All about ignition coils

Technical Information

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Perfection built in

FEDERAL-MOGUL MOTORPARTS

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TRUSTED TECHNOLOGY

OVER 400 IGNITION COILS TYPES FOR MORE THAN 12.500 DIFFERENT VEHICLE TYPES

BERU Ignition Coils are developed, tested and built in Western Europe, Asia and Mexico by BorgWarner to the OE specifications and quality standards. BERU offers a large range of Ignition Technologies for petrol engines.

BorgWarner supplies OEM's with ignition coils for nearly all significant European volume applications. The company currently offers a range of over 400 ignition coils to the maintenance and repair markets – needless to say in original equipment quality. Today the market penetration of the range in VW vehicles is 99%, in BMW Group vehicles 96%, in the VW Group as a whole 95% – and today the range is being continuously extended in accordance with market requirements.

BERU Ignition Coils are engineered and manufactured at BorgWarner

BERU QUALITY

- Products are designed by BorgWarner in close cooperation with car manufacturers
- Products are developed according to the specifications of the automotive industry
- Manufacturing according to ISO standards
- Products are subjected to special BERU tests
- Manufacturing according to up to date production methods

Fewer emissions, lower fuel consumption, higher ignition voltage, restricted space in the drive unit and engine compartment: The design demands on modern ignition coils are constantly increasing. Although the task of spark-ignition engines remains the same: the fuel / air mixture must be ignited at the right time with the optimum ignition energy so that complete combustion occurs. To reduce fuel consumption and emissions and to increase the efficiency, engine technologies are constantly developed further – and thus also the BERU ignition systems.

In particular, BorgWarner runs its own R&D departments at its Ludwigsburg, Germany plant and in Asia, in which ignition technologies are driven forward in cooperation with the international automotive industry. Thus BERU ignition coils are being precisely adapted to the requirements of modern spark-ignition engines such as turbocharging, downsizing, direct injection, lean mix, high exhaust gas recirculation rates etc. In the process, we are able to fall back on a whole century of valuable experience as an ignition technology expert.

OE BUSINESS

BorgWarner (manufacturer of BERU products) has an international reputation for delivering innovative ignition solutions that meet original equipment (OE) manufacturer standards.

BorgWarner is delivering OE Ignition Coils, also for recent applications such as those displayed (depending on the engine), which are delivered to the aftermarket via Federal-Mogul Motorparts under the BERU brand.

- Audi A1 1.2 (05-2010→), A3 1.2-1.8 (08-2000→05-2013)
- Seat Ibiza II/III/IV 1.2-2.0 (05-2000→)
- VW Golf IV/V/VI 1.2-2.0 (08-1997→12-2013)
- BMW X3 2.0-3.0 (01-2004→)
- Citroën C4 1.4-1.6 (07-2008→)
- Ford Kuga 2.0 (09-2014→)
- Mini 1.4-1.6 (09-2006→10-2016)
- Peugeot 208 1.4-1.6 (03-2012→), 3008 1.6 (06-2009→)
- Volvo S40 1.6 (01-2005→12-2012)
- Mercedes-Benz G-Class 3.2 - 5.5 (07-1997→)

THE SPARK IGNITION ENGINE

OPERATION OF IGNITION COILS IN THE SPARK-IGNITION ENGINE

Optimum ignition of the compressed fuel / air mixture has been one of the greatest challenges for designers since the early days of engine construction. In the case of ignited sparked engines, this conventionally occurs in sequence with the compression cycle by an electrical spark from the spark plug. So that the voltage can make the jump between the electrodes, a charge must first be accumulated by the vehicles' low voltage electrical system, then stored and finally discharged at the spark plug at the ignition timing.

This is the job of the ignition coil as an integral part of the ignition system.

An ignition coil must be exactly attuned to the respective ignition system. The required parameters include:

- The spark energy, which is available to the spark plug
- The spark current at the time of the spark discharge
- The combustion duration of the spark at the ignition plug
- The ignition voltage under all operating conditions
- The spark count at all speeds

Spark-ignition engines with turbocharger or direct fuel injection require higher spark energies. The high voltage connection between ignition coil and spark plug must be functional and safe. This is where BERU comes in with high-quality ignition cables with suitable contacts or high-voltage ignition coil connectors.

THE DEMANDS PLACED ON A MODERN IGNITION COIL

Ignition coils in the ignition systems of modern cars generate voltages of up to 45,000 V. It is essential that misfiring – and as a consequence incomplete combustion – is avoided. It is not only that the vehicles' catalytic converter could be damaged. Incomplete combustion also increases emissions and thus environmental pollution.

Ignition coils are – regardless of the system (static high voltage distribution, rotating high voltage distribution, double spark coil, single spark coil) – electrically, mechanically and chemically highly stressed components of the spark-ignition engines. They must perform faultlessly under a wide variety of installation conditions (on the body, engine block or directly on the spark plug in the cylinder head) over a long service life.

Plug shaft ignition coils are mounted deep in the engine compartment and must withstand extreme thermal loads.

Ignition coils:
electrical, mechanical, thermal, electrochemical requirements.

- Temperature range -40 °C to +160 °C
- Secondary voltage to 45,000 V
- Primary current 6 to 20 A
- Spark energy 40 mJ up to approx. 90 mJ (at present) or 120 mJ (future) with same coil size
- Vibration range to 55 g
- Resistance to gasoline, oil, brake fluid

IGNITION COILS DESIGN AND MODE OF OPERATION

IGNITION TECHNOLOGY TERMINOLOGY

Ignition coils work on the transformer principle. They basically consist of a primary winding, a secondary winding, the iron core and a housing with isolation material, nowadays two-component epoxy resin.

On the iron core of individual thin steel sheets two coil elements are applied e.g.:

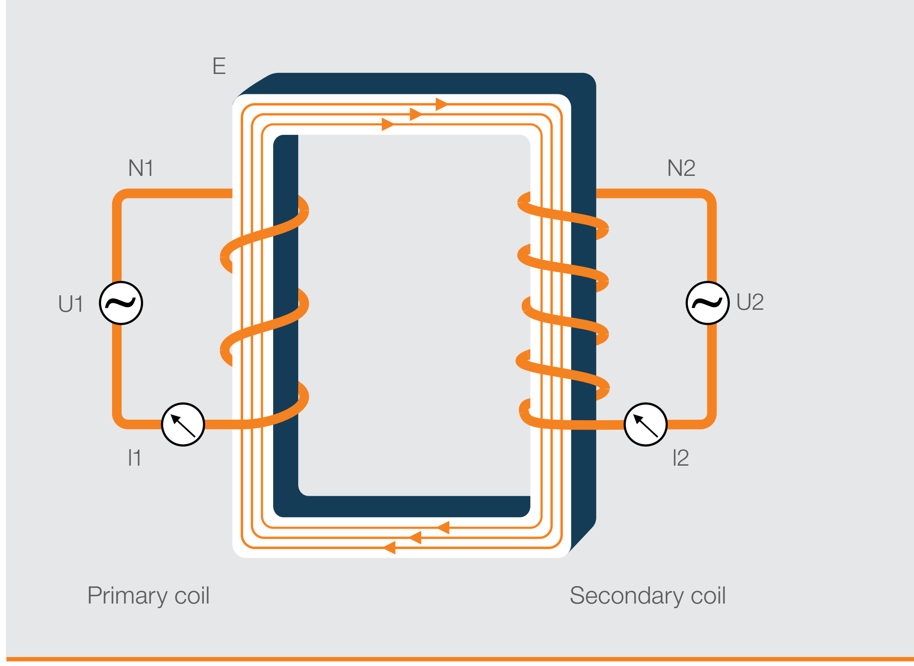
- The primary winding is made of thick copper wire with approx. 200 windings (diameter approx. 0.6mm),
- The secondary winding is made of thin copper wire with approx. 20,000 windings (diameter approx. 0.063 mm)

