POCKET GUIDE

Spark Plugs

Never settle for second best, always insist on NGK, the world’s No.1 OE fitment.
We need to keep the temperature at the firing end of the spark plug within a certain region to prevent problems. Engine types differ enormously in their performance characteristics therefore we need to choose a plug with a suitable 'heat range' to match the engine and its intended use. This complex selection process is carried out by NGK engineers working with the vehicle manufacturer.

Spark plugs do not generate heat. They make good use of the heat produced by combustion to elevate the temperature of the insulator nose, keeping it free of carbon deposits. The optimum temperature range of the firing end is shown in the chart overleaf. As conditions vary considerably from engine to engine a spark plug must be selected that can get up to temperature quickly but not become overheated under high loads. The 'heat range' of a spark plug is a measure of its ability to dissipate, thereby controlling this heat energy. Most of this energy is transferred from the combustion chamber to the cylinder head via the threaded portion and gasket/seating area.
Understanding heat range & heat dissipation

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Checking the firing end appearance

Firing end temperature °C

Overheating area

870°

Optimum temperature area

450°

Fouling area

Idle Temp

{ 250°, 150° }

Overheating
The insulator is white and sometimes blistered. If the insulator temperature is over 870˚C pre-ignition may occur. Engine power will be reduced and the piston may be damaged.

Good condition
The insulator is brown or light grey.

Fouling
Carbon accumulates on the insulator nose forming a leakage path to earth. The engine misfires resulting in bad starting and poor acceleration. Particularly common with unleaded fuel.
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Causes
- Over advanced ignition timing
- Too lean a fuel mixture
- Blocked injectors
- Insufficient cooling
- Excessive deposits in the combustion chamber
- Spark plug heat range too hot

Even if the spark plug is used under good conditions, deposits will accumulate. Regular inspection and replacement is advisable.

Fouling
Carbon accumulates on the insulator nose forming a leakage path to earth. The engine misfires resulting in bad starting and poor acceleration. Particularly common with unleaded fuel.

Causes
- Too rich a fuel mixture
- Excessive use of choke
- Prolonged slow speed driving or idling
- Blocked air filter
- Spark plug heat range too cold
Recommended Installation Procedure

- Refer to current NGK catalogue for correct spark plug selection
- Check condition and cleanliness of threads in cylinder head
- Ensure plug is gapped according to vehicle manufacturers specification (fig 1)
- Multi ground electrode and precious metal plugs should not be regapped - visual inspection only
- Install new spark plug by hand until it seats - (fig 2) a length of rubber tubing pushed over the insulator can be a useful aid for plug installation where access is difficult
- Tighten to specified torque setting as shown in the chart overleaf
- If a torque wrench is unavailable then refer to vehicle/engine manufacturers installation instructions or the tightening angle advice which is displayed on current NGK packaging (excluding specialist race plugs). Note that this angle advice can differ between part numbers due to individual spark plug design (e.g. seating type, thread diameter and gasket material)
• It is important not to over or under tighten spark plugs during installation. Over-tightening can lead to distortion of the spark plug. Under-tightening can cause overheating due to poor heat dissipation. In extreme cases incorrect tightening can cause spark plug breakage and/or engine damage

• NGK does not recommend the application of lubricant to spark plug threads as the resultant reduction of frictional forces at the thread faces will render the torque charts inaccurate and over tightening could occur

• If a gasket type spark plug is re-installed, it should only require a further 1/12 of a turn after it has been seated

• Always carefully use the correct tools for removal/installation to prevent damage to the spark plug or engine

• Inspect spark plug cover and renew if necessary
## Torque Tightening Chart

FOR FLAT SEAT TYPE (WITH GASKET)

<table>
<thead>
<tr>
<th>Thread Ø</th>
<th>18mm</th>
<th>14mm</th>
<th>12mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>35-45Nm (3.5-4.5kgm)</td>
<td>25-35Nm (2.5-3.5kgm)</td>
<td>15-25Nm (1.5-2.5kgm)</td>
</tr>
<tr>
<td></td>
<td>(25.3-32.5lbs ft)</td>
<td>(18.0-25.3lbs ft)</td>
<td>(10.8-18.0lbs ft)</td>
</tr>
<tr>
<td>Cast iron head</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35-40Nm (3.5-4.0kgm)</td>
<td>25-30Nm (2.5-3.0kgm)</td>
<td>15-20Nm (1.5-2.0kgm)</td>
</tr>
<tr>
<td></td>
<td>(25.3-28.9lbs ft)</td>
<td>(18.0-21.6lbs ft)</td>
<td>(10.8-14.5lbs ft)</td>
</tr>
<tr>
<td>Aluminium head</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Torque Tightening Chart

### Flat Seat Type (With Gasket)

<table>
<thead>
<tr>
<th>ASKET</th>
<th>TAPER SEAT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10mm</td>
<td>8mm</td>
</tr>
<tr>
<td>10-15Nm (1.0-1.5kgm) (7.2-10.8lbs ft)</td>
<td>--------</td>
</tr>
<tr>
<td>10-12Nm (1.0-1.2kgm) (7.2-8.7lbs ft)</td>
<td>8-10Nm (0.8-1.0kgm) (5.8-7.2lbs ft)</td>
</tr>
</tbody>
</table>
Standard Plugs

e.g. BKR6ES
     BPR6ES

Parallel face nickel alloy electrodes
  typical centre electrode diameter
  2.5mm, gap setting 0.7-.08mm

Wide Gap Types

e.g. BPR5FS-15

Wide gap plugs offer a reduction
  in emissions but require suitable
  ignition coils to provide sufficient
  voltage.
Extra Projected Types

e.g. FR5-1, ZFR5E-11, ZFR5F

Spark position projected much further into combustion chamber providing stable combustion when using leaner air/fuel mixtures. Only use where specified.

