FireBall™

INSTALLATION INSTRUCTIONS for HI-4 MOTORCYCLE IGNITION

Part Number 8-2300

CAUTION: READ INSTRUCTIONS CAREFULLY BEFORE STARTING INSTALLATION

INTRODUCTION

The HI-4 ignition system is intended for use with Harley-Davidson® motorcycles. The HI-4 replaces the original equipment (OE) electronic ignition system on 1978 and later models as well as the points and mechanical advance on early models. The HI-4 offers switch selectable single and dual fire mode. The unit can initially be set to operate in dual fire mode with the OE coil. At a later time, the user can add a Crane single fire coil and switch the unit to single fire mode. In single fire mode, each cylinder is fired independently and only on the compression stroke. Single fire operation increases engine power at high RPM, improves starting, and reduces the likelihood of backfiring at low RPM.

The HI-4 features state-of-the-art RISC microcontroller technology that allows adjustable advance and RPM limit settings in 100 RPM increments. A timing LED indicates static timing (top dead center) and gives diagnostic information. A tach output gives accurate tach readings even at the rev limit.

A programming port together with optional PowerLink cable and software (P/N 8-2400) adds the ability to program individual custom advance curves to fine tune ignition system performance.

WARNING: 1996 and later models have a vehicle tilt sensor that shuts off the ignition if the motorcycle rolls on its side. This feature is disabled when the HI-4 ignition is installed.

ADDITIONAL REQUIRED PARTS

FX series Big Twin® and XL series Sportster® models prior to 1984, FL series Big Twin® models prior to 1985, and all models with OE points will require OE timing rotor P/N 32402-83. This part is not included with the HI-4 installation kit and can be purchased from your local dealer.

COIL AND SPARK PLUG CABLE CONSIDERATIONS

Coils used with the HI-4 must have at least 2 ohms primary resistance. Coils with 4 ohms or higher may be used, but may not produce optimum output. We recommend the following coils depending on application:

Dual Fire. Use hookup shown in Figure 5. You can use the OE coil. However, the Crane 8-3006 coil will provide optimum performance and output. The Crane 8-3006 will fit all stock mounting locations.

Single Fire With Single Plug Heads. Use hookup shown in Figure 6. Use Crane 8-3005 coil. This is a "Siamese" coil with two independent sections and will fit in the stock mounting location on most H-D® motorcycles. You can also use two dual spark tower coils and ground one of the towers on each coil to the engine case or frame. You will have to fabricate a bracket to mount the second coil.

Single Fire With Dual Plug Heads. Use hookup shown in Figure 7. Use two Crane 8-3006 coils. You will have to fabricate a bracket to mount the second coil.

Crane FireWire spiral core wires are recommended for maximum performance. Do not use solid copper spark plug cables; they may cause interference with your ignition system and accessories.

REMOVAL OF POINTS IGNITION - EARLY MODELS PRIOR TO 1978

1. Turn ignition switch off and disconnect battery ground cable. Disconnect wire going from breaker points to Coil – (negative) terminal.
2. Refer to Figure 1. Remove ignition cover plate, gasket, and hardware (items 1-3). Save these items for later re-use.
3. Note location of breaker plate. There is a V notch in the breaker plate used for alignment. When you install the HI-4, align the V notch in the same location. This should set the timing close enough to

CRANE Cams®
The Leader in Performance Technology
530 Fentress Boulevard, Daytona Beach, FL 32114
Tech Line: (386) 258-6174 Fax: (386) 258-6167
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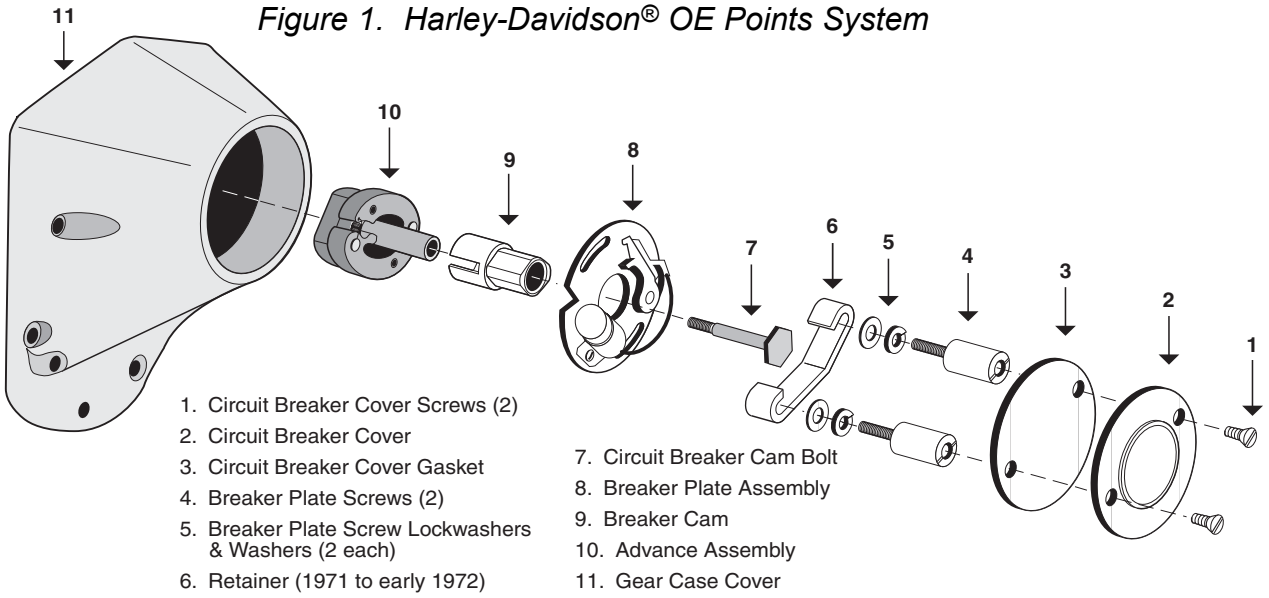
Figure 1. Harley-Davidson® OE Points System



1. Circuit Breaker Cover Screws (2)
2. Circuit Breaker Cover
3. Circuit Breaker Cover Gasket
4. Breaker Plate Screws (2)
5. Breaker Plate Screw Lockwashers & Washers (2 each)
6. Retainer (1971 to early 1972)
7. Circuit Breaker Cam Bolt
8. Breaker Plate Assembly
9. Breaker Cam
10. Advance Assembly
11. Gear Case Cover

start the engine. Remove and save the two standoffs and washers (items 4-5). Remove the breaker plate assembly, wiring, cam, and advance assembly (items 6-10).

