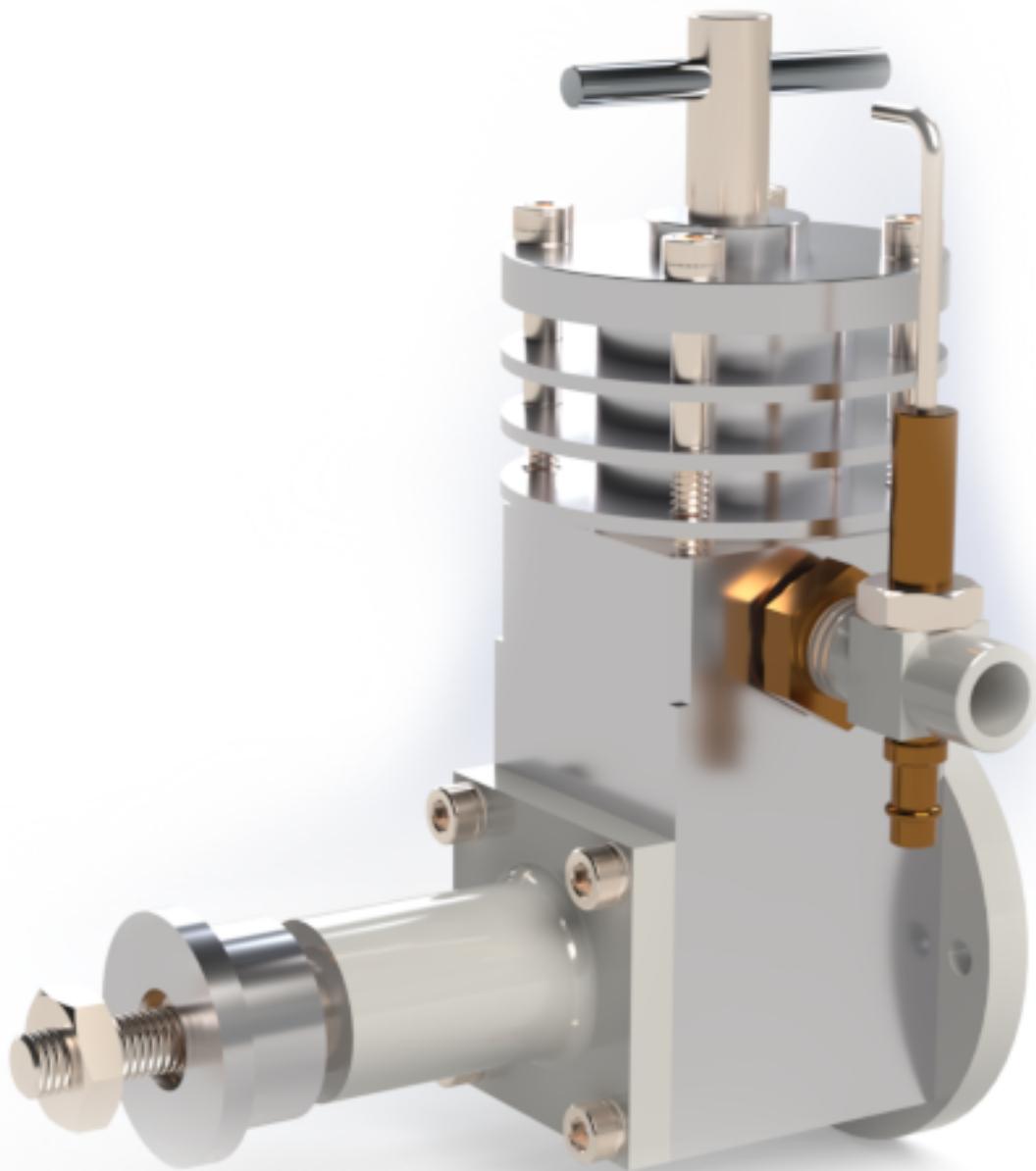


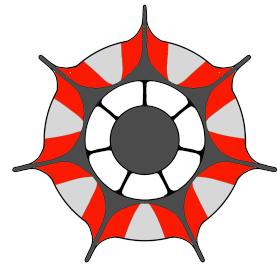
BOLLAERO 18

MENG 152



PROPOSAL

Owen Brady
OW-ENgineering Ltd.
977 Langford Pkwy #101.
Victoria, BC, V9B 0A5
Canada



OW-ENgineering Ltd.

04 MAR 2025

Benj Birch
Lab Instructor
Camosun College Mechanical Department
4461 Interurban Rd.
Victoria, BC, V9E 2C1
Canada

Dear Benj Birch,

I am submitting the **BollAero 18** in fulfillment of the projection portion of MENG 152, which I understand is a minimum of 50% of my mark. Deliverables include a full drawing package that consists of an estimated Bill of Materials(eBOM), multiple part and assembly drawings, and additional datasheets.

The final project will consist of a minimum of 3 assemblies, 15 make parts, and 8 purchased components. The aim for this project is to complete the entire project, which is a total of 4 assemblies, 21 make parts, and 15 purchased components. Drawings will be created for all make parts, while datasheets will be provided for purchased items.

I estimate that it will take approximately 198 hours to complete the project. This estimation is based on 3 hours for the eBOM, 18 hours for assemblies, 63 hours for make parts, and 18 hours for purchased components; this information can be found in Table 1. Estimation of total hours to complete project

Table 1. Estimation of total hours to complete project

Name	Total Number	Multiplier	Estimated Hours
Assemblies	4	3	12
Assembly Drawings	4	3	12
Make-Parts	21	3	63
Make-Part Drawings	21	3	63
Purchased Parts	15	3	45
eBOM	1	3	3

PROPOSAL CONT.

It is estimated that in order to complete the project on time, by April 11, I will have to spend at least 15 hours in class labs, and 183 hours outside of school time. To ensure the accuracy of the total hours, I have included a series of “MENG Final Project” buttons in the productivity app I use, one button for each category. Whenever a specific category is being worked on, the button will activate a stopwatch that keeps track of the total hours put in.

Signatures:

Company: OW-ENgineering Ltd.

Company: Camosun College Mechanical Department

Name: _____

Name: _____

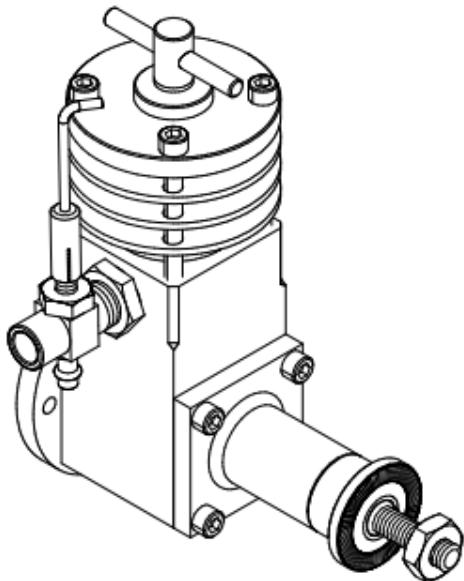
Signature: _____

Signature: _____

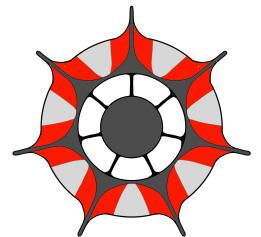
Date: _____

Date: _____

Preview of expected full project:



LETTER OF TRANSMITTAL



Owen Brady
OW-ENgineering Ltd.
977 Langford Pkwy #101.
Victoria, BC, V9B 0A5
Canada

07 APR 2025

Len Mar
Lab Instructor
Camosun College Mechanical Department
4461 Interurban Rd.
Victoria, BC, V9E 2C1
Canada

Dear Len Mar

I am submitting the **BollAero 18** in fulfillment of the project portion of MENG 152, which I understand is a minimum of 50% of my mark. Deliverables include a full drawing package that consists of an engineering Bill of Materials(eBOM), multiple part and assembly drawings, and additional datasheets.

The contractual agreement was to submit at least 3 assemblies, 15 make parts, and 8 purchased components by April 11, 2025. The total amount of parts submitted is 4 Assemblies, 20 make parts, and 15 purchase parts. This constitutes the BollAero 18 engine project in full, for I am over the minimum by 1 assembly, 5 make parts, and 7 purchased parts. The difference in make part estimations, 21 in the proposal and 20 in final deliverables, stems from a miscount error on my behalf.

The estimated number of hours was calculated using a straight multiplier value of 3 times the total part number for each category. The total hours estimated was 198, a stark contrast to the 30 total hours the project actually required. Table 1. Estimated vs Actual Hours Necessary shows all values, and displays a new column labeled “Calculated Multiplier.” This column uses a formula `[ceiling(Actual Hours / Total, 0.01)]` to derive the multiplier necessary to correctly estimate total hours.

Table 1. Estimated vs Actual Hours Necessary

Name	Total Number	Multiplier	Hours	Actual Hours	Calculated Multiplier*
Assemblies	4	3	12	3	0.75
Assembly Drawings	4	3	12	3	0.75
Make-Parts	21	3	63	7	0.34
Make-Part Drawings	21	3	63	13	0.62
Purchased Parts	15	3	45	1	0.07
eBOM	1	3	3	3	3
	Total Hours	198	30		

* Data uses a ceiling modifier with a value of 0.01

LETTER OF TRANSMITTAL CONT.

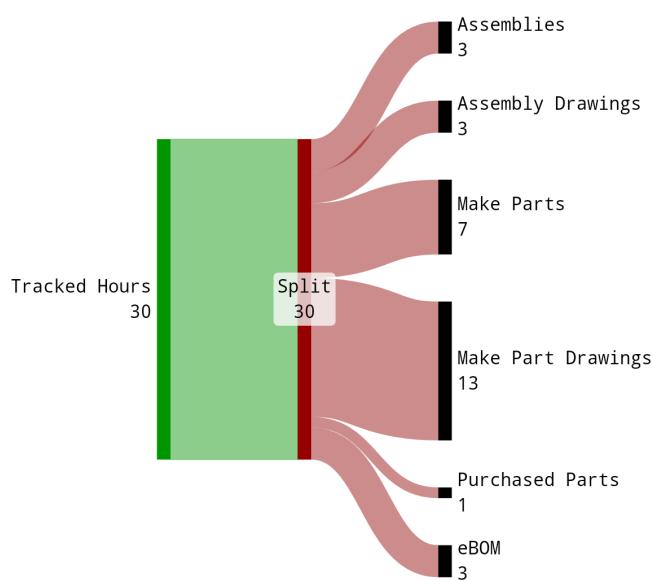


Figure 2. Distribution of Tracked Hours

The calculated multipliers will need further refinement due to the simplicity of the BollAero 18's individual parts. Projects in the future will most likely contain more complex parts, and this will add extra hours and increase the calculated multiplier.

Figure 2. Distribution of Tracked Hours is provided as a secondary visual to display the total hours worked. The key point shows that just under half of the time was put towards "Make Part Drawings", which makes sense because that is what the majority of the final project teaches.

Some reference values and dimension choices were chosen in order to make the manufacturer's life a little easier. An example is in drawing 10015 where the reference value 1.531 is dimensioned from the outer edge, so the machinist can accurately measure using calipers.

Further deviation from the original drawings comes in the form of a mirrored full assembly. Due to the crankshaft exit hole on the crankcase being the same on both front and back, there is the option to flip the orientation and have it come out the other end instead. I went with this option, and reoriented the crankshaft to still face forward. This route was taken accidentally, and upon further inspection later at the time of discovery, it was determined that it did not affect the final outcome.

If I was to do this project again, there are three things I would do differently:

- I would flip the crankshaft orientation to match the original drawing.
- I would finish each drawing in entirety before advancing to the next one.
- I would review more of my completed drawings with an instructor.

For any additional information or questions, please contact me at owen@owenbrady.ca or via cell phone: 250-867-5309

Sincerely,

Owen Brady



ENGINEERING BOM

791

ASSY, BOLLAERO 18

Creation Date: 03-Apr-25
Last Modified Date: 07-Apr-25
Last Modified By: OWEN BRADY
Revision: X1
State: RELEASED
Filename: BOLLAERO18_eBOM.xlsx

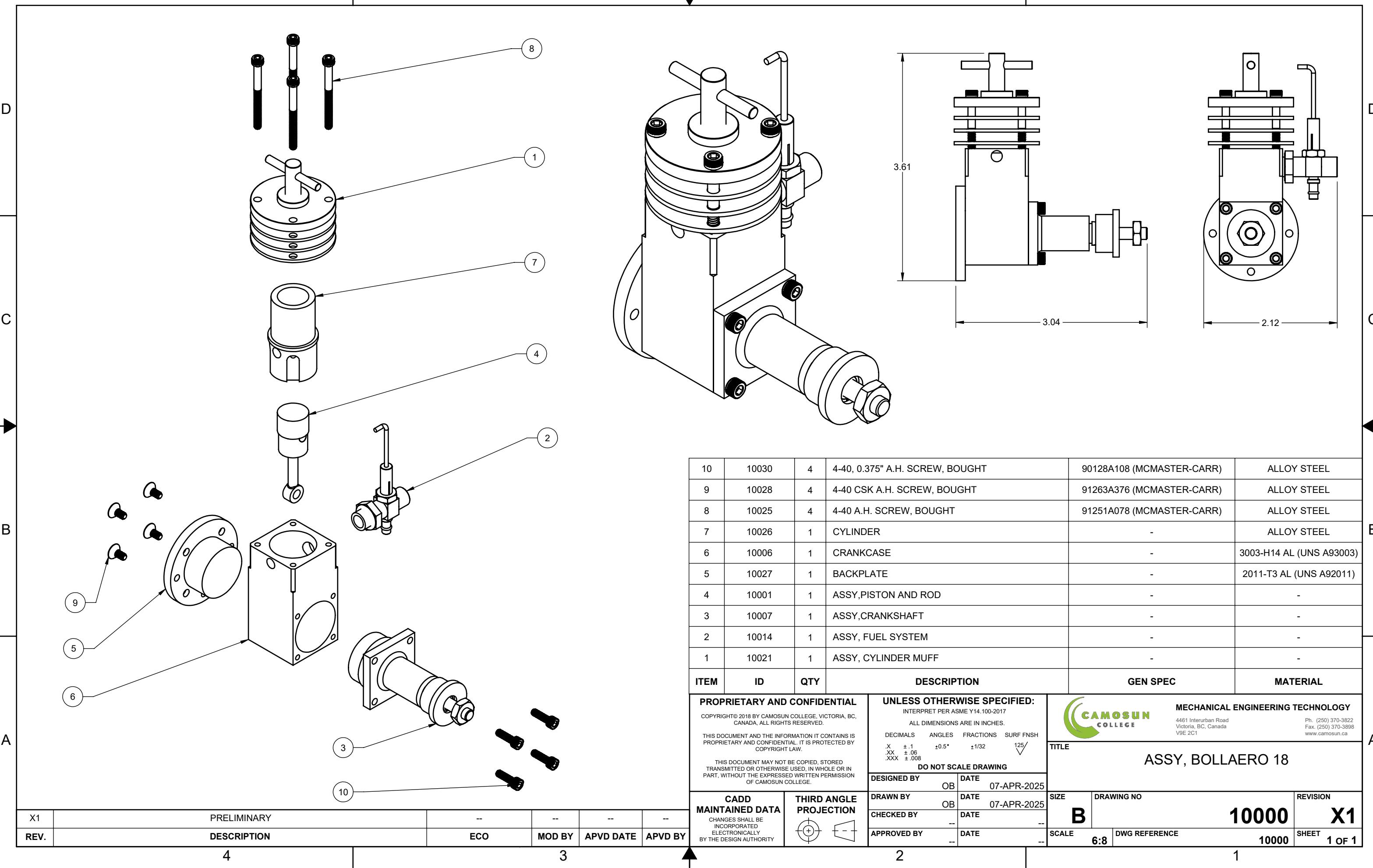
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1	0	1	EA	10000	ASSY, BOLLAERO 18	MAKE	PRODUCT	-	-	-	-	A	0007919	X1	RELEASED
2	01	1	EA	10021	ASSY, CYLINDER MUFF	MAKE	MANUFACTURED	-	-	-	-	A	10021	X1	RELEASED
3	01.01	1	EA	10022	CYLINDER HEAD	MAKE	MANUFACTURED	2011-T3 AL (UNS A92011)	-	-	-	P	10022	X1	RELEASED
4	01.02	1	EA	10023	COMPRESSION SCREW	MAKE	MANUFACTURED	ALLOY STEEL	-	-	-	P	10023	X1	RELEASED
5	01.03	1	EA	10024	TOMMY BAR	MAKE	MANUFACTURED	18-8 SST	-	-	-	P	10024	X1	RELEASED
6	02	1	EA	10014	ASSY, FUEL SYSTEM	MAKE	MANUFACTURED	-	-	-	-	A	10014	X1	RELEASED
7	02.01	1	EA	10018	VENTURI	MAKE	MANUFACTURED	2011-T3 AL (UNS A92011)	-	-	-	P	10018	X1	RELEASED
8	02.02	1	EA	10015	NEEDLE	MAKE	MANUFACTURED	ALLOY STEEL	-	-	-	P	10015	X1	RELEASED
9	02.03	1	EA	10016	NEEDLE,THIMBLE	MAKE	MANUFACTURED	BRASS	-	-	-	P	10016	X1	RELEASED
10	02.04	1	EA	10017	JAM NUT	MAKE	MANUFACTURED	BRASS	-	-	-	P	10017	X1	RELEASED
11	02.05	1	EA	10019	SPRAY BAR	MAKE	MANUFACTURED	BRASS	-	-	-	P	10019	X1	RELEASED
12	02.06	1	EA	10020	6-32 MACHINE NUT, BOUGHT	BUY	COTS	ALLOY STEEL	MACHINE NUT	90480A007	MCMASTER	P	10020	X1	RELEASED
13	03	1	EA	10007	ASSY,CRANKSHAFT	MAKE	MANUFACTURED	-	-	-	-	A	10007	X1	RELEASED
14	03.01	1	EA	10008	CRANKSHAFT	MAKE	MANUFACTURED	ALLOY STEEL	-	-	-	P	10008	X1	RELEASED
15	03.02	1	EA	10009	CRANKPIN	MAKE	MANUFACTURED	TOOL STEEL, AISI TYPE A2 (UNS T30102)	-	-	-	P	10009	X1	RELEASED
16	03.03	1	EA	10010	COLLET	MAKE	MANUFACTURED	BRASS	-	-	-	P	10010	X1	RELEASED
17	03.04	1	EA	10011	PROP DRIVER	MAKE	MANUFACTURED	6061-T6 AL (UNS A96061)	-	-	-	P	10011	X1	RELEASED
18	03.05	1	EA	10029	MAIN BEARING HOUSING	MAKE	MANUFACTURED	2011-T3 AL (UNS A92011)	-	-	-	P	10029	X1	RELEASED
19	03.06	1	EA	10012	10-32 STUD 1 INCH, BOUGHT	BUY	COTS	ALLOY STEEL	MACHINE STUD	90322A639	MCMASTER	P	10012	X1	RELEASED
20	03.07	1	EA	10013	10-32 MACHINE NUT, BOUGHT	BUY	COTS	ALLOY STEEL	MACHINE NUT	90480A195	MCMASTER	P	10013	X1	RELEASED
21	04	1	EA	10001	ASSY,PISTON AND ROD	MAKE	MANUFACTURED	-	-	-	-	A	10001	X1	RELEASED
22	04.01	1	EA	10002	CONROD	MAKE	MANUFACTURED	2011-T3 AL (UNS A92011)	-	-	-	P	10002	X1	RELEASED
23	04.02	1	EA	10003	PISTON	MAKE	MANUFACTURED	GRAY CAST IRON	-	-	-	P	10003	X1	RELEASED
24	04.03	1	EA	10004	GUDEON,PIN	MAKE	MANUFACTURED	TOOL STEEL, AISI TYPE A2 (UNS T30102)	-	-	-	P	10004	X1	RELEASED
25	04.04	1	EA	10005	CONTRAPISTON	MAKE	MANUFACTURED	GRAY CAST IRON	-	-	-	P	10005	X1	RELEASED
26	05	1	EA	10027	BACKPLATE	MAKE	MANUFACTURED	2011-T3 AL (UNS A92011)	-	-	-	P	10027	X1	RELEASED
27	06	1	EA	10006	CRANKCASE	MAKE	MANUFACTURED	3003-H14 AL (UNS A93003)	-	-	-	P	10006	X1	RELEASED
28	07	1	EA	10026	CYLINDER	MAKE	MANUFACTURED	ALLOY STEEL	-	-	-	P	10026	X1	RELEASED
29	08	4	EA	10025	4-40 A.H. SCREW, BOUGHT	BUY	COTS	ALLOY STEEL	ALLEN HEAD	91251A078	MCMASTER	P	10025	X1	RELEASED
30	09	4	EA	10028	4-40 CSK A.H. SCREW, BOUGHT	BUY	COTS	ALLOY STEEL	ALLEN HEAD	91263A376	MCMASTER	P	10028	X1	RELEASED
31	10	4	EA	10030	4-40, 0.375" A.H. SCREW, BOUGHT	BUY	COTS	ALLOY STEEL	ALLEN HEAD	90128A108	MCMASTER	P	10030	X1	RELEASED

