

Hardware Hero – Badge Requirements



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Task 1 – Intro Skill Task

Objective: Practice selecting Mate Connectors for proper hardware placement

Primer: Requirement 1 – Fastener Assembly Practice

Before beginning Task 2, complete **Hardware Hero Requirement 1**. This includes assembling and grouping a variety of standard hardware sets (socket head cap screws, shoulder screws, spring pins, U-bolts, etc.) and applying appropriate mates and limits in a sample assembly. It is purely exploratory and documentation is not required, but encouraged.

Primer: [Complete Hardware Hero Requirement 1](#)

Task 2 – Complex Task

Objective: Practice using the Hole Tool and apply thread standards.

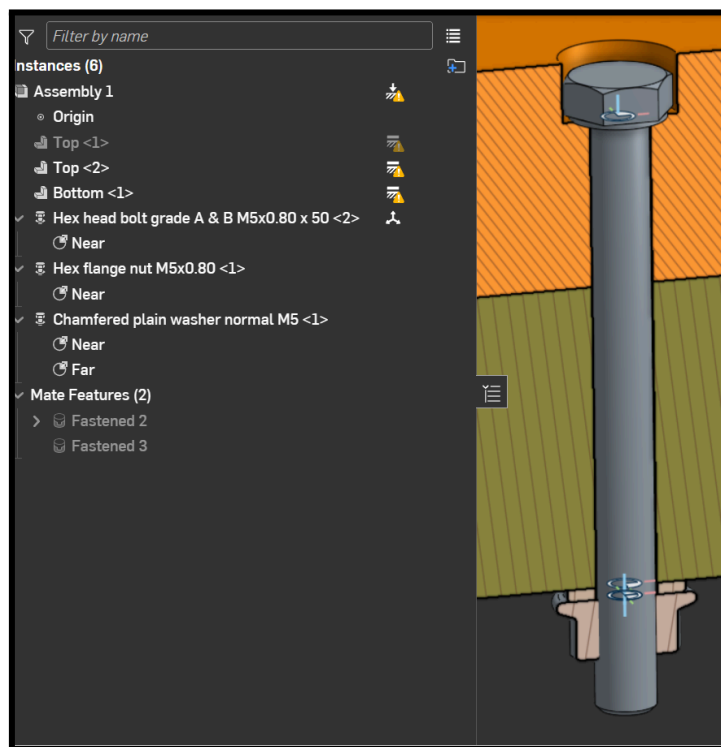
- Extrude New a new Rectangular Practice Part (e.g., 4" x 2" x 0.25") on the Top Plane.
- Part Mirror using the bottom face of Part_1.
- Add **four evenly spaced counterbore holes** for **1/4-20 socket head cap screws** along the long edges. Set the merge scope for merge with all.
- Use the Hole Tool's **ANSI Inch** settings and match fastener type to hole type.
- Practice changing hole types and observe how countersinks, counterbores, and threads differ in appearance and purpose.

Task 3 – Slightly More Complex Task

Objective: Demonstrate hole-type variety and fastener integration.

- Design a **mounting plate** that includes the following:
 - **2 simple holes**
 - **2 countersink holes**
 - **1 counterbore hole with a nut on the opposite side**
- Use **ANSI Inch fasteners** from the Hole Tool's **Standard** settings.
- In **Onshape**, insert fasteners using **Standard Content**, and apply appropriate mates.
- Add a **nut** to the counterbore hole from the opposite side so it assembles correctly.
- Create a **3D Section View** in the **Assembly tab** showing how the plate and hardware fit together.

Capture a similar PNG image file as below document application of the Replicate Feature in your portfolio.



✓ Task 4 – Precision/Technical Task

Objective: Apply parametric design and metric fasteners with full assembly and drawing documentation.

