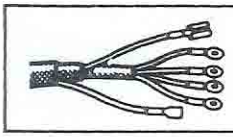

ELECTRICAL

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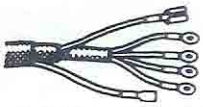

SEE I.S. NOTES

ELECTRICAL

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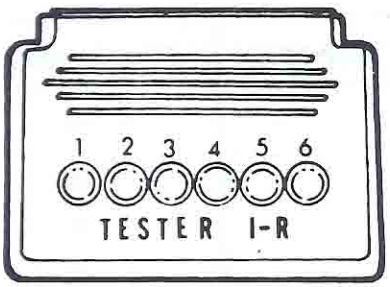
SEE I.S. NOTES

SPECIAL TOOLS

Tool Ref.	Description	Required	Recommended
AMA 21-317	Circuit Tester		■
AMOT ET-502	Digital Multimeter		■
AM PC-1-R	Cruise Command System Tester		■
J-21008	Continuity Lamp		■
J-22124-A	Pressure Gauge and Valve		■
J-22516	Starter Pole Screw Wrench		■
J-23738	Hand Operated Vacuum Pump		■
J-25300-10	Headlight Aimer		■
J-25359-C	Torx Bit and Socket Set		■
J-28509	Distributor Trigger Wheel Puller		■
J-23653	Lock Plate Compressor	■	

SEE I.S. NOTES

SEE I.S. NOTES



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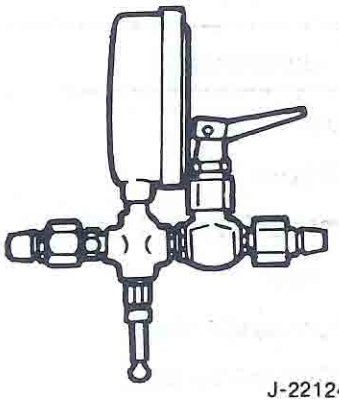

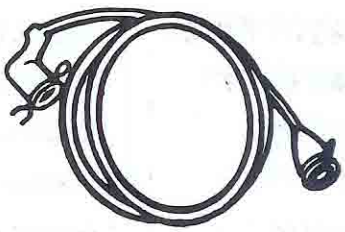

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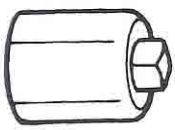
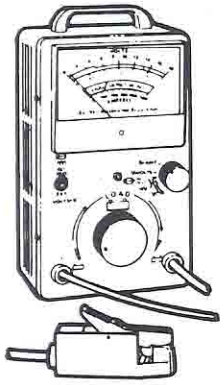


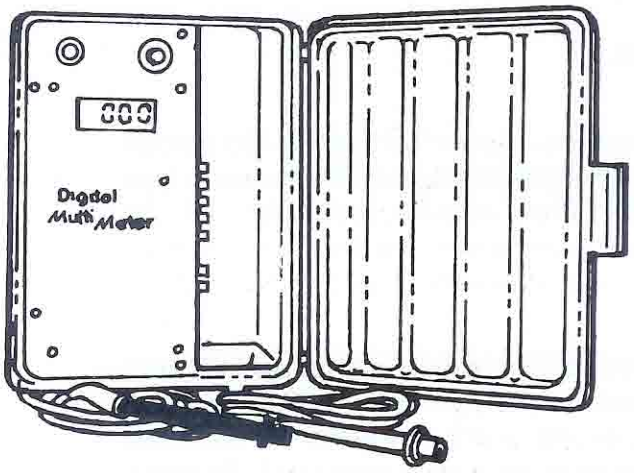
J-22516

J-25300-10

84900A

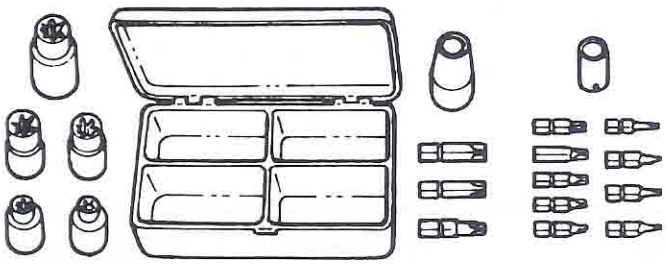


AMA 21-317



AMOT ET-502

SEE I.S. NOTES



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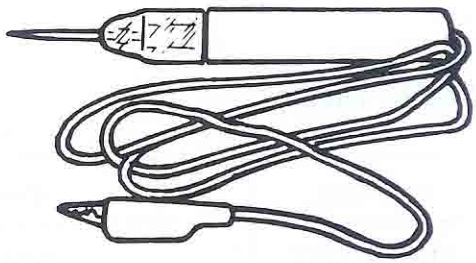

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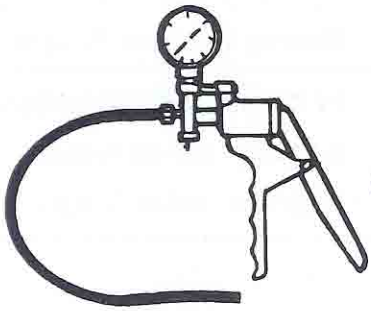

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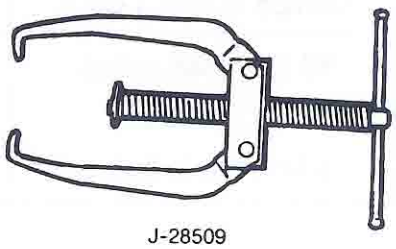

J-28509

GENERAL

The batteries used on 1984 CJ/Scrambler models are lightweight, low-maintenance type batteries. They require inspection of the electrolyte level only at the beginning of each winter season and every 24 000 km (15,000 mi).

SEE I.S. NOTES

In addition to the standard equipment 421 cold crank amps battery, a 452 cold crank amps battery is optionally available for vehicles equipped with heavy-duty equipment. Both batteries are 12-volt, lead composition-acid units.

The vehicle battery tray has a removable spacer that, when removed, will permit the installation of a substitute conventional size group 24 battery in the event a lightweight replacement battery is not available.

SPECIAL TOOLS

Tool Ref.	Description	Required	Recommended
AMA 21-317	Battery Tester		■

TORQUE SPECIFICATIONS

Component	Service Set-To Torque	Service Recheck Torque
Battery Box Screw	16 N·m (145 in-lbs)	11-20 N·m (95-180 in-lbs)
Battery Holddown Screw	8 N·m (75 in-lbs)	6-11 N·m (50-95 in-lbs)
Battery Cable Clamp	8 N·m (75 in-lbs)	7-10 N·m (60-90 in-lbs)

SPECIFICATIONS

Battery Specifications

Engine	Group Size	Rating
150 & 258	55	421 amps 75 min.
Optional	56	452 amps 81 min.

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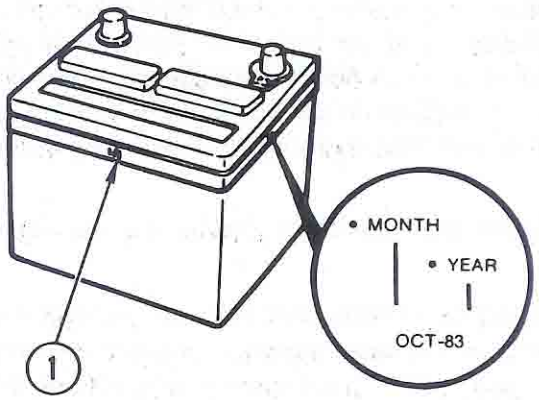
BATTERY CODES

Each battery is date coded at the time of shipment from the manufacturer. This code is stamped into the edge of the plastic case cover. A second code number stamped on the side (1) of the battery case represents manufacturing data and may be ignored.

The date code is decoded as follows:

- month: Jan., Feb., etc.
- year: 83-1983, 84-1984



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SEE I.S. NOTES

BATTERY REPLACEMENT

Removal

SEE I.S. NOTES

Loosen the cable terminal clamps.

Use a puller to remove the cable terminal clamps, if necessary.

Remove the negative cable terminal clamp first.

WARNING: Use extreme care to prevent dropping the battery and splattering the electrolyte because it can cause severe eye injury and skin burns. Rubber gloves, rubber aprons, protective eye shields and steel-toed shoes will decrease the hazards of this type of accident. Immediate first aid is required for electrolyte splashed into the eyes and on the skin. Electrolyte spills should be neutralized immediately with a solution of sodium bicarbonate (baking soda) and water and then thoroughly rinsed with water.

Loosen the holddowns and remove the battery.

Inspect the cable terminals for corrosion and damage. Remove corrosion using a wire brush or a post and terminal cleaner and sodium bicarbonate/water (baking soda) solution. Replace the cables that have damaged or deformed terminals.

Inspect the battery tray and holddowns for corrosion. Remove the corrosion using a wire brush and sodium bicarbonate/water solution. Paint exposed bare metal. Replace the damaged components.

Clean the outside of the battery case, if the original battery is to be installed. Clean the top cover with a diluted ammonia or sodium bicarbonate/water solution to remove the acid film. Flush the cover with clean water. Ensure that the cleaning solution does not enter the cells.

Remove any corrosion from the terminals with a wire brush or post and terminal cleaner. Inspect the case for cracks or other damage that would result in leakage of electrolyte.

Installation

Refer to the Specifications to determine if the battery has the correct classification and rating for the vehicle.

Use a hydrometer to test the battery electrolyte. Charge the battery if necessary.

CAUTION: Ensure the battery tray is clear of loose hardware, tools or debris that could damage the battery case.

Position the battery in the tray. Ensure that the positive (+) and negative (-) terminals (posts) are correctly located. The cables must reach their respective terminals without stretching.

Ensure that the tang at the battery base is positioned in the tray properly before tightening the holddown.

CAUTION: It is imperative that the cables are connected to the battery positive-to-positive and negative-to-negative. Reverse polarity will damage the alternator diodes and radio.

Connect and tighten the positive cable first. Then connect and tighten the negative cable.

NOTE: The tapered battery positive terminal (post) is approximately 1.6 mm (1/16 in) larger in diameter than the negative terminal. The opening in the positive cable terminal clamp is correspondingly larger.

Apply a thin coating of petroleum jelly or chassis grease to the cable terminals and the battery posts.

Inspect the negative cable connections on the engine and vehicle body for condition, security and electrical continuity.

BATTERY MAINTENANCE

Always observe the correct polarity when connecting a charger to a battery. Reversed battery connections will damage the alternator diodes and the radio. The battery negative terminal is grounded to the engine and vehicle body.

WARNING: Explosive gases are present within and around the battery at all times. Avoid open flames and sparks. The danger of battery explosion is compounded by the fact that the acid would be splattered in every direction. Wear protective eye shields and clothing when servicing any battery. Ensure the battery has adequate ventilation when charging.

It is important that the battery be fully charged when a new vehicle is delivered. Maintaining a battery at partial charge could shorten its life.

Inspect the electrolyte level in standard equipment batteries at 24 000 km (15,000 mi) intervals and at the beginning of the winter season. Add distilled water to each cell until the level reaches the bottom of the vent well. DO NOT OVERFILL. Operate the engine immediately after adding water (particularly in cold weather) to assure proper mixing of the water and electrolyte.

Inspect to determine the external condition of the battery and the cables periodically.

The holddown should be tight enough to prevent the battery from vibrating or shifting position and causing damage to the battery case.

CAUTION: Keep the filler caps tight to prevent the neutralizing solution from entering the cells.

Take particular care to ensure that the top of the battery is free of acid film and dirt between the battery terminals. For best results when cleaning the battery, wash with a diluted ammonia or soda solution to neutralize any acid present and flush with clean water.

To ensure good electrical contact , the battery cables must be tight on the battery posts. Ensure that the terminal clamps have not stretched. This could cause the clamp ends to become butted together without actually being tight on the post. If the battery posts or cable terminals are corroded, disconnect the cables by loosening the terminal clamp bolts and remove the terminals with the aid of a puller. Do not twist, hammer or pry on a terminal to free it from the battery post. Clean the terminals and posts with a soda solution and a wire brush or a post and terminal cleaner. Connect the cable terminal clamps (positive terminal first) to the battery posts and apply a thin coat of petroleum jelly or grease. Inspect the battery negative cable and body ground cable for condition and good electrical continuity with the engine and body.

Frozen Electrolyte

WARNING: Do not attempt to charge or use a booster on a battery with frozen electrolyte. The frozen battery may explode.

A 75 percent charged battery will not freeze. Maintain batteries at 75 percent charge or more, especially during winter weather. Refer to the Hydrometer Test.

SEE I.S. NOTES

Replace the battery, if the electrolyte becomes either slushy or frozen. A battery in this condition, depending on the severity of the freeze, may accept and retain a charge, and even perform satisfactorily under a load test. However, after 120 - 150 days in service, a reduction in storage capacity and service life will become apparent as the individual plates lose their active material.

SEE I.S. NOTES

Electrolyte Freezing Temperature

Specific Gravity (Corrected to 80° F)	Freezing Temperature
1.270	– 84°F (– 64°C)
1.250	– 62°F (– 52°C)
1.200	– 16°F (– 27°C)
1.150	+ 05°F (– 15°C)
1.100	+ 19°F (– 7°C)

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BATTERY CHARGING

General

The relative amount of charge or stored energy is directly proportional to the specific gravity value of the electrolyte. This allows the use of a hydrometer to determine the state of charge or energy storage level of a battery in relation to the maximum possible charge (full charge). Refer to the Hydrometer Test.

NOTE: The specific gravity is a ratio of the density of the electrolyte and the density of pure water.

Dry Charged Battery

WARNING: Before activating a dry-charged battery, carefully read the instructions and poison/danger warning on the electrolyte carton.

Do not remove the seals until the battery is to be activated. Once the seals are removed, the battery must be activated immediately. Discard the seals after removal.

Activation Procedure

Fill each cell with battery electrolyte to the bottom of the well, observing the handling precautions listed on the electrolyte carton.

After the cells are filled, tilt the battery from side to side to release trapped air bubbles.

Recheck the electrolyte level in each cell and add as necessary. The electrolyte level must be above the plates and below the split ring.

NOTE: Filling the cells unevenly will affect the battery capacity and service life.

Install the caps supplied with the battery.

Inspect the battery case for leakage to ensure no damage occurred during the handling.

Boost charge the battery for 15 minutes at 30 amps or slow charge until the battery electrolyte is gassing freely.

Install the battery in the vehicle.

NOTE: Because the battery's apparent state of charge, as indicated by a hydrometer, is depressed for the first few cycles, load testing is

the only valid test at the time of activation. Hydrometer testing may be used after the battery has been cycled in service.

The specific gravity of a newly installed AMC/Jeep battery will be approximately 1.225 (±0.010). The specified gravity will normally rise to 1.250 - 1.265 after a few days in service.

NOTE: The electrolyte is composed of sulfuric acid and water. Approximately 35 percent by weight or 24 percent by volume is acid.

WARNING: Never add pure acid to a battery.

Slow Charge

WARNING: Battery charging generates hydrogen gas, which is highly flammable and explosive. Hydrogen gas is present within and around a battery at all times, even when it is in a discharged condition. Keep open flames and sparks (including cigarettes, cigars, pipes) away from the battery. Always wear eye and skin protection when handling, testing and charging a battery.

WARNING: Do not attempt to charge or use a booster on a battery with frozen electrolyte because this can cause the frozen battery to explode.

Slow charging is the preferred method of recharging a battery. The slow charge method may be safely used, regardless of charge condition of the battery, provided the electrolyte is at the proper level in all cells and is not frozen.

The normal slow charging rate for a lightweight battery is three to five amps. A minimum period of 24 hours is required when charging at this rate. Charge time is inversely proportional to the temperature of the electrolyte.

A battery may be fully charged by the slow charge method unless it is not capable of accepting a full charge. A battery is in a maximum charged condition when all cells are gassing freely and three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in the specific gravity.

Fast Charge

CAUTION: Always disconnect the battery cables before using a fast charger.

A battery may be charged at any rate that does not cause the electrolyte temperature of any cell to exceed 51.7°C (125°F) and does not cause excessive gassing and loss of the electrolyte.

A fast battery charger cannot be expected to fully charge a battery within an hour, but will charge the battery sufficiently so that it may be returned to service. The battery will be fully charged by the vehicle's charging system, provided the engine is operated a sufficient length of time.

Booster Charging

WARNING: If the battery electrolyte is not visible or is frozen, do not attempt to "jump-start" an engine because the battery could rupture or explode. The battery electrolyte must be warmed up to 4.4°C (40°F) and water added, if necessary, before it can be safely charged or the engine "jump-started".

The correct method for starting an engine with a discharged battery requires either a portable starting unit or a booster battery. When using either method, it is essential that the connections be made correctly.

When using a portable starting unit, the voltage must not exceed 16 volts or damage to the battery, alternator or starter motor may result. Because of the accompanying high voltage, a fast charger must not be used for "jump-starting" engines.

Remove the vent caps from the booster battery and cover cap openings with a dampened cloth.

CAUTION: If the engine is being "jump-started" with a battery located in another vehicle, the vehicles must not contact each other.

Connect the jumper cable between the positive posts of the batteries. The positive post has "+" sign stamped into it. POS is also embossed on the battery cover in 3 mm (1/8 in) letters adjacent to the battery post.

Connect one end of a second jumper cable to the negative post of the booster battery. NEG is embossed on the battery cover in 3-mm (1/8- in) letters adjacent to the battery post. Ensure the cable terminal clamps have a good electrical contact with the posts. DO NOT CONNECT THE OTHER END OF THE JUMPER CABLE TO THE NEGATIVE POST OF THE DISCHARGED BATTERY. Connect the cable to a bolt, bracket, nut or other good ground connection on the engine. Do not connect the cable to the carburetor, air cleaner or fuel pipe. Keep the cable clear of the fan, belts and pulleys.

WARNING: Use extreme caution when the engine is operating. Do not stand in a direct line with the fan. Do not put hands near the pulleys, belts or fan. Do not wear loose clothing.

When the engine starts, remove the jumper cables. Disconnect the negative cable from the engine ground location first.

Discard the cloth used to cover the cap openings because it has been exposed to sulfuric acid.

Install the battery caps.

BATTERY TESTING

General

NOTE: A complete battery test includes cleaning the top of the battery case, cleaning the battery posts and the cable terminals and performing the Hydrometer Test and Heavy Load Test.

The condition of a battery may be determined from the result of two tests – state of charge (Hydrometer Test) and the ability to supply current (Heavy Load Test). Refer to Battery Diagnosis and Repair Simplification (DARS) Chart.

Perform the hydrometer test first. If the specific gravity is less than 1.225, the battery must be charged before proceeding with further testing. A battery that will not accept a charge is defective and further testing is not necessary.

NOTE: A battery with sulfated plates may require an overnight "slow charge" to determine if the sulfate coating is thin enough to be eliminated by a "charge".

A battery that has been fully charged but does not pass the heavy load test is defective.

If a battery discharges and no apparent cause can be determined, the battery should be fully charged and allowed to stand on a shelf for three to seven days to determine if the self-discharge is excessive. The Self-Discharge Rate chart lists the amount of allowable self-discharge for the first ten days of standing after a battery has been fully charged. A battery is fully charged when all cells are gassing freely and three corrected specific gravity tests, taken at one-hour intervals, indicate no increase in specific gravity.

SEE I.S. NOTES

Self-Discharge Rate

Temperature	Approximate Allowable Self-Discharge Per Day For First Ten Days
100°F (37.8°C)	0.0024 Specific Gravity
80°F (26.7°C)	0.0009 Specific Gravity
50°F (10°C)	0.0003 Specific Gravity

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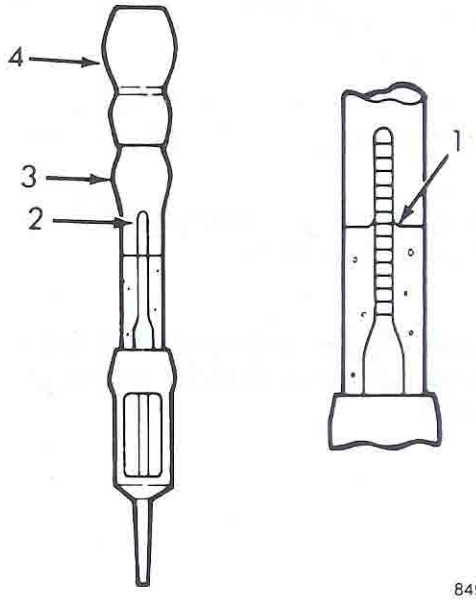
Hydrometer Test

NOTE: Periodically disassemble the hydrometer and wash the components with soap and water. Inspect the float for possible leaks. If the paper inside has turned brown, the float is defective.

Prior to tosting, visually inspect the battery for any damage (cracked case or cover, loose post, etc.) that would cause the battery to be unserviceable. To interpret the hydrometer correctly, hold it with the top surface of the electrolyte in the hydrometer at eye level.

Disregard the curvature of the liquid (1) where the surface rises against the float because of surface cohesion. Remove only enough electrolyte from the battery to keep the float (2) off the bottom of the hydrometer barrel (3) when pressure on the bulb (4) is released. Keep the hydrometer in a vertical position while raising the electrolyte into the hydrometer and observing the specific gravity. Exercise care when inserting the tip of the hydrometer into a cell to avoid damage to the separators. Damaged separators can cause premature battery failure.



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Hydrometer floats are generally calibrated to indicate the specific gravity correctly only at one fixed temperature, 26.6°C (80°F). When testing the specific gravity at any other temperature, a correction factor is required. The correction factor is approximately a specific gravity value of 0.004, referred to as four points of specific gravity. For each 5.5°C above 26.6°C (10°F above 80°F), add four points. For each 5.5°C below 26.6°C (10°F below 80°F), subtract four points. Always correct the specific gravity for the temperature variation. Test the specific gravity of the electrolyte in each battery cell.

Example: A battery is tested at -12.2°C (10°F) and has a specific gravity of 1.240. The actual specific gravity is determined according to the following example:

- number of degrees above or below 26.6°C (80°F) equals 38.8°C (70°F); 26.6 minus -12.2 (80 minus 10)

SEE I.S. NOTES

- 38.8°C divided by 5.5°C (70°F divided by 10°F), each 5.5°C (10°F) difference equals 7
- 7 multiplied by 0.004 (temperature correction factor) equals 0.028
- temperature is below 26.6°C (80°F), therefore, the temperature correction is subtracted
- temperature corrected specific gravity is 1.212 (1.240 minus 0.028)
- a fully charged battery should have a temperature corrected specific gravity of 1.250 - 1.265

SEE I.S. NOTES

State of Charge	Specific Gravity (Cold and Temperate Climates)
Fully Charged	1.265
75% Charged	1.225
50% Charged	1.190
25% Charged	1.155
Discharged	1.120

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If the specific gravity of all cells is above 1.235, but the variation between cells is more than 50 points (0.050), it is an indication that the battery is unserviceable. Remove the battery from the vehicle for additional testing.

If the specific gravity of one or more cells is less than 1.235, recharge the battery at a rate of approximately five amps until three consecutive specific gravity tests, taken at one-hour intervals, are constant.

If the cell specific gravity variation is more than 50 points (0.050) at the end of the charge period, replace the battery.

When the specific gravity of all cells is above 1.235 and variation between cells is less than 50 points (0.050), the battery may be tested under heavy load.

Heavy Load Test

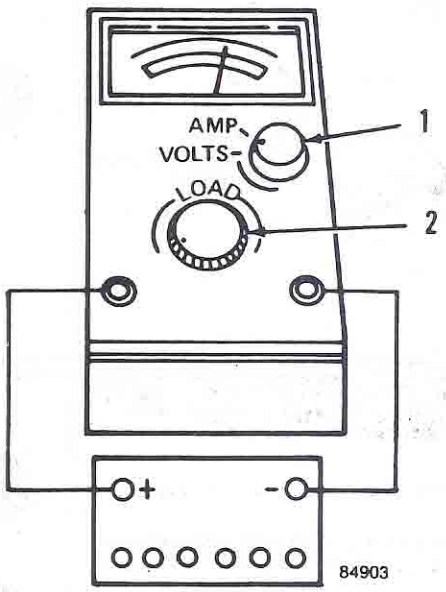
NOTE: The following instructions refer to Amserv Battery-Alternator-Regulator-Starter Motor Tester, model AMA 21-317, or equivalent.

Before performing the Heavy Load Test, the battery must be fully charged. Refer to Slow Charge.

Turn the selector knob (1) to the AMP position.

Turn the carbon pile rheostat knob (2) of the battery tester to the OFF position.

Connect the battery tester to the battery as illustrated.



Turn the carbon pile rheostat knob clockwise until the ammeter indicates the correct test amperage:

- 210 amperes for the 55 battery (75 reserve capacity minutes, 421 cold crank amps)
- 225 amperes for the 56 battery (80 reserve capacity minutes, 450 cold crank amps)

Maintain the load for 15 seconds. Turn the selector switch to VOLTS and note voltage.

If the voltmeter indicates 9.6 volts or higher with the battery temperature at a minimum of 21°C (70°F), the battery is in good condition. If less than 9.6 volts, replace the battery.

DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART

When an engine will not start because the starter motor is inoperative, follow the steps outlined in the DARS Chart to determine if the battery or the starting system is the cause of the malfunction.

SEE I.S. NOTES

BATTERY DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART

PROBLEM: STARTER MOTOR INOPERATIVE

Chart 1

SEE I.S. NOTES

STEP	SEQUENCE	RESULT
1	CHECK FOR: ● LOOSE POST OR CLAMP ● LOOSE ALTERNATOR DRIVE BELT ● LOOSE CONNECTION ● DEFECTIVE CABLE ● DAMAGED CASE OR COVER REPAIR OR REPLACE IF NECESSARY	2
2	● CHECK ELECTROLYTE LEVEL AND TEST SPECIFIC GRAVITY IN EACH CELL AND RECORD. ELECTROLYTE LEVEL TOO LOW FOR SPECIFIC GRAVITY TEST—ADD WATER. CHARGE BATTERY FOR 10 MIN. AT 20 AMP RATE. TEST SPECIFIC GRAVITY OK — AVERAGE SPECIFIC GRAVITY 1.225 OR MORE CELLS ARE EQUAL WITHIN 0.050 (50 POINTS) O.K — REPLACE BATTERY — AVERAGE SPECIFIC GRAVITY 1.225 OR MORE BUT CELLS VARY 0.050 (50 POINTS) OR MORE O.K — AVERAGE SPECIFIC GRAVITY BELOW 1.225	5 6 3
3	● CONNECT BATTERY CHARGER AND VOLTMETER ● CHARGE BATTERY FOR 3 MINUTES AT 40 AMP RATE ● AT THE END OF 3 MINUTES OBSERVE VOLTMETER WHILE CHARGER IS STILL CHARGING OK — VOLTAGE IS 15.5 VOLTS OR LESS O.K — SLOW CHARGE BATTERY AT 3 TO 4 AMPS FOR 48 TO 72 HOURS — VOLTAGE ABOVE 15.5 VOLTS	4 5

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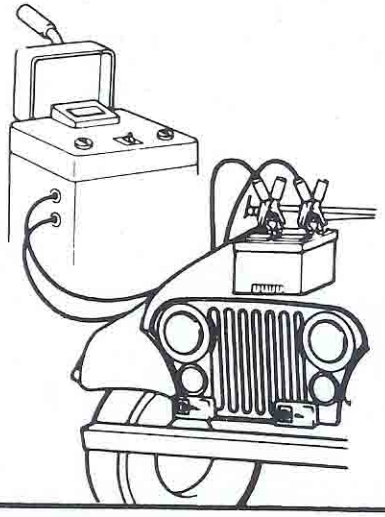
STEP | SEQUENCE | RESULT

4



CHARGE BATTERY AS INDICATED IN CHART. AFTER CHARGE IS COMPLETED, RECHECK SPECIFIC GRAVITY.

