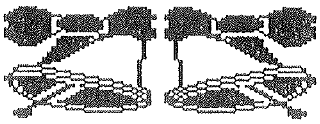
MAIDSTONE MODEL ENGINEERING SOCIETY

NEWSLETTER



Merry Christmas.

WINTER - 1987.

DIARY DATES 1987 INTO 1988
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Sunday December 27th : Christmas Run.
Friday January 1st : Bits and Pieces Evening.
Friday February 5th : Ray Milliken recounts his autumn adventures in Japan.
Friday March 4th : Annual General Meeting.
Friday April 1st : George Barlow looks back over 1987.
Sunday April 3rd : Public Running Season commences.

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SUE'S SPOT
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Due to this being a bumper Christmas issue my contribution is much reduced this time and alas Club Trek : The Voyages of the LNER Enterprise will be held over until the next issue. Closing date for articles is Sunday April 3rd.
In September we had an attempted break-in at the Park and the padlock to the coalshed was smashed. Therefore anyone who had a key to the coalshed and still requires one will now need a new one. A replacement can be obtained from our Treasurer Peter Roots who will exchange an old key for a new one, so please contact him if necessary. Peter also requires expenses claims in the near future, the rate is 20 pence per mile so please advise him accordingly. The night of Thursday October 15th cannot go unrecorded for the devastation that the hurricane caused. Those of you who have not been down the Park since before then will see the difference in the landscape when next you visit. So many trees have been lost but the club buildings and the track itself were miraculously unscathed. I have made a video of the aftermath but as Adrian fell asleep twice while watching it you may assume that it is not really riveting enough for public viewing. However, we shall see, as we are still working on ideas for another Club Video.
In winter life is fairly quiet at the Park ; we are constructing supports underneath some of the beams and a couple of our newer members are brave enough to try out their locomotives despite the cold. We are now sometimes duty bound with control of the gate at the end of our road to the clubhouse so please close it behind you if you find it closed. For the January Club Night, as well as bringing your bits 'n' pieces, why not enthrall us all with your favourite christmas present you received ? Finally, we say farewell (for the time being) to our vice chairman Peter Chislett who is off to work in Belgium for three years. We hope to still see him from time to time as he is still keeping his house here, but he will be sorely missed, particularly on the committee. We wish good luck and all the very best to Peter and Wendy in Europe. Peter Kingsford has been co-opted to join us on the committee for the time being.
Merry Christmas and a Happy New Year to one and all,

Sue X

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MAIDSTONE MODEL ENGINEERING SOCIETY OFFICERS 1987

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Norman Clark, Adrian Gurr, Don Paterson,Geoff Riddles,Robin Spencer, Chris Williams and Peter Kingsford.

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My Trip To The U.S.A. - by Andy Probyn.

I had intended to do this article on Garrett locomotives, however a recent trip to the States has offered some steam interest, so with the editors permission, we shall 'hold the front page' (or at least one lurking somewhere in the middle) whilst I tell you about it.

One of the nice things about being in the Model Engineering trade is the number of people one meets and the friends made, not just in England but abroad as well. One such friend from New Jersey, U.S.A. is Kim Kromer, a steam enthusiast, teacher and Maxitrak loco importer. Kim and his wife very kindly invited me and my family to spend a holiday with them during last summer, so after much scraping together of pennies and hounding of travel agents, we all set off at the end of July for nearly four weeks in the States. I will not relate all of our adventures during our stay, like seeing wild bears or riding 'space mountain', just those with steam connections.

Our first encounter with steam was a 4" scale Case traction engine owned by one of Kim's friends, Bob McHale. This is a typical American engine, quite different from our own in many respects. The boiler is long and thin, without lagging. The wheels have a lot of thin round spokes. The cylinder is mounted on a casting, well offset to one side of the boiler and drives a crank on the end of the crankshaft 'Mamod' style. A rather small, wide flywheel is mounted on the other end with an internal clutch arrangement which takes the drive down to the differential mounted on a cross shaft. Drive is taken to each wheel by an internal ring gear from each end of the cross shaft. There is only one speed and the clutch is the only way to disconnect the drive. A small tank with two bunkers mounted either side completes the picture. Bob's model is a commercial design, built by a company in the States. It has a steel boiler and uses a number of commercial fittings on the pipework, regulator etc. All in all a very robust and powerful model, which I had the pleasure of driving round Bob's garden.

Our next close encounter of the steamy kind came about a thousand miles further south in Florida, at Disney World. Walt Disney was quite a steam enthusiast, and it shows in the way the park is arranged. Round the outside of the whole park is a Railroad, 3' or 3'6" gauge, with four large American locos, from the 1900's and 1920's. The locos were salvaged from somewhere in South America and rebuilt at great expense, in fact they look so smart they are almost too good to be true. There is a large Mississippi stern wheel steamboat, obviously new. This must be driven by diesel, and not by that stern wheel either, thinks I. When I investigated however, I was greeted by two beautiful steam cylinders, complete with poppett valves operated by a cam and lifting levers and apparently working on steam! If there is steam, there must be a boiler, and sure enough there was a large oil fired job quietly roaring away amidships. I was still sure the stern wheel was not driving the boat and on this point at least I was right as in front of the boiler was a steam turbine doing the work, while the cylinders idle round on the exhaust steam. Various stationary steam engines are also used for decore on some of the rides.

Once we had sampled the delights of Daytona beach, Georgia, South and North Carolina, Virginia, Washington and New York, it was time to return to the lure of steam, this time at the track of the New Jersey Livesteamers. The club scene is very different in the U.S., at New Jersey anyway. Because of insurance problems, there is absolutely no public passenger hauling. The club is on private ground and only opens to non-members twice a year when they have the Spring and Fall meets. Fortunately, friends were not barred and we were made most welcome on a Wednesday afternoon when the older members were enjoying a quiet steam up.

The track consists of a double circuit of 7 1/4" gauge, passing either side of a large club hut, with quite a number of crossings and passing loops. Inside the 7 1/4 circuit is a similar loop of 4 3/4" gauge track which connects into a large elevated turntable and in turn to a loop of elevated 4 3/4" and 3 1/2" track. The turntable has a great number of roads running off, each belonging to an individual member. Some members build small engine sheds on their line and keep their locos in them. They look rather flimsy and would not last five minutes at Mote Park.

The 7 1/4" boys have some large and very solid loco sheds and their own elevated steaming bays with an excellent hydraulic lift. The vast majority of models are of American prototype, though there are a few British intruders, some of which emanate from a certain corner of West Malling. I was fortunate enough to have a drive of a beautiful 7 1/4" 4-4-0, not the real wild west type but more a turn of the century coal burner. She had all sorts of gadgets including a steam powered bell with a very realistic tinkle, in spite of that she ran beautifully and was a real pleasure to drive. The track is surrounded by extensive woodland which is quite pleasant and cool out of the sun.

