**Compensated underframe and floor for Adrian Johnstone’s RCH Wagon body**

These are the construction notes for my compensated chassis for Adrian’s excellent RCH mineral wagon. This only fits the 1:32 scale version, although it might be possible to enlarge it for 10mm scale, there may be problems, e.g. with the holes for the ball bearings being too large.

A picture containing handcart, transport, table, sitting

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*The completed wagon*

I did try and modify Adrian’s original floor and underframe, but as usual the imported mesh was too clunky to work with and it seemed easier to start again, especially as my underframe unlike Adrian’s does not attempt to match the prototype in the parts not visible when running. Therefore the body (side and stanchions) is the only part of Adrian’s model which I have used. I have modelled the floor of a wagon with bottom doors.

There are some bought in components. I have designed this to take commercial 8mm outside diameter ball bearings (3mm shaft diameter and 4mm depth). These can be bought very cheaply on Ebay or Amazon – quality is not amazing but it is hardly a demanding role. Axles are 3mm stainless rod about 65mm long, and 2mm stainless rod is used for the brake shafts, two pieces roughly 15mm long. Nice straight stainless rod is sold in packs of short lengths primarily for RC aircraft and car modellers. The 2mm rod I bought is extremely hard – too hard to saw but it can be held in a vice and snapped to length. A couple of items are secured using very small screws, something like 1.6mm diameter for the axleboxes and 1mm diameter for the brake racks. They just have to be a size where the threads can grip the printed hole, and otherwise rely on friction. Sets of 600 stainless metric screws from 1 to 1.6mm in a circular tray (see picture) are extremely cheap on Ebay. The other brake components and door springs are either simple push fits into printed holes, or components such as the buffer stocks and coupling plates are superglued in place.

A picture containing sitting, table, front, bicycle

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*Set of 600 metric stainless machine screws and nuts from Ebay*

Other bought in components are 3 link couplings from Walsall Model Industries, and Peter Korzilius’ very nice steel buffer heads with springs.

A mineral wagon seems a very simple thing but it is amazing how many parts there are once all the brake gear is taken into account. I have taken a photo of all the parts laid out, including the bought in components.

A close up of a device

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*All the parts…*

**The underframe**

Like Adrian’s, the underframe should be printed upside down, with the planking against the bed. This is a good way of finding any flaws in your printer bed! Not a problem if you have a glass or steel bed but on the Prusa Mk2 it seems to be built of similar material to printed circuit boards, and mine has a couple of dents… It is also important to make sure that the first layer is not squished too hard against the bed or the planking grooves will be filled. I have produced a little 15mm square test piece with planking to allow this to be tested in a few minutes, rather than waiting for the whole underframe to be printed only to find that the planks have vanished in whole or in parts. The test piece can also be printed in various positions across the bed to make sure all is level.

A picture containing accessory, building

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*The underframe from above as printed. Note flaw next to one of the bottom doors, caused by some waste plastic on the bed.*

*A picture containing building, bench, sitting, open

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*Underframe from beneath. The five slots in a row are to take the brake gear and door spring.*

**Buffers and couplings**

It is easiest to fit the buffers and couplings before fitting the wheelsets. Being spring loaded It can be slightly awkward getting tweezers in to fit the nuts to the buffer shafts or split pins to the couplings with the wheels and W iron units in place.

The underframe has square sockets to take buffer stocks and coupling plates. This was done to allow them to be printed vertically and easily fitted while making sure they are not crooked. It also allows for different models of buffer stock or coupling plate in case these exist.

The buffer stocks are somewhat difficult to print being complex shapes and very small. See the cruel enlargement or one of them as printed below. I find they need quite a bit of cleaning up on my printer. I am sure an SLA resin printer would do a much better job. I find them best printed vertically sitting on the square plug, with base supports. The holes to take the buffer shaft then need to be opened out, with a 1.7mm drill for the thin rod and 2.6mm drill for the thicker shaft near the head. I find it best to use a hand brace – it is easy to melt the plastic, and much too easy to take the 2.6mm drill too far and have to print the buffer stock again. Make sure that the 1.7mm drill passes through easily, then use the 2.6 drill to open out to a depth where the buffer head gets to the bottom of its travel, but there is still enough material to retain the spring. They are easy to hold in a vice by the square plug base. The 2.6 mm drill leaves the walls of the stock very thin, but so far all seems to hold together. Will see how these do in service.

