



THE IGNITION SPECIALIST™

## 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?



# 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?

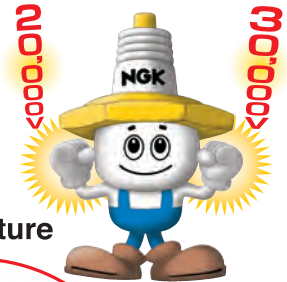


Q1

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

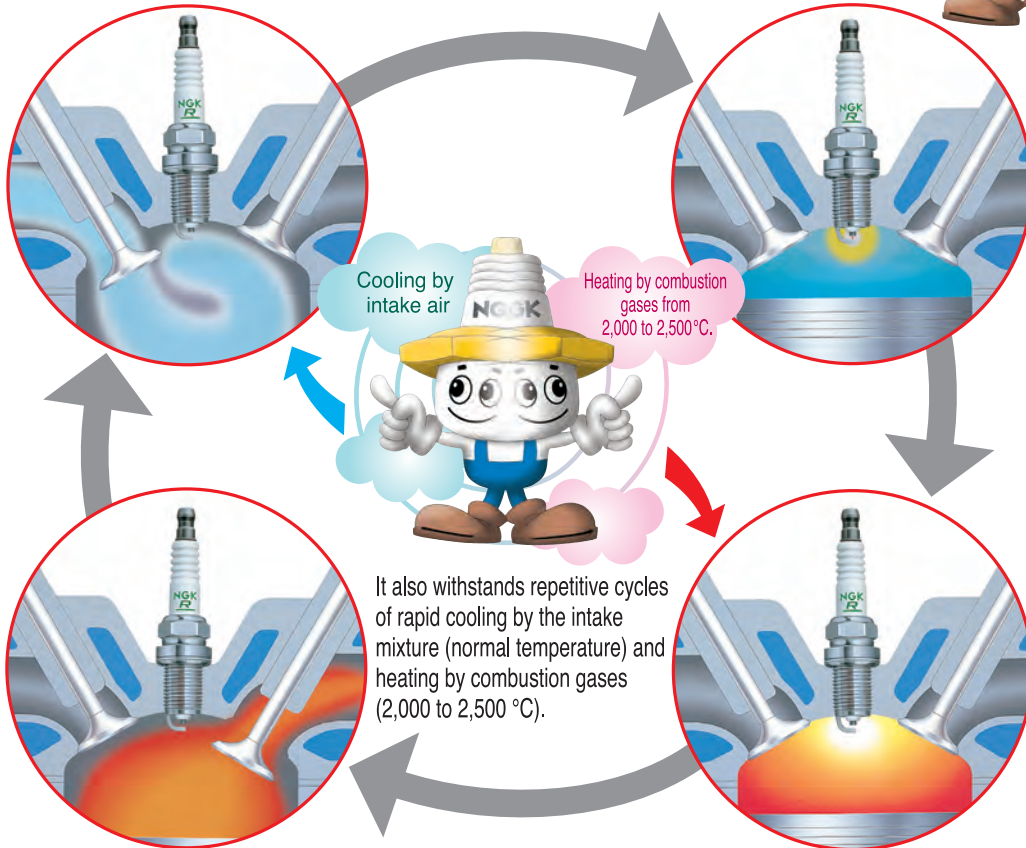
It operates under extreme conditions.

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



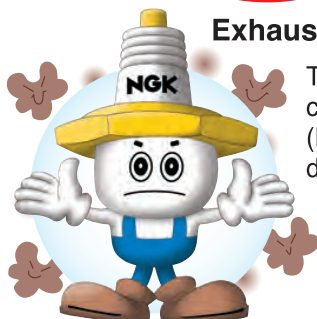
**Intake of the air-fuel mixture**

**Compression / Ignition of the air-fuel mixture**



**Exhaust of the combustible gas**

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



**Explosion / Expansion**

It withstands repetitive explosive pressures of 5 MPa (50 kg/cm<sup>2</sup>).



# Q2

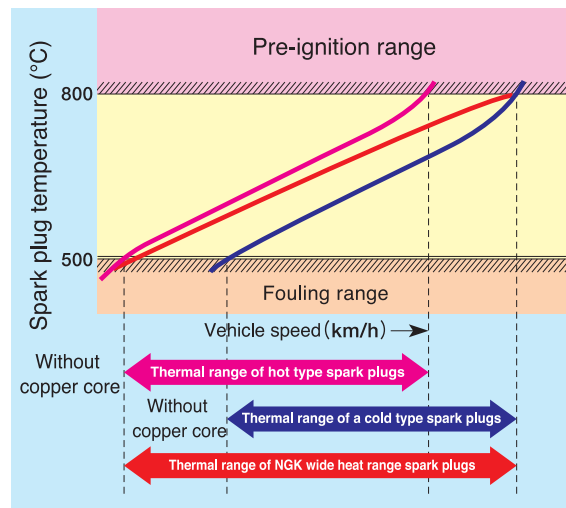
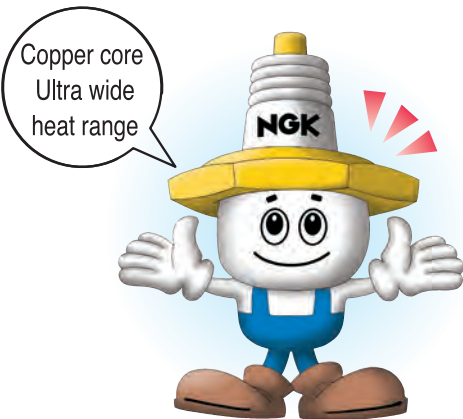
## Why are NGK spark plugs superior?



