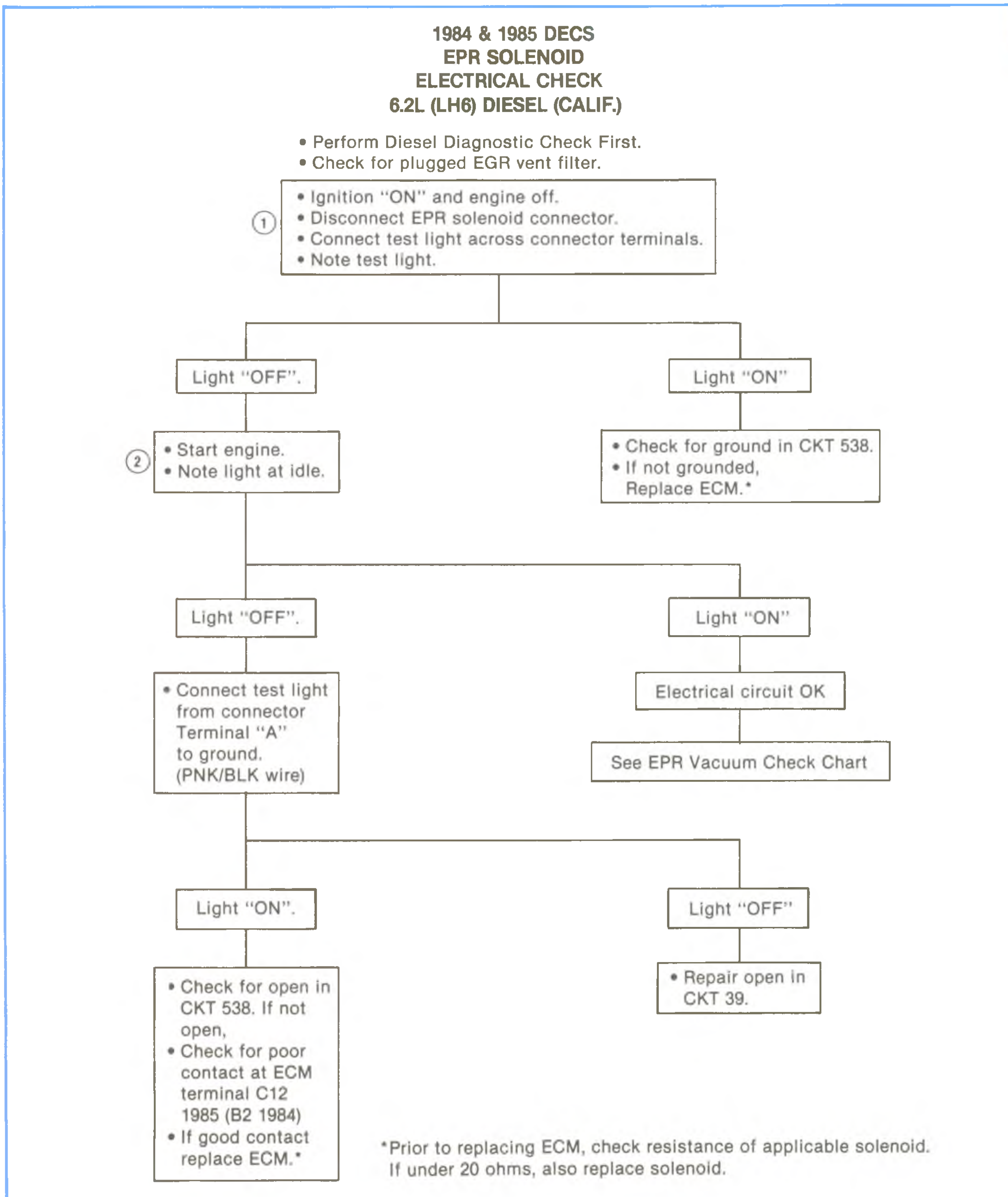


Figure 5-50, EPR Solenoid Electrical Check (1984 & 1985).

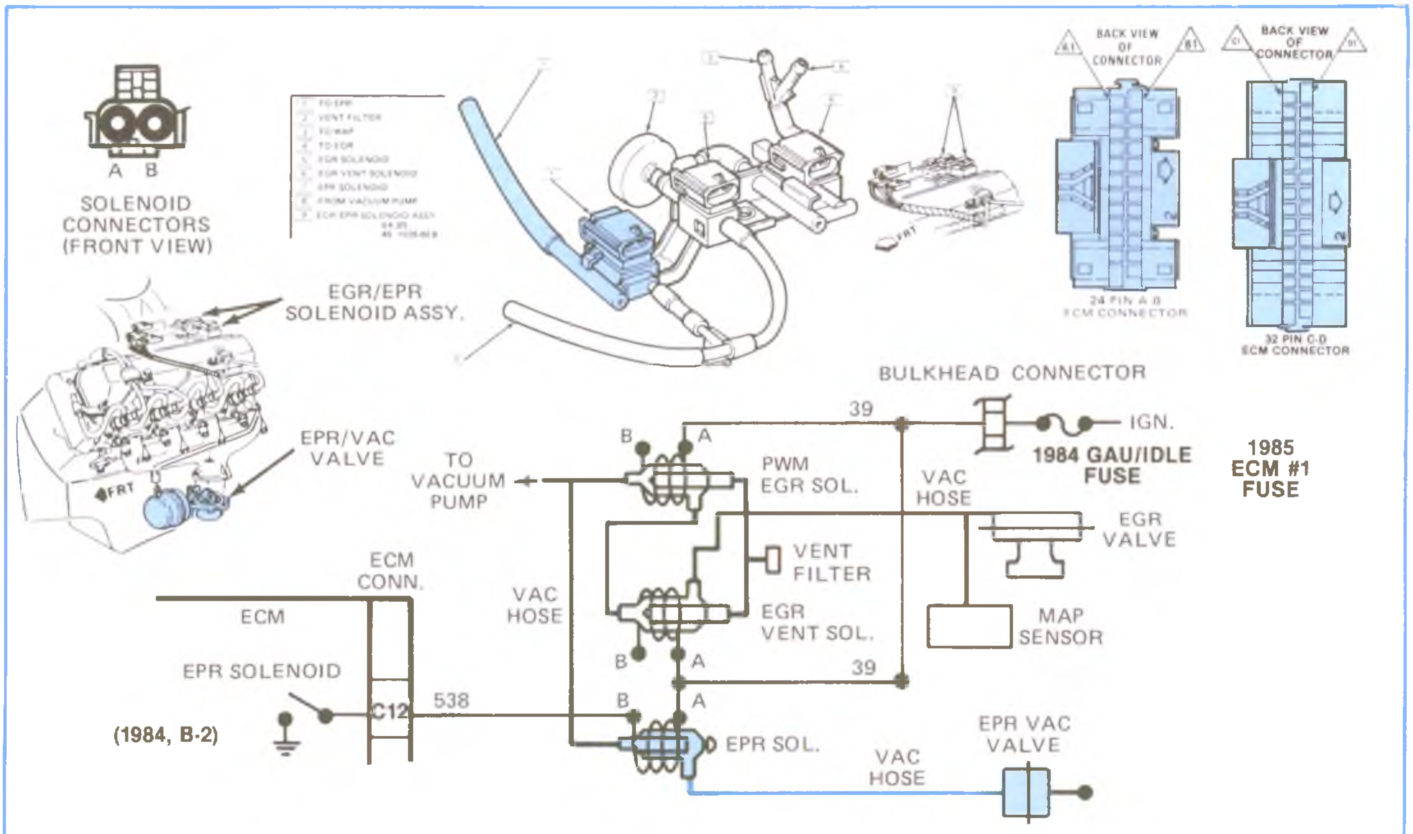


Figure 5-51, **EPR Solenoid Schematic (1984 & 1985).**

EPR Vacuum Check (1984 & 1985)

The EPR Solenoid controls vacuum to the EPR valve. The EPR solenoid, when energized, allows vacuum pump vacuum to close the EPR valve and increase exhaust back pressure for proper EGR operation. The EPR valve is a combination vacuum, actuator and exhaust restrictor plate. When vacuum is applied to the actuator, the restrictor plate closes to increase exhaust system back pressure to allow the EGR valve to function more efficiently. See Figure 5-51.

- Checks for normal EPR vacuum at idle. Since electrical circuit was verified as OK on prior chart, if no vacuum is present, it is due to no source vacuum (vacuum pump) or a restriction or leak in vacuum lines to valve including the solenoid.
- Checks to see if solenoid will respond to ECM command. In 3.9k mode, EPR solenoid is de-energized, so no vacuum should be present if the solenoid did close.
- Checks for normal operation of EPR valve. When vacuum is applied to vacuum, valve actuator should move and hold.

1984 & 1985 DECS
6.2L (LH6)
EPR VACUUM CHECK

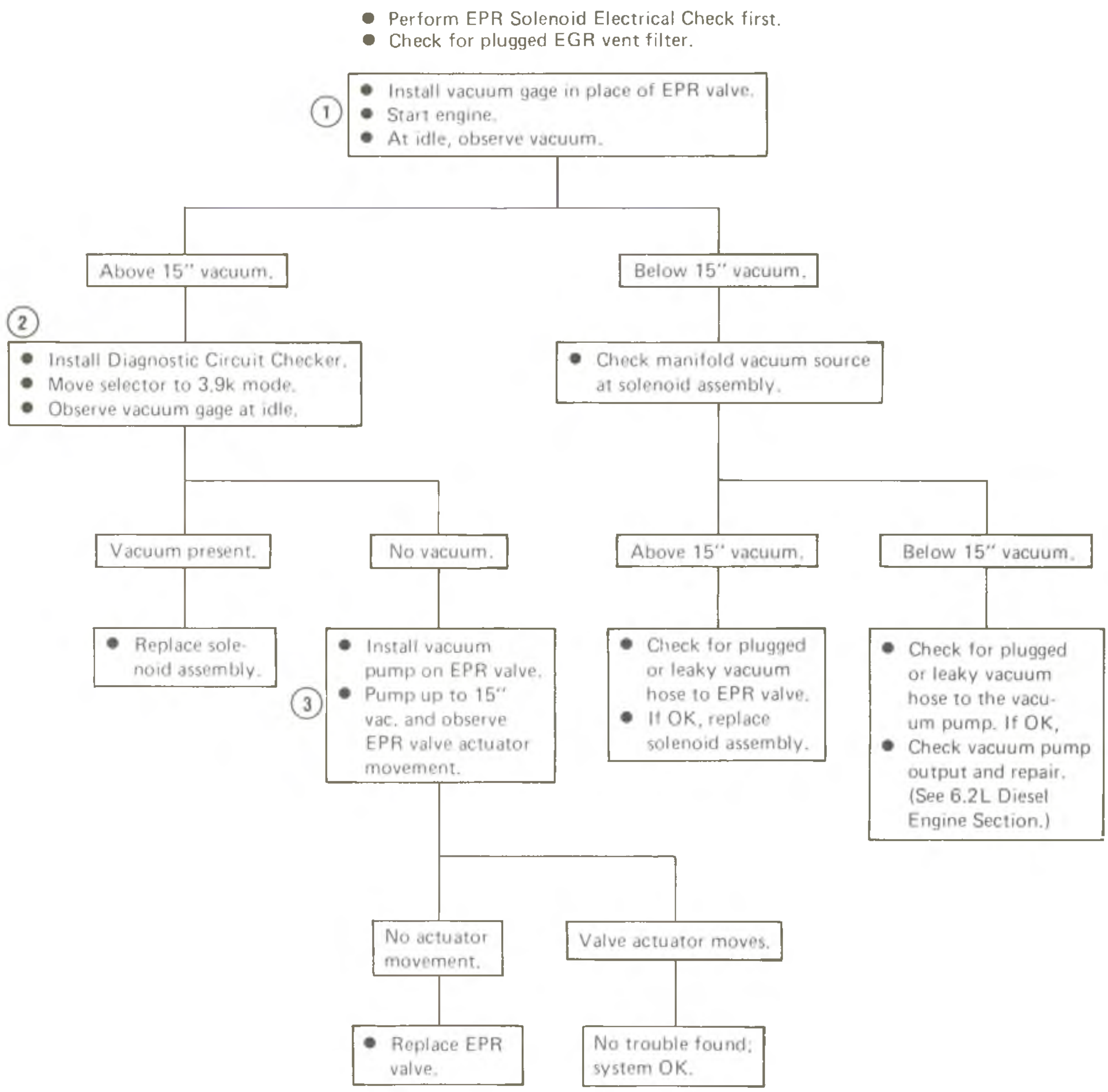


Figure 5-52, **EPR Vacuum Check (1984 & 1985).**

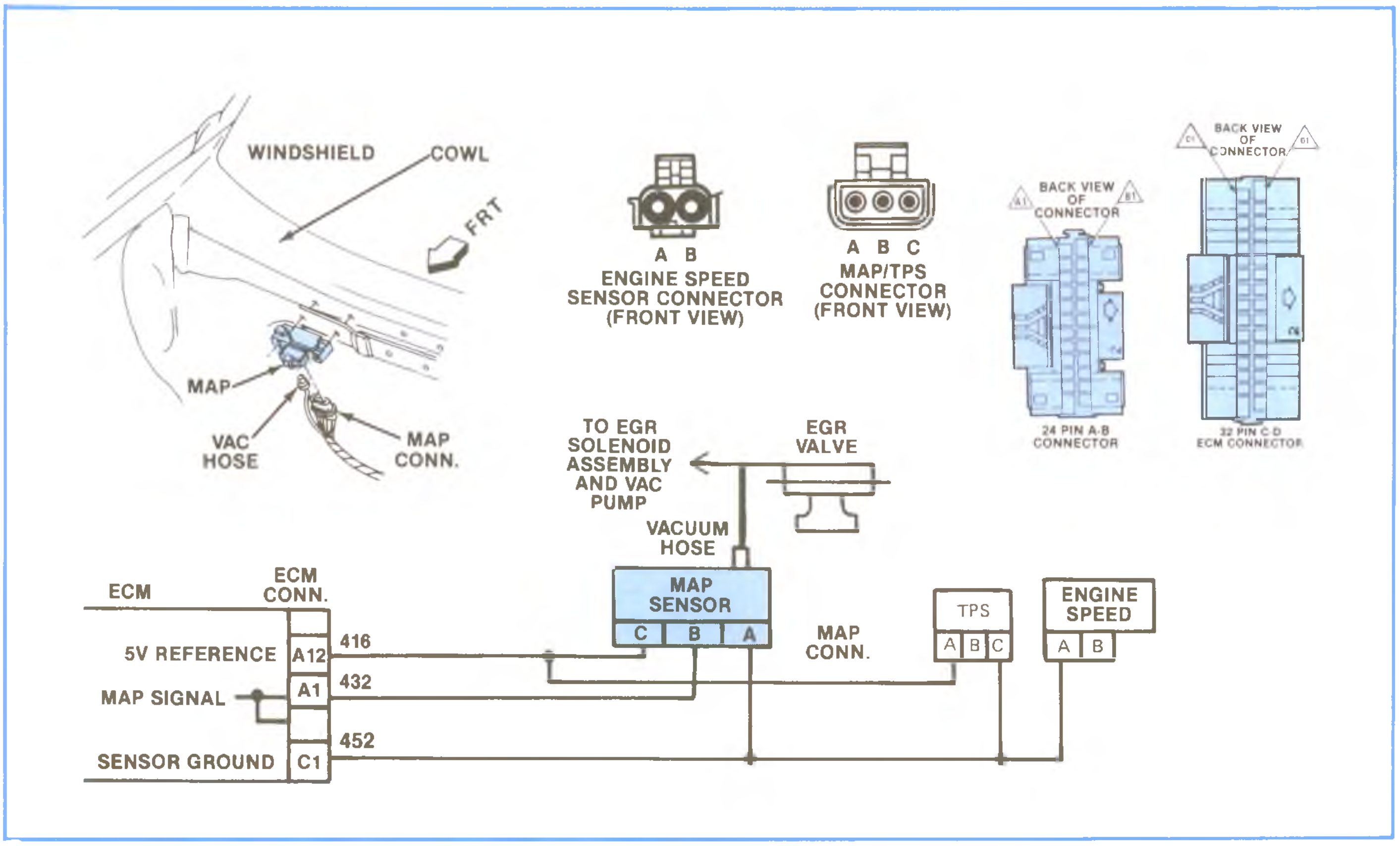


Figure 5-53, 1985 MAP Sensor Schematic.

1985 CODE 32 EGR LOOP ERROR

Malf Code 32 is detected when the engine is running and all of the following are true:

*1. If the difference between calibrated vacuum and actual vacuum is greater than 2 kPa.
2. If the calibrated vacuum is less than the EPR switch point (in ECM memory).
3. If the calibrated vacuum is greater than 25 kPa.
4. If Code 31 is not set.
5. If Code 33 is not set.
6. If Code 51 is not set.
7. If Code 52 is not set.
8. If Code 53 is not set.
9. If Code 54 is not set.
10. Ignition is on.
11. In normal mode of operation.
12. If all the above conditions have been present for a period of time greater than 10 seconds.

* = Major Condition.

CODE 32
EXHAUST GAS RECIRCULATION
(LOOP ERROR)
6.2L (LH6) DIESEL (CALIF)

- Ignition "OFF", clear codes.
- DDC tool connected and in "normal" mode.
- Start engine and run for 1 minute or until "Check Engine" light comes on.
- Position DDC tool in "Ground" mode.
- Note code.

Code 32

Any other code . . .
See applicable chart.

No code stored. Problem is intermittent.

Figure 5-53A, Code 32.

NOTES

Strain Gage MAP Sensor

The 6.2L DEC System uses a strain gage type MAP sensor. This sensor uses a silicone chip which is approximately 3 millimeters square. Along the outer edges, the chip is approximately 250 micrometers (1 micrometer = 1 millionth of a meter) thick but the center area is only 25 micrometers thick to form a diaphragm. The edge of the chip is sealed to a pyrex plate under vacuum thereby forming a vacuum chamber between the plate and the center area of the silicone chip.

A set of sensing resistors are formed around the edge of this chamber. The resistors are formed by diffusing a "doping impurity" into the silicon. External connections to these resistors are made through wires connected to the metal bonding pads.

This entire assembly is placed in a sealed housing which is connected to the vacuum system by a small diameter tube. Pressure applied to the diaphragm causes it to deflect. The resistance of the sensing resistors changes in proportion to the applied manifold pressure by a phenomenon which is known as piezo-resistivity. Piezo-resistivity occurs in certain semiconductors so that the actual resistivity (a property of the material) changes in proportion to the strain (fractional change in length).

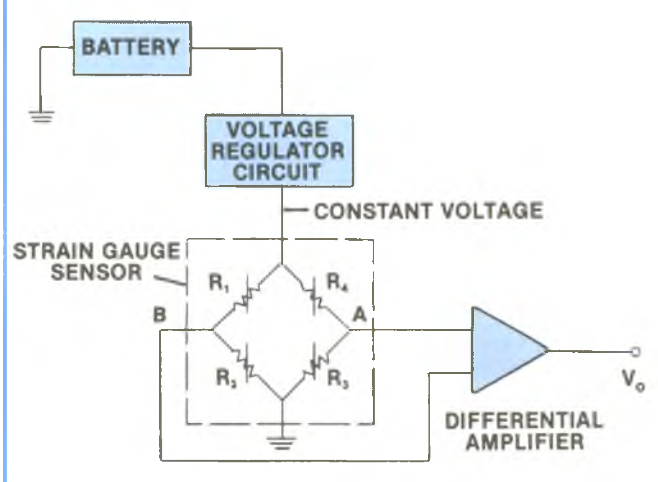


Figure 5-54A, Wheatstone Bridge Set-up.

An electrical signal which is proportional to the pressure is obtained by connecting the resistors in a circuit called a "Wheatstone bridge" as shown in the schematic diagram of Figure 5-54a. The voltage regulator holds a constant dc voltage across the bridge. The resistors diffused into the diaphragm are denoted R_1, R_2, R_3 and R_4 in Figure 5-54a. When there is no strain on the diaphragm, all four resistances are equal, the bridge is balanced, and the voltage between points A and B is zero. When manifold pressure changes, it causes these resistances to change in such a way that R_1 and R_3 increase by an amount which is proportional to pressure and, at the same time, R_2 and R_4 decrease by an identical amount. This unbalances the bridge and a net difference voltage is present between points A and B. The differential amplifier generates an output voltage proportional to the difference between the two input voltages.

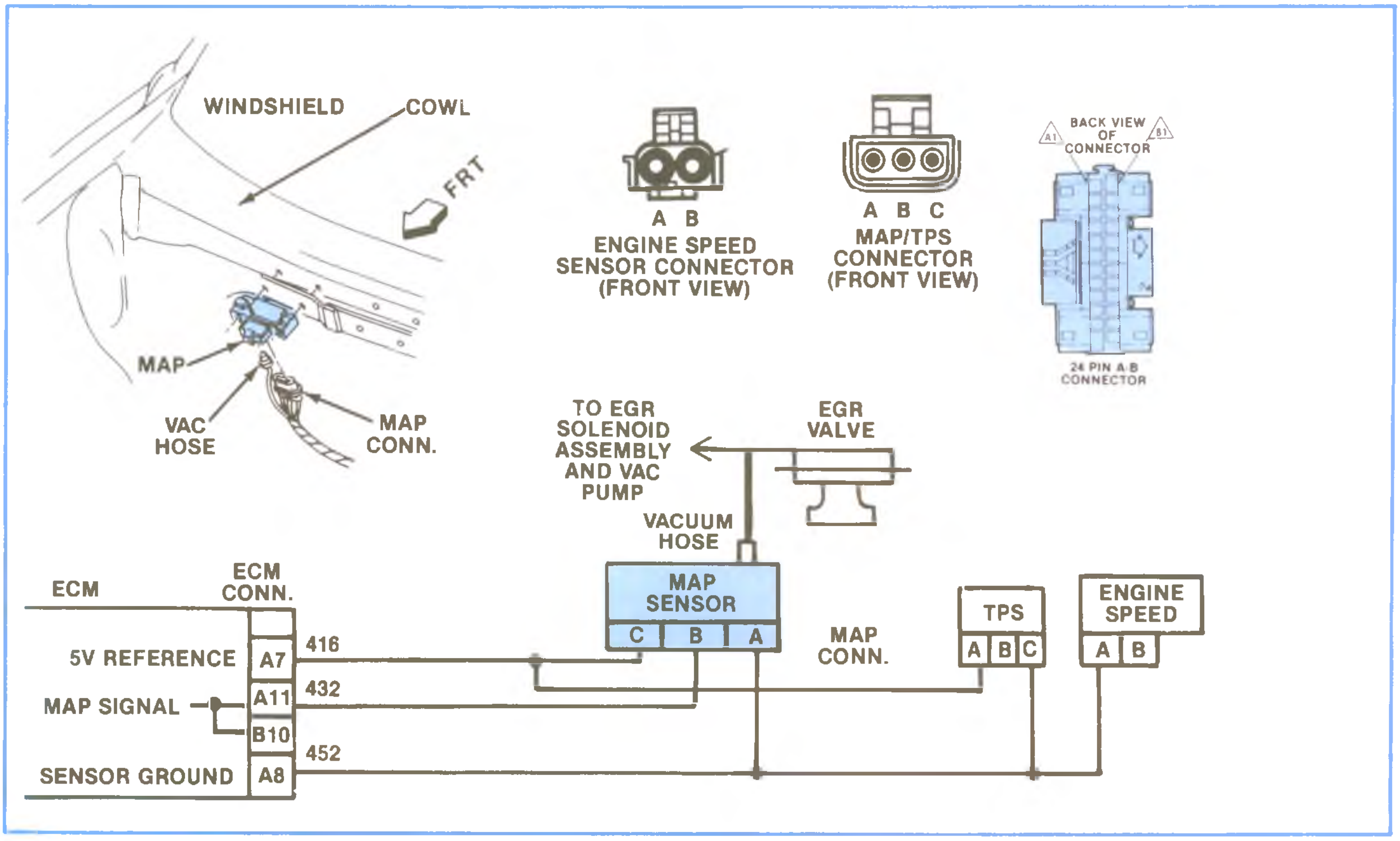


Figure 5-54, 1984 (Only) MAP Sensor Check Schematic.

MAP Sensor

A Manifold Absolute Pressure Sensor is used to monitor the amount of vacuum in the EGR circuit. It senses the actual vacuum in the EGR vacuum line and sends a signal back to the ECM. The signal is compared to the EGR duty cycle calculated by the ECM. If there is a difference in the ECM command and what is at the EGR valve sensed by the MAP, the ECM makes minor adjustments to connect.

The system can sense a high or low vacuum error, indicating a vacuum leak or faulty electrical component in the vacuum control system. Once a gross vacuum error is sensed, like a disconnected vacuum hose, the ECM de-energizes EGR solenoid. This causes full EGR and excessive smoking.

1984 MAP SENSOR CHECK

See Figure 5-54.

- Check for 5-volt reference signal to MAP Sensor. Normally, about 5 volts should be present with the key "ON" at Terminal "C".
- Check for a complete circuit from MAP sensor back through the sensor ground wire. As in Step 1, this should be about 5 volts.
- Check for normal response from the MAP to an external vacuum signal. There should be an immediate voltage as vacuum is applied.

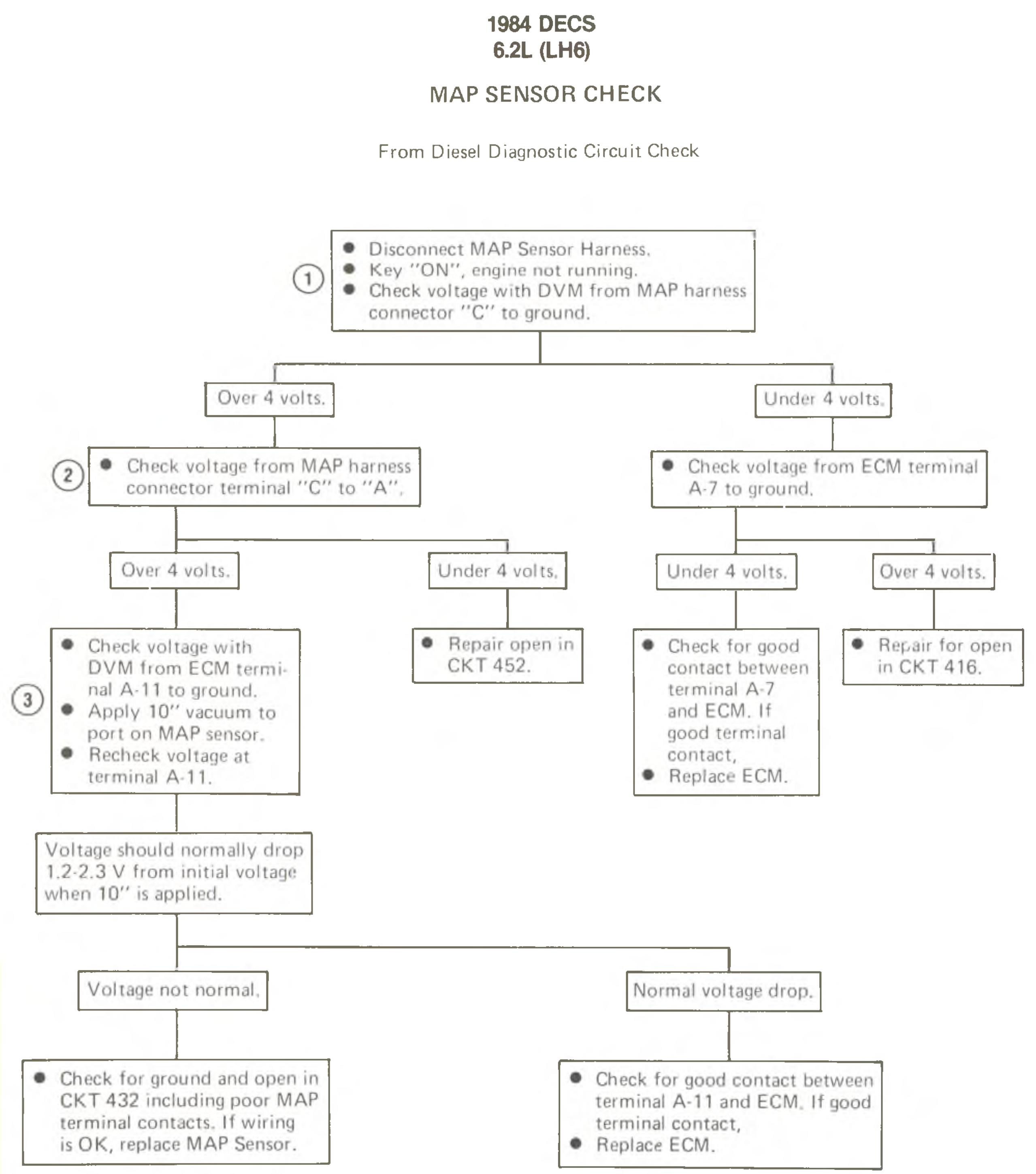


Figure 5-55, MAP Sensor Check.

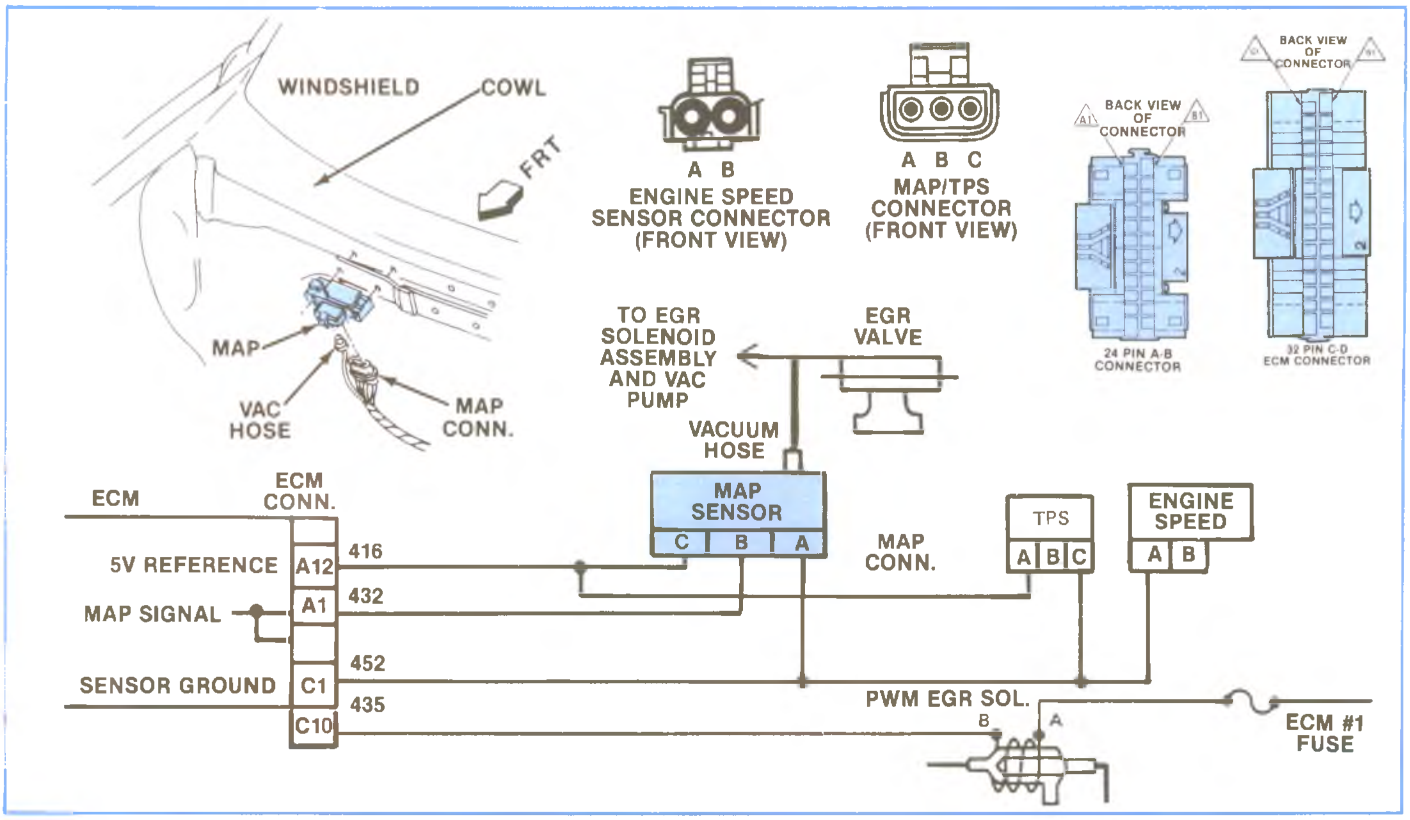


Figure 5-56, 1985 MAP Sensor Schematic (Code 31).

CODE 31 MAP SENSOR TOO LOW

Malf Code 31 is detected when the engine is running and all of the following are true:

*1. MAP voltage is less than ½ volt (voltage low = vacuum high).
2. If Code 51 is not set.
3. If Code 52 is not set.
4. If Code 53 is not set.
5. Ignition is on.
6. In normal mode of operation.
7. Conditions 1 thru 4 has to be present for a period of time greater than 10 seconds.

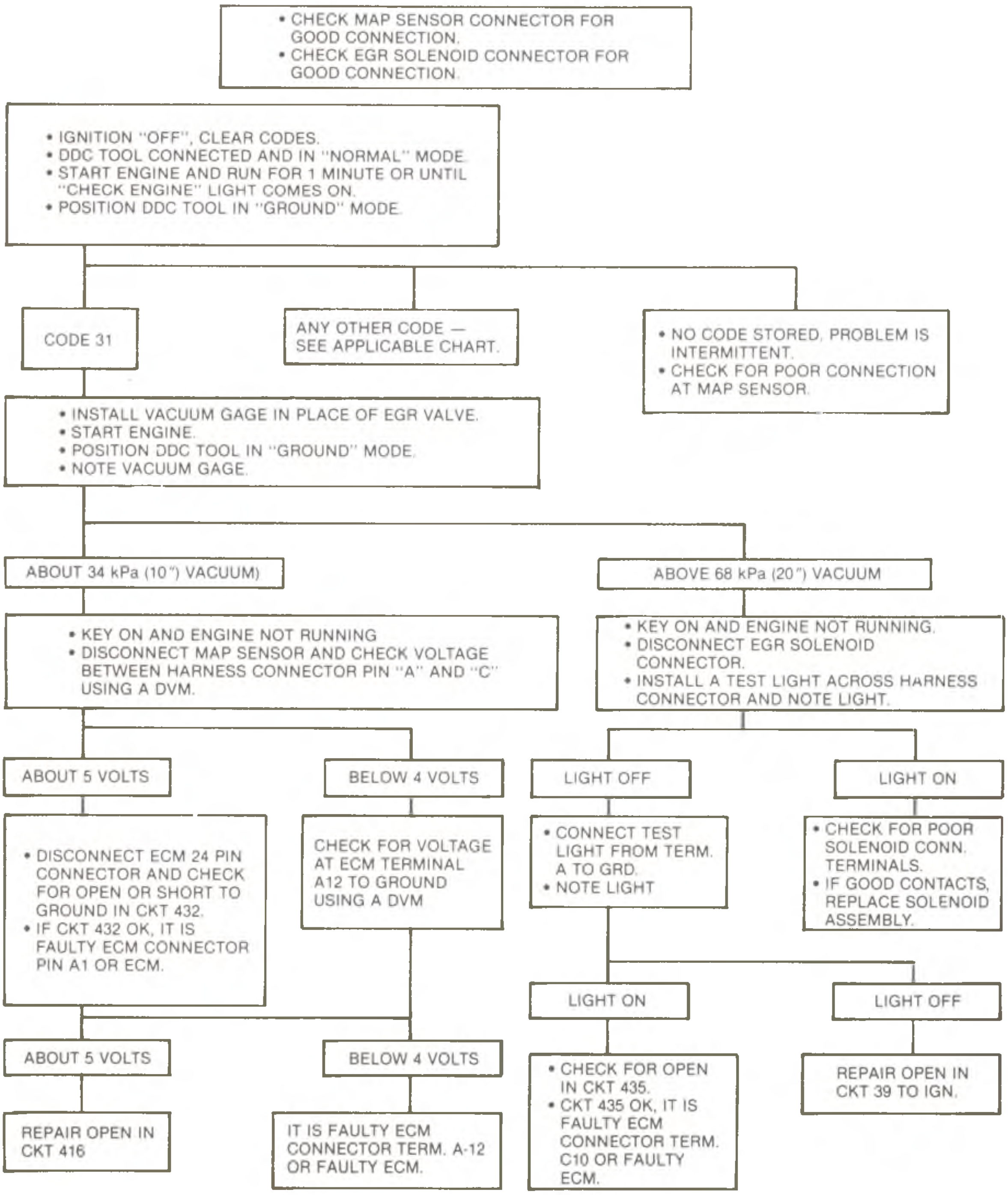
* = Major Condition.

The engine must run at idle for 10 seconds before code will set.

— NOTE —

If Code 31 is detected the EGR duty cycle should be assigned to 0% (off = full vacuum), the EPR value should be turned off and the dump solenoid should be turned off. Also the baro term should be forced to 100 kPa.

CODE 31
MAP SENSOR
(SIGNAL VOLTAGE TOO LOW)
6.2L (LH6) DIESEL (CALIF)



CLEAR CODES AND CONFIRM NO "CEL" WITH ENGINE RUNNING

Figure 5-57, Code 31.

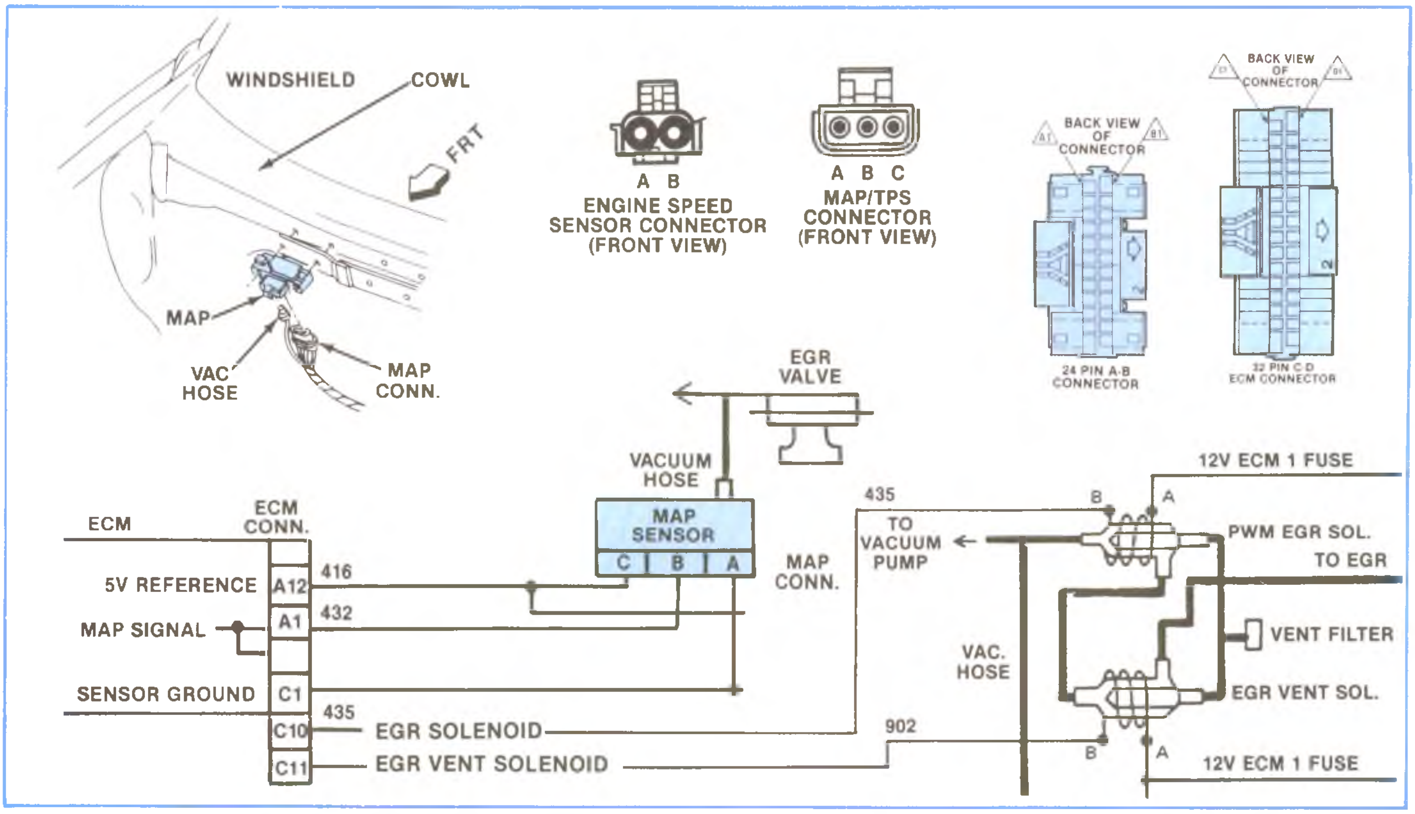


Figure 5-58, **MAP Sensor Schematic (Code 33).**

CODE 33 MAP SENSOR TOO HIGH

Malfunction Code 33 is detected when the engine is running (**REFPER** less than **KRUNPER**) and all of the following are true:

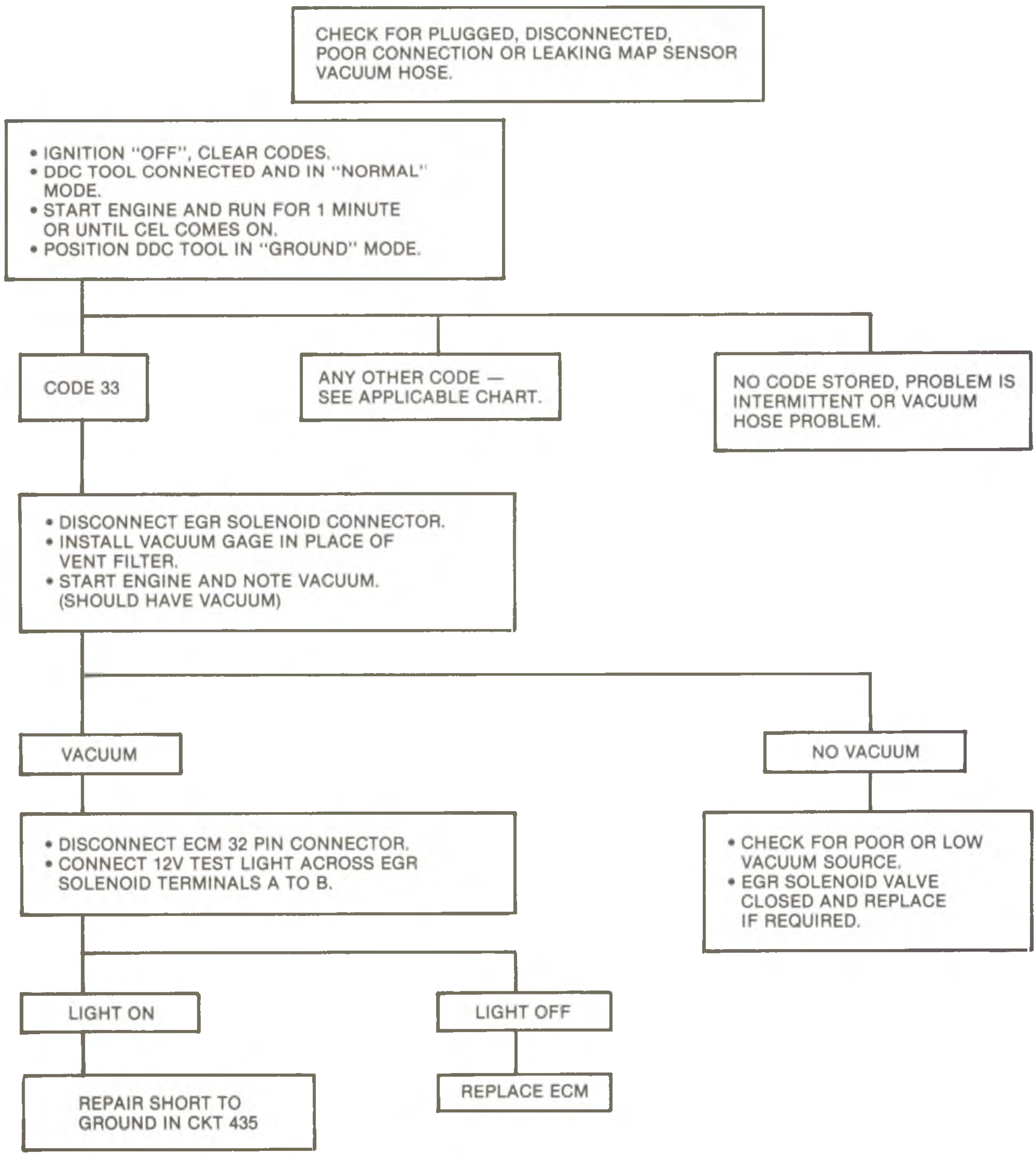
*1. If the actual vacuum is greater than EPR switch point.
2. If the calibrated vacuum is less than EPR switch point.
3. If Code 51 is not set.
4. If Code 52 is not set.
5. If Code 53 is not set.
6. If Code 54 is not set.
7. Ignition is on.
8. In normal mode of operation.
9. If all of the above conditions have been present for a period of time greater than 10 seconds.

* = Major Condition.

