

## MECHANICAL TIPS FOR FIRST TEAMS

1. **Know your limitations.** Innovation and new ideas are great, but trying to do more than your team is able to handle doesn't help anyone. It is much better to do one thing really well than to do a lot of things badly.
2. **Keep track of weight.** Having an overweight robot is the number one problem of robots at their first competitions. To avoid this, assign someone the job to keep track of the weights of each part going on the robot. This person can also perform weight estimates during design as well.
3. **Think about maintenance during design.** Some parts will require more maintenance than others (like gearboxes, motors, etc). Make sure those parts are easily accessible and that you have spares.
4. **Keep the center of gravity low.** There is a lot of interaction between robots on the field. Many robots get tipped over. To avoid this, try to keep the CG as low as possible and distribute weight on your base accordingly.
5. **Prototype ideas.** Test ideas with simple prototypes with materials like card board, wood, etc. Helps to find problems early in the design phase and give visual people a better idea of what's going on.
6. **Create design drawings.** The best would be full 3D CAD models but at a minimum have hand drawn scaled drawings or 2D CAD. This helps avoid mistakes during manufacturing.
7. **Standardize hardware.** Have one or two types of nuts and bolts. Makes it much easier since only one or two tools are needed for building and repairs. At the very least, choose either metric or English.
8. **Make spares.** The easiest time to make spares is at usually at the same time as the original piece. Taking some time to do this will save you a lot of stress during competitions.
9. **Get a base and drive train done soon.** Not only is this a big moral booster, it gives drivers more practice and gives you more time to debug this most vital system of your robot.
10. **Don't forget about pneumatics.** Pneumatics are sometimes an easier solution than a motor for simple applications. Their advantage increases when they are used in several locations on robot (weight).
11. **Avoid set screws.** Robots have a lot of vibrations and they tend to shake the set screws loose. Use pins, welding, keyways, etc to attach parts to shafts.

12. **Too much traction can be bad.** With too much traction, your robot won't go anywhere or will be jumping all over the place when you're turning. This is another good reason to have the drive train up and running early, to test out your wheels.
13. **Be aware of robot systems when drilling or machining parts on the robot.** A square tube makes as good an electrical conduit as it does a support member. Your electrical team may have passed motor wiring through the tube you are drilling!
14. **Avoid cantilevered shafts.** This adds a lot of stress on the motor and the one connection point of the shaft. Avoid problems by supporting and having bearings on at least two points.
15. **Avoid stalling your motors.** Motors do draw "stall current" when you stop them. Avoid stalling motors or running them in near stall in your designs. The currents are extreme and the motors will run very hot.
16. **Use the right tool for the job.** Avoid using a leatherman tool to do everything or you will end up with problems such as stripped bolts and nuts. Using the wrong tool also adds risk of injury.