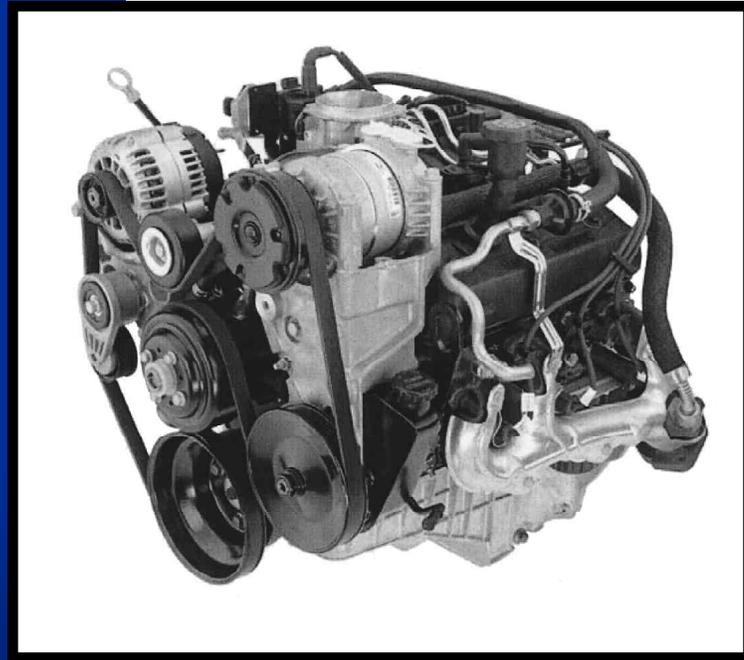


GM

POWERTRAIN

Application Manual



**Gasoline 4.3L
V6 90 Degree
2001 Model Year**

**General Motors
Powertrain Group**

ENGINE APPLICATION MANUAL

**Gasoline 4.3L V6 90 Degree
Engines RPO : L35**

Model Year: 2001

**General Motors Powertrain Group
895 Joslyn Ave
MC: 480-710-225
Pontiac MI 48340**

1.0 INTRODUCTION

This manual assists the reader in the application of the 4.3L V6 90 Degree family of engines to Transportation Vehicles, Marine and Industrial applications. It gives an overview of the engine, its features, and systems. Details are provided on typical interfaces between the engine, related subsystems, and the vehicle.

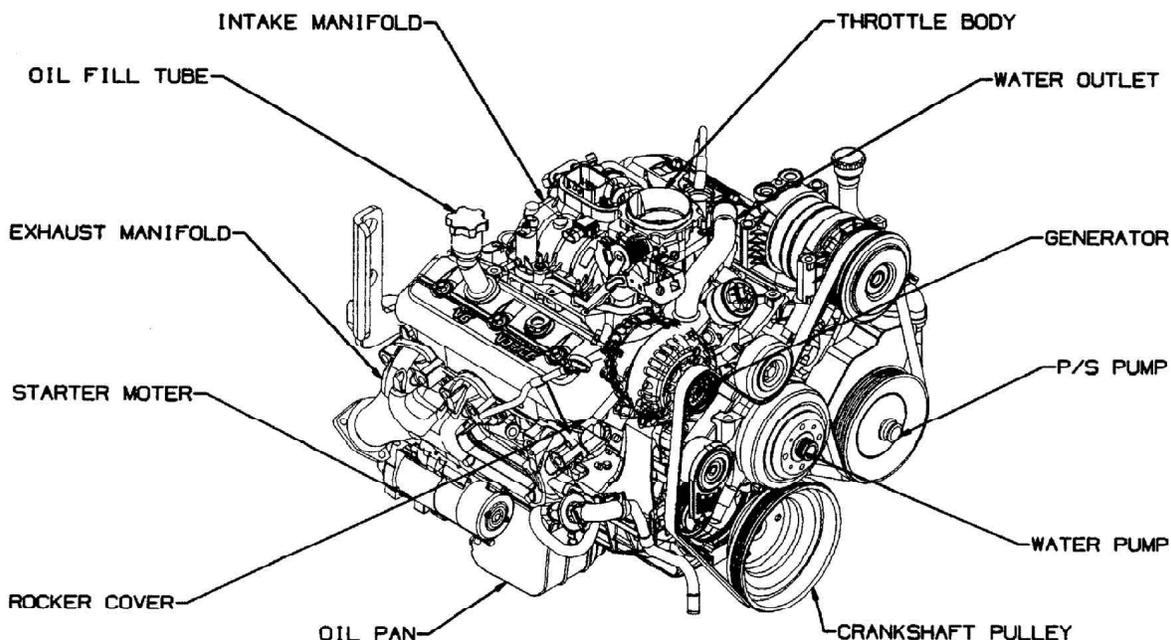
Caution:

The performance of the engine is dependent on the specific application. It is recommended that the owner of this document be contacted before specific application decisions are made.

2.0 PRODUCTSUMMARY

2.1 APPEARANCE

The figure 2.1-I shows the 4.3L V6 90 Degree Engine.



L35 Isometric View

Figure: 2.1-I

2.2 FEATURES

The model year 2001 for 4.3L V6 90 Degree Engine has one version: L35.

This Engine has specific values of power and torque, which allow for a very wide range of application up to 15000 Lbs. GVW.

The more distinctive common features of this family of engines are:

- Optimized Intake Manifold
- Stiff Oil Sump
- High reliability and durability
- OBDII compliant

2.3 PRODUCT SPECIFICATION SUMMARY
2.3.1 SPECIFICATION

ENGINE	L35 Truck Application	L35 Marine Application	UNITS
PERFORMANCE			
Rated Power	200	223	hp
Rate Power Speed	4600	4800	rpm
Rated Torque	260	275	Lb. ft
Rated Torque Speed	2800	3800	rpm
Torque Extension Speed Range (From Peak Torque to Peak Power)	1800	1000	rpm
Exhaust Restriction at Rated Power (Better than)	8.85 to 8.58 @ 4600 rpm	0	in hg Piezometer
Inlet Restriction at Rated Power w/Filter	-0.89 @ 4600 rpm	0	in hg Piezometer
Redline Speed	5000	5000	rpm
Fuel Cut-Off Speed, Nominal Conditions	5200	5200	rpm
Fuel Cut-Off Speed, Cold Conditions	5200 (-40)	5200 (-40)	rpm
Maximum Upshift Speed	5100 Man - 5200 Auto	N/A	rpm
Minimum Idle Speed	525	650	rpm
Minimum Unassisted Start Temperature	-20	-20	Degree C
PHYSICAL/CONTENT			
Type:	4 Cycle	4 Cycle	
Service Type	Naturally Aspirated	Naturally Aspirated	
Configuration:	V	V	
Bank Angle:	90	90	Degree
Number of Cylinders:	6	6	
Valvetrain Configuration:	OHV	OHV	
Number of Valves per Cylinder:	2	2	
Displacement:	4302	4302	cc.cm
Bore:	101.6	101.6	mm
Stroke:	88.4	88.4	mm
Compression Ratio:	9.4:1	9.4:1	
Firing Order:	1-6-5-4-3-2	1-6-5-4-3-2	
Rotational Direction:	CW	CW	
Fuel Injection Pump	Electronic	Electronic	
Certification	Federal & California	N/A	
Engine Mass	200	200	Kg
Spark Plugs	41-932 (0.060")	41-932 (0.060")	
Oil Filter	PF-52	PF-52	
Controller	Electronic	Electronic	
SubSystems			
Air Intake Subsystem			
Throttle Body Type	SCPI Sequential Central Port Injection	SCPI Sequential Central Port Injection	
Max Air Flow Rate:	158@ 4600 rpm	158@ 4600 rpm	Gr/sec
Intake manifold :	Symmetrical Runner	Symmetrical Runner	
Lower Intake:	Aluminum	Aluminum	
Upper Intake:	Composite	Composite	

ENGINE	L35 Truck Application	L35 Marine Application	UNITS
Cylinder Head Subsystem			
Cylinder Head			
Material	Cast-Iron GM232-M	Cast-Iron GM232-M	
Cylinder Head Type:	OHV	OHV	
Valves Actuation:	Push Rod	Push Rod	
Rocker Arm Ratio	1.5:1	1.5:1	
Valve Train			
Valves per Cylinder:	2	2	
Valves Angle from Vertical:	15	15	Degree
Lifters - Type	Hydraulic Roller	Hydraulic Roller	
Valve Guides	Cast Iron	Cast Iron	
Intake Valves			
Material	1541 Steel	1541 Steel	
Head Diameter	49.3	49.3	mm
Stem Diameter	7.965	7.965	mm
Length	123.68	123.68	mm
Seats	45 Degree	45 Degree	
Lift	11.2	11.2	mm
Exhaust Valves			
Material	21 - 4N Stainless Steel with	21 - 4N Stainless Steel with	
3140 Welded Tip	3140 Welded Tip		
Head Diameter	38.1	38.1	mm
Stem Diameter	7.965	7.965	mm
Length	124.84	124.84	
Seats	45 Degree	45 Degree	
Lift	11.0	11.0	mm
Main Block Subsystem			
Block Assembly:			
Material	Cast-Iron GM232-M	Cast-Iron GM232-M	
Cylinders	Cast Iron	Cast Iron	
Lower Structure	Four main bearing Supports	Four main bearing Supports	
Bore Spacing	111.76	111.76	mm
Deck Height	234.7	234.7	mm
Connecting rods:			
Material -	Forged-SAE 1141	Forged-SAE 1141	
Length -	154.9	154.9	mm
Bolts	9	9	mm
Bearings	Aluminum Tin Silicon Alloy	Aluminum Tin Silicon Alloy	
Rod Length to Stroke Ratio	1.68:1	1.68:1	
Piston			
Type -	Strutless Flat Top	Strutless Flat Top	Cam Turned
Material -	Eutectic Cast Aluminum Alloy	Eutectic Cast Aluminum Alloy	
Weight	437	437	Gr

ENGINE	L35 Truck Application	L35 Marine Application	UNITS
Piston Pins			
Type -	Fixed 24X70	Fixed 24X70	mm
Material -	Steel SAE 1019	Steel SAE 1019	
Piston Rings			
Compression Rings Number:	2	2	
Top Compression	Steel Barrel 1.5mm	Steel Barrel 1.5mm	
Second Compression	Cast Iron 1.5 mm	Cast Iron 1.5 mm	
Oil Control Rings Number -			
Type -	Low Tension 3 Pieces	Low Tension 3 Pieces	
Material -	Plated Steel	Plated Steel	
Camshaft			
Material -	5150 Steel Billet	5150 Steel Billet	
Description	Gun Drilled	Gun Drilled	
Base Circle Diameter:	39.4	39.4	Mm
Drive Chain Pitch Roller	3/8	3/8	
<u>Camshaft Valve Timing:</u>			
Intake Valve.....Opens	-33 BTDC	-33 BTDC	Crk Degree
Closes	286 ATDC	286 ATDC	Crk Degree
Exhaust Valve.....Opens	-271 BTDC	-271 BTDC	Crk Degree
Closes	48 TDC	48 TDC	Crk Degree
Camshaft Bearings	Steel Backed Copper/Lead	Steel Backed Copper/Lead	
Valve Springs			
Material	Super Clean Cr-Si	Super Clean Cr-Si	
Type	Double Shot Peened	Double Shot Peened	
Dimension	4.6 mm Round	4.6 mm Round	
Closed (Valve Closed)	356	356	Newtons
Open (Rate)	65	65	Newtons/mm
Crankshaft			
Material -	Cast Nodular Undercut Rolled Fillet	Cast Nodular Undercut Rolled Fillet	
Number of Counterweights	6	6	
Main Journal Diameter -	62.2	62.2	Mm
Crank Pin Journal Diameter	57.1	57.1	Mm
Bearings	Aluminum Tin Silicon Alloy	Aluminum Tin Silicon Alloy	
Torsional Damper	Ring Inertia	Ring Inertia	Rubber Mounted
Crankcase Ventilation	Negative Closed (Vacuum created from Intake Manifold)	Negative Closed (Vacuum created from Intake Manifold)	

ENGINE	L35 Truck Application	L35 Marine Application	UNITS
Balance Shaft			
Type	First Order	First Order	
Material	Nodular Cast	Nodular Cast	
Rotation	CCW	CCW	
Speed	Same as Crank.	Same as Crank.	
Drive	Helical Gear 14 ° Off Cam	Helical Gear 14 ° Off Cam	
Oil Lubrication			
Main and Rod Bearings	Pressure	Pressure	N/a
Camshaft	Pressure	Pressure	N/a
Timing Gear	Splash	Splash	N/a
Connecting Rods	Pressure	Pressure	N/a
Valve Mechanism	Pressure	Pressure	N/a
Cylinder Walls	Splash	Splash	N/a
Piston & Pins	Splash	Splash	N/a
Cylinder Head	Hollow Push Rod	Hollow Push Rod	N/a
Oil Capacity			
Oil	5W-30W Mineral	5W-30W Mineral	N/a
W/ Filter	4.5	4.5	Qts
W/o Filter	4.0	4.0	Qts
Oil Filter			
Type	Full Flow PF-47	Full Flow PF-47	N/a
Capacity	0.3	0.3	Qts
Oil Pump			
Type	Spur Gear	Spur Gear	N/a
Normal Pressure	40-45 psi	40-45 psi	@ 2000 RPM
Idle Pressure	20-25 psi	20-25 psi	@ Idle
Oil Flow @ 1000 RPM	2	2	GPM
Drive	Camshaft	Camshaft	N/a
Fuel Injection System			
Mean Features			
Injection Pump Make	Delphi	Delphi	
Type	Top Feed	Top Feed	
Model	SCFI	SCFI	
Injection Timing	Sequential	Sequential	
Operating Pressure	425 +/- 9	425 +/- 9	KPa
Opening Pressure	285 +/- 9	285 +/- 9	KPa
Fuel Pump			
Fuel Pump Make	Delphi	Delphi	
Type	44MM -G-Rotor	44MM -G-Rotor	
Minimum Fuel Flow	25	25	Gram/Sec
Maximum Fuel Flow	TBD	TBD	Gram/Sec
Fuel Pump Voltage Range	6-12	6-12	Volts
Fuel Pump Pressure	425	425	Kpa
Fuel Filter			
Type	Delphi	Delphi	
Type	Full Recirculation	Full Recirculation	
Material	Nylon 66	Nylon 66	

ENGINE	L35 Truck Application	L35 Marine Application	UNITS
Regulator	Delphi Cartridge	Delphi Cartridge	
Nominal Pressure	425	425	Kpa
Injectors	Delphi	Delphi	
Recommended Fuel	87	87	Octane = (R+M)/2
Water Pump Type:	Centrifugal	Centrifugal	
Water Pump Maximum Flow @ Engine RPM:	76.5	76.5	GPM @ 4600 RPM
Maximum Sustained Coolant Temperature:	262	262	F
Thermostat Setting			
Starts to Open	180	180	F
Full Open	262	262	F
Bearing Type	Ball/Roller	Ball/Roller	
Impeller Material	Cast iron	Cast iron	
Housing Material	Cast iron	Cast iron	
By Pass Recirculation Type	External	External	
Water Jackets full length of Cylinder	Yes	Yes	
Water Jackets all around Cylinder	Yes	Yes	
Water Jackets open at head face	No	No	
Surge Tank System	No	No	
Coolant Fill Location	Deaeration Tank		
Circulation Thermostat Type	Bypass	Bypass	
- direction of rotation :	CCW	CCW	
- drive ratio (relative to crankshaft)	1.25	1.25	

2.3.2 Fuel Requirements

The 4.3L V6 90 Degree Engine System meets the emissions standard established in the FMVS and EPA regulations with fuel quality in accordance with the API standards.

The engine must operate on the following types of fuels:

Unleaded Gasoline 87 (R+M)/2 (ASTM D4814),

Unleaded Gasoline 87 (R+M)/2 with up to 15 % MTBE (Methyl Tertiary-Butyl Ether),

Canadian Gasoline 87 (R+M)/2 (CGSB 3.5-92) w/ MMT @ 18 mg/L manganese,

Reformulated Gasoline,

Premium Unleaded 91 (R+M)/2,

Export Gasoline as low as 80 (R+M)/2,

South American Gasoline with Peroxide contamination to 2.5%

Methanol mixes with gasoline to 15 %,

Ethanol mixes with gasoline to 25 %, Brazilian fuel system (SCPI) required.

Leaded Gasoline. Special cylinder heads required- NM8

2.3.2 Performance

2.3.2.1 Engine Power & Torque

The performance of the 4.3L V6 Engine is specified in the following paragraphs.

The Fig 2.3.2.1-I shows the following performance characteristics for the L35 engine: Power, Torque and Speed Range.

The engine will deliver the power and torque levels within +/-5% (after run in) as shown in Table 2.3.2-I.

RPM	Truck Applications		Marine Applications		Industrial Applications		Notes
	Power HP	Torque Lbs.-ft	Power HP	Torque Lbs.-ft	Power HP	Torque Lbs.-ft	
800	32.4	210.4	35.7	233.5	N/A	N/A	
1200	50.7	221.9	57.0	248.6	35	200	
1600	72.6	238.1	78.7	257.7	60	210	
2000	93.8	246.1	99.1	260.2	80	220	
2400	116.3	254.3	120.3	262.5	105	230	
2800	137.9	258.2	143.4	269.1	118	220	
3200	157.5	257.9	166.4	272.7	120	210	
3600	174.7	254.4	188.2	274.1	119	200	
4000	188.5	247.1	206.2	270.2	118	190	
4400	195.8	233.0	217.6	259.5	N/A	N/A	
4600	198.1	226	220.8	252.0	N/A	N/A	
4800	197.8	216.3	221.6	242.3	N/A	N/A	
5200	192.3	194.2	216.0	218.0	N/A	N/A	

Fig 2.3.2.1 -I 4.3L V6 Engine Power & Torque

Test Conditions for Truck Applications

* Based on the following conditions (measured at maximum rated speed W.O.T):

- Exhaust restriction 8.5" of Hg
- Air Intake temperature 77° F
- Intake restriction - 1" of Hg
- SAE J1349

Test Conditions for Marine & Industrial Applications

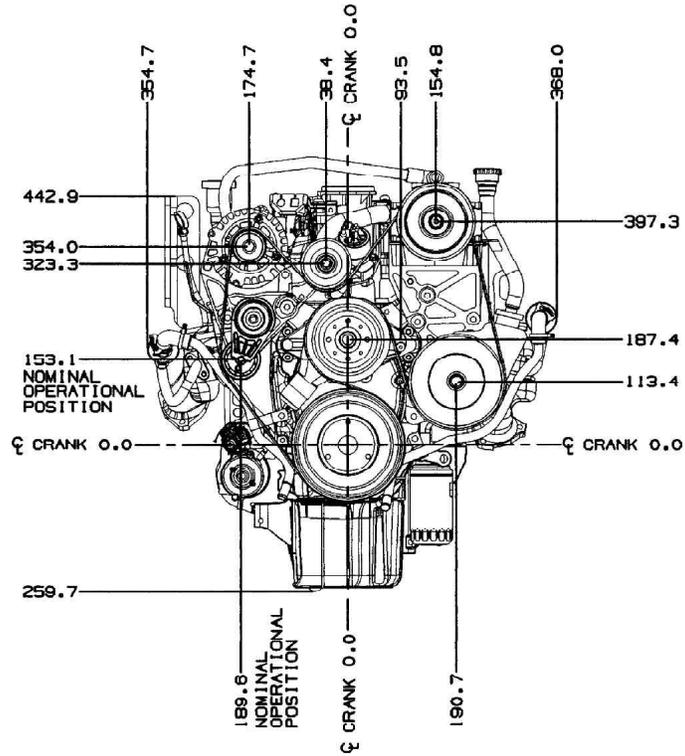
* Based on the following conditions (measured at maximum rated speed W.O.T):

- Exhaust restriction: 0 of Hg
- Air Intake temperature: 77 ° F
- Intake restriction - 1" of Hg
- GMPT Test #20
- This data reflects the Maximum values obtained with Different Intakes Manifolds & Fuel Systems

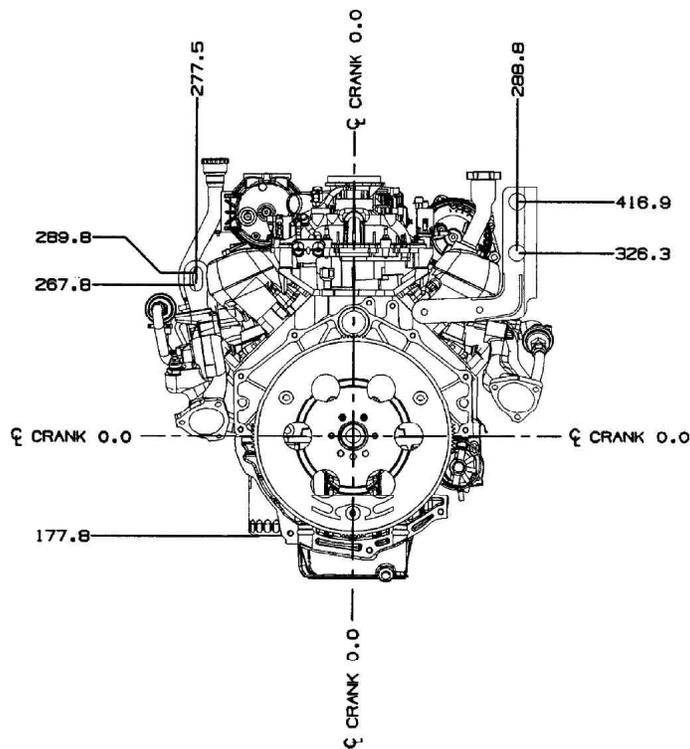
2.4 FEATURE LOCATION ILLUSTRATIONS

Front, Rear, Rh and Lh views of the 4.3L V6 90 Degree are included here with its overall dimensions for preliminary packaging evaluations.

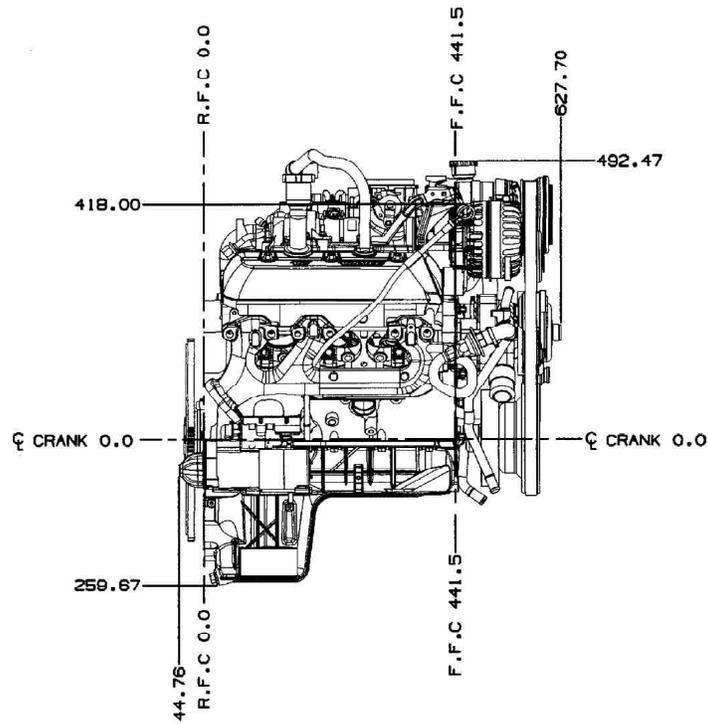
L35 Main Views



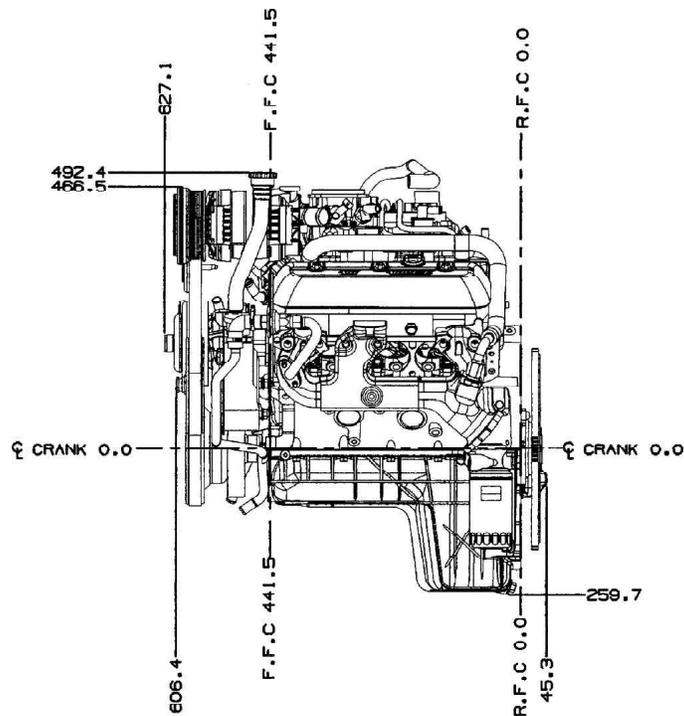
L35 Front View



L35 Rear View



L35 RH Side View



L35 LH Side View

2.5 CONFIGURATION AS SHIPPED

2.5.1 Engine as Shipped

Engine as shipped from the engine plant is to conform to a common state of dress as described below. The following components are installed at the engine plant:

Harmonic balancer	Crankshaft sensor
Direct drive accessories (not belt driven)	E.G.R. system
Engine lift brackets	Engine oil
Engine oil dipstick and tube	Exhaust manifold(s)
Exhaust manifold heat shields (As required)	Engine Fuel system
Heater hose nipples	Coolant temperature sensor/switch
Manifold air pressure sensor	Oil pressure sensor/switch
Oil filter (except remote mounted)	Transmission alignment dowels
Water pump	Flywheel and or Flexplate
	Crankcase ventilation system

2.6 IDENTIFICATION AND MARKING

2.6.1 VIN Identification Labeling

There are two places for the stamping of the V.I.N.: one is provided side by side on the left hand side of powertrain and the other is in rear face of cylinder case.

2.6.2 Emissions Certification Labeling

A vehicle emission control label that meets the format and content requirements of Federal Regulation 40 CFR 86.095-35 and CARB Regulation Title XIII California Code of Regulations Section 1965 shall be attached to the vehicle subsystem in the location required by the regulations above.

Incomplete Vehicles manufactured in two or more stages shall meet the certification labeling requirements of the regulations above.

Emissions Certification is not provided for Marine Industrial Applications.

2.6.3 Engine Identification - Broadcast Codes

The 4.3L V6 Engine has an identification number cast into the cylinder case front LH side.

Also, an Engine Verification Label is applied to the rear of the left bank cylinder head. This is the single label location for passenger car engines. In addition to the LH rear head location, the truck engines have another identical label applied to the oil pan (near the bottom of the engine) on the right side.

The labels show the following information:

- First Two characters: 10 - Indicates an engine not a transmission.
 - Next 3 characters: Broadcast code (engine configuration which includes a cross reference to model year of build):
 - Model year (1st letter)
- characters: Julien Date of Build
- Last 4 Characters: Sequence number of build on that date.

Translated the engine verification number shown in the sample label below identifies an engine, broadcast code (XJB) (1999 5.3L Federal Auto), built at Romulus on February 10 , 1999; sequence number 1034.

