2.5
Valve seat inserts

Since usage of aluminium cylinder heads, valve seat inserts have significantly gained in importance. Together with the valves they seal off the combustion chamber of the cylinder head. The valve seat insert prevents the impact/burying of the valve into the cylinder head. It absorbs a proportion of the combustion heat with which the valve is charged. The valve seat insert gives off this heat to the cylinder head. To meet the different strains, an optimum material composition of the valve seat inserts must be found. Not only must the operating conditions in the engine be considered, but also the machinability of the material for the engine reconditioner.

Materials
In the most recent engine generations of renowned car manufacturers, valve seat inserts made of sintered material (powder metallurgical procedure) are used.
The increasingly high, thermal strain of the seat insert in the combustion chamber can hardly be met anymore by materials from conventional casting processes.

For this reason, Motorservice offers sintered valve seat inserts amongst others from three different material combinations, which covers the entire application range of future engines.

Sintered metal seat inserts:

HM series semi finished
(high machinability)
This material combination is characterised by its excellent machinability. The sintered HM valve seat insert has a composition of tungsten carbide precisely adapted to the strain, embedded in alloy steel.
This way, so far impossible combinations of material properties like high hardness and very good machinability can be combined. Furthermore, the HM series has good wear resistance and good heat resistance. The HM series was developed for naturally aspirated and turbocharged engines from the bottom to top performance segment.

HT series semi finished
(high temperature resistance)
This material combination is characterised by its high wear resistance, which also withstands extremely high temperatures. The sintered HT valve seat insert corresponds to ceramic tool steel made of tungsten carbide, with respectively adapted, high temperature resistant additives embedded into its matrix. Due to the high quantity of firmly embedded lubricants, these inserts are particularly suited to powerful, highly charged and highly stressed petrol and Diesel engines. Despite the high strain of these engines, “micro welding” of the valve seat insert with the valve is prevented. The operational area of the HT valve seat insert includes particularly highly stressed engines.

HT+ series semi finished
(high temperature and high wear resistance - very high temperature and wear resistance)
This material combination is characterised by its very high wear resistance, which also withstands extremely high temperatures. The material composition of the HT+ valve seat inserts is designed for medium strain of the cutting material and simplified machining despite increased wear resistance. The combination of the ceramic tool steel made of tungsten carbide and the very high quantity of firmly embedded lubricants is particularly suited to dry combustion, which occurs during use in gas engines like LPG, CNG, propane gas and flex fuel. Another usage for powerful petrol and Diesel engines is also possible for example. Furthermore, the HT+ valve seat insert has excellent thermal conductivity, and despite the high strain of these engines, “micro welding” of the valve seat insert with the valve is prevented.

Cast iron seat inserts:

G1 series finished
(highly heat resistant)
The G1 series consists of a highly heat resistant grey cast iron alloy with the additives chromium and molybdenum.
The G1 series has been developed for a large application area and is mainly used for utility vehicles.
This valve seat insert has a composition of annealed martensite precisely adapted to the strain, with a distinct carbide network. This valve seat insert thus has good wear resistance and is highly heat resistant.

G2 series finished
(highly wear resistant)
The G2 series consists of a highly wear resistant grey cast iron alloy with a high proportion of the additives molybdenum and vanadium.
This material combination is characterised by its high wear resistance, which also withstands very high temperatures.
It is a high-alloy material with a distinctive, closed network of composite or special carbides respectively in a martensitic matrix and evenly distributed proportions of solid lubricant.
This material was developed fro dry fuels like CNG, LPG and Flex Fuel.

Overview

	HM (High Machinability)	HT (High Temperature Resistance)	HT+ (High Temperature Resistance)	G1 (High Temperature Resistance)	G2 (Highly wear-resistant)
Fuel type/ combustion	Petrol (unleaded), Diesel	Petrol (unleaded), Diesel	Petrol (unleaded), Diesel, CNG, LPG, propane gas, flex fuel	Petrol (unleaded), Diesel	CNG, LPG, flex fuel, petrol (unleaded), Diesel
Cylinder head materials	Aluminium, grey cast iron	Aluminium, grey cast iron	Aluminium, grey cast iron	Aluminium, grey cast iron	Aluminium, grey cast iron
Engines	Low-power petrol and Diesel engines with low to normal strain	Powerful, highly charged and highly stressed petrol and Diesel engines	Used in gas engines like LPG, CNG, propane gas, flex fuel, powerful petrol and Diesel engines	Naturally aspirated engines, turbocharged engines	Highly strained engines, performance-enhanced engines, all above mentioned gas engines

Caution!

Extreme operating conditions as well as high strains of the respective engine must be taken into consideration and are the responsibility of the engine repairer.

The selection of the specification of engine parts must be carefully checked by the engine repairer.

