

Automotive Components NZ Limited

GASKETS AND ENGINE PARTS

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AUTOMOTIVE COMPONENTS NZ LIMITED

ACL ENGINE PARTS WARRANTY

All engine parts sold by Automotive Components NZ Limited are guaranteed against faulty workmanship and materials for a period of 12 months or 20,000 Kilometres, whichever occurs first. This warranty is effective from the date of sale by Automotive Components NZ Limited. Should a product found upon examination by an ACL representative to be defective in materials or workmanship and not from a cause beyond the control of ACL including, but not limited to, misuse, improper installation or operation, that product will be replaced by ACL free of charge.

Automotive Components NZ Limited obligations under this warranty shall cease if the supplied part is:

- Used in any performance or modified engine application including but not limited to street, strip, race, drag, and circuit racing.
- Used in any marine or aviation environments.
- Altered and/or modified in any way or form from its supplied dimensions.
- Damaged in any way by abuse, incorrect fitting procedures, operated in an environment not suitable for the requirements of that component, lack of preventive maintenance and/or continued to be operated after the component is known to be defective.

This warranty is in addition and subject to the conditions and warranties prescribed by statute.

Subject to prescribed terms, ACL's obligations for liability for breach of prescribed terms is limited at its option to replacement of the goods or supply of equivalent goods, repair of the goods, payment of the cost of replacing the goods or acquiring equivalent goods or payment of the cost of having the goods repaired.

The above warranty supersedes and excludes all prior and other discussions, representations and arrangements relating to the supply of products including without limitation the suitability or performance of the products or the results expected from using the products.

Subject to prescribed terms and the warranty set out above ACL shall not be liable for any loss, damage or injury of any kind whatsoever (including, without limitation, loss, damage or injury caused by the default or negligence of ACL or its servants or agents and incidental and consequential loss, damage or injury) in any manner wholly or partly arising from or in connection with any order relating to the supply of or otherwise concerning any products including, without limitation to the foregoing, any defect in material design or workmanship of any other defect whatsoever.

ACL RACE SERIES PRODUCTS WARRANTY

ACL "RACE" or "RACE SERIES" branded products are designed for improved performance and durability in engines which have moderate increases in compression ratio and output compared to standard engines. ACL does not provide any implied or express warranty on products used in engines over whose design it has no knowledge or control. Users must accept responsibility for use in non-standard applications including any use in engines used in competition or where exhaust emissions regulations apply. ACL reserves the right to make product changes without notice and without incurring any liability for similar products previously manufactured.

This special warranty prevails over any other ACL warranty for engine parts or products.

MITSUBOSHI BELT WARRANTY

MITSUBOSHI belts are warranted to be free from product defects in materials and workmanship at the point of purchase. The warranty period is 24 months or 40,000 kilometres, whichever occurs first, and shall commence from the date of purchase of the product. This warranty is effective from the date of sale by Automotive Components NZ Limited.

These warranty conditions apply provided the application, installation and maintenance are carried out in accordance with vehicle manufacturer's recommended procedures. Consequential and incidental damages, and damage caused through misapplication, improper installation or service, misuse, and abuse are all excluded under this warranty.

In case of any failure occurrence before the service interval recommendation, all related parts must be available and returned to Automotive Components NZ Limited (ACL) for analysis and investigation to ascertain the exact cause of failure. The liability of ACL is limited only to the replacement of the defective product.

IMPORTANT TIPS ON MONOTORQUE HEAD GASKETS

- Head and block surfaces must be thoroughly cleaned.
- Ensure the head and block surfaces are flat (0.002" longitudinally and transversely).
- Ensure the cylinder head is free from corrosion.
- Follow the manufacturer's recommendations for surface finishes and cylinder head hardness, as a rule of thumb the hardness should be above 65 Brinell.
- Check and clean all bolt holes, waterways and galleries. Unless otherwise stated by the manufacturer use a tap to clean out the threads in the block.
- Ensure head bolts are clean and that the threads are not bent, burred, stretched or damaged.
- Lubricate bolt threads and undersides of every bolt head and washer with a quality thread lubricant, if required use non-hardening sealants on threads.
- Monotorque gaskets are specially treated and NO additional sealants are required except when fitting with an ACL head shim.
- Adhere to torque settings provided with Monotorque gasket sets, using a calibrated torque wrench. If no torque settings are provided with an ACL head gasket, follow manufacturers recommendations.

NOTE:

Monotorque sets contain head gaskets of several material designs including fibre based, graphite based and multi-layered steel (MLS). These gaskets are not required to be re-torqued.

NON MONOTORQUE GASKETS

If the label on the gasket set is marked **Monotorque** then it is not necessary to retension the head gasket, otherwise it is recommended that you re-torque.

DETONATION

IS A MAJOR CAUSE OF HEAD GASKET AND ENGINE COMPONENT FAILURE

WHAT IS DETONATION?

Detonation is an uncontrolled explosion within the cylinder which creates an abnormal rise in pressure and temperature. Components exposed to these excessive temperatures and pressures will suffer damage and fail as a result.

WHAT CAN CAUSE DETONATION?

- Incorrect ignition timing
- Lean mixture
- Overheating
- Heat range of spark plugs too high
- Excessive build up of carbon deposits
- Compression ratio too high
- Fuel octane rating too low

Detonation can be caused by all of the above either individually or in combination and can result in the following damage to engine components.

- Cracked or broken piston skirts, lands and pin bosses
- Eroded or melted piston crowns
- Scuffed piston skirts and damaged cylinder bores
- Broken or damaged compression rings
- Cylinder head gasket failure
- Engine bearing failure

ACHIEVING MAXIMUM TORQUE

Even under ideal conditions, most of the torque applied is lost to friction. **Lubrication is the best way to overcome this friction loss. It is therefore essential that a quality thread lubricant be applied to the bolt/stud threads and washers.** Tests carried out by ACL have proved that up to a 300% gain in clamping load can be achieved by using light lubrication on the bolt thread and under the bolt washer and bolt head.

Conversion Factors

ft lb multiplied by 1.357 = Nm

Nm multiplied by 0.737 = ft lb

TORQUE TO YIELD HEAD BOLTS

LET'S CLARIFY THE ISSUES

There is a lot of controversy about torque to yield head bolts, also known as angle torque or stretch bolts. I would like to clarify some issues regarding these types of bolts in this bulletin.

FIRST SOME HISTORY

Torque to yield (TTY) head bolts are extensively used in modern design engines predominantly for cylinder heads but also main bearing caps, rod bolts, etc. TTY head bolts offer a number of advantages for the engine manufacturer, which include flexibility in cylinder head design as this type of clamping style requires less head bolts and there is also a reduction in component costs. Another advantage for the manufacturer is controlled cylinder head clamping torque.

HOW DO THEY WORK?

When the TTY head bolts are tightened they undergo two main phases. First is the *elastic phase*, which is a state whereby the bolt will stretch under tension but will return to its original dimensions when the axial loading is released. If this loading is increased the bolt will reach its *plastic phase*. The plastic phase is the state whereby the bolt has stretched past its *yield point* and will not return to its original dimensions or state, when the loading is released. If the bolt loading is increased even further the bolt will reach its *shear point* and the bolt material wastes and breaks.

CAN TTY HEAD BOLTS BE REUSED?

Simple and clear, the answer is NO. Due to the very nature of their design these bolts do wear out and cannot be reused. Unlike a conventional bolt the TTY bolts are tightened beyond their yield point into the plastic phase and will not return to their original dimensions when the tension is released. If these types of bolts are to be used a second time or any subsequent times thereafter, the already permanently stretched bolts will stretch even further and rapidly lose clamping load, which could ultimately lead to head gasket failure. The end user will ultimately have to pay for the extra cost of new bolts, but this is a relatively inexpensive form of insurance against head gasket failure.

HOW ARE TTY HEAD BOLTS FITTED?

Torque to yield head bolts require a different torque procedure than a conventional head bolt. These bolts will require a numerical initial torque setting, sometimes called a pre-load, followed by one or more angle settings. Care must be taken that the correct procedure is adhered to and an accurate angle gauge is used to ensure correct and even bolt loading. As with conventional head bolts a good thread and under bolt head lubricant is still important. Lubricants reduce the amount of friction between the fastener and the surface it contacts while being tightened. A quality thread lubricant will convert more of the torque to more usable clamping force instead of having it lost to friction.

IN SUMMARY

ACL recommends NOT to reuse torque to yield head bolts. It is imperative that new bolts are fitted following cylinder head gasket replacement.

SURFACE FINISH OF CYLINDER HEADS

HEAD SURFACE FINISHES

Head surfacing is just one of the jobs usually performed when rebuilding an engine or reconditioning a cylinder head. It is important that the correct surface finish is achieved because not only will it affect the gaskets' ability to cold seal fluids and combustion gases, but also the long term durability. As head gasket design and materials have changed over the years and castings have become lighter and less rigid, the need for smoother, flatter surfaces have become more important.

