



## Test Sequence

### 1-A) Check primary input voltage to coils. (See Test Chart).

1. If voltage readings to coil(s) are **BELOW** specification, proceed with **Step 2-A**.
2. If voltage readings to coil(s) are **WITHIN** specifications, proceed with **Step 1-B**.

### 1-B) Check coils for spark. [Connect Spark Gap Tester (91-63998A1) between coil high voltage tower and spark plug.]

1. No spark or weak spark. **COIL** is bad.
2. Spark is OK, proceed with **Step 1-C**.

### 1-C) If Step 1-A and 1-B check OK, replace spark plugs.

If problem exists after replacing spark plugs, proceed with **Step 1-D**.

### 1-D) If Steps 1-A, 1-B, and 1-C check OK, check ignition timing.

1. If ignition timing **does not** check to specification (or a sudden or unexplained timing change occurs) check trigger advance linkage for loose and/or broken parts and check trigger magnet ring (on flywheel hub) for looseness and/or a shift in position.
2. If ignition checks to specification and engine does not run or runs poorly, **trouble exists with fuel system or engine mechanical**.

### 2-A) Check switch box “stop” circuit. (See Test Chart).

1. If reading is **BELOW** specifications, proceed with **Step 2-B**.
2. If reading is **ABOVE** specifications, the **Trigger** or **Switch Box** is bad (test trigger as outlined in this service manual section; if trigger checks OK, replace switch box and repeat check).
3. If reading is **WITHIN** specifications, proceed with **Step 3-A**.

### 2-B) Check ignition switch/wiring, as follows:

#### CAUTION

To prevent engine from starting, remove spark plug leads from **ALL** spark plugs and ground leads to engine.

1. Disconnect **ignition switch** and **stop switch** leads from switch box and isolate the leads.
2. Repeat check in **Step 2-A**.

3. If reading is still **BELOW** specification, proceed with **Step 3-A**.

4. If reading is **WITHIN** specification, **either the ignition switch, stop switch, or wiring** is bad.

### 3-A) Check stator low speed and high speed input to switch box. (See Test Chart).

1. If either the low speed or high speed reading to switch box is **BELOW** specification, **Stator** or **Switch Box** is bad (test stator as outlined in this service manual section; if stator checks to specification replace switch box and repeat check).
2. If both the low speed and high speed reading are **WITHIN** specification, replace switch box and repeat test.



# Ignition System Test Chart

**IMPORTANT: BEFORE attempting the ignition system checks, following, thoroughly read the preceding pages of these instructions to become familiar with the proper Automatic Distributorless Ignition (ADI) test sequence and procedures (particularly any “Safety Warnings” and “Cautions”). ALL tests are performed with lead wires connected – terminals exposed. SWITCH BOX MUST BE GROUNDED (CASE TO ENGINE BLOCK) FOR ALL TESTS – IF NOT, SWITCH BOXES MAY BE DAMAGED.**

## 3 Cylinder Stators – 398-9710A13/14/28 and all 398-8778A– Stators 4 Cylinder Stators – 398-9710A15/31 and all 398-8778A– Stators

ADI Test Seq.	Test	Selector Sw. Position	DVA Leads		Voltage Reading (1) @ 300-1000 RPM	Voltage Reading @ 1000-4000 RPM
			Red	Black		
1-A	Coil Primary	400 VDC*	Coil (+) Terminal	Coil (-) Terminal	150-250	180-280
2-A	Sw. Box – Stop Circuit	400 VDC*	Black/Yellow (3) Sw. Box Terminal	Ground	200-360	200-360
3-A 4-A	Stator – Low Speed	400 VDC*	Blue Sw. Box Terminal	Ground	200-300	200-330
3-A 4-A	Stator – High Speed	400 VDC*	Red Sw. Box Terminal	Ground	20-90	130-300
5-A	Sw. Box – Bias	20 VDC or 40 VDC	Ground	[See Note (1)] White/Black Sw. Box Terminal	2-10	10-30

(1) Using meter only, REVERSE LEAD POLARITY; connect leads as specified.

\* If using a meter with a built-in DVA, place selector switch in the DVA/400 VDC position.

