



SPARK PLUGS

TECHNICAL MANUAL

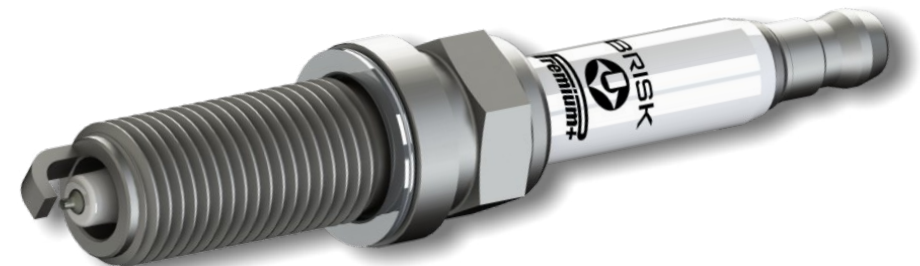


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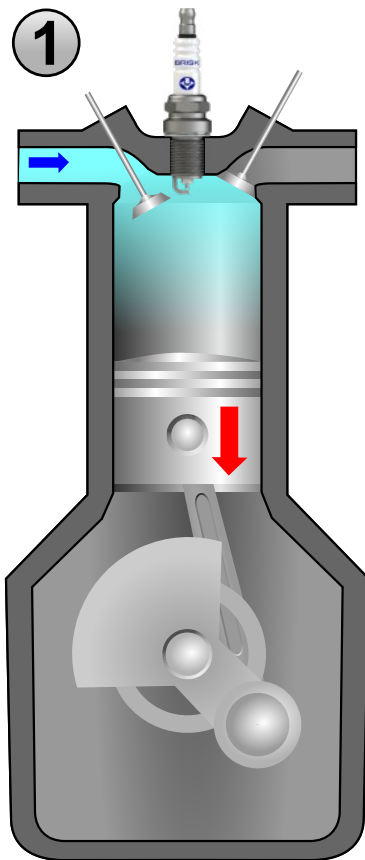
FAST MOVE AND SEARCH BUTTONS

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- WORKING PHASE OF TWO-STROKE PETROL ENGINE
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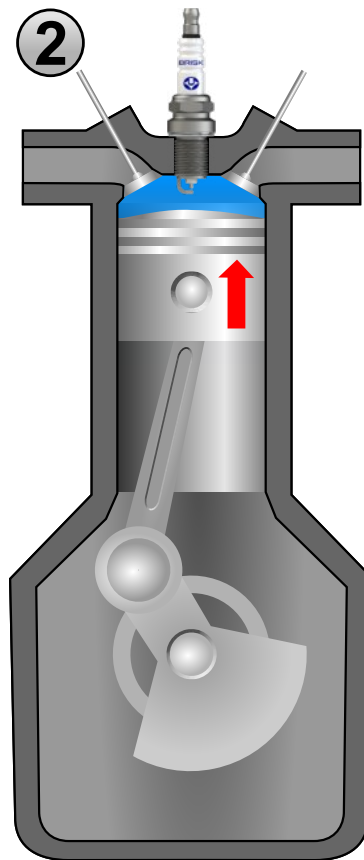


WORKING PHASES OF A FOUR-STROKE PETROL ENGINE

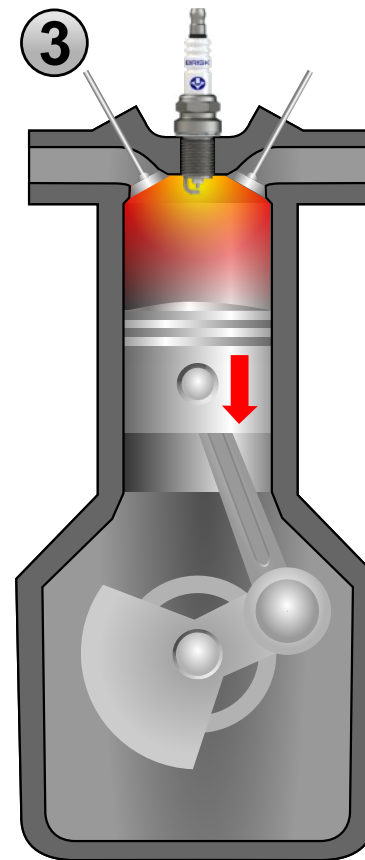
Spark plugs are part of the spark-ignition engine. The running of the engine fully depends on their proper function. They affect fuel consumption, the amount of harmful emissions in exhaust gases, reliability of the vehicle and safety on the roads.



