# The Use of Mathematics in Train Wheelset Management

During my Year in Industry I have been working at a Rolling Stock Leasing company called Eversholt Rail Group. Whilst at Eversholt I have completed some work involving the development of a wheelset management programme. In this process it is important to be able to plan future wheel use and when they need to be overhauled. This helps to prevent any problems for the Train Operator, and therefore the paying public. A basic understanding of algebra is needed to be able to work out two crucial pieces of information; wheel size after certain mileages, and future overhaul dates.

## Wheel Size:

To work out a wheel size after a certain mileage we have to know several figures;

- The mileage of the train
- The wear rate of the wheels
- The start size and the scrap size
- The average amount turned (cut off) during maintenance and how regularly it is turned.

With these we can work out the wheel size:

*Size = Start Size - Basic Wear – Amount turned during maintenance*

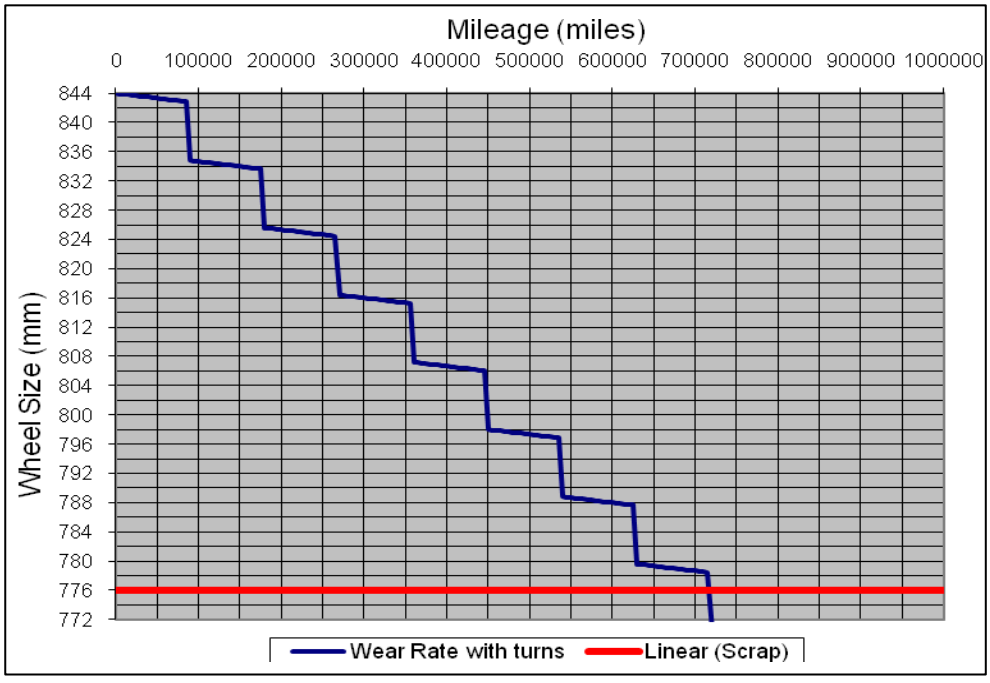
Unfortunately, the calculation is not as simple as the above formula would suggest;

*Size = Start Size – (Mileage ÷ Wear Rate) – ((Mileage ÷ Average turn rate) × Average amount turned)*

This number is rounded down to the nearest integer, as it is a count of how many times the vehicle has had wheel turning.

From this we are able to come up with a predicted wheel size after given mileages:

For example – If a train has wheels with a starting size of 844mm, a scrap size of 776mm, a basic wear rate of 75,000 miles per mm and an average of 8mm turned off every 90,000 miles, we can produce a graph to show what size the wheel will be throughout its life. The graph shows the different predicted wheel size for each mileage. It also shows the potential total mileage of the wheel. In this case you can see that the wheel life is around 715,000 miles.




For one specific example we can use the calculation shown above.

For example – what is the potential wheel size after 450,000 miles?

*Size = 844mm – (450,000 miles ÷ 75,000 miles/mm) – ((450,000 miles ÷ 90,000 miles) × 8mm)*
*= 844mm – 6mm – (5× 8mm) =* <u>*798mm*</u>

## Overhaul Dates

To work out the date on which a wheel will reach its scrap size, and have to be replaced, we have to know several pieces of information;

- The daily mileage of the train
- A recently measured wheel size and the date on which it was taken
- The scrap size
- The wear rate of the wheel (different to the one given above, as it is a linear rate over the whole life including the turning completed)

With these we are able to work out the wheel's overhaul date:

*Predicted Scrap Date = Date wheel size taken + Days left till wheel reaches scrap size*

However, again, this is a simplified version of what has to be calculated:

*Predicted Scrap Date = Date wheel size taken + (((Wheel size on given date – Scrap size) × Wear Rate) ÷ Mileage per day)*

For example – suppose a train has a wheel measured to be 840mm on the 1/1/2010, its scrap size is 776mm, it has a daily mileage of 235 miles and a wear rate of 15,000 miles per mm; when will it require a new wheel?

*Predicted Scrap Date = 1/1/2010 + (((840mm – 776mm) ×15,000 miles per mm) ÷ 235 miles per day)*
*= 1/1/2010 + 4085 days*
*= 9/3/2021*

Using these data, I am able to create shopping plans for wheels, across fleets of trains, as I am able to predict when the wheels will potentially need replacing. Below is an example to show the potential shopping plan for around 100 trains.