NEWSLETTER December 2022

Good Day Everyone. I hope you are all refreshed after the Christmas break. I wish you all a happy and healthy New Year and all your projects go according to plan. If you get stuck and need a little inspiration, have a look at Fred Dibnah on YouTube, laddering a chimney. It is amazing what you come across on a lazy afternoon.

Sadly, John Powell died at the end of November and we said our final goodbye at his funeral on the 15th December. The snow prevented one or two from attending but PEEMS was nicely represented on the day. John was a staunch supporter of PEEMS and was an active Committee member until about 18 months ago and has in the past donated quite a bit to the workshop. Our thoughts and best wishes go to his wife, children, grandchildren and great grandchildren,

We visited Sylatech in Kirkbymoorside which was very interesting and heartening to know that a local firm is flourishing in a global market.

It is looking like we will have a good turnout for the National Model Engineering Show at Harrogate in March. We have a bit of work to do to get the stand ship-shape again, and that is planned to be done in January. We must not be complacent though, because it won't be long till March comes around.

The purpose of the February 1st Club meeting is primarily to run through the arrangements for the Harrogate show and other details. The organiser of the show has been invited to come and meet us and answer any questions we have. It will be interesting to find out a little bit about running a large event.

I am not a veteran of Model Engineering shows, but know the stewards are very important, and it isn't fair to rely on the exhibitors to do all the stewarding all of the time. With the best will in the world, its not easy to enthusiastically stay on station for hours on end, so if you are attending the show as a visitor, please volunteer to help out for an hour or two.

Thank you. Jonathan.

John Powell Receiving The Mike Sayers Trophy For A Clock Based On A John Harrison Time-Piece. July 2018

☐ **Forthcoming Events.**

- **Workshop Morning ~ Tuesday 17th January.**
- **Wednesday 1st February ~ Club Evening.** *Organising For The Harrogate Show*.
- **Friday 10th and Saturday 11th March 2023**. ***National Model Engineering Show*** at Harrogate to be held at the Great Yorkshire Show Ground.

Club Evening December 6th ~ Mike Sayers Trophy Evening.

Three exhibits were entered in to the 2022 Mike Sayers Trophy (MST) competition.

All members then voted for their first, second and third choices, the votes were then added up to give the overall first, second and third positions.

- **David Hick: Clock With Movement Designed By Richard Gretton.**

This was David's first attempt at making a clock.

The movement was originally designed by Richard Gretton, and it's taken David two to three years to make.

It needs some more precise adjustment, but was ticking away nicely on the evening.

It has an automatic rewind. The weight goes to the bottom and triggers a switch, which then takes the weight back up, and that works alright. The other weight comes done and switches off the rewind.

The case was a bit easier to build as David has cabinet making skills.

Q: Did you follow the design through step by step? Did you have any problems in the build?

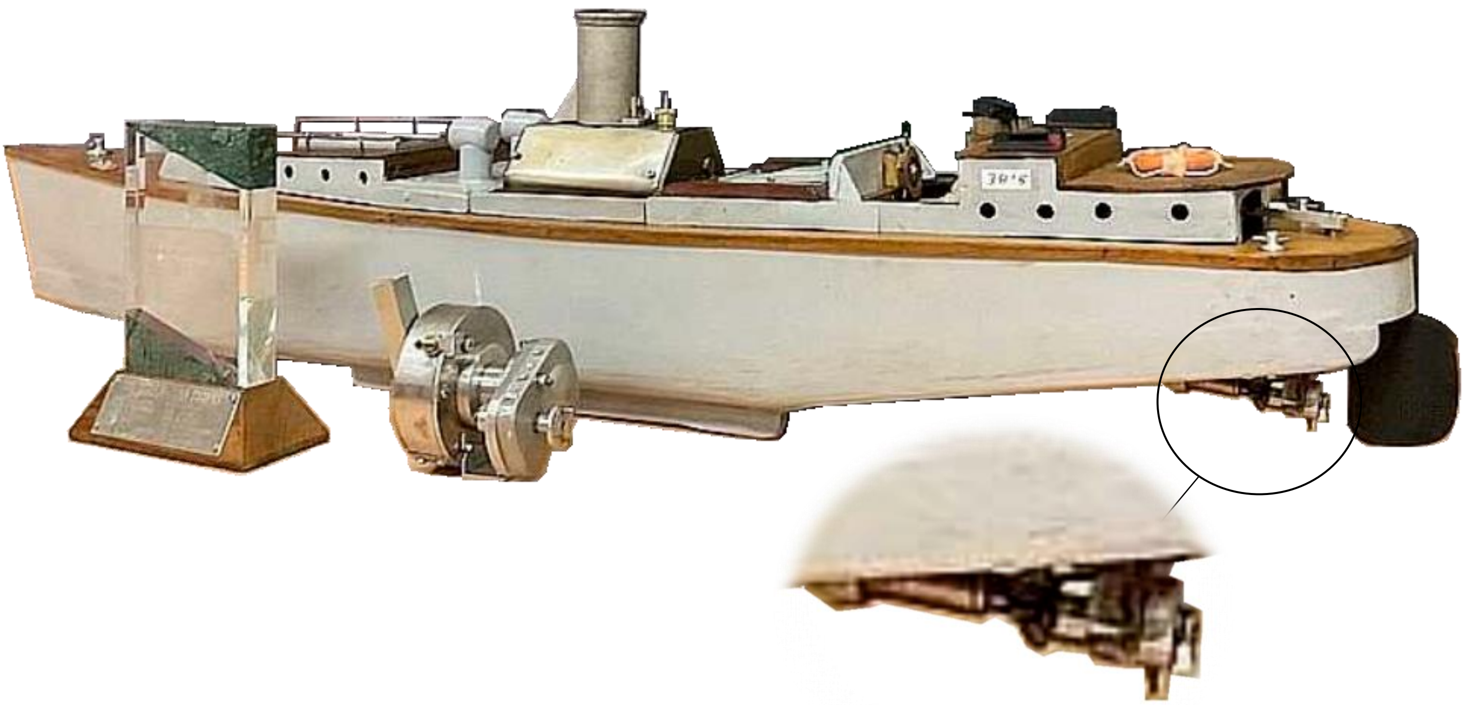
David: No, not really, apart from the gear cutting for the escape wheel. I ground the fly cutter to cut the escape wheel.

