

Maserati 5000 GT Twin Ignition V8 Engine

by Dr.-Ing. Hans Doll

An engine rebuild requiring experience in engine design



Maserati 5000 GT Allemano (SN 103.036), today in 3rd Ownership

The Maserati 5000 GT V8 engine is supposed to be derived from the race engine of the Maserati 450S. This is widely thought by motoring journalists.

Indeed, a superficial comparison of engine properties will reveal some similarities: Both engines have V8 configurations with an angle of 90° between banks and overhead camshafts (DOHC), similar bore/stroke figures, and twin ignition.

However, upon closer inspection, key parameters – like the dimensions of the engine block and the cylinder – suggest that the 5000 engine has to be a new design. The 5000 engine, introduced in 1958/59, is much more compact than the 450 S engine. Nevertheless, experience gained from the 450 S engine certainly influenced not only the design of the new engine but of many engine generations to follow, the more compact dimensions of the 5000 engine were kept the same from the QuattroPorte 1 (QP1), the Mexico, then the Ghibli until the last QP3 from 1989.

The distance between cylinders of the 5000 engine and its successors always stayed at 104 mm and bank offset at 20 mm. By contrast, the 450S engine had a much larger cylinder distance of 120 mm and bank offset 24 mm. Overall, the

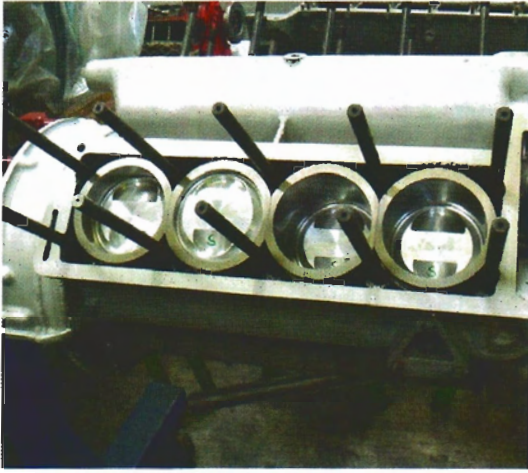


450 S engine, including all peripherals like the longitudinally mounted Marelli distributors, was about 30% larger than the 5000 engine. As a result, a 450 S engine block could accommodate larger bores allowing for engine displacements between 4.2 litres and 6.4 litres (i.e. for race boats).

The 5000 engine has a bore of 94 mm and a stroke of 89 mm. The displacement is set to 4.941 litres. Maximum exploitation of the engine block's geometry provides for a theoretical displacement of 5.2 litres. Claims and reports about a possible increase in displacement of a Maserati Ghibli engine to up to more than 6 litres are the results of a fascination with superior power figures and should be banished to the world of Maserati myths.

Some vendors offer prefabricated liners with a bore size of 95 mm or even 96 mm. However, the resulting increase in displacement is a meager 105 cc /150 cc with a possible but marginal increase in power.

The Maserati liners are neither entirely wet liners (as used in Alfa Romeos) nor are they dry liners. The upper quarter (36,0 mm) is directly exposed to the cooling water, whereas the lower section (108,0 mm) is directly shrunk into the aluminum block. This combination of both construction principles results in a rather critical area around the sealing seat in the engine block.

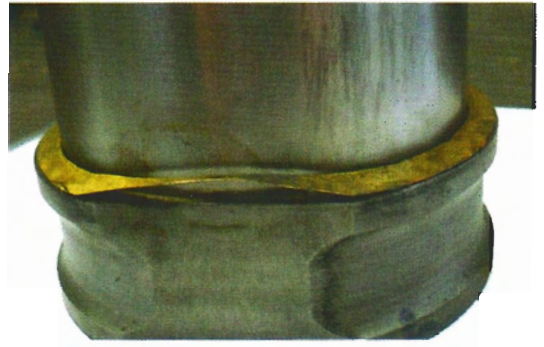


Cylinder sleeves of 5000 GT engine block: deck height machined to 236 mm, Maseratis open deck design creates less stiffness compared to any closed deck design, all bolts threaded new with helicoil inserts for improve strength, the reuse of old aluminum threads of the same size is not at all recommended.

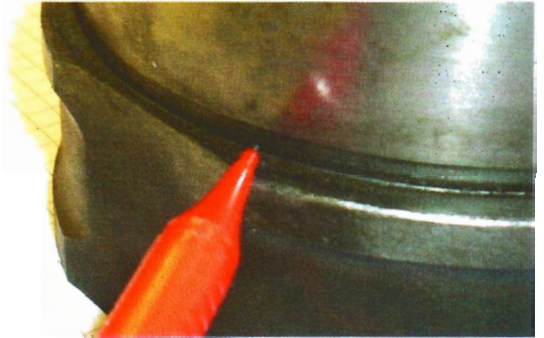
The thermal conductivity and expansion coefficients of aluminum and steel are quite different: e.g., the thermal expansion of aluminium is approx. twice that of steel. This results in warpage on the liner surface, especially in case of wall thicknesses below 3.0 mm.

Even a small warpage of the inner liner surface acts like ski jump to the piston rings. Broken piston rings are a known phenomenon on Ghibli engines and others as well. Enlarging the bore beyond 94 mm results in a weakening of the wall and cannot be recommended.

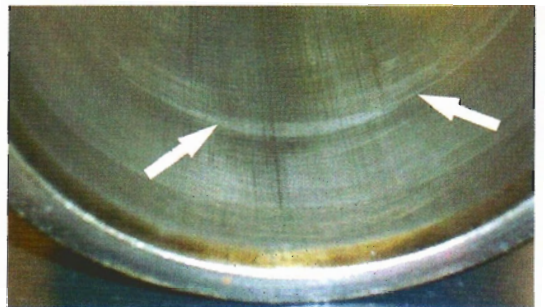
During the rebuilding of these engines, individually matched custom liners are preferable over available prefabricated liners. New liners must be mounted with a relatively large interference. Their tolerances should be individually calculated for each engine block, taking into account the larger bored boss in old engine blocks. This complexity and the resulting tight tolerance requirements are difficult to meet with prefabricated liners and exceed the capabilities of less sophisticated engine shops. Compromise in this area inevitably leads to failure and Humphrey Bogart's famous line: "do it again – Sam"



Sealing seat as found on disassembled engine block. The deck height of the prefabricated sleeve had been adjusted using brass film. This kind of rebuilt engine with 0 km running time would not even survive low rpm break-in driving.



Prefabricated liner with groove and edge, thermal warpage and crack of piston rings are most probable (ideal fillet radius would be 2 mm without groove but is not feasible, therefore any soft radius in accordance to the bevel of the block bore is preferred) Maserati diameter with interference target OD = + 0,02 mm, in contrast here edge with existing OD = - 0,20 mm : insufficient conductivity of heat in the circle zone.



