On Testing And Test Tracks

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Through December 2015 there has been a topic on the (0 Gauge) Guild Forum on Test Tracks. This was initially raised to discuss the validity of testing on a round and round "test track". In response I believe such a track I would not be a good test bed for a loco; often they are simply tracks where a model is displayed running without the encumbrance of scenery. A number of points have been made on the Forum but I would like to elaborate on the question of testing a model loco based on my practice.

I believe there are a number of steps that should occur before a loco reaches the stage of any extended running on a track. What follows are the stages I go through, with an occasional aside, to achieve a model locomotive that performs. Some of which I and others have written on in earlier issues of the Gazette and references to the Gazette Archive will enable you look them up.

INITIAL CONSTRUCTION.

Erecting the chassis.

For a loco that runs well the first steps take place during the initial stages of chassis construction. When erecting the frames every care should be made to get them square and parallel. Details of how this can be achieved can be found in the Manual (Part 3 Section 6).

Bearings – plain.

Fitting the bearings will follow this. But before fitting them check for a small burr at one end or the other created when the bearing is parted off during manufacture. The burr is easy to remove with a counter sinking tool run around the ends of the bore or a drill bit at least three times the diameter of the hole.

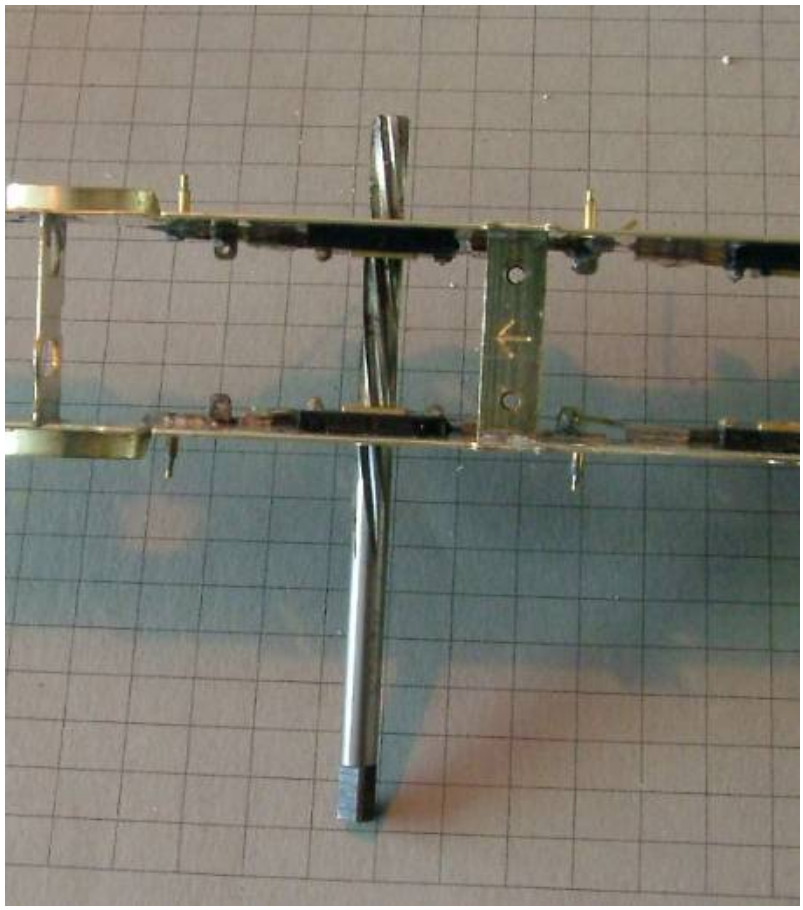
It does not matter whether horn guides or fixed plain bearings are used. The same requirements apply to both. The bearings must be opposite each other and square in the frames. The use of jury axles or an adjustable chassis jig does help especially when the bearings are positioned by the coupling rods. This should eliminate binding once the rods are fitted to the wheels.

Free movement.

