At a glance:
PIA spark plugs

Automotive Product Information for spark plugs, or PIA, supplements existing information on the Bosch spark plug line. It combines the most important facts and provides a quick, up-to-date overview item by item. In this way it provides standard argumentation for all spark plugs. In addition, the PIA provides information on technical features, customer service and the comprehensive competence of Bosch in the field of spark plugs.

In the tradition of progress
Bosch presented the first spark plug in combination with a high-voltage magneto over 114 years ago. This reliable ignition system for engines with ever-higher speeds solved the ignition problem once and for all. Together with industrial manufacturing techniques, the Bosch spark plug provided the breakthrough for the continuously increasing production of automobiles in the following decades.

Today, modern vehicles must satisfy ever more demanding requirements. They are measured by low fuel consumption, low emissions and maximum possible enjoyment when driving. It is no longer enough to refine individual components further in order to meet these requirements. Progress requires a holistic approach. Bosch uses its system know-how about the complex relationships between the subsystems to achieve new, pioneering solutions across systems.

In cooperation with leading automakers, Bosch develops and manufactures individual components such as spark plugs as well as complete systems. This experience and the high quality standards for OEM equipment are incorporated in their entirety into Independent Aftermarket (IAM). This is why Bosch offers a product range that is characterized by exceptional quality and reliability as well as by wide market coverage. In addition, Bosch offers professional assistance to retailers and workshops.
Global customer solutions:
Worldwide manufacturing

Spark plug know-how
Leading automakers rely on the system expertise of Bosch for their OEM equipment and the high quality standards of Bosch spark plugs. As a pioneer in the field of ignition, Bosch offers a wide range of products for automobiles (including gas-powered engines), two-wheeled vehicles, small engines and industrial applications.

Common manufacturing standards worldwide
An international network of manufacturing sites develops and produces the entire line of spark plugs in 5 countries. This standardization ensures the consistently high quality of Bosch products regardless of the country of manufacture. Worldwide manufacturing produces about 300 million spark plugs per year.

Plants worldwide

Bamberg
Bamberg
Germany

Saratow
Saratow
Russia

Nanjing
Nanjing
China

Aratu
Aratu
Brazil

Naganathapura
Naganathapura
India

The high quality standards at a world-class level are documented and monitored by various certifications. Good to know: All plants must comply with the same high quality standards of Bosch.

Bosch spark plugs – A success story
Bosch introduced its spark plugs with a high-voltage magneto over 113 years ago. With this product, Bosch solved the ignition problem of early automobiles. Through the possibilities offered by industrial manufacturing, automobiles became affordable for all. On January 7, 1902, Bosch received the patent for its spark plug and the string of successes began. Since then, Bosch has developed more than 22,000 types of spark plug.

Only the best is good enough
To ensure quality, Bosch products undergo continuous development. As a result, the performance of the Bosch spark plug has improved continuously since its invention. The result: Spark plugs have become more rugged and today have – depending on the application – a service life of up to 60,000 km without the use of precious metals. Spark plugs with precious metals may even achieve up to 100,000 km.

1902 – The first spark plug with a high-voltage magneto is developed by Bosch and revolutionizes motoring.

Over 114 years of experience
- Bosch is the inventor of the spark plug
- Bosch manufactures about 300 million spark plugs annually
- Worldwide manufacturing to the same, high quality standard
- Spark plugs for every segment of the market and almost every application
Over 114 years old –
As innovative as on its first day

Spark plug innovations since 1902

Copper-cored center electrode
For better thermal conduct committee, the center electrode has a copper core. To reduce wear, the copper core is surrounded by a nickel-alloy.

Platinum plus line
The Platinum plus spark plugs from Bosch feature a sintered center electrode of pure platinum. This provides better protection against soot buildup.

Surface discharge technology
Multiple ground electrodes are positioned such that only surface air-gap sparks form. This creates a larger flame core, considerably improving combustion.

Laser-welded double platinum
Platinum pins are laser-welded (center electrode) or inlaid (ground electrode), assuring better ignition and a considerably longer service life.
Many years of know-how and intensive continuous development of spark plugs in close cooperation with almost all vehicle manufacturers make Bosch one of the world's leading suppliers in terms of OEM equipment and the retail trade.

Intensive research and development
Bosch continuously adapts spark plugs to further developments in engine technology. Whether four-valve technology, lean-burn engines or fuel-efficient gasoline direct injection - the many applications of Bosch spark plugs result from design modifications and the use of especially resistant metals such as platinum and iridium or the rare earth element yttrium. Bosch will continue to develop new spark plugs in the future as well and guarantee the high quality of Bosch products.

Research: To exploit synergies, Bosch cooperates with many scientific institutes and universities around the world.

Development: In cooperation with vehicle manufacturers, Bosch uses its system of competence for fuel injection systems.

In this way, Bosch develops spark plugs that satisfy all regional requirements worldwide.

Bosch guarantees quality
Bosch spark plugs can be used in all engines based on catalogue application recommendations issued by Bosch. Bosch provides a guarantee of quality and freedom from defects. The guarantee covers material and manufacturing defects for 24 months worldwide and includes repair as well as replacement of defective parts.

Intentional deception with "stolen" appearance
Manufacturers of knockoffs copy the design of Bosch spark plugs in an attempt to give an impression of quality that they do not offer: the high quality of Bosch. With the "stolen" appearance, they intentionally mislead retailers and consumers.

Low-cost production, poor-quality raw materials
Bosch spark plugs are based on time-consuming research, careful production and more than 100 years of experience. Spark plug knockoffs cannot offer this.

Deceptively similar – But without the same performance
Even knowledgeable professionals often have difficulty distinguishing the original from counterfeits on the basis of the external appearance of the product or the packaging. Sometimes the lower price can be an indication of a cheap copy.

The value inside is what matters
How good a spark plug really is can be seen only by inspecting what is inside. It takes a look at the "inner workings" to see the faulty workmanship and inferior material that result in poor performance.

Cheap copies with expensive shortcomings
The poor quality of imitations can have fatal consequences for the engine: misfiring, false starts and even costly engine damage. Bosch has carefully examined various imitations with regard to design, material and workmanship. The results show serious shortcomings in all of the imitations examined.

High-quality Bosch spark plugs are available only from your authorized speciality retailer.

Whoever intentionally purchases or sells imitations is liable to prosecution!
Choice for quality: Vehicle manufacturers rely on Bosch

The task of the spark plug
Actually quite simple: The spark plug must ignite the air-fuel mixture in the combustion chamber of a gasoline-powered engine by means of an electric spark. Always reliable, always at the right moment, many thousand times per minute. It
- must guarantee a reliable cold start
- must function over the entire service life without misfiring
- must not overheat even after long operation under maximum load

Applications
Spark plugs are the ‘heart’ of gasoline engines powering a variety of vehicles and equipment:
- Passenger cars
- Commercial vehicles
- Motorcycles
- Boats
- Agricultural and construction machinery
- Power saws
- Gardening tools
- Snowmobiles

For many leading vehicle manufacturers, spark plugs from Bosch are the right decision from the very start. And that has good reasons. After all, when it comes to gasoline injection and ignition Bosch stands for exceptional quality and innovation, extensive know-how and and exemplary product line.

