

# St Albans & District Model Engineering Society

## Dynamometer Project

### Fish Scales trial

10<sup>th</sup> July 2019, 18:00 at Puffing Park

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**Introduction** In order to understand the scale and nature of the forces generated at the drawbar it was decided to do a simple trial using a £6.50 set of fish scales from the Internet. The idea was to couple up a load to a loco using the fish scales and then observe the force on the coupling in terms of the Kg of weight displayed on the screen of the device. We were particularly keen to understand the range of forces as well as whether there were peaks generated by coupling snatch for example.

When we come to use a strain gauge in the dynamometer car we will be dealing in Newtons, a unit of force. A mass of 1Kg on planet earth generates gravitational force of 9.8N.

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**How the Fish scales were rigged up for the trial**

The strain gauge within the fish scales was located at the hook end (where the fish would be suspended) and secured by being embedded in the plastic body. The handle to suspend the gauge and fish combination was embedded in the plastic at the other end. In between was the electronics including the buttons and display.



The hook end and the handle end each had a 6mm hole drilled to make it compatible with the standard club couplings. As it would mean the coupling was effectively a piece of cheap plastic to be on the safe side a

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bicycle brake cable was looped around the two couplings to secure load to loco if the plastic body of the fish scales gave way.

For simplicity we connected the device between the rear of the driving truck and the extra load, which was a passenger on a club passenger truck observing the gauge display. In an efficiency trial we would instead install the device between the loco drawbar or the rear of the loco's tender if it has one and the load.

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The results      We ran the trial twice

1/ Initially I went around on the truck alone on the passenger truck and the force peaked at about 2.7Kg when starting (not sure whether Roger was accelerating as hard as he could or not) and hovered around 1.0Kg - 1.2Kg until we went up the gradient on the final straight when the force was around 1.9Kg - 2.3Kg. I estimate the mass of the load was about 140Kg

2/ For the second trial we increased the load to about 240Kg by adding another passenger. The loco had to work hard to get the load going and ran out of steam just before the incline up through the wooded section. I measured the load peaking at 3.8Kg during the acceleration out of the station and then it hovered between roughly 2.0Kg and 2.6Kg until steam was lost. No evidence of a snatching load was seen as Roger started out from the station very smoothly and I had made sure there was no slack before starting. On the first attempt Princess Marina slipped so we could make a rough assumption that she was at the limit of adhesion when she did get the load moving. We were operating at the upper limits of Princess Marina's capability on our track.

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Extrapolating the Results      From this data it is hard to confidently extrapolate to get an estimate of the force the East African would generate but let us assume the East African could pull six trucks each weighing 240Kg then to achieve the same acceleration we would see a force of  $6 \times 3.8\text{Kg} = 22.8\text{Kg} (=223.4 \text{ N})$

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Conclusion      The forces generated at the drawbar by the locos likely to be used by the club in efficiency trials are easily catered for by low cost commercially available strain gauges found in low cost commercially available scales.

Regarding coupling snatch, the scales didn't register any, though as there appeared to be a small lag between the force being exerted and the display responding it is likely that if a snatch actually occurred it would be effectively discarded by the scales software. From the passenger's perspective no snatching was observed. The use of rigid bar couplings makes the likelihood of snatch a lot less than if chain type couplings were used.

No attempt was made in this trial to establish the accuracy of the fish scales, though the reading given was four significant digits.

