A visit with Steve Maney

Brent Fraser
2 Dec 2007

The shop

Index:

Crankshafts: phasing, lightened flywheels, One-piece cranks, susceptibility to breaking, Practical considerations on balance factors.

Camshaft & Lifters: design considerations

Exhaust Systems: Single pipes or two-into-one style

Carburetors and Intake configuration: Bore size, Brand, Manifold length, twin carbs vs. 2-into-1 style.

Crankcase Design: Inherent weakness of stock crankcase halves used in high output Nortons.

Transmissions & Primary drives: 4 speed or 5 speed Quaife. Considerations on belt drive pulley sizing.

Cylinder Heads: Modifications, porting, valve sizing & valve re-angling

Cylinder Barrels & Pistons: Aluminum with steel sleeves, 920 & 1007cc, compression ratio considerations.

General notes on race performance tuning: Case history of actual race engines. 920 dyno chart producing 89 rear wheel HP.

Middlestown Engineering is located at Middlestown, a hamlet not far from Sheffield. This is the shop of Steve Maney. The walls of the office are covered with race trophies and photo memorabilia. The office itself is a simple little brick attachment to the shop. The shop itself is a 200 + year old barn that Steve's dad converted many years ago.

I had a chance to tour the machine shop which houses two NC mills. Steve told me to look around all I wanted and he was going to get back to running through a batch of crank shafts. Steve says some of his biggest sellers are cranks and exhausts. Last year (2006) he brought in 3 tons of forgings. Keep in mind though it takes about 100 lbs of forgings to make a crank assembly. Steve said his supplier says he is the single largest consumer of that particular type of alloy.

Steve doesn't see a big advantage in one piece cranks and they certainly are not a requirement for high horse-power race engines. Steve says the main thing is to keep the fly-wheel weight to a minimum. This greatly reduces the stress on the crank. He says most cranks (stock ones) break as a result of twisting forces. It seems that quick downshifts coming into corners are big issue. Practically instantaneously the crank has to spin up from about 4000 RPM to 7000 or 8000 RPM. This is where a light flywheel comes in. There is less inertial weight to spin up.

We also talked about offset cranks and balance factors. Steve says many people including well known builders like Herb Becker have experimented with offset cranks. The degree of offset has typically varied from 72 degrees to 90 degrees. The upshot of all these efforts has yet to show any measurable improvement in motor performance, either on the dyno or on the track. Also there doesn't appear to be any significant or rider-noticeable reduction in vibration. It seems that when one 'couple' is eliminated another becomes more noticeable.
Although many racers have experimented with these offset cranks, nobody has continued to use them. Major detractions are building offset camshafts and ignition timing gear. Steve says that this introduces several more variables which introduce potential error. Motors are very sensitive to small changes in mechanical and electrical timing. It is worth noting that Steve's crankshaft mounted timing plate typically results in about a 2 to 3 HP gain on an 80+ HP motor. It accomplishes this by eliminating two independently

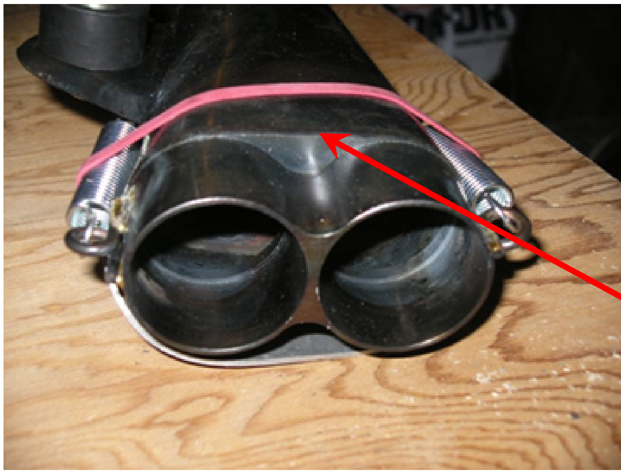
generated signals and replaces them with one. With offset cranks, the cams and timing points would have be exact. Dyno testing has yet to confirm any power output advantage to offset cranks. In Steve's words "it is all pain and no gain".

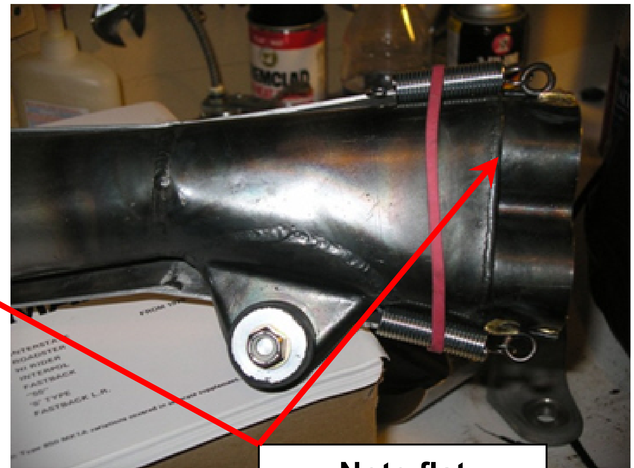
-A brief note on Steve's crank mounting ignition timing system, the system uses a Boyer ignition. Also, mounting the system requires the elimination of the alternator assembly. The race bikes use a small battery to power the ignition system for the duration of the race so no alternator is needed.

