

NEWSLETTER December 2019

COMMENT

Once again, we come to the end of another creative, interesting, and informative year for PEEMS. We wish all our members a great New Year, and expect 2020 to be equally good (if not better than 2019) with regard to creativity and interest. There will be no newsletter in January.

FORTHCOMING EVENTS

January 2020

There Is No Club Meeting In January

Workshop Morning: Tuesday 21st January 10-12 noon

PEEMS Talk To Residents at Mickle Hill Retirement Village ~ Wednesday 22nd January 2.30pm.

February 2020

Club Meeting: Wednesday 5th February - Chris Kelly from the North York Moors Railway will speak on "Boiler Smithing".

Workshop Morning: Tuesday 18th February 10-12 noon.

CLUB MEETING: Wednesday 4th December ~ A Talk By Pete Smith About His *Norton Special* Motorcycle.

Our new Chairman, Jonathan Milner called the meeting to order and started with the usual housekeeping and other announcements.

- Brian Mallot passed away last month and his funeral was today (the 4th December). The Club was represented at his funeral in Flamborough, on that Wednesday afternoon. PEEMS would like to extend our sympathy and condolences to Brian's family at this sad time.
- Workshop Morning: On Tuesday 21st January there will be a workshop morning, at the usual time of 10am. If anyone wants to use the workshop before then, please get in touch with Jonathan.
- Events in January: There will be no Club meeting in January as is normal, but there will be a workshop morning on Tuesday 21st January (see above), followed by a Committee meeting. On the next day (Wednesday) the Club are giving a talk and presentation at *Mickle Hill* at 2.30 pm. It's a long way ahead but if anyone wants to come along, please do. It should be nice and warm there!
- **Railway Stability.** At October's club meeting there was a discussion about the operational stability of the locomotive and carriages. This was discussed again at the Committee meeting. After a lot of discussion, the conclusion was that it was important to control passengers alighting from the carriages. One suggestion was to have a rope or bar across the carriage doorway controlled by an attendant. This seems a simple and effective solution. This idea will be implemented before the railway is used again. If anyone else has any ideas, please let the Club know.
- Safety Officer: There is still a vacancy for a Safety Officer in the Club.

• That's North Yorkshire Freeview Channel 7:

If anyone is not aware, "*That's North Yorkshire Freeview Channel 7*" visited the workshop morning last month and recorded a brief programme. It was Jonathan's 'baptism by fire'. Jonathan doesn't know how many watched it, because Freeview was going through a retune phase. Jonathan has Sky so tried to view it on YouTube the next day, but no joy yet. Jonathan had a call from a neighbour who saw it and said it was OK. Looking at their YouTube channel it looks mainly a charity orientated channel. The Club turnout was brilliant considering the short notice, so thanks to everyone who made the effort.

- Arc Euro Trade Ltd. (tools and tooling): Ted Fletcher has asked that if anyone wanted to order anything from *Arc Euro* he would like to join in to split delivery costs.
- **Silver Soldering**: Following on from September's meeting and the talk about *Silver Soldering*, a member said that he had never needed to silver solder, yet but would like to watch and learn via a practical demonstration. We have a workshop and equipment, so if anyone wants to do any silver soldering, and at the same time show how it's done, please do. Jonathan has 'stuck things together' but in no way considers himself very competent so would appreciate any practical tuition. How about anyone else?

A Talk By Pete Smith About The Development Of His Norton Special ES2 Motorcycle.



Introduction

Peter Smith thanked PEEMS for inviting him down, and introduced himself and Len Auckland, who is Peter's '*Ideas Man*'. Len had a big part to play in the development of the *Norton Special*. Peter wanted to thank all the people who had helped, two of whom were at the meeting ~ Richard and Rob Gretton. Richard and Rob have been one hundred percent behind the project, and have fallen over backwards to help when needed. Bill Sweeting has also played a big part.

A Bit Of History

The story begins in 2006 when Len wanted a *Boxford* lathe. There was one for sale in Plymouth along with several racing bikes. There was a filing cabinet marked *"ES2"*. They bought the *Boxford*, and Peter went back the next week to transport the lathe on a pallet. Looking into the filing cabinet, there were some cranks, crank cases, and heads. There was also a frame, spokes and a tank. Peter reckoned he could build a good bike out of the *ES2* parts, made a deal. He transported the parts in the back of his car. When he got home he found there were components missing, such as a piston. This was February 2006, and by June the components had been manufactured, a new piston had been bought, and the bike was running. The bike runs on methanol.

