1991

SERVICE MANUAL SUPPLEMENT

DIESEL ENGINE

REAR WHEEL DRIVE TRUCK

D&W 250-350

CHRYSLER MOTORS

CHRYSLER MOTORS

DIESEL ENGINE SERVICE MANUAL SUPPLEMENT

1991 1/2 DODGE TRUCKS

To order the special service tools used and illustrated, please refer to the instructions on inside back cover.

CHRYSLER MOTORS

Chrysler Motors reserves the right to make changes in design or to make additions to or improvements in its products wihtout imposing any obligations upon itself to install them on its products previously manufactured.

Litho in U.S.A. Copyright ©1991 Chrysler Motors 20M191

FOREWORD

The information contained in this service manual has been prepared for the professional automotive technician involved in daily repair operations. This manual does not cover theory of operation, which is addressed in service training material.

Information in this manual is divided into groups. These groups contain general information, diagnosis, testing, adjustments, removal, installation, disassembly, and assembly procedures for the components.

To assist in locating a group title page, use the Group Tab Locator on the following page. The solid bar after the group title is aligned to a solid tab on the first page of each group. This first page of the group has a contents section that lists major topics within the group.

Chrysler Motors reserves the right to change testing procedures, specifications, diagnosis, repair methods, or vehicle wiring at any time without prior notice or incurring obligation.

Information describing the operation and use of standard and optional equipment is included in the Owner's Manual provided with the vehicle.

COMPONENT AND SYSTEM INDEX

Navigation Tools: Click on the “Table of Contents” below, or use the Bookmarks to the left.

GROUP	TAB LOCATOR

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

BRAKES

CONTENTS

DIESEL VACUUM PUMP

A new design power brake vacuum pump is used on 1991-1/2 AD models with the Cummins turbo diesel engine. However, the new vacuum pump is still combined with the power steering pump into a single assembly (Fig. 1).

The new vacuum pump is a constant displacement, vane-type pump. Vacuum is generated by four vanes mounted in the pump rotor. The rotor is located in the pump housing and is pressed onto the pump shaft.

The vacuum and steering pumps are both operated by a single drive gear pressed onto the vacuum pump shaft. The drive gear is operated by the camshaft gear.

The vacuum and power steering pump shafts are connected by a coupling. Each pump shaft has an adapter with drive lugs that engage in the coupling.

The vacuum pump rotating components are lubricated by engine oil. Lubricating oil is supplied to the pump through an oil line at the underside of the pump housing.

VACUUM PUMP SERVICEABILITY

The vacuum pump is not a serviceable component. If diagnosis indicates a pump malfunction, the pump must be removed and replaced as an assembly. Do not disassemble or attempt to repair the pump.

The combined vacuum and steering pump assembly must be removed for access to either pump. However, the vacuum pump can be removed without having to disassemble the power steering pump.

If the power steering pump requires service, simply remove the assembly and separate the two pumps. Refer to the pump removal and installation procedures in this section.

LOW VACUUM WARNING SWITCH

A vacuum switch is used to monitor output of the vacuum pump. The switch is in circuit with the brake warning light.

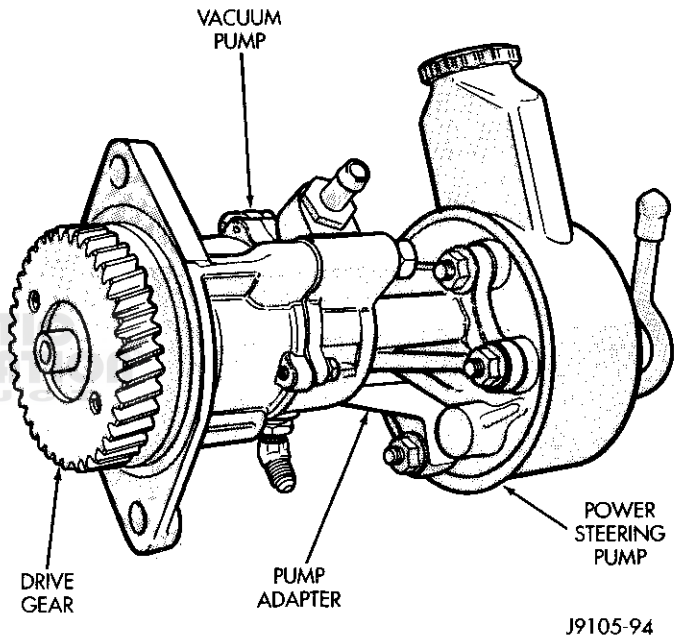


Fig. 1 Vacuum And Steering Pump Assembly

A vacuum hose connects the switch to the power brake booster. A wire harness connects the switch to the brake warning light.

The switch is mounted on the driver side inner fender panel just below the hood hinge (Fig. 2).

VACUUM PUMP OPERATION

Vacuum pump output is transmitted to the power brake booster through a supply hose. The hose is connected to an outlet port on the pump housing and to the check valve in the power brake booster.

Pump output ranges from a minimum of 8.5 to 25 inches vacuum.

The pump rotor and vanes are rotated by the pump drive gear. The drive gear is operated by the camshaft gear.

Booster vacuum level is monitored by a warning switch (Fig. 2). The switch consists of a vacuum chamber that measures vacuum level and a sensor in circuit with the brake warning light.

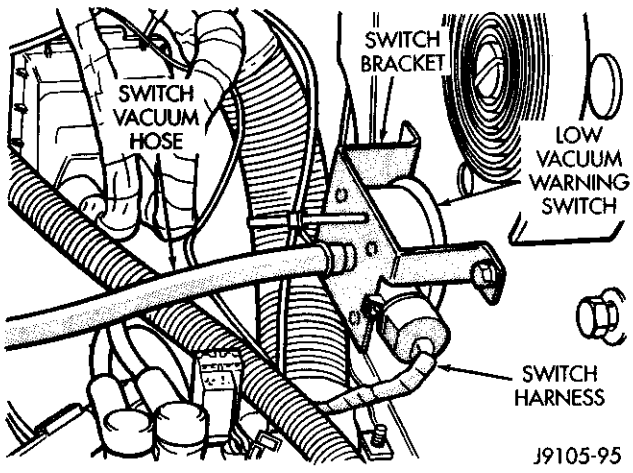


Fig. 2 Vacuum Switch Location

The vacuum chamber is connected to the booster check valve by a vacuum supply hose. A wire harness connects the switch sensor to the brake warning light. If booster vacuum falls below 8.5 inches for 8-10 seconds or more, the switch sensor completes the circuit to the warning light causing it to illuminate.

VACUUM PUMP DIAGNOSIS

Vacuum pump diagnosis involves checking pump output with a vacuum gauge. The low vacuum warning switch can also be checked with a vacuum gauge. Refer to the diagnosis procedure in this section.

A standard vacuum gauge can be used to check pump output when necessary. Simply disconnect the pump supply hose and connect a vacuum gauge to the outlet port for testing purposes. Vacuum should hold steady in a range of approximately 8.5 to 25 inches at various engine speeds.

DIAGNOSING LOW VACUUM OUTPUT CONDITION

A low booster vacuum condition or a faulty low vacuum warning switch will cause the brake warning light to illuminate. If the light does go on and indicates the existence of a low vacuum condition, check the vacuum pump, booster and warning switch as follows:

(1) Check vacuum pump oil feed line. Verify that line connections are secure and not leaking. If leakage is noted and pump is noisy, replace pump.

(2) Check vacuum pump output with a standard vacuum gauge. Disconnect the supply hose to the booster. Connect the gauge to this hose and run the engine at various throttle openings. Output should range from 8.5 to 25 inches vacuum. If vacuum is consistently below 8.5 inches, the problem is with the vacuum hoses or a vacuum pump component. If output is within specified limits, continue testing.

(3) Check booster operation as described in the diagnosis section. Replace the check valve, vacuum hoses, or booster if necessary. However, if booster operation is correct but the warning light is still on, continue testing.

(4) Disconnect the vacuum hose from the warning switch, plug the hose and connect a hand vacuum pump to the switch.

(5) Start and run the engine.

(6) Apply 8.5 to 9 inches of vacuum to the warning switch and observe the warning light. If the light goes out, the switch vacuum hose is either loose or leaking. If the light remains on, leave the engine running and continue testing.

(7) Apply 20-25 inches vacuum to the switch and observe warning light operation. If the light now goes out, the switch is at fault and should be replaced. If the light remains on, continue testing.

(8) Reconnect the vacuum hoses and replace the original warning switch with a known good switch. Run the engine and observe warning light operation. If the light is now off, the old switch is faulty. If the light remains on, the problem is in the wiring between the switch and warning light.

REMOVING VACUUM—STEERING PUMP ASSEMBLY

(1) Disconnect battery negative cable.

(2) Position drain pan under power steering pump.

(3) Disconnect vacuum and steering pump hoses from respective pumps (Fig. 3).

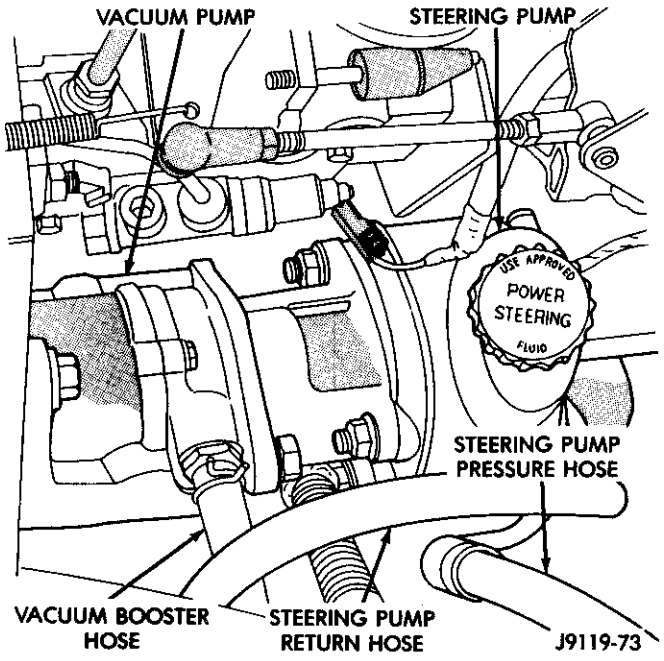


Fig. 3 Vacuum And Steering Pump Hose Connections

(4) Disconnect oil pressure sender wires at sender (Fig. 4).

(5) Remove oil pressure sender (Fig. 4).

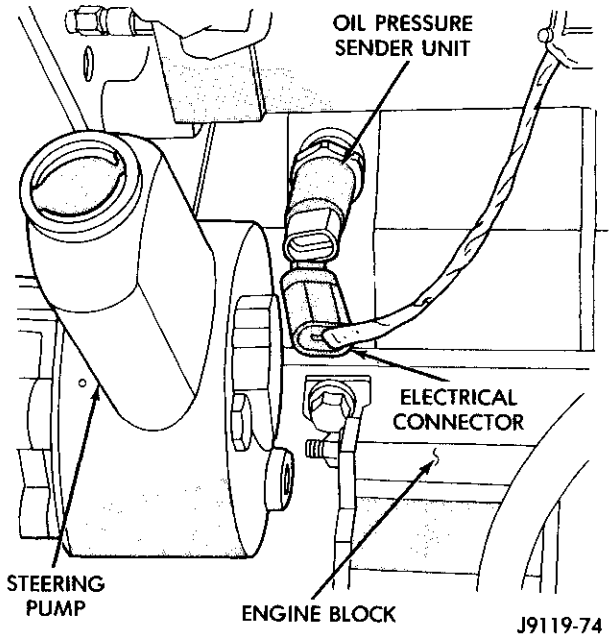


Fig. 4 Oil Pressure Sender Location

(6) Disconnect lubricating oil feed line from fitting at underside of vacuum pump (Fig. 5).

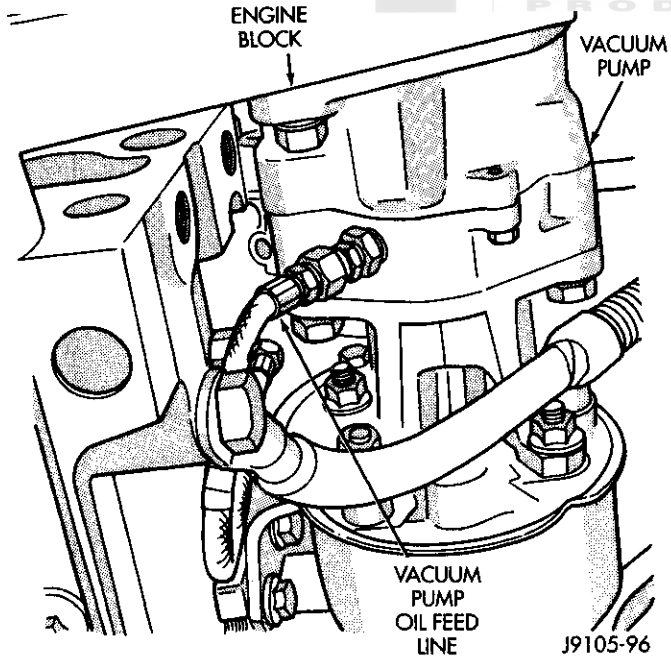


Fig. 5 Oil Feed Line Connection At Pump

(7) Remove lower bolt that attaches pump assembly to engine block (Fig. 6).

(8) Remove bottom, inboard nut that attaches adapter to steering pump (Fig. 6). This nut secures a small bracket to engine block. Nut and bracket must be removed before pump assembly can be removed from block.

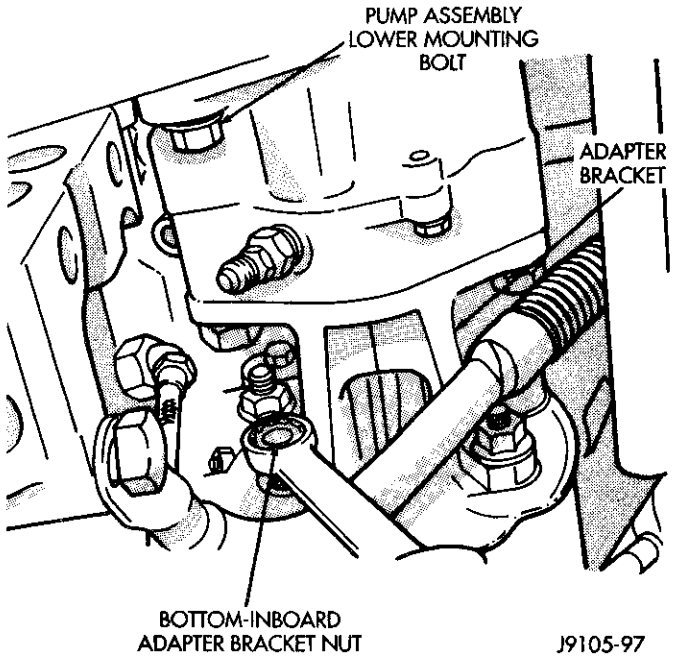


Fig. 6 Adapter And Pump Mounting Fastener Location

(9) Remove upper bolt that attaches pump assembly to engine block (Fig. 7).

(10) Remove pump assembly from vehicle (Fig. 8).

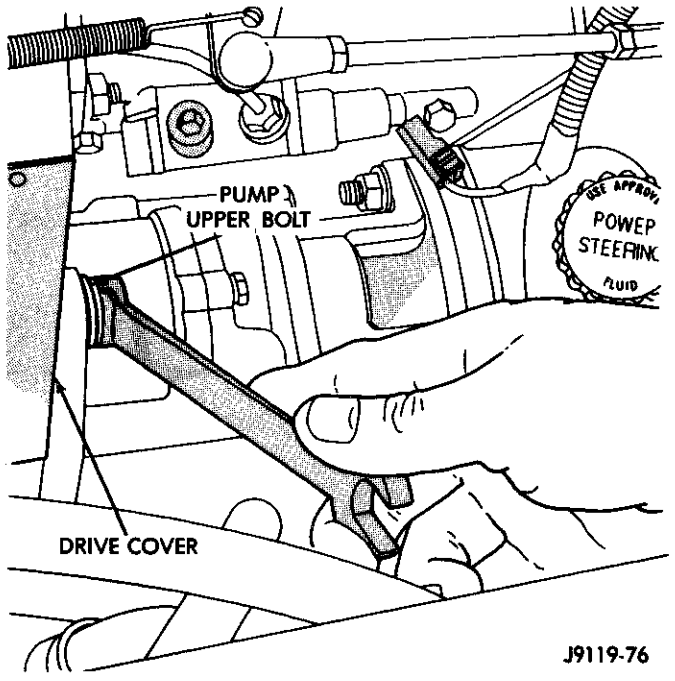


Fig. 7 Removing Pump Assembly Upper Mounting Bolt

VACUUM PUMP REPLACEMENT

(1) Remove nuts attaching vacuum pump to adapter (Fig. 8).

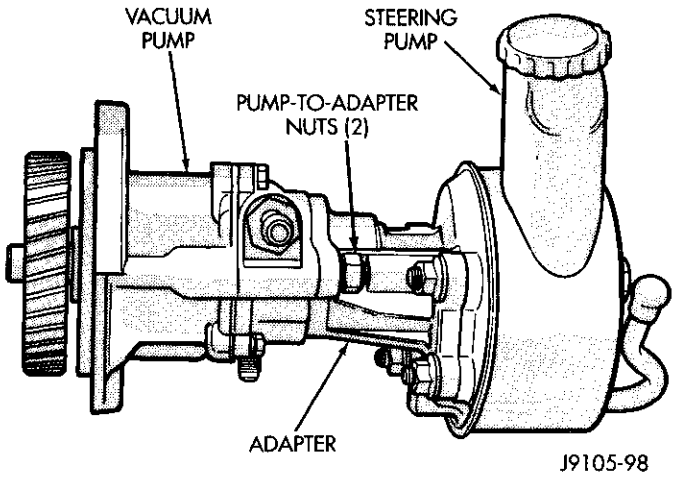


Fig. 8 Pump Assembly Removal

(2) Remove vacuum pump from adapter (Fig. 9). Turn pump gear back and forth to disengage pump shaft from coupling if necessary.

(3) Inspect adapter O-ring (Fig. 9). Replace O-ring if cut or torn.

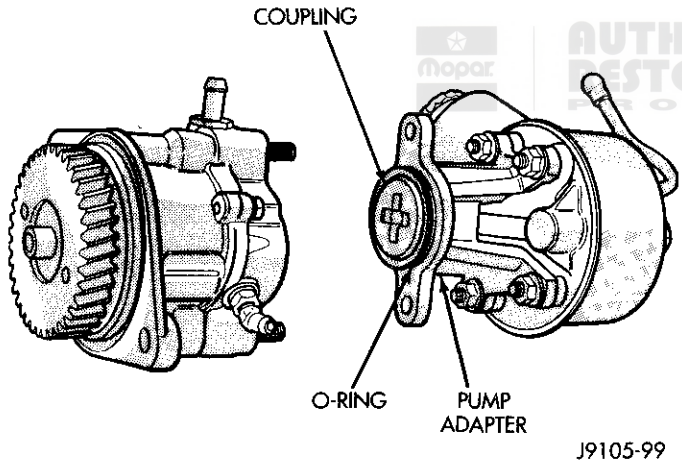


Fig. 9 Vacuum Pump Removed From Adapter

(4) Lubricate adapter O-ring with engine oil.

(5) Note position of drive slots in coupling. Then rotate drive gear to align tangs on vacuum pump shaft with coupling (Fig. 10).

(6) Verify that pump is seated in adapter and coupling.

(7) Install and tighten pump attaching nuts and washers.

PUMP ADAPTER REPLACEMENT

(1) Remove coupling from adapter (Fig. 11).

(2) Remove remaining adapter attaching nuts and remove adapter from steering pump (Fig. 12).

(3) If steering pump will be serviced, remove spacer from each inboard mounting stud on pump (Fig. 12).

(4) Clean and lubricate pump shaft with engine oil.

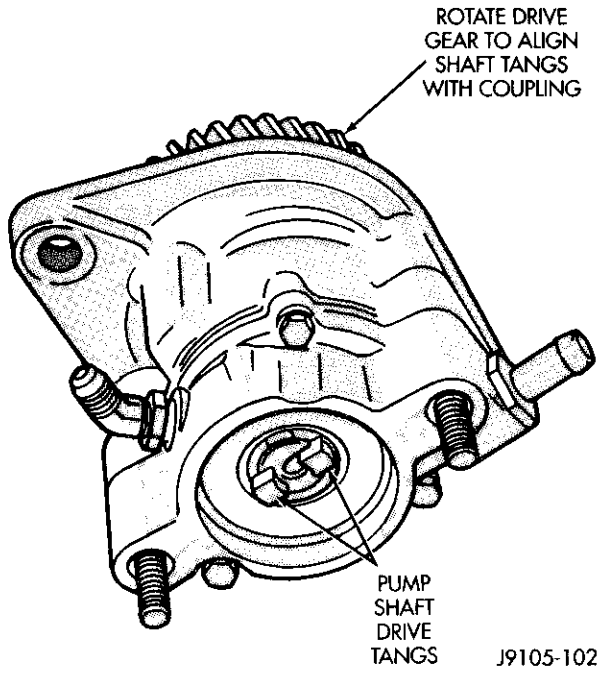


Fig. 10 Aligning Pump Shaft Drive Tangs

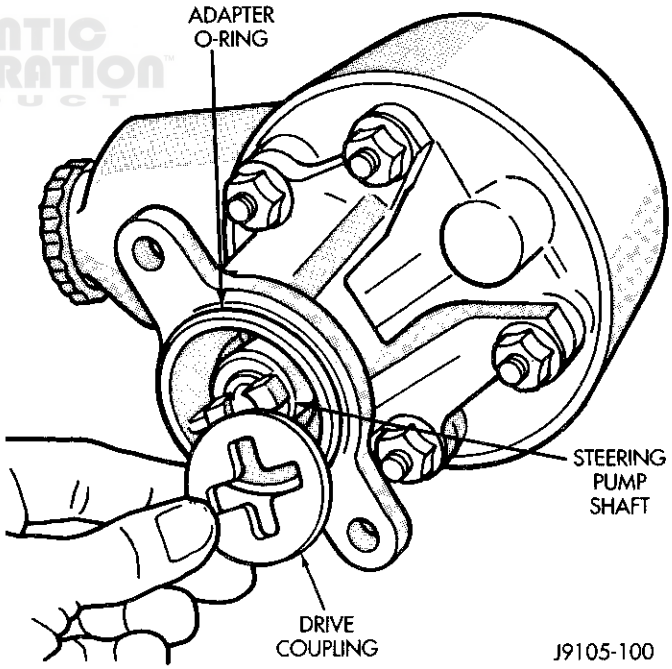


Fig. 11 Removing/Installing Pump Drive Coupling

(5) Install spacers on steering pump studs (Fig. 12).

(6) Install O-ring on adapter (Fig. 11).

(7) Position adapter on pump studs.

(8) Install attaching nuts on outboard stud and on the two upper pump studs. Do **not** install nut on lower, inboard stud at this time. Tighten nuts to 24 N•m (18 ft. lbs.) torque.

(9) Install coupling on pump shaft. Be sure coupling is securely engaged in shaft drive tangs.

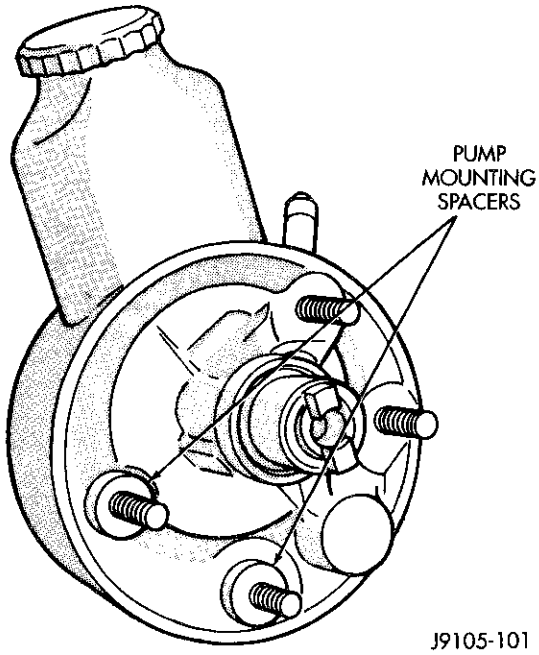


Fig. 12 Steering Pump Mounting Stud Spacer Locations

(10) Install vacuum pump on adapter. Rotate drive gear until tangs on pump shaft engage in coupling. Verify that pump is seated before installing attaching nuts.

(11) Install and tighten vacuum pump attaching nuts.

INSTALLING VACUUM—STEERING PUMP ASSEMBLY

(1) Position new gasket on vacuum pump mounting flange (Fig. 13). Use Mopar perfect seal, or silicone adhesive/sealer to hold gasket in place.

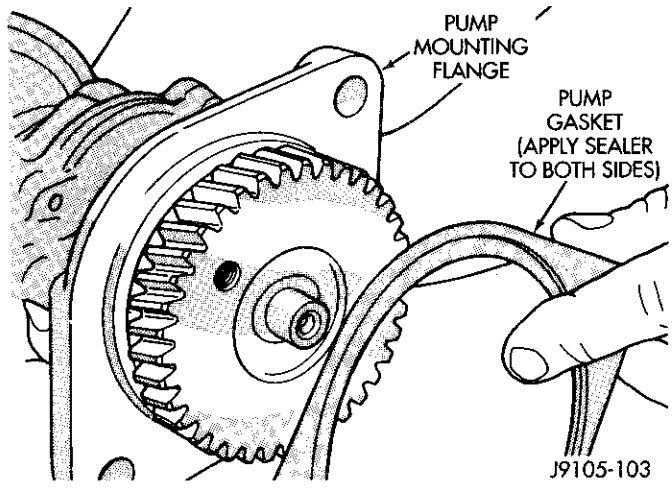


Fig. 13 Positioning Gasket On Pump Mounting Flange

(2) Insert pump assembly upper attaching bolt in mounting flange and gasket. Use sealer or grease to hold bolt in place if necessary.

(3) Position pump assembly on engine and install upper bolt (Fig. 14). Tighten upper bolt only enough to hold assembly in place at this time.

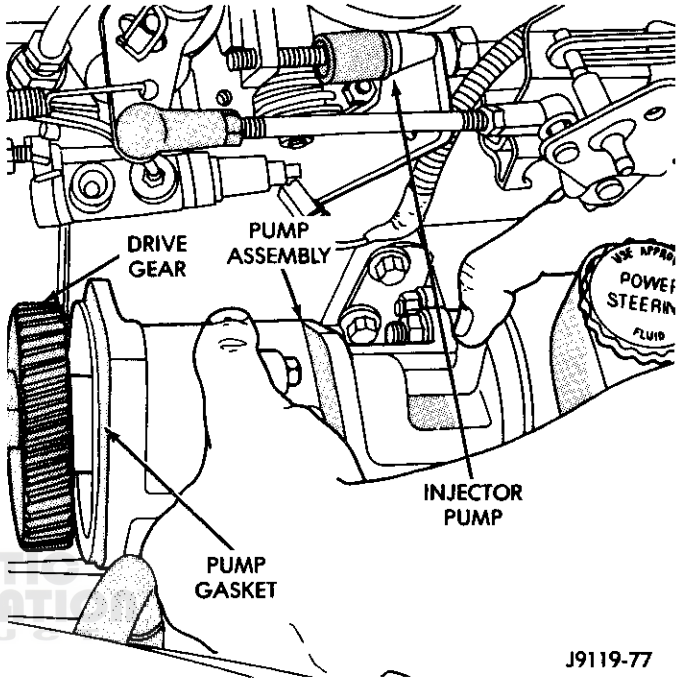


Fig. 14 Installing Pump Assembly On Engine

(4) Working from under vehicle, install pump assembly lower attaching bolt. Then tighten upper and lower bolt to 77 N•m (57 ft. lbs.) torque.

(5) Position bracket on steering pump inboard stud. Then install remaining adapter attaching nut on stud. Tighten nut to 24 N•m (18 ft. lbs.) torque.

(6) Connect oil feed line to vacuum pump connector. Tighten line fitting securely.

(7) Install oil pressure sender and connect sender wires.

(8) Connect steering pump pressure and return lines to pump. Tighten pressure line fitting to 30 N•m (22 ft. lbs.) torque.

(9) Connect vacuum hose to vacuum pump.

(10) Connect battery cables, if removed.

(11) Fill power steering pump reservoir.

(12) Purge air from steering pump lines. Start engine and slowly turn steering wheel left and right to circulate fluid and purge air from system.

(13) Stop engine and top off power steering reservoir fluid level.

(14) Start engine and check brake and steering operation. Verify that power brake booster is providing vacuum assist and firm brake pedal is obtained. Then verify that steering action is correct. Do this before moving vehicle.

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

COOLING SYSTEM

GENERAL INFORMATION

This group contains changes made to the diesel cooling system during the mid-1991 model year. The main change is a new higher capacity cross-flow radiator. The cooling system capacities have changed as a result of the new radiator.

RADIATOR

A cross-flow radiator is used in the mid-1991 model year. The radiator cools the engine and automatic transmission (if equipped).

REMOVAL

(1) Disconnect battery negative cable from battery.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAINCOCK WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

(2) Drain the cooling system. Refer to Draining Cooling System in the 1991 Rear Wheel Drive Truck Service Manual.

(3) Remove hose clamps and hoses from radiator. Remove coolant reserve tank hose from radiator filler neck nipple.

(4) Remove fan shroud retaining clips. The shroud has two tabs that fit into clips in the bottom of the radiator. Lift the shroud up and position it back onto the engine (Fig. 1).

(5) Remove radiator top mounting brackets. The brackets fit over support dowels on the radiator inlet tank (Fig. 1).

(6) The bottom of the radiator has two dowels that fit into holes in the lower support panel. Taking care not to damage radiator cooling fins or tubes, lift radiator straight up out of engine compartment.

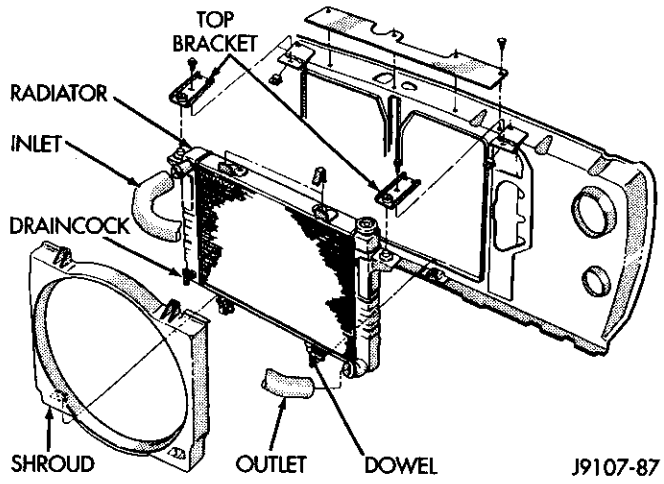


Fig. 1 Radiator and Fan Shroud

INSTALLATION

(1) Position shroud rearward on engine.

(2) Lower radiator into position. The dowels on the bottom of the radiator fit into alignment holes in the lower support panel.

(3) Install top mounting brackets. Tighten mounting screws to 23 N•m (17 in. lbs.) torque.

(4) Connect radiator hoses. Install hose clamps.

(5) Position fan shroud on radiator flange. Install retaining clips.

(6) Open heater valve.

(7) Fill cooling system with coolant. Refer to Filling Cooling System in the 1991 Rear Wheel Drive Truck Service Manual.

(8) Operate engine until it reaches normal temperature. Check cooling system.

SPECIFICATIONS

COOLING SYSTEM CAPACITIES

ENGINE	MODEL	TRANS		RADIATOR				FAN				CAPACITY	
		A	M	WIDTH INCHES	THICKNESS	ROWS OF TUBES	FINS PER INCH	DIAMETER INCHES	NO. OF BLADES	PITCH INCH	CLUTCH ENGAGEMENT TEMPERATURE	QUARTS	LITERS
Diesel	All	•		26	2.25	3	13	22.0	7	2.20	140 °F	17.0	16.1
Diesel	All		•	26	2.25	3	13	22.0	7	2.20	140 °F	16.0	15.1

J9107-88

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

INSTRUMENT PANEL AND GAUGES

OVERDRIVE LOCKOUT SWITCH

REMOVAL

(1) Locate bracket holding chime module and intermittent wipe module (Fig. 2).

(2) Remove 2 nuts holding bracket to instrument panel support.

(3) Remove ground straps and bracket.

(4) Depress lock tabs on switch and push it out of the instrument panel.

INSTALLATION

(1) Hold wiring connector in switch opening.

(2) Push switch on to wiring connector.

(3) Continue to push until switch snaps into place.

(4) Install bracket with modules. Be sure ground straps are installed.

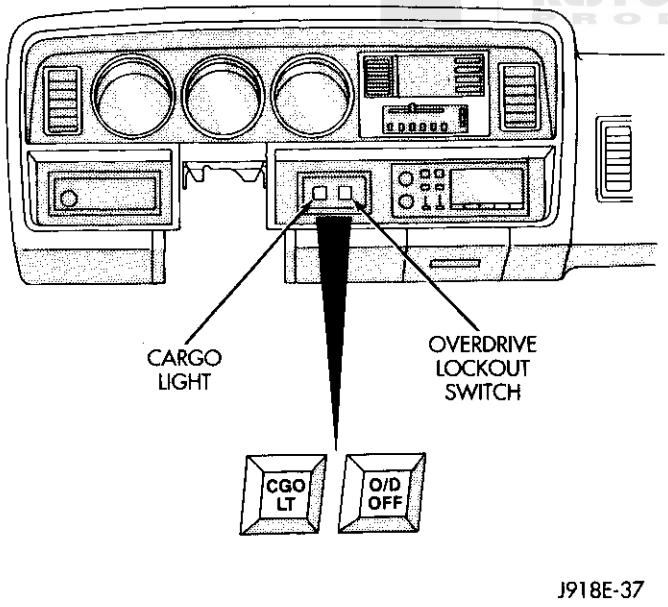


Fig. 1 Overdrive Lockout Switch Location

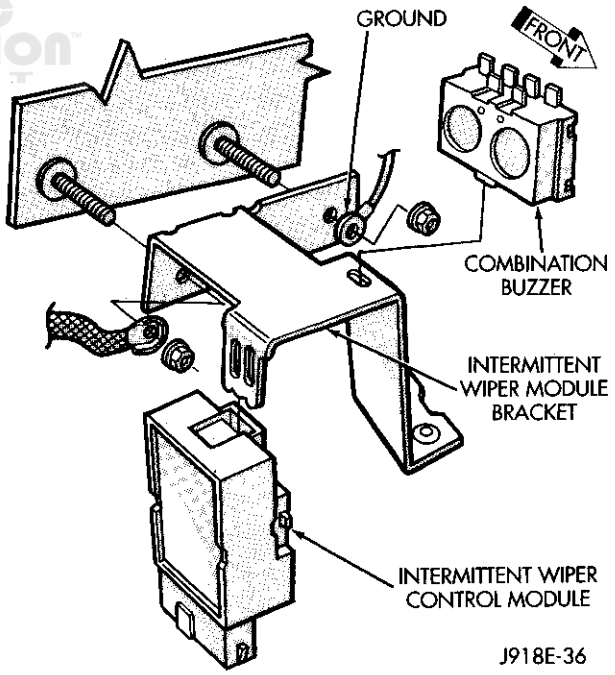


Fig. 2 Intermittent Wiper Module Bracket

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

SPEED CONTROL SYSTEM

CONTENTS

GENERAL INFORMATION

The speed control system (Fig. 1) is electrically actuated and vacuum operated. The electronic control is integrated into the engine controller, located next to the battery. The controls are located on the steering wheel and consist of the ON/OFF, RESUME/ACCEL and SET/DECEL buttons. The system is designed to operate at speeds between 35 mph (50 km/h) and 85 mph (142 km/h).

WARNING: THE USE OF SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS IN HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED, OR SLIPPERY.

TO ACTIVATE: By pushing the ON/OFF button to the depressed latched position, ON, the speed control function is now ready for use.

TO DEACTIVATE: A soft tap of the brake pedal, or normal brake application while the system is engaged will disengage speed control without erasing memory. Pushing the ON/OFF button to the unlatched position or turning off the ignition erases the memory.

TO SET SPEED: When the vehicle has reached the desired speed push the SET/DECEL button to engage system which will then automatically maintain the desired speed.

TO DECELERATE: When speed control is engaged, holding the SET/DECEL button depressed allows the vehicle to coast to a lower speed setting.

TO RESUME: After disengaging the speed control system by tapping the brake pedal push the RESUME/ACCEL button to return vehicle to the previously set speed.

TO ACCELERATE: While speed control is engaged, hold the RESUME/ACCEL button depressed and release at a new desired speed. This will allow the vehicle to continuously accelerate and set at a higher speed setting.

TAP-UP: When the speed control system is engaged, tapping the RESUME/ACCEL button will increase the speed setting by 2 mph (3 km/h). The system will respond to multiple tap-ups.

TO ACCELERATE for PASSING: Depress the accelerator as you would normally. When the pedal is released the vehicle will return to the speed setting in memory.

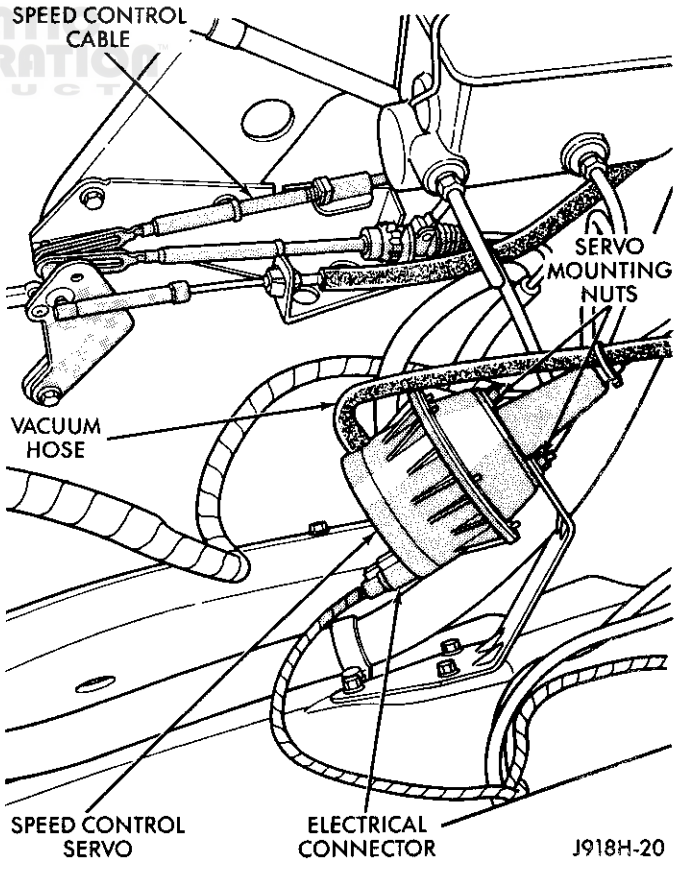
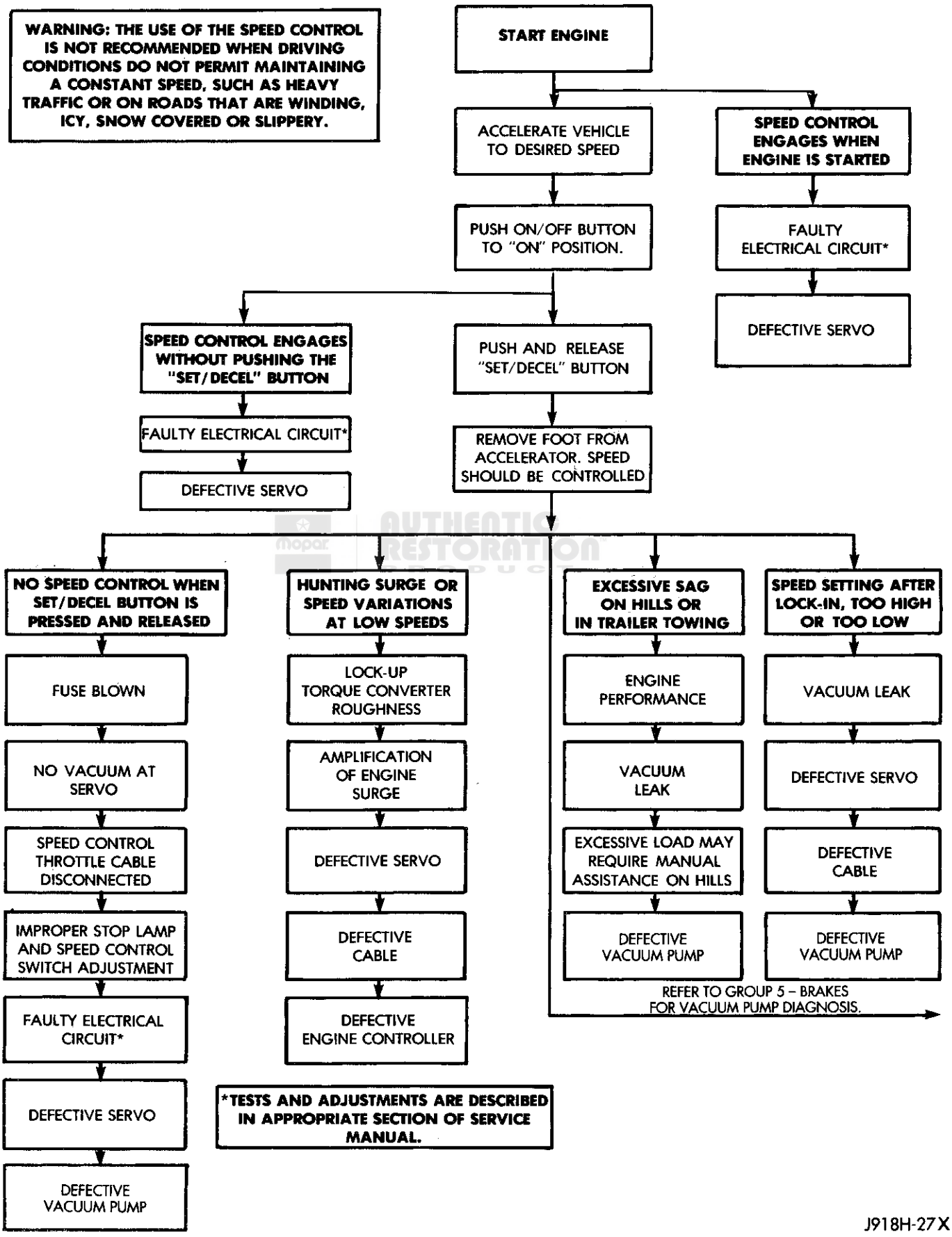
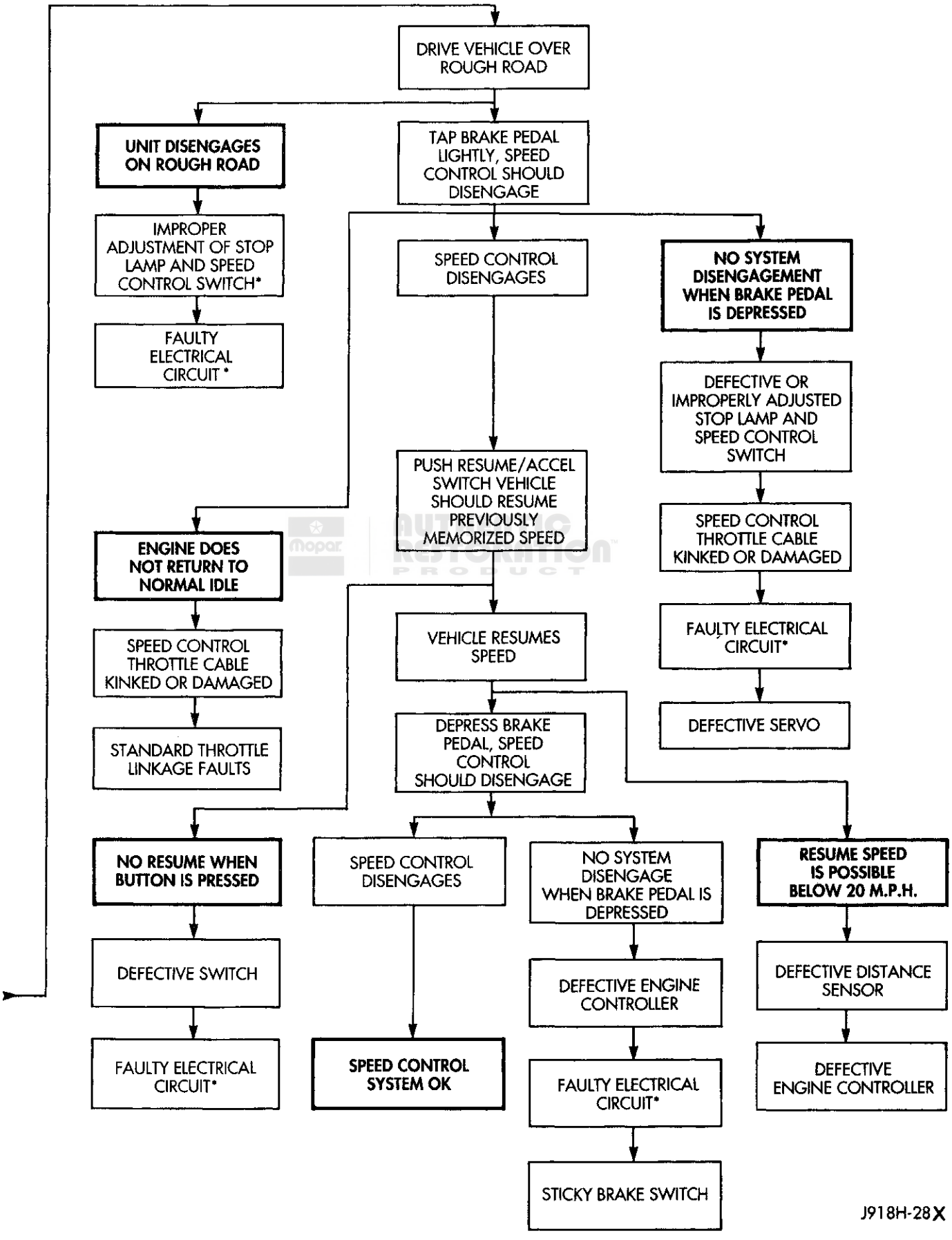


Fig. 1 Speed Control System


WARNING: THE USE OF THE SPEED CONTROL IS NOT RECOMMENDED WHEN DRIVING CONDITIONS DO NOT PERMIT MAINTAINING A CONSTANT SPEED, SUCH AS HEAVY TRAFFIC OR ON ROADS THAT ARE WINDING, ICY, SNOW COVERED OR SLIPPERY.
START ENGINE
ACCELERATE VEHICLE TO DESIRED SPEED
SPEED CONTROL ENGAGES WHEN ENGINE IS STARTED
PUSH ON/OFF BUTTON TO "ON" POSITION.
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
SPEED CONTROL ENGAGES WITHOUT PUSHING THE "SET/DECEL" BUTTON
PUSH AND RELEASE "SET/DECEL" BUTTON
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
REMOVE FOOT FROM ACCELERATOR. SPEED SHOULD BE CONTROLLED
NO SPEED CONTROL WHEN SET/DECEL BUTTON IS PRESSED AND RELEASED
FUSE BLOWN
NO VACUUM AT SERVO
SPEED CONTROL THROTTLE CABLE DISCONNECTED
IMPROPER STOP LAMP AND SPEED CONTROL SWITCH ADJUSTMENT
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
DEFECTIVE VACUUM PUMP
HUNTING SURGE OR SPEED VARIATIONS AT LOW SPEEDS
LOCK-UP TORQUE CONVERTER ROUGHNESS
AMPLIFICATION OF ENGINE SURGE
DEFECTIVE SERVO
DEFECTIVE CABLE
DEFECTIVE ENGINE CONTROLLER
EXCESSIVE SAG ON HILLS OR IN TRAILER TOWING
ENGINE PERFORMANCE
VACUUM LEAK
EXCESSIVE LOAD MAY REQUIRE MANUAL ASSISTANCE ON HILLS
DEFECTIVE VACUUM PUMP
SPEED SETTING AFTER LOCK-IN, TOO HIGH OR TOO LOW
VACUUM LEAK
DEFECTIVE SERVO
DEFECTIVE CABLE
DEFECTIVE VACUUM PUMP
REFER TO GROUP 5 – BRAKES FOR VACUUM PUMP DIAGNOSIS.
*TESTS AND ADJUSTMENTS ARE DESCRIBED IN APPROPRIATE SECTION OF SERVICE MANUAL.

J918H-27X


DRIVE VEHICLE OVER ROUGH ROAD
UNIT DISENGAGES ON ROUGH ROAD
IMPROPER ADJUSTMENT OF STOP LAMP AND SPEED CONTROL SWITCH*
FAULTY ELECTRICAL CIRCUIT *
TAP BRAKE PEDAL LIGHTLY, SPEED CONTROL SHOULD DISENGAGE
SPEED CONTROL DISENGAGES
PUSH RESUME/ACCEL SWITCH VEHICLE SHOULD RESUME PREVIOUSLY MEMORIZED SPEED
VEHICLE RESUMES SPEED
DEPRESS BRAKE PEDAL, SPEED CONTROL SHOULD DISENGAGE
NO SYSTEM DISENGAGEMENT WHEN BRAKE PEDAL IS DEPRESSED
DEFECTIVE OR IMPROPERLY ADJUSTED STOP LAMP AND SPEED CONTROL SWITCH
SPEED CONTROL THROTTLE CABLE KINKED OR DAMAGED
FAULTY ELECTRICAL CIRCUIT*
DEFECTIVE SERVO
ENGINE DOES NOT RETURN TO NORMAL IDLE
SPEED CONTROL THROTTLE CABLE KINKED OR DAMAGED
STANDARD THROTTLE LINKAGE FAULTS
NO RESUME WHEN BUTTON IS PRESSED
DEFECTIVE SWITCH
FAULTY ELECTRICAL CIRCUIT*
SPEED CONTROL DISENGAGES
SPEED CONTROL SYSTEM OK
NO SYSTEM DISENGAGE WHEN BRAKE PEDAL IS DEPRESSED
DEFECTIVE ENGINE CONTROLLER
FAULTY ELECTRICAL CIRCUIT*
STICKY BRAKE SWITCH
RESUME SPEED IS POSSIBLE BELOW 20 M.P.H.
DEFECTIVE DISTANCE SENSOR
DEFECTIVE ENGINE CONTROLLER

J918H-28X

TEST PROCEDURES

INDEX

ROAD TEST

Road test vehicle to verify reports of speed control system malfunction. The road test should include attention to the speedometer. Speedometer operation should be smooth and without flutter at all speeds.

Flutter in the speedometer indicates a problem which might cause surging in the speed control system. The cause of any speedometer deficiencies should be corrected before proceeding.

INOPERATIVE SYSTEM

If road test verifies that system is inoperative and speedometer operation is satisfactory, inspect for loose electrical and vacuum connections at the servo.

Corrosion should be removed from electrical terminals and a light coating of Mopar Multi-Purpose Grease, or equivalent, applied.

Inspection should also be made to verify that both ends of the speed control cable are securely attached.

CHECKING FOR FAULT CODE

(1) When trying to verify a speed control system electronic malfunction use a DRB II to determine the cause (refer to Powertrain Diagnostic Procedures manual).

(2) Correct any problems found and recheck for Fault Code if changes were made.

DISTANCE (SPEED) SENSOR TEST

For testing of the distance sensor and related components refer to the Powertrain Diagnostic Procedures manual.

SPEED CONTROL SYSTEM ELECTRICAL TESTS

Electronic speed control systems may be tested using two different methods. One involves use of a DRBII. If this test method is desired, please refer to the Powertrain Diagnostic Test Procedures manual.

The other test method uses a voltmeter. The voltmeter method is described in the following tests.

If any information is needed concerning wiring, refer to Group 8W - Wiring Diagrams.

CAUTION: When test probing for voltage or continuity at electrical connectors, care must be taken not to damage connector, terminals, or seals. If these components are damaged, intermittent or complete system failure may occur.

ELECTRICAL TESTS AT SERVO

(1) Turn ignition switch to the ON position. With the speed control switch in the ON position, set up a voltmeter to read battery voltage and connect the negative lead to a good chassis ground.

(2) Disconnect the 4-way connector going to the servo (Fig. 2). The blue wire with the red tracer of the main harness 4-way connector should read approximately battery voltage. If not, check for loose connections, brake switch adjustment or, repair the main harness as necessary.

(3) Connect a jumper wire between the male and female terminals of the blue wire with red tracer. The other three male terminals from the servo should show battery voltage. If not, replace the servo.

(4) Using an ohmmeter, connect one lead to a good body ground. Touch other lead to the black (BK) wire terminal in the 4-way connector of the main harness. The meter should show continuity. If not, repair the ground circuit as necessary.

ELECTRICAL TESTS AT ENGINE CONTROLLER

(1) Unplug 60-way connector from the engine controller, located on the left fender (Fig. 3).

(2) Connect negative lead of voltmeter to a good body ground near the module.

(3) For the following tests, the ignition switch must be in the ON position. Refer to Fig. 4 for controller terminal locations. Touch the positive lead of the voltmeter to the terminal in cavity number 33. With the speed control switch in the OFF position, the voltmeter should read 0 volts. With the speed control switch in the ON position, the voltmeter should read battery voltage. If not, repair the main harness as necessary.

(4) Touch the positive lead of the voltmeter to the terminal in cavity number 53. As in step (3), the voltmeter should read 0 volts with the switch in the OFF position and battery voltage with the switch in the ON position.

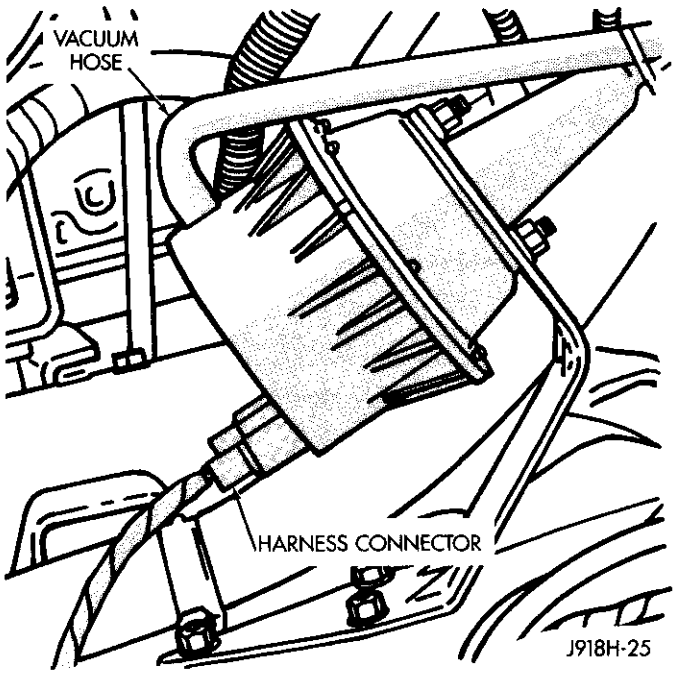


Fig. 2 Servo And Harness Connector

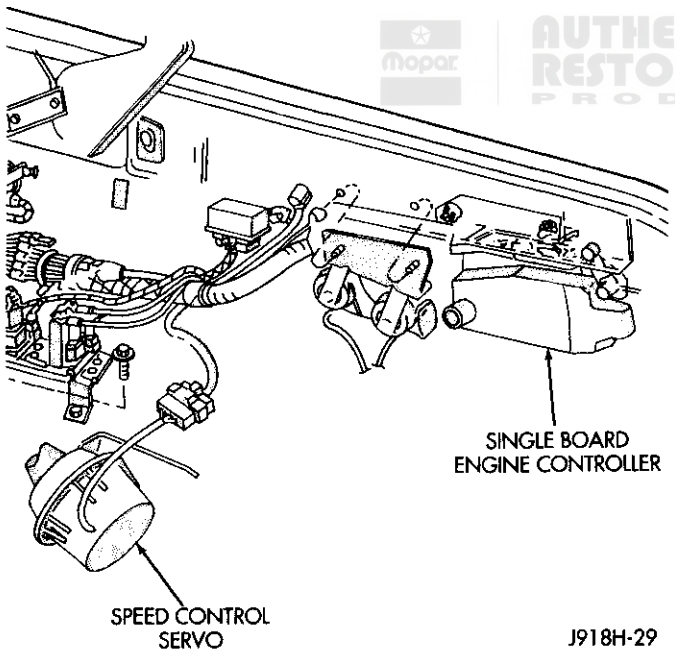


Fig. 3 Engine Controller and Connector Location

(5) Touch the positive lead of the voltmeter to the terminal in cavity number 48. With the speed control switch in the OFF position, the voltmeter should read 0 volts. With the switch in the ON position, the voltmeter should read battery voltage. Pressing the SET button should cause the voltmeter to change from battery voltage to 0 volts for as long as the switch is held. If not, perform the speed control switch test. If the switch is not at fault, then check the main harness and repair as necessary.

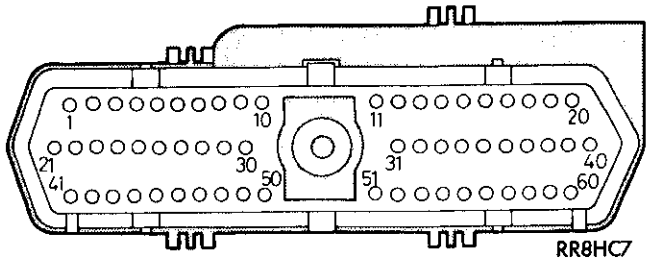


Fig. 4 Engine Controller 60-Way Connector Shown from Terminal End

(6) Touch the positive lead of the voltmeter to the terminal in cavity number 50. The voltmeter should read 0 volts with the speed control switch in either the OFF or ON position. With switch in either RESUME or SET position, the voltmeter should read battery voltage. If not, perform the speed control switch test. If the switch is not at fault, then check the main harness and repair as necessary.

(7) Touch the positive lead of the voltmeter to the terminal in cavity number 49. The voltmeter should read 0 volts with the switch in the OFF position. With the switch in the ON position, the voltmeter should read battery voltage. The voltmeter will continue to read battery voltage when either the SET or RESUME switch is pressed. If not, perform the speed control switch test. If the switch is not at fault, then check the main harness and repair as necessary .

(8) Using an ohmmeter, connect one lead to a good body ground and touch the other lead to the terminal in cavity number 29. With the brake pedal released, the meter should show continuity. When the pedal is depressed, the meter should show open circuit.

SPEED CONTROL SWITCH TEST

To check the switch, remove the switch from its mounting position. Use an ohmmeter and refer to the Switch Continuity Chart to determine if continuity is correct. If there is no continuity at any one of the switch positions, replace the switch.

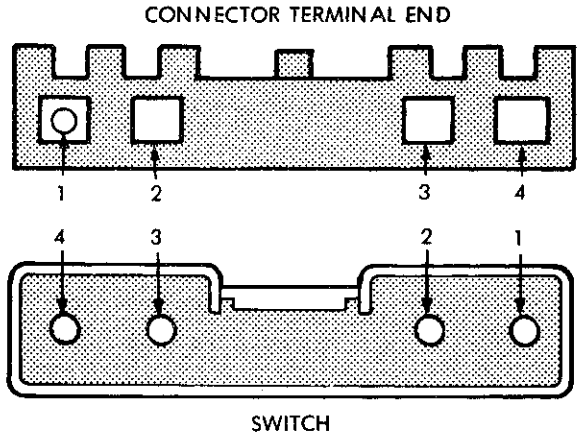
STOP LAMP SPEED CONTROL SWITCH TEST

(1) Disconnect the connector at the stop lamp switch. Using an ohmmeter, continuity may be checked at the switch side of the connector as follows (Fig. 5):

(a) With the brake pedal released, there should be no resistance between:

- the black (BK) and white with red tracer (WT/PK) wires
- the yellow with red tracer (YL/RD)
- dark blue with red tracer (DB/RD) wires
- pink (PK) and white (WT) wires.

SPEED CONTROL SWITCH CONTINUITY CHART



SPEED CONTROL SWITCH CONTINUITY	
SWITCH POSITION	CONTINUITY BETWEEN
OFF	PIN 1 AND PIN 4
ON	PIN 1 AND PIN 4 PIN 1 AND PIN 2 PIN 2 AND PIN 4
ON AND SET	PIN 1 AND PIN 2
ON AND RESUME	PIN 1 AND PIN 3

918H-14

(b) With brake pedal depressed, there should be continuity between pink (PK) and white (WT) wires. There should be no continuity between black (BK) and white with red tracer (WT/PK) wires. There should be no continuity between the yellow with red tracer (YL/RD) and dark blue with red tracer (DB/RD) wires.

(2) If the above results are not obtained, the stop lamp switch is defective or out of adjustment.

Stop lamp switch adjustment is detailed in Group 5 - Brakes.

VACUUM SUPPLY TEST

(1) Disconnect vacuum hose at the servo and install a vacuum gauge in the hose (Fig. 6).

(2) Start engine and observe gauge at idle. Vacuum gauge should read at least ten inches of mercury.

(3) If vacuum does not meet this requirement, check for vacuum leaks or poor engine performance.

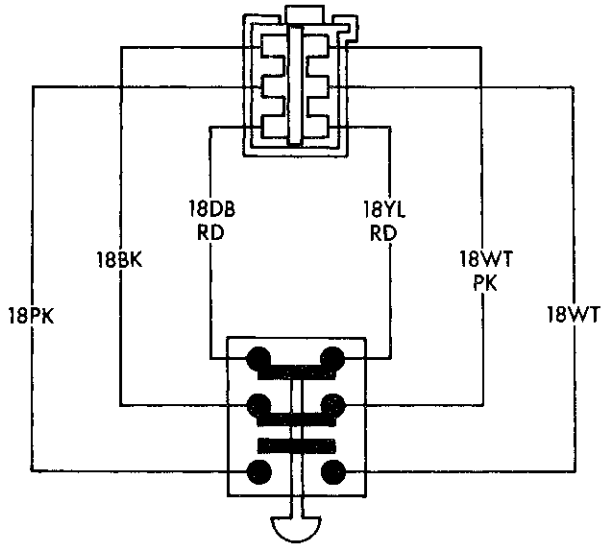


Fig. 5 Stop Lamp Switch Connector

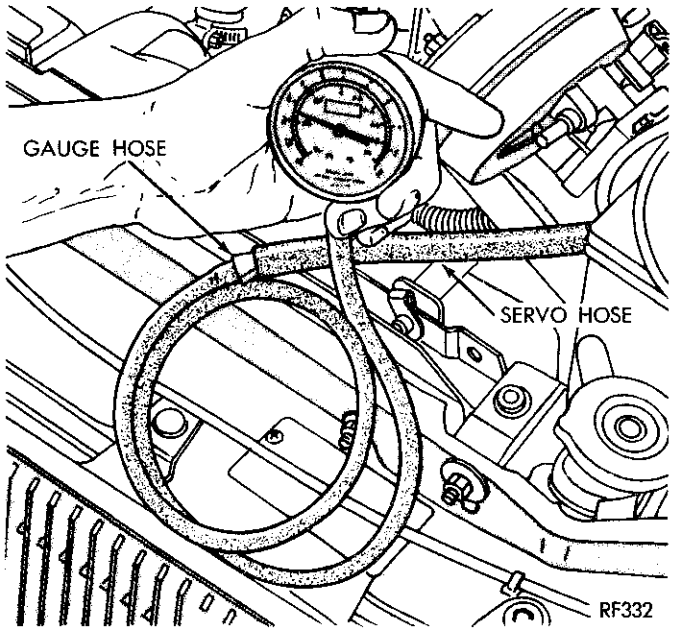


Fig. 6 Vacuum Gauge Test

SPEED CONTROL CABLE ATTACHMENT—ENGINE

(1) The clevis of the speed control cable is retained to the bellcrank by a washer and hairpin clip.

(2) Visual inspection will verify that the cable is securely attached. If the cable is not attached, the speed control system will be inoperative.

SPEED CONTROL CABLE ATTACHMENT—SERVO

The speed control cable is attached to the servo with a wire clip (Fig. 7). A check should be made to verify that the clip is in place. If the clip is missing the speed control system will be inoperative.

