THE LIGHT SPEED ENGINEERING™

PLASMA I CDI SYSTEMS
INSTALLATION AND OPERATION MANUAL

FOR FOUR AND SIX CYLINDER INSTALLATIONS

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CONGRATULATIONS ON YOUR PURCHASE OF A LIGHT SPEED ENGINEERING (LSE) PLASMA I CAPACITOR DISCHARGE IGNITION (CDI) SYSTEM.

YOU WILL NOW BE ABLE TO EXPERIENCE THE SIGNIFICANT ADVANTAGES OF DISTRIBUTORLESS HIGH ENERGY ELECTRONIC IGNITION IN FLIGHT PERFORMANCE AND EFFICIENCY.

TO ENSURE RELIABLE LONG TERM OPERATION, AND TO ACHIEVE THE FULL PERFORMANCE POTENTIAL, PLEASE READ THE ENTIRE MANUAL CAREFULLY, AND FOLLOW THE PROCEDURES.

SINCERELY,

KLAUS SAVIER, President LSE

NOTICE

Light Speed Engineering Plasma CD Ignition products are intended only for installation and use on aircraft which are licensed by the FAA in the "e*xperimental"* category pursuant to a Special Airworthiness Certificate, or aircraft which are the subject of a Supplemental Type Certificate for modifications which include Plasma ignition. All products must be installed and used in accordance with the current instructions from Light Speed Engineering which are available on the website at www.LightSpeedEngineering.com.

WARNING

Failure of the Plasma CD ignition system(s) or products, or improper installation of Plasma ignition systems or products, may create a risk of property damage, severe personal injury or death.

Though a system manual may be shipped with your order, the MOST CURRENT AND COMPLETE version of the INSTALLATION INSTRUCTIONS AND OPERATING MANUAL for each of our products is available on our website under "Manuals", or by calling Light Speed Engineering at 805-933-3299.

ALL SYSTEMS AND PRODUCTS MUST BE INSTALLED ACCORDING TO THE INSTALLMENT INSTRUCTIONS CONTAINED IN THE OPERATING MANUAL POSTED ON OUR WEBSITE.

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Section 1 INTRODUCTION

This manual covers all **4 and 6 cylinder** versions of the LSE ***PLASMA*** **CDI** Systems. Included herein is a description of concept and design philosophy, installation instructions, testing procedures, troubleshooting guidelines, and repair and warranty instructions for those systems.

The LSE ***PLASMA*** **CDI** System was designed to replace one or two magnetos on home built aircraft and in other aircraft for which a specific supplemental type certificate has been issued.

1.1 FEATURES AND OPTIONS

The LSE ***PLASMA*** **CDI** Systems have all the possible technical features you might want from a high performance ignition system for your aircraft. A ***PLASMA*** **CDI** systems can replace either one or both magnetos since the automatic spark retard to top dead center ensures reliable starting under all conditions, even when the engine is flooded. Even high compression fuel injected 6 cylinder engines start easily by hand or electric start.

LSE ***PLASMA*** **CDI** Systems provide optimum ignition timing for best performance under all conditions. The extremely wide timing curve extends from 15° to 42° degrees BTDC. Full retard for starting holds the timing back to TDC. After starting, the system advances according to RPM and manifold pressure. RPM information comes from the supplied sensor system, manifold pressure is supplied to the CD ignition module from your engine manifold pressure source.

For the ultimate improvement in performance and ignition reliability you can replace both magnetos with LSE ***PLASMA*** **CDI** Systems. In this case LSE recommends the installation of a standby battery as a backup to your electrical system. Due to the light weight of the LSE ***PLASMA*** **CDI** Systems a dual system with backup battery is still several pounds lighter than two magnetos. If two systems are installed, either or both tachometer outputs can be used.

Also, dual systems can be connected to each other such that each system knows if the other one is operating. If one of the two systems is turned off or has failed, the remaining system will automatically shift its timing curve to provide optimum engine performance with one system. The extremely wide operating voltage range, from 5v-35v allows hand starting long after the electric starter has stopped due to a low battery.

On aircraft with 24v systems no special considerations need to be addressed, just hook up the power leads to positive (+) and negative or ground (-) as you would with a 12v electrical system. There is no need to install an external noise filter capacitor on LSE ***PLASMA*** **CDI** Systems; they were designed from the ground up to operate in aircraft with radios.

The LSE ***PLASMA*** **CDI** System can be turned on and off at any time in flight without the risk of misfiring.

The system can be turned on by supplying power to its power lead via a toggle switch or, if this key option was installed (some Plasma I modules, all Plasma II Plus and all Plasma III systems only), by un-grounding a "P lead", just as you would with a magneto. Grounding this P lead will then shut the system off.

An optional digital timing display can be installed to monitor the current ignition timing. This output can also be used to supply a data acquisition system with timing information. Manifold pressure can also be monitored with the MP option.

The 25 pin "D" connector (Plasma I) or the 15 pin input connector (Plasma II, II+, and III) to the system is pre-wired with its trigger mechanism inputs and power inputs. Wiring required for use in optional features (Plasma I) should be added later. Plasma II Plus and Plasma III systems are supplied with a 15 pin output connector wiring pack for accessing the output features. Systems wired for reluctance sensor type trigger inputs are identified with a T in their serial number. Those with an H, for Hall Effect input, come with different connections. Refer to PLASMA CDI Electrical Connections (figure 1). Hall Effect versions get their timing input from a Hall Effect Sensor module which is installed in place of the magnetos or a Direct Crank Sensor mechanism which uses magnets in the flywheel for crankshaft position information. After 2000 All Plasma I systems use hall effect sensor technology.

Four and six cylinder systems share the same enclosures and most of the electronics. A 4 cylinder module can be upgraded to a 6 cylinder module by LSE and will fit into the same space, should you decide to change from a 4 to a 6 cylinder engine.

Coaxial leads are supplied as primary ignition wires with BNC connectors, ready to connect to the single electronic module. They must be terminated at the LSE provided ignition coils with standard spade connectors.

LSE PLASMA CDI Systems are designed using discrete logic in place of programmable memory or microprocessors, to avoid any potential problems from static discharges, minor lightning strikes or Single Event Upsets (SEU).

As with all electronic devices, their enemies are heat, moisture and vibration. This should be considered for the best installation of the system.

1.2 "TRIGGER COIL" CRANKSHAFT TRIGGER CONCEPT (sold before 2001)

The LSE *PLASMA* CDI System has solid state electronic circuitry with high reliability. There are no points to wear and no distributor to arc. As in today's state-of-the-art auto racing engines, reluctance sensors are mounted firmly on the engine block (Hall effect sensors since Jan. 2001), adjacent to the crankshaft or flywheel for precise firing. The flywheel carries a small bolt or otherwise ferrous metal piece which rotates past the trigger coils or hall effect sensors as in the newer systems.

The trigger coils sense the bolt and produce an electrical signal each time the bolt passes. This timing signal together with RPM and manifold pressure information is used to calculate the best timing of the spark in each cylinder. A second bolt is installed in the TDC position. The system will automatically fire when this second, more retarded bolt provides a signal during the starting process.

The 4 cylinder trigger coil system uses two equally spaced sensors (the 6 cylinder system uses three sensors) mounted on the supplied precision plate and firmly bolted to the crank case. This is the lightest, most reliable and cost effective method to provide accurate timing information to the system.

On any four cycle engine, regardless of the number of cylinders, only two trigger bolts are installed on the crankshaft, prop-extension or fly-wheel. However, the number of trigger coils changes with the number of cylinders.

A four cylinder engine requires two coils phased 180° apart to produce the two firing cycles per revolution. A six cylinder system requires three coils 120° apart to produce three sparks per revolution.

The mounting of trigger coils and bolts is critical for proper operation and is explained in detail in drawing 3a, 3b, or 3c. LSE provides accurate mounting plates for most engines. The installation must be tested with an automotive type, clip-on timing light before flight as described in Section Three.

1.3 HALL EFFECT MODULE

The Hall Effect sensor module (shown at left) is used in place of a magneto and is designed to make the installation extremely easy and more similar to magnetos. Two modules can be used to provide full trigger redundancy when two electronic ignitions are used.

A standard magneto gear from a **non impulse magneto** must be provided. A timing light is built into the module. The 9 pin "D" connector on the sensor module simply connects to the harness from the ignition module.

The Hall Effect sensor module should be removed every 50 hours and inspected for gear, bearing, and seal wear. After first inspection, inspect as necessary or at least every 100 hours by removing cover plate and checking for bearing and seal wear.

1.4 DIRECT CRANK SENSOR (sold after January 1, 2001)

Alternatively, the direct crank sensor system provides complete redundancy for single or dual Plasma CDI systems. This crank sensor concept requires removal of the flywheel for installation. Its reliability and performance is expected to be superior to that of the accessory case mounted Hall Sensor Module because of its lack of bearings, seals, and gears. All 6-cylinder versions purchased after January 1, 2001 use direct crank sensors.

The LSE ***PLASMA* CDI** System contains the following items. If any items are missing or damaged, contact LSE ***immediately***.

