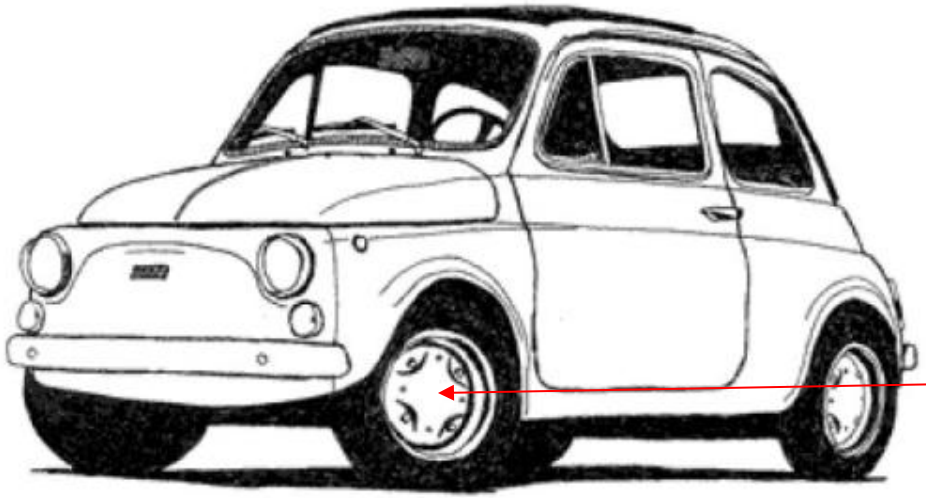
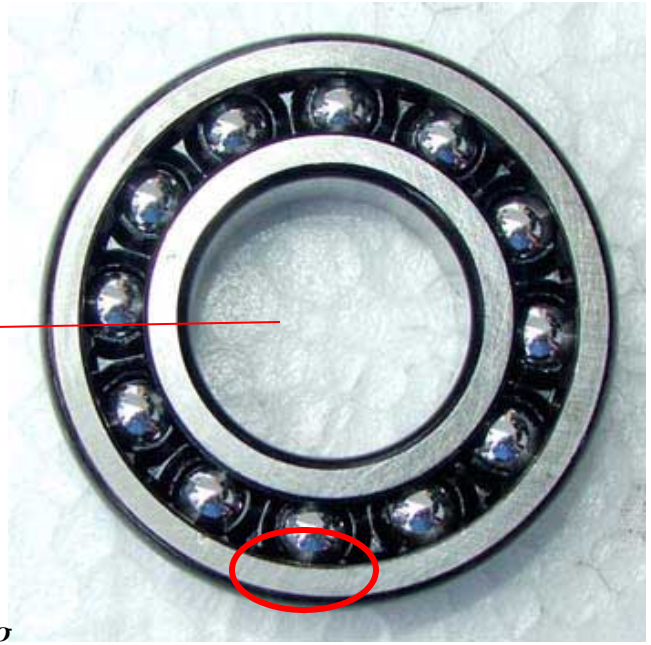
Contact pressure on an imaginary car ball bearing



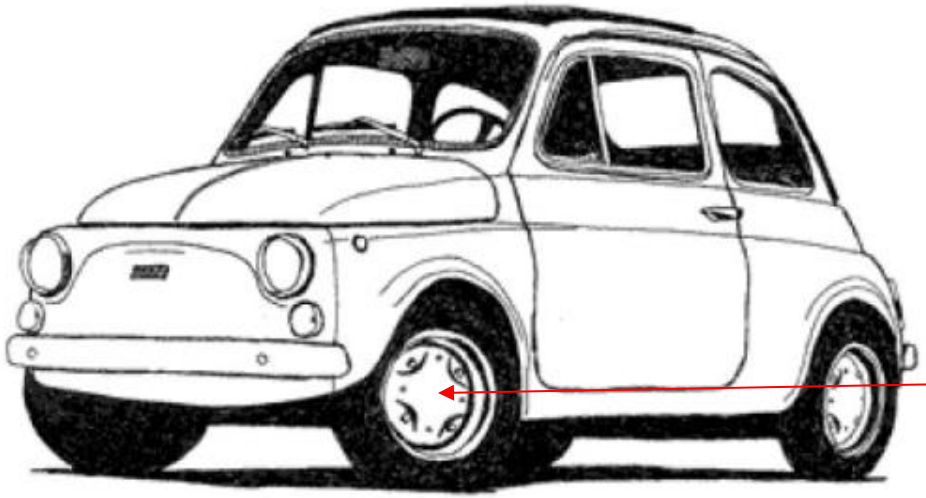


Data:

- *Car weight: 1.6 t*
- *Highest loaded ball carries ~1/2 of total load on bearing*
- *$R_{race} >> R_{ball}$ -> ball on flat configuration*
- *Materials: steel ($E = 210GPa$, $\nu = 0.3$), Ball radius 10 mm*

As tribology specialist, do you validate this bearing choice for this car application?

