SCUTTLE Mechanical Guide
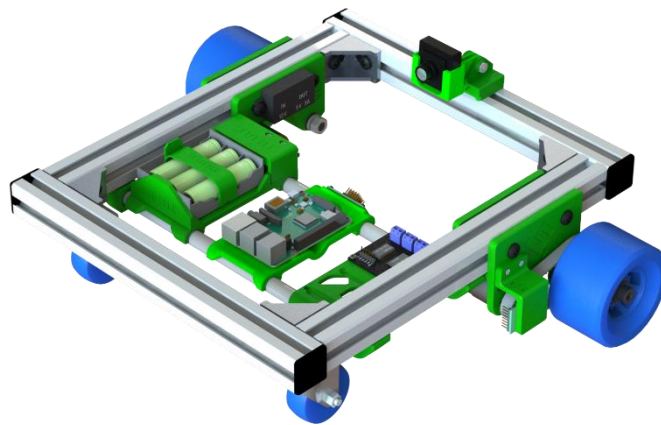
revised 2022.11

In This Guide

▶ Mechanical Design Upgrades

  ▶ Key upgrades between parts variants

▶ Mechanical Design Plans

  ▶ Key upgrades coming soon

▶ Quality of Mechanical parts

  ▶ Refined quality addressed by SCUTTLE Designers

  ▶ How to check & countermeasure important quality-related items in your mechanical assemblies

Part 1: Mechanical Upgrades

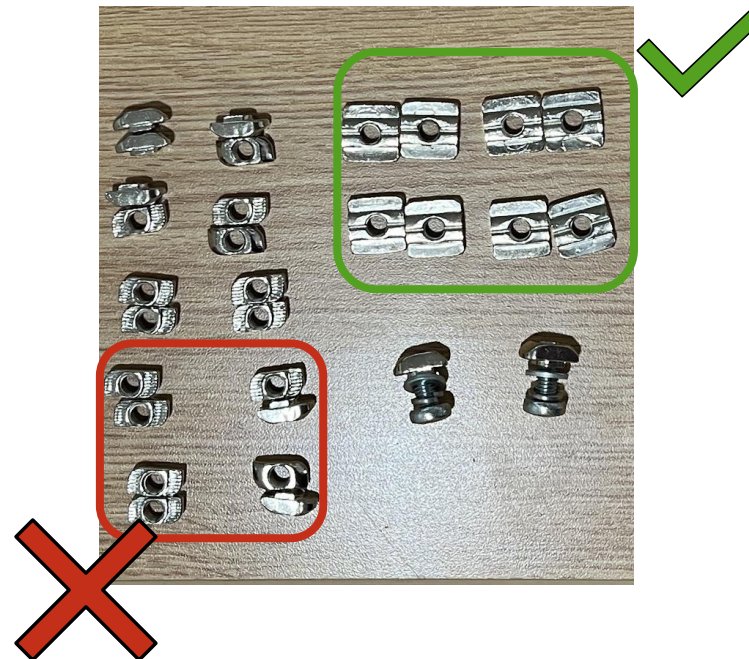These slides show the mechanical improvements between design versions.

M6 Hardware:

SCUTTLE v2.3 to v2.4

▶ Replace 8 drop-in nuts with slide-in nuts

  ▶ Easier assembly of wheel bracket

▶ Increase casters fasteners

  ▶ From 2 sets to 3 sets per caster

  ▶ (screw + washer + lock washer + drop-in nut)

Slide-in Nuts for Wheel Brackets

Extrusion Cap

- Extrusion caps aim to match the extrusion type
  - Asia: small center hole
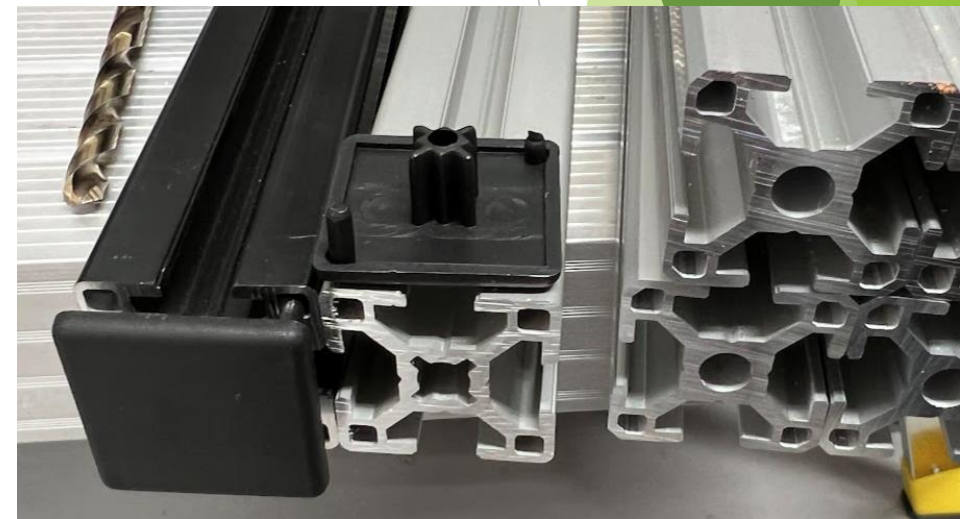 - North America: large center hole