Some examples have an extended shell design to enhance ground electrode performance and protect insulator nose.

Intermittent Gap

e.g. BKR6EK

Spark discharge at the intermittent gaps can burn away carbon deposits reducing possibility of mis-sparking.
Multi Electrode

**e.g.**  
BKR6EKC  
DCPR8EKC  
CR9EK

Two ground electrodes allow sacrifice of more material before gap size becomes too large therefore service mileage is increased.

Multi Electrode

**e.g.**  
BCPR6ET  
BKR6ETA-10

Three ground electrodes provide large surface area for long service life. These plugs often combine other special features mentioned elsewhere in this booklet.
Supplementary Gap

e.g. BUR6ET
     BKUR6ET

Small gap between metal shell and insulator nose allows carbon to be burnt off by spark discharge and restricts combustion gas reaching insulator root.

Semi Surface Types

e.g. BKR5EKU
     BKR6EQUP

Spark always discharges across insulator burning away carbon deposits thereby offering excellent resistance to fouling. This mechanism also allows the use of large spark gap.
V-Grooved Types

e.g. BKR6E
     BKR6EZ

90° groove cut in centre electrode forces spark to occur at the periphery of the electrode resulting in
• less material to obstruct burn - faster flame kernel growth
• less heat energy absorbed by electrode mass - reduced quenching effect
• enhances the potential gradient - less voltage required to create spark
• no loss of service life
Fine Wire Types

Smaller diameter centre electrodes allow a reduction in voltage requirement, better gas flow around spark position, less heat absorbing ‘quench effect’ and more consistent spark position. Special precious metal alloys employed at the electrode tips prevent high rates of wear.

Single Platinum and Platinum VX

e.g. BKR6EVX
     LFR5AP-11
     TR6AP-13

Platinum alloy chip (typically 0.8mm diameter) is laser welded to centre electrode. VX types also have taper cut ground electrode to further improve ignition quality.
Double Platinum

e.g. BKR6EP-11
    PFR6N-11
    PTR5A-10

In addition to a platinum centre electrode a platinum alloy chip is welded to the ground electrode to enhance service life still further especially with dual polarity ignition systems.
Iridium & Iridium IX

e.g. BKR6EIX IFR5N10
IMR9C-9H ITR6F13
LZFR6AI

Iridium alloy chip allows reduction in centre electrode diameter as small as 0.4mm.

This offers reduction in required voltage, a consistent spark position, reduction of “quench effect”, more complete combustion and lower emissions.

Often used in conjunction with platinum chip on ground electrode.

Used in high stress, high performance engines.

Some types, including all Iridium IX plugs, also have a taper cut ground electrode to improve ignition quality further.
**SPE Type**

e.g.  SILFR6A11

To improve the ignitability of conventional iridium plugs, a special angular Platinum chip is welded to the leading edge of the external electrode. The centre electrode is therefore less shrouded by the ground electrode.

**Double Fine Electrode**

e.g.  DIMR8B10

Similar to other Iridium types but with special projected precious metal pin welded to the ground electrode. Fastest, least restricted flame kernel growth and consistent spark position. Typical use – high performance off road racing motorcycle.
Hybrid types

e.g. PZFR5N-11T

Excellent ignition quality offered by platinum fine wire and single main ground electrode design but should excessive carbon become deposited on the insulator nose additional auxiliary side electrodes allow spark to discharge to shell. This action suppresses drop in overall insulator resistance.

- Spark is not ‘lost’
- Unburnt fuel cannot reach catalytic converter

Extended shell design reduces ground electrode temperature.
Rotary Engine Types

e.g. BUR9EQP
    RE8C-L
    RE9B-T

Special conditions in rotary engines often dictate unusual features in spark plugs which may include the following:

• High heat range plugs
• Different heat range in leading and trailing plugs
• Special protection of insulator nose
• Different thread reach for leading and trailing types
• Specific shell dimensions
Competition & Racing Types

e.g. B7ECS R7435-9
R7436-9 R0045J-10 – semi surface

Racing spark plugs are generally constructed with higher heat ranges due to the production of more thermal energy from racing and performance modified engines. Different designs offer varying projection into combustion chamber to match engine design and performance characteristics. Ground electrode designs vary to offer better engine flexibility or resistance to damage by high levels of combustion vibration and high temperatures. Semi surface design plugs similar to the true surface discharge types shown overleaf offers the most robust characteristics only used in the most extreme conditions.
Surface Discharge Types

e.g. BUZHW

True surface discharge design has no given heat rating as the structure of the plug prevents almost all rises in electrode temperature. Wall of insulator is in complete contact with metal shell to dissipate heat quickly. Used in some two stroke marine engines with fast rise short duration CDI ignition systems.
Terminal

Corrugations
To prevent flash over

NGK and part no.

Special packing
Excellent air tightness
Robust construction

Insulator
Made of high purity alumina providing better heat dissipation, higher electrical insulation and stronger thermal shock resistance

Metal Shell
Zinc plated and chromated to guard against corrosion

Spark Gap

Ceramic Resistor
A 5kΩ ceramic resistor to suppress radio frequency noise protecting:
- Car radios
- Mobile phones
- Engine management systems

Gasket

Copper core
Deeply inserted in the centre electrode for improved thermal conductivity. Providing an ultra wide heat range plug that gives maximum performance at both high and low speeds

Centre and ground electrodes
Special nickel alloy ensures superior heat resistance and durability