

2002 ENGINE PERFORMANCE

System & Component Testing

INTRODUCTION

Before testing separate components or systems, perform procedures in BASIC DIAGNOSTIC PROCEDURES article. If system or component testing procedure is not cover in this article, and since many computer-controlled monitored components, or related control system circuits can set a trouble code if they malfunction, also perform procedures in appropriate SELF-DIAGNOSTICS article.

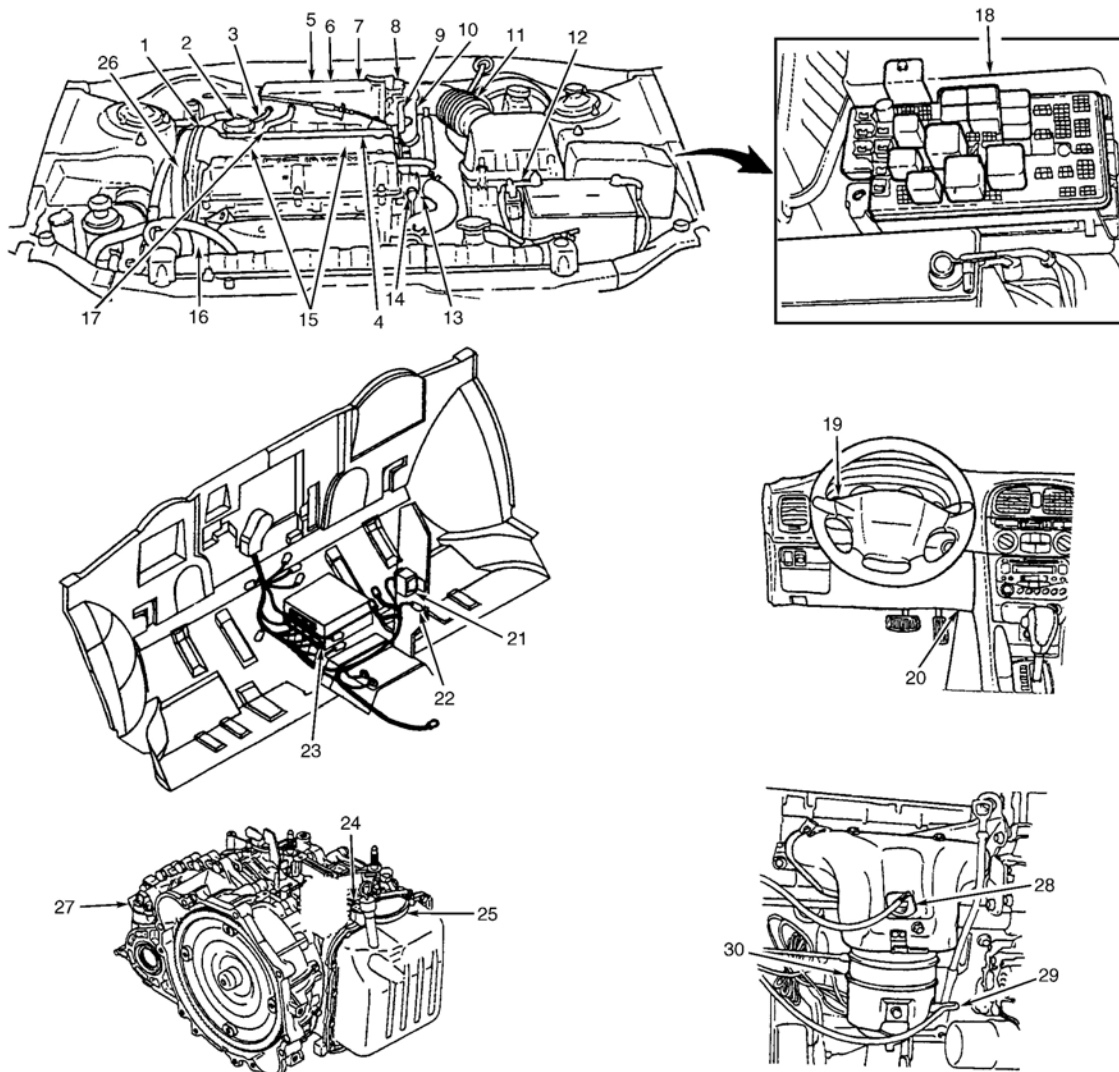
CAUTION: When battery is disconnected, vehicle computer and memory system may lose memory data. Driveability problems may exist until computer system have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

NOTE: Testing individual components does not isolate shorts or opens. Perform all voltage tests using a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless stated otherwise in test procedure. Use ohmmeter to isolate wiring harness shorts or opens.

NOTE: For assistance on component harness connectors wire color(s) and pin connector number(s), see appropriate wiring diagram under ENGINE PERFORMANCE in WIRING DIAGRAMS.

COMPONENT LOCATIONS

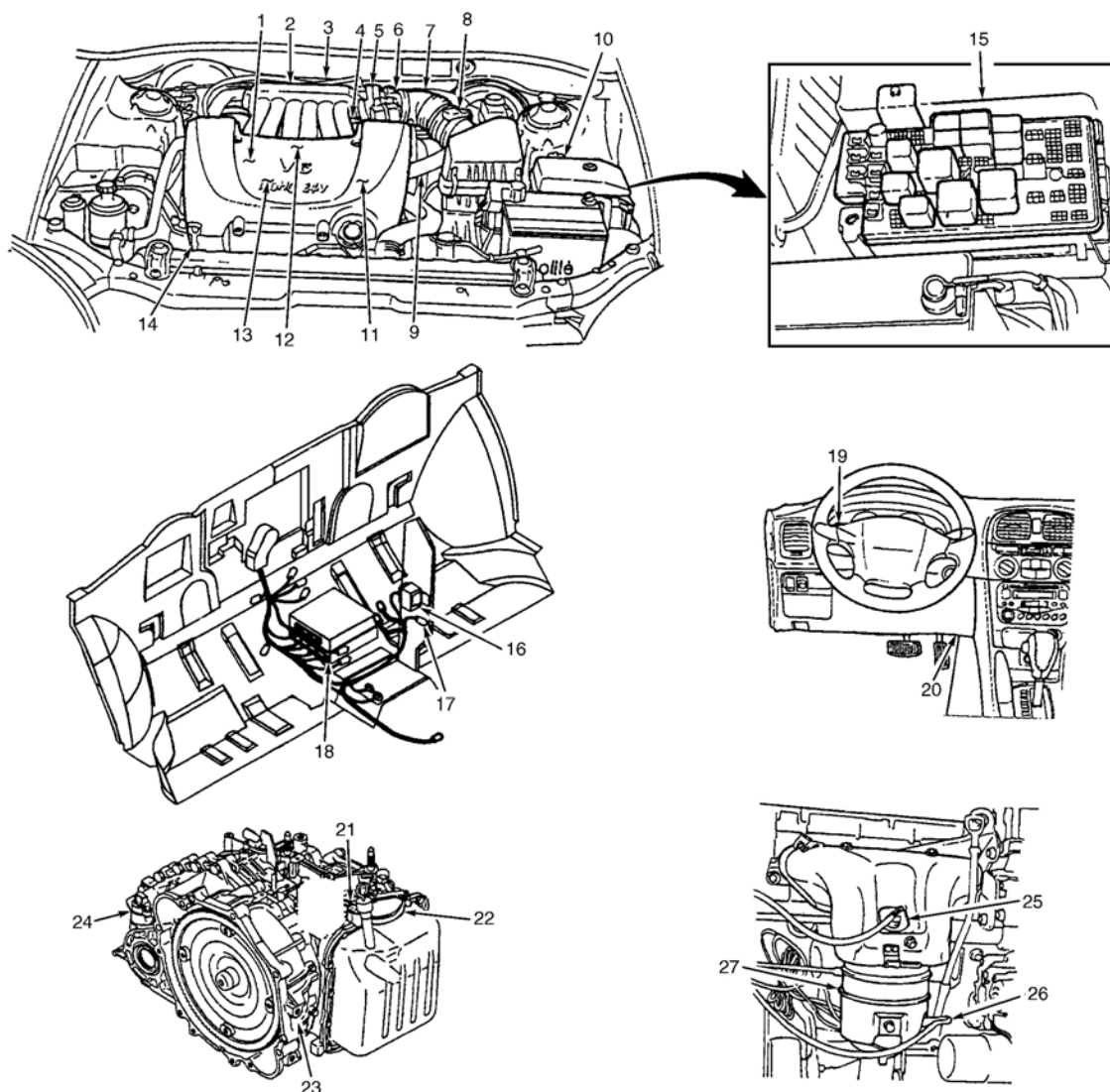
NOTE: For component locations on Optima, Rio, Sedona, Spectra and Sportage, see Fig. 1 -Fig. 6 .



- | | | |
|--|---|---------------------------------------|
| 1. Power Steering Switch | 11. Mass Air Flow (MAF) Sensor | 21. Engine Control Module (ECM) Relay |
| 2. Evaporative Canister Purge Solenoid (CPS) Valve | 12. Data Link Connector (DLC) | 22. Fuel Pump Relay |
| 3. Fuel Pressure Regulator | 13. Engine Coolant Temperature (ECT) Sensor | 23. Engine Control Module (ECM) |
| 4. Fuel Injector | 14. Camshaft Position (CMP) Sensor | 24. Solenoid Connector |
| 5. Manifold Absolute Pressure (MAP) Sensor | 15. Ignition Coils | 25. Transaxle Range (TR) Switch |
| 6. Exhaust Gas Recirculation (EGR) Solenoid Valve | 16. Crankshaft Position (CKP) Sensor | 26. Crankshaft Position (CKP) Sensor |
| 7. Knock Sensor | 17. Positive Crankcase (PCV) Valve | 27. Vehicle Speed Sensor (VSS) |
| 8. Throttle Position (TPS) Sensor | 18. Fuse & Relay Box | 28. Front Heated Oxygen Sensor (HO2S) |
| 9. Exhaust Gas Recirculation (EGR) Valve | 19. Malfunction Indicator Light (MIL) | 29. Rear Heated Oxygen Sensor (HO2S) |
| 10. Idle Air Control (IAC) Valve | 20. Data Link Connector (DLC) | 30. Warm-Up Catalytic Converter (WCC) |

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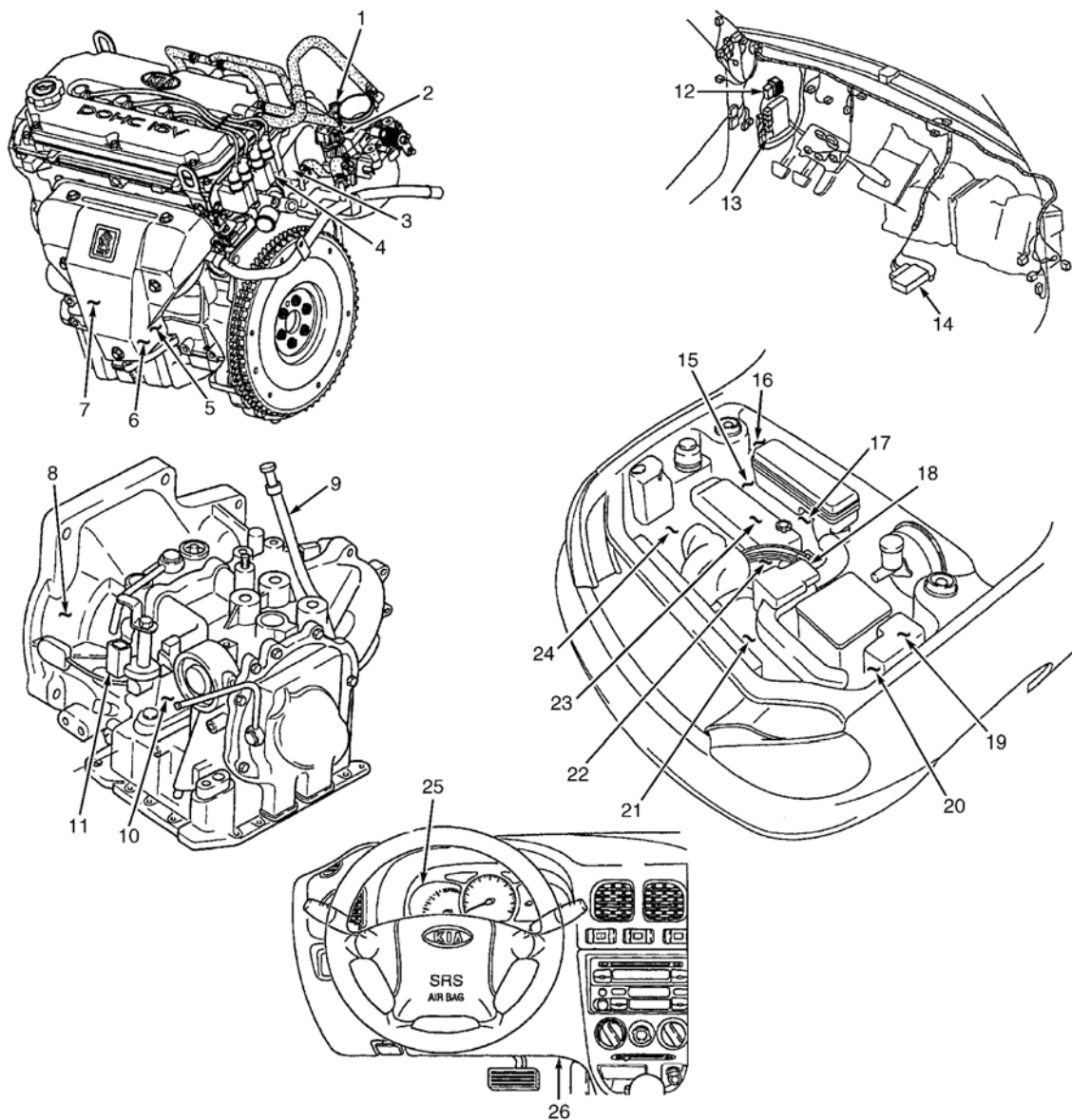
Fig. 1: Identifying Component Location (Optima 2.4L)
Courtesy of KIA MOTORS AMERICA, INC.



- | | | |
|--|--|---------------------------------------|
| 1. Fuel Injector | 10. Data Link Connector (DLC) | 19. Malfunction Indicator Light (MIL) |
| 2. Intake Air Temperature (IAT) Sensor | 11. Positive Crankcase Ventilation (PCV) Valve | 20. Data Link Connector (DLC) |
| 3. Evaporative Canister Purge Solenoid (CPS) Valve | 12. Knock Sensor | 21. Solenoid Connector |
| 4. Fuel Pressure Regulator | 13. Ignition Coil | 22. Transaxle Range (TR) Switch |
| 5. Throttle Position (TPS) Sensor | 14. Power Steering Switch | 23. Crankshaft Position (CKP) Sensor |
| 6. Idle Air Control (IAC) Valve | 15. Fuse & Relay Box | 24. Vehicle Speed (VSS) Sensor |
| 7. Camshaft Position (CMP) Sensor | 16. Main Relay | 25. Front Heated Oxygen Sensor (HO2S) |
| 8. Mass Air Flow (MAF) Sensor | 17. Fuel Pump Relay | 26. Rear Heated Oxygen Sensor (HO2S) |
| 9. Engine Coolant Temperature (ECT) Sensor | 18. Engine Control Module (ECM) | 27. Warm-Up Catalytic Converter (WCC) |

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Fig. 2: Identifying Component Location (Optima 2.7L)
Courtesy of KIA MOTORS AMERICA, INC.

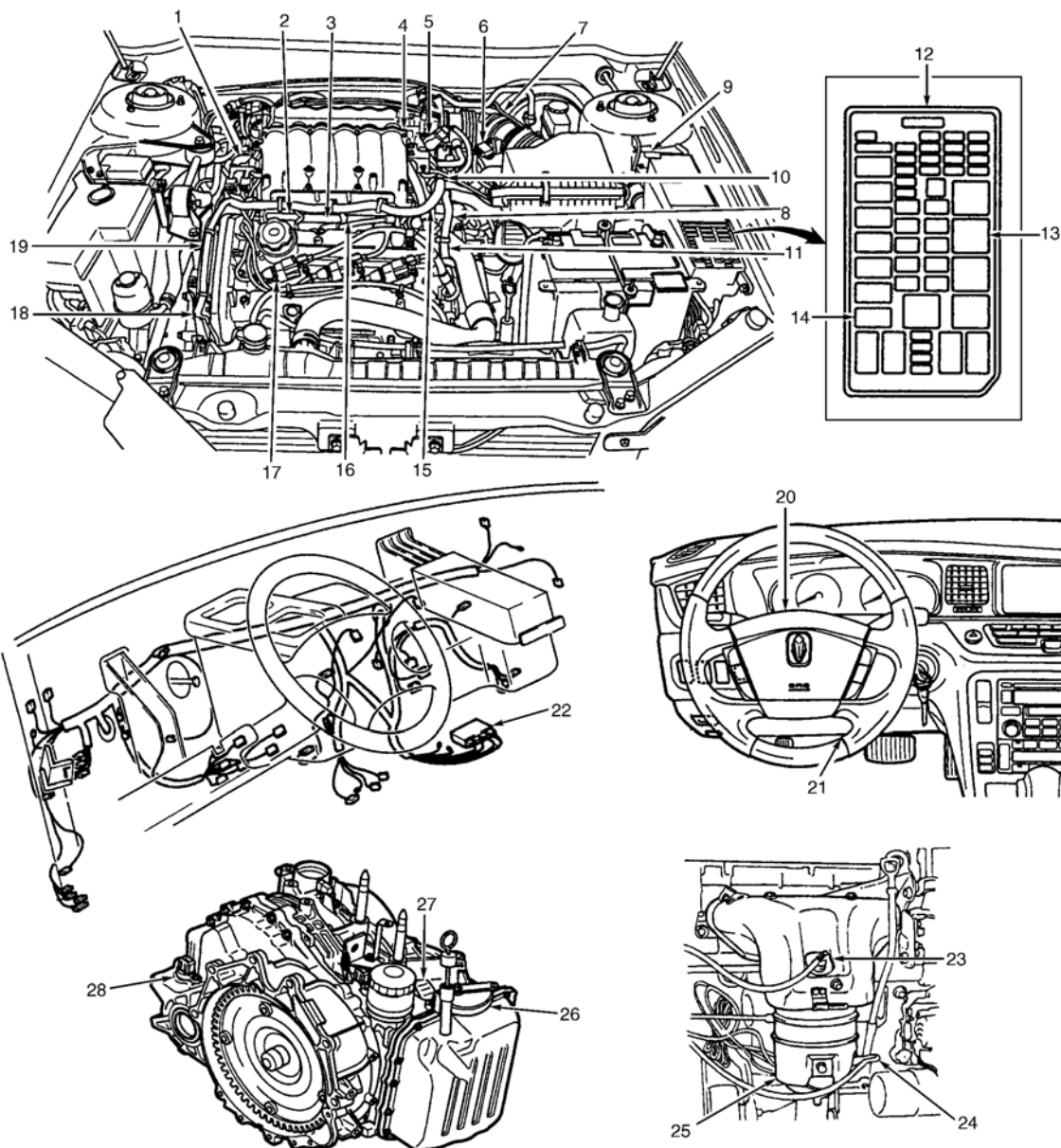


1. Throttle Position (TP) Sensor
2. Idle Air Control (IAC) Motor
3. Engine Coolant Temperature (ECT) Sensor
4. Ignition Coil (DIS)
5. Catalytic Converter
6. Rear Heated Oxygen Sensor (HO2S)
7. Front Heated Oxygen Sensor (HO2S)
8. Crankshaft Position (CKP) Sensor
9. Vehicle Speed Sensor (VSS)
10. Transmission Solenoid Valve Connector
11. Transmission Range Switch
12. Transmission Control Module (TCM) A/T Only
13. Engine Control Module (ECM)

14. Air Bag Control Module
15. Fuel Injectors/Fuel Rail
16. Evaporative Emission (EVAP) Purge Solenoid
17. Intake Air Temperature (IAT) Sensor
18. Volume Air Flow (MAF) Sensor Assembly
19. Main Fuse/Relay Box
20. Engine Speed Detection Connector (DLC)
21. Radiator Cooling Fan Assembly
22. Camshaft Position (CMP) Sensor
23. Knock Sensor (Located On Right Side Of Engine Block)
24. Power Steering Switch
25. Malfunction Indicator Light (MIL)
26. Data Link Connector (OBD-II)

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Fig. 3: Identifying Component Locations (Rio)
Courtesy of KIA MOTORS AMERICA, INC.



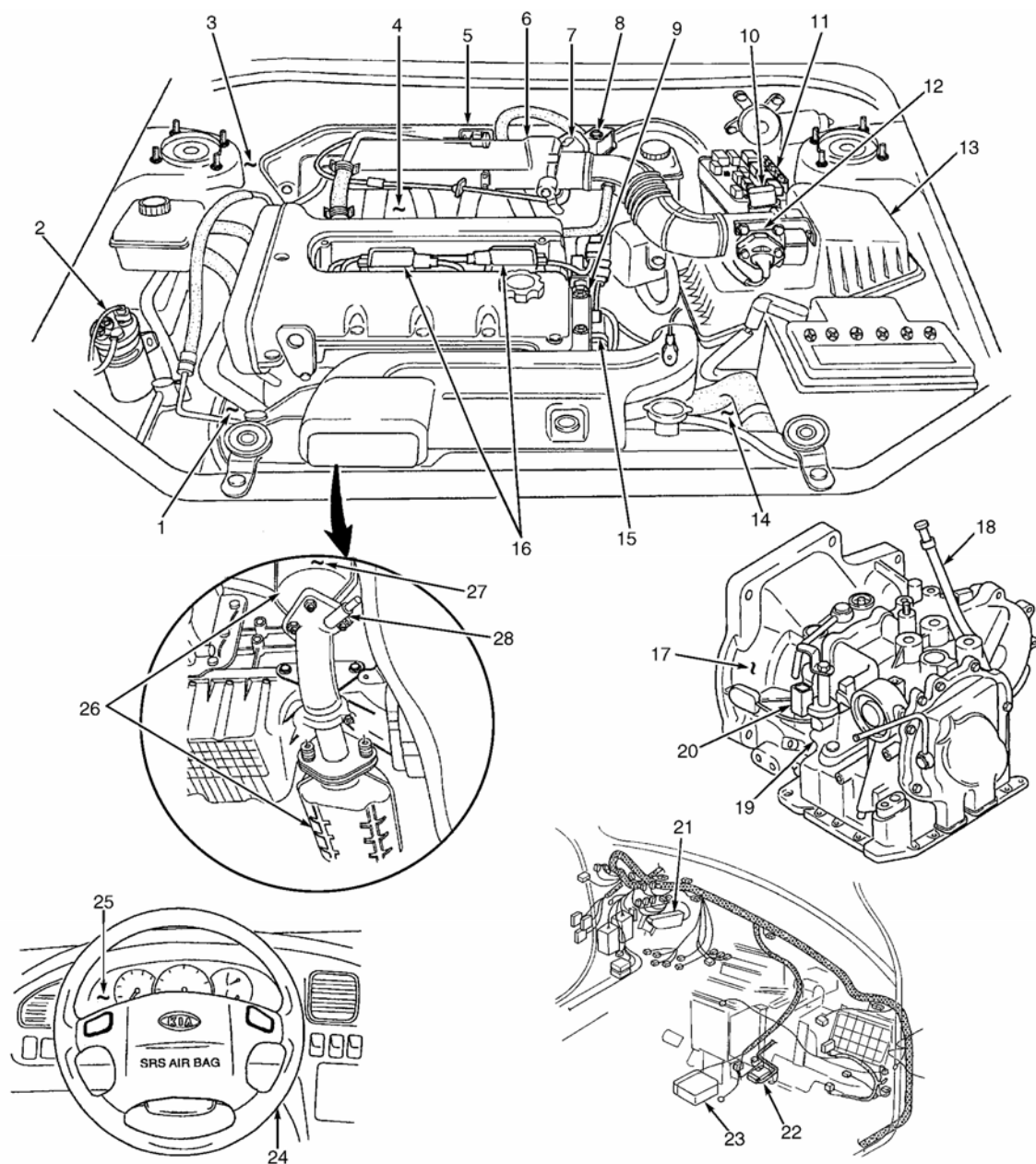
1. Power Steering Switch
2. Fuel Injector
3. Knock Sensor
4. Idle Air Control (IAC) Valve
5. Throttle Position (TPS) Sensor
6. Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensors
7. Evaporative Canister
8. Ignition Fail Safe Sensor
9. Data Link Connector (DLC)
10. Evaporative Purge Control Solenoid (PCS)

11. Engine Coolant Temperature (ECT) Sensor
12. Fuse & Relay Box
13. Main Relay
14. Fuel Pump Relay
15. Fuel Pressure Regulator
16. Positive Crankcase Ventilation (PCV) Valve
17. Ignition Coil
18. Crankshaft Position (CKP) Sensor
19. Camshaft Position (CMP) Sensor

20. Malfunction Indicator Light (MIL)
21. Data Link Connector (DLC)
22. Engine Control Module (ECM)
23. Front Heated Oxygen Sensor (HO2S)
24. Rear Heated Oxygen Sensor (HO2S)
25. Warm-Up Catalytic Converter (WCC)
26. Transaxle Range (TR) Switch
27. Solenoid Connector
28. Vehicle Speed Sensor (VSS)

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Fig. 4: Identifying Component Location (Sedona)
Courtesy of KIA MOTORS AMERICA, INC.

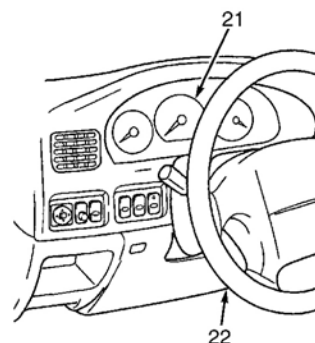
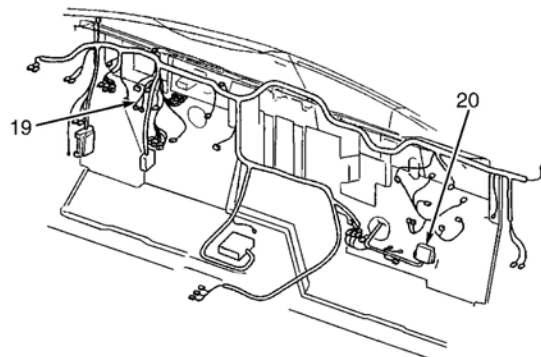
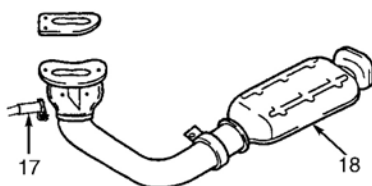
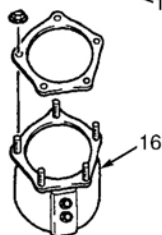
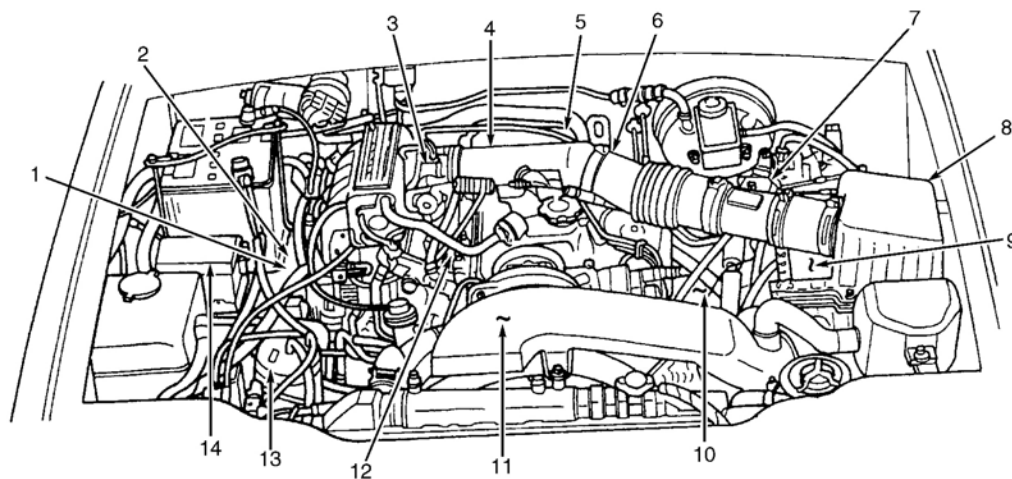


1. Power Steering Switch
2. A/C Differential Pressure Switch
3. Chassis Acceleration Sensor(CAS)
4. Fuel Injectors/Fuel Rail
5. Evaporative Emission (EVAP) Purge Solenoid
6. Knock Sensor (Engine Block)
7. Throttle Position (TP) Sensor
8. Idle Air Control (IAC) Motor
9. Engine Coolant Temperature (ECT) Sensor
10. Engine Speed Detection Connector (DLC)
11. Main Fuse/Relay Box
12. Volume Air Flow (MAF) Sensor
13. Intake Air Temperature (IAT) Sensor
14. Radiator Cooling Fan Assembly

15. Camshaft Position (CMP) Sensor
16. Ignition Coils (DIS)
17. Crankshaft Position (CKP) Sensor
18. Speed Sensor (VSS)
19. Transmission Solenoid Valve Connector
20. Transmission Range Switch
21. Transmission Control Module (TCM) A/T Only
22. Engine Control Module (ECM)
23. Air Bag Control Module
24. Data Link Connector (OBD-II)
25. Malfunction Indicator Light (MIL)
26. Catalytic Converters (TWC)
27. Heated Oxygen Sensor (HO2S) - Front
28. Heated Oxygen Sensor (HO2S) - Rear

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Fig. 5: Identifying Component Locations (Spectra)
Courtesy of KIA MOTORS AMERICA, INC.



1. Chassis Acceleration Sensor (CAS)
2. Evaporative Emission (EVAP) Purge Solenoid
3. Throttle Position (TP) Sensor
4. Idle Air Control (IAC) Motor
5. Camshaft Position (CMP) Sensor
6. Crankshaft Position (CKP) Sensor
7. Volume Air Flow (MAF) Sensor
8. Engine Speed Detection Connector (DLC)
9. Intake Air Temperature (IAT) Sensor
10. Knock Sensor (Engine Block)
11. Engine Coolant Temperature (ECT) Sensor

12. Fuel Injectors/Fuel Rail
13. Evaporative Emission Canister
14. Main Fuse/Relay Box
15. Front Heated Oxygen Sensor (HO2S)
16. Catalytic Converter (TWC)
17. Rear Heated Oxygen Sensor (HO2S)
18. Catalytic Converter (TWC)
19. Transmission Control Module (TCM) A/T Only
20. Engine Control Module (ECM)
21. Malfunction Indicator Light (MIL)
22. Data Link Connector (OBD-II)

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Fig. 6: Identifying Component Locations (Sportage)

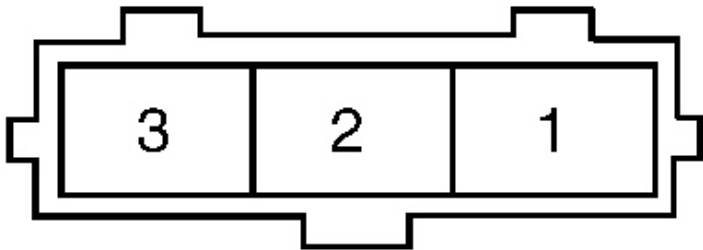
Courtesy of KIA MOTORS AMERICA, INC.

AIR INDUCTION SYSTEM

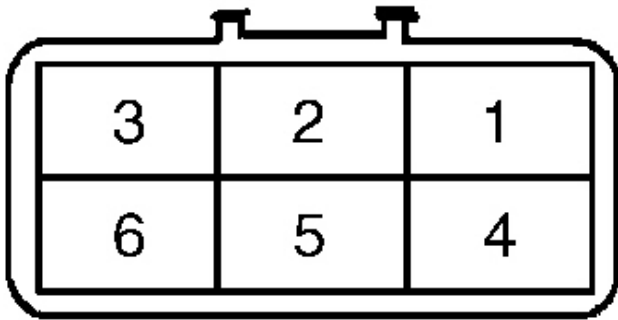
IDLE AIR CONTROL VALVE

NOTE: Only component testing procedure is covered. For Idle Air Control (IAC) valve system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

Turn ignition off. Disconnect Idle Air Control (IAC) valve 3-pin harness connector for Optima, Rio, Spectra and Sportage, and 6-pin harness connector for Sedona. For IAC valve location, see **Fig. 1 -Fig. 6** . Check resistance between IAC valve terminals. For IAC valve terminal identification and resistance specification. See **Fig. 7** . See **IDLE AIR CONTROL VALVE RESISTANCES** table. If resistances are not as specified, replace IAC valve. For IAC valve removal and installation, see IDLE AIR CONTROL VALVE under AIR INDUCTION SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.



OPTIMA, RIO, SPECTRA & SPORTAGE



SEDONA

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Fig. 7: Identifying Idle Air Control Valve Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

IDLE AIR CONTROL VALVE RESISTANCES

Measure Between Terminals No.	(1) Resistance - Ohms
Optima	
1 & 2	17-18
2 & 3	15-16

Rio	
1 & 2	16.5-18.5
2 & 3	14.5-16.5
Sedona	
1 & 2	29-38
2 & 3	29-38
4 & 5	29-38
5 & 6	29-38
Spectra	
1 & 2	16.5-18.5
2 & 3)	14.5-16.5
Sportage	
1 & 2	16.5-18.5
2 & 3	14.5-16.5
(1) At 68° F (20° C).	

COMPUTERIZED ENGINE CONTROLS

ENGINE CONTROL MODULE

NOTE: Engine Control Module (ECM), can also be referred to as Powertrain Control Module (PCM). For ECM location. See Fig. 1 -Fig. 6 .

NOTE: For ECM removal and installation, see **ENGINE CONTROL MODULE** under **COMPUTERIZED ENGINE CONTROLS** in **REMOVAL, OVERHAUL & INSTALLATION** article.







1. Using a Digital Volt-ohmmeter (DVOM), check for ignition power, battery power, and ground at terminals listed in table by application. Turn ignition on. Check for ignition voltage at ECM power terminals. Turn ignition off. Check for battery voltage between ECM power and ground terminals. For ECM connectors and terminals identification. See **Fig. 8 -Fig. 14** and for ECM ignition power, battery power and ground terminals, see **ECM POWER & GROUND TERMINALS** table.

ECM POWER & GROUND TERMINALS




Model	(1) Terminals No.
Optima 2.4L (A/T)	
Battery Power	B26
Ignition Power	B1, B7, C7, C19, C28
Ground	B2, B8, C6, C18, C27
Optima 2.4L (M/T)	

Battery Power	D10
Ignition Power	A12, A25, D12
Ground	A13, A26, D21
Optima 2.7L	
Battery Power	V7
Ignition Power	V1, V8, V9
Ground	V4, V5, V6, Z5
Rio	
Battery Power	(B01) 7
Ignition Power	(B01) 1, 8, 9
Ground	(B01) 4, 5, 6
Sedona	
Battery Power	B18
Ignition Power	B4, B6, B17, C1, C8, C20
Ground	B5, B16, C2, C9, C21
Spectra	
Battery Power	12
Ignition Power	13, 45
Ground	3, 51, 61, 74, 78, 80
Sportage (A/T)	
Battery Power	26
Ignition Power	54, 58, 86
Ground	6, 28, 34, 55, 72
Sportage (M/T)	
Battery Power	26
Ignition Power	54, 58
Ground	6, 28, 34, 55, 86
(1) For circuit identification, see WIRING DIAGRAMS article. For connector views, see Fig. 8 -Fig. 14 .	





2. If battery voltage is not present, check appropriate fuses. Check ECM B+ fuses, FUEL INJ fuses and IGN COILS fuses in engine or passenger compartment fuse/relay boxes. Replace fuse(s) as necessary and check for cause of blown fuse. If fuses are okay, check EGI main relay. See **RELAYS & SOLENOIDS** under RELAYS & SOLENOIDS. If relay is okay, locate and repair power open between main relay and ECM connector or ground open between body and ECM connector.

8 BLU	7 *		6 LT BLU	5 *						4 *	3 PNK		2 GRY	1 BLK
23 YEL/BLK	22 BRN/WHT	21 GRN/WHT	20 GRN/WHT	19 *	18 GRN	17 YEL	16 *	15 *	14 BLU	13 *	12 ORG	11 WHT	10 *	9 LT GRN/BLK
35 WHT	34 GRN/WHT		33 *	32 *	31 *	30 *		29 *	28 ORG/BLK	27 *	26 BLK		25 *	24 PNK/BLK

CONNECTOR "A"

6LTBLU/ BLK	5YEL	4GRN					3WHT	2BLK	1PNK	
17BLK/ WHT	16BLK	15BRN	14PNK	13★	12ORG/ BLK	11★	10GRY	9TAN	8BLK	7PNK
26ORG	25★	24TAN		23★	22RED	21BRN	20★		19★	18YEL

CONNECTOR "B"

7 RED	6 BLK/ WHT	5 WHT					4 *	3 TAN	2 *	1 TAN	
19 RED	18 BLK/ WHT	17 *	16 *	15 GRN	14 *	13 WHT	12 *	11 *	10 BRN	9 *	8 BLU
28 PNK	27 BLK/ WHT		26 *	25 *		24 *	23 *	22 VIO		21 *	20 BLU

CONNECTOR "C"

7 ORG/BLK	6RED/BLK	5 *						4 WHT	3 WHT		2 PNK	1 BLU
20 LTBLU/BLK	19 *	18 *	17 *	16 *	15 *	14 *	13 YEL	12 *	11 *	10BLK/WHT	9 GRY	8 LTGRN
30 YEL/WHT	29 VIO		28 *	27 *	26 RED		25 *	24 GRY		23 LTBLU	22 YEL	21 YEL

CONNECTOR "D"

OPTIMA 2.4L A/T B01 ENGINE/TRANSAXLE CONTROL MODULE

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Fig. 8: Identifying Engine Control Module Connectors & Terminals (Optima 2.4L A/T)
Courtesy of KIA MOTORS AMERICA, INC.