AVERAGE SPECIFIC GRAVITY	CHARGE RATE (AMPS)	TIME
LESS THAN 1.125	5	12 HOURS
1.125 TO 1.149	20	90 MIN.
1.150 TO 1.174	20	70 MIN.
1.175 TO 1.199	20	50 MIN.
1.200 TO 1.224	20	30 MIN.

OK → AVERAGE SPECIFIC GRAVITY 1.225 OR MORE CELLS ARE EQUAL WITHIN 0.050 (50 POINTS) → **5**

O.K → REPLACE BATTERY → **6**
AVERAGE SPECIFIC GRAVITY 1.225 OR MORE BUT CELLS VARY 0.050 (50 POINTS) OR MORE

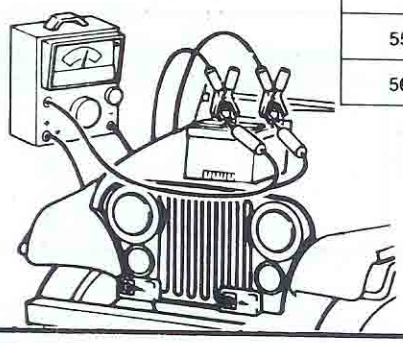
5

- CLEAN BATTERY POSTS AND CABLE TERMINALS
- CONNECT HEAVY LOAD TESTER
- DETERMINE HEAVY LOAD AMPS FROM CHART
- ADJUST TESTER FOR LOAD AMPS
- HOLE LOAD FOR 15 SECONDS
- NOT VOLTS

HEAVY LOAD OUTPUT TEST

HEAVY LOAD CHART

GROUP SIZE	COLOR CODE	RESERVE CAPACITY (MINUTES)	COLD CRANK AMPS	HEAVY LOAD (AMPS)
55	Green	75	421	135
56	Red	81	452	180



- VOLTAGE 9.6 OR MORE → **6**
- VOLTAGE LESS THAN 9.6 → REPLACE BATTERY → **6**

6

OK → ENGINE STARTS → STOP

O.K → ENGINE DOES NOT START → PERFORM STARTER MOTOR DIAGNOSIS LISTED IN STARTING SYSTEMS

SEE I.S. NOTES

86387

GENERAL

A Delco charging system is installed on all vehicles. This negative-ground system consists of two primary components: an alternator with an integral regulator and a battery. The non-repairable, non-adjustable regulator is a solid-state device located within the alternator housing.

The standard equipment alternator used with the four- and six-cylinder engines is rated at 56 amps. The optional, heavy-duty electrical system alternators for the four- and six-cylinder engines are rated at 66 and 78 amps. The actual alternator used depends upon the combination of accessories installed in the vehicle.

SEE I.S. NOTES

SPECIAL TOOLS

Tool Ref.	Description	Required	Recommended
AMA 21-317	Circuit Tester		■
AMOT ET-502	Digital Multimeter		■
J-21008	Continuity Lamp		■

TORQUE SPECIFICATIONS

Component	Service Set-To Torque	Service Recheck Torque
Alternator Adjusting Bolt	24 N·m (18 ft-lbs)	20-27 N·m (15-20 ft-lbs)
Alternator Mounting Strap Bolt	38 N·m (28 ft-lbs)	31-41 N·m (23-30 ft-lbs)
Alternator Pivot Bolt or Nut	38 N·m (28 ft-lbs)	27-47 N·m (20-35 ft-lbs)
Pulley Nut	68 N·m (50 ft-lbs)	58-78 N·m (45-55 ft-lbs)

SPECIFICATIONS

Alternator

Manufacturer	Delco
Rating	
Standard (4-cylinder)	56 amp
Optional (4-cylinder)	66 amp
Optional (4-cylinder)	78 amp
Standard (6-cylinder)	56 amp
Optional (6-cylinder	66 amp
Optional (6-cylinder)	78 amp
Field Current	4.0 to 5.0 amps at 80°F(27°C)
Rotation (Viewing Drive End)	Clockwise
Pully Size	2.43 in (6.18 cm)
4-cylinder Serpentine Drive	Polyvee
Belt Tension	
New Belt	Set to 125-155 lbf (556-689N)
Used Belt	Recheck 90-115 lbf (400-512N)
New Belt (4-cylinder Serpentine Drive)	180-200 lbf (800-890N)
Used Belt (4-cylinder Serpentine Drive)	140-160 lbf (616-704N)

Regulator

Manufacturer	Delco
Model	1116387
Type	Solid State
Adjustment	None

Output Voltage Specifications

Ambient Temperature in Degrees Fahrenheit (C)	Acceptable Voltage Range
0-50 (-18 to 10)	14.3-15.3
50-100 (10 to 38)	13.9-14.9
100-150 (38 to 66)	13.4-14.4
150-200 (66to 93)	13.0-14.1

84904

ALTERNATOR

Other than a regularly scheduled drive belt tension adjustment, the alternator assembly requires no periodic adjustment or maintenance. The bearings have sufficient lubricant for the life of the alternator and do not require periodic lubrication.

NOTE: All bolt and screw threads are in metric dimensions.

Voltage Regulator

The voltage regulator unit is attached inside the rear housing of the alternator. The voltage regulator is not adjustable or repairable.

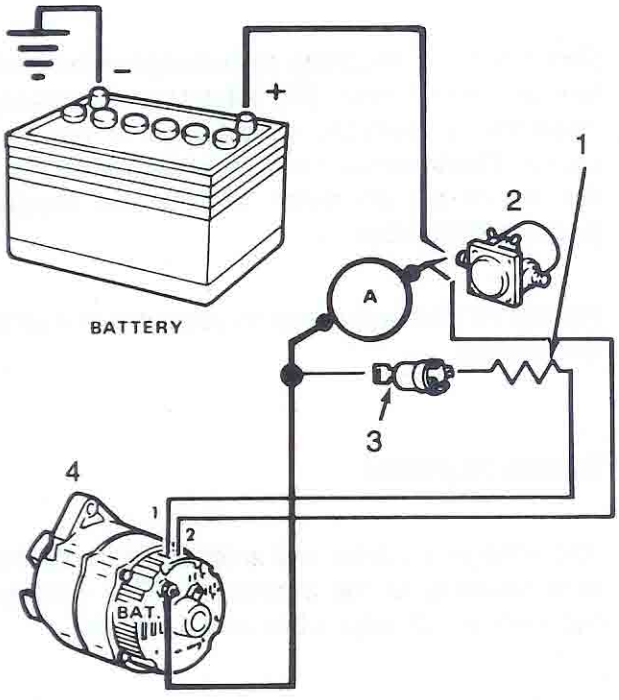
DIAGNOSIS

Close adherence to the following procedures in the order presented will result in locating and correcting charging system malfunctions in the shortest possible time.

A basic wiring diagram for the charging system is shown in the illustration.

SEE I.S. NOTES

SEE I.S. NOTES



1. Resistance Wire
2. Solenoid
3. Ignition Switch
4. Alternator

70136A

To avoid damage to the charging system, always observe the following precautions:

- do not attempt to polarize the regulator
- do not short across or ground any of the terminals in the charging system except as specifically instructed
- never drive the alternator with the engine when the ouput terminal circuit is open and the No. 1 and No. 2 wire terminals are connected to the alternator
- ensure that the alternator and battery have the same ground polarity
- when connecting a charger or a booster battery to the battery, connect negative to negative and positive to positive

NOTE: CJ and Scrambler models are equipped with a voltmeter.

Malfunction of the charging system is usually indicated by one or more of the following symptoms:

- faulty voltmeter operation
- an undercharged battery, indicated by slow engine cranking and battery electrolyte having low specific gravity
- an overcharged battery, indicated by excessive water usage

Prior to performing any electrical tests, visually inspect all charging system components and wiring for obvious discrepancies.

Visual Inspection

Inspect for clean and tight cable terminal connections at the battery posts, engine block, and starter motor solenoid. Inspect for corrosion and loose wire terminal connections at the alternator, starter motor solenoid, dash panel connector and the charging system indicator. Inspect all wires for cracked or broken insulation. Ensure that the alternator mounting screws are tight and that it is properly grounded. Inspect the electrolyte level in the battery and add water if necessary. Test the alternator drive belt tension.

Alternator Noise

Unusual alternator noise may be caused by any one or more of the following conditions:

- loose mounting bolts
- loose or misaligned pulley
- worn or contaminated bearings
- out-of-round or rough slip rings
- defective brushes
- shorted rectifier diode(s) indicated by a high frequency whine

Noise from the cooling system can also sound like alternator noise. When testing disconnect and plug the heater hoses to eliminate the possibility of the alternator bracket reproducing heater core noise.

Faulty Ammeter or Voltmeter Operation

Diagnostic procedures for the instrumentation circuits are described in Engine Instrumentation.

Overcharged/Undercharged Battery

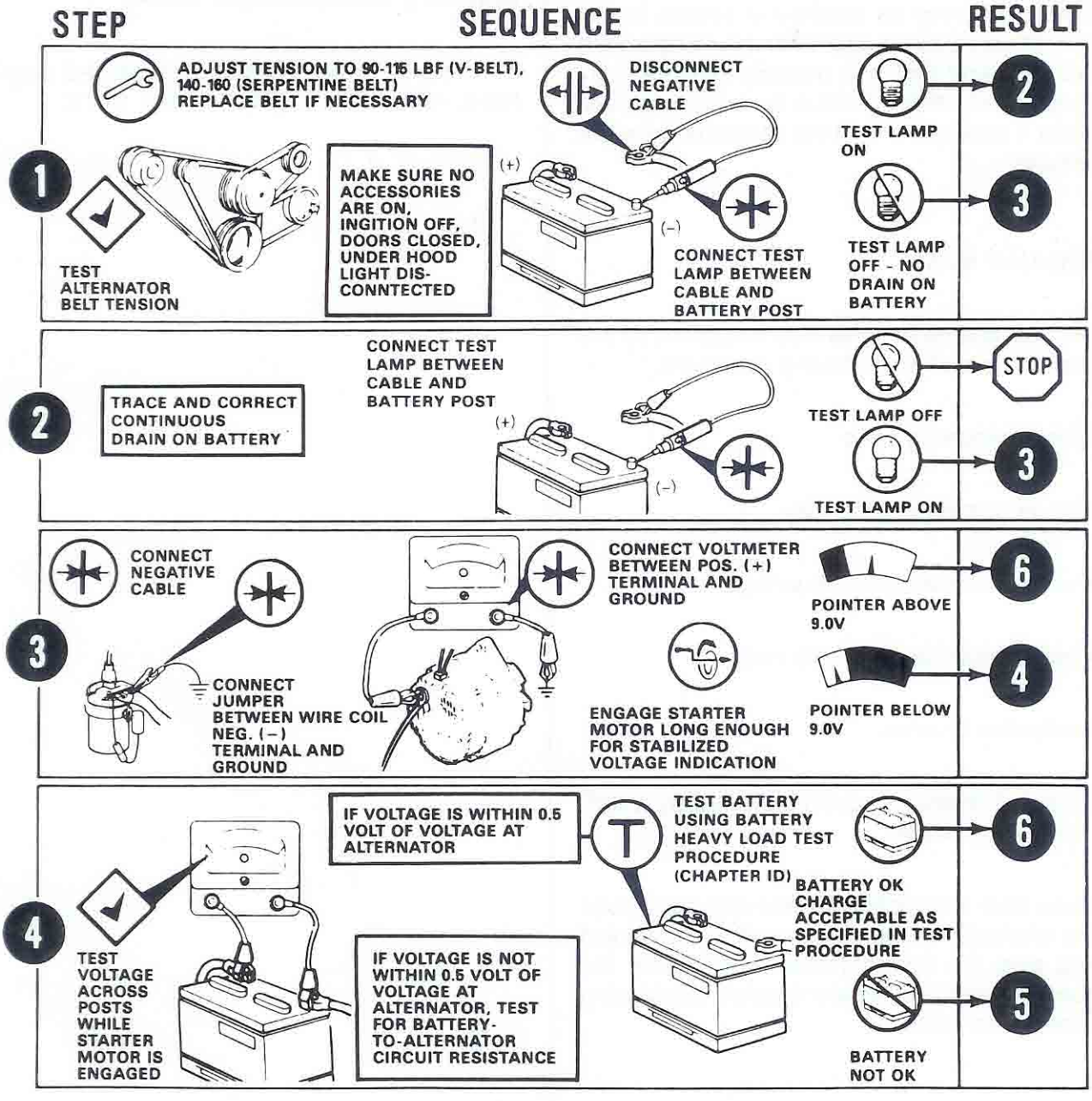
For battery undercharged-overcharged diagnosis, refer to the DARS Charts 1 and 2.

FOUR- AND SIX-CYLINDER ENGINE CHARGING SYSTEM
DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

PROBLEM: BATTERY UNDERCHARGED

Chart 1

SEE I.S. NOTES



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STEP	SEQUENCE	RESULT
5	REPLACE BATTERY	6
6	CONNECT VOLTMETER ACROSS BATTERY RECORD VOLTAGE DISCONNECT JUMPER WIRE FROM COIL NEG. (–) TERMINAL PLACE CARBUETOR THROTTLE ON HIGH STEP OF FAST IDLE CAM START ENGINE. DO NOT TOUCH ACCELERATOR PEDAL	7
7	TURN ON ACCESSORIES: HEADLIGHTS-HI; A/C - HI; RADIO; BLOWER-TYPE DEFROSTER CHECK VOLTAGE	IF VOLTAGE IS LOWER THAN IN STEP 6 → 9 IF VOLTAGE IS HIGHER THAN IN STEP 6 → 8
8	TURN OFF ACCESSORIES WAIT UNTIL UPPER RADIATOR INLET IS HOT AND VOLTMETER POINTER STOPS CHECK VOLTAGE	IF VOLTAGE IS LESS THAN 12.5V → 9 IF VOLTAGE IS MORE THAN 15.5V → 10 IF VOLTAGE IS 12V TO 15.5V SEE NOTE BELOW → STOP
9	GROUND ALTERNATOR FIELD WINDING. TOUCH SCREW-DRIVER TO TAB AND ALTERNATOR BODY CHECK VOLTAGE	IF VOLTAGE IS HIGHER THAN IN STEP 6 → 10 IF VOLTAGE IS LOWER THAN IN STEP 6 → 11
10	REPLACE VOLTAGE REGULATOR	STOP
11	OVERHAUL ALTERNATOR	STOP

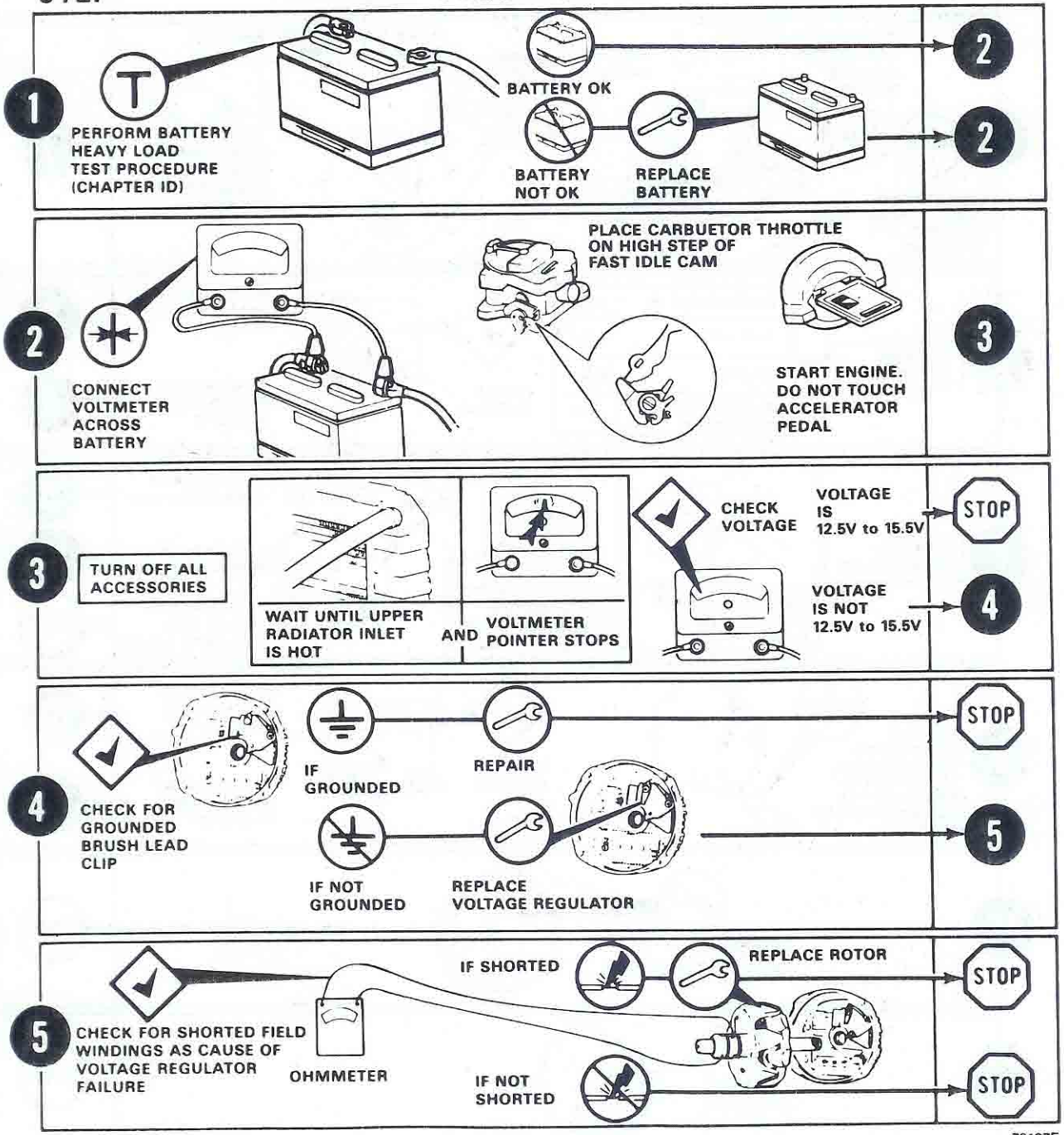
NOTE: IF NO FAULT HAS BEEN FOUND, EXCESSIVE IDLING AND SLOW OR SHORT DISTANCE DRIVING, WITH ALL ACCESSORIES ON, MAY HAVE CAUSED HEAVY DRAIN ON BATTERY – RESULTING IN UNDERCHARGED CONDITION.

70137A

PROBLEM: BATTERY OVERCHARGED (USES TOO MUCH WATER)

Chart 2

SEE I.S. NOTES



70137F

Battery Discharge Through the Alternator

If the alternator is suspected of discharging the battery because of excessive current leakage, perform the following test procedure with a No. 158 bulb and bulb socket with attached jumper wires.

WARNING: Failure to disconnect the battery negative cable before disconnecting alternator output wire can result in injury.

Disconnect the battery negative cable. Disconnect the output wire (red) from the alternator output terminal.

Connect the test bulb jumper wires in series with the output wire and alternator output terminal. Connect the battery negative cable. The bulb should not light. If the bulb lights, even dimly, replace the alternator bridge rectifier.

Disconnect the battery negative cable and remove the jumper wires.

Disconnect the wires from the No. 1 and 2 terminals of the alternator.

Connect the test bulb jumper wires between the No. 1 terminal at the alternator and the battery positive post. Connect the battery negative cable. The bulb should not light. If the bulb lights, even dimly, test the alternator diode trio. If the diode trio is not defective, replace the voltage regulator.

Connect the test bulb jumper wires between the No. 2 terminal at the alternator and the battery positive post. The bulb should not light. If the bulb lights, even dimly, replace the voltage regulator.

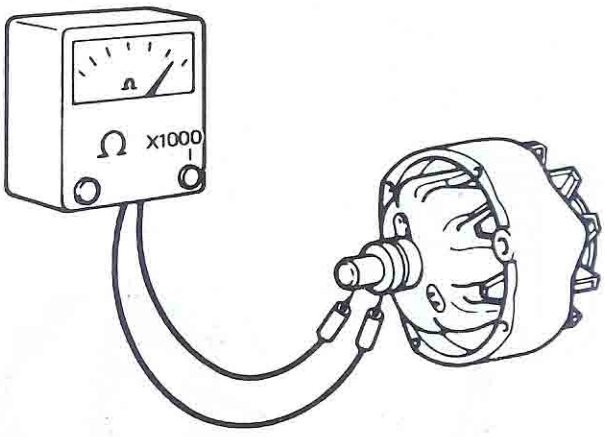
TESTING – OFF-VEHICLE

Rotor (Field) Winding Short Circuit-to-Ground Test

To perform this test, remove the rotor and front housing assembly from the stator and rear housing assembly. Refer to Alternator Overhaul for the procedure.

Perform the test with an ohmmeter set for the x1000 ohm scale or with a 110-volt test lamp.

Touch one test lead probe to the rotor shaft and touch the other probe to one slip ring. Repeat with the other slip ring. In each test, the ohmmeter should indicate infinite resistance (no pointer movement) or the test lamp should not light.



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SEE I.S. NOTES

SEE I.S. NOTES

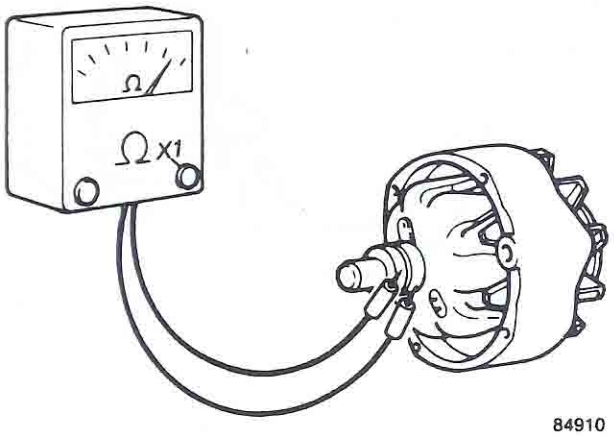
Test Results

If the ohmmeter indicates other than an infinite resistance or the test lamp lights, a short circuit to the rotor shaft (ground) exists. Inspect the soldered connections at the slip rings to ensure they are secure and not shorted to the rotor shaft, or that excess solder is not shorting the rotor winding to the shaft. Replace the rotor, if defective.

Rotor (Field) Winding Open Circuit Test

To perform this test, remove the rotor and front housing assembly from the stator and rear housing assembly. Refer to Alternator Overhaul for the procedure. Perform the test with an ohmmeter set for the x1 scale or with a 110-volt test lamp.

Touch one test lead probe to one slip ring and the other test lead probe to the other slip ring. The ohmmeter should indicate 2.2 - 3.0 ohms or the test lamp should light.



84910

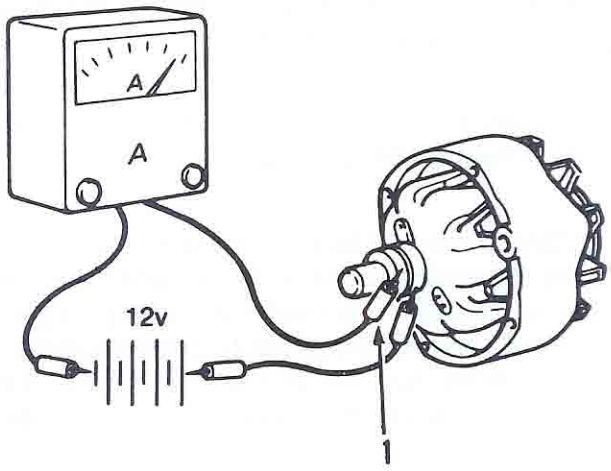
Test Results

If the ohmmeter indicates infinite resistance or the test lamp fails to light, the rotor (field) winding has an open circuit.

Rotor (Field) Winding Internal Short Circuit Test

To perform this test, remove the rotor and front housing from the stator and rear housing assembly. Refer to Alternator Overhaul for the procedure. This test is performed with a 12-volt battery and an ammeter.

Connect the battery and ammeter in series with the slip rings (1). The field current with 12 volts applied at 27°C (80°F) should be between 4.0 and 5.0 amps.



84911

Test Results

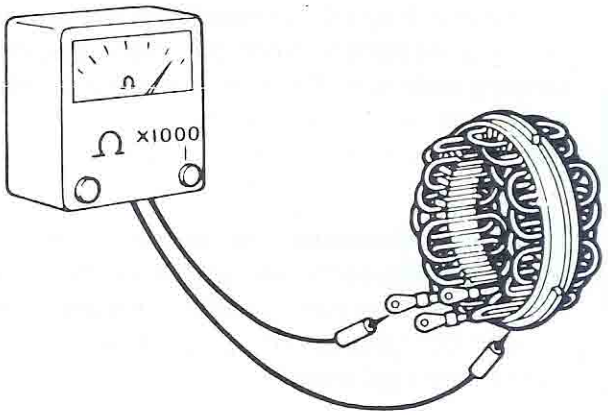
Current flow exceeding 5.0 amps indicates internally shorted windings.

NOTE: The winding resistance and ammeter indication will vary slightly with winding temperature changes. A current flow that is the less than the specified value indicates excessive winding resistance. An alternate test method is to determine the field winding resistance by connecting an ohmmeter to the two slip rings. If the resistance is less than 2.2 ohms at 27°C (80°F), the windings are internally shorted. If the resistance is more than 3.0 ohms at 27°C (80°F), the windings have excessive resistance.

Stator Windings Short Circuit-to-Ground Test

To perform this test, separate the rear housing and stator from the rotor and front housing assembly. Disconnect the stator winding terminals from the bridge rectifier (and diode trio) terminal studs. Refer to Alternator Overhaul for the procedure. The test is performed with an ohmmeter set for the x1000 scale or with a 110-volt test lamp.

Touch one test lead probe to the bare metal surface of the stator core and the other test lead probe to the end of one stator winding. Because all three stator winding terminals are soldered together, it is not necessary to test each winding. The ohmmeter should indicate infinite resistance (no pointer movement) or the test lamp should not light.



84912

Test Results

If the ohmmeter indicates other than an infinite resistance or the test lamp lights, the stator windings have a short circuit to the core (ground) and must be replaced.