Close cooperation – exceptional results
Bosch develops all spark plugs for use as original equipment in close cooperation with automakers – they are tailored to the individual engines.

A benefit for retailers and workshops
Even in the aftermarket, Bosch offers original equipment quality – now and in the future. Bosch spark plugs bring the current trends in original equipment directly to retailers and workshops. Just two examples: aligned and welded ground electrode and interference-suppression resistor.

New technology for reliable ignition:
The aligned and welded ground electrode
The aligned and welded ground electrode ensures greater reliability of ignition through optimal positioning with respect to the injector. Additional benefits:
- Greater cold-start reliability
- Engine/catalytic converter protection through optimal combustion
- Reduced fuel consumption through prevention of misfiring

Uncompromisingly good:
Spark plugs with an interference-suppression resistor
Spark plugs with an interference-suppression resistor are being used increasingly as original equipment in order to shield the electronics in the vehicle from electromagnetic interference. This is why Bosch also offers spark plugs with such a resistor on the replacement part market:
- Maximum interference suppression
- Reliable operation of all electronic systems such as ABS, ASR and ESP®
- Interference-free radio reception

Bosch spark plugs supplied as original equipment:
- Audi
- Bajaj Auto
- BMW
- BYD
- Changan
- Cherry
- Dodge
- Fiat-Chrysler
- Ford
- Geely
- Holden
- Honda
- Jeep
- Maruti
- Mercedes-Benz
- Mini
- Mitsubishi
- Opel
- Peugeot
- Porsche
- Renault
- Seat
- Škoda
- Smart
- Suzuki
- Tata
- Vauxhall
- Volkswagen
- Volvo
- Weichai
The choice of winners:
Bosch spark plugs lead the field

Bosch spark plugs stand up to any comparison
When requirements are demanding, Bosch spark plugs are the reliable choice. It’s no wonder that they are used successfully in international motorsports.

Pole position for Bosch quality
Whether at the 24-hour race of Le Mans, the IndyCar Series, the NASCAR® races or the DTM – Bosch spark plugs show their winning qualities. The innovative yttrium alloy with the extreme ruggedness and wear resistance guarantees maximum performance on the racetrack. Bosch also supplies spark plugs to most of the teams competing in Formula 1 races.

High tech from motorsports adopted for volume production
Bosch spark plugs are leading in motorsports – thanks to their special technical features and standards as well as high-quality materials such as yttrium or Alloy 602. Innovations designed especially for the demanding requirements in motorsports are also incorporated into spark plugs supplied as original equipment. Frequently, they are even developed further and then mass-produced for retailers and automobile mechanics.

At the DTM, Bosch spark plugs always come out first.

Bosch shows its colors in motorsports
For many years now, Bosch has participated in the DTM. The most popular international touring car race, which is now broadcast live not only in Europe and Africa, but also in China and North America, is one of the motorsports events that draws the largest audiences. The Bosch brand is always visible: on the windshield and rear window, the vehicle and the inboard cameras at the pit lanes.

Bosch technology: The driving force for victory
Bosch is active as both a sponsor of the DTM and as a supplier of equipment used in the races. After all, the teams rely on top-of-the-line products. Thus, all DTM vehicles are fitted with Bosch spark plugs. Moreover, the entire engine management system is supplied by Bosch Motorsport, including the displays in the cockpit, the sensors, the injectors, the starters and alternators.

Bosch – An active participant in motorsports
Spark plugs must withstand a lot
Able to take the stress and still perform

Everything from a single source
Spark plugs are not only subjected to extreme stresses; they must also function reliably. Even the smallest flaw can cause expensive engine damage. That is why Bosch manufactures each component in-house for every spark plug – the only manufacturer to do so.

Requirements: Electrical properties
- Voltages of up to over 45,000 V must not cause electrical breakdown of the insulator
- The electrical resistance of the insulator must be assured even at temperatures of 1000 °C

Requirements: Chemical properties
- Resistance to all chemical processes in the combustion chamber
- Even at combustion temperatures up to 3000 °C
- Resistance to aggressive deposits contained in the fuel

Requirements: Thermal properties
- Resistance to rapid, extreme temperature changes (hot combustion gases and a cold fuel-air mixture)
- Good dissipation of the heat in the cylinder head

Requirements: Mechanical properties
- Reliable gas tightness at pressures of over 100 bar
- Ability to withstand tightening torques during installation

Cup terminal technology
In order to make engines more efficient, vehicle manufacturers are reducing the displacement or the number of cylinders (downsizing) while simultaneously increasing the charge air pressure. This necessitates a higher ignition voltage, which in turn requires an insulator with greater flashover resistance. Bosch has specifically developed spark plugs for this purpose. On these spark plugs, the insulator is approx. 8 mm longer. To compensate for this increased length the spark plug now has a stud with a cup to act as the contact connection. The contact pressure spring of the spark plug connector is centered in the cup.

Pin-to-pin spark plugs from Bosch
The innovative pin-to-pin spark plugs from Bosch are tailored to the special requirement profile of engines with gasoline direct injection with their high exhaust gas recirculation rate. The lean fuel-air mixture requires efficient energy transfer for ignition.
To compensate for the poor ignition resulting from a small electrode gap (quenching losses), Bosch has developed pin-to-pin spark plugs. In pin-to-pin technology the spark plug has two particularly thin electrodes that cause very low quenching losses. This ensures high power transmission and reliable ignition.

Structure and function:
- Nickel-plated spark plug shell with thread
  To protect against corrosion and seizing of the thread in the aluminum cylinder head.
- Effective leakage current barriers:
  Prevent flashover and thus misfiring.
- Shrink fit assembly:
  Guaranteed absolute gas tightness and exact heat range.
- Interference-suppression resister:
  Reliable operation of all electronic systems and interference-free radio reception.
- Multi-material center electrode:
  Highly conductive copper core in a wear-resistant chrome-nickel jacket for rapid attainment of the operating temperature. Protects against thermal overloading, corrosion and spark erosion.
- In precious metal spark plugs, precious metal pins are laser-welded to or inlaid in the center electrode.
Smaller, more efficient, more durable
With a significant investment in research and development and in close cooperation with international automobile manufacturers, Bosch brings new spark plugs that meet the requirements of modern gasoline engines to a level of manufacturing readiness. This means above all: better fuel economy, lower emissions, reduced dimensions and optimal performance.

Exceptional precision as the starting point
Modern internal combustion engines are highly complex systems where every detail must be matched precisely to every other. The spark plug is an important component in this regard and must meet entirely new requirements from the latest generation of direct injection systems, for instance. The starting point for meeting these requirements is almost tolerance-free production as well as new developments in the areas of materials, geometry and manufacturing processes.

New materials
Modern engines operate at especially high combustion temperatures. This also stresses the spark plugs. Electrode wear is greater and must be addressed through use of more resistant materials. This is why Bosch uses high-quality alloys such as platinum, iridium or rhodium, among others.

