



4B11 REPORT

□ Engine Component Manufacturer Tomei Powered's Approach

Following the public release of the Mitsubishi EVO X, Tomei Powered immediately acquired and disassembled the 4B11 powerplant to begin research. The first step of this research is extremely important, for it involves familiarizing and discovering the basic characteristics of Mitsubishi's new engine design. Another aspect of this research includes a side by side comparison with its predecessor, the 4G63. This comparison will provide further insight on how this engine is going to be modified and its capabilities.

□ Changes from the Final Version 4G63

The first thing that was noticed about the 4B11 was that the block was made from die cast aluminum, a huge change compared to the cast iron 4G63. The 4G63 was setup to be a long stroke engine, however the 4B11 measured in 86mm for both bore and stroke. Some other major changes included the rocker arm type valve train being replaced with a direct acting unit and the timing belt being replaced with a silent chain setup. The MIVEC feature, which was only available on the intake side on the latest version of the 4G63, was not available on both intake and exhaust on the 4B11. Basically, a wide powerband and emissions friendly setup are the two main characteristics that this engine holds. The silent shafts (balance shafts) were also discontinued in the new setup but the engine still maintained minimal vibration. The intake and exhaust layout were reversed, with the exhaust manifold being closer to the firewall. Other changes include an electric throttle body setup, and the usage of smaller spark plugs because of the larger valve size.

Highly Efficient Cylinder Head Engineered for Low Emissions and Power

- The cylinder design was well calculated with balance in mind, whereas the piston top geometrically matches sound with the combustion chamber design. By looking at the design, it does not resemble the conventional forced induction profile, but looks to be designed to that of a low emissions engine. The intake and exhaust ports have large diameter ports for improved efficiency. The low emissions producing design was also made with the MIVEC feature in mind.



●4B11 INポート



●4B11 EXポート



●4B11 INポート



●4B11 EXポート



●4B11 シリンダーヘッド



●4G63 シリンダーヘッド



●4B11 燃焼室



●4G63 燃焼室

Bearings Adopted onto Exhaust Side Cam Journals

- Several devices equipped on this engine indicate that the engineers at Mitsubishi have particularly emphasized on the oil system design. On the exhaust side #1 cam journal, has been equipped with bearings because it is the furthest from the oil line. This was adopted to increase reliability and decrease friction in this area. Thicker oil lines via cylinder head had also been installed to supply the increased oil amount because of the MIVEC system.



●4B11 EXカムジャーナルメタル

Bigger Valves and Plugs with Decreased Diameter

- 35mm intake and 29mm exhaust valves had been measured. 5.5mm stems measure in that these new valves are definitely larger than that from the 4G63. With these increased factors, the spark plug size was decreased to optimize valve seat and spark plug hole clearance. Compared to an SR unit with the same bore, the intake bigger by 1mm, and the exhaust is smaller by 1mm.



●4G63 プラグ



●4B11 プラグ



●プラグ比較 左-4G63 右-4B11

Exhaust Valve Designed with the Environment in Mind

- The exhaust camshaft was found to have less lift and angle. The objective was to design a system that produced cleaner exhaust gases and good power output with the help of MIVEC. The sodium filled valves had been replaced with standard surface treated units, which were considered for environmental reasons. The exhaust valves may be prone to heat damage since the seat rings and valve guides were not manufactured with copper materials.



●4G63 /バルブ



●4B11 /バルブ



Camshafts with No Rocker Arms

- The rocker arm setup was tossed aside for a direct acting configuration. This new setup means that there are less components needed for operation, allows a compact design, less mechanical trouble, and less friction, which the camshaft lobes benefit the most. The camshaft specs measured in at 254 degrees intake with 9.4mm lift and 224 degrees exhaust with 8.2mm lift. 35mm diameter valve lifters were combined with shims that allow valve clearance adjustment were also discovered. Considering future plans for this area, the lift can be raised to a sufficient height and the valve springs and lifter nose should clear, if the base circle was kept standard.



●4B11 カムシャフト 左-EX 右-IN



●左-EX 右-IN



■INカムシャフト



●EXカムシャフト

Valve Springs

- The lifters, retainers, and valves were noticeably designed with lightweight in mind. The valves have plenty of room from bottoming out but the spring rates are rated fairly low. Therefore in terms of tuning aspects, these might need to be replaced depending on the camshaft profile and lift.



