



The A.B.C. of Shorrock Supercharging

By Jonathan Peck

This booklet is the **Shorrock Bible of Supercharging for 'A' Series Engines**, which list just about everything you, need to know about supercharging a Mini, Austin Healey Sprite, A40 or Morris Minor.

SUPERCHARGING is itself a misleading term when applied to the low boost, that is the everyday practice as applied to ordinary touring car of the 30's to 70's. The expression CAPACITY FILLER would be more accurate, for a supercharger is really only a mechanical device to overcome the inefficiency of the internal combustion engine.

Normally the mixture in the carburettor at atmospheric pressure flows into the vacuum created in the cylinder by the suction stroke of the piston. The volume thus admitted is obviously not the full capacity of the cylinder at atmosphere pressure, and consequently the efficiency of the engine suffers.

Various mechanical methods are employed to improve this inefficiency, such as polished induction ports, and high compression ratios, but these all have their drawbacks. Polished ports lose their effectiveness as soon as any carbon deposit is formed, and very high compression leads to 'pinkings' and roughness.

The advantage of supplying the mixture to the cylinder under a moderate boost instead of the piston absorbing power in sucking in the mixture is obvious. The power developed from a fully charge cylinder is as much as a third greater than normal. In addition to the greater power available from an engine when "fully charged" the power curve continues to rise with the engine speed far beyond the point at which the normal engine begins to fall off.

In addition to the question of power, there are other advantages to be considered.

1. The normal car is fitted with a 'hot spot', which breaks up the mixture of petrol and air into a more rarified and combustible mixture. The supercharger "stirs up" this mixture and so further increases the amount of atomisation of the fuel. That, and the more even distribution of the gas when under pressure, definitely enables a supercharged engine to use less petrol for a given B.H.P. output.
2. In the normal unsupercharged engine, when the petrol mixture is being introduced by means of the vacuum in the cylinder as explained before, this vacuum also exerts a suction, which draws the oil on the cylinder walls past the piston into the combustion chamber. In a supercharged engine however, this vacuum does not exist, hence less oil consumption.
3. When a car is started from cold, in the normal engine, the atomisation is necessarily poor, so that a "wet" mixture is introduced into the cylinders. This wet mixture washes away the oil film on the cylinder walls, which fact has been proved by many leading authorities to account for the greater part of cylinder wear. With a supercharged engine however, the mixture has been well "masticated" by the supercharger blades, and the petrol air mixture issues as a combustible gas, enabling the car to be driven away from cold, and avoiding the detrimental "washing" of the cylinder walls.

Super-tuning versus supercharging

Some very wonderful performances are attained with unsupercharged racing and sports cars in the hands of experts, simply by tuning, though perhaps 'simply' is hardly the word to use, as tuning entails special high lift cams, overlapping of valve timing to extreme degree, light valves, multiple valve springs of great strength, polished induction passages, multiple of carburettors, etc, to mention just some of the essentials – few of which are conducive to any permanence of performance. Expert tuning for maximum power produces a temporary condition only, and, moreover, it is accompanied by lack of flexibility and poor top gear performance. On the other hand supercharging calls for none of the above, and enables an ordinary commonplace car engine to become an all round



performer entirely superior to the tuned sports engine, and the condition is permanent. A supercharger is a tangible added mechanical aid to power, and is equivalent to adding another two cylinders to a four-cylinder engine. Even better, in fact because there is not the falling off in volumetric efficiency at high r.p.m. which is inherent to normal types of unsupercharged petrol engines.

Take a look at these records: -

1937

As early as 1937, Shorrock Superchargers have been fitted to small cars, the M.G. range in particular. Subsequent world records by this famous car were achieved with a Shorrock supercharged engine. The most noteworthy was in May 1939, when the M.G., then driven by the late Lt.col.A.T. Gardner, at Dessau Germany, was the first car in the world, in class G, to exceed 200 m.p.h.

1957

1 1/2litre supercharged M.G. Ex 181 driven by Stirling Moss at Utah broke five international class F records, including the flying kilometre at 245.64 m.p.h.