As soon as the primary coil circuit closes, a magnetic field is generated in the coil. Induced voltage is generated in the coil by self induction. At the time of ignition, the coil current is switched off by the ignition output stage. The instantaneously collapsing magnetic field generates a high induction voltage in the primary winding. This is transformed on the secondary side of the coil and converted in the ratio of "number of secondary windings to primary windings". A high voltage flashover occurs at the spark plug, which in turn leads to ionization of the spark gap and thus to a flow of current. This continues until the stored energy has been discharged. As it jumps, the spark ignites the fuel/air mixture.

The maximum voltage depends on:

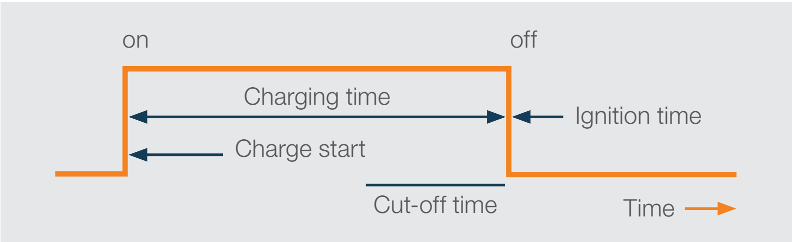
- The ratio of the number of windings from the secondary winding to primary winding
- The quality of the iron core
- The magnetic field

- E = Laminated iron core (magnetic)
- N1 = Windings primary side 100–250 windings
- N2 = Windings secondary side 10,000–25,000 windings
- U1 = Primary voltage (battery voltage) 12–14.7 V
- U2 = Secondary voltage 25,000–45,000 V
- I1 = Primary current 6–20 A
- I2 = Secondary current 80–120 mA



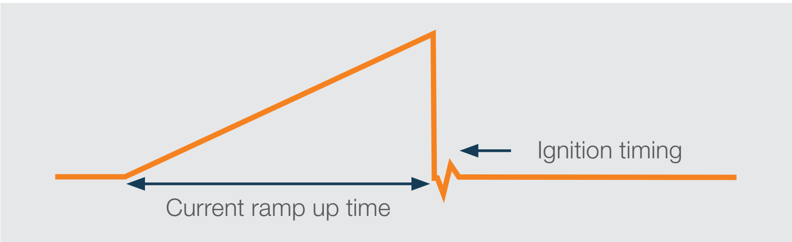
Schematic diagram:
structure of an ignition coil

Control



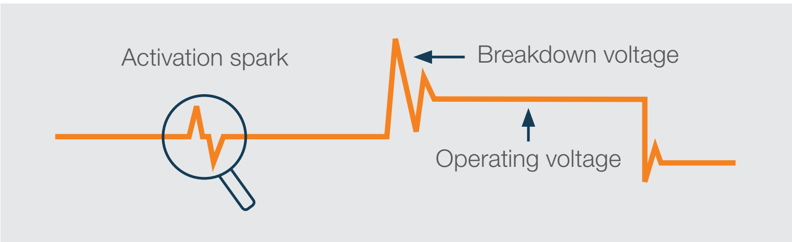
Energy storage: During current supply to the coil, energy is being stored in the magnetic field. Power on, coil is charged (primary circuit is closed, secondary circuit is open). At a specified ignition point the current is interrupted.

Primary current



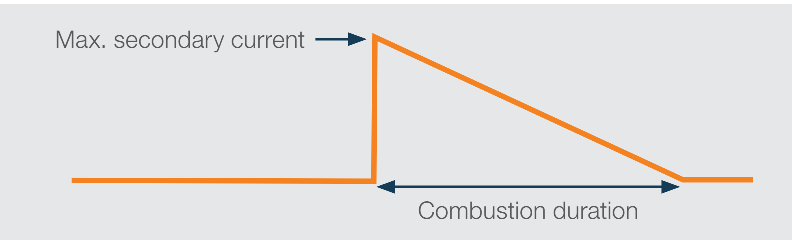
Induced voltage: Every change in current in an inductance (coil) induces (creates) a voltage. Secondary high voltage builds up.

Secondary voltage



High voltage: As in a transformer, the achievable voltage is proportional to the primary / secondary winding ratio. The spark flashover occurs when the ignition voltage has been reached (breakthrough).

Secondary current



Ignition spark: After the high voltage flashover on the spark plug, the stored energy is discharged in the spark channel (primary circuit is open, secondary circuit is closed).

SPARK ENERGY

An important performance criterion for ignition coils is their spark energy. This determines the spark current and the spark combustion duration at the spark plug electrodes. The spark energy of modern BERU ignition coils is 50 to 100 millijoules (mJ). 1 millijoule = 10^{-3} J. Ignition coils of the latest generation have spark energies of up to 120 mJ. This means that there is a risk of fatal injuries from touching these high voltage parts! Please note the safety regulations of the respective vehicle manufacturer.

HOW MANY IGNITION SPARKS DOES AN ENGINE NEED?

$$\text{Spark count F} = \frac{\text{rpm} \times \text{number of cylinders}}{2}$$

For example:
4-cyl. 4-stroke engine, speed 3,000 rpm

$$\text{Spark count} = \frac{3{,}000 \times 4}{2} = 6{,}000 \text{ sparks / min}$$

For a driven distance of 300.000km, with an average speed of 60km/h, an engine is performing 5000 hours. This is corresponding to 450 million sparks/ignition coil.

