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**LPG LASERLINE**  
The best for the engine.



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**NGK** **NTK**  
SPARK PLUGS TECHNICAL CERAMICS  
NGK SPARK PLUG EUROPE GmbH

Reap the full potential!

500,000

500,000: This was the number of liquefied petroleum gas vehicles in Germany in 2012 – and the trend was rising. Back in 2004, there were only 50,000.

Dramatic: Fuel prices are climbing to dizzying heights. It's no wonder that an increasing number of drivers are discovering liquefied petroleum gas as an alternative – especially as there has also been a noticeable improvement in the network of service stations.

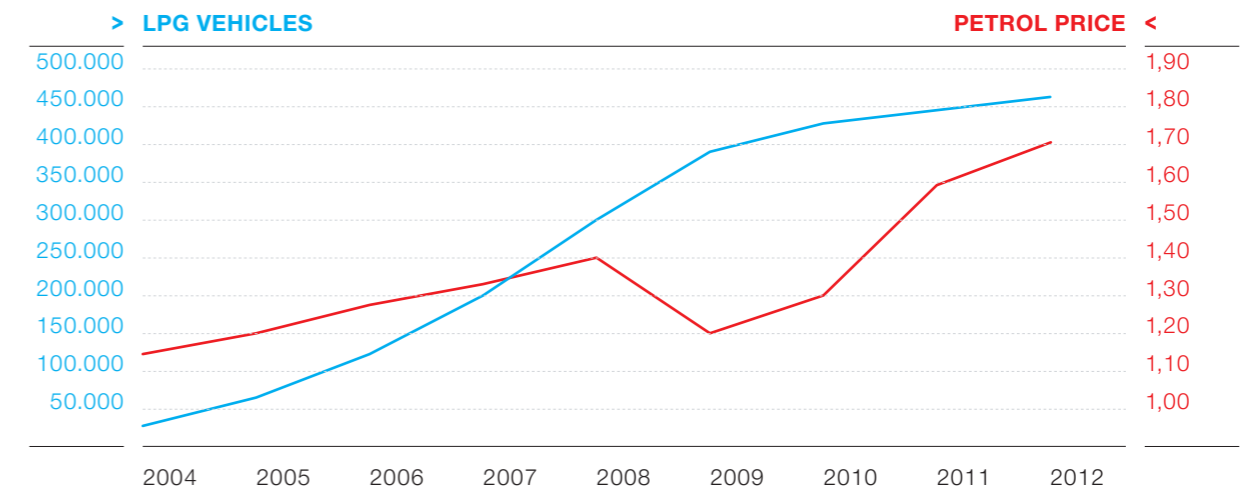


#### LPG LASERLINE SPARK PLUGS FROM NGK

- > Eight double precious metal spark plugs for natural gas and liquefied gas-operated engines
- > Market coverage of around 95 percent, with regard to all conversion-capable vehicles in Europe
- > With the renowned NGK short numbering system for easy identification and reordering
- > Pre-set electrode gap
- > Special anti-corrosion coating

## Petrol prices are constantly on the rise!

Ten years ago, one litre of premium petrol cost 1.05 €. At Easter in 2012, the price rose to a temporary all-time high of 1.70 €. That's a price increase of 60 percent in one decade – and everyone knows that there's no end in sight to the spiralling prices. The development is causing an increasing number of drivers to convert their vehicles to liquefied petroleum gas (LPG). Today, 500,000 vehicles are on the road with an additional liquid gas tank in Germany alone. By 2014, this figure is expected to increase to around 900,000 vehicles.



#### Why LPG LaserLine?

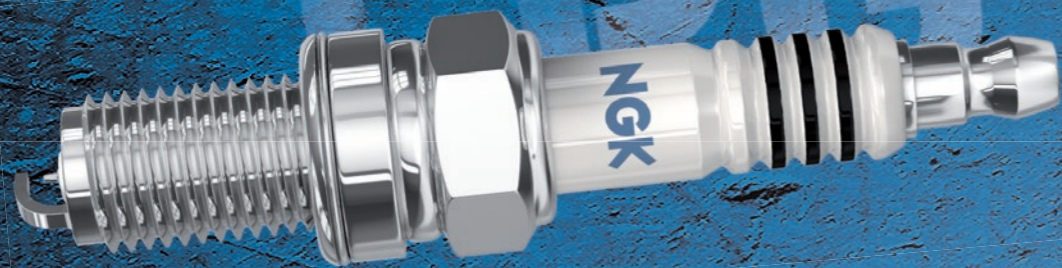
Anyone investing a lot of money in converting their vehicle wants the gas system to run as efficiently and for as long as possible. There is a clear willingness to invest in more expensive spark plugs. With LPG LaserLine, NGK is offering you precisely the right product at precisely the right time.