13 BLK	12 PNK	11 *	10 WHT	9 GRN/WHT	8 GRN/WHT	7 *	6 LT BLU	5 *	4 BLU	3 *	2 PNK/BLK	1 BLK
26 BLK	25 PNK	24 *	23 ORG	22 GRN/WHT	21 GRN	20 YEL	19 *	18 *	17 ORG/BLK	16 *	15 GRY	14 LT GRN/BLK

CONNECTOR "A"

8 TAN	7 ORG/BLK	6 BRN/WHT	5 *	4 BLU	3 BLU	2 *	1 *
16 *	15 WHT	14 *	13 *	12 RED	11 PNK	10 *	9 *

CONNECTOR "B"

6 *	5 WHT	4 BLK	3 *	2 YEL/BLK	1 *
12 GRN	11 VIO	10 PNK	9 *	8 WHT	7 *

CONNECTOR "C"

11 LT BLU/BLK	10 ORG	9 YEL	8 BLU	7 *	6 TAN	5 TAN	4 *	3 BRN	2 TAN	1 YEL
22 BLK/WHT	21 BLK	20 *	19 YEL	18 BLK	17 *	16 BRN	15 BRN	14 BLU	13 GRN	12 PNK

CONNECTOR "D"

OPTIMA 2.4L M/T B01 ENGINE CONTROL MODULE

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Fig. 9: Identifying Engine Control Module Connectors & Terminals (Optima 2.4L M/T)

Courtesy of KIA MOTORS AMERICA, INC.

40 YEL	39 ★ (LT BLU)	38 ★ (YEL)	37 TAN/BLK TAN/BLK	36 ORG/BLK ORG/BLK	35 ★	34 VIO	33 ★	32 ★	31 ★
30 ★	29 GRN/ WHT	28 ★	27 ★	26 ★	25 RED	24 LT GRN	23 WHT	22 ★ (WHT)	21 ★
20 BRN/ WHT	19 ★	18 GRN	17 WHT	16 ★	15 BLK/ WHT	14 BLK/ WHT	13 ★	12 ★	11 ★
10 GRN/ WHT	9 ★	8 BLK/ WHT	7 BLK	6 ★	5 VIO	4 LT BLU/ BLK	3 ★	2 ★	1 ★

CONNECTOR "F"

52 ★	51 ★	50 ★	49 ★	48 BLK	47 ORG/ BLK	46 BLU	45 ★	44 ★	43 ★	42 GRN/ WHT	41 ★	40 ★
39 ★	38 YEL/ WHT	37 BLK/ WHT	36 GRN	35 PNK/ BLK	34 LTGRN/ BLK	33 BLK	32 GRN	31 WHT	30 YEL	29 BRN	28 ★	27 ★
26 ORG/ BLK	25 BLK/ WHT	24 GRN	23 BLK/ WHT	22 TAN	21 BLK/ WHT	20 BLK/ WHT	19 BLU	18 ★	17 BLK/ WHT	16 ★	15 ★	14 ★
13 ★	12 ★	11 ★	10 GRN/ WHT	9 ★	8 YEL	7 ★	6 ★	5 ★	4 ★	3 ★	2 ★	1 YEL

CONNECTOR "M"

24 TAN/ WHT	23 BLU	22 TAN	21 TAN/ WHT	20 TAN	19 PNK
18 VIO/ WHT	17 ★	16 VIO	15 YEL	14 VIO	13 PNK
12 ★	11 ★	10 ★	9 ★	8 ★	7 PNK
6 ★	5 ★	4 ★	3 ★	2 ★	1 PNK

CONNECTOR "P"

9 PNK	8 PNK	7 ORG
6 BLK	5 BLK	4 BLK
3 GRN	2 ★	1 PNK

CONNECTOR "V"

9 ★	8 ★	7 ★
6 ★	5 BLK/ BLK	4 ★
3 YEL	2 WHT	1 BLK

CONNECTOR "Z"

OPTIMA 2.7L V6 B01 ENGINE CONTROL MODULE

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Fig. 10: Identifying Engine Control Module Connectors & Terminals (Optima 2.7L)
Courtesy of KIA MOTORS AMERICA, INC.

9	RED/ YEL	8	RED/ YEL	7	GRN/ WHT
6	BLK/ BLU	5	BLK/ BLU	4	BLK/ BLU
3	BLU/ RED	2	★	1	WHT

B01

24	★	23	★	22	★	21	★	20	RED	19	GRN/ RED
18	LTGRN/ YEL	17	LTGRN/ RED	16	★	15	WHT	14	★	13	★
12	LTGRN/ RED	11	LTGRN/ YEL	10	★	9	BRN	8	★	7	★
6	★	5	★	4	★	3	★	2	★	1	★

B02

52	★	51	★	50	BRN	49	BRN/ RED	48	RED	47	GRN/ BLK	46	BLK	45	★	44	WHT/ RED	43	WHT	42	WHT/ BLU	41	★	40	GRN
39	★	38	★	37	★	36	GRN/ BLU	35	YEL/ GRN	34	★	33	RED	32	★	31	BRN/ RED	30	★	29	★	28	<YEL/ RED>	27	<YEL/ BLU>
26	★	25	★	24	★	23	YEL	22	YEL/ BLU	21	★	20	BLU	19	★	18	★	17	★	16	BLU	15	BLU/ GRN	14	★
13	★	12	★	11	★	10	★	9	★	8	★	7	★	6	★	5	★	4	★	3	★	2	★	1	★

B03

40	★	39	★	38	★	37	BLU/ YEL	36	BLU/ GRN	35	BRN/ RED	34	RED/ GRN	33	GRN/ BLK	32	★	31	★
30	<RED/ WHT>	29	<RED/ YEL>	28	★	27	★	26	YEL/ RED	25	WHT/ BLU	24	BRN/ YEL	23	WHT/ RED	22	★	21	★
20	WHT	19	★	18	RED/ BLK	17	BLU/ ORG	16	★	15	BLU/ YEL	14	★	13	★	12	★	11	BLU/ RED
10	GRN	9	★	8	YEL	7	WHT/ GRN	6	★	5	GRN/ ORG	4	★	3	★	2	★	1	RED

B04

9	★	8	★	7	★
6	RED/ RED	5	★	4	YEL/BLU YEL/BLU
3	★	2	★	1	★

B05

ENGINE CONTROL MODULE

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Fig. 11: Identifying Engine Control Module Connectors & Terminals (Rio 1.5L)
Courtesy of KIA MOTORS AMERICA, INC.

(A)

1 P	2 *	3 *	4 *	5 R	6 G/W	7 W	8 R
9 O	10 G/R	11 G/B	12 G	13 W	14 Y	15 Y/W	16 *
17 B/W	18 L/R	19 W	20 G	21 Y	22 Y	23 G	24 W
25 G/R	26 G	27 R	28 *	29 *	30 G	31 W/R	32 W
33 G/Y	34 O	35 L					

(B)

1 Y	2 Y/G	3 L/Y	4 Y/R	5 B	6 L
7 B/Y	8 W/G	9 BR	10 B/W	11 W/R	12 G/Y
13 *	14 G/R	15 W/B	16 B	17 L	18 W/R
19 *	20 G	21 BR	22 LG	23 L	24 W/G
25 *	26 G				

(C)

1 W	2 B	3 BR	4 W/Y	5 R	6 Y/G	7 L
8 W	9 B	10 *	11 *	12 W	13 L	14 P
15 *	16 *	17 W	18 L/W	19 R/G	20 P	21 B
22 *	23 *	24 *	25 *	26 R	27 G	28 R

(D)

1 BR	2 Y	3 *	4 L	5 G	6 G/B	7 G/R
8 G	9 L	10 *	11 *	12 *	13 *	14 *
15 R/B	16 *	17 *	18 G	19 G/W	20 R/G	21 W
22 G	23 *	24 *	25 *	26 *	27 L/W	28 W
29 G/Y	30 Y/B					

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Fig. 12: Identifying Engine Control Module Connector & Terminals (Sedona 3.5L)
Courtesy of KIA MOTORS AMERICA, INC.

8 BR/G	9 BR/W	10 Y/W	11 G/Y	12 Y/L	13 *	14 P	15 Y	16 R/L	17 W/Y	18 L/O	19 B/G	20 G/B	21 Y/L	22 Y/G	23 W/G	24 *	25 Y/L	26 W/Y	27 BR/B	28 L/B	29 W/G	30 R/G	31 BR/W	32 L/W	33 L/G	34 W/G	35 Y/W	36 G/L	37 R/W	38 *	39 L/Y	40 *	41 *	42 R/L	43 *	44 R/Y	45 R/Y	46 W/B	47 BR/Y	48 *	49 *	50 *	51 B/Y	52 *	53 *	54 *	55 G/W	56 *	57 BR/Y	58 *	59 O/B	60 R/B	61 B/L	62 *	63 R/Y	64 *	65 *	66 *	67 *	68 L/G	69 L/B	70 BR/G	71 Y/G	72 R/B	73 *	74 B/Y	75 G/Y	76 P/L	77 *	78 B/Y	79 L/R	80 B/L	81 *	82 Y/B	83 B/L	84 G/R	85 Y/B	86 G/B	87 G/R	88 Y/B
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G00082429

Fig. 13: Identifying Engine Control Module Connector & Terminals (Spectra 1.8L)
Courtesy of KIA MOTORS AMERICA, INC.

56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28						

G99108397

Fig. 14: Identifying Engine Control Module Connector & Terminals (Sportage 2.0L)
Courtesy of KIA MOTORS AMERICA, INC.

ENGINE SENSORS & SWITCHES

CAMSHAFT POSITION SENSOR

NOTE: Only component testing procedure is covered. For Camshaft Position (CMP)

sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For CMP location, see Fig. 1 -Fig. 6 .

NOTE: For CMP sensor removal and installation, see CAMSHAFT POSITION SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

Optima

NOTE: DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source as this will affect waveform.

Set lab scope time to 20 milliseconds and voltage to 5 volts. Start engine and allow it to reach normal operating temperature. With engine at idle, compare CMP sensor waveform to normal CMP sensor waveform. See Fig. 15 . Connect lab scope as follows:

- On 2.4L (A/T), connect lab scope positive probe to ECM connector B01 terminal No. B16 (Black wire). See Fig. 8 . Connect lab scope negative probe to ground.
- On 2.4L (M/T), connect lab scope positive probe to ECM connector B01 terminal No. D18 (Black wire). See Fig. 9 . Connect lab scope negative probe to ground.
- On 2.7L, connect lab scope positive probe to ECM connector B01 terminal No. F7 (Black wire). See Fig. 10 . Connect lab scope negative probe to ECM connector B01 terminal No. F8 (Black/White wire).

If waveform is erratic, replace CMP sensor.

Rio

NOTE: DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source as this will affect waveform.

Connect lab scope positive probe to ECM connector B04 terminal No. 18 (Red/Black wire). See Fig. 11 . Connect lab scope negative probe to ground. Set lab scope time to 20 milliseconds and voltage to 5 volts. Start engine and allow it to reach normal operating temperature. With engine at idle, compare CMP sensor waveform to normal CMP sensor waveform. See Fig. 15 . If waveform is erratic, replace CMP sensor.

Sedona

NOTE: DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source as this will affect waveform.

Connect lab scope positive probe to ECM connector B01 terminal No. B8 (White/Green wire). See Fig. 12 . Connect lab scope negative probe to ground. Set lab scope time to 20 milliseconds and voltage to 5 volts. Start

engine and allow it to reach normal operating temperature. With engine at idle, compare CMP sensor waveform to normal CMP sensor waveform. See **Fig. 15** . If waveform is erratic, replace CMP sensor.

Spectra

NOTE: **DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source as this will affect waveform.**

Connect lab scope positive probe to ECM connector terminal No. 79 (Blue/Red wire).See **Fig. 13** . Connect lab scope negative probe to ground. Set lab scope time to 20 milliseconds and voltage to 5 volts. Start engine and allow it to reach normal operating temperature. With engine at idle, compare CMP sensor waveform to normal CMP sensor waveform. See **Fig. 15** . If waveform is erratic, replace CMP sensor.

Sportage

NOTE: **DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source as this will affect waveform.**

Connect lab scope positive probe to ECM connector terminal No. 44 (White/Red wire).See **Fig. 14** . Connect lab scope negative probe to ground. Set lab scope time to 20 milliseconds and voltage to 5 volts. Start engine and allow it to reach normal operating temperature. With engine at idle, compare CMP sensor waveform to normal CMP sensor waveform. See **Fig. 15** . If waveform is erratic, replace CMP sensor.

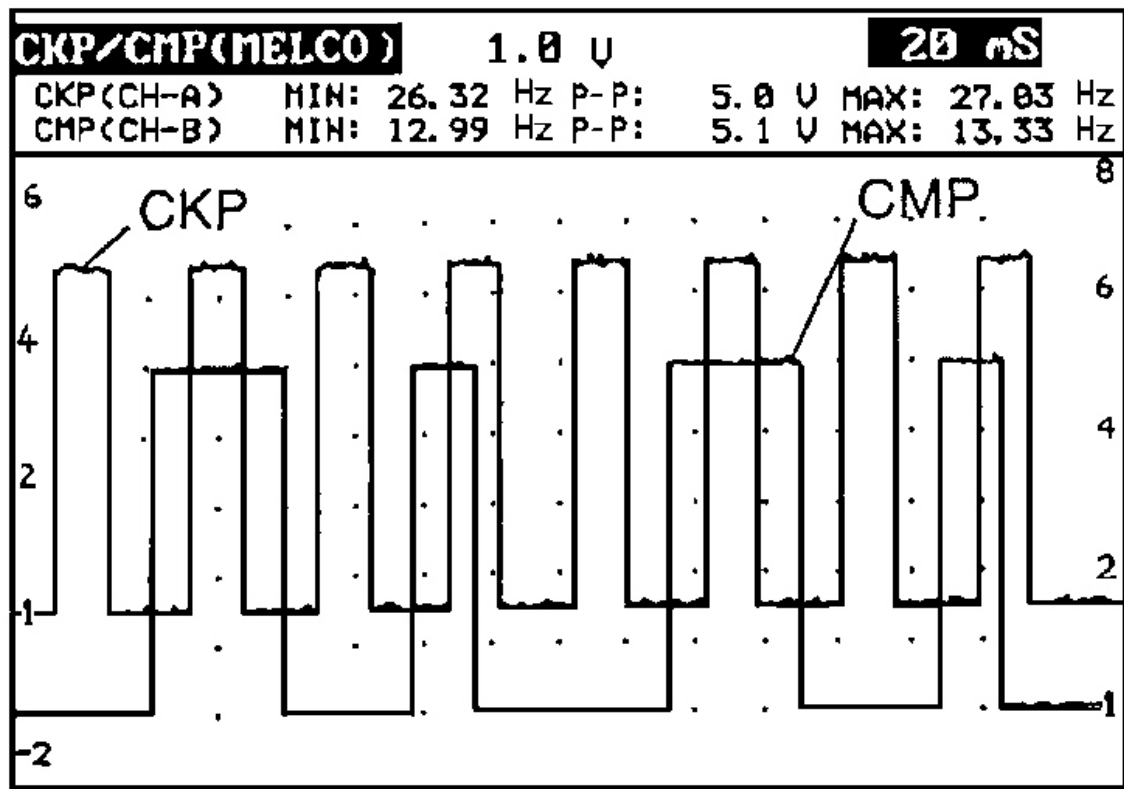


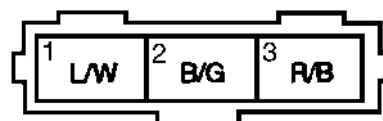
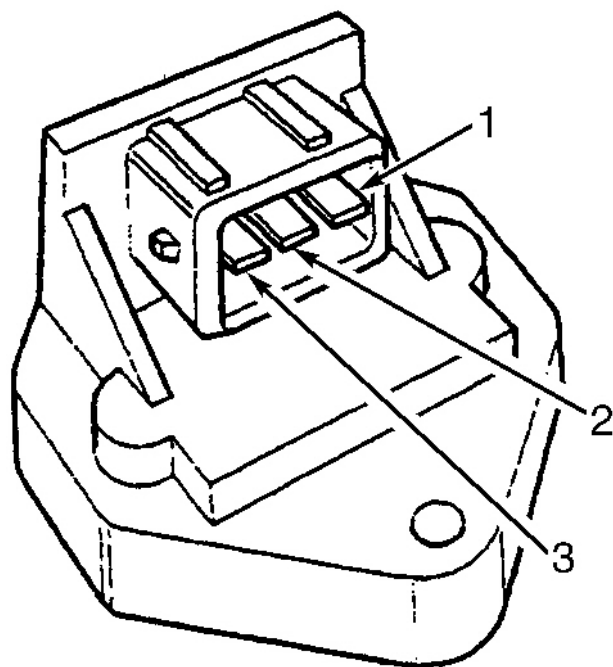
Fig. 15: Typical Camshaft and Crankshaft Sensors Signals
Courtesy of KIA MOTORS AMERICA, INC.

CHASSIS ACCELERATION SENSOR

NOTE: Only component testing procedure is covered. For Chassis Acceleration (CA) sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

Spectra & Sportage

On Spectra, CA sensor is located in right side of engine compartment, behind strut tower. On Sportage, CA sensor is located in right rear engine compartment, below starter. Turn ignition on. On Spectra, backprobe and measure voltage between CA sensor 3-pin harness connector terminal No. 3 (Red/Black wire) and ground. On Sportage, backprobe and measure voltage between CA sensor 3-pin harness connector terminal No. 3 (Blue/Green wire) and ground. See **Fig. 16** . Check for voltage spike (less than one volt) while tapping CA sensor bracket. If no voltage spike is observed, replace sensor. For CA sensor removal and installation, see CHASSIS ACCELERATION SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.



SPECTRA



SPORTAGE

G00102631

Fig. 16: Identifying Chassis Acceleration Sensor Terminal & Connectors (Spectra & Sportage)
Courtesy of KIA MOTORS AMERICA, INC.

CRANKSHAFT POSITION SENSOR

NOTE: Only component testing procedure is covered. For Crankshaft Position (CKP)

sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For CMP location. See Fig. 1 -Fig. 6 .

NOTE: For CKP sensor removal and installation, see appropriate CAMSHAFT POSITION SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

Optima

NOTE: DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source as this will affect waveform.

Set lab scope time to 50 milliseconds and voltage to 5 volts. Start engine and allow it to reach normal operating temperature. With engine at idle, compare CKP sensor waveform to normal CKP sensor waveform. See Fig. 17 . Connect lab scope as follows:

- On 2.4L (A/T), backprobing, connect lab scope positive probe to ECM connector B01 terminal No. B5 (Yellow wire) and negative probe to ground. See Fig. 8 .
- On 2.4L (M/T), backprobing, connect lab scope positive probe to ECM connector B01 terminal No. D19 (Yellow wire) and negative probe to ground. See Fig. 9 .
- On 2.7L, backprobing, connect lab scope positive probe to ECM connector B01 terminal No. M8 (Yellow wire) and negative probe to ECM connector B01 terminal No. M21 (Black/White wire). See Fig. 10 .

If waveform is erratic, replace CKP sensor.

Rio

NOTE: DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source, as this will affect waveform.

Backprobing, connect lab scope positive probe to ECM connector B04 terminal No. 20 (White wire) and negative probe to ECM connector B04 terminal No. 10 (Green wire). See Fig. 11 . Start engine and allow it to reach normal operating temperature. With engine at idle, observe CKP waveform. Compare to normal waveform. See Fig. 17 . If CKP sensor waveform is erratic, replace CKP sensor.

Sedona

NOTE: DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source, as this will affect waveform.

Backprobing connect lab scope positive probe to ECM connector B01 terminal No. B2 (Yellow/Green wire) and negative probe to ground. See Fig. 12 . Start engine and allow it to reach normal operating temperature.

With engine at idle, observe CKP waveform. Compare to normal waveform. See **Fig. 17** . If CKP sensor waveform is erratic, replace CKP sensor.

Spectra

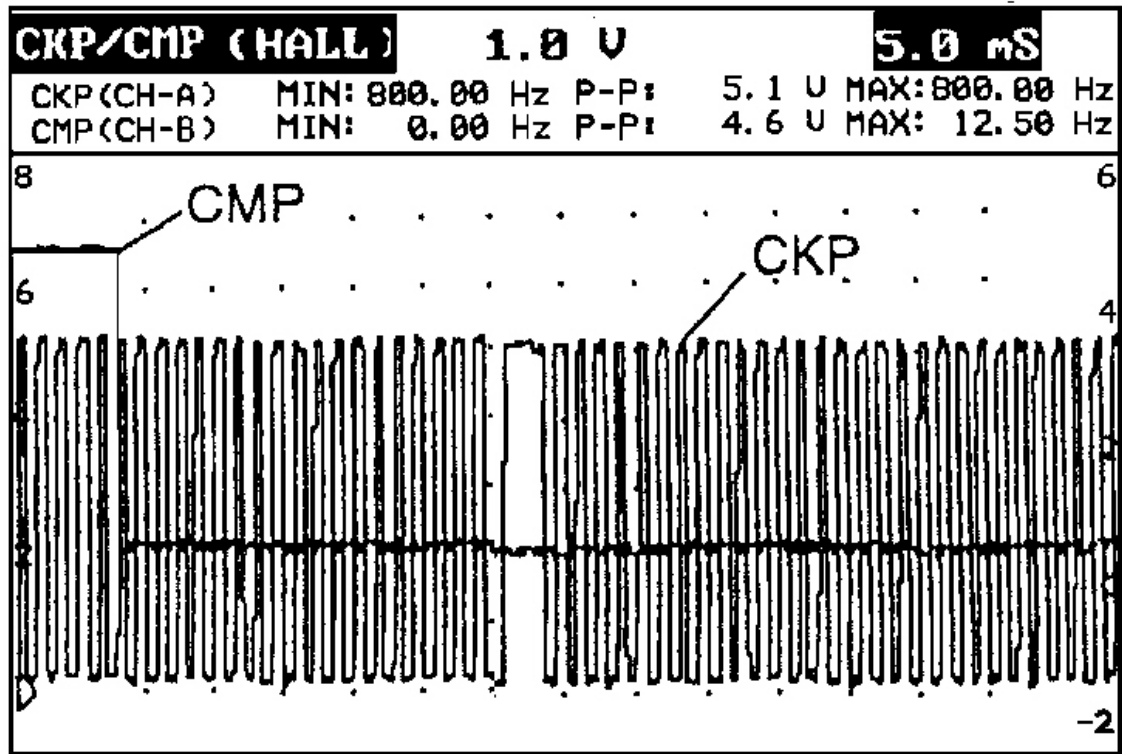
NOTE: **DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source, as this will affect waveform.**

Backprobing connect lab scope positive probe to ECM connector B01 terminal No. 34 (White/Green wire) and negative probe to ECM connector terminal No. 78 (Black/Yellow wire). See **Fig. 13** . Start engine and allow it to reach normal operating temperature. With engine at idle, observe CKP waveform. Compare to normal waveform. See **Fig. 17** . If CKP sensor waveform is erratic, replace CKP sensor.

Sportage

NOTE: **DO NOT use OBD-II Data Link Connector (OBD-II DLC) for lab scope power source as this will affect waveform.**

Backprobing connect lab scope positive probe to ECM connector B01 terminal No. 43 (Yellow/Blue wire) and negative probe to ECM connector terminal No. 6 (Black/Blue wire). See **Fig. 14** . Start engine and allow it to reach normal operating temperature. With engine at idle, observe CKP waveform. Compare to normal waveform. See **Fig. 17** . If CKP sensor waveform is erratic, replace CKP sensor.



G00038158

Fig. 17: Typical Crankshaft And Camshaft Sensor Signals

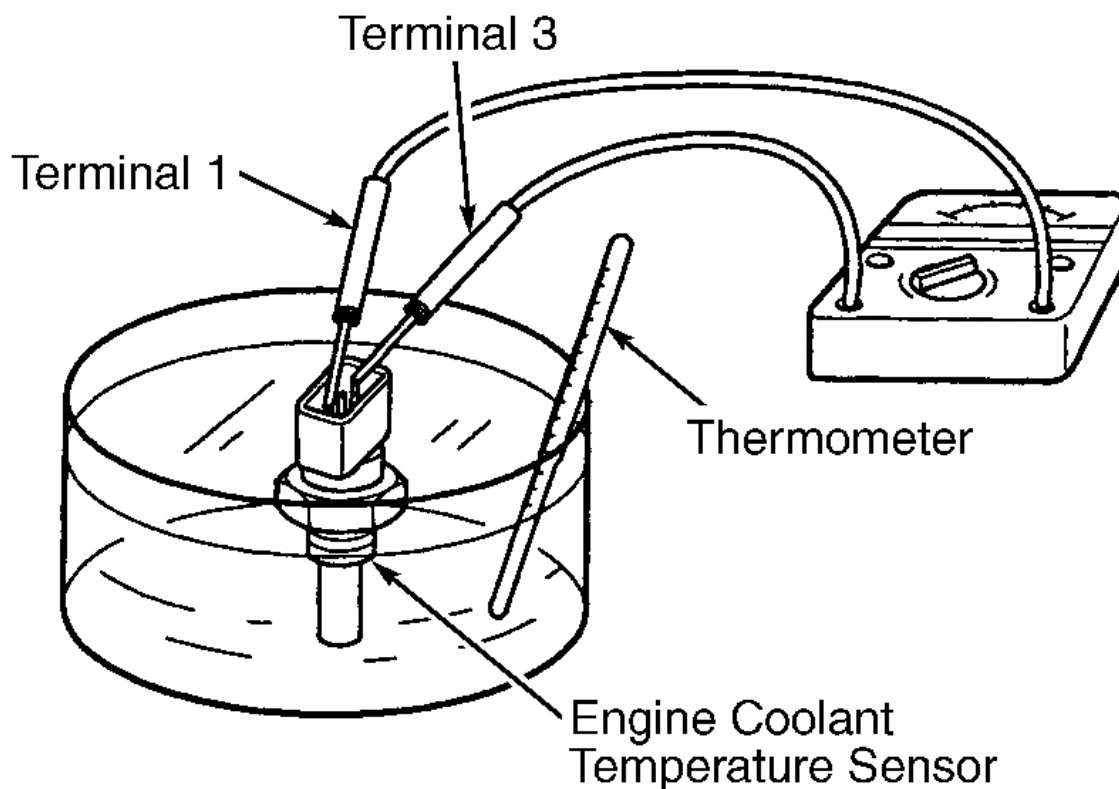
ENGINE COOLANT TEMPERATURE SENSOR

- NOTE:** Only component testing procedure is covered. For Engine Coolant Temperature (ECT) sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.
- NOTE:** For ECT sensor location. See Fig. 1 -Fig. 6 .
- NOTE:** For ECT sensor removal and installation, see ENGINE COOLANT TEMPERATURE SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

Remove (ECT) sensor. Place sensor and thermometer in container with water and slowly heat water. Measure resistance between ECT sensor terminals No. 1 & 3. See Fig. 18 . Note resistance at specified temperatures. For ECT sensor specifications, see **ECT SENSOR RESISTANCE SPECIFICATIONS** table. Replace ECT sensor as necessary. For ECT sensor removal and installation, see ENGINE COOLANT TEMPERATURE SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

ECT SENSOR RESISTANCE SPECIFICATIONS

Sensor Temperature - °F (°C)	(1) Resistance - K/Ohms
Optima	
68 (20)	2.31-2.59
176 (80)	0.30-0.33
Rio	
-6 (-20)	13.3-16.8
68 (20)	0.65-4.24
176 (80)	0.30-0.33
Sedona	
32 (0)	5.9
68 (20)	2.31-2.59
104 (40)	1.1
176 (80)	0.30-0.33
Spectra & Sportage	
-6 (-20)	14.6-17.8
68 (20)	2.30-2.70
176 (80)	0.30-0.33
(1) Measure resistance between sensor terminals.	



G00102632

Fig. 18: Checking Engine Coolant Temperature Sensor Resistance
 Courtesy of KIA MOTORS AMERICA, INC.

FUEL TANK PRESSURE SENSOR

NOTE: Only component testing procedure is covered. For Fuel Tank Pressure (FTP) sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For FTP sensor removal and installation, see appropriate FUEL TANK PRESSURE SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

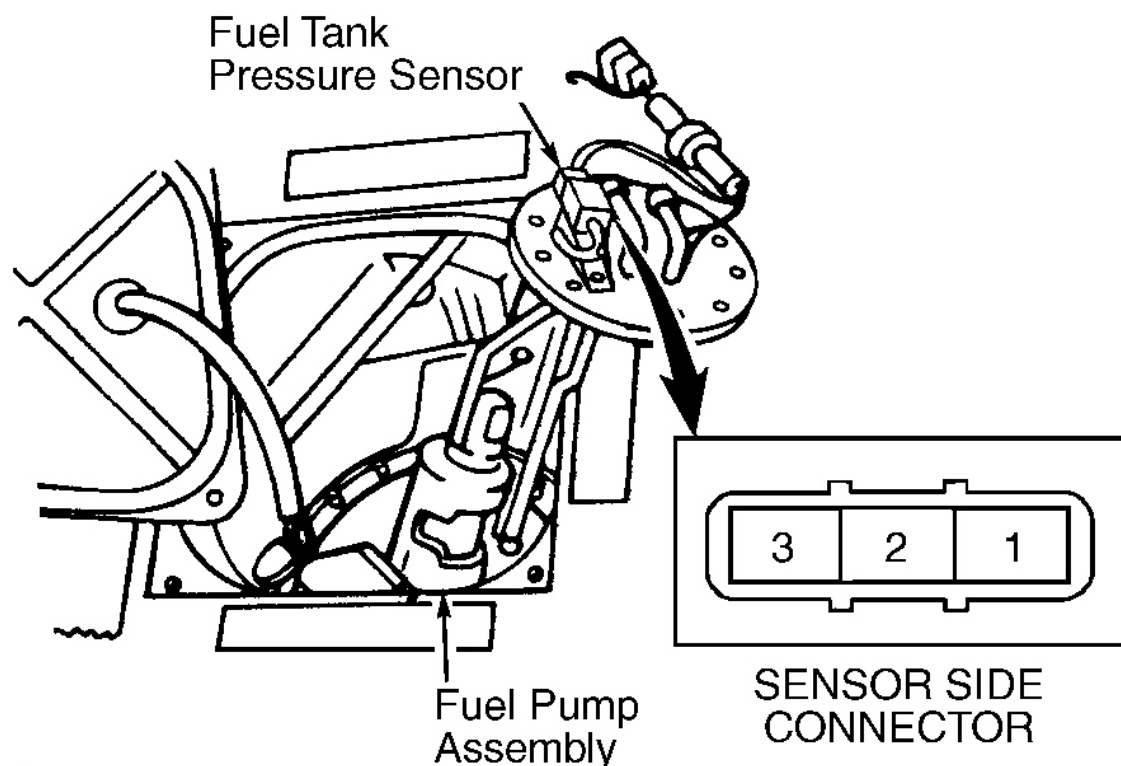
NOTE: On Spectra, component testing procedure does not apply (not equip).

Vent fuel tank by removing fuel filler cap. Ensure ignition is off. Locate FTP sensor 3-pin harness connector under rear seat, through fuel pump assembly access panel on vehicle floor (except Optima). For Optima remove fuel pump access cover in trunk. Disconnect FTP sensor harness connector. Check resistance between FTP sensor connector terminals. See **Fig. 19** . See **FUEL TANK PRESSURE SENSOR RESISTANCE SPECIFICATIONS** table. If FTP sensor is not as specified, replace FTP sensor.

FUEL TANK PRESSURE SENSOR RESISTANCE SPECIFICATIONS

Application	K/ohms
-------------	--------

Optima	
Sensor Terminals 1 & 2	5-6
Sensor Terminals 1 & 3	5-6
Sensor Terminals 2 & 3	2.5-3
Rio, Sedona & Sportage	
Sensor Terminals 1 & 2	2.5-3
Sensor Terminals 1 & 3	5-6
Sensor Terminals 2 & 3	5-6



G00102637

Fig. 19: Identifying Fuel Pressure Sensor Connector Terminals
 Courtesy of KIA MOTORS AMERICA, INC.

HEATED OXYGEN SENSOR

Optima (2.4L)

NOTE: Only component testing procedure is covered. For Heated Oxygen (HO2S) sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For HO2S sensor location. See Fig. 1 -Fig. 6 .

NOTE: For HO2S sensor removal and installation, see appropriate **HEATED OXYGEN SENSOR** under **ENGINE SENSORS & SWITCHES** in **REMOVAL, OVERHAUL & INSTALLATION** article.

NOTE: HO2S heater resistance will vary depending on temperature. In some instances, temperature value is not given by manufacturer.

1. Disconnect front or rear HO2S 4-pin harness connector. At front or rear HO2S side connector measure resistance between terminals No. 3 and 4. See **Fig. 20** . HO2S heater resistance should be between 3-6 ohms at 68°F (20°C). If HO2S is not as specified, replace HO2S.
2. Connect HO2S connector. Start and run engine at normal operating temperature for at least 10 minutes. Using scan tool, lab scope or voltmeter, monitor appropriate HO2S signal. If using voltmeter or lab scope, connect positive lead to front or rear HO2S harness connector terminal No. 2 (Tan wire). Connect negative lead to ground. HO2S signal should switch from lean to rich, or rich to lean, at least 3 times every 10 seconds. Front HO2S signal should switch between 0-1 volt. Rear HO2S signal should switch between .6-.8 volt. If HO2S is not as specified, replace HO2S.

Optima (2.7L)

1. Disconnect front or rear HO2S 4-pin harness connector. At front or rear HO2S side connector measure resistance between terminals No. 3 and 4. See **Fig. 20** . HO2S heater resistance should be between 3-6 ohms at 68°F (20°C). If HO2S is not as specified, replace HO2S.
2. Connect HO2S connector. Start and run engine at normal operating temperature for at least 10 minutes. Using scan tool, lab scope or voltmeter, monitor appropriate HO2S signal. If using voltmeter or lab scope, connect positive lead to right front HO2S harness connector terminal No. 2 (Violet wire) or to left front HO2S harness connector terminal No. 2 (Yellow wire). Connect negative lead to ground. On rear HO2S, connect positive lead to right rear HO2S connector terminal No. 2 (Violet wire) or to left rear HO2S connector terminal No. 2 (Violet/White wire). Signal should switch from lean to rich, or rich to lean, at least 3 times every 10 seconds. Front HO2S signal should switch between 0-1 volt. Rear HO2S signal should switch between .6-.9 volt. If HO2S is not as specified, replace HO2S.

Rio

1. Disconnect front or rear HO2S 4-pin harness connector. At front or rear HO2S side connector measure resistance between terminals No. 1 and 3. See **Fig. 20** . HO2S heater resistance should be between 3-7 ohms at 68°F (20°C). If HO2S is not as specified, replace HO2S.
2. Connect HO2S connector. Start and run engine at normal operating temperature for at least 10 minutes. Using scan tool, lab scope or voltmeter, monitor appropriate HO2S signal. If using voltmeter or lab scope, connect positive lead to front HO2S harness connector terminal No. 3 (Yellow/Blue wire) or to rear HO2S harness connector terminal No. 3 (Light-green/Yellow wire). Connect negative lead to ground. HO2S signal should switch from lean to rich, or rich to lean, at least 3 times every 10 seconds. Front HO2S signal should switch between 0-1 volt. Rear HO2S signal should switch between .6-.9 volt. If HO2S is not as specified, replace HO2S.

Sedona

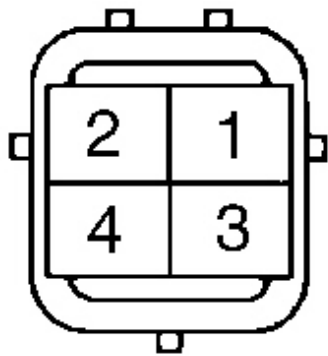
1. Disconnect front or rear HO2S 4-pin harness connector. At front or rear HO2S side connector measure resistance between terminals No. 3 and 4. see **Fig. 20** . HO2S heater resistance should be between 3-6 ohms at 68°F (20°C). If HO2S is not as specified, replace HO2S.
2. Connect HO2S connector. Start and run engine at normal operating temperature for at least 10 minutes. Using scan tool, lab scope or voltmeter, monitor appropriate HO2S signal. If using voltmeter or lab scope, connect positive lead to right front HO2S harness connector terminal No. 2 (Yellow/Green wire) or to left front HO2S harness connector terminal No. 2 (Blue wire). Connect negative lead to ground. On rear HO2S, connect positive lead to right rear HO2S connector terminal No. 2 (White/Yellow wire) or to left rear HO2S connector terminal No. 2 (Red wire). Signal should switch from lean to rich, or rich to lean, at least 3 times every 10 seconds. Front HO2S signal should switch between 0-1 volt. Rear HO2S signal should switch between .6-.9 volt. If HO2S is not as specified, replace HO2S.

