Physics Lecture 22 -Data on Standard Wheel Roundness

Introduction

In **Lecture 12** we gave details of bore hole measurements on the Standard 1999 wheel, shown in **Figure 1**. In this lecture we will give more data dealing with wheel roundness, flatness, and more on bore size. The effect of wheel roundness and bumps such as mold marks on car performance is covered in some detail in the previous **Lecture 21.**

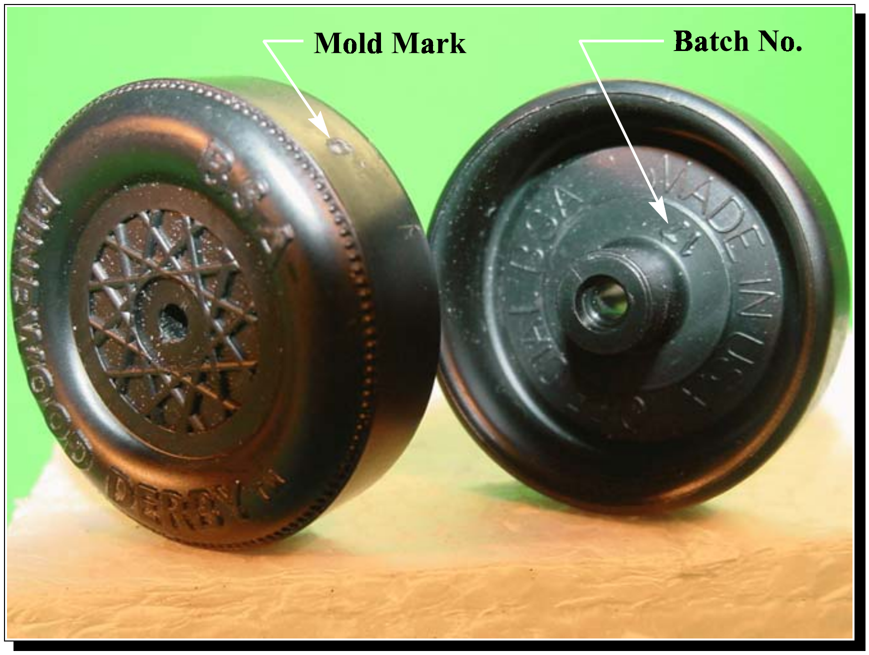

Figure 1 - *The Cub Scout wheel introduced in 1999.*

Roundness Measurements

The first thing to do is to find a drill bit shaft that is a snug fit into the bore. Selecting from a group of "miked" drill bits to make measurements of the bore hole itself are described in detail in **Lecture 12.** Usually the bore diameter is slightly larger on the outside compared to the inside. Once a good fit is obtained on the inside, the bit shaft is inserted through the bore and then it is chucked into a lathe as shown in **Figure 2.** The shaft should be well polished so the wheel can be rotated on the shaft by hand. This will give a truer measure of roundness compared with turning the whole chuck. Often times 3-jawed self centering chucks have only 0.002 to 0.003" accuracy, and this introduces too much error. There is a 4-jawed chuck that can be adjusted to a fraction of a mil axial accuracy if needed, but this process is tedious and it is much simpler to just carefully rotate the wheel by hand on a fixed shaft.

Roundness measurements are made on the tread just inside the inside edge of the wheel and just inside the outside edge of the tread as shown in **Figure 3.** Dial caliper interpolation can give a measurement to the nearest thousandths of an inch. For example, in **Figure 2** the dial indicator is reading 0.0086".

Figure 2 - *Measuring amount of off-center on the wheel.*

Table 1 shows the collection of measurements on 10 wheels which came from 2 separate boxes of 5 each as sold by the Scout shop. The batch number refers to the mold from which the wheel was made. If a box contained more than one of a certain batch number, then A and B, etc., were used as additional identifiers. More wheels will be examined later if time permits.

In **Figure 3** one can see the different areas of the wheel that were inspected and measured. An interesting area is the flatness of the tread, a departure from which can be noted for some wheels. If a straight edge is held as shown and a bright light is positioned behind the wheel, a sliver of light can be seen illuminating the space (if any) between the tread and the straight edge. The smallest concave “sag” in the tread that could be observed is estimated as 0.0001. According to **Lecture 6**, if the tread is not totally flat then there is less contact adhesion and rolling resistance between the tread and the track surface leading to faster race times for such wheels. This needs to be tested further.