Mcmaster holes around 7.12mm

AutomationDirect holes around 7.24mm

Caps with "X" cannot fit AutomationDirect Extrusion
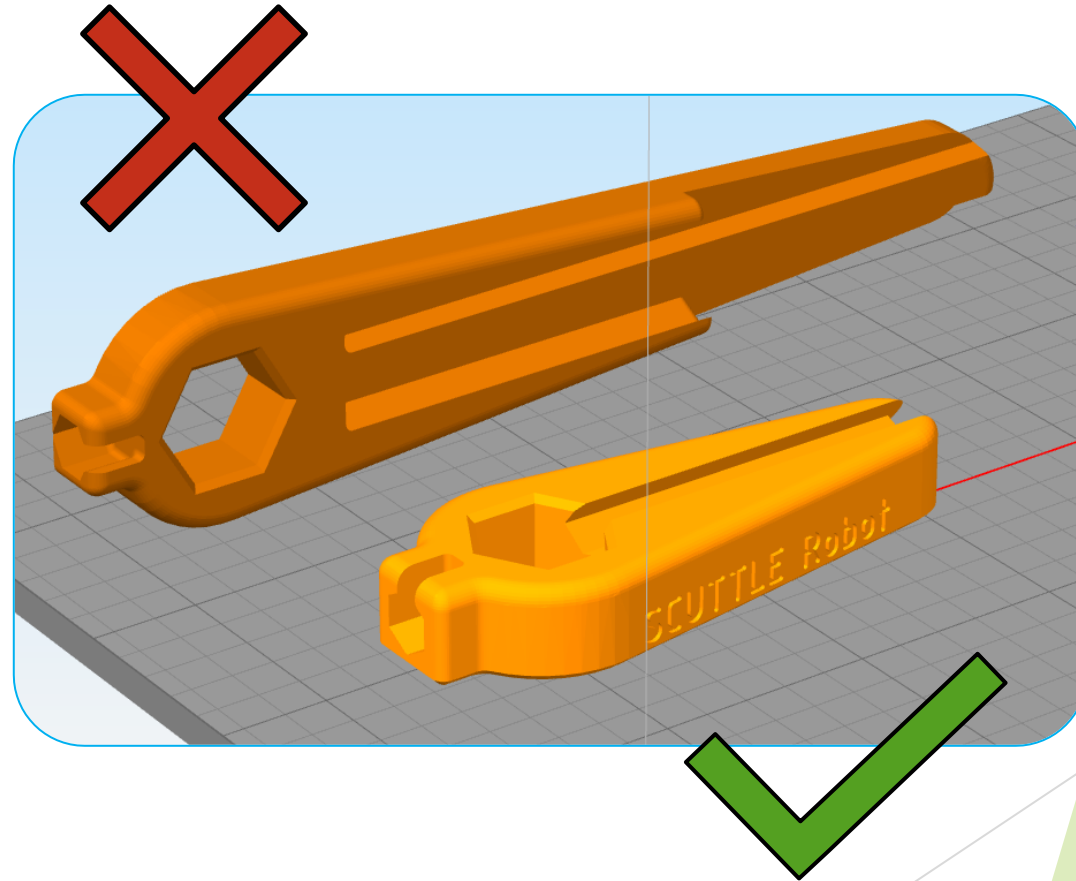
BOM Changes

