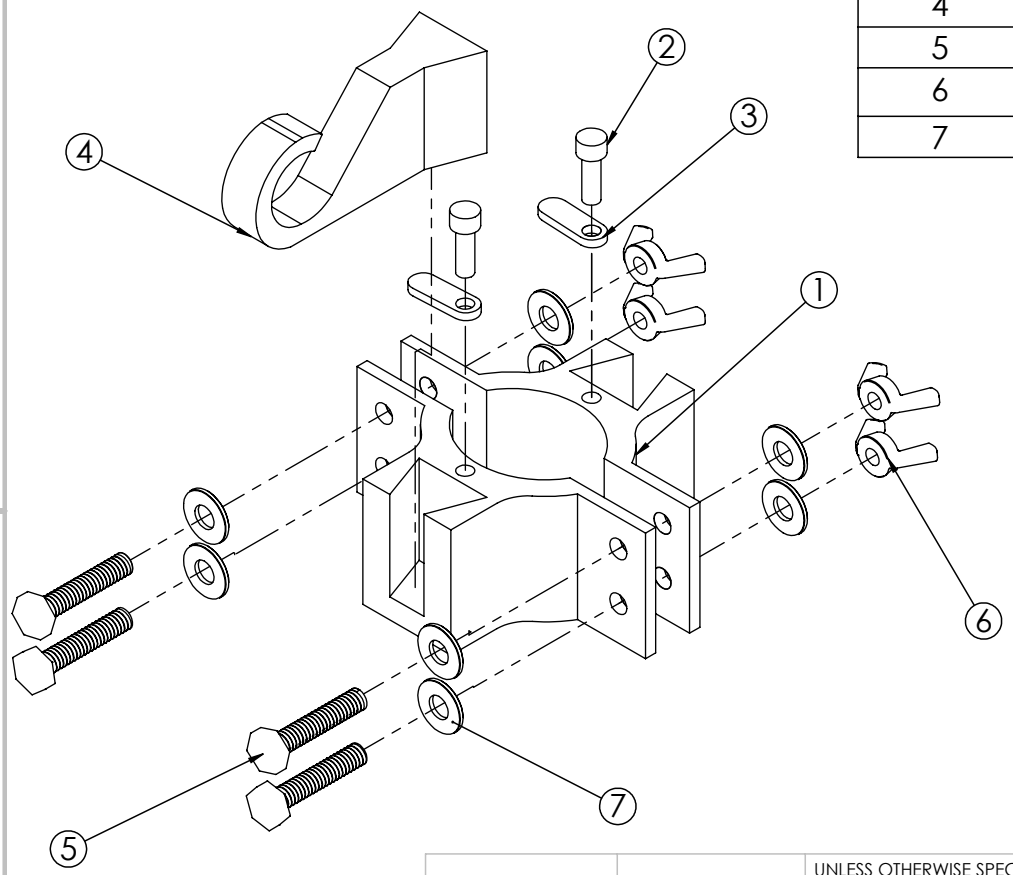
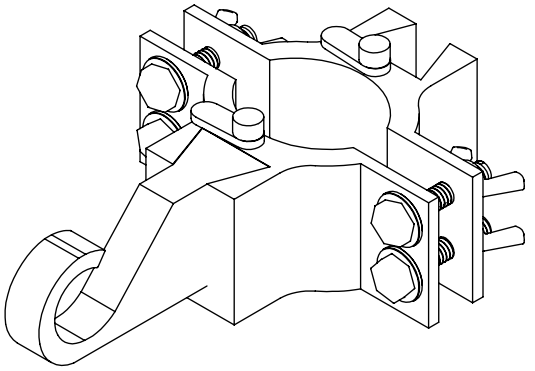
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	E29-F22-1039-1	Clamp Half	2
2	E29-F22-1039-2	Peg	2
3	E29-F22-1039-3	Tab	2
4	E29-F22-1039-4A	Attachment (Hook)	1
5	800616	Screw	4
6	802371	Wingnut	4
7	802481	Washer	8





E29 Group 1039

NEXT ASSY	USED ON	
APPLICATION		DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES:

TOLERANCES:
Linear: ±0.005
Angles: ±2°
All other angles: ±0.02

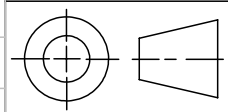
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M-1994

MATERIAL

FINISH

	NAME	DATE
DRAWN	E.C.	30NOV22
CHECKED	R.D.	08DEC22
ENG APPR.	A.L.	08DEC22
MFG APPR.		
Q.A.		

COMMENTS:



S.H.A.M.

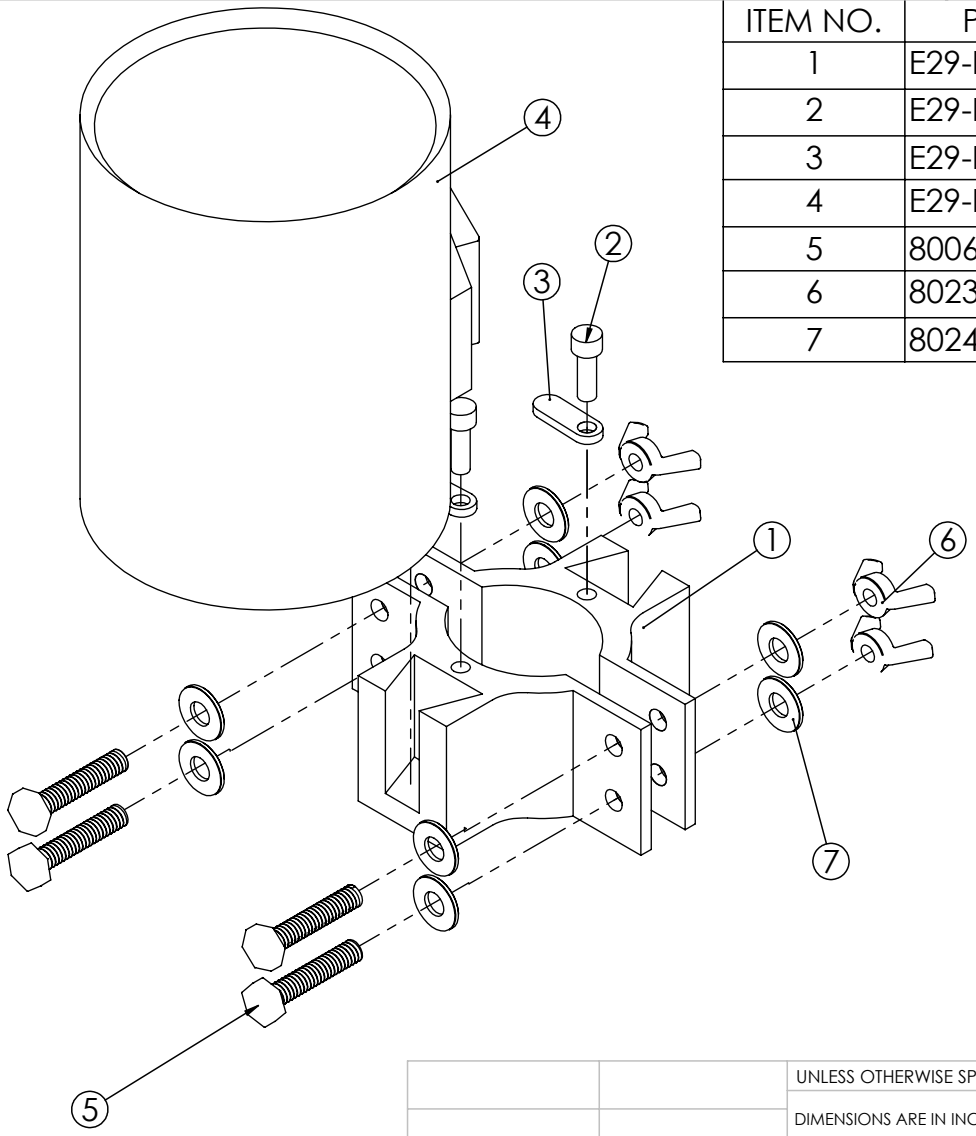
TITLE:

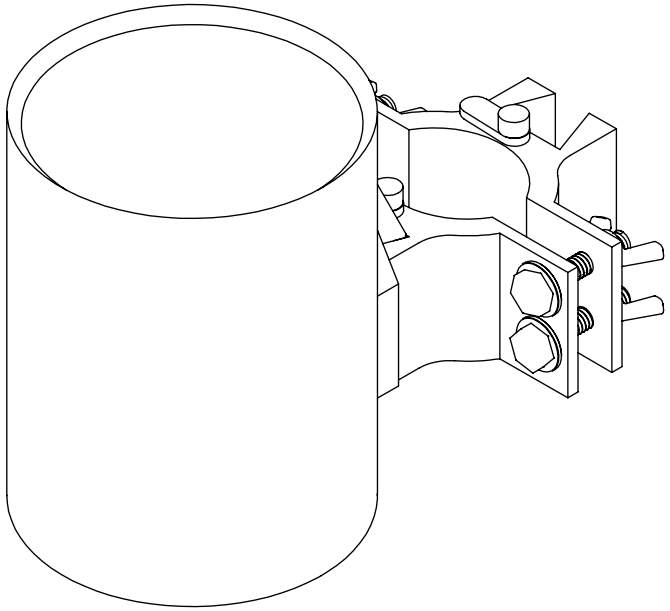
Clamp Assembly (Hook)

SIZE	DWG. NO.	REV
A	E29-F22-1039-A	

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	E29-F22-1039-1	Clamp Half	2
2	E29-F22-1039-2	Peg	2
3	E29-F22-1039-3	Tab	2
4	E29-F22-1039-4B	Attachment (Cup Holder)	1
5	800616	Screw	4
6	802371	Wingnut	4
7	802481	Washer	8





E29 Group 1039

NEXT ASSY	USED ON	
APPLICATION		DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES:

TOLERANCES:
Linear: ±0.005
Angles: ±2°
All other angles: ±0.02

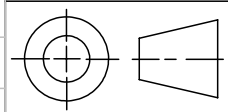
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M-1994

MATERIAL

FINISH

	NAME	DATE
DRAWN	E.C.	30NOV22
CHECKED	D.R.	08DEC22
ENG APPR.	A.L.	08DEC22
MFG APPR.		
Q.A.		

COMMENTS:



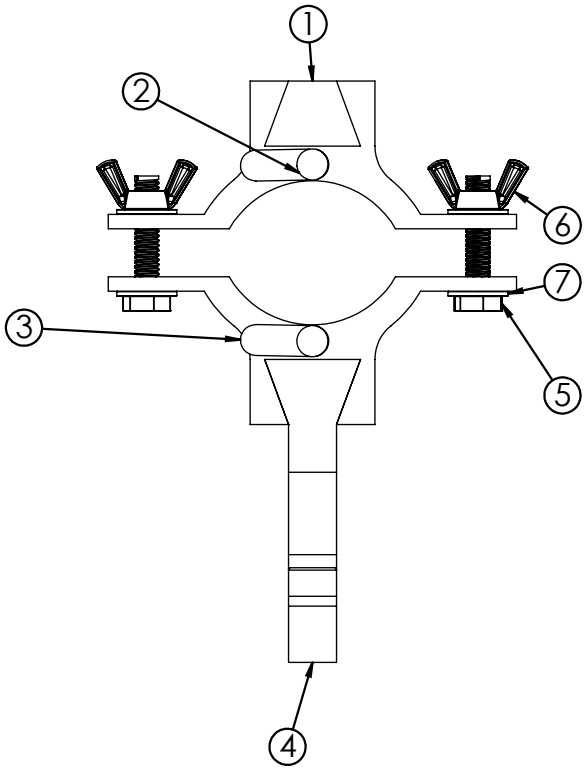
S.H.A.M.

TITLE:

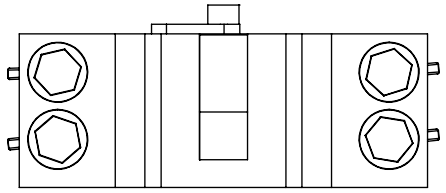
Clamp Assembly (Cup Holder)

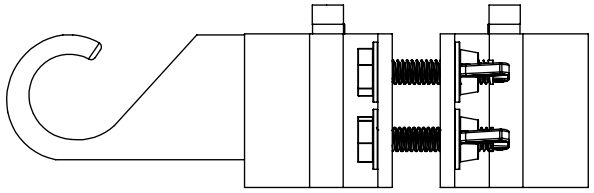
SIZE	DWG. NO.	REV
A	E29-F22-1039-B	

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	E29-F22-1039-1	Clamp Half	2
2	E29-F22-1039-2	Peg	2
3	E29-F22-1039-3	Tab	2
4	E29-F22-1039-4A	Attachment (Hook)	1
5	800616	Screw	4
6	802371	Wingnut	4
7	802481	Washer	8





E29 Group 1039

NEXT ASSY	USED ON	
APPLICATION		DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES:

TOLERANCES:
Linear: ±0.005
Angles: ±2°
All other angles: ±0.02

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M-1994

MATERIAL

FINISH

	NAME	DATE
DRAWN	D.R.	08 DEC 22
CHECKED	NDLT	08 DEC 22
ENG APPR.	A.L	08 DEC 22
MFG APPR.		
Q.A.		

COMMENTS:

THIRD ANGLE PROJECTION

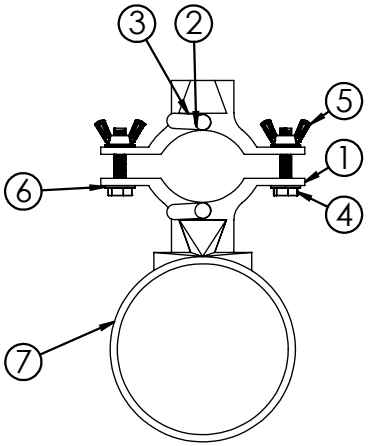
S.H.A.M.