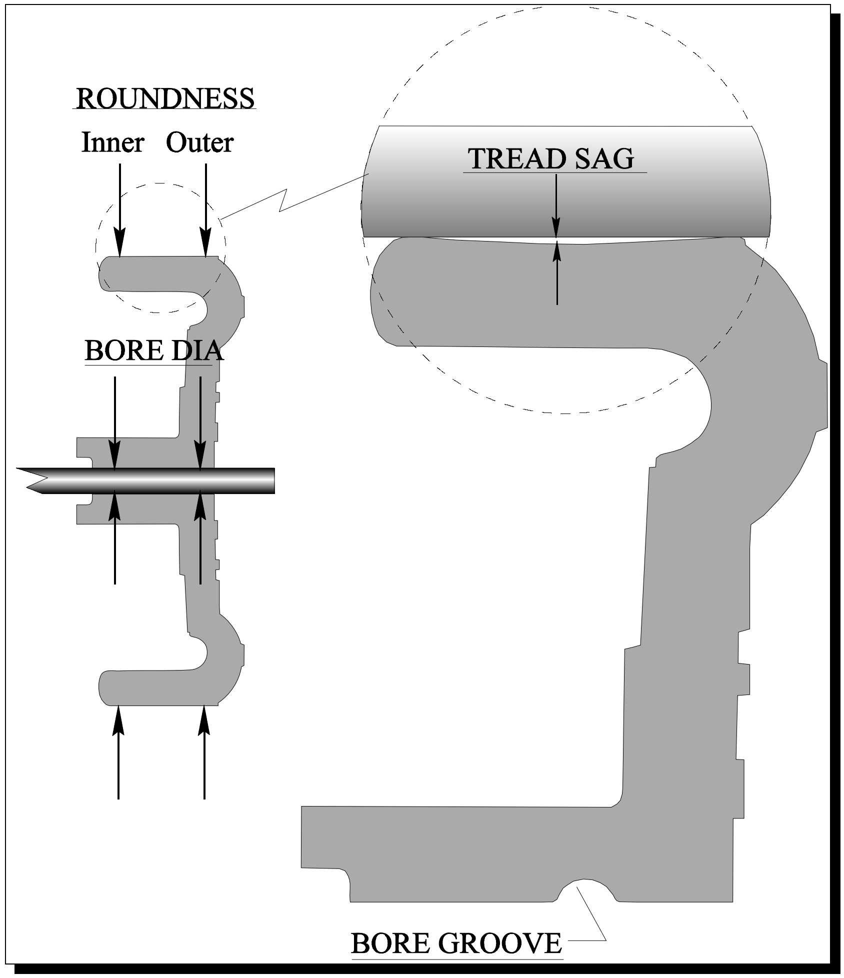

Figure 3 - *Areas of wheel measured.*

Regarding the bore groove, this appears sometimes as a result of molding details and does not seem to favor certain batches. Such grooves can hold solid particles, such as graphite, and this forces the wheel bore/axle surface to be a graphite crusher which unwisely uses energy.

For a judgement on how serious wheel roundness and mold marks are at the finish line, refer to the graphs in **Lecture 21.** There is shows that a 0.005" high mold mark like on wheel 1 B in **Table 1** could cost you ½ inch at the finish line on a 32 ft track.

Table 1 - *Wheel measurement data for 2 boxes of 5 ea (distances in inches).*

Batch	Bore Diameter		Wheel Roundness		Tread		Weight (g)	Bore Groove
	Inside	Outside	Inside	Outside	Sag	Mold Mark		
16	0.0982	0.0978	0.010	0.010	0.0002	0.002	3.661	No
1 A	0.0982	0.0978	0.013	0.015	0.0002	0.002	3.580	No
17	0.0968	0.0958	0.003	0.004	0.0001	0.003	3.560	No
13	0.0982	0.0976	0.009	0.010	0.0002	0.001	3.579	No
1 B	0.0982	0.0978	0.010	0.010	0.0002	0.005	3.658	No
18	0.0980	0.0978	0.008	0.006	0.0006	0.002	3.610	Yes
15	0.0971	0.0971	0.006	0.006	0.0002	0.002	3.661	Yes
5 A	0.0978	0.0978	0.008	0.008	0.0001	0.003	3.571	No
5 B	0.0980	0.0978	0.008	0.008	0.002	0.002	3.577	No
8	0.0980	0.0976	0.009	0.008	0.002	0.002	3.527	Yes