Sleeve after 30 kms use only with greater thermal warpage in height of the sealing seat to the engine block and huge blow-by.



Sleeve showing heavy debris, poor heat conductivity at a critical area, thermal warpage. Reason: Far too large chamfer of the block bore, the function of this sealing area was not recognized/regarded (Bologna, Ghibli Spider 4.9SS).

Until 1975, Maserati power figures were routinely overstated. But then, what did it matter anyway? Who in those days could have verified such power figures (variously stated in Italian CUNA HP, SAE HP or DIN HP)? TUEV-Berlin (technical supervision and safety authority) disposed of its own dyno in 1978.

But what if a Maserati V8 engine is to be rebuilt in accordance to works specifications and when Maserati's overly optimistic power figures become contracted and obligatory?

Every engine rebuilding starts with a thorough evaluation of the condition and wear levels of parts like pistons, bearings and valves. This is followed by the machining of parts to over- or under-sizes and the procurement of replacement parts, all according to the tolerance requirements of the OEM. In the case of the 5000 engine, original Maserati or related spec sheets for the engine were not obtainable. The 5000 engine had prototype character and it is doubtful that 5000 spec sheets ever existed outside the factory walls.

Subsequent versions of this same basic engine (all the way up to the QP3) benefitted from numerous changes and improvements to address

design flaws that had resulted in cracked cranks, warpage of engine blocks, water in oil, and thermal overloads.

The most successful modification to the original 5000 design was the reduction of the bore from 94 mm to 88 mm and the stroke from 89 mm to 86 mm. To achieve the latter, Maserati gradually reduced the machining deck height of the engine block: 5000 block = 235.9 mm, 4,9 l block = 232.9 mm, 4,7 l block = 230.9 mm. The length of the connecting rods remained unchanged at 155.00 mm.

For the QP1 and the early Mexico, these parameters resulted in a displacement of 4.2 litres with an official power figure of 260 hp at 5200 rpm. Max. rpm was limited to 5200 rpm and marked with a red section on the tach. In 1982, TUEV-Berlin tested a Mexico 4,2 and confirmed 208 DIN hp. A very well tuned 1970 Indy 4.2 was tested at 212 DIN hp.

The 4.2 litre engines were very reliable, long-lived and established Maserati's impeccable reputation. With the presentation of the Ghibli 4.9 in 1970/71 the power was increased and Maserati returned to the dimensions for bore and stroke first seen on the 5000 engine.

Gradually problems with water in oil caused by cylinder warpage, and cracked cranks by harmonics became more and more obvious. Even a late QP3 automatic showed a cracked block on 2nd main after german autobahn speeding.

The Maserati V8 was the first V8 engine in full aluminum alloy design. In 1961, Buick also presented a 5 litre V8 aluminum engine. However Buick encountered serious technical problems and, in 1965, Buick sold this development project to Rover in Great Britain. In a bid to improve operational dependability Rover reduced the displacement to 3.5 litres and the power output accordingly. Until the year 1996 all Range Rovers were equipped with these engines.

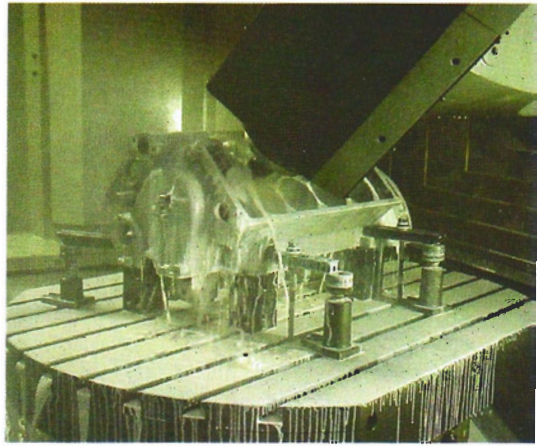
Maserati's own recommendations in the comprehensive QP3 manual and earlier materials for tolerances and bolt tightening torques are 30 years or older. Because of peculiarities of the aluminium used in Maserati's early design, any engine rebuilding of a Maserati V8 today should basically not follow these recommendations. Maserati misguided maintenance main bearing caps with far too small washer sizes for the Ghiblis but had nearly correct washer sizes for the inline six engine bolts of same size and torque. Should you follow the Ghibli spares book for original and genuine replacement if you know better? That simple washer geometry will lead to extensive main bearing tolerances and finally with high rpm to cracked cranks/blocks?

Hello purists, here are the benefits of a 50 cent washer with an OD 25 mm against the Maserati parts book specified OD 22 mm as a hidden trap with another inevitable 30.000 USD overhaul later after break in driving. There are many negative samples the author has experienced but not yet discouraged.

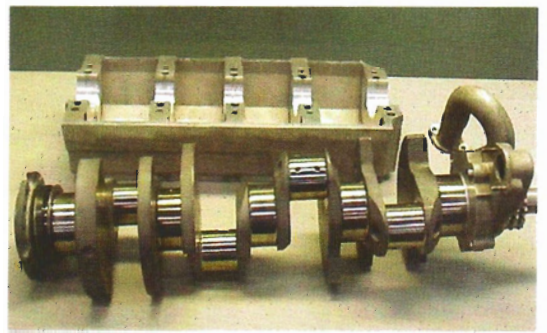
The engine block is made from a still relatively modern Al-Si casting alloy and was subjected to a tempering procedure to improve its mechanical strength.

However, after about 10 years all known aluminum alloys loose up to 30 % of their original strength. This is even true for "new old stock" (NOS) spareparts, that spent their life untouched in storage. A 30-year-old, dry-stored, unused piston from Mahle or Borgo, in its original package will show an almost 30 % loss of strength. What is the purists attitude concerning new pistons and design? By comparison, the more common cast iron blocks even gain a little in strength with age by absorbing nitrogen from the surrounding air and present basically no problems in strength or material structure to the engine builder.

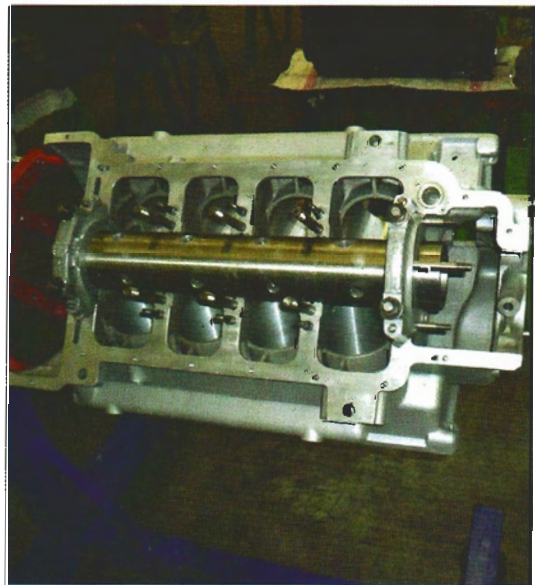
The rebuilding of aluminum engines requires much higher technical skills and more sophisticated methods than gray cast engines.