Our last major trip on the holiday was into Pennsylvania for a visit to a steam rally or 'meet' at Kinsers, the steam Strasbourg Railroad and the Pennsylvania Railroad Museum. All these attractions are quite close together and are in the heart of 'Armish' country where the Armish farmers grow sweetcorn and tobacco without the aid of modern technology. They use horses for all farm work and do not have phones or electricity or use cars. In spite of this a number of Armish were driving traction engines and tractors in the steam rally. Their straw hats and white bonnets were certainly a common site in the crowds.

The spread of interest at the steam meet was very wide, including not just traction engines but tractors, cars, stationary engines, locomotives and models amongst other things. It would be virtually impossible to recount all the items to be seen, I will just try to recount some of the things that caught my eye. There were some fifteen odd traction engines, Case, Peerless, Frick, etc. mostly to the same design as the model Case described earlier. There were some odd men out however, one engine had tandem compound cylinders with just one slide valve and steamchest. This loco also had a circular firebox. There were two locos with return flue boilers, looking more like one of Trevithicks locos than a traction engine and even more odd were two vertical boiler engines built by Westinghouse. Amongst all this was a Fowler showmans tractor, complete with dynamo and canopy in full maroon livery imported some years earlier from England. There were a great number of tractors in all shapes and sizes, John Deer, International, etc with quite a number of very early tractors of a type we do not seem to have. They are similar to a traction engine but powered by a giant single or twin petrol/paraffin engine. The only thing I have seen like them here is the Aveling roller in a playground at Darnley Road, Strood, but then we did not go in for direct action ploughing as they did on the prairies. There were several large sheds which form a permanent part of the museum, with interesting noises emanating from each. The first contained stationary petrol, oil and diesel engines in all shapes and sizes. I particularly liked a big four cylinder marine engine which spent most of its life operating a lifting bridge. The second shed promised to be even more interesting judging by the number of pipes emitting steam from the roof, I was not disappointed as inside were half a dozen stationary steam engines ranging in size from large to enormous. They all had corless valves and a couple also had ammonia compressor cylinders as they had come from refrigeration plants. There were two railways round the site, the first was about 2'-6" gauge and had a Shay on it. After looking at the engine it slowly dawned on me that it was not an original, the chassis was all welded, the cylinder set had no reverse and the gear drive used offset helical gears. Sure enough she was a recent concoction using a traction engine boiler, but she looked the part none the less and had the slow speed and soft whirring engine noise so typical of shays. The second railway was a much smaller circuit of about 15" gauge with a nice green commercially built 4-4-0 pulling a couple of sit-in coaches. There has been a long tradition of building this type of loco in the U.S., started by 'Cagney' before the first war. This one was not a Cagney but was built in the same style with small drivers, tiny bogie wheels and deep flanges looking for all the world like a scaled up O gauge tin plate toy loco. She was getting a little worse for wear and the driving axle could be seen moving to and fro in the frames with each stroke of the piston. Another shed housed models, here was a fair collection including a 'Minnie' and a 'Thetford Town' amongst others, it was nice to see all the stationary engines running on real steam piped in for the occasion rather than the air we see here so often. In general the models and full size engines were not turned out in the spotless condition we are used to seeing here, some engines looked as though they had just come from a hard days work in the fields. One notable exception in the model display was a beautiful fire engine, quite large and capable of squirting a good stream of water. It was so clean and highly polished it just had to be gas fired, and it was. The cars were a fairly ordinary bunch, with Ford S's and T's predominating. Having seen Pierce Arrows, Packards, Dusenburgs, Delauney Bellivilles etc. in museums previously these were not very inspiring, however one caught my eye, an American La France of the mid 1900's judging by the chain drive rear axle. She had a very basic sporting body with large wooden wheels and beaded edge tyres. Even the front axle had been lightened with a row of holes. The engine was a large T head four cylinder job with exposed tappets which looked capable of propelling this beast at quite a speed. There was a notable lack of any commercial vehicles, only one steam roller, a Buffalo tandem and only one motorbike, an English Sunbeam twin cylinder with shaft drive.

There was a good selection of stationary 'hit and miss' engines in full size and model form. One of these engines powered the worst contrivance in the world built to the following recipe, take a school bus (the old yellow type you see on T.V.) cut it down to window level and remove the engine. Weld on two bits of R.S.J. where the engine was and mount a large red hit and miss engine in its place. Take a belt drive from the flywheel to a pulley mounted where the starting handle ought to be, and there you have it, a vehicle capable of a good walking pace lurching forward with every power stroke from the engine.

After staying overnight we set off next day for the Strasburg Railroad, a Pennsylvanian Bluebell line running about the same length as the Bluebell through farming country with some stiff grades. The loco used was a large 2-10-0 of the 1920's, and she worked quite hard with seven heavy clerestory roof coaches. A second train was pulled by a classic looking turn of the century Atlantic with a lighter five coach load. There were several other locos on shed including a small diesel, a camel back (centre cab) loco and a 'galloping goose'. This is an ordinary 1920's bus with rail wheels on the back axle and a small bogie under what looked like a Mack bonnet at the front. The Strasburg is a very clean, neat and well organised line, they use full time employees rather than voluntary workers and carry some freight from the main line as well as passengers. Just over the road from the station is the Pennsylvanian Railroad Museum, with a number of locos well preserved inside the building and some looking a little sadder outside awaiting a new building. The Pennsylvania locos have a certain style to them, all black with a brick red cab window surround and Belpaire fireboxes, right from the largest freight loco to the smallest 0-4-0 camel back switcher (which in spite of its small size had a large bogie tender). The 'Pen' was early on the scene with electrification and several early electric locos were present including two of the famous streamlined G.G.1. class, introduced in the 1930's. Also streamlined, but not quite in the same class, was a fireless 0-8-0 complete with 'skyline' boiler and enclosed cab, quite an oddity. Amongst the coaching stock was a beautiful railroad directors car with superb inlay work and air conditioning using 1400 lbs. of ice.

Two other places of railway interest were also near and certainly worth a mention. The first was a model train museum, really a model 'Lionel' train museum as almost all the exhibits and layouts were from the well known 'Lionel Lines' company. Lionel are still going, and as far as I know the only company making true O gauge tin plate 3 rail track though the locos and rolling stock are plastic nowadays.

In the museum were fine examples of old and new Lionel in both O and 1 gauge with a magnificent blue tin plate Atlantic taking pride of place, closely followed by a B&O steeple cab electric in gauge 1. There was also a layout for the visitors to use, quite complicated and with a couple of trains on independent controllers offering the chance of some spectacular accidents. It shows how robust O gauge railways can be.

The second item of interest was the Motel adjoining the toy train museum, it was called the Red Caboose and all the rooms were indeed in red cabooses, surplus now that nearly all freight trains are air braked. We did not stay in the Motel as it was booked some time in advance, however we did have a meal in the dining car. At intervals the background music stopped playing Casey Jones and such and a recording of a steam loco starting was played. At this point the dining car was vibrated about in a most realistic manner just as if it was travelling.