Pin/Condition	Pin Name	CEL/Code	Vacuum/Condition	Remarks
C10 GND	EGR solenoid	CEL - 33 after 10 sec.	No/to Full	Not throttle sensitive
MAP Vacuum off		10 sec. CEL - 33	½/Flutters	
MAP hose pinched		10 sec. CEL -33	Full	

NOTE: A grounded Pin C11 CKT902 EGR vent solenoid may set a Code 33.

CODE 33
MAP SENSOR
(SIGNAL VOLTAGE TOO HIGH)
6.2L (LH6) DIESEL (CALIF)



CLEAR CODES AND CONFIRM NO "CEL" WITH ENGINE RUNNING

Figure 5-58A, Code 33.

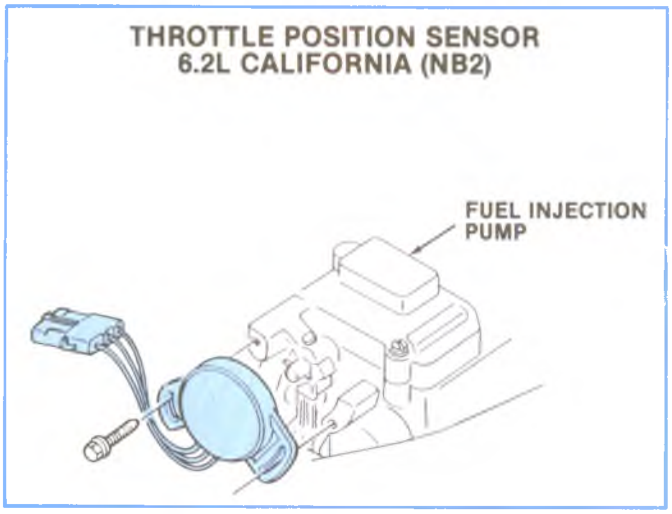


Figure 5-59, Throttle Position Sensor.

Throttle Position Sensor, TPS

A throttle position sensor is used to indicate throttle position, in calculating EGR pressure amount and T.C.C. engagement. (See Figure 5-60).

- The TPS is a 4000 to 6000 ohm (4k to 6k potentiometer) variable resistor. It signals the ECM, the degree of throttle opening.
- The TPS is connected to a 5-volt reference and has its highest resistance at closed throttle (idle). At wide open throttle (WOT), the resistance is lowest and the output will be near 5 volts.
- The TPS is ratio-metric which means it measures the quotient of two quantities. It operates by the balancing of electromagnetic forces which are a function of the moving element.

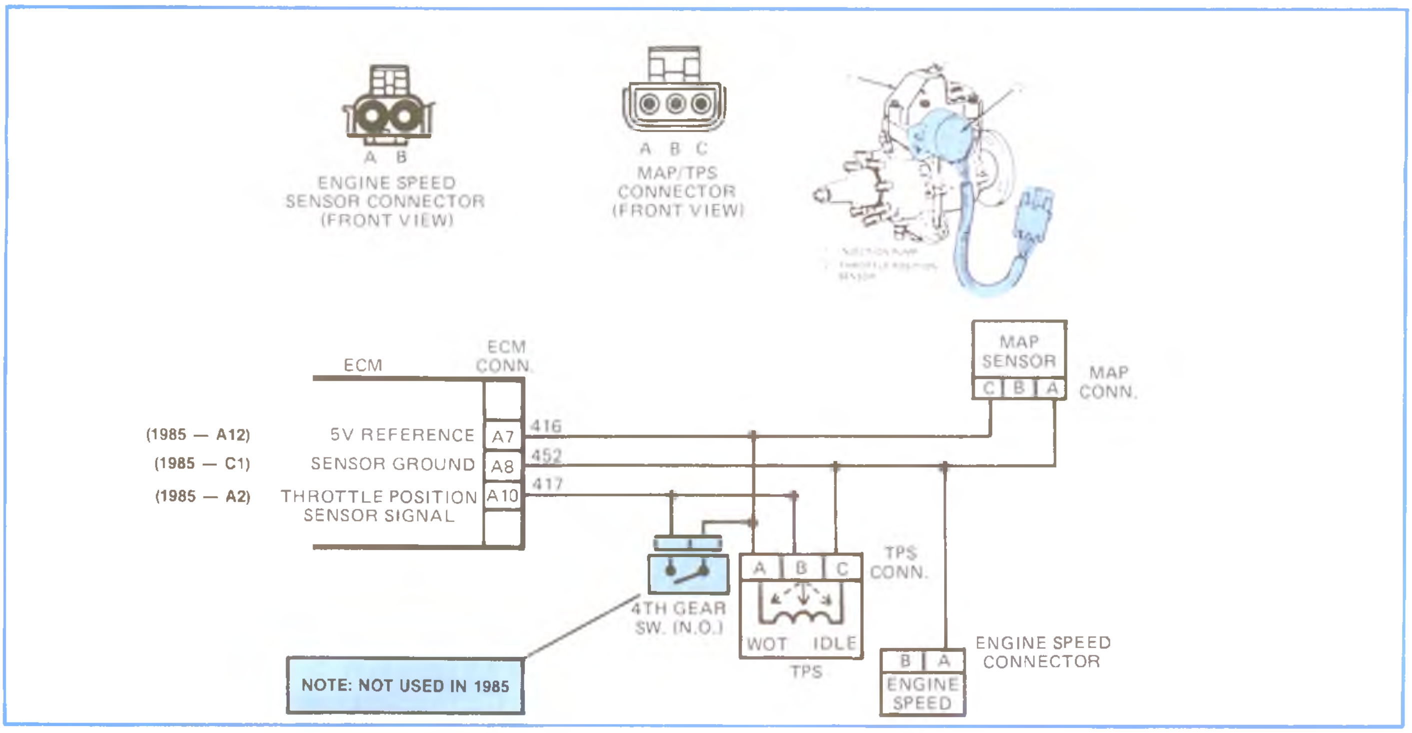


Figure 5-60, TPS Check (1984 & 1985).

1984 & 1985 TPS Check

See Figure 5-61:

- Check for complete 5-volt reference circuit. If the circuit is complete from V-ref and back to sensor ground in ECM, DVM will read about 5 volts.
- Check for a shorted or stuck 4th gear switch. When the transmission shifts to 4th gear, this switch will close and signal the ECM to turn "OFF" EGR. If the 4th gear switch is not faulty, there could be a short to V-ref or a faulty TPS adjustment or switch.
- Check for normal response at ECM from TPS. Voltage should be normally less than 1 volt at closed throttle and go to about 5 volts at WOT. If voltage change is OK, circuit is complete.

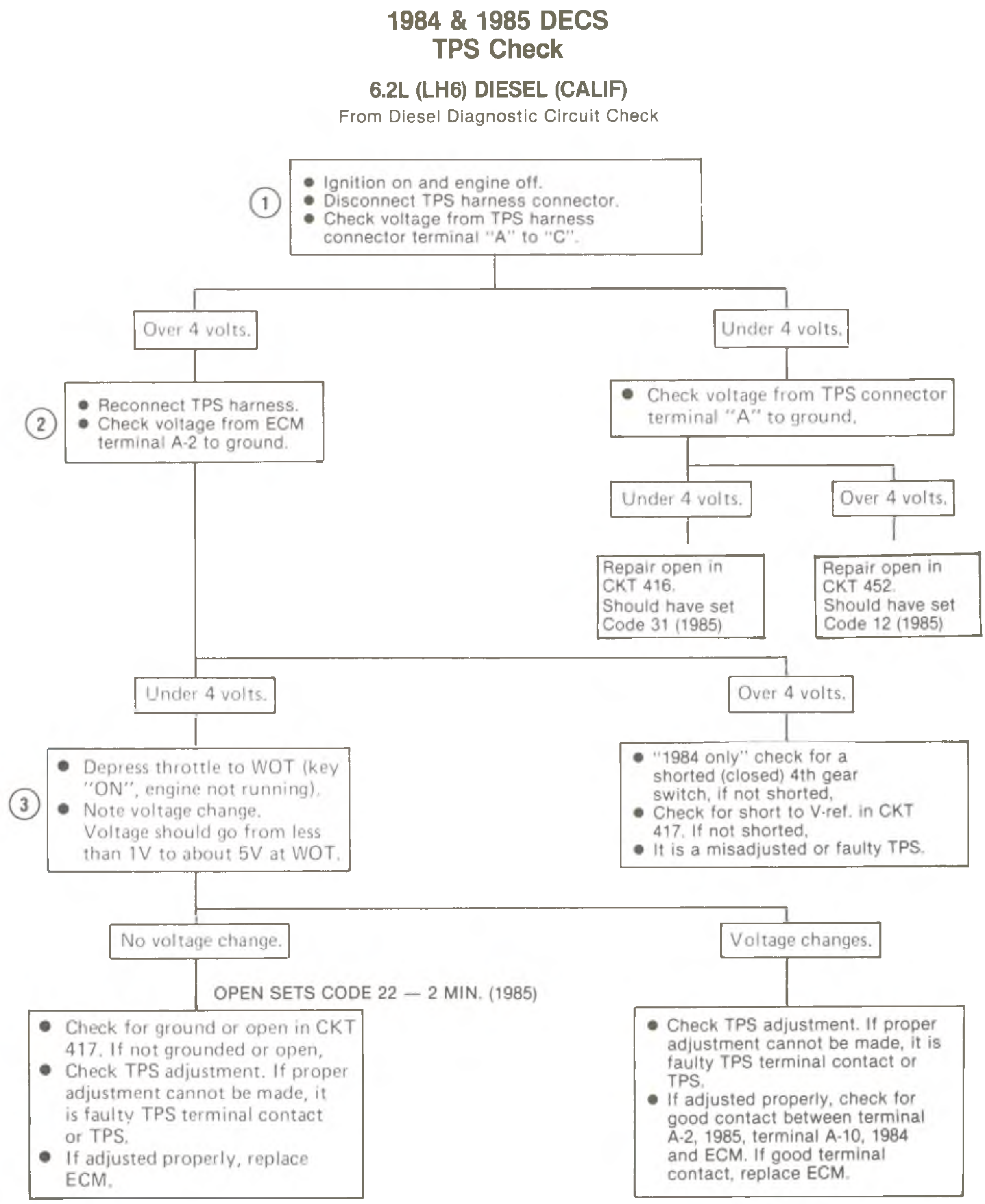


Figure 5-61, TPS Check, 1984-1985.

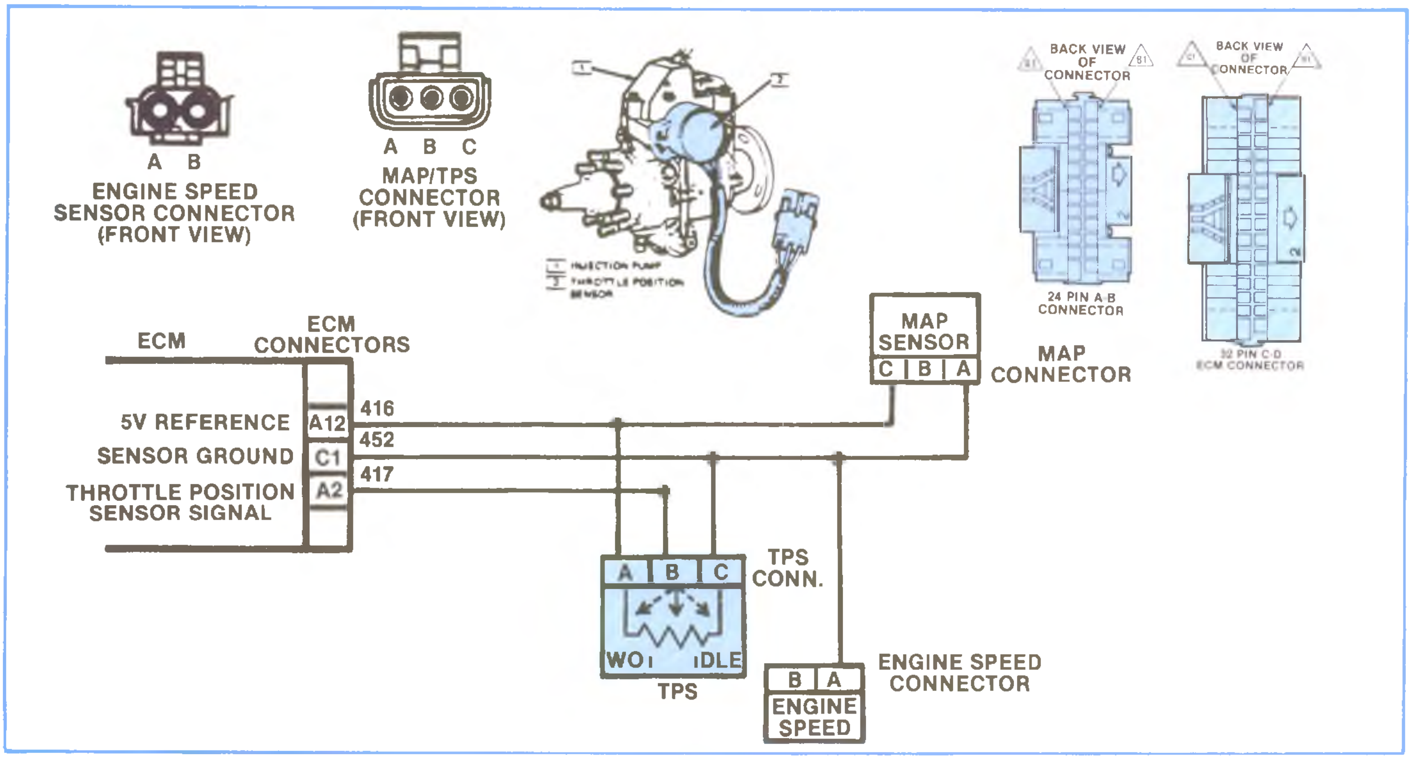


Figure 5-62, 1985 TPS Schematic.

TPS	Conn. off	No EGR, No EPR for 2 min.	After 2 min. CEL-22 code	Full/None	Vacuum
A2	OPN	TPS	Yes - 22	Full/off	Pull up resistor — 2 min. code

CODE 21 TPS TOO HIGH

Malf Code 22 is selected when the ECM detects an "engine running" condition (**REFPER** less than **KRUNPER**) and all of the following are true:

1. If the throttle angle is greater than 70%
2. Engine speed less than 1120 RPM
3. Vehicle speed greater than 0 mph
4. If Code 51 is not set
5. If Code 52 is not set
6. If Code 53 is not set
7. Conditions 1 thru 6 have been present for a period of time greater than 2 minutes.

— NOTE —

If Code 22 exists then the control algorithm is to use the throttle percent of 15 for all throttle variables. This can cause the controller to deliver full EGR. Also EPR is to be turned off.

HARDWARE

A pull-up resistor should be used on the TPS input so that an open sensor will be a Code 21.

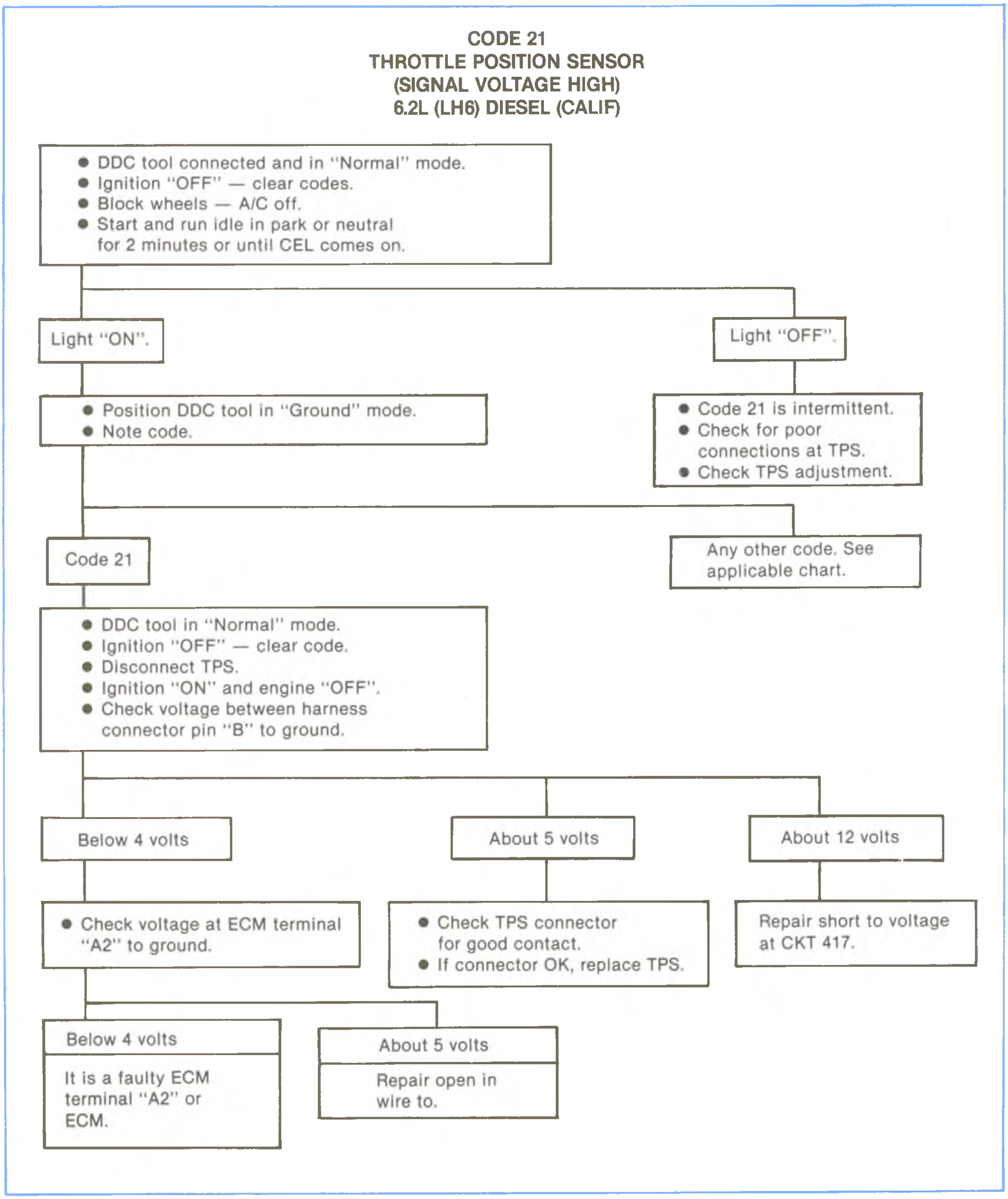


Figure 5-62A, Code 21.

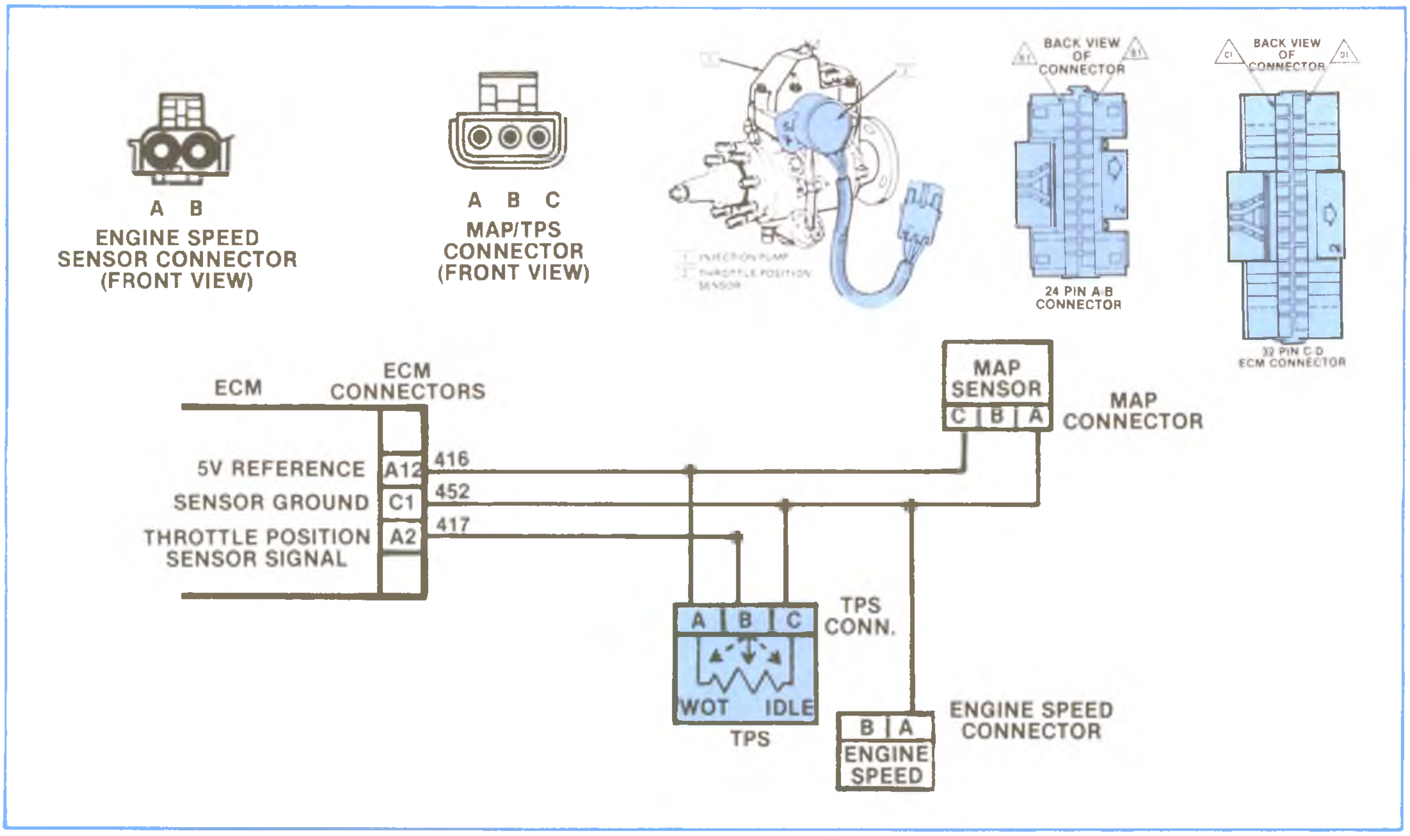


Figure 5-63, **1985 TPS Schematic.**

CODE 22 TPS TOO LOW

Malf Code 21 is detected when the engine is running at 375 RPM or more, and all of the below conditions are met:

1. The throttle angle is less than 40%.
2. Engine speed greater than 1250 RPM
3. If Code 51 is not set
4. If Code 52 is not set
5. If Code 53 is not set
6. Conditions 1 thru 5 have existed for greater than **KKTAT21** time

If Code 22 exists then EPR is to be turned off.

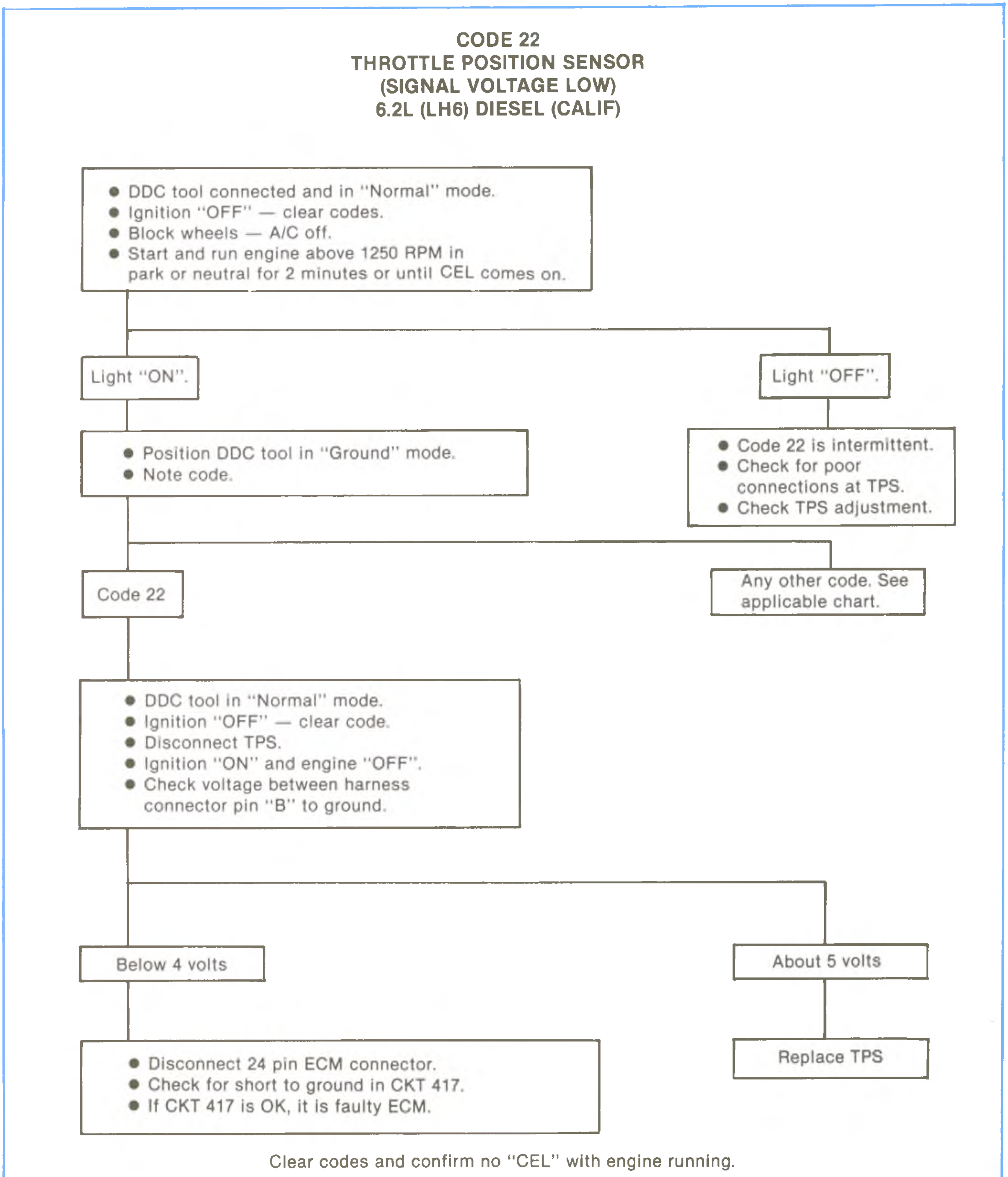


Figure 5-63A, Code 22.

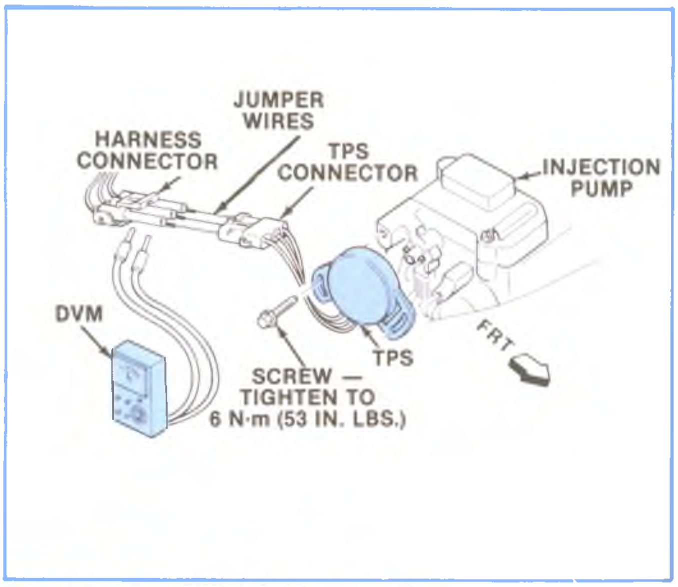


Figure 5-64, **TPS Adjustment.**

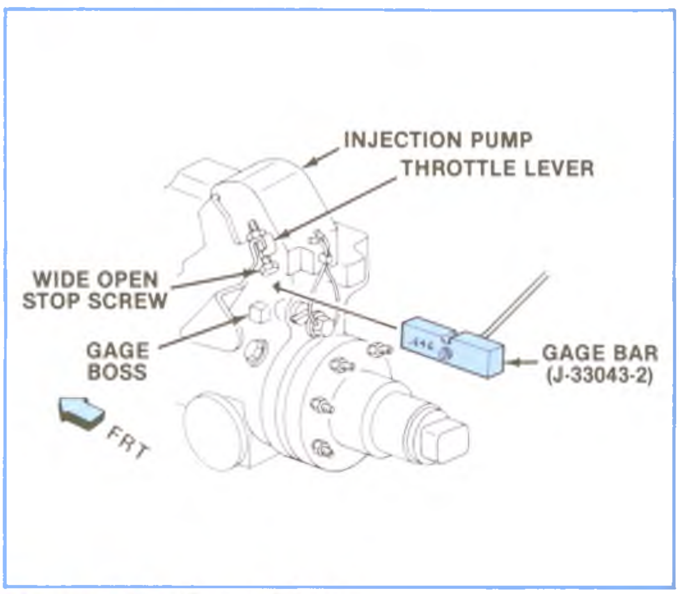


Figure 5-65, **Gage Block.**

Throttle Position Sensor, TPS Adjustment

1. Remove Air Cleaner Assembly and related hoses.
2. Disconnect TPS connector. Install jumper wires between TPS and harness. Jumpers can be made using terminals P/N 12014836 and 12014837. Three jumpers or their equivalent will be necessary (Figure 5-67).
3. Key "ON", engine not running.
4. Install TPS/VRV gage block to J-33043-2 or equivalent using the .646 side of the block. Position tool between gage boss on injection pump and the wide open stop screw on throttle shaft (Figure 5-68).
5. Rotate the throttle lever and hold the wide open stop screw against the gage block.
6. Using a DVM J-29124 or equivalent, measure voltage from TPS connector terminals "A" to "C". This is V-ref. Record the voltage reading (Figure 5-66).
7. Now measure and record voltage between terminals "B" to "C". This is the TPS voltage (Figure 5-66).
8. Compare the voltage recorded in Step 7 under the corresponding V-ref. recorded in Step 6 against the data in TPS table (Figure 5-66).

   The TPS voltage should be within ±1% of voltage shown. Example: A V-reference of 4.6 — the TPS voltage may be 2.87 to 2.93 volts and be within tolerance.
9. If no adjustment is necessary, proceed to Step 12.
10. To adjust TPS, loosen the two attaching screws and rotate TPS until the correct TPS voltage is obtained as per TPS Table (Figure 5-66).
11. When the correct TPS value is obtained, tighten the TPS attaching screws to 6 N·m (53 in. lbs.).
12. Check TPS voltage by releasing the throttle lever allowing it to return to the idle stop position measuring voltage from terminals "B" to "C".

Return lever against gage block. Voltage should be about 1 volt at closed throttle and return to TPS voltage within ±1% of the adjusted voltage when throttle is again opened against gage block. If voltage does not return to TPS voltage, repeat Steps 10, 11 and 12. If at closed throttle, voltage is not less than 1 volt or adjustment cannot be made, replace TPS.

V-REFERENCE →	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5
TPS VOLTAGE → (with gage tool installed)	2.84	2.90	2.96	3.02	3.09	3.15	3.21	3.28	3.34	3.40	3.47

Figure 5-66, **TPS Voltage Table.**

13. Remove gage block tool.
14. Turn ignition "OFF".
15. Remove jumper wires and reconnect TPS harness connector.
16. Reinstall Air Cleaner Assembly and related hoses.

• REMOVE OR DISCONNECT

1. Air cleaner and related hoses.
2. TPS connector.
3. TPS attaching screws.
4. TPS

• CONNECT OR INSTALL

1. TPS and attaching screws.
2. Adjust TPS voltage following procedure above.
3. TPS connector.
4. Air cleaner and related hoses.

MAP SENSOR

Refer diagnosis that checks MAP sensor circuit and replace sensor as required.

EGR/EGR SOLENOID ASSEMBLY

The EGR solenoid, EGR vent solenoid and EPR solenoid are replaced as an assembly. The vent filter can be replaced as required. If diagnosis has determined that any solenoid does not operate, replace with complete assembly.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sensor, MAP	3.682
Sensor, Throttle Position	3.440
Sensor, Vehicle Speed	3.682

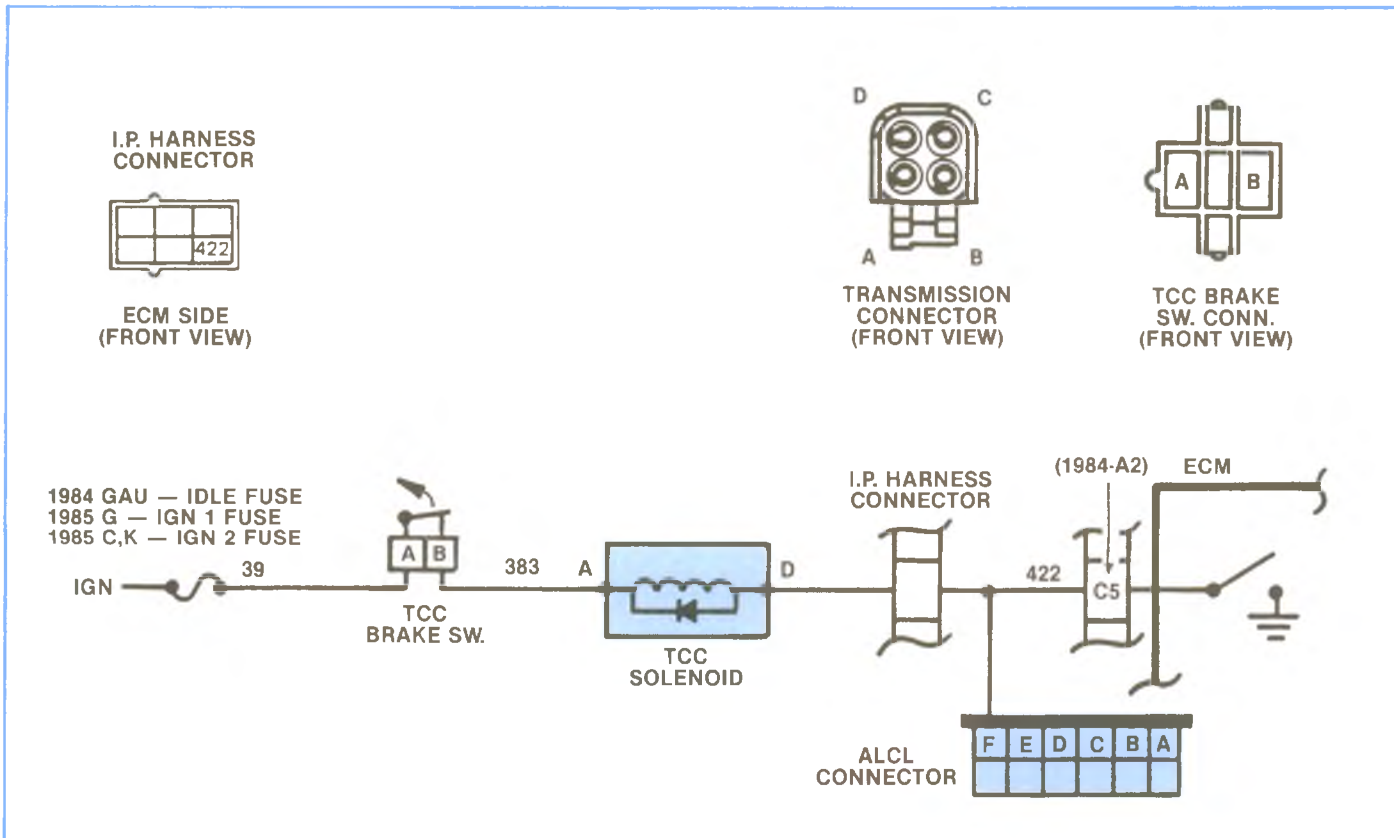


Figure 5-67, Torque Converter Clutch, TCC Circuit.

Torque Converter Clutch Control

The purpose of the automatic transmission torque converter clutch feature is to eliminate the power loss of the torque converter stage when the vehicle is in a cruise condition (Figure 5-67). This allows the convenience of the automatic transmission and the fuel economy of a manual transmission. The heart of the system is a solenoid located inside the automatic transmission which is controlled by the ECM.

The solenoid is configured mechanically such that when the coil is activated (ON) the torque convertor clutch is applied which results in straight through mechanical coupling from the engine to transmission output.

Ignition power feed to the solenoid passes through a brake switch which opens when the brake is applied. The ECM completes the ground to activate the TCC solenoid for clutch engagement.

The ECM completes the circuit whenever the TPS exceeds a calibrated valve for throttle opening.

When the transmission solenoid is de-activated, the torque converter clutch is released which allows the torque converter to operate in the conventional manner (fluidic coupling between engine and transmission).

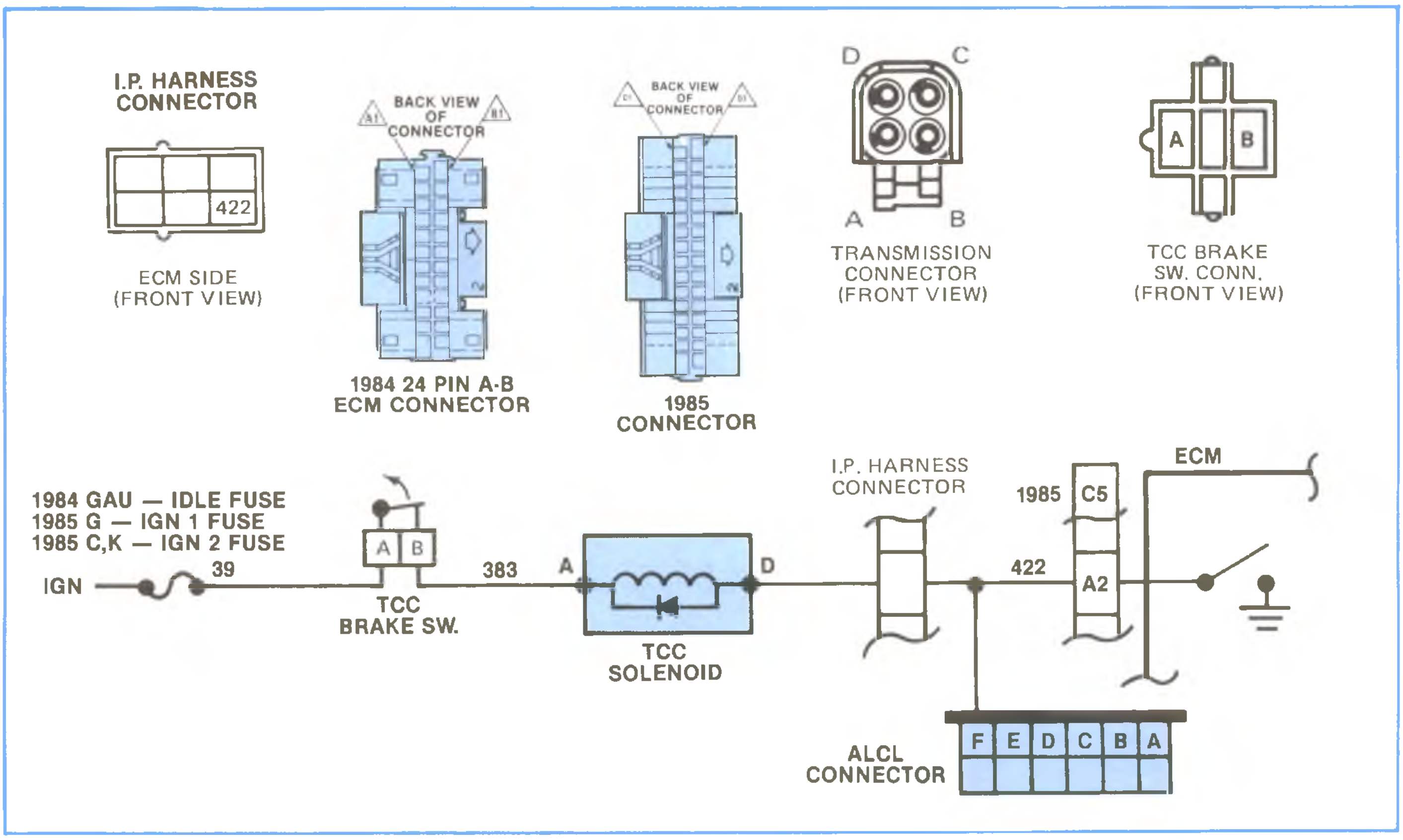


Figure 5-68, 1984 and 1985 TCC Check.

1984 AND 1985 TCC CHECK

The ECM completes the circuit whenever the TPS exceeds a calibrated valve for throttle opening. (See Figure 5-68).

- Checks for complete circuit from ignition through solenoid up to test point. Test light should be "ON" normally since ECM has not completed circuit yet.
- Checks for ECM to complete circuit to ground to energize TCC solenoid and engage TCC. Test light should normally go out when ECM completes circuit.
- Checks for TPS signal. If signal to ECM is correct, fault is in ECM connection or ECM. If TPS signal to ECM is incorrect (voltage) proper operation will not occur.
- Checks for ground in circuit to ECM Terminal A-2. Normally, light should be "OFF".
- Checks for ignition voltage to Terminal "A" of TCC connection. Light should normally be "ON".
- Checks for complete circuit from ignition to ground via TCC test terminal in ALCL. Normally, light should go "ON" if harness is good.

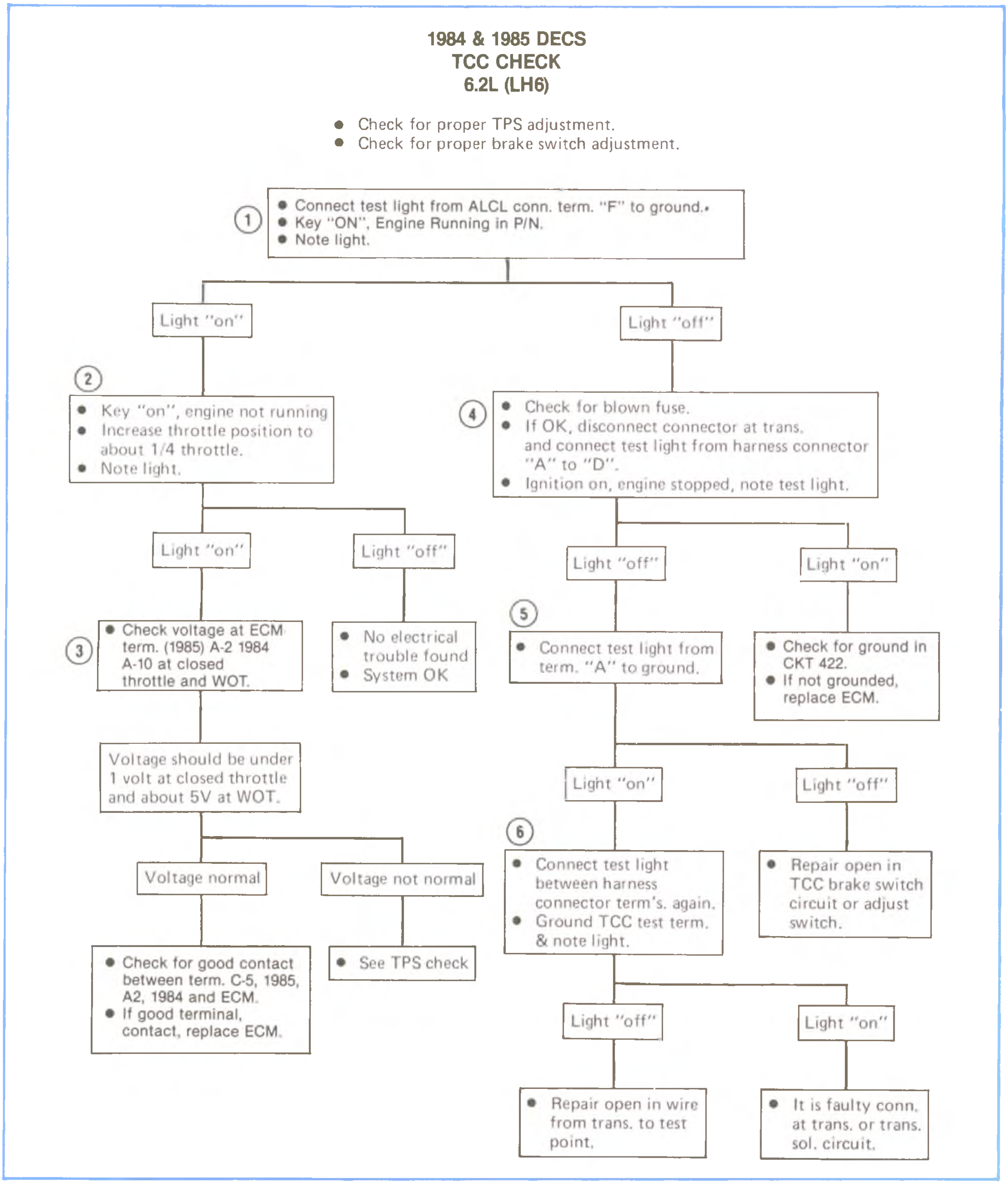


Figure 5-69, TCC Check (1984 & 1985).

TCC SOLENOID OPERATION

The TCC solenoid is actuated (clutch applied) by up to two separate control devices in series. These devices consist of:

- Vehicle brake switch.
- Electronic driver in ECM.

