

All about spark plugs

Technical Information



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Perfection
built in



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Starting characteristics, service life, performance, fuel consumption, and exhaust performance – these critical engine parameters are all influenced by the spark plug. The functional part of the spark plug is concealed within the engine’s combustion chamber; only a part of the insulator and connector are visible from outside.

During operation, spark plugs have to deliver outstanding performance: in all situations they must produce a spark reliably, ensure correct cold starts, and prevent misfiring – even under severe conditions – playing their part in ensuring optimum combustion with low emissions.

They have to cope with temperatures in the combustion chamber of up to 3,000 °C and pressures of up to 100 bar, not to mention ignition voltages of up to 40,000 volts, with transient power peaks of up to 300 A. Chemical influences also make high demands on quality. So this is tough work, that the spark plug has to maintain for many thousands of kilometers.

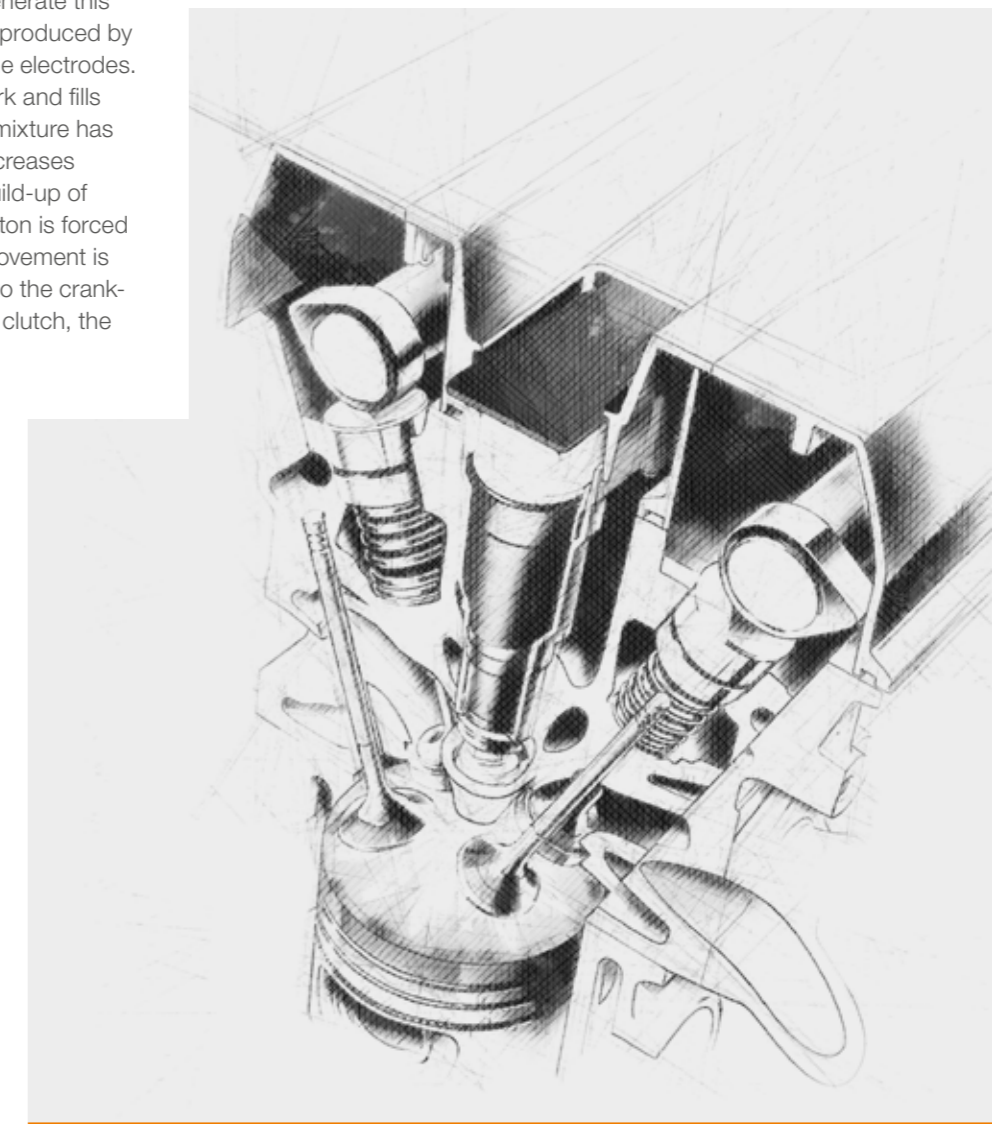
BERU spark plugs are specialized, precision components, which have been developed to meet vehicle manufacturers’ specifications and are produced on up to date production lines.

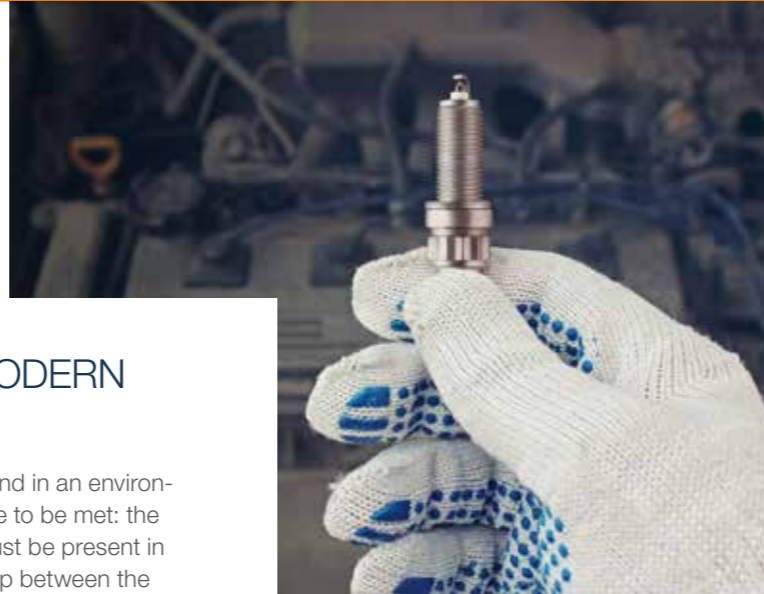
THE SPARK IGNITION ENGINE

THE FUNCTION OF A SPARK PLUG

The ignition system on petrol-driven engines – in contrast to diesel engines – is external: during the compression cycle the combustion of the compressed fuel-air mixture is triggered by an electrical spark produced by the spark plug. It is the task of the spark plug to generate this spark. Created by the high voltage produced by the ignition coil, it leaps between the electrodes. A flame front spreads from the spark and fills the combustion chamber until the mixture has been burned. The heat released increases the temperature, there is a rapid build-up of pressure in the cylinder and the piston is forced downwards (Power stroke). The movement is transferred via the connecting rod to the crankshaft; this drives the vehicle via the clutch, the gears and the axles.