I didn't have any instructions really, all I had was Richard's drawing, and acquired parts from John Powell. It has a *Meccano* chain and sprockets.

Q: How long does it take before it rewinds?

David: An hour and a half.

- **John Heeley ~ Steam Launch With Oscillating Engine and Variable Pitch Propeller.**



- **Model Version 5**

The launch John brought in was not the launch PEEMS has seen before. It might look like it, because John has painted it grey. The designation was 3B-5 (3B standing for "Badly Built Boat" and 5 for the 5^{th} in the series.)

In the previous model, the stern was 'tied in', a temporary bulkhead was put in the middle, and the bow pulled in which gave a nice 'boat shape'. The trouble with the other boat was that it had a relatively flat keel plank on it and it didn't have much of a bilge. Version 5 is an improvement with regards to bilge shape. Building the boat like the previous one means that it is still a very quick way of building a boat. John bought the plywood on a Saturday, and the boat was in the water and under power on the following Saturday. It took another week to mount the deck housing and making the various sliding hatches. In all it took 14 days to complete and cost £22.

The good thing about this version of the model has been the various experiments carried out with variable pitch propellers.

- **The Manoeuvring Turbine Engine.**

At the last club meeting in July, John presented the previous model of the launch, and he talked about turbine units and how he had introduced a second reversing turbine wheel into the unit so the prop could reverse in rotation. This is what he called a 'manoeuvring' engine. In practice a turbine can be reversed. It's not a problem, but with this system the boat goes a long distance while the forward turbine is spooling down and the reverse is spooling up. It makes this particular type of turbine engineering useless in practice for an effective 'manoeuvring engine. For this reason, John has been experimenting with variable pitch propellers.

- **Variable Pitch Propeller.**

The version 5 launch hull has been specifically designed to have a large cavity underneath, so a big variable pitch propeller can be installed. It's been a lot easier to make it with two blades with the same overall blade area as the original four bladed prop.

The original four bladed variable pitch propeller looked a lot more streamlined, but there wasn't a lot of leverage onto the individual blades. It only worked out at about 4mm. John couldn't get it to work properly. The variable pitch prop has all the mechanism on the outside. All along the propeller shaft is a sliding sleeve. This sliding sleeve is keyed to the shaft underneath it through a slot. This means the sleeve can move backwards and forwards whilst the shaft is revolving. At the top end of the sleeve is a ball race (fastened to the sleeve) which actuates it. On the outside of the ball race is a 'saddle' which is like two prongs which move backwards and forwards. As it's being moved, the ball race 'can make up its own mind' whether it's going to turn or it's going to stop. If the 'saddle' decides to stop it, it can still carry on revolving. At the other lower end of the sleeve John has attached a block with two mountings on it for two arms which run to the prop blades themselves. The two arms move the blades.

It's unbelievably crude, and has had to be made with a lot of clearance. It's a lot more 'waggly' now than when it was built, but it gets better by the day. It's one of those things where you don't want to over engineer it, but it does mean that you can power a boat with any type of steam plant you want, without needing to control the steam plant at all.

- **Steam Plant.**

This is the third type of power plant that John has had in this hull since he's built it. At the moment, the steam plant installed is a single cylinder oscillating engine which is not self-starting. It was built in a fortnight in July. The hull has had a turbine in it, but it really needs a bigger boiler. When the turbine is installed, the bigger boiler is a bit top heavy. There is a removable plate on the deck to allow the reinstallation of the turbine unit.

John has three boats, four boilers and eight engines. They can be installed in the hull in any order or sequence required.

The current configuration of steam plant was put together on Sunday, and John was a bit bothered about stability because the boiler in the hull is a bit tall. It's not been in the hull before. John then tested it on the pond and it is stable, and the launch ran beautifully.

- **Operations.**

With the variable pitch propeller, it means that the simplest steam plant can be built with a non-reversing engine. The launch can be put in the water with the engine running. However, the minute the prop pitch is altered, it's like releasing the clutch on a car that's being revved; the launch accelerates away very quickly. It's a lot better than starting an engine in forward or reverse, because the propeller pitch is always put against an engine already at full power.