TCC OPERATION MODES

1. **RESET.** When the ECM is reset, the ECM shall activate the TCC solenoid driver clutch ON.
2. **ALCL 1 MODE OR ALCL 2 MODE/ENGINE NOT RUNNING.** The ECM driver is de-activated (clutch OFF) if either ALCL Mode is selected and the engine not running.
3. **ALCL 1 MODE/ENGINE AT IDLE-ALCL LEAD GROUNDED WITH 10K OHMS.** The ECM driver is activated (clutch ON) if the ALCL 1 Mode is selected and the engine is at idle.
4. **ALCL 2 MODE/ENGINE AT IDLE-ALCL LEAD GROUNDED WITH 3.9K OHMS.** The ECM driver is de-activated (clutch OFF) if the ALCL 2 Mode is selected and the engine is at idle.
5. **DIAGNOSTIC MODE — ALCL LEAD GROUNDED.** The ECM driver is activated (clutch ON) whenever the Diagnostic Mode is selected.

TORQUE CONVERTER CLUTCH CONTROL

Provided the ECM is not in any of the 5 special ALCL cases, the TCC control is determined by TCC control ECM programming.

If the solenoid driver is not activated (TCC released), the ECM will control the solenoid driver to activate the TCC solenoid (clutch ON) when the throttle position is at position greater than the minimum throttle position for clutch engagement (12 degrees ±2 degrees).

If the solenoid driver is activated (TCC ON), the ECM will control the solenoid driver to de-activate the TCC solenoid (clutch released) when the throttle position is less than the maximum throttle position for clutch release. However, the solenoid will remain activated as long as the throttle position remains greater than, or equal to, the **"Maximum Throttle Position for Clutch Release".**

VEHICLE SPEED SENSOR, VSS

In 1985 a vehicle speed sensor (VSS) is used, so the operation of TCC changes slightly with vehicle speed. If the vehicle speed is below the calibration value, the TCC operates as previously described.

If vehicle speed is above this value, the apply and release is also the same as described with one exception. The release of the TCC will be delayed by 3 seconds. Re-apply will occur as soon as throttle position requirements are met.

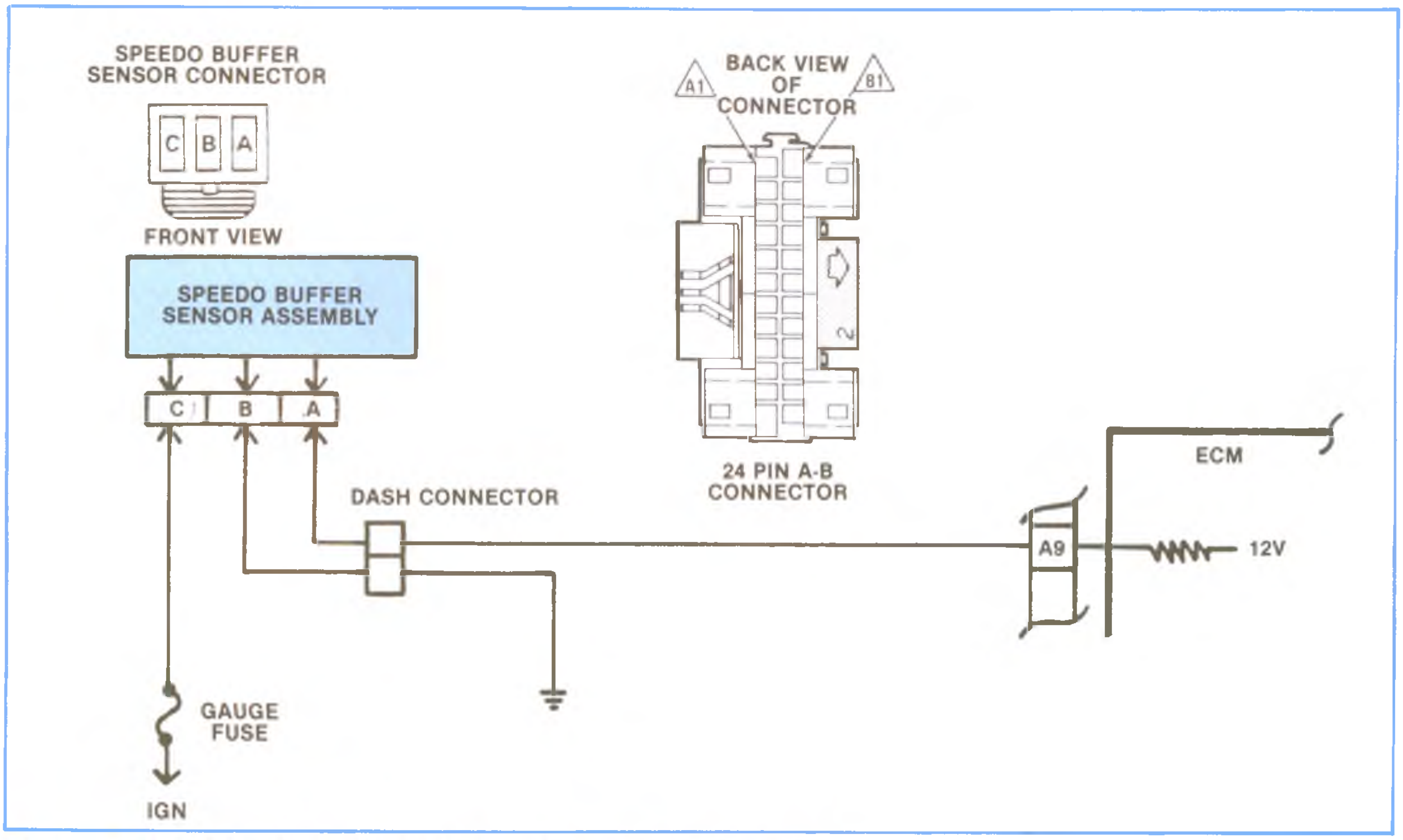


Figure 5-70, VSS Wiring Diagram — Code 24 (1985 only).

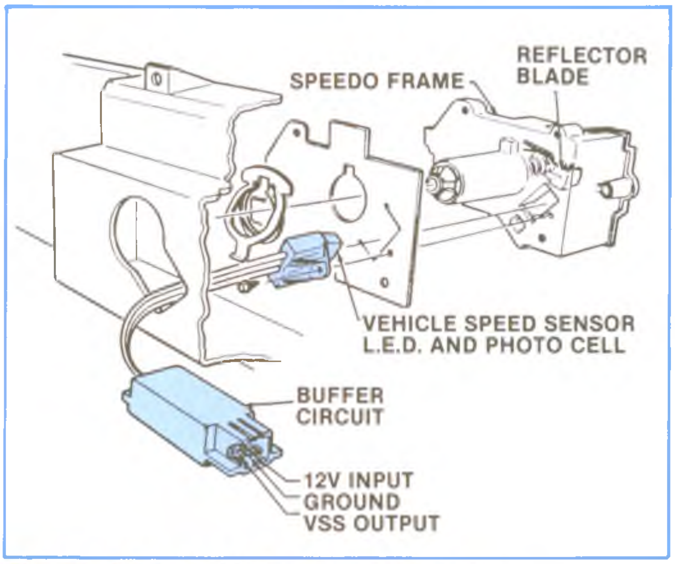


Figure 5-71, Vehicle Speed Sensor.

The speed of the vehicle is sensed by the speed sensor. The speed sensor consists of a light emitting diode and a phototransistor both of which are enclosed in one connector. This connector is located in the back of the speedometer cluster next to the speedometer cable. A wiring harness connects the sensor to the ECM (Figure 5-70).

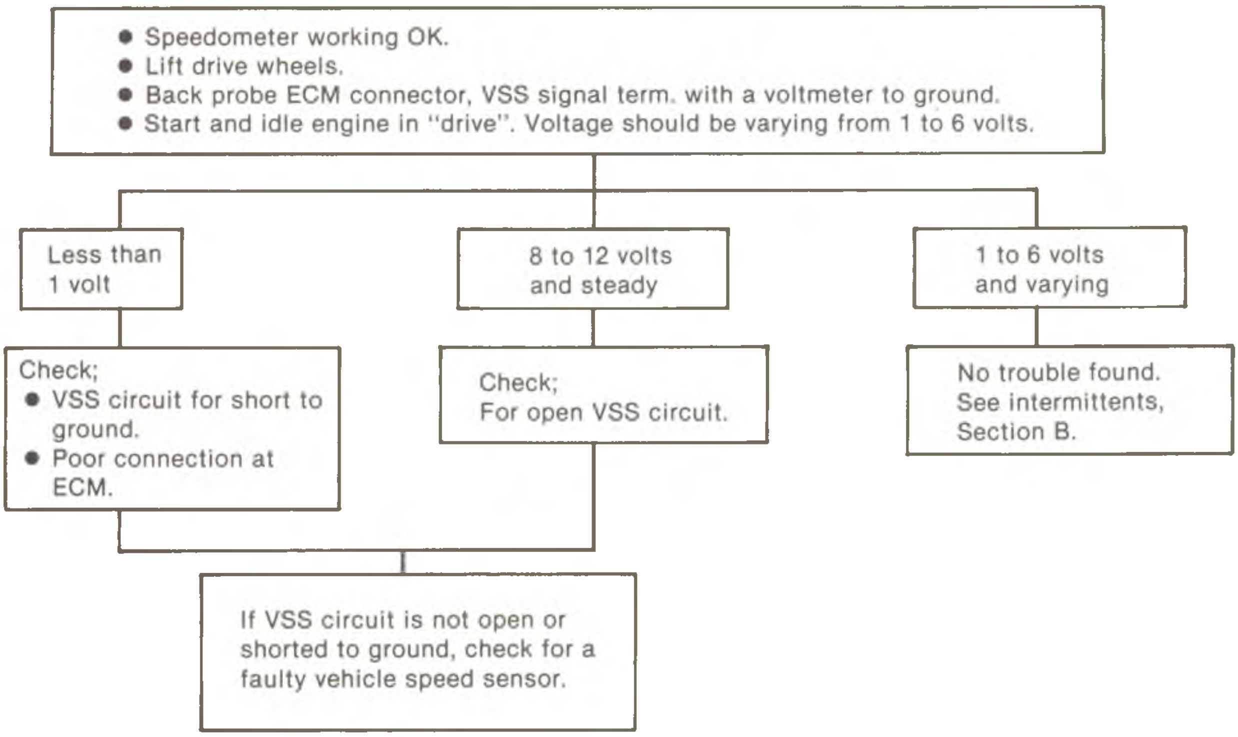
The light emitting diode is lit any time the ignition is turned on. The light given off is in the infrared area of the light spectrum and is not visible to the human eye. The diode directs its light toward the back of the speedometer cup which is painted black, and the shiny drive magnet which is part of the speedometer rotating parts.

As each bar of the drive magnet passes the light beam of the diode, the light beam is reflected back to the photo transistor. The photo transistor generates an electrical signal to the ECM. This signal is representative of vehicle speed.

See Figure 5-71. The speed sensor is supplied with 12 volts. When a voltmeter is hooked from terminal A9 of the ECM to ground and the speedometer cable turned, the voltage will swing between 8 volts and something under 1 volt rather than going up to 12 volts.

DRIVEABILITY AND EMISSIONS — DECS
CODE 24
VEHICLE SPEED SENSOR (VSS)

NOTICE; TO PREVENT MISDIAGNOSIS, THE TECHNICIAN SHOULD REVIEW ELECTRICAL SECTION 8A OR THE ELECTRICAL TROUBLESHOOTING MANUAL AND IDENTIFY THE TYPE OF VEHICLE SPEED SENSOR USED PRIOR TO USING THIS CHART. DISREGARD CODE 24 SET WHEN DRIVE WHEELS ARE NOT TURNING.



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "CHECK ENGINE" LIGHT.

Figure 5-72, **Code 24.**

CODE 24 VEHICLE SPEED SENSOR

Malf Code 24 is detected when the engine is running at 375 RPM or more, and all of the following are true:

1. The vehicle speed is less than 5 mph.
2. The engine speed is above 2000 RPM.
3. The throttle angle is greater than 60%.
4. If Code 51 is not set.
5. Ignition is on.
6. Conditions 1, 2, and 3 have been present for a period of time greater than 10 seconds.

— NOTE —

This code could be tricked on a "K" truck by putting the transfer case in neutral and running a load with the PTO pad.

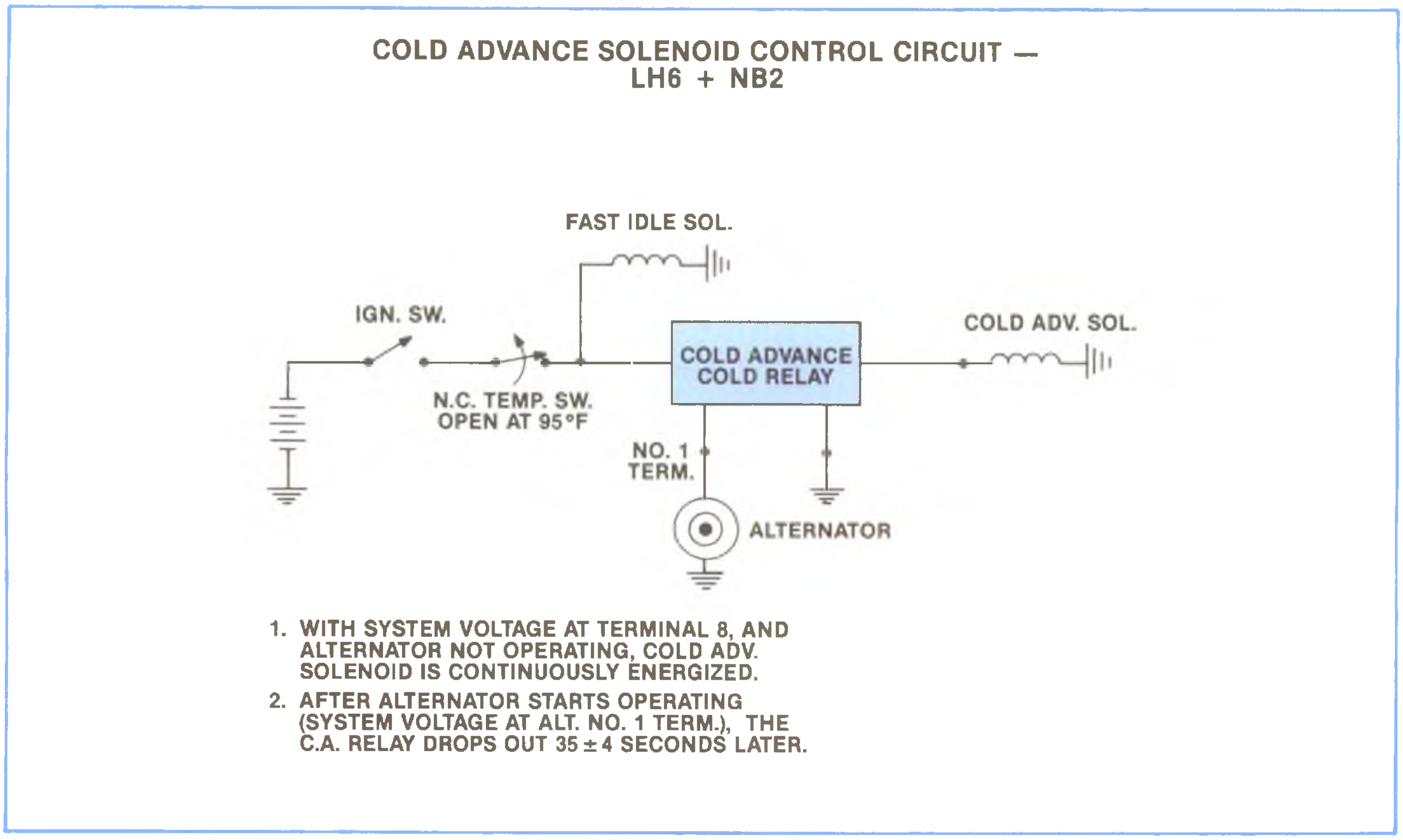


Figure 5-73, **Cold Advance Solenoid Control Circuit.**

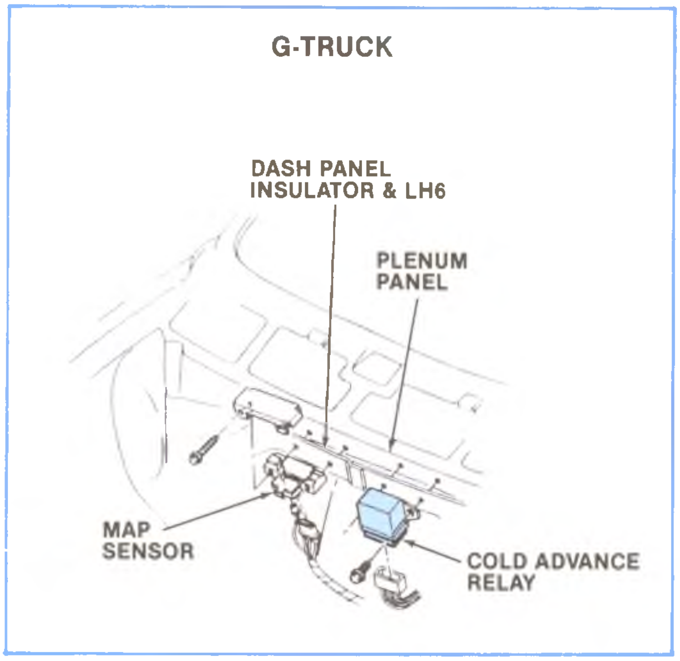


Figure 5-74.

Cold Advance Circuit, CAC

The 1984 California LH6 6.2 Diesel uses a cold advance circuit (CAC) to terminate housing pressure cold advance (H.P.C.A.) before the temperature switch does (Figures 5-73 and 5-74). It uses a cold advance control relay, which is activated by generator output.

CAC OPERATION

When the generator is not operating, and the voltage at relay terminal 8 is system voltage, the H.P.C.A. is energized.

The generator starts charging and system voltage (12-14 volts) appears at generator Terminal 1. In 35 ± 4 seconds the CAC relay will disengage the H.P.C.A.

1984-85 DECS
6.2L (LH6) CALIFORNIA ONLY
COLD ADVANCE CONTROL (CAC) CHECK

Check for blown fuse, repair for short if blown.
Engine coolant temperature below 95°F.

- Key "ON", engine not running.
- Connect test light from Cold Advance Solenoid conn. to ground. (leave harness connected to solenoid).
- Note light.

Light "ON"

- Start engine.
- Light should remain "ON" for approx. 35 sec. then go "OFF" with a drop in engine RPM.

OK

No trouble found.

Not OK

Light goes "OFF". No drop in RPM.

- It is faulty CAC solenoid.

Light remains "ON" or not "ON" for 35 sec.

- Remove CAC relay conn.
- Connect test light across Terms. "A and G".
- Start engine and note light.

Light "OFF"

- Check for open to ground in CKT 150 or open to generator in CKT 25. (CKT 25 will have system voltage only while generator is operating).

Light "ON"

- It is faulty relay connections or relay.

Light "OFF"

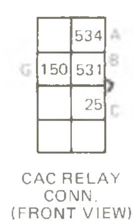
- Remove and jumper Cold Advance Coolant temperature switch connector.
- Note test light at relay Terminal "A".

Light "OFF"

- Repair open in CKT 39 to ign. or CKT 534 to CAC relay.

Light "ON"

- It is a faulty temperature switch connection or temperature switch. (Switch should be closed below 95°F).



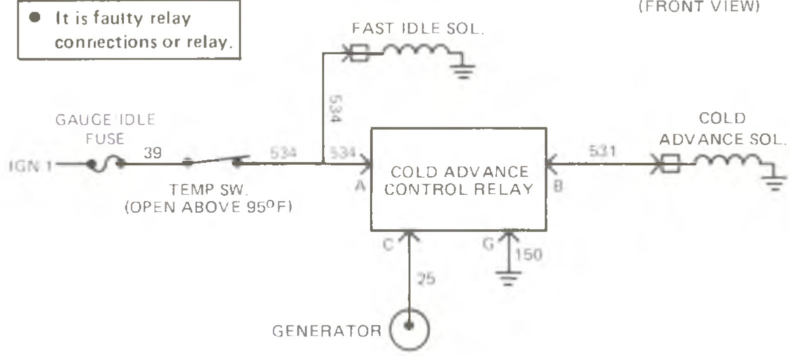


Figure 5-75.

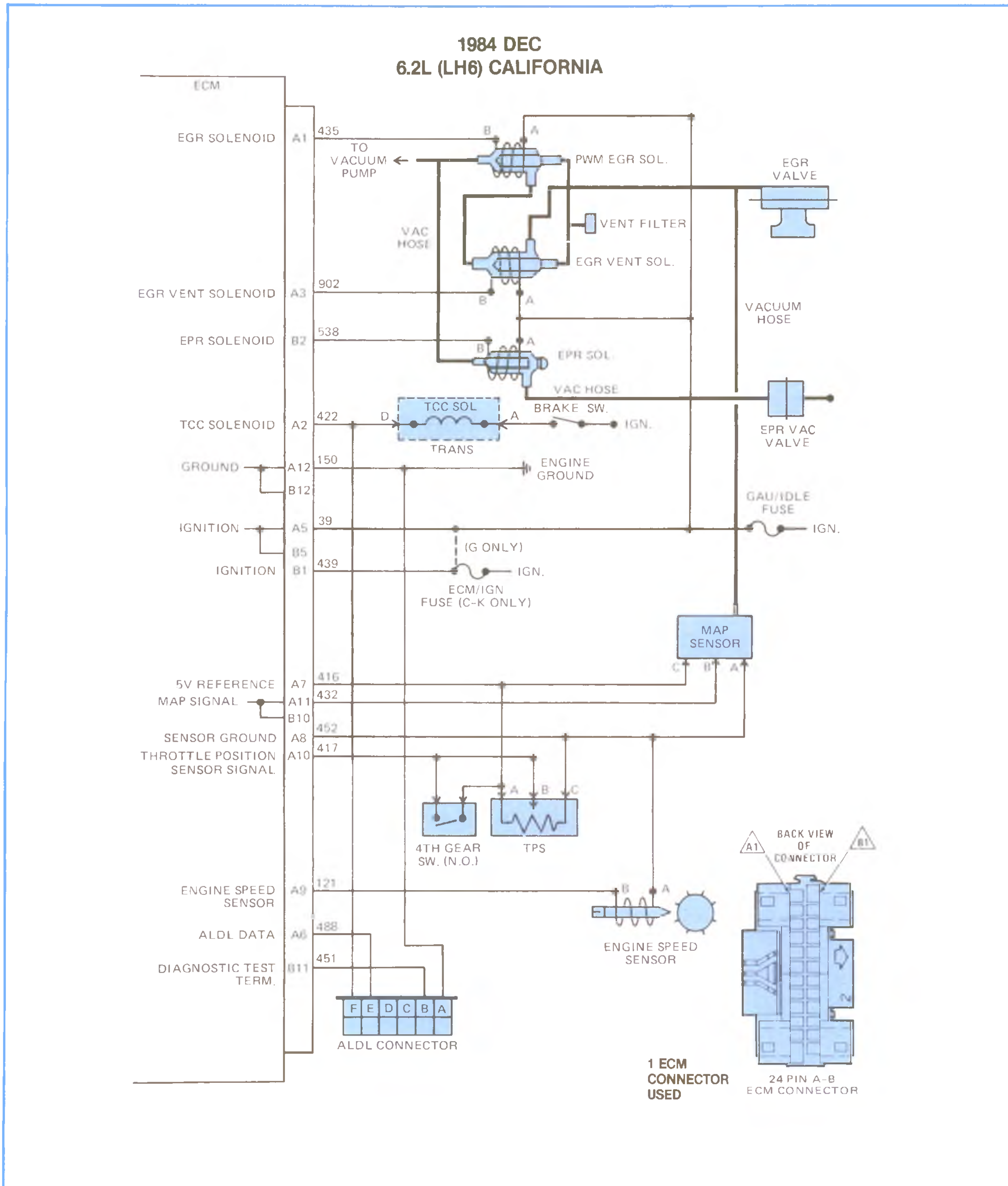


Figure 5-76, 1984 Calif. (DECS) Diesel Electronic Control System Wiring Schematic.

1984 DECS ECM TERMINAL VOLTAGE

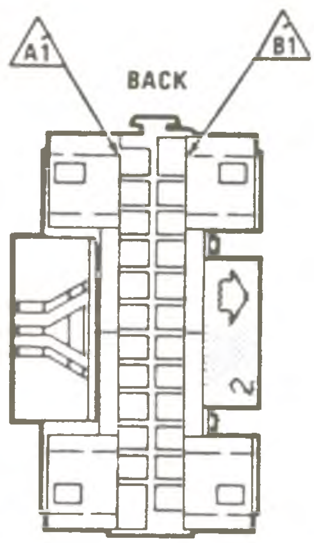
6.2L DIESEL (LH6) CALIFORNIA

THIS ECM VOLTAGE CHART IS FOR USE WITH A DIGITAL VOLTMETER TO FURTHER AID IN DIAGNOSIS. THE VOLTAGES YOU GET MAY VARY DUE TO LOW BATTERY CHARGE OR OTHER REASONS, BUT THEY SHOULD BE VERY CLOSE.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- ENGINE AT OPERATING TEMPERATURE
- BATTERIES FULLY CHARGED AND GLOW PLUGS NOT CYCLING
- TEST TERMINAL NOT GROUNDED
- DDC TOOL NOT INSTALLED

VOLTAGE				
KEY "ON"	ENG. RUN	OPEN CRT.	CIRCUIT	PIN
*1.0	14	*.5	EGR SOLENOID	A1
12	14	*.5	TCC SOLENOID	A2
*1.0	14	*.5	EGR VENT SOLENOID	A3
—	—	—	NOT USED	A4
12	14	*.5	IGNITION	A5
12	*.5	*.5	ALCL DATA	A6
5.01	5.01	5.01	5V REFERENCE	A7
*.5	*.5	*.5	SENSOR GROUND	A8
*.5	.22 var.	*.5	† ENGINE SPEED SENSOR	A9
.57 var.	.57 var.	*.5	TPS SIGNAL	A10
4.83 var.	.45	3.0	MAP SIGNAL	A11
*.5	*.5	—	GROUND	A12



24 PIN A-B CONNECTOR

		VOLTAGE		
PIN	CIRCUIT	KEY "ON"	ENG. RUN	OPEN CRT.
B1	IGNITION	12	14	*.5
B2	EPR SOLENOID	12	*1.0	*.5
B3	NOT USED	—	—	—
B4	NOT USED	—	—	—
B5	NOT USED	—	—	—
B6	NOT USED	—	—	—
B7	NOT USED	—	—	—
B8	NOT USED	—	—	—
B9	NOT USED	—	—	—
B10	NOT USED	—	—	—
B11	DIAGNOSTIC TEST TERMINAL	5.01	5.01	5.01
B12	NOT USED	—	—	—

† — AC VOLT SCALE READING
* — VOLTAGE LESS THAN THAT VALUE
var. — VARIES WITH ENGINE SPEED, THROTTLE POSITION, OR ALTITUDE

Figure 5-77, 1984 Calif. (DECS) ECM Terminal Voltage.

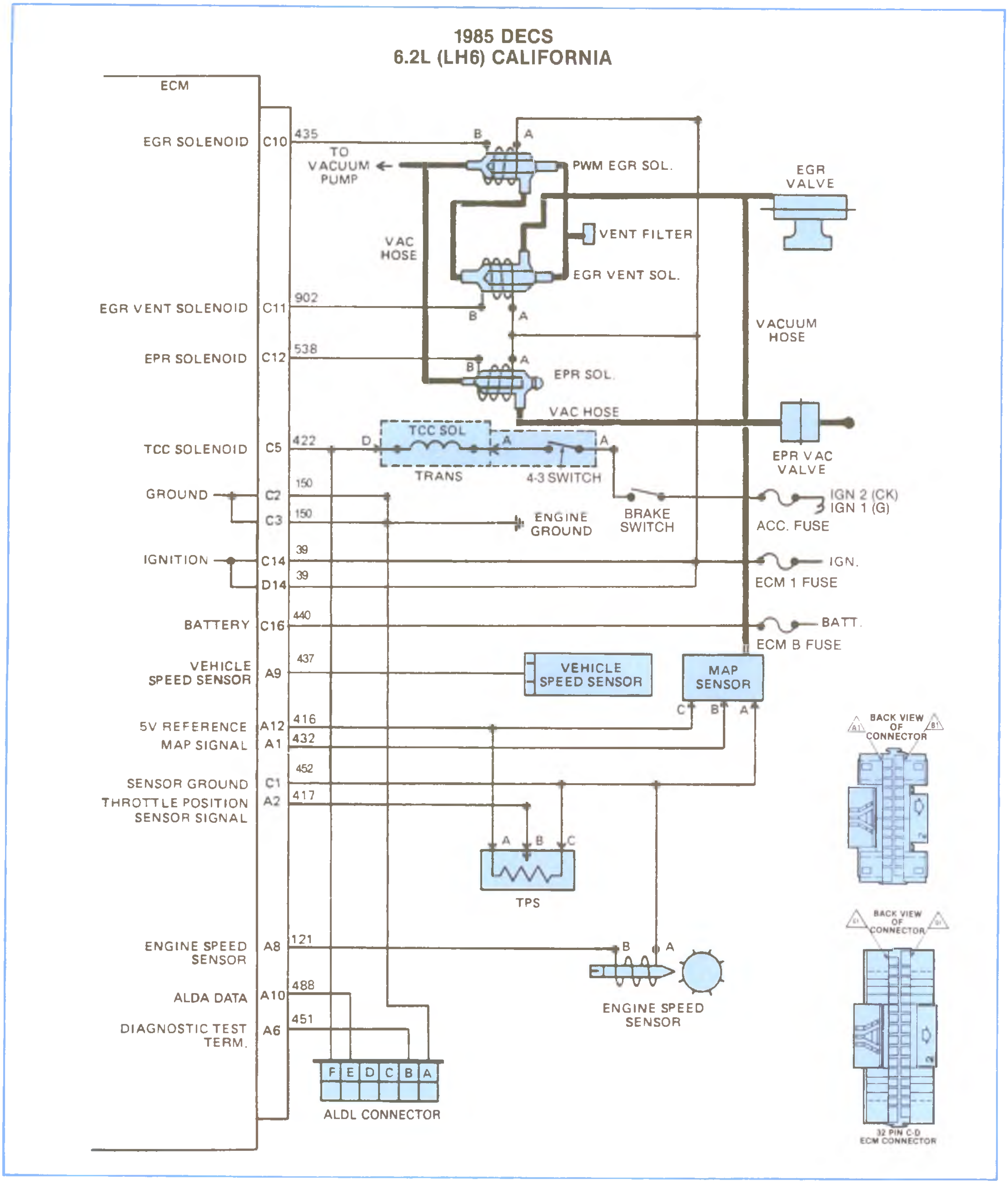


Figure 5-79, 1985 California (DECS) Diesel ECS Wiring Schematic.

1985 6.2L (LH6) CALIFORNIA (DECS)

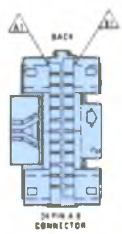
ECM CONNECTOR IDENTIFICATION

THIS ECM VOLTAGE CHART IS FOR USE WITH A DIGITAL VOLTMETER TO FURTHER AID IN DIAGNOSIS. THE VOLTAGES YOU GET MAY VARY DUE TO LOW BATTERY CHARGE OR OTHER REASONS, BUT THEY SHOULD BE VERY CLOSE.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

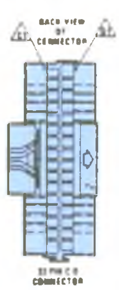
• ENGINE AT OPERATING TEMPERATURE • BATTERIES FULLY CHARGED AND GLOW PLUGS NOT CYCLING •
• TEST TERMINAL NOT GROUNDED • ALCL TOOL NOT INSTALLED •

	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.	CIRCUIT	PIN	WIRE COLOR
4	4.64	.70	432	MAP SIGNAL	A1	LT GRN
	1.01	1.01	417	TPS SIGNAL	A2	BLU
				NOT USED	A3	
				NOT USED	A4	
				NOT USED	A5	
	5.0	5.0	451	DIAGNOSTIC TEST TERMINAL	A6	YEL
				NOT USED	A7	
	.01	.02	121	ENGINE SPEED SENSOR	A8	WHT
	10.72	12.32	437	VEHICLE SPEED SENSOR	A9	PPL
1	12.41	.03	488	ALCL DATA	A10	TAN
				NOT USED	A11	
	5.0	5.0	416	5V REFERENCE	A12	BRN



WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.
	B1	NOT USED			
	B2	NOT USED			
	B3	NOT USED			
	B4	NOT USED			
	B5	NOT USED			
	B6	NOT USED			
	B7	NOT USED			
	B8	NOT USED			
	B9	NOT USED			
	B10	NOT USED			
	B11	NOT USED			
	B12	NOT USED			

	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.	CIRCUIT	PIN	WIRE COLOR
	0	0	452	SENSOR GROUND	C1	BLK
	0	0	150	GROUND	C2	TAN/BLK
	0	0	150	GROUND	C3	TAN/BLK
				NOT USED	C4	
	8.88	10.40	422	TCC SOLENOID	C5	YEL
				NOT USED	C6	
				NOT USED	C7	
				NOT USED	C8	
				NOT USED	C9	
2	.94	14.47	435	EGR SOLENOID	C10	PINK
	1.88	14.47	902	EGR VENT SOLENOID	C11	LT BLU
	12.40	.87	538	EPR SOLENOID	C12	GRN
				NOT USED	C13	
	12.40	14.52	39	IGN.–ECM FUSE	C14	PNK/BLK
				NOT USED	C15	
	12.35	14.32	440	BATT. 12 VOLTS	C16	RED



WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	VOLTAGE OPEN CRT.	
	D1	NOT USED				
	D2	NOT USED				
	D3	NOT USED				
	D4	NOT USED				
	D5	NOT USED				
	D6	NOT USED				
	D7	NOT USED				3
	D8	NOT USED				
	D9	NOT USED				
	D10	NOT USED				
	D11	NOT USED				
	D12	NOT USED				
	D13	NOT USED				
PNK/BLK	D14	IGN.–ECM FUSE	12.40	14.32	39	
	D15	NOT USED				
	D16	NOT USED				

Figure 5-80, 1985 ECM Connector Identification.

NOTES

6. Electrical System

Starting System

Components of these systems are described here. Figure 6-1 shows the 27MT starter used in the 6.2L. Starting procedures are covered in detail in Section 1.

Starter Motor

Due to the high compression ratios in the diesel engine, a high torque starter motor is required for starting.

A heavy duty starter with a center armature bearing is used on the diesel. This is needed to handle the higher compression ratios and to produce the minimum cranking speeds needed for starting of 100 rpm when the engine is cold and 180-200 rpm on a warm engine.

The diesel engine is fitted with a heavy-duty 12-volt cranking motor with increased strength pinion and ring gear teeth. Power is supplied by two 12-volt batteries connected in parallel.

This cranking package provided all-weather starting capability.

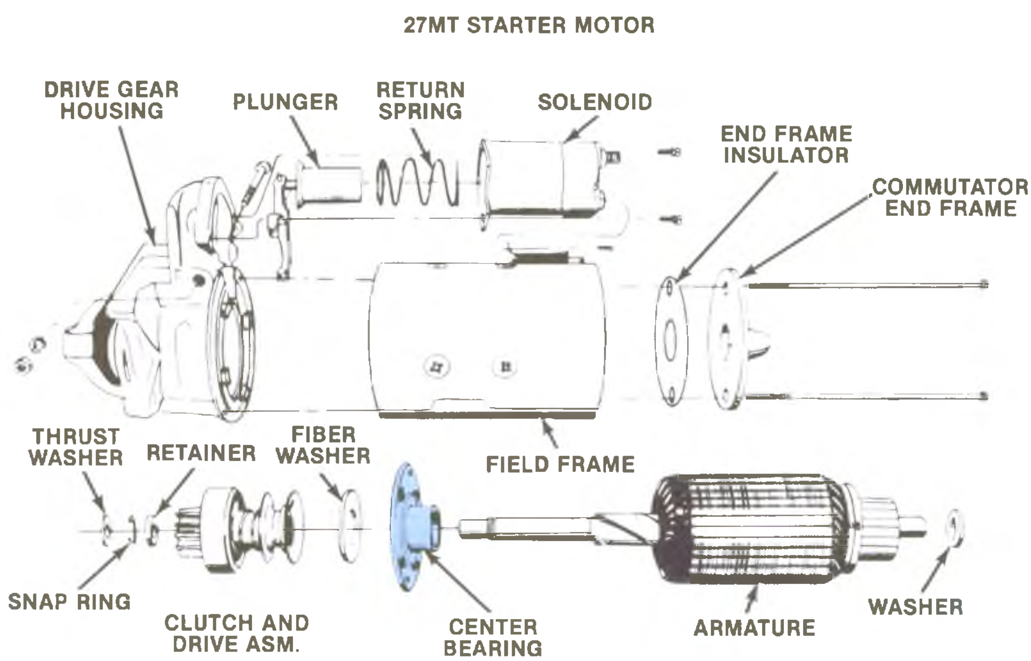


Figure 6-1, 6.2L - 27MT Starting Motor Exploded View.

STARTER MOTOR NOISE DIAGNOSIS

	PROBLEM	CAUSE
1.	HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OKAY.	DISTANCE TOO GREAT BETWEEN STARTER PINION AND FLYWHEEL'
2.	HIGH PITCHED "WHINE" AFTER ENGINE FIRES, AS KEY IS BEING RELEASED. ENGINE CRANKS AND FIRES OKAY. THIS INTERMITTENT COMPLAINT IS OFTEN DIAGNOSED AS "STARTER HANG-IN" OR "SOLENOID WEAK."	DISTANCE TOO SMALL BETWEEN STARTER PINION AND FLYWHEEL. FLYWHEEL RUNOUT CONTRIBUTES TO THE INTERMITTENT NATURE.
3.	A LOUD "WHOOP" AFTER THE ENGINE FIRES BUT WHILE THE STARTER IS STILL HELD ENGAGED' SOUNDS LIKE A SIREN IF THE ENGINE IS REVVED WHILE STARTER IS ENGAGED.	MOST PROBABLE CAUSE IS A DEFECTIVE CLUTCH. A NEW CLUTCH WILL OFTEN CORRECT THIS PROBLEM.
4.	A "RUMBLE", "GROWL" OR (IN SEVERE CASES) A A "KNOCK" AS THE STARTER IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE.	MOST PROBABLE CAUSE IS A BENT OR UNBALANCED STARTER ARMATURE. A NEW ARMATURE WILL OFTEN CORRECT THIS PROBLEM.

Figure 6-2, Starter Motor Noise Diagnosis.

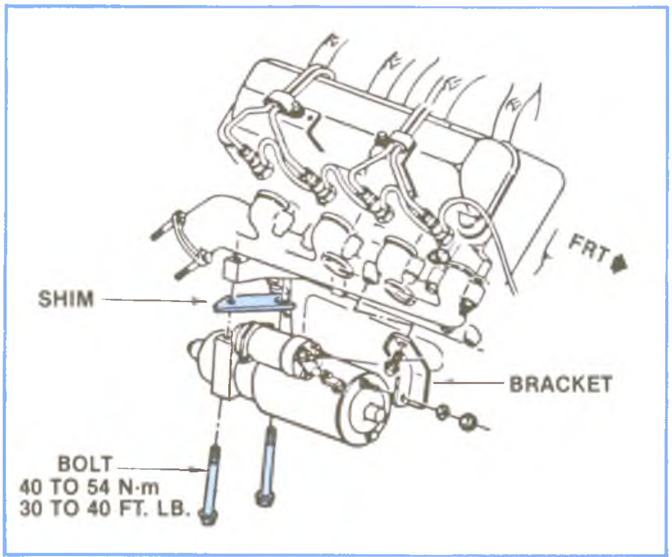


Figure 6-3, Starter Shims.

STARTER NOISE/NO-START CONDITION 1982-83 C-K-P-G WITH 6.2L DIESEL

Starter noise or a no-start condition may result from inadequate flywheel ring gear to starter pinion clearance, due to insufficient shimming.

To correct these conditions, proper starter shimming procedures should be followed:

1. Disconnect both battery ground wires.
2. Remove flywheel inspection cover.
3. Inspect for damage to flywheel teeth. Replace flywheel if teeth are damaged. (The 6.2L engine will normally stop in one of four positions approximately 90 degrees apart where, due to repeated starter pinion gear engagements, the teeth will be more worn than others. Do not fail to check these four locations for excessive damage.)
4. Loosen both starter bolts. Remove the outboard bolt. Remove the shim(s).
5. Check the shim(s) for thickness. Regardless of the total shim thickness present, add more shim(s) to bring the total thickness to 3.0 mm. If the shim thickness is 3.0 mm, add a 1.0 mm shim. Do not exceed 4.0 mm. 1.0 mm shim is P·n 14028933. (Figure 6-3).
6. Position shim(s) and insert outboard bolt.

— NOTE —

1982-1983 Starter Motor Noise Repair Procedure

Noise during cranking...reduce shim thickness by removing one 2mm or one 1mm shim or by leaving both shims out.

Noise after engine fires...remove existing 1mm shim and install a 2mm shim (total 4.0mm) do not exceed 4.0mm.

— NOTE —

1984 only

Install one 2mm shim on every job. Additional shimming or shim removal is a repair procedure.

Starter Motor Noise Repair Procedure

Noise during cranking...reduce shim thickness by removing existing shim and using one 1mm shim or by leaving shim out.

Noise after engine fires...add one 1mm or 2mm as required up to a maximum total shim stack (original shim plus corrective) of 4.0mm. DO NOT EXCEED 4.0mm.

PINION TO FLYWHEEL CLEARANCE

Pinion to flywheel clearance can be checked, using a wire gage of .508mm (.020 in.) minimum thickness. Center the pinion tooth between the flywheel teeth and gage, and not in the corners, where a misleading larger dimension may be observed.

7. Torque bolts to 40 to 54 N·m (30 to 40 ft. lbs.). Torque is very important. Do not overtorque. Overtorque will cause the starter housing to crush. Undertorque can cause the bolts to loosen.
8. If the starter and/or the starter pinion gear has to be repaired or replaced, remove the bracket bolt from the front of the starter. Disconnect wires. Remove both bolts and shims. Be sure to replace the front bracket bolt on reassembly. Replace shims as in Step 5.
9. Reinstall inspection plate.
10. Connect battery wires.

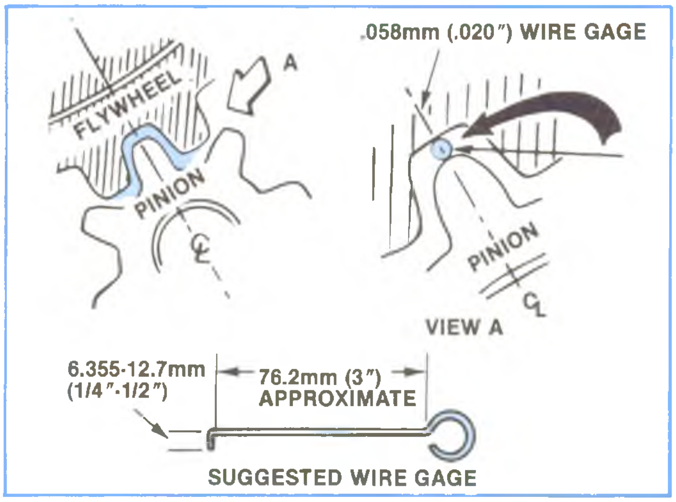


Figure 6-4, **Measure Pinion To Flywheel Clearance**

Batteries

The 6.2L diesel engine uses two 12 volt batteries. This doubles the amperage output and eliminates the need for a special double size battery to meet the high amperage requirements of the starter motor and glow plug circuits.

— IMPORTANT —

The batteries are connected in parallel to provide 12 volts and must never be hooked up in series. This could produce over 24 volts in the system and cause damage to the electrical circuits and equipment in the car.

Block Heater

To help assist the diesel with cold weather starts, a block heater comes as optional equipment with this engine. The heater is built into the right center block core freeze plug and operates off of normal 110 volt house current.

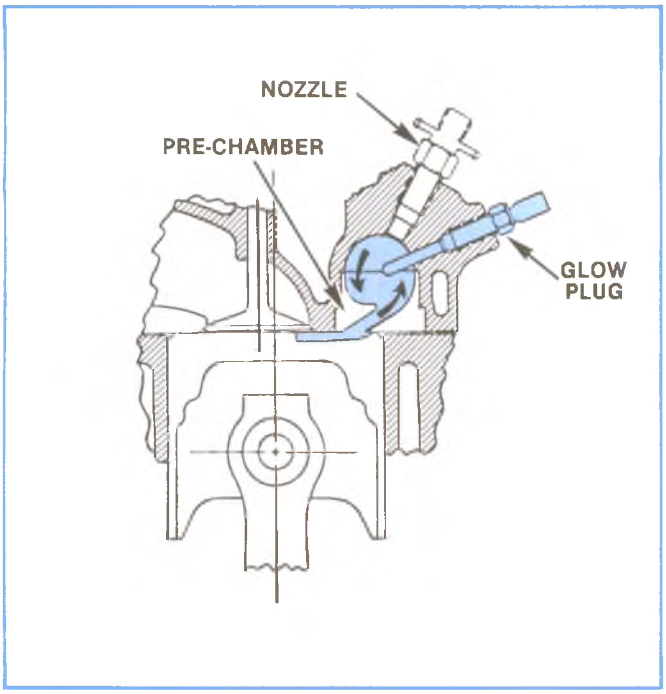


Figure 6-5, **Diesel Engine Glow Plug Location.**

Glow Plugs

On initial or cold start-up, glow plugs (Figure 6-5) preheat the air in the diesel engine prechambers. This along with the heat created by compression, makes the air hot enough to vaporize diesel fuel being sprayed into the prechambers by the nozzles. Once the engine starts, the glow plugs cycle to keep the engine running smoothly until warm-up time is complete. When the engine obtains proper temperature, the glow plugs turn off.