With bearings in place the wheels can be fitted and checked individually for free turning. Bearing bores, both square for horn guides or top hat, are often the nominal 3/16" diameter as the axle. This can leave a very small clearance between the axles and the bearings. This will be detectable turning the wheel on its axle in the bearing. If not tight then certain stiffness may be present or it may just not feel free. A shaft in a plain bearing should have running clearance (in the engineering industry these are defined by a British Standard for Limits and Fits BS EN20286-1,-2 1993 or ISO 286-1,-2 1998). These standards go way beyond what we need to know, sufficient to say is that we want something that turns freely. Experience says that for us the bore should be about 0.002" larger than the nominal 3/16"bore. A 4.8mm diameter HAND reamer works well. A MACHINE reamer is likely to be too short to cross a chassis. A 3/16" reamer usually does nothing towards enlarging a hole being the same nominal size as the hole.

Ideally the bearing should be reamed with them in place in the chassis. The reamer is used across the chassis opening up both bearings together; hence a Hand reamer. Crossing the chassis will help align the holes. The probable slight misalignment one bearing relative to the other during installation

will be corrected by one bearing pulling the reamer into alignment with the other. The reshaping of the bores is miniscule and of no consequence apart from the positive alignment of one to the other.



Trial fit of wheels and axles.

Check the rear of plastic spoked wheels for any moulding pips. These can pick up on the edges of the chassis. Remove and smooth off.

Fit one wheel to an axle and insert in the first pair of axle holes. The wheel and axle should spin freely. Experience says it usually does and requires no further work. Repeat for the other axle positions.

Fit all the axles and wheels to each position. Bearings in horn guides do not need to have the springs fitted yet.

Run the chassis back and forth; there should be no binding. If feels free then try it on a piece of sloping track, see if it runs down hands free; the shallower the slope the freer the chassis. It should be possible to run down a slope of around 1:10.

This note excludes ball or roller bearings. These are basically free running but for their installation same issues of alignment apply. A mismatch across the chassis can lead to added friction in these bearings.

Rods and motion.

Having achieved a free running with a basic wheeled chassis there is potential to lose this as coupling rods and valve gear components are added.

Add the motion in stages; first the coupling rods. If the chassis has been assembled using these with a jig or jury axles there should only be a need to ensure there is a free fit on the crank pin bushes. With rods on the chassis should still roll freely.

However binding may occur; this will show in two places. It will be either at the nine or three o'clock positions. If the bind is on the left hand side only then that is the side that needs attention, similarly if the right then that side. This is where the rod centres match or fail to match the axle centres. If the rods are really tight then a serious error occurred when the bearings were fitted and it may be worth returning to them to position them correctly.

Usually any binding is only slight. Opening up the holes with broach will usually suffice. When using a broach work on the holes from both sides to even out the taper the broach cuts.

DO NOT attempt to use a drill. The amount of material that has to be removed is small and the drill is likely to pick up and rip the rod from either fingers or vice. If it doesn't turn into a propeller it can be bent into an interesting but useless shape!

I have elaborated on the preparation of coupling rods in Gazette Vol 17 No.4 which can be found in the Archive.

For a small inside cylindered loco this is usually the end of the process, but a loco with outside cylinders and valve gear there is more.