REMOVAL OF OE ELECTRONIC IGNITION SYSTEM - 1978 AND 1979 MODELS

1. Turn ignition switch off and disconnect battery ground cable.
2. Refer to Figure 2. Disconnect wires going from ignition module (item 3) to coil (14).
3. Remove ignition cover plate and hardware (items 1 and 2). Save these items for later re-use. Remove ignition module (3).
4. Note location of timer plate (10). There is a V notch in the timer plate used for alignment. When you install the HI-4, align the V notch in the same location. This should set the timing close enough to start the engine. Remove and save the two standoffs and washers (items 4-5). Remove the sensor, shield, timer plate, trigger rotor, and advance assembly (items 6-12).

REMOVAL OF OE ELECTRONIC IGNITION SYSTEM - 1980 AND LATER MODELS

1. Turn ignition switch off and disconnect battery ground cable.
2. Refer to Figure 3. Remove OE ignition module and wire harness (items 1-4). You will disconnect two wires at the coil, a wire going to the VOES (Vacuum Operated Electrical Switch), ans a ground wire at the module, and the 3 pin plug (20) that connects to the sensor plate. Refer to shop manual for locations.
3. Remove ignition cover plates and gasket (items 5-9). This will require drilling out two rivets. The rivets will later be replaced with two supplied self threading screws.
4. In order to remove the sensor plate cable, the cable plug (20) must be removed first. Use needle nose pliers to pull the terminals out of the plug. Then pull the cable through the exit hole at the bottom of the timing cover.
5. Note location of sensor plate (11). There is a V notch in the sensor plate used for alignment. When you install the HI-4, you should align the V notch in the same location. This should set the timing close enough to start the engine. Remove and save the two standoffs and washers (10). Remove the sensor plate (item 11).

HI-4 INSTALLATION

Refer to Figure 4. The HI-4 requires OE timing rotor P/N 32402-83. Check your rotor (9) for correct part number. For models prior to 1980, use the supplied 10-32 x 3/4" bolt and washer to mount the rotor.

1. Install HI-4 system in place of OE breaker or sensor plate. Rotate the HI-4 about 90 degrees to give better access to the cable exit hole in the gear case cover. On some early models and Sportsters, it will be necessary to enlarge this hole. Install the HI-4 first, then push the cable through the hole. Align the V notch on the HI-4 same as the OE plate you removed. Use the OE standoffs to secure the HI-4. You must use lock washers under the standoffs for proper clearance between the HI-4 and cover

Figure 2. Harley-Davidson® 1978-79 OE Electronic System

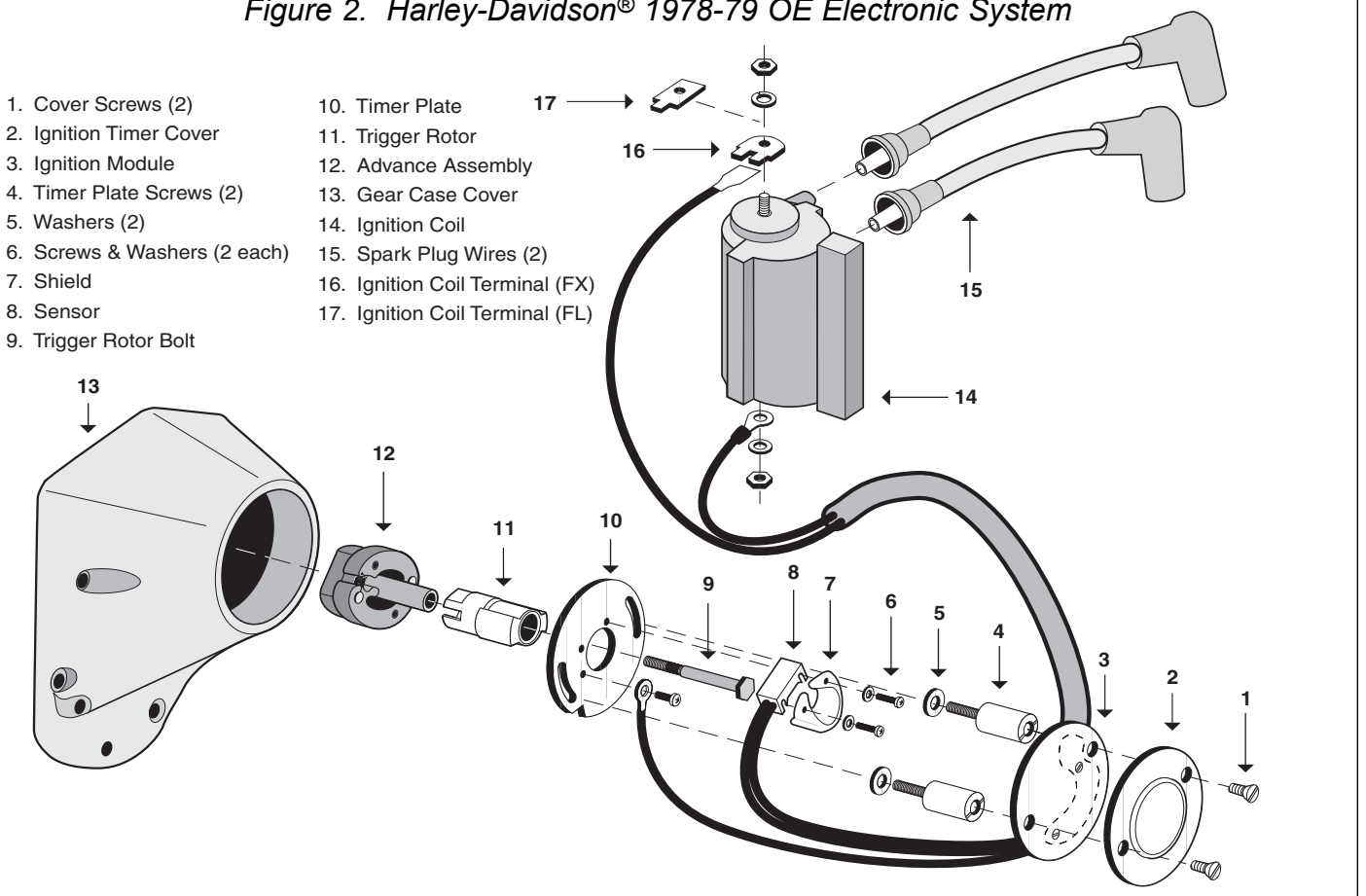


plate. Do not fully tighten the standoffs until the timing has been set.

