Ice detection laser modification, 2006

Osmond, T.

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AUTHOR(S)
T.Osmond

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SUMMARY

This document contains the following design work regarding the IOT Ice Detection Laser:

- Attaching a timing belt and pulleys to the focus dial of the laser to that the focus of the laser may be controlled remotely,
- Mounting the Laser and a camera on a base plate as a single unit,
- Design of a weather resistant housing to protect the laser and camera from wind and rain.

ADDRESS National Research Council
Institute for Ocean Technology
Arctic Avenue, P. O. Box 12093
St. John's, NL A1B 3T5
Tel.: (709) 772-5185, Fax: (709) 772-2462

National Research Council Canada
Institute for Ocean Technology

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ICE DETECTION LASER MODIFICATION, 2006

SR-2006-11

T. Osmond

April 2006

Summary
Ongoing within the Institute for Ocean technology as of the first quarter of 2006, is a research project centered around Institute patented technology developed for Ice Monitoring and Measuring. As part of the Ice Monitoring and Measuring project under the project lead of Robert Gagnon, a laser is controlled from a remote location. It must be controlled and pointed at ice from distances as far away as several hundred feet. There are several modifications and features needed for the laser to be used in the Ice Monitoring and Measuring project. First of all, the operator must have pointing direction control over the laser via remote control. Second, one must be able to focus the laser remotely. And lastly the laser must be contained with a power supply and a video feed camera in a weather resistant housing so that the device can operate in wet weather. Automating the direction of the laser has been accomplished by purchasing a mechanism that allows for remote control of pan and tilt angles. To this mechanism, the weather resistant housing will attach. The tasks of designing the weather resistant housing and the remote control adjustment control over the focus of the laser came to the Design and Fabrication group within the Institute. This report details these designs.

TABLE OF CONTENTS

1.0 – Design Criteria

The laser being used in the Ice Monitoring and Measuring project is a long cylindrically shaped device approximately 24 inches in length and 1.74 inches in diameter, shown in Figure 1. There are focusing screws in the front third of the laser and just ahead of those screws there is a dial that is designed to be turned with the fingers. A small experiment was conducted and it was measured to require approximately 18.9 oz.in of torque to turn the focus dial. It was also decided that approximately 180 degrees of rotation would offer a sufficient range of focus for the Ice Measurement project purposes.

The electro-mechanical device capable of turning the focus dial on the laser proposed by the electronics department is a HiTec HS-785HB Winch Servo (see figure 2). The servo offers 152.75 oz.in of torque, significant strength in shear and at least 1080 degrees rotational range (three rotations). The electronics department claim to be capable of achieving about 1800 degrees rotation (five rotations) using their own drive controller. These parameters define the design criteria for the remote laser focus control.

The challenge was to connect the winch servo to the focus dial translating approximately three rotations on the winch servo into a half turn or 180 degrees rotation on the laser dial without exceeding torque capacity.

The basic concept used to meet this challenge is a system of toothed pulleys and a single sized, trapezoidal-toothed timing belt. One pulley is connected to the servo and another is locked onto the focus dial. A third pulley called the idler is used on the opposite side of the servo to reduce the load on the laser when the timing belt is tightened.

We now have the challenge of tightening the timing belt. This is accomplished by attaching the servo to an adjustable rail that moves up and down in a slot. There are two parts of the adjustable rail, the static piece and the dynamic piece. Tightening the timing belt is simply a matter of tightening the nut on the adjustment screw coming out of the top of the static piece of the rail (see figure 3). A locking screw on the back of the static piece of the rail locks the system in place so that the timing belt will not loosen over time. This whole system of rail and servo is thus attached to the laser.

A split clamp (see figure 4) is used as the connecting mechanism between the Laser and the Servo. The split clamp is also used to hold the laser in place within the housing. The split clamp bolts to a base plate that in turn screws into the housing floor.

Also connected to the base plate is the video feed camera (see figure 5). The camera sits on an adjustable pan\ tilt stand purchased to allow the camera to be adjusted to point in the correct direction and locked in place. It is intended that

the camera should only need to be adjusted once so that it points in line with the laser and should be left in that position for extended periods of time.

The base place attaches to the bottom of the housing using several screws. Because the camera and laser both mount to the base plate it is intended that if necessary the base plate can be removed and returned to the housing without disturbing the alignment between the laser and the camera nor without needing to readjust the timing belt.

The housing for the laser and camera is a modified design of another housing that has already been used at the Institute for Ocean Technology. A larger housing was used for another Ice Measuring system and the design was found to function properly. Only the dimensions of this newer housing have been changed.

The weather resistant housing is shown in dwg 2096T14 contained in Appendix A. It is primarily composed of lexan. It has a thick bottom to which the base plate for the laser is screwed. Buckles on the side of the housing tighten the top down. The back of the housing has a hinged door that opens down with hinges on the bottom edge. A waterproof hatch is attached to the door so that minor adjustments to the inner contents of the housing may be made if necessary. The front face of the housing contains a slot for glass to be installed. Optical glass will be used as the medium through which the laser beam will pass upon exiting the housing. The top of the housing has an overhanging ledge to protect the front glass to a certain extent from rain falling straight down.

2.0 – Components

There are a number of mechanical and electrical components needed for the laser aspect of the Ice Monitoring and Measuring project. There are components that have been purchased or fabricated by the Institute already and there are components in need of fabrication. There are also components that are to be purchased, some of which require some modifications. All components in need of fabrication or modification have associated drawings included under source file CAD_User:\Projects\42_2096 Ice Detection\TOsmond\Laser.ckd and are contained in Appendix A.

Already in possession by the Institute:
A 15 mW Melles Griot Laser,
An Optical Power Zoom Color DSP Camera,
A pan/tilt adjusting mount for the camera,
A HiTec HS-785HB Winch Servo that will be used to adjust the focus dial of the laser.

The Institute has also already purchased a remote pan/tilt adjusting mechanism to which the weather resistant housing will mount.

Three pulleys, a timing belt and a clevis pin must be ordered from McMaster-Carr (see Appendix D).
Order:
2 x 6495K711,
1 x 57105K27,
1 x 6484K222,
1 x 92735A160.
Two of the pulleys must be bored out to larger diameters as shown in drawings 2096T12, and 2096T13.

The weather resistant housing for the entire system must be fabricated. The housing will be composed mostly of lexan, dwg 2096T14 – 2096T23.

Other components needing to be fabricated include:
Two pieces for the adjustable rail, dwg 2096T01, 2096T02,
Components to which the servo will attach, dwg 2096T03 – 2096T05,
An Angle bar piece connecting the rail to the split clamp, dwg 2096T06,
A spit clamp, dwg 2096T07,
A base plate, dwg 2096T11,
Two idler brackets, dwg 2096T08.
And mounting bases for both the laser and camera, dwg 2096T09, 2096T10.

A list of all the fasteners needed to fully assemble all components is contained in Appendix C.

3.0 – Calculations

Pulley Gear Ratio

Servo Pulley – Pitch Diameter: 0.637”
Laser Pulley – Pitch Diameter: 2.292”
Ratio: 2.292:0.637 = 3.6:1.0
Thus 3.6 rotations of the servo will provide a complete rotation of the laser focus dial.

Torque Ratio

Maximum torque for servo: 152.75 oz.in.
Minimum required torque to turn focus dial: 18.9 oz.in
152.75 oz.in * 3.6 = 549.9 oz.in
549.9 oz >> 18.9 oz.in
Therefore we have acceptable torque from the servo to turn laser focus dial.

Length of Timing Belt

The length of the timing belt was calculated from the dimensions contained in appendix B taken directly from the laser CAD file.
The following calculations were used to determine the necessary belt length:

142° * π / 180 = 2.478 rads
θ r = 2.478 * 0.319 = 0.790 “
133° * π / 180 = 2.321 rads
θ r = 2.321 * 0.319 = 0.740”
42° * π / 180 = 0.733 rads
θ r = 0.733 * 1.146 = 0.840”

2 * 2.425” = 4.850”
2 * 1.889” = 3.778”
2 * 0.840” = 1.680”
1 * 0.790” = 0.790”
1 * 0.740” = 0.740”
11.838”

Because the timing belt may be adjusted to within a range of 0.75” it is clear that a 12” timing belt is the suitable length.