1959

In 1959 Shorrock were proud to be associated with phenomenal success of the Austin Healey Sprite. Driven by T.H. Wisdom Ed Leavens and Gus Ehrman, it put up a fantastic performance in class G smashing 15 international records and 52 American records – maximum speed 145.56 m.p.h. and 12 hour endurance at 138.75 m.p.h. In the same month Phil Hill captured 6 new international class E records in the Shorrock supercharged M.G. 181 including the flying mile at 254.53 m.p.h.

The effect of supercharging on engine wear

As the supercharged engine develops more power, the first thought is that there will be proportionately more stress on the engine parts. In practice we find that supercharged engines wear equally as well or even better than before, and this we attribute principally to the very much smoother (more stream like) turning effort of the supercharged engine, and to the fact that there is less use of the lower gears. Furthermore, supercharging only increases the firing pressure, whereas it is the inertia stresses of a reciprocating engine which are the important factors as regards mechanical failures.

Performances

The benefits from supercharging a normal road vehicle are; (1) Enormously improved acceleration; (2) Much greater speed on hills; (3) Better top gear performance; (4) Increased maximum speed. Normal touring cars reduce the time for acceleration from 0.50 m.p.h. by 40% or more, while hills which previously called for lower gears are taken “flying” on top. The combined benefits of rapid acceleration and high speed on hills enable very high averages to be maintained without effort.

Power absorbed

Superchargers require so little power to overcome mechanical losses that if the drive were disconnected the engine will still run, as the suction of the engine will cause the supercharger to rotate freely

General Technical Information

Shorrock Supercharger installation are designed for fitting to a wide range of popular cars for normal road use, with in most cases no modifications to the internals of the engine other than fitting a ‘colder’ set of spark plugs and the re-setting of the ignition. However, to get the best from your supercharged engine, it is very important to apply the following general rules.



Fuel

On all occasions when full performance is likely to be required use a 100 octane rated fuel. However for round town or for trips where a very small amount of boost is used the engine will usually run on normal four-star grade fuel.

Spark plugs

All engines fitted with a supercharger installation must be fitted with a cooler grade of plug than normally fitted to the unsupercharged engine a Champion types N.3 or N5 or the equivalent heat range of plug should be used for best performance, with standard gap setting.

Compression Ratio

For all normal roadwork where a maximum boost of not more than 7.5p.s.i. is employed it is not usually necessary to reduce the compression ratio below 9.0:1 on a 1098cc engine. However, generally it is not recommend more than 9.0:1. An ideal ratio for the average engine with a maximum boost of 7.0 p.s.i. would be approximately 8.0:1.

Note 26cc head chamber = compression ratio of 8.0:1

If a higher compression ratio is already being used on the motor, for example 10.0:1, it will be necessary to lower it by inserting a cooper gasket between the cylinder head and the block. The compression ratio should be lowered in proportion to the sq. roots of the absolute pressure.

Ignition Setting

For most road installations, a static ignition setting of 7° to 10° advance will prove most satisfactory, but as engines vary final adjustments should be made after road testing. For certain engines a limiting bush 5/16" should be fitted over the bob-weight stop peg to limit maximum advance. Also the vacuum advance pipe is normally disconnected. (See fitting instruction)

Camshaft

Modified camshafts can be fitted to supercharged engines to improve performance, but generally speaking a full race camshaft with a lot of valve overlap should not be used as this will result in a loss of boost pressure and power, as well as a large increase in fuel consumption. This is due to too much of the unburnt or partially burnt gas going straight through the cylinder and out through the exhaust pipe.

Exhaust

All supercharged engines will benefit to a large extent from the fitting of a bigger bore free flow exhaust manifold and system, allowing the engine which is handling a far greater quantity of gas when supercharged to get rid of this additional gas flow. By reducing or eliminating the exhaust back pressure the engine will run cooler, and therefore produce more power.

Cylinder heads

As previously mentioned, many engines will benefit from a reduction in compression ratio, which can be achieved by modifying the combustion chamber and or change the pistons for a low compression set, depending on the design of the engine.

Carburettors



The Shorrock Superchargers use a single S.U. H4 1. 1/2 carburettor or Stromberg unit

With a tickover of around 750 to 850 rpm.

An S.U. H4 Specification on 998cc engine is a 90 main jet, "BG" needle and a blue spring. On 1275cc engine is a 100 main jet, "A" needle and a red spring.