Defined ignition spark orientation
The stratified charge approach used with modern direct injection requires exact orientation of the ignition sparks toward the region of the combustion chamber that contains the ignitable mixture. An exactly defined spark orientation provides the required reliability.

Aligned and welded ground electrode
Precision-manufactured spark plugs with welded ground electrodes that are already aligned during production ensure reliable ignition in engines with spray-guided direct injection. The installation angle and installation orientation with respect to the injector are defined on the basis of the engine type. Tight manufacturing tolerances, modern measuring systems and, of course, close cooperation with engine manufacturers assure optimal alignment of the ground electrodes in this regard. The wrong installation angle can cause malfunctions.

Smallest installation dimensions
Powerful, efficient engines require a significant amount of air to ensure optimal combustion of the fuel. More air, however, means bigger channels in the intake and exhaust valves. This leaves less space available for installation of the spark plug. Or, said in a different way: The smaller the diameter of the spark plug, the more options engine designers have.

The perfect spark plug
The trend to ever more efficient and cleaner engines results in increasingly demanding – and sometimes contradictory – spark plug requirements. The perfect spark plug is thus always adapted to the particular engine. The spark plug must reliably ignite the fuel-air mixture under all operating conditions. At the required electrode operating temperatures of between 500 and 800 °C, they must withstand the high voltages of the sparks as well as wear for an extensive period of time.

At an early stage in engine development, the initial models are created on a computer and their suitability is confirmed virtually through various simulations before they are built physically and tested in the real world. As an important part of the engine, the spark plug subsequently contributes to energy-efficient operation of modern, environmentally friendly vehicles with low emissions.

At critical operating points in the full load, partial load and idle regions, optimized spark plugs ensure:
- Increased ignition reliability
- Improved fuel economy and lower emission levels through optimized combustion
- The best possible protection of the catalytic converter

Current development trends
Modern, supercharged gasoline engines with direct injection require – especially with a centrally positioned injector – further advances in the development of spark plugs. In the future, spark plug developers will have to address demanding requirements:
- Spark plugs with an M10 thread
- Operation at an even higher ignition voltage (up to 50 kV)
- Increased dielectric strength
- Greater thermomechanical and mechanical ruggedness to withstand sporadically occurring, irregular combustion
- Reduced electrode temperatures
- Minimization of wear (or retention of life expectancy despite complex requirements)

To develop the best possible spark plug, Bosch engineers work closely with vehicle and engine manufacturers as well as renowned universities.
Developed to withstand extreme loads:
High-performance spark plugs

**More power, less fuel**
Today, providing power and economy are the most challenging requirements in the performance specifications for modern engines. Only vehicles that are comfortable and a pleasure to drive have chances of succeeding in global markets. Globally, the laws are increasingly stringent regarding reduction of emissions and fuel consumption.

**Modern gasoline direct injection system with stringent requirements for spark plugs**
“Intelligent” injection systems, like the gasoline direct injection system, are not making it easy for the ignition systems. If the injection pressures in the combustion chamber are between 100 – 120 bar in case of normal combustion, they can be as high as 250 bar in a modern turbo engine. The ignition voltage requirements also increase due to the higher working pressures. Bosch high-performance spark plugs not only withstand this, but also ensure reliable ignition of the fuel-air mixture at all the operating points.

**Material development and design**
The electrodes need to be stable under these difficult engine conditions. High exhaust gas recirculation rates and high thermal as well as electrical loads have to be withstood. Through continuous development of the ceramic material and specific design modifications, the high-performance spark plug has been designed for maximum electrical, thermal and mechanical strength. The head bending strength has been improved by increasing the wall thickness of the insulator. At the same time, the high-performance spark plug has a dielectric strength exceeding 45,000 V and meets the Original Equipment Manufacturers’ stringent wear and tear requirements.

**Precious metal and CW laser welding process**
It is now more than 114 years ago that Bosch patented the spark plug. More than a century of experience in developing and manufacturing goes into Bosch spark plugs. During this time, spark plug technology has been perfected by Bosch. Many more patents have been granted along this journey. Continuous Wave (CW) laser welding is one of them and is used in production only by Bosch. Use of this process significantly increases the service life of the spark plug; the center electrode is stabilized against formation of cracks and consequently withstands the high pressures in the combustion chamber.

**New material alloy 602**
The high-performance spark plug from Bosch does not have only a center electrode with an extremely fine precious metal pin (fine wire). A new material has been used for the center electrode: the nickel alloy 602 with a higher proportion of chromium than in standard nickel alloys. The advantage compared to the previously used nickel alloys is the resistance of alloy 602 to high-temperature corrosion, which contributes to the higher service life of the spark plug.

**Exclusive “high-voltage end-of-line test”**
A product can meet the highest quality requirements only if appropriate quality assurance measures and tests are conducted. The quality requirements at Bosch are particularly challenging and a so-called “high-voltage end-of-line test” is carried out. At the end of production, all high-performance spark plugs are tested under conditions that are similar to those in the combustion chamber without exception. This happens only at Bosch.
Original equipment quality for the aftermarket: The Bosch spark plug program

Bosch spark plugs: As many different types for as many engine designs there are
The Bosch spark plug program has the right spark plug for every vehicle – always tailored to the requirements of the particular engine.

Structure of portfolio: Clearly organized, making products easy to find
Despite its big range, the Bosch spark plug program is easy to navigate. Different electrode alloys have different benefits to meet the requirements of a particular engine. They are named by the electrode alloy used. Thus, the spark plugs have names such as Bosch Platinum, Bosch Double-Platinum, Bosch Iridium, Bosch Double-Iridium, Bosch Silver or just Bosch*.  

*Previously: Bosch Super, Bosch Super plus

New, modern packaging design
- Technology-oriented, modern packaging design
- Fast orientation when placed on the shelves
- Quick and easy identification of the Bosch brand by means of white stripe with Bosch logo on blue packaging
- Product image, information field with electrode gap and tightening torque as well as installation instructions directly on the packaging
- Reliable protection of the spark plugs during transportation and storage
- QR code for fast access to additional information

The advantages for the workshop from leading spark plug technology

The advantages at a glance

<table>
<thead>
<tr>
<th>Original equipment quality</th>
<th>Extensive market coverage</th>
<th>Innovative alloys</th>
<th>Optimized electrode geometries</th>
<th>Heavy-duty ceramic</th>
<th>Advanced laser welding technology</th>
<th>Copper core</th>
<th>Also for gas-powered engines</th>
<th>Innovations from motorsports</th>
</tr>
</thead>
<tbody>
<tr>
<td>From one of the world’s leading original equipment suppliers</td>
<td>The right spark plug for almost every engine</td>
<td>With nickel and yttrium or precious metals (platinum or iridium)</td>
<td>Profiled ground electrode, pin-to-pin, multi-ground electrodes</td>
<td>Specifically for the requirements of modern engines</td>
<td>Maximum reliability and life span</td>
<td>Improves heat conduction</td>
<td>All Bosch spark plugs provide peak performance with gasoline as well as gas (CNG, LPG) as fuel</td>
<td>Are incorporated into spark plug production for passenger cars</td>
</tr>
</tbody>
</table>

Without a doubt, the “Best Brand” for motorists
For the 11th time in succession, they selected Bosch as their favorite brand in the spark plug category. Over 115,000 readers of the magazine “auto motor und sport” participated in the 2016 survey.

