

2 - COTS Parts & Suppliers

Although we manufacture many parts ourselves, not everything on the robot can be produced this way. Many more robot parts, in fact, are purchased from suppliers and assembled alongside custom parts. In FRC lingo, these are called Commercial Off-the-Shelf (COTS) parts. The game manual every year defines exactly what a COTS part is, since there are rules about them, but for the sake of this document we'll consider them to be any non-custom parts which we purchase from a supplier.

2.1 - COTS Parts

The main advantage of using COTS parts is that we simply couldn't make everything we need. We can't cut gears, injection mold wheel hubs, or machine bearing blocks, so we purchase these kinds of parts from companies that can. Even if we did have the ability to make such parts, it is not always worthwhile to spend design and manufacturing time on things that we could purchase instead.

There is a great variety of COTS parts available, from motors to ball bearings to compliant wheels. It would be impossible to summarize them all here.



Figure 1: A 3-CIM Ball Shifter gearbox, used to power drivetrains (Image from VexPro.com)



Figure 2: Compliant wheels, flexible wheels often used in intakes (Image from AndyMark.com)



Figure 3: An HTD Timing Pulley, used to transmit power via belts (Image from VexPro.com)



Figure 4: A Colson wheel, a common wheel used in both drivetrains and mechanisms (Image from VexPro.com)

2.2 - Suppliers

Since the sheer number of stock options and COTS parts is so large, it is more useful to become familiar with the suppliers from which we buy them than with the parts themselves. Although there are likely hundreds of possible suppliers, we typically buy our

robot parts from just a few places: VexPro, AndyMark, McMaster-Carr, and OnlineMetals.com.

VexPro and AndyMark are both robotics-specific suppliers, with a wide variety of parts that exist just for FRC. They both offer FRC-legal motors, gearboxes, wheels, timing belts, and electronic components, to name a few. Since both companies know that FRC makes up a large portion of their business, their websites offer CAD models, weight specifications, and other information useful to FRC teams.

McMaster-Carr, on the other hand, is a common industry supplier, used by companies all across the country. They carry parts such as nuts and bolts, rivets, rod ends, and stock metal and plastics, as well as thousands more items that are beyond the scope of FRC. McMaster provides CAD models for most of their items, too.

Finally, OnlineMetals.com is where we buy most of our aluminum stock. They offer a wide variety of shapes and sizes.

2.3 - Importing COTS Part Models to Common Parts

Team 1732's parts library, simply called Common Parts, is a collection of CAD files of COTS and other commonly used parts that is found in the GrabCAD directory for each competition season project. Nearly all parts in it were downloaded from suppliers' websites as STEP files, a common CAD file exchange format, and converted into Inventor file formats. Although most of the parts you will need are already in Common Parts, it is important to understand how to properly import more part models to it.

To do this, we will use the example of downloading a wheel from VexPro.com. The first step is always to find the product page on the supplier's website. Somewhere on the page, often near the bottom, is a link to download the part as a STEP file. For this example, we will use a 4" x 1.5" Colson Wheel (part number 217-4051.)

After downloading the part and opening it in Inventor, a dialogue box appears with importing options. "Inventor Length Units" should be set to "inch," but the rest of the default settings should be kept.