- > In gas operation, the required ignition voltage increases by up to 5,000 volt – increasing the risk of ignition coil failure. LPG LaserLine spark plugs, on the other hand, work with low ignition voltage and unburden the ignition coils.
- > The temperature load of the spark plug increases considerably with the combustion of LPG. The spark plug must be able to dissipate more heat. LPG LaserLine spark plugs are also ideally prepared for this.
- > Conventional electrode and housing materials corrode very quickly with the combustion of LPG. LPG LaserLine spark plugs have precious metal electrodes which are almost entirely wear-resistant and also possess a special anti-corrosion coating on the housing.

#### Converters to LPG want LPG LaserLine!



LASERLINE



## An assortment like no other

Until now, there was no special spark plug assortment for gas-powered car engines (LPG/CPG) on the market. NGK Spark Plug Europe has filled this gap. With LPG LaserLine, the trade and workshops can now avail themselves of an assortment whose spark plugs have been developed especially for gas operation. For the trade and workshops, this means: Conversion and service are significantly easier and safer.

Anyone who converts his or her car to gas operation can benefit from significantly lower fuel prices throughout Europe due to the lower taxation of gas. The number of conversions is therefore increasing from year to year. The trade and workshops can benefit from this development. Until now, however, there were many factors to be taken into account when selecting the appropriate spark plug – which often led to additional work. Because the combustion of gas is very different to the combustion

of petrol: The gas-air mixture is more difficult to ionise. The required ignition voltage is higher (see graphic) and, with it, the risk of ignition coil failure.

Conventional electrodes and housing materials corrode faster in this environment and the spark plug has to dissipate more heat. Until now, the best solution was considered to be switching from standard spark plugs to precious metal spark plugs with a different heat value and adapting the electrode gap in individual cases. But now there is a better alternative: the special spark plugs from the LPG LaserLine assortment.

The assortment comprises eight special spark plugs and covers more than 95 percent of conversion-capable vehicles in Europe, and in some countries even up to 98 percent. As such, LPG LaserLine offers the ideal spark plug for almost every car which is converted.

## Optimum market coverage

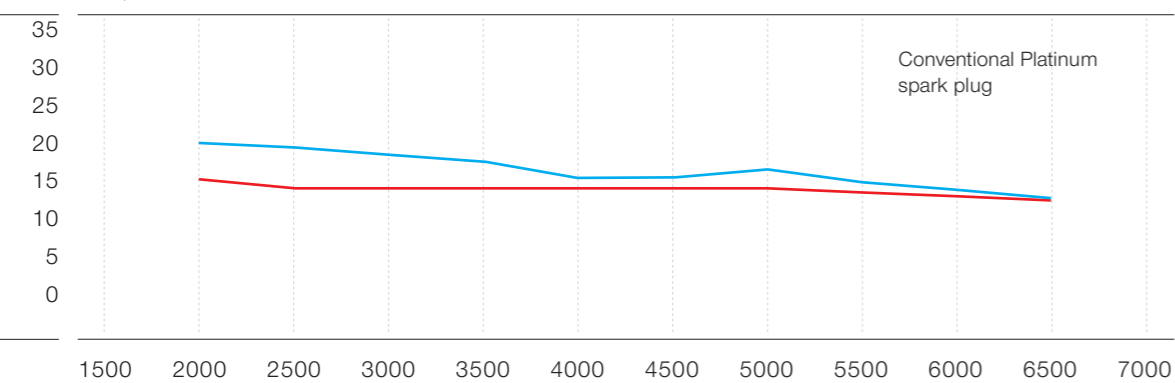
LPG LaserLine – eight special spark plugs for the ignition of gas-air mixtures. For more than 95 percent of all conversion-capable vehicles in the European market.

The table shows you eight examples of application possibilities for LPG LaserLine spark plug types. You can find all applications in the NGK spark plug catalogue 2012/2013, in TecDoc or in the online product finder at [www.ngk.de](http://www.ngk.de).