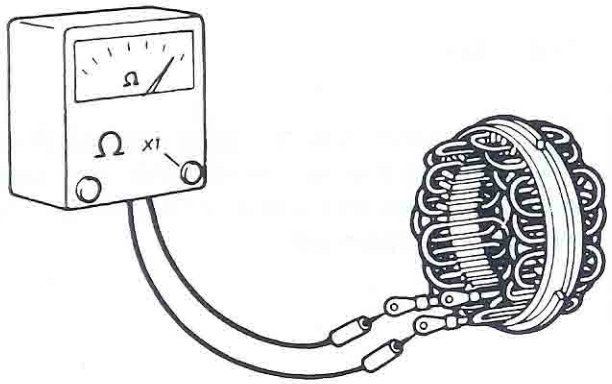
SEE I.S. NOTES

SEE I.S. NOTES

Stator Windings Continuity Test

To perform this test, remove the stator and rear housing assembly from the rotor and front housing assembly. Refer to Alternator Overhaul for the procedure. An ohmmeter set for the x1 scale is used to perform the test.

Touch the ohmmeter test probes to any two stator winding terminals and note the resistance. Test all the stator windings in this manner. Equal indications should be obtained for each pair of windings tested.



84913

Test Results

An infinite resistance (no pointer movement) indicates open windings. Inspect the neutral junction splice for an inadequate solder connection. Resolder the connection even if it appears to be electrically and mechanically good. Retest for winding continuity. If an open circuit still exists, replace the stator windings.

An indication of more than one ohm indicates a possible cold solder joint. Inspect the neutral junction splice and resolder, if necessary.

Stator Windings Internal Short Circuit Test

An internal short circuit (e.g., between the adjacent windings) is difficult to locate without laboratory test equipment. If all other alternator test results are normal and the alternator fails to supply the rated output, shorted stator windings are probable.

Diode Trio Short Circuit Test

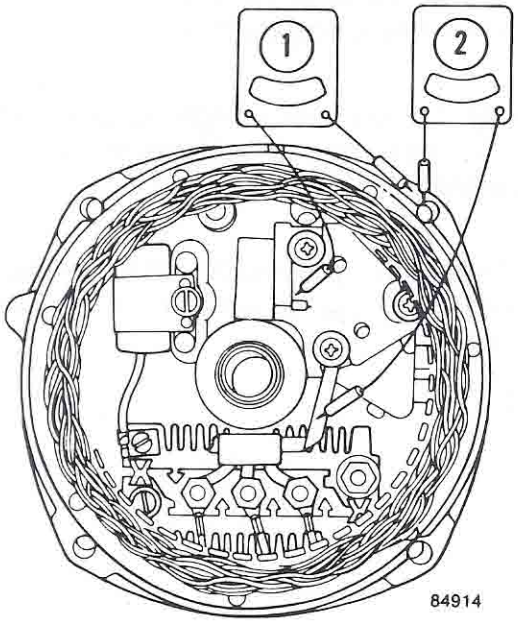
The diode trio is tested in two ways: when installed in the rear housing and when removed from the rear housing.

CAUTION: Do not use high voltage test device, such as a 110-volt test lamp, to test the diode trio.

Test with the Trio Installed

Before removing the diode trio, connect an ohmmeter, with the lowest range scale selected, from the brush holder clip, to rear housing (1) and note the resistance.

Reverse the test probe connections (2). If both indications are zero, inspect for a shorted brush holder clip caused by absence of the insulating washer/sleeve around the screws or damaged insulation.



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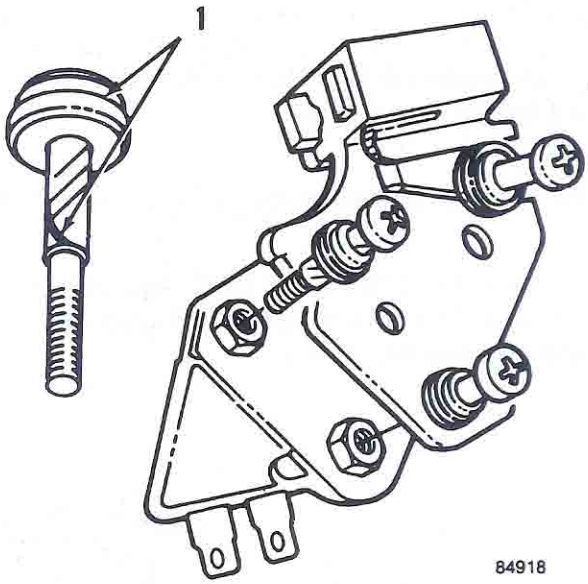
Remove the screws to inspect the insulating washers/sleeves (1). If insulator assemblies are correct and both ohmmeter observations are identical, replace the voltage regulator.



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SEE I.S. NOTES

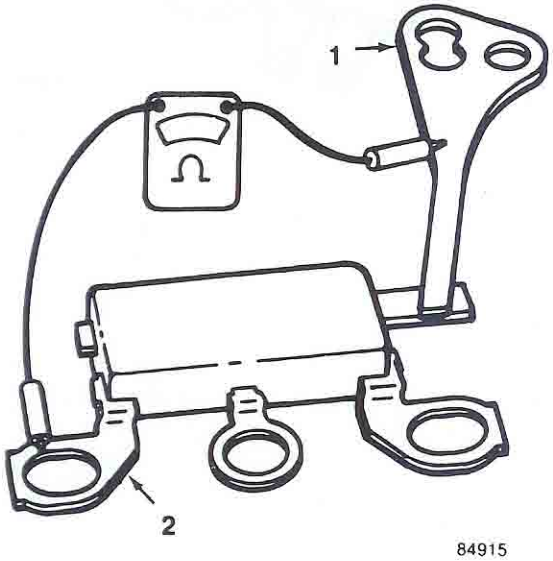
Test with Diode Trio Removed

Remove the diode trio from the rear housing assembly.

Use an ohmmeter having 1½ volt cell for the test. Touch one test probe to the brush terminal (1) and the other probe to one of the stator winding terminal (2). Observe the resistance on the lowest range scale.

Reverse the probes at the same two terminals.

Replace the diode trio if both resistances are identical. The good diode trio will have one high and one low resistance.



84915

Repeat the procedure for each stator winding terminal of the diode trio.

Connect the ohmmeter test probes to any two stator winding terminals. If the resistance is zero, a shorted diode is indicated. Replace the diode trio. Repeat the test for each combination of stator winding terminals.

Bridge Rectifier Test

The bridge rectifier assembly contains six diodes. If one diode is defective, the entire bridge rectifier assembly must be replaced.

CAUTION: Do not use a high voltage test device, such as a 110-volt test lamp, to test the bridge rectifier.

NOTE: Press down firmly on the flat metal area surrounding the thread studs with the ohmmeter test probes.

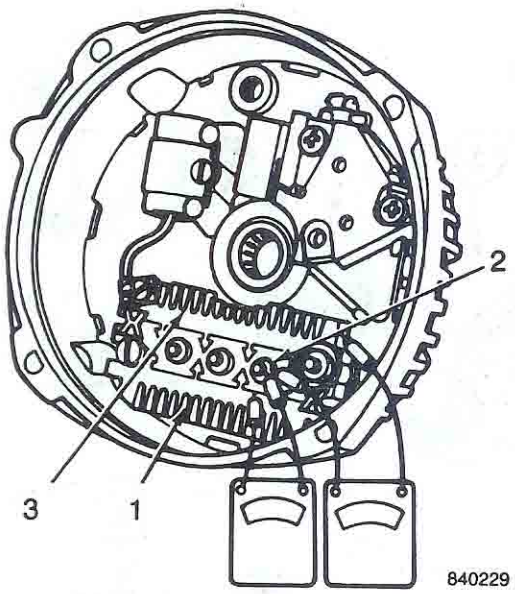
SEE I.S. NOTES

Firmly touch the ohmmeter test probes to the grounded heat sink (1) and any one of three terminals (2). Note the resistance.

Reverse the ohmmeter test probe contacts to the grounded heat sink and the same terminal. Note the resistance.

Repeat the procedure for the remaining two terminals.

In the same manner as described above, test between the insulated heat sink (3) and each of the three terminals.



Test Results

Each combination of the terminal and heat sink tested should have one high and one low resistance. Replace the bridge rectifier, if any one pair of resistance indications is the same.

NOTE: Replacement bridge rectifiers may vary in appearance but are completely interchangeable.

ALTERNATOR REPLACEMENT

Removal

NOTE: All bolt and screw threads are in metric dimensions.

WARNING: Failure to disconnect the battery negative cable before disconnecting the red (output) wire from the alternator can result in injury.

Disconnect the battery negative cable.

Disconnect the two-terminal plug and red wire at the back of the alternator.

Remove the mounting and adjusting bolts, washers and nuts.

Remove the alternator drive belt from the alternator pulley and remove the alternator from the mounting bracket.

Remove the pulley and fan from the alternator, Refer to Alternator Overhaul for procedure.

Installation

Install the original pulley and fan on the replacement alternator. Refer to Alternator Overhaul.

Attach the alternator to the mounting bracket with the washers and bolts. Tighten the bolts finger-tight only.

Install the alternator drive belt.

Tighten the belt to the specified tension. Refer to Cooling Systems in Chapter B for procedure.

Tighten the bolt at the sliding slot bracket with 27 N·m (20 ft-lbs) torque. Tighten the remaining bolts with 41 N·m (30 ft-lbs) torque.

SEE I.S. NOTES

Install the two-terminal plug and red (output) wire on the alternator.

Connect the battery negative cable.

ALTERNATOR OVERHAUL

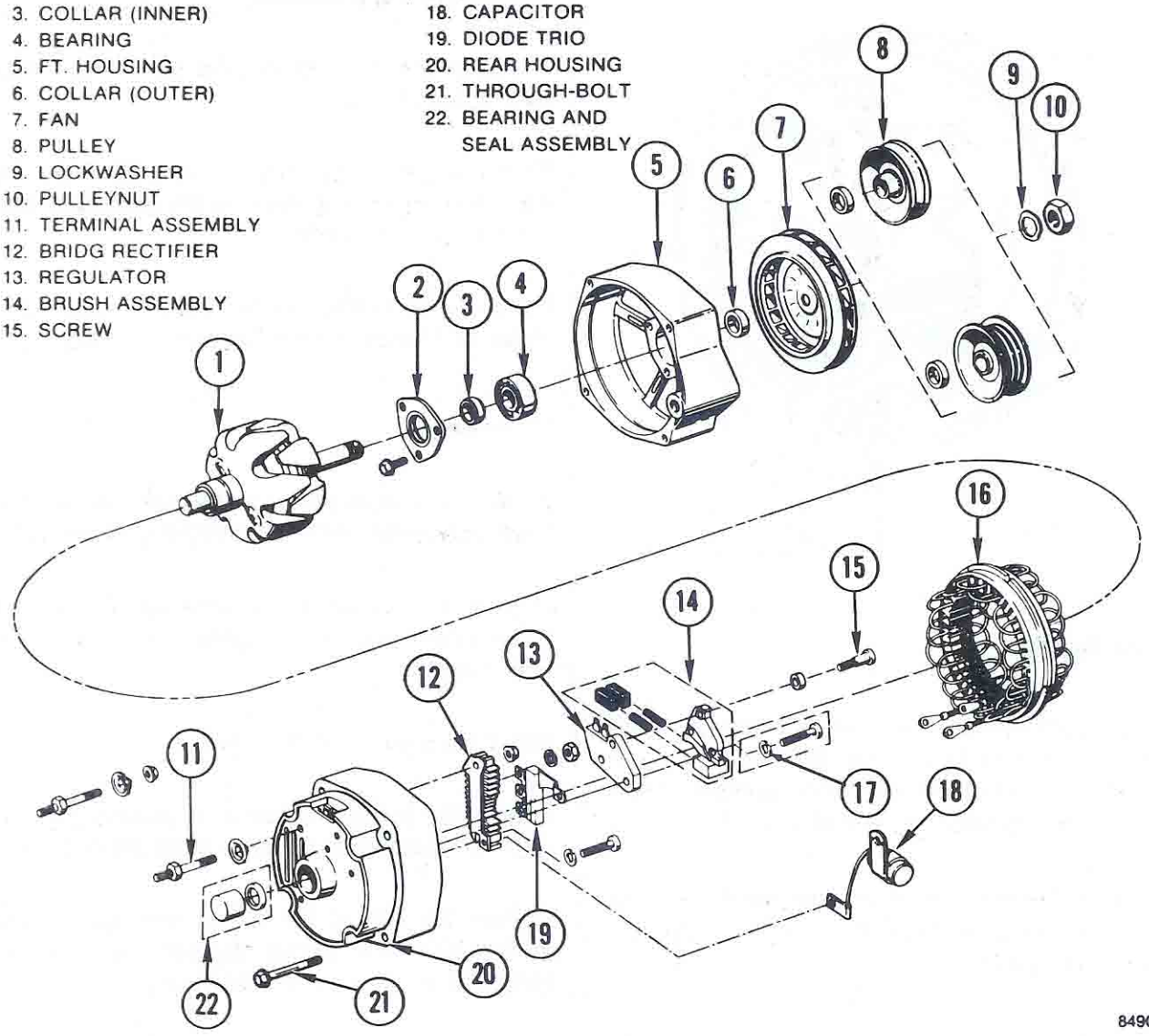
Disassembly

CAUTION: As the rotor and drive end (front) housing assembly is separated from the rear housing assembly the brushes can spring out onto the rotor shaft and come in contact with lubricant. Immediately clean the brushes that contact the shaft to avoid contamination by lubricant, otherwise, they will have to be replaced.

NOTE: All bolt and screw threads are in metric dimensions.

SEE I.S. NOTES

1. ROTOR
2. FRONT BEARING RETAINER PLATE
3. COLLAR (INNER)
4. BEARING
5. FT. HOUSING
6. COLLAR (OUTER)
7. FAN
8. PULLEY
9. LOCKWASHER
10. PULLEYNUT
11. TERMINAL ASSEMBLY
12. BRIDG RECTIFIER
13. REGULATOR
14. BRUSH ASSEMBLY
15. SCREW
16. STATOR
17. INSULATING WASHER
18. CAPACITOR
19. DIODE TRIO
20. REAR HOUSING
21. THROUGH-BOLT
22. BEARING AND SEAL ASSEMBLY



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Scribe across the front housing, stator frame and rear housing for assembly reference.

Remove the four through-bolts that connect the rear housing to the front housing.

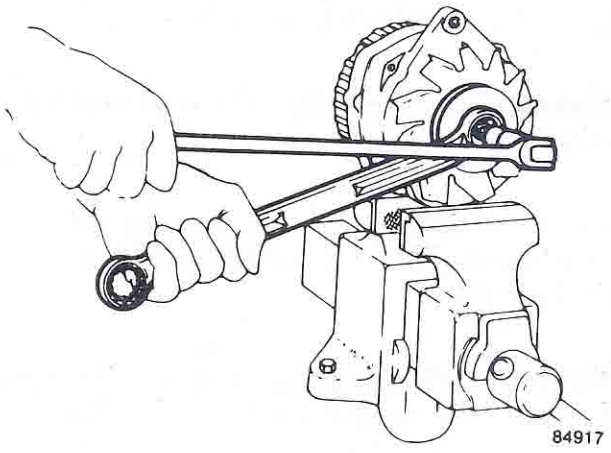
Separate the front housing and rotor assembly from the rear housing and stator assembly by prying the housings apart with a screwdriver.

NOTE: After disassembly, cover the rear housing bearings with tape to prevent entry of dirt and other foreign material. Also, cover the rotor shaft on the slip ring end with tape. Use pressure-sensitive tape, not friction tape, which would leave a gummy deposit on the shaft. If the brushes are to be reused, clean with a soft, dry cloth.

CAUTION: Avoid excessive tightening of the rotor in the vise to prevent rotor distortion.

Place a rotor in a vise and tighten the vise only enough to permit the removal of the pulley nut.

An alternate pulley nut removal procedure requires the use of an Allen wrench to prevent the rotor from turning while loosening the nut with a wrench.


84917

Remove the pulley nut, lockwasher, pulley, fan and outer collar.

Separate the front housing from the rotor shaft.

Remove the three stator winding terminal attaching nuts and washers and remove stator winding terminals from the bridge rectifier terminal studs.

Separate the stator from the rear housing.

Remove the diode trio strap terminal attaching screw from the brush holder and remove the diode trio.

Remove the capacitor holddown screw.

Disconnect the capacitor wire terminal from the bridge rectifier. Remove the capacitor.

Remove the bridge rectifier attaching screws and the battery wire terminal (output) stud.

Remove the bridge rectifier. For assembly reference, note the insulator located between the heat sink and the rear housing.

Remove the remaining two brush holder screws. Note the location of all the insulator washer/sleeves to facilitate the correct assembly.

Remove the brush holder and brushes. Carefully note the position of the parts for assembly reference.

Remove the voltage regulator.

Remove the front bearing retainer plate screws, retainer plate and inner collar.

SEE I.S. NOTES

Press out the front bearing and slinger from the front housing with the appropriate tube or collar.

NOTE: If the bearing is in satisfactory condition, it may be reused.

Press out the rear bearing from the rear housing using the tube or collar that fits inside the bearing housing. Press from inside of the housing toward the outside.

SEE I.S. NOTES

NOTE: Replace the rear bearing if its lubricant supply is exhausted. Do not attempt to lubricate and reuse a dry bearing.

Cleaning and Inspection

CAUTION: Do not clean the rotor with a degreasing solvent.

Clean the rotor poles by brushing with oleum spirits, or equivalent.

Inspect the slip rings for contamination and roughness. Clean with solvent. If necessary, clean and finish the slip rings with commutator paper, or 400 grit (or finer) polishing cloth. Do not use metal-oxide paper. Spin the rotor in a lathe or other rotatable support while holding the abrasive against the rings.

NOTE: When using an abrasive, support the rotor while spinning to clean the slip rings evenly. Cleaning the slip rings without support may result in flat spots on slip rings. This will cause brush noise and premature brush wear.

True rough or out-of-round slip rings in a lathe to 0.051-mm (0.002-in) maximum gauge indication. Remove only enough material to make the rings smooth and round. Finish with commutator paper, or 400 grit (or finer) polishing cloth, and blow away all dust.

CAUTION: Do not clean the stator with a degreasing solvent.

Clean the stator by brushing with oleum spirits, or equivalent.

Inspect the brush springs for damage or corrosion. Replace the springs, if there is any doubt about their condition.

Inspect the brushes for wear or contamination. If the brushes are to be reused, clean them with a soft, dry cloth until it is completely free of lubricant.

Inspect the condition of the brush holder screw insulating washer/sleeves for broken or cracked insulation.

Thoroughly clean the bridge rectifier, diode trio and voltage regulator with a brush and high pressure air.

Assembly

CAUTION: Overfilling may cause the bearing to overheat.

Fill the cavity between the retainer plate and front bearing one-quarter full with Delco lubricant No. 1948791, or equivalent.

Assemble the slinger and bearing into the front housing.

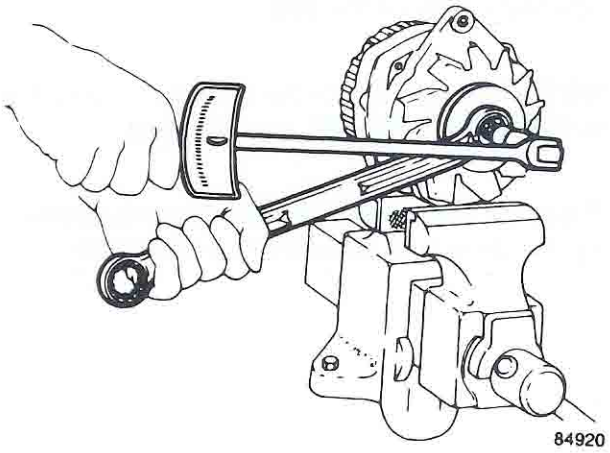
Press the bearing into the housing with the appropriate tube or collar that fits over the outer bearing race.

NOTE: Install a replacement retainer plate if the felt seal in the retainer plate has hardened.

Install the inner collar, retainer plate and screws.

Position the housing, outer collar, fan, pulley and washer on the rotor shaft and install the pulley nut.

Place the rotor in a vise. Tighten the vise only enough to permit tightening of pulley nut. Tighten the nut with 68 N·m (50 ft-lbs) torque.



An alternate method of tightening the pulley nut requires the use of an Allen wrench to prevent the rotor from turning while tightening the nut with a torque wrench.

If the rear bearing was removed, support the inside of the rear housing with a hollow cylinder.

CAUTION: Use extreme care to avoid misalignment or placing undue stress on the bearing.

Place a flat plate over the bearing and press the bearing into the housing from the outside until the bearing is flush with the housing.

Install a replacement bearing seal. Lightly lubricate the lip with oil to facilitate installation of the rotor shaft. Press the seal into the housing with the lip away from the bearing.

Install the springs and brushes into the brush holder. The brushes should slide in and out of the brush holder without binding.

NOTE: Should any of the brush holder assembly parts require replacement, it is necessary to replace the entire brush holder assembly. Individual parts are not serviced.

Insert a straight wooden or plastic toothpick (to prevent scratching the brushes) into the hole at the bottom of the holder to retain the brushes.

Install the voltage regulator.

Attach the brush holder to the rear housing. Carefully note the correct locations for insulating the washer/sleeves. Allow the toothpick to protrude through the hole in the rear housing.

Install the diode trio terminal strap attaching screw and insulating washer.

Tighten the remaining two brush holder screws securely.

Position the bridge rectifier on the rear housing with the insulator inserted between the insulated heat sink and the rear housing.

SEE I.S. NOTES

Install the bridge rectifier attaching screw and battery wire (output) terminal stud.

Connect the capacitor wire terminal to the bridge rectifier and tighten the screw securely.

Install the capacitor holddown screw.

SEE I.S. NOTES

Position the diode trio strap terminals on the bridge rectifier terminal studs.

Install the stator in the rear housing.

Attach the stator winding terminal to the bridge rectifier terminal studs. Secure with washers and nuts.

Before joining the rotor and the front housing assembly with the stator and rear housing assembly, remove the protective tape and ensure that the bearing surface of the shaft is clean.

Join the front housing and rear housing together with the scribe mark aligned.

Install the four through-bolts and tighten securely.

Remove the toothpick from the brush holder assembly. Rotate the rotor.

DRIVE BELT ADJUSTMENT

If the belt has been in service for some time, inspect the general condition of the belt before attempting an adjustment. Replace the belt if it is severely cracked or oil-soaked.

Install the belt tension gauge on the longest accessible span of belt, midway between pulleys. Acceptable tension for a V-belt arrangement is 400-512 N (90-115 pounds-force).

NOTE: When using the gauge on a notched belt, position the middle finger of the gauge in the notched cavity of the belt.

NOTE: The tension for the serpentine drive belt is 616-704 N (140-160 pounds-force).

Refer to Chapter B – Engines-Cooling Systems for the drive belt adjustment procedures.

GENERAL

The starting system used with four- and six-cylinder engines consists of a lightweight positive engagement starter motor, a starter motor solenoid, an ignition/start switch, circuits protected by fusible links and the battery. Vehicles equipped with an automatic transmission also have a neutral safety switch. The starter motor has a moveable pole shoe and appropriate linkage to engage the drive mechanism. Inside the drive assembly, an overrunning clutch prevents the starter motor from being driven by the ring gear.

CAUTION: Starter motor solenoids used in previous years (before solid-state ignitions) look similar to the solenoids presently used but are very different internally. Use of the wrong type solenoid can damage the neutral safety switch. Verify the part number stamped on the replacement solenoid before installation.

CAUTION: Starter motor solenoids are equipped with both blade terminals and long studs. The blade terminals are attached to the long studs and held in place by retaining nuts. Loosening of the retaining nuts could cause the loss of internal connections and necessitate replacement of the solenoid.

SEE I.S. NOTES

SPECIAL TOOLS

Tool Ref.	Description	Required	Recommended
AMA 21-317	Circuit Tester		■
AMOT ET-502	Digital Multimeter		■
J-22516	Starter Pole Screw Wrench		■

TORQUE SPECIFICATIONS

Component	Service Set-To Torque	Service Recheck Torque
Neutral Safety Switch-to-Transmission Case	23 N·m (17 ft-lbs)	19-28 N·m (14-21 ft-lbs)
Starter Motor-to-Flywheel/Converter Housing	24 N·m (18 ft-lbs)	18-34 N·m (13-25 ft-lbs)
Starter Terminal Screw	6 N·m (55 in-lbs)	4.5 - 9 N·m (40-70 in-lbs)

SEE I.S. NOTES

SPECIFICATIONS

Four-Cylinder Engine Starter Motor Specifications

Item	Specifications
Frame diameter	101.6 mm (4.0 in)
Brush Length	12.7 mm (0.5 in)
Wear Limit	6.35 mm (0.25 in)
No Load Test (Free Speed) Volts Amps Min. RPM Max. RPM	 12 67 7380 9356
Contact Point Clearance	2.5-0.5 mm (0.100-0.020 in) 1.5 mm (0.060 in) preferred

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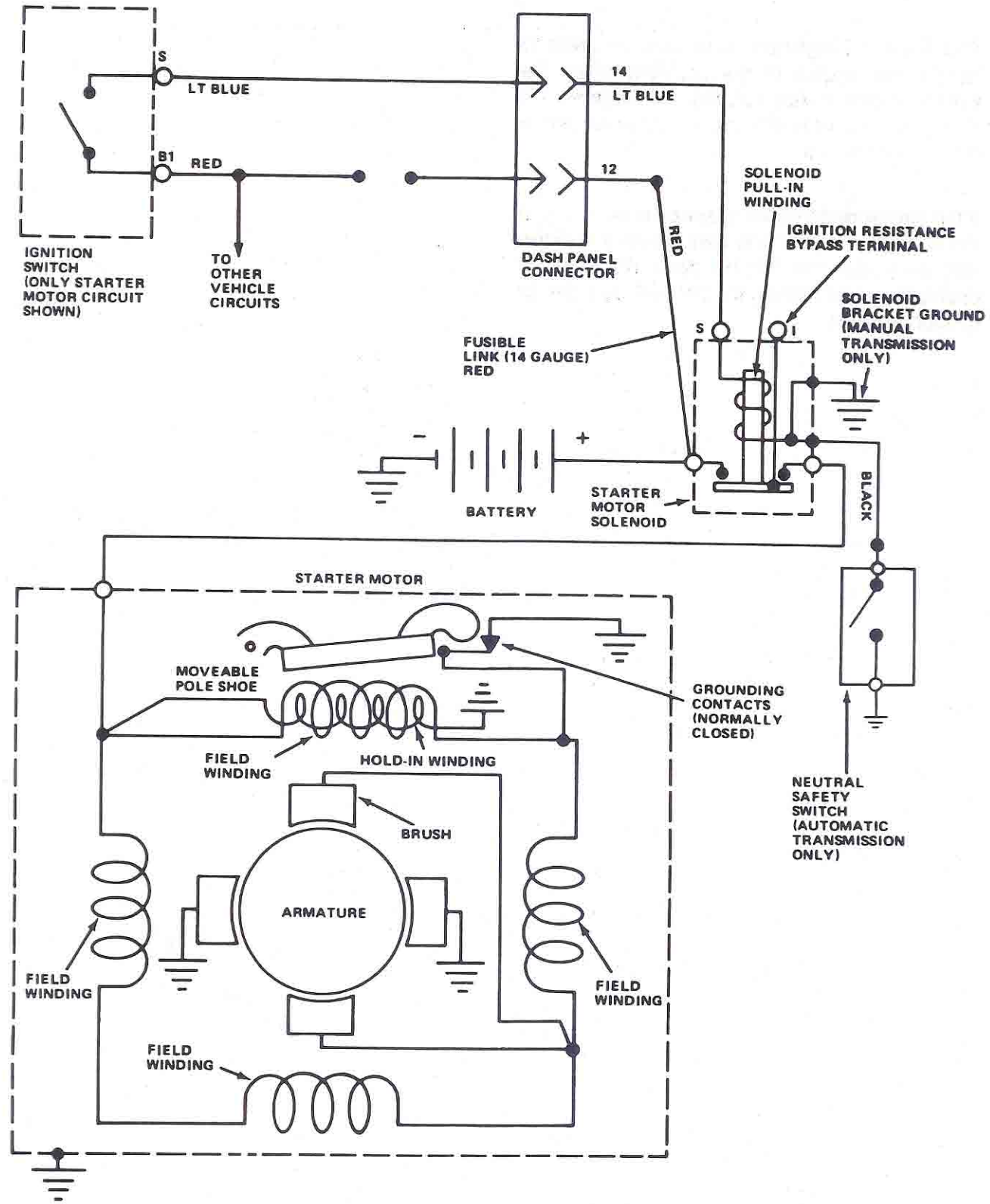
Six-Cylinder Engine Starter Motor Specifications

Item	Specifications
Frame diameter	114.3 mm (4.5 in)
Brush Length	12.7 mm (0.5 in)
Wear Limit	6.35 mm (0.25 in)
No Load Test (Free Speed) Volts Amps Min. RPM Max. RPM	 12 67 7380 9356
Contact Point Clearance	2.5-0.5 mm (0.100-0.020 in) 1.5 mm (0.060 in) preferred

840233



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SEE I.S. NOTES

TROUBLESHOOTING

The Service Diagnosis chart may be used to isolate the source of the problem when the starter motor either rotates the engine too slowly, will not rotate the engine or has abnormal drive engagement.