Supercharger Unit C75b and C142b.

The supercharger is a positive displacement eccentric-drum-type compressor, employing four vanes. The vanes are mounted radially to the compressor casing, each vane being carried by two ball journals mounted on shafts of ample dimensions, concentric with the outer casing. The vanes are impelled by the internal rotor, which is mounted eccentrically to the outer casing, and through which the vanes pass. The angular motion of the vanes relative to the rotor is accommodated by specially designed trunnions. This construction makes practical the very fine clearances necessary for high efficiencies, since the vanes being mounted radially to the casing, and anchored by the vane shaft, cannot come into contact with the casing, yet can be run at very high speeds.

The four vanes passing through the rotor, and having very fine clearances between their extremities and the casing and the end plates, virtually subdivide the crescent-shaped chamber into four separate chambers. The inlet port of the supercharger is so positioned that as one of the chambers receives its full volume of air the adjacent chamber (on the inlet side of the until) is increasing in volume and creating a vacuum at the inlet port. Immediately the vanes have reached the position where, the chamber between them contains its maximum volume, the volume between the vanes diminishes as the space between the rotor and the casing becomes less, thus compressing the charge within the supercharge; itself, before releasing it through the outlet port into the engine manifold.

The rotor itself is carried on its own eight bearings, mounted in the supercharger end plates. The rear end of the rotor is carried by a large ball race bearing whilst the drive end is carried by a substantial roller journal mounted on the drive shaft. The drive shaft is integral with the rotor end plate, the outer race of the roller journal being mounted in the supercharger front end plate. In this end plate is fitted a twin lip seal. (Note: I have found that there are two different size rear end bearing used).

All these bearings and seals are available.

Lubrication for C75b & C142b

Particular attention has been given to the superchargers lubrication system, which is fully automatic. Due to the special design features only a very small quantity of lubricant is required to enable the supercharger to function with complete reliability.

The supercharger lubrication is obtained from the engine oil supply from a "T" piece at oil pressure switch take off, the other end being connected to the supercharger by a 3/16" copper oil pipe. The lubricator consists of reamed 5/16" bore .3125. Into this bore is fitted a finely machined restrictor or metering pin. The size of this pin is dependant upon the engine oil pressure and the viscosity of the oil used, but a range of pins is made to cover nearly all eventualities. The largest of these pins which are lettered alphabetically is the 'A' .311. These decrease in size a 1/2 thou. .0005 at a time, thus a 'B' pin will be .3105 and a 'C' pin .3100 and so on. The supercharger, when it was dispatched by the manufacturer, is fitted with a correct diameter oil metering pin in its lubricator, which should prove satisfactory for initial and permanent running. When starting up from cold there will be a slight amount of smoke from the exhaust, but this is quite normal and should clear after a few minutes running. An oversized metering pin can be fitted should signs of pronounced oiling arise. It is in place of the standard pin. After fitting the new pin check that the supercharger is receiving an adequate supply of oil. Every 5,000 miles remove the lubricator

pin and wipe with a soft rag. **Abrasives must not be used.** To remove the lubricator pin proceed as follows; (Superchargers with external brass lubricator.) Unscrew the plug at the end of the lubricator farthest from the shaft, when the plug spring and pin will come out together. To reassemble, assemble pin, spring and plug together, insert and screw down plug firmly. For superchargers with the lubricator inside the drive shaft unscrew the pipe union at the end of the supercharger, when the spring will push out the pin. To reassemble, insert the spring first, then the pin, and screw up the pipe union firmly.



It will no doubt be realised that if for some reason the engine oil is changed for one of a higher or lower viscosity some adjustment may have to be made by changing the metering pin to compensate for this, and again if a very thin additive is used, thus bringing down the oil viscosity the same will apply. It has been found that the correct rate of oiling for the supercharger is approximately one pint per 850 miles. As this is completely lost to the engine, topping up of the sump oil should be slightly more frequent. Also I should point out that although the oil used by the supercharger is lost to the engine, it has some compensation in the fact that it supplies the engine with upper cylinder lubricant nearly all the time. More especially when the engine is started from cold the presence of oil in the fuel will be visible from the exhaust smoke.

Note; The lubricating oil must be kept clean and free from sludge, as dirty, unsuitable or graphited oil will clog the lubricating passage, eventually leading to serious damage.

