Lab 0 – Car Assembly

MIT Beaver Works Racecar Curriculum

https://matthewcalligaro.github.io/RacecarWebsite/

Lab Objectives

Main objective: Build a racecar

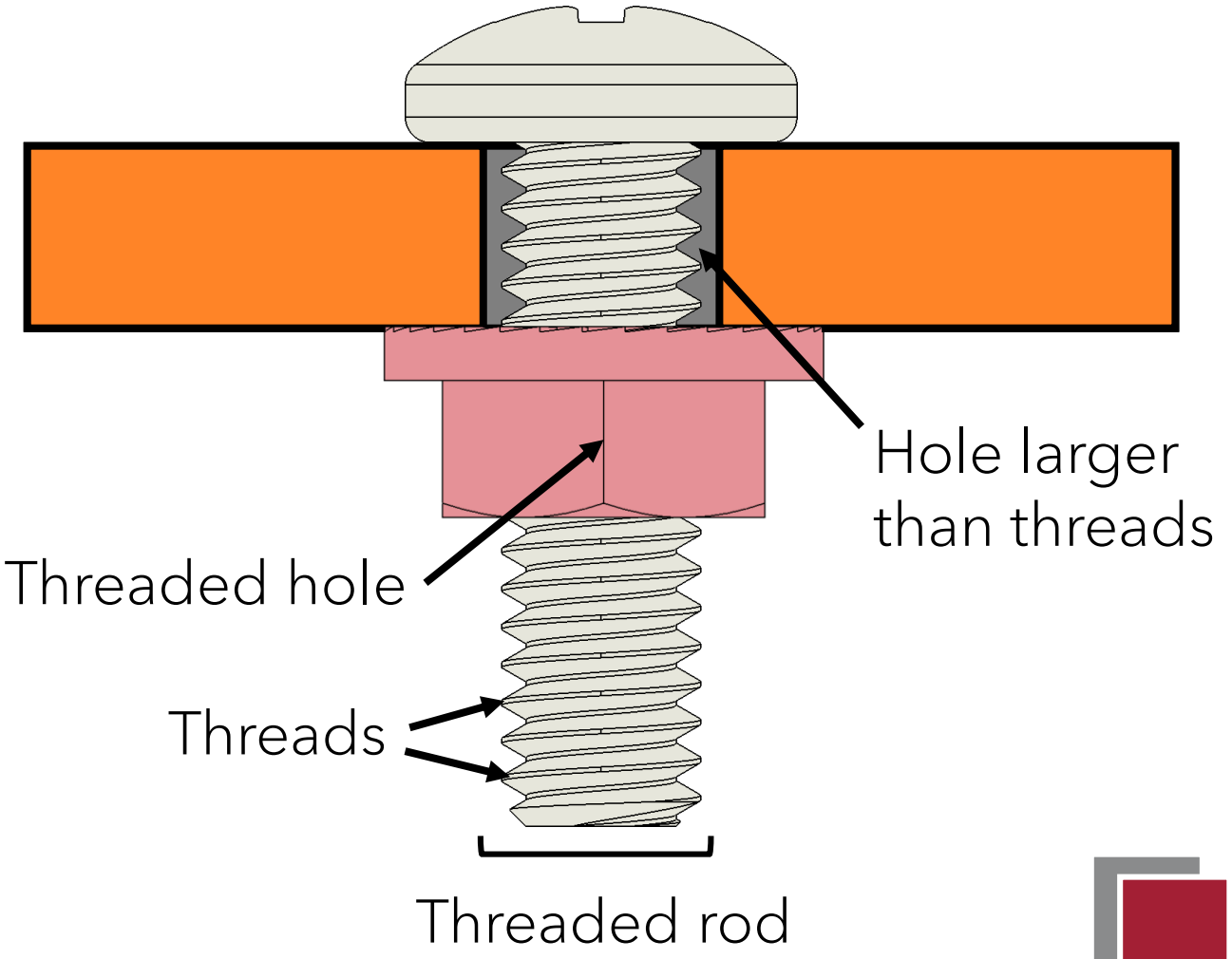
Learning objectives

- Understand the hardware of the RACECAR-MN
- Learn how to use common pieces of hardware and tools
- Gain experience translating 2D pictures and diagrams into a 3D product