## 3 Cylinder Stator – 9 Ampere 398-9873A21 & 15 Ampere 398-9873A24

ADI Test Seq.	Test	Selector Sw. Position	DVA Leads		Voltage Reading (1) @ 300-1000 RPM	Voltage Reading @ 1000-4000 RPM
			Red	Black		
1-A	Coil Primary	400 VDC*	Coil (+) Terminal	Coil (-) Terminal	145-250	210-240
2-A	Sw. Box – Stop Circuit	400 VDC*	Black/Yellow (3) Sw. Box Terminal	Ground	215-340	280-320
3-A 4-A	Stator – Low Speed	400 VDC*	Blue Sw. Box Terminal	Ground	215-340	280-320
3-A 4-A	Stator – High Speed	400 VDC*	Red Sw. Box Terminal	Ground	10-55	45-255
5-A	Sw. Box – Bias	20 VDC or 40 VDC	Ground	[See Note (1)] White/Black Sw. Box Terminal	2-30	10-30

(1) Using meter only, REVERSE LEAD POLARITY; connect leads as specified.

\* If using a meter with a built-in DVA, place selector switch in the DVA/400 VDC position.

## 4 Cylinder Stator – 16 Ampere 398-9710A33

ADI Test Seq.	Test	Selector Sw. Position	DVA Leads		Voltage Reading (1) @ 300-1000 RPM	Voltage Reading @ 1000-4000 RPM
			Red	Black		
1-A	Coil Primary	400 VDC*	Coil (+) Terminal	Coil (-) Terminal	110-300	215-265
2-A	Sw. Box – Stop Circuit	400 VDC*	Black/Yellow (3) Sw. Box Terminal	Ground	160-385	270-330
3-A 4-A	Stator – Low Speed	400 VDC*	Blue Sw. Box Terminal	Ground	160-385	270-330
3-A 4-A	Stator – High Speed	400 VDC*	Red Sw. Box Terminal	Ground	8-33	33-205
5-A	Sw. Box – Bias	20 VDC or 40 VDC	Ground	[See Note (1)] White/Black Sw. Box Terminal	2-30	10-30

(1) Using meter only, REVERSE LEAD POLARITY; connect leads as specified.

\* If using a meter with a built-in DVA, place selector switch in the DVA/400 VDC position.



## ⚠ WARNING

When testing or servicing the ignition system, high voltage is present, be extremely cautious! **DO NOT TOUCH OR DISCONNECT** any ignition parts while engine is running, while key switch is on, or while battery cables are connected.

## ⚠ CAUTION

Failure to comply with the following items may result in damage to the ignition system.

1. **DO NOT** reverse battery cable connections. The battery negative cable is (-) ground.
2. **DO NOT** “spark” battery terminals with battery cable connections to check polarity.
3. **DO NOT** disconnect battery cables while engine is running.
4. **DO NOT** crank engine when switch box is not grounded to engine.

A process of elimination must be used when checking the ignition system without a Multi-Meter/DVA Tester (91-99750) or a voltmeter (capable of measuring 400 volts DC, or higher) and Direct Voltage Adaptor (91-89045), as the switch box and ignition coils cannot be thoroughly checked with conventional test equipment.

All other components can be tested with an ohmmeter. Before troubleshooting the ignition system, check the following:

1. Make sure that electrical harness and ignition switch are not the source of the problem.
2. Check that plug-in connectors are fully engaged and terminals are free of corrosion.
3. Make sure that wire connections are tight and free of corrosion.
4. Check all electrical components, that are grounded directly to engine, and all ground wires to see that they are grounded to engine.
5. Check for disconnected wires, and short and open circuits.

## STATOR TEST

*NOTE:* Stator can be tested without removing from engine.

1. Disconnect stator leads from switch box.
2. Use an ohmmeter and perform the following tests.

**IMPORTANT:** If stator is mounted on engine, black stator lead must be grounded to powerhead when testing.

### 9/18/24 AMPERE STATORS (3 CYLINDER)

Test Leads	Resistance (OHMS)	Scale Reading (x _____)
Between Blue Stator Lead and Red Stator Lead (Low Speed)	3600-4200 (90-140)	3.6-4.2 (R x 1000)
Between Red Stator Lead and Engine Ground* (Hi-Speed)	90-140	90-140 (R x 1)

### 9/18/24 AMPERE STATORS (4 CYLINDER)

Test Leads	Resistance (OHMS)	Scale Reading (x _____)
Between Blue Stator Lead and Blue/White Stator Lead (Low Speed)	6800-7600 (90-140)	6.8-7.6 (R x 1000)
Between Red Stator Lead and Red/White Stator Lead* (Hi-Speed)	90-140	90-140 (R x 1)

\* Connect test lead to black stator lead if stator is removed from engine.