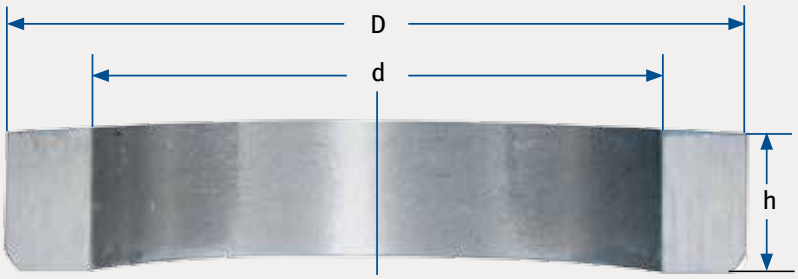
Installation instructions

KS/TRW valve seat inserts are machined and finished on the external diameter. The dimension for the locating hole in the cylinder head can be determined based on the following overlap table. For the sintered metal seat inserts, the valve seat angle must be machined after insertion. The cast iron seat inserts are finished.

Insert the sintered metal valve seat inserts

Make sure that the seat insert to be inserted is always attached with the radius side downwards.

Due to the radius and the “spring effect”, the KS sintered metal valve seat insert does not require liquid nitrogen for cooling down the seat inserts and no heating up of the cylinder head to press in the valve seat inserts into the cylinder head. The seat inserts are driven in cold with a respective tool.



Main dimensions of a valve seat insert
D = external diameter
d = internal diameter
h = height

Note:

Replacing valve seat inserts and valves within the scope of the gas conversion always represents an interference with the original engine specifications. Whether the new material combinations harmonise and the desired results are achieved under the changed conditions can only be estimated in advance. Extreme operating conditions and the specific engine strains must be taken into consideration. These are the sole responsibility of the engine modifier.

Attention:

Heed valve specifications when performing conversion work.

KS/TRW recommends the following overlaps/press fittings

Outer diameter valve seat insert		Cast iron cylinder head		Aluminium cylinder head	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
20–30	0.7874–1.1811	0.06	0.0024	0.08	0.0031
30–40	1.1811–1.5748	0.08	0.0031	0.10	0.0040
40–50	1.5748–1.9685	0.10	0.0040	0.12	0.0047
50–60	1.9685–2.3622	0.12	0.0047	0.14	0.0055
60–70	2.3622–2.7559	0.14	0.0055	0.16	0.0063

To be able to provide you with a complete programme at all times, new types are regularly added to our range. Please get in touch with your KS contact. They will keep you up to date.

The materials of the valves and valve guides are coordinated with each other with the seat inserts and ensure optimum use.

Order information
If you need another dimension not listed here, please get in touch with your KS contact. Every dimension not listed can be produced within 14 weeks on request.

2.6 Camshafts

The camshaft controls the opening and closing of the valves. For each valve usually one cam is required. The shape of the cam determines the valve stroke and a smooth (jolt-free) opening of the valve as much as possible.

Installation instructions
To ensure safe and correct function of the camshaft after installation, the following points are to be observed during installation:

- The camshaft is the main component of the complex valve train system. Camshafts must only be installed by trained personnel. When replacing the camshaft, the specific installation and adjustment instructions of the engine manufacturer are to be observed. Non-observance can result in damage of the new shaft as well as costly consequential damage of the whole engine.
- Before opening the engine, the negative terminal of the starter battery must be clamped to avoid accidental startup of the engine as well as short circuits. Absolute cleanliness must be ensured during the work. Following deinstallation of the old camshafts and the associated parts, the surrounding components, bearing positions and guides are to be checked for perfect condition and intactness. In this context, bent valve push rods, broken valve springs or worn valve stem faces are also to be ruled out. Damaged components are to be replaced or repaired.
- Before installation, the movable parts at the bearing and contact positions must be generously lubricated with the specified engine oil. A torque spanner is always to be used for tightening the screws. The screws must be tightened with the torque specified by the engine manufacturer and in the right order.
- For valve trains with hydraulic valve clearance compensation, the hydraulic elements already filled with oil must be granted enough time for excessive oil to escape. To prevent damage to valves and pistons through mechanical contact, the engine must only be put into operation after an interval of at least 30 minutes following assembly. To check clearance of all components, following the interval and before startup, the engine should be manually turned (without using the starter motor) twice.
- The engine should startup immediately after replacement of the camshaft and build up oil pressure. Longer startup without the engine firing up could result in insufficient oil pressure, dry running of the new camshaft and it being damaged.
- For vehicles with hydraulic valve clearance compensation, there can still be slight ticking or rattling noises from the valve train during the warm-up phase. This is normal operating behaviour and is caused by the hydraulic tappets still needing to fill with oil during operation before correct functioning can be restored. Depending on the engine design, this can last until the normal operating temperature is reached. If the noise does not disappear once the engine has warmed up, the engine must be switched off and the cause must be found and remedied.
- The new camshaft should be granted a certain running-in time. High engine speeds and high loads during the first few operating hours should thus be avoided.
- The remove the metal particles generated during running-in of the camshaft from the oil system, oil change and filter replacement after the camshaft is run in is recommended.