Example: * 10XJB W990411034*

2.6.3.1 Engine Option Description

RPO	Description	Notes
L35	4.3L V-6 Engine w/ SCPI	
M30/MT1	Automatic Transmission	
M50/MG5	Manual Transmission	
K18	Air Injection (Electric pump)	
KC4	Engine Oil Cooler	
KL5	Gaseous Fuel Compatible	
NA1	Below 8500# GVW	
NA3	Emission System - Japan	
NA4	Above 8500# GVW	
NB6	Emission System - Calif.	Tier 1 (-K18 on CK Manuals)
NC1	Emission System - Calif. LEV	(+K18 on CK / -K18 on M/L)
NC8	Emission System - Calif. ULEV	(-K18 on ML)
NF2	Emission System - Federal Tier 1	(-K18 on CK & P)
NF4	Emission System - Clean Fuel Fleet	
NF7	Emission System - Federal N LEV	
NM2	Emission System - Leaded Fuel	(Export for ML & P)
NM8	Leaded Fuel System Compatible	(Export for ST)
NN8	Emission Override - Unleaded Fuel	(Export)
NW7	Traction Control	
RHD	Right Hand Drive	
S5I	Brazil Equipment	
W99	Venezuela Equipment	
TZ0	Mexican Equipment	(Manual Transmission)
ZK3	G-Van Pull Ahead	(Vehicle only)

2.6.3.2 Engine Broadcast Codes & Part Numbers

Part Number	TON	ROM	Broad Cast Code	Vehicle	Description
12559672	X		AAA	CK	L35+M30+NF2 (-K18)
12559676	X		AAF	CK	L35+M30+NC1 (+K18)
12559673	X		AAB	CK	L35+MG5+NF2 (-K18)
12559677	X		AAH	CK	L35+MG5+NC1 (+K18)
12559680		X	ABA	G-LD	L35+M30+NA1-K18
12559681		X	ABB	G-HD	L35+MT1+NA4 (-K18)
12559682		X	ABC	G-LD	L35+M30+NA1+NF4+K18
12559684	X		ACA	ML	L35+M30+NA3/NC1/NC8/NF2/NF4/ NF7
12559685		X	ACB	ML	L35+M30+NM2
12559687		X	ADA	P	L35+MT1+NF2-KL5
12559688		X	ADB	P	L35+MT1+KL5+NF2
12559691	X	X	AFC	S	L35+M30-K18-NM8 (+NN8)
12559707		X	AFL	S	L35+M30+NM8
12559692	X	X	AFD	S	L35+M50-K18-NM8 (+NN8)
12559708		X	AFN	S	L35+M50+NM8
12559701	X	X	AFJ	S	L35+M30+K18+NF4
12559702	X	X	AFK	S	L35+M50+K18+NF4
12559695	X	X	AHC	T	L35+M50-K18-NM8-RHD
12559696	X	X	AHD	T	L35+M30-K18-NM8-RHD
12559709		X	AHP	T	L35+M50+NM8-W99
12559710		X	AHS	T	L35+M50+W99+NN8
12560378		X	AHX	T	L35+M30+RHD-NM8-K18
12560379		X	AHY	T	L35+M50+RHD-NM8-K18
12559711		X	AHT	T	L35+M30+NM8
12559705	X	X	AHL	T	L35+M30+NF4+K18
12559706	X	X	AHN	T	L35+M50+NF4+K18
12560483	X		1LB	---	Marine (Volvo) 2Bbl w/Dist.
12560485	X		1LJ	---	Marine (Merc) 2Bbl w/o Dist.
12560484	X		1LC	---	Marine 4Bbl w/ Dist.
12560486	X		1LK	---	Marine 4Bbl w/o Dist.
12560481	X		1LT	---	Indust 2Bbl Gaseous - Bucks Irrigation
12560482	X		1LX	---	Indust 2Bbl Gas - Williams Powertrain
12559712		X	1LA	T	L35+M50+S5I (Brazil)
12559713		X	1LD	T	L35+M30+S5I (Brazil)

3.0 GMPT SYSTEM INTERFACES

3.1 INTERNAL INTERFACES TO GMPT

3.1.1 Engine Interface to transmission

The transmission shall be attached to the rear end of the engine, which provided the flange face attachment illustrated in the figure 3.1.1- I.

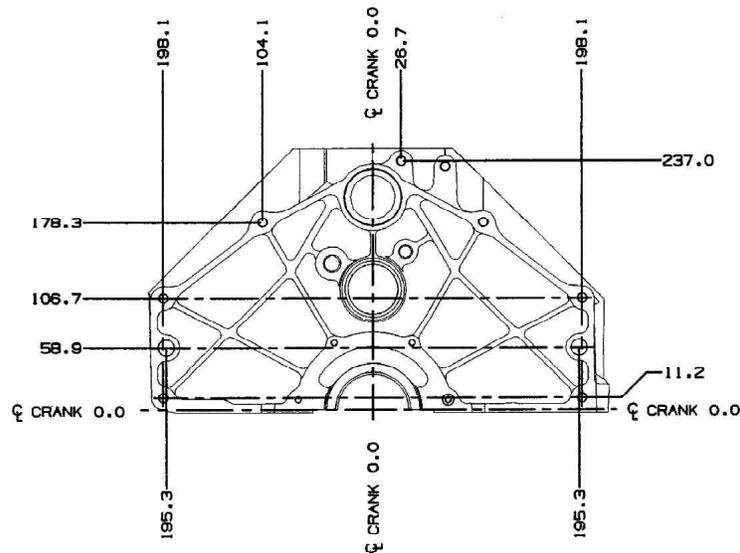


Figure 3.1.1-I: Transmission attachment

3.1.1.1 Automatic Transmission

The 4.3L V6 engine could be mated to either: the GM Automatic Transmission Hydra Matic 4L60E or the GM Automatic Transmission Hydra Matic 4L80E

Figure 3.2.1-I to 3.2.1-XVIII shows the PCM Engine to Automatic Transmission Mechanization Diagram.

3.1.1.2 Manual Transmission and Clutch

The GM Manual Transmission recommended is a Five Speed Manual (MW 3)

The following engine-transmission, clutch interface issues must be considered:

Manual transmissions require the engine crankshaft pilot bearing to be able to support up to 920 lbs (4292 N) of radial load due to transmission internal gear forces.

The following table shows the different Transmissions and Components coupled to the L35 engine and GM platforms.

Transmission (UPC: 7)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Auto 4L80E MT1	24210752	N/A	24210754	N/A	N/A
Bolt/Screw/Stud	15724226 11514224	N/A	15724226 11514224	N/A	N/A
Auto 4L60E M30	N/A	24211665 24211666 24211667	24211668	24211663 24211664	24211662 24211663
Brace	N/A	N/A	N/A	15992466	N/A
Bolt/Screw/Stud	N/A	11515768 15724226	11515768 15724226	15724226 11517000 25624806	11517000 1261968
Manual 5-Speed MW3	15020892	N/A 15031131	N/A	N/A	N/A
Bolt/Screw/Stud	11514224	N/A	N/A	N/A	N/A
Manual 5-Speed MG5	N/A	15769087 15769088	N/A	N/A	N/A
Bolt/Screw/Stud	N/A	11515768	N/A	N/A	N/A
Manual 5-Speed MW2	N/A	N/A	N/A	N/A	15045050
Bolt/Screw/Stud	N/A	N/A	N/A	N/A	11515768
Manual 5-Speed M50	N/A	N/A	N/A	N/A	15769696 15769697 15769698
Bolt/Screw/Stud					11517000

3.1.2 Engine Interface to PCM (Vehicular and Marine/Industrial Application)

The 4.3L V6 90 Degree Engine uses the Powertrain Control Unit (PCM) to control the engine, automatic transmission, the vehicle performance parameters and the onboard diagnostic system.

3.1.2.1 Inputs from the Engine to the PCM

The following Inputs are internal engine parameters and must be supplied to the Powertrain Control Module:

Barometric Pressure (Or Manifold Absolute Pressure) - POA Engine Assembly

Mass Airflow Sensor (Air Cleaner/Air Duct)

Engine Speed

Crankshaft Sensor and Camshaft Sensor

Knock Sensor

Air intake Temperature Sensor (POA MAF) - (Only for the GMT-800 Truck)

Engine Coolant Temperature ECT Sensor-POA Engine Assembly

Engine Oil Pressure Sensor

3.1.2.2 Outputs from PCM to the Engine

Fuel Injectors Management – (Injection Pulse Width Signal)

Idle Air Control Motor (IACV)

Ignition Control Coil Module

Linear EGR Valve Solenoid

Evap. System

Purge Solenoid

Secondary Air (AIR) System

A/C Control

Serial Data

3.1.3 PCM Interface to Transmission

The PCM uses an Electronic Transmission Control Algorithm to monitor and control the transmission. This algorithm is actually a combination of four algorithms, these algorithms monitor and control the various aspects of the transmission shifting.

3.1.3.1 Input Algorithm:

The Input Algorithm samples all external sensors and scale these values.

3.1.3.2 Shift Control Algorithm:

The Shift Control Algorithm determines which gear ratio the transmission is currently in and changes the state of the control solenoid to accomplish a shift.

The shift pattern is controlled by a set of tables. These contain the vehicle speed at which the shift is to occur as a function of throttle position.

In the manual mode, the current gear may be determined by the operator's movement of the gearshift selector lever.

3.1.3.3 Shift Quality Algorithm:

The Shift Quality Algorithm determines shift quality (or firmness).

This is accomplished by controlling the pressure control solenoid, which regulates the torque signal modulation pressure.

This pressure is determined by a table that is based on vehicle speed and Throttle position.

Garage Shift quality (shifting from Park or Neutral to Drive or Reverse when the vehicle is stationary) is also controlled by torque signal pressure.

3.1.3.4 TCC Control Algorithm

The TCC algorithm determines when the torque converter clutch is applied or released, using a set of tables. These tables also determine and control the rate of application and release of the TCC based on Throttle position

3.1.3.5 Inputs from Transmission to PCM

The following are external Inputs coming from the Transmission to the PCM:

- Transmission Speed Sensor
- Transmission Fluid Temperature Sensor
- Transmission Range Pressure Sensor

3.1.3.6 Output to the Transmission from PCM

- TCC Solenoid
- Transmission Shift solenoids
- Pressure Control Solenoid

3.1.4 PCM Interface to Vehicle

3.1.4.1 External Inputs of the Engine

The following are external Inputs coming from the vehicle to the PCM:

- A/C Status
- Ignition Voltage
- Serial Data (Diagnostics)
- Brake/ Clutch Status
- 4WD Lo Switch (If Applicable)
- Diagnostic Enable
- Cruise Control Inputs
- Tow/Haul Input Switch

3.1.4.2 Output to the Vehicle:

- Data link Connector
- MIL "Service Engine Soon" Lamp
- "Service Throttle Soon" (STS) Lamp

3.1.5a PCM Pin Out and Pin In – Truck Applications

See Figure 3.1.5 - I Powertrain Control Module Diagram to reference the following pin out and pin in connector information

ENGINE - BASE (GEN 1E L35 & M30/MT1)
PCM CONNECTOR CAVITY CHART
J1 (F) CONNECTOR
PCM CONNECTOR ASSY: 12191489
TPA (BLUE) 2 REQ'D: 12176408
COVER: 12191108

CAVITY	FUNCTION	CIRCUIT/COLOR	USAGE			CAVITY	FUNCTION	CIRCUIT/COLOR	USAGE		
			Y	N	N. C.				Y	N	N. C.
J1-01	PWR GRO A	451 BLK/WHT	Y			J1-41	VREF RTN A	SEE APP DWG	Y		
J1-02	CRANK SENSOR SUPPLY	1867 LT GRN	Y			J1-42	FAN1 RELAY/ENG SHUTDOWN	SEE APP DWG			N
J1-03	INJ H	1746 PNK/BLK			N	J1-43	INJ C	877 RED/BLK	Y		
J1-04	INJ D	1745 LT GRN/BLK	Y			J1-44	INJ C	844 LT BLU/BLK			N
J1-05	FUEL TANK PRESS (SEC)	TBD			N	J1-45	VREF SUP 2 A	474 GRA			N
J1-06	BHC CURRENT MONITOR	TBD			N	J1-46	VREF SUP 2 B	474 GRA	Y		
J1-07	VREF SUP 1 C	SEE APP DWG			N	J1-47	VREF SUP 1 A	SEE APP DWG	Y		
J1-08	VREF SUP 1 D	SEE APP DWG	Y			J1-48	VREF SUP 1 B	SEE APP DWG	Y		
J1-09	FLAT ODD HI	TBD	Y			J1-49	FLAT ODD LO (SHIELD)	TBD	Y		
J1-10	FLAT EVEN HI	TBD			N	J1-50	FLAT EVEN LO (SHIELD)	TBD			N
J1-11	RES KNOCK 2	1876 LT BLU			N	J1-51	RES KNOCK 1	496 DK BLU			N
J1-12	CRANK 1 POS	1869 DK BLU/WHT	Y			J1-52	PTO STATUS	SEE APP DWG			N
J1-13	REQUEST TORQ	463 DRN/BLK			N	J1-53	VREF RTN F	407 BLK	Y		
J1-14	BTC SDATA A	SEE APP DWG			N	J1-54	VREF RTN B	469 DRN/BLK	Y		
J1-15	BTC SDATA B	SEE APP DWG			N	J1-55	LEGR 1 POS	1456 BRN	Y		
J1-16	CRANK 2 POS	TBD			N	J1-56	FUEL COMPOSITION SEN	TBD			N
J1-17	TRANS PSH B	1225 DK BLU	Y			J1-57	BATT B	SEE APP DWG	Y		
J1-18	TRANS PSH C	1226 RED	Y			J1-58	CLASS 2 SDATA A	1849 GRN DK	Y		
J1-19	IGN 1	*39 PNK	Y			J1-59	CLASS 2 SDATA B	710 YEL			N
J1-20	BATT A	SEE APP DWG	Y			J1-60	VREF RTN D	452 BLK	Y		
J1-21	CRANK SEN RTN	1868 YEL/BLK	Y			J1-61	CAM SENSOR RTN	632 PNK/BLK	Y		
J1-22	PTO ENAB SW	488 GRN LT			N	J1-62	EXTENDED BRAKE SW	TBD			N
J1-23	VREF RTN H	SEE APP DWG	Y			J1-63	VREF RTN C	SEE APP DWG			N
J1-24	O2 F LO	TBD			N	J1-64	O2 F HI	TBD			N
J1-25	O2 D LO	1871 TAN			N	J1-65	O2 D HI	1670 PPL			N
J1-26	O2 B LO	1667 TAN	Y			J1-66	O2 B HI	1666 PPL	Y		
J1-27	O2 E LO	TBD			N	J1-67	O2 E HI	TBD			N
J1-28	O2 C LO	1669 TAN/WHT	Y			J1-68	O2 C HI	1668 PPL/WHT	Y		
J1-29	O2 A LO	1653 TAN/WHT	Y			J1-69	O2 A HI	1665 PPL/WHT	Y		
J1-30	LOW CLT SW/SIG	SEE APP DWG			N	J1-70	LOW OIL SW	1174 BRN			N
J1-31	HI IDLE SW	534 GRN DK			N	J1-71	PTO ENGINE KILL SW	494 BLU LT			N
J1-32	PRNDL A/CLUTCH SW	SEE APP DWG			N	J1-72	PRNDL B	772 YEL			N
J1-33	TCC BRAKE SW	420 PPL	Y			J1-73	CAM SEN POS	633 BRN/WHT	Y		
J1-34	PRNDL P/P-N SW	SEE APP DWG	Y			J1-74	BNG CLT TEMP	410 YEL	Y		
J1-35	EXTENDED CLUTCH SW	SEE APP DWG			N	J1-75	IGN B	1820 PNK	Y		
J1-36	INJ A	1744 BLK	Y			J1-76	INJ F	845 BLK/WHT	Y		
J1-37	INJ E	846 YEL/BLK	Y			J1-77	INJ B	878 DK BLU/WHT	Y		
J1-38	CHNG OIL LP/LIFT DIVE	SEE APP DWG			N	J1-78	PTO ENGAGE	TBD			N
J1-39	START RELAY (LSD)	SEE APP DWG			N	J1-79	3/2 SHIFT/SKIP SHIFT	SEE APP DWG			N
J1-40	PWR GRO B	451 BLK/WHT	Y			J1-80	VREF RTN E	SEE APP DWG	Y		

Figure : 3.1.5a - I PCM Pin Out /In Connector C1

ENGINE - BASE (GEN 1E L35 & M30/MT1)

PCM CONNECTOR CAVITY CHART

J2 [SI] CONNECTOR

PCM CONNECTOR ASSY: 12191488
TPA (RED) 2 REQ'D: 12176410
COVER: 12191108

Pcm 32u99 Pin Map
99pcn32u.proto3 006

CAVITY	FUNCTION	CIRCUIT/COLOR	USAGE			CAVITY	FUNCTION	CIRCUIT/COLOR	USAGE		
			Y	N	N. C.				Y	N	N. C.
J2-01	PWR GRD C	451 BLK/WHT	Y			J2-41	LEGR 1 LO	SEE APP DWG	Y		
J2-02	TCC CONTROL SOL	418 BRN	Y			J2-42	TCC ENAB/TR MO RELAY	SEE APP DWG			N
J2-03	BHC COM/SEC F_PMP RLY	T80		N		J2-43	A/C CLUTCH RELAY	459 DK GRN/WHT	Y		
J2-04	AIR SOL RELAY	421 PPL		N		J2-44	HI ID LP/REVLKOUT SOL	SEE APP DWG			N
J2-05	DELIVERED TORQ	454 TAN/BLK		N		J2-45	FUEL TANK VENT	1310 WHT	Y		
J2-06	FMTR 1 HI	1228 RED/BLK	Y			J2-46	MALF IND LAMP	419 BRN/WHT	Y		
J2-07	LEGR 1 HI	1676 RED	Y			J2-47	SEE NOTES BELOW	SEE APP DWG	Y		
J2-08	FMTR 1 LO	1229 LT BLU/WHT	Y			J2-48	SHIFT A	1222 LT GRN	Y		
J2-09	FUEL PUMP RELAY	465 DK GRN/WHT	Y			J2-49	SECONDARY PPM	SEE APP DWG	Y		
J2-10	TACH	121 WHT		N		J2-50	PRIMARY PPM	817 DK GRN/WHT	Y		
J2-11	SEC A/C HI PRESS SW	604 DK BLU		N		J2-51	TRANS OIL TEMP	1227 YEL/BLK	Y		
J2-12	LEGR 2 POS	T80		N		J2-52	ALT F TERM	23 GRA	Y		
J2-13	CRUISE ENGAGED	SEE APP DWG	Y			J2-53	TCS/SPK_RTD/MIL REQ	1687 GRA/BLK			N
J2-14	A/C PRESS SEN	388 RED/BLK		N		J2-54	FUEL LEVEL SEN	1589 PPL	Y		
J2-15	ALT L TERM	SEE APP DWG	Y			J2-55	A/C PRESS CYC SW	603 DK GRN	Y		
J2-16	MND LOW GEAR SW	1694 GRA/BLK		N		J2-56	EHC DIAGNOSTIC	T80			N
J2-17	A/C REQUEST	762 GRN DK/WHT	Y			J2-57	VREF RTN G (IATREFLO)	SEE APP DWG	Y		
J2-18	A/C STATUS	59 DK GRN		N		J2-58	ENG OIL PRESS	SEE APP DWG			N
J2-19	FRT AXLE SW	1695 BLK/WHT		N		J2-59	CRANK REQUEST	SEE APP DWG			N
J2-20	TOSS LO	822 LT GRN/BLK	Y			J2-60	EST RTN ODD	2129 BRN			N
J2-21	TOSS HI	821 PPL/WHT	Y			J2-61	EST RTN EVEN	2138 BRN/WHT			N
J2-22	TISS HI	1230 RED/BLK	Y			J2-62	PRNDL C	773 GRA	Y		
J2-23	TISS LO	1231 DK BLU/WHT	Y			J2-63	TRANS PSM A	1224 PNK	Y		
J2-24	TPS	417 DK BLU	Y			J2-64	FUEL TANK PRESS	890 GRN DK	Y		
J2-25	INDUCTION AIR TEMP	472 TAN	Y			J2-65	BHC VOLTAGE MONITOR	T80			N
J2-26	BST A	2121 PPL	Y			J2-66	BST B	2128 PPL/WHT			N
J2-27	EST C	SEE APP DWG		N		J2-67	EST D	SEE APP DWG			N
J2-28	EST E	2126 LT BLU/WHT		N		J2-68	EST F	2125 DK GRN			N
J2-29	EST G	SEE APP DWG		N		J2-69	EST H	SEE APP DWG			N
J2-30	VATS	229 DK BLU		N		J2-70	CAN SDATA HI	T80			N
J2-31	MAF	492 YEL	Y			J2-71	CAN SDATA LO	T80			N
J2-32	MAP	432 LT GRN	Y			J2-72	O2 HEATER LO/ FMTR 2	T80			N
J2-33	FAN 2/CK GA LP/ACREC	SEE APP DWG		N		J2-73	FUEL LEVEL SEN (SEC)	T80			N
J2-34	CANISTER PURGE	428 DK GRN/WHT	Y			J2-74	O2 HEATER HI/LEGR 2	T80			N
J2-35	ALTERNATOR LAMP	25 BRN	Y			J2-75	O2 HEATER HI/ FMTR 2	T80			N
J2-36	AIR PUMP RELAY	436 BRN		N		J2-76	IAC B HI	1749 LT GRN/WHT	Y		
J2-37	SEE NOTES BELOW	SEE APP DWG		N		J2-77	IAC B LO	444 LT GRN/BLK	Y		
J2-38	FUEL/OIL PRESS GA	SEE APP DWG	Y			J2-78	IAC A LO	1748 LT BLU/BLK	Y		
J2-39	CAM SEN SUP	631 RED	Y			J2-79	IAC A HI	1747 LT BLU/WHT	Y		
J2-40	PWR GRD D	451 BLK/WHT	Y			J2-80	O2 HEATER LO/LEGR 2	T80			N

Figure : 3.1.5a -II PCM Pin Out /In Connector C2

The following table shows the different PCM ASM and Components coupled to the L35 engine per GM platforms.

PCM (12 F)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Module ASM	9368071	12201281	12201281 52370668	12201281	12201281
Housing Extension	15003789				
Bracket	15005865 15714426	15047570	15766026	15047570	15767011
Bolt/Screw/Nut	3846202 11514139	11516568	11514519 11514006	11516568	11516568
Sensors (12 F)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Oxygen Sensor	25312191 25312201	25312191 25314006	25312191 25314006	25312191 25314006	25312191 25314006
Mass Air Flow Sensor	25168491	Include in Air SubSystem	Include in Air SubSystem	Include in Air SubSystem	Include in Air SubSystem

3.1.5b PCM Pin Out and Pin In – Marine and Industrial Applications

Marine Applications use a different control module : MEFI – 4 Multiport Electronic Fuel Injection. Interfaces as those described for vehicles application, OBD II, and Emissions requirement are not longer needed.

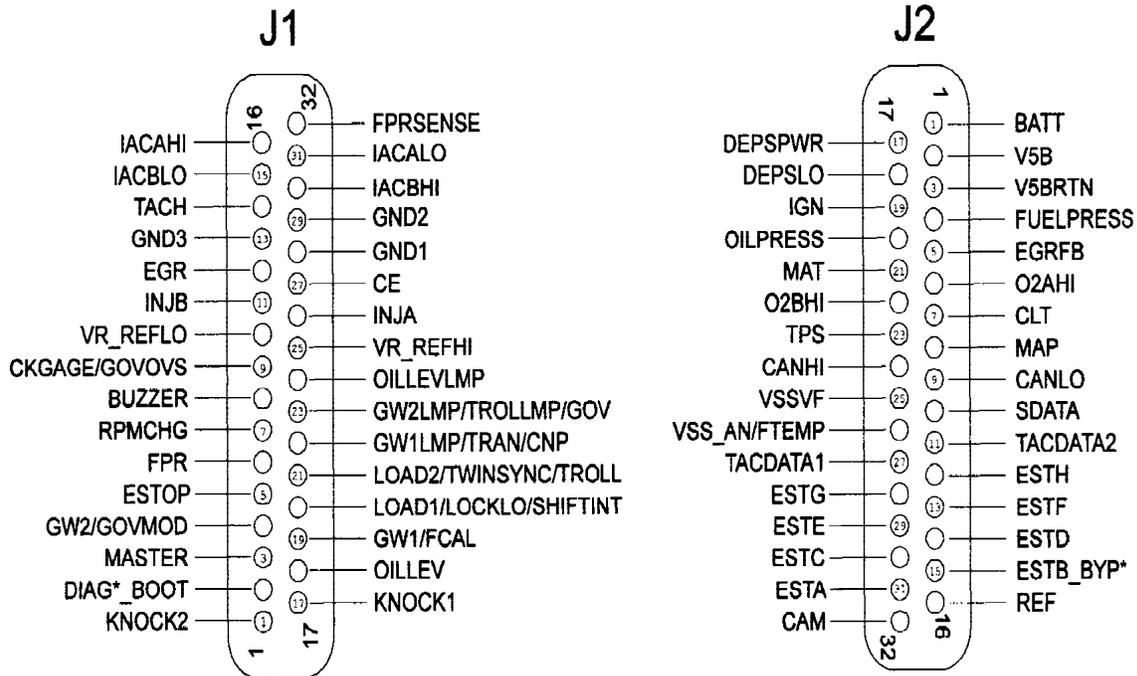
Table A.1 shows the connector pin out for MEFI Electronic Control Module (ECM) Part Number 12569494 Rev B.

Table A.1 – Pinout

PIN	MEFI4 PIN NAME	PIN	MEFI4 PIN NAME
J1-1	KNOCK2	J2-1	BATT
J1-2	DIAG*_BOOT	J2-2	V5B
J1-3	MASTER	J2-3	V5BRTN
J1-4	GW2/GOVMOD	J2-4	FUELPRESS
J1-5	ESTOP	J2-5	EGRFB
J1-6	FPR	J2-6	O2AHI
J1-7	RPMCHG	J2-7	CLT
J1-8	BUZZER	J2-8	MAP
J1-9	CKGAGE/GOVOVS	J2-9	CANLO
J1-10	VR_REFLO	J2-10	SDATA
J1-11	INJB	J2-11	TACDATA2
J1-12	EGR	J2-12	ESTH
J1-13	GND3	J2-13	ESTF
J1-14	TACH	J2-14	ESTD
J1-15	IACBLO	J2-15	ESTB_BY*P*
J1-16	IACAH	J2-16	REF
J1-17	KNOCK1	J2-17	DEPSPWR
J1-18	OILLEV	J2-18	DEPSLO
J1-19	GW1/FCAL	J2-19	IGN
J1-20	LOAD1/LOCKLO/SHIFTINT	J2-20	OILPRESS
J1-21	LOAD2/TWINSYNC/TROLL	J2-21	MAT
J1-22	GW1LMP/TRAN/CNP	J2-22	O2BHI
J1-23	GW2LMP/TROLLMP/GOV	J2-23	TPS
J1-24	OILLEVLMP	J2-24	CANHI
J1-25	VR_REFHI	J2-25	VSSVF
J1-26	INJA	J2-26	VSS_AN/FTEMP
J1-27	CE	J2-27	TACDATA1
J1-28	GND1	J2-28	ESTG
J1-29	GND2	J2-29	ESTE
J1-30	IACBHI	J2-30	ESTC
J1-31	IACALO	J2-31	ESTA
J1-32	FPRSENSE	J2-32	CAM

MEFI4 PROTO1 ECM Pinout

CONNECTORS AS VIEWED EXTERNAL TO MODULE



h:~\MEFI4\pinouts\m4p1_po.cdr
03/19/99

3.1.6 Engine interface to exhaust

3.1.6.1 Content

The engine is provided with exhaust manifolds for vehicles and Industrial Applications. The exhaust manifold system includes the manifold, fasteners to the cylinder head, and partial or full cover type heat shield. The exhaust manifold may also incorporate provisions for EGR attachment.