Ignition coil specifications / characteristics

I_1	Primary current	6–20 A
T_1	Charging time	1.5–4.0 ms
U_2	Secondary voltage	25–45 kV
T_{Fu}	Spark duration	1.3–2.0 ms
W_{Fu}	Spark energy	10–60 mJ for "normal" engines, up to 120 mJ for "DI" engines
I_{FU}	Spark current	80–115 mA
U_1	Primary voltage (battery voltage) 12–14.7 V	0,3–0,6 Ohm
U_2	Secondary voltage 25,000–45,000 V	5–20 kOhm
N_1	Number of primary windings	100–250
N_2	Number of secondary windings	10.000–25.000

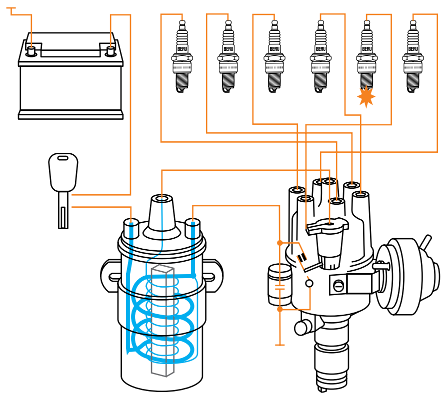
IGNITION COILS TYPES AND SYSTEMS

IGNITION COILS TYPES AND SYSTEMS

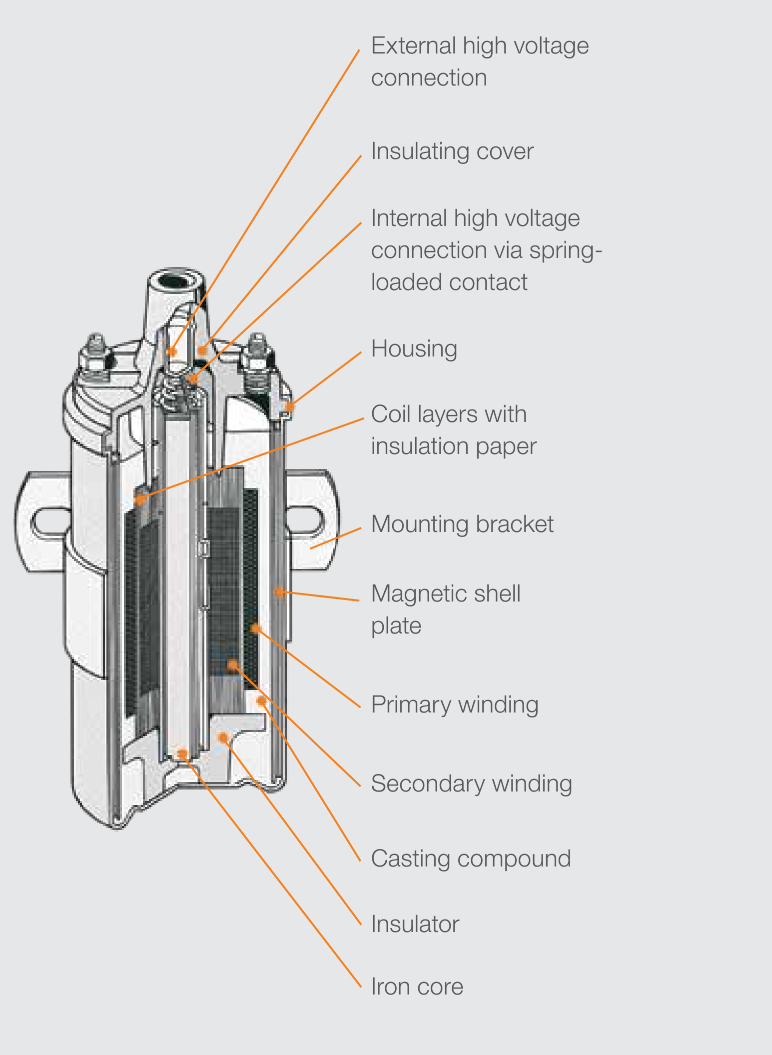
The range of ignition coils from BERU embraces over 400 ignition coil types for all current technologies: from the canister-type coils for older cars through ignition coils with integrated electronics for cars with mechanical ignition distributors and double-spark ignition coils (for Fiat, Ford, Mercedes-Benz, Renault, VW and others) to rod or pencil-coil ignition coils (plug-shaft ignition coils), which are directly mounted on the spark plug. In the case of the VW brand, the market penetration of BERU ignition coils reaches 99%. Moreover, the company produces complete ignition coil rails in which several individual ignition coils are combined in a common casing (rail).

CANNISTER TYPE IGNITION COILS

Nowadays canister-type ignition coils are only installed in classic cars. These are for vehicles with rotating high voltage distribution and contact breaker control.



Triggering by contact breaker. In this case the voltage is centrally generated by an ignition coil and is mechanically distributed by an ignition distributor to the individual spark plugs. This kind of voltage distribution is no longer used in modern motor management systems.



ELECTRONIC DISTRIBUTOR IGNITION COILS

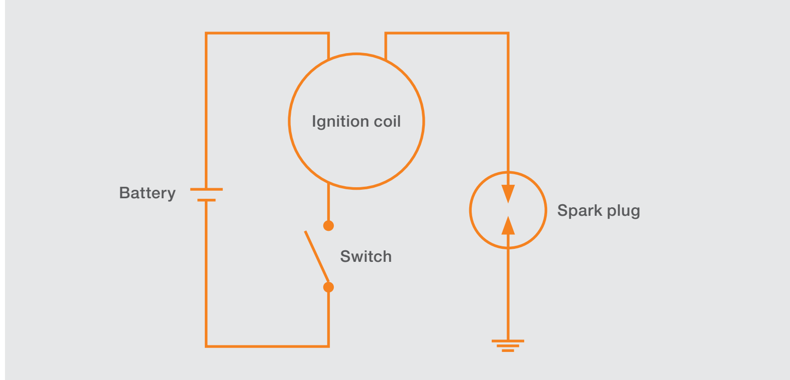
In older ignition systems, the output stage was mounted as a separate component in the engine compartment on the vehicle body or – in the case of rotating high voltage distribution – in or on the ignition distributor. The introduction of static high-voltage distribution and the development of microelectronics made it possible to integrate the output stage into the ignition coil. This results in numerous advantages:

- Diagnostic possibilities
- Ion current signal
- Interference suppression
- Power cut-off
- Current limitation
- Thermal cut-off
- Short circuit recognition
- High voltage stabilization

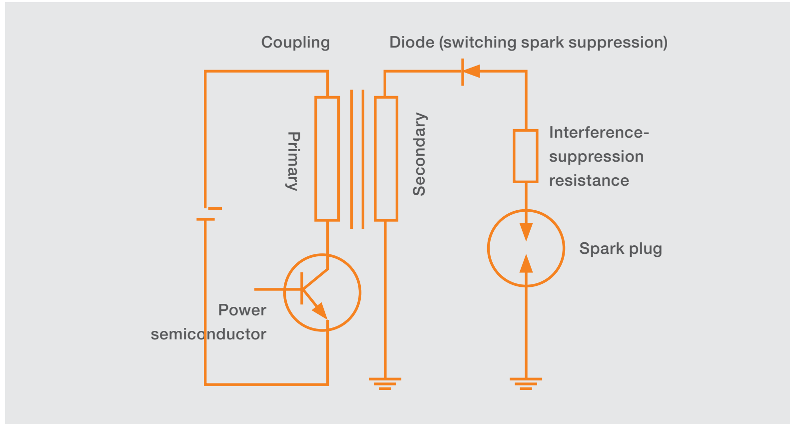
BERU distributor ignition coil with built-on output stage for vehicles with mechanical ignition distributor.

Double-spark ignition coil.

Contact-controlled ignition system



Electronic ignition system



Closing time
In a contact-controlled ignition system, the closing time is the time in which the contact breaker is closed. In an electronically controlled ignition system, the closing time is the time in which the primary current is switched on.