The crank conversation lead to a brief discussion of balance factors. Steve recommends staying with the 52% balance factor for isolastic commando. Practically all race bikes are rigid mount. These typically use balance factors between 70 and 80%. Steve says there is nothing 'hard and fast' about balance factors. Basically the main concerns are rider comfort and vibration in the carburetors. Steve told me several stories where vibration at higher RPM caused the fuel in the float bowl to 'froth' and the float valves to malfunction. The actual balance factor number is not as important as satisfying those two primary conditions and this will vary somewhat from bike to bike.

We also spoke of camshafts. Typically, more intake exhaust overlap will result in better top end torque. However this usually comes at the expense of bottom end power. When Steve looked at my dyno chart with the bottom end torque bog, he said a similar condition can result from excessive intake/exhaust overlap. I asked Steve about radiused lifters similar to ones required with the installation of the Megacycle cam. He said that his race cams are intended to be used with flat bottom lifters. Again, consistent with Steve's philosophy of simplicity and reducing potential sources of error, he says that radiused lifters add another variable. In Steve's experience he has seen people use lifters that are flat in the middle and radiused at the ends. He says this has the effect of 'squaring off' the valve movement. (open and close quickly with a longer, flatter peak).

We talked of the exhaust system that Steve developed. Steve says that the (primary) pipe length is critical. The magic number falls between 31 and 34 inches. He says if you go even a 1/4" on either side of that number range there will be a significant reduction in performance. Also the "collector" design is critical. The primary pipes terminate through a flat plate then the collector portion is formed around that plate, then necks down, then expands into the megaphone (see pictures below) Steve says that designs where two pipes are reverse 'Y'ed together do not work. In his words, "the pulse needs to know where it ends". A 'Y' connection simply merges the pulses and pushes them together. This flat plate design "causes one pulse to 'pull' the other one out.

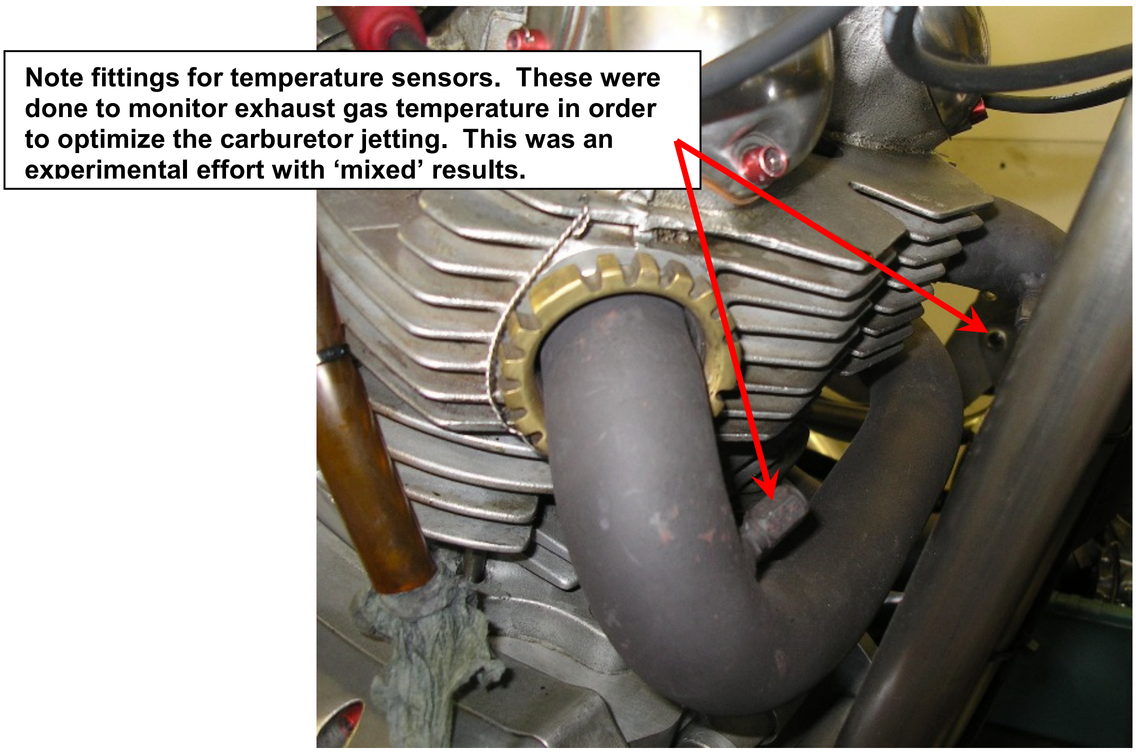




The megaphone taper and length are also critical as is the taper and opening of the reverse cone on the end. In the current version of the megaphone, the last section consists of a large diameter perforated plate surrounded by fiber glass, inserted into a large diameter aluminum cylinder. The reverse cone is attached to the end of this.

