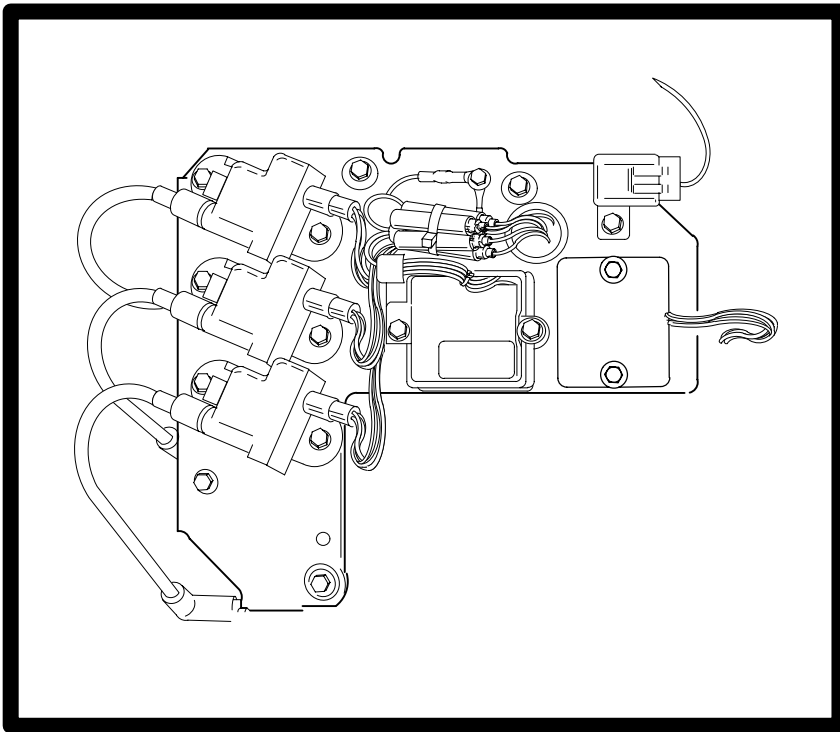




# ELECTRICAL AND IGNITION

2

B



**CDM IGNITION**



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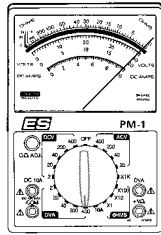
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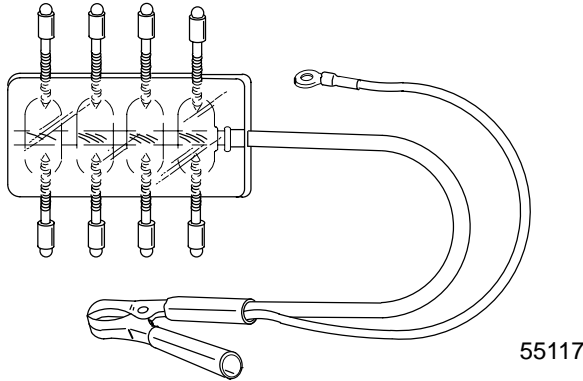


## Special Tools Required

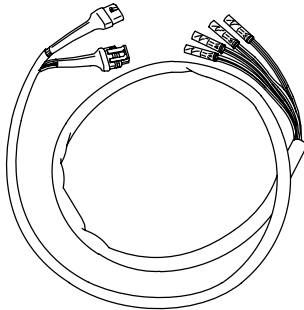
Multimeter/ DVA Tester 91-99750



Spark Tester 91-850439



Ignition Test Harness 84-825207A2



## General

The ignition system is self-energizing (creates its own power for ignition) and has proven reliability. Should testing be required it is important to check all components in the order outlined.

**IMPORTANT:** Read the entire procedure before attempting to test components.

*The procedures in this section are designed to test the complete ignition system. In an actual situation, test only the components that control the misfiring cylinder(s).*

### **⚠ WARNING**

**When testing or servicing the ignition system high voltage is present; be extremely cautious! DO NOT TOUCH OR DISCONNECT any ignition components while engine is cranking or running.**

## Principles of Operation

### Capacitor Discharge Module (CDM) Ignition System

The ignition system is alternator driven with distributorless capacitor discharge. Major components of the ignition system are the flywheel, stator, trigger, capacitor discharge module, and spark plugs.

The stator assembly is mounted stationary below the flywheel and has one capacitor charging coil.

The flywheel is fitted with permanent magnets inside the outer rim. As the flywheel rotates the permanent magnets pass the capacitor charging coil. This causes the capacitor charging coils to produce AC voltage. The AC voltage is conducted to the CDM (Capacitor Discharge Module) where it is rectified and stored in a capacitor.

The trigger assembly (also mounted under the flywheel) has one coil for each cylinder. The flywheel has a second set of permanent magnets located around the center hub. As the flywheel rotates the second set of magnets pass the trigger coils. This causes the trigger coils, in turn, to produce an AC voltage that is conducted to an electronic switch (SCR) in the CDM.

The SCR switch discharges the capacitor voltage into the primary side of the ignition coil.

The ignition coil multiplies this voltage to a value high enough to jump the gap at the spark plug.

The preceding sequence occurs once per engine revolution for each cylinder.

Spark timing is changed (advanced/retarded) by rotating the trigger assembly which changes each trigger coil position in relation to the permanent magnets on the flywheel hub.

## Test Procedures

### **⚠ CAUTION**

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

- DO NOT reverse battery cable connections. The battery negative cable is (–) ground. DO NOT “spark” battery terminals with battery cable connections to check polarity.
- DO NOT disconnect battery cables while engine is running.

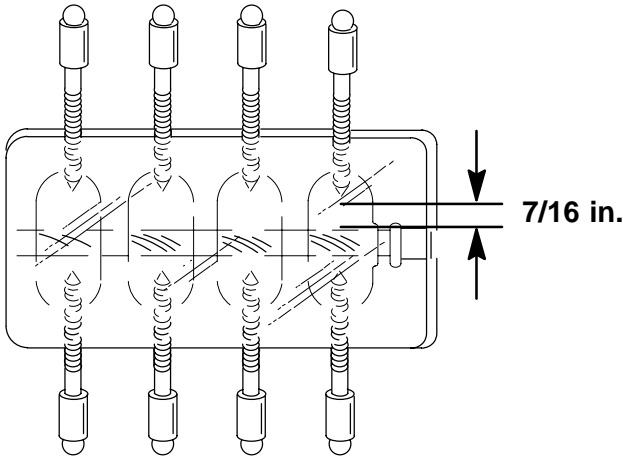
Before troubleshooting the ignition system:



- Check that plug-in connectors are fully engaged and free of corrosion (trigger connectors are located behind the ignition plate).
- Check that electrical components are grounded to the ignition plate and that ignition plate is grounded to the engine block.
- Check for disconnected wires, short and open circuits.