There was something that John didn't anticipate, and it might be a characteristic of just this hull and that is if the boat is run towards the bank, and it's 'one boat length' away, and the rudder is 'slammed' full left, with full reverse, the big propeller at the back acts as a paddle, and it spins in its own length, almost like a ‘handbrake turn’. If the prop is then engaged forward, the launch accelerates away again.

The manoeuvrability has to be seen to be believed. The variable pitch propeller has exceeded all expectations.

- **Boilers.**

John has got the turbine working in Version 3 hull which is a little less crude than the Version 5 hull on display. Version 5 looks ‘horrible’ but works well and Version 3 works well, looks a bit better and has brass blades. The boats are purely built as vehicles in order to run the engine units. John wants to build boilers and he likes building engines of various types. As mentioned, he’s had three engines in the Version 5 hull since July, and it must have had 15 hours on the water. The engine runs for 20 minutes at a time.

All the boilers run on methylated spirits. The boiler is a ‘tin can’ with some torn up blanket in the bottom with a bit of gauze. All the boilers have the same heat input, but different designs of boilers and different amounts of surface area will evaporate more or less water.

The Version 5 boiler is ‘not happy’ with the turbine. This boiler has fire tubes arranged in a ‘V’ and they are in this configuration so John can get a centre stay down the middle to hold the boiler together. The other boilers John has made have water tubes underneath. The next boiler will have the ‘V’ shape fire tubes and will have water tubes as well. If the water tubes and the fire tubes work why not have both. The new boiler will be built sometime in the new year, and hopefully can be mounted lower in the boat.

Question and Answers.

Q: Do you have a thrust block on your propeller shaft?

John: There is a small bracket which supports the top end of the shaft, and there’s a copper washer which it presses against. It could probably benefit from one of those caged rollers you can buy. At the moment, I need room, but it probably does need something it can push against.

Q: Is there a problem with the shaft trying to pull and push.

John: It is pushing and pulling against a bracket with a slip washer in there. I should really have two radial races each side of it. I don’t know if it would make a difference or not. Anything that will reduce the internal friction is a benefit.

As I’ve said before, if I use normal lubricant on the turbines, they won’t run anywhere near maximum power. I made the gears out of nylon, but we’re still not there with regards to reducing friction. This gearbox is nominal 3:1 (more like 2.87:1). This is higher geared than the other boats. I’ve always used 4:1 in the other boats. The other advantage is that it’s a smaller gear case. The whole thing has become comparatively lighter. The setup that’s it’s got now with the oscillating engine with its ½” bore and 1” stroke is really “doing the business”. The launch moves at a brisk walking pace (about 5-6 mph). It looks very serious on the water.

Q: Do you have and control over the speed of the engine?

John: No, it’s constant speed. There is a valve on the top, but I’ve never bothered to turn it. I always let it go full speed. I don’t even turn it off when I get into steam. Being an oscillator, it has a ‘stop place’, and I just wait until the safety valves blow, flick the propeller and plonk it in the water. My remote-control box is spring loaded in neutral. When the prop is in the water the launch just sits there. Then, with the remote you can just push it into forward or reverse with regard to prop pitch.

When I first set it up with the radio control, I had to be careful because, as the engine isn’t self-starting, if the remote is arranged wrong you can ‘over pitch’ it and the engine can stop. Once it’s stopped, it won’t start again and the launch can get stuck out on the water. This is a problem at the Club pond because we can’t wade in the pond because of the very expensive liner that was put in. The pond is about the size of an Olympic swimming pool.

The problem with the engine stopping is that the boiler doesn’t know the engine has stopped and if the boat is stuck out on the pond too long, it boils all the water away. That doesn’t do the boiler any good. It’s one of the reasons I run on methylated spirits. Methylated spirits will not melt silver solder whatever is done to it. It is safe to run the boiler dry, but it’s not something I like to do.

Q: What pressures do you run your boilers at?

John: The boilers are rated at 50 psi. They are made from solid drawn copper tube, and flanged plates (I form the flanges over wood). They’ve all got centre stays down the middle. I’ve tested them to 150-200psi. This boiler had to be tested last Saturday as it was ‘out of test’, and I’ve tested it to 100psi. I expect these boilers to take up to 400-500 psi. The walls are 1/16” thick.

Q: Are they vertical boilers?