- Recreate your Task 2 design, but using **metric hardware**.
- Include the same hole types:
 - **2 simple holes**

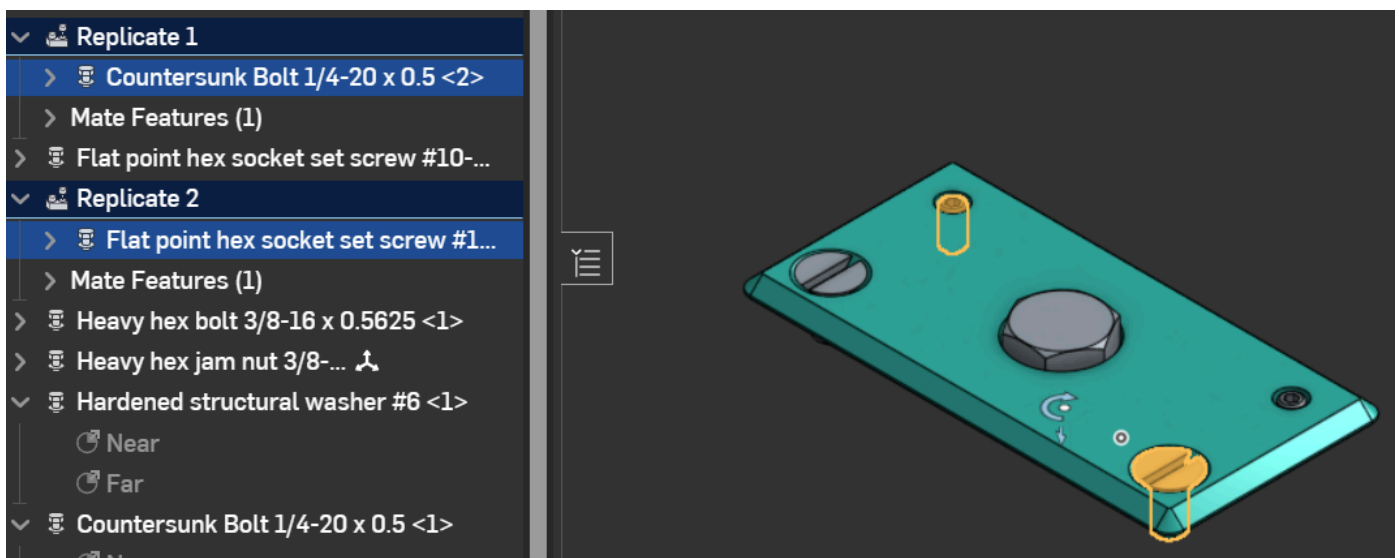
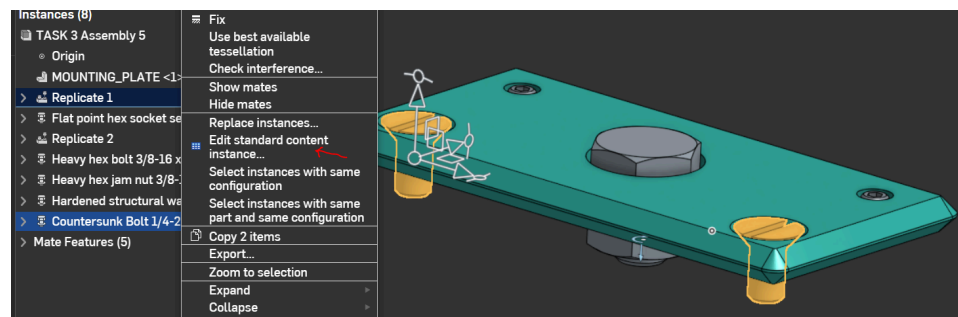
- **2 countersink holes**
- **2 counterbore holes, each with a nut and washer on the opposite side.**
- **Use Onshape Standard Content to add appropriate metric nuts and washers in an Assembly.**

Pro Tip:

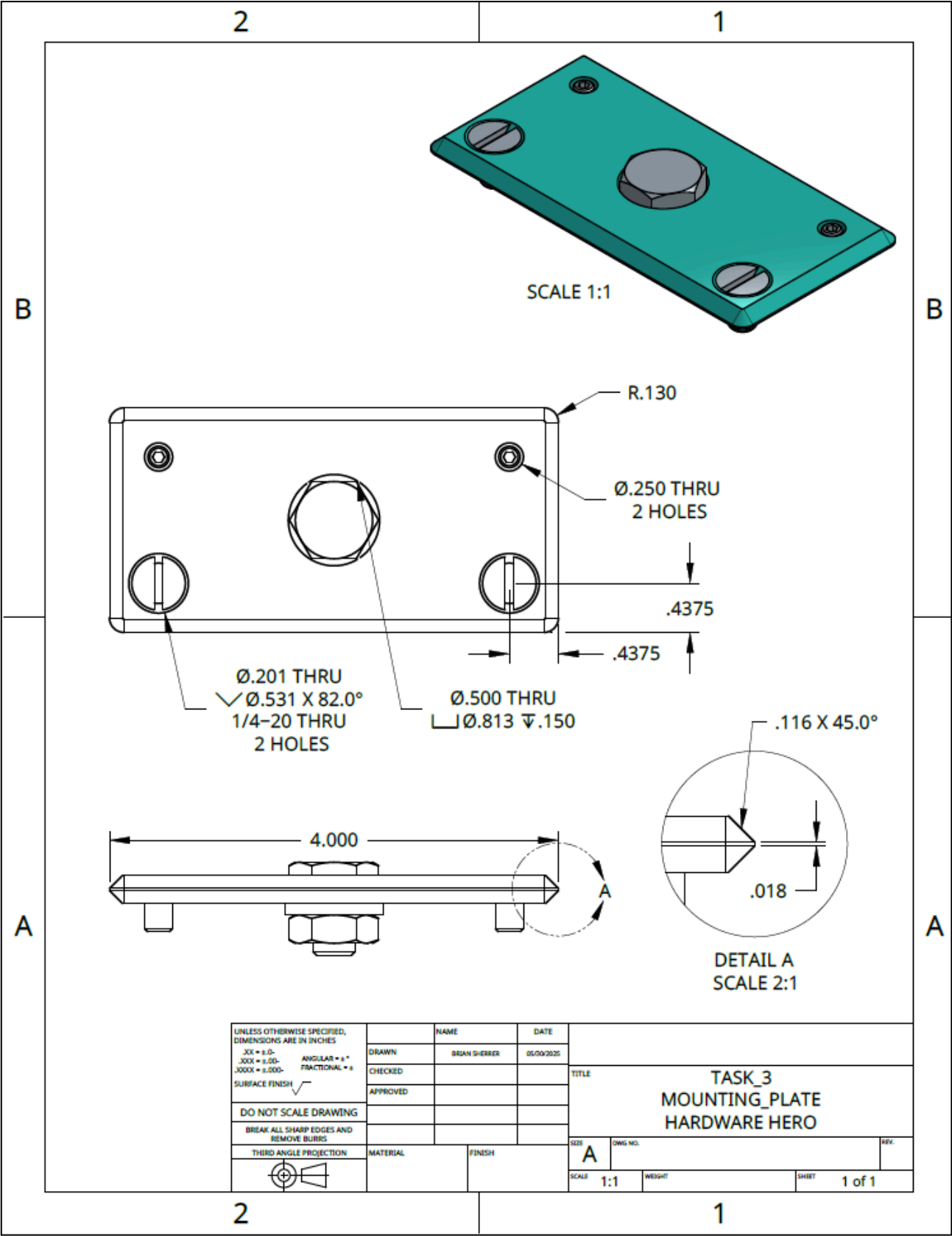
Part Studio: Use Sketch Mirror and Patterns to create your points in a single sketching. Then group all holes of the same callout as one single Hole Feature.