The spark from the spark plug triggers the combustion of the compressed fuel-air mixture during the compression cycle





THE DEMANDS PLACED ON A MODERN SPARK PLUG

In order for the engine to operate smoothly, powerfully and in an environmentally friendly manner, a number of requirements have to be met: the correct amount of perfectly balanced fuel/air mixture must be present in the cylinder, and the high-energy ignition spark must leap between the electrodes precisely at the predetermined moment. For this purpose spark plugs have to meet high performance requirements : they must deliver a powerful ignition spark between around 500 and 3,500 times a minute (in 4-stroke operation) - even during hours of driving at high revs or in stop-and-go traffic conditions. Even at -20 °C, they have to ensure a completely reliable ignition. High-tech spark plugs provide low-emission combustion and optimum fuel efficiency – without misfiring, which can cause unburnt fuel to get into the catalytic converter, and destroying it. A modern spark plug must meet the following requirements:

Electrical requirements

- Reliable high-voltage transmission, even at ignition voltages of up to 40,000 volts
- Good insulation capability, even at temperatures of 1,000 °C, prevention of arcing and flashover

Mechanical requirements

- Pressure-tight and gas-tight sealing of the combustion chamber, resistance to oscillating pressures up to approx. 100 bar
- High mechanical strength for reliable installation

Thermal requirements

- Resistance to thermal shock (hot exhaust gases – cold intake mixture)
- Good thermal conduction by insulator tip and electrodes

Electrochemical requirements

- Resistance to spark erosion, combustion gases and residues
- Prevention of build-up of deposits on the insulator

BERU spark plugs are designed and manufactured using high-quality materials to consistently meet these requirements. Even at the engine development stage, engineers work closely with the motor industry to ensure that the spark plugs are precisely adapted to specific conditions in the combustion chamber.

SPARK PLUG DESIGN AND TYPES

MATERIALS

BERU offers a wide range of spark plugs to ensure that the optimum spark plug is always available for the many different engine types and applications. Diverse materials are used for the center electrodes. Special nickel-based alloys and copper-core electrodes offer good thermal conductivity and high corrosion resistance. Platinum and Iridium offer excellent resistance to erosion, so it extends the length of time between replacements. The design of the earthing electrode is just as important. Its geometry influences mixture accessibility, wear, heat dissipation and ignition voltage requirement, among other things. Titanium, platinum and iridium offer particularly long operating lives, for the same electrode gap.

ELECTRODE GAP

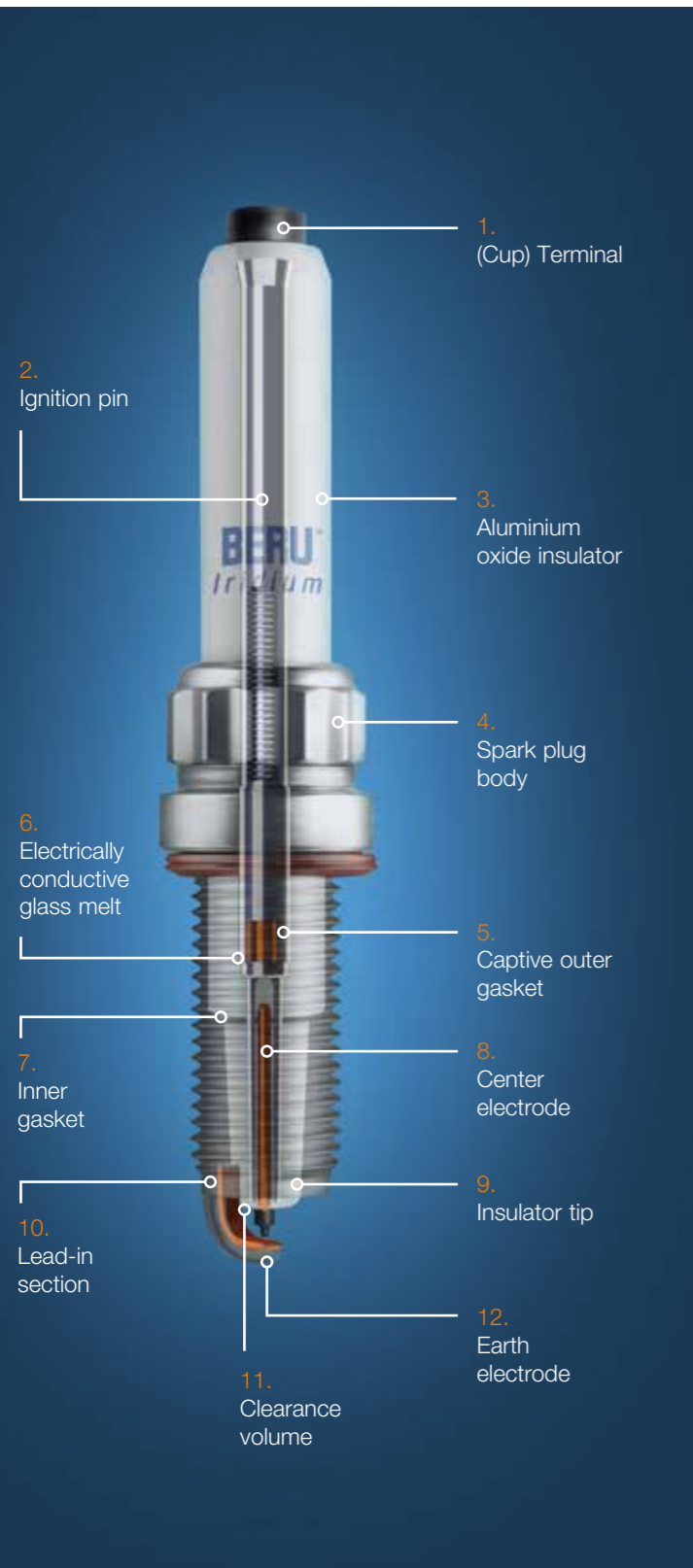
The shortest distance between the central and earth electrode(s) on the spark plug is called the electrode gap. This is what the ignition spark must jump across. The optimum electrode gap in any particular situation depends partly on the engine, and it is determined in close collaboration with the vehicle manufacturer. Precision in maintaining the electrode gap is important since an incorrect gap can have a considerable detrimental effect on spark plug function and consequently on engine performance.

- If the electrode gap is too small this may cause misfiring, noisy idling and poor exhaust gas quality levels.
- If the electrode gap is too large, this may lead to misfiring.
- The co-ordinated spark positioning on multi-electrode plugs means the electrode gaps do not have to be adjusted.