Finished Car

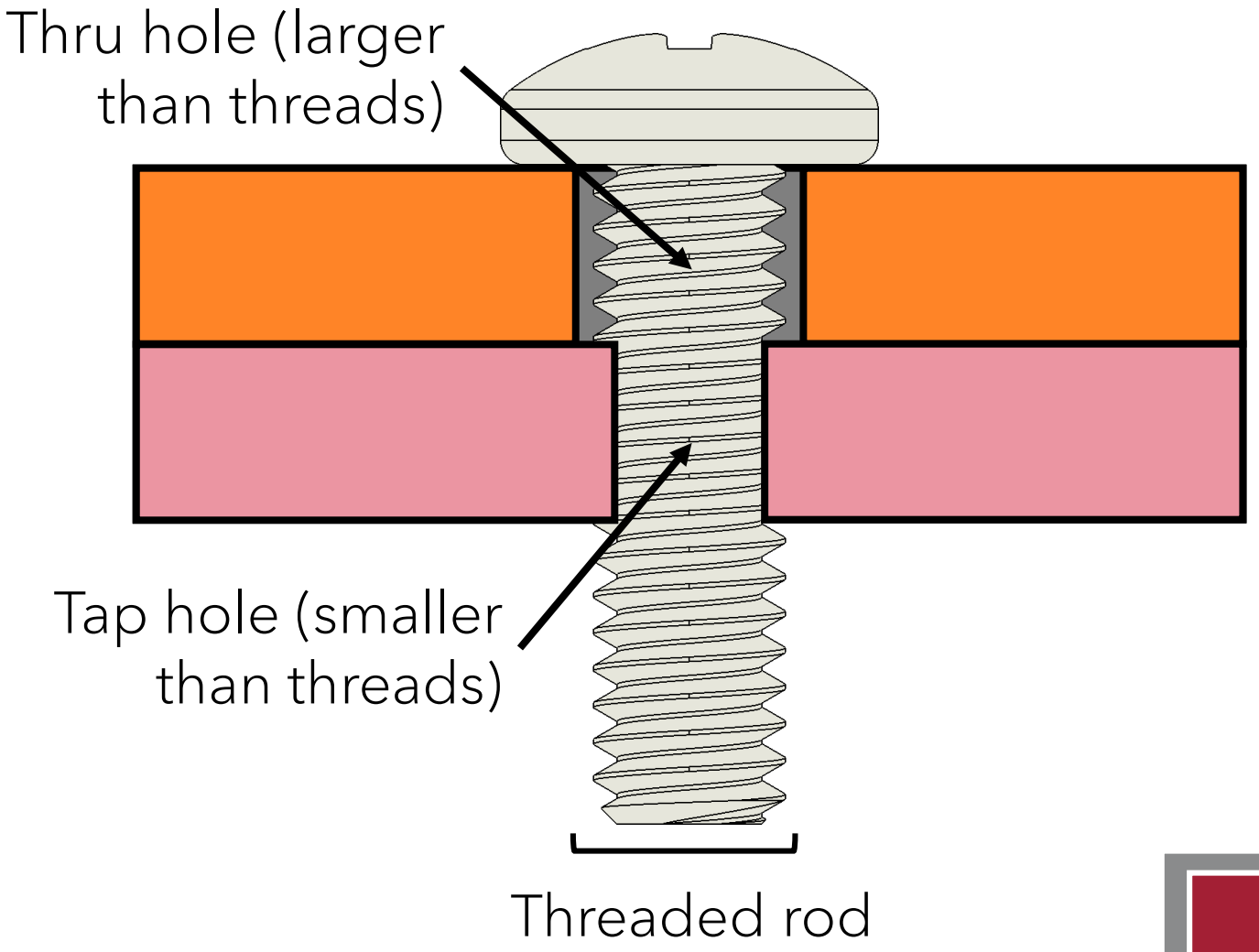
Threads

- **Threads**: metal spirals that allow two pieces to lock together
- Every threaded rod should attach to **exactly one** threaded hole
- Any holes in between must be larger than the threads



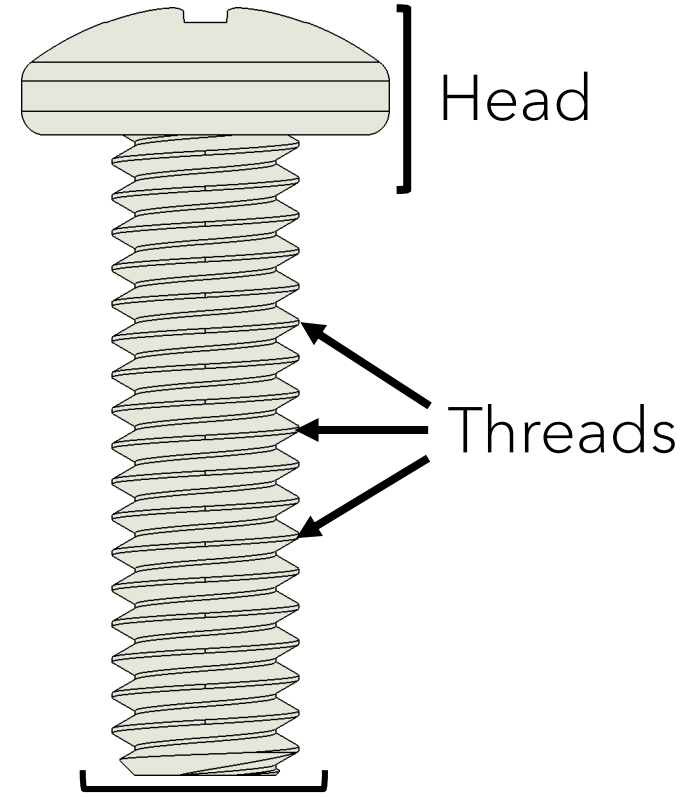
Tapping

- Some hardware (like standoffs and nuts) have pre-threaded holes
- We can also **tap** a hole without threads by twisting in a rod with threads larger than the hole (which cuts threads into the tap hole)
- Once again, there should be **exactly one** tap hole

