Seat shape and thread

A	D	E	F	H	K	L	M	N	S	T	U	V	W	X	Y	Z
14	20.8	12 [1]	16	16	14* [1]	14	26	14	14 [1]	16	16	14	20.8 [2]	17.5	16	14 [1]
M 12x1.25	M 18x1.5	M 10x1.0	M 14x1.25	M 14x1.25	M 14x1.25	M 14x1.25	M 18x1.5	M 10x1	M 12x1.25	M 10x1	M 10x1	M 12x1.25	M 14x1.25	M 12x1.25	M 12x1.25	M 12x1.25

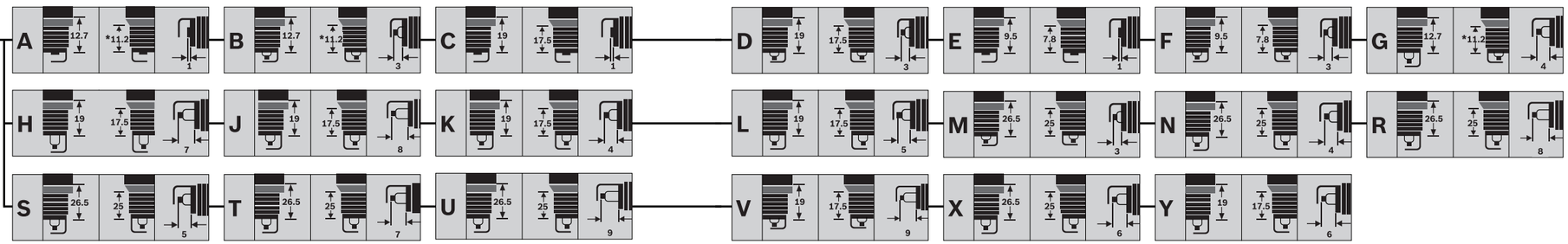
Design

B	Water-tight, for shielded ignition cable dia. 7 mm
C	Water-tight, for shielded ignition cable dia. 5 mm
E	Surface gap spark plug without ground electrode
G	Surface gap spark plug with ground electrode (s)
H	Half thread
L	Surface air gap spark plug
M	For motor sport
Q	Quickheat
R	With interference suppression resistor
S	For low-power engines

Heat range code number

13 12 11 10 9 8 7 6 5 4 3 2 09 08 07 06

Thread length Spark position



* The thread length for spark plugs with seat shape D and spark position A or B is 10.9 mm.

Type of electrode

	D	T	Q

Electrode material

C	E	P	S	I
Copper	Nickel-yttrium	Platinum	Silver	Platinum-iridium

Version

R	S	T	U	V
Burn-off resistor	0.7	0.8	1.0	1.3

W	X	Y	Z	+
0.9	1.1	1.5	2.0	*SUPER plus* Technology

0	Differences from basic design
1	P0 design with Ni ground electrode
2	Binary ground electrode
3	Special length thread
4	Extended insulator nose
9	Special design

	Center electrode with welded-on platinum wafer Diameter 0.8 or 1.1 mm possible	Center electrode with welded-on platinum wafer Diameter 0.6 or 0.8 mm possible	Ground electrode Mono nickel-yttrium	Ground electrode Binary nickel-yttrium	Ground electrode Mono nickel-yttrium with laser-alloyed platinum inlay	Ground electrode Binary nickel-yttrium with laser-alloyed platinum inlay
10	●	–	●	–	–	–
15	●	–	●	–	–	–
22	●	–	–	–	●	–
222	●	–	–	–	–	●
23	–	●	–	–	●	–
232	–	●	–	–	–	●
30	–	●	●	–	–	–
302	–	●	–	●	–	–
33	–	●	–	–	●	–
332	–	●	–	–	–	●

[1]) Double hexagon [2]) Hexagon size 19.0 mm for low-power engine version WS

Spark Plug Faces

Spark Plug Faces — Part 1

BOSCH

1. **Normal Condition**
   Insulator nose grayish-white or grayish-yellow to brown. Engine is in order. Heat range of plug correct. Mixture setting and ignition timing are correct, no misfiring, cold-starting device functioning. No deposits from fuel additives containing lead or from alloying constituents in the engine oil. No overheating.