2. Route the HI-4 harness along the frame rails to the coil. Make sure that harness will not be chafed or burned by exhaust heat. Secure harness with tie wraps. Do not install timing cover.

HI-4 HOOKUP

Crimp terminals and hardware are supplied for your convenience. Use the ring terminals for coil hookup. Use male-female quick disconnects for connections to the tach and vacuum switch (VOES). Tape up unused wires.

1. Identify switched +12 volt wire and tach wire (if equipped) going to the coil. Refer to your service manual, or reconnect the battery and use a test light or voltmeter. The switched +12 volt wire will be hot when the ignition key is turned on.

2 Refer to Figure 5, 6, or 7 depending on your application. Connect the HI-4 red wire and switched +12 volt wire to Coil+ (positive).

3. Connect the HI-4 black and white Coil- wires as shown. Note that the white wire is only used for single fire applications. Tape up white wire if unused.

4. Connect the HI-4 green wire to the vacuum switch (Figure 3, item 18), if used.

NOTE: Damage will result if the brown tach wire comes in contact with +12V.

5. Connect the HI-4 brown wire to the tach wire, if equipped with a tachometer. Tape up if unused.

6. The HI-4 is grounded by means of the timing housing; a separate ground connection is not required.

NOTE: Most motorcycle coils do not have terminals marked. Most single-fire coils use the center terminal for +12V and the outer two terminals for front and rear cylinder Coil-. For dual-fire coils use either terminal for Coil+ and the other one for Coil-.

7. Reconnect battery ground cable. Verify proper ground connections to the frame and engine.

Figure 3. Harley-Davidson® 1980 and Later OE Electronic System

1. Screws (2)
2. Washers (2)
3. Ignition Module
4. Well Nuts (2)
5. Rivets (2)
6. Outer Cover
7. Inner Cover Screws (2)
8. Inner Cover
9. Gasket
10. Sensor Plate Screws & Washers (2 each)
11. Sensor Plate
12. Rotor Screw & Star Washer
13. Rotor
14. Gear Case Cover
15. Ignition Coil
16. Ignition Coil Terminal
17. Spark Plug Wires (2)
18. Vacuum Operated Electrical Switch (VOES)
19. VOES Connector
20. Sensor Connector

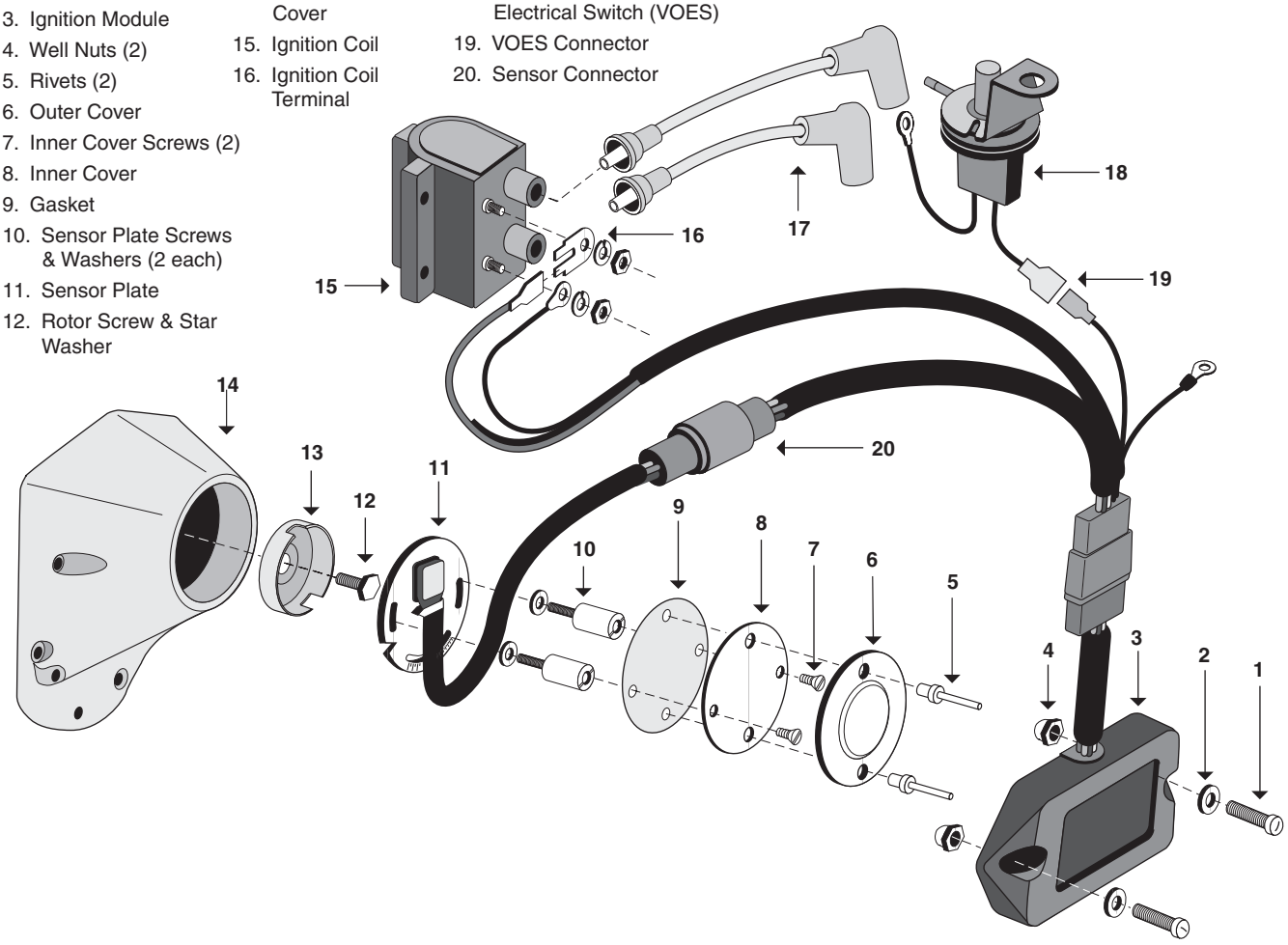


Figure 4. HI-4 Ignition System Installation

1. Buttonhead Screws (2)
2. Outer Cover
3. Inner Cover Screws (2)
4. Inner Cover
5. Gasket
6. Sensor Plate Screws & Washers (2 each)
7. HI-4 Unit
8. Rotor Screw & Star Washer
9. Rotor
10. Gear Case Cover