## Testing For Spark

1. Adjust spark tester to a  $7/16$ " gap setting.



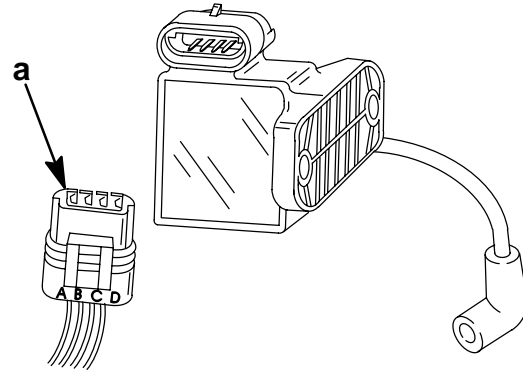
2. Secure spark tester to a good engine ground.
3. Remove leads from spark plugs.
4. Connect spark plug leads to corresponding spark tester leads.
5. Remove spark plugs.
6. Turn the ignition key to the "on" position.
7. Crank motor.

**NOTE:** Battery voltage must be a minimum of 10 volts at the starter solenoid to adequately crank the engine.

Results:	Action Required:
Spark jumps $7/16$ " gap (all cylinders)	Ignition system operational - If required, check timing & setup.

No spark	Go to next step.
No spark on 1 or 2 cylinders	Go to Ignition Diagnostic Procedures.

8. Disconnect all CDM plugs and verify that each ground lead has continuity to engine ground.



a - Each CDM ground wire is labeled "A".

9. Re-connect all CDMs.



10. Check that safety stop switch lanyard is in place. If safety lanyard is NOT in place, spark plugs will not fire.
11. Sport Jet Models Only: Isolate the rev limiter by disconnecting the black/yellow lead to the rev limiter. Tape back the black/yellow lead. Re-test for spark. If all cylinders spark, replace rev limiter. No spark: continue with next step.
12. Isolate the stop circuit by disconnecting black/yellow bullet connector located on the ignition plate wire bundle.

**IMPORTANT: Be sure this lead is not grounded.**

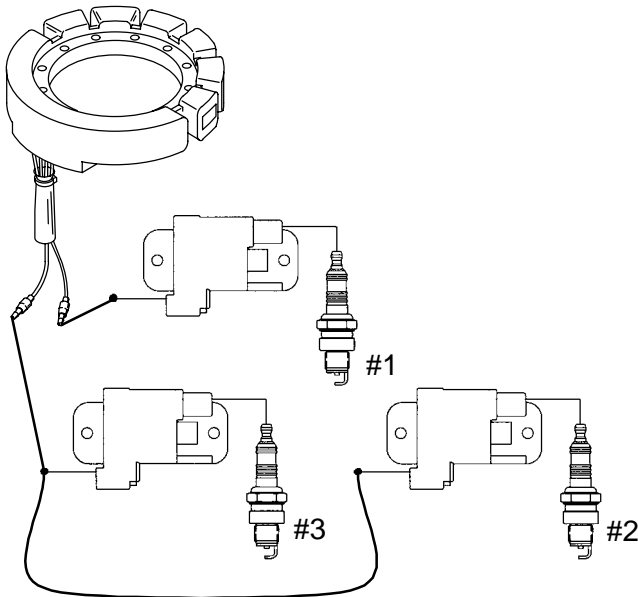
13. Crank motor.

Results:	Action Required:
All cylinders spark normally	Repair stop circuit: ignition key switch and/or boat wiring.
No spark (all cylinders)	Go to Ignition Diagnostic Procedures.

14. Re-connect rev limiter and/or stop circuit.

## 95 HP

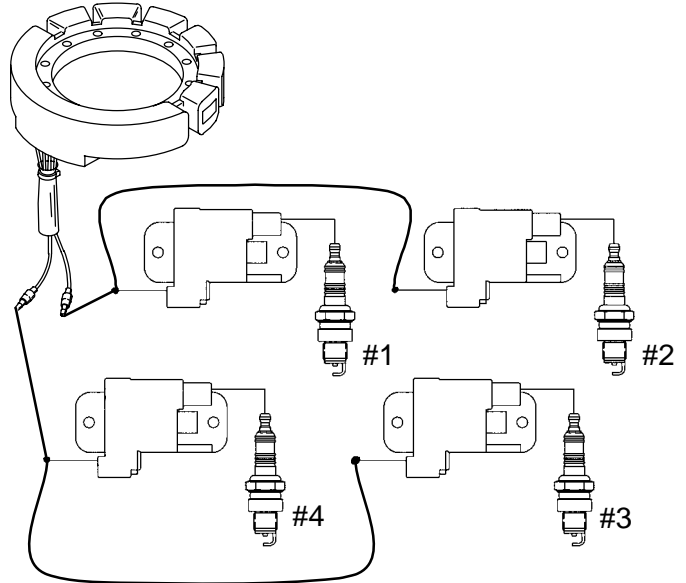
**IMPORTANT: The voltage return path for #1 CDM is through either #2 or #3 CDM. The return path for #2 and #3 is through #1 CDM. If the #1 CDM is disconnected the engine will loose fire on all cylinders as the capacitors cannot be charged.**



**NOTE: Each CDM is grounded through the engine wiring harness via the connector plug. It is not necessary to have the CDM mounted on the ignition plate for testing.**

## 120 HP

**IMPORTANT: The voltage return path for #1 and #2 CDM is through either #3 or #4 CDM. The return path for #3 and #4 is through either #1 or #2 CDM.**



## Ignition Diagnostic Procedures

PROBLEM	CORRECTION
1. No spark on one cylinder	<ol style="list-style-type: none"> <li>1. Plug in a CDM that is known to be good. If spark returns, replace bad CDM.</li> <li>2. No change: go to Testing Voltage Output to CDM.</li> </ol>
3. No spark on all cylinders	Go to Testing Voltage Output - Test all CDMs.