Glow plug systems include a network of electrical components which coordinate the operations of the plugs themselves with various sensors and controllers.

The glow plug is energized prior to cranking the engine for a period of time called "pre-glow". The pre-glow time period is dependent upon engine coolant temperature. Figure 6-5 shows that when the engine coolant temperature reaches 140°F (60°C), pre-glow is not required. At temperatures of 0°F (–18°C) and below, maximum pre-glow is necessary.

When operating, the glow plugs remain on for up to 60 seconds after the engine starts. This maintains ignition in all cylinders, improves throttle response and reduces exhaust smoke. This glow plug operating period is called "after glow".

Two types of glow plugs are used.

- Fast glow 6 volt plug max pre-glow is approximately 8 ± 2 seconds.
- Positive temperature coefficient (PTC) 6 volt glow plugs, max pre-glow is approximately 15 seconds (CUCV military).

The maximum operating temperature of the glow plug is 1800 °F (982 °C).

G.M. DIESEL GLOW PLUG COMPARISON							
STAMPED	ENGINE	YEAR	SYSTEM	VOLT	AMP	OHM	TANG WIDTH
7G	5.7L (4.3L V-8)	78-79	Slow Glow	12	7.5	1.8	1/4″
8G	5.7L (4.3L V-6)	79-83	Fast Glow	6	15	.7-.8	5/16″
9G	6.2L	82-85	Fast Glow	6	15	.7-.8	1/4″
12G	5.7L (4.3L V-6)	84-85	PTC Fast Glow	6	10	.7	1/4″
13G	CVCV 6.2L	84-85	PTC Fast Glow	6	9	.7	3/16″

— IMPORTANT —

Be sure to use the proper replacement glow plug(s) for the system you are working on. If 12 volt glow plugs are used in the "second type" 6 volt pulsing system, the plugs will never get hot enough. If 6 volt glow plugs are used in the "first type" system, steady current will cause the glow plugs to quickly burn out and the tip may break off and drop into the prechamber. (Figure 6-7).

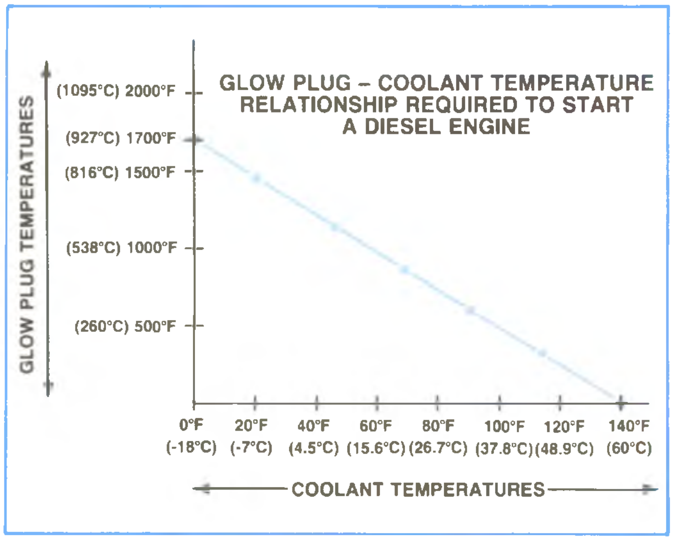


Figure 6-6, Glow Plug Temperature Required for Engine Start.

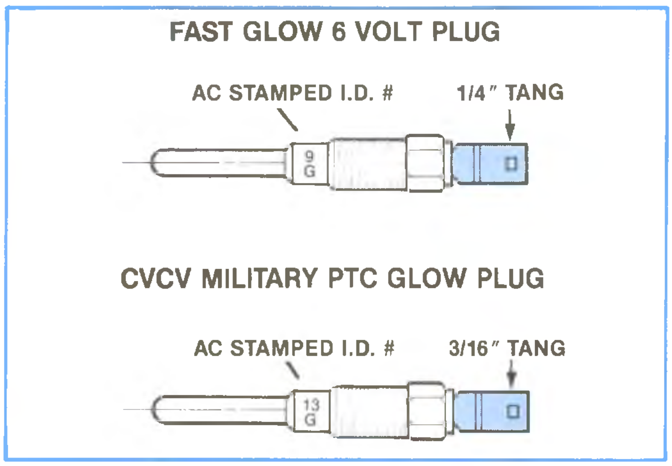


Figure 6-7, Glow Plug Comparison.

COMMERCIAL UTILITY CARGO VEHICLE (CUCV) MILITARY 6.2L APPLICATION (D-TRUCK)

See Figure 6-7.

Glow plugs from the "D" (military) truck are AC 13G glow plugs. They will fit into any 6.2L head but have a thinner electrical connection than the normal 6.2L glow plug, AC 9G. Therefore, they could be installed in a non-military 6.2L diesel, but they would not heat up correctly and a hard start condition would occur. The wider electrical tab on the AC 9G will not allow them to be hooked up in a military unit.

Glow Plug Design Considerations

Figure 6-8 is a typical AC diesel engine glow plug. The Heater Coil Element is a resistance wire centrally positioned in the sheath. The Heater Coil Element is welded to the Center Terminal Conductor and to the Sheath. The Heater Coil Element and the Center Terminal Conductor are supported and electrically insulated from the Sheath by Magnesium Oxide. The entire assembly is joined to a Threaded Shell which has a tapered seat and a Hex Section. Above the Hex Section are an Insulator and Electrical Terminal Blade.

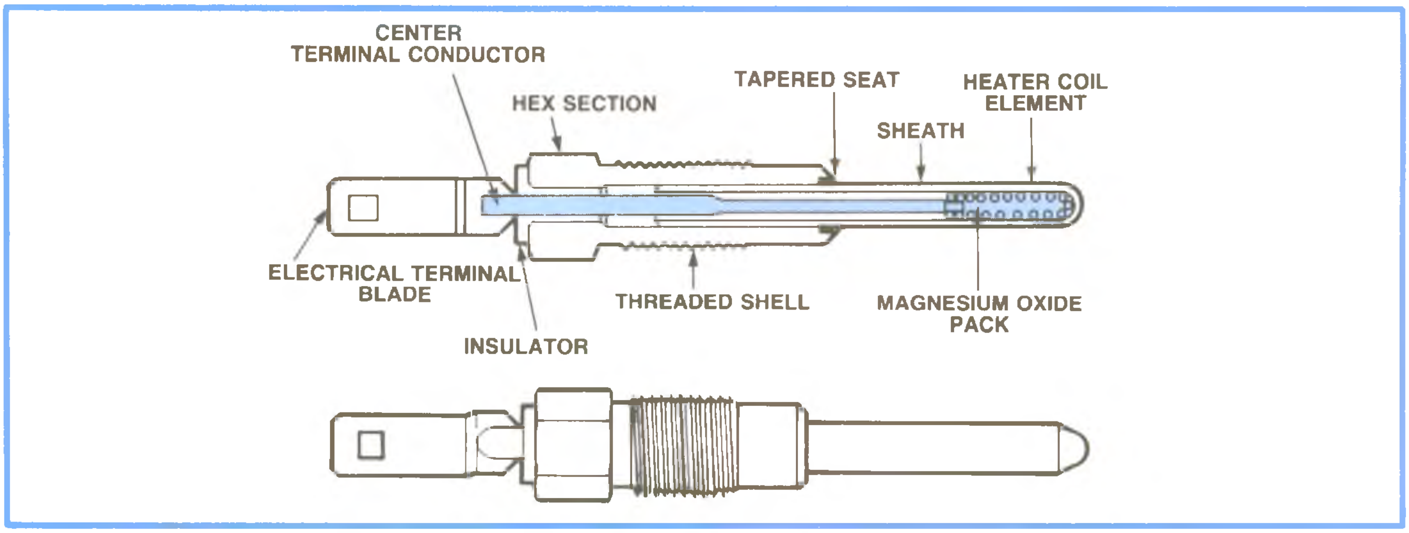


Figure 6-8, Typical AC Diesel Engine Glow Plug.

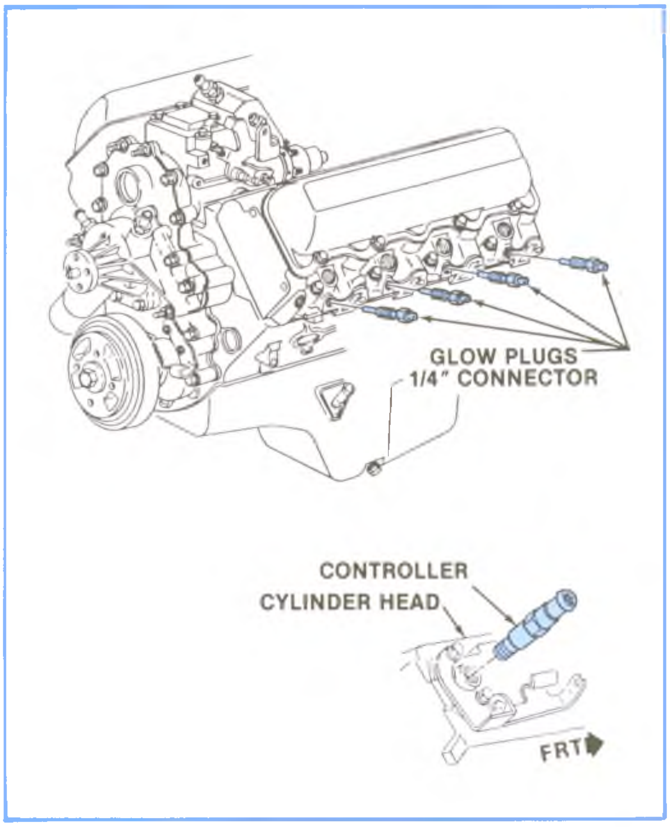


Figure 6-9, Glow Plug Location.

See Figure 6-9. The glow plug is assembled to the cylinder head and into the pre-chamber. It has only one purpose and this is to aid the engine in starting in cold weather.

When the ignition of the vehicle is turned on, the glow plugs are immediately energized. They rapidly heat up the air in the pre-chamber to approximately 1400°F. In 0°F weather the glow plug can pre-heat the pre-chamber in only 8 seconds. The engine will then start much easier. After the engine starts, the function of the glow plugs is complete, except for afterglow.

PTC GLOW PLUGS

— NOTE —

Used in the "D" truck military application, commercial utility cargo vehicle (CUCV).

The CUCV diesel engines will incorporate glow plugs that are, temperature self-regulating. These new glow plugs have PTC (positive temperature coefficient) characteristics (low resistance at low temperature — high resistance at high temperature) that provide the self-regulating feature.

The PTC plugs offer rapid temperature rise similar to the present fixed resistance plugs, but do not require the critical shuf-off timing and cycling, and can therefore be operated by a simpler and less costly control. However, the PTC plugs do require protection from voltages above 13.7 volts.

The glow plugs are self-regulating at 11.5 volts.

PTC GLOW PLUG SPECIFICATIONS

	BODY	TIP
Length (mm)	16.5	6.35
Cold Resistance (Ohms)	.30	.70
Power (Watts)	40	93
	(133w Total)	
Hot Resistance (Ohms)	1.3	.70
Power (Watts)	43	23
	(66w Total)	

The PTC (Figure 6-10) is a dual coil plug. It is used to aid cold weather starting of the diesel engine. In a typical installation, the heated sheath of the glow plug extends into the pre-combustion chamber of the engine near the injection nozzle.

The glow plug is energized prior to cranking the engine for a period of time called "pre-glow". The pre-glow time period is dependent upon battery voltage and underhood air temperature. For temperatures above 131 degrees F (55 degrees C) pre-glow is not required. At temperatures of 0 degrees F (– 18 degrees C) and below, maximum pre-glow (10-13 seconds) is necessary.

The PTC duel coil glow plug is so named because it consists of two coils in series. The tip consists of a steady resistance element. This tip coil is controlled by the body coil. This occurs because the body coil consists of a positive temperature coefficient (PTC) wire which increases in resistance with an increase in temperature. As voltage is applied to the plug, the body coil resistance is very low allowing high current to pass through the tip coil. As the body coil heats up, its resistance increases 400% to reduce the current through the tip. This allows the tip to heat up quickly while self-regulating itself for various voltage levels less than 14 volts.

The self-regulating nature makes the plug more forgiving of voltage levels which allows a simpler, less expensive controller to be used. In addition, this new plug continues to heat during cranking, thus improving cold starts. (The earlier quick heat glow plug cooled down during cranking after being superheated to its maximum possible temperature.)

The dual coil remains on after engine start-up for up to ninety seconds. This maintains ignition in all cylinders, improves throttle response and reduces exhaust smoke. This glow plug operating period is called "after-glow".

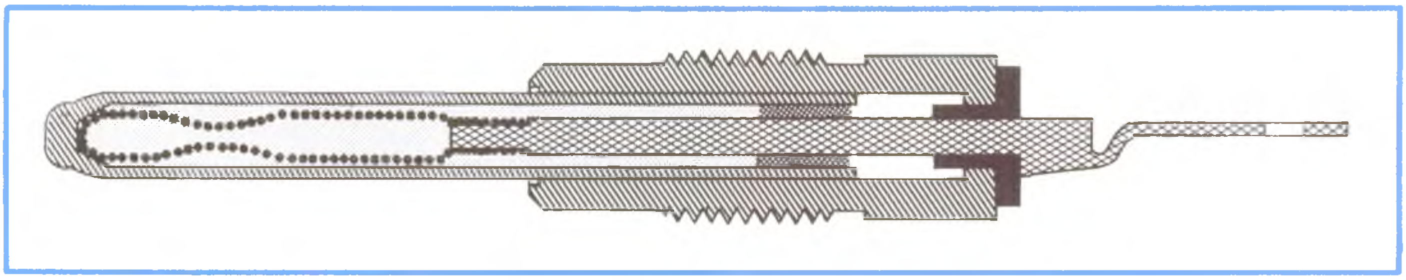


Figure 6-10, PTC Glow Plug.

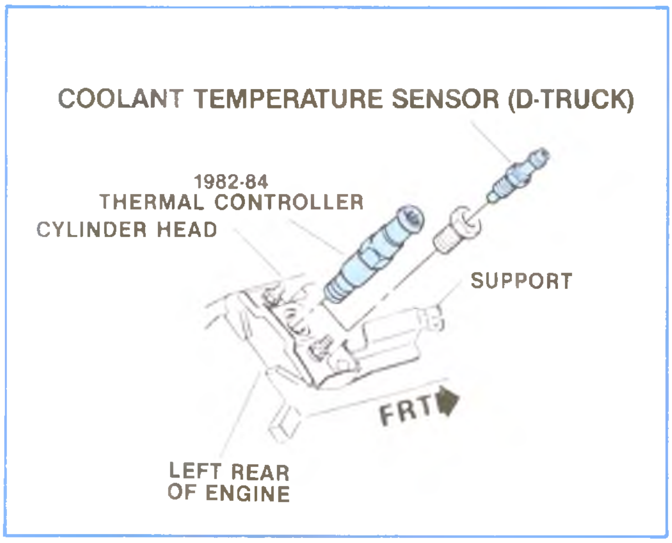


Figure 6-11, Thermal Controller.

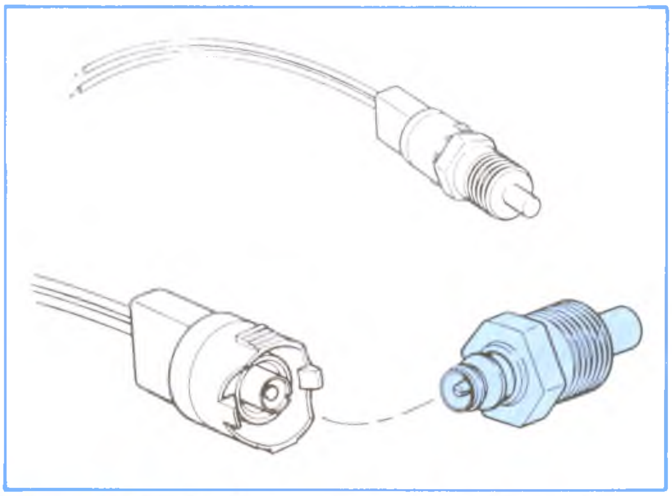


Figure 6-12, Coolant Temperature Sensor.

Electro-Mechanical Thermal Controller

The electro-mechanical thermal controller controls glow plug temperature, pre-glow time, and after-glow time. It signals the "wait" and "start" lamp relay. See Figure 6-11.

It senses ambient temperature and glow plug voltage to control system operation. The glow plug relay is pulsed on and off by the thermal controller to control current to the glow plugs and maintain glow plug temperature without overheating.

COOLANT TEMPERATURE SENSOR

See Figure 6-12. This sensor is used on the military CUCV (D-truck) application only. This sensor provides engine temperature information to the electronic module glow plug controller.

The sensor is a two-wire thermister type that lowers its resistance with coolant temperature increase. The resistance raises as temperature goes down.

Measuring resistance of this sensor, while in the engine will indicate engine temperature condition.

ENGINE COLD	– 40 °C – 40 °F	Approximate 100,000 OHMS
	0 °F	3200 OHMS
	130 °C 266 °F	70 OHMS

The resistance of the coolant sensor changes approximately 300 OHMS per degree of water temperature.

"D" TRUCK MILITARY (CUCV) APPLICATION

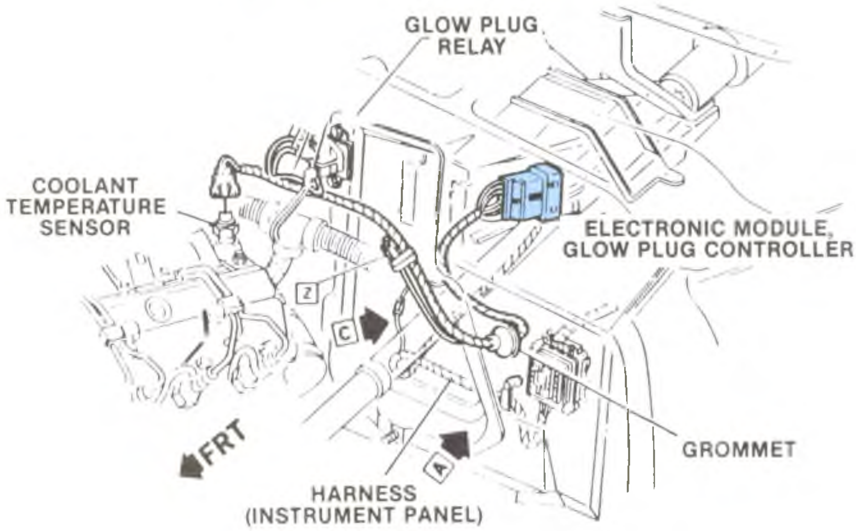


Figure 6-13, Electronic Module Glow Plug Controller (D-Truck).

Electronic Module Glow Plug Controller

With the ignition switch in "run", the Electronics Module sends constant voltage to the glow plug relay to maintain proper glow plug temperature (Figure 6-13). It receives feedback signals from the control sensor to control glow plug and "wait" lamp operation. The module also contains circuits which monitor the system for failures, and keep the "wait"lamp on to indicate a problem in the system.

The "D" truck (CUCV) military application also uses a cowl mounted glow plug relay (Figure 6-13). This relay is turned on and off by the Electronic Module Glow Plug Controller.

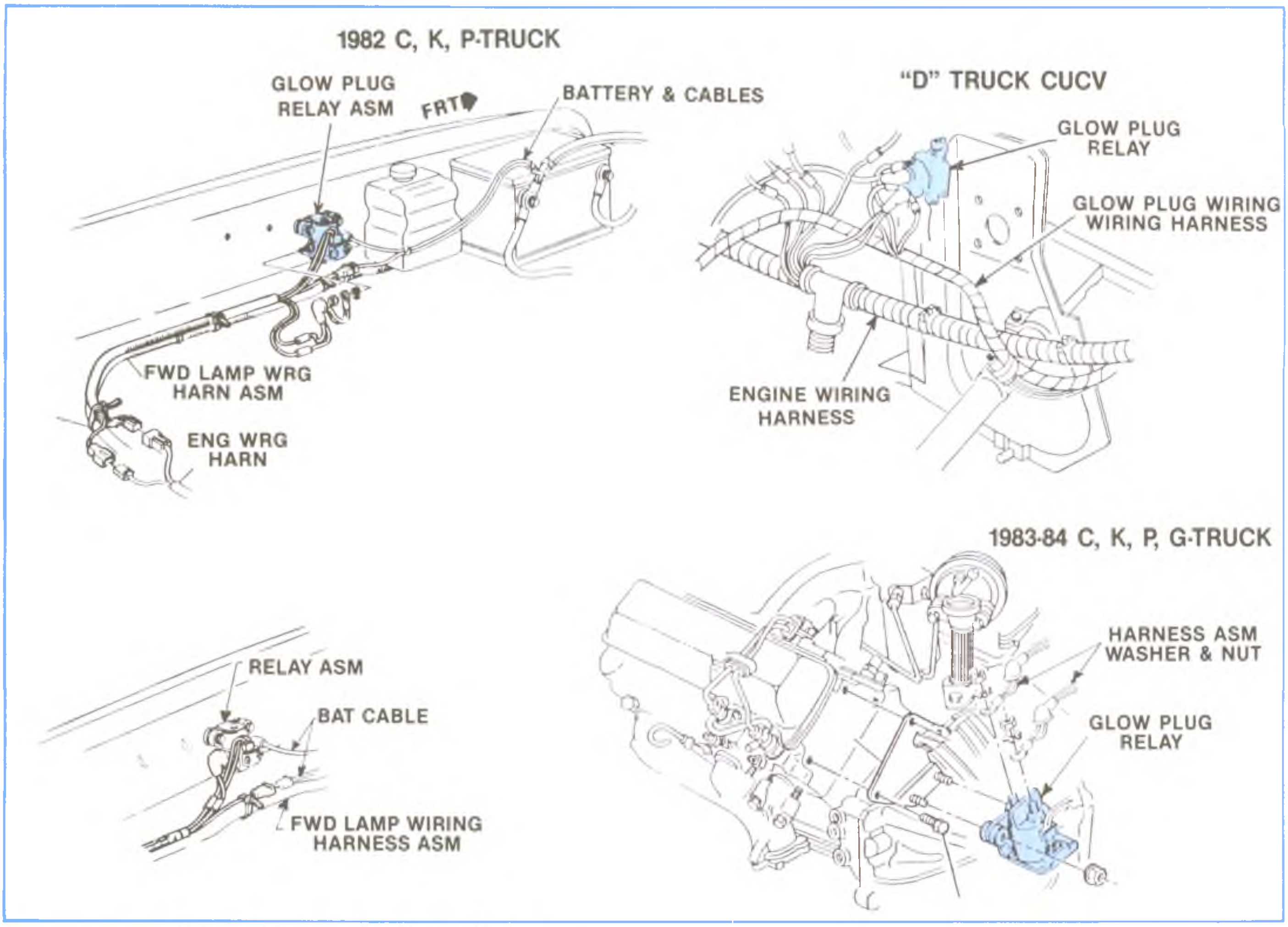


Figure 6-14, Glow Plug Relay Locations.

GLOW PLUG RELAY

The glow plug relay is pulsed on and off by the controller to control current to the glow plugs and maintain glow plug temperature to prevent overheating (Figure 6-14).

> **— NOTE —**
>
> **The "D" truck (CUCV) military application relay does not pulse, it is "ON" or "OFF".**

> **— NOTE —**
>
> **1985 and later C, K, P, G trucks use a combined electronic module controller and relay in one unit.**

GLOW PLUG TEMPERATURE INHIBIT SWITCH

The non-military glow plug system in 1984 and later uses a temperature switch in the wire between the glow plug relay and Pin 3 of the controller (Figure 6-15). It opens above 125 degrees F and terminates all glow plug operation. This helps glow plug life, by reducing needless glow plug cycles. It is located in the rear of the right cylinder head, across from the glow plug controller.

Figure 6-16 illustrates the Temperature Inhibit Switch Circuit.

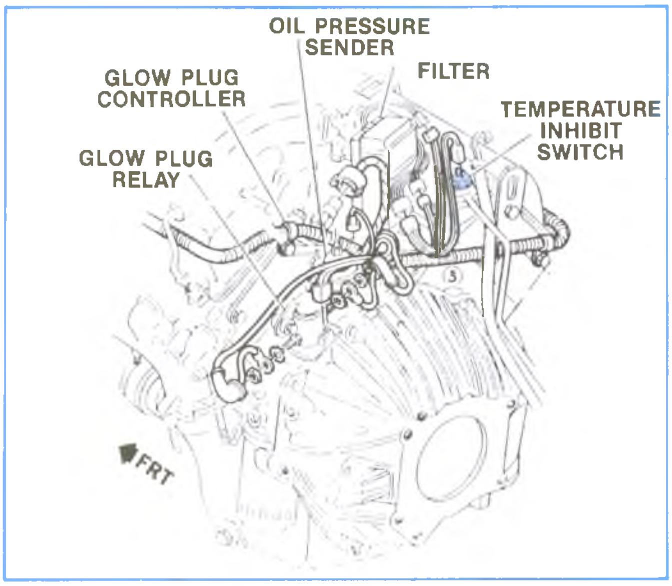


Figure 6-15, **Temperature Inhibit Switch.**

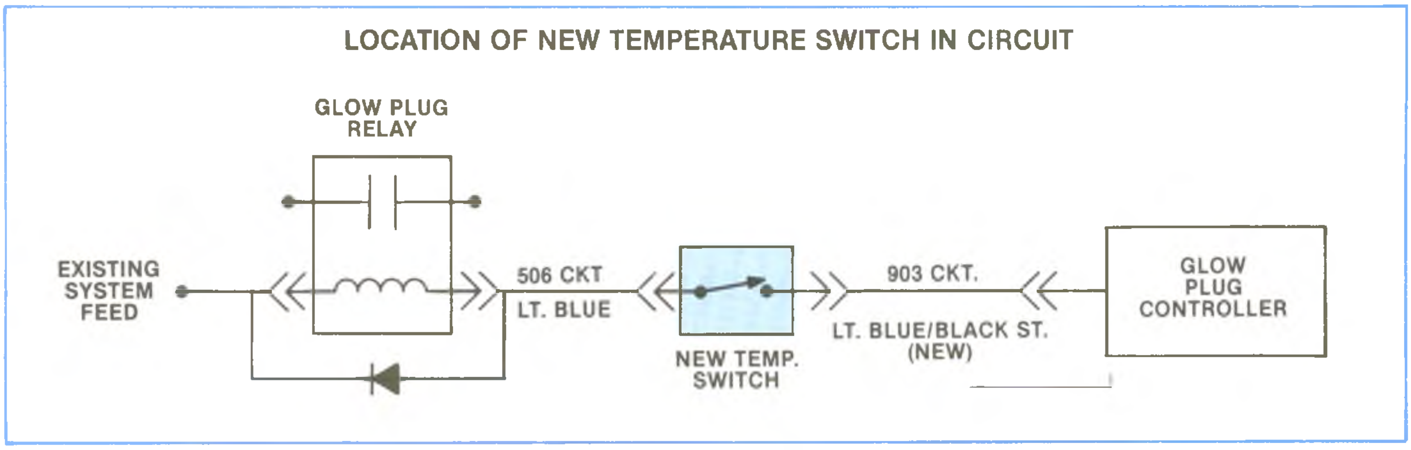


Figure 6-16, **Temperature Inhibit Switch Circuit.**

— NOTE —

This switch can be fitted to all past models. The procedure is in this section.

CONTROLLER (THERMAL SWITCH) DESCRIPTION

A controller is an electro-thermal device that threads into the engine water jacket to sense engine coolant pressure and contains small electric heaters to operate three bi-metal switches. There are four electrical heaters that alternately heat and cool causing the bi-metal switches to open and close the glow plug relay circuit. Typical circuit schematics are shown in Figure 6-17.

The circuit for heater H-1 is fed by the glow plug side of the glow plug Relay, and gets hot when the glow plugs get hot. The heater has 300 OHMs resistance. This causes switch S-1 to open (at 180°F) and close to pulse the glow plug Relay coii and the glow plugs. Heater H-2 is energized by generator output and gets hot when the engine runs. This heater has a 115 OHMs resistance. It opens switch S-3 (at 160°F) and keeps the glow plug Relay de-energized when the glow plugs are no longer needed. Switch S-2 is acted on by heat from heaters H-3 and H-4. The resistance of H-3 is 45 OHMs, and H-4 is 32 OHMs.

The operating temperature of switch S-2 is about 300°F. Heater H-3 is a low heat unit and heater H-4 only supplies heat when switch S-2 is open. Switch S-2 is also effected by engine coolant temperature so that at engine operating temperature in combination with heat from heater H-3 and water temperature will open switch S-2. This will cause heater H-4 to warm up and maintain switch S-2 in the open position.

System Operation, (Engine Cold-Pre-Glow)

When the ignition switch is turned to the "ON" position, current flows through; gau-idle fuse, 3 Ω glow plug relay coil, closed temperature switch, and closed controller switches S-2, 1 and 3 to ground. This energizes the glow plug relay, which connects battery to the 8 glow plugs. The "glow plugs" light is wired in parallel with the glow plugs, so when they are "ON", the glow plugs "LIGHT". It will cycle "ON" and "OFF" with the glow plugs.

When H1 heater of the controller reaches 180°F, S-1 will open. This de-energizes the glow plug relay, and turns "OFF" the glow plugs. As this heater cools off, if the engine is not started, S-1 will close again and turn "ON" the glow plugs. The glow plugs and light will cycle "ON" and "OFF" in a controlled heating mode before the engine is started.

AFTER-GLOW

When the engine is running, the glow plugs light may pulse on for a time period determined by generator output. The total after-glow time period is controlled by a signal from the alternator to the control system.

Current from generator output entering the controller at Pin 1, will cause heater 2 to get hot and open S-3 at 160°F. This ends the after-glow period.

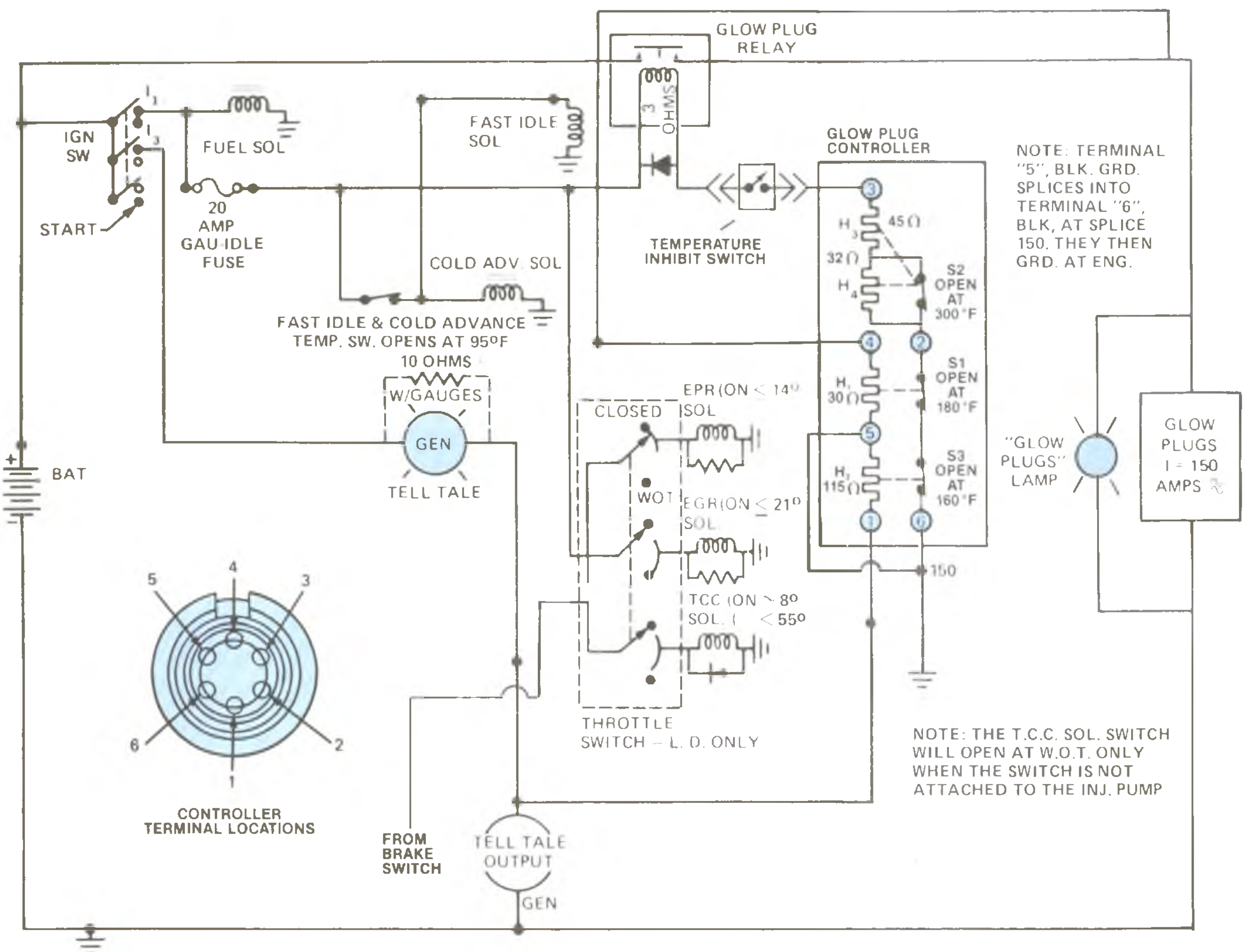


Figure 6-17, Glow Plug Schematic.

General Glow Plug System Diagnosis

Tools for Diagnosis

Successful diagnosis of any condition depends on having the proper tools. This section tells you what tools are needed and how they must be used.

- **DIGITAL MULTIMETER — (TOOL J-29125)**
  The multimeter has become an essential tool for the glow plug system because it measures extremely low voltages, without burning out the delicate circuits in the electronic module.
- **SELF POWERED TEST LIGHT**
  Necessary for checking glow plug continuity and opens and grounds in circuit checks where no voltage can be applied.
- **12 VOLT TEST LIGHT**
  Used to check for opens and grounds in circuit checks requiring 12 volts or more for proper diagnosis.
- **VOLT AMPERE TESTER (VAT-40) OR EQUIVALENT (INDUCTION PICK-UP TYPE)**
  Measures current flow (amps). Used in conjunction with Diesel Glow Plug Systems to measure amperage draw between right and left glow plug banks.

(When using any of these tools, be sure to follow the manufacturer's instructions for proper use.)

Preliminary Checks

Make the following preliminary checks before proceeding to diagnosis:

- Check wait light operation D-Truck (CUCV) military application — the wait light will remain on if there is a problem in the glow plug system. Usually the engine can still be started, but the glow plug control system must be repaired.
- Check glow plug light operation — non-military with the key in the "RUN" position, glow plug light should come "ON", and should stay "ON" 8 to10 seconds. When it goes out, start the engine. The light should then cycle a few times and go out. If the system doesn't cycle or continues to cycle, the glow plug system needs repair.

— NOTE —

1984 and later non-military trucks have a temperature inhibit switch which prevents glow plug operation above a coolant temperature of approximately 125°F.

- Check all the glow plugs to see that they are working properly — Refer to the preliminary diagnosis flow charts at the end of this section.
  — If the glow plugs are working properly refer to the appropriate Chassis Service Manual for further diagnosis.
  — If the glow plugs are not working properly refer to the appropriate flow charts for diagnosis.
- Check all fuses, bulbs and grounds before replacing any components.
- Make sure that all connections are clean, dry and that no wires are exposed.
- Perform ammeter test (next page) to isolate condition to glow plug system.

Glow Plug Controller and Advanced Engine Timing

The glow plug controller has three internal circuits, a pre-glow timer, an after-glow timer and a circuit breaker. Failure of the pre-glow timer will cause the circuit breaker to operate. The fact that the circuit breaker is controlling the glow plugs can be determined on a cold start by observing the glow plug light on the instrument panel. If the pre-glow timer **is** working, the glow plug light will continue to cycle "ON" and "OFF" with the ignition key "ON" and the engine "OFF". If the pre-glow timer **is not** working, the glow plug light will only cycle once with the ignition key "ON" and the engine "OFF".

If it is found that the circuit breaker is controlling the glow plugs, the glow plug controller should be replaced. Extended operation of the glow plugs with the circuit breaker can cause premature failure of the glow plugs.

— NOTE —

Be sure A, 6.2L diesel controller is IN THE ENGINE, not a 5.7L diesel. The 6.2L controller has a light gray connector and a silver label. The 5.7L (4.3L V-6) diesel controller has a black connector, and a gold label. Because of different resistance values between the two controllers, do not interchange them.

— NOTE —

Advanced fuel injection pump timing will cause glow plug failures due to higher than normal cylinder temperatures. When an advanced timing condition exists, several glow plugs may not operate; however, usually not all eight.

A normal looking glow plug, which is electrically open, or that has a small blister could probably be due to a glow plug or system fault. Glow plugs however, that have burned off tips are more likely a result of advanced engine pump timing.

Preliminary Diagnosis With Ammeter

The following procedure (Figure 6-18) provides a fast way to determine whether the glow plug system is functioning correctly or if you have another condition to contend with. It is suggested that this procedure be performed whenever there is doubt about correct system operation. Then refer to the diagnosis charts that follow to pinpoint the condition.

Connect an ammeter in series (induction type meter may also be used)* with DK red wire leading from the Glow Plug Relay to the LH bank of glow plugs. Operate the system and note the ammeter reading. Repeat the procedure for the red wire leading from the Glow Plug Relay to the RH bank of glow plugs. Operate the system and note the reading.

VEHICLE MODEL
NORMAL AMP READINGS

G-Van
50 MIN.

C, K, P
55 MIN.

CUCV
35 MIN.

LH BANK AMMETER READING LESS THAN NORMAL

One or more glow plugs on LH bank not operative. Check individual glow plug leads by connecting ammeter in series with GRN wire that feeds glow plug. Operate the system and note the reading on ammeter. Repeat procedure for each glow plug. Each individual wire should have a reading of approximately:

AMMETER READING NORMAL

Glow plug operating normally.

RH BANK AMMETER READING LESS THAN NORMAL

One or more glow plugs on RH bank not operative. Check individual glow plug leads by connecting ammeter in series with GRN wire that feeds glow plug. Operate the system, note the reading on ammeter. Repeat procedure for each glow plug. Each individual wire should have a reading of approximately:

C, K, P = 14 amps
G-Van = 13 amps
CUCV = 9 amps

READINGS NORMAL

Glow Plugs and harness OK.

READINGS LESS THAN NORMAL

On those cylinders with less than normal readings, check for continuity through the harness by disconnecting the lead and connecting a 12 volt test light from the connector to ground. Operate the glow plug system.

TEST LIGHT LIGHTS

Harness OK. Replace glow plug

TEST LIGHT DOES NOT LIGHT WHEN GLOW PLUGS ARE OPERATING

Repair or replace harness. Retest glow plug for proper operation.

*If using an in line ammeter read both banks at once. Do not cut wire.
(Snap-on meter MT552, VAT-40, or equivalent)

Figure 6-18, Preliminary Ammeter Diagnosis.

1982-1984 6.2L Diesel Glow Plug System Diagnosis

1982 C/K/P AND 1983 C/K/P/G 1500 THRU 3500 SERIES TRUCK WITH LH6 (6.2L DIESEL L.D. EMISSIONS) OR LL4 (6.2L DIESEL H.D. EMISSIONS)

GLOW PLUG CONTROLLER CONNECTOR CIRCUIT CHECKS

PIN 1: (Brown Wire) Should have continuity (0 Ohms resistance) to the brown wire at the alternator with the engine off or alternator voltage with the engine running. If there is battery voltage at this pin with the ignition key off, the alternator has failed a diode (see below).

PIN 2: There is no connection to this pin on 1982 vehicles. On 1983-84 vehicles, there may be a white tube or a wire to this pin, it is only to seal the position in the connector. It is hooked to the wiring harness. DO NOT GROUND THIS PIN FOR ANY REASON, IT WILL PROHIBIT NORMAL OPERATION OF THE CONTROLLER AND CAN DAMAGE GLOW PLUGS.

PIN 3: (Blue Wire) Should have battery voltage with the vehicle ignition key on.

PIN 4: (Orange Wire 82MY, Dark Green Wire 83,84MY) Should have continuity (0 Ohms resistance) to the double red wire terminal on the glow plug relay.

PIN 5: (Black Wire) Should have continuity (0 Ohms resistance) to Pin 6 (Black Wire) and to ground.

PIN 6: (Black Wire) Same as Pin 5.

— NOTE —

Complaint of a "no-start — due to no glow plugs heating" where the no-start problem was a result of a failed delcotron positive diode.

When the diode fails in the delcotron, battery voltage can be supplied to the glow plug controller with the key off and the engine stopped. This battery voltage is normally supplied to pin #1 in the glow plug controller from the delcotron after the engine starts. This voltage, in effect, tells the controller that the engine has started and shuts off the glow plug heating cycle.

When a "no glow plug heating" problem is received, a quick check should be made to see if a diode failure is the cause.

Follow this procedure:

1. With the key off and the engine stopped, check for voltage in the brown wire that goes from the delcotron to the glow plug controller.
2. If a voltage is present, disconnect the wire from the delcotron. Again, check for voltage in the brown wire. There should be none. (If the key is "ON", a low voltage — approximately 3 volts — will be present in a properly operating system.)
3. Wait for a minimum of 15 minutes, or sufficient time for the controller to cool off.
4. Turn the key on. If the glow plugs heat, the problem was with the delcotron.

— NOTE —

The only time battery voltage should be present in the brown wire is when the engine is running. With the key on, and the engine not running, a low voltage (approximately 3 volts) will be present in the brown wire. This is normal.

GLOW PLUG CONTROLLER CHECK FOR PROPER FUNCTION

ENGINE COLD, IGNITION SWITCH OFF

1. First connect a VOM between the negative side (Blue Wire) of the power relay coil and ground.

— CAUTION —
Do not short the positive terminal to any metal object.

2. Monitor the VOM when the ignition switch is turned on. Turn the ignition switch on.
3. The VOM should read about 2 VDC for approximately 4 to 10 seconds depending on the engine coolant temperature. NOTE: If the engine is hot, you may get a continuous voltage reading of about 12 VDC, (the battery voltage).
4. The VOM will then repeat an on-off cycle, about 12 VDC then 2 VDC. NOTE: The power relay should also be heard turning on and off.
5. If this occurs, the controller is functioning properly. Remove the positive lead of the VOM from the power relay coil and connect to the relay output.
6. With the ignition switch still on, the VOM should continue to repeat the on-off cycle of 3 above.
7. If this is occurring, the proper voltage is being applied to the wiring harness connected to the glow plugs.

ASEMBLY PLANT CHECKOUT OF 1983 G-VAN 6.2L DIESEL GLOW PLUG SYSTEM

NORMAL OPERATION

With cold engine (below approximately 100°F), and good batteries (green eye visible):

1. Ignition switch on.
2. Glow plugs light "ON" for 10 seconds maximum (engine below 20°F), "ON" for 7 seconds maximum with engine at room temperature.
3. Glow plug light then cycles on-off.
4. Start engine.
5. Glow plug light continues to cycle on-off for up to one minute with cold engine (below 20°F), less time if engine is warmer.
6. Light remains off as long as engine is running.

VISUAL CHECK

If glow plug light does not operate as above, check the following:

1. Check connections on glow plug lamp jumper harness in I.P. area.
   a. "Ground" at bus bar ground terminal.
   b. Fuse block.
   Two wire connections to bulkhead connector (Orn/Dbl. Blk. stripe and Yel/Dbl. Blk. stripe).
2. Check connections in engine compartment.
   a. "Ground" at stud — power steering brace.
   b. Glow plug relay 2-way connector and connections at studs.
   c. Glow plug controller.
   d. 2-way connector on delcotron.

If all connections are intact, but glow plug system is not operating as stated, proceed with normal diagnostic procedure. **Do not bypass or manually operate the glow plug relay.**

GLOW PLUG CONTROLLER CONTAMINATION

On early 1982 production vehicles, the engine wiring harness connector at the glow plug controller has an open hole at the No. 2 pin connection. Moisture and/or dirt entering this hole can cause deterioration of the pin connections and result in a controller malfunction (Figure No. 6-19).

If a comment such as poor starting, burned glow plugs, etc. is received, remove the connector from the controller. Check for moisture and dirt. Clean the pin area on the controller and the connector. Reinstall the connector.

Apply a small amount of R.T.V. 1052734 or similar silicone sealant over the No. 2 pin hole to prevent water from entering.

If the controller cycles normally, replacement is not necessary. However, if corrosion of the pins was excessive and/or the controller does not cycle correctly, it should be changed.

The two (2) wires from No. 5 and No. 6 pin position are ground wires. The ground connection is at the rear of the right hand head on a stud which also grounds the body ground strap. (The stud is on the opposite side of the engine from the controller.) Make sure the ground connection is secure (Figure 6-19).