Vehicle Exhaust System

The 4.3L V6 90 Degree Engine shall be attached to the vehicle and interface with the Vehicle Exhaust System.

The Vehicle Exhaust System will be designed or adapted considering the following Issues: Vehicle Exhaust System Back pressure: All performance parameters specified in paragraph: 2.3.2.1 were measured with a maximum exhaust restriction of 8.5" of Hg.

Thermal Management of Exhaust

Thermal management of exhaust

The following issues must be considered:

- a. Location of Catalytic Converter: The location of the catalytic converter is determined by resolving three competing needs. The first need is to locate the converter such that it is close enough to the engine so that sufficient heat is transferred to the converter via the exhaust stream so as to initiate catalytic activity and therefore constituent conversion soon enough to meet emission requirements. The second need is to locate the catalytic converter far enough downstream from the engine in the vehicle's exhaust system so that the converter will not be damaged during extended duration high exhaust gas stream temperature excursions resulting from high speed and load operation of the engine. The third need is to locate the converter in a position in the chassis where it will package with sufficient clearance to surrounding components or systems to prevent heat related failures in those systems or components.
- b. Location of Oxygen Sensor(s)
All OBD II compliant exhaust systems contain enough oxygen sensors to guarantee proper monitoring of the exhaust gases. Each engine cylinder bank requires an oxygen sensor for air/fuel ratio control. An oxygen sensor is required behind each catalytic converter for diagnosis purposes. Post converter oxygen sensors are also implied for slow air/fuel ratio trim. Oxygen sensor wiring connections must be located to as to avoid moisture contamination.
- c. Converter Volume and Flow
- d. Location of muffler
- e. Vibration/shock of catalytic converter
- f. Material life for exhaust system through catalytic converter
- g. Thermal Characteristics
- h. Exhaust Leakage

The exhaust system must be leak free for the emission useful life of the vehicle. In order to have a working definition of leak free, the exhaust system is divided into three zones:

Zone A (A/F Control)	Cylinder head / exhaust manifold interface to control oxygen sensor
Zone B (Converter Feedstream)	Control oxygen sensor to converter
Zone C (Diagnostic Feedstream)	Converter to 12 inches downstream of the diagnostic oxygen sensor

Maximum allowable leakage in each zone is 2 liters/minute at 15 kPa.

The following table shows the different Exhaust Assemblies and Components coupled to the L35 engine per GM platforms.

Exhaust (8 C)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Manifold ASM	15986438	15029769	15029769	15029769	15029769
Pipe ASM Exhaust		15045399 15034810 15743099		15749444	15744824 15744826 15744828/9
Manifold Seal	12555091	15035747 15035748	11514597	12555091	12555091
Manifold Gasket	15997189	15997189 15767098	15997189	15997189	15997189
Shield		15753676	15027911	15027911	15736668
Screw/Bolt/Nut	11514597 15733192	15733192 15032594	15997953	15023752 11514597	15023752 11514597
Converter ASM	25160620 15986441	15052911 15756278	15159709 15160977 15700838 15747730	15744810 15749445	15744810 15749445 12568312
Converter Pipe ASM	15986425 15986425 15986428	15709444	15709444	N/A	N/A
Converter Gasket	15027074	15027074	15027074	15027074	15027074
Shield	15739194 1507912	TBD	15739194 1507912	15027095 15150934	TBD
Clamp	15529483	15529483	15529483	15529483	15529483
Screw/Bolt/Nut	15709703 9442939	15709703 15997953 11517501	15709703 15997953 11517501	15709703 15997953 11517501	15709703 15997953 11517501
Muffler ASM	15727690	15040396 15040397 15061814	15008799 15159716 15761545	15756876 15756877	15756876 15756877
Exhaust Pipe ASM	15727691	15756780	15739879	N/A	15156883/4 15156936/5
Shield	15739195		15739195	15990607	15990607
Hanger/Bracket	15986421 15986422	15986421 15986422	15986421 15986422	15152715	15023065/6 15976360 15976332
Clamp	15595047 15529483	15595047 15529483	15595047 15529483	15595047 15529483	15595047 15529483
Screw/Bolt/Nut	11515799 11515216 9424320	11515799 11515216 9424320	11515799 11515216 9424320	11500831 11515768 15695050	11500831 11515768

3.1.6.2 Back Pressure

Exhaust back pressure shall not exceed 8.5 inches of Hg at rated speed and load. Lower exhaust back pressure is desired from a performance and fuel economy standpoint.

3.1.6.3 Packaging

The vehicle assembly plant attaches the exhaust pipe to the manifold with the proper fasteners and a gasket or seal. Exhaust manifold takedowns will be 2 or 3 fastener designs. Consult GM application engineer.

The current exhaust manifolds are made from Nodular Iron with incorporated and detachable heat shields.

Fasteners at the manifold takedown must be capable of withstanding temperatures up to 800°C and will require stainless steel or sernagard coated steel. The gasket/seal must also withstand these temperatures and will require stainless steel or stainless steel with mica or grafoil.

The heat shield provided on the exhaust manifold will reduce radiant heat to nearby critical components and reduce or minimize the number of separate shields required by the vehicle.

3.1.6.4 Exhaust Gas Recirculation (EGR)

EGR (6 L 3)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
EGR ASM Valve	17200268	17200268	17200268	17200268	17200268

3.1.6.5 Secondary Air

GMPT will indicate the needs for secondary air recirculation.

The following table shows the different Secondary Air and EGR Assemblies and Components coupled to the L35 engine per GM platforms.

Engine Secondary Air (6T)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Pump Air Inj ASM		15059238	15053709		15056764
Hose ASM		15022544	N/A		15023825
Hose ASM By Pass		15022570	N/A		15760279
Stud		20513798	N/A		
Washer					15953691
Strap					11509086
Bolt Screw					11508706
Pipe ASM		12561825	12562572		12561250/51
Check Valve (or Bypass)		12567731	12567745		15037955
Check Valve (or Bypass)		12567732	12567746		15056713
Bolt Screw		12558020	11515210		15695050 9440034
Gasket		12561871	12561871		12561871
Shield					15026631
Nut					11514596

3.1.7 Engine Interface to Cruise Control

Figure 3.2.1-I to 3.2.1-XVIII shows the PCM Engine to Vehicle Mechanization Diagram with this interface. The following table shows the different Cruise Control Modules and Components used with the L35 engine and GM platforms.

Cruise Control (6 N 4)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Cruise Control Module	25315559	25315559	25315090	25315087	15028014 15717608 25315088
Cable	15040802 15040801	15040802 15040801	15031096	15045430	15045460 15751730
Bolt/Screw	11517009 11518009	11517009 11518009	15685170 15983425 15685170	11515928	11508010 11517507 15685170

3.1.8 Accelerator Pedal

Figure 3.2.1-I to 3.2.1-XVIII shows the PCM Engine to Vehicle Mechanization Diagram with this interface. The following table shows the different Pedal Accelerator Assemblies and Components used with the L35 engine and GM platforms.

Pedal Accelerator (6 N 2)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Pedal Accelerator ASM	15944514	15944514 15160381	15756441	15756441	15015757 15716466 15729139
Cable	15148661 15148662	15038820	15031093 15741073	15031093 15153422	15010419
Bolt/ Screw	9433298	11514516	11514516 11516150 11517519		15010419

3.1.9 Engine to Evaporative Fuel System

Figure 3.2.1-I to 3.2.1-XVIII shows the PCM Engine to Vehicle Mechanization Diagram with this interface. The following table shows the different Fuel Lines, Fuel Tank and Evaporative Assemblies and Components coupled to the L35 engine per GM platforms.

Fuel Evaporative (8 D)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Canister ASM	17098106	15056485	17098085	17098085	17201171 17097127 17097120
Shield	15004076				
Hose	10282447 15721451 15733597 15721447 15721448 15731510	15759042 15759043	N/A	15012787	9439150 15150414 15726983 15768562
Clamp	10108259 11516221	10108259 11516221	N/A	10108259 11516221	10108259 11516221
Separator	17096210	N/A	15032645 15032646	15032645 15032646	15032645 15032646
Bracket	15009801 15013689 15746404 17565062 15731699	15056490	15769694	15769694	15049107 15742240 15734230 15992101
Harness	12556909	12555973	12561900	12561900	11509087 12566190
Strap	11509087	11509087	15000499	11509087	11509087
Valve	12559015	15032643 15032644	15032643 15032644	15759225	25658328 12559015
Bolt/Screw/Nut	11508797 3847758 3975550 11515211	11516573 11513914	11515211 11508797 3847758 3975550	11515211 11508797	11515654 11515656 11515658

3.1.10 Accessory Drive System

The engine is released with an accessory drive system whose components are dimensioned and released as indicated in the paragraphs 3.1.11 to 3.1.16.

The maximum torque from the front crankshaft pulley is 150 ft lb., regardless of the engine speed; so it is recommended that the Belt System Drive maximum Torque requirement not to exceed 140 ft lb.

For torque values above 140 ft. lb. the customer shall provide different PTO assembly.

3.1.11 Standard Accessory Descriptions

GMPT accessory drive design release engineer will provide attachment points and drive of these components on the engine.

The following table 3.1.11-I shows the different combinations of components coupled to the L35 engine accessory drive brackets per GM platforms.

3.1.12 Cooling Fan

Cooling Fan assembly is not part of the engine scope or extent of supply.

Cooling fan is designed, dimensioned and released by the GM - HVAC engineering group taking in consideration the Heat Rejection (indicated in the paragraph 3.4.5) needed to evacuate from the engine through the radiator assembly.

If the Fan is driven from the crankshaft front pulley and the maximum torque values specified in paragraph 3.1.10 shall be taken in consideration.

3.1.13 Alternator

Alternator is not part of the engine scope or extent of supply.

Alternator is designed, dimensioned and released by the GM - Electrical engineering group taking in consideration all vehicles electrical power needs.

If the alternator is driven from the crankshaft front pulley and the maximum torque values specified in paragraph 3.1.10 shall be taken in consideration.

3.1.14 Power Steering Pump

Power Steering Pump is not part of the engine scope or extent of supply.

Power Steering Pump is designed, dimensioned and released by the GM - Chassis engineering group taking in consideration the vehicles drive needs.

If the power steering pump is driven from the crankshaft front pulley and the maximum torque values specified in paragraph 3.1.10 shall be taken in consideration.

3.1.15 AC Compressor

AC Compressor assembly is not part of the engine scope or extent of supply.

AC Compressor is designed, dimensioned and released by the GM - HVAC engineering group taking in consideration the Vehicle Air Conditioned needs.

AC Compressor is driven from the crankshaft front pulley and the maximum torque values specified in paragraph 3.1.10 shall be taken in consideration.

3.1.16 Crank Shaft Nose Load

Crankshaft maximum load at the nose will not exceed 140 Lbs.

The application engineer can provide information above accessory bracket assemblies available for various engine applications.

	MY-2001	MY-2001	MY-2001	MY-2001	MY-2001
Steering Pump System (9E)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Steering Pump	26042592	15772602 26068923 26081015 15754215/16	26070078 26070099	26057292	26058060
Steering Pump Pulley	10085755	10085755	10085755	10085755	10085755
Steering Pump Bracket RR	10236998	10236998	10236998	N/A	10236998
Steering Pump Reservoir	15682455	N/A	26073040/1	26057780	N/A
Steering Pump Cooler	26063303/5	26063303/5	26063303/5	N/A	N/A
Steering Pump Hose	3931898	26051184	26040765	26057733	26057936
Steering Pump Hose	3773687	26068830	26063303	26063303	26042259
Steering Pump Hose	3786228	N/A	N/A	26055306	26055306
Steering Pump Strap	11501907	N/A	N/A	11509086	11509086
Steering Pump Pipe	15983287	26051176	26051176	26050743	15159570
Steering Pump Clamp	11516255	11516255	11516223	15735493	22514443
Steering Pump Bracket Nut	10242827	10242827	10242827	10242827	10242827
Steering Pump Stud	10224557	10224557	10224557	10224557	10224557
Steering Pump Nut	10242827	10242827	10242827	10242827	10242827
Steering Pump Bolt	11516349	11516349	11516349	11516349	11516349
Steering Pump Bolt	10244162	10244168	10244168	10244168	10244168
Steering Pump Bolt	11517950	11517950	11517950	11517950	11515586
Steering Pump Bolt	52476687	52476687	52476687	52476687	52476687
HVAC Compressor ASM (1A 2G)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Compressor	1136580	15766590	15766591	15765192	15765201/2
Brace	N/A	N/A	N/A	12555015	N/A
Bolt Screw	11516285	11516285	11516285	11516285	11516285
Bolt Screw	N/A	11516704	N/A	11516246	N/A
Bolt Screw	N/A	N/A	N/A	10157953	N/A
Engineer	WE08	XS03-U101	0AHD	U101	0UR1-U101
Bracket HVAC ASM (9E)	12554522	12554522	12554522	12554522	12554522
Generator ASM (6Y1)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Alternator	10480270/1	10480388/90	15768829/30	10480326	10480288
Screw/Bolt Alternator	11516704	11516704	11516285	11516285	11516285
Screw/Bolt Alternator	11516283	11516283	11516283	11516283	11516283
Screw/Bolt Tensioner	10244168	10244168	10244168	10244168	10244168
Nut Tensioner	10242827	10242827	10242827	10242827	10242827
Stud Tensioner	10224557	10224557	10224557	10224557	10224557
Generator Bracket Rr	10237271	N/A	N/A	N/A	N/A
Screw/Bolt Bracket Rr	11516284	N/A	N/A	N/A	N/A
Bolt Screw					
Bolt Screw					
Engineer	WE08	UT06	OAKQ	UQ12	UT06
Bracket ASM	10236997	10236997	10236997	10236997	10236997

Table 3.1.11-I Accessory Drive Brackets Components Combination

3.2 INTERFACES WITH VEHICLE SUBSYSTEMS

3.2.1a GMPT interface with Electrical Supply System-Truck Application

Battery	Type	Description
	Model	78A-72
	Voltage	12
	Amps (Minimum)	600
	Minutes Reserve Capacity	115
	Amps/hrs.-20 hr. rate	69
Alternator	Type	Description
	Rating (idle/max. rpm)	50 / 120 Amps
	Ratio (alt. crank/rev)	2.52:1
	Volt Nominal Output	12 volts
Regulator	Type	Description
	Electronic	Integral to alternator
Electric Ignition	Type	Description
	High Energy Single Coil	Electronic Distributor
Spark Plug	Type	Description
	AC 41-931-Dual Pad Platinum	Gap 1.5mm

See Table 3.1.11-I Accessory Drive Brackets Components Combination for Generator usage information.

The following table shows the different Harnesses and components used with the L35 engine per GM platforms.

Electrical (12 H)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Harness ASM	15323118 15301067 15301068 12153424 12153346 15301097 15311589 15323111 15323112	12172550 12172551 12172552 12172553	15059848 15059849 15059850 15059851 15059852 15059853 15059854 15059855 15059856 15059857 15059858	15045564 15045565 15045566 15062567 15062568 15062569 15062570 15763497	15328570 15328572 15328574 15328576 15328577 15328578 15365302 15365303 15365306 15365307 15770834
Harness Extension	15323114 15323164 15323165	15969147 15328807 15038561	15709061 15319959 15350451	15709061 15319959 15350451	N/A
Bracket	15985078 15002035 15708423 15023004 15985076 11501907 11509087 15517469 15990187	15033674	15738436	15993897 15733696	15999051 15741029
Strap	11501907 11509087 15517469	11501907 11509087 15517469	11501900	11501900	11509086
Bolt/Screw/Nut	3975550 566314 9440963 9440034 11509572	11516587 15714906 11516793 15709062 15735328	11516587 15714906 11516793 15709062 15735328	9419301 11516567 15994522 11503740 11515971	9440034 11500815 15961952 11506117 15961953

Figure 3.2.1-I to 3.2.1-XVI shows the PCM Engine to Vehicle Mechanization Diagram for the P-Truck platform application.

Figure Number	Description
	Figure 3.2.1 - I Cooling, MAP, TPS and OIL Sensors
Figure 3.2.1a - II	EGR, Purge & Vent Solenoid Fuel Canister
Figure 3.2.1a - III	VSS (TISS & TOSS), Air Pump & Solenoid Relay
Figure 3.2.1a - IV	Engine to Transmission (Auto & Manual)
Figure 3.2.1a - V	Engine Injectors
Figure 3.2.1a - VI	TCC Switch & Cruise Control
Figure 3.2.1a - VII	Starter, Alternator & IP Gages
Figure 3.2.1a - VIII	Brake, ABS Switch, Serial Data Link I/P Cluster & Cruise Module
Figure 3.2.1a - IX	Oxygen Sensors
Figure 3.2.1a - X	Idle Air Controller & Knock Sensor
Figure 3.2.1a - XI	Fuel System and Optional ETC
Figure 3.2.1a - XII	Engine Ignition System
Figure 3.2.1a - XIII	Engine Crank & Cam Sensors
Figure 3.2.1a - XIV	HVAC
Figure 3.2.1a - XV	Power Distribution
Figure 3.2.1a - XVI	Note & references

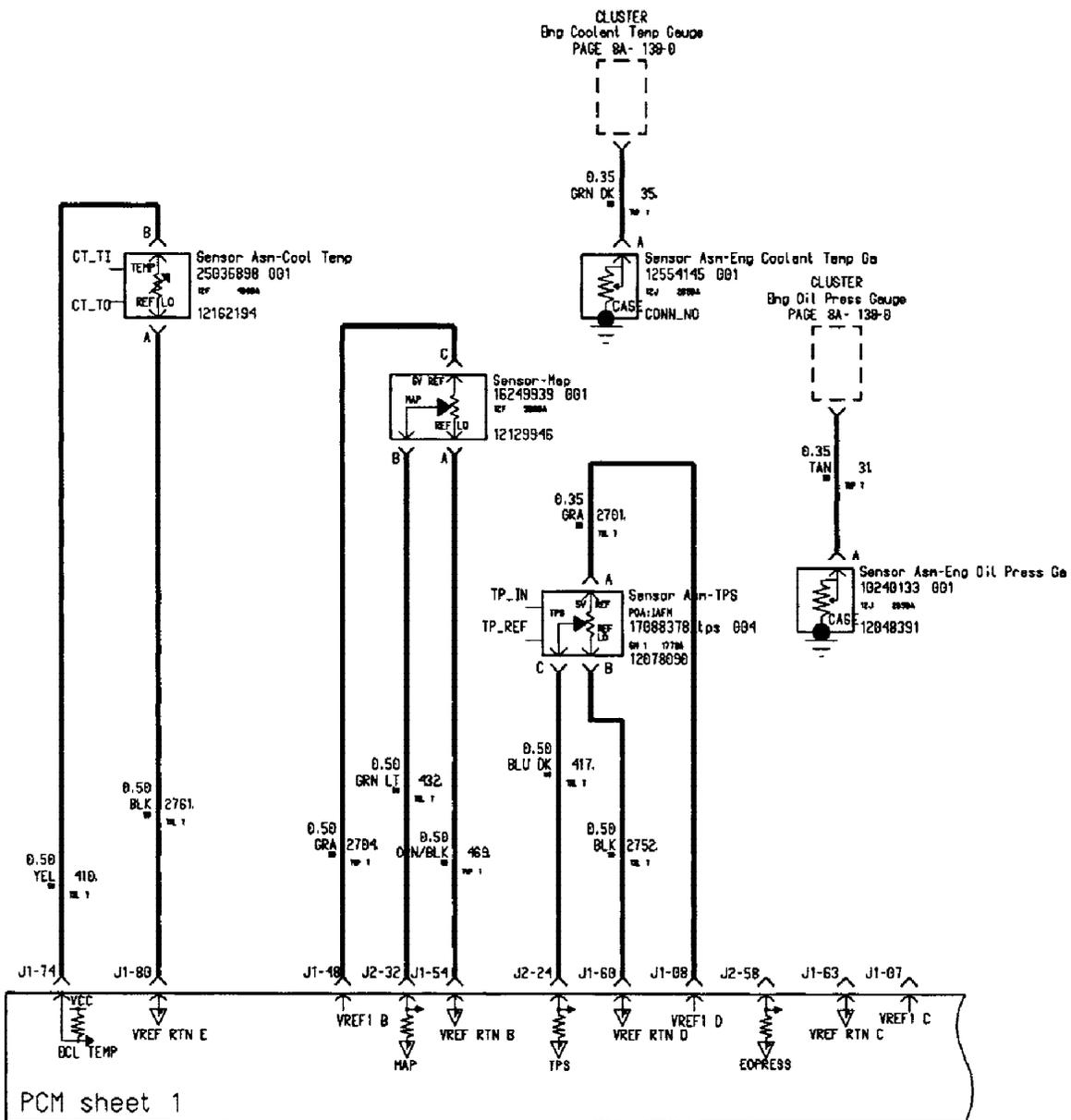


Figure 3.2.1a - I - P/Truck - Mechanization Diagram – Cooling, MAP, TPS and OIL Sensors

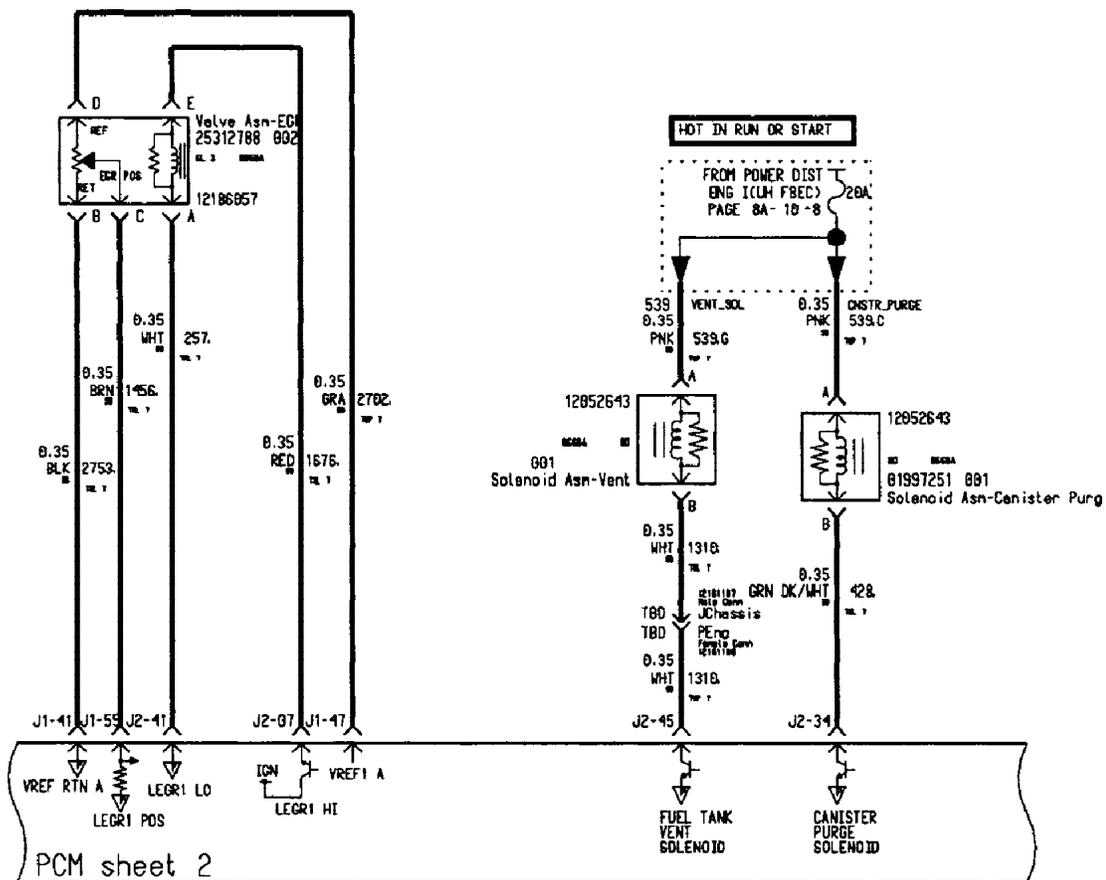


Figure 3.2.1a – II – P/Truck - Mechanization Diagram – EGR, Purge & Vent Solenoid Fuel Canister

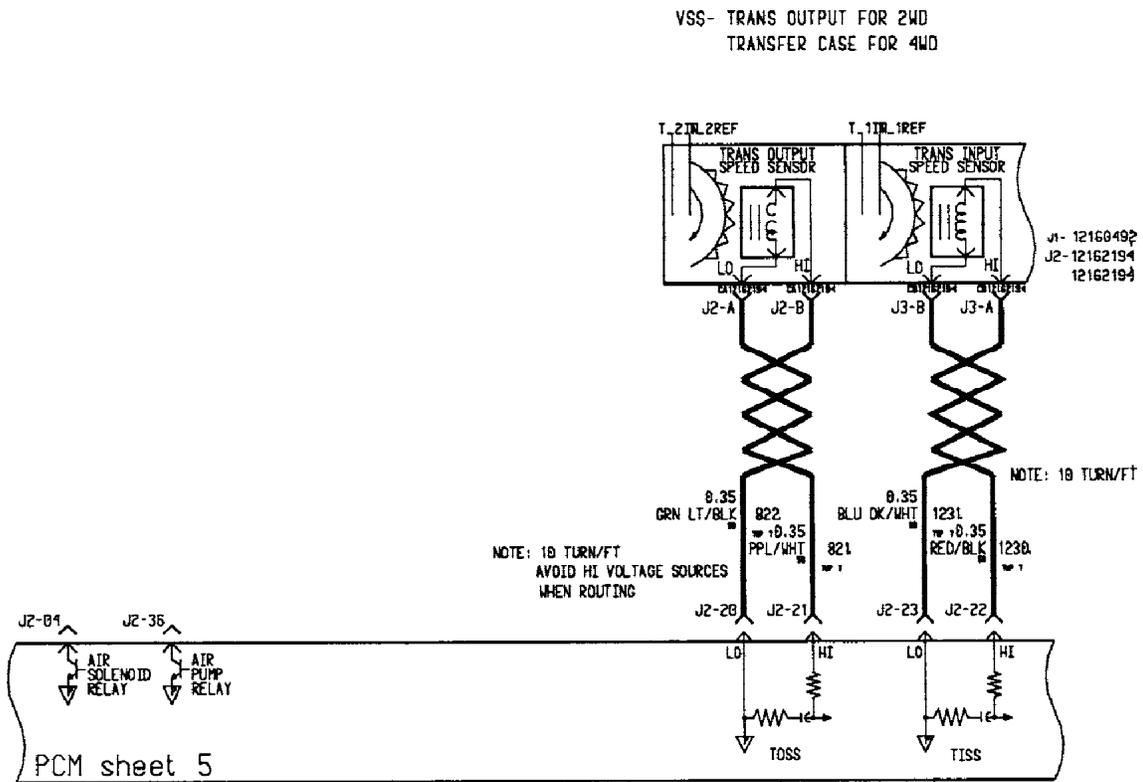


Figure 3.2.1a - III - P/Truck - Mechanization Diagram-VSS (TISS & TOSS), Air Pump & Solenoid Relay