TRIGGER COIL SYSTEMS		**HALL EFFECT**	**DIRECT CRANK SENSOR SYSTEMS**	
4-cyl system	**6-cyl system**	**4-cylinder system**	**4-cylinder system**	**6-cylinder system**
1 PLASMA Ignition Module 2 dual ignition coils 2 High Tension Ignition Leads Electrical wiring and connectors 2 trigger coils 2 trigger bolts Trigger coil bracket 1 magneto hole cover plate & gasket 1-4" section Heat Shrink	1 PLASMA Ignition Module 3 dual ignition coils 3 High Tension Ignition Leads Electrical wiring and connectors 3 trigger coils 2 trigger bolts Trigger coil mounting plate 1 magneto hole cover plate & gasket 1-6" section Heat Shrink	PLASMA Installation Instr. 1 PLASMA Ignition Module 1 Hall Effect Sensor Module & gasket Wiring Harness 2 dual output ignition coils with mounting bracket 2 primary cables with BNC connectors and 4 spade terminals 4 High Tension Ignition Leads 4ea. Spark Plugs and Inserts	PLASMA Installation Instr. 1 PLASMA Ignition Module Crank Sensor circuit board & bracket 2 Trigger Magnets / Ignition System Wiring Harness 2 dual output ignition coils with mounting bracket 2 primary cables & 4 spade terminals 4 High Tension Ignition Leads 4ea. Spark Plugs and Inserts 1 magneto hole cover plate	PLASMA Installation Instr. 1 PLASMA Ignition Module Crank Sensor circuit board and bracket 2 Trigger Magnets per Ignition System Wiring Harness 3 dual output ignition coils with mounting bracket 3 primary cables and 6 spade terminals 6 High Tension Ignition Leads 6ea. Spark Plugs and Inserts 1 magneto hole cover plate

Section 2 INSTALLATION

It is important to locate antennas, receiving or transmitting, away from the engine and ignition systems. Signal noise is drastically reduced with distance. Any static noise emitted from the system is usually canceled by the squelch of the radio. Common aircraft radio systems are not affected by ignition noise.

SHIELDING: The wires supplied in the ***PLASMA*** **CDI** System kit are high quality ignition leads designed to transmit spark energy efficiently and to suppress ignition noise. Therefore, they usually do not need shielding. It is also necessary to use resistor spark plugs to avoid radio noise. High tension leads should be kept as short as possible. ADF and Strikefinder use may call for additional shielding.

2.1 FLYWHEEL

To verify proper operation of the ignition system, the timing must be checked with a timing light (strobe light) as described in **section 3.2**. Only use a simple strobe light that does not have a potentiometer or display. The Plasma CDI's wastespark ignition will give erroneous readings on these strobe lights. For this, the flywheel or prop-extension must be graduated with the proper timing marks. Also an indicator should be built to mount on the case center adjacent to the timing marks on the flywheel. Always use only the timing marks on the engine side of the flywheel.

NOTE: You may also send the flywheel to LSE for trigger bolt/trigger magnet and timing mark installation. The cost is $50 plus $10-20 for insured shipping.

LYCOMING ENGINES

TDC, 20 deg., and 25 deg. BTDC markings are stamped on the flywheel engine side by the factory. Add markings at 35 and 40 degrees. These markings should be duplicated 180 degrees out, to reference the other ignition coil timing. On 6 cylinder engines the factory timing marks should be duplicated twice, 120 deg. and 240 degrees from TDC.

If you are installing a direct crank sensor system, refer to section 2.3 for the installation of the trigger magnets on the flywheel.

ALL OTHER ENGINES

Apply the same concept to install timing reference marks on the propeller extension or spinner bulkhead.

(Section 2.2 "TRIGGER COILS" is only applicable to ***PLASMA*** **I CDI TRIGGER COIL SYSTEMS purchased before 2001. Trigger coil systems can be identified by a "-T" after the serial number.)**

2.2 TRIGGER COILS

Lycoming Engines

LSE provides trigger mounting plates ready to install to your Lycoming engine.

There are 5 different plates available depending on your engine model and size of flywheel used. The older generator flywheel has a pulley measuring 6.5 inches on the inside. It requires a 7° skewed mounting bracket to mount the coils closer to the case. This 7° offset must be considered when the trigger bolts are installed. *Refer to drawings 3a, 3b, or 3c.*

The trigger coil plates also come in two different sizes of bolt patterns:

1) The 0-235, 0-290 and early 0-320 cases use the smaller pattern.

2) Later 0-320s and 0-360 cases use the larger bracket.

Some very old engines do not have any bosses around the crankshaft main seal. In this case the trigger coil plate needs to be mounted from fabricated aluminum angles under the through bolts of the case.

TRIGGER COILS, LYCOMING ENGINES

Some later engines come from the factory with seal retainer plates installed. Here the LSE trigger plates are a direct replacement and will also act as a seal retainer.

4-CYLINDER BRACKET (FIGURE 3A OR 3B):

The alignment tabs (not available on 6 cylinder trigger coil plates) assure concentricity to the crankshaft and the "V" notch aligns with the seam in the case. After tapping the threads, trial-fit the bracket one more time, making sure that the alignment tabs contact the crankshaft and the "V" aligns with the seam of the case when the bolts are tightened.

Now break off the three inner centering tabs first **and then** the two outer control tabs. **This sequence is important as you might damage your crankshaft if you fail to break all three centering tabs off.** The outward pointing control tabs allow easy verification of the removal of the centering tabs. **DO NOT REMOVE THE OUTER CONTROL TABS UNLESS ALL THREE CENTERING TABS ARE REMOVED.**

Don't forget to set the clearance between trigger coils and bolts. There are 4 places to check on 4 cylinder engines and 6 places on 6 cylinder engines.

6-CYLINDER PLATE (FIGURE 3C):

Use an LSE supplied spacer, or a dial indicator for concentric installation of the mounting plate. Clock the mounting plate per drawing 3C.

CONTINENTAL ENGINES

LSE provides brackets for various Continental engines from 0-200 to TIO 550.

On the 6 cylinder engines a trigger bolt holder is installed under two of the propeller studs. Be sure the trigger coils are mounted concentrically around the crankshaft so the bolt clearance is equal to all trigger coils. Position the trigger coil plate and the trigger bolts such that the second bolt is adjacent to the core of one of the trigger coils when the crankshaft is at TDC.

The first bolt (in the direction of engine rotation) should then be adjacent to the core of the same trigger coil when the crankshaft is at 45° BTDC for engines with compression ratios of up to 8.5:1 and at 40° on higher compression engines. A small metal rectangle is the reference (core) on the trigger coils.

All 6 cylinder engines need 3 ignition pulses per revolution for the processor, thus the 120 degree spacing of the trigger coils on their mounting plate.

This plate is mounted to the engine case on 4 predrilled holes. The plate must be mounted concentrically to the crankshaft so that its ID fits around the crankshaft. Rest the plate against the shaft and fasten it to the case using existing 10/32 holes in the case. Mark the exact position of the plate on the case, and remove the plate to provide ¼" clearance from the shaft by enlarging the ID of the plate. If the plate overlaps onto the seal it will act as a seal retainer.

Install the trigger coil plate with the trigger coils and their spacers mounted facing forward. The trigger bolt bracket is mounted as shown under the top two nuts that fasten the propeller hub to the crank shaft when the crank shaft is in the TDC position.

The top trigger coil fires cylinder 1 and 2. If the crank is at TDC a trigger bolt must be installed adjacent to the center of that trigger coil. Drill and tap the bracket for the trigger bolts such that they align with the center of the coils. Rotate the crank backwards to 37 or 38 degrees BTDC and the other boss on the trigger bolt bracket should align with the same coil. Install the second trigger bolt in alignment with the trigger coil center.

Install trigger coils following the procedures outlined below.

TRIGGER COIL INSTALLATION PROCEDURES:

Mount the trigger plate to your engine per drawing 3a, 3b, or 3c. **Be sure to remove the alignment tabs (first, inner centering tabs then outer control tabs, in that order) from the plates before you run your engine.**

The trigger is a modified 10-32 AN bolt. It must protrude from the surface a minimum of 0.7" when locked by the jam nut to avoid false triggering at high RPM. The threads should be engaged 0.2" or more. Adjust the clearance between both bolts and all trigger coils to .025" ±.010".

If a trigger coil bracket is not available from LSE you may need to build your own. On 4 cylinder engines two trigger coils must be mounted firmly to the crank case, concentrically around the crankshaft such that a 10-32 bolt mounted to the crankshaft, flywheel, extension or spinner moves past the face of each trigger coil with a clearance of .025" ± .010". On 6 cylinder engines three coils are mounted with 120° spacing.

On all engines, the second bolt that moves past the trigger coil must be mounted across from the center of the coil when the crankshaft is at TDC. The first bolt is installed 40° or 45° ahead depending on compression ratio of your engine.

Refer to the LSE drawings 3a, 3b, or 3c for detailed information.

2.3 HALL EFFECT SENSOR MODULE INSTALLATION

To install the accessory case driven Hall Effect Sensor Module, please follow these instructions:

Install a magneto drive gear from a non-impulse magneto onto the shaft of the sensor module using the same woodruff key as well as the LSE supplied washer and locknut.

Fasten the gear in a soft jaw vise and tighten the supplied nut to 30 lbs/ft ensuring that the washer is centered on the shaft.

The module can be installed on either mag pad using standard clamps. Install all ignition system wiring except the BNC connectors on the ignition module.

Remove one sparkplug from each cylinder and turn the crankshaft to TDC #1 using the factory timing marks on the engine side of the flywheel.

Turn electrical power on and rotate the sensor module in the accessory case **counter-clockwise** until the **green light on the module case turns on and then off again**. Maintaining its position, fasten the sensor module with the toe clamps commonly used with Slick Magnetos.

This procedure positions the Hall Effect Module for engines normally timed at 25 degrees BTDC (usually standard compression ratio).

If your engine is normally timed at 20 degrees BTDC (usually compression ratios of 8.7:1 or higher), the timing must be retarded another 5 degrees. In this case, position the crankshaft to 5 degrees past TDC in the direction of rotation and use the procedure outlined above.

To ensure the timing is set correctly, LSE recommends that you check the timing using an automotive strobe light. Please refer to section 3.2: “Timing Light Hookup and Tests” for details.