That just about concludes my ramblings for the moment, I hope to return to Garretts for the next article as promised last time.

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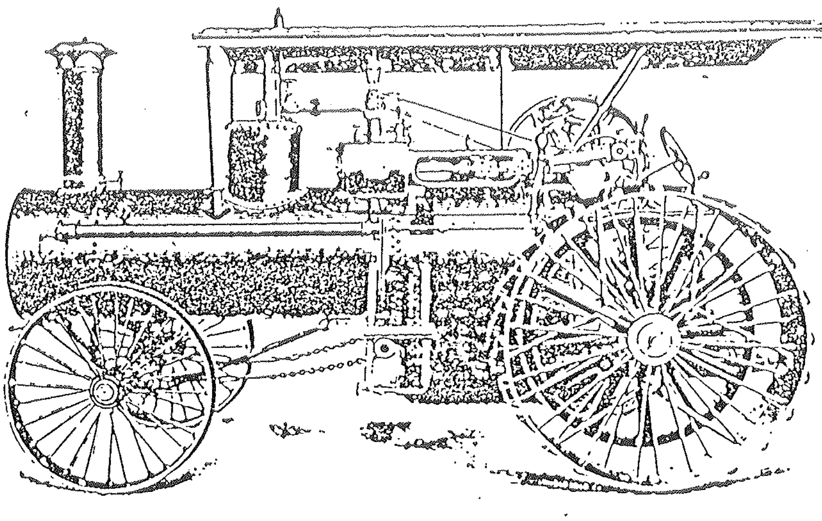

Model Locomotive Research

a brief survey by

J. Ewins

Members may know that one of my preoccupations in the field of model locomotives is that of researching into what makes them tick. In my view mechanical engineering is applied physics and models are a branch of mechanical engineering which I am able to practice at home in accordance with my own interpretation of the laws of physics. Having theories about various matters is sterile unless they can be and are tested by experiment. All the engines I have so far constructed have had an element of experiment about them to test the validity of my ideas. Needless to say, not all aspects of my endeavours have had a positive result and were it possible to predict with certainty the results of all innovations, experiment would be superfluous. It is a continuing annoyance to me to hear and read pontifications on this, that or the other by those who because of the volume of their verbal or literal output are held to be 'authorities' when in fact their depth of knowledge and experience are conspicuous by their absence. I must confess that in some cases I tend to pity them because I feel that it is a question of them *not knowing what they do not know.* We all have our limitations in regard to our knowledge and understanding of the things around us and there is a lot in *knowing what you do not know* and upon occasions keeping quiet to let others inform. One individual who is well known to our society is, whatever the topic under discussion, an 'authority' on the subject- but I have yet to see an engine he has made!

Research into model locomotive design has in the main followed the course of that in full size practice wherein the early work was on the basis of 'cut and try' and only later was there any scientific approach made to testing and evaluation. Unfortunately for the model case, innovators relied (and some still do) on regarding full size criteria as being similarly applicable to models. It does not require a very deep knowledge of the physics of fluid flow heat transfer and thermo-dynamics to be aware that when one reduces the scale of a piece of apparatus to 1/10th size say, that things are liable to be different. In trying to calculate the magnitude of this difference one is up against a number of imponderables and it is only by carrying out tests that the matter can be resolved- this is research.

Building equipment and carrying out the necessary testing is a time consuming activity which detracts from finished model output. A well known model locomotive designer writing to to me on the 6th of July 1962 said "When I get my test stand finished I hope it will be possible to get down to such things as accurate measurement of power output, drawbar pull, fuel consumption, superheat temperature, steam chest pressure etc. But it will be a little time yet." He can say that again! After a quarter of a century there is not much evidence of a test stand!. There are however plenty of designs. Wouldn't it have been better if the test stand had preceded the designs? Actually there is not much point in his making a test stand now as he can come and run his engines (if he has any) on my track using my dynamometer. Or better still use my results in his designs. Or would that involve the consumption of too much humble pie?

Delving back into past model engineering literature I have been trying to locate reports of research from the ealiest days. Mr James Crebbin appears to have been one of the earliest investigators of overall loco design involving solid fuel boilers and in fact it was he who alerted me to the possibility of using radiant superheaters. He fitted one to his "Cosmo Bonsor" which according to Bill Carter writing in the S.M.E.E. Journal started as a 4-4-2 four cylinder tandem compound and finished up as a 4-6-0 two cylinder simple. The radiant superheater he used (which is still in it) was a simple "hairpin" pipe up one firetube into the firebox and back down another. This engine which was on

4½" gauge is reported to have hauled a passenger at the first Exhibition in 1907. Things have come some way since then!

After Mr Crebbin there seems to have been an era during the thirties when a few brave souls were venturesome enough to kick over the traces of the Greenly philosophy of large boilers and small cylinders and adopt a proceedure of suck it and see. It takes a great deal of courage to invest much time and money in a project which may turn out to be an abject failure. Among this band of workers may be mentioned Mr.G.Willoughby, Mr.C.M.Kieller and of course L.B.S.C. I do not know whether trial and error methods can be classed as 'research' but there is no doubt that results can be achieved this way and in the absence of a sound technical education as was the case of L.B.S.C., this is the only way to make progress. In his case this process was greatly speeded up by his being able to devote all his time to producing many engines of a rudimentary nature and being able to test them under what was then typical working conditions. Some of his pronouncements in the M.E. were greeted with derision by the more erudite but he had the great advantage that he could point to things he had done which the others had not. I have a certain sympathy with this!

In the thirties also, Mr E.J.Linden and Keiller(1) devoted much of their time to research in connection with miniature injectors. Prior to this several experimenters introduced injectors which operated after a fashion but which could not be relied upon and needed the back-up of mechanical or hand pumps. This is an area where a sound technical knowledge of how injectors work pays great dividends which enabled Linden to virtully tie things up whilst L.B.S.C. was left floundering. Linden never published his findings and it was left to Keiller to publish designs based on Linden's work. Even today we see injectors made to L.B.S.C's instructions by manufacturers who ought to know better. Basil Palmer(2) in South Africa published a useful article based upon Eric Rowbottom's work on injectors for use at high altitudes and higher pressures. Looking through Journals of the Society of Model and Experimental Engineers there is little experiment reported apart from three articles of mine(3). Way back in 1948 a locomotive test bench was made by the combined efforts of Prof. Chaddock and Messrs. Hutton, Wildy and Latta. This was a well made equipment but suffered from the intrinsic drawback of slip between the wheels of the loco being tested and the rollers which applied the load allowing only small values of draw bar pull loads to be applied and measured accurately. One set of results with this equipment have been published by G.W.Wildy(4) which demonstrate the difficulty mentioned above. Mr Bert Woodford of the Malden Society has built a similar test stand which he showed at the 1987 Model Engineer Exhibition this had the same limitations but he has supplimented his experiments with track runs using a dynamometer. Mr Woodford's test-bed results are similar to mine in that efficiencies of the order of 4% are obtained whereas on the track efficiency figures of half this value are normal, similarly at I.M.L.E.C. A key piece of research was carried out by Brian S. Lee in 1968 using an electronic sensor to produce indicator diagrams in small models. His work was confined to an unsuperheated engine and showed severe back-pressure when the engine was driven hard. I used this equipment on a small vertical engine at a Model engineer Exhibition and found the same effect. At the time this work was not understood by the few who knew about it and a suggestion of mine to extend the investigations to a well superheated engine seems not to have been taken up. As I write issue No3813 of the Model Engineer is to hand in which appears a report of some research by Basil Markham on the collapsing pressure of annealed copper tubes. This is a useful piece of work which confirms that which I have several times quoted and throws some doubt on data which appears in M.Evans' book 'Model Locomotive Boilers'. Mr Markham has shown that manufacturing variations in nominal tube diameter and wall thickness can result in tube collapse under boiler test pressure if sufficient allowance has not been made for this. I have always recommended that test pressures should not exceed half experimentally known collapsing pressures and that test pressure should be twice working pressure. In this way there is ample margin to allow for manufacturing tolerances and the accidental flattening of tubes during the boiler construction. Also just published in M.E. issue No 3814 is a report from Mr H.F.Atkinson on "Testing

