LINK

NEWSLETTER OF THE
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Photos by Editor

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Cover Picture

Aveling and Porter became the largest manufacturer of steam rollers and traction engines in the world. Among their less well known products were a number of Tramway Locomotives. Approximately thirty five of these machines were manufactured of which only five survive. Of these four are still operational. "Sydenham", an 0-4-0WT was built in 1895 and is seen here on loan to the East Anglian Railway Museum in September 2012. Also in attendance at the museum on that occasion was "Blue Circle" (inset), a 2-2-0 WT built in 1926. The third operational survivor "Sirapite", an 0-4-0WT, is based at the Longshop Museum at Leiston. The last working survivor "Sir Vincent" is on a private railway.

Editorial

Readers may recall that in the 2012 July edition of LINK I was bemoaning the negative approach towards technology taken by the commission set up by the education secretary to review the National Curriculum. Did you sign the petition? If so you will be pleased to know that it has contributed to Michael Grove's change of heart and that technology subjects are to continue to be included in the National Curriculum.

The government are claiming to recognise the decline in the countries skills base and proclaiming the need for apprenticeships to train the artisans of the future. These so called apprenticeships are not the sort of training schemes that most of us recognise as producing skilled craftsmen. In many cases they seem to be limited to one, or possibly two years training in a works environment compared with the five, and at one time seven years considered to be necessary in the past. Personally I do not believe that an apprentice can learn sufficient to become a competent journeyman carpenter, plumber or toolmaker in such a short time.

What, you may ask, has this to do with model engineering? There is not much that we can do to influence the future of training in industry. We do, however, often hear the question asked "where are the model engineers of the future coming from?" Model engineers are drawn from all walks of life and all professions. They may be postmen, bakers or brain surgeons in their every day calling (or even engineers!) but if they do not have an engineering background they all have to learn the basics. This, surely, is where clubs such as ours come into their own. We should be encouraging those with an interest, and in particular the younger generation, by offering some level of training. Last Autumn I was privileged to visit the Hereford Model Engineering Society and was most impressed by their efforts to train up and coming model engineers. The society has three workshops on its site, one of which is devoted to the junior members use. The Society has a very pro active approach to the training of their younger members, many of who were actively engaged on site during my visit. The Chingford society also has a very positive approach to the training of its younger members and involving them in the running of the Club. I understand from a friend belonging to the Plymouth Miniature Steam Club that they are also active in the training field with four of their members acting as tutors at weekly evening classes held at a Plymouth school. The initiative for this programme came from the Club, not the local authority, who agreed the use of the school facilities for classes run by the Club. The age group covered is 12 to 16 and the charge only £25 per term.

How about us? We have excellent workshop facilities and many competent engineers among our members. Should we be thinking more of the future and making greater efforts to recruit and encourage the development of the next generation of model engineers? Since these notes were

drafted Ian Pryke has initiated a training scheme to introduce any newcomers to our hobby to the basics of workshop practice. Ian's scheme is not directed specifically towards the junior membership but I am sure that he will welcome juniors to his training sessions. It is down to the rest of us to point them in the right direction!

Once again this issue of LINK is bereft of "Letters to the Editor" and no one has felt able to support my new initiative with a contribution to "The Confessional". In this edition Artisan is addressing one of the problems which we suffered during the 2012 running season on the Club track. He tells me that he anticipates some controversy over some of the points he makes, so how about some "letters to the editor" for the next edition!

Editor

From the Chair

In my notes for the 2012 July issue of LINK I began to relate some of the history of our club site and the building of the track layouts. I got as far as the building of the bridge to span the new raised track and the relocation of the garage. After finishing the raised track bridge our attention was turned to setting out the track supports, starting with the long supports at the tunnel end of the site and working towards the club house. An adjustable radius jig was made so that we could align the supports on the curved sections, working on the centre line of the supports with the gradient being taken from two string lines on the level pegs put in by Brian Coates. Holes were dug to put the supports in to, using the radius gauge on the centre line. Each support was tapped into the holes, using a level across the top of the support, until it just touched the string line. After getting the supports in place up to the straight section the next job was to make the supports for the girder which would carry the track over the tunnel. These supports were made from steel tee section recovered from the old raised track station. The tee section was cut to length and welded together to make two joists with plates welded on the tops to take the girder over the tunnel. These were cemented in place and painted for protection. While the team continued with the track supports Malcolm Bradford started the foundations for the tunnel walls. These walls were built using eighteen by nine by nine hollow cement blocks. When completed reinforcing rods were inserted and the hollows filled with concrete to make a slid structure.

Track supports being installed at the tunnel end of the site

While Malcolm and his gang were working on the tunnel another group started to make up the track panels. This activity was mentioned briefly at the end of part 1. The panels were made from the angle and flat bar mentioned there. The flat bar was cut to the design lengths and drilled as necessary for the stainless steel fixing studs which were welded in position using dissimilar metal welding rods. The track panels were all made using jigs for spacing the angle and positioning the flat bars. These flat

Steaming Bays under construction

bars extended half an inch beyond the angles to carry the anti tip tubes which were welded in place. The anti tip tubes were fitted with a length of solid bar at one end to locate in the open end of the tube on the adjacent panel to form a solid joint. Two curved panels were completed each Sunday and painted by the Wednesday Gang ready for installation the following Sunday prior to manufacture of the next batch. The straight panels were easier to produce and it was possible to complete four of these each week. By the time the manufacture of the track panels was nearing completion Malcolm's group had almost finished the tunnel portals and a start was made on two wooden formers for the tunnel roof. This was cast in concrete in seven sections reinforced with steel mesh. We were now into the spring and the longer hours of daylight enabled most of this work to be carried out on Friday evenings. The track was laid in the tunnel before the roof was cast as it was easier to ensure that the track was fair and to set the superelevation on the curved section.

The Sunday Gang was now split into three groups. The first group was laying track on the prepared panels, from the tunnel up towards the Club House. Another group was working on the transporter and steaming bays whilst the third group put in the girder over the tunnel and made up the remaining track panels to complete the layout. This group went on to build the embankments from the mountain of earth piled up where the gauge one track now is, together with associated retaining walls.

Gordon Ross trials the first section of track to be completed

By the first week in April the track had been laid from the tunnel to the road bridge and Gordon Ross steamed his J15 for a trial run up the gradient and was quite surprised how easy it was to climb. Having removed some of the old track to achieve this run it was now time to remove the whole of this track as it was obstructing work on the new project. Having finished painting track panels the Wednesday Gang took over building retaining walls and moving earth to finish off embankments. They also laid water pipes and electrical cables, paving slabs in the steaming bays and made “hoopy” fencing for around the bays. The Sunday Gang completed track laying and built the foot bridge by the Club House while Malcolm Bradford moved on to build the little bridge to the East of the tunnel.

The whole project was completed in March 1999

Photos by Andy Hope

Andy Hope

Secretary's Report

This is the quiet time of the 12 months season, brought on by the restricted daylight hours but also by the extremely cold and wet weather which has encouraged all but the very hardy to keep their locos tucked away in the workshop. The Boxing Day Steam up was an exception as many members, following the weather forecast, spotted that the morning would be dry and mild and they turned up in some numbers, along with families. It was a really good time and many visitors were introduced to the pleasure of riding behind serious model steam engines. Thanks to the members who ran their locos to give all comers rides.

Last year we received from our friends at the Southern Federation of Model Engineering Societies (the Fed), to which we are affiliated, Guidance Sheet No 6 which introduced us to the concept of a "Safety Management System (SMS). The first and slightly daunting statement was to the effect that as part of the Duty of Care by which we are all legally bound, Guidance Sheets are produced with the objective of maintaining and improving the high levels of safety which we currently enjoy in the hobby. The inference was that we would be well advised to read the document carefully and act upon it where necessary.

Turning the page found us confronted by the heading "Risk Management" and the need to undertake Risk Assessments covering all our activities. For the Raised Level track we proved to be pretty well covered, having had a full Risk Assessment done some years ago with little changing in the intervening period. However it was a different story for the Ground Level track where we obviously needed to get up to speed and where it was known that there were safety hazards. An example was the steaming bay which had unprotected drops of at least 2 feet down into the pit. There was also the problem caused by the 7 1/4" gauge passenger trolley which is now in use for passenger hauling at Parties and Open Days, having too little clearance from the water column in the station. We have also had instances where blood has flowed from wounded scalps due to contact with the signal gantry and the low door frames at the carriage sheds.

It's easy to be blasé about safety taking the robust approach that our members are all experienced and can look after themselves quite adequately, when in fact we have enough examples to convince otherwise. I remember witnessing a member falling into the steaming bay and landing on his back, thankfully without suffering injury.

