E29 Final Report

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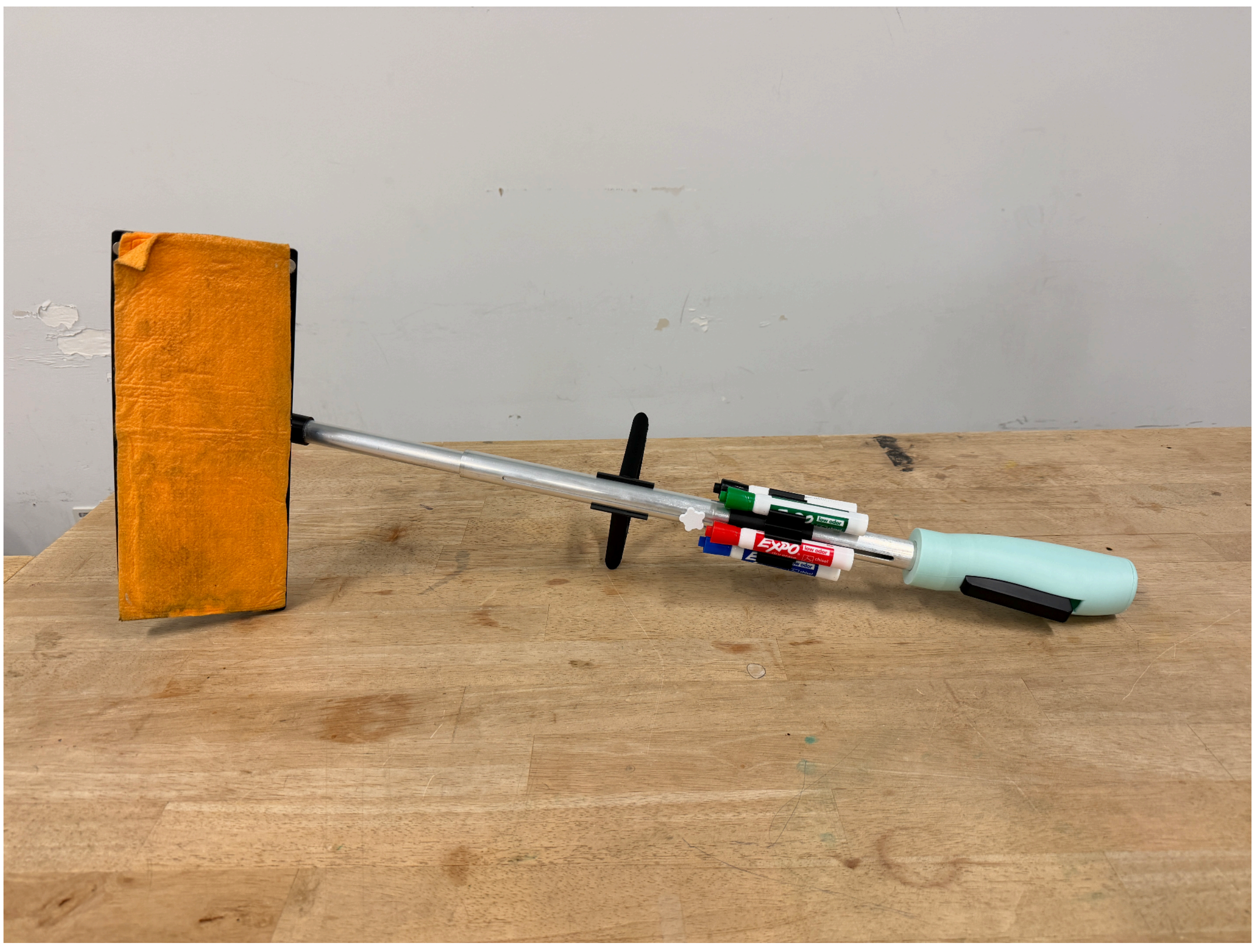

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Presentation Video

E29 Final Project - GlideAssist.mp4

Material and Process Selection Table:

Component	Component name	Material candidate	Process candidate (must be compatible with the material candidate to the left)	Potential advantages of this material/process combination	Potential disadvantages of this material/process combination	Selected material/process combination, and brief justification
1	Handle	PLA	FDM	Lighter weight, more customizable, good with complex geometry. Plastic has good elasticity for snap fits and friction fits.	Less durable, less precise, lower quality feel	3D printing, easier to rapidly prototype and less risky. Lighter in weight.
		Aluminum	CNC	Precise, durable, and more premium feel.	More complex to set up, with ergonomic geometry, hard to produce and DFM	
2	Handle Cap	PLA	FDM	Lighter weight, more customizable, good with complex geometry. Plastic has good elasticity for snap fits and friction fits.	Less durable, less precise, lower quality feel	3D printing, easier to rapidly prototype and less risky. Lighter in weight.
		Aluminum	CNC	Precise, durable, and more premium feel.	More complex to set up, with ergonomic geometry, hard to produce and DFM	
3	Trigger	PLA	FDM	Lighter weight, more customizable, good with complex geometry. Plastic has good elasticity for snap fits and friction fits.	Less durable, less precise, lower quality feel	3D printing, easier to rapidly prototype and less risky. Works well with snap fits.
		Aluminum	CNC	Precise, durable, and more premium feel.	More complex to set up, with ergonomic geometry, hard to produce and DFM. Not suitable for snap fits.	
4	Squeeze Bottle	TPU	FDM	Customizable geometry and volume	Sourcing TPU filament with right shore value and tweaking settings for this filament. Nozzle geometry would be hard to produce.	Off the shelf part, easier to integrate an OTS part and focus on other components.
		Off the shelf part	N/A (injection molded)	Component is consistent and durable. Mass manufactured so tested and validated.	Less freedom with geometry. Must design around the given geometry.	