ENGINE - BASE (GEN 1E L35 & M30/MT1)
AUTOMATIC & MANUAL TRANSMISSION

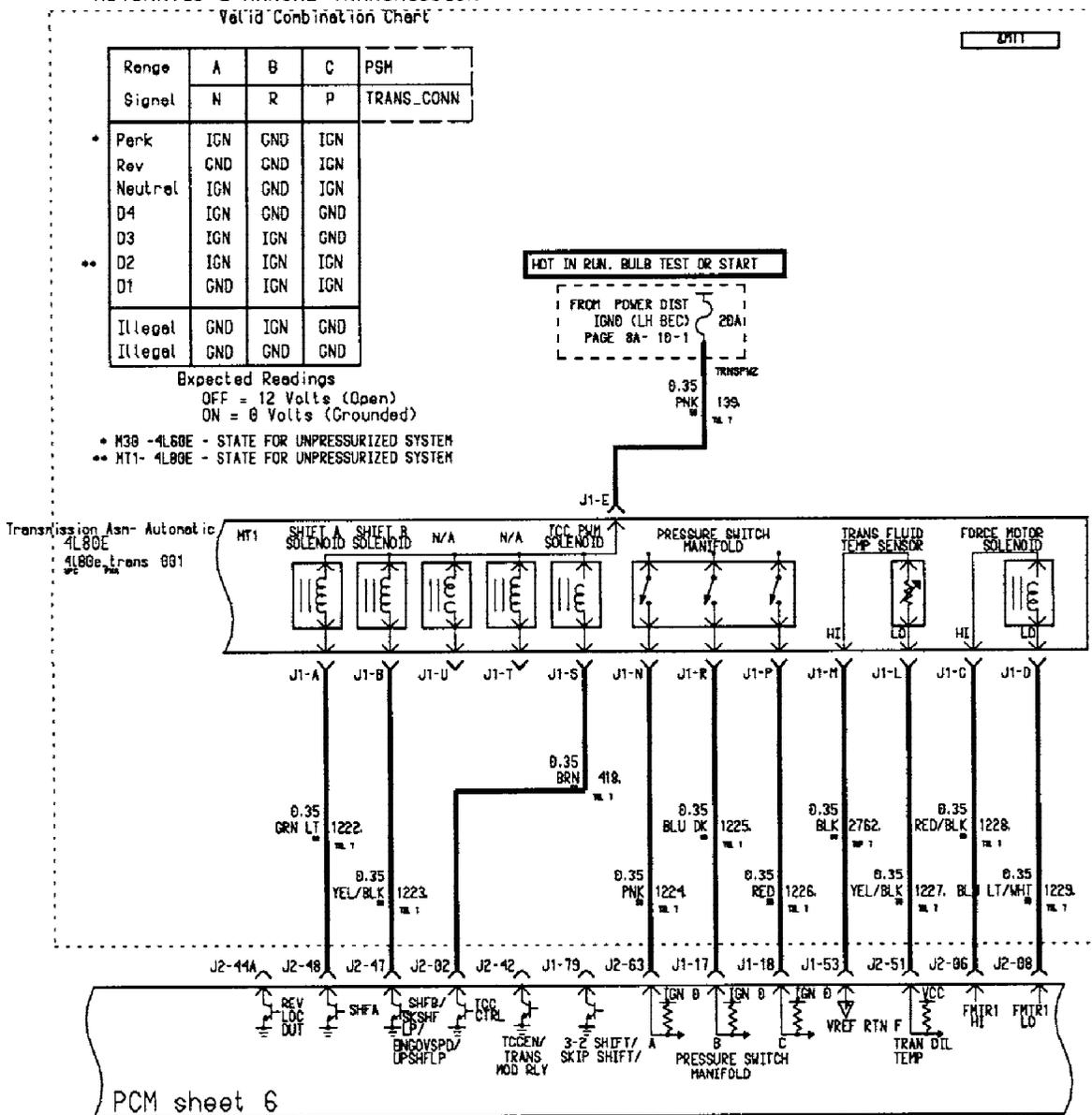


Figure 3.2.1a - IV - P/Truck - Mechanization Diagram – Engine to Transmission (Auto & Manual)

ENGINE - BASE (GEN 1E L35 & M30/MT1)
FUEL INJECTORS

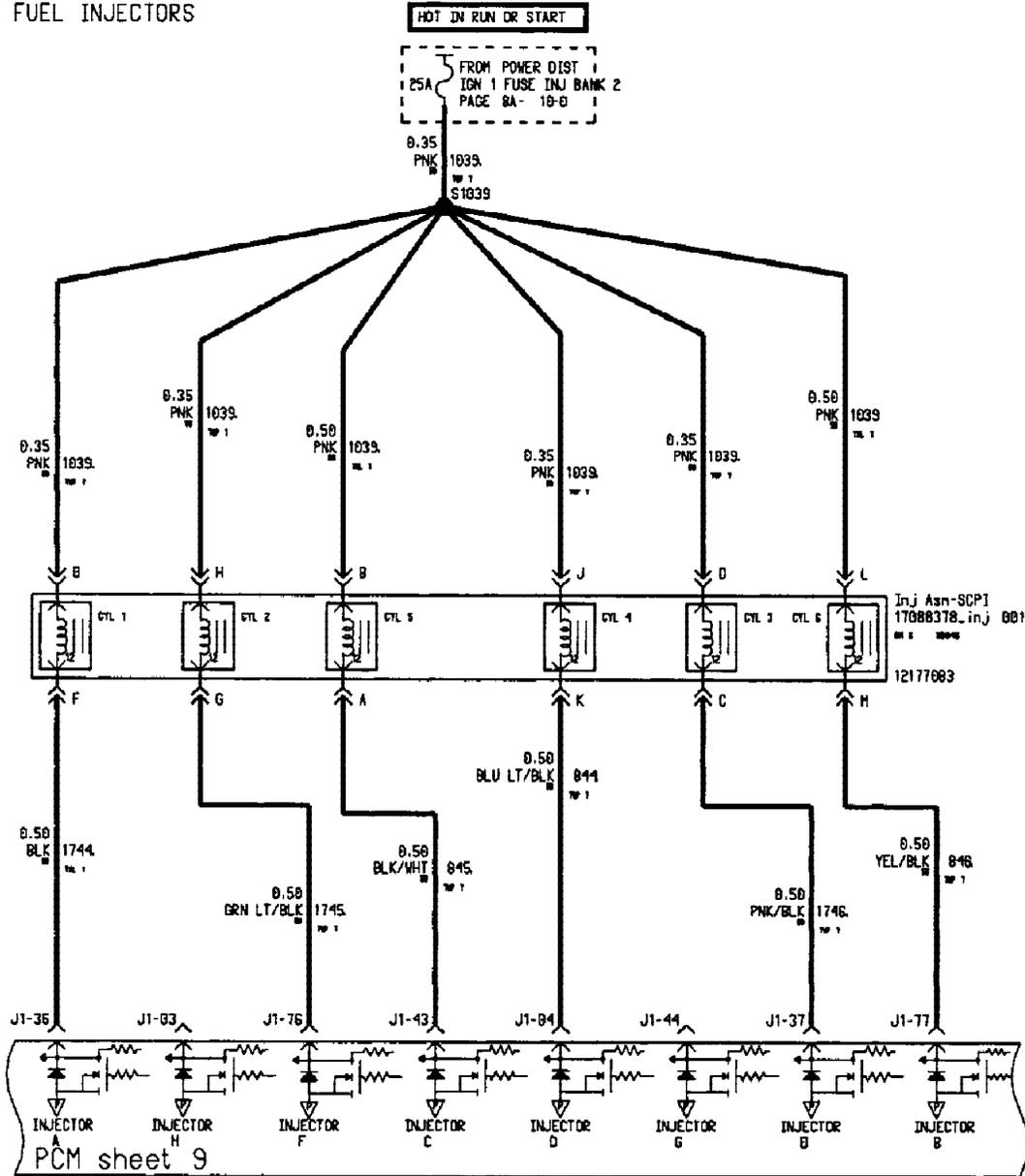


Figure 3.2.1a - V - P/Truck - Mechanization Diagram – Engine Injectors

ENGINE - BASE (GEN 1E L35 & M30/MT1)
PLATFORM CONNECTIONS

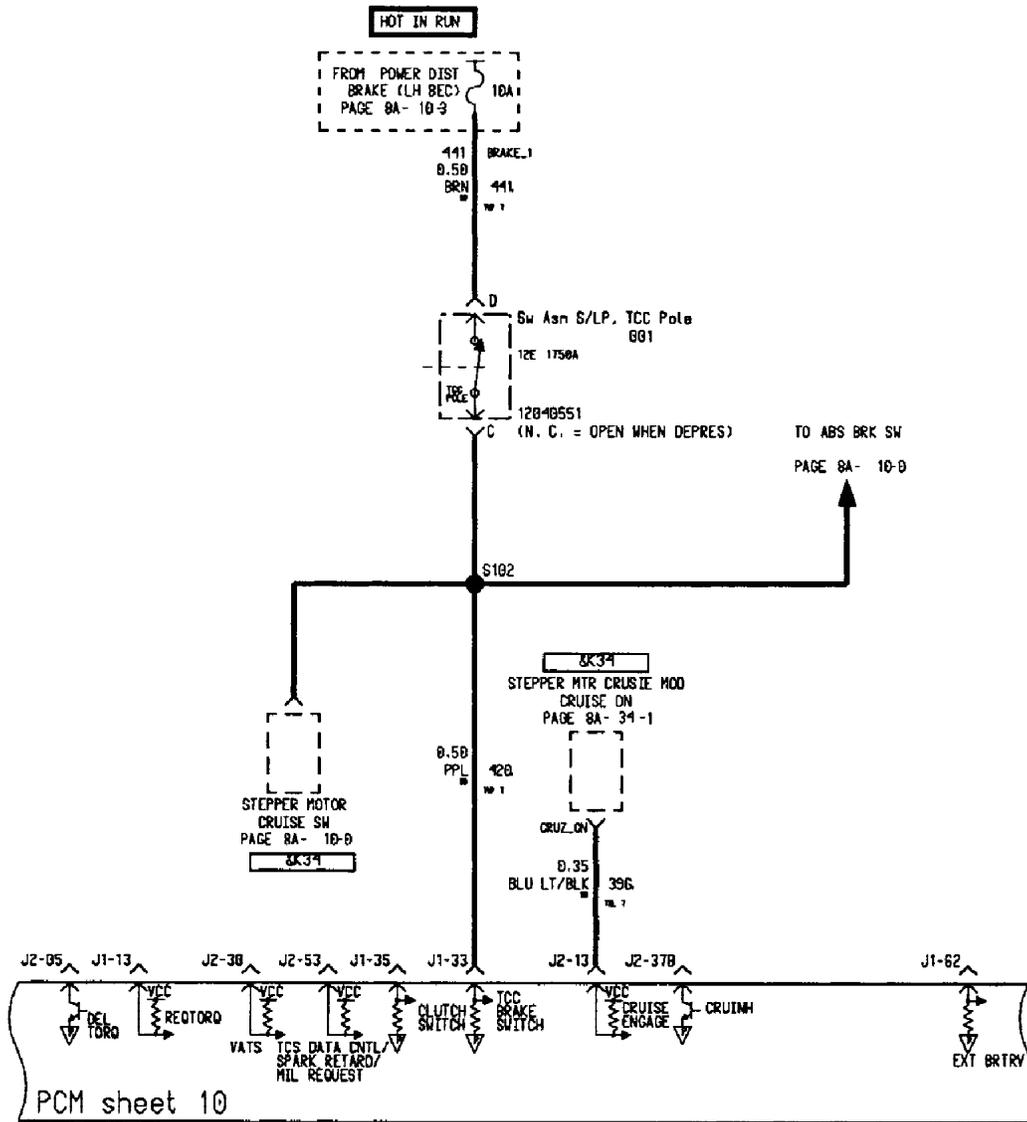


Figure 3.2.1a - VI - P/Truck - Mechanization Diagram – TCC Switch & Cruise Control

ENGINE - BASE (GEN 1E L35 & M30/MT1)
PLATFORM CONNECTIONS

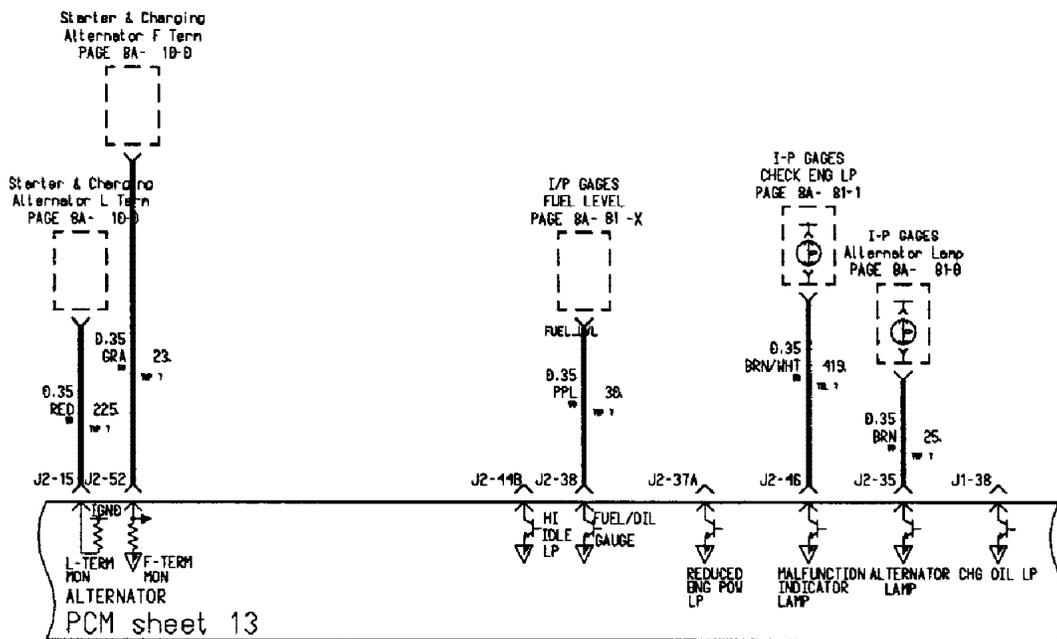


Figure 3.2.1a - VII - P/Truck - Mechanization Diagram – Starter, Alternator & IP Gages

ENGINE - BASE (GEN 1E L35 & M30/MT1)
PLATFORM CONNECTIONS & POWER INTERFACES

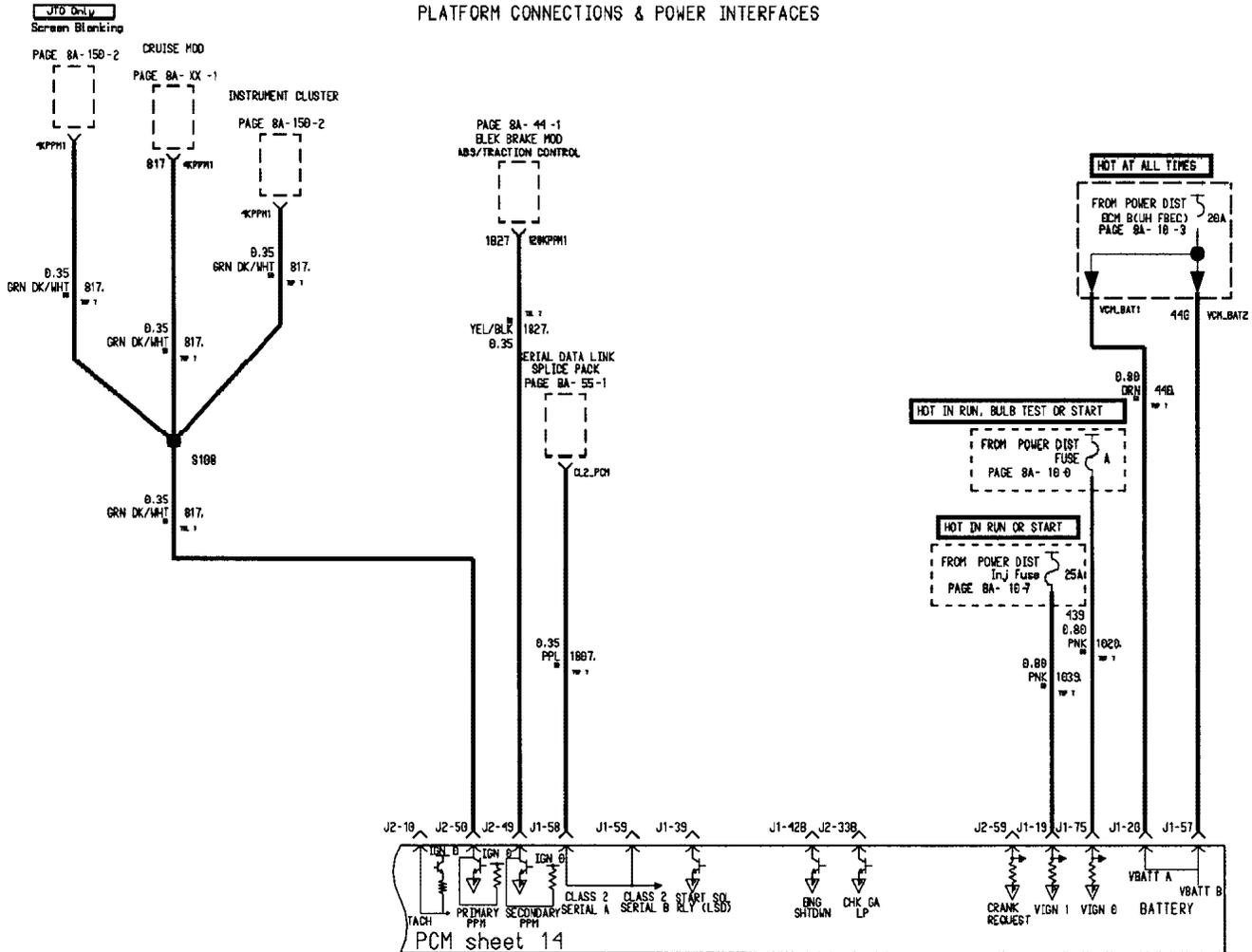


Figure 3.2.1a - VIII - P/Truck - Mechanization Diagram –
Brake, ABS Switch, Serial Data Link I/P Cluster & Cruise Module

ENGINE - BASE (GEN 1E L35 & M30/MT1)
ENGINE DATA SENSORS

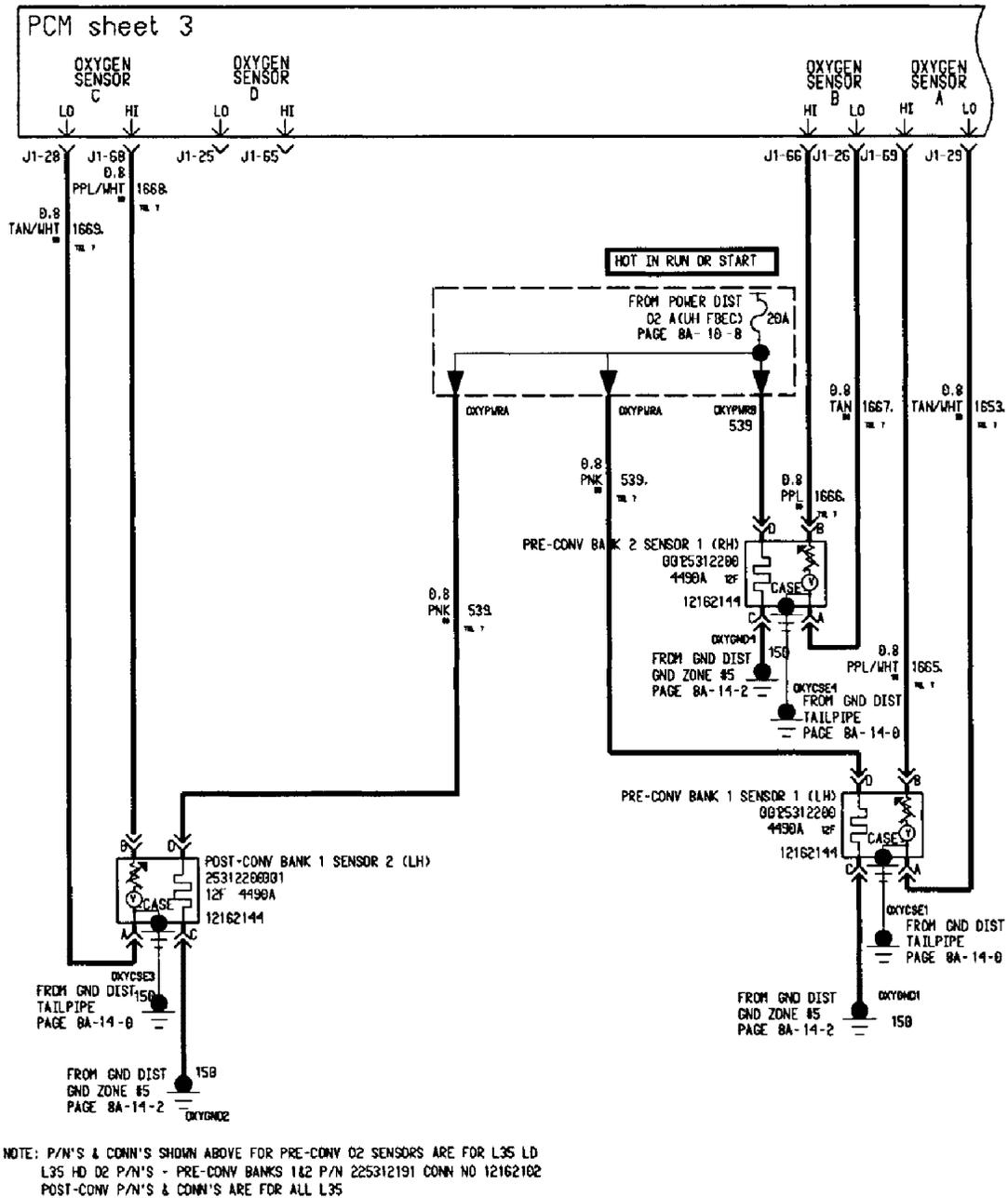


Figure 3.2.1a - IX - P/Truck - Mechanization Diagram – Oxygen Sensors

ENGINE - BASE (GEN 1E L35 & M30/MT1)
ENGINE DATA SENSORS AND CONTROLS

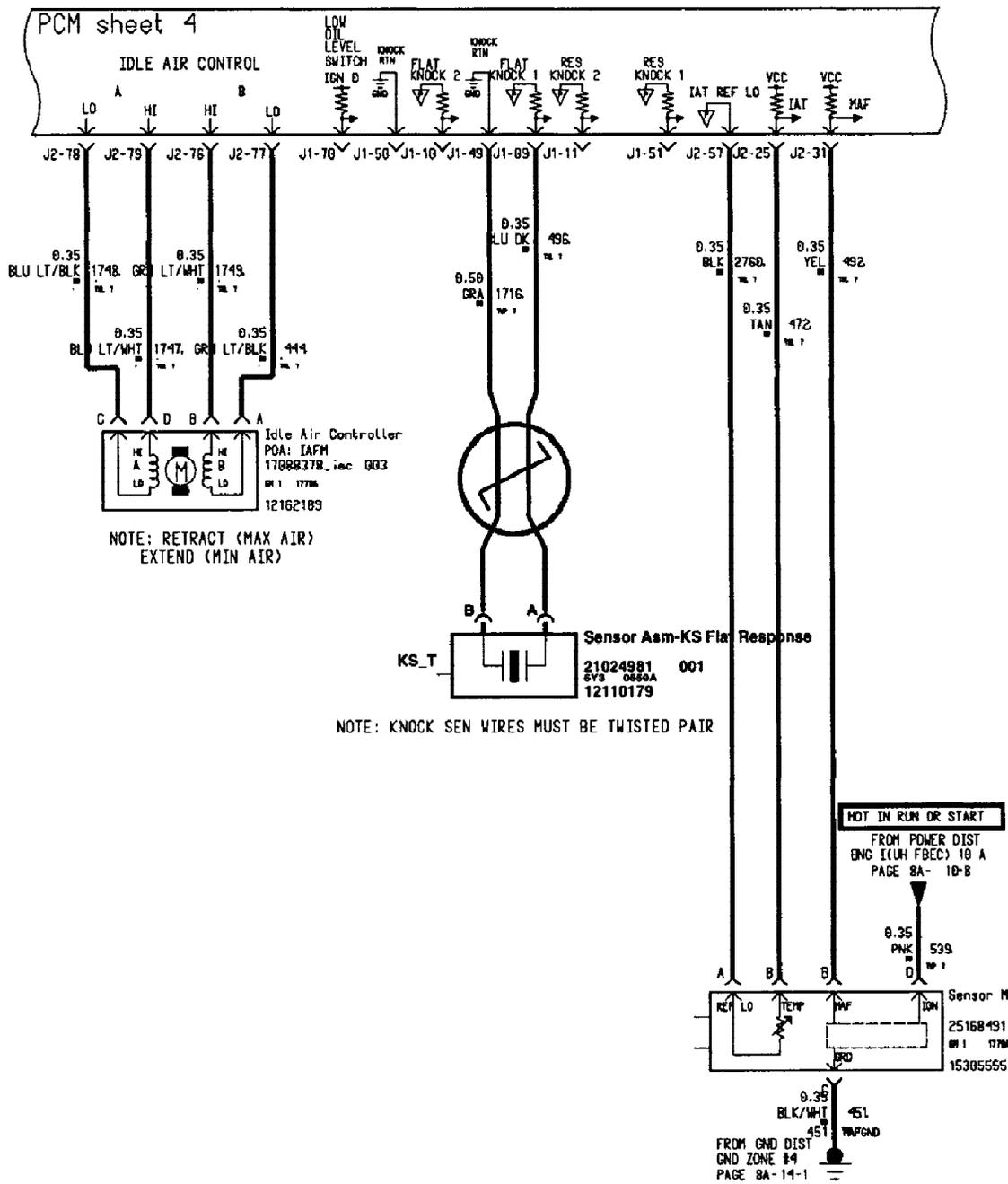


Figure 3.2.1a - X - P/Truck - Mechanization Diagram – Idle Air Controller & Knock Sensor