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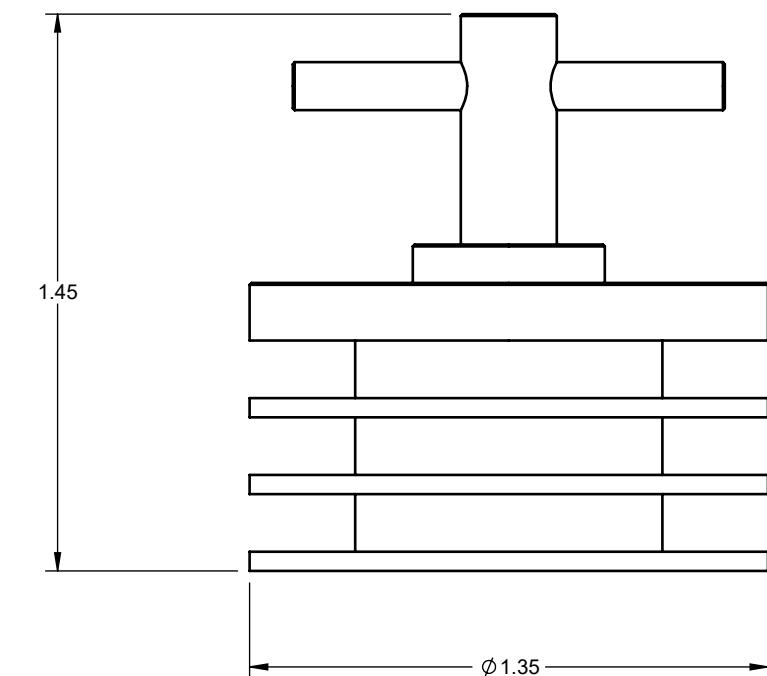
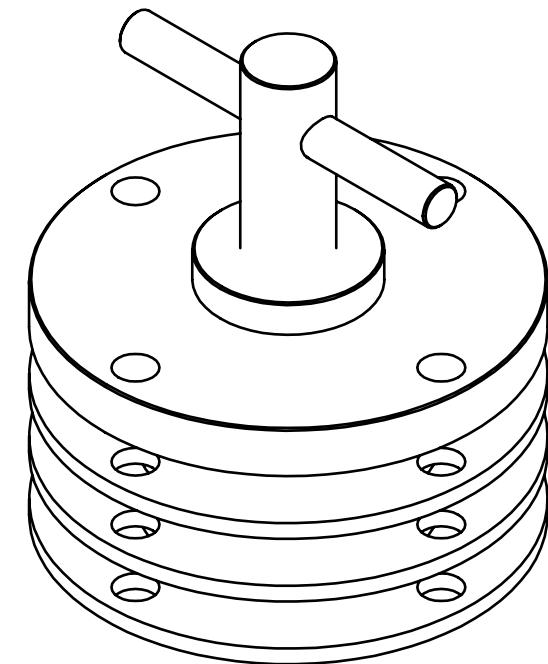
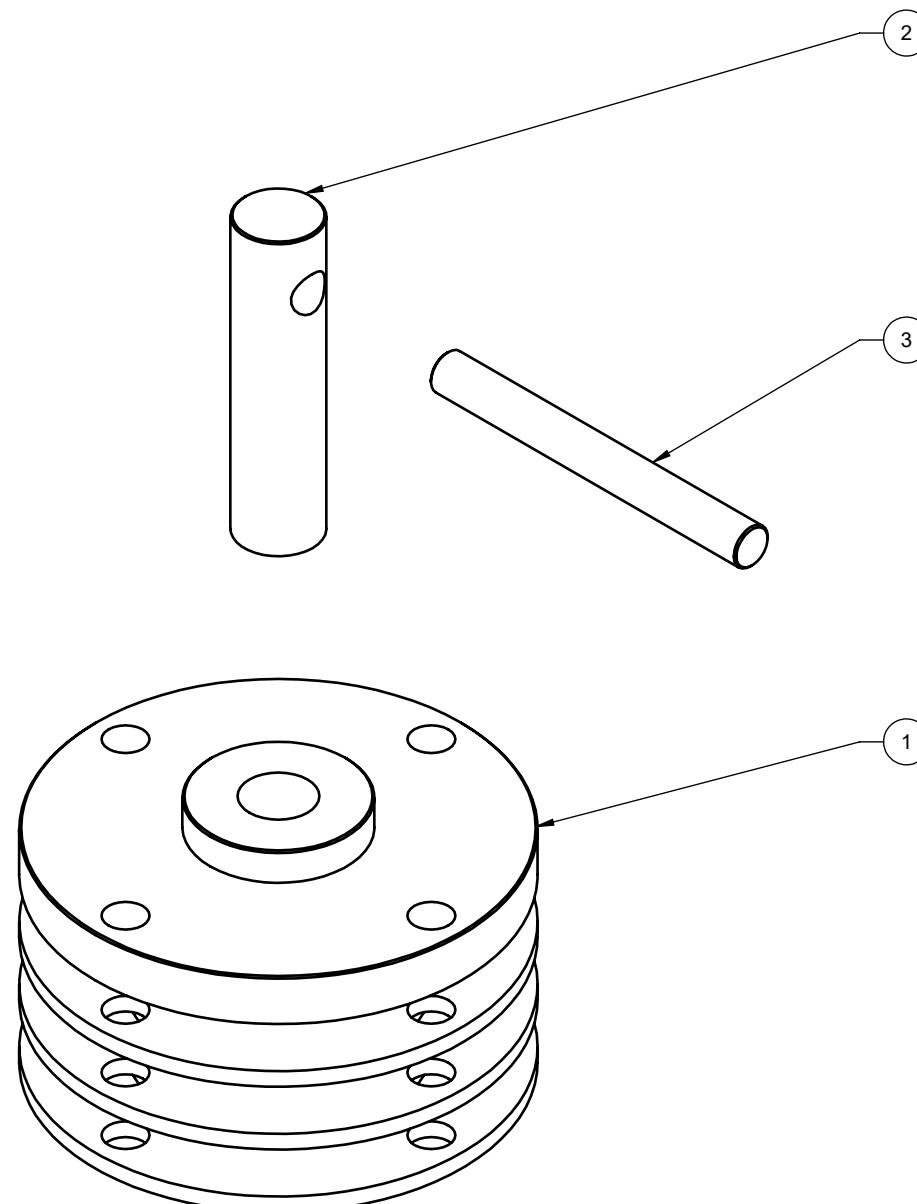


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ITEM	ID	QTY	DESCRIPTION	GEN SPEC	MATERIAL
3	10024	1	TOMMY BAR	-	18-8 SST
2	10023	1	COMPRESSION SCREW	-	ALLOY STEEL
1	10022	1	CYLINDER HEAD	-	2011-T3 AL (UNS A92011)

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		X ± .1 ± 0.5° ± 1/32 125/			
		XX ± .06			
		XXX ± .008			
DO NOT SCALE DRAWING		TITLE			
DESIGNED BY	OB	DATE	07-APR-2025	ASSY, CYLINDER MUFF	
DRAWN BY	OB	DATE	07-APR-2025	SIZE	DRAWING NO
CHECKED BY	--	DATE	--	B	10021
APPROVED BY	--	DATE	--	SCALE	2:1
				DWG REFERENCE	10021
				SHEET	1 OF 1

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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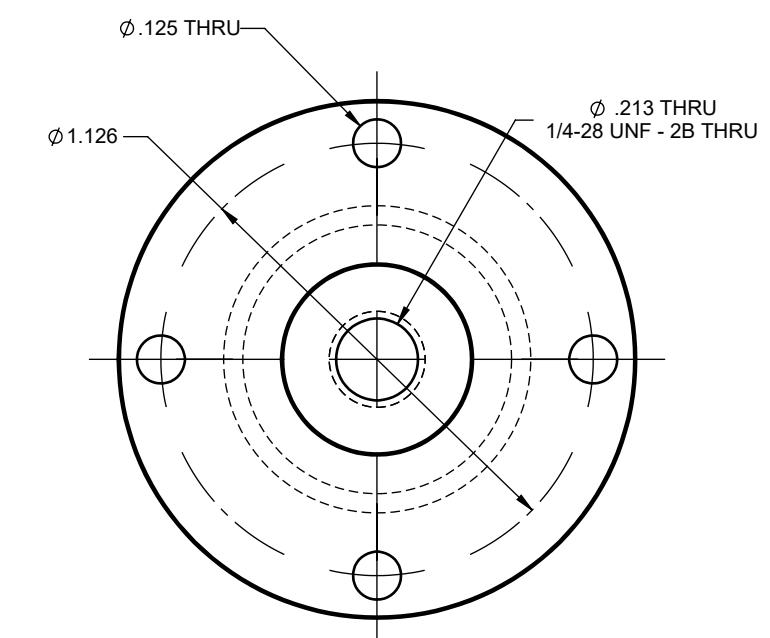
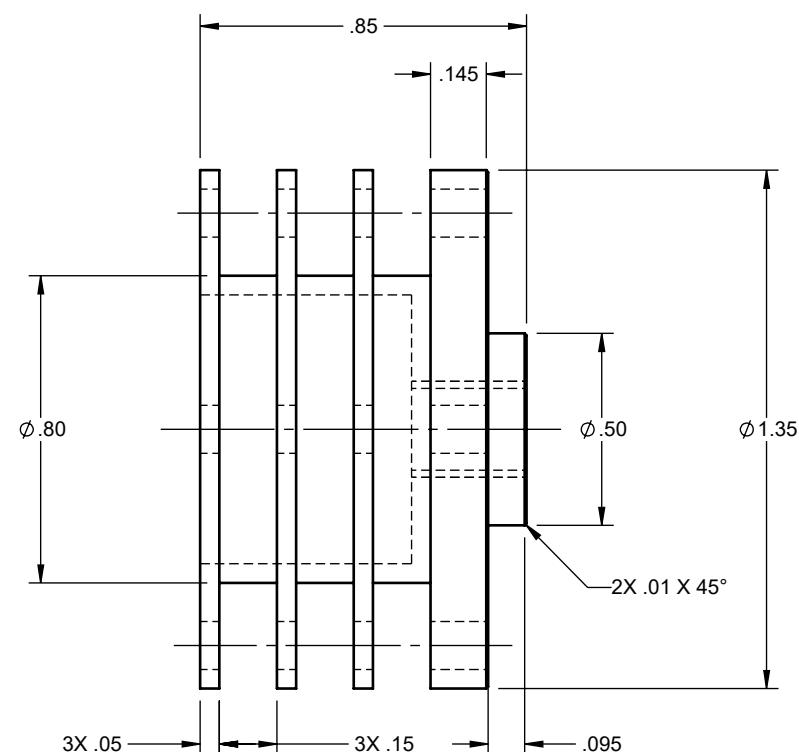
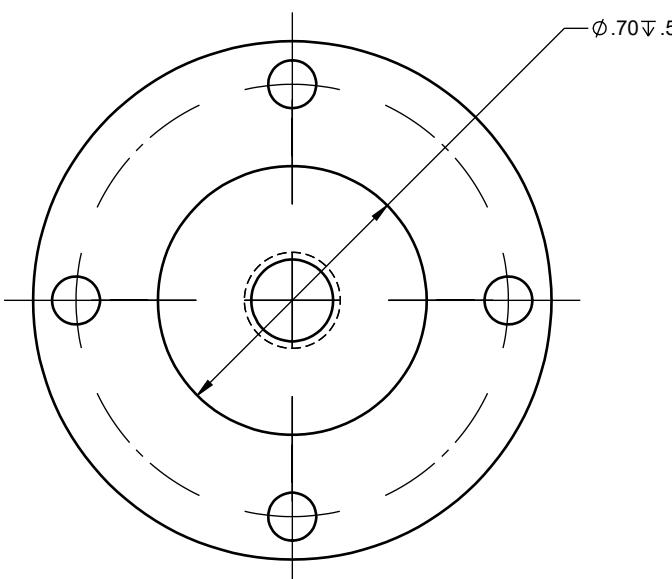
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- NOTES:**
1. MATERIAL: 2011-T3 AL (UNS A92011)
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X	± .1	± 0.5°	± 1/32	125/
XX	± .06			
XXX	± .008			

DO NOT SCALE DRAWING

DESIGNED BY OB DATE 07-APR-2025

DRAWN BY OB DATE 07-APR-2025

CHECKED BY -- DATE --

APPROVED BY -- DATE --


MECHANICAL ENGINEERING TECHNOLOGY

4461 Interurban Road
Victoria, BC, Canada
V9E 2C1

Ph. (250) 370-3822
Fax. (250) 370-3898
www.camosun.ca

TITLE

CYLINDER HEAD

CADD MAINTAINED DATA
CHANGES SHALL BE INCORPORATED ELECTRONICALLY
BY THE DESIGN AUTHORITY



SIZE	DRAWING NO	REVISION
B	10022	X1
SCALE	2:1	DWG REFERENCE
10022		SHEET 1 OF 1

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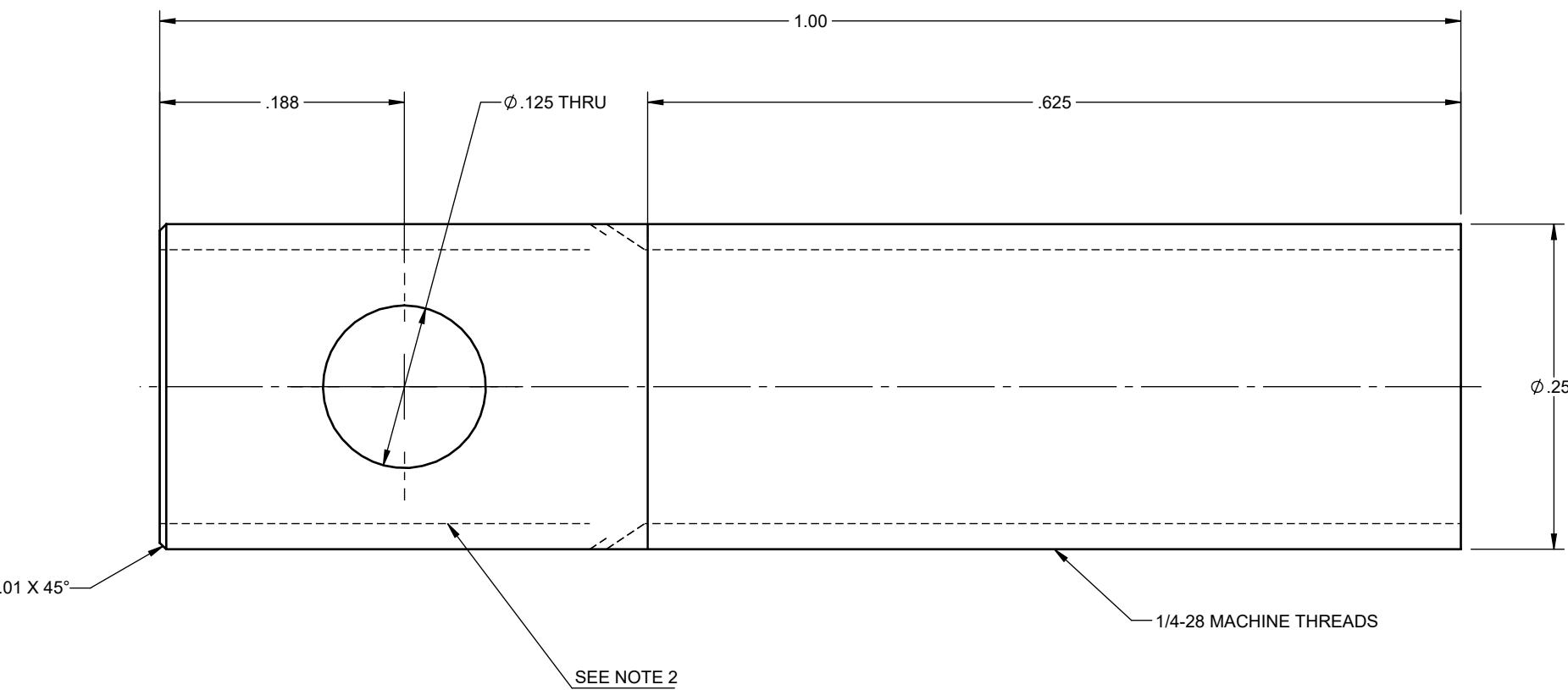
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- NOTES:**
1. MATERIAL: ALLOY STEEL
 2. SOME HIDDENS LINES ARE AN ARTIFACT OF SW
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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 DECIMALS ANGLES FRACTIONS SURF FNSH
 X ± .1 ± 0.5° ± 1/32 125/✓
 XX ± .06 -- -- --
 XXX ± .008 -- -- --

DO NOT SCALE DRAWING

DESIGNED BY OB DATE 07-APR-2025

DRAWN BY OB DATE 07-APR-2025

CHECKED BY -- DATE --

APPROVED BY -- DATE --


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 4461 Interurban Road
Victoria, BC, Canada
V9E 2C1
Ph. (250) 370-3822
Fax. (250) 370-3898
www.camosun.ca

TITLE

COMPRESSION SCREW

CADD MAINTAINED DATA	THIRD ANGLE PROJECTION
CHANGES SHALL BE INCORPORATED ELECTRONICALLY BY THE DESIGN AUTHORITY	

SIZE	DRAWING NO	REVISION
B	10023	X1

4

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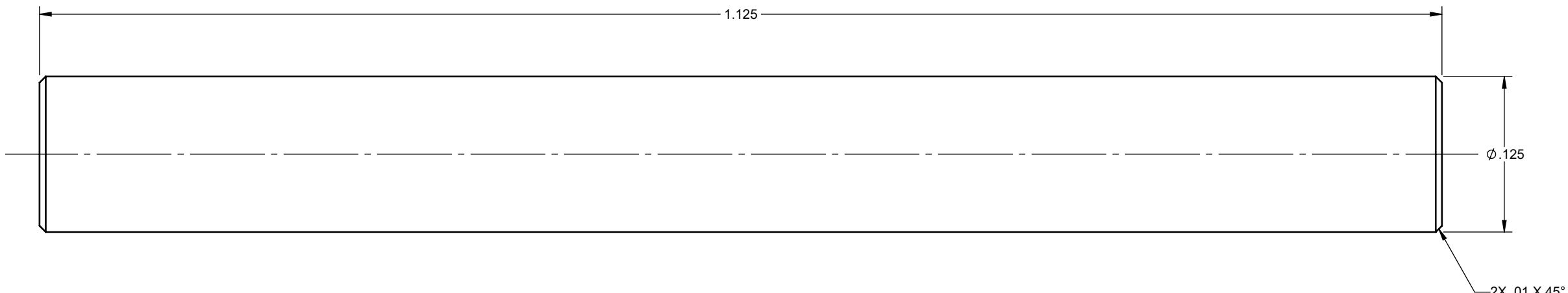
C

B

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- NOTES:
1. MATERIAL: 18-8 SST
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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CHANGES SHALL BE
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ELECTRONICALLY
BY THE DESIGN AUTHORITY

THIRD ANGLE
PROJECTION

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ALL DIMENSIONS ARE IN INCHES.

DECIMALS	ANGLES	FRACTIONS	SURF FNSH
.X ± .1	± 0.5°	± 1/32	125/
.XX ± .06			
.XXX ± .008			

DO NOT SCALE DRAWING

DESIGNED BY	DATE
OB	07-APR-2025

DRAWN BY	DATE
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CHECKED BY	DATE
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APPROVED BY	DATE
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MECHANICAL ENGINEERING TECHNOLOGY

4461 Interurban Road
Victoria, BC, Canada
V9E 2C1
Ph. (250) 370-3822
Fax. (250) 370-3898
www.camosun.ca

TITLE

TOMMY BAR

SIZE

B

DRAWING NO

10024

REVISION

X1

SCALE

10:1

DWG REFERENCE

10024

SHEET

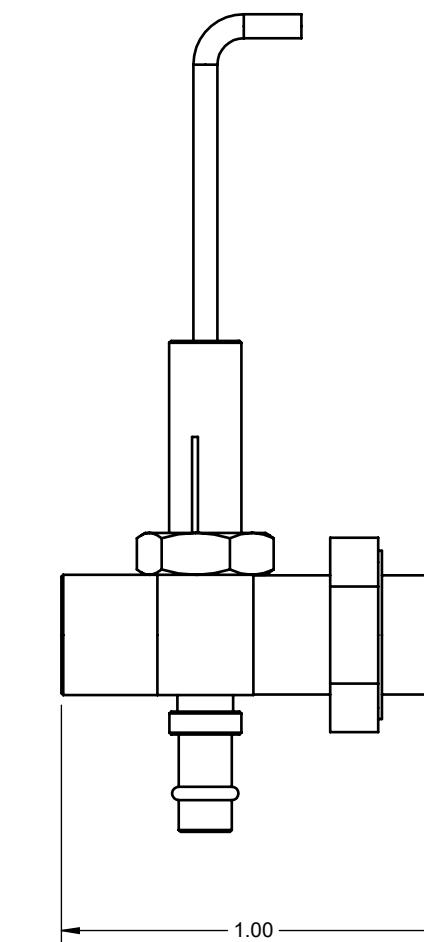
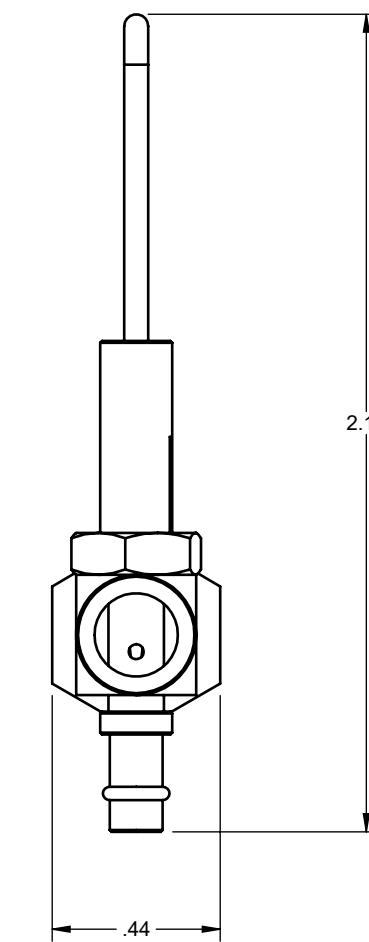
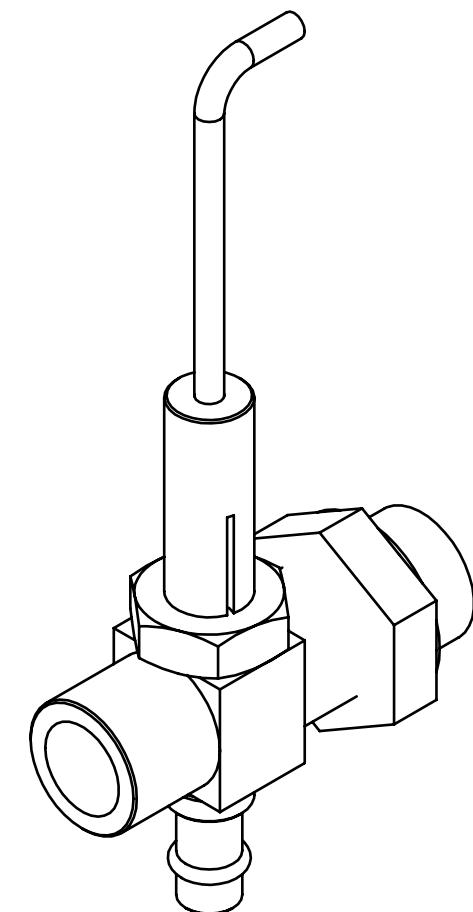
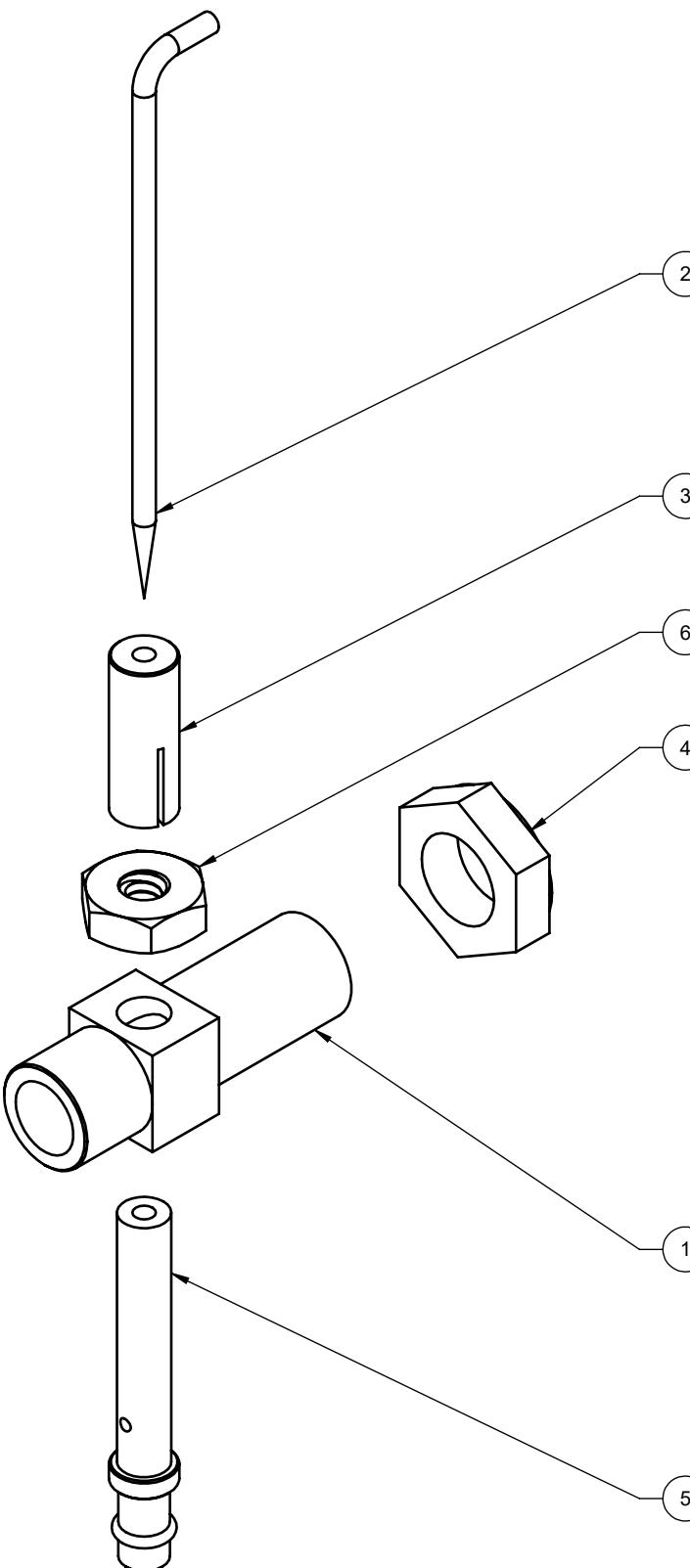
1 OF 1