CAST IRON CYLINDER HEADS

ACL recommends surface finish with a roughness average (Ra) of anywhere from 40 to 100 micro-inches for composite and graphite head gaskets. As long as the surface finish on the cylinder head and block is somewhere between the minimum smoothness and maximum roughness, there should not be any cold sealing or durability problems with the head gasket as long as factory torque specifications are adhered to.

ALUMINIUM CYLINDER HEADS

For aluminium cylinder heads the surface finish becomes more critical as there are different thermal expansion rates in bi-metal engines. The thermal expansion rates between a cast iron block and an aluminium cylinder head creates a tremendous amount of shearing force on the head gasket. If the surface finish is too rough the metal will bite into the gasket and pull it sideways as the cylinder expands and contracts. The cumulative effect over time can cause a de-laminating effect in the gasket, literally tearing it apart. Surface finish recommendations are from 40 to 100 micro-inches Ra.

MULTI-LAYER STEEL (MLS) HEAD GASKETS

This type of laminated steel gasket is extremely durable because the multiple layers of metal prevent the gasket from losing torque due to gasket relaxation. This design also reduces the amount of torque required on the head bolts to seal the gasket, which in turn reduces cylinder bore distortion and blowby. The recommended surface finish for ACL MLS gaskets is 8 to 22 micro-inches Ra.

CYLINDER HEAD/BLOCK DISTORTION

Flatness is an aspect of surface finish that needs to be mentioned, because a cylinder head that is not flat won't seal no matter how smooth it is. Near perfection is required on many of today's engines for a good cold seal. Measure the cylinder head and block faces with a straight edge and a feeler gauge. If the gap exceeds 0.051mm (.002") at any point then have the surface machined.

Hardness of aluminium cylinder heads is one more factor that could affect gasket-sealing performance. Cylinder heads are made in a variety of aluminium alloys and may be either gravity or low pressure die cast. Different heat treatments achieve between 80 & 120 Brinell from factory. As a guide, any used aluminium head which has a hardness lower than 65 Brinell is likely to have been permanently softened by overheating.

ALUMINIUM CYLINDER HEADS

Care should be taken when straightening aluminium cylinder heads. The manufacturers of these components recommend against the practice because of the residual stresses generated and the risk of softening. However, aluminium cylinder heads are expensive to replace and as a result numerous straightening techniques have been developed and are in use in the reconditioning industry.

The following comments are intended to point out that a straightened cylinder head may never be as good as a new one and that the risk of problems developing later, particularly in relation to gasket sealing, are greater.

The process of straightening involves the application of heat, whether in an oven or by flame, and under no circumstances should the temperature be high enough to cause annealing (i.e. permanent softening) of the aluminium alloy.

The aluminium alloys used in cylinder heads will anneal at 662° F (350° C), but considerable softening begins at around 554 - 590° F (290 - 310° C) depending on the alloy and the time that the head is held at that temperature.

When using temperature sensitive crayons, excessive temperatures may be experienced due to the delay in the response of the crayon, or to uneven heating of the head. It is recommended that cylinder heads are not heated beyond 482° F (250° C) when straightening.

If annealing has occurred in an aluminium cylinder head, the material strength is reduced and it becomes more ductile. There could be some permanent thickness change in the areas underneath the head studs or some penetration of the washer into the softened and more ductile head material. This effect will be increased when the engine heats up due to the greater expansion of the aluminium head compared to the steel studs.

Any thickness change which occurs in a softened aluminium cylinder head will reduce the clamping pressure on the gasket. The achievement of correct clamping pressure on the gasket is critical to its performance and any loss could lead to a lack of sealing and failure of the gasket. At this point, it is no use being critical of the gasket, it is the condition of the aluminium cylinder head which caused the failure.

The behaviour of aluminium cylinder heads in an overheating situation will differ, however in either case overheating (whether on the engine or when straightening) will reduce hardness and strength. As a guide, any used aluminium head which has hardness lower than 65 Brinell is likely to have been permanently softened by overheating.

Cylinder heads are made in a variety of aluminium alloys and may be either gravity or low pressure die cast. The heat treatment applied to the casting varies according to the alloy used and results required. It is not possible to generalize on the hardness achieved in manufacture. For example, some aluminium heads are solution heat treated and aged to a hardness of 110 – 120 Brinell, while others are stabilised only (i.e. oven aged) as the removable core is burnt out and these have a hardness of around 80 90 Brinell.

The above implies that anyone straightening an aluminium cylinder head should have equipment for measuring hardness.

REMINDER

- An aluminium alloy cylinder head which has been distorted by overheating in a vehicle may be unfit for further service
- Overheating during straightening causes a permanent change to the material's properties
- Reuse of an aluminium head which has been overheated during straightening may lead to gasket failure

COOLANTS, ETHYLENE GLYCOL AND ENGINE ASSEMBLY

Modern, high quality coolant is an invaluable necessity in any modern engine. The ethylene glycol in the coolant helps to prevent freezing and boiling, and the inhibitor reduces the potential for engine component corrosion.

There are a number of types of corrosion that can affect both the engine and gasket performance. Two of the most common forms within an engine are *general corrosion* and *galvanic corrosion*. *General corrosion* will occur wherever there is metal in contact with both water and air. The form of *galvanic corrosion* is prevalent in modern engines with aluminium cylinder heads. This occurs when there are two or more dissimilar metals in contact with each other or when immersed in a fluid capable of conducting electric charge. This is a faster process than *general corrosion*.

Inhibitors can work in two ways, either by removing oxygen (oxygen and water are needed for corrosion to take place) or by promoting passivity. Passivity is the slowing down of the rate at which metal oxides are released into the cooling fluid.

Many coolants also contain ethylene glycol to help prevent freezing and boiling. However, due to the nature of ethylene glycol, care must be taken when adding coolant to newly assembled motors. The ethylene glycol molecule is a lot more flexible than the water molecule. It is therefore more likely to track into any available crevice, such as scratch grooves made when cleaning or machining marks on the cylinder head or block faces. The machined surface of the cylinder head and block in any motor is made up of a series of peaks and troughs. When a traditional head gasket is fitted to this relatively rough surface, it does not generally fill all these troughs. If ethylene glycol is introduced in the coolant at this point, the ethylene glycol can track along the fibers of the gasket material and cylinder head machine marks. Once a path of leakage is created it is generally irreversible.

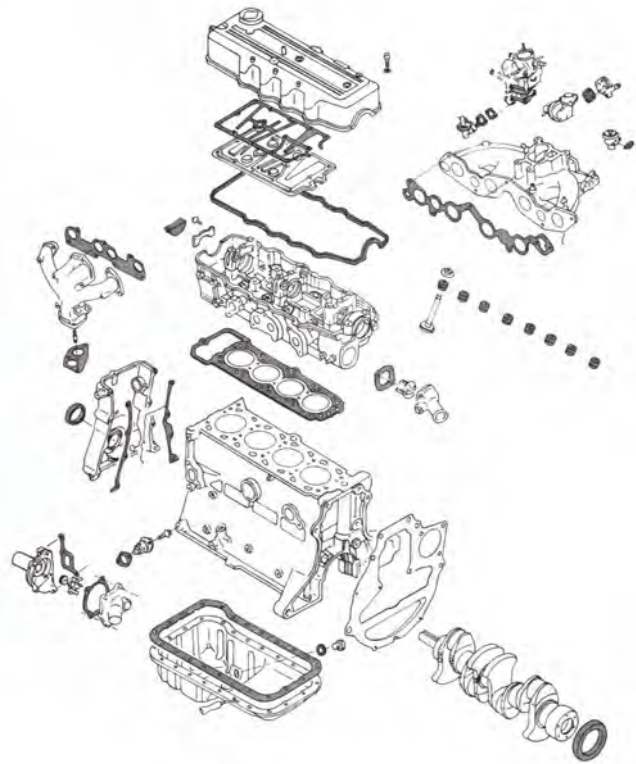
Fortunately, many new generation ACL head gaskets have a special resin coating that creates a cold seal. This cold seal will fill the crevices immediately during gasket assembly. In instances where grooves are too deep for any coating to reach into the very bottom, the coating is designed to flow into any remaining voids the first time the engine gets hot. In this way a complete and effective seal is achieved. The following practice is recommended by ACL:

1. Fill the cooling system with distilled/demineralised water
2. Start the engine, carry out standard engine adjustments/checks, test run vehicle and allow the engine to reach normal operating temperature
3. Stop the engine and allow the engine to cool down, remove the radiator cap safely, drain and add a good quality coolant (including inhibitor) according to the manufacture recommendations.

BASIC GUIDE TO ENGINE PARTS TERMINOLOGY

PRODUCT: GASKETS

WHERE ARE THEY IN THE ENGINE?



WHAT DO THEY DO?

The gaskets in an engine create the seal between static parts.

WHAT ARE THEY?

Gaskets are traditionally made of a soft fibrous material, which is compressed under the assembly loading to conform to the irregularities of the mating surfaces to achieve an effective seal. Gasket material can also be paper, rubber, cork, metal, polymer, graphite or composite.