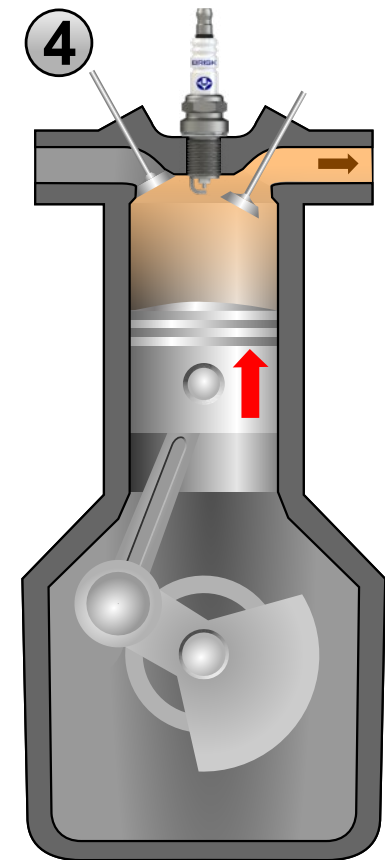
INTAKE



COMPRESSION



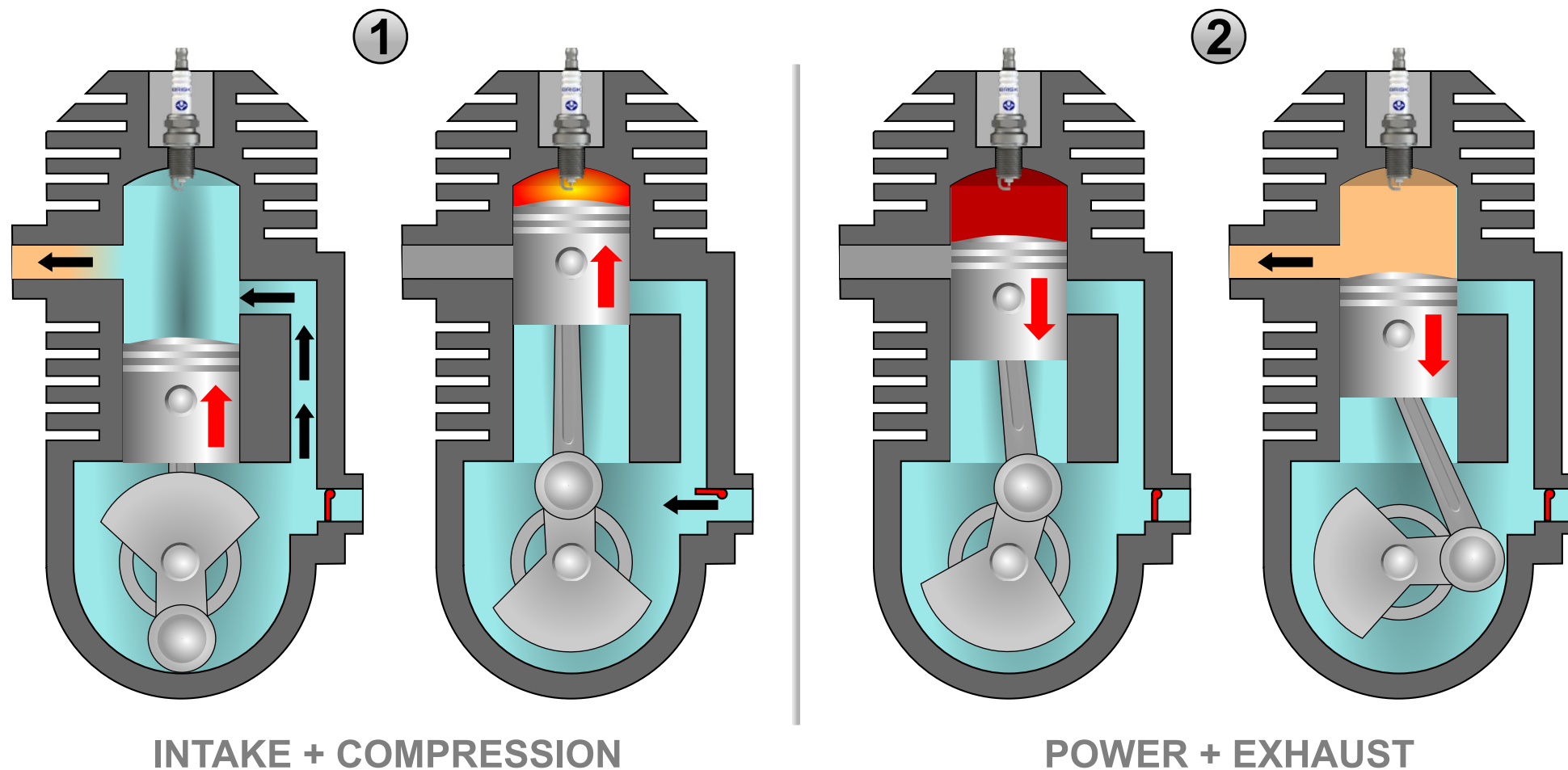
POWER



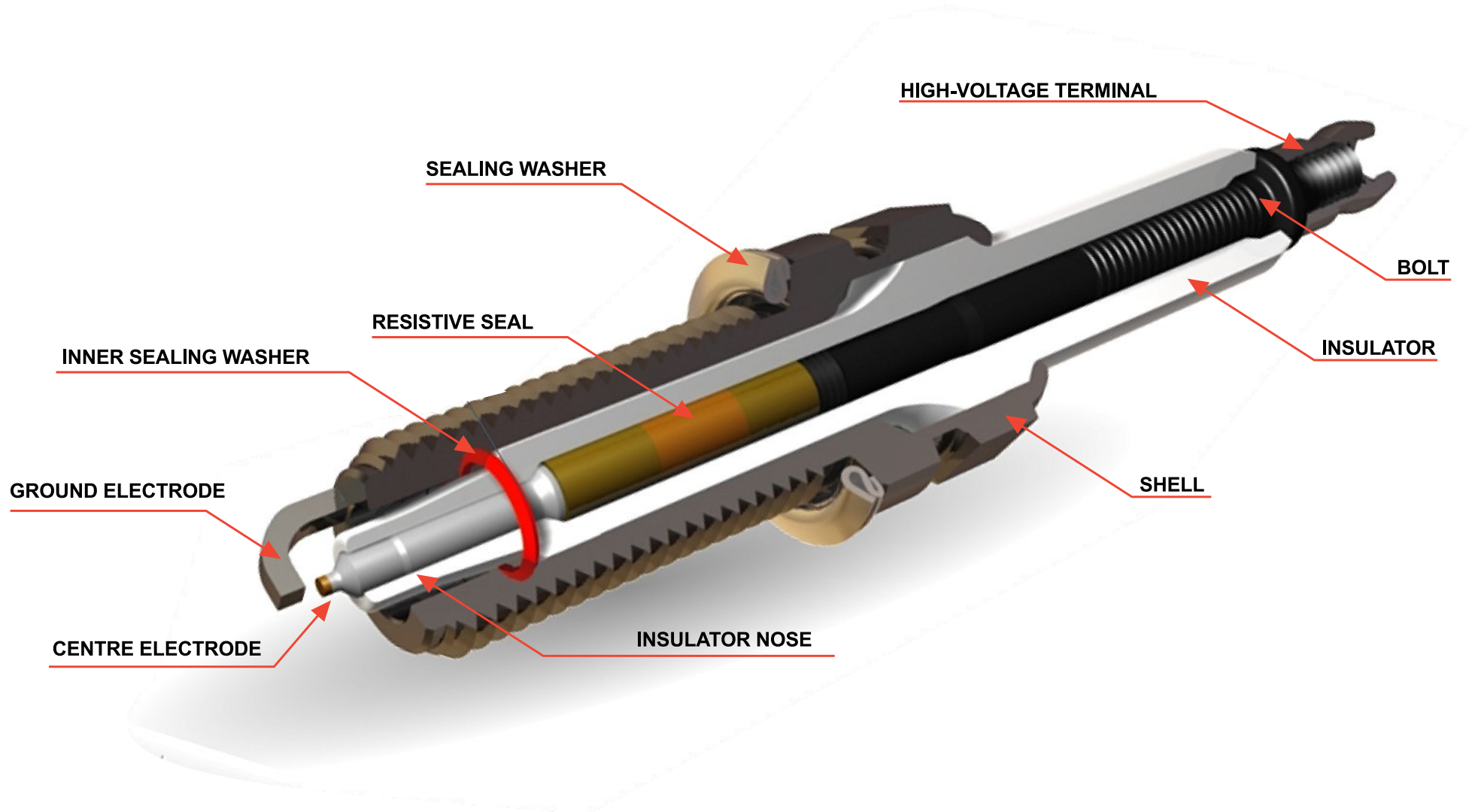
EXHAUST

WORKING PHASE OF TWO-STROKE PETROL ENGINE

Spark plugs are part of the spark-ignition engine. The running of the engine fully depends on their proper function. They affect fuel consumption, the amount of harmful emissions in exhaust gases, reliability of the vehicle and safety on the roads.



SPARK PLUG CONSISTS OF

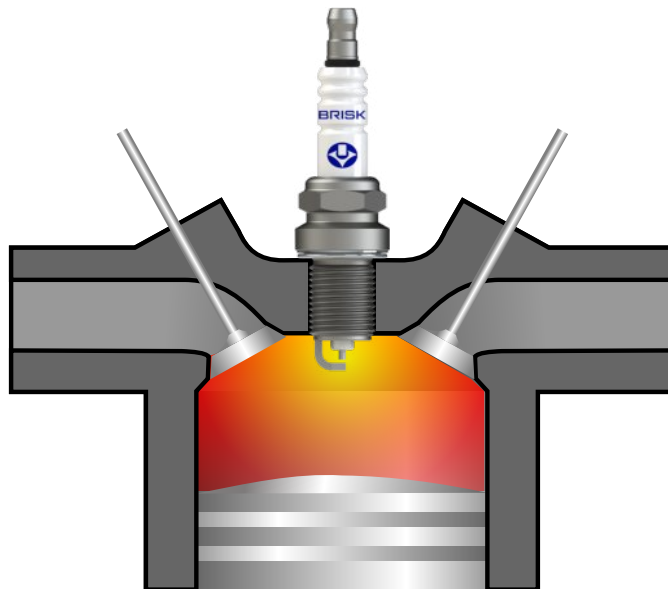


FUNCTIONS

Spark plug is a device placed in cylinder head of an internal combustion engine operating on the principle of firing ignition of air/fuel mixture.

Spark plug is connected to cylinder head with a thread. The active part projects into the engine combustion chamber. The upper part is designed for assurance of high voltage inlet from the ignition system to the spark gap of the spark plug.

The basic function of a spark plug is the ignition of a air/fuel mixture in the engine combustion chamber at an exactly given moment.



REQUIREMENTS

Spark plug must be designed in such a manner that it can be reliably resistant to:

- high heat stress
- electrical voltage
- mechanical stress
- vibrations
- sudden temperature variation
- chemical influences in the combustion area
- erosion at high temperatures
- deposits from combustion
- atmospheric humidity



The following conditions must be ensured for an optimum performance of a spark plug:

SPARK PLUG

- Sufficient electrical insulation between the positive and the negative electrodes of the spark plug. There must not be any short circuits, brake-through or leakage of electrical energy.
- Heat transfer from the active part of the spark plug into cylinder head must ensure a sufficient electrical insulation of the insulator tip and prevention from pre-ignitions.
- Perfect connection of the spark plug and cylinder head. Combustion area tightness, heat transfer from the combustion chamber and a possibility of spark plug replacement.
- Appropriate electrode gap corresponding with the energy supplied by the ignition system, compression of the mixture in cylinder and burn-off of electrodes.
- Proper location of the spark gap of the spark plug in combustion area in such a manner that the flame face can be fast enough on the one hand, but on the other hand, it shall not cause detonation combustion or imperfect ignition of the mixture of air and fuel.

USER

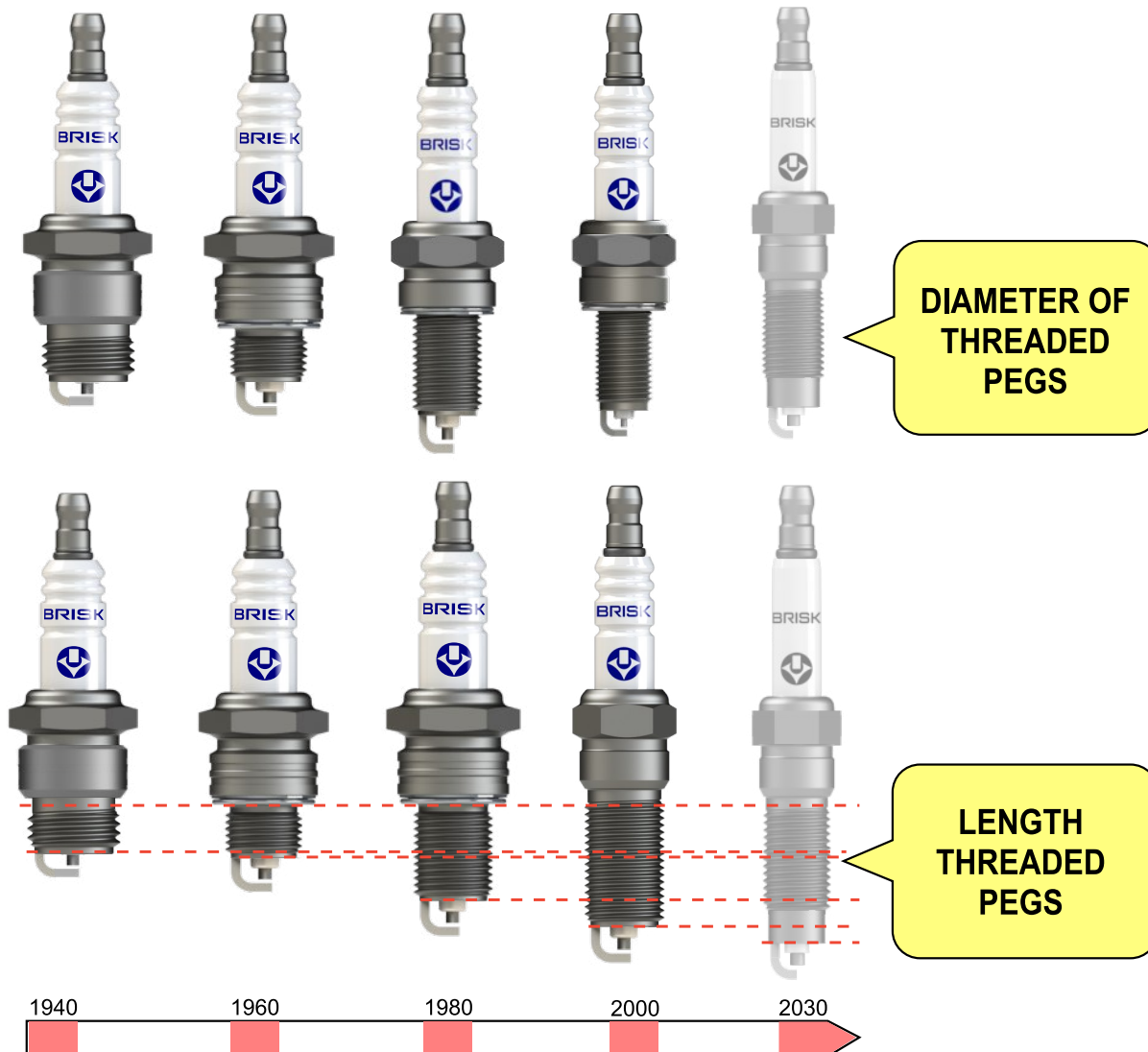
- To use the vehicle in an ordinary manner. For example: not to leave the vehicle running at idle speed of the engine for several minutes uselessly, etc.
- To equip vehicle engines with a proper type of spark plugs. The important parameters are construction arrangement dimensions, thermal value, electrode gap, location of spark gap in the combustion chamber and interference elimination.
- Timely replacement of spark plugs after the achievement of a pre-specified mileage.