DOUBLE-SPARK IGNITION COILS

Dual-spark ignition coils produce for every two spark plugs/two cylinders each an optimum ignition voltage in different cylinders. The voltage is distributed so that

- The air/fuel mixture of a cylinder is ignited at the end of compression stroke (ignition time) (primary sparks - powerful ignition spark),
- The other cylinder's ignition spark jumps in the exhaust stroke (secondary sparks – low energy).

Double spark ignition coils generate two sparks per crankshaft rotation (primary and secondary spark). No synchronization with the camshaft is required. However, double spark ignition coils are only suitable for engines with even numbers of cylinders. Thus in vehicles with four cylinders and six cylinders, two and three double spark ignition coils respectively are installed.

IGNITION COILS TYPES AND SYSTEMS

Double spark ignition coils
2 x 2 for four cylinders
Double spark ignition coil for 2 x 2 spark plugs. For example, for: Volkswagen, Audi.

Double-spark ignition coil

I II

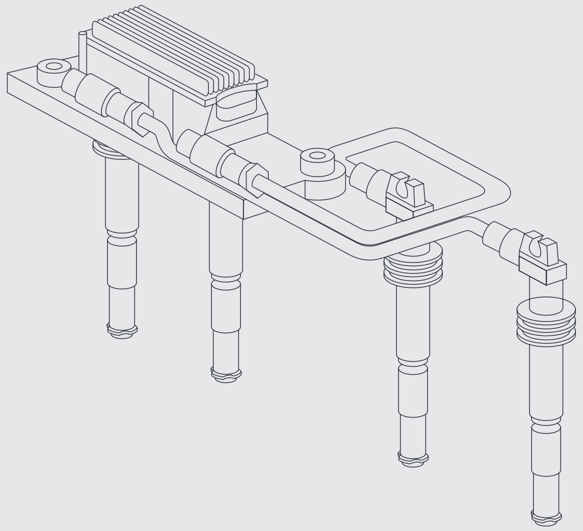
360° Kw

Cyl. 1	Power	Exhaust	Intake	Compression
Cyl. 2	Exhaust	Intake	Compression	Power
Cyl. 3	Compression	Power	Exhaust	Intake
Cyl. 4	Intake	Compression	Power	Exhaust

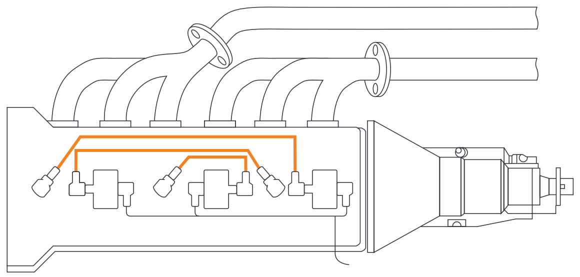
Point of time 1 2 3 4

Ignition cycle: 1 - 3 - 4 - 2

Static high-voltage distribution:
ignition cable set consisting of two cables with spark plug connectors. The ignition coil is mounted on the other two spark plugs.



Double spark ignition coils 3 x 2 for six cylinders
Ignition coils are mounted on the spark plugs for cylinders 2, 4 and 6. For example, for: Mercedes-Benz M104.



IGNITION COIL RAILS

In an ignition coil rail (ignition module), multiple ignition coils – depending on number of cylinders – are arrayed in a common housing (rail). However, these coils are functionally independent and operate like single spark ignition coils. The design advantage is that fewer connecting cables are required. One compact plug connection is sufficient. Moreover, the modularity of the ignition coil rail helps make the entire engine compartment more 'elegant', more clearly arranged and uncluttered.

Ignition coil rails or ignition rails are commonly used in 3- or 4-cylinder engines.

PLUG TOP- / PENCIL- / SMART- COILS

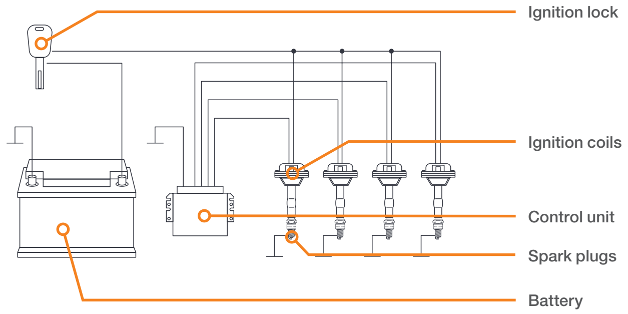
Single spark ignition coils – also known as plug shaft/connector ignition coils, rod or pencil coil or smart-plug-top-coil ignition coils – are directly mounted on the spark plug. Normally no ignition cables are required for this (with the exception of double spark ignition coils), whereby high-voltage connectors are required. In this design, each spark plug has its own ignition coil, which is located directly above the spark plug insulator. This design enables particularly filigree dimensions.

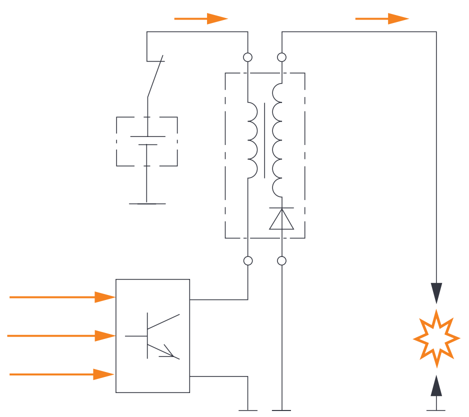
Modular, compact, light smart plug-top-coil ignition coils of the latest generation are especially suited with their space-saving geometry for modern downsized engines. Even though they are more compact than larger ignition coils, they generate greater combustion energy and higher ignition voltage. Innovative plastics and the extremely safe connection technology of the components inside the ignition coil body also ensure an even greater reliability and durability.

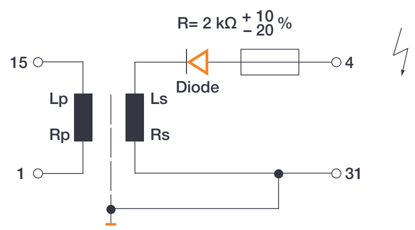
Single spark ignition coils can be used in engines with both even and uneven numbers of cylinders. However, the system must be synchronized via a camshaft sensor. Single spark ignition coils generate one ignition spark per power stroke. Ignition voltage losses are the lowest of all ignition systems due to the compact design of the single spark coil / spark plug unit and the absence of ignition cables. Single spark coils enable the largest possible range of ignition angle adjustment. The single ignition coil system supports monitoring of misfiring in the ignition system on both the primary and secondary side. Any problems that occur can thus be saved in the control unit, rapidly read out in the workshop via OBD and specifically rectified.

Wiring diagram for single spark ignition coil

For activation of spark suppression in the secondary circuit, single spark ignition coils require a high-voltage diode.