GASKETS: COMMON TERMINOLOGY

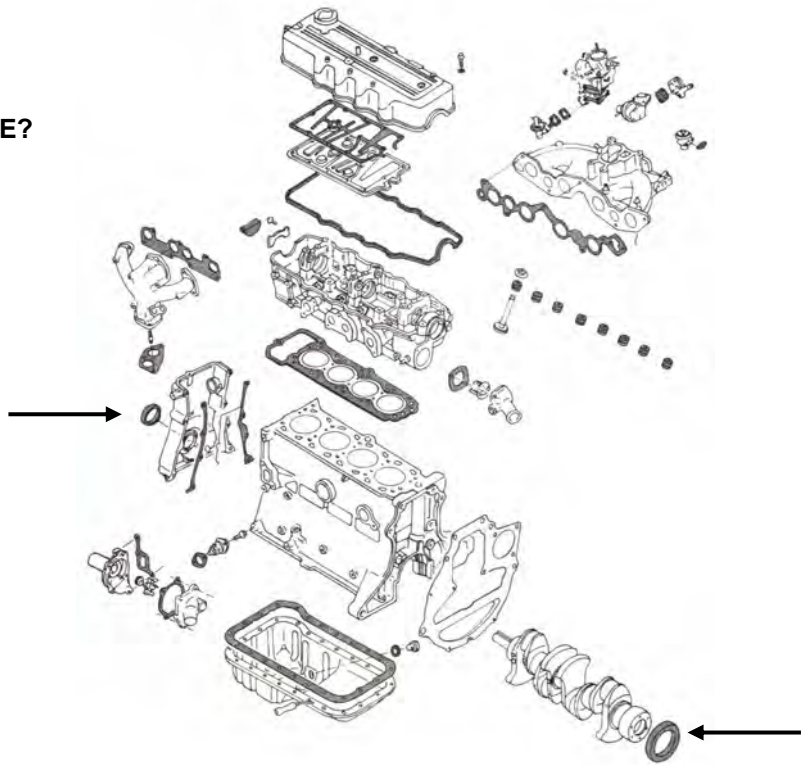
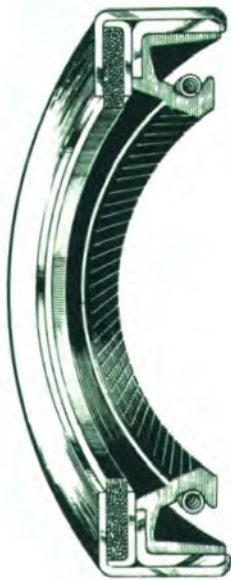
- **Monotorque ®:**
This is a premium brand head gasket, which does not require to be retorqued
- **Multi-layer Steel:**
Gaskets made of layers of steel, sandwiched together. Predominantly used in high heat, high compression or performance applications
- **Silicone Beading:**
Coloured beading on the gasket face to assist sealing by increasing clamping load in that particular area
- **Head Gasket:**
Gasket that seals to the cylinder head to the cylinder block. Usually made of composite or graphite but can also be steel
- **Head Bolt Set:**
One set of cylinder head bolts to repair one engine
- **Head Set:**
Set of gaskets and seals required when performing maintenance to the cylinder head
- **Full Set:**
Set of gaskets and seals required for a complete engine overhaul
- **Conversion Set:**
Set of gaskets that presents the difference between the head set and full set
- **Head Shim:**
A steel spacer to compensate for the loss of material when machining a cylinder head

GASKETS: COMMON TERMINOLOGY continued

- **Intake Manifold Gasket:**
Gasket to seal the intake manifold to the cylinder head
- **Exhaust Manifold Gasket:**
Gasket to seal the exhaust manifold to the cylinder head
- **Plenum Gasket:**
Gasket between intake manifold and plenum chamber on EFI models
- **Flange Gasket:**
Gasket that seals the exhaust pipe flange, manifold and muffler system
- **Turbo Gasket:**
Gaskets to seal the exhaust manifold to the turbo and turbo to drop pipe
- **Rocker Cover Gasket:**
Also called valve cover or tappet cover gasket. Gasket to seal rocker cover to cylinder head
- **Spark Plug Seals:**
Gaskets that seal the sparkplug recess in the rocker cover
- **Rocker Bolt Seals:**
Nitrile washers that seals the rocker cover bolts
- **Sump Gasket:**
Also called a sump set or oil pan gasket. It contains the gaskets required to seal the sump
- **Valve Stem Seals:**
Special oil seals that fit over valve stems
- **Balance Shaft Oil Seal:**
Oil seal that seals the balance shaft in the cylinder block
- **Camshaft Oil Seal:**
Oil seal that seals the camshaft in the cylinder head
- **Rear Main Oils Seal:**
Oil seal that seals the crankshaft in the rear of the cylinder block
- **Oil Pump Seal:**
Oil seal that seals the oil pump shaft in the cylinder block
- **Timing Cover Oil Seal:**
Oil seal that seals the crankshaft in the timing cover housing
- **Timing Seal Kit:**
Set containing all the oil seals that may be required when replacing a timing belt
- **Cam Plug (1/2 Moon):**
Round or half round sealing plug in back of camshaft tunnel on cylinder head
- **Water Pump Gasket:**
Gasket to seal the water pump to cylinder block
- **Thermostat Gasket:**
Gasket to seal thermostat housing to cylinder head

PRODUCT: OIL SEALS

WHERE ARE THEY IN THE ENGINE?



WHAT DO THEY DO?

Oil seals in an engine create the seal between moving parts.

WHAT ARE THEY?

Dynamic oil seals are generally made from a material that has high heat and wear resistance with the ability to conform to a surface. Common materials for dynamic oil seals in use today are Nitriles, Poly-acrylics, Silicones, and Fluoroelastomers (Viton).

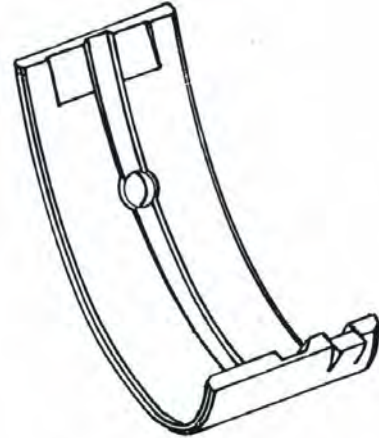
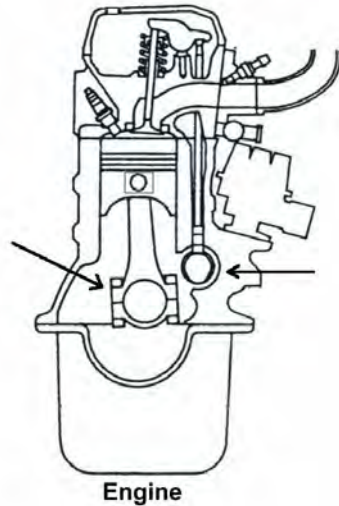
- **Nitrile:**
Common seal material for many O.E. and aftermarket replacement
- **Poly-acrylate:**
Premium seal range used for many cam seals, timing cover seals and oil pump seals
- **Silicone:**
High temperature, high surface speed seal material used as rear main seals
- **Fluoroelastomer:**
Also called Viton®. High temperature and abrasive resistance. Predominantly used in high heat and/or diesel engine applications

OIL SEALS: COMMON TERMINOLOGY

- **Cam Seal:**
Oil seal that seals the camshaft in the cylinder head
- **Timing Cover Seal:**
Oil seal that seals the crankshaft in the timing cover housing
- **Rear Main Seal:**
Oil seal that seals the crankshaft in the cylinder block
- **Balance Shaft Seal:**
Oil seal that seals the balance shaft in the cylinder block
- **Oil Pump Seal:**
Oil seal that seals the oil pump shaft in the cylinder block
- **Timing Seal Kit:**
Set containing all the oil seals that may be required when replacing a timing belt

PRODUCT: BEARINGS

WHERE ARE THEY IN THE ENGINE?



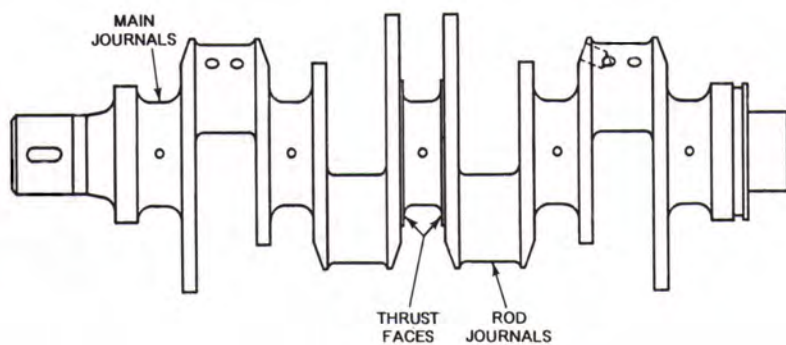
Straight shell bearing

WHAT DO THEY DO?