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

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

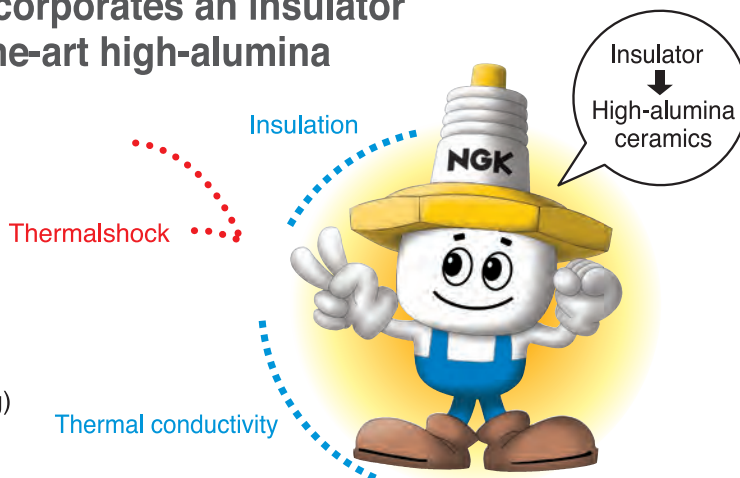
It has a center electrode with copper deeply inserted in the tip to quickly dissipate large amounts of heat. This makes for a spark plug with an "ultra wide heat range" that resists both overheating and fouling.



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.





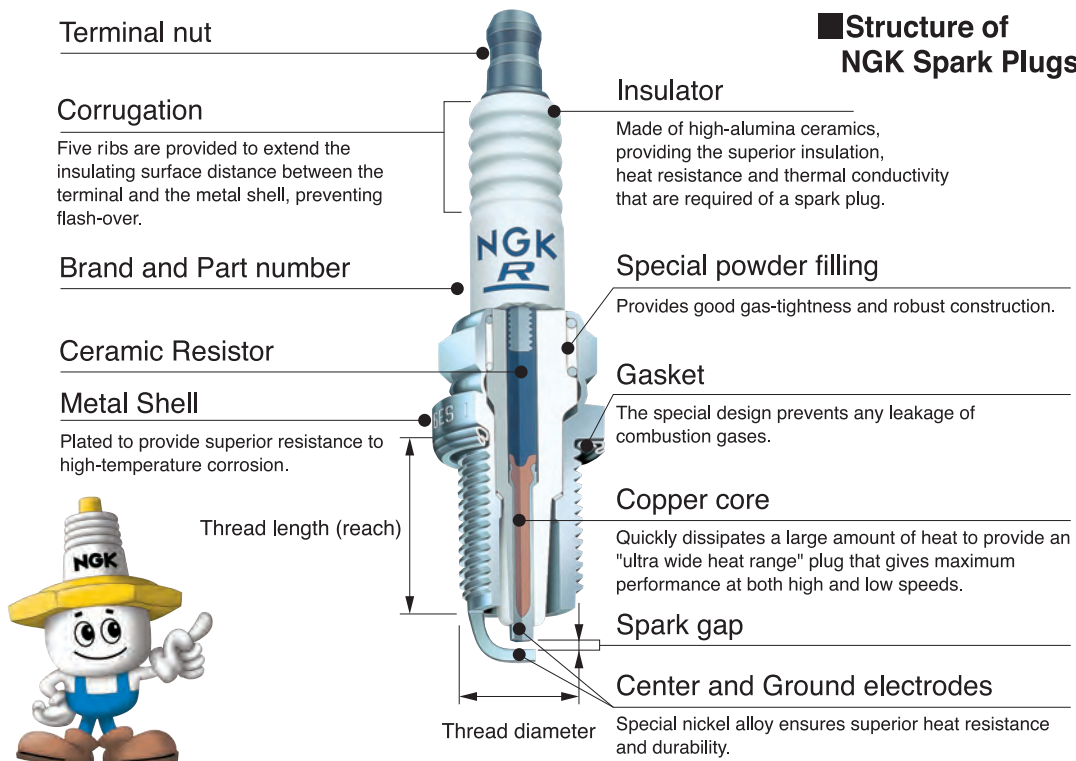
**3 It has solid construction to ensure superb gas-tightness.**

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.

**Structure of NGK Spark Plugs**





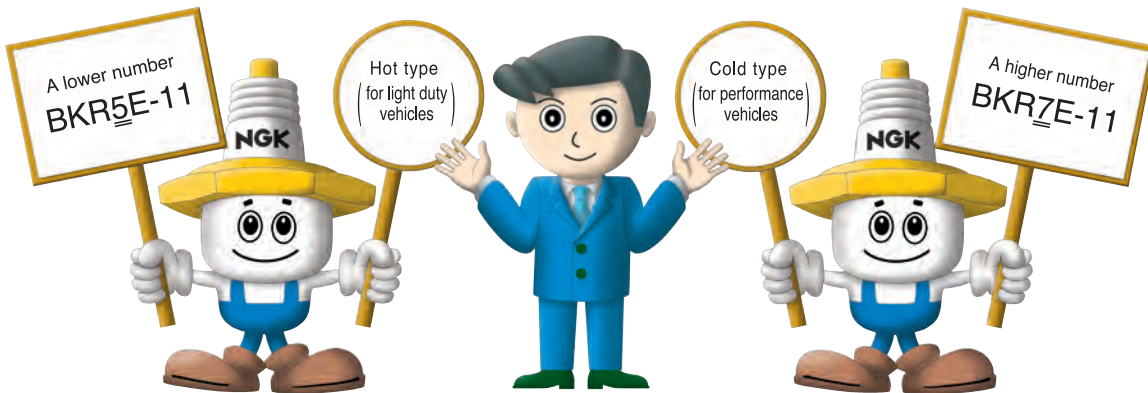
# Q3

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.