5	Tubing	Off the shelf part	N/A (extruded)	Component is consistent and durable. Mass manufactured so tested and validated.	N/A not feasible to produce ourselves	Off the shelf part, easier to integrate an OTS part and focus on other components.
6	Aluminum Pipe	Aluminum	Hot Extrusion	Mass manufacturing leads to cheaper cost of component with mostly consistent tolerances. Light weight and durable.	N/A not feasible to produce ourselves. This type of stock is typically bought off the shelf and then adjusted using subtractive manufacturing.	Off the shelf part, easier to integrate an OTS part and focus on other components.
7	Marker Holder	PLA	FDM	Lighter weight, more customizable, good with complex geometry. Plastic has good elasticity for snap fits and friction fits.	Less durable, low quality feel.	3D printing, easier to rapidly prototype and less risky. Lighter in weight.
8	Shower Head	PLA	FDM	Lighter weight, more customizable, good with complex geometry. Plastic has good elasticity for snap fits and friction fits.	Less durable, low quality feel.	3D printing, easier to rapidly prototype and less risky. Lighter in weight.
9	Snap Fit Joint	PLA	FDM	Lighter weight, more customizable, good with complex geometry. Plastic has good elasticity for snap fits and friction fits.	The spring back clip for the snap fit mechanism had to be printed in a certain orientation, against the layers, which would allow for more elasticity.	Still 3d printing, maybe we could incorporate an actual spring in case the plastic wears down over time.
10	Rotation Joint	PLA	FDM	Lighter weight, more customizable, good with complex geometry. Plastic has good elasticity for snap fits and friction fits.	Less durable, low quality feel.	3D printing, easier to rapidly prototype and less risky. Lighter in weight.

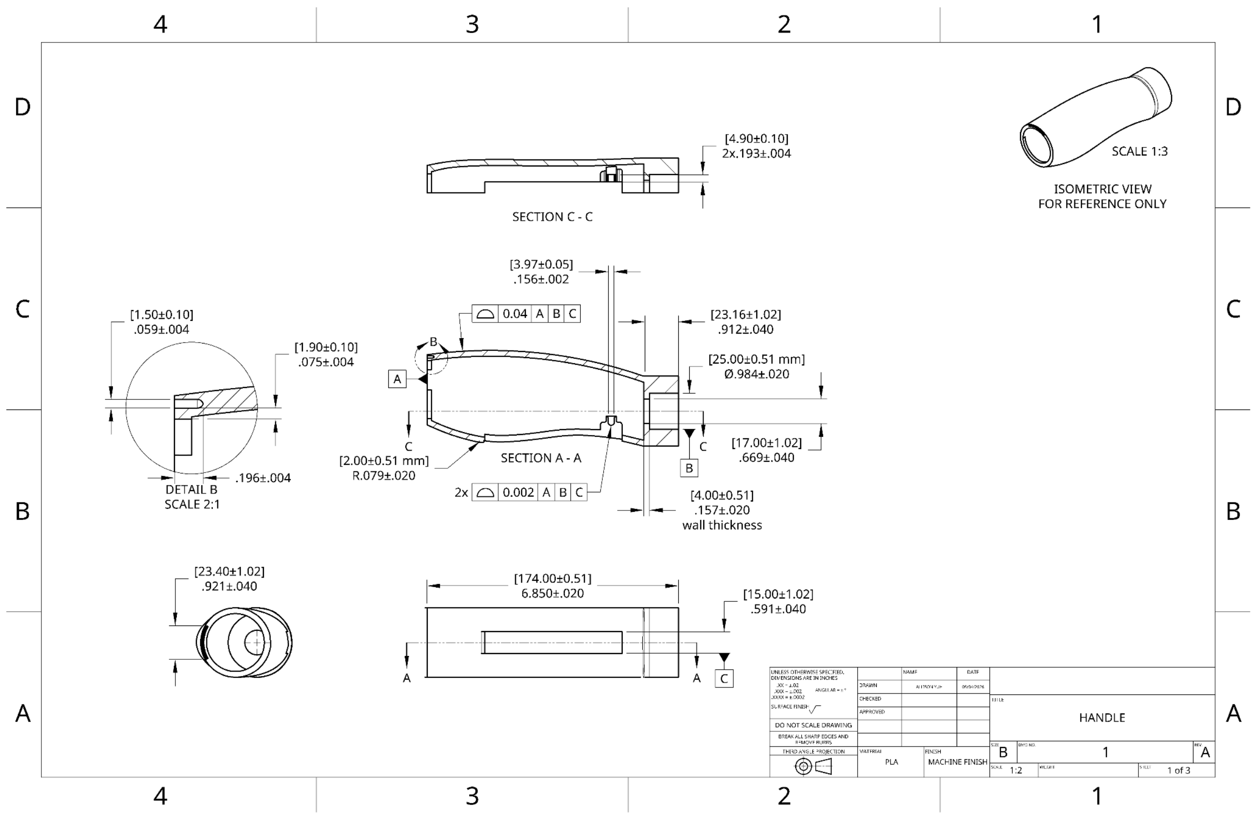
Fit and Tolerancing Specification Table:

Fit #	Connects component #… (A)	…to component # or external object (B)	Function of fit (e.g. rotation joint, hold phone in place, etc)	ANSI grade of fit (e.g. RC6) or "snap fit"	Component A critical dimension tolerance e.g. diameter 10.0±0.1 mm	Component B critical dimension tolerance	Can your chosen manufacturing process deliver the required tolerance(s)?
1	1 Handle	2 Handle cap	Removable friction / snap fit. Cap should press into handle and stay in place, but still be removable by hand. Slot in handle allows flexing.	Light interference / snap fit. Closest ANSI equivalent: **FN1** light drive fit, but functionally this is a snap/friction fit rather than a standard rigid shaft-hole fit.	Handle inner diameter: 40.0 ± 0.1 mm	Handle cap outer diameter: 40.05 ± 0.1 mm	For 3D printing, yes if test-fitted and tuned. The current printed dimensions, 40 mm ID and 39.9 mm OD, are intentionally adjusted for printer error and surface roughness.
2	1 Handle	3 Trigger	Rotating pivot fit. Trigger barrels snap into channels and rotate freely with very little side/translation play.	Close running / close clearance fit. ANSI equivalent: **RC1 or RC2**	Handle channel diameter: 4.05 ± 0.05 mm	Trigger barrel diameter: 4.00 ± 0.03 mm	For typical FDM 3D printing, this is hard because the fit is small and sensitive. The current 4.4 mm printed channel for a 4 mm barrel makes sense to compensate for printing inaccuracy. Resin printing or machining would handle this better.
3	4 Squeeze bottle nozzle	5 Tubing	Tubing slides over tapered nozzle and becomes friction-fitted so it does not slip off.	Flexible interference / press fit. Closest ANSI equivalent: **FN1/FN2,** but because tubing is elastic, this is better described as a barbed/tapered hose interference fit.	Nozzle outer diameter at seated location: 3.2 ± 0.1 mm	Tubing inner diameter: 3.0 ± 0.1 mm	Yes, if the tubing is flexible and the nozzle is tapered. The interference comes from the tubing stretching over the nozzle, so this does not need the same precision as a rigid press fit.
4	1 Handle	6 Shaft	Holds by friction, removable with hand force or light tool force for the shaft of the wiper.	LN1 light interference fit / light press fit	Hole diameter: 24.98 ± 0.02 mm	Rod outer diameter: 25.00 ± 0.01 mm	Machining can deliver this.Typical FDM 3D printing likely cannot reliably hold this tolerance without test fitting, sanding, or reaming. The shaft is standardized, so the 3D print will need to be adjusted to fit.

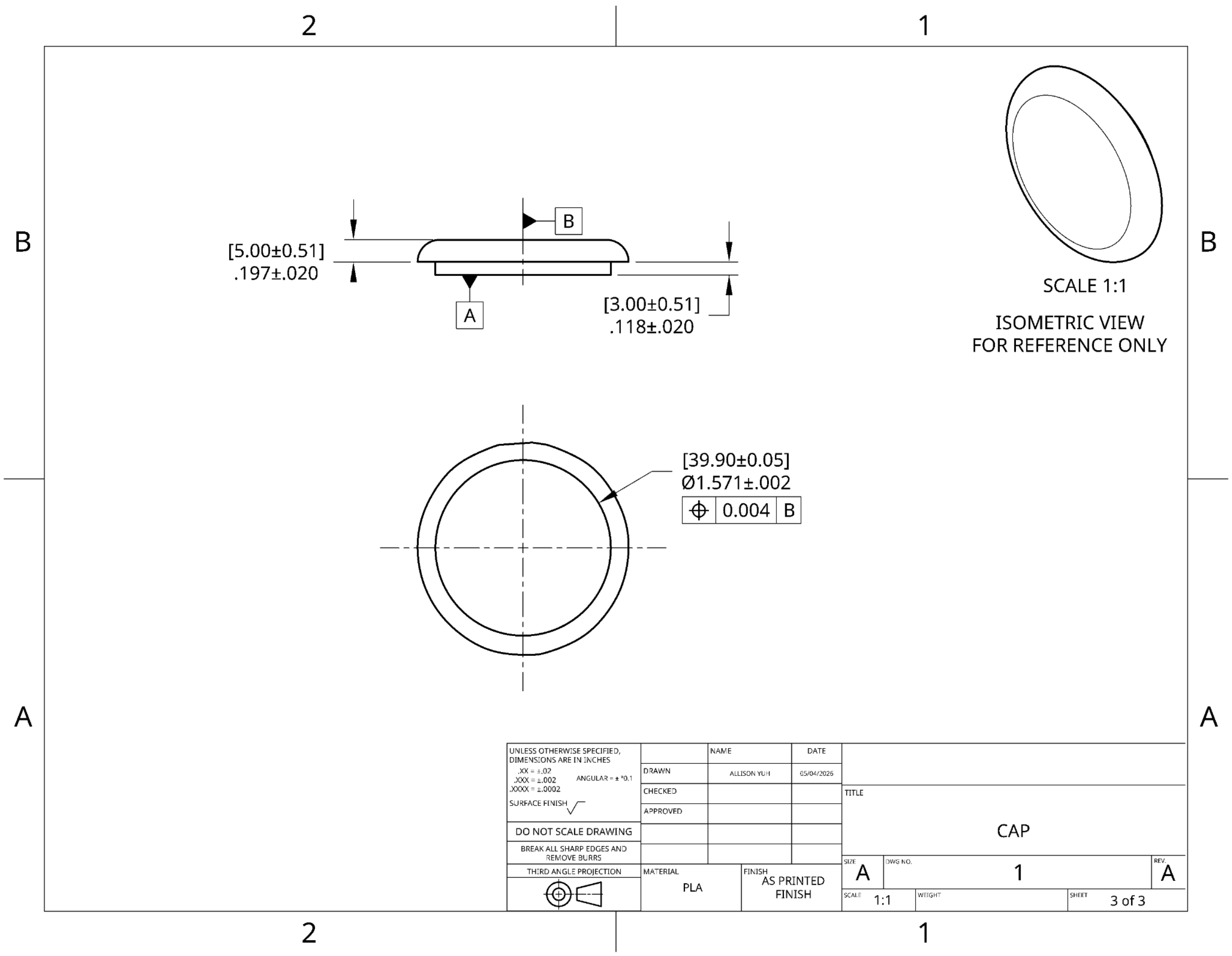
5	7 Marker Holder	6 Shaft	Light transition fit fit that will be superglued onto the rod once position is finalized.	LN1 light interference fit / light press fit	Holder Hole diameter: 25.1 + 0.05	Rod outer diameter: 25.00 ± 0.01 mm	For FDM printing this is a very tight fit with a 0.1mm nominal clearance and 0.4mm worst case. Typical FDM accuracy is +/- 0.1-0.2mm, however for a part like this that we would like to have some light interference it will meet the requirements.
6	8 Shower Head	9 Snap Fit Joint	Clearance fit to allow for smooth snap in and out of the spring clip	Snap Fit	Female Snap Fit Inner Diameter: 28.575 mm	Male Snap Fit outer diameter: 28.575 mm	