CNC Workcenter machining all Maserati engine block surfaces in one setup.



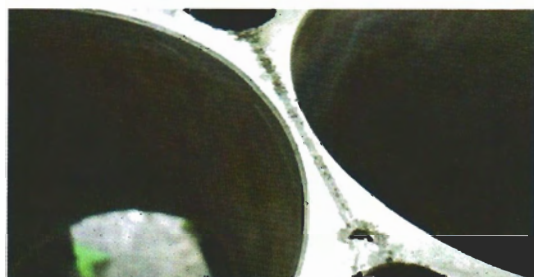
- Integrated Main Bearing Block (IMBB) reinforcing the engine block by 1400 %.
- Maserati crank with redesigned oilpump, triplex chain wheel.
- Crankshaft weight reduced, nitrided, polished and balanced with mallory metal.



- All measurments related to fixed center axis of 90°V cylinder angle.
- Heavy steel rod reinforcing engine block for any warpage while processing.

An oven capable up to 250°C for heating the alloy engine block is necessary as well as liquid nitrogen or dry ice for mounting cast iron liners with larger interference.

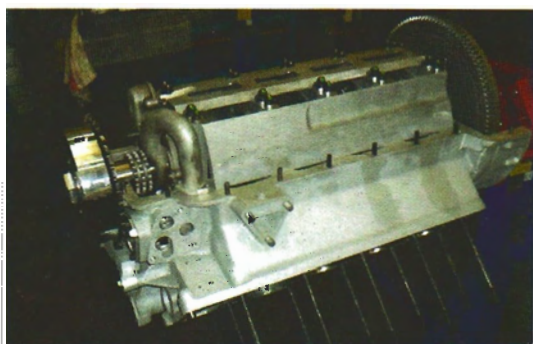
The best aluminum alloys known today withstand surface pressures of no more than 200 N/mm² (MPa). When this limit is exceeded through excessive torquing or bolting, aluminium alloys will start to cold flow by as much as several 1/100th of a mm. Recommended levels of torque in Maserati manuals exceed these limitation figures, in some cases by more than 100%. High material stress over long times will also create warpage within the engine block. Marks and impressions of main bearing caps on the surfaces of the engine block are witnesses of excessive material stress.



Closeup of engine block sealing area showing cavitation steam damage (high speed collapsing steam bubbles). This is where the sleeves seal against coolant. The main purpose of the rubber seals seated in grooves around the outside is not seal the water in main consideration but to avoid oil intergration and pumping up effects from the crank case.

As a result of their fundamental design Maserati V8-blocks are not very rigid. The bottom of the engine block ends at the level of the crankshaft centre axis. Lamborghini, Alfa Romeo etc., extend the bottom further in order to strengthen the area around the main bearings. Strength in this area of the engine is critical to control radial and torsional oscillations of the crankshaft.

To overcome this shortcoming of the basic architecture of Maserati engines, the author has designed and built an Integrated Main Bearing Block (IMBB) from an Al-Si alloy with reinforced cast-in steel structure. This keeps main bearing tolerances more precisely with any engine temperature. The IMBB increases rigidity against flexing by 1400 %, thus reducing radial oscillations ("bending") of the crank to a minimum.



- Engine block with IMBB installed.
- Gain in bending stiffness approx 1400 %.
- Resistance against torsional distortion even larger.

Torsional distortion of a crank ("twisting") can reach up to 3 degrees. Torsional oscillations of the crank appears always in combination with bendings (harmonics up to 8 degrees twist) and are the silent killers of main bearings and can result in a cracked crankshaft. A hydro crank damper can be employed to reduce torsional vibrations and reduce resulting high main bearing loads over the entire rpm.

As a result of the IMBB and a hydro crank damper the engine runs noticeably smoother and quieter.



Engine with crank damper and ignition trigger wheel installed 2 openings for chain driven ignition distributors.

Today's advances in technology challenge again the age-old belief held by guardians of automotive history that restorations should honour originality. After all, these engines worked in their day, didn't they? Is it then possible to restore a Maserati 5000 engine exactly as it was originally conceived and built?

The answer is clearly "NO"! Not unless efforts are made to recreate the design flaws of a prototype, flaws that Maserati themselves addressed in subsequent versions of this basic design. Originality would run counter to better judgement with respect to performance, functionality, and durability. And anyhow, how can originality be achieved without original documentation and parts lists – if they ever existed.

Omissions of functional modifications and improvements could not even be considered homage to either the designer, Dott. Giulio Alfieri or the achievements of those years.

The very first 5000 GT with Touring bodies (SN 103.002 Shah of Iran and SN 103.004 Basil Read, South Africa) were delivered in summer of 1959 and were obviously equipped with original 450S race engines which had 2 (noisy) gear-driven cams (DOHC, valve position angle 45°) per bank.

45 IDM twin Weber carburetors provided the fuel air mixture. In order to improve driveability, the compression ratio was lowered from 1:9,5 of the race engines to 1:8,5 for street engines.

At the time output was reported at 340 hp at 6000 rpm with maximum torque of 456 Nm (337 ft lbs) at 4000 rpm. Top speed of the 5000 GT was quoted at 270 km/h, until then the highest speed of any street vehicle. This record speed was obtained on the very first section of the "Autostrada del Sole" in 1959 near Bologna.

Assuming a tyre size of 6.50 x 16, a rear axle ratio of 1 : 3.31 and a ZF 4 speed box in top gear, a speed of 270 km/h translates into 6.500 rpms. Only for a very short time could this 5 litre engine withstand such a high rpm figure under full power.

Subsequent 5000 GT coupes (there were 36 cars in total) were equipped with the newly-designed compact engines and 4 triplex chain driven overhead camshafts (DOHC, smaller valve position angle 30°) and Lucas fuel injection. This new fuel injected engine had a compression ratio of 1 : 8.5 and its domesticated power was reported at 325 hp at 5500 rpm. The very last 5000 GT cars were finally equipped with the more reliable 4.2 and 4.7 litre carburetted engines and much lower hp output of course.



Fuel injected engine:

- Aluminum common rail below the throttle bodies, invisible inside the airbox.
- 90° gear drive (white arrow) ignition distributor,
- Separate high pressure oil outlet (red arrow) for both cylinder heads oil supply (ID 18 mm pipe not yet attached).

Every single 5000 engine underwent considerable modifications compared to its predecessor. Initially two Lucas distributors provided twin ignition. In 1964 this setup was changed to single spark ignition with one Bosch distributor as seen on 5000 GT, SN 103.058.