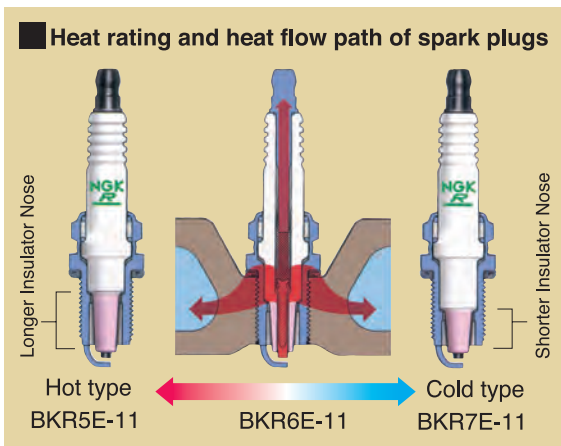
Its firing end heats up quickly.

### 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 carbons to build up on the firing end; the carbons 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.

B		P		R		5		E		S		-11		
< Thread Size >				< Resistor >		< Heat Rating >		< Thread length >				< Spark gap >		
A	18mm	P	Projecting insulator type	R	Resistor	2	Hot type	E	19.0mm	B	Integral terminal (CR8EB)	None	motorcycle : 0.7-0.8mm	
B	14mm	M	Small spark plug	Z	Inductive resistor type	4	↑ Hot type ↓ Cold type	EH	19.0mm half-thread	CM	Oblique ground electrode Compact type (insulator length:18.5mm)	-8	0.8mm	
C	10mm	U	Surface gap, Semi-surface discharge gap or Supplementary gap			5			H	12.7mm	CS	Oblique ground electrode	-9	0.9mm
D	12mm					6			L	11.2mm	G, GV	Racing spark plug	-10	1.0mm
E	8mm					7					I	One-side Iridium spark plug	-11	1.1mm
AB	18mm					8			None	Bantam type	IX	Iridium IX spark plug	-13	1.3mm
BC	14mm					9				BM ---- 9.5mm	IX-P	Iridium MAX spark plug	-14	1.4mm
BK	14mm					10				BPM --- 9.5mm	IX-LPG	Iridium IX spark plug for LPG	-15	1.5mm
DC	12mm									CM ---- 9.5mm	J	2-projecting-electrode for DAIHATSU	-S	Special gasket
										* Tapered-seat type	K	2-ground-electrode	-E	Special resistance
										A-F ----10.9mm	-L	Medium heat rating		
									B-F ----11.2mm	-LM	Compact type (insulator length:14.5mm)			
									B-EF --17.5mm	N	Special ground electrode			
									BM-F ---7.8mm	P	Platinum spark plug for TOYOTA			
										Q	4-ground-electrode			
										QP	4-ground-electrode, Platinum center electrode			
										S	Standard type			
										T	3-ground-electrode			
										U	Semi-surface discharge gap			
										VX	VX spark plug			
										Y	V-grooved center electrode			
										YA	Fouling resistant			
										Z	Special design			

BK The length from the gasket circuit to the terminal contact on parts using International Standard (ISO) dimensions is 2.5mm shorter than the Japan Standard (JIS) BCP type.

P		F		R		5		A		-11		
		Thread dimensions / Hex. size		< Resistor >		< Heat Rating >				< Spark gap >		
D	High ignitability plug : Double fine electrodes	KA	φ12.0 19.0mm Gasket 14.0	R	Resistor	2	Hot type	A, B, C...	None	motorcycle : 0.7-0.8mm		
I	Iridium spark plug	KB	φ12.0 19.0mm Gasket Bi-Hex 14.0			4	↑ Hot type ↓ Cold type	Suffix code	car : 0.8-0.9mm			
L	Long thread reach plug	MA	φ10.0 19.0mm Gasket 14.0			5				-7	0.7mm	
P	Platinum spark plug	NA	φ12.0 17.5mm Tapered-seat 14.0			6			I	One-side Iridium spark plug	-9	0.9mm
S	High ignitability plug : Thin square tip type	F	φ14.0 19.0mm Gasket 16.0			7			P	One-side Platinum spark plug	-10	1.0mm
Z	Extended Gap	G	φ14.0 19.0mm Gasket 20.8			8				-11	1.1mm	
		J	φ12.0 19.0mm Gasket 18.0			9				-13	1.3mm	
		K	φ12.0 19.0mm Gasket 16.0			10				-14	1.4mm	
		L	φ10.0 12.7mm Gasket 16.0							-15	1.5mm	
		M	φ10.0 19.0mm Gasket 16.0									
		T	φ14.0 17.5mm Tapered-seat 16.0							-A	Non gasket	
		U	φ14.0 11.2mm Tapered-seat 16.0						-D	Metal shell plating spec change		
		W	φ18.0 10.9mm Tapered-seat 20.8						-E	Special resistance		
		X	φ14.0 9.5mm Gasket 20.8						-G	Copper core ground electrode		
		Y	φ14.0 11.2mm Tapered-seat 16.0						-H	Special thread type		
			** It requires socket wrench for Bi-HEX type.						-J	2-ground-electrode		
									-K	Vibration-resistant ground electrode		
									-N	Special ground electrode		
									-Q	4-ground-electrode		
									-S	Special gasket		
									-T	3-ground-electrode		

Above alphabets are occasionally used in combination. Ex. ILFR..., PLZFR...

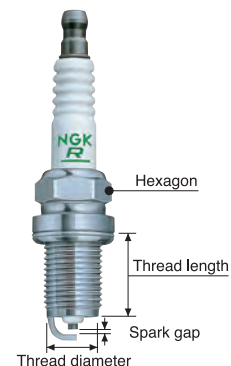
"L", long thread reach, is prior to other letters which stand for thread reach. Ex. \*Gasket type FR5AP-11; reach 19.0mm LFR5AP-11; reach 26.5mm \*Tapered-seat type PTR5C-13; reach 17.5mm PLTR6A-10G; reach 25.0mm

This is essential information!