ENGINE - VEHICLE

- Supply of sufficient energy from the ignition system to the spark plug at all operation modes of the engine.
- Preparation, before ignition, of a suitably mixed mixture of air and fuel as possible with regard to the operation conditions in question.
- Good technical condition of the engine, in particular:
 - a) sufficient compression pressure
 - b) exact timing
 - c) exact adjustment of ignition and fuel system
 - d) zero leakage of lubrication oil into the combustion chamber
 - e) sufficient insulation of high voltage inlet
 - f) good thermal balance of the engine cooling system
 - g) undamaged system for air and fuel mixture enrichment at start and acceleration
 - h) properly operating sensors, connected with timing of ignition and control

DIMENSIONS



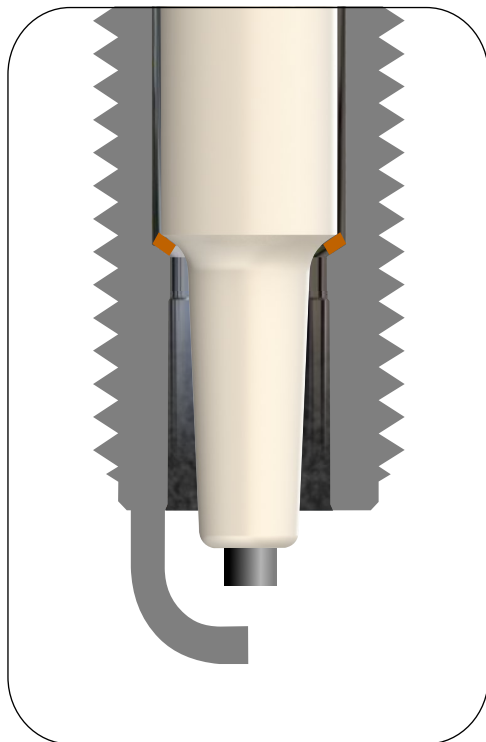
Trends of development of the spark plugs dimensions

Permanent reduction of the space for the spark plug in cylinder heads resulting from "downsizing" and improvement of heat balance of the entire engine affects the spark plugs dimension. Permanent reduction of the thread diameter and prolongation of the threaded peg places bigger and bigger demands on quality of the insulator.

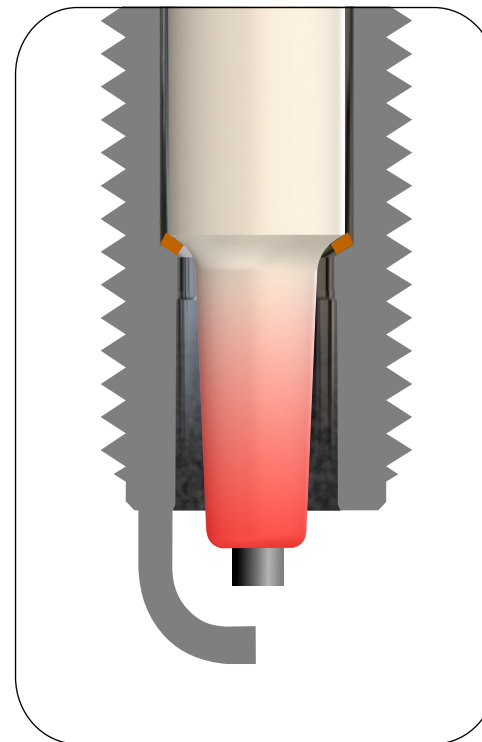


HIGH TEMPERATURE

The temperature in the combustion chamber fluctuates in quick succession from several thousand degrees during the working cycle down to about 80°C during intake. Average temperature increases with the engine revolutions and the change in the ratio of air-fuel mixture. The leaner the mixture is, i.e. the less fuel in the mixture, the higher the temperature of combustion products.



LOW RPM



HIGH RPM

SPARK PLUGS HAVE TO RESIST



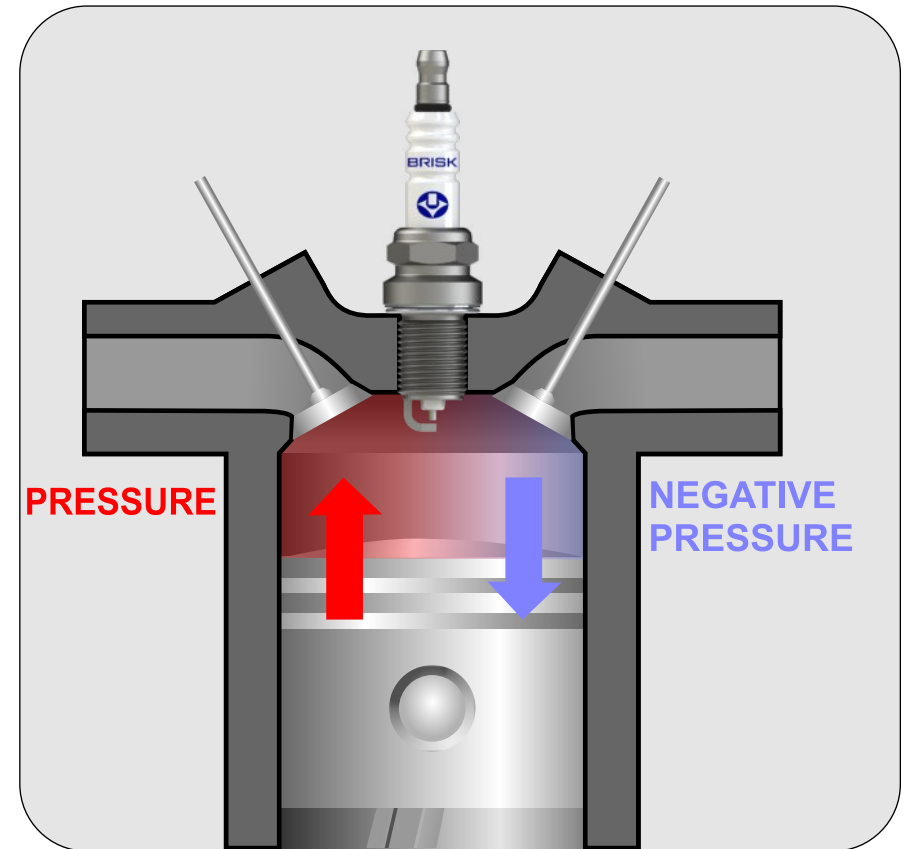
HIGH VOLTAGE

High voltage and lesser diameters of spark plugs require insulating features of the insulators to be much higher than in the past.



MECHANICAL STRESS

Changing the enormous pressure in the combustion chamber during the working cycle with negative pressure during intake places high mechanical demands on the insulator and the electrodes of the spark plug.

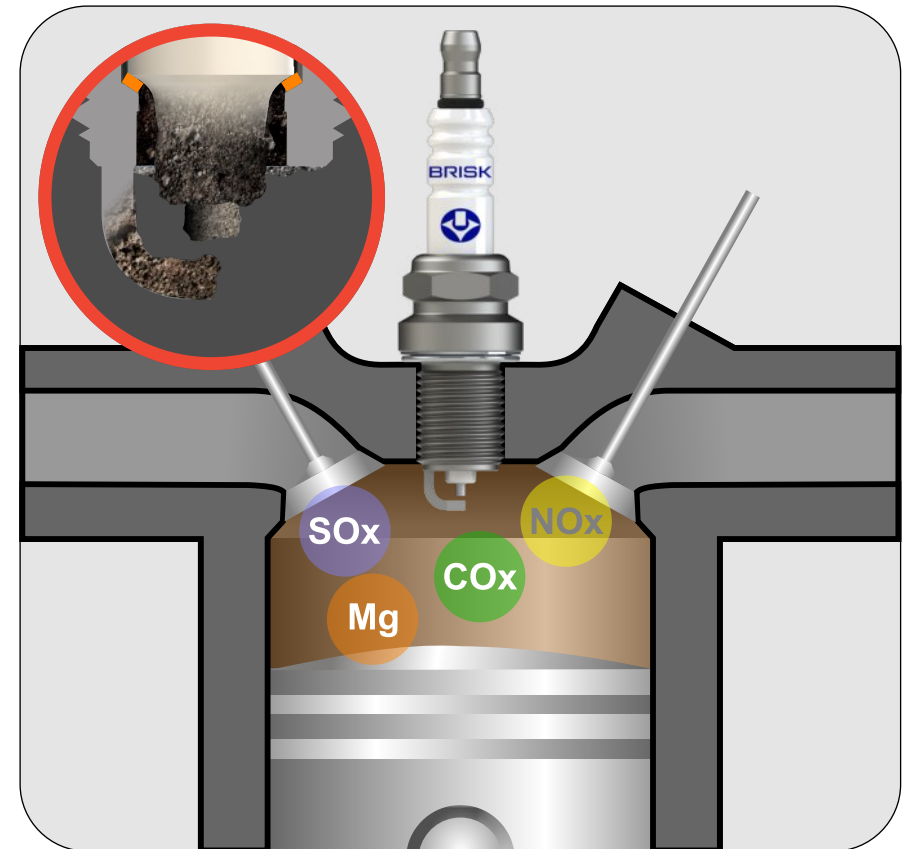
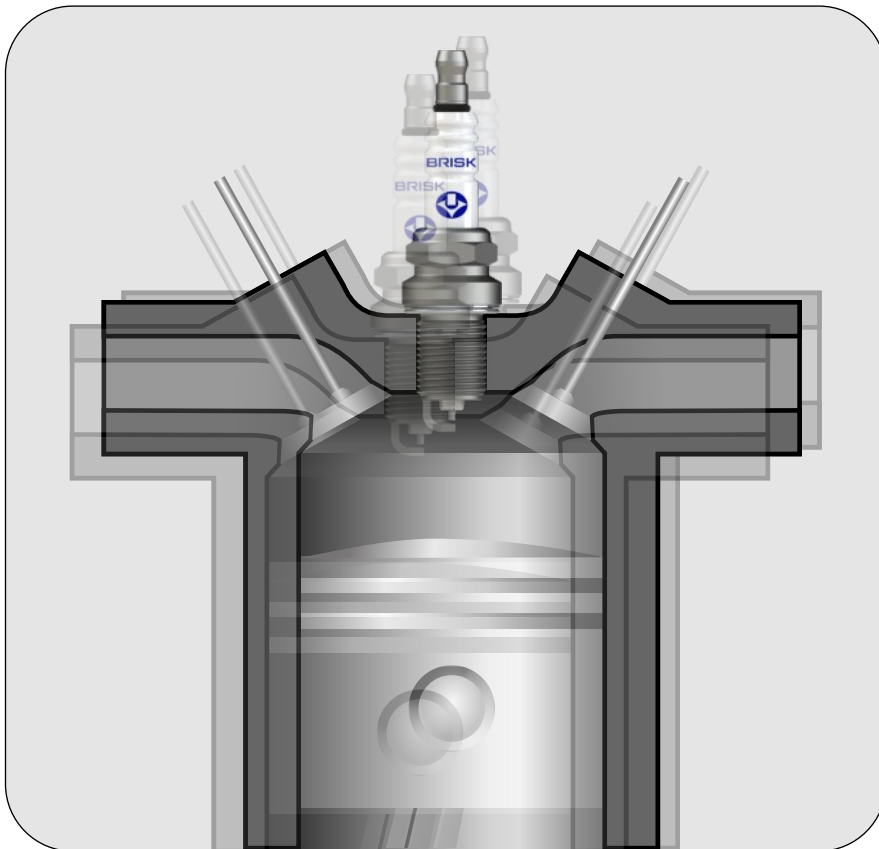


VIBRATIONS

High revolutions connected with unbalanced engines weight cause vibrations of several 'g'. Particularly the manual tools small engines with the combustion engine generate vibrations several times bigger than vehicles with multi-cylinder engines.

