NEWSLETTER September 2019

FORTHCOMING EVENTS

<u>October</u>

Club Meeting: Wednesday 2nd October – **"Bring and Brag"**

Workshop Morning: Tuesday 15th October 10-12 noon.

<u>November</u>

Club Meeting: Wednesday 6th November **– Annual General Meeting (AGM) + Pie and Peas.**

Workshop Morning: Tuesday 19th November 10-12 noon.

CLUB MEETING: Wednesday 4th September. '*The Art Of Silver Brazing'*, a talk by Shaun Meakin of "CuP Alloys (Metal Joining) Ltd ".

Chairman Colin Bainbridge welcomed members and guests to the meeting, for which there was a good turnout.

- **Annual August Club Auction.**

The club auction was very well attended, with a lot of interesting items for sale. The evening was very successful both for sellers and purchasers. Some sales resulted in welcome donations to club funds. Colin thanked everyone who brought items for sale.

- **Mickle Hill Retirement Village Summer Fair** (17th August).

The fair was busy and the PEEMS stand generated a lot of interest. Colin thanked everyone who took models, and helped on the stand. The summer fair is good publicity for PEEMS, as it is open not only to the residents, but also to the general public. The club has been asked by *Mickle Hill* to give them a talk later in the year, and from that maybe PEEMS will get a few more members.

- **The Midlands '*Model Engineer'* Exhibition on Saturday 19th October**

Charles Hill has organised a luxury mini-bus to the Midlands '*Model Engineer'* Exhibition. It will be a 7am departure as it is a long way to the exhibition. The pickup points will be at the following locations:

- Thornton Le Dale Bus Stop.
- Pickering Eastgate Carpark.
- Old Malton opposite '*The Royal Oak'.*

As of the club meeting, there were sixteen seats available. The cost is £10 per person, which is very good value, so if anyone is interested, please get in touch with Charles. His contact details are in *The Members List.*

- **Welburn Hall School**

The usual annual trip to *Welburn Hall School* in June was cancelled due to poor weather. PEEMS were seeking an alternate date in September. In the absence of the traction engines in September, there was a need to find some alternative attraction(s) to supplement the railway. Colin has recently received an e-mail from the school saying that owing to unforeseen circumstances, they were unable to accommodate PEEMS this year. They were however, keen to accommodate PEEMS next year.

- **Management of The PEEMS Workshop.**

  At the last club meeting, it was announced that John Powell and George Gibbs, were intending to give up the running of the club workshop. Colin has already asked for someone to take on this role, and as yet no-one has come forward. Jonathan Milner has said that he is willing to run things in the event that no-one else came forward. If there is anyone who would like to take over as Workshop Manager, please let the Chairman know.

- **Officers of the Club.**

  Colin once again asked members to stand as officers of the club at the AGM in November. There is a candidate for *Club Secretary* (to take over from Tony Leeming). There is also a requirement for a *Vice Chairman* to take over from Jonathan Milner. The *Vice Chairman* will take over as Chairman from Jonathan in 2021, and to deputise for him in the event he cannot attend any meetings in 2020.

- **Further News From Paul Windross At Elvington Airfield ~ Guy Martin and '*Top Gear'***

  Elvington 10th September 2019 was a hectic day with BBC '*Top Gear'* filming various cars and some of the more unusual machines.

  For me, the climax was Guy Martin riding a Jack Frost prepared machine, achieving a terminal speed of just over 270 mph. **

  Guy is just like his TV performances, a very hands on person and very good with the spanners.

  Please note: Elvington records attempt days might be numbered as an application has been made to build a large number of houses on the airfield.

  Paul

  ** The '*Straightliners*' record sheet is shown on page 18 of the newsletter. Guy Martin was the fastest on the day.

The Art Of Silver Brazing, a talk by Shaun Meakin of "CuP Alloys (Metal Joining) Ltd ".

PEEMS welcomed Shaun to the meeting and what followed was a very informative and detailed explanation of *Silver Brazing*.

Shaun's first slide introduced the talk, the title being *"Brazing Made Easier ~ Not Easy".* The reason is that brazing is a skill, but it is an easily acquired skill, providing the principles described in the talk are adhered to.
The principles apply to any supplier's materials not just **CuP Alloys**, but the talk referenced **CuP** materials.

Some History

Brazing is a very old process, used for over 5,000 years. Egyptian jewellery found from that era shows very intricate brazing. One example is small gold beads brazed onto a gold bracelet with gold alloys. 5,000 years ago, only gold alloys were used. Gold isn't used today because of its very high price. The skill in brazing at the time was phenomenal. Traders took brazing to China and India, and eventually the techniques found their way to Northern Europe. It wasn't until the 19^{th} century that it was recognised as an industrial process, used mostly for jewellery and ornaments. The principles used then though, are exactly the same as in modern times.

Why Braze?

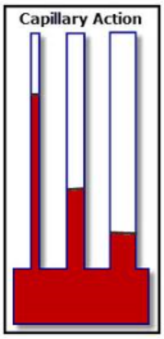
- A very versatile process
- Produces strong joints
- Produces ductile joints
- Relatively quick process
- Can join similar and dissimilar metals e.g. Copper to copper, brass to brass, copper to steel, brass to steel etc. It is not so easy to join these metals with any other process.
- It is a low temperature process. In welding, the parent metal interfaces are being melted. brazing is done below the melting point of the parent metals.

What Is Brazing?

The definition of brazing is*: "The joining of two metals by capillary flow, by using heat with a filler rod, with a melting temperature above 450°C, but below that of the parent metals."*
Brazing is therefore above 450°C melting point. Anything below 450°C is "soldering".

Shaun's talk was specifically about "Silver Brazing".

Capillary Flow.



The two vital words in the definition of brazing, above, are *"capillary flow".* This is where brazing is different to welding, and indeed soldering at lower temperatures.

What is meant by capillary flow? Capillary flow is an action where a liquid flows between two parallel surfaces, without the effect of gravity. A sugar cube on a cup of tea will absorb the tea and it will go up the cube against gravity, due to the small gaps in the sugar grains. As is seen in the picture, the closer the two parallel sides are together, the greater the capillary flow.

There are a couple of actions/stages that need to be done to promote capillary flow:
Joint Length and Joint Gaps

Joint Design.

Joints fall mainly into two categories:

- Butt Joints
- Lap Joints

- **Joint Length**

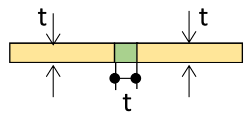
  Butt joints aren't the best type of joints, but they are probably sufficient for model engineering. One of the reasons for that is the concept of joint length.

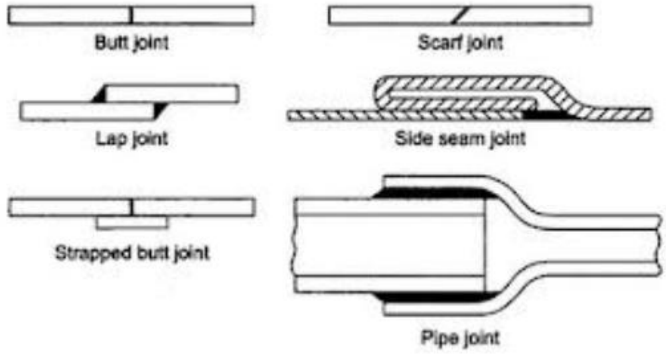
  The optimal butt joint length for two metals with the same thickness = 1 x parent metal thickness.