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2

1



ITEM	ID	QTY	DESCRIPTION	GEN SPEC	MATERIAL
6	10020	1	6-32 MACHINE NUT, BOUGHT	90480A007 (MCMASTER-CARR)	ALLOY STEEL
5	10019	1	SPRAY BAR	-	BRASS
4	10017	1	JAM NUT	-	BRASS
3	10016	1	NEEDLE,THIMBLE	-	BRASS
2	10015	1	NEEDLE	-	ALLOY STEEL
1	10018	1	VENTURI	-	2011-T3 AL (UNS A92011)

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DECIMALS ANGLES FRACTIONS SURF FINISH
X $\pm .1$ $\pm 0.5^\circ$ $\pm 1/32$ 125/

DO NOT SCALE DRAWING

DESIGNED BY OB DATE 07-APR-2025

DRAWN BY OB DATE 07-APR-2025

CHECKED BY -- DATE --

APPROVED BY -- DATE --



MECHANICAL ENGINEERING TECHNOLOGY

4461 Interurban Road
Victoria, BC, Canada
V9E 2C1
Ph. (250) 370-3822
Fax. (250) 370-3898
www.camosun.ca

TITLE ASSY, FUEL SYSTEM

CADD MAINTAINED DATA
CHANGES SHALL BE INCORPORATED ELECTRONICALLY BY THE DESIGN AUTHORITY

THIRD ANGLE PROJECTION

(+/-)

SIZE B DRAWING NO 10014 REVISION X1

SCALE 2:1 DWG REFERENCE 10014 SHEET 1 OF 1

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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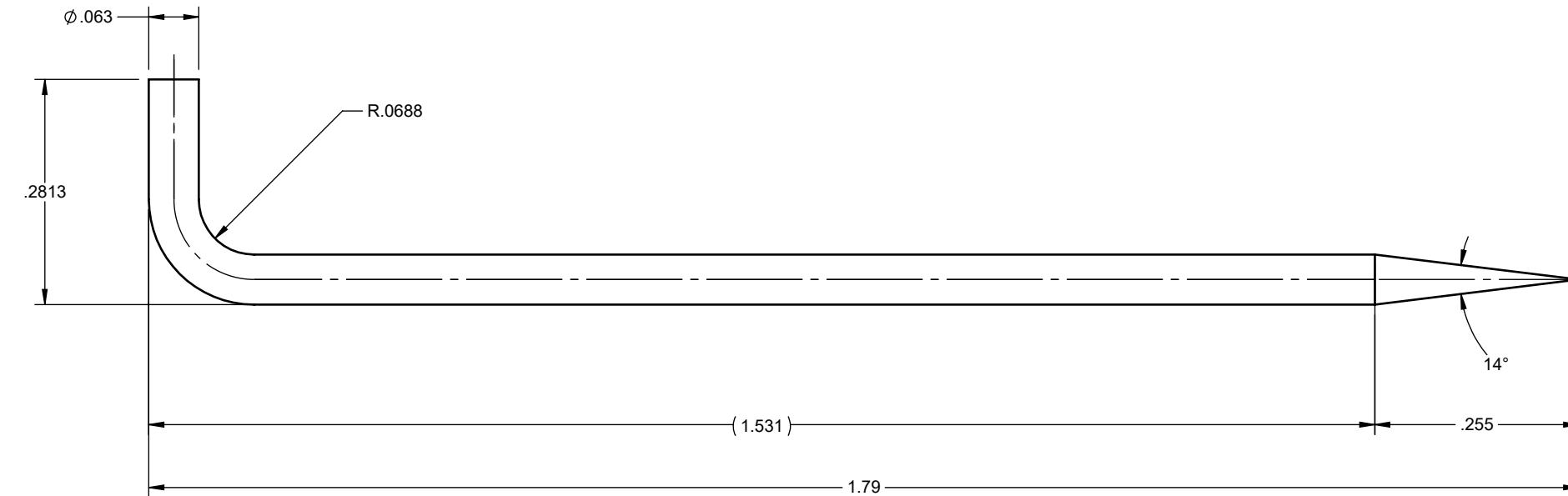
C

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- NOTES:**
1. MATERIAL: ALLOY STEEL
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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ALL DIMENSIONS ARE IN INCHES.

DECIMALS ANGLES FRACTIONS SURF FNSH

 X $\pm .1$ $\pm 0.5^\circ$ $\pm 1/32$ 125/✓

 XX $\pm .06$

 XXX $\pm .008$

DO NOT SCALE DRAWING

DESIGNED BY OB DATE 07-APR-2025

DRAWN BY OB DATE 07-APR-2025

CHECKED BY -- DATE --

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TITLE

NEEDLE

SIZE

B

DRAWING NO

10015

REVISION

X1

SCALE 5:1 DWG REFERENCE 10015 SHEET 1 OF 1

4

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C

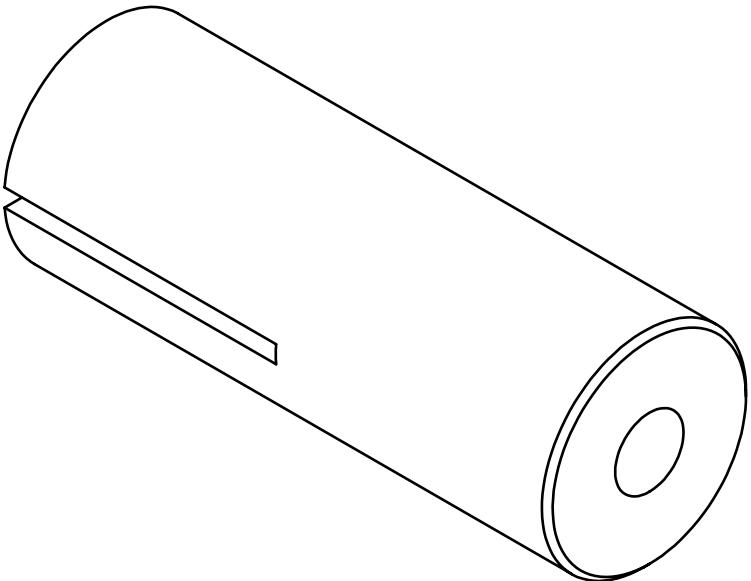
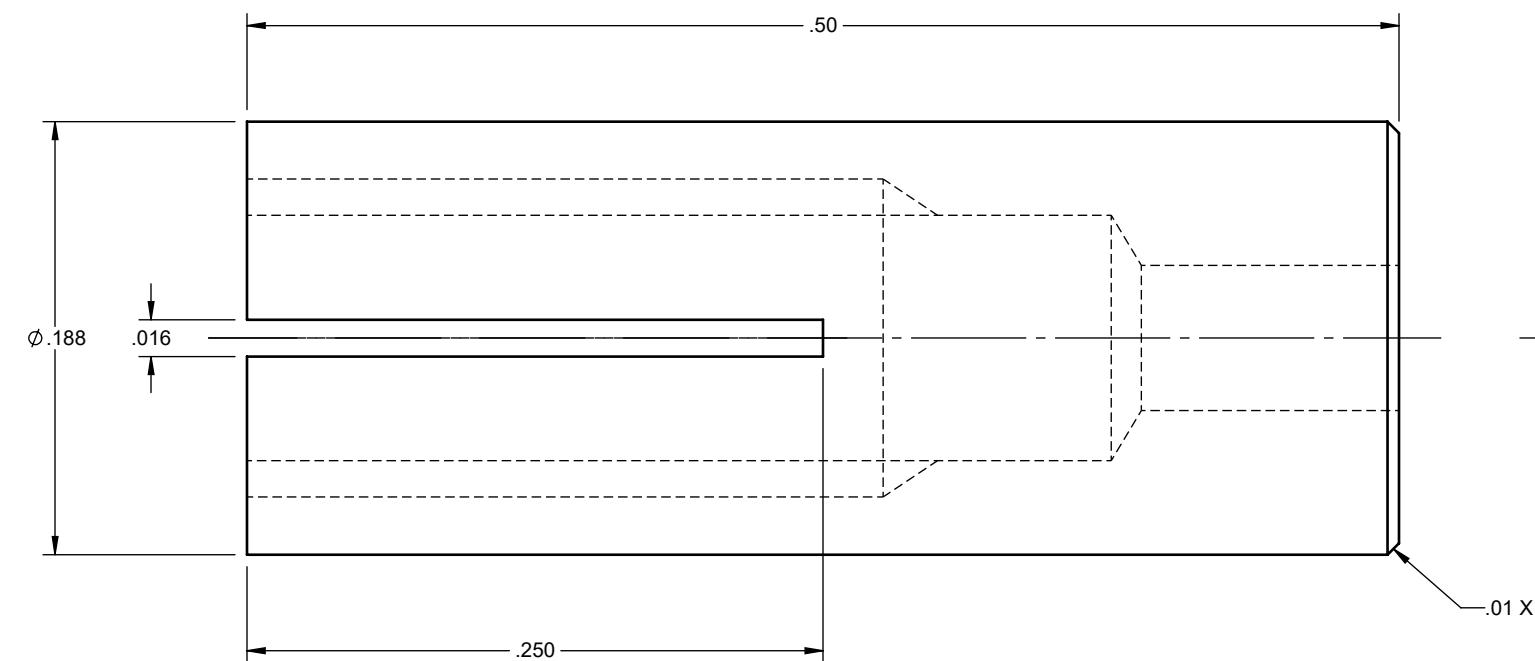
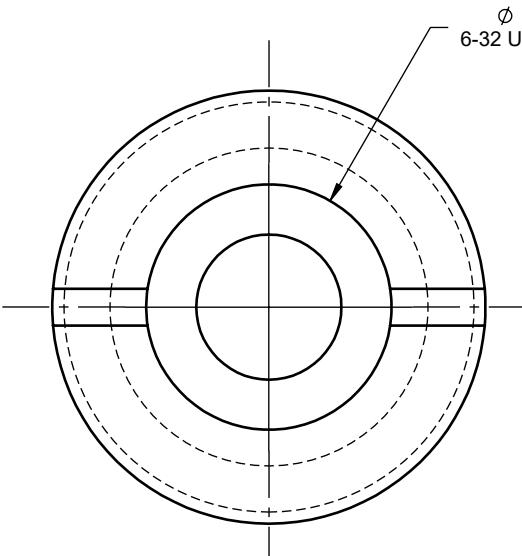
C

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- NOTES:**
1. MATERIAL: BRASS
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X	± .1	± 0.5°	± 1/32	125/
XX	± .06			
XXX	± .008			

DO NOT SCALE DRAWING

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TITLE

NEEDLE, THIMBLE

CADD MAINTAINED DATA	THIRD ANGLE PROJECTION
CHANGES SHALL BE INCORPORATED ELECTRONICALLY BY THE DESIGN AUTHORITY	

SIZE	DRAWING NO	REVISION
B	10016	X1
SCALE 12:1	DWG REFERENCE	10016

4

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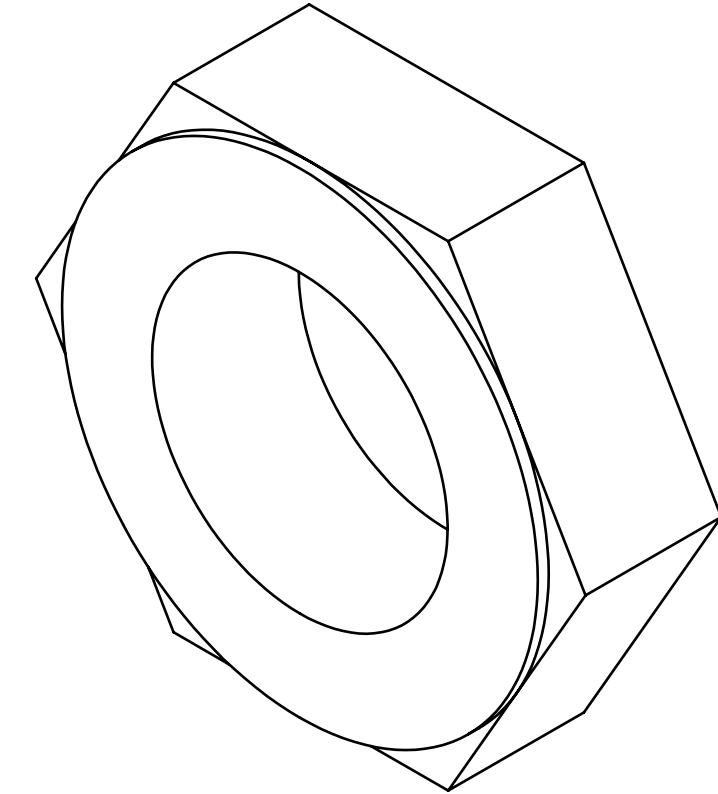
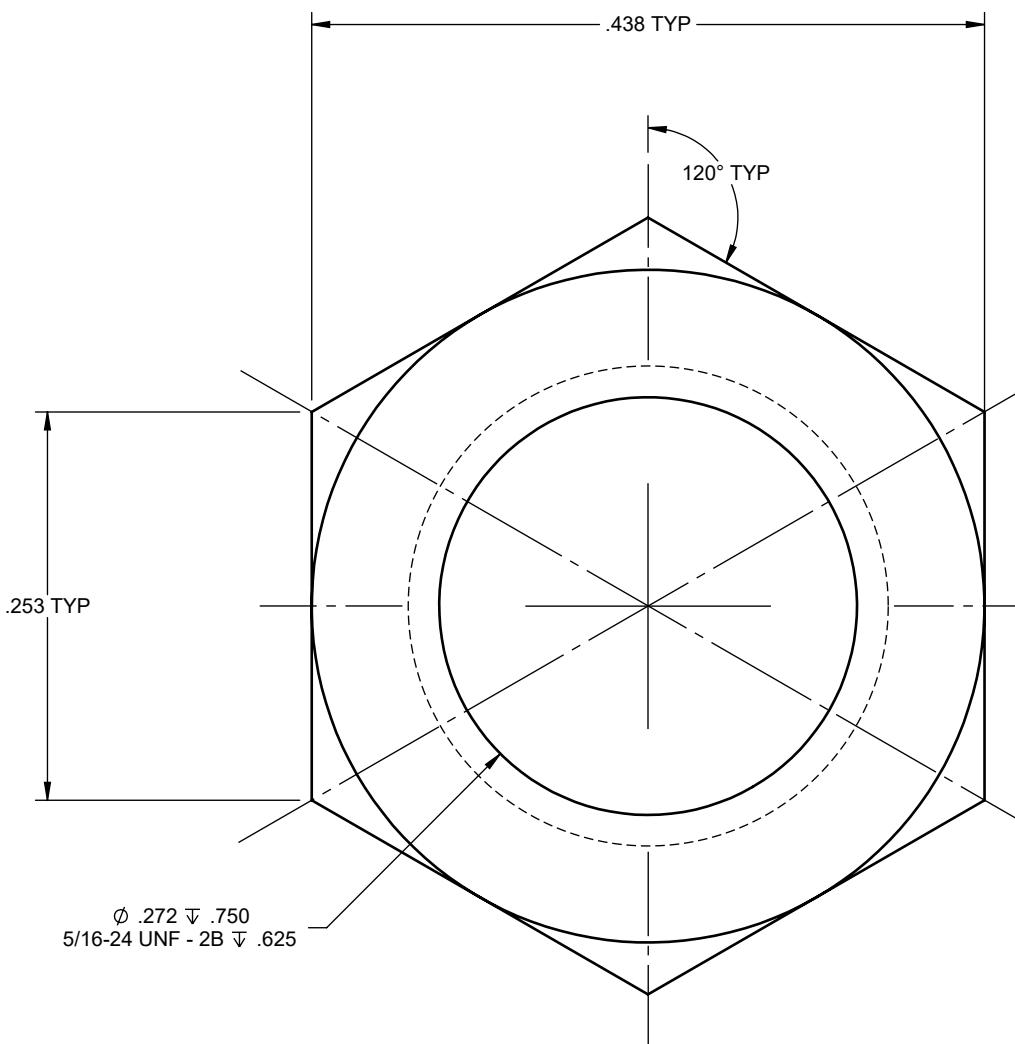
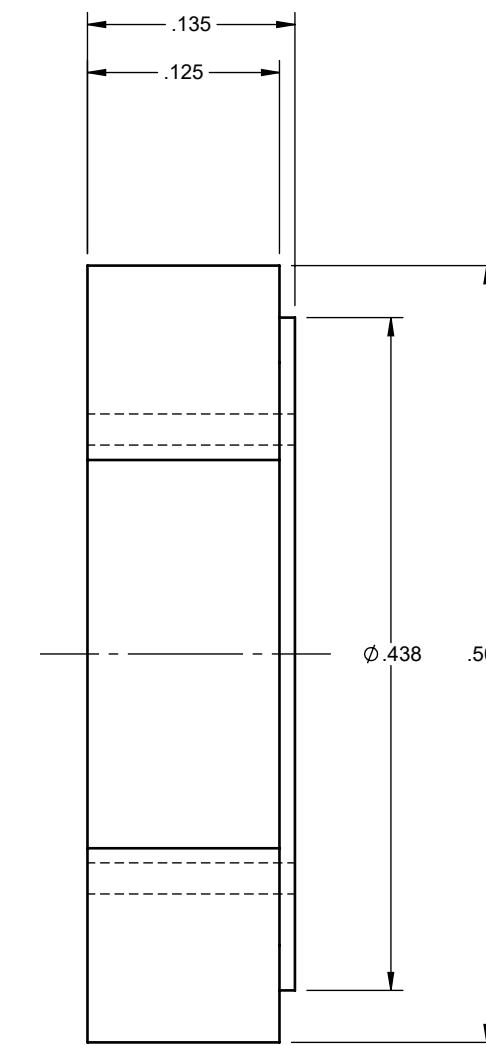
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- NOTES:
1. MATERIAL: BRASS
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X	± .1	± 0.5°	± 1/32	125/
XX	± .06			
XXX	± .008			