TITLE:

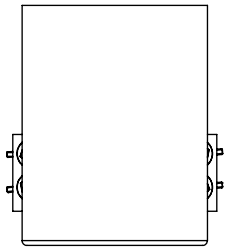
Assembled Drawing

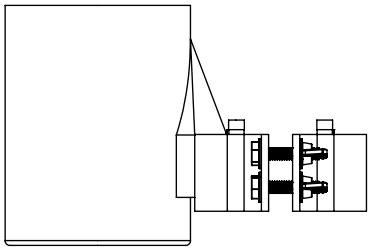
SIZE	DWG. NO.	REV
A	E29-F22-1039-C	

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	E29-F22-1039-1	Clamp Half	2
2	E29-F22-1039-2	Peg	2
3	E29-F22-1039-3	Tab	2
4	E29-F22-1039-4B	Attachment (Cup Holder)	1
5	800616	Screw	4
6	802371	Wingnut	4
7	802481	Washer	8





E29 Group 1039

NEXT ASSY	USED ON	
APPLICATION		DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES:

TOLERANCES:
Linear: ±0.005
Angles: ±2°
All other angles: ±0.02

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M-1994:

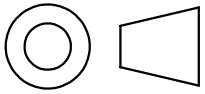
MATERIAL

FINISH

	NAME	DATE
DRAWN	D.R.	08DEC22
CHECKED	E.C.	08DEC22
ENG APPR.	A.L.	08DEC22
MFG APPR.		
Q.A.		

COMMENTS:

THIRD ANGLE PROJECTION



S.H.A.M.

TITLE:

Assembled Drawing

SIZE	DWG. NO.	REV
A	E29-F22-1039-D	

SCALE: 1:4 | WEIGHT: | SHEET 1 OF 1

Bill of Materials

Clamp:

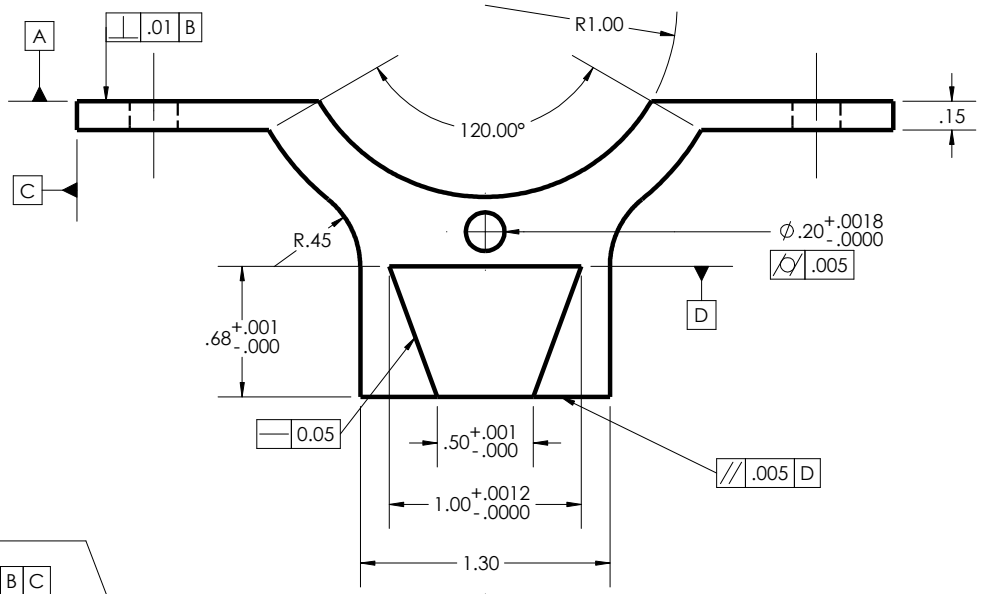
Part #	Component Name	Quantity	Hypothesized material(s) and justifying comments	Hypothesized manufacturing process(es) and justifying comments
1	Clamp	2	PLA plastic (Jacobs 3D printed)	Jacobs Self Service Printing: https://jacobsinstitute.berkeley.edu/jacobs-self-service-printing/
2	Peg	2	PLA plastic (Jacobs 3D printed)	Jacobs Self Service Printing: https://jacobsinstitute.berkeley.edu/jacobs-self-service-printing/
3	Tab	2	PLA plastic (Jacobs 3D printed)	Jacobs Self Service Printing: https://jacobsinstitute.berkeley.edu/jacobs-self-service-printing/
5	Winged Bolt (¼ 20)	4 (1 pack of 5)	Steel and zinc, easily store-bought while also providing enough strength to hold everything together	store-bought: https://www.homedepot.com/p/Everbilt-1-4-in-20-x-1-in-Thumbscrew-Thumb-Zinc-Plated-Machine-Screw-2-Pack-815261/204274858
6	Winged Nut (¼ 20)	4 (1 pack of 5)	Steel and zinc, easily store-bought while also providing enough strength to hold everything together	store-bought: https://www.homedepot.com/p/Everbilt-1-4-in-20-Zinc-Plated-Wing-Nut-4-Pack-802371/204274202
7	Washer (6 mm)	8	Steel and zinc, easily store-bought while also providing enough strength to hold everything together	Store-bought: https://www.lowes.com/pd/Hillman-10-Count-6-mm-Zinc-Plated-Metric-Flat-Washer/3012713

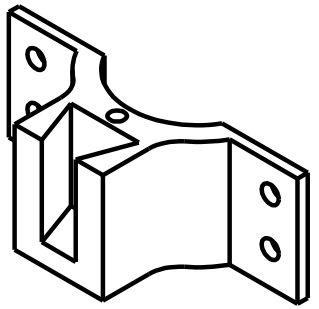
Hook:

Part #	Component Name	Quantity	Hypothesized material(s) and justifying comments	Hypothesized manufacturing process(es) and justifying comments
4A	Hook Attachment	1	PLA plastic (Jacobs 3D printed)	Jacobs Self Service Printing: https://jacobsinstitute.berkeley.edu/jacobs-self-service-printing/