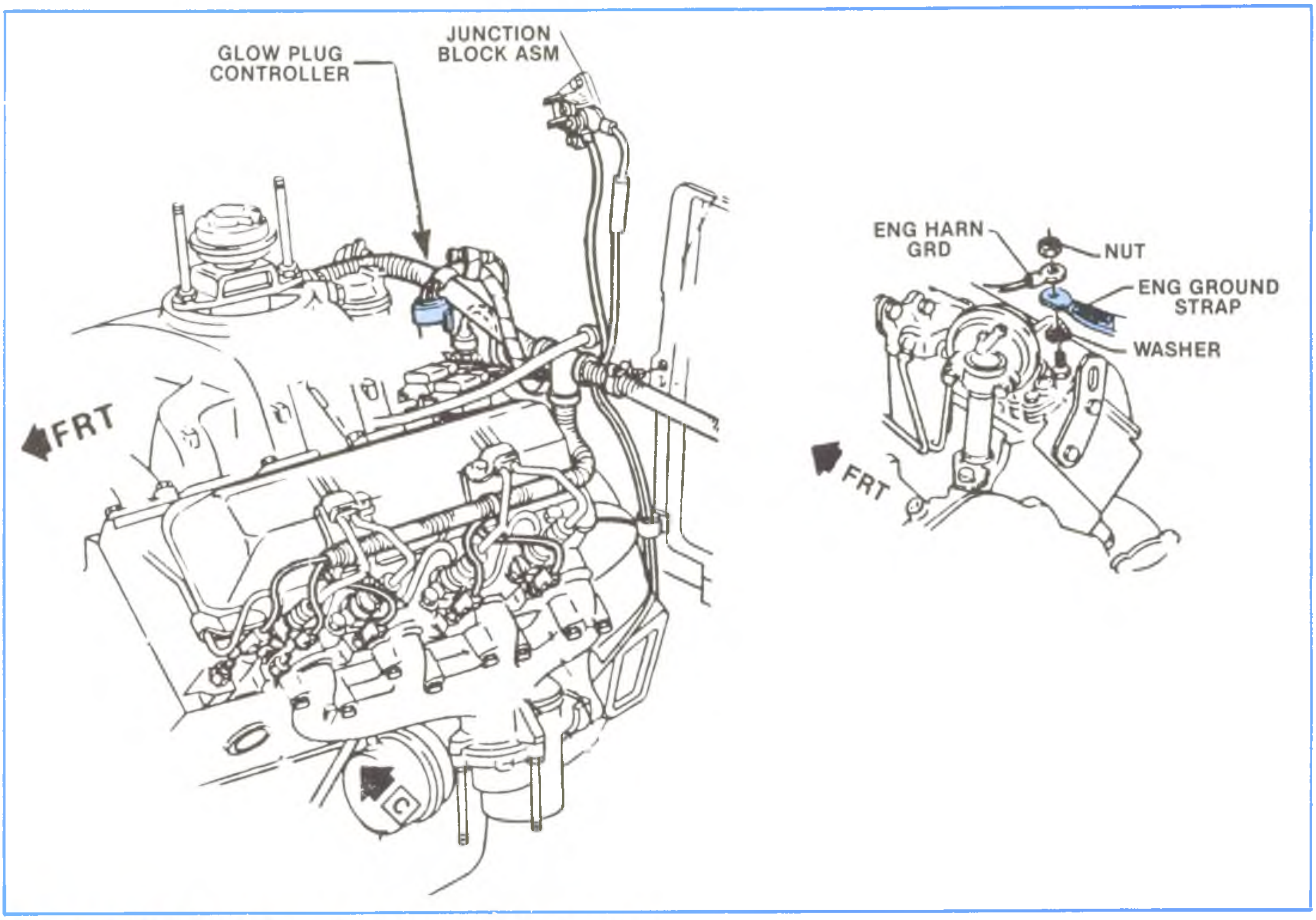


Figure 6-19, Glow Plug Controller Contamination.

THERMAL CONTROLLER CHECK

This should be used when diagnosing the glow plug system on all 1982-84 model trucks with the 6.2L diesel engine, excluding the military (CUCV) vehicles.

With the connector removed from the glow plug controller, the controller bimetal heaters may be tested using a high impedance digital Ohm meter on the 200 Ohm scale. See Figure 6-20.

CHECK	READING
Pins 2 to 3	0.40 to 0.75 Ohms
Pins 4 to 5	24 to 30 Ohms
Pins 1 to 5	117 to 143 Ohms
Pins 2 to 6	Continuity ("0" Ohms)

If the controller does not measure within all the above values, the controller should be replaced.

If the controller checks good to the above measurements, the harness connector should be put back on and insure that the controller cycles on and off more than once with the ignition key on (engine not running). If the controller cycles more than once and the measurements are correct, the controller is good. If the controller cycles only once, the controller is bad or a harness problem exists. Refer to the Glow Plug Electrical System Diagnosis Chart for testing for a harness problem.

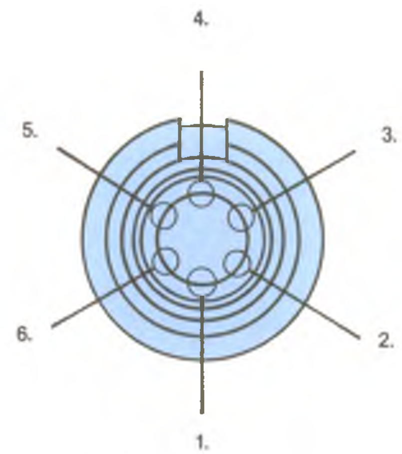


Figure 6-20, Controller Pin-Outs.

DIAGNOSTIC PROCEDURE CHARTS

Figure 6-21 is Chart #1, 6.2L Diesel Glow Plug Electrical System Diagnosis. Figure 6-22 describes the relay not operating diagnostic procedure.

Chart #1 — 6.2 L DIESEL GLOW PLUG ELECTRICAL SYSTEM DIAGNOSIS

Engine does not start cole "GLOW PLUGS" lamp may or may not come on.
1. Fuel system checked and is OK.
2. Battery voltage is 10 volts or more when glow plugs cycle on.
3. Cranking speed OK (100 RPM or more).

Check for glow plug current using clamp on ammeter. (Snap-on MT-552 or equivalent) clamp around dark green wire leading to each plug.

Current at all 8 wires, but glow plugs only come on once.

Check for open circuit in GRN. wire from controller to splice 503.

If OK, go to chart "THERMAL CONTROLLER CHECK"

Current all 8 wires and plugs cycle on and off. Glow plug system is OK, check for other cause of hard starting.

No current at one or more wires. One or more glow plugs not functional. (Approx. 15 amps per plug).

No Current

CHECK 20 AMP FUSE

Fuse OK

Listen for glow plug relay operation. Should be clicking on and off if engine is cold.

Relay Not Operating

Go To Chart "RELAY NOT OPERATING"

Relay Operating

Connect 12-volt test light to ground. Touch the glow plug relay terminal with 2 fusible links. Test light should turn on and off as controller operates relay.

Test Light Does Not Come On

Touch test light to single red wire terminal (Batt. feed) on glow plug relay.

Test Light On

Replace relay. (Contacts burned).

Test Light Off

Locate and repair open circuit in red wire from glow plug relay to battery.

Test Light On Steady

Relay contacts shorted. Replace glow plug relay and all glow plugs.

Test Light Turns On and Off

Touch each glow plug harness terminal with 12-volt test light connected to ground. Test light should pulse on/off.

Test Light Comes On, All 8 Wire Terminals

Disconnect harness from all glow plugs. Connect test light to 12-volt source and touch each glow plug terminal. Light should be on. Replace glow plug if light is off.

Test Light Does Not Come On, One Or More Terminals

Repair open circuit in glow plug harness. If open circuit is caused by burned wire, glow plug is shorted and should be replaced.

Fuse Blown

Disconnect glow plug relay connector at relay. Install new 20 amp fuse and turn ignition to run.

Fuse Blows

Locate and repair short circuit in one of the following:
1. Cold Adv/fast idle temp. switch, fuel heater, or solenoid circuits.
2. L.D. only, throttle switch circuits EPR, EGR, and TCC solenoids.

Fuse OK

Reconnect glow plug relay connector

Fuse Blows

Locate and repair short in wire from relay to connector and replace diode at glow plug relay. (No diode in 1982). (If the diode is shorted or installed backwards the circuit breaker heater in the controller may be damaged).

Fuse OK

Locate and repair intermittent short in glow plug relay coil feed circuit (circuit breaker heater in controller may be damaged).

Figure 6-21, Glow Plug System Diagnosis.

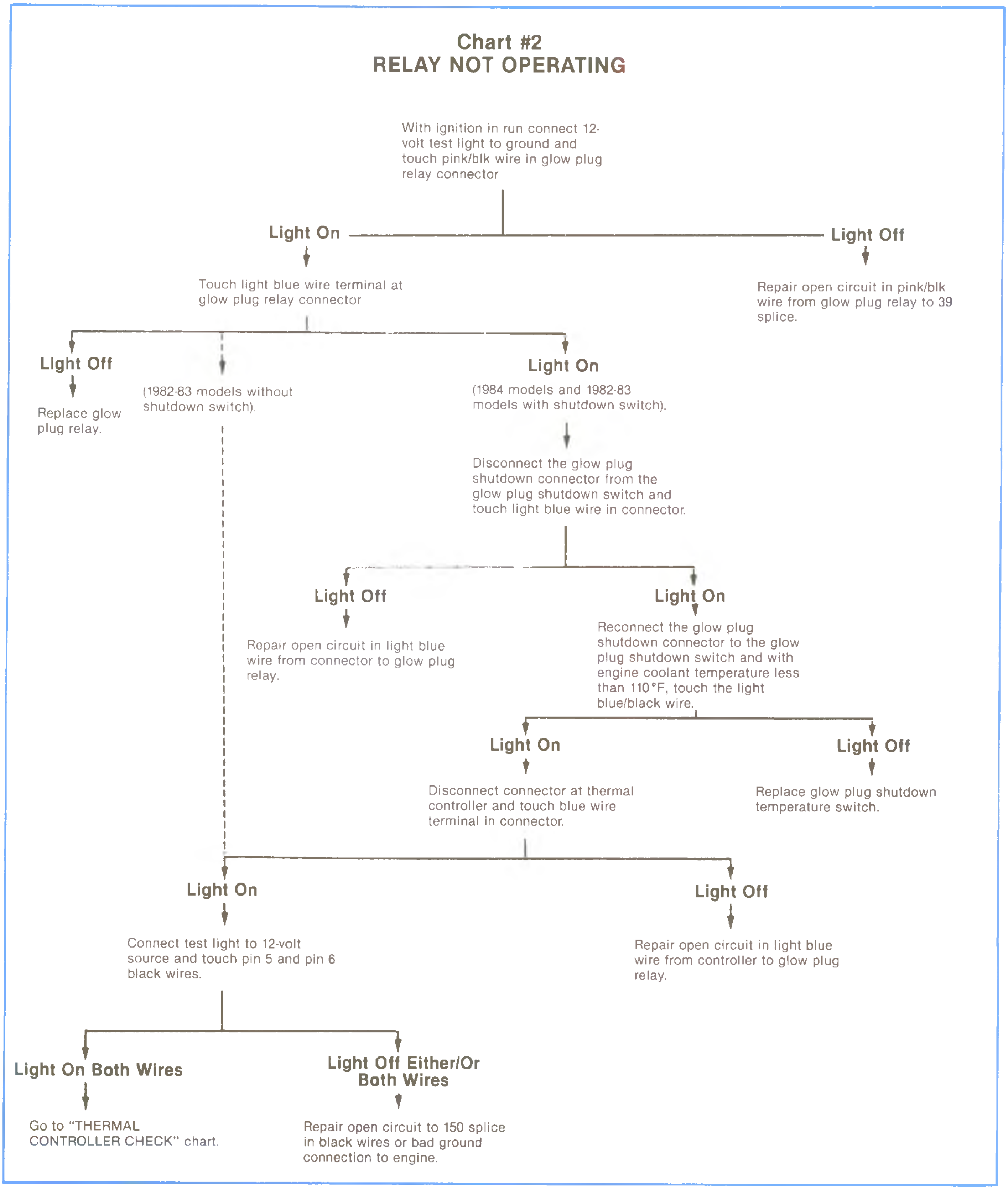


Figure 6-22, Glow Plug System Diagnosis.

Installation of Glow Plug System Inhibit Switch

1982-83 C/K/G/P TRUCK WITH 6.2L DIESEL — RPO LH6 — L.D. EMISSIONS
RPO LL4 — H. D. EMISSIONS

Many times a 6.2L diesel will not require glow plugs to start, such as a warm engine or warm climate.

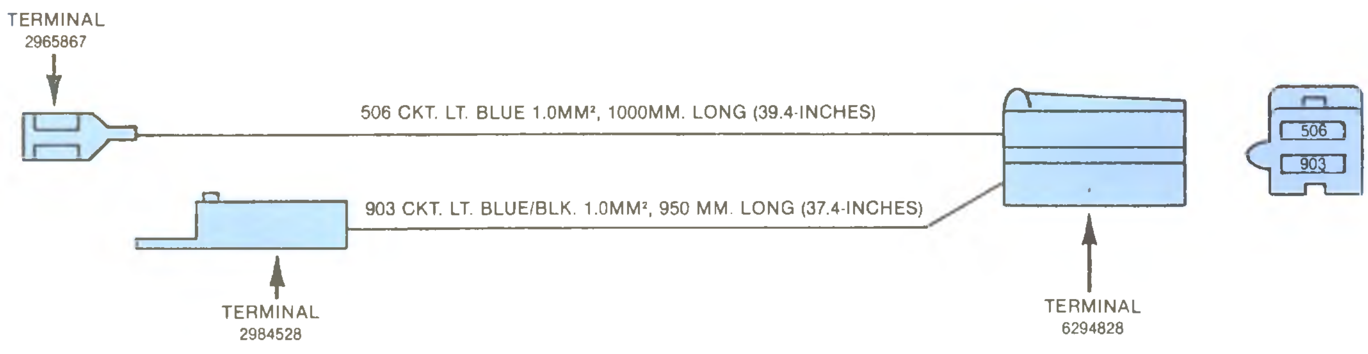
To inhibit glow plug system function when engine coolant temperature is above 125°F and lower glow plug usage, the following parts can be installed.

Inhibit wire assembly; should be assembled per attached drawing (Figure 6-23).

GLOW PLUG INHIBIT TEMPERATURE SWITCH INSTALLATION

1. Disconnect batteries.
2. Replace cover on R.H. rear head (Figure 6-24A) with cover 14028949 (same as on L.H. head) (Figure 6-24B). Use new gasket 14028951. Drain coolant as required.
3. Install new temperature switch 15599010 using appropriate pipe thread sealer. Tighten to 19-27 N·m (13-20 ft. lb.). Replace any lost coolant.
4. Connect glow plug inhibit wire assembly to switch with the light blue (without the stripe) wire terminal mating with the switch terminal.
5. Route the wire assembly toward the left side of the vehicle, strap to the engine harness as required.
6. Disconnect the 4-way engine harness connector from its mate on the glow plug relay extension harness 12031493 (Figure 6-25).
7. Remove the light blue wire female terminal from the engine harness 4-way connector and install connector body 2977253 on this terminal. Plug mating connector on new jumper wire assembly (light blue/black stripe) to 2977253.
8. Insert female terminal of jumper wire assembly into empty cavity of 4-way connector. Reconnect 4-way connectors.
9. Reconnect batteries.

GLOW PLUG INHIBIT WIRE ASSEMBLY



**Use with Temperature Switch #15599010 in 6.2L Diesel Engine.
Connector Body #2977253 also required.**

Figure 6-23, **Glow Plug Inhibit Wire Assembly.**

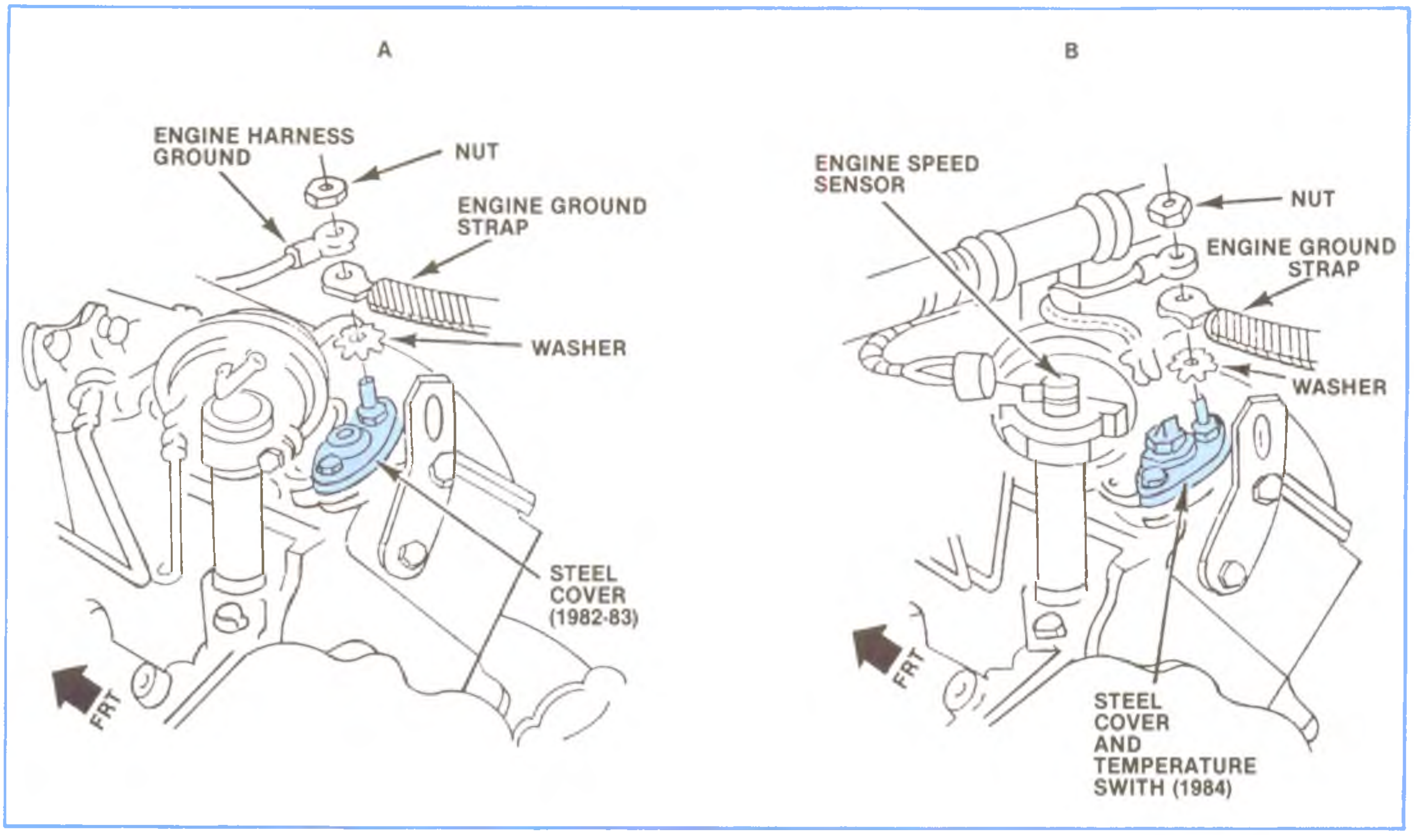


Figure 6-24 A and B, Installation of Temperature Inhibit Switch.

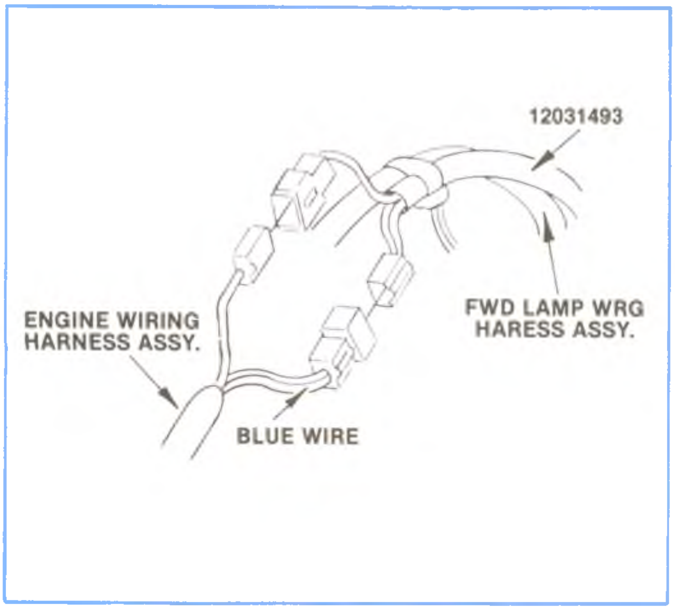


Figure 6-25, Harness Connection.

D-Truck (CUCV) Military 6.2L (LL4) PTC Glow Plug System

The D-Truck (CUCV) System is Composed of:

- 2 Reducing Resistors
- Electronic Module Controller
- Wait Lamp
- Reducing Resistors
- 8 PTC Glow Plugs

REDUCING RESISTORS

See Figure 6-26. Two 300 watt (.280 Ohm) reducing resistors are hooked in a parallel circuit to reduce the 24 volts (used for starting) to 12 volts nominal. This was done to provide voltage to the glow plug system when using the 24 volt slave (jump) start socket.

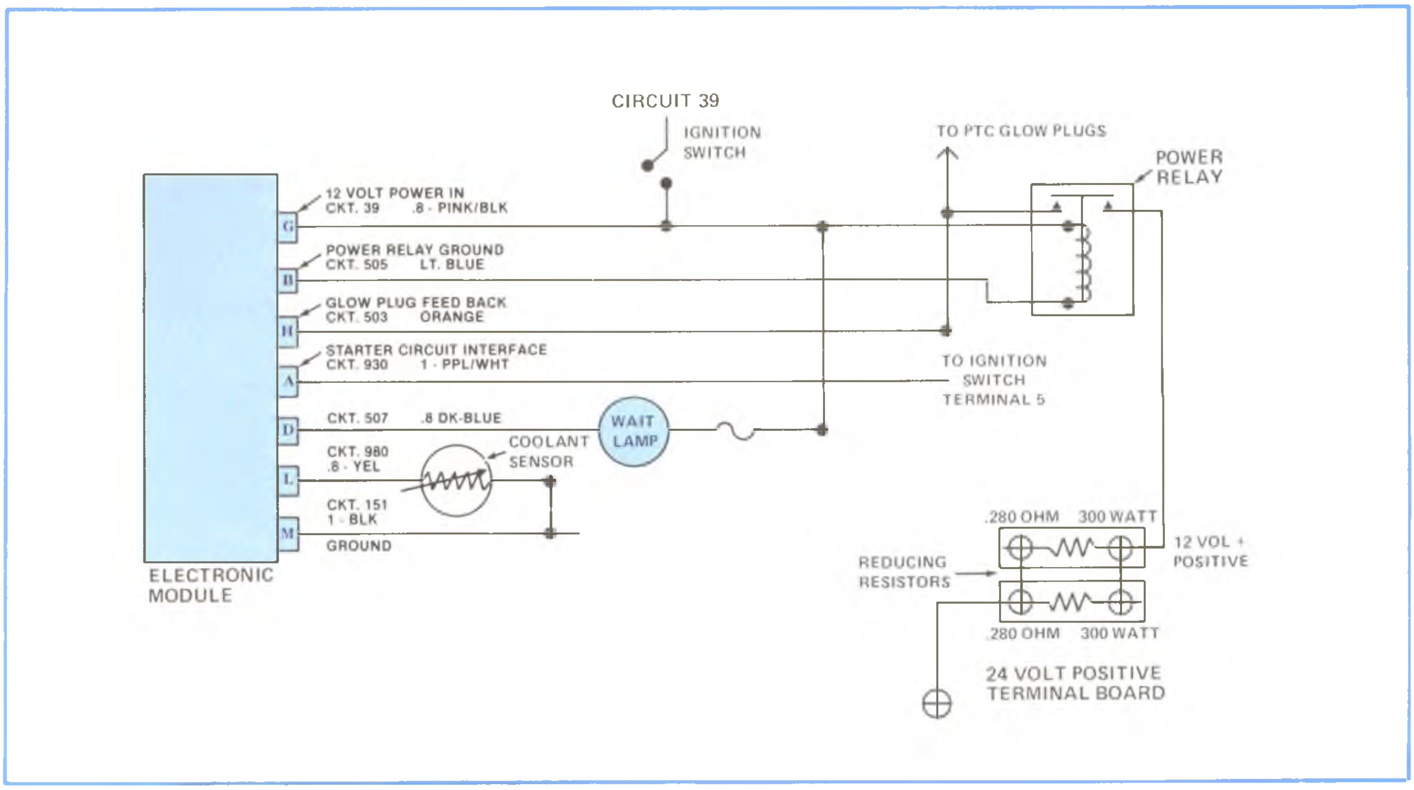


Figure 6-26, **D-Truck Glow Plug System.**

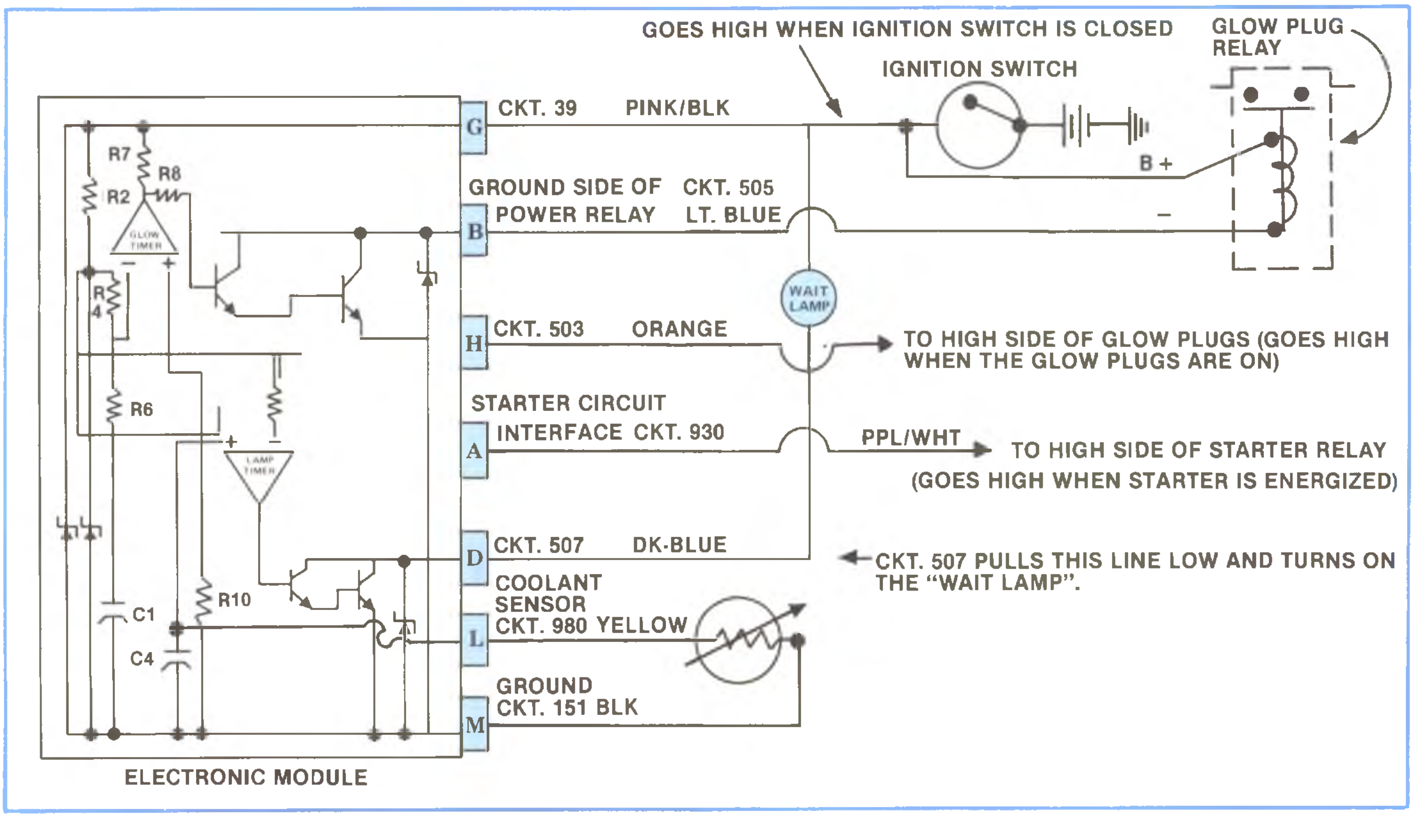


Figure 6-27, **D-Truck Electronic Module Controller.**

System Operation, D-Truck

Refer to Figure 6-27. When turning "ON" the ignition, the following occurs:

WAIT LAMP INDICATION

12 volts B+ flows from the Ignition Switch Circuit 39 to the top pin of the electronic module. This energizes the Darlington Compound Q1 and turns "ON" the second transistor. This transistor grounds the wait lamp and turns it "ON".

POWER RELAY ACTIVATION

12 volts flow from Ignition Circuit 39 to Darlington Compound Q2. This turns "ON" the second transistor, which provides a ground for the power relay.

— NOTE —

This system is regulated by voltage and coolant temperature rise.

When the power relay is energized, 12 volts flow to the glow plugs.

The Power Relay and the wait lamp will both turn "OFF" at the same time.

The system "On-Time" is about 14.5 seconds. The "On-Time" is regulated by:

- Coolant temperature
- Battery voltage
- Battery temperature
- Combustion chamber temperature
- Glow plug counter voltage

When the pre-chamber temperature is about 1650°F, which is determined by glow plug counter voltage, the glow plug timer in the module goes low and turns off Q2 transistor which removes the power relay ground. This turns "OFF" the glow plugs. At the same time, the module lamp turns "OFF" Q1 transistor which ungrounds the wait lamp.

The plugs will be "OFF" for 4.5 seconds. Then they turn "ON" for an "after glow" period. The "after glow" is controlled by generator output voltage, which changes the voltage into the module. The wait lamp will not turn on during after glow.

If the coolant temperature is above 48°C (118°F), the wait lamp will not turn "ON".

Anytime the starter is energized, it will maintain glow plug operation, engine cold, or energize them if the engine is hot.

Glow Plug System Troubleshooting Procedure, D-Truck

1. SYSTEM DEFINITION

For troubleshooting purposes, the glow plug system is divided into two subsystems; the power system and the control system. The power system is shown in Figure 6-28. It consists of the glow plugs, the contacts of the control relay, the series voltage dropping resistor assembly, and associated wiring. The control system is shown in Figure 6-29. It consists of the electronic controller module, the "wait" lamp, the coolant temperature sensor, and associated wiring.

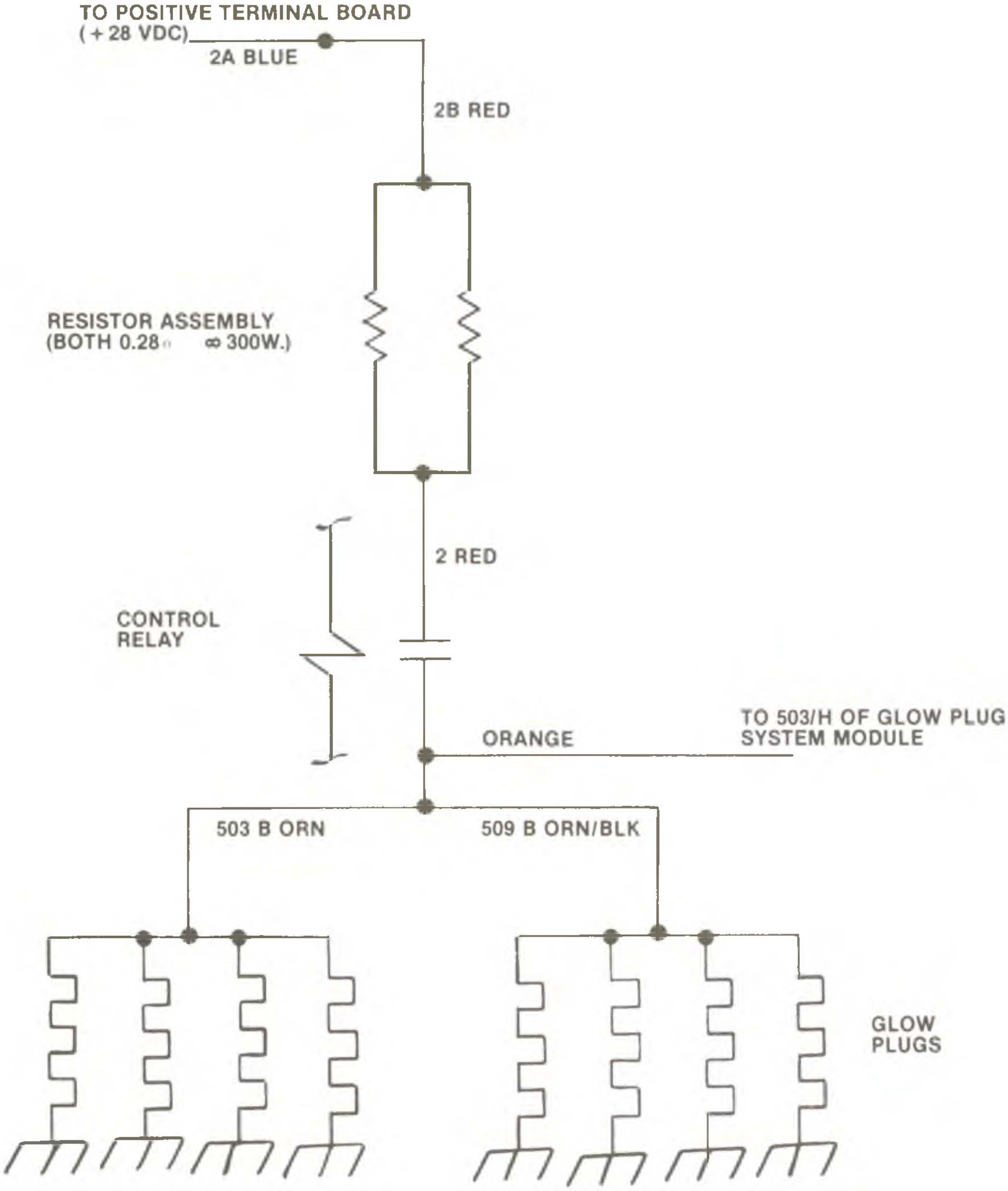


Figure 6-28, Glow Plug Power System, D-Truck.

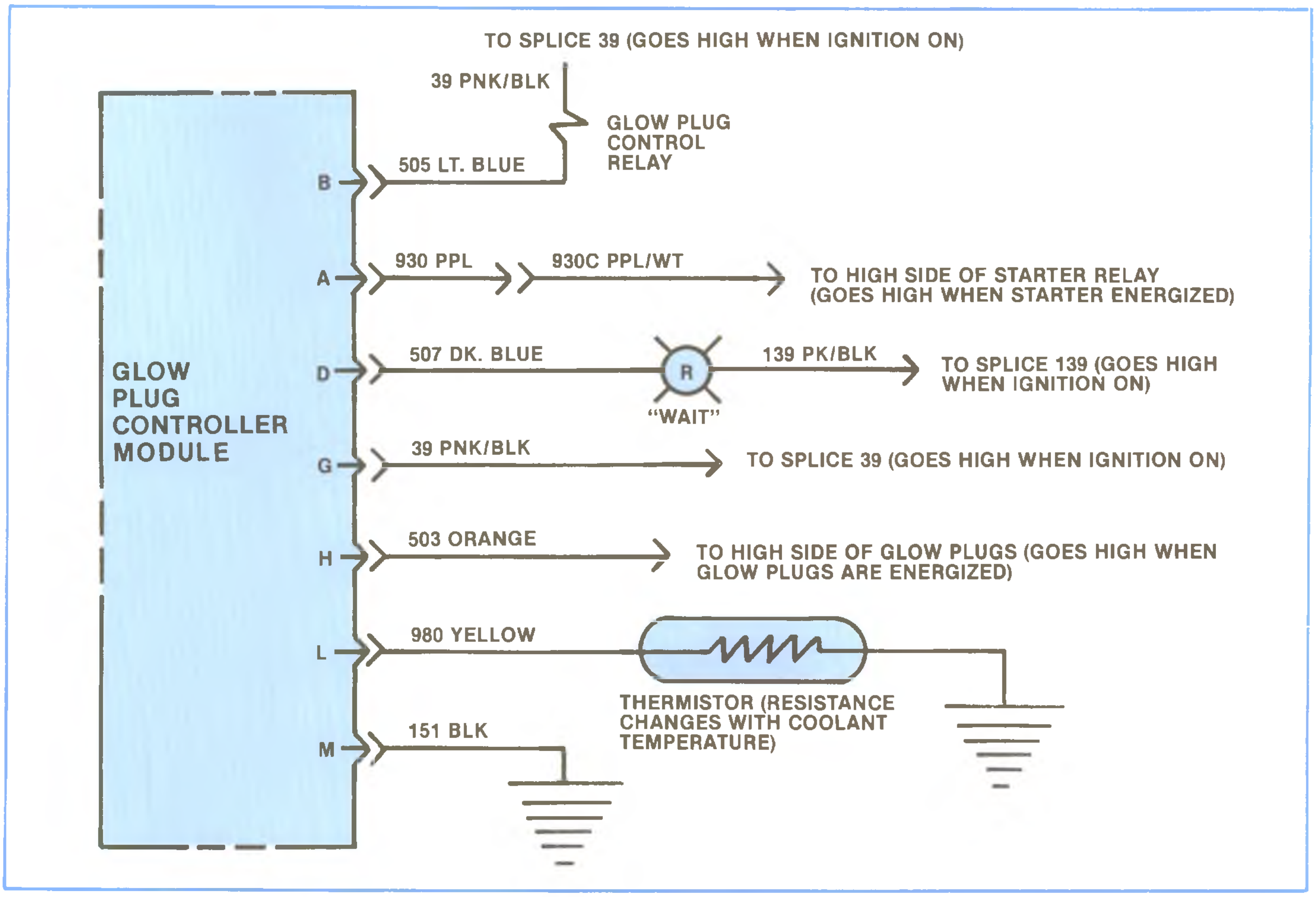


Figure 6-29, **Glow Plug Control System, D-Truck.**

2. TROUBLESHOOTING THE POWER SYSTEM, D-TRUCK

This procedure is illustrated in flow chart form in Figure 6-30. In this procedure, the low side of the control relay coil is disconnected from its harness. This is done to prevent the controller from turning the circuit "ON" and "OFF" during the test. A DC voltmeter is connected across the resistor assembly, and the control relay is briefly turned "ON" by grounding the disconnected terminal. The voltage across the resistors can be quite useful for isolating faults in the system. For example:

- **OV WITH RELAY "OFF" . . .**
  10-15V with relay "ON". Expected values; relay OK, resistors OK, harness and plugs probably OK (maybe one or two open).
- **OV WITH RELAY "OFF" . . .**
  22-28V with relay "ON". Open resistors.
- **10-15V WITH RELAY "ON" OR "OFF" . . .**
  Stuck relay contacts.
- **22-28V WITH RELAY "ON" OR "OFF" . . .**
  Stuck relay contacts and open resistors (since the resistors are operated at a power level considerably higher than their rating, continuous duty could cause them to burn open).
- **OV WITH RELAY "ON" OR "OFF" . . .**
  No current flow. Defective relay or open circuit (possibly all plugs open).

Depending on the findings in this step, the technician is directed to a fault path in the flow chart which will isolate the problem to a particular component.

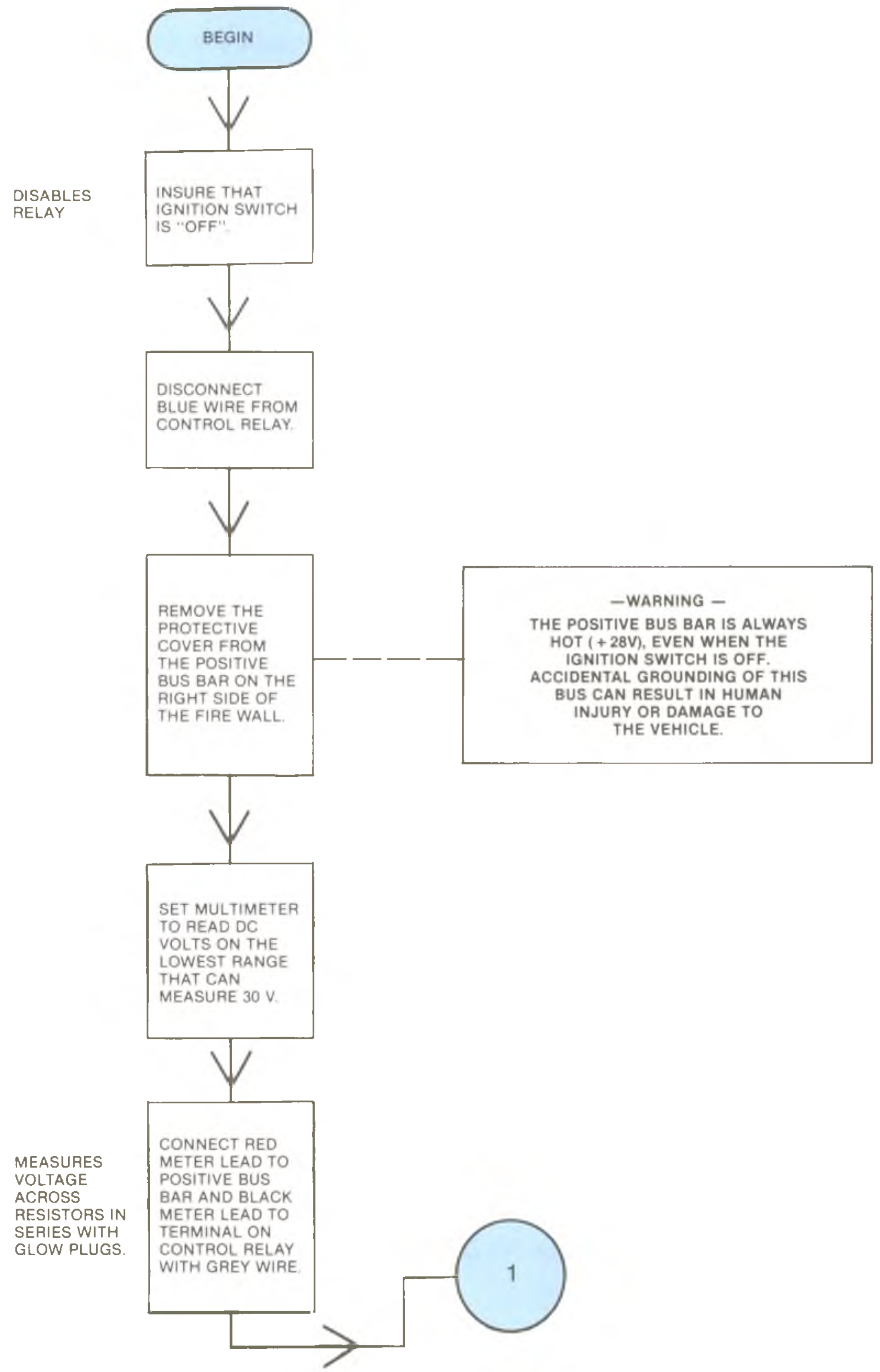


Figure 6-30, Troubleshoot Glow Plug Power Circuit, D-Truck.

3. TROUBLESHOOTING THE CONTROL SYSTEM

Before testing the control system, the power system will be tested and, if necessary, repaired.

Due to the near-nonaccessability of the controller module, no direct measurements will be taken. Instead, the following procedure will be used:

1. Connect a DC voltmeter between ground and the orange wire connector on the relay.
2. Disconnect the pink wire from the fuel shut-off solenoid on the injector pump to keep the engine from starting.
3. Turn "ON" the ignition switch. Plugs and "WAIT" lamp should turn "ON" and "OFF" at irregular intervals lasting several seconds (10-15V displayed on the voltmeter indicates that the plugs are "ON").
4. When plugs and "WAIT" lamp are "OFF", crank engine. Plugs should come "ON" and stay on for duration of cranking. "WAIT" lamp should be "OFF".
5. Plugs should remain "ON" for several seconds after cranking. "WAIT" lamp should be "OFF".

If the plugs and lamp act as described during this sequence, the system can be assumed to be OK. Any major deviation can be assumed to be the fault of the controller module or wiring harness (unless the "WAIT" lamp never comes "ON", whereupon the light bulb is suspect).

The technician should first replace the controller module. If this does not solve the problem, the wiring harness should be replaced. A controller module input-output line description (Figure 6-31) so that, if desired, the technician can trace continuity or voltage levels on specific lines.

PIN NO.	CIRCUIT NO.	WIRE COLOR	I/O	DESCRIPTION
G	39	Pink/Black	I	From splice 39. Goes high when ignition "ON". Serves 3 functions: 1) Provides power to module. 2) When it first goes high, the module starts the glow plug sequence. 3) Allows the module to monitor system voltage level. This value is one of the factors used to determine the duration of "WAIT" light display and "AFTERGLOW".
A	930	Purple	I	From high side of starter relay. Goes high when starter is energized. When this line is high, the glow plugs are "ON" unconditionally.
H	503	Orange	I	From high side of glow plugs. The voltage on this line varies with glow plug resistance, which varies with pre-combustion chamber temperature. Used to determine "ON-time".
L	980	Yellow	I	From thermistor in cooling system. Measures coolant temperature. Used to determine duration of "WAIT" light display.
B	505	Light Blue	O	Normally high. Goes low to turn "ON" glow plug control relay.
D	507	Dark Blue	O	Normally high. Goes low to turn "ON" "WAIT" lamp.
M	151	Black	—	System ground.

