Building PYRTE

This is a picture of the number 3 build in progress, just to give you an idea of what she will look like...

PYRTE is the simplest live-steam Pull-You-Round-Traction-Engine you’ll ever come across.

You just fill her up, light her fire and a short time later she’ll be pulling you round.

She’s robust and made easily inside three months at around seven or eight hours per week, with easy to understand instructions that any absolute beginner to model engineering can follow, and requires mostly basic tools, much as you would find any novice or wannabe steam engine builder/owner already has.

The only extras involve a little lathe usage, 3½ inch centre height is plenty, and the use of a blow torch for silver soldering, and maybe the use of a bench drill for some drilling and very light and basic milling (nothing too fancy).

Gears and the chain drive can be purchased very economically ready cut for this model, making PERTE a quick and easy model to produce before the enthusiasm of the project drains away - a common fault with longer term builds that leads to many models never being completed.
At around 26” long, 18” high and 13” wide and weighing in (bone dry) at around 60 lbs, with a working pressure of 50lbs/square inch, PERTE is quite capable of pulling most adults around with ease, and on top of that, she’s produced relatively cheaply compared to other models of a similar size.

Ok. she’s not your typical traction engine with all the bells and whistles on, but was built originally as a workhorse, a pull-you-(me really)-round with a view to function rather than a pleasing appearance.

Simply put, it was intended to be a good way for me to get my steam-fix whenever the mood grabbed me.

Perhaps a little explanation of how this all came about would enlighten you.

What you are about to follow, if you choose to take on the build of PERTE, is written by the hand of a now more experienced model engineer and aimed purely at any absolute novice to engineering, omitting many of the unnecessary and wasteful mistakes that were experienced in the initial build of this model, making it a step-by-step easy to complete project for anyone who fancies having a go at building their own, and possibly their first, live steam engine.

It fills the huge gap between steam engines requiring great skill, and the little easily built models that have very little use other than decoration.

And so to learn more about how PYRTE came into being, please read on…….

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This all started off for me way back from when I was a kid.

I was given a Mamod Steamroller one Christmas as a present, after exploring a real full-size one with my mate about Septemberish one year back in the late 1950’s, and I must have been really excited and gabbing on about it no end right then for me to get a model of my own to play with.

I remember that Bill, (I know, I should really have called him ‘Mister’, but being a cocky kid, he was Bill, the bloke who drove this roller in the gang of men who were laying the tarmac) well, he’d finished his days work putting the new roads in on a local new estate and had gone off home, only a few doors down from where I lived then, and a few hours later I was out mooching about with my mate Sam.

We’d spotted this roller – I’d be guessing it was a Marshall, but I couldn’t swear to it because of the fogs of time, and it must have been one of the last of the steam engines in use in the UK, for it was only about ten years later that I heard it was off to the scrap yard and was sold for £50 – if only I had known then what I know now – so we clambered on board and I was amazed at the great mound of coal sat behind the driver’s seat ’cause my dad was always going on about the cost of it, and I honestly thought “should I take some home for my mam”.

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Well, that thought soon evaporated as my eyes landed on all the grimy wheels and levers covered in muck and oil everywhere, as I hadn’t a clue what they were for back then, and there seemed to be so many of them it was almost frightening to me, as a spindly kid of around nine or ten years old.

So we played there, absorbing the heat, getting grimy as hell and pretending to be laying the tarmac with this giant monster of a machine, and sitting in the big bum-shaped seat I couldn’t even reach the levers or the floor, but I still imagined myself driving it round the roads, gliding smoothly just off the edge of the kerb amidst great clouds of white smoke, just like I’d seen, and pushing the tarmac down to perfection.

I was mesmerised! I was enthralled! I was swallowed deeply, hook, line and sinker into all mechanical things, especially with the steam era, and it’s never really blasted me out of any steam orifice since. Sounds painful that?

I couldn’t wait to get into everything mechanical, like building that bike I’d always wished for back then, even though I couldn’t ride one as I’d never even been near one. Times were hard then you know!