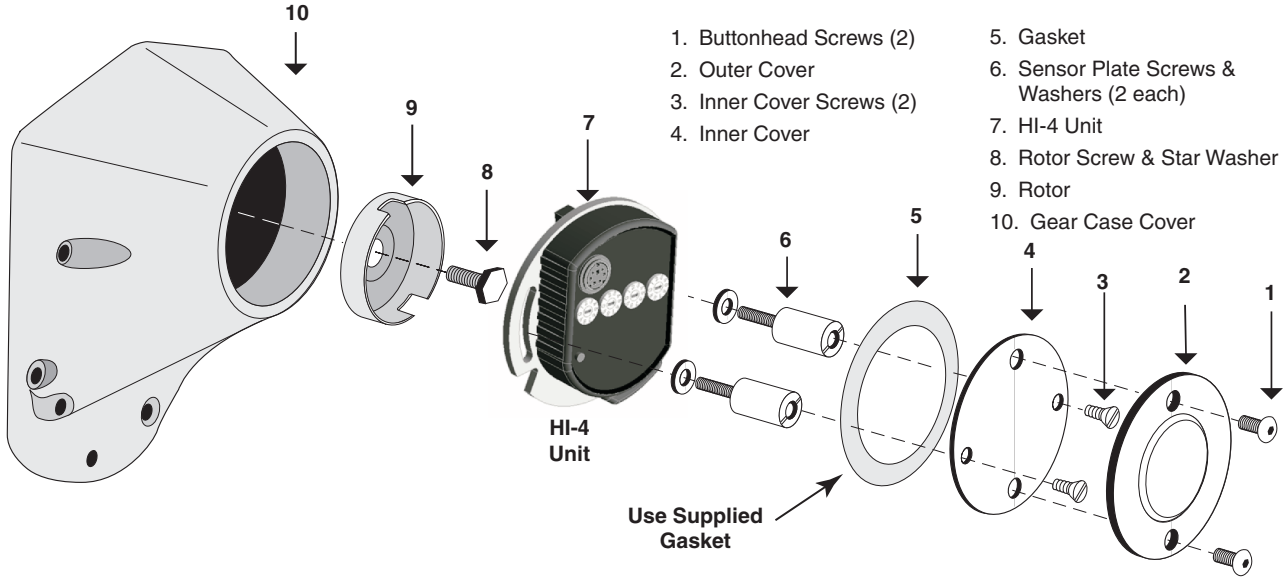


Figure 5. HI-4 Dual Fire System Hookup

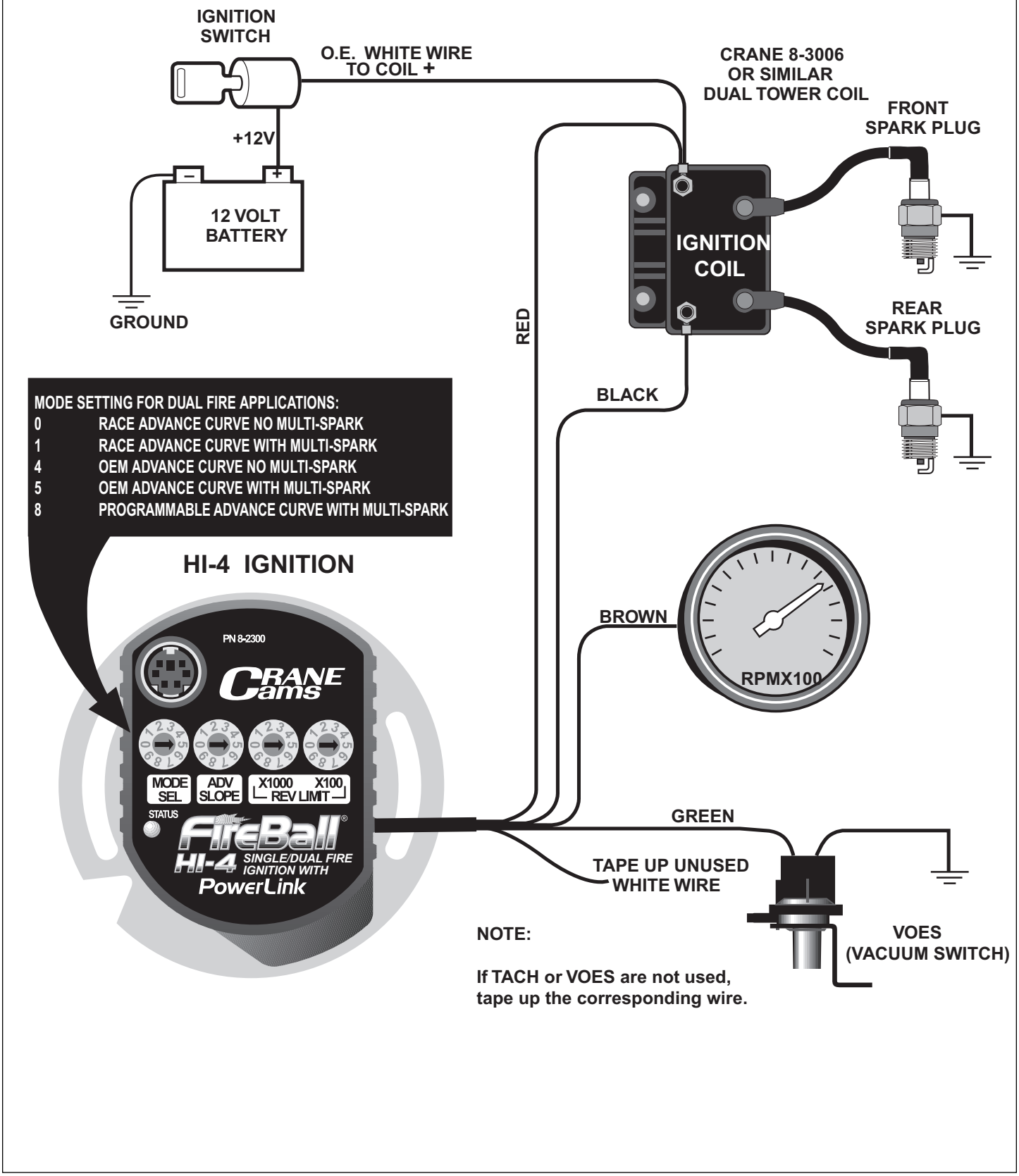


