611-0120 (40-380) Rolling Friction Cars

Introduction:
What is rolling friction? Friction is the resistance to sliding, flowing, rolling, and other movements of an object. It occurs when an object travels through any medium. If one objects slides along another there is friction, if an object travels through water or air there is friction. There are no known materials that are frictionless.

Sliding an object along the ground produces large amounts of friction, which makes it difficult to move. Adding wheels to it drastically reduces friction, making the object easier to move. However, not all wheels are created equally. Some wheels provide more friction than others. Rubber on concrete is a very high friction environment, which is useful for cars because it allows cars to brake quickly. In contrast, trains, which use steel wheels on steel rails, have very low friction. However, it is very difficult for trains to brake.

In general, rolling friction is caused when the wheel, the surface, or both deform under the stress of rolling, causing imperfections. The less susceptible to deformation a material is, the less rolling friction it will have.

Our set utilizes 4 types of wheels: wooden, felt, soft rubber, and extra soft silicone. Each of the cars is the same mass to simplify calculations.

Operation:
There are several possible ways to measure the rolling friction of the different wheels.

The first method is to launch the cars along a level surface. Using a spring launcher or similar device, fire the cars and observe how far they travel. If you know how much force was imparted to the car by the spring, you can calculate the friction between the wheels and the surface. As a twist, you can use different surfaces and measure the change in the friction force.

A more precise method is to use an inclined plane. Since you can release each car at a known height, it is easy to calculate the velocity the car will achieve under ideal conditions. Using this value as a guide, drop each car and measure how long it takes to go down the ramp. From this information you can calculate the velocity of each car and compare it to the control value.

A third way is to place the car on a flat surface such as a table and attach a string to it. Pass this string over a low friction pulley on the end of the table. Attach a mass to the end of the string and watch as the car moves forward. Measure its velocity. Since you know the force in Newtons that the mass imparts to the car, you can compute the friction force. Compare this to the calculated value of a car with the same mass but frictionless wheels.

Before performing any of the above experiments, discuss the situation with your students. Have them estimate which material will produce the greatest and least friction. Do the experimental results support your student's expectations?

To calculate firction, use the following formula:

$$\mu = F / N$$

Where:

- μ is the friction coefficient
- F is the force required to produce sliding
- N is the normal force between the object and the surface.

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Not designed for children under 13 years of age.