The bike was taken to Oliver's Mount and it won. Peter thought *"this is brilliant, this is a 500cc and it flies".* After trialling it all year, Peter decided to develop it further.

During the winter it was dismantled. The frame was plastic coated, and aluminium mudguards were put on it. However, it was still a standard *Norton ES2*, with a 500cc pushrod engine just *"tweaked here and there"*. It was producing 30 BHP, on the back wheel using methanol. Originally the bikes were 18 bhp on petrol, so it was doing quite well. The bike ran through the next year, and it did well winning *The Auto 66 Vintage Class Championship*.

Development

Peter then decided to bore out the engine to 640cc. Len suggested they '*stroked*' it a little bit. A longer stroke means more torque. This means getting the power to '*'dig it out of the hole, and get it up the hill*'' at Oliver's Mount.

• The Piston

The original piston dimensions were 79 mm diameter with a 100 mm stroke. Peter and Len had to decide what pistons they could get, as it is one of the crucial components. Pistons are hard to make, especially when they are stressed up running on methanol. They started looking at *Manx* pistons which are 86 mm diameter, and can be bought 'off the shelf'. Peter and Len went to work on a 110 mm stroke. They then had to consider how far that would stretch, and what they could do, because this all has to fit in a frame. This was tried out on a piece of card, and was mapped out. (CAD ~ Cardboard Aided Design! Ed.). Once the mechanism was decided upon, they had to find a rod. They sourced a *Carrillo* rod from America.

• The Barrel.

Peter and Len then looked at a standard Norton Barrel. They found this was inadequate for the new requirements. This meant they had to make a new barrel. They went under the bench and found a pressure vessel. They were able to get a cast iron liner from *Westwood Cylinder Liners Ltd*. Peter did a lot of research in magazines to find these suppliers. The liner in the pressure vessel looked a good possibility, but what could they do for cooling fins? Methanol doesn't need much cooling. In fact there is a problem getting the engine hot, so the less fins the better. Peter already had a *Triumph* 'Open Bore Sprocket'. It was a solid blank. Peter trepanned the middle out of the sprocket. It was machined down and then shrink-fitted and welded onto the barrel, forming the bottom fin. The top two fins were formed from an aluminium pulley. These were also machined, shrunk onto the barrel and welded.

Grooves were machined in to allow the oil to come back down. It took three months to make the barrel.



The barrel with the three fins on it was machined in the lathe. Plugs were manufactured for the bottom to centralise it and to make sure that when it was removed from the bike, it could be put back in as many times as was needed, and it would still run true.

• The Head

The head needed to be modified. This is where Len's ideas were exploited, and every other fin was taken off to get the heat into it.

The standard ES2 head has two 1³/₄" valves. Len's new head incorporated a cast iron weld and a bigger inlet valve. The exhaust valve was welded up at the same time to make it smaller. This is a departure from *Norton*, and is the modern way of doing things. *Lotus* actually did this. It is a *Lotus* concept. The results of this type of design is that the fuel ignition is better. There was lot of work involved.

These modifications were pushing the design in the right direction, but the compression ratio was over 18:1, which is far too high, even for methanol. This meant the further machining of the pistons until the compression ratio reduced to a respectable 15:1.

The Crank Shaft

The next item to be made was the crank shaft. The crank shaft had to be developed to cope with the increase in stroke from 100 mm to 110 mm. Bill Sweeting had the idea of using a face-plate. Two disks were faced across, top-turned, clamped to the face-plate and then centralised. A hole was then bored through the middle for the main shafts. A button, the same size as the main shaft, was made. The face-plate was then removed, drilled and tapped at 55mm from the centre, and the button was put on. The fly-wheels were then put on and the assembly was clamped up. The *'Big-End'* holes were then bored out.

'Balance Factor'

A *'balance factor'* was derived. The derivations are included in a book called *'Tuning For Speed'* (Phil E. Irving). This contains a lot of maths and equations. Peter and Len took a more empirical approach, weighing components and removing metal by boring six holes in the fly-wheel on a rotary table. This was done until a *balance factor* of 70% was achieved.



An *INA* '*Big-End*' needle roller bearing was used which was originally bought for a Norton *Manx*.

The *Carrillo* rod, bearing and flywheel were pressed together, and set up on two plates so that all the assembly ran true when clamped.