Figure 6. HI-4 Single Fire System Hookup with Single Plug Heads

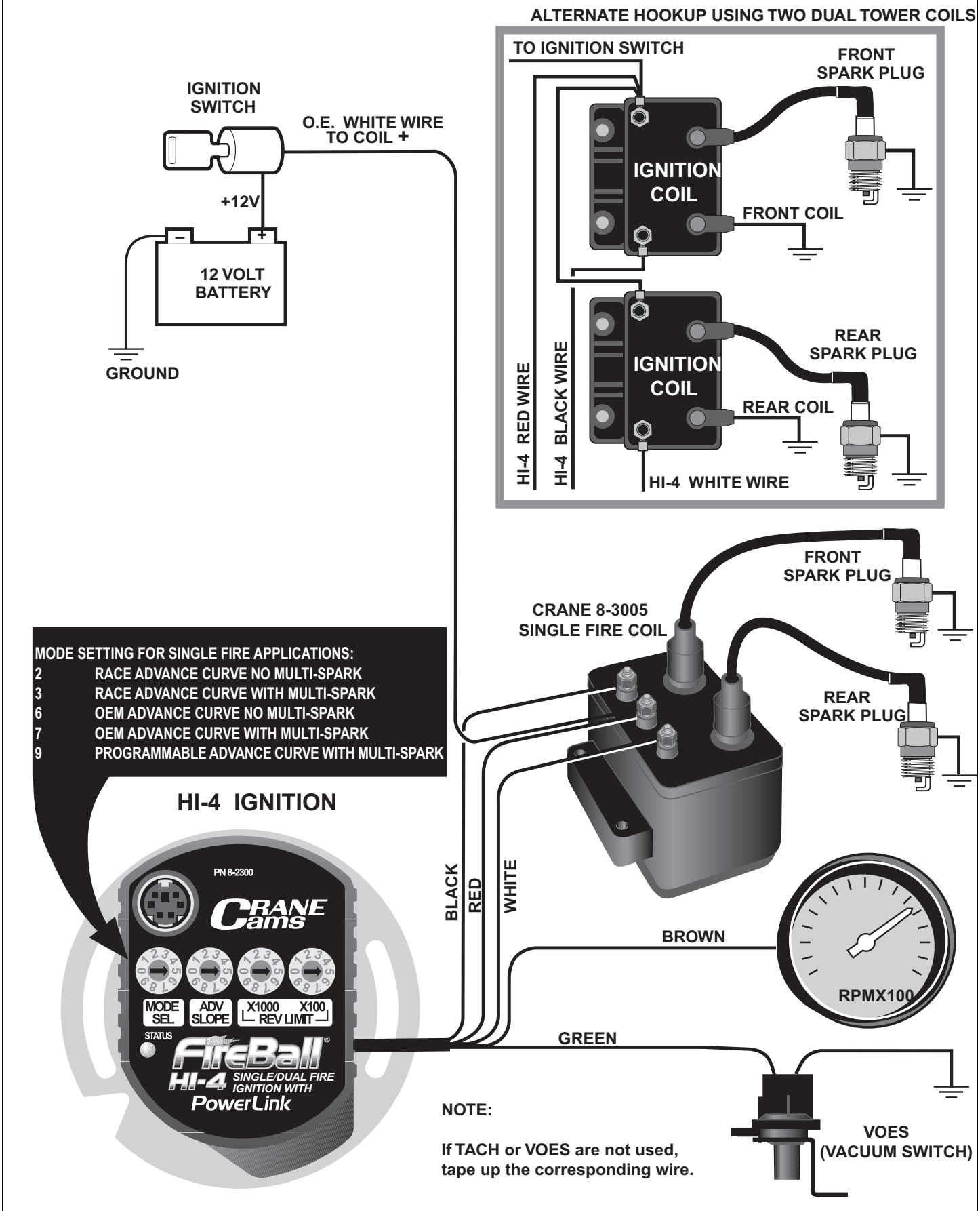
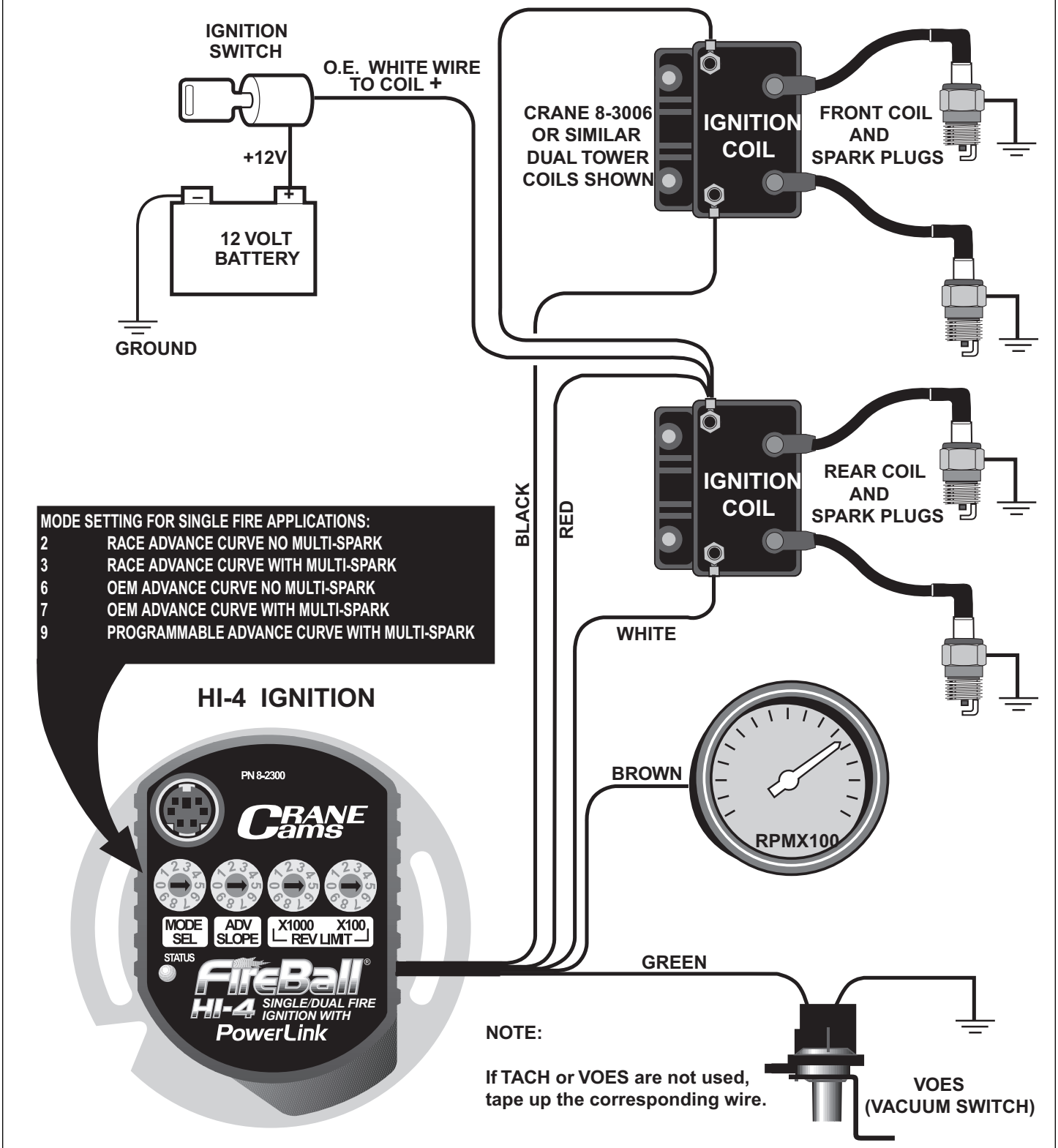