DO NOT SCALE DRAWING

DESIGNED BY	OB	DATE
		07-APR-2025

DRAWN BY	OB	DATE
		07-APR-2025

CHECKED BY	--	DATE
		--

APPROVED BY	--	DATE
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TITLE

JAM NUT

SIZE

B	DRAWING NO	10017	REVISION
8:1	DWG REFERENCE	10017	X1
SCALE		SHEET	
		1 OF 1	

4

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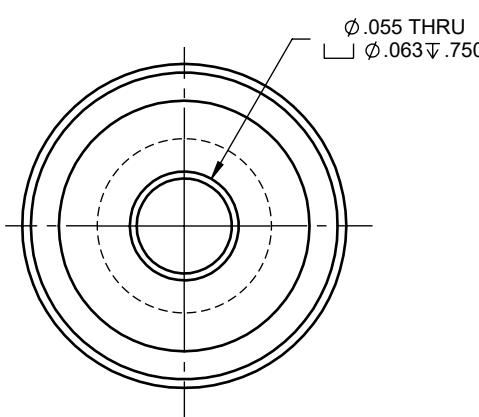
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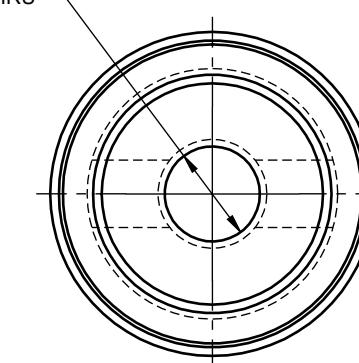
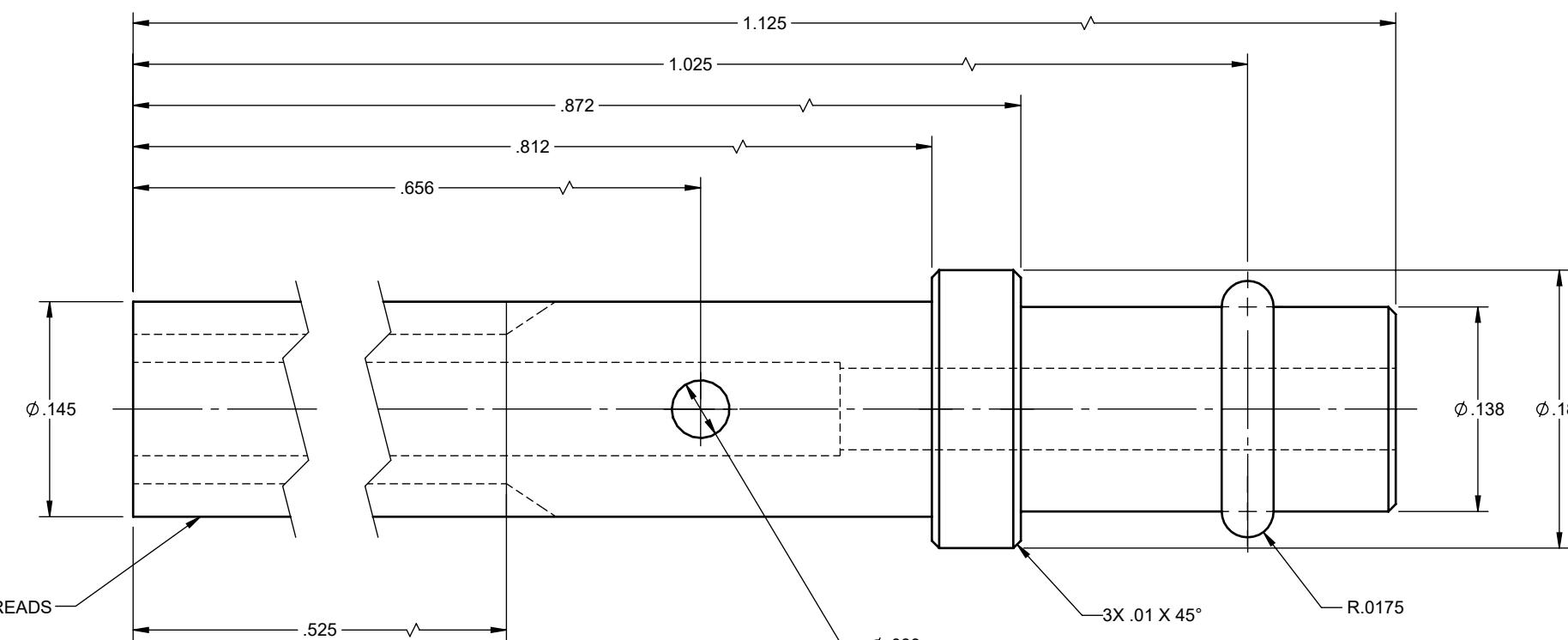
B

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$\phi .055$ THRU
 $\phi .063 \pm .750$



- NOTES:
 1. MATERIAL: BRASS
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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X $\pm .1$ $\pm 0.5^\circ$ $\pm 1/32$ 125/

XX $\pm .06$

XXX $\pm .008$

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TITLE

SPRAY BAR

SIZE

DRAWING NO

10019

X1

REVISION

10019

1 OF 1



Low-Strength Steel Hex Nut

Zinc-Plated, 6-32 Thread Size



Delivers tomorrow

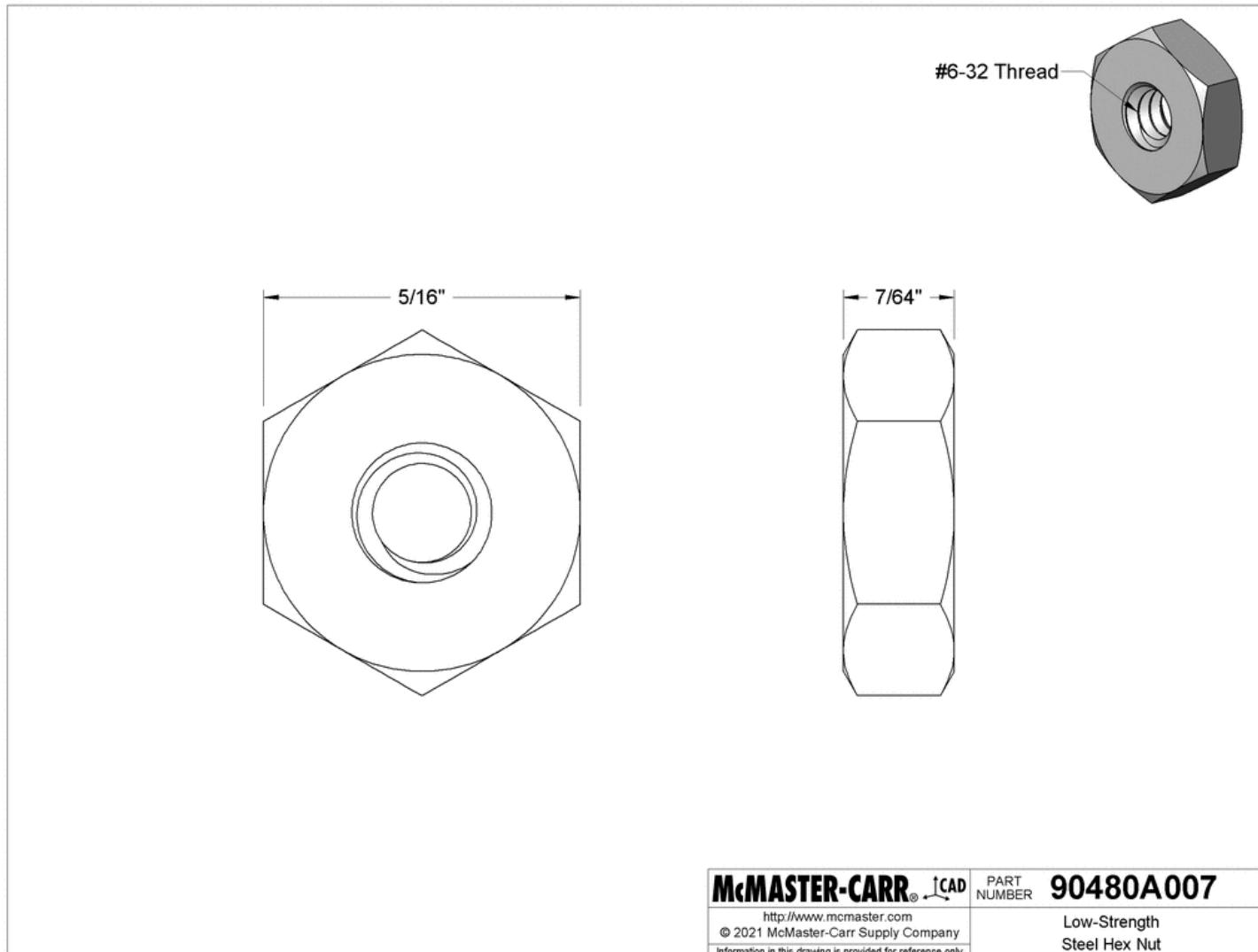
\$1.57 per pack of 100
90480A007

Hex Nut Profile	Standard
Fastener Strength Rating	Low
Material	Zinc-Plated Steel
Thread Size	6-32
Width	5/16"
Height	7/64"
Specifications Met	ASME B18.6.3
Drive Style	External Hex
Nut Type	Hex
System of Measurement	Inch
Thread Direction	Right Hand
Thread Fit	Unified Standard Class 2B
Thread Spacing	Coarse
Thread Type	UNC
Country of Origin	Taiwan
DFARS Compliance	Specialty Metals COTS-Exempt
Export Control	EAR99
Classification Number (ECCN)	
REACH Compliance	REACH (EC 1907/2006) (06/14/2023, 235 SVHC) Compliant
RoHS Compliance	RoHS 3 (2015/863/EU) Compliant
Schedule B Number	731816.0000
U.S.-Mexico-Canada Agreement (USMCA) Qualifying	No

The most commonly used hex nuts, these are suitable for fastening most machinery and equipment.

Low-Strength Steel—Rated Grade 2, Class 6, or lower, these nuts are about half as strong as medium-strength nuts. They are suitable for light duty fastening applications, such as securing access panels. Use them with screws that have a similar strength rating to avoid stripping threads during installation.

Zinc-Plated Steel—A step up from plain steel, the zinc plating withstands occasional exposure to moisture.

**McMASTER-CARR** CADhttp://www.mcmaster.com
© 2021 McMaster-Carr Supply CompanyInformation in this drawing is provided for reference only.PART
NUMBER**90480A007**Low-Strength
Steel Hex Nut

The information in this 3-D model is provided for reference only.

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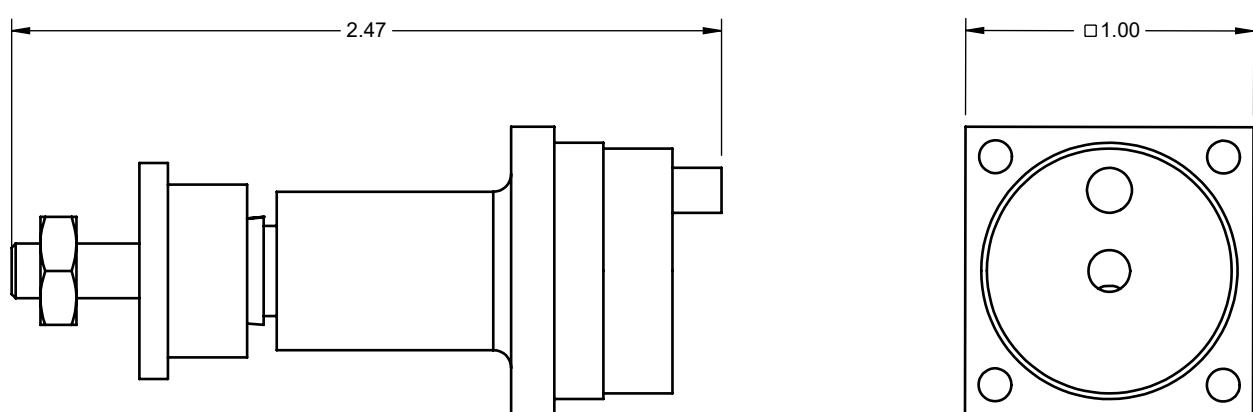
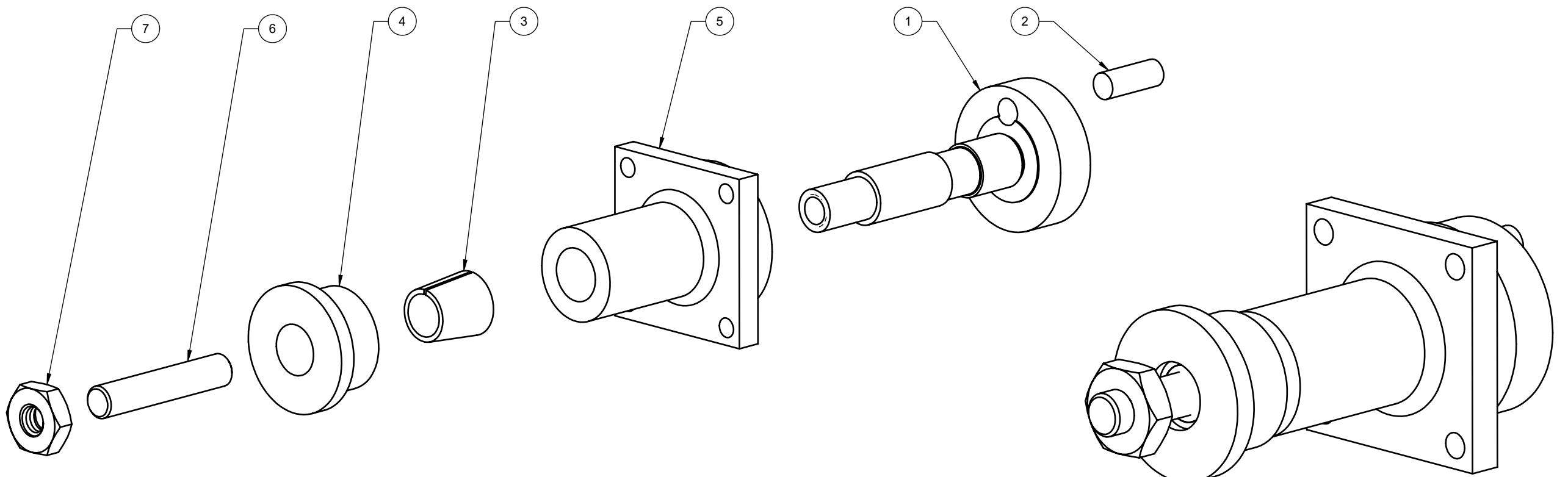
C

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ITEM	ID	QTY	DESCRIPTION	GEN SPEC	MATERIAL
7	10013	1	10-32 MACHINE NUT, BOUGHT	90480A195 (MCMASTER-CARR)	ALLOY STEEL
6	10012	1	10-32 STUD 1 INCH, BOUGHT	90322A639 (MCMASTER-CARR)	ALLOY STEEL
5	10029	1	MAIN BEARING HOUSING	-	2011-T3 AL (UNS A92011)
4	10011	1	PROP DRIVER	-	6061-T6 AL (UNS A96061)
3	10010	1	COLLET	-	BRASS
2	10009	1	CRANKPIN	-	TOOL STEEL, AISI TYPE A2 (UNS T30102)
1	10008	1	CRANKSHAFT	-	ALLOY STEEL

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X .± .1 ± 0.5° ± 1/32 ✓
XX .± .06
XXX .± .008

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TITLE ASSY, CRANKSHAFT

CADD MAINTAINED DATA
CHANGES SHALL BE INCORPORATED ELECTRONICALLY BY THE DESIGN AUTHORITY

THIRD ANGLE PROJECTION

(+/-)

SIZE B DRAWING NO 10007 REVISION X1

SCALE 3:2 DWG REFERENCE 10007 SHEET 1 OF 1

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

4

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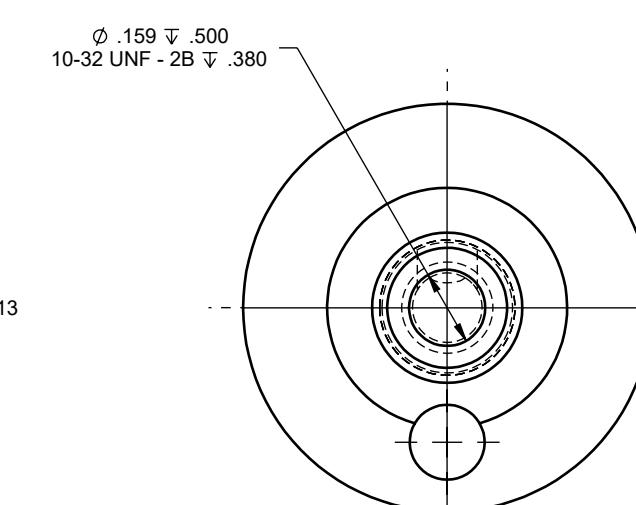
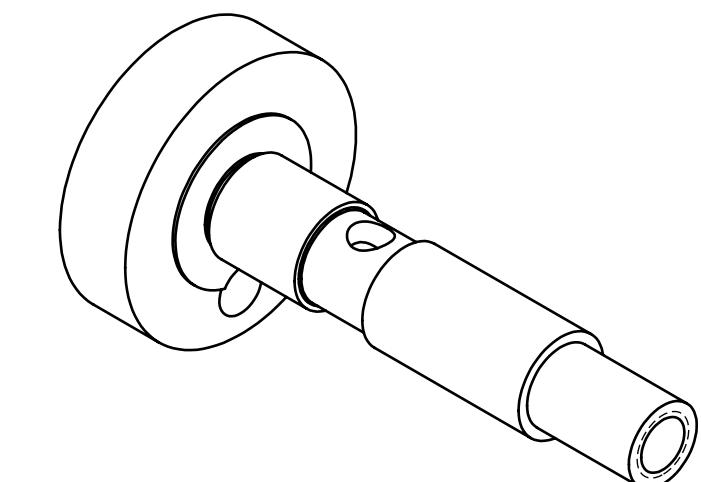
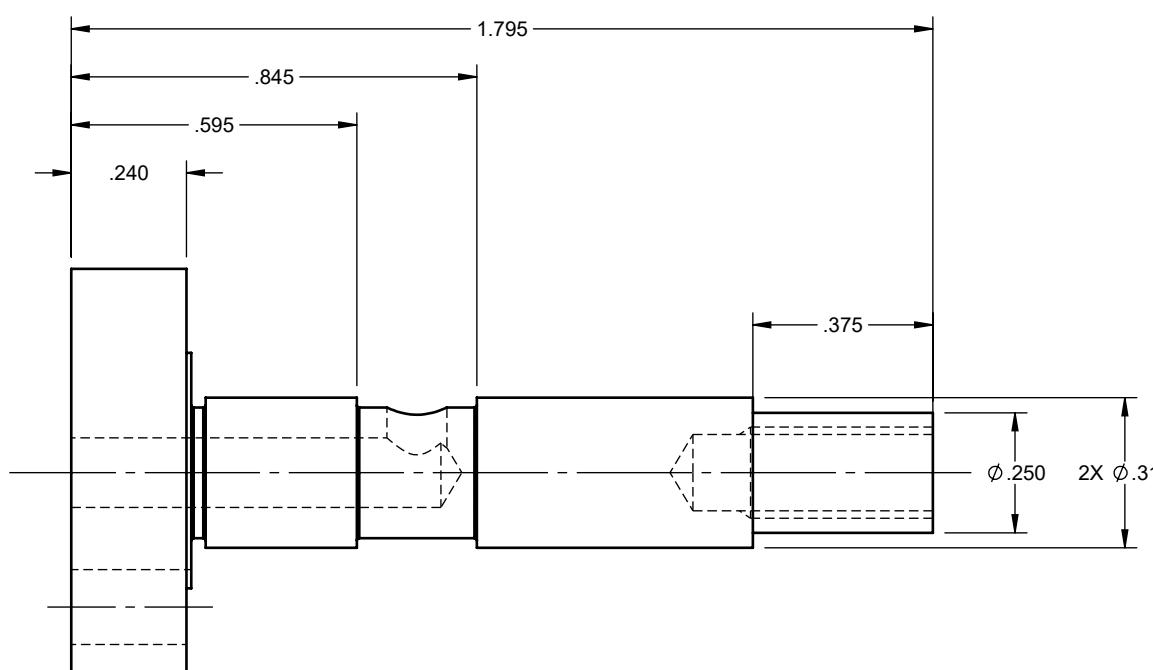
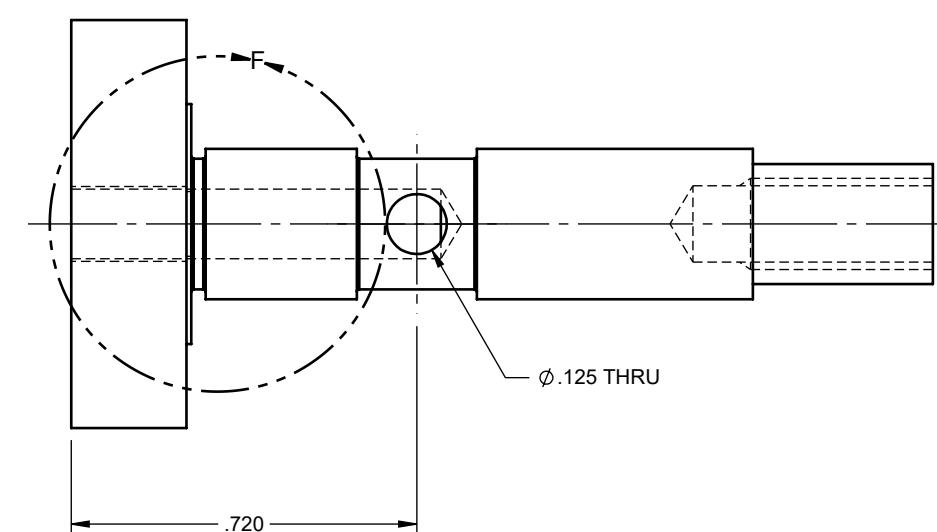
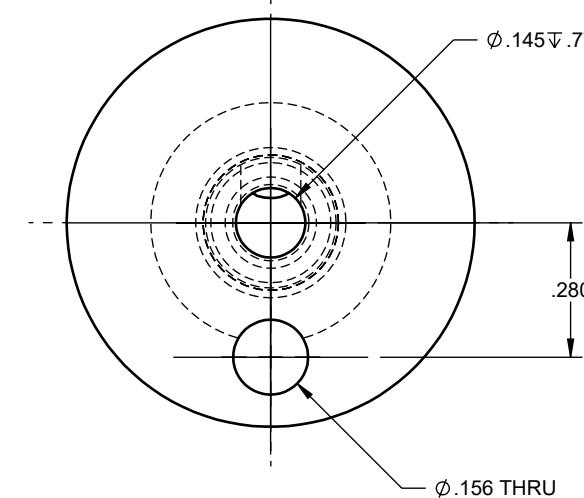
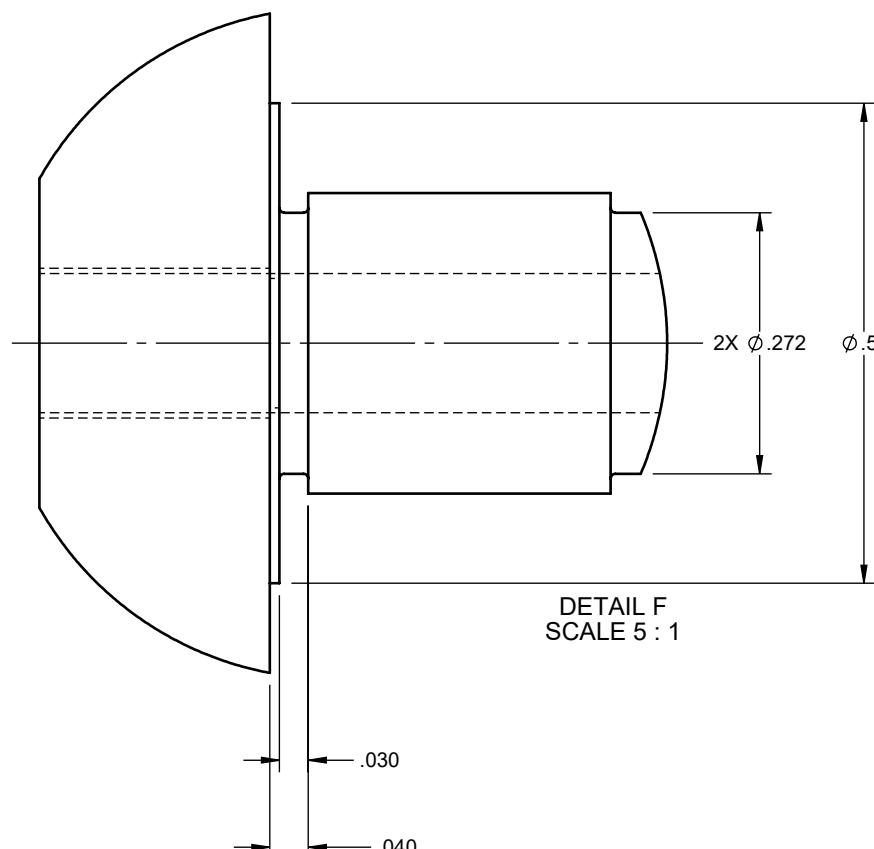
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D