Copper Joints". Mr Atkinson concludes that Lap, Joggled Lap, Plain Butt and Flanged joints if silver soldered with Easiflo yield strengths in excess of that of the parent plate. This is as I discovered some years ago in the laboratory and have demonstrated at talks I have given to various Societies. He concludes, as I have held for many years, that flangless joints might well be considered in copper boilers. However Mr Atkinson's tests on a Plain Butt joint were in pure tension which does not occur in practice so don't use these joints on the main barrel. The above brief survey is probably by no means complete and if readers should know of additional work I should be happy to include this in a future update of this article and re-issue in due course.

As a result of the above endeavours engines are now built which have vastly improved performance than hitherto thought possible. If one had lived before the turn of the century and been told of the goings on at tracks up and down the country now many would have said "rubbish" as indeed the late Henry Greenly was apt to do. We owe it to the likes of L.B.S.C. who, through some intuitive process, was driven to try things another way that the break-through came. To try to get an idea of what went wrong in those early days I looked back through some of the first Model Engineers and found an article in Vol 2 No 14 Feb 1899 describing an engine made by a Mr S.G.E.Copestake. Fortunately very complete details were given for this engine which were as follows:-

Diameter of cylinders (brass)	1 5/8"
Stroke of Pistons (brass with steel rod)	2 1/4"
Diameter of driving wheels (brass)	6"
Diameter of bogie wheels (brass)	2 1/4"
Wheel base between driving wheels	9"
Wheel base (total)	24"
Thickness of frames (steel)	1/8"
Height of platform from rail	5 1/2"
Width of platform	11 1/2"
Water in boiler	1 1/2 galls.
Diameter of boiler	6 5/8"
Length of boiler including firebox	20 1/2"
Heating surface of firebox	137 sq.in.
Heating surface of tubes	1066 sq.in.
Grate area	40 sq.in.
Chimney diameter	1 3/4"
Thickness of boiler plates (copper)	1/16"
Chimney height from rail	18 1/2"
Diameter of pump rams (two)	3/16"
Weight of engine in working order	145 lbs
Weight of tender in working order	66 lbs
Extreme length of engine over tender and buffers	63"
Gauge	7"
Working pressure	40 p.s.i.
Fuel Hardwood charcoal	

In the text it is stated that the boiler had 79 brass tubes 3/8" outside diameter and thick enough to take a fine thread. The engine is stated as being capable of taking one person up a one in ninety gradient and two on the level and is referred to by the editor as "a powerful model for its size". What were they doing wrong?

I have devised a set of criteria by which the vital parameters of model locos may be compared and those of "good" engines taken as the desirable ones so that one might compare these with other existing and proposed designs to access their likely characteristics. I have now got this technique into a computor program which has come up with a read-out for the above engine (Fig1) given overleaf along with the expressions from which the factors are obtained.

The first parameter to notice is that of the boiler factor (Eb=90) which is very close to that which gives good results today. Unfortunately this parameter contains the Keiller tube factor (Kt) which should be around 80 but is in fact 178. So here is the first mistake. Out friend Copestake has (presumably) tried to get so much heating surface into the tubes (1066 and all that) that he has used too many small tubes.

The next error lies in the engine factor Ee which is 0.07 instead of being around 0.15. Ee involves the cylinder dimensions the grate area and wheel diameter from which it is clear that the grate is disproportionately large compared with the rest. This was a common fault with early designs. Because of the low values of Ee and Eb the value of Eo which denotes a balance between the 'engine' and the 'boiler' is also low

The nominal tractive effort comes out at 79 lbs. but the program works this out for a boiler pressure of 80 p.s.i. instead of the 40 p.s.i. which was used. 40 lbs. tractive effort is pretty feeble for an 1 1/2" scale loco now-a-days and accounts partly for the poor performance. The adhesive weight being about half the weight of the engine would have been around 72 lbs giving a factor of adhesion of 0.4 not much chance of slipping here and not much chance of the resulting feeble exhaust blast making much impression on the large grate area of 40 sq. in. No wonder charcoal was used for fuel I suppose coal would not stay alight under those condidtions and a coal fire if it had been tried would have burnt most inefficiently if at all. We now know (at least some of us do) that coal fires need to be driven hard to burn efficiently.

The computer was next set the task of redesigning the engine by retaining the same wheel diameter and stroke whilst it was given some latitude with the other parameters. This is achieved by inserting limits to the range of scan of the parameters that one wishes the computer to work on, whilst reducing this range to zero for those required to remain unaltered. This resulted in the revised design (Fig2) in which the following modifications are called for. Increase bore to 1.9 inches. Reduce grate area to 28 sq. inches. Reduce number of tubes to 28. Increase tube bore to .45 inches. Increase tube length to 16 inches. The revised engine would have had a nominal tractive effort of 108 lbs and would have needed the adhesive weight to have been increased to 168 lbs. This could have been achieved by making the boiler from 1/8" plate instead of 1/16" which would have been necessary for the higher working pressure built into the program.Additional weight could have been obtained by making the frames from 3/16" plate instead of 1/8". To sum up then assuming Mr Copestake wished to use the 6" wheels and 2 1/4" stroke, he should have (1) used larger cylinders, (2) Cut down the grate area, (3) reduced the number of tubes (4) used larger tubes (5) made the boiler from 1/8" copper and worked it at 80 p.s.i. This latter modification would have gone a long way towards getting the adhesive weight up to that recommended in the program and further progress in this direction could have been obtained by making the frames from 3/16" material instead of the 1/8" used. Another possible improvement would be the substitution of an 1 3/8" chimney choke tube instead of the 1 3/4". And finally a radiant superheater would have really made it get up and go.