A picture containing knife

Description automatically generated

The coupling plates are fitted in a similar way to the buffer stocks. The slots are the correct size for the Walsall 3 link couplings. It can be a fiddle to get the spring, washer, and split pin into position in the relatively small recess under the underframe but it can be done.

**W Irons**

Compensation is achieved by holding the wheel sets in one fixed and one pivoted W iron unit. These are held in the underframe by some printed pins, two for the fixed W iron and one for the pivoted one. The fixed W iron can be printed upside down without supports, the pivoted one will need supports. I print it on its side so only the overhanging W iron part needs supports and the pivoting base is printed cleanly. The pin has a flat side so it can be printed without supports.

A picture containing outdoor, beach

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A close up

Description automatically generated

Once printed the holes for the bearings may need cleaning up – I use an 8mm reamer. It is important not to open this out too far as the bearing has to be a push fit into the hole.

A close up of a device

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I have included a 3 hole disc wheel to G1MRA standard profile. A 20mm half axle spacer is also included – this is following Peter Jackman’s design for the 16 ton mineral – much easier than printing a 40mm long tube. I am including a 40mm back to back gauge. I find it difficult to get the wheels to run totally true which was one reason to produce the gauge. Note that the half axles have a slightly coned shape, with a parallel section 6mm in diameter which fits at the wheel end. So make sure the slightly wider ends are together in the middle of the axle. All are threaded onto the 3mm stainless rods and superglued, with the 3mm rod protruding an equal amount at each end.

A picture containing sport, road, sitting, riding

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A picture containing light

Description automatically generatedOnce the glue has set the wheelset can be fitted into a W iron unit, without the ball bearings. There is a slot down the back of the W iron to allow the 3mm axle to get down into the bearing recess. The ball bearings can then be pressed in from the outside. They are quite a slack fit on the 3mm rod, which makes fitting them quite easy.

A picture containing sitting, table, cat, wooden

Description automatically generated A picture containing sitting, table

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**Fitting the W irons**

The W irons are retained using printed pins. These can be printed flat on the bed without supports because they have a flat on one side The pins have some flexibility which allows them to be worked into position using small pliars. They can be slightly loose so may need some help (eg low strength retainer or even blu-tack) to stay in position in the long run.

Fixed W iron held in place by two printed pins


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**Axleboxes and dummy springs.**

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*The four axleboxes as printed*

I find these need to be printed on their backs, with base supports. They are designed to be screwed into holes printed in the base of the underframe. The blocks at the ends of the springs to take the screws are rather unsightly – I may redesign this at some point. Screws are about 1.6mm diameter x – they cut their own thread into the plastic hole.

A picture containing sitting, camera, cat, laying

Description automatically generated

*Fitting the first axlebox.*

**Brake gear**

The prototype had independent brake gear on each side because of the bottom doors. Each side has five parts, the brake gear itself, inner and outer vee hangers, the brake lever, and the rack for the brake lever. The brake gear can be printed on its back but needs base supports for the supporting plugs. The vees don’t need supports - there are bolt heads on the outer vee so that needs to have these on the upper surface when printing. The levers need lots of support because of their complex shape. I print these with the eyes on the bed and there is more support material than lever. Unfortunately they are difficult to print cleanly, a .5mm layer hight would help. The brake lever racks can be printed without supports, on their sides.

