HOW TO TUNE

What is tuning? Tuning is the process of optimizing your race car's performance by making modifications. Tuning can fall into one of the following categories:

- Minimizing weight
- Minimizing rolling resistance
- Minimizing aerodynamic drag

PITSCO EDUCATION

CONSIDER THE SPECS

The race competition rules usually include a set of specifications, or specs, which must be considered while tuning the car. Specs usually include a minimum car weight. This is a race-ready car with paint, wheels, axles, screw eyes installed. Other specs might be:

- Minimum/maximum car length
- Wheelbase or distance between axles (min/max)
- Body width at axles (min/max)
- Thickness of body material around cartridge hole (min)

While tuning, make sure you stay within the required specifications or your car might be disqualified on race day. If you have removed too much material from the car body and have gone below a minimum spec, there might be no going back.

CHECK OUT:
HIGH-IMPACT PLASTIC DIAL CALIPERS

CHECK OUT:
CJ300 DIGITAL SCALE

CHECK OUT:
METRIC DRAGSTER GO/NO GO GAUGE

MEASURING TOOLS

Complying with a set of specifications requires constant measurement of a car while it's under construction. You'll definitely need an accurate scale, and it's very helpful to have a set of calipers.

- **Calipers –** Calipers enable you to get precise measurements very quickly – that's why they are used by engineers, machinists, and other pros.
- **Digital Scale –** Car weight might be the most important factor in race car performance. While you'll want to minimize the car weight, don't overdo it and get your car disqualified for being underweight. That's why an accurate scale is critical. A variety of digital scales are available, and most measure in grams or ounces and can handle up to 600 grams (more than a pound).
- **Go/No Go Gauge –** This is a quick and convenient way to check your race cars for TSA specifications. Use this gauge for measuring minimum and maximum requirements for front and rear wheel widths and diameters, body length, width, height, and screw eye and axle positions. **Note:** The TSA specs change from time to time and so does the Go/No Go Gauge, so always order one of TSA's competitive-event guides online to ensure you are working with the current specifications.

MINIMIZING **DRAGSTER** WEIGHT

In almost all forms of racing, lighter means faster. The goal is to minimize weight without going under the minimum weight spec. If you haven't yet assembled your car, weigh the car body with the wheels, axles, and screw eyes.

If you've assembled your car and need to lighten it, consider removing material from the underside of the car body. What if you've gone too far and have gone under the minimum weight? In some cases, it's possible to add weight back to your car by adding extra coats of paint or using heavier wheels and axles.

LIGHT BUT STRONG

Another important consideration is car strength and durability. A champion CO_2 car must survive several races. Each race, the car will be subjected to considerable forces – 0 to 40 mph to 0 in 1 second. Blasting down the track and smacking into the barrier at the end can easily break a car – rendering it unable to continue. As you remove body material, make sure you're not weakening your car body to the point that it will not withstand the rigors of repeated races.

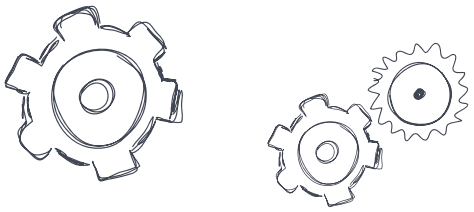
MINIMIZING **ROLLING** RESISTANCE

What is rolling resistance? It is simply the force that is resisting motion when the dragster rolls on the track. While there will always be some resistance due to friction, such as between the wheels and axles or the axles and car body, there are things that can increase resistance in a dragster. Test for spinning friction by rolling your car down a ramp and observing how far the vehicle travels. Though less scientific, another method is to spin the wheels while holding the car in an inverted position and note the time it takes for the wheels to come to a stop.

TIP: Details Matter: A well-built car can be slowed to a snail's pace by carelessly positioned screw eyes. Make sure they don't cause the guideline to bind on the car.