▶ Coming soon: details on Bill of Materials Updates (dated 2022.10)
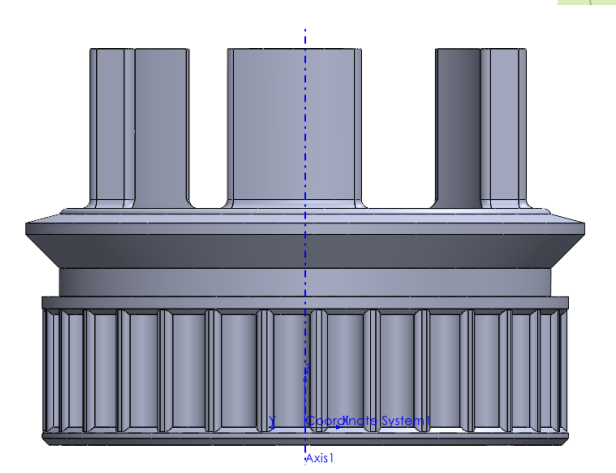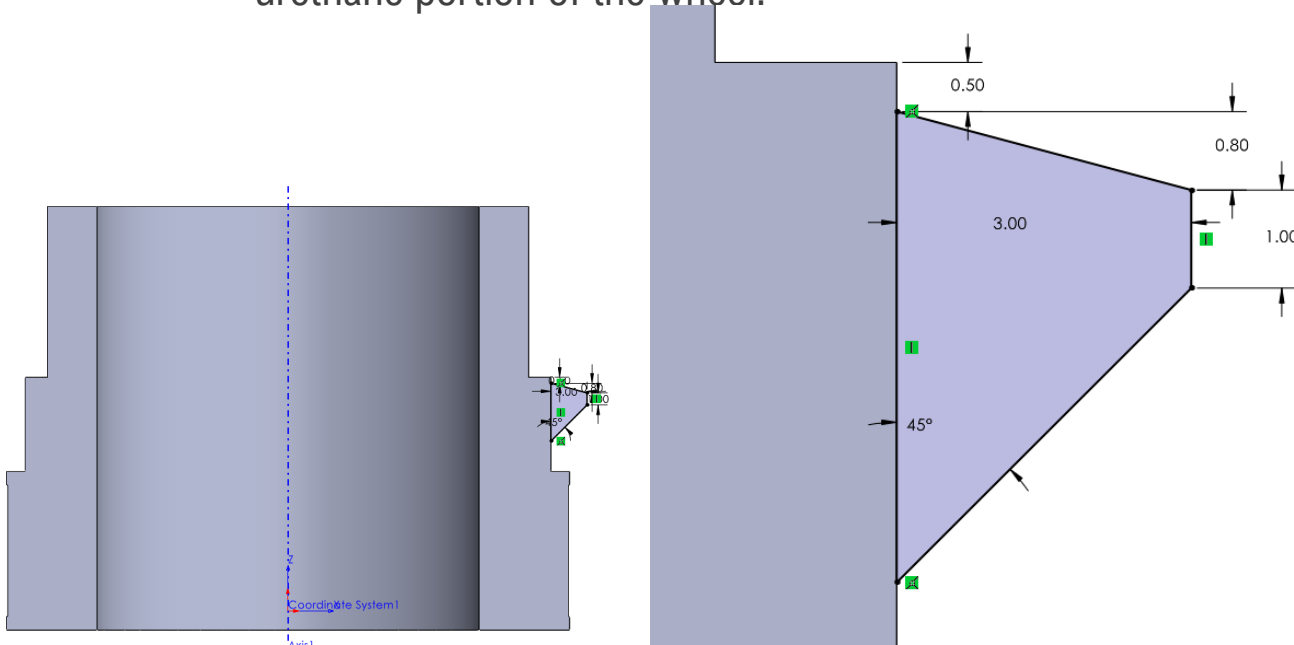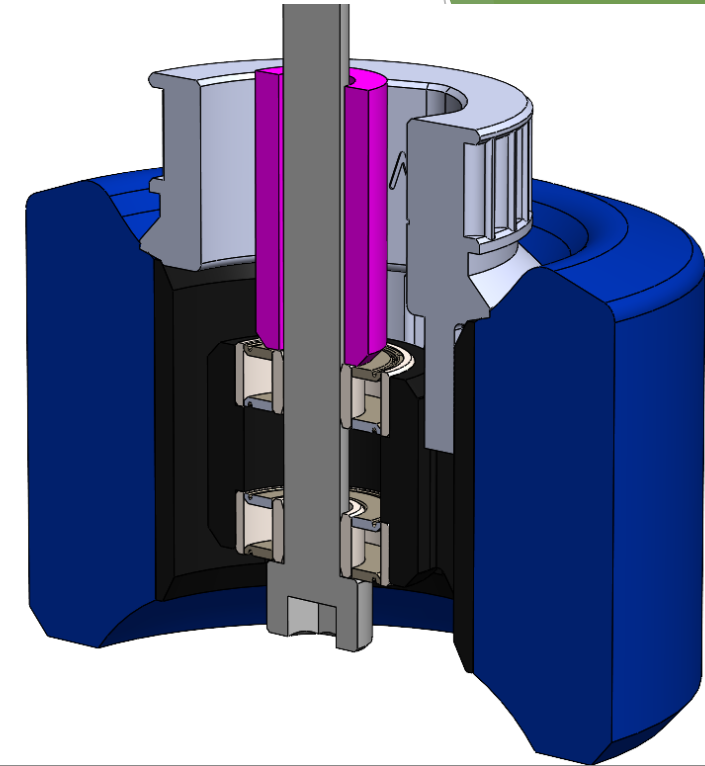
2022.08 SCTL Wrench v2