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LOCOMOTIVE DESIGN USING J.Ewins' 'E' numbers

Name of Engine	Mr Copestake's (M.E. Feb.1899).	
Gauge	7"	
Scale	About 1 1/2"	

		Range of Scan
Number of cylinders	2	2 - 2
Bore of cylinders inches	1.625	1.625 - 1.625
Stroke inches	2.25	2.25 - 2.25
Grate area sq. inches	40	40 - 40
Driving wheel diameter inches	6	6 - 6
Number of tubes	79	79 - 79
Bore of tubes	0.28	0.28 - 0.28
Length of tubes inches	14	14 - 14

Eb= 90 (Target value 80)

Ee= 0.077 (Target value 0.15)

Eo= 7 (Target value 12)

Kt= 178 (Target value 80)

Nominal Tractive Effort lbs	79
Recommended adhesive weight lbs	240
Factor of adhesion	0.33
Choke tube diameter inches	1.58
Gas/Grate ratio %	12
Percentage accuracy	1000
Number of calculations	1

Fig 1

$$\text{Engine Factor } Ee = \frac{\text{Swept Volume of the Cylinders per Revolution}}{\text{Grate Area X Driving Wheel diameter}}$$

$$\text{Boiler Factor } Eb = \frac{\text{Grate Area in sq. in. X Tube length in in.}}{\text{Number of Tubes X (Tube diameter in inches)}^2}$$

$$\text{Overall Factor } Eo = Ee \text{ X } Eb$$

$$\text{Tube Factor } Kt = \frac{\text{Length of tubes}}{(\text{Diameter of tubes})^2}$$

LOCOMOTIVE DESIGN USING J.Ewins' 'E' numbers

Name of Engine	Mr Copestake's (Revised design).	
Gauge	7"	
Scale	About 1 1/2"	

		Range of Scan
Number of cylinders	2	2 - 2
Bore of cylinders inches	1.9	1.8 - 2
Stroke inches	2.25	2.25 - 2.25
Grate area sq. inches	28	26 - 30
Driving wheel diameter inches	6	6 - 6
Number of tubes	28	25 - 30
Bore of tubes	0.45	0.4 - 0.5
Length of tubes inches	16	14 - 18

Eb= 79 (Target value 80)

Ee= 0.151 (Target value 0.15)

Eo= 11 (Target value 12)

Kt= 79 (Target value 80)

Nominal Tractive Effort lbs	108
Recommended adhesive weight lbs	168
Factor of adhesion	0.64
Choke tube diameter inches	1.32
Gas/Grate ratio %	15
Percentage accuracy	2
Number of calculations	1430

Fig 2

****

FOR SALE -

5" Gauge "AJAX" 0-4-0 tank loco chassis. Frames assembled with hornblocks, axleboxes, axles and wheels fitted, plus axle pump and eccentric fitted, coupling rods, con rods and most parts of Walschaerts valve gear completed. Castings for buffer heads and stocks and complete set of drawings for the loco. £50-00.

Members interested in this offer are asked to contact Mr.G.B.Garlick on Medway 716803.

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NEW MEMBERS

Please welcome to the society:

Robert Marshall of Maidstone who is a project manager interested in model aircraft and boats and is building a vertical engine.

Charles Darley (rejoined) of Hempstead who is a chartered surveyor and has recently completed a Sweet Pea and is also interested in amateur radio.

"SAMUEL I KNOW MAKING THE MODEL CHURCH WAS HELPING YOU MAKE YOUR ENGINE, BUT YOU CAN'T KEEP IT INSIDE!"

It should never be "That will do" but always "That's it".

I would like to thank everyone for such a nice welcome on my return to the Club. More than that a thank you to those who have answered my endless questions and given practical help in the construction of the Sweet Pea Loco that should, all being well, make its first run on the track in the new year (which one my wife Jean asks), well 1988 I hope.

For several years I have been building the loco and have often wondered why it was described as "Simple/easy to build". The only part that I found to be easy, was opening the parcel that contained that plans and the starter pack of bits and pieces. From then on it has been the learning of new skills. Never before had I ever tackled silver soldering on a scale and cost as with the construction of the boiler. I still find difficulty in assessing tolerances and as for hardening of materials that is still a black art, as far as I am concerned.

The Loco, when finished, will regrettably be far from the exhibition standard of many that I see in the steaming bays. It will, to me however, represent many hundreds of happy hours in the work shop, making the best I can, with the knowledge I have at the present time.

I read with interest the article on "Tools for the beginner" and hope that more of these such articles will be forthcoming from the experienced builder, for the benefit of those who like my self have had no training on the tools but have had to learn from reading and sometimes having the benefit of watching others work in the club's workshop.

Regarding the comment on polythene covering I have successfully used the sheet covering, sold in BOOTS the Chemist, and used by students for covering notes. By the use of such coverings, sheet can be removed, marked with ones own useful data from time to time and returned to the safety of the cover.

Thinking of safety in the workshop I recently located a shop in Maidstone that catered for industrial safety items and have been able to obtain at very reasonable cost goggles. They are to BS specification. I have found them a great deal better that those available from DIY outlets. The shop, ALLSAFE, is located in Peel Street Maidstone 0622 61166.

Charles Darley.

A FEW USEFUL CHARTS

No. 1. A copy of the old Newall Standard for Limits and Fits, this is an earlier system to use for our purposes than the latest British Standard. Should prevent cracking those expensive wheel castings.

No. 2. This is the most comprehensive Tapping Drill Chart I have yet found and is a boon pinned up behind the lathe etc.

No. 3. This is useful for marking out or setting your dividers for those horrible divisions.

No. 4. This will give a better idea for sensible bolt head and rivet sizes on models. BA head sizes are standard, not one size down as seems to be common these days with M E suppliers.

Graham Kimber.

No. 1

Allowances for Fits,

(Newall Standard)

Tolerances in Standard Holes*

Class	Nominal Diameters	Up to ½ Inch	9/16–1 Inch	1 1/16–2 Inches	2 1/16–3 Inches	3 1/16–4 Inches	4 1/16–6 Inches
A	High Limit Low Limit Tolerance	+0·00025 −0·00025 0·0005	+0·0005 −0·00025 0·00075	+0·00075 −0·00025 0·0010	+0·0010 −0·0005 0·0015	+0·0010 −0·0005 0·0015	+0·0010 −0·0005 0·0015
B	High Limit Low Limit Tolerance	+0·0005 −0·0005 0·0010	+0·00075 −0·0005 0·00125	+0·0010 −0·0005 0·0015	+0·00125 −0·00075 0·0020	+0·0015 −0·00075 0·00225	+0·00175 −0·00075 0·0025

Allowances for Forced Fits

Class	Nominal Diameters	Up to ½ Inch	9/16–1 Inch	1 1/16–2 Inches	2 1/16–3 Inches	3 1/16–4 Inches	4 1/16–6 Inches
F	High Limit Low Limit Tolerance	+0·0010 +0·0005 0·0005	+0·0020 +0·0015 0·0005	+0·0040 +0·0030 0·0010	+0·0060 +0·0045 0·0015	+0·0080 +0·0060 0·0020	+0·0100 +0·0080 0·0020