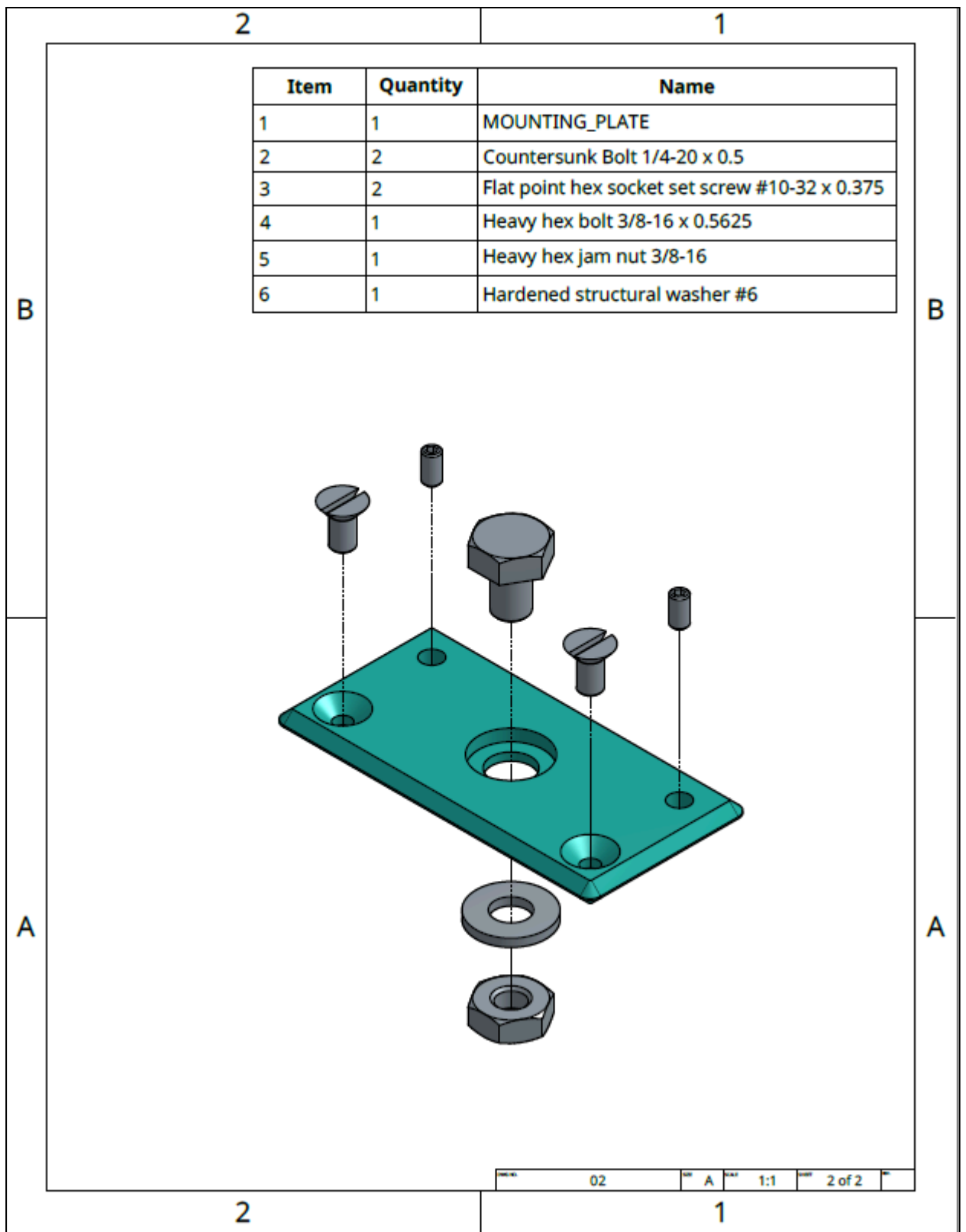
Repeat this for all hole types.

Assembly: Finally, once you have a single instance in your assembly, use the Replica Tool to find all matching holes for easy part placement. This allows you control all instances from a single edit of the original part.



- **Create an *exploded view* of your full assembly.**
- **Create 2 *drawing sheets* that includes:**
 - **1 Exploded view**
 - **1 Assembly Drawing with Hole Callouts for all holes**
 - **Basic dimensions of Part 1, 2, and hole placement (distance from edges and space between)**