## Testing Voltage Output to CDM

### ⚠ CAUTION

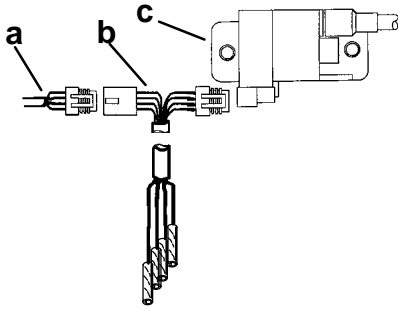
To protect against meter and/or component damage, observe the following precautions:

- **INSURE** that the Positive (+) meter lead is connected to the DVA receptacle on the meter.
- **DO NOT CHANGE** meter selector switch position while engine is running and/or being "cranked".

**NOTE: Each CDM is grounded through the engine wiring harness via the connector plug. It is not necessary to have the CDM mounted on the ignition plate for testing.**



1. Make sure all CDMs are plugged in.
2. Test Stator and Trigger voltage to CDM:
  - a. Install test harness between Ignition Harness and CDM.



- a - Stator/Trigger Harness  
 b - Test Harness  
 c - Capacitor Discharge Module <http://motorka.org>

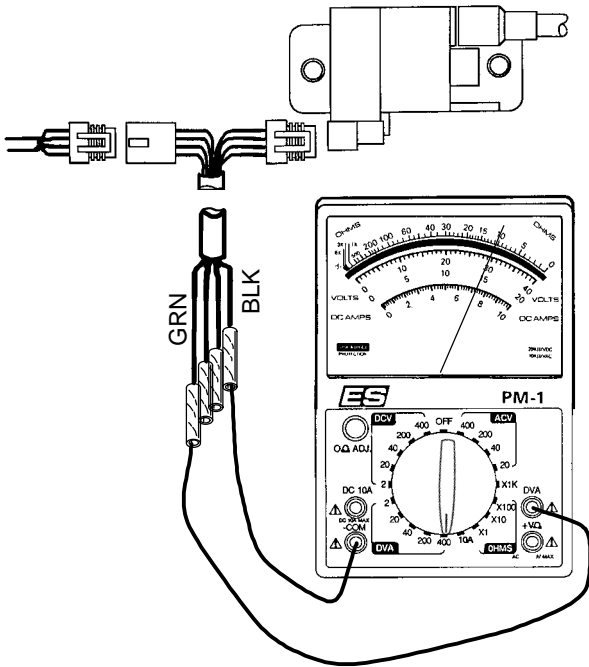
b. Perform the following tests:

**CRANKING ENGINE:**

Test each CDM.

Stator Output Test		400 DVA Scale
Positive Meter Lead (+)	Negative Meter Lead (-)	DVA Reading
Connect to Green Test Harness Lead	Connect to Black Test Harness Lead	100 - 350

If only one CDM stator reading is below specifications, replace that CDM. If all CDM stator voltage readings are low, go to Testing Stator Resistance.

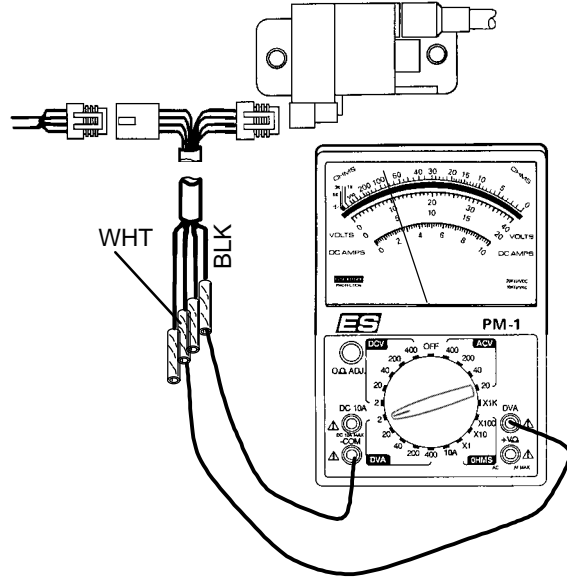


Test each CDM.

Trigger Output Test		2 DVA Scale
Positive Meter Lead (+)	Negative Meter Lead (-)	DVA Reading
White Test Harness Lead	Black Test Harness Lead	0.2 - 2.0

If reading is below specifications replace trigger. If reading is above specifications check CDM.

**NOTE:** If voltage remains low after installing a new trigger, replaced CDM.



**ENGINE RUNNING AT IDLE:**

It is not necessary to perform this test if the voltage output was tested in the previous step CRANKING ENGINE.

Stator Output Test		400 DVA Scale
Positive Meter Lead (+)	Negative Meter Lead (-)	DVA Reading
Connect to Green Test Harness Lead	Connect to Black Test Harness Lead	200 - 350

If stator output is low, go to Testing Stator Resistance.

Trigger Output Test		20 DVA Scale
Positive Meter Lead (+)	Negative Meter Lead (-)	DVA Reading
White Test Harness Lead	Black Test Harness Lead	2 - 8 Volts

If reading is below specifications replace trigger. If reading is above specifications check CDM.

**NOTE:** If voltage remains low after installing a new trigger, replaced CDM.

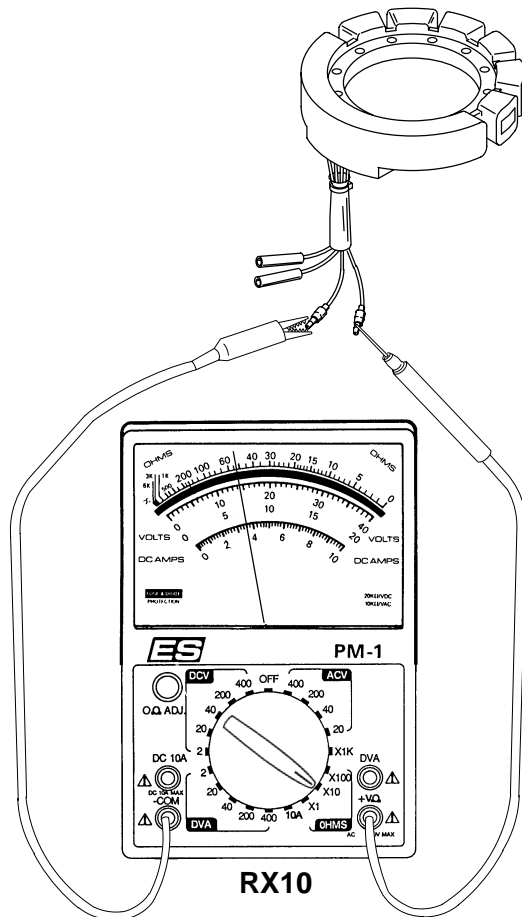


## Testing Stator Resistance - 95/120 HP

Disconnect stator leads.