- ▶ Upgrade to v2 from v1
  - ▶ uses less material
  - ▶ accommodates just the latest tools
  - ▶ reduce leverage on the nut, reducing chance of over-torquing the wheel screw.
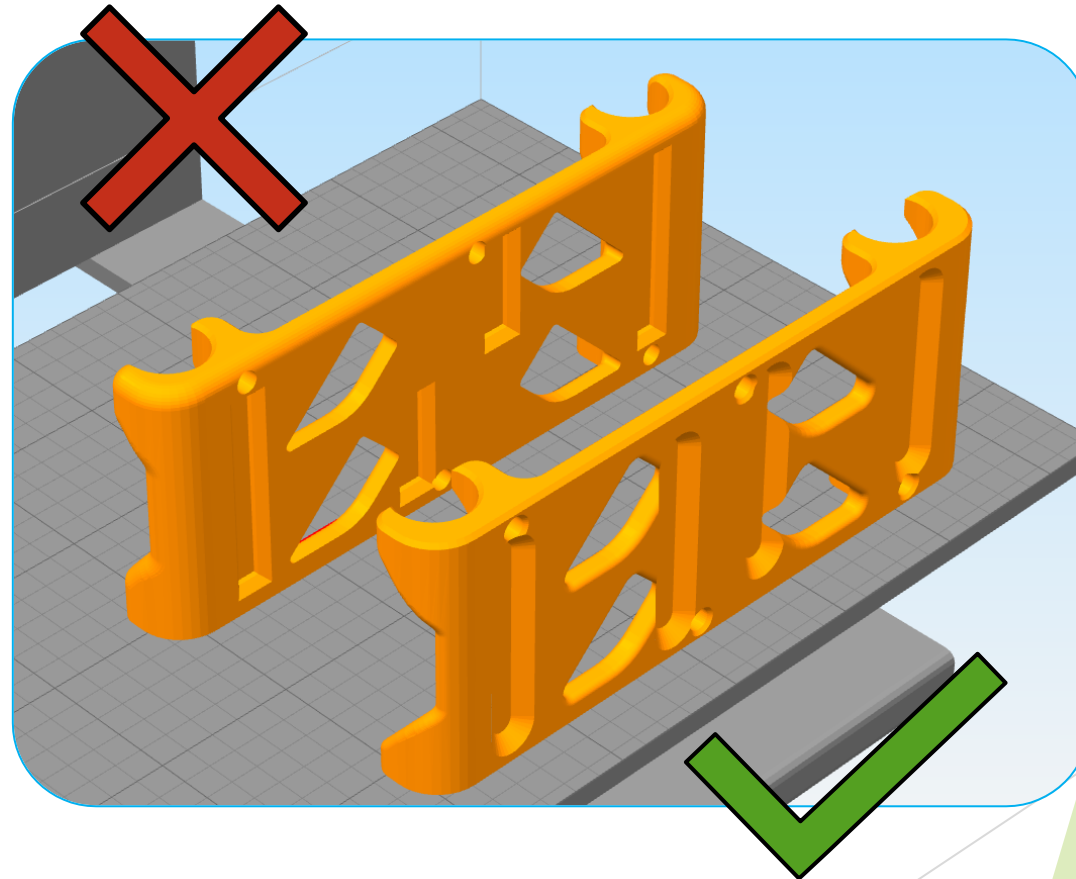
2022.04 Wheel Bracket v3.3

▶ Updated from v3.2

   ▶ Lateral dimension increases from 2.2 to 3.0mm

   ▶ Increase of the reach of the adhesion face to make more contact with urethane portion of the wheel.

2022.08 Motor Driver Bracket v1.5

- Upgrade to v1.5 from v1.4
  - uses less material
  - holes chamfered for threaded inserts insertion
 - improved clearance for motor drivers pins

2022.07 Belt Assembly Countermeasure (pt1)

▶ Motor Pulley v3.2 updated to v3.3

- ▶ base shelf is cleared so belts can move when the motor shaft length deviates.

▶ DM making countermeasures that eliminate the motor spacer requirement.

▶ Belt tension too high when the belt is slightly misaligned.