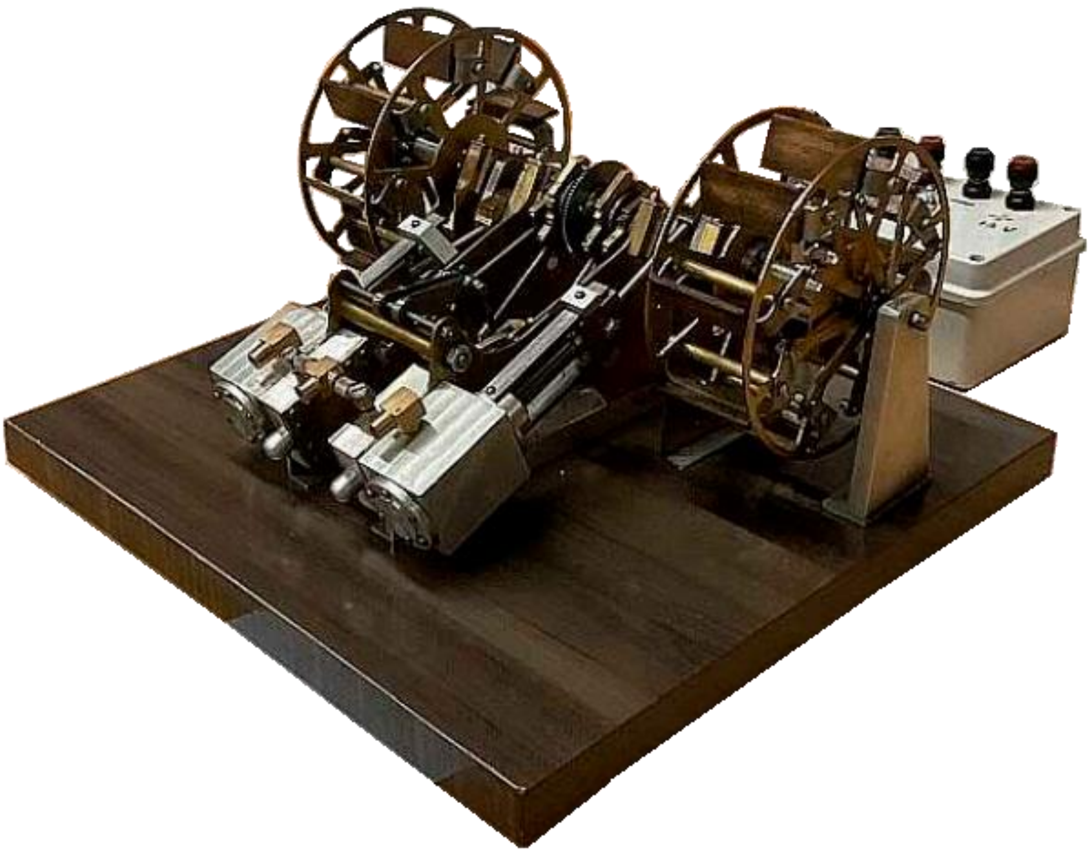
John: No, they are mostly horizontal. No.1 boiler is vertical with a fire tube up the middle, but the rest are horizontal.

Two of them have water tubes and this one has fire tubes arranged in a 'V'. This is a fairly efficient boiler, but it takes longer than the others to get steam up. On a cold day, it takes about 10 minutes to get steam on it, but it will run for 20 minutes. The water tube boilers seem to be a bit more active. I think I will have water tubes and fire tubes in the new boiler. If they're both good, they will be twice as good together.

Q: Do you have superheaters in the boiler?

John: Yes, to a degree. The housing includes a 'steam dome' and the tube goes down and runs around the flame inside, emerges out the back and connects to the engine. Whether you can say it's a "superheater" or whether it's just "drying the steam", I don't know. It certainly helps.

- **Brian Stephenson: Twin Steam Paddle Engine.**



This was one of Brian's "COVID" projects, which kept him going through the pandemic.

The model includes a lot of identical parts so Brian had to make jigs to produce these. He had to make four jigs altogether because there's lots of moving parts. It was a fairly simple model to make once Brian got the idea of how it works. Unfortunately, the drawing used didn't show how the model operated, so this had to be worked out.

The model does have a forward and a reverse, and Brian made the bits and pieces that did that.

Questions and Answers.

Q: Is the design yours?

Brian: No, I made it from a drawing**.**

Q: Is it a Westbury design?

Brian: Yes**.**

Q: Is your model based on a working paddle steamer?

Brian: I would have thought so. It works on compressed air.

Q: Can you alter the speed of each wheel independently?

Brian: No. There is a solid crankshaft going right through, so they don't run independently. There's nothing on the drawing to allow that.

Q: Is that how you steer a paddle steamer, with different speeds and direction s of rotation on each wheel.