4.0 – Figures

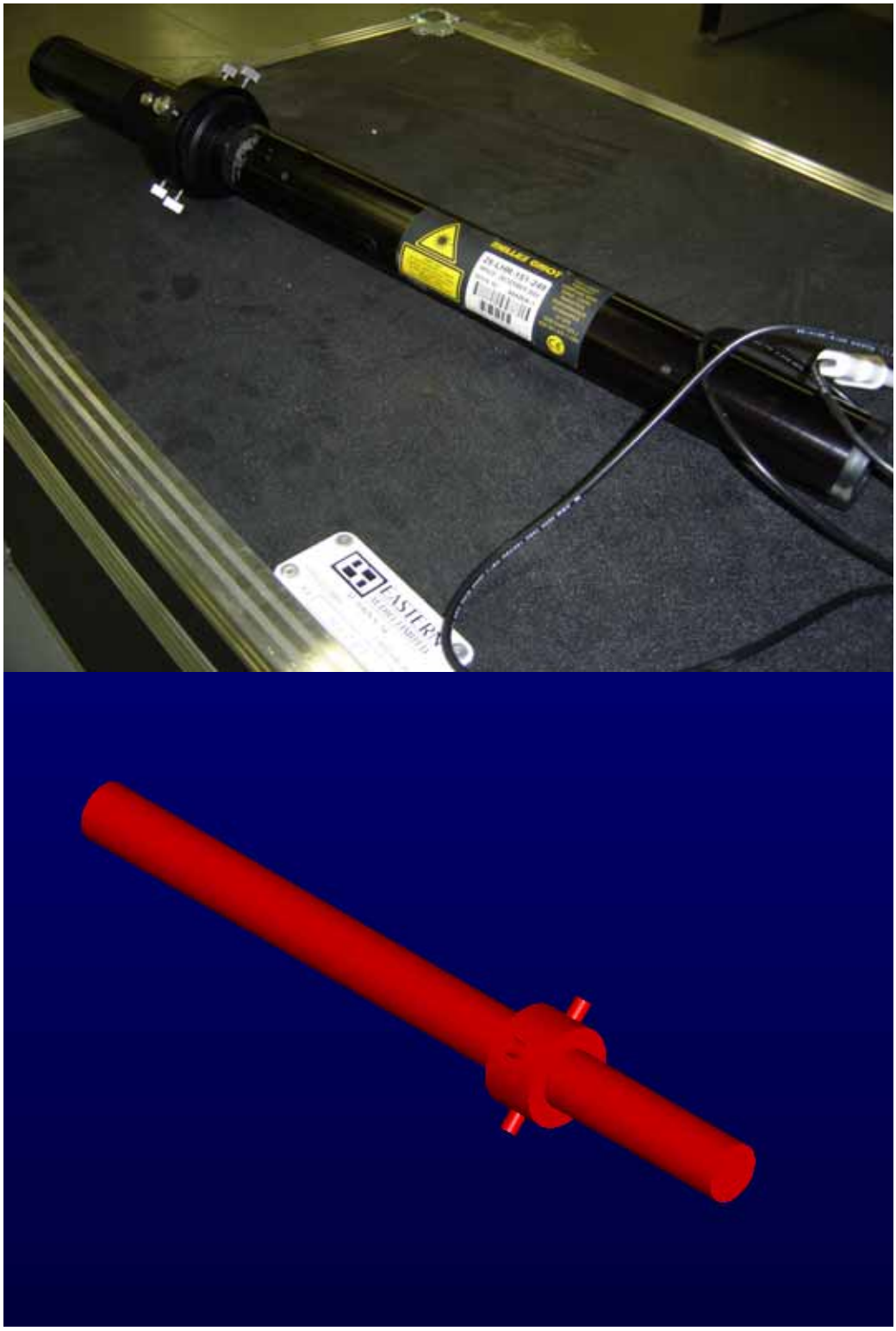

Figure 1 – Ice Measuring Laser

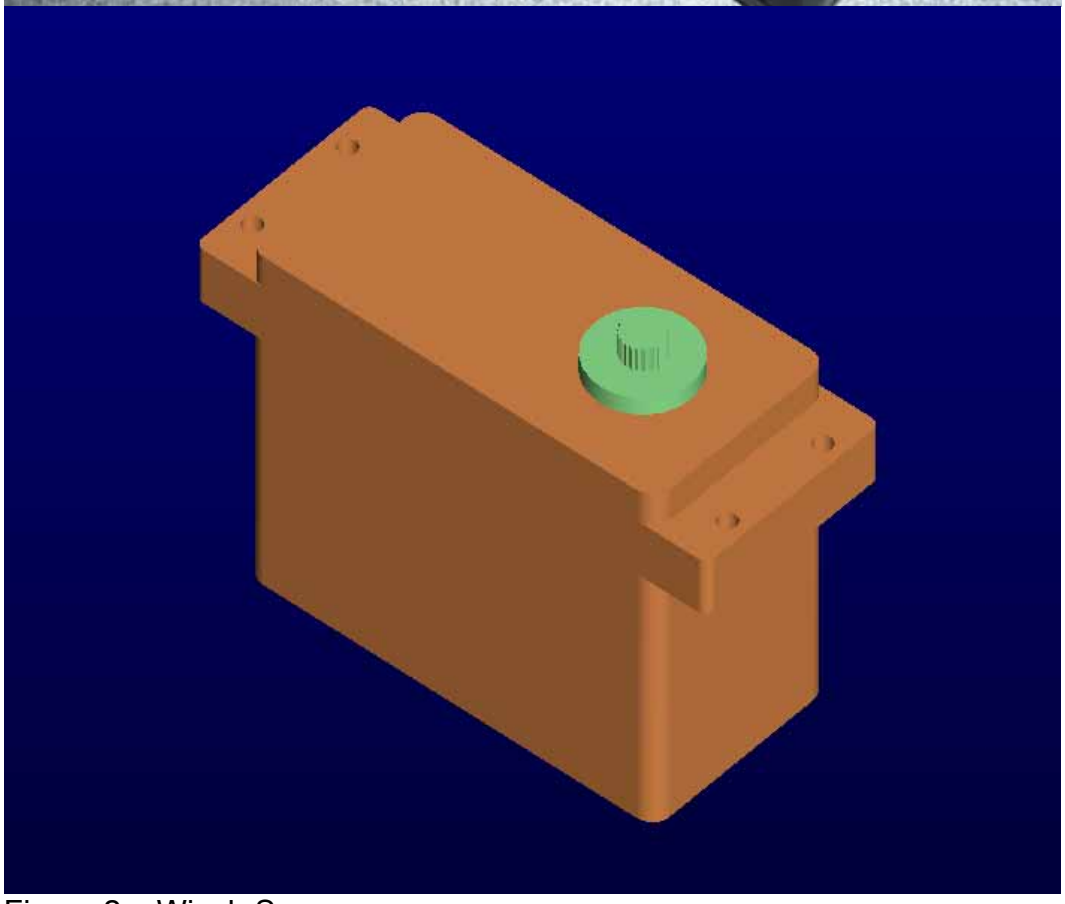

Figure 2 – Winch Servo

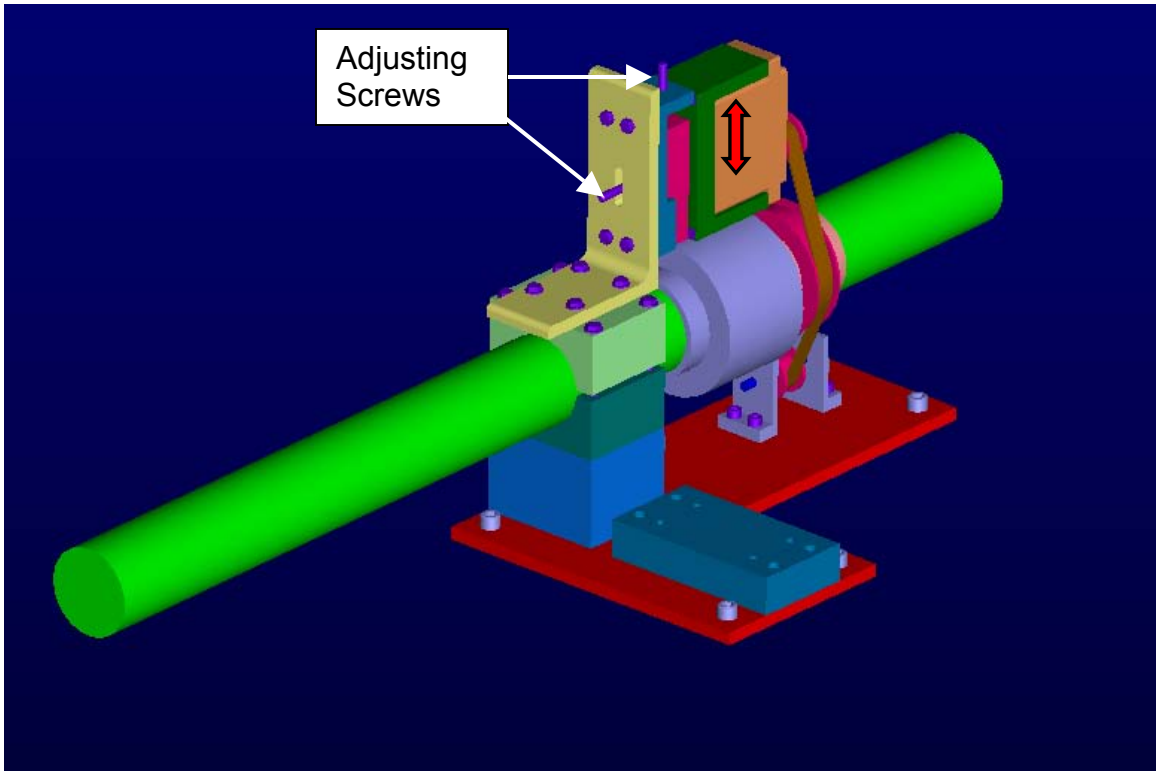

Figure 3 – Timing Belt Adjustment Screws

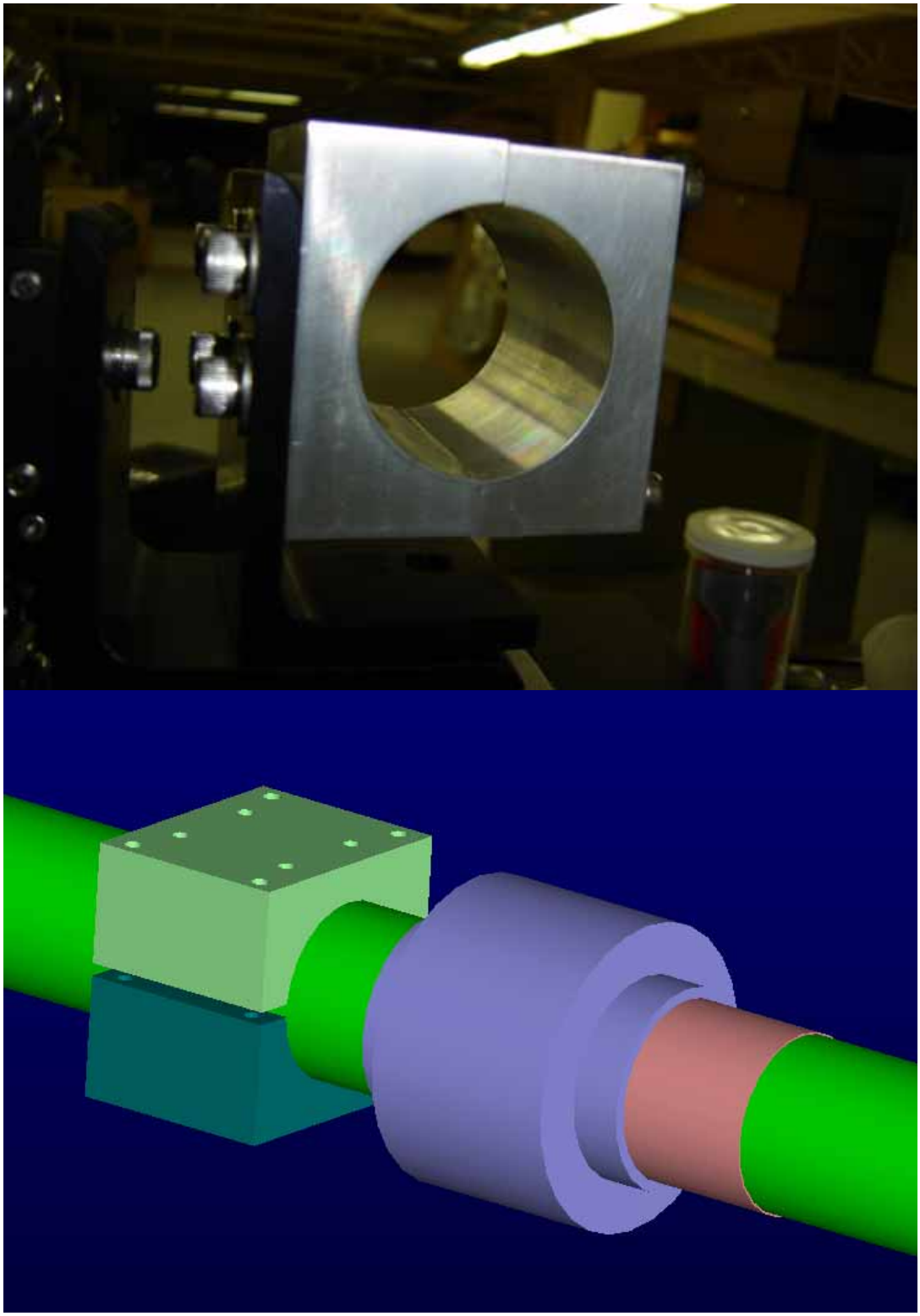

Figure 4 – Split Clamp Used to Hold Laser

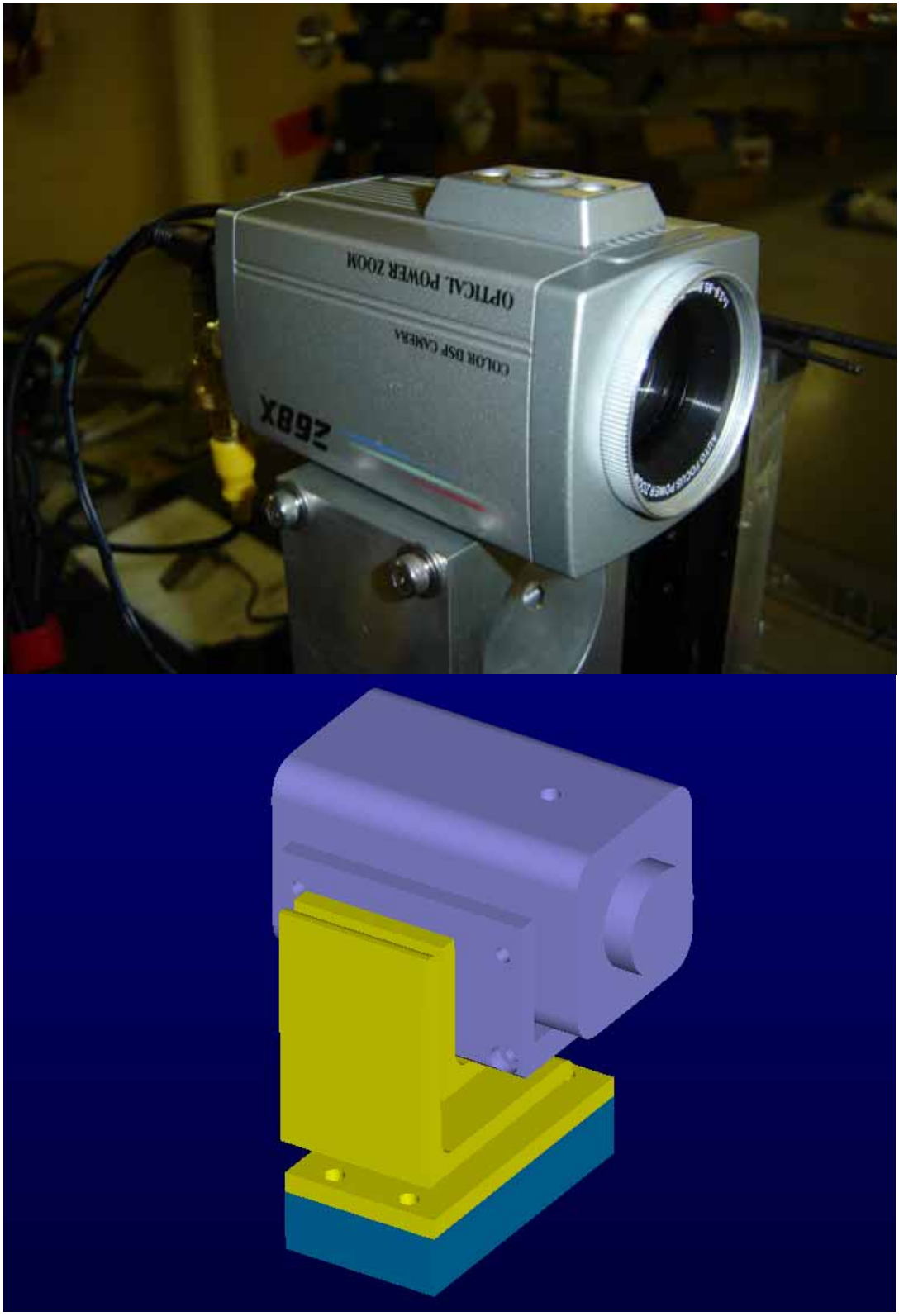

Figure 5 – Camera and Pan/Tilt Mechanism

5.0 – Appendices

Appendix A – Drawings
Appendix B – Timing Belt Dimensions
Appendix C – Fastener List
Appendix D – Data Sheets

APPENDIX A – DRAWINGS

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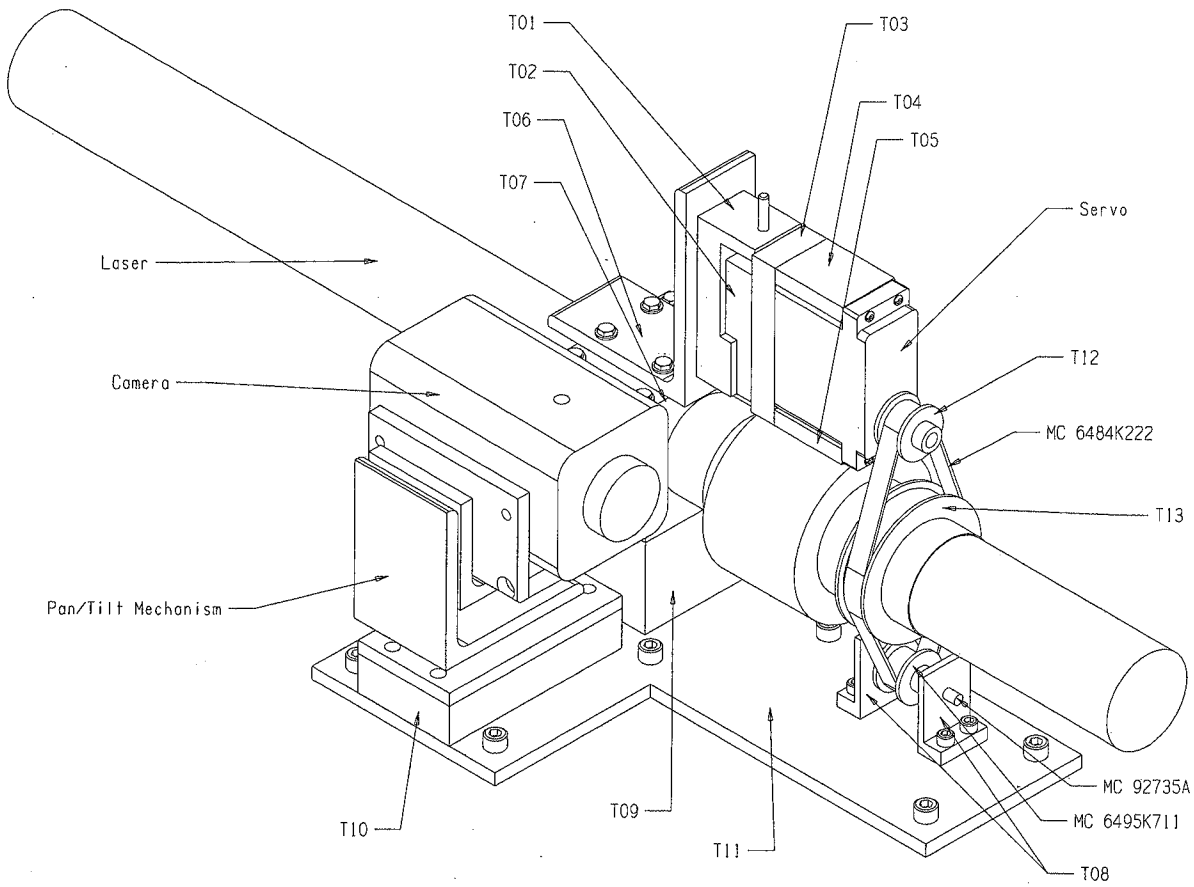