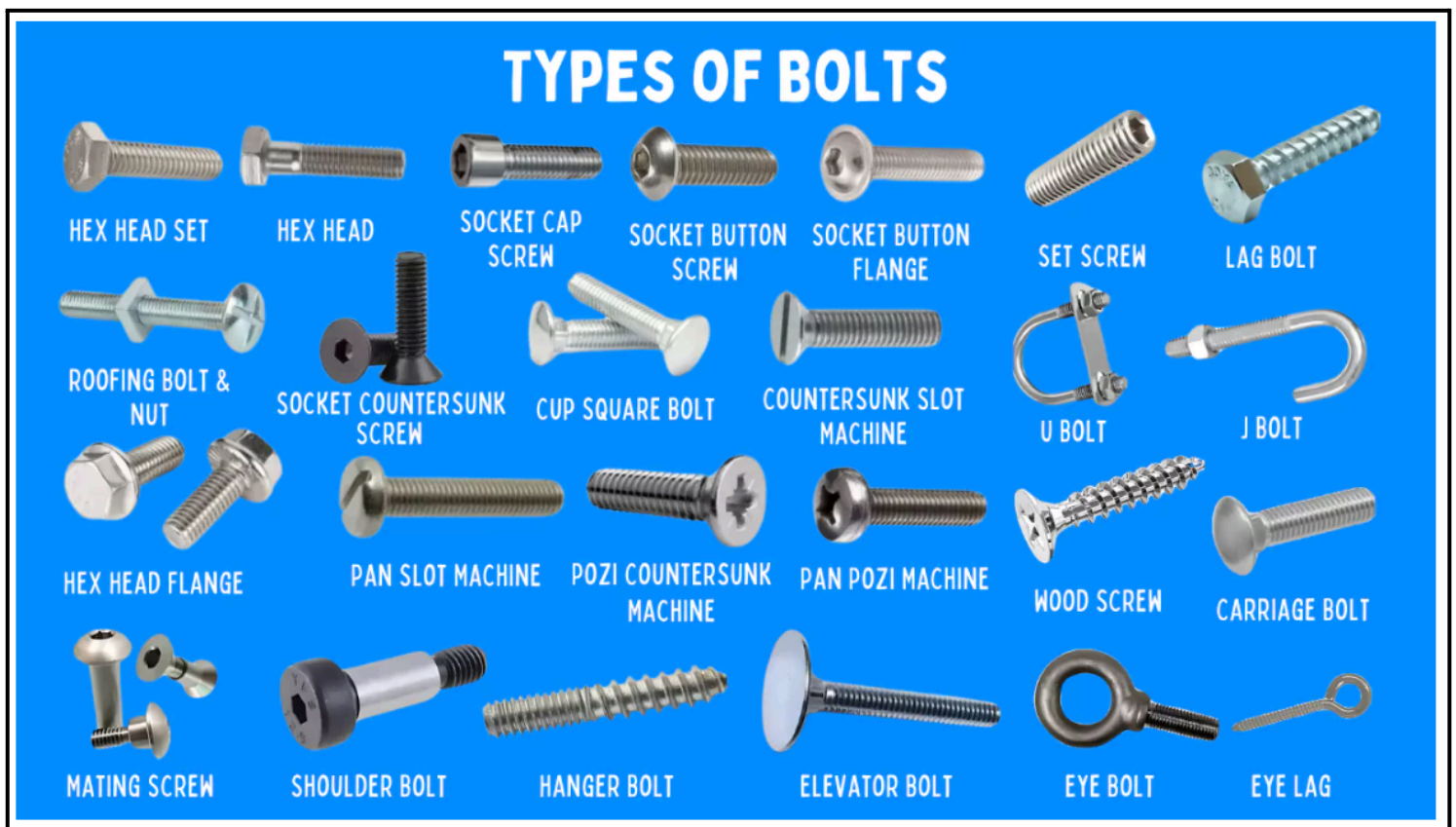
Suggested Hardware Reference Table

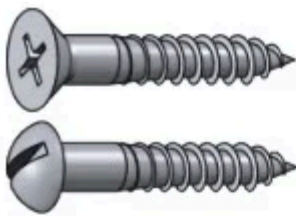
Hole Type	Inch Hardware Example	Metric Hardware Example
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Simple	<i>#10-24 Pan Head Machine Screw + Hex Nut</i>	<i>M5 Pan Head Machine Screw + M5 Hex Nut</i>
Countersink	<i>¼-20 Flat Head Socket Cap Screw + Washer</i>	<i>M6 Flat Head Socket Cap Screw + M6 Washer</i>
Counterbore	<i>¼-20 Socket Head Cap Screw + ¼-20 Hex Nut</i>	<i>M6 Socket Head Cap Screw + M6 Hex Nut + Washer</i>



- A **bolt** has a portion of the shank that is not threaded, whereas the set screw is threaded all the way to the head. This makes the bolt slightly stronger than the set screw, as whenever a thread is cut onto a shank a small amount of metal is removed by the process.
- Bolts are usually used to secure items in place, tightening and holding by use of a **threaded nut** (and often a **washer**). The plain part of the shank varies in length.
- **Set screws** are usually fully inserted into the receiving object, and are commonly used to connect two objects together. They are usually used with wood, metal and plastics