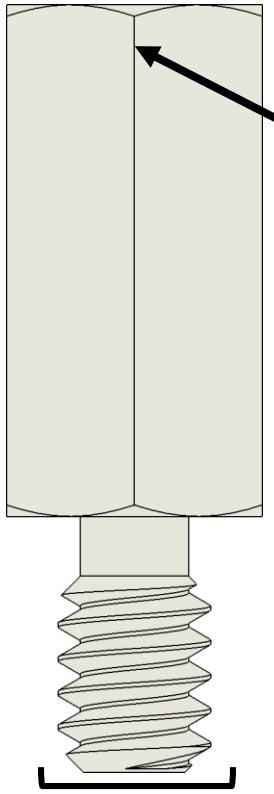


Hardware

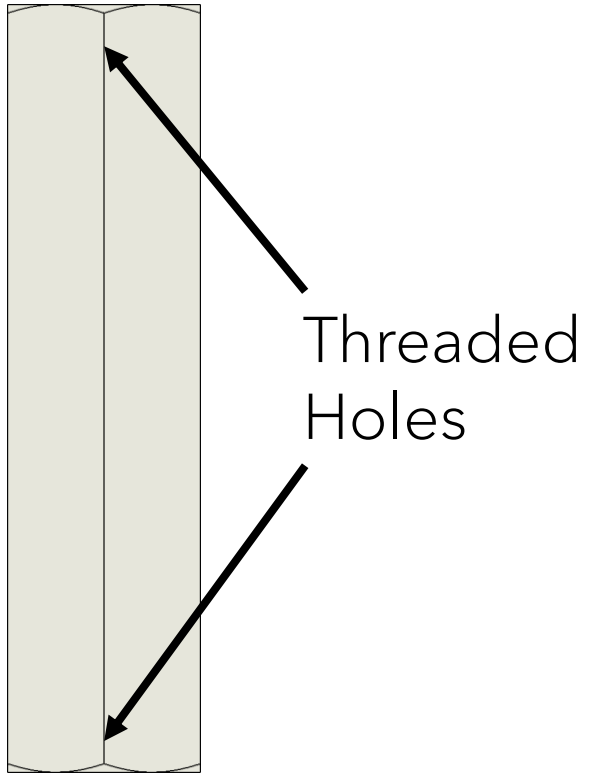
Screw



MF Standoff



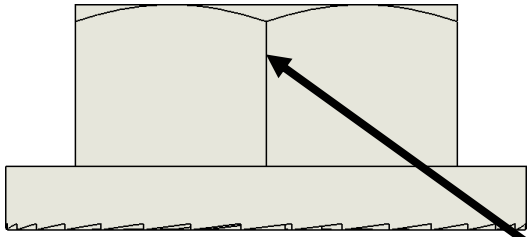
FF Standoff



Hardware

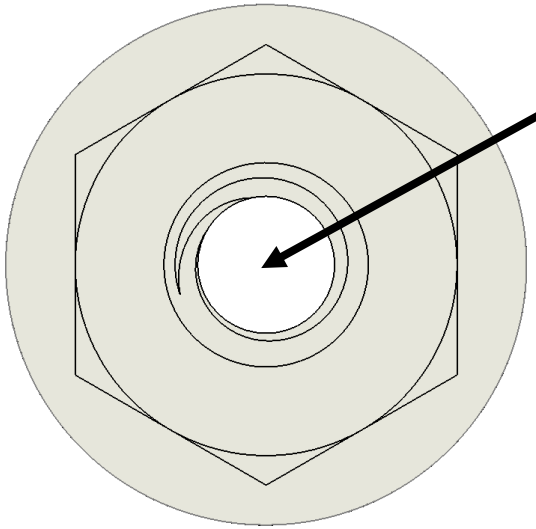
Locknut

Side view

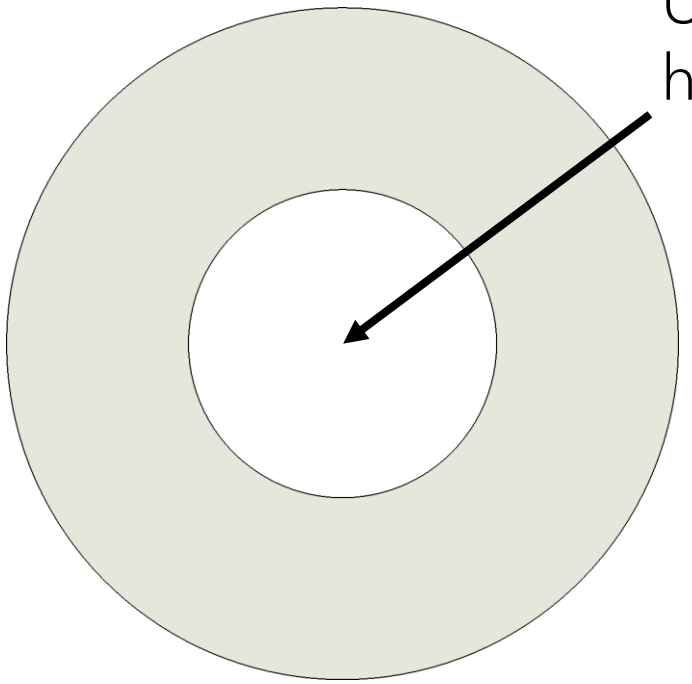


Threaded Hole

Top view



Washer

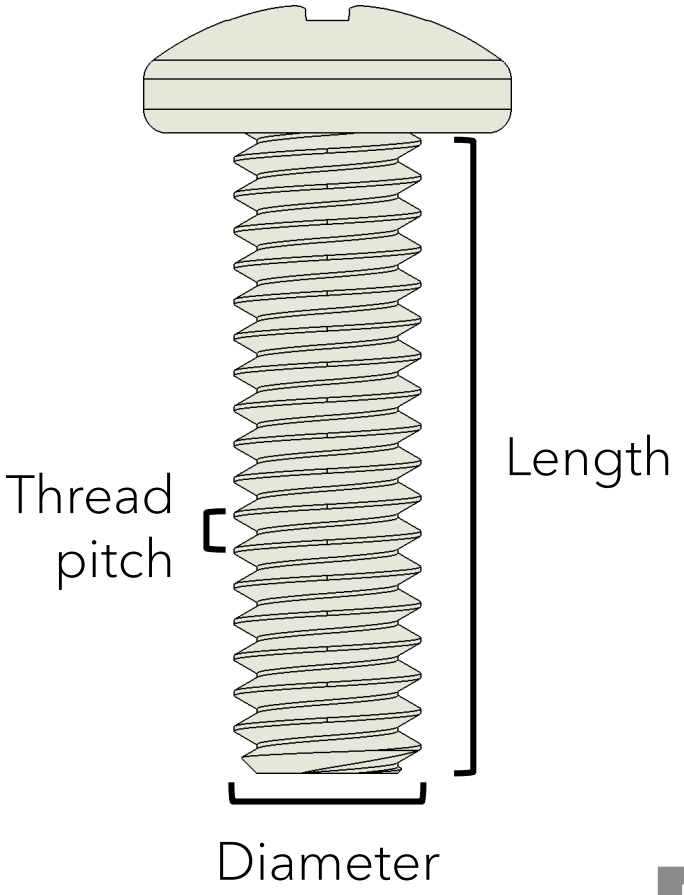


Unthreaded hole

Screw Dimensions

4-40 5/8 screw (C)

- Diameter
- Threads per inch (determined by thread pitch)
- Length (inches)
- Letter for RACECAR-MN*



*We have lettered the screws in the RACECAR-MN from largest (A) to smallest (F) to help identify them
(Letters G and H are metric screws)

Tools

Philips Screwdriver

Tightens screws

Hex Screwdriver

Tightens standoffs

Adjustable Wrench