For those who might have been wondering, this explains the reasoning for the putting up of safety fencing around the steaming bay, the re-location of the water column in the station and the construction of the steps leading down to the ground level track. Ian Pryke and others have been carrying out this work very successfully. It now remains to write this up in a straight forward format which demonstrates that the track has been Risk Assessed and where appropriate corrective measures taken. This is not to claim that the Safety Management System which we have followed caused all these changes to be made. Some would have happened anyway but we have at least taken our responsibilities seriously particularly when we have to allow for an increase in visitors coming on site and indeed our own grand children racing around and not looking where they are going.

Jon Mottershaw

Treasurer's Report

We welcome the following to our Society:-

Terry Borsey	Full
Tim Wix	Full
Trevor Westcott	Full
Robert Geoghegan	Full
Paul Pallent	Full

Membership stands at 129 including 14 juniors and 1 student.

There are a number of members who have not yet renewed their subscription including several juniors. Regrettably, this will be their last issue of LINK if they do not renew.

Just a reminder – subscriptions were due on 1st January 2013.

Rates are:-

Full member	£52
Junior member	£2
Student member	£26

Cheques should be made payable to CSMEE LTD.

David Cocks

Event Organisers Report

By the time you read this article we will be well into the New Year and looking forward to the coming running season.

Last year attendance at club steaming days was patchy at times, in some cases caused by bad weather. Family days were, on the whole, well attended. I would like to take this opportunity to thank all those members who help to make these days the success they were.

I hope to be able to organise two trips to other societies during the summer. One has already been arranged - a visit to Basingstoke on 12th May 2013. They will make a return visit to us on 23rd June 2013. When we visit them there will be no public running and as arrangements stand we should have the track to ourselves. Their web site gives a good idea of their set up. I am not sure at the time of writing where the other trip will be so keep an eye on the notice board and the Club web site.

This winter talk programme was my first attempt at organising such events. Hopefully the majority of members found the talks of interest. I am always looking for new speakers. If you fancy giving a talk come and speak to me and I will help as much as I can. Alternatively, if you know of someone who gives a talk on a subject which might interest us please let me have some contact details and I will do the rest. Most speakers charge a fee plus travelling expenses which can make the cost

prohibitive, hence the appeal for speakers from within our own ranks.

Due to lack of support for the last Midland Exhibition trip (we ran at a loss) considerable thought will have to be given as to whether we continue to go to this exhibition. Nearer the date I will put a list on the notice board as usual and if enough members are interested the trip will go ahead, so please make every effort to support this event. As the saying goes "use it or lose it."

Club steaming days will be on the first Sunday of each month as usual (7th April, 5th May, 7th July, 4th August and 5th October)

Family Days will be on 2nd June and 1st September

Ian Pryke

The Wednesday Wrinklies Report

LINK time again already! It seems only yesterday that I wrote the last report. Time seems to go by faster than ever, and it will be Xmas before we know it!

The Wednesday gang have been just as active during the cold weather, "tuning up" the site here and there to further improve our access. You will now find a set of steps going down onto the Lexden signal box marshalling yard from the high level of the raised track over the tunnel. This work has been done by a hardy gang consisting of Ian Pryke, Gordon Ager and others, who do not appear to have felt the cold weather. Alongside the steps they have provided a handrail so that the less nimble of us can hold on to something as we go down into the yard,

At the same time as this has been done the rails in the yard have been lifted and moved over to enable longer head shunts to be put in. The concrete slab walls have been tidied up in the approach into the tunnel. Mike Gipson has been involved in this work.

Recently Paul Beeby was to be seen fixing a leak in one of the water pipes in the steaming bays. It appears that one of the pipes was assembled without being soldered and that the pipe had come out of the fitting, allowing water to leak away.

In the workshop (should that be hobby room) Dave Chadwick can be heard clunking away on the Myford lathe making a new crankshaft for his Claud Hamilton. He is machining this from a solid billet of steel. This is a major task for anyone to attempt, but he is nearing the end of the roughing out stage as I write this. He is machining it on the Myford in case anything goes wrong, as the belt will slip and no harm is done. If this were to happen on the Colchester lathe the bang would be much louder and the crankshaft possibly ruined. When the crankshaft is ready to put into the locomotive his next task will be to machine up the four new split eccentrics for the valve gear. The project has had a lot of attention from the Wednesday gang members who are watching the crankshaft emerge from the lump of steel with interest.

In the club room there has been a lot of activity as Don Green and Mike Gipson have sorted and labelled the items for the Friday night auction. It must be said that a good job is done every time that we have an auction. I must record our thanks to Graham Austin who has donated much of the goodies for us to fight over, as he is stopping his modelling hobby because of his health problems. I am sure that we all wish him good luck for the future.

Out on the raised track a new locomotive has appeared. Danny Jukes has now steamed his Sweet Pea for the first time. He left the clubhouse at the end of the day with a very wide smile (and so he should) as the locomotive put up a good show on its début. To date of writing this report he has steamed the loco again with equally good results, and an even bigger smile.

Now for some personal 2012 statistics. I have run 182 miles with my locos over the last year, of which over 25 miles were run on visits to other society's tracks. This corresponds to approximately 910 laps of our raised track.

Geoff King

INDENTURED

A tale of old time learning in industry

Episode 9

Prior to leaving Stafford the coach driver made it clear that he would not be telling anyone the exact destination for the trip – that is beyond the broad definition of the 'Cotswolds'. The young couple were not much concerned about this as they were quite happy to be sitting together and letting the countryside roll by. For the first part of the journey the scenery was impressive – especially when skirting Cannock Chase.

As they sped southwards Edward realised that he had not even taken note of the make of the coach; indeed he would normally have made himself aware of both the chassis and engine makers and sometimes even the type of transmission; but there again, today was no ordinary day and his mind really was on other things.

Despite his preoccupation though, he had still figured out the engine type that was powering this particular coach. When the vehicle passed through built up areas with high walls the exhaust note that was reflected back could only belong to a 2-stroke; further reflection meant that there were only two possibilities: a Foden or a Commer. (GM was not selling in the UK at this time). One local firm did operate a Foden service bus but he did not know of anyone using a Foden coach whereas he'd heard that the company with which they were travelling with today had taken a Commer on a sale or return basis and were so pleased that they promptly placed firm orders for two more. Of course, all this was of limited interest to Julie but she did comment on the high pitched tone, particularly when going uphill, which she'd said she had initially assumed to be caused by some idiotic youth following them on a fancy motor bike. This comment caused Edward to reflect for a moment – after all, he was a youth (hopefully not an idiotic one) and he was yet to introduce her to the Morgan; true it was not a motorbike but it had a motorbike engine and it sounded rather like one. Clearly the situation might call for some diplomacy in the weeks to come.

And so, at length they arrived at their destination which turned out to be Bourton-On-The -Water. They had a brilliant day aided by fine weather and returned to Stafford well after dark. On leaving the coach, he went and retrieved her bike and then arm in arm he walked her home. She lived a short distance outside of the town just off what was known as the Weston Road. This ran nearly parallel to Tixall Road on which Dorman's was situated.

Near to her house he kissed her lightly on the cheek, but then things got a bit more serious before he bade her goodnight and, supremely happy, wandered back to his own lodgings which were nearer to

the town centre. In so doing he had to pass a place called Coton Hill which was an asylum and he was surprised to hear noises emerging from that establishment -- much wailing and even shrieking could be heard. It was a full moon that night and the following day he was told that this was quite normal and that the word 'lunatic' was derived from this situation.

As an aside to the story, Francis Webb – the famous locomotive engineer of the LNWR at Crewe -- was brought here after being taken seriously ill at the railway works. Nobody seems to know the exact nature of his illness except that he was behaving in a peculiar manner. It is probable that he suffered from what today would be called a nervous breakdown but at that time all mental illness was classed under a more general heading.

It is believed that he was brought to Stafford from Crewe by his brother-- Canon A.H.Webb. Both would have played together as children at Tixall Rectory many years before. His father the Rev. William Webb being Rector of Tixall at the time. (The hamlet of Tixall was about three miles outside Stafford). Hence his returning to Stafford was, in a sense, coming back home. In any event, whatever treatment he received at Coton Hill was such that he was able to leave after a while and subsequently purchased a house in Bournemouth where he spent his declining years.

The routine of the test house on the Monday morning soon brought Edward back to the realities of the working day. He found himself setting yet another 3L to the dyno when Denis approached him and requested his help with an ancient looking engine that he was preparing to test. This engine was a 2DL – a variant of the 6DL of the MOS contract – but this one dated back a long way. It had no electric starter and the flywheel was in the open. Because it was hand started Denis had asked him to work the decompressor. The signal for this to be activated was given when one of the three men on the starting handle emitted a shout. There weren't many rules at the time but one that was observed rigorously was that apprentices were not allowed to do the cranking of a hand started diesel engine..(As we shall see in due course, it was alright for them to crank the one petrol engine that was still in production). So the three men assembled themselves on the starting handle; two facing the same way and the chap in the middle facing the others. All Edward had to do was ensure that the decompressor was in the open position.(If it wasn't the men would not have got very far anyway). At length they got the thing up to a reasonable speed whence one of them emitted a somewhat desperate cry and he wacked the lever over to full compression. A couple of revolutions may have resulted from their strenuous efforts but absolutely no sign of combustion.