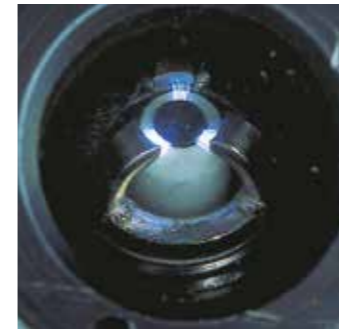
Electrode gap



THE SPARK PLUG IN DETAIL



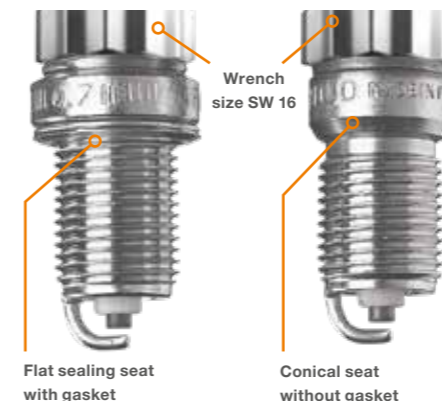
- (Cup) Terminal. Because the terminal is smaller, the plug has an extended insulator neck creating a greater insulation surface and better ignition performance.
- The steel pin (ignition pin) enclosed in a gas-tight fit within the conductive glass melt, forming a link with the central electrode.
- The insulator is made of an aluminium oxide ceramic and insulates the central electrode against earth at up to 40,000 Volts. The insulator can be produced in a plain form or with profiles to prevent flashover.
- Nickel- or Zinc-plated spark plug body forms a gas-tight connection with the insulator through a heat shrinkage method, which is why the shrinkage zone shows the blue oxydation colour. Thread serves to secure the spark plug in the engine block (not all plugs use the heat shrinkage - hot lock - method).
- Captive outer sealing washer, for sealing and heat dissipation.
- Electrical connection of spark pin and central electrode. On suppressed (R types) glass melt resistors. By means of appropriate additives the glass melt can be given a defined degree of resistance in order to ensure the required resistance and suppression characteristics.
- The inner sealing ring forms the gas-tight junction between the insulator and the metallic body and provides heat conduction.
- The center electrode consists of a copper core enclosed in nickel. Depending on the type, the central electrode can be in platinum or iridium.
- The insulator tip extends into the combustion chamber. It has a fundamental influence on the thermal rating.
- The lead-in chamfer makes it easier to screw the spark plug into engine block.
- The clearance volume influences self-cleaning action.
- One or more ground electrode are welded onto the body of the spark plug, and with the central electrode form the spark path. Specially developed nickel-based alloys (or platinum or titanium reinforcements) increase the erosion resistance of the electrodes.



Spark path



The innovative Poly-V design :
5 ignition points are targetted by the spark in a continually changing sequence – thus ensuring great reliability for the ignition and consequently fuel-saving combustion with an ignition performance that remains constant over long periods.



SPARK POSITION AND SPARK DISTANCE

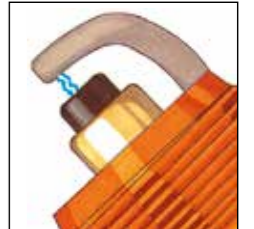
The function of the spark plug in the combustion chamber is influenced by three main factors: the spark position, the spark distance and the electrode gap for spark plugs using variable spark technology.

Spark position is the name given by engine developers to the spark path geometry, the extent to which the spark path extends into the combustion chamber.

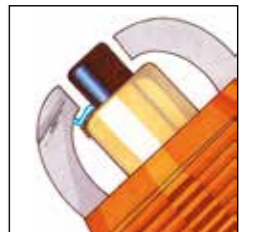
With regard to the spark distance, a distinction is made between:

- The air spark distance which denotes the path the spark takes between central and earth electrode in order to ignite the fuel-air mixture in the combustion chamber.
- The variable spark distance which denotes the path which the spark takes if it first passes over the surface of the insulator tip before then jumping across to the earth electrode. Taking this path burns off harmful deposits and combustion residues.
- Air spark distance/variable spark distance: spark distances, that can pass via air and the insulator. By combining the mutually independent air spark and variable spark distances, electrode burn-off can be reduced, leading to a significantly increased service life for spark plugs.

Sparkling air distance



Variable sparking distance



SEAT SEALING

The spark plug must be screwed into the cylinder head so that it is gas-tight. Depending on engine construction features, there are two different types of seal:

- Flat seat or level seat: a captive outer gasket acts as a seal around the plug body.
- Taper seat or conical seat: the conical surface of the plug body fits into a correspondingly shaped contact surface in the cylinder head to create a seal.

In restricted spaces (e.g. multi-valve engines), FineLine or BiHex spark plugs are commonly used, which require smaller wrench sizes and have more miniaturised dimensions.

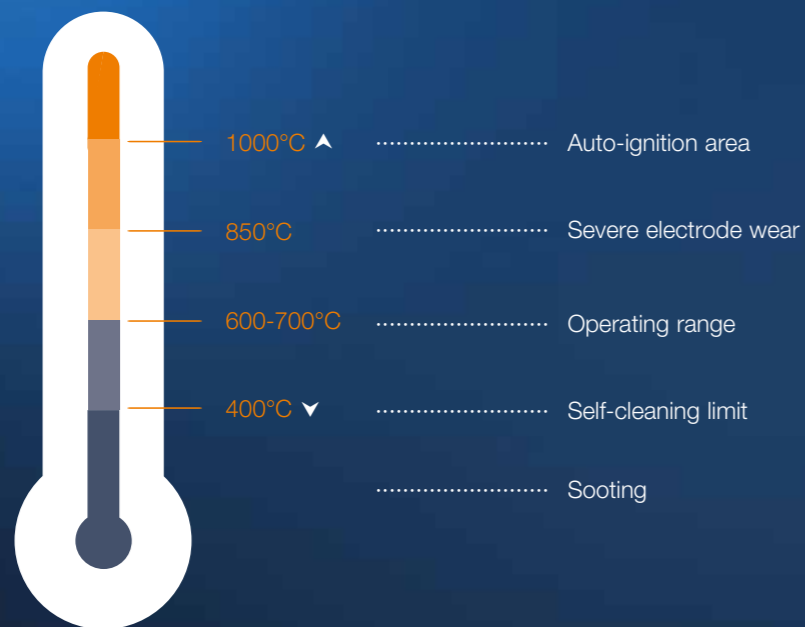
THERMAL RATING AND THERMAL CONDUCTION

THERMAL RATING

The thermal rating is a measure of the thermal structure of a spark plug. It indicates the maximum thermal loading on the spark plug in equilibrium between heat absorption and heat dissipation.

It is vital to choose the correct thermal rating when selecting a spark plug:

- If the thermal rating characteristic is too high (for example thermal rating 9) the plug is unable to dissipate the resultant heat quickly enough. This leads to incandescent ignition; in other words it is not the ignition spark that ignites the mixture but the overheated plug.
- If the thermal rating characteristic is too low (for example thermal rating 5) then the free burning temperature required in the lower performance range for self-cleaning the plug, is not reached. Result: misfiring, increased fuel consumption and higher exhaust emissions. (For pictures of faults, see Pages 8 and 9).



Heat conduction path of a spark plug



THE INFLUENCES ON THERMAL RATING

The higher the engine output, the higher in most cases is the combustion chamber temperature. The size of the insulator base has a critical influence on heat absorption; heat dissipation takes place through the insulator tip, via the center electrode and the inner gasket on the plug body to the cylinder head.

- Spark plugs with a long insulator tip absorb more heat. However, since they emit less heat on the long path to the plug body they are called hot plugs.
- Spark plugs with a small insulator tip absorb less heat. However, since they are able to emit a lot of heat on the short route to the plug body they are called cold spark plugs.

THE THERMAL CONDUCTION

Cylinder temperatures of up to 3,000 °C are generated for short periods during the combustion process and these temperatures also cause the spark plugs themselves to heat up. The spark plugs give off around 80 per cent of this absorbed heat to the surroundings through various methods of heat conduction (illustration). The vast majority of the heat is transferred from the plug thread directly to the cylinder head.

The spark plug must therefore always be screwed in with the correct torque. Only about 20 per cent of the heat is absorbed and dissipated by the passing fuel-air mixture.

BERU SPARK PLUG RANGE

BERU IRIIDIUM

Iridium Technology has a stabilizing effect on ignition voltage and offers excellent wear characteristics



Meet the BERU Iridium, our first spark plug with an iridium-based centre electrode. It's the best technology that you can find on the market today.