The impressive intake with 8 separate throttle bodies was redesigned from 1963//64 in favour

of one large butterfly housing in order to simplify maintenance efforts. Dismounting of just one intake manifold in order to replace a simple gasket would require disassembly of the complete cylinder head with camshafts, ignition distributor, exhaust header etc. followed by re-assembly with a new head gasket and with all adjustments in cam timing etc.etc.

These are the disadvantages of prototypes. Over the years prototypes mature and such teething issues are addressed. In this case, fuel injection was later discontinued in favour of carburetors.

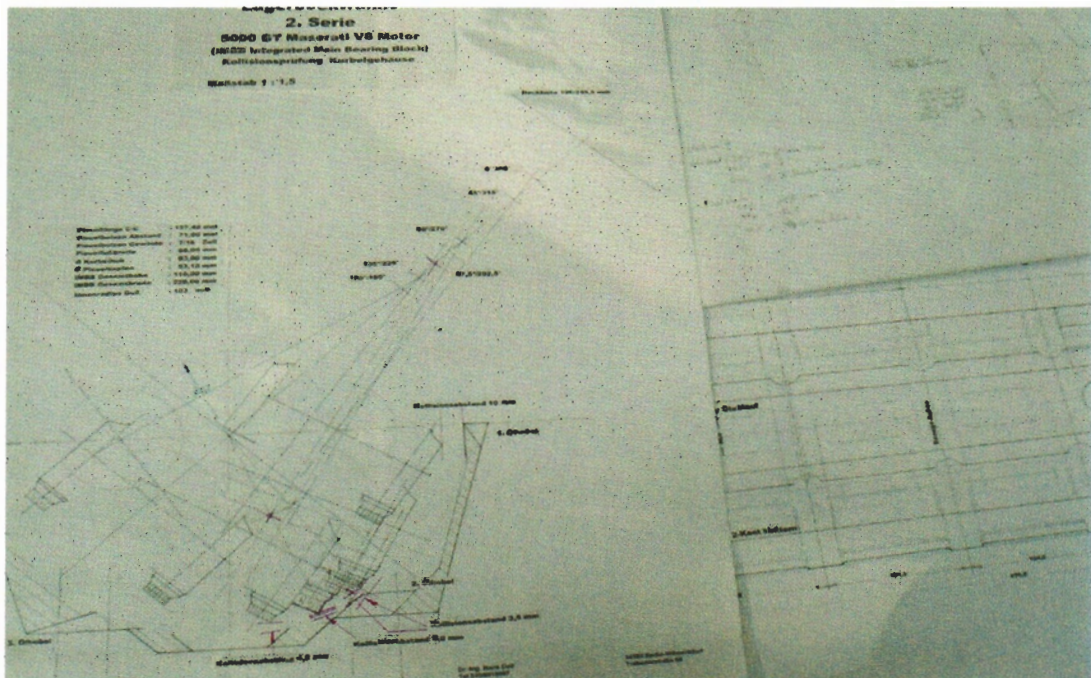
The author estimates that no 5000 engine has ever reached 10.000 km (6000 miles) without any heavy repair and maintenance efforts.

The engine featured here was installed in 5000 GT (SN 103.036), an Allemano-bodied car that belonged to famous movie star Stewart Granger. In addition to his cloak-and-dagger movies, Mr. Granger is well known to European audiences for his portrayal of the character "Old Surehand" in the Western series "Winnetou". The entire recorded mileage of this 3 – owner car is a mere 18.000 km or 12.000 miles. "Old Surehand", the first owner, did not use the car very much and sold the 5000 Coupe to an US Airforce Colonel, stationed in Ramstein, Germany. The Colonel paid for his fascination with a damaged engine, finally resigned and returned to the USA without his Maserati.

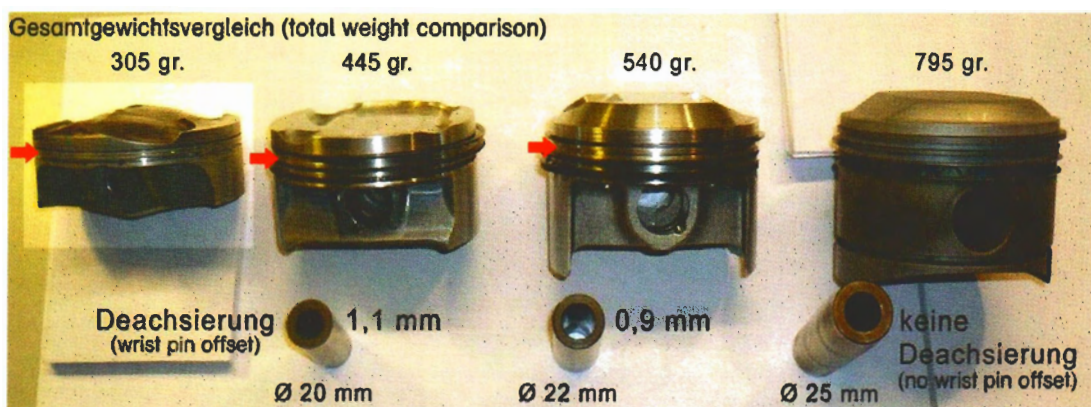
What might be the value of such a car? In the year 2000, a Frua-bodied 5000 GT from Egypt (6th owner King Saud Ibn Abd Al Aziz) with only 12.500 km on the clock was auctioned in Monaco for approx. 480.000 USD. Mind you, this was a restoration project car.

Many design flaws of the engine are related to its twin ignition and particularly to the Lucas injection. Fuel injection has advantages for high-compression engines because of the higher increase in temperature during the rapid compression phase of the combustion cycle. Maserati listed a compression ratio (CR) for the fuel injected engines of 1:8.5 (5000 GT book, Maurice Khawam).

Compression ratio is a result of the geometry for stroke, conrod length, piston height and combustion chamber volume in the cylinder head. When this calculation was made using the parts found in the engine of SN 103.036 the actual compression ratio turned out to be only 1 : 7.5. This surprise triggered the redesign of the moving parts and resulted in new designs for rods and pistons.



More than 200 drawings of the 5000GT engine. Collision detection crank case, stroker conrods, stroke.