The trio of panting men didn't look at all pleased about this and at first were tempted to blame him for some presumed error. However, he had done nothing wrong and the probability was that the fuel system had not been purged sufficiently – especially the high pressure side. This was down to Denis unfortunately -- and his colleagues lost no time in pointing this out. Trouble was that any starting system that only gave a few revs of rotation was prone to this difficulty but regular use of electric starters had made the men tend to forget the nature of hand starting.

This time Denis purged the system using the 'CAV fork' -- a device that enabled you to actuate each element of the pump in turn whilst watching for the bubbles to turn to solid fuel at the injector unions. Once again the three heroes swung into action on the handle and once again he slammed the decompressor over as soon as he heard the breathless yell – this time to be followed by the welcome sound of the engine bursting into life. He held it steady at about 1000 rpm whilst the men recovered and then handed it over to Denis.

He returned to his 3L rather glad that his was a modern engine with electric start. As he prepared to set the fuel he peered over the top of the rocker cover and was surprised to see Julie emerging from the main East/West corridor into the test house; this was most unusual. As his engine was settled for a while he immediately rushed over to her and led her into the cross corridor where there was less noise.

She had come to tell him that she had an errand to run and so would not see him lunchtime. As he wandered back to his 3L he became aware that Denis's engine didn't sound quite right and looking across he was confounded by what he saw-- according to the valve train and rocker gear the engine was stationary but clearly the flywheel was still spinning and, as he watched, it fell off the back and dropped onto the concrete floor. For a moment it stayed there issuing a stream of sparks akin to those from a very large grinding wheel. Then, as mother nature came to terms with the problems of friction and inertia, the flywheel (which weighed around a quarter ton) began to accelerate down the shop -- having torn itself free from the Layrub coupling.. Men were shouting and could be seen visibly jumping sideways as it careered remorselessly down the centre of the shop-- eventually passing clean through the wall at the far end. (It made a very neat hole). Later they found that it had managed to miss the foundry and also miraculously miss some cars parked in that vicinity. It ended up innocuously on some waste ground near Dorman's scrapheap.

By now Mr.Lance had appeared from his office anxious to know what all the commotion was about. Naturally, it was all something of a 'fait accompli' by this time and he instructed Denis to send the engine back to the repair shop from whence it had come. (Mr.Lance also managed to convey the impression that it was entirely their fault). In fact the engine was an old one sent in for overhaul by a proud owner.

Jobs of this kind were handled by the repair shop to avoid the delays that a 'one off' might have caused in the main erecting shop. For sure it was a cast crank and had probably developed the crack over many years of service. The only valid comment being that perhaps they should have applied crack detecting fluid in the first place. In the event the engine got a new crankshaft but it was said that Dorman's thriftily elected to simply skim over the flywheel to remove any superficial damage resulting from its escapade and it went back with the repaired engine to the customer.

That evening, whilst changing the sparking plugs on the Morgan, he reflected on the flywheel incident realising that Julie had been close to the path of its trajectory just a few moments before it tore itself loose; this made him feel strangely uncomfortable, so much so that he quit working on the Morgan and went up the pub for a pint. Soon, with the help of Joule's best bitter plus the natural resilience of youth, the issue drifted from his mind but nevertheless it still brought home to him just how deeply attached he was to this girl. (Joule's brewery was in the town of Stone --a short distance North of Stafford -- the brewery was started by the famous scientist as a means of financing his experiments; many readers will know that the name Joule remains in use today).

Coming into work next morning he was collared by Mr.Lance who asked him to pass off a number of 1AB engines. These were the only petrol engines that Dorman's currently produced and were made for Aveling-Barford who fitted them into a machine called a 'calfdozer'. This, as the name suggests, was a miniature bull dozer used for preparing the ground for paving. The engine was a single cylinder side valve job with a Zenith carburettor and magneto ignition. Although of modest specification the engine was made to the usual Dorman standards of quality featuring two massive ball races as main bearings. The big end was a plain bearing and the lubrication was by a dipper on the connecting rod.

This latter worked very well – it was said that the engines typically outlived the machine in which they were installed.

He had six of these to pass off and they offered no difficulty; but they did need the crane to move them around. Starting was easy –it was a 'click' magneto – but it was prudent to start cranking from around one and a half turns prior to TDC firing –this allowed you to get a decent amount of energy into the flywheel before compression built up; you could thus avoid it kicking back.

Dorman's used to make a 2AB and, as those possessed of an incisive intellect will guess, this was the two cylinder version of the 1AB. As mentioned before, such an engine powered the crane which operated in the scrap yard adjacent to the foundry. The 2AB powered both the crane itself and also provided the motive power when travelling around the site. However, the movement of the jib was a manual function. This latter was a point of some contention as raising it demanded considerable muscle power. Copious amounts of graphite grease on the worm helped but most men tried to avoid lowering the thing anymore than was absolutely necessary since sooner or later it would need raising again. When moving the crane about the site there were one or two places where power cables crossed the roadway and so it was necessary to bear this in mind when moving it around.

Naturally, the crane's drivers got to know the maximum height to which the jib could be set to just pass safely beneath the cables. However, immediately beyond the end of the foundry building there was a further cable which was slightly lower than the others. It emerged from the main factory and headed away across the boundary fence to an unknown destination. Nobody ever thought about it until one day the crane driver misjudged his jib height and hooked it down. As it fell across the corrugated iron roofs of some outhouses belonging to the foundry the driver noticed blue sparks so clearly it was live. He duly reported the misdemeanour to his boss –the foundry manager – who, after checking that the power supply to the foundry was unaffected, took no further action beyond protecting the ruptured ends.

Two days went by and the incident was all but forgotten though people began complaining of an obnoxious smell about the place. Moreover, people over a wide area of the town were making similar complaints. Eventually, a team from Midlands Electricity Board (MEB) called upon the plant manager to explain that the power supply to the sewage farm had been cut off some two days earlier and they, receiving complaints from the sewage farm, had followed the cable until it reached Dorman's boundary. At least now everyone knew the purpose of the cable; but why should Dorman's be supplying power to the sewage farm? In fact they weren't. It seemed that as a temporary expedient, possibly during the war, a cable was taken from the supply into Dorman's and run across to the sewage farm but by-passing Dorman's meter. Like most temporary things it turned out to be pretty permanent ! Nonetheless, when they were supporting the load-shedding concept by running their own engines to feed the grid they might well have actually been powering the sewage farm. Rest assured this was still no loss to Dorman's as they were paid by the MEB for each unit fed into the national grid.

Dorman's scrap yard did, from time to time, yield some surprising items. Mike (his friend on the 4BK gang) came to him in the test house to say that they'd found something very strange on the scrap heap and wondered if Edward would be able to throw any light on its identity. It was mostly made of brass and seemed to be a pump of some kind; additionally it had a number stamped on it followed by another which might have been a date – namely 1916. They naturally assumed that it was something made by Dorman's (which was certainly in business at that time) but for the moment they were completely

baffled. They weren't to know that within a couple of weeks a full explanation of its purpose and origin would be given to them from a quite unexpected source.

Returning to the testhouse, which by now had settled down again following the flywheel incident, everyone's interest was stirred when Denis was seen to be preparing to put a truly ancient engine on to the test bed. This was a Dorman 6JO—a massive side valve petrol engine dating back to 1930 -- possibly a bit earlier.

Apparently, after the usual running in procedure it would be required to demonstrate its power across the speed range. This, of course, was quite normal but in this instance the owner had asked that he be allowed to witness the test. With the diesel engines this would have presented little difficulty as the men were well versed in extracting optimum power from this type of unit but a petrol engine of this age might catch them out. In fact it was to transpire, in due course, that all such tricks were not entirely forgotten. Meanwhile Edward continued with the business of passing off the six 1ABs but had already been told that his next engine would be a 4DSM --this would be quite different to anything he had so far tested. For one, it was a marine engine and would be raw water cooled and for another it was an indirect injection job with the old style smouldering (i.e. non-electric) glow plugs.

On a personal front he was pleased to receive an invitation to tea on the forthcoming Sunday afternoon at Julie's house. Whilst she was the messenger he realised that the invitation really came from her Mother; he would need to be on his best behaviour for such an occasion. His only suit would have to be brought out of captivity once more and he would need to decide whether to use the Morgan as transport. (One's best suit and the Morgan didn't always go together all that well).He pondered these weighty matters for a while before deciding in favour of the Morgan.

