



20 questions and answers on spark plugs

20 Q&A

What is the Iridium IX spark plug?

How to read NGK part numbers?

What is a resistor spark plug?

What is the heat rating of a spark plug?

What is a V-grooved type spark plug?

What is the tightening torque for a spark plug?



NGK SPARK PLUGS

INTRODUCTION

Proper engine operation requires the following three conditions:



1
Good mixture
of fuel and air

2
Good
compression

3
Good spark
production

Even when a good fuel and air mixture is supplied to an engine and good compression exists, the engine will not start without good spark production. A quality spark plug is a critical part in the production of good sparks; this Q & A Booklet is designed to provide you with technical information about spark plugs and instructions on how to use them.

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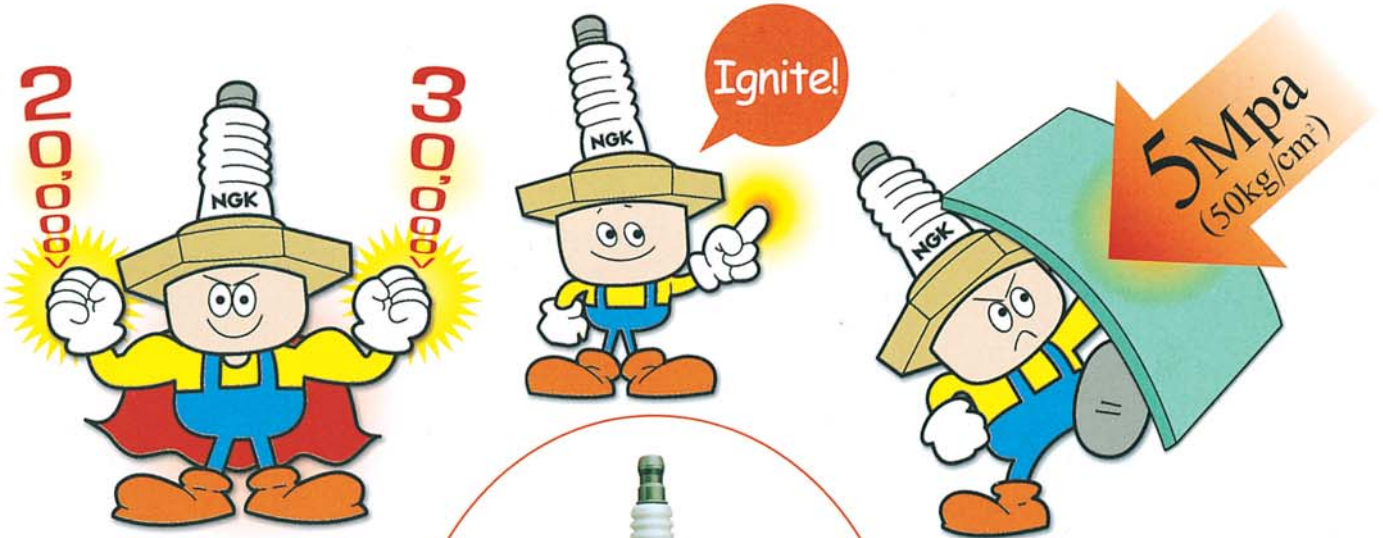
Q1 What is the function of a spark plug?



Q1

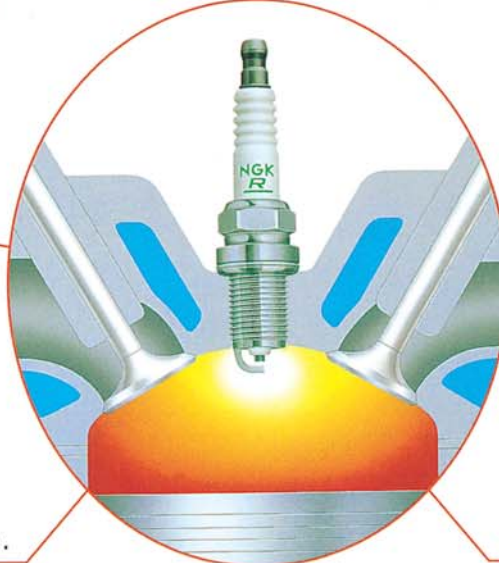
A It serves as a lighter to ignite the air/fuel mixture.

It operates under extreme conditions.



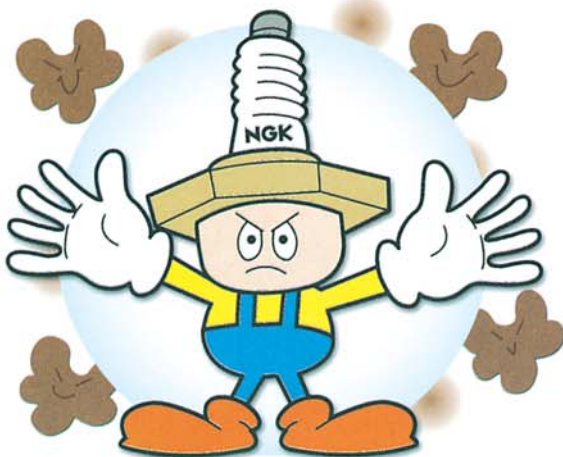
It withstands high voltages of 20,000 - 30,000 V.

It withstands repetitive explosive pressures of 5 MPa (50 kg/cm²).



The electrode material withstands corrosion from combustion products (Pb, P and S compounds) created during combustion.

It also withstands repetitive cycles of rapid cooling by the intake mixture (normal temperature) and heating by combustion gases (2,000 to 2,500 °C).



Q2

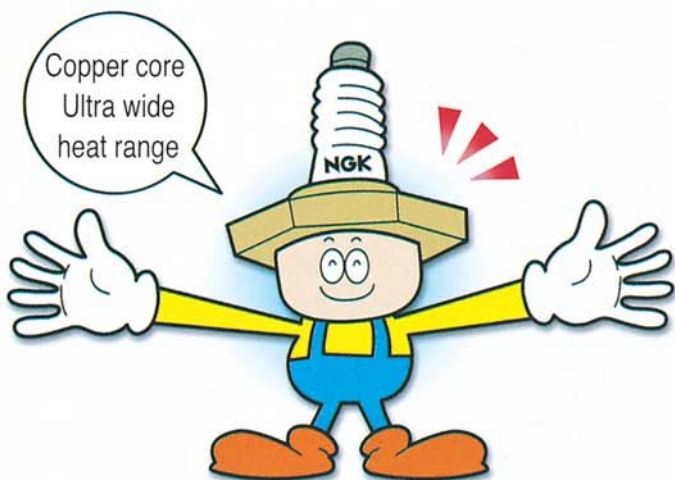
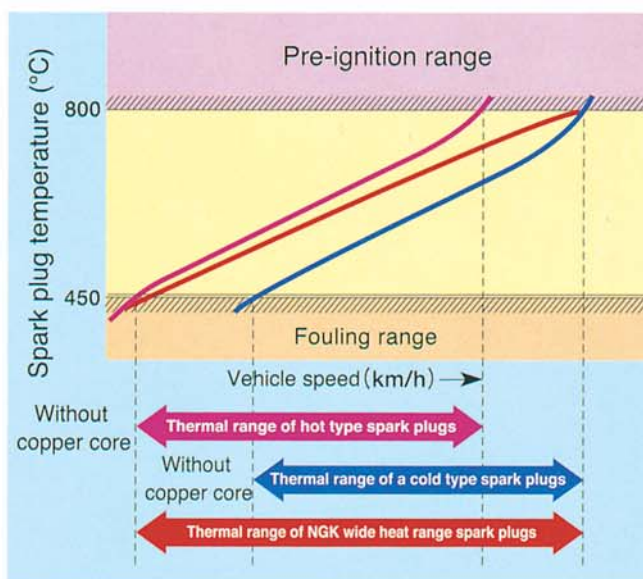
Why are NGK spark plugs superior?



A They are designed to extract maximum performance from the engine throughout its range.

1 It is an "ultra wide heat range" spark plug.

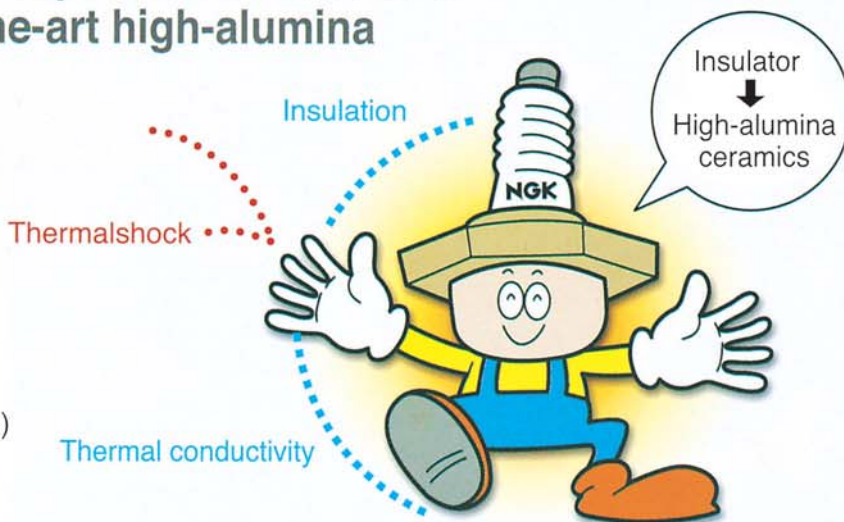
It has a center electrode with copper deeply inserted in the tip to quickly dissipate large amounts of heat. This makes for a spark plug with an "ultra wide heat range" that resists both overheating and fouling.