I managed to get a very small Meccano set as a Christmas present the year before, and this occupied me no end, trying to build my own copy of a steam roller of some sort, but there were never enough parts to complete anything.

Over the years that followed there was a place in my heart that was still fascinated with all things steam, and a wish in my mind to have my own roller or traction engine, but with a growing family and the large holes in my pockets that silly notion was always shelved.

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The Mamod has long since died a death from being over-used and left mangled – mainly from me just being a kid I suppose, and I’d finished work owing to poor health and was looking for something to do to fill my time.

Mamods are all well and good for young kids - not forgetting the ‘big kids’ as well, for decoration purposes, or something to bring back childhood memories, aren’t they; but the problem is they just don’t do anything, do they; and you’ve always got to add water and fuel tablets if you want to run them for any time, and that’s not so easy to do once they are hot.

Just having them running round in circles for a few minutes is not the most interesting thing in the world is it?

Okay, if you have one, you can get it running for longer these days by using a gas tank and burner, rather than forcing it to keep on taking the tablets, but it’s not very successful as I can testify with burnt fingers from trying to get the extra water in.

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In my view, they leave an awful lot to be desired!

Well, once I was forced to take retirement, the one thing I fancied most of all was a steam engine capable of pulling me round my garden – something quite robust – something that I could actually drive – something I’d built myself that didn’t cost a bomb and was functional, rather than one that looks really arty-farty like some of them are, with all the bells and whistles on - not a train, as that would need tracks and all that extra costly palaver, but a roller or a traction engine that was capable of moving randomly about, providing it was on solid ground - just like my path at home, would you believe.

I had, over the last ten years, got me a lathe, a Chinese job – a Clarke CL500M lathe/mill combination; basic, to say the least, try reading my review of this lathe if you are interested, but I’ve sort of got used to it by now, even though all I was capable of when I bought it was maybe a bit of turning that was learned at school. I’ve progressed a bit now, but this steam engine being described is aimed at the easier build option like when I first kicked off my model engineering projects.

With this lathe, along with a much smaller fiddly one at first, I’d had a go at making small steam models, trying to build up my confidence a bit without wasting too much money, you know the score, with a little bit of success on top of many failures and mistakes, so experience was in very short supply back then.

Despite this, the nagging want was there all the time, and I decided to begin looking at something a bit bigger that would allow a bit of flexibility because of its size (bigger size = bigger tolerances, which suited my abilities, rather than me trying to be so precise, which I wasn’t), like making my own traction engine or roller.

I sent off for plans for various models only to find that my fiddly lathe limited the diameters I would be able to turn and that was the reason I got the CL500M. And some of them looked so over-complicated and super-duper professional, it was almost frightening, and more than likely I would have to buy other special lathe bits to perform some of the required operations I was reading about in the model engineering magazines at the time.

In fact, at one steam fair I visited in my early years, one beautiful three inch model owner (and you can take that how you want – it was a beautiful model, but he was really ugly) suggested I pay for a complete traction engine rather than buy all the tackle and machinery I would need to produce one for the same sort of price, and then have the expense of the parts and castings needed on top, let alone saving a lot of time.
That was then. If you tried to buy a three or four inch model nowadays, you’d have a bit of deep digging to do!

But at that time I was more interested in building something for myself, using my own hands to produce a model I could play with, something I could appreciate, but the worst of it was I was coming across all sorts of new names. There were things like front plate and back head, the fairlead, Walshaerts valve gear, spectacle plate and cross head. What were they?

Honestly, it’s all so confusing and off-putting when you want to have a go at something new isn’t it. And the worst of it was my doubts in my own ability were growing all the time, the longer I put it off.

- Would I need to buy all sorts of tooling before I was able to make my engine?
- What if it was a fad and I went off building my own steam engine before it was completed?
- Would I be wasting an awful lot of money and time?
- Would this mean I’d never get my own steam engine running for years – if ever?