Tightens locknuts and large standoffs

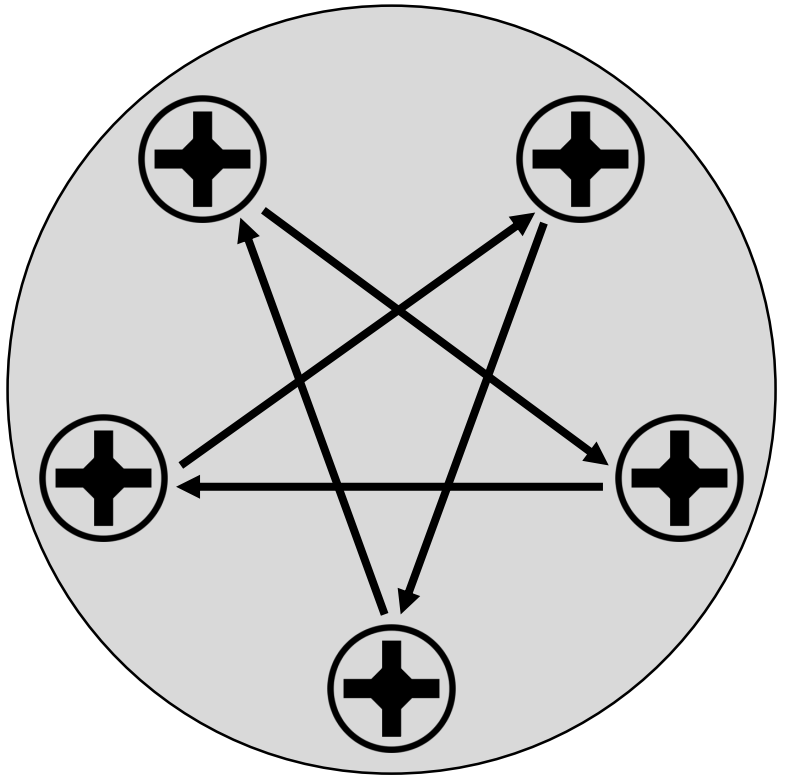
Tightness

The instructions refer to the following levels of tightness:

- **Partial**: Do not tighten the screw all of the way and intentionally leave extra room so the part is free to move
- **Very gentle**: Slowly tightening the screw or MF standoff and stop as soon it touches the part
- **Gentle**: Slowly tighten the screw until it touches the part, then apply a small amount of pressure to tighten it further
- **Moderate**: Slowly tighten the screw until it touches the part, then apply a moderate amount of pressure to tighten it further
- **Tight**: Tighten the screw with a large amount of pressure
- **Very tight**: Tighten the screw as much as you can without hurting yourself