v3.2 Motor Pulley

v3.3 Motor Pulley

v3.2 not robust

accommodates varied belt location
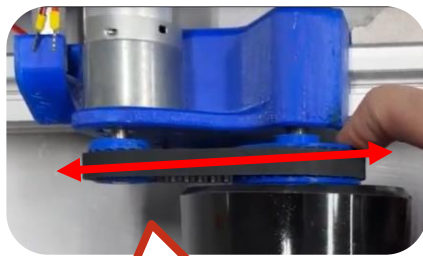
without CM, belt is misaligned due to longer motor shafts.
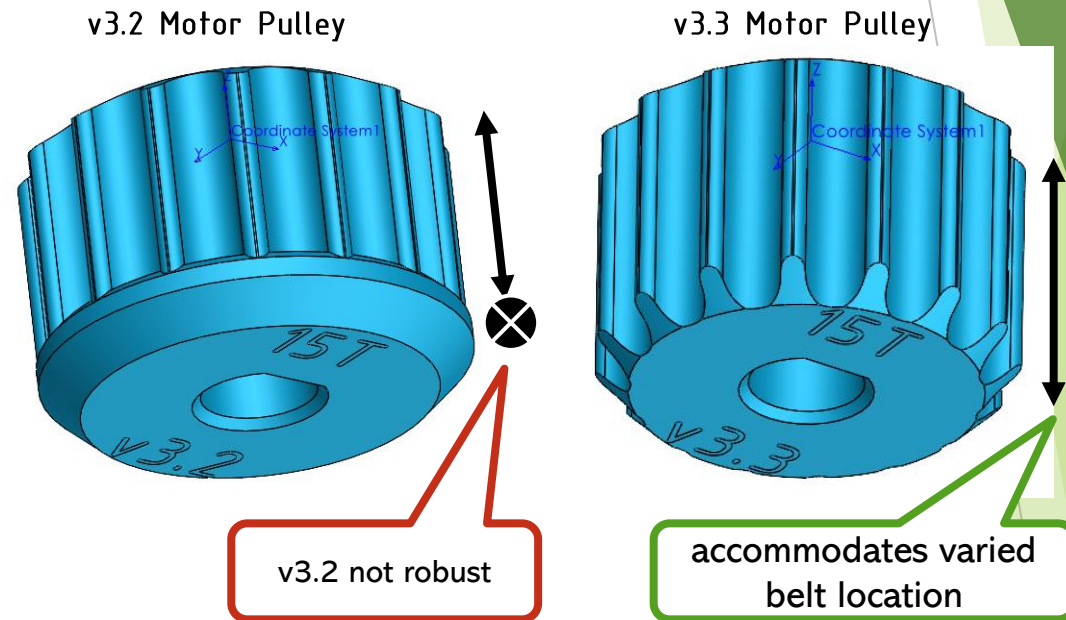
# 2022.07 Belt Assembly Countermeasure (pt2)

► Encoder Bracket variant created (v2.8)

  ► reach is extended to accommodate motors with longer shaft.

  ► This is an alternative to motor spacers

  ► This variant is intended for bulk Malaysia motors from summer 2022

► Requires further verification for full assembly and for all motor variants.

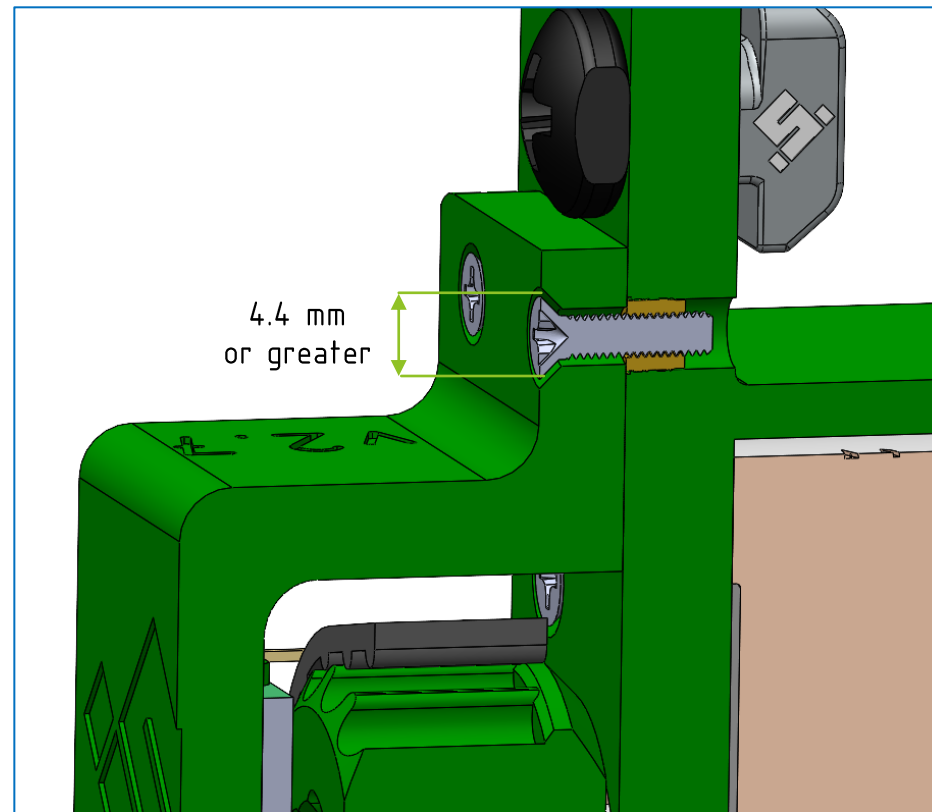v2.7 gives 20.75mm reach
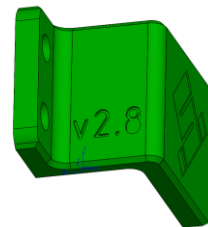
v2.8 gives 21.75mm reach