I did not want to make a start on one and then find I could not complete it for lack of enthusiasm, knowledge, finances or tooling. I’d never done any silver soldering or gear cutting, and I was scared to death of trying them, along with many machining methods like trepanning and reaming and fly cutting, things I’d barely even heard of, which all the scale traction engine and roller models needed.

What I wanted was a simple model to build so that even someone with my lack of experience could complete it, and hopefully in a reasonable time too. I’d heard of blokes who had spent the best part of five years, and more, building their own steam engine.

I remember one bloke in particular mentioned in the Model Engineer about his steam lorry taking twelve years to complete, and I certainly wasn’t prepared to wait that long before I got the pleasure of driving my own live-steam engine - and that’s even if I lived that long.

So to break it down into very simple terms, I needed:

- A very easy to build live-steam engine that fitted in with my poor ability and lack of experience and precision.
- A very easy to understand building process, with a full set of instructions that even a dope like me could understand.
- A model that could be completed in around six months (preferably a lot less - seven or eight hours or so per week) by using readily available parts.
- One with no gear cutting to worry about and very little silver soldering needed.
- A model big enough to pull me round (and with a bit of puff to spare).
- One that could be refilled on the go.
- Nothing too fancy or costing a fortune to make (just in case of cock-ups and my still shallow pockets).
- A relatively simple and safe to operate machine.
• None of the super delicate and complicated motion work and valve-timing needed.
• *Almost everything bought from stock, and maybe very few castings needed.*
• Something that did not need what seems like millions of fiddly parts to be made.
• *Something durable that would stand the test of time.*
• A model that did not require lots of different and confusing sized nuts and bolts and fittings.

But, Lo and Behold, as usual, there was nothing out there in the wild blue yonder like this.

(This is **PYRTE** in the almost finished state – just needs some more painting and the exhaust and water tank sorting, along with hub caps to complete her after she’s been run and steam tested with the new brass cylinder block. Did you notice the melted plastic table top? Silly me... You can see the trial run and my comments [here](#).)

There were lots of instruction books and guides available for engine building, assuming you were an experienced model engineer and knew one end of a lathe or milling machine from another, but for the complete novice there was nothing - **absolutely nothing** - other than fiddly little motors of around half a cc.

Don’t get me wrong, these models are a relatively inexpensive way for semi-skilled novices to cut their teeth with engineering projects, assuming they already have a fair bit of engineering tackle or understanding, but they were not what I wanted.

You may wonder why I did not join a modeling club; well the simple answer is I attempted too, but found that I was the newbie and was as embarrassed as hell when they got talking about things I hadn’t a clue about. And talk about them being ‘Clickish’! Most model engineers tend to be loners, quite happy with their own company for hours on end, and I fit the bill quite nicely.

Anyway, I’ve strayed a bit. Sorry about that! I’ll do my best to keep on track!

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It was about that time I thought of the basic Mamod!

Why not use a simple model like my old Mamod – maybe scaled up a bit, and with a few easy modifications – say being driven directly from the crankshaft by a bike chain to the back axle, that way driving both wheels, or an alternative would be to just drive one wheel like the Mamod does.

It should be OK providing there is enough weight on the back end, surely.

**The idea was born...**

Here’s a brief description of the Mamod set-up.

The Mamod boiler is classed as a pot boiler, being basically a tube, sealed at both ends and heated for half its length at the back end, with no fancy flue tubes sitting inside the barrel, demanding complicated silver soldering to worry about.

The steam pressure is limited to around 15 to 30lbs per sq. inch, which makes it very safe to use, and the machining is very simple to do.

It fits the bill most nicely, apart from four points:

1. The fuel arrangements would need to be looked into.
2. The water replenishment needed sorting.
3. The drive to the wheels wanted some consideration, as I didn’t like the idea of using a drive belt fitted to the outside of a rear wheel.
4. And the last was the steering arrangement.