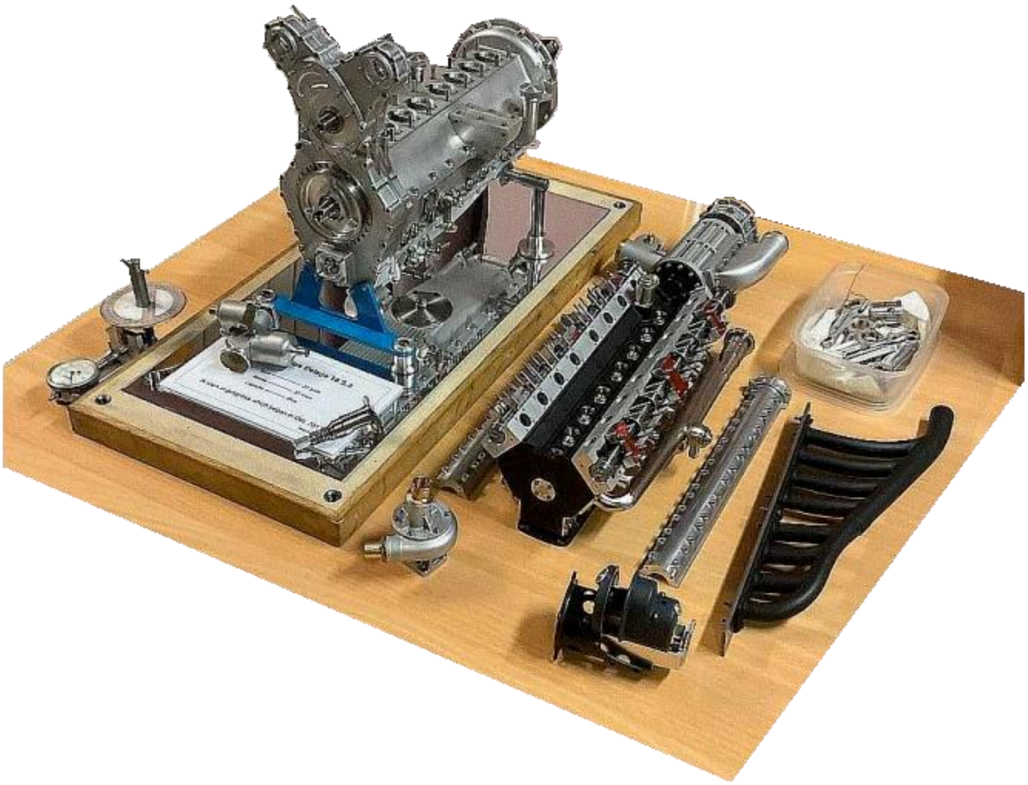
Brian: I don't know

Comment: I think that's how a paddle steamer is steered with independent motion of the wheels.

The Vote: The models were then inspected for five minutes, and the models were voted for (the exhibitors weren't allowed to vote for their own models).

The Winner: The Winner of The Mike Sayers Trophy for 2022 was John Heeley.

In addition to the Mike Sayers Trophy competition models, Mike brought in his *Delage* model



PEEMS Visit To Sylatech (formerly Micrometalsmiths) At Kirkbymoorside On Friday 9th December.

On Friday 9th December thirteen PEEMS members visited Sylatech in Kirkbymoorside. We were given a conducted tour by Nigel Griffin the Technical Sales Manager.

Sylatech: Sylatech specialise in producing *Investment Castings*** which are thin walled, light weight non-ferrous components for both commercial and aerospace applications. The process results in high quality components with very good surface finish. Sylatech's capabilities extend to RF/Microwave. They offer the custom design and manufacture of microwave subsystems, assemblies and wave guide components for the defence industry. To enhance their capabilities, they also operate CNC machining.

**** Investment casting** is an industrial process based on lost wax casting, one of the oldest known metal-forming techniques. The term "lost-wax casting" can also refer to modern investment casting processes.

Investment casting has been used in various forms for the last 5,000 years. In its earliest forms, beeswax was used to form patterns necessary for the casting process. Today, more advanced waxes, refractory materials and specialist alloys are typically used for making patterns. Investment casting is valued for its ability to produce components with accuracy, repeatability, versatility and integrity in a variety of metals and high-performance alloys.

The fragile wax patterns must withstand forces encountered during the mould making. Much of the wax used in investment casting can be reclaimed and reused.

Investment casting is so named because the process *invests* (surrounds) the pattern with refractory material to make a mould, and a molten substance is cast into the mould. Materials that can be cast include stainless steel alloys, brass, aluminium, carbon steel and glass. The cavity inside the refractory mould is an exact duplicate of the desired part. Due to the hardness of refractory materials used, investment casting can produce products with exceptional surface qualities, which can reduce the need for secondary machine processes. **(ref: *Wikipedia*)**

The Sylatech Process:

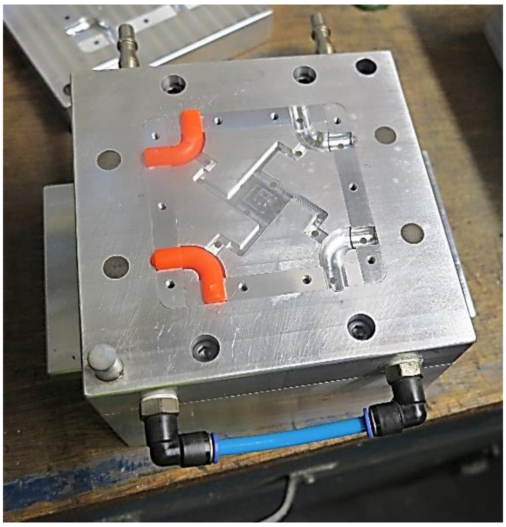
This is a schematic of The Sylatech Process which is a block moulding version of the 'Lost Wax Method'. A fine plaster investment is applied under vacuum. The plaster penetrates all external features and fills internal voids to ensure that, as the mould is formed, every detail of the wax pattern is faithfully reproduced.

Please Note: *This chart has been taken from the Sylatech website and has been reproduced with the kind permission of Sylatech. This chart should not be reproduced without Sylatech's permission*

- **Tooling.**

The investment casting process begins with tooling to produce the wax injection. The tooling made at Sylatech is very similar to those used for plastic injection moulding tools, but these tools are made from aluminium because wax is being injected. Wax is non-abrasive, and self-lubricating. The advantage in using aluminium tools is that they effectively “last forever”. They don’t need refurbishment and are therefore relatively inexpensive.