When the thermal characteristics of spark plugs with and without copper cores are compared, spark plugs with copper cores prove to be superior in heat and fouling resistance and provide a wider thermal operating range.

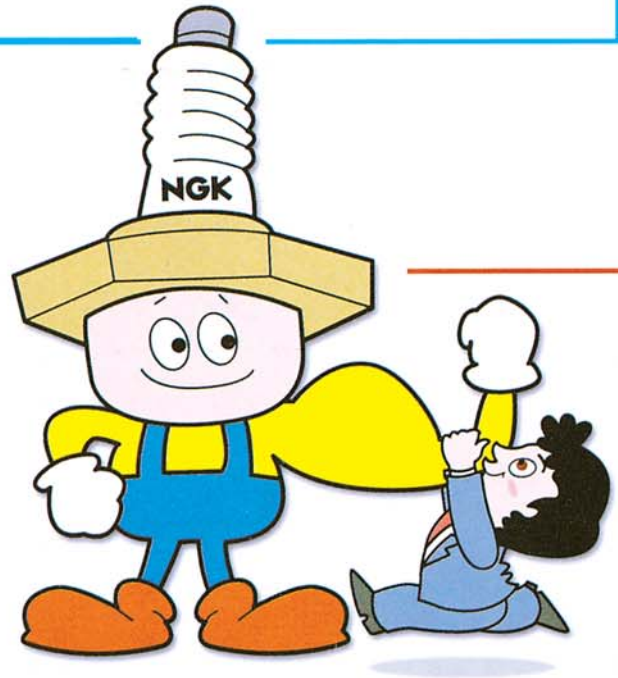
2 This spark plug incorporates an insulator made of state-of-the-art high-alumina ceramics.

- It has superior insulation at high temperatures and offers sure sparking.
- It provides superior thermal conductivity and prevents overheating.
- It resists thermal shock (sudden heating and cooling) and provides superior mechanical strength.



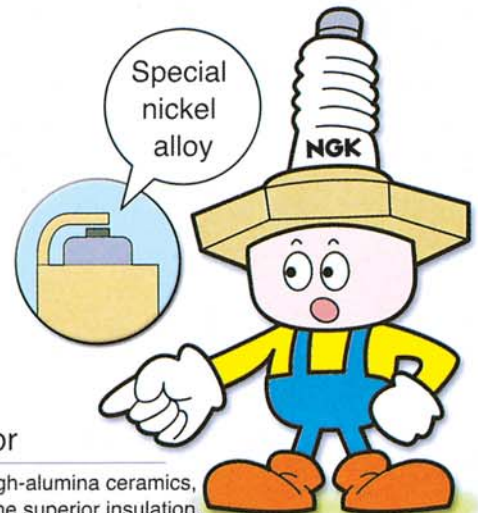
3 It has solid construction to ensure superb gas-tightness.

Special powders to connect the insulator and the metal shell offer superior gas-tightness and strong construction.



4 The electrode tip made of special nickel alloy ensures superior durability.

Special nickel alloy ensures superior heat resistance and durability.



Terminal nut

Corrugation

Five ridges are provided to extend the insulating surface distance between the terminal and the metal shell, preventing flash-over.

Brand and part number

Metal Shell

Plated to provide superior resistance to high-temperature corrosion.

Thread length (reach)

Thread diameter

Insulator

Made of high-alumina ceramics, providing the superior insulation, heat resistance and thermal conductivity that are required of a spark plug.

Special powder filling

Provides good gas-tightness and robust construction.

Gasket

The special design prevents any leakage of combustion gases.

Copper core

Quickly dissipates a large amount of heat to provide an "ultra wide heat range" plug that gives maximum performance at both high and low speeds.

Spark gap

Center and ground electrodes

Special nickel alloy ensures superior heat resistance and durability.

Structure of NGK Spark Plugs

Q3

What is the heat rating of a spark plug?

A A spark plug must dissipate the heat produced by the combustion gases. The heat rating is a measure of the amount of heat dissipation.

The heat rating is expressed as a number.



Hot Type : Long Insulator Nose

- There is a greater surface area exposed to the hot combustion gases.
- Heat transfer to the engine head is slower.



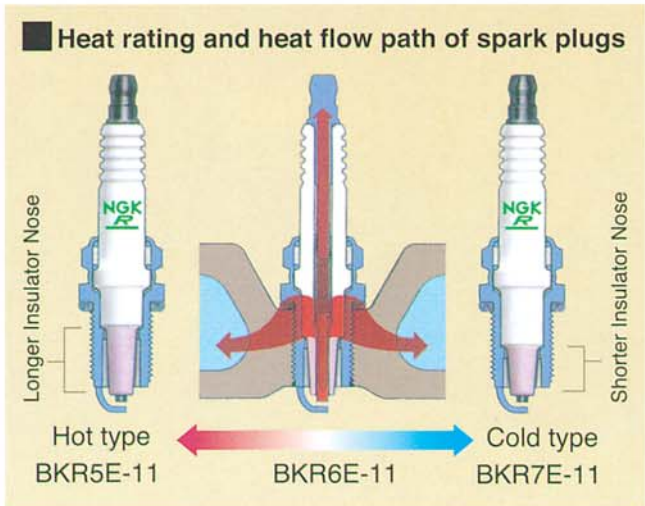
Its firing end heats up quickly.

Cold Type : Short Insulator Nose

- Less surface area exposed to the hot combustion gases.
- Heat transfer to the engine head is quicker.



Its firing end does not heat up quickly.



MEMO

It is essential to use a spark plug with a heat rating that matches a specific engine and its condition of use.

When a wrong heat rating is selected,

- **When the heat rating is too high,**
The spark plug temperature remains too low and causes deposits to build up on the firing end; the deposits provide an electrical leakage path that gives rise to a reduction of spark.
- **When the heat rating is too low,**
The spark plug temperature rises too high and induces abnormal combustion (pre-ignition); this leads to melting of the spark plug electrode that could cause problems such as piston seizure.

Q4

What do NGK part numbers signify?

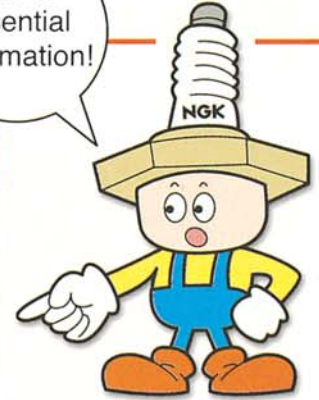


Q4

A

The NGK part numbers are the basis for selecting the spark plug specified by the manufacturer.

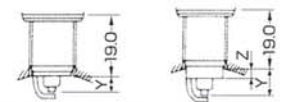
This is essential information!



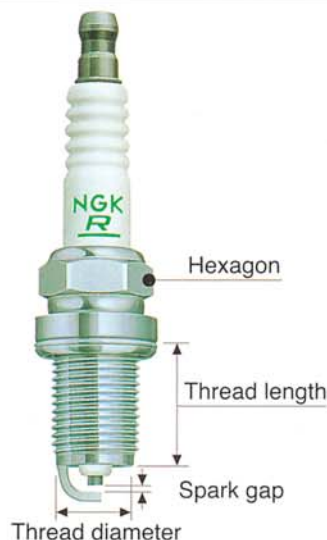
B	P	R	5	E	S	-11
Thread diameter A-18mm B-14mm C-10mm D-12mm E-8mm BC-14mm BK-14mm DC-12mm	P Projecting insulator type M Small spark plug (CMR6H; Seat height is shorter than CR6HS) U Surface gap, semi-surface gap or supplementary gap (such as BUHW, BUR6ET)	R Resistor Z Inductive resistor type	Heat Rating Hot type 2 3 4 5 6 7 8 9 Cold type	Thread length E 19.0mm H 12.7mm L 11.2mm EH 19.0mm half-thread M Bantam type BM 9.5mm BPM-A 9.5mm F Conical seat type A-F 10.9mm B-F 11.2mm B-EF 17.5mm BM-F 7.8mm	B: Integral terminal CM: Short seat height CS: Oblique ground electrode D: Daihatsu only (BCPREED) G, GV: Racing spark plug IX: Iridium IX spark plug IX-P: Iridium MAX spark plug J: 2 projecting electrodes K: 2 ground electrodes LPG: LPG only N: Thick ground electrode P: Platinum spark plug Q: 4 ground electrodes (BKREQUIP: BMW) (BKREQUIPA: Nissan) (BUR9EQP: Mazda) QP: 4 ground electrodes, platinum center electrode S: Standard type T: 3 ground electrodes U: Semi surface gap spark plug VX: VX spark plug Y: V-grooved center electrode YA: Fouling resistant (BR9EYA)	Spark gap None: Standard -9: 0.9mm -10: 1.0mm -11: 1.1mm -13: 1.3mm -14: 1.4mm -15: 1.5mm -L: Medium heat rating
BK The length from the plug gasket circuit to the terminal contact on parts using International Standard (ISO) dimensions is 2.5mm shorter than the Japan standard (JIS) BCP type.						