New Global Packaging Design:
Ordering numbers, applications, type codes, quick-search numbers and EAN codes remain the same.
At a glance: The Bosch spark plug program for workshops and DIY customers

**Bosch (Automotive)**
- Bosch
- Bosch Platinum
- Bosch Double-Platinum
- Bosch Iridium
- Bosch Double-Iridium
- Bosch Silver

**Super 4 Premium Line**
For passenger cars
- Four thin ground electrodes
- Surface air-gap principle

**Bosch (Non-automotive):**
for two-wheelers and small engines (in blister packaging for installation by user)

**Chrome-nickel ground electrode:**
for all non-automotive applications

The widest range of spark plug technologies combined in a single line:
- Precious metal
- Without precious metals

Sales arguments at a glance: Spark plugs with and without precious metals

**Advantages of spark plugs with precious metals**

<table>
<thead>
<tr>
<th>Precious metals</th>
<th>Customer benefit</th>
<th>Reason why</th>
</tr>
</thead>
</table>
| Platinum        | • Longer interval between service compared to Silver spark plugs  
                   • Very good corrosion and oxidation resistance as well as erosion resistance  
                   • Consistent ignition performance over the entire service life  
                   • High melting point of platinum  
                   • High chemical resistance  
                   • Less wear  
                   • Longer service life than Silver spark plugs  
                   • Extremely high erosion resistance of iridium |
| Iridium         | • Thinner center electrode for better accessibility by the mixture  
                   • Longer service life than standard spark plugs  
                   • Maximum thermal conductivity  
                   • Exceptional chemical resistance against lead-free fuels |
| Silver          | • Thinner center electrode for better accessibility by the mixture  
                   • Longer service life than standard spark plugs  
                   • High melting point of platinum  
                   • High chemical resistance |
| Precious metals |                  |            |

**Advantages of spark plugs without precious metals**

<table>
<thead>
<tr>
<th>No precious metals</th>
<th>Customer benefit</th>
<th>Reason why</th>
</tr>
</thead>
</table>
| Standard spark plugs | • Great reliability  
                         • Good price-performance ratio  
                         • Wide range of application  
                         • Extensive experience (continued development since 1902), proven materials  
                         • Large quantities without the use of precious metals  
                         • Electrodes made from high quality nickel-based alloys with copper core |
| Super 4            | • Longer service life than standard spark plugs without the use of (expensive) precious metals  
                         • Improved cold-start characteristics  
                         • Erosion distributed over 4 ground electrodes  
                         • Smaller ground electrode takes less energy from the spark|

Reason why: No precious metals
Sales arguments at a glance: **Original equipment quality for the independent aftermarket (IAM)**

**Original equipment quality for the IAM:**
The Bosch spark plug program

<table>
<thead>
<tr>
<th>Type</th>
<th>Customer benefit</th>
<th>Reason why</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long service life: Achieves or exceeds the replacement intervals recommended by the vehicle manufacturer</td>
<td>Worldwide market coverage of 95%.</td>
<td></td>
</tr>
<tr>
<td>Reduced fuel consumption, improved acceleration and corrosion resistance</td>
<td>Precious metal alloys based on the best erosion-resistant materials such as platinum, iridium, nickel, nickel-yttrium or silver</td>
<td></td>
</tr>
<tr>
<td>Improved cold-start ability, even at a low battery voltage</td>
<td>Highly wear-resistant electrodes made from nickel and precious metal alloys with copper core offer high thermal conductivity</td>
<td></td>
</tr>
<tr>
<td>Protects the housing against corrosion – fast and easy replacement – No seizing of the threads, especially in aluminum cylinder heads</td>
<td>Lower ignition requirement and optimum ignition through use of pointed and profiled ground electrode and taper-cut center electrode</td>
<td></td>
</tr>
<tr>
<td>Quick installation</td>
<td>Nickel-plated spark plug housing and threads is a standard on all Bosch spark plugs</td>
<td></td>
</tr>
</tbody>
</table>

**1st and 2nd trade level:**
- Original equipment quality
- Product line for automobiles of every age and any vehicle class
- Fast and easy ordering
- Technologically at the latest level with the newest trends and innovations

**1st trade level:**
A variety of different packaging

Sales arguments at a glance: **Spark plugs for CNG/LPG-powered engines and older passenger cars**

<table>
<thead>
<tr>
<th>Type</th>
<th>Customer benefit</th>
<th>Reason why</th>
</tr>
</thead>
</table>
| Bosch spark plugs for CNG/LPG-powered engines | 1st and 2nd trade level: | Nickel-plated spark plug housing and standard threads for the best ignition performance when using CNG/LPG.
- Spark plugs designed for more severe electrode wear and higher operating temperatures when using CNG/LPG as fuel.
- Replacement intervals: – 15,000 km for Bosch spark plugs – 30,000 km for Bosch precious metal spark plugs |
| End consumer: Stress-free dual-fuel operation |

<table>
<thead>
<tr>
<th>Type</th>
<th>Customer benefit</th>
<th>Reason why</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bosch Super 4</td>
<td>End consumer:</td>
<td>Adapted to the ambient conditions of modern engine management systems.</td>
</tr>
<tr>
<td>1st trade level:</td>
<td>Premium product for older engines</td>
<td>Long, energy-rich sparks for the lean-fuel operating conditions that frequently occur in older engines.</td>
</tr>
<tr>
<td>Extensive product line</td>
<td>Stronger acceleration</td>
<td>Thin electrodes for high energy transfer.</td>
</tr>
<tr>
<td>Better margins</td>
<td>Greater fuel efficiency</td>
<td>Surface-gap technology prevents soot buildup and reinforces the self-cleaning action of the spark plug.</td>
</tr>
<tr>
<td>1st trade level:</td>
<td>Extensive product line</td>
<td>Wide operating range is covered by fewer spark plugs.</td>
</tr>
<tr>
<td>Better margins</td>
<td>Better sales thanks to unique product benefits in a given segment</td>
<td></td>
</tr>
</tbody>
</table>

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**Reason why**

**Type**

**Customer benefit**

**1st and 2nd trade level:**
- Original equipment quality
- Product line for automobiles of every age and any vehicle class
- Fast and easy ordering
- Technologically at the latest level with the newest trends and innovations

**1st trade level:**
- Fast and easy ordering
- Technologically at the latest level with the newest trends and innovations

**End consumer:**
- Premium product for older engines
- Improved engine response
- Stronger acceleration
- Greater fuel efficiency
- Better margins
### Sales arguments at a glance: Spark plugs for two-wheelers and small engines