The main bearings in an engine support and position the crankshaft in the block while providing a suitable surface for its rotary motion. The rod bearings support the connecting rod on the crankshaft journal.

WHAT ARE THEY?

- **Main Bearings:**
Bearings to support and position the main journal of the crankshaft
- **Rod Bearings:**
Also called big end bearings. These support and position the big end journal of the connecting rod
- **Thrust washers:**
Special washers that control the end float of the crankshaft
- **Cam Bearings:**
Bearings that support and position the camshaft
- **Balance Shaft Bearings:**
Bearings that support and position the balance shaft
- **Rod Bushes:**
Bushes that support and position the piston pin in the connecting rod. Also called little end bushes or gudgeon bushes



CRANKSHAFT

BEARINGS: WHAT ARE THEY? continued

Engine bearings are half shell or full circular bearings generally made from a steel backing covered in a suitable overlay material. The bearing overlay can consist of the following materials:

- **Babbitt:**
Whitemetal material used as a bearing overlay suitable for low loading, low performance applications
- **Aluminium-Tin:**
Common material used in many O.E. applications and suitable for medium performance engines. Also called bi-metal bearings or Alutin bearings
- **Copper-Lead:**
Suitable for high performance use due to their high fatigue strength. Also called tri-metal or F780 Duraglide bearings
- **Aluminium-Silicon:**
Similar performance to the copper-lead bearing with the added advantage of not containing lead. The global impact of lead requires car and engine manufactures to look at alternatives to lead based products. Also called Aluglide

BEARINGS: COMMON TERMINOLOGY

- **Bearing Clearance:**
Clearance between the bearings and crankshaft journal
- **RACE H-Series:**
These bearings have special features that will make them withstand increased fatigue loading and therefore much more suitable for high performance use

PART NUMBERS

Part numbers are formed around the base number of the bearing set and contain suffixes and prefixes denoting the properties of the set.

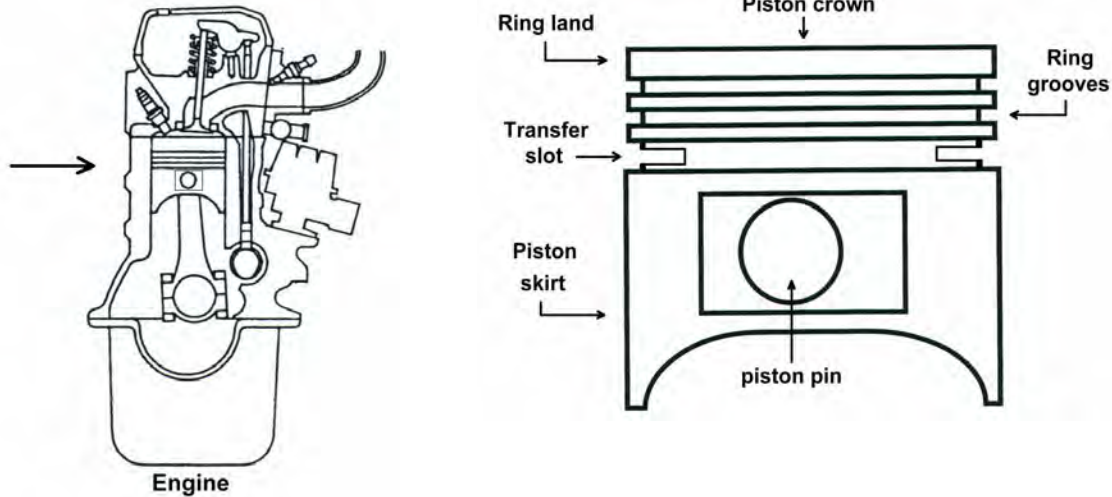
8B2356HX-STD and **8B2356H-010** can be broken down as follows:

8	Kit is for an 8-cylinder engine.
B	Kit contains rod bearings.
2376	Base number of the bearing shells
H	Kit contains H-Series Race shells.
HX	Kit contains bearings that have .001" (1/1000 of an inch) increased clearance over standard
H-001	Kit contains bearings that have .001" (1/1000 of an inch) decreased clearance over standard
010	Bearing undersize. This one is 10/1000 of an inch undersize
M	Mains bearings
C	Cam bearings
BS	Balance shaft bearings
T	Thrust bearing

SIZING	Imperial	Metric
• Bearings are available in either standard size or under size.	001	0.025
• Under size measurements can be either metric or imperial.	010	0.25
• Standard is shortened to STD	020	0.50
• Imperial sizes are written as 001, 010, 020, 030, 040, 060	030	0.75
• Metric sizes are written as .025, 0.25, .50, .75, 1.00, 1.50	040	1.00
• Imperial sizes can be easily converted to metric and metric to imperial.	060	1.50

PRODUCT: PISTONS

WHERE ARE THEY IN THE ENGINE?



WHAT DO THEY DO?

The piston in an engine provides the movable wall of the combustion chamber by which the forces of combustion are transmitted via the connecting rod to the crankshaft of the engine. The characteristics required of the piston are that it be light, strong, wear resistant, a good conductor of heat and also it must carry the piston rings as nearly as possible at right angles to the cylinder bore so that they can seal effectively.

WHAT ARE THEY?

Pistons can be cast or forged and made from Aluminium, Copper and Silicon alloy. Most original equipment (O.E.) pistons are gravity die cast pistons with the exception of a select few. Forged pistons are usually reserved for high performance engines only and have superior strength over their cast counterpart. The cost to produce these is also considerably higher.

PISTONS: COMMON TERMINOLOGY

- **Hypo-eutectic Pistons:**
The composition of Aluminium alloy material containing no more than 12.5% silicon. Most O.E. pistons are hypo-eutectic with silicone content of around 9%
- **Eutectic Pistons:**
The composition of Aluminium alloy material containing maximum silicon (12.5%)
- **Hyper-eutectic Pistons:**
The composition of Aluminium alloy material containing more than 12.5% silicon, sometimes in excess of 18%. Silicon can be present in the Aluminium alloy in free form, which will usually make the piston a lot harder, but also be less ductile.
- **Cast Pistons:**
Gravity cast pistons made with collapsible dies
- **Forged Pistons:**
Forged pistons made from a solid billet and forged into shape
- **Piston Crown Type:**
Pistons can be finished on the crown as dished, domed or flat top depending on the combustion chamber, shape of valve pockets and engine design. Many are dished. Sometimes customers require flat tops in effect to raise the compression ratio

PISTONS: COMMON TERMINOLOGY continued

- **Valve Pockets:**
Cut outs on top of the piston crown to allow for valve clearance
- **Compression Height:**
The distance from the center of the piston pin hole to the top of the piston. This controls the height of the piston in the cylinder bore
- **Ring Grooves and Ring Lands:**
Carry and support the piston rings at right angle to the cylinder bore
- **Transfer Slots:**
Cut out in oil control ring groove that stops combustion heat traveling to the piston skirt to control expansion. Also used to allow oil scraped off the cylinder wall to return to the sump
- **Piston Skirt:**
Skirts on side of piston that guide the piston down the cylinder bore
- **Solid Skirt:**
Piston skirt design that has eliminated transfer slot in the oil groove to improve rigidity and strength
- **Piston Pins:**
Cylindrical pins inside the piston boss that transfer the forces from the piston to the connecting rod. Also called wrist pins or gudgeon pins
- **Circlips:**
Special clips that hold the piston pin in the piston boss

PART NUMBERS

Part numbers are formed around the base number of the piston and contain suffixes and prefixes denoting the properties of the kit.

8MKRY9302SH-040 can be broken down as follows;

8	Kit is for an 8 cylinder engine.
M	Kit contains premium piston rings.
K	Advises that this is assembled as a kit.
RY9302	Base number of the piston and pin
S	PTFE/molybdenum coated piston skirt
H	Kit contains file back compression rings.
040	Piston oversize. This one is 40/1000 of an inch oversize

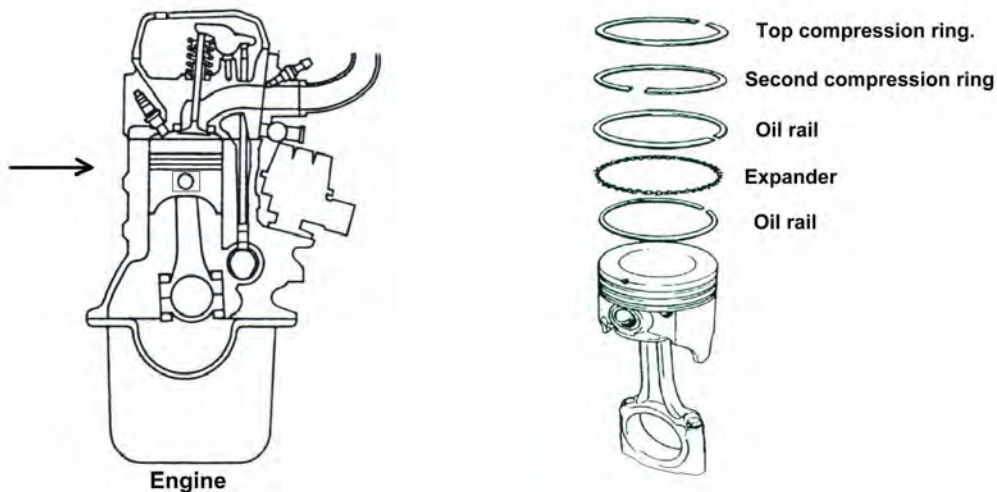
SIZING

- Pistons are available in either standard size or over size.
- Over size measurements can be either metric or imperial.
- Standard is shortened to STD
- Imperial sizes are written as 020, 030, 040, 060
- Metric sizes are written as .50, .75, 1.00, 1.50
- Imperial sizes can be easily converted to metric and metric to imperial.