GD&T Drawings

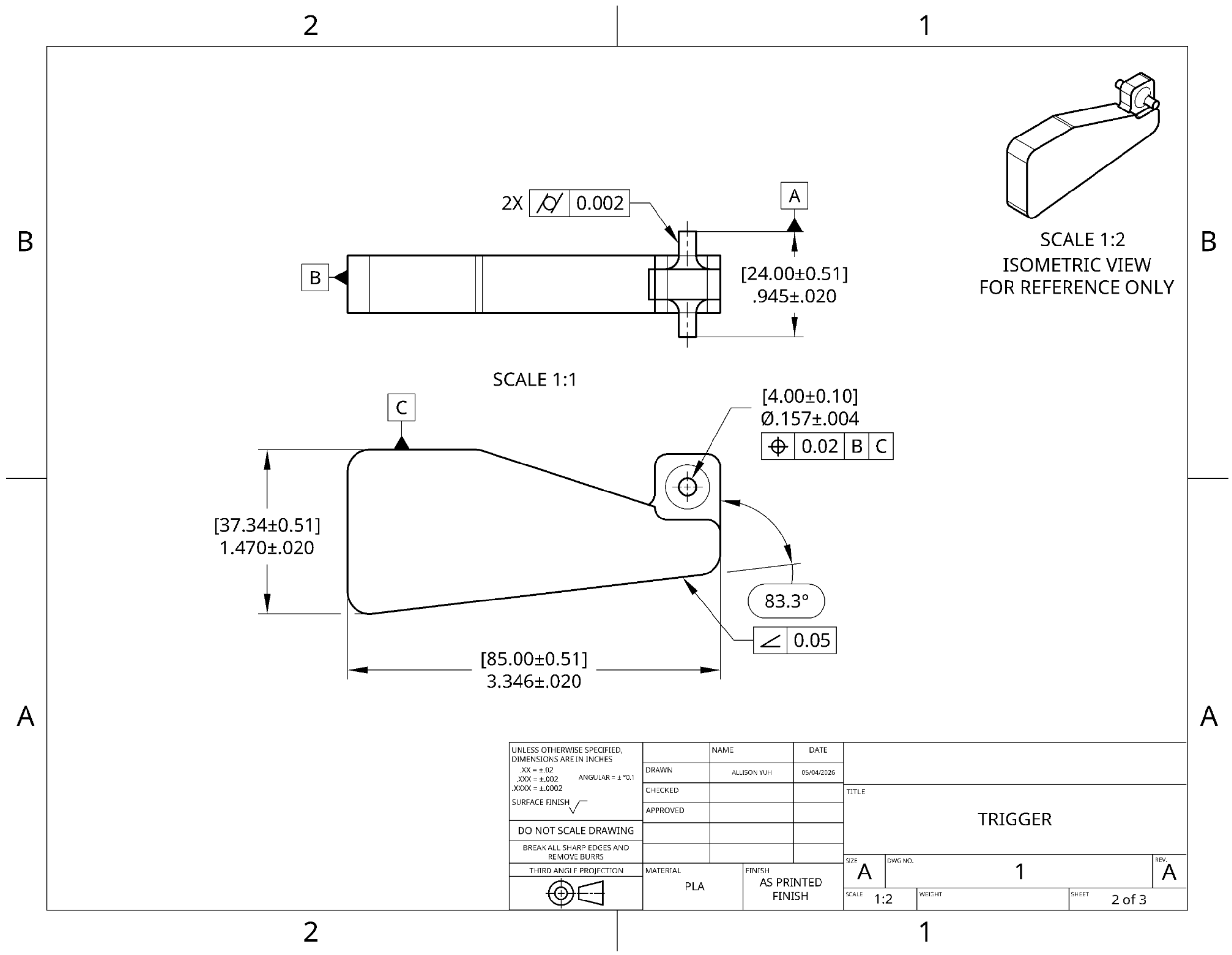
Handle Housing



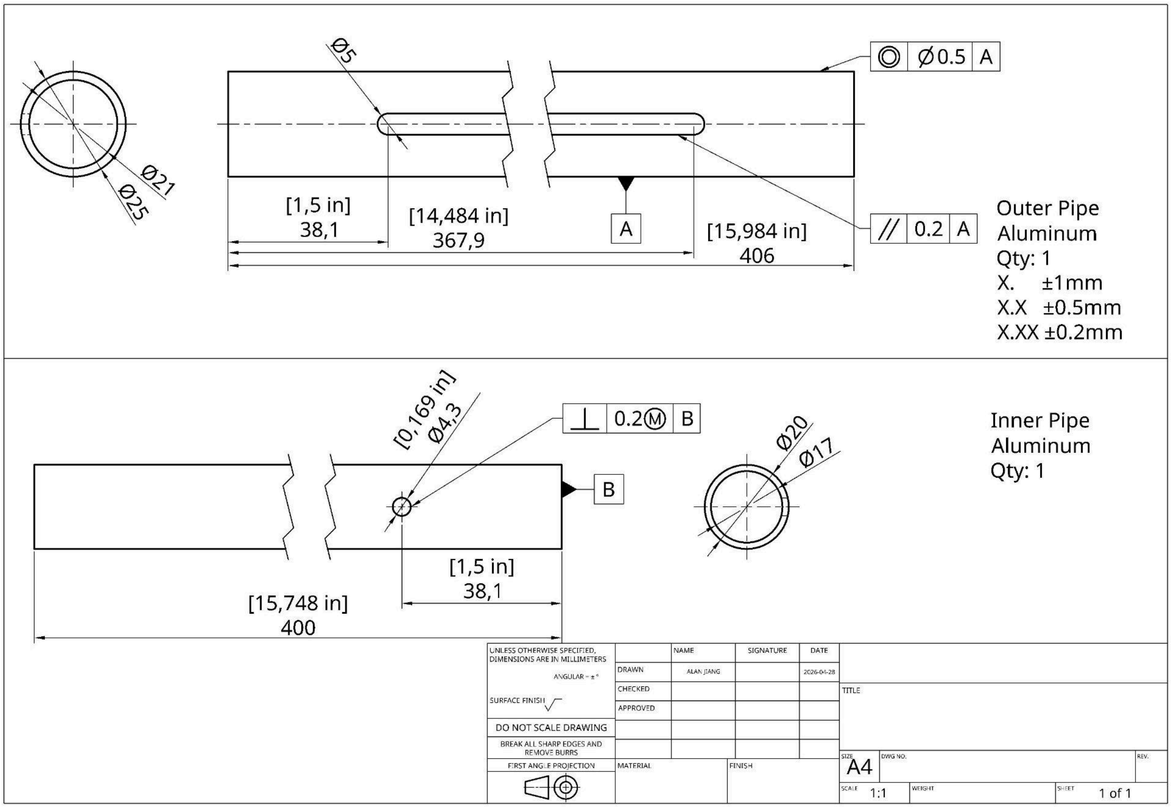
<u>Handle Cap</u>



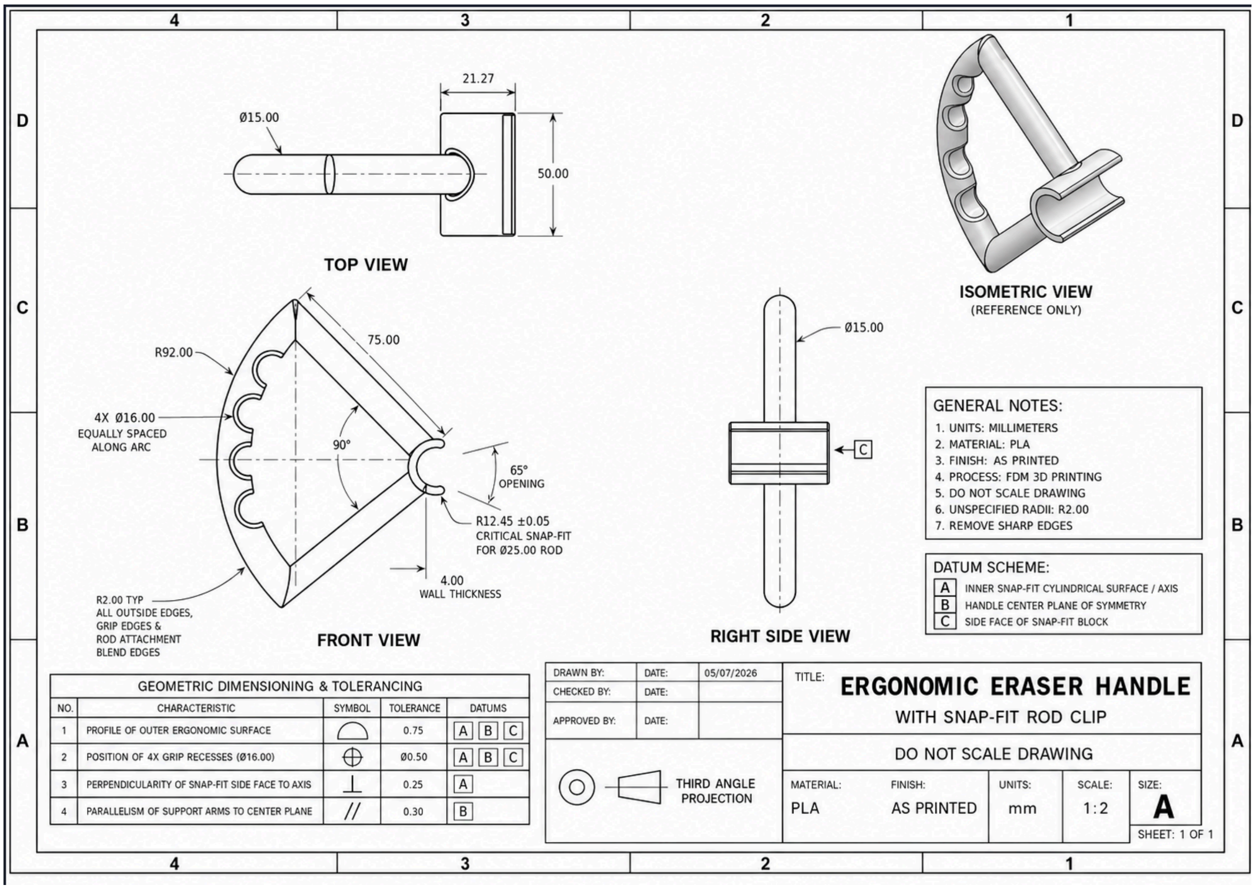
<u>Solution Trigger</u>



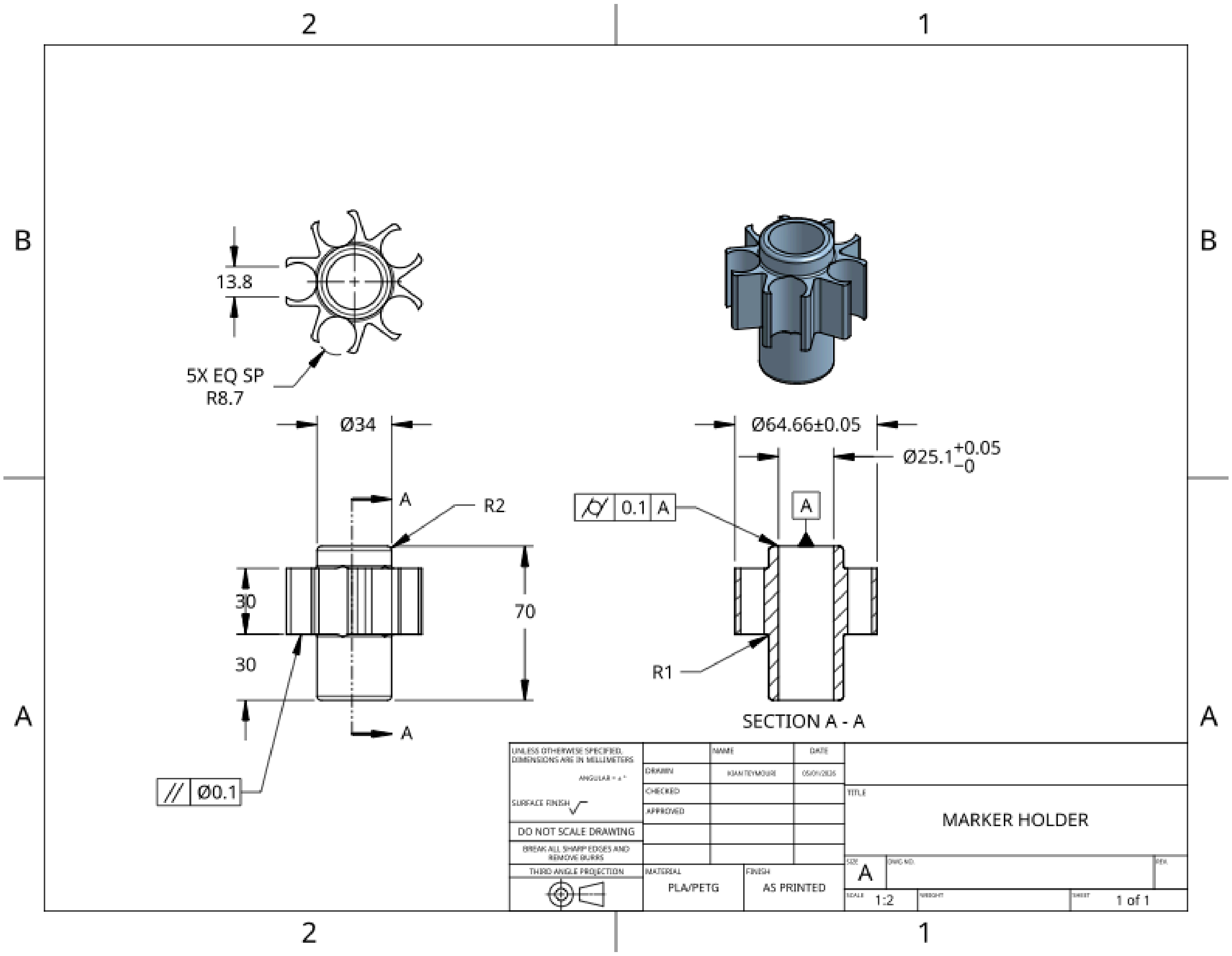
Aluminum Stock



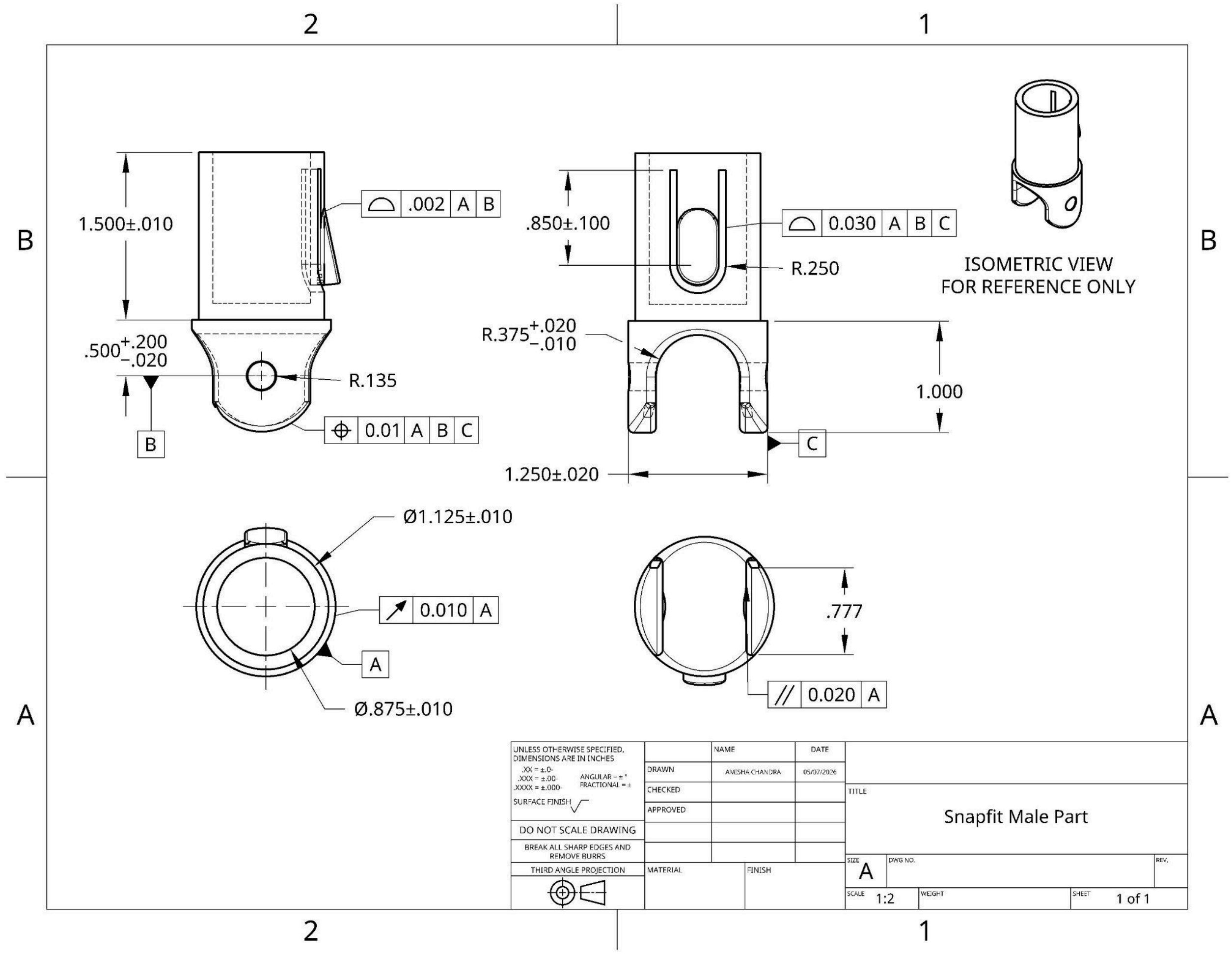
Handle Drawing



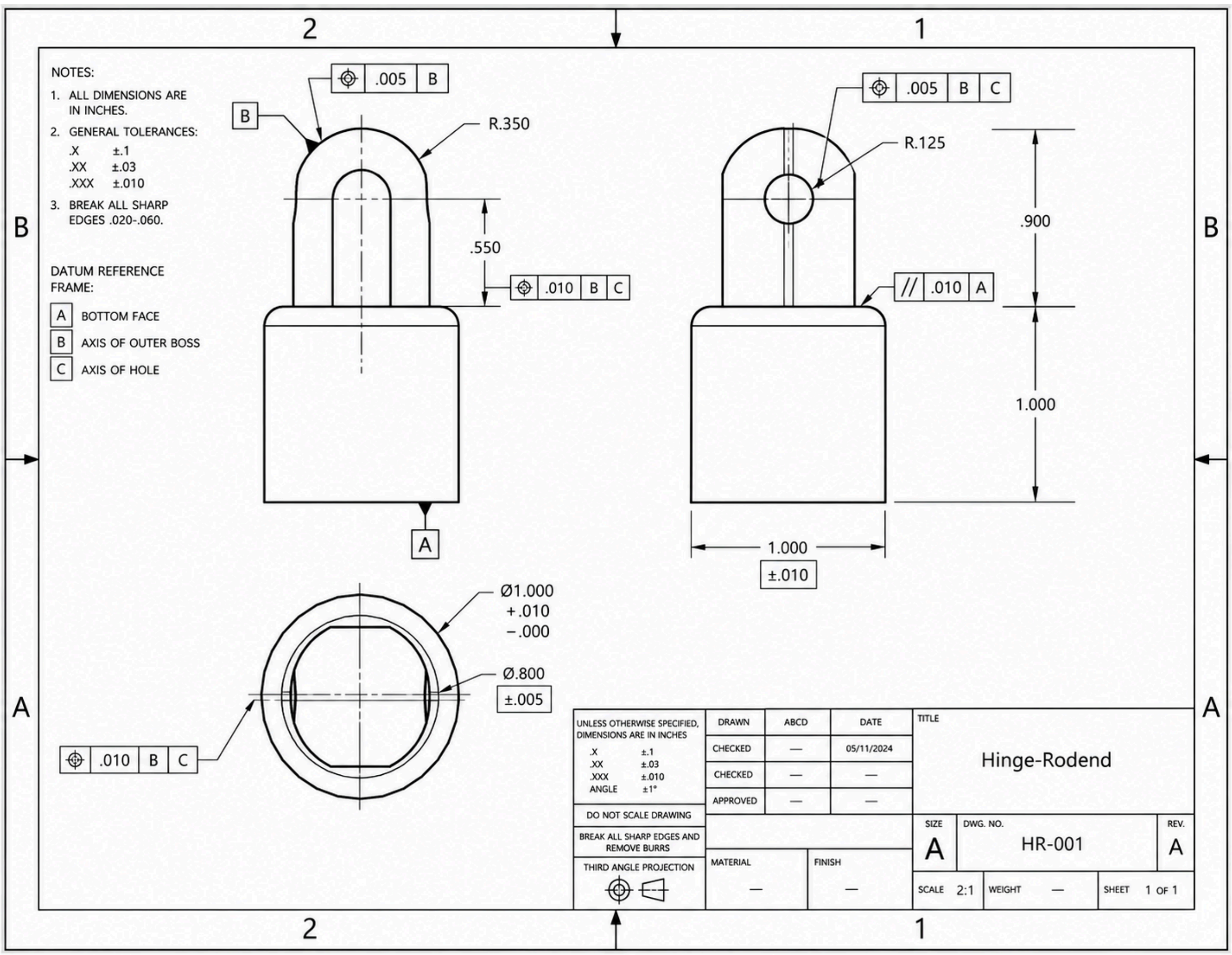
Marker Holder Drawing



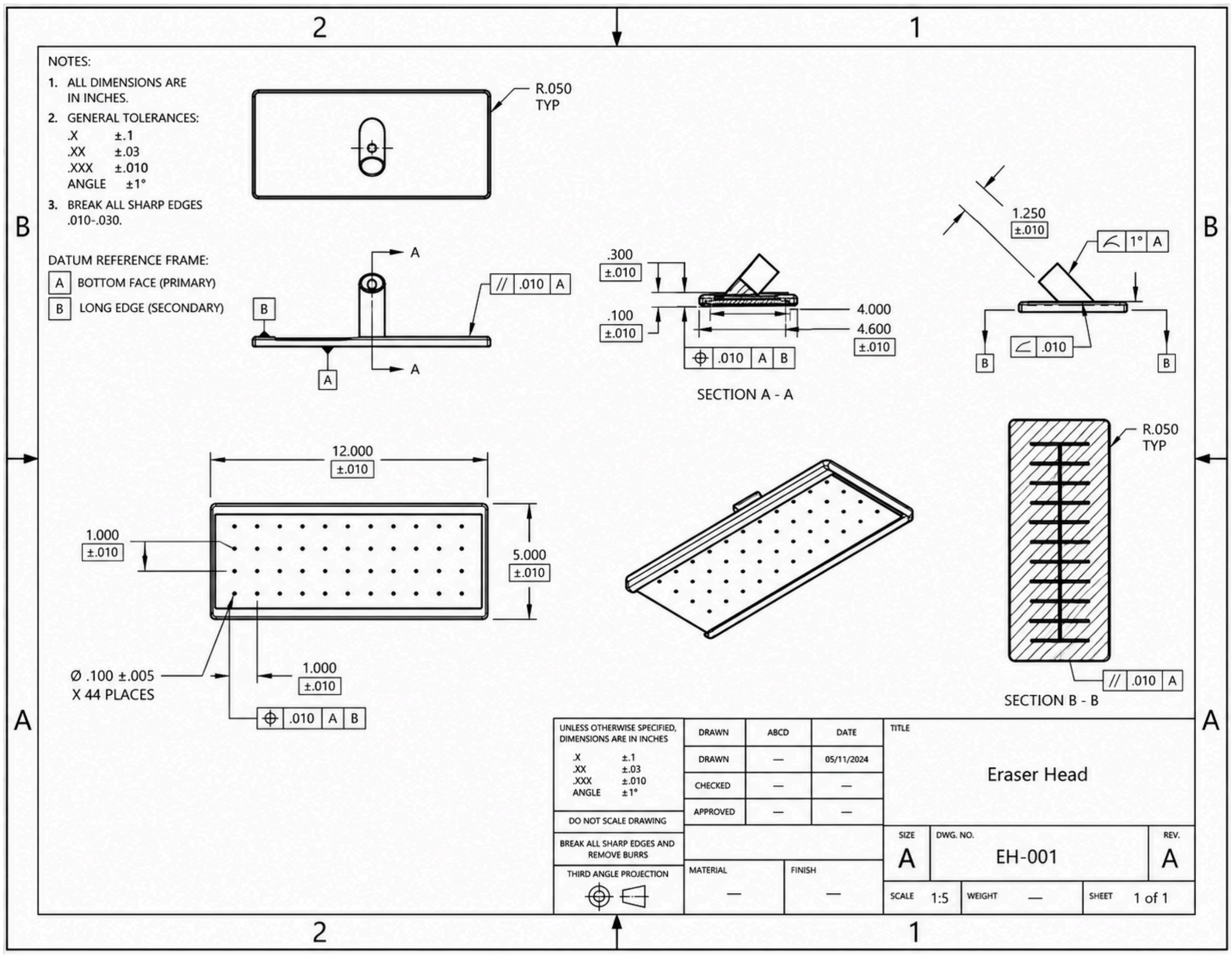
Male Snap Fit Drawing



Hinge Joint Rod-End



Eraser Head



NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. GENERAL TOLERANCES:
.X ±.1
.XX ±.03
.XXX ±.010
ANGLE ±1°
3. BREAK ALL SHARP EDGES .010-.030.
DATUM REFERENCE FRAME:
A BOTTOM FACE (PRIMARY)
B LONG EDGE (SECONDARY)
R.050 TYP
SECTION A - A
SECTION B - B
12.000 ±.010
5.000 ±.010
1.000 ±.010
Ø .100 ±.005 X 44 PLACES
.300 ±.010
.100 ±.010
4.000
4.600 ±.010
1.250 ±.010
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING
BREAK ALL SHARP EDGES AND REMOVE BURRS
THIRD ANGLE PROJECTION
DRAWN ABCD
DATE 05/11/2024
CHECKED
APPROVED
MATERIAL
FINISH
TITLE Eraser Head
SIZE A
DWG. NO. EH-001
REV. A
SCALE 1:5
WEIGHT
SHEET 1 of 1

<u>Final Prototype</u>


Sharpie
FLIP CHART
DRY ERASE
MARKER
MK7073
LOW ODOR
CHISEL POINT
low odor
chisel
dry erase

Additional Research

Market Sizing

Our market research identified schools, universities, teachers, and accessibility-focused users as the primary target audience for this product. In the United States alone, there are approximately 3.8 million K–12 teachers and 1.5 million university faculty members, creating a potential market of over 5.3 million educators. Since roughly 77% of teachers regularly use whiteboards in classrooms, whiteboard cleaning is a frequent and repetitive task. Assuming even 20% of these educators would realistically adopt a more ergonomic and efficient solution, the estimated customer base exceeds 816,000 potential users. This demonstrates a strong demand for a product that simplifies whiteboard maintenance while reducing physical strain. Our product, GlideAssist, is especially valuable because it combines familiarity, ease of use, and accessibility into a simple handheld tool that can help users clean large whiteboards more comfortably and efficiently, particularly for teachers or users with shoulder, mobility, or repetitive strain issues.

Design Calculations

Handle - trigger snap feature:

$d=4.00$ mm

$L=8.50$ mm

Cross-sectional area of the PLA cylinder:

$A=(\pi 4^2)/4 =12.57\ mm^2$

Using a typical 3D-printed PLA ultimate tensile strength:

$\sigma_{UTS} =45.5$ MPa

The tensile force required to break the cylinder is:

$F_{break} =\sigma_{UTS} * A =(45.5)(12.57) =572$ N

So the estimated axial force to break the PLA cylinder is:

$F_{break} \approx 570$ N

For design with a safety factor FoS = 2:

$F_{allowable} = Fos * F_{break} = 2 * 572 = 286$ N