RE		7		C		-L	
		< Heat Rating >					
RE	Plug for rotary engines	5	Hot type	A, B, C... Suffix code		-L	L-side
SD	Plug for rotary engines (Semi-surface discharge gap)	6	↑ Hot type ↓ Cold type			-T	T-side
		7					
		8					
		9					
		10					
		11		Cold type			

HB		6		A		IX		-11		P		
		< Heat Rating >		Thread dimensions / Hex. size				< Spark gap >				
HB	HYBD® (3-ground-electrode hybrid type)	4	Hot type	A	φ14.0 20.5mm Gasket 16.0	IX		-8	0.8mm			
		5	↑ Hot type ↓ Cold type	B	φ14.0 19.0mm Gasket 16.0			-9	0.9mm			
		6							-10	1.0mm		
		7							-11	1.1mm		
		8							-13	1.3mm		
		9							-14	1.4mm		
		10		Cold type					-15	1.5mm		

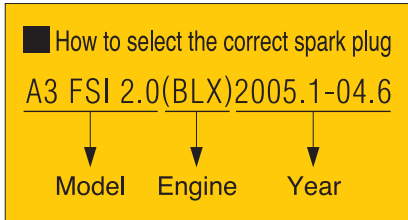


Q5

**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.



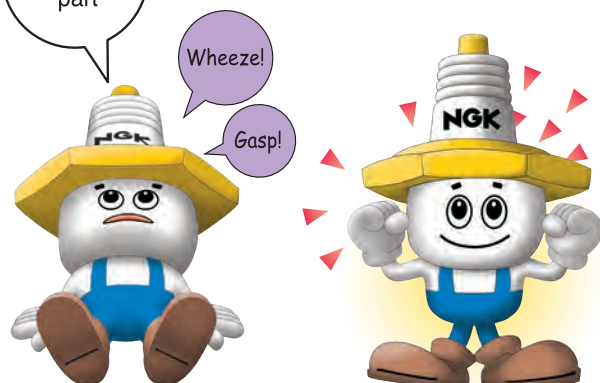
**NGK SPARK PLUGS**

\*Follows are just examples. The latest adaptation might be different.

MODEL	NGK	U
<b>AUDI</b>		
<b>Gasoline Engines</b>		
A3 FSI 2.0(AWX)2004.5-03.5	PZFR5N-11T	1.1
A3 FSI 2.0(BLX)2005.1-04.6	PZFR5N-11T	1.1
A3 FSI 2.0(BMB)2004.5-04.3	PZFR5N-11T	1.1
A3 FSI 2.0(BLY)2005.11-04.6	BKR6E	0.9
A3 FSI 2.0(BLR)2005.11-05.1	PZFR5N-11T	1.1
A3 FSI 2.0(BVY)2005.11 →	PZFR5N-11T	1.1
A3 FSI 2.0(BVZ)2005.11 →	BKR6E	0.9
A3 TFSI 2.0(AXX)2005.10-04.9	PFR6Q	0.8
A3 TFSI 2.0(BWA)2005.11 →		
A3 TFSI 2.0(BWA)2004.8-03.7 →		

The right plugs for the car above.

Consumable part



**MEMO**

Remember that spark plugs are consumable parts that require periodic inspection and replacement.

Please refer to Question 20.