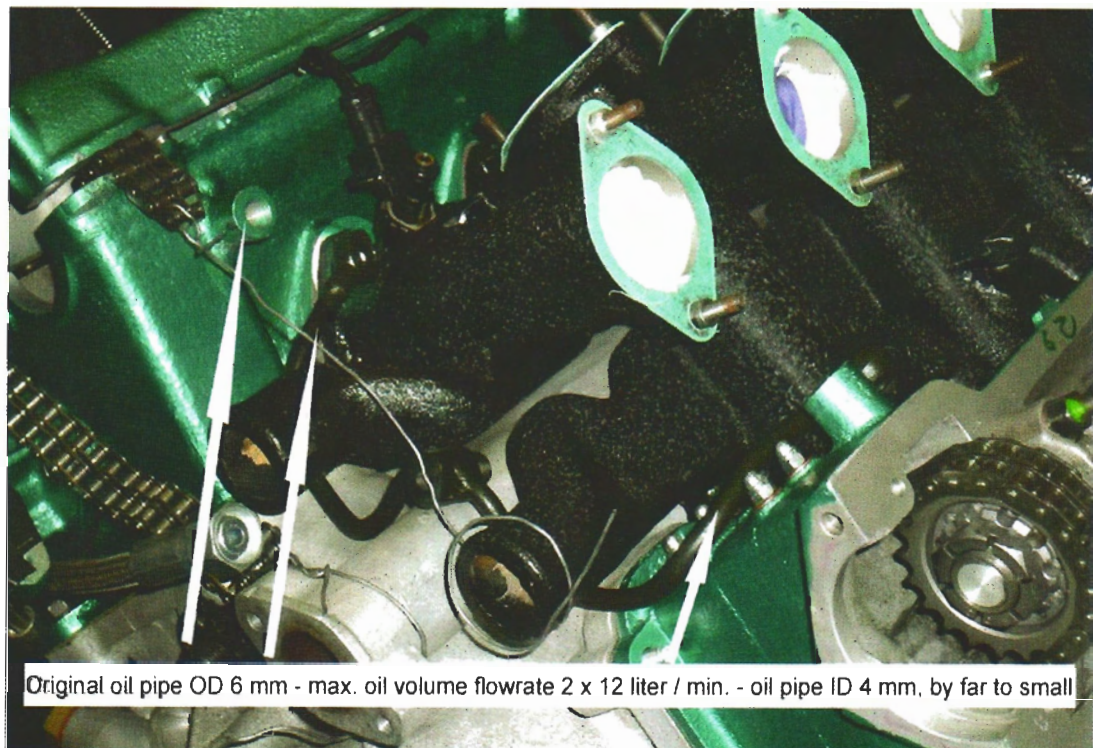
By comparison of pistons from right to left:

- Original full skirt cast piston of 5000GT SN 103.036, 1. ring 2.50 mm, 2. ring 2.00 mm, 3. oil ring 6.00 mm, 4. oil ring 3.50 mm.
- Newly-designed forged box type piston for 5000 GT still without removed sleeves at the skirt, auxilliary offset of piston pin 0.9 mm, alloy by Mahle 1. ring 1.00 mm, accumulator groove (red arrow), 2. ring 1.20 mm, 3. oil ring 2.00 mm - 4-valve box type piston of a new Maserati 4.2 litre by Mahle, Ecoform forged 1. ring 1.00 mm, accumulator groove (red arrow), 2. ring 1,50 mm, 3. oil ring 2.00 mm.
- Low height box type piston formula1 race engine, 1. ring 0,65 mm, 2. oil ring 1.50 mm.

Any low compression ratio combined with manifold fuel injection leads to wetted cylinder walls, spark plug fouling, oil contaminated with un-burnt fuel and never-ending cold-start problems. Surprisingly, the Lucas injection was not directed towards the intake valves but in the opposite direction toward the airbox. Perhaps Maserati believed that this would result in better atomization of the fuel. One of the Lucas engineers involved is today over 80 years old and lives in N.Teamworth. He still remembers this unusual injection arrangement and still cannot see any reason for it. Maybe the Italians simply did not understand the engineers from Lucas?

Modified intake manifolds, new bungs for injectors ►
 The original injectors squirted from the same position but opponent towards the air box.





Original oil pipe OD 6 mm - max. oil volume flowrate 2 x 12 liter / min. - oil pipe ID 4 mm, by far too small

Black wrinkle finish on intake manifolds.

Long oil pipe (ID=4 mm!) leading to the pressure gauge on the dashboard and with a Y junction to supply both heads - insufficiently.

The 450 S engine had two twin ignition Marelli 7073 DTEM distributors in horizontal position. Each distributor worked for one bank only feeding 2 x 4 spark plugs. In order to fire the twin plugs of one cylinder simultaneously two breaker contacts within one distributor had to be synchronized. The system required a total of four ignition coils, two coils for each bank. On later 5000 GTs with four chain driven cams, two upright Lucas distributors were used. Distribution was now organized into 2 x 8 spark plugs.

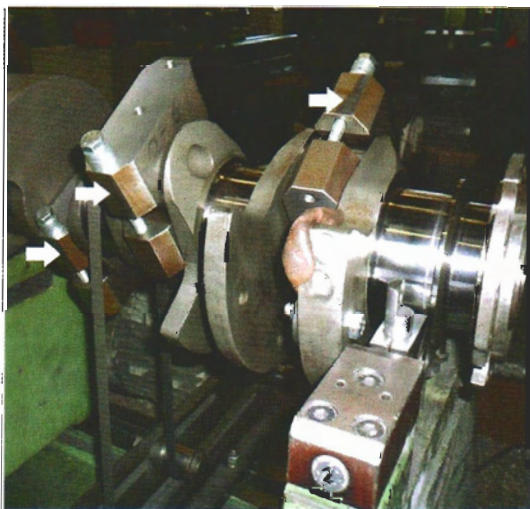
In reality, the theoretical advantage of twin ignition was lost because of the impossibility to sustainably synchronise two different chain driven distributors, given tolerances and play in 90°-gear drives, vacuum advance mechanisms, etc.

Most probably even a precisely adjusted distributor lost its synchronization with the first warmup and ended up firing too late and thus uselessly into already burnt gas. The flame front travelling the distance of 48 mm from the 1st firing spark plug to the 2nd spark plug will pass the latter within less than 4/1000 of a second. Maserati probably realized this and, in 1963, changed from twin to single spark ignition and one directly gear driven Bosch distributor from the crank.

Some design flaws became apparent when the parts of the dismantled engine were carefully inspected and measured. As mentioned earlier, no technical documentation for any of the 5000 engines was available as guidance for the rebuilding. For a prototype engine, another option is to

use later volume production versions of the engine to guide reconstruction – although this conflicts with the idea of a faithful reconstruction of a prototype. Nevertheless, this route became the starting point. All modifications of the basic engine until the end of its production in 1989 were carefully evaluated.

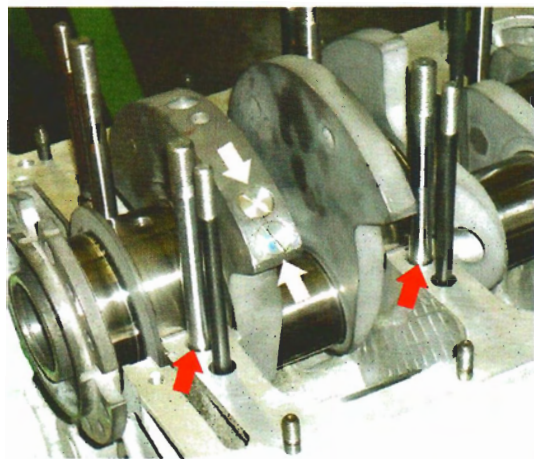
In the end, entirely new designs were created for pistons, connecting rods and the oil pump, and oil pipes to feed the cylinder heads and the main oil galley. Modifications in design were made to the crank to keep the hydro damper, the conrod bearings, the main bearings and the crank counterweights.