(This table shows how to read general part numbers.)

P	F	R	5	A	-11
I: Iridium spark plug L: Long thread reach spark plug P: Platinum spark plug Z: Protruding type spark plug	Mounting thread dimensions Hex. size F $\phi 14 \times 19$ mm 16.0mm G $\phi 14 \times 19$ mm 20.8mm J $\phi 12 \times 19$ mm 18.0mm K $\phi 12 \times 19$ mm 16.0mm M $\phi 10 \times 19$ mm 16.0mm T Conical seat type $\phi 14 \times 17.5$ mm 16.0mm (Except PTR-A $\phi 14 \times 25$ mm) U Conical seat type (BP-FS) $\phi 14 \times 11.2$ mm 16.0mm Y Conical seat type (B-FS) $\phi 14 \times 11.2$ mm 16.0mm	R Resistor type	Heat rating 4 Hot type 5 6 7 8 9 Cold type	A, B, C, Suffix code I One-side iridium spark plug (KR7A) P One-side platinum spark plug (FR6BP-11)	Spark gap None: Standard -9: 0.9mm -10: 1.0mm -11: 1.1mm



	Spark position (Y)	Shell projection dimension (Z)	Code	
PFR5A-11	53.0(JIS)	3.5	0	JIS specification
PFR5A-11A	53.0(JIS)	3.5	0	No plug gasket type of PFR5A-11
PFR5A-11B	53.0(JIS)	6.5	3.5	Metal Shell projection
PFR5B-11, (-9)	50.5(ISO)	3.5	0	ISO spec of PFR5A-11
PFR5B-11B	50.5(ISO)	6.5	3.5	Metal Shell projection
PFR5B-11C	50.5(ISO)	3.5	1.5	Ground electrode spec change, Metal Shell projection
PFR5B-D	50.5(ISO)	3.5	0	Metal Shell plating spec change
PFR5C-11	50.5(ISO)	3.5	0	Ground electrode spec change of PFR5B-11
PFR5E-11A	53.0(JIS)	3.5	0	No plug gasket type, Ground electrode spec change of PFR5A-11
PFR6G, (-11)	50.5(ISO)	3.5	0	Ground electrode spec change of PFR5B-11
PFR5J-11	50.5(ISO)	3.5	0	Ground electrode specification change of PFR5B-11
PFR5K-11	53.0(JIS)	3.5	0	JIS spec of PFR5G-11
PFR6L-11	50.5(ISO)	3.5	0	Ground electrode spec change of PFR6J-11
PFR6M	50.5(ISO)	3.5	0	Ground electrode spec change of PFR6J-11
PFR6N, (-11)	50.5(ISO)	3.5	0	Electrodes spec change
PFR5P, (-11)	50.5(ISO)	3.5	0	Specification with thermo-edge
PZFR6B	50.5(ISO)	5.0	0	Manufacturer use only, Projected core nose
PZFR5C	50.5(ISO)	7.0	3.0	Manufacturer use only, Metal Shell projection
PZFR5E, (-11)	50.5(ISO)	5.0	0	Projected core nose
PGR6A, (-11)	56.0	3.5	0	Platinum type of BPR6ES
PGR6A-D	56.0	3.5	0	Metal Shell plating spec change
PGR6C-11	56.0	3.5	0	Electrodes specification change
PGR6D	56.0	3.5	0	Ground electrode specification change
PLFR6A-9, (-11)	50.5(ISO)	3.5	0	Thread length 26.5mm
PLFR6B-10	50.5(ISO)	3.5	0	Thread length 26.5mm, ground electrode specification change
LFRA5AQP	50.5(ISO)	3.5	0	Thread length 26.5mm, 4ground electrodes, platinum center electrode
LZFR5AQP	50.5(ISO)	6.5	3.0	Thread length 26.5mm, 4ground electrodes, Metal Shell projection, platinum center electrode
ZFR5A-11	53.0(JIS)	5.0	0	JIS specification V-groove center electrode, core nose projection
ZFR5E-11	50.5(ISO)	6.5	3.5	V-groove center electrode, shell projection
ZFR6F-11	50.5(ISO)	5.0	0	V-groove center electrode, core nose projection
ZFR6F-11G	50.5(ISO)	5.0	0	V-groove center electrode, core nose projection, copper core in ground electrode
ZGR5A	56.0	5.0	0	V-groove center electrode, core nose projection
ZGR5C	56.0	8.5	3.0	V-groove center electrode, core nose projection, Metal Shell projection

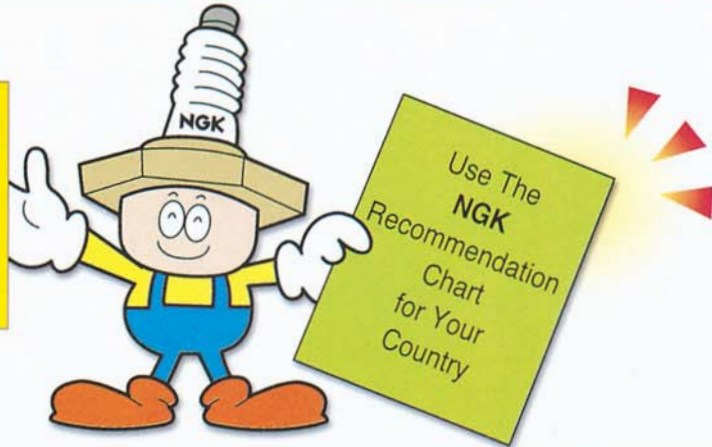




Q5 What is the best way to select the correct spark plug?

A It is essential to select a spark plug specified by the vehicle manufacturer from the **NGK Recommendation Chart**.

- How to select the correct spark plug.
- Model : Bluebird 1800
 - Year: June 1989
 - Model: RU12
 - Engine type: CA18

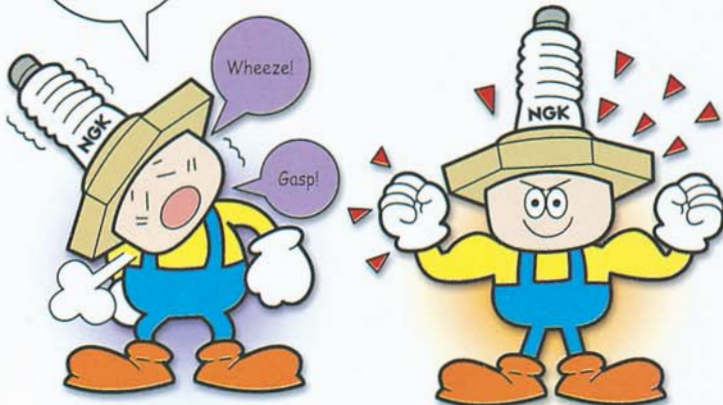


NGK Recommendation Chart

Displacement	Model	Engine	Year	Spark plug number	Stock number	Genuine part number	NGK iridium IX plug	Stock number	Number of plugs required
Bluebird									
1800	RU12, RNU12	CA18i	5/1988 - 10/1989	BCPR5ES-11	3524	22401-01P15	BCPR5EIX-11	3185	4
	TRU12		10/1989 - 9/1991	BCPR5ES-11	3524	22401-01P15	BCPR5EIX-11	3185	4
	RU12	CA18DE	9/1987 - 9/1991	PFR6A-11	1257	22401-58S16	BCPR6EIX-11	3667	4
	RNU12	CA18DET (Turbo)	9/1987 - 10/1989	PFR6A-11	1257	22401-58S16	BCPR6EIX-11	3667	4
	EU12, ENU12	SR18Di	10/1989 - 9/1991	BKR5EY	7390	22401-53J05	BKR5EIX	1159	4
	EU13, ENU13	SR18DE	9/1991 - 1/1996	BKR5EY	7390	22401-53J05	BKR5EIX	1159	4
	TEU13								
	ENU14	SR18DE	1/1996 -	BKR5EY-11	2355	22401-2J200	BKR5EIX-11	3184	4
	EU14	SR18DE (Lean burn)	1/1996 - 9/1997	PFR5G-11	2091	22401-1P115	BKR5EIX-11	3184	4
	QU14	QG18DE	9/1997 -	BKR5E-11	6953	22401-50Y05	BKR5EIX-11	3184	4
	QG18DD (NEO-Di)	9/1997 -	PFR5B-11B	2838	22401-40P65	—	—	4	
PC910	Z18P (LPG)	2/1985 - 6/1993	PGR6A (GAP:0.7)	4683	22401 18V16	BPR6EIX-LPG	2347	8	

The right plugs for the above-mentioned car

Consumable part



MEMO

Remember that spark plugs are consumable parts that require periodic inspection and replacement. It is recommended that spark plugs be changed every **20,000 km**. Please refer to Question 20.

Q6 Why is the firing end appearance of a spark plug important?