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

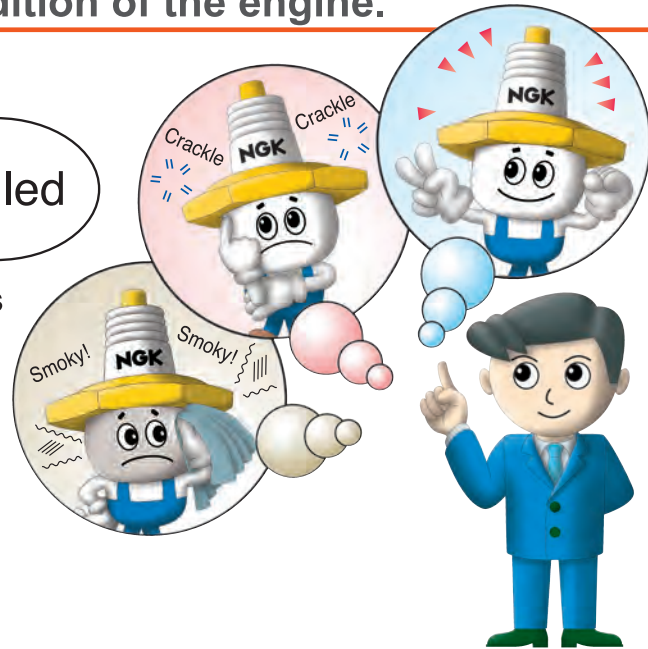


Q6

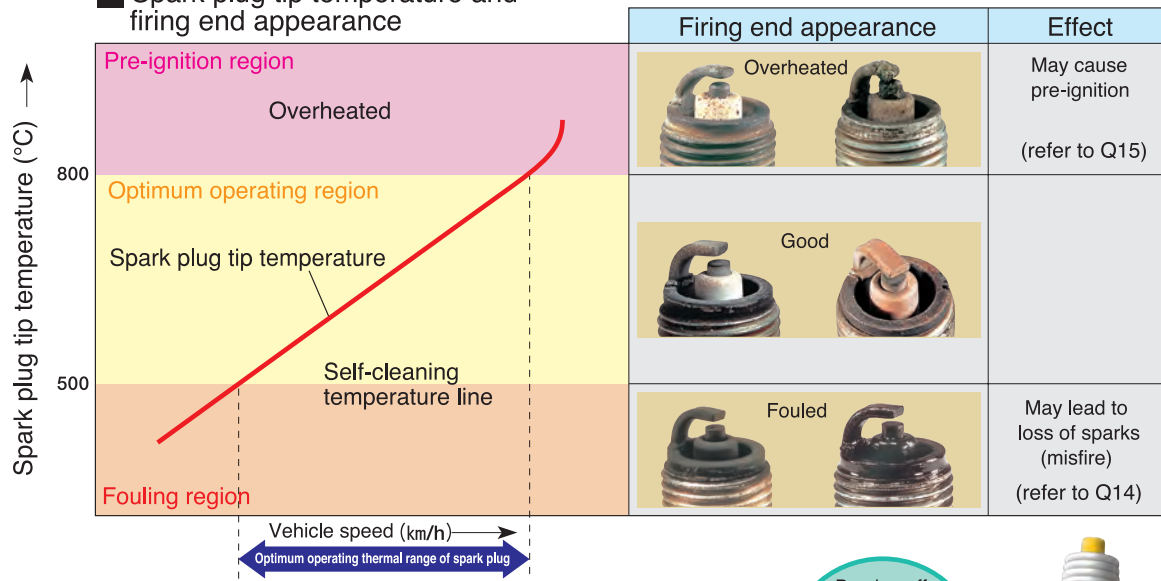
**A** Because the firing end appearance reflects the suitability of the spark plug as well as the condition of the engine.



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

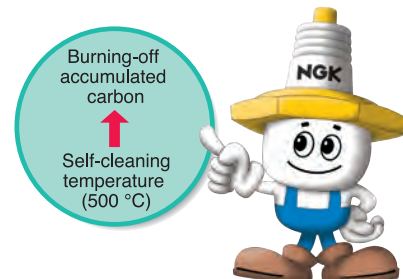


Spark plug tip temperature and firing end appearance



## MEMO

The border-line between the fouling and optimum operating regions (500 °C) is called the spark plug self-cleaning temperature. It is at this temperature that accumulated carbon deposits are burnt off.



Q7

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.

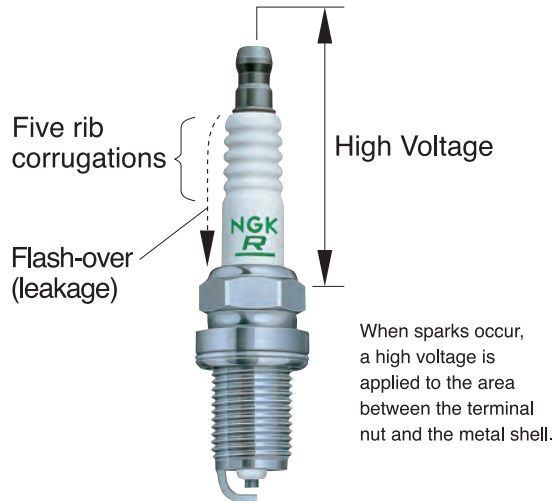


**During sparking:**

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.



When sparks occur, a high voltage is applied to the area between the terminal nut and the metal shell.

**Flash-over resistance voltage**

	Flash-over resistance voltage (kV)				
	15	20	25	30	35
Five rib corrugations	[Orange bar spanning from 15 to 30 kV]				
Without corrugations	[Blue bar spanning from 15 to 20 kV]				

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 to suppress ignition noise generated during sparking.

## Features

It incorporates a ceramic resistor

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

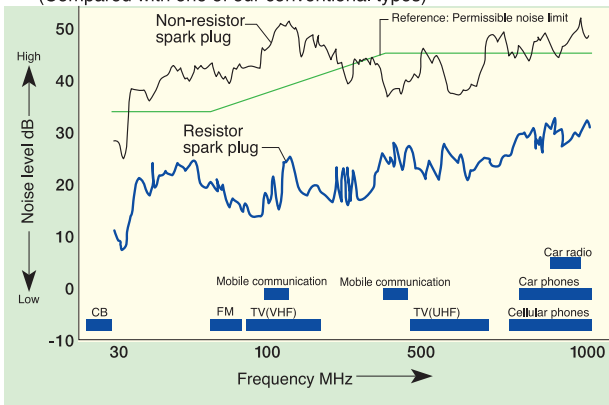
\*Generally, resistance value is 3-5kΩ.

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)

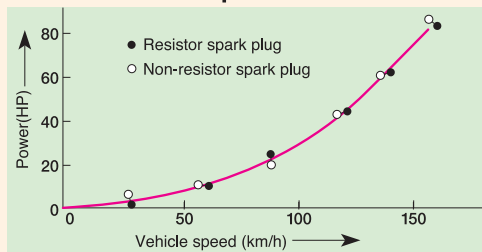


As shown above, noise is reduced in all frequency zones by installing resistor spark plugs.

## 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

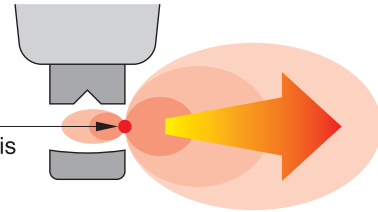
# Q9 What is a V-grooved type spark plug?



**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	[Orange bar from 18 to 19]		
Standard spark plug	[Blue bar from 18 to 18.5]		

### Comparison for spark voltage (required voltage)

	Spark voltage (kV)		
	Good ← 10	15	20
V-grooved spark plug	[Orange bar from 10 to 15]		
Standard spark plug	[Blue bar from 10 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

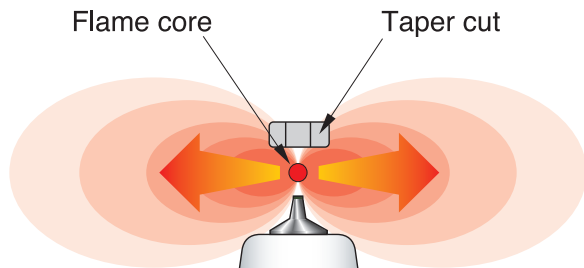
**A** Iridium is used at the tip of the center electrode. This allows the electrode to be thinner than the platinum type, improving ignitability. In addition, the thermo edge designed in the Iridium IX spark plug makes it highly resistant to carbon fouling.