Hardened steel tooling would be used for pressure die casting, and plastic moulds would be hardened steel costing thousands of pounds. Aluminium tools are a tenth of the cost of hardened steel tools. This means it’s a lot cheaper to get going with this process. Any moving parts in the tool are either brass or steel.



The number of parts to be produced will depend on the number of impressions put in the tool. If the quantity is in the 50s or 100s, tooling costs are kept down by having only one impression in the tool. If the quantity is in the thousands, Sylatech makes as many impressions in the tools as is practical.

Sylatech hold about 5,000 of these tools now, with a few hundred still active. Sylatech are still making a range of products which incorporate a number of parts, for a large number of customers.

The vast majority of customers are commercial and aerospace. One part that we saw was a static discharger for aircraft wings. These are the little black rods that are seen on the trailing edge of the wing. Sylatech makes the component which sticks to the wing and holds the holder. These are being manufactured in very high volumes.

Q: Do these parts fail in service?

Nigel: Yes, they burn out, they break, they fall off. Although this particular business was affected when airlines stopped flying during COVID, the business is already back up to volume again.

Sylatech makes all its own tools in its own tool room and has the capacity to make a good number of tools a year.

One of the products Sylatech makes is high security hand cuffs for moving prisoners between facilities (ie not police hand cuffs). We could see the level of surface finish on the cuffs from the wax impression.

If the surface finish in the tool is good, the surface finish on the wax will be good. The surface finish is maintained throughout the process resulting in good surface finish on the finished part. Silicon release agents are used to release the wax models from the moulds.

One part manufactured, was armoured plating for wiring conduits. This forms part of a wiring loom in aircraft. What is critical for these parts are smooth corners in the conduit which won’t chafe the wires. Two types of waxes are used to produce this component, a water-soluble wax and a thermal wax. The pink wax is soluble in water and can be removed by water or mild acid solution to speed it up. The use of these different types of waxes allows very difficult shapes to be formed internally in conduits, which would not be able to be produced with pressure die casting.

- **3D printing of wax models.**

In addition to the injection moulding of wax models, these can be produced by 3D printing. We saw a door knocker wax produced by 3D printing. The part will eventually be cast in brass. 3D printing of wax in layers allows whatever shape is required to be produced. Someone else produces the 3D model, but once Sylatech have that model, it can be put onto the wax printers, and several hours later there is the part. For low volume manufacture of parts, it's a great process. It saves on paying thousands of pounds on a tool.

In conclusion: the tool designers will create a tool, programme a tool, and make a tool.

- **Setting The Wax Parts Up On A Tree (Frame).**

Sylatech are introducing robots into the manufacturing process for repetitive operations. Here is a robot for loading wax models onto a tree (frame). The robot picks up each model with little jaws on the left-hand side and it has heater elements on the right-hand side.

The robot brings the wax models over to the frame, melts a pool of wax on the frame and places the part in it. The pool of wax then solidifies and the wax model is attached. This continues until the tree is full.

The way this process works, like for all investment castings, is that the frame (tree) is filled up. The trees then go into boxes which are filled with plaster. The wax is then melted out (the lost wax method) before the metal is poured in.

The plaster is then removed leaving the metal part. The removed plaster is usually put into landfill.

- **Plaster or Ceramic Shell Moulds?**

Ceramic shell moulds are used when casting ferrous materials or for larger castings than Sylatech's boxes would accommodate. Typically used where pour temperatures are over 1250°C. The ceramic shell mould consists of very fine ceramic particles in a slurry. The wax models on the tree are dipped in this slurry which is then covered in sand and dried. The whole process of creating metal parts from a ceramic shell mould typically takes five or six days, compared with overnight for a plaster mould.

Sylatech only operates the plaster process. The plaster mould is a quicker process and is used for non-ferrous components like aluminium and brass. The plaster process is what PEEMS was shown on the visit. The steel shackles of the handcuffs are made elsewhere using the ceramic shell process, whilst the aluminium parts of the handcuffs are made on site.

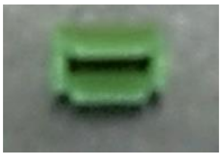
The plaster process achieves a surface finish of less than 1 micron compared with the ceramic shell of 3.2 microns typically.

- **Types Of Waxes.**

There are several types of waxes used at Sylatech. There are the soluble waxes which melt out in water (a process that can be accelerated with a mild acid solution). The blue wax is 'non filled', and is the most expensive, but gives the best surface finish. The green wax has filler in it and tends to be a bit more dimensionally stable. The green wax doesn't tend to get 'sinks'. The brown wax is the cheapest and is used for the basics and parts that aren't critical.

- **Microwave Components.**

In 1964, Christopher Shaw set up this foundry to specifically make parts for the microwave industry. They made very tiny waveguide bends. At the time, they were chasing good surface finish, dimensional accuracy and no draft angles. These components were being made in 1964 and are still being made today. Sylatech has just received another order for waveguide bends. These components go into satellites.


Wax Model

- **Single Part ~ Three Different Waxes.**

Here is a wax model of a very complex part that's been made out of three different waxes. The different waxes are just glued together. They are set up on a frame and cast in one piece.