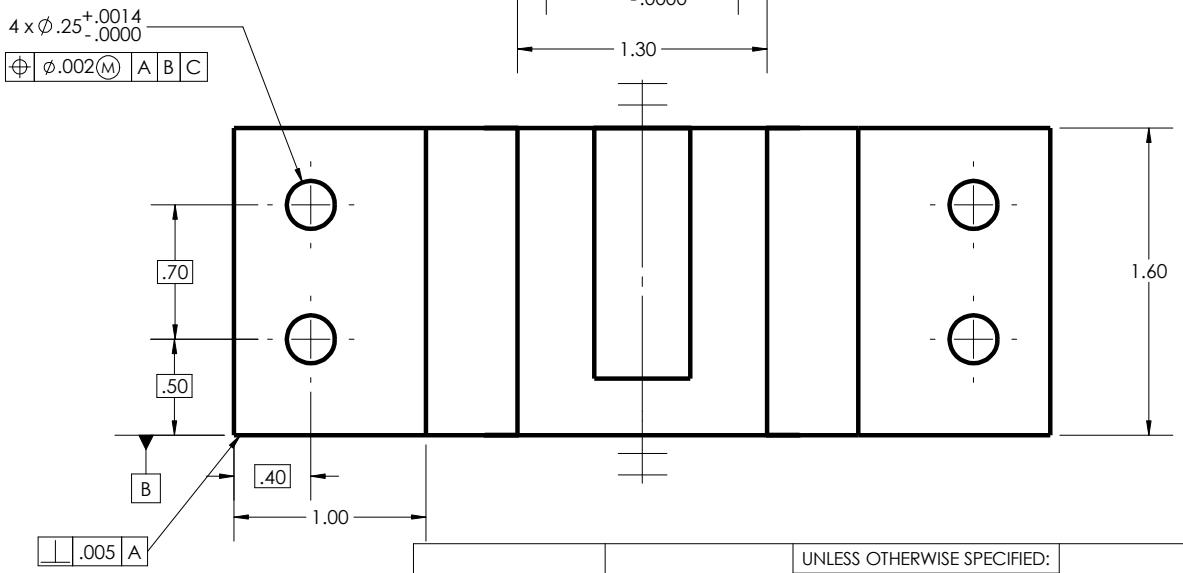
Cup Holder:

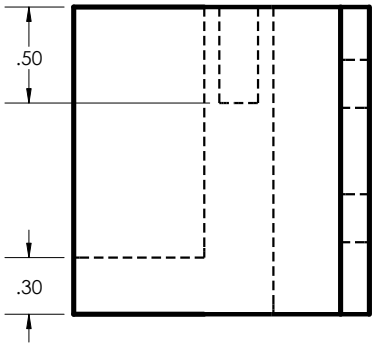
Part #	Component Name	Quantity	Hypothesized material(s) and justifying comments	Hypothesized manufacturing process(es) and justifying comments
4B	Cup Holder Attachment	1	PLA plastic (Jacobs 3D printed)	Jacobs Self Service Printing: https://jacobsinstitute.berkeley.edu/jacobs-self-service-printing/





PICTORIAL FOR CLARITY





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES:	DRAWN	KI	28NOV22
		TOLERANCES: Linear:: ±0.005 Angles: ±2° All other angles: ±0.02	CHECKED	EC	08DEC22
			ENG APPR.	AL	08DEC22
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M-1994	Q.A.		
		MATERIAL: PC Plastic	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

S.H.A.M.

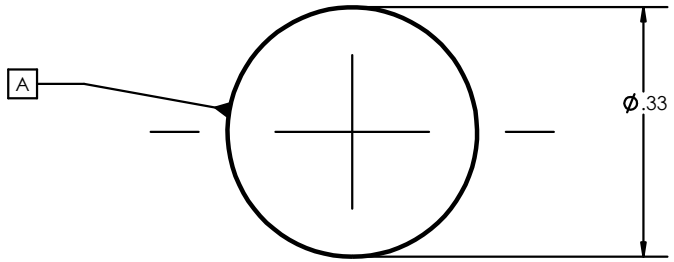
TITLE:

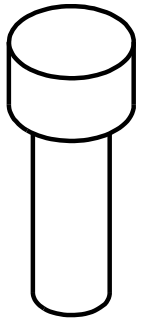
Clamp Half

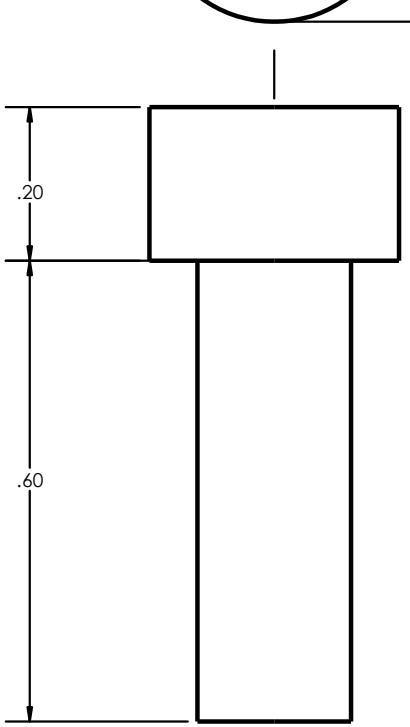
SIZE	DWG. NO.	REV
A	E29-F22-1039-1	

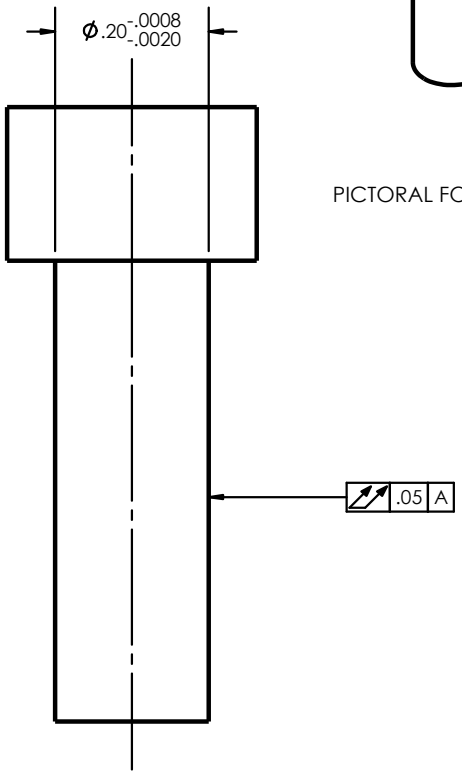
SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

E29 Group 1039









PICTORAL FOR CLAIRTY

		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES:	DRAWN	R.D.	08DEC22
		TOLERANCES: Linear: ±0.005 Angles: ±2° All other angles: ±0.02	CHECKED	N.T.	08DEC22
			ENG APPR.	A.L.	08DEC22
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5 M-1994	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH	THIRD ANGLE PROJECTION		
APPLICATION		DO NOT SCALE DRAWING			

S.H.A.M.