Paul Davies

A Challenge from Artisan

My friend Joe Hardup has a problem and I am wondering if any members can help. Joe's workshop is equipped with a 5" lathe, a small milling machine, a shaper and a drill press. All of the machines are old and not in particularly good condition. The only precision measuring equipment that Joe has is a very old 1" to 2" micrometer for which he does not have a setting standard. Many of Joe's other tools have also seen better days, including his engineers square. Joe is about to embark on a job which requires a very accurate square and he cannot afford to purchase a new one. How can he make a reference square which he can be confident will be accurate to within 0.001" over a six inch length using the limited equipment available to him and (bearing in mind his name) without spending any money? He does not have a DTI so cannot try to use the technique described by Andrew Becker in LINK No. 40. He does have a very good stock of material (the source of which should not be questioned too closely) and which will undoubtedly provide anything that might be necessary for the project.

If you can suggest to Joe how he can solve his problem please let me know. Answers via the ubiquitous post card or better still an e-mail to the editor please. There are no prizes on offer other than the glory of having your solution to Joe's problem appear in the next edition of LINK!

Artisan

Car Colours that may be useful for Painting Locomotives

Some time ago I came upon an item on 'The Model Railway Forum web site that identified some car spray paints that were a near match to railway livery colours. They may be approximate but I understand they are near matches. Most local car accessory shops now have facilities for mixing an almost infinite number of car tints and they may be a useful source of paint. My local shop also stocks an etching primer that I have just started to use.

Here is the list:-

MR/LMS/BR red	Rover Damask Red
GWR/BR loco green	Rover Brooklands Green
GWR/BR loco green	Ford Laurel Green
BR diesel light green band	Ford Highland Green
BR coach Carmine (blood)	Ford Rosso Red
Br coach cream (custard)	Vauxhall Gazelle Beige
BR coach cream (worn)	Peugeot Antellope Beige
BR diesel blue	VW Pargas Blue
BR steam loco blue	Peugeot Royal Blue
LNER garter blue	VW Pargas Blue
LMS Coronation blue	Rover pageant mid blue
Stanier Coronation blue	Peugeot Royal blue
GWR/Pullman brown	Rover Russet Brown
GWR coach cream	Rover Primula Yellow
SR dark olive green	Land Rover Coniston Green
LNWR/LYR coach plum	Daewoo Dark Red
LNWR coach upper panels	Daewoo Casablanca White
CR loco steam	Peugeot Royal Blue
SDJR loco blue	Rover Midnight Blue
LBSCR Stroudley I.E.G.	BMC tan
LBSCR Marsh umber	Vauxhall Brazil Brown
North Staffs maroon	Vauxhall Gambia Red

I cannot vouch for the accuracy of the matches so it becomes a suck-it and-see exercise. There is also the caveat that if the surface being sprayed has already been painted with an oil based paint there may be compatibility issues, unless of course you were after a crackle finish!

Eddie Carter

Sealing Washers

Having been a boiler inspector for some years now it seems to me to be time to 'feed back' some of the information gained and to offer some help in one particular aspect, that of sealing the various bushes in a boiler both for testing and subsequent service.

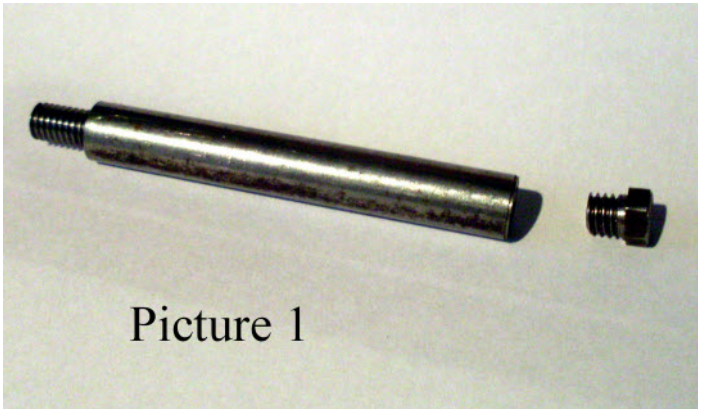
In the majority of cases boilers offered for both Hydraulic and Steam testing are presented in good order. For older boilers the bugs have, of course, been ironed out but new boilers made by club members are also to a high standard. This, I hope, is in part due to members who are building boilers seeking help and guidance from one of the boiler inspectors throughout the process. If you are embarking on a boiler build it does no harm to take an inspector along with you by showing him the design and build as it progresses. You may only ever build one boiler so any advice can only be beneficial.

As I remarked above, boilers submitted for inspection are usually well presented. There is, however, one area where a great improvement can be made and which also has some safety issues associated with it. This concerns how the various bushes are sealed in preparation for the test. The same considerations apply when sealing the fitting once the boiler is put into service on the engine.

Almost every boiler submitted for hydraulic test leaks at the blanks, and it is invariably because there is no washer fitted underneath the blanking plug or fitting, the reliance for sealing being on the dreaded PTFE thread tape and the thread binding where it runs out. In my opinion PTFE tape is for plumbers NOT engineers. If you want to add a sealing compound use one like Boss White or Gold End, these are at least liquid and any excess will leave the boiler via the blowdown valve once the boiler has been steamed a few times.

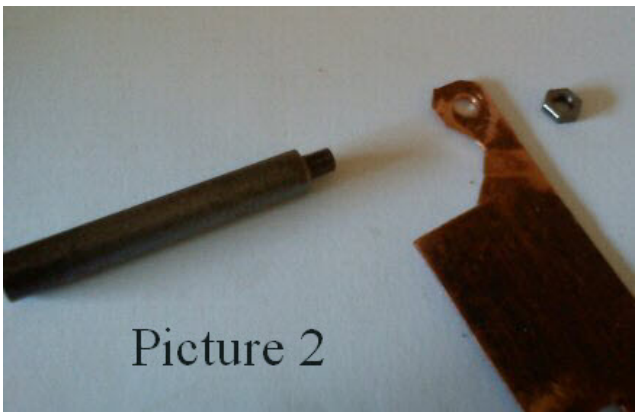
I have lost count of the number of boilers where, when looking into the open bush that I am about to screw the pump connection/adaptor into, I am looking at a string of PTFE tape floating around inside (probably soon to be added to the next time the fitting is replaced). PTFE tape will NOT dissolve or break down in your boiler. The next part of its journey could well be the smallest orifice it can find, where it will then lodge. The smallest and most important office is invariably the gauge glass – that's the last thing we want to block up! Any false reading on the glass could spell disaster.

The answer is to use proper engineering copper washers. Whilst some are able to be bought from our model suppliers they do not cover all of the sizes that may be required. They are, however, relatively easy to make. I am in the process of making the fittings for a boiler of my own and for the gauge glass fittings needed washers for 0BA, 1BA and 3BA. As far as I am aware these are definitely not available commercially. To make your own all that is needed is some off cuts of copper sheet of various thickness and some simple tooling.

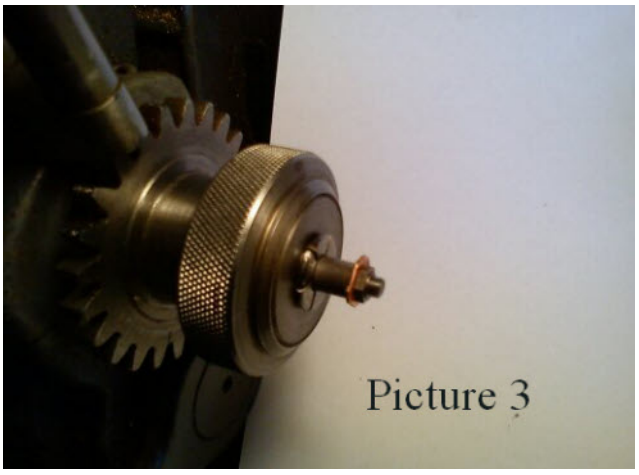


Picture 1

My procedure is to make an arbor to fit in the chuck (collet chuck preferably) for each size I need. The arbors are usually made from a



Picture 2



Picture 3

Picture 4

Picture 5

Photos - Mike Gipson

piece of ½", ⅜", 5/16" or ¼" steel rod. Check that it is a good round quality, preferably ground.

Picture 1

On one end of the piece of steel turn a short length of the thread required and on the other end drill and tap a short hole to the same size. My arbors are approximately 2 ½" long with a ½ "deep tapped hole and ⅜" long externally threaded portion. To make the washers a short bolt or nut made to the same thread size is needed. The smaller the OD of the hex the better as it allows a small washer OD.

Picture 2

To make a washer select a suitable thickness of copper and drill a hole in it the same size as the clearance for the thread. Roughly crop out a washer sized piece and using the short bolt (or the actual fitting) screw the blank onto the arbour which is in the collet chuck. A couple of points here – it is worth making more than one washer at a time. You will always want spares and with more than one washer the 'pack' is stiffened and is better better able to resist any temptation to rotate under the tool. Thin washers are often required, especially if they are being used under a fitting that needs to be aligned vertically - gauge glass top and bottom fittings for example. The trick is to sandwich the thin material between two pieces of thicker scrap material before drilling. Making a thicker pack of material in this way prevents the thin washer being distorted or grabbed by the drill. Of course if you use thicker copper for the outside of the sandwich you will also make a couple of spares!