Supercharger and engine pulleys

Requiring so little power to drive Shorrock supercharge. Supercharge are generally driven with twin “V” belts off the front main crank pulley. There are many advantages for this type of drive, as it calls for no oiling, or attention, and is absolutely silent. With the exception on the Mini “A” series engine set-up, which requires a twin “V” 55mm jockey wheel due to the length of the vee belts, used.

The main crank pulley is replaced with the three-vee- grooved 115.5mm single vee to twin 89mm dia pulley. The 89mm size pulley is the drive for the supercharger. However in the 1960's the Mini installation kits used a 2 'V' crankshaft pulley and a single V pulley on the supercharger. Which meant that no modification required the fan cowling. In the 1970's the Mini installation kit was modified for the 998 and 1275 Coopers, that the single drive belt is replaced by twin 'V' belt, together with new twin 'V' supercharger and 3'V' crankshaft pulleys, the belt tension being adjusted by means of an adjustable tensioner pulley mounted on the front plate. The fitting of the twin 'V' belt drivesetup does necessitate some modification to the fan cowling and engine mounting on Minis

Ratio

This area I believe to be a point where pulley sizes and ratio vary from article to article and boost pressure are what one would like to see but not necessarily achievable

Anyway I record my own set-up and the results obtained. The Supercharger used was a C75b on a Downton 998cc Cooper Mk1 Mini with a new engine. Main crank pulley 89mm dia and the first supercharger pulley a 92mm. Running up to 7,000 r.p.m. I only managed to achieve a maximum boost of 6 p.s.i. Ratio = 0.97:1
I changed the supercharger Pulley for an 82mm pulley and at 7,000r.p.m managed to achieve 10 p.s.i. Ratio = 1.085:1 Ah you say but will it hold up? Well I completed the 1998 Monte Carlo rally where we drove some 4000 hard miles in 8 days from Aberdeen to Monte Carlo indirect route and back again. The supercharger never missed a beat !

This following information on ratios and pulley sizes has been handed down over the year.

First to find the ratio the calculation is as follows: - Main crank pulley divided by supercharger pulley. I.e. measure across the flat of the pulley to give you the diameter. If the crank pulley = 89mm and the supercharger = 82mm. The sum of 89 divided by 82 = 1.085:1 = ratio.

Now you have to find out what size of drive belts are required to drive the supercharger from the engine crank. The calculation is as follows: -

Crank pulley = 89 X 1.5708 div by 10 = 13.98
Supercharger pulley = 82 X 1.5708 div by 10 = 12.8806
Add both together = 26.86

Measure the distance between both drive centres i.e. crank centre to supercharger centre. I n my case it = 42cm X by 2 = 84.



Then add the number $26.86 + 84 = 110.86\text{cm}$. This = the length of vee belt required. and you should be able to find a vee belt close to this size, taking up any slack with the jockey wheel adjustment.

Its worth noting that the pulley I use only has a 40^a inc. (the vee)

Below I have listed some of the ratio and engine size data that I know about.

Early Duplex belts

Using a 70mm dia crank pulley: -

79mm supercharger pulley = drive ratio of 0.886:1 believed to have been used on 850cc engine.
74mm supercharger pulley = drive ratio of 0.946:1 believed to have been used on 950cc engine.
69mm supercharger pulley = drive ratio of 1.0145:1 believed to have been used on 998cc engine.

Later twin Vee belts

Using a 89mm dia crank pulley: -

92mm supercharger pulley = drive ratio of 0.97:1 has been used on 950cc engine.
92mm supercharger pulley = drive ratio of 0.97:1 has been used on 998cc engine
82mm supercharger pulley = drive ratio of 1.085:1 has been used on 998cc engine.
74mm supercharger pulley = drive ratio of 1.2:1 believed to have been used on 1275cc engine.
74mm supercharger pulley = drive ratio of 1.20:1 has been used on 1098cc engine.

Other pulley size also exist, but the above have been used, and size depends on what performance one is looking for.