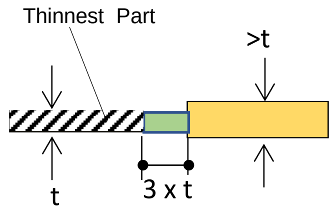
  This would probably produce a joint suitable for model engineering. The joint can be stronger by castellating the interface thus increasing the joint length or by using a strap. Scarfing the joint also gives a bit more length

  For joining plates of different thickness, the formula for optimal joint length is 3 x the thickness of the thinnest part. For example, joining 1mm to 2mm sheet the joint length is 3 x 1mm = 3mm when the thinnest part is 1mm thick. There is no gain in a longer length and it will be more expensive and money wasted. Silver Braze alloy is expensive.

Recommended Butt Joint Length







In a butt joint, any less than the optimum length runs the risk of producing a weaker joint.

Longer than 3 x thickness of thinnest part also runs the risk of flux entrapment, and that can break off due to vibration, leaving a void and possible leak point. With soft soldering there is not as much ductility and strength, so a joint length of 6 x thickness of the thinnest part is recommended.

Also, when the brazing rod is melted it will alloy with the parent metal. For example when joining two copper sheets using a 455 brazing rod (55% Silver (Ag) 21% Copper (Cu) 22% Zinc (Zn) 2% Tin (Sn)), the filler will alloy with the parent metal. If the joint is analysed after it is made, the %age silver could be reduced by a few percentage points, as it has alloyed with parent metal copper, and the %age of Cu could have increased by a few percentage points. That affects the flow characteristics of the brazing alloy. It may be free flowing to start with, but it could be travelling down a very long joint length. It may not be as free flowing further along and become sluggish, not filling the gap. A good reason for not having a very long joint.

Also when the joint comes to be remelted, for example when there are joints in close proximity, the way to start is with a higher melting point brazing alloy, and then a lower melting point brazing alloy on the next joint. However, if you are careful and the joints aren't too close, because the alloy is alloyed with the parent metal, and the melting temperature has gone up, for example, approximately 50°C – 60°C, you may get away with using the same alloy in the next joint without melting it.

- **Joint Gaps**

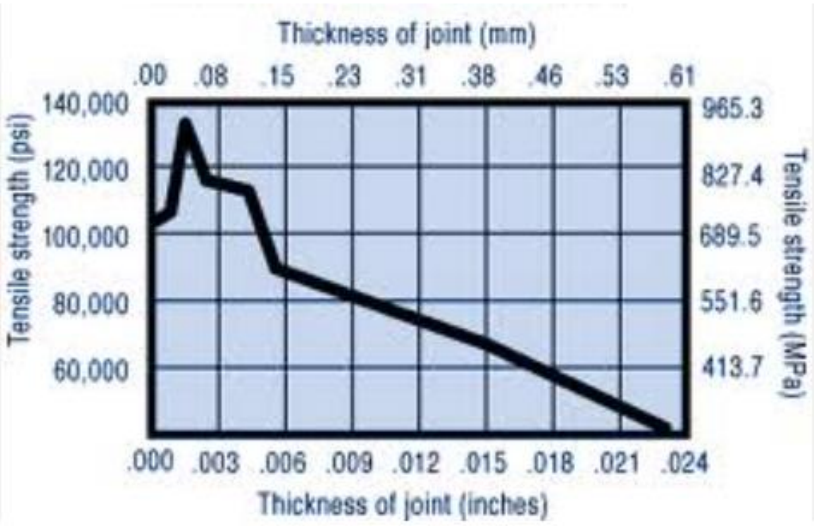
Overlap joints are better than butt joints, as there is more of a joint length. With regard to joint gaps on overlap joints, 4 to 10 thou is recommended. If a joint has a 'rattling good fit", e.g. one tube inside another, that will be fine.

Capillary flow of the alloys is very forgiving. The joint doesn't have to be very precise, however there needs to be a gap or there will be no capillary flow. If there is no capillary flow, a fillet will form at the joint edges and a weak joint results.

For overlapping plates, gaps can be engineered by "jigging" and in general, the two metal surfaces interfacing the braze should be rough enough (for keying). If not, a slight dent can be knocked into each surface using a punch.

As seen previously, the thinner the gap the greater the capillary flow. Therefore the narrower the gap the stronger the joint. As stated before, joint gaps of 4 to 10 thou are recommended, however, as shown in the graph below, with an 18 thou gap, a joint strength of 60 KSI is indicated.

Effect Of Joint Thickness On Joint Tensile Strength

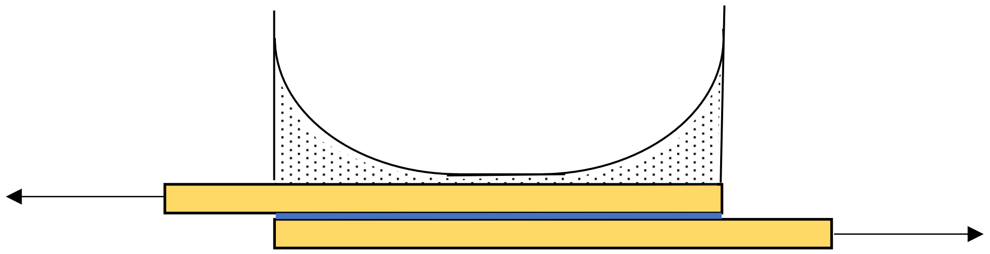


Recommended Gap and Joint Thickness ~ 4 to 10 thou

Therefore, for model engineering there is plenty of scope for the joint gap.

It should be remembered that the joint gap specified is at the brazing temperature. For a copper tube joined to a steel tube, the steel will not expand as much as the copper at the brazing temperature. In this case try to make the copper the female part, so that when the joint cools there is the benefit of compression on the joint.

Another reason for not having long joints, is that the high stress levels occur at the end of the joint, so there is no point in having an extra long joint where a lot of the joint is unstressed:



Free Cutting Materials

If a free cutting material is used, like leaded brass, and some steels with leaded inclusions/impurities in them, it should be noted that lead has a relatively low melting point at 200°C. The lead will melt and come out at silver brazing temperatures. This is not ideal for silver brazing as it reduces capillary flow. If a leaded material has to used, to improve flow, the joint gap needs to be increased and more brazing alloy used.

Question: Does the lead affect the joint strength?

Shaun**:** Not really, I am going to be talking about the 455 (55% Silver Alloy), which is the most common alloy used. It is the easiest to use, it has the lowest melting point, and it is free flowing. Because cadmium has been banned as an alloying element, the silver alloys are cadmium free. The alloy itself doesn't have any bearing on the final strength, so a 55% silver alloy will not produce a stronger joint than an 18% silver alloy joint (418 has the lowest silver content but the highest brazing temperature). If there is lead in the parent metal, you want a free flowing alloy like 455, (maximum 438). The greater the flow properties, the less the effect of the lead on the alloy. If you follow these principles you will get a strong joint.

Cleaning Of The Joint.

So long as the joint has no dirt or grease or oil and is generally clean, it will be OK for brazing. The brazing torch will create oxides on the surface anyway. Don't worry too much about finger grease, the brazing temperature will burn that off (with soft soldering, the joint cleanliness is more important because of the lower temperatures, and parts should be clean and handled with gloves).

Don't use sandpaper or any refractory materials to clean the parts. A refractory material can leave a coating on the metal, and the fluxes won't shift that. Emery cloth is glued together, and sometimes glue is left on the surface of the material. *'Scotch-brite'* is similar to Emery cloth. Wirewool is OK to use.