Tightening Patterns

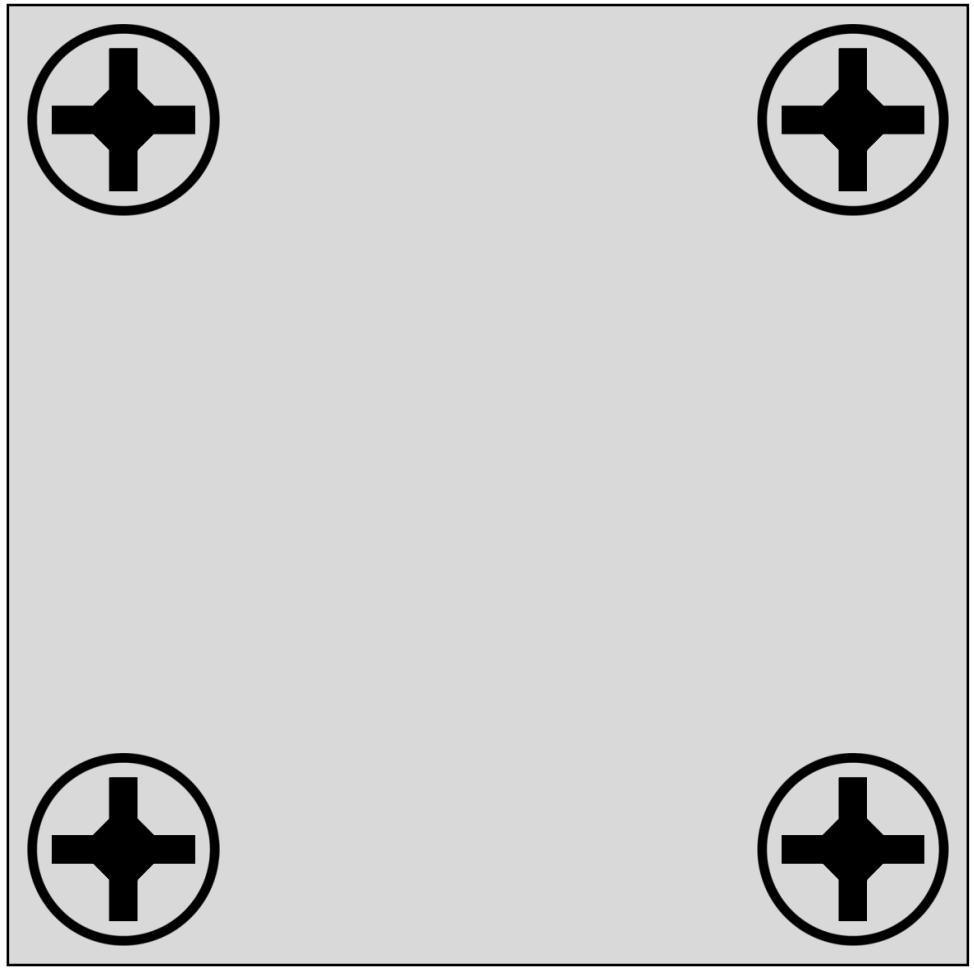
- Use the following steps when a part is attached with multiple screws:
  1. Screw in each screw partially (such that the part can still move freely)
  2. Gently tighten each screw and use a **crisscross pattern** in which you move to the next screw that is farthest away
  3. Repeat this same pattern a second time, this time tightening screws to the desired tightness
- This ensures consistent tightness and avoids unwanted stress on the part