The Hall Effect Sensor module should be removed after 50 hours and inspected for gear, bearing, and seal wear. After first inspection, inspect as necessary or at least every 100 hours by removing the cover plate and checking for bearing and seal wear.

2.4 DIRECT CRANK SENSOR INSTALLATION

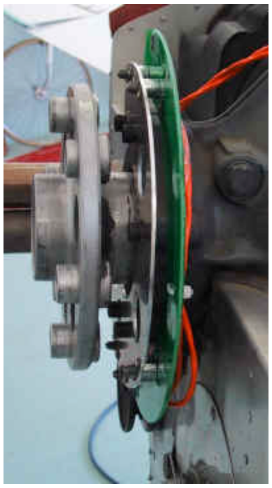
The crank sensor circuit board has two completely independent triggering systems if it is used for dual Plasma CDI applications.   On single installations only the outer set of sensors and associated wiring is installed.

Remove the flywheel to install the magnets and the crank sensor assembly. The outer trigger magnets are installed in the flywheel on a **4.000" radius**. The inner trigger magnets, used for a second system, are installed on a **3.840" radius** (refer to the picture below). You may wish to send your flywheel to LSE for installation of the magnets and the timing marks; cost is $50 plus shipping; plan on 1 day plus shipping time.

Please refer to the attached pictures and those on the Crank Sensor page of the web site (www.LightSpeedEngineering.com) to mount the sensor plate to your crankcase and integrate the trigger magnets into your flywheel. Use a number 32 drill, 1/8" deep so that the magnets can be pressed in flush with the surface. Use Loctite and stake around them. Two or four magnets are included. Single systems require only two magnets on the 4" radius. Looking into the pulley side of the flywheel, the left magnet position should always line up with the TDC indication under the starter ring gear. For the other magnet position, add 20 degrees to the recommended timing for your engine and install it on the same radius to the right of the first magnet. On engines that should have their magnetos timed at 25 degrees the leading magnet should be installed at 45 deg BTDC and thereby 45 degrees to the right of the TDC magnet. High compression engines should have their leading magnets installed 40 degrees BTDC. Only the magnet's south pole can trigger the sensors. This is the face marked with an X and therefore, should point to the sensor. In other words, the X must be visible after installation. If the X is not clearly visible, use a compass to identify the correct polarity.

Large diameter alternator pulley required (**8.5" ID**).

If you have seal retainer plates installed, remove them and use existing holes to mount the bracket. You might have to adjust the holes in the bracket using a dremmel to make them align with the existing holes. If the bosses are not drilled, use the mounting plate as a drill template as follows.



Align plate concentric to crankshaft by registering on centering tabs. Visually align crankcase split line with the v notches between the top and bottom 2 holes of the mounting plate. Mark the crankcase mounting locations through the existing holes in the bracket. If possible, use a #2 centering drill for a pilot hole. Drill #6 (0.2040) x 5/8" deep. Tap ¼-20. For best results, use a 2-flute spiral point HSS tap with aluminum tapping fluid such as Tap-Magic. Once the bracket is mounted to the crankcase, remove the three alignment tabs then remove the two control tabs. This sequence allows you to later verify that the alignment tabs were removed. If the circuit board was removed for this operation, re-install it. All screws holding the crank sensor circuit board to the mounting plate must be secured with Loctite and the proper torque. The 0 degree mark on the circuit board should now align with the split line in the crankcase when the screws are fastened in the center of their positioning slot.

Now that the sensor plate is installed perform a simple operational check: disconnect all high tension leads from the ignition coils. With power to the system and all else connected, take any magnet and swipe it back and forth past each sensor (speed is important, > 2x per second). Every other pass should produce a loud spark at the coil. Only the south pole works. Check each sensor.

Lycoming external engine dimensions can vary significantly, so you need to verify the proper clearance between the sensor and the magnets installed in the flywheel surface. Two measurements need to be compared to determine the gap.

- First, measure the height from the inside of the flywheel where it touches the crankshaft flange to the surface that has the magnets installed.

- Then, measure from the face of the crankshaft flange back to the sensor face on the circuit board. This second dimension needs to be larger by .030"-.060". The clearance should fall within these parameters with the **crankshaft pushed in and pulled out**.

Too little gap and a flexing crankshaft might touch the sensors.
Too much gap will not activate them.

Adjust by adding washers to the circuit board spacers (adding clearance) or by adding washers underneath the bracket attachments (subtracting clearance).

Note- Magneto removal: When removing the magneto(s), be sure to remove the mag with its drive gear and pilot bearing. Install the mag hole cover plate provided by LSE in place of the magneto. Use only liquid sealant and the magneto "toe clamps" to secure this plate. Gaskets are not recommended as they may distort the cover plate.

2.5 IGNITION MODULE AND IGNITION COILS

The ***PLASMA* CDI** module should be mounted in a clean and dry place on the cold side of the firewall. If space limitations require mounting on the engine side of the firewall, a protective metal cover should be used to protect the module from water/engine cleaning materials and heat. In this situation, the module should be oriented such that the connectors are to the sides of the plane. **Air must be allowed to flow between the bottom of the module and the mounting surface**.

Ignition coils are typically mounted on the top center of the engine. They can also be mounted on the motor mount tubes using adell clamps or on the firewall to a piece of angle aluminum. Ignition coils should be mounted so that spark plug lead length will be kept to a minimum for maximum spark energy and minimum noise. It is important that each coil connects to **opposing** cylinders, i.e. one coil fires cylinders 1 and 2 and the other coil fires 3 and 4.

CAUTION!

BE CAREFUL NOT TO DRILL INTO ANY PRIMARY AIRCRAFT STRUCTURE WHILE MOUNTING YOUR *PLASMA* CDI SYSTEM. THE BEST IGNITION SYSTEM IN THE WORLD WILL BE NO HELP IF YOUR MAIN SPAR FAILS.

WARNING!

- **ALL ELECTRICAL SYSTEMS MUST HAVE OVER-VOLTAGE PROTECTION!**
- **WIRING CAN CAUSE ELECTRICAL SHOCKS WHEN IGNITION IS TURNED ON.**
- **DO NOT TOUCH ANY WIRES WHEN SYSTEM IS IN OPERATION.**
- **DISCONNECT BATTERY BEFORE INSTALLATION AND TESTING TO AVOID SHOCK.**

2.6 ELECTRICAL REQUIREMENTS AND OPERATION

Electrical System Requirements

All Plasma CDI systems can be used with 12 or 24 volt electrical systems. Input voltages above 35 volts or reversed polarity can cause system damage.

For this reason, it is mandatory that all aircraft using Plasma CD Ignitions are equipped with over-voltage protection in their alternator charging system(s). Over-voltage protection is a requirement for certified aircraft. Power connection must be directly to the battery terminals to avoid voltage spikes and electrical noise. Aluminum should never be used as an electrical conductor for the Plasma CDI. Use only the supplied aircraft quality stranded wire.

Minimum supply voltage for starting is 6.5 Volts.
Minimum operating voltage is 5.5 Volts.

Electrical Operating Instructions

No operational limits or special procedures are necessary during normal use. You can either hand start your engine or use your electrical starter. All Plasma CDI systems retard timing to TDC during start and advance timing optimally for all flight conditions based on manifold pressure and rpm.

- In case of a charging system failure, it is recommended that you land at the nearest safe airport and repair the charging system before further flight.

- If you are using Dual Plasma CD Ignition, you can turn one system off, together with all other electrical loads not essential for flight, to maximize your range with your remaining battery capacity.

- Dual Systems only: If you have installed an aux battery per the LSE supplied drawing, monitor your voltmeter and do not switch to the aux battery until the supply voltage of the main battery is below 6.5 Volts or the engine is not running smoothly. After switching to the aux battery, your voltmeter will read the voltage remaining in your aux battery.

- Do not switch your main alternator breaker in flight to avoid potentially damaging voltage spikes. This does not apply to the alternator field breaker.

This information should be contained in the Aircraft Operating Manual.

2.7 ELECTRICAL CONNECTIONS

HERE ARE SOME NOTES ON HOW THE SYSTEM IS WIRED UP:

The ***PLASMA* CDI** System includes a pre-assembled electrical harness/connector(s) with all essential wires ready to route between the triggering mechanism (Hall Effect Sensor, Direct Crank Sensor, or Trigger coils) and Plasma CD ignition module input connector. The power wires in the harness remain un-terminated. The input connector, output connector and manifold pressure input barb are located on one side of the Plasma CD module; BNC connectors for the primary ignition wires are located on the other side of the Plasma CD module.

Pictured here: Primary ignition wire terminal connection to the ignition coil.

When connecting the power supply, route the positive lead to a 5A pull-able circuit breaker and then to the battery plus terminal, bypassing any electrical buss or master solenoid. Refer to input connector diagram.

If a toggle switch is used as an on/off switch, it should be installed next to the circuit breaker. If an aircraft key switch is used (some Plasma I systems and all Plasma II Plus and Plasma III systems only), do not use a toggle switch; instead, hook up the "P"-Lead from the output connector to your key switch. Route the negative lead directly to the battery ground terminal (not airframe or ground buss) to avoid ignition noise. The shield should not be connected.

For Dual Plasma CDI Installations, an auxiliary battery is recommended. Please click here for a wiring diagram.

Trim the power supply wires to length and connect them with quality crimp connectors or by soldering and heat shrink insulation. Do not use any heat shrink on the black RG58 cable going to the ignition coils.

Route the RG58 coax cables to the ignition coils. Avoid their exposure to heat from cylinder heads or exhaust systems. The primary ignition coil wires running from the Plasma CD Ignition module to the ignition coils can be routed together, however they should be kept separate from the ignition system input wires (harness). There is no polarity on these, even though they might be labeled (+) and (-). Connect the center conductor to one ignition coil blade and the shield to the other blade using standard spade terminals. Again, polarity at the coils does not matter.