Picture 3

Turn down the O.D. of the washer to the size required.

The arbors are also useful for other things:-

Picture 4

In this picture I am using the arbor to hold the fitting for final cleaning up and in this case I also used it for drilling the cross hole in the valve. You can also final turn the fitting in the lathe by mounting in the arbour.

Picture 5

This picture shows a variety of washers in use in the steam fountain I am making for the next engine.

Finally, I keep the arbors and their nuts or plugs in the same storage place as I keep my taps and dies. By doing so I always know if an arbor has already been made and more importantly, where it is!

Mike Gipson

Winter programme reports

October 26th

The first talk of the winter programme was presented by Ian Pryke who stepped in at short notice after the originally scheduled speaker was taken ill. Ian addressed the meeting on the subject of FIDO. This was not a talk about his pet dog but about the system developed during the second world war to facilitate the landing of aircraft in fog and named Fog Intense Dispersal Operation. In those days it was not uncommon for very dense fogs to develop over the UK and this presented a serious problem for aircraft returning from raids over Germany as they were unable to land. The system that was developed involved burning petrol pumped along pipelines along either side of the runway and equipped with jets at intervals. Vast quantities of fuel were used – as much as 100,000 gallons per hour – but this was preferable to the loss of the aircraft and in many cases the crews. Ian's talk was a fascinating look back in time, reminding some of the older members of his audience of the grim days of the early 1940's.

November 9th

This evening was devoted to the auction of the contents of the workshop of the recently deceased member John Bye. John had left the workshop contents to the Club in his will. The sale realised the sum of £1234 for the Club funds.

November 23rd

Paul Davies entertained the meeting with a talk on rotary engines. This type of engine is usually associated with powering early aircraft but Paul described how the first engines of this type appeared as power units for bicycles, the earliest being incorporated as part of the rear wheel of the machine. These must have been frightening machines to ride and very noisy! Paul went on to describe how this type of engine had been adapted for aircraft propulsion, with gradual improvements to valve gear and carburetion. One of the disadvantages of these engines was the total loss lubrication system which results in the aircraft and crew being covered in oil! Another very interesting evening, looking back at the pioneering engineering of the past.

December 7th

On this occasion Eddie Carter presented a talk on his participation in the restoration of wagons and coaches at the Bluebell Railway. Eddie has been an active supporter of the Bluebell for some years and his enthusiasm for his work there was clear. Most people's concept of restoration is minor repairs

and touching up the finish. It was clear from Eddie's talk that this is far from the case. Many of the vehicles acquired for restoration by the Railway arrive as what can only be described as flat packs, having been dismantled at the location where they were found in use as a garden shed or similar ready for transport to the Railway. It must be a daunting experience to be presented with the remains of a vehicle in this form and be faced with the task of rebuilding it. Clearly the team at the Bluebell are well up to the task for they have produced some beautifully restored vehicles. One can only speculate on how much of the original coach or wagon body survives in the finished product and how much is new! Another fascinating evening's entertainment.

December 21st

This was the occasion of the Christmas Get Together, organised by our secretary Jon Mottershaw. Following a greeting with a glass of mulled wine the first part of the evening saw the gathering entertained by singer Rick Christian with his guitar. Rick had obviously taken on board the age profile of his audience when choosing his selection of music and anecdotes! After an hour with Rick the buffet was served by a willing group of ladies and Bob Taylor presented the raffle with no less than thirty one prizes donated by members. Tired and satisfied the gathered members began to wend their way home soon after ten thirty.

December 26th

This was, of course, the occasion of the Boxing Day Steam Up. The weather was kinder to us than we had been used to recently , which resulted in half a dozen locos in steam ahead of the rain forecast for the afternoon. The Ground level track saw a B1 towing the 7 1/4" gauge passenger trolley and with a guard riding at the back, gave rides to the many children on site. A tank engine also ran on the ground level track taking some of the pressure off the raised track.

On the raised track there was a lot of activity, with a full set of signals indicating several locos running simultaneously This meant frequent signal checks but the time was used to explain to the children and their parents / grandparents on the rides why this was happening. Several youngsters "had a go" at driving under supervision.

Though the weather deteriorated in the afternoon, the bulk of our members and guests had departed by then, no doubt heading for another Christmas feast.

January 4th

A last minute change of programme saw a very interesting talk by Derek Wickes, a retired airline pilot. Derek described how his early training as a Handley Page apprentice had led on to training as a pilot, initially flying light aircraft but eventually flying large passenger and freight aircraft. Most of Derek's time had been spent on freight traffic in a wide range of aircraft ranging from piston engine planes to wide bodied jets.

January 20th

This Sunday was the occasion of the annual Club pilgrimage to the London Model Engineering Exhibition at Alexandra Palace. This year the weather was a source of some anxiety, the Club meeting scheduled for the previous Friday evening having been cancelled and snow forecast for later in the day on Sunday.

The snow materialised soon after leaving the Club house and continued all day. Whilst it did not present any problem to the coach some of us had a tricky drive home in the evening.

February 1st

Treasurer David Cox made his annual informal presentation of the Company accounts to appraise members of the financial status of the organisation ahead of the presentation of the final accounts for the year at the AGM at the end of April. There were no unpleasant surprises to alarm members and it was apparent that the birthday parties held during the year had made a useful contribution to income. David recommended a modest increase in subscriptions for 2014 and the members present indicated that they would be in favour of accepting this recommendation if presented to the AGM.

February 15th

This was the occasion of the annual auction, conducted in his usual efficient way by Hugh Mothersole supported by his band of porters and accountants. This year many of the items on offer were from the workshop of Graham Austin who is scaling down his modelling activities due to declining health. A total of 150 lots came under the hammer. Since all of the items submitted for auction were cleared on this occasion the reserve date for a second auction was not required and the programme original scheduled for 18th January was substituted for 22nd February.

Editor

A Naval Gun Barrel Transporter Wagon in 5" Gauge

Part 2

In part 1 of this article I described the manufacture of the bogie diamond frames. Completion of the bogies was delayed while the delivery of the wheel castings was awaited and to keep the project moving the "load" for the wagon – a Naval gun barrel- had been fabricated. By this time the wheel castings were to hand..

Having made the 12 diamond frames the next thing was to assemble the 6 individual bogies but first I needed to machine the 24 wheels. I don't intend to go into great details about the machining of wheels as most people have their own preferred method. My own procedure is to check each wheel and remove any imperfections, caused where the two halves of the mould came together, with a file and generally tidy the casting up before I start turning operations. Due to the number of wheels each separate operation was carried out on each wheel before I moved onto the next. It did get a little boring having to do each operation 24 times before moving on to the next but it does save time in the long run. I seem to recall that it worked out at well over 150 separate operations. After three days work I had 24 complete wheels which I then fitted to axles using Loctite to secure the wheels to the axles.

Next came the assembly of the bogies. First of all I put a 1/32nd washer on each end of the each axle. This washer was removed at the final assembly stage and allow the axle to float. I then slide the diamond frame onto the journal. I forgot to mention in part 1 of the article that each of the axles boxes was drilled and a small needle roller bearing fitted. This will ensure the finished wagon will

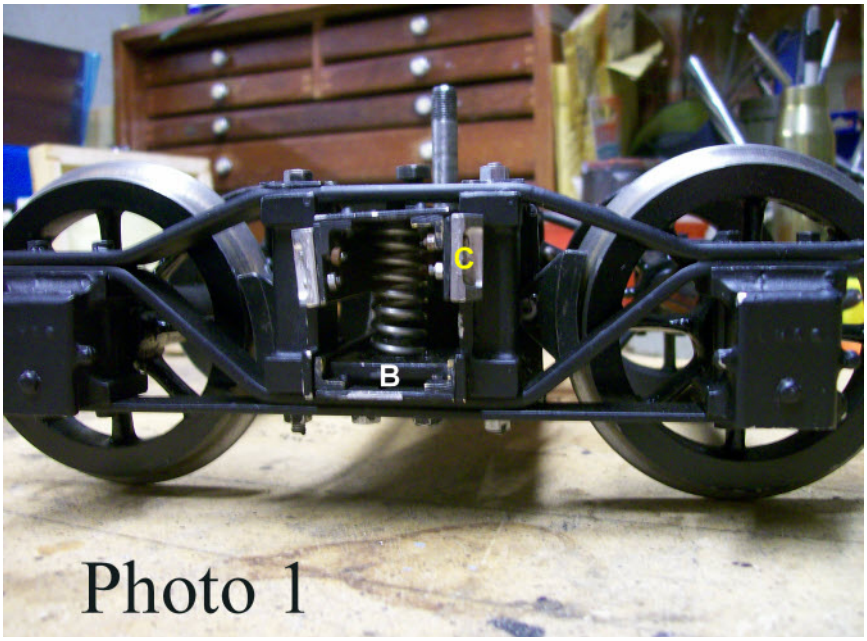


Photo 1

be free running. I then clamped a strip of metal bridging the 2 frames and checked to ensure that the wheels turned freely and the frames were parallel. The distance between the frames was measured and a strip of 1"x 20g steel cut to the required size. Two pieces of ¼ x ¼ x 1/16 brass angle were cut to the same size and riveted to the 20g strip to form the bottom part of the assembly which holds the unit together and forms the bottom support for the suspension. This is indicated at B photo1. The centre of the bogie was then established and a 2 BA clearance hole drilled. This is the bottom fixing for the pivot pin that the sub frame connects too and the bogie rotates around. One piece of 1"x 20g, two pieces 5/8"x20g steel strip and two pieces brass angle were cut and riveted together to form a "U" section which was inverted and fitted between the pillars in the diamond frames and a clearance hole was drilled in the centre to allow the pivot pin the pass through. A further two holes equally spaced about the pivot pin hole were drilled and captive nuts fitted to allow adjustment of the ride height of the finished model. White metal angle brackets were bolted to the ends of the "U" section which rub against the main pillars. This movement is what gives the bogie its suspension movement. This is indicated at C photo1.