If the starter motor rotating speed is normal and the drive pinion gear engages properly with the ring gear but the engine does not start, a problem exists either in the fuel system or ignition system.

SEE I.S. NOTES

SERVICE DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
STARTER MOTOR ROTATES ENGINE SLOWLY	(1) Battery charge low or battery defective.	(1) Charge or replace battery
	(2) Defective circuit between battery and starter motor.	(2) Clean and tighten, or replace cables.
	(3) Low load current.	(3) Bench-test starter motor. Inspect for worn brushes and weak brush springs.
	(4) High load current.	(4) Bench-test starter motor. Check engine for friction, drag or coolant in cylinders. Check ring gear-to-pinion gear clearance.
STARTER MOTOR WILL NOT ROTATE ENGINE	(1) Battery charge low or battery defective.	(1) Charge or replace battery.
	(2) Faulty solenoid.	(2) Check solenoid ground. Repair or replace as necessary.
	(3) Damage drive pinion gear or ring gear.	(3) Replace damaged gear(s).
	(4) Starter motor engagement weak.	(4) Bench-test starter motor.
	(5) Starter motor rotates slowly with high load current.	(5) Inspect drive yoke pull-down and point gap, check for worn end bushings, check ring gear clearance.
	(6) Engine seized.	(6) Repair engine.
STARTER MOTOR DRIVE WILL NOT ENGAGE (SOLENOID KNOWN TO BE GOOD)	(1) Defective contact point assembly.	(1) Repair or replace contact point assembly.
	(2) Inadequate contact point assembly ground.	(2) Repair connection at ground screw.
	(3) Defective hold-in coil.	(3) Replace field winding assembly.
STARTER MOTOR DRIVE WILL NOT DISENGAGE	(1) Starter motor loose on flywheel housing.	(1) Tighten mounting bolts.
	(2) Worn drive end busing.	(2) Replace bushing.
	(3) Damaged ring gear teeth.	(3) Replace ring gear or driveplate.
	(4) Drive yoke return spring broken or missing.	(4) Replace spring.
STARTER MOTOR DRIVE DISENGAGES PREMATURELY	(1) Weak drive assembly thrust spring.	(1) Replace drive mechanism.
	(2) Hold-in coil defective.	(2) Replace field winding assembly.
LOW LOAD CURRENT	(1) Worn brushes.	(1) Replace brushes.
	(2) Weak brush springs.	(2) Replace springs.

SEE I.S. NOTES

84926

ON-VEHICLE TESTING

Starter Motor Will Not Rotate

SEE I.S. NOTES

Verify the battery and cable condition as underlined under Batteries to assure that the correct voltage is available.

Inspect and tighten the battery and starter motor cable connections at the starter motor solenoid terminals.

Disconnect the wire at the solenoid S-terminal.

WARNING: Place the transmission in Neutral (manual) or Park (automatic) position and apply the parking brake before conducting the solenoid test.

Connect a jumper wire from the battery positive post to the solenoid S-terminal. If the starter motor rotates the solenoid is not defective. Inspect the ignition/start switch circuit.

If the starter motor does not rotate, connect another jumper wire from the battery negative terminal to the solenoid mounting bracket (manual transmission) or the ground terminal (automatic transmission). Ensure that a good connection is made.

If the solenoid energizes, it was not properly grounded. Remove any rust or corrosion and attach the solenoid to the inner-fender panel with cadmium-plated screws (manual transmission) or test the operation of the neutral safety switch (automatic transmission).

If the starter motor does not rotate, remove the jumper wires and connect a heavy gauge jumper cable between the battery positive post and the starter motor terminal on the solenoid. If the starter motor rotates, the solenoid is defective and must be replaced. If the starter motor does not rotate, inspect the starter motor.

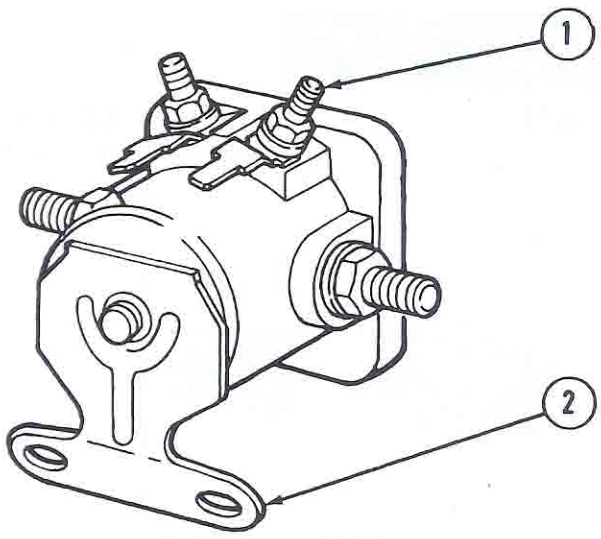
Solenoid Pull-In Coil Winding Test

This test will determine if the solenoid pull-in winding is either shorted or open.

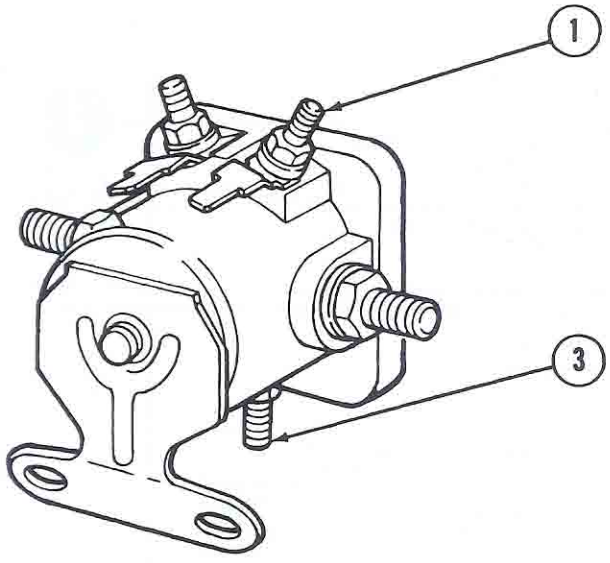
Disconnect the S-terminal wire from the solenoid.

Connect the ohmmeter test probes to the S-terminal (1) and mounting bracket (2) (manual transmission) or ground terminal (3) (automatic transmission).

If the solenoid fails the test, replace the solenoid.



MANUAL TRANSMISSION



AUTOMATIC TRANSMISSION 84928

Solenoid Ground Test

An inadequate solenoid ground can be determined with an ohmmeter.

Connect one ohmmeter test probe to the battery negative post and the other probe to sheet metal adjacent to the solenoid (manual transmission) or the ground terminal (automatic transmission). Note the resistance.

Move the test probe to the solenoid S-terminal. Note the resistance.

If the resistance increases more than five ohms, the solenoid has an inadequate ground.

Starter Motor Cable and Ground Cable Tests (Voltage Drop Method)

The results of voltage drop tests will determine if there is excessive resistance in the high current circuit. When performing these tests, it is important that the voltmeter test lead probes be in contact with the terminals that the cables are connected to instead of with the cables themselves. For example, when testing between the battery and solenoid, the voltmeter probes must touch the battery post and the solenoid threaded stud.

Before performing the tests, ensure the following items are accomplished:

- disconnect and ground the ignition coil secondary wire
- place the transmission in Neutral (manual) or Park (automatic) and apply the parking brake
- ensure the battery is fully charged

Test Procedure

Follow the steps as outlined in the Starter Motor Voltage Drop Tests (DARS) charts.

SEE I.S. NOTES

STARTER MOTOR VOLTAGE DROP TEST DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHARTS

STARTER MOTOR VOLTAGE DROP TESTS

Chart 1

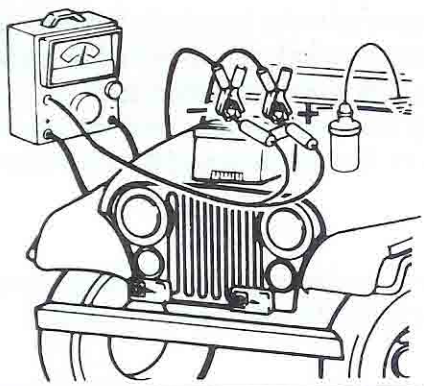
SEE I.S. NOTES

STEP	SEQUENCE	RESULT

STARTER MOTOR FULL LOAD CURRENT TEST

- CLEAN AND CONNECT BATTERY CABLES
- REMOVE COIL WIRE FROM DISTRIBUTOR AND CONNECT TO GROUND
- CONNECT HEAVY LOAD TESTER
- ENGAGE STARTER MOTOR FOR THREE SECONDS AND OBSERVE VOLTMETER
- TURN LOAD CONTROL UNTIL VOLTMETER INDICATES SAME VOLTAGE AS WHEN STARTER MOTOR WAS ENGAGED
- OBSERVE AMMETER. NOTE AMPS FOR USE IN LATER STEPS.

1



OK — 4&6 CYL. – 150-180 AMPS → STOP

C.K — 4&6 CYL. – ABOVE 180 AMPS

- BATTERY CABLES AND SOLENOID NOT TESTED → 2

OR

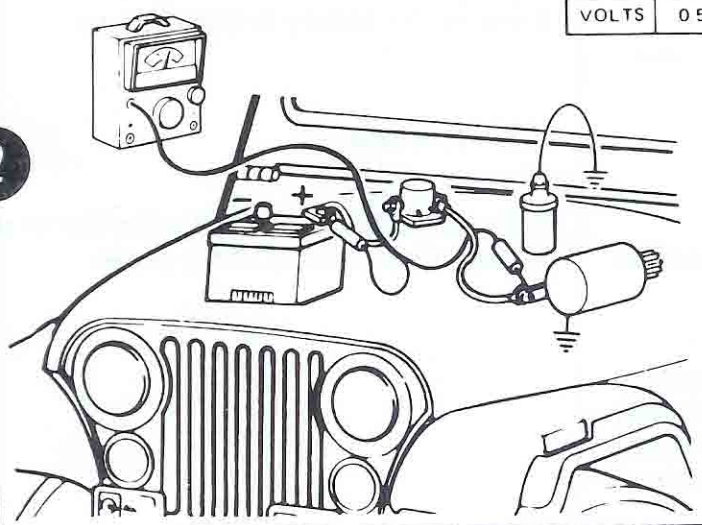
- BATTERY CABLE AND SOLENOID REPAIRS COMPLETED → REPAIR STARTER → STOP

VOLTAGE DROP TEST
(NOTE TEST POINTS IN ILLUSTRATION)

- GROUND COIL WIRE
- CONNECT VOLTMETER
- ENGAGE STARTER MOTOR
- OBSERVE VOLTMETER
- COMPARE AMPS FROM STEP 1 AND VOLTS TO CHART

MAXIMUM VOLTAGE DROP BY FULL LOAD AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.5 V	0.7 V	1.0 V	1.5 V

2



OK — VOLTAGE AT OR BELOW MAXIMUM → 5

C.K — VOLTAGE ABOVE MAXIMUM → 3

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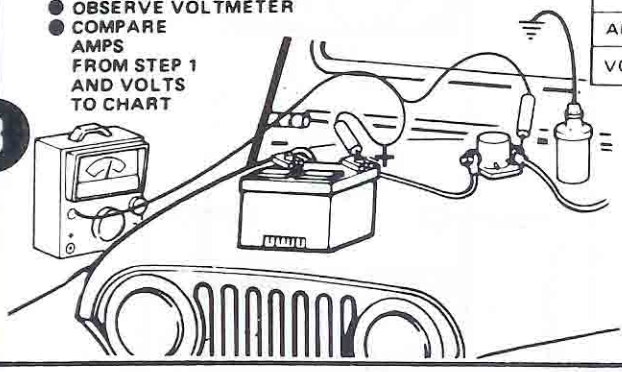
STEP	SEQUENCE	RESULT

VOLTAGE DROP TEST

(NOTE TEST POINTS IN ILLUSTRATION)

- GROUND COIL WIRE
- CONNECT VOLTMETER
- ENGAGE STARTER MOTOR
- OBSERVE VOLTMETER
- COMPARE AMPS FROM STEP 1 AND VOLTS TO CHART

MAXIMUM VOLTAGE DROP BY FULL LOAD AMPERAGE				
AMPS	150-210	215-295	300-420	425-500
VOLTS	0.3 V	0.5 V	0.6 V	0.9 V



3

OK → VOLTAGE AT OR BELOW MAXIMUM → REPAIR SOLENOID-TO-STARTER MOTOR CABLE → 5

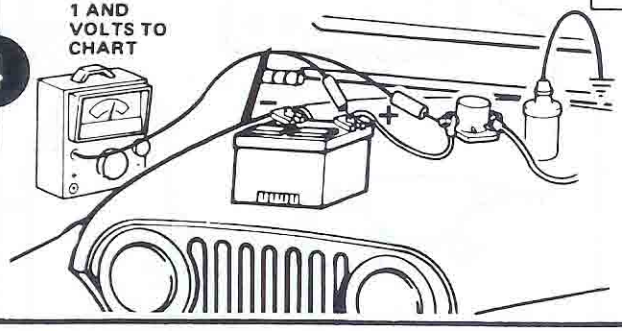
OK → VOLTAGE ABOVE MAXIMUM → 4

VOLTAGE DROP TEST

(NOTE TEST POINTS IN ILLUSTRATION)

- GROUND COIL WIRE
- CONNECT VOLTMETER
- ENGAGE STARTER MOTOR
- OBSERVE VOLTMETER
- COMPARE AMPS FROM STEP 1 AND VOLTS TO CHART

MAXIMUM VOLTAGE DROP BY FULL LOAD AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.2V	0.3V	0.4V	0.5V



4

OK → VOLTAGE AT OR BELOW MAXIMUM → REPAIR SOLENOID → 5

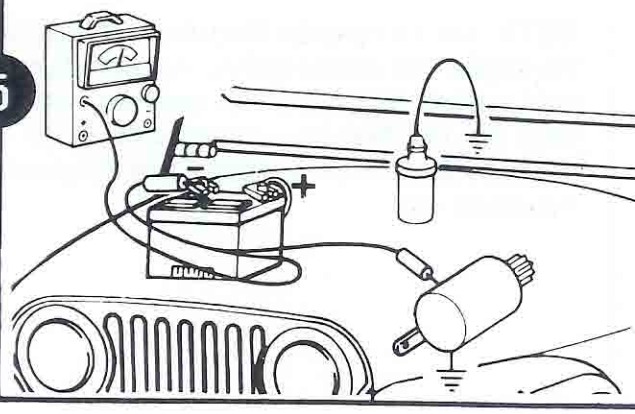
OK → VOLTAGE ABOVE MAXIMUM → REPAIR BATTERY-TO-SOLENOID CABLE → 5

VOLTAGE DROP TEST

(NOTE TEST POINTS IN ILLUSTRATION)

- GROUND COIL WIRE
- CONNECT VOLTMETER
- ENGAGE STARTER MOTOR
- OBSERVE VOLTMETER
- COMPARE AMPS FROM STEP 1 AND VOLTS TO CHART

MAXIMUM VOLTAGE DROP BY FULL LOAD AMPERAGE				
AMPS	150-210	215-295	300-420	425-600
VOLTS	0.2V	0.3V	0.4V	0.5V



5

OK → VOLTAGE AT OR BELOW MAXIMUM

- REPAIRS TO SOLENOID OR CABLES PERFORMED IN A PREVIOUS STEP → 1
- REPAIRS TO SOLENOID OR CABLES NOT REQUIRED IN A PREVIOUS STEP → REPAIR STARTER MOTOR → STOP

OK → VOLTAGE ABOVE MAXIMUM → REPAIR ENGINE-TO-BATTERY CABLE → 1

86384B

SEE I.S. NOTES

Starter Motor Full Load Current Test

Prior to performing the full load current test, the battery must be fully charged as described in Batteries.

Starter Motor Full-Load Current Test

Before performing the full-load current test, ensure the battery is fully charged.

NOTE: The lower the available voltage, the higher the amperage.

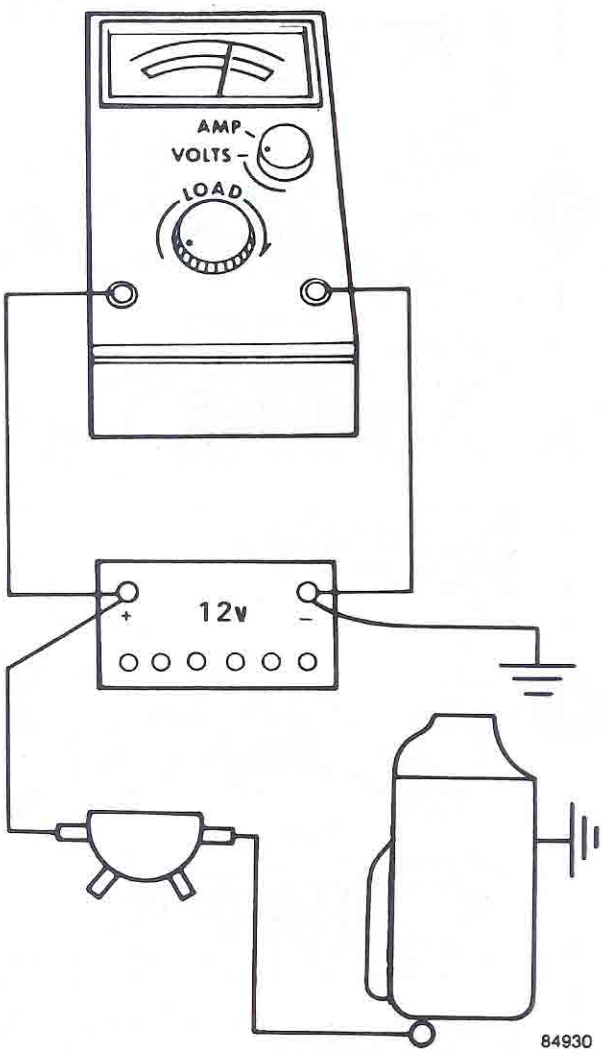
Disconnect and ground the ignition coil secondary wire.

Connect a remote control starter motor switch between the positive battery terminal and the S-terminal on the starter motor solenoid.

CAUTION: Do not operate the starter motor for more than 15 seconds.

NOTE: The tester load control knob must be in the full decrease position (counterclockwise).

Connect the battery-alternator-regulator-starter motor tester as illustrated. Actuate the remote control starter motor switch and observe the voltage indicated on the voltmeter while the starter motor is rotating the engine.



NOTE: Do not consider the initial voltage when the engine first starts rotating. A very hot or very cold engine may cause an excessive voltage drop for the first few revolutions. Note the voltage after the starter motor has obtained its maximum rpm.

SEE I.S. NOTES

Turn the remote control starter switch OFF.

Turn the load control knob toward INCREASE (clockwise) until the indicated voltage is exactly the same as it was when the starter motor was rotating the engine. Switch the meter to the AMP position.

Observe the current on the ammeter scale. This is the current flowing through the starter motor high current circuit under full-load conditions. If the current flow is not within 180-220 amperes for four- and six-cylinder engines at room temperature, approximately 21°C (70°F), remove the starter motor from the engine for bench testing.

Neutral Safety Switch Test

Remove the wire connector from the switch and test the continuity between the center terminal pin and the transmission case. Continuity should exist only when the automatic transmission is in the Park or Neutral position.

NOTE: Check the linkage adjustment before replacing the switch.

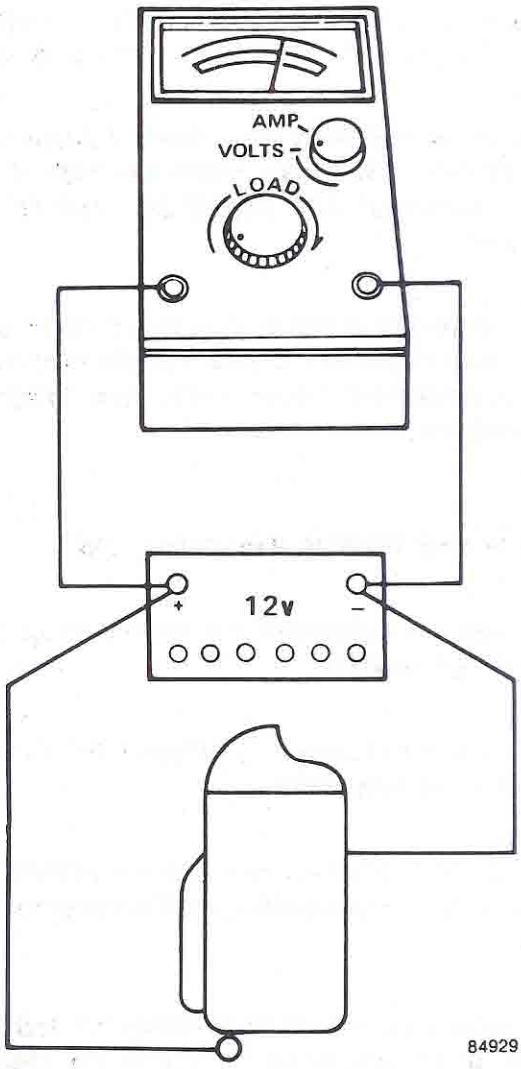
OFF-VEHICLE TESTING

No-Load Current Test

The starter motor no-load current test will indicate faults such as open or shorted windings, worn bushings (rubbing armature) or a bent armature shaft.

NOTE: The tester load control knob must be in the full DECREASE (extreme counterclockwise) position.

Operate the starter motor with the test equipment connected as illustrated. Note the voltage.



Determine the exact starter motor rpm using a mechanical tachometer (not shown).

NOTE: To connect a mechanical tachometer, remove the seal from the end of the drive end housing and clean the grease from the end of the armature shaft.

SEE I.S. NOTES

Disconnect the battery cable from the starter motor.

Turn the load control knob toward INCREASE (clockwise) until the voltage is exactly the same as it was with the battery connected to the starter motor. Switch to the AMP position on the tester.

SEE I.S. NOTES

If the amperage at no-load speed is below the specification, the starter motor has high electrical resistance and should be repaired or replaced.

If the amperage is higher than specification and the starter motor rpm is less than the minimum rpm specification, disassemble, clean, inspect and test the starter motor.

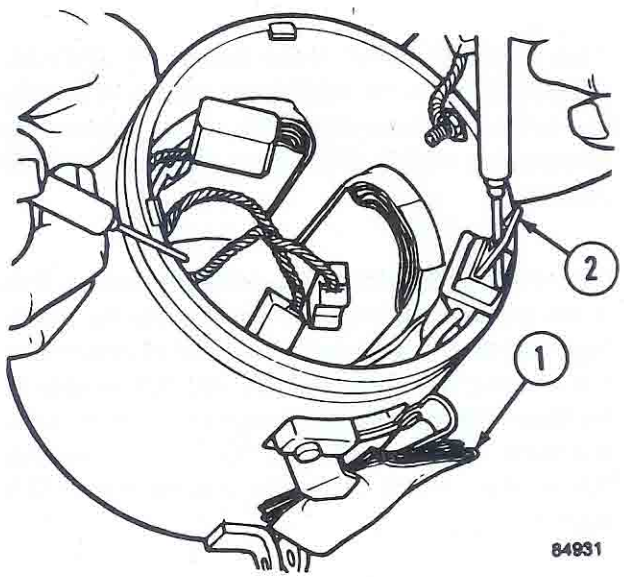
Hold-In Coil Winding Resistance Test

This test will determine the resistance of the hold-in coil winding.

Insert a piece of paper (1) between the contact points to insulate them.

Use an ohmmeter to measure the resistance between the S-terminal (2) and the starter motor frame.

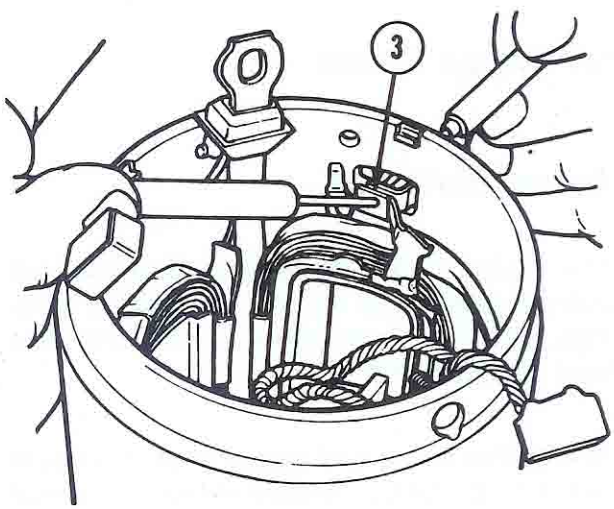
The resistance should be between 2.0 and 3.5 ohms. If the resistance is outside the specification, replace the field winding assembly.



