



Heavy Duty Troubleshooting Guide

Starting and Charging System Testing

PERFORM A VISUAL INSPECTION

- 1 Visually inspect the alternator belt for glazing, cracking and wear, and confirm that belt tensioner is operating properly and within the working range.
- 2 Check the pulleys for proper alignment and for any damage.
- 3 Visually inspect the electrical connections and cables at the starter, battery bank and alternator for corrosion, wiring chafing and proper torque on all terminals. Make any necessary repairs.



GENUINE PRODUCTS

INSPECT BATTERIES

1. Inspect the batteries for signs of physical damage, contamination, cracks, leaks or loose terminals.
2. Make sure the battery hold downs are secure and in good working order.
3. Verify that all batteries are the same brand, CCA rating, type, and age.
4. Disconnect the battery bank & measure the Open Circuit Voltage (OCV) of each battery to assure that they are at least 80% State-of-Charge (SOC). If necessary, charge batteries before testing - low SOC batteries may result in false test results of batteries or other system components.

PERFORM BATTERY TESTING

1. With batteries at or above 80% SOC, Test Batteries using one of the two methods:
 - a. Automated Tester: Follow the on-screen prompts and procedures.
 - b. Carbon Pile Testing Procedure:
 - i. Connect carbon pile to battery using proper battery terminal adapters.
 - ii. Adjust carbon Pile to ½ the CCA rating and apply for 15 seconds.
 - iii. Measured voltage at the end of test must exceed the value outlined in battery temp-voltage chart or the battery is failed.
2. If any battery fails testing, it is recommend the entire bank be replaced. Old batteries can be charged and used with other batteries of the same brand, type, CCA and age.
3. Reconnect battery bank and tighten connections to OEM or battery mfg specs.



BATTERY STATE OF CHARGE ESTIMATION

	Flooded OCV (Volts)	AGM OCV (Volts)
100	12.6	12.8
80	12.4	12.6
60	12.3	12.4
40	12.1	12.2
20	12.0	12.0
0	11.8	11.8

Battery Temperature	12 Volt Battery
70°F (21°C) or above	9.60
60°F (16°C)	9.50
50°F (10°C)	9.40
40°F (4°C)	9.30
30°F (-1°C)	9.10
20°F (-6°C)	8.90
10°F (-12°C)	8.70
0°F (-18°C)	8.50

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PERFORM STARTER MAIN CABLES VOLTAGE DROP TEST

1. With known good batteries, connect carbon pile to starter B+ and ground posts.
2. Connect a volt meter red lead to the positive side of the battery pack.
3. Connect a volt meter black lead to the B+ post of the starter.
4. Load the carbon pile to 500A and record the positive side voltage drop.
5. Move the volt meter black lead to the negative battery post.
6. Move the volt meter red lead to the starter negative post.
7. Load the carbon pile to 500 A and record the negative side voltage drop.
8. Add the Positive side and Negative side voltage drops to get total voltage drop.
9. If the total voltage drop is 0.5 V or below, move on to the next test section your starter cable voltage drop is acceptable.
10. If the total voltage drop is greater than 0.5V, the voltage drop is too high. Clean and tighten connections, inspect for corroded or damaged cables, and replace cables as needed. Retest after any repairs.

PERFORM STARTER CONTROL CIRCUIT TEST

1. Connect DVOM to start enable circuit on IMS and starter ground.
2. Crank engine and measure voltage. If $> 9V$, the start enable circuit is good.
3. If the IMS start enable $< 9V$ during crank, correct the source of voltage drop in the start enable circuit.
4. If voltage is present and starter fails to crank, replace starter.

PERFORM CHARGING SYSTEM VOLTAGE DROP TEST

1. Inspect cables and connections for damage, corrosion and proper tightness.
2. Connect a carbon pile red lead to the B+ post (output) of the alternator.
3. Connect the black lead to the case (or ground stud on an insulated unit).
4. Connect a volt meter red lead to the battery positive post.
5. Connect the black lead to the B+ post of the alternator.

6. With the carbon pile, load the circuit to the rated output of the alternator and record the positive voltage drop.
7. Move the red lead of the voltmeter to the case of the alternator (or ground stud on an insulated unit).
8. Move the black lead of the voltmeter to the battery negative post.
9. With the carbon pile, load the circuit to the rated output of the alternator and record the negative voltage drop.
10. Add the positive and negative voltage drops to get total circuit voltage drop.
 - a. If the voltage drop is < 0.5 volts, move on to the alternator output tests.
 - b. If the voltage drop is > 0.5 volts, the voltage drop is too high. Clean and tighten connections, inspect for corroded or damaged cables, and replace cables as needed. Retest after any repairs.

PERFORM ALTERNATOR OUTPUT TEST

1. With engine running at governor speed, measure Amperage output and apply loads until you reach 70% of rated output.
2. If output is $> 70\%$ of rated output, system is working properly.

SAFETY REMINDER FROM BORGWARNER

The various electrical systems within a vehicle are highly charged and may include corrosive, poisonous, and hazardous materials.

To remain safe, you must:

- Know where the nearest eye wash station is located
- Always wear eye protection
- Remove watches, jewelry, etc. and any metallic item that could create an electrical change.
- Never smoke near batteries
- Never use batteries as a tool rest
- Dispose of batteries properly when necessary
- Follow usual safety precautions near rotating machinery



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