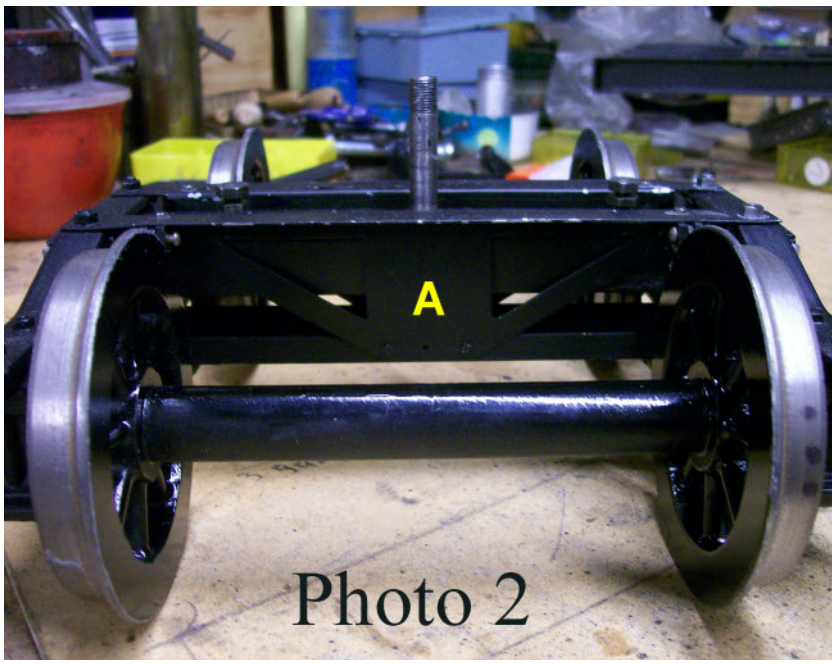


Photo 2

To give additional rigidity to the bogie frames, a further two pieces of steel were cut out in the form of an oblong. On one of the long sides a 1/2"wide leg was bent up at right angles. At each end of this leg a hole was drilled to correspond with the centres of the pillars. The remaining leg had two triangular lightening holes cut in it and cut to form a triangle shape so that the top edge was held at the top of the pillars and the bottom was bolted in the centre of the bottom support as indicated at A in photo 2. The main suspension springs were held in position by small spigots top and bottom fitted within the two fabricated "U" sections (see photo 1).

In the part 3 of the article I will be covering construction of the main load carrying frame and the sub frames

Photos by Ian Pryke

Ian Pryke.

Jottings from the Workshop by "Artisan"

Locomotive Springing, Adhesion and Pulling Power

My contribution to LINK this time has been inspired by two occurrences during the 2012 running season on the Club track. The first of these was the installation by Keith Wraight of a locomotive axle weigh bridge in the steaming bay. The second occurrence, if it can be so described, was the severe slipping problem experienced by virtually all of our locomotives during passenger hauling at birthday parties. I decided that it would be interesting to examine the whole issue of tractive effort and pulling power from first principles and to see if Keith's new weighbridge might be used to help improve the performance of our locomotives. A good starting point for this investigation is to examine the full size situation and extrapolate to our miniature sizes.

First of all, what is meant by the term "tractive effort", how is it defined and how is it determined. Most people understand that it is a measure of the ability of a locomotive to haul a train, i.e. the drawbar pull that can be exerted, but the term needs some further qualification. The figure that is usually quoted in the specification for a locomotive is the force that it can exerted at the coupling between the engine and the train to move the train from rest. In this respect it is analogous to the bollard pull of a tug. Once the train begins to move at anything more than a crawl the drawbar pull will not be sustained and the continuous tractive effort with the train in motion will invariably be less than the starting value. So how is tractive effort predicted? A typical specification for a full size locomotive will include a figure for tractive effort, usually qualified as "at 85% boiler pressure". This figure is determined using the formula:-

$$\text{Tractive Effort } E \text{ (in pounds)} = \frac{N}{2} \times \frac{d^2 \times S \times 0.85p}{D}$$

Where N = Number of cylinders

d = Cylinder diameter in inches

S = Piston stroke in inches

D = Driving wheel diameter in inches

p = Boiler pressure in lbs/sq.inch

A little thought will show that although the formula makes use of some of the parameters that would be expected to affect the force the locomotive might exert on the train there are many other factors which it ignores. The number that it yields has only a crude relationship to the tractive effort which the locomotive might produce in practice and serves primarily as a means of comparison with other engines. Tractive effort calculated from this formula is analogous to motor vehicle horse power calculated from the formula for old RAC horsepower rating. Both are based on the use of relevant

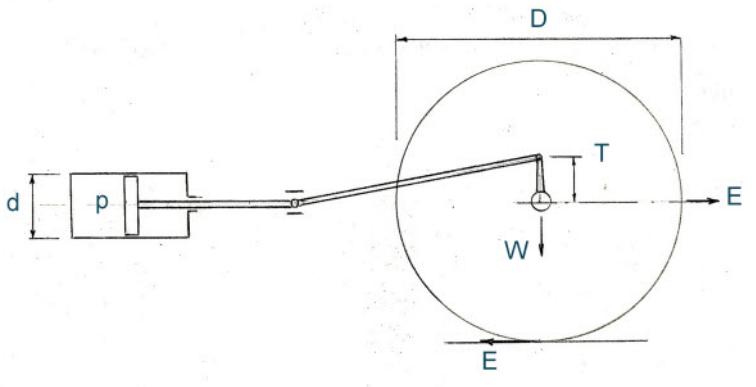


Figure 1

parameters of the machines involved but neither yield a result of absolute accuracy! So how has the formula been arrived at? The diagram in figure 1 illustrates the relationship between the various parts of a locomotives mechanism which actually produce the tractive effort E. The diagram illustrates the forces applied to the driving wheel by a single cylinder. The locomotive will, of course, have at least two cylinders and the contribution of the other cylinders is dealt with later.

Force F on the piston = p x piston area

$$= p \times \frac{ð d^2}{4}$$

Please note that the symbol for pi has been corrupted to ð in the equations on this page and on page 22

Ignoring the small errors introduced by the obliquity of the connecting rod and the effect of back pressure in the cylinder the torque applied to the driving axle with the crank at right angles to the motion centre line as shown is therefore :-

$$\text{Torque} = p \times \frac{ð d^2}{4} \times T$$

This torque is balanced by the force acting at the wheel/ rail interface i.e. $E \times \frac{D}{2}$

$$\text{Thus} \quad E \times \frac{D}{2} = p \times \frac{ð d^2}{4} \times T$$

But $T = \frac{S}{2}$ Thus, transposing and rationalising the formula and substituting for T:

$$E = p \times \frac{ð d^2}{4} \times \frac{S}{2} \times \frac{2}{D}$$

$$= \frac{S\, d^2\, p}{D} \times k$$

Where *k* is a factor which incorporates ð/4 and an arbitrary allowance for friction losses in the system, pressure losses between boiler and cylinder, etc. i.e. it is a fudge factor! !

This formula is the same as the "official" formula quoted above applied to a two cylinder locomotive with the fudge factor *k* set at 0.85. The constant *k* is, in fact, nothing to do with boiler pressure and the fact that tractive effort is quoted at a percentage of boiler pressure only arises from the fact that the constant is normally placed in front of the symbol for boiler pressure in the formula! It will not have escaped the readers notice that the "official" formula incorporates a figure N for the number of cylinders. For a two cylinder locomotive the cranks will be at 90 degrees to each other and it will be apparent from Figure 1 that the second crank will be contributing nothing when the one illustrated is contributing maximum effort and the term N/2 is 1. For three and four cylinder locomotives the term enhances the predicted tractive effort by an appropriate amount although it takes no account of relative crank angles or cut off. The constant *k* is usually taken as 0.85 in the UK and America but on the continent a figure of 0.6 has been used and some industrial locomotive builders have used 0.75. The figure for tractive effort yielded by the formula therefore have very little meaning in absolute terms and serve primarily as a means of comparison between different locomotives. It is interesting to note that when applied to our miniature locomotives the formula predicts tractive effort vastly in excess of anything that can be achieved in practice.