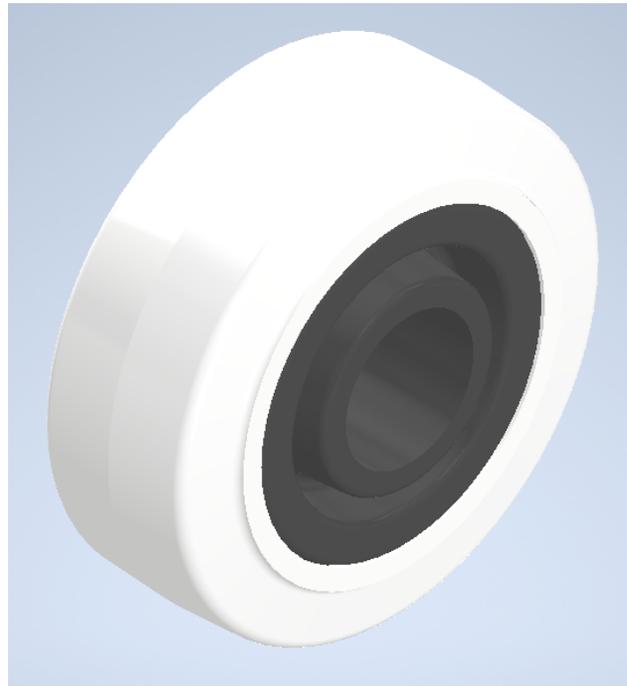
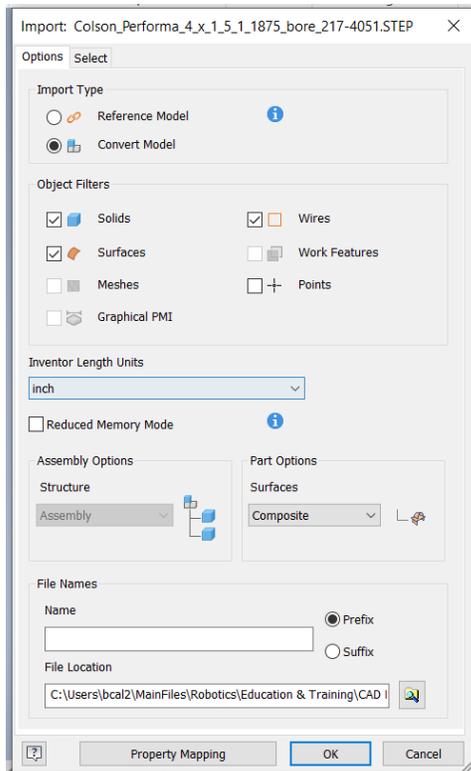


Figure 5: Import dialogue box that appears when a STEP file is opened

Figure 6: The wheel(as an assembly file) after it is opened

Occasionally, you might find that a STEP file imported into Inventor opens as an assembly file, but it is a part that we would normally use as an individual piece, so it would be better saved as a part file. This is the case in our example part. Additionally, it is often better to save parts such as these as part files, since it reduces the number of separate files in the Common Parts directory, and it reduces the computing power necessary when these files are used in Inventor. To convert an assembly to a part, we can use the Shrinkwrap tool.

In the Shrinkwrap dialogue box, under the "Create" tab, "Break link" should be selected. This separates the new part entirely from the original assembly, allowing you to only save one file. Finally, this tab also allows you to set a name for the part, under "Part Name."

The part name is especially important, since other team members need to know what the part is. It should be descriptive, but not unnecessarily long, and it should list information in order of increasing specificness. For the wheel in the example, this could be the type of wheel, Colson, followed by the diameter and width, 4" by 2", followed by the bore size, 1.1875", so a good part name might be "ColsonWheel_4x1.5_1.1875b."