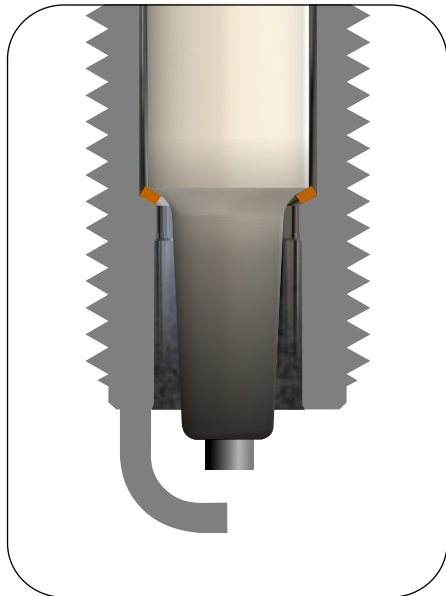
CHEMICAL INFLUENCE

In the combustion chamber chemical elements and compounds occur and settle on the surface of the insulator nose decreasing insulation strength. These are mainly the compounds of carbon resulting from insufficiently burnt fuel and residues of oil additives and impurities which went through the air filter.

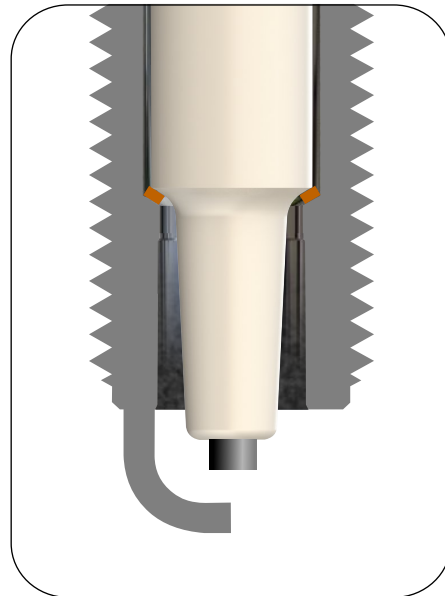


DEPOSITS OF COMBUSTION

Spark plugs must be designed so that they have to resist conductive deposits of combustion. These are burnt when the temperature of the insulator nose is higher than 450°C. The speed of warming the insulator nose to the self-cleaning temperature is given by the appropriate heat range, appropriate structure of the insulator nose and by proper material of the centre electrode.



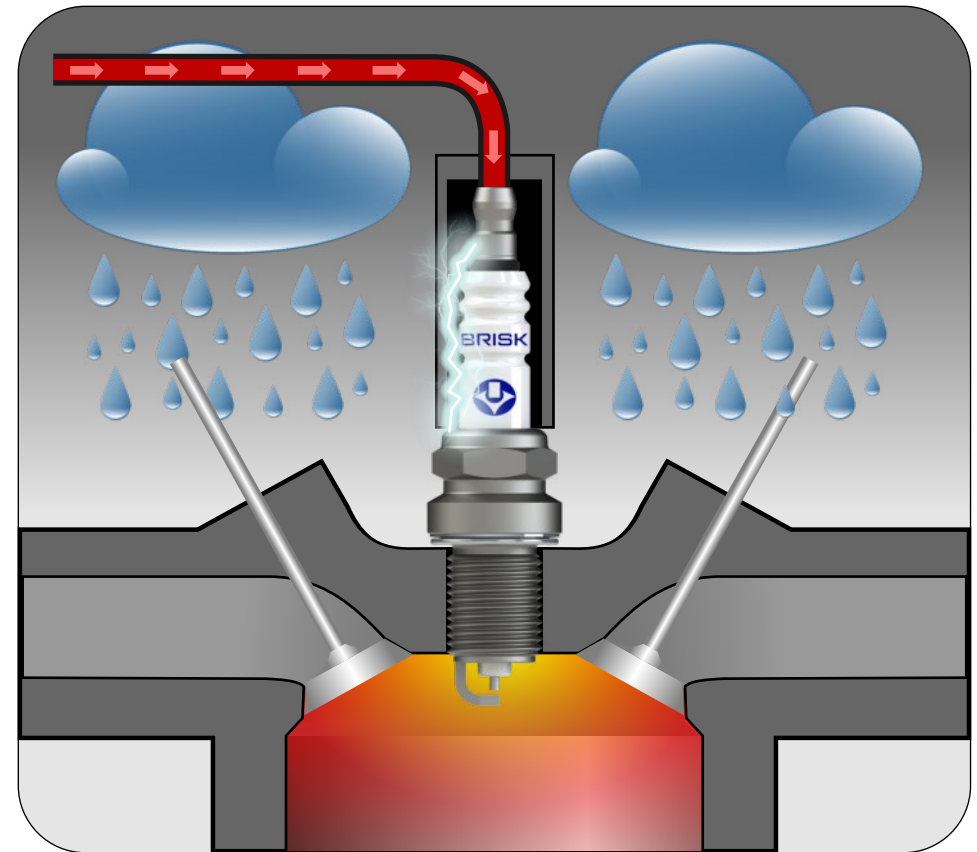
LOW RPM



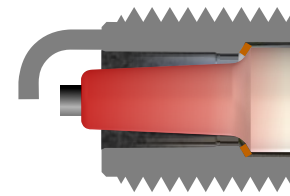
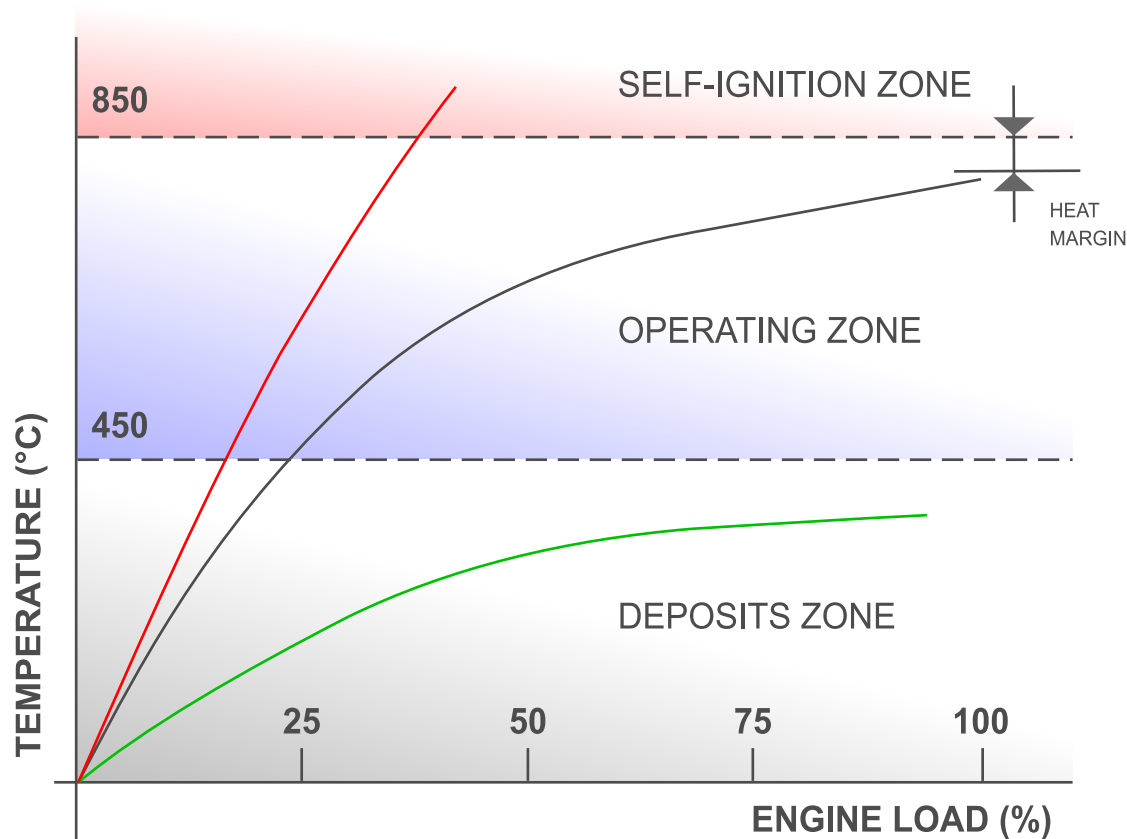
HIGH RPM

ATMOSPHERE INFLUENCE

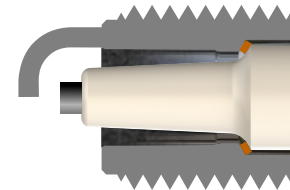
The length, shape and glaze of the insulator upper part must resist surface leakage of electric power even at high air humidity during cold starts.



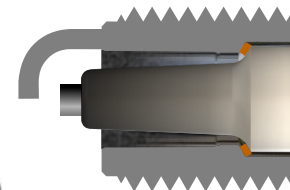
THE NOSE TEMPERATURE - DEPENDENCY ON HEAT RANGE AND ENGINE LOAD



When temperature of the insulator nose achieves more than 850°C, the red-hot nose starts igniting the air-fuel mixture in the combustion chamber before a spark flashes over between the electrodes of the spark plug. This rapidly increases the temperature in the combustion chamber and the spark plug or the engine is destroyed.