84931

Solenoid Contact Point Connection Test

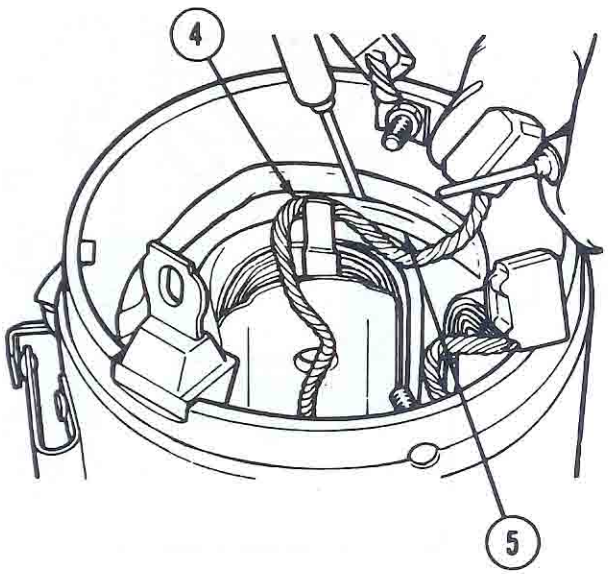
This test will determine the quality of the solder joint at the contacts. Use an ohmmeter to test the resistance through solder joint (3). If the resistance is more than zero ohms, the joint has excessive resistance. Repair by resoldering the joint with a 600 watt soldering iron.



84932

Insulated Brush Connection Test

This test will determine the quality of the solder joint between the insulated brush braided wire and the field windings. Use an ohmmeter to test the resistance through the solder joint by touching the test probes to the brush (4) and to the copper bus bar (5). If the resistance is more than zero ohms, the joint has excessive resistance. Repair by resoldering the joint with a 600 watt soldering iron.



84933

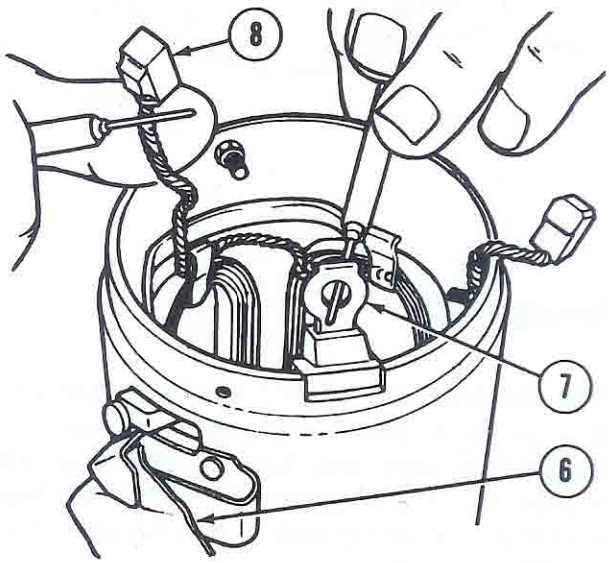
Field Winding Terminal-to-Brush Continuity Test

This test will determine the condition of all the field winding solder joints.

Insert a piece of paper between the contact points to insulate them (6).

Touch the ohmmeter test probes to the field winding terminal (7) and to the insulated brush (8).

If the resistance is greater than zero ohms, inspect all the solder joints to determine which have excessive resistance. Repair the faulty joint(s) by resoldering with a 600 watt soldering iron.



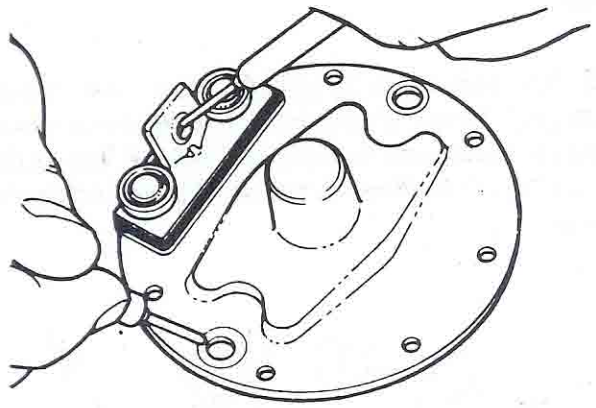
84934

SEE I.S. NOTES

SEE I.S. NOTES

Terminal Bracket Insulation Test

This test will determine if the terminal bracket is properly insulated from the end cap. Use an ohmmeter to test the resistance between the bracket and cap. If the resistance is less than infinite, the insulator is faulty. Repair by replacing the end cap.



84935

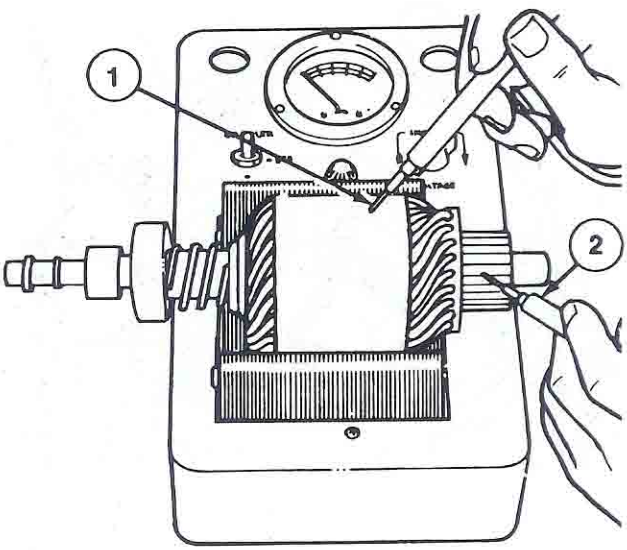
Armature Tests

Test the armature winding for short circuits to the ground, short circuits between the commutator bars and balance whenever the starter motor is overhauled. Follow the test equipment manufacturer's procedure or the following procedure.

Armature Ground Test

Place the armature in the growler jaws and turn the power switch to the TEST position.

Touch one test probe to the armature core (1), touch the other probe to each commutator bar (2) one at a time and observe the test lamp. The test lamp should not light. If the test lamp lights on any bar, the armature has a short circuit to the ground and must be replaced.



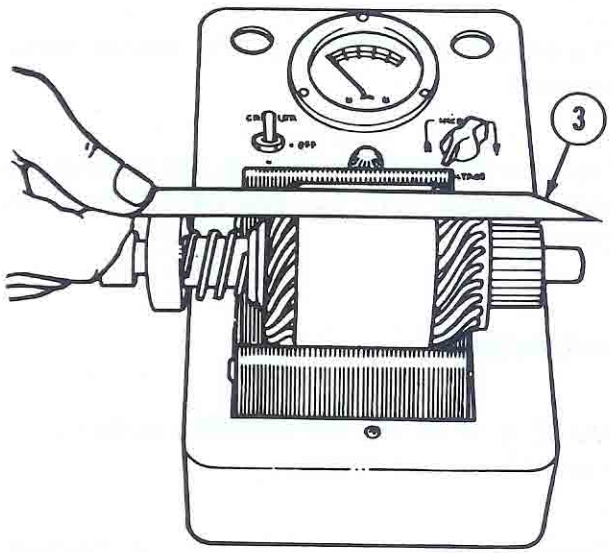
84936

Armature Short Test

CAUTION: Never operate the growler with the power switch in the growler test position without an armature in the jaws.

Place the armature in the growler jaws and turn the power switch to the GROWLER position.

Hold the steel blade (3) parallel to and touching the armature core. Slowly rotate the armature one or more revolutions in the growler jaws. If the steel blade vibrates at any area of the core, the winding has a short circuit and the armature must be replaced.



84937

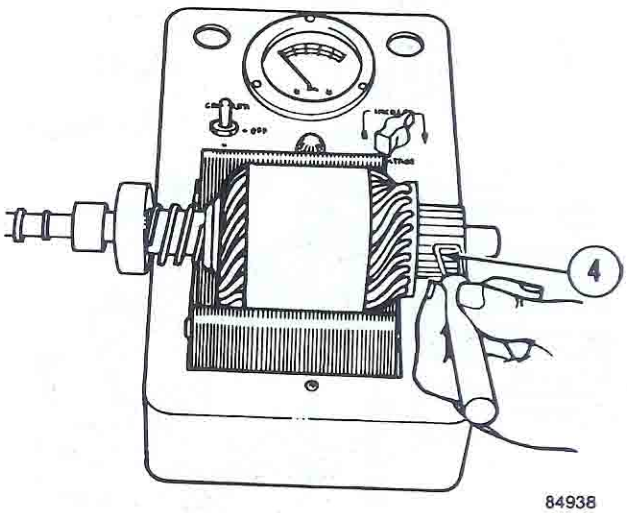
Armature Balance Test

Place the armature in the growler jaws and turn the power switch to the GROWLER position.

Place the contact fingers of the meter test probe across adjacent commutator bars at side of commutator (4).

Adjust the voltage control until the pointer indicates the highest voltage on the scale.

Test each commutator bar with the adjacent bar until all bars have been tested. Zero voltage indicates a short circuit in a particular pair and the armature must be replaced.



84938

STARTER MOTOR REPLACEMENT – FOUR-CYLINDER

Removal

Disconnect the negative battery cable at the battery.

Disconnect the cable from the starter motor terminal.

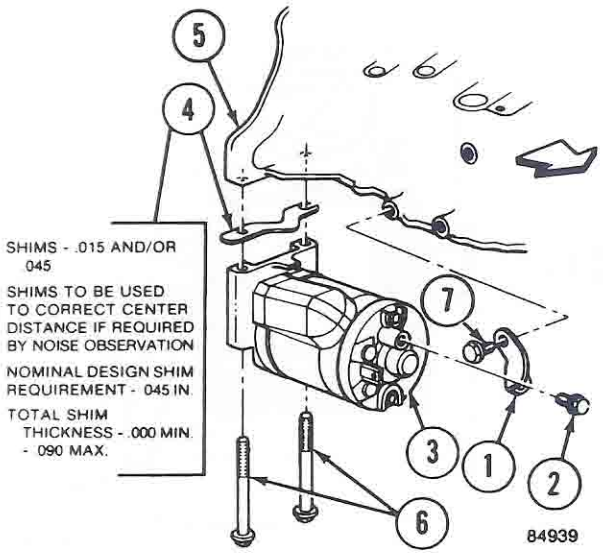
Remove the attaching bolts and remove the starter motor and shims.

SEE I.S. NOTES

Installation

Assemble the bracket (1) and bolt/washer (2) to the starter motor (3).

Install the motor and shim(s) (4) to the cylinder block (5) with dowel bolts (6).



NOTE: The dust cover for the manual transmission clutch mounting must be in place before installing the starter motor.

Install the bracket (1) and the mounting bolt/washer (7) to the engine block.

Tighten all attaching bolts with 18-34 N·m (13-24 ft-lbs).

Attach the cable to the starter motor terminal and tighten the screw with 6 N·m (55 in-lbs) torque.

NOTE: The initial torque required may exceed this specification if the end plate has been replaced. The terminal screw cuts threads in the end plate terminal bracket during initial installation.

NOTE: Shims are used to correct the center distance, if required. The total shim thickness should be from 0.000 mm (0.000 in) minimum to 2.3 mm (0.090 in) maximum.

STARTER MOTOR REPLACEMENT – SIX-CYLINDER

Removal

Disconnect the negative battery cable at the battery.

Disconnect the cable from the starter motor terminal.

Remove the attaching screws and remove the starter motor from the flywheel (drive plate) housing.

Installation

NOTE: Ensure that the mounting surfaces are free of burrs and debris.

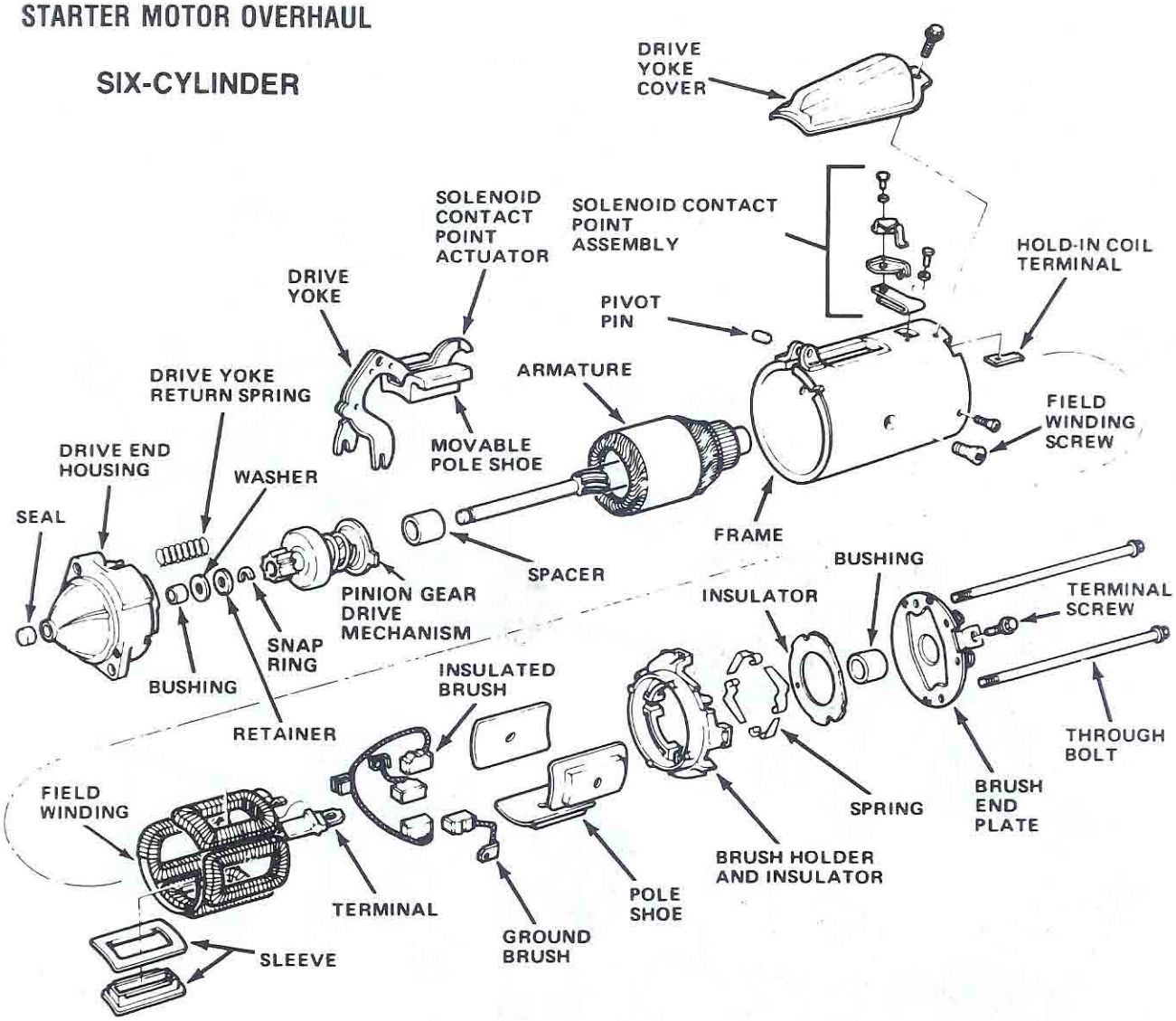
Position the starter motor on the flywheel housing and install the mounting screws and tighten with 24 N·m (18 ft-lbs) torque.

Attach the cable to the starter motor terminal and tighten the retaining screw with 6 N·m (55 in-lbs) torque.

NOTE: The initial torque required may exceed this specification, if the end plate has been replaced. The terminal screw cuts threads in the end plate terminal bracket during initial installation.

STARTER MOTOR OVERHAUL

SIX-CYLINDER

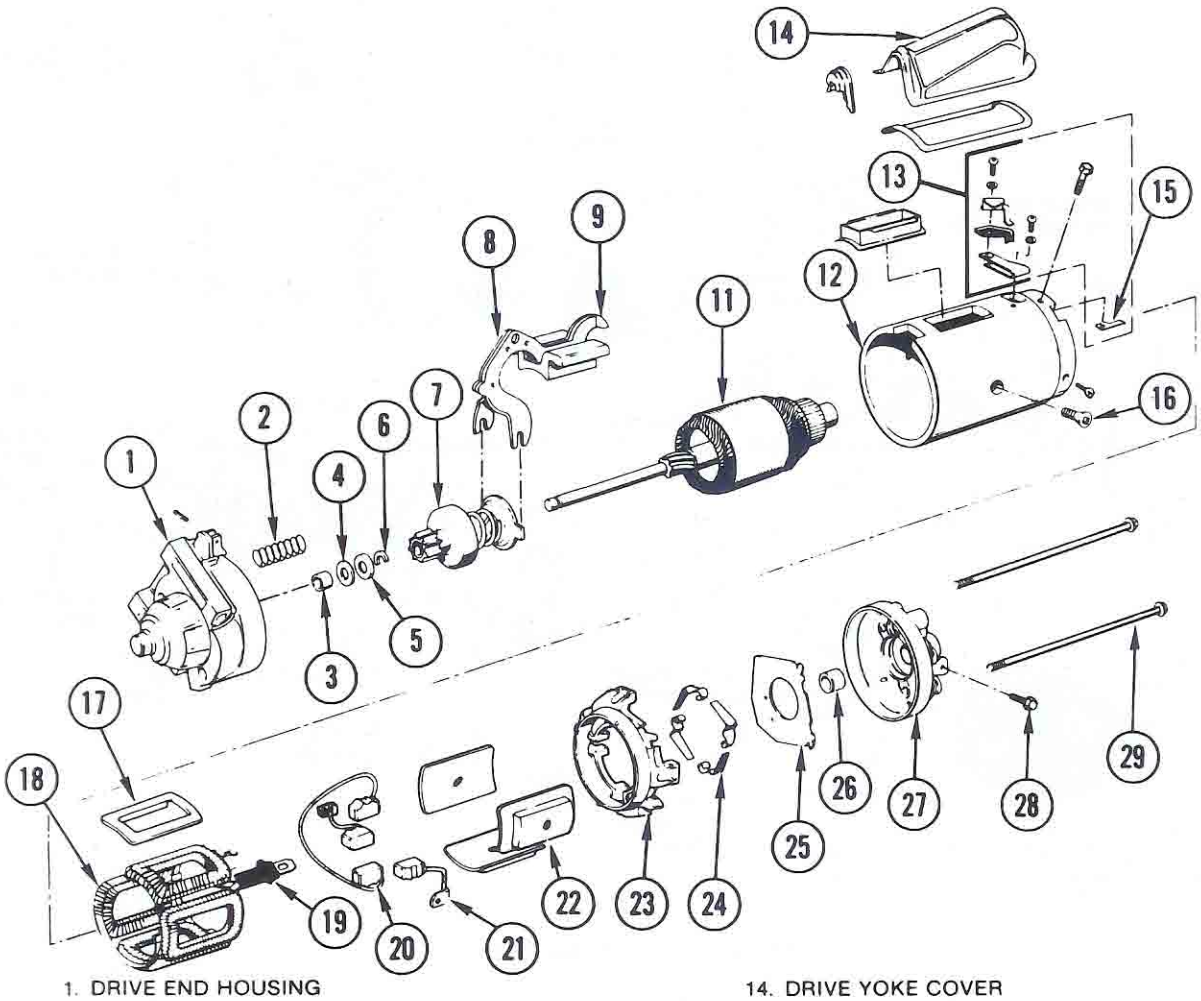


Starter Motor—Exploded View

1. Seal
2. Drive End Housing
3. Bushing
4. Drive Yoke Return Spring
5. Washer
6. Retainer
7. Snap Ring
8. Pinion Gear Drive Mechanism
9. Drive Yoke
10. Solenoid Contact Point Actuator
11. Spacer
12. Movable Pole Shoe
13. Armature
14. Pivot Pin
15. Solenoid Contact Point Assembly
16. Drive Yoke Cover
17. Hold-In Coil Terminal
18. Field Winding Screw
19. Bushing
20. Frame
21. Insulator
22. Insulated Brush
23. Field Winding
24. Sleeve
25. Terminal
26. Ground Brush
27. Pole Shoe
28. Brush Holder and Insulator
29. Spring
30. Brush End Plate
31. Through Bolt
32. Terminal Screw

SEE I.S. NOTES

SEE I.S. NOTES



1. DRIVE END HOUSING
2. DRIVE YORK RETURN SPRING
3. BUSHING
4. WASHER
5. RETAINER
6. SNAP RING
7. PINION GEAR DRIVE MECHANISM
8. DRIVE YOKE
9. SOLENOID CONTACT POINT ACTUATOR
10. MOVEABLE POLE SHOE
11. ARMATURE
12. FRAME
13. SOLENOID CONTACT POINT ASSEMBLY
14. DRIVE YOKE COVER
15. HOLD-IN COIL TERMINAL
16. FIELD WINDING SCREW
17. SLEEVE
18. FIELD WINDING
19. TERMINAL
20. INSULATED BRUSH
21. GROUN BRUSH
22. POLE SHOE
23. BRUSH HOLDER AND INSULATOR
24. SPRINGS
25. INSULATOR
26. BUSHING
27. BRUSH END PLATE
28. TERMINAL SCREW
29. THROUGH BOLT

84922

Disassembly

Remove the drive yoke cover screw and cover.

Remove the through-bolts and remove the brush end plate.

Remove the brush springs. Pull the brushes from the brush holder. Remove the brush holder from the frame.

Remove the drive end housing and drive yoke return spring.

Remove the pivot pin and drive yoke.

Remove the drive mechanism and armature.

Cleaning and Inspection

Use a brush or air to clean the starter motor frame, field windings, armature, drive mechanism and drive end housing.

Wash all other parts in solvent and dry them thoroughly.

NOTE: Do not wash the overrunning clutch or drive mechanism.

Inspect the armature windings for broken or burned insulation and poor connections.

Test the armature winding for open circuits and short circuits to ground (core).

Clean the commutator with commutator paper. Never use emery cloth to clean the commutator.

If the commutator is worn, out-of-round, 0.125 mm (0.005 in) or more, or has insulation protruding from between the bars, turn it down on a lathe.

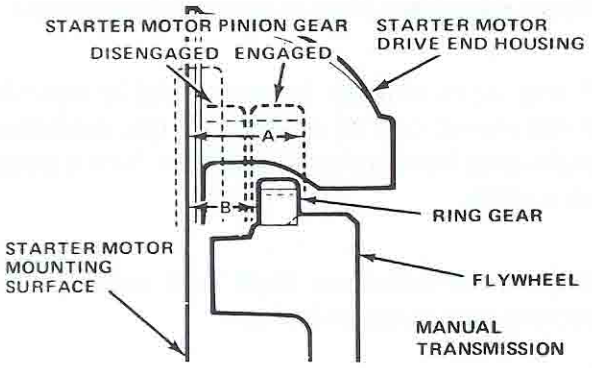
Inspect the armature shaft and bushings for scoring and excessive wear.

Inspect the drive mechanism pinion gear for damage. If the pinion gear has failed repeatedly, perform the following inspection:

Inspect for a wobbling ring gear. The maximum allowable runout is 0.76 mm (0.030 in). Inspect for broken welds or a broken drive plate (automatic transmission).

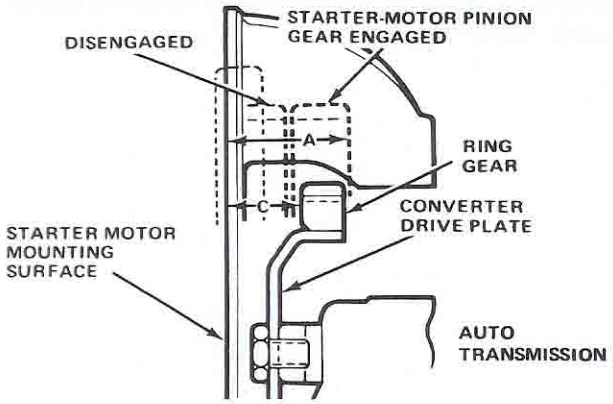
Inspect for foreign objects such as a converter balance weight in the converter housing (automatic transmission).

SEE I.S. NOTES



SEE I.S. NOTES

ENGINE	FLYWHEEL			
	A		B	
4-CYLINDER	21.1 mm TO 23.1 mm	0.8350 in. TO 0.9000 in.	9.7 mm TO 12.0 mm	0.3830 in. TO 0.4745 in.
6-CYLINDER	30.8 mm TO 31.7 mm	1.2060 in. TO 1.2465 in.	19.5 mm TO 21.2 mm	0.7660 in. TO 0.8365 in.



ENGINE	DRIVE PLATE			
	A		C	
4-CYLINDER	21.1 mm TO 23.1 mm	0.8350 in. TO 0.9000 in.	9.7 mm TO 12.0 mm	0.3830 in. TO 0.4745 in.
6-CYLINDER	30.8 mm TO 31.7 mm	1.2060 in. TO 1.2465 in.	19.6 mm TO 21.1 mm	0.7700 in. TO 0.8305 in.

841278

NOTE: Inspect the entire circumference of the ring gear for damage when the teeth of the drive mechanism pinion gear are damaged. A normal wear pattern will be found in two places on a four-cylinder and three places on a six-cylinder. The normal wear pattern extends approximately 5 cm (2 in) along the circumference of the ring gear.

Inspect the drive mechanism overrunning clutch by grasping and rotating the pinion gear. The gear should rotate freely in the clockwise direction and lock in the opposite direction.

Inspect for broken brush springs. Replace springs that are discolored from the heat. Replace the brushes if they are worn down to 6.35 mm (1/4 in) in length.

Inspect the field windings for burned or broken insulation and for broken or loose connections. Inspect the field brush connections and the wire insulation.

Field Winding Replacement

Remove the armature and brush holder before starting this procedure.

Remove the field winding screws using an arbor press and Starter Pole Screw Wrench J-22516. Remove the pole shoes.

CAUTION: Do not cut the solenoid contact point connection joint.

Cut the field winding terminal strap as close as possible to the solenoid contact-point-to-field winding joint.

Cut the hold-in coil winding terminal wire at the terminal strip.

Straighten the tabs of the pull-down coil winding sleeve. Remove the sleeve and flange.

Remove the field winding assembly from the frame.

Clean and tin the surfaces of the contact tab and the field winding terminal strap that are to be soldered.

Install the replacement field winding assembly in the frame using the original pole shoes and screws. Apply a drop of Loctite 222, or equivalent, to the screw threads. Tighten the screws using the arbor press and Starter Pole Screw Wrench J-22516.

Install the pull-down coil winding sleeve and flange. Have a helper hold the winding and sleeve assembly against the frame while bending the retaining tabs.

Wrap the hold-in coil winding terminal wire around the terminal strip and solder. Cut off the excess wire.

Solder the field winding terminal strap to the contact strap. Use a 600 watt soldering iron and rosin-core solder.

Solenoid Contact Point Assembly Replacement

Remove the armature and brush holder before starting this procedure.

CAUTION: Do not cut the field winding terminal strap.