Spectra

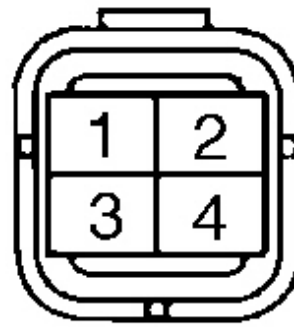
1. Disconnect front or rear HO2S 4-pin harness connector. At front or rear HO2S side connector measure resistance between terminals No. 1 and 3. See **Fig. 20** . HO2S heater resistance should be between 2-4 ohms at 68°F (20°C). If HO2S is not as specified, replace HO2S.
2. Connect HO2S connector. Start and run engine at normal operating temperature for at least 10 minutes. Using scan tool, lab scope or voltmeter, monitor appropriate HO2S signal. If using voltmeter or lab scope, connect positive lead to front HO2S harness connector terminal No. 4 (Green/Brown wire) or to rear HO2S harness connector terminal No. 4 (Green/White wire). Connect negative lead to ground. HO2S signal should switch from lean to rich, or rich to lean, at least 3 times every 10 seconds. Front HO2S signal should switch between 0-1 volt. Rear HO2S signal should switch between .6-.8 volt. If HO2S is not as specified, replace HO2S.

Sportage

1. Disconnect front or rear HO2S 4-pin harness connector. At front or rear HO2S side connector measure resistance between terminals No. 1 and 3. See **Fig. 20** . HO2S heater resistance should be between 6 ohms at 68°F (20°C). If HO2S is not as specified, replace HO2S.
2. Connect HO2S connector. Start and run engine at normal operating temperature for at least 10 minutes. Using scan tool, lab scope or voltmeter, monitor appropriate HO2S signal. If using voltmeter or lab scope, connect positive lead to front HO2S harness connector terminal No. 4 (Yellow/White wire) or to rear HO2S connector harness terminal No. 4 (Blue wire). HO2S signal should switch from lean to rich, or rich to lean, at least 3 times every 10 seconds. Front HO2S signal should switch between .1-.9 volts. Rear signal should switch between .6-.7 volts. If HO2S is not as specified, replace HO2S.



**SENSOR SIDE
CONNECTOR**



**HARNESS SIDE
CONNECTOR**

G00012869

Fig. 20: Identifying Front & Rear Heated Oxygen Sensor Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE AIR TEMPERATURE SENSOR

NOTE: Only component testing procedure is covered. For Intake Air Temperature (IAT) sensor system and circuit testing procedure, see appropriate **SELF-DIAGNOSTICS** article.

NOTE: For IAT sensor location. See Fig. 1 -Fig. 6 .

NOTE: For IAT sensor removal and installation, see appropriate **INTAKE AIR TEMPERATURE SENSOR** under **ENGINE SENSORS & SWITCHES** in **REMOVAL, OVERHAUL & INSTALLATION** article.

Optima (2.4L), Sedona & Spectra

IAT sensor, is built into Mass Air Flow (MAF) sensor. Disconnect MAF/IAT sensor 5-pin harness connector. Measure resistance between IAT sensor terminal No. 1 and 2 for Optima (2.4L) and Spectra. And terminal No. 1 and 3 for Sedona. See Fig. 21 . Resistance should be 2.22-2.82 k/ohms at 68°F (20°C). If resistance is not as specified, replace IAT sensor.

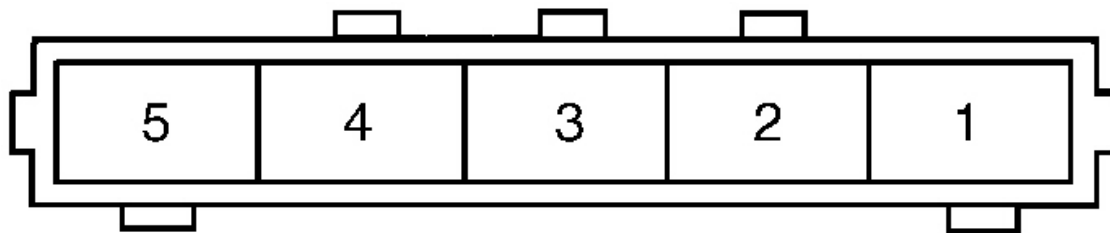
Optima (2.7L)

Disconnect IAT sensor 2-pin harness connector. Located IAT sensor on back part of intake manifold. Measure resistance between IAT sensor terminals No. 1 and 2. See Fig. 21 . Resistance should be 2.22-2.82 k/ohms at 68°F (20°C). If resistance is not as specified, replace IAT sensor.

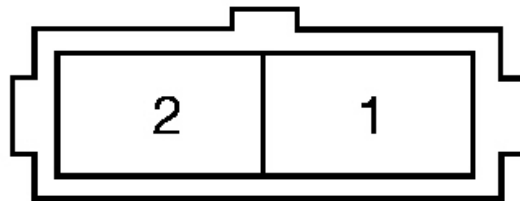
Disconnect IAT sensor 2-pin harness connector. Locate IAT sensor on intake manifold, near fuel injector No. 4. Measure resistance between IAT sensor terminals 1 and 2. See **Fig. 21** . Resistance should be 2.22-2.82 k/ohms at 68°F (20°C). If resistance is not as specified, replace IAT sensor.

Sportage

Disconnect IAT sensor 2-pin harness connector. Located IAT sensor on air cleaner assembly. Measure resistance between IAT sensor terminals No. 1 and 2. See **Fig. 21** . Resistance should be 2.22-2.82 k/ohms at 68°F (20°C). If resistance is not as specified, replace IAT sensor.



OPTIMA 2.4L, SEDONA & SPECTRA



OPTIMA 2.7L, RIO & SPORTAGE

G00102633

Fig. 21: Identifying Intake Air Temperature Sensor Connectors & Terminals
Courtesy of KIA MOTORS AMERICA, INC.

KNOCK SENSOR

NOTE: Only component testing procedure is covered. See appropriate SELF-DIAGNOSTICS article.

NOTE: For Knock sensor location, see **Fig. 1 -Fig. 6** .

NOTE: For Knock sensor removal and installation, see appropriate KNOCK SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

Optima (2.4L)

Knock sensor is located on left side of engine block. Disconnect 2-pin harness connector from sensor. At component side connector measure resistance between terminals No. 1 and 2. See **Fig. 22** . Resistance should be 4.50-5.50 k/ohms at 68°F (20°C). If resistance is not as specified, replace Knock sensor.

Optima (2.7L)

There are 2 knock sensors, one on each side of block. Disconnect 3-pin harness from sensor. At component side connector measure resistance between terminals No. 2 and 3. See **Fig. 22** . Resistance should be 4.50-5.50 k/ohms at 68°F (20°C). If resistance is not as specified, replace Knock sensor.

Rio

Remove knock sensor from engine. Mount knock sensor in jaws of bench vise. Connect voltmeter between knock sensor connector terminals No. 1 and 2. See **Fig. 22** . Using hammer, sharply rap on bench vise and check for voltage spike (less than one volt). If no voltage spike is observed, replace knock sensor.

Sedona

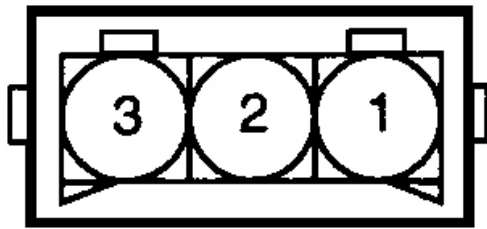
Knock sensor is located on right side of engine block. Disconnect 2-pin harness connector from sensor. At component side connector measure resistance between terminals No. 1 and 2. See **Fig. 22** . Resistance should be 4.50-5.50 k/ohms at 68°F (20°C). If resistance is not as specified, replace Knock sensor.

Spectra

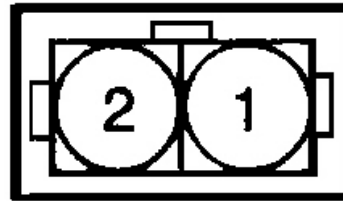
Remove knock sensor from engine. Mount knock sensor in jaws of bench vise. Connect voltmeter between knock sensor connector terminals No. 1 and 2. See **Fig. 22** . Using hammer, sharply rap on bench vise and check for voltage spike (less than one volt). If no voltage spike is observed, replace knock sensor.

Sportage

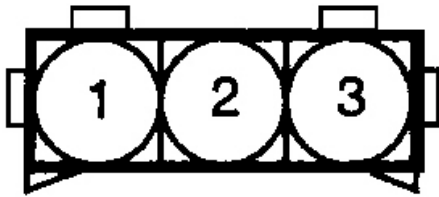
Knock sensor is located on right side of engine, above oil filter. Turn ignition on. Backprobe and measure voltage between knock sensor connector terminal No. 1 (Yellow/Green wire) and ground. See **Fig. 22** . Tap engine crossmember bracket and check for voltage spike (less than one volt). If no voltage spike is observed, replace knock sensor.



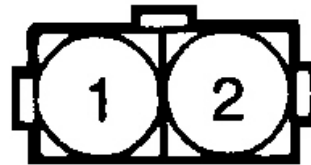
SENSOR SIDE
CONNECTOR



SENSOR SIDE
CONNECTOR



HARNESS SIDE
CONNECTOR



HARNESS SIDE
CONNECTOR

G00102634

Fig. 22: Identifying Knock Sensor Connectors & Terminals

Courtesy of KIA MOTORS AMERICA, INC.

MASS AIR FLOW SENSOR

NOTE: Only component testing procedure is covered. For Mass Air Flow (MAF) sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For MAF sensor location. See Fig. 1 -Fig. 6 .

NOTE: For MAF sensor removal and installation, see appropriate MASS AIR FLOW SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

Optima

Warm up engine to normal operating temperature and let idle. Using DVOM to backprobe, measure voltage between following MAF sensor harness connector terminals and ground:

- On 2.4L, terminal No. 5 (Brown wire). See **Fig. 23** . At idle, voltage should be 1.2-1.6 volts. When engine is accelerated voltage should increase, at 3000 RPM voltage should be between 1.6-2.2 volts. If voltage is not as specified, replace MAF sensor.

- On 2.7L, terminal No. 2 (Yellow wire). See **Fig. 23** . At idle, voltage should be 0.6-1.0 volts. When engine is accelerated voltage should increase, at 2000 RPM voltage should be between 1.0-1.6 volts. If voltage is not as specified, replace MAF sensor.

Rio

Warm up engine to normal operating temperature and let idle. Backprobe and measure voltage between MAF sensor harness connector terminal No. 2 (Green/Blue wire) and ground. See **Fig. 23** . At idle, voltage should be 0.6-0.8 volts. When engine is accelerated, voltage should be between 3.0-4.0 volts at 3000 RPM. If voltage is not as specified, replace MAF sensor.

Sedona

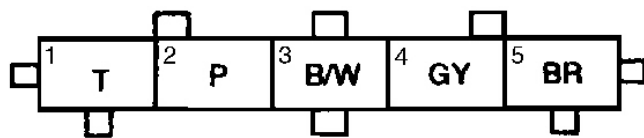
Warm up engine to normal operating temperature and let idle. Backprobe and measure voltage between MAF sensor harness connector terminal No. 5 (Brown wire) and ground. See **Fig. 23** . At idle, voltage should be 0.6-0.8 volts. When engine is accelerated, voltage should be about 1.0 volts at 2000 RPM. If voltage is not as specified, replace MAF sensor.

Spectra

Warm up engine to normal operating temperature and let idle. Backprobe and measure voltage between MAF sensor harness connector terminal No. 5 (Red/White wire) and ground. See **Fig. 23** . At idle, voltage should be 0.8-1.2 volts. When engine is accelerated, voltage should be between 3.5-4.0 volts at 3000 RPM. If voltage is not as specified, replace MAF sensor.

Sportage

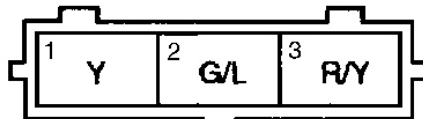
Warm up engine to normal operating temperature and let idle. Backprobe and measure voltage between MAF sensor harness connector terminal No. 1 (Red/Green wire) and ground. See **Fig. 23** . At idle, voltage should be 0.8-1.2 volts. When engine is accelerated, voltage should be between 3.5-4.0 volts at 3300 RPM. If voltage is not as specified, replace MAF sensor.



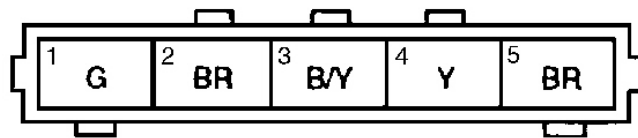
OPTIMA (2.4L)



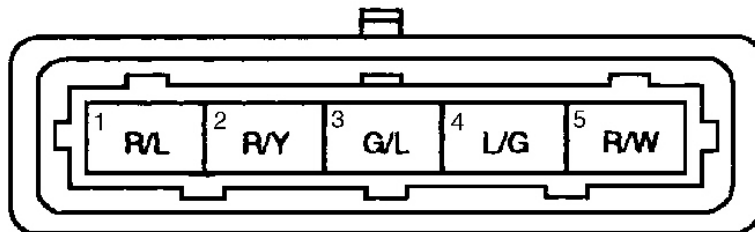
OPTIMA (2.7L)



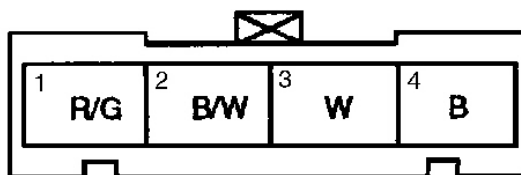
RIO



SEDONA



SPECTRA



SPORTAGE

G00102635

Fig. 23: Identifying Mass Air Flow Sensor Harness Connectors
Courtesy of KIA MOTORS AMERICA, INC.

MANIFOLD ABSOLUTE PRESSURE SENSOR

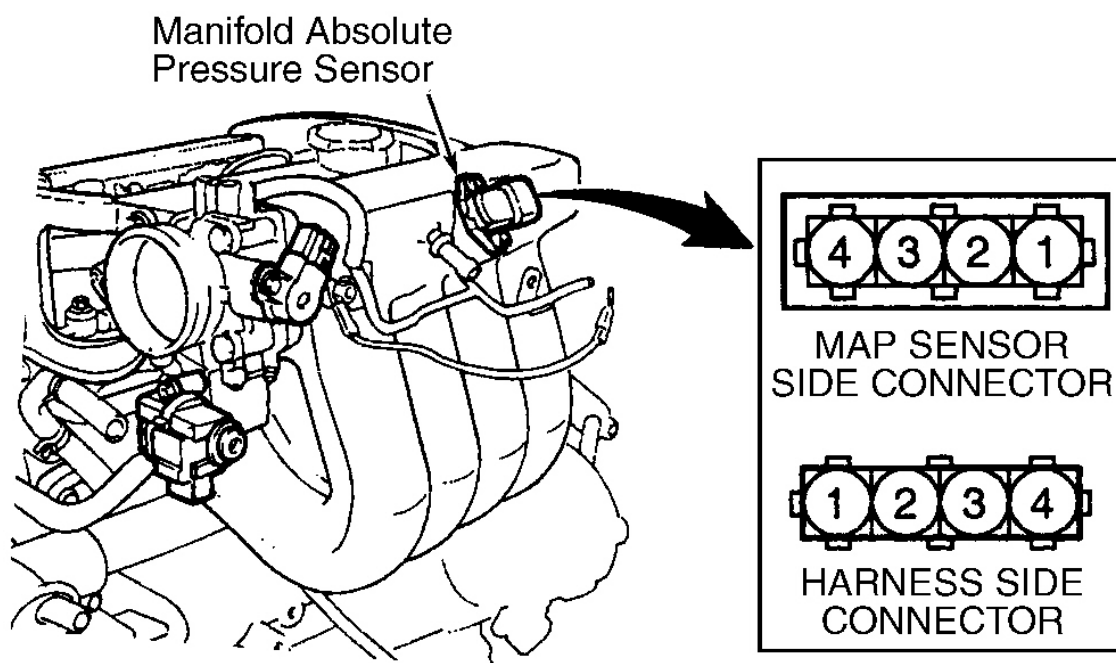
NOTE: Only component testing procedure is covered. For Manifold Absolute Pressure (MAP) sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For MAP sensor location, see Fig. 1 -Fig. 6 .

NOTE: For MAP sensor removal and installation, see appropriate **MANIFOLD ABSOLUTE PRESSURE SENSOR** under **ENGINE SENSORS & SWITCHES** in **REMOVAL, OVERHAUL & INSTALLATION** article.

Optima (2.4L) & Sedona

Turn ignition off. Locate MAP sensor on upper center part of intake manifold. Using DVOM backprobe MAP sensor 4-pin harness connectors terminal No. 1 and 4. See **Fig. 24** . Check voltage with ignition on. Voltage should be 4-5 volts. Also check voltage with engine running at idle. Voltage should be 0.8-2.4 volts. If voltage is not as specified, replace MAP sensor.



G00102638

Fig. 24: Identifying Manifold Absolute Pressure Sensor Connectors & Terminals
Courtesy of KIA MOTORS AMERICA, INC.

THROTTLE POSITION SENSOR

NOTE: Only component testing procedure is covered. For Throttle Position (TP) sensor system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For TP sensor location. See **Fig. 1 -Fig. 6** .

NOTE: For TP sensor removal and installation, see appropriate **THROTTLE POSITION SENSOR** under **ENGINE SENSORS & SWITCHES** in **REMOVAL, OVERHAUL & INSTALLATION** article.

Optima (2.4L)

1. Turn ignition off. Disconnect TP 3-pin sensor harness connector. Measure resistance at component side between connector terminals No. 2 and 3. See **Fig. 25** . With throttle fully closed, resistance should be 3.5-6.5 k/ohms. If resistances are as specified, go to next step. If resistances are not as specified, Adjust or replace TP sensor as necessary.
2. Connect TP sensor connector. Turn ignition on. Backprobe and measure voltage between TP sensor connector terminals No. 1 (Blue wire) and No. 3 (Black/White wire). See **Fig. 25** . With throttle fully closed voltage should be .3-.9 volts. With throttle wide open, voltage should be 4.0-4.6 volts. If voltages are not as specified, Adjust or replace TP sensor as necessary.

Optima (2.7L)

1. Turn ignition off. Disconnect TP sensor 3-pin harness connector. Measure resistance at component side between connector terminals No. 2 and 3. See **Fig. 25** . With throttle fully closed, resistance should be 1.6-2.4 k/ohms. If resistances are as specified, go to next step. If resistances are not as specified, Adjust or replace TP sensor as necessary.
2. Connect TP sensor connector. Turn ignition on. Backprobe and measure voltage between TP sensor connector terminals No. 1 (Blue wire) and No. 2 (Black/White wire). See **Fig. 25** . With throttle fully closed voltage should be .2-.8 volts. With throttle wide open, voltage should be 4.0-4.4 volts. If voltages are not as specified, Adjust or replace TP sensor as necessary.

Rio

1. Turn ignition off. Disconnect TP sensor 3-pin harness connector. Measure resistance at component side between connector terminals No. 1 and 2. See **Fig. 25** . With throttle fully closed, resistance should be 1.6-2.4 k/ohms. If resistances are as specified, go to next step. If resistances are not as specified, replace TP sensor as necessary.
2. Connect TP sensor connector. Turn ignition on. Backprobe and measure voltage between TP sensor connector terminals No. 1 (White/Green) and No. 3 (Blue/Orange wire). See **Fig. 25** . With throttle fully closed voltage should be .2-.8 volts. With throttle wide open, voltage should be 4.0-4.8 volts. If voltages are not as specified, replace TP sensor as necessary.

Sedona

1. Turn ignition off. Disconnect TP sensor 4-pin harness connector. Measure resistance at component side between connector terminals No. 1 and 4. See **Fig. 25** . With throttle fully closed, resistance should be 3.5-6.5 k/ohms. If resistances are as specified, go to next step. If resistances are not as specified, Adjust or replace TP sensor as necessary.
2. Connect TP sensor connector. Turn ignition on. Backprobe and measure voltage between TP sensor

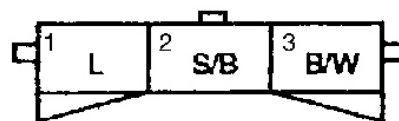
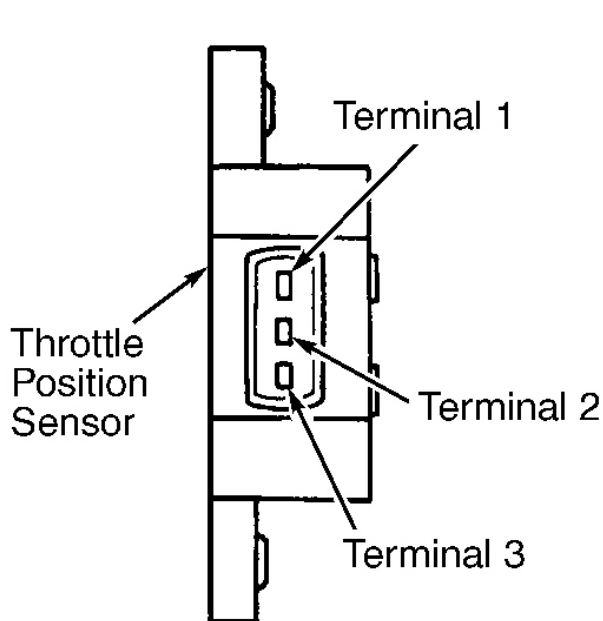
connector terminals No. 2 (Red/Green wire) and No. 4 (Black/Yellow wire). See **Fig. 25** . With throttle fully closed voltage should be .3-.9 volts. With throttle wide open, voltage should be 4.0-4.6 volts. If voltages are not as specified, Adjust or replace TP sensor as necessary.

Spectra

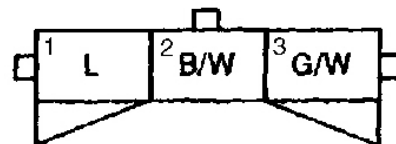
1. Turn ignition off. Disconnect TP sensor 3-pin harness connector. Measure resistance at component side between connector terminals No. 1 and 2. See **Fig. 25** . With throttle fully closed, resistance should be 1.6-2.4 k/ohms. As throttle is opened, resistance should smoothly increase linearly to 4.1-4.3 k/ohms at wide open throttle. If resistances are as specified, go to next step. If resistances are not as specified, replace TP sensor as necessary.
2. Connect TP sensor connector. Turn ignition on. Backprobe and measure voltage between TP sensor connector terminals No. 1 (Black/Green wire) and No. 3 (Blue/Orange wire). See **Fig. 25** . With throttle fully closed, voltage should be .3-.9 volts. With throttle wide open, voltage should be 4.0-4.4 volts. If voltages are not as specified, replace TP sensor as necessary.

Sportage

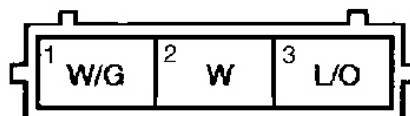
1. Disconnect TP sensor 3-pin connector. Measure resistance at component side between TP sensor connector terminals No. 1 and 2. See **Fig. 25** . Resistance should be about 1.0 k/ohms with throttle closed and about one ohm with throttle wide open. If resistances are as specified, go to next step. If resistances are not as specified, replace TP sensor as necessary.
2. Connect TP sensor connector. Turn ignition on. Backprobe and measure voltage between TP sensor connector terminals No. 1 (Green/Yellow wire) and No. 3 (Yellow/Black wire). See **Fig. 25** . With throttle fully closed, voltage should be about .5 volts. With throttle wide open, voltage should be about 4.1 volts. If voltages are not as specified, replace TP sensor as necessary.



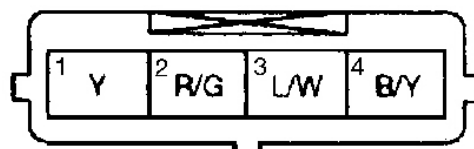
OPTIMA (2.4L)



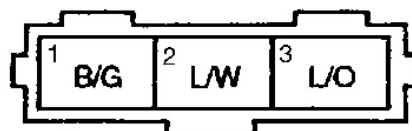
OPTIMA (2.7L)



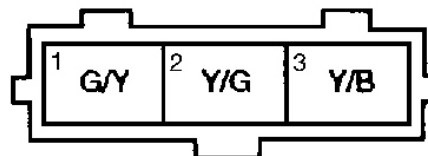
RIO



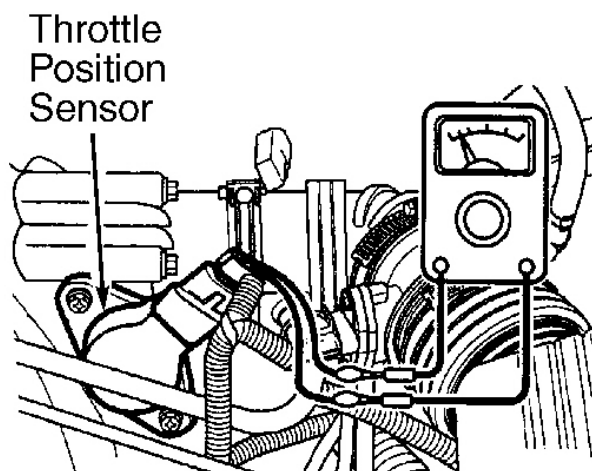
SEDONA



SPECTRA



SPORTAGE



BACKPROBE

G00102636

Fig. 25: Identifying Throttle Position Sensor Terminal & Connector
Courtesy of KIA MOTORS AMERICA, INC.

VEHICLE SPEED SENSOR

NOTE: Only component testing procedure is covered. For Vehicle Speed Sensor (VSS) system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For VSS sensor location. See Fig. 1 -Fig. 6 .

NOTE: For VSS sensor removal and installation, see appropriate **VEHICLE SPEED SENSOR** under **ENGINE SENSORS & SWITCHES** in **REMOVAL, OVERHAUL & INSTALLATION** article.

Optima

Remove VSS from rear of transmission at top of transaxle. Connect 3-10 k/ohm resistor as shown in **Fig. 26** . Connect voltmeter between terminals No. 2 and 3. Spin shaft of VSS and check for voltage pulsations. There should be 4 voltage pulsations per revolution. If there are not 4 pulsations per revolution, replace VSS.

Rio

VSS is mounted on rear of transmission at top of transaxle. Raise and support vehicle. Block one drive wheel. Turn ignition on. Backprobe and measure voltage between VSS connector terminal No. 3 (Green/Orange) wire and ground while assistant spins free drive wheel. Voltage should toggle between 1-10 volts as wheel is rotated. If voltage does not toggle as specified, replace VSS.

Sedona

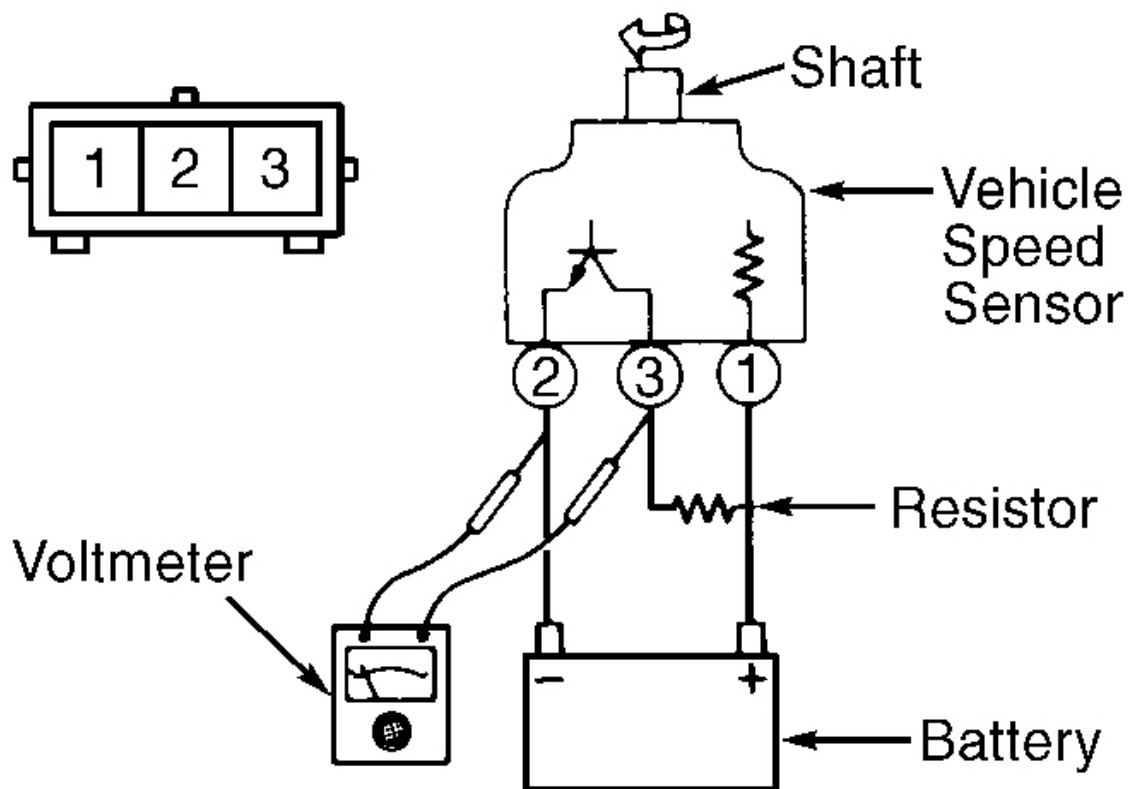
Remove VSS from rear of transmission at top of transaxle. Connect 3-10 k/ohm resistor as shown in **Fig. 26** . Connect voltmeter between terminals No. 2 and 3. Spin shaft of VSS and check for voltage pulsations. There should be 4 voltage pulsations per revolution. If there are not 4 pulsations per revolution, replace VSS.

Spectra

VSS is mounted on rear of transmission at top of transaxle. Raise and support vehicle. Block one drive wheel. Turn ignition on. Backprobe and measure voltage between VSS connector terminal No. 1 (Green/Orange wire - A/T) or No. 3 (Green/Orange wire - M/T) and ground while assistant spins free drive wheel. Voltage should toggle between 1-10 volts as wheel is rotated. If voltage does not toggle as specified, replace VSS.

Sportage

On 2WD, VSS is mounted on right side of transmission. On 4WD, VSS is mounted at left rear (transfer case) side of transmission. Raise and support vehicle. Block one drive wheel. Disconnect VSS 2-pin harness connector. Connect DVOM at sensor terminal No. 1 & 2, measure sensor resistance while assistant spins free drive wheel. Resistance should toggle between 0-10 ohms. If voltage does not toggle as specified, replace VSS.



G95J31541

Fig. 26: Testing Vehicle Speed Sensor
 Courtesy of KIA MOTORS AMERICA, INC.

BRAKE PEDAL SWITCH

NOTE: Only component testing procedure is covered. For brake pedal switch circuit testing, see appropriate **WIRING DIAGRAM** article.

Optima (With Cruise Control)

1. Disconnect brake pedal switch 4-pin harness connector. Locate brake pedal switch mounted at upper part of brake pedal assembly. Measure resistance between brake pedal switch terminals No. 1 and 2. See **Fig. 27**. With brake pedal released, there should be no continuity. With brake pedal depressed, there should be continuity. Adjust or replace switch as necessary.
2. Measure resistance between brake pedal switch terminals No. 3 and 4. With brake pedal released, there should be continuity. With brake pedal depressed, there should be no continuity. Adjust or replace switch as necessary.

Optima (Without Cruise Control)

1. Disconnect brake pedal switch 2-pin harness connector. Locate brake pedal switch mounted at upper part of brake pedal assembly. Measure resistance between brake pedal switch terminals No. 1 and 2. See **Fig. 27**. With brake pedal released, there should be no continuity. With brake pedal depressed, there should

be continuity. Adjust or replace switch as necessary.

Rio

1. Disconnect brake pedal switch 2-pin harness connector. Locate brake pedal switch mounted at upper part of brake pedal assembly. Measure resistance between brake pedal switch terminals No. 1 and 2. See **Fig. 27** . With brake pedal released, there should be no continuity. With brake pedal depressed, there should be continuity. Adjust or replace switch as necessary.

Sedona

1. Disconnect brake pedal switch 4-pin harness connector. Locate brake pedal switch mounted at upper part of brake pedal assembly. Measure resistance between brake pedal switch terminals No. 1 and 4 (Red wire and White wire). See **Fig. 27** . With brake pedal released, there should be no continuity. With brake pedal depressed, there should be continuity.
2. Measure resistance between brake pedal switch terminals No. 2 and 3 (Green/White wire and Yellow wire). With brake pedal released, there should be continuity. With brake pedal depressed, there should be no continuity. Adjust or replace switch as necessary.

Spectra (With Cruise Control)

1. Disconnect brake pedal switch 4-pin harness connector. Locate brake pedal switch mounted at upper part of brake pedal assembly. Measure resistance between brake pedal switch terminals No. 1 and 4 (Pink/Black wire and Red/Black wire). See **Fig. 27** . With brake pedal released, there should be no continuity. With brake pedal depressed, there should be continuity.
2. Measure resistance between brake pedal switch terminals No. 2 and 3 (Blue wire and Brown/Red wire). With brake pedal released, there should be continuity. With brake pedal depressed, there should be no continuity. Adjust or replace switch as necessary.

Spectra (Without Cruise Control)

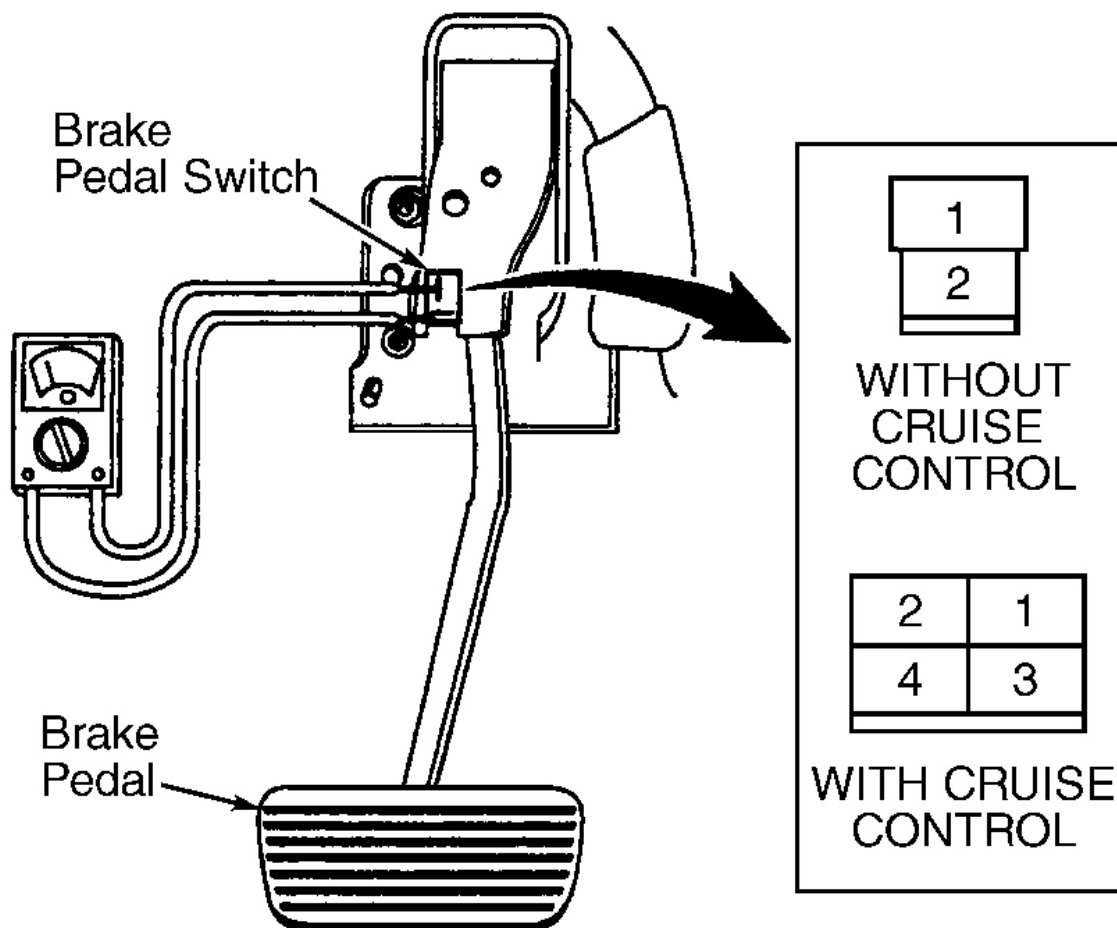
1. Disconnect brake pedal switch 2-pin harness connector. Locate brake pedal switch mounted at upper part of brake pedal assembly. Measure resistance between brake pedal switch terminals No. 1 and 2. See **Fig. 27** . With brake pedal released, there should be no continuity. With brake pedal depressed, there should be continuity. Adjust or replace switch as necessary.

