

Delphi Ignition Coils

Delphi Ignition Coils supply the required electrical energy needed to ignite air-fuel mixtures in an engine's combustion chamber. They are designed to meet a wide variety of continually evolving requirements for combustion calibrations. Delphi Ignition Coils are also designed to operate dependably and reliably under all operating conditions and throughout the entire engine speed range to help manufacturers meet the highest engine performance, exhaust emissions, and fuel economy objectives.

Delphi offers the most comprehensive line of ignition coils and smart ignition systems in the industry. Packaging options include the following:

- Pencil coils
- Plug top coils
- Coil-near-plugs
- Waste spark systems

All design options are available in single coil, multi-coil packs, and cassette configurations.



Delphi Pencil Coil Cassette

► Benefits

- Improved dwell accuracy decreases module and coil temperatures for greater reliability
- Noise abatement material between laminations reduces audible coil noise
- Cassettes have improved primary connector for greater ease of assembly compared to designs with one connector for each coil
- Lower primary inductance provides high-speed performance
- Early and precise electronic spark timing helps improve fuel economy and provides faster crank-to-run
- Higher energy delivered to combustible mixture provides cleaner combustion to help manufacturers meet on-board diagnostics (OBD II) requirements
- Direct connection to spark plugs (via small boot) eliminates spark plug wires
- Composite iron coils provide programmable energy
- Coil per cylinder dwell overlap electronics deliver better high speed performance and better heat dissipation compared to some conventional technologies
- Coil per cylinder ramp and fire electronics decrease power dissipation and increase efficiency
- Radio frequency interference (RFI) suppressor optional

► Typical Applications

Delphi Ignition Coils can be designed for use with conventional multi-port fuel injection or gasoline direct injection (GDI) engines. Delphi offers ignition coils for a wide range of gasoline engine products including the following:

- Automotive
- Motorcycles
- Marine engines
- Commercial products
- Power sports products

▶ Delphi's Ignition Coils Product Portfolio

Delphi Pencil Coils are designed to take advantage of unused space typically found above a conventional spark plug (spark well). Their compact size enables them to fit directly into any typical spark plug hole (>23 mm of inside diameter) of four-valve engines. Delphi pencil coils are available in a variety of configurations and they are offered with outside diameters ranging from 22.0 mm to 29.1 mm, and energy rates from 35 mJ to 80 mJ (depending on size). They can include magnetic biasing that provides a combination of small size, high energy performance, and ease of packaging.

Additional options include:

- Igniter
- Twin spark capability
- Cassette design
- Conventional or boltless fastening
- Ion Sense capability
- Multi-Charge feature

Delphi Gasoline Direct Injection (GDi) Pencil Coils offer the highest energy density coil in the industry and industry-leading durability. They are designed to provide variable energy output to match engine operating conditions and supply the required energy level needed to ignite a diluted stratified charge. Typically, they are packaged within the GDi cylinder head space constraints.

Delphi Plug Top Coils are designed to be used when packaging constraints prevent the use of pencil coils (spark well inside diameter <22 mm) and when a high output energy coil is required (energy >80 mJ). Secondary output energy ranges between 35 mJ and 100 mJ, depending on the size of the coil. Delphi plug top coils are available in coil per cylinder configurations, either individual or cassette-type packages. They offer small package size while providing the required output voltage to break the spark plug gap and the necessary high energy level to ensure and enhance combustion stability.

Options include:

- Igniter
- Twin spark capability
- Cassette design
- Conventional or boltless fastening
- Ion Sense capability
- Multi-Charge feature



Delphi Pencil Coils



Delphi Gasoline Direct Injection (GDi) Pencil Coil



Delphi Plug Top Coils

Delphi Coil-Near-Plugs are typically used in overhead valve (OHV) engine applications in which the spark plugs are located close to the exhaust system and, thus, will experience extreme temperatures. Coil-near-plugs are connected to the spark plugs via short plug wires. They feature coil per cylinder configurations and are available with or without integrated igniters. Delphi coil-near-plugs offer high quality, robust durability and excellent reliability.