## 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.



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

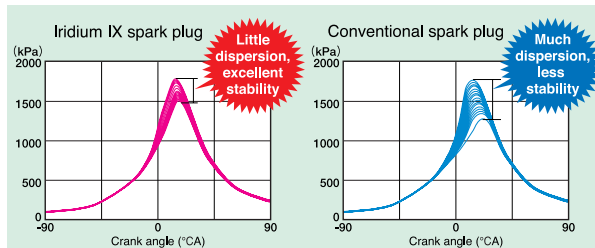
**BKR5EIX-11**

IX spark plug

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

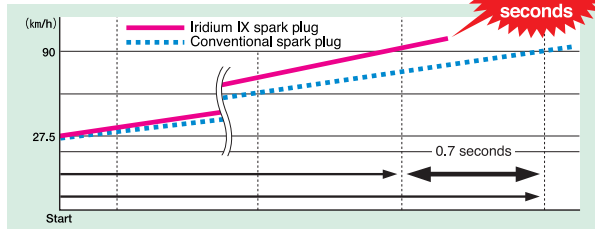
### Combustion pressure test

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



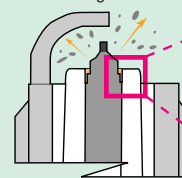
### Acceleration test

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

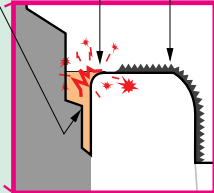


### Thermo edge design

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

# 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.

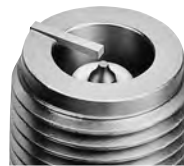
### Various racing spark plugs



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?




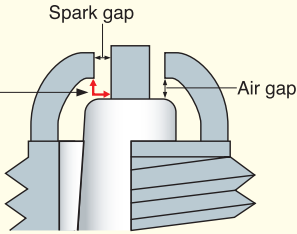
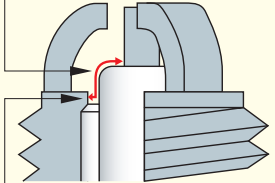
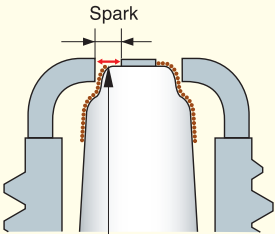
Q12

**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.



## Features

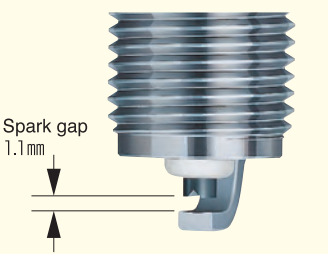
Intermittent discharge spark plug BKR6EK	Spark plug with supplementary spark gap BUR6ET	4-electrode semi surface gap BKR6EQUP
		
 <p>Spark path when carbon accumulates</p>	 <p>Supplementary spark gap</p>	 <p>Carbon is burned off</p>
<p>Usually, the spark is discharged at the spark gap. However, when 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

# 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.

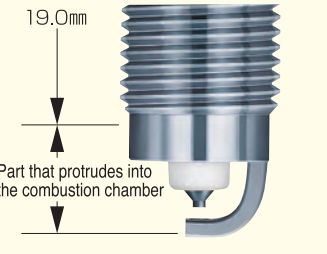
**Wide-gap spark plug**  
Example : BKR5E-11



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

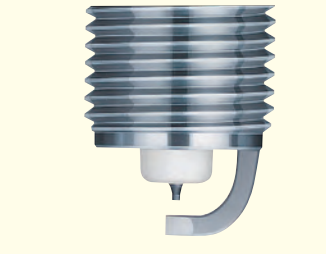


19.0mm

Part that protrudes into the combustion chamber

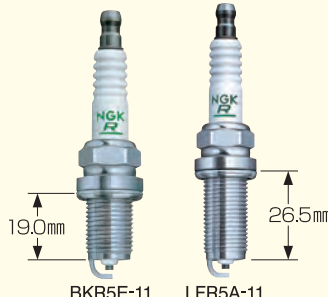
The projected metal shell spark plug is designed to provide stable combustion by preventing the heating of the ground electrode and by locating the spark position at the optimal position in the combustion chamber.  
(Note) This type of spark plug can only be used in specified engines.

**Iridium IX spark plug**  
Example : BKR6EIX-11



Iridium is used at the tip of the center electrode. This alloy the electrode to be thinner than the 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

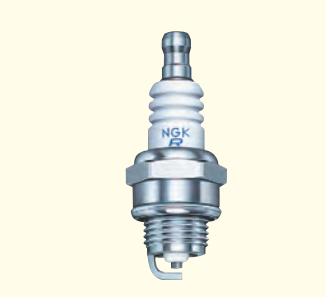
Extending the length of spark plug thread helps to improve the cooling efficiency of the cylinder head. There is a possibility that there will be an increase in the number of engines using long-reach spark plugs in the future. An "L" before the part number indicates a long-reach spark plug.

**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 : BPMR6A



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?