The high tension leads supplied in the kit **must** be used with the ***PLASMA I and the PLASMA III* CDI** System since its spark energy is far too great to be used with any shielded aircraft leads or high resistance automotive wires. The two high tension leads from each coil connect to spark plugs on opposite sides of the crankshaft. One coil fires cylinders 1 and 2 and the other coil fires 3 and 4.

Connect the manifold pressure line to your ignition processor. If you have a MP gauge, you can tee into that line. A standard 1/8" ID MP Tygon tube is recommended. Refer to your engine manual for manifold pressure pick-up.

(The next two items are only applicable to TRIGGER COIL SYSTEMS purchased before 2001.)

On 6 cylinder systems the top trigger coil should be connected to the wire having one blue ring around it at the 25 pin connector. The next trigger coil in the direction of engine rotation connects to the coax with two blue rings and the last trigger coil is connected to the one with three rings.

On 4 cylinder engines the coax with one blue ring communicates with output 1 & 2, the other with output 3 & 4. But you need not worry about any phasing here. If the system does not work, you just switch the two BNC connectors.

IMPORTANT: The two high tension leads from each coil connect to spark plugs on opposite sides of the crank shaft. That means one coil fires cylinder 1 and 2 the other coil fires 3 and 4. If your mag fires top and bottom plugs, reroute the cables to fire either all on top or all on the bottom spark plugs. The ***PLASMA* CDI** can fire either the top or the bottom plugs. If you use one magneto, your engine runs a little better with the PLASMA CDI advanced spark on the top plugs.

ALL SYSTEMS:

Ensure wiring is securely fastened, especially near the terminals, to avoid damage from vibration.

<u>SPARK PLUGS:</u> Gap spark plugs fired by the ***PLASMA* CDI** to .032"-.045" for standard compression engines and .026"-.035" for high compression engines. Turbo / Supercharged engines should gap the spark plugs to .026” - .035” while turbo normalized engines should gap the spark plugs according to the compression ratio. Install the spark plugs and inserts using 15 and 25 lb/ft respectively, using anti-seize.

If you disconnected your battery during the installation, don't forget to reconnect it now.

CONGRATULATIONS!

YOU HAVE NOW COMPLETED THE INSTALLATION OF YOUR LSE *PLASMA* CDI SYSTEM.

YOUR NEXT STEP TO IS PERFORM OPERATIONAL TESTING TO ENSURE THE UNIT IS CORRECTLY INSTALLED AND ACCURATELY TIMED.

Section 3 OPERATIONAL TESTING

It is important to check timing accuracy and range before attempting flight.

WARNING!

WIRING CAN CAUSE ELECTRICAL SHOCKS WHEN IGNITION IS TURNED ON. HIGH TENSION LEADS AND IGNITION SYSTEM OUTPUT WIRES CAN ALL CAUSE ELECTRICAL SHOCKS.

DO NOT TOUCH ANY WIRES WHEN SYSTEM IS IN OPERATION.

3.1 PHASING (CYLINDER FIRING ORDER)

Since we have not specified wire tracing and valve position, which define the difference between compression stroke and exhaust stroke, on 4-cylinder engines there is a 50% chance that the timing will be 180° out of phase.

With all spark plug wires removed from the coils and one sparkplug removed from each cylinder, turn your ignition on and rock the propeller back and forth near cylinder 1 TDC. A spark should jump between the output terminals of one ignition coil. The high tension leads from this coil must be connected to cylinders 1 & 2. Repeat this procedure 180º out and confirm firing the second coil, then connect the high tension leads from this coil to cylinders 3 & 4.

On 6-cyl engines, refer to the engine firing order to assign the second and third coil.

On Direct Crank Sensor systems, this test should be done before the flywheel is installed by waving the "N"-pole of a magnet past each top sensor. The top sensor(s) relate to cylinders 1 & 2 on all installations. Connect the high tension leads to opposing cylinders since they fire simultaneously, use your engine's firing order as a reference for the remaining coil assignments.

If your coils are connected correctly to opposing cylinders, you can change phasing by switching BNC connectors.

Due to the performance increase, the engine idle is now increased by 50-150 RPM. Reduce idle to normal by adjusting the carburetor or fuel injection system. Re-adjust idle mixture.

The engine may now be running extremely well, smooth and quiet. However, **DO NOT FLY UNTIL THE REST OF THE OPERATIONAL TESTS ARE COMPLETED.**

3.2 TIMING LIGHT HOOKUP AND TESTS

LSE highly recommends that you check ignition timing using a strobe light, automotive style, both on your new ignition and, should you still have one, on the magneto. The magneto timing should be set to the manufacturers specs.

Use a conventional "clip-on" inductive timing light to verify the timing accuracy and range. Only use a simple strobe light that does not have a potentiometer or display. The Plasma CDI's waste-spark ignition will give erroneous readings on these strobe lights. Always use only the timing marks on the engine side of the flywheel. The reference for this is the split line of the case.

You can build a pointer in line with the case seam.
Mark the timing marks on the flywheel per the picture in the manual under section 2.3, "Direct Crank Sensor Installation", and duplicate them 180 degrees out on 4-cyl engines and 120 and 240 degrees out on 6-cyl engines. You can then point the timing light from the cockpit in line with the center of the case, and your pointer, at the indications on the flywheel.

Engines Normally Timed at 25 degrees BTDC:
These are usually engines with compression ratios less than 8.7:1.
At idle the strobe light should indicate 40º ± 2º when the manifold pressure hose is connected and 21º ± 2º when disconnected.

Engines Normally Timed at 20 degrees BTDC:
These are usually engines with compression ratios of 8.7:1 or higher.
The timing is retarded another 5 degrees. This setting should show idle strobe light readings of 35º ± 2º when the manifold pressure hose is connected and 16º ± 2º when disconnected.

Turbo and Super-Charged engines:
These settings are for turbo and super-charged engines. Turbo normalized engines should use the above settings for engines normally timed at 20 degrees BTDC.
At idle the engine timing should be 35º ± 2º when the manifold pressure hose is connected and 24º ± 2º when disconnected. The leading magnet(s) should be installed 40º BTDC.

Note that these numbers are for sea level. You can add 1 degree for each 1,000 ft of density altitude. The low number (MP hose disconnected) is the most important!

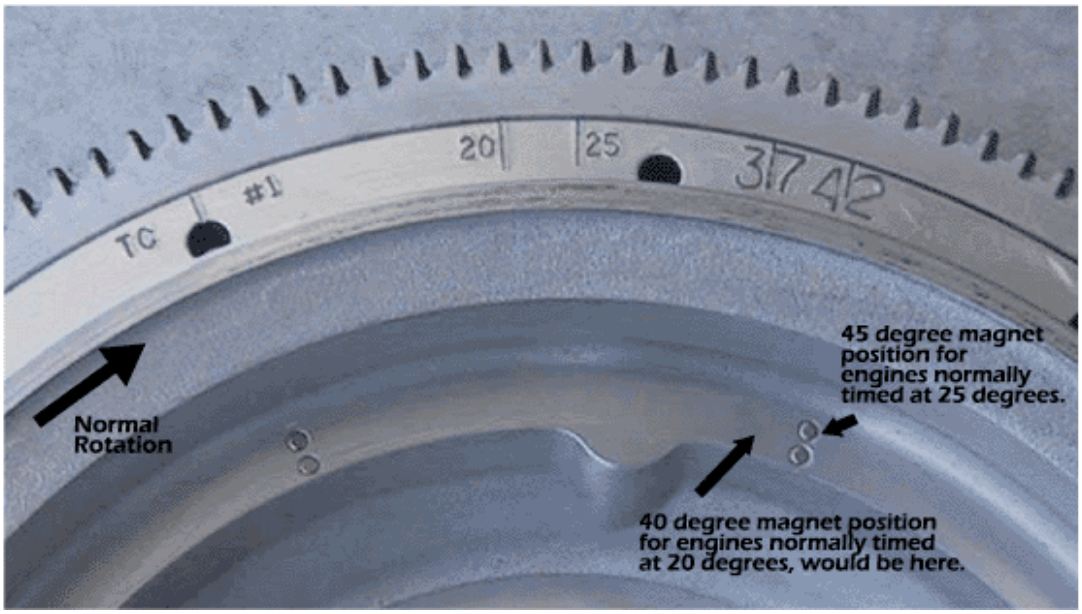
Be aware that the indicated timing is dependent on the accuracy of the timing marks.