2. **Sooted — Carbon-fouled**
   Insulator nose, electrodes and spark plug shell covered with velvet-like dull black soot deposits.
   Cause: Incorrect mixture setting (carburetor fuel injection); mixture too rich, air filter very dirty, automatic choke not in order or manual choke pulled too long, mainly short-distance driving, spark plug too cold, heat-range code number too low.
   Effects: Misfiring, difficult cold-starting.
   Remedy: Adjust A/F mixture and choke device, check air filter.

3. **Oil-fouled**
   Insulator nose, electrodes and spark-plug shell covered with shiny soot or carbon residues.
   Cause: Too much oil in combustion chamber. Oil level too high, badly worn piston rings, cylinders and valve guides. In two-stroke engines, too much oil in mixture.
   Effects: Misfiring, difficult starting.
   Remedy: Overhaul engine, adjust oil/fuel ratio (2-stroke engines), fit new spark plugs.

4. **Lead fouling**
   Insulator nose covered in places with brown/yellow glazing, which can have a greenish color.
   Cause: Lead additives in fuel. Glazing results from high engine loading after extended part-load operation.
   Effects: At high loads, the glazing becomes conductive and causes misfiring.
   Remedy: Fit new spark plugs since cleaning the old one is pointless.

5. Pronounced lead fouling

Insulator nose covered in places with thick brown/yellow glazing, which can have a greenish color.
Cause: Lead additives in fuel. Glazing results from high engine loading after extended partload operation.
Effects: At high loads the glazing becomes conductive and causes misfiring.
Remedy: Fit new spark plugs since cleaning the old ones is pointless.

6. Formation of ash

Heavy ash deposits on the insulator nose resulting from oil and fuel additives, in the scavening area and on the ground electrode. The structure of the ash is loose to cinder-like.
Cause: Alloying constituents, particularly from engine oil, can deposit this ash in the combustion chamber and on the spark-plug face.
Effects: Can lead to auto-ignition with loss of power and possible engine damage.
Remedy: Repair the engine. Fit new spark plugs. Possibly change engine-oil type.

7. Center electrode covered with melted deposits

Melted deposits on center electrode. Insulator tip blistered, spongy and soft.
Cause: Overheating caused by auto-ignition. For instance, due to ignition being too far advanced, combustion deposits in the combustion chamber, defective values, defective ignition distributor, poor-quality fuel. Possibly, spark-plug heat-range value is too low.
Effects: Misfiring, loss of power (engine damage).
Remedy: Check the engine, ignition and mixture formation system. Fit new spark plugs with correct heat-range code number.

8. Partially melted center electrode

Center electrode has melted and ground electrode is severely damaged.
Cause: Overheating caused by auto-ignition. For instance, due to ignition being too far advanced, combustion deposits in the combustion chamber, defective values, defective ignition distributor, poor-quality fuel.
Effects: Misfiring, loss of power (engine damage). Insulator-nose fracture, possibly due to overheated center electrode.
Remedy: Check the engine, ignition and mixture-formation system. Fit new spark plugs.

9. Partially melted electrodes

Cauliflower-like appearance of the electrodes. Possible deposit of materials not originating from the spark plug.
Cause: Overheating caused by auto-ignition. For instance, due to ignition being too far advanced, combustion deposits in the combustion chamber, defective values, defective ignition distributor, poor-quality fuel.
Effects: Power loss becomes noticeable before total failure occurs (engine damage).
Remedy: Check engine and mixture-formation system. Fit new spark plugs.

10. Heavy wear on center electrode

Cause: Spark plug exchange interval has been exceeded
Effects: Misfiring, particularly during acceleration (ignition voltage no longer sufficient for the large electrode gap). Poor starting.
Remedy: Fit new spark plugs.

11. Heavy wear on ground electrode

Cause: Aggressive fuel and oil additives. Unfavorable flow conditions in combustion chamber, possibly as a result of combustion deposits. Engine knock. Overheating has not taken place.
Effects: Misfiring, particularly during acceleration (ignition voltage no longer sufficient for the large electrode gap). Poor starting.
Remedy: Fit new spark plugs.