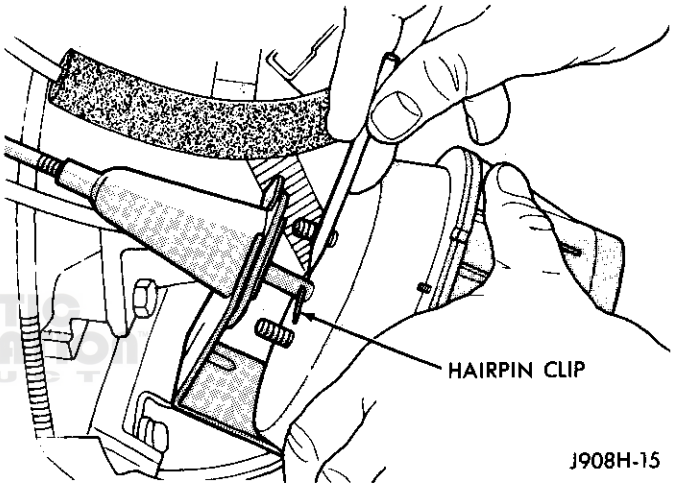


Fig. 7 Speed Control Cable Attachment at Servo

SERVICE PROCEDURES

SERVO UNIT

REMOVAL

(1) Disconnect vacuum hose at servo.
(2) Disconnect electrical connector at servo.
(3) Remove 2 nuts from servo mounting bracket.
(4) Pull servo away from mounting bracket.
(5) Remove and discard push nuts on servo studs.
(6) Pull speed control cable away from servo to expose cable retaining clip.
(7) Remove clip attaching cable to servo.

INSTALLATION

(1) With bellcrank pivoted full rearward align hole in cable sleeve with hole in servo pin and install retaining clip.
(2) Insert servo studs through holes in the cable.
(3) Install new push nuts on the servo studs.
(4) Insert servo studs through holes in servo mounting bracket. **One stud mounts reservoir.**
(5) Install the 2 attaching nuts and tighten to 6 N•m (50 in. lbs.).
(6) Connect vacuum hose to servo.
(7) Connect the electrical connector to servo terminals.

SERVO THROTTLE CABLE ASSEMBLY

REMOVAL

(1) Remove hairpin clip and washer retaining cables on bellcrank. Remove servo throttle cable from bellcrank.
(2) Disconnect cable at servo and remove cable assembly.

INSTALLATION

(1) Locate cable through servo mounting bracket.
(2) Connect cable sleeve to servo stud, align holes, and install hairpin clip.
(3) Insert servo studs through holes in cable.
(4) Install new push nuts on servo studs.
(5) Insert servo studs through holes in bracket. Install nut washers and torque to 6 N•m (50 in. lbs.).
(6) Route cable from servo, to cable support bracket.
(7) Install cable end on bellcrank rod.
(8) Install washer and hairpin clip on end of bellcrank rod.

SPEED CONTROL SWITCH

REMOVAL

(1) Disconnect battery negative cable.
(2) Remove 2 screws from back side of steering wheel (Fig. 1).
(3) Rock switch away from horn pad while lifting switch out of steering wheel.
(4) Disconnect 4-way electrical connector from clockspring.

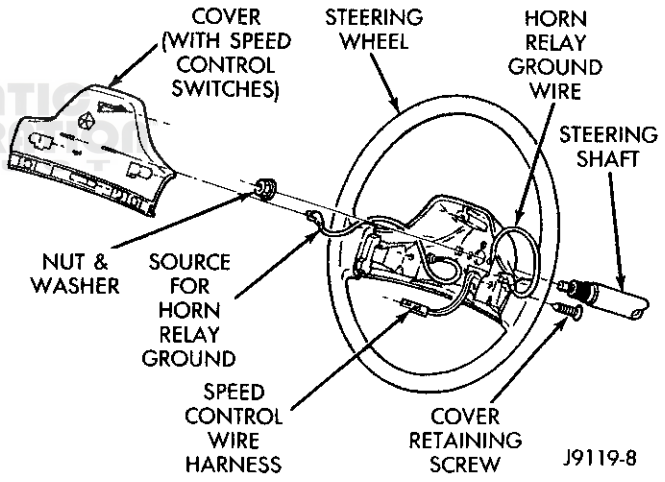


Fig. 1 Speed Control Switch Removal

INSTALLATION

(1) Connect 4-way electrical connector from clockspring to switch.
(2) Place switch in steering wheel, sliding the forward edge of switch under horn pad. Line up locating pins on switch with holes in steering wheel frame.
(3) Attach switch to wheel with 2 screws starting with the screw at the left end of the switch.

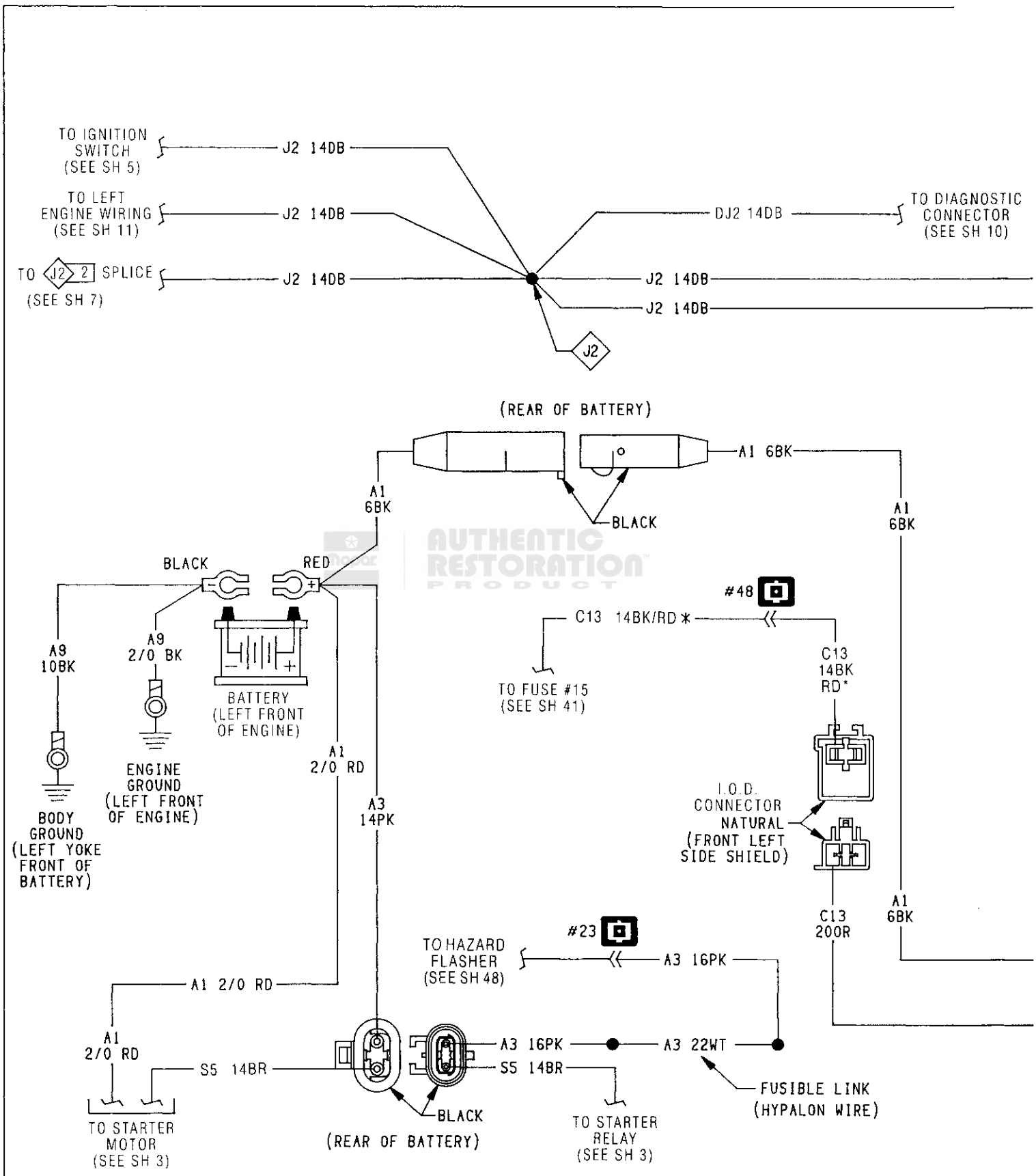
VACUUM PUMP

Refer to Group 5 - Brakes for removal and installation of the vacuum pump.

WIRING DIAGRAMS

INDEX

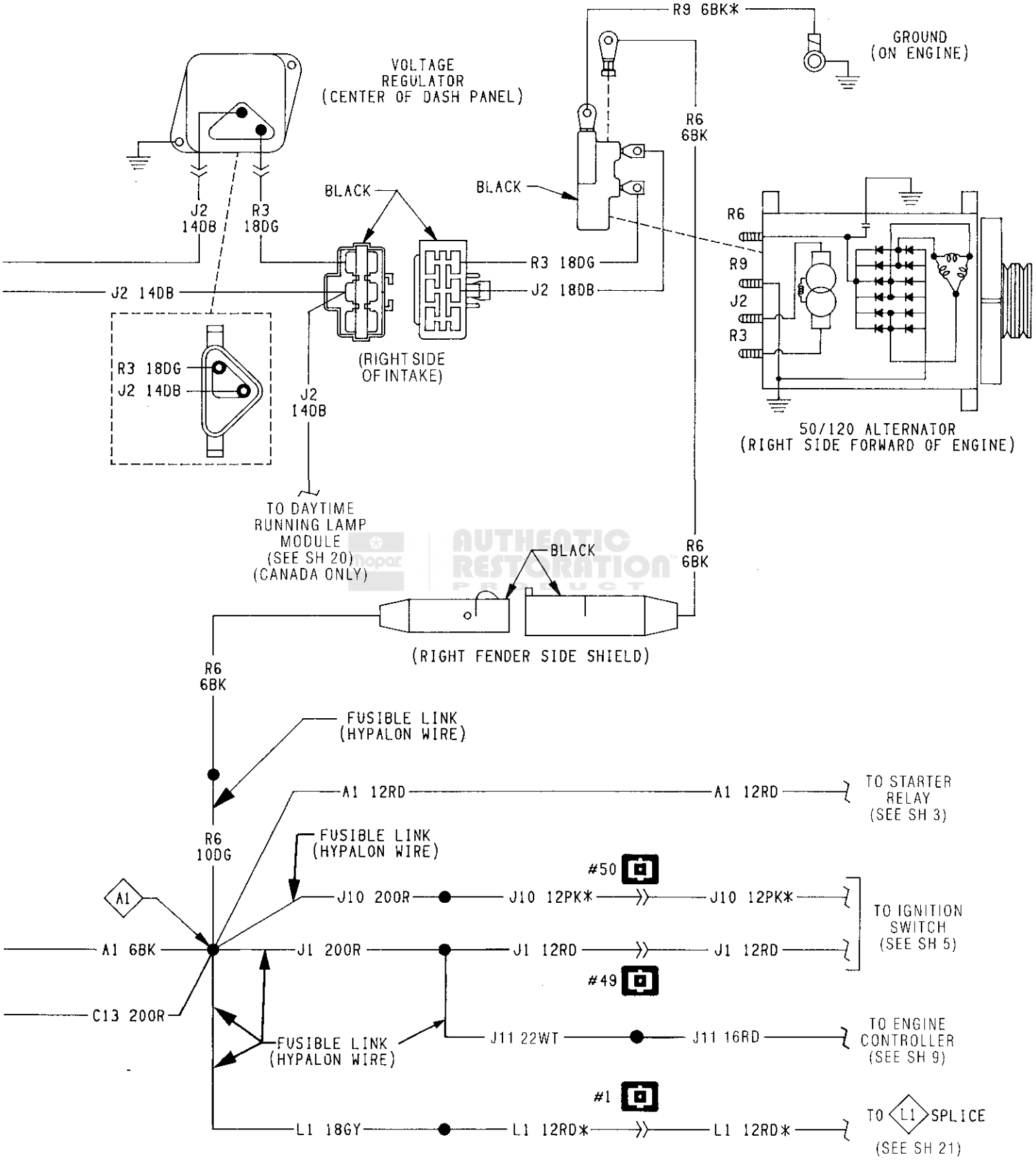
Mopar
AUTHENTIC
RESTORATION™
PRODUCT



CHARGING SYSTEM WITH DIESEL 5.9L ENGINE

AD 1

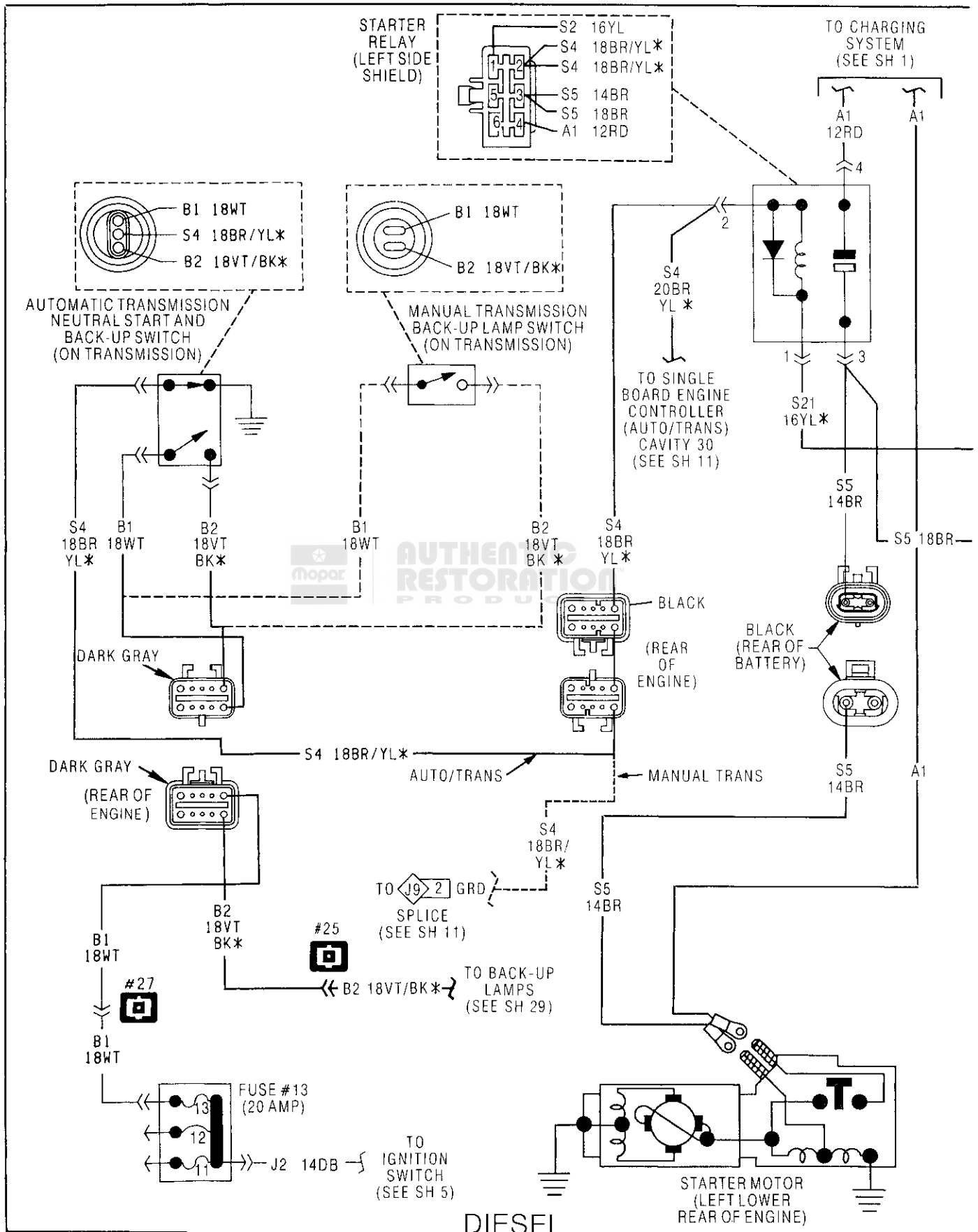
J918W-13



CHARGING SYSTEM WITH DIESEL 5.9L ENGINE

J918W-13

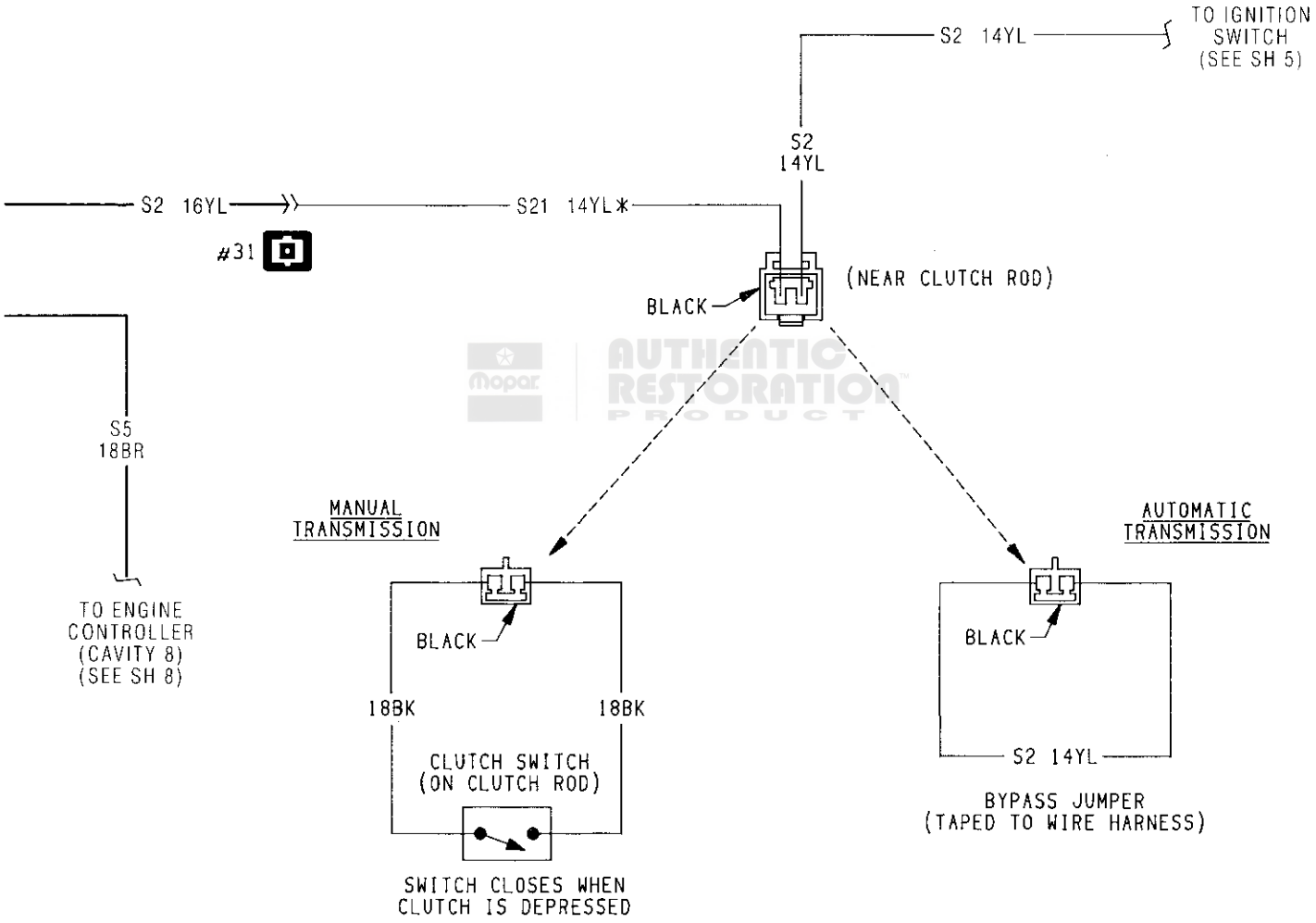
AD 2



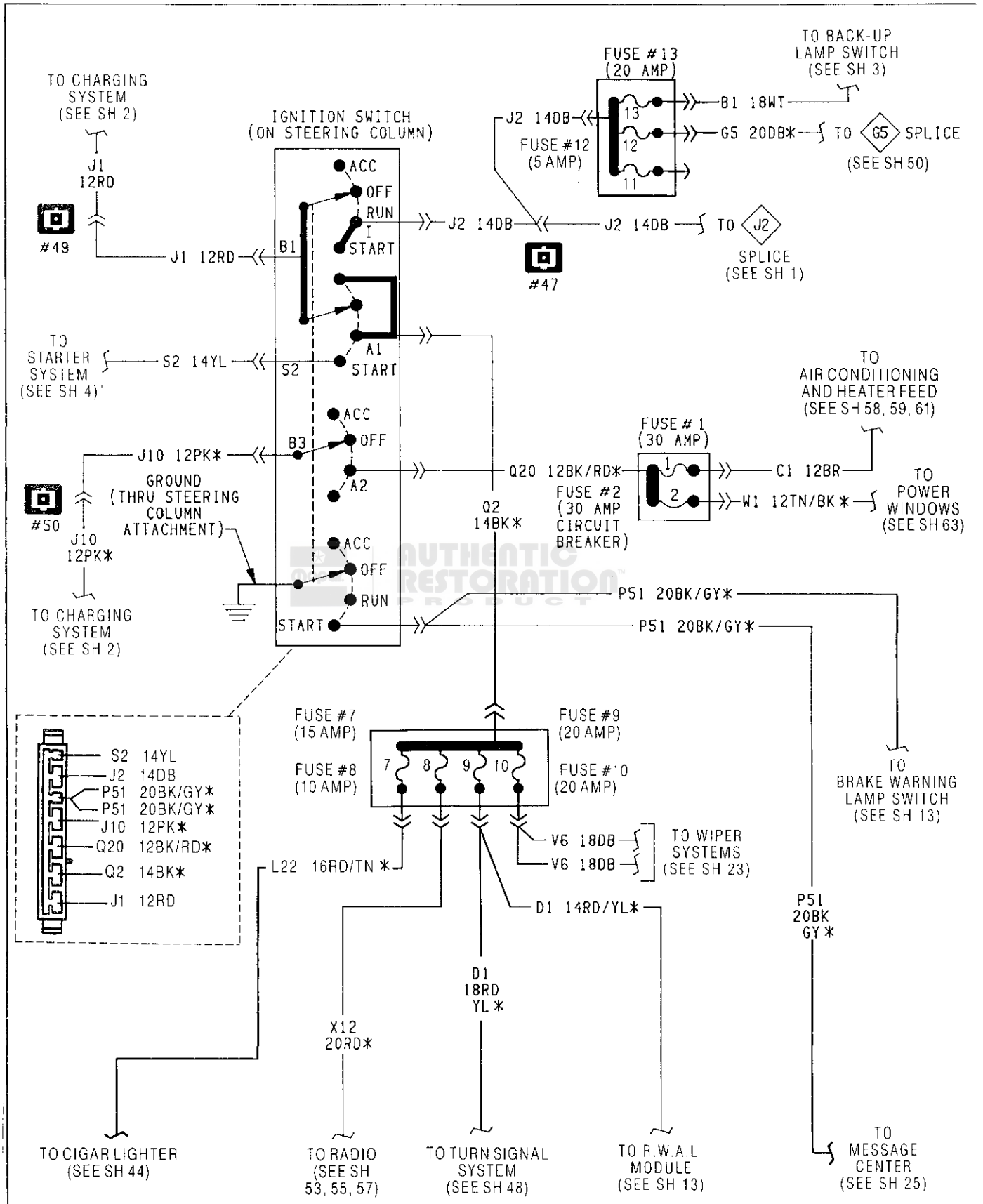
DIESEL STARTER SYSTEM

AD 3

J918W-13

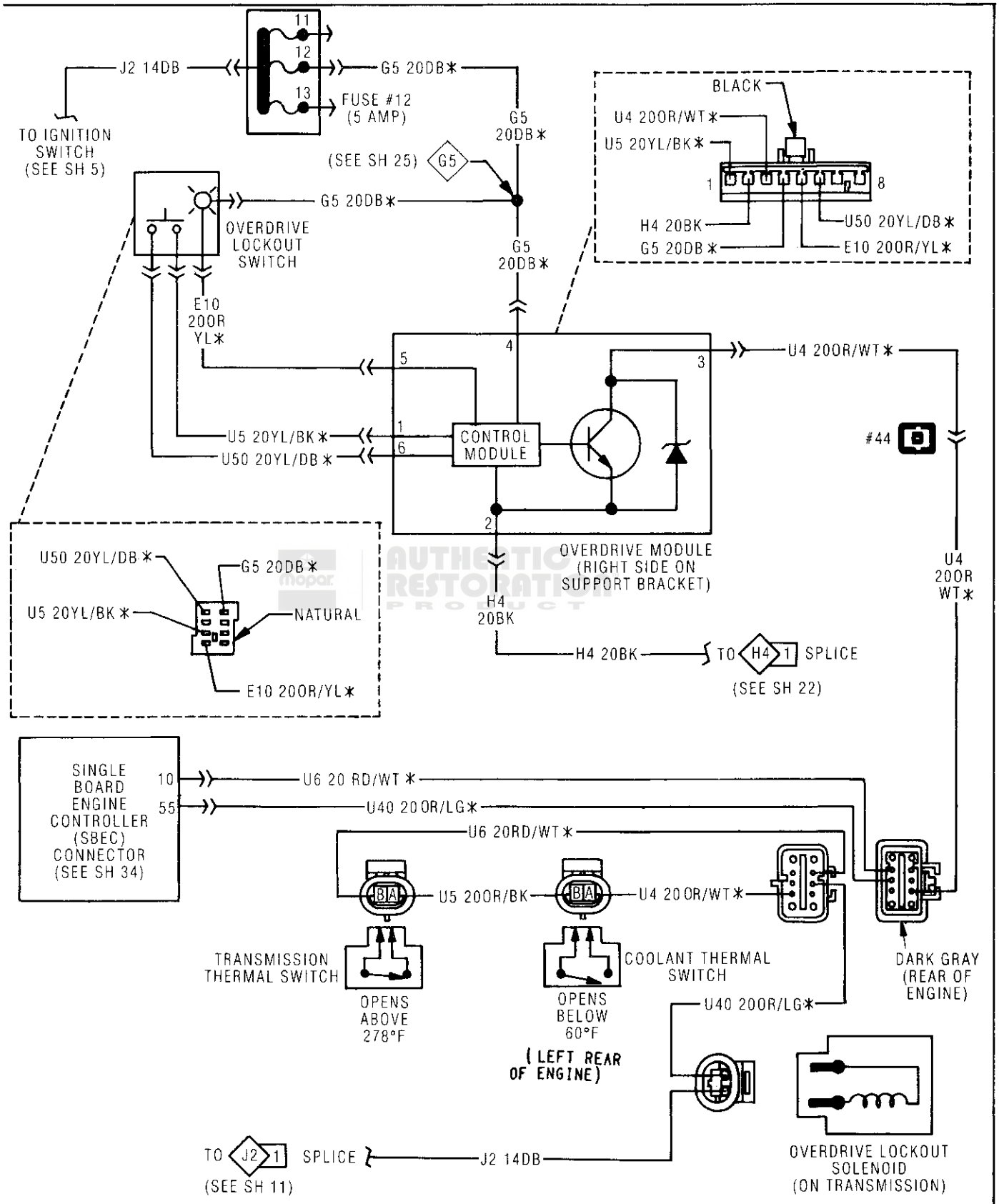


DIESEL
STARTER SYSTEM



AD 5 IGNITION SWITCH

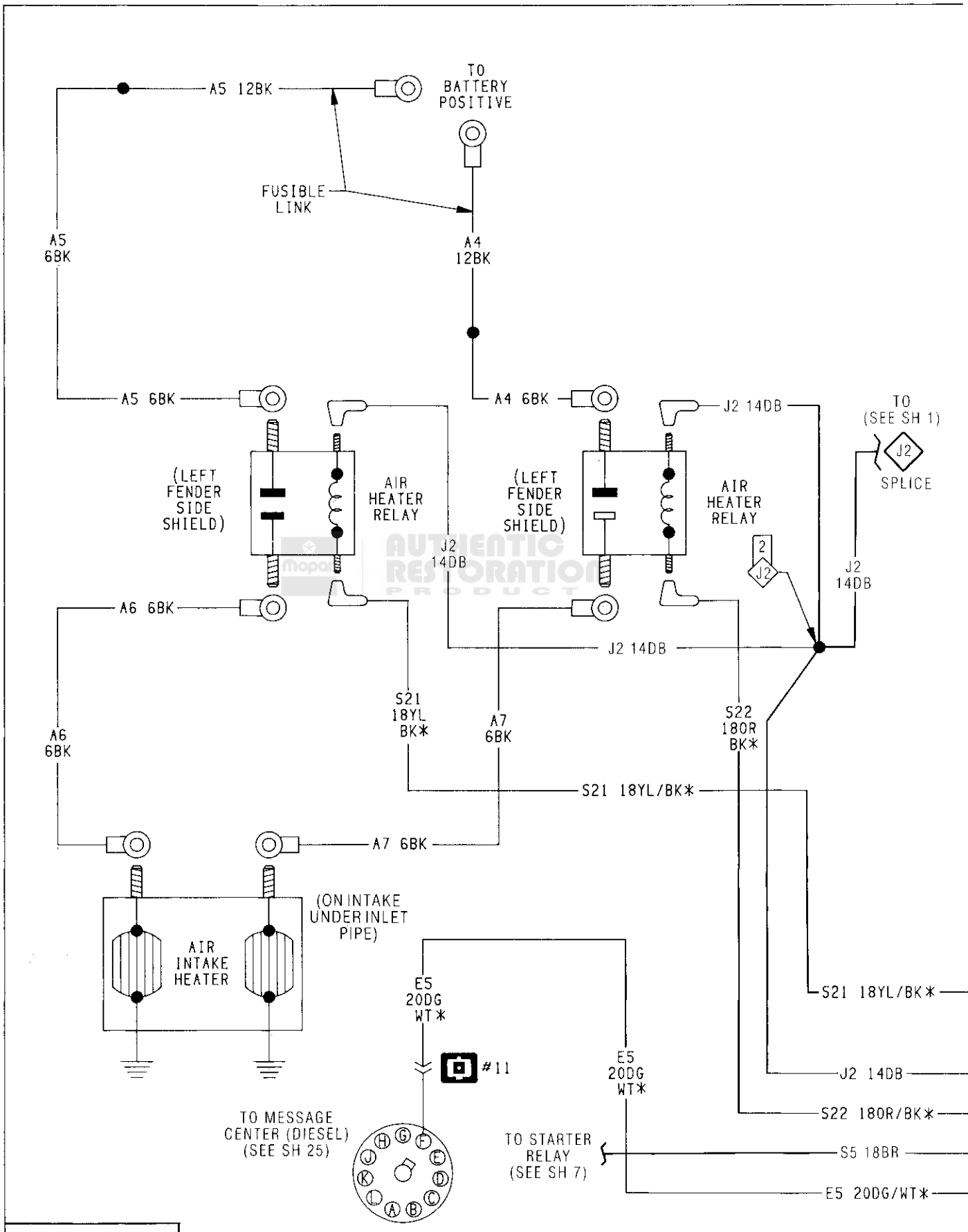
J918W-13



OVERDRIVE LOCKOUT SYSTEM (DIESEL) (A518 AUTO/TRANSMISSION)

J918W-13

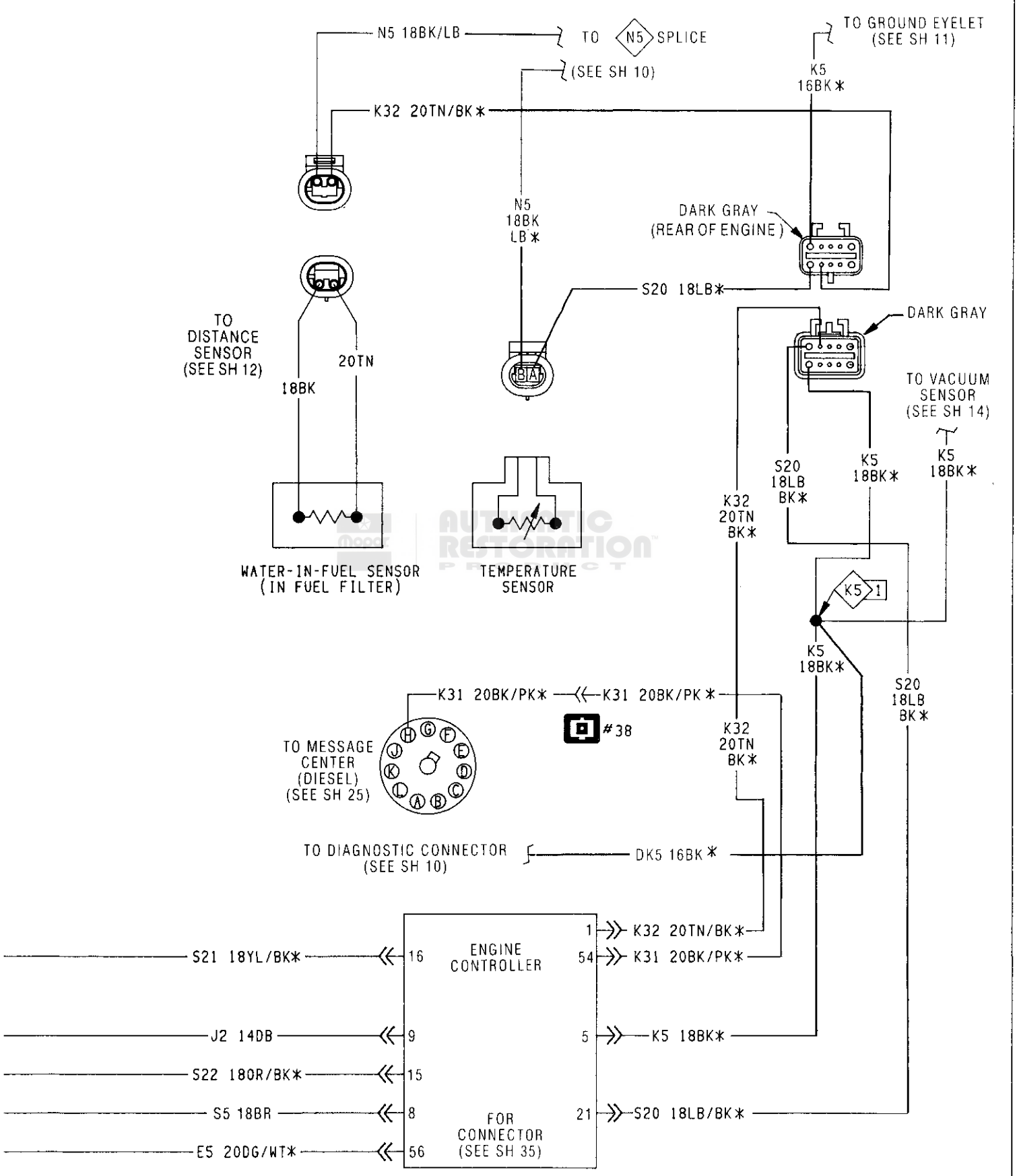
AD 6



AD 7

DIESEL ENGINE WIRING

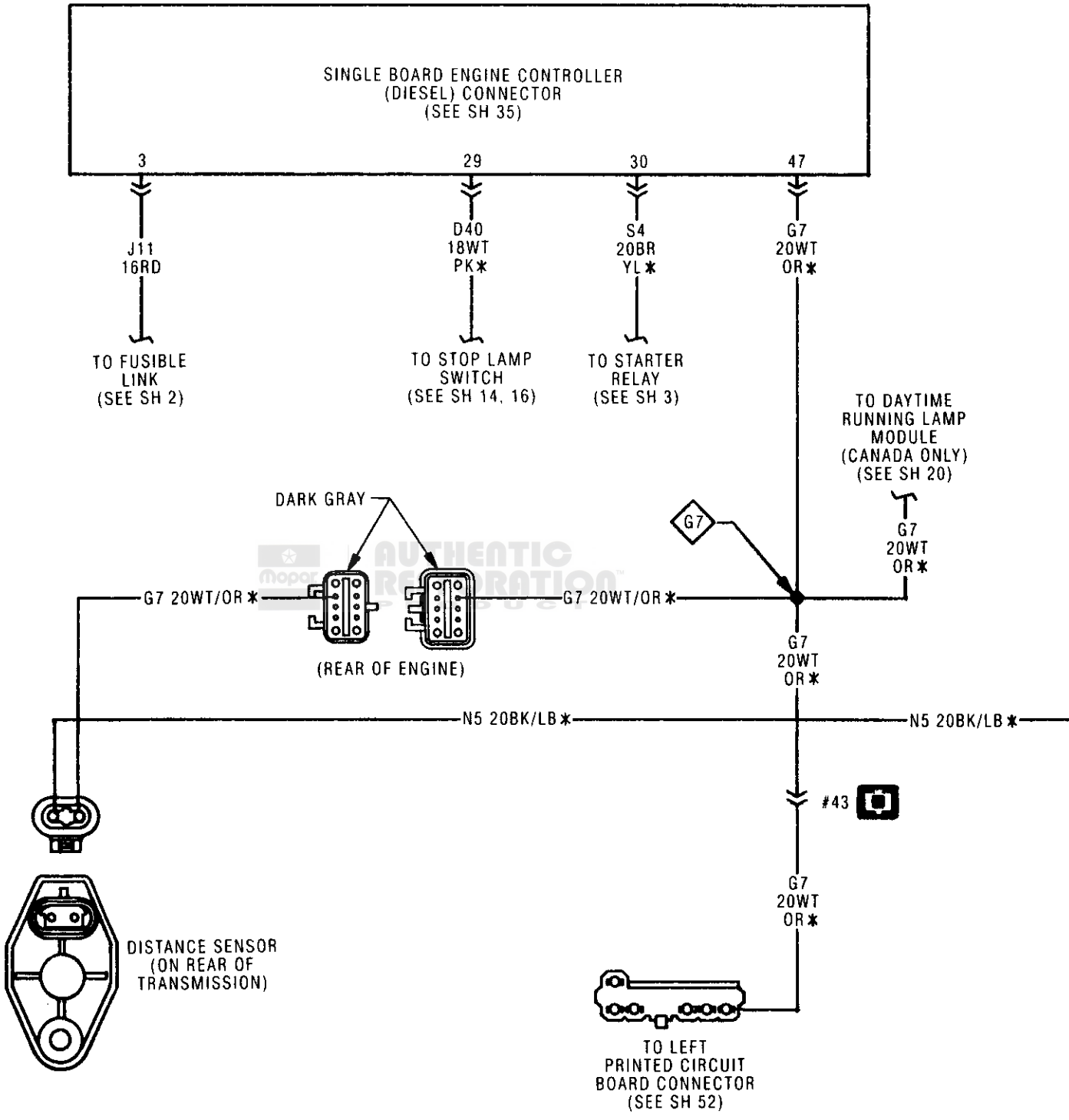
J918W-13



J918W-13

DIESEL ENGINE WIRING

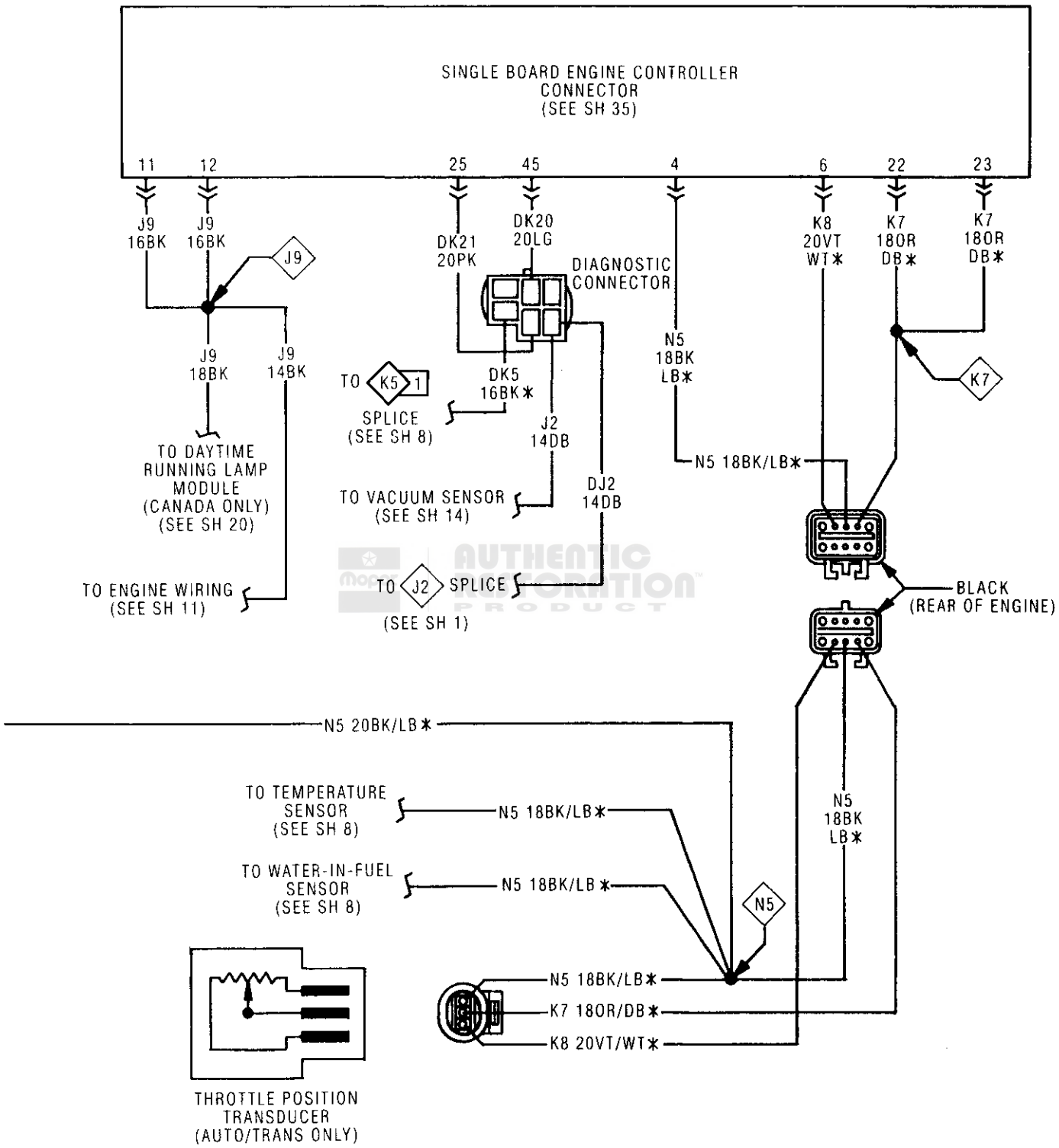
AD 8



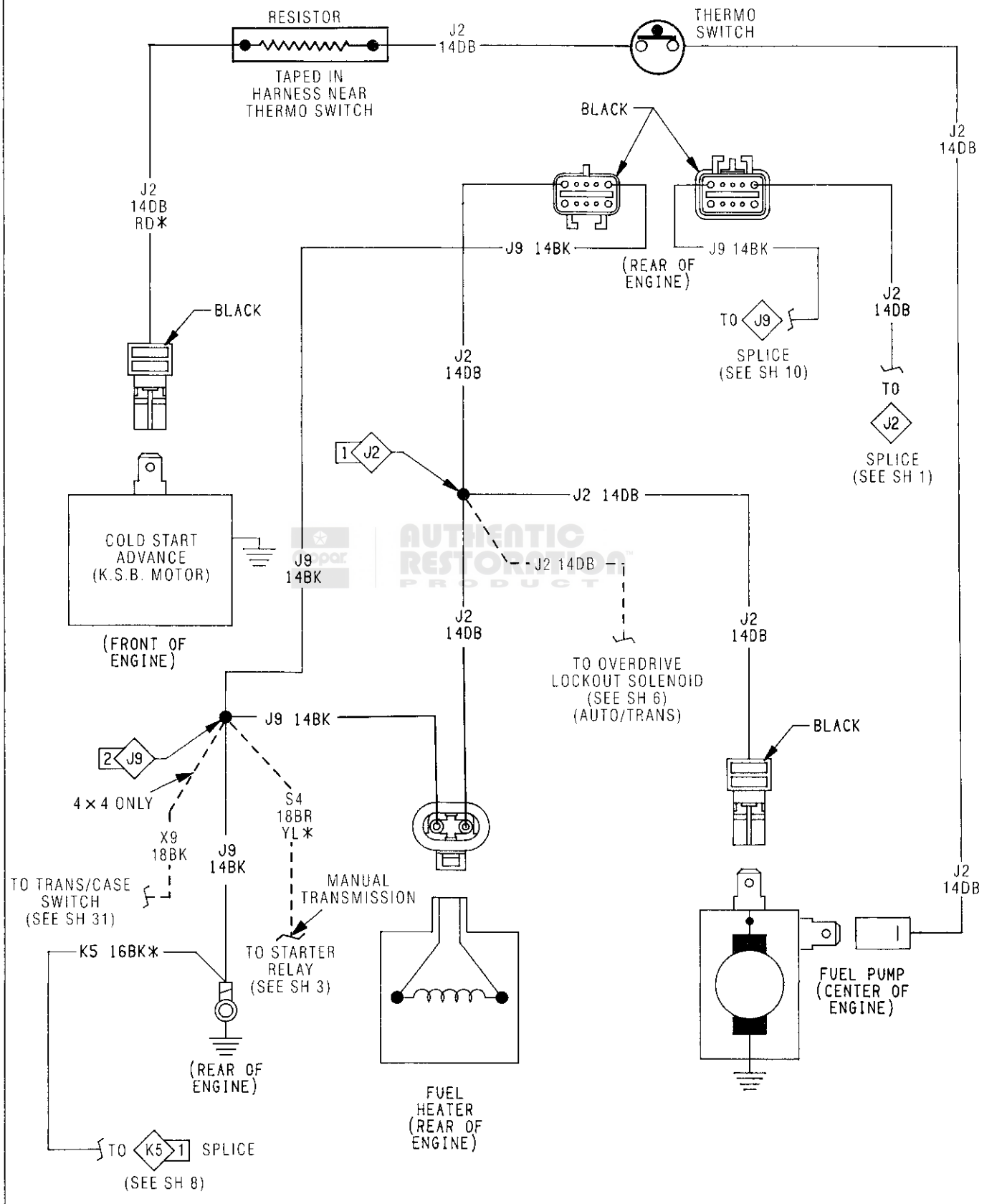
AD 9

DIESEL ENGINE WIRING

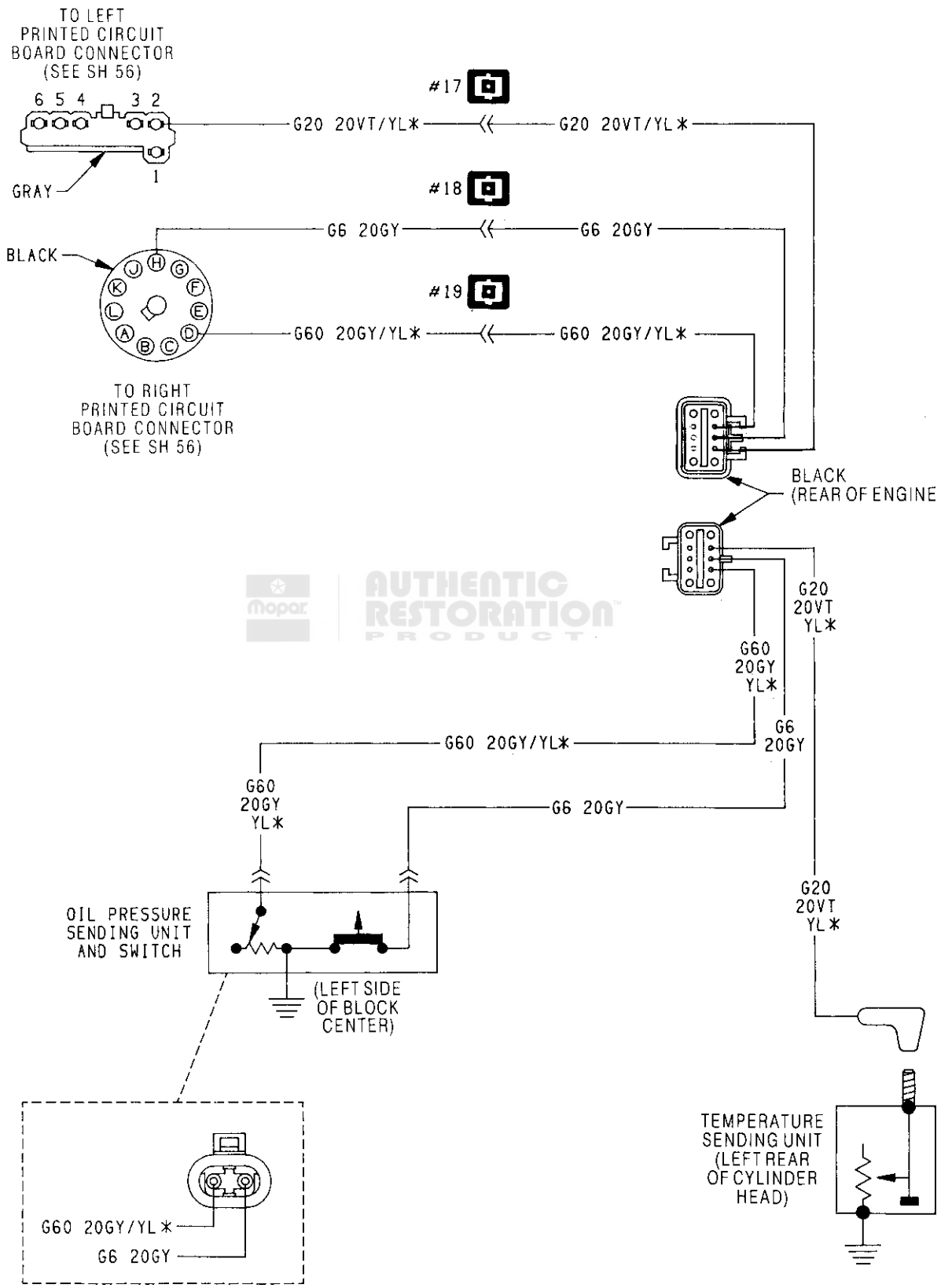
J918W-13



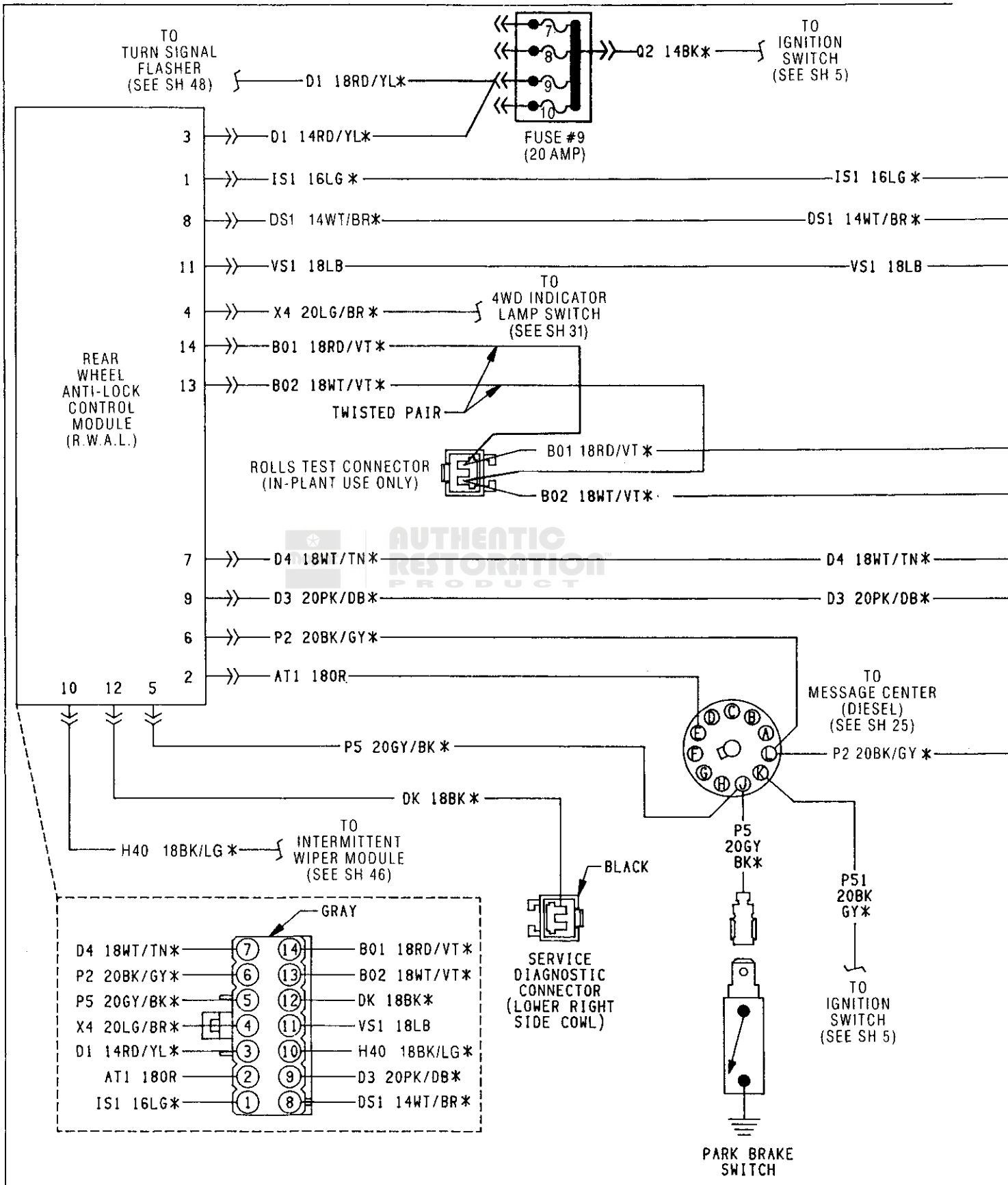
DIESEL ENGINE WIRING



AD 11 DIESEL ENGINE WIRING J918W-13



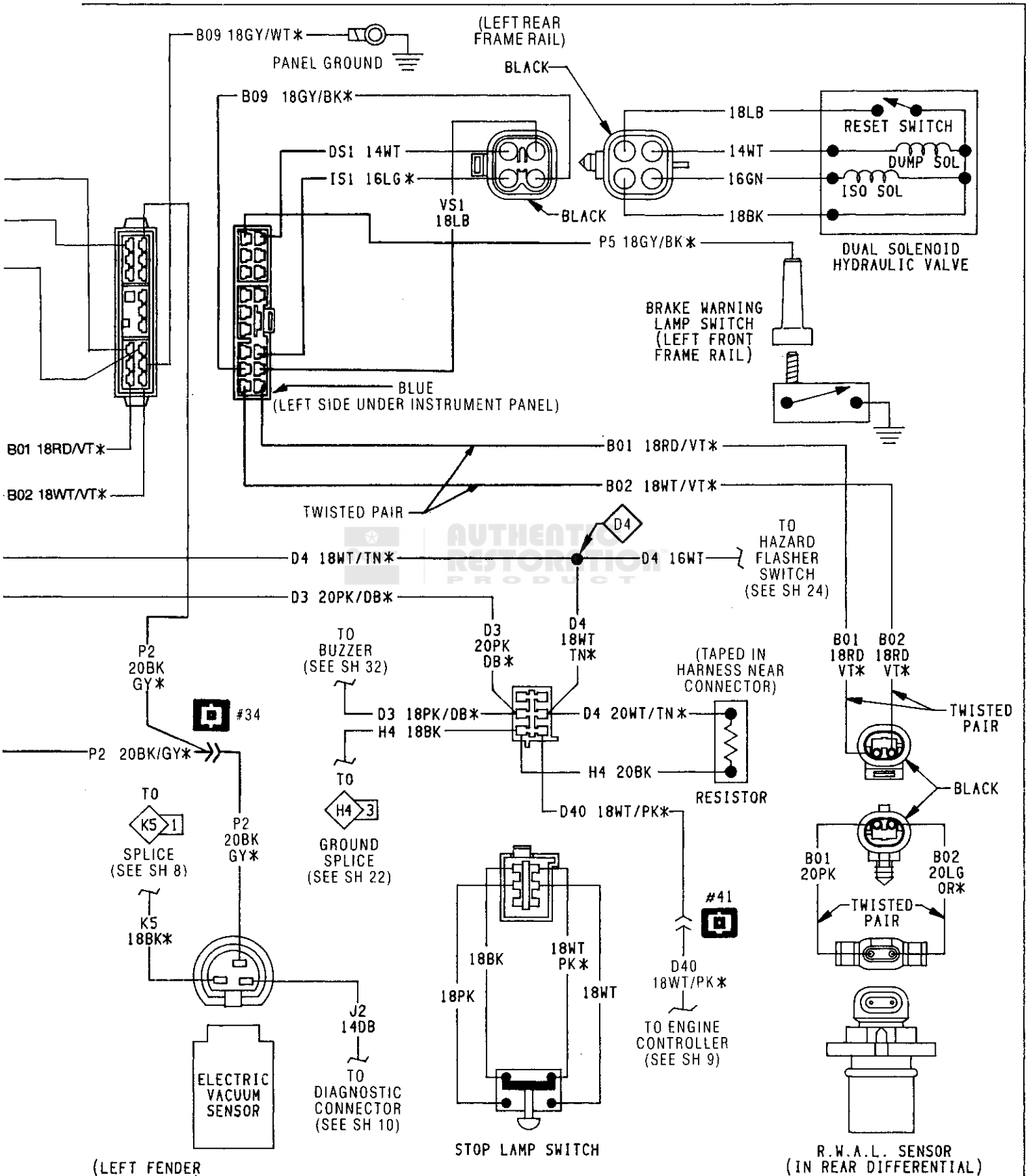
OIL PRESSURE AND TEMPERATURE SYSTEM FOR DIESEL ENGINE



AD 13

REAR WHEEL ANTI-LOCK BRAKE SYSTEM (DIESEL ENGINE)

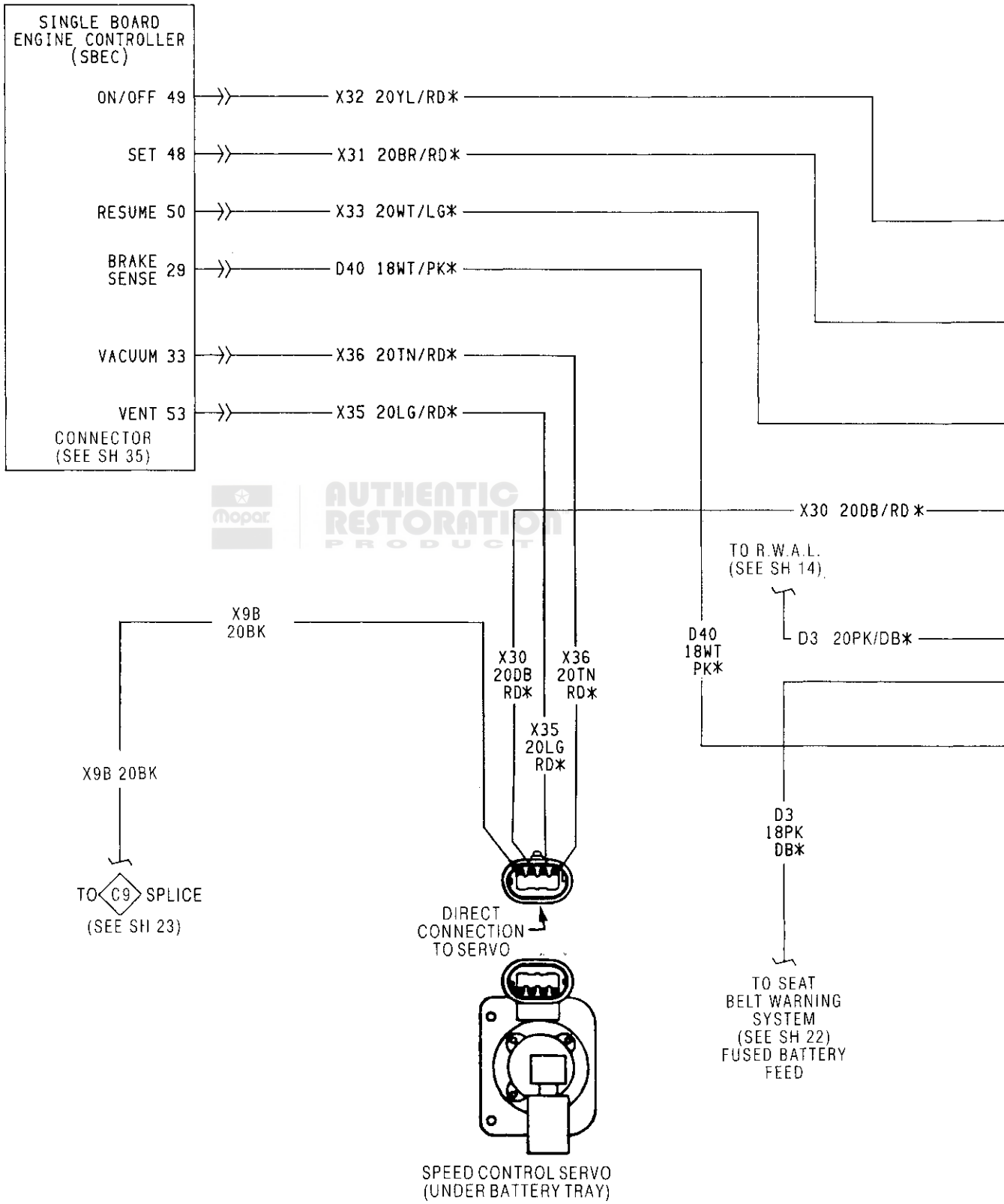
J918W-13



REAR WHEEL ANTI-LOCK BRAKE SYSTEM
(DIESEL ENGINE)