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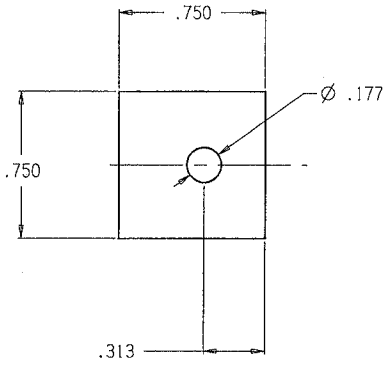

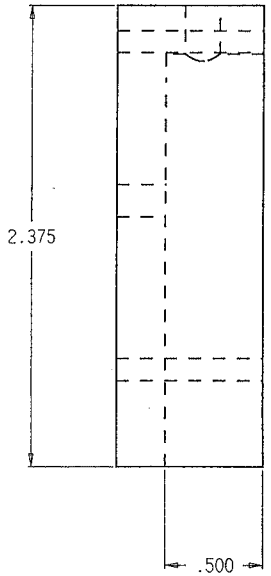

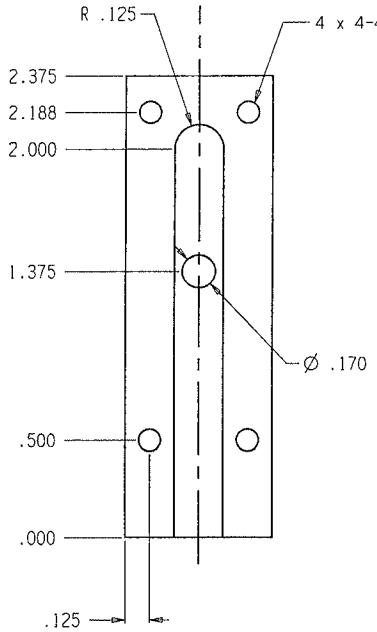

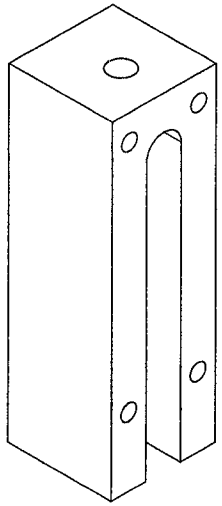

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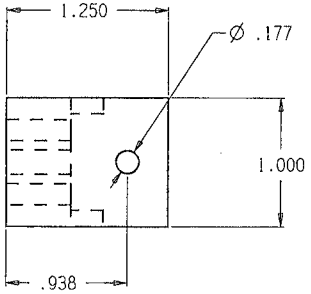

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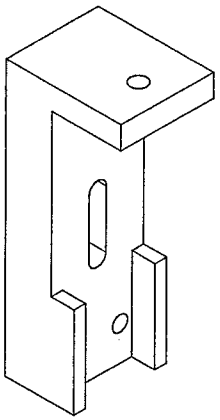

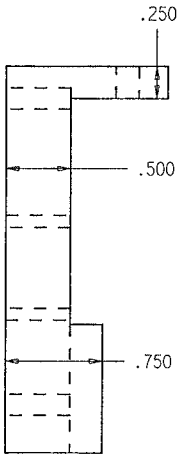

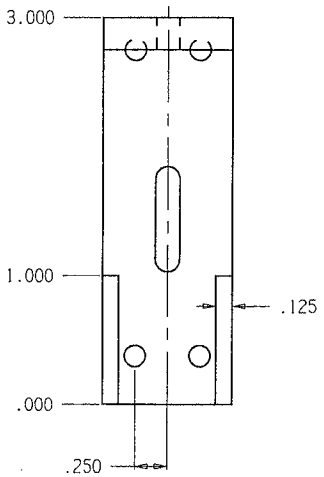

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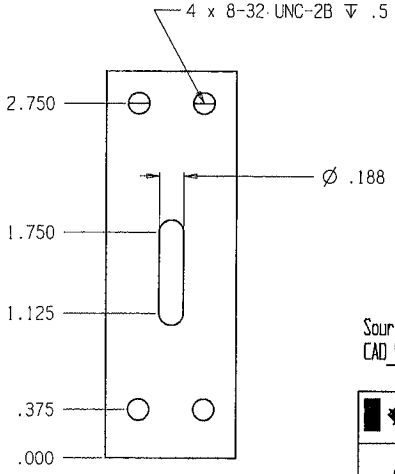

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Third Angle	
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Drawn	T. Osnond
Approved	
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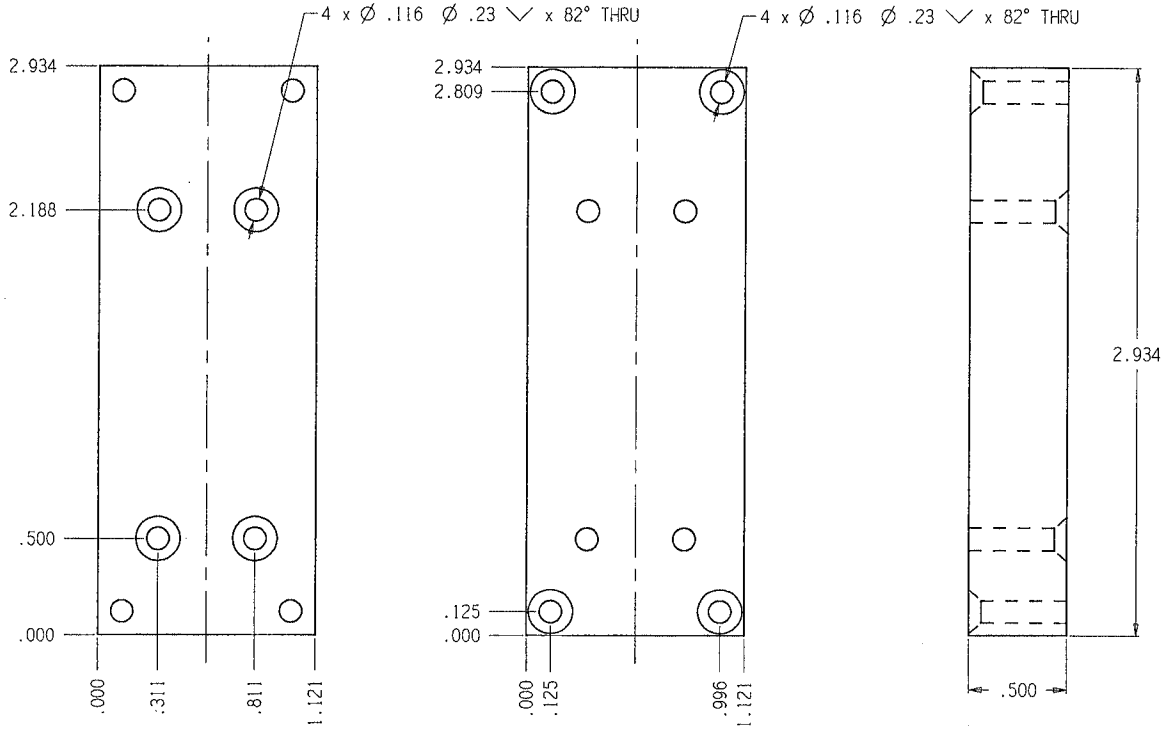

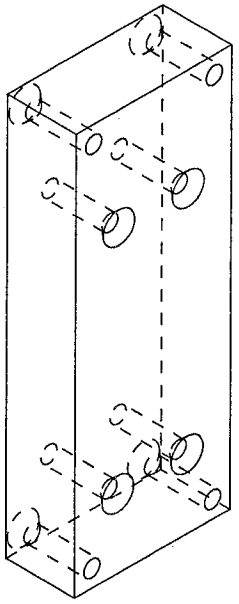

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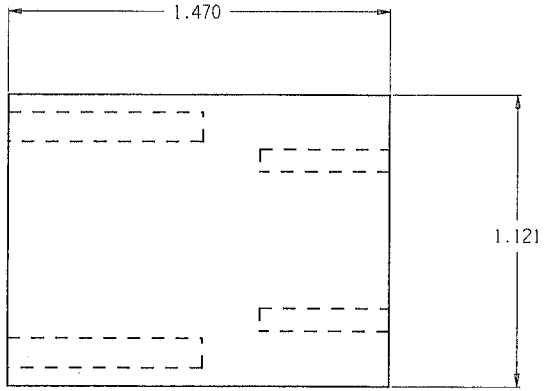

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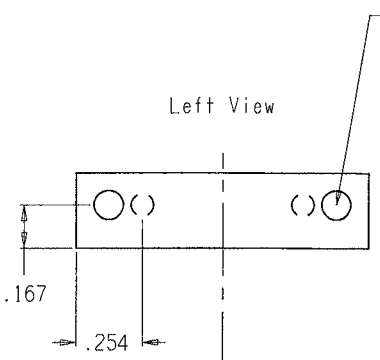

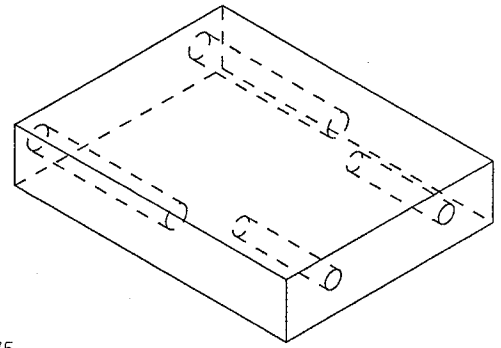

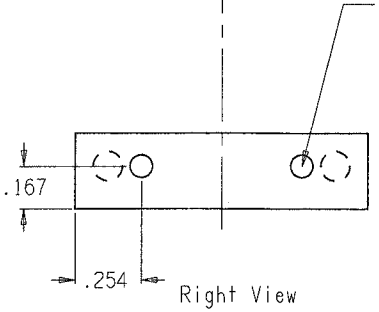

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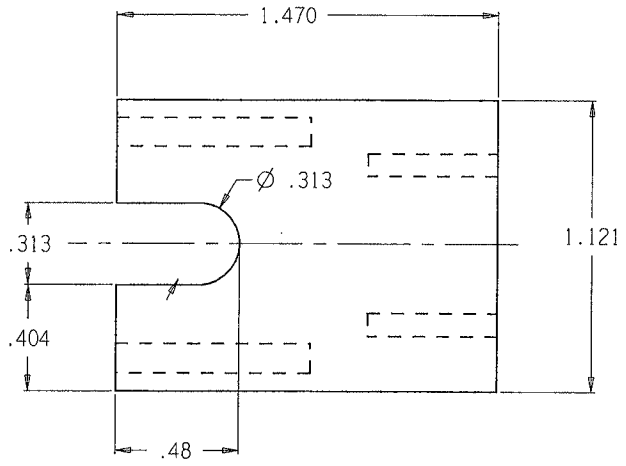

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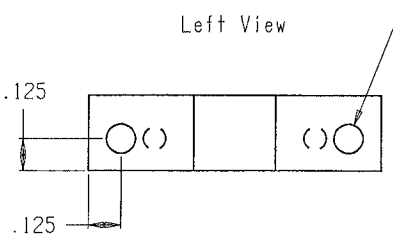

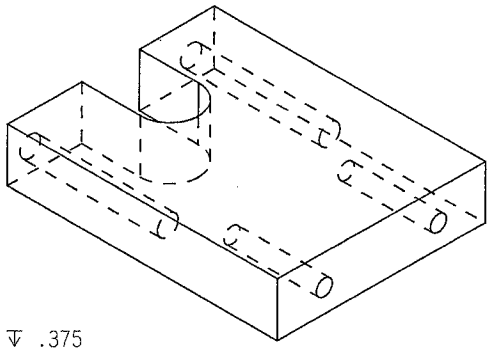

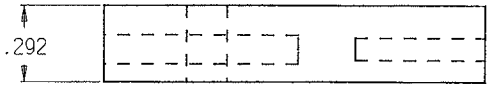

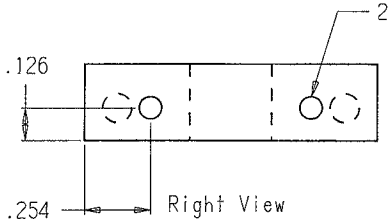

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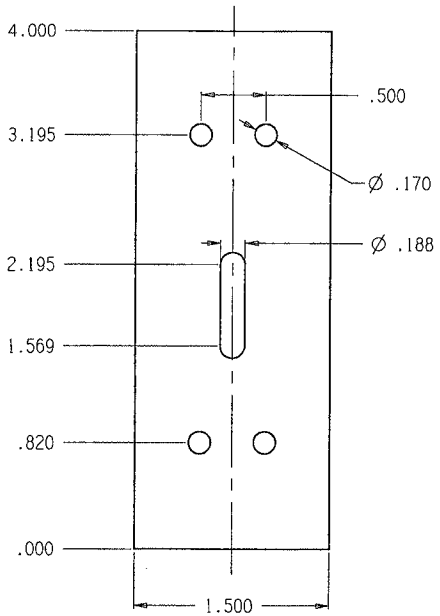