Application examples		
LPG type	Order No.	Vehicle
LPG LaserLine No. 1	1496	Audi
LPG LaserLine No. 2	1497	Volvo
LPG LaserLine No. 3	1498	Saab
LPG LaserLine No. 4	1511	Ford
LPG LaserLine No. 5	1516	Ford
LPG LaserLine No. 6	1565	VW
LPG LaserLine No. 7	1640	Peugeot
LPG LaserLine No. 8	6806	Fiat



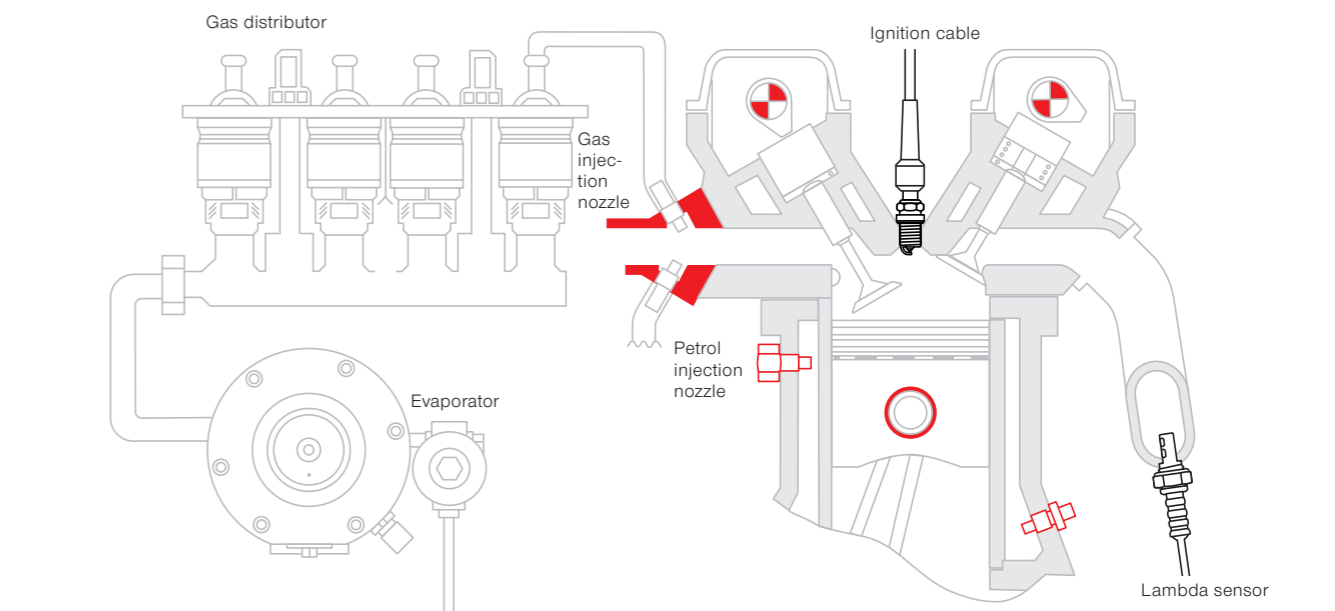
KV\* REQUIRED IGNITION VOLTAGE INCREASES IN GAS OPERATION



ENGINE SPEED (1/MIN.)

\* Required ignition voltage  
 — Premium petrol electrode gap 0.80 mm  
 — Liquefied petroleum gas LPG electrode gap 0.80 mm

### Functioning method of a gas-powered engine



# State-of-the-art technology for gas operation

## 1. High-tech electrodes

LPG LaserLine spark plugs have a centre electrode with Iridium tip and a ground electrode with Platinum chip. These precious metal platelets are incorporated in a complicated process which has been patented by NGK. The centre electrode is even laser-welded. The advantage: The precious metals are far more resistant to the less favourable conditions in gas operation.



The centre electrode with laser-welded Iridium tip and the Platinum chip in the ground electrode ensure the highest level of resistance and ignition reliability – over the entire service life.

## 2. Individual electrode gap

With every LPG LaserLine type, the gap between the centre and ground electrodes has been pre-set to 0.80 mm for gas operation. In most cases, therefore, there is no need for manual adjustment.

## 3. Optimal thermal behaviour

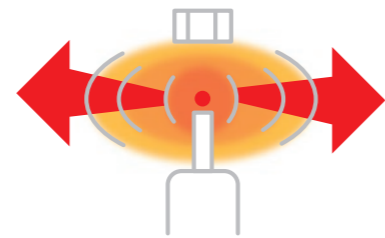
A copper core in the ground electrode of each LPG LaserLine spark plug improves the temperature discharge, thereby helping to optimally regulate the higher temperature level during gas combustion. Design characteristics provide these spark plugs with better protection against sooting.