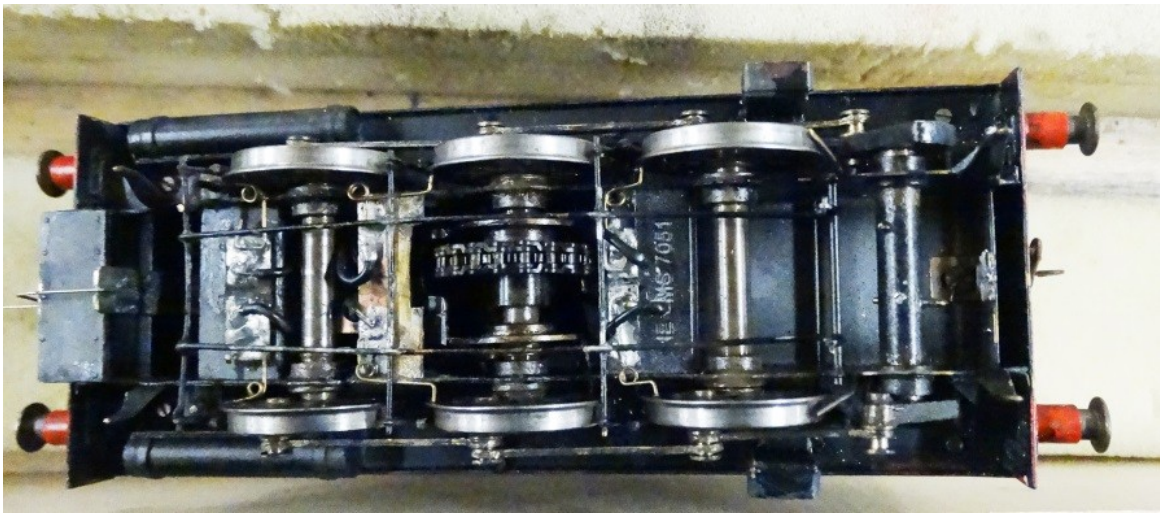
A lot will depend on how the loco is to be assembled. There is much variation across kits how parts are assembled; cylinder one with the frames, cylinders that are bolted on, similarly the fixing of motion brackets.

Again I have written on this in Gazette Vol 15 No 9 emphasising how to get freedom of movement in the system.

<u>Pick-ups</u>

Any pick-up that bears on the wheels introduces friction to the system and it is no longer as free as it was.

Phosphor bronze strip, brass or nickel silver wire can be used with great effect but with the latter keep the diameter down; 0.5mm or less. The wire will have to move to accommodate wheel movement in the bearing, up, down, left and right. A length of around 25mm, if feasible, will be sufficiently springy to accommodate the movement without excessive pressure. If it has to be short, or very short then wind a coil or two into the wire and that will provide the spring in a reduced space. The chassis below illustrates this.



Plunger pick-ups are popular. I have heard that once fitted they were effectively brakes! I would suggest that something has been overlooked in the installation. In kits the distance between the frames can be variable, some narrower than others and some near scale spacing. This will affect the plunger especially in the wider configurations. Some installations will then bottom out with ends of the plungers wider than the back to back dimension of the wheels; a very effective brake! To accommodate it I have heard of modellers reducing the length of the spring. This can/will have the effect of severely reducing the bearing pressure of the plunger and making electrical pick up ineffective. It is better to leave the spring as it is and reduce the plunger length. Some plungers have conical ends; file this off until the end bears on the wheels and movement is accommodated. It does not matter that end of the plunger is flat.

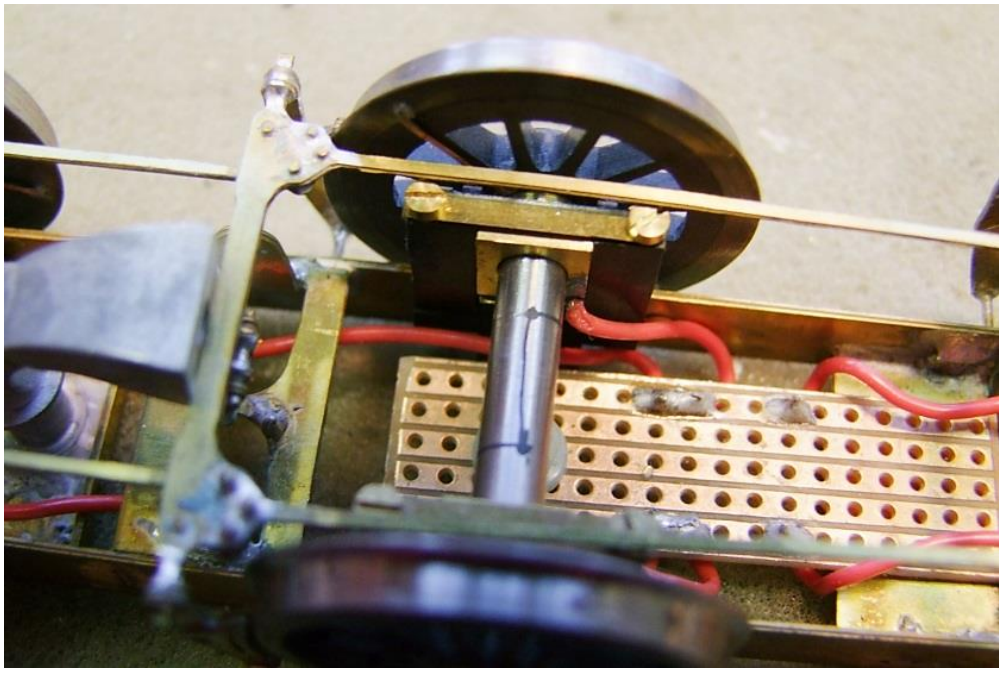
The method of pick-up with least friction is split axle running in an insulated horn guide. It is particularly suited to fit on tenders.