A picture containing arrow

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*All the brake parts, top are the two brake levers, on left the two sets of brake gear, in the centre the lever racks, and on the right the inner (with plugs to fit underframe slots) and outer vee hangers, with the two lengths of 2mm stainless rod.*

The brake gear and inside vee hanger plug into sockets along the inside of the solebar. I am hoping friction is enough to hold them in place. A 15mm length of 2mm stainless rod represents the brake shaft and is threaded through the brake gear and inner and outer vees. The outer vee may stay in place without securing because they are pressed up against the bottom of the side, but otherwise may need gluing in place. Finally the brake lever fits on the end of the rod. The holes to take the 2mm shaft may need a bit of cleaning out but should not be made too slack a fit. Best to try with a 1.9mm drill bit (held in the hand)

The brake lever rack is held on using a very small (1 or 1.2mm dia) screw, the hole in the rack may need cleaning out with a very fine drill. This is the only fastening for the rack so not particularly secure, I don’t know yet whether this will be enough.

**Side door spring**

On the prototype this was bolted onto the outside of the solebar, the printed part has a (hopefully hidden) plug to go into the central slot between the arms of the inner vee. It can be printed on its side without supports. It needs to be worked into position then pressed into the socket using a screwdriver or similar – this area will now be quite crowded.

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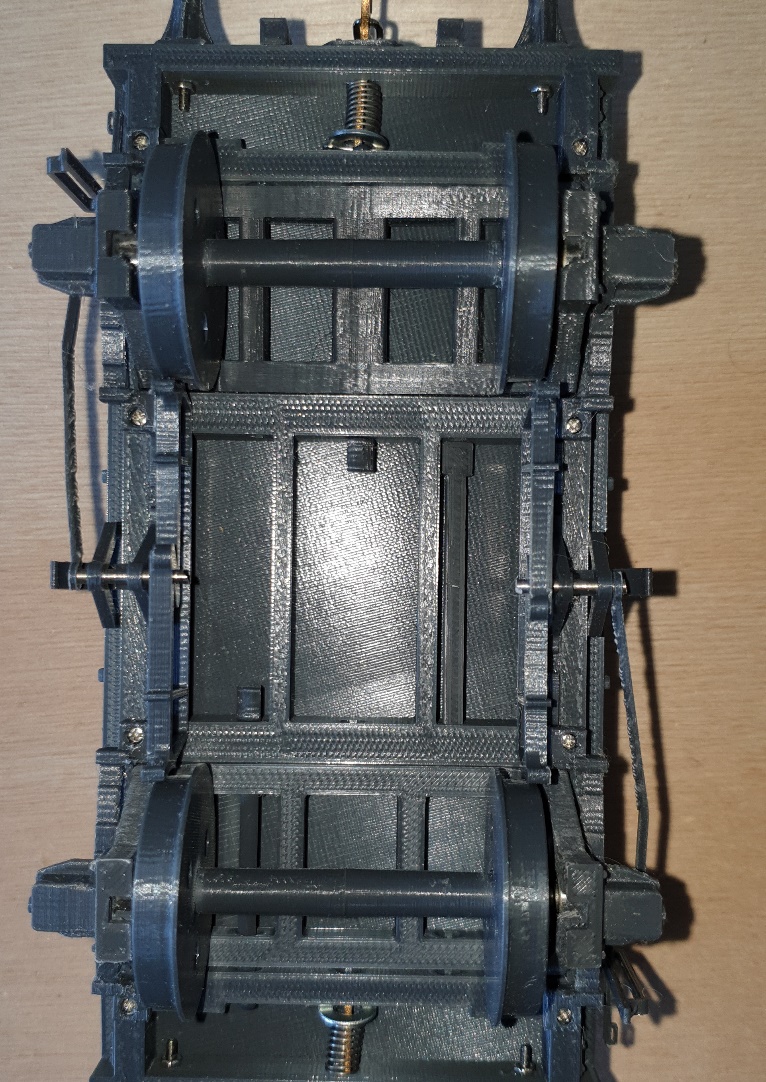
*The two door springs*

**The completed underframe**

**A picture containing sitting, water, standing, snow

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*The completed wagon with the body fitted.*



*View of the completed wagon from beneath. Note that one of the pins for the fixed W iron has come adrift. Some sort of low strength retainer would be appropriate, or possibly a bit of wire to help wedge it in position.*