I thought that for the fuel I could go down the conventional route and use coal, but that is not very controllable – and can be very fiddly and mucky, as well as adding a lot more work and time to the project. So basically I decided on using gas as it cuts down drastically on the time and precision needed, and is much easier to install.

The Mamod type of model may not be very efficient in its fuel usage, but then again, it’s not as if it is going to be used day in and day out, is it? And I suppose that what is not spent on the parts, machining and labour - like a normal traction engine or roller, can be spent on a little extra fuel over the years, especially as most of the driving is done at weekends in the summer months anyway.

Another point, looking back on it, which a novice is not aware of, is the fact that everything has to be precisely square on a conventional live-steam traction engine or roller. But the reason Mamods are so successful is their simplicity. The precision standards are minimal, to say the least. There’s no awkward lining up of the boiler with the horn plates. No multiple gear shafts to line up. Nothing anchored off the fire-box like the horn plates (which generally can be all over the show).
If there wasn’t already a roller called Simplicity, this proposed new model would most surely claim that title, so instead of that, I decided to call it BERNIE (the bolt – Bob Monkhouse fame over here in the UK) as nuts and bolts are the simplest and main form of holding its parts together, which is how this model was built, rather than using small (easily breakable) taps.

The next thing to consider was the size, so my first thoughts were to double the size of everything Mamod, which would give a boiler barrel length of ten inches with a diameter of three and a half inches – my mind still works in imperial, so in the build all measurements are shown in imperial sizes, as when my model was first built the materials were mostly imperial sizes as they were just beginning to change over to metric sized materials here in the UK.

Some of the metric dimensioned materials supplied these days (2011/12) here in the UK will need a slight allowance for the difference in size, but this is easily overcome with a little forethought, and you will be assured of a true and easy build.

Right... Now to some metric dimensions, just to be awkward and confuse things a little...

The Mamod’s cylinder bore is 0.8cm with a stroke of 2cm, giving a swept volume of around 1cc, while doubling the size would produce a bore of 1.6cm and the stroke would be 4cm which would give a capacity of a little over 8cc. (That’s double times double times double, as the dimensions are doubled in three planes).

This size was my first attempt with ‘Bernie’, but I found it was very underpowered, and would barely move itself with my poor workmanship.

This scale is a little on the small size, much like a 1 inch to the foot scale model of a traction engine, which, if running on smooth hard ground at say, eighty pounds pressure would just barely pull an adult along, and even then it may have needed to go downhill. But as this model was only aiming at thirty pounds initially, and especially with my poor engineering skills to boot, then a larger swept volume was required to achieve any useful power.

By making everything 2.5 times the size of the Mamod, it sits around the 1½ inch scale, and the swept volume becomes 15.7cc, which is more like it, provided everything is run-in and not tight.

This gives a model traction engine or roller with a boiler barrel length of 31.25cm and a diameter of 11.25cm (near enough 1ft by 4½ inches diameter – for the old hands).

This size brought the problem of the boiler diameter not being readily available and my confidence of boring the cylinder accurately for the single cylinder, so I thought I’d reduce the stroke and widen the

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bore – having a long stroke looks more appealing visually when it’s under steam, but it also means the engine needs more room for the crank to rotate, and I did not like the idea of an overhung crank like on the normal Mamod, as I could see problems arising owing to its weakness. Either that or it would have to be made so big it would be cumbersome and look totally wrong.

And also it would mean the cylinder would have more metal in it, so it would lose heat more readily, which was something I did not want.

Because of this I decided initially on two oscillating cylinders, supported on the outside of a pivot shaft, with the cylinders against the two valve faces, sat above, but on either side of the barrel, and using an easily built up, shorter stoke crankshaft. *(This picture was taken before the cylinder blocks and piping were made for Bernie, but gives a rough idea of what it looked like).*

This meant a two-cylinder oscillating engine was produced with a bore of 2cm and a stroke of 2.8cm giving a swept volume of just under 17.6cc, which is a little over the original size.