v2.8
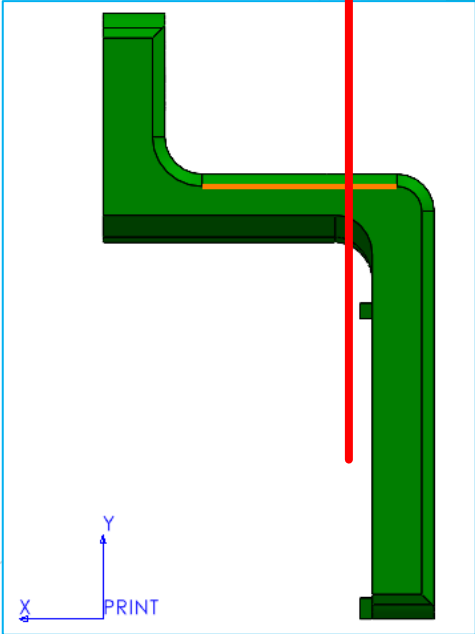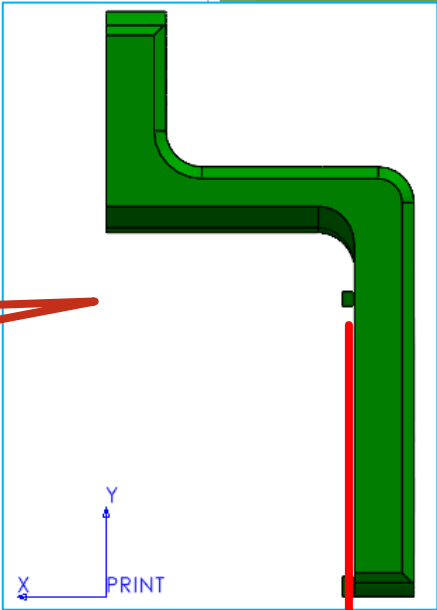
2022.06 M3 Screw Selection

- ▶ Encoder Bracket Screws:
  - ▶ Finer control of the head diameter

- ▶ Next Design
  - ▶ Migrate to flat heads for reduced stress
 - ▶ Update Encoder Bracket accordingly

4.4 mm or greater

2022.06 Shaft Holes Spec

- The shaft hole diameter is critical.

  - The wheel bracket experiences impact when the robot drives on bumps.

  - Impact forces can be 100x the force of a static weight of your payload.

  - If the shaft diameter is smaller than the hole, the force concentrates on a very small region of the plastic material.

  - Pressure = Force / Area, and high pressure will yield in broken brackets.

- Shaft hole requires size "O" drill bit.   The shank measures approx 7.96mm. The resulting hole (due to cutting mechanism) is around 8.02mm

If hole is oversized, resulting in loose fitment.
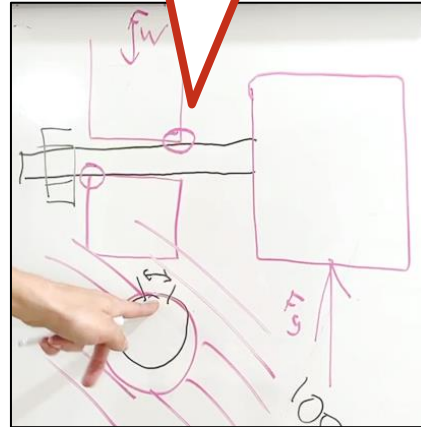
Holes made with size "o" drill

shaft can wiggle in the hole when shaken.

Encoder Assembly Dims (per CAD)

Item	Name	Design (mm)
o	shaft offset	19.5
A	magnet gap	2.05
B	pulley offset	15.95
C	mag offset	15.18
D	belt gap	4.33