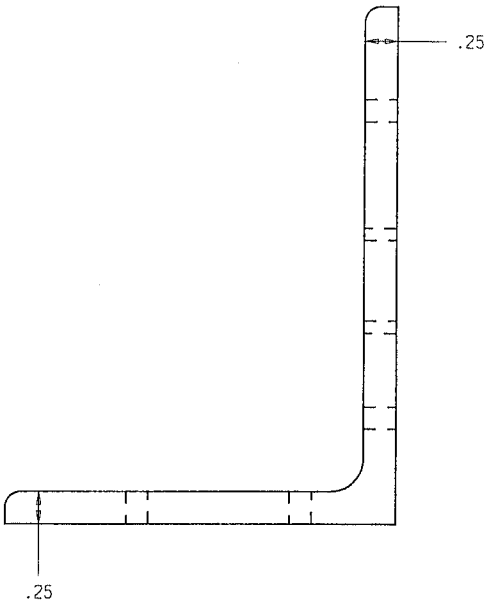

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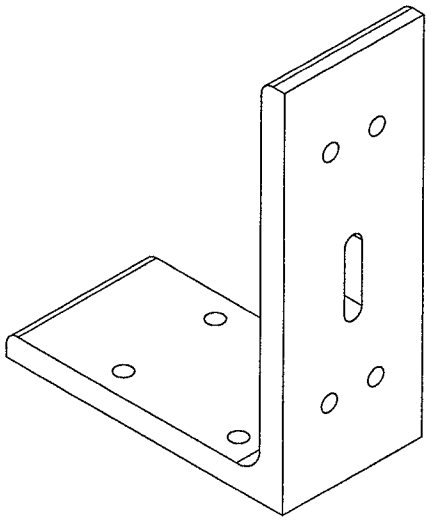
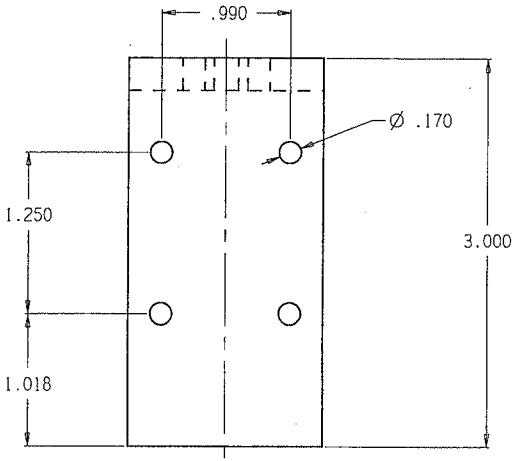




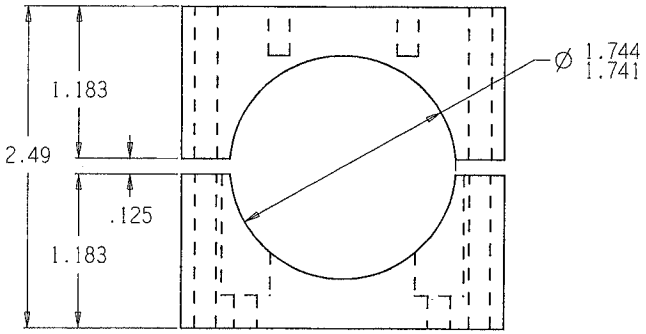
Bottom View

Source File
CAD_User\Projects\42_2096 Ice Detection\TOsmond\Laser.ckd

National Research Council Canada | Conseil national de recherches Canada | NRC-CNRC

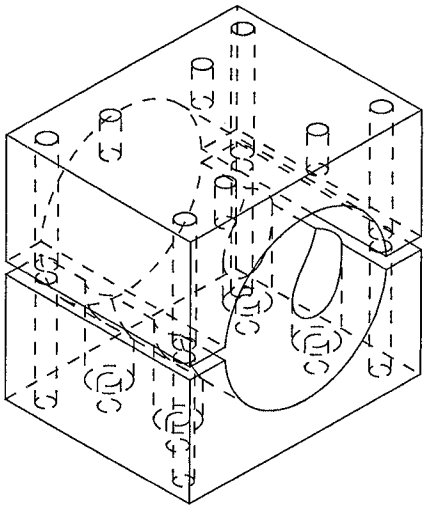
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32	Material: Al FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 YEAR: 2096 DRAWN: T. Osmond APPROVED Quantity: 1
TITLE: Angle Bar A3 NUMBER: 2096T06 REV SCALE: 1 : 1 DATE: 01-Mar-2006 SHEET 1 OF 1		

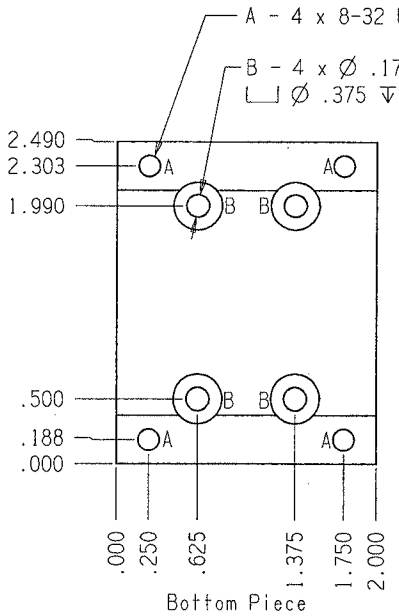
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

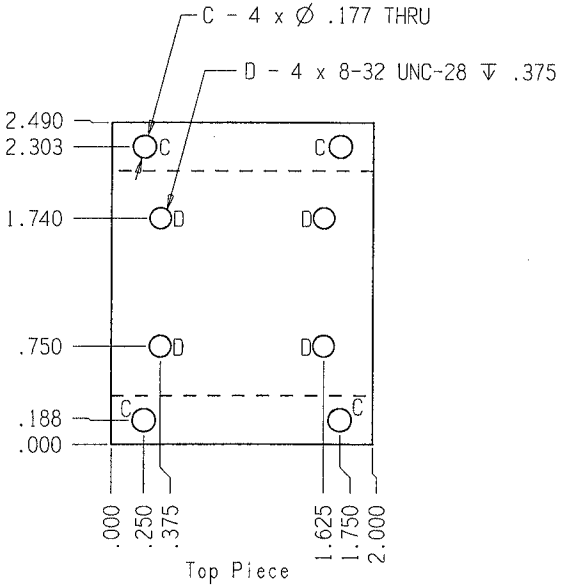


Notes:

Deburr - Renove All Sharp Edges







Source File
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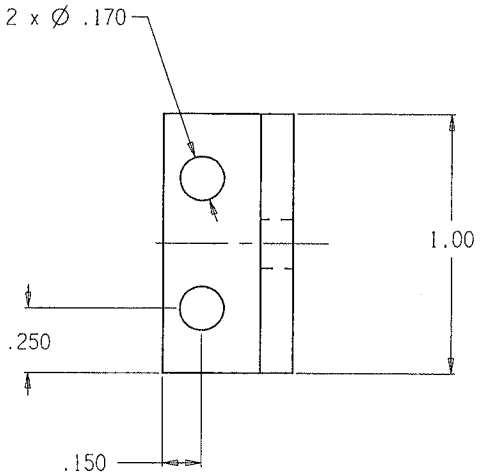
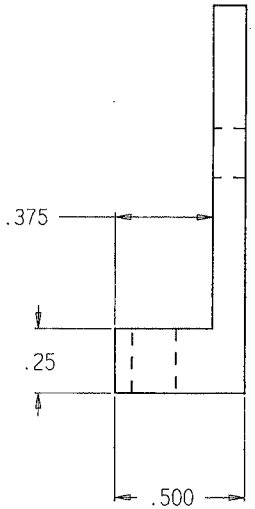
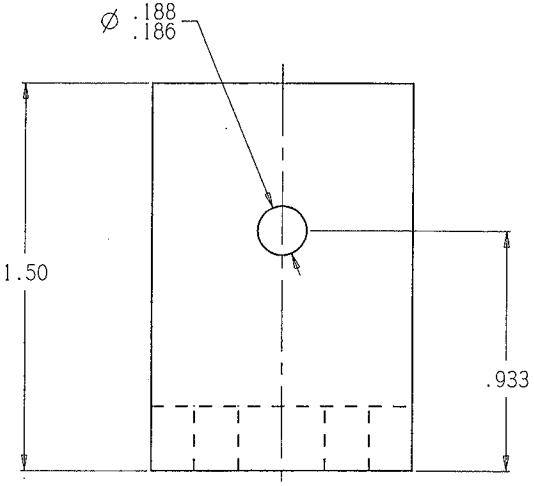
Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

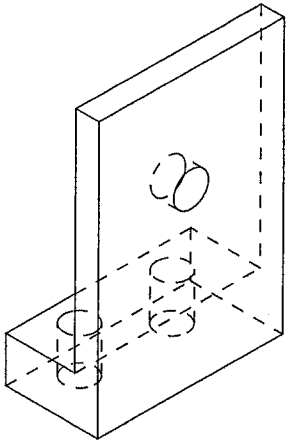
TOLERANCES (unless specified)	
0.X ± 0.03	
0.XX ± 0.015	
0.XXX ± 0.005	
Angle +/- .5 deg.	
Fabrication +/- .04	
Fraction < 6 inch +/- 1/64	
> 6 inch +/- 1/32	
Material	Al
Finish	
Dimensions in: Inches ☒ Millimeters ☐	
Third Angle	
Proj	2096
Drawn	T. Osnond
Approved	
Quantity	1
Title	Split Clamp
Size	A3
Number	2096T07
Rev	
Scale	1 : 1
Date	01-Mar-2006
Sheet	1 of 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED









Notes:

Deburr - Renove All Sharp Edges

Source File
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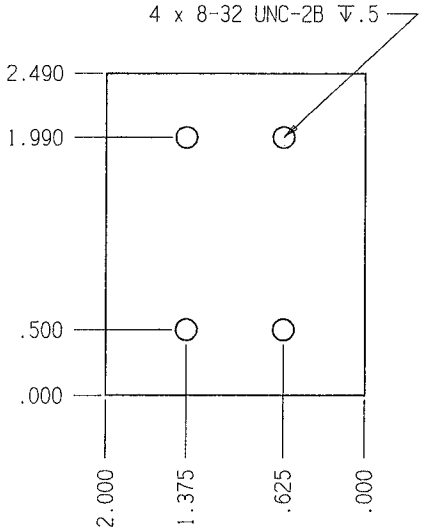
National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

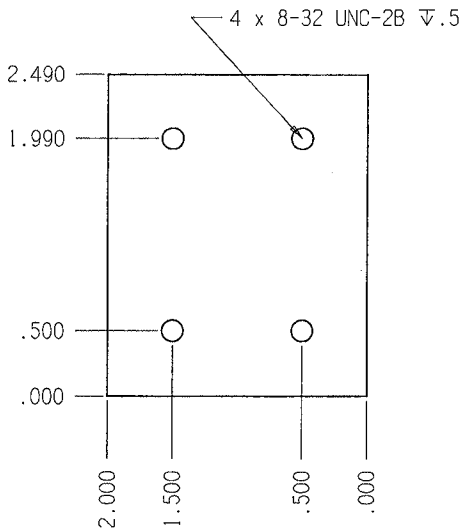
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 Inch +/- 1/64 > 6 Inch +/- 1/32	Material: Al FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 YEAR: 2096 DRAWN: T. Osmond APPROVED Quantity: 2
TITLE: Idler Bracket SIZE: A3 NUMBER: 2096T08 REV SCALE: 1 : 2 DATE: 01-Mar-2006 SHEET 1 OF 1		

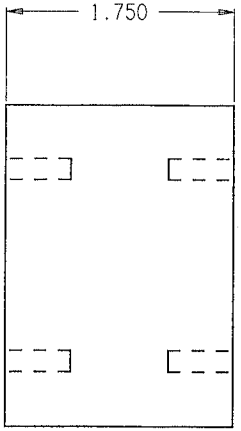
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

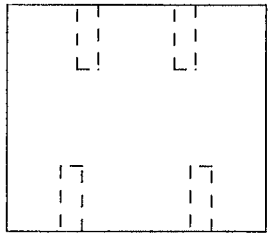
Top View



Bottom View

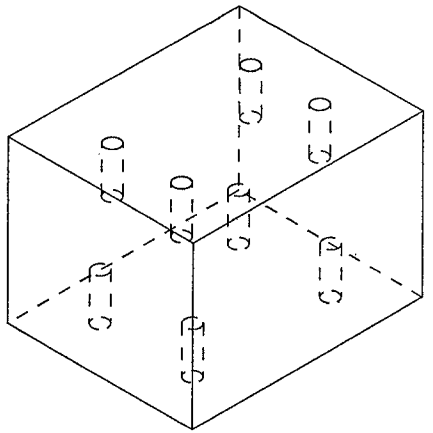






Notes:

Deburr - Remove All Sharp Edges



Source File
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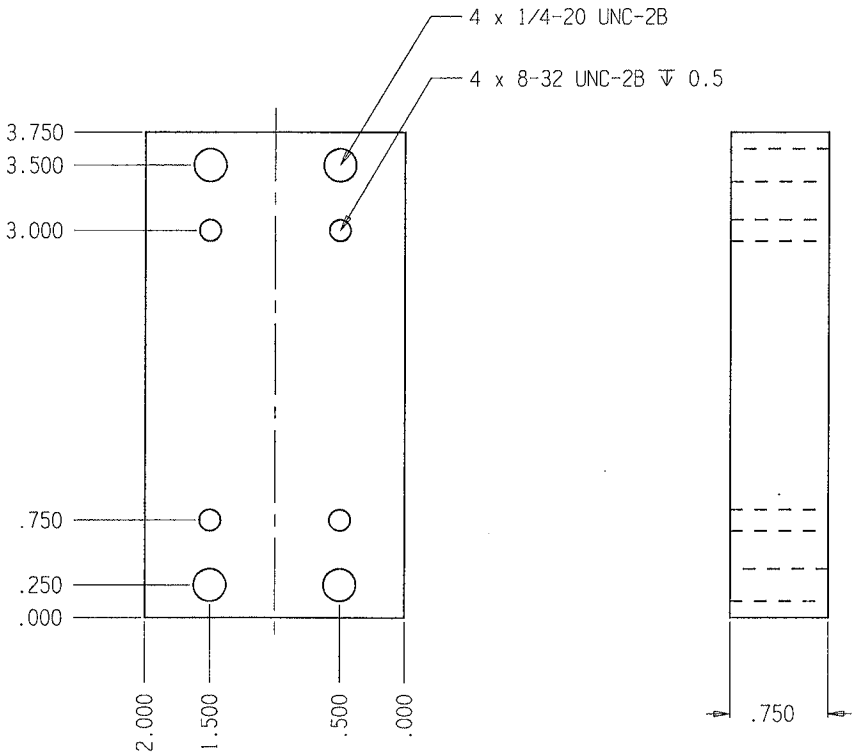
National Research Council Canada | Conseil national de recherches Canada | NRC-CNRC

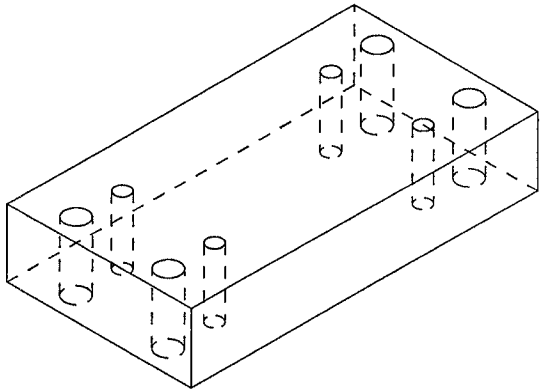
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32	Material: Al FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 YEAR: 2096 DRAWN: T. Osmond APPROVED Quantity: 1
TITLE: Laser Mount A3 NUMBER: 2096T09 REV SCALE: 1:1 DATE: 01-Mar-2006 SHEET 1 OF 1		

NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Deburr - Renove All Sharp Edges





Source File
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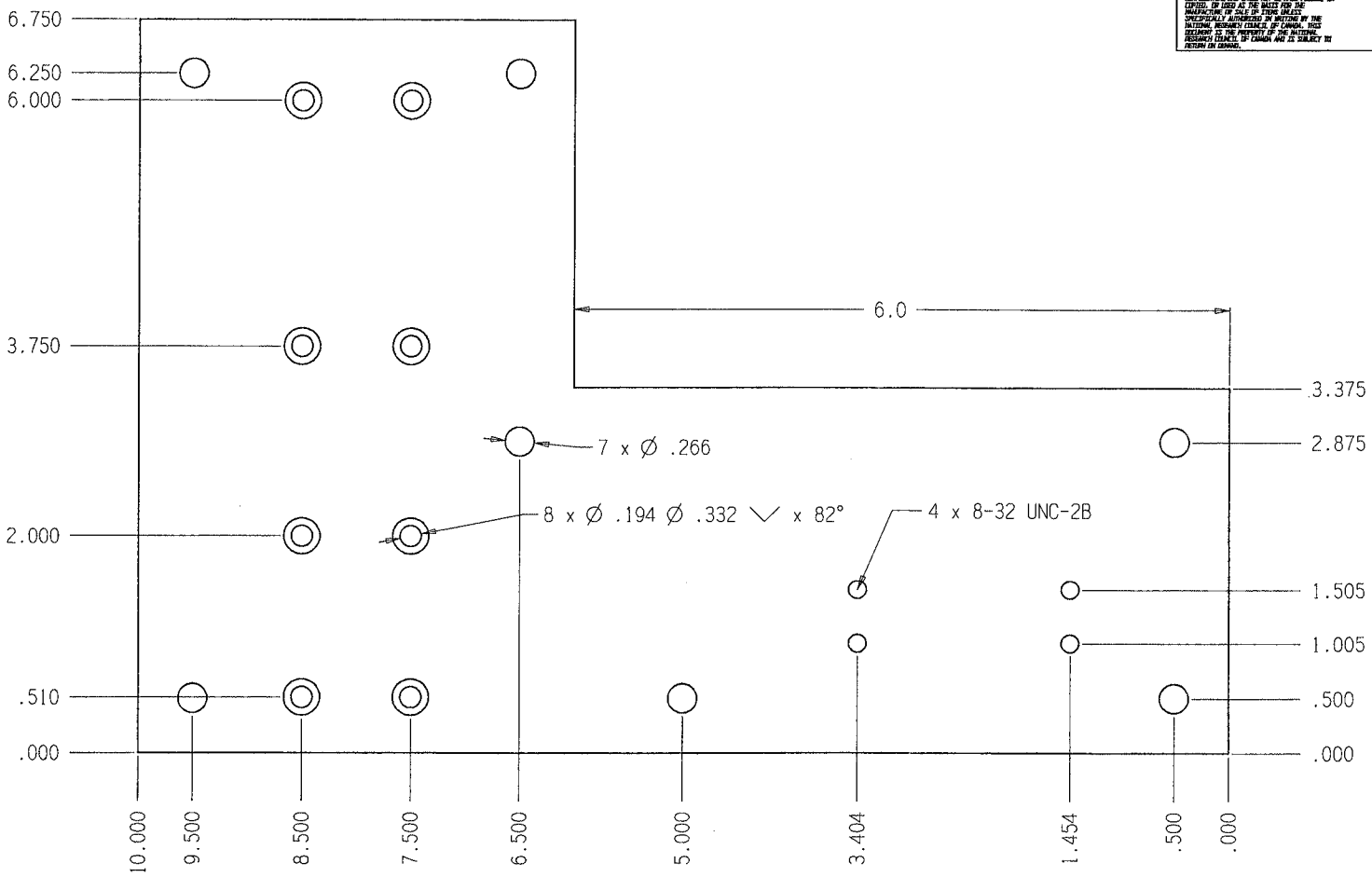
Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

TOLERANCES (unless specified)	
0.X ± 0.03	
0.XX ± 0.015	
0.XXX ± 0.005	
Angle +/- .5 deg.	
Fabrication +/- .04	
Fraction < 6 Inch +/- 1/64	
> 6 Inch +/- 1/32	
Material	Al
Finish	
Dimensions in: Inches ☒ Millimeters ☐	
Third Angle	
Job	2096
Drawn	T. Osmond
Approved	
Quantity	1
Title	Camera Mount
Size	A3
Number	2096T10
Rev	
Scale	1 : 1
Date	01-Mar-2006
Sheet	1 of 1



Bottom View

Notes:

Deburr - Renove All Sharp Edges

Source File
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National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

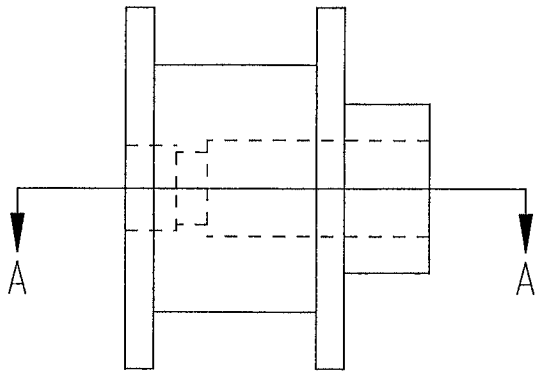
Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

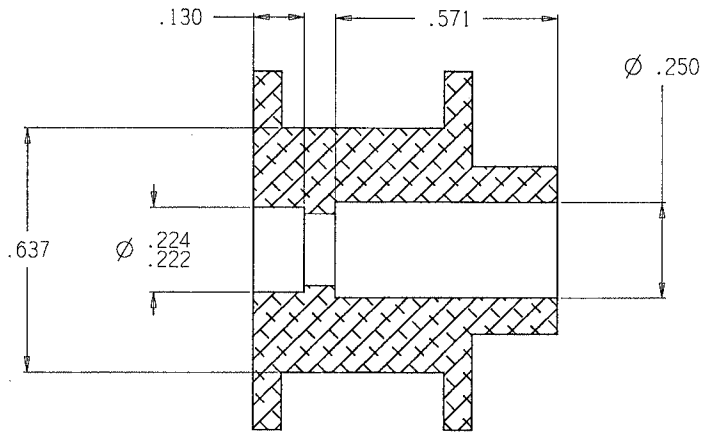
TOLERANCES (unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04
Fraction < 6 Inch +/- 1/64
> 6 Inch +/- 1/32

Material: 1/4" Al
Finish:
Dimensions in: Inches ☒ Millimeters ☐
Third Angle
Drawn: T. Osmond
Approved:
Quantity: 1

Title: Base Plate
Size: A3
Number: 2096T11
Rev:
Scale: 9 : 10
Date: 01-Mar-2006
Sheet 1 of 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED





SECTION A–A

Notes:

Deburr - Remove All Sharp Edges

McMaster Carr Part Number 6495K711
PD - .929"
OD - .637
Bore - 3/16"
Pitch - .2"

Source File
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Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

TOLERANCES (unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04
Fraction < 6 Inch +/- 1/64
> 6 Inch +/- 1/32

Material: Al

FINISH

DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐

THIRD ANGLE

JOB: 2096
DRAWN: T. Osnond
APPROVED:
Quantity: 1

TITLE: Pulley 1 Modification

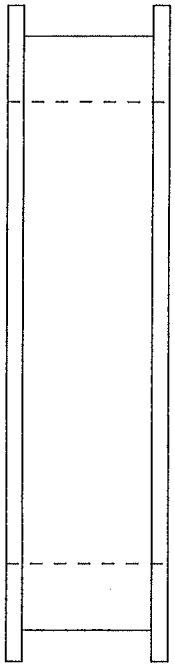
SIZE: A3
NUMBER: 2096T12
REV:
SCALE: 1 : 3
DATE: 01-Mar-2006
SHEET 1 OF 1

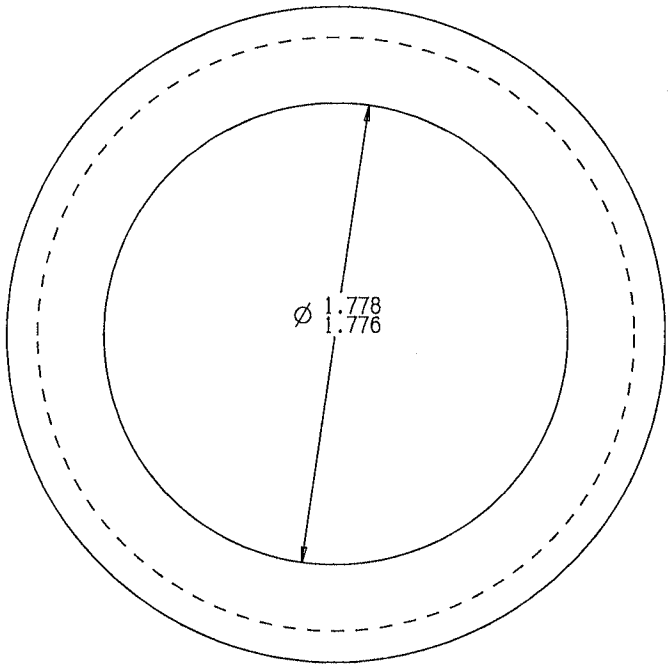
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Deburr - Remove All Sharp Edges
Light Press Fit over Laser Dial

McMaster Carr Part Number 57105K27
PD - 2.292"
OD - 2.53"
Pitch - .2"





Source File
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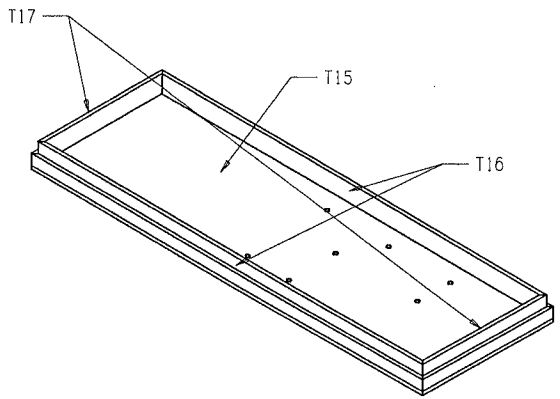
National Research Council Canada | Conseil national de recherches Canada | NRC-CNRC

TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction <6 Inch +/- 1/64 >6 Inch +/- 1/32	Material: Al FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 YEAR: 2096 DRAWN: T. Osmond APPROVED Quantity: 1
TITLE: Pulley 2 Modification A3 | NUMBER: 2096T13 | REV SCALE: 1 : 2 | DATE: 01-Mar-2006 | SHEET 1 OF 1		

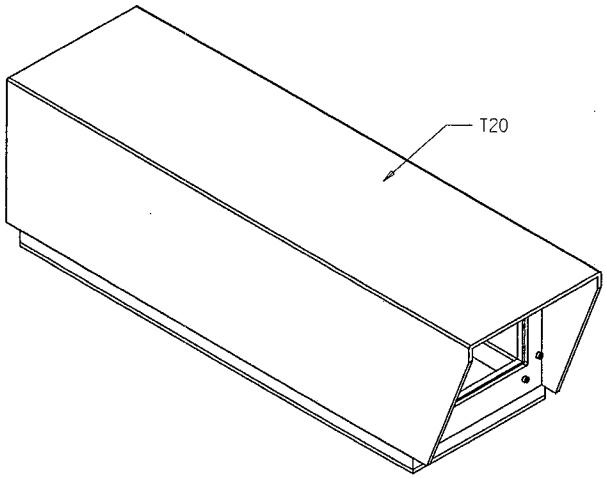
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