By keeping to this size the ratio between boiler capacity and cylinder capacity is more or less maintained, although this can be, and is altered owing to the fixed nature of the water reservoir and the time of heat output from the tablets on the original Mamod model, versus the ability to add water and gas as-and-when on the proposed new model.

Because water can be added on the go, as in a normal traction engine fashion, the boiler capacity is reduced a little as there is now no tubing available – that I am aware of - of the right size (down to 4 inches rather than 4.5 inches diameter) for the boiler barrel, and there are no flue tubes taking up the water space within the boiler, which allows for a faster steam-up and allows any eager driver to get trundling around just a little sooner.

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So, to cap it all; all nuts and bolts are 4BA (well, almost all) to make life a bit easier. *(If you don’t want to use BA, then ⅛th inch or 3mm diameter threaded nuts and bolts are fine).*

The flywheel size and front wheels are OK for a 3½ inch centre-height lathe (7 inches swing), being 5 inches in diameter, which leaves only the rear wheels to worry about.

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This little problem was overcome by using a discarded gas bottle and an awful lot of hack-sawing and filing with a plate soldered in for the middle, giving rear wheels just over 25cm (10) inches in outside diameter.

I also modified the crankshaft with its bearings, making it more robust, although the idea of mounting the cylinders and crankshaft on a separate frame, a-la-Mamod, does away with the problems of having to fix a cylinder to a curved surface like the usual and awkward method of fixing requires, and also does away with really complicated lining up procedures, all prone to cause problems for inexperienced hands.

The steering has been modified so that the driver can sit on a towed truck, containing the gas and main water reservoir behind the traction engine and be controlled from there, along with replenishment of water with the aid of a hand pump, whilst on the go.

What in fact happened with this engine, due to my lack of experience, was that I could not get the oscillating cylinders and their faces on their valve blocks to remain anything like steam tight, which meant very little power was getting through to the crankshaft, which in turn meant my engine just sat there and wouldn't move.

This is the third part-built version called PYRTE, so don't be alarmed about the gap around the boiler near the fire box, as the instructions following have an improved method of fastening the boiler to the fire box, along with a brass cylinder as in the picture you have already seen, rather than the cast iron one in the photograph.

Because of this trouble with the twin cylinders, in the third and then the final version a very simple double acting fixed single cylinder is being used, as in the picture, with no complicated valve gear, which means a good, practical working engine has been produced, although rust problems made the brass modification a necessity.

It is a very basic model, with a total loss steam engine.

Lubrication is achieved by the very simple method of a displacement lubricator (the small brass container on the left hand side of the cylinder block in the photograph), which is very easy to make or can be purchased relatively economically.
Generally, a hand pump is needed with the total loss system along with minimal piping and this pump can be mounted on the rear of the engine or even on your trailer, wherever suits you as an individual, but on this model it is mounted on the rear of the engine on top of the water tank in the tender and is used for priming the boiler with water before it is fired up and generally keeping the boiler topped up.

A further pump can easily be incorporated on the back axle, driven by an eccentric cam, should you wish to make it up once your engine is running, but this is a future improvement I shall have to do.

The heating is achieved through using burners powered with readily available gas canisters.

Speed control is governed by a regulator (the throttle) as is the usual practice and direction is produced by a single rotation of the flywheel before starting off, unlike the slap-dash finger-burning/scalding method used on the normal Mamod model.

I did not consider adding a brake as being a necessity. After all, what’s wrong with throwing a wooden chock under the rear wheels like they used to do years ago on the full sized versions? It’s not as if a model of this size (around 26 inches long – 650mm) needs one anyway, and simply putting your feet on the deck does the trick.

On this model there are no compensating gears to worry about, as generally one rear wheel with the driving pin engaged is enough to drive her along and if both driving pins are engaged there is enough slippage on the wheel rims to allow steering to be maintained.