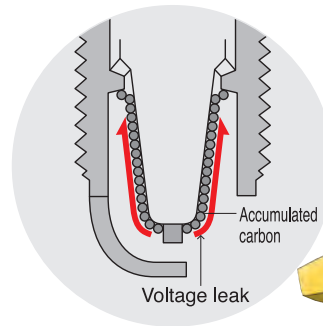


Q14

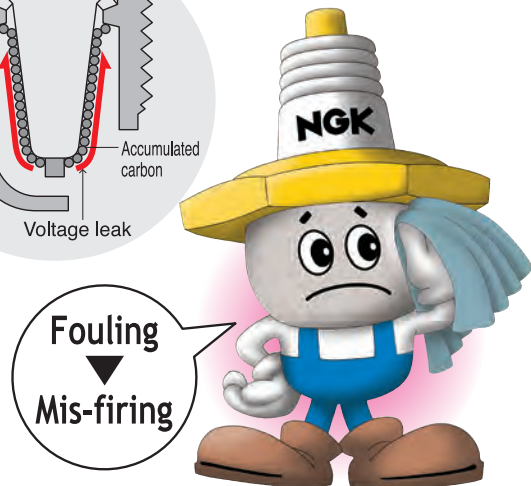
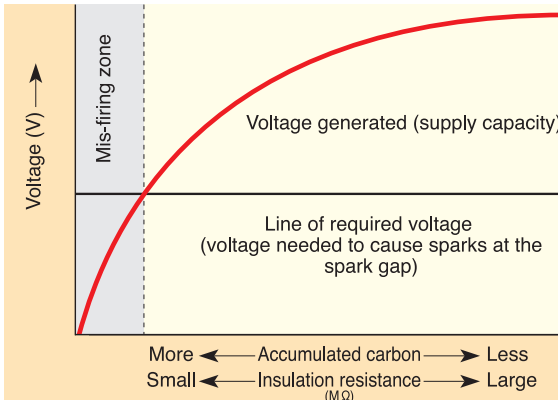
**A** It is a phenomenon by which carbon accumulated at the firing end causes electrical leakage that leads to mis-firing.

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

**Q15**

# Q15 What are the effects of spark plug overheating?

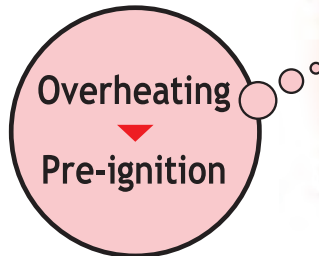


**A** Prolonged overheating may induce abnormal combustion (pre-ignition), resulting in melting of the spark plug electrodes.

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
● Extremely 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

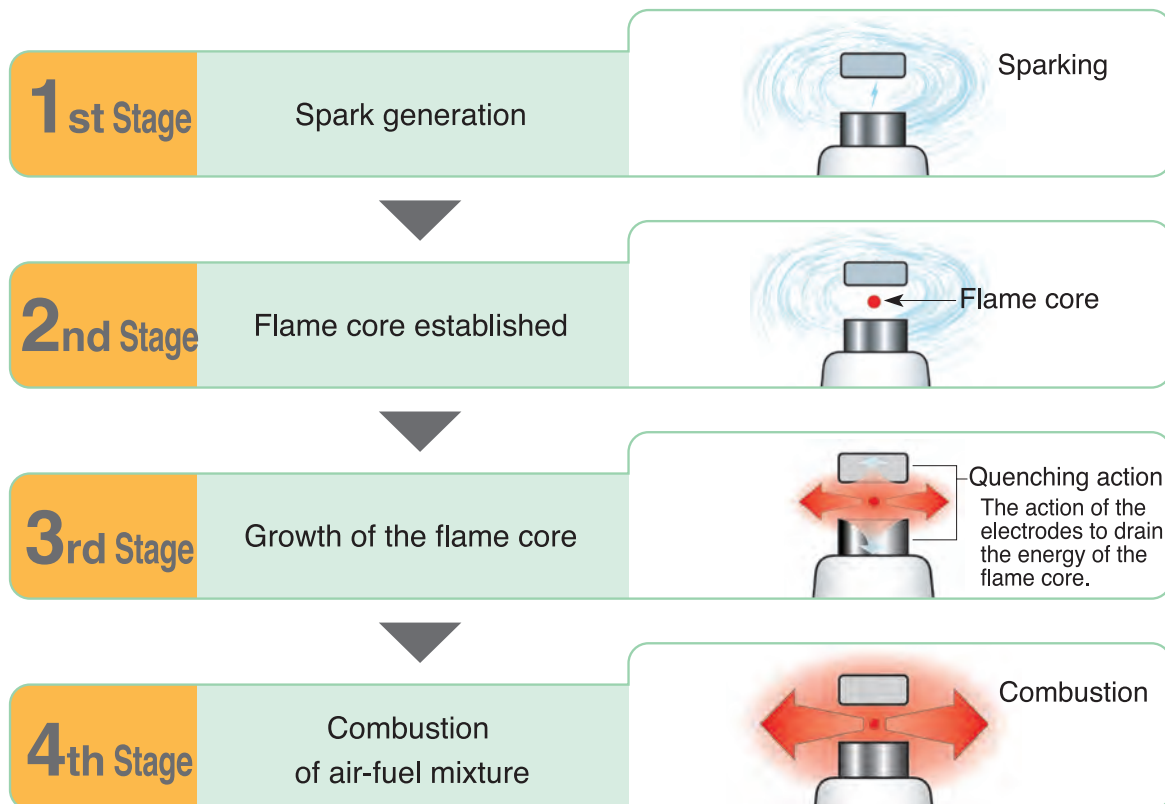
## What is good ignitability?