Figure 6-31, Glow Plug Controller Module I/O Description, D-Truck.

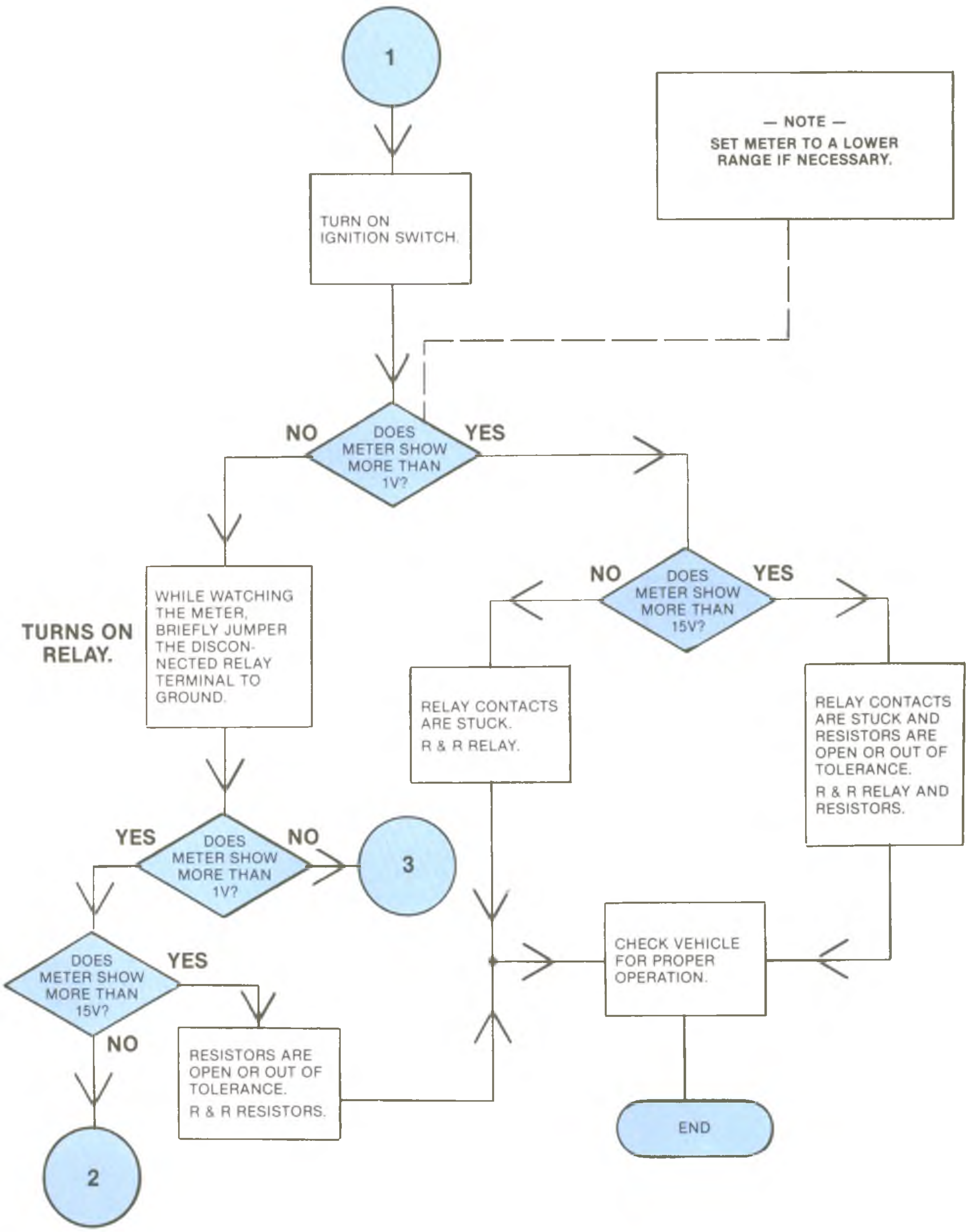


Chart #1, Glow Plug Trouble Shooting Procedure, D-Truck.

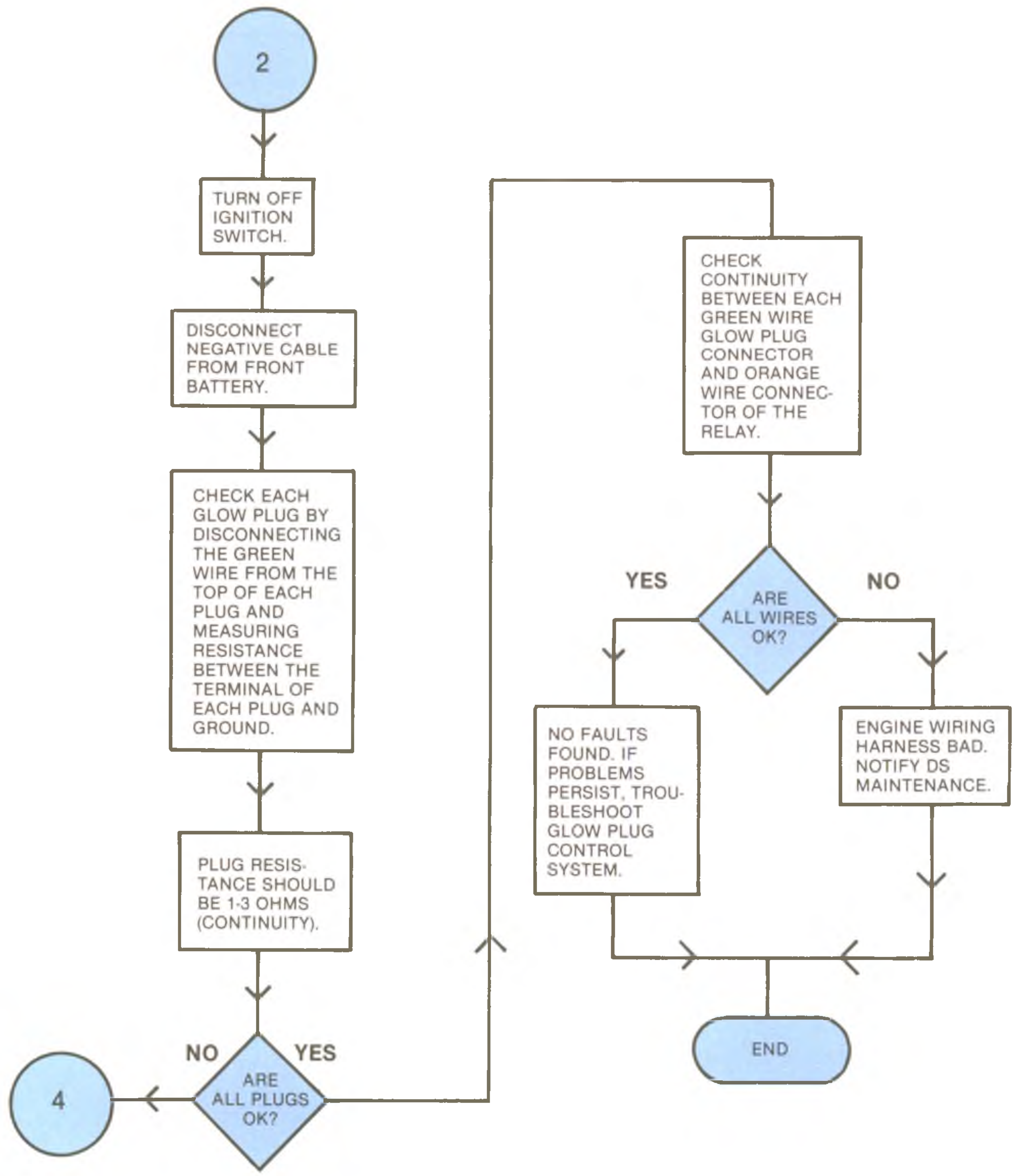


Chart #2, Glow Plug Trouble Shooting Procedure, D-Truck.

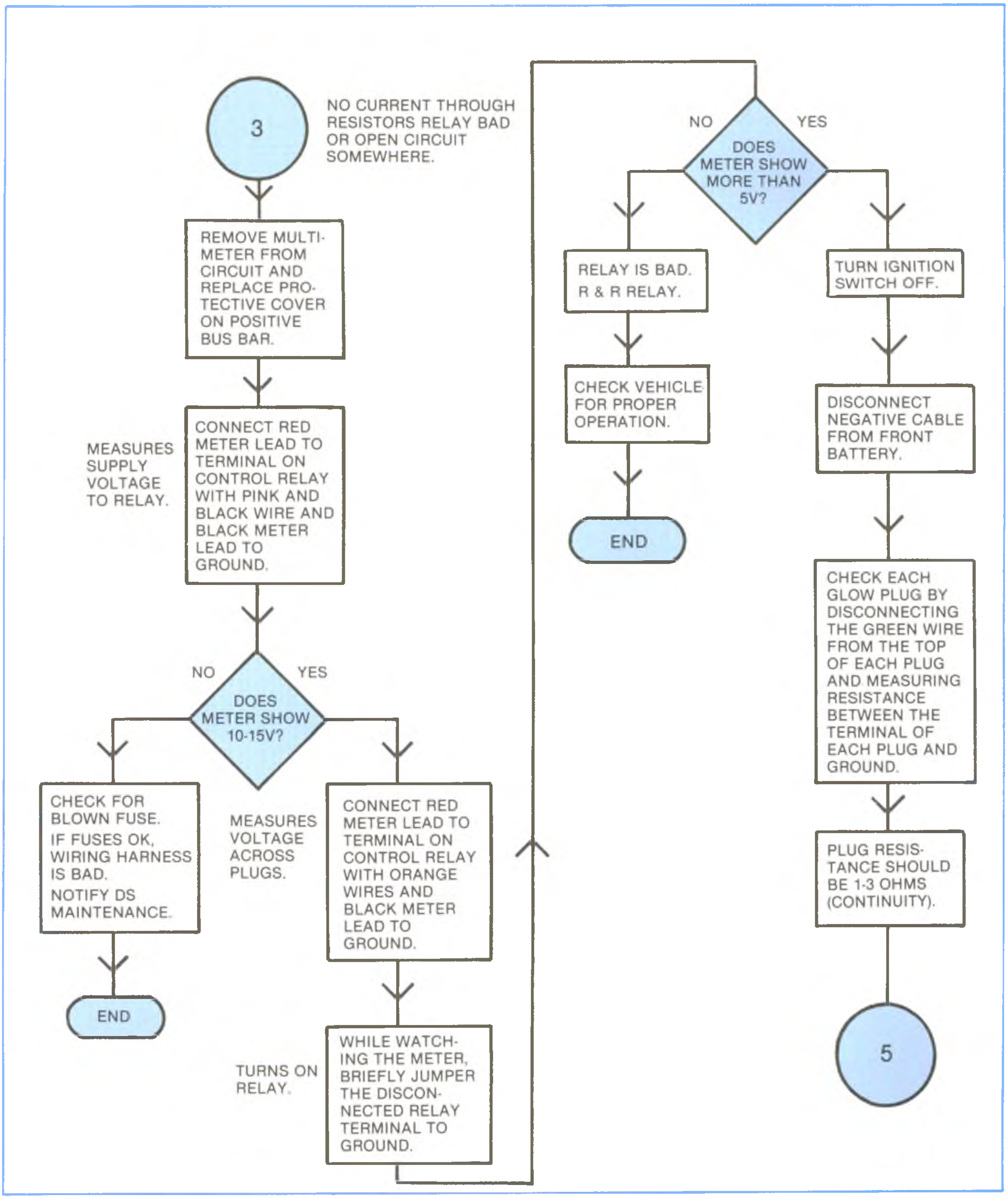


Chart #3, **Glow Plug Trouble Shooting Procedure, D-Truck.**

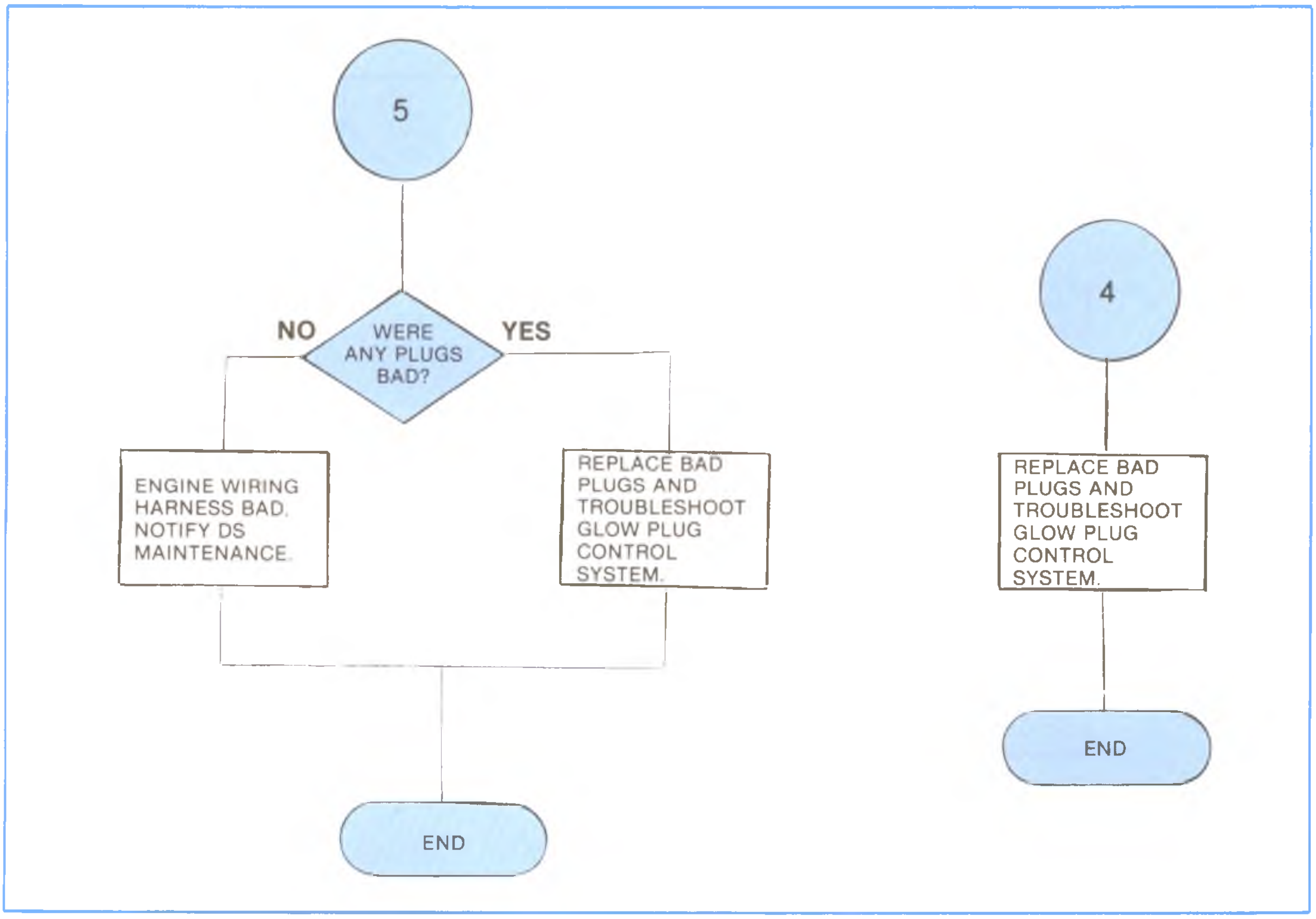


Chart #4-5, Glow Plug Trouble Shooting Procedure, D-Truck.

1985 6.2L (LH6/LL4) Glow Plug Control System, CKGP-Truck

A new glow plug controller is used in the 1985 CK/G, & P trucks with the 6.2L Diesel engine (Figure 6-32). This new controller is electronic and contains an integral glow plug relay. This single unit installs to two 10mm studs at the rear of the left hand head.

The glow plugs are the same as in 1984 and the operation of the "Glow Plug" light remains basically unchanged — that is, it is on wherever the glow plugs are energized.

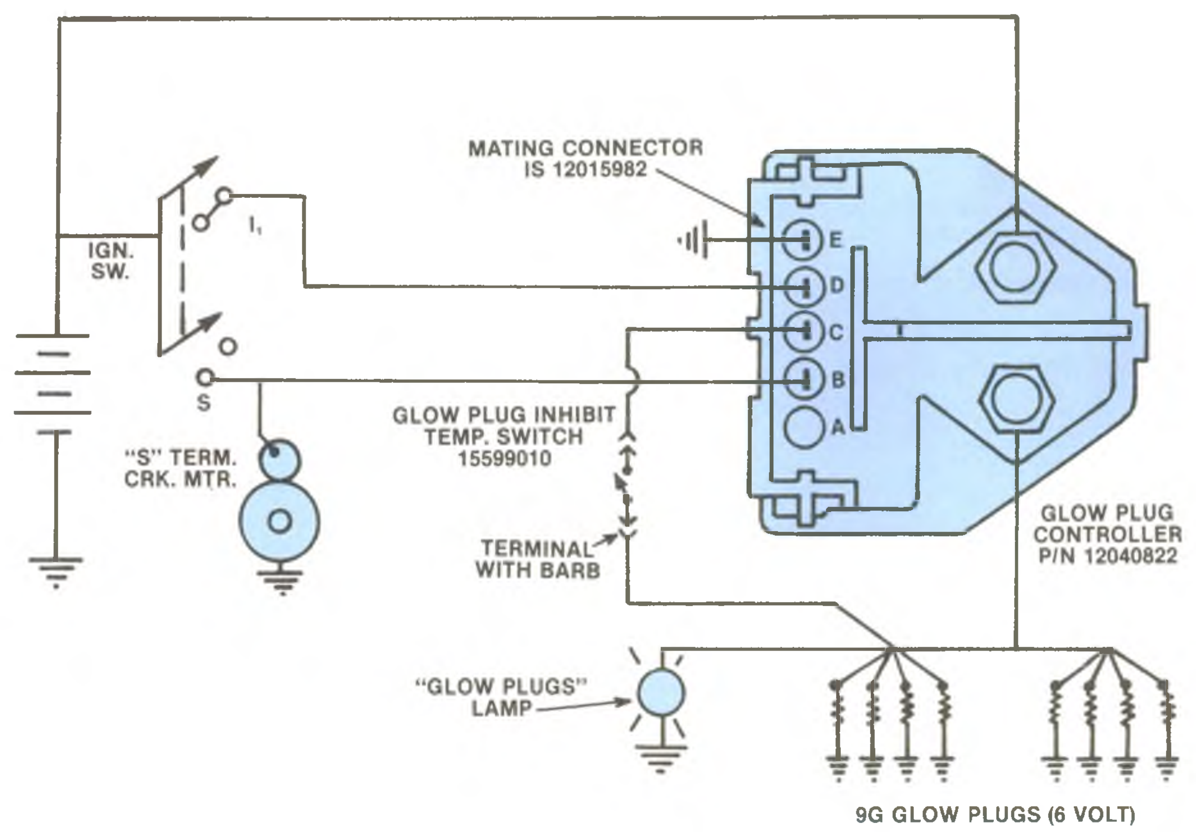


Figure 6-32, Electronic Glow Plug Control System.

A normal functioning system (Green eye in batteries) operates as follows:

- **KEY "ON" — ENGINE NOT RUNNING — VEHICLE AT ROOM TEMPERATURE**
  1. Glow plugs "ON" for 4 to 6 seconds, then "OFF" for approximately 4.5 seconds,
  2. Then cycle; "ON" for approximately 1.5 seconds, "OFF" for approximately 4.5 seconds, and continue to cycle 1.5 "ON"/4.5 "OFF", for a total duration (including the initial 4-6 seconds) of about 25 seconds.
- If the engine is cranked during or after the above sequence, the glow plugs will cycle "ON/OFF" for a total duration of 25 seconds **after** the ignition switch is returned from the crank position, whether the engine starts or not. The engine does not have to be running to terminate the glow plug cycling. All the "times" shown above are approximate because they vary with initial engine temperature.

The initial "ON" time and cycling "ON/OFF" times vary also with system voltage. That is, longer "ON" times are produced by lower voltage and/or temperature. Longer duration of cycling is produced by lower temperature only. The temperature switch in the upper rear of the R.H. head is calibrated to 125°F and above this temperature the glow plugs are not energized.

If the system does not operate as described, check all connectors to ensure they are fully seated. As in the 1982-84 6.2L diesels, the engine harness ground connection to the engine is critical . . . make sure the nut is tightened to specifications and the ground ring terminal is tight.

- **THE OTHER CONNECTIONS TO CHECK IN THE ENGINE COMPARTMENT ARE:**

1. Four-wire connector on controller. If this connector isn't fully seated and latched, the glow plugs may not function.
2. Both stud nuts on controller. Tighten to 4-5 N·m (35-45 lb.-in.). Do not overtorque.
3. Temperature switch connector at top rear of R.H. Head. If this connection is not made, the glow plugs will not energize (Engine temperature must be below 110°F for glow plugs to operate).

If the glow plugs function normally, but the "Glow Plugs" light does not, check all the connections and bulb in the jumper harness in the IP area.

If all connections are intact, but the glow plug system does not operate as stated, proceed with normal electrical diagnostic procedures (Figure 6-33).

— CAUTION —

Do not manually bypass relay in the glow plug controller. Do not jump start with more than 12 Volt System.

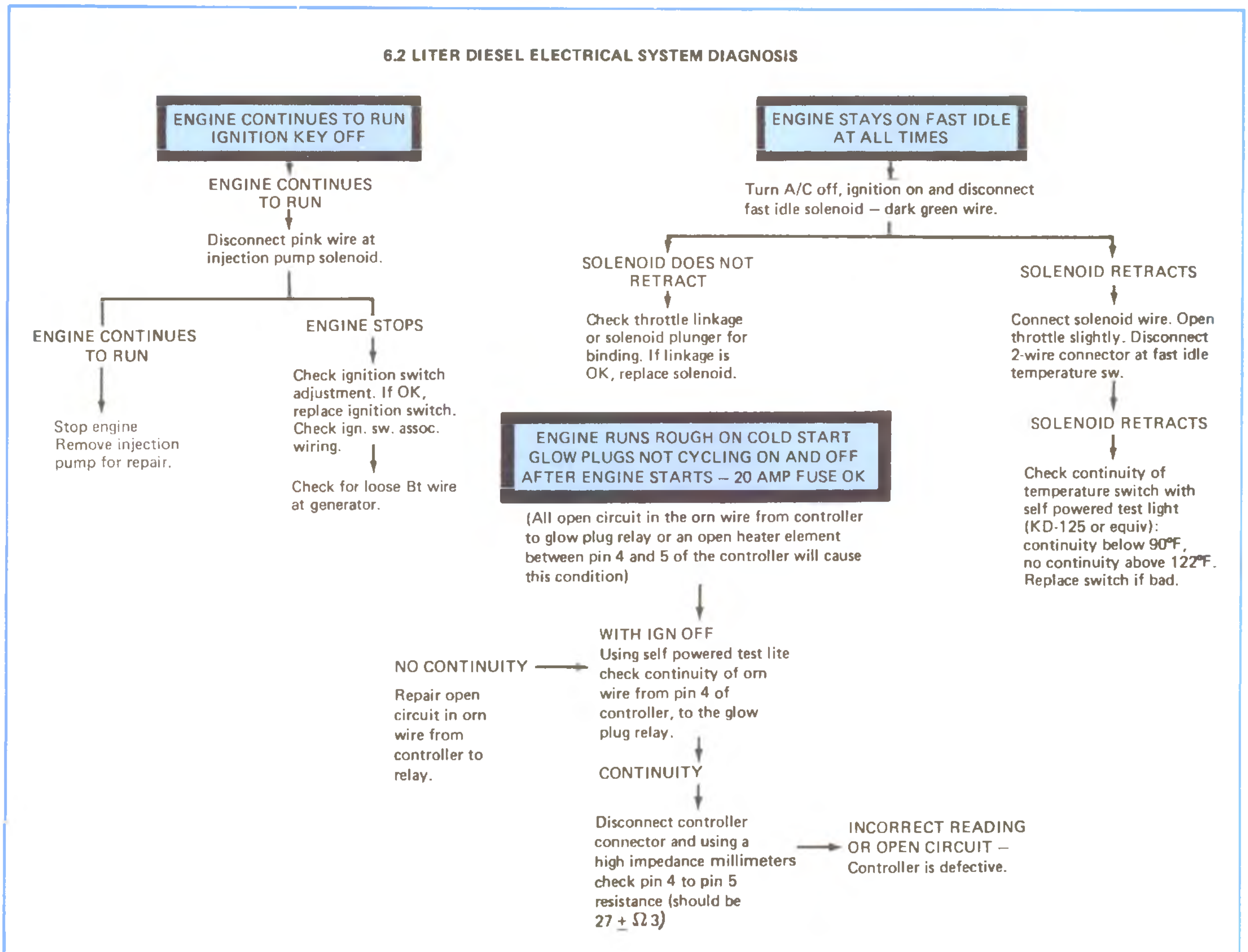


Figure 6-33, General Electrical Diagnosis

1983 Diesel G-Truck Engine Run-On, 6.2L Diesel with Base Engine Warning Lights

A condition exists whereby an electrical feedback signal from the alternator can caust the engine to continue running with the key in the "OFF" position.

The feedback signal prevents the injection pump solenoid from shutting off the fuel supply. This is only in 1983 "G" Truck vehicles equipped with the 6.2L Diesel and base warning light system (tell-tale lights).

To correct an affected vehicle, install jumper wire harness P/N 12038051 (Figure 6-34). This wire incorporates a diode which prevents a feedback signal. This harness assembly is installed in production vehicles starting approximately March, 1983.

USE THE FOLLOWING PROCEDURE TO INSTALL THIS WIRE ON AFFECTED VEHICLES:

1. Disconnect the negative battery cable from both batteries.
2. Remove the engine harness bulkhead connector.
3. Looking into the terminal end of the bulkhead connector, locate the #25 circuit (brown wire) and remove.
4. Insert the end of the jumper harness into the bulkhead connector.
5. Using the supplied terminal, connect the other end of the #25 circuit (brown wire) to the jumper harness.
6. Attach the bulkhead connector.
7. Re-connect both negative battery cables.

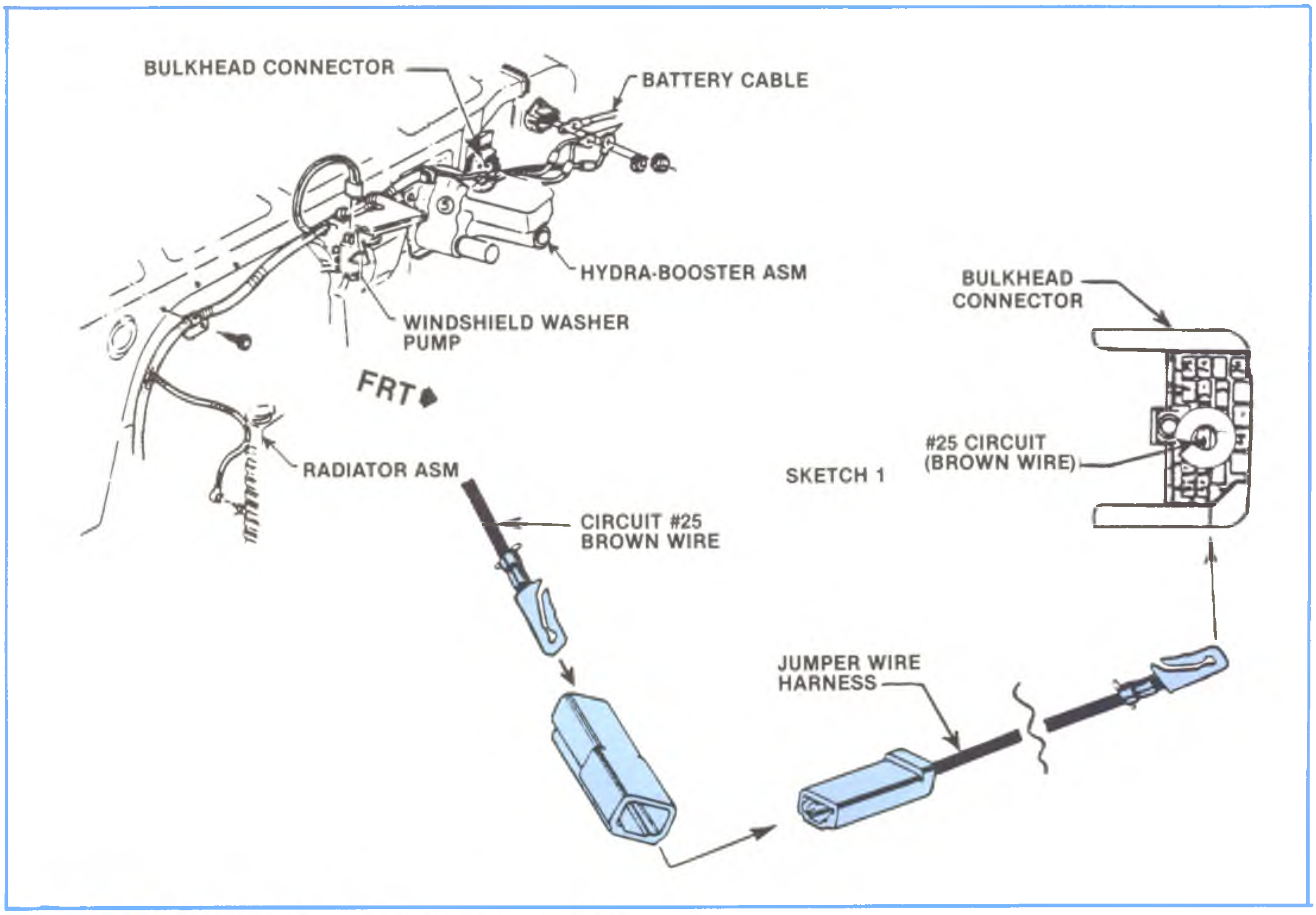


Figure 6-34, Jumper Wire Harness Installation.

6.2L Diesel Drive Belts, 1982-1984 C/K/P/G Truck With 6.2L Diesel Engine

BELT USAGE	RECOMMENDED BELT
Alternator	14050449
A/C Belt	14033869
P.S. Belt	14050459

Pre-delivery retensioning of drive belts in 6.2L diesel engines is **MANDATORY** to maintain proper adjustment throughout the life of the belt.

A high percentage of belt tension is lost during the first 15 minutes that the engine is run. This occurs when the initial stretching of the belt fibers relaxes as the belt seats itself in the pulleys. Vibrations unique to diesel engines, especially at idle, continue to stretch belt fibers throughout the life of the belt, although a majority of this occurs during the first 15 minutes of running time. Once a belt has accumulated 15 minutes running time, it is considered a used belt, and the parameters of belt tension change accordingly.

During the dealer pre-delivery inspection, the belt tension **MUST** be checked. If the tension is below 350 N (80 pounds), the tension must be reset to 445 N (100 pounds).

It is recommended that when a vehicle is in for service and a **NEW** belt is installed that the belt be tensioned to the new belt specification (See attached chart). The engine should then be run for a minimum of 15 minutes at idle and the tension rechecked. If below 350 N (80 pounds), retention the belt to 445 N (100 pounds).

A used belt should never be tensioned to more than 445 N (100 pounds). When checking used belt tension, it will be necessary to run the engine 5 to 15 minutes to assure the belts are hot. Check the belt tension. If under 275 N (60 pounds) **HOT**, the belt must be retentioned to 445 N (100 pounds) **COLD.**

— CAUTION —

Avoid over- or under- tightening belts. Loose belts result in slippage which can lead to belt and pulley "glazing" and inefficient component operation. Once a belt has become "glazed", it will be necessary to replace the belt. Loose belts can also place high impact loads on driven component bearings due to the whipping action of a loose belt. Over tightened belts can lead to bearing damage and early belt failure.

When adjusting drive belts, use belt tension gage J-23600-B.

BELT TENSION (ALL BELTS)		
	IF BELOW: Newton (Pounds)	RETENSION TO: Newton (Pounds)
DEALER (Pre-delivery inspection)	350 (80)	445 (100)
SERVICE (New Belt)	Set Tension to 775 N (175 lbs.)	
SERVICE (New belt after minimum of 15 minutes running time)	350 (80)	445 (100)
SERVICE (Used belt — any mileage over 50 miles)	275-HOT* (60-HOT*)	445-COLD** (100-COLD**)

*HOT = Belt feels hot to the touch. Engine may have to be run 5 to 15 minutes to warm the belt.

**COLD = Belt feels only warm to the touch, or cooler.

— NOTE —

The alternator/vacuum pump belt for 1984 G and P models is #14071081. This is a cog type belt, 49″ x 3/8″.

7. Diagnosis

THIS DIAGNOSIS SECTION IS DIVIDED INTO THE FOLLOWING:

- General/Mechanical Diagnosis
- Smoke Diagnosis
- Idle and Performance Diagnosis
- MPG Diagnosis
- Fuel and Air System Diagnosis
- Brake Diagnosis
- Engine Oil Leak Diagnosis
- Checking For Air Leaks
- Testing Fuel System Pressures

General/Mechanical Diagnosis

Diesel Engine Mechanical Diagnosis such as noisy lifters, rod bearings, main bearings, valves, rings and pistons is the same as for a gasoline engine. This diagnosis covers only those conditions that are different for the diesel engine.

General Diagnosis Charts

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Will Not Crank	a. Loose or Corroded Battery Cables	Check connection at batteries, engine block and starter solenoid.
	b. Discharged Batteries	Check generator output and generator belt adjustment.
	c. Starter Inoperative	Check voltage to starter and starter solenoid. If OK, remove starter for repair.
Engine Cranks (Slowly) But Will Not Start or is Hard to Start — Hot or Cold (Minimum Cranking Speed is 100 RPM Cold, 180 RPM Hot.	1. Low Cranking Speed Due to:	
	a) Loose or Corroded Battery Connections	Clean and/or tighten terminals.
	b) Partially Discharged Batteries	Charge batteries and check charging system including belt tension and battery terminals.
	c) Wrong Engine Oil	Use correct viscosity oil.
	d) Defective Cranking Motor	Repair or replace as necessary.

Figure 7-1, Summary of Major Diagnosis Conditions.

◉ LIKELIEST CAUSES

• POSSIBLE CAUSES

	CONDITION	WILL NOT START	HARD STARTING	STARTS – THEN STOPS	ROUGH IDLE	MISSES	DILUTION OF OIL	KNOCKS	LOW POWER	BLACK SMOKE AT IDLE	BLACK SMOKE AT LOAD	WHITE SMOKE	EXCESSIVE FUEL CONSUMPTION	NO HEAT FROM HEATER
AIR SYSTEM	RESTRICTED AIR INTAKE		•	•					•	•	•		•	
	HIGH EXHAUST BACK PRESSURE			•					•		•		•	
FUEL SYSTEM	OUT OF FUEL	◉		•										
	RESTRICTED FUEL RETURN LINE			•	•	•			•			•	◉	
	AIR LEAKS IN SUCTION LINES	•	•	•	•	•			•			•		
	RESTRICTED FUEL LINE OR FILTER	•	•	•		•			•	•	•	•	•	
	EXTERNAL FUEL LEAKS		•	•	•	•			•				•	
	NOZZLES		•		◉	◉		◉	◉	•	◉		◉	
	FAST IDLE INOPERATIVE			•	•									
	FAULTY FUEL SUPPLY PUMP	•	•	◉	•	•	•						•	
	INCORRECT FUEL (GASOLINE)	•	•			•		•	•		•		•	
	PARAFFIN DEPOSIT IN FILTER	•	•	•					•					
	IDLE SPEED TOO LOW			◉	•									
	INJECTION PUMP	•	•	•	•	•	•	•	•		•	•	•	
OIL	WRONG GRADE FOR AMBIENT	◉	•									•		
MECHANICAL	HEAD GASKET LEAKS								•				•	◉
	BROKEN OR WORN PISTON RINGS				•		•	•	•	•			•	
	VALVE LEAKAGE				•	•			•				•	
	INCORRECT BEARING CLEARANCE							•						
	DAMAGED BEARINGS							•						
	LOW COMPRESSION	•	•		•	•					•		•	
	LOOSE TIMING CHAIN				•	•			•			•	•	
	TIMING ADVANCED		•		•			•	•	◉	◉		•	
	TIMING RETARDED		•		•				•			◉	•	
	CAMSHAFT WORN		•		•	•			•		•		•	
	STUCK OPEN EGR										◉			
ELECTRICAL	BATTERIES NOT CHARGED	◉												
	GLOW PLUGS INOPERATIVE	◉	◉									•		

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Cranks Normally — Will Not Start	a. Incorrect Starting Procedure	Use recommended starting procedure.
	b. Glow Plugs Inoperative	Refer to Section 6.
	c. Glow Plug Control System Inoperative	Refer to Section 6.
	d. No Fuel Into Cylinders	Remove any one glow plug. Depress the throttle part way and crank the engine for 5 seconds. If no fuel vapors come out of the glow plug hole, go to step e. If fuel vapors are noticed remove the remainder of the glow plugs and see if fuel vapors come out of each hole when the engine is cranked. If fuel comes out of one glow plug hole only clean and test the injection nozzle in that cylinder. Crank the engine and check to see that fuel vapors are coming out of all glow plug holes. If fuel is coming from each cylinder, go to step k.
	e. Plugged Fuel Return System	Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection, route it to the metal container. Crank the engine. If it starts and runs, correct restriction in fuel return lines. If it does not start, remove the top of the injection pump and make sure that it is not plugged. NOTE: If fitting is plugged and/or small black particles are visible in the pump, a governor weight retaier flex ring may be needed (See Section 4B).
	f. No Fuel to Injection Pump	Loosen the line coming out of the filter. Crank the engine, the fuel should spray out of the fitting, use care to direct fuel away from sources of ignition. If fuel sprays from the fitting go to step j.
		NOTE: Perform fuel supply system checks at the end of this section.
	g. Restricted Fuel Filter	Loosen the line going to the filter. If fuel sprays from the fitting, the filter is plugged and should be replaced. Use care to direct the fuel away from sources of ignition.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Cranks Normally — Will Not Start (Cont'd)	h. Fuel Pump Inoperative	Remove inlet hose to fuel pump. Connect a hose to the pump from a separate container that contains fuel. Loosen the line going to the filter. If fuel does not spray from the fitting, replace the pump. Use care to direct the fuel away from source of ignition.
	i. Restricted Fuel Tank Filter	Remove fuel tank and check filter. (Filter for diesel fuel is blue.)
	j. No Voltage to Fuel Solenoid	1. Connect a voltmeter to the wire at the injection pump solenoid and ground. The voltage should be a minimum of 9 volts. If there is inadequate voltage, refer to the ELECTRICAL DIAGNOSIS in Service Manual for more information. 2. Disconnect pink lead from terminal on top of injection pump. Turn key to "ON" position. Touch lead to and remove — audible clicking sound should be heard from within pump. If no sound is heard, turn key off and remove governor cover. Check solenoid arm and plunger for freedom of movement. Repair or replace solenoid as necessary. *NOTE: Occasionally, plunger solenoid stickiness may be caused by an accumulation of metallic debris in the mechanism. Before replacing inoperative solenoids, blow off the debris with compressed air and recheck for proper operation by applying a minimum of 12 volts to the terminal and grounding the cover.*
	k. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel. Replace with correct fuel. To verify suspected poor quality fuel, connect a hose to the inlet of the fuel supply pump and route to a container of known good quality fuel. If engine starts and runs, drain and flush poor fuel from vehicle.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Cranks Normally — Will Not Start (Cont'd)	l. Pump Timing Incorrect	Make certain that pump timing mark is aligned with mark on adapter or front cover. Check timing with timing meter (if available or applicable)
	m. Low Compression	Check compression to determine cause. Repair as necessary. The 6.2L Diesel should have compression in each cylinder of at least 380 psi, and the lowest cylinder reading should not be less than 80% of the highest cylinder reading.
	n. Bent Upper Compression Ring	Replace rings.
	o. Injection Pump Malfunction	With pump on engine, check transfer pressure during cranking. Housing pressure should be a minimum of 2 psi **less** than transfer pressure which should be at least 10 psi. Also check the transfer pump pressure at idle, should be approximately 30 psi. If incorrect, remove pump from engine and have the calibration checked by an authorized repair agency. Particular attention should be paid to cranking delivery and transfer pressure at cranking speed.
	p. Nozzle Malfunction	Remove nozzles from engine and check on nozzle tester according to manufacturers' instructions.
	q. Air In Fuel Supply Lines	Connect a known good hose to a container of known good fuel, if engine starts, locate source of air leak in supply lines. See "checking for air leaks", page 7-38).
Instrument Panel Oil Warning Lamp "ON" at Idle	a. Oil Cooler or Oil or Cooler Line Restricted	Remove restrictions in cooler or cooler line.
	b. Oil Pump Pressure Low	See oil pump repair procedures in the Service Manual.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Will Not Shut Off With Key	a. Injection Pump Fuel Solenoid Does Not Return Metering Valve to "OFF" Position	Refer to ELECTRICAL DIAGNOSIS in the Service Manual.
NOTE: With Engine at Idle, Pinch the Fuel Return Line at the Flexible Hose to Shut Off Engine.	b. Disconnect Pink Wire at Solenoid, if Engine Now Shuts Off	Refer to ELECTRICAL DIAGNOSIS in the Service Manual.
	c. An Electrical Feedback Signal From the Generator.	1. 1983 G-Van without gages use a jumper wire pin 12038051. This wire incorporates a diode which prevents feedback. 2. Disconnect the negative battery cable from both batteries. 3. Remove the engine harness bulkhead connector. 4. Looking into the terminal end of the bulkhead connector, locate the #25 circuit (brown wire) and remove it. 5. Insert the end of the jumper harness into the bulkhead connector. 6. Using the supplied connector, connect the other end of the #25 circuit (brown wire) to the jumper harness. 7. Attach the bulkhead connector. 8. Reconnect both negative battery cables.
	d. If the Engine Still Does Not Shut Off	Remove injection pump for repair.
Engine Starts But Will Not Continue to Run at Idle and Stalls	a. Slow Idle Incorrectly Adjusted	Adjust idle screw to specification.
	b. Fast Idle Solenoid Inoperative	With engine cold, start engine; solenoid should move to hold injection pump lever in "fast idle position". If solenoid does not move, refer to ELECTRICAL DIAGNOSIS in the Service Manual.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Starts But Will Not Continue to Run at Idle and Stalls (Cont'd)	c. Restricted Fuel Return System	Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection; route it to the metal container. Crank the engine and allow it to idle. If engine idles normally, correct restriction in fuel return lines. If engine does not idle normally, remove the return line check valve fitting from the top of the pump and make sure it is not plugged.
		NOTE: If the fitting is plugged and/or small black particles are visible in the pump, a governor weight retainer flex may be at fault. See Section 4B
	d. Glow Plugs Turn Off Too Soon	Refer to Section 6.
	e. Pump Timing Incorrect	Make certain that timing mark on injection pump is aligned with mark on adapter or front cover.
	f. Limited Fuel to Injection Pump (Fuel Supply)	Test the engine fuel pump; check fuel lines. Replace or repair as necessary.
	g. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	h. Low Compression	Check compression to determine cause.
	i. Fuel Solenoid Closes in Run Position	Ignition switch out of adjustment. If OK, refer to ELECTRONIC DIAGNOSIS in Service Manual.
	j. Injection Pump Malfunction	Remove injection pump for repair.
	k. Incorrect or Poor Quality Fuel	Replace with correct fuel. To verify suspected poor quality fuel, connect a hose to the inlet of the fuel supply pump and route to a container filled with known good quality fuel. Start and run engine. If performance of engine improves, drain and flush system of poor fuel and replace with correct fuel.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Starts But Will Not Continue to Run at Idle and Stalls (Cont'd)	I. Air in Fuel	Check for presence of air by disconnecting fuel return line from top of pump and connecting a clear hose to return fitting. Route hose to a metal container. Start engine and allow to idle. Watch return fuel for air bubbles. If bubbles are present, locate source of air leak in fuel supply system and correct. If stalling occurs *only* on cold engine start up, check for fuel leaking backwards, or air leaking into the fuel supply lines. See page 7-38 for "Checking for Air Leaks". Pin hole in tank sending unit.
Engine Stalls Under Deceleration or Heavy Braking	a. Idle Speed Too Low	Adjust to specification and also check and adjust fast idle solenoid.
	b. Governor Weight Retainer Ring Fault.	Remove governor cover and check for small black particles. If they are present, a governor weight retainer flex ring may be at fault.
	c. Binding Condition Between Min-Max Block and Throttle Shaft	To check for binding between min-max block and throttle shaft, remove governor cover, place throttle in low idle position and slide min-max governor back and forth on guide stud. Assembly should move freely without binding.
	d. Sticky Metering Valve or Linkage in Injection Pump	Remove pump from engine, mount on test bench and check calibration paying particular attention to low idle settings and action of governor around low idle speed. Repair or replace metering valve or other governor components as necessary (See appendix 5).
Excessive Surge at Light Throttle, Under Load **NOTE:** If Engine Has a Rough Idle	a. Torque Converter Clutch Engages Too Soon	See Section 7A, of the Service Manual "Torque Converter Clutch Diagnosis".
	b. Timing Retarded	Be sure timing mark on injection pump is aligned with mark on adapter or front cover.