ELECTRONIC THROTTLE CONTROL FUEL SYSTEM

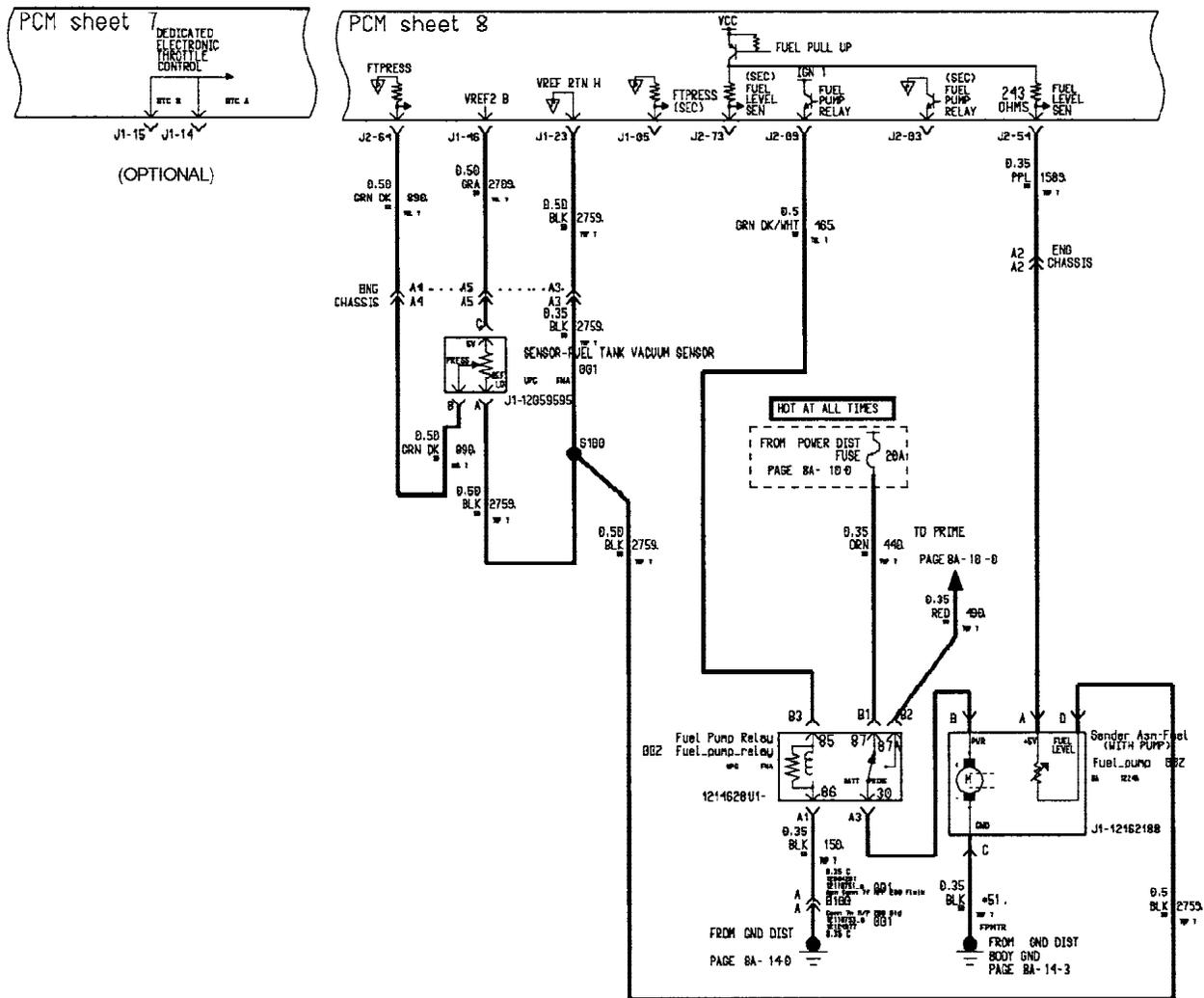


Figure 3.2.1a - XI - P/Truck - Mechanization Diagram – Fuel System and Optional ETC

ENGINE - BASE (GEN 1E L35 & M30/MT1)
IGNITION & DATA SENSORS

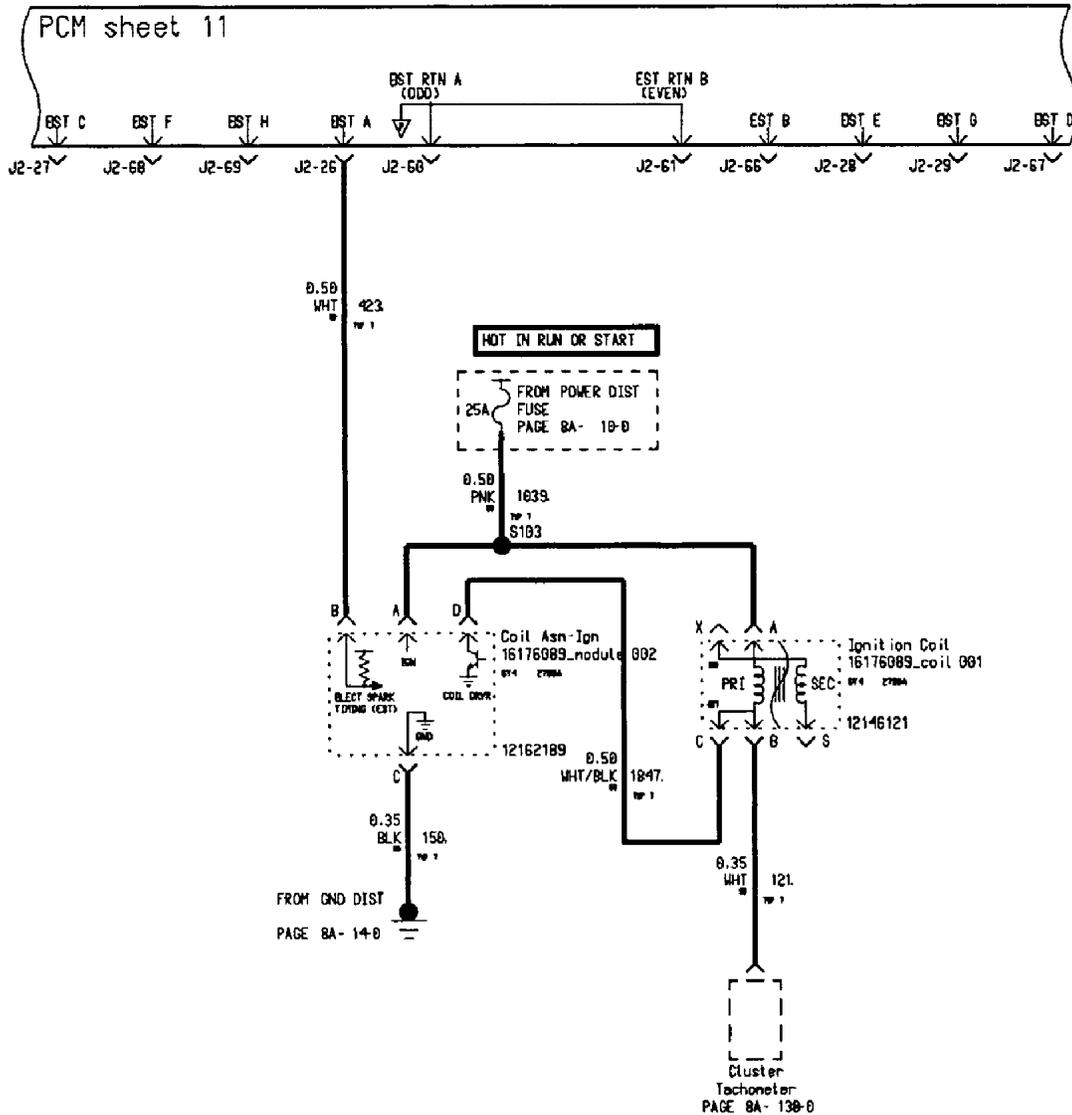


Figure 3.2.1a - XII - P/Truck - Mechanization Diagram – Engine Ignition System

ENGINE - BASE (GEN 1E L35 & M30/MT1)
ENGINE DATA SENSORS

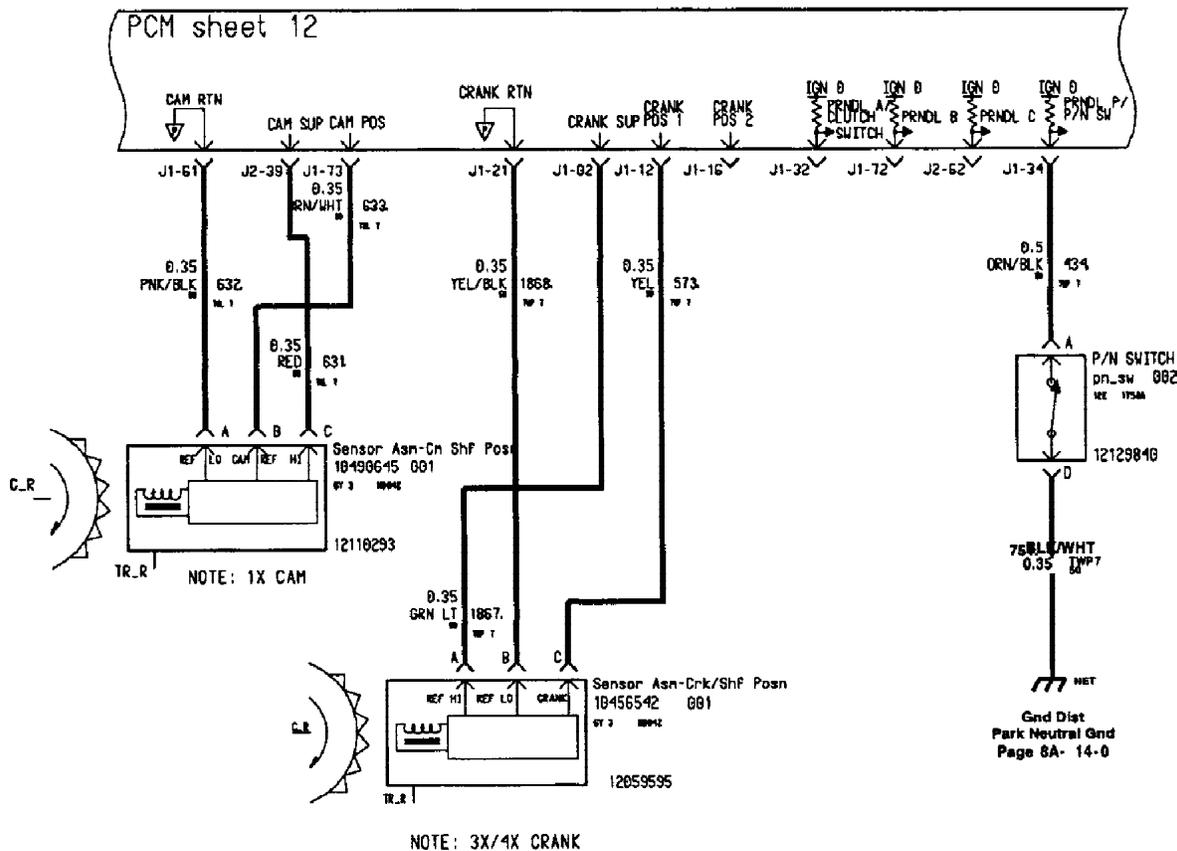


Figure 3.2.1a - XIII - P/Truck - Mechanization Diagram – Engine Crank & Cam Sensors

ENGINE - BASE (GEN 1E L35 & M30/MT1)
HVAC & COOLING FAN SYSTEM

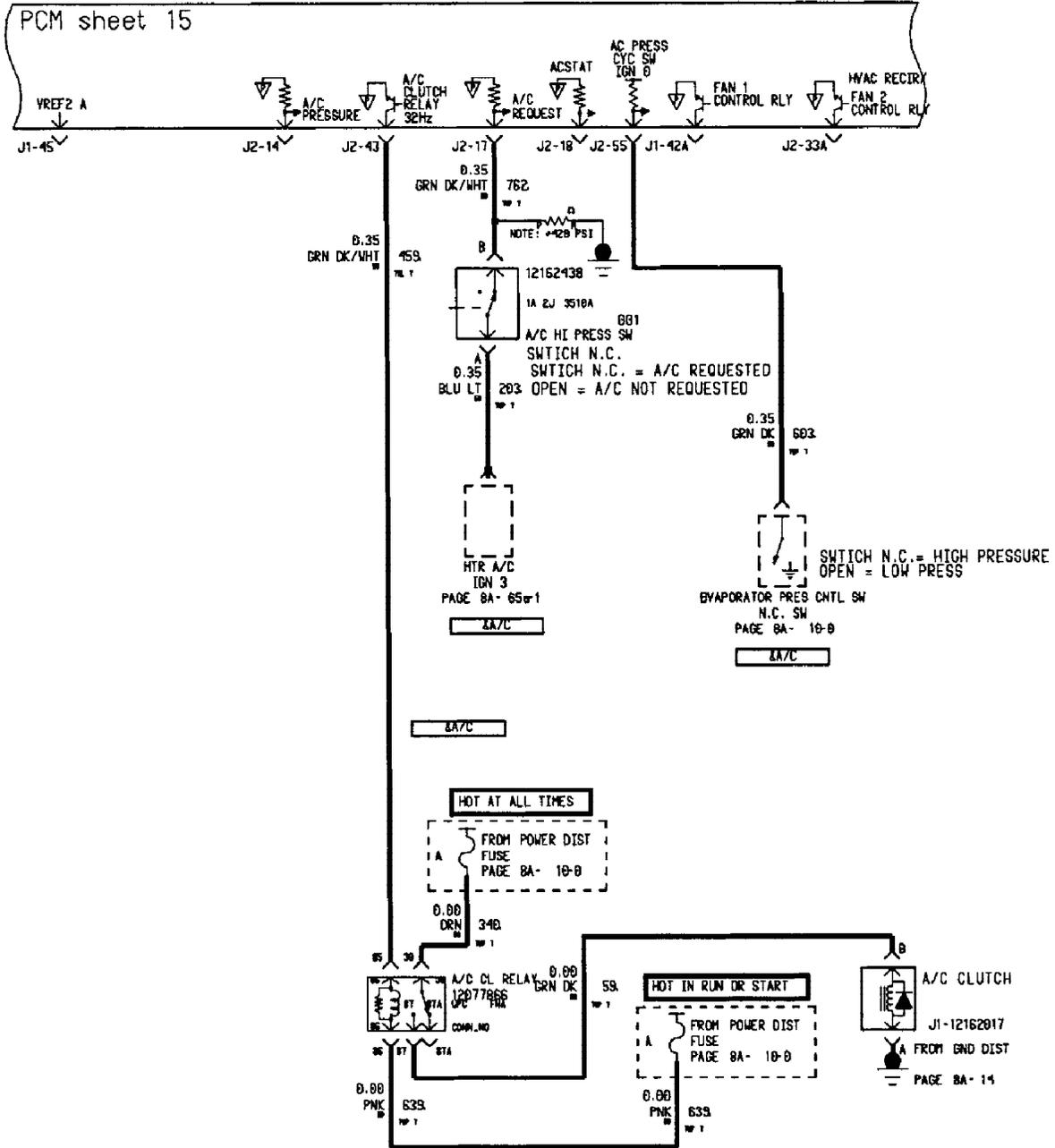


Figure 3.2.1a - XIV - P/Truck - Mechanization Diagram – HVAC

ENGINE - BASE (GEN 1E L35 & M30/MT1)
PLATFORM CONNECTIONS & GROUNDS

Powertrain Control Module
16226610_v6 002
IPC PBA
J1- 12191489
J2- 12191488

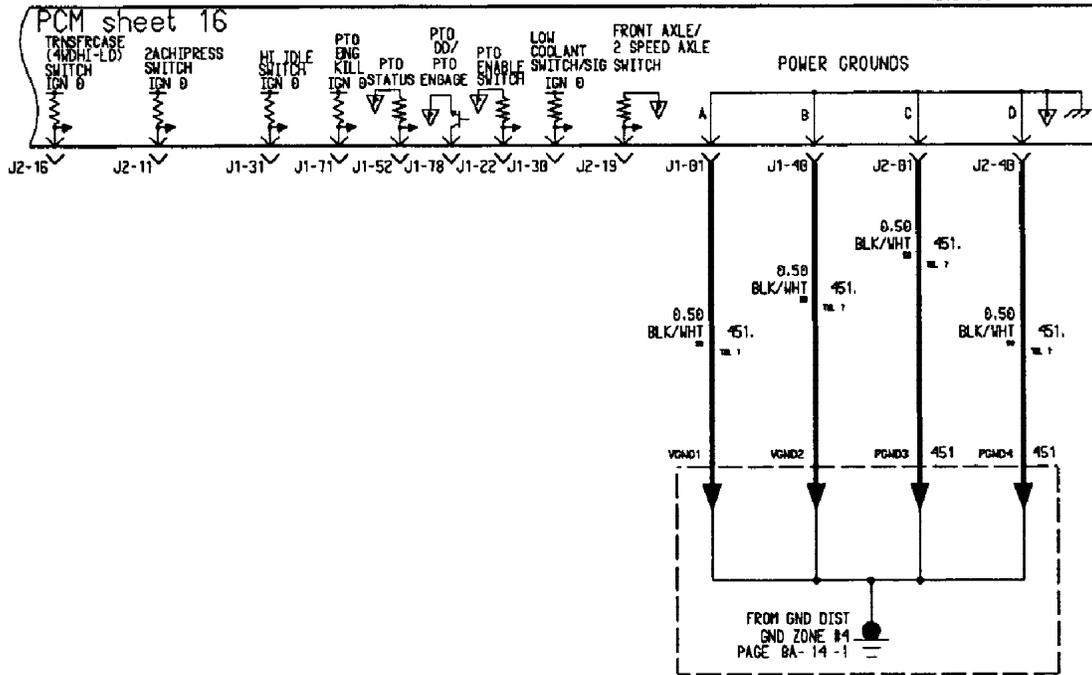


Figure 3.2.1a - XV - P/Truck - Mechanization Diagram – Power Distribution

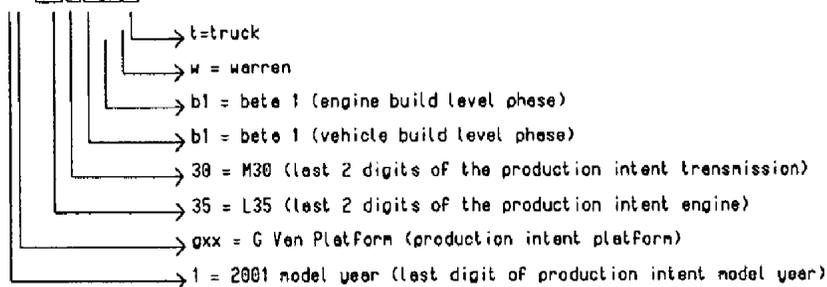
ENGINE - BASE (GEN 1E L35 & M30/MT1)
SPECIAL NOTES:

- NOTE # COMMENTS
- 1 OXYGEN SENSORS REQUIRE AIR REFERENCE, WHICH SHALL BE PROVIDED THROUGH THE WIRES CONNECTING THE OXYGEN SENSOR TO THE PCM.
- 2 PCM PIN NUMBERS WITH SUFFIX ALPHABET INDICATES SPLICE
J1-42A AND J1-42B
J2-33A AND J2-33B
J2-37A AND J2-37B
J2-44A AND J2-44B

3 BRAKE SWITCHES SPECIFIC PRIORITIES AND DEPENDENCIES

DESCRIPTION	ORDER OF STATE CHANGE	ELECTRICAL CONTACTS
CC/TCC	1	N. C.
BLS	2	N. O.
BTS1	3	N. C.
LOW OIL LVL		N. C.

- 4 LEGEND FOR "OBJECT ID"
OBJECT ID = 1gxx3530b1wt



5. FIRING ORDER 1 - 8 - 7 - 2 - 6 - 5 - 4 - 3
BST DRIVERS A - B - C - D - E - F - G - H
(GEN III ONLY)
- FIRING ORDER 1 - 6 - 5 - 4 - 3 - 2
BST DRIVERS A - B - C - D - E - F
(GEN 1E -V6 ONLY)
- FIRING ORDER 1 - 8 - 4 - 3 - 6 - 5 - 7 - 2
A - B - C - D - E - F - G - H
(GEN 1E -V8 ONLY)

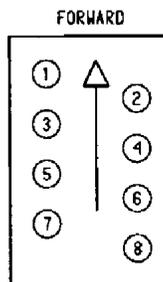


Figure 3.2.1a - XVI - P/Truck - Mechanization Diagram – Note & references

3.2.1b GMPT interface with Electrical Supply System- Marine and Industrial Application

Figure 3.2.1b-I to 3.2.1b-II shows the PCM Engine to Vehicle Mechanization Diagram for the Marine and Industrial Applications

Figure Number	Description
Figure 3.2.1b - I	Cam, Crank, MAP, TPS and OIL Sensors
Figure 3.2.1b – II	Engine Injectors, Spark Plugs

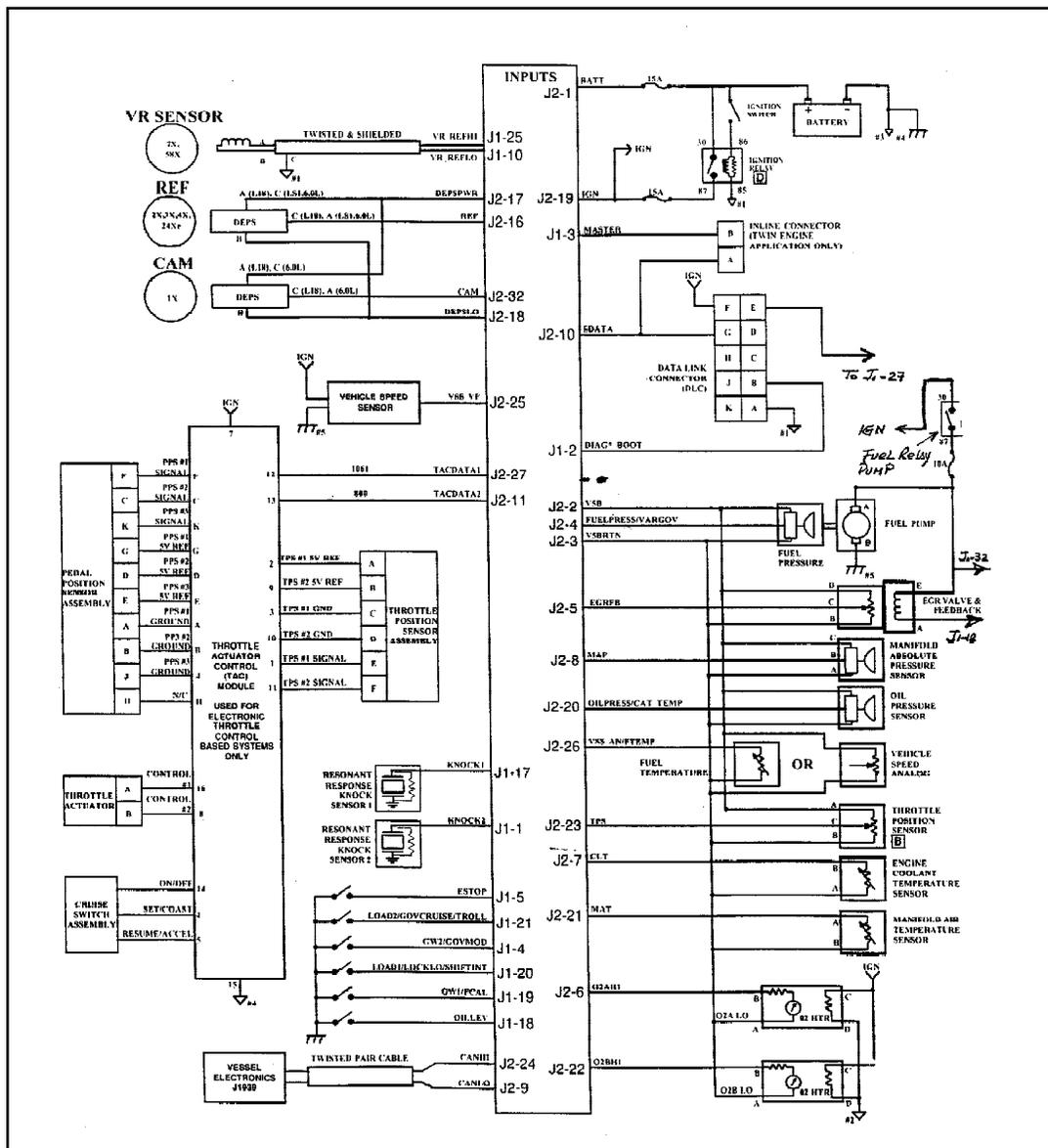


Figure 3.2.1b - I - Mechanization Diagram – Cam, Crank, MAP, TPS and OIL Sensors

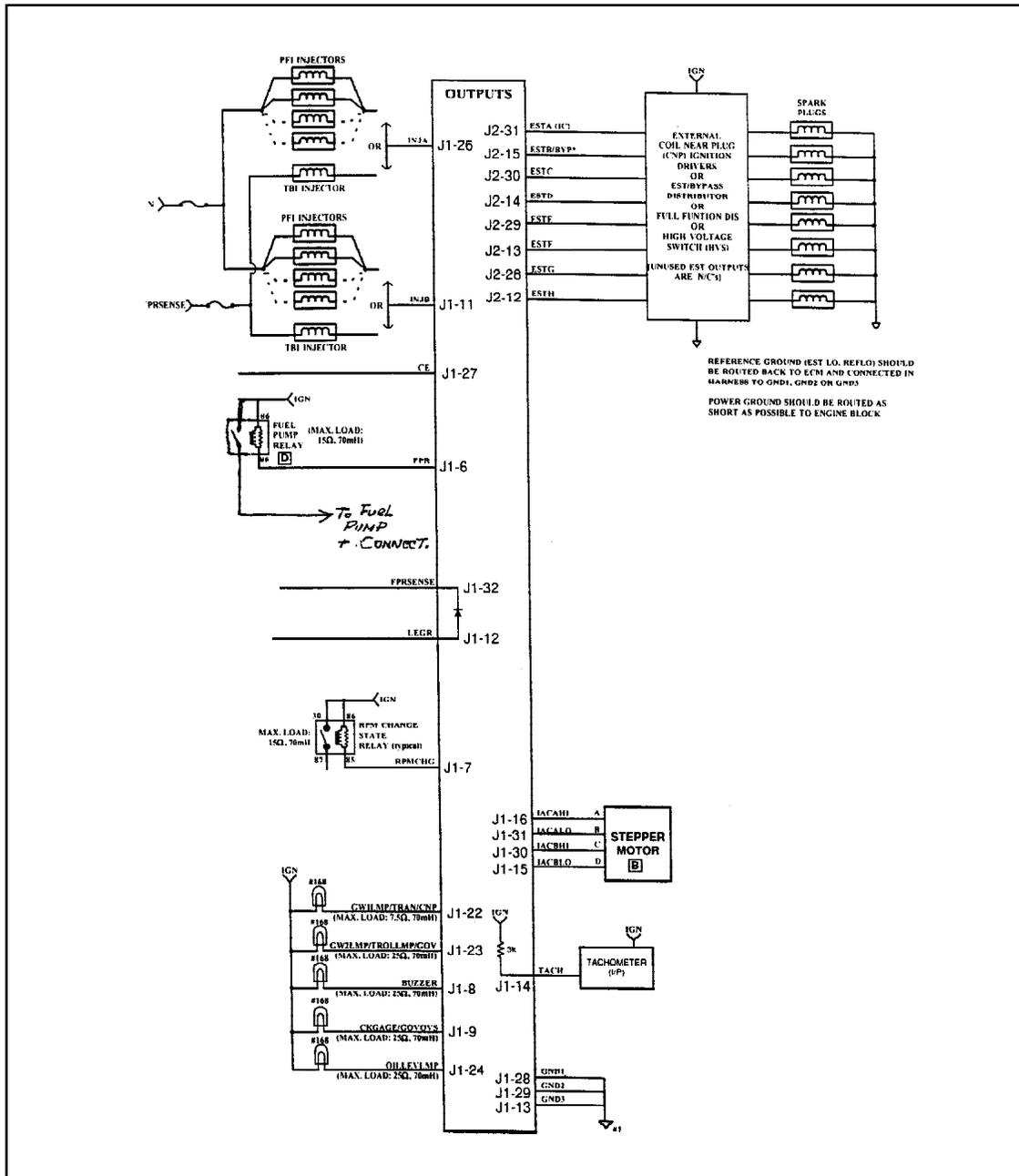


Figure 3.2.1b – II - Mechanization Diagram – Engine Injectors, Spark Plugs

3.2.2 GMPT interface with Electrical Starting System

		L35
Motor		
PG260	Current Drain	312 Amps
	Power Rating Kw	1.4Kw
Motor Drive	Engagement Type	Solenoid Actuated Positive Engagement
Gear Reduction Type	Pinion Engages From:	Front

The following table shows the different Starters and Components coupled to the L35 engine and GM platforms.