Fluxes.

In creating the joint, the flux is put on first. For model engineers, the **CuP Alloys** recommended fluxes:

- EF Flux and
- HT5 Flux (High Temperature).

The EF flux is easy flowing and is a general purpose flux. It can be used on most common engineering materials, such as copper, brass, bronze and mild steel. It is used where brazing temperatures are less than 800°C. Using 455 brazing alloy at between 630°C and 660°C on, for example, copper to brass, copper to steel, and steel to steel, EF flux is fine.

HT5 flux is used for large parts which take a lot of time to heat up. This is a more aggressive flux.
For brazing stainless steel, the HT5 must be used, because stainless steel when heated, produces chromium oxide. Chromium oxides are stubborn to get off. HT5 works at 550°C to 1000°C, as opposed to 550°C to 850°C. If a low silver brazing alloy like 418 (18% Ag) is being used, this has a brazing temperature of 784° to 816°C. This is getting to the top end of the EF Flux working temperature, so in this case the HT5 flux should be used

CuP Alloys sell the flux in a powder form and most model engineers can mix the paste. Shaun recommends the use of Flux paste. The flux is applied to the joint before applying the torch. The flux can be very easily mixed with water including a couple of drops of washing-up liquid, and it should be mixed to the consistency of a yoghurt or wallpaper paste.

Note: When the powder is removed from the pot, the pot should be resealed immediately as it is hygroscopic and will absorb moisture and harden. Washing up liquid is used for the following reasons:

- It keeps the power in suspension even when it's dried out
- It gets rid of grease.
- It is another aid in cleaning the joint.

Question: Can methylated spirits be used?

Shaun: Methylated spirits are excellent. You need to mix the flux into a paste, but you don't want it going everywhere. The methylated spirits will just boil off and the flux won't spread too far. *'Tippex'* or a lead pencil can be used to define flux boundaries. The brazing alloy will stay within the flux boundary.

The job of the flux is to remove any surface oxides that are already there, and it acts as a barrier to the atmosphere, preventing more oxides building up. It is both a cleaner and a barrier. With a large part which takes time to heat up, the flux should absorb the oxides. Sometimes the flux will bake on the surface of the metal, but it can be removed. Flux should be adequately painted on the joint. Shaun suggested more flux be used on the joint rather than less.

Flux And The Application Of Heat ~ Best Practice.

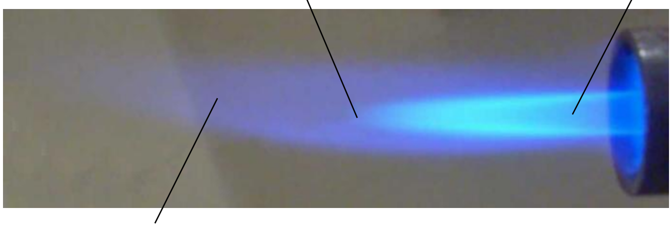
Flux paste may dry and it may be knocked off when the components are being moved about. For this reason, the best practice is to the flux the part just before brazing. This will reduce contamination.

The application of the heat is the really skilful part. It is vital that the joint is brought up to temperature as quickly as possible. The heat is used to form the *'heat pattern'*. Brazing alloys always flow to the hottest point, so everything should be brought up to temperature, and then one part made hotter than the rest so the alloy will flow there by capillary action.

There are many ways to heat up a joint for brazing, but model engineers generally use a gas torch so that is what will be discussed.

The heat source could be gas, or it could be gas and air. For example, Propane could be used alone or oxygen and acetylene. If oxyacetylene is used, that is the hottest flame that can be produced. A lot of care should be taken, because it produces a very precise hot flame. A lot of people find a hole is burnt into the material if care isn't taken.

MAPP gas (**M**ethyl**a**cetylene-**p**ropadiene **p**ropane) is a less hot than oxyacetylene, but is hotter than Propane. Shaun likes Propane because it is readily available. The flame should be played around the fitting joint to get it to temperature. Go in with the rod once the required temperature is met. With Propane this is the profile of the flame:



There is a very neat inner blue cone and a lighter blue cone outside. The inner cone is all unburned gas and has very little oxygen if any. The outer cone is oxygen rich burnt gas, carbon monoxide, water and other bi-products of combustion. So, if we don't want any oxides, why don't we just use the inner flame. Because it is unburned gas, it is not hot, and everything needs to be as hot as possible. It certainly is no substitute for flux. There is no shortcut by using the inner 'reducing flame', instead of the flux. The oxidising (oxygen rich) flame is what is required, and the position of the hottest point of the flame is shown above, the point of which is required on the joint.

Please Note for Safety: Flux is a mixture of chemicals which can be irritating, so when working the joint, don't stand over the joint looking down on it. There needs to be plenty of ventilation. Barrier cream or gloves are recommended. <u>Always light the torch from underneath</u>.

If there is a big component like a marine type boiler, supplementary heat may be required to get the component up to temperature like a big burner. Also, a hearth can be made with *vermiculite* blocks (see later). These reflect heat back into the joint area very efficiently. The other advantage of flux is that it can act as a guide to the temperature of the component.

Flux Temperature Indications

At 100°C the flux will boil because of the water content, then it will go white like milk, and then it goes clear like water. When it is clear, that is when it starts to work at its working temperature 500°C to 600°C.

The brazing alloy will melt at 650°C, so a little bit more heat at the flux working temperature and the brazing rod can be applied.

Note: be patient with the rod, don't apply the rod before the correct temperature is reached. The rod will act as a heat sink, so as soon as it applied, the temperature will dip, and what is not needed are 'cold spots' where the alloy will not flow. It is important to get capillary flow all around the joint to get a good sound leak free joint.

To Recap:

The fundamental principles of getting a good brazed joint are:

- Joint Length
- Joint Gap
- Cleanliness
- Getting the joint area up to temperature as quickly as possible.

Silver brazing alloys suffer from *'liquation'*. The alloys are made up of alloys of Silver, Copper, Zinc and Tin.

For 455 alloy: Silver 55% Copper 21% Zinc 22% Tin 2%

For 438 alloy : Silver 38% Copper 31% Zinc 28% Tin 3%

Tin melts a temperature lower than the other alloys, so there is a possibility that the tin will melt first. If it does, this will change the characteristics of the brazing alloy, which can lead to low flow characteristics, and a poor unsightly joint. This is why the joint should be brought to temperature as quickly as possible.

Note: Overheating a joint can cause as many problems as not heating it enough. Use the flux to guide the temperature, as explained above.

Alloy Working Temperatures

Below are the main brazing alloys recommended for model engineers ~ 455, 440 and 438.
These are:

Alloy	Silver (Ag)	Copper (Cu)	Zinc (Zn)	Tin (Sn)	Temperature Range
455	55%	21%	22%	2%	630°C - 660°C
440	40%	30%	28%	2%	650°C - 710°C
438	38%	31%	28%	3%	650°C - 720°C

As can be seen, the higher the silver content, the narrower the melting range between the *solidus* and *liquidus*.

The *solidus* is the highest temperature at which the alloy is still solid. For 455 it will start to melt above 630°C. The *liquidus* is the lowest temperature at which it is fully molten for 455 this is 660°C.