Delphi Waste Spark Pencil Coil Packs (PCP) provide one coil per two pairs of cylinders. (Two coils for 4-cylinder engines; three coils for 6-cylinder engines.) Delphi waste spark PCP feature pencil coil technology in a lower cost waste spark configuration. The pack design offers the highest energy density to enable mass reduction of up to 40 percent compared to conventional ignition coils. Delphi waste spark PCP include:

- Cassette/miniature package or semi-direct mount
- Laminated core
- Enhanced performance option

Delphi Ignition Coils for Small Engines are typically used on one- and two-cylinder gasoline engines and range from small inductive ignition coils to stand-alone smart ignition modules that can adjust spark timing to help provide economical fuel consumption and optimal engine performance. They offer a fully laminated core and a coil igniter circuit that provide reliable, robust design to meet harsh off-road conditions and demanding engine requirements. RFI (radio frequency interference) and EMC (electromagnetic compatibility) compliant versions are also available.



Delphi Coil-Near-Plugs



Delphi Waste Spark Pencil Coil Packs



Delphi Ignition Coil for Small Engines

Delphi Ionized Current Sensing Ignition Subsystem

features direct in-cylinder measurement of combustion quality. It uses conventional spark plugs as "in cylinder" sensors for combustion quality. The Delphi ion sense ignition subsystem also offers more precise misfire detection (determined by combustion results instead of speed calculations) and more accurate knock detection (measured by combustion signal not engine vibration). In the ion sense ignition subsystem, the igniter, bias and buffer circuits are fully integrated and encapsulated in the coil as one unit. The ion sense ignition subsystem enables continued development of future functionality and advanced features such as:

- Location of peak pressure (LLP)
- Cold start compensation
- Dilution control
- Pre-ignition detection

Delphi Multi-Charge features a coil-per-cylinder control that enables longer spark duration, increased spark energy and re-ignition in the event of combustion blow-out when liquid is present. It offers multiple opportunities for the initiation of robust combustion, improved geometric strength, and compensation of fuel spray variation. Delphi Multi-Charge is designed for spray guided GDi applications and other engines that use highly diluted fuel mixtures. Coil smart electronics are fully integrated and encapsulated.



Delphi Ionized Current Sensing Ignition Subsystem



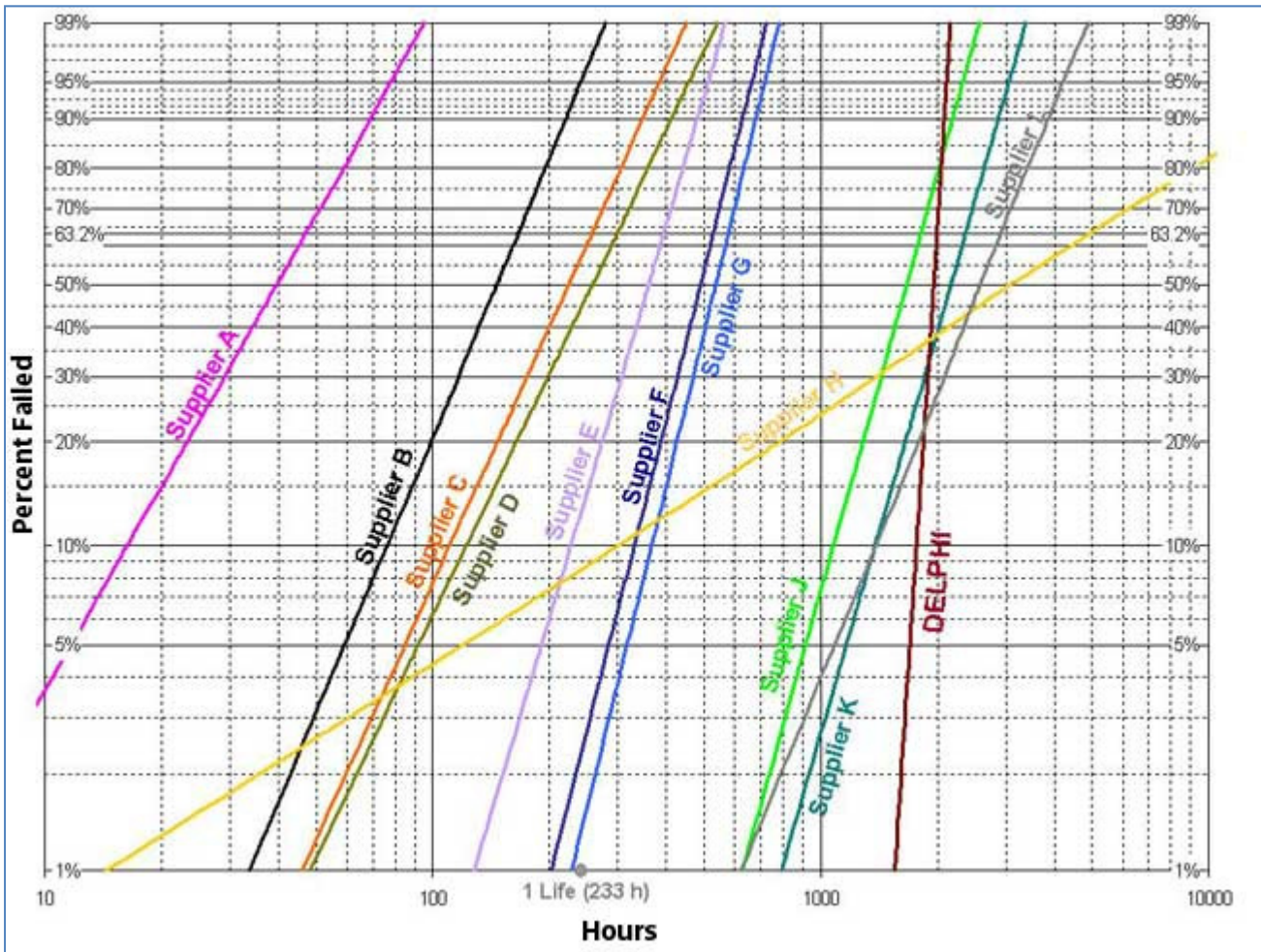
Delphi Plug Top Ignition Coil with Multi-Charge