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Surge at Light Throttle, Under Load (Cont'd)	c. Clogged Fuel Filter	Check fuel pump pressure on inlet and outlet sides of filter, 5.5-6.5 psi.
	d. Injection Pump Housing Pressure Too High	1. Repair return line restriction. 2. Replace back leak connector.
	e. Injection Line Volume Too Low	Replace affected line(s).
	f. Low Opening Pressure Nozzle	Replace nozzle.
Engine Starts, Idles Rough, WITHOUT Abnormal Noise or Smoke (Fully Warmed Up Engine)	a. Slow Idle Incorrectly Adjusted	Adjust slow idle screw to specification.
	b. Injection Line Leaks	Wipe off injection lines and connections. Run engine and check for leaks. Correct leaks.
	c. Restricted Fuel Return Systems	Disconnect fuel return line at injection pump and route hose to a metal container. Connect a hose to the injection pump connection; route it to the metal container. Start the engine and allow it to idle; if engine idles normally, correct restriction to fuel return lines. If engine does not idle normally, remove the return line check valve fitting from the top of the pump and make sure it is not plugged.
	d. Air in System	Install a section of clear plastic tubing on the fuel return fitting from the engine. Evidence of bubbles in fuel when cranking or running indicates the presence of an air leak in the suction fuel line. Locate and correct. If foam or bubbles are present, proceed as follows: 1. Raise vehicle and disconnect both fuel lines at the tank unit. 2. Plug the smaller disconnected return line. 3. Attach a low pressure (preferably hand operated pump) air pressure source to the larger 3/8 fuel hose and apply 8-12 psi. 4. Observe the pressure pump reading of 8-10 psi. A decrease in pressure will push fuel out at the leak point indicating the location of the leak.

CONDITION	POSSIBLE CAUSE	CORRECTION
Fully Warmed Up Engine Idles Rough in Neutral and/or Drive (Cont'd)	d. Air in System (Cont'd)	5. Repair as necessary. In checking for air comments, the proper size clamps on all hoses should be checked. Also, a burr on the edge of a pipe could rip the inside of a line and create air ingestion. Particular attention should be given to improper installation or defective auxiliary filters or water separators.
	e. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	f. Nozzle(s) Malfunction	Perform glow plug resistance test (in this section), or crack open the nozzle inlet fitting, to locate the missing cylinder.
	g. Incorrect Timing **NOTE: Retarded timing will cause white smoke. Advanced timing will cause black smoke.**	1. Check housing pressure and supply pressure. If housing pressure is higher than 12 psi or supply pressure is lower than 5 psi, the injection pump advance mechanism may be too far retarded. Replace fuel filters, supply pump, or clear return line restriction as necessary to correct. 2. Check timing. 3. If pump is equipped with mechanical light load advance, check for sticky or stuck advance mechanism (internal timing) by depressing the rocker level on the side of the injection pump while the engine is idling. If the engine sound does not change, the pump should be removed and sent to an authorized agency for repairs.
	h. Governor Weight Retainer Flex Ring Fault	Remove governor cover and check for small black particles. If they are present a governor weight retainer flex ring may be at fault. See Section 4B.
	i. Low or Uneven Engine Compression	Check compression according to engine manual. GM diesel engines should have compression in each cylinder of at least 380 psi, and the lowest cylinder reading should not be less than 80% of the highest cylinder reading.

CONDITION	POSSIBLE CAUSE	CORRECTION
Fully Warmed Up Engine Idles Rough in Neutral and/or Drive (Cont'd)	j. Internal Injection Pump Fault	Remove pump from engine and have calibration checked by an authorized agency.
Cold Engine Idles Rough After Start-up But Smooths Out as it Warms Up. (This Problem is Often Accompanied by White Exhaust Smoke)	a. Incorrect Starting Procedure	See section 1 or owners manual for starting procedure.
	b. Fast Idle Solenoid Inoperative or Set Incorrectly	Test and re-set according to engine manual or vehicle emissions sticker.
	c. Air in Fuel	See page 7-38 "Checking For Air Leaks".
	d. One or More Glow Plugs Inoperative	Perform glow plug system diagnosis, Section 6.
	e. Injection pump timing to engine.	Check alignment of timing mark on pump with the engine front cover.
	f. Insufficient engine break-in time.	Break-in engine 2,000 or more miles.
	g. Incorrect Internal Timing	1. *Automatic Advance Fault* The pump is equipped with mechanical light load advance, check for stuck or sticky advance mechanism by depressing the rocker lever on the side of the pump while the engine is idling. If the engine sound doesn't change, the pump should be removed and sent to an authorized agency for repairs. 2. *Housing Pressure Cold Advance Malfunction* Check pump housing pressure. Pressure should be 0-1 psi when the engine is cold and 8-12 psi when the engine is fully warmed up.
	h. Nozzle Valve(s) Sticking Open (Usually Accompanied by Knocking Sound)	Remove nozzles from engine and repair or replace as necessary.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine Misfires Above Idle or Runs Rough While Driving But Idles OK ("Chuggle" in Vehicles Equipped with a Transmission Converter Clutch (TCC).	a. Incorrect Pump to Engine Timing	Check and adjust timing to specifications.
	b. Air in Fuel	Check for presence of air by disconnecting fuel return line from top of pump and connecting a clear hose to return fitting. Route hose to a metal container. Start engine and allow to idle. Watch return fuel for air bubbles. If bubbles are present, locate source of air leak in fuel supply system and correct.
	c. Fuel Return System Restricted	Measure pump housing pressure at idle speed. Pressure should be 12 psi maximum. If pressure is greater than 12 psi, correct restriction in fuel return system.
	d. Fuel Supply Restriction	Test fuel supply pump and check fuel filter for plugged condition.
	e. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
Poor Fuel Economy	a. See page 7-24	See page 7-24
Noticeable Loss of Power	a. Restricted Air Intake	Check air cleaner element.
	b. Timing Set to Specifications	Be sure timing mark on injection pump is aligned with mark on adapter or front cover.
	c. EGR or EPR Malfunction	Refer to Emissions Diagnosis, Section 5.
	d. Restricted or Damaged Exhaust System	Check system and replace as necessary.
	e. Plugged Fuel Filter	Replace filter.
	f. Plugged Fuel Tank Vacuum Vent in Fuel Cap	Remove fuel cap. If loud "hissing" noise is heard, vacuum vent in fuel cap is plugged. Replace cap (Slight hissing sound is normal).

CONDITION	POSSIBLE CAUSE	CORRECTION
Noticeable Loss of Power (Cont'd)	g. Restricted Fuel Supply From Fuel Tank to Injection Pump	Examine fuel supply system to determine cause of restriction. Repair as required.
	h. Restricted Fuel Tank Filter	Remove fuel tank and check filter. (Filter for diesel fuel is blue.)
	i. Pinched or Otherwise Restricted Return System	Examine system for restriction and correct as required.
	j. Incorrect or Contaminated Fuel	Flush fuel system and install correct fuel.
	k. External Compression Leaks	Check for compression leaks at all nozzles and glow plugs, using "Leak-Tec" or equivalent. If leak is found, tighten nozzle or glow plug.
	l. Plugged Nozzle(s)	Remove nozzles. Have them checked for plugging and repair, replace or clean (where applicable) as necessary.
	m. Low Compression	Check compression to determine cause
	n. Transmission Fault	See Section 7A of the Service Manual.
Engine Stalls on Deceleration or Stalls at Idle	a. Sticking Metering Valve	Remove metering valve. Clean with 400 or 500 sandpaper. Wet sandpaper with diesel fuel and turn the metering valve in the wet paper no more than 5-6 turns.
Engine Will Not Return to Idle	a. External Linkage Binding or Misadjusted	Free up linkage. Adjust or replace as required.
	b. Fast Idle Malfunction	Check fast idle adjustment.
	c. Internal Injection Pump Malfunction	Remove injection pump for repair.
Fuel Leaks on Ground —No Engine Malfunction	a. Loose or Broken Fuel Line or Connection	Examine complete fuel system, including tank, lines, and injection lines. Determine source and cause of leak and repair.
	b. Injection Pump Internal Seal Leak	Remove injection pump for repair.

CONDITION	POSSIBLE CAUSE	CORRECTION
Noise—"Rap" From One or More Cylinders (Sounds Like Rod Bearing Knock)	a. Nozzle(s) Sticking Open or With Very Low Nozzle Opening Pressure	Remove nozzle for test and replace or clean (where applicable) as necessary.
	b. Mechanical Problem	Refer to Mechanical Diagnosis.
	c. Piston Hitting Cylinder Head	Replace malfunctioning parts. Be sure timing mark on injection pump is aligned with mark on front housing. Break in engine 2000 miles.
Noise—Objectionable	a. Timing Not Set to Specification	Make certain that timing mark on injection pump is aligned with mark on front housing.
Noise Over Normal Noise Level High Excessive Black Smoke	a. EGR Malfunction	Refer to the Emission Section 5.
	b. Injection Pump Housing Pressure Out of Specifications	Check housing pressure as described in this section.
	c. Injection Pump Internal Problem	Remove injection pump for repair.
Engine Noise Internal or External	a. Engine Fuel Pump, Generator, Water Pump, Valve Train, Vacuum Pump, Bearings, Etc.	Repair or replace as necessary. If noise is internal, see Diagnosis For Noise — Rap From One or More Cylinders and Engine Starts and Idles Rough With Excessive Noise and/or Smoke.
Engine Overheats	a. Coolant System Leak, Oil Cooler System Leak or Coolant Recovery System Not Operating	Check for leaks and correct as required. Check coolant recover jar, hose and radiator cap.
	b. Belt Slipping or Damaged	Replace or adjust as required.
	c. Thermostat Stuck Closed	Check and replace if required.
	d. Head Gasket Leaking	Check and repair as required.
Poor Performance Extended Hot Crank Time No W.O.T. Upshift	a. King in the Fuel Supply Hose Between the Fuel Tank and Body	Shorten the fuel supply hose at the kinked area.
Excessive Engine Blowby	a. Bent Upper Compression Ring	Check compression. If about 100 psi low, change the piston rings.

General Diagnosis Conditions

DIESEL STARTING

It must be remembered that diesels need three ingredients to start — air, fuel, and heat. If the valves open, the engine should have air. The best method to check for fuel is to pull a glow plug, crank the engine and look for fuel vapors. Heat is furnished by the glow plugs and the heat of compression by cranking.

DIESEL COMPRESSION LEAK

Some diesel engine equipped vehicles may exhibit an inadequate amount of passenger compartment heat. If you experience inadequate heat at idle, the cause may be a compression leak to the cooling system. Examine the coolant recovery tank to see if bubbles are evident with the engine running. If bubbles are evident, the cause may be a head gasket leak. To determine which head gasket is leaking, remove the water pump belts and the water outlet and thermostat. Run the engine and observe which side of the engine bubbles are coming from.

DIESEL ENGINE KNOCK

Diesel engine knock may be caused by a piston. The piston knock sounds very similar to combustion knock.

To assist in the diagnosis, with the engine off, retard the injection pump timing as far as the slot in the pump flange will allow. This will quiet down a combustion knock. If the knocking is not substantially reduced, the noise is most likely a mechanical problem. Crank the fuel injection lines one by one to identify the cylinder with the knock. The knock tone will change when the line is cracked feeding the cylinder with the problem.

Smoke Diagnosis Principles

Three different types of smoke will be reviewed in this section. Black, white and blue.

BLACK SMOKE

Black smoke is the most common smoking complaint. Diesels are usually rated according to the maximum horsepower developed at the "smoke limit." At a certain speed, a definite amount of air enters the cylinder. This amount of air is sufficient to produce complete combustion of a given quantity of fuel. If more fuel is injected, overloading the engine beyond the rated horsepower, there will not be sufficient air for complete combustion and black smoke will result. Under these conditions, the black smoke contains a large quantity of unburned carbon (soot) formed by thermal decomposition of the fuel in the over-rich mixture in the cylinder.

The injection pump is incapable of delivering rich or lean mixtures. Therefore any variable that increases fuel or reduces the amount of air taken into the cylinder will increase the tendency to produce black exhaust smoke.

Some sources of black smoke directly related to improper burning of fuel are:

- Air into injection pump
- Fuel return restricted (both of the above will change automatic advance; EPR 1981 only)
- Pump timing advanced (usually will be accompanied by excess combustion noise)
- Wrong fuel
- Excess fuel delivery from nozzles due to low opening pressure or stuck nozzle
- Less than 5½ lbs of fuel pump pressure

Although not directly fuel related some indirectly related sources of black smoke are:

- EGR stuck open (at w.o.t. only)
- Restricted exhaust
- Low compression
- Clogged air inlet
- Missing prechamber (causes black smoke when hot and white smoke when cold)

Presence of prechamber can be checked externally. To check, remove glow plug and insert a probe into the prechamber. If more than 3⅜"-2¾" of the probe can be inserted, prechamber is missing.

The fuel variables that can affect black smoke are gravity (an indirect measure of heating value); viscosity, and cetane number. An engine may smoke when a fuel of lower gravity is used. This is an overfueling problem that occurs because injectors meter fuel on a volume basis and low gravity fuels have more Btu's per gallon, and therefore, less fuel is required for equal power, equal air utilization, and equal smoke.

Increasing viscosity can also cause overfueling by reducing the leakage in the injection pump, thus allowing more fuel to be injected into the cylinder.

In engines which are sensitive to cetane number, the tendency toward black smoke is greater as cetane number increases. The short delay period of a high cetane number fuel assures that some raw fuel is sprayed into an established flame where the atmosphere is too lean for complete combustion.

WHITE SMOKE

At light loads, the average temperature in the combustion chamber may drop 500 degrees due to the decreased amount of fuel being burned. As a result of the lower temperature, the fuel ignites so late that combustion is incomplete at the time the exhaust valve opens and fuel goes into the exhaust in an unburned or partially burned condition producing the white smoke. Under these conditions, a higher cetane fuel or a more volatile fuel will tend to promote better combustion and reduce smoke. Any operating variable (jacket temperature, inlet air temperature, etc.) that increases compression temperature or reduces ignition delay will improve the white smoke problem. White smoke is considered normal when the car is first started but should stop as the car warms up. A continuing white smoke condition could indicate a loss of compression. Retarded timing and plugged fuel return can cause white smoke.

BLUE SMOKE

Blue smoke indicates that engine oil is burning in the cylinders and may be accompanied by excessive oil consumption.

Some mechanical conditions which should be considered are:

- Stuck piston rings
- Worn piston rings
- Failed valve seals
- Faulty crankcase vent valve

Some non-mechanical checks would include:

- Lube oil level too high
- Fuel oil in crankcase
- Wrong dipstick

Black Smoke Diagnosis Chart

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive Black Smoke	a. Air Inlet Restriction	Replace air filter element.
	b. EGR or EPR Valve Malfunction	Refer to Section 5 for diagnosis.
	c. Advanced Timing	Check timing marks and correct as necessary.
	d. Nozzle Malfunction	Check function of injection nozzles on nozzle tester according to manufacturers' instructions.
	e. Engine Mechanical Problem Resulting in Air Inlet Restriction or Low Compression	Check for carbon buildup in intake manifold or valve train wear which would cause air inlet restriction. Check engine compression. The 6.2L diesel engine should have compression in each cylinder of at least 380 psi, and the lowest cylinder reading should not be less than 80% of the highest cylinder reading.

White Smoke Diagnosis Chart

CONDITION	POSSIBLE CAUSE	CORRECTION
White Smoke During Cold Weather Starting	a. Increased Operating Noise and Light White Smoke	This is normal.
	b. Incorrect Starting Procedure, Pumping the Accelerator	Consult Owners Manual, for correct starting procedure.
	c. Glow Plugs Not On Long Enough	Check Glow Plug Diagnosis in Section 6.
	d. H.P.C.A. Inoperative	1. Check for current at the H.P.C.A. terminal on the right side of the injection pump, when engine temperature is less than 115°F (1982) 95°F on 1983's and later. If there is no current, determine the cause and correct. 2. If current is available at the H.P.C.A. terminal, remove the governor cover and connect a feed wire to H.P.C.A. terminal and ground governor cover, the H.P.C.A. solenoid should activate. If it does not, replace H.P.C.A. solenoid.
	e. Timing Incorrect	Time engine to specification, (see Section 4).
White Smoke on Start Up	a. Sticking Advance Piston	1. Hook up a dynamic timing meter. Push in on the bottom of the face cam rocker lever on the right side of the pump. This will retard the timing and cause the engine to run rough, if the advance piston is free. 2. If there is no change, the piston is sticking, polish the piston to correct.
	b. Low Compression	Check compression, repair as necessary. The 6.2L diesel engine should have compression in each cylinder of at least 380 psi, and the lowest cylinder reading should not be less than 80% of the highest cylinder reading.
	c. Retarded Pump to Engine Timing	Time engine to specifications, see Section 4.

Rough Idle Diagnosis

Rough idle is caused by variable power output between cylinders as they fire in sequence. The following can cause variable fuel flow to each cylinder and, therefore, its relative power output.

- Air in fuel system
- Nozzle opening pressure
- Nozzle tip leakage (seat tightness)
- Injection line volume and internal diameter
- Line fitting leakage — normally this engine uses approximately .3 gal per hour at idle, and considering one wet nozzle out of eight cylinders, the amount of fuel being consumed is so small that even a damp, not yet dripping nozzle fitting can cause that cylinder not to fire
- Injection pump output
- Injection pump low speed governor sensitivity

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A rough idle condition may be caused by a damaged injection pump drive shaft retaining ring.

If the ring is bent rearward, the governor arm can contact the ring. This affects governor control of fueling at idle, causing a rough idle.

The retaining ring can be damaged during manufacture or repair. It is used to retain the pump drive shaft.

If a vehicle is received with a rough, idle condition, use the following steps:

STEP 1 Request the date condition first appeared.

A. If since new, the retaining ring may be the cause.

B. If after pump removal or repair, the ring may be the cause.

C. If neither A nor B, then the ring is not likely the cause of rough idle.

STEP 2 If 1A or 1B does apply, and the condition is only a rough idle, with smooth operation above a 1,000 RPM, proceed to Step 3.

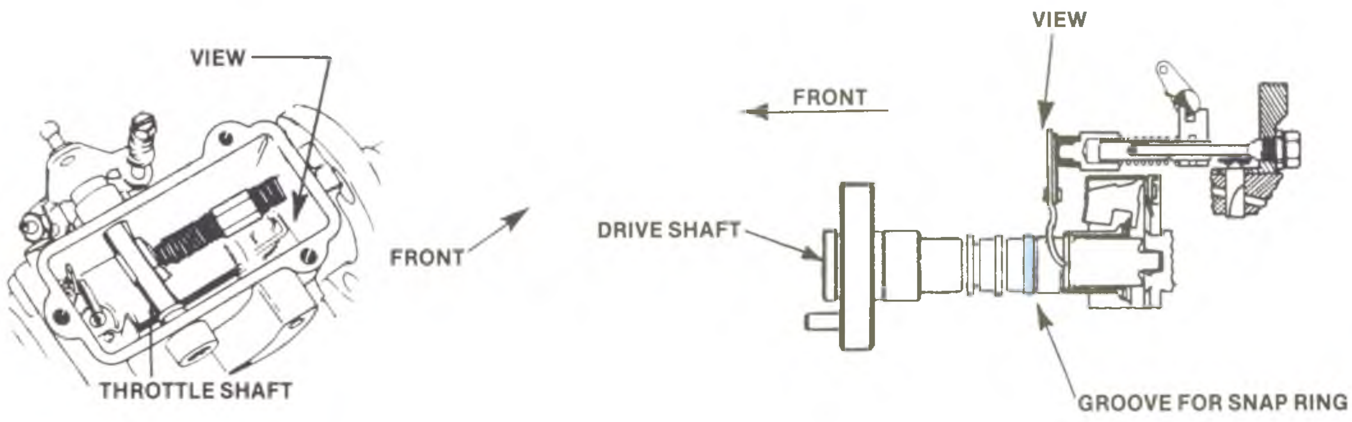
STEP 3 Remove the injection pump governor cover.

STEP 4 Using a flashlight, look between the forward edge of the housing and the governor. The main shaft will be visible below the governor. Where the main shaft enters the forward edge of the housing, a snap-ring should be visible. The use of a mirror may help to get a better view. Refer to Figure 7-2.

STEP 5 If the snap ring appears to be bent out of the shaft groove rearwards towards the governor, the ring must be replaced.

STEP 6 To replace the snap ring the injection pump must be removed and should be repaired at an authorized pump repair facility.

STEP 7 If the ring is not bent, the rough idle is due to some other cause such as a fuel line air leak, timing, etc.



TOP VIEW OF PUMP WITH HOUSING COVER REMOVED

CROSS SECTION VIEW OF INJECTION PUMP

Figure 7-2, Diesel Injection Pump.

DIAGNOSIS PROCEDURE, ROUGH IDLE

See Figure 7-3.

DIESEL ENGINE IDLE ROUGHNESS DIAGNOSIS PROCEDURE

CONDITION

IDLE ROUGHNESS

Idle roughness is defined as an uneven shaking of the engine in comparison to others with the same number of cylinders and in the same body style.

A rough idle condition may be caused by a difference in the output between cylinders on diesel engines. By selection of parts it is possible to alter the output between cylinders, and smooth out the idle quality.

CORRECTION

Follow the diesel engine idle roughness diagnosis procedure. Make all necessary adjustments and corrections. The idle roughness procedure must be followed step by step prior to performing the glow plug resistance check. The glow plug resistance check will only be successful after the idle roughness procedure is performed and corrections made.

CONDITION

COAST DOWN ROUGHNESS

A condition may exist where a roughness is observed on coast down at 50 mph or less with a closed throttle.

CORRECTION

Confirm that this condition is engine roughness rather than a tire waddle or a bent wheel by coasting down through the roughness period in neutral with the engine at 1500 to 2000 RPM. If roughness still exists, during the coast down, the condition is not caused by engine roughness. If the roughness condition is gone, follow the idle roughness diagnosis procedure. If not corrected prior to the glow plug resistance procedure, correct the roughness using the glow plug resistance procedures.

Diesel engine roughness at idle

On new vehicles — vehicle should have ¼ tank fuel and it may be necessary to run engine at high rpm to purge air from system

Remove air cleaner, install intake or crossover cover

Install Mag-Tach J-26925 — check idle speed (slow and fast)

Idle speeds OK | Idle speed incorrect → Set idle to specification

Make certain that timing mark on injection pump is aligned with mark on front cover. (if available or applicable)

Timing OK | Timing off → Reset timing

Continue on next page

Figure 7-3, Diesel Engine Idle Roughness Diagnosis Procedure.

Disconnect vacuum hose from vacuum pump — check idle quality

No improvement

Idle improves

Reinstall vacuum hose to pump. Loosen vacuum pump hold down clamp. Rotate pump in engine. If idle improves, clamp in that position. If idle does not improve, remove vacuum pump and reinstall with drive gear in different relationship to camshaft.

Examine nozzles for leaks at nozzle body or at fuel line connection (engine running)

No leaks

Leaks

Correct

Check for leak at injection pump to high pressure lines

No leaks

Leaks

Correct

Check for fuel pressure by cracking line at fitting between fuel filter and injection pump

Pressure evident

No pressure evident

Determine cause of lack of/or low pressure

Remove fuel return line from top of pump. Install short pieces of clear plastic tube between return line and check for presence of bubbles or foam in tube

No bubbles or foam

Bubbles evident

Find cause in fuel supply

*Loosen the line at the nozzles to bleed a small amount of fuel from the line. If solid fuel appears, go on to the next nozzle. If foam appears, shut the engine off and disconnect the line from the nozzle. Move the line so the inlet to the nozzle can be observed. Remove the pink wire to the pump and crank the engine and observe the nozzle inlet for bubbles. If bubbles are evident, replace the nozzle. Squirt some oil or fuel in the new nozzle inlet and recheck for bubbles. If bubbles are not evident, reconnect the line and pink wire, and go on to the next nozzle and repeat the process. Check the removed nozzle on a tester to determine if it is inoperative or if it is incompatible with the cylinder head.

If an objectionable rough idle condition still exists, proceed using glow plug resistance check to correct rough idle

Figure 7-3, (Cont'd.) Diesel Engine Roughness Diagnosis Procedure.

Glow Plug Resistance Procedure

To determine glow plug resistance, use the following steps:

STEP 1 Use the Kent-Moore High Impedence Digital Multimeter (Essential Tool J-29125A, J-34520 or J-34029) for measurements.

If another ohmmeter is used, different values will result. This does not mean that another ohmmeter is not accurate for measuring resistors or solenoids. Glow plugs can be individually probed, or a Cylinder Balance Tester (J-34116) can be used with the Digital Multimeter to select cylinders.

STEP 2 Select scales as follows: On K-M Tool J-29125A, LH Switch to "OHMS," RH Switch to full counter-clockwise, "200 Ohms," Slide Center Switch to the left "DC.LO." On J-34520 or J-34029, select 200 "OHS."

STEP 3 Start engine, turn on heater and allow engine to warm up. REMOVE all the feed wires from the glow plugs.

STEP 4 Disconnect the generator two lead connector.

STEP 5 Using a tachometer, adjust engine speed by turning the idle speed screw on the side of the injection pump to the worst engine idle roughness, but do not exceed 900 rpm.

STEP 6 Allow engine to run at worse idle speed for at least one minute. The thermostat must be open and the upper radiator hose hot.

STEP 7 Attach an alligator clip to the **black** test lead of the multimeter. THIS CLIP MUST BE GROUNDED TO THE FAST IDLE SOLENOID. It must remain grounded to this point until all tests are complete.

STEP 8 On a separate sheet of plain writing paper, write down the engine firing order. The 6.2L engine's firing order is 1-8-7-2-6-5-4-3.

STEP 9 With engine still idling, probe each glow plug terminal and record the resistance values on each cylinder in firing sequence. Most readings will be between 1.9 and 3.9 Ohms. If these readings are not obtained, turn engine "OFF" for several minutes and recheck the glow plugs. The resistance should be .5 to 1.6 Ohms. (Ohm readings depend on method used to check glow plug resistance.) If this reading is not obtained, check meter for correct settings, check for low or incorrect battery in meter, and check the meter ground wire to the engine.

If the vehicle is equipped with an electric cooling fan, record the resistance values with the cooling fan not running. Do not disconnect the cooling fan electrically.

The resistance values are dependent on the temperature in each cylinder, and therefore indicate the output of each cylinder.

STEP 10 If an Ohm reading on any cylinder is between .5 and 1.6 Ohms (Ohm readings obtained depend on the method used to check glow plug resistance), check to see if there is an engine mechanical problem. Make a compression check of the low reading cylinder and the cylinders which fire before and after the low cylinder reading. Correct the cause of the low compression before proceeding to the fuel system.

STEP 11 If the engine misfires erratically, install the glow plug luminosity probe that is included with the Diesel Timing Meter (J33300-100, J33075, or equivalent) into the cylinder with the lowest resistance reading. Observe the combustion light flashes. They will be erratic in time with the misfire that is felt. If it is not, move the probe to the next highest reading cylinder until the malfunctioning cylinder is found.

STEP 12 Examine the results of all cylinder glow plug resistance readings, looking for differences between cylinders. Normally, rough engines will have a difference of .4 Ohms or more between cylinders in firing order. It will be necessary to raise or lower the reading on one or more of these cylinders by selection of nozzles.

A nozzle with a tip leak can allow more fuel than normal into the cylinder, which will raise the glow plug Ohm reading. This will rob fuel from the next nozzle in the firing sequence and will result in that glow plug having a low Ohm reading. If this is encountered, it is advisable to remove and check the nozzle with a high reading. If it is leaking, it could be causing the rough idle. Plugged nozzle(s) will be indicated by low glow plug resistance readings.

Some glow plugs have been found which do not increase in resistance with heat. If you experience low readings on a glow plug and it does not change with nozzle change, then switch glow plugs between a good and bad cylinder. If the reading of each cylinder is not the same as before the switch, then the glow plug cannot be used for rough idle diagnosis, although it will function for starting the vehicle.

STEP 13 Remove the nozzles from the cylinders in which you wish to raise or lower the Ohm reading. Determine the pop off pressure of the nozzles as well as checking the nozzle for leakage and chatter. (Refer to Testing of Nozzles Section of Service Manual.)

- Install nozzles with a high pop off pressure to lower the Ohm reading, and nozzles with lower pop off pressure to raise an Ohm reading. Normally, a change of about 30 psi in pressure will change the reading by about .1 Ohm. Nozzles normally will drop off in pop off pressure with miles. Use nozzles from parts stock or a new vehicle. Use broken-in nozzles on a vehicle with 1500 or more miles, if possible.
- Whenever a nozzle is cleaned or replaced, before installing the injection pipe, crank the engine and watch for air bubbles at the nozzle inlet. If bubbles are present, clean or replace the nozzle.
- Install the injection pipe, restart engine, and check idle quality. If idle is still not acceptable, recheck glow plug resistance of each cylinder in firing order sequence. Record readings.
- Examine all glow plug resistance readings looking for differences of .4 Ohms or more between cylinders. It will be necessary to raise or lower the reading on one or more of these cylinders as previously done.
- After making additional nozzle changes again check idle quality. Normally, after completing two series of resistance checks and nozzle changes, idle quality can be restored to an acceptable level.

STEP 14 An injection pump change may be necessary if the following occurs:

A. If the problem cylinder moves from cylinder to cylinder as changes in nozzles are made.

B. If cylinder Ohm readings do not change when nozzles are changed.

— NOTE —

It is important to always recheck the cylinders at the same RPM. Sometimes the cylinder readings do not indicate that an improvement has been made although the engine may in fact idle better.

Rough Idle/Performance Diagnosis Conditions

— NOTE —

An intermittent miss at idle may not show up on the glow plug resistance test. To correct, first find the cylinder that is not firing by moving the timing meter glow plug probe cylinder to cylinder and observing the flash (wear safety glasses when watching the probe.) When the miss is located, remove the nozzle in that cylinder and the prior cylinder in the firing order. Use a lower opening pressure nozzle in the cylinder with the miss and/or a higher opening nozzle in the other cylinder. This will increase the fuel flow to the cylinder that has the miss.

M.P.G. Diagnosis Principles

The diesel, like any engine, is affected by driving habits. Speed is more critical on a diesel than a gas engine. On the highway, in the 50-75 mph range, the fuel economy will go down about 3 mpg for each 10 mph increase in speed. A gasoline engine will lose about 1½ mpg for each 10 mph increase in speed. This condition is perhaps the most significant factor in obtaining good fuel economy. Fuel economy may vary as much as 5 mpg in a given vehicle with different drivers. M.P.G. will increase with use of a steady foot, easy acceleration and light braking. Most drivers are unaware of their "jerky" driving habits. If the owner either traded in or still has a higher performance vehicle, it may be a case of driving the diesel excessively hard trying to match this performance, but at the same time reducing fuel economy.

The type and condition of a trade-in, if there was one, could be a clue to the owner's driving habits. Another indication which would be revealing would be a road test with the owner driving. Since most owners are unaware of their habits, it may be valuable to observe if the accelerator pedal is "pumped" excessively. Stop and go driving uses more fuel and hilly terrain will call for more accelerations, using more fuel.

Mechanical conditions of the vehicle, both engine related and non-engine related, also affect mpg. In diagnosing poor fuel economy complaints, first determine if other conditions such as excessive smoke or poor performance or unusual noises are also present.

NON-ENGINE RELATED CONDITIONS

Some non-engine related items which play an important part in the fuel economy process are:

- Tires and inflation pressure — snow tires, radial types included, will drop fuel mileage by nearly two miles per gallon. Standard inch size tires used in place of metric size tires can generate as high as a 6% error in speedometer readings.
- Speedometer error
- Axle ratio
- Transmission malfunctions
- Weather — cold weather and increased viscosity of all lubricants in the power train (especially wheel bearing grease), stiffer tires, and driving through snow, slush, and ice require more power with a corresponding decrease in mileage.

ENGINE-RELATED CONDITIONS

Some engine related items which should be understood are:

- Check pump timing.
- Engine compression — heat of compression is essential.
- Missing or improperly installed prechambers can result in poor combustion.
- Non-functioning glow plugs will result in poor combustion during engine warm-up.
- A plugged air cleaner element or restrictions in the air intake system will cause a richer running condition.
- Plugged exhaust.
- Worn camshaft or lifter will impair engine breathing.
- Thermostatic fan — If the viscous drive in the thermostatic fan fails or locks up, the fan will be forced to operate at constant engine speed and will produce a very significant drop in mileage. Malfunction is easily recognized by continuous roar from the engine cooling fan.

FUEL SYSTEM RELATED CONDITIONS

Some fuel related items are:

- Fuel type and quality — The heating value of No. 1 Diesel fuel is about 5% less than No. 2 diesel fuel. Gasoline mixed with diesel fuel will also reduce the heating value of the fuel and reduce fuel economy. Winterized blends usually fall somewhere between No. 1 and No. 2, depending on the blend, and consumption decreases commensurately.
- Fuel line leaks.
- Restricted fuel return line retards advance mechanism.
- Restricted fuel filter.
- Pump timing — During factory calibration the pump dynamic timing mark is placed within one quarter degree electronically. Retarding the pump will result in quieter operation with less smoke. Advancing the pump will be noisier with some increase in smoke. "Right on" timing is best for maximum economy.
- Automatic advance malfunction usually demonstrates poor idle or poor part load performance with smoke and low power at higher speeds.
- Nozzle fault — (many possibilities here) opening pressure below spec., valve lift incorrect, excessive seat leakage, sticking or stuck-open valve.

Fuel System Diagnosis

SYMPTOM	No fuel delivery	Low fuel delivery	Excess fuel delivery	Erratic fuel delivery	Incorrect timing	Sticking advance piston
	PUMP CONDITION — POSSIBLE CAUSE					
Engine cranks but will not start – cold	●	●			●	
Engine cranks but will not start – hot	●	●			●	
Engine starts but then stalls				●	●	
Rough operation at idle				●		●
Rough operation at all speeds				●		●
Low power and smoke		●		●		●
Low mileage						●
Engine speed fluctuates				●		
Engine knock				●	●	
Engine stalls	●					●
Engine stalls in panic stop					●	
Engine fails to shut off				●		
Smoke – white					●	●
Smoke – black			●			●

PUMP CONDITION	Plugged return fitting	Cam ring in backwards	Pump seizure	Low housing pressure	High housing pressure	Advanced timing	Faulty advance mechanism	Failed fuel shutoff solenoid	Governor linkage stuck	Governor weight retainer ring	Advance piston sticking
	POSSIBLE CAUSE										
No fuel delivery	●		●		●			●	●		
Low fuel delivery					●			●	●		●
Excess fuel no shutoff								●	●		
Erratic fuel delivery		●				●			●	●	
Incorrect timing		●		●	●	●	●				●

Figure 7-4, General Diagnosis of Fuel System.

SYMPTOM	No fuel or wrong fuel	Fuel leak	Air leak	Faulty fuel pump	High fuel viscosity	Plugged return line	Clogged fuel filter	Clogged fuel tank strainer	Throttle linkage adjustment
	FUEL SYSTEM — POSSIBLE CAUSE								
Engine cranks but does not start – cold	●	●	●	●	●	●	●	●	
Engine cranks but does not start – hot	●	●	●	●	●	●	●	●	
Engine starts but then stalls	●			●	●	●	●	●	
Rough operation at idle			●	●		●			●
Rough operation at all speeds	●								
Low power and smoke	●								
Poor acceleration			●			●	●	●	
Low mileage		●							
Engine speed fluctuates			●						
Engine knock	●		●						
Engine stalls			●	●		●			
Engine stalls in panic stop									
Engine fails to shut off									
Smoke – black	●		●	●	●	●			

Figure 7-4A, Pump Diagnosis.

SYMPTOM \ POSSIBLE CAUSE (NOZZLE CONDITION)	No fuel delivery	Low fuel delivery	Excess fuel delivery	Erratic fuel delivery
Engine cranks but will not start – cold	•	•		
Engine cranks but will not start – hot	•	•		
Engine starts but then stalls				•
Rough operation at idle				•
Rough operation at all speeds				•
Low power and smoke		•		•
Low mileage			•	•
Smoke – black			•	

NOZZLE CONDITION \ POSSIBLE CAUSE (SYMPTOM)	Excess return fuel	Nozzle valve hanging up	Low opening pressure	High opening pressure	Clogged nozzle tip
No fuel delivery					•
Low fuel delivery	•			•	•
Excess fuel delivery		•	•		
Erratic fuel delivery		•			

Figure 7-4B, **Nozzle Diagnosis.**

Diagnosis of Fuel System Conditions

DIESEL ENGINE INTERMITTENT START

An intermittent no-start condition on some diesel engines could be due to an inoperative check valve in the engine fuel delivery (lift) pump. This condition could occur after the engine has been running, then stopped for a short time. Fuel could drain past the inoperative check valve back into the fuel tank. To correct this condition, replace the fuel delivery (lift) pump.

PLUGGED DIESEL FUEL FILTERS — ALL DIESELS

Condition: Plugged fuel filters. Stanadyne checks a percentage of fuel filters with a light petroleum product before leaving the factory. As a result, air will not pass through a wet filter element as easily as one that is dry. Therefore, blowing through the filter element with your mouth cannot be used as a criteria to determine if the element is plugged. Installation on the engine, or regulated air pressure of 2-3 PSI is the only way to determine if the filter is plugged.

HARD START IN COLD WEATHER — ALL DIESELS

A condition of hard start in cold weather can be caused by SAE 30 weight oil in a diesel engine. Change the oil using SAE 10W30 SF/CD.

— NOTE —

Do not use 10W40 oil.

6.2L DIESEL — HARD STARTING

Poor starting (good cranking speed but limited ignition) and excessive smoke after start up can be the result of a restricted fuel supply. This can be misdiagnosed as a glow plug system condition. This restriction most likely will be from a plugged fuel filter but can also be caused by a pinched or kinked fuel line. After the engine warms up, it generally will run satisfactorily. If the restriction gets progressively worse, top speed and performance will be affected also.

Even though the filters may have relatively few miles, purchase of dirty fuel can plug the filters in a short time. A check of the fuel lines for restrictions should also be made.

6.2L DIESEL INJECTION NOZZLE RETURN HOSE — 1982 C/K/P AND 1983 C/K/P/G WITH 6.2L DIESEL

Conditions may arise where the fuel return hose or nipple is disconnected from the fuel injection nozzle.

The purpose of the fuel hose is to return the fuel which leaks past the pintle in the injector nozzle, back to the fuel tank. This is a relatively small amount of fuel. Starting with the end cylinders on each side of the engine, the fuel passes through each succeeding nozzle. If a blockage occurs in this flow path, pressure will build up and result in a small fuel leak or the cap or hose becoming disconnected.

One cause of blockage is the leak-off nipple on the nozzle being plugged on the bottom end. During assembly of the nipple into the nozzle body, the epoxy sealant may have flowed over the hole in the nipple on the bottom end. If this happens, the return flow of fuel is restricted (Figure No. 7-5).

To determine if the hose or nipple fall off was caused by a blocked nozzle passage:

1. Remove the hoses from all nozzle nipples on the side of the engine involved.
2. Using a vacuum source, attach it to one nipple on a nozzle. If the nozzle nipple end is plugged, a vacuum reading will result. Check each nozzle.
3. Those nozzles that indicate a plugged or partially plugged opening will generate some reading on the vacuum scale.
4. To unplug a suspected plugged nipple insert a small drill bit into the nozzle nipple and turn by hand to break the epoxy covering.
5. Recheck with vacuum. If unable to break the epoxy barrier, the nozzle should be replaced.
6. Replace hoses and nipple.

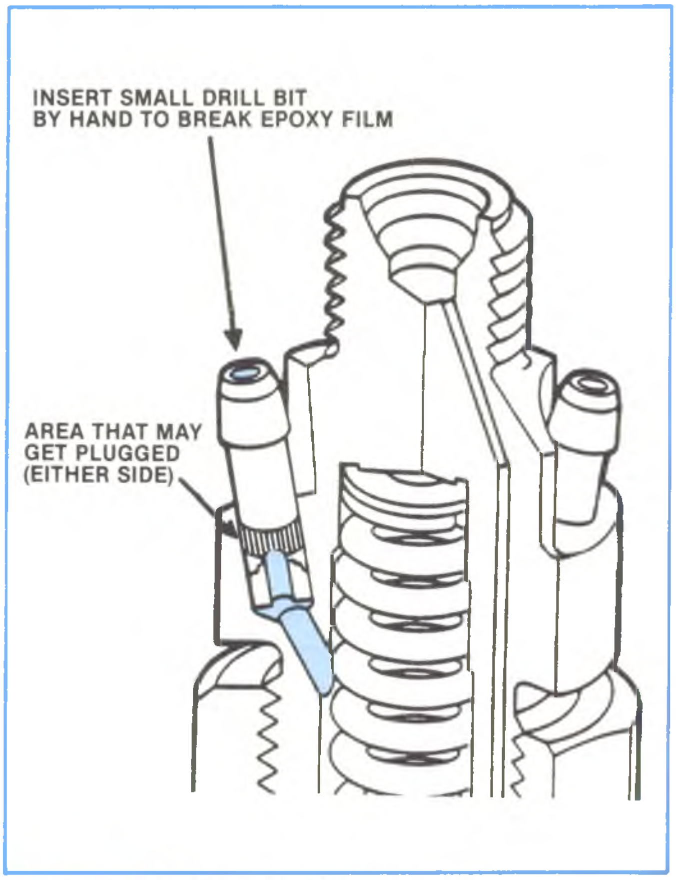


Figure 7-5, Fuel Injection Nozzle.

Brakes Diagnosis — Diesel Vehicles

NO POWER STEERING OR POWER BRAKES ON DIESEL ENGINE COLD STARTS

Diesel equipped trucks use the Hydro-Boost Brake System. In this system, the power steering pump provides the hydraulic fluid pressure to operate both the power brake booster and power steering gear. If hard steering and a lack of brake assist immediately after a cold start occur, make sure that the correct starting procedure is followed by the owner (starting procedure on sun visor above driver.) The fast idle solenoid must be extended prior to starting by depressing and releasing the accelerator pedal to obtain engine fast idle speed. This allows the power steering pump to build up the necessary fluid pressure to operate the power steering and brake systems immediately after start up. If you verify that the solenoid has extended and is holding the throttle open and the condition persists, check the fast idle speed as per the emission label. If this is correct, and the power steering pump belt is tight and not damaged, the cause may be in the power steering pump.

BRAKE ROUGHNESS FEEL — DIESEL VEHICLES

On cars equipped with a diesel engine, a brake roughness feel may be experienced, just before the car comes to a complete stop. This condition could be caused by a rough engine idle transmitting a pulsation through the transmission. To determine whether the rough idle is the cause of the complaint, shift the transmission into neutral while braking. If there is no brake roughness feel, refer to the Service Manual for procedures to correct the rough engine idle.

Diesel Engine Oil Leak Diagnosis

This section tells how to locate an oil leak, how to repair the leak and what sealer should be used.

The removal and installation procedures will not be covered in detail. Refer to the Service Manual for these procedures.

The only equipment needed to help locate any leaks is a spray can of foot powder.

The RTV sealer referred to in the book is room temperature vulcanizing sealer GE 1673 (22521437 or 1052915).

VENTILATION SYSTEM-CAUSED OIL LEAKS

The diesel engine is more subject to oil leaks than the gasoline engine because of no intake manifold vacuum in the diesel engine. With no vacuum, the crankcase pressure is higher in the diesel engine than in the gasoline engine.

The CDR valve in the ventilation system helps to reduce some of the pressure. It is very important that the ventilation system be free from any restriction.

OIL LEAKS FROM FRONT OF ENGINE

Wipe the front of the engine clean and spray foot powder over the entire area.

With the engine at operating temperature, let it idle for about 10 to 15 minutes or until a leak is evident.

OIL PAN

If leak is coming from the rear oil pan seal, remove the pan and install a new rear seal as shown in Figure 7-6.