Allowances for Driving Fits

Class	Nominal Diameters	Up to ½ Inch	9/16–1 Inch	1 1/16–2 Inches	2 1/16–3 Inches	3 1/16–4 Inches	4 1/16–6 Inches
D	High Limit Low Limit Tolerance	+0·0005 +0·00025 0·00025	+0·0010 +0·00075 0·00025	+0·0015 +0·0010 0·0005	+0·0025 +0·0015 0·0010	+0·0030 +0·0020 0·0010	+0·0035 +0·0025 0·0010

Allowances for Push Fits

Class	Nominal Diameters	Up to ½ Inch	9/16–1 Inch	1 1/16–2 Inches	2 1/16–3 Inches	3 1/16–4 Inches	4 1/16–6 Inches
P	High Limit Low Limit Tolerance	−0·00025 −0·00075 0·0005	−0·00025 −0·00075 0·0005	−0·00025 −0·00075 0·0005	−0·0005 −0·0010 0·0005	−0·0005 −0·0010 0·0005	−0·0005 −0·0010 0·0005

Allowances for Running Fits†

Class	Nominal Diameters	Up to ½ Inch	9/16–1 Inch	1 1/16–2 Inches	2 1/16–3 Inches	3 1/16–4 Inches	4 1/16–6 Inches
X	High Limit Low Limit Tolerance	−0·0010 −0·0020 0·0010	−0·00125 −0·00275 0·0015	−0·00175 −0·0035 0·00175	−0·0020 −0·00425 0·00225	−0·0025 −0·0050 0·0025	−0·0030 −0·00575 0·00275
Y	High Limit Low Limit Tolerance	−0·00075 −0·00125 0·0005	−0·0010 −0·0020 0·0010	−0·00125 −0·0025 0·00125	−0·0015 −0·0030 0·0015	−0·0020 −0·0035 0·0015	−0·00225 −0·0040 0·00175
Z	High Limit Low Limit Tolerance	−0·0005 −0·00075 0·00025	−0·00075 −0·00125 0·0005	−0·00075 −0·0015 0·00075	−0·0010 −0·0020 0·0010	−0·0010 −0·00225 0·00125	−0·00125 −0·0025 0·00125

Formulas for Determining Allowances

Class	High Limit	Low Limit	Class	High Limit	Low Limit
A	$+\sqrt{D} \times 0{\cdot}0006$	$-\sqrt{D} \times 0{\cdot}0003$	X	$-\sqrt{D} \times 0{\cdot}00125$	$-\sqrt{D} \times 0{\cdot}0025$
B	$+\sqrt{D} \times 0{\cdot}0008$	$-\sqrt{D} \times 0{\cdot}0004$	Y	$-\sqrt{D} \times 0{\cdot}001$	$-\sqrt{D} \times 0{\cdot}0018$
P	$-\sqrt{D} \times 0{\cdot}0002$	$-\sqrt{D} \times 0{\cdot}0006$	Z	$-\sqrt{D} \times 0{\cdot}0005$	$-\sqrt{D} \times 0{\cdot}001$

* Tolerance is provided for holes, which ordinary standard reamers can produce, in two grades, Classes A and B, the selection of which is a question for the user's decision and dependent upon the quality of the work required; some prefer to use Class A as working limits and Class B as inspection limits.

†Running fits, which are the most commonly required, are divided into three grades: Class X, for engine and other work where easy fits are wanted; Class Y, for high speeds and good average machine work; Class Z, for fine tool work.

TAPPING DRILL CHART

No. 2

Fraction (Fraction–Old Drill Gauge and Letter Drill)	Old Drill Size	Dec. Equiv. In.	Tapping Drill British Standard (International) Series New Size mm.in.	Dec. Equiv.	Thread UNF UNC	Thread BA BSW BSF
	80	·0135	0·35	·0138		
	79	·0145	0·38	·0150		
1/64		·0156				
	78	·0160	0·40	·0157		
	77	·0180	0·45	·0177		
	76	·0200	0·50	·0197		
	75	·0210	0·52	·0205		
	74	·0225	0·58	·0228		
	73	·0240	0·60	·0236		16 BA
	72	·0250	0·65	·0256		
	71	·0260	0·65	·0256		
	70	·0280	0·70	·0276		15 BA
	69	·0292	0·75	·0295		
	68	·0310	1/32	·0312		14 BA
1/32		·0312				
	67	·0320	0·82	·0323		
	66	·0330	0·85	·0335		
	65	·0350	0·90	·0354		
	64	·0360	0·92	·0362		
	63	·0370	0·95	·0374		
			0·975	·0384		13 BA
	62	·0380	0·98	·0386		
	61	·0390	1·00	·0394		
	60	·0400	1·00	·0394		
	59	·0410	1·05	·0413		12 BA
	58	·0420	1·05	·0413		
	57	·0430	1·10	·0433		
0 DIA	56	·0465	3/64	·0469	0–80	
3/64		·0469				
			1·20	·0472		11 BA
12BA DIA	55	·0520	1·30	·0512		12BA DIA
	54	·0550	1·40	·0551		10 BA
			1·45	·0571	1–64	
	53	·0595	1·50	·0591	1–72	
			1·55	·0610		9 BA
1/16		·0625				
	52	·0635	1·60	·0630		
10BA DIA	51	·0670	1·70	·0669	2–56	10BA DIA
			1·75	·0689	2–64	
	50	·0700	1·80	·0709		8 BA
	49	·0730	1·85	·0728		
	48	·0760	1·95	·0768	3–48	
5/64		·0781				
	47	·0785	2·00	·0787		
	46	·0810	2·05	·0807	3–56	7 BA
	45	·0820	2·10	·0827		
8BA DIA	44	·0860	2·20	·0866	4–40	8BA DIA
	43	·0890	2·25	·0886		
			2·30	·0906	4–48	6 BA
	42	·0935	3/32	·0938		
3/32		·0938				
	41	·0960	2·45	·0965		
7BA DIA	40	·0980	2·50	·0984	5–40	7BA DIA
	39	·0995	2·55	·1004	5–44	1/8 BSW
	38	·1015	2·60	·1024		
	37	·1040	2·65	·1043		5 BA
	36	·1065	2·70	·1063	6–32	
7/64		·1094				
6BA DIA	35	·1100	2·80	·1102	6BA DIA	
	34	·1110	2·80	·1102		