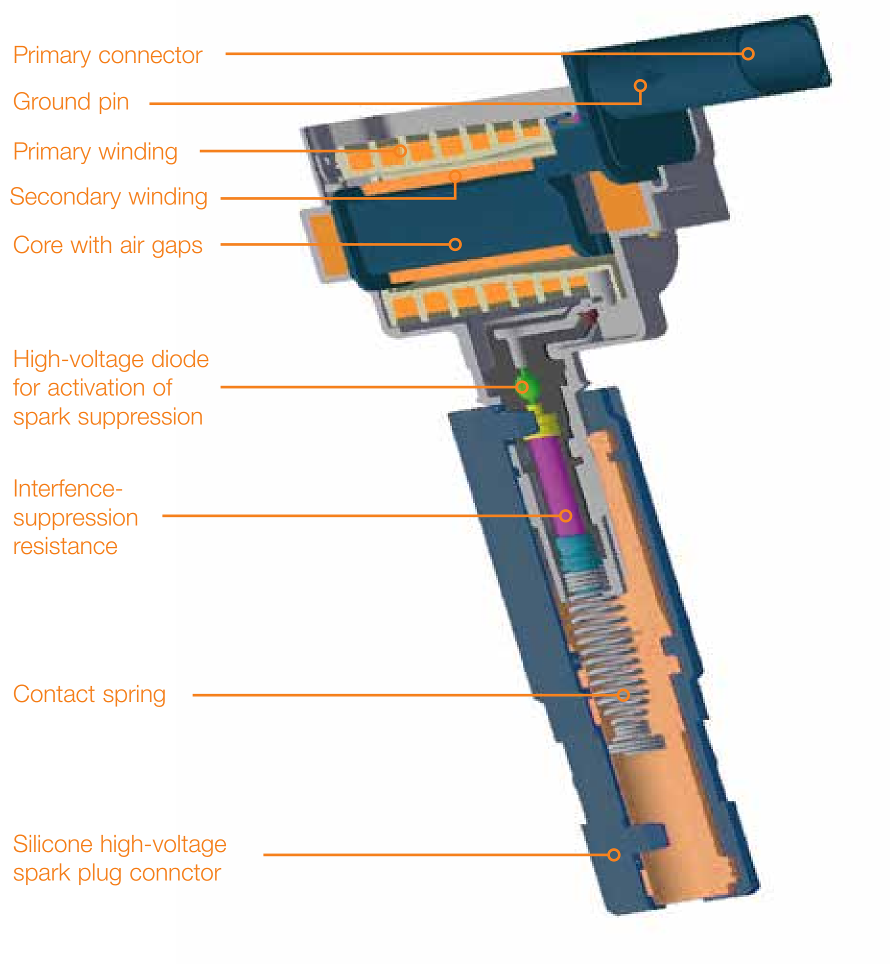




Design of single spark ignition coil

Single spark ignition coils generate one ignition spark per power stroke; therefore they must be synchronized with the camshaft.

Single spark ignition coils, for example for Audi, Porsche, VW



When the primary circuit is activated, a magnetic field builds up around the primary coil. This increase in magnetic field strength is sufficient to induce the undesired activation voltage of around 1.5 kW in the secondary winding. This can enable a weak activation spark to jump the ignition electrodes, which under some circumstances can result in the fuel / air mixture igniting at a completely incorrect time.

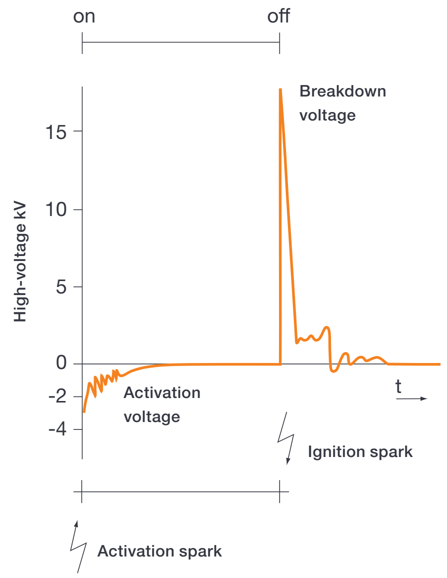
The activation spark is suppressed in all 3 systems (rotating high-voltage distribution, double ignition coil, single ignition coil):

No special measures are required in rotating high-voltage distribution systems: The sparking distance between the distributor rotor and the dome electrode of the distributor cap automatically suppresses activation sparks.

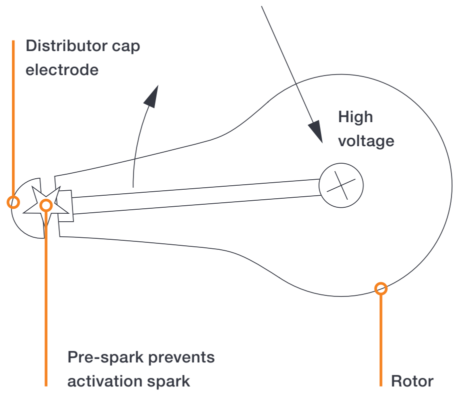
In the case of static high-voltage distribution with double spark ignition coils, the spark plugs are connected in series,that is the activation spark must jump the electrodes of both spark plugs. Only half of the activation voltage (1.5 kV: 2 = 0.75 kV) of the secondary winding is applied across each spark plug – a voltage which is too low to generate an activation spark.

In the case of static high-voltage distribution with single spark ignition coils, no activation spark is produced as the high voltage diode in the secondary circuit blocks the discharge of the activation voltage. Note: the polarities of terminals 1 and 15 may not be reversed as otherwise the high-voltage diode will be destroyed.