Stator Resistance Test		R x 10 Ohms Scale
Positive Meter Lead (+)	Negative Meter Lead (-)	
Connect to White/Green stator lead	Connect to Green/White stator lead	500 - 600 ± 10%
Connect to White/Green stator lead	Connect to engine ground	No continuity
Connect to Green/White stator lead	Connect to engine ground	No continuity

**IMPORTANT:** If all CDM stator output voltage is low and stator resistance tests are within specifications, then each CDM (one at a time) must be replaced with a CDM known to be good until stator output voltage returns to proper levels. This process of elimination will reveal a defective CDM.

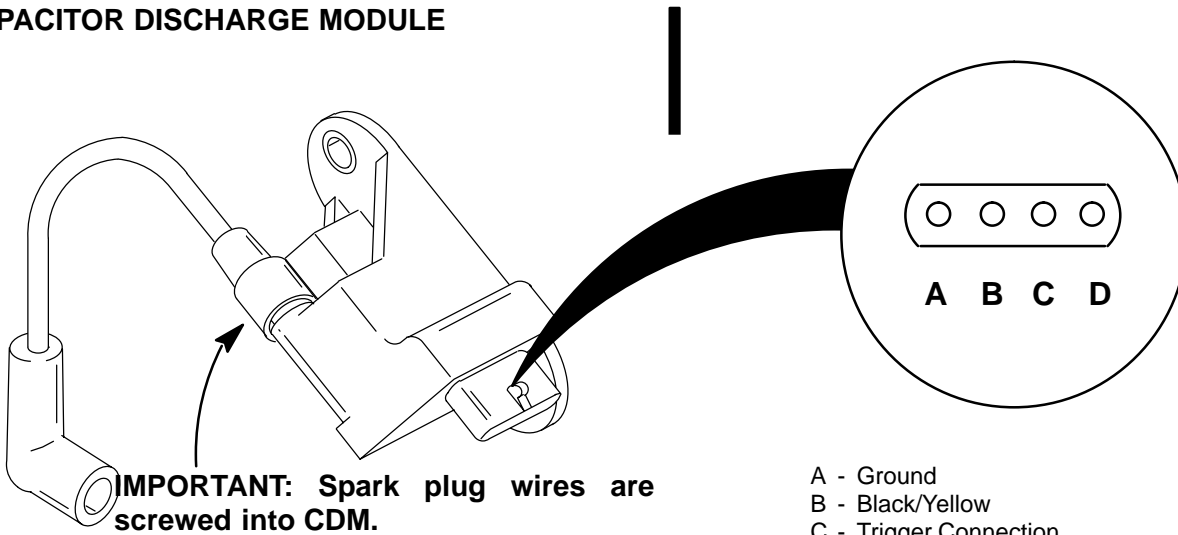


### TRIGGER - 95/120

A resistance test is not used on the trigger. Test trigger as outlined under "Testing Voltage Output to CDM".



## CAPACITOR DISCHARGE MODULE



- A - Ground
- B - Black/Yellow
- C - Trigger Connection
- D - Stator Connection

A resistance check, although not necessary for any troubleshooting procedure, can be made of the CDM as follows:

**NOTE:** This test can be performed using the test harness (p/n 84-825207A2). Do Not connect the test harness plug to the stator/trigger engine wire harness.

CAPACITOR DISCHARGE MODULE			
Connect Positive (+) Meter Lead To:	Connect Negative (-) Meter Lead To:	Ohms Scale	Results:
Ground Pin (A)/ or Black test harness lead	White (C)/ or White test harness lead	R x 100	1250 ± 100 Ohms
Green (D)/ or Green test harness lead	Ground Pin (A)/ or Black test harness lead	R x 1 Diode Reading*	Continuity
Ground Pin (A) or Black test harness lead	Green (D)/ or Green test harness lead	R x 1 Diode Reading*	No Continuity
Green (D)/ or Green test harness lead	Black/Yellow (B)/ or Black/Yellow test harness lead	R x 1 Diode Reading*	No Continuity
Black/Yellow (B)/ or Black/Yellow test harness lead	Green (D)/ or Green test harness lead	R x 1 Diode Reading*	Continuity
Spark Plug Terminal (At Spark Plug Boot)	Ground Pin (A) or Black test harness lead	R x 10	1050 ± 150 Ohms

\*Diode Readings: Due to the differences in test meters, results other than specified may be obtained. In such a case, reverse meter leads and re-test. If test results then read as specified CDM is O.K.. The diode measurements above will be opposite if using a Fluke equivalent multimeter.