- NOTES:
- MATERIAL: ALLOY STEEL
 - STOCK:
 - FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FINISH

X	$\pm .1$	$\pm 0.5^\circ$	$\pm 1/32$	125
XX	$\pm .06$			
XXX	$\pm .008$			

DO NOT SCALE DRAWING

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APPROVED BY -- DATE --



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TITLE

CRANKSHAFT

SIZE B DRAWING NO

10008 X1

REVISION

5:2 DWG REFERENCE 10008

SHEET 1 OF 1

4

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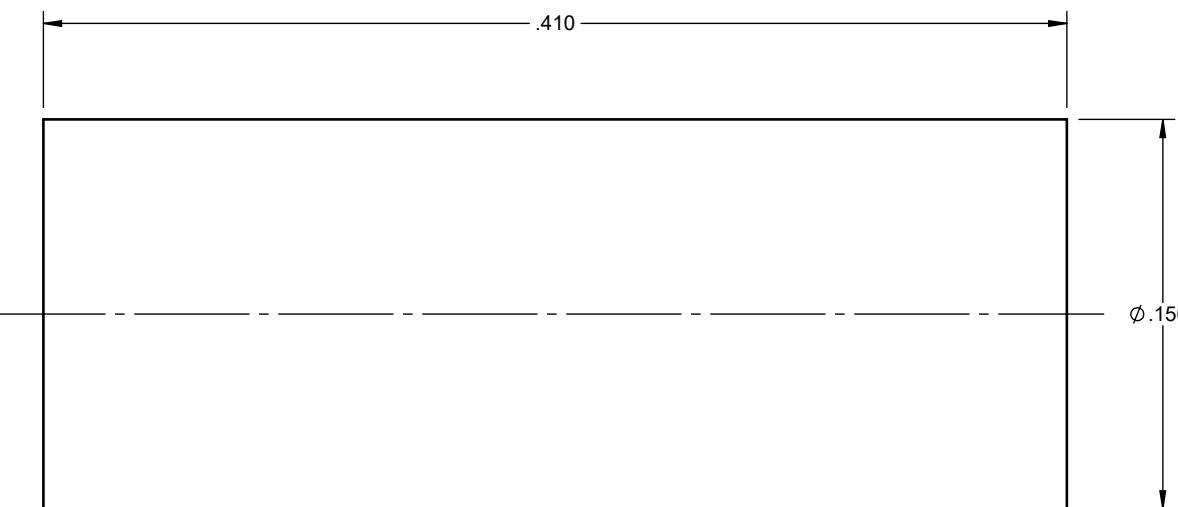
C

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- NOTES:**
1. MATERIAL: TOOL STEEL, AISI TYPE A2 (UNS T30102)
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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CHANGES SHALL BE
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ELECTRONICALLY
BY THE DESIGN AUTHORITY

**THIRD ANGLE
PROJECTION**

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DECIMALS	ANGLES	FRACTIONS	SURF FNSH
X	± .1	± 0.5°	± 1/32
XX	± .06		125/
XXX	± .008		

DO NOT SCALE DRAWING

DESIGNED BY	OB	DATE
		07-APR-2025

DRAWN BY	OB	DATE
		07-APR-2025

CHECKED BY	--	DATE
		--

APPROVED BY	--	DATE
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TITLE

CRANKPIN

SIZE

DRAWING NO

10009

X1

10009

1 OF 1

4

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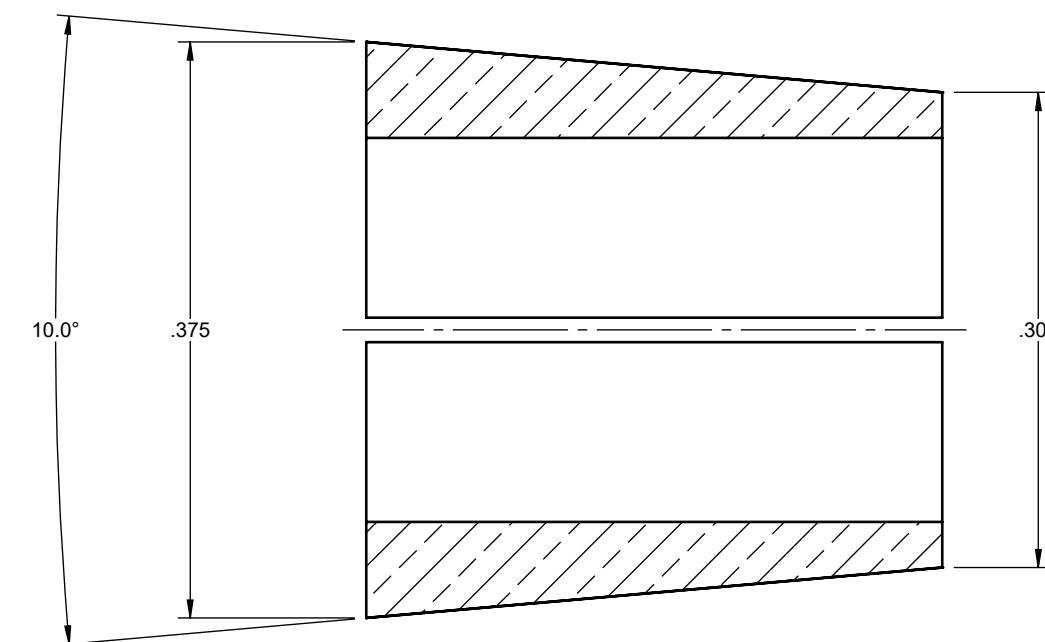
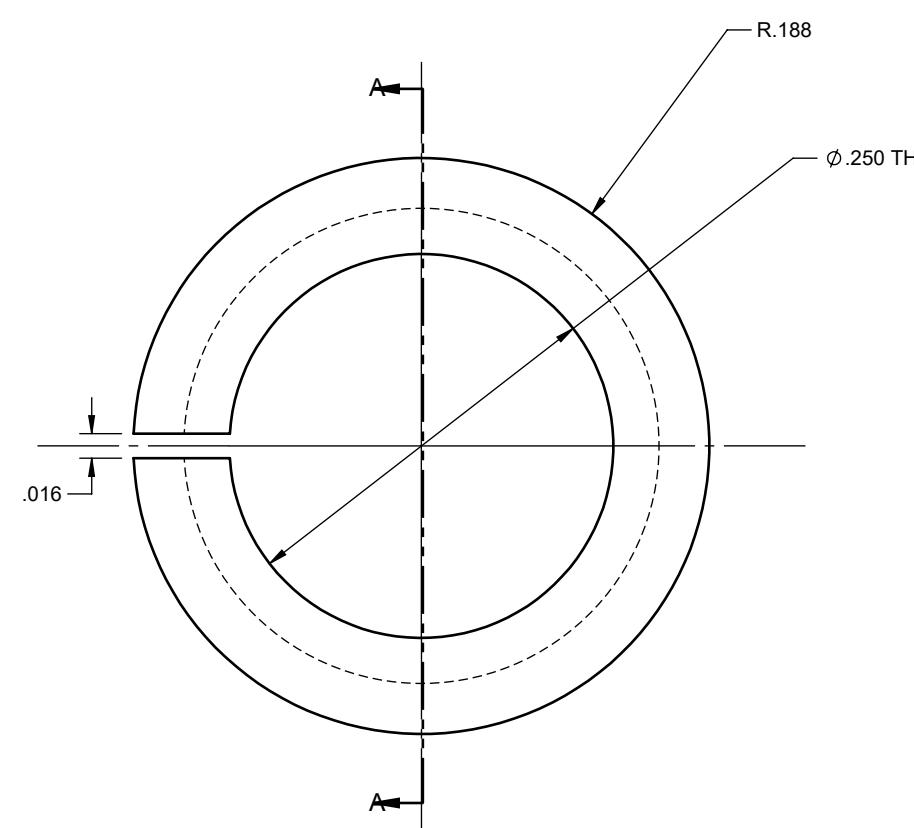
C

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SECTION A-A

- NOTES:**
1. MATERIAL: BRASS
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FINISH

X	± .1	± 0.5°	± 1/32	125/
XX	± .06			
XXX	± .008			

DO NOT SCALE DRAWING

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TITLE

COLLET

SIZE

DRAWING NO

10010

X1

REVISION

10010

SHEET 1 OF 1

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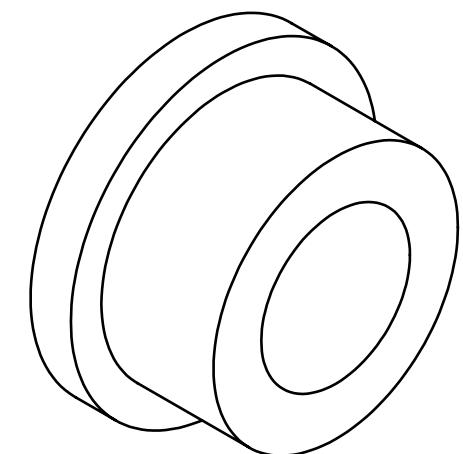
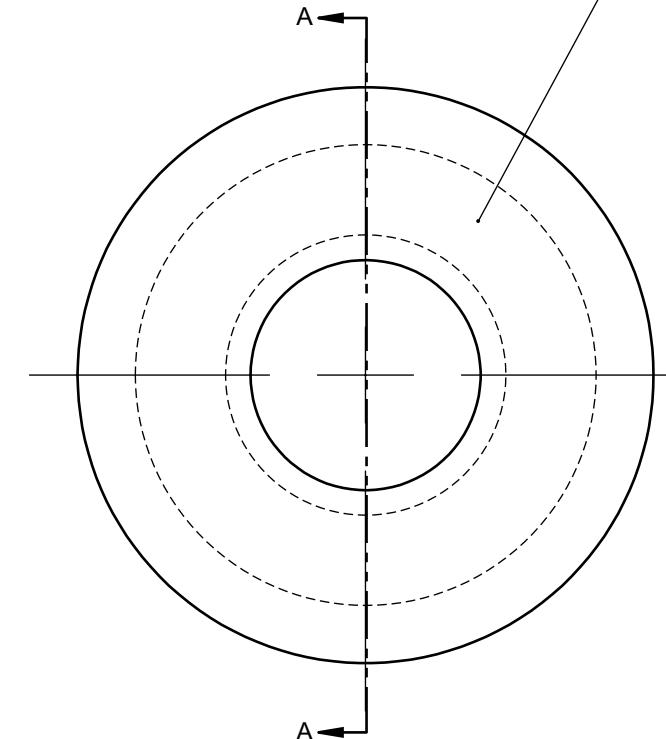
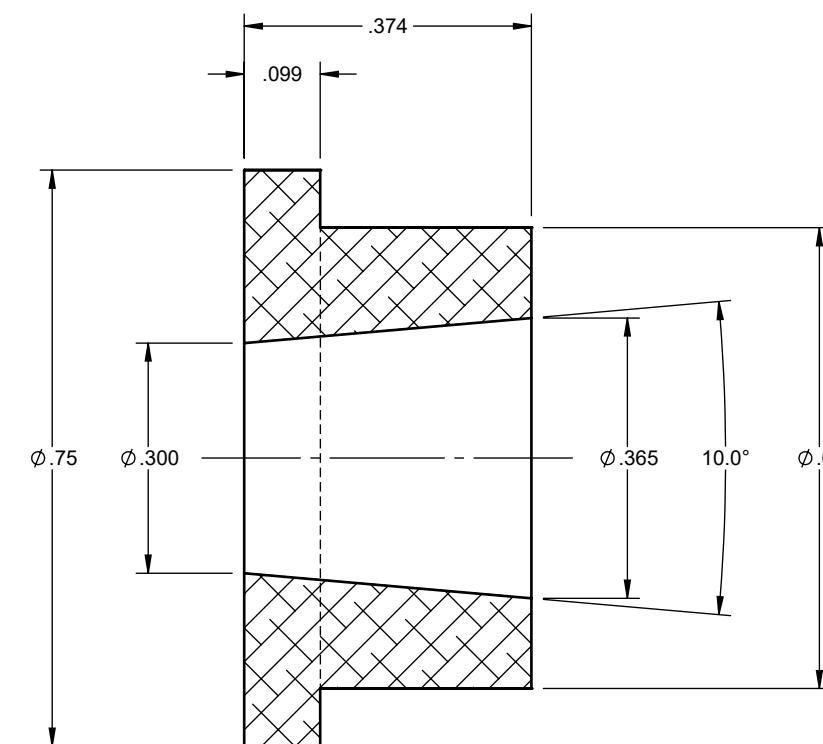
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- NOTES:**
1. MATERIAL: 6061-T6 AL (UNS A96061)
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X	± .1	± 0.5°	± 1/32	125/
XX	± .06			
XXX	± .008			

DO NOT SCALE DRAWING

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		07-APR-2025

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		--

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		--



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TITLE

PROP DRIVER

CADD
MAINTAINED DATA

THIRD ANGLE
PROJECTION

CHANGES SHALL BE
INCORPORATED
ELECTRONICALLY
BY THE DESIGN AUTHORITY



SIZE	DRAWING NO	REVISION
B	10011	X1
SCALE 4:1	DWG REFERENCE	10011

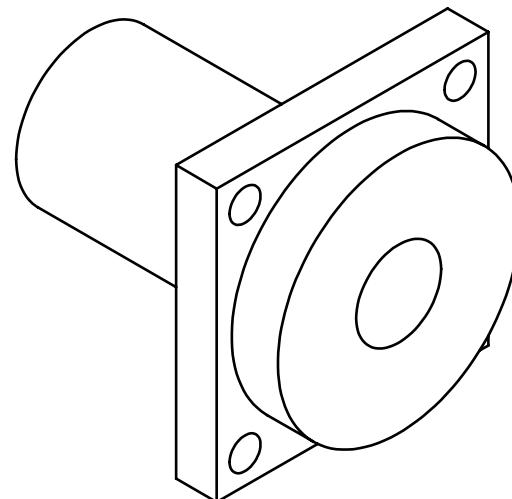
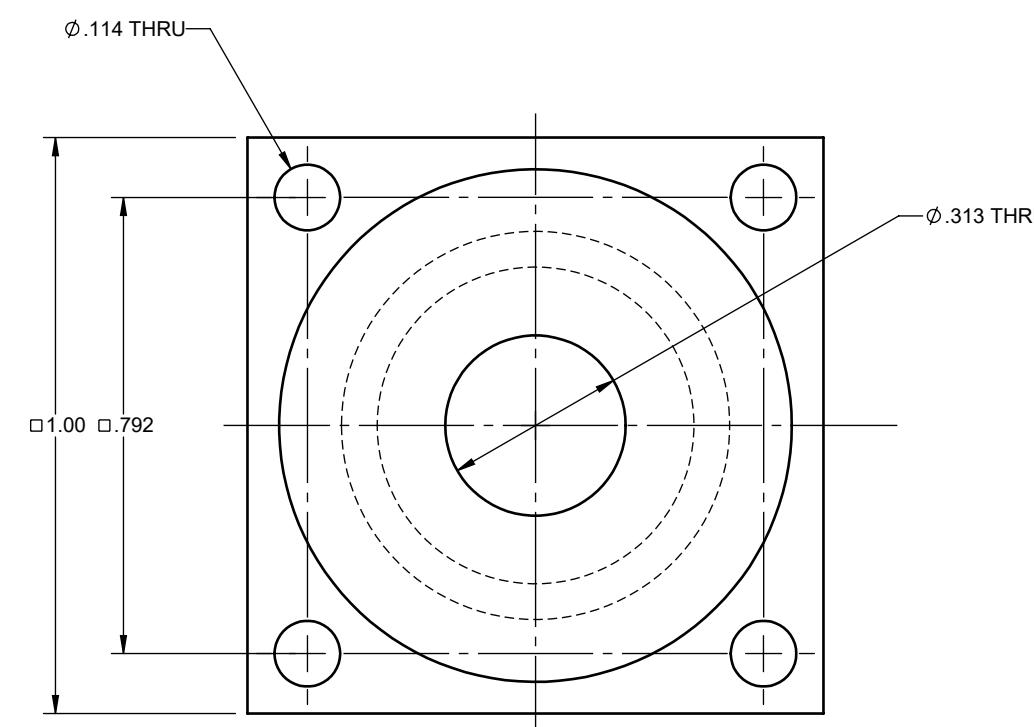
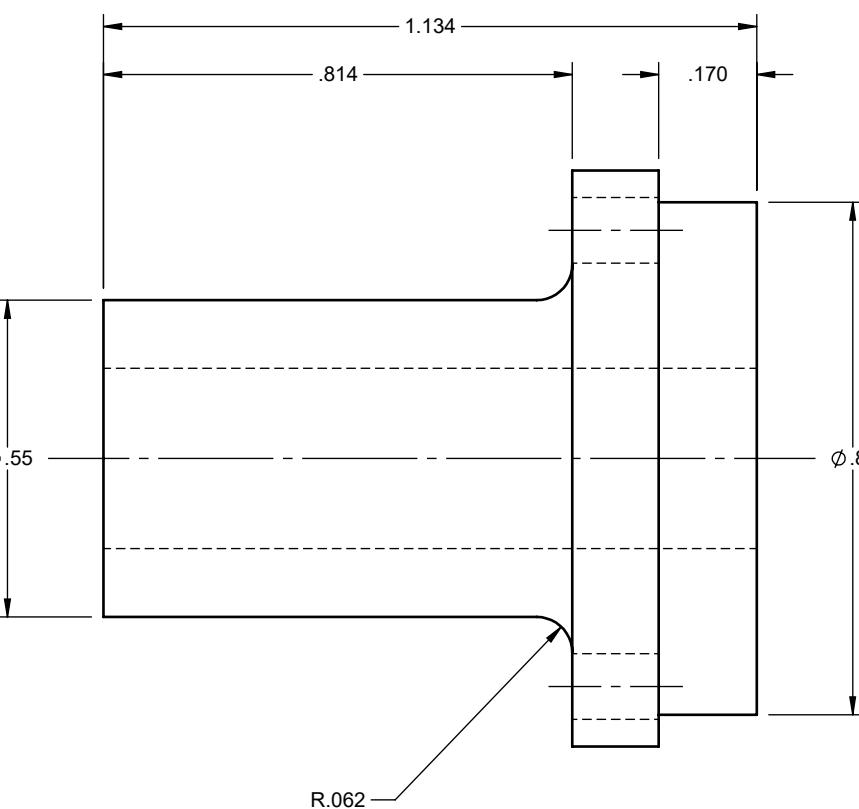
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- NOTES:**
1. MATERIAL: 2011-T3 AL (UNS A92011)
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X $\pm .1$ $\pm 0.5^\circ$ $\pm 1/32$ 125/

XX $\pm .06$

XXX $\pm .008$

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TITLE

MAIN BEARING HOUSING

CADD MAINTAINED DATA	THIRD ANGLE PROJECTION
CHANGES SHALL BE INCORPORATED ELECTRONICALLY BY THE DESIGN AUTHORITY	

SIZE	DRAWING NO	REVISION
B	10029	X1

SCALE 3:1 DWG REFERENCE 10029 SHEET 1 OF 1



High-Strength Steel Threaded Rod

10-32 Thread Size, 1" Long



Delivers tomorrow

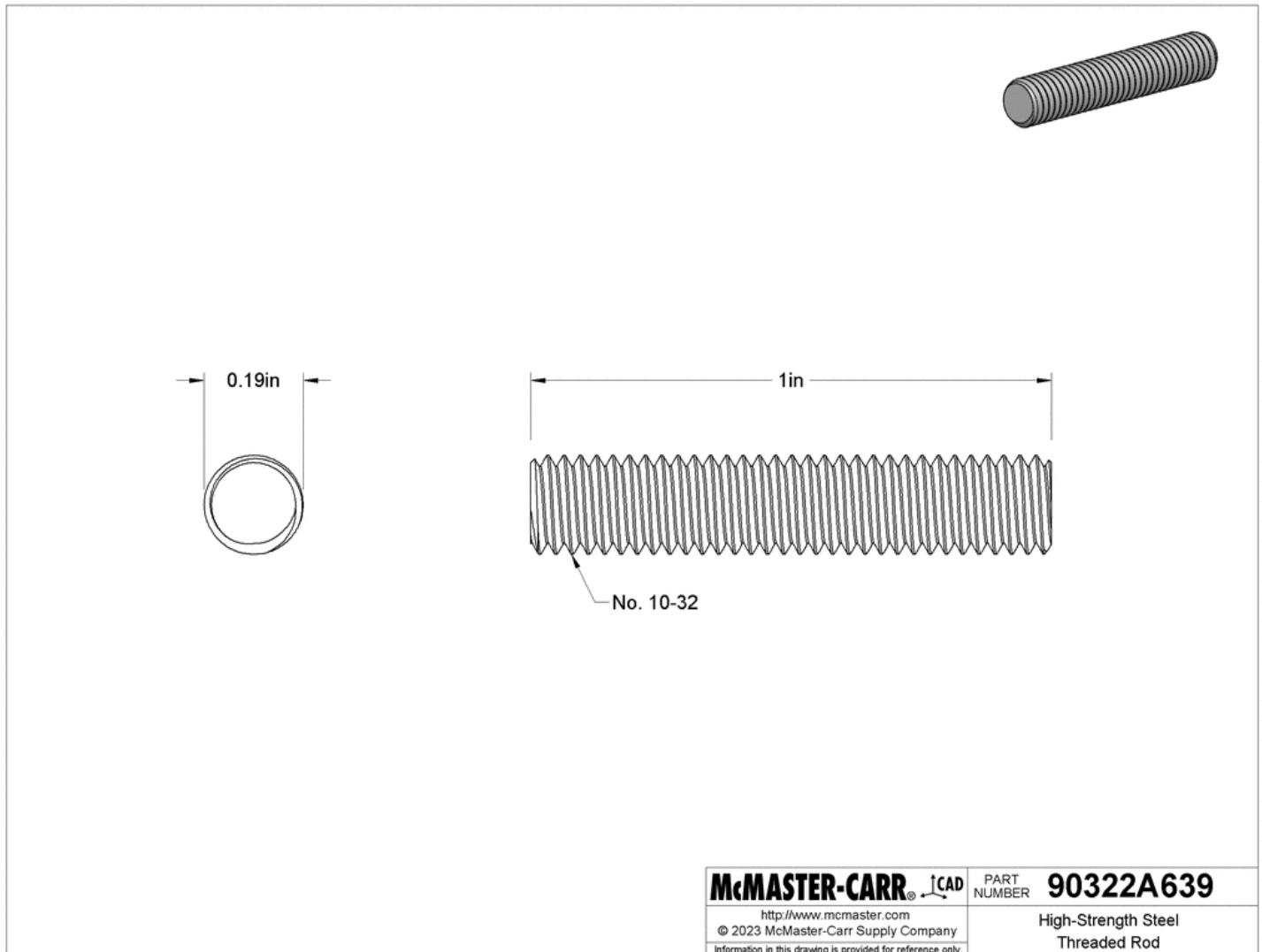
\$2.47 each
90322A639

Thread Direction	Right Hand
Fastener Strength Rating	High
Thread Size	10-32
Length	1"
Tensile Strength	150,000 psi
Hardness	Rockwell C33
Material	Steel
Performance	High Strength
System of Measurement	Inch
Thread Fit	Unified Standard Class 2A
Thread Spacing	Fine
Thread Type	UNF
Threading	Fully Threaded
Country of Origin	China
DFARS Compliance	Not Specialty Metals Compliant
Export Control	EAR99
Classification Number (ECCN)	
REACH Compliance	REACH (EC 1907/2006) (01/17/2023, 233 SVHC) Compliant
RoHS Compliance	RoHS 3 (2015/863/EU) Compliant
Schedule B Number	731815.5000
U.S.–Mexico–Canada Agreement (USMCA) Qualifying	No

Anchor, connect, or hang components in a wide variety of applications, from mounting I-beams to suspending light fixtures.