Electronic balancing of the crankshaft with bob weights (arrows).

Bob weights are calculated and necessary only for balancing V8 engines.

Initially, tests were run using plasticine to determine heavy metal bore and location.



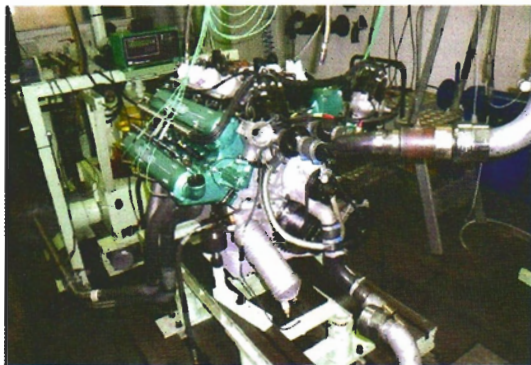
- Heavy metal inserted and sealed threaded bolts in counter balance weights (arrow white).
- Main bearing bolts OD reduced from 12 mm to new OD 10.5 mm.
- New bolt length + 40% (arrow red).
- Bolt material with defined tensile strength.
- Thread size engine block 12 x 1,5 mm cut deeper into by 14 mm with helicoils, created a more homogeneous stress pattern around the main bearing seats.

The Lucas fuel injection had been altered to an invisible, state-of-the-art EFI system. The ignition system employs a crank trigger and an invisible, programmable ignition amplifier. If required, these modifications can be reversed.

The fuel injection system and twin ignition timing were optimized on a dyno. It was now possible to demonstrate the advantage of short distance in flame travel provided by a fully synchronized twin ignition. When equipped with a single spark system and a single coil the engine lost approximately 150rpm translating into a power loss of approx. 2 – 3 %. However a higher degree in advanced ignition will compensate a little.

Cam phasing, alternating injection cycles and a more responsive programmed ignition curve led to a further optimization of the power curve: ignition advance is gradually reduced from a maximum of only 24° at 2400 rpm to 21° at 5800 rpm.

Maximum torque was tested at 488 Nm (360 ft lb) at 4400 rpm and maximum power at 412 hp at 6200 rpm. In order to sustain such figures over longer times it would be necessary to apply piston cooling. The author has developed a valve controlled oil squirting system for piston cooling of Maserati V8 engines but it was not applied to this 5000 GT block.



Engine on the dyno, one thermostat for each bank of cylinders wide band O2-sensors closed loop injection control.



- Engine on the dyno, Lucas Metering Unit not yet installed.
- Different design between left and right header.
- 8 exhaust temperature sensors.
- 2 wide band O2 sensors.

The rebuilt engine starts without hesitation and runs reliably under all conditions. It is even-tempered over the entire rpm span, yet spontaneous and powerful when challenged providing an incomparable combination of grand touring and race car performance – which was the original intent. True Maserati feeling at its best.

No longer will Kings, billionaires, famous Western legends and US Air Force Generals suffer the humiliation of non-starting, coughing or stalling engines nor will they be ruined by Italian (or other) repair bills.

The extraordinary performance of this engine returns “Old Surehand’s” Allemano 5000GT back to its rightful place in the league of the “Grandi del Mondo” – maybe even as a winner.

At long last:

In exchange for his destroyed 5000 GT Allemano, Mexican president Adolfo Lopez Matheos (1958 – 1964), received a carbureted, 4.2 litre Maserati Vignale prototype. To create a perfect Maserati illusion, the new car was given chassis number 103.022, the same number as his destroyed 5000 GT Allemano. It may be easier to comprehend this magical act in the context of a rather disrespectful attitude toward the sovereign duties of Mexican tax authorities. 🇲🇽



The 5000GT – Another View

by *Andy Heywood*

I write in response to the fascinating article by Dr Hans Doll on the vagaries of the Maserati V8 engine to offer counterpoint to some of his criticisms and findings based on the collective experience of Bill McGrath Limited here in the UK. My motivation is not to discredit anything the good doctor says, for it is clear that his own experience of these engines is extensive and many of the problems he has encountered are problems that we have also coped with for decades.

Nor is it my intention to try to suggest that what came out of the factory in the sixties and seventies was perfectly designed and executed. I sense and share some frustration that Dr Doll clearly has with motoring journalists who have propounded falsehoods over the years and let their emotions muddy the logical engineering waters.

While the majority of my article will dissect his technical assertions, I have to say that there is also a fundamental difference in our philosophies and that is on the subject of modification or modernising. His logical mind asserts that if Maserati said the engine should produce X horsepower (even though this was impossible hyperbole released by an over-eager marketing department at the time), then it is his job to modify the engine to make sure it will produce said horsepower. My logical mind would argue that the conclusion of modifying any 'classic Maserati' would be to produce a car like an Eagle E-Type, which gives the visual thrills of a classic with an up-to-date driving experience. It is inevitably a much better car than the original as it benefits from 50 years more technical development but is it really the same car?

In a 5000GT therefore, why not fit the V8 engine from a current Quattroporte? It is after all, a four cam V8 with electronic fuel injection producing around 400bhp and would address all

of the concerns that Dr Doll has with the original engine. Just paint the cam covers green and park it outside. I suspect that most of you are reeling at the thought of this but a few may be thinking what a great idea! To me this is wrong on many levels. Firstly, the historical significance of these cars is high and there should be some sense of duty to preserve them in their original form. Secondly, the market for these cars is biased towards originality and modification therefore reduces value. Thirdly, it is all very well modifying the engine of a 5000GT to produce more horsepower, but what about the rest of the running gear? The original brakes for instance are identical to a late series 3500GTI, a car with 235 horsepower, and therefore marginal in a 5000GT to start with. It may be that Dr Doll has fitted 6 pot Brembo callipers and carbon ceramic discs to his car, with ABS and traction control thrown in. Why not, because all of this is possible? Well because he will no longer be getting an authentic 5000GT experience. Like an Eagle E, the car will still look like a 5000 but no longer drive like one. I'm sure some of you are still thinking; what's the problem if it is an improvement?

It's true, I am a purist in such things but I am not so inflexible as to think that no modification at all is necessary. I truly believe that these cars were made for driving and because of that, things like seat belts and electric cooling fans are required to cope with modern traffic. I just think that the driving experience ought to be as authentic as possible. But by that I don't mean that the experience should be fraught with unreliability. Dr Doll strives to suggest that unreliability in Maserati engines is due to inbuilt design flaws, where as I am about to suggest that in most cases it is more likely due to poor maintenance and lack of experience by owners and mechanics alike.