What follows is a revision of the much modified ‘BERNIE – the bolt’, showing the final version of the engine I made, now known as ‘PYRTE’ – pronounced like the Southern States drawl for “Pretty” (as so many people have asked for instructions on the build after seeing it on the rally field) providing a very simple to follow building process, that any absolute novice could complete.

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I am still using this model regularly, which proves its durability, and it still has many of the original ‘faults’ accidentally or perhaps I should honestly say ‘naively’ built in, but is still very serviceable. However, now that I have a little more experience in model building, you can benefit with your own build by skipping the unnecessary parts and be guided so that you do not follow my mistakes.

The photographs show many of the parts used on the original model (and many were taken some years back so are not that good) and they have lots of mistakes – holes bored in places where bolts would be hard to place, the wrong materials used in odd places, things like that, so if you just use them as a guide and follow the drawings and words rather than the photographs, you will be successful.
This old picture shows number 3 part completed model in a basic red lead paint, no steering or controls completed, no water tank etc. (notice the chain drive on the right hand side – very easy to make).

This model is being described with a view to simplicity, and if any builder wishes to modify their machine, say replacing the solid wheel centres with spokes, or cutting fancy designs in them, then these things are easy to do, but require a little experience and an awful lot more time.

Regarding the rear wheels rims, they are left smooth. No strakes (the treads that go at an angle on the outside of the rims) have been added, along with no rubber tyres, as the rims are rough enough to maintain grip generally, although she has slipped in single wheel drive a few times on wet grass before now.

Other chapters regarding the various modifications will follow in the coming months and will be published on the website for free download, so why not build the basic machine so that you can get up steam quite quickly, gaining experience both in building and driving your own steam engine, and then take your time with the following:

1. Build the rear axle pump and pipe work
2. Building ‘real’ rear wheels
3. Fitting conventional steering
4. Building the winding drum and brake
5. Installing “proper” steering

There are so many other options, but for now, why not use this easy to follow song and dance routine, showing just what happens where and when to get your show on the road.

*It can be pointed out here, that, I went in for the traction engine version for this model as it is far easier to build a traction engine than a steam roller, for the novice builder. That is perhaps why the majority of plans and castings for models on offer these days are for traction engines rather than steam rollers.*
Along with this introduction, you will have snippets from various chapters to give you an idea of the setup so that you may judge how easy it is for yourself to do, and whether you can follow it easily, and finally, whether to proceed any further.

I suggest you read it two or three times before you jump in, but I feel I have covered everything you need to know. If in doubt, just email me on steamshed@gmail.com

If you wish to produce this model and have the benefit of steaming around your own place quite soon, the whole book is available for immediate download, showing the drawings, with photographs and instructions for the economical sum of £18.67 directly through PAYPAL from http://www.steamshed.com where you will have other tips and options available to you.

It is also available as a cd through Ebay, but would incur extra costs to cover the production, extra fees and postage.

It is a sizable book, being almost 29 mb, so is offered for download as either individual chapters for those people with slower connections, or as a one off for the lucky high speed merchants.

It should be noted here that the drawings were done by me so there is no professionalism about them, but they will show you what is needed as you go along.

The chapters of the build are sequential, as should be the building process, and are as follows:

1. Building the boiler
2. Fire box
3. Tender
4. The smokebox, chimney and perch bracket
5. The front axle and steering
6. Front and Rear wheels
7. Rear axle and drive
8. Cylinder and assembly
9. Crankshaft, flywheel, valve gear, bearings, bed plate and boiler insulation.
10. Water tank, pipework and hand pump
11. Heating and base plate
12. Insulation and Painting
13. General running tips

Upgrades will be on the web site in the near future and will be freely available.
Help is readily available regarding the build by email should you need it from me at
steamshed@gmail.com and is available anytime, and I will do my utmost to reply within one day.

If you decide to take up this easy model, then may I wish you good luck and a successful and speedy build.

This link takes you through to the download page.

Best regards,

George http://www.steamshed.com and steamshed@gmail.com

PS. Feel free to pass this on to anyone you think may be interested.