●4G63 バルブスプリング/ロッカーアーム



●4B11 バルブスプリング/リフター

MIVEC on Intake & Exhaust

- The 4B11 was engineered with clean emissions which is friendly towards the environment, while pushing out a significant amount of power. The MIVEC feature (intake and exhaust variable valve timing system) is mainly responsible for this great balance of two opposite features. Eventhough the Evo 9 4G63 was equipped with the variable valve timing on the intake side only, the 4B11 proves to have a great improvements on the low to mid range torque. The MIVEC is controlled with an ordinary vein that partitions 2 different chambers managed with 2 different pressures.



●4G63 VVT



●4G63 VVT/ベーン室



■VVT比較 左-4B11 右-4G63



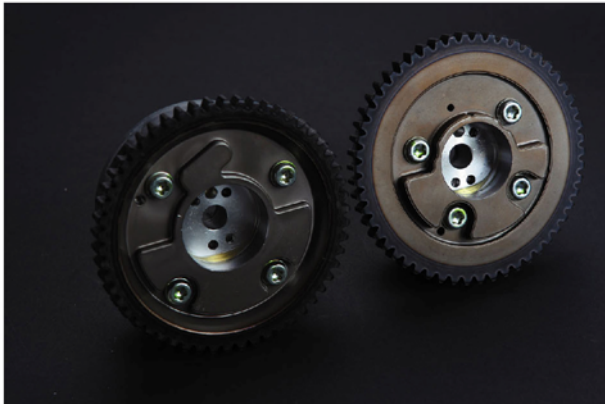
●4B11 VVT



●4B11 VVT/ベーン室

Timing Belt Replaced with Silent Chain

- The 4B11 is powered by a silent chain instead of the traditional timing belt. Chains are beneficial over belts because of friction loss and longevity. The front cover is a single unit, not split into upper and lower, so service and modifications such as head / block resurfacing, head gasket change, compression changes can be more troublesome.



●4B11 スプロケット

Metal Headgasket

- The basic-structured head gasket which is 0.9mm thick, and it is a 5 layer laminated metal type. Since these are not super grommet types, it may not be very trustworthy after modifying other areas of the engine.



●4B11 ヘッドガスケット



●0.9mmメタルリードタイプ/5枚積層

Stretch Type Head Bolt Angle Tightening Method (Torque To Yield Torque Procedure)

- The 1mm length head bolts will be tightened by the torque to yield method used on elastic stretch type bolts). Since the engine has an aluminum block, the bolts are longer with increased torque specs. The washers on the bolts are fixed except for #1, for the ease of service and maintenance.



●4B11 ヘッドボルト

Cylinder Block that Endures High Power Output

- The newly engineered aluminum die cast block features a half skirt design which was incorporated to keep the decrease the overall length of the engine. The bore pitch measured in at 96mm. (SR engine measures at 97mm). The crank caps are equipped with 4 bolts and the 2 structure ribbed oilpan were designed to provide rigidity and strength to the aluminum block. The deck areas are reinforced at the necessary areas and provide plenty of strength and support. The rear section of the 4th cylinder did not receive strengthening which raises concern if the unit will be affected by the transmission. The emphasis on stress dispersion can be seen on the internals of the block. A smooth design (no rough edges) at the blow-by tunnels / oil pan entrance & exits and the connecting portion between the crank journal to the inside of the block shows that this engine is not affected by stress applied.



●4B11 シリンダーブロック



●4G63 シリンダーブロック

4 Bolt Crank Cap Increases Block Strength

- For each journal, 4 bolts clamp down each of the crank caps to increase the block strength and rigidity. This design is widely seen in V- style engines and not much so in inline or straight style engines. 4 bolts provide more strength than the conventional 2 bolt style.