Contact pressure on an imaginary car ball bearing



Data:

- Car weight: 1.6 t

- Highest loaded ball carries ~1/2 of total load on bearing

- $R_{race} >> R_{ball}$ -> ball on flat configuration

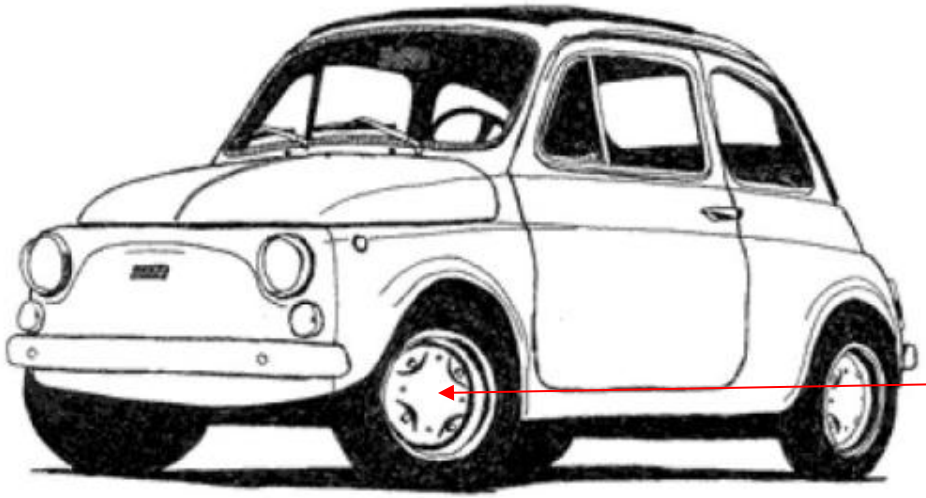
- Materials: steel ($E = 210GPa$, $\nu = 0.3$), Ball radius 10 mm

In engineering practice you are often requested (not necessarily explicitly) to assess the pertinence of certain technical choices.

In this case, as tribology engineer you are supposed to evaluate whether the proposed ball bearing can effectively operate.

The first step is to calculate the contact pressure to make sure that the bearing materials can withstand without risk of plastic (permanent) deformation.

Contact pressure on an imaginary car ball bearing



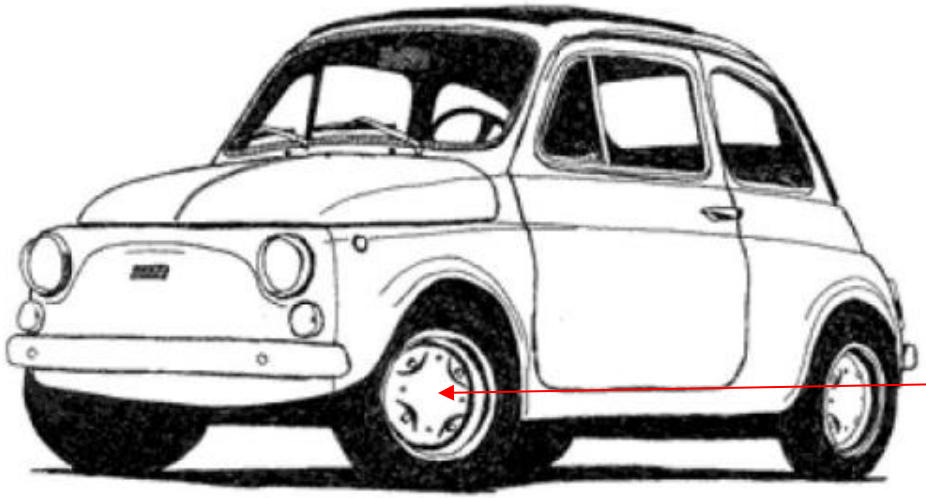
Data:

- *Car weight: 1.6 t*
- *Highest loaded ball carries ~1/2 of total load on bearing*
- *$R_{race} >> R_{ball}$ -> ball on flat configuration*
- *Materials: steel (E = 210GPa, ν = 0.3), Ball radius 10 mm*

By applying Hertz mechanics (ball on flat) one obtains:

Radius	*0.508*	*[mm]*
Pressure max	*3700*	*[MPa]*
Pressure av.	*2466*	*[MPa]*
Shear str. max	*1233*	*[MPa]*
at depth	*0.324*	*[mm]*

Contact pressure on an imaginary car ball bearing



Data:

- Car weight: 1.6 t

- Highest loaded ball carries ~1/2 of total load on bearing

- $R_{race} >> R_{ball}$ -> ball on flat configuration

- Materials: steel (E = 210GPa, ν = 0.3), Ball radius 10 mm

To avoid plastic deformation the average contact pressure P_m should satisfy: $P_m < 1.07\ YS$ where YS is the yield strength of the material.

Thus, in the present case, $YS > 2466\ MPa/1.07 = 2304\ MPa$

The best ball bearing steels have YS<2000 MPa, so the proposed design is not acceptable as it would imply plastic deformation of the balls and thus rapid failure of the bearing.

Indeed, roller bearing (cylinders instead of balls) are used in cars.