As a precious metal, iridium is ideally suited for this vital element of your car. It's extremely heat resistant, giving this spark plug a longer lifespan, by far. In addition, BERU Iridium spark plugs let your engine achieve great performance in terms of power, fuel consumption and emissions. Confirmed technology combined with state of the art innovations, that's our promise.

- FISS** suppression
- COPPER** core nickel centre electrode
- COPPER** core nickel ground electrode
- IRIDIUM** Iridium tipped centre electrode
- PLATINUM** pad on ground electrode



BERU ULTRA – THE CAR MANUFACTURERS' CHOICE

The brand-name spark plug in uncompromising OEM matching quality.

- Environment-friendly combustion: saves fuel and protects the catalytic converter
- Reliable ignition, even at low temperatures
- Long service life, good durability
- Proven materials: two-element center electrode with nickel-sheathed copper core
- Precious metals : Iridium & Platinum
- OEM specification & technology



SPARK PLUG SELECTION FOR STANDARD-TYPE GAS OPERATION (MOSTLY LPG)

BERU offers the right spark plugs for gas-powered vehicle engines – an important prerequisite for reliability, performance, favorable consumption values and a long service life. In vehicles that are equipped with gas operation by standard, the respective thermal values of the spark plugs are indicated in the operating instructions or in the respective documentation.



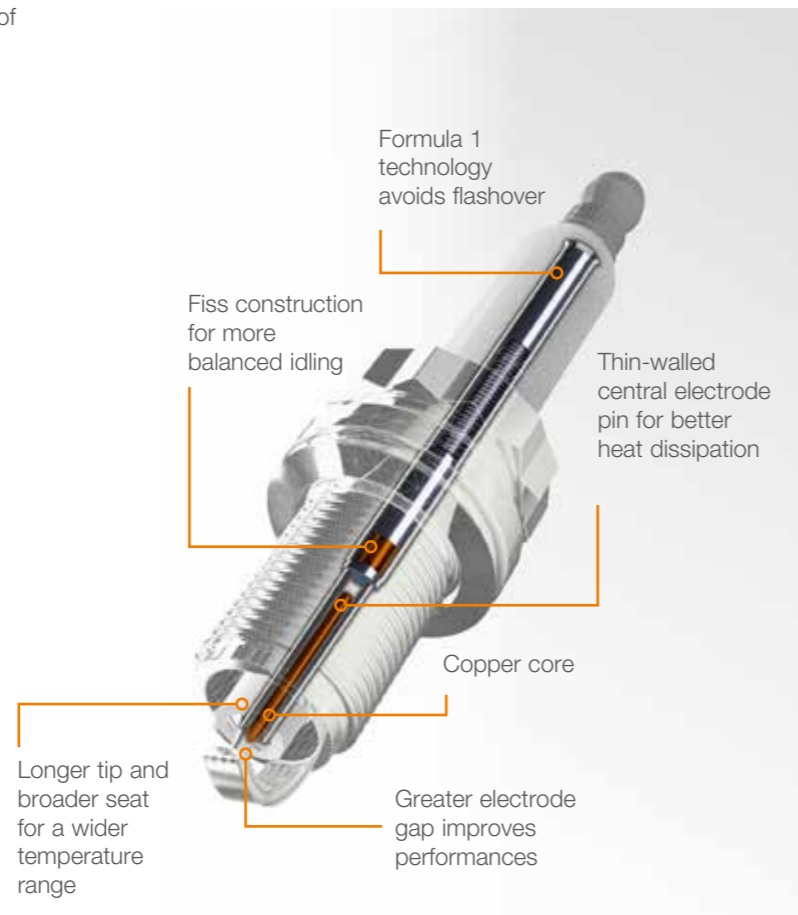
ULTRA PLUS TITAN

90%* coverage of the European Car Parc with only 18 plugs

ULTRAPLUS TITAN

Ultra Plus Titan is a short universal range of spark plugs designed for naturally aspirated engines as well as turbo and direct injection high power engines.

BERU Ultra Plus Titan is the result of an intensive development programme in the spark plugs sector. The combination of knowledge from different fields led to the ultimate spark plug, suitable for today's most advanced multi-valve engines.



Poly-v-electrode from titanium alloy



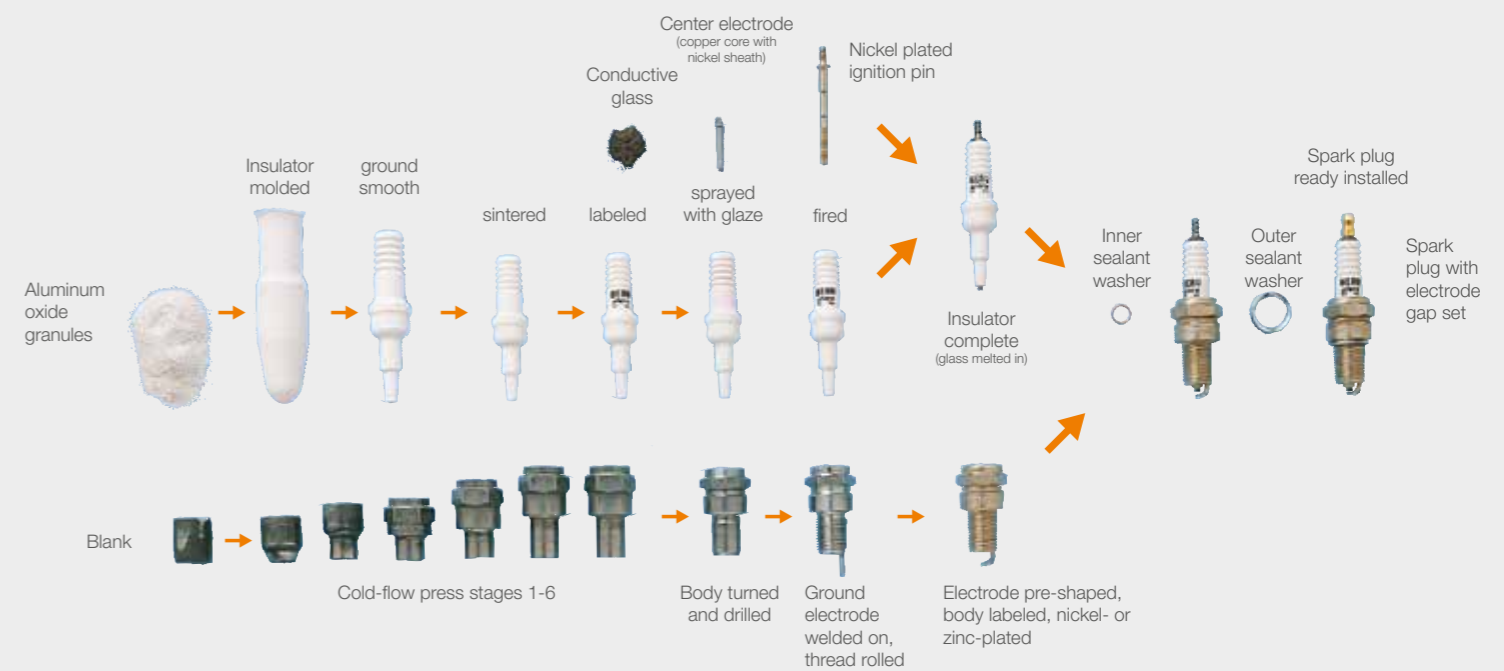
SPARK PLUG PRODUCTION

FROM BLANK TO PRECISION COMPONENT

Original BERU spark plugs are manufactured in factories on computer-controlled production lines – from preparation of the ceramic materials for insulator production from high-grade aluminum oxide, to fitting of the outer gasket.