High-Strength Steel—With a tensile strength of 150,000 psi, these rods are strong enough to stabilize steel frameworks and structural supports, such as I-beams. They are about 25% stronger than medium-strength steel rods. To avoid stripped threads during installation, make sure your nuts are also high-strength steel.

Steel—Best for dry environments since moisture will cause these rods to rust.



The information in this 3-D model is provided for reference only.



Low-Strength Steel Hex Nut

Zinc-Plated, 10-32 Thread Size



Delivers tomorrow

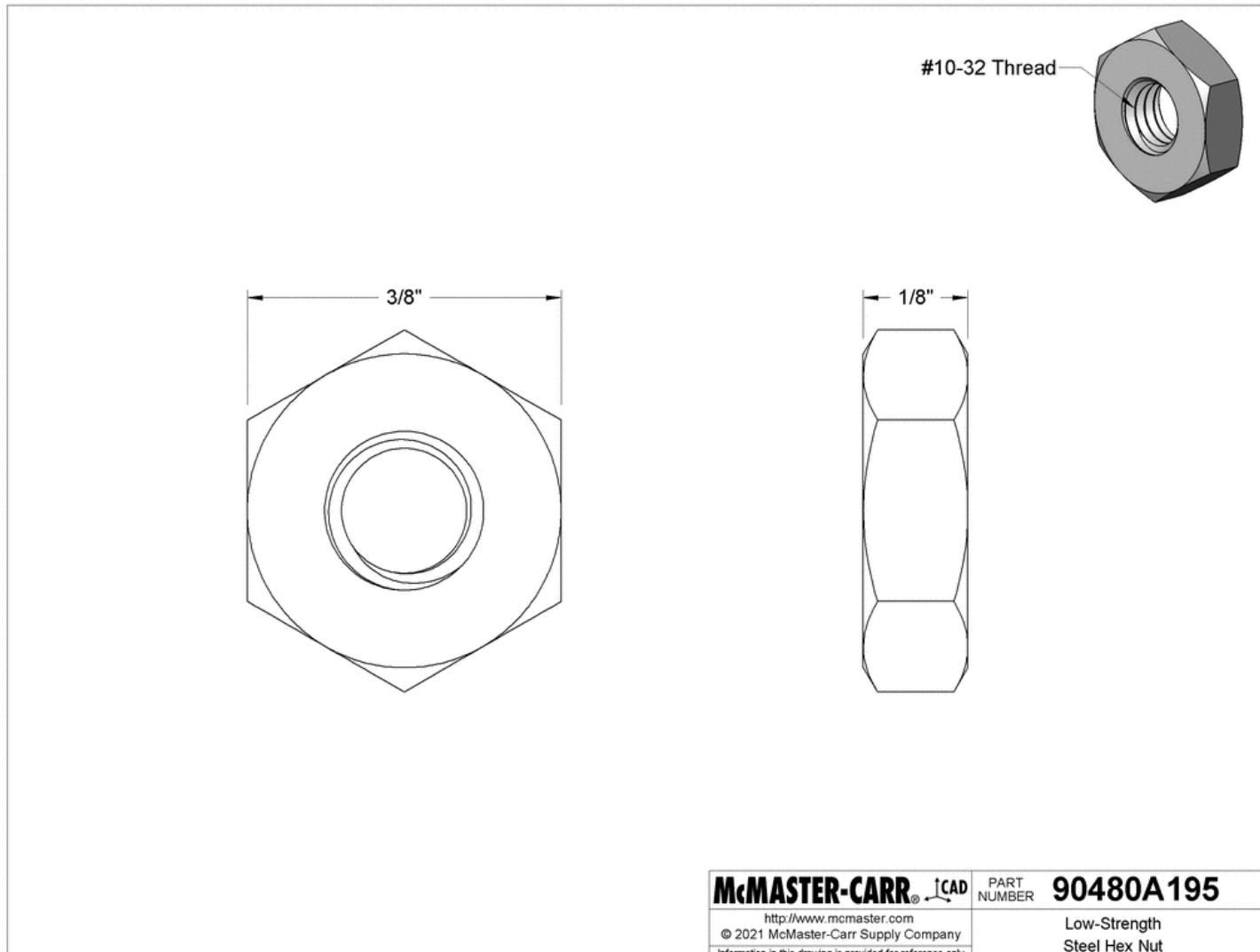
\$2.32 per pack of 100
90480A195

Hex Nut Profile	Standard
Fastener Strength Rating	Low
Material	Zinc-Plated Steel
Thread Size	10-32
Width	3/8"
Height	1/8"
Specifications Met	ASME B18.6.3
Drive Style	External Hex
Nut Type	Hex
System of Measurement	Inch
Thread Direction	Right Hand
Thread Fit	Unified Standard Class 2B
Thread Spacing	Fine
Thread Type	UNF
Country of Origin	Taiwan
DFARS Compliance	Specialty Metals COTS-Exempt
Export Control Classification Number (ECCN)	EAR99
REACH Compliance	REACH (EC 1907/2006) (06/14/2023, 235 SVHC) Compliant
RoHS Compliance	RoHS 3 (2015/863/EU) Compliant
Schedule B Number	731816.0000
U.S.-Mexico-Canada Agreement (USMCA) Qualifying	No

The most commonly used hex nuts, these are suitable for fastening most machinery and equipment.

Low-Strength Steel—Rated Grade 2, Class 6, or lower, these nuts are about half as strong as medium-strength nuts. They are suitable for light duty fastening applications, such as securing access panels. Use them with screws that have a similar strength rating to avoid stripping threads during installation.

Zinc-Plated Steel—A step up from plain steel, the zinc plating withstands occasional exposure to moisture.



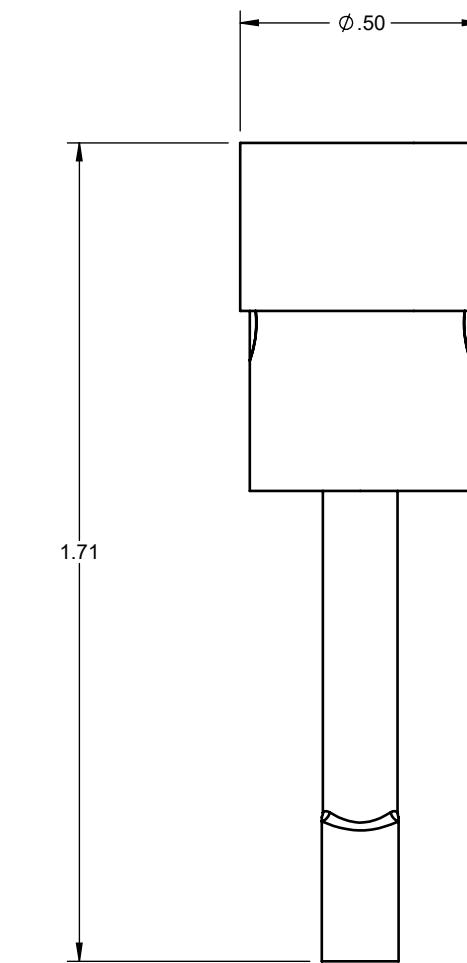
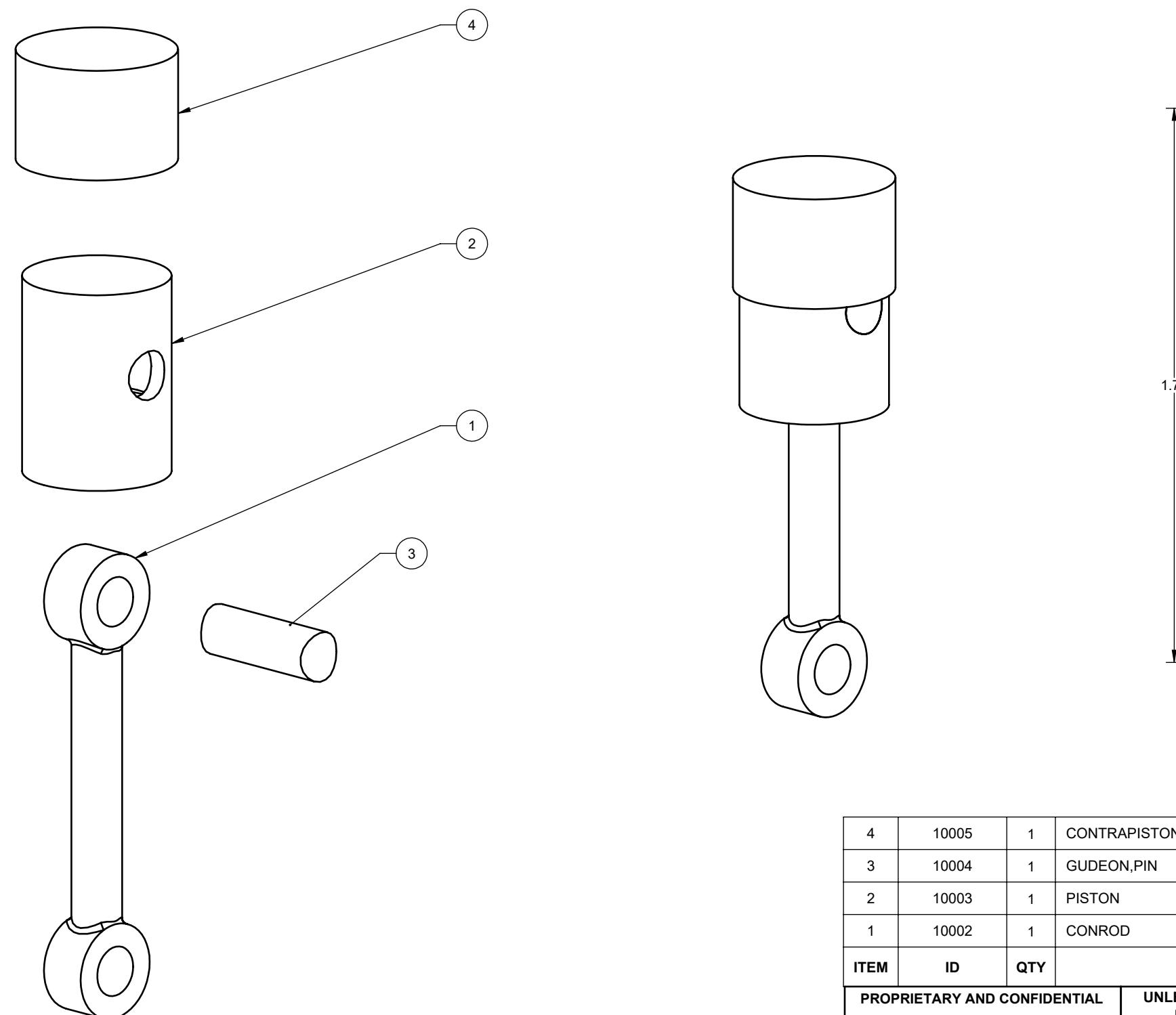
The information in this 3-D model is provided for reference only.

4

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1



ITEM	ID	QTY	DESCRIPTION	GEN SPEC	MATERIAL
4	10005	1	CONTRAPISTON	-	GRAY CAST IRON
3	10004	1	GUDEON,PIN	-	TOOL STEEL, AISI TYPE A2 (UNS T30102)
2	10003	1	PISTON	-	GRAY CAST IRON
1	10002	1	CONROD	-	2011-T3 AL (UNS A92011)
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DO NOT SCALE DRAWING					
DESIGNED BY	OB	DATE	07-APR-2025		
DRAWN BY	OB	DATE	07-APR-2025	SIZE	DRAWING NO
CHECKED BY	--	DATE	--	B	10001
APPROVED BY	--	DATE	--	SCALE	5:2
				DWG REFERENCE	10001
X1	PRELIMINARY	--	--	REVISION	X1
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

CHANGES SHALL BE INCORPORATED ELECTRONICALLY BY THE DESIGN AUTHORITY

CADD MAINTAINED DATA

THIRD ANGLE PROJECTION

INTERPRET PER ASME Y14.100-2017
ALL DIMENSIONS ARE IN INCHES.
DECIMALS ANGLES FRACTIONS SURF FNSH
X .± .1 ±0.5° ±1/32 125/ ✓
XX .± .06
XXX .± .008

DO NOT SCALE DRAWING

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DRAWN BY OB DATE 07-APR-2025

CHECKED BY -- DATE --

APPROVED BY -- DATE --



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TITLE ASSY,PISTON AND ROD

ASSY,PISTON AND ROD

REVISION X1
SHEET 1 OF 1

4

3

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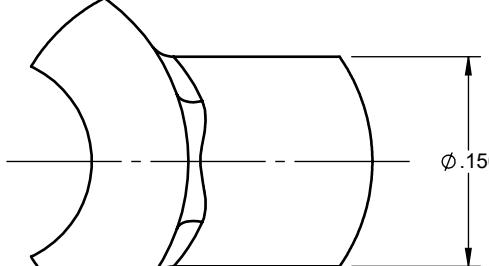
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B

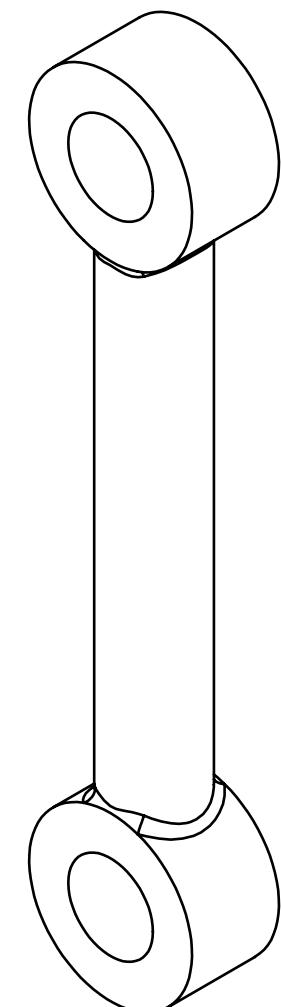
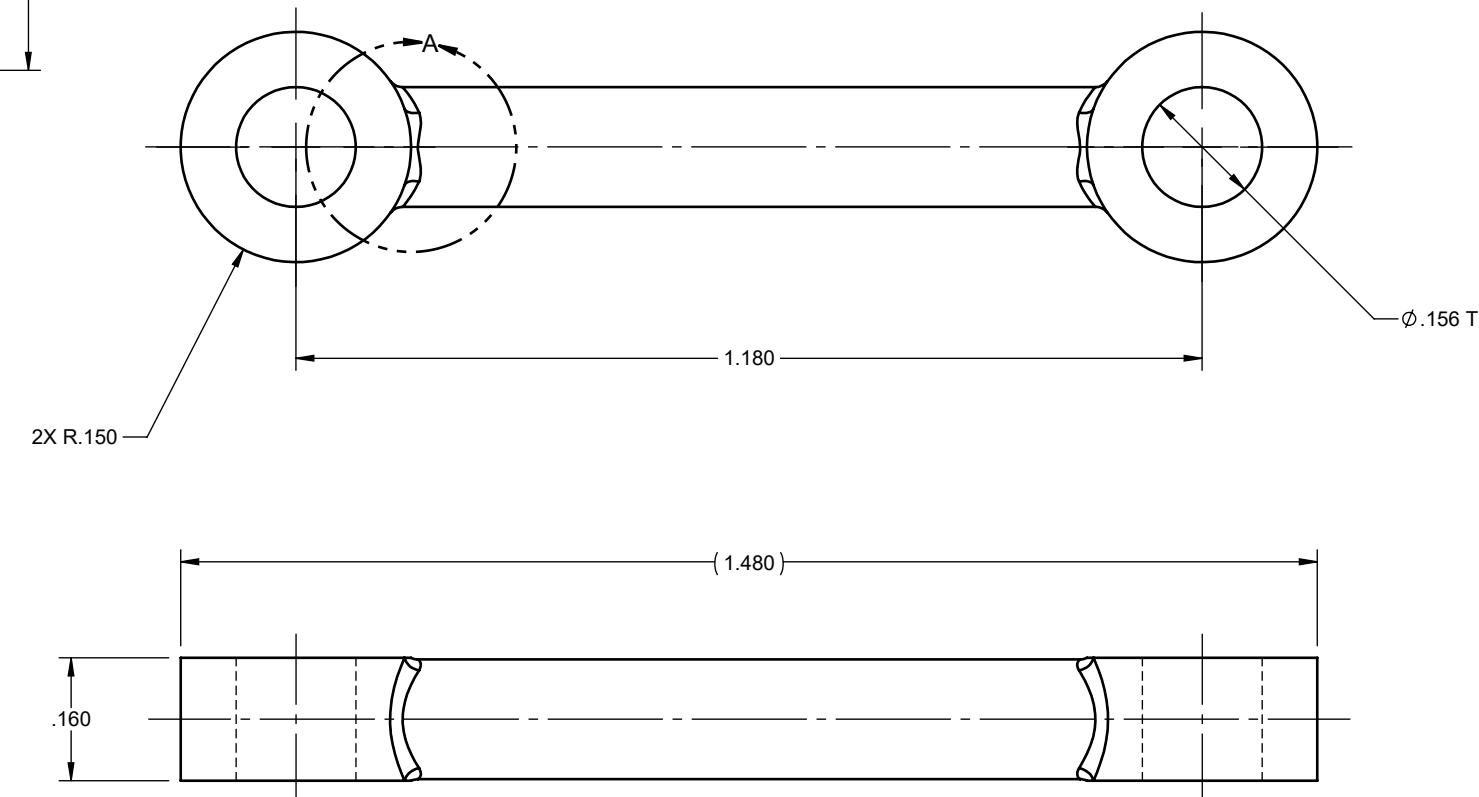
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A

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY



DETAIL A
SCALE 7 : 1



- NOTES:
1. MATERIAL: 2011-T3 AL (UNS A92011)
2. STOCK:
3. FINISH:

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BY THE DESIGN AUTHORITY

THIRD ANGLE
PROJECTION

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DECIMALS ANGLES FRACTIONS SURF FNSH
X ± .1 ± 0.5° ± 1/32 125/

XX ± .06 -- -- --
XXX ± .008 -- -- --

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APPROVED BY -- DATE --



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TITLE

CONROD

SIZE

B

DRAWING NO

10002

X1

REVISION

SCALE

4:1

DWG REFERENCE

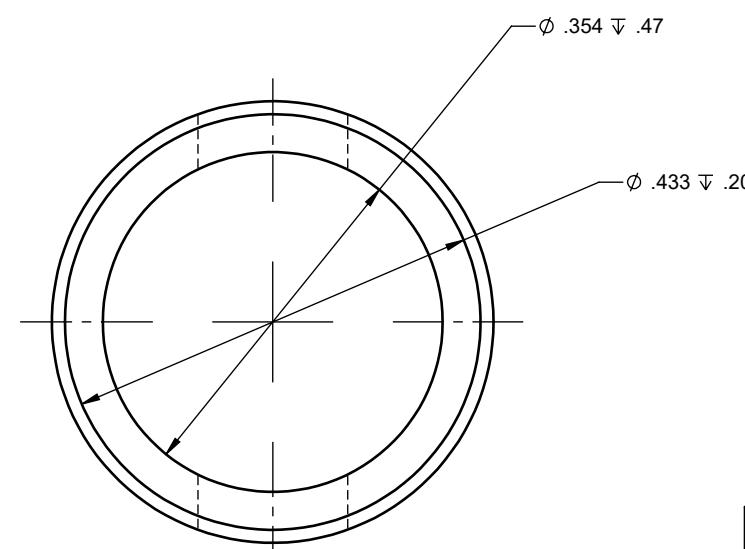
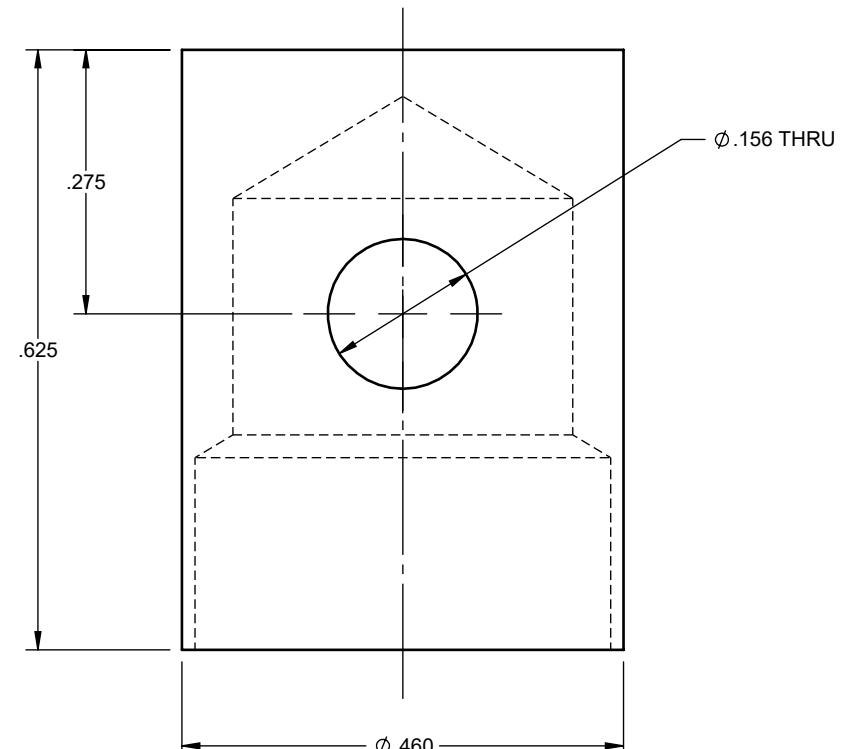
10002