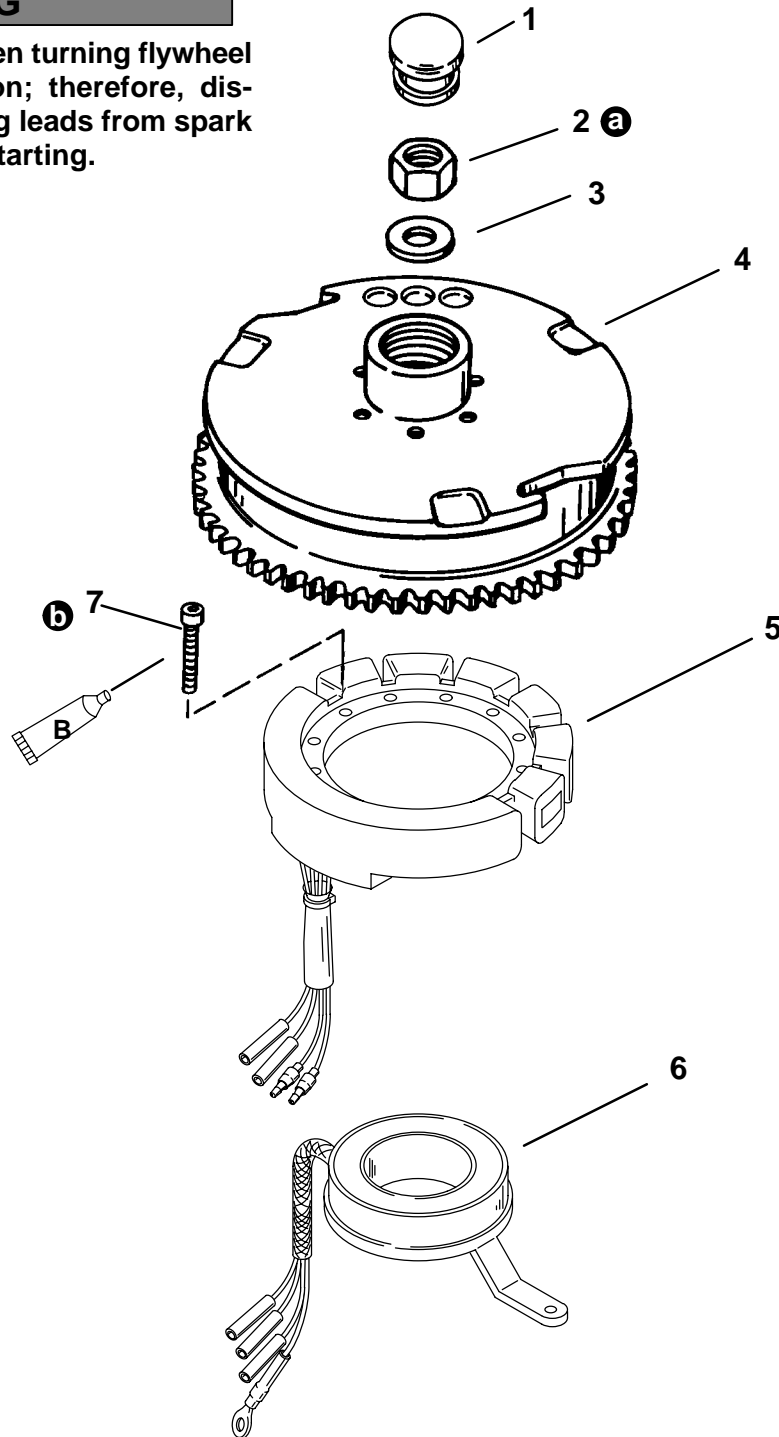


# Ignition Components Removal and Installation

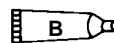
## **⚠ WARNING**

Engine could possibly start when turning flywheel during removal and installation; therefore, disconnect (and isolate) spark plug leads from spark plugs to prevent engine from starting.

- 1 - Cap, Plastic
- 2 - Flywheel Nut
- 3 - Washer
- 4 - Flywheel
- 5 - Stator
- 6 - Trigger
- 7 - Screw



## Quicksilver Lubrication/Sealant Application Points

 Loctite "271" (92-823089--1)

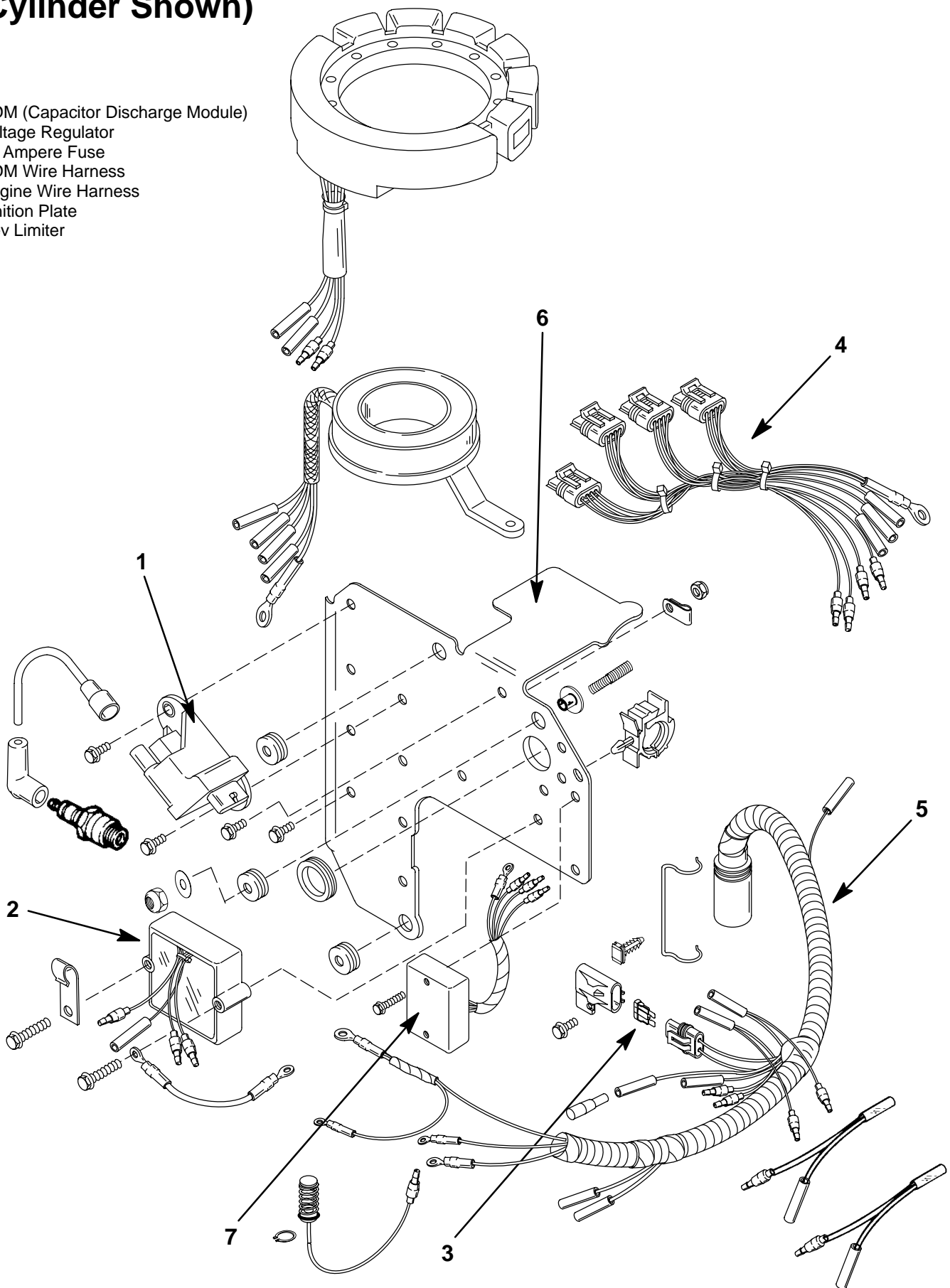
## Torque Specifications

- a** 125 lb. ft. (170 N·m)
- b** 50 lb. in. (5.6 N·m)



# Ignition Components Removal and Installation (4 - Cylinder Shown)

- 1 - CDM (Capacitor Discharge Module)
- 2 - Voltage Regulator
- 3 - 20 Ampere Fuse
- 4 - CDM Wire Harness
- 5 - Engine Wire Harness
- 6 - Ignition Plate
- 7 - Rev Limiter