I have found the easiest method is that of progressively dividing the axle and filling the gap with epoxy resin. No special tooling or lathe is required. An article in the Gazette Vol. 16 No.7 describes this. Looking at the Archive no one describes what to do with the wheels though! Assuming Slater's then a shorting wire between the tyre and centre is required.

I use 0.5mm dia. copper wire from telephone cable for this. If you wish you can flatten it to reduce its profile by passing it through a set of rollers.

At each end of a spoke drill a 0.5mm hole in the tyre and in the brass insert. Ensure the wire is not in the way of the axle end and prevents it from seating. Solder the wire in place with cored solder for electrical work. I you are unhappy about this tin the wire with this solder then solder it into the wheel with low melt solder. You may feel that it is worthwhile to recess the back of the spoke to accept the wire.

The picture below shows the wire on the back of the wheel and the resin filled split in the axle.



A wire is soldered to the bearing and, in the example shown, taken to piece of Veroboard from which two wires go forward to the motor.

The bearings in this assembly have been reamed to 4.8 mm dia. as the loco. This clearance and lubricating oil has no discernible effect on the electrical continuity.

Motors and gearboxes.

The use of off- the- shelf motors combined with a gearbox has little effect on the established free running of a loco. It is just a matter of installing them.

A motor/gearbox that is built up from etched components needs to assembled with care and set up to run well before fitting to a loco. This is described in the Gazette Vol. 17 No.7. With satisfactorily assembly this can be installed without undue effect on the free running.

Flywheels With today's mechanisms and control systems I think using a flywheel is a moot point. Modern motors are multi pole and are free from the slow running cogging that the old three and five pole open frame motors had. A flywheel helped smooth the rotation. There is the argument it helps a loco cross an area of poor contact with the track. I would say look to the track and correct that. Ensure it is properly level and in common with DCC practice, every rail is connected by wires. Do not rely on fishplates to conduct the current from one rail to another. Even so there is the DCC feature of "stay alive" running that combats dead sections or poor pick up.

The best flywheels are fitted to shaft with adhesive not grubscrew. A grubscrew can force the flywheel eccentric and ruin any chance of true running. Similarly a flywheel where the mass is concentrated at the periphery is better than a solid one.

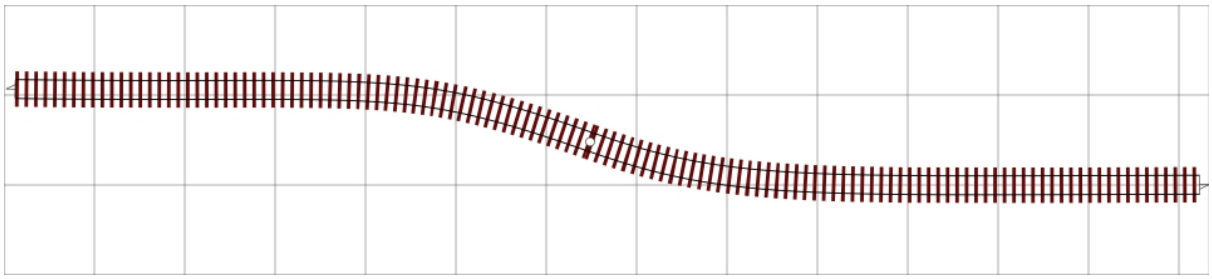
If a flywheel is to be fitted then it is wise to ensure it is balanced. An out of balance flywheel does nothing for smooth running and will eventually wreck the motor bearings. To balance or check the balance temporarily fit the flywheel to a temporary shaft e.g. a piece of silver steel. Allow the shaft to extend beyond the flywheel. Ideally pair of engineering parallels or equivalent set side by side to provide "rails" to run the flywheel up and down are required. A lathe bed may do. Set the shaft on the "rails" and roll along. If there is a heavy side it will come to rest at the "bottom"; do this several times to confirm. Once confirmed mark the "bottom" and then drill into the flywheel at that