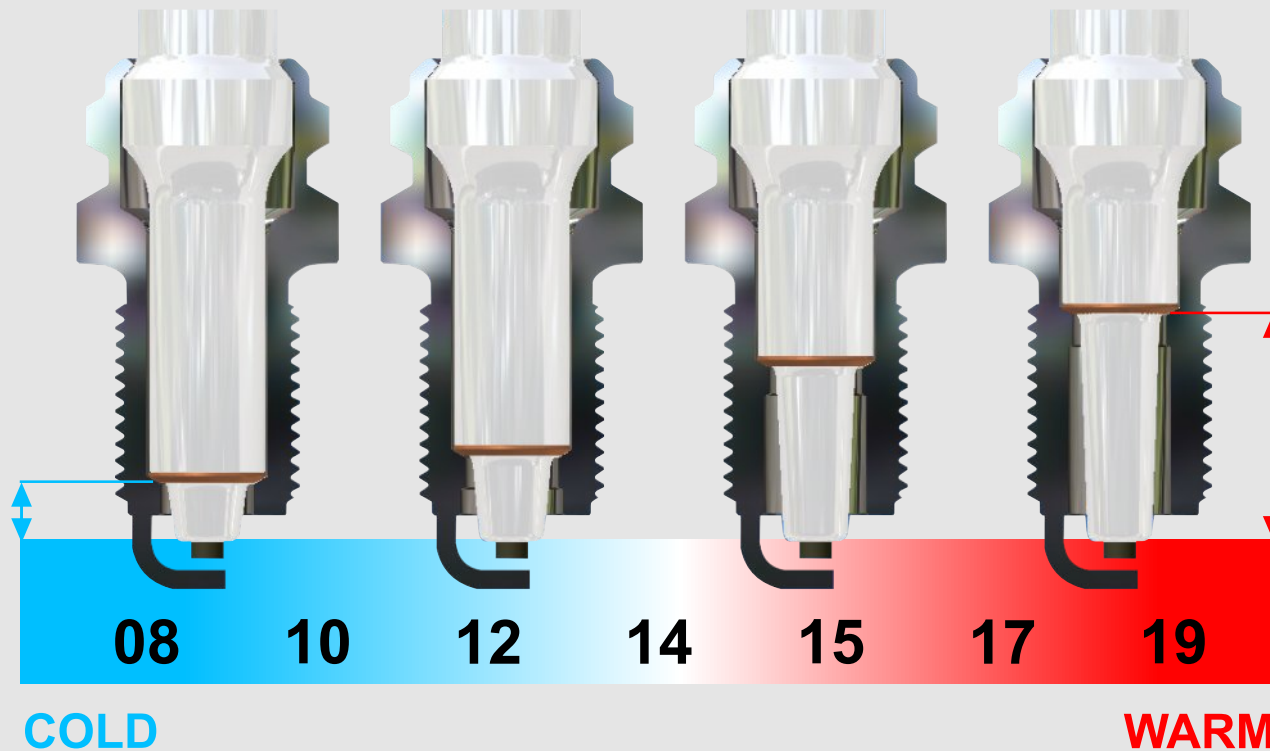
The spark plug must have such heat features that during the engine operation the insulator nose achieves the self-cleaning temperature higher than 450°C as fast as possible and does not achieve the temperature of 850°C in any case.



When the insulator nose temperature is lower, deposits of burning settle on it and, after a certain time, their growth causes a spread of electric power on the surface and malfunction.



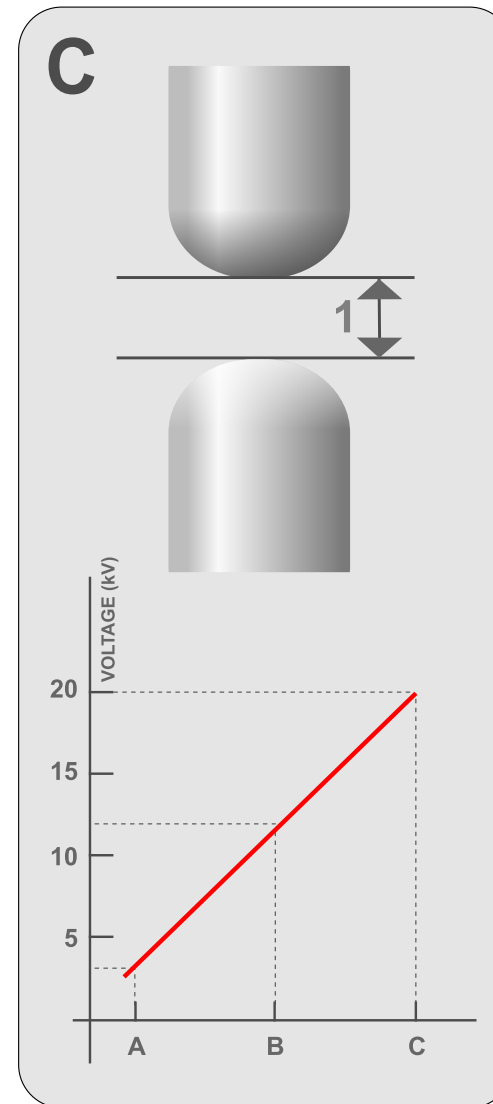
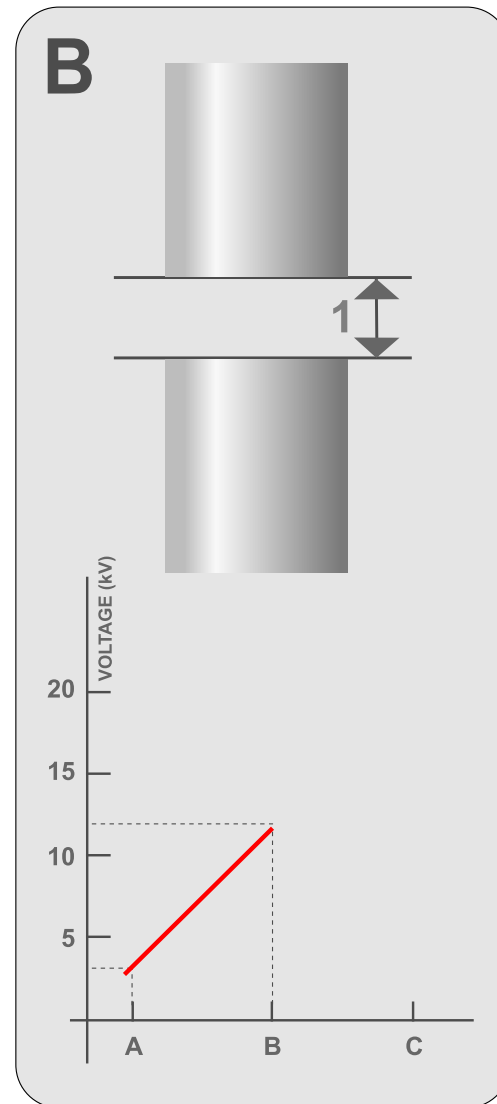
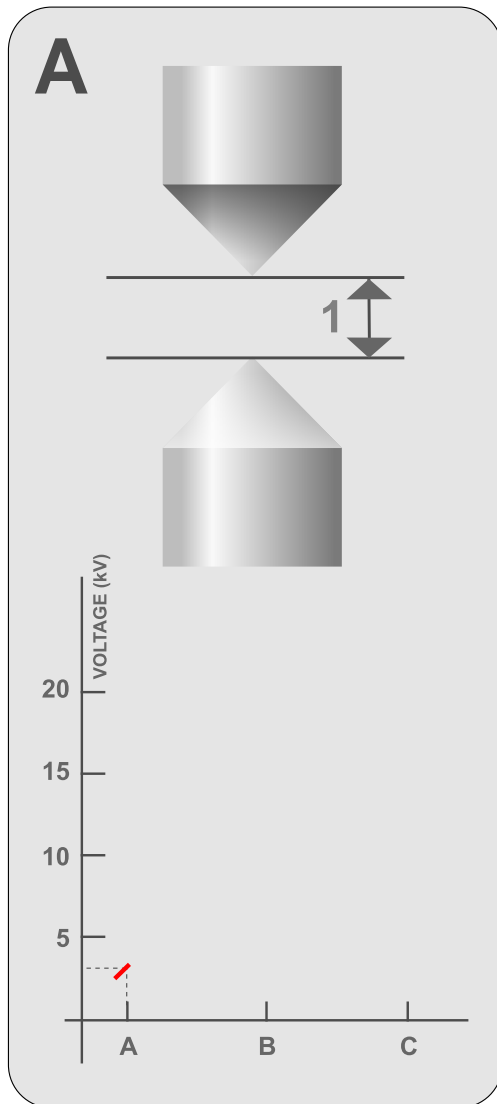
THE NOSE TEMPERATURE - DEPENDENCY ON THE ENGINE POWER



Heat range of the spark plug expresses the heat balance between heat intake and conduction. In the BRISK system the plugs with a minimum of heat-load (warm) are marked with 19 and the plugs with a maximum of heat-load (cold) are marked with 08.



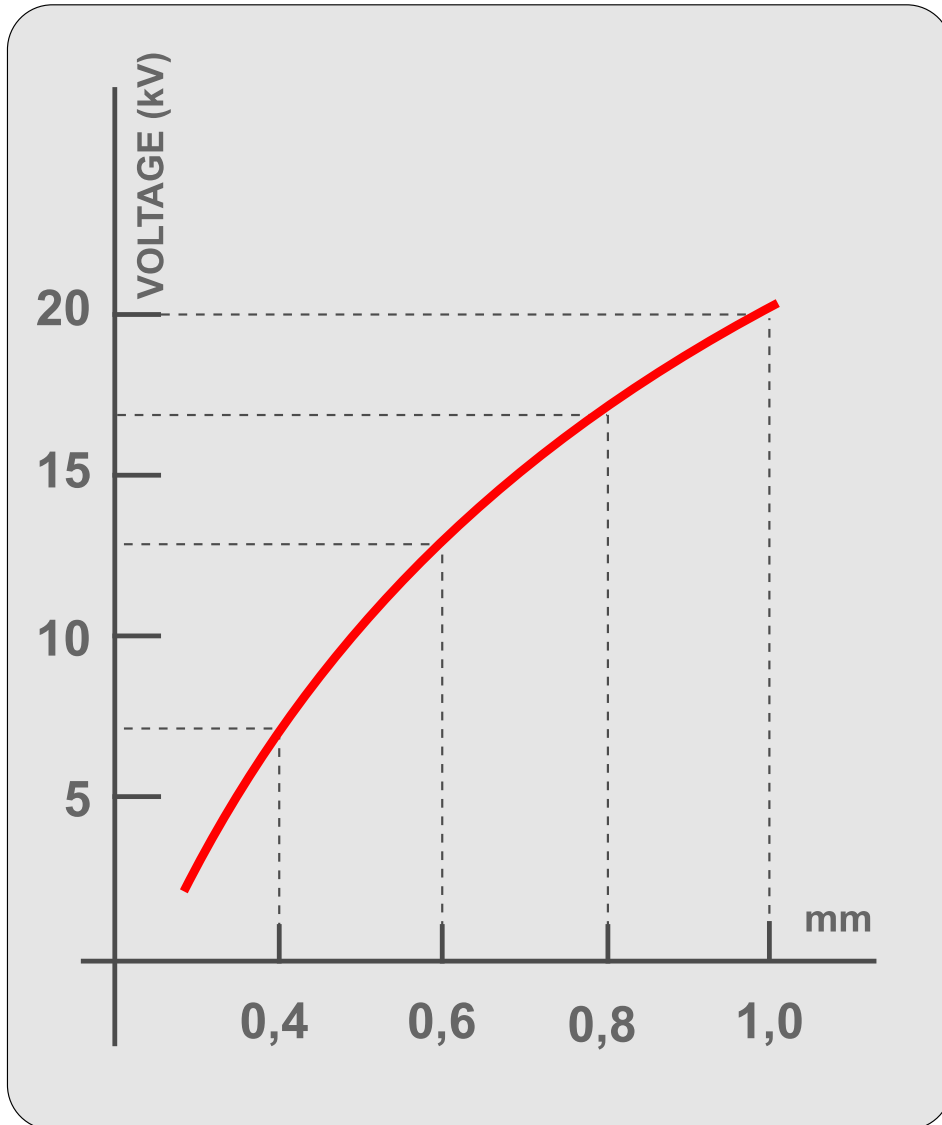
INFLUENCE OF THE SPARK GAP SHAPE ON VOLTAGE



