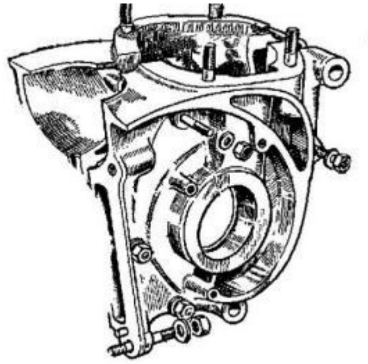
3 Crankcases



9E crankcases

Two types of crankcases were originally fitted to the Villiers motor. The first version was that of the original 9E, which featured cast in fairings for the flywheel housing, carburettor pocket and the chaincase. The 250 variant was dimensionally the same externally, but the crankcase mouth was opened up to accept the larger cylinder spigot of the 66 mm barrel.

On the off road versions of the 9E and A series engines, which used a long cranked induction stub, the carb pocket became redundant, and was protected by a cover plate which was screwed into the original drain hole, tapped ¼" for the purpose.

When the 36A and 37A engines appeared they were fitted with cases that did not feature the fairings or carb pocket, and were of a cleaner appearance. These later cases allowed cooling air to get at the main bearing housings, a problem often solved on the earlier cases by the drilling of holes through the outer fairings, it being preferable to cut away the chaincase inner and the magneto cover rather than to weaken the already fragile crankcases.

Original Villiers cases are just about man enough for the job in hand, but need a bit of work around the transfer passages, to clean up the gas flow and to increase the primary compression ratio. In standard form the bottom edge of the passage is well below the flywheel rim. What is required is the raising of the passage floor to the flywheel rim and to blend it into the passage in the crankcase mouth. This can be achieved by the use of alloy blocks screwed in from the outside or metal putty, but don't forget to redrill the bearing oil holes.

Figure 9 Crankcase stuffers

In the sixties cast alloy stuffers were available to do the job, but these were large ungainly affairs with extensions that protruded up into the underside of the piston. Their primary intention was to raise the crankcase compression, the major tuning tweak of the sixties, but did little or nothing at all for gas flow in the transfer passages.

Crankcase part numbers

9E SIBA	9E	11E	31,35A	32,33,34A	36,37A
A9077	A9077	A12087	D11657	D11787	80300
B9530	A9078	B12217	D11658	D11788	80301
	or				
	D10275				
	D10276				

Primary compression

Modern short stroke water cooled engines that employ large transfer port areas do not require a high primary compression ratio, in fact a high primary compression ratio substantially increases the pumping losses and decreases the power available. However, this does not apply to the long stroke of the Villiers unit that uses small transfer ports, even though pumping losses do increase there is a net increase in power. For road racing a minimum geometric primary compression ratio of 1.4:1 is required, 1.5:1 would be better but it needs work, 1.6:1 is very difficult to achieve without extreme measures but produces the best power at higher revs. The higher ratio is used to squirt the charge through the narrow port. The speed of the charge entering the cylinder is further enhanced by the narrowing of the port, its inlet area should be at least 150% larger than its outlet. A good primary compression will improve tractability and performance whether for road or off-road riding, don't allow this pressure to be diluted through the use of a hollow gudgeon pin.

Modern Japanese style engines should be considered as having transfers fulfilling a ‘store and forward’ function for the fuel with the real control being exercised by the exhaust. The modern exhaust shape required easy access to a supply of fuel mixture, exactly what the large transfer system supplies. What a modern system cannot do is sustain a long deep draw of fuel from the crankcase through inadequate transfer passages.

In the long stroke small transfer engines, there is significant advantage to be gained from the truly explosive entry of the compressed gases from the crankcase into the cylinder, sweeping the remaining exhaust gases out into the exhaust port in a manner described by Dr Adolf Schnuerle in 1925. As the piston descends and before the transfer ports are uncovered, a hollow gudgeon pin will bleed off some of the primary pressure that you have fought to create. The hollow pins should be plugged with an alloy or nylon slug which should have no more than a 1 thou clearance fit and be coated with Loctite or similar. Interference fits will swell the gudgeon pin causing fitment problems. The lack of interference fit is required to allow the Loctite to key and bond, a zero or interference fit will not allow the Loctite to work properly. At racing speeds, the difference in power can be measured on the dynamometer.

To measure the primary compression ratio of your motor, place the motor on the floor with the inlet tract vertically upwards and the piston at TDC. Now pour in oil from a calibrated measuring jar (20/50 or similar will do) until the oil comes up to the cylinder wall port, rocking the engine as you go, to expel any air trapped inside. Record this volume and label it as V1. Now pour in more oil to determine the volume of the inlet tract, up to the carburettor flange, and record this additional volume as V2. To V2 add the volume of the carburettor choke, up to and including the bell mouth, this is best done with a calculator. Keep a note of this reading as it is required when calculating the max torque rpm in the section on Carburation.

To calculate the primary compression ratio we must find the true swept volume of the engine

$$\text{Swept volume (SV)} = \text{Pi} \times \text{stroke} \times \text{bore}^2 / 4$$

$$\text{Geometric primary compression ratio (GPCR)} = V1 / (V1 - SV)$$

The geometric primary compression ratio (GPCR) is useful in determining whether crankcase stuffers are necessary. Be under no illusion: good primary compression is important. If your GPCR is less than 1.2 then action is definitely required, using crankshaft stuffers or crankcase stuffers or both.

On John's racing 9E methanol 1993 motor (with exact swept volume of 207 cc) and volume V1 found to be 650 cc, this works out as

$$\text{GPCR} = 650 / (650 - 207) = 1.47$$

The true (or trapped) primary compression of the mixture starts not at TDC but when the back face of the piston closes the inlet port, a tuned inlet will ensure that the local pressure is above current atmospheric pressure at the tuned rpm. The vast majority of the gas to be pumped up the transfer ports comes not from the crankcase but from under the piston as it descends, and the gas has to do a 180 turn to go up the transfers. Note that there is no pumping action from the crankcase. There is however a ramming effect from a correctly designed inlet tract which can significantly increase the gas pressure prior to primary compression starting, and this is discussed in the carburation chapter. From this it can be seen that any tuning effort would be wisely directed to the underside of the piston, smoothing out any sharp edges on the gudgeon pin boss and particularly the transfer cutaway, which should accurately match the cylinder cutaways at BDC. The bottom edge of the piston front skirt should be knife-edged to promote an oil film on the liner wall.

When originally manufactured, the casting tolerances were such that the