Figure 7. HI-4 Single Fire System Hookup with Dual Plug Heads



VOES HOOKUP

The OE vacuum switch (VOES) is normally an open circuit. Above 3-5 inch-Hg vacuum, the VOES closes and grounds the vacuum input on the OE module. This increases the total advance generated by the OE ignition module. Vacuum advance improves part throttle driveability and fuel economy. Connect the VOES to the HI-4 green wire as shown in Figures 5, 6, or 7.

NOTE: 1996 and later models use a 2 wire connector between the VOES and the OE harness. Connect one wire from the VOES switch to frame ground and connect the other wire to the VOES input (green wire) on the HI-4.

MODELS WITHOUT OE VACUUM SWITCH (VOES)

This includes most models prior to 1985. Fuel economy and driveability will be improved if you install a VOES and connect it to the HI-4 green wire as shown in Figures 5, 6, or 7. We recommend you use H-D® VOES P/N 26566-91. If the VOES is not used, tape up the green wire.

HI-4 SETUP AND OPERATION

Refer to the label on the HI-4. The unit has four rotary switches used to select operating mode, advance curve, and RPM limit.

Mode Select. This switch selects single or dual fire mode, multi-spark, and the advance curve family. Mode switch settings are as follows:

0 Race advance curves, dual fire, no multi-spark

1 Race advance curves, dual fire, multi-spark

2 Race advance curves, single fire, no multi-spark

3 Race advance curves, single fire, multi-spark

4 OEM advance curves, dual fire, no multi-spark

5 OEM advance curves, dual fire, multi-spark

6 OEM advance curves, single fire, no multi-spark

7 OEM advance curves, single fire, multi-spark

8 Programmable advance curves, dual fire, multi-spark

9 Programmable advance curves, single fire, multi-spark

The mode switch setting must match the wiring hookup or the engine will not run. For example, if you have a dual fire coil hookup as shown in Figure 5, you can only use mode switch settings 0, 1, 4, 5, or 8. If you have a single fire coil hookup as shown in Figures 6 or 7, you can only use mode switch settings 2, 3, 6, 7, or 9.

Use the race advance curve family (mode switch settings 0-3) for high compression engines. Use the OEM advance curve family (mode switch settings 4-7) for stock and mildly modified engines. The race and OEM advance curves families are shown in Figures 8 and 9. Use mode switch settings 8 and 9 to select custom programmed advance curves. Adjusting these curves requires the optional PowerLink programming cable and software (P/N 8-2400). Use setting 8 for dual fire and 9 for single fire. The default curves that are programmed for settings 8 and 9 are identical to the low vacuum race advance curves.

Use multi-spark (mode switch settings 1, 3, 5, 7, 8 or 9) for optimum performance. Note that engines with very lean carburetor jetting may exhibit excessive spark knock in multi-spark mode. This is the result of faster flame front growth and propagation when multi-spark mode is selected.

Advance Slope. The slope of the advance curve (race or OEM family as selected by the mode switch) is adjustable over a wide range. Advance curves are shown in Figures 8 and 9. Advance slope switch setting zero results in minimum advance. Switch setting 9 results in maximum advance. Switch settings 1 to 8 result in an advance curve that is in between the minimum and maximum curves shown in the figures. Higher switch settings result in a more aggressive slope above idle and more advance at high RPM. We suggest that you start with advance slope switch setting 5.

The advance slope switch selects the corresponding custom programmed advance curve when mode switch is set to either 8 or 9. The default custom programmed curves are identical to the low vacuum race curves. There is difference between low and high vacuum (VOES grounded) advance curves for these mode switch settings.

Note that the high vacuum (VOES grounded) race advance curve is fixed and not affected by the advance slope adjustment.

Stock and modified engines (mild cam, low restriction air cleaner, and aftermarket exhaust) may benefit from a more aggressive advance slope if 93 or higher octane gasoline is used. Race engines with high compression may require a less aggressive advance slope to eliminate spark knock.