Sportage (With Cruise Control)

1. Disconnect brake pedal switch 4-pin harness connector. Locate brake pedal switch mounted at upper part of brake pedal assembly. Measure resistance between brake pedal switch terminals No. 1 and 4 (Yellow wire and Orange wire). See **Fig. 27** . With brake pedal released, there should be no continuity. With brake pedal depressed, there should be continuity.
2. Measure resistance between brake pedal switch terminals No. 2 and 3 (Blue wire and Gray wire). With brake pedal released, there should be continuity. With brake pedal depressed, there should be no continuity. Adjust or replace switch as necessary.

Sportage (Without Cruise Control)

1. Disconnect brake pedal switch 2-pin harness connector. Locate brake pedal switch mounted at upper part of brake pedal assembly. Measure resistance between brake pedal switch terminals No. 1 and 2. See **Fig. 27** . With brake pedal released, there should be no continuity. With brake pedal depressed, there should be continuity. Adjust or replace switch as necessary.



G00102639

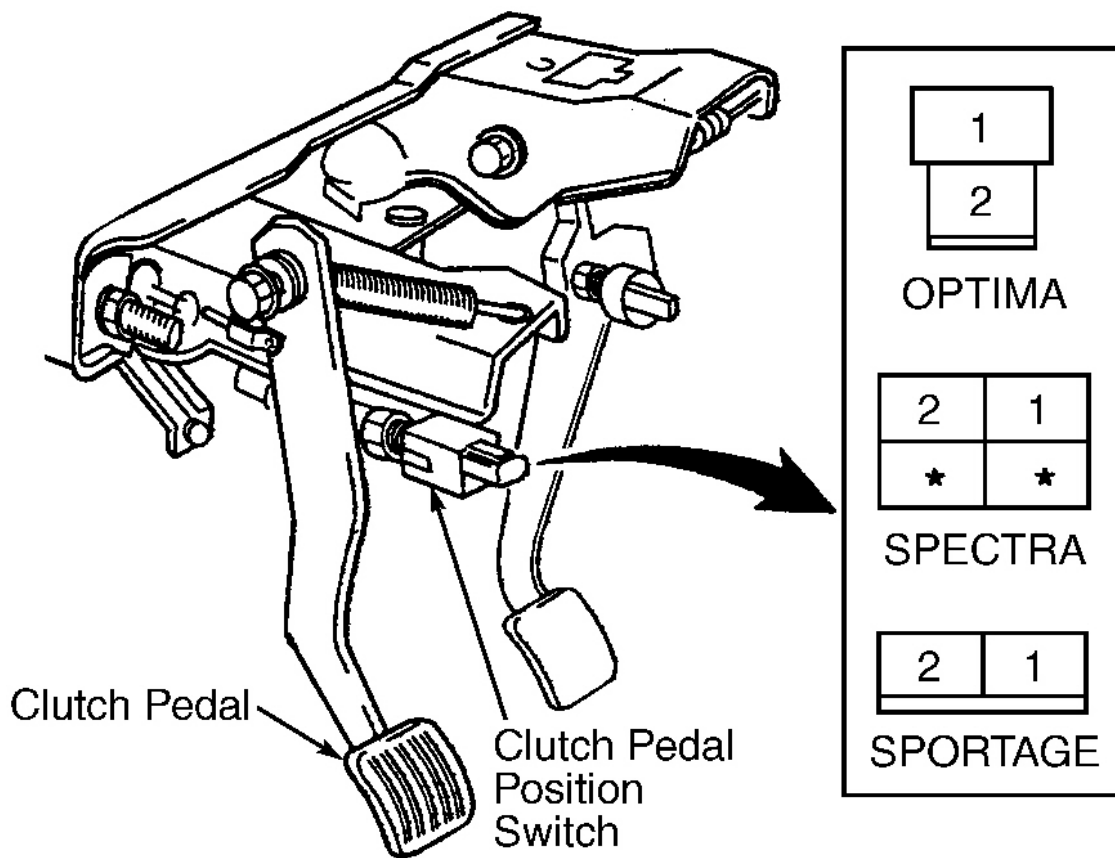
Fig. 27: Identifying Brake Switch Connector Terminals
Courtesy of KIA MOTORS AMERICA, INC.

CLUTCH PEDAL POSITION SWITCH

NOTE: Only component testing procedure is covered. For clutch pedal position switch circuit testing, see appropriate **WIRING DIAGRAM** article.

Optima, Spectra & Sportage

Disconnect Clutch Pedal Position (CPP) switch 2-pin harness connector. Locate CPP switch mounted at upper part of clutch pedal assembly. Check continuity between CPP switch terminals. See **Fig. 28** . With clutch pedal depressed, there should be continuity. With clutch pedal released, there should not be continuity. Adjust or replace CPP switch as necessary.



G00102640

Fig. 28: Identifying Clutch Pedal Position Switch Connector Terminals
 Courtesy of KIA MOTORS AMERICA, INC.

POWER STEERING PRESSURE SWITCH

NOTE: Only component testing procedure is covered. For Power Steering Pressure (PSP) switch system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For PSP sensor location. See Fig. 1 -Fig. 6 .

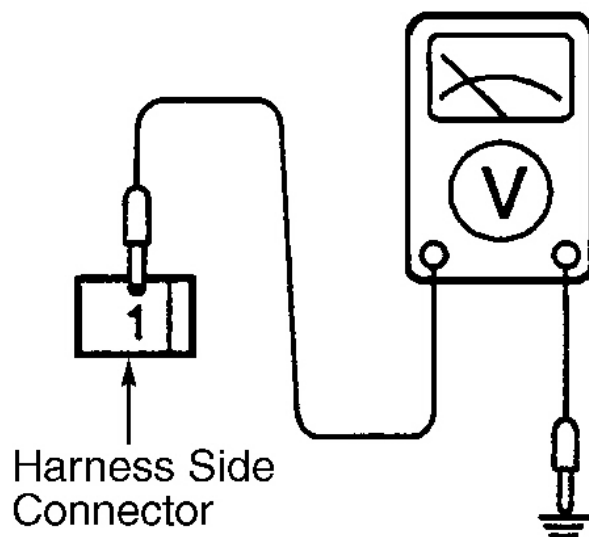
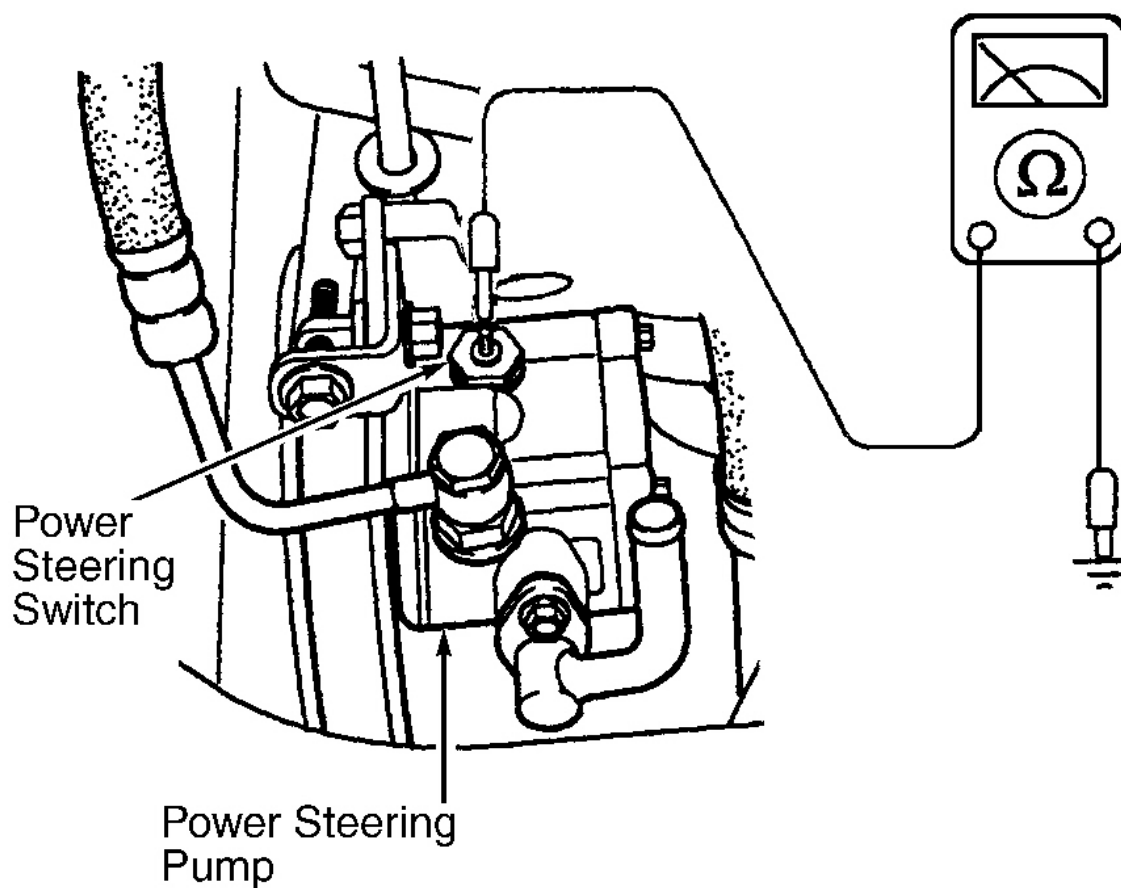
NOTE: For PSP sensor removal and installation, see appropriate POWER STEERING PRESSURE SENSOR under ENGINE SENSORS & SWITCHES in REMOVAL, OVERHAUL & INSTALLATION article.

Power Steering Pressure (PSP) switch closes in response to an increase in power steering fluid pressure (load condition). With switch closed, a monitored voltage circuit supplied by ECM is pulled low to vehicle ground through switch. ECM then sends a signal to ISC actuator to adjust idle speed to compensate for increased engine load.

1. Turn ignition off, disconnect power steering pressure switch 1-pin harness connector located on power

steering pump. Using a DVOM, check for continuity between switch and chassis ground. See **Fig. 29** . Start engine, continuity should not exist with wheels in straight-ahead position and engine idling. Continuity should exist when steering wheel is turned.

2. Turn engine off. Turn ignition switch to ON position. Measure voltage between switch connector and ground. If battery voltage is present, circuit is okay. If battery voltage is not present, repair circuit between switch and ECM.



G00102641

Fig. 29: Identifying Power Steering Switch Connector & Terminal
Courtesy of KIA MOTORS AMERICA, INC.

TRANSMISSION RANGE SWITCH

- NOTE:** Only component testing procedure is covered. For Transmission Range Switch system and circuit testing procedure, see appropriate **SELF-DIAGNOSTICS** article.
- NOTE:** For Transmission Range Switch location. See **Fig. 1 -Fig. 6** .
- NOTE:** For Transmission Range Switch removal and installation, see appropriate **TRANSMISSION RANGE SWITCH** under **ENGINE SENSORS & SWITCHES** in **REMOVAL, OVERHAUL & INSTALLATION** article.

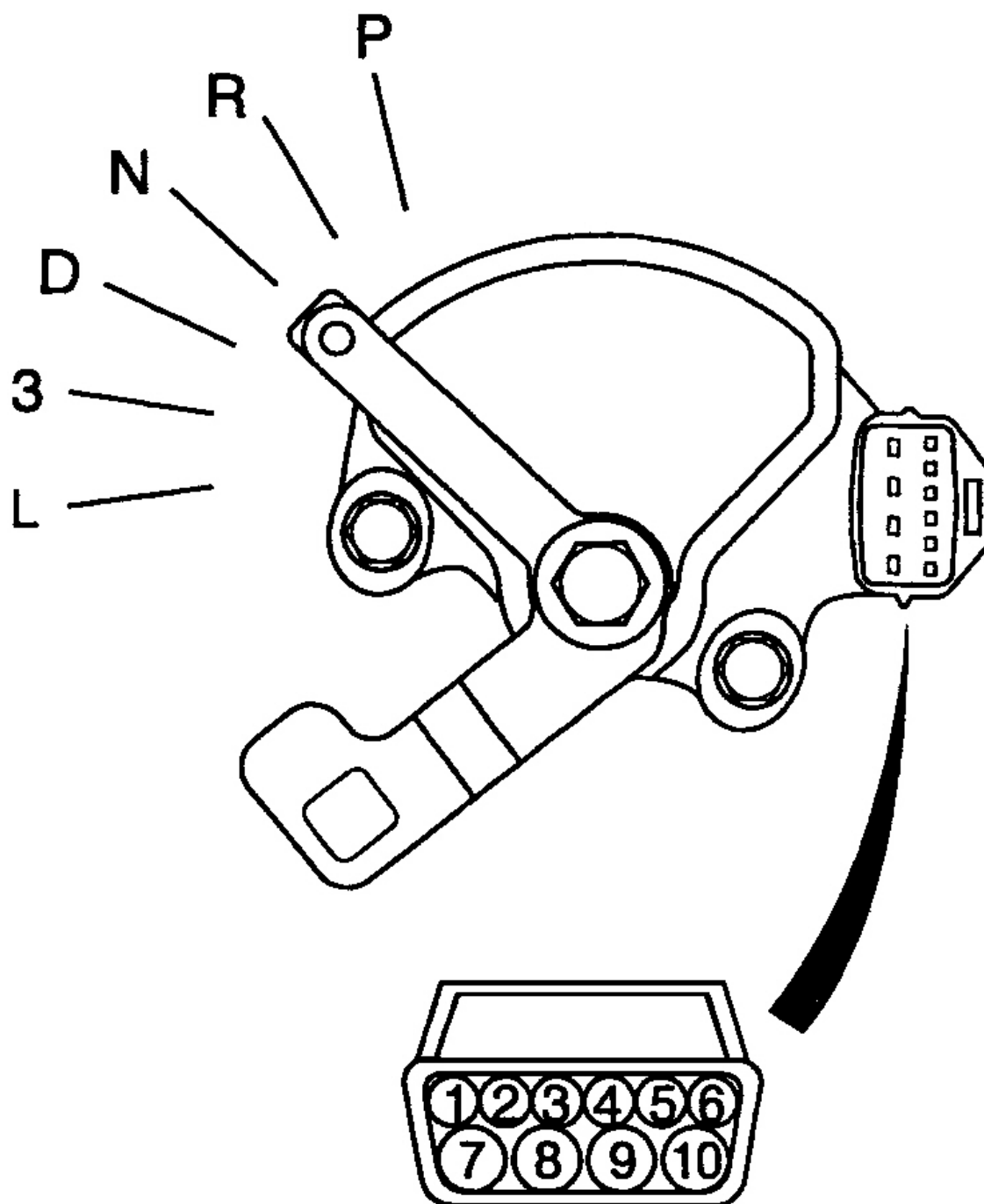
Transmission range switch is located on top left of transaxle (except Sportage). On Sportage 2WD, transmission range switch is located on right side of transmission. On Sportage 4WD, transmission range switch is located on left rear of transfer case.

Disconnect battery negative cable. Disconnect transmission range switch connector. Using DVOM, check continuity in between transmission range switch terminals. See **TRANSMISSION RANGE SWITCH SPECIFICATIONS** table. If sensor does not test as specified, adjust or repair as needed.

TRANSMISSION RANGE SWITCH SPECIFICATIONS

Gear Position	Continuity Between Terminals No.
Optima ⁽¹⁾	
Park	3 & 8; 9 & 10
Reverse	7 & 8
Neutral	4 & 8; 9 & 10
Drive	1 & 8
Third	5 & 8
Second	2 & 8
First	6 & 8
Rio ⁽²⁾	
Park	3 & 4; 1 & 2
Reverse	5 & 3
Neutral	1 & 2; 3 & 6
Drive	3 & 7
Second	3 & 8
First	3 & 9
Sedona ⁽¹⁾	
Park	3 & 8; 9 & 10
Reverse	7 & 8
Neutral	4 & 8; 9 & 10
Drive	1 & 8
Third	5 & 8

Low	2 & 8
Spectra ⁽³⁾	
Park	1 & 2; 3 & 4
Reverse	3 & 5
Neutral	1 & 2; 3 & 6
Drive	3 & 7
Second	3 & 8
First	3 & 9
Sportage ⁽⁴⁾	
Park	2 & 3; 6 & 7
Reverse	6 & 8
Neutral	2 & 3; 6 & 10
Drive	6 & 9
Second	6 & 4
First	6 & 5
(1) See Fig. 30 .	
(2) See Fig. 31 .	
(3) See Fig. 32 .	
(4) See Fig. 33 .	



G00102642

Fig. 30: Identifying Transaxle Range Switch Terminals (Optima & Sedona)
Courtesy of KIA MOTORS AMERICA, INC.

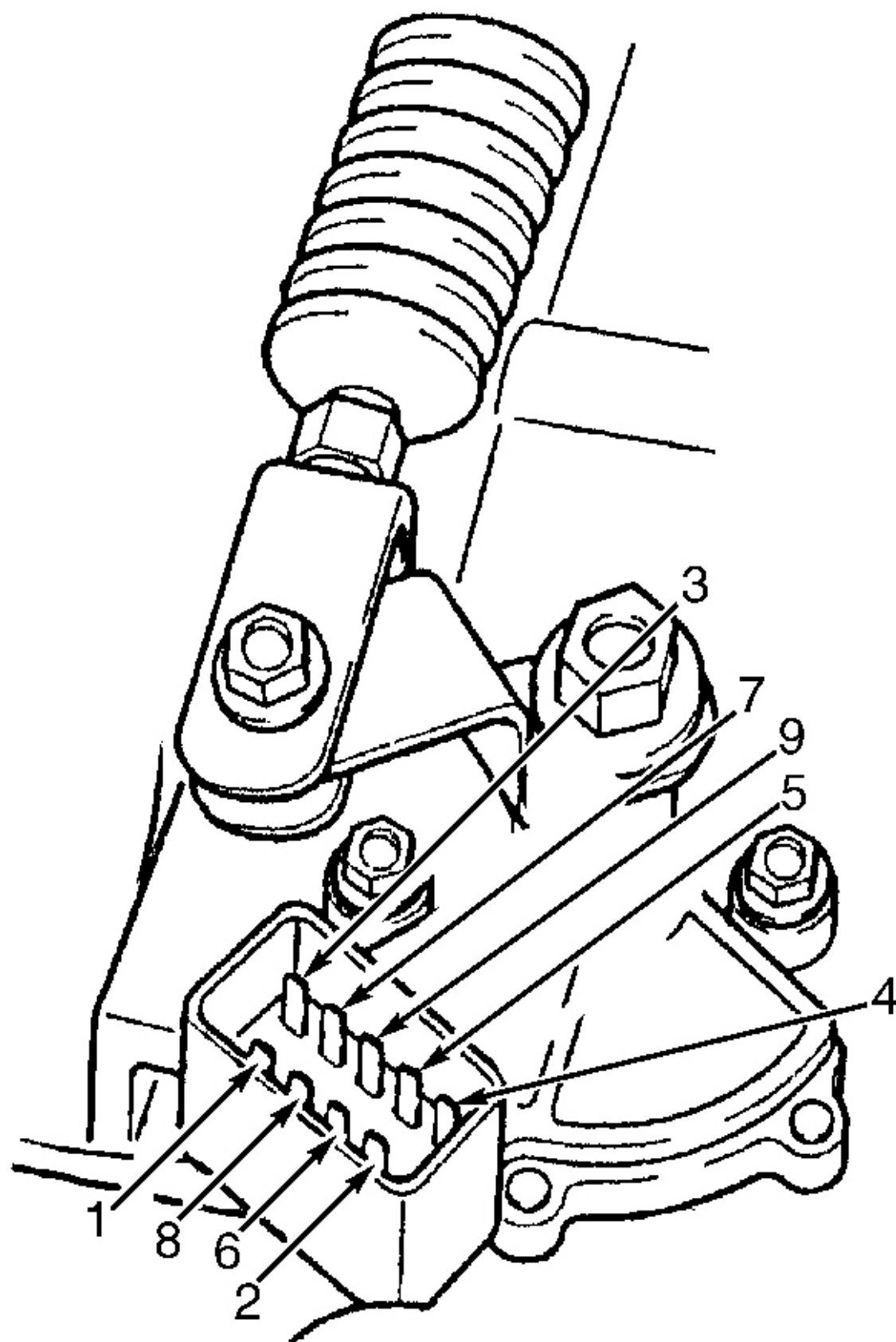
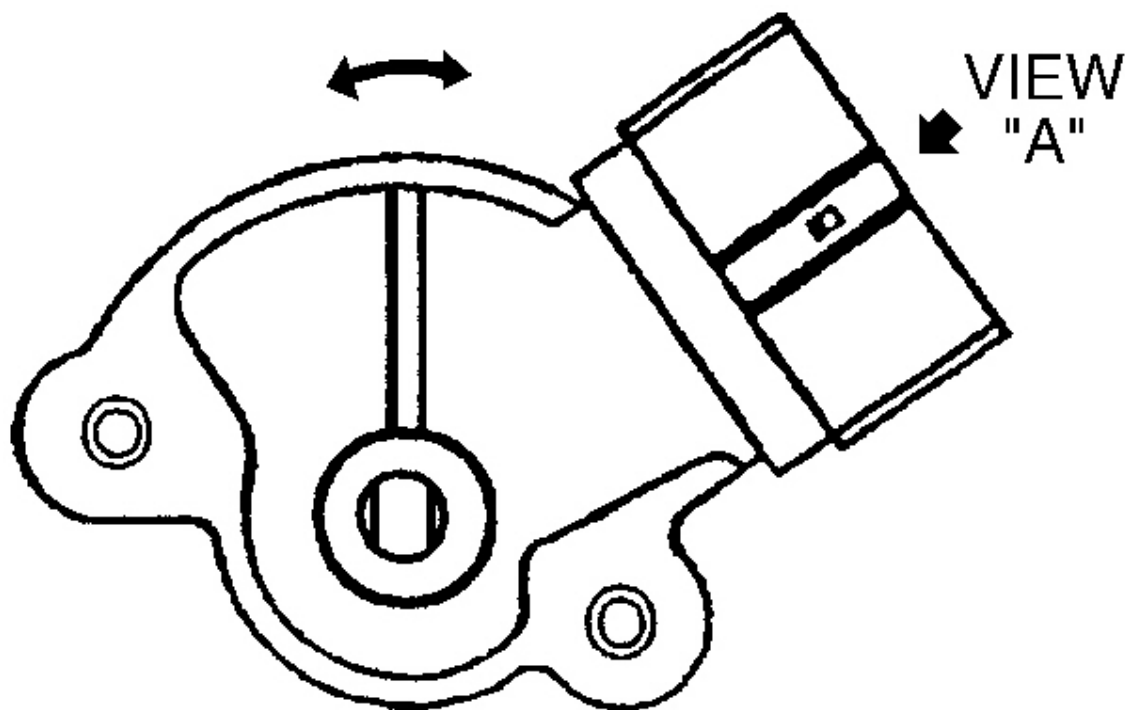


Fig. 31: Identifying Transaxle Range Switch Terminals (Rio)
Courtesy of KIA MOTORS AMERICA, INC.



3	7	9	5	4
1	8	6	2	

VIEW "A"

G99C51260

Fig. 32: Identifying Transaxle Range Switch Terminals (Spectra)
Courtesy of KIA MOTORS AMERICA, INC.

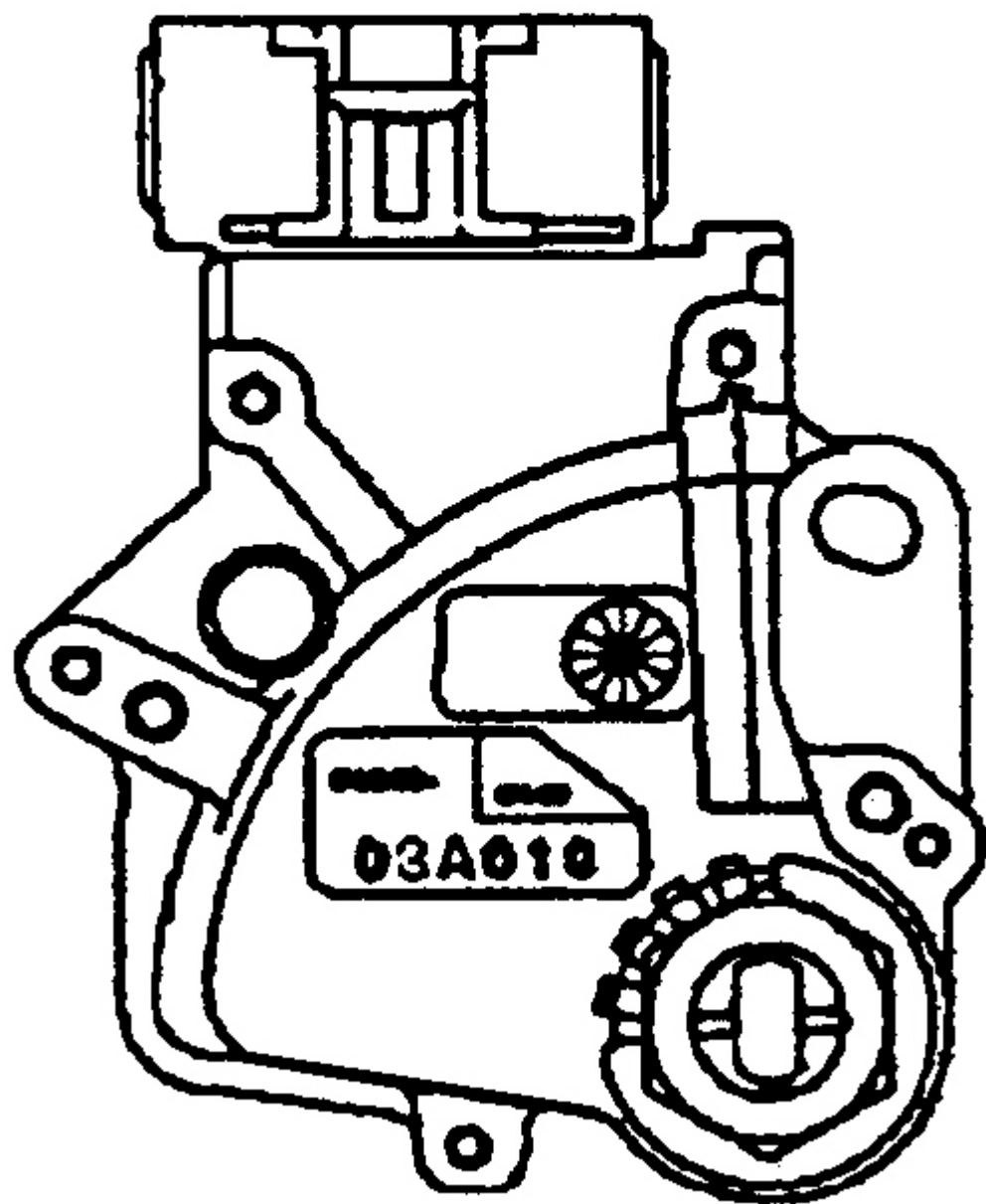
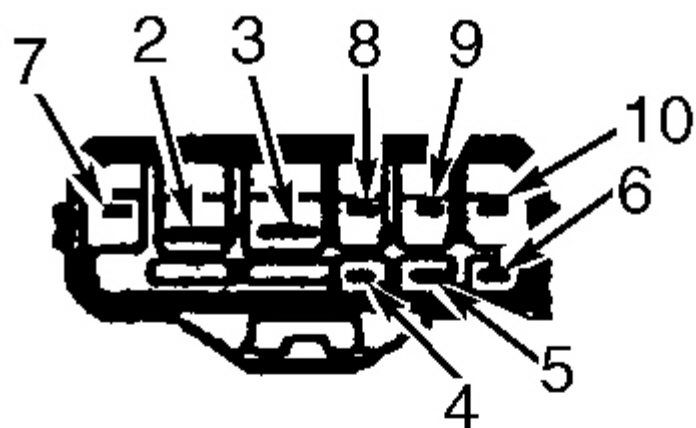


Fig. 33: Identifying Transmission Range Switch Terminals (Sportage)
Courtesy of KIA MOTORS AMERICA, INC.

RELAYS & SOLENOIDS

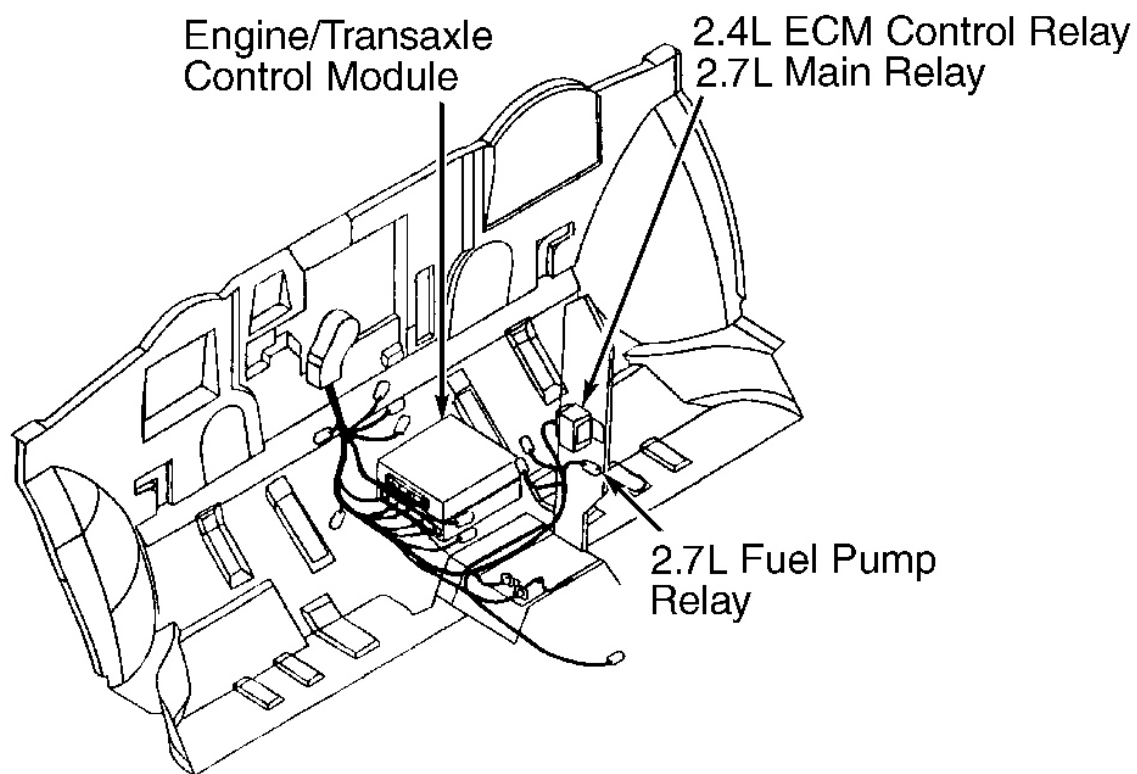
RELAYS

CAUTION: When applying direct battery voltage, ensure voltage is apply to correct terminal using a fused jumper wire, or relay damage could result.

NOTE: Only component testing procedure is covered. For circuit testing and identification, see **WIRING DIAGRAMS** article.

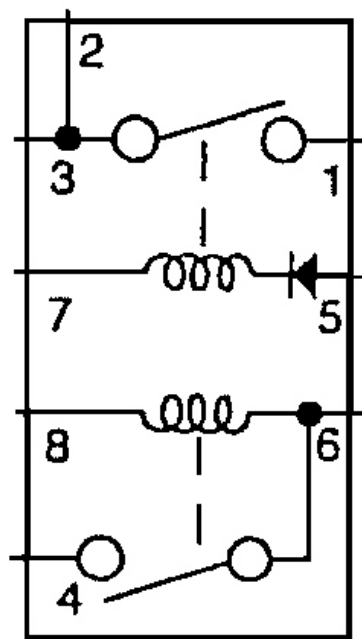
ECM Control Relay (Optima 2.4L)

1. Remove ECM control relay located in vehicle right side of dash. See **Fig. 34** . Check for continuity between relay terminals No. 1 and No. 3. See **Fig. 35** . If continuity does not exist, go to next step. If continuity exists, replace relay.
2. Check for continuity between relay terminals No. 4 and No. 6. See **Fig. 35** . If continuity does not exist, go to next step. If continuity exists, replace relay.
3. Connect a jumper wire between positive battery terminal and relay terminal No. 5. Connect another jumper wire between negative battery terminal and relay terminal No. 7. Check continuity between relay terminals No. 1 and No. 3. If continuity exist, go to next step. If continuity does not exist, replace relay.
4. Connect a jumper wire between positive battery terminal and relay terminal No. 6. Connect another jumper wire between negative battery terminal and relay terminal No. 8. Check for battery voltage at terminal No. 4. Voltage should exist. If battery voltage does not exist, replace relay.



G00102662

Fig. 34: Locating ECM Control, Fuel Pump & Main Relays (Optima 2.4L & 2.7L)
Courtesy of KIA MOTORS AMERICA, INC.



ECM CONTROL RELAY

G00038161

1	2	3	4
5	6	7	8

ECM CONTROL RELAY CONNECTOR

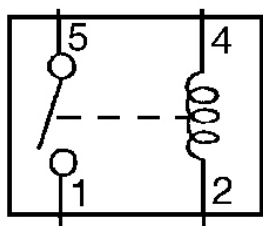
- | | |
|--------------|----------------|
| 1. Pink | 5. Orange |
| 2. Orange | 6. Pink |
| 3. Orange | 7. Tan |
| 4. Gray/Gray | 8. Green/White |

Fig. 35: Identifying ECM Control Relay, Connector & Terminals (Optima 2.4L)
 Courtesy of KIA MOTORS AMERICA, INC.

Fuel Pump & Main Relays (Optima 2.7L)

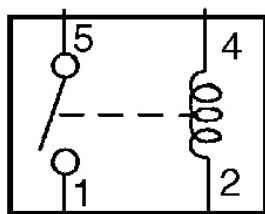
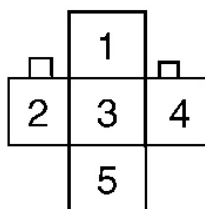
NOTE: Use same procedure to check fuel pump or main relay.

1. Remove fuel pump or main relay, located in vehicle right side of dash. See **Fig. 34** . Check for continuity between relay terminals No. 1 and No. 5. See **Fig. 36** . If continuity does not exist, go to next step. If continuity exists, replace relay.
2. Connect a jumper wire between positive battery terminal and relay terminal No. 4. Connect another jumper wire between negative battery terminal and relay terminal No. 2. Go to next step.
3. Check continuity between relay terminals No. 1 and No. 5. Continuity should exist. If continuity does not exist, replace relay.



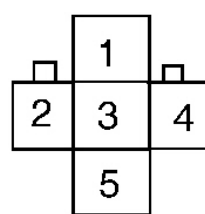
- | | |
|----------------|---------|
| 1. Gray | 4. Pink |
| 2. Green/White | 5. Red |
| 3. Not Used | |

FUEL PUMP RELAY



- | | |
|-------------|-----------|
| 1. Pink | 4. Orange |
| 2. Blue | 5. Orange |
| 3. Not Used | |

MAIN RELAY



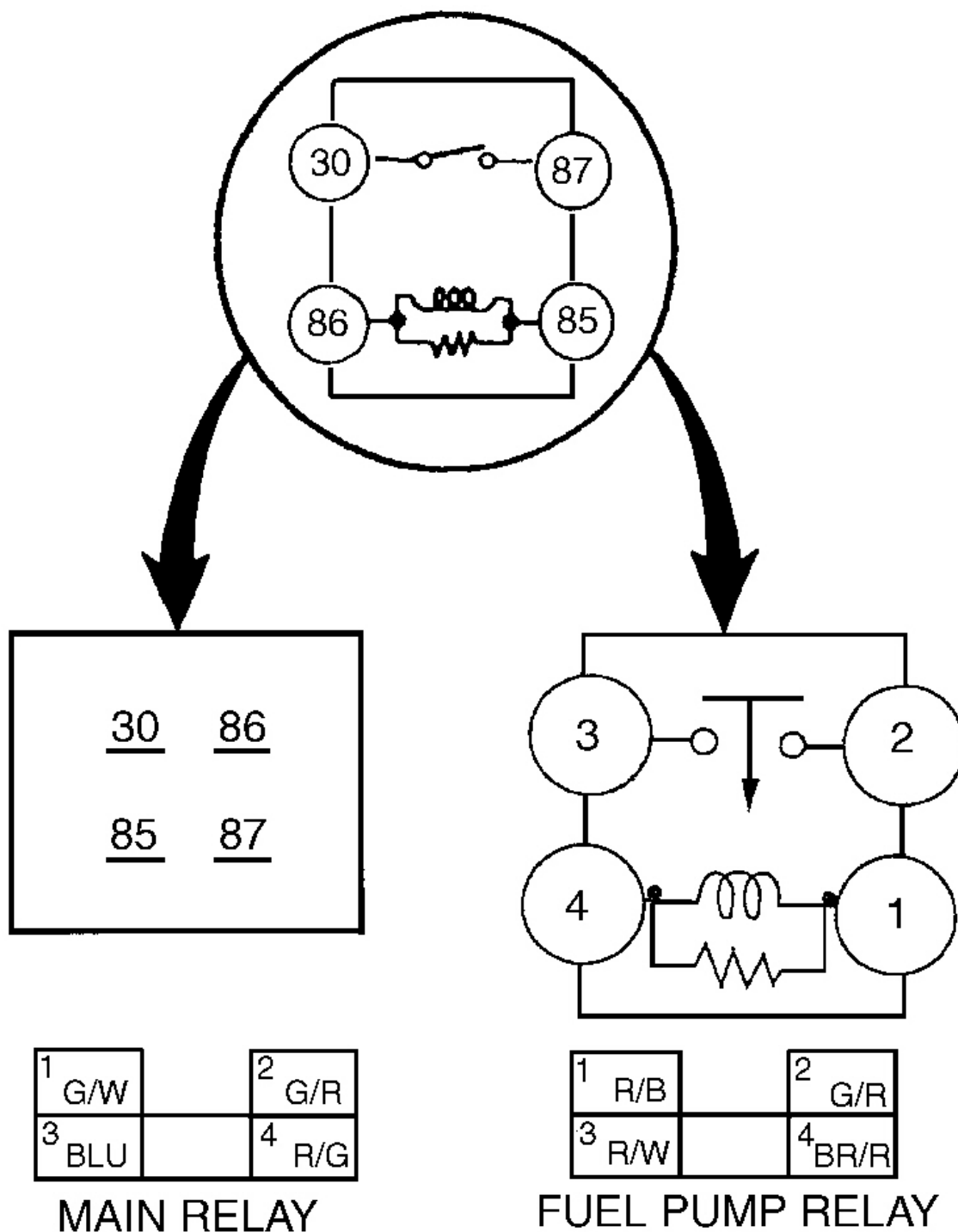
G00038160

Fig. 36: Identifying Fuel Pump & Main Relays, Connector & Terminals (Optima 2.7L)
 Courtesy of KIA MOTORS AMERICA, INC.