If the lost wax method hadn't been used for this part, a lot of fabrication would have been needed to manufacture it.

- **The Investment Station.**

The size of the parts that Sylatech produce are relatively small. The process has been upscaled from the jewellery industry. Jewellers use small cans about the size of a bake bean can filled with an investment plaster. They will suspend the wax model of the ring or pendant, in there, and then melt out the wax once the plaster is solid. The gold or platinum is then poured into the plaster mould. Sylatech have upscaled that process for larger more commercial parts but with the same level of surface finish and detail in the final part.

The limiting part for Sylatech is size. Because plaster is relatively weak, it will start to crack if the mould is too large.

Comment: When the Egyptians made castings, they used to spin them around their heads to consolidate the plaster and drive out air.

Nigel: Yes, that is the process where centrifugal forces are applied to castings, but what Sylatech do now for consolidation, is to use a vacuum rather than spinning.

Once the wax models are set up on the frames (trees), they are suspended in steel boxes. There are four or five boxes on the platform. The plaster is then poured into the boxes under vacuum. The boxes are vibrated to get rid of all the air bubbles. It takes about 15 minutes to fill the five boxes. The boxes are then left overnight. This is quite a quick process compared with the ceramic shell process.

For the ceramic shell process, the wax models are dipped in a slurry containing very small ceramic particles. This is then covered in sand and then dried. This process takes about five or six days.

- **Firing.**

The boxes, full of plaster are then loaded into the furnaces upside down. Forty to fifty boxes can be put into the furnaces. The furnaces are gas fired up to 700°C. That will burn out all of the wax and fire the mould.

The temperature is then brought down to 300-400°C for aluminium and 550°C for brass. The box is then taken out of the furnace hot. It takes about 20 hours firing the mould.

The temperature can't be ramped up to maximum straight away, and has to be taken up in steps, otherwise the mould will crack.

- **The Pouring Station.**

The boxes are then dropped into the pouring station. The boxes have holes around their periphery. The pouring station consists of a very large vacuum pump which sucks air through the porous plaster. The pouring process is “vacuum assisted”. As the metal is poured into the mould, all the gas is being ‘sucked out’ whilst the metal is being ‘sucked in’.

This process allows very thin-walled sections to be produced with a wall thickness down to 0.5mm.


The holes in the boxes are there so that air can move through the boxes under the vacuum assistance, whilst the metal is being poured. The photos above show brass and aluminium in the moulds.

To get the mould out of the boxes, a hydraulic ram is used. The boxes have a loose bottom. The hydraulic ram just pushes the whole chunk of plaster out in one go. A couple of taps of the hammer on the top, and most of the plaster breaks off. It is then cleaned off with high pressure water. The other advantage of this process is that you don’t need a road hammer or sand blaster to remove the plaster. It can be done with high pressure water. All the plaster in the intricate galleries in the final casting can be removed by squirting water into them.

- **The Melters.**

Three melters are full of molten aluminium. Two of them have casting grade aluminium which is LM25 (A356). Two pots keep Sylatech going all day.

The third pot contains a brazable aluminium LM31 which has a very low silicon content. This means the final component can be brazed, but makes the part difficult to cast.

The silicon makes LM25 nice and fluid, and there isn’t the porosity that there is with LM31, but all the cast bends that Sylatech make are consequently brazed, so LM 31 has to be used.

For brass, each melter holds 50 Kg at a time. The vast majority of castings that Sylatech produces are aluminium.

Below is a small brass “coin” sample that has been poured.

The coin sample will be ‘spark analysed’ to make sure the metal content is as it should be. For aerospace everything produced must be traceable.

All the ingots used also have to undergo technical analysis.

A cast brass draw pull:

To recap: surface finish is all important, so the surface finish in the tool is replicated in the wax model, which is replicated in the mould and in the final casting.

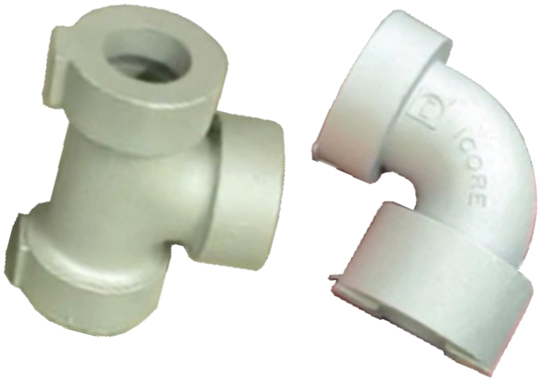
- **Washing.**

Washing components is a fairly horrible process, and that's why Sylatech have installed another robot to do this task. The robot picks up the parts and presents them to a high-pressure water jet in order to wash out all the remaining plater. Every part requires a different instruction.