Shorrock Supercharger kit

Installation superchargers kits were available for the following range of cars:-

Make of Car	Supercharger	Carburettor	Maximum boost
Anglia 997cc	C75b	1 – 11/2” SU	7.0.p.s.i.
Anglia, Cortina 1200	C75b	1 – 11/2” SU	8.0.p.s.i.
Cortina 1300	C75b	1 – 11/2” SU	7.0.p.s.i.
Escort 1100,1300,1300GT	C75b	1 – 11/2” or 13/4”SU	7.0.p.s.i.
Capri 1300,1300GT	C75b	1 –13/4”SU	7.0.p.s.i.
Cortina 1500. 1500 GT	C142b	1 –2”SU	7.5.p.s.i.
Cortina 1600. 1600 GT	C142b	1 –2”SU	7.0.p.s.i.
Capri 1600,1600GT	C142b	1 –2”SU	7.0.p.s.i.
Cortina-Lotus	C142b	2 – 13/4: SU	7.0.p.s.i.
Escort twin cam	C142b	2 – 13/4: SU	7.0.p.s.i.
Herald 1200	C75b		
1300 Triumph	C75b		
Viva 1098	C75b		
Hillman Imp	C75b		
Volkswagen 1200	C75b		
Renault R8	C75b		
Mini / Cooper	C75b	11/2” SU	7.0.p.s.i.
Austin A40	C75b	11/2” SU	7.0.p.s.i.
MGB	C142b	2 – 13/4: SU	7.0.p.s.i.
Morris Minor	C75b	11/2” SU	7.0.p.s.i.
Austin Healey Sprite	C75b	11/2” SU	7.0.p.s.i.
MG 1300	C75b	11/2” SU	7.0.p.s.i.
MG Midget	C75b	11/2” SU	7.0.p.s.i.
MG TD	C75b	11/2” SU	7.0.p.s.i.

Plus other cars, boats and planes. The list goes on.

Installation Parts you will require



Installation part form many different items as follows:-

1. Engine to supercharger mounting bracket, but these all vary depending on which car you intent to fit the supercharger to. Also most engine bracket require distance pieces off the timing cover of the engine. This is important, as you won't be able to line up the pulleys and the inlet manifold.
4. One 2 1/2inch length of 42mm id. rubber inlet hose and two jubilee clips
5. Engine Stay
6. Throttle adaptor
7. Engine to supercharger oil supply hose
8. Crank 3 vee pulley
9. Supercharger pulley
10. Two drive belts
11. BSP union and fittings
12. Set of BSF Bolts 1/4 x 1 1/2 – 5/16 x 1 1/2 – 5/16 x 3/4
13. Distributor bush
14. Metering pins
15. H4 1 1/2 SU Carburettor
16. Distance pieces
17. Gaskets set (or make your own)
18. Copy of Shorrock fitting instruction for the car you intend to fit a supercharger to.
19. Optional Shorrock boost gauge (like rocking horse sh-t to find)

A modern modification which one should consider on an 'A' series engine is to replace the rear scroll for BCSC crank oil seal kit due to the possible crank pressure increase.

Heating

One thing I have found that the supercharge set up runs a lot hotter than normal. This mainly applies to a Mini set-up. But if you have an installation that is running hot you can try the following to over come this:-

1. Have the radiator replaced with a two row high flow unit.
2. Replace the thermostat for a racing blacking kit
3. Fit a 74c thermostat
4. Fit my New 5 Port A-Series Alloy cylinder head with runs a lot cooler, and is 30% more efficient.

Any one of the above should bring the engine temperature back to normal running temperature.

Books to find and read

As for the published books to read, the following are worth reading if you can obtain a copy. I think most are out of print.

1. Quicker off the mark with Shorrock Superchargers
2. Shorrock Superchargers original brochure
3. Supercharging Cars and Motorcycles by Maurice Brierley
4. Turbocharging and Supercharging for Maximum power and Torque by LJK Setright
5. Automotive Supercharging & Turbocharging Manual – A technical guide by John D Humphries
6. Turbocharging and Supercharging by Alan Allard
7. Shorrock fitting instruction
8. Shorrock supercharger dismantling and reassembling instructions book
9. Shorrock supercharger installation parts catalogue

Plus many of the 1960's Autosports and Custom Car magazine's etc.



I hope this data will help those starting out in supercharging, but be warned it is not cheap, however once you have driven a supercharged car there is going back !

Good luck

Jonathan Peck ©