*NOTE:* Above readings are for a cold engine (room temperature). Resistance will increase slightly, if engine is warm.

3. If meter readings are other than specified, replace stator assembly.



## IGNITION COIL TEST

**IMPORTANT:** Ohmmeter tests can only detect certain faults in the ignition coil. Replace ignition coil, if ohmmeter readings (listed in chart, following) are not as specified. If coil tests OK, and coil is still suspected of being faulty, use Multi-Meter/DVA Tester (91-99750) or a voltmeter (capable of measuring 400 volts DC, or higher) and Direct Voltage Adaptor (91-89045) to thoroughly check coil.

1. Disconnect wires from coil terminals.
2. Pull spark plug lead out of coil tower.
3. Use an ohmmeter and perform the following tests.

Test Leads	Resistance (OHMS)	Scale Reading (x _____)
Between (+) and (-) Coil Terminals	.02-.04*	.02-.04* (R x 1)
Between Coil Tower and (-) Coil Terminal	800-1100**	8-11** (R x 100)

\* The primary DC resistance of these coils generally is less than one (1) OHM. If a reading resembling a short is obtained, this would be acceptable.

\*\* Copper wire is an excellent conductor, but it will have a noticeable difference in resistance from cold to hot temperatures. Reasonable variations from these readings are acceptable.

4. If meter readings are not as specified, replace ignition coil.

## TRIGGER TEST (3 CYLINDER)

1. Disconnect all trigger leads from switch box.
2. Use an Ohmmeter and perform the following tests.

Test Leads	Resistance (OHMS)	Scale Reading (x _____)
Between Brown Trigger Lead and White/Black Trigger Lead	1100-1400	11-14 (R x 100)
Between White Trigger Lead and White/Black Trigger Lead	1100-1400	11-14 (R x 100)
Between Violet Trigger Lead and White/Black Trigger Lead	1100-1400	11-14 (R x 100)

**NOTE:** Above readings are for a cold engine (room temperature). Resistance will increase slightly, if engine is warm.

3. If meter readings are not as specified, replace trigger.

## TRIGGER TEST (4 CYLINDER)

1. Disconnect all trigger leads from switch box.
2. Use an Ohmmeter and perform the following tests.

Test Leads	Resistance (OHMS)	Scale Reading (x _____)
Between Brown Trigger Lead and Black Trigger Lead	700-1000	7-10 (R x 100)
Between White Trigger Lead and Violet Trigger Lead	700-1000	7-10 (R x 100)

**NOTE:** Above readings are for a cold engine (room temperature). Resistance will increase slightly, if engine is warm.

3. If meter readings are not as specified, replace trigger.

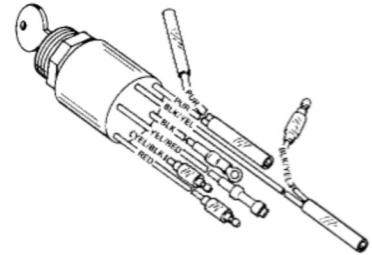
## IGNITION (KEY) SWITCH TEST

1. Disconnect remote control wiring harness and instrument panel connector.

**NOTE:** Wiring diagram for control boxes is located in SECTION 2D.

2. Set ohmmeter on R x 1 scale for the following tests:

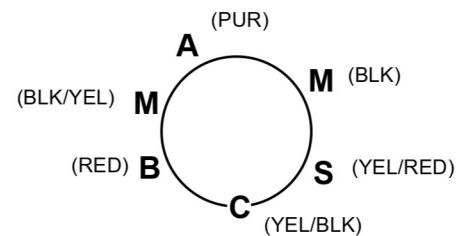
## COMMANDER 2000 KEY SWITCH



23894

## COMMANDER KEY SWITCH

BLK • BLACK  
PUR • PURPLE  
RED • RED  
YEL • YELLOW



KEY POSITION	CONTINUITY SHOULD BE INDICATED AT THE FOLLOWING POINTS:					
	BLK	BLK/YEL	RED	YEL/RED	PUR	YEL/BLK
OFF	• - - - - •					
RUN			• - - - - - •			
START			• - - - - •	• - - - - •		
CHOKE*			• - - - - •	• - - - - •	• - - - - •	• - - - - •

\* Key switch must be positioned to "RUN" or "START" and key pushed in to actuate choke, for this continuity test.

3. If meter readings are other than specified in the preceding test, verify that switch and not wiring is faulty. If wiring checks OK, replace switch.