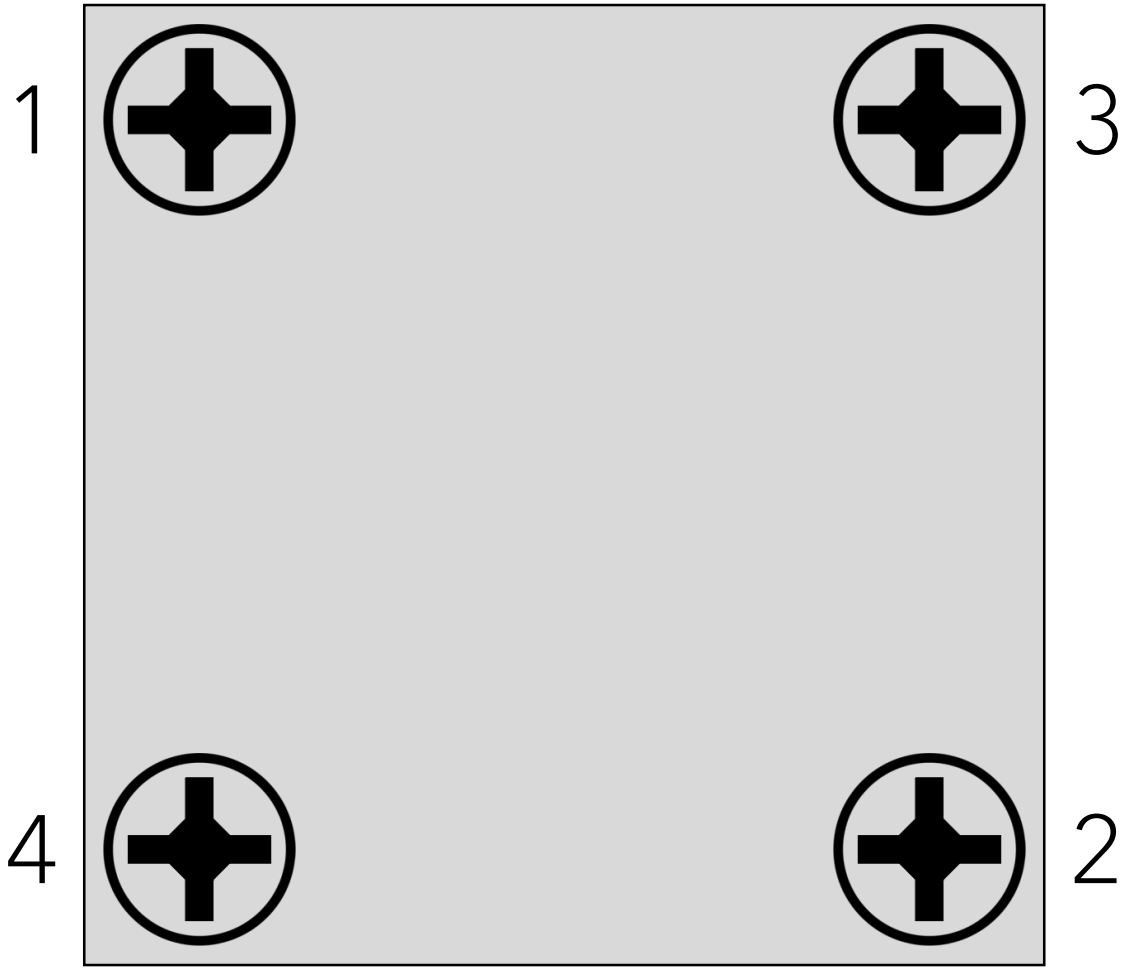
A crisscross pattern

Tightening Patterns

In what order should we tighten these screws?