Running The Bike After Modification

Once the crank shaft was assembled back in the crank case, the bike was ready for running. The developed engine guaranteed quite a bit more torque than the original. The bike ran all year. At the last meeting at Dalby Forest, the bike had a *'fast blast'* up a hill, where it 'coughed' a couple of times. Peter then free-wheeled back down. At the start of the next run, it was found that the engine would not turn. After Peter took the bike back home he found that the engine had *'locked up solid'*. When he took the engine to bits, he found the roller bearings in the main bearing had got very hot.



Roller Bearings In The Main Bearings



Main Bearing (Inner)

The Crank Case Retrofit

When running, the bike had the original crank case, and Peter thinks that there was so much power due to the increase from 18 bhp to 40 bhp, the main shaft had actually distorted the casings and 'glued' the bearings.

Len found he could file the bearings because they had got so hot they had lost their hardness. Len did an experiment with his gas torch, warming a ball bearing up, and it was 'cherry red' before he could file it. This gave an indication of how hot the bearings had got.

At the time, crankcases were very cheap. Peter came across a pair of 'alternator cases' which were '*beefed up*' to mount an alternator around the crank shaft. Peter decided to use a pair of these stiffer crank cases. Len had an idea of shrinking a ring on, picking up the three mounting screws to the alternator to make it much stronger.

The bike was run again, the performance was still there, but there was a much stronger casing. There was a twoday meeting, with Elvington on the Saturday, and Oliver's Mount on the Sunday. At Elvington, Peter came out of the circuit in too high a gear, an action which resulted in the cases 'lifting', causing a large crack shown in the following photographs.



Peter and Len then decided the only option was to cast new crank cases. They referred to John Bradley's books which are brilliant for constructors, giving information on how to make brackets, what types of steel and aluminium to use. They are good informative books.



Some patterns needed to be made for the castings and LM25 aluminium was decided on. *Mallory's Metal Recyclers* in Scarborough, had some aluminium (aluminium wheels are LM25). If Peter and Len could make patterns for the cases, Mallory's were prepared to pour the aluminium.

Patterns



Crank Case Pattern Showing The 'Posts'

When making patterns the concerns are the shrink rates and the angles etc. Peter made some patterns by modifying old crank cases. He added 'posts', so he could eventually spin the castings on a lathe face plate. Webs were also incorporated to strengthen the castings inside. Using modelling clay and cocktail sticks, features were included such as a filter, to stop bearings being sucked up into the oil pump as they had been before. The patterns were then sprayed with *stone chip* paint (as used on cars) to build up the thickness, and then they were varnished. Peter then realised that in order to manufacture the castings, he should seek out someone who really knew what they were doing. He decided on *Derek Harper Foundries Ltd*. This company makes beautiful bronze fins for pumps. They gave a quote which made the decision to go with them viable. Peter then decided to have two sets of crank cases made. After they came out of the foundry they still needed heat treating. This was done at a firm in Birmingham who make *Aston Martin* parts.

The Final Crank Cases



Crank Case Castings

There are two cases, the timing case and the drive case. These are pre-positioned and drilled to mount up on the slots in a face plate. The registers then have to be made. There are male and female parts, which when pushed together make sure the main bearings are in line. These photos show the crank cases being machined:



Crank Case Being Rotated On 'Posts'

Crank Case Being Machined



Crank Case Being Machined

The crank shaft took three months to make, the barrel took three months to make and the crank cases took six months to make. Half way through milling the cases, Peter changed the milling machine head to a "Bridgeport Head" because it is far more versatile. The machine was used for boring out where the barrel and the push rod go, by putting a plate on the bed, because it wasn't long enough. A right-angled drive was then put on with a cutter and it was used like a horizontal milling machine. There was further work using a faceplate template and some sacrificed crankcases to drill all the matching holes for the drive and timing cases. Cam shaft and main bearing crankshaft holes had to line up, as well as the holes for the oil pump.



Comparison Of Old and New Crank Cases



Components Manufactured For The Norton ES2 Special

Questions and Answers

- **Q** There was a lot of work involved, but was it worth it?
- Peter Well, there is now approximately 50 bhp at the back wheel (originally 18 bhp) with 45 ft lbs of torque.
- **Q** After all the modifications, what capacity did the engine have?

Peter 640cc single.