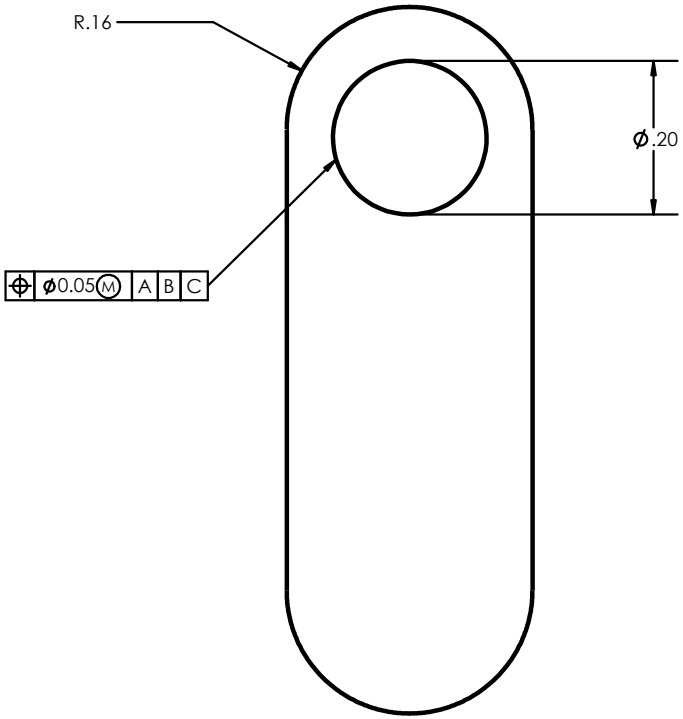
TITLE:

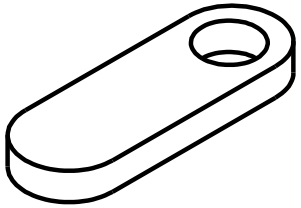
Peg

SIZE	DWG. NO.	REV
A	E29-F22-1039-2	

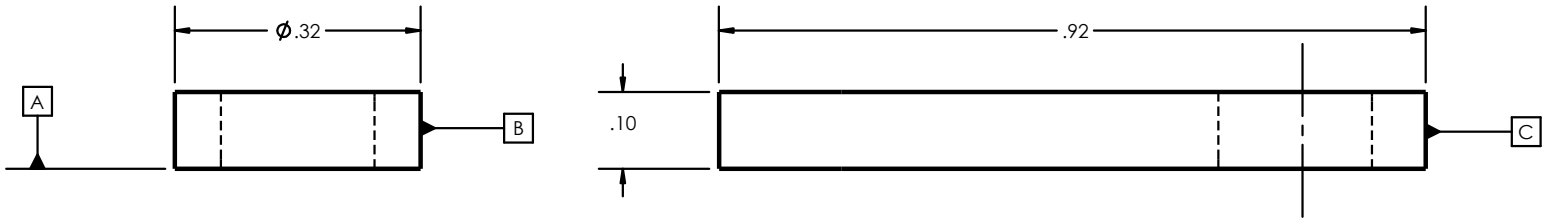
SCALE: 4:1 | WEIGHT: | SHEET 1 OF 1

E29 Group 1039





PICTORAL FOR CLARITY



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES:	DRAWN	R.D.	08DEC22
		TOLERANCES: Linear: ±0.005 Angles: ±2° All other angles: ±0.02	CHECKED	N.T.	08DEC22
			ENG APPR.	A.L.	08DEC22
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M-1994	Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH	THIRD ANGLE PROJECTION		
APPLICATION		DO NOT SCALE DRAWING			

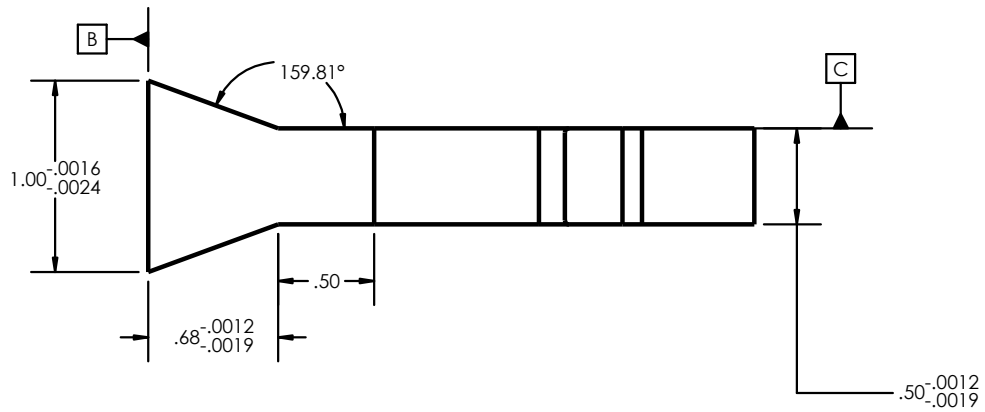
S.H.A.M.

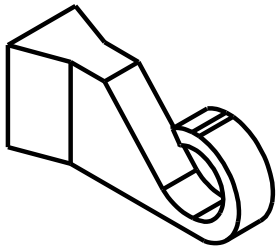
TITLE: Tab

SIZE	DWG. NO.	REV
A	E29-F22-1039- 3	

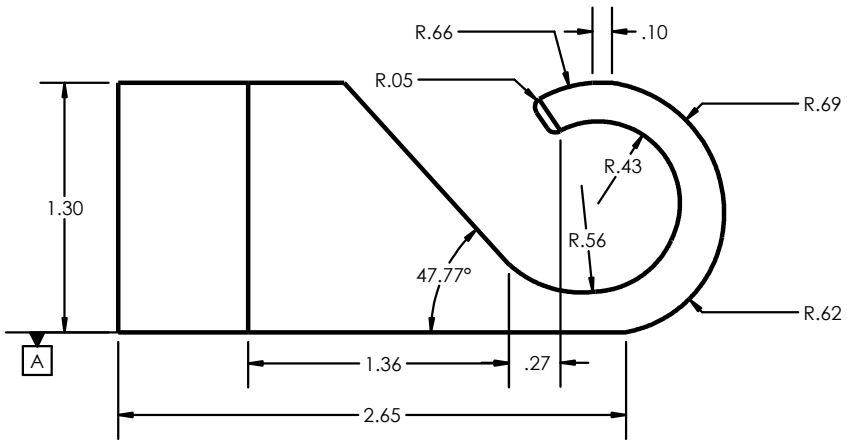
SCALE: 4:1 | WEIGHT: | SHEET 1 OF 1

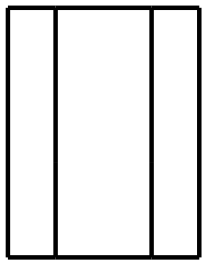
E29 Group 1039





PICTORIAL FOR CLARITY





		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES:	DRAWN	KI	29NOV22
		TOLERANCES: Linear: ±0.005 Angles: ±2° All other angles: ±0.02	CHECKED	EC	08DEC22
			ENG APPR.	AL	08DEC22
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5 M-1994	Q.A.		
		MATERIAL: Acrylic/PC Plastic	COMMENTS: THIRD ANGLE PROJECTION		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

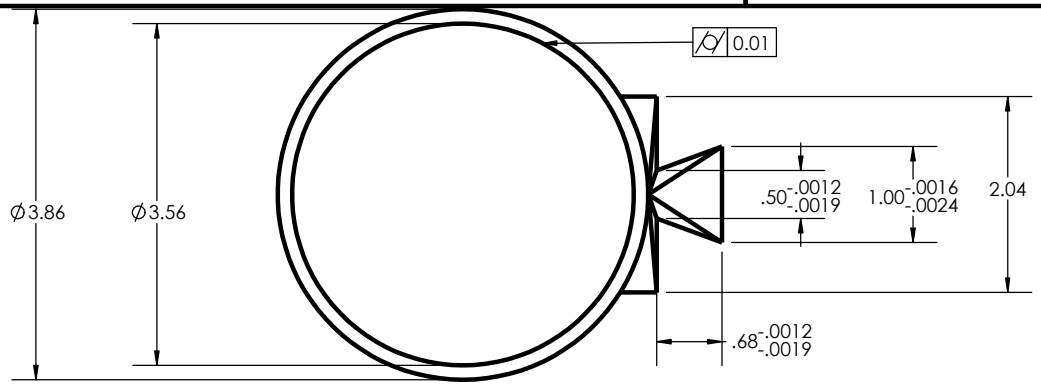
S.H.A.M.

