Coils – The purpose of an ignition coil is to convert the low current from a car battery into enough power to ignite the fuel and start the engine.

Coils are step-up transformers turning a 12 VDC supply into 20,000 or more volts depending on the coil turns ratio between the primary and secondary iron cores in the coil.
Voltage and current, when does each come into play. To produce a spark in the engine cylinder, the electrical system current is allowed to pass through the coil to a ground point creating a magnetic field in the primary and secondary windings. When this current is removed, a voltage is induced in the primary winding of approximately 200 VDC, and approximately 20,000 VDC in the secondary winding depending on the coil turns ratio.

There are modern coil packs that are of the three or four pin variety. The coils with three pins need to use an external ignition module for the ECU to control the coil charge/discharge.

Coils that are of the four-pin variety have an internal coil driver that is controlled by the ECU. This does allow for a more compact installation and you do not have to find a space for an external, separate coil driver.

Coils require a certain amount of time to charge called well time. This is measured in milliseconds (ms), and depends on the coil design and the application.

The coils used in the CFI system have a primary coil resistance are 2.4 to 3 OHM and a secondary resistance of approximately 19K OHMs (spark plug wires attached). These coils are quite robust, and last a long time. The Honda OEM service manual indicates that these coils are not polarity dependent. There is no information available to determine the dwell time of these coils. This is entirely dependent on the ECU of which there are no design specifications available. To determine the CFI coil dwell time will require some testing.

Not all coils are created equal. I have mentioned that the purpose of an ignition coil is to convert the low current from a car battery into enough power to ignite the fuel and start the engine.

An OEM determines the coil design it requires for the ignition system it is using. It is a package deal, and must be realized as such.

A coil has a primary and secondary resistance rating that changes depending on the ignition system design.

Most of us will determine the primary and secondary resistance of the installed coil(s), and if necessary, look for a suitable replacement that matches these resistance ratings. An alternative to this is to use a coil with less primary resistance and use a ballast resistor in series to maintain the current in the OEM coil circuit as designed.

Coils are like spark plugs. There are many factors that affect coil performance and how a coil will react in your ignition system. Using the coil resistance specifications will generally be sufficient for most replacement applications.

If the engine is a performance engine, and performance is the name of the game, other factors such as turns ratio, coil inductance, input voltage all affect the coil operation and potentially engine performance. Coil tuning, yes, I have found information regarding this, may apply to your application.

Coil Tuning has been around for quite a while. The performance industry has been doing this, but the average DIY performance enthusiast has probably overlooked this, or is not aware of it.

It may be applicable to an EFI system, but more so with a capacitor discharge (CD)system.

The CD system was developed to overcome the long coil charge times associated with high inductance coils used in inductive discharge ignition (IDI) systems. This allowed automotive ignition systems to be more applicable for high engine speeds. The CD system uses capacitor discharge current to the coil to fire the spark plugs.

Most IDI systems rely on the electric inductance at the coil to produce high-voltage electricity to fire the spark plugs as the internal coil magnetic field collapses.

A CD system needs to have a good 12 VDC current. In a CDI system, a charging circuit inside the CD module charges a high voltage capacitor, and when required, the capacitor discharges the capacitor charge to the low induction ignition coil before going to the spark plugs. The low induction ignition coil acts as pulse transformer rather than an energy storage medium as in and IDI system.

A points distributor system used with a CD ignition system is basically a trigger system for the CD ignition system to indicate when to fire the capacitor discharge through the ignition coil to the spark plug(s).

When the capacitor discharges its voltage to the ignition coil, in the 250 VDC plus range or so, this voltage is transferred to the secondary coil that has significantly more wiring turns, and as such the transfer of the voltage from the CD capacitor to the primary of 250 VDC is increased into the 25,000 VDC range or more.

You may ask how this happens when no current has been flowing through the ignition coil. My understanding is that in and IDI system, the voltage in the primary coil is created after the current flow through the IDI system ignition coil is stopped, and since the magnetic field is at its peak, the voltage developed in the primary coil could be I the range of 250 VDC or more depending on the application.