position; a 3mm drill is good. A little at a time checking by rolling until there is no longer a “bottom” and the stop position is random confirms it is ready to be fitted.

TEST TRACKS.

A yard of track is good enough for checking the general freedom of movement in a chassis. However its ability to negotiate curves and track imperfections needs to be checked

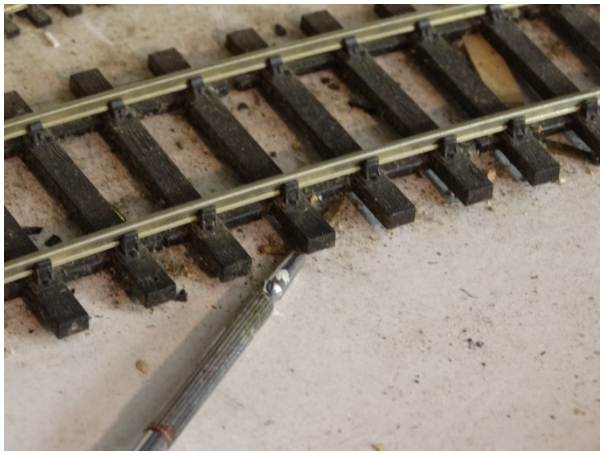
The simplest is a six foot length arranged in a flat “s” and provides the necessary functions. Set the curves to your minimum known radius. Only fix the track in the straight portions, leave the curves free.



Here is my version;

It usually becomes a shelf in the workshop but has been specially cleared for the photo. In addition to its basic shape the track can be pushed to tighten the curve beyond the nominal radius, in this case 4 feet*; and to check the flexibility of a chassis the rails can be lifted; illustrated here by wedging a screw driver under the track. Both inside and outside of the curves can be lifted.

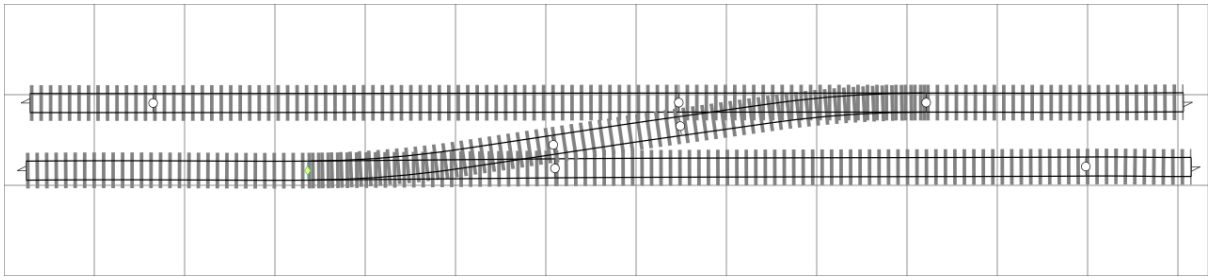
* I set this radius when I was commission building locos. I never believed the customer - “my track has minimum radius of 5 feet 6 inches “. I made the curve tighter so I was certain the loco I was building would go around his track!



Illustrated are gross distortions of the track but if a loco can negotiate this then it should be able go anywhere.

The loco should be turned of course so that the check is balanced.