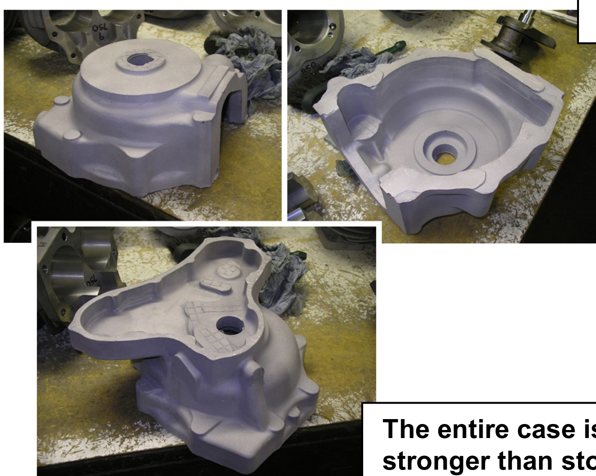
The net effect of this exhaust pipe is to greatly enhance the low and midrange torque without sacrificing top end power. Steve tells a story where he and a fellow racer were coincidentally at the local dyno at the same afternoon. Steve made a deal with the dyno operator where the dyno operator refused to release the fellow racers bike until he bolted on and dyno'ed his bike with Steve's pipes. Apparently this fellow refused to believe that Steve's two into one system would be of any benefit to him. Well, the final result was that this fellow's bike gained a full 12 HP in the midrange (around 4000 to 5000 on a race motor). The top end remained very close to the same.

I talked to Steve of my conversations with Herb Becker a few years ago regarding exhaust pipe design. Herb is still staying with individual high pipes. Apparently he gets great top end performance. It seems Herb remains an un-repentant individual pipe fan. I suppose you can't convert everybody.
In my opinion, Steve's sales of over 20 exhaust systems per year to the race community pretty much speak for themselves because these folks want to win races.

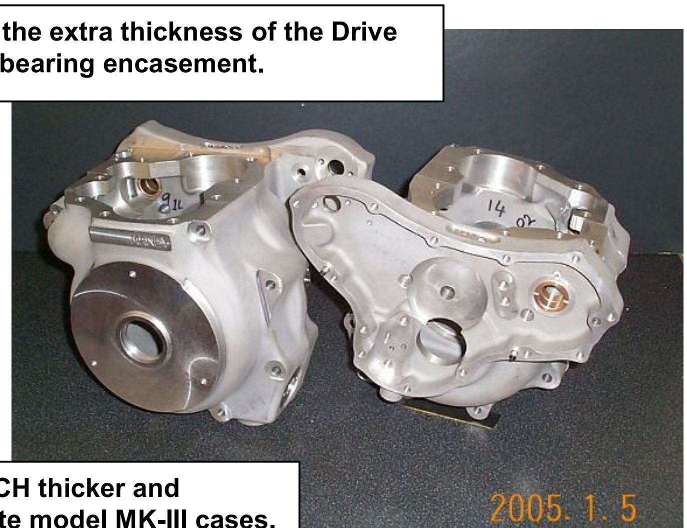


Carburetors was next on the list of topics. As Steve had mentioned to me in phone conversations, the total length of the intake plus the exhaust is the critical thing. In other words, if you add intake length between the carb and the head you must take out the same length out of the exhaust to maintain performance. But all that being said, Steve says the Norton's tend to like longer intakes. Steve feels that this is at least in part due to a reduction in vibration of the carburetor. "Frothing" of the fuel in the float bowl is not an un-common problem that results from motor vibration above the 5000 RPM range.
I mentioned that a few years ago I had talked with Leo Goff (Leo was active in building Norton Drag bikes in the 70's). Leo told me that it was a great benefit to go to a long intake manifold. Leo used a single long manifold fitted with a large bore single carb. Steve is aware of Leo's preferences.

As a side note: Steve still sees Leo at meets in America. He says Leo is still very active and keen on the motorsports business. Steve has also talked with TC Christenson's mechanic about the Norton Drag bikes. The Hogslayer motors each produced over 100 HP. Interestingly they never had a problem with the stock Norton engine cases. Steve says if you race a Norton over 60 HP it is only a matter of time 'til you split a crankcase. So how did they do it? As these drag bikes were 100 HP and above. The key here was that these guys were sponsored by the Norton factory and they routinely changed out their engine crankcases at every rebuild (usually after every meet). Chistiansen said they had crates full of spare crankcases and all other motor parts they might need. Mystery explained!



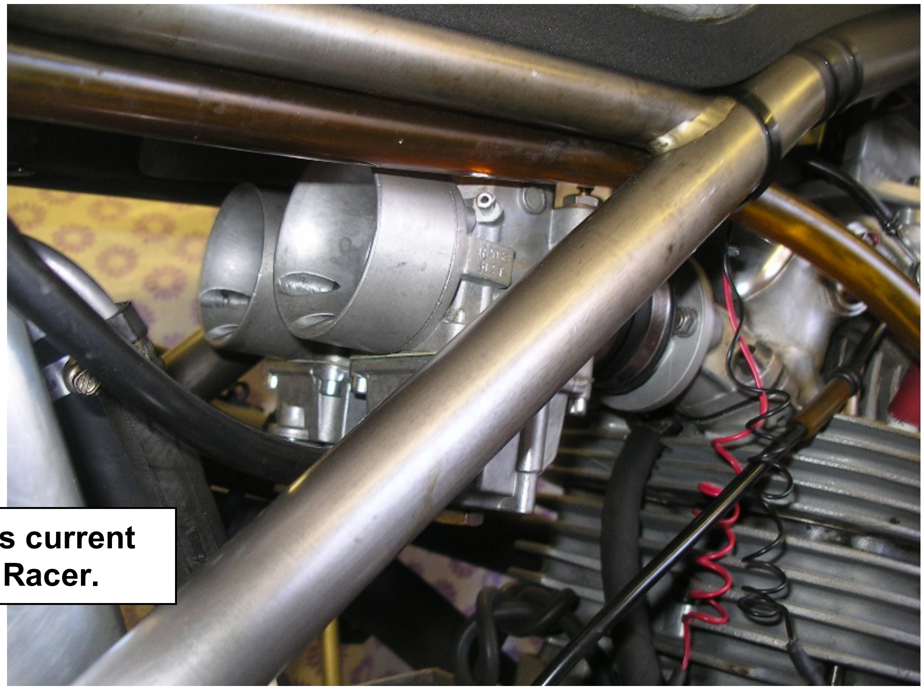
Note the extra thickness of the Drive Side bearing encasement.