The alloys will flow before they reach the fully molten state, and that is known as the *'working temperature'*. This is important when there are two joints in close proximity, but at different times. For 455 the working temperature is at 650°C. This means that if we remain below 650°C, the joint shouldn't remelt. Because the joint has the alloy in it, it will remelt at around 700°C, so if a new joint is brazed the next day at 650°C, in proximity to the first joint, it should be OK.

The greater the melting range the more 'sluggish' the alloy is. If after brazing a component with 455, a joint is found to be too big, and the gap needs to be filled, then 438 or 440 could be used. Both these alloys have a greater melting range than 455.

Shaun thinks that 455 is the best alloy for model engineering, because it has the lowest working temperature, and is the most free flowing. All the brazing alloys will produce a joint that is far stronger than the parent metal if done correctly. If two copper pipes are joined together with all the principles described earlier, the copper parent metal will fail before the joint does. The strength is not determined by the alloy. The alloy determines the working temperature

Heating Techniques ~ To Recap

- General heating to get the joint area up to temperature.
- Specific heating if there is a large component and it needs to be heated quickly.
- Propane, Mapp or Oxyacetylene flames.
- Getting the right amount of heat in the right place. This is where the skill is, getting the alloy to flow where it is required.

- **General Flame**

  Page 6 shows the profile of a propane flame. Oxyacetylene gives a very precise very hot flame, which is great to get rapid heat in, but care needs to be taken as it is so precise. It is useful when one particular point is being heated to very hot temperature very quickly. A propane flame is a lot bushier, and could put oxide on the joint if the area of the hottest part of the flame is not in proximity to the joint.

  CuP supply a general purpose burner **2941** (7-14 kw of heat) which provides a good general flame.

- **Precision Flame**.

  To get a precision flame a **3939** pin point torch (0.9 kw of heat) is recommended.

- **Cyclone Burners**

  CuP supply cyclone burners. These spin the flame, so if a pipe is being brazed, the flame will wrap around the pipe. Very good for pipe-work. In an enclosed space, a general or precision flame can go out if all the oxygen is burnt. The cyclone burner takes surrounding oxygen in through an inlet outside the enclosed space.

- **Pencil Torches**

  CuP sell pencil torches which produce a small flame which is good for small soft soldered joints

Is It Hot Enough?

If you have a small component joining to a large component, heat up the large component first, and allow the small component to take its heat from that.

If copper is joined to steel, these are two metals with different heat characteristics. Steel needs more heat to heat up than copper, which has good thermal conductivity. If joining copper to steel, heat the copper, and the steel will take the heat from the copper. Brass also has good thermal conductivity.

The heat comes from how much gas is burnt. The more gases burned the hotter the flame.

The 2941 standard torch burner comes with kit: it is 28mm diameter, provides 7.7kw of heat and burns 600 gms/hr of gas at 2 bars. Using a variable regulator which goes up to 4 bars on the torch, can double the heat output without the need to change the burner.

With regards to the temperature s of the different gases

Oxyacetylene 3500°C
Oxypropane 1900°C in air

The acetylene is producing a lot more heat, but that is a very fine flame and it can burn more gas as the flame speed is quicker.

Can't Get The Alloy To Flow?

Nine times out of ten, that is a fluxing problem, so make sure the right flux is being used.

"*Dewetting*" is where the flux is not cleaning oxides, and the alloy won't flow and is "balling up". That could be due to the wrong flux, there could be grease on the part, or it could be released lead so just check if there is any lead present.

Cracks In Joints

When the joint is made it has to be cleaned afterwards. That can be with a mechanical brush, dipping in acid or washing under the tap. Make sure when ready to clean, the joint is coolish. Cooling too rapidly can cause stress cracks

"Hot Shortness": As an alloy cools down from the melt temperature, there is a point during the cooling phase where it becomes very brittle. If the joint was quenched at that point the joint would crack. Let the joint cool down so it can be picked it up by hand. Citric acid can be used for cleaning joints. It is organic and can be disposed of safely. Also check the flux is correct for the material combination being used.

If copper is being used, try to use an oxygen free copper such as C106. With C101 and 102 copper there is oxygen in the molecular grains of the copper, and if care is not taken, hydrogen embrittlement can occur during heating. The oxygen can be converted into steam and cracks can form. If the providence of the copper is uncertain, this is the time when the outer oxidising flame can be used. Back the torch off a bit, adding more oxygen to it so hydrogen embrittlement doesn't occur.

Other Heating Defects

If the flux is overheated or the flux is expired and it is full of oxides, it can't take anymore, so it will "bake on", and eventually it will "blow off". That can lead to blow holes and voids.

"Blobbing" is caused by the wrong flux as described earlier, or no flux at all.

"Reflowing" can occur if there is another joint in close proximity. To play it safe, if for example, there is a need to braze three joints in close proximity, start the first with a 418 rod (18% Ag) melting at 800°C, followed by a 438 rod on the next, melting at 700°C, and then finally a 455 rod on the last, melting at 650°. This avoids melting the previous joint.

Corrosion

Working with stainless steel can be awkward. Chromium oxides produced by brazing have already been mentioned and they are very stubborn and difficult to remove. In this situation an aggressive flux is needed. It should be noted that the aggressive flux residues are also corrosive, so it is even more important that the stainless-steel component is clean.

Austenitic (non-magnetic) stainless steel is what is required for brazing. If two pieces of ferritic stainless steel are joined, and the joint is in a water environment (sea or tap water) it can suffer from *'crevice corrosion'*, and the joint just 'peels' apart. Austenitic stainless steels don't suffer from crevice corrosion because they contain nickel. 449 (49%Ag) silver alloy contains manganese and nickel, and prevents crevice corrosion of non-nickel bearing stainless steels (temperature 680°C to 705°C) in a water environment.

Weld Decay.

This happens with stainless steel and braze**.** This is where rust forms on the steel because it either has been welded at a high temperature or brazed with a high temperature braze alloy. In this situation, the chromium content has been boiled out so the steel is not stainless any more. For joining stainless steel, Shaun never recommends any brazing rod less than 38% Ag (650°-720°C).

Brazing Hearths

Mentioned previously, a vermiculite block hearth is recommended during brazing. The vermiculite will direct heat back onto the component. The base shown below is *Kaolin*, a clay-based product with is very good insulation. It can wetted and shaped, and **CuP Alloys** sell these as sheets. If it is wet and is shaped, it should be allowed to dry out. It has no insulation properties when wet.

Finally : **GOLDEN RULE: HEAT THE JOINT, NOT THE ROD.**

CuP Alloys have an excellent and comprehensive website at the following link: https://www.cupalloys.co.uk

PEEMS would recommend the following brazing book and DVD by Keith Hale for a more detailed explanation of brazing techniques: https://www.cupalloys.co.uk/brazing-ancillaries/

PEEMS would to thank Shaun Meakin for taking time out to give such a detailed and informative talk, and for proof reading this article.

Some of the pictures and graphs have been taken from CuP Alloys website and kind permission to use them has been given by Shaun Meakin.

A Visit To The Anson Engine Museum In Poynton Cheshire on Tuesday 10th September.

On the 10th September a coach was filled with forty-three PEEMS members and guests to travel to the Anson Engine Museum in Poynton Cheshire. For those not interested in the Engine Museum, the coach continued to Lyme House a National Trust property.

The museum occupied a site on which there used to be a coal mine. The area containing the mine and surrounding areas was represented in a large diorama in the museum. The diorama showed the industrial and rural areas surrounding Poynton in 1900. The picture below represents the museum site in 1900.