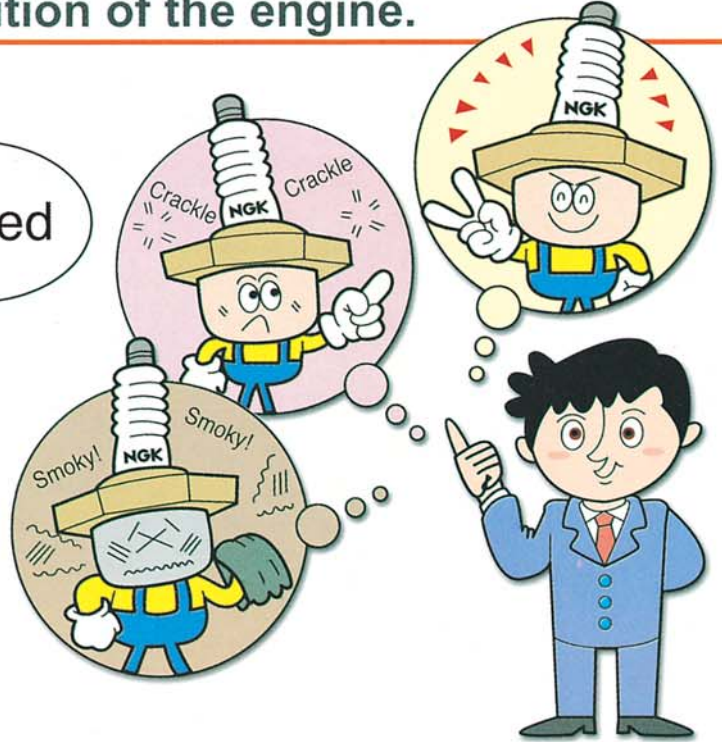


Q6

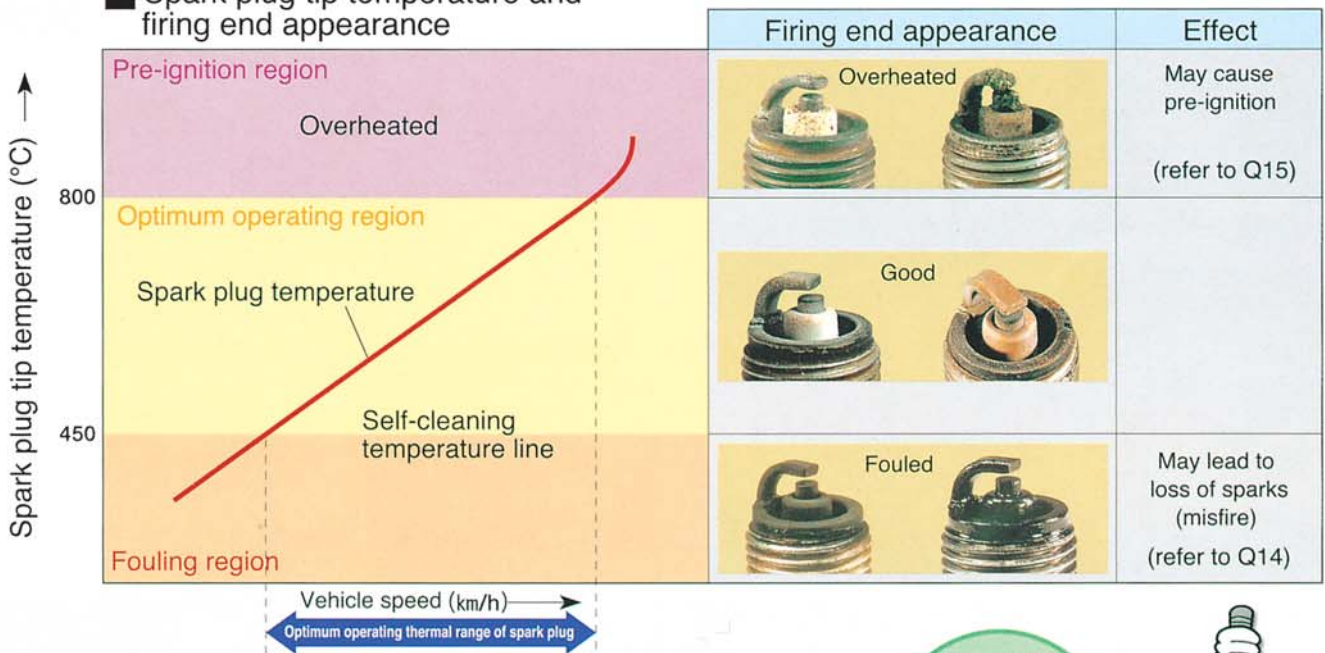
A Because the firing end appearance reflects the suitability of the spark plug as well as the condition of the engine.



These are the three basic standards for evaluating a spark plug.

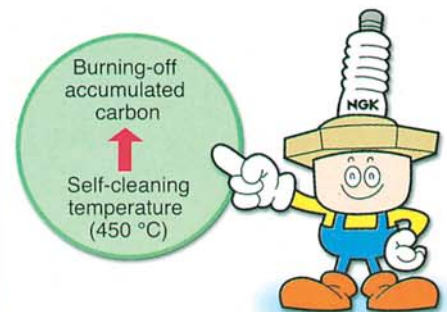


Spark plug tip temperature and firing end appearance



MEMO

The border-line between the fouling and optimum operating regions (450 °C) is called the spark plug self-cleaning temperature. It is at this temperature that accumulated carbon deposits are burnt off.



Q7

What is the function of the corrugations on the insulator?



A They ensure insulation and prevent flash-over.



What is flash-over?

Flash-over is when there is a spark between the terminal and the metal shell, as shown in the picture.

Flash-over is prevented by the following.

Corrugations (ribs) are provided on the insulator to extend the surface distance of the insulator between the terminal and the metal shell. This ensures the insulation needed for preventing flash-over.

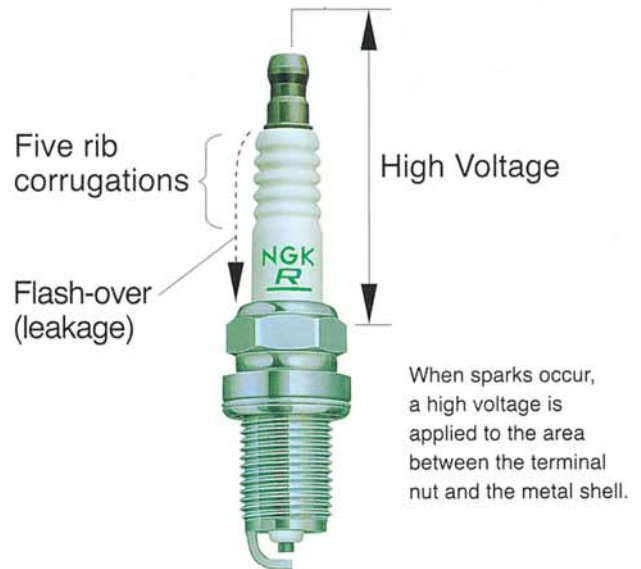
The correct spark can be maintained by the spark gap.



During sparking:
High voltage is constantly applied between the terminal and metal shell.

This high voltage tries to leak along the surface of the insulator.

If the voltage required by the spark gap is high, flash-over can easily occur.



Flash-over resistance voltage

	Flash-over resistance voltage (KV)				
	15	20	25	30	35
Five rib corrugations					
Without corrugations					

NOTE : ALWAYS ENSURE THAT SPARK PLUG COVERS/CAPS ARE CLEAN. OLD OR DIRTY PLUG COVERS/CAPS INCREASE CHANCES OF FLASH-OVER.

Q8 What is a resistor spark plug?

Q8

A It incorporates a ceramic resistor of 5 k ohms to suppress ignition noise generated during sparking.

Features

It incorporates a ceramic resistor of 5 k ohms.

It suppresses ignition noises from sparks.

Resistor spark plugs prevent electrical interference that can disrupt car radio reception, two-way radio and cellular phone operation. This type of spark plug also prevents electrical noise from interfering with the operation of the computer in the engine.



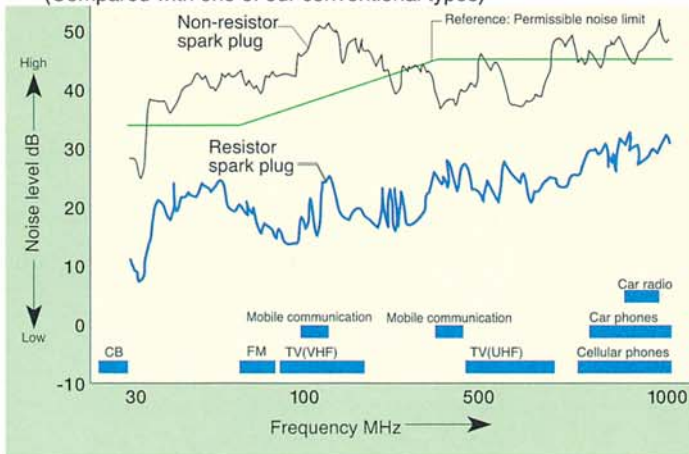
Ceramic resistor of 5 k ohms

Example of part number of a resistor spark plug

BK R5ES-11

Resistor spark plug

Noise suppression effects of a resistor spark plug (Compared with one of our conventional types)

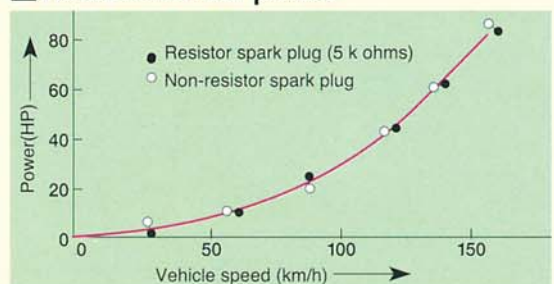


As shown above, noise is reduced in all frequency zones by installing resistor spark plugs.