Imperial	Metric
020	0.50
030	0.75
040	1.00
060	1.50

PRODUCT: PISTONS RINGS

WHERE ARE THEY IN THE ENGINE?



WHAT DO THEY DO?

The piston rings are supported by the pistons and its function includes:

- Prevent the passage of combustion gas from the combustion chamber to the crankcase.
- Prevent the passage of lubricating oil from the crankcase to the combustion chamber.
- To provide a heat transfer path from the piston to the cylinder wall. This heat is the result of the combustion process.

WHAT ARE THEY?

Piston rings are narrow circular rings with an end gap so they can be placed over a piston. These can be cast or ductile iron or made from steel. Ductile iron and steel compression rings have superior strength over their cast counterpart. Commonly there are three rings on each piston. Two compression rings and one oil control assembly. The oil control assembly consists of one expander and two rails.

PISTON RINGS: COMMON TERMINOLOGY

- **Ring Gap:**
Gap left in the piston ring after installation to allow for expansion of the rings due to combustion heat. Also called ring end gap.
- **Moly (Molybdenum) Coated Rings:**
Special insertion of molybdenum on the outer sealing face of the piston ring to enhance sealing properties and resist wear.
- **Chrome Plated Rings:**
Chrome plating on the outer sealing face of the piston ring to enhance sealing properties and resist wear.
- **Chromemoly:**
Chromemoly is a name incorrectly used in describing a premium ring. A ring will either be chrome plated or moly (molybdenum) type, but never both.

PISTON RINGS: COMMON TERMINOLOGY continued

- **Cast Rings:**
Conventional rings are made from grey flake graphite iron which is suitable for a wide range of applications with good resistance to wear where load conditions are moderate.
- **Steel Rings:**
Piston rings made of steel are usually nitrided to be compatible with cast iron cylinder bores. Premium rings for high performance engines, also more common in late model O.E. applications.
- **Ductile Iron:**
High strength Spheroidal Graphite Iron (SGI) ring material that is suitable for high performance use.
- **Proseal:**
Typically a stock replacement ring to suit many standard and medium performance engines.
- **Premium:**
Premium ring sets may contain a higher grade ductile iron or steel rings.
- **File Back:**
Ring set that contains top rings that have zero end gaps on the top compression rings. The engine builder can set the gaps according to their own performance requirements.
- **Keystone Rings:**
Type of top compression ring that has tapered sides. Predominantly used in diesel engine applications.
- **Trapzoidal Rings:**
Type of top compression ring that has taper on top side only. Also called ½ keystone rings. Predominantly used in diesel engine applications.

SIZING

- | | Imperial | Metric |
|--|-----------------|---------------|
| • Piston rings are available in either standard size or over size. | | |
| • Over size measurements can be either metric or imperial. | 020 | 0.50 |
| • Standard is shortened to STD | 030 | 0.75 |
| • Imperial sizes are written as 020, 030, 040 or 060 | 040 | 1.00 |
| • Metric sizes are written as 0.50, 0.75, 1.00 or 1.50 | 060 | 1.50 |
| • Imperial sizes can be easily converted to metric and metric to imperial. | | |

Gasket Application Chart

MAKE	ENGINE	CYL.	CYLINDER HEAD GASKETS		FULL GASKET SETS	
			Proseal MLS	Composite	Composite	Proseal MLS
FORD	200, 250 X Flow Cast Iron	6		AP340GTR	FP340GTR	
	3.3L, 4.1L X Flow Alloy	6		BH100GTR	GH100GTR	
					GH102GTR	
					GN161GTR	
	3.2L, 3.9L, 4.0L EA, EB	6	R&D	BR520GTR	GR520/1GTR	R&D
	4.0L ED- EL Non Intech	6	R&D	BR520GTR	GR522GTR	R&D
	4.0L Intech	6	R&D	BR520GTR	R&D	R&D
	289, 302 Windsor	V8	R&D	BD870GTR	FG971GTR	R&D
	302, 351, 377 Cleveland	V8	R&D	AW980GTR	GC230GTR	R&D
	351 Windsor	V8	R&D	BD870GTR		
GENERAL MOTORS (Chevrolet / Holden / Isuzu)	5.0L EFI Windsor ED On	V8	R&D	BD870GTR	FA5220GTR	R&D
	149, 161, 173, 186, 202 Red Holden	6		AG390GTR	FG392GTR	
	2.85L, 3.3L Blue/Black Holden	6		BH110GTR	FH110GTR	
	253 Red Holden	V8	HG2411GTR	AX130GTR	FX130GTR	FS2411GTR
	253 Blue/Black Holden	V8	HG2411GTR	AX130GTR	FX133GTR	FS2412GTR
	308, 355, 383 Red Holden	V8	HG2403GTR	AX140GTR	FX142GTR	FS2409GTR
	308, 355, 383 Blue/Black Holden	V8	HG2403GTR	AX140GTR	FX143GTR	FS2404GTR
	3.8 Buick Series I	V6		BR720GTR	GR721GTR	
	3.8 Buick Series II	V6		BW940GTR	GW940GTR	
	3.8L VS Ecotec Buick	V6	HG2405GTR-L HG2405GTR-R	BW945GTR-L BW945GTR-R	GW945GTR	FS2407GTR
	3.8L VT On Buick	V6	HG2405GTR-L HG2405GTR-R	BW945GTR-L BW945GTR-R	GZ351GTR	FS2408GTR
	3.8L Supercharged Buick	V6	HG2405GTR-L HG2405GTR-R			FS2405GTR
	4.9L, 5.7L VN On Holden, HSV Engine	V8	HG2403GTR	BS150GTR	GS150GTR	FS2403GTR
	Gen III, LS1 5.7L Up to 2001 Chev	V8	HG2400GTR			FS2400GTR
	Gen III LS1 5.7L From 2001 On Chev	V8	HG2400GTR			FS2401GTR
	G161Z / G180Z Isuzu	4				
	G200Z	4				
	265, 283, 307, 327, 350 Chev	V8 Small Block	R&D	AF830GTR	FP400GTR	R&D
	396, 402, 427, 454 Chev	V8 Big Block	R&D	R&D	R&D	R&D
	400 Chev	V8 Small Block				
MITSUBISHI	4G63-T Galant, Evo I-III, RVR To 1995	4	HG2203GTR			FS2203GTR
	4G63-T Evo IV-VII, RVR 1996 On	4	HG2204GTR			FS2204GTR
NISSAN	CA18DE, CA18DET	4	HG2018GTR			FS2018GTR
	RB20DET	6	HG2019GTR			FS2019GTR
	RB25DET	6	HG2025GTR			FS2025GTR
	RB26DETT	6	HG2026GTR			FS2026GTR
	RB30S, RB30E, RB30ET	6	HG2030GTR			FS2030GTR
	SR20DE, SR20DET Early	4	HG2021GTR			FS2020GTR
	SR20DE, SR20DET Late	4	HG2021GTR			FS2021GTR
	SR20DET, Pulsar GTi-R	4	HG2021GTR			FS2022GTR
	VG30DE, VG30DETT	V6	HG2100GTR			FS2100GTR
SUBARU	EJ20G, EJ20T Up To 1998	H4	HG2120GTR			FS2120GTR
	EJ257, EJ25T, EJ20/EJ25 Hybrid	H4	HG2112GTR			R&D
TOYOTA	2JZ-GE, 2JZ-GTE	6	HG2300GTR			FS2300GTR
	Toyota 1UZFE	V8	HG2305GTR-L HG2305GTR-R			FS2305GTR
	3S-GTE ST185 Celica 1989-1994	4	HG4314GTR			FS4314GTR
	3S-GTE MR2	4	HG4314GTR			FS4315GTR
	4AGE Early Series	4	HG2306GTR			FS2306GTR
	4AGE Late Series	4	HG2306GTR			FS2308GTR
	4AGE 20V	4	HG2306GTR			R&D
	4AGE Supercharged	4	HG2306GTR			FS2307GTR