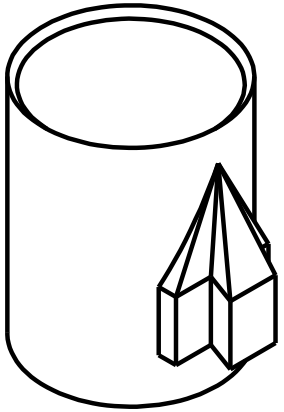
TITLE:

Hook

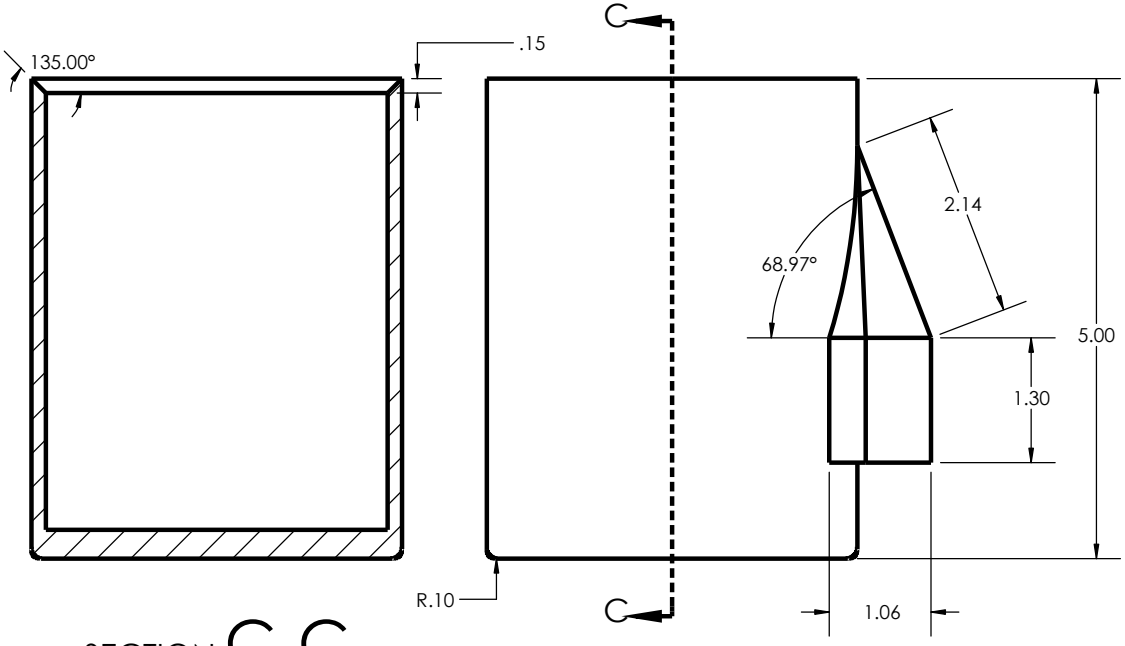
E29 Group 1039

SIZE	DWG. NO.	REV
A	E29-F22-1039-1	
SCALE: 1:1	WEIGHT:	SHEET 1 OF 1

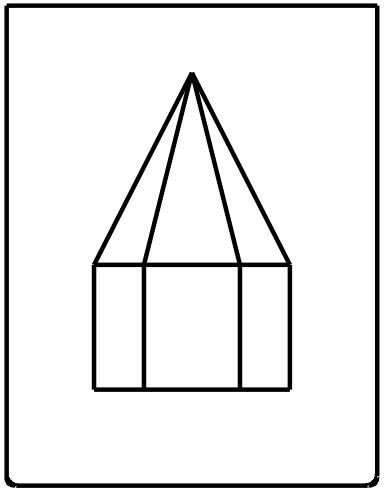




PICTORIAL FOR CLARITY



SECTION C-C



		UNLESS OTHERWISE SPECIFIED:		NAME	DATE
		DIMENSIONS ARE IN INCHES:	DRAWN	KI	01DEC22
		TOLERANCES: Linear: ±0.005 Angles: ±2° All other angles: ±0.02	CHECKED	EC	08DEC22
			ENG APPR.	AL	08DEC22
			MFG APPR.		
		INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5 M-1994	Q.A.		
		MATERIAL: Acrylic/PC Plastic	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

E29 Group 1039

S.H.A.M.

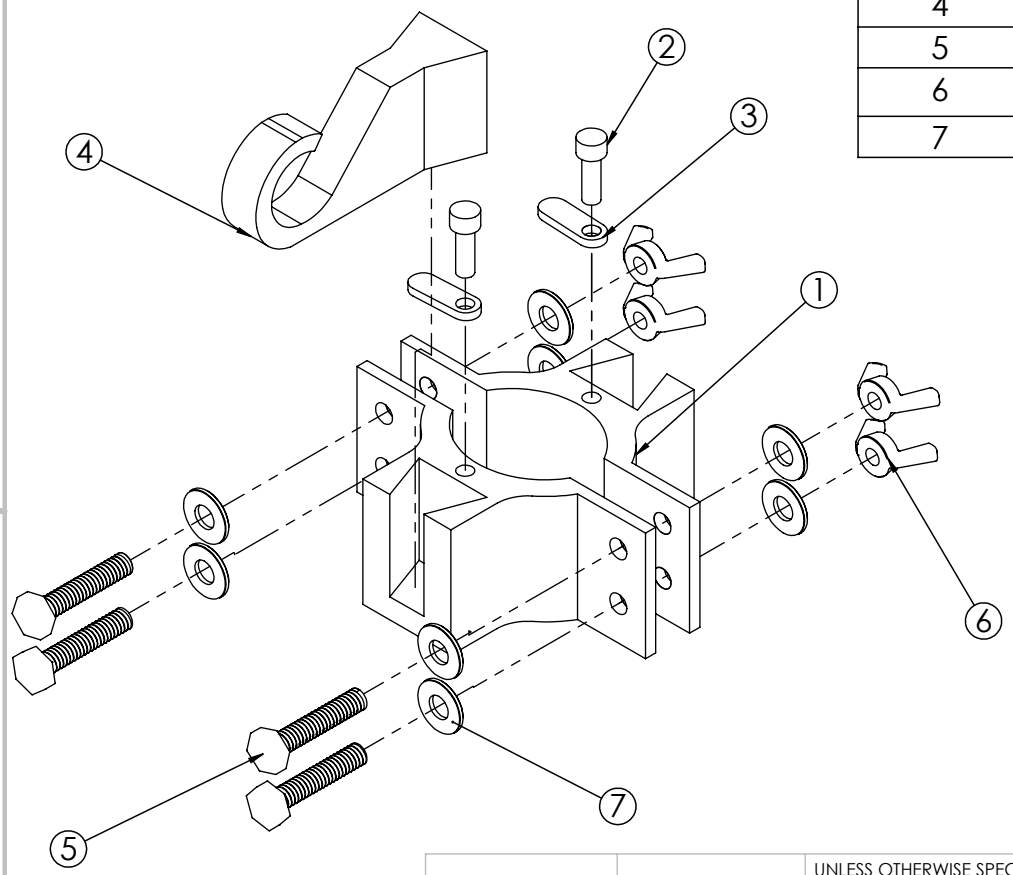
TITLE:

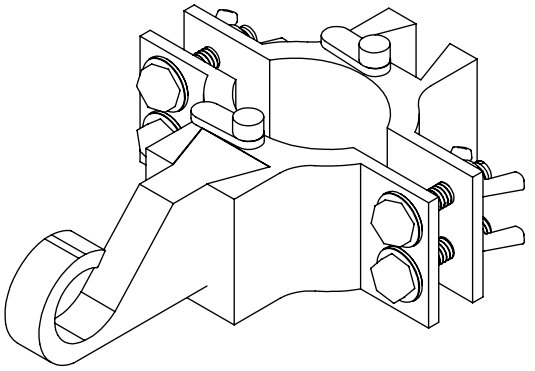
Cupholder

SIZE	DWG. NO.	REV
A	E29-F22-1039-4B	

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	E29-F22-1039-1	Clamp Half	2
2	E29-F22-1039-2	Peg	2
3	E29-F22-1039-3	Tab	2
4	E29-F22-1039-4A	Attachment (Hook)	1
5	800616	Screw	4
6	802371	Wingnut	4
7	802481	Washer	8





E29 Group 1039

NEXT ASSY	USED ON	
APPLICATION		DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES:

TOLERANCES:
Linear: ±0.005
Angles: ±2°
All other angles: ±0.02

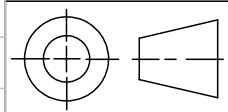
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M-1994

MATERIAL

FINISH

	NAME	DATE
DRAWN	E.C.	30NOV22
CHECKED	R.D.	08DEC22
ENG APPR.	A.L.	08DEC22
MFG APPR.		
Q.A.		

COMMENTS:



S.H.A.M.

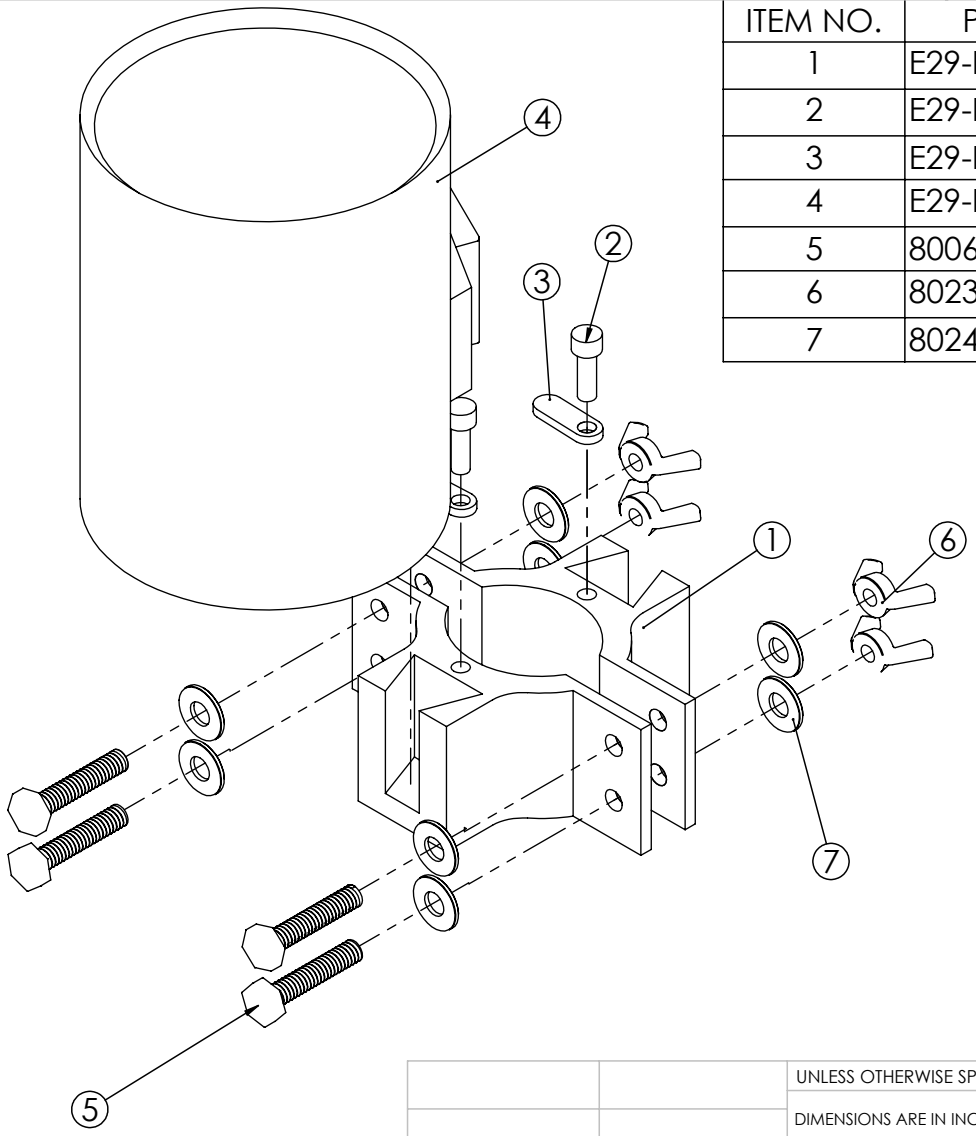
TITLE:

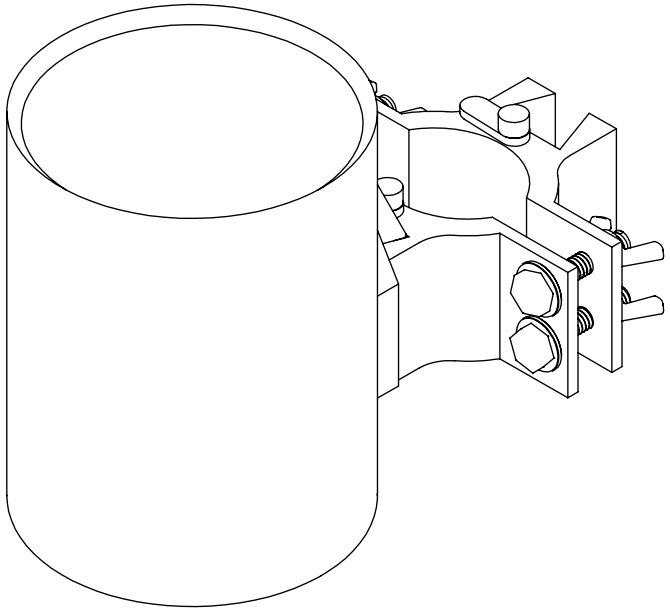
Clamp Assembly (Hook)