Fuel Pump & Main Relays (Rio)

NOTE: Use same procedure to check fuel pump or main relay.

1. Remove fuel pump or main relays from fuse/relay box. Located at left side of engine compartment. Check for continuity between relay terminals No. 2 and No. 3. See **Fig. 37** . If continuity does not exist, go to next step. If continuity exists, replace relay.
2. Connect a jumper wire between positive battery terminal and relay terminal No. 1. Connect another jumper wire between negative battery terminal and relay terminal No. 4. Go to next step.
3. Check continuity between relay terminals No. 2 and No. 3. Continuity should exist. If continuity does not exist, replace relay.



G00038159

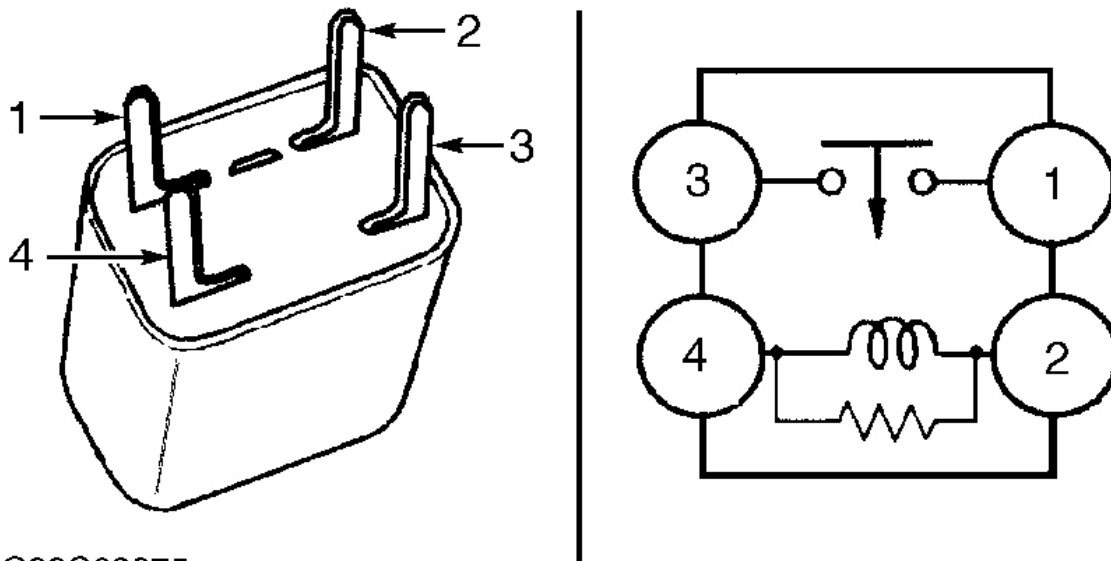
Fig. 37: Identifying Fuel Pump & Main Relays, Connector & Terminals (Rio)
 Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Testing for fuel pump and main relays for Sedona is not available from manufacturer.

Fuel Pump & Main Relays (Spectra)

NOTE: Use same procedure to check fuel pump or main relay.

1. Remove fuel pump or main relay from fuse/relay box. Located at left side of engine compartment. Check for continuity between relay terminals No. 1 and 3. See **Fig. 38** . If continuity does not exist, go to next step. If continuity exists, replace relay.
2. Connect a jumper wire between positive battery terminal and relay terminal No. 2. Connect another jumper wire between negative battery terminal and relay terminal No. 4.
3. Check continuity between relay terminals No. 1 and 3. Continuity should exist. If continuity does not exist, replace relay.



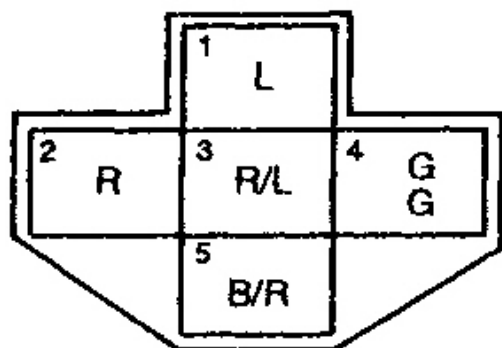
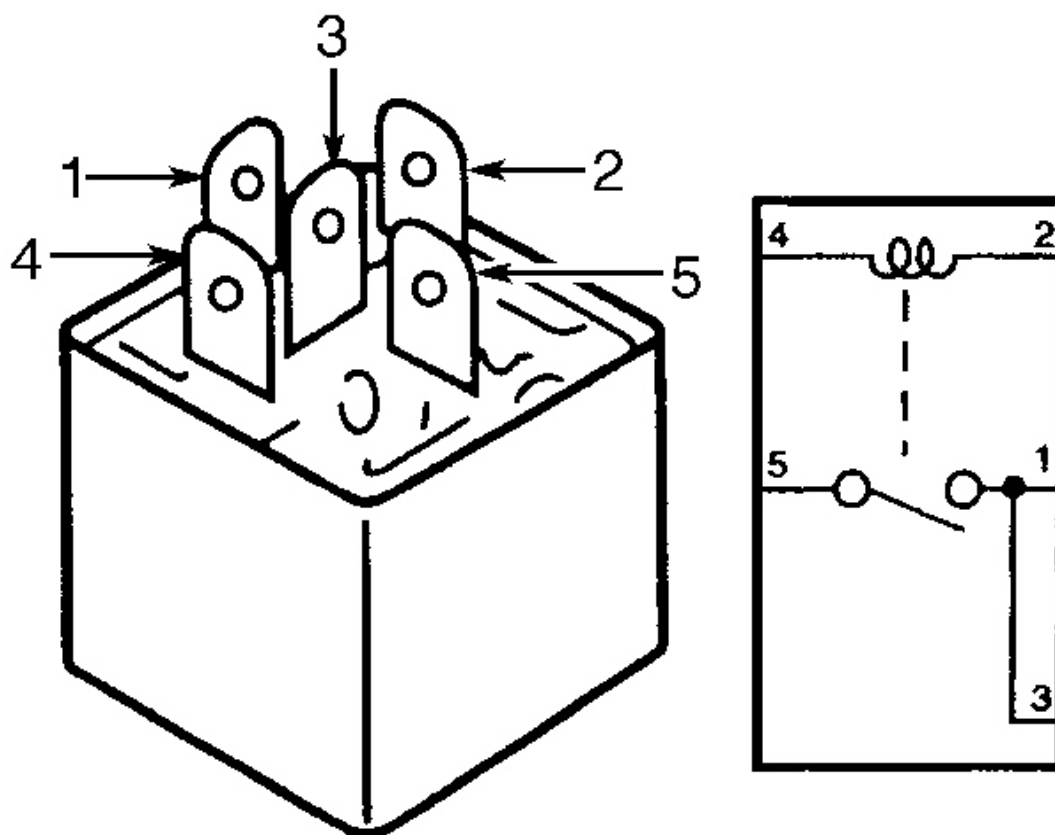
G99C08375

Fig. 38: Identifying Fuel Pump & Main Relays Terminals (Spectra)
Courtesy of KIA MOTORS AMERICA, INC.

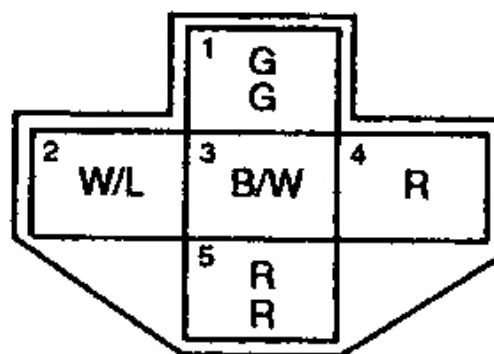
Fuel Pump & Main Relays (Sportage)

NOTE: Use same procedure to check fuel pump or main relay.

1. Remove fuel pump or main relay from fuse/relay box. Located at right side of engine compartment. Check for continuity between relay terminal No. 1 and terminals No. 5. See **Fig. 39** . If continuity does not exist, go to next step. If continuity exists, replace relay.
2. Connect a jumper wire between positive battery terminal and relay terminal No. 4. Connect another jumper wire between negative battery terminal and relay terminal No. 2.
3. Check continuity between relay terminal No. 1 and terminals No. 5. Continuity should exist. If continuity does not exist, replace relay.



FUEL PUMP RELAY



MAIN RELAY

G00082406

Fig. 39: Identifying Fuel Pump & Main Relays, Connector & Terminals (Sportage)
 Courtesy of KIA MOTORS AMERICA, INC.

SOLENOIDS

For solenoids and valves testing procedure, see appropriate test in **EMISSION SYSTEMS & SUB-SYSTEMS**.

FUEL SYSTEM - DELIVERY

WARNING: ALWAYS relieve fuel pressure before disconnecting any fuel injection-related component. DO NOT allow fuel to contact engine or electrical components.

WARNING: After repairs have been completed, Using fuel pump check connector terminal, activate fuel pump and check for leaks. Repair any leaks as necessary.

CAUTION: When battery is disconnected, vehicle computer and memory system may lose memory data. Driveability problems may exist until computer system have completed a relearn cycle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION before disconnecting battery.

NOTE: If fuel pressure is not as specify, perform fuel filter inspection. For fuel filter location, removal & installation, see FUEL FILTER under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If fuel filter check okay, check fuel pump. See FUEL PUMP OPERATION.

FUEL PRESSURE RELEASE

Except Optima

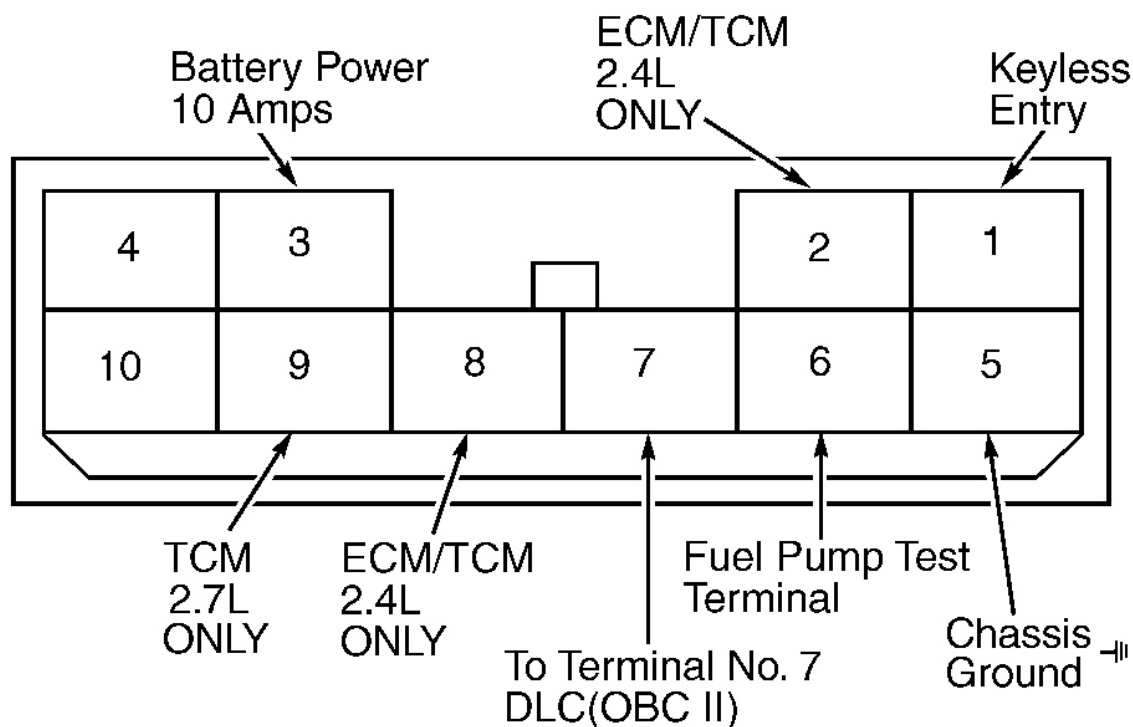
To release fuel pressure, remove rear seat cushion. Locate access to fuel pump harness connector. Disconnect fuel pump harness connector. Start engine and allow to idle until it stalls. Turn ignition off. Disconnect negative battery cable. When testing or repair is complete, reconnect fuel pump connector and negative battery cable. Install rear seat cushion. Prime fuel system. See PRIMING FUEL SYSTEM.

Optima

To release fuel pressure, locate access to fuel pump harness connector in trunk. Disconnect fuel pump harness connector. Start engine and allow to idle until it stalls, turn ignition off. Disconnect negative battery cable. When testing or repairs are complete, reconnect fuel pump harness connector and negative battery cable. Prime fuel system. See PRIMING FUEL SYSTEM.

PRIMING FUEL SYSTEM

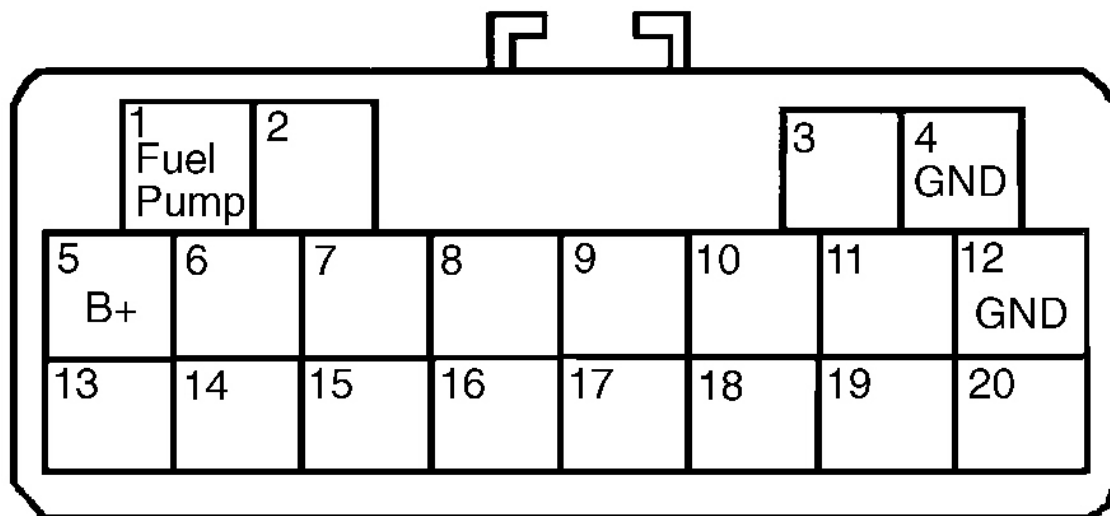
After performing any operation that requires releasing fuel pressure, fuel system should be primed to prevent long cranking times. To prime fuel system, jumper Data Link Connector (DLC) terminal FUEL PUMP and (B+). On Optima, DLC is located on left side under dash. On all other models, DLC is located on left side of engine compartment. See **Fig. 40**, **Fig. 41** or **Fig. 42**. Turn ignition on for no longer than 10 seconds to run pump and pressurize fuel system. Turn ignition off and remove jumper wire. Check for leaks. Repair any leaks as necessary.



G00102661

Fig. 40: Identifying Underdash Data Link Connector Terminals (Optima)

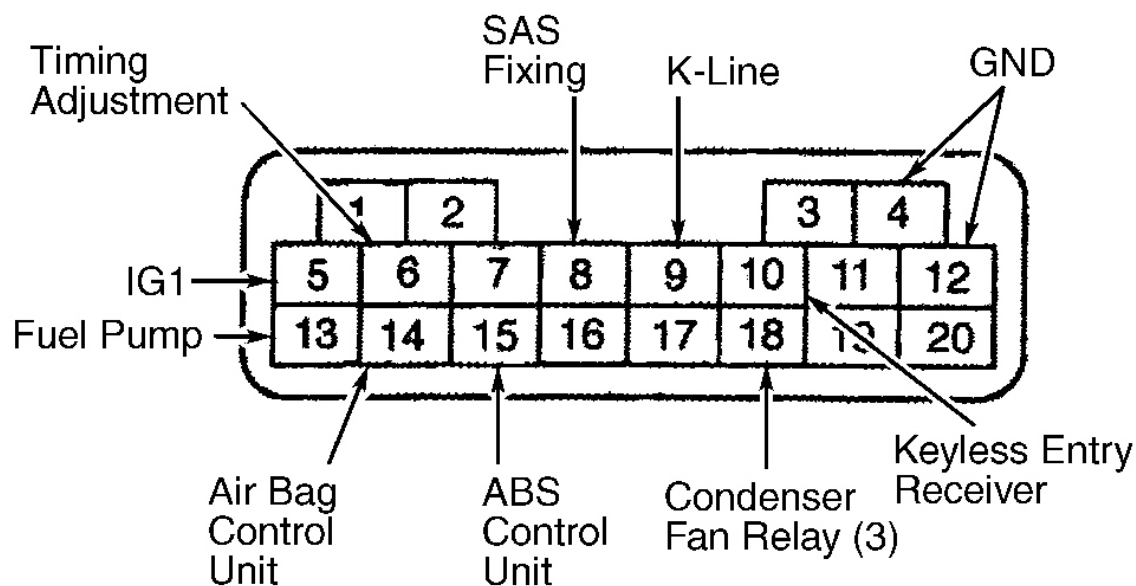
Courtesy of KIA MOTORS AMERICA, INC.



G99D08371

Fig. 41: Identifying Underhood Data Link Connector Terminals (Rio, Spectra & Sportage)

Courtesy of KIA MOTORS AMERICA, INC.



G00082378

Fig. 42: Identifying Underhood Data Link Connector Terminals (Sedona)
 Courtesy of KIA MOTORS AMERICA, INC.

FUEL PRESSURE

WARNING: ALWAYS relieve fuel pressure before disconnecting any fuel injection related component. DO NOT allow fuel to contact engine or electrical components.

Fuel Pressure (Optima)

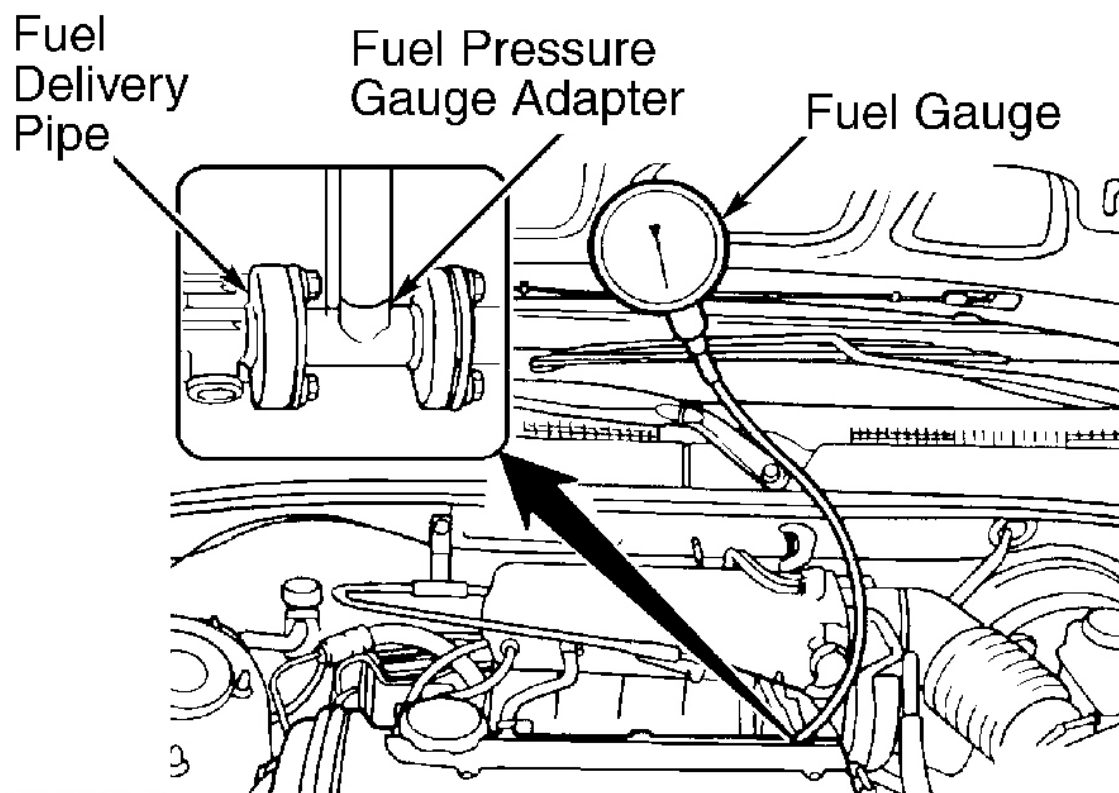
1. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Disconnect high-pressure fuel hose from fuel delivery pipe. Cover hose connection using rags to avoid spraying of fuel.
2. Using Fuel Pressure Gauge Adapter (09353-38000), install fuel pressure gauge to fuel delivery pipe. See **Fig. 43** or **Fig. 44**. Torque fuel gauge adapter bolts to 18-26 ft. lbs. (24-35 N.m). Connect negative battery cable.
3. Using fuel pump check terminal connector, activate fuel pump and ensure no fuel leakage is present at pressure gauge or connection. See **PRIMING FUEL SYSTEM**. If no leaks are present, start engine and allow to idle.
4. Disconnect vacuum hose from fuel pressure regulator, and plug hose end. Measure and record fuel pressure at idle. Reconnect vacuum hose, and again measure and record fuel pressure. See **FUEL PRESSURE SPECIFICATIONS** table. If fuel pressures are not within specification, go to next step. If measurements are okay, go to step 8.
5. If fuel pressure is less than specified, check following conditions:
 - Restricted fuel filter.
 - Fuel pressure regulator leaking fuel to fuel return side.
 - Leaking in-tank fuel pick-up hose.
 - Low fuel pump discharge pressure.

Repair or replace as necessary. Recheck fuel pressure.

6. If fuel pressure is greater than specified, check for sticking fuel pressure regulator. A restricted or bent fuel return hose or pipe. Repair or replace fuel hose or pipe and fuel pressure regulator. To replace fuel pressure regulator, see FUEL PRESSURE REGULATOR under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.
7. If fuel pressure does not change when regulator vacuum hose is connected and disconnected, check for following conditions:
 - Restricted or damaged vacuum hose.
 - Restricted manifold vacuum port.
 - Sticking or poorly seated fuel pressure regulator valve.

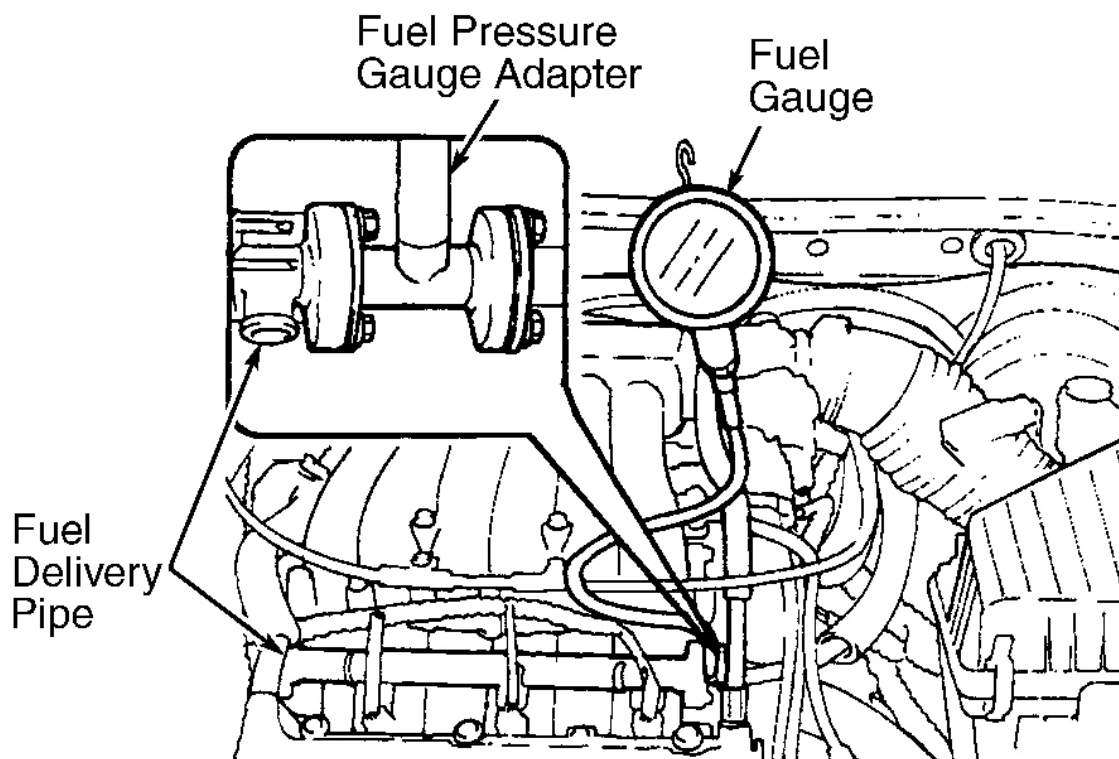
Repair or replace as necessary. Recheck fuel pressure.

8. If fuel pressures are as specified, stop engine and check for decrease in fuel pressure gauge. Fuel pressure should hold for approximately 5 minutes. If fuel pressure decreases slowly after engine is stopped, check for leaking injector. See **FUEL INJECTOR LEAKAGE TEST**, under FUEL INJECTORS. Replace as necessary. If fuel pressure decreases immediately after engine is stopped, check-valve inside fuel pump is not working. Replace fuel pump. To replace fuel pump, see FUEL PUMP under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. After repairs are completed, recheck fuel pressure.
9. After testing is completed, release fuel pressure. See **FUEL PRESSURE RELEASE**. Disconnect fuel pressure gauge from adapter. Ensure hose connection is covered by shop towel to prevent fuel spray. Remove adapter bolts and adapter. Install NEW "O" ring, and reinstall fuel line with original bolts. Apply battery voltage to fuel pump drive connector terminal. See **Fig. 40**. Check for fuel leaks. Repair any leaks as necessary.



G99I03470

Fig. 43: Installing Fuel Pressure Gauge (Optima 2.4L)
Courtesy of KIA MOTORS AMERICA, INC.



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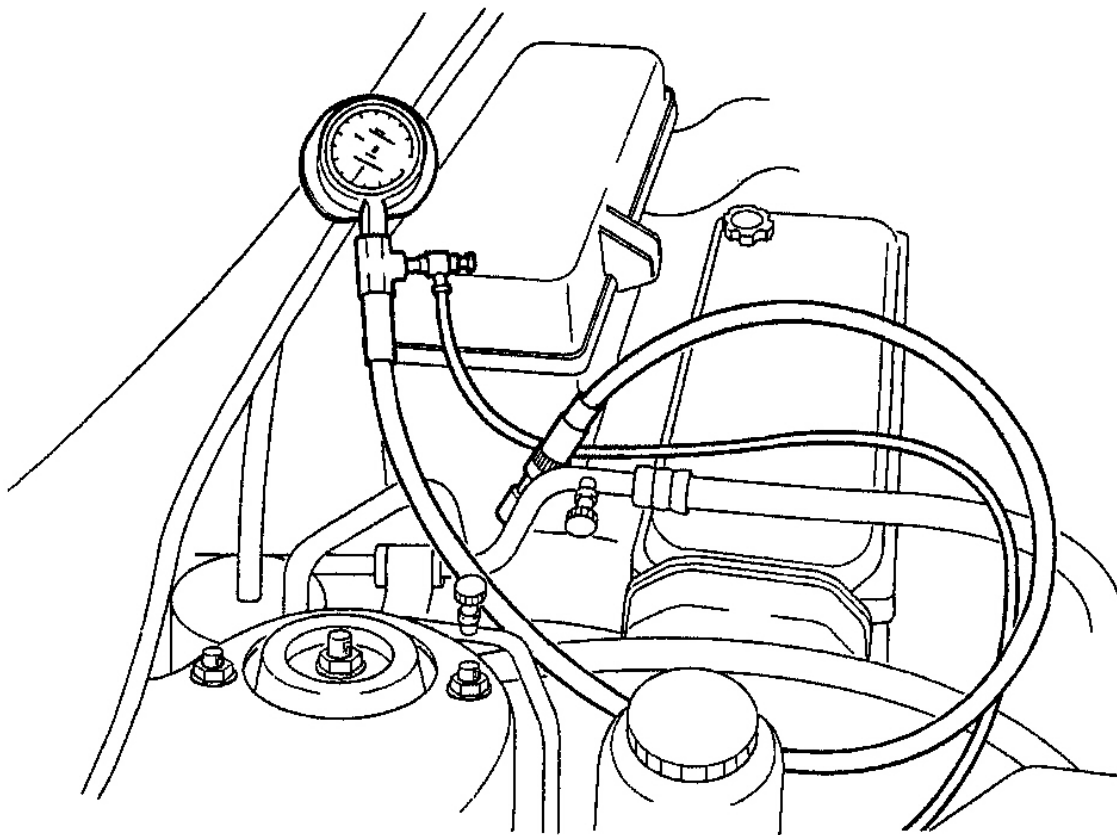
Fig. 44: Installing Fuel Pressure Gauge (Optima 2.7L)
 Courtesy of KIA MOTORS AMERICA, INC.

Fuel Pressure (Rio)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Disconnect high-pressure fuel hose from fuel delivery pipe. Cover hose connection using rags to avoid spraying of fuel. Disconnect battery negative cable. Install fuel pressure gauge (0K2A1 131 001A) on to high-pressure fuel line. See **Fig. 45**. Connect battery negative cable.
2. Using fuel pump check terminal connector, operate fuel pump and ensure no fuel leakage is present at pressure gauge or connection. See **PRIMING FUEL SYSTEM**. If no leaks are present, check fuel pressure. See **FUEL PRESSURE SPECIFICATIONS** table.
3. If fuel pressure is greater than specified, check for sticking fuel pressure regulator or a restricted or bent fuel return hose or pipe. Repair or replace fuel hoses or pipes and fuel pressure regulator as necessary. To replace fuel pressure regulator, see FUEL PRESSURE REGULATOR under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If fuel pressure is less than specified, go to next step.
4. Clamp return line and check if fuel pressure rises. If pressure does rise, replace fuel pressure regulator. To replace fuel pressure regulator, see FUEL PRESSURE REGULATOR under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If pressure does not rise, measure fuel pump maximum pressure. See **MAXIMUM FUEL PRESSURE (RIO & SPECTRA)**.
5. Stop engine and check for decrease in fuel pressure gauge. See **HOLDING FUEL PRESSURE (RIO & SPECTRA)**. Fuel pressure should hold for approximately 25 minutes. If fuel pressure decreases slowly after engine is stopped, check for leaking injector. See **FUEL INJECTOR LEAKAGE TEST**, under

FUEL INJECTORS. Replace fuel injectors as necessary. If fuel pressure decreases immediately after engine is stopped, check-valve inside fuel pump is not working. Replace fuel pump. To replace fuel pump, see **FUEL PUMP** under **FUEL SYSTEM** in **REMOVAL, OVERHAUL & INSTALLATION** article. After repairs are completed, recheck fuel pressure.

6. After testing is completed, release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect fuel pressure gauge from adapter. Ensure hose connection is covered by shop towel to prevent fuel spray. Remove adapter bolts and adapter. Replace any old seals with **NEW** seals, and reinstall fuel line. Apply battery voltage to fuel pump drive connector terminal. See **Fig. 41** . Check for fuel leaks. Repair any leaks as necessary.



G00038178

Fig. 45: Installing Fuel Pressure Gauge (Rio)
Courtesy of KIA MOTORS AMERICA, INC.

Fuel Pressure (Sedona)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect high-pressure fuel hose from fuel delivery pipe. Cover hose connection using rags to avoid spraying of fuel.
2. Using Fuel Pressure Gauge Adapter (09353-24100), install fuel pressure gauge to fuel delivery pipe, See **Fig. 46** . Connect negative battery cable.
3. Using fuel pump check terminal connector, operate fuel pump and ensure no fuel leakage is present at pressure gauge or connection. See **PRIMING FUEL SYSTEM** . If no leaks are present, start engine and allow to idle.

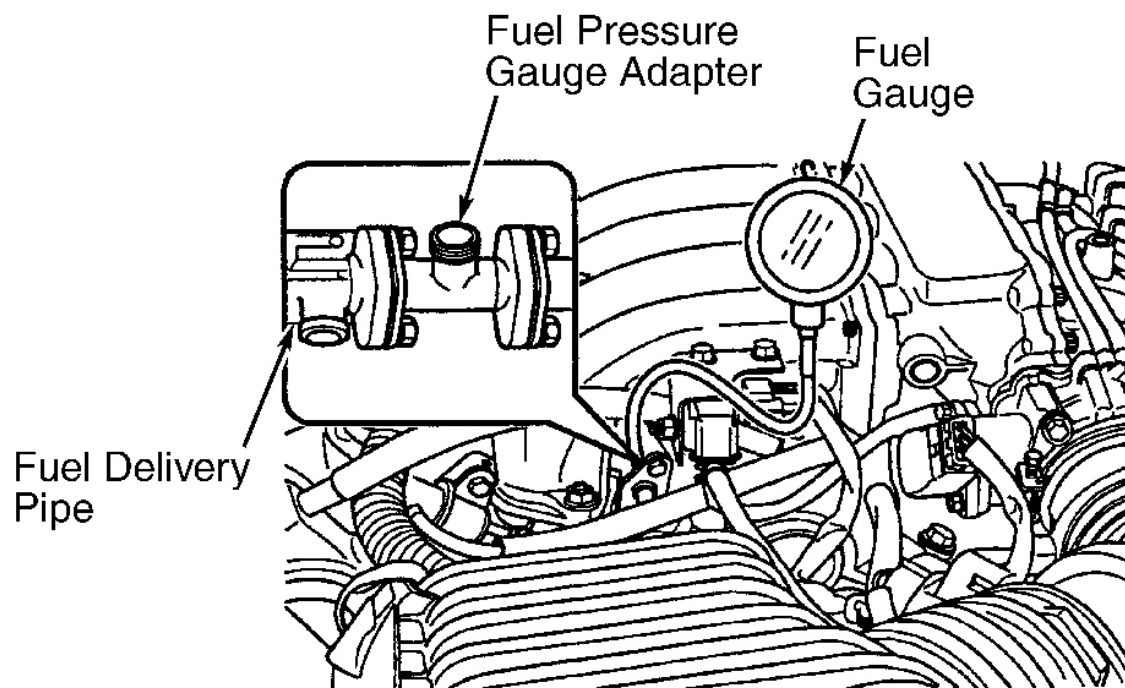
4. Disconnect vacuum hose from fuel pressure regulator, and plug hose end. Measure and record fuel pressure at idle. Reconnect vacuum hose, and again measure and record fuel pressure. See **FUEL PRESSURE SPECIFICATIONS** table. If measurements are not within specification, go to next step. If measurements are okay, go to step 8 .
5. If fuel pressure is less than specified, check following conditions:
 - Restricted fuel filter.
 - Fuel pressure regulator leaking fuel to fuel return side.
 - Leaking in-tank fuel pick-up hose.
 - Low fuel pump discharge pressure.

Repair or replace as necessary. Recheck fuel pressure.

6. If fuel pressure is greater than specified, check for sticking fuel pressure regulator. A restricted or bent fuel return hose or pipe. Repair or replace fuel hose or pipe as necessary, or replace fuel pressure regulator. To replace fuel pressure regulator, see FUEL PRESSURE REGULATOR under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.
7. If fuel pressure does not change when regulator vacuum hose is connected and disconnected, check for following conditions:
 - Restricted or damaged vacuum hose.
 - Restricted manifold vacuum port.
 - Sticking or poorly seated fuel pressure regulator valve.