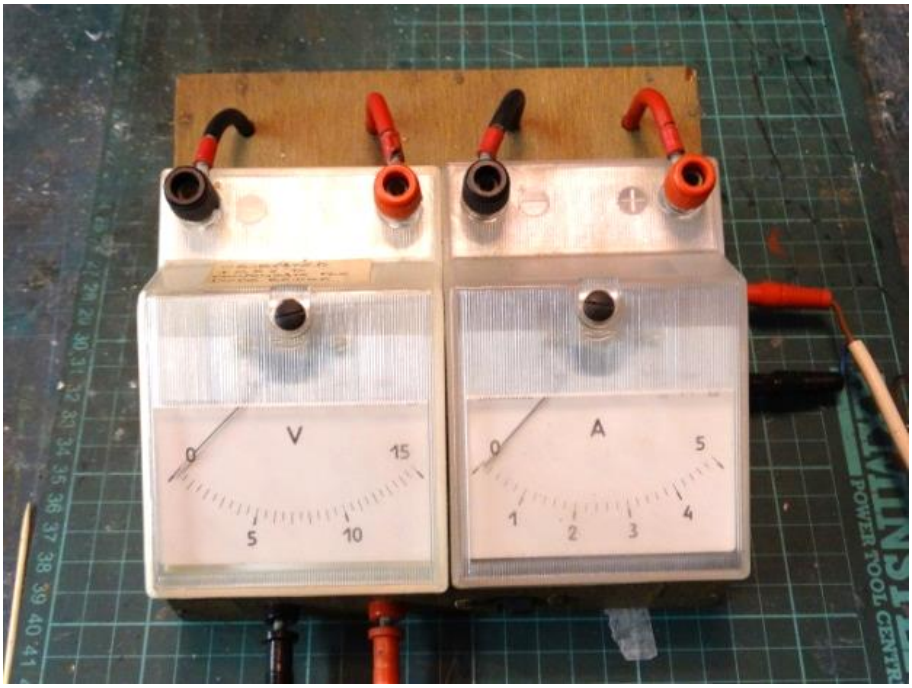
There is a thought that a similar track should incorporate a cross-over to check how a loco will cope with point work.



The points here should match those on the layout; Peco or hand made. The latter should match the standard on the layout otherwise the check will not be valid. It could be a case of it works on the test track but not the layout. On this set up it is not so easy to introduce the “imperfections” of the simpler track.

I am not convinced that this is a really useful design.

One feature of any test track that is beneficial is the means to measure current and voltage.



These are the meters I use; both are analogue as they are better when testing than their digital equivalents. These are Bench Meters. They have a large scale that is easy to read. The particular benefit of analogue over digital is with the ammeter. An intermittent contact will cause the needle to jump or flick as the current varies momentarily. This is immediately visible and is therefore a diagnostic tool indicating a problem and its source. A digital meter does not give such an obvious response; there seems to be internal “damping” that does not show the flicker at all.

The ammeter can also show the stall current of the motor. With wheels turning at full voltage lean on the loco to brake the wheels to the point at which they stop turning. Read the current at point. It sounds brutal but it is very short term and should not damage the motor. A sustained stop at full voltage will.

The final and probably the most popular “test track” is generally that of a large circle or oval of plain track where locos can be run round and round. I think this has little benefit as a true “test” track only as a means of running-in a loco, if it needs it, and as means of displaying it to others. A loco should have been proved by other means long before reaching such a track.

This track is the Exeter Group’s. Like many it is not permanently erected as the group meets in a village hall. It is stored and can be quickly erected for the members to run and show off their locos. It also has narrow gauge tracks reflecting other interests in the group.

Most locos arrive on the track in a completed state and have generally gone through a regime of test and trial similar to that I have described here.

Sources of 4.8 mm Hand reamers. I only found these when I searched the web. I purchased mine from Toolex as they are local. Note they are not cheap.

http://www.chronos.ltd.uk/acatalog/HSS_STANDARD_HAND_REAMERS.html

http://www.toolex.co.uk/

The electrical meters are available from Squires Model & Tools – Electrical catalogue

Simple track plans drawn on AnyRail https://www.anyrail.com/index_en.html