The entire case is MUCH thicker and stronger than stock late model MK-III cases.

The price of Steve's crankcase sets borders on unbelievable considering the work that goes into them. 795 GBP ($1,600 CDN) gets you a set. Steve gets castings done in bulk lots and then machines them on the NC mill. I remember Herb Becker talking about machining his own cases from billet aluminum. At that time Herb estimated his total cost, including time, to be well in excess of $5,000.

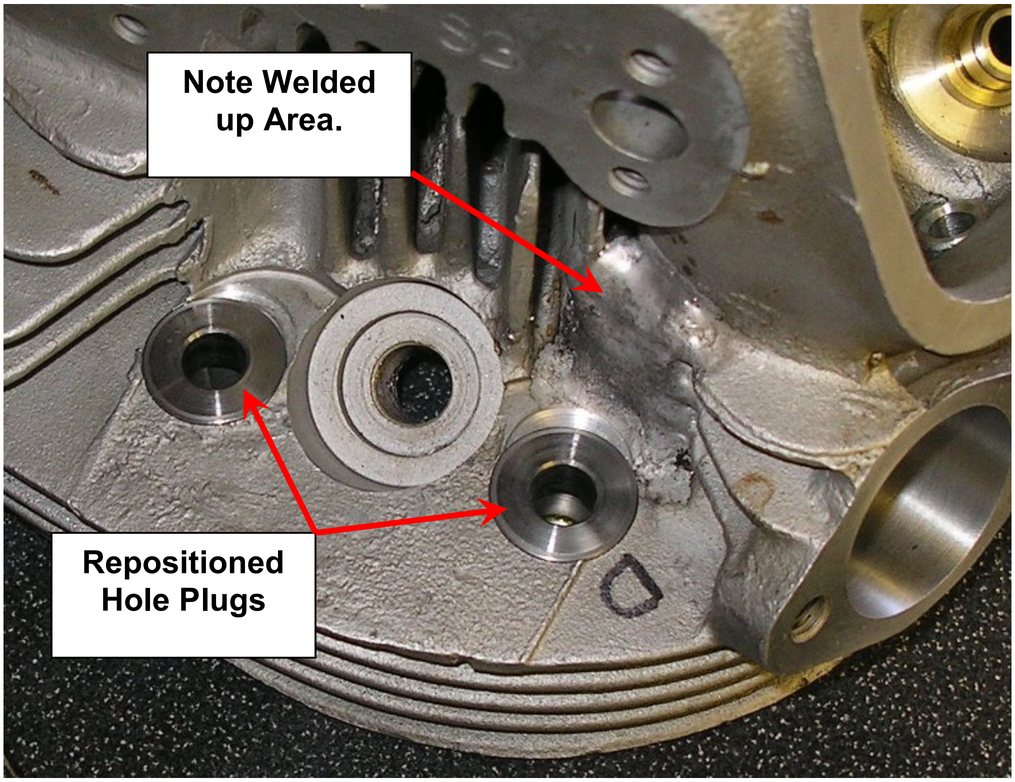
Back to carburetors. Most racers stay with big bore Amal MkII's and Mikuni's. Steve said that, in America, there is this notion that you can bolt on HP with a carburetor. This has not been proven on a dyno. The main advantage of modern design carbs (such as the Kehin flat slides) is the performance in the partially open phases. Racers typically run at full throttle or no throttle. So, as long as the main mixture is right, the style of carburetor doesn't matter. Also Steve says the modern design carbs tend to last longer and keep their partially opened throttle performance longer.



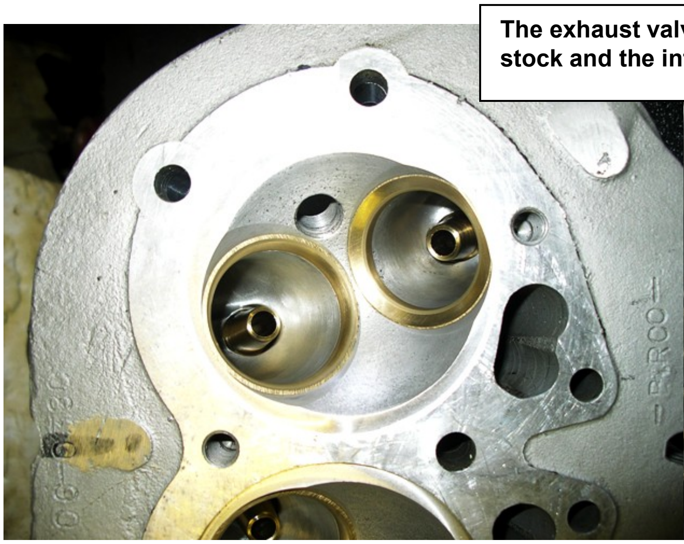
Steve's current 920 Racer.