SIZE	DWG. NO.	REV
A	E29-F22-1039-A	

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	E29-F22-1039-1	Clamp Half	2
2	E29-F22-1039-2	Peg	2
3	E29-F22-1039-3	Tab	2
4	E29-F22-1039-4B	Attachment (Cup Holder)	1
5	800616	Screw	4
6	802371	Wingnut	4
7	802481	Washer	8





E29 Group 1039

NEXT ASSY	USED ON	
APPLICATION		DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES:

TOLERANCES:
Linear: ±0.005
Angles: ±2°
All other angles: ±0.02

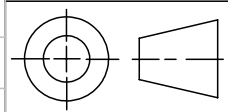
INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M-1994

MATERIAL

FINISH

	NAME	DATE
DRAWN	E.C.	30NOV22
CHECKED	D.R.	08DEC22
ENG APPR.	A.L.	08DEC22
MFG APPR.		
Q.A.		

COMMENTS:



S.H.A.M.

TITLE:

Clamp Assembly (Cup Holder)

SIZE	DWG. NO.	REV
A	E29-F22-1039-B	

SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

Fits and Tolerances Table

Fit #	**Connects Component #... (A)**	**…To Component # or External Object (B)**	**Function Of Fit**	**ANSI class of fit (e.g. RC6) or "reversible snap-fit" or "permanent snap-fit" with a description of relative forces**	**Component A critical dimension and tolerance e.g. diameter 10.0±0.1 mm**	**Component B critical dimension and tolerance**
1	5 (Screw)	1 (Clamp)	Connect the screw to the part of the clamp (w/o attachment).	Clearance Fit: RC6 (Medium Running Fits) The screw should be able to go through the hole of the clamp, but not move around much.	Screw: (diameter) ¼″-20 UNC-2A x 1	Hole in Clamp: (diameter) 0.25″+.0010″/ +.0014″
2	5 (Screw)	6 (Wingnut)	Tightens the two halves of the clamp together	Threaded, starts as clearance and ends up interference	Screw: (diameter) ¼″-20 UNC-2A x 1	Nut: (diameter) ¼″-2 UNC-2B
3	2 (Peg)	3 (Tab)	Connects the peg to one of the tabs.	Clearance Fit: RC5 (Precision Running Fits) The screw should be able to fit through the tab and hold it in place securely so that it stays once it has been rotated.	Peg: (diameter) 0.20″ -.0008″/-.002″	Hole in Tab: (diameter) 0.20″ +0/ +.0007″
4	2 (Peg)	1 (Clamp)	Fastens down the peg to the clamp half.	Clearance Fit: LC7 (Precision Running Fits) The peg should be able to fit in the hole, but it should be snug after assembly.	Peg: (diameter) 0.20″ -.0008″/-.002″	Hole in Clamp: (diameter) 0.25″+.0010″/ +.0014″

5	4 (Attachments)	1 (Clamp)	Connects the attachment to the clamp (allows for customization)	Clearance Fit: RC5 (Medium Running Fits) We want the attachment to be able to slide in, but we want it to be fairly stationary after that.	Trapezoidal Attachment Short Edge Length: 0.50″ -.0012″/ -.0019″ Height: .68″ -.0012″/ -.0019″ Long Edge Length: 1.00 -.0016″/ -.0024″	Trapezoidal Cut-out: Short Edge Length: 0.50″ +.001″ Height: .68″ +.001″ Long Edge Length: 1.00″ +.0012″

Additional fits and tolerances:

We did not have any additional fits or tolerances that didn't fit on the table.

Process selection:

For the prototype we built, we used ABS plastic and 3D printing to manufacture all our designed parts. We did this because 3D printing is quick, cheap, and easy to utilize allowing us to quickly test our product.

Scaled-up Production Plan

Production Choices

Component #	Component Name	Mass Production Manufacturing Process	Process Advantages
1	Clamp (Half - reflected for another side)	Injection Molding (Mold for Clamp)	-Fast -Low cost (per part) -Precise -Repeatable
		Injection Molding	-Fast -Low-cost -Repeatable -Allows for precise specific geometry
2	Peg	Injection Molding	-Fast -Low cost (per part) -Precise -Repeatable
3	Tab	Injection Molding	-Fast -Low cost (per part) -Precise -Repeatable
4A	Hook	Injection Molding	-Fast -Low cost (per part) -Precise -Repeatable
4B	Cup Holder	Injection Molding	-Fast -Low cost (per part) -Precise -Repeatable
5	Screw	Purchase from other manufacturers	-Fast -Convenient -Easy
6	Wingnut	Purchase from other manufacturers	-Fast -Convenient -Easy
7	Washer	Purchase from other manufacturers	-Fast -Convenient -Easy

Materials choices:

Component #	Component Name	Material Choice(s)	Reasoning
1	Clamp (Half-reflected for another side)	Polycarbonate (PC) Plastic	Weather resistance, UV resistance, and impact resistance. It's also the main component, so it should be made out of the most durable materials.
2	Plastic Peg	High-Density Polyethylene (HDPE) Plastic	Inexpensive and sustainable → easily replaceable if lost; doesn't need to be strong because it's not load-bearing
3	Tab	High-Density Polyethylene (HDPE) Plastic	Inexpensive and sustainable → easily replaceable if lost; doesn't need to be strong because it's not load-bearing
4A	Hook	Polycarbonate (PC) Plastic or Acrylic	Weather resistance, UV resistance, and impact resistance. If necessary, can use acrylic instead of polycarbonate to reduce costs for users.
4B	Cup Holder	Polycarbonate (PC) Plastic or Acrylic	Weather resistance, UV resistance, and impact resistance. If necessary, can use acrylic instead of polycarbonate to reduce costs for users.
5	Screw (using many of the same screws to make manufacturing easier)	Steel and Zinc	Cheap and readily available/easily obtainable.
6	Wingnut	Steel and Zinc	Cheap and readily available/easily obtainable.
7	Washer	Steel and Zinc	Cheap and readily available/easily obtainable.

Design for manufacturing:

We believed that our design needed to be as simple as possible to work with injection molding; however, our attachment was the most difficult design to work with. It had to be extremely reliable but easy to use so we decided on a dovetail shape/tolerance. It was a complicated tolerance and we had to utilize separate research to understand the correct form of tolerancing, but it ended up being one of our best-fitting tolerances. It allowed us to create no overhang that would create less risk in our injection molding process.