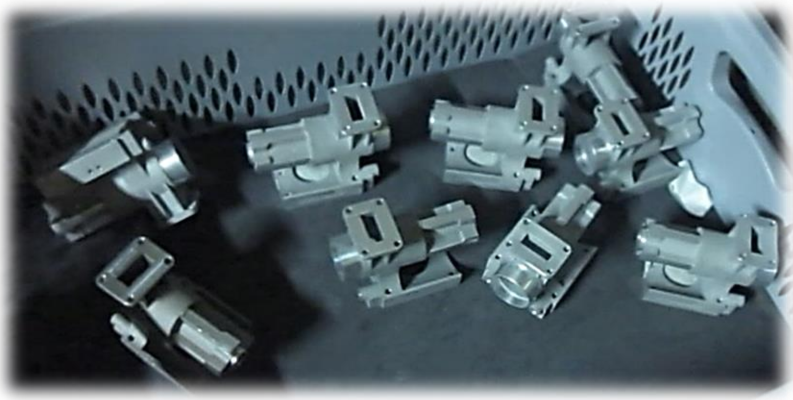
- **Finished Parts.**

These are the conduits which used soluble wax. They have a nice smooth finish on the inside. There's nothing inside which is going to chafe a wire. These components have been made since the 1980s.

Sylatech makes bends, tees and lots of different sizes of conduits.



This is another waveguide vane. This includes a rectangular port going through a 90°bend and another 90° bend. This was done by sticking two different waxes together.



- **Fettling Department**.

A lot of components will go straight from here to the customer. Most components need to be machined and the only reason that Sylatech will machine parts is for tolerance. All the machine details that are seen could be simply cast, but a tolerance of ±4 thou/inch is needed for that.

If a tolerance of ±2 thou/inch is needed, then the part will need CNC machining.

- **Machine Shop.**

For a foundry, the factory is well set up machine wise. The machine shop includes twelve ROBODRILLs. Every drill has a Renshaw probe on it so each hole on a casting can be probed and the casting machined relative to it.

Most of the machines have 4-axis cubes on as well, so that allows the machinist to get at least three faces of a casting.

The DATRON is a little bit different to a normal CNC machine. These are German machines and operate at 40,000rpm. There is vacuum clamping on the bed. Big flat plates of aluminium are normally put on these machines. There is no coolant, and all of the swarf is dry. The machine runs on an ethanol mist. There is ½ litre of ethanol sprayed onto the cutter each hour.

The parts come off the machine burr free, clean and without any clamping marks. A lot of the microwave components that are made tend to be single wall, flat plate antennae or similar. The DATRON is absolutely ideal for that kind of work, but it costs a lot to run. A spindle on one of these machines lasts 2000 hours, then a refurbished spindle needs to be installed. That means there are two DATRONs and three spindles, with one spindle being back at DATRONs for refurbishment ready for the next replacement. The reason these machines are used is because they are very fast and they are good with flat panels.

Parts that come off the DATRON often have 95% of the metal removed. This means that the resulting component, such as the microwave antenna, is a very flimsy part which is usually braced with a lid.

Sylatech have had the DATRONs for two to three years, and these replaced a very big MAZAK machine which used to take eleven hours to machine a particular panel that takes the DATRON three hours.

ROBODRILL

DATRON

- **Inspection Department.**

The inspection department contains a computer-controlled measuring machine which can check components far bigger than those produced in the factory. This is an optical measuring machine. The part is placed on the bed and the machine focuses on the edges and can measure parts very accurately and very quickly.

In addition, there is a spectrum analyser to test the chemical composition of the aluminium and brass used in the foundry.

PEEMS would like to thank Sylatech and Nigel Griffin for allowing us to visit their foundry, and especially thank Nigel for his very informative tour and for checking this article.

Things We Take For Granted by Ted Fletcher

In this modern age there a great many things we take for granted. Do we ever ask why, for example, the UK electrical frequency is 50 cycles or 50Hz alternating current? Hertz is named after the German who discovered it and Tesla was a Russian who discovered alternating electricity.

So why do we use 50Hz in the UK (60Hz is used in some other countries)?

There are many reasons and some are due to the mechanical and electrical limitations of early generators.

- When electrical power generation was in its infancy in the late 19th century, the design of electrical plant was limited by the electrical and mechanical constraints of the time, for instance:
  - Mechanical strength.
  - Bearings which would have been plain journals.
  - Electrical Insulation which would have been guttapercha.
  - Use of cast iron rather than fabricated or cast steel.
  - Air cooled generators rather than the hydrogen cooled ones we use today.
- 50 Hz is 50 cycles or rotations/sec and this is equivalent to 3000 rpm. 3000 rpm is a reasonable speed for steam turbines that turn generators. Modern final stage turbine blades can have an effective length of 2 metres and this means tip speeds of 630m/s = 1400 mph. This means that higher frequency, or speed, would limit the maximum size of the turbine. This is unless intermediate gearing was included, but this would entail additional cost.
- A lower frequency than 50 Hz would cause filament bulbs to flicker.
- A higher frequency than 50 Hz would cause skin effects in transmission lines and this would reduce their current carrying capacity or result in unwanted heating. At 50 Hz the electricity only travels in the outer 9.2mm of the copper conductor, so anything that has a diameter greater than 18.4mm is a waste of material unless it is there for mechanical strength.
- To reduce weight and cost, many large conductors are made of copper-aluminium so that the electricity flows through the higher conductive copper skin, whilst the aluminium core provides mechanical strength.
- In electric pylons the conductors are often arranged in groups of three (all three effectively one conductor). The reason for this is that a single wire using the amount of metal / km required would have higher skin losses due to the skin effect.

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