Testing insulators at 40,000 volts: BERU spark plugs have to demonstrate their reliability on the test rigs before being accepted for starting up in series production.



** Source : F-M PI/TecDoc (www.tecalliance.net/en/company/contact)

THE BERU ENDURANCE TESTS

Whether in stop-and-go traffic or marathon motorway trips, whether in the bitter cold or the burning heat of the sun – a BERU spark plug must always continue to function. In order to fulfil these high quality demands, spark plugs are subjected to a variety of tests during their development and after production.

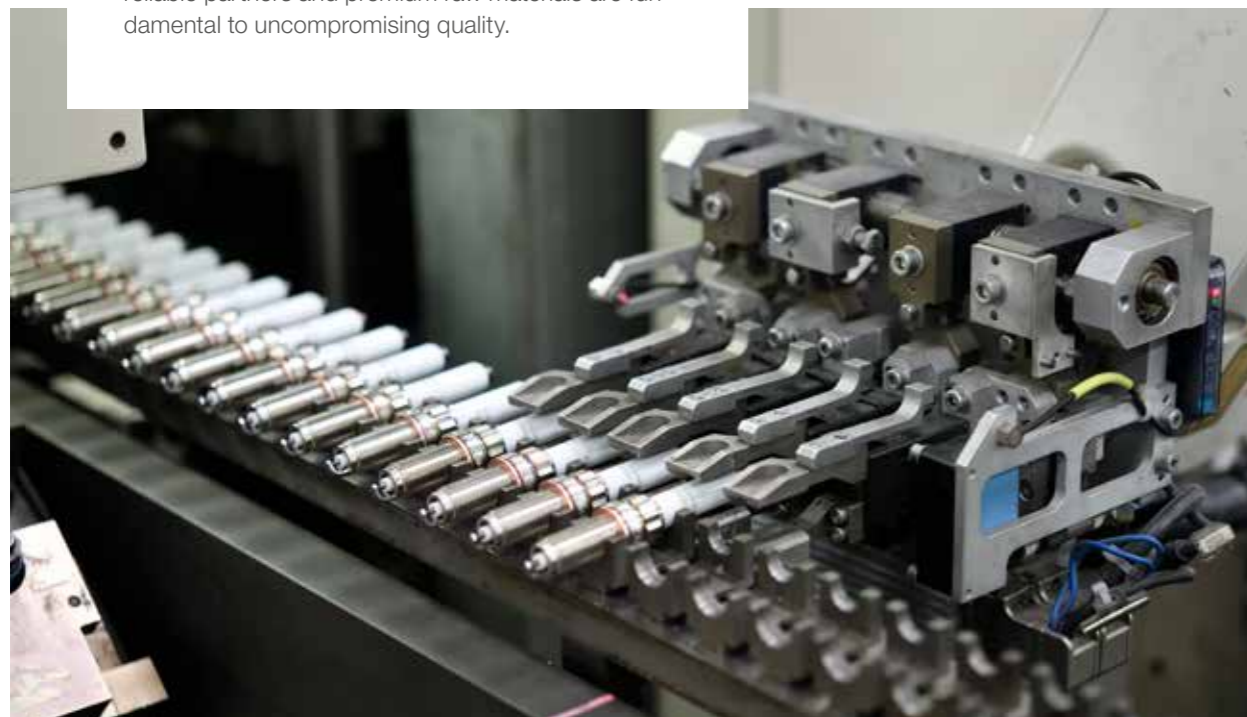
HIGH QUALITY STANDARDS

In order to compete at an international level, quality is paramount. All production sites are ISO9001 & ISO/TS16949 certified. The certificates are renewed at regular intervals and always correspond to the latest standards.

Around ten percent of all factory employees are involved in quality assurance. One of the principles behind the quality philosophy is production control rather than product inspection. That's because quality has to be built in, not inspected in. We rely on qualified employees and the latest, computer-controlled processes. This is the only way to ensure that the specifications promised to the customer are reliably reproduced in every spark plug. Yet quality assurance starts with the selection of suppliers and materials: reliable partners and premium raw materials are fundamental to uncompromising quality.

Spark plugs are wearing parts which must be replaced regularly. Otherwise there is a danger of incomplete combustion. This in turn leads to a strong increase in fuel consumption and pollutant production. In addition, due to misfiring, unburnt fuel gets into the catalytic converter, burns there and heats up the catalyser support. If misfiring occurs more frequently, then the catalytic converter may be completely destroyed – and pollutant production can increase by up to ten-fold: this means that it would not pass the legally prescribed exhaust gas check.

As a general rule, independently of annual mileage, spark plugs should be replaced within the period recommended by the manufacturer – in order to maintain engine performance and to protect the catalytic converter.

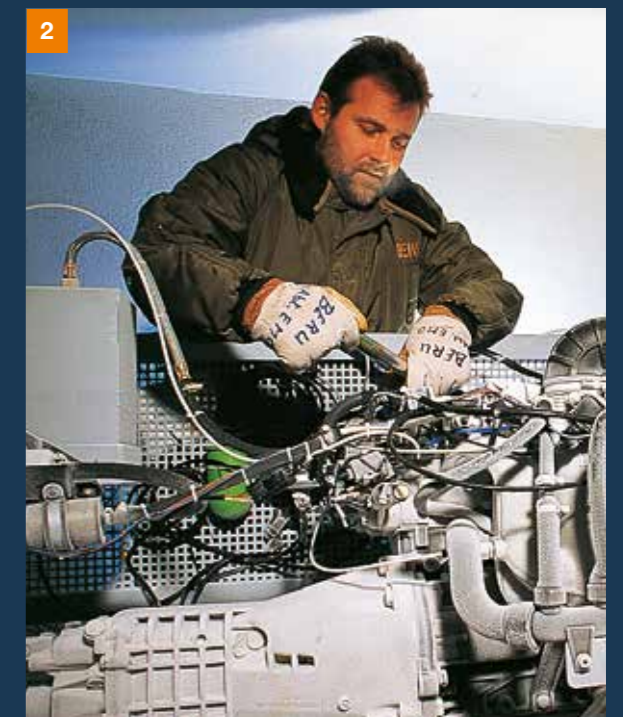


BERU SERVICES

Today BERU is one of the world's leading suppliers of electrical components to the automotive industry. BERU is flexible and quick to respond to customers' needs. Around 150 developers and designers are constantly working on optimizing existing products and developing new ones - in close association with customers from the car and engine manufacturing sectors. Special applications, specially tailored to BERU's partners, ensure that vehicle manufacturers can rely on products that exactly match their needs. That is why BERU is increasingly offering complete system solutions instead of individual components.

1 | Service life test – test bench

2 | A view inside the Cold Chamber in the BERU Research and Development Center Testing the cold start response in the refrigeration unit at -30 °C.



FUTURE



In close co-operation with international automotive manufacturers engineers are developing innovative spark plug concepts for modern spark ignition engines.

THE FUTURE OF THE SPARK PLUG

In the development of modern petrol engines, the technology trends are going towards modified combustion processes and high-charged, smaller engine units (downsizing). BERU engineers are developing the optimal spark plugs for this purpose in close co-ordination with the international automobile manufacturers.