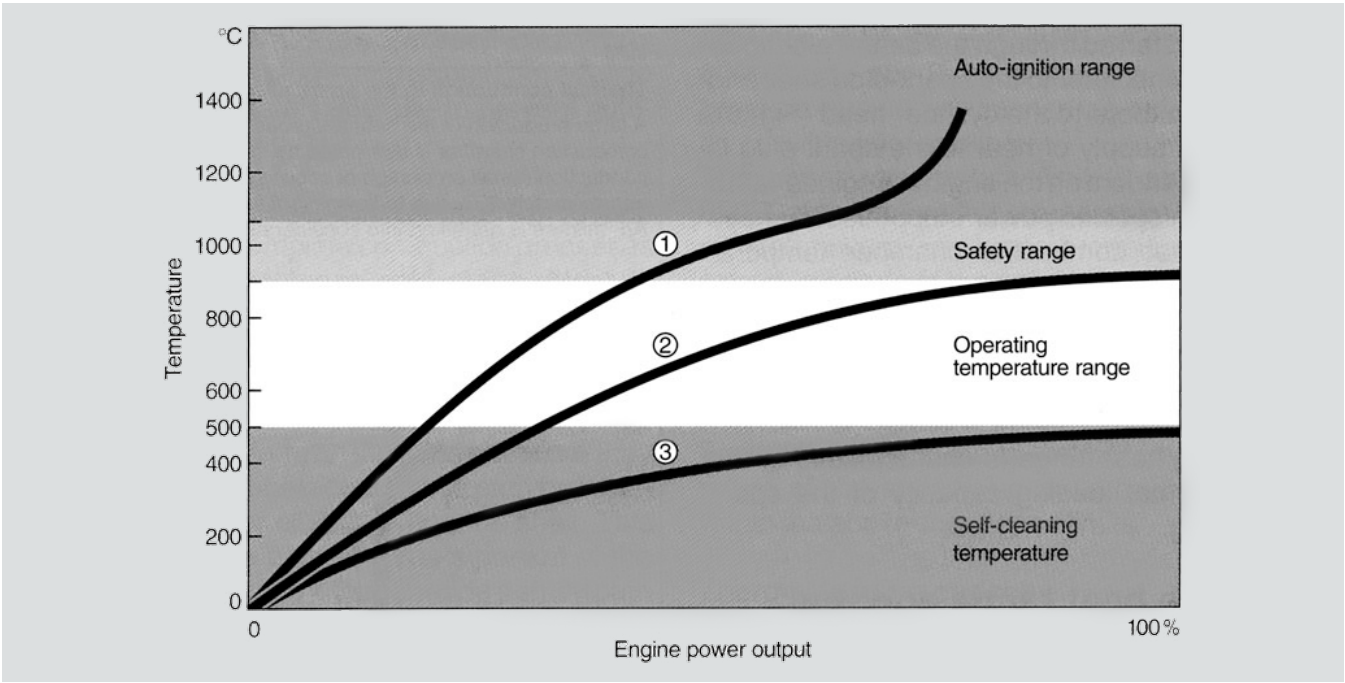
12. Insulator-nose fracture

Cause: Mechanical damage (spark plug has been dropped or bad handling has put pressure on the center electrode). In exceptional cases, deposits between the insulator nose and the center electrode, as well as center-electrode corrosion, can cause the insulator nose to fracture (this applies particularly fro excessively long periods of use).
Effects: Misfiring, spark arcs-over at a point that is inaccessible for the fresh charge of A/F mixture.
Remedy: Fit new spark plugs.

Spark Plug Heat Range

Temperature curves of spark plugs with different heat-range code numbers at full load in the same engine.

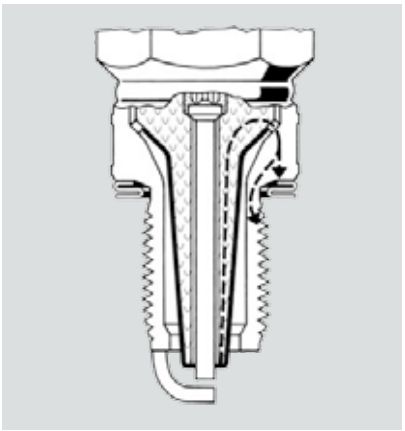
BOSCH

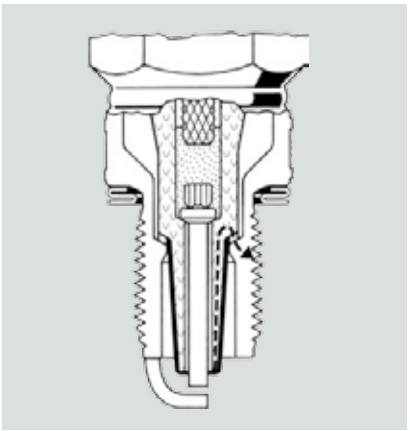


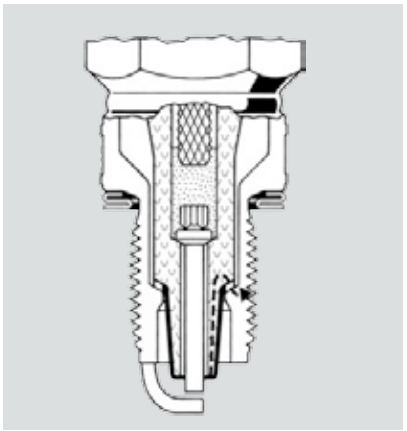
① Spark plug with high heat-range code number (“hot plug”). Large insulator nose area absorbs much heat, low heat dissipation.