▶ Design requires measurements of A and D to be **controlled**.
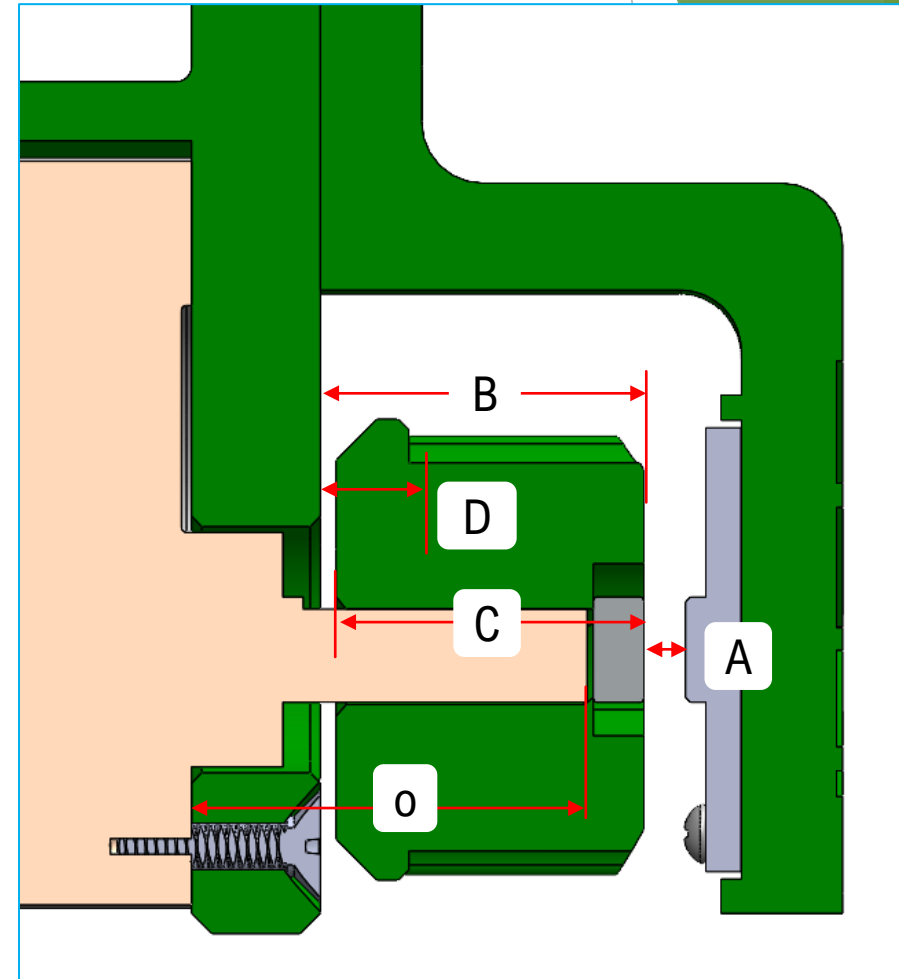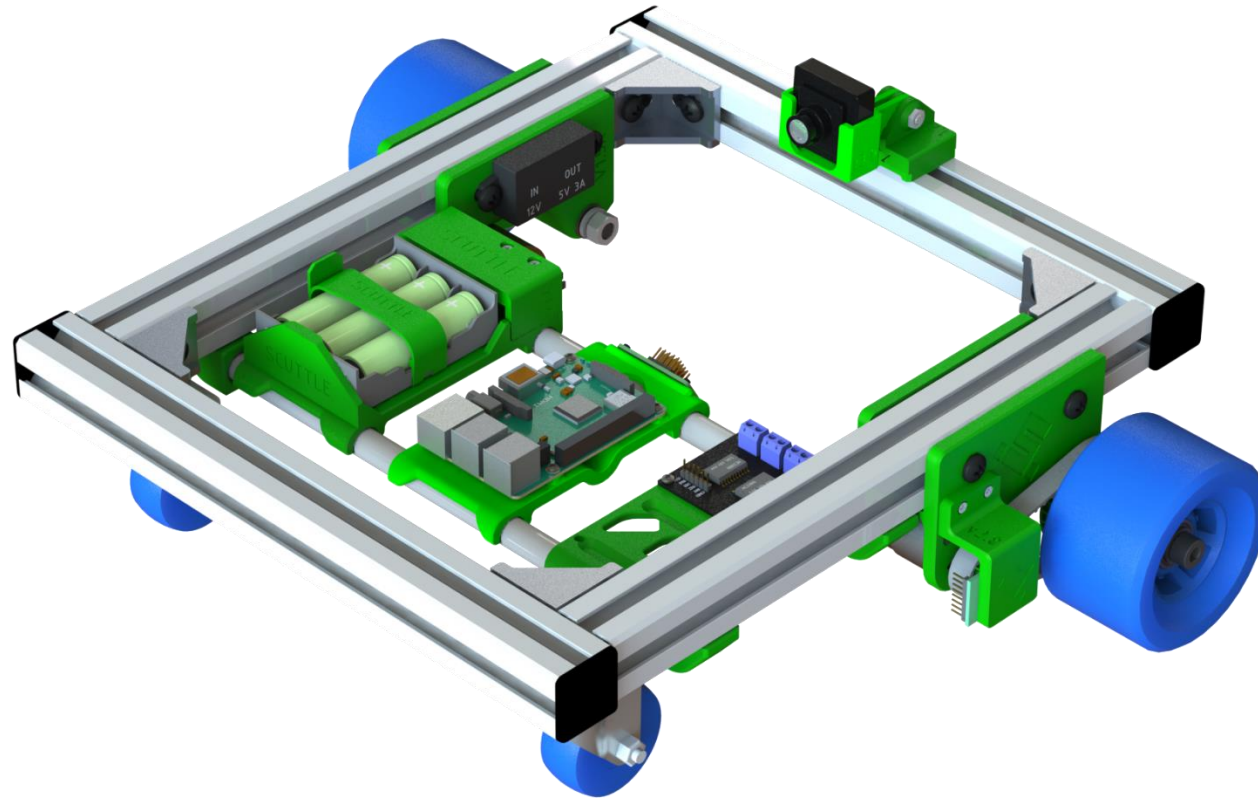
Part 3: Quality Verification

High quality of mechanical assembly is required for heavy payloads and refined robot control.
Many of these details are unnecessary for beginners.