## 4. Head shield for the housing

The housing of each LPG LaserLine spark plug is covered with a coating made from a special alloy. This protects it from the higher temperatures or the higher risk of corrosion. No other manufacturer on the market currently offers a similar coating.

## 5. Unburdening of the ignition coils

Studies by NGK have proven that in gas operation, the required ignition voltage increases by up to 7,000 volt – a test of stamina for the ignition coils. The Iridium centre electrode of an LPG LaserLine spark plug, which is only 0.6 mm thick, counteracts this. It requires very little ignition voltage. Its shape also promotes the optimal spread of the flame front.



Even spread of flame front. The slim shape of the centre electrode promotes the optimal spread of the flame front towards all sides.

# Comparison list LPG type

LPG LaserLine No. 1			
NGK type	V-Line	Bosch	Beru
BKR5E	35	FR8DC0	14FR-8DU
BKR5E-11	33	FR8DCX	14FR-8DUX
BKR5EK	23	FLR8LDCU	14FLR-8LDUX
BKR5ES	35	FR8DC0	14FR-8DU
BKR5ES-11	33	FR8DCX	14FR-8DUX
BKR5EY			14FR-8KU
BKR5EY-11			
BKR5EYA-11	39		
BKR5EZ	36	FR8KDC	
BKR6E	28	FR7DC	14FR-7DU
BKR6E-11	14	FR7DCX	14FR-7DUX
BKR6EK	20	F8LDCR	14FR-6LDU
BKR6EK	26	FR7LDC	14FR-7LDU
BKR6EKUB		FGR7DQE0	14FGR-6DDU
BKR6EQUA		FGR7KQE0	14FGR-7KQU
BKR6EQUP	30	FGR7DQP	14FR-7DQUP7
BKR6ES	28	FR7DC	14FR-7DU
BKR6ES-11	14	FR7DCX	14FR-7DUX
BKR6EY			14FR-7KU
BKR6EYA			14FR-7KUO
BKR6EYA-11			14FR-7KUOX
BKR6EZ	38	FR7KDC	
BKUR5ET	29	F8KTCR	14FGH-8DTURXO
BKUR5ET-10			
BKUR6ET	27	F7KTCR	14FGH-6DTUR
BKUR6ET-10	24		14FGH-7DTURX
IFR6D10		F7DPP332	14FGH-8DPURX2
PFR5R-11		FR8DPP33	14FGH-8DPURX2
PFR6N-11		FR7KPP33U	14FR-7DPUX02
PFR6Q	37	F6KPP332S	14F-7DPUR02

LPG LaserLine No. 2			
NGK type	V-Line	Bosch	Beru
BP5E	8		
BP5ES	8	W8DC	14-8DU
BP5ESZ			14-8DUO
BP5EY			
BP6E	4		
BP6ES	4	W7DC	14-7DU
BP6ESZ	4		
BPR5E	6		
BPR5ES	6	WR8DC	14R-8DU
BPR5ES-11		WR8DCX	14R-8DUX
BPR5EY	9		
BPR5EY-11			
BPR6E	2		
BPR6ES	2	WR7DC	14R-7DU
BPR6ES-11	13	WR7DCX	14R-7DUX
BPR6EY			
BPR6EY-11	10		
BUR5ET	22	W8LTCR	14GH-8DTUR
BUR5ET-10	21		
BUR6ET	1	W7LTCR	14GH-7DTUR

LPG LaserLine No. 3			
NGK type	V-Line	Bosch	Beru
BCP5E	16		
BCP5ES	16	F8DC	14F-8DU
BCP6E	17		
BCP6ES	17	F7DC	14F-7DU
BCP6ES-11		F7DCX	
BCPR5E	32		
BCPR5ES	32	F8DCOR	14FR-8DU
BCPR5ES-11			14FR-8DUX
BCPR5EY			

LPG LaserLine No. 3			
NGK type	V-Line	Bosch	Beru
BCPR6E	12	FR2LS	14FR-6DU
BCPR6E-11	11	FR7DCX	14FR-6DUX
BCPR6ES	12	FR2LS	14FR-6DU
BCPR6ES-11	11	FR7DCX	14FR-6DUX
BCPR6EY			
BCPR6EY-11			