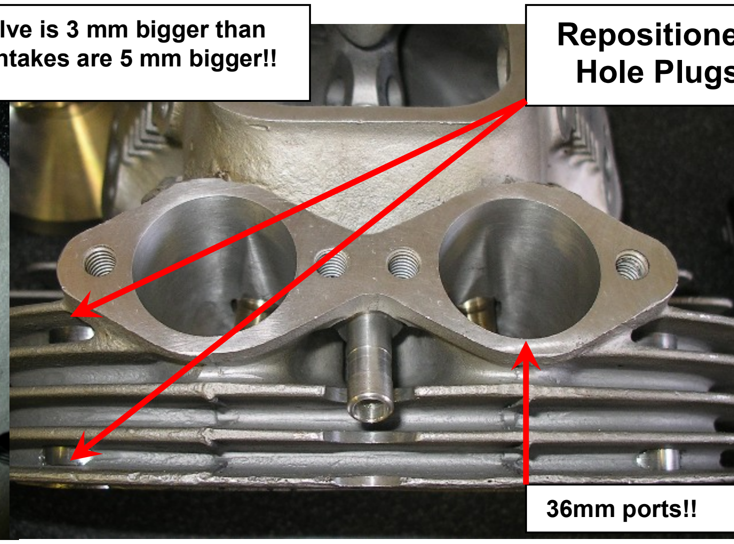
The gearboxes Steve and most racers use is the Quaife 5-speed gear set. He says they typically don't have reliability issues. The belt drive with a good size front sprocket is an essential item both for reduction in power loss and gear box life. Also, you want to go with at least 36 teeth or more on your front sprocket. This is important for adequate belt life as well as reducing the torque going through the transmission.

I had a chance to carefully examine a cylinder head for a 1007 cc motor. Steve prefers to use 750 heads for his base material. This is mainly because the ½" guides are more suitable for valve re-angling. As well Steve explained how he repositions the bolt holes. He used a flat spot-face style end mill and mills the new position down about 5/8 of an inch. This is done on both top and bottom faces. Into this aluminum plugs are fitted then the new hole is drilled in the correct location. (see pictures) Of course the oil drain hole at the back is plugged and a hose fitting is installed at the bottom-middle of the rear valve cavity/chamber.



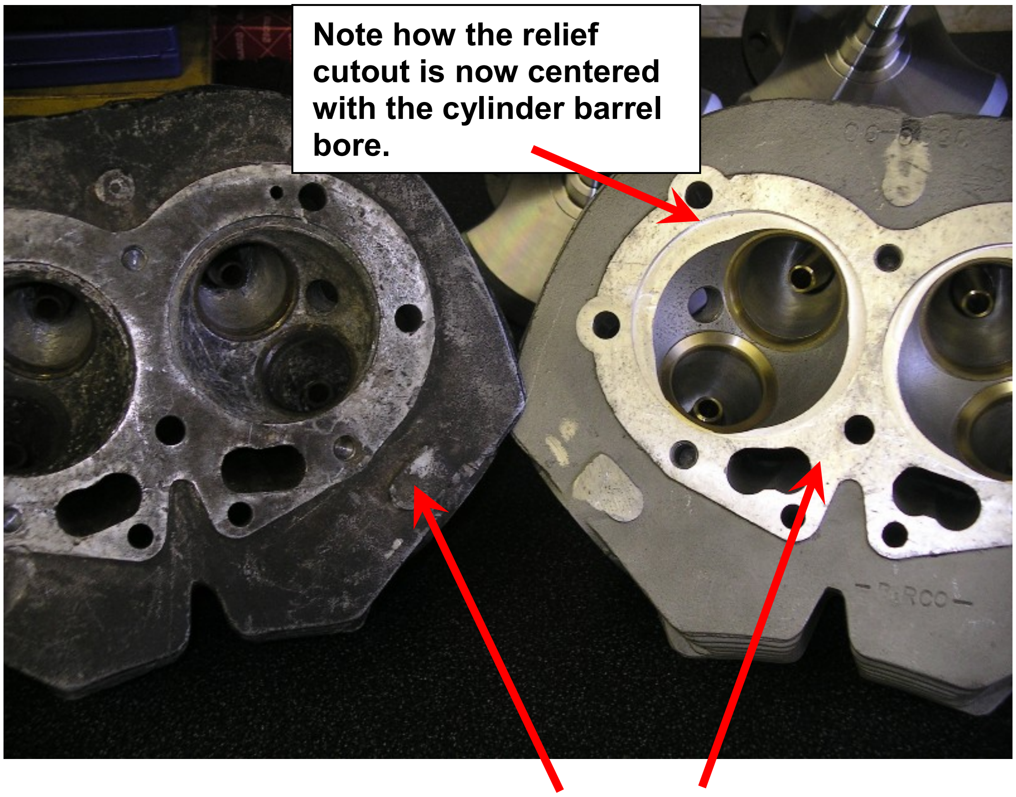
This is a 1007cc head. This represents the upper limit of what Steve can do with a head.





Steve does conversions on 750 heads for 910 GBP. That's about $1,850 CDN. With the amount of work that goes into these heads, that is one heckuva bargain.

The ports are done with a ball-nose cutter on the NC mill. To create the programming Steve took one of his ported race heads and 'touch-probed' the cavity. Each port on a Maney head is identical. Head after head….



Steve converts this into this!!!