R&D indicates Product in Development

Engine Bearings Application Chart

APPLICATION	ROD BEARING SET	SIZES	MAIN BEARING SET	SIZES	CAM BEARING SET / THRUSTWASHER SET / PISTON PIN BUSH	SIZE
Alfa Romeo 1570cc, 1779cc, 1962cc Alfetta, Giulia, Giulietta, Spider, GT	4B1110H	Std, .25	5M1112H	Std, .25		
BMW M40B16, M40B18, M42B18, M43B16, M43B18, M43B19, M44B19 (1.6, 1.8, 1.9L) 316, 318, Z3	4B1490H	Std, .025, .25, .50	5M1538H	Std, .025, .25, .50		
	4B1490HX	Std	5M1538HX	Std		
BMW M20B20, M20B25, M20B27, M50B20, M50B25, M50B27, M52B20, M52B25, M52B28, M54B22, M54B25, M54B30	6B1490H	Std, .025, .25, .50	7M1532H	Std, .025, .25, .50		
	6B1490HX	Std	7M1532HX	Std		
Custom Performance (1.889" journal, 0.792" wide)	8B1663H	Std, 001, 010				
	8B1663HX	Std				
Custom Performance (1.889" journal, 0.896" wide w/ dowel)	8B1665HD	Std, 001				
	8B1665HDX	Std				
Chev 262, 267, 302, 305, 307, 327, 350 ci V8	8B663H	Std, 001, 009, 010, 011, 020	5M909H	Std, 001, 009, 010, 011, 020	5C3349C	Std
	8B663HX	Std	5M909HX	Std	5C3346C (housing bores constant at 1.999/2.001" (50.775/50.825mm))	Std
	8B663HD	Std, 001, 010			5C004AS (+0.010" OD, hsg bore 2.029/2.031" (51.537/51.587mm), customer to drill oil holes)	Std
	8B663HDX	Std			5C004BS (+0.020" OD, hsg bore 2.039/2.041" (51.791/51.841mm), customer to drill oil holes)	Std
Chev 265, 283, 327 ci V8	8B745H	Std, 001, 010	5M429H	Std, 001, 010	5C3349C	Std
	8B745HX	Std	5M429HX	Std	5C3346C (housing bores constant at 1.999/2.001" (50.775/50.825mm))	Std
	8B745HD	Std, 001, 010			5C004AS (+0.010" OD, hsg bore 2.029/2.031" (51.537/51.587mm), customer to drill oil holes)	Std
	8B745HDX	Std			5C004BS (+0.020" OD, hsg bore 2.039/2.041" (51.791/51.841mm), customer to drill oil holes)	Std
Chev 294 (4.8L), 325 (5.3L) 346 (5.7L) Gen III, 365 (6.0L) Vortec	8B663H	Std, 001, 009, 010, 011, 020	5M7297H	Std, 001, 010, 020	5C1000S (1st design 1997-2003)	Std
	8B663HX	Std	5M7297HX	Std	5C1001S (2nd design 2003-on)	Std
	8B663HD	Std, 001, 010				
	8B663HDX	Std				
Chev 400 ci V8	8B663H	Std, 001, 009, 010, 011, 020	5M1038H	Std, 001, 010	5C3349C	Std
	8B663HX	Std	5M1038HX	Std	5C3346C (housing bores constant at 1.999/2.001" (50.775/50.825mm))	Std
	8B663HD	Std, 001, 010			5C004AS (+0.010" OD, hsg bore 2.029/2.031" (51.537/51.587mm), customer to drill oil holes)	Std
	8B663HDX	Std			5C004BS (+0.020" OD, hsg bore 2.039/2.041" (51.791/51.841mm), customer to drill oil holes)	Std
Chev 366, 396, 402, 427 454 ci V8	8B743H	Std, 001, 009, 010, 011, 020	5M829H	Std, 001, 009, 010, 011, 020	5C615S (1965-66)	Std
	8B743HX	Std	5M829HX	Std	5C616S (1967 on)	Std
	8B743HD	Std, 001, 010				
	8B743HDX	Std				
Chrysler 273, 318 ci V8	8B481H	Std, 001, 010	5M540P**	Std, 10, 20, 30, 40	5C875S (was part # 5C4636)	Std
	8B481HX	Std				
Chrysler 318 ci LA / Magnum V8	8B481H	Std, 001, 010	5M1344P**	Std, 01, 10, 20, 30, 40	5C875S (1974-79)	Std
	8B481HX	Std			5C1112S (1980 on)	Std
Chrysler 345 ci (5.7L) Hemi	8B1808H	Std, .025, .25	5M2220H	Std, .025, .25	1T611S	Std
	8B1808HX	Std	5M2220HX	Std		
Chrysler 360 ci V8	8B481H	Std, 001, 010	5M1051P** (1971-73)	Std, 10, 20, 30, 40	5C875S (1971-79)	Std
	8B481HX	Std	5M1266P** (1974 on)	Std, 01, 10, 20, 30	5C1112S (1980 on)	Std
Chrysler 350, 361, 383, 400 ci V8	8B527HD	Std, 010	5M876P**	Std, 10, 20, 30, 40	5C876S	Std
	8B527HDX	Std				
Chrysler 413, 440 ci V8	8B527HD	Std, 010	5M1277P** (1974-80)	Std, 10, 20, 30	5C876S	Std
	8B527HDX	Std	5M877P** (1959-73)	Std, 10, 20, 30, 40		
Ford BDA, BDB, BDC, BDD etc.	4B1060H	Std, 001, 010, 020	5M2152H	Std, 001, 010, 020	1T2152	Std, +005
	4B1060HX	Std	5M2152HX	Std		
Ford Cosworth 2.0L	4B2166H	Std, .25, .50	5M2167H	Std, .25, .50	2T2167	Std, +005
	4B2166HX	Std	5M2167HX	Std		
Ford 2300 Stroker (Ford USA)	1B2280H	Std, 01, 10, 20	5M1117H	Std, 01, 10, 20	4C777S	Std
	1B2280HX	Std	5M1117HX	Std	4C777BS	Std
			5M1743H	Std, 01, 10, 20	2C1095S (Aux.)	Std
			5M1743HX	Std		
Ford 200ci, 250ci Non X Flow 3.2L, 3.3L, 3.9L, 4.0L, 4.1L X Flow Inline 6 (Ford Australia)	6B2150H	Std, 001, 010, 020	7M2158H	Std, 001, 010, 020	4C5826	Std
	6B2150HX	Std	7M2158HX	Std		
Ford 4.0L Inline 6 (AU/BA) (Ford Australia)	6B2150H	Std, 001, 010, 020	7M2092H	Std, 001, 010, 020		
	6B2150HX	Std	7M2092HX	Std		

** indicates Duraglide 780 material
HX - 0.001" extra clearance on standard journal
HD - Bearing has dowel hole location

PLEASE NOTE:
WE RECOMMEND BEFORE GRINDING YOUR CRANKSHAFT, YOU CHECK WITH YOUR LOCAL DISTRIBUTOR TO ENSURE THE UNDERSIZE REQUIRED IS AVAILABLE