SHEET

1 OF 1

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NOTES:

1. MATERIAL: GRAY CAST IRON
2. STOCK:
3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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X	\pm .1	\pm 0.5°	\pm 1/32	125/
XX	\pm .06			
XXX	\pm .008			

DO NOT SCALE DRAWING

DESIGNED BY	OB	DATE	07-APR-2025
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DRAWN BY	OB	DATE	07-APR-2025
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CHECKED BY	--	DATE	--
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APPROVED BY	--	DATE	--
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TITLE

PISTON

SIZE

DRAWING NO

REVISION

10003

X1

SHEET

1 OF 1

4

3

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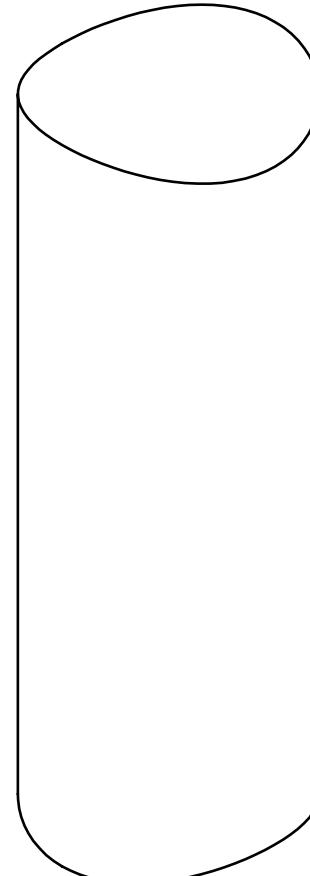
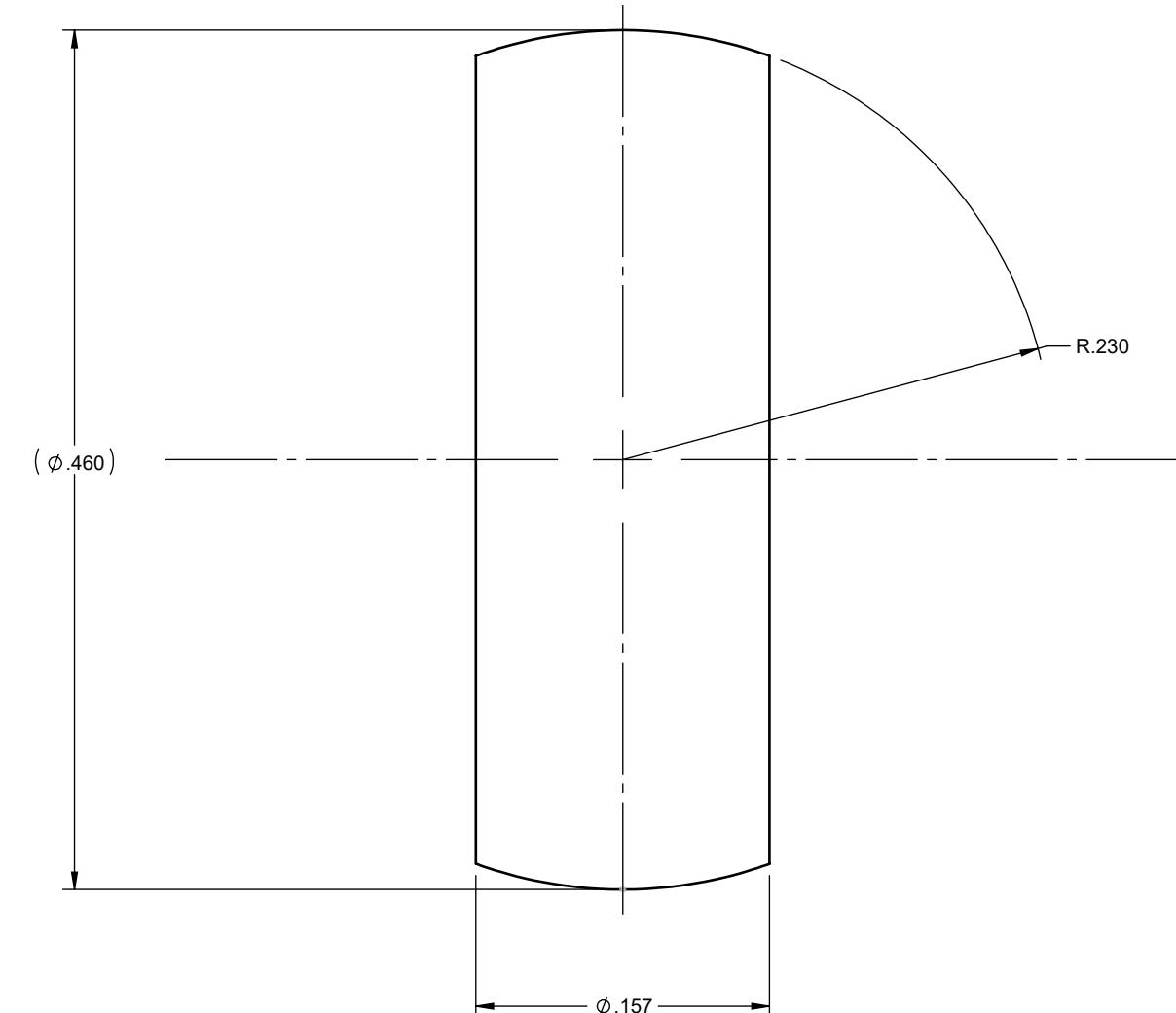
1

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**NOTES:**

1. MATERIAL: TOOL STEEL, AISI TYPE A2 (UNS T30102)
2. STOCK:
3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X	± .1	± 0.5°	± 1/32	125/
XX	± .06			
XXX	± .008			

DO NOT SCALE DRAWING

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DRAWN BY	OB	DATE
		07-APR-2025

CHECKED BY	--	DATE
		--

APPROVED BY	--	DATE
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TITLE

GUDEON,PIN

SIZE

DRAWING NO

10004

REVISION

X1

SCALE

10:1 DWG REFERENCE

10004

SHEET

1 OF 1

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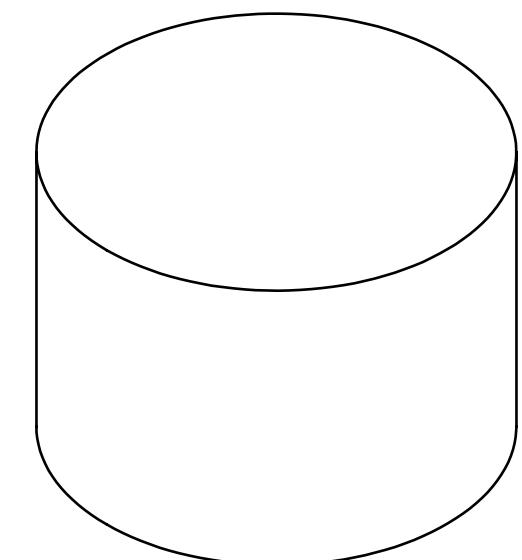
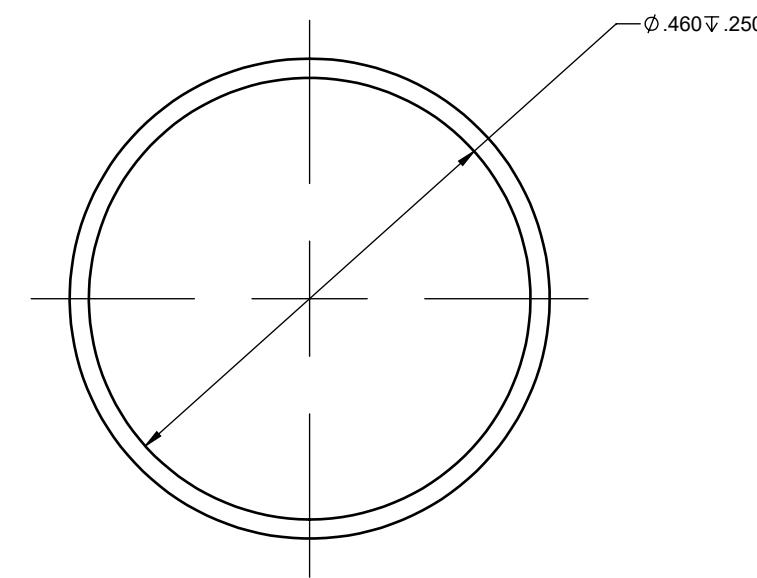
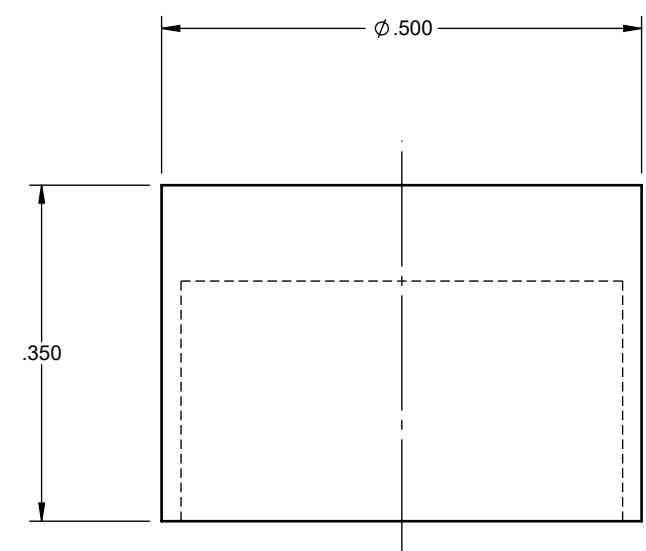
B

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NOTES:

1. MATERIAL: GRAY CAST IRON
2. STOCK:
3. FINISH:



X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X ± .1 ± 0.5° ± 1/32 125/✓
XX ± .06
XXX ± .008**DO NOT SCALE DRAWING**

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TITLE CONTRAPISTON

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THIRD ANGLE PROJECTION

SIZE B DRAWING NO 10005 REVISION X1

SCALE 5:1 DWG REFERENCE 10005 SHEET 1 OF 1

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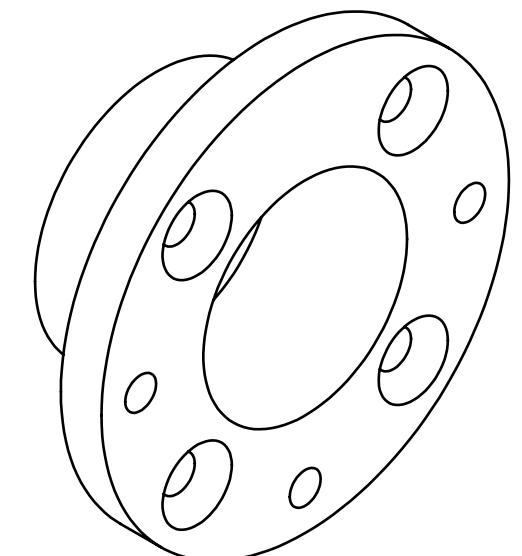
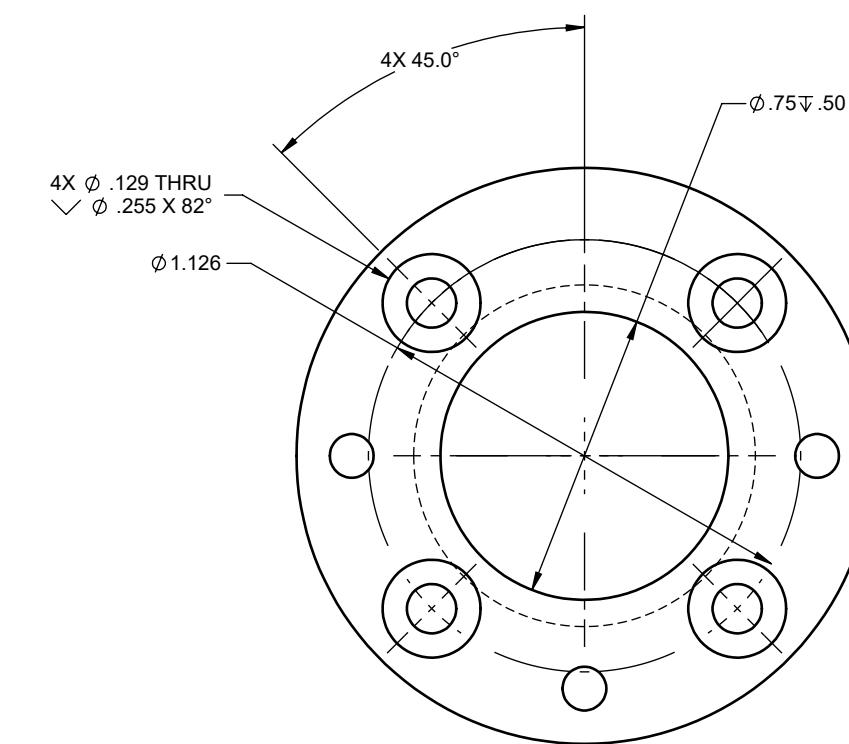
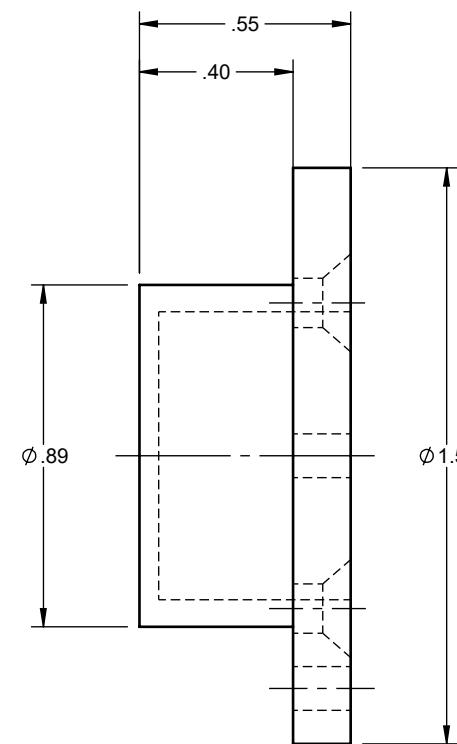
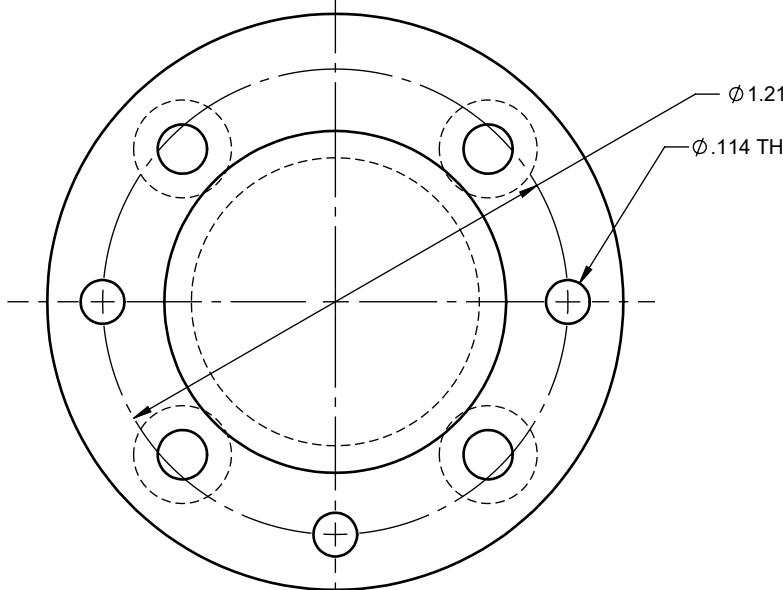
A

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- NOTES:**
1. MATERIAL: 2011-T3 AL (UNS A92011)
 2. STOCK:
 3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS	ANGLES	FRACTIONS	SURF FNSH
X	±.1	±0.5°	±1/32
XX	±.06		125
XXX	±.008		

DO NOT SCALE DRAWING

DESIGNED BY	OB	DATE
		07-APR-2025

DRAWN BY	OB	DATE
		07-APR-2025

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		--

APPROVED BY	--	DATE
		--

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TITLE

BACKPLATE

SIZE

DRAWING NO

10027

X1

REVISION

SCALE

2:1 DWG REFERENCE

10027

SHEET

1 OF 1

4

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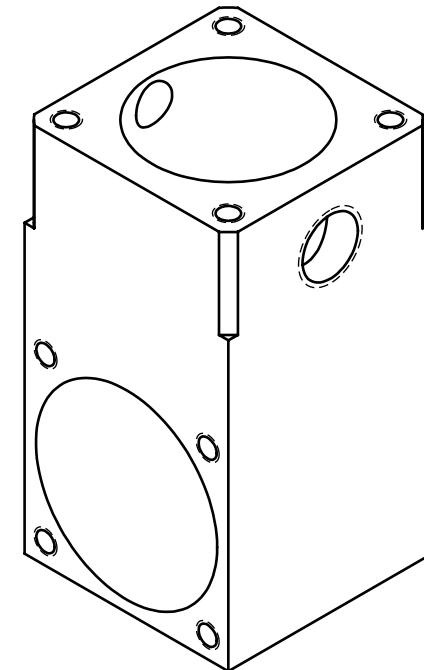
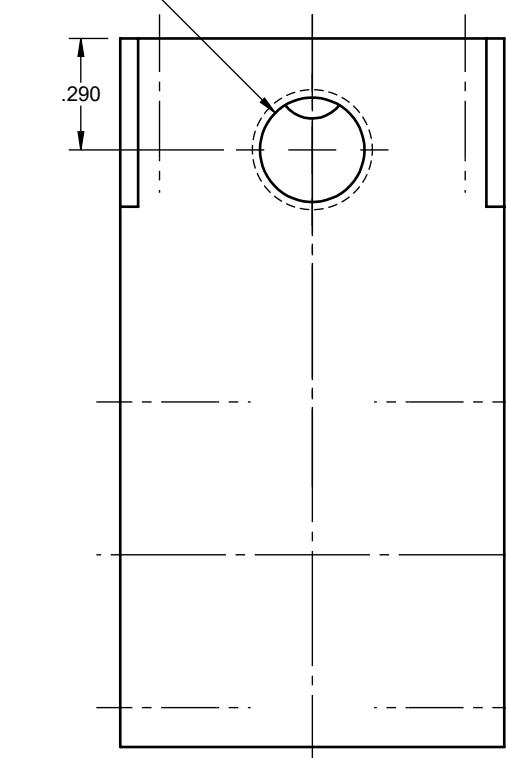
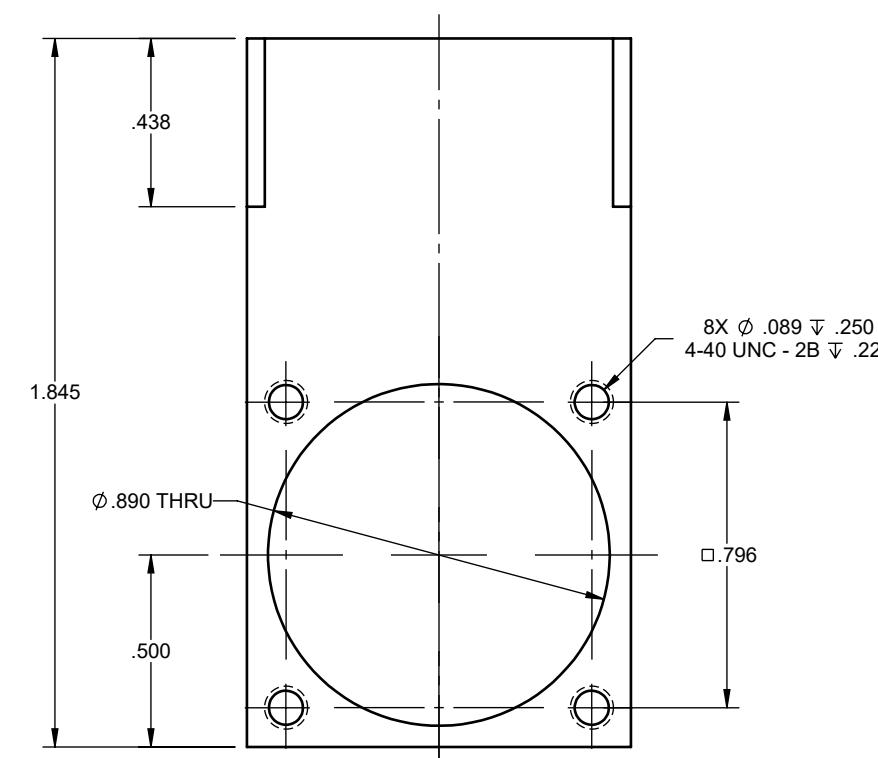
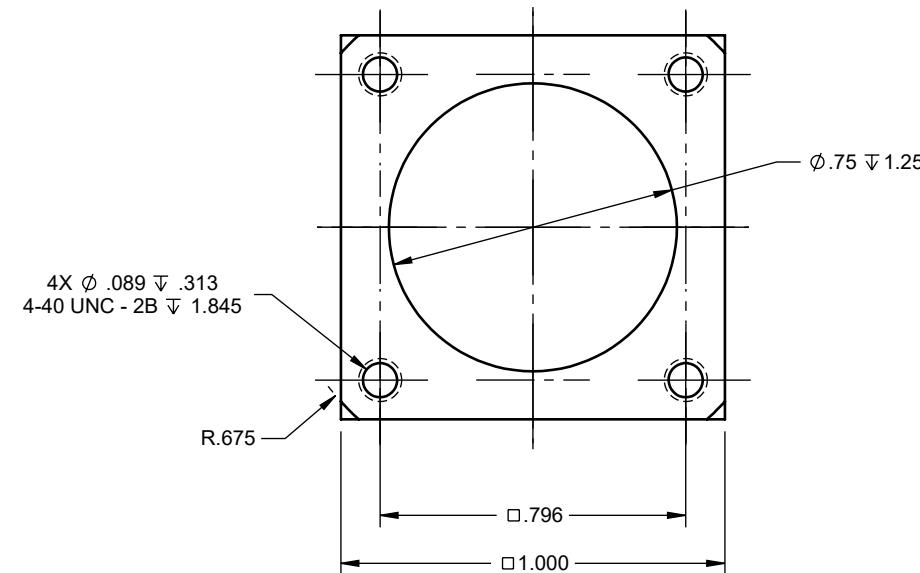
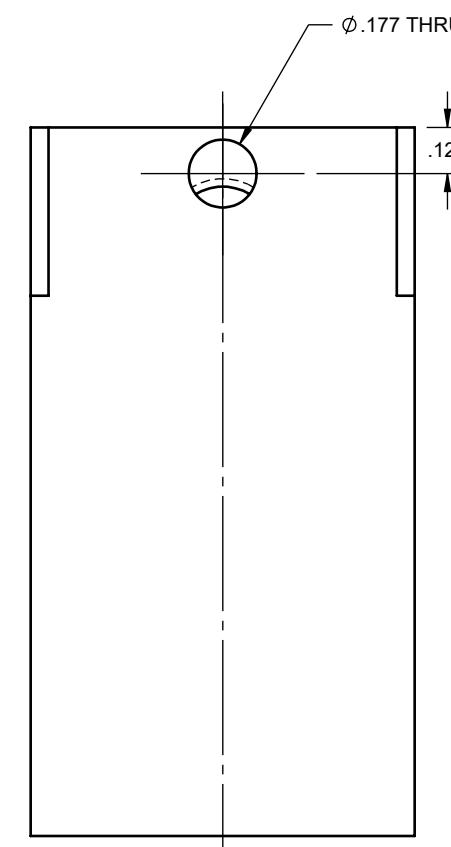
1

