CWTT wave probe arm, 2006
Osmond, T.

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SUMMARY
A new wave probe arm has been designed for the clear water tow tank as of 2006. This arm is much smaller and lighter than the currently existing wave arm. It is intended for low load applications. This document contains the details of this design.

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CWTT Wave Probe Arm, 2006

SR-2006-02

T. Osmond

April 2006

Introduction

January, 2006 – the Institute for Ocean Technology has established a need for a folding arm that extends almost half way across the clear water tow tank at full deployment. The arm is intended to be used to attach wave probes. The arm is to be a lighter more practical arm than the one currently employed in the tank. It is to operate in conjunction with the currently existing, much larger arm and is not intended to serve as a replacement. Howard Mesh established the necessity for this arm and its design has been the responsibility of the coop student within the Design and Fabrication Group working under Tony Randell. The design of the new wave probe arm was undertaken during the last three weeks in January, 2006. The arm is a basic aluminum frame hinged from a Stainless Steel bracket, anchored to the cement wall of the Clear Water Tow Tank. Fully deployed the arm extends away from the tank wall at a 90 degree angle. The arm can be locked both fully deployed and folded against the tank wall. An additional support piece has also been designed. Its purpose is to brace the arm against sway should it be a problem. The fabrication of this support piece is subject to its necessity pending testing of the arm. There were two phases to the design of this piece of equipment. The first phase led up to the design review meeting. Following the design meeting the wave probe arm was extensively redesign to accommodate many new requests and suggestions posed by the group attending the design review meeting. The following report presents the factors of consideration and the features that were implemented into the design of both the wave probe arm and the supporting piece. Full CAD design is available under CAD_User:\Projects\421009_cwt\ProbeArm\ProbeArm.ckd.

Shape

The total length of the wave probe arm is 175 inches from the wall of the tank to the tip of the arm at full deployment. This length includes the added distance of the bracket. The arm is almost 14 inches in height with two inches of width. Two parallel lengths of aluminum box tube are cross braced and supported by three 10 inch long, aluminum box tube supports and two aluminum gusset plates. The

purpose of the supports is to provide structural integrity and to reduce bending in the arm from externally applied loads and under its own weight. The lower length of box tube extends 50 inches beyond the upper as less support is necessary near the end of the arm. The arm is bolted to a stainless steel bracket that was previously fabricated. The bracket is to be modified to suit the purposes of the wave probe arm application. Modifications include two thick stainless steel plates welded to the upper and lower surfaces of the bracket and machined to be parallel with each other. This is necessary because the surfaces of the currently existing bracket are not parallel due to welding deflections during fabrication. Aluminum bushings and screws are used as the axis of rotation for the arm.

Strength

The strength demands on the design of the wave probe arm are minimal. The weight of the wave probes are merely a few grams therefore the arm must be capable of sustaining very little beyond its own weight. For this reason the arm is designed of only 2 x 2 x 0.188 inch aluminum box tubing. The material is light, corrosion resistance and rigid. By separating the top and bottom lengths of tube a distance of approximately 10 inches the moment of inertia is elevated around the bending axes. This reduces deflection caused by loading of the arm should any loading be necessary in future applications. The box tube and gusset supported design also provide considerable rigidity in torsion and sway and will prevent the arm from folding in or collapsing under increased bending stress.

Support Component

A supporting component has been designed to brace the wave probe arm against sway. It has not yet been determined whether this component is necessary. Should it be found that there is a flexing in the wave probe arm that interferes with the readings of the wave probes, the supporting component will be fabricated. The supporting component is more complicated in design then the wave probe arm itself. The base plate and joint attachment are made of stainless steel and bolts are used to attach the two together. The height of the

joint attachment is designed to be adjustable ± one inch because the exact positioning of the plate through drilling the cement anchors cannot be set accurately. Attached to the joint is a long aluminum hollow rod. An optional cable can be attached to prevent the rod from bending if it is to be left unsupported for extended periods of time. At the end of the rod a threaded bushing is welded and set. A threaded rod is screwed into the bushing and screwed into an aluminum bottle screw at the other end. A rod end screws into the bottle screw and loops over a hook that is welded to the wave probe arm. When the bottle screw is turned it tightens and holds the arm in place.