<table>
<thead>
<tr>
<th>Type</th>
<th>Customer benefit</th>
<th>Reason why</th>
</tr>
</thead>
</table>
| Bosch spark plugs for two-wheelers and small engines | ► Removable SAE connection nut  
► One Bosch part number covers several competitors’ types  
► Nickel-plated spark plug housing and rolled threads on all Bosch spark plugs  
► Electrode gap preset at factory  
► Leading OE supplier for market-leading manufacturers  
► High market coverage  
► Optimized design: Nickel center electrode for reliable starts  
► Electrode gap preset at factory | 1st and 2nd trade level:  
Extensive market coverage with a few types  
Housing protected against corrosion and thread seizing  
Fast installation |
| End consumer:                       | ► OEM know-how and reliable commitment to quality  
► Extensive market coverage  
► Reliable quick starts  
► Quick installation | 1st and 2nd trade level:  
Leading OE supplier for market-leading manufacturers |

### Sales arguments at a glance: Competence from OE experience and motorsports

<table>
<thead>
<tr>
<th>Type</th>
<th>Customer benefit</th>
<th>Reason why</th>
</tr>
</thead>
</table>
| Original equipment competence       | 1st and 2nd trade level:  
Leading in technology and quality | ► Direct knowledge transfer from original equipment products to IAM program  
 ► Successful cooperation with all leading automakers  
 ► Preferred original equipment supplier in Europe  
 ► More than 114 years of experience in the development and production of spark plugs |
| Motorsports competence              | 1st and 2nd trade level:  
Latest motorsports technology transferred to the aftermarket | Latest technologies – developed in cooperation with international motorsports teams:  
Whether in 24-hours races in Le Mans, the IndyCar Series, the Brazilian Stock Car Series or the DTM – the motorsports elite relies on spark plugs from Bosch.  
For a good reason. Bosch also supplies spark plugs to teams that participate in Formula 1 racing. |
The specialists for spark plugs: For all motorized equipment

Few types, high market coverage:
The compact product line from Bosch
Whether for the hobby gardener or professional – motorized, mobile work equipment is becoming ever more popular and the variety of gardening and forestry equipment is growing accordingly. With only a few spark plug types, the Bosch line of spark plugs for small engines covers all commonly encountered equipment. In this way, the customer is offered the correct spark plug in a small sales area:

- Leaf blowers
- Hedge trimmers
- Leaf vacuums
- Power generators
- Lawn trimmers
- Snow blowers
- Garden tractors
- Chainsaws
- String trimmers
- Lawn mowers
- Snow blowers
- Water pumps

Self-explanatory sales support
The blister packaging is an attractive and self-explanatory sales aid that provides ideal sales support for the retailer. The simple system with search number, type code and Bosch number ensures that customers immediately find the appropriate spark plug. All important information for safe and professional installation is provided as well.

Spark plugs contribute decisively to optimal performance and reliable operation of the engine.
Motorcycle spark plugs from Bosch are specially designed for the particular requirements of engines on two wheeled vehicles:
- Quiet operation
- Reliability without misfiring over the entire service life
- Reliable cold starts
- Optimal combustion and high fuel economy
- Extensive product line with applications for many brands and engine types
- Factory-preset electrode gap, designed for the specific engine
- Easy and quick change without seized spark plugs
- High insulating capability even at temperatures above 1 000 °C
- Able to withstand pressures up to about 100 bar
- High mechanical strength for safe installation
- Resistant to chemical processes in the combustion chamber and aggressive residues
- Resistant to thermal shock from hot exhaust gases alternating with incoming cold fuel-air mixture
- Good dissipation of heat by insulator and electrodes
- Bosch system competence for motorcycles

Spark plugs must withstand special stresses in motorcycle engines in particular because of their high rpm.

Reliable, well-organized, practical: Motorcycle spark plugs from Bosch are available individually packaged, in 10-packs or in blister packaging.
A different fuel, a different spark plug
When motorists decide in favor of gas engines, they obtain information on many things: fuel economy, safety, availability of the fuel etc. Above all, service shops must be familiar with the special technology of gas engines. Important for a conversion: When powered by gas, the engine needs new spark plugs with the appropriate characteristics.

Convert: Improve performance, protect the engine
Spark plugs used in gas-powered engines are subject to greater wear than in gasoline-powered engines. For this reason, they must be changed at intervals of 15,000 km or 30,000 km. Usually, manufacturers of conversion kits cannot provide any binding information about the spark plug needed, because they do not know in advance in which engine the kit will be installed. This is where the retailer and service shop with its competence and knowledge are needed to identify which spark plug is the right one and how often it needs to be changed.

Adapting spark plugs to gas engines
Spark plugs from Bosch can be designed perfectly for the requirements of gas engines: A gas control unit automatically compensates for the higher ignition voltage required if an ignition timing advance mechanism is incorporated. If this is not done, Bosch recommends that a spark plug with an electrode gap of 0.7 mm be used or the gap be adjusted appropriately.

Bosch spark plugs: Also ideal for gas engines
Bosch spark plugs impress with their high quality. In addition, the right spark plug is available for virtually every vehicle. Because of their material, Bosch platinum spark plugs in particular experience less wear and achieve a longer service life, making them ideal for gas as fuel.

The differences between gasoline and gas engines
Converting from gasoline to gas as fuel results in special requirements for the engine:
- Gas requires a higher ignition voltage than gasoline. While a gasoline-powered engine needs 14 kV, for instance, a gas-powered engine requires 16 kV for reliable ignition under the same conditions.
- A higher operating temperature occurs in the combustion chamber when gas is the fuel.
- The higher ignition voltage and the higher operating temperature in the combustion chamber mean that the electrodes reach the end of their service life faster.

Gas engines reduce fuel costs, protect the environment – and need the right spark plugs for their special requirements.
This is how you find the right type: 

Type code for Bosch spark plugs

No need for a long search; instead, find what you need quickly: 
Seat form and thread, heat range code number, thread length and spark length – here you can see at a glance what the code on the spark plug means.

See pages 34/35
Design and materials: Type code for Bosch spark plugs

Find important information quickly: Here you can see at a glance the type of design and which materials are used in the spark plug.

Version Deviation from the basic design
0 Pin-to-pin technology
1 2 Ground electrode: NiCr 1) ground electrode
3 4 Ground electrode: Copper core in ground electrode
5 6 Thread with special length
7 8 Profiled, chisel-shaped ground electrode
9 10 Center electrode: Platinum wafer
11 12 Center electrode: Platinum wafer
13 14 Center electrode: Platinum wafer
15 16 Center electrode: Platinum wafer
17 18 Center electrode: Platinum wafer
19 20 Center electrode: Platinum wafer
21 22 Center electrode: Platinum wafer
23 24 Center electrode: Platinum wafer
25 26 Center electrode: Platinum wafer
27 28 Center electrode: Platinum wafer
29 30 Center electrode: Platinum wafer
31 32 Center electrode: Platinum wafer
33 34 Center electrode: Platinum wafer
35 36 Center electrode: Platinum wafer
37 38 Center electrode: Platinum wafer
39 40 Center electrode: Platinum wafer
41 42 Center electrode: Platinum wafer
43 44 Center electrode: Platinum wafer
45 46 Center electrode: Platinum wafer
47 48 Center electrode: Platinum wafer
49 50 Center electrode: Platinum wafer
51 52 Center electrode: Platinum wafer
53 54 Center electrode: Platinum wafer
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69 70 Center electrode: Platinum wafer
71 72 Center electrode: Platinum wafer
73 74 Center electrode: Platinum wafer
75 76 Center electrode: Platinum wafer
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81 82 Center electrode: Platinum wafer
83 84 Center electrode: Platinum wafer
85 86 Center electrode: Platinum wafer
87 88 Center electrode: Platinum wafer
89 90 Center electrode: Platinum wafer
91 92 Center electrode: Platinum wafer
93 94 Center electrode: Platinum wafer
95 96 Center electrode: Platinum wafer
97 98 Center electrode: Platinum wafer
99 100 Center electrode: Platinum wafer