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**NOTES:**

1. MATERIAL: 3003-H14 AL (UNS A93003)
2. SOME HIDDEN LINES OMITTED FOR CLARITY
3. FINISH:

X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X	± .1	± 0.5°	± 1/32	125/
XX	± .06			
XXX	± .008			

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TITLE

CRANKCASE

CADD MAINTAINED DATA	THIRD ANGLE PROJECTION
CHANGES SHALL BE INCORPORATED ELECTRONICALLY BY THE DESIGN AUTHORITY	

SIZE	DRAWING NO	REVISION
B	10006	X1
SCALE 2:1	DWG REFERENCE 10006	SHEET 1 OF 1

4

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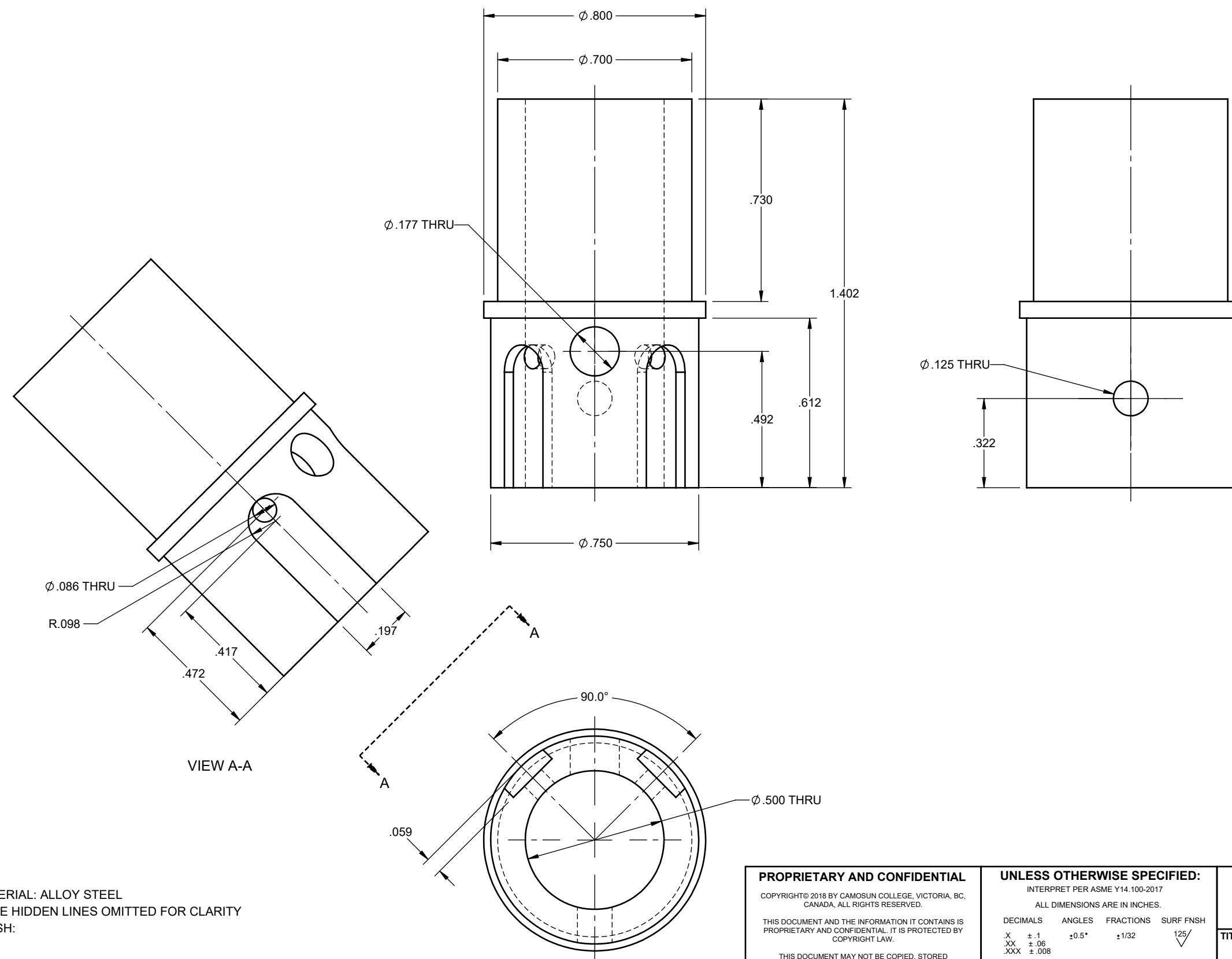
D

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- NOTES:**
1. MATERIAL: ALLOY STEEL
 2. SOME HIDDEN LINES OMITTED FOR CLARITY
 3. FINISH:



X1	PRELIMINARY	--	--	--	--
REV.	DESCRIPTION	ECO	MOD BY	APVD DATE	APVD BY

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DECIMALS ANGLES FRACTIONS SURF FNSH

X	$\pm .1$	$\pm 0.5^\circ$	$\pm 1/32$	125/
XX	$\pm .06$			
XXX	$\pm .008$			

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DRAWN BY OB DATE 07-APR-2025

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TITLE

CYLINDER

10026 X1

10026 1 OF 1

SCALE 5:2 DWG REFERENCE

SHEET



Black-Oxide Alloy Steel Socket Head Screw

4-40 Thread Size, 1-1/4" Long



\$7.43 per pack of 50
91251A078

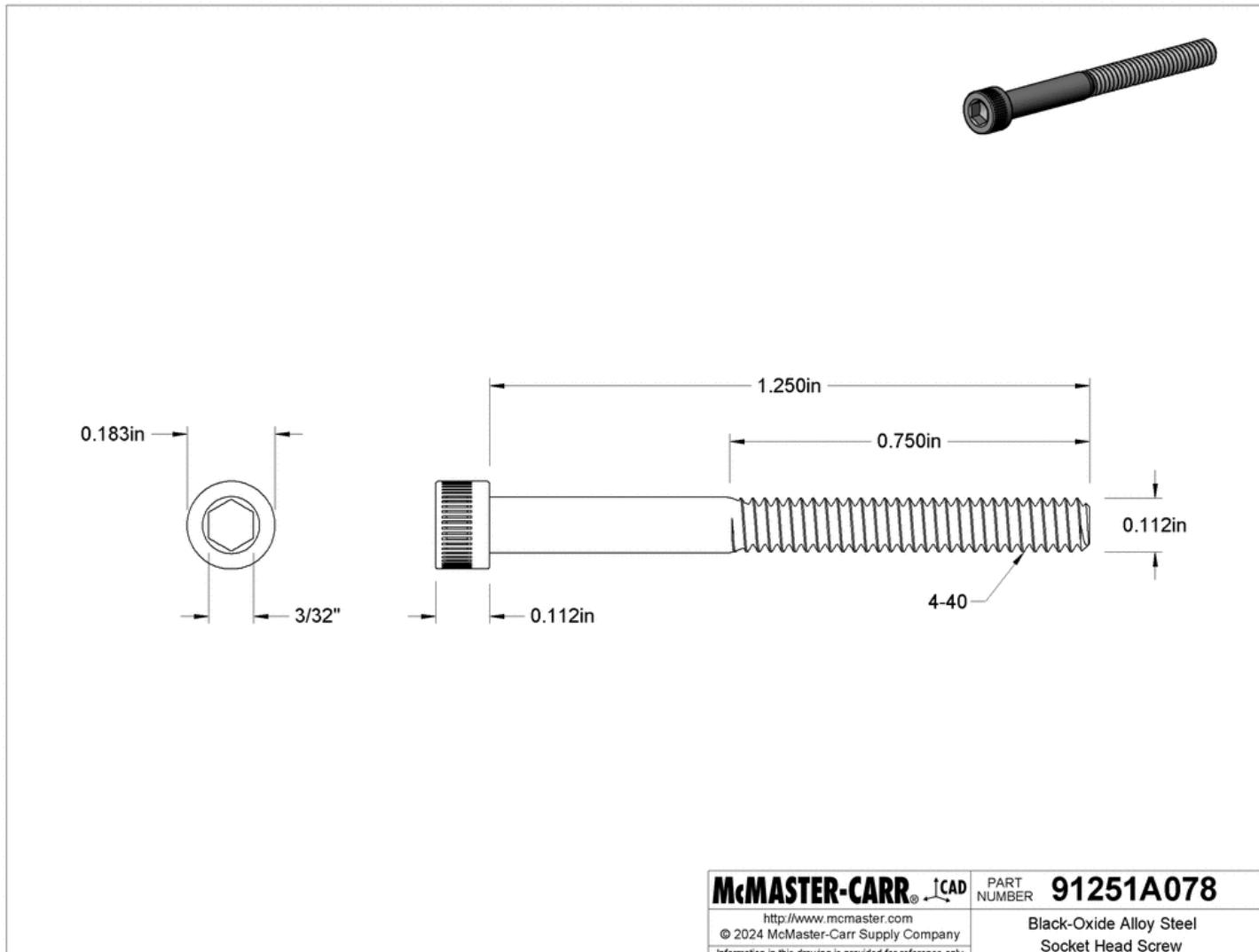
Head Type	Socket
Socket Head Profile	Standard
Drive Style	Hex
System of Measurement	Inch
Thread Direction	Right Hand
Thread Size	4-40
Screw Size Decimal Equivalent	0.112"
Thread Type	UNC
Thread Fit	Class 3A
Length	1 1/4"
Threading	Partially Threaded
Min. Thread Length	3/4"
Thread Spacing	Coarse
Head	
Diameter	0.183"
Height	0.112"
Drive Size	3/32"
Material	Black-Oxide Alloy Steel
Tensile Strength	170,000 psi
Hardness	Rockwell C37
Specifications Met	ASTM A574
RoHS	RoHS 3 (2015/863/EU) Compliant
REACH	REACH (EC 1907/2006) (01/17/2023, 233 SVHC) Compliant
DFARS	Specialty Metals Compliant (252.225-7009)
Country of Origin	United States
USMCA Qualifying	No
Schedule B	731815.9000
ECCN	EAR99

With a tensile strength of 170,000 psi, these alloy steel screws are stronger than Grade 8 steel screws. Length is measured from under the head.

Black-oxide steel screws are mildly corrosion resistant in dry environments.

Coarse threads are the industry standard; choose these screws if you don't know the pitch or threads per inch.

Screws that meet ASTM A574, ASTM A574M, and ISO 898-1 comply with specifications and testing requirements for material quality.



The information in this 3-D model is provided for reference only.



Zinc-Plated Alloy Steel Hex Drive Flat Head Screw

4-40 Thread Size, 1/4" Long

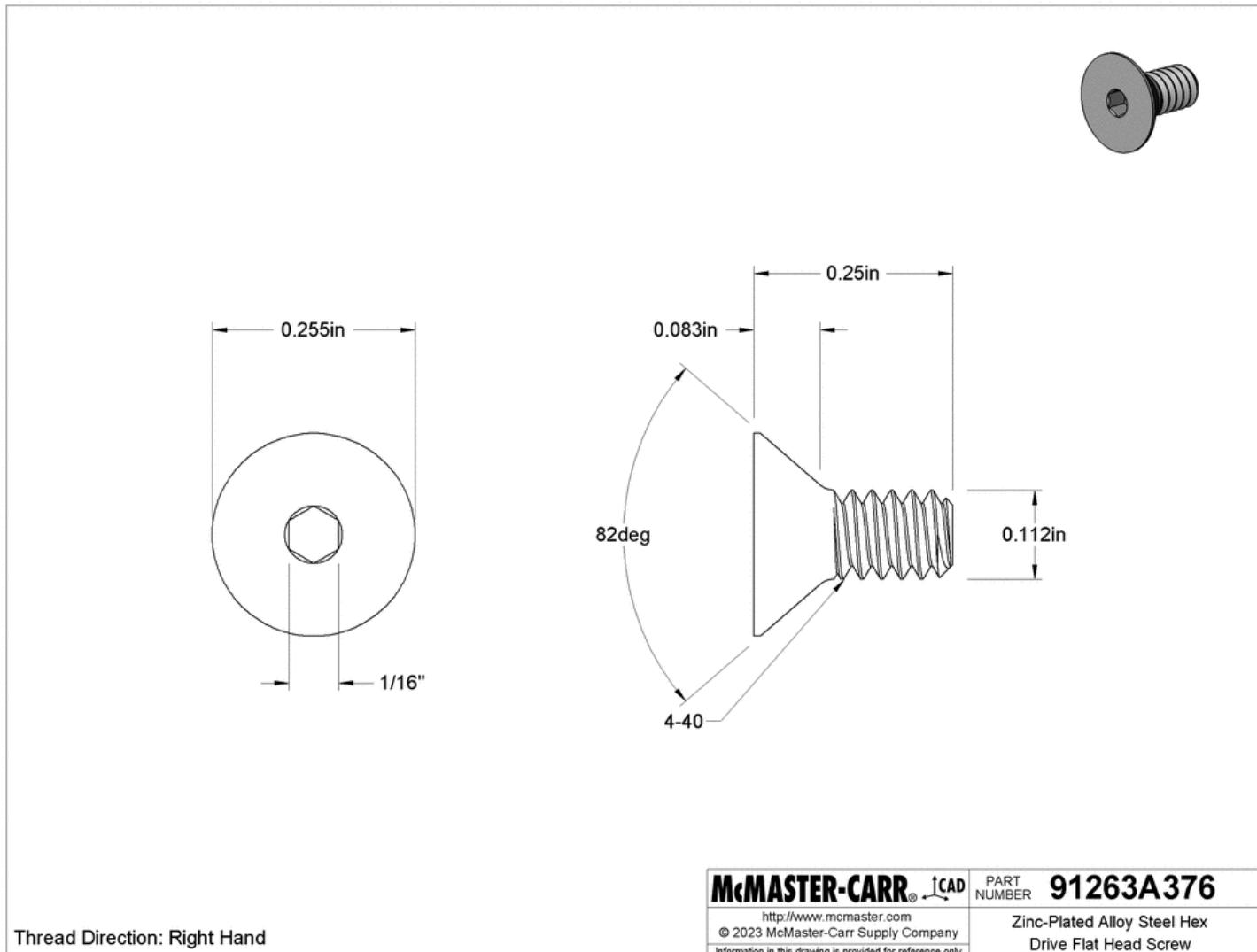


\$11.96 per pack of 100
91263A376

Thread Size	4-40
Length	1/4"
Threading	Fully Threaded
Flat Head Profile	Standard
Head Diameter	0.255"
Head Height	0.083"
Countersink Angle	82°
Drive Style	Hex
Drive Size	1/16"
Material	Zinc-Plated Alloy Steel
Hardness	Rockwell C39
Tensile Strength	130,000 psi
Screw Size Decimal Equivalent	0.112"
Thread Type	UNC
Thread Spacing	Coarse
Thread Fit	Class 3A
Thread Direction	Right Hand
Head Type	Flat
System of Measurement	Inch
Specifications Met	ASTM F835
RoHS	RoHS 3 (2015/863/EU) Compliant
REACH	REACH (EC 1907/2006) (11/07/2024, 242 SVHC) Compliant
DFARS	Not Specialty Metals Compliant
Country of Origin	Taiwan
Schedule B	731815.9000
ECCN	EAR99

Made from alloy steel, these screws are nearly twice as strong as stainless steel flat head screws. They're angled under the head to sit flush within countersunk holes. Length is measured from the top of the head.

Zinc-plated alloy steel screws resist corrosion in wet environments.



The information in this 3-D model is provided for reference only.



Zinc-Plated Alloy Steel Socket Head Screw

4-40 Thread Size, 3/8" Long



\$9.59 per pack of 25
90128A108

Head Type	Socket
Socket Head Profile	Standard
Drive Style	Hex
System of Measurement	Inch
Thread Direction	Right Hand
Thread Size	4-40
Screw Size Decimal Equivalent	0.112"
Thread Type	UNC
Thread Fit	Class 3A
Length	3/8"
Threading	Fully Threaded
Thread Spacing	Coarse
Head	
Diameter	0.183"
Height	0.112"
Drive Size	3/32"
Material	Zinc-Plated Alloy Steel
Tensile Strength	170,000 psi
Hardness	Rockwell C37
Specifications Met	ASME B18.3, ASTM A574
RoHS	RoHS 3 (2015/863/EU) Compliant
REACH	REACH (EC 1907/2006) (11/07/2024, 242 SVHC) Compliant
DFARS	Not Specialty Metals Compliant
Country of Origin	United States
USMCA Qualifying	No
Schedule B	731815.9000
ECCN	EAR99

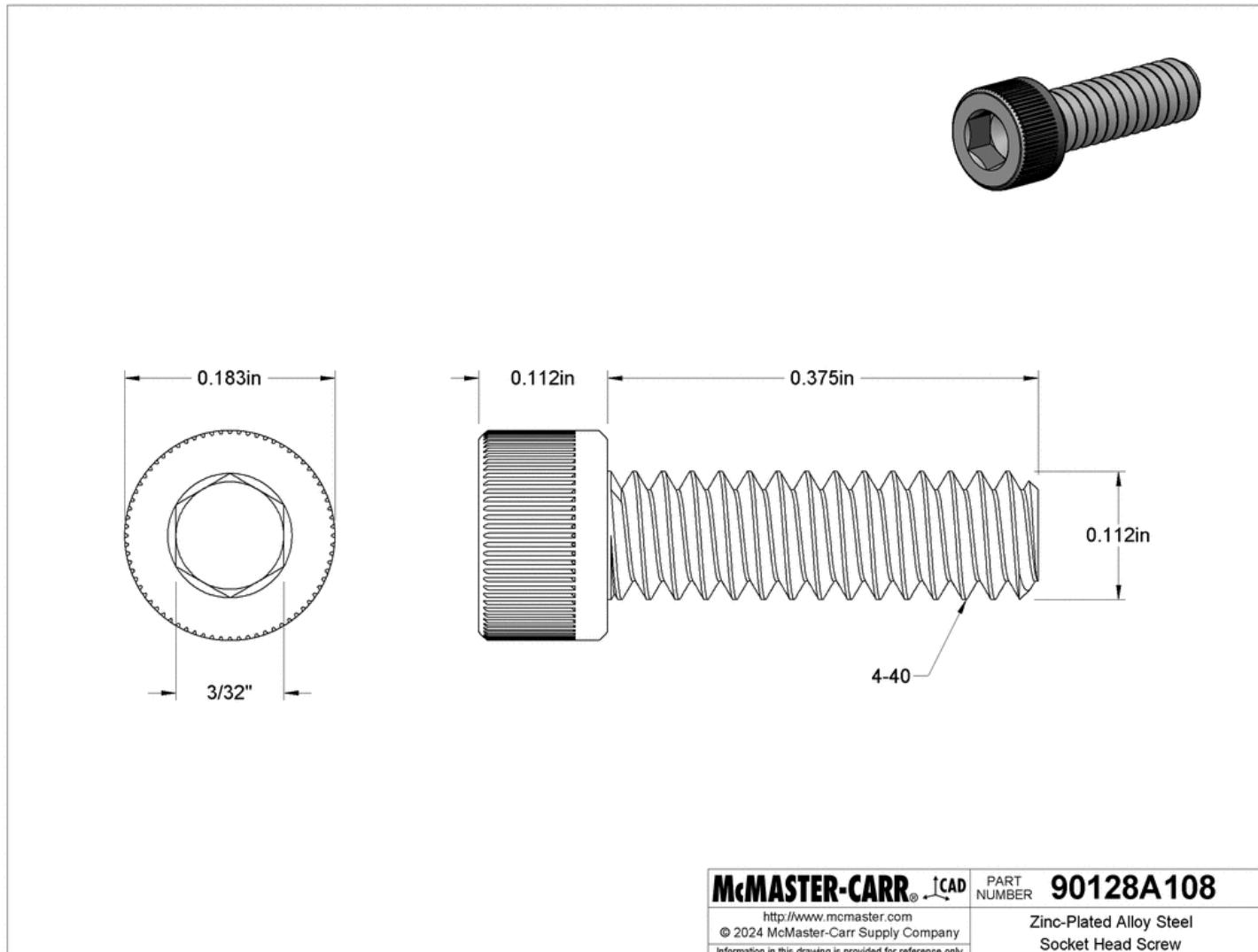
With a tensile strength of 170,000 psi, these alloy steel screws are stronger than Grade 8 steel screws. Length is measured from under the head.

Zinc-plated steel screws resist corrosion in wet environments.

Coarse threads are the industry standard; choose these screws if you don't know the pitch or threads per inch.

Screws that meet ASTM A574, ASTM A574M, and ISO 898-1 comply with specifications and testing requirements for material quality.

Screws that meet ASME B18.3, ASME B18.3.1M, ISO 21269, and ISO 4762 (formerly DIN 912) comply with specifications for dimensional standards.



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