Repair or replace as necessary. Recheck fuel pressure.

8. If fuel pressures are as specified, stop engine and check for decrease in fuel pressure gauge. Fuel pressure should hold for approximately 5 minutes. If fuel pressure decreases slowly after engine is stopped, check for leaking injector. See **FUEL INJECTOR LEAKAGE TEST** under FUEL INJECTORS. Replace as necessary. If fuel pressure decreases immediately after engine is stopped, check-valve inside fuel pump is not working. Replace fuel pump. To replace fuel pump, see FUEL PUMP under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. After repairs are completed, recheck fuel pressure and go to next step.
9. After testing is completed, release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect fuel pressure gauge from adapter. Ensure hose connection is covered by shop towel to prevent fuel spray. Remove adapter bolts and adapter. Install NEW "O" ring, and reinstall fuel line with original bolts. Torque bolts to 27-35 INCH lbs (3-4 N.m). Apply battery voltage to fuel pump drive connector terminal. See **Fig. 42** . Check for fuel leaks. Repair any leaks as necessary.

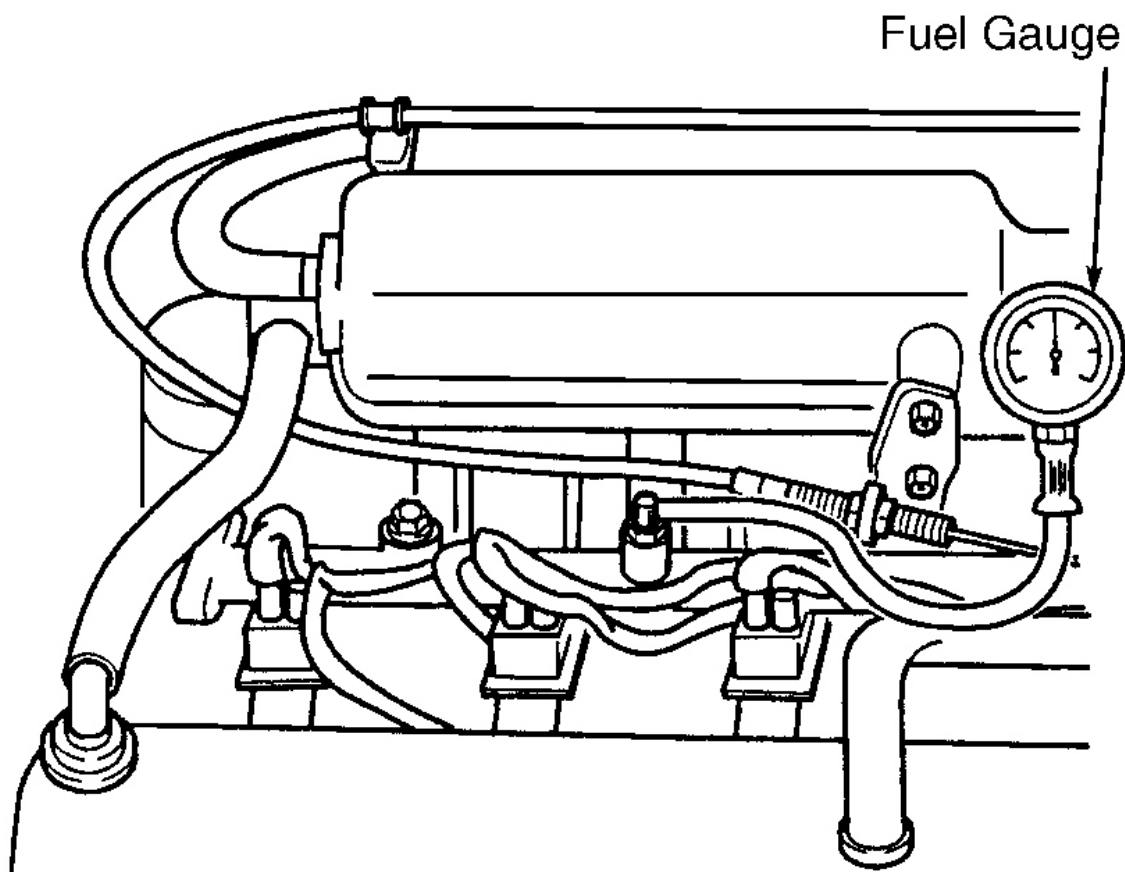


G00082401

Fig. 46: Installing Fuel Pressure Gauge (Sedona)
 Courtesy of KIA MOTORS AMERICA, INC.

Fuel Pressure (Spectra)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect battery negative cable. Install Fuel Pressure Gauge (0K2A1 131 001) on service port at center of fuel rail. See **Fig. 47** .
2. Connect battery negative cable. To operate fuel pump, jumper DLC terminals FUEL PUMP and (B+). DLC is located on left side of engine compartment. See **Fig. 41** .
3. Turn ignition on for 10 seconds or less. Check fuel pressure. See **FUEL PRESSURE SPECIFICATIONS** table. Turn ignition off and remove jumper wire.
4. If fuel pressure is too high, check for restricted return line. If return line is open, replace pressure regulator. To replace fuel pressure regulator, see FUEL PRESSURE REGULATOR under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.
5. If fuel pressure is too low, block return line. Operate fuel pump again and see if pressure rises. If pressure rises, replace fuel pressure regulator. To replace fuel pressure regulator, see FUEL PRESSURE REGULATOR under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If pressure does not rise, check fuel pump maximum pressure. See **MAXIMUM FUEL PRESSURE (RIO & SPECTRA)** .

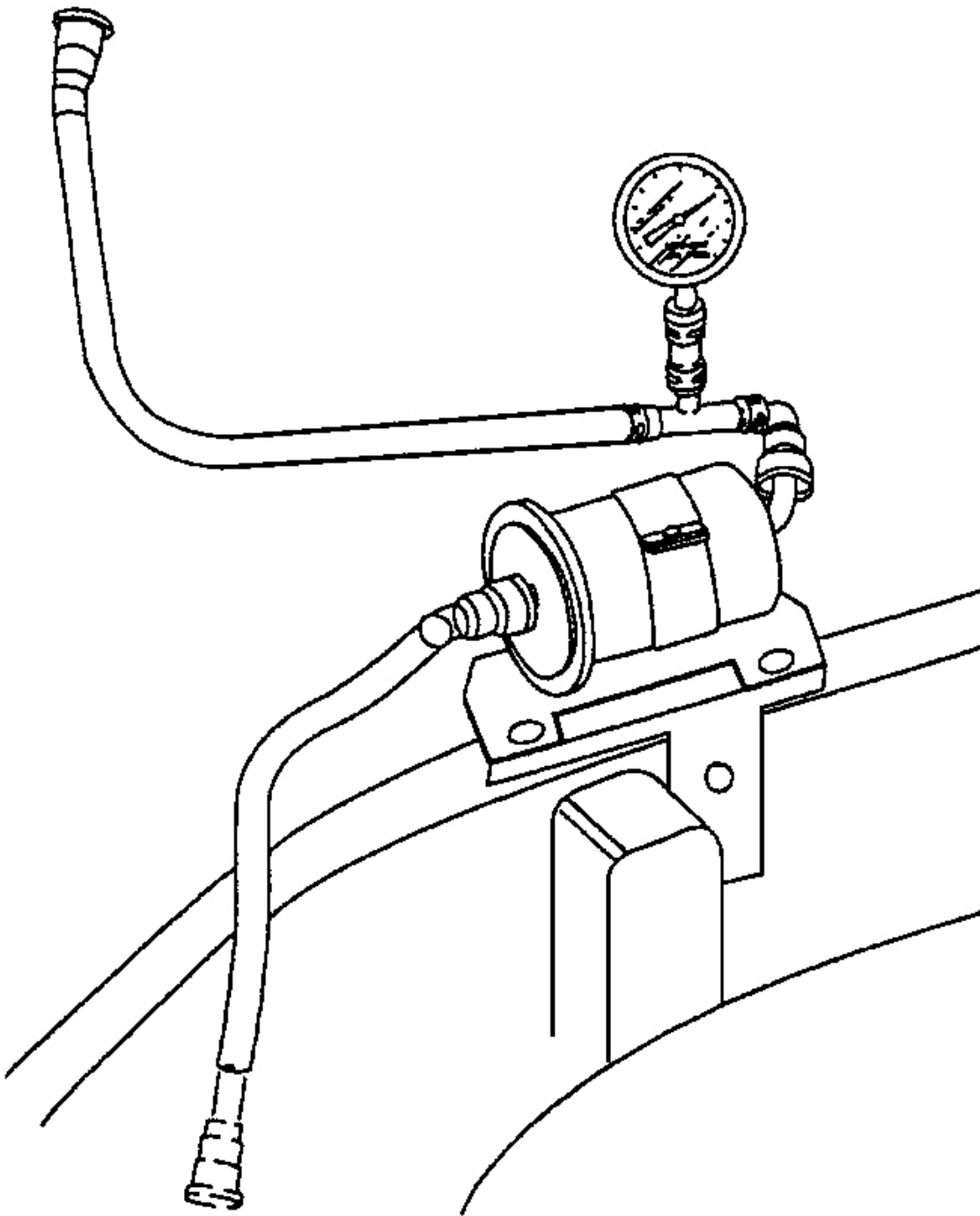


G00038180

Fig. 47: Installing Fuel Pressure Gauge (Spectra)
 Courtesy of KIA MOTORS AMERICA, INC.

Fuel Pressure (Sportage)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect battery negative cable. Install fuel pressure gauge on service fuel rail near fuel filter. See **Fig. 48** . Connect battery negative cable.
2. Using fuel pump check terminal connector, operate fuel pump and ensure no fuel leakage is present at pressure gauge or connection. See **PRIMING FUEL SYSTEM** .
3. Start engine and allow it to idle. Disconnect vacuum hose from pressure regulator, and plug hose end, Measure and record fuel pressure at idle. Reconnect vacuum hose, and again measure and record fuel pressure. See **FUEL PRESSURE SPECIFICATIONS** table. If pressure is not as specified, check fuel line and filter for restrictions. For fuel filter location, removal & installation, see FUEL FILTER under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Also check holding fuel pressure and maximum fuel pressure. See **HOLDING FUEL PRESSURE (SPORTAGE)** and **MAXIMUM FUEL PRESSURE (SPORTAGE)** test.



G00038181

Fig. 48: Installing Fuel Pressure Gauge (Sportage)
Courtesy of KIA MOTORS AMERICA, INC.

HOLDING FUEL PRESSURE

Holding Fuel Pressure (Rio & Spectra)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect battery negative cable. Install fuel pressure gauge on to high-pressure fuel line. For Rio, see **Fig. 45** . And for Spectra, see **Fig. 47** . Connect battery negative cable.
2. Jumper DLC terminals FUEL PUMP and (B+). DLC is located on left side of engine compartment. See **Fig. 41** . Turn ignition on for 10 seconds or less to operate fuel pump and pressurize system. Turn ignition off and remove jumper wire.
3. On Rio, check fuel pressure after 25 minutes. On Spectra, check fuel pressure after 15 minutes. See **FUEL PRESSURE SPECIFICATIONS** table. If pressure is not as specified, check fuel pump, pressure regulator and injectors.

Holding Fuel Pressure (Sportage)

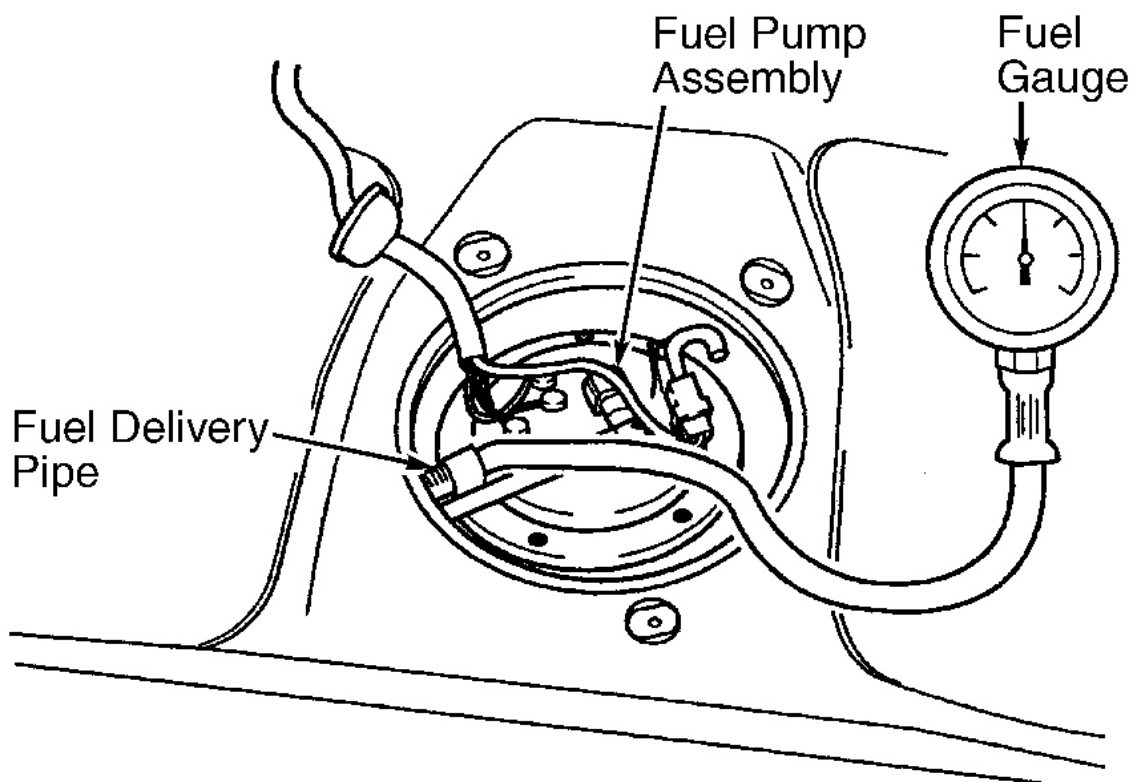
1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect battery negative cable. Install fuel pressure gauge on service port at front of fuel rail. Connect battery negative cable.
2. Jumper DLC terminals FUEL PUMP and (B+). DLC is located on left side of engine compartment. See **Fig. 41** . Turn ignition on for 10 seconds or less to operate fuel pump and pressurize system. Turn ignition off and remove jumper wire.
3. Pinch off fuel return hose at pressure regulator. Observe fuel pressure for 5 minutes. It should stay above specified pressure. See **FUEL PRESSURE SPECIFICATIONS** table. If pressure drops below specification, replace pressure regulator. To replace fuel pressure regulator, see FUEL PRESSURE REGULATOR under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Also check fuel pump and injectors.

MAXIMUM FUEL PRESSURE

NOTE: **Maximum fuel pressure specification and test procedure for Optima & Sedona is not available from manufacturer.**

Maximum Fuel Pressure (Rio & Spectra)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect battery negative cable. Remove rear seat cushion. Connect Fuel Pressure Gauge (0K2A1 131 001) to main fuel line at fuel tank. See **Fig. 49** . Connect battery negative cable.
2. To operate fuel pump, jumper DLC terminals FUEL PUMP and (B+). DLC is located on left side of engine compartment. See **Fig. 41** . Turn ignition on. Check maximum fuel pressure. Do not run fuel pump longer than necessary to check fuel pressure. See **FUEL PRESSURE SPECIFICATIONS** table. If fuel pressure is not as specified, replace fuel pump. To replace fuel pump, see FUEL PUMP under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

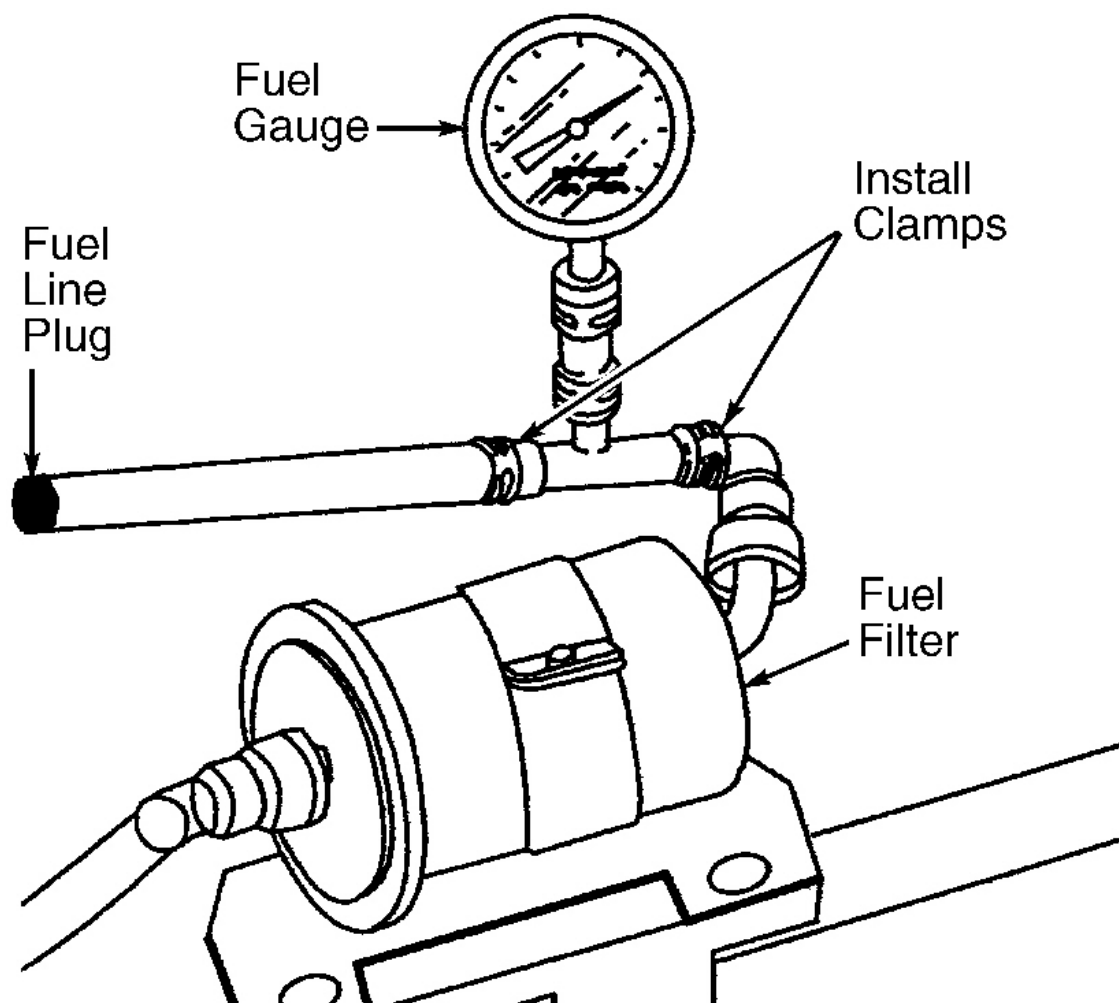


G00082407

Fig. 49: Installing Fuel Pressure Gauge at Fuel Tank (Rio & Spectra)
Courtesy of KIA MOTORS AMERICA, INC.

Maximum Fuel Pressure (Sportage)

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** . Disconnect battery negative cable. Connect fuel pressure gauge to fuel filter and plug outlet of gauge, install clamps as shown, see **Fig. 50** . Connect battery negative cable.
2. To operate fuel pump, jumper DLC terminals FUEL PUMP and (B+). DLC is located on left side of engine compartment. See **Fig. 41** . Turn ignition on. Measure maximum fuel pressure. Do not operate fuel pump longer than necessary to check fuel pressure. See **FUEL PRESSURE SPECIFICATIONS** table. Turn ignition off and remove jumper wire. If pressure is not as specified, replace fuel pump. To replace fuel pump, see FUEL PUMP under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.



G00082408

Fig. 50: Installing Fuel Pressure Gauge At Fuel Filter (Sportage)

Courtesy of KIA MOTORS AMERICA, INC.

FUEL PRESSURE SPECIFICATIONS

Application	psi (kPa)
Optima	
Fuel Line Pressure ⁽¹⁾⁽²⁾	
Regulator Vacuum Connected	37 (255)
Regulator Vacuum Disconnected	46-49 (320-340)
Rio & Spectra	
Maximum Pressure ⁽¹⁾	65-94 (450-650)
Fuel Line Pressure ⁽³⁾	46-51 (320-350)
Holding Pressure ⁽⁴⁾	Minimum 25 (180)
Sedona	

Fuel Line Pressure ⁽¹⁾⁽²⁾	
Regulator Vacuum Connected	39 (270)
Regulator Vacuum Disconnected	46-49 (320-340)
Sportage	
Maximum Pressure ⁽⁵⁾	Minimum 43 (340)
Fuel Line Pressure ⁽²⁾⁽⁶⁾	
Regulator Vacuum Connected	34 (235)
Regulator Vacuum Disconnected	42 (292)
Holding Pressure ⁽⁷⁾	Minimum 21 (150)
<p>(1) With pressure gauge connected to main fuel line with adapter.</p> <p>(2) Engine at idle.</p> <p>(3) With pressure gauge connected to fuel rail service port.</p> <p>(4) With pressure gauge connected to fuel rail service port. Minimum pressure 15-25 minutes after ignition is turned off.</p> <p>(5) With pressure gauge connected to fuel filter and pressure gauge outlet hose plugged.</p> <p>(6) With pressure gauge connected to fuel rail service port.</p> <p>(7) With pressure gauge connected to fuel rail service port. Minimum pressure 5 minutes after ignition is turned off.</p>	

FUEL PUMP OPERATION

NOTE: **Ensure battery is fully charged, and all related fuses in fuel system are in good condition before start any fuel system diagnose.**

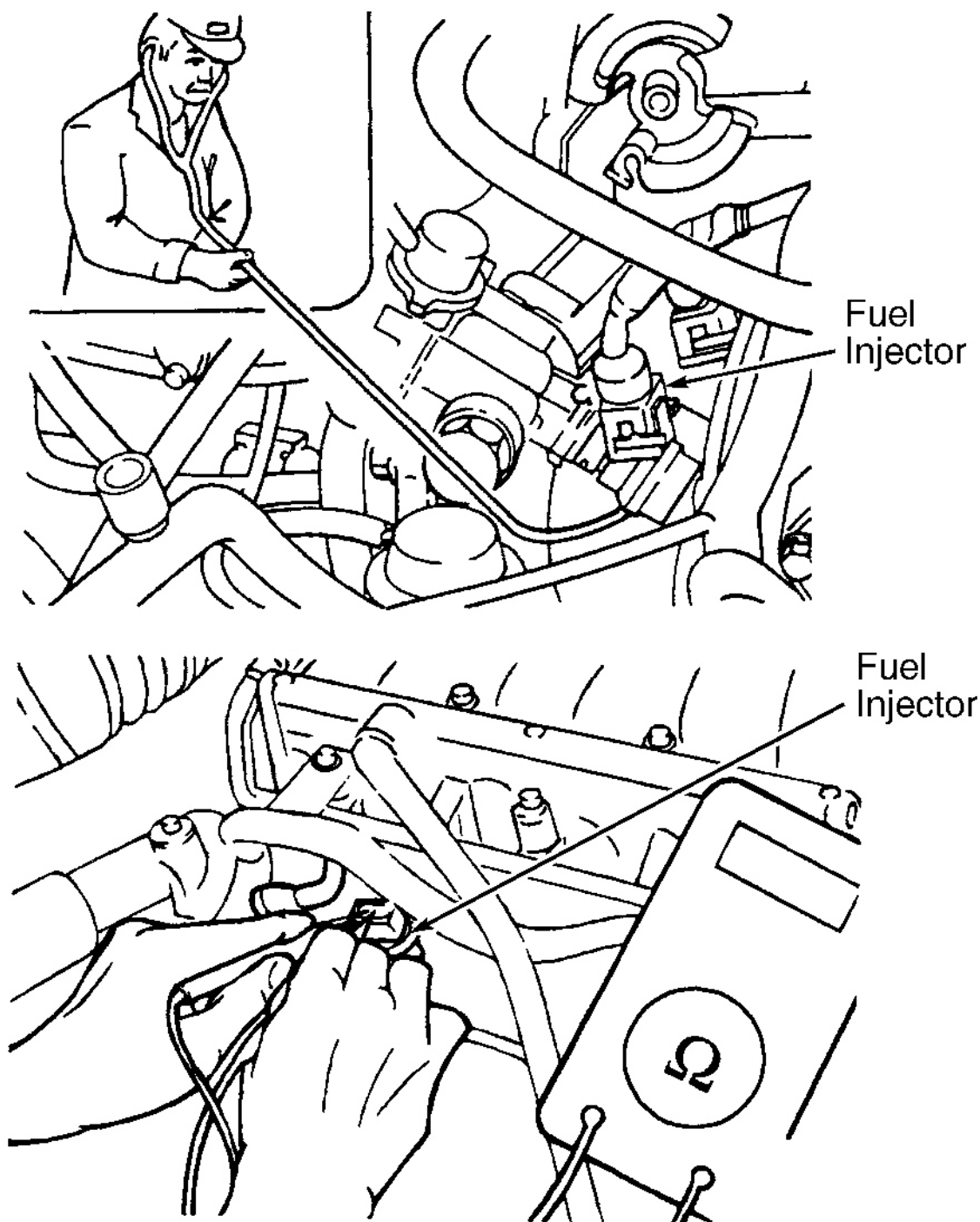
Fuel pump is electric in-tank type. Remove fuel filler cap. To operate fuel pump, jumper DLC terminals FUEL PUMP and (B+). DLC on Optima, is located on left side under dash. On all other models DLC is located on left side of engine compartment. See **Fig. 40 -Fig. 42** . Turn ignition on and listen at fuel filler neck for fuel pump operation sound. If fuel pump operation sound is not heard, do the following:

1. Check fuel system relays. See appropriate **RELAYS & SOLENOIDS** for proper relay operation. If relays are operating properly, go to next step. If relays are not operating properly, replace relays as necessary.
2. Check for battery voltage and good ground at fuel pump harness connector. For fuel pump harness connector identification, location and also circuit testing, see **WIRING DIAGRAMS** article. If battery voltage and ground are found acceptable, go to next step. If battery voltage or ground is not found acceptable, repair or replace wiring and connectors as necessary.
3. After fuel system fuses, relays, wiring and connectors check at good operating condition, replace electric in-tank type fuel pump. For fuel pump replacement, see **FUEL PUMP** under **FUEL SYSTEM** in **REMOVAL, OVERHAUL & INSTALLATION** article.

FUEL SYSTEM - CONTROL

FUEL INJECTOR INSPECTION

1. Warm up engine and let idle. Using screwdriver or stethoscope, listen to each injector. Clicking sound should be heard. If no sound is heard, measure resistance of each injector. See **Fig. 51** . Replace injectors that do not meet specification. To replace injectors, see appropriate FUEL DELIVERY PIPE & FUEL INJECTORS under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. If injectors are okay, and no operational sound is heard. Go to next step.
2. Check wiring to injectors. Ensure electrical connectors fit tightly and are not corroded. For circuit testing, see WIRING DIAGRAMS article.



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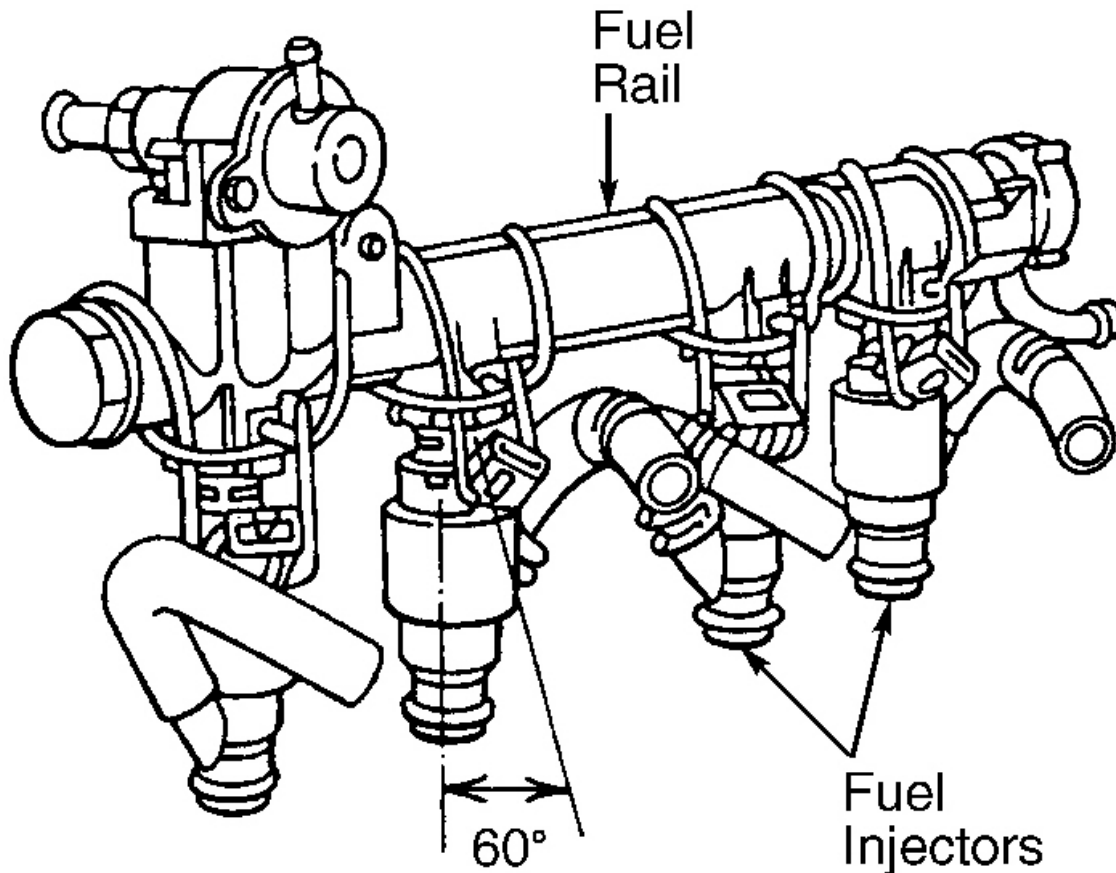
Fig. 51: Checking Fuel Injector Operation & Resistance
Courtesy of KIA MOTORS AMERICA, INC.

FUEL INJECTOR LEAKAGE TEST

1. Remove fuel injectors together with fuel rail. For fuel injectors removal, see FUEL DELIVERY PIPE & FUEL INJECTORS under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article.

Using wire, secure fuel injectors to fuel rail, see **Fig. 52** . Leave harness connected to fuel injectors.

2. Ensure fuel hoses are connected to fuel rail. To operate fuel pump, jumper DLC terminals FUEL PUMP and (B+). On Optima, DLC is located on left side under dash. On all other models, DLC is located on left side of engine compartment. See **Fig. 40 -Fig. 42** .
3. Turn ignition on. Tilt injectors 60 degrees and watch for leaks. Replace any injectors that leak. Use new "O" rings when installing injectors.



G00082404

Fig. 52: Securing Fuel Injectors To Fuel Rail Assembly
Courtesy of KIA MOTORS AMERICA, INC.

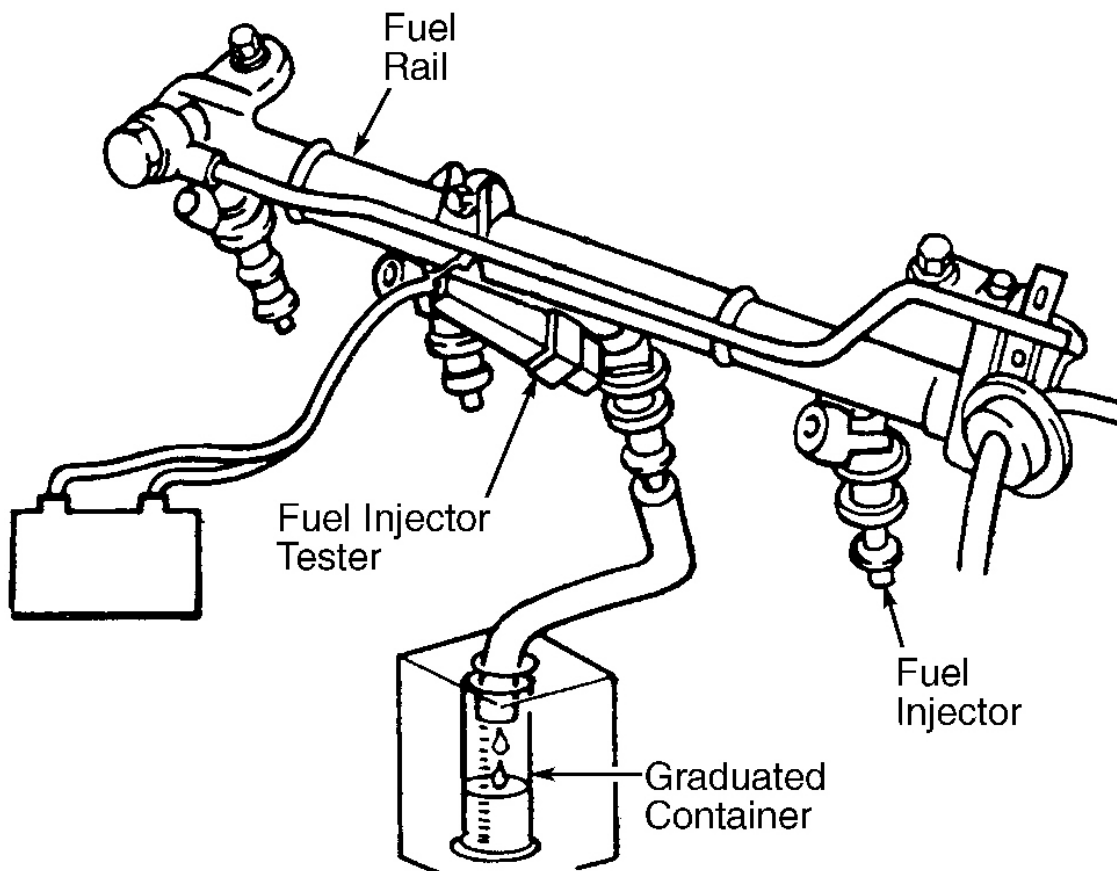
FUEL INJECTOR VOLUME TEST

NOTE: Injector volume specification for Optima, Rio and Sedona is not available from manufacturer.

1. Remove fuel injectors together with fuel rail. For fuel injectors removal, see FUEL DELIVERY PIPE & FUEL INJECTORS under FUEL SYSTEM in REMOVAL, OVERHAUL & INSTALLATION article. Secure fuel injectors to fuel rail. See **Fig. 52** . Place end of injector to be tested in graduated cylinder.
2. If using injector tester, connect injector tester between battery and injector. See **Fig. 53** . If not using injector tester, reconnect injector connectors. Connect jumper wire between injector to ECM wire and

ground. See WIRING DIAGRAMS article for wire colors.

3. Turn ignition on. Time injector flow and measure volume. Injector flow should be 4.4 oz. (130 ml) per minute. If volume is not as specified, replace injector. Use NEW "O" rings when installing injectors.



G00082405

Fig. 53: Performing Fuel Injector Volume Test
Courtesy of KIA MOTORS AMERICA, INC.

IGNITION SYSTEM

SPARK

NOTE: All model are equipped with a Distributorless Ignition System (DIS).

NOTE: Ensure high tension leads are routed properly after removal and installation.

Check for spark at each spark plug wire using a high output spark tester. Check spark plug wire resistance on suspect wires. High tension wire resistance should not exceed 16,000 ohms per 3.3 feet.

CAMSHAFT POSITION SENSOR

Camshaft Position Sensor (CMP) sensor detects No. 1 piston at TDC of compression stroke. ECM uses input for fuel and ignition control. For CMP sensor testing, see **CAMSHAFT POSITION SENSOR**.

CRANKSHAFT POSITION SENSOR

Crankshaft Position Sensor (CKP) sensor detects crankshaft angle. ECM uses input to determine engine speed, misfire detection, and for fuel and ignition control. For CKP sensor testing, see **CRANKSHAFT POSITION SENSOR**.

IGNITION COIL POWER SOURCE

Ensure ignition is off. Disconnect ignition coil harness connectors. Turn ignition on. Check for battery voltage at ignition power source wire. To identify wire, see **IGNITION COIL POWER SOURCE** table. On all models, if battery voltage is not present, check battery feed circuit, main fuse, ignition switch and wiring harness.