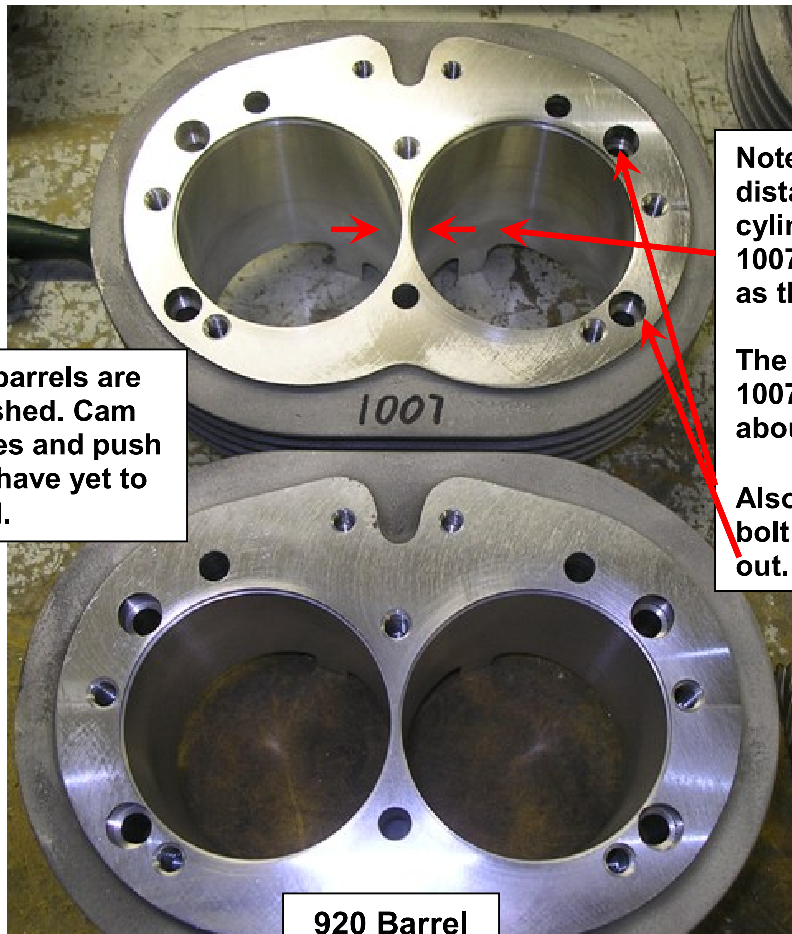
The valve seats are made from aluminum bronze which, Steve feels, is the best seat material. It is exceedingly tough. He says it is nearly like titanium to machine. I have had some personal experience with aluminum bronze and know that it can be a very high grade material. This is the first I've seen it used for valve seats though. But, as with all of Steve's work, I am confident that he gets the results he wants.

As you can see in one of the previous pictures, Steve has added some aluminum to the outside of the inlet port. This is a wall break through point for the big throat and extra material is required. That big looking intake port measures 36mm. The valves are basically bigger versions of stock valves. No exotic materials are employed and the stem size is the standard 5/16". On Steve's 'Stage 3' head conversions the inlet valves are 5mm oversize and the exhaust valves are 3mm oversize.

Some notes on the 1007cc motors: the 1007 motor has a 83mm bore and a 93mm stroke. The cylinders (and crank centers) have been moved apart about .080". This requires a modified crank and new barrels. The barrel mounting studs on the crankcases are moved out on Steve's existing castings, and mounting through holes on the head are moved out beyond standard 850 placement.
The barrels use Steve's existing casting. Also, this necessarily changes the outside cylinder head bolt placement on the head by moving them out a bit more than the 850/920 configuration.

Another interesting thing I found out is that all of Steve's <u>own</u> race motors use stock Commando con-rods. He has never had one break on him. Of course they are x-rayed and polished but that's it. However, on customer's bikes he uses Carillo rods. I think it's just a personal thing; limiting potential liability, just in case.

On to Cylinder barrels. These things are works of art. The major advantages of the aluminum barrels are two-fold. Greatly improved heat dissipation (essential for the all-out racer), and a weight reduction of about 11 lbs.



The barrels pictured above still need to have the sleeves installed in them. Steve uses about a .002" interference fit on his sleeves. He says that you don't need much crush. In fact, he says, on a Kawasaki, the liners will just fall out when you turn the barrels upside down. Also Steve likes to leave a about a .003" raised portion at the top of the sleeve when installed the barrel. This gives a bit extra crush on the head gasket and results in a better seal.

I showed Steve pictures of my stressed boring blocks and he thought that was a pretty good idea. Especially the base block. He says that sometime boring bar operators will turn the barrels upside down and use the flat face where the head mounts. This is potentially dangerous because there is no guarantee that the top surface is "square with

the world”. Something to note when a fellow is getting some Norton cylinder barrel boring done.
- Also of note, Steve always uses copper head gaskets mainly because of the superior heat transfer from the head to the barrels.

Finally, I should mention a bit about Steve’s pistons.