MEMO

As the resistor spark plug has an incorporated resistor, some people think that it has adverse effects on start-up, acceleration, fuel economy and emissions. However, this is wrong. It does not affect engine performance so don't hesitate to use it.

Resistance vs. power



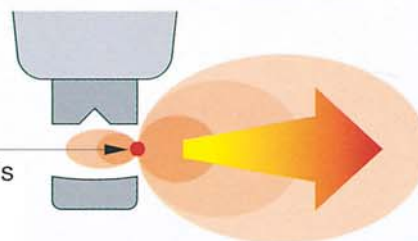


Q9 What is a V-grooved type spark plug?

A It has a 90°V-groove in the tip of the center electrode to enhance ignitability.

Features

- It has a 90°V-groove in the tip of the center electrode.
- The V-groove ensures that the spark is directed to the periphery of the electrodes.
- The flame core is generated near the perimeter of the electrodes and grows.
- Ignitability is improved because the electrodes are interfering less with the growth of the flame core.



Flame core
The flame core is generated near the edge of the electrodes and grows larger away from the plug, improving flame spread.

Comparison for ignitability

	Air/fuel ratio (A/F) at ignition limits		
	18	19	20 → Good
V-grooved spark plug	[Bar extending to 19]		
Standard spark plug	[Bar extending to 18]		

Comparison for spark voltage (required voltage)

	Spark voltage (KV)		
	Good ← 10	15	20
V-grooved spark plug	[Bar extending to 15]		
Standard spark plug	[Bar extending to 20]		

Example of part number of a V-grooved spark plug

V-groove plugs have green printing on insulator.

BKR5E Y

▶ V-grooved spark plug
Spark projection 4 mm
Center electrode with a 90°V-groove

BKR5E

▶ V-grooved spark plug
Spark projection 3 mm
Center electrode with a 90°V-groove

Q10

What is the Iridium IX spark plug?

Q10

A A new material called iridium is used at the tip of the center electrode. This allows the electrode to be thinner than the previous platinum type, improving ignitability. In addition, the thermo edge designed in the Iridium IX spark plug makes it highly resistant to carbon fouling.

Features

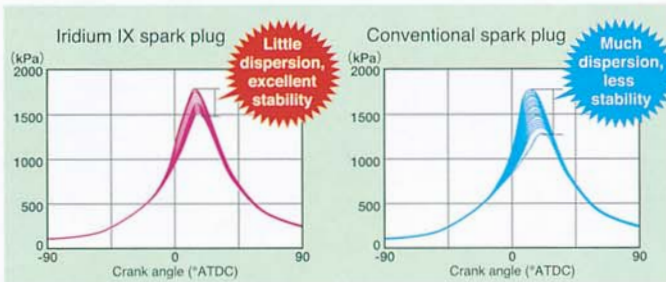
The diameter of the center electrode is very fine.
The tip of ground electrode is taper cut.

It produces sparks very easily and has excellent ignitability.

Better performance is achieved with improved starting, acceleration, and idling stability, as well as fuel-efficiency.

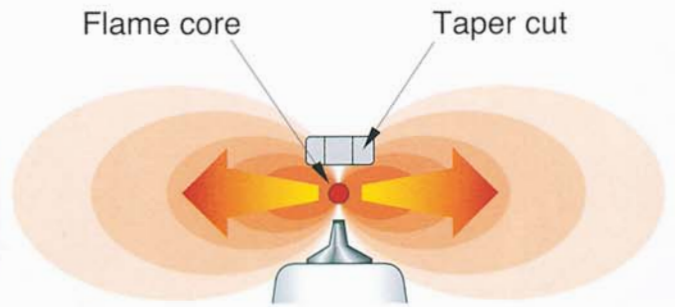
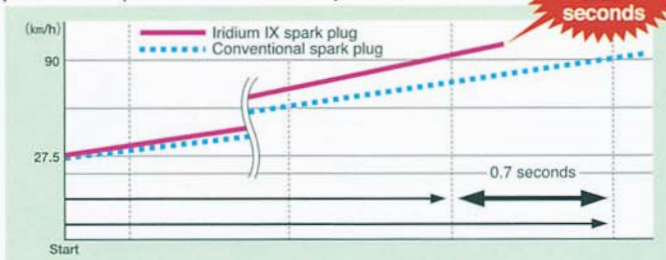
Combustion pressure test

The Iridium IX spark plug has less dispersion than a conventional spark plug, allowing it to maintain stable performance.



Acceleration test

Increased power in the middle rpm range provides improved acceleration performance.



Since the center electrode is very fine, the flame core grows larger. Moreover, the tip of ground electrode is taper cut.

Example of part number of IX spark plug

BKR5E IX-11

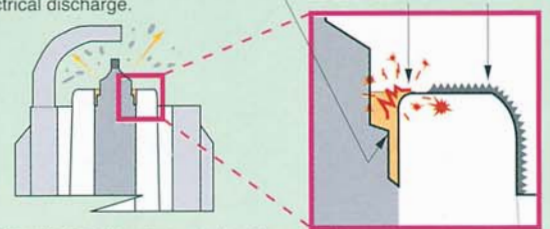
IX spark plug

Ignitability is improved because the quenching action of the spark plug electrode is diminished. Please refer to Question 16.

Thermo edge design

Carbon on the inside of the insulator is burnt off by minute electrical discharge.

Section where accumulated carbon has been burnt off



*The shape of the tip section will vary according to the part number.

A space has been provided in the tip of the insulator where accumulated carbon is burnt off by minute electrical discharge, preventing a decline in insulating performance.



Q11

What is a racing spark plug?



A

It is a high-performance spark plug for high-power engines with increased compression ratio and higher rpm.

Features

This type of spark plug is used under harsh conditions, such as continuous full-throttle acceleration, ultra high-rpm and high-speed operations.

Racing spark plugs must provide Sure Sparks, Good Ignitability and must support Rapid Acceleration whilst surviving the most extreme operating conditions.

Spark plugs that are used under harsh conditions use the following types of electrode materials and shapes.

- ① **Electrode material**
Precious metals, such as platinum and iridium, are widely used.
- ② **Electrode shape**
A small-diameter electrode is used to make sparking easier, improving ignitability.
- ③ **Insulator shape for spark section**
Special insulator shapes are available for improving acceleration response.

■ Various racing spark plugs



Projected insulator type



Common electrode type



Exterior flat type



Oblique electrode type



Semi surface gap type



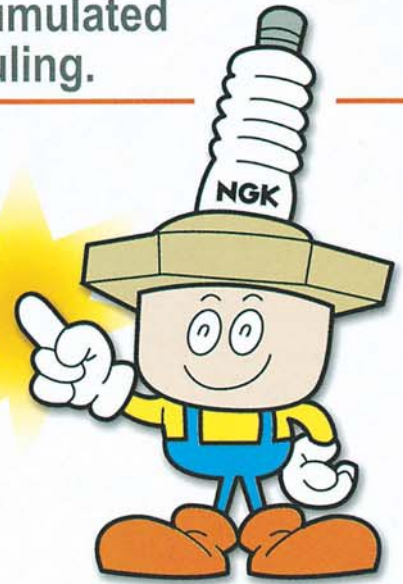
Q12 What kinds of spark plugs offer good resistance to carbon build-up?

Q12




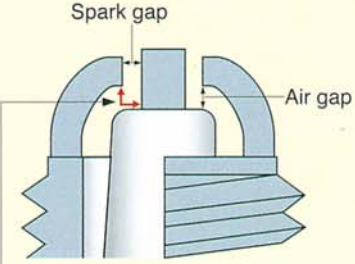
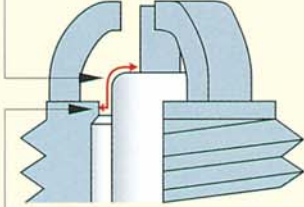
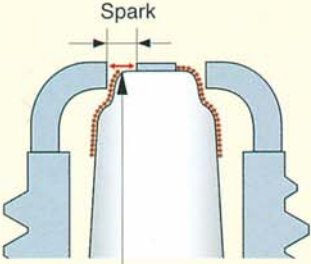
A A spark plug designed for the spark to jump along the insulator surface, and in doing so, burn off accumulated carbon deposits which may lead to fouling.

The intermittent discharge plug, the spark plug with a supplementary gap, and the semi surface gap type.