Fraction (Fraction–Old Drill Gauge and Letter Drill)	Old Drill Size	Dec. Equiv. In.	Tapping Drill British Standard (International) Series New Size mm.in.	Dec. Equiv.	Thread UNF UNC	Thread BA BSW BSF
	33	·1130	2·85	·1122	6–40	
	32	·1160	2·95	·1161		
	31	·1200	3·00	·1181		4 BA
5BA 1/8		·1250		·126	5BA DIA	
	30	·1285	3·30	·1299		
			3·40	·1339	8–32	
			3·45	·1358	8–36	3 BA
	29	·1360	3·50	·1378		
	28	·1405	9/64	·1406		
9/64 4BA		·1406		·142	4BA DIA	
	27	·1440	3·70	·1457		5/32 BSW
	26	·1470	3·70	·1457		
	25	·1495	3·80	·1496	10–24	
	24	·1520	3·90	·1535		
	23	·1540	3·90	·1535		
5/32		·1562		·1562		3/16 BSF
	22	·1570	4·00	·1575	10–32	2 BA
	21	·1590	4·00	·1575		
3BA DIA	20	·1610	4·10	·1614	3BA DIA	
	19	·1660	4·20	·1654		
	18	·1695	4·30	·1693		
11/64		·1719				
	17	·1730	4·40	·1732	12–24	
	16	·1770	4·50	·1772		1 BA
	15	·1800	4·60	·1811	12–28	
	14	·1820	4·60	·1811		
			4·65	·1831		7/32 BSF
2BA DIA	13	·1850	4·70	·1850	2BA DIA	
3/16		·1875				
	12	·1890	4·80	·1890		
	11	·1910	4·90	·1929		
	10	·1935	4·90	·1929		
	9	·1960	5·00	·1968		
	8	·1990	5·10	·2008		0 BA
	7	·2010	5·10	·2008		1/4 BSW
13/64		·2031				
	6	·2040	5·20	·2047	1/4–20	
	5	·2055	5·20	·2047		
	4	·2090	5·30	·2087		1/4 BSF
	3	·2130	5·40	·2126		
			5·50	·2165	1/4–28	
7/32		·2188				
	2	·2210	[illegible]	·2205		
	1	·2260	5·80	·2283		
	A	·2340	15/64	·2344		
15/64		·2344				
	B	·2380	6·00	·2362	0BA DIA	
	C	·2420	6·10	·2402		
	D	[illegible]	6·20	·2441		
1/4	E	·2500	1/4	·2500		
	F	·2570	6·50	·2559		5/16 BSW
	G	·2610	6·60	·2598	5/16–18	
17/64		·2656				
	H	·2660	17/64	·2656		5/16 BSF
			6·75	·2657		
	I	·2720	6·90	·2717	5/16–24	
	J	·2770	7·00	·2756		
	K	·2810	9/32	·2812		
9/32		·2812				
	L	·2900	7·40	·2913		

Fraction (Fraction–Old Drill Gauge and Letter Drill)	Old Drill Size	Dec. Equiv. In.	Tapping Drill British Standard (International) Series New Size mm.in.	Dec. Equiv.	Thread UNF UNC	Thread BA BSW BSF
	M	·2950	7·50	·2953		
19/64		·2969				
	N	·3020	7·70	·3031		
5/16		·3125		·3125		3/8 BSW
	O	·3160	8·00	·3150	3/8–16	
	P	·3230	8·20	·3228		
			8·25	·3248		3/8 BSF
21/64		·3281				
	Q	·3320	8·40	·3307		
			8·50	·3346	3/8–24	
	R	·3390	8·60	·3386		
11/32		·3438				
	S	·3480	8·80	·3465		
	T	·3580	9·10	·3583		
23/64		·3594				
			9·25	·3642		7/16 BSW
	U	·3680	9·30	·3661		
			9·40	·3701	7/16–14	
3/8		·3750				
	V	·3770	3/8	·3750		
			9·70	·3819		7/16 BSF
	W	·3860	9·80	·3858		
			9·90	·3898	7/16–20	
25/64		·3906				
	X	·3970	10·10	·3976		
	Y	·4040	10·30	·4055		
13/32		·4062				
	Z	·4130	10·50	·4134		1/2 BSW
27/64		·4219				
			10·80	·4252	1/2–13	
7/16		·4375		·4375		1/2 BSF
		·4488	11·40	·4488	1/2–20	
29/64		·4531				
15/32		·4688				
		·4764	12·10	·4764		9/16 BSW
		·4823	12·25	·4823	9/16–12	
31/64		·4844				
1/2		·5000		·5000		9/16 BSF
			12·90	·5079	9/16–18	
33/64		·5156				
17/32		·5312				
			13·50	·5315	5/8–11	5/8 BSW
35/64		·5469				
			14·00	·5512		5/8 BSF
9/16		·5625				
			14·50	·5709	5/8–18	
37/64		·5781				
19/32		·5938				
39/64		·6094				
5/8		·6250				
41/64		·6406		·6406		3/4 BSW
			16·50	·6496	3/4–10	
21/32		·6562				
			16·75	·6594		3/4 BSF
43/64		·6719				
11/16		·6875		6875	3/4–16	
45/64		·7031				
23/32		·7188				
47/64		·7344				
3/4		·7500				

Fraction (Fraction–Old Drill Gauge and Letter Drill)	Old Drill Size	Dec. Equiv. In.	Tapping Drill British Standard (International) Series New Size mm.in.	Dec. Equiv.	Thread UNF UNC	Thread BA BSW BSF
			19·25	·7579		7/8 BSW
49/64		·7656		·7656	7/8–9	
25/32		·7812		·7812		7/8 BSF
51/64		·7969				
		·8040		·8040	7/8–14	
13/16		·8125				
53/64		·8281				
27/32		·8438				
55/64		·8594				
			22·00	·8661		1 BSW
7/8		·8750				
			22·25	·8760	1–8	
57/64		·8906				
			22·75	·8957		1 BSF
29/32		·9062				
			23·25	·9154	1–12	
59/64		·9219				
15/16		·9375				
61/64		·9531				
31/32		·9688				
			24·75	·9744		1 1/8 BSW
63/64		·9844		·9844	1 1/8–7	
1		1·0000				
			25·50	1·0039		1 1/8 BSF
			26·50	1·0433	1 1/8–12	
1 3/32		1·0938		1·0938		1 1/4 BSW
1 7/64		1·1094		1·1094	1 1/4–7	
1 1/8		1·1250				
			28·75	1·1319		1 1/4 BSF
			29·50	1·1614	1 1/4–12	
			30·75	1·2106	1 3/8–6	
			31·50	1·2402		1 3/8 BSF
1 1/4		1·2500				
		1·2900		1·2900	1 3/8–12	
			33·50	1·3189		1 1/2 BSW
1 21/64		1·3281		1·3281	1 1/2–6	
1 23/64		1·3594		1·3594		1 1/2 BSF
1 3/8		1·3750				
			36·00	1·4173	1 1/2–12	
1 1/2		1·5000				
			39·00	1·5354		1 3/4 BSW
1 35/64		1·5469		1·5469	1 3/4–5	
1 5/8		1·6250				
1 3/4		1·7500				
			44·50	1·7520		2 BSW
1 25/32		1·7812		1·7812	2–4·5	