► **Typical Delphi Coil Per Cylinder Ignition Performance Data**

Measurement Description	Pencil Coil Multi-Port Fuel Injection	Pencil Coil Gasoline Direct Injection (GDi)	Coil-Near-Plug	Plug Top Coil
Energy (1000 V zener load)	40 mJ	86 mJ	90 mJ	50 mJ
Peak Secondary Current (1000 V zener load)	80 mA	120 mA	110 mA	70 mA
Spark Duration (1000 V zener load)	1.3 ms	1.7 ms	2.0 ms	1.6 ms
Secondary Voltage (* Primary Clamped)	34 kV	39* kV	40* kV	36* kV
Secondary Load	25 pF	25 pF	30 pF	30 pF
Primary Resistance	0.71 Ω	0.52 Ω	0.43 Ω	0.44 Ω
Primary Charge Time (14 V)	2.2 ms	3.4 ms	3.1 ms	2.0 ms
Nominal Primary Current	7.5 A	10.5 A	12.5 A	12.3 A
Weight	175 g	240 g	370 g	300 g

(Note: Performance information is based on actual product data. Delphi can design an ignition system to meet specific customer requirements.)

▶ **Pencil Coils Accelerated Life Testing**



Delphi Ignition Coils are designed for long-term durability and they consistently outlast products from major competitive suppliers as demonstrated by this graph showing accelerated life test results.

▶ **Performance Advantages**

Delphi Ignition Coils and Ignition Systems are built of sturdy materials and designed for long-term durability and reliability. They feature cost-effective designs and are produced by smart manufacturing processes that enable successful implementation across a wide range of engine applications. Delphi offers manufacturers a complete systems integration approach to ignition systems development. Every step of the ignition process is analyzed, including the creation, transmission, timing and delivery of the ignition spark energy. This strategy provides optimized ignition systems tailored to customer requirements.

▶ The Delphi Advantage

Delphi has a deep understanding of ignition systems and the combustion process. We offer the benefits of more than 100 years' experience in ignition systems and today we build millions annually. We offer a low cost, global manufacturing footprint and the most comprehensive line of ignition systems in the industry. Our ignition products excel in performance, quality and durability. We provide advanced and innovative technologies designed to help our customers meet the market challenges of the future.

As a global leader in engine management systems technology, Delphi can help manufacturers meet emissions requirements, improve fuel economy and enhance performance. Delphi is a source for high value solutions and our systems expertise is built into every product. Delphi's flexible engineering approach encourages collaboration. And, Delphi has as thorough understanding of automotive markets around the world and a global network of resources.