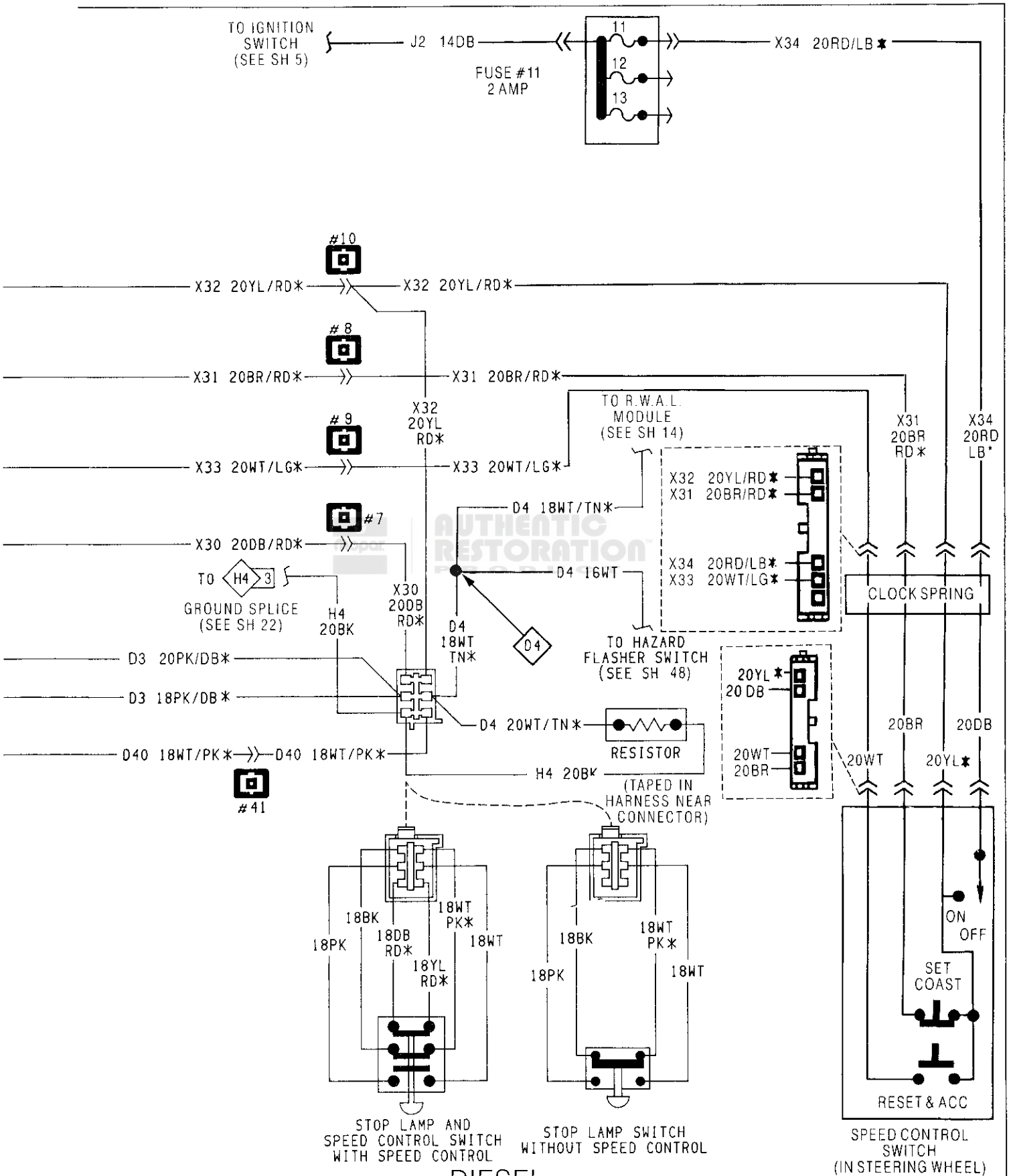
J918W-13

AD 14



DIESEL
ELECTRONIC SPEED CONTROL SYSTEM

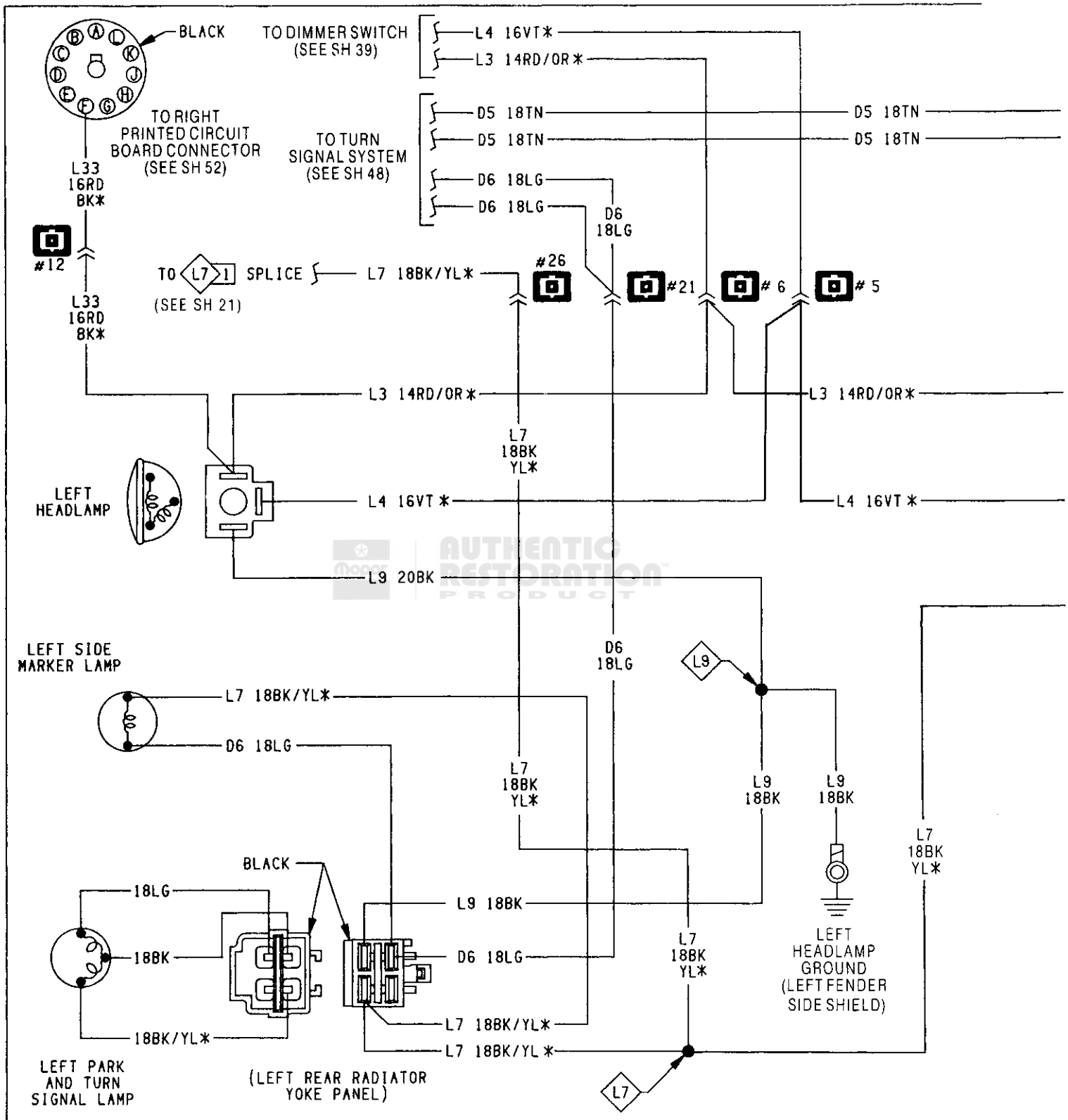
J918W-13



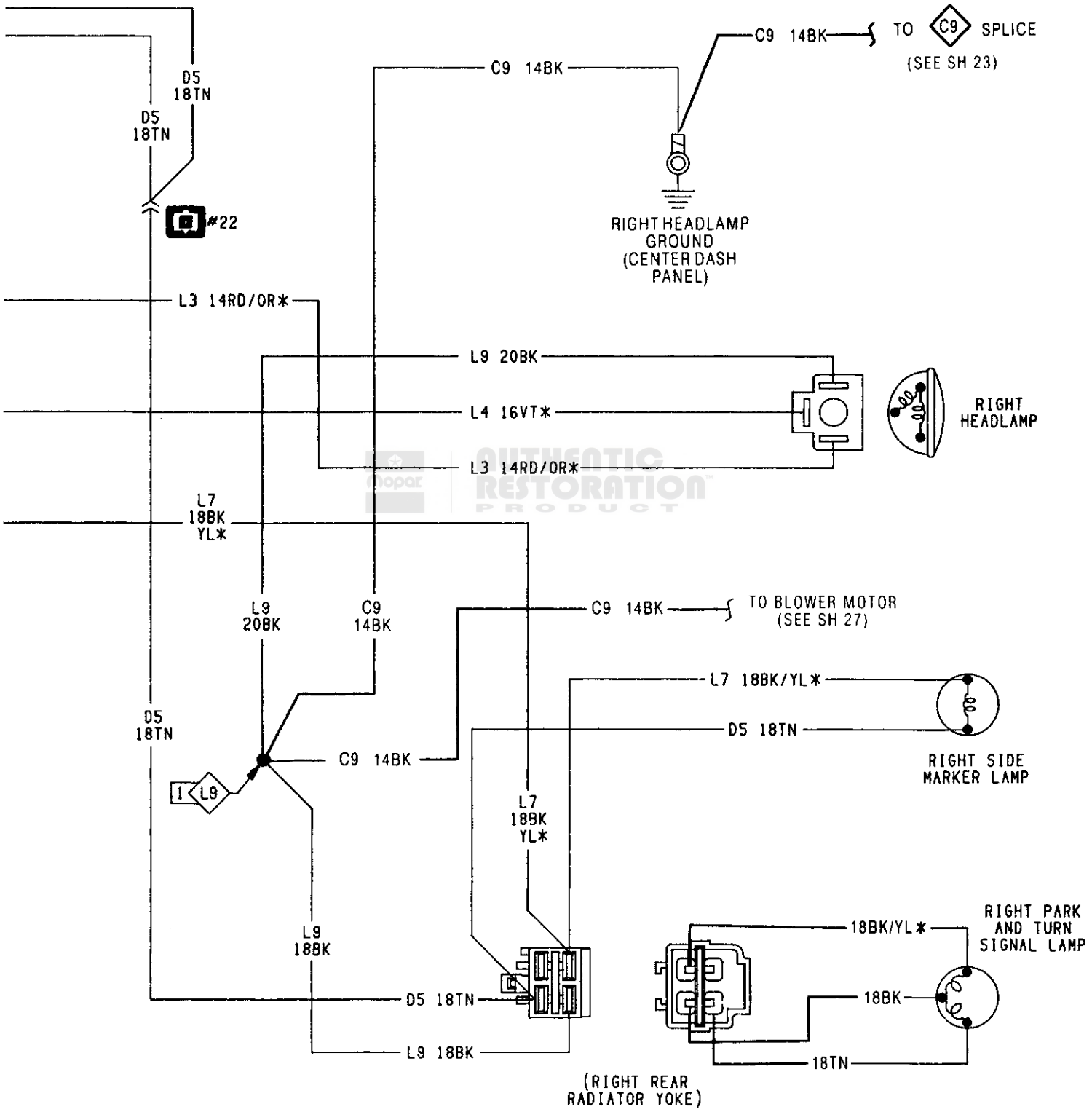
DIESEL
ELECTRONIC SPEED CONTROL SYSTEM

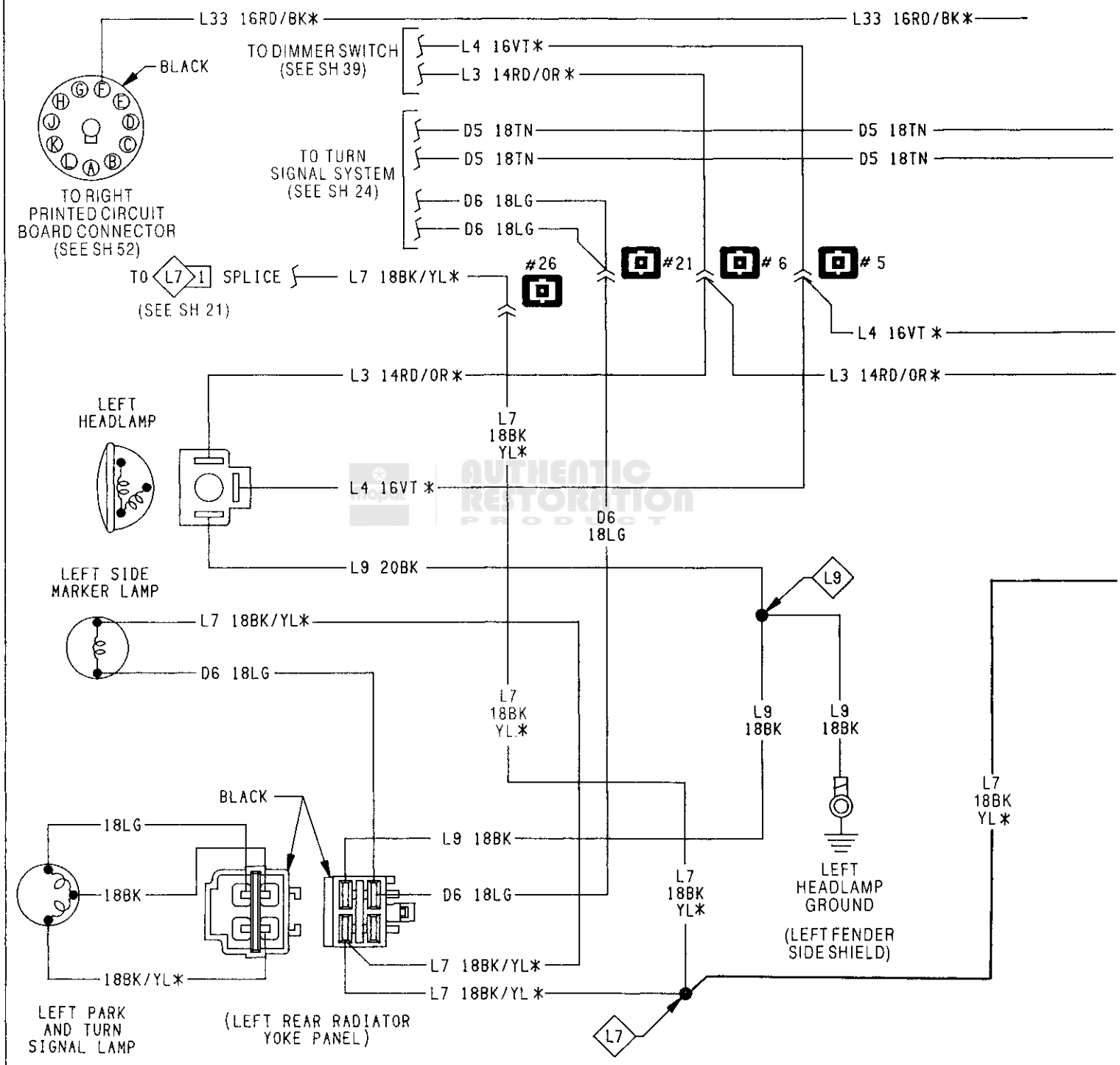
J918W-13

AD 16

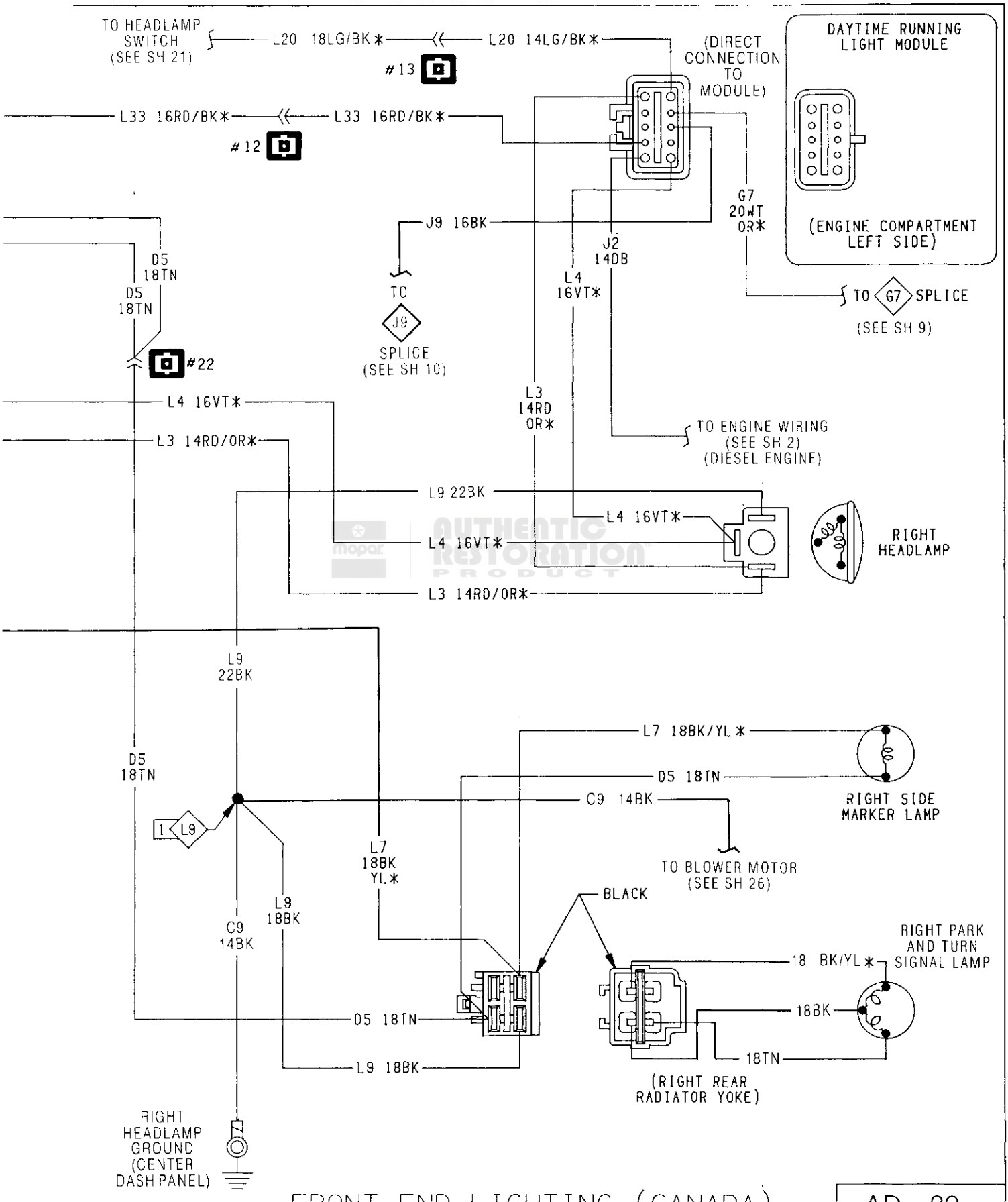


AD 17 FRONT END LIGHTING J918W-13





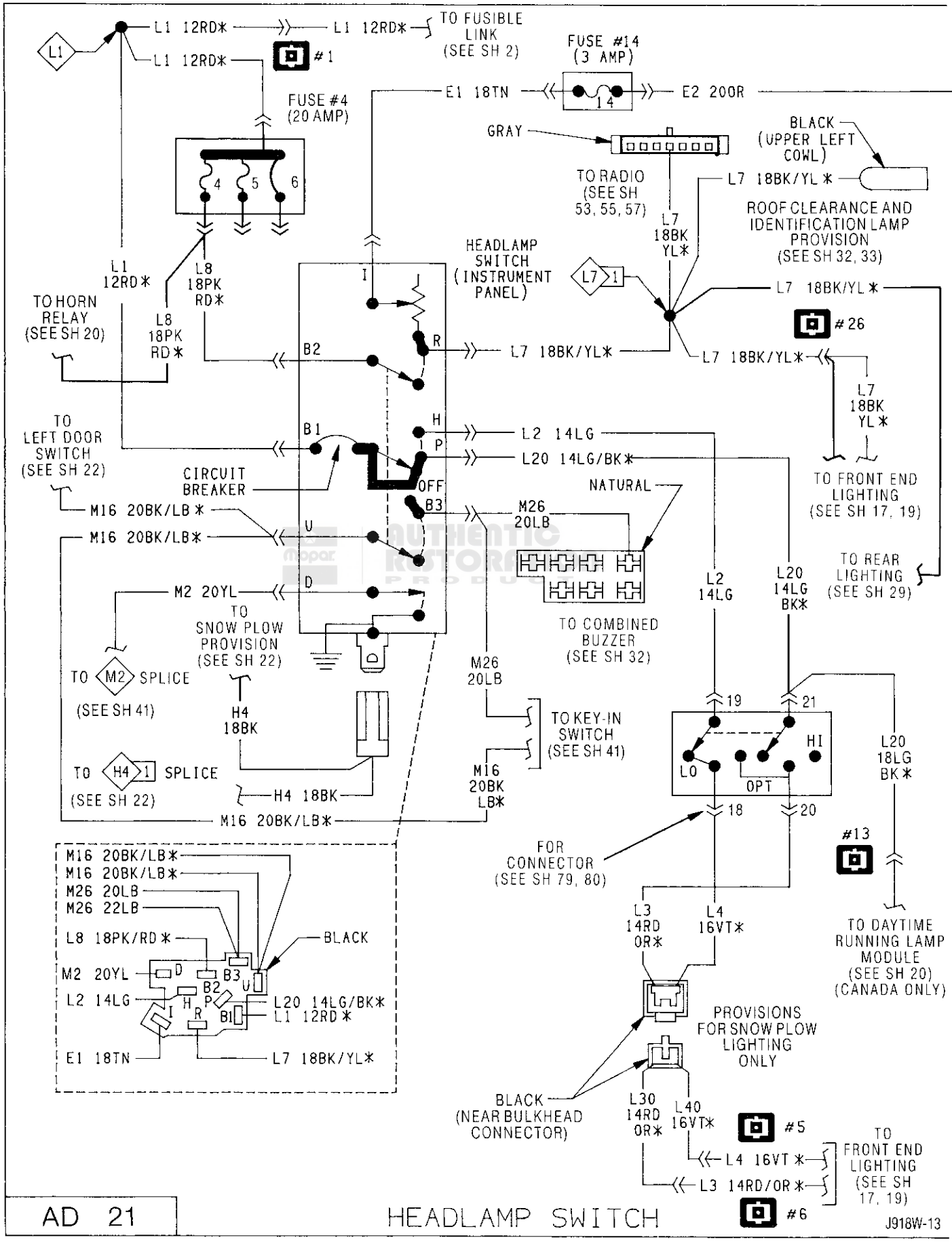
AD 19 FRONT END LIGHTING (CANADA) J918W-13



J918W-13

FRONT END LIGHTING (CANADA)

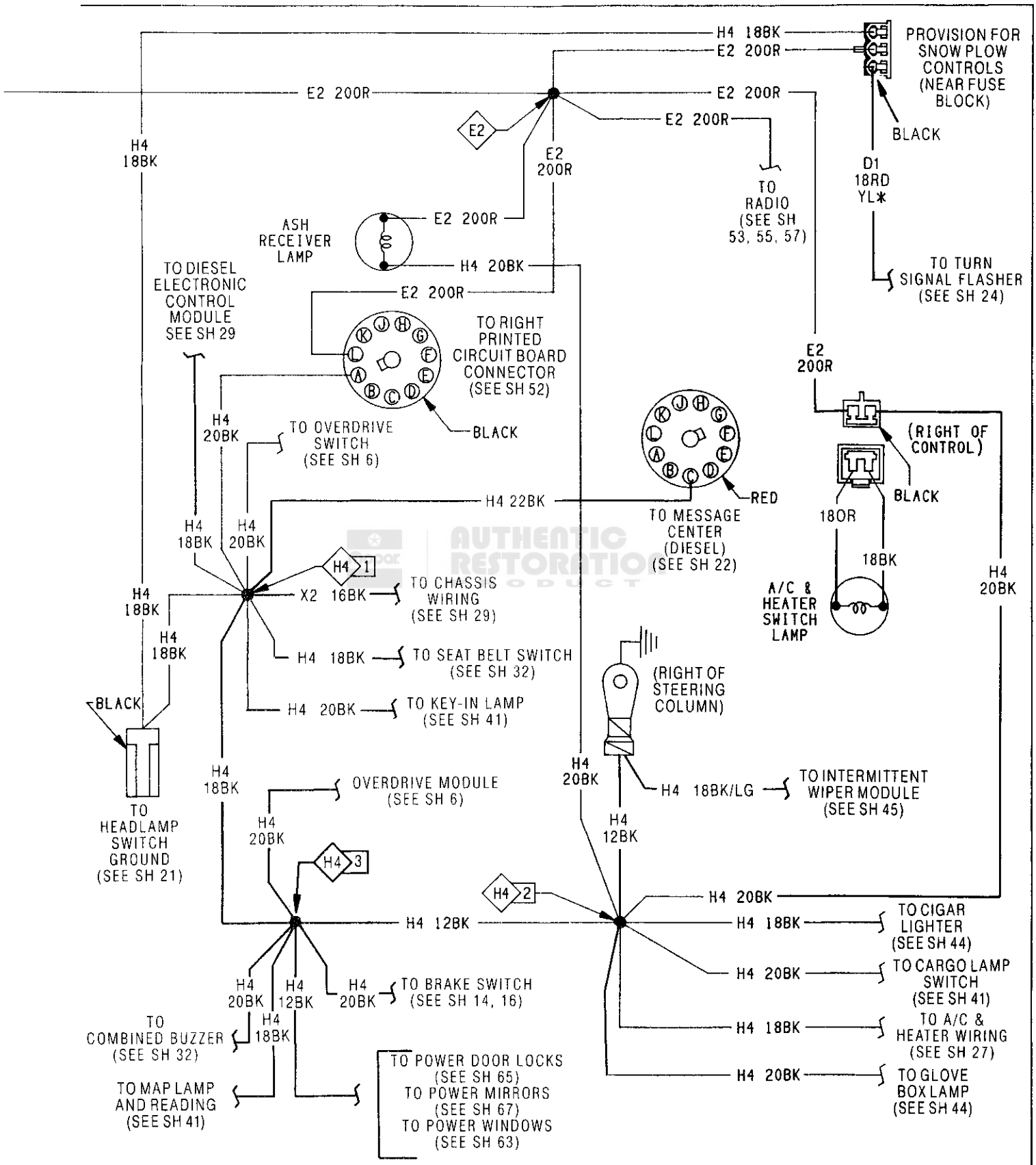
AD 20



AD 21

HEADLAMP SWITCH

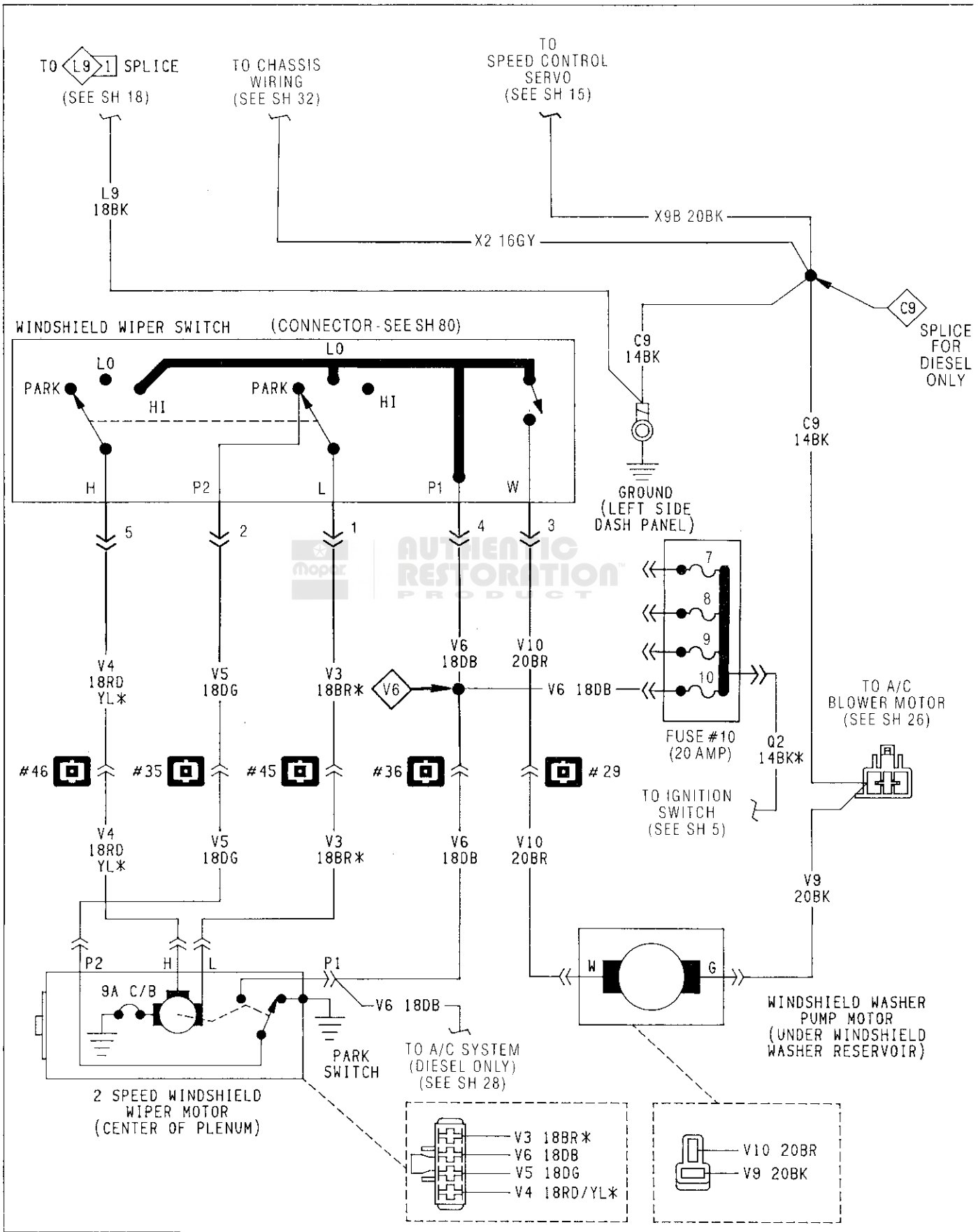
J918W-13



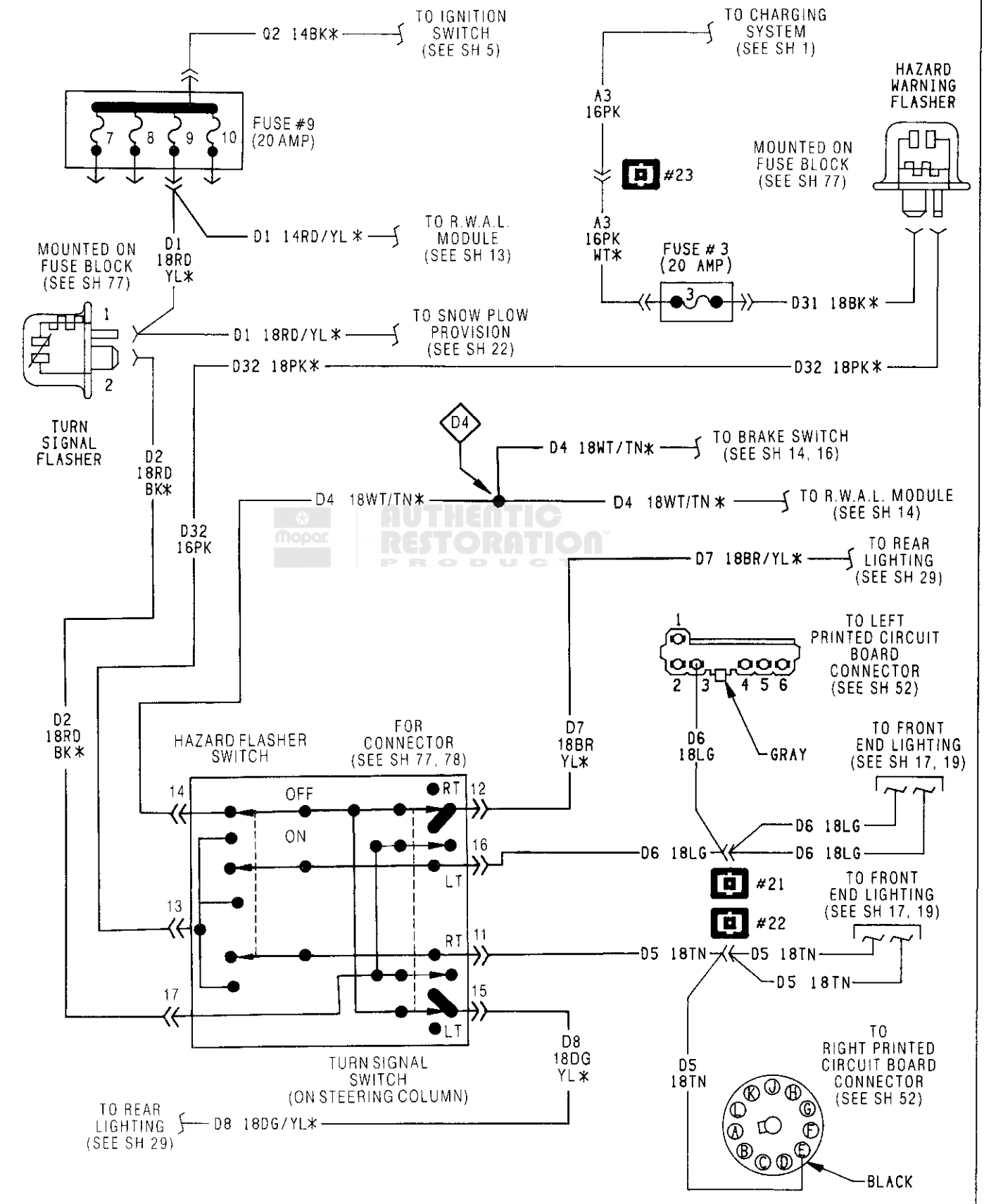
HEADLAMP SWITCH CONTROLLED INTERIOR LIGHTING

J918W-13

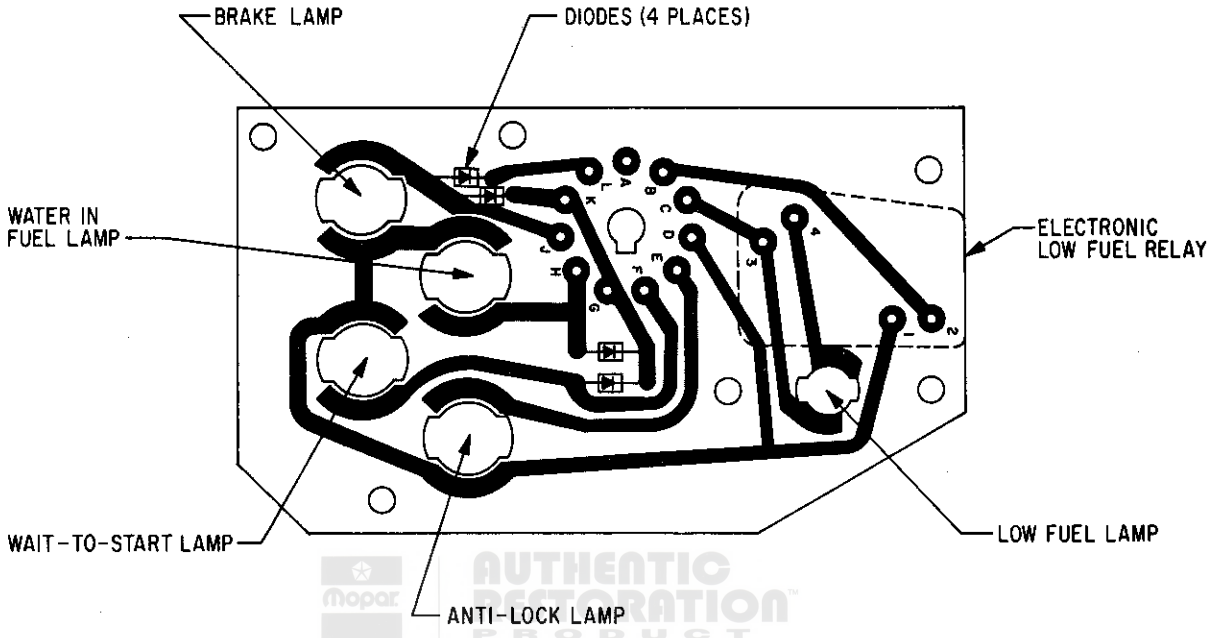
AD 22

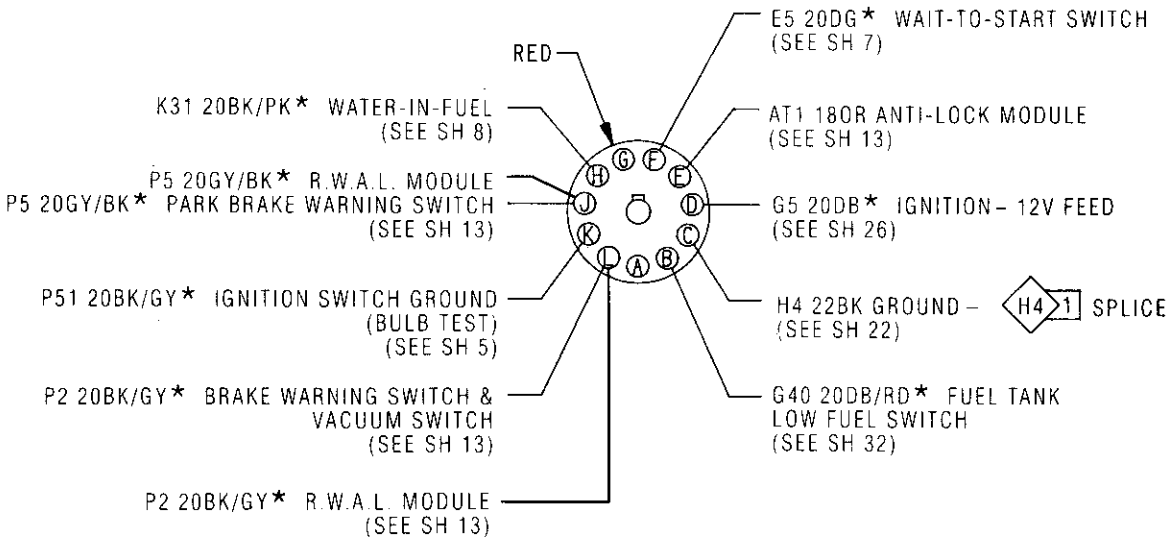


AD 23 WINDSHIELD WIPER SYSTEM J918W-13

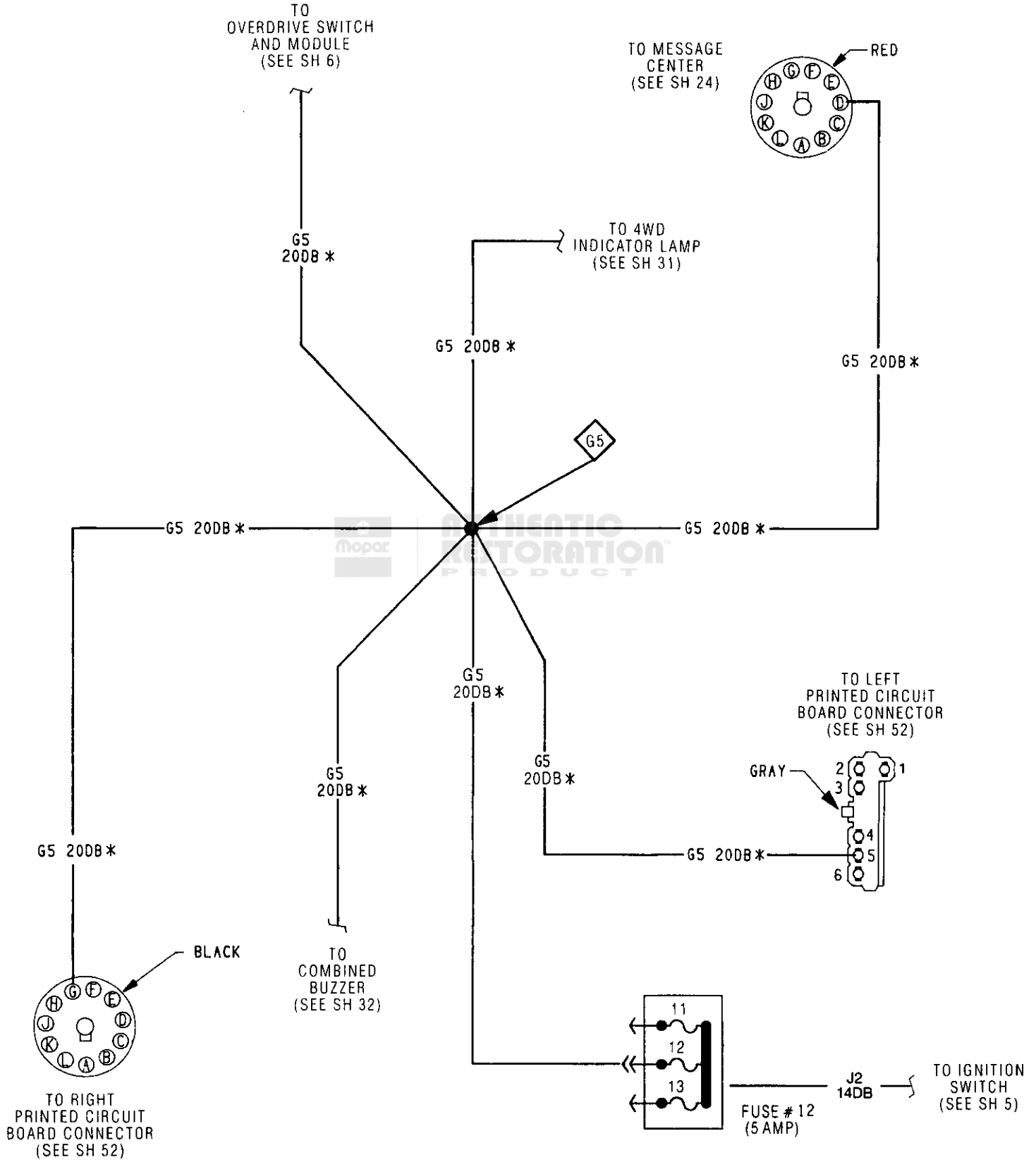


J918W-13 STOP/TURN AND HAZARD FLASHER SYSTEMS AD 24





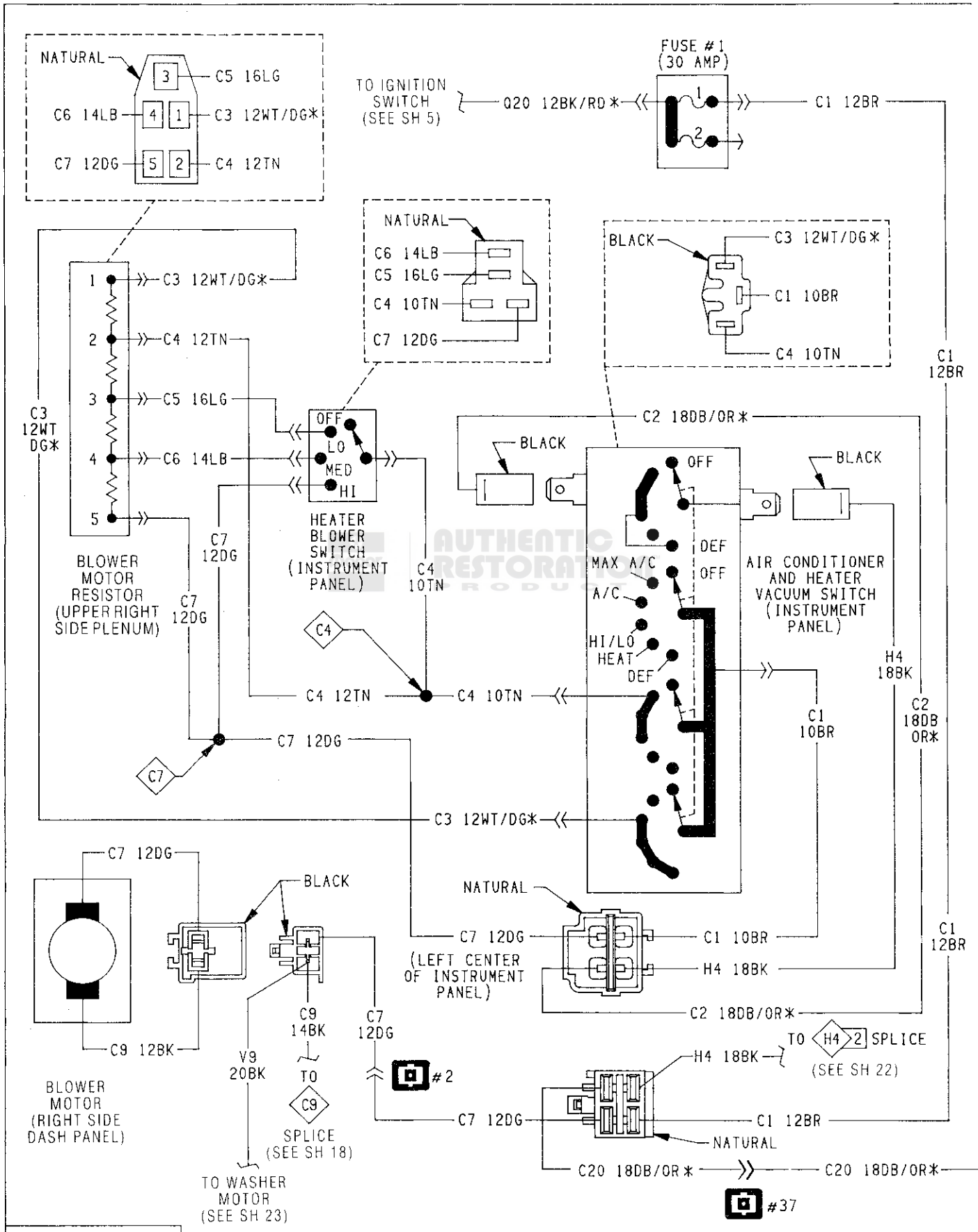
AD 25 MESSAGE CENTER (DIESEL) J918W-13



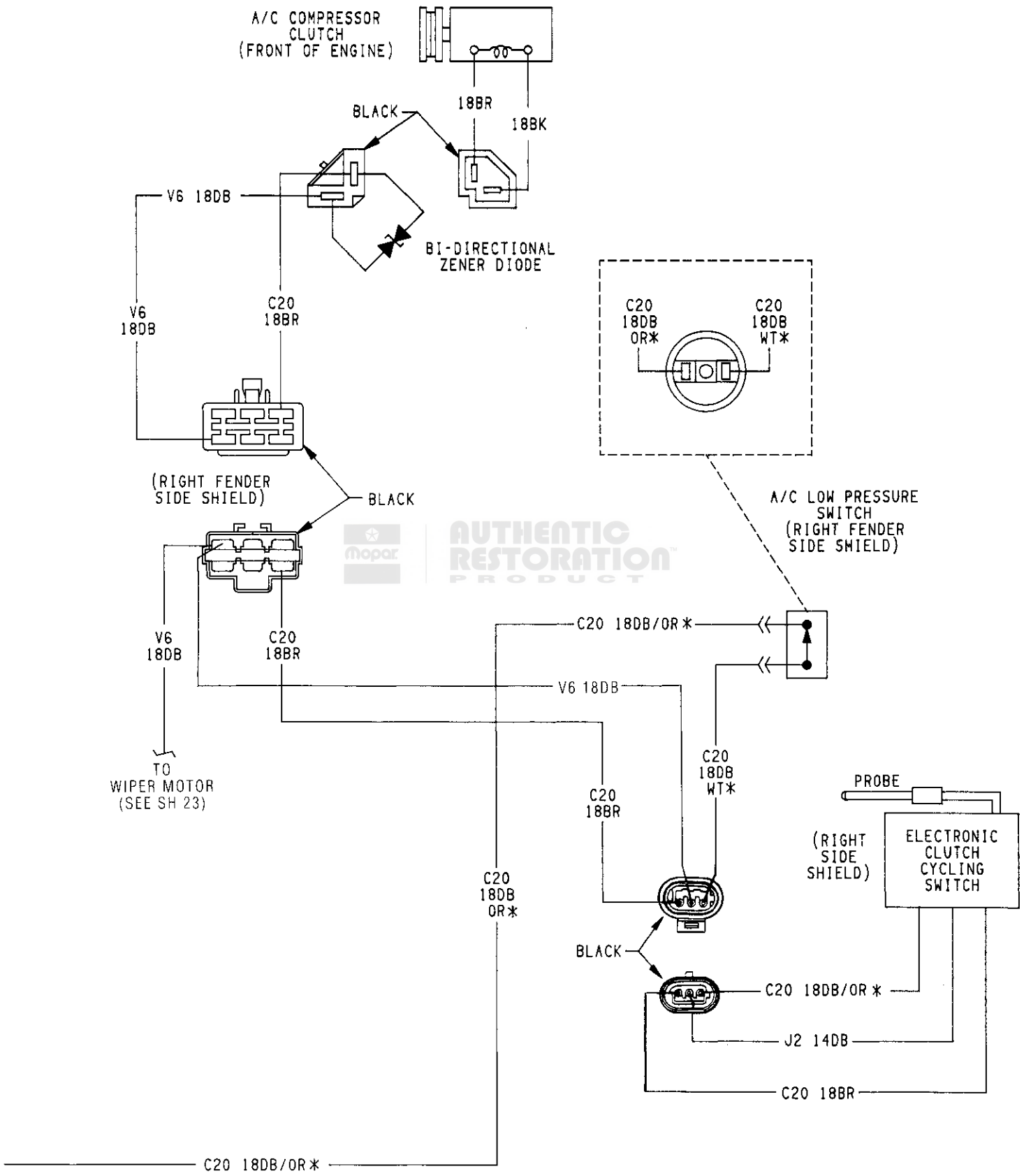
J918W-13

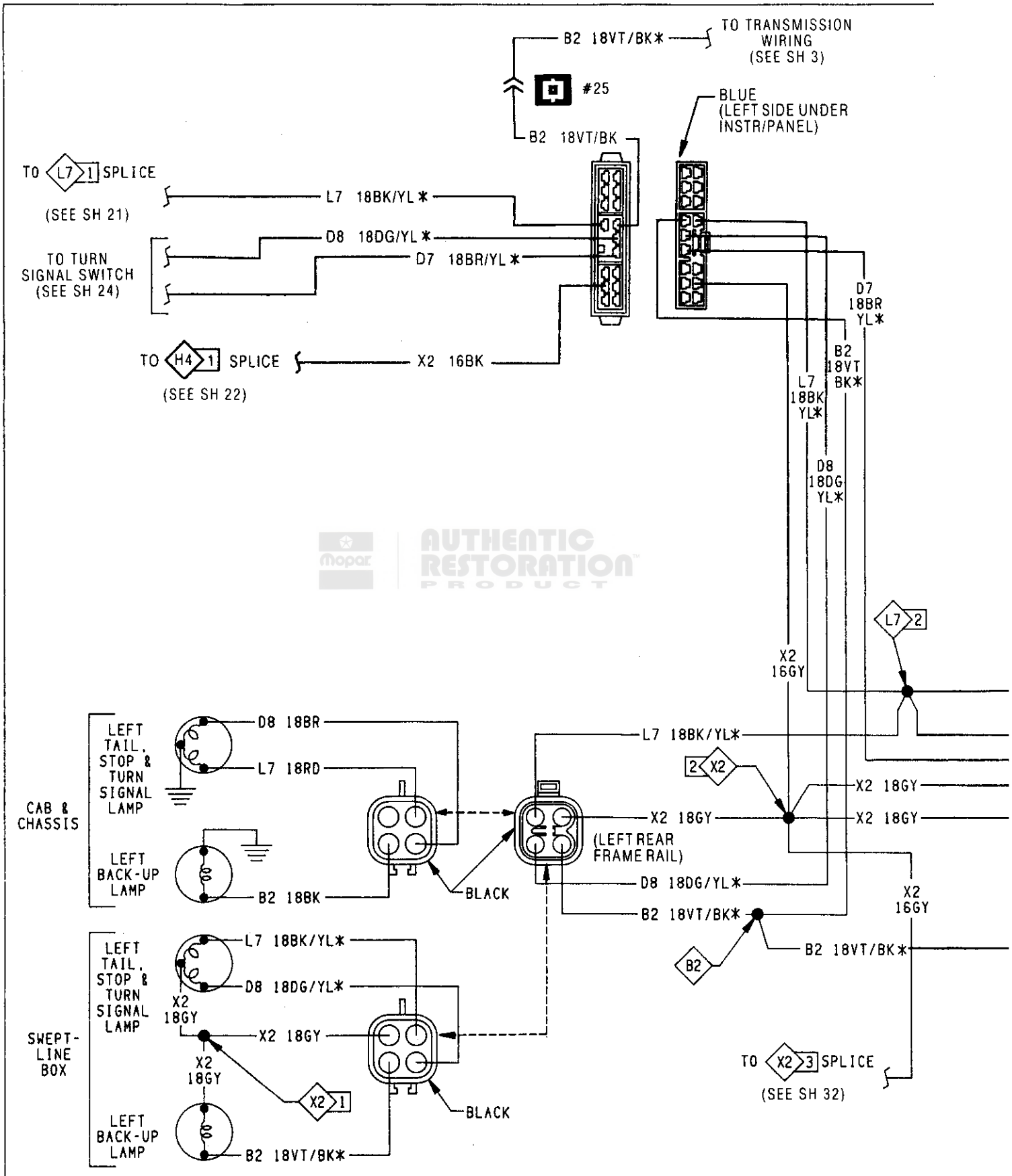
MESSAGE CENTER SPLICE (DIESEL)

AD 26



AD 27 A/C & HEATER-DIESEL ENGINE J918W-13

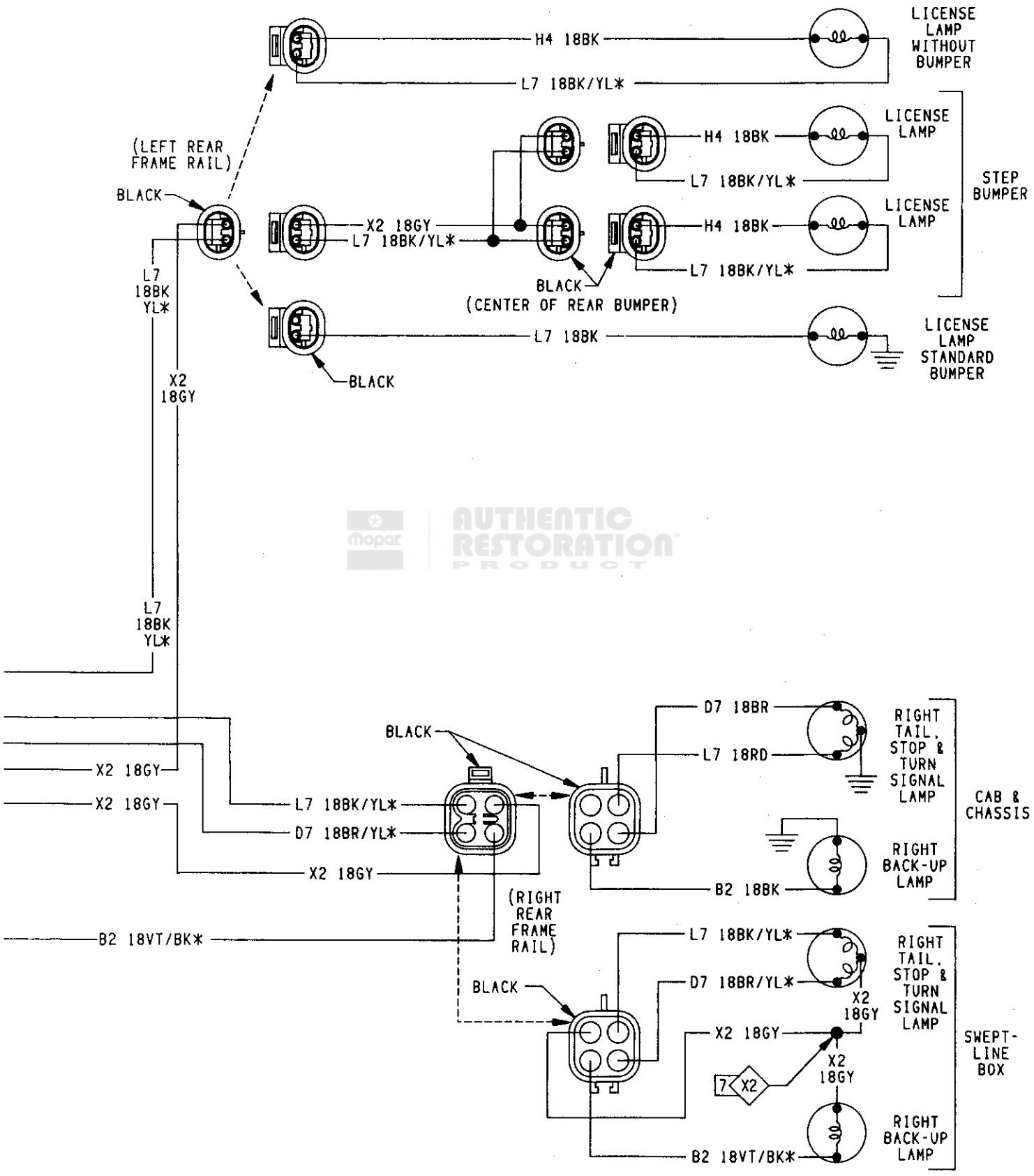

A/C COMPRESSOR CLUTCH (FRONT OF ENGINE)
18BR
18BK
BLACK
V6 18DB
BI-DIRECTIONAL ZENER DIODE
V6 18DB
C20 18BR
C20 18DB OR*
C20 18DB WT*
(RIGHT FENDER SIDE SHIELD)
BLACK
A/C LOW PRESSURE SWITCH (RIGHT FENDER SIDE SHIELD)
C20 18DB/OR*
V6 18DB
V6 18DB
C20 18BR
TO WIPER MOTOR (SEE SH 23)
C20 18BR
C20 18DB WT*
PROBE
(RIGHT SIDE SHIELD)
ELECTRONIC CLUTCH CYCLING SWITCH
C20 18DB OR*
BLACK
C20 18DB/OR*
J2 14DB
C20 18BR
C20 18DB/OR*

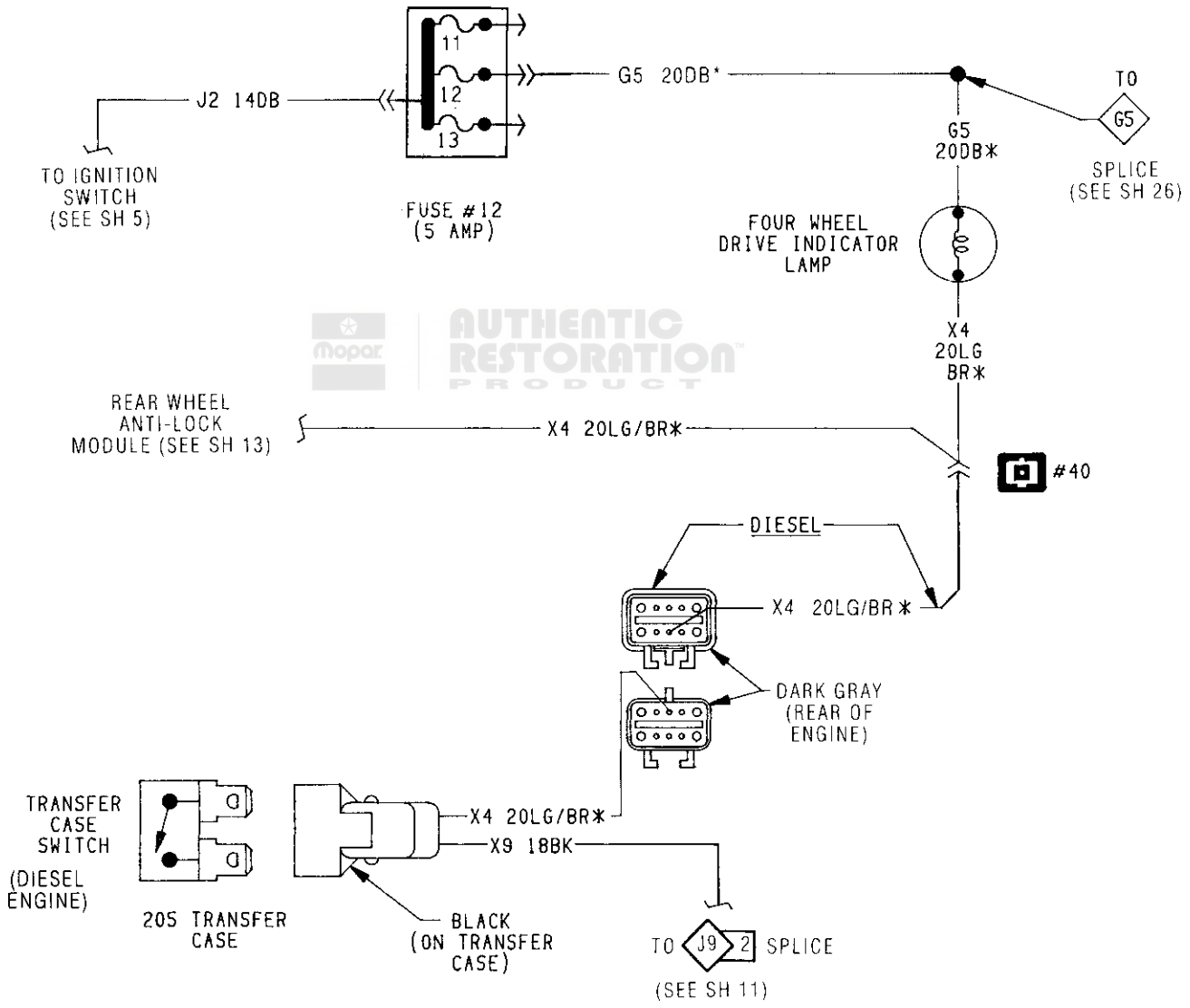


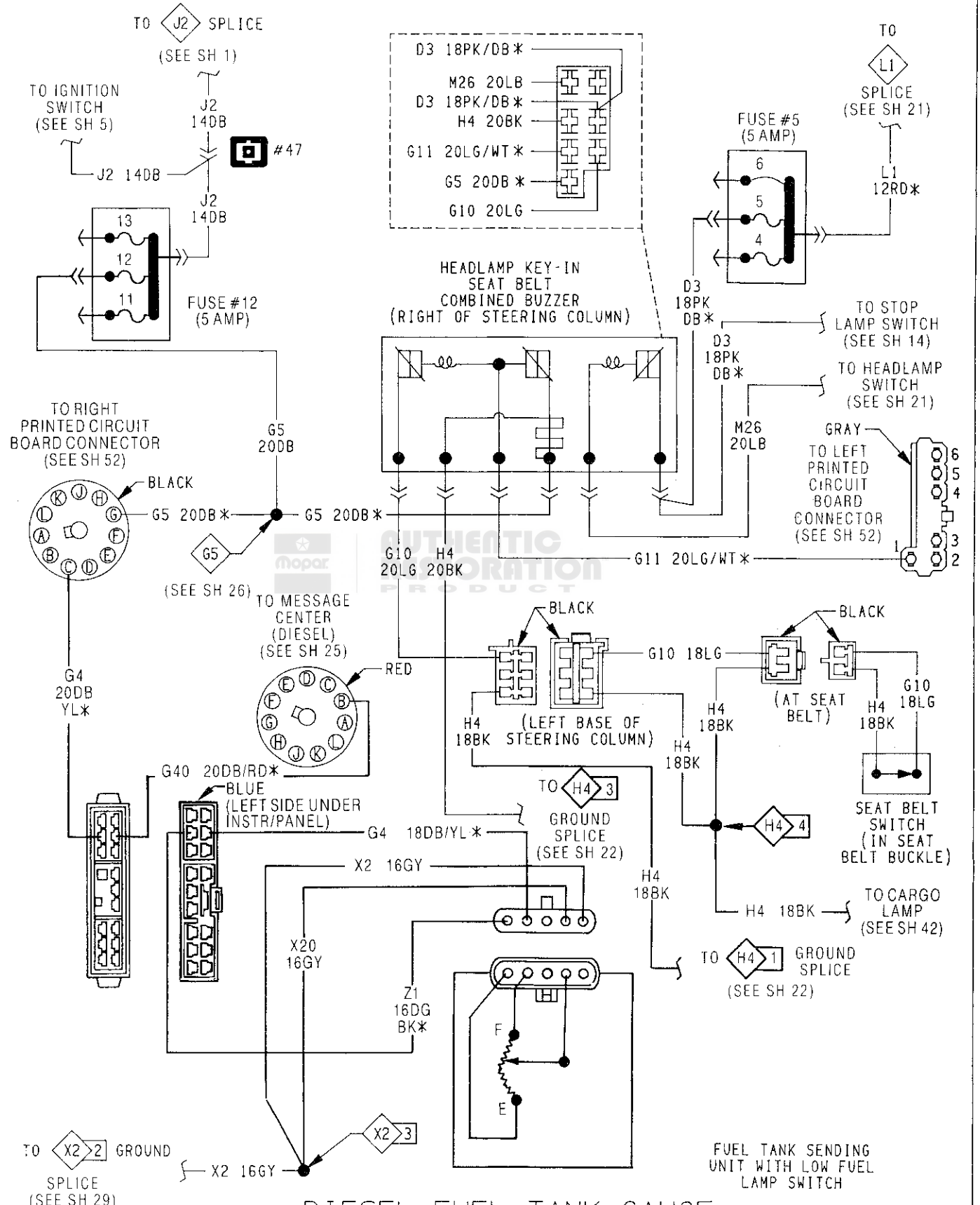
AD 29

REAR LIGHTING

J918W-13



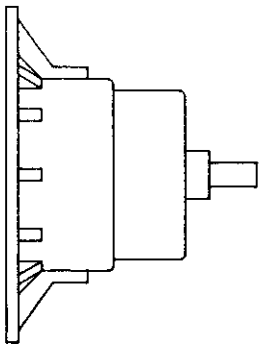


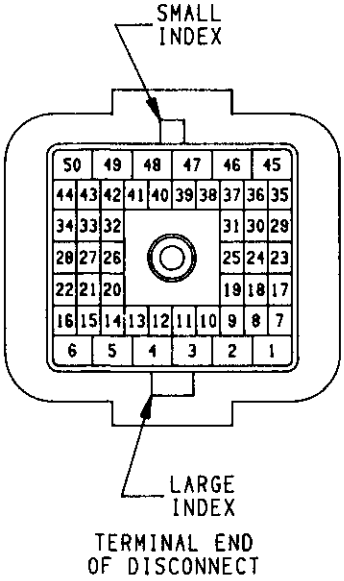


DIESEL FUEL TANK GAUGE AND SEAT BELT WARNING SYSTEM

J918W-13

AD 32

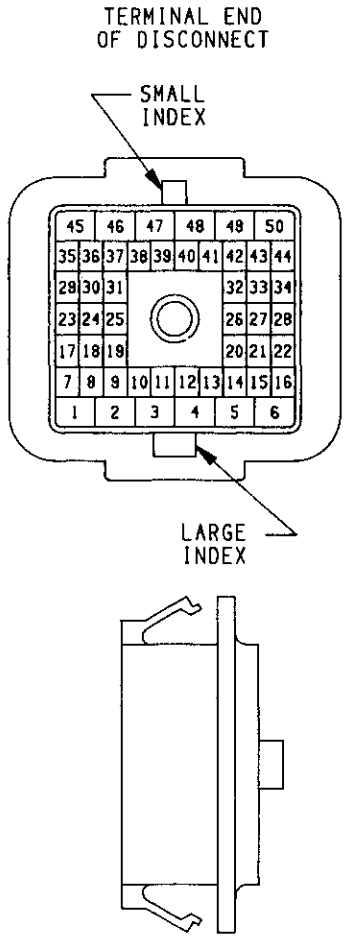


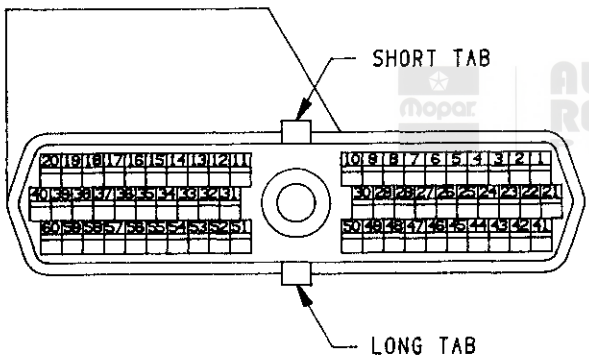


TERMINAL END OF DISCONNECT

CAVITY	ENGINE COMPARTMENT CIRCUITS	
1	L1 12RD ★	HEADLAMP SWITCH
2	C7 12DG	A/C & HEATER BLOWER MOTOR
3		
4		
5	L4 16VT/WT ★	HEADLAMP LOW BEAM (2 WIRES)
6	L3 14RD/OR ★	HEADLAMP HIGH BEAM (2 WIRES)
7	X30 20DB/RD ★	SPEED CONTROL
8	X31 20BR/RD ★	SPEED CONTROL
9	X33 20WT/LG ★	SPEED CONTROL
10	X32 20YL/LG ★	SPEED CONTROL
11	E5 20DG/WT ★	WAIT TO START LAMP
12	L33 16RD/BK ★	HIGH BEAM INDICATOR LAMP
13	L20 14LG/BK ★	HIGH BEAM FEED (D.R.L. MODULE)
14		
15		
16		
17	G20 20VT/YL ★	WATER TEMPERATURE SENDING UNIT
18	G6 20GY	OIL PRESSURE SWITCH
19	G60 20GY/YL ★	OIL PRESSURE SENDING UNIT (DIESEL)
20	–	–
21	D6 18LG	LEFT TURN SIGNAL LAMP (2 WIRES)
22	D5 18TN	RIGHT TURN SIGNAL LAMP (2 WIRES)
23	A3 16PK	BATTERY-HAZARD FLASHER
24		
25	B2 18VT/BK ★	BACK-UP LAMPS
26	L7 18BK/YL ★	PARKING LAMPS (2 WIRES)
27	B1 18WT	BACK-UP LAMP SWITCH
28		
29	V10 20BR	WINDSHIELD WASHER MOTOR
30	–	–
31	S2 16YL ★	STARTER RELAY-IGNITION
32	H2 18DG/RD ★	HORN
33	L22 18BK/RD ★	UNDERHOOD LAMP
34	P51 20GY/BK ★	BRAKE WARNING LAMP SWITCH
35	V5 18DG	WINDSHIELD WIPER MOTOR
36	V6 18DB	WINDSHIELD WIPER MOTOR
37	C20 18DB/OR ★	AIR CONDITIONING DAMPED PRESSURE SWITCH
38	K31 20BK/PK ★	WATER IN FUEL LAMP
39		
40	X4 20LG/BR ★	4 WHEEL DRIVE SWITCH
41	D40 18WT/PK ★	BRAKE SENSOR
42		
43	G7 20WT/OR ★	SPEED SENSOR
44	U4 20OR/WT ★	OVERDRIVE LOCKOUT
45	V3 18BR/WT ★	WINDSHIELD WIPER MOTOR
46	V4 18RD/YL ★	WINDSHIELD WIPER MOTOR
47	J2 14DB	SPLICE-IGNITION RUN CIRCUIT
48	C13 12BK/RD ★	IGNITION OFF DRAW
49	J1 12RD	IGNITION SWITCH
50	J10 12PK ★	IGNITION SWITCH