Engine Bearings Application Chart

APPLICATION	ROD BEARING SET	SIZES	MAIN BEARING SET	SIZES	CAM BEARING SET / THRUSTWASHER SET / PISTON PIN BUSH	SIZE
Ford 221, 255, 260, 289, 302 ci Windsor V8	8B634H	Std,001,009,010,011,020	5M590H	Std,001,009,010,011,020	5C1321S	Std
	8B634HX	Std	5M590HX	Std	5C1763S [constant hsg bores at 2.2041"/2.2051" - SVO engines]	Std
	8B634HD	Std,001,010				
	8B634HxD	Std				
Ford 4.6L VIN 6,W,X Windsor SOHC, 5.4L SOHC V8	8B1442H	Std,.025,.25	5M7296H	Std,.025,.25	6C1100A	Std
	8B1442HX	Std	5M7296HX	Std	RB4113	Semi
Ford 4.6L DOHC, 4.6L SOHC 24V V8	8B1442H	Std,.025,.25	5M5647H	Std,.025,.25	6C1201A (late '96 on)	Std
	8B1442HX	Std	5M5647HX	Std	RB4113	Semi
Ford 351 Windsor V8	8B831P**	Std,01,10,20,30,40	5M1432H	Std,001,010	5C1321S	Std
			5M1432HX	Std		
Ford 302/351ci Cleveland V8	8B927H	Std,001,010,020	5M1010H	Std,001,010,020	5C710C (was part # 5C5696)	Std
			5M1010HX	Std	5C1763S [constant hsg bores at 2.2041"/2.2051" - SVO engines]	Std
Ford 377ci Cleveland stroker (using Chev conrods)	8B1227H	Std,01,10	5M1010H	Std,001,010,020	5C710C (was part # 5C5696)	Std
	8B1227HX	Std	5M1010HX	Std	5C1763S [constant hsg bores at 2.2041"/2.2051" - SVO engines]	Std
Ford 429, 460 ci V8	8B818H	Std,001,010	5M1039H	Std,001,010	5C1763S [constant hsg bores at 2.2041"/2.2051" - SVO engines]	Std
			5M1039HX	Std		
Ford/Lotus 1500cc-1600cc Inline 4 OHV & Twin Cam (Elan/Escort/Cortina)	4B603H	Std,001,010,020	5M2152H	Std,001,010,020	10C5808 (Twin Cam)	Std
	4B603HX	Std	5M2152HX	Std	1T2152	Std, +005
Ford / Lotus 1598cc twin cam	4B603H	Std, 001, 010, 020	5M2152H	Std,.025,.25,.50		
	4B603HX	Std				
	4B1060H	Std, 001, 010, 020	5M2152HX	Std		
	4B1060HX	Std				
Ford/Mazda 2.0L (LF) Duratec	4B4390H	Std,.025,.25				
	4B4390HX	Std				
Ford/Mazda 2.3L (L3) Duratec	4B8170H	Std,.025,.25				
	4B8170HX	Std				
GM/Holden/Opel 1.6/1.8/2.0/2.4L Family II engines	4B2322H	Std,.025,.25,.50				
	4B2322HX	Std				
Holden 202ci Inline 6 Red, Blue, Black	6B2380H	Std,001,010,020	7M2398H	Std,001,010,020	4C5116	Std,001
	6B2380HX	Std	7M2398HX	Std		005, 010
Holden 138, 149, 161, 173, 179, 186 ci Inline 6	6B2380H	Std,001,010,020	7M2384H	Std,001,010,020	4C5116	Std,001
	6B2380HX	Std	7M2384HX	Std		005, 010
Holden/Buick 231 ci (3.8L V6) (Universal Main Set to suit all)	6B2306H	Std,001,010,020	4SM2222H	Std,001,010,020	4C5106 (1988-5/95)	Std,010
	6B2306HX (1990 on)	Std	4SM2222HX	Std	4C5108 (5/95 on)	Std,010
Holden 253ci, 4.9L, 308ci, 5.7L V8 Red, Blue, Black	8B2356H	Std,001,010,020	5M2357H	Std,001,010,020	5C5146C	Std,002,010
	8B2356HX	Std	5M2357HX	Std		
Honda A20A4, A20A2, ES, ET 1955cc	4B1946H	Std,.025,.25				
	4B1946HX	Std				
Honda/Acura D16A1/A6, D16Z, D16Y 1590cc Inline 4	4B1956H	Std,.025,.25	5M1957H	Std,.025,.25	1T1957	Std
	4B1956HX	Std	5M1957HX	Std		
Honda/Acura B16A2/B16A3	4B1946H	Std,.025,.25	5M1959H	Std,.025,.25	1T1957	Std
	4B1946HX	Std	5M1959HX	Std		
Honda/Acura B17A1/B18A1/B18B1 1678cc/1834cc Inline 4	4B1946H	Std,.025,.25	5M1959H	Std,.025,.25	1T1957	Std
	4B1946HX	Std	5M1959HX	Std		
Honda/Acura B18C1 /B18C5 VTEC 1797cc Inline 4	4B1925H	Std,.025,.25	5M1959H	Std,.025,.25	1T1957	Std
	4B1925HX	Std	5M1959HX	Std		
Honda B20B/B20Z 1972cc Inline 4	4B1946H	Std,.025,.25	5M1959H	Std,.025,.25	1T1957	Std
	4B1946HX	Std	5M1959HX	Std		
Honda/Acura K20A3 2.0L Inline 4	4B1906H	Std,.025,.25,.50	5M1959H	Std,.025,.25	1T1957	Std
	4B1906HX	Std	5M1959HX	Std		
Honda/Acura K20A2/K24A 2.0L/2.4L Inline 4	4B1972H	Std,.025,.25	5M1959H	Std,.025,.25	1T1957	Std
	4B1972HX	Std	5M1959HX	Std		
Honda F20C / F22C 2.0L/2.2L Inline 4	4B1912H	Std,.025,.25	5M1913H	Std,.025,.25	1T1957	Std
	4B1912HX	Std	5M1913HX	Std		
Honda H22A4 (97-01) 2.2L Inline 4	4B1912H	Std,.025,.25	5M1957H	Std,.025,.25	1T1957	Std
	4B1912HX	Std	5M1957HX	Std		
Honda F23A (1998 on) 2.3L Inline 4	4B1906H	Std,.025,.25,.50	5M1957H	Std,.025,.25		
	4B1906HX	Std	5M1957HX	Std		
Mazda 2.3L (L3) Duratech, Mazda 3,6	4B8170H	Std,.025,.25				
	4B8170HX	Std				
Mazda B6/B6-T, BP/BP-T, ZM, B3, B5, 1.6L, 1.8L Inline 4	4B8351H	Std,.025,.25,.50	5M8353H	Std,.025,.25,.50	1T8353	Std
	4B8351HX	Std	5M8353HX	Std		
Mitsubishi 4G63/4G63T/4G64 (1983-1992)	4B1146H	Std,.025,.25	5M1144H	Std,.025,.25		
	4B1146HX	Std	5M1144HX	Std		
Mitsubishi 4G63/4G63T/4G64 (1992-97 with flange main)	4B1185H	Std,.025,.25	5M1186H	Std,.025,.25		
	4B1185HX	Std	5M1186HX	Std		

Engine Bearings Application Chart

APPLICATION	ROD BEARING SET	SIZES	MAIN BEARING SET	SIZES	CAM BEARING SET / THRUSTWASHER SET / PISTON PIN BUSH	SIZE
Mitsubishi 4G63/4G63T/4G64 (1997 on with T/W)	4B1185H	Std., .025, .25	5M1219H	Std., .025, .25	1T1219	Std
	4B1185HX	Std	5M1219HX	Std		
Mitsubishi 4G91/4G92/4G93 1.5L/1.6L/1.8L Inline 4	4B8036H	Std., .25	5M8037H	Std., .25	1T8037	Std
Mitsubishi 4G94 2.0L Inline 4	4B8050H	Std., .025, .25	5M8037H	Std., .25	1T8037	Std
Mitsubishi 4B11T (EVO X) Lancer Evolution	4B1236H	Std., .025, .25	5M1237H	Std., .025, .25	1T1237	Std
	4B1236HX	Std	5M1237HX	Std		
Nissan CA16DET, CA18ET, CA20ET 1.6L/1.8L/2.0L Inline 4	4B1630H	Std., .025, .25, .50	5M1633H	Std., .025, .25, .50		
	4B1630HX	Std	5M1633HX	Std		
Nissan RB20DET 2.0L Inline 6	6B2630H	Std., .025, .25	7M2394H	Std., .025, .25, .50	RB4074 (DOHC)	
	6B2630HX	Std	7M2394HX	Std	RB4107 (SOHC)	
Nissan RB25DETT 2.5L Inline 6	6B2960H	Std., .025, .25, .50	7M2394H	Std., .025, .25, .50	RB4074	
	6B2960HX	Std	7M2394HX	Std		
Nissan RB26DETT 2.6L Inline 6	6B2960H	Std., .025, .25, .50	7M2428H	Std., .025, .25, .50	RB4074	
	6B2960HX	Std	7M2428HX	Std		
Nissan RB30/RB30ET 3.0L Inline 6	6B2390H	Std., .025, .25, .50	7M2394H	Std., .025, .25, .50	RB4074	
	6B2390HX	Std	7M2394HX	Std		
Nissan SR20DE/DET (non GTiR) 2.0L Inline 4	4B2960H	Std., .025, .25, .50	5M2964H	Std., .025, .25, .50	1T2964	Std
	4B2960HX	Std	5M2964HX	Std		
Nissan SR20DET (GtiR) 2.0L Inline 4	4B2976H	Std., .025, .25	5M2975H	Std., .025, .25	1T2964	Std
	4B2976HX	Std	5M2975HX	Std		
Nissan TB42/TB48 L6 4.2L/4.8L Inline 6	6B2955H	Std., .025, .25				
	6B2955HX	Std				
Nissan VG20-ET 2.0L V6 Turbo			4M2737H	Std., .025, .25		
			4M2737HX	Std		
Nissan VG30DE/VG30DETT VG30E, VG30T, VG33E 3.0L V6	6B2390H	Std., .025, .25, .50	4M2737H	Std., .025, .25, .50		
	6B2390HX	Std	4M2737HX	Std		
Nissan VQ35DE 3.5L V6	6B2640H	Std., .025, .25	4M2633H	Std., .025, .25	2T2633	Std
	6B2640HX	Std	4M2633HX	Std	6RB4128 (set of 6)	
Opel 1.6/1.8/2.0/2.4L Family II	4B2322H	Std., .025, .25, .50				
	4B2322HX	Std				
Peugeot 1905cc (XU9S/XU92C), 1998cc (XU10J4/XU10J4RS) 406	4B7700H	Std., .25				
Peugeot TU5J2/TU5J4/TU5JP 1587cc Inline 4	4B7712H	Std., .30, .50	5M2797H	Std., .30, .50	1T7709	Std, +.10
	4B7712HX	Std	5M2797HX	Std		
Porsche 911/914 (incl. Turbo) 1990cc/2193cc H6	6B2452H	Std., .025, .25				
	6B2452HX	Std				
Renault F7P, F7R 16V 1763cc/1998cc Inline 4	4B7820H	Std., .25, .50	5M7807H	Std., .25, .50	1T7807	Std, +.10
	4B7820HX	Std	5M7807HX	Std		
Subaru EJ20/EJ22/EJ25 (incl. Turbo) 2.0L/2.2L/2.5L H4	4B8296H	Std., .025, .25, .50	5M8297H	Std., .025, .25, .50		
	4B8296HX	Std	5M8297HX	Std		
Subaru EJ20/EJ22/EJ25 (incl. Turbo) 2.0L/2.2L/2.5L H4	4B8320H	Std., .025, .25, .50	5M8309H	Std., .025, .25, .50		
	4B8320HX	Std	5M8309HX	Std		
Suzuki G13A/G13BA/G13K 1.3L Inline 4	4B8336H	Std., .25, .50	5M8337H	Std., .25, .50	1T8337	Std
	4B8336HX	Std	5M8337HX	Std		
Suzuki M16A Liana	4B8440H	Std., .025, .25	5M8443H	Std., .025, .25		
	4B8440HX	Std	5M8443HX	Std		
Toyota 4AGE, 4AGZE 1.6L Inline 4	4B1780H	Std., .025, .25, .50	5M1695H	Std., .025, .25, .50	2T1695	Std
	4B1780HX	Std	5M1695HX	Std		
Toyota 3SGTE 2.0L Inline 4	4B8366H	Std., .025, .25, .50	5M8361H	Std., .025, .25, .50	2T1689	Std
	4B8366HX	Std	5M8361HX	Std		
Toyota 2AZFE 2.4L Inline 4	4B8411H	Std., .025, .25	5M8412H	Std., .025, .25	1T8412	Std
	4B8411HX	Std	5M8412HX	Std		
Toyota/Lexus 2JZGE/2JZGTE 3.0L Inline 6	6B8100H	Std., .025, .25	7M8103H	Std., .025, .25	2T8103	Std
	6B8100HX	Std	7M8103HX	Std		
Toyota/Lexus 1UZFE 4.0L V8	8B8091H	Std., .025, .25, .50	5M8092H	Std., .025, .25, .50	2T8092	Std
	8B8091HX	Std	5M8092HX	Std		
Toyota/Lexus 2UZFE 4.7L V8	8B8091H	Std., .025, .25, .50			2T8092	Std
	8B8091HX	Std				
Toyota 3UZFE Lexus GS430, LS430	8B8091H	Std., .025, .25, .50				
	8B8091HX	Std				
Toyota 1FZFE 4.5L Inline 6	6B7990H	Std., .025, .25	7M7989H	Std., .025, .25		
	6B7990HX	Std	7M7989HX	Std		
VW/Audi 1781cc, 1984cc, 1998cc (incl Turbo) Inline 4	4B1606H	Std., .025, .25, .50	5M1644H	Std., .25, .50	2T1644	Std
	4B1606HX	Std	5M1644HX	Std		