SPARK



Features

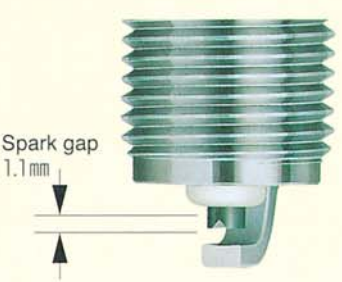
Intermittent discharge spark plug BKR6EK	Spark plug with supplementary spark gap BUR6ET	4-electrode semi surface gap BKR6EQUP
		
 <p>Spark gap</p> <p>Air gap</p> <p>Spark path when carbon accumulates</p>	 <p>Spark path when carbon accumulates</p> <p>Supplementary spark gap</p>	 <p>Spark</p> <p>Carbon is burned off</p>
<p>Usually, the spark is discharged at the spark gap. However, when there is carbon fouling, the spark is discharged at the air gap and it burns off the carbon on the insulator surface, suppressing the decline in insulation.</p>	<p>If enough carbon accumulates on the insulator, the voltage will track down the carbon path and sparking will occur at the supplementary spark gap. The spark discharge at the supplementary gap, burns away the carbon on the insulator to suppress a decline in insulation resistance that leads to carbon fouling.</p>	<p>When there is carbon fouling, the spark discharge jumps between the surface of the insulator and the air gap. This spark discharge burns off the carbon on the insulator to suppress the decline of insulation resistance.</p>

Q13 What are the features of special-type spark plugs?

A

There are several kinds of special type spark plugs including: the wide-gap spark plug, the projected metal shell spark plug, the Iridium IX spark plug, the long-reach spark plug, the half-thread spark plug and the compact-type spark plug for industrial engines. Each has its own special characteristics.

Wide-gap spark plug
Example : BKR5E-11

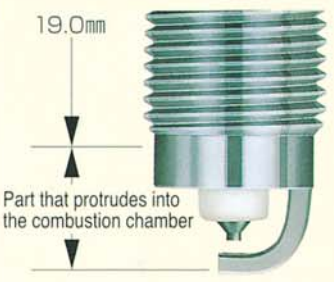


Spark gap 1.1 mm

The spark gap dimension is increased by 1.1. to 1.5 mm to reduce the quenching action of the electrode and improve ignitability.

(Note) That the wide-gap spark plug cannot be used unless there is a source of sufficient electrical capacity.

Projected metal shell spark plug
Example : BKR6EPA-8




19.0mm

Part that protrudes into the combustion chamber

The projected metal shell spark plug is designed to provide stable combustion by preventing the heating of the ground electrode and by locating the spark position at the optimal position in the combustion chamber.


(Note) This type of spark plug can only be used in specified engines.

Iridium IX spark plug
Example : BKR6EIX-11



A new material called iridium is used at the tip of the center electrode. This allows the electrode to be thinner than the previous platinum type, improving ignitability. In addition, the taper-cut design of the tip of the ground electrode makes this a high-performance spark plug that improves ignitability and acceleration.

Long-Reach plug
Example : LFR5A-11




19.0mm

26.5mm

BKR5E-11 LFR5A-11


Extending the length of spark plug thread helps to improve the cooling efficiency of the cylinder head. There is a possibility that there will be an increase in the number of engines using long-reach spark plugs in the future. An "L" before the part number indicates a long-reach spark plug.

Half-thread spark plug
Example : CR9EH-9



The mounting thread section that has been provided on spark plugs with small thread diameters has a special shape. Only use this type of spark plug on designated vehicles. If this type of spark plug is used in vehicles other than those that specify this spark plug, the spark plug threads for the cylinder head will be damaged.

Compact spark plug for power equipment
Example : BMR6A



This is a compact and lightweight spark plug for use in small-engine equipment, such as chain saws, lawn mowers and generators.

Q14 What is spark plug fouling?

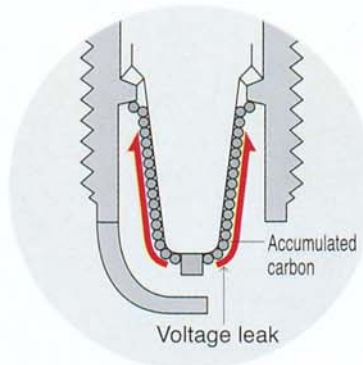


Q14

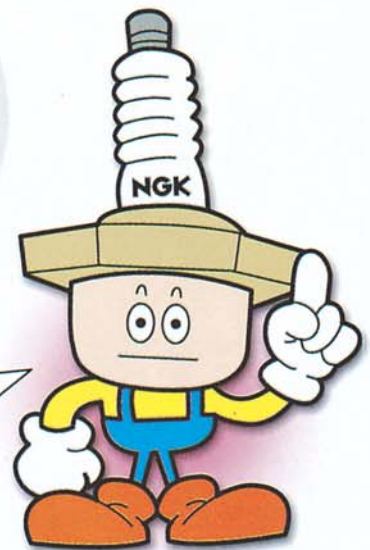
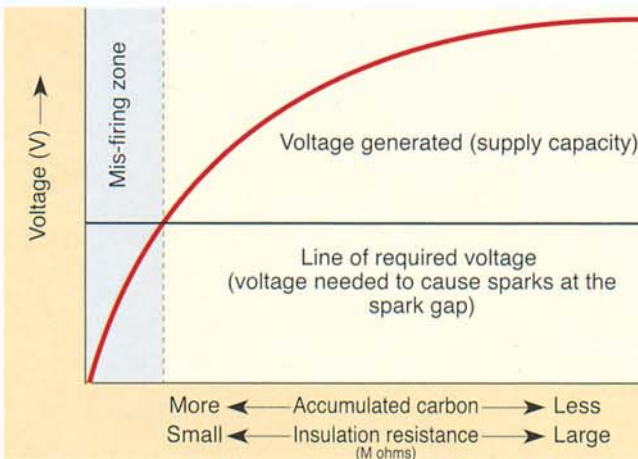
A It is a phenomenon by which carbon accumulated at the firing end causes electrical leakage that leads to mis-firing.

As the high voltage generated by the ignition coil leaks away through the carbon, mis-firing may occur and cause running and starting difficulties.

■ Fouling



■ Insulation resistance vs. voltage generated by ignition coil



As carbon builds up, the insulation resistance of the spark plug drops and the voltage generated by the ignition coil is reduced. When the generated voltage becomes lower than the required voltage of a spark plug (the voltage needed to cause sparks at the spark gap), sparking is suppressed and mis-firing occurs.

■ Causes of fouling and corrective actions

Causes	Corrective actions
<ul style="list-style-type: none"> ● Rich air/fuel mixture (A/F) <ul style="list-style-type: none"> ● Improper carburetor adjustment ● Defective choke system ● Defective fuel injection system ● Worn or Failed Oxygen or other sensor. 	<ul style="list-style-type: none"> ➔ Inspection and maintenance of carburetor, fuel injection system and sensors is necessary.
<ul style="list-style-type: none"> ● Defective electrical system <ul style="list-style-type: none"> ● Cracked or broken high-tension cords, etc. 	<ul style="list-style-type: none"> ➔ Inspection and maintenance of electrical system is necessary.
<ul style="list-style-type: none"> ● Improper operating conditions <ul style="list-style-type: none"> ● Long idling ● Continuous low-speed operation, etc. 	<ul style="list-style-type: none"> ➔ Occasionally drive under high-speed conditions (approximately 80 km/h or more) to ensure spark plugs reach their self cleaning temperature.

Q15

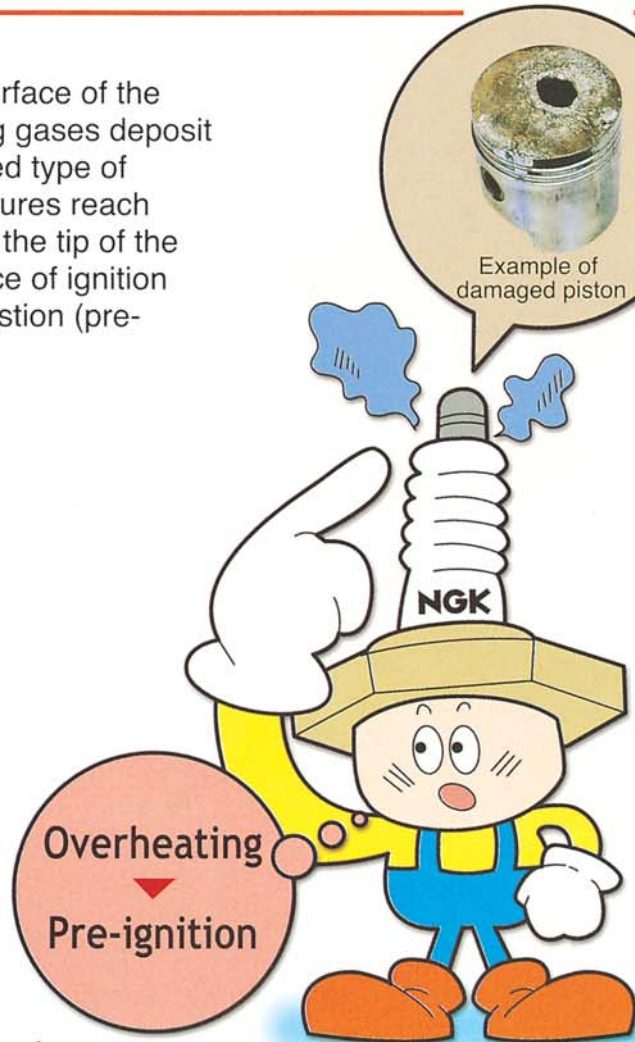
Q15 What are the effects of spark plug overheating?