CAVITY	INSTRUMENT PANEL CIRCUITS	
1	L1 12RD★	BATTERY FEED
2	C7 12DG	A/C & HEATER BLOWER MOTOR
3		
4		
5	L40 16VT/WT★	HEADLAMP – LOW BEAM
6	L30 14RD/OR★	HEADLAMP – HIGH BEAM
7	X30 20DB/RD★	SPEED CONTROL
8	X31 20BR/RD★	SPEED CONTROL
9	X33 20WT/LG★	SPEED CONTROL
10	X32 20YL/AD★ X32 20YL/RD★	SPEED CONTROL
11	E5 20DG/BK★	WAIT TO START LAMP
12	L33 16LG/BK★	HIGH BEAM INDICATOR LAMP
13	L20 20LG/BK★	HIGH BEAM FEED (DRL MODULE)
14		
15		
16		
17	G20 20VT/YL★	TEMPERATURE-SEND/UNIT OR SWITCH
18	G6 20GY	OIL PRESSURE LAMP
19	G60 20GY/YL★	OIL PRESSURE GAUGE-SEND UNIT
20	–	–
21	D6 18LG D6 18LG	LEFT FRONT TURN SIGNAL LAMP
22	D5 18TN D5 18TN	RIGHT FRONT TURN SIGNAL LAMP
23	A3 16PK/WT★	HAZARD FLASHER
24		
25	B2 18VT/BK★	BACK-UP LAMPS
26	L7 18BK/YL★	PARKING LAMPS
27	B1 18WT	BACK-UP LAMP FEED
28		
29	V10 20BR	WINDSHIELD WASHER MOTOR
30	–	–
31	S2 14YL	IGNITION START
32	H2 18DG/RD★	HORNS
33	L22 18BK/RD★	UNDERHOOD LAMP
34	P51 20BK/GY★	BRAKE WARNING LAMP SWITCH
35	V5 18DG	WINDSHIELD WIPER SWITCH
36	V6 18DB	WINDSHIELD WIPER SWITCH
37	C2 18DB/OR★	A/C CLUTCH
38	K31 20BK/PK★	WATER IN FUEL LAMP (DIESEL ONLY)
39		
40	X4 20LG/BR★ X4 20LG/BR★	4 WHEEL DRIVE SWITCH
41	D40 18WT/PK★	BRAKE SENSOR
42		
43	G7 20WT/OR★	SPEED SENSOR (2 WIRES)
44	U4 20OR/WT★	OVERDRIVE LOCKOUT SWITCH
45	V3 18BR★	WINDSHIELD WIPER LOW SPEED
46	V4 18RD/YL★	WINDSHIELD WIPER HIGH SPEED
47	J2 14DB J2 14DB	IGNITION-RUN & START
48	C13 12BK/RD★	BATTERY FEED
49	J1 12RD	IGNITION SWITCH (B1)
50	J10 12PK★	IGNITION SWITCH (B3)





VIEWED FROM WIRE END OF CONNECTOR

CAV	IGNITION SYSTEM CIRCUITS		SHEET
1	K32 20TN/BK *	WATER-IN-FUEL SENSOR	8
2			
3	J11 16RD	DIRECT BATTERY	9
4	N5 18BK/LB *	SENSOR RETURN	10
5	K5 16BK *	SIGNAL GROUND	8
6	K8 20VT/WT *	5 VOLT SUPPLY	10
7			
8	S5 18BR	START SIGNAL	8
9	J2 14DB	IGNITION FEED	8
10	U4 20RD/WT *	OVERDRIVE LOCKOUT CONTROL	6
11	J9 18LB/RD *	POWER GROUND	10
12	J9 18LB/RD *	POWER GROUND	10
13	–	–	–
14	–	–	
15	S22 18OR/BK *	HEATER #2 RELAY	8
16	S21 18YL *	HEATER #1 RELAY	8
17	–	–	–
18	–	–	–
19			
20			
21	S20 18LB *	INTAKE AIR TEMPERATURE	8
22	K7 18OR/DB *	THROTTLE POSITION SENSOR	10
23	K7 18 OR/DB *	THROTTLE POSITION SENSOR	10
24			
25	DK21 - 20PK	SCI TRANSMIT	10
26	–	–	–
27			
28			
29	D40 18WT/PK *	BRAKE SENSE	9, 15
30	S4 20BR/YL *	PARK/NEUTRAL SWITCH	9
31	–	–	–
32			
33	X36 20TN/RD *	SPEED CONTROL - VACUUM	15
34			
35			
36			
37	–	–	–
38	–	–	–
39	–	–	–
40			
41			
42	–	–	–
43	–	–	–
44			
45	DK20 20LG	SCI RECEIVE	10
46	–	–	–
47	G7 20WT/OR *	SPEED SENSOR PICKUP	9
48	X31 20BR/RD *	SPEED CONTROL - SET	15
49	X32 20YL/RD *	SPEED CONTROL - ON/OFF	15
50	X33 20WT/LG *	SPEED CONTROL - RESUME	15
51			
52			
53	X35 20LG/RD *	SPEED CONTROL - VENT	15
54	K31 20BK/PK	WATER-IN-FUEL LAMP	8
55	V40 20OR/LG *	OVERDRIVE LOCKOUT SOLENOID	6
56	E5 20DG *	WAIT-TO-START LAMP	8
57	–	–	–
58	–	–	–
59	–	–	–
60			

SINGLE BOARD
ENGINE CONTROLLER CONNECTOR (DIESEL)

J918W-13

5.9L DIESEL ENGINES

CONTENTS

GENERAL INFORMATION

The 5.9 Liter (359 CID) Cummins Turbocharged/Intercooled six-cylinder diesel engine is an In-line valve-in head type (Fig. 1). The cylinder block and head are cast iron.

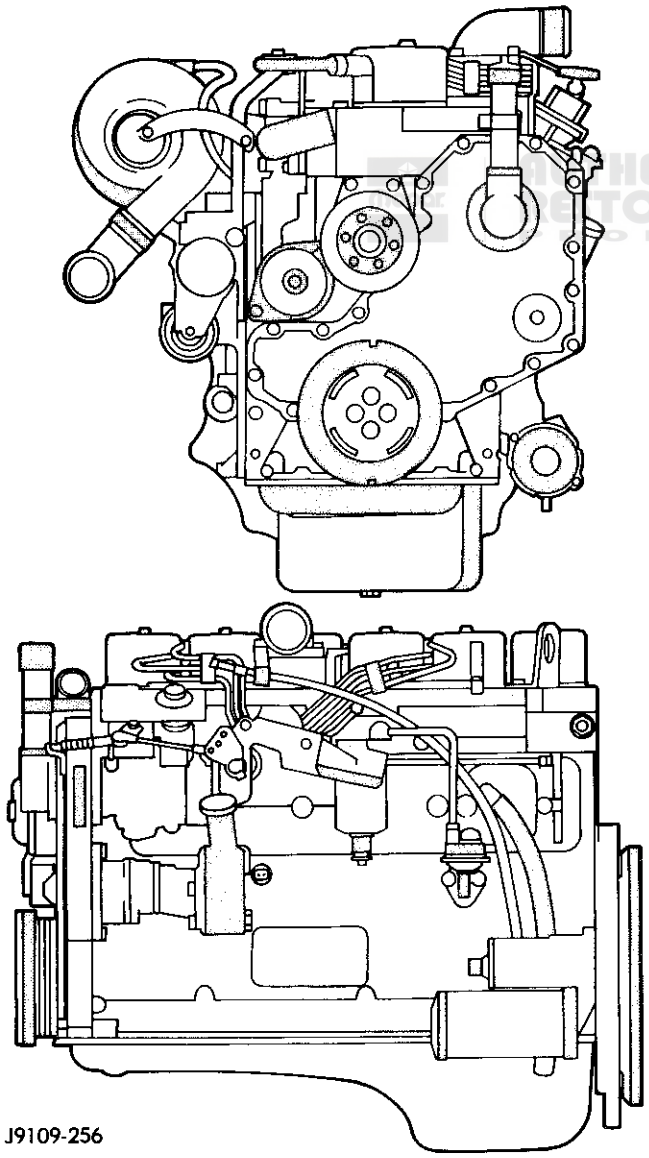


Fig. 1 Six-Cylinder In-line Engine

This engine is designed for No. 2 Diesel Fuel. Only use No. 1 Diesel Fuel where extended arctic conditions exist (below -23°C or -10°F).

The cylinders are numbered from front to rear (1, 2, 3, 4, 5 and 6). The firing order is 1-5-3-6-2-4 (Fig. 2).

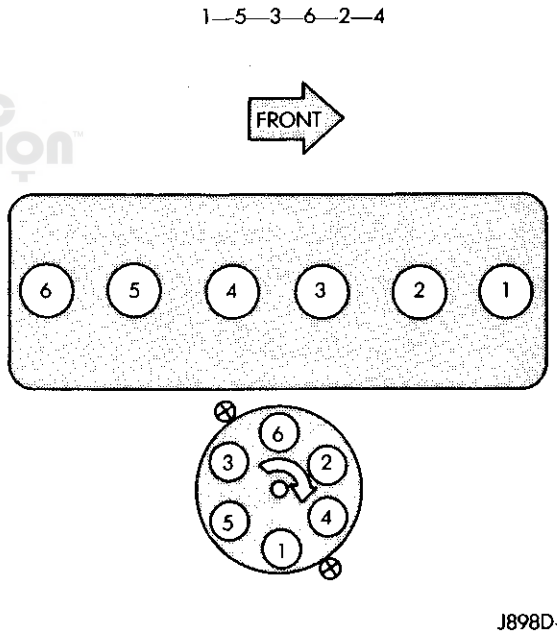


Fig. 2 Engine Firing Order

Engine lubrication system consists of a gerotor type oil pump and a full flow oil filter with a bypass valve.

ENGINE DESCRIPTION—5.9L DIESEL ENGINES

Type	In-line 6	
Bore and Stroke	102 x 120 mm	(4.02 x 4.72 inch)
Displacement	5.9 Liters	(359 cubic inches)
Compression Ratio	17.5:1	
Engine Torque	542 N•m (400 ft. lbs.) @ 1750 rpm	
Firing Order	1-5-3-6-2-4	
Lubrication	Pressure Feed-Full Flow Filtration with Bypass Filter	
Engine Oil Capacity	11.4 Liters	(12 Quarts)
Cooling System	Liquid Cooled-Forced Circulation	
Cooling Capacity (Auto Trans)	16.2 Liters	(17 Quarts)
(Manual Trans)	15.2 Liters	(16 Quarts)
Coolant Recovery Tank	0.95 Liter	(1.0 Quart)
Cylinder Block	Cast Iron	
Crankshaft	Induction Hardened-Forged Steel	
Cylinder Head	Cast Iron	
Combustion Chambers	High Swirl Combustion Bowl	
Camshaft	Chilled Cast Iron	
Pistons	Cast Aluminum	
Connecting Rods	Forged Steel	

J9109-255

ENGINE DIAGNOSIS

GENERAL INFORMATION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine tune-ups.

These malfunctions may be classified as either mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

Refer to the Service Diagnosis—Mechanical Chart and the Service Diagnosis—Performance Chart for possible causes and corrections of malfunctions. Refer to Group 14, Fuel System for the fuel system diagnosis.

SERVICE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL PRESSURE LOW	Low oil level.	(a) Check and fill with clean engine oil. (b) Check for a severe external oil leak that could reduce the pressure.
	Oil viscosity thin, diluted or wrong specification.	Verify the correct oil is being used. Check for oil dilution. Refer to Contaminated Lube Oil (Engine Diagnosis—Mechanical).
	Improperly operating pressure switch/gauge.	Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	Relief valve stuck open.	Check/replace valve.
	Plugged oil filter.	Change oil filter. Oil filter change interval may need to be revised.
	If cooler was replaced, shipping plugs left in cooler.	Check/remove shipping plugs.
	If pump replaced, four cylinder oil pump installed in a six cylinder engine.	Verify that the correct pump is installed. If not, install an oil pump for a six cylinder engine.
	Loose or missing cup plugs.	Check and replace cup plugs.
	Worn oil pump.	Check and replace oil pump.
	Suction tube loose or seal leaking.	Check and replace seal.
	Loose main bearing cap.	Check and install new bearings and tighten cap to proper torque.
	Worn bearings or wrong bearings installed.	Inspect and replace connecting rod or main bearings. Check and replace piston cooling nozzles.

J9109-237

SERVICE DIAGNOSIS - MECHANICAL (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
LUBRICATING OIL PRESSURE TOO HIGH	Pressure switch/gauge not operating properly.	Verify the pressure switch is functioning correctly. If not, replace switch/gauge.
	Engine running too cold.	Refer to Coolant Temperature Below Normal (Engine Diagnosis—Performance)
	Oil viscosity too thick.	Make sure the correct oil is being used. Refer to Group O, Lubrication and Maintenance.
	Oil pressure regulator valve stuck closed or binding.	Check and replace valve, and/or oil cooler cover.
LUBRICATING OIL LOSS	External leaks.	Visually inspect for oil leaks. Repair as required.
	Crankcase being overfilled.	Verify that the correct dipstick is being used.
	Incorrect oil specification or viscosity.	(a) Make sure the correct oil is being used.
		(b) Look for reduced viscosity from dilution with fuel.
		(c) Review/reduce the oil change intervals.
	Oil cooler leak.	Check and replace the oil cooler.
	High blow-by forcing oil out the breather.	Check the breather tube area for signs of oil loss. Perform the required repairs.
	Turbocharger leaking oil to the air intake.	Inspect the air ducts for evidence of oil transfer. Repair as required.
	Worn valve seals.	Inspect and replace the valve seals.
	Piston rings not sealing (oil being consumed by the engine).	Perform blow-by check. Repair as required.
COMPRESSION KNOCKS	Air in the fuel system.	Bleed the fuel system (refer to Group 14, Fuel System).
	Poor quality fuel.	Verify by operating from a temporary tank with good fuel. Clean and flush the fuel supply tanks. Replace fuel/water separator filter.
	Engine overloaded.	Verify that engine load rating is not being exceeded.
	Incorrect injection pump timing.	Check and time injection pump (refer to Group 14, Fuel System).
	Improperly operating injectors.	Check and replace inoperative injectors.

SERVICE DIAGNOSIS - MECHANICAL (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
EXCESSIVE VIBRATION	Loose or broken engine mounts.	Replace engine mounts.
	Damaged fan or improperly operating accessories.	Check and replace the vibrating components.
	Improperly operating vibration damper.	Inspect/replace the vibration damper.
	Improperly operating fan hub.	Inspect/replace the fan hub.
	Worn or damaged alternator bearing.	Check/replace the alternator.
	Flywheel housing misaligned.	Check/correct flywheel alignment.
	Loose or broken power component.	Inspect the crankshaft and rods for damage that causes an unbalance. Repair/replace as required.
	Worn or unbalanced driveline components.	Check/repair driveline components.
EXCESSIVE ENGINE NOISES	Drive belt squeal, insufficient tension or abnormally high loading.	Check the tensioner and inspect the drive belt. Make sure water pump, tensioner pulley, fan hub and alternator turn freely.
	Intake air or exhaust leaks.	Refer to Excessive Exhaust Smoke (Engine Diagnosis—Performance).
	Excessive valve lash	Adjust valves. Make sure the push rods are not bent and rocker levers or adjusting screws are not severely worn. Replace bent or severely worn pads.
	Turbocharger noise.	Check turbocharger impeller and turbine wheel for housing contact. Repair/replace as required.
	Gear train noise.	Visually inspect and measure gear backlash. Replace gears as required.
	Power function knock.	Check/replace rod and main bearings.
ALTERNATOR NOT CHARGING OR INSUFFICIENT CHARGING	Loose or corroded battery connections.	Clean/tighten battery connection.
	Alternator belt slipping.	Check/replace belt tensioner. Check/replace belt.
	Alternator pulley loose on shaft.	Tighten pulley.
	Improperly operating alternator.	Check/replace alternator.

SERVICE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK OR CRANKS SLOWLY	Starting motor operating, but not cranking the engine.	Remove the starter motor. Check for broken flywheel teeth or a broken starting motor spring.
	Crankshaft rotation restricted.	Rotate the engine to check for rotational resistance.
	Starting circuit connections loose or corroded.	Clean and tighten connections.
	Neutral safety switch or starter relay inoperative.	Check starter relay for supply voltage and proper operation of neutral safety. Replace defective parts.
	Battery charge low.	Check battery voltage. Replace battery if a charge cannot be held.
	No voltage to starter solenoid.	Check voltage to solenoid. If necessary, replace the solenoid.
	Solenoid or starting motor inoperative.	Replace starter motor.
ENGINE CRANKS, BUT WILL NOT START—NO SMOKE FROM EXHAUST	No fuel in supply tank.	Fill fuel supply.
	Electrical fuel shutdown not open.	Check for loose wires and verify that the valve is functioning. Check to be sure manual shutoff lever is in the run position.
	Air intake or exhaust plugged.	Remove the obstruction.
	Fuel filter plugged.	Drain fuel/water separator and replace fuel filter.
	Injection pump not getting fuel or fuel is aerated.	Check fuel flow/bleed fuel system.
	Worn or inoperative injection pump.	Visually check fuel delivery with an externally connected injector to one of the pump outlets. Replace the pump if fuel is not being delivered.
	Internal pump timing incorrect.	Time the pump (refer to Group 14, Fuel System).
	Camshaft out of time.	Check/correct gear train timing alignment.
ENGINE HARD TO START, OR WILL NOT START—SMOKE FROM EXHAUST	Incorrect starting procedure.	The manual fuel shutoff control must be in the run position.
	Cranking speed too slow.	(a) Verify that the transmission is not engaged. (b) Check the battery, starting motor and look for loose or corroded wiring connections. (c) Rotate the engine with a barring tool (Snap-On Tool SP371, MTE No. 3377462, or equivalent) to check for internal rotational resistance.
	Cold starting aids not working or are needed.	Verify the aids are operating. Repair/replace inoperative parts.
	Intake heater system not working.	Verify system is working. Repair/replace inoperative parts.
	Insufficient intake air.	Inspect or replace filter and check for obstructions to the air supply tube.
	Air in the fuel system or the fuel supply is inadequate.	Check the flow through the filter and bleed the system. Locate and eliminate the air source.

J9109-232

SERVICE DIAGNOSIS - PERFORMANCE (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE HARD TO START, OR WILL NOT START—SMOKE FROM EXHAUST (Cont'd)	Fuel pump inoperative.	Disconnect fuel line and verify fuel delivery. If needed replace pump.
	Injection pump throttle linkage loose or damaged.	Visually check the linkage. Tighten/replace linkage.
	Contaminated fuel.	Verify by operating the engine with clean fuel from a temporary tank. Check for presence of gasoline. Drain and flush fuel supply tanks. Replace fuel/water separator filter.
	Worn or inoperative injection pump.	Visually check fuel delivery with an externally connected injector to one of the pump outlets. Replace the pump if fuel is not being delivered.
	Injection pump out of time.	Check/time the pump (refer to Group 14, Fuel System).
	Valves incorrectly adjusted.	Adjust valves.
	One or more injectors worn or not operating properly.	Check/replace bad improperly operating injectors.
ENGINE STARTS, BUT WILL NOT KEEP RUNNING	Idle speed too low for the accessories.	Adjust the idle speed.
	Intake air or exhaust system restricted.	Visually check for exhaust restriction and inspect the air intake. Repair/replace restricting parts.
	Air in the fuel system or the fuel supply is inadequate.	Check the flow through the filter and bleed the system. Locate and eliminate the air source.
	Fuel waxing due to extremely cold weather.	Verify by inspecting the fuel filter. Clean the system and use climatized fuel. Replace fuel/water separator filter. Check fuel heater for proper operation.
	Contaminated fuel.	Verify by operating the engine with clean fuel from a temporary supply tank. Check for presence of gasoline. Replace fuel/water separator filter.
SURGING (SPEED CHANGE)	If the condition occurs at idle, the idle speed is set too low for the accessories.	Adjust the idle.
	High pressure fuel leak.	Inspect/correct leaks in the high pressure lines. Fittings and delivery valve sealing washers.
	One or more injectors worn or not operating properly.	Check/replace the inoperative injectors.
	Improperly operating injection pump.	Replace the injection pump.
ROUGH IDLE (IRREGULARLY FIRING OR ENGINE SHAKING)	Cold engine.	Refer to troubleshooting logic for intake manifold heater system (see Group 11, Exhaust System & Intake Manifold)
	Idle speed too low for the accessories.	Adjust idle speed.
	Engine mounts damaged or loose.	Repair or replace mounts.

SERVICE DIAGNOSIS - PERFORMANCE (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
ROUGH IDLE (IRREGULARLY FIRING OR ENGINE SHAKING) (Cont'd)	High pressure fuel leaks.	Correct leaks in the high pressure lines, fittings or delivery valves.
	Air in the fuel system.	Bleed the fuel system and eliminate the source of the air.
	Sticking needle valve in an injector.	Check and replace the injector with the sticking needle valve.
ENGINE RUNS ROUGH OR MISFIRING	Fuel injection lines leaking.	Correct leaks in the high pressure lines, fittings, injector sealing washers or delivery valves.
	Air in the fuel or the fuel supply is inadequate.	Check the flow through the filter and bleed the system. Locate and eliminate the air source.
	Contaminated fuel.	Verify by operating the engine with clean fuel from a temporary supply tank. Check for presence of gasoline. Replace fuel/water separator filter.
	Incorrect valve adjustment.	Check for a bent push rod and adjust valves. Replace push rod, if necessary.
	Injection pump timing incorrect.	Check/time pump (refer to Group 14, Fuel System).
	Improperly operating injectors.	Replace inoperative injectors.
	Defective injection pump (delivery valves).	Replace injection pump.
	Camshaft out of time.	Check/correct gear train timing alignment.
	Damaged camshaft or tappets.	Inspect camshaft valve lift. Replace camshaft and tappets.
ENGINE RPM WILL NOT REACH RATED SPEED	Engine overloaded.	Verify high idle speed without load. Investigate operation to be sure correct gear is being used.
	Improperly operating tachometer.	Verify engine speed with hand tachometer—correct as required.
	Throttle linkage worn or incorrectly adjusted.	Adjust linkage for stop-to-stop fuel control lever travel. Replace linkage if necessary.
	Partially engaged mechanical shutdown lever.	Adjust and place shutdown lever in the run position.
	Inadequate fuel supply.	Check the fuel flow through the system to locate the reason for inadequate fuel supply—correct as required.
	Improperly operating injection pump.	Replace injection pump.
LOW POWER	Fuel control lever not moving to full throttle.	Check/correct for stop-to-stop travel.
	Mechanical/shutdown lever partially engaged.	Check to see if the shutdown lever is in run position.
	High oil level.	Check/correct oil level.
	Engine overloaded.	Check for added loading from accessories or driven units, brakes dragging and other changes in vehicle loading. Repair/replace as needed.

J9109-264

SERVICE DIAGNOSIS - PERFORMANCE (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
LOW POWER (Cont'd)	Slow throttle response, leaking air fuel control tube or improperly operating control in the pump.	Tighten the fittings. Replace the pump if the controls are not functioning.
	Incorrect external injection pump timing.	Verify that injection pump timing marks are aligned (see Group 14, Fuel System).
	Inadequate intake air flow.	Inspect/replace air cleaner element. Look for other restrictions.
	High pressure fuel leak.	Inspect/correct leaks in the high pressure lines, fittings injector sealing washers or delivery valve seals.
	Inadequate fuel supply.	Check the flow through the filter to locate the source of the restriction.
	High fuel temperature.	Verify that fuel heater is off during warm weather. Check for a restricted fuel drain manifold. Repair/replace as needed.
	Poor quality fuel or fuel contaminated with gasoline.	Verify by operating from a temporary tank with good fuel. Check for presence of gasoline. Replace fuel/water separator filter.
	Air leak between the turbocharger and the intake manifold.	Check/correct leaks in the air tubes, intercooler, hoses, gaskets, and around mounting capscrews or through holes in the manifold cover.
	Intercooler blocked.	Check pressure drop across intercooler (4" of Hg. max. @ rated power).
	Exhaust leak at the manifold or turbocharger.	Check/correct leaks in the manifold or turbocharger gaskets. If manifold is cracked, replace manifold.
	Improperly operating turbocharger.	Inspect/replace turbocharger.
	Valve clearance incorrect.	Check/adjust valves.
	Injection pump improperly operating.	Check/time pump (refer to Group 14, Fuel System).
	Worn or improperly operating injectors.	Check/replace injectors.
	Improperly operating injection pump.	Replace injection pump.
	Excessive exhaust restriction.	Check/correct the restriction in the exhaust system.
EXCESSIVE EXHAUST SMOKE	Engine running too cold (white smoke).	Refer to troubleshooting logic for coolant temperature below normal (refer to Group 14, Cooling System). Inspect intake manifold heater/KSB valve for proper operation.
	Inadequate intake air.	Inspect/change air cleaner. Look for other restriction.
	Air leak between turbocharger and intake manifold.	Check/correct leaks in the air tubes, intercooler, hoses, gaskets, mounting capscrews or through holes in the manifold cover.
	Intercooler blocked.	Check pressure drop across intercooler (4" of Hg. max. @ rated power).
	Exhaust leak at the manifold or turbocharger.	Check/correct leaks in the manifold or turbocharger gaskets. If cracked replace manifold.
	Improperly operating turbocharger.	Inspect/replace turbocharger.

SERVICE DIAGNOSIS - PERFORMANCE (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
EXCESSIVE EXHAUST SMOKE (Cont'd)	More than one sealing washer under an injector.	Check and remove extra washer.
	Improperly operating injectors.	Check and replace inoperative injectors.
	Improperly operating or over-fueled injection pump.	Replace injection pump.
	Piston rings not sealing (blue smoke).	Perform blow-by check. Correct as required.
ENGINE WILL NOT SHUT-OFF	Fuel shutoff valve inoperative.	Stop the engine mechanically with lever on the fuel pump. Check/replace sealing washer, piston and spring.
	Engine running on fumes drawn into the air intake.	Check the air intake ducts for the source of the fumes. TO STOP AN ENGINE THAT IS RUNNING ON FUEL SOURCES OTHER THAN THE DIESEL FUEL INJECTION SYSTEM, SPRAY A FIRE EXTINGUISHER INTO THE AIR INTAKE SYSTEM. THE AIR PICKUP IS LOCATED BELOW THE RIGHT HEAD LIGHT (PASSENGER SIDE) BEHIND THE BUMPER.
COOLANT TEMPERATURE ABOVE NORMAL	Low coolant level.	(a) Check coolant level. Add coolant, if necessary. (b) Locate and correct the source of the coolant leak. Refer to troubleshooting logic for coolant loss.
	Incorrect/improperly operating pressure cap.	Replace cap with the correct rating for the system.
	High lube oil level.	Check/drain oil to correct level.
	Loose drive belt on water pump/fan.	Check/replace belt or belt tensioner.
	Inadequate air flow to the radiator.	Check/repair radiator core, fan shroud and fan clutch as required.
	Radiator fins plugged.	Blow debris from fins.
	Collapsed radiator hose.	Replace the hose.
	Improperly operating temperature sensor/gauge.	Verify that the gauge and temperature sensor are accurate. Replace gauge/sensor, if bad.
	Improperly operating, incorrect or no thermostat.	Check and replace the thermostat.
	Air in the cooling system.	(a) Make sure the fill rate is not being exceeded and the correct vented thermostat is installed. (b) Check for loose hose clamps. Tighten if loose. (c) If aeration continued, check for a compression leak through the head gasket.
	Inoperative water pump.	Check and replace the water pump.
	Incorrect injection pump timing.	Verify pump timing marks are aligned. Check/time the injector pump (refer to Group 7, Cooling System).

SERVICE DIAGNOSIS - PERFORMANCE (CONT.)

CONDITION	POSSIBLE CAUSES	CORRECTION
COOLANT TEMPERATURE ABOVE NORMAL (Cont'd)	Overfueled injection pump.	Replace the injection pump.
	Plugged cooling passages in radiator, head, head gasket or block.	Flush the system and fill with clean coolant.
	Engine overloaded.	Verify that the engine load rating is not being exceeded.
COOLANT TEMPERATURE BELOW NORMAL	Too much air flow across the radiator.	Check/repair viscous fan as required.
	Incorrect thermostat, broken thermostat jiggle pin or contamination in thermostat.	Check and replace thermostat.
	Temperature sensor or gauge inoperative.	Verify that the gauge and sensor are accurate. If not, replace gauge/sensor.
	Coolant not flowing by temperature sensor.	Check and clean coolant passages.

J9109-254

INSPECTION (ENGINE OIL LEAKS)

If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Attach an air hose with pressure gauge and regulator to the dipstick tube.

(2) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(3) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(4) After the engine is sealed, set the air pressure regulator NO HIGHER than 27 kPa (4 psi).

(5) Using a liquid soap solution or preferable a stethoscope, inspect all suspected oil leak areas. If an oil leak area is detected, repair per the service manual instructions.

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs. Install the PCV valve and breather cap hose. See step 7 and check for higher pressure leaks occurring during normal engine operation.

(7) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Check the engine for signs of an oil leak. If an oil leak is found, repair per the service manual instructions.

(8) If the leakage occurs at the crankshaft rear oil seal:

(a) Raise the vehicle.

(b) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. A circular spray pattern generally indicates seal leakage. Where leakage tends to run straight down, possible causes are a porous block and the rear cam and galley plugs. See Group 9, Engines (Rear Main Bearing Oil Seals), for the proper seal (and retainer) installation.

(c) If no leaks are detected while the crankcase is pressurized 27 kPa (4 psi), very slowly turn the crankshaft and watch for leakage. If a leak is detected while turning the crankshaft, its possible the crankshaft seal surface is damaged in the seal area, minor nicks or scratches can be polished out with emery cloth.

ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292.

(3) Start engine and record pressure (refer to Oil Pressure in Engine Specifications for the proper pressures).

ENGINE SERVICE PROCEDURES

INDEX

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the electrical connection into the hood. Scribe the hood hinge bolt locations and remove the hood (Fig. 1).

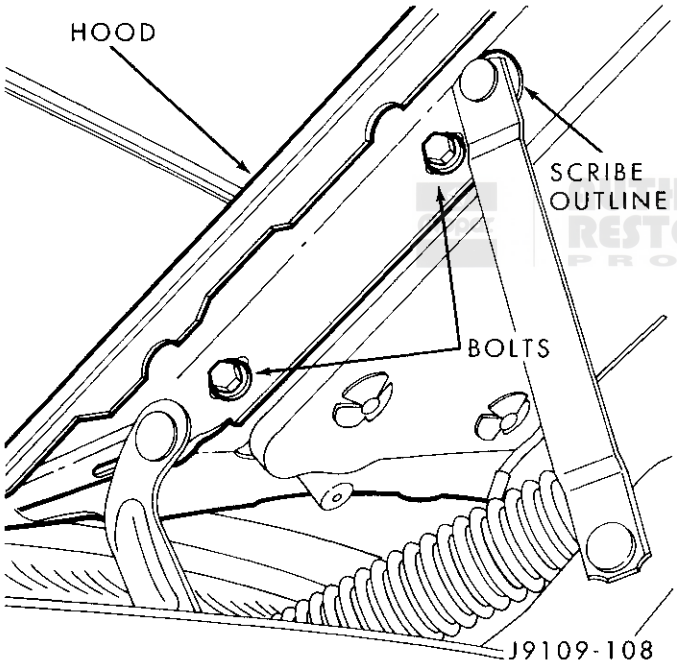


Fig. 1 Scribe Hood Hinge

(2) Disconnect the battery cables and remove the battery.

(3) Drain the coolant from the cooling system (refer to Group 7, Cooling System for the proper procedures). Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(4) Disconnect the radiator hoses. Remove the fan shroud, fan/fan clutch assembly and radiator (refer to Group 7, Cooling Systems for the proper procedures).

(5) Disconnect the heater hoses at the dash panel and at the water valve (Fig. 2).

(6) Disconnect the air inlet tube from the turbocharger (Fig. 3) and the air intake housing. Remove the tube.

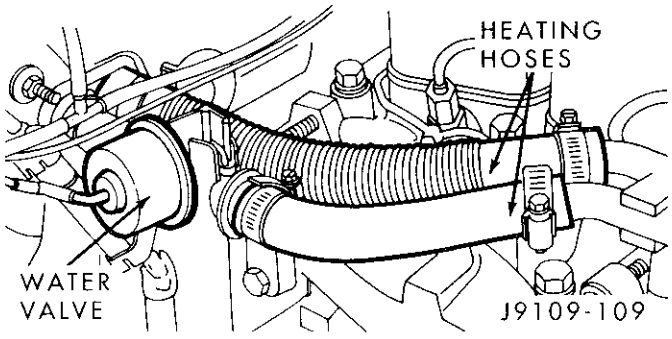


Fig. 2 Heater Hoses

(7) Remove the exhaust pipe from the turbocharger outlet flange (Fig. 3).

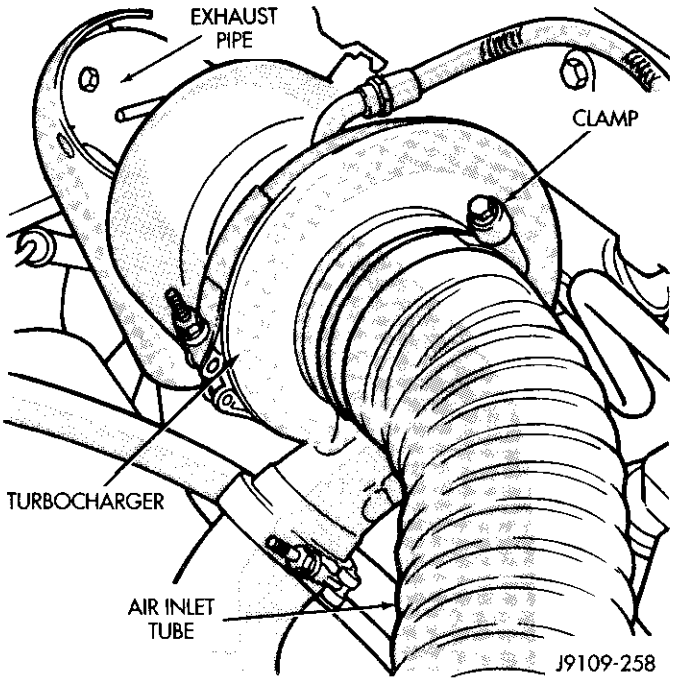


Fig. 3 Air Inlet Tube and Exhaust Pipe Connection

(8) Disconnect the intercooler inlet duct from the turbocharger and the intercooler (Fig. 4). Remove the inlet duct.

(9) Disconnect the intercooler outlet duct from the air inlet housing and the intercooler (Fig. 4). Remove the outlet duct.

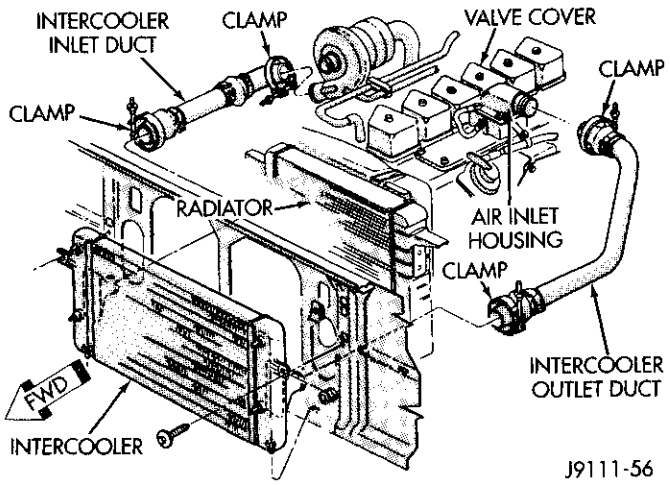


Fig. 4 Intercooler Ducts

(10) Remove the drive belt. Disconnect the alternator ground wire. Remove the alternator and set aside (Fig. 5).

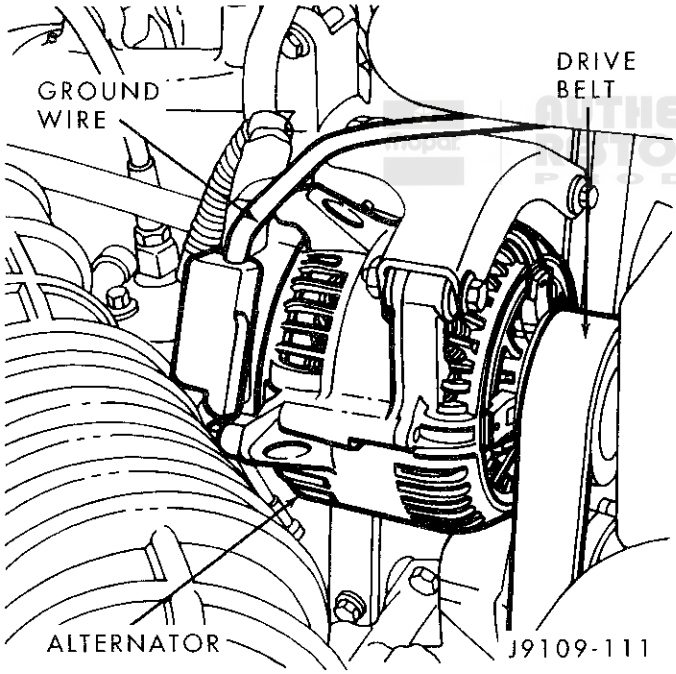


Fig. 5 Alternator Removal

(11) Remove the A/C compressor and set aside. The A/C compressor is located below the alternator.

(12) Disconnect the accelerator linkage, the speed control linkage and the throttle valve linkage (Fig. 6).

(13) Raise and support the vehicle on a hoist.

(14) Drain the engine lubricating oil. Dispose of the oil according to all applicable regulations.

(15) Disconnect the exhaust pipe steady rest clamp and remove.

(16) Disconnect the starter connections (Fig. 7).

(17) Disconnect the transmission cooler lines.

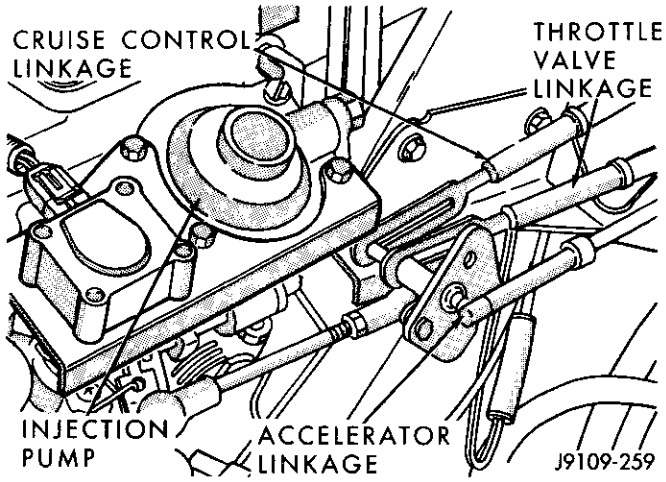


Fig. 6 Accelerator/Speed Control/Throttle Valve Linkage

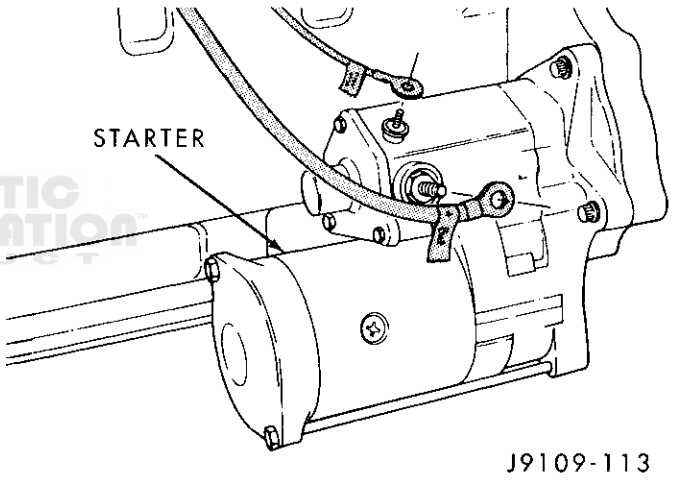


Fig. 7 Starter Connections

(18) **MANUAL TRANSMISSION**—See Group 21, Transmissions for the G360 Manual Transmission Removal procedure.

(19) **AUTOMATIC TRANSMISSION**

(a) Remove torque converter bolt access cover.

(b) Mark torque converter and drive plate for assembly alignment (Fig. 8). Note that bolt holes in crankshaft flange, drive plate and torque converter all have one offset hole.

(c) Rotate crankshaft in clockwise direction until converter bolts are accessible. Then remove bolts one at a time. Rotate crankshaft with socket wrench on damper pulley bolt.

(d) Support the transmission.

(e) Remove bell housing bolts and inspection plate.

(20) Lower the vehicle.

(21) Disconnect the power steering lines.

(22) Disconnect the vacuum pump lines.

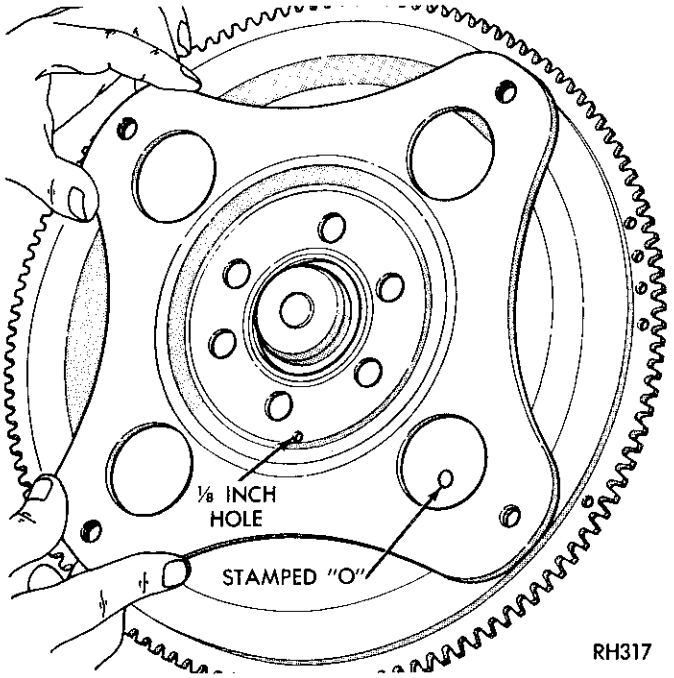


Fig. 8 Marking Converter and Drive Plate for Alignment Reference

(23) Disconnect all electrical connections from the engine. Put tags on the connections to identify their locations.

(24) Disconnect the fuel lines to the lift pump and fuel return. Use tags to identify the lines (Fig. 9).

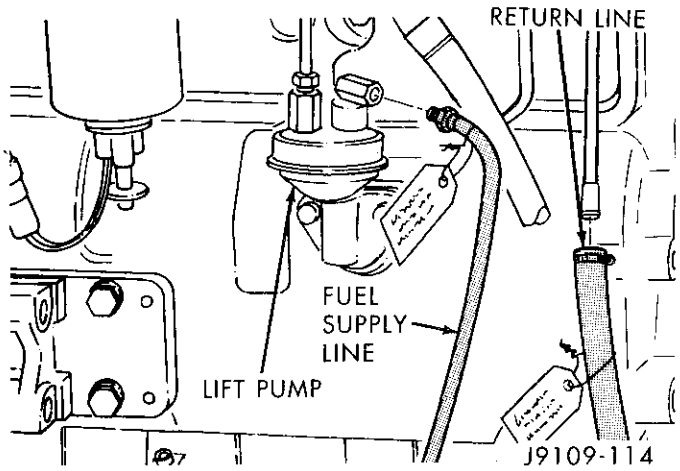


Fig. 9 Lift Pump and Fuel Lines

(25) Put a cover or tape over all engine openings.

(26) Make sure that the lifting brackets are mounted with the eye up. If not, remove the bracket and install in the proper position. Tighten the lifting bracket bolts to 77 N•m (57 ft. lbs.) torque.

(27) Use the lifting brackets to apply tension to the engine. Remove the engine mount through-bolts from the cylinder block mounting bracket.

CAUTION: When removing the engine, take care not to damage the wiper motor and voltage regulator mounted on the dash panel (Fig. 10).

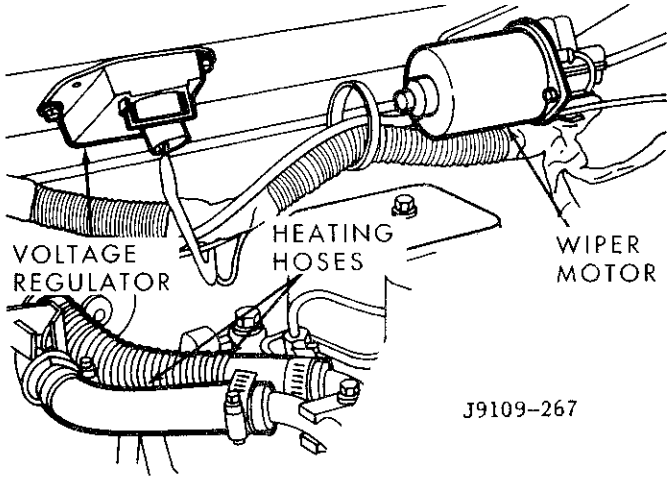


Fig. 10 Wiper Motor/Voltage Regulator

(28) Lift the engine out of the vehicle (Fig. 11).

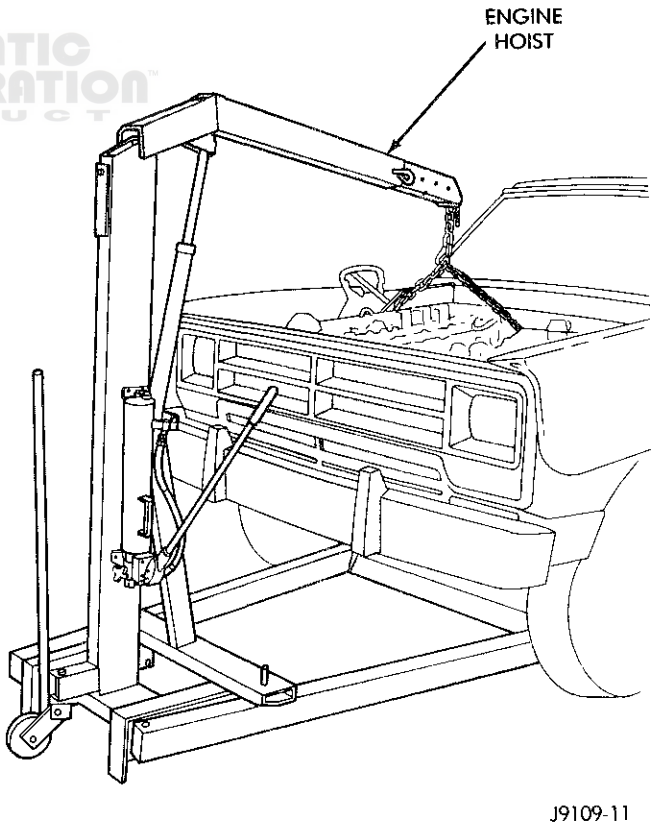


Fig. 11 Lifting Engine from Vehicle

(29) Install the engine on a suitable stand.

(30) Remove all accessories and brackets not previously removed for use with the replacement engine.

INSTALLATION

(1) If removed, install and tighten the rear engine lifting bracket to 77 N•m (57 ft. lbs.) torque. Do not exceed this torque valve.

(2) Check the data plate to verify that the replacement engine is the same model and rating as the engine that was removed.

(3) Install all accessories and brackets that had been removed from the previous engine.

(4) Use the lifting brackets to lift the engine off of the stand.

(5) Position the engine in the chassis and install the through bolt. Tighten the through bolt nut to 41 N•m (30 ft. lbs.) torque.

(6) Remove the covers or tape covering the engine openings.

(7) Connect the fuel lines to the lift pump and fuel return.

(8) Connect all electrical connections.

(9) Connect the power steering lines.

(10) Raise and support the vehicle on a hoist.

(11) **MANUAL TRANSMISSION**—See Group 21, Transmissions for the G360 Manual Transmission Installation procedure.

(12) **AUTOMATIC TRANSMISSION**

CAUTION: If new flex plate is installed, remove flashing from the engine back plate at the 5 and 7 o'clock positions.

(a) Rotate converter until alignment mark on the converter is aligned with mark on drive plate. Offset holes in plate are next to 1/8 inch hole in inner circle of drive plate (Fig. 8).

(b) Install bell housing bolts. Tighten the bolts to 41 N•m (30 ft. lbs.) torque.

(c) With the torque converter plate aligned to the torque converter, install and tighten the bolts to 31 N•m (270 in. lbs.) torque.

(d) Install the converter housing access plate.

(e) Remove the transmission support.

(13) Connect the ground cable and tighten the nut to 22 N•m (16 ft. lbs.) torque. Connect the solenoid cable and tighten the nut to 5 N•m (44 in. lbs.) torque.

(14) Connect the transmission cooler lines.

(15) Install the exhaust pipe to the exhaust system.

(16) Lower the vehicle.

(17) Install the A/C compressor and tighten the bolts to 47 N•m (35 ft. lbs.) torque. If removed, connect the clutch electrical wire.

(18) Install the alternator. Tighten the upper mounting bolts to 24 N•m (18 ft. lbs.) torque. Now tighten the lower mounting bolts to 43 N•m (32 ft. lbs.) torque. Connect all wires.

(19) Install the radiator, fan/fan clutch assembly and fan shroud (refer to Group 7, Cooling Systems for the proper procedures). Connect the radiator hoses.

(20) Position the intercooler inlet duct to the turbocharger and the intercooler (Fig. 4). With the clamps in position, tighten the clamp nut to 8 N•m (72 in. lbs.) torque.

(21) Position the intercooler outlet duct to the air inlet housing and the intercooler (Fig. 4). With the clamps in position, tighten the clamp nut to 8 N•m (72 in. lbs.) torque.

(22) Connect the air intake tube to the turbocharger inlet flange and the air cleaner housing. Tighten the clamps to 8 N•m (72 in. lbs.) torque.

(23) Install the exhaust pipe to the turbocharger. Tighten the steady rest clamp to 8 N•m (72 in. lbs.) torque.

(24) Make sure the air intake and exhaust pipe connections are tight and free of leaks.

(25) Fill the engine with the required amount of clean engine lubricating oil (see Group 0, Lubrication and Maintenance).

(26) Fill the cooling system with a mixture of 50% water and 50% ethylene-glycol base antifreeze (refer Group 7, Cooling System for the proper procedure).

(27) Install the battery and connect the battery cables.

(28) Check the oil level after the engine has run for 2 or 3 minutes. Oil held in the oil filter and oil passages will cause the oil level in the pan to be lower.

(29) Operate the engine at idle for 5 to 10 minutes and check for leaks and loose parts.

ROCKER LEVERS/PUSH RODS

REMOVAL

(1) Remove the valve covers (Fig. 1).

(2) Loosen the adjusting screw locknuts. Loosen the adjusting screws until they stop (Fig. 2).

(3) Remove the bolts from the rocker lever pedestals. Remove the pedestals and rocker lever assemblies (Fig. 2).

(4) Remove the push rods.

DISASSEMBLE—ROCKER LEVERS

(1) Remove the retaining rings and thrust washers (Fig. 2).

(2) Remove the rocker levers (Fig. 2). Do not disassemble the rocker lever shaft and pedestal. The pedestal and shaft must be replaced as an assembly.

(3) Remove the locknut and adjusting screw (Fig. 2).

(4) Clean all parts in a strong solution of laundry detergent in hot water.

(5) Use compressed air to dry the parts after rinsing in clean hot water. The pedestals are made from

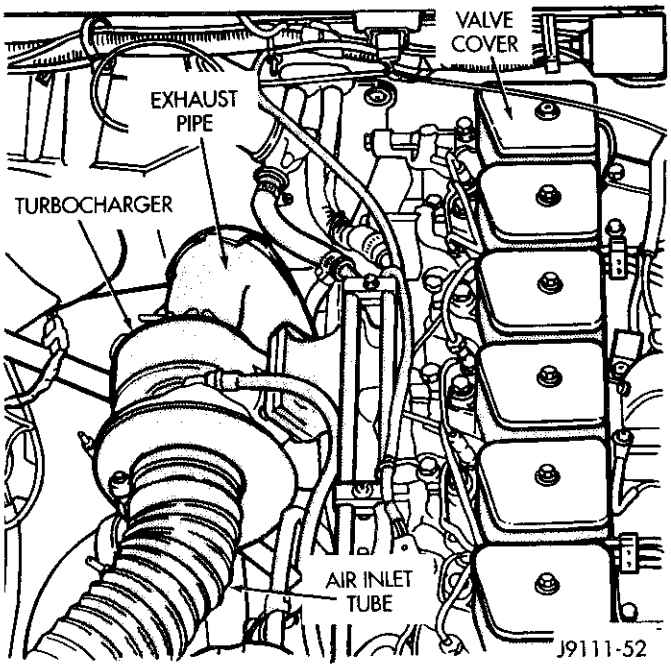


Fig. 1 Valve Covers

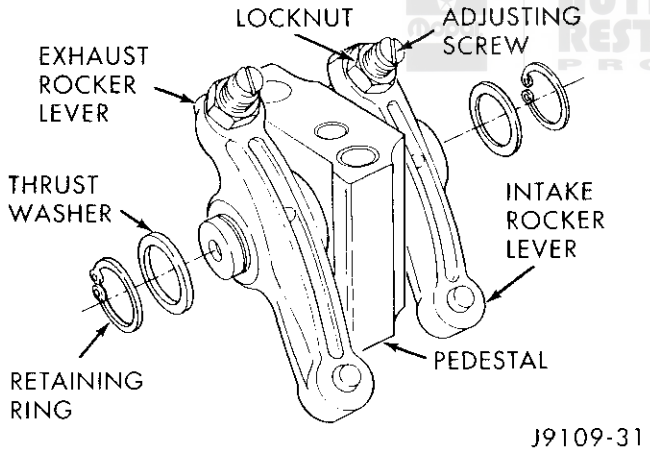


Fig. 2 Location of Rocker Lever Components

powdered metal and may continue to show wetness after they have been cleaned and dried.

(6) Inspect for excessive wear in the bore and the contact surface for the valve stem.

(7) Measure the rocker lever bore diameter. The maximum diameter is 19.05 mm (0.75 inch). Replace if out of limits.

(8) Inspect the pedestal and shaft.

(9) Measure the shaft diameter. The minimum diameter is 18.94 mm (0.746 inch). Replace if out of limits.

ASSEMBLE—ROCKER LEVERS

(1) Install the adjusting screw and locknut.

(2) Lubricate the shaft with clean engine oil. Be sure to assemble the intake and exhaust rocker levers in the correct location.

(3) Position the levers on the rocker shaft. Install the thrust washers.

(4) Clean the push rods in the hot soapy water.

(5) Inspect the push rod ball and socket for signs of scoring or cracks where the ball and the socket are pressed into the tube.

(6) Check the push rods for roundness and straightness.

(7) Install the push rods into the sockets of the valve tappets. Lubricate the push rod sockets with clean engine oil.

(8) Make sure the rocker lever adjusting screws are completely backed out.

INSTALLATION

(1) Make sure the dowel rings in the pedestals are installed into the dowel bores in the cylinder head.

(2) If the push rod is holding the pedestal off of the cylinder head, bar the engine until the pedestal will set on the head surface without interference.

(3) Use clean engine oil to lubricate the cylinder head bolt threads and under the bolt heads.

(4) Install the long bolts (12 mm) into the rocker lever pedestals. Tighten the bolts as follows:

- Step 1—Tighten the bolts, in sequence (Fig. 3), to 90 N•m (66 ft. lbs.) torque. Check the torque. If lower than 90 N•m (66 ft. lbs.), tighten to this torque.
- Step 2—Tighten the bolts, in sequence (Fig. 3), to 120 N•m (89 ft. lbs.) torque. Check the torque. If lower than 120 N•m (89 ft. lbs.), tighten to this torque.
- Step 3—Tighten the bolts, in sequence (Fig. 3), an additional 90°.

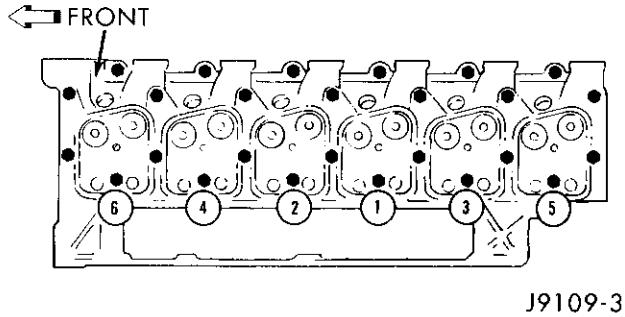


Fig. 3 Rocker Lever (Head Bolts) Tightening Sequence

(5) Tighten the 8 mm bolts to 24 N•m (18 ft. lbs.) torque.

(6) Install the valve cover. Tighten the valve cover bolt to 24 N•m (18 ft. lbs.) torque.

CYLINDER HEAD

The cylinder heads on the 1991½ engine are a new design and can not be interchanged with earlier models.

REMOVAL

(1) Drain the coolant. Do not waste reusable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(2) Drain the engine oil. Dispose of the used oil properly.

(3) Disconnect the radiator and heater hoses (refer to Group 7, Cooling System).

(4) Remove the turbocharger (Fig. 1).

(5) Remove the exhaust manifold (Fig. 4).

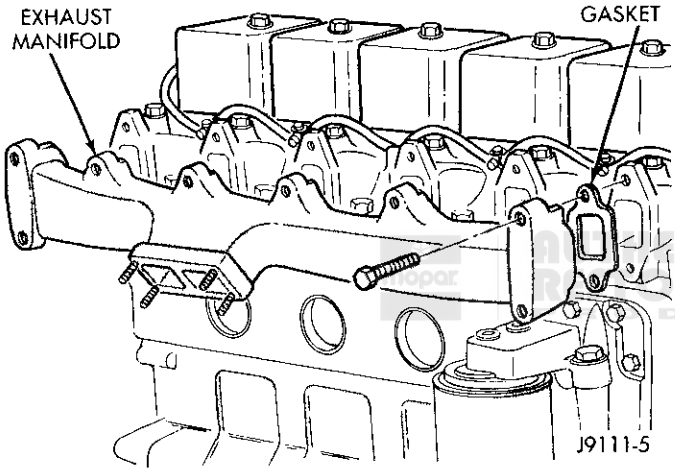


Fig. 4 Exhaust Manifold

(6) Remove the fuel lines and injector nozzles (refer to Group 14, Fuel System).

(7) Remove the valve covers (Fig. 5).

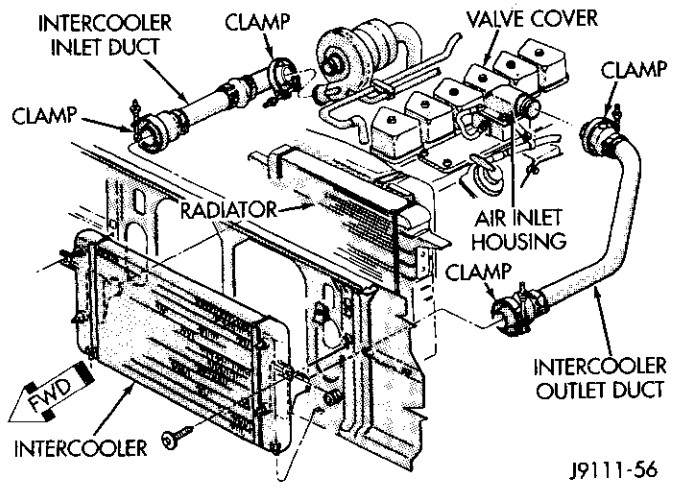


Fig. 5 Valve Cover

(8) Remove the rocker levers and push rods.

(9) Remove the fuel/water separator filter (Fig. 6). Refer to Group 14, Fuel System, for the proper procedures.