IGNITION COIL POWER SOURCE

Application	Coil (+) Terminal Wire Color
Optima	Pink/Black
Rio	
Coil 1	Yellow/Green
Coil 2	Yellow
Sedona	Red
Spectra	Yellow
Sportage	White/Red

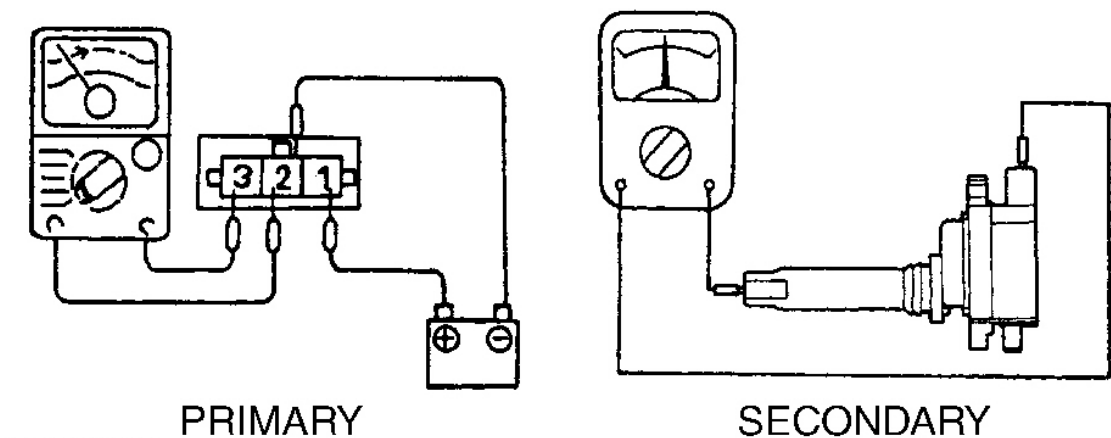
IGNITION COIL RESISTANCE

Optima 2.4L & Sedona

NOTE: **Power transistor is built into ignition coil.**

To perform primary coil resistance check, connect negative (-) terminal of a 3 volt power supply to terminal No. 2 of power transistor. See **Fig. 54** . Check for continuity, about .78 Ohm, between terminals No. 2 and 3. Continuity should exist when terminal No. 1 is connected to 3 volt power (+) supply. When 3 volt power supply is removed, continuity should no longer exist. If problem exists, replace power transistor/ignition coil. To test secondary resistance measure resistance between high-voltage terminals of ignition coil, see **Fig. 54** . For resistance specification, see **IGNITION COIL RESISTANCE** table.

Terminal 1 and (+) terminal	Terminal 3 and terminal 2
Connected	Continuity (Approximately 0.78Ω)
Disconnected	No continuity

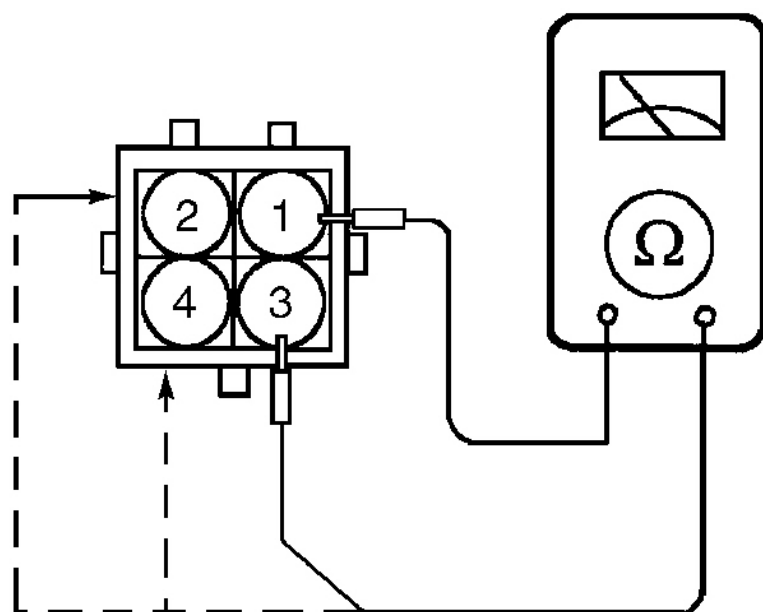


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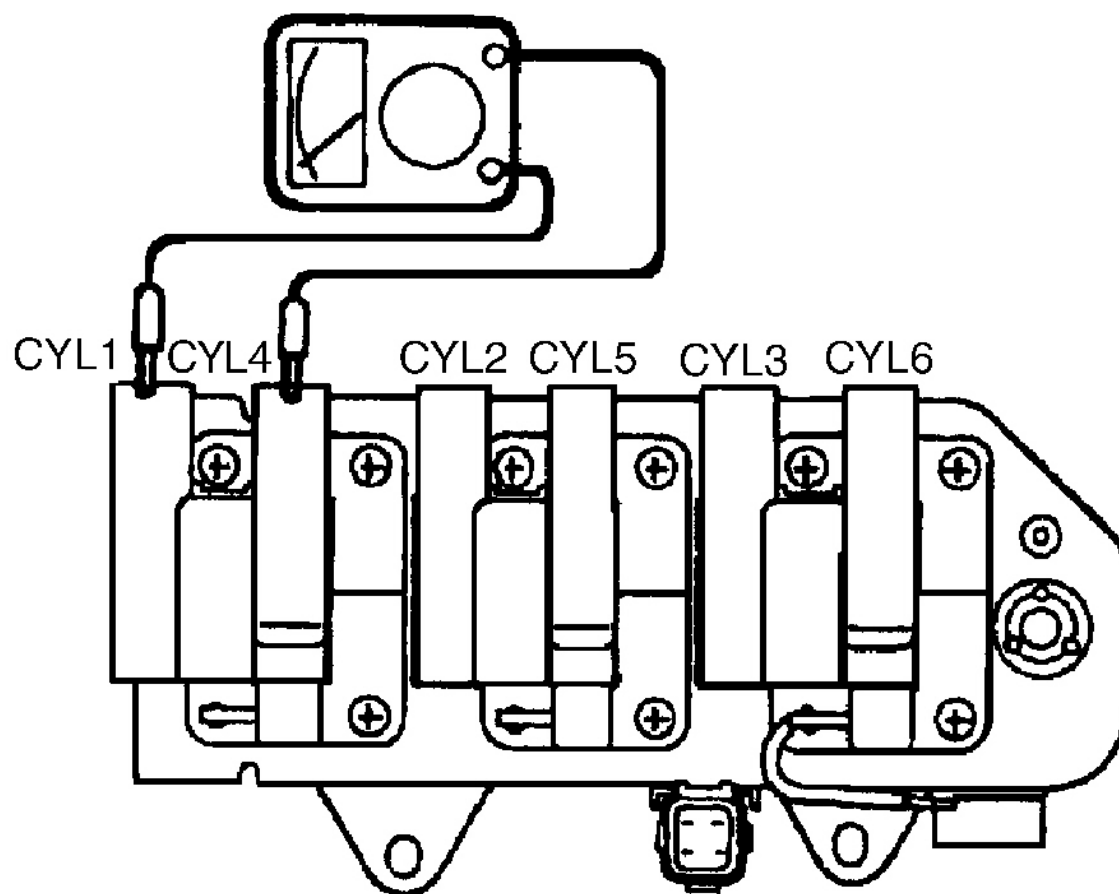
Fig. 54: Checking Primary & Secondary Coil Resistance (Optima 2.4L & Sedona)
Courtesy of KIA MOTORS AMERICA, INC.

Optima 2.7L

Measure resistance between connector terminals No. 1 and 2, 1 and 3 and 1 and 4. See **Fig. 55** . For ignition coil resistance, see **IGNITION COIL RESISTANCE** table. If resistance is not as specified, replace coil pack.



PRIMARY

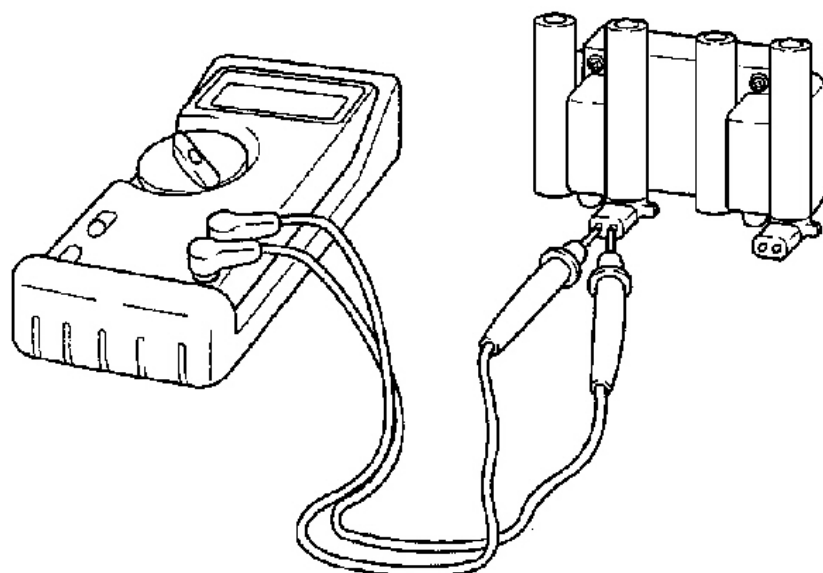


SECONDARY

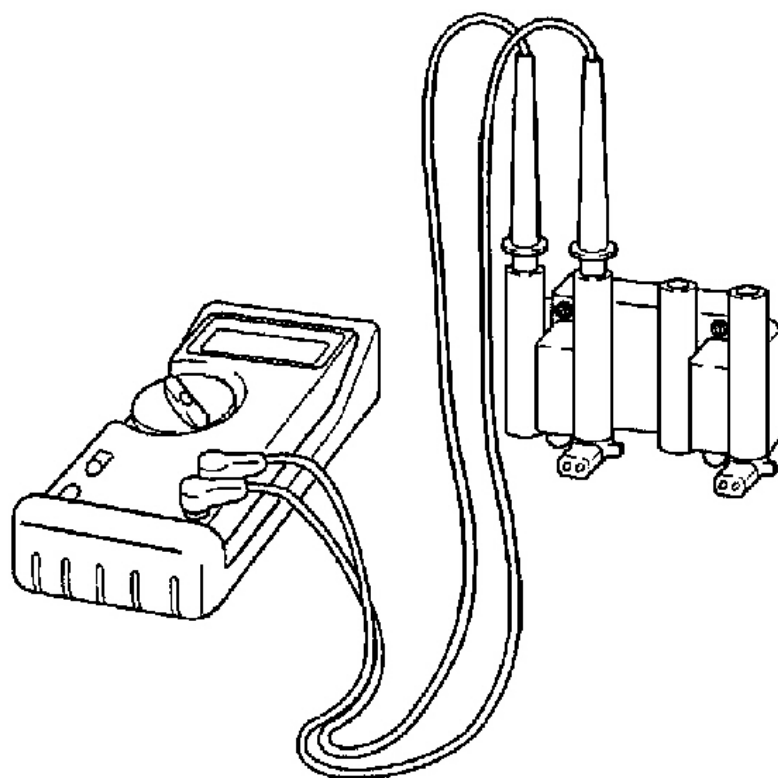
Fig. 55: Checking Primary & Secondary Coil Resistance (Optima 2.7L)
Courtesy of KIA MOTORS AMERICA, INC.

Rio, Spectra & Sportage

To check primary coil resistance, disconnect ignition coil harness connector. Using ohmmeter, check primary resistance between positive (+) and negative (-) terminal of coil or coil pack. Check secondary resistance between coil towers. For resistance check procedure on Rio, see **Fig. 56** . For Spectra and Sportage resistance check procedure, see **Fig. 57** . And see **IGNITION COIL RESISTANCE** table for resistance specification. If readings are not within specification, replace ignition coil(s).



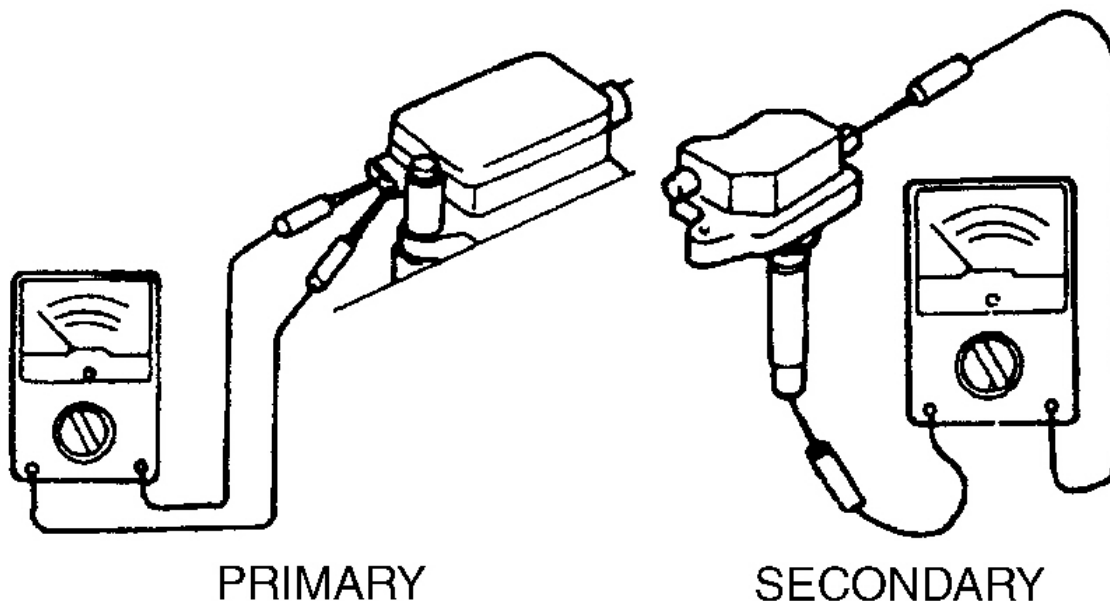
PRIMARY



SECONDARY

G00038176

Fig. 56: Checking Primary & Secondary Coil Resistance (Rio)
Courtesy of KIA MOTORS AMERICA, INC.



G00082410

Fig. 57: Checking Primary & Secondary Coil Resistance (Spectra & Sportage)
 Courtesy of KIA MOTORS AMERICA, INC.

IGNITION COIL RESISTANCE - Ohms @ 68°F (20°C)

Application	Primary	Secondary
Optima		
2.4L	.78	20,000
2.7L	.74-.81	13.300-15.300
Rio	.60-.80	11,000-15,000
Sedona	.78	13.000
Spectra & Sportage	.45-.55	13,000-15,000

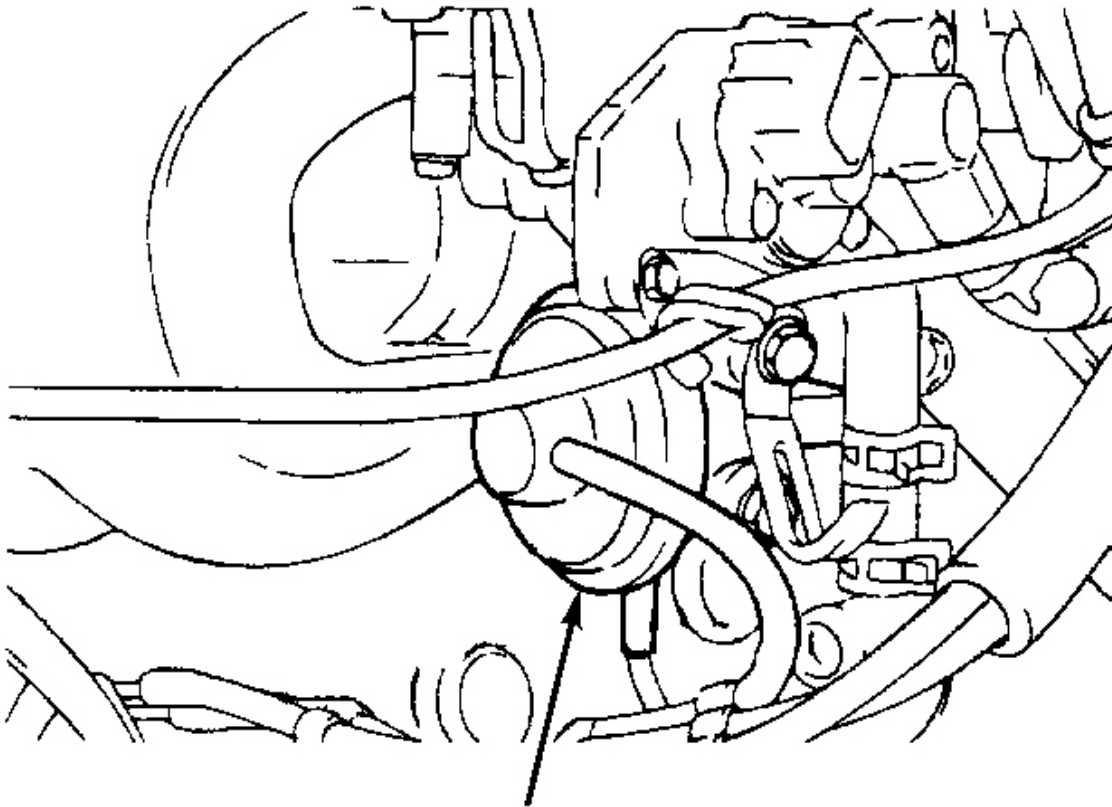
EMISSION SYSTEMS & SUB-SYSTEMS

EXHAUST GAS RECIRCULATION SYSTEM (OPTIMA 2.4L)

NOTE: For component identification and location, see **Fig. 58 -Fig. 59** .

1. Exhaust Gas Recirculation (EGR) system is operated by ECM during coasting. ECM activates EGR solenoid valve allowing intake vacuum to EGR valve. The manifold pressure is measured before and after EGR valve has been activated and the corresponding pressure variation is compared with reference value to detect a EGR system malfunction. If malfunction is detected, go to next step.
2. Check all EGR system vacuum hoses, pipe and passage for damage, blockage or restriction between:
 - Throttle body to EGR solenoid valve vacuum hose.
 - EGR solenoid valve to EGR valve vacuum hose.
 - EGR valve to exhaust manifold pipe.

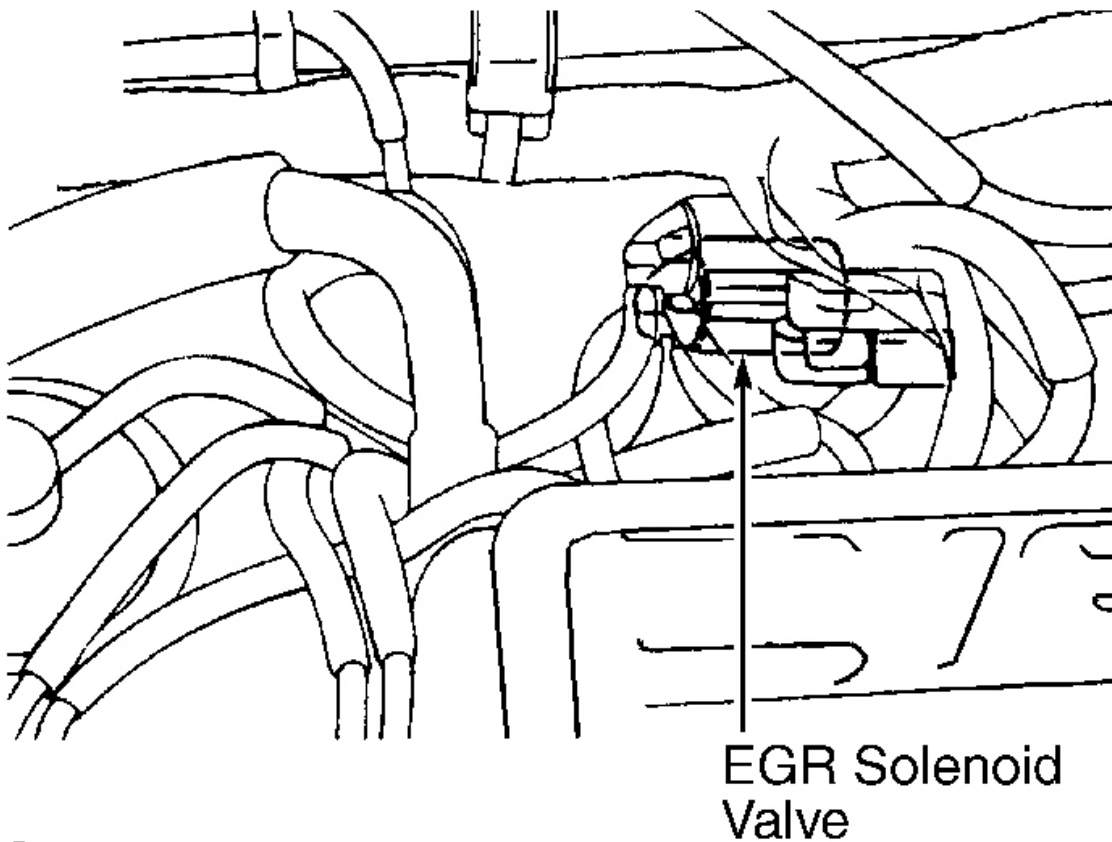
- EGR valve to intake manifold passage.
 - If malfunction is found, repair or replace as necessary. If no malfunction is found, go to next step.
3. Check EGR valve operation. For EGR valve operation, see **EXHAUST GAS RECIRCULATION VALVE**. If EGR valve malfunction is found, repair or replace as necessary. If no malfunction is found, go to next step.
 4. Check EGR solenoid valve operation. For EGR solenoid valve operation, see **EXHAUST GAS RECIRCULATION SOLENOID VALVE**. If EGR solenoid valve malfunction is found, repair or replace as necessary. If no malfunction is found, go to next step.
 5. For more EGR system circuit testing procedure, and check other systems related to EGR system. See appropriate SELF-DIAGNOSTICS article.



Exhaust Gas
Recirculation
Valve

G00082385

Fig. 58: Identifying And Locating Exhaust Gas Recirculation Valve (Optima 2.4L)
Courtesy of KIA MOTORS AMERICA, INC.



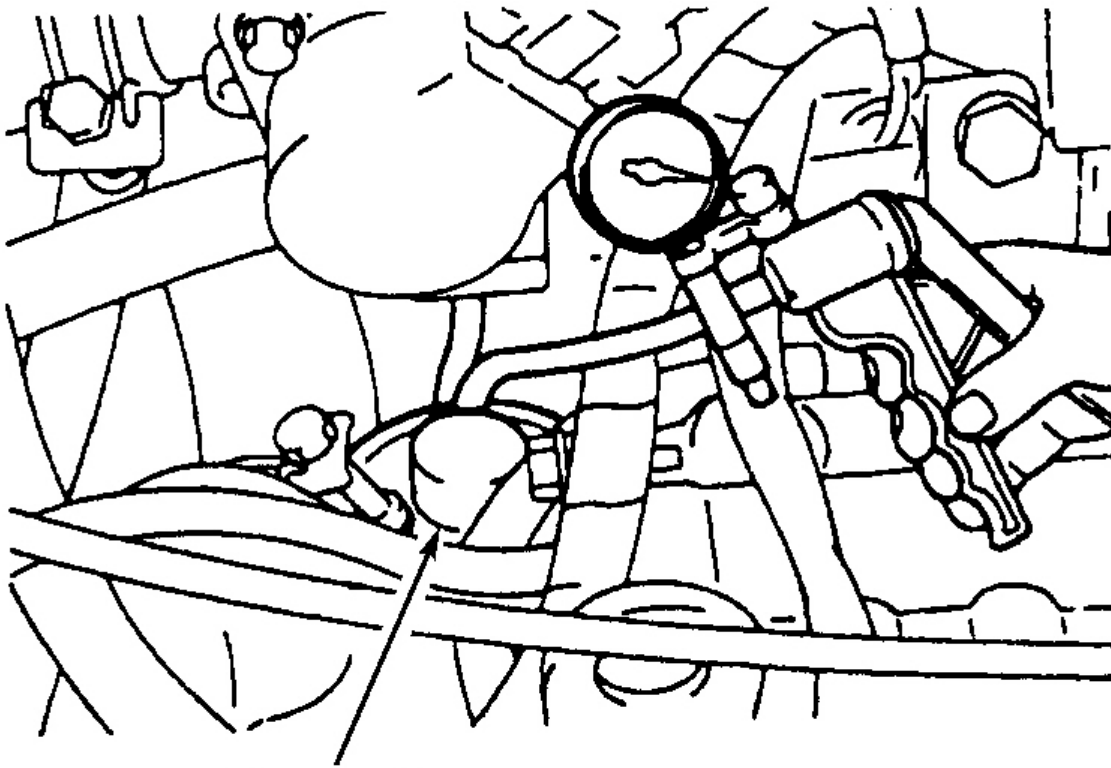
G00082386

Fig. 59: Identifying And Locating Exhaust Gas Recirculation Solenoid Valve (Optima 2.4L)
Courtesy of KIA MOTORS AMERICA, INC.

EXHAUST GAS RECIRCULATION VALVE (OPTIMA 2.4L)

NOTE: For Exhaust Gas Recirculation (EGR) valve removal and installation, see **EXHAUST GAS RECIRCULATION VALVE** under **EMISSION SYSTEMS & SUB-SYSTEMS** in **REMOVAL, OVERHAUL & INSTALLATION** article.

1. Connect vacuum pump to EGR valve fitting port. Apply vacuum to EGR valve and observe if vacuum is held. See **Fig. 60** . If vacuum is held, go to next step. If vacuum is not held, replace EGR valve.
2. While vacuum pump is connected to EGR valve fitting port. Start engine and let it idle. Apply vacuum and observe for idle changes. If idle change is observe, EGR valve is operating properly. If no idle change is notice, turn engine off and go to next step.
3. Remove EGR valve, check for excessive carbon deposit. Connect vacuum pump to EGR valve fitting port. Apply vacuum and ensure EGR valve moves freely, blow air into exhaust pipe port, while vacuum is apply. See **Fig. 61** . Air should go through and out intake port. While blowing air into exhaust pipe port, release vacuum and ensure no air passes through. If malfunction is found, repair or replace EGR valve as necessary.

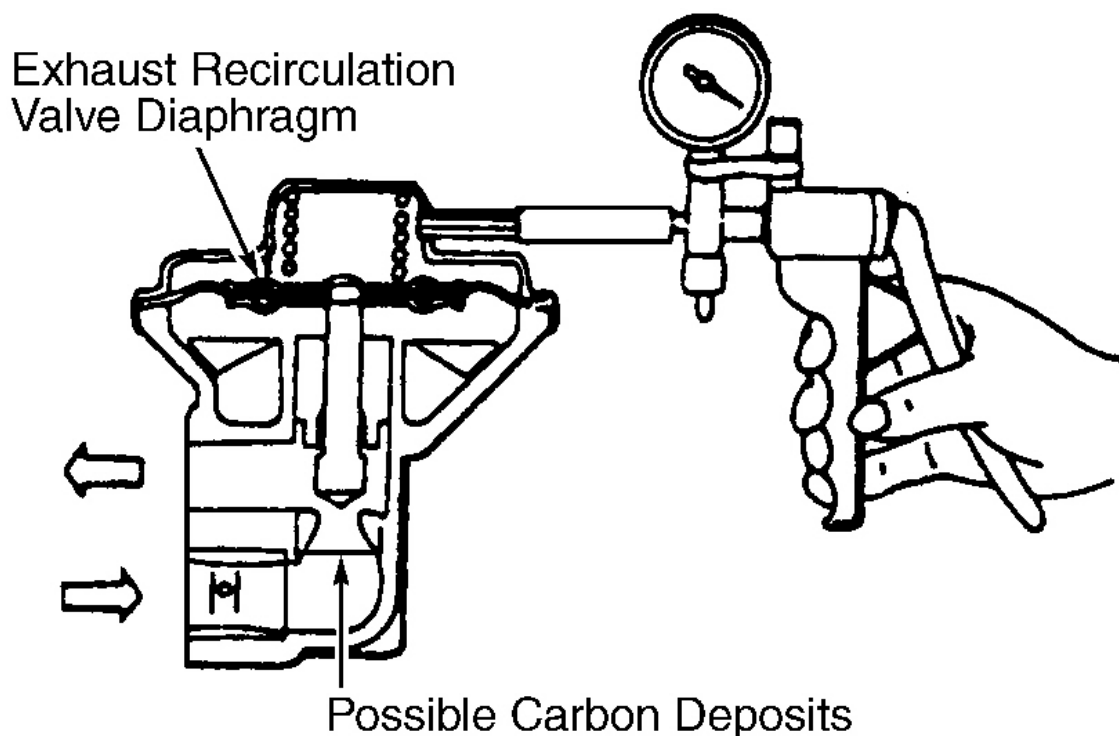


Exhaust Gas Recirculation Valve

G00102645

Fig. 60: Testing Exhaust Gas Recirculation Valve (Optima 2.4L)

Courtesy of KIA MOTORS AMERICA, INC.



G00102646

Fig. 61: Testing Exhaust Gas Recirculation Valve Operation (Optima 2.4L)

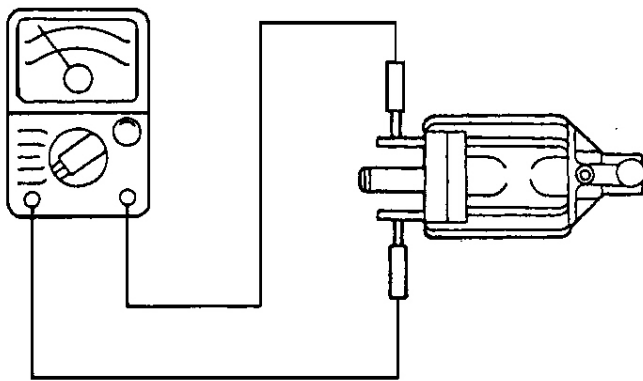
Courtesy of KIA MOTORS AMERICA, INC.

EXHAUST GAS RECIRCULATION SOLENOID VALVE (OPTIMA 2.4L)

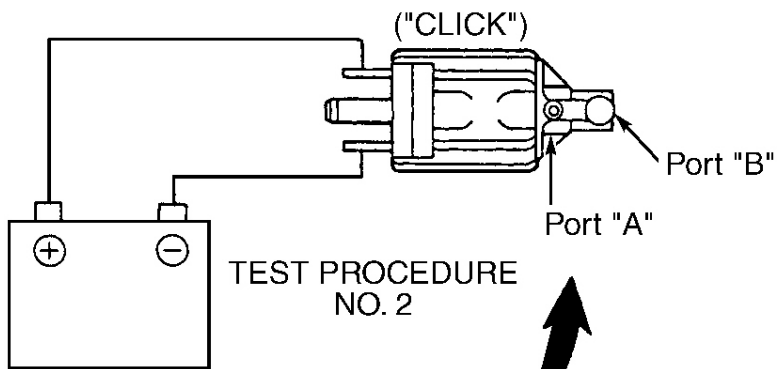
NOTE: Only component testing procedure is covered. For Exhaust Gas Recirculation (EGR) solenoid valve system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For EGR solenoid valve removal and installation, see EXHAUST GAS RECIRCULATION SOLENOID VALVE under EMISSION SYSTEMS & SUB-SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION article.

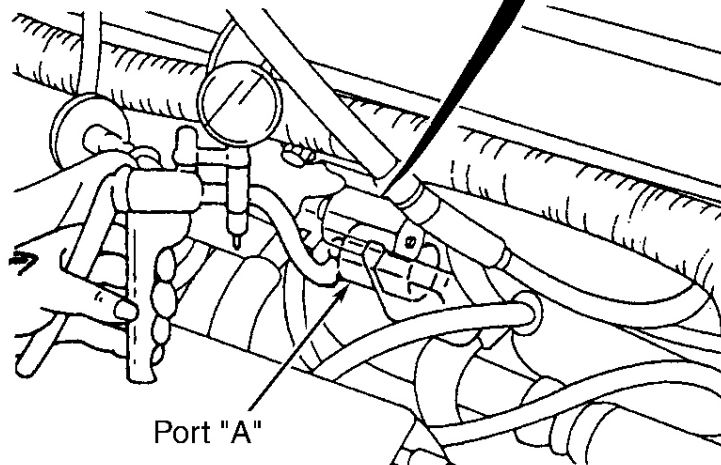
1. Disconnect EGR solenoid valve 2-pin harness connector. Check resistance between EGR solenoid valve terminals. See test procedure No. 1 in **Fig. 62** . Resistance should be 24-28 ohms at 68°F (20°C). If resistance is not as specified, replace EGR solenoid valve. If resistance is as specified, go to next step.
2. Using a fused jumper wire, connect battery voltage to terminal No.1, energize EGR solenoid by grounding terminal No. 2. Listen for operational sound (click). See test procedure No. 2 in **Fig. 62** . If operational sound is heard, go to next step. If operational sound is not heard, replace EGR solenoid valve.
3. Connect vacuum pump to port "A" of EGR solenoid valve. While EGR solenoid valve is operated by battery power, Apply vacuum. See test procedure No. 3 in **Fig. 62** . If vacuum is not held, EGR solenoid valve is operating properly. If vacuum is held, replace EGR solenoid valve.



TEST PROCEDURE
NO. 1



TEST PROCEDURE
NO. 2



TEST PROCEDURE
NO. 3

G00102647

Fig. 62: Exhaust Gas Recirculation Solenoid Valve Testing Procedures (Optima 2.4L)
Courtesy of KIA MOTORS AMERICA, INC.

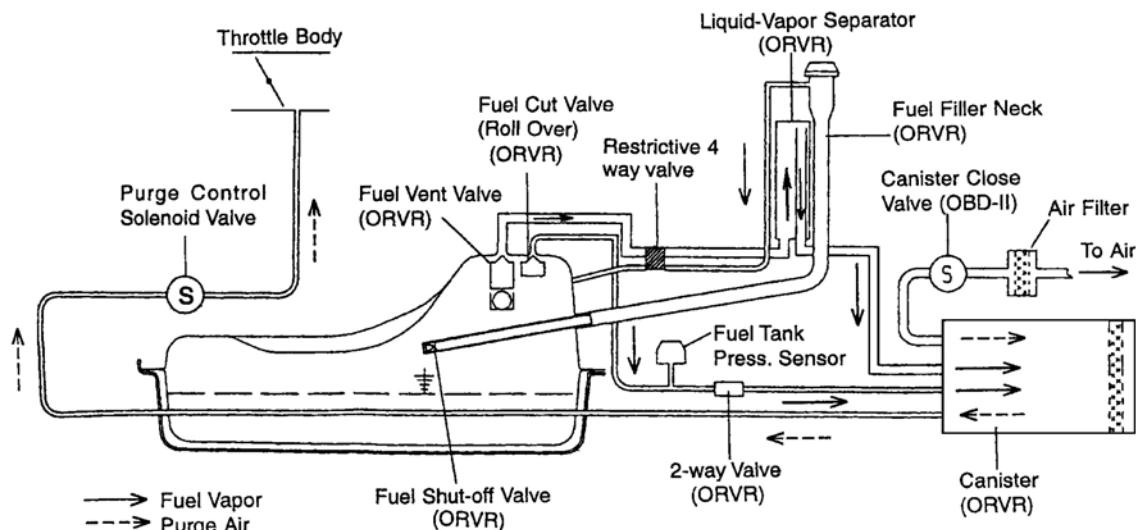
FUEL EVAPORATION SYSTEM

NOTE: Only component testing procedure is covered. For component system and circuit testing procedure, see appropriate SELF-DIAGNOSTICS article.

NOTE: For component removal and installation, see appropriate component under EMISSION SYSTEMS & SUB-SYSTEMS in REMOVAL, OVERHAUL & INSTALLATION article.

System Components Identification

For fuel evaporation system components identification and location, see **Fig. 63** .

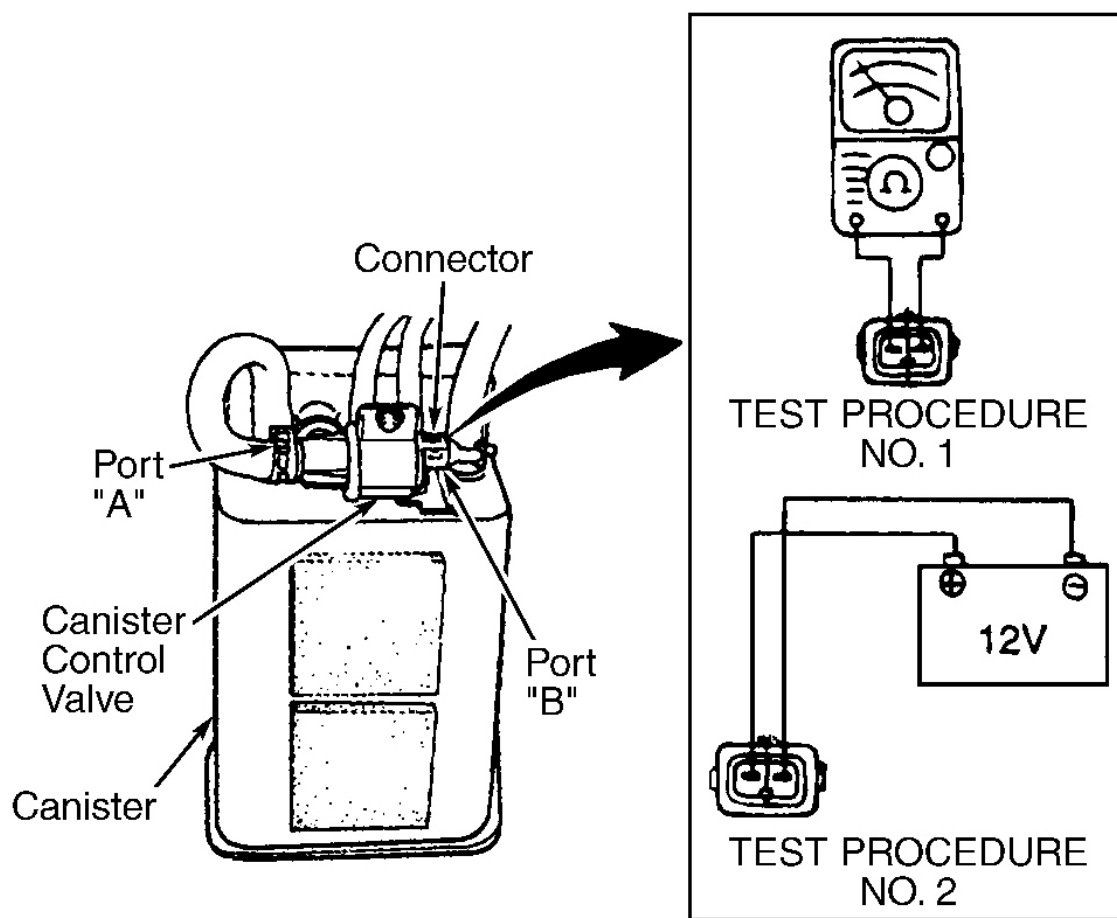


G00102644

Fig. 63: Identifying Fuel Evaporative System Components
Courtesy of KIA MOTORS AMERICA, INC.