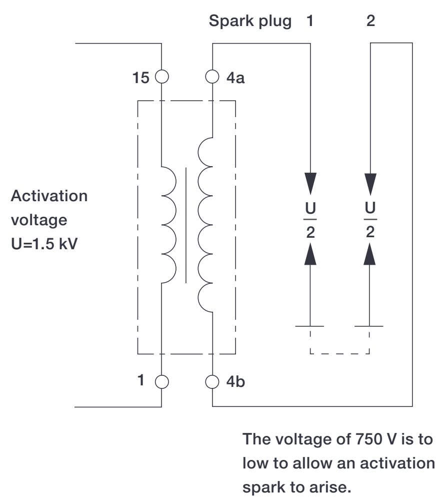
Activation spark



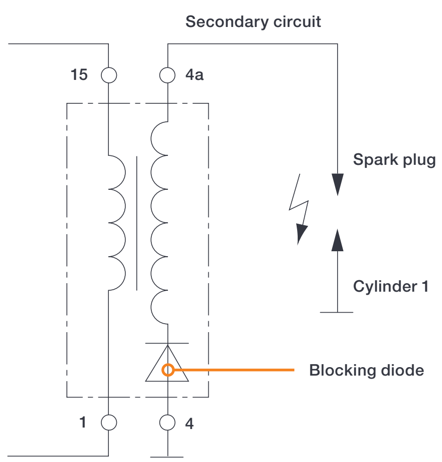
Rotating high-voltage distribution



Static high-voltage distribution with double spark ignition coil



Static high-voltage distribution with single spark ignition coil



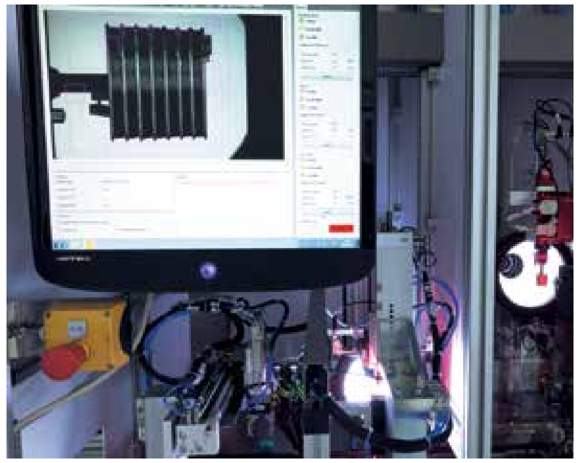
IGNITION COIL – PRODUCTION

THE BORGWARNER HIGH-TECH PRODUCTION SYSTEM FOR PLUG-TOP IGNITION COILS

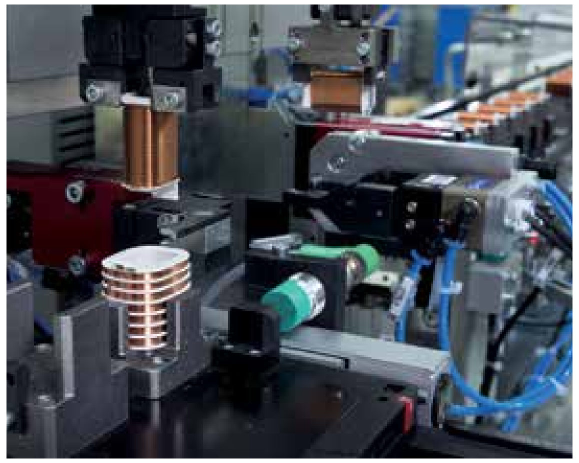
Every year several million ignition coils which are developed in partnership with the automotive industry, roll off computer-controlled, sophisticated production lines in BorgWarner production facilities.

The individual components are channeled into the line at the respective stations.

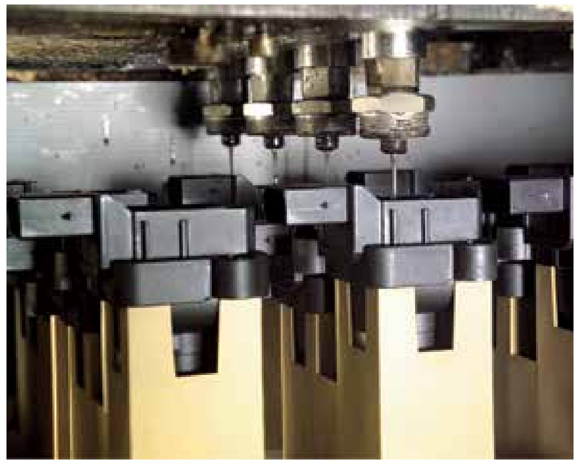
The winding of primary and secondary coils ...



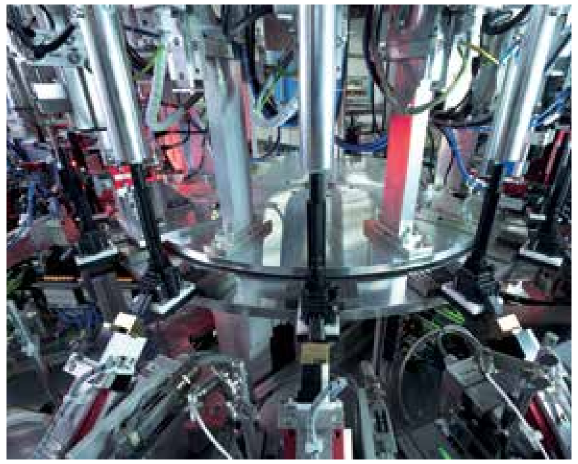
… is executed and monitored by computers.



This is where the primary and secondary coils are fully automatically assembled.



The secondary wire is embedded in the casting resin by vacuum casting.



One of the most important steps in the production sequence: final inspection of the ignition coil.

IGNITION COIL – PRODUCTION

TESTED QUALITY

BERU ignition coils meet the highest quality standards and ensure operational safety even under extreme operating conditions. In addition, even during the development phase and of course during production, the coils undergo numerous QA tests, which are indispensable for ensuring long-term function and performance.

Already in the development phase, BERU engineers precisely modify coils for the specific vehicle application in close cooperation with the vehicle manufacturers. They pay special attention to electromagnetic compatibility, which is the subject of exhaustive test series in the company R&D center in Ludwigsburg, Germany, in order to exclude a priori faults or restrictions of communication and safety systems in the vehicle.

When the development phase is completed, the BERU ignition coils are then produced according to the highest standards – and once more undergo numerous QA test. All the company's production facilities are DIN ISO 9001 certified. In addition, all BorgWarner production facilities in Germany are certified according to QS 9000, VDA 6.1 and ISO TS 16949 and according to the ISO 14001 environment certificate. BERU applies the most stringent quality standards in its selection of suppliers.

GENUINE ARTICLE AND FAKES

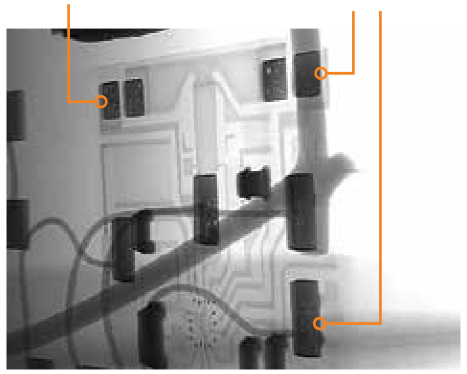
Copies of ignition coils are often cheap – but they are also cheaply made. For reasons of costs and due to a lack of know-how, manufacturers of such cheap products cannot match the quality standards, which BERU offers.

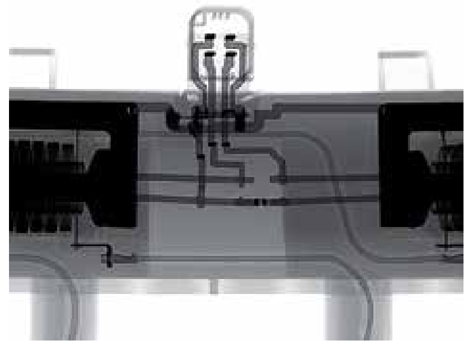
Most copies are made of low-quality materials and are cobbled together from a large number of individual components. They do not have the electrical properties and thermal load capacity of original ignition coils. Specifically in the case of coils with integrated electronics, copies only work properly in a few engine versions. Furthermore, they are often produced without reliable quality checks. For this reason, if such counterfeit goods are installed, costly sequential damage is to be expected.

What is so dangerous about this is that even specialists cannot easily detect such defects with the naked eye. For this reason BERU has closely examined original and bogus parts below.

