NOTES ON TRAMWAY RAIL AND TYRE WEAR:

The wear of wheel tyres is influenced by the condition of tramway rail, and to a lesser extent the wear of tramway rail is influenced by the condition of wheel tyres.

The grooved tram rail laid in the Bendigo and Ballarat tram tracks originally had inclined tread surfaces. After a period in service these surfaces became convex with the exception of some locations such as curves, where the pattern of wear varies because of side thrust and other factors.

A new parallel tread wheel tyre, running on rails predominantly with convex surfaces, soon wears concave. With the side movement of a tram, mainly due to slight irregularities in track levels, the movement of the wheel tread across the rail tread surface, (within the limits of the gauge tolerance) reduces the contact between the convex and concave surfaces. This concentrates extreme pressure on a much reduced area, thereby causing a swaging or flow of metal on both the rail and the tyre. Any extrusion on the gauge line of the rails is usually shorn off by wheel flanges, thus wearing the tread side of the wheel flanges, (reducing wheel gauge) and wearing the gauge line of the rail (increasing rail gauge). The gauge difference is thereby increased allowing greater side movement, and produces more irregular wear.

Once the gauge difference becomes great enough for the wheel flanges to contact the groove side of the check, a true shearing action takes place and the rate of flange wear is greatly increased. This action is unavoidable on curves in the track, and for this reason a special heavy check rail is usually employed.

It is because of this excessive wear on the rail checks and subsequent widening of the rail grooves that the width of new and re-machined flanges of wheel tyres in Ballarat have been increased by 1/16" since 1958.

In addition to this, the minimum size of worn flanges has been increased, from 5/16" X 5/16" to $\frac{3}{8}$" X $\frac{3}{8}$" in

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the interests of safety and to minimise the effects of the badly worn rails.

In some parts of both the Ballarat and Bendigo tracks, wear into the side of the checks of rails is so great that a shelf or false bottom in the groove has been formed. A new or full height flange can run on these portions thus transferring a great portion of the load on the wheel, from the ball to the check of the rail, which is not designed for such loads even when new and full size.

The tyre profiles used in Ballarat are M. & M.T.B. standard with the exception that flange width has been increased to 13/16". Flange height remains the same at 9/16".

As the ball of a rail wears down, the tyre flange approaches the bottom of the rail groove. When the depth of the groove is reduced to 9/16" a new flange will contact the bottom of the groove, and may for a short period prevent the tread of the tyre from contacting the tread of the rail.

As a point on the flange of a tyre contacts the rail every revolution, whereas a point in the groove of a rail is only contacted once by the tyre flange each trip by the tram, the rate of flange wear is infinitely greater than that of the rail groove. Coupled with this, is the fact that the greater part of peripheral flange wear takes place as trams pass over special work, which is 'ramped' in the grooves so that flanges will take the weight, reduce friction, avoid the bumps over the mating grooves, and guide the tram through.

Therefore, as a tram rail wears to the stage where flange clearance in the groove is reduced to nothing, it is only a new full size flange that can produce what is commonly termed 'flange running', and then only for as long as it takes the flange to wear sufficiently for the tyre tread to be once again borne by the ball of the rail. Once this stage is reached, both rail tread and groove wear at different rates, depending upon the state of tyre flanges in the entire fleet over a period,

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and the rate of flange wear due to other factors. As mentioned earlier, the rate of flange wear is infinitely greater than that of the rail, so that even though rail tread wear may reduce groove depth below new flange height, 'flange running' does not occur for very long.

Although there are some misconceived ideas about 'flange running' in the Bendigo and Ballarat tracks, the fact remains that the majority of rail has very little groove clearance on new flanges (and in a few places, none), which means that the rail has outlived its intended life, and reduced its safety factor beyond a reasonable limit.