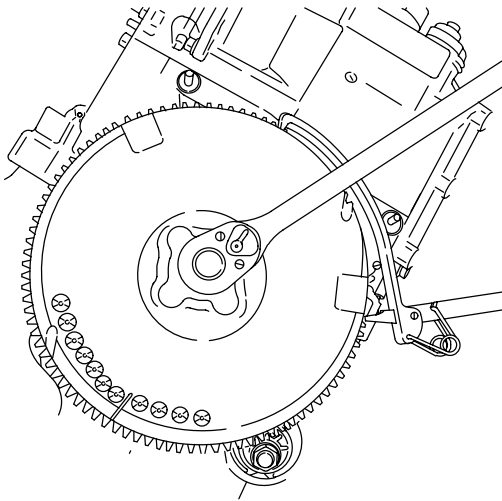


# Removing Flywheel

## ⚠ WARNING

Always disconnect battery and remove spark plug leads from spark plugs before working on motor.

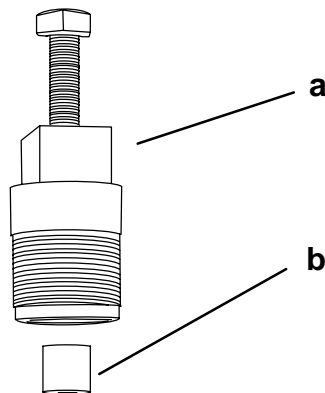
1. Remove flywheel guard.
2. While holding flywheel with Flywheel Holder (91-52344), remove flywheel nut and washer.



## ⚠ CAUTION

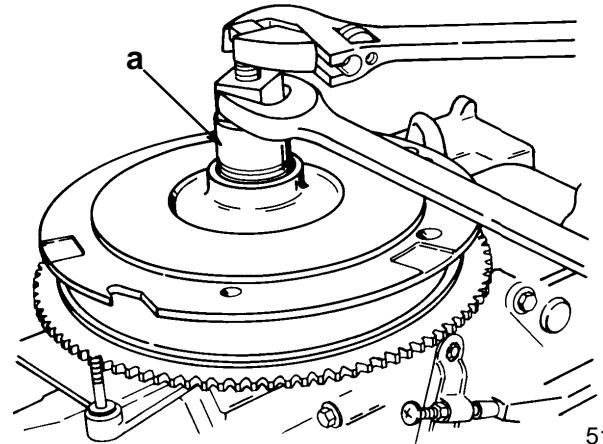
Crankshaft damage may result if a protector cap is not used between crankshaft and puller.

- Install a crankshaft Protector Cap (91-24161) on end of crankshaft, then install Flywheel Puller (91-73687A1) into flywheel.



a - Flywheel Puller  
 b - Protector Cap (Included in Flywheel Tool 91-73687A1)

- Hold flywheel tool with wrench while tightening bolt down on protector cap. Tighten bolt until flywheel comes free.

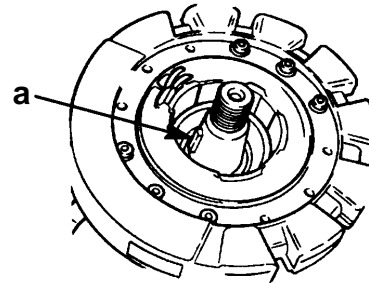


51124

a - Flywheel Puller (91-73687A1)

**NOTE:** Neither heat nor hammer should be used on flywheel to aid in removal as damage to flywheel or electrical components under flywheel may result.

- Remove flywheel. Remove flywheel key.



a - Flywheel Key

3. Inspect flywheel.
- Carefully inspect flywheel for cracks or damage.

## ⚠ WARNING

**A cracked or chipped flywheel must be replaced. At high RPM a damaged flywheel may fly apart and throw metal over a large area.**

- Inspect crankshaft and flywheel tapers for worn or damaged key ways.
- Check for loose or damaged flywheel magnets (outer rim and center hub).

*Arc burns on magnets are normal.*

- Replace flywheel if necessary.

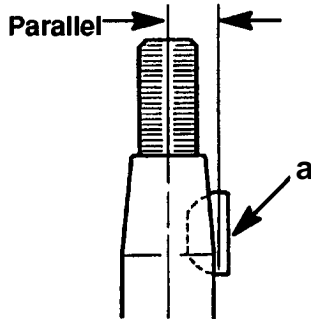


## Installing Flywheel

1. Clean tapered surfaces of flywheel and crankshaft with solvent.
  - Blow dry tapered surfaces with compressed air.

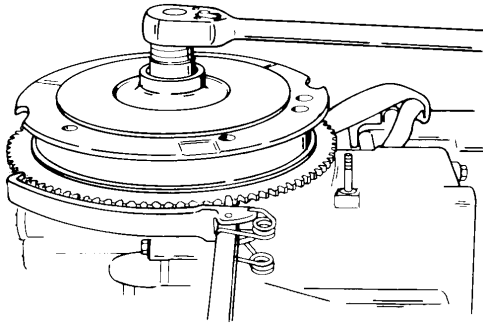
*If the flywheel key appears damaged in any way replace it.*

2. Install flywheel key in crankshaft slot with outer edge of key parallel to center line of crankshaft.



a - Flywheel Key

3. Install flywheel.
  - Place flywheel down over crankshaft.
  - Install flywheel nut.
  - Torque flywheel nut to 125 lb. ft. (169.5 N·m).

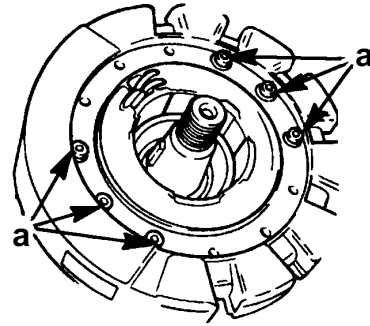


## Removing Stator

1. Remove flywheel.  
SEE "REMOVING FLYWHEEL" IN THIS SECTION.
2. Remove yellow stator leads from rectifier/regulator leads.
3. Disconnect all stator leads from CDM wire harness.