IN FOCUS: SOLDER CONNECTION, CONTACTS, POWER TRANSMISSION

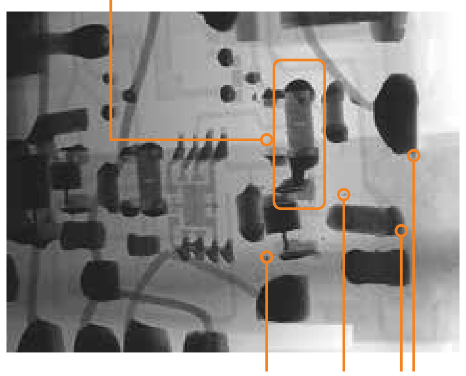
Original:
Printed circuit board with bus bar connections enables auto-mated production processes and optimum process control and, thus, consistent quality.

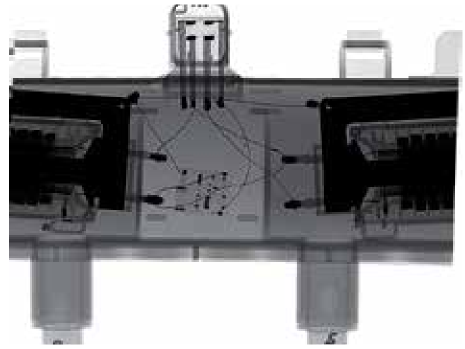




Original:
Exactly placed and welded bus bars and components fixed straight into the housing in the original BERU part – a sign of quality and durability.

Copy:
There are various foreign bodies in the coil, which is evidence of question-able production quality. Depending the location, material and thickness, these may subsequently result in short circuits and coil failure. Also noticeable: a slipped or incorrectly inserted component.

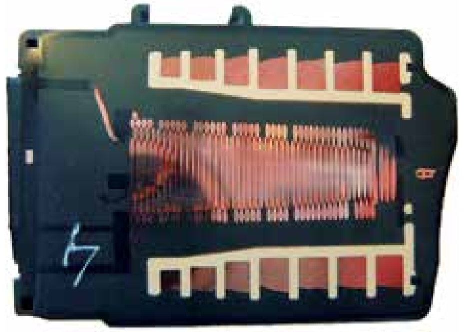




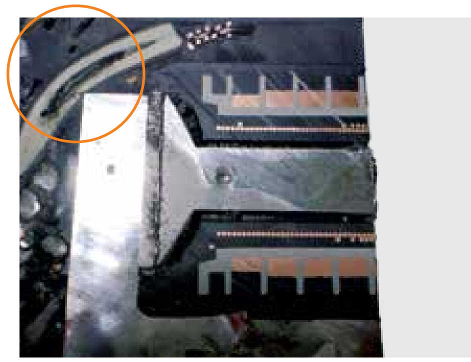
Copy:
Wires running in every which way, distorted contact fields in the high-voltage connection, crooked coil bodies and boards: premature failure of the ignition coil is only a matter of time.

IN FOCUS: CASTING COMPOUND AND IMPREGNATION QUALITY

Original:
BERU ignition coil with even casting compound. The filling material has been poured into the ignition coil housing under vacuum, thus preventing the formation of air bubbles.

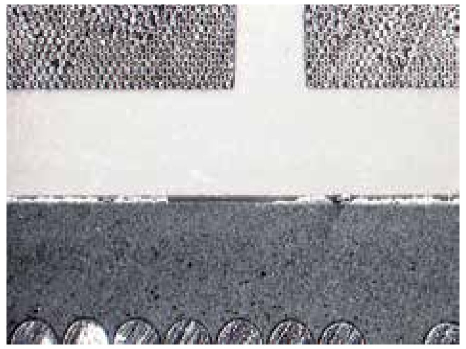


Copy:
The high-voltage cable and iron core must have a secure distance from the high voltage. In this case the high-voltage cable is too close to the iron core. Possible consequences are high voltage flashover and thus total failure of the ignition coil.



Copy:
Ignition coil housing and high-voltage cable have been filled with gravel to save on expensive casting compound. Air bubbles have formed in the gaps, the impregnation quality suffers, especially in the high-voltage section: If air collects in the secondary winding, it will become ionized – this means the air becomes conductive and in effect corrodes the coil housing until a ground potential is reached. This will result in a short circuit or flash-over and failure of the ignition coil.

Copy:
Separation between primary and secondary coil bodies due to unoptimized material pairings. This can result in leakage currents and disruptive discharge at the primary coil and thus lead to failure of the ignition coil.



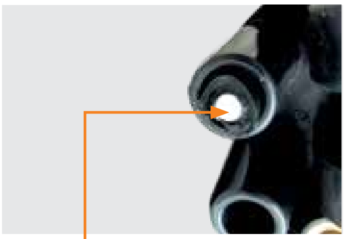
WORKSHOP TIPS

REASONS FOR REPLACEMENT

BERU ignition coils are designed to last for a car's entire life cycle. Notwithstanding this, there is always a need for replacements in practice. Usually this is not due to the ignition coils themselves but to problems in adjacent components or to improper installation / removal.

Old or subsequently installed substandard ignition coils or spark plug connectors often turn out to be responsible for supposed ignition coil defects.

Defect ignition cables / ignition coil connectors



The plug of the retrofitted, low quality ignition cable has broken due to clearly visible material faults (massive cavities / air inclusions).

Ignition coil that is no longer functional due to adjacent substandard components. It was sent in to BERU for examination.

Corroded ignition coil connection that was ripped out of the coil housing when the ignition cable plug was removed. The cause was a badly fitting, low quality plug that led to corrosion and hence to fusion with the ignition coil.

Contaminated surroundings

Ignition coils, which due to their installation position frequently come into contact with spray water or road salt are especially at risk. This exposure is exacerbated by the use of engine cleaning with high pressure sprays. As a result seals can be destroyed and contacts corroded.

Ignition coils that are directly mounted on the bulkhead are especially exposed. The possible consequence is oxidation of the contacts.

Plug shaft ignition coils are mounted deep in the engine compartment and must withstand extreme thermal loads.

PROPER REMOVAL / INSTALLATION

Coils in the immediate vicinity of the catalytic converter or exhaust manifold / cylinder head are exposed to high thermal loads. The same problem arises with plug-shaft ignition coils: The installation space is extremely limited and offers hardly any engine cleaning cooling. These extreme loads can in the long-term mean that even the best quality ignition coil can fail under certain circumstances.

In order to ensure that the transmission of high voltage is safe and reliable, the plug-shaft ignition coils are very firmly attached to the spark plugs. Due to the resulting high temperatures, there is a risk of the spark plug fusing with the ignition coils' silicone plug. It is therefore essential that BERU plug grease (order no. 0 890 300 029) is used when a spark plug is changed. This ensures that plugs are also easily removed.

SPECIAL TOOL FOR IGNITION COIL REPLACEMENT

Only the spark plug was to be exchanged. Because of the wrong removal tool, now the coil has to be replaced as well.

Because the plug-shaft ignition coils, are mounted on the spark plugs due to the slim built, it is very difficult to remove them because of the firm attachment of the SAE contact and the shield of the hexagon of the spark plug. Practical experience shows that when incorrectly removed, the ignition coil frequently breaks in two.