② Spark plug with medium heat-range code number. Insulator nose area smaller than in “hot plug”. Lower heat absorption, better heat dissipation.

③ Spark plug with low heat-range code number (“cold plug”). Smaller insulator nose area absorbs little heat. Very good heat dissipation through short thermal conduction path.







——— Heat-absorbing surface
- - - - - - Thermal conduction path

Spark Plug Demands

Racing Places Enormous Demands on Spark Plugs

BOSCH

Racing improves the breed. This is an old automotive adage, and today more than ever, racing definitely improves the breed when it comes to spark plugs – especially premium spark plugs. Racing is the ultimate test for a spark plug, and other than the given fact that the plugs must fire on command; spark plugs must not fail in a race! It doesn't matter whether it is a 200-mile dirt track event, the Indy 500, or the 24 hours of LeMans – the plugs cannot fail, and they have to work perfectly

- The spark plugs must exhibit absolute, rock-solid durability
- They must ignite the fuel-air mixture for maximum power
- They must provide maximum fuel efficiency
- They must operate with minimum draw on the ignition system
- They must operate effectively with the particular fuel being used
- They must provide a strong, consistent spark from the start to finish, however many hundreds of miles that may be

Racing, as it has for at least 100 years, provides a great developmental impetus and test bed for spark plug durability and performance, and what is learned at Indy or Darlington or LeMans helps improve the spark plugs installed in today's cars and trucks.

Take Indianapolis for instance. In addition to Ray Harroun's Marmon Wasp that won the very first Indy 500 in 1911, the past 16 Indy 500 winners and many in between have run specially developed premium spark plugs to get to victory lane. Spark plugs in today's Chevrolet, Honda, or Toyota Indy racing engines undergo tremendous stress, heat, and harmonic vibrations from running full throttle at 10,000-plus rpm for several hours without letup.

Although most spark plugs for Indianapolis and most other major racing events are actually hand made, they use the same basic design and the same premium metals and ceramics as the premium plugs used in passenger cars. The primary difference is in the center ground electrode configuration.

Rather than welding the multiple ground electrodes onto a steel shell, the entire outer shell and ground electrodes on racing plugs are machined from a single piece of steel. This helps ensure maximum reliability under the extreme stress of racing.

Premium plugs use “race-bred” technology

Similarly, many premium passenger car spark plugs use multiple ground electrodes and precious metals, which are a direct result of their development and testing in long distance racing. In long distance racing, the voltage and the spark must remain constant for the entire race, and multiple electrodes minimize the effects of metal losses on both the center and ground electrodes, which can actually widen the plug gap and degrade the spark. Multiple electrodes — and the use of precious metals — ensure the integrity of the spark plug for an entire race. Spark plugs for the most major race series use two or more ground electrodes and precious metals.

This is important for a couple of reasons.

First, the spark jumps in the cylinder radially from the multiple electrodes rather than axially from a single electrode. This provides better mixture accessibility, and multiple ground electrodes provide greater assurance of creating a strong, consistent spark every time it is needed – whether flat out in the straightaway at Indy or in heavy traffic on the freeways in L.A. or the Cross Bronx Expressway in New York.

Every time a spark plug fires, a tiny bit of metal is lost in the electrical discharge. Over the course of 500 miles at 10,000 rpm – or 50,000 miles at 2500 rpm in a passenger car – this can degrade the plug’s performance. Multiple electrodes and precious metals minimize this degradation from metal transfer.

Precious metals and multiple electrodes ensure ultimate reliability and durability, provide the correct, consistent spark to keep the engine running smoothly and efficiently, and keep emissions under control.

There are many variations in multiple electrodes. A new plug is just being developed for the Honda Indy engine utilizing three ground electrodes. These electrodes protrude slightly into the combustion chamber, providing better mixture accessibility for more power.