●4B11 クランクキャップ



●4B11 4本留めクランクキャップ



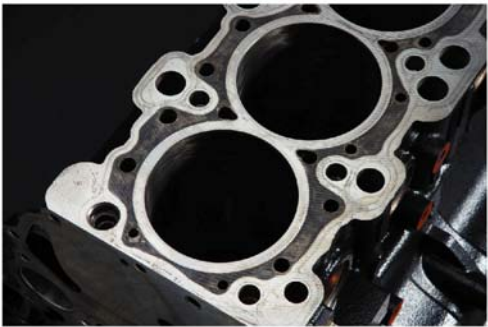
●4G63 クランクキャップ

Semi Closed Deck Design for Longevity and Endurance

- The 4B11 is equipped with a semi closed deck design with cast sleeves which promotes longevity while cooling the engine significantly. The water jacket is designed not to be affected by the bore structure, especially when installing the head bolts.



●4B11 シリンダーブロック



●4G63 シリンダーブロック

A Newly Designed Engine with No Balance Shafts

- The premodern 4G63 was fitted with balance shafts which were used to eliminate vibration. Many modified 4G63 engines have had to have their balance shaft removed because it became a nuisance when tuning an engine. However, it is considered a great setup if vibrations are to be fully eliminated. The new 4B11 does not come equipped with balance shafts. The engine itself is overall, cleverly designed so that the vibrations are non-existent even without the balance shafts.
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Ventilation Openings that Lower Friction

- The 4B11 is fitted with many devices that eliminates friction of the assembly. The ventilation opening on the upper portion of the main journal is one of these. This was adopted straight from race engine designs which is known to fight pump loss. The blow-by gas is efficiently released, lowering friction as a result.



●4B11 メインジャーナル/上部換気口

Baffle Plate that Lowers Blow-by Gas

- The oil pan is in 2 separated pieces, and the upper aluminum oil pan is combined with a baffle plate. 6 oil passes on the each of the intake and exhaust sides on the cylinder head lead to exclusive oil return passages which the oil drops down inside the oil pan. The amount of oil accumulated on the inner crank case and crank shaft is decreased, which benefits lowering the blow-by gases and improving oil pressure. On the 4G63, the level gauge tends to blow out when this engine is modified. The 4B11 already comes with a counter device that prevents the increased pressure of the blow-by gas from doing this type of damage. However this raises an issue of the area where the oil jets from the piston cooling nozzle have the possibility of dropping straight below, or the wide clearance area between the crank weights and the baffle.



●4B11 オイルパン



●オイルパン側/オイルライン



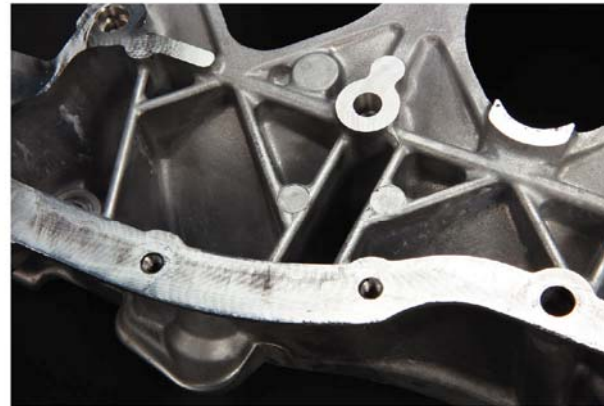
●ブロック側/オイルライン

2 Section Oil Pan and Low Friction Oil Pump

- The upper portion of the oil pan features ribs to keep the structure rigid. The oil pump is positioned at the lower end of the engine assembly, right below the upper oil pan to keep the suction of the pump at a minimal resistance. This setup is ideal during cornering and hard acceleration/deceleration, however if the pan comes in contact with the ground, the immediate oil pressure issues may come about. This gear type oil pump further minimizes friction than the conventional trochoid pumps seen on SR20s.



●4B11 オイルパン



Forged Mahle Pistons for High Power Output

- Forged Mahle pistons equipped with 86mm bore and 23mm pin diameter are equipped in the 4B11. These pistons come with cooling channels which with different number of passages to the oil rings according to the intake and exhaust sides. The new piston pins were switched to a skirt type, full floating unit, replacing the ordinary forced pin oiler on the 4G63. Further inspection of the piston top reveals a rather shallow design suited for a forced induction engine with an almost flat shape. Comparing it to an SR20DET which is also a square 86 x 86 and 8.5 compression configuration, the 4B has a slightly increased compression of 9.0. The top and secondary ring lands come thick in design, and along with the relatively high compression, this engine was made to withstand high horsepower. The piston pin and the rings weigh in at 546.2 grams.