Tightening Patterns



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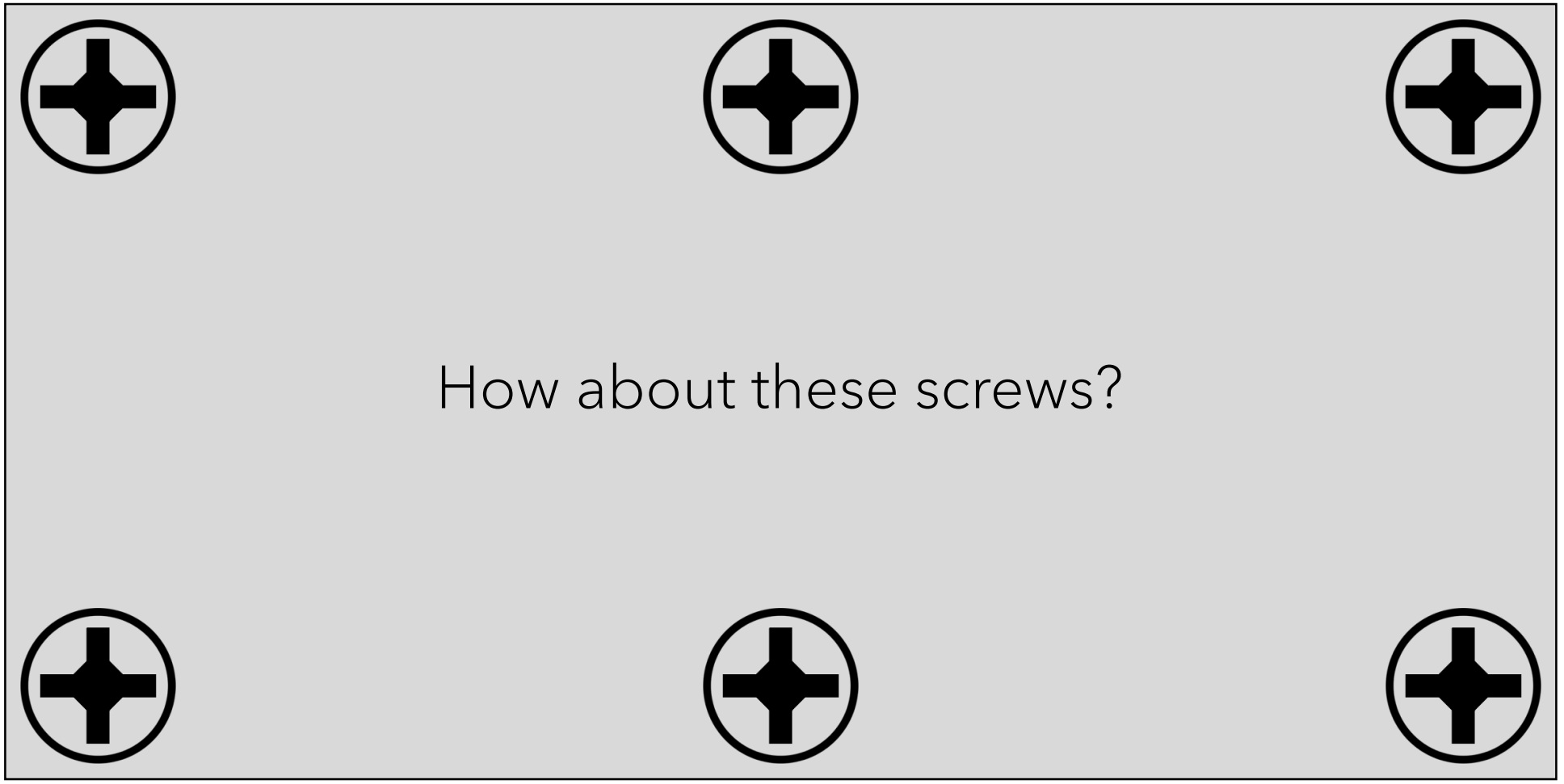
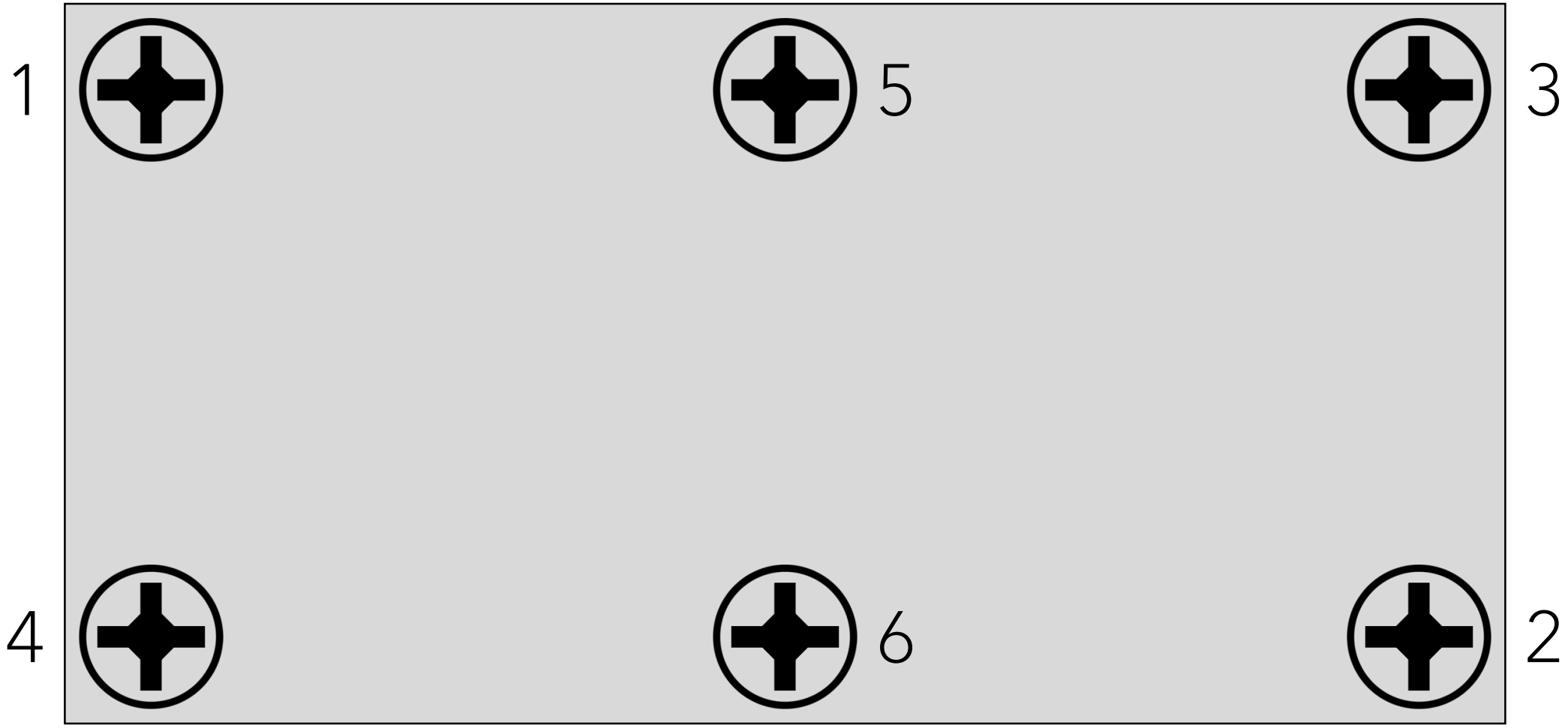
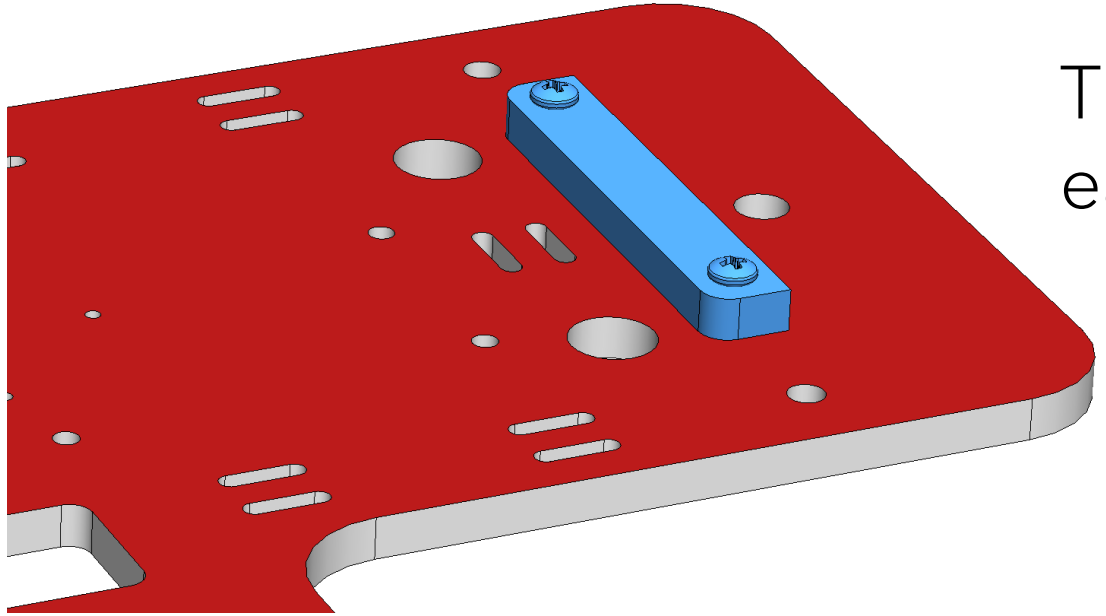