The formula described above may or may not produce a realistic figure for the theoretical tractive effort but it makes the assumption that the force E can in fact be transmitted to the rail. This relies entirely on the friction between the wheel and rail which in turn depends on the load between the two applied at right angles to the rail. This load arises solely from the dead weight of the locomotive and

will depend on how that weight is distributed between the driving coupled wheels and the carrying wheels of the bogies and pony trucks if these are present. That portion of the weight which is supported by the driving and coupled wheels is classified the adhesive weight. The ratio of tractive effort to adhesive weight has a maximum value of μ, the coefficient of static friction between wheel and rail and is not affected by the number of wheels or the distribution of weight between axles. The coefficient of friction between a steel tyre and rail in dry conditions is usually of the order 0.25 to 0.3 although it can be significantly higher. It follows that the maximum tractive effort that is likely to be achieved in practice regardless of the size of cylinders, boiler pressure, etc. is approximately 0.25 to 0.3 times the adhesive weight. How this weight is distributed between the coupled axles does not, in theory, affect the traction that can be achieved for a given coefficient of friction. The figures quoted above for the coefficient of friction are for static friction – sometimes referred to as stiction. If sliding occurs between two surfaces the friction between them, now known as kinetic friction, is invariably less than the static friction. In other words, if the wheels start to slip the available tractive effort is reduced – a situation familiar to all drivers who know that if a locomotive starts to slip when starting the regulator must be closed until slipping stops and then reopened. All of the comments so far apply equally to miniature and full size locomotives.

Clearly, as far as our miniature locomotives are concerned, the aim must be to achieve the highest possible degree of friction between wheel and rail and to avoid the onset of slipping. The first and most obvious cause of slipping is greasy track which can easily reduce the coefficient of friction to as little as 0.05. Nothing other than cleaning and degreasing the track and wheel treads can be done about this. I have discounted the idea of sanding the track as advocated in some quarters as I consider this not to be in the best interests of the locomotives in our sizes.

The next point to consider is the railway itself. If the track is, like most club railways, a continuous run, then for every 360 degree circuit the wheels on the outside of the circuit will have to travel 2ð times the track gauge further than those on the inside. For a railway like the Colchester Club layout which involves two complete circuits per lap this means that the wheels on the outside of a 5" gauge train will travel over five feet further than those on the inside for every lap! This "slip distance" will be distributed around the layout depending on the radius of the curves involved. For a typical radius of forty feet the wheels of a locomotive with six inch diameter driving wheels will need to accommodate 0.2 inch of slip per revolution. The smaller the track radius the larger the slip distance to be accommodated per revolution of the wheels. It might be thought that if the wheels are machined to the conical shape specified in the generally accepted standard for wheel profiles the problem will be accommodated. This is not so however and it is easy to show that for a 6 inch diameter wheel the radius of the curve would need to be 125 feet for no slip to occur assuming a 2 degree taper on the tread. Furthermore, this "no slip" radius is a function of wheel diameter and will vary from engine to engine. This means that all the while the locomotive is traversing a curved section of the railway the wheels on one side will be slipping and, because the coefficient of kinetic friction is invariably less than the coefficient of static friction, will not be capable of contributing as much to the tractive effort of the moving locomotive as would be possible on a straight section of track. If starting from rest on a curved section the tractive effort available due to static friction will be the same for all wheels but as soon as the train begins to move the wheels on one side of the engine will begin to slip, with consequent loss of traction. Since the most demanding task the locomotive has to perform is starting a train from rest and imparting the initial acceleration it follows that starting should, wherever possible take place on a straight section of track. Stations should not be located on a curve! Not only is the available tractive effort limited but the resistance to be overcome to start the train is increased by flange friction on both the locomotive and train wheels and, if the train wheels are fixed on their axles,

they also have to be persuaded to slip on one side. Anyone familiar with the CSMEE track will be well aware that drivers dread being stopped with a full train by the signal just before the steaming bay traverser. The signal is located on a curved section of track with an upward gradient demanding maximum effort from the locomotive when it is least able to deliver.

Unfortunately there is little that can be done to overcome the loss of traction due to the effects of track curvature. We can, however optimise the weight distribution between axles to produce the maximum adhesive weight. In doing this we have far more flexibility when dealing with our miniature locomotives than the designers of the full size equivalents. The choice of wheel size and formation and the distribution of the locomotives weight between wheels was controlled by quite different criteria in full size than in our sizes. Civil engineering and permanent way considerations limited the axle loading that could be employed whilst factors such as piston speed, bearing velocity and the balancing of reciprocating mass dictated the choice of wheel size for any given track speed. Thus heavy freight locomotives tended to have four or five coupled axles with relatively small wheels to distribute the weight over as great a length of permanent way as possible consistent with an acceptable fixed wheel base but with limited upper speed limits. By contrast, locomotives designed specifically for express passenger service had larger diameter wheels with two or three driving/coupled axles. Mixed traffic locomotives usually represented a compromise between these extremes. In either case the locomotives weight was distributed as evenly as possible between axles to avoid upsetting the civil and permanent way engineers. None of these design considerations present any limitations for our miniature locomotives. One suspects that the arrangement of the springing of many of our locomotives is arrived at by trial and error approach rather than by a proper engineering design procedure. There is no good reason for this and I will describe the procedure which I have adopted on my own locomotives. I intend to base this description on a 4-4-0 wheel configuration since this is probably the most difficult to optimise. The starting point for the design procedure must always be the establishment of the position of the centre of gravity of the engine. Whilst it is theoretically possible to do this by calculation (and is indeed done for such things as aircraft) life is too short to attempt doing so for our models. It is therefore not practical to design the springing until construction has reached a fairly advanced stage and it is possible to determine the C of G by measurement with a fair degree of confidence. The procedure should be to assemble the locomotive as completely as possible and measure the load to support each end on the buffer / drag beams as illustrated Figure 2. It is unlikely that the kitchen scales will have sufficient capacity for this operation and I always use the bathroom scales. The position of the C of G is calculated as shown. The next stage is to decide how we wish the weight to be distributed between the various axles. My original approach was to follow full size practice and design the springing to achieve approximately the same load on each of the coupled axles but this is not the optimum arrangement

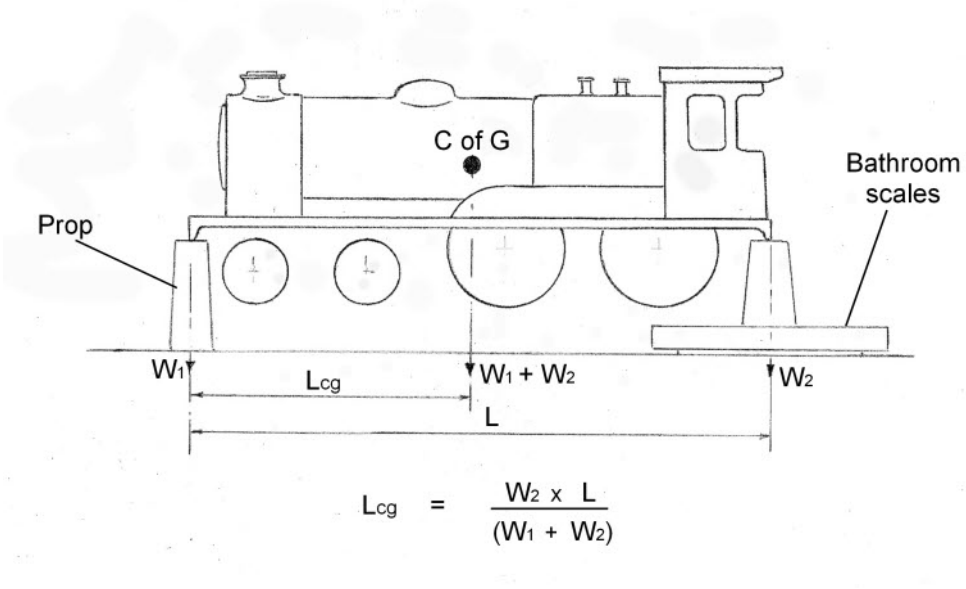


Figure 2 Determination of position of C of G

for maximum adhesion. A better approach is to decide what minimum weight should be carried by the bogie to ensure adequate guidance of the front end of the locomotive without any risk of derailment and then design the springing to suit. The easiest way to illustrate this procedure is to

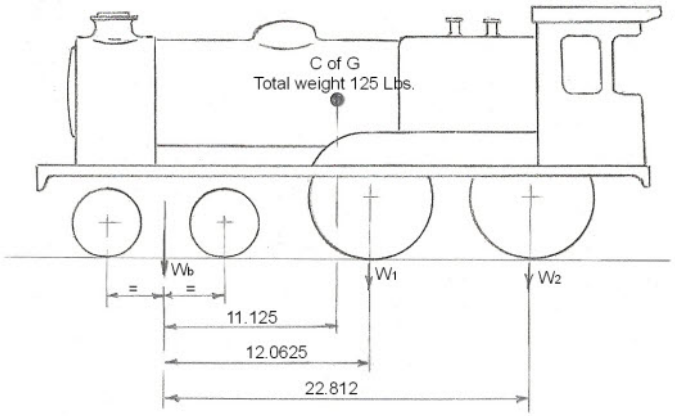


Figure 3 Typical dimensions for 5" gauge 4-4-0

describe the calculations for an actual locomotive. Details of the weights and dimensions of the example chosen are shown in Figure 3. For the wheel configuration concerned it will be assumed that no more than 25% of the total weight will be supported by the bogie. For the purpose of this example calculation the total weight supported by the coupled wheels, i.e. the adhesive weight, will be taken as 95lbs which is 76% of the total.