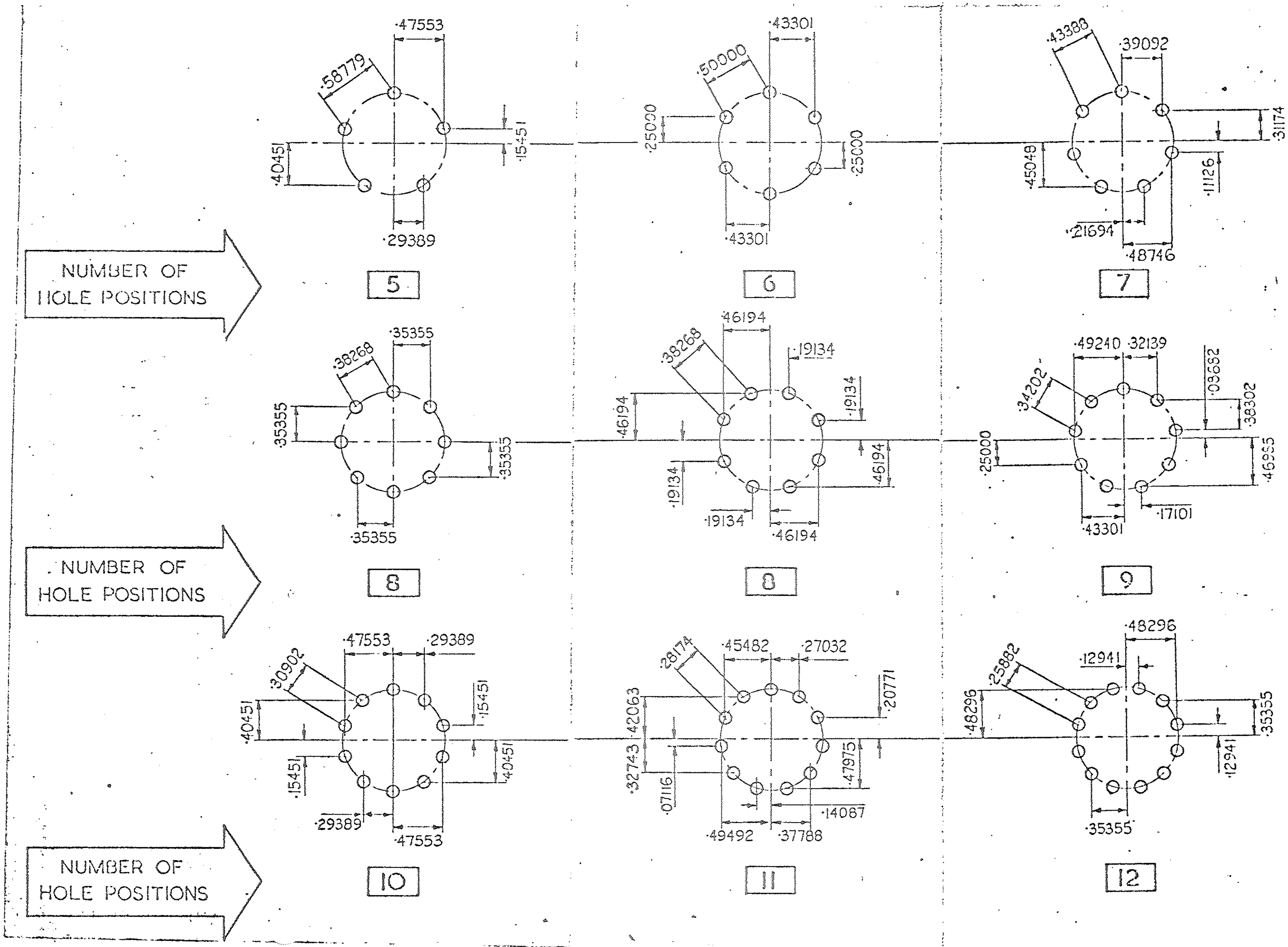
BRITISH STANDARD PIPE THREADS

Thread	Tapping Drill mm	Tapping Drill in.	Dec. Equiv.	Thread	Tapping Drill mm	Tapping Drill in.	Dec. Equiv.
1/8–28	8·75		·3445	7/8–14	28·25		1·1122
1/4–19	11·80		·4546	1–11	30·75		1·2106
3/8–19	15·25		·6004	1 1/4–11	39·50		1·5551
1/2–14		3/4	·7500	1 1/2–11		1 25/32	1·7812
5/8–14		53/64	·8281	1 3/4–11	51·00		2·0079
3/4–14	24·50		·9646	2–11		2 1/4	2·2500

CONSTANTS FOR VARIOUS EQUI-SPACING

No. 3

MULTIPLY VALUE SHOWN BY DIA OF CIRCLE BEING CALCULATED



Rivet & Bolt Head Scale Equiv.

Full Size: Size	Whit Bolt or Nut	Nom. A/F	Scale Equiv: Std G 3½	Std G 5"	Std G 7¼"	18" Gauge 2½	18" Gauge 3½	18" Gauge 5"	18" Gauge 7¼		BA Sizes	BA A/F	Thread Dia.
1/4"	" " "	.441	–	–	16BA	16BA	12BA	9BA	7BA		0	.410	.236"
5/16"	" " "	.521	–	16BA	14BA	14BA	11BA	8BA	5BA		1	.362	.209"
3/8"	" " "	.596	–	16BA	12BA	12BA	10BA	7BA	4BA		2	.321	.185"
7/16"	" " "	.706	–	14BA	12BA	11BA	9BA	6BA	3BA		3	.280	.161"
1/2"	" " "	.816	16BA	14BA	11BA	10BA	8BA	5BA	2BA		4	.245	.142"
9/16"	" " "	.916	16BA	12BA	10BA	9BA	7BA	4BA	1BA		5	.218	.126"
5/8"	" " "	1.005	14BA	12BA	9BA	8BA	6BA	3BA	0BA		6	.191	.110"
3/4"	" " "	1.195	14BA	11BA	8BA	7BA	5BA	2BA	1/4" Whit		7	.170	.098"
7/8"	" " "	1.294	12BA	10BA	7BA	6BA	4BA	1BA	5/16" Whit		8	.151	.086"
1"	" " "	1.474	12BA	9BA	6BA	5BA	3BA	0BA	3/8" Whit		9	.130	.075"
											10	.115	.067"
	Rivets. RH	Head Dia.									11	.102	.059"
1/4"	" "	.438	1/64"	1/64"	1/32"	1/32	1/16"	3/32"	3/32		12	.089	.051"
5/16"	" "	.547	1/64"	1/32"	1/16"	1/16"	1/16"	3/32"	1/8"		14	.068	.039"
3/8"	" "	.656	1/32"	1/32"	1/16"	1/16"	1/16"	3/32"	5/32"		16	.055	.031"
1/2"	" "	.875	1/32"	1/16"	1/16"	3/32	3/32"	1/8"	3/16"				
5/8"	" "	1.094	1/32"	1/16"	3/32"	3/32"	1/8"	3/16"	1/4"				
3/4"	" "	1.312	1/1[illegible]	1/16"	3/32"	1/8"	5/32"	3/16"	5/16				