LPG LaserLine No. 4			
NGK type	V-Line	Bosch	Beru
PTR5A-13	25	HR8MEV	14KR-8MUV
TR5A-10			

LPG LaserLine No. 5			
NGK type	V-Line	Bosch	Beru
BP6EF	5		
BP6EFS	5	H6DC	14K-6DU
BPR6EF	7		
BPR6EFS	7	HR6DC	14KR-6DU
PTR5D10	31	HR7DCX	14KR-7DUX
PTR6D-13			
PTR6F-13		HR7DPP22	14KR-6DPUV02
TR5			
TR55			14KR-8DPUOV
TR5IX			

LPG LaserLine No. 6			
NGK type	V-Line	Bosch	Beru
PZFR5D-11	34	FR7HPP222	14F-7HPURX2
PZFR6F		FR7KPP33U	
PZFR6F-11			
PZFR6J-11		FR7HPP222U	
ZFR5F		FQR8LEU2	14F-8LUR
ZFR5F-11		FR8LCX	
ZFR5P-G		FR7HE2	14F-7HUR2
ZFR6F-11		FR7LCX	

LPG LaserLine No. 7			
NGK type	V-Line	Bosch	Beru
LFR5A-11			
LFR5AP-11			
LFR5B		FR8ME	14FR-8NQU23
LFR6B			14FR-7MU2
PLFR5A-11		FGR8MQPE	14FR-8MPUX02
PLFR6A-11			

LPG LaserLine No. 8			
NGK type	V-Line	Bosch	Beru
DCPR7E-N		YR7DE	12FR-6DU
		YR7DC+	
		YR6KI332S	
DCPR7E-N-10		YR6KI332S	12FR-6DU
		YR6KI332S	
DCPR8E		YR7DC+	12FR-5DU
		YR6KI332S	
DCPR8E-N		YR7DC+	12FR-5DU
		YR6KI332S	
ZKR7A-10		YR6KI332S	12FR-6LUX
DCPR8EKC		YR7DC+	12FR-5DU
		YR6KI332S	
		YR5LDE	



## Comparison list NGK > NGK

NGK type	V-Line	LPG No.
BCP5E	16	LPG3
BCP5ES	16	LPG3
BCP6E	17	LPG3
BCP6ES	17	LPG3
BCP6ES-11		LPG3
BCPR5E	32	LPG3
BCPR5ES	32	LPG3
BCPR5ES-11		LPG3
BCPR5EY		LPG3
BCPR6E	12	LPG3
BCPR6E-11	11	LPG3
BCPR6ES	12	LPG3
BCPR6ES-11	11	LPG3
BCPR6EY		LPG3
BCPR6EY-11		LPG3
BKR5E	35	LPG1
BKR5E-11	33	LPG1
BKR5EK	23	LPG1
BKR5ES	35	LPG1
BKR5ES-11	33	LPG1
BKR5EY		LPG1
BKR5EY-11		LPG1
BKR5EYA-11	39	LPG1
BKR5EZ	36	LPG1
BKR6E	28	LPG1
BKR6E-11	14	LPG1
BKR6EK	20	LPG1
BKR6EK	26	LPG1
BKR6EKUB		LPG1
BKR6EQUA		LPG1
BKR6EQUA	30	LPG1
BKR6ES	28	LPG1
BKR6ES-11	14	LPG1
BKR6EY		LPG1
BKR6EYA		LPG1
BKR6EYA-11		LPG1
BKR6EZ	38	LPG1
BKUR5ET	29	LPG1
BKUR5ET-10		LPG1
BKUR6ET	27	LPG1
BKUR6ET-10	24	LPG1
BP5E	8	LPG2
BP5ES	8	LPG2
BP5ESZ		LPG2
BP5EY		LPG2
BP6E	4	LPG2
BP6EF	5	LPG5
BP6EFS	5	LPG5