Engine Starter (6 Y 2)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Starter ASM	12563829	12564107	12564107	12564107	12564107
Shield	12561327	12561327	12561327	12561327	12561327
Bolt/Screw	12561387 12555162 1246249	12561387 12555162 1246249	12561387 12555162 1246249	12561387 12555162 1246249	12561387 12555162 1246249

- Ignition voltage to PCM must be maintained at or above 7 volts during cranking.
- The operation of the 4.3L V6 90 Degree Engine System shall not adversely affect any of the vehicle electrical subsystems.
- Conversely, the operation of any vehicle electrical subsystem shall not adversely affect the operation of the 4.3L V6 90 Degree Engine System.
- Before performing any welding, disconnect negative battery cable and PCM connectors to avoid damage to other systems components.
- All engine electrical systems and controllers are not to exceed the allowable levels of radiated electromagnetic emissions described in specification GM 9114P dated December 14, 1994.
- Engine Electric Wiring Harness Including Connections Provisions For:
Battery, Grounding Requirements, Mounting (Wiring Retention for Function and Appearance), Starter, Alternator, Sensors and Switches, Thermal Environment, IP Signal Information, Oil Life, Monitoring, Oil Level Sensing, PCM & Governor Wiring Assembly.
- All Electrical Connector Insertion Forces Less than 80 Newton's.
- The electrical generator assembly is not part of the engine scope of supply.

The following table shows the different Pre-Heaters and Components coupled to the L35 engine and GM platforms.

Engine Pre Heather (6 Y 2C)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Pre Heather ASM	12556261	12556261	12556261	12556261	12556261
Screw/Bolt	15969147 11509126 11515763	15969147 11509126 11515763	15969147 11509126 11515763	15969147 11509126 11515763	15969147 11509126 11515763
Cord ASM	52353022 15726112	52353022 15726112	52353022 15726112	52353022 15726112	52353022 15726112
Strap	15517469	15517469	15517469	15517469	15517469

3.2.3 GMPT interface with CHASSIS BRAKE ABS System

Figure 3.2.1-I to 3.2.1-XVIII shows the PCM Engine to Vehicle Mechanization Diagram with this interface.

3.2.4 GMPT Interface with HVAC System

In order to properly attach the engine to the vehicle and interface with the Vehicle Cooling System the following cooling issues must be considered:

This engine is designed to operate with a surge tank that shall be located at the highest point of the cooling system.

- | | |
|--|---|
| <ul style="list-style-type: none"> a. Coolant contamination level b. Corrosion protection <ul style="list-style-type: none"> 1. Coolant change intervals 2. Coolant type c. Ports/Sealing <ul style="list-style-type: none"> 1. Water pump | <ul style="list-style-type: none"> e. By-pass System <ul style="list-style-type: none"> 1. Deaeration 2. Fill rate & capacity 3. System pressure and Draw Down f. Engine Oil Cooler d. Temperature Management <ul style="list-style-type: none"> 1. Thermostat and Low Coolant Sensor location |
|--|---|

Figure 3.2.1-I to 3.2.1-XVIII shows the PCM Engine to Vehicle Mechanization Diagram with this interface.

3.2.4.1 Fan Cooling System

Figure 3.2.1-I to 3.2.1-XVIII shows the PCM Engine to Vehicle Mechanization Diagram with this interface. The following table shows the different Fan ASM and Components coupled to the L35 engine per GM platforms.

Engine Air Fan ASM (6K1)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Tensioner	12561094	12561094	12561094	12561094	12561094
Bolt/Screw Tensioner	11517648 11517649	11517648 N/A	N/A 11517649	N/A 11517649	N/A 11517649
Belt	12559620 12564759/60 12564763/4 N/A	12569349 12569350 N/A N/A	12564749 12564760 12564761 12564763	12564762 12564759 N/A N/A	12564761 12564763 12564759 N/A
Blade ASM FAN	15738321	15017911	15002575	15976889	15600390
Blade ASM FAN	N/A	N/A	15657381	N/A	15976889
Bolt/Screw Blade	15548719	11516869	15548719	15548719	15548719
Clutch ASM FAN	15735393 15735394 N/A	22149836 22149880 15710101	22135998 22136704 N/A	15976997 N/A N/A	15154901 22136712 N/A
Engine Pulley Crank Shaft	10085754	10085754	10085754	10085754	10085754
Bolt/Screw Pulley Crank Shaft	10179287	10179287	10179287	10179287	10179287
Pulley FAN	12550053	12550053	12550053	12550053	12550053
Bolt/Screw Pulley Fan	11516292	11516292	11516292	11516292	11516292
Pulley ASM Belt Idler	12555609	12555609	10239930	10239930	10239930
Pulley ASM Belt Idler	12556612	12556612	12557819	12557819	12557819
Pulley ASM Belt Idler	12557819	N/A	N/A	N/A	N/A
Bolt/Screw Fan Idler	11515756 12550053	11515756 N/A	11515756 N/A	11515756 N/A	11515756 N/A

3.2.4.2 Coolant Properties

GMPT engines are liquid cooled and designed to operate with a mix of ethylene glycol and water. GMPT recommends a daily audit of glycol to water concentration and a yearly audit of water quality at the vehicle assembly fill station.

Mixture Ratio	52 % Ethylene Glycol and 48 % Water By Volume
Ethylene Glycol Specifications	Any Meeting GM 6277 M Specification
Water Specifications	Maximum Contaminants Or Range
- Total Solids	350 PPM
- Total Hardness	150 PPM
- pH	6.9-9.0
- Calcium And Magnesium	100 PPM (COMBINED)
- Chlorides	50 PPM
- Sulfates	100 PPM
- Bicarbonates	150 PPM

3.2.4.3 Coolant Radiator (Recommended Minimum Values)

Cooling Radiator	L35	UNITS
Radiator Heat Evacuation To Coolant	4460	BTU/Min
Total Average Heat Coefficient- GM Recommend Better Than	34	BTU/Hr-sq. ft-F
Radiator Efficiency - GM Recommend Better Than	60%	
Radiator Type	Crossflow	
Radiator Capacity (minimum) GM Recommend Better Than	11.8	Liters
Minimum Radiator Frontal Area	TBD by Customer	Sq. Meter
Radiator Total Area	TBD by Customer	Sq. Meter
Radiator Coolant Flow @ Rated Power		GPM
Radiator Coolant Peak Pressure	103	kPa
Thermostat Open	170	F
Thermostat Fully Open	190	F
Radiator Coolant Inlet Location & Size	Top/ 46.2	mm
Radiator Coolant Outlet Location & Size	Bottom/ 60.0	mm
Fan	Engine Driven 1:25 Ratio to Crank	

3.2.4.3.1 Heater Performance

Three coolant temperature performance exist in support of heater performance for the purpose of providing adequate cab heat. These temperatures shall be selected through the thermostat setting.

3.2.4.3.1.1 Fast Warm-Up

The engine can provide a minimum of 170°F coolant to the heater in 10 minutes after the engine started to run from cold conditions.

3.2.4.3.1.2 Uniform Comfort.

The engine can provide 190°F +/-5°F coolant to the heater at 20 minutes after the engine started to run from cold conditions.

3.2.4.3.1.3 Degradation of Comfort

The engine can provide 190°F +/-5°F coolant to the heater during the 20 minutes idle, after the engine started to run from cold conditions.

A thermostat temperature of 190°F is assumed. A higher thermostat temperature is acceptable.

The following table shows the different Radiator ASM and Components coupled to the L35 engine per GM platforms.

Engine Coolant Radiator (13A)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Radiator ASM	52473151	52486600	15766916	52482175	52472963
Radiator ASM	N/A	52486601	15762434	N/A	52472964
Radiator ASM	N/A	N/A	15762437	N/A	N/A
Radiator ASM	N/A	N/A	15766914	N/A	N/A
Cap Radiator	15977333		15982188	15982188	15982188
Reservoir Coolant ASM	15687277		15030565 15058245	15720807 15720808	
Bolt Screw or Retainer	11509745		11515904	22535007	15999164
Bolt Screw or Retainer	N/A	N/A	N/A	N/A	15685170
Bracket ASM	15996772		15958651	N/A	
Cap Reservoir	14054390				
Hose Reservoir Coolant	9439035				15007480
Hose Reservoir Coolant	9439124				15689607
Hose Reservoir Coolant	9439145				
Clamp	3786276		1622710	1622710	1626260
Clamp	14029188				

3.2.4.3 Operating Conditions and Measures

3.2.4.3.1 Heat Rejection

Heat rejection levels for combined engine coolant and oil are measured per GM Test #9 and are summarized in the table below. The values for the specific heat rejection to the coolant and Lube oil are shown below in table 3.5.3.1-I.

RPM	L35 Truck Applications	L35 Marine Applications	Condition
	Heat rejection BTU/Min	Heat rejection BTU/Min	
2000	1339	n/a	Road Load
2800	2038	n/a	Road Load
3600	2937	n/a	Road Load
1600	1536	n/a	7.2% Grade
2400	2226	n/a	7.2% Grade
2000	2209	2336	WOT
3000	3001	3202	WOT
4000	3910	4274	WOT
4200	4080	4314	WOT
4400	4309	4799	WOT
4600	4460	4716	WOT
750	486	539	Idling
1300	1016	1074	Parked
2200	1756	1826	Parked

Table 3.5.3.1-I 4.3L V6 90 Degree Engine Heat Rejection

3.2.4.3.2 System Pressure

GMPT engines are designed to operate with a pressurized cooling system and surge tank. System pressure is controlled with a spring loaded pressure (RC33) relief cap with a nominal setting of 15 Psi.

3.2.4.3.3 Coolant Operating Temperatures

This engine has been validated for continuous duty including continuous operation at WOT with the coolant temperature under thermostat control (see thermostat start to open and full open temperatures). Limited operation above thermostat full open temperature is allowed as shown in the table below.

OPERATION	MAX ALLOWABLE TEMP
Extended Idle (Up To 30 Minutes) In Ambient up to >38 C	262.4 F
City Traffic Operation In Ambient	
- Up To 109.4 F	237.2 F
- Up To 118.4 F	255.2 F
Grades	
- Trucks At GCW, 7.2% Grade, 100 F, Ambient	250 F
- Passenger Cars At GVW, 7.2% Grade, 100 F , Ambient	250 F
High Speed Operation	
- Passenger Cars At GVW, 167 kph, Up To 48 C Ambient	237 F
Soaks Following Grade Operation	262 F

3.2.4.3.4 Flow Rates

Flow to the radiator and heater vary with pump speed, thermostat valve position, and pressure drop across the heat exchangers.

RPM	L35 All Applications	Condition
	Coolant Flow GPM	
2000	32.5	Road Load
2800	46.1	Road Load
3600	59.9	Road Load
1600	26.1	7.2% Grade
2400	37.7	7.2% Grade
2000	32.6	WOT
3000	49.5	WOT
4000	66.6	WOT
4200	70.1	WOT
4400	73.6	WOT
4600	76.5	WOT
750	12.1	Idling
1300	21.2	Parked
2200	36.0	Parked

Figure: 3.2.4.3.4 - I - Water Pump Flow Rates

3.2.4.3.5 Coolant Fill

Assembly Plant- GMPT requires the engine cooling system to be at least 95% filled (from a dry system no bleed valves) before the engine is started.

Service- GMPT requires a clear unobstructed view of the coolant deaeration tank be provided in an underhood location. The system should be designed to be capable of replacing 95% of the coolant drained during a service situation without starting the engine or opening any bleed valves.

3.2.4.3.5.1 System Drain Down

The system is to be designed to displace all air in the engine, hoses, heater(s), and radiator into the deaeration tank while the engine is operating. After the engine, upper radiator hose, and radiator are charged with coolant the charge must be maintained at all times prior to low coolant light activation. The only air in the cooling system should be located in the deaeration tank.

Letting air enter the engine, upper radiator hose, or radiator can allow coolant in the system to drain down, which is unacceptable. Drain down can result in a false indication of the coolant level at the deaeration tank.

It also forces the system to run aerated coolant for a short time after every cold start while the engine, upper radiator hose, and radiator are recharged with coolant.

3.2.4.3.5.2 Service Fill/Procedure

Capability to fill the system to 95% or more of capacity without running the engine. This ensures enough coolant is in the system to prevent engine damage if run for extended periods of time without checking the coolant level. Rear heater systems generally can not be filled without running the engine making it difficult to achieve a 90% static fill. However, rear heaters are difficult to drain as well and typically do not have to be refilled during service fill. If the rear heater is drained, a few minutes of running at moderate engine speeds is usually adequate to flush the air out of the heater and achieve a 90% fill.

3.2.4.3.5.3 Fill Rate

The system should be able to achieve a 95% static fill at the 3 GPM rate.

This indicates adequate sizing of the deaeration tank fill line and proper venting of the system.

3.2.4.3.5.4 Drawdown Capacity

The cooling system must be capable of losing approximately 10% or 2.4L (2.5 QTS.) of coolant without aeration occurring or loss of flow. Run at 3500 RPM with a blocked open thermostat.

This allows the engine to operate without damage when only a 95% fill is obtained.

3.2.4.3.5.5 Deaeration Capability

The ability for the system to run un-aerated within 20 minutes after a service fill. Run with an operating thermostat and at 3500 RPM. The system needs to be able to purge air into the deaeration tank during closed and partially open thermostat conditions.

3.2.4.3.5.6 Air Handling Capability

The ability to lose no more than 50% of the water pump flow with 0.2 CFM of air injected into the engine. The air is injected into an area after the water pump to simulate a combustion leak into the coolant. Coolant loss during the test should not exceed the Drawdown capacity. Test run at 3500 RPM with a blocked open thermostat.

3.2.4.3.5.7 Low Coolant Light Calibration

The low coolant light is to be calibrated to activate prior to coolant aeration occurring. Normally the low coolant light should come on when the amount of coolant lost is less than or equal to the Drawdown capacity.

In some installation (see 3.5.3.5.1) the Low Coolant Light will have to come on prior to the Drawdown capacity to prevent drain down.

3.2.4.4 Coolant and Heater Subsystem Descriptions

3.2.4.4.1 Coolant Inlet- Water Pump Inlet Restriction

Typical Diameter: **60** mm +/- 0.3 mm.

The suction at the water pump inlet should not exceed approximately 1.0" HG (-1.0" HG pressure) when run at 3500 RPM without a pressure cap. Exceeding this suction could cause the lower radiator hose to collapse if the system loses cap pressure.

3.2.4.4.2 Coolant Outlet-

Typical Diameter: **46.2** mm +/- 0.3 mm.

3.2.4.4.3 Heater Feed-

Typical Diameter: 15.9 mm +/- 0.3 mm or 19.05 mm +/- 0.3 mm

3.2.4.4.4 Heater Return

Typical Diameter: 15.9 mm +/- 0.3 mm or 19.05 mm +/- 0.3 mm

3.2.4.4.5 Coolant Hose Material

GMPT requires hose material meeting GM specification 6140m, 6250m, 6278m, or 6149m (hose material specifications vary by the severity of the environment they will be subjected to).

Reference radiator and heater hose dimensional specifications listed on drwg. # 12552514. Suggested lubricant for ease of hose assembly to inlet nipple is GM 9985406

3.2.4.4.6 Hose Clamps

GMPT requires the use of constant tension clamps for all hose connections.

Reference dimensional information on hose clamp drwg. # 11516215 and equivalents.

3.2.4.4.7 Thermostat

- start to open temperature- **170°F**
- full open temperature- **190°F**

3.3.1 GMPT Interface with CHASSIS Fuel System

Figure 3.2.1-I to 3.2.1-XVIII shows the PCM Engine to Vehicle Mechanization Diagram with this interface.

RPM	L35 Truck Application	L35 Marine Application	Units
800	17.16	17.7	PPH
1200	26.45	27.3	PPH
1600	35.12	37.9	PPH
2000	44.17	46.7	PPH
2400	54.79	56.1	PPH
2800	64.74	67.9	PPH
3200	75.30	76.3	PPH
3600	84.40	85.1	PPH
4000	94.33	94.9	PPH
4400	102.80	104.3	PPH
4800	105.4	112.2	PPH
5200	106.97	119.0	PPH

Figure: 3.3.1 - I 4.3L V6 90 Degree Engine - Fuel requirements vs. Engine Speed

The following table shows the different Fuel Lines, Fuel Tank and Evaporative Assemblies and Components coupled to the L35 engine per GM platforms.

Fuel (8 A)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Pipe ASM Fuel	N/A	N/A	15030585	15000300	N/A
Pipe ASM Fuel Feed	N/A	N/A	15043227 15043228	15023800 15023801 15023802	15023800 15023801 15023802
Fitting Fuel Pipe	15550219	15550219	N/A	15036790	15036790
Hose	15733594 15035085 15721387	15765804 15765806	N/A	15054322	15054322
Fuel Filter	15530354 25055129	N/A	25121800	25171788	25171788
Bracket	N/A	15013855	15009324	N/A	N/A
Clip/Clamp	343449 15973085 15677730	343449 15973085 15677730	343449 15973085 15677730	343449 15973085 15677730	343449 15973085 15677730
Bolt/Screw/Nut/Stud	11515211 11516076 11508279	11515211 11516076 11508279	11515211 11516076 11508279	15604106 15708937 3932368 9428638	15604106 15708937 3932368 9428638

Fuel Tank (8 B)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Fuel Tank ASM with Pump	N/A	15759638 15759639	15017931 15017932 15767150	15747872 15066407 15020046 15062877	15013150 15028431 15048831 15761468 15762977 15762978
Fuel Tank ASM no Pump	15721311	N/A	N/A	N/A	N/A
Fuel Pump	25315352 25314575	N/A	N/A	15062879	N/A
Fuel Valve	15978533	N/A	N/A	N/A	N/A
Pipe Filler	15030687	15747585		15052676 15015206	15061623 15062980 15062981
Strap	15311568	15745095 15745096 15770877 15770878	15015617 15015618 15745014 15745015	15745065	15015589 15032208
Cap	22616285	15763225	15746557	22660002	22660002
Bolt/Screw/Nut/Stud	9428638 11518477	11516551 11516770	11516523 11518476 11517784	15604106 11508561	15604106 11508561
Fuel Evaporative (8 D)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Canister ASM	17098106	15056485	17098085	17098085	17201171 17097127 17097120
Shield	15004076				
Hose	10282447 15721451 15733597 15721447 15721448 15731510	15759042 15759043	N/A	15012787	9439150 15150414 15726983 15768562
Clamp	10108259 11516221	10108259 11516221	N/A	10108259 11516221	10108259 11516221
Separator	17096210	N/A	15032645 15032646	15032645 15032646	15032645 5032646
Bracket	15009801 15013689 15746404 17565062 15731699	15056490	15769694	15769694	15049107 15742240 15734230 15992101
Harness	12556909	12555973	12561900	12561900	11509087 12566190
Strap	11509087	11509087	15000499	11509087	11509087
Valve	12559015	15032643 15032644	15032643 15032644	15759225	25658328 12559015
Bolt/Screw/Nut	11508797 3847758 3975550 11515211	11516573 11513914	11515211 11508797 3847758 3975550	11515211 11508797	11515654 11515656 11515658

3.3.2 GMPT interface with Air Induction System

3.3.2.1 Air Requirement

RPM	L35 Truck Application	L35 Marine Application	Units
800	23.8	24.9	gr/sec
1200	37.8	39.3	gr/sec
1600	51.8	52.7	gr/sec
2000	65.8	67.4	gr/sec
2400	81.3	82.9	gr/sec
2800	97.7	99.0	gr/sec
3200	113.7	116.3	gr/sec
3600	128.8	130.5	gr/sec
4000	143.3	142.3	gr/sec
4400	154.7	154.0	gr/sec
4800	160.9	165.1	gr/sec
5200	163.7	175.0	gr/sec

Figure: 3.3.2.1-I 4.3L V6 90 Degree Engine Air Requirements

3.3.2.2 Air Flow Path

The air flow path in the vehicle at the air inlet of the air induction system shall not be obstructed with vehicle components that will cause loss of pressure or flow disturbance.

All performance parameters specified in paragraph: 2.3.2.1 were measured with a maximum air restriction of 1" of Hg.

As reference in table 3.3.2.1 - I, development power and torque data is shown to illustrate the order of magnitude that may result as increasing the induction restriction.

Table 3.3.2.1 - I 4.3L V6 Development Peak Power and Torque Levels Induction Restriction *		
Induction Restriction	Torque (Lb.-Ft)	Power (Hp)
1" Hg.	264	200
1.2" Hg.	262	198
1.4" Hg.	260	196
1.6" Hg.	258	194

* Exhaust backpressure held at 11" Hg.

3.3.2.4 Temperature Rise

The intake of air must avoid the suction of air coming from the hot spot areas of the inside of the engine bay such as proximity to exhaust manifold.

As referenced in table 3.3.2.4 - I, development power and torque data is shown to illustrate the order of magnitude that may result as increasing the induction temperature.

Inlet Air Temperature (Deg-F)	Power Loss (%)
77	0
90	2.7
100	5.1
122	8.5
144	11.6
176	16
208	20.3

3.3.2.4 Filtration Requirements

GMPT requires an air filtration medium that is capable of removing 98.7% of the material contained in reference material SAE "Course Dust".

The following table shows the different Air Cleaner ASM and Components coupled to the L35 engine per GM platforms.

Engine Air Cleaner (6 M 3)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Air Cleaner	25147074	25322546 15766610	15754209	15747601	15747865 15747867
Bracket	15982176 15987694	15735434 15735435			25171130
Adapter	15997186				
Bolt/Screw/Nut/Stud	3846202 11508300 11509542 14045263 15992647 15994910	11516484 11516589 11516587 15994910	11516727 11992647 11514596	15992646	15994910 11515933
Duct	15985845 15985846 15729512 15971184 15755160 15020026	15057511 25168087	15016578	25160175	25173868
Clamp	15986419 2465839 8868639	15986419 2465839 8868639			
Elbow	15003750 15994899	15003750 15994899			

3.3.3 GMPT Interface with Oil Cooling Subsystem

3.3.3.1 Oil Cooler Requirements -

Heat Rejection to Oil - Consult GM Application Engineer.

The following table shows the different Oil Cooling, Filter Assemblies and Components coupled to the L35 engine per GM platforms.

Oil Cooling (6 G 3)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Oil Cooler ASM	15722841	15021207	15021207	15021207	15021207
Oil Hose Cooler ASM	15007061	15736423	15736423	15764375	15760333
Bolt/Screw/Nut	9419683 11514139 15679508	9419683 11514139 15679508	9419683 11514139 15679508	9419683 11514139 15679508	9419683 11514139 15679508
Bracket	15557752				
Bolt Screw w/Nut	11508253	11508253 11516071	11508253 11516071	11508253	11508253
Strap	11501907	15607246	15607246	15607246	15607246
Bracket	15996659	15029984	15029984	15029984	15029984
Bolt Screw	11509759	11515210	11515210	11504357	11504357
Connector				15719697	15719697
Oil Filter (6 G 5)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Filter	25170846	25014831	25014831	25014831	12556880 15026051 15026052
Adapter	12558731 12562830	3952301 12562831	3952301 12562831	3952301 12562831	12556880 15760334
Fitting	N/A	3853870	3853870	3853870	15689615
Gasket	12551589 12552828	12551589 12552828	12551589 12552828	12551589 12552828	12551589 12552828
Bolt/Screw	10168445	3951644 9421634	3951644 9421634	3951644 9421634	11508253 11505347 15701734

3.3.4 GMPT Interface with Chassis Engine Mountings

3.3.4.1 Engine Packaging Dimensions

The packaging dimensions for the 4.3L V6 90 Degree referenced from the center line of crankshaft and the rear face of block are shown in the Figure 3.3.4.1-I. Adequate engine roll, load, or thermal clearances (which ever is largest) should be added to these dimensions.

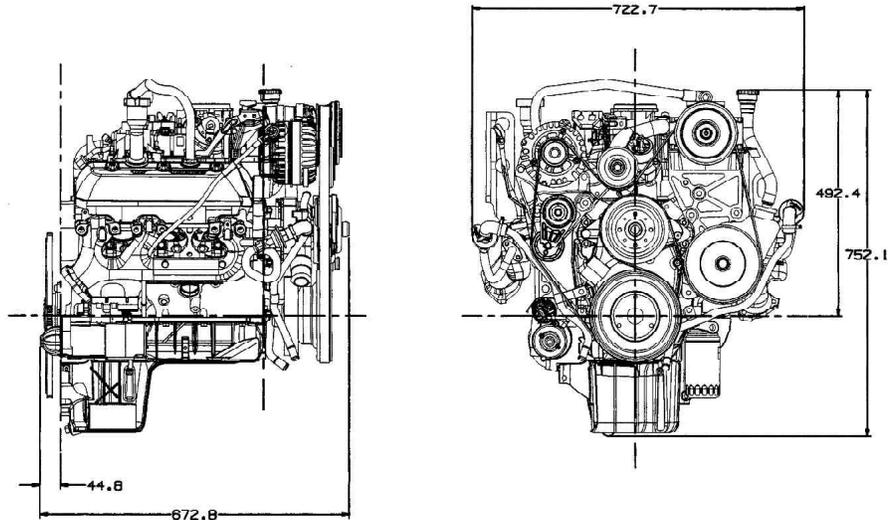


Figure 3.3.4.1 – L 4.3L V6 90 Degree Packaging Dimensions

3.3.4.2 Recommended Installation Angles

See Figure 3.3.4.2 for the vehicle installation angle description in a transverse powertrain application.

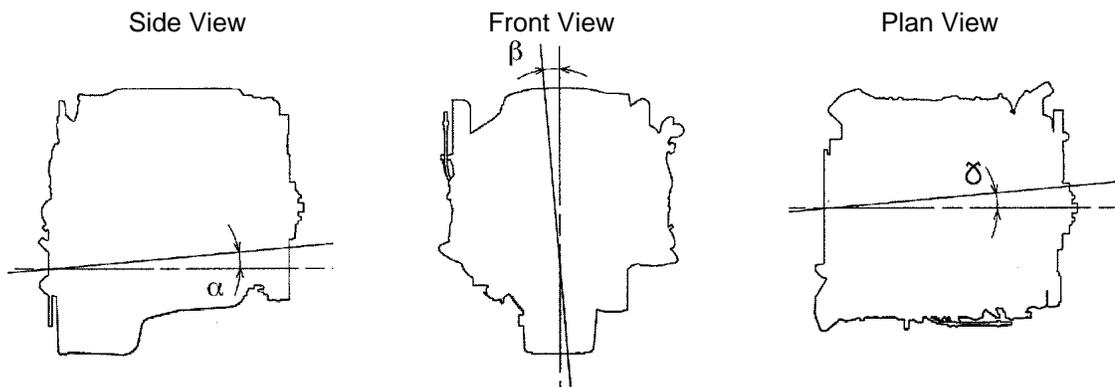


Figure 3.3.4.2 Installation Angles

3.3.4.2.1 Recommended Side View Angle

The α angle shown in powertrain side view shall not exceed 5 Degree. For greater values consult GM Application Engineering.