- **Q** Does it take much starting?
- Peter No. You can run and bump it, but I have built a starter for it now which can start it from a battery. Bumping starts it instantly.
- **Q** Were the flywheels made from scratch?
- **Peter** Yes. They were made from two EN19 steel flat disks supplied by *Boothams*. It's a nice steel to turn. As you saw, the flat disks were faced off and then the recesses and cut outs were machined.
- **Q** Are the shafts 'in-situ'?
- **Peter** No. The shafts are pushed in, they're pressed drive shafts. The '*Big-Ends*' are pressed in with castellated nuts.

- **Q** Does the exhaust have to be tuned to get extra power?
- **Peter** Yes. We put a Dyno on the 500cc and found that pulling it forward an inch increased the power. There is an optimum length on it. In front of the carburettor, there is a big tube that threads onto the head. We had the idea that it could be bored out in order to slide in an aluminium tube in which there was the diameter for the Venturi. We put it on the Dyno three times: one with parallel sides, one with a slow taper down the length and one with parallel sides but 'nipped in'. We thought the parallel one would be best, but there was no difference between them, probably because the engine's sucking so hard with a 110 mm stroke.
- **Q** With the LM25 aluminium, did you part machine the crank case castings, before you had them hardened or did you just machine them?
- **Peter** The castings were already hardened before we started machining them. It actually machines like steel. It comes off as chippings and shavings.
- **Q** Is the *Big-End* a pressure fit?

Peter Yes.

- **Q** What sort of oil pump pressure did you run at?
- **Peter** Very little, because of the roller bearings. It's not like a 'white metal' bearing where you're running at 60 ft lbs when it's cold and 20-25 ft lbs when it's hot. You don't need much pressure, as it's *'escaping out of the bearings'* all the time.
- **Q** Where did the rod come from?
- Peter America. Carrillo, a well known I section steel rod.
- Q Was it made specifically for you?
- **Peter** Yes, actually it was. We were working out the size of everything, and were compromising with the rod, to bring everything down to fit in the frame. We ended up with a *G50 "Matchless"* rod. However, the "*Little-End*" was a different size. We needed a bigger "*Little-End*". So the rod was specially made. *Carrillo* are used to "one-offs".
- **Q** Did you stick with your original cam-shafts?
- **Peter** When the bike came as a 500cc, it already came with some cam shafts in. However, it came with a spare set which I put into that engine. If you send a blank cam to *Phil Joy*, he will usually also want your followers and *Stellite* so he can grind them all to suit.
- **Q** Did all these modifications alter the class you raced in?

Peter No, because it is Vintage Class. Our bike fits into the 'above 350cc and before 1958' Vintage Class.

- Q What '*Red-Line*' do you have on it, and do you get 'valve float' with high compression?
- Peter When the bike was a 500cc, it revved to 6000 rpm and no more. Whatever we increased the engine size to, we increased the inlet tract too. We thought it would stop at 6000 rpm. On the Dyno with no rev counter on it, it went to 7500 rpm, and it was still going. It was still providing power at the top end. I wanted to take the *Vintage Class Hill Climb* record at Oliver's Mount, and I did it, but the engine was at 7000 rpm most of the way up the hill. I've never matched those times again and have always stuck to 6500 rpm max.
- **Q** Did the clutch stand it alright?

Peter Yes. It came with a 'Bob Newby' clutch which has a belt drive rather than a chain. It's a strong clutch.

- **Q** Did the modifications have any effect on the gearbox?
- **Peter** The output shaft bearing on the gearbox is taking all the punishment during the runs with full throttle and the *'dumping of the clutch'*. The shaft tends to 'go oval' in shape. In AMC boxes that have raced, the bearing houses go oval, and this is similar. I ended up buying a brand new and much stronger casing from RGM.
- **Q** Are you hoping Oliver's Mount will open again?
- **Peter** Yes. They've done well with the road races this year, and they've got a programme for next year, so let's hope the hill climbs are included in it.

The meeting then came to a conclusion for tea and biscuits.



PEEMS would like to thank Peter and Len for all the work they have done to bring us such an interesting talk.

Peter has given kind permission to reproduce his photographs in this newsletter, and thanks go for his help in compiling this article.

Ivan Shaw and G-SEKR

Ivan currently has G-SEKR hangered at Leeds East Airport (ex RAF Church Fenton) where the aircraft is currently undergoing brake adjustments and systems checks.

We will keep you up to date with developments, as Ivan is taking it very carefully during this phase of ground testing.