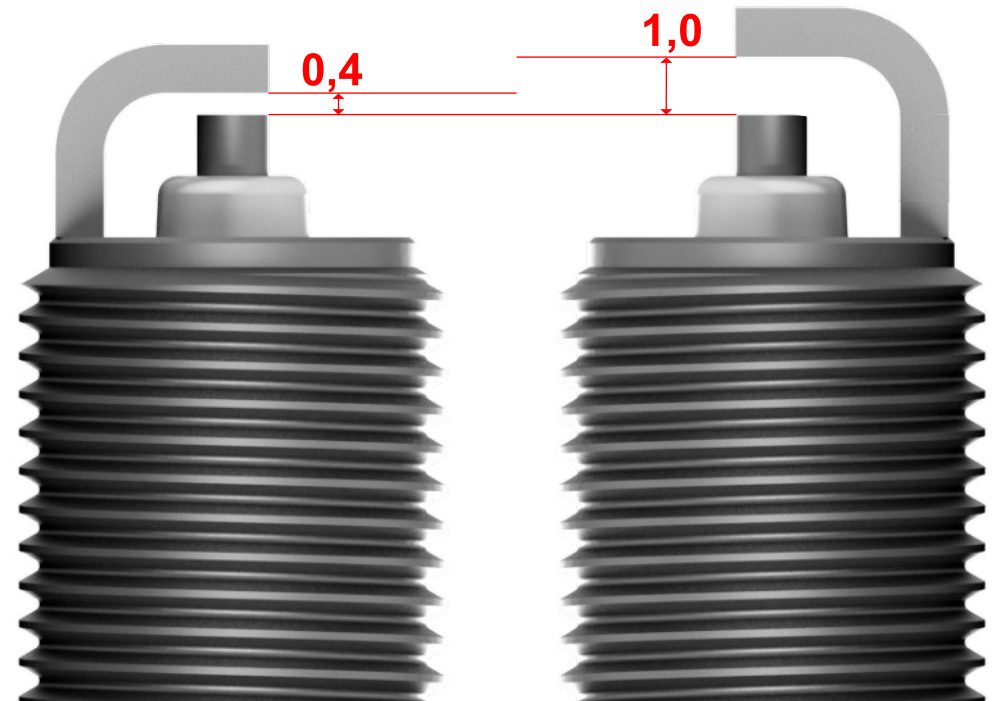
With the same spark gap the requirement for supplied voltage differs also by the shape of electrodes. It is low with the sharp noses and high with the spherical shape.



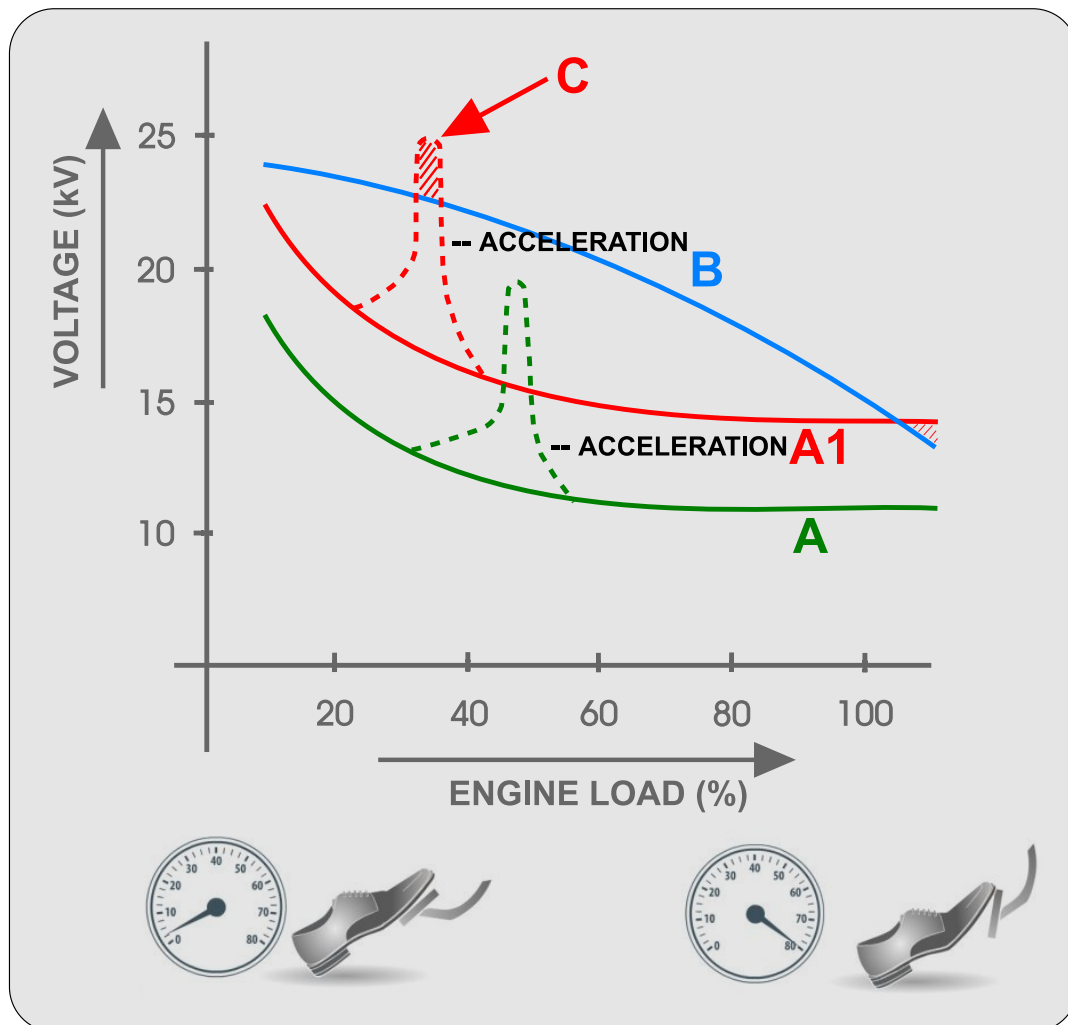
INFLUENCE OF SPARK GAP ON VOLTAGE



The bigger the electrode distance is, the bigger the requirement for supplied voltage.



INFLUENCE OF ACCELERATION ON VOLTAGE



Voltage required by the spark plug (new)



Voltage required by the spark plug (used)



Voltage supplied by the ignition system

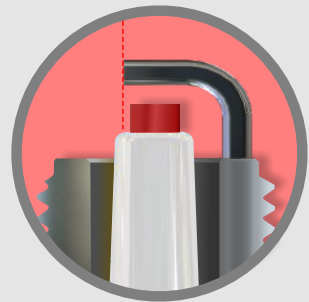


Insufficient voltage supplied by the ignition system

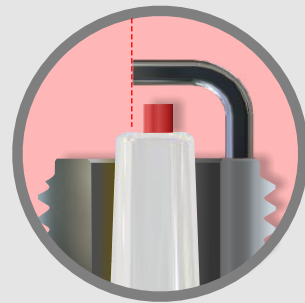
THE REQUIREMENTS FOR VOLTAGE

Reducing the centre electrode diameter results in concentrating electromagnetic field lines and achieving breakdown voltage earlier than with the thicker electrodes.

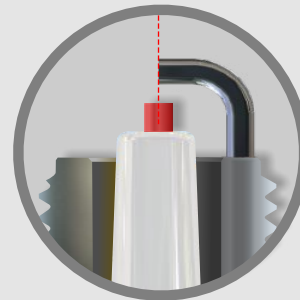
Using the convenient geometric shape of electrodes it is possible to reduce the requirement for voltage supplied by the ignition system.