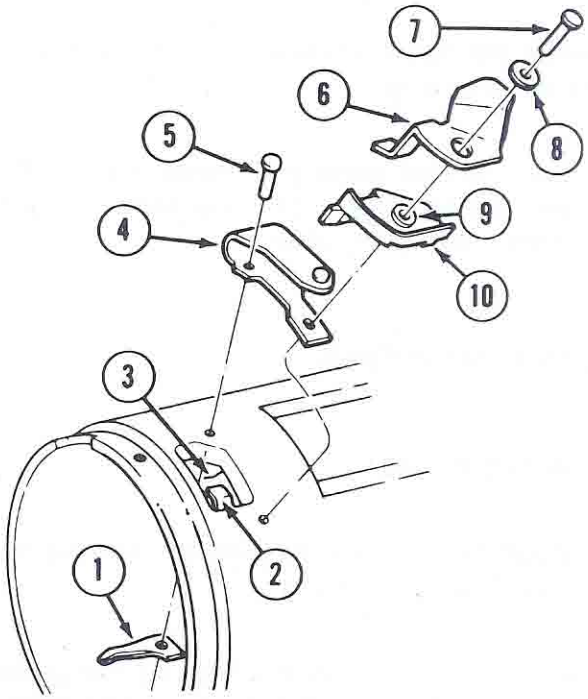
Cut the upper contact as close as possible to the contact-point-to-field winding joint.

Unsolder the hold-in coil winding terminal wire from the terminal strip.

Remove the field winding screws with an arbor press and Tool J-22516. Remove the pole shoes.

Cut the rivets inside the frame with a chisel. Remove the contact point assembly.

Position the replacement lower (movable) contact on the frame. Position the hold-in coil winding terminal strip inside the frame. Install a copper rivet through the contact, frame and terminal. Upset the rivet.



1. HOLD-IN COIL TERMINAL
2. FIELD WINDING STRAP TERMINAL
3. HOLD-IN COIL WIRE
4. LOWER CONTACT
5. COPPER RIVET
6. UPPER CONTACT
7. ALUMINUM RIVET
8. FIBER WASHER
9. SHOULDER
10. PLASTIC INSULATOR

84940

SEE I.S. NOTES

NOTE: Ensure the holes for the second rivet are aligned before upsetting the copper rivet.

Install the plastic insulator, upper contact and fiber washer to the remaining hole in the frame. Install an aluminum rivet and upset.

NOTE: Ensure the upper contact is positioned on the shoulder of the plastic insulator before upsetting the rivet.

SEE I.S. NOTES

Install the field winding assembly, pole shoes and screws. Apply a drop of Loctite 222, or equivalent, to each screw.

Solder the hold-in coil winding terminal wire to the terminal strip.

Solder the field winding terminal strap to the upper contact. Use a 500-600 watt soldering iron and rosin-core solder.

Bushing Replacement

Drive End Bushing

Support the drive end housing and remove the original bushing and seal.

Install a replacement bushing by using the armature and pinion gear as a bushing driver. Do not install the drive end housing seal at this time.

Commutator End Bushing

Carefully remove the original bushing with a chisel.

Drive a replacement bushing into the end plate until it is seated, using suitable socket or bushing driver.

Drive Mechanism Replacement

Pry the stop ring off and remove the starter motor drive from the armature shaft.

Apply grease to the armature shaft and end bushings. The replacement drive mechanism is prelubricated.

Apply a thin coating of Lubriplate, or an equivalent, on the armature shaft splines.

When installing the drive mechanism, inspect the snap ring for a tight fit on the shaft. Slide the drive assembly over the shaft and install the stop ring and original retainer.

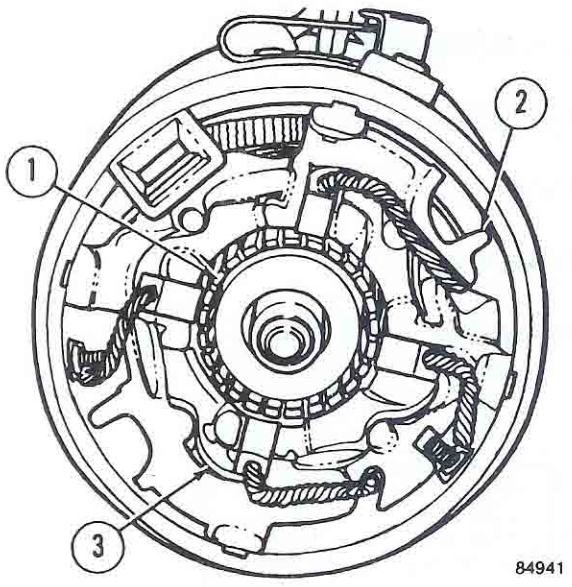
Assembly

Insert the armature into the motor frame (1). Install the drive yoke and pivot pin. The drive yoke must engage the lugs on the drive mechanism.

Insert the drive yoke return spring into the recess in the drive housing. Join the housing to the motor frame.

Install the brush holder (2). Ensure the depression in the holder aligns with the rubber boot on the terminal.

Insert the brushes into the brush holder. Refer to the illustration for correct wire routing. Install the brush springs (3).



Install the end plate. Align the hole in the terminal with the hole in the terminal bracket.

Install the through-bolts.

Depress the movable pole shoe and adjust the contact point clearance by bending the upper contact, as required. Refer to the specifications.

Install the drive yoke cover and clamp.

NEUTRAL SAFETY SWITCH REPLACEMENT

Disconnect the wiring harness connector and remove the switch from the transmission. Allow the fluid to drain into a container.

Move the automatic transmission selector lever to the Park and Neutral positions. Inspect the location of the switch operating lever fingers in both positions to ensure they are properly centered in the switch opening on the transmission.

Install the replacement switch and seal on the transmission case. Tighten the switch with 23 N·m (17 ft-lbs) torque.

Test the switch continuity (center terminal to transmission case) in both the Park and Neutral positions.

Connect the wire harness connector.

Correct the transmission fluid level, as required.

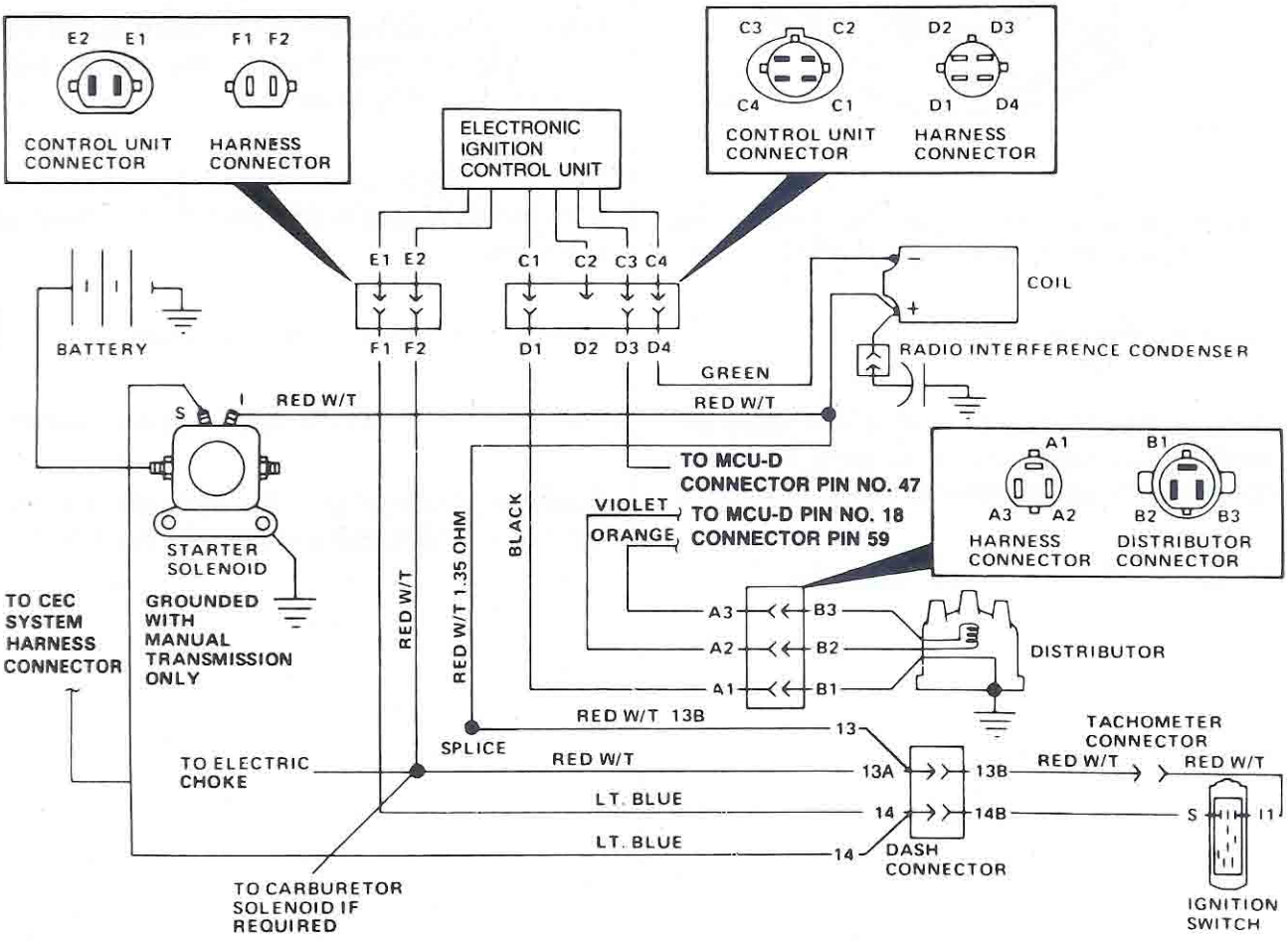
Start the engine in both the Park and Neutral positions. Check the operation of the back-up lights.

GENERAL

The Solid State Ignition (SSI) system is used on both the four- and six-cylinder CJ and Scrambler Models. The SSI system consists of the following major components:

- micro computer unit (MCU)
- electronic ignition control unit
- ignition coil
- resistance wire
- distributor
- knock sensor
- cap and rotor
- spark plugs and wires

SEE I.S. NOTES



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SPECIAL TOOLS

Tool Ref.	Description	Required	Recommended
AMOT ET-502	Digital Multimeter		■
J-23738	Hand Operated Vacuum Pump		■
J-28509	Trigger Wheel Puller		■

TORQUE SPECIFICATIONS

Component	Service Set-To Torque	Service Recheck Torque
Distributor Clamp Screw	23 N·m (17 ft-lbs)	20-27 N·m (15-20 ft-lbs)
Spark Plugs	37 N·m (27 ft-lbs)	30-40 N·m (22-33 ft-lbs)

SPECIFICATIONS

SSI Distributor and Ignition Coil Specifications

Distributor Pickup Coil
Resistance..... 400 to 800 ohms @ 24°C (75°F)
Ignition Coil
Primary Resistance ..... 1.13 to 1.23 ohms @ 24°C (75°F)
..... 1.5 ohms @ 93°C (200°F)
Secondary Resistance ... 7700 to 9300 ohms @ 24°C (75°F)
..... 12,000 ohms @ 93°C (200°F)
Minimum Open Circuit Output
at 1000 rpm..... 24 kv
Spark Plugs
Required Voltage at 1000 rpm..... 5 to 16 kv
Maximum Variation Between Cylinders ..... 3 to 5 kv

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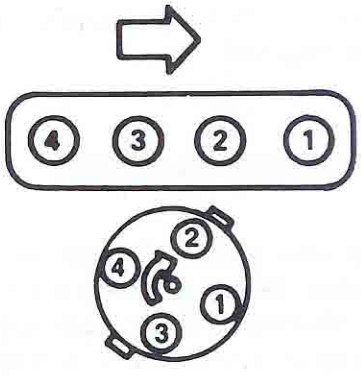

Four-Cylinder Engine

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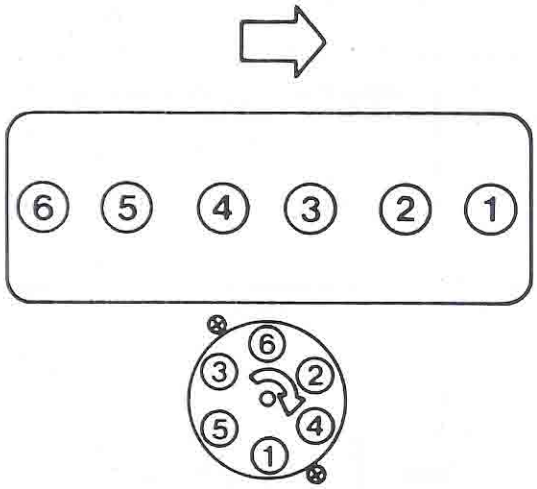
SEE I.S. NOTES



Six-Cylinder Engine

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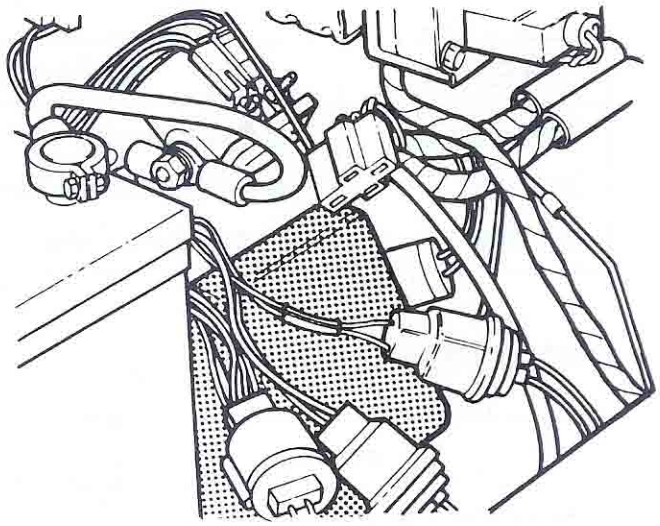
SEE I.S. NOTES

COMPONENTS

The MCU is a permanently sealed module located in the passenger compartment. It is not repairable and must be replaced as a unit if service is required.

Electronic Ignition Control Unit

The Electronic Ignition Control Unit is a solid-state module. Its components are permanently sealed. This module is not repairable and must be replaced as a unit if service is required.



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NOTE: When disconnecting the SSI system connectors, pull them apart with a firm, straight pull. Do not attempt to pry them apart with a screwdriver. When connecting them, press together firmly to overcome hydraulic pressure caused by the silicone dielectric compound.

NOTE: If the connector locking tabs weaken or break off, do not replace the associated component. Bind the connectors together with tape or a harness tie strap to assure good electrical connection.

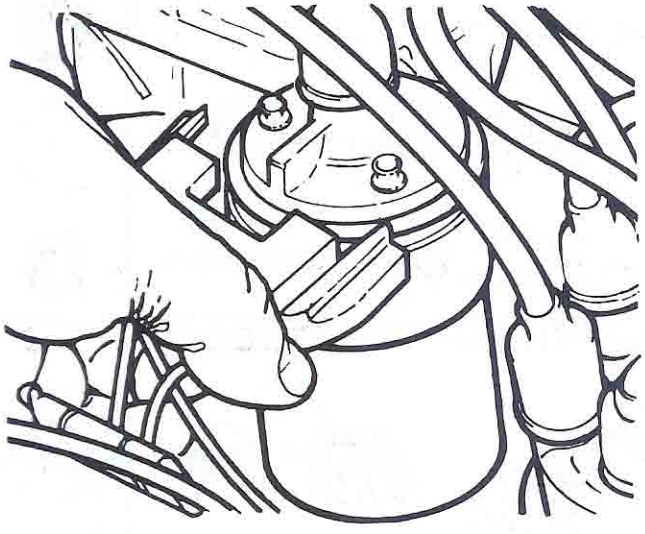
Ignition Coil

The ignition coil does not require special service other than maintaining the terminals and connectors.

When an ignition coil is suspected of malfunctioning, test it on the vehicle. A coil may "break down" after the engine has heated it to a high temperature. It is important that the coil be at operating temperature when tested. Perform the test according to the test equipment manufacturer's instructions.

Ignition Coil Connector

The ignition coil terminals and connector are of unique design. The connector is removed from the coil by grasping both sides and pulling away from the coil.



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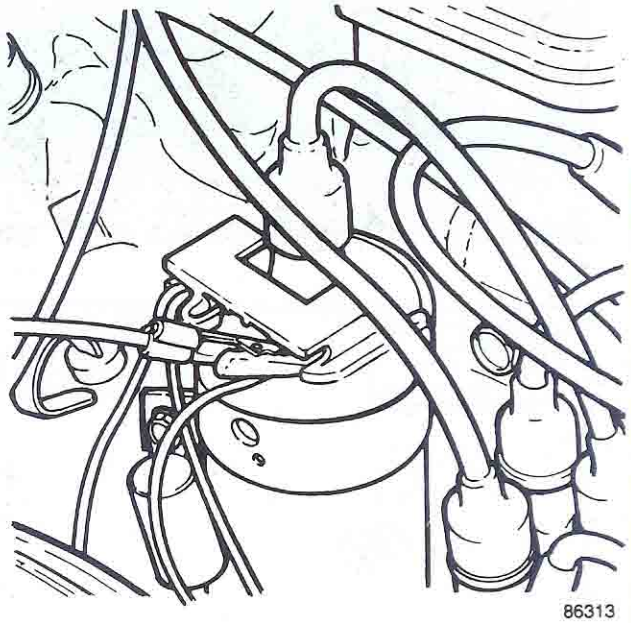
When a tachometer is required for engine testing or tune-up, connect it using an alligator jaw-type connector as illustrated.



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DIAGNOSIS

For diagnostic purposes, ignition system problems are considered in three categories: complete failure, intermittent failure and spark knock (pre-ignition).

Complete failure is always a no-ignition situation. The engine will not start. If a complete failure occurs when the engine is operating, it will not restart.

Intermittent failure is temporary. The engine may not start on the first try, but will eventually start. If an intermittent failure occurs when the engine is operating, it may falter and possibly stop. If it stops, it will restart and will continue to operate intermittently.

Spark knock (pre-ignition) is not actually an ignition system failure. The engine will start and will continue to operate. If not corrected, spark knock can cause extensive internal engine component damage.

SEE I.S. NOTES

SSI SYSTEM DIAGNOSIS AND REPAIR SIMPLIFICATION (DARS) CHART

IGNITION COIL PRIMARY CIRCUIT

FUNCTION: CONNECTS BATTERY VOLTAGE TO COIL AND COIL TO GROUND

Chart 1

SEE I.S. NOTES

STEP	SEQUENCE	RESULT
1	REFER TO FIGURE 1G-1 FOR SCHEMATIC ● CONNECT VOLTMETER TO COIL POSITIVE TERMINAL AND TO GROUND ● TURN IGNITION ON VOLTAGE ACCEPTABLE (6V ± .5V) — OK	2
	VOLTAGE NOT ACCEPTABLE (BATTERY VOLTAGE) — OK	4
	VOLTAGE NOT ACCEPTABLE (BELOW 6V) — OK → DISCONNECT CAPACITOR WIRE TERMINAL VOLTAGE ACCEPTABLE (6V ± .5V) — OK → REPLACE CAPACITOR	STOP
	VOLTAGE NOT ACCEPTABLE — OK	6
2	● TURN IGNITION SWITCH TO START ● OBSERVE VOLTAGE AT POSITIVE TERMINAL WHILE CRANKING VOLTAGE ACCEPTABLE (BATTERY VOLTAGE) — OK	STOP
	VOLTAGE NOT ACCEPTABLE (LESS THAN BATTERY VOLTAGE) — OK	3

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Chart 1

STEP | **SEQUENCE** | **RESULT**

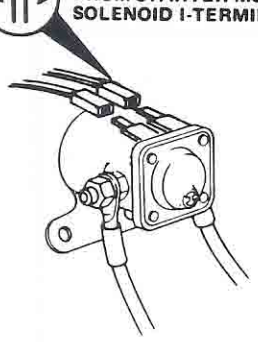
3

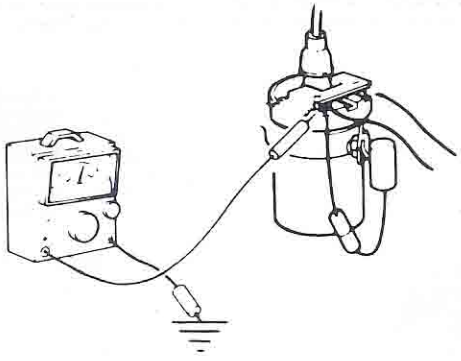
- CHECK FOR SHORT OR OPEN IN WIRE ATTACHED TO STARTER MOTOR SOLENOID I-TERMINAL
- CHECK STARTER MOTOR SOLENOID AS OUTLINED IN CHAPTER 1F

→ REPAIR AS REQUIRED → STOP

4

- DISCONNECT WIRE FROM STARTER MOTOR SOLENOID I-TERMINAL
- IGNITION REMAINS ON
- OBSERVE VOLTAGE AT COIL POSITIVE TERMINAL





VOLTAGE DROPS TO 6V ± .5V → OK → REPLACE STARTER MOTOR SOLENOID → STOP

VOLTAGE REMAINS AT BATTERY VOLTAGE → OK → CONNECT JUMPER BETWEEN COIL NEGATIVE TERMINAL AND GROUND

- VOLTAGE DROPS TO 6V ± .5V → OK → **5**
- OK → VOLTAGE DOES NOT DROP → TEST RESISTANCE WIRE → **6**

5

CHECK:

- CONTINUITY BETWEEN COIL NEGATIVE TERMINAL AND CONNECTOR OR TERMINAL D4

OK → CONTINUITY OK → REPLACE CONTROL UNIT → STOP

- DI CONTINUITY BETWEEN CONNECTOR TERMINAL AND GROUND

OK → CONTINUITY NOT OK → LOCATE AND REPAIR OPEN → **2**

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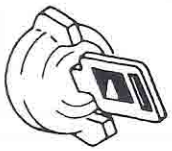
SEE I.S. NOTES

Chart 1

STEP | SEQUENCE | RESULT

6

- TURN IGNITION OFF



CONNECT OHMMETER BETWEEN COIL POSITIVE TERMINAL AND DASH CONNECTOR FW

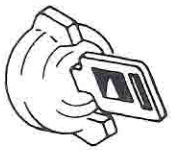
OK → RESISTANCE TOO HIGH (1.40 OHMS OR MORE) → REPAIR RESISTANCE WIRE → STOP

OK → RESISTANCE ACCEPTABLE (1.35 ± .05 OHMS) → **7**

SEE I.S. NOTES

7

CONNECT OHMMETER BETWEEN DASH CONNECTOR FW AND IGNITION SWITCH TERMINAL I1



- IGNITION REMAINS OFF

OK → RESISTANCE ACCEPTABLE (LESS THAN 0.1 OHM) → REPLACE IGNITION SWITCH OR REPAIR SWITCH WIRE FROM BATTERY → STOP

OK → RESISTANCE TOO HIGH (MORE THAN 0.1 OHM) → ✓ → REPAIR DEFECT → STOP

- POOR TERMINAL CONNECTIONS AT DASH CONNECTOR OR IGNITION SWITCH
- DEFECTIVE WIRING
- PROCEED TO COIL TEST

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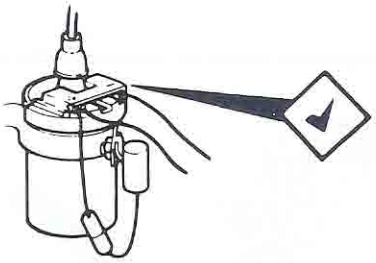
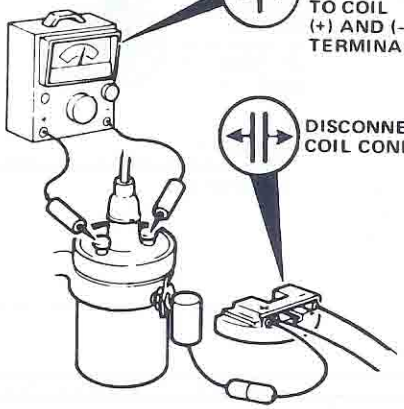
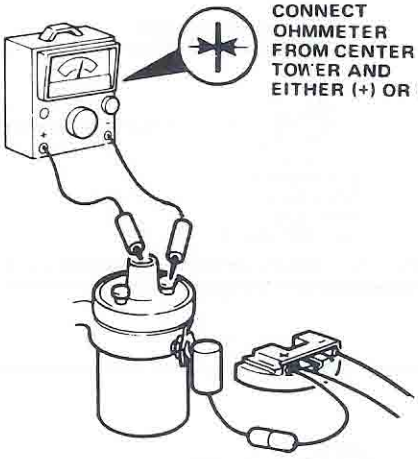
COIL TEST

Chart 2

STEP	SEQUENCE	RESULT
1	 INSPECT COIL FOR OIL LEAKS, OTHER EXTERIOR DAMAGE, AND CARBON TRACKS OK → 2 O.K → REPLACE COIL → STOP	
2	 CONNECT OHMMETER TO COIL (+) AND (–) TERMINALS DISCONNECT COIL CONNECTOR OK → 3 RESISTANCE ACCEPTABLE (1.13 TO 1.23 OHMS AT 75°F OR 24°C) (1.5 OHMS AT 200°F OR 93°C) O.K → REPLACE COIL → STOP RESISTANCE NOT WITHIN LIMITS	
3	 CONNECT OHMMETER FROM CENTER TOWER AND EITHER (+) OR (–) OK → STOP RESISTANCE ACCEPTABLE (7700 - 9300 OHMS @ 75°F OR 24°C) (12,000 OHMS @ 200°F OR 93°C) O.K → REPLACE COIL → STOP RESISTANCE NOT WITHIN LIMITS	

SEE I.S. NOTES

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SENSOR CHECK AND CONTROL UNIT CHECK

Chart 3

SEE I.S. NOTES

STEP	SEQUENCE	RESULT
1	● TURN IGNITION ON ● DISCONNECT COIL WIRE FROM CENTER TOWER OF DISTRIBUTOR AND HOLD 1/2 - INCH FROM ENGINE WITH INSULATED PLIERS ● DISCONNECT 4–WIRE CONNECTOR AT CONTROL UNIT SPARK AT COIL WIRE (NORMAL) → 2 NO SPARK → 5	
2	MCU-D J2 CONNECTOR DISCONNECT J2 CONNECTOR FROM MCU AND CONNECT OHMMETER TEST LEADS TO PINS 3 AND 5 OF MCU-D J2 CONNECTOR OK → OHMMETER INDICATES 400-800 OHMS (NORMAL) → 6 OHMMETER DOES NOT INDICATE 400 - 800 OHMS → 3	
3	● DISCONNECT AND RECONNECT 3 - WIRE CONNECTOR AT DISTRIBUTOR OK → OHMMETER NOW INDICATES 400 - 800 OHMS → 6 OHMMETER REMAINS OUTSIDE 400 - 800 OHMS → DISCONNECT 3 - WIRE CONNECTOR AT DISTRIBUTOR → 4	