Electrode designs

Center electrode material

See pages 32/33

1) Nickel-chromium
2) Nickel-yttrium
Troubleshooting at a glance: Look at the “face” of the spark plug

**Normal**
- Insulator nose from gray-white/gray-yellow to fawn brown color. Engine is OK. Heat range correctly selected. Mixture setting and timing OK, no misfiring, cold start and functioning properly. No residues from fuel additives containing lead or alloying constituents from engine oil. No thermal overload.

**Carbon-fouled**
- Insulator nose, electrodes and spark plug shell covered with velvet-like dull black soot deposits.
- **Cause:** Incorrect mixture setting (carburetor, injection). Mixture too rich, air cleaner severely fouled, automatic choke not OK or manual choke actuated too long, predominationly short distance driving, spark plug too cold, heat range code number too low.
- **Effect:** Misfiring, poor cold starting performance.
- **Remedy:** Set mixture and starting device correctly, check air cleaner.

**Oil-fouled**
- Insulator nose, electrodes and spark plug shell covered with shiny soot or carbon deposits.
- **Cause:** Too much oil in combustion chamber. Oil level too high, heavily worn piston rings, cylinders and valve guides. In two-stroke gasoline engines, too much oil in mixture.
- **Effect:** Misfiring, poor starting performance.
- **Remedy:** Overhaul engine, correct fuel/oil mixture, new spark plugs.

**Partially melted center electrode**
- Center electrode partially melted, blistered, spongy, soft insulator nose tip.
- **Cause:** Thermal overload due to auto-ignition, e.g., excessively advanced ignition timing, combustion residue in combustion chamber, defective valves, defective ignition distributor and poor fuel grade. Heat range possibly too low.
- **Effect:** Misfiring, loss of power (engine damage).
- **Remedy:** Check engine, ignition and mixture formation. New spark plugs with correct heat range.

**Melted center electrode**
- Center electrode melted, ground electrode also severely corroded.
- **Cause:** Thermal overload due to auto-ignition, e.g., excessively advanced ignition timing, combustion residue in combustion chamber, defective valves, defective ignition distributor and poor fuel grade.
- **Effect:** Misfiring, loss of power, possibly engine damage. Overheated center electrode may cause insulator nose to crack.
- **Remedy:** Check engine, ignition and mixture formation. New spark plugs.

**Partially melted electrodes**
- Cauliflower-like appearance of electrodes.
- **Possibly precipitation of material not originating from the spark plug.**
- **Cause:** Thermal overload due to auto-ignition, e.g., excessively advanced ignition timing, combustion residue in combustion chamber, defective valves, defective ignition distributor and poor fuel grade.
- **Effect:** Misfiring, loss of power prior to total failure (engine damage).
- **Remedy:** Check engine, ignition and mixture formation. New spark plugs.

**Ferrocene**
- Ferrocene on insulator nose, electrodes and part of the spark plug shell coated with red-orange adherent deposits.
- **Cause:** Fuel additive containing iron. The deposits occur after a few thousand kilometers of normal operation.
- **Effect:** The iron-containing coating is electrically conductive and causes misfiring. Overheat engine, correct fuel/oil mixture, new spark plugs.

**Severe center-electrode wear**
- Top edges of the center electrode rounded by erosion and corrosion. The electrode spacing has increased significantly.
- **Cause:** Spark plug replacement interval not observed.
- **Effect:** Misfiring, particularly during acceleration (ignition voltage no longer sufficient for large electrode gap). Poor starting performance.
- **Remedy:** New spark plugs.

**Severe lead deposits**
- In places, brownish yellow glaze on insulator nose which may also have a greenish tinge.
- **Cause:** Fuel additives containing lead. Glow develops under heavy engine load after lengthy operation under partial load.
- **Effect:** With heavy loading, coating becomes conductive and causes misfiring. New spark plugs; cleaning has no effect.

**Ash fouling**
- Thick ash coating from oil and fuel additives on insulator nose, in scavenging area (annular orifice) and on ground electrode. Loose to cinder-like structure.
- **Cause:** Alloying constituents, particularly from oil, may deposit such ash in the combustion chamber and on the spark-plug face.
- **Effect:** Can lead to auto-ignition with loss of power and engine damage.
- **Remedy:** Repair engine. New spark plugs, possibly use different oil.

**Severe ground-electrode wear**
- The cross-section of the ground electrode has been reduced severely by erosion and corrosion. The electrode spacing has increased significantly.
- **Cause:** Aggressive fuel and oil additives. Unfavorable flow conditions in combustion chamber, possibly due to deposits, engine knocking. No thermal overload.
- **Effect:** Misfiring, particularly during acceleration (ignition voltage no longer sufficient for large electrode gap). Poor starting performance.
- **Remedy:** New spark plugs.

**Cracking of insulator nose**
- The ceramic insulator on the combustion chamber side is broken. Parts of the insulator base are missing.
- **Cause:** Mechanical damage due to impact, dropping or pressure on the center electrode resulting from incorrect handling. In marginal cases – especially after excessively long use – the insulator nose may crack due to deposits between the center electrode and insulator nose, and due to corrosion of the center electrode.
- **Effect:** Misfiring, sparkover at points not reliably supplied with fresh mixture.
- **Remedy:** New spark plugs.
From actual practice: 
**The Bosch tip for spark plugs**

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**Spark plug installation with a torque wrench**
Tightening torque (N • m): 10 N • m = 1 kpm for dry, non-greased and non-oiled threads and new gaskets. For lubricated threads, reduce the specified torques by 1/3.

<table>
<thead>
<tr>
<th>Thread Size</th>
<th>Torque (N • m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 10 x 1.25</td>
<td>10</td>
</tr>
<tr>
<td>M 12 x 1.25</td>
<td>15</td>
</tr>
</tbody>
</table>

**Exception:** Spark plugs with aligned ground electrode. Follow the instructions on the packaging.

1. in cast iron
2. in aluminum

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**Spark plug installation without a torque wrench**
Screw in spark plug by hand until it is seated in the cylinder head. Spark plugs with flat seat and a new gasket are then turned about 90° further with the spark plug wrench. Spark plugs with conical seat and spark plugs with a used flat gasket are then turned about 15° further.