*Removal of ignition plate may be necessary to gain access to stator leads.*

4. Remove screws and lift stator off bearing cage.



a - Stator Screws

## Installing Stator

1. Set stator on bearing cage. Secure with screws.
 

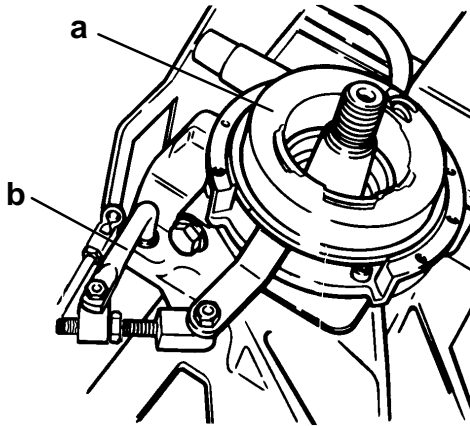
**IMPORTANT: Be sure the stator is positioned so the wire harness is on the port side of the motor.**
2. Connect yellow stator leads to yellow voltage regulator leads.
3. Connect all stator leads to corresponding CDM wire harness.
4. Install flywheel.

## Removing Trigger

1. Remove flywheel.  
SEE "REMOVING FLYWHEEL" IN THIS SECTION.
2. Remove stator.  
SEE "REMOVING STATOR" IN THIS SECTION.
3. Disconnect trigger leads from CDM wire harness.
4. Disconnect spark control link from tower shaft.



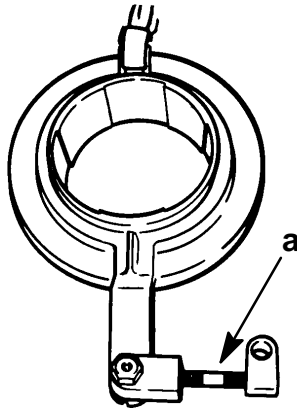
- Lift trigger off bearing cage.



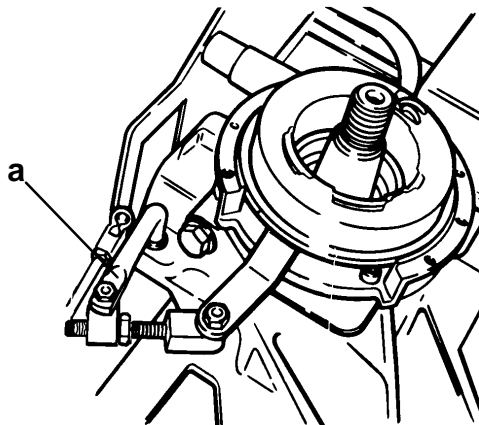
a - Trigger  
b - Spark Control Link

## Installing Trigger

- Install spark control link on new trigger.



- a - Spark Control Link
- Lubricate outer ring of trigger with grease.
  - Place trigger on bearing cage.
  - Secure spark control link to towershaft.



a - Towershaft

- Route lead wires under ignition plate and down to the CDM wire harness.
- Connect corresponding trigger leads to CDM wire harness.
- Install stator.

SEE INSTALLING STATOR IN THIS SECTION.

- Install flywheel.

SEE INSTALLING FLYWHEEL IN THIS SECTION.

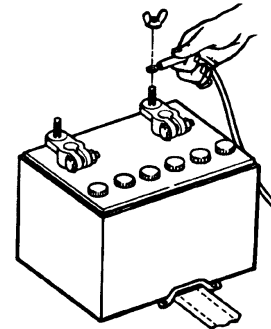
- Check engine timing.

SEE ENGINE TIMING IN THIS SECTION.

## Removing CDM (Capacitor Discharge Module)

### **⚠ WARNING**

Always disconnect battery and disconnect spark plug leads from spark plugs before working on motor.