The Anson Pit in 1900 showing the rail head. (The main railway line no longer exists)

Introduction

On arrival at the site, members and guests were welcomed by the staff and a free cup of coffee. The location of the museum used to be the "Anson Pit" **. The wooded slope at the back of the museum was the remains of the shale spoil tip. A lot of the Poynton area was owned by Lord Vernon and he owned the pit. It was called the Anson Pit because one of the Vernons married into the Anson ++ family who were from Shugborough Hall in Staffordshire.

The pit closed in 1930. Lord Anson sold it to Les Cawley in 1947. Les had a lumber business, so he sold off a lot of the shale from the spoil tip, and managed his timber business on site. He had engines to run his circular saws, and he became keen about engines. He started rallying engines. He teamed up with Geoff Challinor, (Geoff now runs the museum) and started collecting engines. They finished rallying because the engines were getting bigger and were less practical to cart about. That is when they decided to start the museum.

The museum continues to acquire engines. The museum's engines are in various stages of repairs which the museum will get around to finishing. There are plans to expand the museum, and there is planning permission to expand some of the buildings. There are some large engines at the back of the museum which will be built around.

The day we were visiting was not a public opening day, but it was a "volunteers day" which was good because the volunteers were only too pleased to operate engines and answer questions. Some engines were from other museums with specific instructions not to run, but there were sufficient engines running to provide five hours of interest.

** Anson Pit: The colliery was one of many in the area. At one point, Poynton collieries produced 244.516 tons of coal (about 1/3rd of all the coal in Cheshire). Over 400 men worked underground. There were 60 mine shafts around Poynton. After being the main industry for 150 years, they closed in 1935.

++ Anson Family: Lord Admiral Anson led the first official navy circumnavigation of the world.

The Steam Hall

The first area visited was the steam hall. This was dominated by the *S.S Stott Horizontal Compound Condensing Steel Mill Engine* (1903). This engine was built for *The Chorley Railway Wagon Company* driving line shafting in the works. In 1926 it was sold to *Barton's Albion Mill* in Hazel Grove where it drove textile machinery via line shafting.

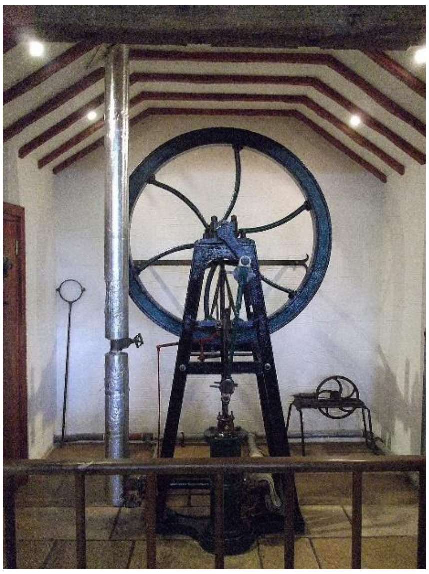
We were met there by Geoff Baker who told us that all the engines in the Steam section were "runners", but unfortunately not on the day. The *S.S.Stott* only runs four times a year, because gas is expensive. There is a programme to run all the smaller engines at least once a month on special weekends. They try to run the engines on Bank Holiday weekends.

The first engine was rare and unique. It is a *"Single Cylinder Double Acting Vertical 'Wall' Steam Engine".* It was made from a design by Scotsman Andrew Meikle and was built in 1835 for the Duke of Northumberland to work on a farm. It drove a 'barn thresher' right at the beginning of mechanised threshing boxes. Up to then it was hand work with flails on the barn floor. One part that makes it unique is the whole casting which is 'one piece. From the front edge to the top where the bearing is, is one-piece cast iron, moulded in 1835.

On the right-hand side of it is the steam inlet. The steam comes into the leg, across and forward, and enters the valve chest from underneath. It is a double acting engine, pushing up and pushing down. Originally when it exhausted it did so into a container where cold water was introduced, and steam and warm water were pumped out. The exhaust is now captured in a little tank, and travels across and up the leg, then out behind the ladder. The engine is unique as no other engine has that setup.

The engine was originally at the *Hunday Tractor Museum* and when that closed went to *Beamish* where it was in store. The engine didn't fit into Beamish's time scales so it came to the Anson who restored it and got it running. It runs really well.

An interesting feature of the engine is the "Crowther" 'Parallel Motion' mechanism to keep the piston rod running in a straight line.



The next engine viewed was what is believed to be the oldest engine on site. It is from 1825-1830 and is a *"Single Cylinder Double Acting Vertical 'A' Frame Steam Engine".* This was also an agricultural engine driving line shafting to oak crushers and chaff cutters etc, for making animal feed. This worked at the local Addlington Hall. It had 100 years rest, not doing anything. It was rescued in the 1960s. Nothing was done to it until 2002, when it was restored to fully working condition. An interesting feature is the "pitch-fork" type connecting rod.

Single Cylinder Double Acting Beam Steam Engine (1872).

The beam engine was produced by John Fowler, the traction engine Manufacturers. They made one or two small industrial engines and this is one of them. The engine was used to drive line shafting at Higgs Motors Ltd of Witton Birmingham. They were Electric Motor Manufacturers.

The large engine in the centre of the Steam Room has already been mentioned and this is the *S.S Stott Horizontal Compound Condensing Steel Mill Engine* (1903). This was the largest engine in Cheshire. It started its life at *The Chorley Railway Wagon Company* driving line shafting for machines making axles for railway carriages.In the mid 1920s it was sold and moved from Chorley to Hazel Grove where it was used to drive cotton processing machinery. It still provided shafting with a flat belt off the large driven wheels. The Anson museum thinks the engine still worked up to the 1960s, and then lay derelict. The engine is only 250 HP, and is easily replaced with an electric motor drive. It is believed the machinery was easily converted to electric.

The engine came to the Anson museum in the 1980s and it took 27 years to get it running again. It runs reasonably well. What it wants is a cross compound engine. The high pressure side (which does all the work) works quite well. During its working life, the air pump on the low pressure side had dropped a few thou and wore the bottom of the packing away. It is difficult to get it steam tight again. It can be fixed, but after a few hours of working starts leaking again. It really needs all new packing, but that will cost too much money. It runs, but not as it should do.

1/3rd Size Newcomen Atmospheric Engine from Norbury Coal Works. The original engine was built in 1750 and was nicknamed "Fairbottom Bobs". This is a famous engine which is now in the *Henry Ford Museum* in America. It started its life at the Norbury Coal Works a mile away from the Anson Museum. In 1750 Norbury had an atmospheric engine installed for pumping water out of the mine. In 1764, the engine was advertised for sale and was sold to the Fairbottom coal company at Ashton -Under-Lyne, 10 miles away from the museum. The engine stayed at Ashton until 1926 (from 1765). Henry Ford came over and bought the engine, and is now in the museum in America.

NEWCOMEN PUMPING ENGINE NEAR ASHTON-UNDER-LYNE

They won't let it back, so what Anson did was go to America, measured it up, and built a 1/3rd scale replica. It only stands 8 ft high whereas in reality it is 24 ft high. The cylinder should be 96" x 27" and the replica is 3ft x 9".

Like the original it is a pyramid column with a kingpost in the beam.
The only difference between Henry Ford's and Ansons is that Ansons can run theirs!!
The replica is run off the exhaust steam of the the other engines.