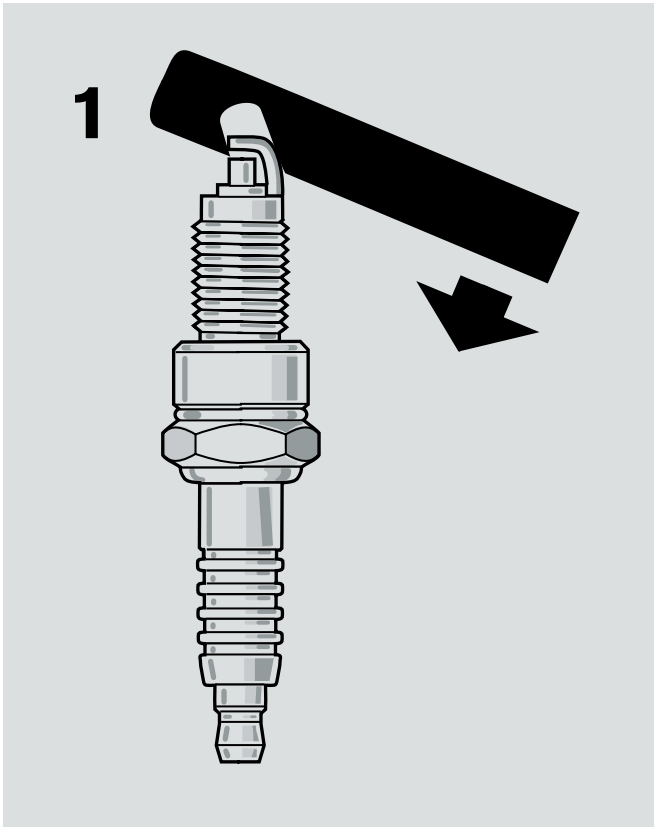
Another trend on the racetrack is the demand for smaller and smaller plug diameters. Smaller diameter plugs have been growing in popularity for years, and increasingly racing plugs are changing from 14-mm plugs to 12-mm and 10-mm plugs, and 8-mm plugs. Why? It gives engine builders more room for water jackets and bigger valves in already constricted cylinder heads. This has the engineers working nights, and these smaller plugs are already starting to appear in performance oriented sports cars. Soon they will be in conventional automobiles as well.

Racing gives invaluable testing of advanced spark plug designs, durability and performance in an incredibly harsh environment. Increasingly, what is learned at the racetrack influences everyday spark plugs. And much of what is designed into premium spark plugs could well represent the future of spark plug use for efficient, economical driving.

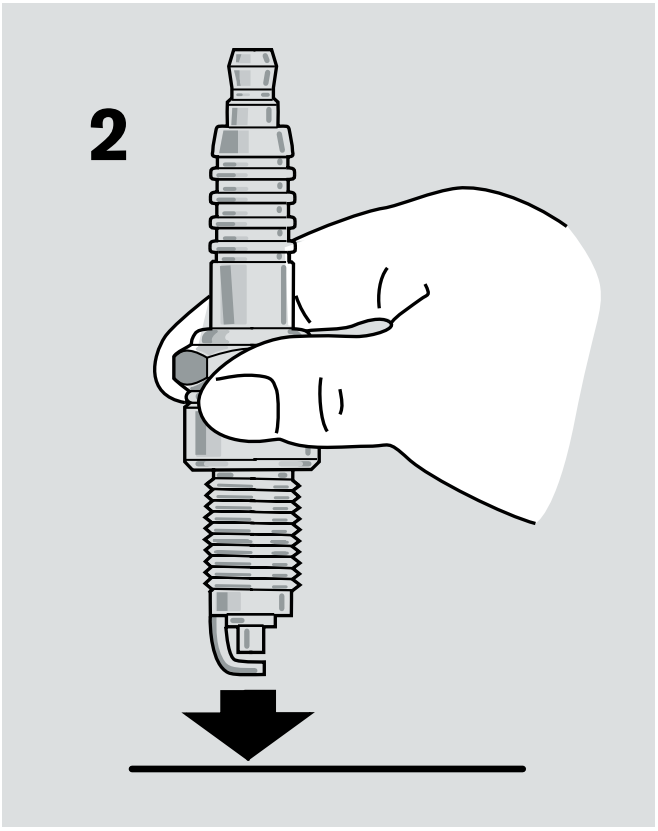
Bosch Spark Plugs

Spark Plug Gapping

BOSCH



Widen Electrode Gap



Close Electrode Gap