A Prolonged overheating may induce abnormal combustion (pre-ignition), resulting in melting of the spark plug electrodes.

When there is overheating, the insulator surface of the igniter becomes pure white and the burning gases deposit spots. Electrode melting is a more advanced type of overheating and when spark plug temperatures reach 800°C or more (abnormal excessive heat), the tip of the plug may glow red hot and become a source of ignition prior to sparking, causing abnormal combustion (pre-ignition) that can damage the engine.

Overheating



Causes of Overheating and corrective actions

Causes	Corrective actions
● Excessive ignition timing advance	→ Inspection and adjustment of ignition timing is necessary
● Lean air/fuel mixture (A/F)	→ Inspection of oxygen sensors and other such equipment necessary
● Insufficient coolant and lubricant	→ Supply coolant and lubricant
● Turbo-equipped vehicles Excessive turbo pressure	→ Inspection and adjustment of turbo pressure is necessary
● Knocking (Detonation)	→ Inspection and adjustment of airflow sensors, other sensors and ignition timing is necessary. Ensure fuel octane rating is adequate
● Insufficient tightening of spark plug	→ Tighten to recommended torque

Q16

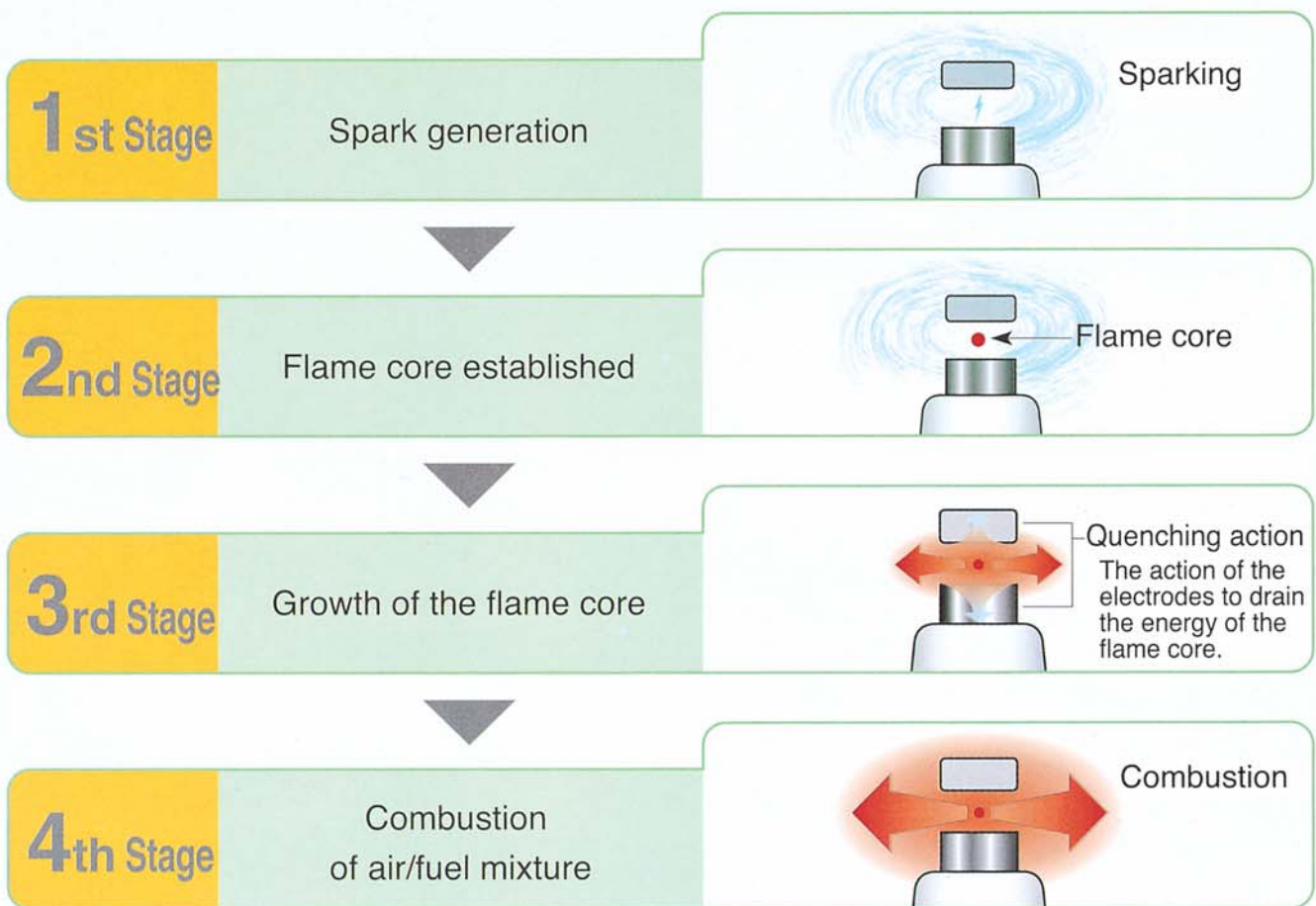
What is good ignitability?



Q16

A "Ignition performance" refers to an engine's ability to successfully and effectively, burn a wide range of air/fuel mixtures. A good spark plug can improve "Ignition performance"

There are four stages from the time the spark is generated at the gap, to the combustion of the air/fuel mixture.



The quenching action is where the cooler center and ground electrodes drain the energy of the flame core by way of heat transfer. If quenching is severe, the flame core can be extinguished, causing ignition to fail. Therefore, spark plugs designed to reduce the quenching effect have better "Ignition performance".

NGK offers the following types of spark plugs to improve ignitability.

- **V-Groove Spark Plugs**
The center electrode has a 90° V-groove (Refer Q9)
- **Iridium IX Spark Plugs**
Incorporate fine center electrodes. (Refer Q10)
- **Wide Gap Spark Plugs**
The wider gap reduces quenching action. (Refer Q13)
- **Projected Firing End Spark Plugs**
The spark position is closer to the center of the combustion chamber. (Refer Q13)

Q17

Q17

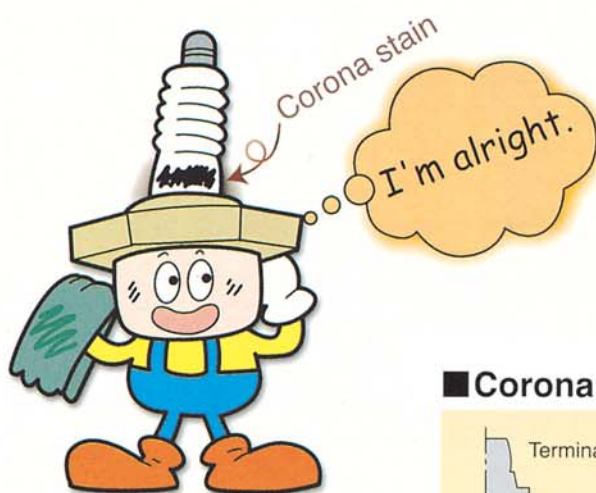
Is a stain between the insulator and metal shell caused by gas leakage?

A It is not a stain caused by gas leakage but by corona discharge (corona stain).

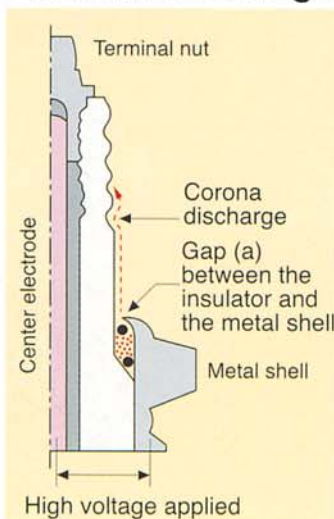
When a spark plug is removed, a brownish stain that looks like a sign of combustion gas flow is often seen at the caulked portion of the metal shell.

This stain is the result of oil particles suspended in air adhering to the surface of the insulator due to the high voltage. It does not affect spark plug performance.

■ Corona stain



■ Corona discharge



MEMO

● Mechanism of corona discharge

The high voltage applied to the spark gap is also applied to the area between the center electrode and the metal shell, causing an insulation breakdown of the air at the gap (a) between the insulator and the metal shell. The phenomenon is called a corona discharge. The generated corona discharge develops toward the terminal nut. This last process is the pale blue corona discharge that may be observed in dark conditions.

Q18 Is there a specified tightening torque for the spark plug?

Q18

A The tightening torque for a spark plug changes with the diameter of the spark plug. The following are the recommended torque values.

When installing the spark plug, first screw it in by hand. Once the gasket has made contact with the cylinder head, use the torque wrench to tighten it to the tightening torque shown below.

A rubber pipe as shown in the figure to the right is a good substitute for hand tightening/removing spark plugs.