NGK type	V-Line	LPG No.
BP6ES	4	LPG2
BP6ESZ	4	LPG2
BPR5E	6	LPG2
BPR5ES	6	LPG2
BPR5ES-11		LPG2
BPR5EY	9	LPG2
BPR5EY-11		LPG2
BPR6E	2	LPG2
BPR6EF	7	LPG5
BPR6EFS	7	LPG5
BPR6ES	2	LPG2
BPR6ES-11	13	LPG2
BPR6EY		LPG2
BPR6EY-11	10	LPG2
BUR5ET	22	LPG2
BUR5ET-10	21	LPG2
BUR6ET	1	LPG2
DCPR7E-N		LPG8
DCPR7E-N-10		LPG8
DCPR8E		LPG8
DCPR8E-N		LPG8
DCPR8EKC		LPG8
IFR6D10		LPG1
LFR5A-11		LPG7
LFR5AP-11		LPG7
LFR5B		LPG7
LFR6B		LPG7
PFR5R-11		LPG1
PFR6N-11		LPG1
PFR6Q	37	LPG1
PLFR5A-11		LPG7
PLFR6A-11		LPG7
PTR5A-13	25	LPG4
PTR5D10	31	LPG5
PTR6D-13		LPG5
PTR6F-13		LPG5
PZFR5D-11	34	LPG6
PZFR6F		LPG6
PZFR6F-11		LPG6
PZFR6J-11		LPG6
TR5		LPG5
TR55		LPG5
TR5A-10		LPG4
TR5IX		LPG5
ZKR7A-10		LPG8
ZFR5F		LPG6
ZFR5F-11		LPG6
ZFR5P-G		LPG6
ZFR6F-11		LPG6



## Comparison list Bosch > NGK

Bosch	LPG No.
F6KPP332S	LPG1
F7DC	LPG3
F7DCX	LPG3
F7DPP332	LPG1
F7KTCR	LPG1
F8DC	LPG3
F8DCOR	LPG3
F8KTCR	LPG1
F8LDCR	LPG1
FGR7DQE0	LPG1
FGR7DQP	LPG1
FGR7KQE0	LPG1
FGR8MQPE	LPG7
FLR8LDCU	LPG1
FQR8LEU2	LPG6
FR2LS	LPG3
FR2LS	LPG3
FR7DC	LPG1
FR7DC	LPG1
FR7DCX	LPG1
FR7DCX	LPG1
FR7DCX	LPG3
FR7DCX	LPG3
FR7HE2	LPG6
FR7HPP222	LPG6
FR7HPP222U	LPG6
FR7KDC	LPG1
FR7KPP33U	LPG1
FR7KPP33U	LPG6
FR7LCX	LPG6
FR7LDC	LPG1
FR8DC0	LPG1
FR8DC0	LPG1
FR8DCX	LPG1
FR8DCX	LPG1
FR8DPP33	LPG1
FR8KDC	LPG1
FR8LCX	LPG6
FR8ME	LPG7
H6DC	LPG5
HR6DC	LPG5
HR7DCX	LPG5
HR7DPP22	LPG5
HR8MEV	LPG4
W7DC	LPG2
W7LTCR	LPG2
W8DC	LPG2
W8LTCR	LPG2
WR7DC	LPG2
WR7DCX	LPG2
WR8DC	LPG2
WR8DCX	LPG2
YR5LDE	LPG8
YR6KI332S	LPG8
YR7DC+	LPG8
YR7DE	LPG8

Beru	LPG No.
12FR-5DU	LPG8
12FR-6DU	LPG8
12FR-6LUX	LPG8
14-7DU	LPG2
14-8DU	LPG2
14-8DUO	LPG2
14F-7DPUR02	LPG1
14F-7DU	LPG3
14F-7HPURX2	LPG6
14F-7HUR2	LPG6
14F-8DU	LPG3
14F-8LUR	LPG6
14FGH-6DTUR	LPG1
14FGH-7DTURX	LPG1
14FGH-8DPURX2	LPG1
14FGH-8DPURX2	LPG1
14FGH-8DTURXO	LPG1
14FGR-6DDU	LPG1
14FGR-7KQU	LPG1
14FLR-8LDUX	LPG1
14FR-6DU	LPG3
14FR-6DU	LPG3
14FR-6DUX	LPG3
14FR-6DUX	LPG3
14FR-6DUX	LPG3
14FR-6LDU	LPG1
14FR-7DPUX02	LPG1
14FR-7DQUP7	LPG1
14FR-7DU	LPG1
14FR-7DU	LPG1
14FR-7DUX	LPG1
14FR-7DUX	LPG1
14FR-7KU	LPG1
14FR-7KUO	LPG1
14FR-7KUOX	LPG1
14FR-7LDU	LPG1
14FR-7MU2	LPG7
14FR-8DU	LPG1
14FR-8DU	LPG1
14FR-8DU	LPG3
14FR-8DUX	LPG1
14FR-8DUX	LPG1
14FR-8DUX	LPG3
14FR-8KU	LPG1
14FR-8MPUX02	LPG7
14FR-8NQU23	LPG7
14GH-7DTUR	LPG2
14GH-8DTUR	LPG2
14K-6DU	LPG5
14KR-6DPUV02	LPG5
14KR-6DU	LPG5
14KR-7DUX	LPG5
14KR-8DPUOV	LPG5
14KR-8MUV	LPG4
14R-7DU	LPG2
14R-7DUX	LPG2
14R-8DU	LPG2
14R-8DUX	LPG2