Canister Close Valve

1. Canister Close Valve (CCV) is located near EVAP canister. Measure resistance between CCV terminals. Resistance should be 23-26 ohms at 68°F (20°C). See **Fig. 64** test procedure No. 1. If resistance is not as specified, replace CCV. If resistance is as specified, go to next step.
2. Remove CCV. CCV should be open. Blow air into port "A" and verify air escapes from port "B". Close CCV using a fused jumper wire connect to battery voltage and terminal No.1, and grounding terminal No. 2. See **Fig. 64** test procedure No.2. Blow air into port "A" and verify air does not escape from port "B". If air does not escape from port "B", CCV is operating properly. If air escapes from port "B" replace CCV.



G00102648

Fig. 64: Identifying & Testing Canister Close Valve
 Courtesy of KIA MOTORS AMERICA, INC.

Evaporative Emissions Canister

Check for loose connections, sharp bends or damage fuel vapor lines, canister cracks or fuel leakage. Repair or replace as necessary. No liquid should exist in Evaporative Emissions Canister (EVAP) canister. For EVAP Canister location, see **EVAPORATIVE EMISSIONS CANISTER LOCATION** table.

EVAPORATIVE EMISSIONS CANISTER LOCATION

Model	Location
Optima	Right Rear Of Rail, Forward of Left Rear Wheel
Rio	Left Side Of Vehicle, Near Fuel Tank
Sedona	Left Side Of Engine Compartment, Near Brake Master Cylinder
Spectra	Right Rear Of Vehicle Frame Rail
Sportage	Right Side Of Engine Compartment, Near Main Fuse And Relay Box

On-Board Refueling Vapor Recovery

NOTE: For on-board refueling vapor recovery system, only some component testing procedures are available from manufacturer.

On-Board Refueling Vapor Recovery (ORVR) system, is properly designed to prevent the fuel tank vapor emissions (HC), escape to ambient air during refueling.

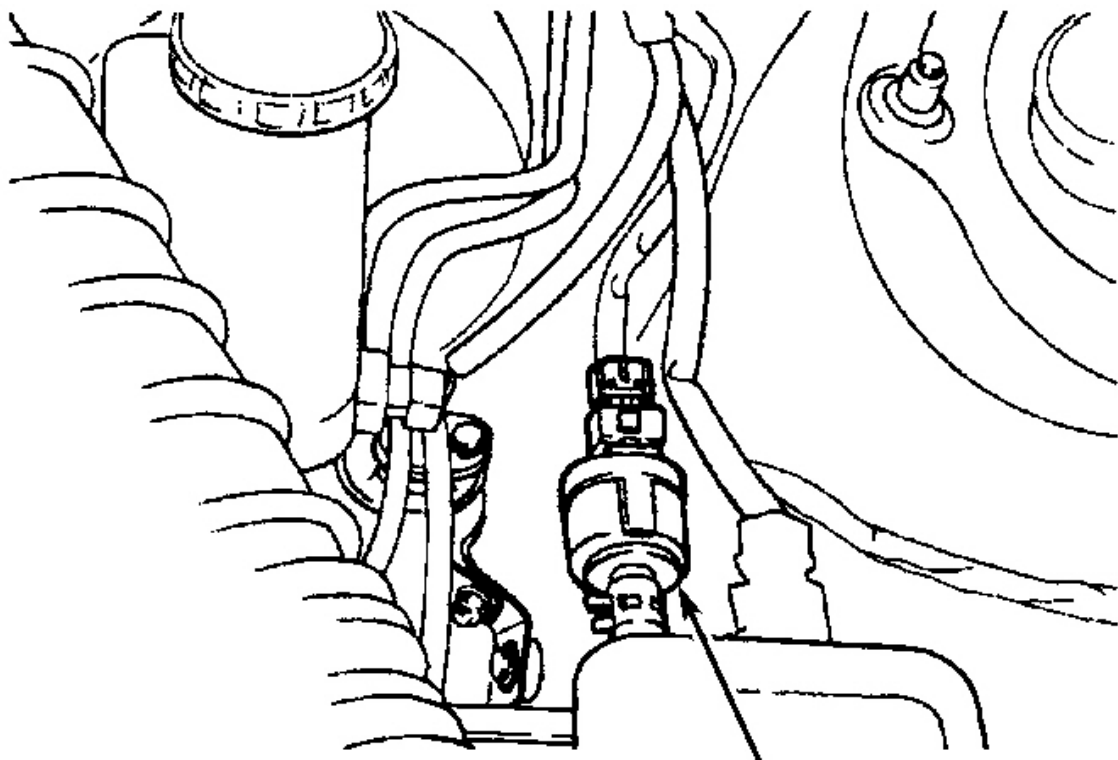
This system consists of fuel filler neck, fuel vent valve, fuel shot-off valve, fuel cut valve (roll over), two way valve, fuel liquid/vapor separator and charcoal canister. For component identification, see **Fig. 63** .

While refueling, flow and column of refueling draws ambient air into filler pipe so fuel vapor is not emitted in the ambient air. Fuel vapor in tank is then forced to flow into canister via fuel vent valve and fuel liquid/vapor separator, which insulates liquid fuel ingredients and transfer pure vapor into charcoal canister.

While engine is operating, trapped vapor emissions in canister is draw and fed by intake manifold vacuum into engine combustion chamber. According to this process, charcoal canister is purged and recovers its absorbing capability.

Purge Control Solenoid Valve (Optima 2.7L, Rio, Spectra & Sportage)

1. Disconnect Purge Control Solenoid Valve (PCSV) 2-pin harness connector. To locate PCSV, see **Fig. 65** -**Fig. 67** . Measure resistance between two terminals (component side). Seetest procedure No. 1 in **Fig. 68** . Resistance should be 24-28 ohms at 68°F (20°C). If resistance is not as specified, replace PCSV. If resistance is as specified, go to next step.
2. Remove PCSV. Blow air into port "A" and verify air does not escape from port "B", PCSV should be closed. Open PCSV by jumpering one PCSV terminal to battery positive terminal. Jumper other PCSV terminal to battery negative terminal. See test procedure No. 2 in **Fig. 68** . Blow air into port "A" and verify air escapes from port "B". If air escapes from port "B" when PCSV is closed and/or does not escape when PCSV is open, replace PCSV.

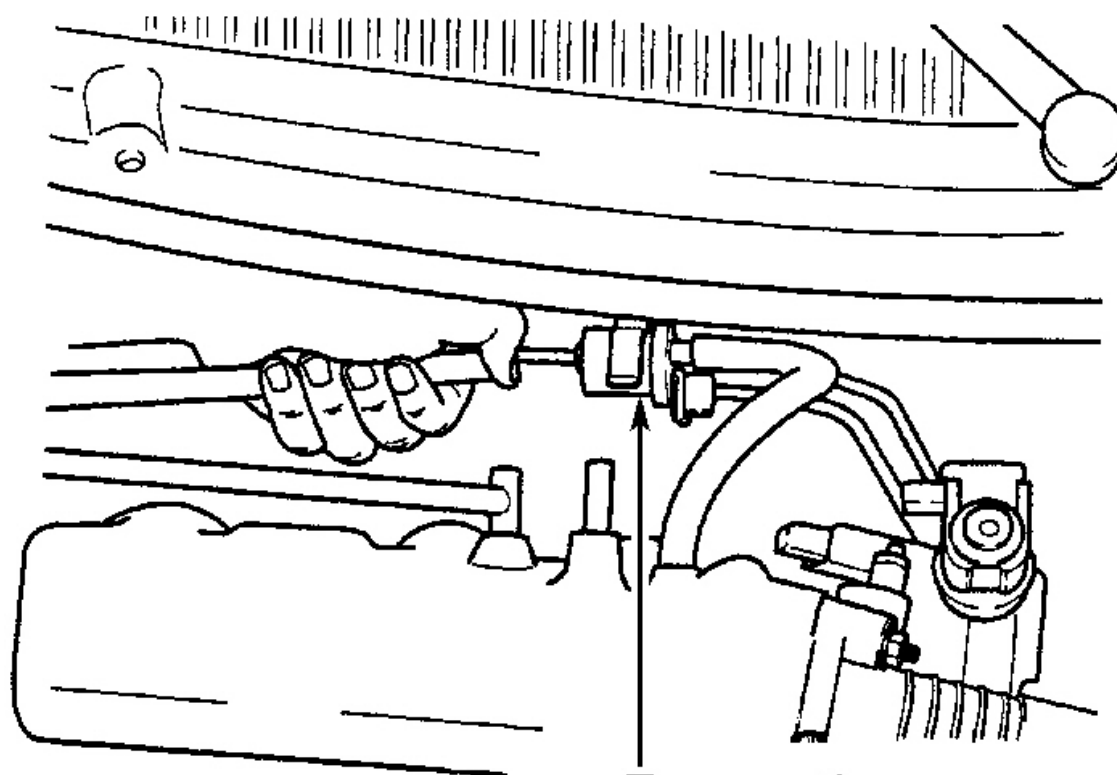


Evaporative
Canister Purge
Solenoid Valve

G00082381

Fig. 65: Locating Evaporative Purge Control Solenoid Valve (Optima 2.7L)

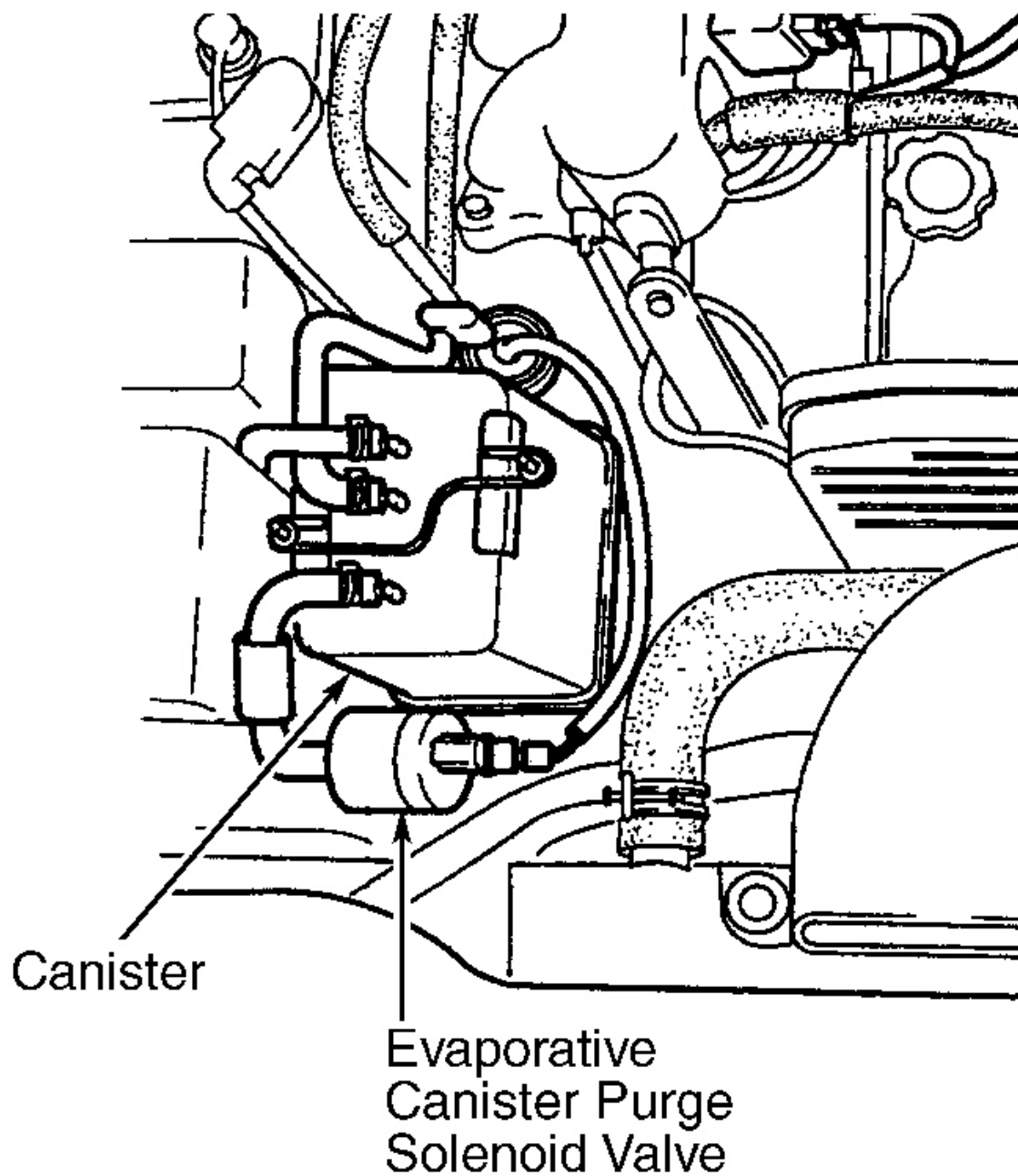
Courtesy of KIA MOTORS AMERICA, INC.



Evaporative
Canister Purge
Solenoid Valve

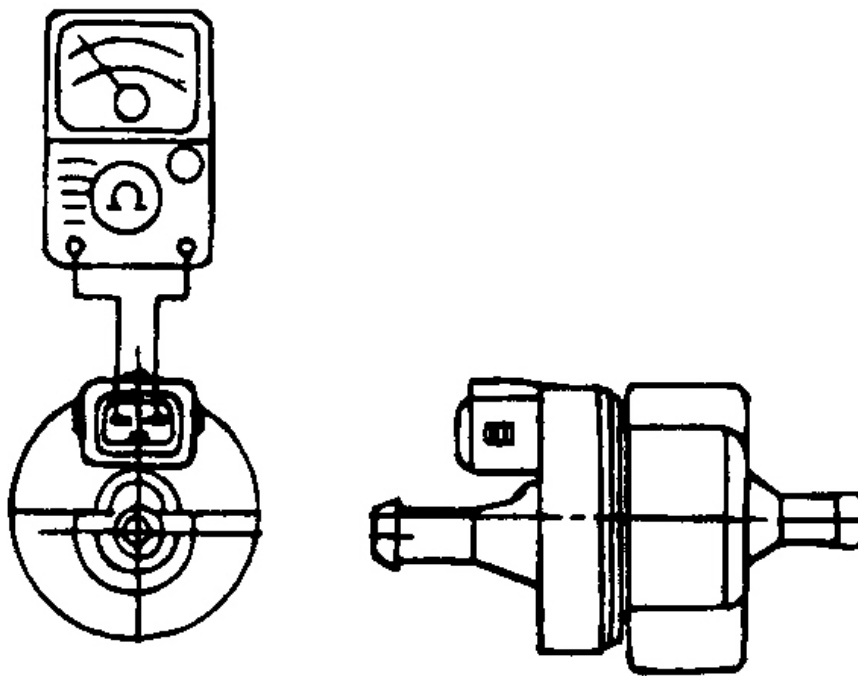
G00082382

Fig. 66: Locating Evaporative Purge Control Solenoid Valve (Spectra Shown; Rio Is Similar)
Courtesy of KIA MOTORS AMERICA, INC.

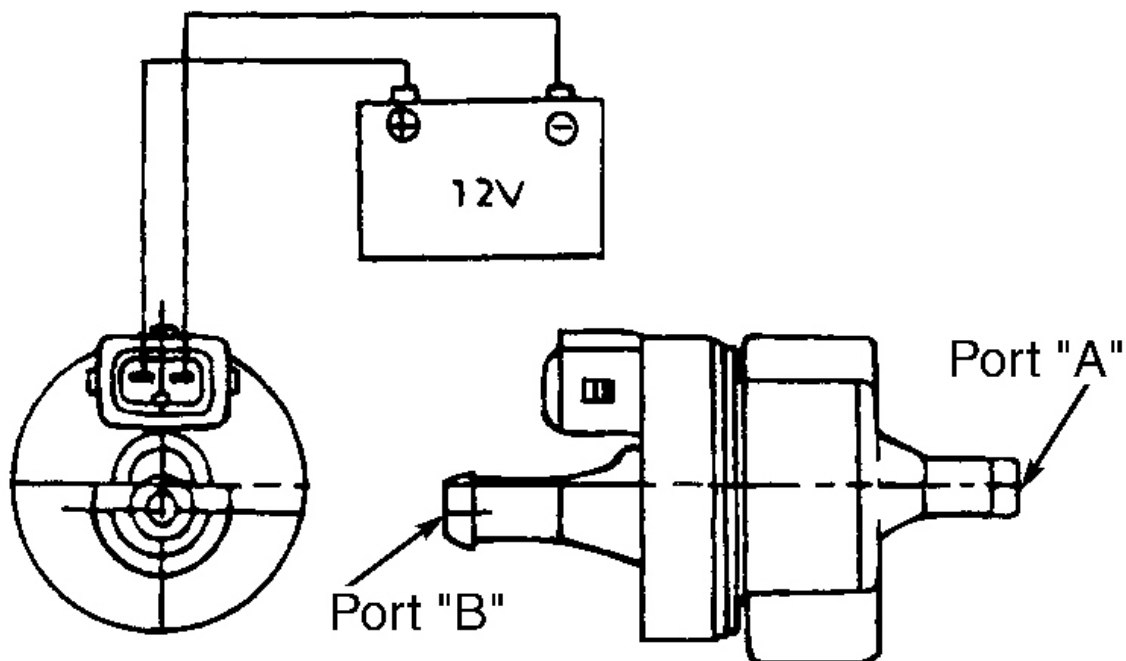


G00082383

Fig. 67: Locating Evaporative Purge Control Solenoid Valve (Sportage)
Courtesy of KIA MOTORS AMERICA, INC.



TEST PROCEDURE
NO. 1

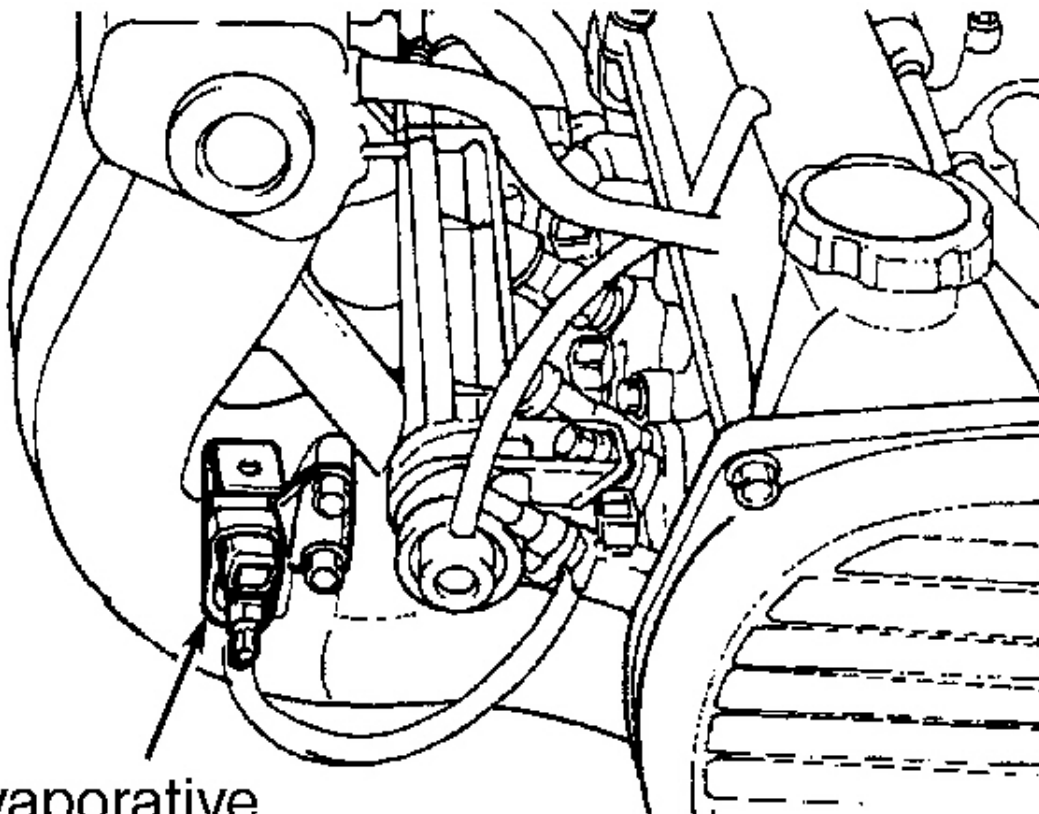


TEST PROCEDURE
NO. 2

Fig. 68: Identifying & Testing Purge Control Solenoid Valve (Optima 2.7L, Rio, Spectra & Sportage)
Courtesy of KIA MOTORS AMERICA, INC.

Purge Control Solenoid Valve (Optima 2.4L & Sedona)

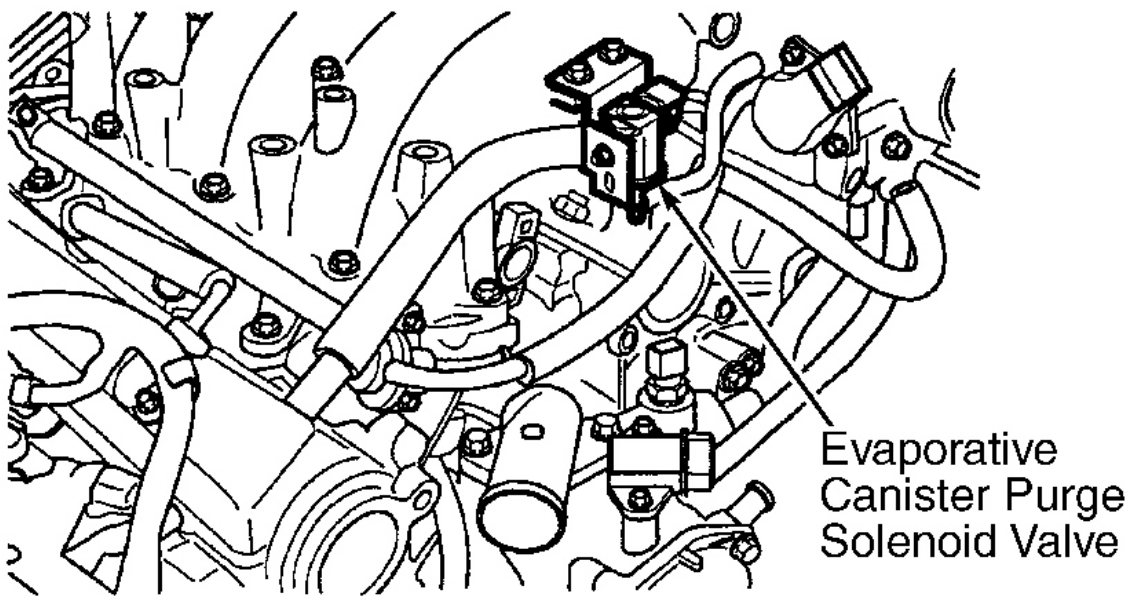
1. Disconnect Purge Control Solenoid Valve (PCSV) 2-pin harness connector. To locate PCSV, see **Fig. 69** and **Fig. 70** . Measure resistance between two terminals (component side). Seetest procedure No. 1 in **Fig. 71** . Resistance should be 23-26 ohms at 68°F (20°C). If resistance is not as specified, replace PCSV. If resistance is as specified, go to next step.
2. Remove PCSV. PCSV is normally closed. Connect a vacuum pump to PCSV port "A" and apply vacuum, vacuum should be held. While applying vacuum, open PCSV by jumpering one PCSV terminal to battery positive terminal. Jumper other PCSV terminal to battery negative terminal. Seetest procedure No. 2 in **Fig. 71** . Check if vacuum is released when PCSV is open. If problem exists, replace PCSV.



**Evaporative
Canister Purge
Solenoid Valve**

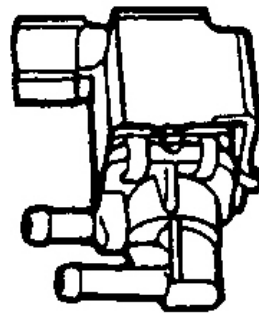
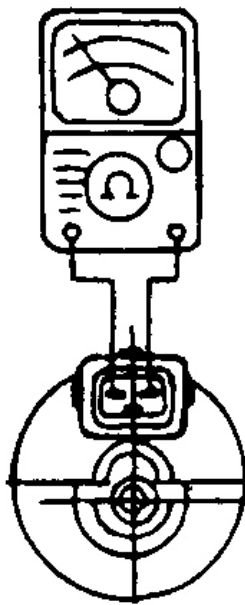
G00082380

Fig. 69: Locating Evaporative Purge Control Solenoid Valve (Optima 2.4L)
Courtesy of KIA MOTORS AMERICA, INC.

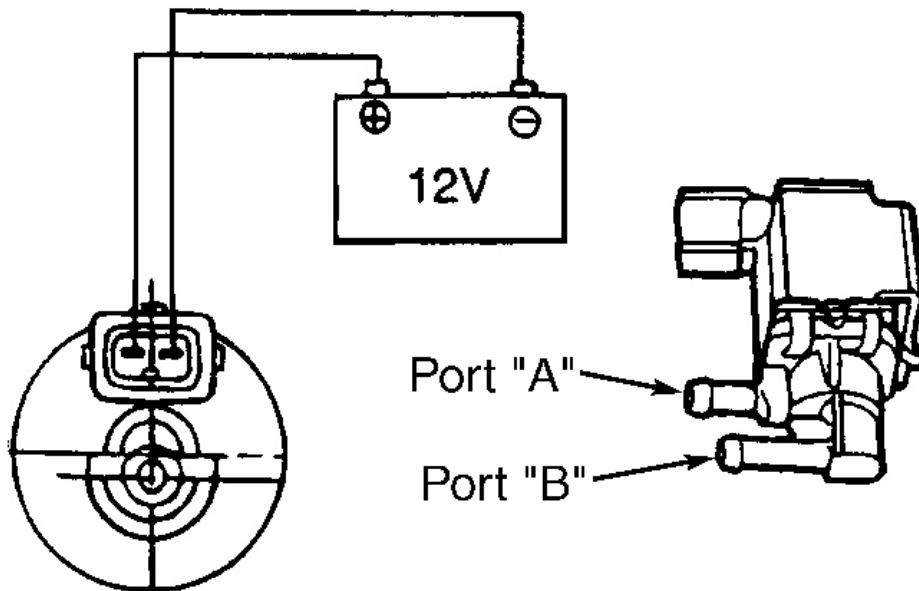


G00082384

Fig. 70: Locating Evaporative Purge Control Solenoid Valve (Sedona)
Courtesy of KIA MOTORS AMERICA, INC.



TEST PROCEDURE
NO. 1



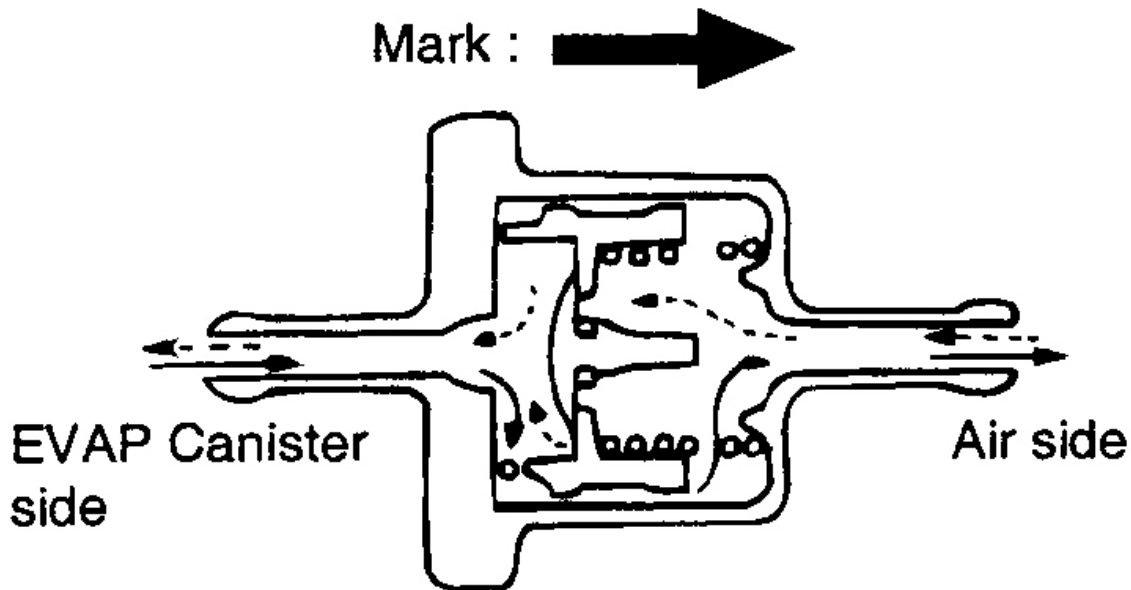
TEST PROCEDURE
NO. 2

G00102650

Fig. 71: Identifying & Testing Purge Control Solenoid Valve (Optima 2.4L & Sedona)
Courtesy of KIA MOTORS AMERICA, INC.

Two-Way Valve (Overfill Limiter)

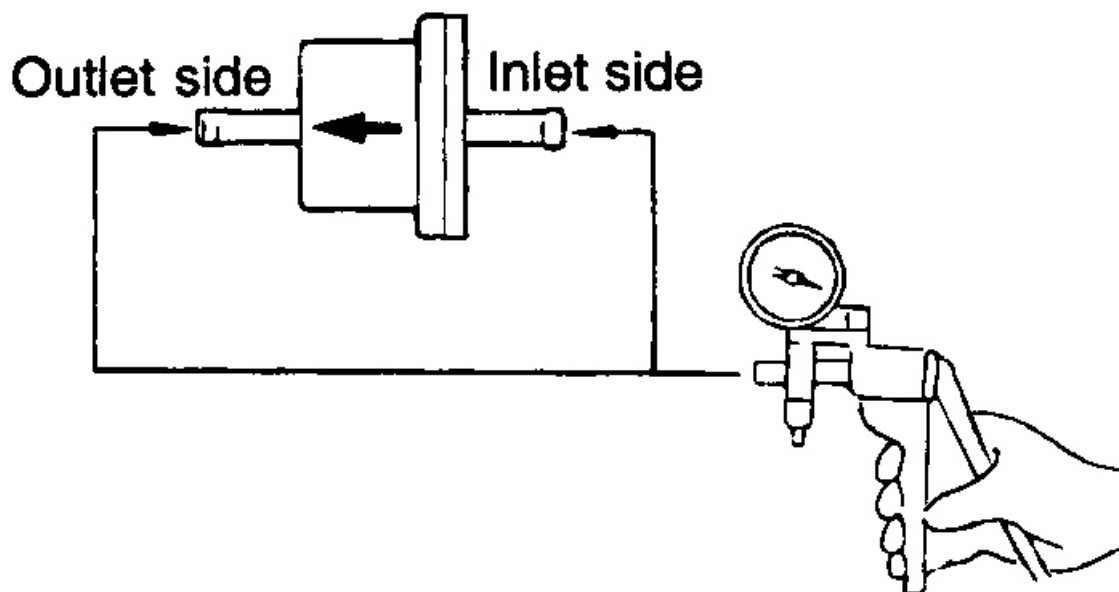
1. Two-Way valve consist of a pressure valve and a vacuum valve. Pressure valve side is designed to open when fuel tank internal pressure has increased over normal pressure, and vacuum valve side opens when vacuum has been produced in fuel tank. For Two-Way valve identification, see **Fig. 72** . For valve test, go to next step.
2. Connect vacuum pump to inlet side of Two-Way valve. See **Fig. 73** . Apply vacuum, negative pressure is generated and vacuum should be held. If vacuum is not held, replace Two-Way valve. If vacuum is held, go to next step.
3. Connect vacuum pump to outlet side of Two-Way valve. Apply vacuum, negative pressure should not be generated. If is negative pressure is generated, replace Two-Way valve as necessary.



G00102652

Fig. 72: Identifying Two-Way Valve

Courtesy of KIA MOTORS AMERICA, INC.



G00102653

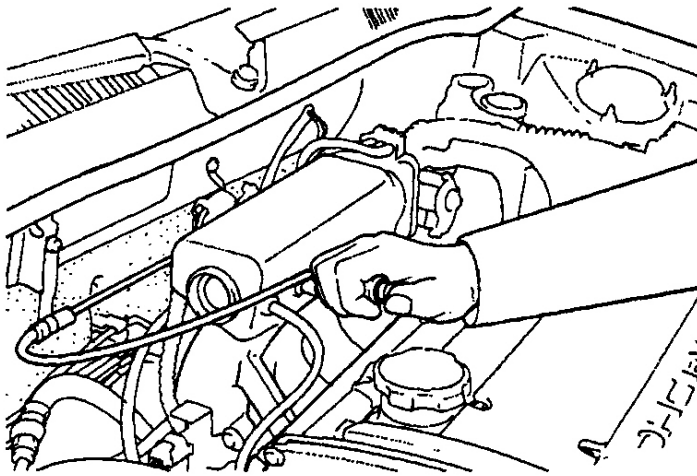
Fig. 73: Testing Two-Way Valve

Courtesy of KIA MOTORS AMERICA, INC.

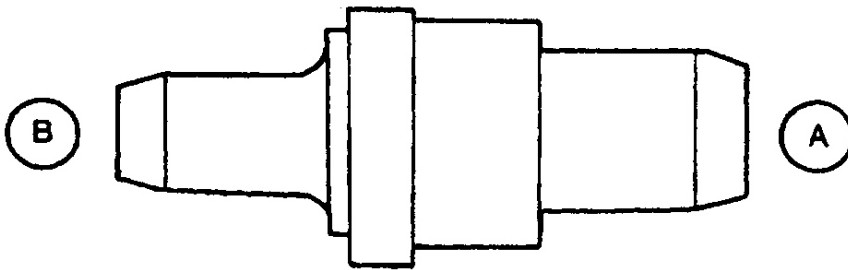
POSITIVE CRANKCASE VENTILATION

System Inspection

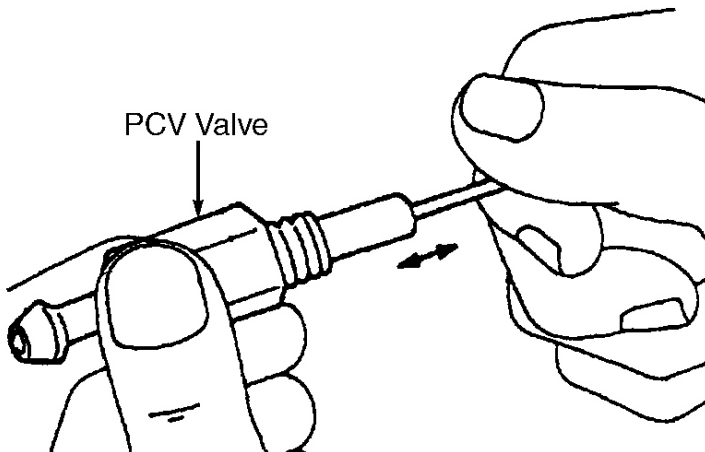
1. Warm engine to normal operating temperature, and let it idle. Remove Positive Crankcase Ventilation (PCV) valve from cylinder head cover port. With PCV valve attached to vent hose, block PCV valve opening and check for vacuum. See test procedure No. 1 in **Fig. 74** . If no vacuum is felt, check for blockage or collapsed vent hose, or restricted PCV valve. For vent hose problem, replace or repair as necessary. For PCV valve problem, go to next step.
2. For plug in type PCV valve. Note direction of valve installation. Remove PCV valve from vent hose. Blow air into port "A", verify that air comes out of port "B". Blow air into port "B", verify that no air comes out of port "A". See test procedure No. 2 in **Fig. 74** . If problem is found, clean or replace PCV valve as necessary. For PCV valve screw-on type, go to next step.
3. For screw-on type PCV valve. Remove PCV valve from vent hose. From threaded side insert a thin stick into PCV valve to check if plunger moves. See test procedure No. 3 in **Fig. 74** . If plunger does not move, PCV valve will be clogged. Clean or replace as necessary.



TEST PROCEDURE
NO. 1



TEST PROCEDURE
NO. 2



TEST PROCEDURE
NO. 3

G00102651

Fig. 74: Locating, Identifying & Testing PCV Valve
Courtesy of KIA MOTORS AMERICA, INC.