This voltage is then transferred to the spark plugs through the secondary coil of wire that has a significant number of more wire turns in the range of 100 times more. This raises the voltage I the secondary coil windings to approximately 25,000 VDC or more.

Using a CD system with a “matched” ignition coil can have the benefits of improving engine on-street performance.

The EFI system works exactly the same way. There is a trigger wheel that indicates to the ECU the engine cylinder orientation, The ECU determines from this when the best time to fire the coils through the spark plugs.

Even though the EFI system does not use a capacitor in the ignition system, the ECU controls the coil dwell time to suit engine RPM, and operating parameters as well as electrical system voltage, and external influences such as barometric pressure, ambient air temperature, and the likes. Coil charge time can also be adjusted by doing some coil tuning as well.

Spark Igniters – these units, generally called coil drivers or ignition modules, are used to turn a coil(s) grounding circuit on/off so that a “charge” can be built-up in the coil. When the ECU grounding circuit is removed from the coil driver, the coil discharges the internal “charge” to ground through the spark plugs, firing the engine cylinder.

These coil drivers can be classified as “smart” or “dumb” coil driver modules. Smart coil drivers have internal circuitry that controls the dwell time of the coil(s) it controls.

A dumb coil driver relies on the ECU to control the coil(s) dwell time, turning the coil driver grounding circuit on off to suit. This is the most common type of factory ignition module.

The CDI system has two coil drivers called spark units (coil drivers), one for each coil. Each coil discharges the built-up coil charge to two cylinders, one on the compression/power stroke, the other on the exhaust stroke. This is called a wasted spark system.

These spark units control the current flow through the coil(s), allowing for a charge to build up in the coil then discharged through the spark plugs at the appropriate time.

These CFI spark units have stood the test of time and are very reliable. The issue is there have been no alternative coil drivers identified as a replacement.

Spark units (coil drivers/ignition modules) can be either “smart” or “dumb” units. It is not known which the CFI spark units are, but suffice it to say a good guess would be that these are “dumb” ignition modules probably from an economic point of view.

My research into coil drivers indicates that the CFI spark units may be able to be replaced with a more modern dumb coil driver. What needs to be determined is what signal the ECU provides current/grounding, to the coil driver to activate it, and for how long.

The ECU may send a small current/voltage to the dumb ignition module, or provide a grounding signal to turn the ignition module on. Removing the voltage signal causing the voltage signal to drop to “0” and cause the ignition module to fire the coils, as will removing the ground and the voltage at the transistor goes back up.

Smart ignition modules generally receive a simple digital square wave from the ECU that is ON/OFF for an equal amount of time. You need to know when these ignition modules fire the coils through the spark plugs, when the voltage signal is ON or OFF.

The disadvantage to using a smart ignition module is, that these generally work well in an EFI system designed for these. Smart ignition modules have preprogramed dwell times and specific current requirements, and generally need to be matched to a coil, coil set or sets that have a current draw and dwell time that matches the ignition module. Using a smart ignition module that controls the coil dwell time and pairing it with a coil that may need considerably less dwell time can “fry” the coil, ignition module or both.

A dumb ignition module may be used with a coil not designed specifically to be used with it, but you can adjust the coil dwell time using the ECU program, minimizing and sometimes eliminating operating issues.

How the ignition module is switched ON/OFF by the ECU must be determined. This is generally known as GOING HIGH or GOING LOW. GOING HIGH or GOING LOW for an ECU may be the opposite for a different ECU. In other words, GOING HIGH may mean GOING LOW for a different ECU.

The coil drivers used with an aftermarket ECU are well documented as are the coil driver settings that you enter into the ECU tuning software.

Ballast resistors deserve a very quick mention. There are no ballast resistors used in an EFI system. There, I’m done.

Dwell Time

Dwell time is the amount of time required to fully charge the coil so that when it discharges through the spark plug, the spark created for combustion is powerful enough to ensure complete combustion as per design. Too little dwell time and the spark will not be as powerful as it should be, too great a dwell time and you have the potential to “fry” your ignition module, coil or both.