Experiment with different bearing materials or use a lubricant such as dry powder graphite to improve performance in this area. Make sure that your tires aren't deformed. The following issues are also potential sources of rolling resistance – test for each one:

- **Improper wheel alignment –** This happens when axle holes are not drilled straight. Stated more precisely, *straight* means the holes should be perpendicular to the car's longitudinal axis. Roll the car forward on a flat, smooth surface; it should go fairly straight. If the car veers drastically to the right or left, there's a good chance the wheels are misaligned.
- **Careless location of screw eyes –** If a screw eye is poorly placed, the guideline can drag on the body or wheels of the car as it moves down the track and cause a great deal of friction. Invert your car and thread an 18-inch length of monofilament (fishing) line through both screw eyes. Pull the line taut and move it back and forth. If the movement of the line is restricted, consider relocating one or both of the screw eyes.
- **Wheel imperfections –** Small imperfections from the molding process might be found on the rolling surface of a wheel. Examine your wheels and carefully remove any imperfections with fine-grit sandpaper. You can also use a wheel lathe to ensure the wheel is properly shaped.



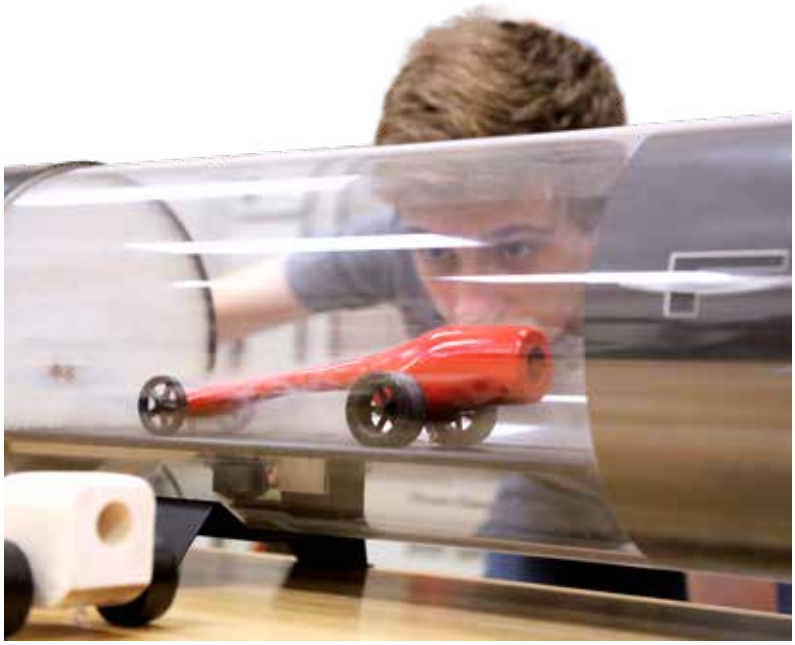
CHECK OUT:
AirTech X-Stream Wind Tunnel

MINIMIZING AERODYNAMIC DRAG

Minimizing aerodynamic drag is best done in one of two ways: computational fluid dynamics (CFD, if you use CAD to design the dragster) or a wind tunnel designed for testing scale models, such as Pitsco's AirTech X-Stream Wind Tunnel, which measures the frontal drag force on your car.

Inside the test chamber of the wind tunnel, the car is held stationary in an air stream. The force of the air pushing back on the car is measured, giving an indication of the car's aerodynamic efficiency. Lower frontal drag numbers (measured in grams) indicate a higher efficiency of the car's shape.

By slowing the airspeed and introducing a fog vapor into the air stream, you can visually observe the airflow around your car. Laminar flow, which is a smooth and layered-looking flow, is desirable. Turbulence in the airflow is indicated by eddies, or swirling currents of air, around the car body. Eddies are clearly visible in the wind tunnel.



The presence of eddies indicates that features of your car body are causing aerodynamic drag. Streamlining such features can improve the efficiency of the car's shape and help it cheat the wind as it moves down the track. The bottom line: more speed!

Eddies

CHECK OUT:
FLO Visualization Tunnel

CHOOSING A WIND TUNNEL

Many aerodynamics concepts such as drag, turbulence, lift, and laminar flow are difficult for students to grasp – wind tunnels give these concepts a visual representation.

Wind tunnels vary in ability, so when looking for one for the classroom, you need to decide whether you want a basic one with a fogger to show laminar flow or you want to be able to measure frontal drag. Also, consider the amount of room available to you, as some wind tunnels can be quite large.

CFD

For those who created their cars in a CAD program, there is the option to test the cars with computational fluid dynamics (CFD), which is a digital way to study the fluid flow around your car, much like a wind tunnel. It creates a computer simulation of how air will flow around the car.

Like CAD, there is an extra learning curve involved with using CFD as well as specialized software. If this is available, it is a good tool to use – many of the TSA Dragster Design winners in recent years have used CFD testing and analysis.

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