Less fuel consumption, lower emissions, more driving enjoyment: these simple watchwords summarize the current technical trends in the development of spark ignition engines. Total and partial variability in the valve drive through phasers or valve stroke control, as well as direct injection with wall, air or jet-driven injection represent the current state of the art. The newest generations of injection systems with piezo-controlled injectors extends the range for de-throttled, lean engine operation, and should thus ensure the required reductions in petrol consumption and emissions.

This all results in new demands on the spark plugs:

- smaller construction dimensions
- specifically positioned ground electrodes (earth electrodes)
- more accurate spark positions, and
- higher dielectric and mechanical strength in spark plug ceramics.

HIGH DEMANDS PLACED ON THE NEW GENERATIONS OF SPARK PLUGS

With the new direct injection systems, there is less room available for the spark plug within the cylinder head in spark ignition engines. This in turn makes it necessary to have a lengthened fitting thread and/or a modified spark plug geometry. M12 spark plugs are being increasingly used, although in comparison to the traditional M14 spark plugs, they must manage to work with a reduced ceramic wall thickness. Demands in the opposite direction – smaller wall thicknesses on the insulator and increased voltage requirements – make it necessary to achieve new developments in materials, geometry and processes. more accurate spark positions, and higher dielectric and mechanical strength in spark plug ceramics.

IMPROVEMENT OF CERAMICS PROPERTIES

As an insulator material for passenger car spark plugs, an aluminium oxide based ceramic has proved dependable, since this material fulfils the electrical and mechanical requirements regarding dielectric strength, even at temperatures of up to 1,000 °C. The main factor that determines the properties of the present ceramics is residual porosity. In order to obtain a considerable reduction in this, and consequently to improve even further the dielectric strength and the mechanical strength of the spark plugs, the development engineers for the BERU have, amongst other things, undertaken modifications to the ceramic additives.



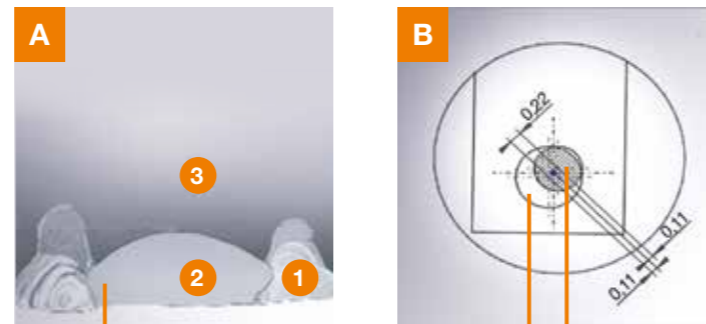
THE LATEST MEASUREMENT AND APPLICATIONS SYSTEMS

The development of spark plugs specific to individual engines necessitates a close collaboration between the automotive manufacturer and the spark plug manufacturer. The preconditions for this are optimum technical possibilities for establishing:

- the appropriate heat rating
- the electrode temperatures
- the required ignition voltage
- the required form of ignition voltage
- the optimum cold-starting performance of the spark plugs.

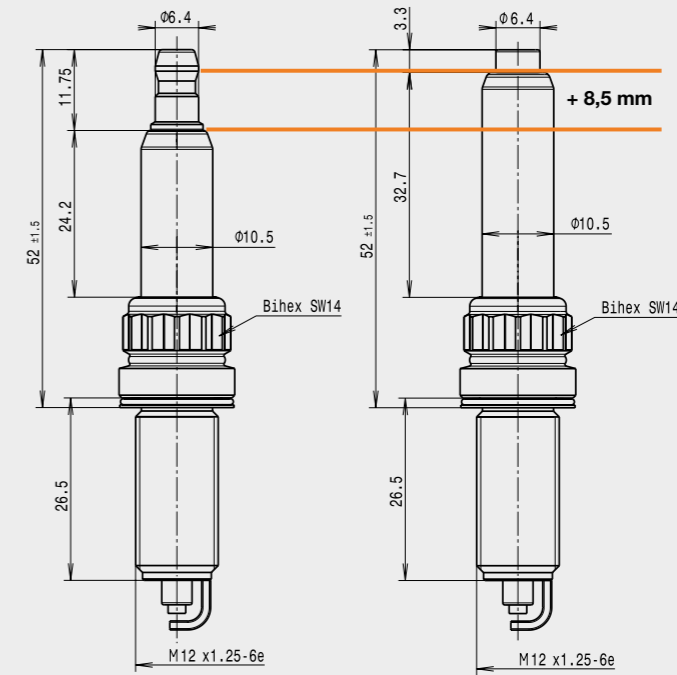
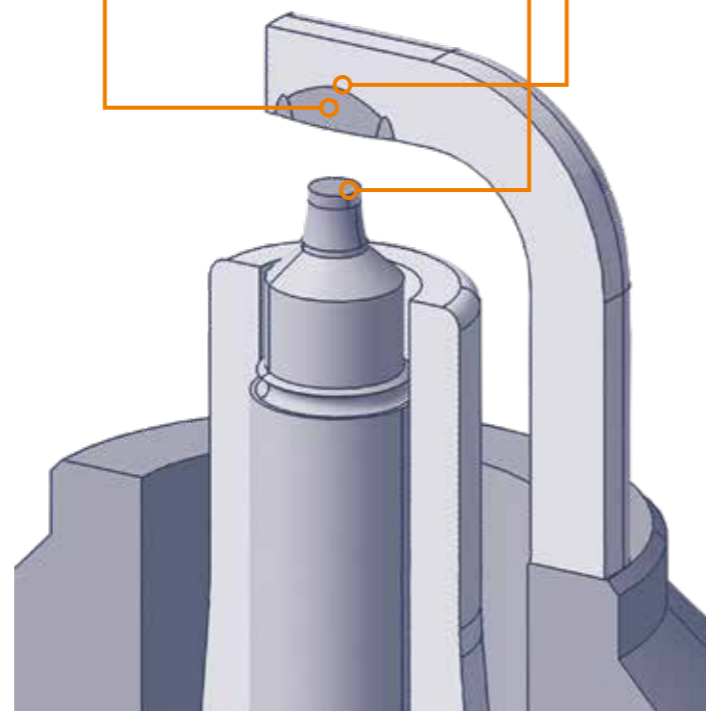
NEW SPARK PLUG GEOMETRIES FOR MODERN ENGINES

The automotive manufacturers are developing small, powerful, clean engines. This increases the performance requirements of the spark plug. This means that it is necessary to develop novel electrode geometries, materials and processes. For spark plugs with nickel alloy-based electrodes, the wear mechanism is determined to a large extent by oxidation. This results in a requirement for nickel alloys that have a stable, durable oxide layer. In the case of spark plugs with electrodes coated with oxidation-stabilized precious metals, e.g. platinum or iridium, it must above all be ensured that there is a permanent attachment of the precious metal onto the nickel-based spark plug electrodes.



- 1. NIPT ALLO
- 2. PLATINUM
- 3. ALLOY OF NICKEL-BASE.

The nickel-based electrodes in BERU High-end spark plugs are coated with an oxidation-stabilized precious metal such as platinum or iridium. Thanks to a special laser welding process, BERU produces an extremely long-lasting bond between the two materials. (A) A coverage of the precious metal surfaces at the centre and body electrodes of at least 92% (B) enables extremely high operating performance.