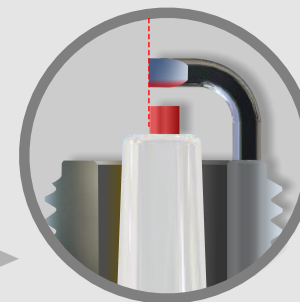
REGULAR VERSION



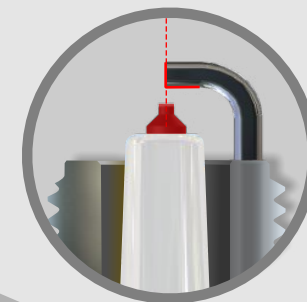
SMALL DIAMETER OF THE CENTRE ELECTRODE



SMALL DIAMETER OF THE CENTRE ELECTRODE AND CUT OF THE GROUND ELECTRODE

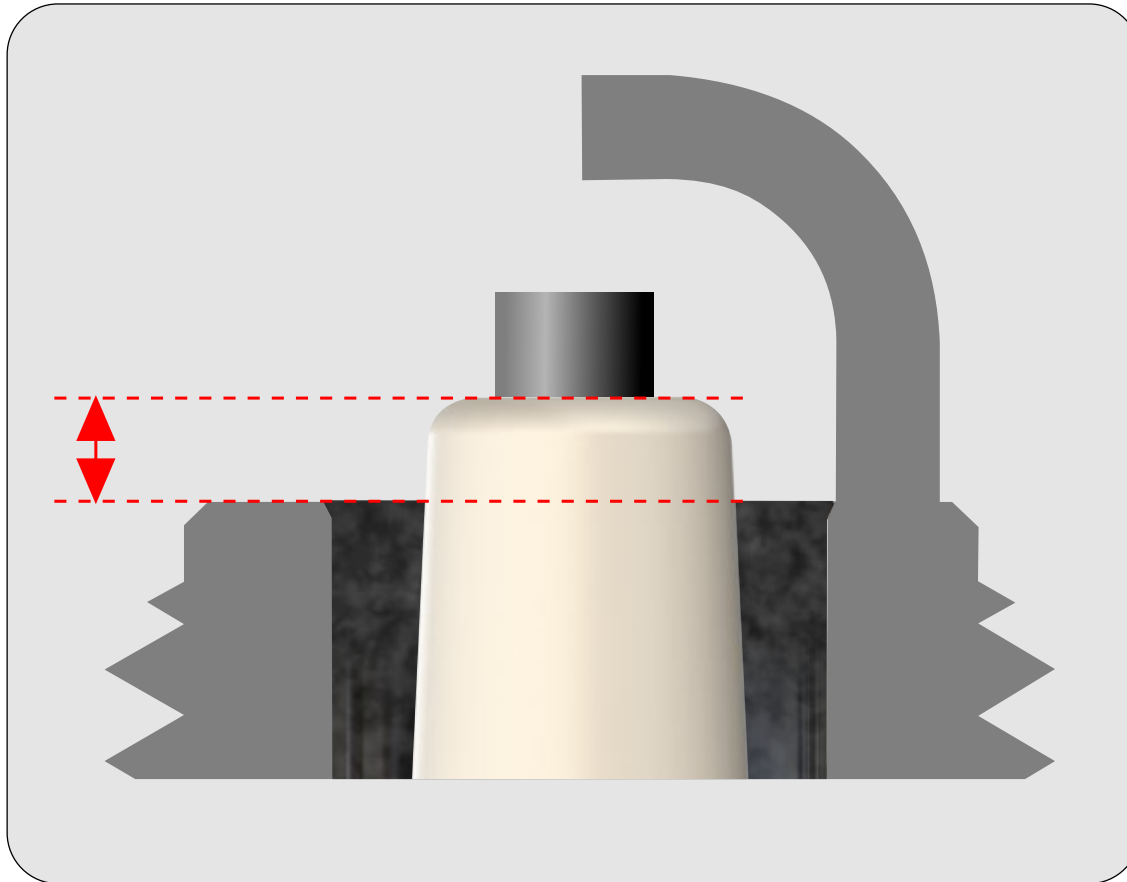


SMALL DIAMETER OF THE CENTRE ELECTRODE AND CUT OF THE GROUND ELECTRODE



REDUCED CENTRE ELECTRODE AND CUT OF THE GROUND ELECTRODE

FUNCTION UNDER SMALL LOAD



By projecting the insulator nose into the combustion chamber the insulator nose cooling increases by flow of the cold air of the mixture sucked in at high revolutions of the engine and conversely the nose is heated fast at small revolutions.

THE INSULATOR NOSE SHAPE, PROJECTION OF THE INSULATOR NOSE INTO THE COMBUSTION CHAMBER OR REDUCTION OF DIAMETER OF THE ELECTRODE END CAN RESULT IN FAST HEATING OF THE INSULATOR NOSE TO THE OPERATING (SELF-CLEANING) TEMPERATURE.

ALSO THE ELECTRODE WITH INCREASED THERMAL CONDUCTIVITY ENABLES USE OF THE SPARK PLUGS WITH BIGGER SURFACE OF THE INSULATOR NOSE FOR THE SAME HEAT RANGE.

THE ZONE CONDUCTING HEAT FROM THE COMBUSTION CORE IN THE INITIAL PHASE AT COLD START



Large parallel surfaces take a large amount of heat to the cold electrodes at cold starts and they can cause the core to die in the first phases of burning.



Small surfaces of the electrodes in the flame core zone substantially limit the amount of heat conducted to the cold electrodes in the initial phase of combustion. At the same time, they do not inhibit spreading of the flame front to the combustion chamber during usual operation.

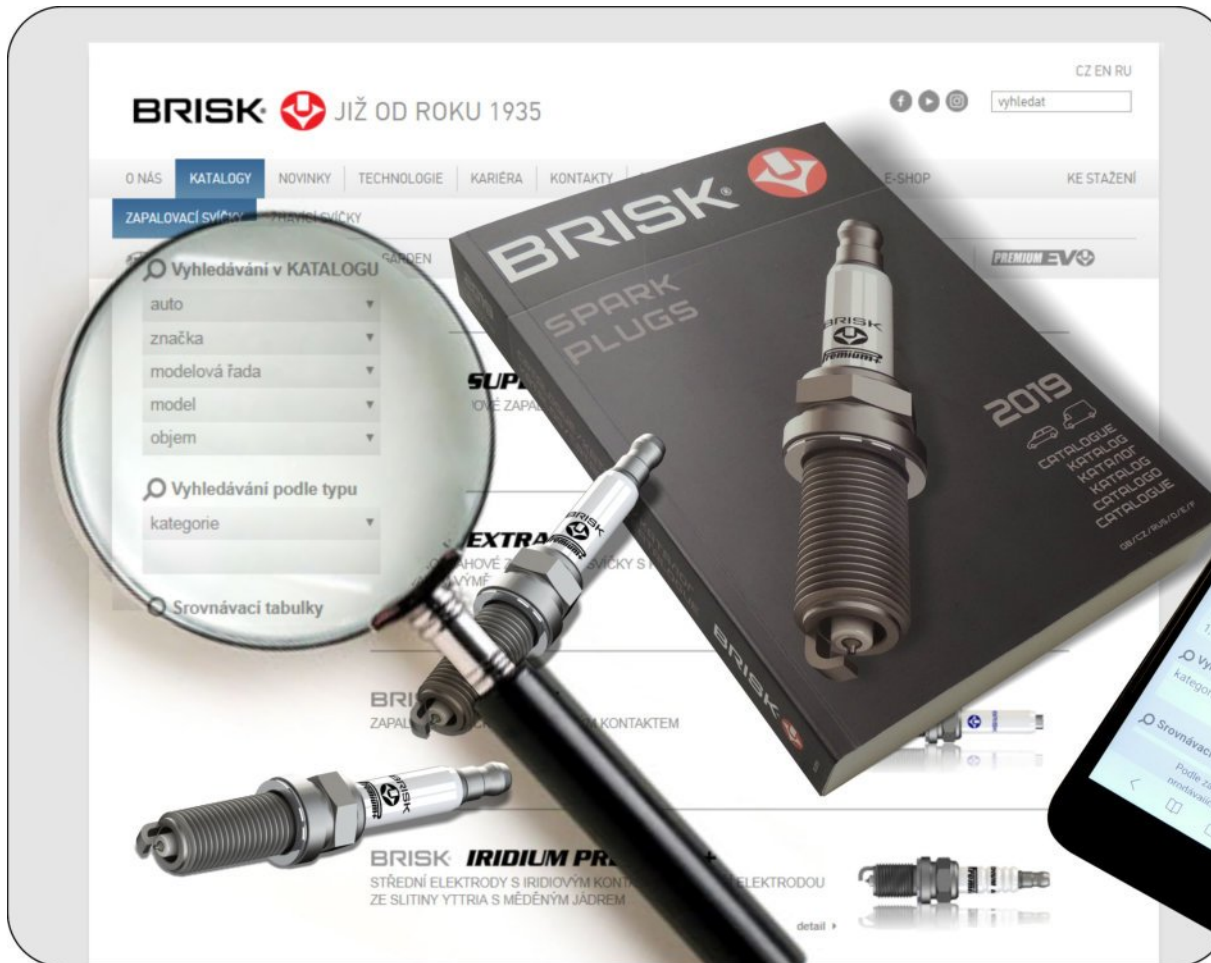
At cold starts it is very important to prevent conducting of the heat from the combustion core by the cold electrodes. Convenient design can fundamentally decrease the surfaces which cool the flame core in the first phases after cold start.



PROPER INSTALLATION OF SPARK PLUGS



SELECTION OF THE SPARK PLUG



Source of information for the correct installation:

- a) website: www.brisk.cz
- b) TecDoc
- c) BRISK catalogue printed

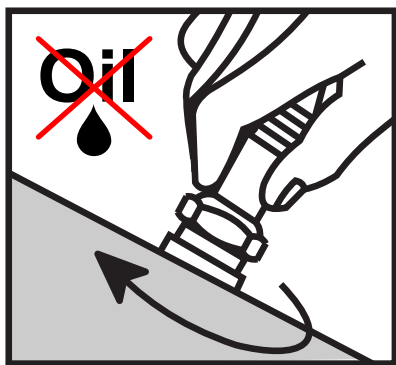


CHECK BEFORE INSTALLATION IF YOU ARE USING THE CORRECT TYPE OF SPARK PLUG FOR THE GIVEN TYPE OF ENGINE.

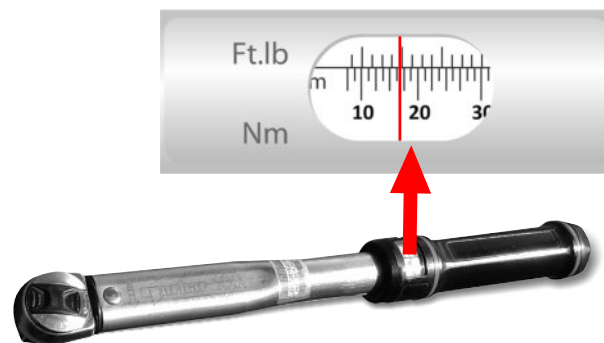


TIGHTENING TORQUE

DO NOT LUBRICATE THREAD BEFORE INSTALLATION!

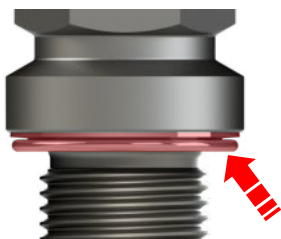


USE A TORQUE WRENCH FOR INSTALLATION OF SPARK PLUGS

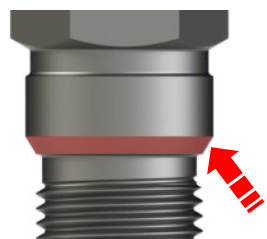


It is necessary to observe thoroughly the specified tightening torque for installation of the spark plug in the engine. As a result of downsizing the specified tightening torque is lower and lower. It is always necessary to use a torque wrench.