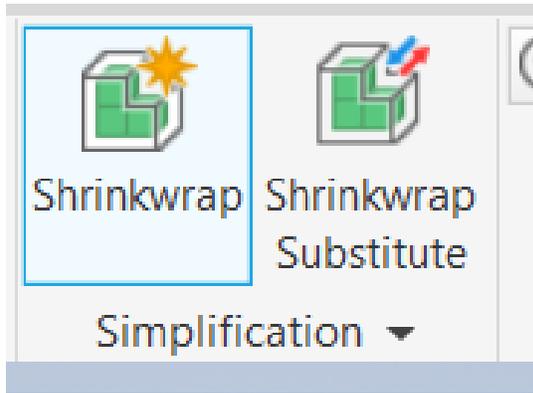


Figure 7: The Shrinkwrap tool on the Toolbar

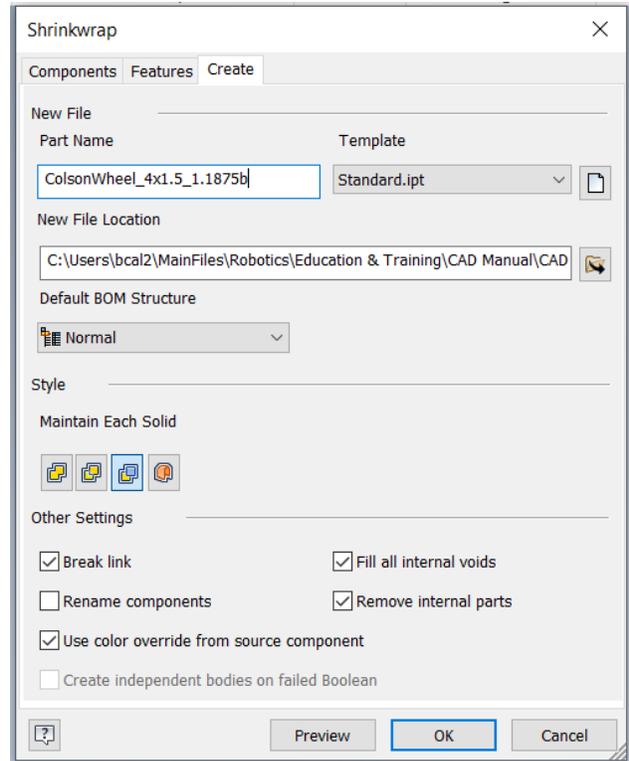


Figure 8: The Shrinkwrap tool dialogue box, with correct settings shown

Finally, appropriate properties, such as material, appearances, mass, and part numbers should be set. The material and appearances are important so that your designs look like what they actually will be, and the mass is important so that the weight of the robot can be tracked accurately throughout the design process. The part number is important for ordering the correct parts from suppliers, so the supplier's part number should be used.

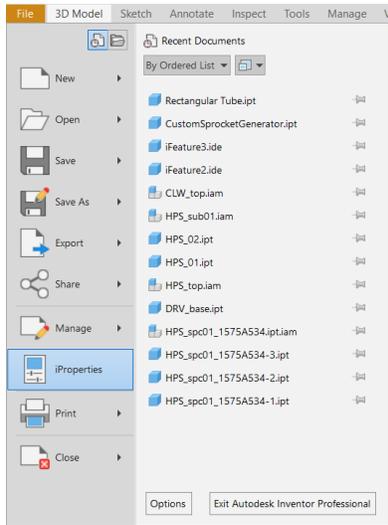


Figure 9: Location of the iProperties tool

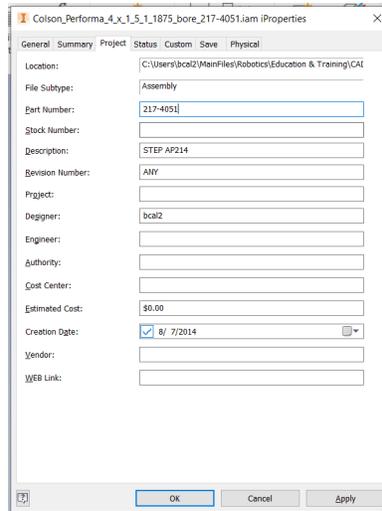


Figure 10: iProperties Project tab, from which the part number can be set

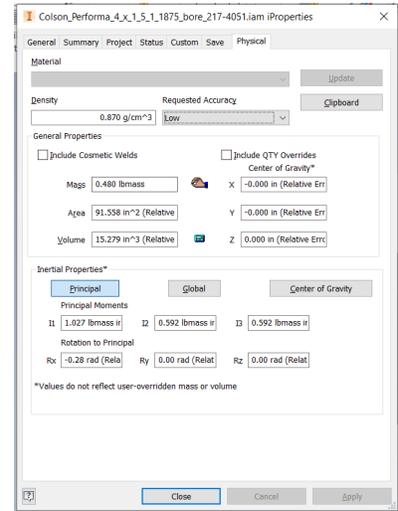


Figure 11: iProperties Physical tab, from which the mass can be set

Many STEP files do import as single parts, so the Shrinkwrap tool is not always necessary. In that case, you can skip to the step of setting materials, appearances, and the other properties.

Design Challenge 2: Importing COTS Parts

This exercise will familiarize you with a few suppliers' websites. Import the following COTS parts, following the instructions given in Section 2.3. Some will require the Shrinkwrap tool. Additionally, since part numbers are not given, you will have to explore the suppliers' websites a bit to find what you need. However, these already exist in Common Parts, so save them to your own directory to avoid creating duplicate files.

1. 6" Omni-Directional Wheel (VexPro)
2. Power Distribution Panel (VexPro)
3. 2" Compliant Wheel with 1/2" Hex Bore (AndyMark)
4. Viar Air Compressor (AndyMark)
5. Steel Eyebolt with Shoulder, for Lifting, 1/4-20 thread size, 2" thread length (McMaster)
6. Alloy Steel Shoulder Screw, 3/8" shoulder diameter, 3" shoulder length, 5/16-18 thread size (McMaster)