●4G63 ピストン/ピストンピン



●4B11 ピストン/ピストンピン



●4B11 オイルリング給油口/IN側



●4B11 オイルリング給油口/EX側



●4B11 ピストン比較 左-4B11 右-4G63



●ピストン比較 左-4B11 右-4G63



●4B11 ピン径23mmピストンピン



●ピストンピン比較 左-4B11 右-4G63

CONNECTING RODS

- It cannot be denied that once the 4G63 were heavily modified, the stock connecting rods cannot be used with full confidence. On the contrary, the 4B11 rods have beefier qualities with plenty of 'meat' on the unit, with great shoulder design. These rods also show indications of strength in design because of the lack of oil jet and bearing lubrication holes. Details of the connecting rods include M8 1.0 pitch type rod bolts, and the 4G63's dowel pin structure being replaced with a knock pin type. This part was designed with the bolt placement as center as possible. With the larger sized crank pins, the bearing thickness was changed from 21 to 17mm to contribute to less friction. The 4B11 rods are 20 grams lighter at 572.5g versus the 4G63 rods weighing in at 592.0g each. The slope ratio of the piston and connecting rod measures in at 3.34, an advantageous criteria if the engine is going to be considered a 2.4 liter long stroke setup in the future. However, the torque to yield type connecting rod bolts which lack sufficient diameter may be an issue, once engine is modified to pump out more power.



●4G63 コンロッド



●4B11 コンロッド



●コンロッド比較 左-4B11 右-4G63



●コンロッド小径部 左-4B11 右-4G63



●コンロッド大径部 左-4B11 右-4G63



●4B11 コンロッドボルト



Compact Design Crankshaft

- The fully countered crankshaft has a 52mm main and crank pin areas, which is skinnier than the 4G63's main pin but with thicker crank pins. This enables an overall strengthened crankshaft layout. The crank pick up sensor was moved to the rear area of the crankshaft as well. It seems as the flywheel position has been attempted to be relocated to the center of the entire assembly in order to create a more compact engine in terms of longblock height. The oil line that feeds lubrication to the crankshaft journals are not the traditional "H" or "X" pattern, but a one of a kind design from Mitsubishi, presumably to supply plenty of oil to the bearings during high RPM. The concept of excessive oil supply related to extreme centrifugal force has been well balanced in this area. The crankshaft weighs in at 16.6kg.



●4G63 クランクシャフト



●4B11クランクシャフト



●4B11クランクジャーナル/給油口



Turbocharger Matched For 2.0 Liters on the Brink of Completion

- The EVO 9 was fitted with a TD05H166C-10.5T turbocharger, whereas the 4B11 comes equipped with a TD05H152G6-12T turbine. The new turbo has gone back to the traditional spinning rotation from EVO 9's reversed scroll setup. Although the 4B11 turbo handles more volume, its characteristics can be described as building boost from the low RPM region with the lower trim impellor size. The impellor itself is made from aluminum, with a titanium aluminum turbine wheel, good for 360 horsepower. The turbo charger relative to the 2.0 liter setup feels like a modified setup that is on its last tuning stages. As an option, an inconel turbine wheel is available for higher loads.



●EVO IX タービン



●EVO IX タービン/EX機



●EVO X タービン



●EVO X タービン/EX機



Rear Facing Exhaust Manifold Layout

- The reversed intake layout puts the exhaust side towards the rear of the vehicle. The manifold is designed for the traditional twin scroll type and is made from stainless steel, weighing in at 6.45kg. The same unit from the final version of the 4G63 weighs in at 6.8kg. The front pipe never extends across the oil pan, minimizing oil temperature problems.



●4G63 EX マニホールド



●4B11EX マニホールド



Big Capacity Outlet Pipe

- The outlet pipe is constructed in a bigger capacity to yield the combination of the exhaust gas coming from the turbo and the bypass gas coming from the swing valve. The 57mm outlet weighing in at 3.3kg seems as though it is a high quality aftermarket product.