3.3.4.2.2 Recommended Front View Angle

The β angle shown in powertrain front view shall not exceed 5 Degree. For greater values consult GM Application Engineering.

3.3.4.2.3 Recommended Plan View Angle

The δ angle shown in powertrain plan view shall not exceed 5 Degree. For greater values consult GM Application Engineering.

3.3.4.3 Rear Face of Block Configuration

The rear face of block is illustrated in Figure 3.3.4.3. Dimensions are from the center line of crank.

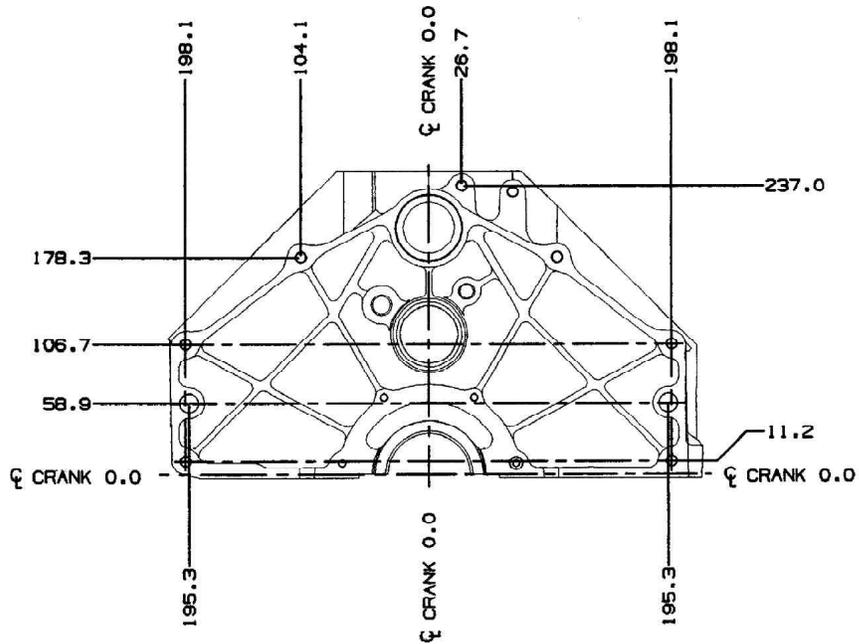


Figure 3.3.4.3 Rear Face of Block

3.3.4.4 Ground Clearance

No engine component shall be positioned below the vehicle dynamic ground line.

The following table 4.4.1-I shows the different Mounting Components coupled to the L35 engine per GM platforms.

Powertrain Mounting (6 Q)	P-Truck	C/K Truck	G-Van	M/L -Van	S/T Truck
Engine Mountings					
Engine Mounting ASM	14031472	22174978	15017907	22112499	22173023
Engine Mounting ASM	15037192	22179440	15017908	22112500	
Bolt Screw	9420462 9424320 6262211	11516941-2-3 11517017-8	11515765 25623779	11509141 15596428	9442966 11517706
Nut	9442946 9442947 9418897	9442946 9442947 9418897	9442946 9442947 9418897	11516077 9442947 9418897	15956061 9442947 9418897
Spacer	15160007	15160007	N/A	N/A	N/A
Bracket	15041538 6259949	15753409 15753410	15969182 15054180	22145863 15697577	15725993 15725994
Bracket	15953632 6259950	15753411	N/A	15708672 15708673	
Bracket	15037193	15732463	N/A	15999045	
Bracket	15557731	15732464		15999046	
Bolt Screw	9433115 9420462	9433115 9420462		11509141 11509141	15672901
Bolt Screw	11517706	11517706			
Washer	407795 15531204	407795 15531204			
Shield	15037194	N/A	15764435-6		15977043
Transmission Mountings					
Trans Mounting ASM M74	15683966	N/A			
Bolt Screw	9441662 15592071				
Washer	11505575				
Nut	11516077 15151028 9442946				
Trans Mounting ASM MT1	17990857	N/A	22179376-7	22145766 15717594	15767866
Bolt Screw	15592071	N/A	11515946	11500831 11514071	15726468
Washer	11505575	N/A	N/A	11500046 11500223	
Nut	11516077	N/A	11514521	11515552	11515552
Shields	N/A	N/A	15160656		
Bolt Screw Shield	N/A	N/A	15712486		
Trans Mounting ASM MG5	N/A	15761786	N/A		
Bolt Screw	N/A	15592071	N/A		
Washer	N/A	11505575	N/A		
Nut	N/A	11516077	N/A		
Trans Mounting ASM M30	N/A	15768333	N/A		
Bolt Screw	N/A	15592071	N/A		
Washer	N/A	11505575	N/A		
Nut	N/A	11516077	N/A		

4.0 DETAILED PERFORMANCE DESCRIPTION

4.1 EXHAUST AND EVAPORATIVE EMISSIONS

4.1.1 EPA Certification

This engine when equipped with GMPT specified exhaust after treatment systems and GMPT transmissions has been certified to **EPA requirements**

4.1.2 CARB Certification

This engine when equipped with GMPT specified exhaust after treatment systems and GMPT transmissions has been certified to **CARB requirements**

4.1.3 Other Regulations

The Engine must comply with the following regulations: (Based on application and time of production.)

GVWR #	LVW#	FEDERAL (TIER 1) (g/mile)						CALIFORNIA (TIER 1) (g/mile)					
		NOx	THC	NMHC	CO	PM	MILES	NOx	THC	NMHC	CO	PM	MILES
6001 - 8500	3751 - 5750	—	—	.32	4.4	—	50K	.98		.45	6.4	.10	120K
		.98	.80	.46	6.4	.10	120K						
	5751 - 8500	—	—	.39	5.0	—	50K	1.53		.56	7.3	.12	120K
		1.53	.80	.56	7.3	.12	120K						
8501 - 14,000	8501- 10,000	4.0*	1.3*		15.5*	.10*	110K	1.81		.66	8.1	.15	120K
	10,000 - 14,000	4.0*	1.3*		15.5*			NOx	THC	THC	CO	PM	MILES
		4.0*	1.9*		37.7*			2.77		.86	10.3	.18	120K
>14000	>14000	NOx	THC	NMHC	CO	PM	MILES	NOx	THC	THC	CO	PM	MILES
		4.0*	1.9*		37.7*			3.9*			14.4*	.10*	110K
						OPT FOR		DIESEL/INCOMPL.* (GVW 8501-14,000)					
								NOx & NHM C			CO	PM	MILES
								3.9*			14.4*	.10*	110K
													* g/bhp - hr

Figure: 4.1.1-I EPA Regulations

4.1.3.1 Onboard Diagnostics

Onboard diagnostic refers to the ability of the Powertrain control system to self diagnose emission performance related problems and communicate the existence of such problems to the vehicle operator via the "Service Engine Soon" telltale light present in the vehicle instrument panel, or to the service technician via a serial data communication tool attached to what has been the Assembly Line Data Link (ALDL), but what is becoming an industry standard "Class 2" serial data link per SAE J1850.

- a. Improve in-use compliance with emission standards for the lifetime of the vehicle.
- b. Detect & identify deterioration and malfunction of emission related components and systems.
- c. Augment/supplant current inspection/maintenance programs.
- d. Detect deterioration or malfunction of individual emission related components.
- e. Define a standardized electronic communication protocol to enable interrogation of the control system so as to allow independent service stations the ability to diagnose and repair emission related failures with communized electronic instruments across various manufacturer's product lines.

4.1.3.2 Applicability

Table 4.1.3.2 -1 defines the applicability of Federal OBD II requirements to Federally emission certified full size GMTG vehicles.

GVWR (Lbs.)	OBDII Compliance Requirements	
	EPA	California
≤ 8500 Lbs.	yes	yes
8500 ≤ GVWR ≤ 14000	no	N/a
≥ 14000 Lbs.	N/a	N/a

Table 4.1.3.2-I. Applicability of Federal/California OBD II Full-Size Vehicles

4.1.3.3 Requirements

Federal OBD II requirements may be categorized into two basic groups. The two groups include:

- a. Standardization requirements
- b. Diagnostic Requirements specific to Federal OBD II

Requirement	Description
Data Link Connector and Protocol	SAEJ1850 - Specifics requirements for vehicle data communications network. GM implementation of this standard known as Class 2 Serial Data
	SAEJ1962 - Specifies the new 16 pin under dash diagnostic connector.
	SAEJ1978 - Specifies the OBD II scan tool which is designed to attach and communicate via the under dash diagnostic connector.
Test Modes and Fault Codes	SAEJ1979 - Specifies CARB/EPA functions and messages
Parameter Information	SAEJ2012 - Specifies format and messages for diagnostic trouble codes

5.0 OPERATING ENVIRONMENT

5.1 ROADWAY GRADES, SURFACES AND HAZARDS

The careful selection of 4.3L V6 90 Degree Engine and Transmission in accordance with the proper installation to the vehicle will assure the operation of the engine in a very wide range of roadway grades, surfaces, hazard and Off Road conditions.

Altitude: The engine is designed to function at altitudes from 200ft (61M) below sea level to 14500ft (4420M) above sea level.

Gradability: The engine is designed to function at grades $-16 < 0 < 16\%$ GM Application engineering will support the customer with applications out of this range.

5.2 CRITICAL COMPONENT TEMPERATURE LIMITS

The following table 5.2 shows Critical Component Temperature Limits as a reference value for different components. The GM application will verify these values for each specific application. All engine non-metallic components not listed in the table will withstand a minimum underhood temperature of 121 Degree Celsius.

Component	Temperature Range	Excursion Temp (Deg. C)
Coolant Temperature Sensor	-40 to 132	172
Aux. Cooling Fan Switch	-40 to 132	172
ESC Sensor	-50 to 135	185
Spark Plug Wire Conduit - Nylon	-40 to 120	180
Spark Plug Wire Clips - Nylon 66	-40 to 135	200
Spark Plug Wire Boots - Hi Temp Silicone	-40 to 232	272
Fuel Injectors	-40 to 120	160
MAP Sensors	-40 to 105	145
Fuel Rail	-40 to 125	165
Coil Driver Module	-40 to 125	165
Crank Sensor	-40 to 150	165
Oxygen Sensor Connector	-40 to 125	165
Starter Motor	-40 to 121	161
High Voltage Switch & Internal CAM Sensor	-40 to 150	165
ECM Coolant Sensor	-40 to 155	195
Ignition Coil	-40 to 105	145
MAF sensor	-40 to 125	165
Throttle Body	-40 to 120	160
Purge Valve	-40 to 125	150
Evap. Tube	-40 to 125	150
Canister	-40 to 90	125
IAT Sensor	-40 to 125	165
EGR & Internal	-40 to 135	175
Oil Pressure Sensor	-40 to 150	190
Ignition Cable	-40 to 232	272
Block Heater	-40 to 135	175
Bypass Coolant Hose	-40 to 130	170
Exhaust Manifold & Components	-40 to 950	1100
Underbody Attaching Harnesses/Connectors	-40 to 125	165
Transmission to Engine Electrical Connectors	-40 to 135	175
Oil Pan Gasket	-40 to 150	190
Quick Connect Cooler Fitting Seal	-40 to 150	190
Oil Pan Drain Plug Seal	-40 to 150	190
NSBU Switch	-40 to 150	190
Oil Mineral	-30 to 128	150
Belts	-40 to 121	121

5.3 HUMIDITY, RELATIVE HUMIDITY (SEE CHART 5.2-I)

5.4 PRESSURE (SEE CHART 5.2-I)

The 4.3L V6 90 Degree Engine shall be able to withstand any combination of environment conditions that it may be exposed to in 10 years.

For the purpose of this application manual the environment is defined as the 4.3L V6 90 Degree Engine exposed during the percentage of his life to the conditions showed in the chart 5.2.1-I.

Table : 5.2.1-I Temperature Operating Environment		
Functionality	Minimum Temperature	Maximum Temperature
Operate, Start Unassisted	-20 F	120 F
Operate, Start Assisted ⁽¹⁾	-40 F	135 F

(1) Assisted starts in the -20 to -40 degree Fahrenheit range shall be interpreted as meaning that the vehicle must start under the defined condition with use of appropriate aids such as an RPO engine block heater, reduced viscosity oil, an auxiliary battery and or battery blanket(s). In the 120 to 135 degree Fahrenheit range an assisted start is defined as permitting a hot engine to cool down to a level at which it will restart.

Chart 6.2.1-I Environment Definitions

The temperature of the different Subsystems configuring the 4.3L V6 90 Degree Engine during operation might be appreciable different from the values indicated in the Chart 5.2.1-I but will never jeopardize the engine performance .See paragraph 5.2 for component max. temperatures. The GM Application Engineer will define the TBD values in correspondence with the test procedure adopted by the customer.

5.5 Underhood/Underbody Car Wash

No actual or projected loss of function or performance of the engine system shall occur as a result of operating the vehicle in a car wash environment.

5.6 Fording

Consult the GM Application Engineer for application in conditions during Fording Operations.

5.7 Sand And Dust Exposure

No actual or projected loss of function or performance of the engine system shall occur as a result of operating the vehicle in a sandy or dusty environment when the recommended air induction system maintenance is performed.

5.8 Gravel And Stone Chip Exposure

No actual or projected loss of function or performance of the engine system shall occur as a result of operating the vehicle in a gravel and stone environment.

5.9 Ozone exposure

No actual or projected loss of function or performance of the engine system shall occur as a result of operating the vehicle in an environment with ozone exposure.

5.10 Electromagnetic Environment

The 4.3L V6 90 Degree Engine System is tested to ensure that electromagnetic environmental conditions would not interfere with engine performance.

5.11 Shock, Impact

During the course of the normal operating life of the vehicle, the engine may be exposed to shock loading. The engine, when installed in the vehicle, will be able to withstand the following G forces. These are considered as random singular occurrences and are not cyclic.

- a. Vertical - 2g's, b. Fore-Aft - 6g's, c. Lateral - 2g's.

5.12 Vibration Powertrain Bending

Powertrain Bending is a source of low frequency noise (50-200 Hz) which results in vibration. Powertrain bending is defined as the point of the powertrain's first vertical or horizontal bending. In the case of the 4.3L V6 90 Degree Engine, the 2nd and 3rd orders of vibration are considered. The low frequency vibration generated by Powertrain bending can be transmitted through the mounts and into the frame and body of the vehicle.

This induced energy can cause vibration of vehicle components, which set up objectionable resonance for the driver and passengers. For this reason, it is desired to make the Powertrain package stiff enough so the Powertrain bending occurs at an engine RPM outside of the normal operating mode or driving conditions of the vehicle. The ideal situation is to target the powertrain's bending moment so it occurs past the engine's maximum RPM.

The minimum Powertrain stiffness as measured in units of Hertz to accomplish this can be determined from the following equation:

$$\text{Min. Bending Frequency (Hz)} = \frac{(\text{Constant} *) \times (\text{RPM Max. Rated})}{60 \text{ sec.}} \quad * \text{ Use constant from table 6.12.1-I.}$$

Table 6.12.1-I. Significant Orders of Vibration

Engine Configuration	Orders of Vibration	Constant *
L4	2nd Order	2
V6 - 60°	2nd Order	2
V6 - 90°	2nd Order	2
V6 - L6	3rd Order	3
V8 - 90°	1st Order	1
V8 - 90°	1-1/2 Order	1.5
V8 - 90°	4th Order	4

Example: a. 4.3L V6 90 Degree Engine = $\frac{(2) \times (5000 \text{ RPM})}{60 \text{ sec.}}$ = 166 Hz Bending Frequency

In the case of a 4.3L V6 90 Degree Engine, it is desired to have the Powertrain stiffness great enough so the bending resonance occurs at or above 90 Hz when the Powertrain is installed in the vehicle. If the 4th order of vibration is considered, it is necessary to move the bending resonance out past 240 Hz to assure no resonance occurs within the engine operating speed. Since this is impractical because of the design of the engine block and transmission housing, it is desirable to tailor the component design so the bending resonance does not occur at idle or between 1800 and 2500 RPM. See GM Application Engineer for further analysis.

6.0 RECOMMENDED USAGE CONSTRAINTS

The following defines the outer limits of the envelope of operation that this engine has been validated to (for its original application). Due to the extreme variation of potential usages, the attached information should only be used as a guide toward pursuing alternate applications. Operation "outside" of the described envelope should not be attempted without extensive testing and guidance from product engineering. Data monitoring and providing shutdown capability would provide additional assurance that the application's intended envelope is not violated. The following parameters warrant measurement consideration.

- Engine Speed -PCM controlled and monitored- Dash Light Sign
- Oil Temperature -Dash Light Sign
- Coolant Temperature -PCM controlled and monitored- Dash Light Sign
- Coolant Level -Dash Light Sign

6.1 ENGINE PRE-CONDITIONING PRIOR TO NORMAL OPERATION

No towing or continuous WOT operations for the first 500 miles or 12 hours.

6.2 ENGINE SPEED

Engine speed range has the ability to impact vehicle fuel economy, durability, and driveability performance, particularly under heavy load.

The engine will provide the following speed dynamic range values shown in Table 2.2.3-II.

6.2.2 Maximum Start Time.

Engine start time is directly affected by the design of the starting subsystem. The starting subsystem parameters include starter efficiency, battery cable length, battery cable gauge, corrosion resistance and conductivity of cable connectors and battery cold cranking capacity.

The vehicle will start within the maximum times specified in Table 6.2.2 -I and continue to run at idle.

120 to 0 F	1 sec.
0 to -20 F	2 sec.

Table 6.2.2 -I 4.3L V6 90 Degree Engine Cranking

For temperature operating environment see table 5.2.1-I.

All starting times require at least 80% battery charge.

A starting aid (block heater) is required below -20°F.

Ignition voltage to PCM must be maintained at or above 7 volts during cranking.

6.2.3 Idle Quality (Speed and Stability)

6.2.3.1 Idle Stability

The PCM algorithm modifies fuel pulse and engine parameters to create smooth engine idling at the values specified by the application engineer.

6.2.3.2 Idle Speed

The idle speed selected shall comprehend other subsystem requirements (i.e. cooling, electrical, noise, accessory drive, etc. and be developed in the vehicle).

The engine idle speed will be targeted at the values shown in table 6.2.3.2-I to minimize fuel consumption and emissions.

Engine Speed Condition	L35
Idle Speed - Auto Transmission	575 rpm
Idle Speed - Manual Transmission	525 rpm
Maximum Upshift	5200 rpm
Maximum Upshift Hysteresis	5200 rpm

Table 6.2.3.2 -I V 6 Speed Dynamic Range

- a) Operation at normal operating coolant temperature (Range : 80 -128 C)
- | | |
|----------------------------|-----------------|
| Maximum Transient (W.O.T.) | <u>5200 RPM</u> |
| Minimum Transient (W.O.T.) | <u>600 RPM</u> |
| Instantaneous Maximum | <u>5200 RPM</u> |
| Continuous Maximum | <u>4600 RPM</u> |
- b) Operation at cold coolant temperature
Maximum @ - 28°C 4600 RPM
- c) Operation at hot coolant temperature
Maximum @ 128°C 4600 RPM

6.3 ENGINE LOAD

Sustained high engine loads (loads in excess of 90% of W.O. T. torque) should not be applied below peak torque - engine rpm, See paragraph 2.3.2.1.

Torque Fluctuations.

Torque Fluctuations at WOT, will not exceed a value of $\pm 5\%$ of the nominal torque value between 1000 RPM & max. rated speed.

Brake Specific Fuel Consumption

The engine brake specific fuel consumption (bsfc) shall be as follows:

1. The engines nominal brake specific fuel consumption point on a W.O.T. curve is shown in table 6.3 -I.
2. The engine nominal specific fuel consumption shown in table 7.3 -I are for an operating range between peak torque and maximum power at full load.
3. The engines best part throttle bsfc (on a fuel map) is shown in table 7.3 -I.

RPM	L35 Truck Applications	L35 Marine Applications	Notes
800	0.529	0.495	lb./BHP-Hr
1200	0.521	0.478	lb./BHP-Hr
1600	0.484	0.481	lb./BHP-Hr
2000	0.470	0.471	lb./BHP-Hr
2400	0.471	0.466	lb./BHP-Hr
2800	0.469	0.472	lb./BHP-Hr
3200	0.478	0.458	lb./BHP-Hr
3600	0.483	0.452	lb./BHP-Hr
4000	0.500	0.460	lb./BHP-Hr
4400	0.525	0.479	lb./BHP-Hr
4800	0.532	0.506	lb./BHP-Hr
5200	0.556	0.550	lb./BHP-Hr

Table 6.3 -I V6 4.3L Engine BSFC

Engine Brake Capacity

FMVSS requires engine braking in at least one of the lower ratios, below 25mph.

For a transmission type similar to the 4L60-E this is equivalent to 2nd gear. For another type of transmission combination the braking capability should be verified.

For manual transmissions, engine braking is calibrated with the GM transmissions to occur in the highest ratio in each forward selector range

Some off road applications or very heavy load situations might require additional subsystems to increase engine brake capacity.

Depending on the application, the GM release engineer and the customer will determine the necessity of auxiliary or additional engine brake aid sub systems.

6.4 OIL & CRANKCASE VENTILATION

Ambient Operating Temperature

-30°C to 128°C:use SAE 5W-30

Oil Quality: Use oil that meets the CF-2 quality standards of the API

Crankcase Ventilation

Pcv Positive Crankcase Ventilation is used in the 4.3L V6 90 Degree.

6.5 COOLANT:

Coolant (See 3.5 Cooling/Heater)

Ethylene Glycol water mix 52/48 (normal) up to maximum of 60% glycol, 40% water

Coolant Temperature: See Section 3.5

Coolant Pressure: See Section 3.5

Warm-Up Rate: See Section 2.3.2.3.4

6.6 COMBUSTION CONTROL

All combustion controlled parameters are adjusted automatically through the PCM

7.0 QUALITY, RELIABILITY, & DURABILITY (QRD)**7.1 QUALITY AND RELIABILITY**

Minimum Level of warranty is 12 month and 12000 miles, but there are available alternative warranty plans throughout the GMPT and GM Service Group.

7.2 DURABILITY - USEFUL LIFE

Useful Life Definition		
Usage	Mileage	Years
4.3L (Light Duty) Unleaded Fuel	120,000	10

8.0 SERVICE REQUIREMENTS

8.1 MAINTENANCE SCHEDULES (SEVERE USAGE AND NON SEVERE USAGE).

There are two maintenance schedules applicable to the 4.3L V6 90 Degree Engine. These maintenance schedules relate to severe usage and non-severe usage.

8.1.1 Maintenance Schedules - Severe Usage (Schedule I)

Severe usage or short trip/city shall continue to be defined by the following description of typical operation in the vehicle's owner's manual:

- Most trips are less than 4 miles (6km);
- Most trips are less than 10 miles (16km), and the ambient temperature is below freezing
- The engine is at low speed most of the time (door to door delivery, stop and go traffic, commercial use)
- The vehicle is operated in dusty areas or off road frequently;
- The vehicle is used to tow a trailer

8.1.2 Maintenance Schedule - Non Severe or Long Trip/Highway Usage (Schedule II)

Long trip/highway shall continue to be defined in the vehicle owner's manual as all typical vehicle usage not defined to be included in the severe usage schedule.

8.2 SERVICE INTERVAL BY SCHEDULE

The service intervals for engine related service are defined in Table 8.2 - 1 as a function of vehicle usage category, i.e. short trip/city usage or long trip/ highway usage.

Table : 8.2 - I Routine Service Interval by Usage				
Item	Schedule I (<8500 GVWR)	Schedule II (<8500 GVWR)	Schedule 1 (>8500 GVWR)	Schedule II (>8500 GVWR)
Engine Oil and Filter	3000 miles/3 month Or on condition detected by oil quality monitoring system	7500 miles/12months Or on condition detected by oil quality monitoring system	3000 miles/3 month Or on condition detected by oil quality monitoring system	7500 miles/12months Or on condition detected by oil quality monitoring system
Engine Coolant	50000 miles	50000 miles	50000 miles	50000 miles
Air Cleaner Filter	30000 miles	30000 miles	24000 miles	24000 miles
Spark Plug	100000 miles	100000 miles	100000 miles	100000 miles
Engine Wire ASM	100000 miles	100000 miles	100000 miles	100000 miles
Accessory Drive Belt	100000 miles	100000 miles	100000 miles	100000 miles

9.0 DIAGNOSTICS

Diagnosis shall be accomplished using industry standard electronic diagnosis tools such as Techline Equipment (Tech 1/Tech 2 / Tech XS / CAMS).

10.0 OTHER AVAILABLE DOCUMENTS

The Application engineer will supply all technical documents needed to support the application and validation process.

11.0 VALIDATION REQUIREMENTS

11.1 GENERAL

The validation of GM Powertrain units may follow a wide variety of validation procedures. GMPT will participate with the customer in establishing the validation procedure needed to validate the application of the V6 Gasoline Engine into the customer vehicle.

11.2 METHODS

When required, The GM Application and the Customer Release Engineer will determine a method of design validation from the four acceptable methods listed below.

- A: Validation by Analysis:
- 1) *Simulation* of the product (or its functions) or manufacturing process and the specified conditions *using mathematical representation* (math models, algorithms, equations, etc.), in accordance with a procedure, and documenting the results to ensure that a particular requirement has been met.
 - 2) The generation of conclusions through the *examination of known data* to ensure that a particular requirement has been met.
- I: Validation by Inspection: *Examination* of the product or manufacturing process, in accordance with a procedure, and documenting specified *physical characteristics* to ensure that a particular requirement has been met.
- D: Validation by Demonstration: *Exercising* the product or manufacturing process under specified conditions, in accordance with a procedure, and documenting the results to ensure that a particular requirement has been met.
- T: Validation by Test: *Exercising* the product or manufacturing process under specified conditions, in accordance with a procedure, *collecting quantitative data via instrumentation* and documenting the results to ensure that a particular requirement has been met.

11.3 VALIDATION DETAILS

Inspection and testing will be required to demonstrate that each V6 Gasoline Engine application is adequate for the duty cycle and life demanded by the end user. This will take place as part of the initial release process, and for significant changes to either the engine, transmission or vehicle systems. Validation Methods of each application of the V6 4.3L Gasoline Engine will be applied at minimum to the following issues:

11.3.1 Installation Review

The installation of the engine shall be validated and verified by comparison with the engineering drawings created by vehicle manufacturer.

11.3.2 Emissions Test

To be negotiated between GM and Customer

11.3.3 Cooling System Performance Test

Cooling Subsystem Performance Test must be approved by the GM application engineer.

11.3.4 Water Snow Inhalation Performance Test

Test shall be performed to verify water and or snow can not be ingested by the engine.