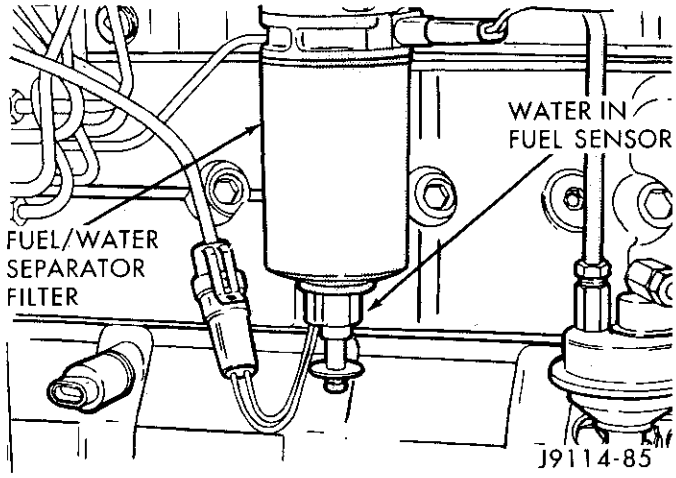


Fig. 6 Fuel/Water Separator Filter

(10) If the engine is hot, remove the cylinder head bolts in the sequence shown in Fig. 7. The removal sequence is not important if the engine is cold. There are 3 sizes of head bolts. Note the position of each bolt for future installation.

(11) Remove the cylinder head and gasket from the cylinder block.

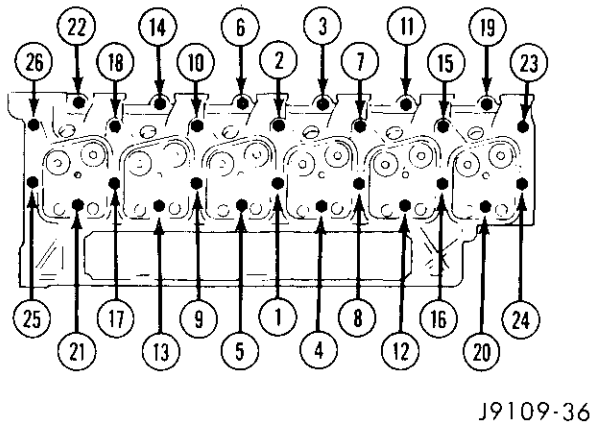


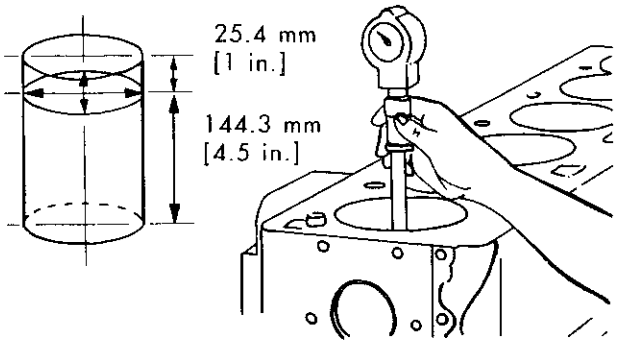
Fig. 7 Cylinder Head Bolt Removal Sequence—Cylinder Head Hot

INSPECTION

Remove the cup plugs and inspect the coolant passages. A large build up of rust and lime will require removal of the cylinder block for cleaning in a hot tank.

Inspect the cylinder bores for damage or excessive wear. Rotate the crankshaft so the piston is at Bottom Dead Center (BDC) to inspect the bores.

Measure the cylinder bores (Fig. 8). Do not proceed with in-chassis repair if the bores are damaged or worn beyond the limits (refer to Cylinder Bore Repair - Cylinder Block).



MIN.	102.0 mm	(4.0157 inch)
MAX.	102.116 mm	(4.0203 inch)
Out-of-Round	0.038 mm	(0.0015 inch)
Taper	0.76 mm	(0.003 inch)
Oversize pistons and rings are available for bored cylinder blocks.		

J9109-75

Fig. 8 Cylinder Bore Diameter

Check the top surface for damage caused by the cylinder head gasket leaking between cylinders.

Inspect the block and head surface for nicks, erosion, etc.

Check the head distortion (Fig. 9). The distortion of the combustion deck face is not to exceed 0.010 mm (0.0004 inch) in any 50.8 mm (2.00 inch) diameter. Overall variation end to end or side to side 0.30 mm (0.012 inch).

Do not proceed with the in-chassis overhaul if the cylinder head or block surface is damaged or not flat (within specifications).

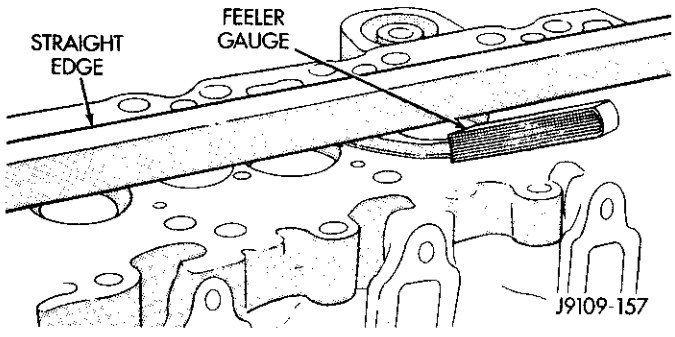


Fig. 9 Cylinder Head Combustion Deck Face Measurement

REFACING HEAD SURFACE

The cylinder head combustion deck may be refaced in whatever increments necessary to clean up the surface and maintain the surface finish and flatness tolerances. The combined total of stock removed must not exceed 1.00 mm (0.03937 inch). The amount of stock removed each time must be steel stamped just above the edge of the combustion deck on the lower right hand corner of the rear face (Fig. 10). Check valve protrusion after head surface refacing.

Surface finish requirements are 1.5-3.2 micrometers (60-126 microinch).

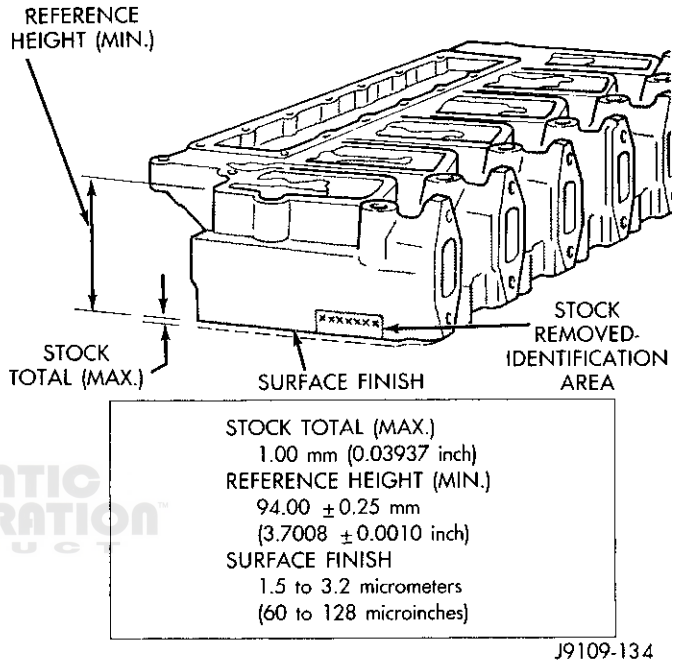


Fig. 10 Cylinder Head Stock Removal

CLEANING

Clean the carbon from the injector nozzle seat with a nylon or brass brush.

Scrape the gasket residue from all gasket surfaces.

Wash the cylinder head in hot soapy water solution (88°C or 140°F).

After rinsing, use compressed air to dry the cylinder head.

Polish the gasket surface with 400 grid paper. Use an orbital sander or sanding block to maintain a flat surface.

INSTALLATION

(1) The cylinder block and head must be clean and dry.

(2) Position the gasket onto the dowels (Fig. 11). Make sure the gasket is correctly aligned with the holes in the cylinder block.

(3) Carefully put the cylinder head onto the gasket and cylinder block. Make sure the cylinder head is installed onto the dowels in the cylinder block (Fig. 11).

(4) Install the push rods and rocker levers.

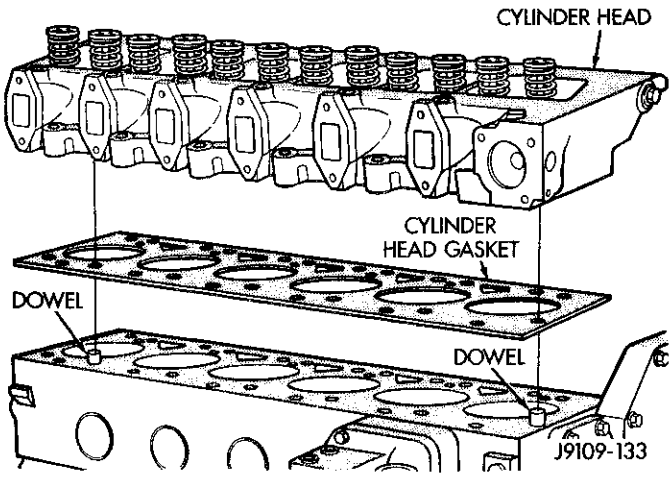


Fig. 11 Cylinder Head/Gasket Alignment

(5) Use clean engine oil to lubricate the cylinder head bolt threads and under the bolt heads.

(6) The cylinder head bolts are 3 different sizes. Install the bolts in the proper hole. Tighten the bolts as follows:

- Step 1—Tighten all bolts, in sequence (Fig. 12), to 90 N•m (66 ft. lbs.) torque. Check the torque. If lower than 90 N•m (66 ft. lbs.), tighten to this torque.
- Step 2—Tighten all 12 mm bolts, in sequence (Fig. 12), to 120 N•m (89 ft. lbs.) torque. Check the torque. If lower than 120 N•m (89 ft. lbs.), tighten to this torque.
- Step 3—Tighten all bolts, in sequence (Fig. 12), an additional 90°.

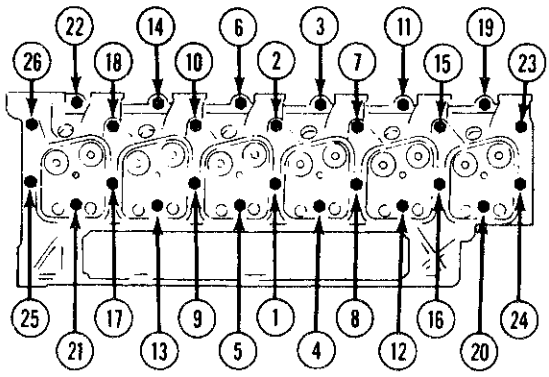


Fig. 12 Cylinder Head Tightening Sequence

(7) Be sure to lubricate the push rod sockets with clean engine oil.

(8) Install the rocker lever pedestal bolts and tighten to 24 N•m (18 ft. lbs.) torque.

(9) Adjust the valve clearance.

(10) Install the valve covers. Tighten the bolts to 24 N•m (18 ft. lbs.) torque.

(11) Install the injector nozzles and fuel lines (refer to Group 14, Fuel System).

(12) Install the fuel filter (refer to Group 14, Fuel System for the proper procedures).

(13) Install the exhaust manifold (refer to Group 11, Exhaust System and Intake Manifold).

(14) Install the turbocharger.

(15) Connect the radiator and heater hoses.

(16) Fill the engine with new coolant or the clean drained coolant (refer to Group 7, Cooling System for the proper procedure).

(17) Fill the engine with clean lubricating oil (refer to Group 0, Lubrication and Maintenance).

PISTON/CONNECTING ROD ASSEMBLY

The turbocharged intercooler piston has a Ni-Resist insert with a keystone profile for the top compression ring. The new piston has a new design bowl and a 7 mm longer piston pin. The 1991½ pistons can not be interchanged with earlier models.

PISTON COOLING NOZZLES

The piston cooling nozzles (Fig. 13) on the 1991½ engine are a new design with increased flow capabilities. The 1991½ piston cooling nozzles can not be interchanged with earlier models.

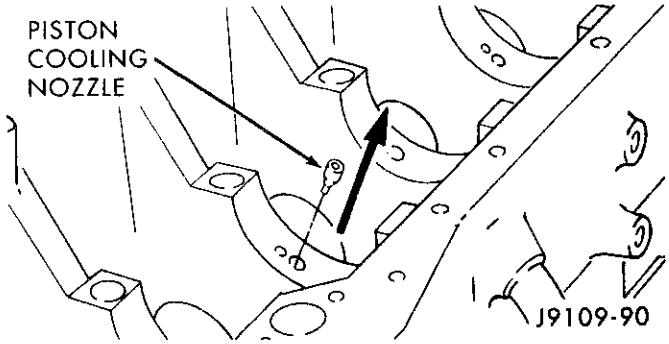


Fig. 13 Piston Cooling Nozzles

OIL PUMP

The 1991½ oil pump can be used on earlier model engines. However, earlier oil pumps can not be used on 1991½ engines.

OIL PRESSURE REGULATOR VALVE/SPRING

When oil pressure from the oil pump exceeds 448 kPa (65 psi), the regulator valve opens to allow oil to drain back into the pan.

OIL COOLER ELEMENT/GASKET

The 1991½ filter head/cooler assembly can be interchanged with earlier models. However, earlier model filter head/coolers can not be used on 1991½ engines.

SPECIFICATIONS—5.9L DIESEL ENGINES

ENGINE SPECIFICATIONS

VALVE TRAIN		
Valve Clearance		
Intake	0.25 mm	(0.010 inch)
Exhaust	0.51 mm	(0.020 inch)
Valve Guide Diameter		
Minimum	8.019 mm	(0.3157 inch)
Maximum	8.089 mm	(0.3185 inch)
Valve Stem Diameter		
Minimum	7.935 mm	(0.3126 inch)
Maximum	7.960 mm	(0.3134 inch)
Valve Seat Angle		
Intake Valve	30°	
Exhaust Valve	45°	
Valve Depth (Installed)		
Minimum	0.99 mm	(0.039 inch)
Maximum	1.52 mm	(0.060 inch)
Valve Spring		
Free Standing Length	55.63 mm	(2.19 inch)
Inclination (Max.)	1.00 mm	(0.039 inch)
Minimum Load	49.25 mm	(1.94 inch)
	289.32 N	(65 lbs.)
Valve Rim Thickness (Min.)	0.79 mm	(0.031 inch)
Valve Seat Width		
Minimum	1.50 mm	(0.060 inch)
Maximum	2.00 mm	(0.080 inch)
CYLINDER HEAD		
Cylinder Head Flatness		
Max. Overall	0.030 mm	(0.012 inch)
Max. Variation within 0.01 mm (0.0004 inch) in any 50.8 mm (2.0 inch) diameter area.		
GEAR TRAIN		
Gear Backlash (all gears)	0.08-0.33 mm	(0.003-0.013 inch)
Camshaft End Clearance	0.152-0.254 mm	(0.006-0.010 inch)
CAMSHAFT		
Journal Diameter (Min.)	53.962 mm	(2.1245 inch)
Valve Lobes (Min. Diameter at Peak of Lobe)		
Intake	47.040 mm	(1.852 inch)
Exhaust	46.770 mm	(1.841 inch)
Lift Pump Lobe (Min. Diameter at Peak of Lobe)	35.50 mm	(1.398 inch)
TAPPETS		
Stem Diameter (Min.)	15.925 mm	(0.627 inch)
ROCKER LEVER		
Rocker Lever Bore (Max.)	19.05 mm	(0.75 inch)
Shaft Diameter (Min.)	18.94 mm	(0.746 inch)
CYLINDER BORES		
Cylinder Bore Diameter (Max.)	102.116 mm	(4.0203 inch)
Out of Round (Max.)	0.038 mm	(0.0015 inch)
Taper (Max.)	0.076 mm	(0.003 inch)
CONNECTING ROD		
Pin Bore Diameter (Max.)	40.053 mm	(1.5769 inch)
Side Clearance	0.10-0.30 mm	(0.004-0.012 inch)

J9109-246

ENGINE SPECIFICATIONS (CONT.)

PISTONS		
Skirt Diameter (Min.)		
Nominal	101.880 mm	(4.0110 inch)
Worn Limits	101.823 mm	(4.0088 inch)
Pin Bore Diameter (Max.)	40.025 mm	(1.5758 inch)
Ring Groove (Max.)		
Intermediate Groove	0.15 mm	(0.006 inch)
Oil Control Groove	0.13 mm	(0.005 inch)
Piston Pin Diameter (Min.)	39.99 mm	(1.5744 inch)
Ring End Gap		
Top Ring	0.40-0.70 mm	(0.016-0.0275 inch)
Intermediate Ring	0.25-0.55 mm	(0.010-0.0215 inch)
Oil Control Ring	0.25-0.55 mm	(0.010-0.0215 inch)
CRANKSHAFT		
Main Bearing Journal Diameter		
Standard	82.962 mm	(3.2662 inch)
Machined 0.25 mm	82.712 mm	(3.2564 inch)
Machined 0.50 mm	82.462 mm	(3.2465 inch)
Machined 0.75 mm	82.212 mm	(3.2367 inch)
Machined 1.00 mm	81.962 mm	(3.2269 inch)
Out of Round (Max.)	0.050 mm	(0.002 inch)
Taper (Max.)	0.013 mm	(0.0005 inch)
Oil Clearance (Max.)	0.119 mm	(0.0047 inch)
End Clearance	0.13-0.30 mm	(0.005-0.012 inch)
Connecting Rod Journal		
Standard	68.962 mm	(2.7150 inch)
Machined 0.25 mm	68.712 mm	(2.7052 inch)
Machined 0.50 mm	68.462 mm	(2.6954 inch)
Machined 0.75 mm	68.212 mm	(2.6855 inch)
Machined 1.00 mm	67.962 mm	(2.6757 inch)
Out of Round (Max.)	0.050 mm	(0.002 inch)
Taper (Max.)	0.013 mm	(0.0005 inch)
Oil Clearance (Max.)	0.089 mm	(0.0035 inch)
CYLINDER BLOCK		
Top Surface Flatness		
(Max. Overall Variation)	0.075 mm	(0.003 inch)
Max. Variation any 50 mm		
(2 inch) Diameter Area	0.010 mm	(0.0004 inch)
Refacing Combustion Deck		
First Reface	0.15 mm	(0.0058 inch)
Second Reface	0.35 mm	(0.0138 inch)
Total	0.50 mm	(0.0197 inch)
Surface Finish	1.5-3.2 micrometers	(60-126 microinch)
Main Bearing Bore Diameter (Max.)		
with bearing installed	83.106 mm	(3.2719 inch)
Camshaft Bore Diameter (Max.)		
#1 w/o Bushing	57.258 mm	(2.2543 inch)
#1 with Bushing	54.133 mm	(2.1312 inch)
#2 thru #7	54.133 mm	(2.1312 inch)
Tappet Bore Diameter (Max.)	16.055 mm	(0.632 inch)
OIL PUMP		
Tip Clearance (Max.)	0.1778 mm	(0.007 inch)
Gerotor Drive/Planetary to Port Plate Clearance (Max.)	0.127 mm	(0.005 inch)
Gerotor Planetary to Body Bore Clearance (Max.)	0.381 mm	(0.015 inch)
Gear Backlash (Used Pump)	0.08-0.38 mm	(0.003-0.015 inch)

TORQUE SPECIFICATIONS

COMPONENT	TORQUE	
Air Fuel Control Banjo Screw (In Pump)	12 N•m	9 ft. lbs.
Air Fuel Control Fitting (In Head)	8 N•m	6 ft. lbs.
Alternator Ground Cable Mounting to Block	24 N•m	18 ft. lbs.
Alternator Mounting to Water Pump Inlet	41 N•m	30 ft. lbs.
Alternator Pulley	80 N•m	60 ft. lbs.
Alternator Support (Upper)	24 N•m	18 ft. lbs.
Battery Cable (Negative) Mounting to Block	77 N•m	57 ft. lbs.
Belt Tensioner Mounting	43 N•m	32 ft. lbs.
Block Heater Mounting	12 N•m	9 ft. lbs.
Cab Heater Hose Clamp	4 N•m	(35 in. lbs.)
Cab Heater Tubing Clamp Mounting	24 N•m	18 ft. lbs.
Camshaft Thrust Plate	24 N•m	18 ft. lbs.
Clutch Cover Mounting to Flywheel	23 N•m	17 ft. lbs.
Connecting Rod (Alternately tighten in 3 steps)		
Step 1	35 N•m	26 ft. lbs.
Step 2	70 N•m	51 ft. lbs.
Step 3	100 N•m	73 ft. lbs.
Cooling Fan Mounting to Fan Clutch	20 N•m	15 ft. lbs.
Crossover Clamp (Air)	5 N•m	(44 in. lbs.)
Cylinder Head Mounting Bolts		
1. All Bolts	90 N•m	66 ft. lbs.
2. Long Bolts	120 N•m	89 ft. lbs.
3. Tighten All Bolts An Additional		90°
Exhaust Manifold	43 N•m	32 ft. lbs.
Exhaust Outlet Pipe - V Band Clamp	8 N•m	(72 in. lbs.)
Exhaust Pipe Clamp Mounting	27 N•m	20 ft. lbs.
Exhaust Pipe Steady Rest Mounting to Trans	68 N•m	50 ft. lbs.
Fan Clutch Mounting/Fan Hub (L Hand Threads)	57 N•m	42 ft. lbs.
Fan Hub Bracket Mounting	24 N•m	18 ft. lbs.
Fan Hub Bearing Retaining Capscrew	77 N•m	57 ft. lbs.
Fan Pulley to Fan Hub	9 N•m	7 ft. lbs.
Fan Pulley Crankshaft	9 N•m	7 ft. lbs.
Fan Shroud Mounting Nuts	11 N•m	(95 in. lbs.)
Flywheel Bolts	137 N•m	101 ft. lbs.
Flywheel Housing - Adaptor	60 N•m	44 ft. lbs.
Front Engine Mount Isolator Mounting to Mount	109 N•m	80 ft. lbs.
Front Engine Mount Through Bolt	41 N•m	30 ft. lbs.
Front Engine Mount to Block	60 N•m	44 ft. lbs.
Front Oil Filler Pipe - Access Cover		Hand Tighten
Fuel Banjo Screw (In Fuel Pump)	32 N•m	24 ft. lbs.
Fuel Banjo Screw (In Head)	24 N•m	18 ft. lbs.
Fuel Banjo Screw (In Injector)	8 N•m	6 ft. lbs.
Fuel Filter		½ Turn after contact
Fuel Heater Assembly Mounting	32 N•m	24 ft. lbs.
Fuel Heater Ground Mounting to Intake Manifold	12 N•m	9 ft. lbs.
Fuel Link Fitting (High Pressure)	24 N•m	18 ft. lbs.
Fuel Low Pressure Supply	24 N•m	18 ft. lbs.
Fuel Pump Drive Gear (With Pump Unlocked)	65 N•m	48 ft. lbs.
Fuel Pump Lock (Bosch)	30 N•m	22 ft. lbs.

J9109-261

TORQUE SPECIFICATIONS (CONT.)

COMPONENT		TORQUE	
Fuel Pump Mounting Nut		24 N•m	18 ft. lbs.
Fuel Pump Solenoid		43 N•m	32 ft. lbs.
Fuel Pump Support Bracket		24 N•m	18 ft. lbs.
Fuel Pump Unlock (Bosch)		13 N•m	10 ft. lbs.
Fuel Vent Screw (In Banjo)		8 N•m	6 ft. lbs.
Gear Cover		24 N•m	18 ft. lbs.
Gear Housing-to-Block		24 N•m	18 ft. lbs.
Injector Retaining Nut		60 N•m	44 ft. lbs.
Intake Manifold Cover		24 N•m	18 ft. lbs.
Intercooler Attaching Bolts		2 N•m	(17 in. lbs.)
Intercooler Duct Clamp Nuts		8 N•m	(72 in. lbs.)
Lift Pump Mounting		24 N•m	18 ft. lbs.
Lifting Bracket (Rear)		77 N•m	57 ft. lbs.
Main Bearing Cap Bolts	Step 1	60 N•m	45 ft. lbs.
	Step 2	119 N•m	88 ft. lbs.
	Step 3	176 N•m	129 ft. lbs.
Oil Cooler Assembly		24 N•m	18 ft. lbs.
Oil Fill Tube Bracket		43 N•m	32 ft. lbs.
Oil Filter		¾ Turn after contact	
Oil Pan Drain Plug		80 N•m	60 ft. lbs.
Oil Pan Mounting		24 N•m	18 ft. lbs.
Oil Pressure Regulator Plug		80 N•m	60 ft. lbs.
Oil Pressure Sender/Switch		16 N•m	12 ft. lbs.
Oil Pump Mounting		24 N•m	18 ft. lbs.
Oil Suction Tube (Flange)		24 N•m	18 ft. lbs.
Oil Suction Tube Brace		24 N•m	18 ft. lbs.
Power Steering Pump to Vacuum Pump Mounting		24 N•m	18 ft. lbs.
Radiator Hose Clamp - Upper		4 N•m	(35 in. lbs.)
Radiator Mounting Nuts		11 N•m	(95 in. lbs.)
Rear Seal Mounting		9 N•m	7 ft. lbs.
Refrigerant Compressor Lines - Flange Mounting		20 N•m	15 ft. lbs.
Refrigerant Compressor Mounting		47 N•m	35 ft. lbs.
Rocker Lever Nut		24 N•m	18 ft. lbs.
Rocker Support		24 N•m	18 ft. lbs.
Starter Mounting		43 N•m	32 ft. lbs.
Starter Battery (Positive) Cable Nut		22 N•m	16 ft. lbs.
Starter Solenoid Nut		5 N•m	(44 in. lbs.)
Tappet Cover/Fuel Drain Line Supports		24 N•m	18 ft. lbs.
Thermistor		24 N•m	18 ft. lbs.
Thermostat Housing		24 N•m	18 ft. lbs.
Throttle Bracket Mounting to Mounting Bracket		24 N•m	18 ft. lbs.
Throttle Rod Mounting to Throttle Lever Nut		10 N•m	7.5 ft. lbs.
Timing Pin Flange Mounting		5 N•m	(44 in. lbs.)
Torque Converter Access Cover Plate Mounting		4 N•m	(35 in. lbs.)
Transfer Case Linkage Bracket Mounting/Trans		41 N•m	30 ft. lbs.
Transfer Case Mounting to Transmission		47 N•m	35 ft. lbs.

TORQUE SPECIFICATIONS (CONT.)

COMPONENT	TORQUE	
Trans Cooler Tubing Mounting to Oil Pan Flange	24 N•m	18 ft. lbs.
Trans Kickdown Cable Bracket Mounting/Trans	68 N•m	50 ft. lbs.
Trans Mount Mounting to Trans (Manual)	68 N•m	50 ft. lbs.
Trans Mount Through Bolt Mounting (Manual)	68 N•m	50 ft. lbs.
Transmission Mounting to Engine	41 N•m	30 ft. lbs.
Transmission Oil Cooler Line Connection	54 N•m	40 ft. lbs.
Transmission Oil Cooler Line Flange	6 N•m	(50 in. lbs.)
Transmission Oil to Air Cooler Hose Clamps	2 N•m	(18 in. lbs.)
Transmission to Clutch Housing Mounting	47 N•m	35 ft. lbs.
Transmission Torque Converter Mounting	47 N•m	35 ft. lbs.
Turbine Housing	11 N•m	8 ft. lbs.
Turbo Compressor Housing Clamp	8.5 N•m	(75 in. lbs.)
Turbo Mounting Nut	32 N•m	24 ft. lbs.
Turbo Oil Drain Tube	24 N•m	18 ft. lbs.
Turbo Oil Supply (Both Ends)	15 N•m	11 ft. lbs.
Vacuum Pump Mounting	9 N•m	7 ft. lbs.
Vacuum Pump to Gear Housing Mounting	77 N•m	57 ft. lbs.
Valve Cover	24 N•m	18 ft. lbs.
Vibration Damper Mounting	125 N•m	92 ft. lbs.
Water Hose Clamps	4 N•m	(35 in. lbs.)
Water Inlet Connection	43 N•m	32 ft. lbs.
Water Pump Mounting	24 N•m	18 ft. lbs.
Water Temperature Sensor	50 N•m	37 ft. lbs.

J9109-263

EXHAUST SYSTEM AND INTAKE MANIFOLD

CONTENTS

SERVICE PROCEDURES (DIESEL ENGINES)

INDEX

EXHAUST MANIFOLD

REMOVAL

(1) Disconnect the air intake and exhaust pipes (Fig. 1).

(2) Disconnect the turbocharger oil supply line and the oil drain tube from the turbocharger (Fig. 2).

(3) Disconnect the intercooler inlet duct from the turbocharger (Fig. 2).

(4) Remove the turbocharger and gasket.

(5) Remove the cab heater supply and return lines.

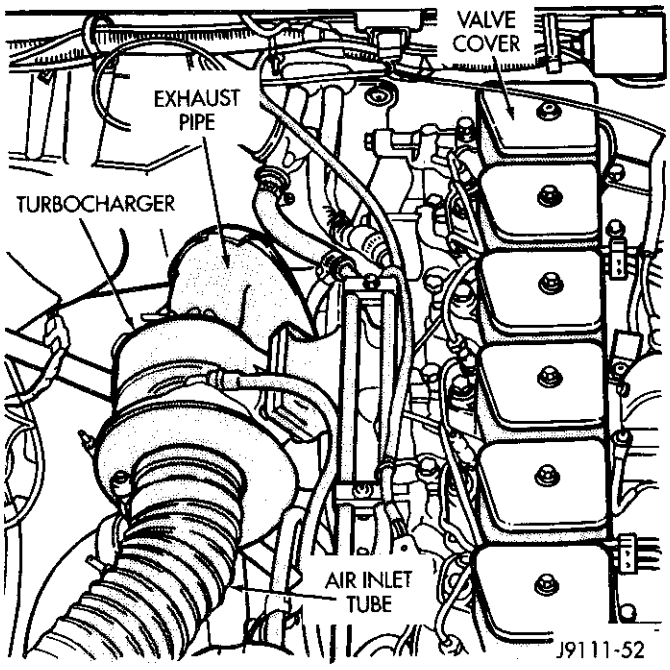


Fig. 1 Air Intake Pipe, Exhaust Pipe and Turbocharger

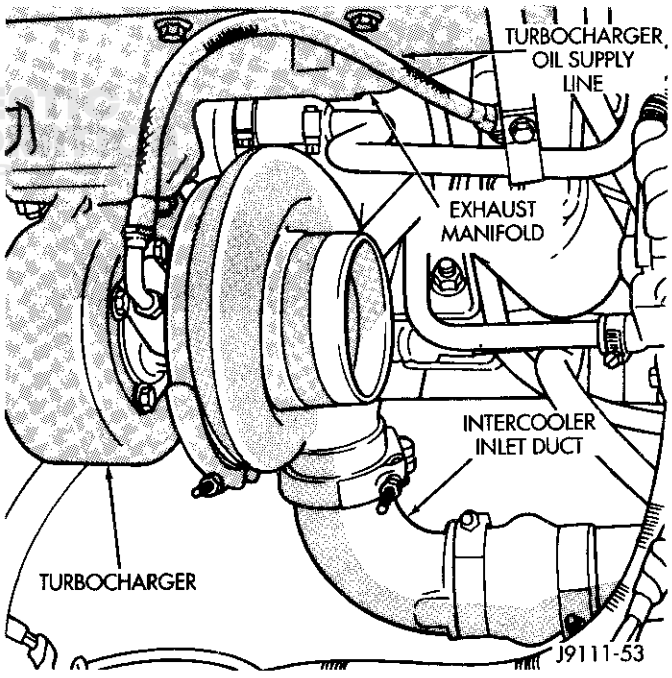


Fig. 2 Oil Supply Line and Intercooler Inlet Duct

(6) Remove the exhaust manifold and gaskets (Fig. 3).

(7) Clean the sealing surfaces.

INSTALLATION

(1) Install the exhaust manifold and gaskets (Fig. 3). Tighten the exhaust manifold bolts in sequence to 43 N•m (32 ft. lbs.) torque (Fig. 4).

(2) Install the turbocharger (Fig. 2). Tighten the turbocharger mounting nuts to 32 N•m (24 ft. lbs.) torque.

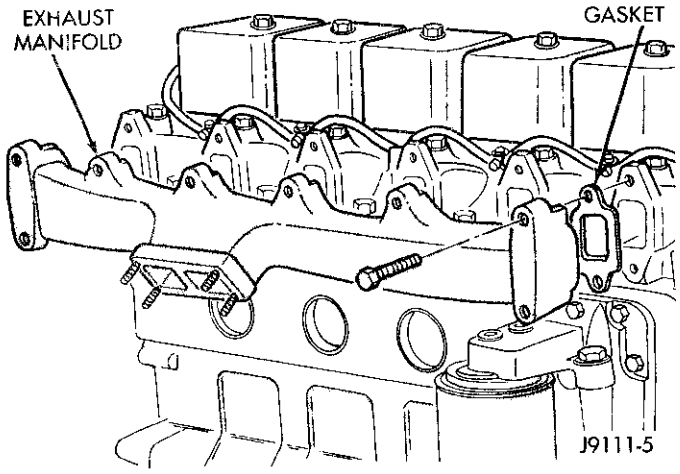


Fig. 3 Exhaust Manifold and Gaskets

(3) Position the intercooler inlet duct to the turbocharger (Fig. 2). With the clamp in position, tighten the clamp nut to 8 N•m (72 in. lbs.) torque.

(4) Position the air intake pipe and the exhaust pipe onto the turbocharger (Fig. 1). Tighten the clamps to 8 N•m (72 in. lbs.) torque.

(5) Install the oil drain tube and oil supply line to the turbocharger (Fig. 2). Tighten the drain tube bolts to 24 N•m (18 ft. lbs.) torque. Tighten the oil supply line fitting nut to 15 N•m (11 ft. lbs.) torque.

(6) Connect the cab heater supply and return lines. Tighten the line nuts to 24 N•m (18 ft. lbs.) torque.

(7) Operate the engine to check for leaks.

INTAKE MANIFOLD COVER/AIR INTAKE HEATER

REMOVAL

(1) Remove the intercooler outlet duct from the air inlet tube (Fig. 5).

(2) Remove the high pressure fuel lines.

(3) Disconnect and remove the air intake heater ground wire (Fig. 5).

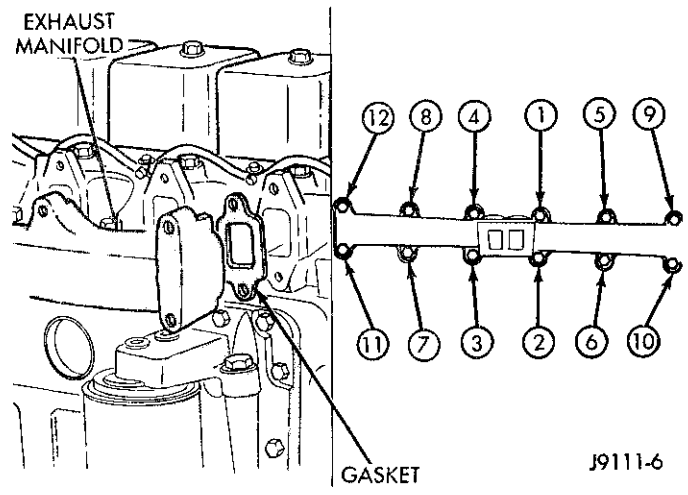


Fig. 4 Exhaust Manifold Bolt Tightening Sequence

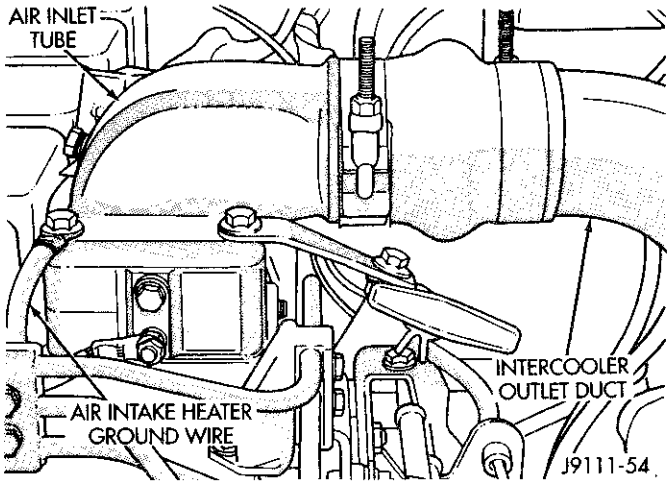


Fig. 5 Air Inlet Tube and Heater Ground Wire

(4) Disconnect the air intake heater power supply lines (Fig. 6). Remove the air intake heater and gaskets (Fig. 6). Clean the mounting surface of the intake manifold cover.

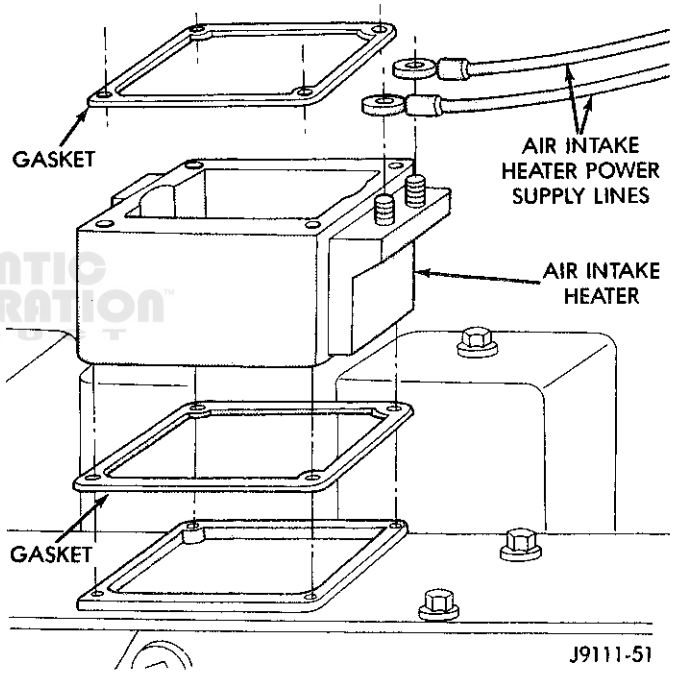


Fig. 6 Air Intake Heater

(5) Disconnect the charge air temperature sensor from the intake manifold cover (Fig. 7).

(6) Disconnect the air temperature switch from the intake manifold cover (Fig. 7).

(7) Disconnect the fuel heater ground wire from intake manifold cover (Fig. 8).

(8) Remove the manifold intake cover and gasket (Fig. 8). Keep the gasket material and any other material out of the air intake.

(9) Clean the sealing surface.

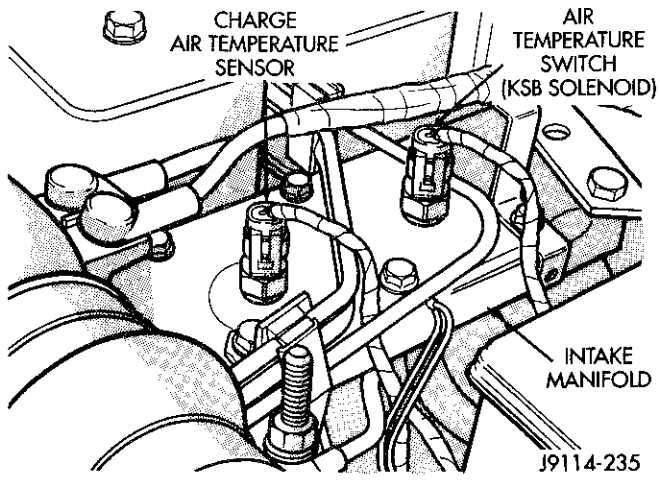


Fig. 7 Charge Air Temperature Sensor and Air Temperature Switch

INSTALLATION

(1) Using a new gasket, install the intake manifold cover (Fig. 8).

(2) Install the fuel heater ground wire (Fig. 8). Tighten the bolt to 12 N•m (110 in. lbs.) torque.

(3) Connect the air temperature switch to the intake manifold cover (Fig. 7).

(4) Connect the charge air temperature sensor to the intake manifold cover (Fig. 7).

(5) Some of the intake manifold bolt holes are drilled through and must be sealed. Apply liquid teflon sealant to the bolts. Install the intake manifold cover bolts. Tighten the bolts to 24 N•m (18 ft. lbs.) torque.

(6) Install a new gasket between the air intake heater and the intake manifold cover (Fig. 6). Install a new gasket on top of the air intake heater (Fig. 6).

(7) Install the air inlet tube (Fig. 5). Tighten the air inlet tube bolts to 24 N•m (18 ft. lbs.) torque.

(8) Connect the intake manifold heater ground wire (Fig. 5).

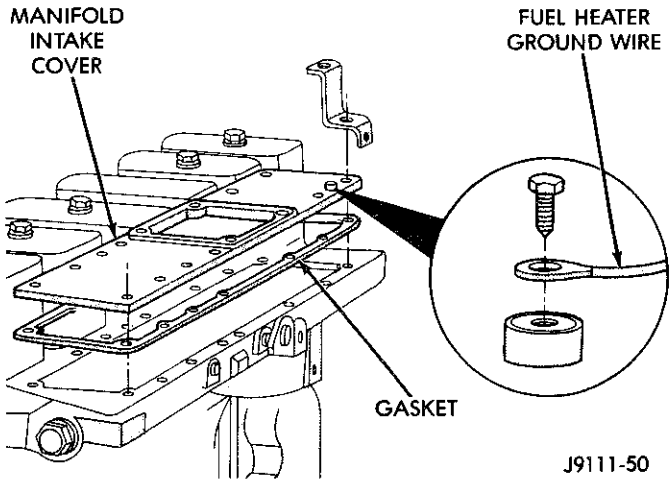


Fig. 8 Manifold Intake Cover and Fuel Heater Ground Wire

(9) Install and tighten the air intake heater power supply nuts to 14 N•m (10 ft. lbs.) torque.

(10) Position the intercooler outlet duct onto the air inlet tube (Fig. 5). Tighten the intercooler outlet duct clamps to 8 N•m (72 in. lbs.) torque.

(11) Install and bleed the high pressure fuel lines. Tighten the high pressure fuel line nuts to 24 N•m (18 ft. lbs.) torque.

TURBOCHARGER

REMOVAL

(1) Disconnect the battery negative cables.

(2) Disconnect the air intake pipe and exhaust pipe (Fig. 9).

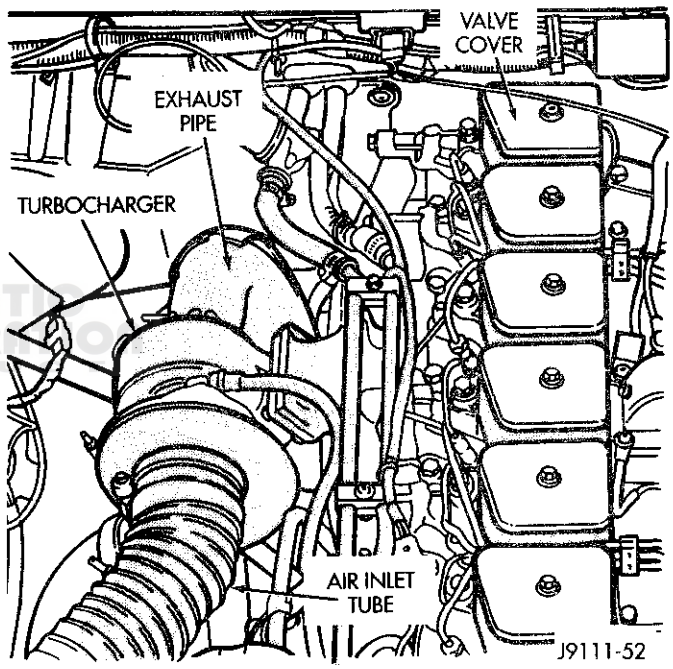


Fig. 9 Air Intake Pipe, Exhaust Pipe and Turbocharger

(3) Remove the oil drain tube bolts.

(4) Remove the oil supply line (Fig. 10).

(5) Disconnect the intercooler inlet duct from the turbocharger (Fig. 10).

(6) Remove the turbocharger mounting nuts and the turbocharger.

(7) If the turbocharger is not to be installed immediately, cover the opening to prevent material from falling into the manifold.

(8) Clean and inspect the sealing surface.

DISASSEMBLY

(1) Scribe the housing so they can be assembled in the same position.

(2) Clamp the turbocharger in a bench vise.

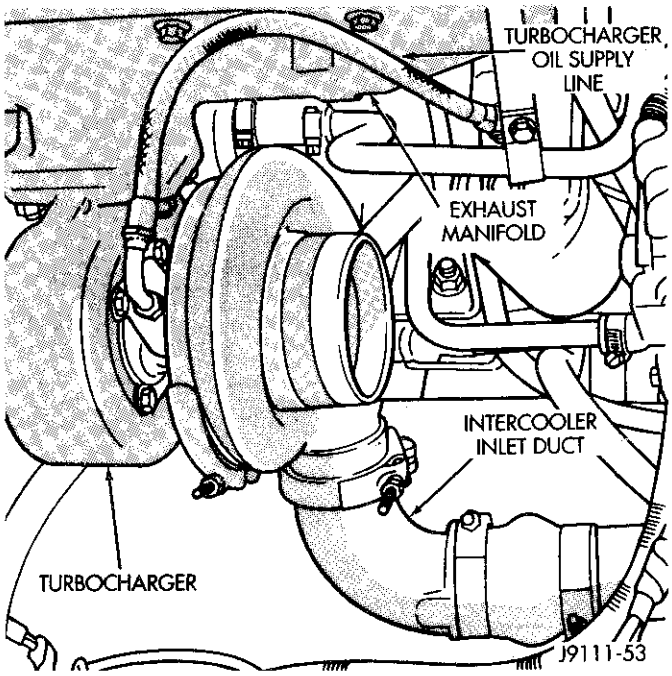


Fig. 10 Oil Supply Line and Intercooler Inlet Duct

(3) Remove the compressor housing V-Band clamps (Fig. 11).

(4) Remove the compressor housing and inspect for impeller contact (Fig. 11).

(5) Remove the square cut O-ring (Fig. 11).

(6) Remove the impeller nut (Fig. 11). Turn the impeller nut to the right to loosen. The nut and shaft have left hand threads.

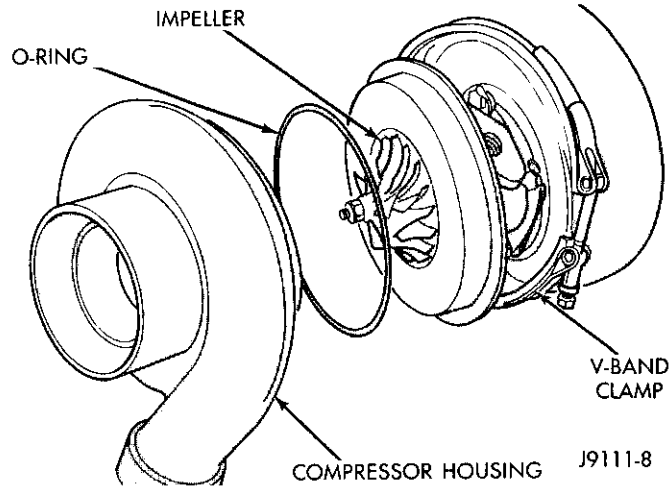


Fig. 11 Compressor Housing and Impeller

(7) Remove the impeller and inspect the blades for damage. The wheel and shaft assembly is balanced as a unit. If the impeller is damaged the complete assembly must be replaced.

(8) Remove the diffuser bolts and lockplate (Fig. 12).

(9) Remove the diffuser and discard the O-ring (Fig. 13).

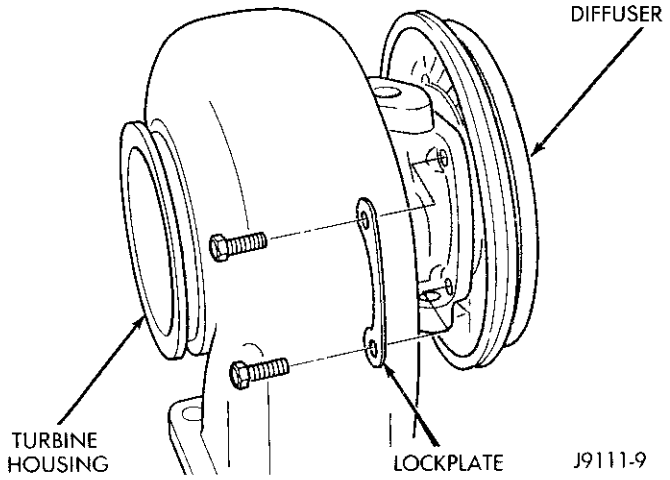


Fig. 12 Diffuser and Lockplate

(10) Remove the oil slinger and discard the piston ring (Fig. 13).

(11) Inspect for cracks and excessive wear.

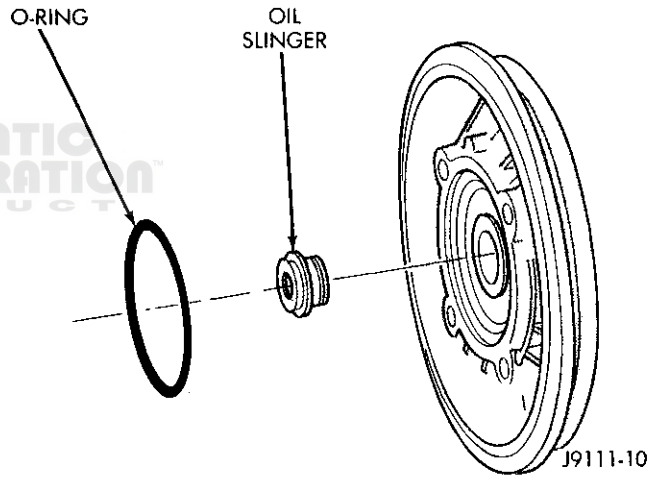


Fig. 13 Diffuser, O-Ring and Oil Slinger

(12) Remove the oil baffle (Fig. 14).

(13) Remove the thrust bearing and retainer screws (Fig. 14). Do not reuse the thrust bearing.

(14) Remove the thrust collar (Fig. 14).

(15) Inspect the collar for excessive wear.

(16) Remove the turbine housing lock plates and clamp plates (Fig. 15).

(17) Remove the bearing housing (Fig. 15).

(18) Remove the turbine shaft and heat shield (Fig. 16).

(19) Inspect the turbine blades and the shaft for excessive wear.

(20) Remove and discard the piston ring type seal (Fig. 16).

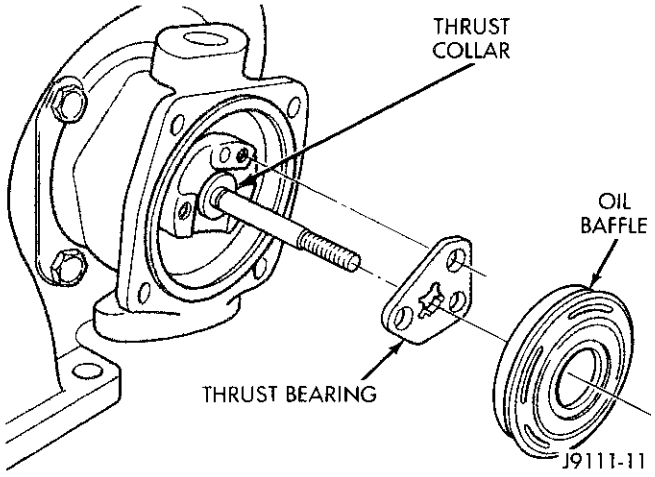


Fig. 14 Oil Baffle, Thrust Bearing and Collar

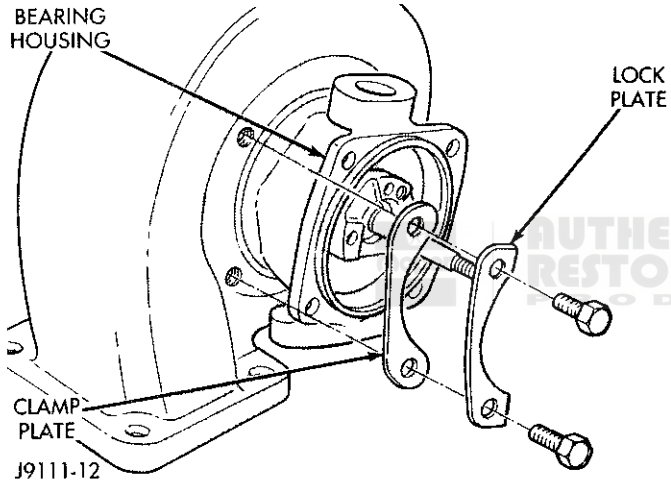


Fig. 15 Turbine Housing Lock Plates and Clamp Plates

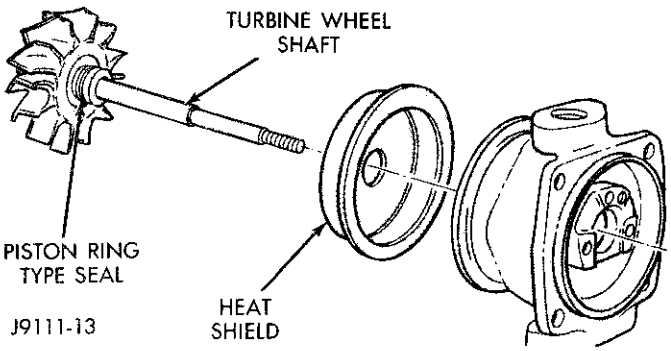


Fig. 16 Turbine Wheel Shaft and Heat Shield

CAUTION: The wheel and shaft assembly is balanced as a unit. If the turbine blades or shaft are damaged, the complete assembly must be replaced.

(21) Remove and discard the outer retainer rings (Fig. 17).

(22) Remove and discard the turbocharger shaft bearings (Fig. 17).

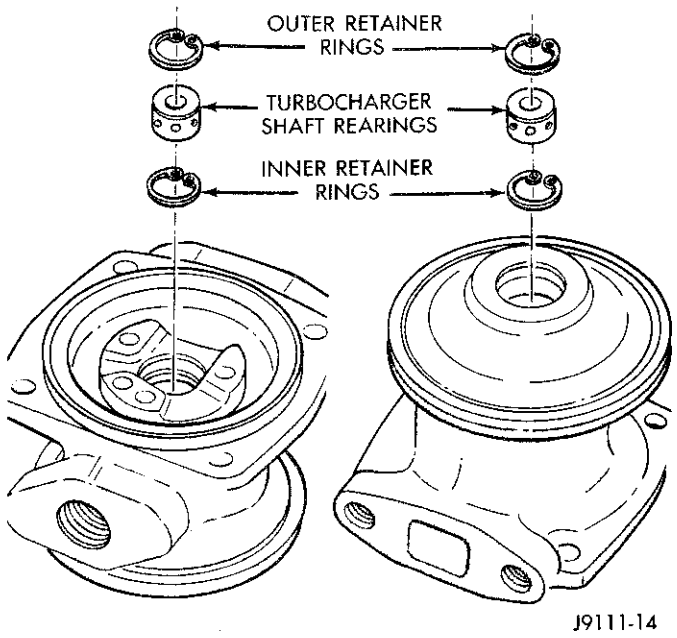


Fig. 17 Snap Rings and Shaft Bearing

(23) Remove and discard the inner snap rings (Fig. 17).

CLEANING

Use a stiff bristle nylon brush and solvent to clean all parts. Do not use a wire brush on the compressor wheel. Do not bead blast the parts.

Remove the carbon build up from the housing with a scraper and a 240 grit emery cloth.

Polish the bearing surfaces with crocus and kerosene or diesel fuel.

After rinsing in clean solvent, use compressed air to dry the parts.

INSPECTION

In addition to the inspection specified during disassembly, inspect all parts after cleaning.

Measure the shaft bearing diameter (Fig. 18). The minimum diameter should be 10.97 mm (0.432 inch).

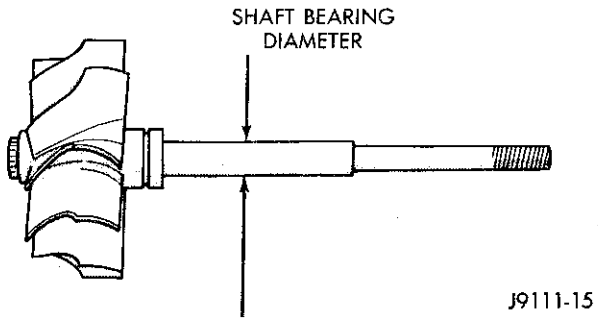


Fig. 18 Shaft Bearing Diameter

ASSEMBLE

The balance marks must be aligned to make sure the wheel and shaft assembly is balanced.

(1) Install the piston ring and lubricate the groove with engine oil.

(2) Install the heat shield (Fig. 19).

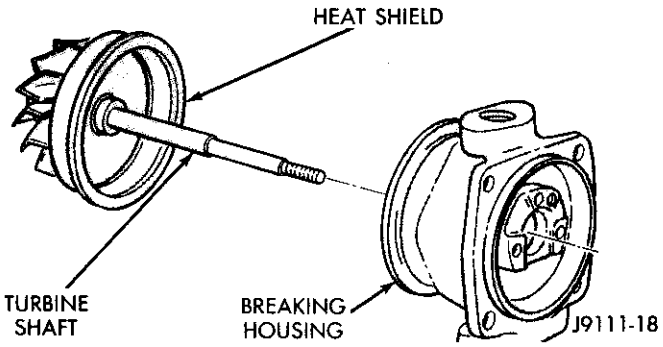


Fig. 19 Turbine Shaft/Heat Shield to Bearing Housing

(3) Clamp a socket in a soft jawed vice and position the shaft in the socket.

(4) Install the inner retainer rings. The beveled face must be towards the bearing (Fig. 20).

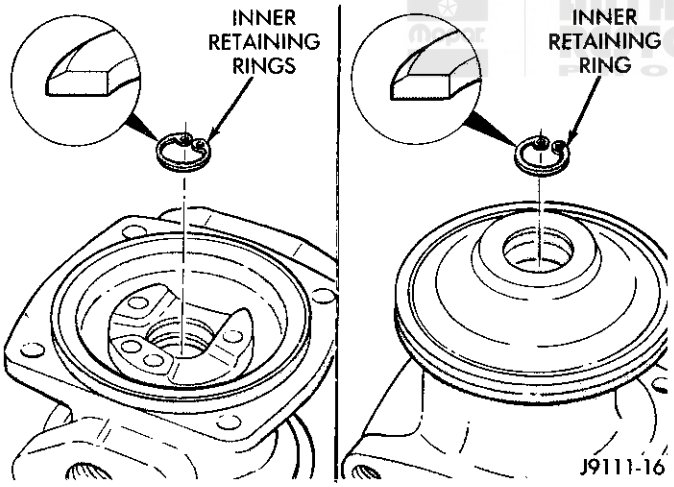


Fig. 20 Beveled Face of Inner Retainer Ring

(5) Lubricate the turbocharger bearing with engine oil and install the bearings in the housing.

(6) Install the outer retainer ring. The beveled face must be towards the bearings (Fig. 21).

(7) Assemble the turbine shaft and heat shield to the bearing housing (Fig. 19). Rotating the housing as you press downward will assist in properly seating the piston ring.

(8) Install the thrust collar. Align the balance mark with the balance mark on the shaft. Mark the top surface with a marker pen so alignment can be verified after installing the thrust bearing.

(9) Lubricate the thrust bearing with engine oil and install it on the housing. Tighten the torx bolts to 4.5 N•m (40 in. lbs.) torque.

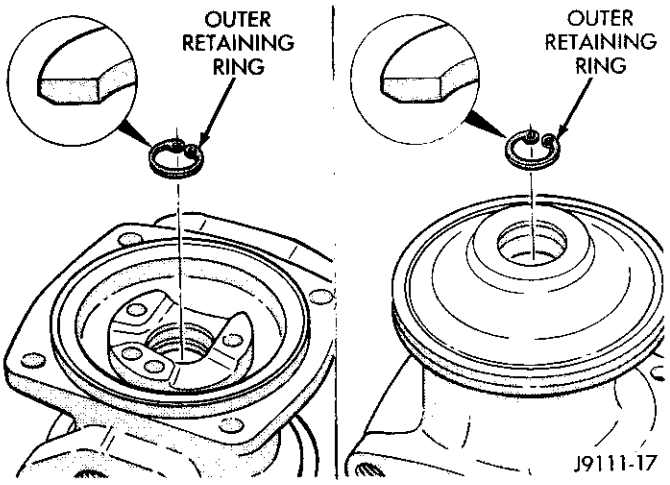


Fig. 21 Beveled Face of Outer Retainer Ring

(10) Install the oil baffle. Check the balance mark alignment.

(11) Install the piston ring type seal on the oil slinger (Fig. 22).

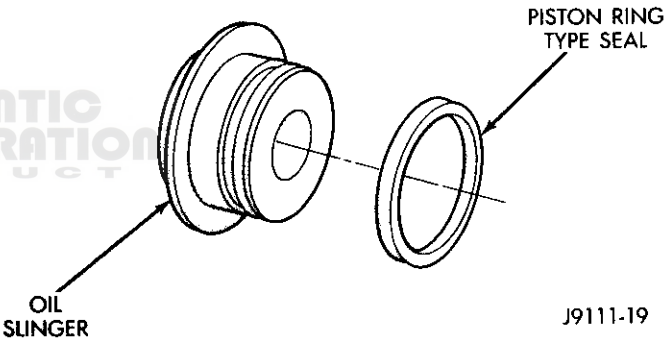


Fig. 22 Piston Ring Type Seal

(12) Mark the top surface of the oil slinger line with the balance mark.

(13) Lubricate the oil slinger with engine oil and install it into the diffuser.

(14) Install the O-ring into the diffuser.

(15) Install the diffuser. Align the balance marks on the shaft and the oil slinger (Fig. 23).

(16) Align the balance mark and install the impeller (Fig. 24). Be careful not to move the bearing housing.

(17) Do not allow the impeller to turn when installing the nut. The impeller nut and the shaft have LEFT hand threads. Tighten the nut to 14 N•m (129 in. lbs.) torque.

(18) Install the bearing housing assembly into the turbine housing (Fig. 25).

(19) Align the scribe marks (Fig. 25).

(20) Apply anti-seize compound to the bolt threads.

(21) Install the clamp plates, lock plates and bolts (Fig. 26). Tighten the bolts to 11.3 N•m (100 in. lbs.) torque.

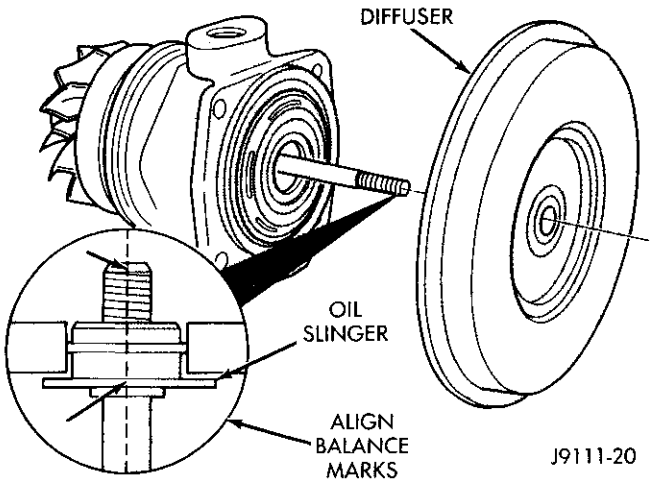


Fig. 23 Align Balance Marks—Shaft and Oil Slinger

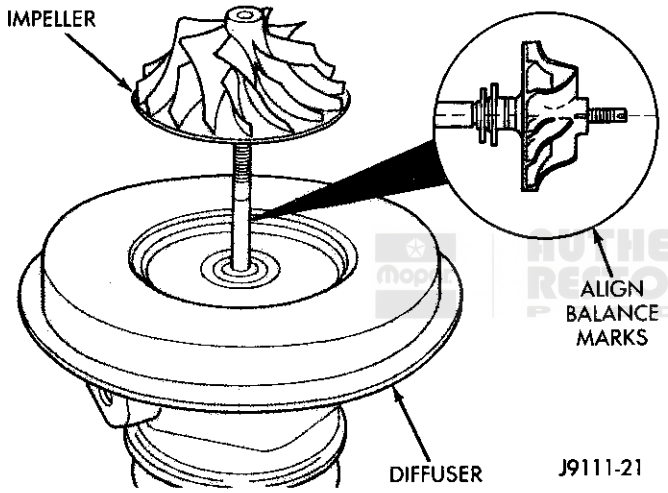


Fig. 24 Align Balance Marks—Impeller

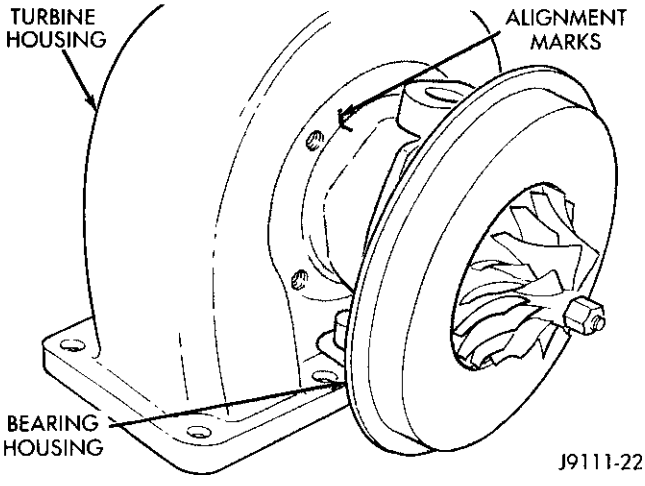


Fig. 25 Bearing Housing Assembly/Turbine Housing

(22) Install the lock plates and bolts into the diffuser (Fig. 27).