- For the same overall dimensions, a larger insulating surface was obtained by lengthening the insulator.
- An increase in voltage overload protection in air of 8,000-9,000V
- Operating range up to 40,000V

NEW HIGH-VOLTAGE CONNECTOR FOR INCREASED FLASHOVER RESISTANCE

Downsizing is a key technology for reducing fuel consumption and emissions. This new technology confronts the ignition systems designer with new challenges, because downsized engines have less installation space available and work at higher combustion chamber pressures and higher ignition voltages, which drastically increases the danger of high voltage flashovers at the spark plug. In order to provide increased flashover resistance, BERU has developed a

high-voltage connector, which – for the same spark plug dimensions – offers a greater insulating surface, thanks to an 8.5mm longer insulator neck, thus increasing the flashover resistance by up to 9000 volts. It is not only the added insulation surface that provides more protection against insulation breakdown and flashovers, but a new type of contact method. Instead of an external contact point (as in SAE or M4) contact occurs on the inside via a pressure spring. This novel, conically converging pressure spring connector is designed in such a way that the front end is securely enclosed by the bowl-shaped recess of the ignition pin in the spark plug (giving it its name “high-voltage bowl connector”). This prevents the build-up of excessive voltage fields – and, in spite of the increased ignition performance, the flashover resistance is visibly improved.

WORKSHOP TIPS

SPARK PLUG CHECKS

A visual inspection of a spark plug can reveal a wide variety of damage patterns. Some of them are listed below, with a description of causes, effects and remedies:



FUEL ADDITIVES

Appearance: Reddish/brown or purple deposits/coloration on the core nose insulator

Cause: Use of fuel additives

Effect: Misfire. Normally additives are non-conductive; however, some are and if the deposit build up is excessive it can create an earth leakage path for the spark

Remedy: Replace spark plugs and ensure that any additives used are compatible with the engine manufacturer's ignition and emission systems and added in the correct proportion/heat rating.



BREAKING THE THREAD

Appearance: The thread of the spark plug is broken off the remaining part of the plug.

Cause: Use of too much force during mounting or demounting. Always use a torque wrench when removing or installing a spark plug.

Effect: Installation becomes difficult and in extreme cases the engine can be damaged.

Remedy: Always use a torque wrench when removing or installing a spark plug



PRE-IGNITION

Appearance: Melting (or partial melting) of the ground and/or central electrode

Cause: Spark plug too hot, air fuel mixture excessively lean, incorrect ignition advance, defective exhaust re-circulation system, faulty detonation sensor, cross induction in the spark plug leads or worn engine components

Effect: In extreme cases engine damage will result

Remedy: Identify the cause and rectify. Replace spark plugs in line with manufacturer's recommendation



OIL FOULING

Appearance: Firing end of spark plug is 'wet' with lubricating oil

Cause: Usually a sign of advanced engine wear (excessive volumes of oil in the combustion chamber), oil fouling can also be caused by a fault in the crankcase breather system

Effect: Misfire due to oil deposits covering the firing end of the plug preventing the spark from 'jumping the gap'

Remedy: Rectify the cause of excessive oil in the combustion chamber and replace spark plugs



DETONATION

Appearance: Light detonation will cause black/grey spots on the insulator or ground electrode. Severe detonation can crack or even break the insulator or ground electrode

Cause: Abnormal combustion, causing pressure spikes/shock waves in the combustion chamber. Can result from: inoperative exhaust gas re-circulation system, defective detonation sensor, lean air fuel mix, incorrect fuel octane rating or spark advance and loose fitted spark plugs

Effect: Misfire and/or general poor/uneven running which may result in engine damage

Remedy: Identify the cause and replace the spark plugs. Identify the cause and replace the spark plugs



WORN-OUT SPARK PLUG

Appearance: Centre and/or ground electrodes are rounded and the gap is excessive

Cause: General wear (spark plug has come to the end of its life). However, the greyish tan/white colour indicates that the plug is the correct heat range and also that the fuel/ignition systems and engine are generally in good condition

Effect: An increased gap will multiply the workload on the ignition system and may cause misfire, poor fuel economy, and damage to other ignition components.

Remedy: Rectify the cause of excessive oil in the combustion chamber and replace spark plugs

SPARK PLUG CHECKS



CORONA DISCHARGE STAIN

Appearance: Discoloration of the ceramic insulator, near to the shell
Cause: Particles of oil/gas (in the spark plug well), becoming attracted to the ceramic by the magnetic field created by the high voltage current flowing through the spark plug
Effect: Not detrimental to spark plug operation
Remedy: Ensure that spark plug “well” is clean when installing new spark plugs



COLD/CARBON FOULING

Appearance: Soft, black, sooty deposits on the firing end of the plug
Cause: Rich air-fuel mixture, weak ignition, spark plug too cold or repetitive short journeys
Effect: Carbon deposits are conductive and can create earth leakage paths, often resulting in misfire problems which can lead to catalyst damage
Remedy: Check fuel & ignition systems, general engine performance and driving style before plug replacement. Confirm that the spark plug (part number) is correct for the application



SPARK PLUG TIGHTENING

Appearance: Spark plug gasket has not been sufficiently crushed (see photographs)
Cause: Incorrect tightening of the spark plug
Effect: If the plug is too loose, correct heat dissipation will be prevented, resulting in overheating of the plug which can lead to pre-ignition or detonation problems. Conversely, if the plug is too tight, damage may result to the insulator and internal components causing operating problems
Remedy: Tighten spark plugs to the manufacturer’s recommended torque value



ASH DEPOSITS

Appearance: Light brown deposits encrusted on the centre and/or ground electrode
Cause: Often due to excessive fuel (or oil) additives, however, general engine wear can have a similar effect on the spark plug
Effect: Ash deposits can ‘shield’ the spark, leading to misfire problems
Remedy: Ensure plug is of the proper heat range and check for engine wear



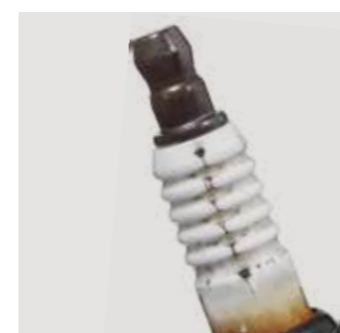
OVERHEATING

Appearance: Chalky white insulator (with no tan colouring) pitted or blistered electrodes. In some cases the insulator will begin to turn grey or dark blue
Cause: Improper heat range plug, lean air fuel mixture, incorrect ignition timing, insufficient plug tightening torque and general engine overheating
Effect: General poor running conditions
Remedy: Identify the cause of overheating and rectify. Replace spark plugs in line with manufacturer’s recommended heat range



FLASH OVER

Appearance: Black burn marks (carbon tracks) running vertically down the spark plug insulator towards the shell
Cause: Current discharge from the top terminal of the spark plug, down the outside of the insulator to earth; due to poor fitting/worn spark plug boot
Effect: Engine misfire
Remedy: Replace the affected plug(s) and plug lead(s)



NORMAL SPARK PLUG WEAR/OPERATION

Appearance: Greyish tan to white colour around the insulator, at the firing end
Cause: Confirms that the spark plug is the appropriate heat range and has been firing correctly. Also indicates that the fuel and ignition systems are working efficiently and the engine is mechanically sound
Remedy: None required other than to check the spark plug gap and replace in line with manufacturer’s recommendations



SPARK PLUG INSTALLATION

As spark plugs are designed for specific engines, the correct plug must always be used. Plugs with the incorrect thermal rating, electrode gap or thread length can lead to reduced engine performance or even damage the engine and/or catalytic converter. Installing and removing them carefully is also imperative.