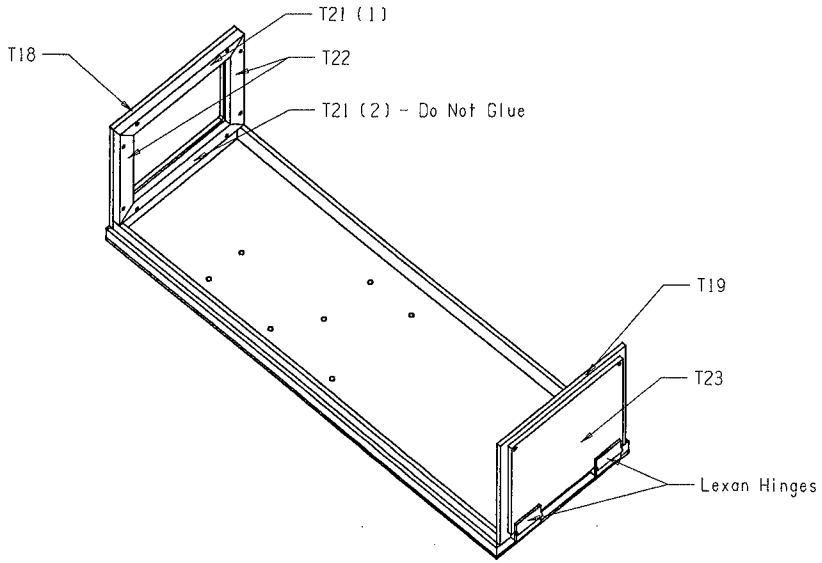


Notes:

Deburr - Renove All Sharp Edges

Glue T18, T19, T21 (1), T22 to T20
Do not glue T21 (2)





Source File
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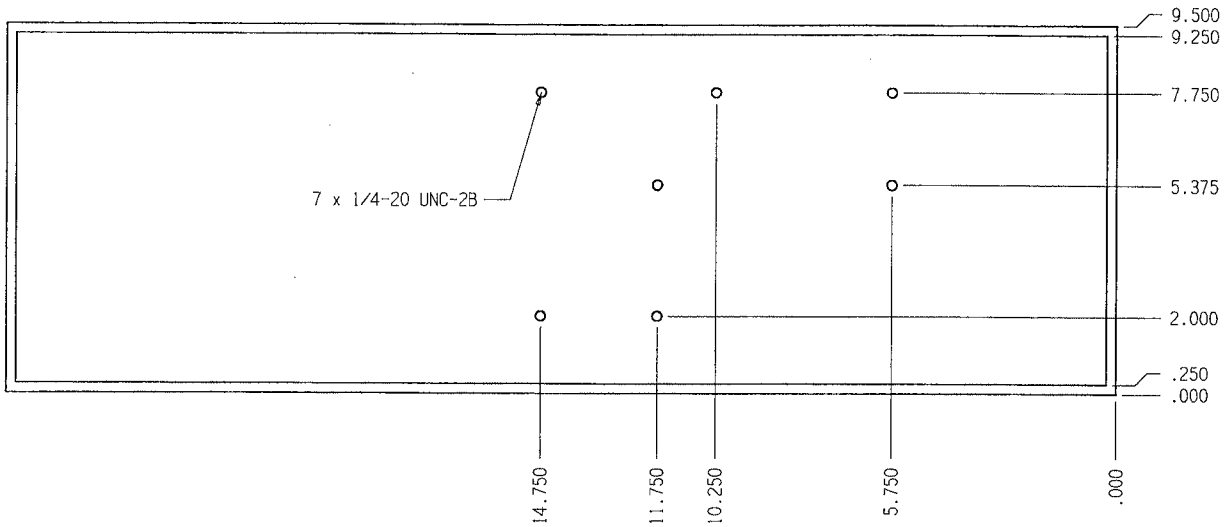
National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

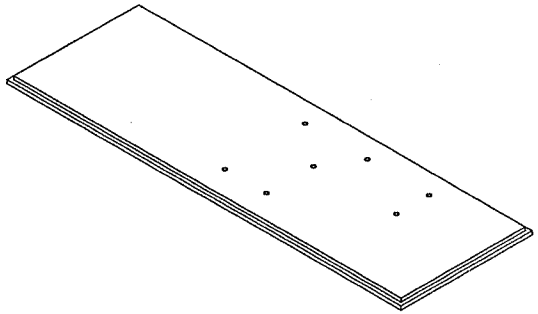
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 Inch +/- 1/64 > 6 Inch +/- 1/32	Material: Lexan FINISH DIMENSIONS ON: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 DRAWN: T. Osmond APPROVED Quantity: 1
TITLE: General Assembly - L Housing SIZE: A3 NUMBER: 2096T14 REV SCALE: NTS DATE: 01-Mar-2006 SHEET 1 OF 1		

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED



Notes:

Deburr - Renove All Sharp Edges



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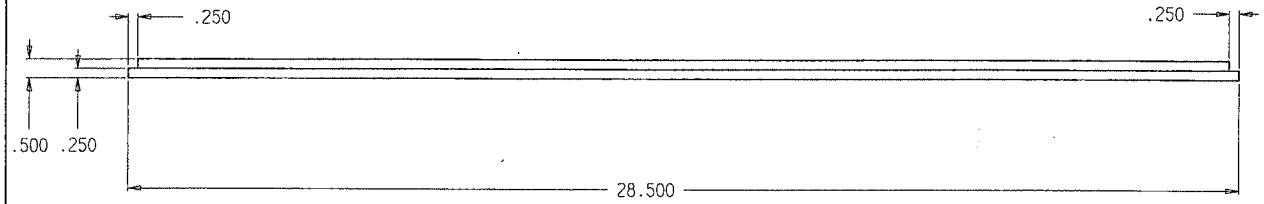


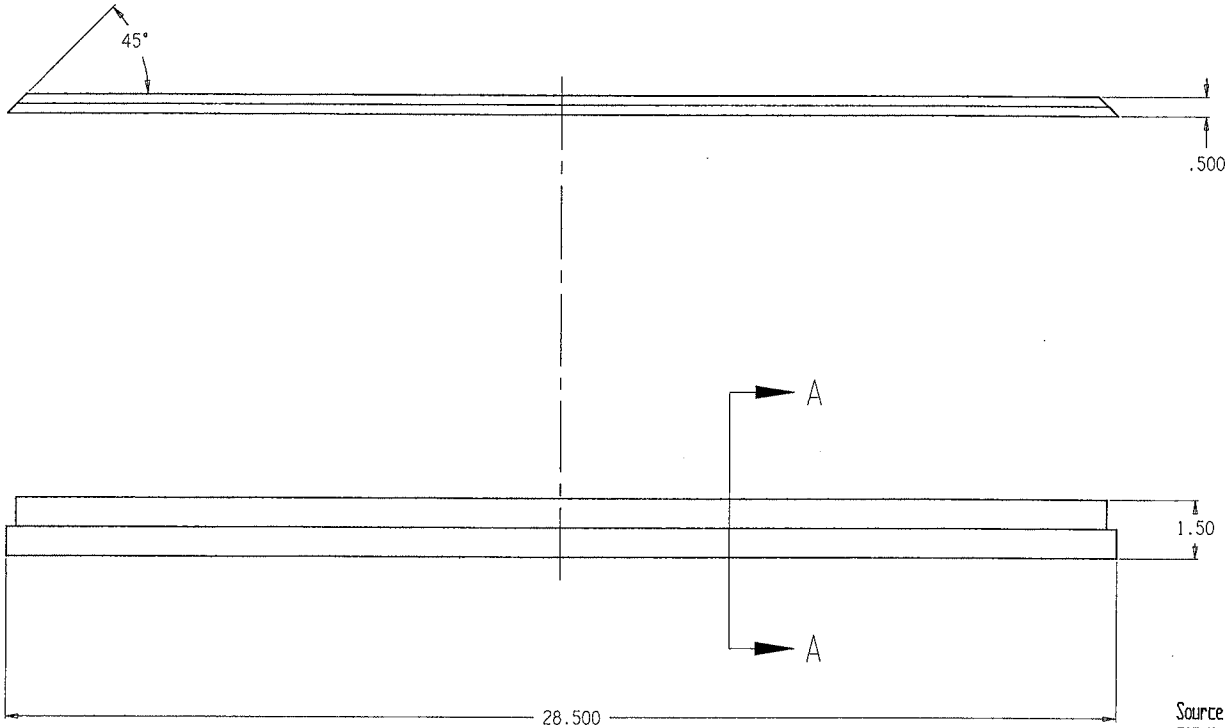
National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

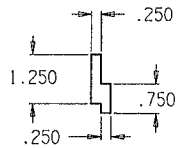
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 Inch +/- 1/64 > 6 Inch +/- 1/32	Material: Al FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 TRAK: 2096 DRAWN: T. Osmond APPROVED: Quantity: 1 TITLE: Bottom - L Housing SIZE: A3 NUMBER: 2096T15 REV: SCALE: 3 : 10 DATE: 01-Mar-2006 SHEET 1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Deburr - Renove All Sharp Edges





SECTION A–A

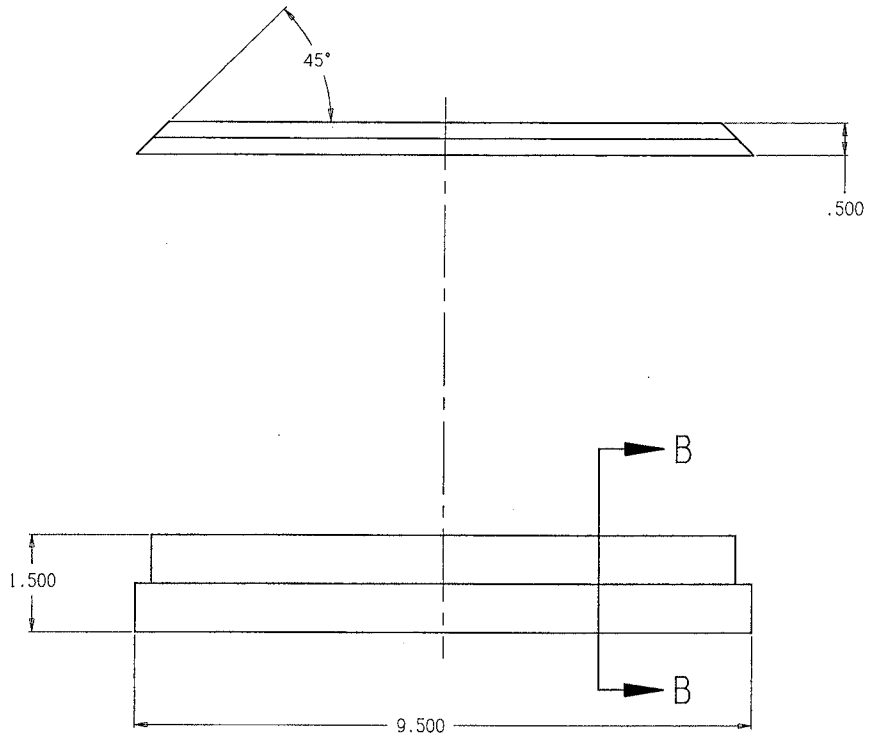
Source File
CAD_User\Projects\42_2096 Ice Detection\TOsmond\Laser.ckd

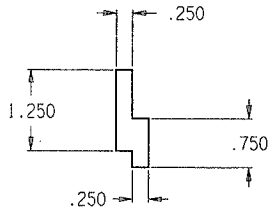
National Research Council Canada | Conseil national de recherches Canada | NRC-CNRC

Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

TOLERANCES (unless specified)	
0.X ± 0.03	
0.XX ± 0.015	
0.XXX ± 0.005	
Angle +/- .5 deg.	
Fabrication +/- .04	
Fraction <6 inch +/- 1/64	
>6 inch +/- 1/32	
Material	Lexan
FINISH	
DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐	
THIRD ANGLE	
JOB	2096
DRAWN	T. Osmond
APPROVED	
Quantity	2
TITLE	Edge 1 - L Housing
SIZE	A3
NUMBER	2096T16
REV	
SCALE	3 : 10
DATE	01-Mar-2006
SHEET	1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED





SECTION B-B

Notes:

Deburr - Renove All Sharp Edges

Source File
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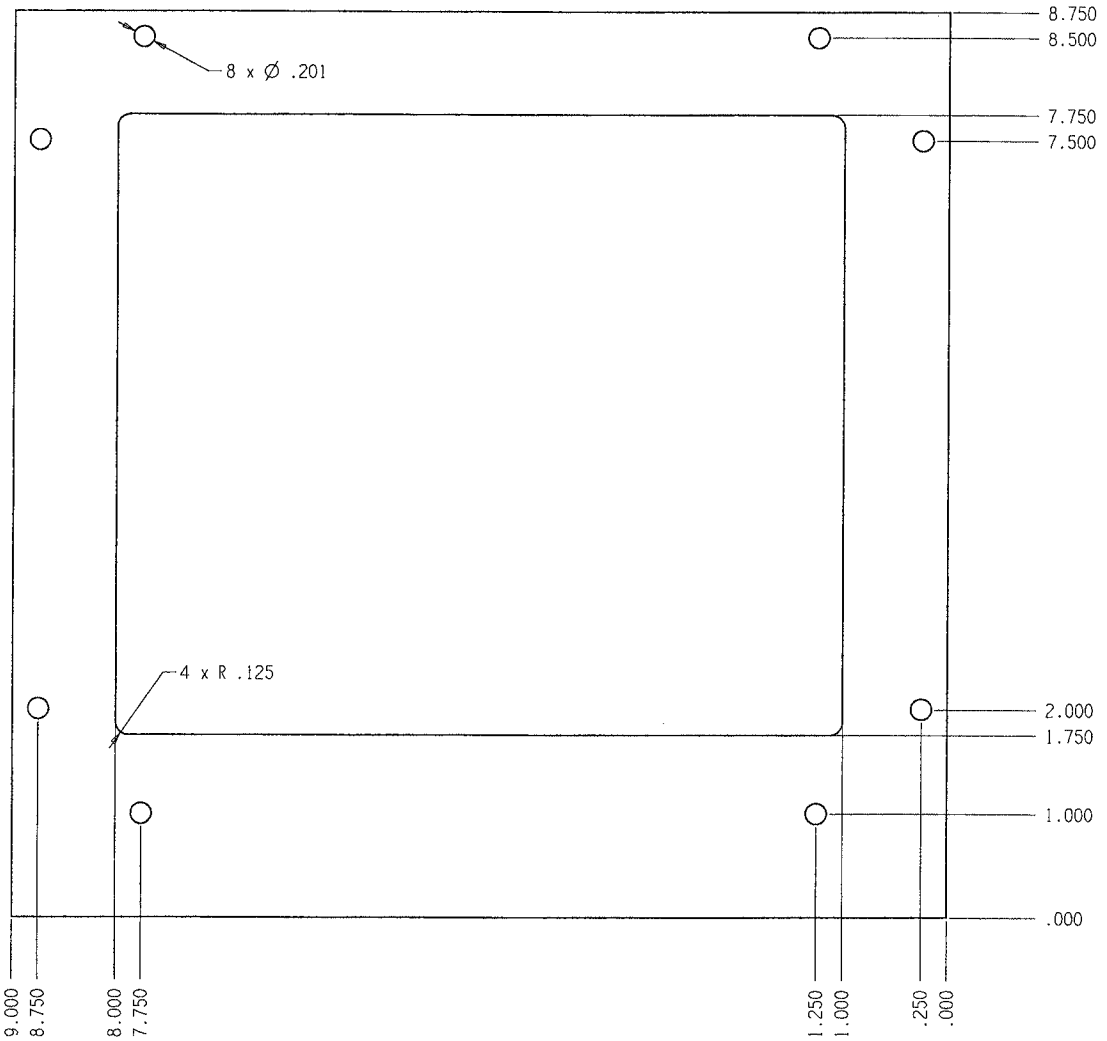
National Research Council Canada | Conseil national de recherches Canada | NRC-CNRC

TOLERANCES (unless specified)	Material	Institute for Marine Dynamics
0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32	Lexan	Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5
FINISH	TASK 2096	TITLE Edge 2 - L Housing
DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐	DRAWN T. Osnond	
THIRD ANGLE	APPROVED	
	Quantity 2	A3 NUMBER 2096T17 REV
		SCALE 1 : 2 DATE 01-Mar-2006 SHEET 1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED



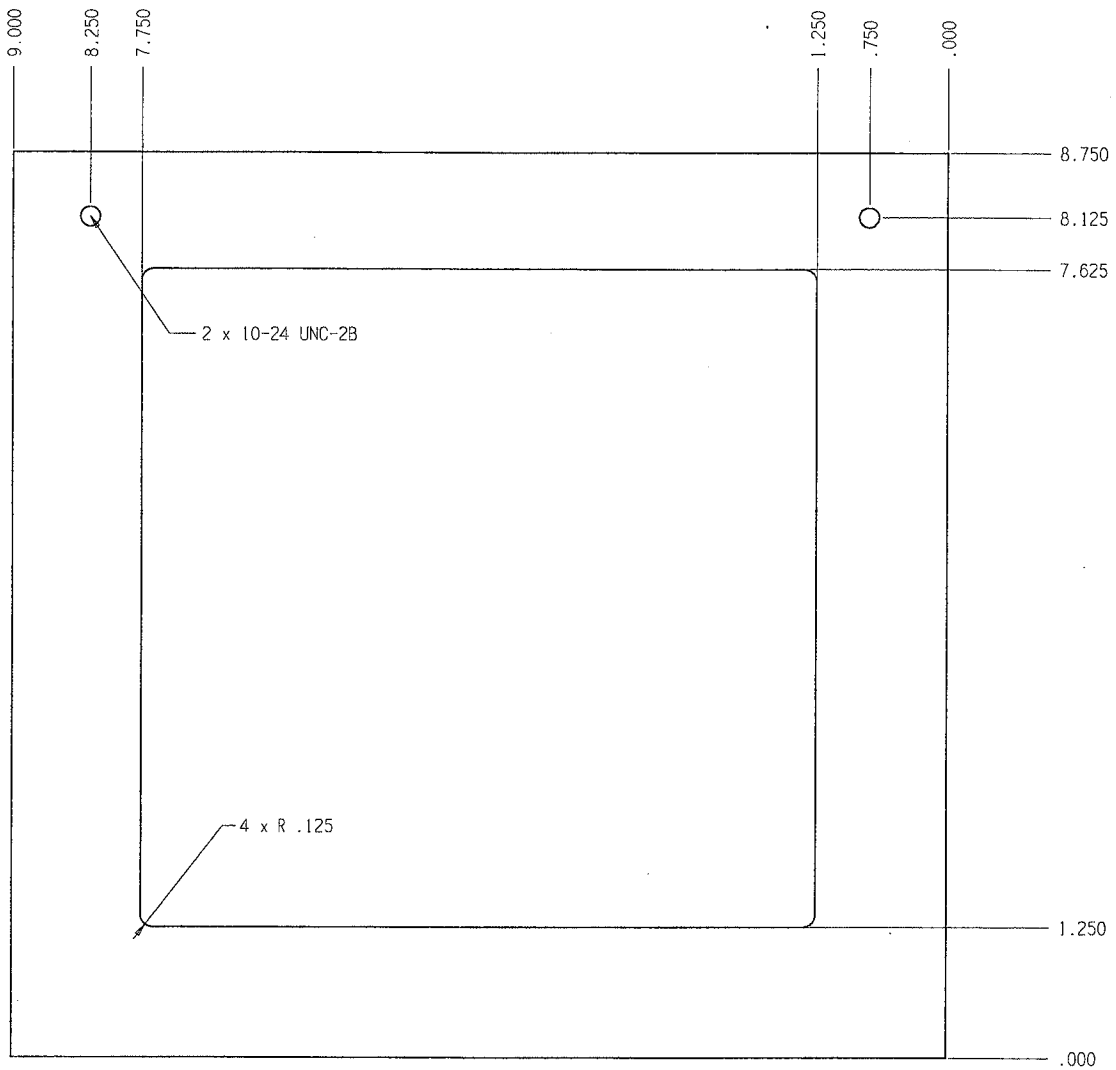
Notes:

Deburr - Remove All Sharp Edges

Source File
CAD_User\Projects\42_2096 Ice Detection\TOsnond\Laser.ckd

National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 Inch +/- 1/64 > 6 Inch +/- 1/32	Material: 1/4" Lexan FINISH DIMENSIONING IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 TEAM: 2096 DRAWN: T. Osnond APPROVED: Quantity: 1 TITLE: Front Wall - L Housing SIZE: A3 NUMBER: 2096T1B REV: SCALE: 4 : 5 DATE: 01-Mar-2006 SHEET 1 OF 1



REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Deburr - Renove All Sharp Edges

Source File
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National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

TOLERANCES (unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04
Fraction < 6 Inch +/- 1/64
> 6 Inch +/- 1/32

Material: 1/4" Lexan

FINISH

DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐

THIRD ANGLE

TASK: 2096

DRAWN: T. Osnond

APPROVED

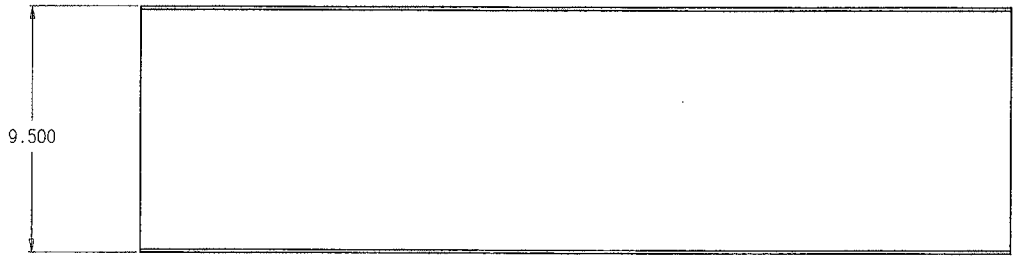
Quantity: 1

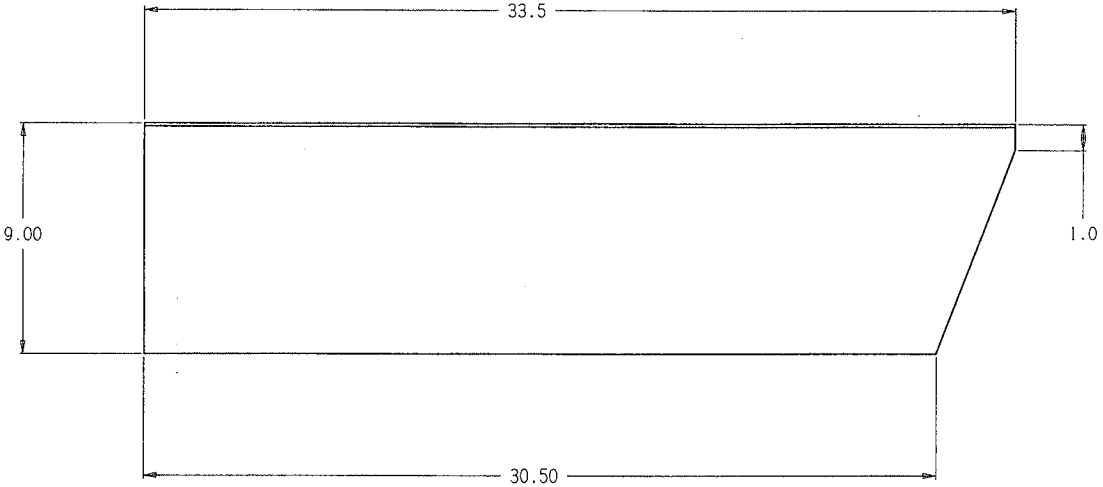
TITLE: Back Wall - L Housing

SIZE: A3 | NUMBER: 2096T19 | REV

SCALE: 4 : 5 | DATE: 01-Mar-2006 | SHEET 1 OF 1

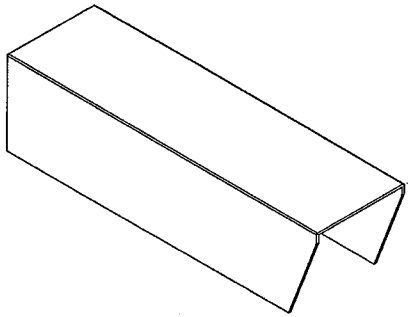
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED





Notes:

Deburr - Renove All Sharp Edges



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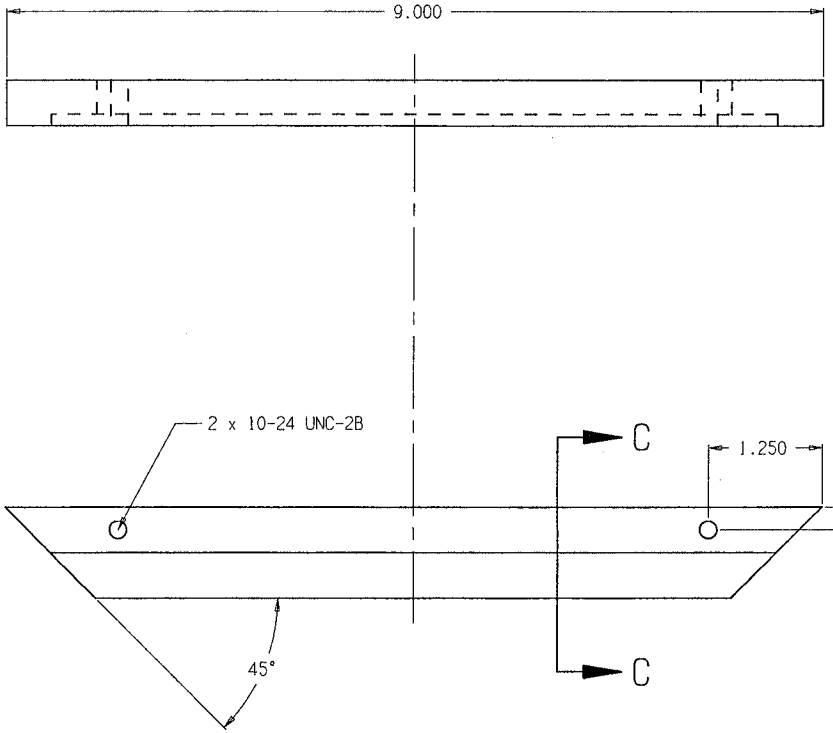
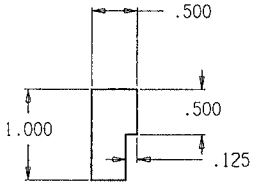
National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction <6 Inch +/- 1/64 >6 Inch +/- 1/32	Material: 1/4" Lexan FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 TASK: 2096 DRAWN: T. Dsmond APPROVED: Quantity: 1 TITLE: Top - L Housing SIZE: A3 NUMBER: 2096T20 REV: SCALE: 1 : 5 DATE: 01-Mar-2006 SHEET 1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

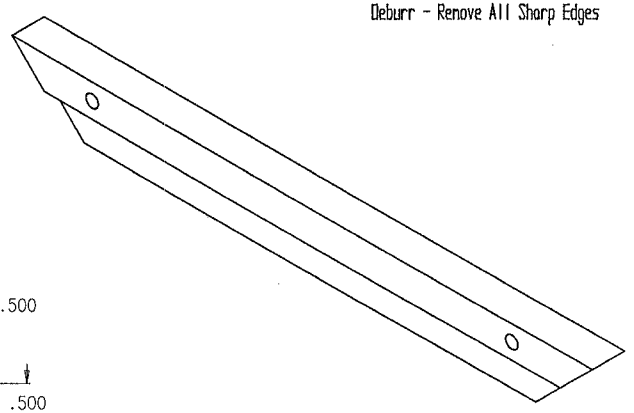




SECTION C-C

Notes:

Deburr - Renove All Sharp Edges



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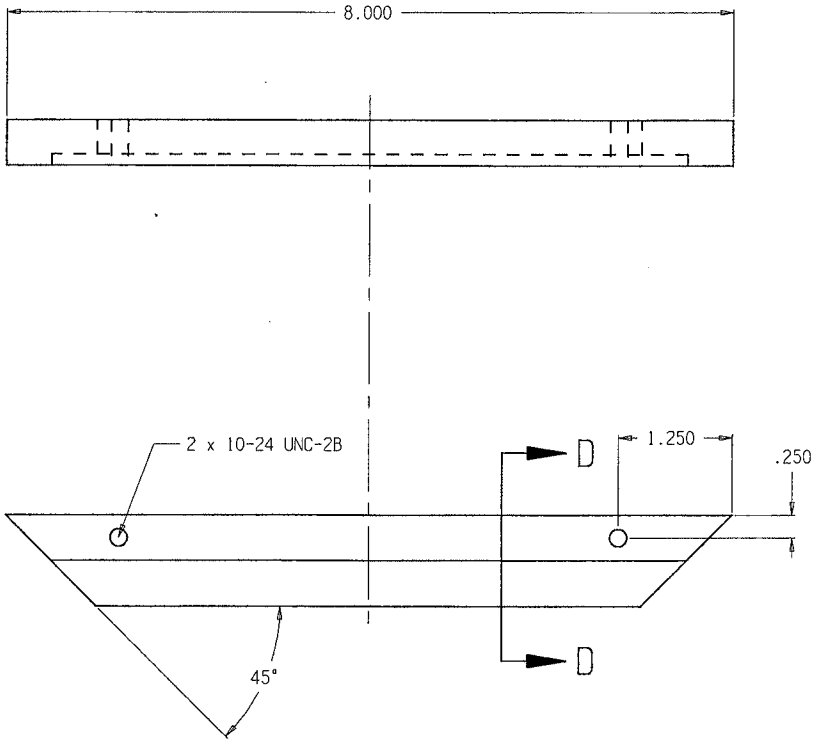
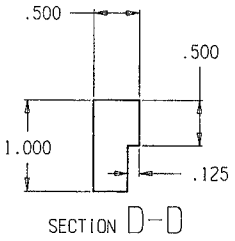
National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

TOLERANCES (unless specified)	
0.X ± 0.03	
0.XX ± 0.015	
0.XXX ± 0.005	
Angle +/- .5 deg.	
Fabrication +/- .04	
Fraction <6 Inch +/- 1/64	
>6 Inch +/- 1/32	
Material	Lexan
Finish	
Dimensions in: Inches ☒ Millimeters ☐	
Third Angle	
Proj	2096
Drawn	T. Osnond
Approved	
Quantity	2
Title	Front Frame 1 - L Housing
Size	A3
Number	2096T21
Rev	
Scale	7 : 10
Date	01-Mar-2006
Sheet	1 of 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED





SECTION D-D

Notes:

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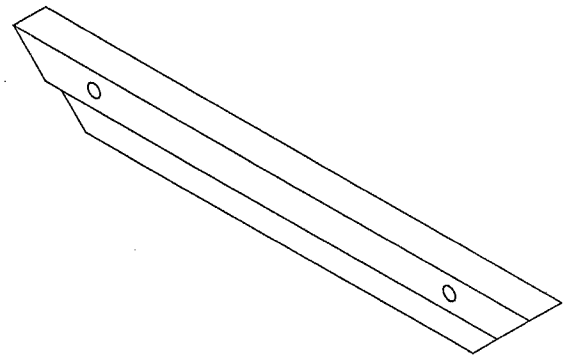

Source File
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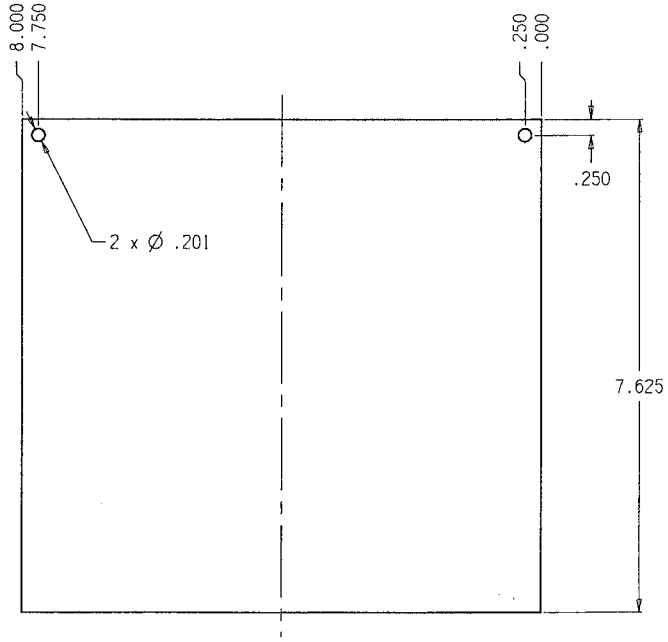
National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction <6 Inch +/- 1/64 >6 Inch +/- 1/32	Material: Lexan FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 PROJ 2096 DRAWN T. Osnond APPROVED Quantity 2	TITLE: Front Frame 2 - L Housing A3 NUMBER 2096T22 REV SCALE 7 : 10 DATE 01-Mar-2006 SHEET 1 OF 1

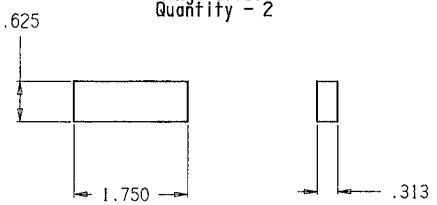
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Deburr - Remove All Sharp Edges



Hinge Offset
Quantity - 2



Source File
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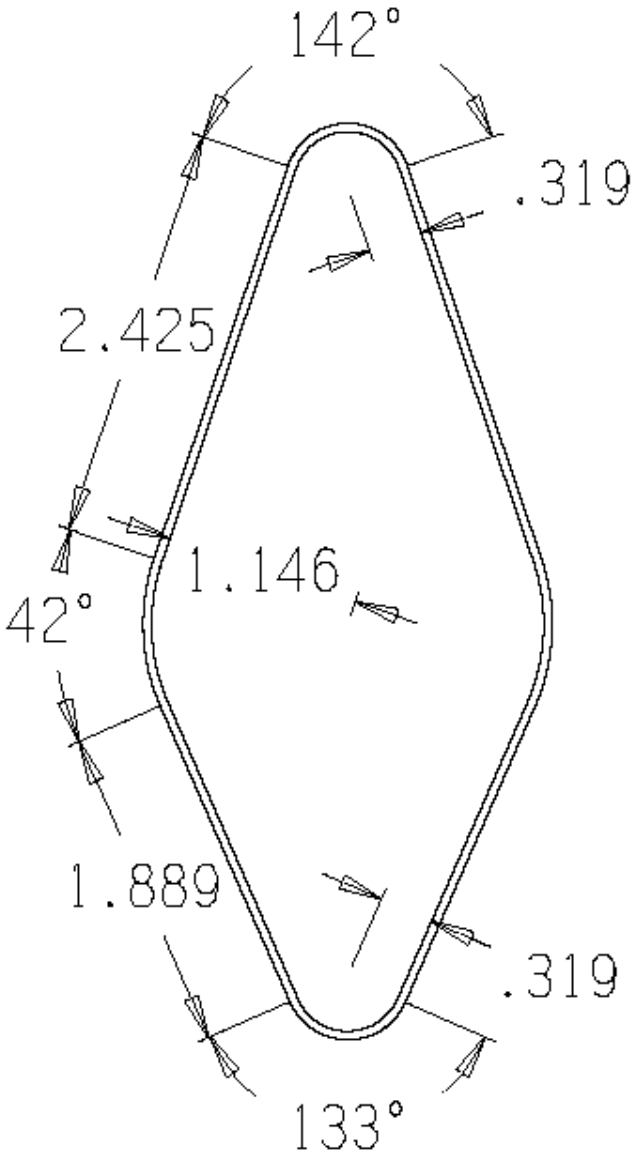
National Research Council Canada / Conseil national de recherches Canada — NRC-CNRC

TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 Inch +/- 1/64 > 6 Inch +/- 1/32	Material: 1/4" Lexan Finish: Dimensions in: Inches ☒ Millimeters ☐ Third Angle	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 Proj: 2096 Drawn: T. Osnond Approved: Quantity: 1 Title: Door - L Housing Size: A3 Number: 2096T23 Rev: Scale: 1 : 2 Date: 01-Mar-2006 Sheet 1 of 1

APPENDIX B – TIMING BELT DIMENSIONS

Appendix B – Timing Belt Dimensions



APPENDIX C – FASTENER LIST

Appendix C – Fastener List

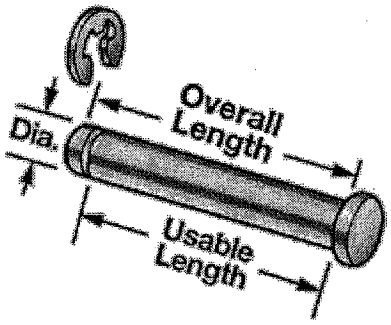
Number	Type	Length	Connecting…	Head
LASER				
4	8-32	0.500	Angle Bar to Laser Lock	Hex
4	8-32	2.000	Laser Lock Together	Hex
4	8-32	0.625	Angle Bar to Adjuster	Hex
1	8-32	1.500	Two adjusting pieces (sliding screw)	Hex
1	8-32	1.500	horizontal adjusting screw	Hex
8	4-40	1.000	servomount pieces	slot flat csk
4	2-56	0.500	servo to servomount	socket screw
8	8-32	0.625	mounts to base plate	slot flat csk
7	1/4-20	0.500	base plate to housing bottom	socket screw
WEATHER HOUSING				
10	8-32	0.625	front glass and back door to housing	socket screw
4	1/2-20	0.500	tilt/pan head to stand	button slot

APPENDIX D – DATA SHEETS

Pin Type > Diameter > Clevis Pin Type > Overall Length

Pins

This product matches all of your selections.



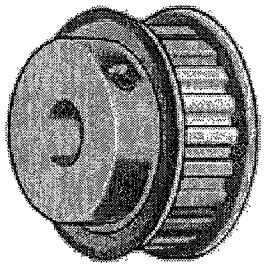
Part Number: 92735A160 $5.90 per Pack of 5

Material Type	Stainless Steel
Finish	Plain
Stainless Steel Type	18-8 Stainless Steel
Pin Type	Clevis Pins
Clevis Pin Type	Grooved with Retaining Ring
System of Measurement	Inch
Diameter	3/16"
Actual Head Diameter (Min.-Max.)	.300"-.320"
Actual Diameter (Min.-Max.)	.181"-.186"
Usable Length	1-29/32"
Overall Length	2"
Actual Head Height (Min.-Max)	.050"-.070"
Specifications Met	Not Rated
Rockwell Hardness	B83-B95

Timing Belt Series > Number of Teeth on Pulley > Outer Diameter

Pulleys

This product matches all of your selections.



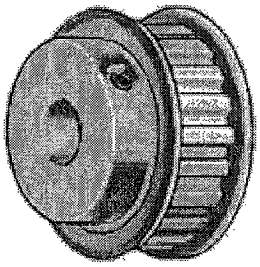
Part Number: 57105K27 $8.19 Each

Pulley Type	Drive Pulleys
For Belt Type	Timing Belt Pulleys
Timing Belt Series	XL Series
Number of Teeth on Pulley	36
For Timing Belt Width	1/4" and 3/8"
Outer Diameter	2.53"
Bore Type	Finished Bore
Finished Bore Pulley Style	Standard
V-Dimension (Pitch Dia.)	2.292"
Bore Size (ID)	5/16"
W-Dimension	.5"
X-Dimension	5/8"
Y-Dimension	7/8"
Z-Dimension	7/8"
Pitch	.2"
Pulley Material	Acetal Plastic with Aluminum Hub
Keyway Size	1/8" Wd. x 1/16" Dp.

Timing Belt Series > Number of Teeth on Pulley > Outer Diameter

Pulleys

This product matches all of your selections.



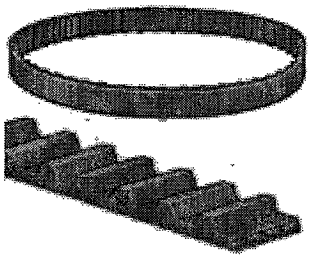
Part Number: 6495K711 $8.13 Each

Pulley Type	Drive Pulleys
For Belt Type	Timing Belt Pulleys
Timing Belt Series	XL Series
Number of Teeth on Pulley	10
For Timing Belt Width	1/4" and 3/8"
Outer Diameter	.929"
Bore Type	Finished Bore
Finished Bore Pulley Style	Standard
V-Dimension (Pitch Dia.)	.637"
Bore Size (ID)	3/16"
W-Dimension	.418"
X-Dimension	9/16"
Y-Dimension	25/32"
Z-Dimension	7/16"
Pitch	.2"
Pulley Design	Solid
Pulley Material	Steel

Timing Belts > Belt Construction > Pitch > Trade Size > Belt Width > Compare Items

Belts

This product matches all of your selections.



Part Number: 6484K222 $3.62 Each

Trade Size	120XL
Form	Endless Belts
Type	Timing Belts
Timing Belt Series	XL Series
Outer Circle	12"
Belt Construction	Single-Sided with Trapezoidal Teeth
Belt Width	3/8"
Pitch	.2"
Number of Teeth	60
Belt Material	Rubber
Cord Material	Polyester
Color	Black
Accessories	Tension Tester - 60275K21