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Please note!
The spark plug recommendations are issued by Bosch, where not originating from the vehicle or engine manufacturer. The recommendations apply under normal operating conditions for production models, not for racing, special-purpose or high-performance vehicles (unless specifically listed). Use of heat ranges other than those recommended may be necessary because of special operating conditions. If spark plugs with the specified electrode gap are not available, the electrode gap must be adjusted. For this, we recommend using the Bosch spark plug gage.

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**Know-how and technology for fast diagnoses:**
**ESI[tronic] 2.0 software and test equipment**

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**Bosch: Specialist for passenger car equipment**
Complex networked systems in vehicles require even more qualified diagnoses in service shops and extensive know-how for repair. For this reason, Bosch offers service shops extensive system expertise and a complete line of test equipment from a single source. Modern, powerful diagnostic equipment and the ESI[tronic] 2.0 software for service shops assist with all repairs and service work.

**ESI[tronic] 2.0: Custom-designed for the service shop**
Simple operation, fast access and a standardized system for all brands make the ESI[tronic] 2.0 software a user-friendly diagnostic tool. Extensive market coverage and ongoing updates are part of the offer. Thanks to the modular design, an ignition system specialist can subscribe to only the types of information relevant to him.

**ESI[tronic] 2.0: Diagnosis with troubleshooting instructions**
ESI[tronic] 2.0 (Electronic Service Information) offers a great deal more than just control unit diagnosis. The troubleshooting instructions SIS (Service Information System) provide step-by-step guidance for troubleshooting. All information needed for maintenance and service – whether passenger car, van or truck – is immediately available at the vehicle. Relevant service and repair data for new vehicle models is available in ESI[tronic] 2.0 starting six months after the vehicle appears on the market.

**ESI[tronic] 2.0 and test equipment from Bosch:**
A successful duo for diagnosis and repair

- A high level of functionality in conjunction with simple operation saves time
- Accurate diagnoses for successful correction of problems
- Fast and reliable repairs for a high level of customer satisfaction
- A combination of troubleshooting instructions (SIS) and control unit diagnosis (SD) across makes
- For gasoline and diesel engine management systems and passenger car brake systems, from Bosch and other manufacturers
- Modular concept, tailored to the needs of the individual service shop
- Exceptional diagnosis with Bosch test equipment
- Extensive range of test equipment for control unit diagnosis, vehicle system analysis, emissions analysis, air conditioning service, battery service, brake tests, tire service and headlight aiming

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**Especially for ignition systems:**
- ESI[tronic] 2.0 information type C
  - Control unit diagnosis, including troubleshooting
- ESI[tronic] 2.0 information type M
  - Information on gasoline systems
Knowledge for a competitive edge: Service training, Technical Hotline and knowledge database

Learning at the highest level: Bosch Service Training
With the new developments in the area of vehicle technology, the technical know-how requirements in service shops are constantly increasing. For service shops to keep up with technology, continuing education is essential. The technical and commercial training offered by Bosch is updated continually to match the state of technology. In this way, service shop professionals always receive up-to-date training.

Technically always up to date: Technical training
There are suitable training courses for every target group – whether novice or pro. The training courses are offered in different technical areas and training series (e.g. gasoline injection, diesel injection, or electrical systems). Extensive know-how is presented for all commonly encountered automotive systems from Bosch and other manufacturers.

Business promotion: Commercial training
The commercial training courses offer service shops a broad spectrum of opportunities to maintain their position over the long term in a highly competitive industry, and to grow. Professional company management, technology for sales personnel, self- and time management are major topics. The commercial training courses from Bosch are aimed at owners, shop managers, chief executive officers, employees from service and sales, and car dealerships.

Fast information: Technical Hotline
In addition to telephone assistance, the Bosch Technical Hotline offers the knowledge database. All Hotline cases processed are documented there and can be searched for solutions with the aid of search filters. If a solution is not available a so-called trouble ticket is issued and processed immediately by a Hotline expert. The How2Fix app offers mobile access (Android/iOS).

Direct access: Remote diagnosis
Especially fast assistance from the Technical Hotline is available in the form of remote diagnosis. In this case, a Bosch technician connects his computer directly to the PC in the service shop and together with the service shop employee carries out help functions and test equipment applications.

Even experienced automotive experts face unknown problems or new systems developed by the automotive industry. The continually updated training offering and the Technical Hotline with the Bosch knowledge database support you in more quickly localizing problems, repairing more vehicles, and reducing the wait times of customers. Moreover, the methodic procedures that are taught ensure faster and more productive work.
Advise, inform, convince: Sales promotion at the highest level

Information for the service shop

Being well-informed also means: selling better. Customers love to receive information about their vehicle. The more that service shops and automotive parts retailers know about service shop products, the better they can provide specific information for customers.

What you need to know: Information brochures

Clearly organized, detailed information about special topics focusing on Bosch spark plugs.

- Spark plug brochure – Provides a comprehensive overview of the entire line of spark plugs from Bosch
- Spark plugs for motorcycles – An overview of the extensive Bosch product line for motorcycles
- Small engines – Everything you need to know about spark plugs in small engines
- Cast gas applications – What is essential to know about gas-powered vehicles

Know-how on a large scale: Service shop posters

Clear, detailed and perfectly made to hang where the information is needed – Service shop posters from Bosch.

- Spark plug faces: Effect and causes
- Spark plug construction: Technology down to the smallest detail

Complete and fast information: Catalogs, drop-down list box

All products, all services. Clearly organized and ready to be found quickly.

- Spark plug catalog
- Spark plug catalog for two wheeled vehicles
- Spark plug and glow plug catalog
- Drop-down list box for rapid matching of the appropriate spark plug to the specific vehicle model

The more knowledge the service shop has about spark plugs, the better the customer can be informed

Extensive advertising and information material

- Greater name recognition and brand acceptance based on media presence
- Complete advertising material from displays to catalogs and brochures
At a glance: Data and facts about spark plugs

**Terminals nuts**
Provides contact between the spark plug connector and center electrode of the spark plug. Conducts the ignition voltage to the electrode.

**Battery-coil ignition**
Use of an ignition coil to generate a high voltage and help create the spark.

**Gasoline direct ignition**
With this modern approach, gasoline is injected under pressure through a common rail system directly into the combustion chamber of the cylinder. This permits stratified mixing with less fuel than in conventional injection.

**Torque**
Unit of measure, to be observed especially when installing spark plugs.

**Sintered center electrode**
With the aid of a high-temperature process, the center electrode is bonded to the electrode tip, and this assembly is bonded tightly to the ceramic through shrinkage.

**Single-ground electrode**
Spark plugs employing the air spark principle with only one ground electrode.

**Electrode gap**
The electrode is the shortest distance between the center electrode and ground electrode. The voltage plays an important role with regard to the electrode gap. If the voltage is too low, the spark cannot jump the gap.

**Spark duration**
The duration of the ignition spark between the electrodes (about 2 ms). It must be maintained long enough for the air-fuel mixture to be ignited.

**Surface gap**
Path that the spark follows when it first moves over the surface of the insulator tip and then jumps to the ground electrode. Along this path, it burns away disturbing deposits and combustion residues.