TIGHTENING TORQUE MUST CORRESPOND TO THE GIVEN DATA



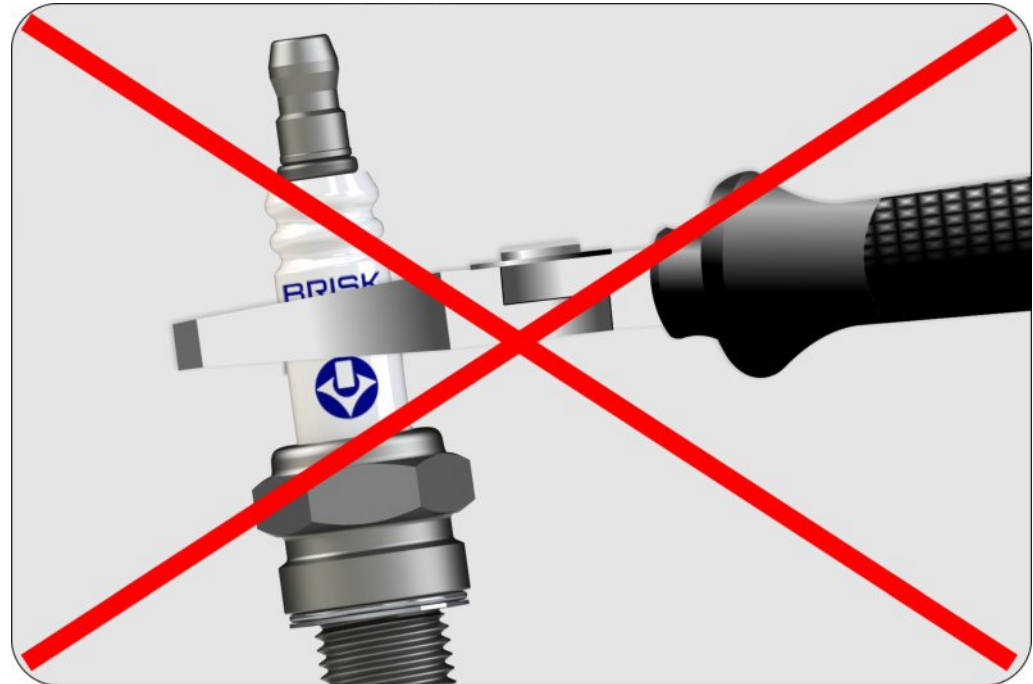
Ø M10x1,00	13 Nm	9.5 ft.lbs
Ø M12x1,25	17 Nm	12.5 ft.lbs
Ø M14x1,25	25 Nm	18.5 ft.lbs
Ø M18x1,5	25 Nm	18.5 ft.lbs



Ø M12x1,25	13 Nm	9.5 ft.lbs
Ø M14x1,25	15 Nm	11 ft.lbs
Ø M16x1,5	15 Nm	11 ft.lbs
Ø M18x1,5	25 Nm	18.5 ft.lbs



INSTALLATION



Check out before installation whether the spark plug is provided with external gasket and whether the external gasket did not stay in the cylinder head from the preceding spark plug after repeated installation (this is not valid for taper seat spark plug).

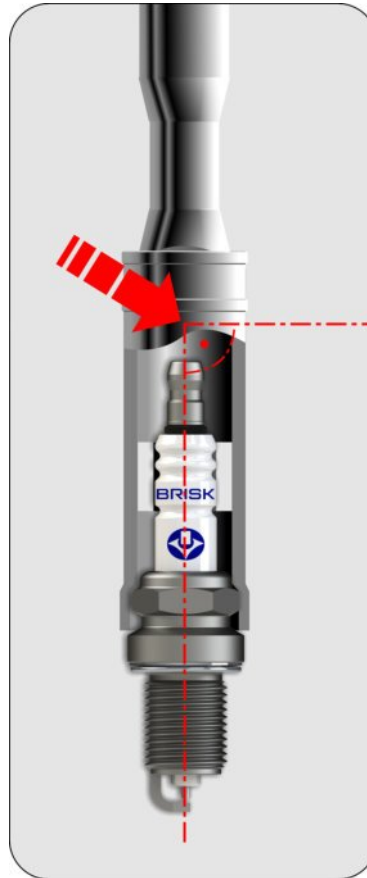


At spark plug installation into and removing from cylinder head it is not allowed to apply force on the insulator.

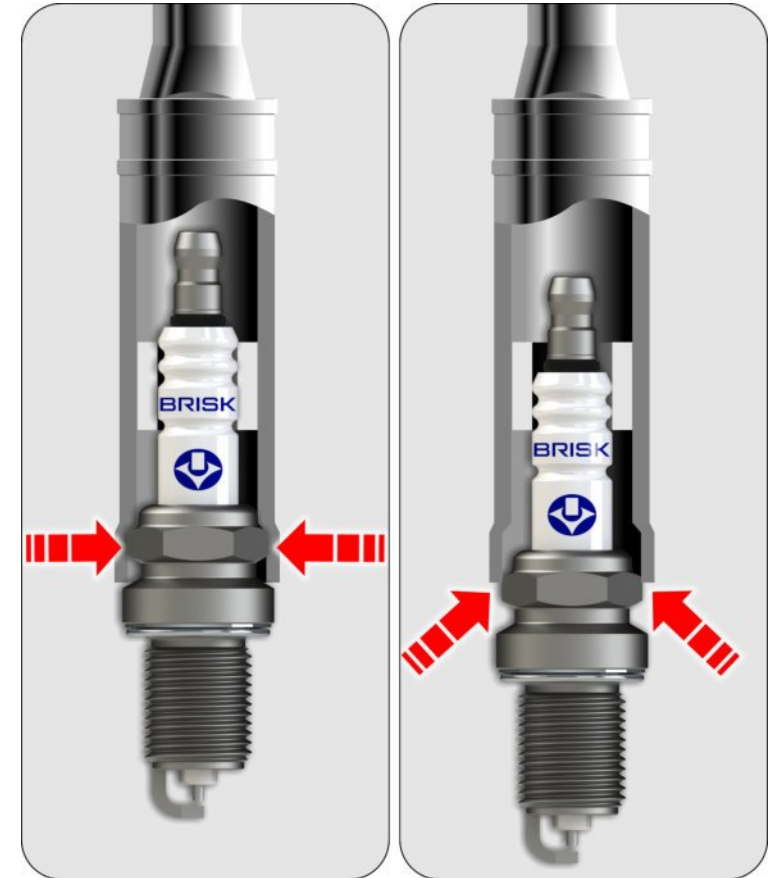
INSTALLATION



Use always the proper spark plug wrench which is not too loose and is provided with centring ring from soft material.



Tightening torque must be applied perpendicular to the spark plug axis.

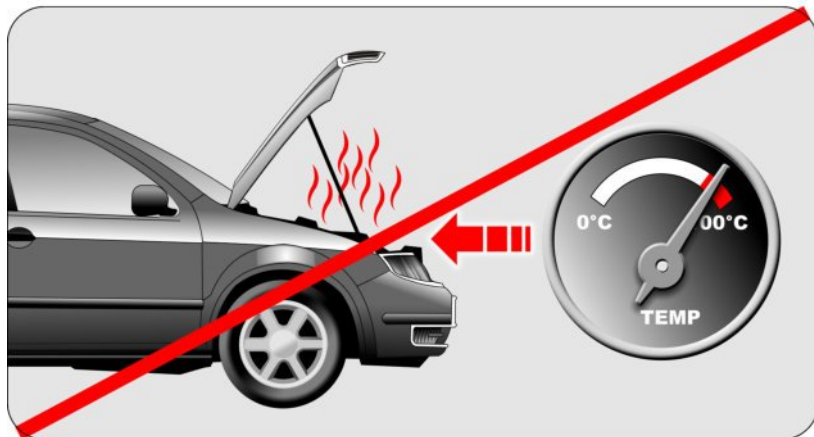
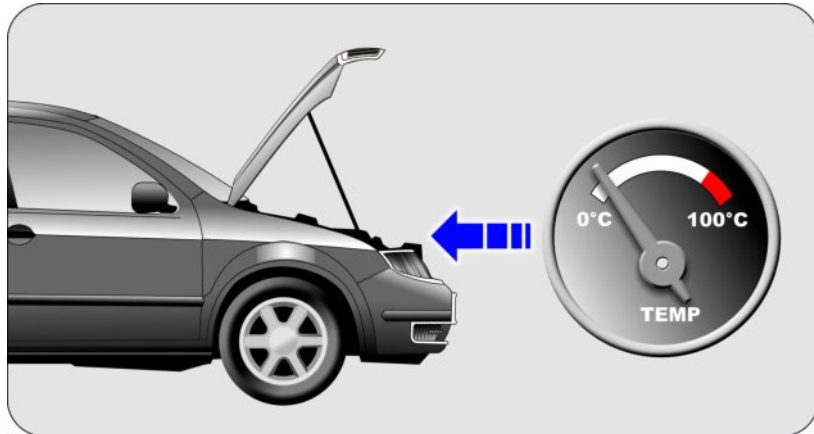


Tightening torque can be applied in such case only when the wrench is put on across the whole length of hexagon of spark plug metall shell.

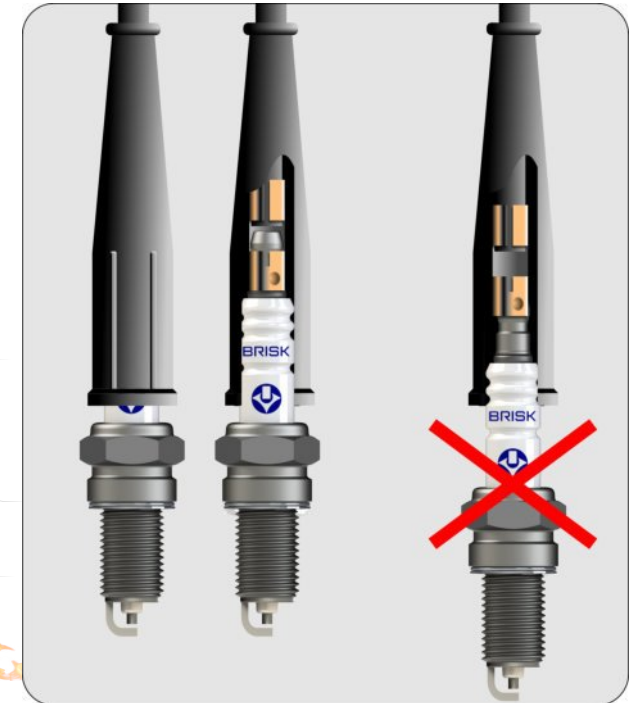
PROPER INSTALLATION OF SPARK PLUGS



INSTALLATION



After spark plug installation check out whether the cable boot are proper fixed to the spark plug.



Spark plugs do not require any maintenance during the replacement interval. Certain level of maintenance is, however, required by the vehicle whose part the spark plugs are. All deficiencies caused by an insufficient vehicle maintenance can be reflected on the spark plug. That is why we recommend, within the framework of prevention, to check the spark plugs at least once a year. Their appearance reflects technical conditions of your vehicle.

Spark plugs replacement intervals are specified for a maximum mileage performance of the engine in a good technical condition. Therefore never exceed the replacement intervals prescribed for a given type of spark plugs! Possible spark plug replacement before the interval prescribed will not cause any problem.

Spark plug installation and removing from the cylinder head must be carried out only when the engine has ambient temperature. Removing and installing spark plug while hot can actually cause thread and cylinder head damage.

MODIFY THE ELECTRODE SPACING



Using screwdriver (this operation requires a certain skill). Insert the screwdriver between external and central electrode in the axle of external electrode the way the screwdriver touched only external electrode. Lever the external electrode by several tenths of millimetre over the back of thumb.