There were some other engines of interest in the Steam Hall:

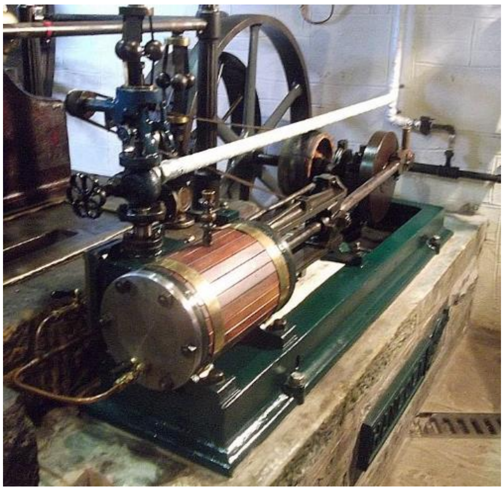


Photo 1: *Single Cylinder Double Acting Horizontal Engine (1866-1870).*

Reputedly built by Hancock and Foden. This worked driving soap mixing vats at Zan Chemical Works at Wheelock Mills, Wheelock.

Photo 2: *Duplex (Twin) Double Acting Inverted Vertical Steam Engine. (1939).*

Engine built for the bucket dredger ‘Arpley’ In 1939. The dredger was scrapped in 1978

Photo 1

Photo 2

Marine Room

Adjacent to the Steam Hall was a small room containing some interesting marine engines.

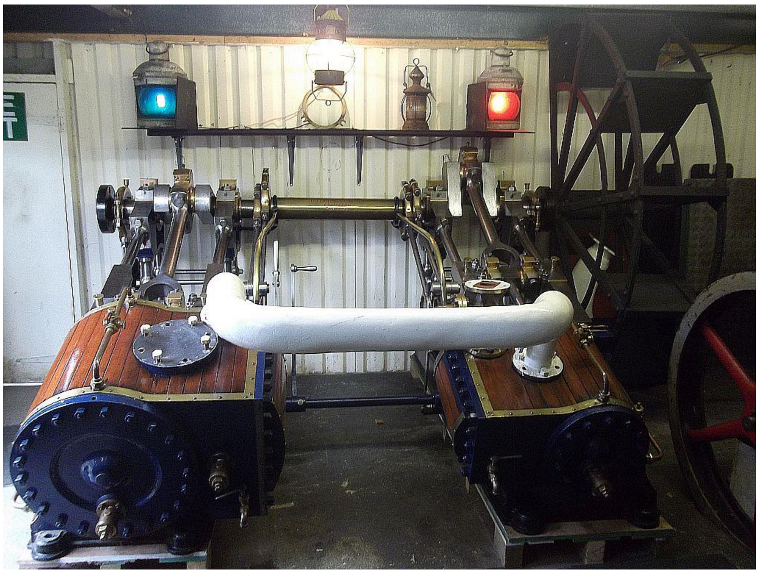


Photo 3

Photo 4

Photo 3: *Compound Engine From Paddle Driven Steam Yacht Firefly II*

The steam yacht Firefly II was built for Lord Newborough in 1900 by W. Roberts of Chester and was driven by this compound direct-acting diagonal steam engine. Shortly after WW1 she was converted to screw propulsion.

Firefly II specifications: Length 72.5’ Beam 11.5’ Draught 5.5’ 42 tons

Engine: Compound Cylinders 9” and 18” diameters 20” stroke Nominal HP 12 Steam pressure 140 psi

Photo 4: *Compound Double Acting Inverted Vertical Steam Engine. John Thornycroft and Co. (1880)*

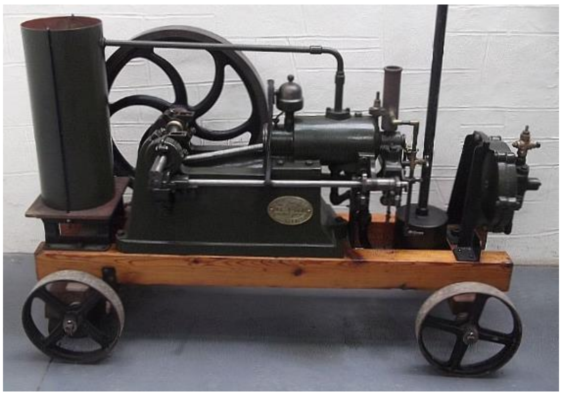
This engine was built for one of a batch of ten second class torpedo boats built for the Royal Navy. Torpedo Boat No. 71 was 63’ long and 7.7’ wide.

The Diorama of The Poynton area in 1900

Anson Pit

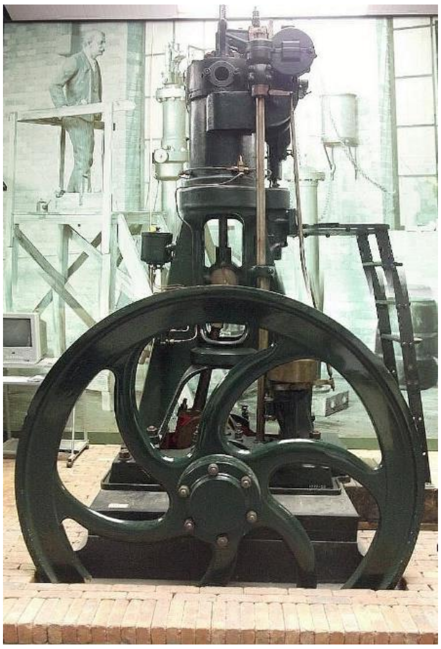
The Gardner Engine Exhibition:

Some other engines:



The first photograph shows the Otto/ Langen *Free Piston Atmospheric Engine* which Nicholas August Otto developed in 1867 in conjunction with Eugen Langen. The engine was shown at the World Exhibition in Paris. Otto (of Otto cycle fame) is probably the most important man in the development of the internal combustion engine.

The third photo shows a *Non-Compression Engine.* Whilst Otto was developing his engine, others were still experimenting with different power transmission methods. One drawback of the free piston engine was the fearsome explosive power stroke to drive the piston up. In 1870, Parisian Alex de Bisschop developed an engine using a crank instead of a rack and pinion. It drew in an air/gas mixture through a spool valve and simple rubber flap valves and at half stroke, a pilot flame is sucked into the cylinder and used to fire the engine. The rubber valves were kept closed by the expanding gases. This was a very simple engine with air cooling – the publicity at the time referred to it being so simple even children can look after them. One fault was the pilot light was extinguished at each stroke, so an additional pilot light was added to relight the pilot light. Over 2000 were made under licence in the UK. The engine was so quiet in operation that they were very popular in churches. Over 900 were purchased specifically for powering blowers for church organs!



Single Cylinder, Four Cycle, Air Injection Diesel Engine (1897)

During March 1897, the Mirlees committee investigating the practical possibilities of a new internal combustion engine visited Dr Rudolf Diesel in Germany. After studying Dr Diesel's 20 BHP engine, an agreement was made that the patentee grant an exclusive licence for the manufacture and sale of the diesel engine in Great Britain. Following this agreement, the first engine was completed in November 1897. This was the third diesel engine in the world, and after exhaustive tests, was put into regular service at the Royal Technical College, Glasgow.

The engine spent many years at the London Science Museum

Crossleys 3Hp Otto and Langen Engine And Winch (1877)

This is an atmospheric (free piston) engine, the largest type built. Fuel ~ Gas

This engine is on loan from Bristol Museum Galleries. It was built in 1877 and was one of the last 14 built at Crossleys in Manchester. It was installed on Bristol Docks at a Tar Distillers where it operated the winch mechanism attached to it to load barrels onto ships. A 3 Hp engine was £150 in 1876, £4,500 in today's money.