**Homogeneous mixture**
For engines with intake manifold fuel injection. Lambda is the same everywhere in the combustion chamber. Even engines with a lean mixture (high amount of air in the combustion chamber) are operated with a homogeneous charge.

**Inner gap**
It provides the gas-tight connection between the insulator and metal body, and dissipates heat.

**Insulating paste**
Used between the spark plug connector and ceramic. The use of insulating paste prevents head sparkovers.

**Insulator**
The insulator consists of an aluminum oxide ceramic and insulates the center electrode with respect to ground for up to more than 45,000 V.

**Insulator nose**
Projects into the combustion chamber and its design has a major impact on the heat range of a spark plug.

**Head sparkover**
Discharge of a high voltage as the result of dirt or moisture. When head sparkover occurs, the spark discharges travel from the high-voltage terminal nut to the shell via the ceramic.

**Shunt**
Branch of a parallel arrangement of electrical power consumers.

**Thermal ignition**
The term “autoignition” is used to describe ignition of the fuel-air mixture that occurs independently of spark plugs and usually at hot surfaces (e.g. on the overly hot surface of the insulator nose of a spark plug with too high a heat range). Based on their time of occurrence relative to the moment of ignition, they can be divided into two categories:

a) **Post-ignition**
Post-ignition occurs after electrical ignition, but is not critical for practical engine operation, since the electrical ignition always occurs earlier. To determine whether the spark plug is causing thermal ignition, the electrical ignition spark must be suppressed during this measurement. When post-ignition occurs, the ion current increases noticeably only after the moment of ignition. However, since ignition is being triggered, a pressure increase and thus torque output can also be registered

b) **Pre-ignition**
Pre-ignition occurs before electrical ignition and can cause serious engine damage because of its uncontrolled behavior. Because of the premature triggering of combustion, not only does the pressure maximum shift to top-dead center; the maximum combustion chamber pressure shifts to higher values as well. This increases the thermal load on components of the combustion chamber. This is why the spark plug must be designed so that no pre-ignition occurs.

**Type code**
The spark plug specifications are contained in the type code. It contains all key characteristics of the spark plug.

**Shrink fit process**
Used to bond the nickel-plated spark plug shell gas-tight to the insulator.

**Heat range**
The term “heat range” was introduced by Bosch. The term applies to specifications of the thermal design of a spark plug. It is an indication of the maximum thermal load established on the spark plug when there is equilibrium between heat absorption and heat dispersal.

**Ignition energy**
The let-through current and design parameters of the ignition coil determine the amount of energy that is stored in the ignition coil and used as ignition energy (ignition spark). The correct ignition energy is important for ignition of the air-fuel mixture, as only efficient ignition guarantees high power and low emissions.

**Ignition**
The ignition process is controlled by the engine. The ignition system generates a high voltage in a periodic manner. This voltage causes, in the form of a spark, an electric discharge between the electrodes of the spark plug. This spark ignites the compressed air-fuel mixture in the combustion chamber.
Frequently asked questions about spark plugs: Know-how from experts for experts

What is the function of the spark plug and why are spark plugs “essential” for operation of the engine?

The spark plug must ignite the air-fuel mixture in the combustion chamber of a gasoline-powered engine by means of an electric spark. During operation, the spark plug becomes soiled and is subject to wear. The larger electrode gap that results increases the ignition voltage required. If the ignition voltage required exceeds the ignition voltage supplied by the ignition coil, misfiring results. For this reason, spark plugs must be replaced regularly.

Is the electrode gap set during manufacturing?

Electrode gaps are set during manufacturing. Readjustment of the electrode gap usually is not necessary when changing spark plugs.

The electrode gap for every vehicle application is listed in the Bosch spark plug catalog. The electrode gap is stated on the spark plug packaging.

What is pre-ignition?

When an unsuitable spark plug is used, pre-ignition or glow ignition may occur. That is why it is especially important that the appropriate spark plug be selected with the aid of the catalog.

Pre-ignition (glow ignition) is an uncontrolled ignition process where the temperatures in the combustion chamber can increase to such an level that serious damage to the engine and spark plug occurs. During operation under full load, glow ignition can occur at the following locations:

► At the tip of the insulator nose on the spark plug
► At the exhaust valve
► At protruding cylinder head gaskets
► At loose deposits

What is knocking in an engine?

When an unsuitable spark plug is used, knocking can occur in the engine. That is why it is especially important that the appropriate spark plug be selected with the aid of the catalog.

The term “knocking” describes uncontrolled combustion with a very rapid pressure increase. Such uncontrolled combustion occurs in auto-igniting portions of the mixture that ignite without a spark. The combustion takes place considerably faster than normal combustion. Pressure fluctuations with high peak pressures and high frequencies occur and are superimposed on the normal pressure curve. When the combustion pressure reaches the walls of the combustion chamber, metallic knocking noises are created. If the cause of knocking is not corrected in time, engine damage can result.

What is the heat range of a spark plug?

The heat range is used to specify the thermal design of a spark plug. It is an indication of the maximum thermal load established on the spark plug when there is equilibrium between heat absorption and heat dispersal.

Can the same spark plugs be used if the engine output has changed?

If the output of an engine is increased, e.g. through use of a turbocharger, a blower system or other systems, the recommended spark plug cannot be used. A spark plug with a lower heat value must be used to compensate for the additional heat generated by the engine. In such a case, Bosch recommends consulting a qualified engine builder to assist with determination of the correct heat range.

What replacement intervals are recommended for spark plugs?

Usually, the spark plug replacement interval is stated in the vehicle manual. Bosch recommends that the spark plugs be inspected annually and, if necessary, replaced in order to ensure optimal engine output.

What are the loads on a spark plug?

A spark plug must meet electrical, mechanical, chemical and thermal requirements.

► Electrical requirements: The spark plug must function under extreme conditions. During ignition, voltages of up to 40,000 V and combustion chamber temperatures greater than 1,000 °C occur. Optimal insulation is a prerequisite.
► Mechanical requirements: Spark plugs must be able to withstand an alternating pressure of about 100 bar in the combustion chamber. They must retain their mechanical integrity under all operating conditions.
► Chemical requirements: Resistance to chemicals in the combustion chamber and aggressive (corrosive) residues from the combustion process.
► Thermal requirements: Thermal shock resistance (hot gases and cold incoming air-fuel mixture). Good thermal conduction by the insulator and the electrodes is a prerequisite for reliable operation.

Why are there ribbed and smooth insulators?

The shape of the insulator depends on the high-voltage connection or spark plug connector used. For closed boot connectors, smooth insulators (i.e. without ribs) are used. For open connectors, insulators with leakage current barriers (i.e. with ribs) provide benefits.
Diagnostics and spare parts
from a single source

Comprehensive system know-how for mechanics and workshops as well as retailers: Only Bosch, the leading OEM supplier, offers both.

Automobile spare parts
- Location of resources, sales and logistics
- Worldwide logistics capability
- Over 160,000 different individual parts

Workshop equipment
- Test technology
- ESI[tronic] 2.0 software
- Workshop equipment
- Technical hotline and knowledge database
- Service training
- Active support across brands

More information at:
www.bosch-zuendkerze.de