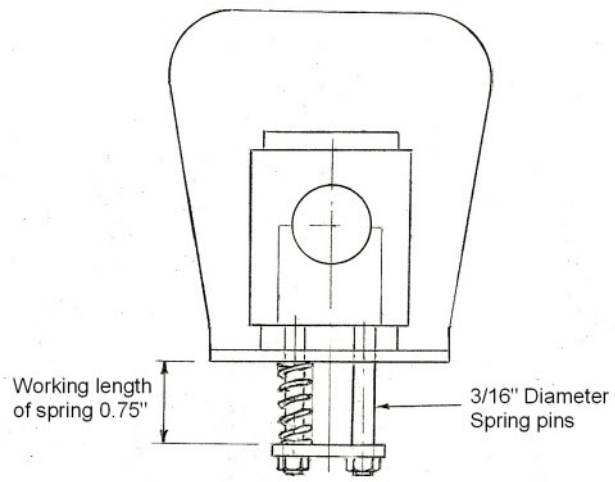


Figure 4 Springing details

Thus, $W_1 + W_2 = 95$ lbs.
Taking moments about the bogie centre we have:-

$$125 \times 11.125 = 12.0625 \times W_1 + 22.812(95 - W_1)$$

From which $W_1 = 72$ lbs and by difference, $W_2 = 23$ lbs It is now necessary to select springs which will support these loads when the wheels are in there correct design positions in the frames. For the locomotive which is the subject of this example the springing arrangement is shown in Figure 4. It is, of course, possible to design and make ones own springs to meet a specific specification. Here again, life is too short and the simplest approach is to select the requirements from a commercial source. Personaly I always select my springs from the range marketed by Lee Spring Limited.

Considering first the driving axle springs, since there are four springs per axle and the axle load to be supported is 72 pounds each spring must carry a load of 18 pounds. The manufaturers recomend that in normal operation a spring should not be compressed to more than 80% of its deflection capability. The catalogue lists springs by outside diameter, wire size and the load to compress to the

solid hight. For our application the load to compress to solid will therefore be approximately 18/ 0.8 = 22.5 pounds. It is now necessary to select a spring which has this characteristic together with a diameter suitable for the spring pin and which will have a working length of 0.75 inch. There is a certain amount of trial and error involved in ths selection. For this application I have selected (from Lee Spring catalogue) their stock item range LC-047D. This range employs 0.047" diameter wire and have an outside diameter of 0.3" and a load when fully compressed of 22.5 pounds. Within the range there are a number of springs available each with a specified free length, rate and solid length. It may be necessary to try several of these options to achieve the required result. For the purpose of this excercise I have selected a spring with a free length of 1.125 inch, a spring rate of 44.1 pounds per inch and a solid length of 0.593 inch.

Thus, deflection = $\frac{18}{44.1}$ = 0.408

Working length = 1.125 - 0.408 = 0.717

Deflection to solid = 1.125 - 0.593 = 0.532

Therefore, spring works at $\frac{0.408}{0.532}$ x 100 = 77% of maximum deflection.

These figures show that the selected spring will be suitable for the application but will require some slight adjustment to bring the axle centre to the correct position due to the working length being a little less than the target figure of 0.75 inch.

A similar procedure for the coupled axle, which is required to support 23 pounds, shows that each spring is required to support 5.75 pounds. Limiting the working load to 80% of that at maximum deflection indicates that a spring requiring a load of 5.75/0.8 = 7.18 pounds to compress to solid should be selected. Consulting the catalouge shows that a spring from the LC-038D range will be suitable. This range employs 0.038" diameter wire with an outside diameter of 0.3" and a load when fully compressed of 12.25 pounds. In this case a spring with a free length of 1.0 inch, a spring rate of 21 pounds per inch and a solid hieght of 0.400 inch appears to be suitable.

Thus, deflection = $\frac{5.75}{21}$ = 0.0.273

Working length = 1.0 - 0.273 = 0.727

Deflection to solid = 1.0 - 0.400 = 0.6

Thus, spring works at $\frac{0.273}{0.6}$ x 100 = 45% of maximum deflection.

Hence this spring is suitable for the application with a small correction for working length. The springing of the bogie is tackled in exactly the same manner and will not be detailed here.

The orignal design of springing, following full size practice by applying approximately the same load to each coupled axle, resulted in an adhesive weight of 76 pounds. This was confirmed by measurement on the new weighbridge. The revised springing arrangement described above increases this to 95 pounds – a worthwhile increase of over 26%. Theoreticaly it would be possible to increase the adhesive weight even further but this would result in very "soft" suspension at the ends of the locomotive and a tendency to "hobby horse". This problem is likely to be more severe with the 4-4-0 wheel configuration than with most others due to the locatioin of the C of G very close to the driving axle.

There is obviously a degree of variation in the characteristics of the available springs – the

manufacturers quote a tolerance of +/-10% on spring rate and loads. The new weighbridge facility provides the perfect means to adjust the axle loading to achieve the design distribution, correcting for the working spring length required and for any variation in parameters due to manufacturing tolerances.

CSMEE Library

As you know our Library contains Bound Reference volumes of The Model Engineer and Engineering in Miniature. These volumes are kept up to date by club members donating their magazines to the Club Library when they have read them. I then have the magazines Bound by "Avalon Associates" in Chelmsford. Before I can have the next batch bound I need the index for Model Engineer vol. 26 (this was issued in vol.27) and for Model Engineer vol. 28, I need issue 4431 (1-14 June).

For Engineering in Miniature vol.33 I need issues 11(May) and 12(June) to complete the set. I will also need a member/members willing to donate their issues of Engineering in Miniature from volume 34 onwards as the present member who donated his copies no longer subscribes to EIM.

If any member can help with the above requirements please contact me via email.

For anyone who is not already aware a printer is available in the clubhouse to enable the printing of pages of both ME and EIM.

Norman Patrick-Librarian

2013 Exhibition and display Programme

The Club have been invited to attend the following events during the coming months:-

The Museum of Power Easter Rally to be held on Sunday 31st March

The Aldham Steam Rally on Saturday and Sunday 8th/9th June

The Five Parishes Summer Show on Sunday 4th August

The Great Bentley Show on Saturday 31st August

In addition to exhibiting at these shows another "Meet the Neighbours" day is to be held at the Club site on Sunday 8th September. If you are able to assist at any of these events or are able to loan models for exhibition please let me know as soon as possible on which dates you can help.

Mick Wadmore

Link No. 44 – July 2013

Articles and reports for the July 2013 edition of LINK should reach the editor by Wednesday 19th June. Please note that this deadline is for last minute news items and reports. Technical articles should be submitted at the earliest possible date.

If prepared on a computer the preferred format is Microsoft Word for text and jpeg for pictures and drawings. Material may be sent by e-mail as attachments (**NOT** as part of the e-mail) or provided on DVD. Hand written copy is acceptable, but allow time for typing.

If in doubt, give me a call – I am here to help.

Editor

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In our game no move is the same, Heavy and wide we can provide

We have a number of Transport units catering for all your needs. The latest addition a DAF 90T double Drive unit has a carrying capacity of 58T and is cross rail compliant and LEZ compliant.

Some of our challenges

VC15 High Flotation Priestman
In the 1970s Preistman developed a range of hydraulic excavators. The VC range of dredging machine with long reach booms to replace draglines, these had an innovative sliding counter weight to balance the boom at long reach. These were popular with small sand and gravel pits and with the drainage board and water companies.

Cadburys Train

The Cadbury works railway operated from 1884 until 1976. At its peak, it incorporated six miles of track. Here we are transporting the old train back to Cadburys to be restored.

ANY JOB BIG OR SMALL SET US A CHALLENGE AND GIVE US A CALL