(23) After tightening the bolts to 5.7 N•m (50 in. lbs.) torque, bend the lockplate tabs to lock the bolts. Be sure the scribe marks are aligned.

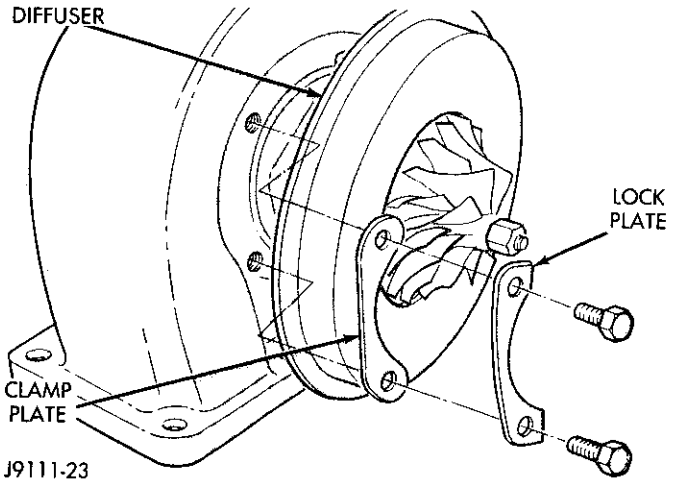


Fig. 26 Install Clamp Plates/Lock Plates

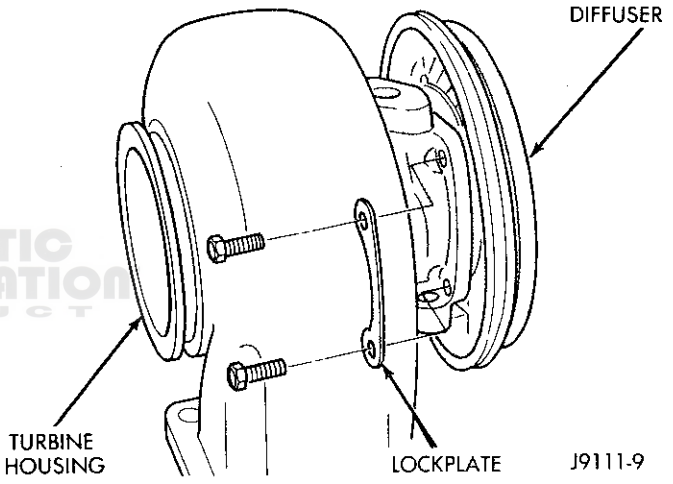


Fig. 27 Diffuser and Lockplate

(24) Measure the end play (Fig. 28). For turbocharger with a serial number before 840638 the end play should be 0.102-0.152 mm (0.004-0.006 inch). For turbocharger with a serial number of 840638 and after the end play should be 0.026-0.076 mm (0.001-0.003 inch).

(25) Measure radial clearance of the shaft (Fig. 28). The clearance should be 0.300-0.460 mm (0.012-0.018 inch).

(26) Install the square cut O-ring.

(27) Be sure the scribe marks are aligned. Install the compressor housing and V-Band clamp. Apply anti-seize compound to the V-Band bolt threads. Tighten the clamp to 8 N•m (72 in. lbs.) torque. Tap against the clamp on 4 places around its circumference. Again tighten the clamp to 8 N•m (72 in. lbs.) torque.

INSTALLATION

(1) Install a new gasket and apply anti-seize compound to the mounting studs.

(2) Install the turbocharger. Tighten the turbocharger mounting nuts to 32 N•m (24 ft. lbs.) torque.

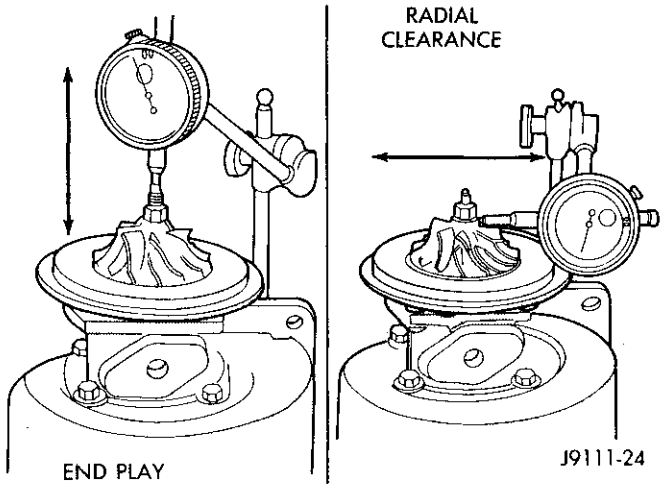


Fig. 28 End Play/Radial Clearance of Shaft

(3) Use a new gasket and connect the drain line. Tighten the drain line connection bolts to 24 N•m (18 ft. lbs.) torque.

(4) New turbocharger must be pre-lubricated with clean engine lubricating oil before start up. Pour 50-60 cc (2-3 ounces) of oil into supply fitting.

WARNING: DO NOT USE YOUR FINGER TO TURN THE TURBINE WHEEL.

(5) Rotate the turbine wheel to allow oil to enter the turbocharger.

(6) Install the oil supply line. Tighten the oil supply line fitting nut to 15 N•m (11 ft. lbs.) torque.

(7) Position the intercooler inlet duct to the turbocharger. With the clamp in position, tighten the clamp nut to 8 N•m (72 in. lbs.) torque.

(8) Position the air intake pipe and the exhaust pipe onto the turbocharger. Tighten the clamps to 8 N•m (72 in. lbs.) torque.

(9) Operate the engine and check for leaks.

INTERCOOLER

Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressurized air from the turbocharger then flows forward through the intercooler located in front of the radiator. From the intercooler the air flows back into the intake manifold.

The intercooler is a heat exchanger that uses air flow to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases engine efficiency and power.

REMOVAL

WARNING: IF THE ENGINE WAS JUST TURNED OFF, THE INTAKE AND OUTLET DUCTS MAY BE HOT.

(1) Remove the grille (see Group 23, Body for the proper procedure).

(2) Remove the front support bracket (Fig. 29).

(3) If the vehicle is equipped with air conditioning, remove the condenser as follows:

(a) Discharge the air conditioning system (see Group 24, Heating and Air Conditioning for the proper procedures).

(b) Remove the bolt from the sealing plate (Fig. 29).

(c) Remove the nuts holding the condenser to the intercooler (Fig. 29). Lift the condenser and sealing plate assembly away from the intercooler.

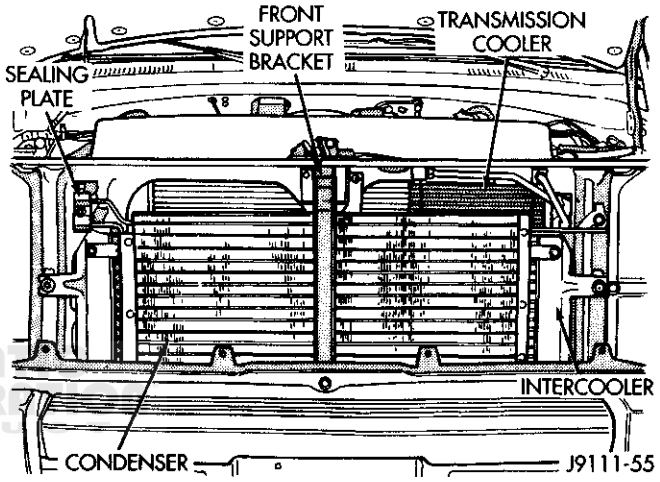


Fig. 29 Condenser and Intercooler

(4) Remove the inlet and outlet ducts from the intercooler (Fig. 30).

(5) Remove the intercooler bolts (Fig. 29). Pivot the intercooler forward and up to remove.

INSTALLATION

(1) Position the intercooler (Fig. 29). Install the bolts and tighten to 2 N•m (17 in. lbs.) torque.

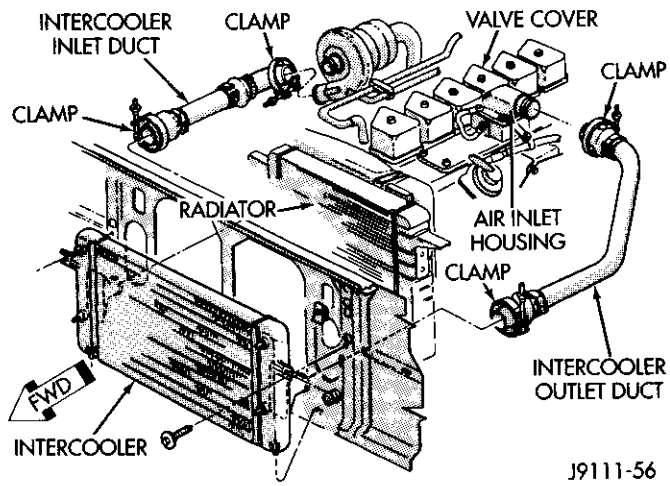


Fig. 30 Intercooler Ducts

(2) Install the inlet and outlet ducts to the intercooler (Fig. 30). With the clamps in position, tighten the clamp nut to 8 N•m (72 in. lbs.) torque.

(3) If the vehicle is equipped with air conditioning, install the condenser as follows:

(a) Position the condenser and sealing plate assembly onto the intercooler studs (Fig. 29). Install the nuts and tighten.

(b) Connect the halves of the sealing plate (Fig. 29). Install the bolt and tighten.

(c) Charge the air conditioning system (see Group 24, Heating and Air Conditioning for the proper procedures).

(4) Install the front support bracket (Fig. 29). Install and tighten the bolts.

(5) Install the grille (see Group 23, Body for the proper procedure).

SPECIFICATIONS

TORQUE SPECIFICATIONS (DIESEL ENGINES)

COMPONENT	TORQUE	
Air Heater Power Supply Nuts	14 N•m	10 ft. lbs.
Cab Heater Supply/Return Line Nuts	24 N•m	18 ft. lbs.
Exhaust Manifold Bolts	43 N•m	32 ft. lbs.
Fuel Heater Ground Bolt	12 N•m	(110 in. lbs.)
Fuel Line Nuts	24 N•m	18 ft. lbs.
Intake Manifold Cover Bolts	24 N•m	18 ft. lbs.
Intercooler Attaching Bolts	2 N•m	(17 in. lbs.)
Intercooler Duct Clamp Nuts	8 N•m	(72 in. lbs.)
Throttle Control Bracket Mounting Bolts	24 N•m	18 ft. lbs.
Thrust Bearing Torx Bolts	4.5 N•m	(40 in. lbs.)
Turbo Bearing Housing/Diffuser Bolts	5.7 N•m	(50 in. lbs.)
Turbo Bearing Housing/Turbine Housing Bolts	11.3 N•m	(100 in. lbs.)
Turbo Mounting Nuts	32 N•m	24 ft. lbs.
Turbo Impeller Nut	14 N•m	(129 in. lbs.)
Turbo Oil Drain Tube Bolts	24 N•m	18 ft. lbs.
Turbo Oil Supply Line Fitting Nut	15 N•m	11 ft. lbs.
Turbo V-Band Clamp	8.5 N•m	(75 in. lbs.)

J9111-57

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

FUEL SYSTEM

CONTENTS

DIESEL FUEL INJECTION

INDEX

GENERAL INFORMATION

Beginning in mid 1991 model year, a Chrysler engine controller regulates the diesel fuel injection system. This group contains information about the fuel injection system. The 1991 Rear Wheel Drive Truck service manual describes 1991 vehicles without an engine controller.

SYSTEM DIAGNOSIS

The engine controller monitors many of it systems for faults. If a fault is found, the controller stores a message in memory. Use the DRB II to access fault messages.

ENGINE CONTROLLER

The Single Board Engine Controller (SBEC) regulates the fuel injection system. **This manual refers to the SBEC as the engine controller.** The engine controller is a pre-programmed, microprocessor digital computer (Fig. 1). The controller operates the air intake heater relays, overdrive solenoid, and speed control. The engine controller also powers the water in fuel lamp and wait to start lamp.

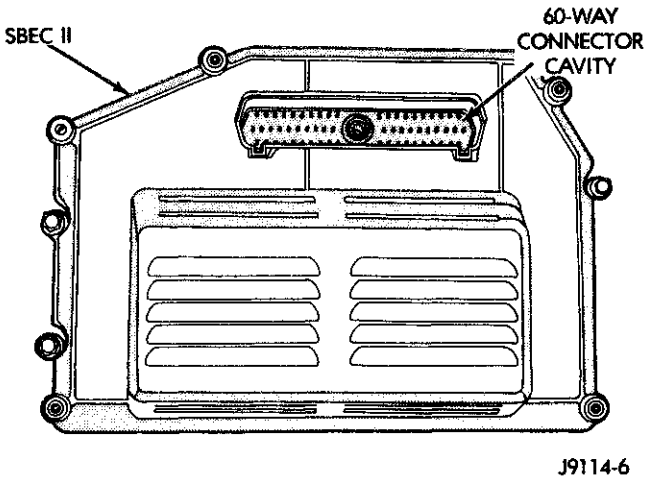


Fig. 1 Engine Controller

The engine controller receives various inputs. The engine controller activates different outputs based on these inputs.

Engine Controller Inputs

- water-in-fuel sensor
- charge air temperature sensor
- vehicle speed sensor

- throttle position sensor
- overdrive override switch
- crank signal
- park/neutral switch
- brake switch
- speed control
- ignition sense
- battery voltage

Engine Controller Outputs

- water-in-fuel lamp
- wait-to-start lamp
- sci transmit
- sci receive
- overdrive solenoid
- air intake heater relays
- speed control

BATTERY VOLTAGE—ENGINE CONTROLLER INPUT

The battery input provides power to operate the engine controller. The input also tells the controller when the engine is running. The engine controller checks battery voltage after it receives a crank signal. If battery voltage is above 12.66 volts it assumes that the engine is running. If battery voltage is below 12.66 volts the controller aborts the post-heat cycle of the air intake heaters.

BRAKE SWITCH—ENGINE CONTROLLER INPUT

If the engine controller receives a brake switch input while the speed control system is on, it will disable speed control.

CHARGE AIR TEMPERATURE SENSOR—ENGINE CONTROLLER INPUT

The charge air temperature sensor is located on top of the intake manifold (Fig. 2). It provides an input to the engine controller that indicates air temperature in the manifold. Based on the charge air temperature input, the engine controller determines when to energize the air intake heaters. The input also tells the engine controller how long to operate the heaters. Refer to Air Intake Heaters in this section.

CRANK SIGNAL—ENGINE CONTROLLER INPUT

The crank signal input informs the engine controller that the starter relay has been engaged. After receiving the crank input the engine controller energizes the air intake heaters for the post-heat cycle as needed. The post-heat stage of the intake heater cycle will not begin if the engine controller does not receive a crank signal. Refer to Air Intake Heaters in this section.

IGNITION SENSE—ENGINE CONTROLLER INPUT

The ignition sense input informs the engine controller that the ignition switch is in the run position.

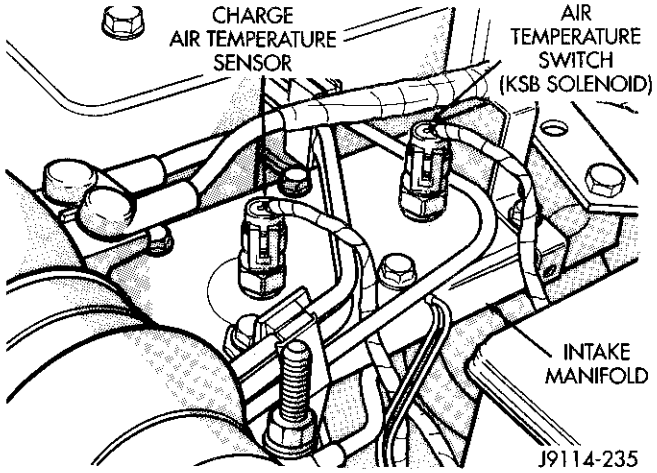


Fig. 2 Charge Air Temperature Sensor

OVERDRIVE OVERRIDE SWITCHITCH—ENGINE CONTROLLER INPUT

On vehicles equipped with overdrive, the engine controller regulates the 3-4 overdrive upshift and downshift through the overdrive solenoid. An override switch is located on the instrument panel.

The overdrive override switch is normally closed. It opens when the operator presses the switch. The transmission will not enter overdrive when the operator presses the override switch. The transmission downshifts if the operator presses the override switch while in overdrive.

The overdrive switch circuit contains two other switches; a transmission thermo-switch and a coolant temperature switch. When either switch opens, the transmission will not shift into overdrive or will downshift if already in overdrive.

COOLANT TEMPERATURE SWITCH

The coolant temperature switch (Fig. 3) opens when the coolant temperature is below 16°C (60°F). When the coolant thermo-switch opens, the transmission will not shift into overdrive. The transmission downshifts if it is in overdrive when the coolant switch opens. Vehicles with a manual transmission do not have a coolant switch.

TRANSMISSION THERMO-SWITCH

The transmission thermo-switch opens when the transmission fluid temperature is above 134°C (273°F). When the thermo-switch opens, the transmission will not shift into overdrive. The transmission downshifts if it is in overdrive when the thermo-switch opens. Once the thermo-switch opens, it will not close until transmission fluid temperature drops to 116°C (240°F). The switch is located in the transmission to radiator cooling line.

PARK/NEUTRAL SWITCH—ENGINE CONTROLLER INPUT

The park/neutral switch (Fig. 4) is located on the

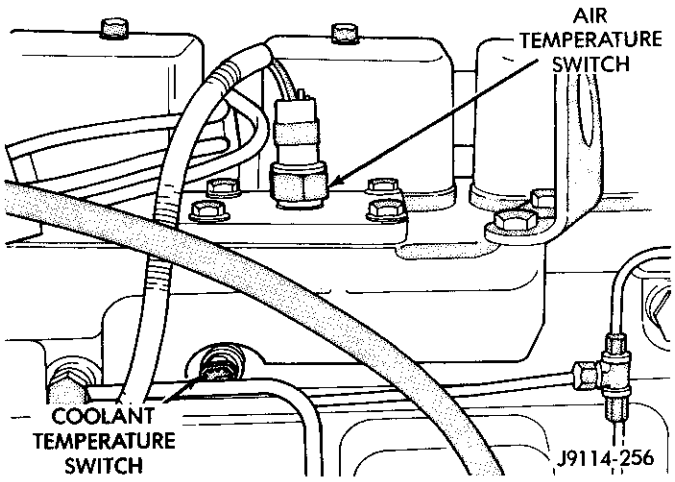


Fig. 3 Coolant Temperature Switch

automatic transmission housing. It provides an input to the engine controller. The input indicates if the automatic transmission is in Park, Neutral or a drive gear selection.

If the transmission is in overdrive and the operator shifts the vehicle into neutral and then back into gear, the transmission will enter overdrive if the engine controller determines all conditions are met.

The engine controller uses the park/neutral switch input when determining speed control strategy. The engine controller will disable speed control if the operator shifts the transmission into neutral. The speed control will have to be reset once the vehicle is placed back into drive.

The park neutral switch is sometimes referred to as the neutral safety switch. Refer to group 21 Transmissions, for adjustment, replacement, and test information.

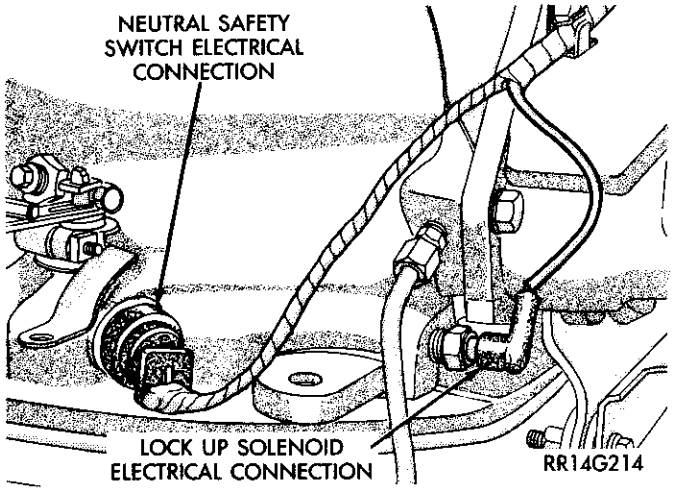


Fig. 4 Neutral Safety Switch

SPEED CONTROL—ENGINE CONTROLLER INPUT

The engine controller regulates the speed control system based on inputs it receives. The speed control operating range is from 35 to 85 mph. Inputs that effect speed control operation are:

- park/neutral switch
- vehicle distance (speed) sensor
- throttle position sensor

THROTTLE POSITION SENSOR (TPS)—ENGINE CONTROLLER INPUT

The throttle position sensor (TPS) is mounted on the top of the fuel injection pump (Fig. 5). The TPS provides an input to the engine controller. The input ranges from approximately zero to five volts. The sensor senses how far the throttle is open (past the idle position). The engine controller uses the TPS input when determining the 3-4 upshift (overdrive) and the 4-3 downshift. Only vehicles with automatic transmissions have a TPS.

The TPS is a potentiometer. The engine controller supplies 5 volts to the sensor. TPS output to the engine controller varies from approximately 1.0 volt at idle to 3.5 volts at wide open throttle (WOT).

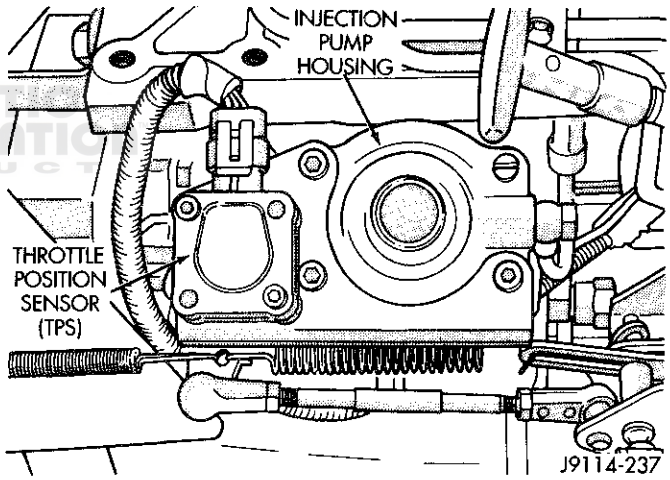


Fig. 5 Throttle Position Sensor

VEHICLE DISTANCE (SPEED) SENSOR—ENGINE CONTROLLER INPUT

The distance sensor (Fig. 6) is located in the extension housing of the transmission. The engine controller uses the TPS and distance sensor inputs to determine when to shift into and out of overdrive.

The distance sensor is also used in determining speed control set, decelerate, accelerate, maximum set speed (85 mph), and minimum set speed (35 mph) operations.

WATER-IN-FUEL SENSOR—ENGINE CONTROLLER INPUT

The water-in-fuel (WIF) sensor is located at the bottom of the fuel/water separator filter (Fig. 7). The sensor sends an input to the engine controller when it senses water in the fuel. The engine controller looks at the water-in-fuel sensor signal when the

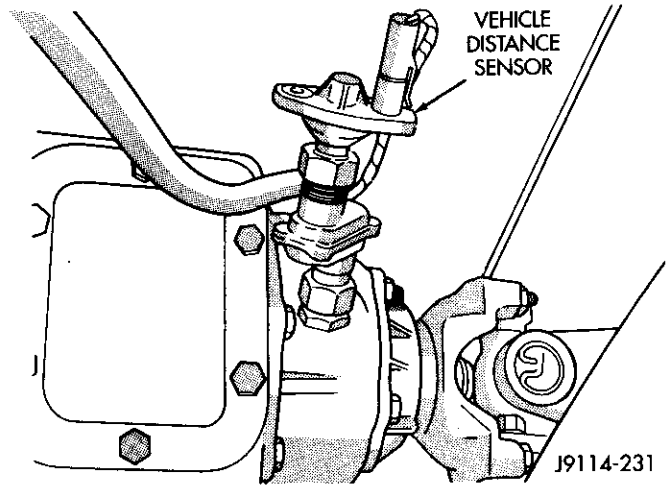


Fig. 6 Vehicle Distance Sensor

ignition key is put in the ON position. It also monitors the input at the end of the intake heater post-heat cycle.

The engine controller turns the Water-in-Fuel lamp on if water is detected in the fuel. The water-in-fuel lamp is located in the instrument panel.

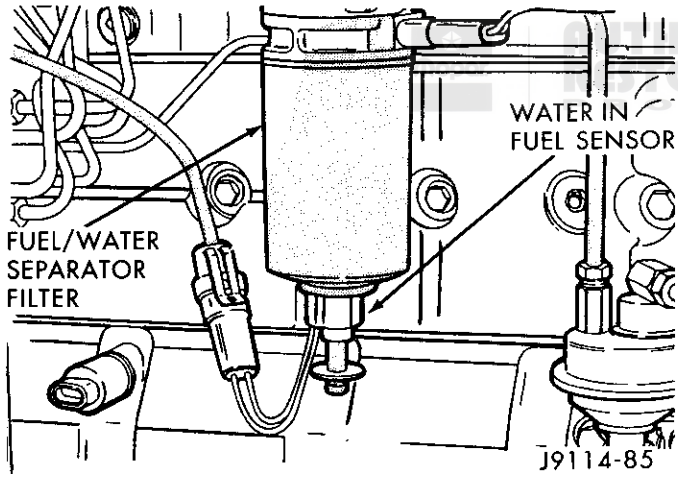


Fig. 7 Water-in-Fuel Sensor

AIR INTAKE HEATER RELAYS—ENGINE CONTROLLER OUTPUT

The engine controller operates the air intake heaters through the air intake heater relays (Fig. 8). The relays may be energized before and after cranking, depending upon intake manifold air temperature. The engine controller monitors intake manifold air temperature through the charge temperature sensor. Refer to Air Intake Heaters in this section.

The relays are not energized during engine cranking. When the solenoids are energized they make a clicking noise.

CAUTION: Do not energize the air intake heater relays more than once per 15 minutes. If the relays are cycled, the key turned off, and then turned back on, the engine could be damaged. Wait 15 minutes before turning the key back to the ON position.

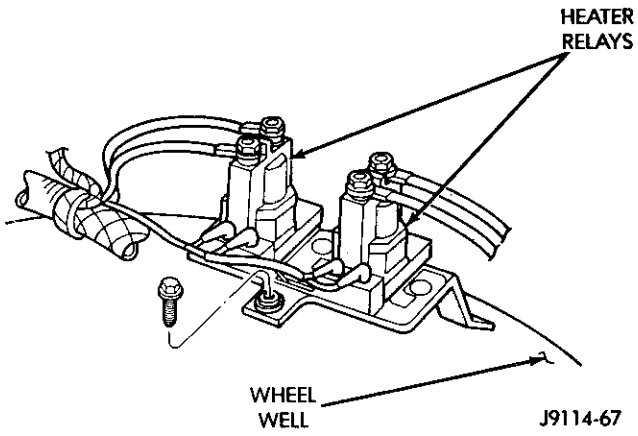


Fig. 8 Air Intake Heater Relays

AIR INTAKE HEATER

When energized, the air intake heaters warm incoming air as it enters the intake manifold. The air intake heaters (Fig. 9) are energized by the engine controller through the air intake heater relays. Intake manifold air temperature determines when the heaters are energized. They may be energized before cranking and after cranking, or both. Refer to Pre-Heat Cycle and Post Heat Cycle. The heaters are not energized during cranking.

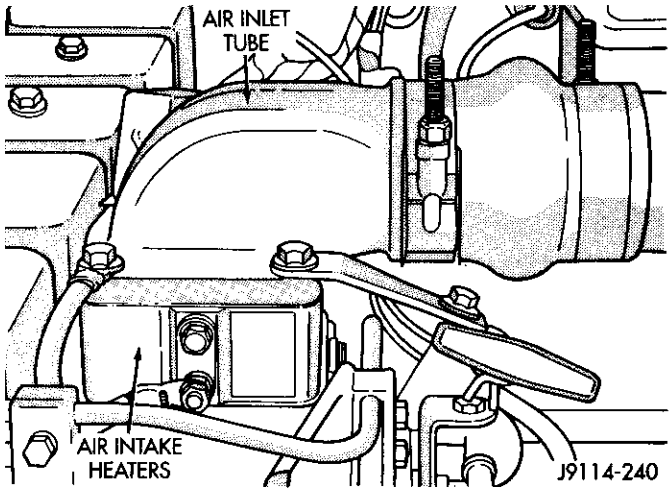


Fig. 9 Air Intake Heaters

PREHEAT CYCLE

The engine controller powers up when the ignition key is turned to the On position. If intake manifold air temperature is 15°C (59°F) or below, the intake heaters are energized and the Wait-to-Start light is illuminated. The heaters are energized for a specific amount of time, based on the intake manifold air temperature. Refer to the Air Intake Heater Cycle Chart.

Once the heaters have cycled, the Wait to Start light goes out. While the engine is cranked, the heaters are not energized.

POST-HEAT CYCLE

After the engine has been started, the post-heat cycle will begin if intake manifold air temperature was 15°C (59°F) or below when the ignition switch was turned on. Depending upon intake manifold temperature, either both heaters are energized or they are cycled on and off (when one is energized, the other is not). The time the heaters are energized depends upon intake manifold air temperature. Refer to the Air Intake Heater Cycle Chart.

AIR INTAKE HEATER CYCLE CHART

Intake Manifold Temperature	Preheat Cycle Time Ignition Key ON Engine Not Running	Postheat Cycle Ignition Key ON Engine Running
Above 15 °C (59 °F)	0 Seconds	No
-8 °C (18 °F) to 15 °C (59 °F)	10 Seconds	Yes
-17 °C (1 °F) -9 °C (16 °F)	15 Seconds	Yes
-26 °C (-15 °F) to -18 °C (0 °F)	17.5 Seconds	Yes
Below -26 °C (-15 °F)	20 Seconds	Yes

J9114-239

OVERDRIVE SOLENOID—ENGINE CONTROLLER OUTPUT

The overdrive solenoid is used on vehicles that have an automatic transmission. The solenoid is operated by the engine controller. It controls shifting in and out of overdrive through the overdrive solenoid. Refer to Group 21 for overdrive solenoid service.

SPEED CONTROL—ENGINE CONTROLLER OUTPUT

The speed control vacuum and vent solenoids are operated by the engine controller. The vacuum solenoid maintains vacuum at a required pressure to resume, set or accelerate the speed control system. The vent solenoid allows vacuum to bleed off during deceleration, when the brakes are applied or the transmission is shifted into park or neutral.

SCI RECEIVE and SCI TRANSMIT—ENGINE CONTROLLER OUTPUT

The serial communication interface (SCI) receive and transmit outputs allow the engine controller to communicate with the DRBII diagnostic tool.

WAIT-TO-START LAMP—ENGINE CONTROLLER OUTPUT

The wait-to-start lamp is turned on and off by the engine controller based on the charge air temperature sensor input.

The light is turned on when the ignition is first activated. It will remain on for two seconds as a bulb test. If the engine controller reads intake manifold air temperature below 15°C (59°F), it will turn the wait-to-start light on for the intake heater preheat cycle. The light stays on until the preheat cycle is over.

The wait-to-start light will flash on and off if the charge air temperature sensor input to the engine controller is below minimum value or above maximum value. The engine controller stores a fault message when these condtions occur.

WATER-IN-FUEL LAMP—ENGINE CONTROLLER OUTPUT

The water-in-fuel lamp is turned on and off by the engine controller. The lamp is turned on by the controller when it receives an input from the water-in-fuel sensor. The sensor sends an input to the engine controller when it detects water in the fuel/water separator filter.

KSB SOLENOID

The KSB solenoid is not an output of the engine controller. The solenoid is located on the injector pump (Fig. 10). It contains a valve that controls venting of the injection pump internal pressure regulator. When voltage is supplied to the solenoid, it closes off the vent circuit in the injection pump. When the vent circuit is closed off, internal pump pressure increases and injection timing advances. The KSB solenoid allows the injection pump timing to reach full advance sooner.

When the KSB solenoid is energized, internal pump pressure reaches 8 bars (116 psi). When the solenoid is not energized, internal pump pressure should be approximately 4 bars (58 psi).

The KSB solenoid circuit contains an air temperature switch and a 3 ohm resistor. The resistor drops battery voltage to 10 volts. Battery voltage is supplied to the solenoid through the ignition switch.

The air temperature switch is mounted on the intake manifold next to the charge air temperature sensor (Fig. 11). The air temperature switch is open at or above 16°C (60°F). The switch is fully closed at or below 12°C (54°F).

SYSTEM OPERATION

IGNITION SWITCH ON

When the ignition switch is put in the ON (run) position the following occurs:

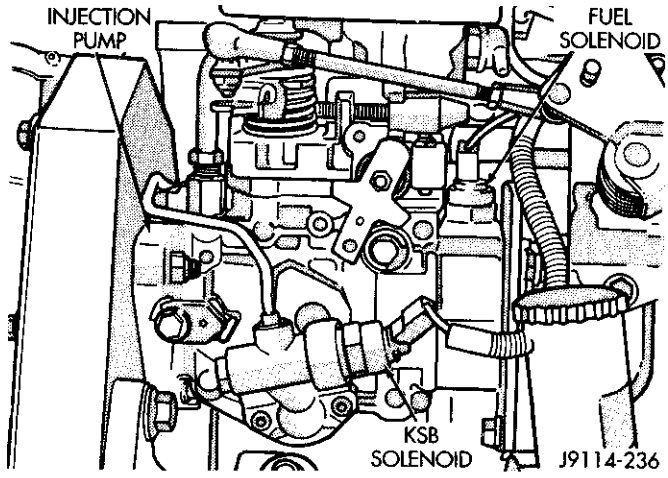


Fig. 10 KSB Solenoid Valve

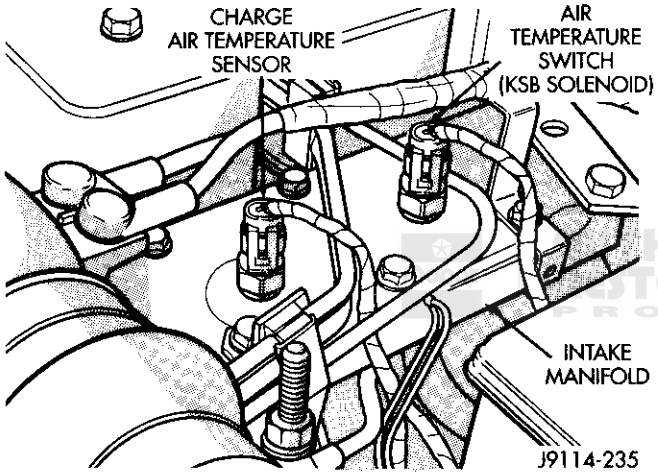


Fig. 11 Air Temperature Switch

- The engine controller receives an ignition sense input. It then powers up. Battery voltage is supplied through the battery voltage input.
- The wait-to-start lamp is turned on by the engine controller for at least 2 seconds as a bulb test.
- The engine controller monitors the charge air temperature sensor input. If manifold air temperature is at or below 15°C (59°F), the engine controller will start the air intake heater preheat cycle. It will energize the intake heaters by grounding the air intake heater relays. The engine controller will turn the wait-to-start light on until the preheat cycle is over. **If the engine controller receives a crank signal before the preheat cycle is over, it will abort the preheat cycle.**
- The engine controller monitors battery voltage. The intake heater preheat cycle is adjusted based on battery voltage.
- The engine controller will turn on the water-in-fuel lamp if a signal is received from the water-in-fuel sensor.

ENGINE START-UP

When the ignition key is put in the start position, the following occurs:

- The engine controller receives the crank signal input when the starter relay is energized.
- The air intake heaters are not energized during cranking.
- The engine controller monitors battery voltage. If battery voltage is above 12.66 volts the engine controller determines that the engine is running.
- If the engine controller received a crank signal before the preheat cycle was over, the heaters will be de-energized. However, the post-heat cycle will begin if battery voltage is above 12.66 volts and intake manifold temperature is below 15°C (59°F).

ENGINE WARM-UP

- The engine controller may start the air intake heater post-heat cycle depending on intake air temperature. If manifold air temperature was at or below 15°C (59°F) when the ignition switch was turned on, the cycle is started.
- If intake manifold air temperature is below 12°C (54°F), the KSB solenoid will be energized through the air temperature switch. The solenoid remains energized until the air temperature switch opens. The switch opens when intake manifold air temperature is above 16°C (60°F).
- If the coolant temperature switch is open, the transmission will not be allowed to enter overdrive (automatic transmission). The switch opens when coolant temperature is below 16°C (60°F).
- The engine controller will turn on the water-in-fuel lamp if a signal is received from the water-in-fuel sensor.

CRUISE OR IDLE

- The engine controller monitors intake manifold air temperature through the charge temperature sensor input.
- If intake manifold air temperature is below 12°C (54°F), the KSB solenoid will be energized through the air temperature switch. The solenoid remains energized until the air temperature switch opens. The switch opens when intake manifold air temperature is above 16°C (60°F).
- The air intake heater post-heat cycle will be completed, if it is not already over.
- The vehicle distance (speed) sensor and throttle position sensor inputs are used to control transmission overdrive operation.
- If the coolant temperature switch is open, the transmission will not be allowed to enter overdrive (automatic transmission). The switch opens when coolant temperature is below 16°C (60°F).
- If the transmission thermo-switch is open, the transmission will not be allowed to enter into overdrive (automatic transmission). If the switch opens

when the vehicle is in overdrive, the transmission will be downshifted. The transmission thermo-switch opens at 134°C (273°F). The thermo-switch will close once the transmission fluid temperature drops to 116°C (240°F).

- The engine controller will turn on the water-in-fuel lamp if a signal is received from the water-in-fuel sensor.

ACCELERATION

- The vehicle distance (speed) sensor and throttle position sensor inputs are used to control transmission overdrive operation.
- If the coolant temperature switch is open, the transmission will not be allowed to enter overdrive (automatic transmission). The switch opens when coolant temperature is below 16°C (60°F).
- If intake manifold air temperature is below 12°C (54°F), the KSB solenoid will be energized through the air temperature switch. The solenoid remains energized until the air temperature switch opens. The switch opens when intake manifold air temperature is above 16°C (60°F).
- If the transmission thermo-switch is open, the transmission will not be allowed to enter into overdrive (automatic transmission). If the switch opens when the vehicle is in overdrive, the transmission will be downshifted. The transmission thermo-switch opens at 134°C (273°F). The thermo-switch will close once transmission fluid temperature drops to 116°C (240°F).
- If the speed control system resume/accelerate function is being used, the engine controller will only allow the vehicle to accelerate at a predetermined rate. If a speed control has been set and the resume/accelerate button is momentarily pushed in, the engine controller will increase vehicle speed by two miles per hour.
- If the brakes are applied, the engine controller will disable the speed control.

DECELERATION

- The vehicle distance (speed) sensor and throttle position sensor inputs are used to control transmission overdrive operation.
- If the coolant temperature switch is open, the transmission will not be allowed to enter overdrive (automatic transmission). The switch opens when coolant temperature is below 16°C (60°F).
- If the transmission thermo-switch is open, the transmission will not be allowed to enter into overdrive (automatic transmission). If the switch opens when the vehicle is in overdrive, the transmission will be downshifted. The transmission thermo-switch opens at 134°C (273°F). The thermo-switch will close once transmission fluid temperature drops to 116°C (240°F).
- If intake manifold air temperature is below 12°C (54°F), the KSB solenoid will be energized through the air temperature switch. The solenoid remains energized until the air temperature switch opens. The switch opens when intake manifold air temperature is above 16°C (60°F).
- If the speed control system coast/set function is being used, the engine controller will only allow the vehicle to decelerate at a predetermined rate. If the coast/set switch is pushed while the system is operating, the controller will set speed control to the rate the vehicle is traveling at when the switch is released.
- If the brakes are applied, the engine controller will disable the speed control.

IGNITION SWITCH OFF

- When the ignition switch is turned to the off position, the engine controller still receives battery voltage through the battery input. Battery voltage is needed to keep engine controller memory alive. The memory stores fault messages and the TPS value from the previous Key-on.

GENERAL DIAGNOSIS—DIESEL

INDEX

VISUAL INSPECTION

A visual inspection for loose, disconnected, or incorrectly routed wires and hoses should be made before attempting to diagnose or service the fuel injection system. A visual check will help find these conditions. It also saves unnecessary test and diagnostic time. A thorough visual inspection of the fuel injection system includes the following checks:

(1) Ensure that the battery connections are tight and not corroded (Fig. 1).

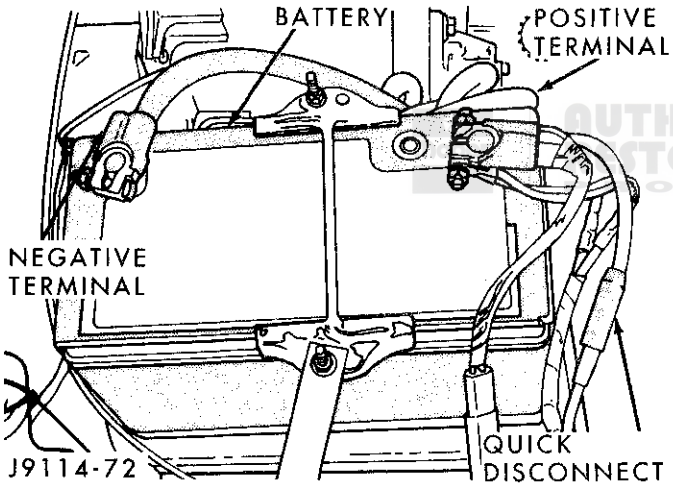


Fig. 1 Battery Connections

(2) Ensure that the 60-way connector is fully engaged with the engine controller. Verify that the connector mounting screw is tight (Fig. 2).

(3) Ensure that the electrical connections at the air intake heater relays (Fig. 3) are tight and not corroded.

(4) Inspect the starter motor and starter solenoid connections for tightness and corrosion (Fig. 4).

(5) Verify that the electrical connectors are connected to the charge air temperature sensor and air temperature switch. Inspect the connectors for corrosion or damaged wires (Fig. 5).

(6) Verify that the electrical connector is connected to the air temperature switch (Fig. 5).

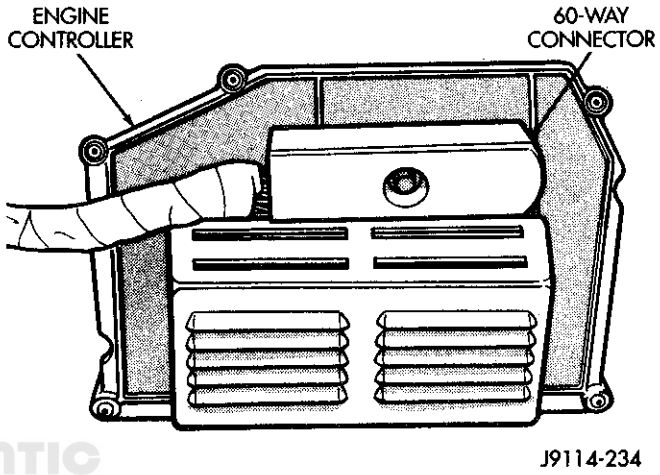


Fig. 2 Engine Controller

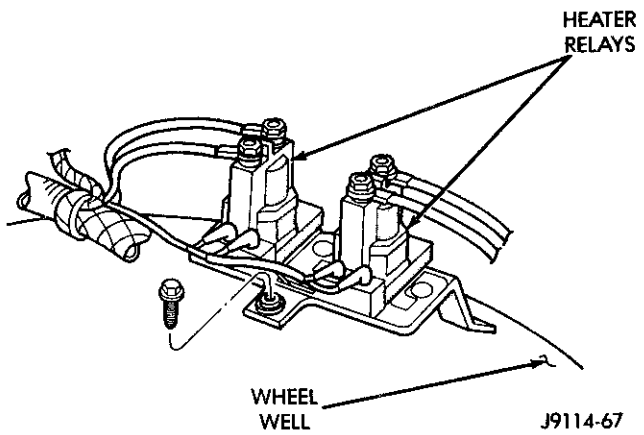


Fig. 3 Air Intake Heater Relays

(7) Verify that the Water-in-Fuel (WIF) sensor electrical connector is connected to the sensor (Fig. 6). Inspect the connector for corrosion or damaged wires.

(8) Place a drain pan under the drain tube (Fig. 6). **With the engine not operating**, hold the drain open until all water and contaminants have been removed and clean fuel exits the drain. Dispose of mixture in drain pan according to applicable regulations.

(9) Verify that the electrical connector is connected to the fuel solenoid on the injection pump (Fig. 7). Inspect the connector for corrosion or damage.

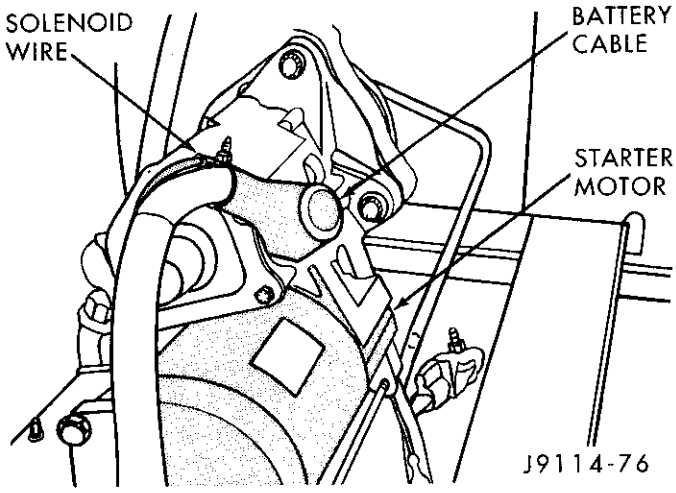


Fig. 4 Starter Motor Connections

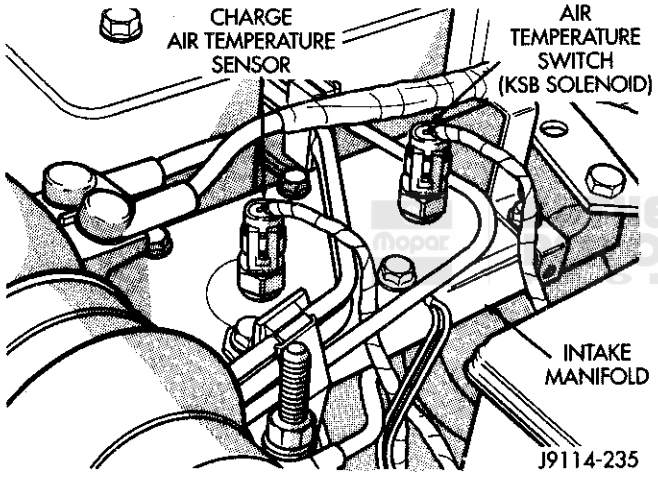


Fig. 5 Charge Air Temperature Sensor and Air Temperature Switch

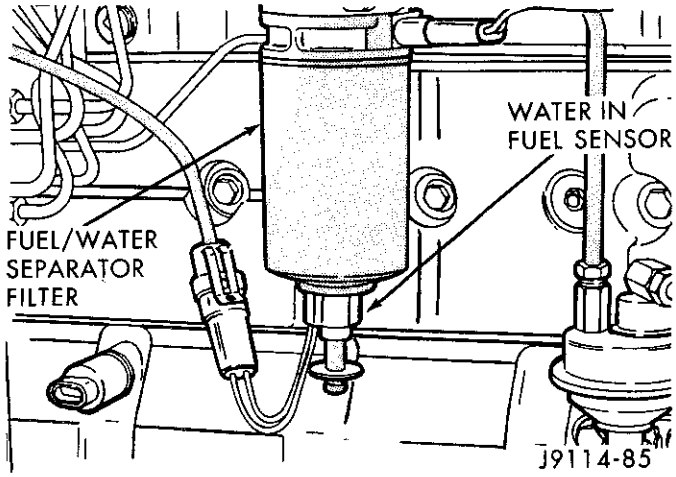


Fig. 6 Water-in-Fuel (WIF) Sensor

(10) Verify that the electrical connector is connected to the KSB solenoid on the injection pump (Fig. 7). Inspect the connector for corrosion or damage.

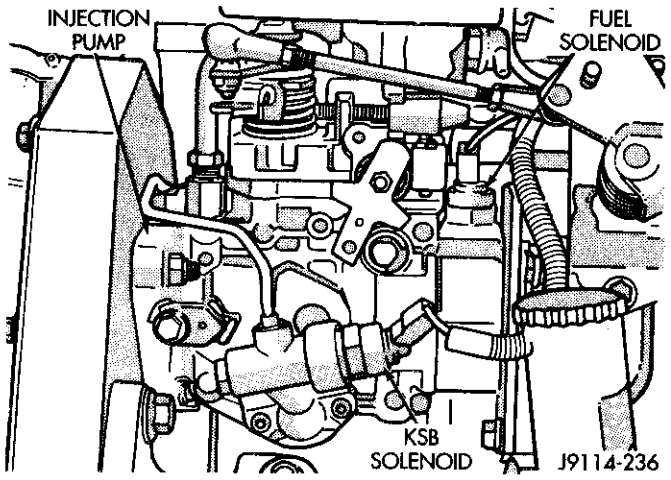


Fig. 7 Fuel Solenoid and KSB Solenoid

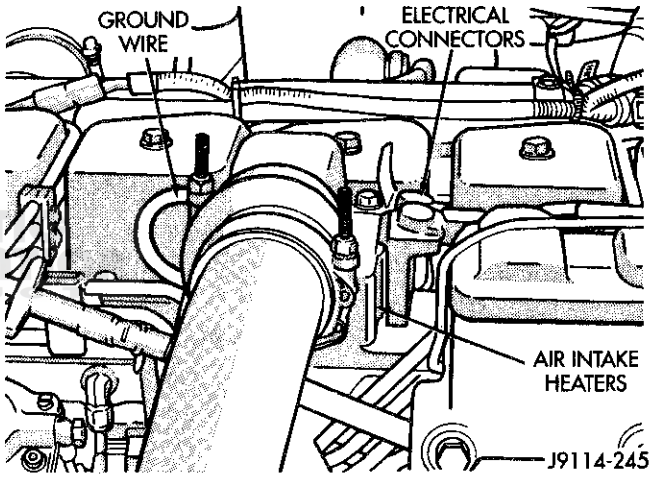


Fig. 8 Air Intake Heater

(11) Ensure that the air intake heater electrical connections are tight and free of corrosion (Fig. 8).

(12) Inspect the throttle linkage and accelerator linkage for binding (Fig. 9).

(13) Ensure that the throttle return spring is connected.

(14) Inspect all fuel lines for signs of leakage.

(15) Ensure that the ground cable connection at the front of the cylinder head is tight and free of corrosion (Fig. 10).

(16) Inspect the air cleaner element for restrictions (Fig. 11).

(17) Ensure that the turbo-charger output hose is connected to the intercooler inlet tube. Verify that the intercooler output hose is connected to the cooler and the intake manifold (Fig. 12).

(18) Ensure that the vacuum pump to brake booster hose is connected and not damaged.

(19) Ensure that the accessory drive belt is not damaged or slipping.

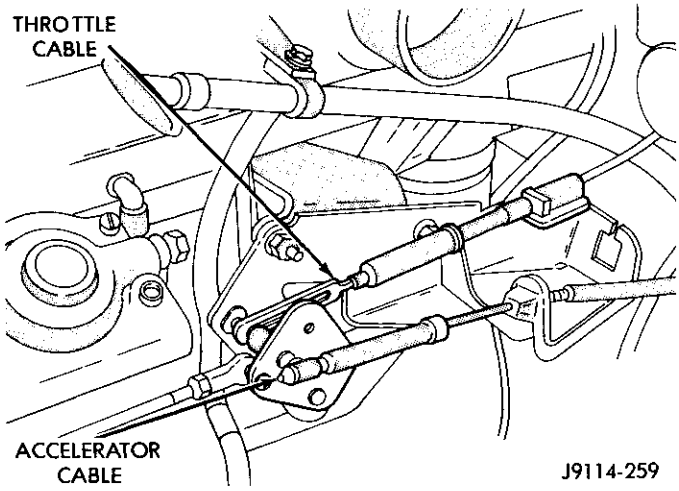


Fig. 9 Throttle and Accelerator Cable Linkage

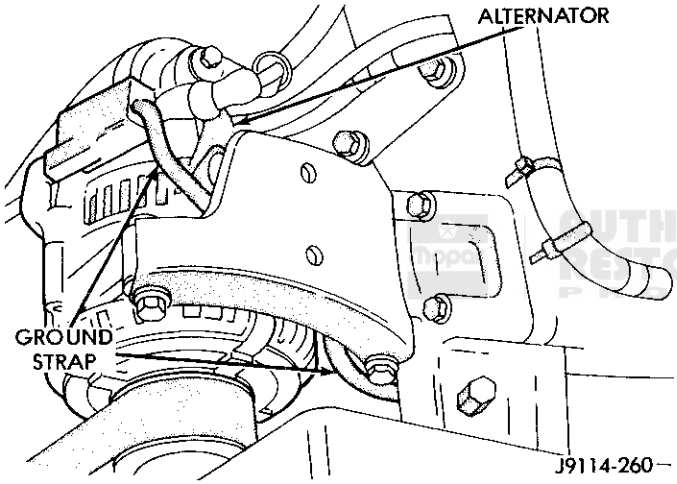


Fig. 10 Ground Strap

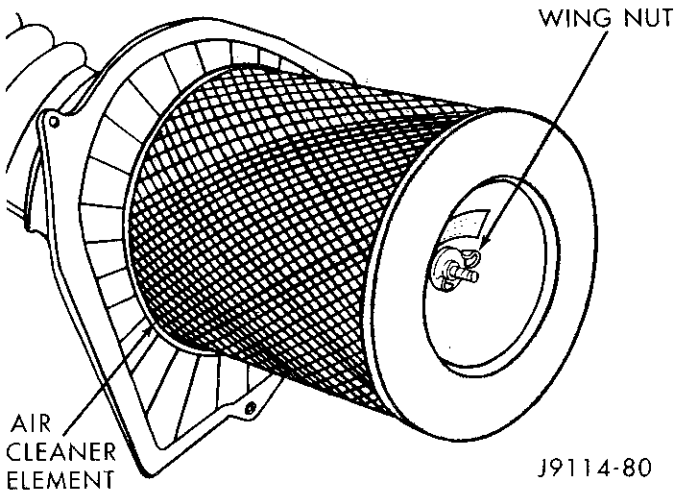


Fig. 11 Air Cleaner Element

THROTTLE POSITION SENSOR TEST

CAUTION: Before checking the TPS, the throttle linkage must be checked for correct adjustment. The throttle lever must contact the low idle speed screw. The throttle lever must reach breakover when the throttle is wide open. Refer to the Accelerator Pedal and Throttle Cable section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.

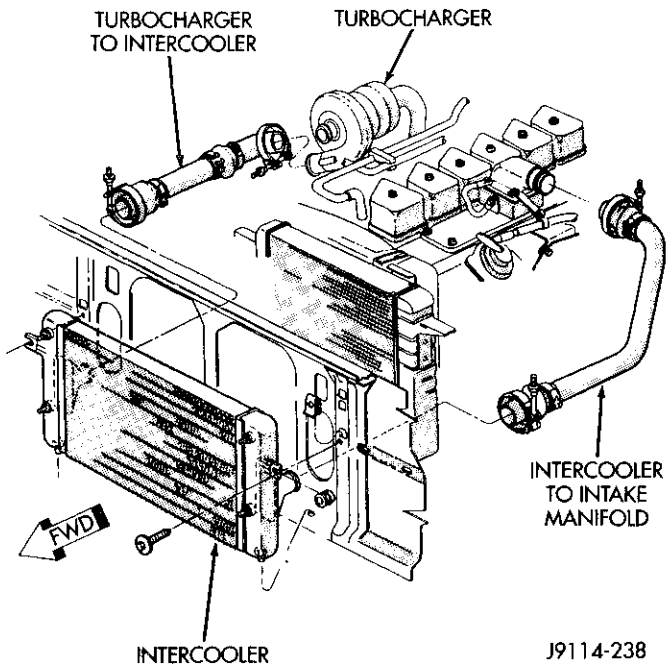


Fig. 12 Intercooler

The throttle position sensor (TPS) can be tested with the DRB II or a digital voltmeter. The center terminal of the TPS is the output terminal (Fig. 13).

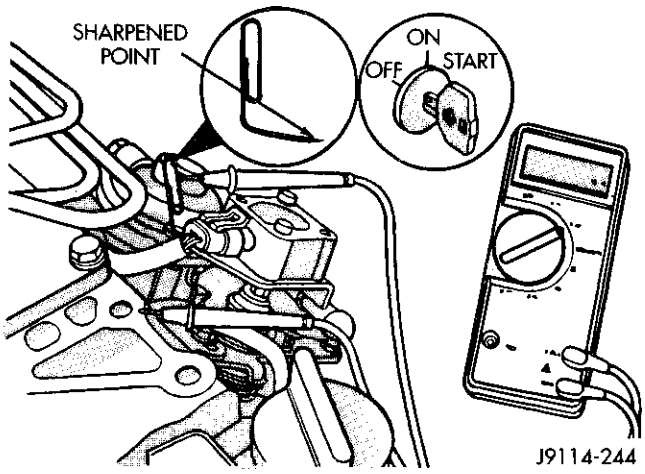


Fig. 13 Throttle Position Sensor (TPS) Testing

Turn the ignition key to the On position. Check TPS output voltage at the center terminal wire of the connector. Measure the voltage at idle (throttle lever contacting low idle speed screw) and at wide open throttle (WOT). At idle, TPS output voltage should be approximately 1 volt. At wide open throttle, TPS output voltage must be 2.25 volts higher than the

reading at idle. The output voltage should increase gradually as the throttle lever is slowly opened from idle to WOT. If the TPS is not within the proper range, adjust the sensor. Refer to the Service Procedures section of this group.

KSB SOLENOID

The KSB solenoid will click when it is energized and de-energized. **The KSB solenoid circuit contains a 3 ohm resistor. The resistor drops the voltage to 10 volts. Do not apply 12 volts to the solenoid.**

If the solenoid does not click when 10 volts are supplied to it, replace the solenoid.

AIR INTAKE HEATER

PREHEAT/POST-HEAT CYCLE

The engine controller provides a ground path for the air intake heater relays. The ground path is provided if intake manifold temperature is below 16°C (60°F) when the ignition key is in the ON position. When the ground is provided the intake heaters are energized to start the preheat cycle.

The preheat cycle can be tested with a voltmeter or test light. **If the intake manifold temperature is above 16°C (60°F) the WAIT to START light will not come on and the air intake heaters will not be energized.**

CAUTION: Do not energize the air intake heater relays more than once per 15 minutes. If the relays are cycled, the key turned off, and then turned back on, the engine could be damaged. Wait 15 minutes before turning the key back to the ON position.

(1) With the engine not running and ambient air temperature below 16°C (60°F) turn the ignition key to the ON position.

(2) The WAIT to START light will come on and the air intake heater relays should CLICK on signaling the start of the preheat cycle.

(3) Check for battery voltage at both intake air heater terminals. **The heaters will only be energized for 10 to 20 seconds.** Refer to the Preheat Cycle Time Interval Chart.

AIR INTAKE HEATER TEST

(1) Disconnect negative battery cable.

(2) Note wire positions on heater terminals for assembly. Disconnect wires from heater.

(3) Use an ohmmeter to test resistance from each heater terminal to ground. The resistance should be zero (0). If the resistance is not to specifications, inspect for corroded or dirty connections. Clean or repair the connections and retest before replacing heaters.

PREHEAT CYCLE TIME INTERVAL

Intake Manifold Temperature	Preheat Cycle Time Ignition Key ON Engine Not Running	Postheat Cycle Ignition Key ON Engine Running
Above 15 °C (59 °F)	0 Seconds	No
-8 °C (18 °F) to 15 °C (59 °F)	10 Seconds	Yes
-17 °C (1 °F) -9 °C (16 °F)	15 Seconds	Yes
-26 °C (-15 °F) to -18 °C (0 °F)	17.5 Seconds	Yes
Below -26 °C (-15 °F)	20 Seconds	Yes

J9114-239

ON BOARD DIAGNOSTICS

The engine controller has been programmed to monitor many different circuits. If a problem is sensed in a monitored circuit often enough to indicate an actual problem, a fault message is stored in the engine controller memory. The fault message can be displayed to the service technician only with the DRB II diagnostic tool (the vehicle does not have a check engine light). If the problem is repaired or ceases to exist, the engine controller cancels the Fault after 51 engine starts.

Certain criteria must be met for a fault to be entered into engine controller memory. The criteria may be a specific range of engine temperature, and/or input voltage to the engine controller.

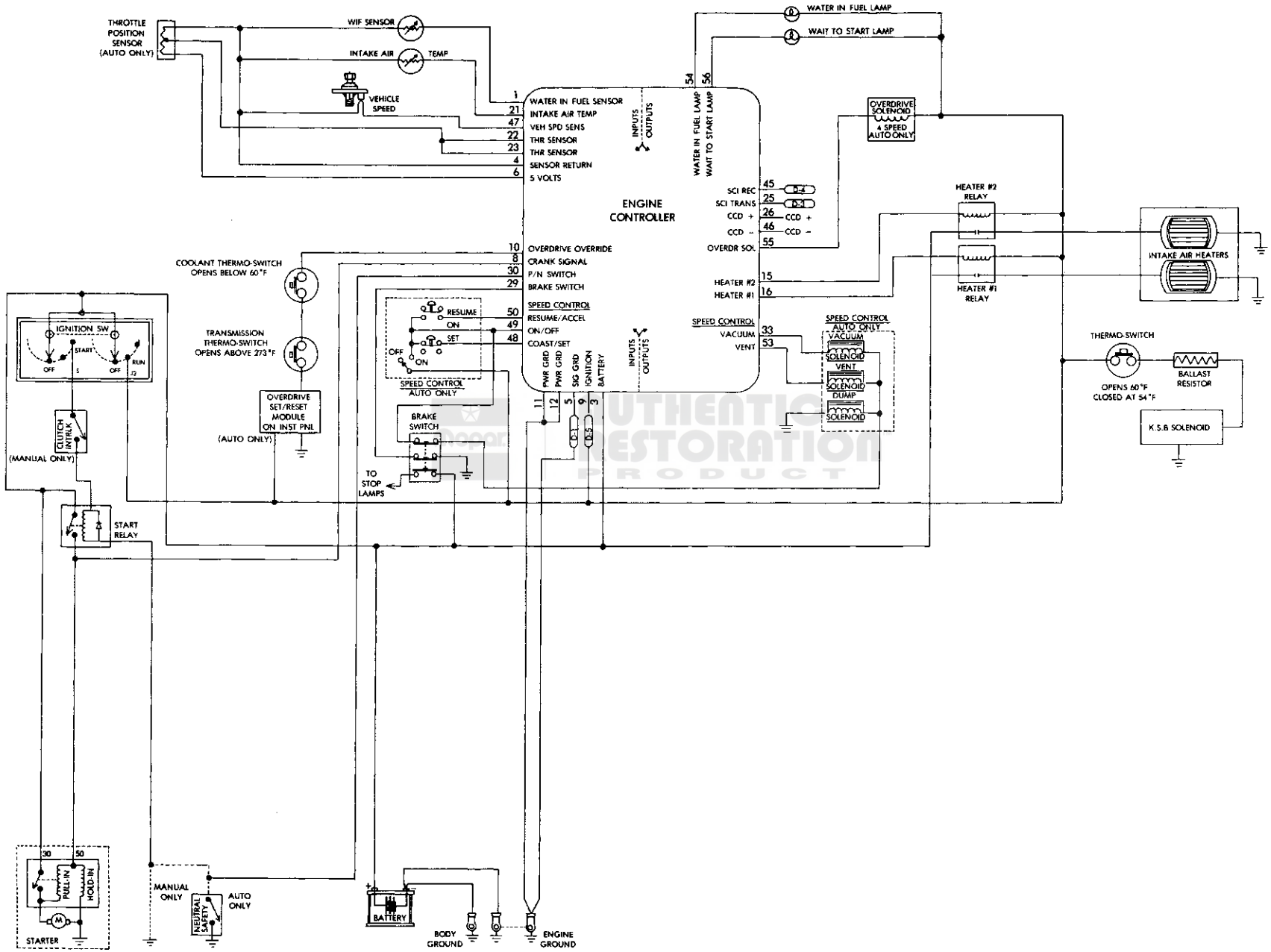
It is possible that a fault for a monitored circuit may not be entered into memory even though a malfunction has occurred. This may happen because one of the fault criteria for the circuit has not been met.