## For perfect ignition – the best from a single source

The trade and workshops now only need one supplier to cover the entire ignition process: NGK. NGK supplies you with products for the entire ignition process from a single source: spark plugs, ignition coils and ignition cables in the

kind of quality that can only be offered by a leading supplier to the automobile manufacturers! For the ultimate quality, practicality and true added-value for the trade and workshops

## Ignition coils – the technology in brief

As part of the ignition system, the task of the ignition coils is to provide the high voltage required to generate the ignition spark. To do this, they transform the output voltage – usually 12 volt – to up to 45,000 volt.

Inside each ignition coil – regardless of whether it's a „traditional“ cylinder ignition coil, an ignition coil with distributor or ignition coil without distributor – there are two coils of copper wire and a laminated iron core. The copper wire is insulated to prevent short circuiting. The battery current flows through the outer primary coil via the low voltage connection generates a magnetic field which is again amplified by the iron core. If the flow of electricity is interrupted, the magnetic field collapses and triggers a high voltage pulse in the secondary coil. This pulse travels to the spark plugs via the high voltage connection.

But how is a high voltage pulse generated from 12 volt? The answer: The secondary coil is wound with finer wire and

thus has significantly more turns than the primary coil. The turns ratio is between 1:150 and 1:200. Furthermore, the level of the output voltage is dependent on

- > the strength of the magnetic field
- > the speed at which the magnetic field collapses
- > the thickness of the secondary coil
- > the coil loading time



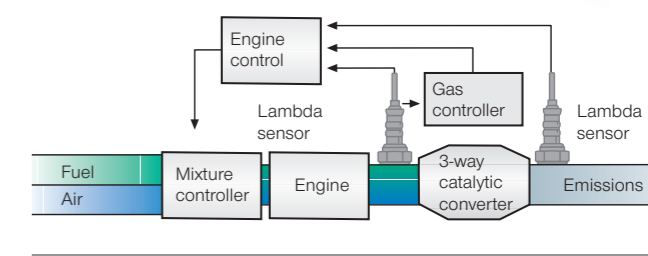
## Lambda sensors – the basis for clean operation

Since the 1980s, regulated catalytic converters have been used in cars with petrol engines in order to convert pollutants into environmentally-friendly gasses as effectively as possible. To do this, the engine requires at least one Lambda sensor in front of the catalytic converter – a regulating sensor. Modern vehicles also have a diagnostic sensor behind the catalytic converter. The regulating sensor supports the engine control with the stoichiometric mixture. Because with this mixture (14.7 kg air to 1 kg fuel), the engine works efficiently and the 3-way catalytic converter can convert the created nitrogen oxide (NOX), hydrocarbon (HC) and carbon monoxide (CO) almost entirely. The diagnostic sensor serves to monitor the entire system.

In vehicles which have been converted for gas operation, it is necessary to convert the Lambda signal. In order to guarantee that the engine runs perfectly, the Lambda signal is adapted for gas operation in a special controller. Generally speaking therefore, the function of the Lambda sensor should be checked. An outdated or sluggish sensor can cause problems when the engine is running.



Functioning method of the Lambda sensor



## Ignition leads – perfect functioning

Ignition leads and their contacts to the spark plug can corrode with increasing age, resulting in an increase in their electrical resistance. In bivalent operation, however, the spark plug is dependent on optimal operating conditions. The ignition voltage must reach the connection nut of the spark plug without dropping. For this reason, the ignition leads must be examined carefully. They must not show any signs of wear and all connections must fit perfectly. Some manufacturers of conversion kits even recommend replacing the ignition leads in any case.

With a market coverage of around 95 percent, the NGK assortment offers a perfectly tuned set of leads for almost every engine. Every detail is just right – from the length of the cable to the connections. In this way, problem-free fitting and removal as well as the highest level of quality in operation are always guaranteed.