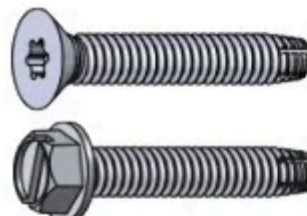
Wood Screws

Screws with a smooth shank and tapered point for use in wood. Abbreviated WS



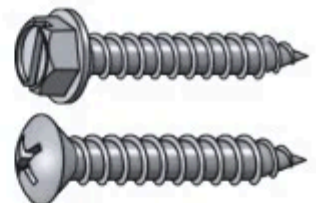
Machine Screws

Screws with threads for use with a nut or tapped hole. Abbreviated MS



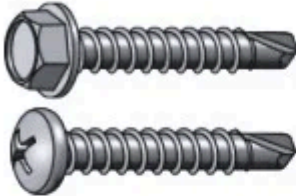
Thread Cutting Machine Screws

Machine screws with a thread cutting (self tapping) point.



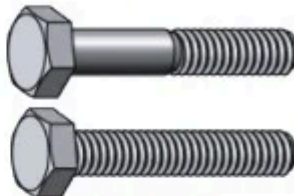
Sheet Metal Screws

Fully threaded screws with a point for use in sheet metal. Abbreviated SMS



Self Drilling SMS

A sheet metal screw with a self drilling point.



Hex Bolts

Bolts with a hexagonal head with threads for use with a nut or tapped hole. Abbreviated HHMB or HXBT.



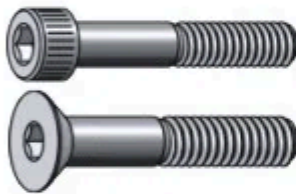
Carriage Bolts

Bolts with a smooth rounded head that has a small square section underneath.



Lag Bolts

Bolts with a wood thread and pointed tip. Abbreviated Lag.



Socket Screws

Socket screws, also known as Allen Head, are fastened with a hex Allen wrench.



Set Screws

Machine screws with no head for screwing all the way into threaded holes.



Eye Bolts

A bolt with a circular ring on the head end. Used for attaching a rope or chain.



Eye Lags

Similar to an eye bolt but with wood threads instead of machine thread.



J-Bolts

J shaped bolts are used for tie-downs or as an open eye bolt.



U-Bolts

Bolts in U shape for attaching to pipe or other round surfaces. Also available with a square bend.



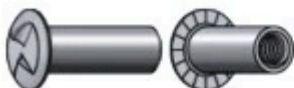
Shoulder Bolts

Shoulder bolts (also known as stripper bolts) are used to create a pivot point.



Elevator Bolts

Elevator bolts are often used in conveyor systems. They have a large, flat head.



Sex Bolts

Sex bolts (a.k.a. barrel nuts or Chicago bolts) have a female thread and are used for through bolting applications where a head is desired on both sides of the joint.



Mating Screws

Mating screws have a shoulder that matches the diameter of the sex bolts they are used with.