3.2b TIMING THE IGNITION SYSTEM

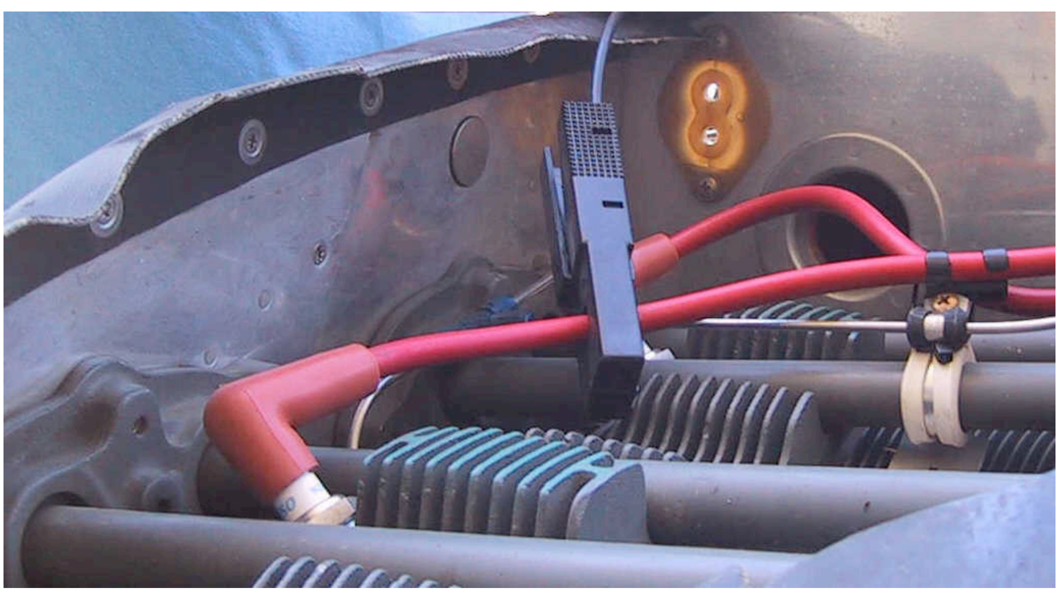
Mark the timing mark on the engine side of the flywheel per the picture below and again for the other channel(s):

- 2 sets of marks for the 4-cylinder - initial setting at TDC #1 and 180 degrees out
- 3 sets of marks for the 6-cylinder - initial setting at TDC #1, then 120 and 240 degrees out.

Make a pointer in line with the case seam to help define your reference.
Then, point the timing light from the cockpit in line with the center of the case, and your pointer, at the timing marks on the flywheel.



Connect the strobe light lead to one of your high tension leads (spark plug wires).



Connect the strobe light to power. Only use a simple strobe light that does not have a potentiometer or display.

*Refer to section 3.2a, *Timing Light Hookup and Tests*, for timing specifications that apply to your engine.

Check to confirm that manifold pressure is connected to your Plasma CD ignition box.

Start the engine.   *The strobe light tests should be at engine idle, 600 - 900 rpm*.

Referencing the split line of the case and your pointer, make a written note of the actual ignition timing as seen with the timing light. This timing, with the manifold pressure connected to the box, is the most advanced position.

Now, disconnect the manifold pressure hose from the Plasma CD box and check the timing with the timing light. Make a written note of the ignition timing; this is the most retarded position.

Clip the timing light pickup to one of the ignition leads from the coil firing the next 2 opposing cylinders. The timing light should illuminate the opposite set of timing marks on the flywheel.

Check the ignition timing with the manifold pressure hose connected and with it disconnected.

If you have a 6-cyl engine, you should check the timing on the coil firing the last 2 opposing cylinders using the same procedure.

Compare the timing of each coil.

It is easier to read the timing illumination out of direct sunlight.

Verify the timing is set to the proper values for your engine.

If not, adjust it:

- In the case of a Hall Effect Module, this can be accomplished by rotating the sensor module in the accessory case.
- Adjust the Direct Crank Sensor system by loosening the screws that hold the circuit board to the mounting bracket and rotating the circuit board.

When finished, secure all hardware with Loctite or safety wire.

YOU ARE NOW READY TO FLY!

HOWEVER, FIRST READ THE REMAINDER OF THIS MANUAL, SO THAT YOU HAVE A THOROUGH UNDERSTANDING OF YOUR LSE *PLASMA* CDI SYSTEM.

3.3 RUN UP TESTS

NOTE:

Due to the significantly higher performance of the LSE ***PLASMA*** **CDI** System, it cannot be compared to magnetos during run up in a conventional manner.

If fuel mixture setting is near optimum, there will be no detectable RPM drop when the mag is turned off and the engine runs on the ***PLASMA*** **CDI** alone.

A large RPM drop will be noticed when the electronic ignition is turned off.

No significant drop is noticed if two Plasma I or III systems, one Plasma I or III and one Plasma II Plus, or two Plasma II Plus systems are used and the interconnect feature is installed.

3.4 IN-FLIGHT TESTS

For normal operation, always turn on both the magneto and electronic systems, even if the benefit of the magneto is not noticeable. If you have sensitive EGT information you may notice a lower EGT when both spark plugs are firing. Verify that all cylinder head temperatures are within normal limits. Too much timing advance might cause high CHT's.

Section 4 TROUBLESHOOTING

One of the first priorities in designing the LSE ***PLASMA*** **CDI** System was its reliability. State-of-the-art circuitry is used throughout combined with professional design. It is unlikely that failures will occur during normal operation.

This is unlike the conventional magneto systems where failure is predictable. Also, contrary to magneto or other distributor systems, there is no wear or other loss in performance over time. In short, it either works or does not.

IF SYSTEM FAILURE DOES OCCUR:

All components supplied with the PLASMA CD systems have been carefully tested. If any of these components are substituted, optimum performance cannot be guaranteed and such changes might affect the warranty. If deviations from the instructions or supplied materials have been made, please correct those changes before contacting LSE with any problems.

Consult the wiring diagram and assure proper connections of signal wires and power supply.

LSE recommends high tension lead replacement every 500 hours or every three years whichever comes first, independent of the ignition source.

Trigger coil version: If one or more channels are not working, check the resistance at the connector for each trigger coil. With an OHM meter verify that each trigger coil input to the 25 pin connector has 470 ohms $\pm$ 50 ohms.

On Hall Sensor modules, remove the cover with its circuit board attached and inspect for bearing wear and oil contamination. If problems are visible, return the housing to LSE for inspection and overhaul.

With the spark plug leads removed from all coils and the 9 pin (Hall Effect Sensor module systems) connector in place and power on, rapidly move the south pole of a magnet past each Hall sensor. You should be able to generate a spark at the coils from each of the four sensors. Also, verify the gap between the sensors and the magnet to be 0.030” – 0.060”.

Using an Ohm meter, the BNC cable should be open between the shield and the center conductor and about 1 ohm when it is connected to the coil. Measuring from each spade terminal to each output terminal of the coil should show an open circuit. Any conductivity here indicates a failed coil.

4.1 STARTING PROBLEMS

If your battery can no longer crank your engine over, you can hand start your engine using proper safe procedures. The LSE ***PLASMA* CDI** System will provide an accurate spark every compression stroke on 4 or 6 cylinder engines as long as the battery has more than 8 Volts.

Do not attempt to hand prop your engine with your non-impulse magneto hot.

If the engine backfires it is also possible that the impulse coupling of the remaining mag is not engaging properly. Any backfiring into the intake side contaminates the intake manifold and starting will be more difficult until fresh fuel is available. Turn the mag off during engine start if it causes a problem.

4.2 Radio Noise

The Plasma CDI systems are designed to not interfere with any aircraft radios if installed per manual. If noise is noticed on the radio, it is an indication of arcing on the high voltage lines. This can be anywhere between the BNC connectors and the sparkplugs.

Powering the system from your avionics buss will also cause noise. Both power and ground should come directly from the battery terminals.

If you experience radio static that disappears when you turn the Plasma CD electronic ignition system off, check the following possible sources and make any necessary corrections.

1. If you are operating an aircraft key switch, confirm there is not a ground wire installed from the ignition switch to aircraft ground. Remove the ground wire if one is installed. Only the shield of the two “P”-leads should be connected to the switch terminal labeled ground.
2. If you are using Denso ESR-U or ESR-V or GPR-U sparkplugs, check the security of the ferules on the sparkplug electrical connection. These plugs have threaded ferules that must be tightened securely. Most sparkplugs included with systems sold after June 2002 have solid terminals.
3. Examine the high-tension lead connection to both the coils and the sparkplugs and confirm they are secured tightly to the metal connector clip inside the boot.

Section 5 FACTORY REPAIR AND WARRANTY

Limited Warranty: Light Speed Engineering products are warranted to be free from defects in materials or workmanship for a period of six (6) months from the date of installation or one (1) year from the date of purchase, whichever occurs first. If within the applicable period, a Light Speed Engineering product is proved to Light Speed Engineering's satisfaction to be defective in materials or workmanship, then the product will be repaired or replaced, or the purchase price refunded, at Light Speed Engineering's sole discretion. The exclusive remedy for defects and materials, and Light Speed Engineering's sole obligation with respect to defects in materials or workmanship, shall be limited to such repair, replacement FOB Light Speed Engineering's headquarters, or refund of the purchase price, and shall be conditioned upon Light Speed Engineering's receipt of notice of the alleged defects within thirty (30) days after its discovery, and at Light Speed Engineering's option, return of the product(s) prepaid to its headquarters. This warranty shall not apply or extend to any product that has been misused, mishandled, modified, or adjusted, or if any electronic components of the product have been opened, disassembled, or otherwise tampered with, whether by the purchaser or others. THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH OTHER WARRANTIES ARE EXPRESSLY DISCLAIMED.

Liability: The obligations of Light Speed Engineering are strictly limited to the limited warranty described above, and Light Speed Engineering shall not be liable for any other obligations or liabilities whatsoever, including but not limited to incidental, consequential, punitive or special damages, or any lost revenues or profits, lost use of equipment, damage to equipment or other property, cost of substitute products, costs of product removal, claims to third parties relating thereto, or any other damages whether based on contract, negligence, tort, or any strict liability theory.

Returns: Products with alleged defects in materials or workmanship may be returned for repair, replacement or refund (at our option) pursuant to the foregoing limited warranty only if a return authorization is obtained.
You may obtain a return authorization by
calling Light Speed Engineering at (805) 933-3299.