11.3.5 Design Review/ Mockup

During the design installation process of the V6 Gasoline Engine into a vehicle, the GM Application Engineer will indicate those areas that need design validation prior to construction.

11.3.6 Underhood Temperature Measurements and Locations

Locations and Results performed by vehicle manufacturer shall be supplied to GMPT Application Engineer

11.3.14 On Road Vehicle Test

This test will reflect performance requirements for speed, load, torque, power, and performance of cooling system.

GMPT Application Engineer will provide vehicle level test specifications to the vehicle manufacturer.

The vehicle manufacturer will execute physical test and provide test results approval by GMPT Application Engineer.

12.0 NOTES**12.1 ACRONYMS, ABBREVIATIONS, AND SYMBOLS**

adv	advance	CAD	Computer Aided Design
A/F	Air -Fuel ratio	CFR	Cooperative Fuel Research
AIR	Air Injection Reaction	COE	Council of Expertise
ASTM	American Society for Testing Materials	Corr	corrected
API	American Petroleum Institute	COV	coefficient of variation
ATDC	after top dead center	CR	compression ratio
avg	average	CR _{eff}	effective compression ratio
ACG	Allied Component Group	Cyl	cylinder
		CEA	Change Engineering Authorization
B	barometric pressure	CNG	Compressed Natural Gas
BMEP	brake mean effective pressure		
BP	brake power		
BSFC	brake specific fuel	D	density
BSHC	brake specific hydrocarbons	Deg	Degree
BSHR	brake specific heat rejection	Dia	diameter
BSCO	brake specific Carbon Monoxide		
BSPM	brake specific Particulate Mass		
BSNO _x	brake specific NO _x (oxides of nitrogen)		
BTDC	before top dead center		
E	engine displacement	N	polytropic compression coefficient
ECM	Electronic Control Unit	N	Engine Speed
econ	economy	N ₂	Nitrogen
EEC	European Economic Community	NAO	North American Operations
EFE	Early Fuel Evaporation	N/V	Engine Speed/Vehicle Speed
eff	efficiency	NMEP	Net Mean Effective Pressure
EFI	Electronic Fuel Injection	NMOG	Non Methane Organic Gas
EGR	Exhaust Gas Recirculation	No.	number
EPA	Environmental Protection Agency		
ESC	Electronic Spark Control		
exh	Exhaust		
exp	experimental	Obs	observed
		O/C	Oxygen-Carbon ratio
FMEP	Friction Mean Effective Pressure	OD	outside diameter
FP	Friction Power		
FESM	Front End Sheet Metal	P	Power
FMVSS	Federal Motor Vehicle Safety Standards	PCV	Positive Crankcase Ventilation
		PFI	Port Fuel Injection
GM	General Motors	PMEP	Pumping Mean Effective Pressure
GMPT	General Motors Powertrain	PN	Part Number
GMTG	General Motors Truck Group		
GPA	Gas Processors Association Program	PON	Pump Octane Number
GVWR	Gross Vehicle Weight Rating	PP	Peak Pressure
GMUTS	General Motors Uniform Test Specifications	PT	Part Throttle
GPH	Gallons Per Hour	PCM	Powertrain Control Module
		P/S	Power Steering
HC	hydrocarbon	PTO	Power Take-Off
H/C	Hydrogen-Carbon ratio		
Hz	Hertz (frequency)	QFD	Quality Function Deployment
IPTV	Initial Defects Per Thousand Vehicle	R	Torque Scale Arm
IAC	Idle Air Control	RAT	Radial Aperture Tube
ID	inside diameter	Rev	revolution
IMEP	Indicated Mean Effective Pressure	RLP	Road Load Power
int	Intake	RON	Research Octane Number
IP	Indicated Power	RPO	Regular Production Option
ISC	Idle Speed Control	RTD	Resistive Temperature Detector
ISO	Interl. Orgn. for Standardization	RVP	Reid Vapor Pressure
		RPM	Revolutions Per Minute
KT	Knock threshold		

L	stabilized dynamometer load	VTS	Vehicle Technical Specification
LBT	Leanest Mixture for Best Torque	VDP	Vehicle Development Process (4-Phase)
LFE	Laminar Flow Element	VCM	Vehicle Control Module
LPG	Liquefied Petroleum Gas	VE	Volumetric Efficiency
LPP	Location of Peak Pressure	WOT	Wide Open Throttle
		WVRM	World Vehicle Regulation Manual
MAP	Manifold Absolute Pressure	SAE	Society of Automotive Engineers
max	maximum	ser no.	serial number
MBT	Minimum Spark Advance for Best Torque	sg	specific gravity
ME	Mechanical Efficiency	SI	International System of Units
MEP	Mean Effective Pressure	std	standard
m(a)	air mass flow rate	SSTS	Subsystem Technical Specification
m(f)	fuel mass flow rate	T	Torque
MMEP	motoring Mean Effective Pressure	TBI	Throttle Body Injection
MON	Motor Octane Number	TDC	Top Dead Center
MT	Motoring Torque	TPS	Throttle Position Sensor
MIL	Malfunction Indicator Lamp	TM	Torque Management
		TWO	Test Work Order

APPENDIX I

Engine-Vehicle Definition Form				UNITS
VEHICLE PERFORMANCE REQUIREMENTS				
Maximum Speed on 1st Gear				mph
Maximum Speed on 2nd Gear				mph
Maximum Speed on 3rd Gear				mph
Maximum Speed on 4 th Gear				mph
Maximum Speed on 5 th Gear				mph
Maximum Speed on Highway				Mph
Body type				
Body Cx				
Body Width				Ft
Body Height				Ft
Body Length				Ft
Body Frontal Area				Sq. ft
Curb Weight				Lbs
Gross Weight				Lbs
Total weight				Lbs
Maximum Acceleration (0-60mph)				
Maximum Gradient				%
CHASSIS				
Single Axle Single Speed Ratio				
Single Axle Double Speed - Low Ratio				
Single Axle Double Speed - High Ratio				
Tandem Axle Single Speed Ratio				
Tandem Axle Double Speed - Low Ratio				
Tandem Axle Double Speed - High Ratio				
Driveline Efficiency				
Single Axle Single Speed				
Single Axle Double Speed				
Tandem Axle Single Speed				
Tandem Axle Double Speed				
Wheelbase				in
Tire Specification				
Tire Footprint Development				ft
Tire Maximum Speed				rpm

Engine-Vehicle Definition Form				UNITS
TRANSMISSION				
Manual transmission				
1 st Gear Ratio				
2 nd Gear Ratio				
3 rd Gear Ratio				
4 th Gear Ratio				
5 th Gear Ratio				
6 th Gear Ratio				
Automatic transmission				
1 st Gear Ratio				
2 nd Gear Ratio				
3 rd Gear Ratio				
4 th Gear Ratio				
5 th Gear Ratio				
6 th Gear Ratio				
Accessories				
Accessory #1:				
Accessory #1 Location:				
Accessory #1 Type Drive:				
Accessory #1 Hp required:				
Accessory #2:				
Accessory #2 Location:				
Accessory #2 Type Drive:				
Accessory #2 Hp required:				
Accessory #3:				
Accessory #3 Location:				
Accessory #3 Type Drive:				
Accessory #3 Hp required:				
Accessory #4:				
Accessory #4 Location:				
Accessory #4 Type Drive:				
Accessory #4 Hp required:				
Vehicle Power & Torque Requirements For Maximum Grade Speed (MPH)	Rolling Power Requirements K W V (1+ f)/ 375 hp	Grade Power Requirements G W V / 375 (100) hp	Aerodyn. Power Requirements 0.00256 C A V³ hp	Total Power Hp
10				
15				
20				
25				
30				
35				
40				
45				
Power for maximum Grade				
Torque for maximum Grade				

Engine-Vehicle Definition Form				UNITS
TRANSMISSION				
Manual transmission				
1 st Gear Ratio				
2 nd Gear Ratio				
3 rd Gear Ratio				
4 th Gear Ratio				
5 th Gear Ratio				
6 th Gear Ratio				
Automatic transmission				
1 st Gear Ratio				
2 nd Gear Ratio				
3 rd Gear Ratio				
4 th Gear Ratio				
5 th Gear Ratio				
6 th Gear Ratio				
Accessories				
Accessory #1:				
Accessory #1 Location:				
Accessory #1 Type Drive:				
Accessory #1 Hp required:				
Accessory #2:				
Accessory #2 Location:				
Accessory #2 Type Drive:				
Accessory #2 Hp required:				
Accessory #3:				
Accessory #3 Location:				
Accessory #3 Type Drive:				
Accessory #3 Hp required:				
Accessory #4:				
Accessory #4 Location:				
Accessory #4 Type Drive:				
Accessory #4 Hp required:				
Vehicle Power & Torque Requirements For Maximum Grade Speed (MPH)	Rolling Power Requirements K W V (1+ f)/ 375 hp	Grade Power Requirements G W V / 375 (100) hp	Aerodyn. Power Requirements 0.00256 C A V³ hp	Total Power Hp
10				
15				
20				
25				
30				
35				
40				
45				
Power for maximum Grade				
Torque for maximum Grade				

Engine-Vehicle Definition Form				UNITS
Vehicle Power & Torque Requirements For Maximum Speed Speed (MPH)	Rolling Power Requirements K W V (1+ f)/ 375 hp	Grade Power Requirements G W V / 375 (100) hp	Aerodyn. Power Requirements 0.00256 C A V ³ hp	Total Power hp
10				
20				
30				
40				
50				
60				
70				
80				
90				
100				
Power for maximum Speed				
Torque for maximum Speed				
Vehicle Cooling System				
Radiator:	Make:	M/N # :	P/N:	
Size:	Height:	Width:	Thickness:	
Number of Rows of Tubes:	Fins/In.			
Minimum Radiator Frontal Area				Sq. Meter
Radiator Total Area				Sq. Meter
Radiator Heat Evacuation Capacity				BTU/Min
Maximum Radiator Coolant Flow				GPM
Maximum Radiator Peak Pressure				bar
Radiator Coolant inlet Size				mm
Radiator Coolant Outlet Size				mm
Surge Tank	Make:	M/N # :	Location:	
	Capacity:	Hose Size:		
Deaeration Tank	Make:	M/N # :	Location:	
	Capacity:	Hose Size:		
Recovery Bottle	Make:	M/N # :	Location:	
	Capacity:	Hose Size:		
Low Coolant Sensor Type				
Low Coolant Sensor Location				
Describe Deaeration System:	Lines Sizes:	Location:		
Describe obstruction to water flow:				
Vehicle Heater Core:	Make:	Type:	Location:	
Auxiliary Heaters:	Make:	Type:	Location:	
Shutoff or By-Pass Valve:				
Air Bleeds:				Sq. Meter
Heater Hose Routing:				Sq. Meter
Fan	Make:	M/N#:	Max. Speed:	
Fan Type:				
Fan Drive	Solid/Viscous	Clutch:	Drive Ratio:	
Suction / Blower Diameter	Blades #			
Vehicle Electrical System				
Battery	Make:	M/N # :	Location:	
	Voltage	Amperage		Ambient
	Voltage	Amperage		Cold

Engine-Vehicle Definition Form				UNITS
Alternator	Make:	M/N # :	Location:	Nominal
	Voltage	Amperage		
Starter	Make:	M/N # :	Location:	Nominal
	Power:	Amperage:		
Vehicle Oil System				
Remote Filter:	Type:	Capacity:		
Location & Measured height relative to bottom of cylinder block				
Oil Radiator Capacity				
Radiator Number of Rows				
Radiator Number of Tubes				
Minimum Radiator Frontal Area				Sq. Meter
Radiator Total Area				Sq. Meter
Radiator Heat Evacuation Capacity				BTU/Min
Maximum Radiator Coolant Flow				GPM
Maximum Radiator Peak Pressure				bar
Radiator Coolant inlet Size				mm
Radiator Coolant Outlet Size				mm
Vehicle Fuel System				
Fuel Tank	Material:	Type:	Capacity:	
Fuel Lines Inlet	Size:	Length;	Material:	
Fuel Lines Return	Size:	Length;	Material:	
Height of Fuel Tank to Fuel Pump				
Fuel Tank Cap Relief Pressure				
Fuel Supply Pump				
Type	Make:	Pressure:	Flow:	
Inlet Restriction @ Pump				
Additional Comments				
Air System				
Air Cleaner	Make:	Type:	Model:	
Cleaner location	Size:	Length:	Material:	
Air Inlet Restriction	@FL/NL:			
Vehicle Exhaust System				
Type : Single/Dual Pipe	Size:	Material:	Make:	
Muffler:	Size:	Material:	Make:	
Muffler/ Pipe Connection:	Location:	Flex / Solid:		
Catalytic Converter	Size:	Material:	Make:	
	@FL/NL:	Location:		
Exhaust Back Pressure	@FL/NL:	Location:		

PREFACE

This document will assist the reader in the application of the 4.3L V6 90 Degree Engine to the vehicle. It gives an overview of the engine, its features, as well as focus on the systems, subsystems and attachments that interface between the engine and the vehicle.

The performance of the 4.3L V6 90 Degree Engine is dependent on the design and processing of the interface systems and their components.

Definitions:

The number between bracket shows the Specification level.

VTS: Vehicle Technical Specification. Level (1) SSTS.

Powertrain SSTS: Powertrain Subsystem Technical Specification. Level (2) SSTS.

Composed of Engine, Transmission and Controls, Similar to the other NAO Major Technical Subsystems, like Electrical, HVAC, Chassis, Body, etc.

Engine SSTS: Engine Subsystem Technical Specification. Level (3) SSTS.

Transmission SSTS: Transmission Subsystem Technical Specification. Level (3) SSTS.

Controls SSTS: Controls Subsystem Technical Specification. Level (3) SSTS.

Cylinder Head SSTS: Cylinder Head Subsystem Technical Specification. Level (4) SSTS.

Piston CTS: Piston Component Technical Specification. Level (5) SSTS.

ACE: Assistant Chief Engineer, AE: Application Engineer, DRE: Design Release Engineer, PTVSE: Powertrain Vehicle System Engineer.

The Word Subsystem is used in this context to indicate that a System Level (2) is part of a major System Level (1).

The diagram 1.1 - I shows the scope of this specification with a dot line around the subsystems in which it place precedence.

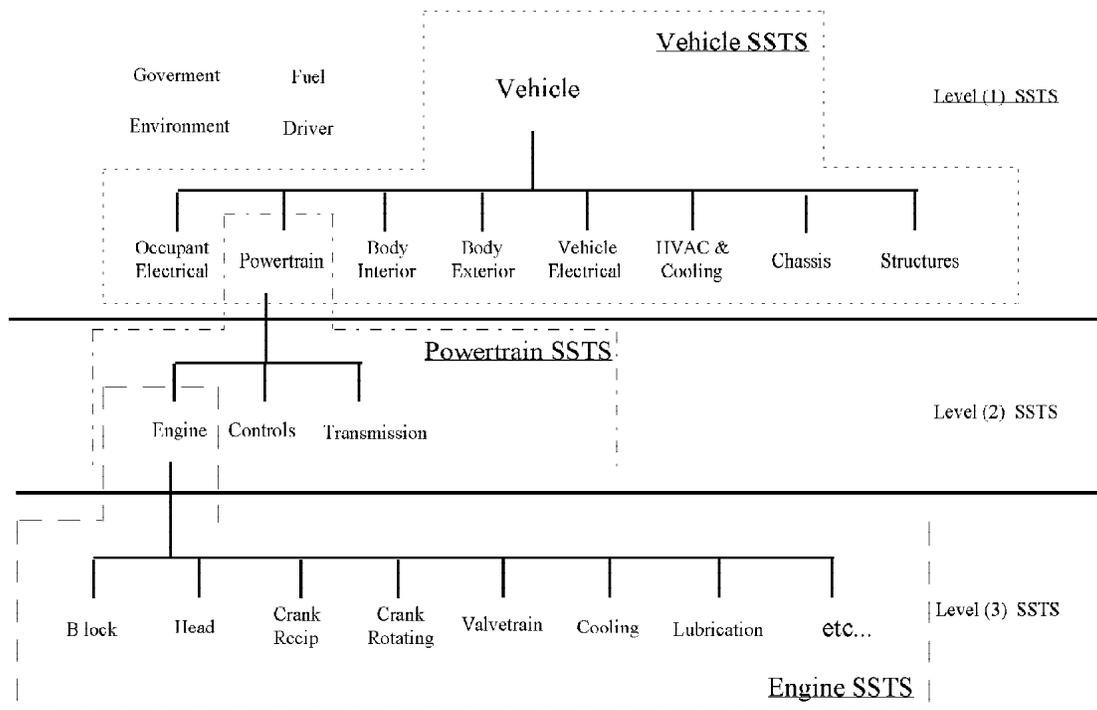


Diagram 1.1-I Powertrain SSTS scope of work

GM Powertrain needs a thorough understanding of each application for the 4.3L V6 90 Degree Engine, including for example, vehicle mass, transmission performance details, vehicle speed and grade as well as vehicle cooling and air intake capabilities.

The OEM customer shall submit a completed “ Model Definition Form”, supplied by GM Powertrain at the start of each project or equivalent “ Vehicle Powertrain Technical Requirement Specification” for each project.

A sample form of the former appears as a supplement to this manual. (See Appendix I)

This data from the Model Definition Form, and the requirements contained within this manual, will be used to generate an agreed specification for the complete 4.3L V6 90 Degree Engine.

All the dimensions and values in this manual are for reference only.

Refer to the appropriate 4.3L V6 90 Degree Engine installation drawing(s) for definitive information.

The following table summarizes the organization of the document.

Section	Comments
1.0 Introduction	
2.0 Product Summary	Summarizes the Product Information, Provides Feature Location Illustrations, and Characterizes the Engine Content as Delivered.
3.0 Major System and Interface Descriptions	Provides the “context” the Engine Operates Within.
4.0 Vehicle Mounting and Packaging	Details Mounting and Packaging.
5.0 Detailed Performance Description	Provides Details on the Performance of the Engine as an Overall System.
6.0 Operating Environment	Details the Intended Operating Environment.
7.0 Recommended Usage Constraints	Provides Cautions and Limits for Intended Usage.
8.0 Quality, Reliability, and Durability	Details Design Intent QRD Performance.
9.0 Service Requirements	Details Service Intervals and Service Parts.
10.0 Diagnostics	Details Supported Diagnostics and Procedures
11.0 Other Available Documents	Provides References to Related Documentation.
12.0 Validation Requirements	Details Validation processes
13.0 Notes	Defines Terms used in Manual.
Appendix I	Engine – Vehicle Definition Form

TEMPLATE OWNERS

Name	Gasoline 4.3L V6 90 Degree Team : Title/Affiliation	Date Approved
Ron Meegan	GMPT Total Integration Engineer L35	
Frank Tenkel	GMPT Application Engineering	
Luis Nespolo	GMPT Application Engineering	
Jeremy Worm	GMPT System Engineering	

REVISION LOG

Revision Date	Document ID	Revision Description	Paragraphs Affected
7/21/00	Engine Application Manual 2001 4.3L V6 90Degree	Revision 0 - Document Issued	All

TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 PRODUCT SUMMARY	1
2.1 APPEARANCE1	
2.2 FEATURES 1	
2.3 PRODUCT SPECIFICATION SUMMARY	2
2.3.1 SPECIFICATION	2
2.3.2 Fuel Requirements	6
2.3.2 Performance	7
2.3.2.1 Engine Power & Torque	7
2.4 FEATURE LOCATION ILLUSTRATIONS	7
2.5 CONFIGURATION AS SHIPPED	10
2.5.1 Engine as Shipped	10
2.6 IDENTIFICATION AND MARKING	10
2.6.1 VIN Identification Labeling	10
2.6.2 Emissions Certification Labeling	10
2.6.3 Engine Identification - Broadcast Codes	10
2.6.3.1 Engine Option Description	11
2.6.3.2 Engine Broadcast Codes & Part Numbers	12
3.0 GMPT SYSTEM INTERFACES	13
3.1 INTERNAL INTERFACES TO GMPT	13
3.1.1 Engine Interface to transmission	13
3.1.1.1 Automatic Transmission	13
3.1.1.2 Manual Transmission and Clutch	13
3.1.2 Engine Interface to PCM (Vehicular and Marine/Industrial Application)	15
3.1.2.1 Inputs from the Engine to the PCM	15
3.1.2.2 Outputs from PCM to the Engine	15
3.1.3 PCM Interface to Transmission	15
3.1.3.1 Input Algorithm	15
3.1.3.2 Shift Control Algorithm	15
3.1.3.3 Shift Quality Algorithm	15
3.1.3.4 TCC Control Algorithm	16
3.1.3.5 Inputs from Transmission to PCM	16
3.1.3.6 Output to the Transmission from PCM	16
3.1.4 PCM Interface to Vehicle	16
3.1.4.1 External Inputs of the Engine	16
3.1.4.2 Output to the Vehicle	16
3.1.5a PCM Pin Out and Pin In – Truck Applications	17
3.1.5b PCM Pin Out and Pin In – Marine and Industrial Applications	20
3.1.6 Engine interface to exhaust	22
3.1.6.1 Content	22
3.1.6.2 Back Pressure	24
3.1.6.3 Packaging	24
3.1.6.4 Exhaust Gas Recirculation (EGR)	24
3.1.6.5 Secondary Air	24
3.1.7 Engine Interface to Cruise Control	25
3.1.8 Accelerator Pedal	25
3.1.9 Engine to Evaporative Fuel System	25
3.1.10 Accessory Drive System	26
3.1.11 Standard Accessory Descriptions	26
3.1.12 Cooling Fan	26

3.1.13	Alternator	26
3.1.14	Power Steering Pump	26
3.1.15	AC Compressor	26
3.1.16	Crank Shaft Nose Load	26
3.2	INTERFACES WITH VEHICLE SUBSYSTEMS.....	28
3.2.1a	GMPT interface with Electrical Supply System-Truck Application	28
3.2.1b	GMPT interface with Electrical Supply System- Marine and Industrial Application	46
3.2.2	GMPT interface with Electrical Starting System	48
3.2.3	GMPT interface with CHASSIS BRAKE ABS System	48
3.2.4	GMPT Interface with HVAC System.....	49
3.2.4.1	Fan Cooling System	49
3.2.4.2	Coolant Properties.....	50
3.2.4.3	Coolant Radiator (Recommended Minimum Values)	50
3.2.4.3.1	Heater Performance	50
3.2.4.3	Operating Conditions and Measures.....	51
3.2.4.3.1	Heat Rejection.....	51
3.2.4.3.2	System Pressure	51
3.2.4.3.3	Coolant Operating Temperatures	52
3.2.4.3.4	Flow Rates	52
3.2.4.3.5	Coolant Fill	53
3.2.4.4	Coolant and Heater Subsystem Descriptions	54
3.2.4.4.1	Coolant Inlet- Water Pump Inlet Restriction.....	54
3.2.4.4.2	Coolant Outlet-	54
3.2.4.4.3	Heater Feed-	54
3.2.4.4.4	Heater Return.....	54
3.2.4.4.5	Coolant Hose Material.....	54
3.2.4.4.6	Hose Clamps.....	54
3.2.4.4.7	Thermostat	54
3.3.1	GMPT Interface with CHASSIS Fuel System.....	55
3.3.2	GMPT interface with Air Induction System.....	57
3.3.2.1	Air Requirement.....	57
3.3.2.2	Air Flow Path	57
3.3.2.4	Temperature Rise	58
3.3.2.4	Filtration Requirements	58
3.3.3	GMPT Interface with Oil Cooling Subsystem	59
3.3.3.1	Oil Cooler Requirements -	59
3.3.4	GMPT Interface with Chassis Engine Mountings.....	60
3.3.4.1	Engine Packaging Dimensions.....	60
3.3.4.2	Recommended Installation Angles	60
3.3.4.2.1	Recommended Side View Angle.....	60
3.3.4.2.2	Recommended Front View Angle.....	60
3.3.4.2.3	Recommended Plan View Angle.....	60
3.3.4.3	Rear Face of Block Configuration	61
3.3.4.4	Ground Clearance	61
4.0	DETAILED PERFORMANCE DESCRIPTION	63
4.1	EXHAUST AND EVAPORATIVE EMISSIONS	63
4.1.1	EPA Certification.....	63
4.1.2	CARB Certification	63
4.1.3	Other Regulations	63
4.1.3.1	Onboard Diagnostics	64
4.1.3.2	Applicability.....	64
4.1.3.3	Requirements	64

5.0 OPERATING ENVIRONMENT	65
5.1 ROADWAY GRADES, SURFACES AND HAZARDS	65
5.2 CRITICAL COMPONENT TEMPERATURE LIMITS	65
5.3 HUMIDITY, RELATIVE HUMIDITY (SEE CHART 5.2-1).....	66
5.4 PRESSURE (SEE CHART 5.2-1).....	66
5.5 UNDERHOOD/UNDERBODY CAR WASH.....	66
5.6 FORDING	66
5.7 SAND AND DUST EXPOSURE	66
5.8 GRAVEL AND STONE CHIP EXPOSURE	66
5.9 OZONE EXPOSURE	66
5.10 ELECTROMAGNETIC ENVIRONMENT.....	66
5.11 SHOCK, IMPACT.....	66
5.12 VIBRATION POWERTRAIN BENDING.....	67
6.0 RECOMMENDED USAGE CONSTRAINTS.....	69
6.1 ENGINE PRE-CONDITIONING PRIOR TO NORMAL OPERATION.....	69
6.2 ENGINE SPEED.....	69
6.2.2 <i>Maximum Start Time.</i>	69
6.2.3 <i>Idle Quality (Speed and Stability)</i>	69
6.2.3.1 <i>Idle Stability</i>	69
6.2.3.2 <i>Idle Speed</i>	69
6.3 ENGINE LOAD	71
6.4 OIL & CRANKCASE VENTILATION.....	72
6.5 COOLANT:.....	72
6.6 COMBUSTION CONTROL.....	72
7.0 QUALITY, RELIABILITY, & DURABILITY (QRD)	72
7.1 QUALITY AND RELIABILITY	72
7.2 DURABILITY - USEFUL LIFE.....	72
8.0 SERVICE REQUIREMENTS	73
8.1 MAINTENANCE SCHEDULES (SEVERE USAGE AND NON SEVERE USAGE).....	73
8.1.1 <i>Maintenance Schedules - Severe Usage (Schedule I)</i>	73
8.1.2 <i>Maintenance Schedule - Non Severe or Long Trip/Highway Usage (Schedule II)</i>	73
8.2 SERVICE INTERVAL BY SCHEDULE	73
9.0 DIAGNOSTICS	73
10.0 OTHER AVAILABLE DOCUMENTS.....	73
11.0 VALIDATION REQUIREMENTS	75
11.1 GENERAL.....	75
11.2 METHODS.....	75
11.3 VALIDATION DETAILS.....	75
11.3.1 <i>Installation Review</i>	75
11.3.2 <i>Emissions Test</i>	75
11.3.3 <i>Cooling System Performance Test</i>	75
11.3.4 <i>Water Snow Inhalation Performance Test</i>	75
11.3.5 <i>Design Review/ Mockup</i>	75
11.3.6 <i>Underhood Temperature Measurements and Locations</i>	76
11.3.14 <i>On Road Vehicle Test</i>	76
12.0 NOTES.....	77
12.1 ACRONYMS, ABBREVIATIONS, AND SYMBOLS	77