Dr Doll has based his article around the rebuild of his 5000GT and this is where we will start

as well. Some of you may well be thinking that this is irrelevant for the vast majority not lucky enough to own a 5000GT, but the fundamental principles are the same for these engines as they are for all the classic straight six, V8 and even Merak V6 engines. So read on...

5000GT.

Dr Doll is correct in saying that the engine fitted in the majority of 5000GT cars is not the same as the 450S racing engine. The latter was only fitted in the first two cars and the subsequent Tipo 103 engine was a completely new unit.

The Tipo 103 engine did however have a racing career of its own, as this was the engine fitted in the Tipo 151 Le Mans cars, the Tipo 65 mid-engined final Birdcage and also a certain Cooper Maserati belonging currently to Michael O'Shea.

I also agree that this engine was something of a prototype. In design terms it is something of a mixture of the straight six engine from the 3500GT and the later V8 units. For instance, it has studs and dome nuts holding the heads on like a six, rather than the bolts of the later V8. As the heads have to be withdrawn up the studs, it means that the heads on a 5000 engine cannot be removed without first removing the engine, as there is insufficient room in the engine bay. It also has a handmade feel about it compared to the later engines. However, as a blueprint for the road going V8 engines that followed, the Tipo 103 engine is very relevant.

I probably agree with Dr Doll's assertion that no 5000GT has done high mileage. Michael Miles, the editor of Trident magazine for much of the 1970s and 1980s owned a 5000GT and drove it on a regular basis, but he is probably the exception. They were always special cars and led

cosseted lives as a result. Yet Dr Doll says that they are incapable of achieving high mileage, which is not the same thing. He bases that assertion on three main areas: the lack of rigidity of the engine block, the potential for wear in the cylinder liners and therefore susceptibility to allowing water and oil to mix and thirdly, on the inappropriateness of the Lucas fuel injection system.

While nobody can really prove or disprove the theory that the 5000GT is incapable of high mileage, all three of those areas are relevant to other Maserati engines and my experience would suggest that none of them would stop a 5000GT achieving high mileage as long as it is looked after correctly.

Block rigidity.

The good doctor asserts that the V8 engine block is too flexible, which leads to premature wear of the main bearings and also crankshaft failures. The design fault is that the centre line of the crankshaft is at the base of the block and the main bearing caps are individual and hang below the centre line. He argues that an integrated bearing cradle that combines all the main bearing caps in one casting increases stiffness by a factor of 1400%. This is clearly an effective improvement and updates the engine design as Maserati themselves started to use an integrated bearing cradle as early as 1969 on the Merak V6 and all variants of Biturbo engine use the same. However, in my experience, crankshaft failures and main bearing wear due to flex are not factors in the longevity of the V8 engine.

There used to be an old wives tale that the crankshafts on 4.9 litre engines (which have longer throws to achieve the extra stroke over a 4.7) were prone to breakage but I have never seen one.

To get some idea of the margin involved here, I would look at the straight six cylinder engine, which is made along the same principles of crankshaft and main bearing design. This engine does sometimes suffer from main bearing wear and the block is certainly more flexible than the crankshaft but then this is 50% longer and half the width of the V8 in simple terms. It is always going to be more flexible. As a result, this engine has a torsional vibration damper fitted to the nose of the crankshaft, though I suspect that this has very little positive effect. But we have never had to rebuild a six cylinder engine because it has worn its main bearings due to flex and we now have rebuilt engines in our care that have covered more than 50,000 miles.

I believe that this is a question of being pragmatic. If one was building a racing engine, either six or V8, then you might consider the integrated bearing block, but on a road car it is unnecessary.

Cylinder liners.

This is an area which is absolutely crucial to a good engine rebuild and one that has been underestimated or ignored by many an engine builder in the past. As was common practice for high performance Italian cars in the 1960s and 1970s, Maserati used aluminium for their engine blocks, into which were then fitted cast iron cylinder liners for the pistons to run up and down in. And like their contemporaries down the road in Maranello and Sant Agata, Maserati used a partial wet/dry liner.

The term wet liner refers to a liner that sits in the engine block on a spigot but open to the water jacket, hence the 'wet'. There is always a shoulder between the liner and the spigot so that when the cylinder heads are fitted, the liners are clamped into place. There is always some kind of seal to stop water in the water jacket and oil from the sump below mixing but the position of this varies. Wet liners are usually a fairly loose fit

in the block and can be removed by hand (the Biturbo engine is like this).

Dry liners on the other hand are usually an interference fit in the block (in other words, the external diameter of the liner is actually slightly greater than the hole into which they fit, meaning that once fitted they are tight). A true dry liner is usually used on a cast iron engine to replace a worn bore and is effectively just a fixed sleeve.

What Maserati and others did was to use the best features of both types of liner in one. The top eighth of the liner is 'wet', the rest of it is 'dry'. The spigots in the block are the length of the remaining 7/8 s of the liner and the liners sit on a shoulder at the top of the spigots. Because they are effectively dry liners, they are fitted using an interference fit. This makes them very rigid but also allows water to surround the top part of the liner, which is the most important area to aid cooling of the engine. Maserati used this method for the straight six, all classic V8 and Merak engines as well as many racing engines before that.

We all know that once the bores in an engine are worn, it can be re-bored and have oversize pistons fitted. This is also true of lined engines and Maserati used to quote oversizes for which pistons were available. However, the maximum oversize on a V8 was 0.4mm based on an original bore size for the 4.7litre of 93.9mm, which is a very small amount. If the wear cannot be eradicated by this then new liners are required.

As Dr Doll says, there are companies out there who will sell you larger oversize pistons (up to 96mm in some cases) but our experience concurs with his that the walls of the liners are actually quite thin and their strength is compromised by over boring. This means that the liners are no longer perfectly cylindrical, with catastrophic results for the piston rings.

Renewing liners means heating the block and then drifting them out. Once the block is hot, the liners slide in and out more easily, and it is worth remembering that once the engine is in use and at normal running temperature, the liners will be 'loose', only clamped by the shoulder on the spigot.

It is essential to remember this in conjunction with the method of sealing the water from the oil. Maserati made a groove 7/8s of the way down the outside of the liner which was fitted with a rubber 'o' ring. This was meant to keep the oil below it in the sump and the water above it in the water jacket.

Dr Doll asserts that the latter is not correct and that the shoulder on which the liners rest on top of the spigot is what actually seals the water. He further argues that if the shoulder is not in perfect condition, then water and oil will mix and that Maserati did not fully understand this during their design stage. I would argue that while the shoulder certainly helps to restrict the flow of water down the outsides of the liners, it is not essential to make this a 100% seal and that, properly fitted, the 'o' ring lower down forms an effective seal. I have never seen a V8 engine mix oil and water in this way. Of course the tricky bit is to make sure that the liner 'o' ring has been properly fitted.