For further information or questions concerning our products, please e-mail info@lightspeedengineering.com or contact us at:

Light Speed Engineering, LLC- PO Box 549, 416 E. Santa Maria St. #15,
Santa Paula, CA. 93060

phone: (805)933-3299 fax: (805)525-0199

This page was last updated

FIGURE 1: DUAL POWER SUPPLY DIAGRAM

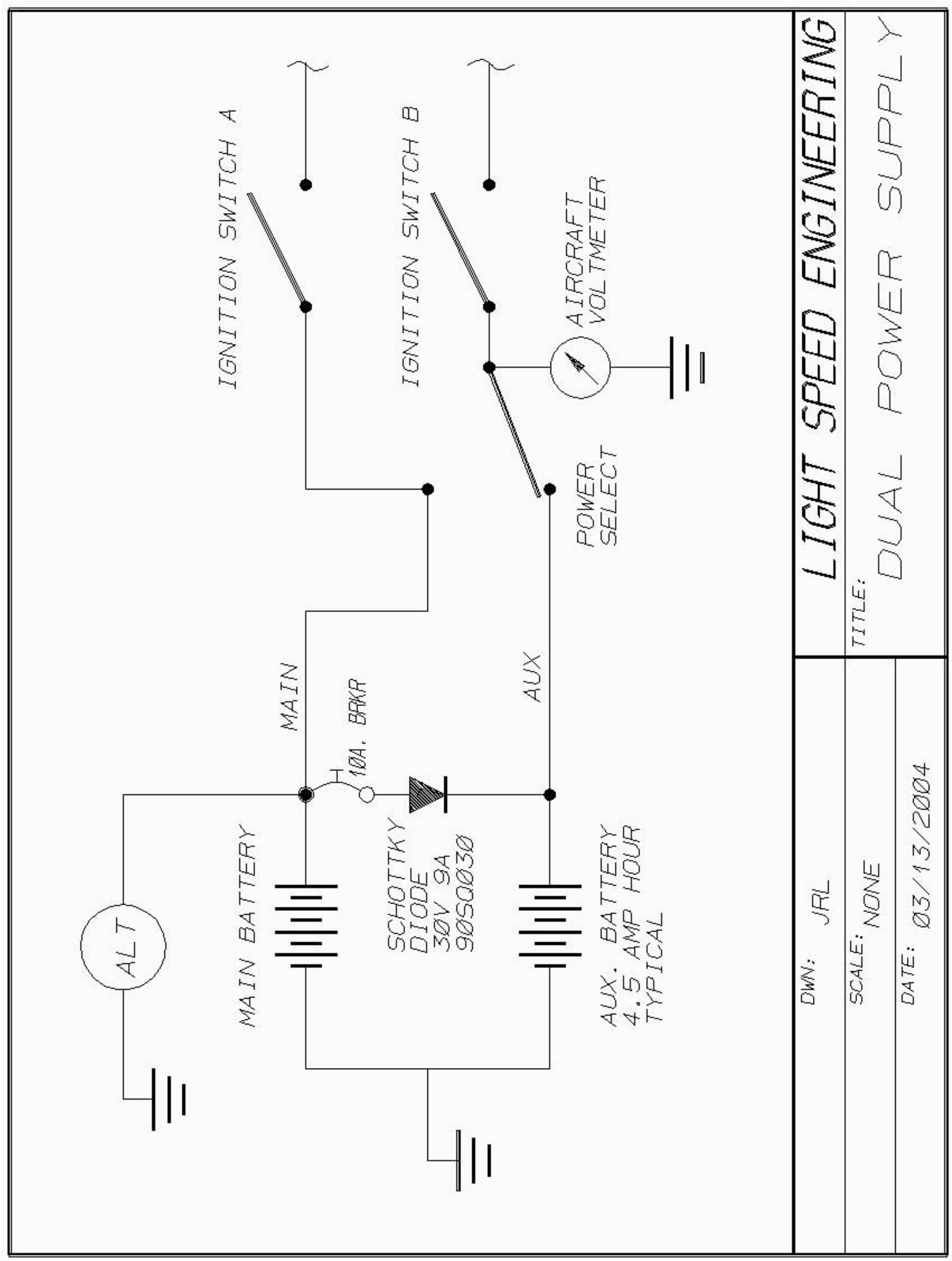


FIGURE 2: PLASMA I ELECTRICAL DIAGRAM

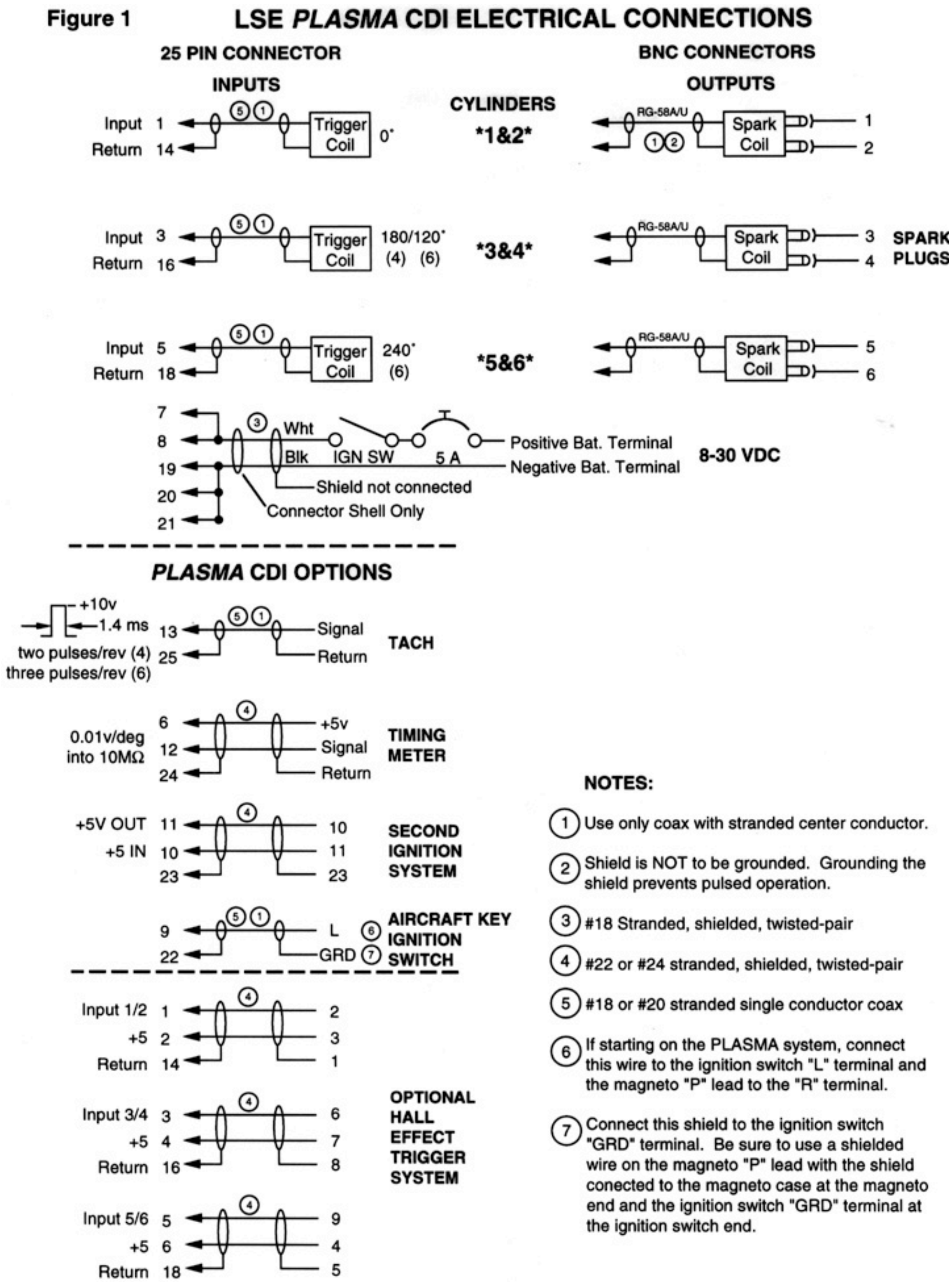


FIGURE 3A PART 1: TRIGGER INSTALLATION, 4-CYL. LARGE PULLEY

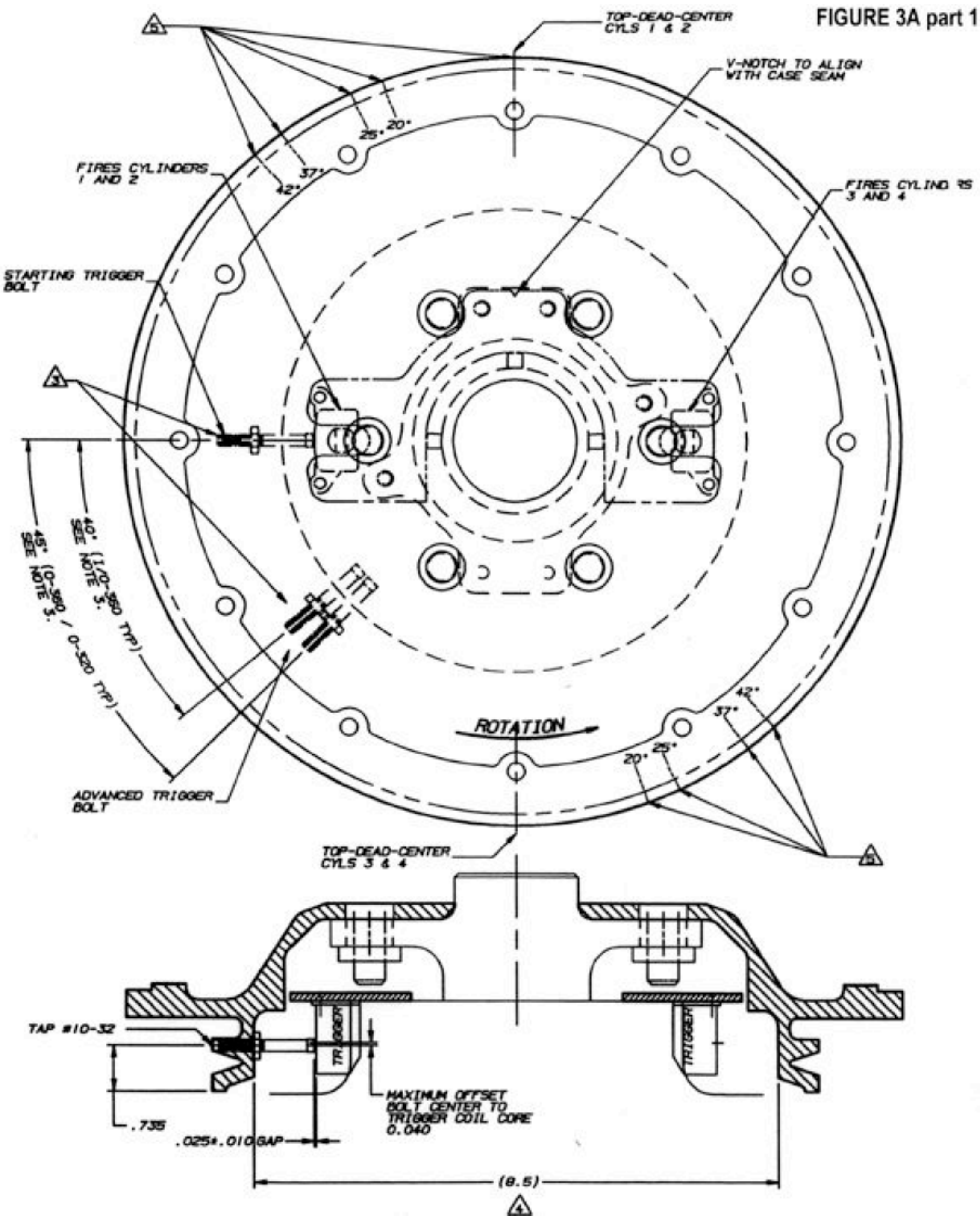


FIGURE 3A PART 2: TRIGGER INSTALLATION, 4-CYL. LARGE PULLEY