FAULT MESSAGES

FAULT MESSAGE DESCRIPTION

DRBII DISPLAY	DESCRIPTION OF FAULT MESSAGE
Internal controller failure	Internal failure in the engine controller
Speed Control Solenoid Circuits	An open or shorted condition detected in the speed control vacuum or vent solenoid circuits
TPS voltage low	Throttle Position Sensor (TPS) input below the minimum acceptable voltage
TPS voltage high	Throttle Position Sensor (TPS) input above the maximum acceptable voltage
No vehicle speed signal	No distance sensor signal detected during road load conditions
Controller failure EEPROM write denied	Engine controller failure – EEPROM write denied
Overdrive Solenoid Circuit	An open or short condition detected in the overdrive solenoid circuit
Charge Air Temperature Sensor voltage low	Charge Air Temperature Sensor input below acceptable minimum voltage
Charge Air Temperature Sensor voltage high	Charge Air Temperature Sensor input above acceptable maximum voltage
Controller failure – SPI communications	Internal failure in the engine controller

J9114-251



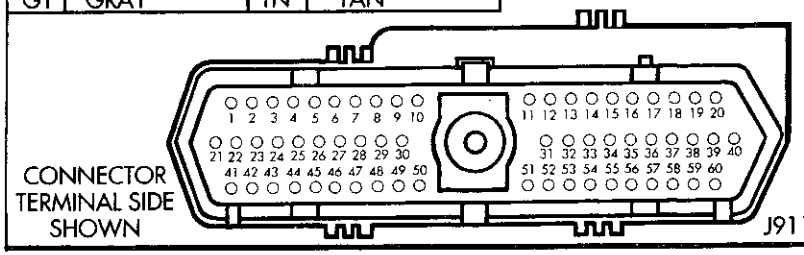
J9114-252

ENGINE CONTROLLER SYSTEM SCHEMATIC

CAV	WIRE COLOR	DESCRIPTION
1	TN/BK*	WATER-IN-FUEL SENSOR
2		
3	RD	BATTERY
4	BK/LB*	SENSOR RETURN
5	BK	SIGNAL GROUND
6	VT/WT*	5 VOLT SUPPLY
7		
8	BR	CRANK SIGNAL
9	DB	IGNITION SENSE
10	RD/WT*	OVERDRIVE OVERRIDE
11	BK	POWER GROUND
12	BK	POWER GROUND
13		
14		
15	OR/BK*	HEATER #2
16	YL	HEATER #1
17		
18		
19		
20		
21	LB	CHARGE (INTAKE) AIR TEMPERATURE SENSOR
22	OR/DB*	THROTTLE POSITION SENSOR
23	OR/DB*	THROTTLE POSITION SENSOR
24		
25	PK	SCI TRANSMIT
26		
27		
28		
29	WT/PK*	BRAKE SWITCH
30	BR/YL*	PARK/NEUTRAL SWITCH
31		
32		
33	TN/RD*	SPEED CONTROL VACUUM SOLENOID
34		
35		
36		

CAV	WIRE COLOR	DESCRIPTION
37		
38		
39		
40		
41		
42		
43		
44		
45	LG	SCI RECEIVE
46		
47	WT/OR*	VEHICLE DISTANCE (SPEED) SENSOR
48	BR/RD*	SPEED CONTROL COAST/SET SWITCH
49	YL/RD*	SPEED CONTROL ON/OFF SWITCH
50	WT/LG*	SPEED CONTROL RESUME/ACCEL SWITCH
51		
52		
53	LG/RD*	SPEED CONTROL VENT SOLENOID
54	BK/PK*	WATER-IN-FUEL LAMP
55	OR/LG*	OVERDRIVE SOLENOID
56	DG*	WAIT-TO-START LAMP
57		
58		
59		
60		

WIRE COLOR CODES					
BK	BLACK	LB	LIGHT BLUE	VT	VIOLET
BR	BROWN	LG	LIGHT GREEN	WT	WHITE
DB	DARK BLUE	OR	ORANGE	YL	YELLOW
DG	DARK GREEN	PK	PINK	*	WITH TRACER
GY	GRAY	RD	RED		
		TN	TAN		



ENGINE CONTROLLER CONNECTOR CAVITY DESCRIPTION

DIESEL FUEL INJECTION SYSTEM DIAGNOSIS

SYMPTOM	CAUSE	ACTION
Starting problem	Improper fuel	Drain fuel tank, flush system, fill with proper fuel. Change filter
	Empty fuel tank or fuel tank vent blocked	Fill tank, bleed system, check tank vent
	Air in fuel system	Bleed fuel system
	Voltage not supplied to fuel solenoid or fuel solenoid inoperative	Correct voltage supply problem or replace solenoid
	Clogged fuel filter	Replace fuel filter
	Restricted or blocked fuel supply lines	Remove restriction or replace lines
	Leaking injection lines, damaged lines or loose connections	Replace damaged lines or tighten connections as necessary. Bleed fuel system
	Wax buildup in fuel filter (cold weather only)	Replace fuel filter, use recommended diesel fuel
	Incorrect injection pump to engine timing	Adjust injection pump timing
	Malfunctioning air heating system	Repair air heating system
	Injection sequence does not correspond with firing order	Install fuel injection lines in correct order
	Malfunctioning KSB valve	Replace injection pump
	Low or uneven engine compression	Repair as necessary
	Restricted or blocked fuel injection lines	Remove restriction or replace lines
	Fuel injection pump malfunction or not adjustable	Replace fuel injection pump
Engine Surge at idle	Empty fuel tank or fuel tank vent blocked	Fill tank, bleed system, check tank vent
	Air in fuel system	Bleed fuel system
	Low idle speed	Adjust idle speed

J9114-22

DIESEL FUEL INJECTION SYSTEM DIAGNOSIS

SYMPTOM	CAUSE	ACTION
Engine surges at idle	Fuel injection pump malfunction or not adjustable	Replace fuel injection pump
Rough idle when engine is warm	Improper fuel	Drain fuel tank, flush system, fill with proper fuel
	Air in fuel system	Bleed fuel system
	Low idle speed	Adjust idle speed
	Injection pump rear support bracket loose	Repair as necessary
	Restricted or damaged injector nozzle	Repair or replace as necessary
	Injection sequence does not correspond with firing order	Install injection lines in correct order
	Low or uneven engine compression	Repair as necessary
	Fuel injection pump malfunctioning or not adjustable	Replace fuel injection pump
Engine misses under load	Improper fuel	Drain fuel tank, flush system, fill with proper fuel
	Empty fuel tank or fuel tank vent blocked	Fill tank, bleed system, check tank vent
	Air in fuel system	Bleed fuel system
	Clogged fuel filter	Replace fuel filter
	Restricted or blocked fuel injection lines	Remove restrictions or replace lines
	Restricted or blocked fuel supply lines	Remove restrictions or replace lines
	Leaking injection lines, damaged lines or loose connection	Replace damaged lines or tighten connections as necessary. Bleed fuel system.

J9114-23

DIESEL FUEL INJECTION SYSTEM DIAGNOSIS

SYMPTOM	CAUSE	ACTION
Engine misses under load	Incorrect injection pump timing	Adjust injection pump timing
	Restricted or damaged injector nozzle	Replace or repair as necessary
	Restricted or blocked fuel injection lines	Install fittings proper positions
	Fuel injection pump malfunction or not adjustable	Replace fuel injection pump
Low power	Improper fuel	Drain fuel tank, flush system, fill with proper fuel
	Empty fuel tank or fuel tank vent blocked	Fill tank, bleed system, check tank vent
	Control lever not going to full throttle position	Adjust throttle linkage
	Clogged fuel filter	Replace fuel filter
	Intercooler internally blocked or leaking	Check pressure drop across intercooler. If pressure drop is more than 4 in. Hg, clean or replace as necessary.
	Restricted or blocked fuel supply lines	Remove restrictions or replace lines
	Injection pump overflow fitting switched with inlet fitting	Install fittings in proper positions
	Leaking injection lines, damaged lines or loose connections	Replace damaged lines or tighten connections as necessary. Bleed fuel system
	Incorrect injection pump to engine timing	Adjust injection pump timing
	Restricted or damaged injector nozzle	Repair or replace as necessary
	Clogged or restricted air filter	Remove restrictions or replace filter if necessary
	Air fuel control tube broken or leaking	Repair or replace as necessary
	Low manifold pressure	Check and repair turbocharger operation. Check intercooler and air pipes for blockage
	Injection sequence does not correspond with firing order	Install fuel injection lines in correct order
	Low or uneven engine compression	Repair as necessary
	Restricted or blocked fuel injection lines	Remove restrictions or replace lines
	Incorrect injection pump to engine timing	Check injection pump to engine timing
	Fuel injection pump malfunction or not adjustable	Replace fuel injection pump

DIESEL FUEL INJECTION SYSTEM DIAGNOSIS

SYMPTOM	CAUSE	ACTION
Excessive fuel consumption	Improper diesel fuel	Use correct fuel for conditions. Refer to owner's manual
	Incorrect injection pump timing	Adjust injection pump timing
	Restricted or damaged injector nozzle	Repair or replace as necessary
	Clogged or restricted air filter	Remove restrictions or replace air filter if necessary
	Injection sequence does not correspond with firing order	Install fuel injection lines in correct order
	Intercooler internally blocked or leaking	Check pressure drop across intercooler. If pressure drop is more than 4 in. Hg, clean or replace as necessary
	Low idle misadjusted	Adjust idle stop screw
	Malfunctioning KSB valve	Replace injection pump
	Incorrect injection pump to engine timing	Adjust injection pump to engine timing
	Fuel injection pump malfunction or not adjustable	Replace fuel injection pump
Unable to shut engine off	Voltage to fuel solenoid interrupted or fuel solenoid inoperative	Correct voltage supply problem or replace solenoid
Either poor performance, black smoke or low power	Improper fuel	Drain fuel tank, flush system, fill with proper fuel for conditions. Refer to owner's manual
	Air in fuel system	Bleed fuel system
	Intercooler internally blocked or leaking	Check pressure drop across intercooler. If pressure drop is more than 4 in. Hg, clean or replace as necessary
	Restricted or blocked fuel injection lines	Remove restrictions or replace lines
	Incorrect injection pump timing	Adjust injection pump timing
	Restricted or damaged injector nozzle	Repair or replace as necessary
	Clogged or restricted air filter	Remove restrictions or replace filter if necessary
	Air fuel control tube leaking or broken	Repair or replace as necessary
	Low manifold pressure	Check and repair turbocharger operation
	Injection sequence does not correspond with firing order	Install fuel injection lines in correct order
	Low or uneven engine compression	Repair as necessary

DIESEL FUEL INJECTION SYSTEM DIAGNOSIS

SYMPTOM	CAUSE	ACTION
Either poor performance, black smoke or low power	Injection pump to engine timing	Check injection pump to engine timing
	Fuel injection pump malfunction or not adjustable	Replace fuel injection pump
White or blue fog-like exhaust in full-load range	Improper fuel	Drain fuel tank, flush system, fill with proper fuel, change filter
	Empty fuel tank or fuel tank vent blocked	Fill tank, bleed system, check tank vent
	Air in fuel system	Bleed fuel system
	Clogged fuel filter	Replace fuel filter
	Restricted or blocked fuel injection lines	Remove restriction or replace lines
	Restricted or blocked fuel supply lines	Remove restriction or replace lines
	Wax buildup in fuel filter (cold weather only)	Replace fuel filter, use recommended diesel fuel. Inspect fuel heater electrical connector for damage.
	Incorrect injection pump to engine timing	Adjust injection pump timing
	Injection pump overflow fitting switched with inlet fitting	Install fittings in proper positions
	Fuel injection pump malfunction or not adjustable	Replace fuel injection pump
Incorrect idle speed	Low idle misadjusted	Adjust idle stop screw
	Fuel injection pump malfunction or not adjustable	Replace fuel injection pump
Engine does not rev up	Improper fuel	Drain fuel tank, flush system, fill with proper fuel, change filter
	Empty fuel tank or fuel tank vent blocked	Fill tank, bleed system, check tank vent

J9114-26

DIESEL FUEL INJECTION SYSTEM DIAGNOSIS

SYMPTOM	CAUSE	ACTION
Engine does not rev up	Control lever not going to full throttle position	Adjust throttle linkage
	Air in fuel system	Bleed fuel system
	Intercooler internally blocked or leaking	Check pressure drop across intercooler. If pressure drop is more than 4 in. Hg, clean or replace as necessary
	Clogged fuel filter	Replace fuel filter
	Restricted or blocked fuel supply lines	Remove restrictions or replace lines
	Wax buildup in fuel filter (cold weather only)	Inspect fuel heater electrical connector for damage. Replace fuel filter, use recommended diesel fuel.
	Incorrect injection pump timing	Adjust injection pump timing
	Injection pump overflow fitting switched with inlet fitting	Install fittings in proper sequence
	Low or uneven engine compression	Repair as necessary
	Fuel injection pump malfunction or not adjustable	Replace injection pump
Injection pump runs hot	Overflow blocked	Clean overflow orifice or replace fitting

J9114-254

SERVICE PROCEDURES

INDEX

THROTTLE POSITION SENSOR

The throttle position sensor is adjustable. The sensor must be adjusted after installation.

REMOVAL

(1) Remove the TPS connector (Fig. 1).

(2) Remove the TPS mounting screws. Lift the sensor straight up to remove it.

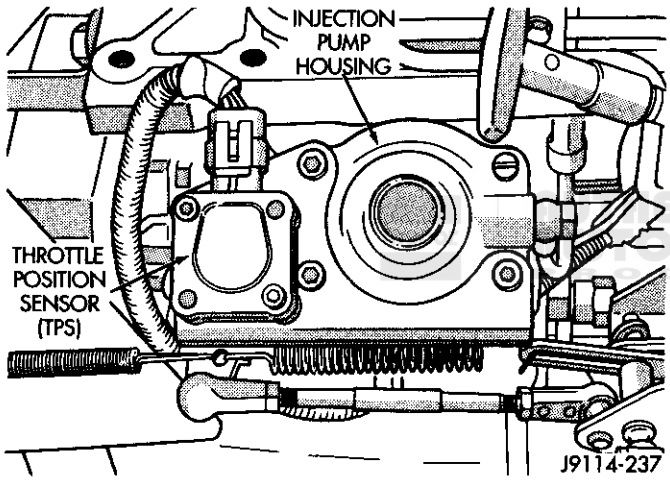


Fig. 1 Throttle Position Sensor

INSTALLATION

The bottom of the throttle position sensor has a hex head. It fits into a hex opening in the injection pump throttle shaft (Fig. 2).

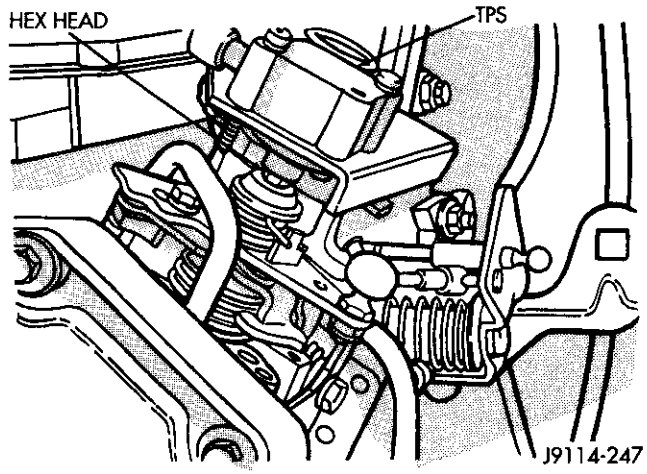


Fig. 2 Throttle Position Sensor Installation

(1) Install the TPS to the bracket. The hex drive on the bottom of the TPS shaft may not align with the opening in the throttle shaft. If not, remove the bracket mounting screws and place the hex drive of the TPS into the socket of the throttle lever. Position the hex drive so the **TPS bracket has to be rotated clockwise to align the mounting holes.**

The hex drive of the TPS should be flush with the top of the throttle lever hex socket or just above it. To adjust the hex head position, hold the nylon shaft in place with an open end wrench while adjusting the hex head position.

(2) If the bracket mounting screws were removed, tighten them to 7 N•m (60 in. lbs.) torque. Tighten the TPS mounting screws.

(3) Connect the electrical connector to the TPS.

(4) Adjust the throttle position sensor. Refer to Adjustment procedure.

ADJUSTMENT

CAUTION: Before adjusting the throttle position sensor, the throttle linkage must be checked for correct adjustment. The throttle lever must contact the low idle speed screw. The throttle lever must reach breakover when the throttle is wide open. Refer to the Accelerator Pedal and Throttle Cable section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.

A digital voltmeter or the DRB II tool is needed to adjust the throttle position sensor.

(1) Connect the negative probe of the voltmeter to a good ground source such as the negative post of the battery.

(2) Backprobe the throttle position sensor output wire at the TPS electrical connector.

(3) With the fuel injection pump throttle lever contacting the low idle speed screw (Fig. 3), the TPS output should be 1 volt or slightly above. If not, use an open end wrench to adjust the TPS sensor shaft until the correct voltage is obtained. The TPS sensor shaft is machined to accept an open end wrench (Fig. 4).

(4) If the output voltage is not within the correct range, adjust the sensor until the correct voltage is obtained.

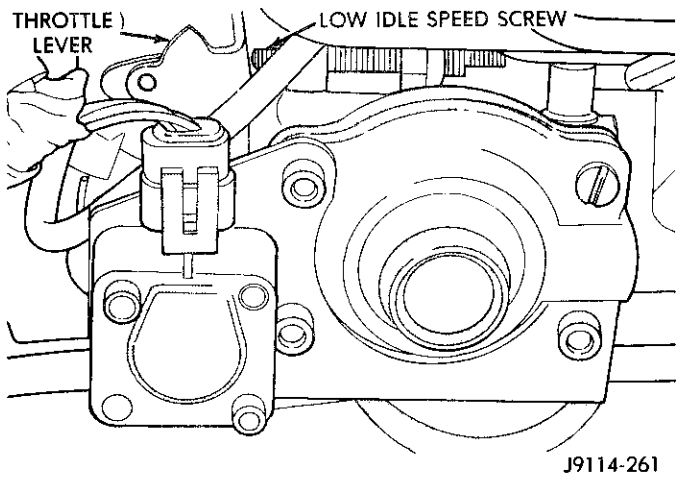


Fig. 3 Throttle Lever Contacting Low Idle Speed Screw

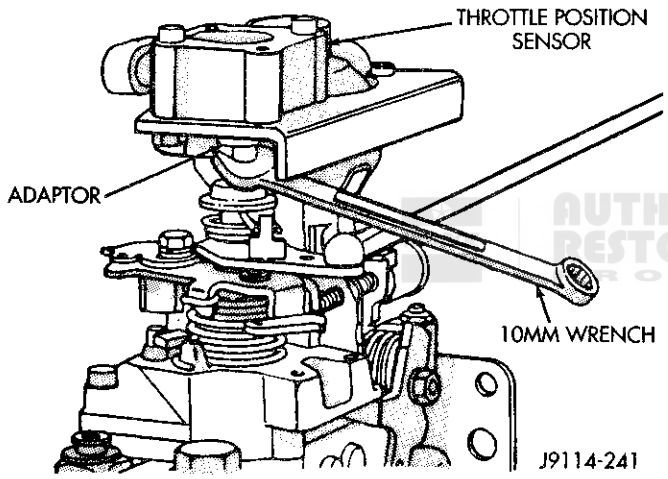


Fig. 4 Adjusting Throttle Position Sensor

(5) Open throttle to the wide open position, the spring load breakover lever should have moved off the stop and rest against the breakover spring (Fig. 5). If not, the throttle actuation rod must be adjusted before adjusting the TPS. Refer to Accelerator Pedal and Throttle Cable section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.

(6) With the throttle held in the wide open position, check the TPS output voltage. It should be at least 2.25 volts higher than the output voltage at closed throttle. If not, adjust the TPS.

KSB SOLENOID

REMOVAL

The KSB Solenoid is not serviceable. It must be replaced as a complete unit.

Air does not have to be bled from the fuel injection pump and fuel system after replacing the KSB solenoid.

(1) Disconnect electrical connector from KSB solenoid (Fig. 6).

(2) Remove KSB solenoid.

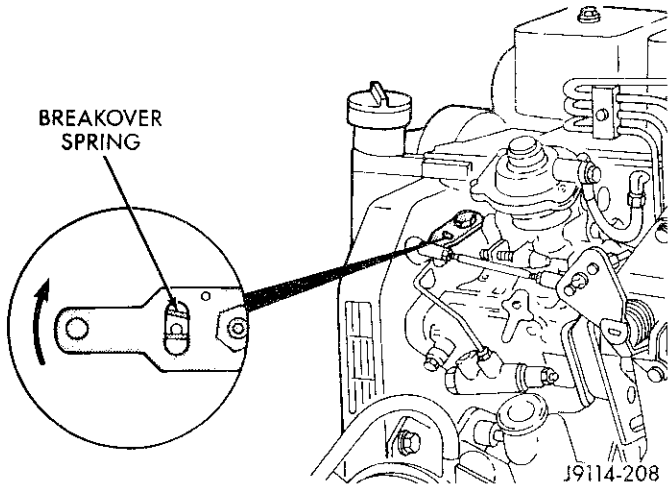


Fig. 5 Correct Breakover Spring Position

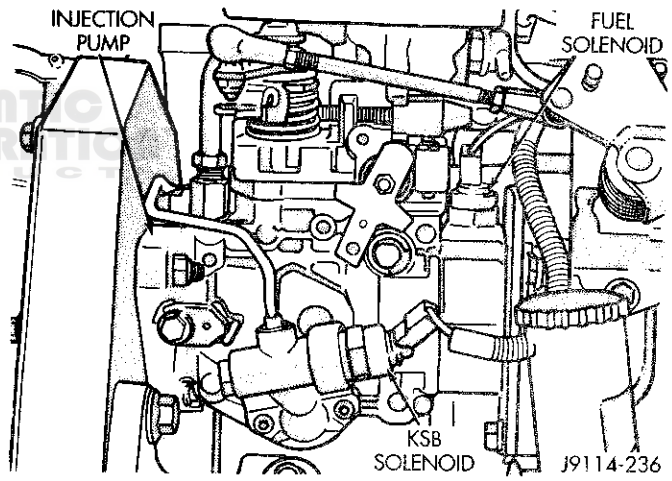


Fig. 6 KSB Solenoid Removal/Installation

INSTALLATION

(1) Install the KSB solenoid in the injection pump. Tighten the solenoid to 43 N•m (32 ft. lbs) torque.

(2) Connect harness connector to KSB solenoid.

FUEL INJECTION PUMP

REMOVAL

(1) Disconnect negative cable from battery.

(2) Disconnect throttle linkage.

(3) Remove throttle bracket (Fig. 7).

(4) Remove injection pump supply line. Refer to "Fuel Injection Pump Supply Line" in the Diesel Fuel Injection section of Group 14, Fuel Systems in the 1991 Rear Wheel Drive Truck Service Manual.

(5) Remove high pressure fuel lines. Refer to "High Pressure Lines" in the Diesel Fuel Injection section of Group 14, Fuel Systems in the 1991 Rear Wheel Drive Truck Service Manual.

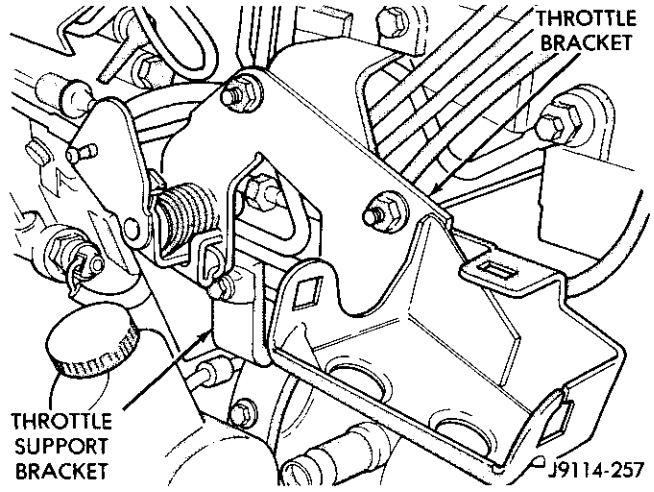


Fig. 7 Throttle Bracket

(6) Disconnect electrical connector from fuel solenoid.

(7) Disconnect electrical connector from KSB Solenoid.

(8) Remove the air control tube (Fig. 8).

(9) Remove fuel pump vent line and capscrew (Fig. 8).

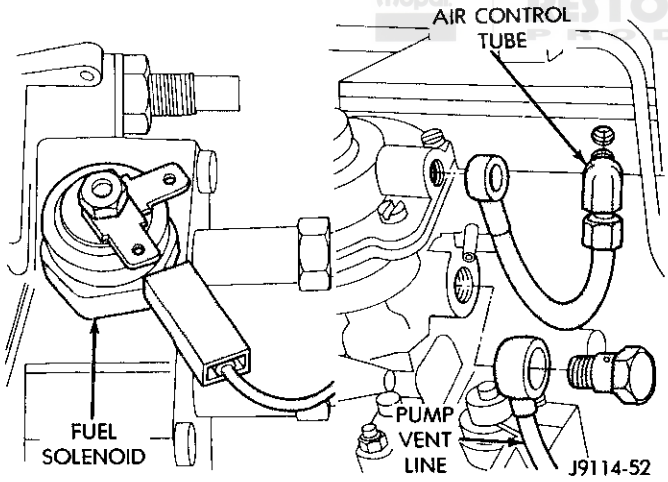


Fig. 8 Fuel Solenoid, Air Control Tube, Pump Vent Line

The control lever is indexed to the shaft during calibration. Do not remove the control lever from injection pump.

(10) Remove bolt attaching the injection pump support bracket to the vacuum pump. Remove the upper and lower bolts attaching the support bracket to the engine block. Loosen the middle bolt and pivot the bracket towards the rear of the engine (Fig. 9).

(11) Remove oil fill tube bracket mounting screw (Fig. 10).

(12) Remove oil fill tube from and adapter from front cover.

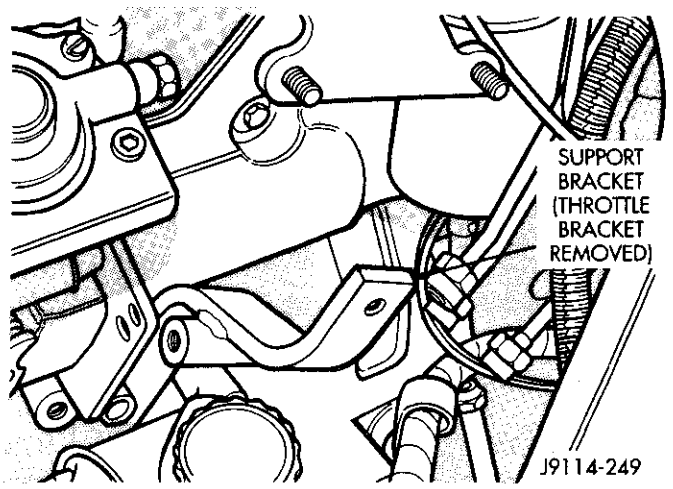


Fig. 9 Injection Pump Support Bracket

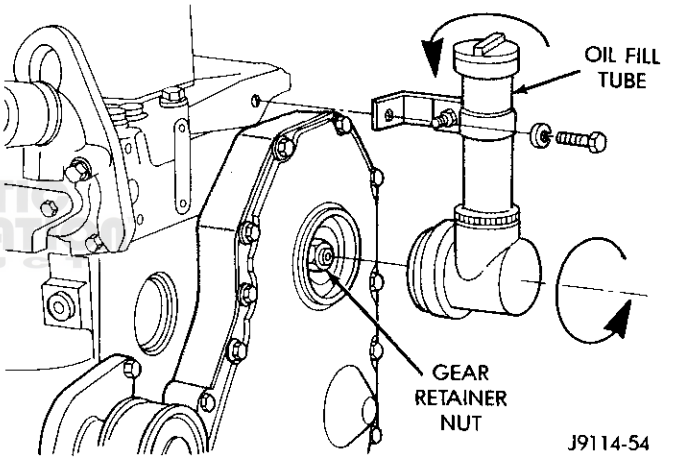


Fig. 10 Oil Fill Tube and Bracket

CAUTION: If the gear retainer nut or washer drops into the gear housing the cover must be removed to retrieve them before the engine is started.

(13) Place a shop towel below the retainer nut in the gear housing cover opening to prevent the nut or washer from falling into the gear housing. Remove the gear retaining nut and washer.

The engine can be rotated with a barring tool such as Snap-On No. SP371, MTE No. 3377462 (Cummins Tool Division), or an equivalent.

(14) Insert the barring tool into the flywheel housing opening. The opening is located in rear flange of the engine, on the exhaust manifold side (Fig. 11).

(15) Rotate engine with the barring tool until the fuel injection pump key-way is in the position shown in Fig. 12.

The engine has a timing pin (Fig. 13). The pin engages a hole in the camshaft gear when cylinder No. 1 is at TDC on the compression stroke.

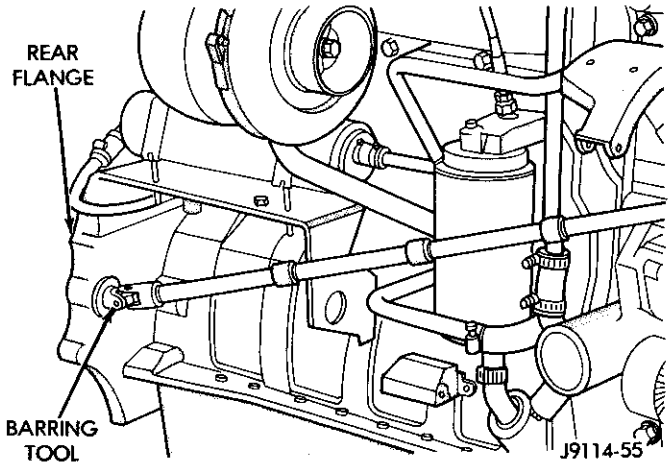


Fig. 11 Rotating Engine with Barring Tool

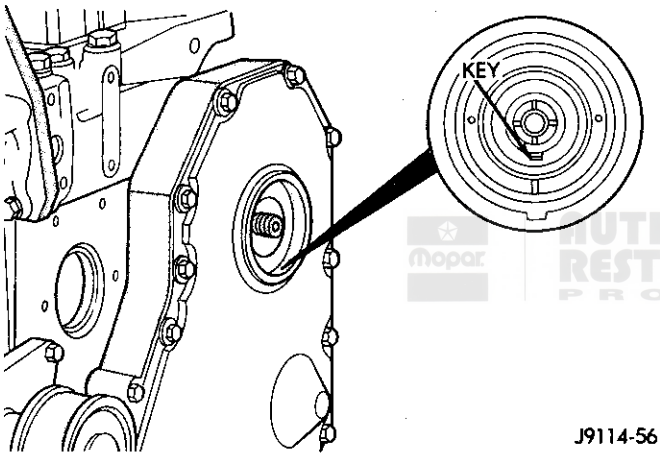


Fig. 12 Injection Pump Key-Way

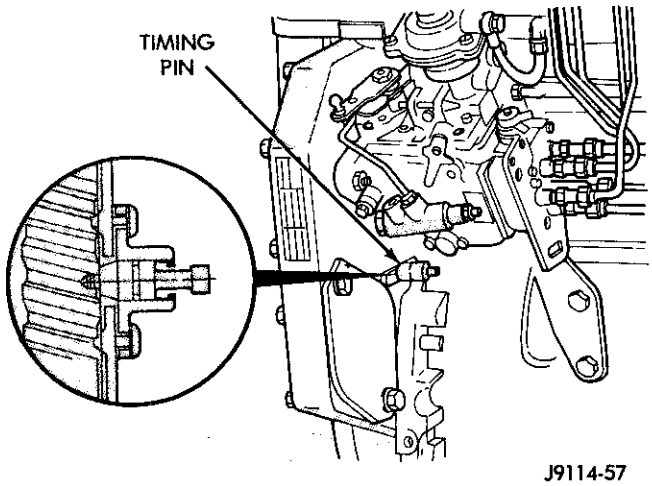


Fig. 13 Timing Pin—Cylinder No. 1

CAUTION: During engine assembly by the manufacturer, the timing pin is positioned to correspond with the compression stroke TDC position of cylinder number one. If the timing pin or gear housing is removed, the timing pin location will not be correct when reinstalled.

(16) Locate TDC position (compression stroke) for No. 1 cylinder by slowly rotating the engine with the barring tool while lightly pushing in on the timing pin. Stop when the timing pin engages the index hole in the camshaft gear.

(17) Disengage the timing pin from the camshaft gear.

Check the timing marks on the flange of the injection pump (Fig. 14). Each pump and engine have unique marks. It is not possible to exchange pumps and use the same marks for alignment.

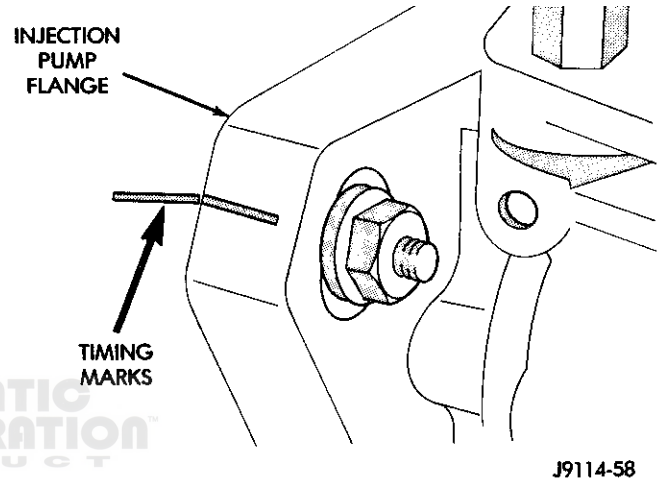


Fig. 14 Injection Pump Timing Marks

The injection pump has a lockscrew. The lockscrew is used to hold the injection pump shaft in place once TDC has been located. New and rebuilt injection pumps should be received with the shaft locked in place by the lockscrew.

(18) Loosen the injection pump shaft lockscrew. It is located below the injection pump mounting nut. Remove washer from injection pump (Fig. 15). **Attach washer to injection pump with wire tag for use during installation.**

(19) Tighten lockscrew.

(20) Use a T-bar puller to separate the gear from the pump shaft. Use M8 X 1.24 mm screws to attach T-bar to shaft. Pull the injection pump gear forward until it separates from the injection pump shaft (Fig. 16). **The injection pump gear cannot be removed from the engine through the oil fill opening in the timing case cover.**

CAUTION: Do not allow the drive gear key-way to drop into the gear housing cover when removing the pump.

(21) Remove the injection pump mounting nuts.

(22) Remove injection pump. Clean gasket surfaces on block and injection pump.

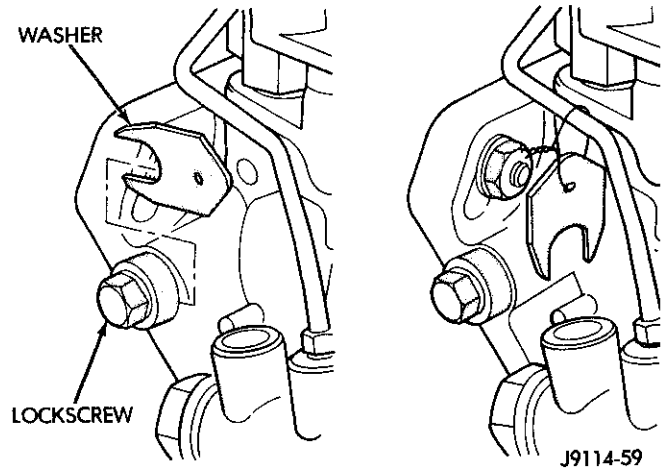


Fig. 15 Injection Pump Shaft LockScrew and Washer

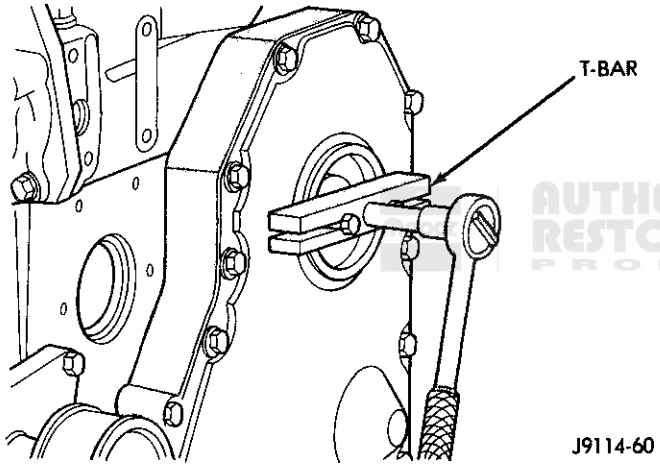


Fig. 16 Separating Pump Gear from Injection Pump Shaft

INSTALLATION

Before installing the injection pump, ensure that No. 1 cylinder is at No. 1 position.

(1) Locate TDC position (compression stroke) for No. 1 cylinder by slowly rotating the engine with the barring tool while lightly pushing in on the timing pin. Stop when the timing pin engages the index hole in the camshaft gear.

(2) Disengage the timing pin from the camshaft gear.

(3) Install a new injection pump gasket.

The shaft of a new or reconditioned pump is locked in place. The key is positioned to align with the drive gear slot when cylinder No. 1 is at TDC on the compression stroke.

CAUTION: Ensure that the injection pump shaft key-way does not fall into the gear housing when installing the injection pump. The key-way must be removed if it falls into the gear housing.

(4) Install the injection pump. Finger tighten the mounting nuts. The pump must be able to move in the slot.

(5) Remove the T-bar from the injection pump gear.

(6) Install pump drive shaft gear retaining nut and spring washer. **The injection pump will rotate slightly if the pump mounting nuts were installed finger tight and the crankshaft does not move.**

(7) Tighten injection pump drive shaft gear retaining nut to 15 - 20 N•m (11 to 15 ft. lbs.) torque. **Do not over tighten. This is not the final tightening torque.**

(8) If installing original injection pump rotate pump to align timing marks. If installing a new or rebuilt pump without a timing mark, take up gear lash by rotating pump counterclockwise towards cylinder head.

(9) Tighten injection pump mounting nuts to 24 N•m (18 ft. lbs.) torque.

If installing a new or rebuilt pump, permanently mark the injection pump flange in line with the mark on the gear housing (Fig. 17).

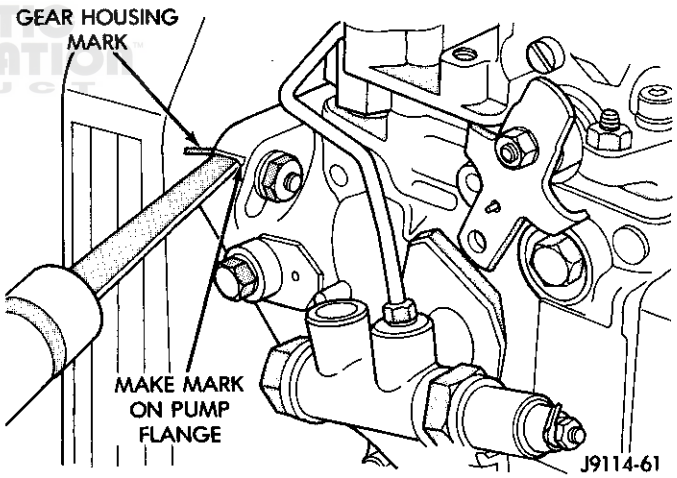


Fig. 17 Marking New or Rebuilt Injection Pump

New and rebuilt injection pumps should be received with the shaft locked in place by the lockscrew.

(10) Loosen injection pump lockscrew and install washer under lockscrew (Fig. 18). Tighten lockscrew to 13 N•m (10 ft. lbs.) torque.

(11) Install injection pump support bracket **with mounting screws finger tight**. Using following the sequence, tighten mounting screws to 24 N•m (18 ft. lbs.) torque.

- Tighten bracket to vacuum pump screw.
- Tighten bracket to block mounting screws.
- Tighten bracket to injection pump mounting screws.

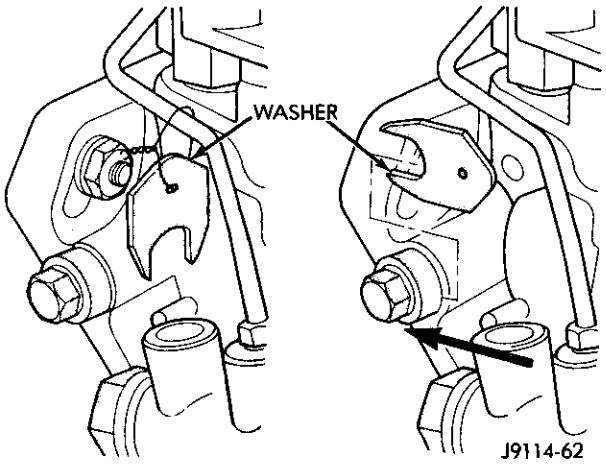


Fig. 18 Installing Lockscrew Washer

- Tighten throttle support bracket mounting screws.

(12) Tighten injection pump drive shaft gear retaining nut to 65 N•m (48 ft. lbs.) torque.

(13) Install oil filler assembly to gear housing. Tighten clamp screw to 43 N•m (32 ft. lbs.) torque.

(14) Install high pressure fuel lines. Refer to "High Pressure Lines" in the Diesel Fuel Injection section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual. Tighten high pressure fuel lines to 24 N•m (18 ft. lbs.) torque.

(15) Install fuel injection pump supply line. Refer to "Fuel Injection Pump Supply Line" in the Diesel Fuel Injection section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.

(16) Connect electrical connector to fuel solenoid.

(17) Connect electrical connector to KSB solenoid.

(18) Install fuel pump vent line and capscrew.

(19) Install air fuel control tube.

(20) Install throttle bracket (Fig. 7). Tighten mounting bolts to 24 N•m (18 ft. lbs.) torque.

(21) Install throttle linkage. When connecting the cable to the control lever, adjust the length so the lever has stop-to-stop movement. Refer to Accelerator Pedal and Throttle Controls section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.

(22) Install and adjust throttle position sensor. Refer to Service Adjustments.

(23) Bleed air from fuel system. Refer to "High Pressure Fuel Lines" in the "Air Bleeding" portion of the Diesel Fuel Injection section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.

(24) Adjust the low idle speed if required. Refer to "Service Adjustments" in this group.

(25) Inspect throttle linkage to ensure that the control lever breaks over the full throttle position. Adjust as necessary. Refer to Accelerator Pedal and Throttle Cable section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.

INJECTION TIMING

If incorrect injection timing is suspected, injection pump to engine timing or injection pump timing may be the cause. Check injection pump timing before checking injection pump to engine timing.

INJECTION PUMP TIMING

CAUTION: When setting injection pump timing, refer to the engine identification plate attached to the timing case flange for the correct specification (Fig. 19).

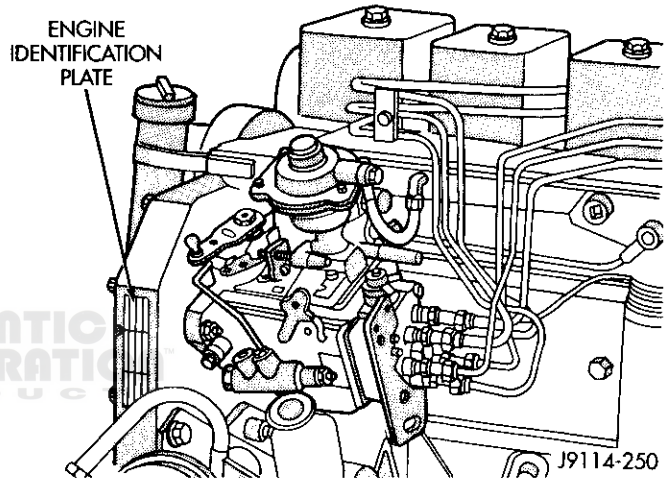


Fig. 19 Engine Identification Plate

The engine can be rotated with a barring tool such as Snap-On No. SP371, MTE No. 3377462 (Cummins Tool Division), or an equivalent.

The engine has a timing pin (Fig. 13). The pin engages a hole in the camshaft gear when cylinder No. 1 is at TDC on the compression stroke.

CAUTION: During engine assembly by the manufacturer, the timing pin is positioned to correspond with the compression stroke TDC position of cylinder number one. If the timing pin or gear housing is removed, the timing pin location will not be correct when reinstalled.

(1) Locate TDC position (compression stroke) for cylinder number one by slowly rotating the engine with the barring tool while lightly pushing in on the timing pin. Stop when the timing pin engages the index hole in the camshaft gear.

(2) **Once TDC has been located, pull the timing pin out of the camshaft gear to the normal run position.**

(3) Remove plug and copper washer from the rear of the injection pump (Fig. 20).

Dial gauges and dial gauge holders used to check injection pump timing are commercially available.

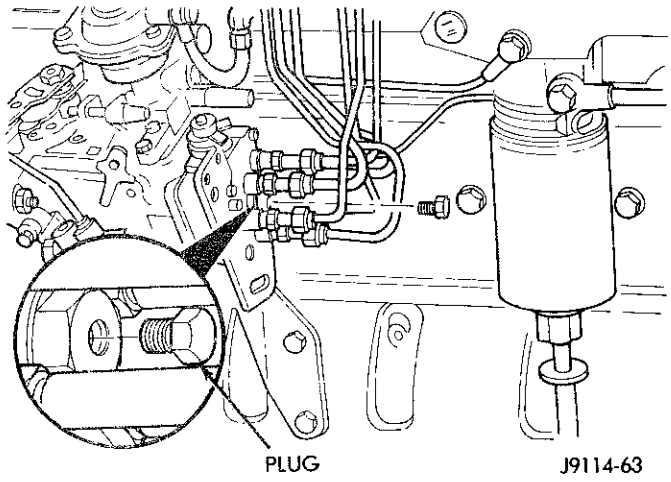


Fig. 20 Timing Indicator Plug

Snap-On dial gauge and gauge holder YA83300, MTE (Cummins Tool Division) dial gauge 3377259 and dial gauge holder 2066 or an equivalent can be used. **Whichever dial gauge is used, note the range of the gauge and what one revolution of needle equals. On gauge shown in Fig. 21 one revolution of the needle equals 0.50 mm.**

It may be necessary to remove one or more high pressure fuel line from the pump to install the gauge (Fig. 21). **If a high pressure fuel line is removed, the system must be bled of air after reinstalling the fuel line. Refer to "High Pressure Fuel Lines" in the "Air Bleeding" portion of the Diesel Fuel Injection section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.**

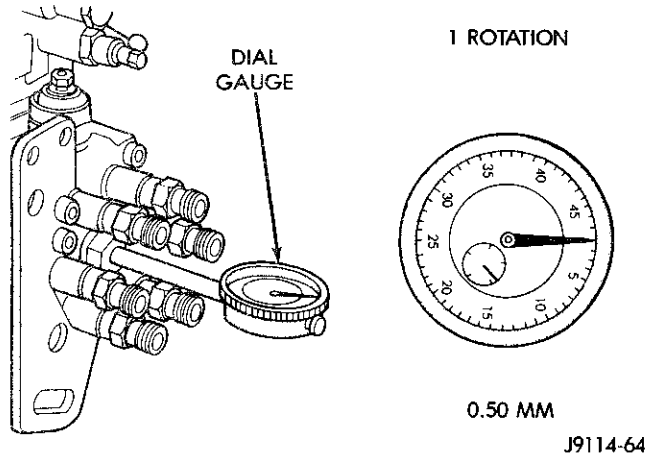


Fig. 21 Checking Injection Pump Timing

(4) Install the gauge holder and gauge in the injection pump (Fig. 21). Ensure gauge travel of at least 2.0 mm.

The engine can be rotated with a barring tool such as Snap-On No. SP371, MTE No. 3377462 (Cummins Tool Division), or an equivalent.

(5) Insert barring tool into the flywheel housing opening. The opening is located in the rear flange of the engine, on the exhaust manifold side (Fig. 11).

(6) Rotate the engine in the direction opposite engine rotation until the needle on the dial gauge stops moving. Adjust the face of the gauge to read zero at the needle.

(7) Rotate the engine (in normal direction) back to TDC on the No. 1 cylinder compression stroke.

CAUTION: The dial gauge needle should move smoothly when the engine is rotated. If the needle jumps or bounces, replace the injection pump.

(8) Taking note of dial gauge travel (number of revolutions), rotate the engine in the normal direction until cylinder No. 1 is again at TDC on the compression stroke. Use the timing pin to locate TDC. The reading on the dial gauge when the timing pin indicates TDC is the amount of plunger lift the pump has at that point. Refer to the specification on the engine identification plate for the correct amount of lift. The injection pump is properly timed when the correct amount of plunger lift is obtained at TDC (TDC pin engages hole in camshaft gear). Mid 1991 model year vehicles were timed with 1.25 mm lift.

(9) If the injection pump does not have the correct lift, rotate the injection pump on the mounting studs while noting the reading on the dial gauge. Rotate the pump to obtain the correct amount of injection pump plunger lift.

(10) Tighten mounting stud nuts to 24 N•m (18 ft. lbs.) torque.

(11) Remove dial gauge and holder.

(12) If removed, install high pressure fuel lines.

(13) Install plug and washer into injection pump. Tighten plug to 10 N•m (7 ft. lbs.) torque.

(14) If high pressure fuel lines were removed, bleed air from the fuel system. Refer to "High Pressure Fuel Lines" in the "Air Bleeding" portion of the Diesel Fuel Injection section of Group 14, Fuel Systems, in the 1991 Rear Wheel Drive Truck Service Manual.

INJECTION PUMP-TO-ENGINE TIMING

(1) With the gear housing cover off, ensure that the crankshaft gear and camshaft gear are correctly timed. Correct as necessary. Refer to Group 9, Engines.

The engine can be rotated with a barring tool such as Snap-On No. SP371, MTE No. 3377462 (Cummins Tool Division), or an equivalent.

The engine has a timing pin (Fig. 12). The pin engages a hole in the camshaft gear when cylinder No. 1 is at TDC on the compression stroke.

CAUTION: During engine assembly by the manufacturer, the timing pin is positioned to correspond with the compression stroke TDC position of cylinder number one. If the timing pin or gear housing is removed, the timing pin location will not be correct when reinstalled.

(2) Locate TDC position (compression stroke) for No. 1 cylinder by slowly rotating the engine with the barring tool while lightly pushing in on the timing pin. Stop when the timing pin engages the index hole in the camshaft gear.

(3) **Once TDC has been located, pull the timing pin out of the camshaft gear to the normal run position.**

(4) With the gear housing cover off, inspect the alignment of the timing marks on the camshaft gear and injection pump gear. The letter "E" on the injection pump gear should be aligned with the mark on the camshaft gear (Fig. 22).

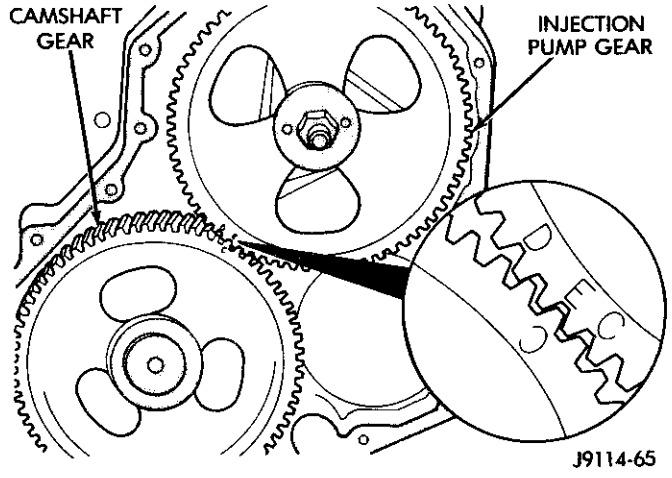


Fig. 22 Injection Pump to Engine Timing

(5) If necessary check and adjust injection pump timing. Refer to "Injection Pump Timing".

STEERING

GENERAL INFORMATION

DESCRIPTION

POWER STEERING PUMP

The power steering pump is a constant flow rate and displacement, vane-type pump. The pump housing and internal components are combined with the reservoir to form a one-piece mechanism. The integral reservoir has a pressure hose attachment located at the rear of the pump.

The power steering pump is connected to the steering gear via the pressure hose and the return hose.

Because of the unique shaft bearings, flow control levels and pump displacements, Ram Truck power steering pumps are not interchangeable with pumps installed in other vehicles.

PUMP—REMOVAL/INSTALLATION

SERVICE INFORMATION

The power steering pump on the **DODGE TURBO DIESEL** engine is bolted onto the rear of the vacuum pump (Fig. 1). The pump is driven by the accessory drive vacuum pump through a connector shaft. **The steering pump is not servicable and must be replaced as a complete unit.** For additional information on the vacuum pump refer to Group 5—Brakes.

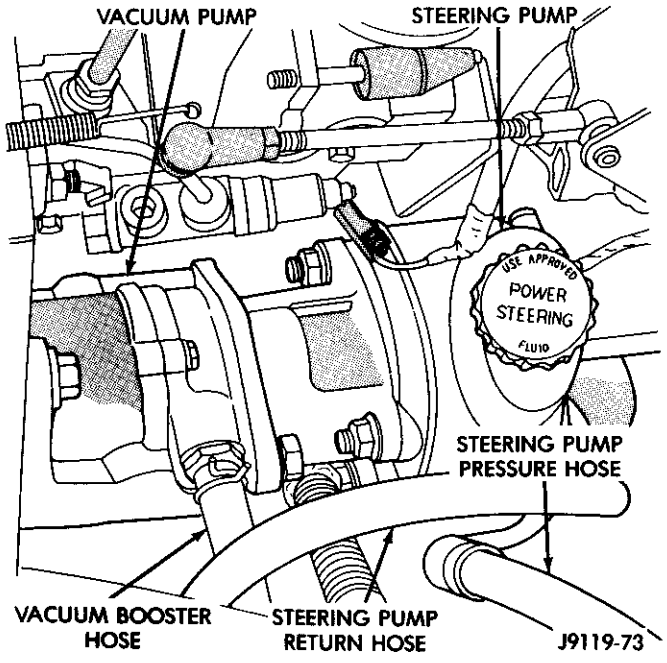


Fig. 1 Vacuum/Steering Pump Assembly

REMOVAL (DIESEL ENGINE)

(1) Place a drain pan under the power steering pump.

(2) Disconnect and cap the vacuum and steering pump hoses (Fig. 1).

(3) Disconnect the electrical connector on the oil pressure sender unit (Fig. 2). Remove sender unit from engine block and plug hole in block.

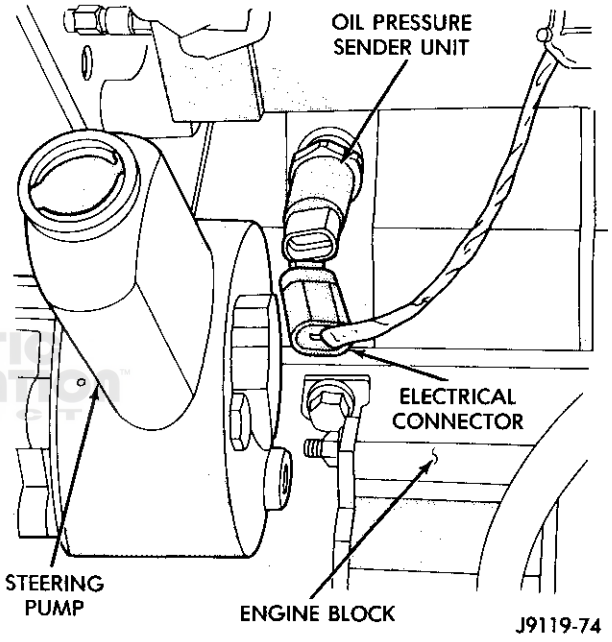


Fig. 2 Oil Pressure Sending Unit

(4) Disconnect and cap the oil feed line from the bottom of the vacuum pump (Fig. 3).

(5) Remove the lower bolt that attaches the vacuum/steering pump assembly to the engine block (Fig. 3). Remove the nut from the steering pump attaching bracket (Fig. 3).

(6) Remove upper bolt from the pump assembly (Fig. 4). Remove the assembly from the engine (Fig. 5).

(7) Remove the gasket from the mounting surfaces on engine block and pump assembly.

(8) Drain the fluid from the steering pump.

(9) Remove the steering pump to vacuum pump bracket attaching nuts (Fig. 6).

(10) Slide the steering pump from the bracket. Use care not to damage the internal oil seal in the vacuum pump (Fig. 7).

(11) Remove the two pump body spacers (Fig. 7), for pump installation.

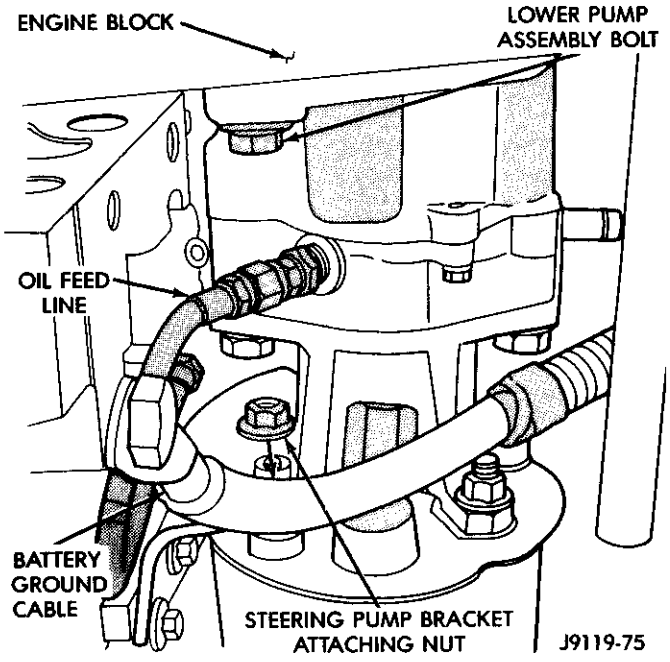


Fig. 3 Oil Feed Line Removal/Installation

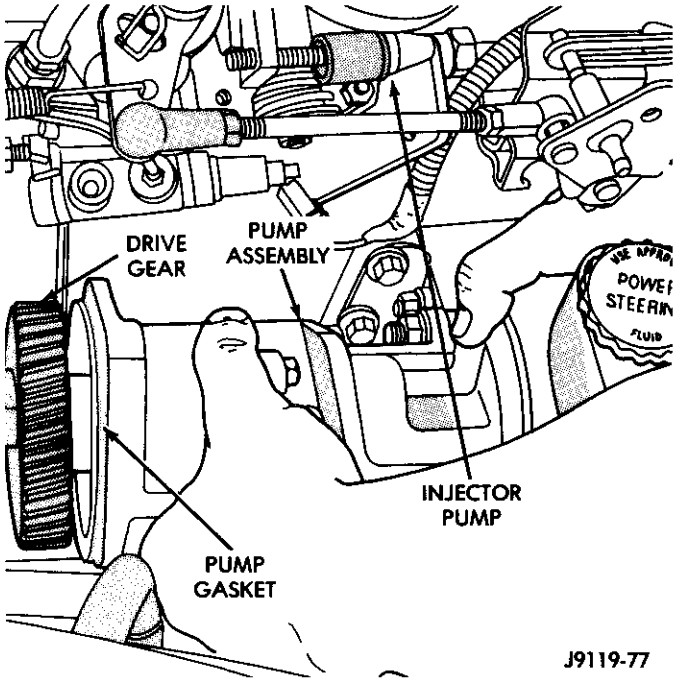


Fig. 5 Pump Assembly Removal/Installation

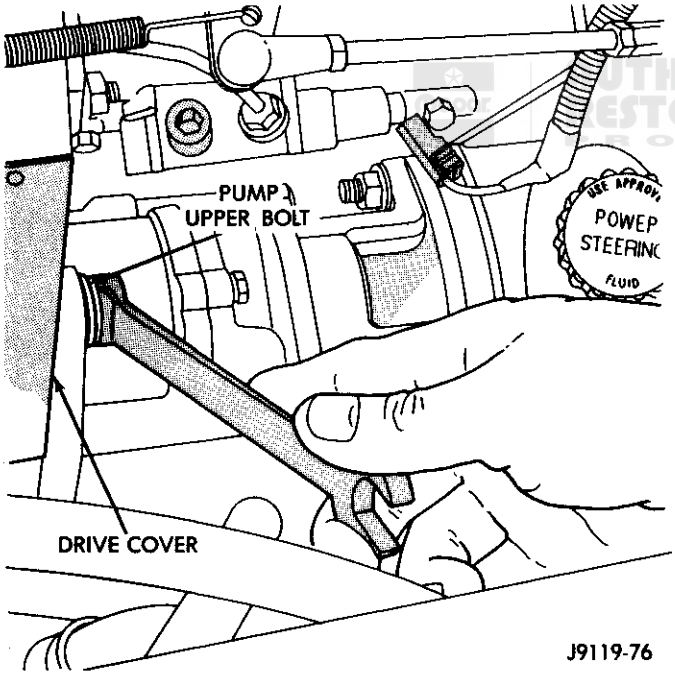


Fig. 4 Pump Assembly Upper Bolt

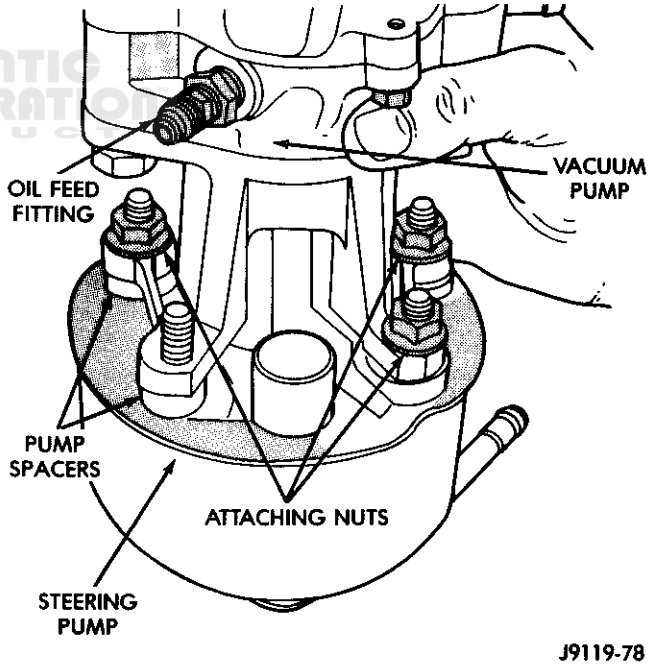


Fig. 6 Bracket Nut Removal/Installation

INSTALLATION (DIESEL ENGINE)

(1) Install the two pump body spacers (Fig. 7).

(2) Rotate the drive gear until the steering pump and vacuum pump drive dogs align. Install the steering pump onto the vacuum pump bracket. Use care to avoid damaging the oil seal in the vacuum pump during installation. **The steering pump housing and spacers must mate completely with the vacuum pump bracket (Fig. 8).**

(3) Install the three (3) vacuum pump bracket to steering pump attaching nuts (Fig. 6) and tighten to 24 N•m (18 Ft. lbs.) torque.

(4) Position a new gasket on the vacuum pump assembly, use sealer if necessary to retain the gasket.

(5) Align and install the pump assembly on the engine (Fig. 5). Ensure the steering pump stud is inserted into the block bracket (Fig. 3). Tighten the pump-to-engine block attaching bolts to 77 N•m (57 ft. lbs.) torque.

(6) Install the steering pump to attaching bracket nut (Fig. 3) and tighten to 24 N•m (18 ft. lbs.) torque.