To watch the video please press the link.
<u>To return to the newsletter press return arrow at the top left-hand side of the screen.</u>

https://www.youtube.com/watch?v=jOeS7XjNBxM

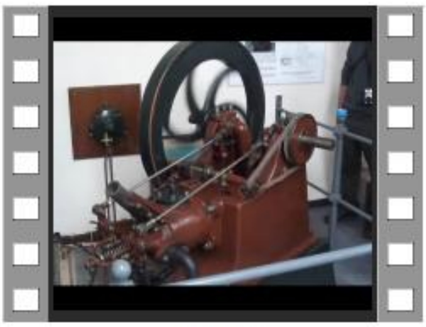
> *Video Quality*: While playing the video, the quality may reduce and then return. If this happens, go to the settings cog select 'Quality' and then set that to 480p and the quality should be maintained.

Crossley.wmv

Atkinson's Cycle Engine (1886)

Atkinson, following on from his earlier differential engine noted that Otto's patent described that four strokes were performed by two revolutions of the flywheel. Atkinson's engine patented in 1886, used an intermediate linkage to achieve 4 strokes in one revolution, which got around Otto's patent. However, the extra linkage was much heavier and the amount of energy required to move it was greater. As a result, the engine was less efficient. In order to get the same power output as an Otto engine, you needed a bigger and therefore more expensive Atkinson engine. Even so, more than 1000 engines were built by the British Gas Engine and Engineering Company Ltd. between 1886 and 1893.

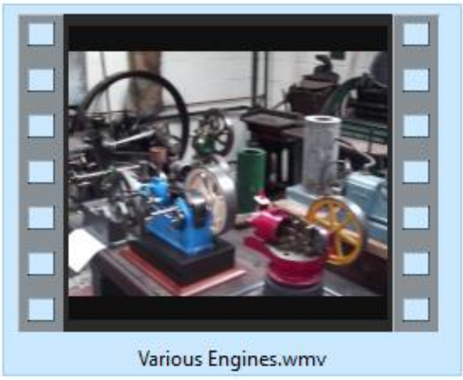
https://www.youtube.com/watch?v=2EcSJBGy-Ks



Atkinson.wmv

There are some videos of other running engines here:

https://www.youtube.com/watch?v=D6W06UJSisA



And finally, going into one of the engine halls to view the *Ruston and Hornsby* 36 HP diesel engine (1933) This engine was used to drive a saw mill for *William Smith Builders* at Newark-on-Trent. It was removed for preservation in 1975.

https://www.youtube.com/watch?v=sv1Y1D2UpoI

The diorama of the Poynton area in 1900 is an amazing piece of work, and there is a video here which explains how it was built.

https://www.youtube.com/watch?v=f1_sYieYInM&t=166s

This was an excellent visit, one member even found an engine he had worked on in the past being rebuilt at the back of the museum.

The day ended with a great carvery meal at the *Pear Tree Farm Restaurant* at Monk's Cross in York.

PEEMs would like to thank the staff at the *Anson Museum* for a very informative and friendly day out, and for taking time out to run machines and answer questions for the benefit of our visit. We also thank the staff of *Pear Tree Farm* for arranging the restaurant for our visit, and providing an excellent meal.

Of course we thank Jim Everett for organising what was a great and informative day out.

Ivan Shaw ~ The Completed Personal Aircraft G-SEKR.

News of Ivan's personal aircraft is being updated in the PEEMS newsletter as progress is made.

Ivan gave a talk to PEEMS a year ago in September 2018.

The aircraft is now complete, and it was revealed to the public at the end of August. This took place at The L.A.A. (Light Aircraft Association) Annual Rally at Sywell Airfield in Northamptonshire.

The aircraft has been painted yellow, an optimal colour for conspicuity.

The aircraft is currently being promoted not only as a 'personal aircraft' called *'The Merlin'*, but also as a surveillance aircraft/drone called *'The Seeker'* (hence the registration).

Some more detailed photos of the aircraft are shown in the following links, one of which is the *'Flyer'* magazine:
To return to the newsletter press return arrow at the top left-hand side of screen.

https://www.flyer.co.uk/ivan-shaw-reveals-new-personal-seeker/

The above link also shows the aircraft specifications.

https://www.facebook.com/permalink.php?id=322995621500299&story_fbid=674507546349103

Click on the main photo in the above for a slide show.

The next stage in the programme is taxy trials (some 'airborne') at *East Leeds Airport* (ex RAF Church Fenton) near Tadcaster. These trials will check out systems, controls and avionics, and will give a 'feel' for the aircraft handling, prior to full scale flight test. Because this is a new concept for Ivan (twin booms/pusher prop), this stage of development will be painstaking.

The aircraft, which has folding wings, is designed to be stored in a single garage (or shipping container), thus saving sometimes high hangarage fees, and is easily transportable by trailer:

STRAIGHTLINERS

Standing Start 1 Mile at Elvington — 10 September 2019

Weather Sunny spells — Timekeeper Martyn Greathead

No.	Name	Machine	Best	s1	s2	s3	s4	s5	s6
Top Speed Riders									
8	Guy Martin	Hayabusa Turbo 1300cc	270.965	206.791	196.595	270.965			
111	Jack Frost	Hayabusa Turbo 1300cc	257.095	184.200	223.418	257.095	246.756	255.494	250.645
1	Becci Ellis	Hayabusa Turbo 1300cc	244.280	244.280	240.478				
888	Ken Dunn	Kawasaki ZX12R Turbo	218.426	218.426	136.767				
1747	Zef Eisenberg	Madmax Gas Turbine	218.286	218.286					
747	Zef Eisenberg	Madmax Gas Turbine	217.390	182.316	206.838	217.390	214.180	217.321	65.762
1111	Jack Frost	Hayabusa Turbo 1300cc	203.413	203.413					
91	Dennis Pettman	Hayabusa s/c 1340cc	203.285	203.285	200.793				
777	Zef Eisenberg	Kawasaki H2R	197.972	193.067	195.090	197.750	195.370	197.972	
1224	Alex Kelly	Kawasaki ZX10R	183.877	183.877	177.892	175.128	183.419		
224	Alex Kelly	Kawasaki ZX10R	182.731	175.280	179.007	180.000	180.679	174.478	182.731
FF3	Freddie Flintoff	Yamaha 350cc	124.399	124.399					
208	Kevin Nicks	Fastest Shed	102.894	102.894					
16	James Gilchrist	Norton 750cc	95.387	92.097	95.387				
1216	Mark Foster	Trojan 300cc	78.143	78.143					
216	Mark Foster	Trojan 300cc	77.035	71.056	52.164	73.812	75.517	76.333	77.035
Wheelie Riders									
373	Tom Swales	Kawasaki ZX10R Turbo	201.900	65.587	130.547	185.207	189.558	201.900	189.315
1373	Tom Swales	Kawasaki ZX10R Turbo	192.406	92.084	192.406	191.838	184.007	114.040	
1333	R1 Lee	Yamaha R1	192.359	177.591	180.244	177.650	186.461	192.359	
1378	Damion Hirst	Suzuki GSXR s/c 1000cc	186.729	171.839	176.739	179.822	186.729	184.549	186.085
2378	Damion Hirst	Suzuki GSXR s/c 1000cc	182.774	182.774					
378	Damion Hirst	Suzuki GSXR s/c 1000cc	180.494	166.064	173.861	176.802	149.063	106.291	180.494
333	R1 Lee	Yamaha R1	180.226	164.288	172.699	167.301	165.968	179.248	180.226
3303	Nev Moss	Suzuki GSXR 1000cc	149.415	146.344	148.823	149.415	124.641		
1303	Nev Moss	Suzuki GSXR 1000cc	148.669	141.997	148.669	142.744	144.748	130.532	146.112
2303	Nev Moss	Suzuki GSXR 1000cc	145.233	140.097	140.740	140.555	136.544	140.991	145.233
303	Nev Moss	Suzuki GSXR 1000cc	138.149	123.121	132.546	137.779	138.149	135.928	121.552
2342	Rob Bradstock	Suzuki GSXR 1000cc	122.110	122.110	113.513	117.347	106.268	96.787	104.094
1342	Rob Bradstock	Suzuki GSXR 1000cc	118.530	115.486	102.376	111.970	118.530	103.288	117.976
1362	Damion Hirst	RMZ 1000cc	116.014	109.474	116.014				
342	Rob Bradstock	Suzuki GSXR 1000cc	114.610	96.564	114.610	111.517	113.042	109.460	110.331
331	Tom Swales	Yamaha R1	112.583	107.353	112.583				
3342	Rob Bradstock	Suzuki GSXR 1000cc	112.506	94.411	112.506	90.638			
362	Damion Hirst	RMZ 1000cc	109.939	105.172	104.701	107.050	103.539	109.939	107.767