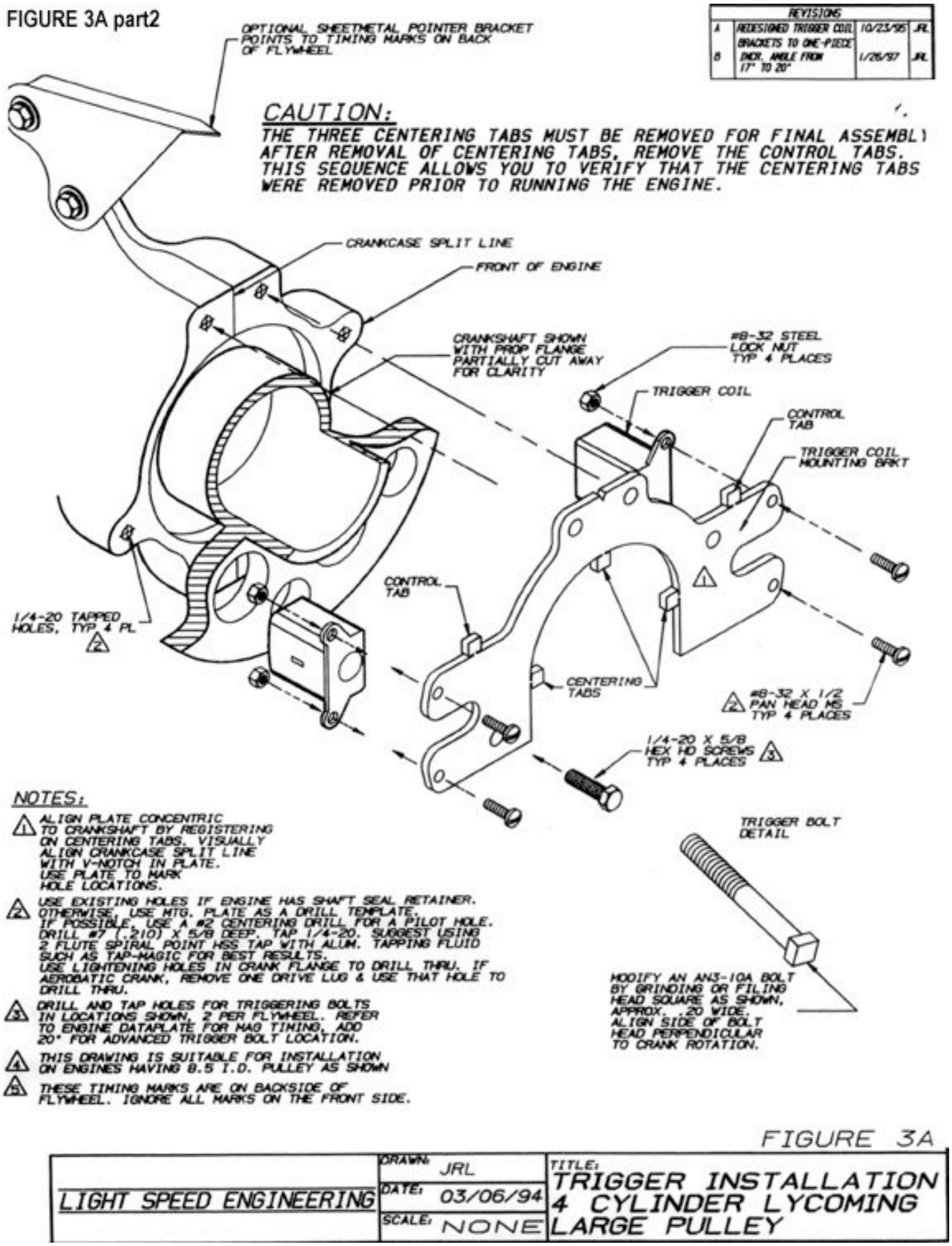


FIGURE 3B PART 1: TRIGGER INSTALLATION, 4-CYL. SMALL PULLEY

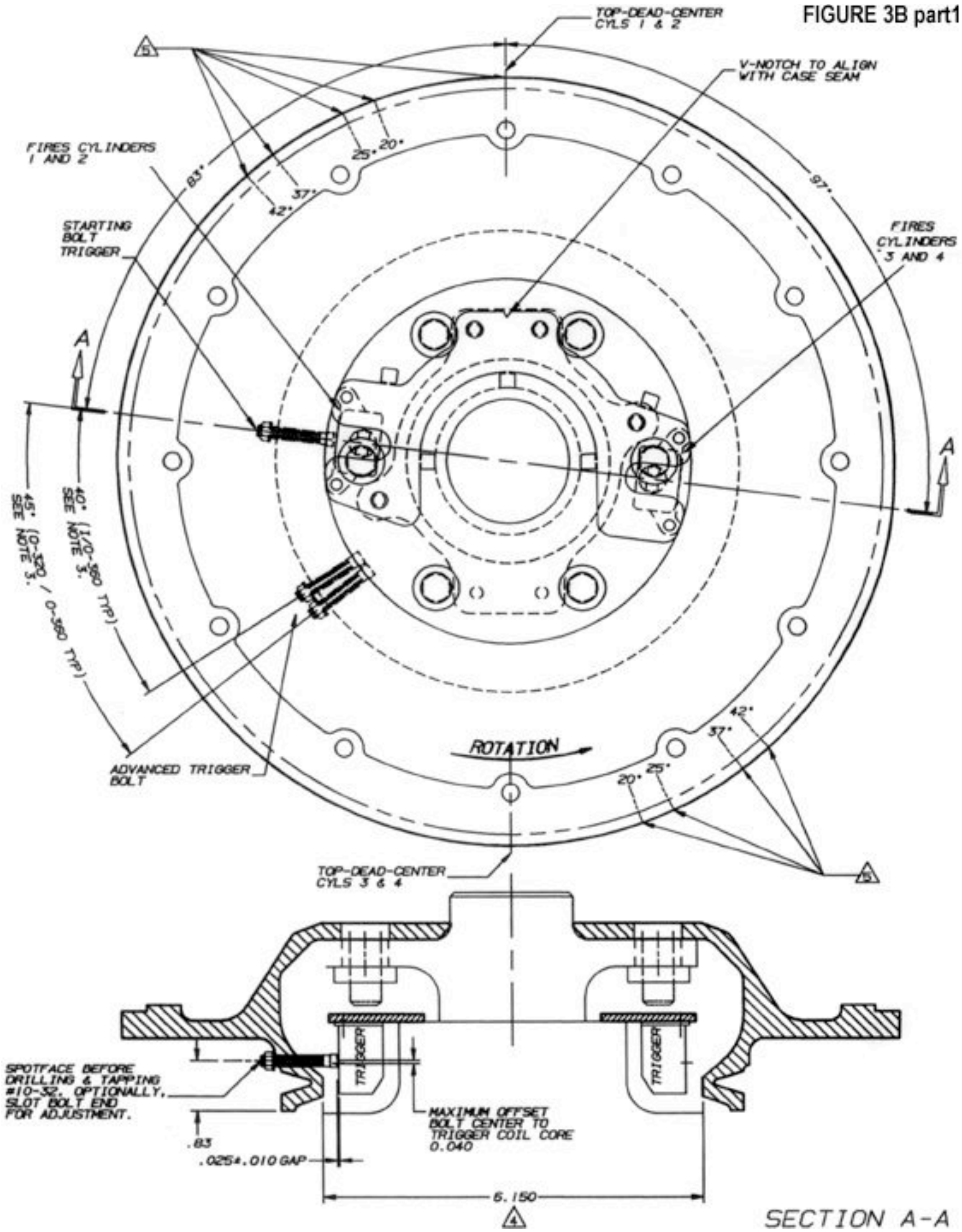


FIGURE 3B PART 2: TRIGGER INSTALLATION, 4-CYL. SMALL PULLEY

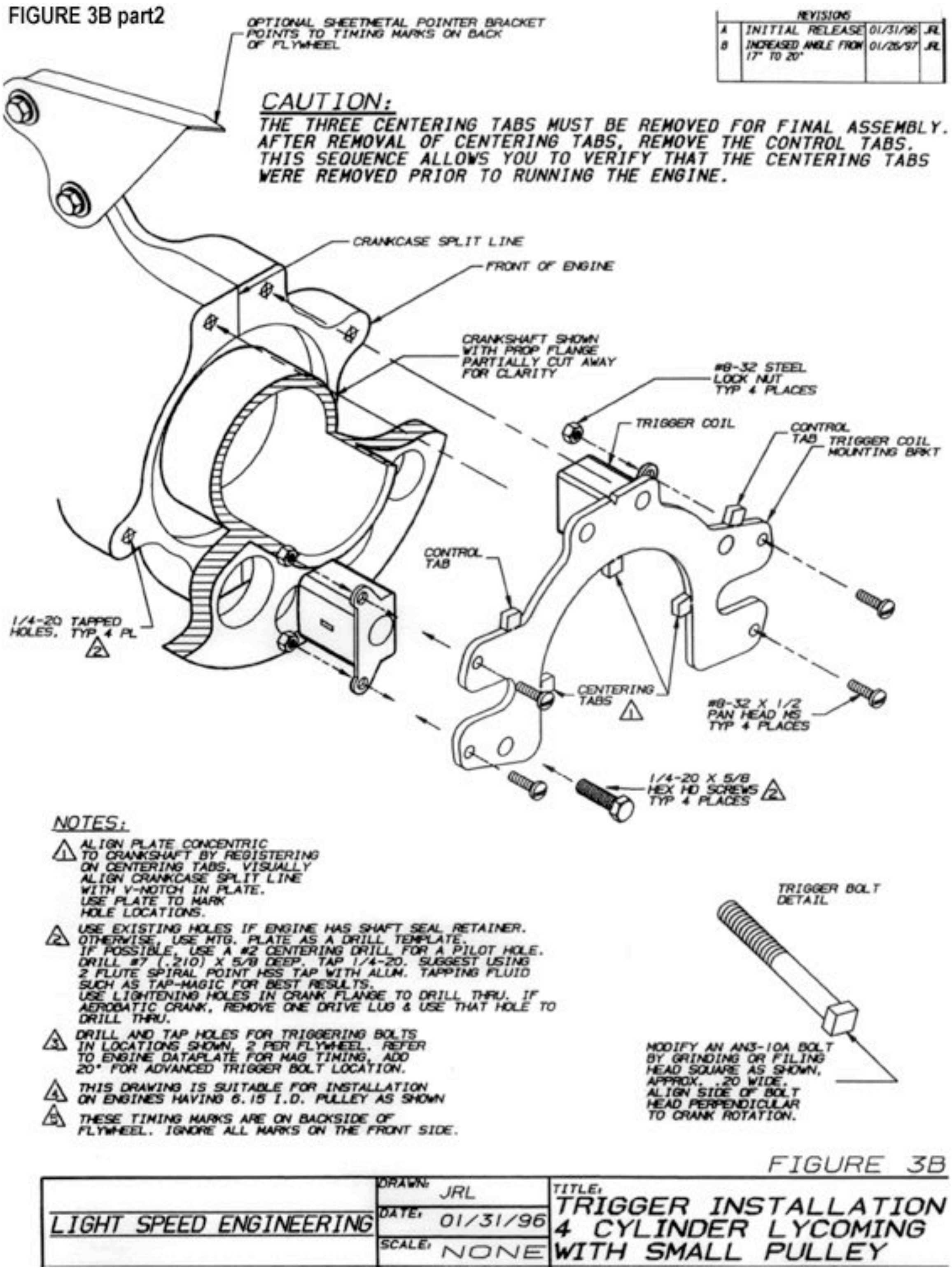
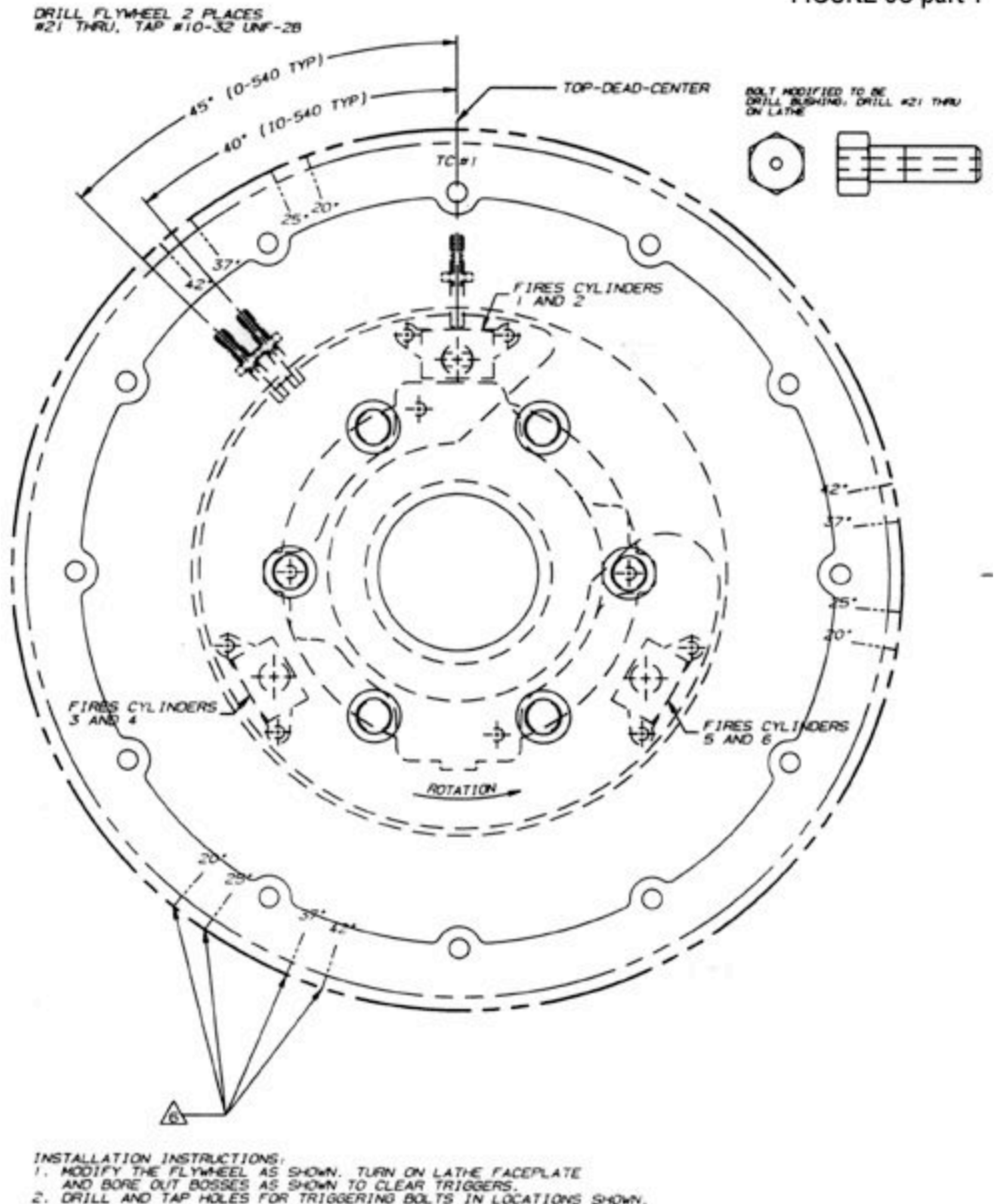


FIGURE 3C PART1: TRIGGER INSTALLATION, 6-CYL.

FIGURE 3C part 1



INSTALLATION INSTRUCTIONS:

1. MODIFY THE FLYWHEEL AS SHOWN. TURN ON LATHE FACEPLATE AND BORE OUT BOSSES AS SHOWN TO CLEAR TRIGGERS.
2. DRILL AND TAP HOLES FOR TRIGGERING BOLTS IN LOCATIONS SHOWN.
3. FABRICATE TRIGGER PLATE PER DRAWING. MAKE FROM .093 2024T3 ALUM. OR EQUIV. FINISH: PHOSPHORIC ACID ETCH AND ALODINE.
4. NOTE THAT HOLES MARKED 'A' ARE DRILLED #21 ON ASSY W/ ENGINE. THEN PLATE IS REMOVED AND HOLES ENLARGED TO .189 DIA. & C'SK.
5. TRIGGER UNITS ARE ATTACHED TO PLATE. PLATE IS SLIPPED IN PLACE AND CLAMPED WITH 2 BOLTS THRU CRANK FLANGE. PLATE IS POSITIONED CONCENTRICALLY (.005 TIR). A THIRD BOLT IS DRILLED #21 THRU AS A DRILL BUSHING AND USED TO DRILL HOLES THRU PLATE INTO ENGINE BOSSES. DRILL DEPTH INTO BOSS IS .625. TAP #10-32 TYP 4 PLCS.

△6 THESE MARKS ARE ON BACKSIDE OF FLYWHEEL. IGNORE ANY MARKS ON FRONTSIDE.

FIGURE 3C PART 2: TRIGGER INSTALLATION, 6-CYL.