●EVO IX アウトレット



●EVO X アウトレット

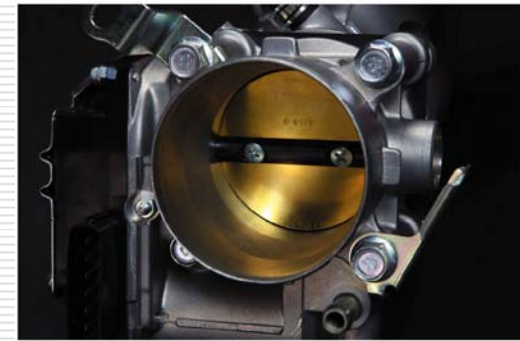


Electric Throttle Enabled Surge Tank

- The 60mm throttle body diameter remains unchanged, however the capacity of the surgetank was increased along with a design that emphasized in consistent and efficient air distribution to each cylinder. However, its unfortunate that since the intake manifold faces the front of the car, the collector portion was designed to be positioned lower, like the SR20s seen in S13s. The electric throttle system should raise problems for the aftermarket tuning industry as well.

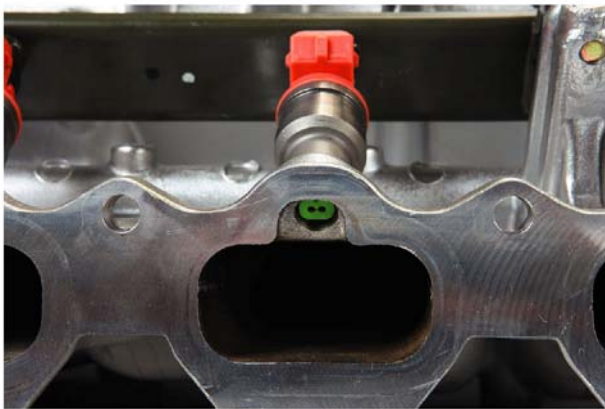


●4G63 サージタンク

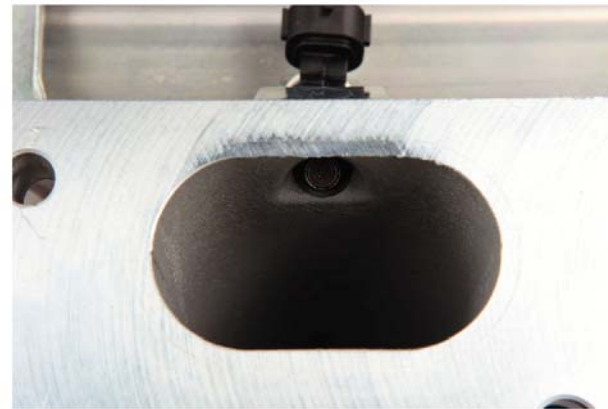


High Resistance Injectors

- High resistance Bosch injectors with 540cc/min(3.0kg/m³) were found in this engine. The exterior looks identical to that from the VQ, but with an extended nozzle. These injectors do not protrude inside the ports, for a decreased intake air resistance. A wide angle of injection can be set.



●4G63 インジェクター



●4B11 インジェクター

4B11 in Comparison

- The overall synopsis of the disassembly of the 4B11 revealed that this is a completely different engine from the 4G63. We found lots of dimensions to be similar to the SR20 engine. Originally, the vertically laid out 4G63 is an old design, which was improved gradually until its final model equipped in the EVO IX. The final 4G63 pushed out 280hp/6500rpm and 41.5kg-m/3000rpm of torque. The 4B11 was designed with this final model in mind, and on top of that more performance / efficiency features were added along with a low emissions characteristic. The 4B11 pushes 280PS/6500rpm as well, and an increased torque output of 43.0kg-m/3500rpm which still complies to the recent Japanese emissions standards. The overall length of the vehicle was tightened down with the side horizontally mounted engine setup, with such emphasis on a design that battles friction. Although the power output regulations were abolished (Japan), the vehicle was kept at 280ps, but with added increased performance aspects over the Evo IX. With the all above said, the overall engine is generally a engine that follows the trends of the modern conventional engines we see today. What can be stated at this moment, is that the fact that the engine is an aluminum block does not make it any less of an good engine. Many fear that since this is an aluminum engine, it is prone to such problems as engine knock during tuning, burnt pistons, boring of the cylinders (ignoring the sleeve thickness), and resleeving. With Tomei knowledge gained with the 4G63, SR, and EJ engines, the 4B11 is definitely an engine that can be modified for increased performance. Please stay tuned for Tomei Powered products for the 4B11 in 2008.
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