BERU offers workshop professional three special ignition coil pullers for Volkswagen Group applications that are especially adapted to the geometry of ignition coil heads. Depending on the respective design, the ignition coil housing may be flat, square or oval. The ignition coil pullers not only make it possible to extract current ignition coils but also previous models with similar head forms.

BERU special tools from left to right: ZSA044 (order no. 0 890 300 044), ZSA043 (order no. 0 890 300 043), ZSA042 (order no. 0 890 300 042).

Formation of longitudinal cracks on coil body due to incorrect and excessive tightening torque of 15 Nm instead of the correct 6 Nm.

Crack formation on the ignition coil insulation due to strain during installation.

SPARK PLUG CONNECTOR GREASE

The problem: After replacing the spark plugs, misfiring occurs intermittently – across the entire speed range. The cause is voltage flash-overs at the spark plug neck, caused by a leaking, damaged or embrittled spark plug connector.

The solution: Before the spark plug is installed, apply a thin layer of BERU connector grease (order no. 0 890 300 029) to the (smooth or fluted) spark plug neck. Important: always check the spark plug connector and, if required, replace. Especially in the case of single and double spark ignition coils with mounted connectors, it is recommended to replace the connector along with the spark plugs – as the latter often become embrittled in the sealing area of the spark plug and thus become leaky.

The hairline cracks are clearly visibly by pressing the spark plug connector.

Scorch marks on the spark plug neck – a sign of misfiring.

Test values for ignition coil ZS 283 installed, for example, in the Fiat Punto, Panda or Tipo.

Note: ignition coil and power output stage are a combined component and cannot be replaced separately.

TESTING AND CHECKING

Irregular engine running, lack of power: The reason for the fault could lie with the ignition coil. A glance in the engine compart-ment of the Fiat Punto shows: the ZSE 283 double spark ignition coil is installed there.

The use of a stroboscopic lamp is recommended for primary diagnosis of the cause of the fault. It is connected to each cylinder in turn with the engine running. If there is an irregular flashing frequency at one or more cylinders, there is a fault in the ignition system or the ignition coil.

The following remedies may be considered:

1. Examine spark plugs and replace, if necessary,
2. Test ignition cable resistance with multimeter. If necessary replace cables,
3. Test the rated resistance of primary and secondary circuits of the ignition coil as per manufacturer specifications. In event of anomalies, replace ignition coil.

Primary resistance test
Test of the primary resistance: rated resistance of the primary circuit at 20 °C.

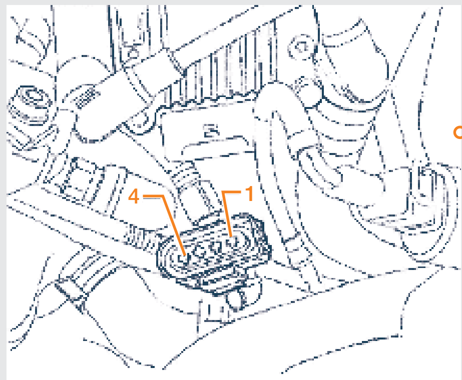
Secondary resistance test
Test the secondary resistance: rated resistance for the secondary circuit at 20°C.

STEP-BY-STEP FAULT ISOLATION

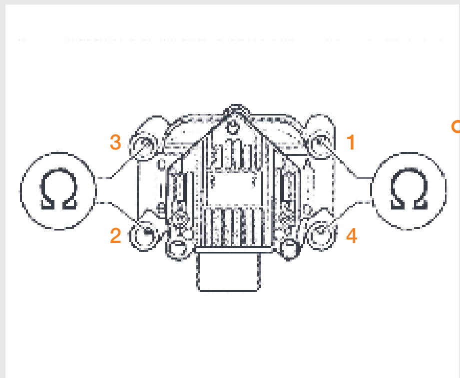
Test conditions:

- Battery voltage at least 11.5 V
- Sensor for engine speed: OK
- Hall sensor: OK

Testing the double spark ignition coil taking the ZSE 003 for VW / Audi as an example: The fuse must be OK (in this case: no. 29).



Switch off the ignition. Remove four pole plug from the ignition coil. Switch on the ignition. A voltage of at least 11.5 V must be present between contacts 1 and 4 of the removed plug. Switch off the ignition.



Measure secondary resistances of the ignition coils with ohmmeter at the high-voltage output. Outputs cylinders 1+4 / outputs cylinders 2+3. At 20 degrees Celsius, the nominal resistance must be 4.0–6.0 kΩ. If the values are not reached, the ignition coil must be replaced.

For additional data visit:
Beruparts.eu

SELF-TEST

SELF-TEST

1. Which coil wire is thicker?

A. Coil wire on primary winding
B. Coil wire on secondary winding

2. How high is the ignition voltage in a modern single spark ignition coil?

A. 20,000 V
B. 25,000 V
C. 45,000 V

3. On which physical law is the ignition coil based?

A. current law
B. induction law
C. voltage law

4. What does the term "closing time" mean?

A. time in which the primary current flows
B. time in which the high voltage flows

5. Which ignition coil energy form is measured in millijoule (mJ)?

A. spark energy
B. ignition voltage

6. For which ignition coil system is synchronization by means of a sensor on the camshaft required?

A. double-spark ignition coils
B. canister-type ignition coils
C. single spark ignition coils

7. What number of cylinders is suited for double spark ignition coils?

A. even number of cylinders
B. odd number of cylinders

8. Why is a high-voltage diode in the secondary circuit required for single spark ignition coils?

A. For activation of spark suppression
B. To increase voltage
C. To protect the coil from overloads

9. How high is the spark energy in the latest BERU ignition coils?

A. 5 mJ
B. 10 mJ
C. ca. 120 mJ

10. Why must the coil connector be pre-greased when mounting a single spark ignition coil on the spark plug?

A. That the connector moves smoothly onto the plug
B. As a moisture barrier
C. As a precaution for voltage flash-over

Solutions: 1A, 2C, 3B, 4A, 5A, 6C, 7A, 8A, 9C, 10 A, B, C.

Ignition Technology & Diesel Cold Start Technology

Glow Plugs

- GN: Heating plug, pre-heating - start heating - after-heating
- GV: Glow plug (pre-heating)
- GF: Glow plug for flame-start engines
- GD: Glow plug with wire filament
- GH: Glow plug for additional heaters

Instant Start System (ISS)

GE: Heating plug electronically controlled, pre-heating - start heating - after-heating

Ceramic Glow Plugs (CGP)

Fast, heat-resistant, durable

Pressure Sensor Glow Plugs (PSG)

PSG is an intelligent glow plug with integrated combustion chamber pressure sensor which reports data to the engine control electronics

Ignition Coils

- Distributor Ignition Coils
- Pencil Coils/Plug Top Coils
- Block Ignition Coils
- Ignition Rail Coils

Glow Control Units

- GR: Glow Plug Relays
- GSE: Glow Plugs Control Units

Spark Plugs

- Ultra
- Platin
- Ultra Plus Titan
- Iridium

Ignition Leads

Sensors

- Lambda sensors
- Speed sensors
- Temperature sensors
- Pressure sensors

Tools

- Tools for Spark Plugs
- Tools for Glow Plugs

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