In my opinion these things are works of art in themselves. Especially when you compare them to standard Norton Pistons. These pistons have been designed by Steve and are manufactured by JE pistons in California. They are fitted with the 1mm ‘metric’ ring packs. Of special interest is the crown height. These pistons are a full .150” taller (measured from the gudgeon pin center) than stock Norton pistons. In most applications you will need to machine down either the whole crown or just the top outside perimeter to achieve your desired compression ratio. When fitted, these pistons (c/w gudgeon pins) will weigh in at about 400g. That’s nearly 50g less than stock. By way of reference, increasing your compression ratio from 8.5:1 to 10.5:1 will net you about 2 to 3 ft-lbs of

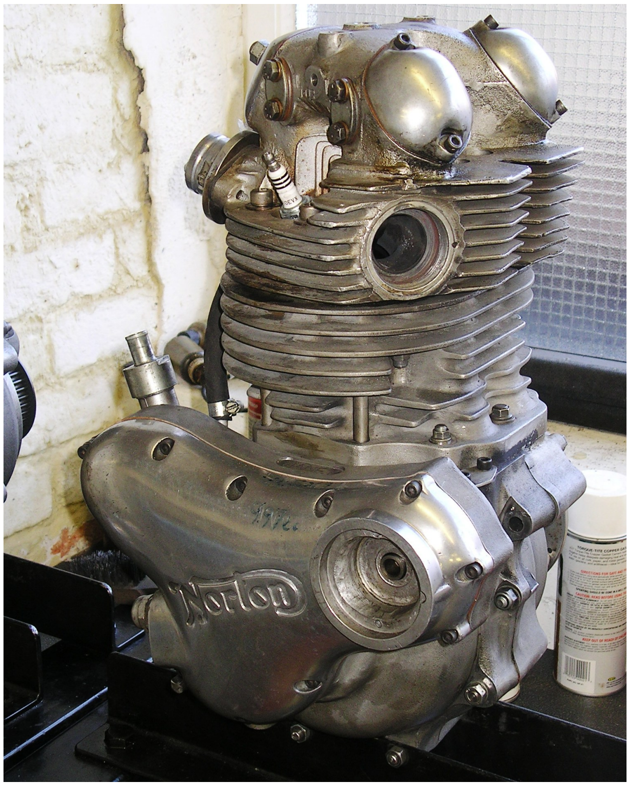
torque throughout most of the RPM range. That translates into about a 5% to 7% HP increase just on piston type alone.
I talked with Steve at length about chasing HP in the Norton engine. Increasing HP is a conceptually simple process but, as always, the devil is in the execution. In essence you need to increase your torque and move the curve further up the RPM range.

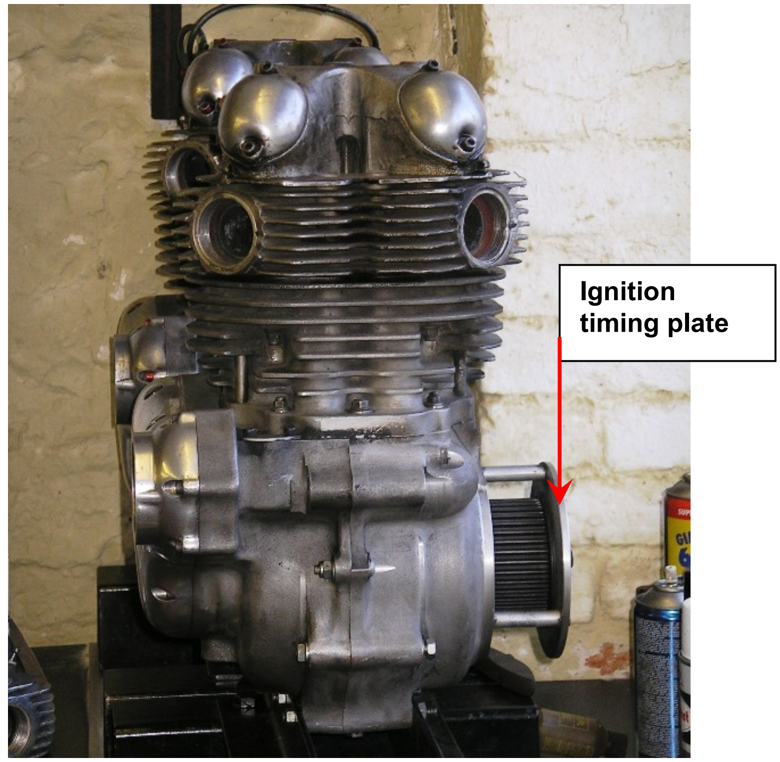
For reference, the formula for HP is simply: $$HP = \frac{\text{Torque (ft-lbs) x RPM}}{5252}$$

As Steve says "everything is related to the other and all the modifications have to work together as a system." Increased torque is mainly achieved by increasing the compression ratio, piston top area (bore) and maximizing the amount of fuel/air mixture that enters the combustion chamber every charge. Increasing the "charge" density is mainly accomplished through favorable resonance or compression wave harmonics. The tools of the trade here are increasing head flow, camshaft design and exhaust/intake design.

It is this latter "increasing the charge density" through resonance and compression wave harmonics that is the realm of the experienced tuner/designer. Very few people have had the degree of success here that Steve Maney has had. This has not come cheap or easily as Steve readily attests. Steve's performance tuning modifications and performance parts are, predictably, the result of a racing career spanning more than several decades. Steve has been meticulous in finding and designing modifications and performance parts that work. His parts and performance systems are systems that work (and work together) and will produce the stated results on the dyno or on the track. Few other parts suppliers can make that claim.