In the pictures accompanying his article, Dr Doll shows a liner removed from an engine which has a seal under the shoulder, which also has the effect of raising the height of the liner. Some engines are designed to have 'adjustable' liners in this way, but the Maserati engines are not and this is somebody's bodge. Another picture shows a liner with a groove cut into it around the base of the shoulder, which is also incorrect and a potential weak spot, but it does highlight one of the biggest problems with renewing the liners –

finding quality replacement parts.

The Doctor talks about 'individually matched custom liners' and I'm not totally sure what he means by that. There are companies that will sell you what they call 'finished' liners, which means that they are pre-bored to the correct size, implying that once fitted, one can just fit the pistons without any more machining. It is a short cut which doesn't work as firstly the liner spigots clamp the liners once in place, meaning that they may not be totally cylindrical and secondly, the spigots are not always machined 100% accurately fore and aft or side to side, meaning that the piston may not be going absolutely up and down in the bore! These things can only be corrected by fitting 'Unfinished' liners and boring them afterwards. I think this is what the Doctor meant and I would wholeheartedly agree. We only supply the unfinished type.

Sometimes however, the spigots are damaged by corrosion and require boring themselves, or in rare cases they are so far out of true that liners with a larger outside diameter have to be made to allow the correction. These are also available.

To attempt to conclude this discussion of what is clearly one of my favourite subjects, I would say that ultimately I agree with the Doctor that fitting cylinder liners requires very careful consideration on the part of the mechanic and there are no short cuts if reliability is required. But, once decent quality liners have been correctly fitted, I do not think there are any residual problems that would stop one of these engines from covering high mileages.

The crucial factor as far as I am concerned for longevity of these engines is to make sure that the antifreeze strength is good and that it is regularly changed. This is because antifreeze carries corrosion inhibitors, which prevent the

cooling water from corroding the aluminium castings around the engine and also the metallic elements of the cylinder head gaskets themselves. I believe that failure to change the antifreeze is responsible for more engine problems, especially on the V8, than any other issue.

It is common with cars that don't get used very much for owners to think that they do not need to get them serviced because they have not reached the next service mileage interval. Actually, nothing could be further from the truth. Changing just the engine oil and the antifreeze on an annual basis regardless of mileage will prolong the life of the engine more than anything else.

There is another old wives tale surrounding the weakness of V8 cylinder head gaskets and while as with all parts, there can be problems with low quality items, most of the head gasket failures we see come about due to corrosion of the aluminium castings of the heads and blocks, which cause the gaskets to weep, allowing water to sit in the cylinders and in the worst cases, weld the piston rings to the walls of the liners. The next time the engine is started, the rings rip a little piece of the liner wall away or even break and so just for the sake of changing the antifreeze, a complete engine rebuild is now necessary.

Lucas Fuel Injection.

This is certainly a subject that divides opinion. The Lucas system, as fitted to the later six cylinder Maseratis and the 5000GT definitely had problems when it was new. Overheating fuel in the high pressure fuel pump caused many a Maserati to splutter to a stop out on the road and fitting a Bosch fuel pump is now considered a sensible modification for those that want to reach their destination (a modification that I do endorse!).

However, Dr Doll's discussion about the Lucas system is more concerned with how it can contribute to premature engine wear and I agree that this is possible. Firstly, the metering unit that distributes fuel to the injectors is driven by the camshafts and therefore attached to the engine. There is a seal that stops fuel from entering the engine but this can fail, especially on cars that don't get used very much where it dries out. It also requires oil pressure balancing the fuel pressure to make the seal function fully. Once fuel enters the engine it dilutes the oil, which causes bearing wear and in the worst cases, seizure.

Secondly, in normal use, especially when the engine is cold and the choke is being used, the Lucas system is fairly crude and will over fuel the engine. This has the effect of 'washing' the bores, which causes premature wear of the liners and pistons.

Dr Doll has addressed all of these issues by fitting a modern electronically controlled fuel injection system which can more accurately meter the engine's fuel requirements. I think that this is a shame for reasons already discussed but I also believe that problems with the Lucas system can be avoided or at least caught early if the owner and his mechanics are aware of the possible problems.

Firstly, fuel in the oil. On Sebrings and early Mistrals, Maserati fitted a system that would protect the engine from the ingress of fuel in the oil. This involved a sender plumbed into the oil gallery on the block that would monitor whether there was oil pressure. This was connected to a timer based on a bi-metallic strip, which was in turn connected to the electrical supply to the fuel pump. As soon as the ignition was switched on and the fuel pump started to run, the timer would start to heat up. If there was no oil pressure – in other words, either the engine was not

started for some reason or it genuinely didn't have any pressure, then the coil would continue to heat up until it cut the electrical supply to the fuel pump. It also put on a large orange light on the dashboard to tell the driver what had happened. By cutting the fuel pump, it stopped fuel from going directly into the engine.

It is true that the 5000GT does not have that failsafe system but a quick check of engine oil should alert an owner to the same possibility. If the oil smells of petrol or if the oil level has mysteriously risen since last checked, it is clear what has happened. The simple thing to do then is to change the oil and try again. And don't leave the ignition on and the fuel pump running without starting the engine!

Washing the bores can be reduced considerably by how the owner starts and runs the engine. The Lucas system has a manual 'choke', which is more accurately termed a 'cold start' device. Unlike with Weber carburettors, it is necessary to use the choke to start the engine from cold. Once started however, the amount of choke should be reduced as quickly as possible without stalling. These are not cars where you can start them and then go back into the house to finish your coffee while they chug away in the drive. By 'working' the choke, clean running can be achieved quickly and with minimum over fuelling. By being sympathetic in this way, it is possible to get cars with the Lucas fuel injection to do high mileages. 🏆

Conclusion.

My main motivation in writing this article was to allay fears that owners of Maserati V8s might have having read Dr Doll's original article. I hope that I've done this and that you don't all think that your pride and joy out in the garage is merely an expensive time bomb waiting to go off. But I also wouldn't want anyone to think that these are easy engines to live with either. Compared to modern engines, they need more understanding and gentle treatment and in rebuilding there are certainly pitfalls for the unwary. Dr Doll obviously doesn't agree that this should be necessary and therefore strives to make his engines every bit as powerful and reliable as a modern. It is his choice. Mine is a different one. I believe that in modifying his engines, they are bound to lose some of their original character. One of the positives of the ownership experience is the antidote it provides to the modern way of life, so why try to dial all of that out. But let's not get sepia tinted about this. I agree with Dr Doll that there is too much of that written about Maserati engines. It's all logical engineering at the end of the day but even when it's black and white, there are still shades of grey.