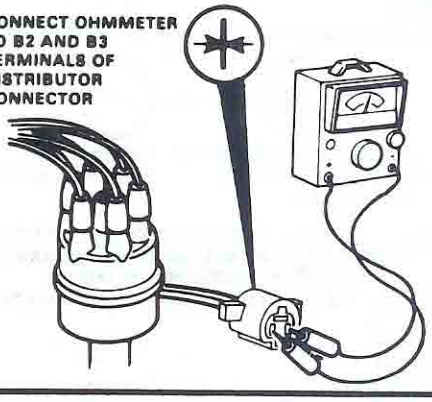
840249

Chart 3

STEP	SEQUENCE	RESULT

4

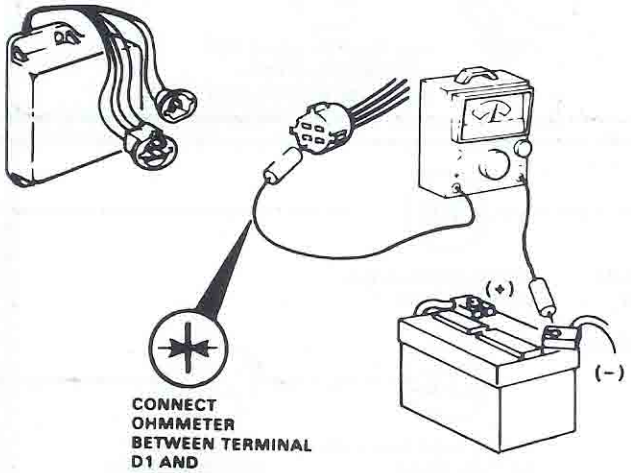
CONNECT OHMMETER TO B2 AND B3 TERMINALS OF DISTRIBUTOR CONNECTOR



OK → OHMMETER INDICATES 400 - 800 OHMS → REPAIR OR REPLACE HARNESS BETWEEN 3 - WIRE AND 4 - WIRE CONNECTOR → STOP

O.K → OHMMETER DOES NOT INDICATE 400 - 800 OHMS → REPLACE PICKUP COIL → STOP

5



CONNECT OHMMETER BETWEEN TERMINAL D1 AND BATTERY NEGATIVE TERMINAL

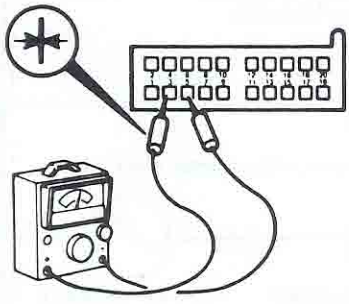
OK → OHMMETER INDICATES ZERO (NOT ABOVE 0.002 OHM) → 2

O.K → OHMMETER INDICATES ABOVE 0.002 OHM → LOCATE AND REPAIR SOURCE OF BAD GROUND
- GROUND CABLE RESISTANCE
- DISTRIBUTOR–TO–BLOCK RESISTANCE
- GROUND SCREW IN DISTRIBUTOR TO D1 TERMINAL

→ STOP

6

CONNECT DC VOLTMETER TEST LEADS TO PINS 3 AND 5 OF MCU-D J-2 CONNECTOR



ENGAGE STARTER MOTOR

OK → VOLTMETER FLUCTUATES, INDICATING PROPER PICKUP COIL AND TRIGGER WHEEL OPERATION → STOP

O.K → VOLTMETER DOES NOT FLUCTUATE → LOCATE AND REPAIR FAULT
- DEFECTIVE TRIGGER WHEEL
- DISTRIBUTOR NOT TURNING
- MISSING TRIGGER WHEEL PIN

→ STOP

840250

SEE I.S. NOTES

IGNITION FEED TO ELECTRONIC CONTROL UNIT

NOTE: DO NOT PERFORM CHART 4 WITHOUT PERFORMING CHART 1

Chart 4

SEE I.S. NOTES

STEP	SEQUENCE	RESULT
1	● TURN IGNITION ON F2 OK → VOLTMETER INDICATES BATTERY VOLTAGE WITHIN 0.2V. → REPLACE CONTROL UNIT → 3 UNPLUG 2-WIRE CONNECTOR AT MODULE AND CONNECT VOLTMETER BETWEEN TERMINAL F-2 AND GROUND O.K → VOLTMETER DOES NOT INDICATE BATTERY VOLTAGE WITHIN 0.2V → 2	
2	LOCATE AND REPAIR CAUSE OF VOLTAGE REDUCTION ● CORRODED DASH CONNECTOR ● IGNITION SWITCH OK → SPARK AVAILABLE AT COIL WIRE → STOP O.K → SPARK NOT AVAILABLE AT COIL WIRE → REPLACE CONTROL UNIT → STOP	
3	DISCONNECT 4-WIRE CONNECTOR AT CONTROL UNIT C1 CONNECT AMMETER BETWEEN TERMINAL C1 AND GROUND CONNECT 2-WIRE CONNECTOR AT CONTROL UNIT OK → AMMETER INDICATES 1 AMP ± 0.1 → STOP O.K → AMMETER INDICATES HIGHER OR LOWER CURRENT → REPLACE MODULE → STOP	

80699G

Engine Spark Knock (Pre-Ignition) Diagnosis

Spark knock (pre-ignition) can be attributed to several factors. The most common are ambient air conditions, such as air temperature, density and humidity.

High Underhood Air Temperature

Underhood air temperature is increased by the use of air conditioning (especially during long periods of idling), overloading (trailer pulling or operating in too high a gear) and the installation of accessories that restrict airflow.

Air Density

Air density increases as barometric pressure rises or as the air temperature decreases. A denser than normal mixture of air and fuel drawn into a cylinder has the same effect as increasing the engine compression ratio and this increases the possibility of spark knock.

Humidity

Low humidity increases the tendency for engine spark knock. High humidity decreases the tendency for engine spark knock.

Fuel Octane Rating

The 4- and 6-cylinder engines are designed to operate on unleaded fuel. Fuels having an equivalent research octane rating may vary in their antiknock characteristics for a given engine. It may be necessary to retard the initial ignition timing (not more than one degree from the specification) or select an alternate source of fuel.

Ignition Timing

Check the ignition timing to ensure it is adjusted to the specification.

NOTE: The white paint mark on the timing degree scale identifies the specified timing degrees before top dead center (BTDC) at 1600 rpm, not top dead center (TDC).

Combustion Chamber Deposits

An excessive buildup of deposits in the combustion chamber may be caused by not using the recommended fuels and lubricants, prolonged engine idling or continuous low speed operation. These deposits can be reduced by the occasional use of Carburetor and Combustion Area Cleaner 8992352, or equivalent, or by operating the engine at higher speeds.

Distributor Ignition Advance Mechanisms

Inspect the centrifugal and vacuum ignition advance mechanisms to ensure they are operating normally.

TESTING

Distributor Advance Tests

Centrifugal (Mechanical) Advance Test

Disconnect the vacuum hose from the vacuum advance mechanism and plug.

Connect a timing light to the No. 1 spark plug and a tachometer to the ignition coil "tach" terminal.

SEE I.S. NOTES

WARNING: Use extreme caution when the engine is operating. Do not stand in a direct line with the fan. Do not put hands near the pulleys, belts or fan. Do not wear loose clothing.

Start the engine and observe the timing degree scale and index with the timing light while the engine is idling.

Slowly increase the engine speed to 2000 rpm. The timing should advance smoothly as engine speed increases. Refer to Chapter B – Engines-General Service and Diagnosis for mechanical advance curve information.

SEE I.S. NOTES

Vacuum Advance Test

NOTE: The engine must be warmed to normal operating temperature.

Connect the vacuum hose to the vacuum advance mechanism.

Observe the timing degree scale and index with the timing light while the engine is at idle speed.

Slowly increase the engine speed to 2000 rpm. With vacuum applied, the ignition timing should advance sooner than with the centrifugal advance alone. At 2000 rpm, the vacuum advance should cause total advance to be more than with the centrifugal advance alone. Refer to Section B – Engines-General Service and Diagnosis for vacuum advance curve information.

Ignition Coil Tests

The ignition coil can be tested on any conventional coil tester or with an ohmmeter. A coil tester is preferable because it can be used to detect faults that are impossible with an ohmmeter.

Primary Winding Resistance Test

Remove the connector from the negative (-) and positive (+) terminals of the ignition coil.

Set the ohmmeter for the low scale and adjust the pointer to zero.

Connect the ohmmeter to the coil negative and positive terminals. The resistance should be 1.13-1.23 ohms at 24°C (75°F). If the coil temperature is above 93°C (200°F), 1.50 ohms is acceptable.

Secondary Winding Resistance Test

Remove the high voltage ignition wire from the high voltage terminal of the ignition coil.

NOTE: The ignition switch must be OFF.

Set the ohmmeter for the x1000 scale and adjust the pointer to zero.

Connect the ohmmeter to the brass contact in the high voltage terminal and to either primary winding terminal. The resistance should be 7700 -9300 ohms at 24°C (75°F). A maximum of 12,000 ohms is acceptable if the coil temperature is 93°C (200°F) or more.

Current Flow Test

Remove the connector from the ignition coil.

Depress the plastic barb and withdraw the positive (+) wire terminal from the connector. The barb is visible from the coil side of the connector.

Repeat the procedure for the negative (-) wire terminal.

CAUTION: Ensure the ammeter current rating is sufficient for the test.

Connect the ammeter between the positive terminal and the disconnected positive wire.

Connect a jumper wire from the coil negative terminal to a known good ground.

Turn the ignition switch to the ON position.

The current flow should be approximately 7 amps and should not exceed 7.6 amps.

If the current flow is more than 7.6 amps, replace the ignition coil.

Leave the ammeter connected to the coil positive (+) terminal. Remove the jumper wire from the negative (-) terminal. Connect the coil green wire to the negative terminal. The current flow should be approximately 4 amps.

If the current flow is less than 3.5 amps, inspect for poor connections in the 4-wire (control unit) and 3-wire (distributor) connectors or poor ground at the ground screw inside the distributor. If the current flow is greater than 5 amps, the electronic control unit is defective.

WARNING: Use extreme caution when the engine is operating. Do not stand in direct line with the fan. Do not put hands near the pulleys, belts or fan. Do not wear loose clothing.

Start the engine. Normal current flow with the engine operating is 2.0 - 2.4 amps. If the current flow is not within specifications, the control unit is defective.

Ignition Coil Output Test

Connect an oscilloscope to the ignition coil. Refer to the test equipment manufacturer's instructions.

WARNING: Use extreme caution when the engine is operating. Do not stand in direct line with the fan. Do not put hands near the pulleys, belts or fan. Do not wear loose clothing.

Start the engine and observe the secondary ignition voltage.

CAUTION: Do not remove the wires from the spark plugs for cylinders 1 or 5 of a six-cylinder engine or cylinder 3 of a four-cylinder engine when performing the next test because the pickup coil can be damaged.

CAUTION: Do not operate the engine with the spark plug disconnected for more than 30 seconds because the catalytic converter can be damaged.

Remove one spark plug wire from the distributor cap. Observe the voltage applied to the disconnected spark plug wire on the oscilloscope. This voltage, referred to as open circuit output voltage, should be 24 kV (24,000 volts) minimum with an engine speed of 1000 rpm.

DISTRIBUTOR REPLACEMENT

Removal

Unfasten the distributor cap retaining screws. Remove the distributor cap with the coil and spark plug wires connected and place aside.

SEE I.S. NOTES

Disconnect and plug the distributor vacuum advance hose.

Disconnect the distributor primary wiring connector.

Scribe a mark on the distributor housing in line with the tip of the rotor. Scribe a mark on the distributor housing near the clamp and continue the scribe mark on the engine block in line with the distributor housing mark. Note the position of the rotor and distributor housing in relation to the surrounding engine components as reference points for installing the distributor.

SEE I.S. NOTES

Remove the distributor holddown bolt and clamp.

Withdraw the distributor carefully from the engine.

Installation

Clean the distributor mounting area of the cylinder block.

Install a replacement distributor mounting gasket in the counterbore of the cylinder block.

Position the distributor shaft in the cylinder block. If engine was not rotated while the distributor was removed, perform the following procedure:

Align the rotor tip with the mark scribed on the distributor housing during removal. Turn the rotor approximately 1/8-turn counterclockwise past the scribe mark.

CAUTION: Ensure that the distributor shaft fully engages the oil pump drive gear shaft. It may be necessary to slightly rotate (bump) the engine while applying downward hand force on the distributor body to fully engage the distributor shaft with the oil pump drive gear shaft.

Slide the distributor shaft down into the engine. Align the scribe mark on the distributor housing with the corresponding scribe mark on the cylinder block.

NOTE: It may be necessary to move the rotor and shaft slightly to start the gear into mesh with the camshaft gear and to engage the oil pump drive tang, but the rotor should align with the scribe mark when the distributor shaft is down in place.

Install the distributor holddown clamp and bolt, but do not tighten the bolt.

If the engine was rotated while the distributor was removed, it will be necessary to establish timing according to the following procedure.

Remove the No. 1 spark plug. Hold a finger over the spark plug hole and rotate the engine until the compression pressure is felt. Slowly continue to rotate the engine until the timing index on the vibration damper pulley aligns with the top dead center (TDC) mark (0 degree) on the timing degree scale. Always rotate the engine in the direction of normal rotation. Do not turn the engine backward to align the timing marks.

Turn the distributor shaft until the rotor tip points in the direction of the No. 1 terminal in the distributor cap. Turn the rotor 1/8- turn counterclockwise past the position of the No. 1 terminal.

Slide the distributor shaft down into the engine and position the distributor vacuum advance mechanism housing in approximately the same location (in relation to the surrounding engine components) as when removed. Align the scribe mark on the distributor housing with the

corresponding scribe mark on the cylinder block.

NOTE: It may be necessary to rotate the oil pump shaft with a long flat-blade screwdriver to engage the oil pump drive tang, but the rotor should align with the position of the No. 1 terminal when the distributor shaft is down in place.

Install the distributor holddown clamp and bolt, but do not tighten the bolt.

CAUTION: If the distributor cap is incorrectly positioned on the distributor housing, the cap or rotor may be damaged when the engine is rotated.

Install the distributor cap with the ignition wires on the distributor housing. Ensure the pickup coil wire rubber grommet in the distributor housing aligns with the depression in the distributor cap and that the cap fits on the rim of the distributor housing.

NOTE: Two different diameter screws are used to retain the distributor cap.

Apply AMC/Jeep Silicone Dielectric Compound, or equivalent, to the connector terminal blades and cavities. Connect the distributor primary wiring connector.

CAUTION: Do not puncture the spark plug wires or boots to make a connection. Use the proper adapters.

Connect a timing light to the No. 1 spark plug.

NOTE: The timing case cover has a socket adjacent to the timing degree scale for use with a magnetic timing probe. Ignition timing may be checked by inserting the probe through the socket until it rests on the vibration damper.

The probe is calibrated to compensate for the probe socket location, which is 9.5° ATDC. Eccentricity of the damper will properly space the magnetic probe. The timing degrees are indicated on a meter.

WARNING: Use extreme caution when the engine is operating. Do not stand in a direct line with the fan. Do not put hands near the pulleys, belts or fan. Do not wear loose clothing.

Operate the engine at the specified idle rpm and observe the timing degree scale and index with a timing light. Rotate the distributor housing as needed to align the timing index on the vibration damper pulley with the correct mark on the timing degree scale.

Refer to the Emission Control Information label or Chapter B – Engines- General Service and Diagnosis for ignition timing specifications. When the ignition timing is correct, tighten the distributor holddown bolt and recheck the timing to ensure it did not change.

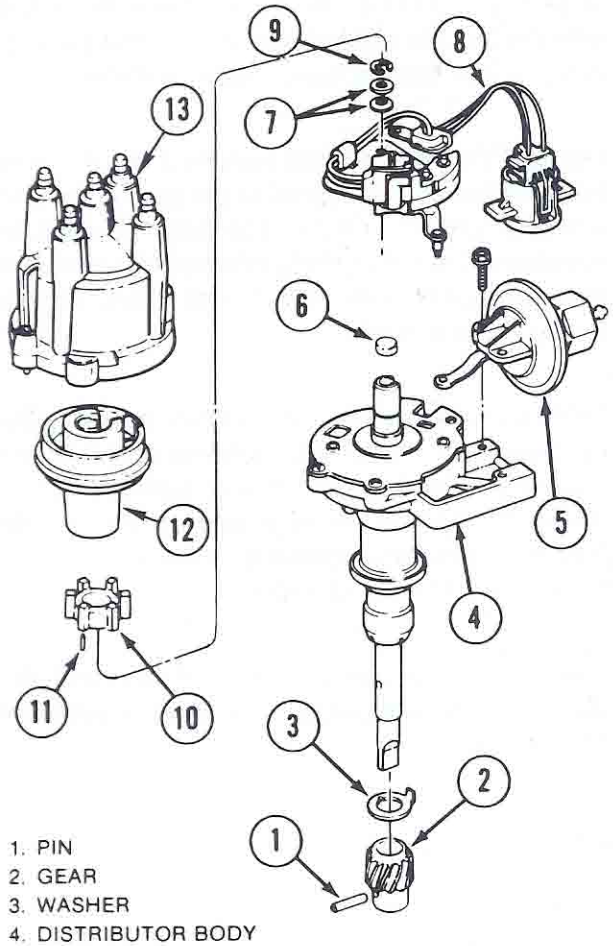
Disconnect the timing light and connect the vacuum hose to the distributor vacuum advance mechanism.

SEE I.S. NOTES

DISTRIBUTOR COMPONENT REPLACEMENT

When replacing the pickup coil assembly, trigger wheel or vacuum advance mechanism, it is not necessary to remove the distributor from the engine. It is necessary to check ignition timing if the pickup coil assembly or vacuum advance mechanism is replaced.

SEE I.S. NOTES



1. PIN
2. GEAR
3. WASHER
4. DISTRIBUTOR BODY
5. VACUUM ADVANCE MECHANISM
6. WICK
7. WASHERS
8. PICK-UP COIL
9. RETAINER
10. TRIGGER WHEEL
11. PIN
12. ROTOR
13. CAP.

84955

Trigger Wheel and/or Pickup Coil Assembly

Removal

Place the distributor in a suitable holding device, if removed from the engine.

Remove the cap.

Remove the rotor.

Remove the trigger wheel with Trigger Wheel Puller Tool J-28509, or equivalent. Use a flat washer to prevent the puller from contacting the inner shaft. By prying alternately, two screwdrivers can be used to remove the trigger wheel from the shaft. Remove the pin.

Remove the pickup coil assembly retainer and washers from the pivot pin on the base plate.

Remove the two pickup coil plate screws.

Lift the pickup coil assembly from the distributor housing.

If the vacuum advance mechanism is to be replaced, remove the screws and lift the mechanism out of the distributor housing. Do not remove the vacuum advance mechanism unless replacement is required.

Installation

If the vacuum advance mechanism was removed, install it on the distributor housing with the attaching screws.

NOTE: If a replacement vacuum advance mechanism is installed, refer to Vacuum Advance Mechanism for the calibration procedure.

Position the pickup coil assembly into the distributor housing.

Ensure the pin on the pickup coil assembly fits into the hole in the vacuum advance mechanism link.

Install the washers and retainer onto the pivot pin to secure the pickup coil assembly to the base plate.

Position the wiring harness in the slot in the distributor housing. Install the two pickup coil plate screws and tighten.

Install the trigger wheel on the shaft with hand pressure. The long portion of the teeth must be up. When the trigger wheel and slot in the shaft are properly aligned, use a suitable drift and small hammer to tap the pin into the locating groove in the trigger wheel and shaft.

If the distributor is not installed in the engine, support the shaft while installing the trigger wheel pin.

Install the rotor. Install the distributor cap.

Vacuum Advance Mechanism

Removal

Remove the vacuum hose from the vacuum advance mechanism.

Remove the attaching screws and remove the vacuum advance mechanism from the distributor housing. It is necessary to tilt the unit to disengage the link from the pickup coil pin protruding through the distributor housing. It may be necessary to loosen the base plate screws for necessary clearance.

Installation

If a replacement vacuum advance mechanism is to be installed, calibrate as follows.

Insert an Allen wrench into the vacuum hose tube of the original vacuum advance mechanism. Count the number of clockwise turns necessary to bottom the adjusting screw.

Turn the adjusting screw of the replacement vacuum advance mechanism clockwise to the bottom. Turn it counterclockwise the same number of turns counted earlier.

Install the vacuum advance mechanism on the distributor housing. Ensure that the link is engaged on the pin of the pickup coil. Install the retaining screws. Tighten the base plate screws, if loosened.

Check the ignition timing and adjust, if required.

Connect the vacuum hose to the vacuum advance mechanism.

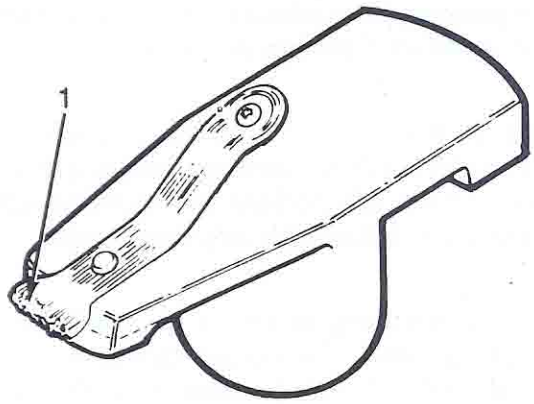
SEE I.S. NOTES

Rotor

A unique feature of the SSI system is the silicone applied to the rotor blade during manufacture. Radio interference is greatly reduced by the presence of a small quantity of silicone dielectric compound on the rotor blade. After a few thousand miles, this compound becomes charred (1) by the high voltage current flowing through the rotor. This is normal. Do not scrape the residue from the rotor blade.

When installing a replacement rotor, apply a thin coat 0.75 - 3 mm (0.03 - 0.12 in) of AMC/Jeep Silicone Dielectric Compound, or equivalent, to the tip of the rotor blade.

SEE I.S. NOTES



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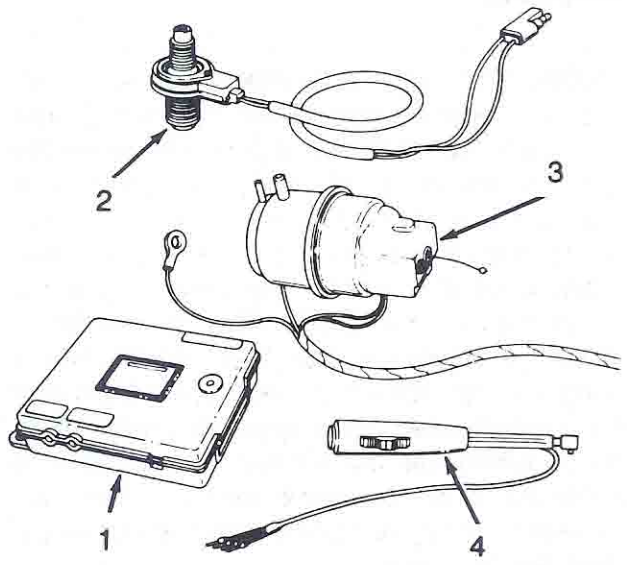
GENERAL

The cruise command is a closed loop electro-mechanical servo system that consists of the following components: electronic regulator (1), speed sensor (2), servo (3), control switch (4), vacuum storage can and check valve and the release mechanisms, which consist of a mechanical vacuum vent and brake lamp switch.



Cruise Command operation is limited to speeds above 48 km/h (30 mph).

WARNING: Do not use the Cruise Command when driving on slippery or congested roads.

SEE I.S. NOTES

SPECIAL TOOLS

Tool Ref.	Description	Required	Recommended
AM PC-1-R	Tester		■
J-21008	Continuity Test Lamp		■

DIAGNOSIS

NOTE: Whenever a Cruise Command malfunction occurs, first verify that the Cruise Command wire harness is properly connected to the electronic regulator before starting normal diagnosis and repair procedures. A poor connection can cause a complete or intermittent malfunction and is also the only nontestable connection in the circuit. This connection is disturbed whenever Test Tool AM PC-1-R is used. For this reason, a loose connection may be misdiagnosed as a regulator malfunction. Also, whenever an electronic regulator is replaced, it will be necessary to adjust the replacement regulator as outlined under Regulator Replacement.

SEE I.S. NOTES

To diagnose Cruise Command system malfunctions, refer to the Service Diagnosis Chart and Testing.

Refer to the Instrument Panels and Components Section in M.R. 255 for details of speedometer cable and gear replacement.

DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
A. SYSTEM DOES NOT ENGAGE IN "ON" POSITION	(1) Restricted vacuum hose or no vacuum.	(1) Locate restriction or air leak and repair.
	(2) Control switch defective.	(2) Replace switch.
	(3) Regulator defective.	(3) Replace regulator.
	(4) Speed sensor defective.	(4) Replace sensor.
	(5) Brake lamps defective.	(5) Replace brake lamp bulbs.
	(6) Brake light switch defective.	(6) Replace switch.
	(7) Brake light switch wire disconnected.	(7) Connect wire to switch.
	(8) Open circuit between brake light switch and brake lamps.	(8) Repair open circuit.
	(9). Mechanical vent valve position improperly adjusted.	(9) Adjust vent valve position.
B. RESUME FEATURE INOPERATIVE	(1) Defective servo ground connection.	(1) Check servo ground wire connection and repair as necessary.
	(2) Control switch defective.	(2) Replace switch.
C. ACCELERATE FUNCTION INOPERATIVE	(1) Accelerate circuit in regulator inoperative.	(1) Replace regulator.
	(2) Control switch defective.	(2) Replace switch.
D. SYSTEM RE-ENGAGES WHEN BRAKE PEDAL OR CLUTCH (MANUAL TRANSMISSION) IS RELEASED	(1) Regulator defective.	(1) Replace regulator.
	(2) Mechanical vent valve not opening.	(2) Adjust position or replace valve.
	(3) Kink in mechanical vent valve hose.	(3) Reroute hose to remove kink.
	(4) Brake light switch defective.	(4) Adjust or replace switch.
E. THROTTLE DOES NOT RETURN TO IDLE POSITION	(1) Improper linkage adjustment.	(1) Adjust properly.
	(2) No slack in lost motion link.	(2) Adjust servo cable.
F. ROAD SPEED CHANGES MORE THAN 2 MPH (3.2 km/h) WHEN SETTING SPEED	(1) Centering adjustment set wrong.	(1) Adjust centering screw.

SEE I.S. NOTES

85464

DIAGNOSIS (cont.)

CONDITION	POSSIBLE CAUSE	CORRECTION
G. ENGINE ACCELERATES WHEN STARTED	(1) No slack in bead chain. (2) Vacuum hose connections reversed at servo. (3) Servo defective.	(1) Adjust chain. (2) Check connection and correct. (3) Replace servo.
H. SYSTEM DISENGAGES ON LEVEL ROAD WITHOUT APPLYING BRAKE OR CLUTCH (MANUAL TRANSMISSION)	(1) Loose wire connection. (2) Loose vacuum hose connection. (3) Servo linkage broken. (4) Defective brake light switch.	(1) Repair connection. (2) Check vacuum hose connection and repair as necessary. (3) Repair linkage. (4) Replace switch.
I. ERRATIC OPERATION	(1) Reverse polarity. (2) Servo defective. (3) Regulator defective.	(1) Check position of speed sensor wires at connector. (2) Replace servo. (3) Replace regulator.
J. VEHICLE CONTINUES TO ACCELERATE WHEN SET BUTTON IN RELEASED	(1) Servo defective. (2) Regulator defective.	(1) Replace servo. (2) Replace regulator.
K. SYSTEM ENGAGES BUT SLOWLY LOSES SET SPEED	(1) Air leak at vacuum hose connection or in hoses. (2) Air leak at vent valve at brake pedal.	(1) Check hoses and connections. Repair as necessary. (2) Replace vent valve.