Figure 8. OEM (with VOES) Advance Curves

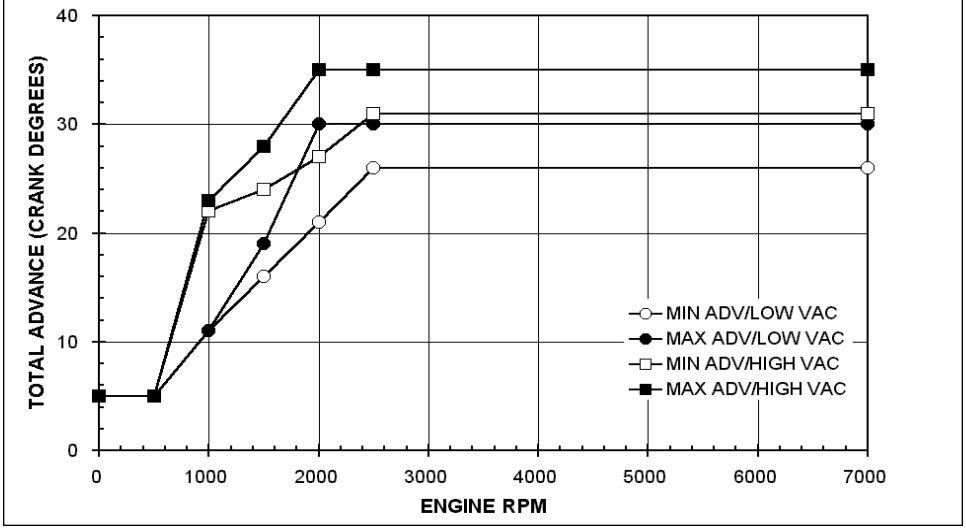
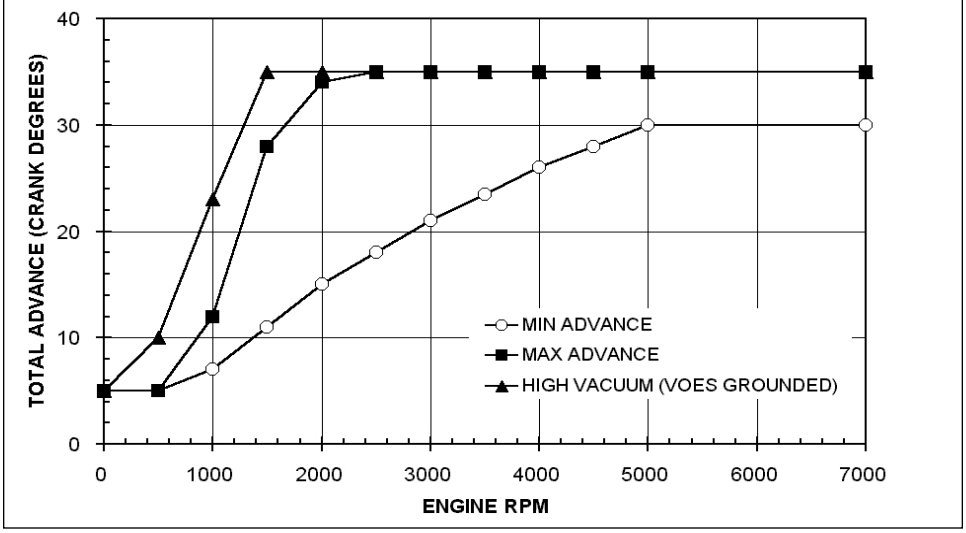


Figure 9. Race Advance Curves



NOTE: Do not use multi-spark when setting timing with a timing light. For setting timing with the HI-4, only use the timing mark at 35° BTDC. 1995 and later models may have a timing mark at 20° BTDC for setting the timing with the OE ignition module. Do not use this mark for setting the timing on the HI-4. In most cases an additional mark will remain at 35° BTDC (see

You can also adjust the initial timing by rotating the entire HI-4 unit relative to the gear housing. For example, if knock occurs only at low RPM, you could reduce the initial timing but maintain a relatively aggressive advance slope for maximum power at midrange and high RPM.

Used together, initial timing and advance slope adjustments provide a high degree of flexibility for fine tuning a particular engine setup. As a general rule of thumb, use the highest settings possible without audible spark knock.

PowerLink Software Exclusive Features. A VOES offset from 0 to 5 degrees generates the high vacuum (maximum) curve when the programmable advance curves are used. The minimum (low vacuum) curve is created using the Powerlink software and cable (P/N 8-2400). The high vacuum curve is then generated from this low vacuum curve plus the VOES offset for every RPM value above 1000. A rear cylinder offset from -4 to +5 degrees can be programmed individually for each of the 10 programmable advance curves. This feature allows slight offset of rear cylinder timing for critical race applications. Normally, the rear cylinder offset should be set to zero (midrange).

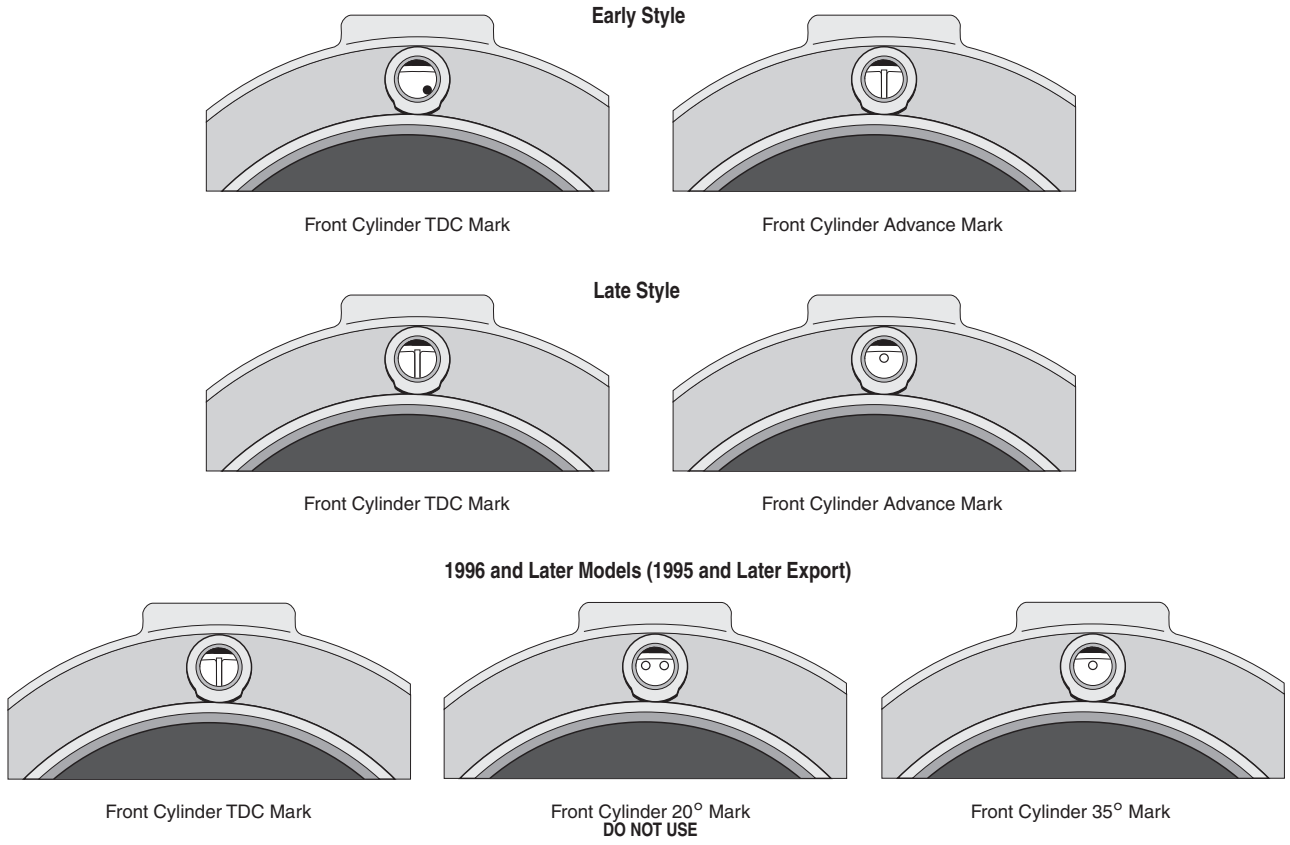
RPM limiter. Two rotary switches are used to digitally set the RPM limit from 1,500 to 9,900 RPM in 100 RPM increments. Settings are X100 engine RPM (i.e. 59 = 5,900 RPM. Select a safe RPM limit that is less than the red line for your engine. Most H-D® engines with OE valvetrain parts should not be revved over 5,600 RPM.