Standing Start 1 Mile at Elvington — 10 September 2019

Weather Sunny spells — Timekeeper Martyn Greathead

No.	Name	Machine	Best	s1	s2	s3	s4	s5	s6
Cars									
C30	Michael Little	The Hulk 3.8 Ltr	220.715	209.435	220.715	211.769			
PM2	Paddy McGuinness	Ferrari Portofino	189.624	184.225	189.624	147.583	144.901		
PM	Paddy McGuinness	Ferrari Portofino	188.614	181.763	185.920	185.427	188.614		
C34	Graham Cartwright	Nissan GTR R35 3.8 Ltr	183.753	175.579	175.550	175.381	175.528	178.084	183.753
1C34	Graham Cartwright	Nissan GTR R35 3.8 Ltr	177.210	177.210	69.522				
CH	Chris Harris	Porsche Carrera	176.004	171.208	162.836	171.327	176.004	175.201	
CH2	Chris Harris	Porsche Carrera	175.381	171.699	175.055	171.488	171.888	175.381	
FF2	Freddie Flintoff	Aston Martin Vantage	175.285	168.787	174.166	170.683	175.285		
FF	Freddie Flintoff	Aston Martin Vantage	174.690	151.237	151.439	170.124	174.690		
C37	David Sagstad	BMW 2.8 Ltr	170.598	170.598	142.673	131.777			

Items For Sale

- **For Sale:**

  TRAILER CHASSIS approximately 4' x 7' (Steel).

  - 10" Mini Wheels.
  - Indespension.
  - Mudguards.
  - There is some rotten wood to replace.
  - Ideal to remodel to your needs.

  Pickup from Thornton Le Dale.

  £75.00 or Best Offer

  Contact: Jonathan Milner 07815 610 416

- **For Sale** - **Contents of Model Engineer's Workshop:**

  Including:

  - Myford 254 lathe on stand (3ph with inverter) with DRO.
  - Axminster Mill ZX25M2 with DRO.
  - Axminster ED16SB2 Pillar Drill.

  Many more items of tooling available.

  Please phone: 01723 658837

- **A 'Flash Steam Tethered' Hydroplane For Sale**

  Due to certain health issues I have decided to sell my 'Flash Steam Tethered' Hydroplane.

  As far as I know it's the 'World's Fastest' at the present time.

  It would be sold with any spare parts including generator coils, history, engine set up details.

  I already have an enthusiast who is interested and he would be given first choice if he can better any offers to buy.

  Please note: this is not a show machine and is purely functional with battle scars after 130+ mph take offs.

  Have the video's showing that and many other fast runs.

  With the correct set up 135+ mph might be achieved.

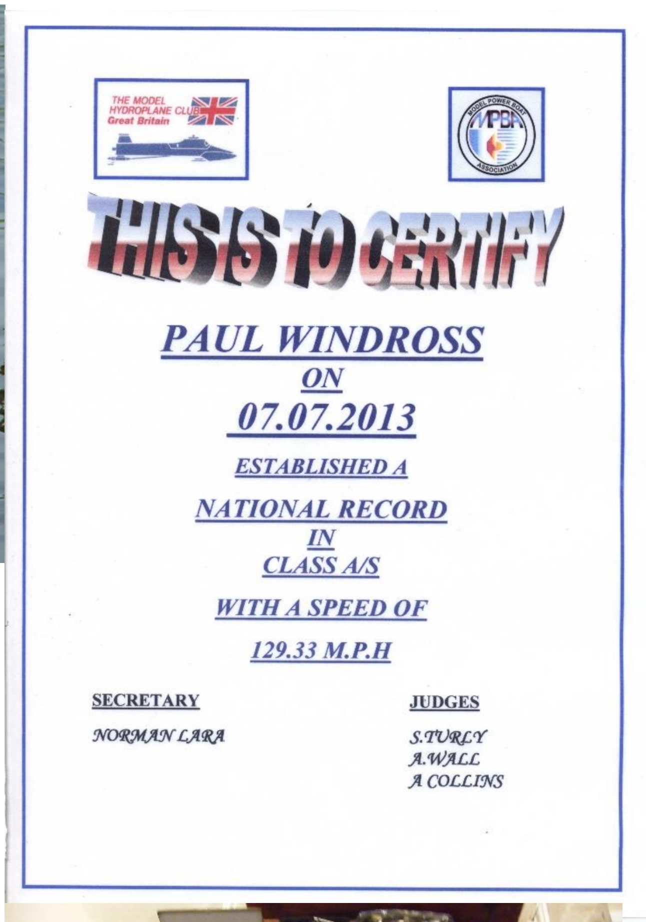
  Keep this in mind: It's experimental. If run, you have to strip and rebuild it after every meeting.
  Also things might need repairing or making.

  Please note: 'Flash steam hydroplane's are not for the faint hearted. To compete with one means you need a machine workshop, not just a few spanners, and the will to continue developing it is a full-time job.

  It could be used just as an exhibit and in that case no work is required.

  Being a *'Yorkshire Man'* I do not have time for 'tyre kickers'. Only genuine interested people will be shown it. 'Time wasters' will 'get the boot'.

  Regards Paul Windross


THE MODEL HYDROPLANE CLUB Great Britain

MPBA

THIS IS TO CERTIFY

PAUL WINDROSS

ON

07.07.2013

ESTABLISHED A

NATIONAL RECORD

IN

CLASS A/S

WITH A SPEED OF

129.33 M.P.H

SECRETARY	JUDGES
NORMAN LARA	S.TURLY A.WALL A COLLINS

- **For Sale :**

Chester D13 Drill Press 1/3HP 600-2500 RPM

\+ **Accessories**

If you are interested in this item, please contact Miker Sayers.

Contact:
If you would like to contribute to the Newsletter, the contact is:
Nevile Foster Tel 01751 474137 or e-mail nevf123@outlook.com