Hanger Bolts

Hanger bolts have wood thread on one end and machine thread on the other end

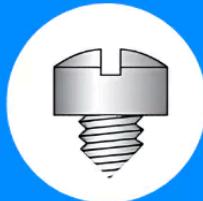
TYPES OF BOLT HEADS



BINDING UNDERCUT



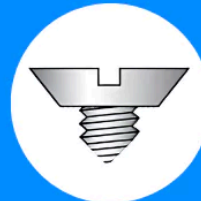
BUGLE



FILLISTER



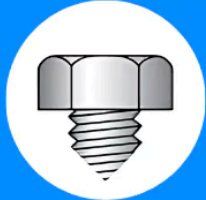
82° FLAT



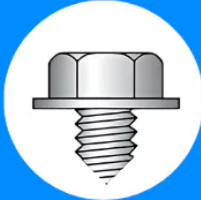
82° FLAT UNDERCUT



100° FLAT



HEX



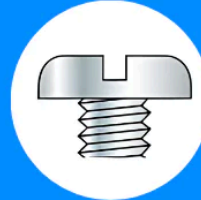
HEX WASHER



OVAL



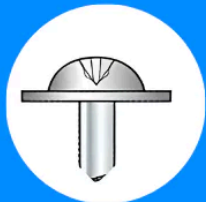
OVAL UNDERCUT



PAN



ROUND



ROUND WASHER



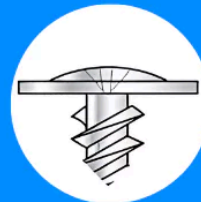
SERRATED



TRIM



TRUSS



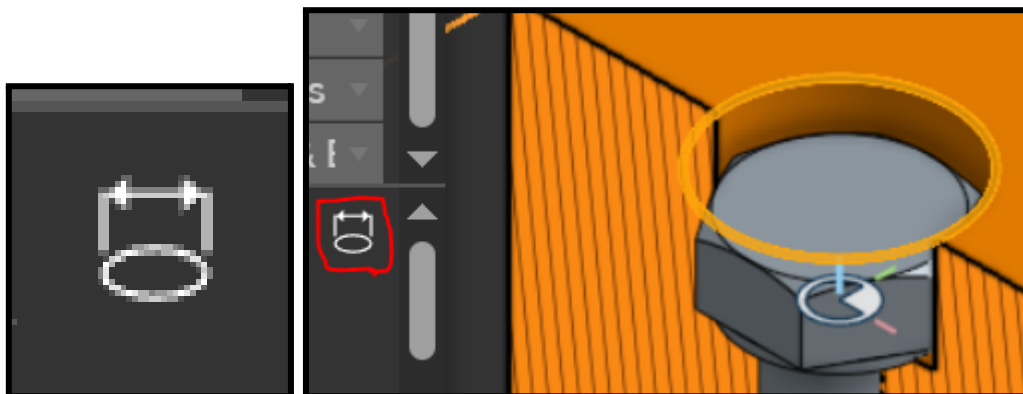
TRUSS MODIFIED



WAFER

? ⚙️ How to Use the Auto Size Fastener Option in Onshape

When working with fasteners in Onshape, you can save time and ensure accuracy by using the **Auto Size** feature. This automatically matches the fastener length and thread length to the depth of your hole or the thickness of your part.



✅ Steps to Use Auto Size

1. Open Your Assembly Tab

2. Click **Insert > Standard Content**

○ Choose:

■ **Standard:** Usually **ISO** for metric or **ANSI** for inch

- **Category:** *Bolts & Screws*
- **Class:** *E.g., Socket Head Screws, Pan Head, etc.*
- **Component:** *Pick the type of screw (e.g., Hex socket head ISO 4762)*

3. **Select a Size** (e.g., *M5, M6*, or *1/4-20*)

4. **Click the ↔ Auto Size Button**

- *It looks like two arrows in a circle next to the **Length** and **Thread Length** fields.*
- *Onshape will automatically:*
 - *Detect the **depth of the hole***
 - *Adjust the **fastener length** so it fits cleanly through the part (and nut, if present)*

5. **Click to Place the Fastener**

- *Place it into your part or hole*
- *Use the **Mate Connector** if it doesn't auto-align*

6. (Optional) **Repeat for Nut or Washer**

- *Go back to *Standard Content**
- *Choose *Nuts* or *Washers**
- *Select matching size and insert*

Tips for Success

- *Works best when your part already has **holes created with the Hole Tool***
- *You can always override Auto Size and choose a **manual length** if needed*
- *If Auto Size isn't working, check that the **hole is "through all"** and **not a sketch circle***



Hardware Hero – Scoring Scale

Progress Level	Score Range	Description
Requirement 1 + Tasks 1–4	A / A- (90–100%)	<i>Demonstrates full mastery of hole features, fastener use, parametric modeling, exploded views, and engineering</i>

		<i>drawing documentation using both inch and metric standards.</i>
Requirement 1 + Tasks 1–3	B+ (87–89%)	<i>Strong understanding of hardware types and hole features with appropriate standard content. Assembly and section view are present but may lack full parametric or drawing detail.</i>
Requirement 1 + Tasks 1–2	B / B- (80–86%)	<i>Demonstrates basic Hole Tool use, fastener insertion, and beginning assembly skills. Some integration or documentation steps may be missing.</i>
Requirement 1 Only	C Range (70–79%)	<i>Assembled basic hardware, but little or no evidence of applying Hole Tool, correct constraints, or documentation.</i>
✗ Incomplete / Missing Req. 1	D or Below (<70%)	<i>Not enough evidence to demonstrate core skills in fasteners, hole features, or assembly documentation.</i>