The HI-4 timing LED should light up when the ignition key is turned on. The timing LED will go off when the crankshaft is rotated past TDC. During cranking, the LED will blink.

TIMING MARKS

The TDC and advance timing marks are located on the flywheel and can be observed via an inspection hole (refer to shop manual for details). Refer to Figure 10 for typical timing marks. Early Style includes most 1980 and earlier models. Late Style includes most 1981-95 models. If the shop manual is not available, remove spark plugs, turn engine until front piston is at TDC on compression stroke and identify TDC mark on the flywheel. Refer to Figure 10 and find the diagram with a matching TDC mark. Use the corresponding advance mark shown in the diagram.

Figure 10. Front Cylinder Top Dead Center (TDC) and Advance Marks for Various Models



INITIAL STATIC TIMING PROCEDURE

In most cases, aligning the V notch on the HI-4 plate to the same location as the OE plate will set the timing close enough to start the engine. If the engine will not start or runs very rough, you can use the following static timing procedure.

Remove spark plugs and turn engine until TDC mark appears in observation hole on compression stroke. Ground spark plugs with an alligator clip so you will not shock yourself. Turn on ignition. Loosen the standoffs holding HI-4 and rotate unit clockwise until timing LED goes out. The point at which LED goes off is TDC. Tighten the standoff screws. Timing is now set approximately at TDC. Turn off ignition and reinstall spark plugs. Once the engine has been started, you must set the timing with a timing light.

NOTE: Make sure that your dial-back timing light is compatible with H-D® engines, otherwise you will get a false reading. Most dial-back timing lights will not work with dual fire systems. Check with the manufacturer of the timing light to be sure.

SETTING ADVANCE TIMING USING STANDARD TIMING LIGHT

This timing procedure requires that a VOES switch be connected to the HI-4. For racing and early points applications without a VOES switch, you must ground the VOES input (HI-4 green wire) while setting the timing with this procedure. Connect a timing light to the front cylinder. Use advance slope switch setting 9 during this procedure. Run the engine at 2,400 to 2,600 RPM. Adjust HI-4 position until advance timing mark is centered in the observation hole. Tighten the standoffs and verify that timing has not shifted.

SETTING PRECISE ADVANCE TIMING FOR RACING USING DIAL BACK TIMING LIGHT

Determine the maximum advance that you want at wide open throttle and high RPM. Use a dial-back timing light. Set the amount of advance you want, say 30 degrees, on the dial-back timing light. Connect the dial-back timing light to the front cylinder. If the VOES is used,

disconnect the VOES input (HI-4 green wire) while setting the timing with this procedure. This simulates wide open throttle. Use advance slope switch setting 9 during this procedure and run engine at 2,500 RPM. Adjust ignition position until the TDC timing mark is centered in the observation hole. Tighten the standoffs and verify that timing has not shifted.

Your engine will now run the maximum advance that you dialed into the timing light. You can then use the advance slope switch to control the RPM at which your new maximum advance is reached.

ADVANCE CURVE SETUP

After you have set the timing as explained above, set the HI-4 advance slope switch to the desired setting.

COVER PLATE ASSEMBLY

You can re-use the OE hardware, except use the supplied Crane gasket to provide proper clearance for the HI-4. For models with a riveted outer cover, use the supplied self-threading screws in place of the rivets.

POWERLINK CABLE AND SOFTWARE

The 8 pin mini-DIN connector on the front of the HI-4 is intended to be used with optional Crane Powerlink cable and software (P/N 8-2400). Powerlink will allow you to use a laptop or PC to program custom advance curves into the HI-4 ignition.

TROUBLESHOOTING

Did the engine run properly before installation of the HI-4? If not, remove the HI-4, reinstall the OE ignition or another known good unit and then find and correct the original problem. Did the HI-4 function correctly before the problem occurred? If the answer is yes, did you change anything that may have affected it? Try going back to the last setup that worked OK to help isolate the problem.

WARNING: Never crank the engine with any spark plug wire disconnect-

If the engine will not start, or runs rough or intermittently, use the following checklist steps:

ENGINE WILL NOT START

1. Check that timing LED lights up when ignition key is first turned on. If not, check for +12 volts on red wire from HI-4. Try jumpering the red wire direct to +12 volts at the battery.
2. Check that timing LED blinks while engine is cranked. If not, HI-4 may be defective.
3. If the timing LED blinks, but engine will not start, recheck all wire harness connections or replace coil(s).
4. Check for low voltage from a faulty or marginal charging system and battery.
5. High compression engines and single fire installations may require a start boost relay (Crane P/N 8-3000) that provides full battery voltage to the ignition system.

CHECKING FOR SPARK

To crank the engine and check for spark, use a KD Tools test plug or H-D® tool HD-26792. These test plugs come with an alligator clip that must be attached to frame or engine ground. Use a length of spark plug wire to connect the test plug to the coil.

MISFIRE OR INTERMITTENT OPERATION

Field experience has shown that popping back through the carburetor, misfiring, and intermittent failure (especially after the engine gets hot) are usually not caused by electrical problems within the HI-4. Carburetor problems, fouled spark plugs, coil failure, and loose wire harness connections are the most common culprits. Verify that spiral core or suppression type spark plug wires and resistor spark plugs are being used.

TACH INOPERATIVE

If the tach is inoperative after installation of the HI-4, you may require a tach adapter. The HI-4 tach output is compatible with ground sensing tachs which includes most OE and aftermarket tachs. Some tachs require a high voltage trigger pulse. In this case, install Crane tach adapter P/N 8-2050. Note that the tach will read correctly at the rev limit only if it is connected to the brown wire from the HI-4. Damage to the HI-4 circuitry may have occurred if 12 volts was applied to the brown tach wire at any time.