Tightening Patterns



Assembly Guide

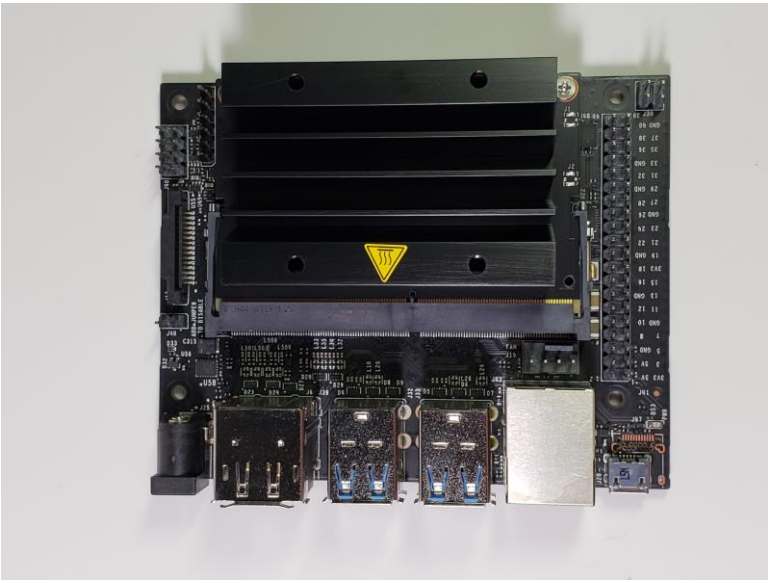
- The assembly guide contains step by step instructions with pictures and diagrams for assembling the RACECAR-MN
- Parts are written in **bold** and can be found in the parts list

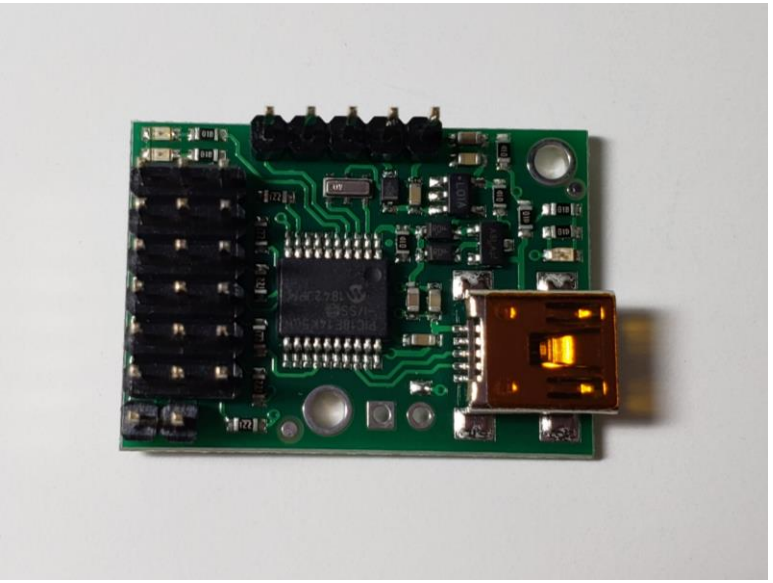


The new part(s) added in each step are shown in blue

Safety Precautions

- Touch a piece of grounded metal (such as a door handle) to discharge static before handling any electronic parts





Safety Precautions

- Leave the protective film on the camera and monitor until you are finished assembling the car

Good luck and have fun!

Let us know if you need any help during the lab