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-Grooved 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

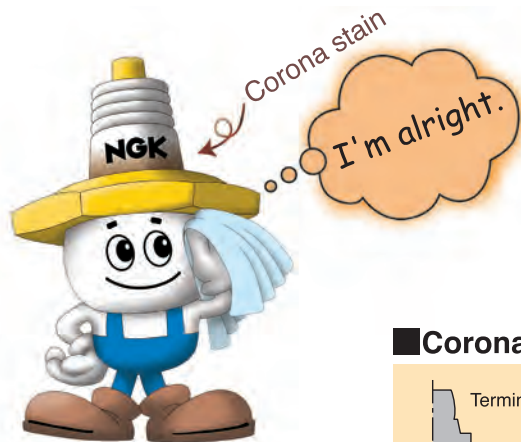
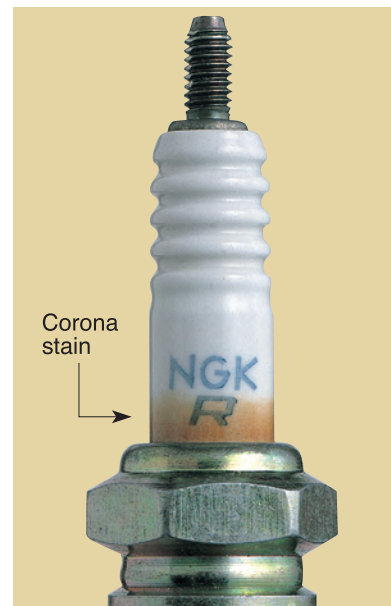
Is a stain between the insulator and metal shell caused by gas leakage?

**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

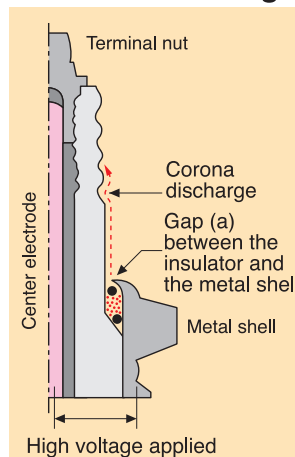


## MEMO

### ● 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.

### Corona discharge



# 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)

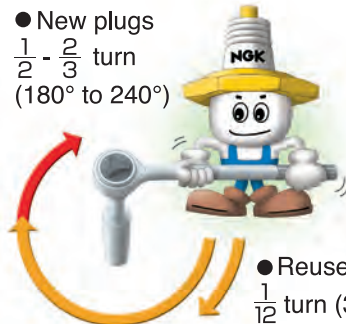
Tightening torque
10 to 20 N·m (1.0 to 2.0 kgm)

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

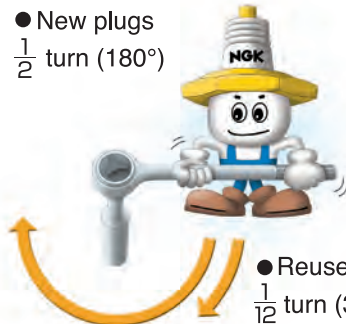
- New plugs  $\frac{1}{2} - \frac{2}{3}$  turn (180° to 240°)



- Reused  $\frac{1}{12}$  turn (30°)

### Spark plugs with thread diameter of 12 and 10 mm

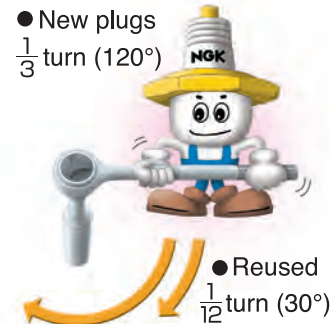
- New plugs  $\frac{1}{2}$  turn (180°)



- 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°)

※There are some exceptions. Look at the adaptation for more information.

## 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 threads</p>	<p>Damage to the caulked portion</p> <p>Damage at the corrugation</p>	
<p><b>Spark plug is inserted at an angle during installation</b></p>	<p><b>Excessive tightening torque</b></p>	<p><b>Spark plug wrench slipped or used at an angle</b></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>	

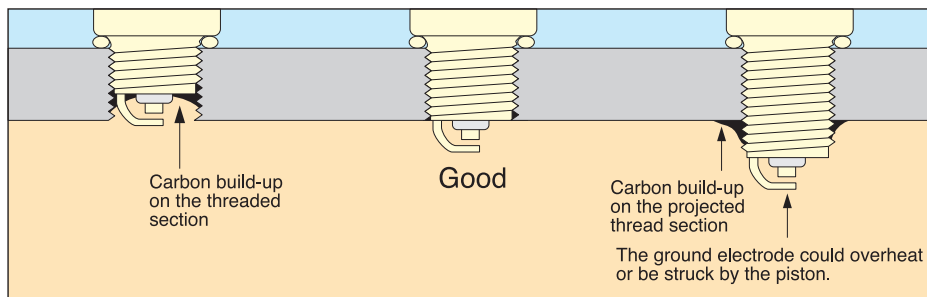
Q19

# Q19

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

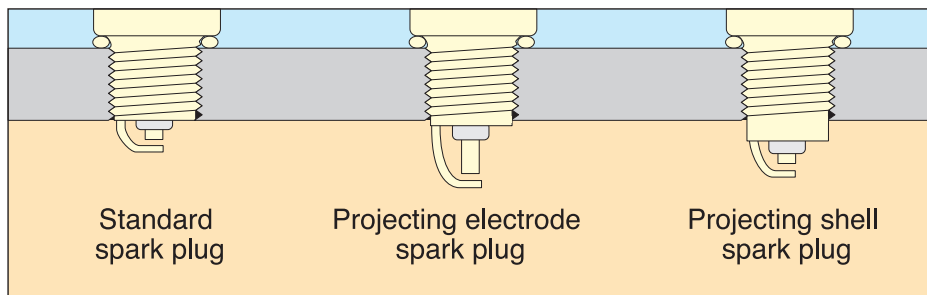
## A Ensure the spark plug has the correct thread reach.

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.



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