■ Tightening torque

Plug thread diameter	Tightening torque
18 mm	35 to 40N·m (3.5 to 4.0 kgm)
14 mm	25 to 30N·m (2.5 to 3.0 kgm)
12 mm	15 to 20N·m (1.5 to 2.0 kgm)
10 mm	10 to 12N·m (1.0 to 1.2 kgm)
8 mm	8 to 10N·m (0.8 to 1.0 kgm)

■ Tapered seat type For (spark plugs without gaskets)

Tightening torque
10 to 20 N·m (1.0 to 2.0 kgf·m)

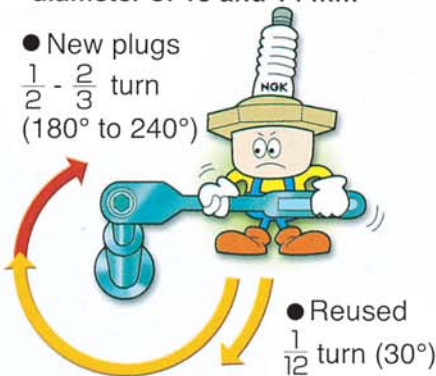
The tightening angle for both new and reused spark plugs is $\frac{1}{16}$ th of a turn.

For reference

When it is difficult to use a torque wrench, or when you don't have a torque wrench, tighten the spark plug to the tightening angle shown in the illustration in accordance with the thread diameter of the spark plug.

■ Spark plugs with thread diameter of 18 and 14 mm

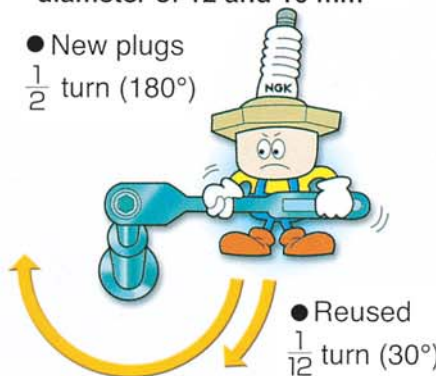
- New plugs $\frac{1}{2} - \frac{2}{3}$ turn (180° to 240°)



- Reused $\frac{1}{12}$ turn (30°)

■ Spark plugs with thread diameter of 12 and 10 mm

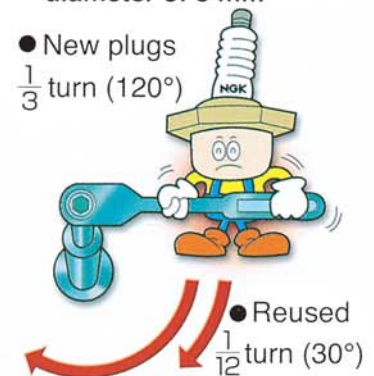
- New plugs $\frac{1}{2}$ turn (180°)



- Reused $\frac{1}{12}$ turn (30°)

■ Spark plugs with thread diameter of 8 mm

- New plugs $\frac{1}{3}$ turn (120°)



- Reused $\frac{1}{12}$ turn (30°)

■ Examples of common installation problems and advise to avoid them.

Thread damage from installation	Metal shell damage	Cracked insulator	Examples of bad spark plug wrench usage
<p>Damage to the ridges of the first and second threads</p> <p>Damage to the ridges of the threads</p>	<p>Damage to the caulked portion</p> <p>Damage to the threads</p>	<p>Damage to the caulked portion</p> <p>Damage at the corrugation</p>	<p>Hits</p>
<p>Spark plug is inserted at an angle during installation</p>	<p>Excessive tightening torque</p>	<p>Spark plug wrench slipped or used at an angle</p>	
<p>Do not use the wrench at first. Start by installing the spark plug by hand.</p>	<p>Tighten to recommended torque.</p>	<p>Use a hex-type wrench that is less likely to slip.</p>	

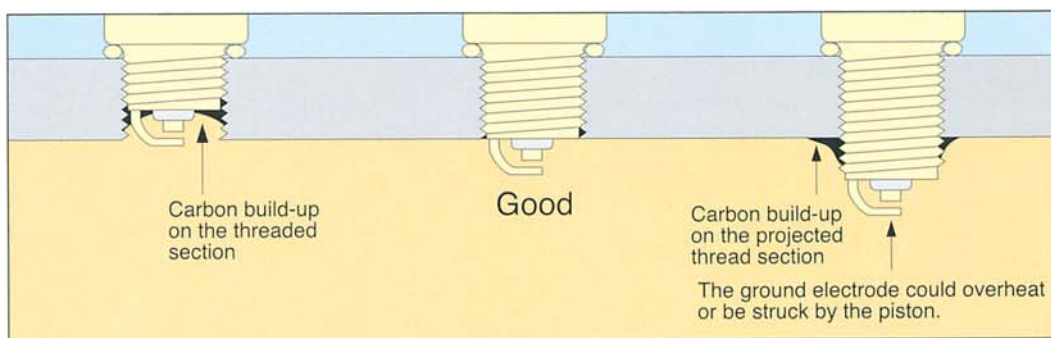
Q19

In addition to correct heat rating, what other precautions should be taken during installation of spark plugs?

A Ensure the spark plug has the correct thread reach.

The engine will not operate properly without the proper thread reach.

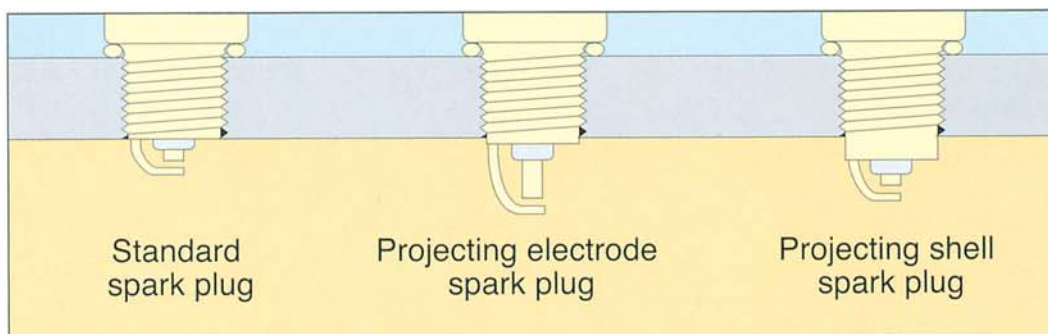
If a spark plug with the wrong thread length is erroneously used, the piston or valve could strike it and damage the engine. Moreover, there is also the concern that the electrode could overheat and melt.



A Ensure the spark plug has the correct projection dimensions.

There are several types of spark plug igniter shapes.

Sometimes, even when the length of the thread is correct, installing a spark plug with long metal shell projection dimensions may cause it to be struck by the piston or valve and result in engine trouble. Only use projection type plugs as specified by the manufacturer.



When trying to remove a spark plug that is tight and will not come out easily, removing it by force may damage the neck of the threaded section and break the seal section of the spark plug, causing the threaded section to remain in the cylinder head. To remove such a spark plug without excessive force, first operate the engine and allow it to warm up the cylinder head, then apply penetrating oil to the threaded section. After a short while, the spark plug can be removed.

Q20 How long will a spark plug last?







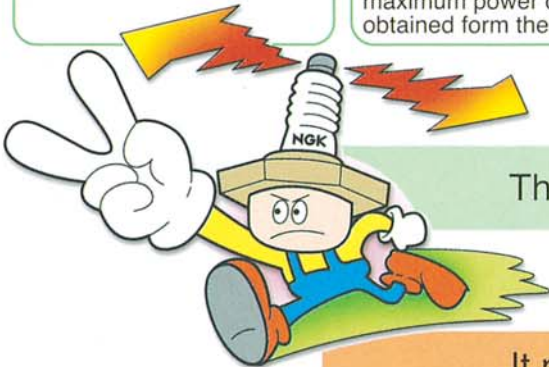
Q20

A Even when a spark plug is correctly used, periodic replacement is required as it is a consumable item.

Examples of problems caused by excessively long periods of use :

- Worn-out electrodes will have difficulty in sparking.
- Deposits accumulated on the firing end may induce abnormal combustion (pre-ignition), causing problems that include melting of the electrodes.

Good	Worn electrodes	Fouled	Deposits
	 <p>If the edges of electrodes are worn and rounded, sparks will not easily occur, which leads to engine starting problems and mis-firing during running: maximum power cannot be obtained from the engine.</p>	 <p>Power leaks through the carbon accumulated on the firing end, causing mis-firing as well as hindering engine starting.</p>	 <p>The deposits accumulated on the spark plug overheat and cause abnormal combustion (pre-ignition) that may lead to melting of the electrodes of the spark plug and engine damage.</p>



These spark plugs require replacement.

It must be noted that these phenomena may also be caused by inadequate engine servicing (fuel systems and ignition system) and incorrect spark plug selection.

■ Guideline distances for changing spark plugs

Four-wheel vehicles	15,000 to 20,000 km
Light four-wheel vehicles	7,000 to 10,000 km
Two-wheel vehicles	3,000 to 5,000 km

- 1) These distances for changing spark plugs are only a guideline. The distance may be shorter depending on the usage conditions of the vehicle and the ignition system. The guideline for changing spark plugs with a part number starting with "P", such as **PFR5G-11** or an iridium spark plug with a part number starting with "I" (such as the **IFR6A11**) is 100,000 km.
- 2) There are various types of NGK spark plugs available. Use a catalog or compatibility chart to select the part number that matches your usage needs.

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