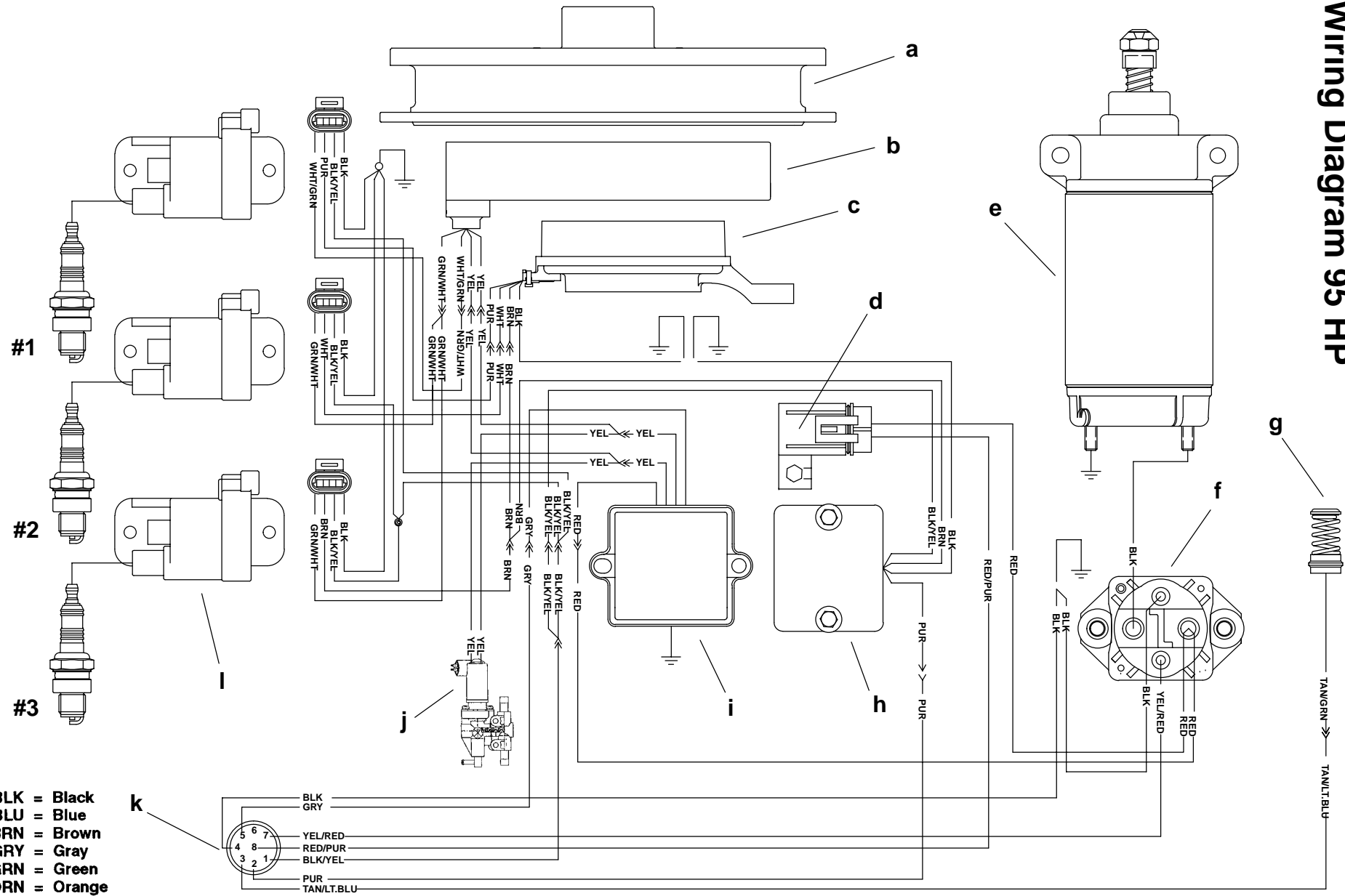


- Disconnect CDM wire harness plug.
- Remove screws securing CDM to ignition plate.

## Installing CDM

- Position CDM on ignition plate. Install screws.
- Connect CDM wire harness plug to CDM.

# Wiring Diagram 95 HP



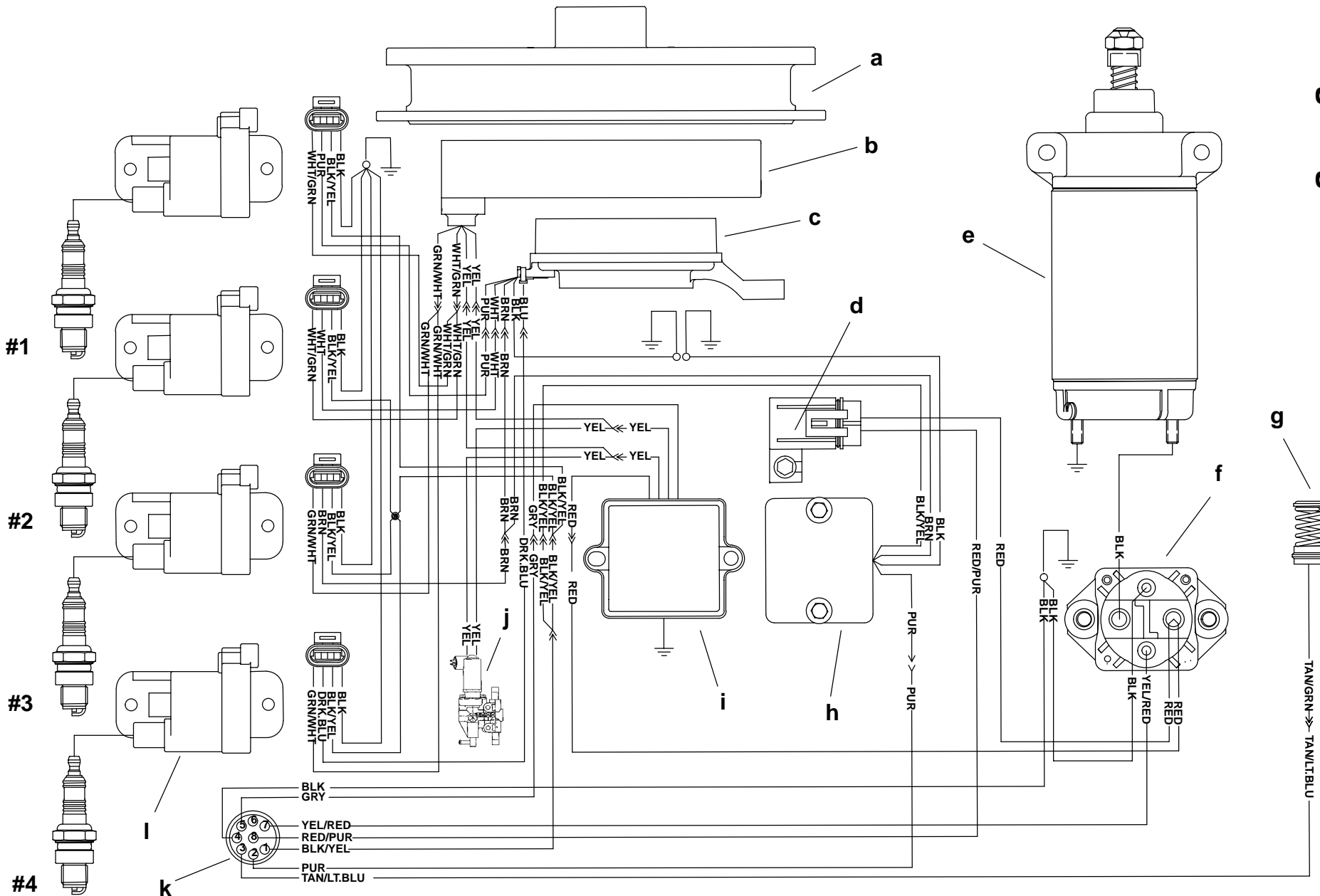
- BLK = Black
- BLU = Blue
- BRN = Brown
- GRY = Gray
- GRN = Green
- ORN = Orange
- PNK = Pink
- PUR = Purple
- RED = Red
- TAN = Tan
- WHT = White
- YEL = Yellow
- LIT = Light
- DRK = Dark

- a - Flywheel
- b - Stator
- c - Trigger
- d - 20 Ampere Fuse
- e - Starter Motor
- f - Starter Solenoid
- g - Cylinder Head Temperature Sender
- h - Rev. Limiter
- i - Voltage Regulator
- j - Turn Key Start Valve
- k - Engine Wire Harness Connector
- l - CDM (Capacitor Discharge Module)





# Wiring Diagram 120 HP



**BLK = Black**      **PUR = Purple**  
**BLU = Blue**      **RED = Red**  
**BRN = Brown**    **TAN = Tan**  
**GRY = Gray**      **WHT = White**  
**GRN = Green**    **YEL = Yellow**  
**ORN = Orange**   **LIT = Light**  
**PNK = Pink**      **DRK = Dark**

**a - Flywheel**  
**b - Stator**  
**c - Trigger**  
**d - 20 Ampere Fuse**  
**e - Starter Motor**  
**f - Starter Solenoid**  
**g - Cylinder Head Temperature Sender**  
**h - Rev. Limiter**  
**i - Voltage Regulator**  
**j - Turn Key Start Valve**  
**k - Engine Wire Harness Connector**  
**l - CDM (Capacitor Discharge Module)**