Steve also shared lots of race stories. Some of them personal experience and some of them stories of his customers. He told me of an Irish open class vintage race (called the "Irish Road Race" where he has a couple of Irish guys that run his motors. At the end of every season these guys send their motors back for a total tear-down and rebuild. He says that particular race and race course is very brutal. It is similar to the Isle of Manx in that it is run on existing street roads. Apparently they have long straight-aways where they get up to and hold over 150 MPH. Steve says if his motors can survive the punishment these guys dish out, they can take anything. Take a look at the following pictures. This motor is a 1007cc unit. (it says 997 on it but that is a political thing. The class limitation is a 1000cc's but they allow a percentage over-bore. Hence the racer/owner fitted his bike with an all-out Maney 1007cc engine but it is classed as a 997)

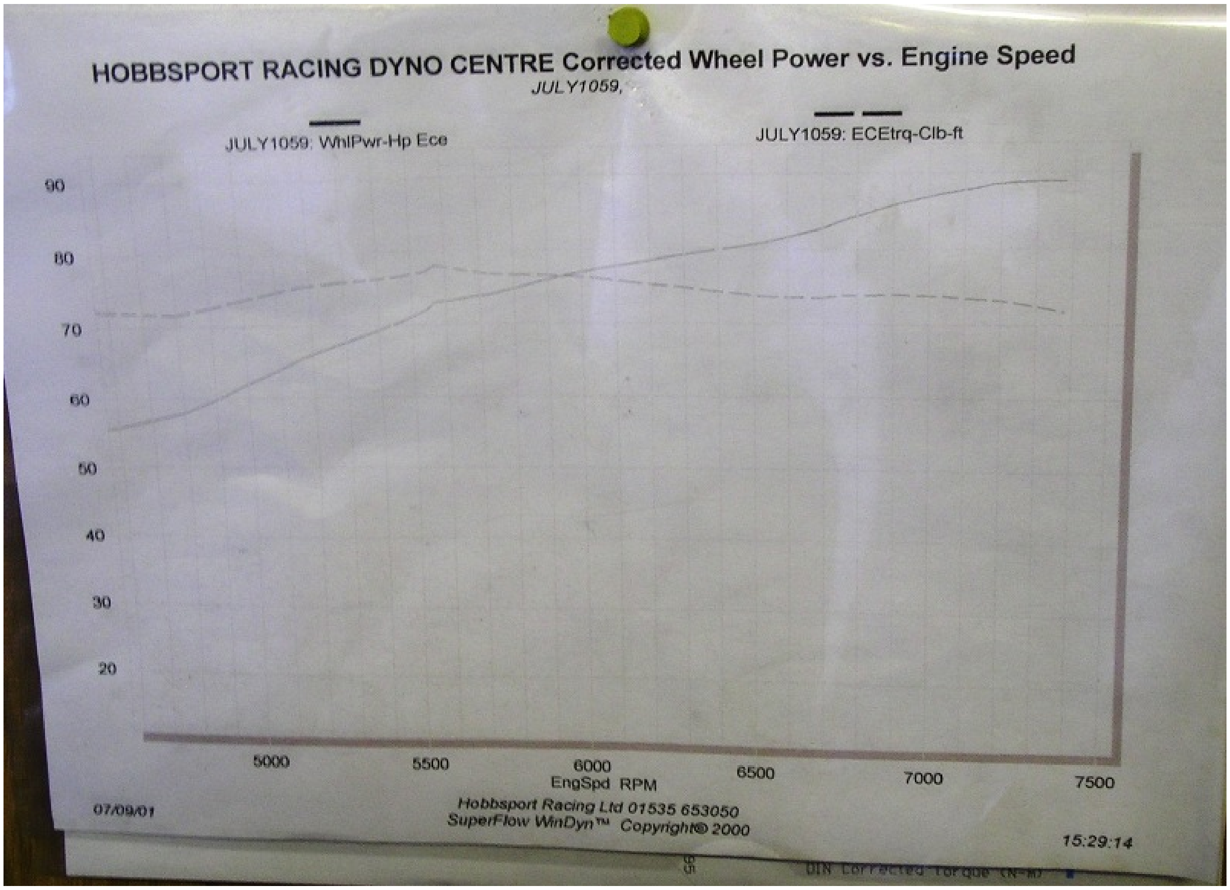




This motor has spent a full season racing, doing it's thing, producing over 100 crank HP. It has not been washed. Note the slight seepage around the head gasket area and rocker boxes. That is a very small amount of seepage, considering the punishment the motor has been through. Also, note the race sized belt drive pulley and the timing plate for the crankshaft driven ignition timing mechanism.

Some further notes on Steve's motors:

- Steve's 920 motor on his racer produces 89 Rear Wheel HP at 7400 RPM (That's over 100 Crank HP) and 79 ft-lbs of torque @ 5600 RPM (see dyno chart below)
- Steve's 750 racer produces 83 rear wheel HP at 7600 RPM (92 crank HP). (I don't know the torque figure but it is somewhat less than the 920. The HP is made up by the increased RPM afforded by the shorter stroke crank.)
- By projecting the performance characteristics of the 750 and 920 motors, the 1007 motor should, theoretically, produce 107 Rear Wheel HP (or about 117 crank HP). Steve feels this may be somewhat optimistic but is confident that he will see at least 100 Rear Wheel HP.



I asked Steve what a full blown race bike would cost. He said he wouldn't think about starting without a minimum 30,000 GBP budget. That's over $62,000 CDN. Racing's not cheap but for the Norton fan, "you can't put a price-tag on a good time"!

Steve offers much more in the way of Norton Performance than what I've mentioned here. To see the full range of his offerings visit his website at:

http://www.stevemaney.com

If you want to contact me, I can be reached via e-mail at:
jbrentfraser@gmail.com

THE END