1. When removing them, make sure that no dirt gets into the combustion chamber. First loosen the plug by a few turns, then clean the plug shaft using compressed air or a brush, before screwing the plug out completely.
2. Apply a thin film of BERU special grease to the spark plug insulator terminal, when fitting the coil or cables on the spark plug.
 - ZKF01 with 10g contents
 - ZKF02 with 50g contents.
3. When installing plugs, make sure that the plug thread and cylinder head bore are clean. With BERU spark plugs, a nickel or zinc coating on the plug body avoids the need for lubrication. Be sure to use the correct tightening torque (see table).
4. Warning: If you drop a spark plug, do not use it. Even invisible damage can lead to misfiring and may even damage the catalytic converter.
5. Check spark plug connectors for wear. If you see signs of embrittlement or hairline cracks, replace the connectors.

FAULTS AND WEAR

Overload, poor fuel, wrong choice of spark plug, and stop-and-go traffic conditions are just a few of the factors that can lead to spark plug faults. Here is a short checklist to help you identify the fault:

Symptom	Cause	Possible consequences
Spark erosion, corrosion	Thermal overload Wrong or poor fuel Incorrect thermal value	Melted electrodes Incandescent ignition Misfiring (due to larger electrode gap)
Incandescent ignition	Residues in combustion chamber Faulty valves Plugs with incorrect thermal value Fuel with insufficient octane count	Piston damage Valve damage Spark plug damage
Knocking	Fuel with insufficient octane count Wrong ignition timing Excessive compression	Uncontrolled rise in pressure and temperature can lead to piston and spark plug damage
Misfiring	Faulty, old, leaking spark plug connector	Spark-over to insulator; Damage of the catalytic converter



IMPORTANT : WHEN INSTALLING PLUGS, IT IS ESSENTIAL TO USE THE CORRECT TIGHTENING TORQUE.

If extreme burn-off or melting occurs on the center electrode, despite using the specified tightening torque, the cause is almost certainly due to an uncontrolled combustion process (e.g. incandescent ignition or high-speed knocking). Possible causes: wrong heat rating, discharge valve clearance too small, wrong ignition timing, unsuitable fuel quality, deposits in the combustion chamber, or too lean a fuel mix.

Flat seat plugs:	Thread size: n	Cast-iron seating: Torque Nm	Aluminum alloy seating: Torque Nm	Installed height: Torque Nm	Gasket thickness: mm
	M14 x 1,25	20 to 40	20 to 30	30	1,0 to 2,0
	M12 x 1,25	15 to 25	15 to 25	25	0,8 to 1,6
	M10 x 1	10 to 15	10 to 15	15	0,7 to 1,6
Conical seat plugs:	Thread size: n	Cast-iron seating: Torque Nm	Aluminum alloy seating: Torque Nm	Installed height: Torque Nm	
	M18 x 1,5	20 to 30	not specified	30	
	M14 x 1,25	10 to 20	10 to 20	20	
	M12 x 1,25	10 to 20	10 to 15	15 (for Al alloy seating), 20 (for cast-iron seating)	

BERU ASSEMBLY AIDS

For easy and reliable spark plug replacement without jamming the wrench or cracking the insulator, we recommend the use of special tools.

BERU SPARK PLUG ASSEMBLY AID ZMH002

Reliable spark plug replacement without tilting

THE PROBLEM The relatively large opening in the spark plug shaft means that when fitting or removing spark plugs using an extension, there is a risk of tilting the wrench, causing the spark plug insulator to crack. The consequence: misfiring due to sparks jumping across the cracked insulator can destroy the catalytic converter.

THE SOLUTION Simply insert the BERU assembly tool, suitable for almost all vehicle models, into the 3/8" spark plug extension and push it into the spark plug shaft. The wrench will now remain parallel to the shaft and cannot be tilted.

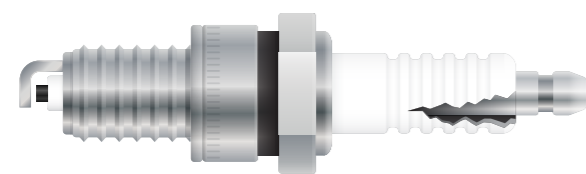
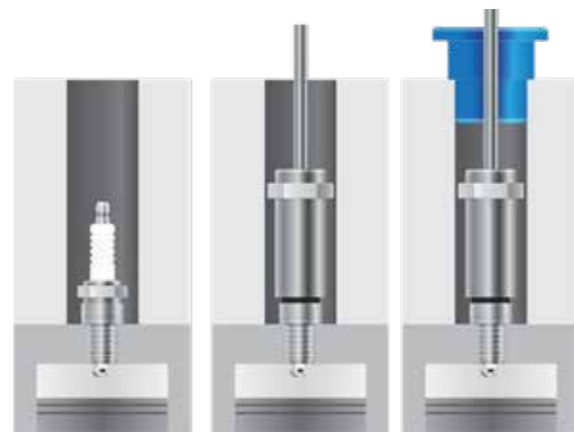


Article Name	BERU short code
Spark plug assembly aid	ZMH002

Left: A glance into the engine compartment clearly reveals the problem of fitting a plug: Spark plugs in modern multi-valve engines are inserted so far down into the cylinder head that they can only be fitted or removed with the aid of an extension. Unfortunately, this can lead to tilting!

Center: The width of the shaft actually makes it easy to tilt the spark plug wrench and extension.

Right: The BERU® spark plug assembly aid 002 enables the spark plug to be screwed in by reducing the risk of tilting. This helps to prevent any insulator cracks and consequential damage such as false firing and misfiring, which would then cause irreparable damage to the catalytic converter.



Fractures in insulator neck – caused by tilting the spark plug wrench or the extension.

BERU SPECIAL GREASE ZKF001/ZKF002

To prevent the spark plug connector from fusing to the spark plug neck and damaging the sealing lips, we recommend greasing the spark plug insulator with BERU special grease. This also increases resistance to spark-over.



Article Name	BERU short code
BERU Special grease, Tube 10 g	ZKF001
BERU Special grease, Tube 50 g	ZKF002

- 1 | Signs of high voltage spark-overs
- 2, 3 | BERU Spark Plug Connector Grease: When smeared into the connector before screwing in the spark plug, the grease protects from embrittlement, and consequently from high voltage spark-overs
ZKF001 / 10 g
ZKF002 / 50 g



SPARK PLUG THREAD REPAIR KIT ZGR SET1

A defective cylinder head thread – time and time again, the reason for a major overhaul, and often entailing the replacement of the cylinder head. BERU® offers you the option of a fast and economical repair – with a professional kit for all standard M16 threads, consisting of a special drill bit for thread-cutting and threaded inserts for all standard spark plug threads. The retroactively installed threaded insert sits securely and is compression tight, of course. Treat yourself to a fast and economic repair with the BERU® special drill for spark plug threads replacement made easy and safe.



Article Name	BERU short code
Spark Plug Thread Repair Kit	ZGR-set1

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

Ceramic Glow Plugs (CGP)

Fast, heat-resistant, long lasting

Instant Start System (ISS)

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

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 Coil Rails

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