2022.06 Encoder Cables

▶ Beginners benefit from labels to decipher left and right cable assemblies.

▶ Encoders to have LH / RH stickers for customers to orient the assembly.

▶ Sticker is oriented upright and front facing when properly assembled.

Encoders sticker.

2022.06 Motor Pulley Fitment

- Motor pulley should press onto shaft with force F

  - F_{min} = 5 Kgf

  - F_{max} = 15 Kgf (updated 2022.07 DM)

- Test strategy:

  - 1) use a verified good printed pulley & test pressure on STANDARD motor

    - motor that we have already shipped or used multiple times

  - 2) use the same pulley (or pulley from same batch of prints) to test on the new shaft

    - make log of forces required

  - 3) if you press the pulley onto shaft 2x, then note if the force changes

    - this means that the plastic has worn during first insertion
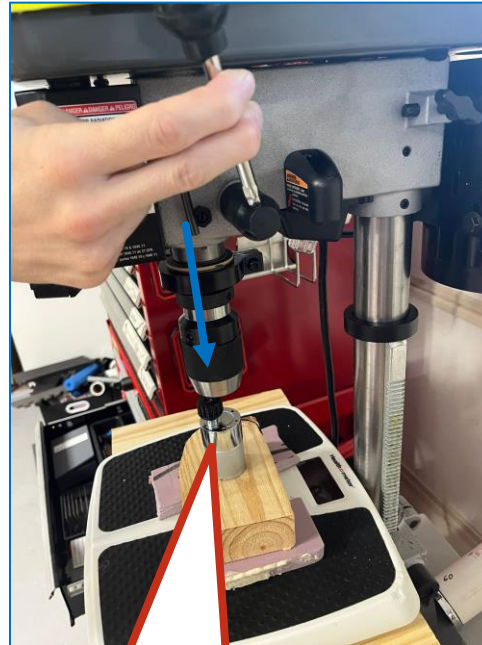
Apply static force by pressing, and measure the maximum force before the pulley slides onto the shaft.

Pulley requiring over 60 lbf (27Kg) of static force to press on

2022.08 Threaded Inserts

- ▶ Inserts do not protrude from bottom of the plastic.

- ▶ For thin brackets, use M2.5x4mm or shorter length of insert.

Should be 4mm long, flush with plastic

2022.08 PCB Pin Clearance

- ▶ Through-hole features on motor driver interfere with the bracket.

- ▶ For Assembled SCUTTLE, we install the motor driver & the pins must have clearance.

  - ▶ Verify the clearance for any assembled units made for demos or customers.

- ▶ If any PCB through-hole pins are contacting a plastic bracket, it is safe to snip the pins flush with the board.

  - ▶ Use flush-cutters to make this cut.

  - ▶ This will not impact electrical performance.
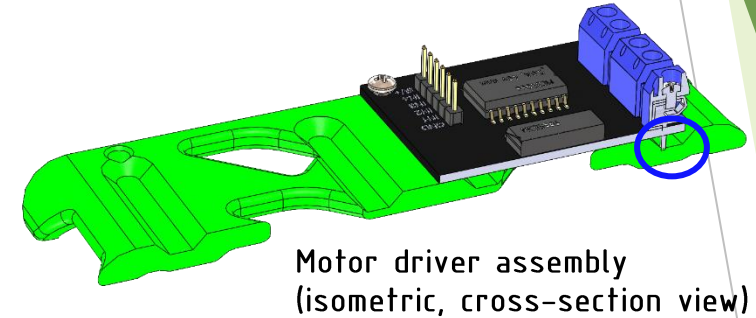
Motor driver assembly
(isometric, cross-section view)
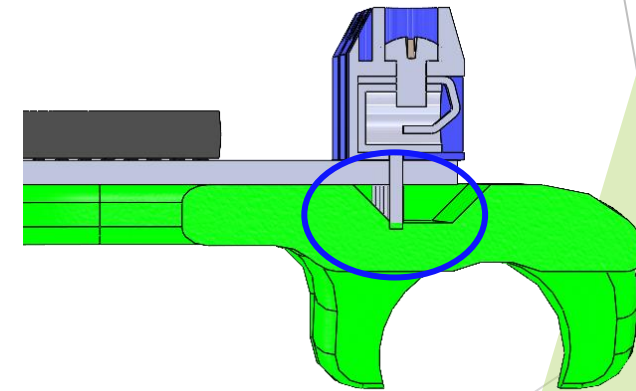
Motor Driver Bracket v1.5
improves clearance from v1.4