(7) Remove plug and install the oil pressure sending unit and electrical connector (Fig. 2).

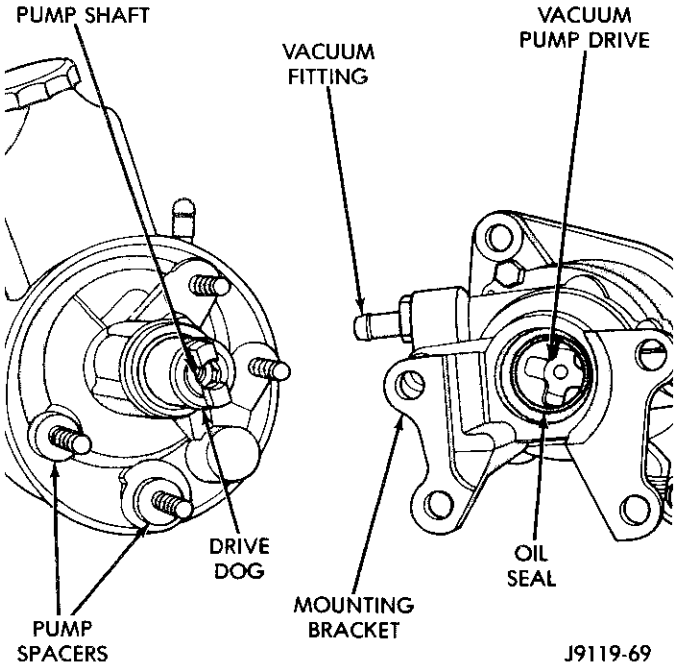


Fig. 7 Steering Pump Removal/Installation

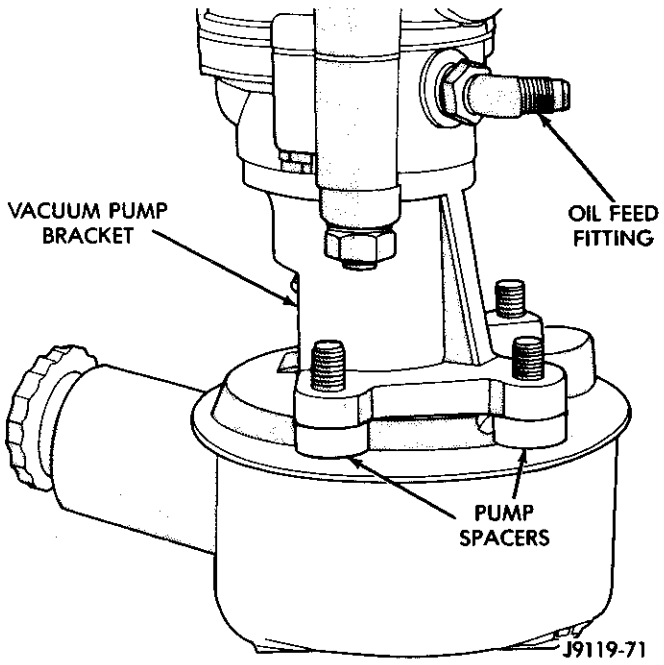


Fig. 8 Steering/Vacuum Pump Assembly

(8) Install the oil feed line to the vacuum pump (Fig. 3). Tighten the oil line connection to 7 N•m (60 in. lbs./ 5 ft. lbs.) torque.

(9) Install the fluid hoses to the power steering pump. Tighten the pressure fitting at the pump with 30 N•m (22 ft. lbs.) torque.

(10) Install and clamp the hose on the vacuum pump.

(11) Fill the reservoir with power steering fluid only. If necessary, refer to **Pump Initial Operation** for detailed instructions.

(12) Start and run the engine. Check the operation of the brakes, if necessary refer to Group 5—Brakes for additional information.

TORQUE SPECIFICATIONS

COMPONENT	SET-TO-TORQUE	RECHECK TORQUE
Vacuum/Steering Pump-to-Block (Diesel)	77 N•m (57 ft. lbs.)	
Oil Pressure Feed Vacuum Pump (Diesel)	7 N•m (60 in. lbs.)	
Pump-to-Bracket Attaching Bolt/Nut	24 N•m (18 in. lbs.)	
Power Steering Gear Housing-to-Frame Bolt/Nut	136 N•m (100 ft. lbs.)	
Sector Shaft Adjustment Screw Locknut (Power Steering Gear)	38 N•m (28 ft. lbs.)	
Sector Shaft Cover Bolt (Power Steering Gear)	203 N•m (150 ft. lbs.)	
High Pressure Hose Fitting (At Pump and Gear)	30 N•m (22 ft. lbs.)	
Steering Wheel-to-Shaft Nut Non-Tilt or Tilt Column	61 N•m (45 ft. lbs.)	
Steering Column Bracket-to-Support Stud Nut	2 N•m (20 in. lbs.)	
Steering Column Bracket-to-Instrument Panel Support Nut	12 N•m (110 in. lbs.)	
Steering Column Shaft-to-Steering Gear Coupler Bolt	23 N•m (200 in. lbs.)	
Steering Column Support Plate Bolt	7 N•m (60 in. lbs.)	

J9119-72

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

TRANSMISSION

CONTENTS

GENERAL INFORMATION

A heavy duty version of the A518, 4-speed automatic transmission has been released for use with the Cummins turbo diesel engine.

Major differences between diesel and gas engine versions of the A518 involve the:

- transmission case
- torque converter
- planetary gears
- transmission shafts
- governor weight assembly
- overrunning clutches
- fluid temperature thermo-switch

TRANSMISSION CASE

The diesel A518 transmission case has a larger converter housing to accommodate the 12.2 in. torque converter. The housing bolt pattern is also different being drilled for the Cummins engine block.

TORQUE CONVERTER

A three element, non-lockup torque converter is used for diesel engine applications. Converter diameter is 12.2 in. (310 mm).

The converter is not a serviceable component. Replace the converter as an assembly if diagnosis indicates this is necessary.

TRANSMISSION OVERRUNNING CLUTCH AND LOW-REVERSE DRUM

A new design overrunning clutch is used in diesel versions of the A518 transmission. The individual components consist of: the cam, which is still pressed into the case; the clutch race which is now pressed onto the hub of the low-reverse drum; and the new cage-type overrunning clutch assembly.

The new overrunning clutch assembly will also be phased into gasoline engine versions of the A727/A518 transmission. Production release is scheduled for sometime in January or February 1991.

The new clutch assembly contains more rollers and springs than previous models. It also features a cage-type retainer for the springs and rollers. The separate retainer used previously is eliminated.

The clutch race is now pressed onto the hub of the low-reverse drum. The race is not removable and is serviced only as part of the drum.

The new clutch cam is essentially the same as the prior design. The tools and service techniques for replacing new and prior design clutch cams are the same. Refer to the procedures in Group 21 of the 1991 manual.

PLANETARY GEARS

The transmission and overdrive planetary gear carriers in the diesel A518 are heavy duty components.

The transmission planetary carriers have four pinion gears. The carrier in the overdrive compounder has five pinion gears. The heavy duty planetary units are unique to the diesel version of the A518.

TRANSMISSION AND OVERDRIVE COMPOUNDER CLUTCH PACKS

Clutch packs used in the diesel version of the A518 contain the following number of discs and plates:

- transmission front/rear clutch has 4 discs and 5 steel plates
- overdrive clutch has 5 discs and 6 steel plates
- overdrive direct clutch has 8 discs and 9 steel plates

GOVERNOR WEIGHT ASSEMBLY

The governor weight assembly in the diesel A518 is made of alloyed brass. The diesel weight assembly is easily identified by the distinctive gold color of the alloyed material.

The heavier weight assembly provides the shift points needed to offset lower operating speeds of a diesel engine.

The alloyed weight assembly is unique to the diesel A518. It is not interchangeable with the weight assemblies used in gas engine versions of the A518.

FLUID TEMPERATURE THERMO—SWITCHES

Fourth gear operation in the diesel A518 is also controlled by two temperature sensitive thermo-switches.

The first thermo-switch is the engine coolant temperature switch. This switch prevents overdrive fourth gear operation when engine coolant temperature is below approximately 65° F.

The second thermo-switch directly monitors transmission fluid temperature. The switch will either downshift the transmission to third gear, or prevent a 3-4 upshift when fluid temperature exceeds 270-275° F.

The fluid temperature switch is located in a boss built into the cooler outlet line. The boss and switch are located approximately 2-3 inches from the outlet line fitting in the transmission case.

The engine coolant and fluid temperature switches are in circuit with the overdrive control switch in the instrument panel. A detailed schematic showing switch circuitry and connection is provided in Group 14 of this supplement.

SERVICE PROCEDURE AND SPECIFICATION CHANGES

Specifications and repair procedures for the diesel and gas engine versions of the A518 are basically the same. The only component requiring different service methods is the new overrunning clutch.

Service procedures for the new overrunning clutch are included in this supplement section. Refer to the 1991 shop manual for all other A518 service procedures.

SERVICING THE NEW OVERRUNNING CLUTCH

CLUTCH COMPONENT REMOVAL

(1) Disassemble the transmission down to the low-reverse drum as described in Group 21 of the 1991 manual.

(2) Remove the snap ring that retains the low-reverse drum on the overdrive piston retainer hub.

(3) Slide the low-reverse drum off the retainer hub and out of the rear band (Fig. 1).

(4) Note that the overrunning clutch race will remain on the splines of the low-reverse drum after removal (Fig. 2). **The race is a permanent press fit on the hub splines. Do not attempt to remove the race.**

(5) Remove the overrunning clutch assembly (Fig. 3). The assembly can be removed without displacing the rollers and springs if care is exercised. Note position of the rollers and springs for assembly reference.

(6) Examine the clutch cam (Fig. 3). If the cam is worn, damaged, or loose, replace it. Refer to the procedure in the A518 section, Group 21 of the 1991 manual.

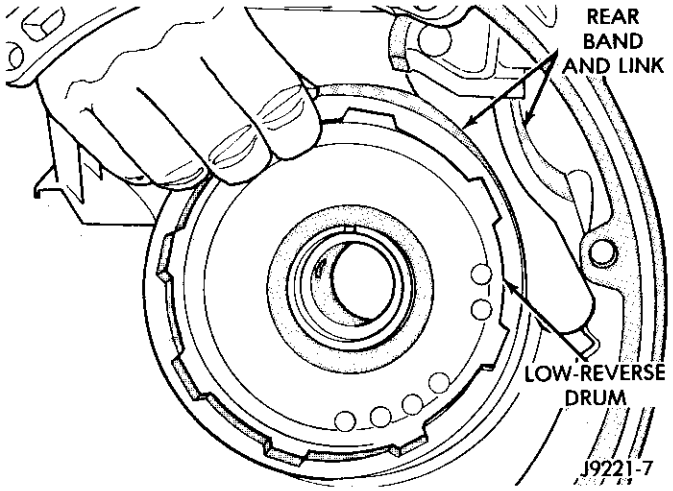


Fig. 1 Removing/Installing Low-Reverse Drum

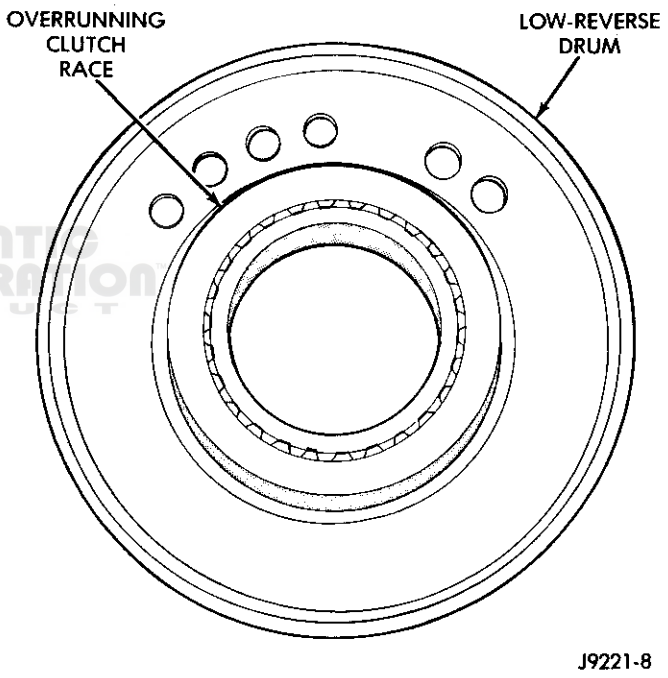


Fig. 2 Overrunning Clutch Race Position

(7) Examine the overrunning clutch race. Replace the low-reverse drum and race as an assembly if either the race, or drum is worn or damaged. Also replace the entire assembly if the race is loose on the splines of the drum hub.

CLUTCH COMPONENT INSTALLATION

(1) Lubricate the overdrive piston retainer hub, clutch race, clutch cam, and overrunning clutch rollers with Mopar ATF Plus, or Dexron II®.

(2) If any of the overrunning clutch rollers and springs came out of the retainer, reinstall them as follows: Install and seat the spring in the retainer first. Then insert the roller between the spring and retainer stop as shown (Fig. 4). Verify that each roller and spring are fully seated before proceeding.

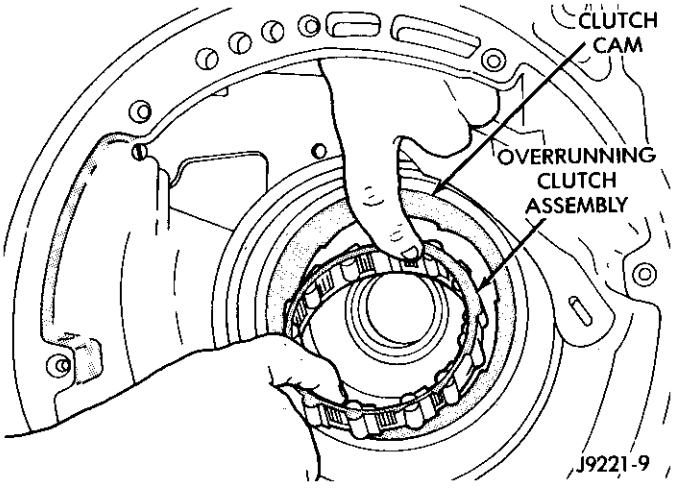


Fig. 3 Removing/Installing Overrunning Clutch

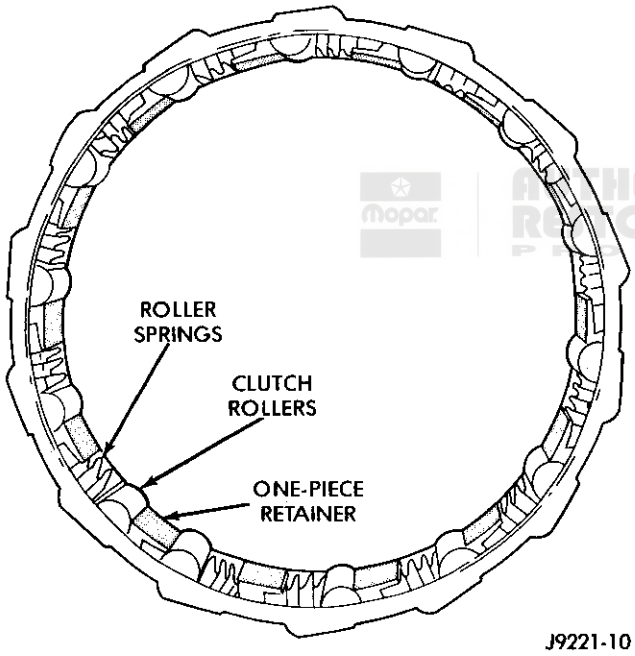


Fig. 4 Clutch Roller, Spring And Retainer Assembly

(3) Install and seat the clutch assembly in the cam (Fig. 5). **The retainer is a one-way fit in the cam. The flanged side of the retainer should be facing outward. The retainer and rollers will slip easily into the cam when properly positioned.**

(4) Insert the low-reverse drum through the rear band.

(5) Tilt the drum slightly and carefully engage the clutch race (on the drum hub) in the overrunning clutch rollers.

(6) Raise the low-reverse drum to a level position. Then rotate the drum in a clockwise direction until fully seated.

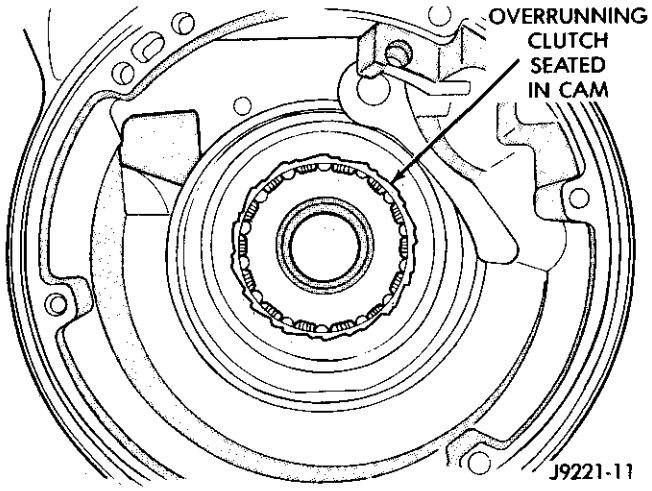


Fig. 5 Overrunning Clutch Seated In Cam

(7) Check overrunning clutch operation. The low-reverse drum should rotate freely in a clockwise direction and lock in a counterclockwise direction.

(8) Install the snap ring that secures the low-reverse drum to the hub of the overdrive piston retainer.

(9) Complete transmission assembly as described in Group 21 of the 1991 manual. Refer to the A518 overhaul section.

GENERAL SPECIFICATIONS—DIESEL A518

Gear Ratios

- First Gear - 2.45:1
- Second Gear - 1.45:1
- Third Gear - 1:1
- Fourth Gear - 0.69:1
- Reverse - 2.21:1

Recommended Fluid

Use Mopar ATF Plus, Type 7176, or Dexron II®

Torque Converter

Three element, 309.8 mm (12.2 in.) diameter, non-lockup

Clutch Packs

- Front Clutch 4 discs and 5 plates
- Rear Clutch - 4 discs and 5 plates
- Overdrive Clutch - 5 discs and 6 plates
- Direct Clutch - 8 discs and 9 plates

End Play—Clearance—Adjustment Specifications

End play, clearance, and adjustment specifications for diesel and gas engine versions of the A518 are essentially the same. Refer to the specifications provided in the 1991 shop manual.

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

AIR CONDITIONING

CONTENTS

COMPRESSOR OVERHAUL (SD-709)

INDEX

DESCRIPTION

The A/C system uses a Sanden compressor. This compressor is a 7 piston design. Designated the SD-709, the compressor is mounted on the front right side of the engine and is driven by a serpentine belt. System lubrication is provided by 135cc ±15cc (4.6 cu. in. ±0.5 cu. in.) of 500 viscosity refrigerant oil.

The clutch used on the compressor consists of 3 basic components: the pulley, front plate and the field coil. The pulley and field coil are attached to the front head of the compressor with tapered snap rings. The hub is keyed to the compressor shaft and is retained on the shaft with a self-locking nut. Special service tools are required to remove and install the clutch plate on the compressor shaft.

COMPRESSOR ISOLATION

It is not necessary to discharge the system for compressor removal. The compressor can be isolated from the remainder of the system and eliminate the need for recharging when performing compressor service.

(1) Connect pressure gauge and manifold.
(2) Close both gauge hand valves.
(3) Mid-position both service valves.

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR FAN. DO NOT WEAR LOOSE CLOTHING.

(4) Start the engine and operate the air conditioning system.
(5) Turn the suction service valve slowly clockwise toward the front seated position.
(6) When pressure drops to zero, stop the engine and compressor and quickly finish front-seating the suction service valve.
(7) Front-seat the discharge service valve.
(8) Loosen the oil level check plug slowly to release any internal pressure in the compressor.

The compressor is now isolated from the remainder of the system.

The service valves can be removed from the compressor.

PURGING COMPRESSOR OF AIR

The compressor must be purged of air whenever it has been isolated for an oil level check or other service procedures without discharging the entire system.

(1) Cap the service gauge ports on both of the service valves.
(2) Back-seat the suction service valve to allow the system refrigerant to enter the compressor.
(3) Place the discharge service valve in the mid-position or cracked-position.
(4) Loosen the discharge service valve gauge port cap to permit the refrigerant to force any air out of the compressor.
(5) Back-seat the discharge service valve and tighten the gauge port cap.
(6) The compressor is now ready for service.

COMPRESSOR

REMOVAL

(1) Isolate the compressor.

(2) Disconnect the battery negative cable and clutch lead wire.

(3) Remove the discharge and inlet (suction) service valves from the compressor. Plug or tape all the openings.

(4) Refer to Group 7, Cooling System and remove the drive belt(s).

(5) Remove the bolts and lift the compressor from the mounting bracket (Fig. 1).

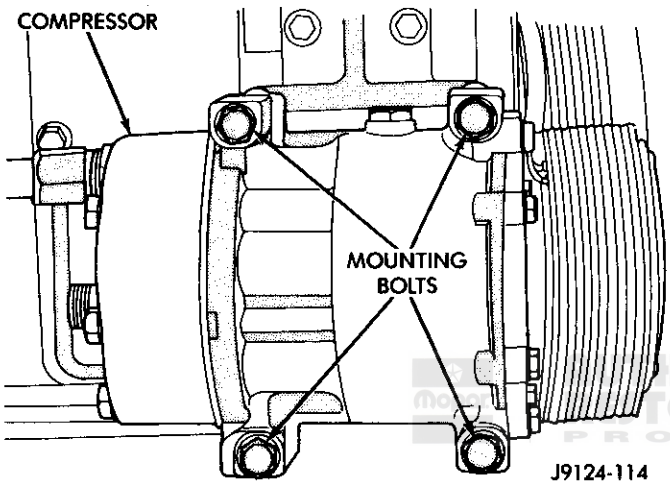


Fig. 1 Compressor Mounting (5.9L Diesel)

INSTALLATION

If a replacement compressor is being installed: check the oil (see oil level filling and checking procedure), add or subtract oil as necessary and install the magnetic clutch on the compressor.

(1) Install the compressor on the mounting bracket. Tighten the bolts to 27 N•m (20 ft. lbs.) torque.

(2) Refer to Group 7, Cooling System and install the drive belt(s).

(3) Check the belt tension.

- New drive belt—800-900 N (180-200 lbs-f).
- Used belt—623-712 N (140-160 lbs-f).

(4) Remove the tape or plastic plugs from all the suction and discharge openings and install the service valves on the compressor.

(5) Connect the battery negative cable.

(6) Evacuate, charge and test the system for leaks.

MAGNETIC CLUTCH

The magnetic clutch consists of a stationary electro-magnetic coil and a rotating pulley and plate assembly.

The electromagnetic coil is retained on the compressor with a snap ring and is dimpled to maintain its position.

The pulley and plate assembly are mounted on the compressor shaft.

When the compressor is not in operation, the pulley free wheels on the clutch hub bearing. When the coil is energized the plate is magnetically engaged with the pulley and turns the compressor shaft.

REMOVAL

(1) Insert the 2 pins of the front plate spanner into any 2 threaded holes of the clutch front plate (Fig. 2). Hold clutch plate stationary. Remove hex nut with 19 mm (3/4 inch) socket.

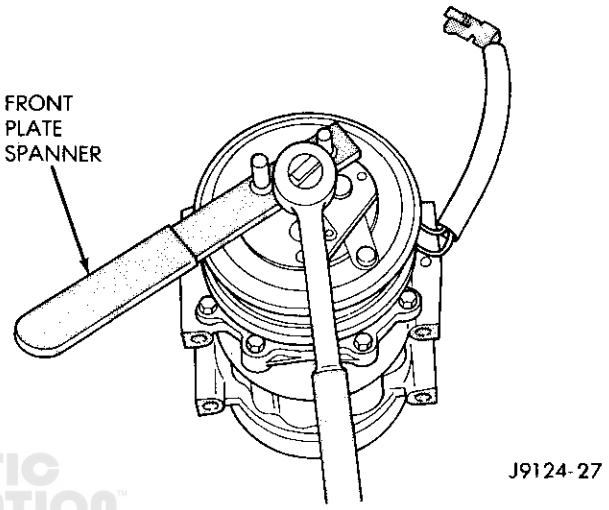


Fig. 2 Remove Hex Nut

(2) Remove clutch front plate using puller. Align puller center bolt to compressor shaft (Fig. 3). Thumb tighten the puller bolts into the threaded holes.

(3) Turn center bolt clockwise with 19 mm (3/4 inch) socket until front plate is loosened.

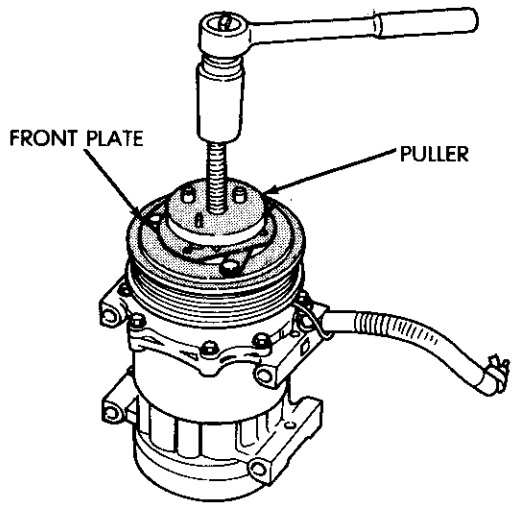
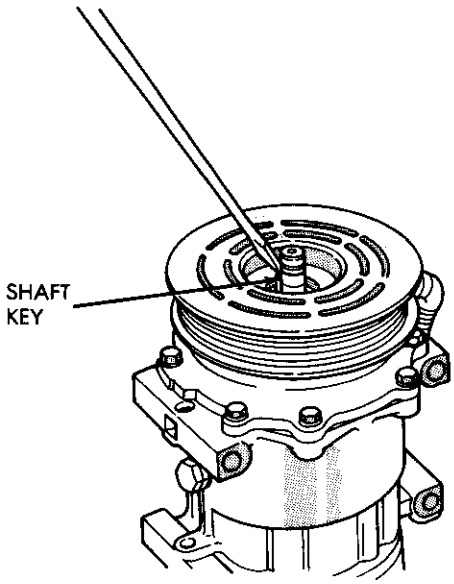


Fig. 3 Remove Clutch Front Plate

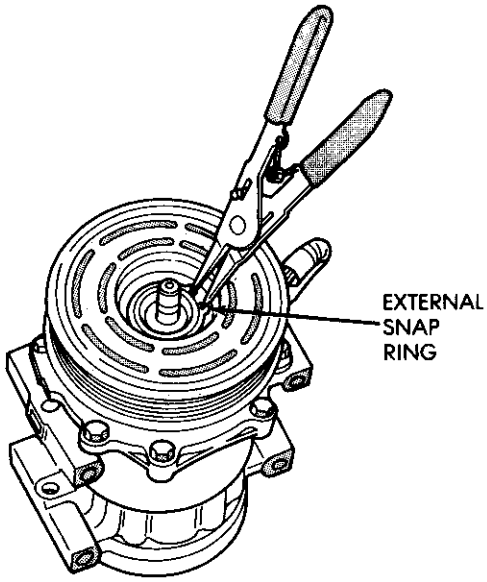
(4) Remove shaft key by lightly tapping it loose with a slot screw driver and hammer (Fig. 4).



J8924-19

Fig. 4 Remove Shaft Key

(5) Remove the external front housing snap ring by using spread type snap ring pliers (Fig. 5).

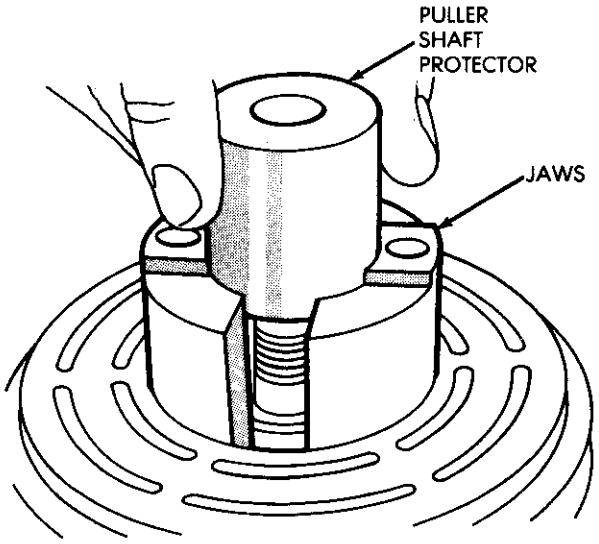


J8924-20

Fig. 5 Remove External Snap Ring

(6) Insert the lip of the jaws of the rotor puller into the snap ring groove exposed in the previous step (Fig. 6).

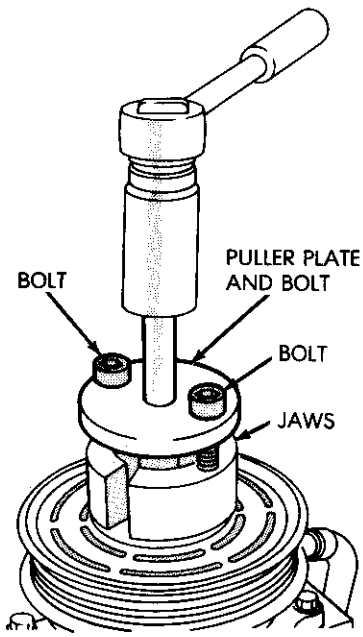
(7) Place rotor puller shaft protector over the exposed shaft.



J8924-21

Fig. 6 Install Shaft Protector

(8) Install the puller plate and bolt (Fig. 7). 2 bolts go through the plate and into the jaws. Finger tighten bolts.



J8924-22

Fig. 7 Install Puller Plate

(9) Turn puller center bolt clockwise using 3/4 inch socket until rotor pulley is free.

(10) Loosen coil lead wire from clip on top of compressor front housing (Fig. 8).

(11) Using spread type snap ring pliers, remove snap ring and field coil (Fig. 9).

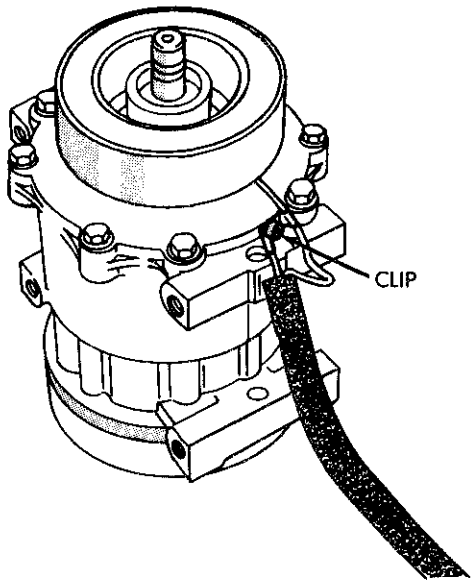


Fig. 8 Loosen Coil Lead Wire

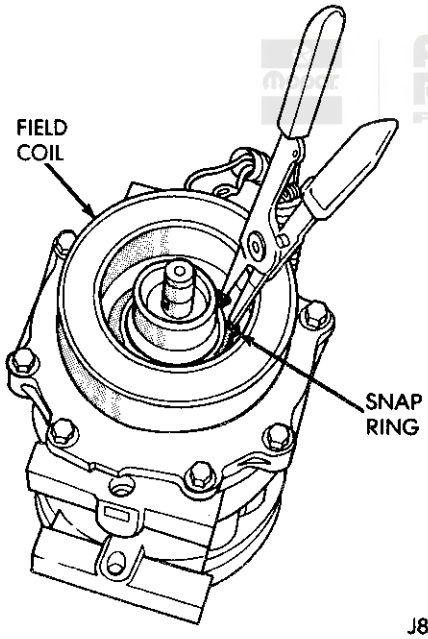


Fig. 9 Remove Snap Ring and Field Coil

INSTALLATION

(1) Install the field coil with the snap ring.

(2) Place coil lead wire under clip on top of compressor front housing and tighten the retaining screw.

(3) Support the compressor on the 4 mounting ears at the compressor rear. If a vise is being used, clamp only on the mounting ears. Never clamp on the compressor body.

(4) Align rotor assembly squarely on the front housing hub.

(5) Using Rotor Installer Set, place the ring part of the set into the bearing cavity (Fig. 10). Make certain the outer edge rests firmly on the rotor bearing inner race.

(6) Place the tool set driver into the ring as shown (Fig. 11).

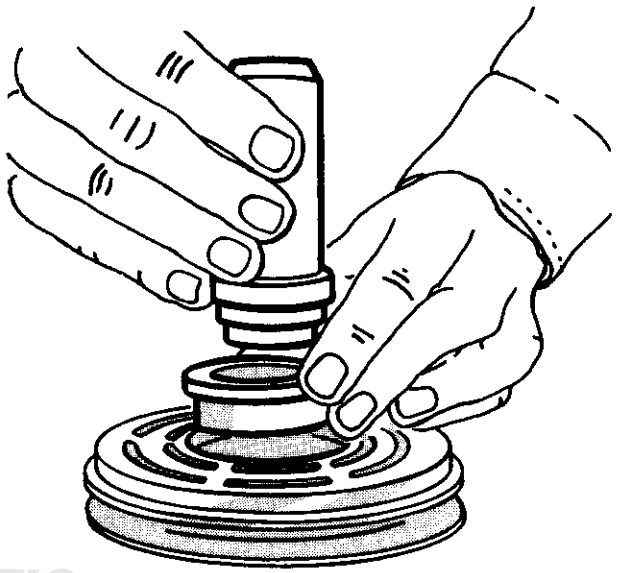


Fig. 10 Install Rotor Installer Set

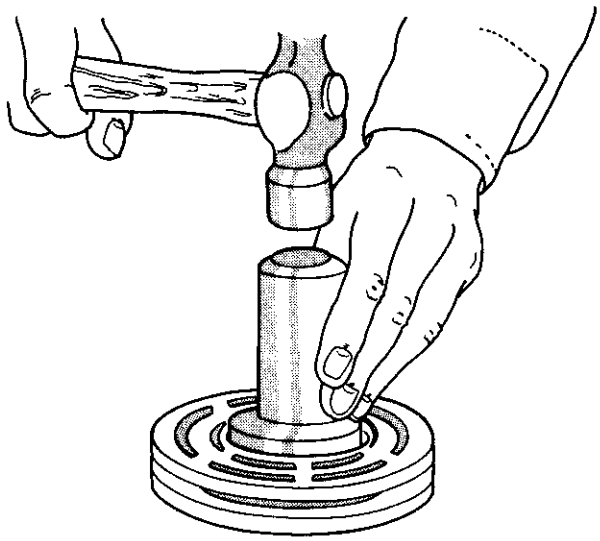


Fig. 11 Install Rotor

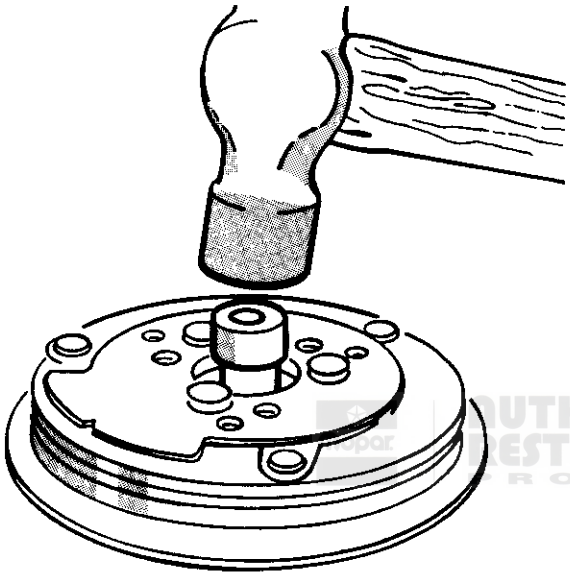
(7) With a hammer, tap the end of the driver while guiding the rotor to prevent binding. Tap until the rotor bottoms against the compressor front housing hub. Listen for a distinct change of sound during the tapping process.

(8) Install external front housing snap ring with spread type snap ring pliers.

(9) Install front plate assembly.

- Check that original clutch shims are in place on compressor shaft.
- Replace compressor shaft key.
- Align front plate keyway to compressor shaft key.

(10) Using shaft protector, tap front plate to shaft until it has bottomed to the clutch shims (Fig. 12). Listen for a distinct change of sound during the tapping process.



J8924-27

Fig. 12 Install Front Plate to Shaft

(11) Replace shaft hex nut. Tighten the hex nut to 37 N•m (27 ft. lbs.) torque.

(12) Check air gap with feeler gauge. The specification is 0.406-0.787 mm (0.016-0.031 inch). If air gap is not consistent around the circumference, lightly pry up at the minimum variations (Fig. 13). Lightly tap down at points of maximum variation.

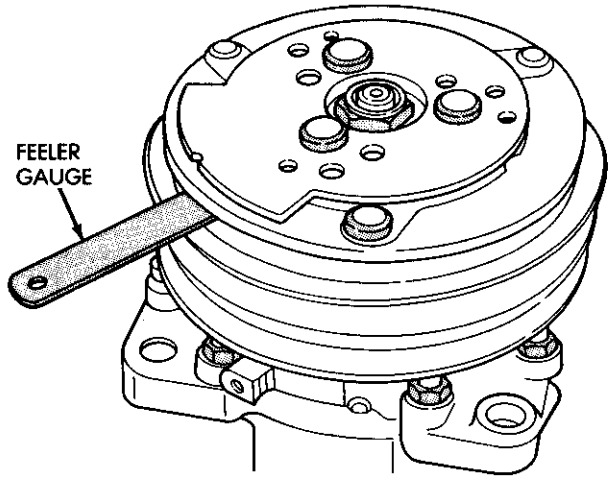
The air gap is determined by the spacer shims. When installing the original or a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that previously did not have a clutch, use 0.040, 0.020, and 0.005 shims from the clutch accessory sack.

(13) If the air gap does not meet the specification given, add or subtract shims as required.

COMPRESSOR SHAFT SEAL

REMOVAL

(1) Insert the 2 pins of the front plate spanner into any 2 threaded holes of the clutch front plate (Fig. 2). Hold clutch plate stationary. Remove hex nut with 19 mm (3/4 inch) socket.



J8924-28

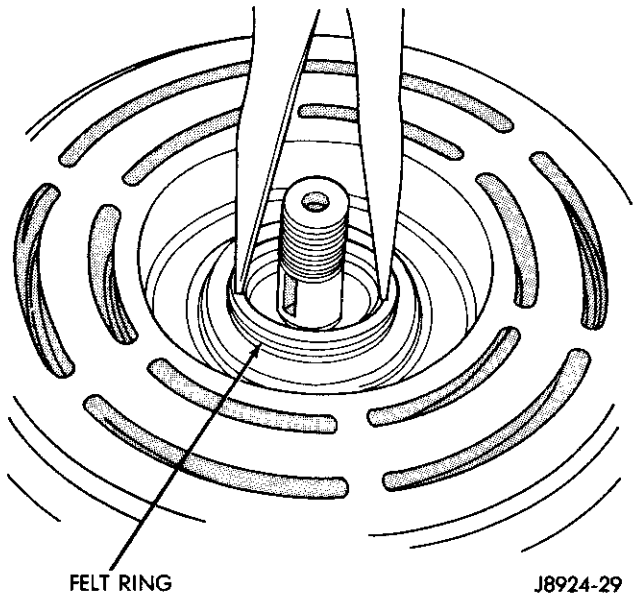
Fig. 13 Check Air Gap

(2) Remove clutch front plate using puller (Fig. 3). Align puller center bolt to compressor shaft. Thumb tighten the 3 puller bolts into the threaded holes.

(3) Turn center bolt clockwise with 19 mm (3/4 inch) socket until front plate is loosened.

Shaft seal replacement should be done on the bench. Never use any old parts of the shaft seal assembly. Rebuild the complete assembly.

(4) Using either of the snap ring tools, insert the tool points into the 2 holes of the felt ring metal retainer and lift out the felt ring (Fig. 14).



J8924-29

Fig. 14 Remove Felt Ring

(5) Remove the clutch shim. Use O-ring hook and a small screwdriver to prevent shim from binding on shaft (Fig. 15).

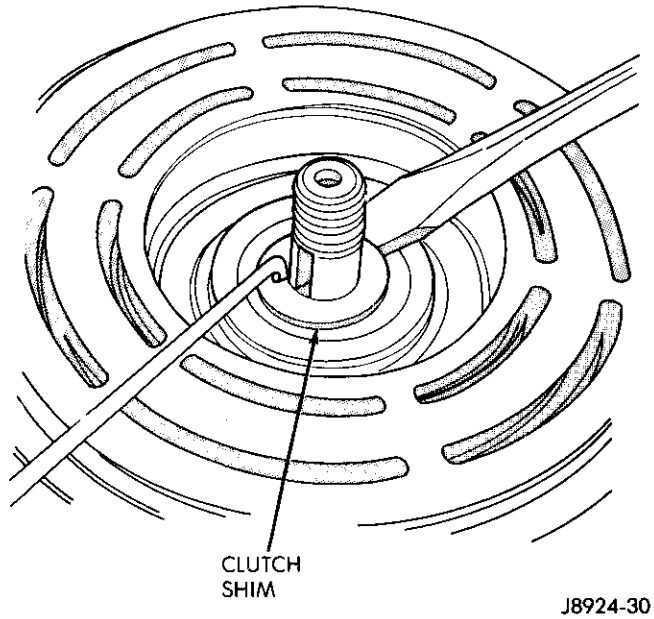


Fig. 15 Remove Clutch Shim

(6) Remove shaft seal seat retaining snap ring with pinch type snap ring pliers (Fig. 16).

(7) Remove the shaft seal seat, using seal seat tool (Fig. 17).

(8) Insert the Seal Remover and Installer Tool against the seal assembly. Press down against the seal spring and twist the tool until it engages the slots of the seal cage (Fig. 18). Lift out seal assembly.

INSTALLATION

(1) Clean seal cavity thoroughly with a lint-free or synthetic cloth and clean refrigerant oil. Then blow out with dry pressurized vapor.

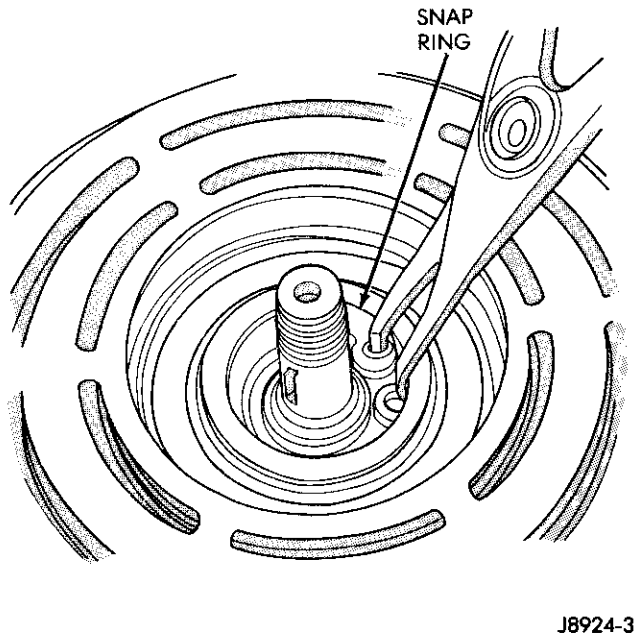


Fig. 16 Remove Snap Ring

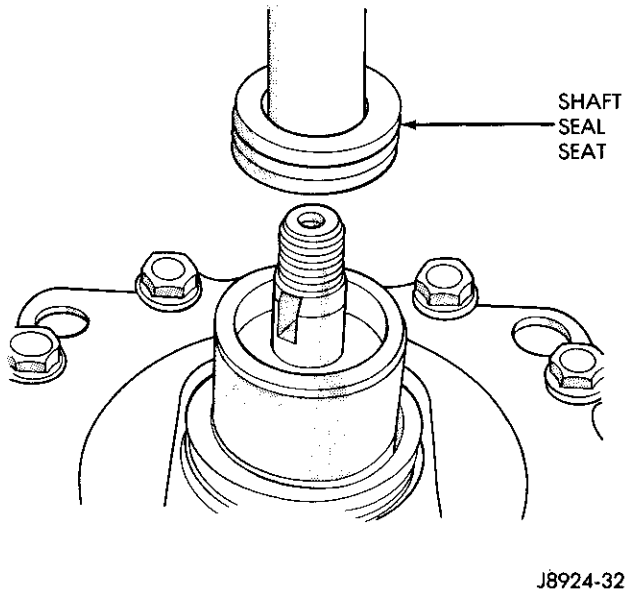


Fig. 17 Remove Shaft Seal Seat

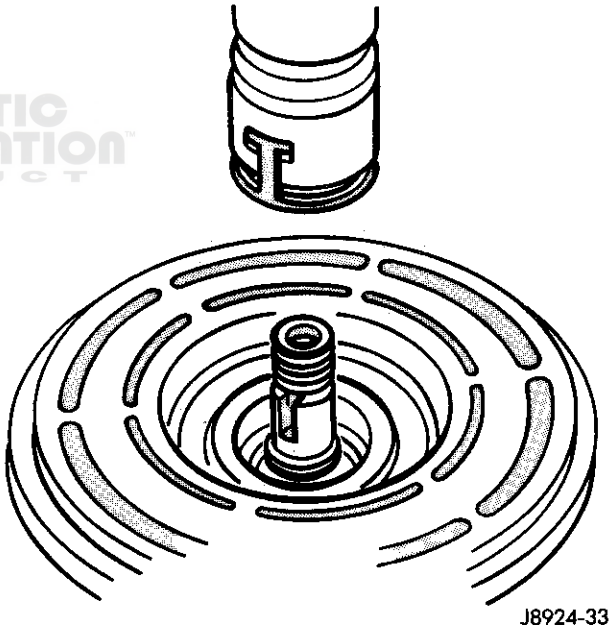


Fig. 18 Remove Seal Assembly

(2) Make sure all foreign substances are thoroughly removed.

(3) Insert Seal Sleeve Protector over compressor shaft (Fig. 19).

(4) Do not touch the new seal lapping surfaces. Dip the mating surfaces in clean refrigerant oil before proceeding.

(5) Engage slots of Seal Remover and Installer to new seal cage and insert seal assembly firmly into place in the compressor seal cavity (Fig. 20). Twist tool in opposite direction to disengage tool from seal cage. Remove tool.

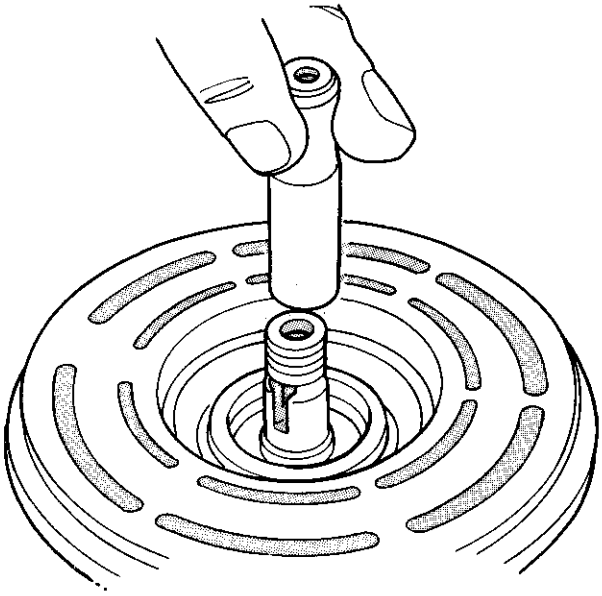


Fig. 19 Insert Seal Sleeve Protector

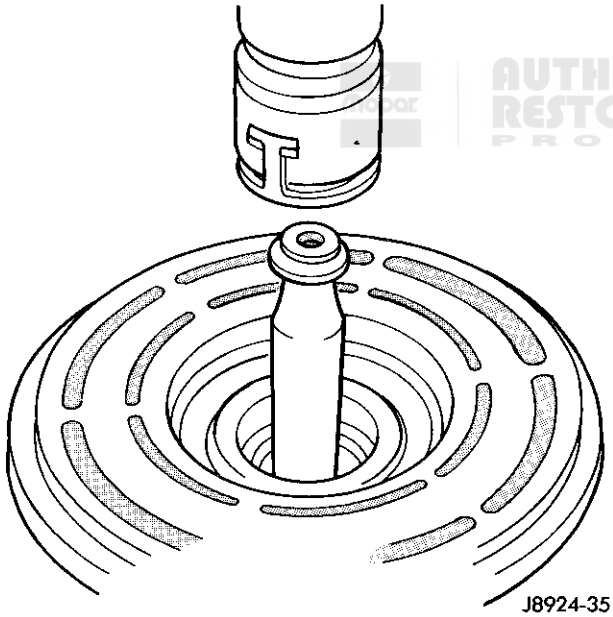


Fig. 20 Install Seal Assembly

(6) Coat seal retainer with clean refrigerant oil. Use seal seat tool to install (Fig. 21). Press lightly against seal.

(7) Install snap ring. Beveled edge lies outward from compressor. Flat side lies toward compressor. It may be necessary to lightly tap the snap ring to securely position it in its groove.

(8) Replace clutch spacer shims.

(9) Tap new felt ring into place (Fig. 22).

(10) Align front plate keyway to compressor shaft key.

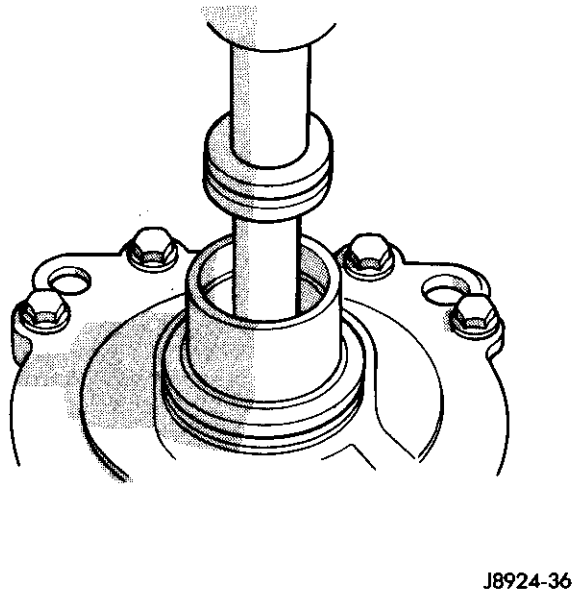


Fig. 21 Install Seal Retainer

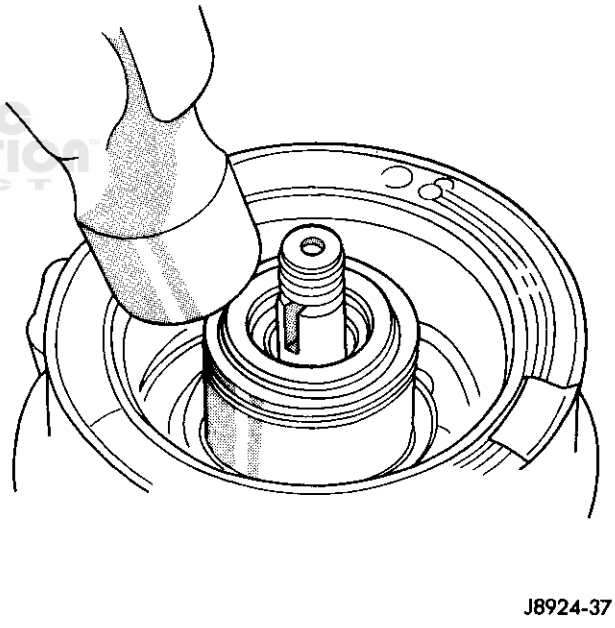


Fig. 22 Install New Felt Ring

(11) Using shaft protector, tap front plate to shaft until it has bottomed to the clutch shims (Fig. 12). Listen for a distinct change of sound during the tapping process.

(12) Replace shaft hex nut. Tighten the hex nut to 37 N•m (27 ft. lbs.) torque.

(13) Check air gap with feeler gauge. The specification is 0.406-0.787 mm (0.016-0.031 inch). If air gap is not consistent around the circumference, lightly pry up at the minimum variations (Fig. 13). Lightly tap down at points of maximum variation.

The air gap is determined by the spacer shims. When installing the original or a new clutch assembly, try the original shims first. When install-

ing a new clutch onto a compressor that previously did not have a clutch, use 0.040, 0.020, and 0.005 shims from the clutch accessory sack.

(14) If the air gap does not meet the specification given, add or subtract shims as required.

CYLINDER HEAD/VALVE PLATE

REMOVAL

(1) Remove cylinder head bolts.

(2) Using a small hammer and a gasket scraper separate the cylinder head from the valve plate (Fig. 23).

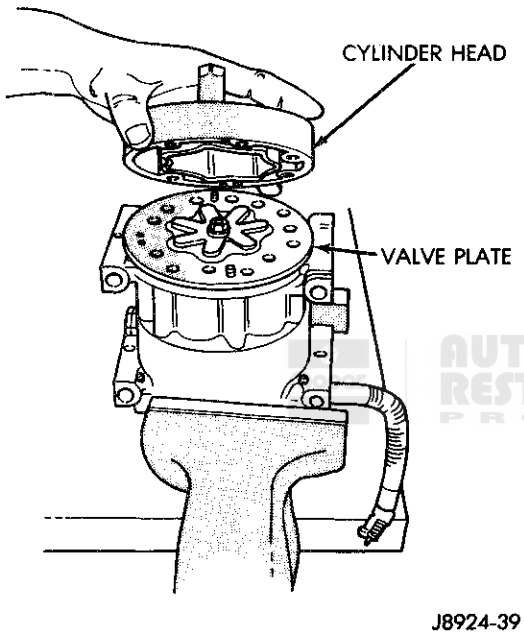


Fig. 23 Remove Cylinder Head

(3) Visually inspect all parts for damage.

(4) Separate the valve plate from the cylinder block (Fig. 24).

(5) Visually inspect the rear valves and discharge retainer for damage. Discard any component if any portion is damaged.

If valve plate and/or cylinder head are to be reused, carefully remove gasket materials using the gasket scraper. Do not damage cylinder block or valve plate surfaces.

INSTALLATION

When installing the cylinder head valve plate, use the new gaskets in the parts kit.

(1) Coat new valve plate gasket with clean refrigerant oil.

(2) Install valve plate gasket by aligning valve plate gasket to locating pin holes and oil orifice in cylinder block. (For easy reference, the gaskets have a notch at the bottom outside edge).

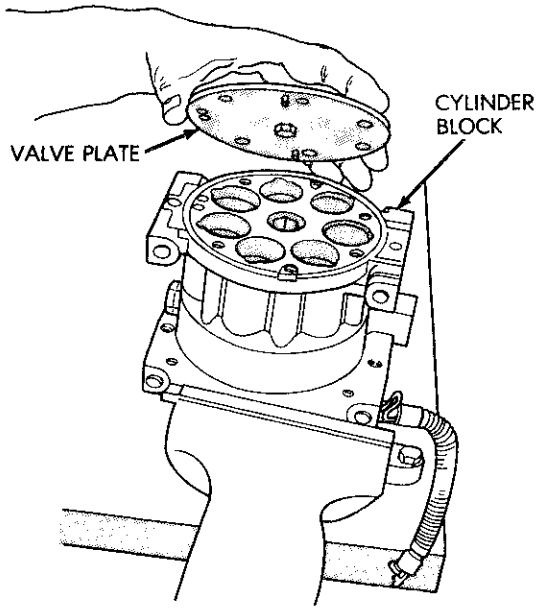


Fig. 24 Remove Valve Plate

(3) Install valve plate by aligning valve plate locating pins to the pin holes in the block and position valve plate.

(4) Install cylinder head and tighten bolts in order to 32 N•m (24 ft. lbs.) torque (Fig. 25).

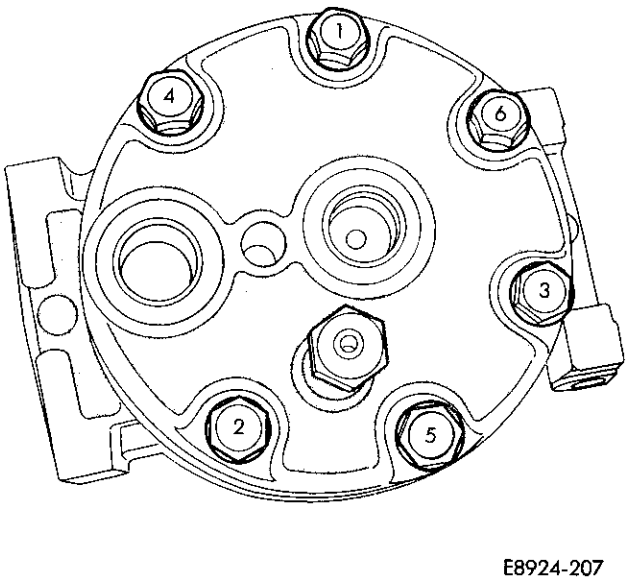


Fig. 25 Cylinder Head Bolt Torque Sequence

TORQUE SPECIFICATIONS—A/C COMPRESSOR

COMPONENT	TORQUE	
Compressor Cylinder Head Bolts	32 N•m	24 ft. lbs.
Compressor Mounting Bolts	27 N•m	20 ft. lbs.
Compressor Oil Filter Plug	10 N•m	7 ft. lbs.
Damped Pressure Cycling Switch	5.65 N•m	(50 in. lbs.)
H-Valve Control Head Torx Drive Screws	11 N•m	(100 in. lbs.)
H-Valve Plumbing Sealing Plate Bolt	23 N•m	(200 in. lbs.)
Magnetic Clutch Hex Nut	37 N•m	27 ft. lbs.
Refrigerant Can-to-Manifold Nut	9.5 N•m	7 ft. lbs.
Service Valve/Compressor Fitting	47 N•m*	35 ft. lbs.*

*Wet Torque - Lubricate the service valve coupling threads and O-rings with compressor oil.

J9124-121

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

EMISSION CONTROL SYSTEMS

EXHAUST EMISSION CONTROLS

AIR INLET—DIESEL ENGINE

The diesel engine air inlet system consists of the:

- air cleaner housing
- filter element
- air cleaner to turbo-charger inlet tube
- air crossover tube
- air intake heaters

Ambient air enters the air cleaner housing through an opening at the bottom of the housing (Fig. 1). Air in the housing is filtered by the air cleaner element (Fig. 2) before it is drawn into the turbo-charger.

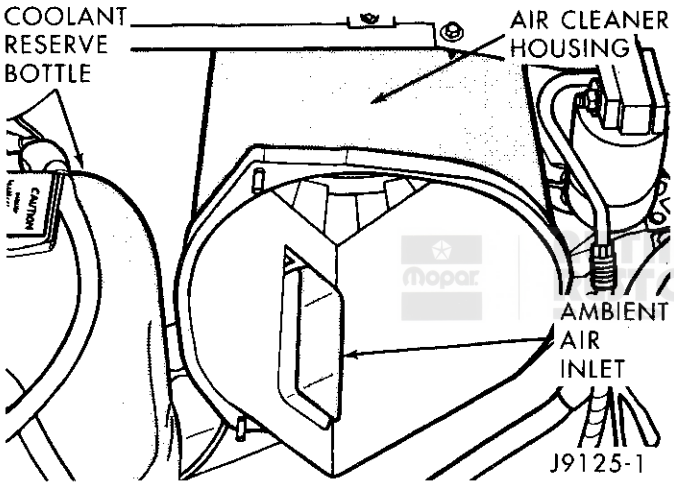


Fig. 1 Air Cleaner Housing

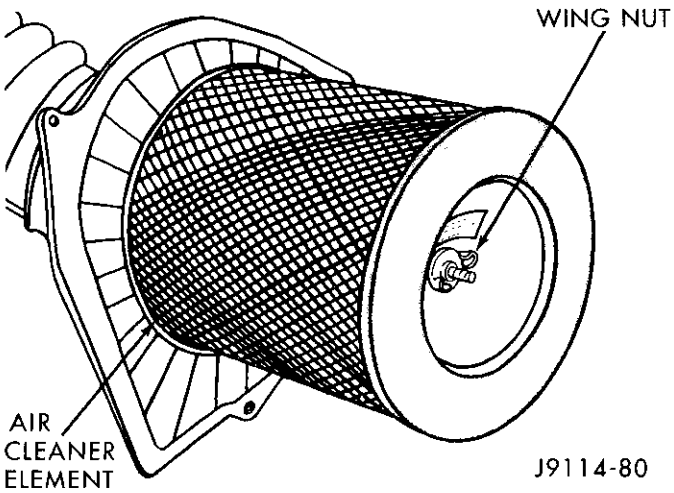


Fig. 2 Air Filter Element

The turbo-charger increases the amount of air flow to the engine. The turbo-charger allows the engine to use a higher air-to-fuel ratio. This results in improved emissions.

Air flows from the turbo-charger into the inter-cooler (Fig. 3). Air leaves the inter-cooler, passes through the air intake heaters and enters the intake manifold.

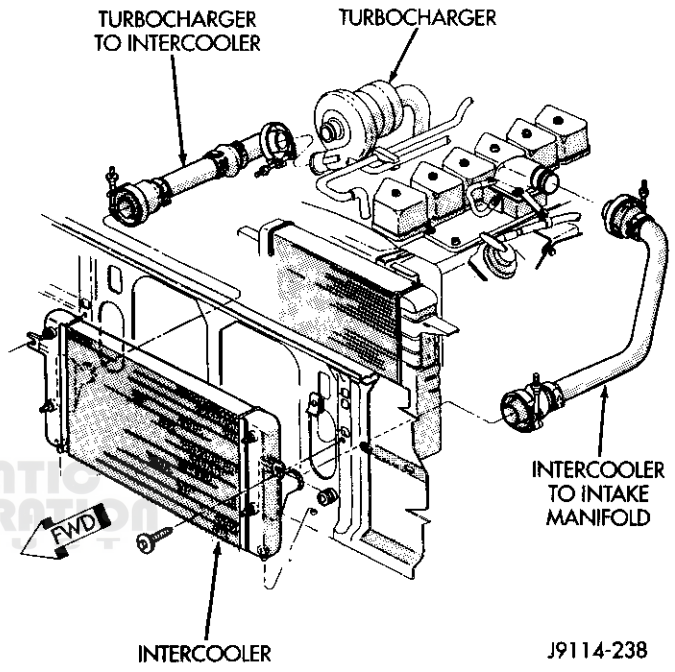


Fig. 3 Diesel Inter-Cooler

AIR INTAKE HEATER—DIESEL ENGINE

The air intake heater warms intake air before it enters the manifold. If intake manifold air temperature is below 16°C (60°F) the engine controller will energize the heaters through the air intake heater relays for startup and initial warmup. Refer to Group 14, Fuel Systems in this supplement for Air Intake Heater operation.

The heater is located on top of the intake manifold, below the air crossover tube (Fig. 4).

CAUTION: Do not energize the air intake heater relays more than once per 15 minutes. If the relays are cycled and the key is then turned off, wait 15 minutes before turning the key to the ON position. The 15 minute period is to prevent damaging the engine.

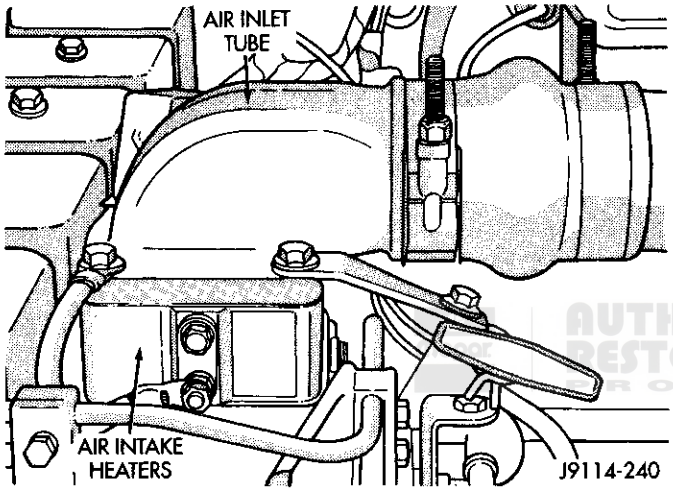


Fig. 4 Air Intake Heaters

AIR INTAKE HEATER RELAYS—DIESEL ENGINE

The engine controller operates the air intake heaters through the air intake heater relays. The relays are energized before cranking if the charge air temperature sensor input to the engine controller indicates air temperature is 16°C (60°F) or below. When the ignition key is turned to the ON position the solenoids will make a clicking noise indicating they are energized. Refer to Group 14 in this supplement for Air Intake Heater Relay operation.

Mopar
AUTHENTIC
RESTORATION™
PRODUCT

Mopar
AUTHENTIC
RESTORATION™
PRODUCT