- Examine the front cover for damage and correct as required.
- Apply GE1673 RTV sealer on top and bottom of seal and also to each end of seal where it contacts the cylinder block.
- Examine the side rails for damage. File off any spot weld dimples at the reinforcement at the end of the pan.
- Torque oil pan bolts, as follows:

  6mm = 6-14 N·m
  8mm = 18-27 N·m

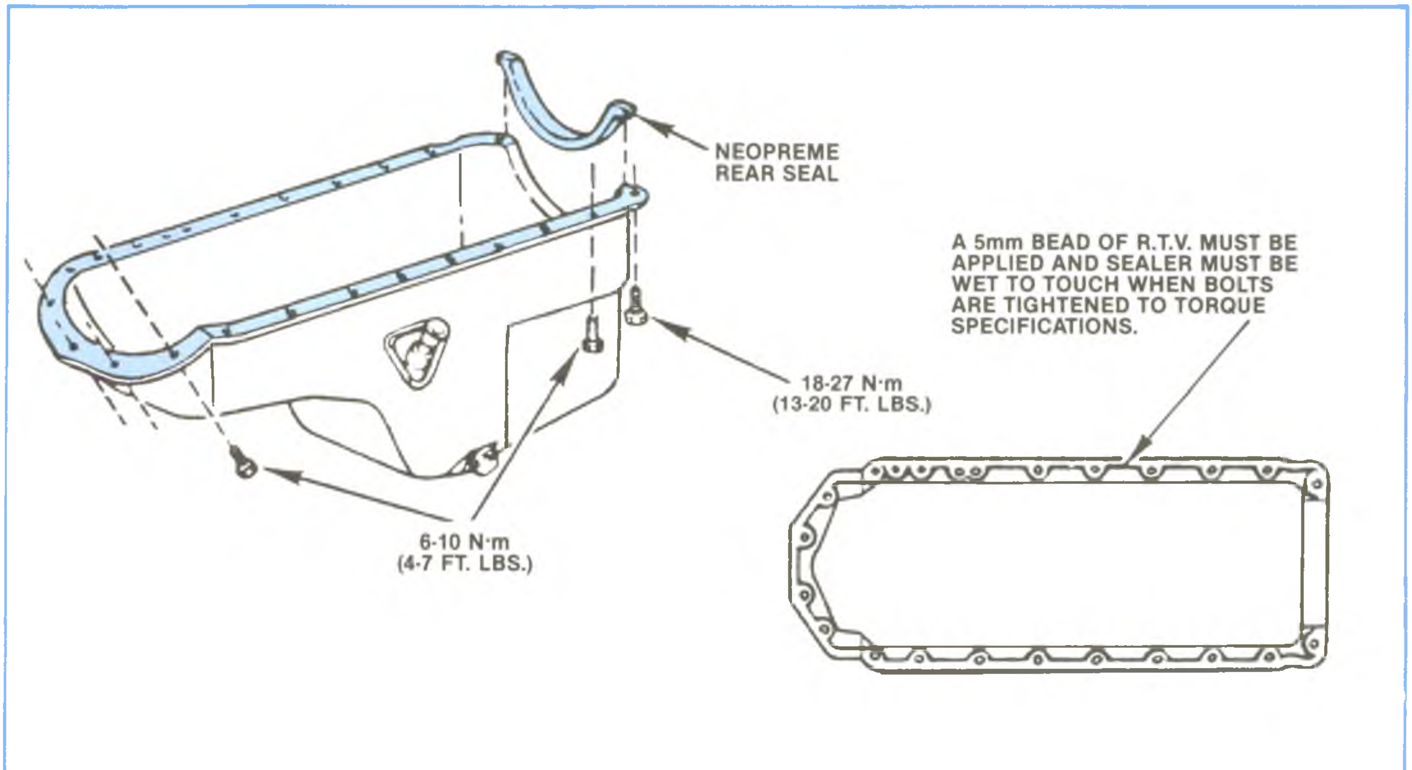


Figure 7-6, Oil Pan Assembly.

RTV Sealer And Gasket Eliminator

There are two (2) sealers used to seal the 6.2L engine. The first is RTV (Room Temperature Vulcanizing) which is used where a non-rigid part is assembled to a cast or rigid part such as rocker covers, oil pans, etc. The second is gasket eliminator, an anaerobic material (cures in the absence of air) which is used where two (2) rigid parts are assembled together, such as the front covers. When two (2) rigid parts are disassembled and no gasket or sealer is readily noticeable it is sealed with gasket eliminator.

When assembling parts, use the preferred material. Don't use RTV to seal together two rigid parts and don't use gasket eliminator on stamped parts such as rocker covers.

- **DIRECTIONS FOR USE OF RTV:**

1. When separating components sealed with RTV, use a rubber mallet and "bump" the part sideways to shear the RTV seal. "Bumping" should be done at bends or reinforced areas to prevent distortion of parts. RTV is weaker in shear (lateral) strength than in tensile (vertical) strength.

   Attempting to pry or pull components apart may result in damage to the part.
2. Surfaces to be resealed must be clean and dry. Remove all traces of oil and RTV. Clean with a chlorinated solvent such as carburetor spray cleaner. Don't use petroleum cleaners such as mineral spirits; they leave a film onto which RTV won't stick.
3. Cut the tube opening to approximately 1/8″ diameter.
4. Apply RTV to one of the clean surfaces. Circle all bolt holes. Use a 5mm bead.
5. Assemble while RTV is still wet (within 3 minutes). Don't wait for RTV to skin over.
6. Torque bolts to specs. Don't over torque.
7. RTV will skin over in 15 minutes sufficiently to allow for testing and limited operation of vehicle. Stop engine and allow RTV to cure for approximately 1 hour before placing vehicle in service.

Don't use RTV when extreme temperatures are expected, e.g. exhaust manifold, head gasket or where gasket eliminator is specified.

— NOTE —

Higher temperature resistant compounds are visually red due to the addition of iron oxide.

• **DIRECTIONS FOR USE OF GASKET ELIMINATOR:**

1. Clean surfaces to be resealed with a chlorinated solvent to remove all oil, grease and old material.
2. Apply a continuous bead of gasket eliminator to one flange.
3. Spread bead evenly with your finger to get a uniform coating on the complete flange.
4. Assemble parts in the normal manner and torque to specs.
5. Vehicle can be operated after completion of assembly. No need to wait for gasket eliminator to cure.

— NOTE —

The useful shelf life of most RTV and gasket eliminator products is one (1) year.

Don't use gasket eliminator where RTV is recommended. The key to satisfaction with RTV and gasket eliminators is following the directions and using where specified.Don't cut the procedure short or a leak may result.

RTV's differ in performance.

For best results, use GM RTV or gasket eliminator from the following table:

GM RTV AND GASKET ELIMINATOR			
SEALANT TYPE	**WDDGM P/N**	**COLOR**	**SIZE AND CONTAINER TYPE**
RTV	1052734	Red	10 Ounce Cartridge
RTV	1052915	Black	10 Ounce Cartridge
RTV	1052751	Red	3 Ounce Tube
Gasket Eliminator (Anaerobic)	1052357	Orange	6 ml. Tube
Gasket Eliminator (Anaerobic)	1052756	Grape	6 ml. Tube

7. Diagnosis

Explanation of Abbreviations

A/T	Automatic Transmission
EGR	Exhaust Gas Recirculation (Valve)
EPR	Exhaust Pressure Regulation (Valve)
VRV	Vacuum Regulator Valve
TCC	Torque Converter Clutch
H.P.C.A.	Housing Pressure Cold Advance
TV	Throttle Valve

Procedure 1. Checking Cranking Speed

Cranking speed is extremely critical for a diesel to start, either hot or cold. Some tachometers are not accurate at cranking speed. An alternate method of checking cranking speed or determining the accuracy of a tachometer is to perform the following procedure:

1. Install a compression gauge into any cylinder. (One such gauge is Kent-Moore P/N J-26999-10.)
2. Disconnect the injection pump fuel shut off solenoid lead on the top of the injection pump or at the harness connector.
3. Install the digital tachometer to be checked.
4. Depress the pressure release valve on the compression gauge.
5. With the aid of an assistant, crank the engine for 2 or 3 seconds to allow the starter to reach full speed, then without stopping, count the number of "puffs" at the compression gauge that occur in the next 10 seconds. Multiply the number of "puffs" in the 10 second period by 12 and the resulting number will be the cranking speed in revolutions per minute (RPM).

   Example: 10 seconds = 1/6 of a minute
   1 puff = 2 RPM
   RPM = No. of puffs × 2 × 6 or
   RPM = No. of puffs × 12

Minimum cranking speed on the 6.2L diesel engine is 100 RPM cold and 180 RPM hot. The actual cranking speed needed will vary depending on the condition of the engine (compression) and nozzles.

Procedure 2.
Checking for Adequate Supply of Fuel to Injection Pump

• Open fold-out page, Figure 7-7, Gage Connections for Diagnosis Procedure.

STEP 1 CHECKING SUPPLY PRESSURE:

A. From fuel supply lift pump and fuel filter.

B. From fuel filter to injection pump.

A. Install a pressure, such as gage "**B**" or equivalent, between the lift pump and the fuel filter inlet. NOTE: This would be the secondary filter for 1982-83 models.

1. The pressure should be 5.5 to 6.5 PSI, if less go to step #2.

B. Install pressure gage "**B**" in series between the filter outlet and the fuel injection pump. NOTE: You will be checking the lift pump pressure drop across the filter. This tells if there is a filter restriction.

1. The pressure at idle should be a 2 PSI minimum and not drop below 1 PSI. If less go to step #2.

STEP 2 CHECK FOR RESTRICTION IN FUEL SUPPLY LINE (USING GAGE "C"):

A. Install pressure/vacuum gage in fuel supply line before supply pump as shown in using gage "**C**". On 1982-83 it can be installed at the primary filter outlet.

If engine is operable, start and check for a maximum vacuum in fuel supply line of 3 inches Hg at idle speed. If engine is not operable, disconnect fuel line from filter inlet, add an extension hose, and route to a metal container. Crank engine and check for a maximum vacuum in supply line of 3 inches Hg. Vacuum greater than 3 inches Hg. indicates a restriction such as a plugged fuel strainer in the fuel tank. If vacuum is less than 3 inches Hg., replace fuel filter element(s) and recheck supply pressure after fuel filter (Step 1). If pressure is still less than 2 PSI, go to Step #3.

STEP 3 PERFORM SUPPLY PUMP VOLUME CHECK:

Disconnect fuel line from filter inlet, add an extension hose and route to a graduated container that can hold at least one pint. Disconnect lead from electric shut off solenoid on top of pump and crank engine (or turn key to "**ON**" position if equipped with an electric supply pump) for 15 seconds. Fuel pump should supply a minimum of ½ pint. If less, replace supply pump and go back to Step #1.

Procedure 3.
Measuring Housing Pressure and Transfer Pressure

STEP 1 CHECKING HOUSING PRESSURE:

Remove the return line connector from the top of the pump (both the blackened and brass fittings). Examine the lower end of the regulator fitting where the glass ball seats for evidence of debris. If present, blow through the fitting with compressed air to eliminate the debris or replace the fitting.

Before reinstalling the fittings to the cover, turn the ignition key to the "ON" position and connect a jumper wire between the electric shut off solenoid terminal and the H.P.C.A. terminal. Make and break the connection to the H.RC.A. terminal and observe the H.P.C.A. solenoid plunger through the return fitting opening. It should move up and down as the current is applied and removed. If it does not function. repair or replace the solenoid as necessary.

STEP 2 MEASURE THE VOLTAGE AVAILABLE AT THE H.P.C.A. TERMINAL:

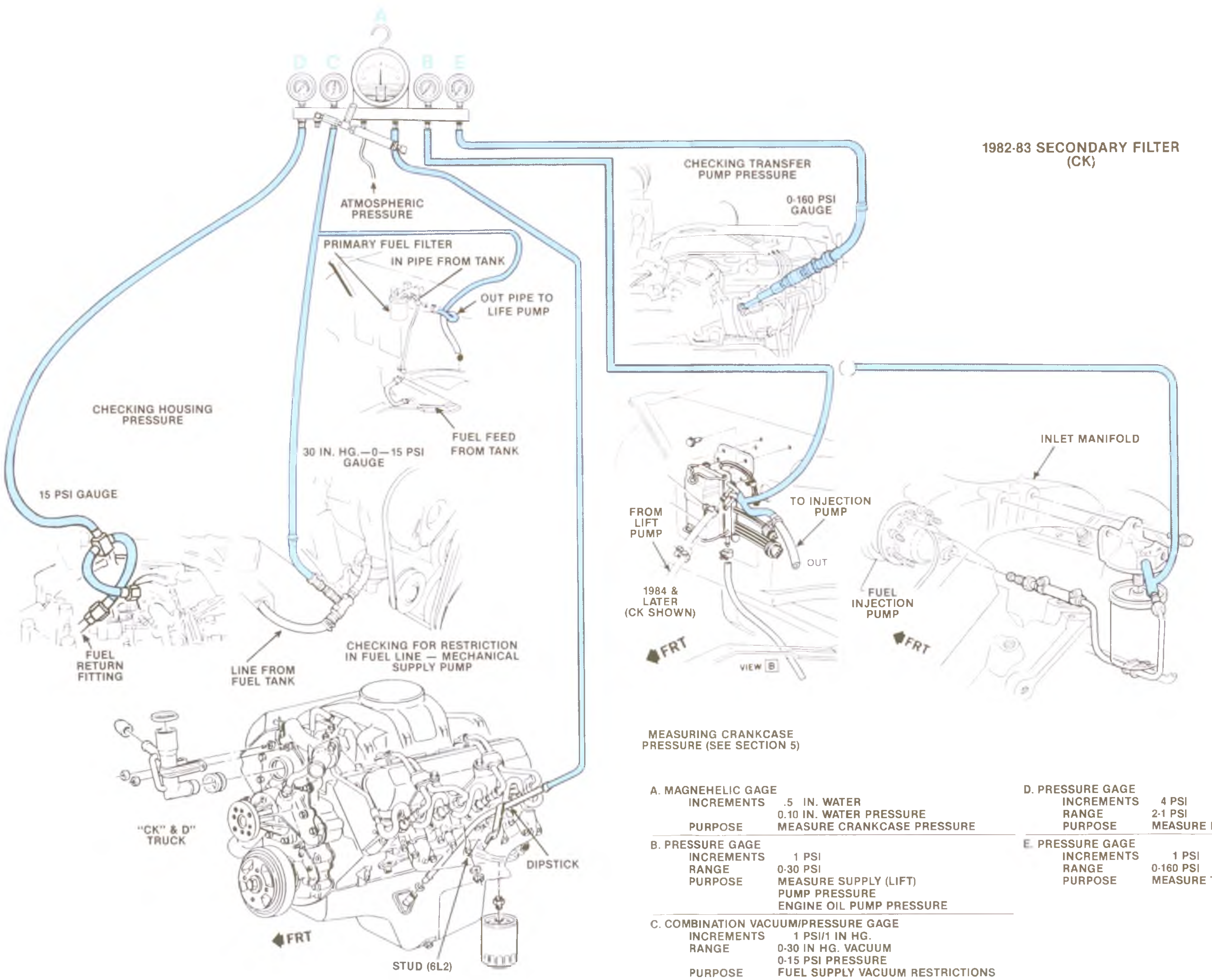
A. When the engine is cold <95°F, there should be 9 volts minimum at the H.P.C.A. terminal. If voltage is low check battery and charging system condition. If there is no voltage at terminal, check operation of temperature sensor located on right rear head. (See chassis service manual).

B. Install housing pressure gage adapter as shown using gage "**D**" or J34151. Reinstall return line connector and fuel return line, then connect pressure gage.

C. Start the engine, the housing pressure should be 8-12 PSI, WHH no more than 2 PSI fluctuation. If pressure is high check for restriction in fuel return system. If pressure is low or fluctuates excessively, replace return line connector fitting.

STEP 3 CHECKING TRANSFER PRESSURE:

Connect adapter and pressure gage as shown above. At cranking speed, transfer pump pressure should be 10 PSI minimum and housing pressure should be at least 2 PSI less than transfer pressure. At idle speed, transfer pressure should be 30 PSI minimum.



A. MAGNEHELIC GAGE
INCREMENTS .5 IN. WATER
RANGE 0-10 IN. WATER PRESSURE
PURPOSE MEASURE CRANKCASE PRESSURE

B. PRESSURE GAGE
INCREMENTS 1 PSI
RANGE 0-30 PSI
PURPOSE MEASURE SUPPLY (LIFT) PUMP PRESSURE
ENGINE OIL PUMP PRESSURE

C. COMBINATION VACUUM/PRESSURE GAGE
INCREMENTS 1 PSI/1 IN HG.
RANGE 0-30 IN HG. VACUUM
0-15 PSI PRESSURE
PURPOSE FUEL SUPPLY VACUUM RESTRICTIONS
FUEL PRESSURE

D. PRESSURE GAGE
INCREMENTS 4 PSI
RANGE 2-1 PSI
PURPOSE MEASURE HOUSING PRESSURE

E. PRESSURE GAGE
INCREMENTS 1 PSI
RANGE 0-160 PSI
PURPOSE MEASURE TRANSFER PUMP PRESSURE

Figure 7-7, Gage Connections for Diagnosis Procedure.

Procedure 4. Checking for Air Leaks

If stalling or rough operation only occurs after cold startup, check for fuel leaking backwards or air leaking into the fuel supply lines. Fuel leaking backwards may be caused by faulty check valves in supply pump. To check for this condition, remove return line connector fitting (ball check) from the top of pump and install a plain fitting in its place. Connect a section of clear hose approximately 3 feet long to the fitting and route to a container. Start engine and allow to idle. Stop engine. Suspend clear hose from hood of vehicle and mark fuel level in hose.

— NOTE —

Allow sufficient room in hose for level of fuel to rise due to thermal expansion. If level drops over a period of several hours (or sooner), a leak back condition is indicated.

Occasionally a very small air leak will only let enough air into the system to cause a stalling problem or rough running condition after the vehicle is shut down for many hours (such as overnight). Double check all fittings, clamps and fuel lines and do not overlook components after the supply pump such as the fuel filter element or base. There have been cases where tiny holes in the filter base casting or in the sealant used in the manufacture of the filter element have allowed air to enter but no external fuel leakage to occur.

Air Leak Diagnosis

AIR LEAK ON THE SUCTION SIDE

The housing vent wire may allow minute quantities of air to pass harmlessly out of the pump. However, at some point there will be more air than can go out the vent and the air will go into the charging circuit. This air will compress and upset fuel flow in the lines which will create a rough running engine. A plastic line placed on the fuel return fitting will show up this condition. To isolate the air leak, it may be necessary to feed the system out of a container and hook it up at various places to bypass certain sections of the fuel system.

AIR LEAK ON SUCTION OR RETURN SIDE

An air leak in either the suction or return side can cause starting problems. Air entering the system will allow fuel to drain back towards the tank. If an air leak occurring at some point like the filter, the fuel will drain back then the fuel on the return side will be heavier and it will pull fuel out of the filter through the pump and back towards the tank. Because there is no fuel in the filter or pump, the engine will not start. When it finally does, surging will be very evident.

Procedure 5. Causes of Underrun or Stalling

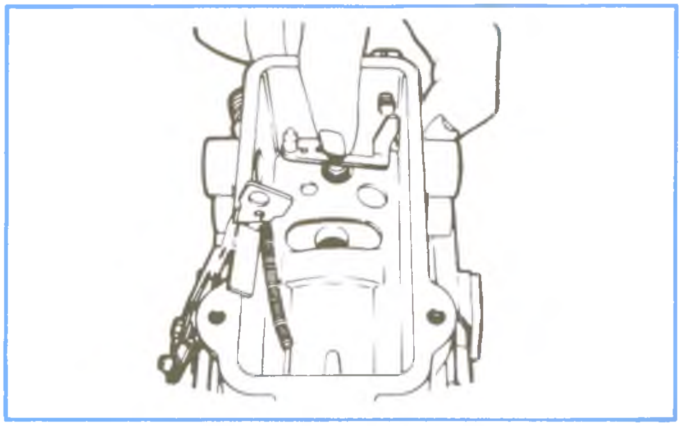


Figure 7-8

1. Sticky Metering Valve Or Linkage

a. Check metering valve for freedom of rotational movement (Figure 7-8).

b. Check for twisted linkage hook spring.

c. Check for burrs on the metering valve arm in the area where the linkage hook rides.

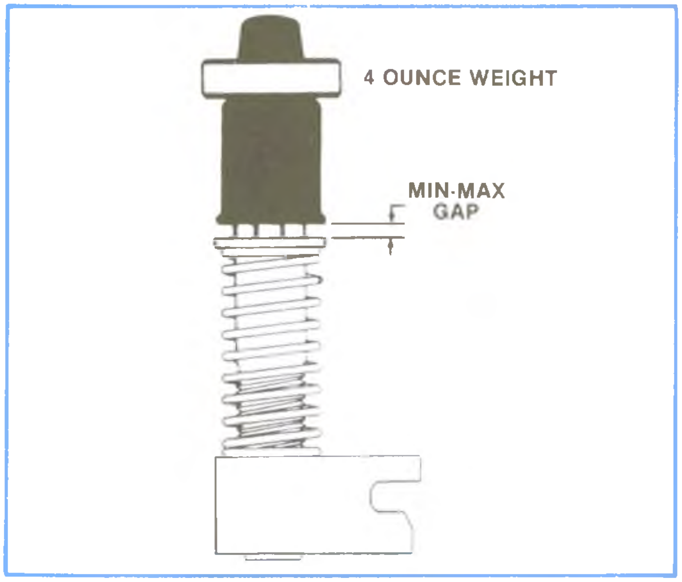


Figure 7-9

d. Check for excessive min-max gap on pumps equipped with internal low idle springs. (See Figure 7-9).

e. Check for binding condition between min-max governor block and throttle shaft by placing throttle lever in low idle position and moving governor block back and forth on guide stud. Governor assembly should move (jiggle) freely on guide stud.

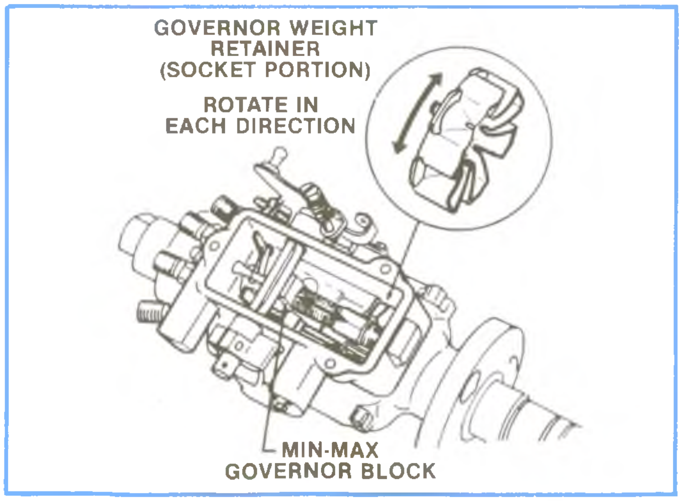
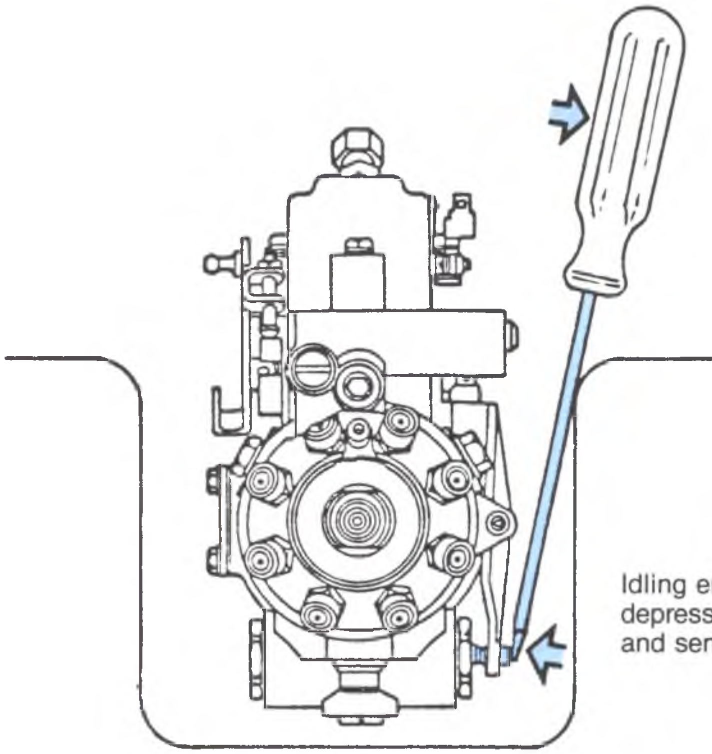


Figure 7-10

f. Check for failed flex ring by attempting to rotate the socket portion of the retainer by hand or with a screwdriver blade (Figure 7-10). If the retainer can be rotated more than 1/16th of an inch in either direction and doesn't return when pressure is released, then a failed flex ring is indicated. See Oldsmobile Dealer Technical Bulletin 80-T16 for instructions regarding flex ring replacement.

Procedure 6.
Checking For Sticky or Stuck Advance Mechanism
(Pumps equipped with mechanical light load advance)



Idling engine sound should change when lever is depressed. If it does not, pump should be removed and sent to an authorized agency for repairs.

Figure 1.

8. Glossary

ANALOG – Continuously variable electrical signal.

ATMOSPHERIC PRESSURE – The air pressure at sea level 14.696 or 14.7 P.S.I.

ATOMIZATION – The breaking up of the fuel into fine particles, so that it can be mixed with air.

BDC – Bottom Dead Center is the point of lowest piston travel in a stroke.

CAFE – Abbreviation for Corporate Average Fuel Economy. Part of the Energy Policy and Conservation Act of 1975. This law mandates GM's fleet mileage at 22 mpg for 1981. By 1985, it will climb to 27.5 mpg.

CALIBRATION –

1. **Balancing** – The setting of the delivery of several elements of an injection system or the setting of the rack pointer on a single unit pump in relation to predetermined positions of a quantity control member.
2. **Adjustment** – Fixing fuel delivery and speed adjustments to specified engine requirements.

CENTRIFUGAL FORCE – The inertial reaction by which a body tends to move away from the center about which it revolved.

CENTRIPETAL FORCE – A constant force acting continuously at right angles to the motion of a particle (body) which causes it to move in a circle at a constant speed.

CETON FILTER – A sock-type filter in the fuel tank capable of wicking diesel fuel but not water. This keeps water from the rest of the fuel system until the sock is 90% submerged in water.

CLOUD POINT – Temperature at which paraffin crystals in diesel fuel separate out of solution and solidify.

COMPRESSION IGNITION ENGINE – Internal combustion engine where the heat of compression ignites the fuel mixture. Diesels are, by definition, compression ignition engines.

CRACKING – Oil refining technique where heavier fractions of crude are subjected to heat and pressure and transformed into lighter fractions.

DELAY PERIOD – Initial phase of diesel combustion. It lasts from about 15° to about 5° before top dead center and is where the injected fuel warms up and begins to burn.

DI – Direct Injection diesel engine.

DIESEL – Engine that is powered by compressed fuel injection.

DIFFUSION – The mixing by thermal agitation of the molecules of two gases.

DISPERSANT – The act of dispersing or to scatter in various directions. A state of matter in which finely divided particles of one substance (the disperse phase) are suspended in another (the dispersion medium) substance.

DRIBBLE – Insufficiently atomized fuel issuing from the nozzle at or immediately following the end of main injection.

DURATION – The period of time during which anything lasts.

EGR – Exhaust Gas Recirculation system. First used in 1980 diesels to control the output of nitrous oxides. The 1980 system was an external type with exhaust being transmitted through hoses outside the engine. The 1981 system is an internal type with exhaust passages cast in the cylinder head and an air crossover comparable to a gas engine's EGR system. In the external type, the system operates at all times except during maximum speed. The internal type is regulated by degrees from full-on at idle to fully closed at maximum speed.

EMULSION –

1. A liquid mixture in which a fatty or resinous substance is suspended in minute globules.
2. The particles of one liquid finely dispersed in another.

FLAMMABILITY – The ability of a substance to catch fire or be combustible.

FLASH POINT – Of a liquid fuel is the temperature at which the fuel gives off sufficient flammable vapor to be ignited in the presence of a flame.

FRACTIONS – Lighter and heavier elements in crude oil. Lighter fractions, such as gas and liquefied gas, have relatively few carbon atoms in each molecule. Heavier fractions, such as wax and asphalt, have many carbon atoms on each molecule.

FUEL ADVANCE SYSTEM – Standard in 1981, this system advances fuel delivery during cold starts. It consists of a thermal-sensitive solenoid on the intake manifold which sends a signal to the HPCA terminal that opens a ball-check valve on top of the injection pump housing. With pump housing pressure reduced, the timing mechanism has less resistance to overcome and so operates earlier to advance fuel delivery 3°.

FUEL DISTRIBUTION – Section of injection pump that feeds fuel to each cylinder at the proper time.

FUEL INJECTION PUMPS (COMPONENTS)

INJECTION PUMP – The device which meters the fuel and delivers it under pressure to the nozzle and holder assembly.

UNIT PUMP – An injection pump containing no actuating mechanism to operate the pumping element or elements. It can be classified as "in-line", "distributor", "submerged", etc.

CAMSHAFT PUMP – An injection pump containing a camshaft to operate the pumping element or elements. It can be classified as "in-line", "distributor", "submerged", etc.

IN-LINE PUMP – An injection pump with two or more pumping elements arranged in line, each pumping element serving one engine cylinder only.

NOTE: A pump which has the elements arranged in line and in more than one bank, for instance, in two banks forming a "V", is a specific case of an in-line pump.

DISTRIBUTOR PUMP – An injection pump where each metered delivery is directed to the appropriate engine cylinder by a distributing device.

SUBMERGED PUMP – A pump with the mounting flange raised to limit pump projection above the mounting face.

CAMSHAFT PUMP MOUNTINGS –

1. **BASE MOUNTED** – A pump mounted on a surface of the engine which is parallel to the axis of the pump camshaft.
2. **CRADLE MOUNTED** – A special form of a "base mount" in which the base is contoured to permit rotation of the pump around the axis of the pump camshaft.
3. **FLANGE MOUNTED** – A pump mounted on a surface of the engine which is at a right angle to the axis of the pump camshaft.

INJECTION PUMP ASSEMBLY – A complete assembly consisting of the fuel pump proper, together with additional units such as governor, fuel supply pump, and additional optional devices, when these are assembled with the fuel injection pump to form a unit.

1. **RIGHT-HAND MOUNTED** – When the pump is mounted on the right-hand side of the engine commonly viewed from the engine flywheel end.
2. **LEFT-HAND MOUNTED** – When the pump is mounted on the left-hand side of the engine commonly viewed from the engine flywheel end.

PUMP ROTATION –

1. **CLOCKWISE** – The rotation of the pump camshaft or driveshaft is clockwise when viewed from the pump drive end.
2. **COUNTERCLOCKWISE** – The rotation of the pump camshaft or driveshaft is counterclockwise when viewed from the pump drive end.

PUMPING ELEMENT – The combination of parts in an injection pump by means of which the fuel is pressurized for injection.

PLUNGER AND BARREL ASSEMBLY (OR PLUNGER AND BUSHING ASSEMBLY) – The combination of a pump plunger and its barrel constituting a pumping element. The plunger and barrel assembly may also perform the additional functions of timing and metering.

PORT AND HELIX METERING – A system of metering fuel delivery by means of one or more helical cuts in the plunger and one or more ports in the barrel. Axial rotation of the plunger alters the effective portion of the stroke by changing the points at which the helices close and/or open the port or ports.

INLET METERING – A system of metering fuel delivery by controlling the amount of fuel entering the pumping chamber during the filling or charging portion of the pump's cycle.

SLEEVE METERING – A system of metering fuel delivery by incorporating a movable sleeve with which port opening and/or port closing is controlled.

PORT CLOSING – A term referring to the fuel injection pump of the port and helix or sleeve metering type in which timing is determined by the point of the closing of the port by the metering member, corresponding to the nominal start of pump delivery.

PORT OPENING – A term referring to a fuel injection pump of the port and helix or sleeve metering type in which timing is determined by the point of the opening of the port by the metering member, corresponding to the nominal end of pump delivery.

HYDRAULIC HEAD ASSEMBLY – The assembly containing the pumping, metering, and distributing elements (and may include the delivery valve) for distributor type pumps.

SPILL VALVE – A valve used to terminate injection at a controllable point on the pumping stroke by allowing fuel to escape from the pumping chamber.

INLET VALVE – A valve used to admit fuel to the pump barrel.

DELIVERY VALVE ASSEMBLY – A valve installed in a pump, interposed between the pumping chamber and outlet, to control residual line pressures and which may or may not have an unloading or retraction function.

DELIVERY VALVE HOLDER – A device which retains the delivery valve assembly within the pump.

FUEL PUMP HOUSING – The main casing into or to which are assembled all the components of the injection pump and it may accommodate the camshaft in the case of camshaft pumps; or the camshaft, or driveshaft in the case of distributor type pumps.

CONTROL RACK (CONTROL ROD) – The rack or rod by means of which the fuel delivery is regulated.

CONTROL PINION (CONTROL SLEEVE) – A collar engaging the plunger and having a segment of gear teeth, integral or attached, which mesh with the control rack. By this means, linear motion of the control rack is transformed into rotary movement of the plunger to regulate the amount of fuel delivered by the pump.

PLUNGER CONTROL ARM – A lever attached to a collar or sleeve engaging the plunger, or attached directly to the plunger, its other end engaging possibly adjustable fittings on the control rod. This transforms linear motion of the control rod to rotary motion of the plunger to regulate the amount of fuel delivered by the pump.

FUEL INJECTION TUBING – The tube connecting the injection pump to the nozzle holder assembly.

FUEL INJECTORS

FUEL INJECTOR – An assembly which receives a metered charge of fuel from another source at a relatively low pressure, then is actuated by an engine mechanism to inject the charge of fuel to the combustion chamber at high pressure and at the proper time.

UNIT FUEL INJECTOR – An assembly which receives fuel under supply pressure and is then actuated by an engine mechanism to meter and inject the charge of fuel to the combustion chamber at high pressure and at the proper time.

DELIVERY VALVE – A spring loaded valve which opens at some predetermined pressure to permit fuel flow from the injector plunger and bushing to the spray tip.

FUEL SOLENOID – Energizes the fuel metering valve whenever the ignition is switched "on".

GLOW PLUG – Used to heat pre-chamber before cold weather starting.

GOVERNORS (TYPES AND COMPONENTS)

MECHANICAL GOVERNOR – A speed sensitive device of the centrifugal type, which controls the injection pump delivery solely by mechanical means.

HYDRAULIC GOVERNOR – A mechanical governor having a hydraulic servo-booster to increase output force.

PNEUMATIC GOVERNOR –

1. **VACUUM OR SUCTION GOVERNOR** – One operated by a change in pressure created by the air actually consumed by the engine.
2. **AIR GOVERNOR** – One operated by air displaced by a device provided for this particular purpose and driven by the engine.

LOAD-SENSING GOVERNOR – An engine speed control device for use on engine-generator sets to control engine fuel settings as a function of electrical load to anticipate resulting changes in engine speed. It may or may not incorporate a mechanical speed-sensing device as well.

VARIABLE SPEED GOVERNOR – One of any of the above varieties which controls injection pump delivery throughout the speed range.

MAXIMUM-MINIMUM GOVERNOR – Any one of the above varieties which exerts control only at the upper and lower limits of the designed engine speed range, intermediate speeds being controlled by the operator setting the fuel delivery directly by throttle action.

OVERSPEED GOVERNOR – A mechanical speed-sensitive device that through mechanical or electrical action (operation of a switch) acts to shut down the engine and limit the speed by cutting off fuel and/or air supply should the engine speed exceed a preset maximum.

TAILSHAFT GOVERNOR – A mechanical speed-sensitive device commonly mounted on an engine driven torque converter to monitor its tailshaft speed. It is mechanically connected to the normal engine governor such that engine output will be governed to maintain a constant tailshaft speed regardless of torque load.

FULL LOAD STOP – A device which limits the maximum amount of fuel injected into the engine cylinders at the rated load and speed specified by the engine manufacturer.

TORQUE CONTROL – A device which modifies the maximum amount of fuel injected into the engine cylinders at speeds below rated speed to obtain the desired torque output.

EXCESS FUEL DEVICE – Any device provided for giving an increased fuel setting for starting only, generally designed to restore automatically action of the normal full load stop after starting.

ACCELERATION SMOKE LIMITER – A device which limits the smoke of a diesel engine during acceleration by temporarily limiting the amount of fuel injected into the engine cylinders during speed and/or load transients below the steady-state limit.

TIMING DEVICE – A device responsive to engine speed and/or load to control the timed relationship between injection cycle and engine cycle.

HELIX (SCROLL) – A term used to describe the control edge of a spill groove provided on the plunger, usually of helical form. The helices may be upper or lower or both and may be the same hand or opposite. They can also be duplicated on both sides of the plunger.

HELIX HAND – The hand of the helix in plungers is designated right or left, the same as a thread.

HELIX LEAD – The axial advance of the helix edge in one revolution.

HOMOGENEOUS – Having the same composition throughout the substance (well mixed).

HYDRO BOOST – Power brake system which operates on fluid from power brake pump.

HYDROCARBON – A complex mixture of hydrogen and carbon compounds.

IDI – Indirect Injection diesel engine.

IGNITION INJECTION – A small charge of fuel used to ignite the main gas charge in dual fuel engines.

IGNITION POINT (AUTO IGNITION) – This is a term applied to the event in which a combustible mixture under certain conditions of density, pressure and temperature ignites without a flame or spark.

INERTIA – A resistance to any change in the state of motion. It is Newton's First Law of Motion.

INJECTION – Method of forcing fuel into chamber when air is highly compressed by the piston.

INJECTION LAG – The time interval (usually expressed in degrees of crank angle) between the nominal start of injection pump delivery and the actual start of injection at the nozzle.

INJECTION NOZZLE (COMPONENTS)

NOZZLE AND HOLDER ASSEMBLY – The complete apparatus which injects the pressurized fuel into the combustion chamber.

NOZZLE – The assembly of parts employed to atomize and deliver fuel to the engine.

NOZZLE HOLDER ASSEMBLY – The assembly of all parts of the nozzle and holder assembly other than those comprised in the nozzle.

OPEN NOZZLE – A nozzle incorporating no valve.

CLOSED NOZZLE – A nozzle incorporating either a poppet valve or a needle valve, loaded in order to open at some predetermined pressure.

1. **POPPET NOZZLE** – A closed nozzle provided with an outward opening, spring-loaded, poppet valve.
2. **DIFFERENTIAL NOZZLE** – A closed nozzle provided with a spring-loaded needle valve.
3. **PINTLE NOZZLE** – A closed nozzle provided with a spring-loaded needle valve. The body of the nozzle has a single large orifice into which enters a projection from the lower end of the needle, this projection being so formed as to influence the rate and shape of the fuel spray.
4. **HOLE TYPE NOZZLE** – A closed nozzle provided with one or more orifices through which the fuel issues. Nozzles with more than one orifice are known as multihole nozzles.

NEEDLE VALVE (IN A CLOSED NOZZLE) – A needle valve has two diameters, the smaller at the valve seat. The fuel injection pressure acting on a portion of the total valve area lifts the valve at the predetermined pressure, then acts on the total area. The end opposite the valve seat is never subjected to injection pressure.

PINTLE VALVE (IN A CLOSED NOZZLE) – A special type of a "needle valve" wherein an integral projection from the lower end of the needle is so formed as to influence the rate and/or shape of the fuel spray during operation.

NOZZLE BODY – That part of the nozzle which serves as a guide for the valve and in which the actual spray openings may be formed. These two parts, the body and the valve, are considered as a unit for replacement purposes.

NOZZLE TIP – The extreme end of the nozzle body containing the spray holes (may be a separate part).

POPPET VALVE – An outwardly opening valve used with certain forms of closed nozzles.

NOZZLE HOLDER CAP – A cap nut or other type of closure which covers the outer end of the nozzle holder.

NOZZLE RETAINING NUT – The nozzle holder part which secures the nozzle or nozzle tip to the other nozzle holder parts.

SPINDLE – A spindle transmits the load from the spring to the valve.

PRESSURE ADJUSTING SCREW (SHIMS) – The screw (shims) by means of which the spring load on the nozzle valve is adjusted to obtain the prescribed opening pressures.

SPRING RETAINER – The spring retainer encloses the spring and carries the adjusting screw or shims.

NOZZLE HOLDER SHANK LENGTH – The distance from the top of the cylindrical shank to the seating face of the nozzle holder.

SEATING FACE – The face upon which the nozzle and holder assembly seats to make a gas tight seal with the cylinder head. Commonly, this face is on the nozzle retaining nut.

DIFFERENTIAL RATIO – The ratio between the guide diameter of the needle valve and the effective diameter of the needle valve seat.

SPRAY ORIFICE/ORIFICES – The opening or openings in the end of the nozzle or tip through which the fuel is sprayed into the cylinder.

SPRAY DISPERSAL ANGLE – The included angle of the cone of fuel leaving any single orifice in the nozzle or tip including pintle type.

SPRAY ANGLE – The included angle of the cone embracing the axes of the several spray holes of a multihole nozzle. In the case of nozzles for large engines, more than one spray angle may be needed to embrace all the sprays, for example, an inner and an outer spray angle.

SPRAY INCLINATION ANGLE – The angle which the axis of a cone of spray holes makes with the axis of the nozzle holder.

SAC HOLE – The recess immediately within the nozzle tip and acting as a feeder to the spray hole(s) of a hole type nozzle.

DIFFERENTIAL ANGLE – The difference between the angles of the seat face of the valve and that of the seat in the body provided to insure its effective sealing.

LEAK-OFF – Fuel which escapes between the nozzle valve and its guide. (This term is also used to describe the leakage past the plunger of a fuel pump.)

NOZZLE OPENING PRESSURE – The pressure needed to unseat the nozzle valve.

PEAK INJECTION PRESSURE – The maximum fuel pressure attained during the injection period (not to be confused with opening pressure).

INJECTION TIMING – The matching of the pump timing mark, or the injector timing mechanism, to some index mark on an engine component, such that injection will occur at the proper time with reference to the engine cycle. Injection advance or retard is respectively an earlier, or later, injection pump delivery cycle in reference to the injection cycle.

IN-LINE FUEL HEATER – A 100-watt heater which is integral to the fuel line. This heat warms the fuel prior to the filter to keep paraffin crystals from stopping fuel flow. The heater warms the fuel by 20°.

INTERFACE – A surface forming the common boundary between two close spaces or substances.

LAMINAR FLAME SPEED – This is the speed at which a flame will burn through a quiet or still fuel-air mixture. A laminar flame burns as a flat flame sheet, as it moves through the mixture.

METERING – Method of controlling the amount of fuel injected on each power stroke.

MIN/MAX GOVERNOR – Controls idle speed and prevents overspeed.

MIN/MAX GOVERNOR KIT – A retro-fit assembly that desensitizes the governor to output variance between cylinders at idle.

MODULE – Electronic control unit that controls the glow plug system.

NOXES – Oxides of nitrogen (NO_X), a component of diesel exhaust.

NUMBER ONE DIESEL FUEL – Diesel fuel used in cold climates. Sometimes blended with #2 diesel fuel to increase #1's energy and #2's cold-weather performance.

NUMBER TWO DIESEL FUEL – Diesel fuel used in moderate climates.

ORIFICE – Restriction to control flow in a line (tube).

OXIDATION – The process of adding oxygen to a substance.

PARAFFIN –

1. A semi-transparent, waxy mixture of hydrocarbons, derived principally from the distillation of petroleum.
2. Any hydrocarbon of the methane series.

PARAFFIN HYDROCARBON – Petroleum-base fuels consist of hydrocarbons with varying molecular weights and atomic structure. The hydrocarbons represented in petroleum are, paraffins, olefins, diolefins, naphthene, and aromatics.

PARAFFINIC – Pertaining to or containing Paraffin.

PCV – Positive crankcase ventilation.

PEAK PRESSURE PERIOD – The phase of diesel combustion lasting from about 5° before top dead center to about 10° after top dead center. During this phase, the majority of diesel fuel burns.

PERPENDICULAR – A line which is at right angles to the horizontal plane.

PILOT INJECTION – A small initial charge of fuel delivered to the engine cylinder in advance of the main delivery of fuel.

POUR POINT – The temperature at which the fuel becomes too thick to flow or be pumped.

POUR POINT DEPRESSANT – Pour point depressants enable oil to flow or pour at low temperatures. Wax, present in all oils, forms a honey-comblike structure at low temperatures and restricts oil flow. Pour point depressants lower or depress the temperature at which this occurs and enable oil to pour more freely. They retard wax crystal growth.

PRECHAMBER – A precombustion chamber built into the cylinder head that creates turbulence in incoming air. Sometimes called a swirl chamber.

PROPAGATE – To spread through a mixture.

PUMPING LOSSES – Energy used as the engine creates a vacuum in the intake manifold.

RECIPROCATE – To move back and forth alternately, as in an engine piston.

RESIDUAL – Pertaining to what is left or remaining in a process, left over as a remainder.

RETRACTION VOLUME – The volume of fuel retracted from the high-pressure delivery line by action of the delivery valve's retraction piston in the process of the delivery valve returning to its seat following the end of injection.

RISING VOLUME PERIOD – The final combustion phase in diesels lasting from about 10° after top dead center to about 60° before bottom dead center. During this period, injection has stopped and the last few droplets of fuel burn.

ROTARY FUEL METERING VALVE – Regulates the flow of pressurized fuel into the charging chamber. It is directly controlled by the throttle linkage and is affected by the fuel solenoid and governor.

SECONDARY INJECTION – The fuel discharged from the nozzle as a result of a reopening of the nozzle valve after the main discharge.

SOCK – The fuel pickup strainer in the tank. It is made of saran, and water will not enter, until it becomes almost totally engulfed by water.

SPECIFIC HEAT – The capacity of any substance for absorbing heat.

SPONTANEOUS COMBUSTION – The oxidation of fuel rapidly enough, to generate sufficient internal heat to ignite it.

SPONTANEOUSLY – A self generated action resulting from something's own impulse.

STRATIFIED – To form or arrange in layers.

SUPPLY PUMP – A pump for transferring the fuel from the tank and delivering it to the injection pump.

T.D.C. – Top Dead Center is the point of highest piston travel in a stroke.

THERMAL EFFICIENCY – The thermal efficiency of a heat engine is that portion of the heat supplied to the engine which is turned into work.

THERMAL SWITCH – Bi-metal switch that contains four switches that control the glow plug system.

THERMODYNAMIC – The branch of physics dealing with heat, heat engines and other forms of energy.

TIMING ADVANCE CHAMBER – Part of the fuel injection pump; the timing advance chamber provides the proper timing of fuel injection for all operating conditions.

TRANSFER PUMP – Part of the fuel injection pump; boosts fuel pressure from 20 PSI to 130 PSI, depending on pump and engine speed.

VACUUM PUMP – Needed because vacuum can't be drawn from the unrestricted air manifold.

VISCOSITY – The viscosity of a liquid, is a measure of its internal resistance to flow or movement. It is a result of the molecular friction within the liquid. Thickness of oil; lower viscosity indicates a thinner oil.

NOTES

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