SEE I.S. NOTES

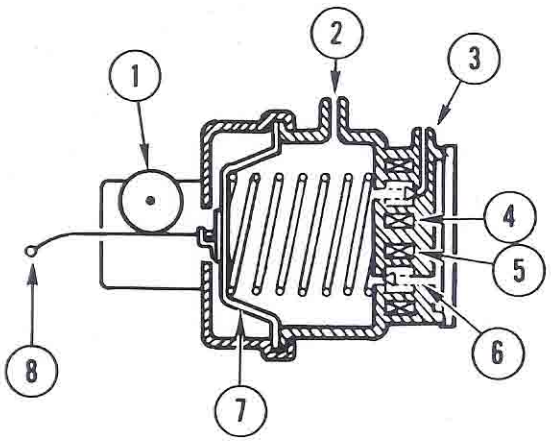
85464A

TESTING

Perform the following tests as part of the service diagnosis to determine the cause of the malfunction and the correction required.

Servo Test

NOTE: This test can be performed with the servo installed in the vehicle.



1. THROTTLE POSITION POTENTIOMETER
2. BRAKE PEDAL VACUUM VENT VALVE
3. MANIFOLD VACUUM SOURCE
4. VACUUM CHARGE VALVE SOLENOID COIL
5. VACUUM VENT VALVE SOLENOID COIL
6. ATMOSPHERE (VENT VALVE)
7. DIAPHRAM
8. TO THROTTLE CABLE

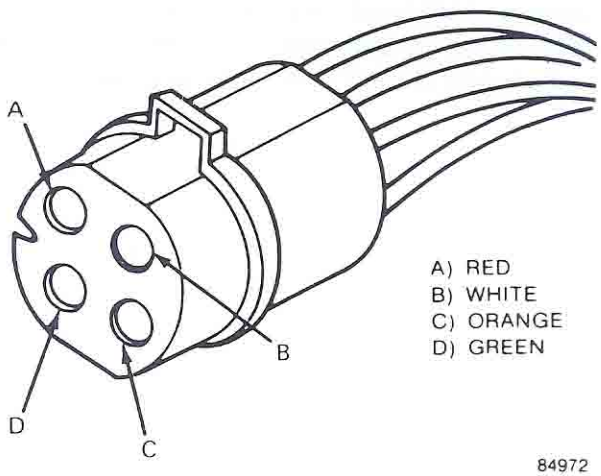
84971

With the ignition switch OFF, disconnect the servo wire harness connector. Remove the vacuum hose from the brake pedal vent valve nipple on the servo.

Disconnect the servo cable from the throttle linkage at the carburetor.

Test the servo for short circuits to ground.

- connect the ohmmeter negative (black) probe to the servo mounting stud
- touch the ohmmeter positive (red) probe to the red, the orange and then the white wire terminal of the servo wire harness connector. Observe the ohmmeter during each test. Infinite resistance should be indicated for each wire terminal
- if the ohmmeter indicates less than infinite resistance on any wire terminal, the servo has a short circuit to ground and must be replaced. The short circuit will also damage the regulator and it must be replaced



A) RED
B) WHITE
C) ORANGE
D) GREEN

84972

SEE I.S. NOTES

NOTE: With no load (or insufficient load), the solid state circuitry in the regulator will be damaged by excessive current flow.

If the servo does not have a short circuit(s) to ground, continue with the test.

Connect a vacuum gauge to the brake pedal vent valve nipple.

Connect a jumper wire from the chassis ground to the orange wire terminal in the servo wire harness connector.

Connect one end of a second jumper wire to the battery positive (+) terminal. Do not connect the other end at this time.

WARNING: Use extreme caution when the engine is operating. Do not stand in direct line with the fan. Do not put hands near pulleys, belts or fan. Do not wear loose clothing.

With the transmission in Park or Neutral, start the engine.

Momentarily connect the jumper wire attached to the battery positive terminal simultaneously to the red and white wire terminals in the servo wire harness connector. Vacuum should be indicated on the gauge while the jumper wire is in contact with the red and white wire terminals.

Perform this same test several times to ensure the solenoid valves are functioning normally.

NOTE: With 12V (battery voltage) applied, the solenoid charge valve is open and the solenoid vent valve is closed. With no voltage applied, the solenoid charge valve is closed and the solenoid vent valve is open.

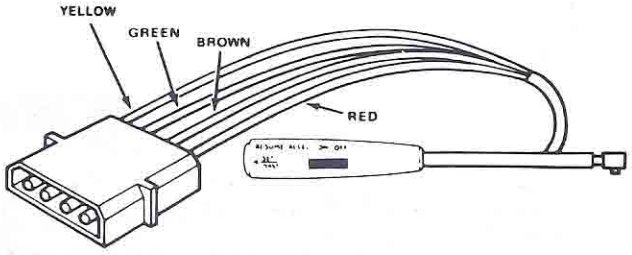
Turn the engine OFF and remove the jumper wires.

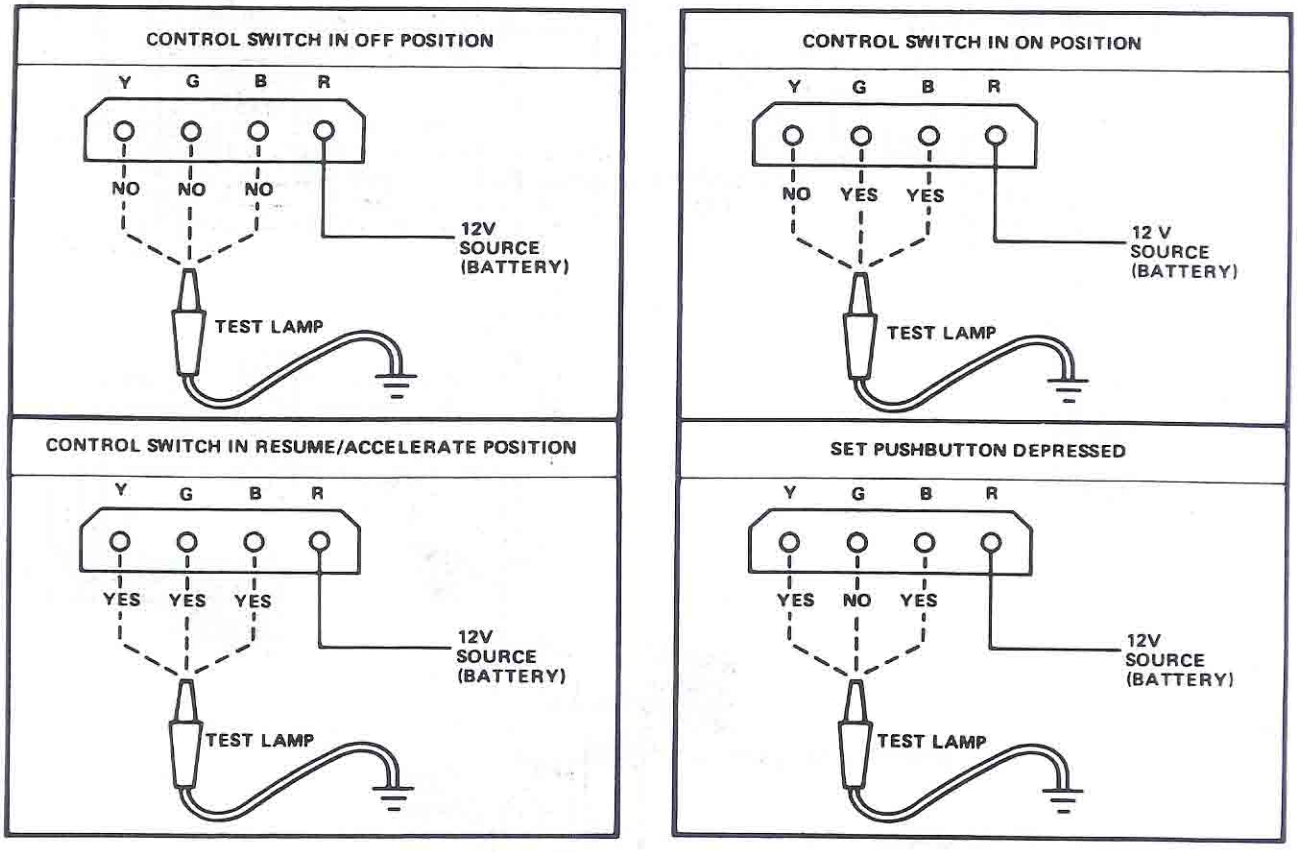
If the servo is defective, replace it. Otherwise, connect the vacuum hose, wire harness connector and throttle linkage to the servo.

SEE I.S. NOTES

Control Switch Continuity Test

Use a 12-volt test lamp to test the control switch continuity. Connect the tester to the wires as indicated in the Control Switch Test illustration.



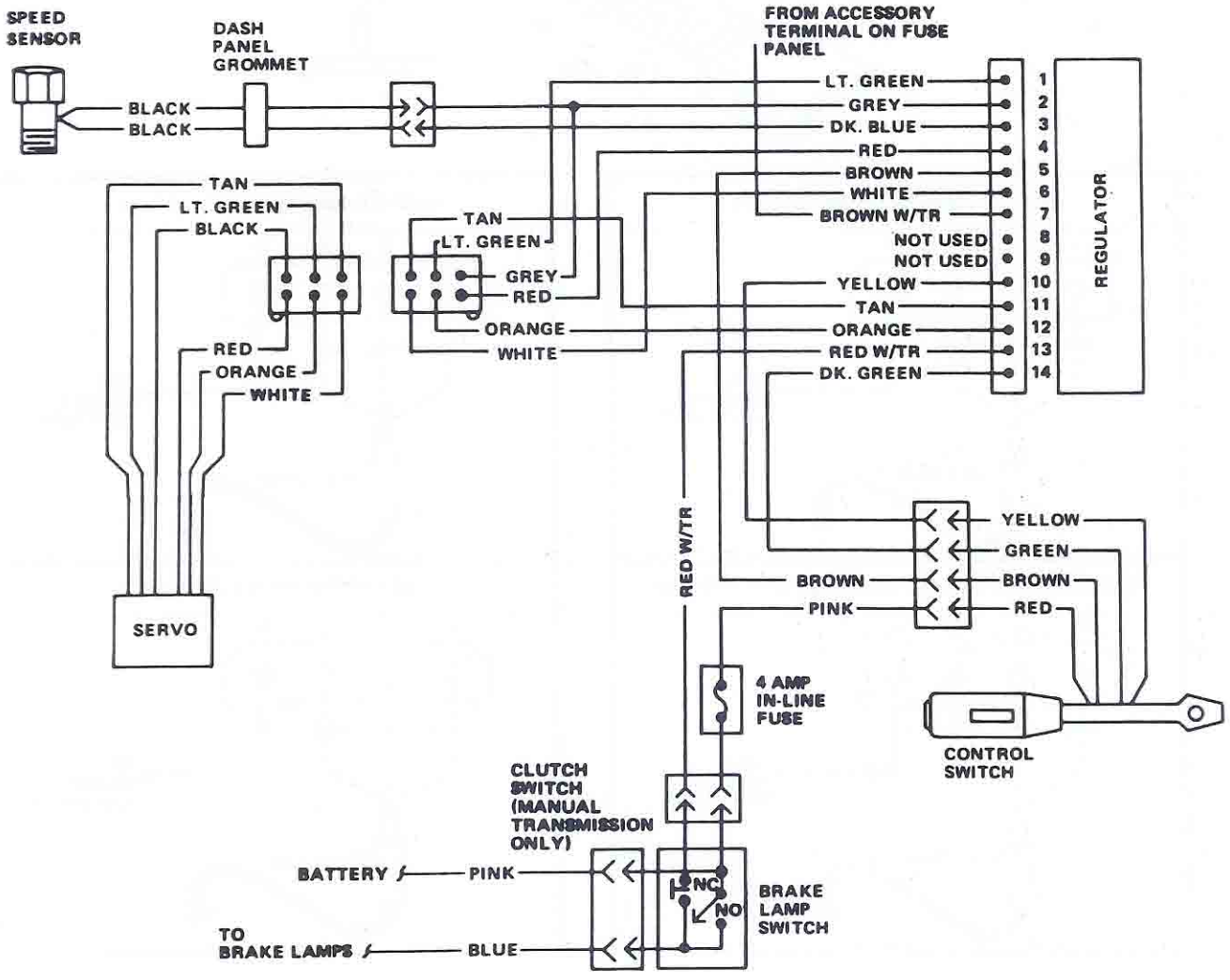


80694

Circuitry Tests

Perform the following tests as part of the service diagnosis to determine the cause and correction of a cruise command system malfunction. Refer to the Cruise Command Wiring diagram.

SEE I.S. NOTES



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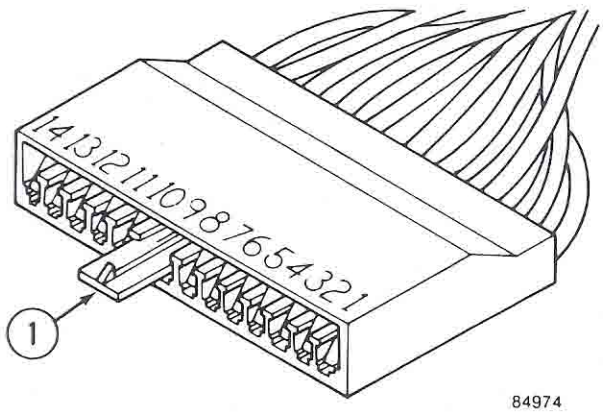
Regulator Wire Harness Connector

Disconnect the wire harness connector at the regulator by using a suitable thin tool to depress the tab inside the hole on regulator identified by "Terminal Release" (1).

Verify that each wire is installed in the correct location according to the color. Refer to the Cruise Command wiring diagram.



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Speed Sensor Test

Disconnect the speed sensor wire harness connector.

Connect a voltmeter set on the low AC scale to the speed sensor wire connector terminals.

Raise the front and rear wheels of the vehicle off the ground and support the vehicle with jack stands.

Operate the engine (wheels spinning freely) at 48 km/h (30 mph) and note the voltage. The voltage should be approximately 0.9 volt. Increases of 0.1 volt per each 16 km/h (10 mph) increase in speed should also be indicated.

Turn off the engine and slowly halt the wheels.

Disconnect the voltmeter.

Replace the speed sensor, if defective.

Connect the speed sensor wire harness connector.

Remove the safety stands and lower the vehicle.

TESTING WITH AM PC-1-R TESTER

A Cruise Command system test can be quickly and accurately performed with the Cruise Command System Tester Tool AM PC-1-R.

Remove the wire harness connector from the regulator.

Connect the Cruise Command system tester to the wire harness connector.

Perform the five tests listed in the Cruise Command Diagnosis Chart for a rapid diagnosis of the Cruise Command System.

SEE I.S. NOTES

Tester AM PC-1-R

The tester lamps are associated with the following components, circuits, etc.

SEE I.S. NOTES

- Lamp 1 – Power source, fuse and ground and ON-OFF and SET-SPEED contacts in control switch.
- Lamp 2 – Speed sensor, associated wiring harness and terminals and connectors.
- Lamp 3 – Brake light or clutch switch adjustment, associated wiring harness and terminals and connectors.
- Lamp 4 – Throttle position potentiometer (feedback voltage), associated wiring harness and terminals and connectors.
- Lamp 5 – Servo vent valve, RESUME/ACCEL contacts in the control switch, associated wiring harness and terminals and connectors.
- Lamp 6 – Servo charge valve, RESUME/ ACCEL contacts in the control switch, associated wiring harness and terminals and connectors.

Cruise Control Diagnosis Chart

TEST AND CONDITIONS	TEST LAMP RESULTS	CHECK—REPAIR
(1) Test for Correct Power Source Connection Ignition Switch—Off Control Switch—Off	All Lamps Off	None
	One or More Lamps On	Remove brown wire (5) at regulator connector from direct source of voltage or repair defective control switch.
(2) Test for System Electrical Continuity Ignition Switch—On Control Switch—On	Lamps 1, 2, 3, & 4 On, Lamps 5 & 6 Off	None
	Lamp 1 Off	Check for blown fuse in brake light switch to control switch circuit. Check red, brown & green wires at control switch connector for continuity to switch. Check dark green wire (14) at regulator connector for continuity to regulator.
	Lamp 2 Off	Check speed sensor for correct output voltage. Check grey & dark blue wire at speed sensor connector for continuity to regulator connector. Check terminals 2, 3, 5 & 7 at regulator connector for proper connection to wires.
	Lamp 3 Off Lamp 4 Off	Check brake light switch adjustment. Check for defective connection at terminals 2 & 11 on regulator connector. Check operation of throttle position feedback potentiometer on servo.
(3) Test for Servo Charge Valve Solenoid Continuity Ignition Switch—On Control Switch—On Set Speed Switch - Depressed WARNING: If engine is operating servo will move throttle to wide open position.	Lamp 2, 3, 4, 5 & 6 On Lamp 1 Off Lamp 4 will dim when servo moves throttle to wide open position with engine operating.	None
	Lamp 2 Off	Refer to Test 2, Lamp 2 Off
	Lamp 3 Off	Refer to Test 2, Lamp 3 Off.
	Lamp 4 Off	Refer to Test 2, Lamp 4 Off.

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SEE I.S. NOTES

TEST AND CONDITIONS	TEST LAMP RESULTS	CHECK—REPAIR
(3) Con't.	Lamp 5 Off	Check for defective connection at terminals 4 & 12 on regulator connector. Replace defective servo.
	Lamp 6 Off	Check for defective connection at terminals 6 & 12 on regulator connector. Replace defective servo.
	All lamps Off after depressing set speed switch or moving control switch to resume/acceleration position.	Check for blown fuse. Check for short circuits in red, pink & brown wire circuits at control switch. Replace defective servo.
(4) Test for System Disengagement with Brake Pedal Depressed Ignition Switch—On Control Switch—On Brake Pedal Depressed	Lamps 1, 2, & 4 On Lamps 3, 5 & 6 Off Lamp 3 On when brake pedal is released.	None
	Lamp 1 Off	Refer to test 2, Lamp 1 Off.
	Lamp 2 Off	Refer to Test 2, Lamp 2 Off.
	Lamp 4 off	Refer to Test 2, Lamp 4 Off.
	Lamp 3 Off when brake pedal is released.	Refer to Test 2, Lamp 3 Off.
(5) Test Resume/Acceleration Function of Control Switch Ignition Switch—On Control Switch—On Move control switch to resume/acceleration position. WARNING: If engine is operating, servo will move throttle to wide open position	All Lamps On Lamp 4 will dim when servo moves throttle to wide open position with engine operating.	None
	Lamp 1 Off	Refer to Test 2, Lamp 1 Off.
	Lamp 2 Off	Refer to Test 2, Lamp 2 Off.
	Lamp 3 Off	Refer to Test 2, Lamp 3 Off.
	Lamp 4 Off	Refer to Test 2, Lamp 4 Off.
	Lamp 5 Off	Refer to Test 3, Lamp 5 Off.
	Lamp 6 Off	Refer to Test 3, Lamp 6 Off.
	All Lamps Off	Refer to Test 3, All Lamps Off.

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ADJUSTMENTS

Regulator Adjustment

Regulator adjustments are pre-set by the manufacturer but, if all other components of the system appear to be functioning normally and the cruise command remains inoperative, perform the following adjustments to determine if the regulator is functional.

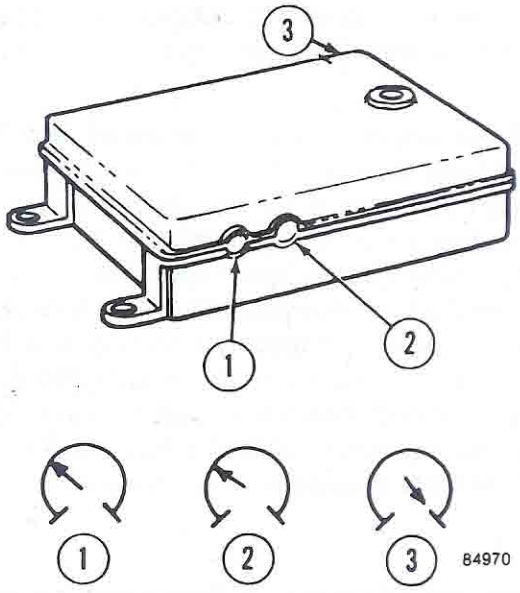
Remove the regulator attaching screws or tie straps and move the regulator downward for adjustment access.

CAUTION: The adjustment potentiometers are extremely delicate. Insert the screwdriver into the slots very carefully and do not push hard or turn hard against the wiper arm stops. The potentiometer wiper arms have a maximum turning angle of 270 degrees (three-quarter turn).

Turn the centering adjustment (1) to the 10 o'clock position.

Turn the low speed adjustment (2) to the 10 o'clock position.

Turn the sensitivity adjustment (3) full clockwise.



NOTE: The adjustments may not be precisely correct for the vehicle, but will be acceptable to determine if the regulator is functioning. The need for more precise adjustments can be determined by a road test.

If the adjustments have no effect on the Cruise Command operation, replace the regulator.

NOTE: The regulator is the only component of the system that cannot be isolated and tested separately. It must be tested while connected to the components of the system.

SEE I.S. NOTES

To adjust the regulator for engagement speed complaints, drive the vehicle on a level road surface and check operation.

If the actual engagement speed is 3.2 km/h (2 mph) or more above the selected engagement speed, stop the vehicle, turn the regulator centering screw approximately 1/16 of a turn counterclockwise and check the engagement speed again. Readjust the speed as needed. If the actual engagement speed is 3.2 km/h (2 mph) or more below the selected engagement speed, stop the vehicle, turn the regulator centering screw 1/16 of a turn clockwise and check the engagement speed again.

SEE I.S. NOTES

Vacuum (Mechanical) Vent Valve Adjustment

Depress the brake or clutch pedal and hold in the depressed position.

Move the vacuum vent valve toward the bracket on the pedal as far as possible.

Release the brake or clutch pedal.

COMPONENT REPLACEMENT

Regulator Replacement

The regulator is mounted on a bracket under the instrument panel near the headlamp switch. Remove the screws or tie straps and unplug the connector. Insert a suitable thin tool to depress the tab inside the hole on the regulator identified by "Terminal Release." To install, plug the connector into the regulator and install the screws.

Servo Replacement

Removal

Remove the retaining nuts and cable housing from the servo.

Spread the clip that connects the cable to the servo and remove.

Disconnect the vacuum hoses from the servo.

Remove the retaining nut and servo from the bracket. Note the position of the ground cable.

Disconnect the wire harness connector under the instrument panel. Carefully maneuver the wire harness through the dash panel and remove the servo.

Installation

Install the servo and nut on the bracket. Tighten with 7 N·m (60 in-lbs) torque. Ensure the ground cable is positioned on the stud.

Maneuver the wire harness through the dash panel and connect the connector.

Attach the cable to the servo and squeeze the clip to retain the cable.

NOTE: Mounting studs are not equally spaced from the hole in the servo. Ensure the housing is installed correctly.

Connect the vacuum hoses.

Servo Cable Replacement

Removal

Remove the clip and washer from the pin on the bellcrank and remove the lost motion link.

Squeeze the tabs that retain the cable housing in the bracket and remove the cable from the bracket.

Remove the retaining nuts and the cable housing from the servo.

Spread the clip that connects the cable to the servo and remove.

Installation

Attach the cable to the servo and squeeze the clip to retain the cable.

Install the cable housing on the servo.

NOTE: The mounting studs are not equally spaced from the hole in the servo. Ensure the housing is installed correctly.

Attach the cable housing on the bracket. Ensure the tabs are locked in the bracket.

Place the lost motion link on the bellcrank pin and install the washer and lock clip.

Control Switch Replacement

The Cruise Command control switch assembly is integral with the turn signal lever. The switch is not repairable. The switch and harness assembly can be replaced only as a complete unit.

Removal

Remove the following items:

- horn cover
- steering wheel
- anti-theft cover
- locking plate and horn contact

Remove the hazard warning knob.

Disconnect the four-wire harness connector located behind the instrument panel.

If equipped with a tilt steering column remove the wires from the connector. Fold back and tape two of the four wires to the wire harness.

Tie or tape string to the wire harness.

If equipped with a standard steering column, tie or tape string to the wire harness connector.

Remove the turn signal/control switch lever retaining screw from the steering column.

Carefully pull the wire harness up through and out of the steering column.

Remove the string from the wire harness.

SEE I.S. NOTES

Installation

Test the operation of the replacement Cruise Command control switch assembly by connecting it to the system before installing it in the steering column. Refer to Control Switch Continuity Test.

SEE I.S. NOTES

Remove the wires from the connector. Tape two of the four wires back along the wire harness (tilt column only) and tape or tie the harness to the string that was attached to the original wire harness before removal.

Pull the replacement harness down through the steering column. On tilt steering columns, the harness must pass through the hole on the left side of the steering shaft.

NOTE: It may be necessary to loosen the steering column mounting screws for easier routing of the harness.

Install the turn signal/control switch assembly and the hazard warning switch knob.

Install the harness wires in the connector (tilt column only) and connect the connector to the system.

Install the locking plate, horn contact and anti-theft cover.

Install the steering wheel and horn cover.

Install the lower steering column cover, if removed for access.

Test the Cruise Command operation.

GENERAL

This section is divided into three parts. The first part, Specifications, contains the gauge and sending unit specifications, and schematics for each gauge circuit.

The second part, Instrumentation Diagnosis, covers the test procedures and replacement procedures.

The third part, Diagnosis and Repair Simplification (DARS) charts, contains pictorial guides for diagnosing instrumentation malfunctions.

NOTE: All reference pertaining to CJ vehicles includes Scrambler vehicles.

SPECIAL TOOLS

Tool Ref.	Description	Required	Recommended
AMOT ET-502	Digital Multimeter		■
J-8681	Short Tester		■
J-21008	Continuity Test Lamp		■
J-24538	Universal Gauge Tester		■

SPECIFICATIONS

SEE I.S. NOTES

Voltmeter Calibrations (Volts)

ACTUAL	INDICATED
12.4	11.7 to 12.3
14.4	13.8 to 14.2

NOTE: Indicated Voltage Observed from Drivers Seat

Tachometer Calibrations (RPM)

ACTUAL	INDICATED
500	380 to 620
1500	1380 to 1620
4500	4330 to 4620

Fuel Gauge Sending Unit Resistance (Ohms)

E	1/2	F
73	23	10

Fuel Gauge Resistance (Internal)

TEST POINTS	OHMS
S to Ground	68 to 72
S to I	19 to 21
S to A	19 to 21
I to A	ZERO
I to Ground	49 to 51
A to Ground	49 to 51

Coolant Temperature Gauge Resistance (Internal)

S to A	19 to 21 ohms

Oil Pressure Gauge Sending Unit Resistance (Ohms)

PSI	0	20	40	60	80
OHMS	234-246	149-157	100.5-105.5	65-69	32.5-34.5

Coolant Temperature Gauge Sending Unit Resistance (Ohms)

C	BEGINNING OF BAND	END OF BAND	H
73	36	13	9

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