Piston Application Chart

MAKE	ENGINE	CYL	FORGED	SIZES	CAST	SIZES	CAST NOTES
FORD	188	6			6MKRY9410 <i>f</i>	020, 030, 040	Flat top
	200 Non X Flow	6			6MKRY9410 <i>f</i>	020, 030, 040	Flat top
					6MKRY9411 <i>f</i>	020, 030, 040	Bowl
	250 X Flow	6			6MKRY9410 <i>f</i>	020, 030, 040	Flat top
					6MKRY9411 <i>f</i>	020, 030, 040	Bowl
					6MKRY9412	020, 030, 040	Bowl and using 200 conrod
	289	V8			8MKRY9302S	020, 030, 040	
	302 Windsor	V8	8MKRY9722S	030, 040	8MKRY9302S <i>f</i>	020, 030, 040	
	302 Cleveland	V8	8MKRY9730	020, 030, 040	8MKRY9351 <i>f</i>	STD, 020, 030, 040, 060	
	347 Windsor Stroker	V8	8MKRY9720S	030, 040	8MKRY9347S	STD, 020, 030, 040, 060	
			8MKRY9721S	030, 040			
	351 Cleveland	V8	8MKRY9730	020, 030, 040	8MKRY9351 <i>f</i>	STD, 020, 030, 040, 060	Flat crown with valve pockets
			8MKRY9731	020, 030	8MKRY9354 <i>f</i>	030	Bowl and valve pockets
			6" Conrod		8MKRY9356	020, 030	With 6" 302 rods - 3 ring design
	377 Cleveland	V8			8MKRY9377 <i>f</i>	030	Flat top using stroker Chev rods
					8MKRY9379 <i>f</i>	030	Bowl version using Chev rod for small chamber heads
	3.3L X Flow	6			6MKRY9410 <i>f</i>	020, 030, 040	Flat top
					6MKRY9411 <i>f</i>	020, 030, 040	Bowl
	3.9L EA-EB	6			6MKRY9390	STD, 0.5, 1.00	
	4.0L EB-ED	6			6MKRY9400	0.5, 1.00	
	4.0L EF-EL	6			6MKRY9400	0.5, 1.00	
GENERAL MOTORS (Chevrolet / Holden)	4.0L BA Turbo	6	6MKRY9710	STD, 0.5			
	4.0L Intech	6			6MKRY9414S	0.5, 1.00	
	4.1L X Flow	6			6MKRY9410 <i>f</i>	020, 030, 040	Flat top
					6MKRY9411 <i>f</i>	020, 030, 040	Bowl
					6MKRY9412	020, 030, 040	Bowl and using 200 conrod
	5.0L Windsor	V8			8MKRY9302S <i>f</i>	020, 030, 040	
	202 Red	6			6MKRY9096 <i>f</i>	030, 040, 060	Bowl
					6MKRY9118 <i>f</i>	030, 040, 060	Flat top
	202 Blue/Black	6			6MKRY9096 <i>f</i>	030, 040, 060	Bowl
					6MKRY9118 <i>f</i>	030, 040, 060	Flat top
	253 Red	V8			8MKRY9115 <i>f</i>	STD, 020, 030, 040, 060	Flat top
					8MKRY9119 <i>f</i>	020, 030, 040	Flat top high comp
	253 Blue/Black	V8			8MKRY9115 <i>f</i>	STD, 020, 030, 040, 060	Flat top
					8MKRY9119 <i>f</i>	020, 030, 040	Flat top high comp
	308 Red/Blue/Black	V8	8MKRY9700	030, 040	8MKRY9500 <i>f</i>	STD, 020, 030, 040, 060	
	355 Red stroker	V6	8MKRY9701	030, 040	8MKRY9355	030, 040, 060	Round Bowl using Chev conrods
			8MKRY9721S	030, 040			
	3.8L Buick Series I	V6			6MKRY9380	020, 040	
	3.8L Buick Series II	V6			6MKRY9380	020, 040	
	3.8L Ecotec	V6			6MKRY9381	020, 040	
MAZDA	3.8L Supercharged	V6	6MKRY9705	STD, 020			
	5.0L	V8			8MKRY9490	020, 030, 040, 060	
	5.7L stroker (Holden)	V8	8MKRY9702	040	8MKRY9570 <i>f</i>	STD, 020, 030, 040, 060	High comp
					8MKRY9571 <i>f</i>	STD, 020, 030, 040, 060	Low comp
	350 (Chevrolet SB)	V8	8MKRY9750S	030, 040	8MKRY9350 <i>f</i>	020, 030, 040	Flat top with single valve recess
	383 stroker (Holden)	V8	8MKRY9740S	030			
	Gen III 5.7L	V8	8MKRY9752S	010			
NISSAN	BP-T	4	4MKRY9651	STD, 0.5			
MITSUBISHI	4G63-T	4	4MKRY9660	STD, 0.5, 1.00			
	CA18DET	4	4MKRY9607	0.5, 1.00			
	RB20DET	6	6MKRY9609	STD, 0.5, 1.00			
	RB25DET	6	6MKRY9603	STD, 0.5, 1.00			
	RB26DETT	6	6MKRY9604	STD, 0.5, 1.00			
	RB30ET	6	6MKRY9608	0.5, 1.00			
	SR20DET	4	4MKRY9600	STD, 0.5, 1.00			
	VG30DETT	6	6MKRY9602	0.5, 1.00			
SUBARU	EJ20T	4	4MKRY9620	STD, 0.5, 1.00			
			4MKRY9621S	STD, 0.5			
TOYOTA	EJ25T	4	4MKRY9625S	STD, 0.5			
	1UZFE	V8	8MKRY9636	0.50, 1.00			High comp
			8MKRY9637	1.00			Low comp
	3S-GTE	4	4MKRY9630	STD, 0.5			
	4A-GE 20v	4	4MKRY9633	STD, 0.5			Suits silver top engines only
	4AGE, 4AGZE 16v	4	4MKRY9634	STD, 0.5			

f indicates File Back Piston Ring Set also available (Use H suffix)
'S' suffix indicates piston skirt is coated