Features

As previously mentioned the lower length of the probe arm extends 50 inches beyond the main frame. It is to this section of the arm that the wave probes are intended to be attached. To do this a thin piece of flat bar is welded to the front surface of the arm so that the probes may clip on.

When deployed at full 90 degrees the arm is capable of locking in place. A ¼ inch screw feeds through a hole in the arm near the bracket and screws into the bracket. Tightening this screw down will lock the arm in position. This however may provide little support for the arm against sway so a supporting component has been designed to account for this and is described above. When the arm is folded against the tank wall the bolt may again be tightened down to hold the arm in position.

The entire assembly has been designed to be corrosion resistant because the assembly will be fixed just above the water level in the Clear Water Tank where humidity will be very high. Most of the load bearing components are composed of stainless steel including the bracket, the wall plate for the supporting component and all of the bolts, buckles and anchors. The frame of the arm, the supporting arm and the bushings are made of aluminum and the tie rod end is

made of plastic. No lubrication should be needed for this design because of low loads and no wear applications.

Due to the low demands on the wave probe arm there are few complicated components. No bearings or lubricated components have been incorporated into the design. The arm is a lightweight, low load piece of equipment designed specifically for wave probes however may be used for other low load purposes. The loading limit for the wave probe arm will depend on the acceptable deflection for the application but the arm should not be loaded with any more than 20 lbs at the very tip of the arm.

Drawings

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Wooden tenplate to be fabricated

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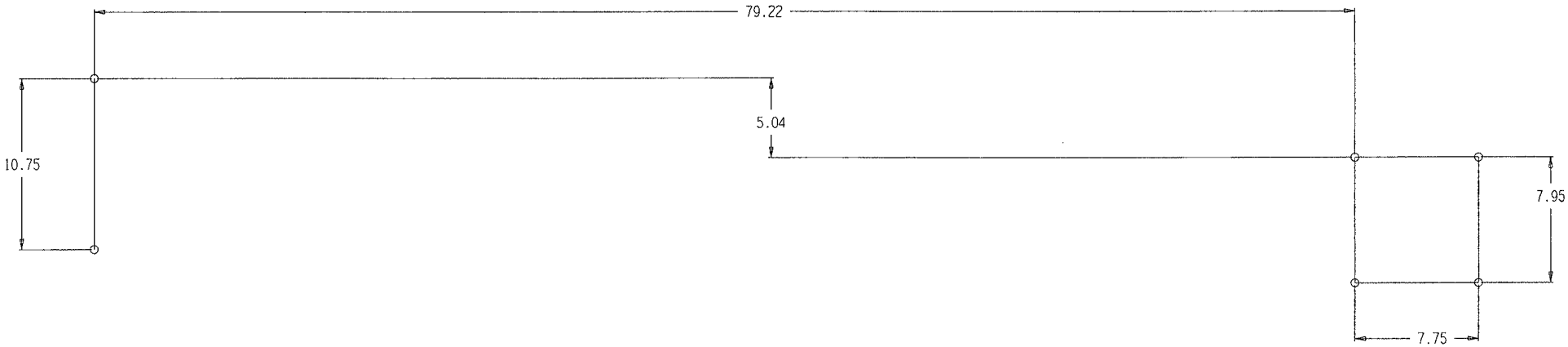
CAD_User\Projects\421009_cwt\ProbeArm\009T01



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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: N/A
Heat Treatment: N/A
FINISH
DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐
THIRD ANGLE

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

DWG NO: 009
DRAWN: T. Osmond
APPROVED:
Quantity: 1

TITLE: Anchor Template
SIZE: A3
NUMBER: 009T01
REV:
SCALE: NTS
DATE: 2006-Jan-25
SHEET 1 OF 1

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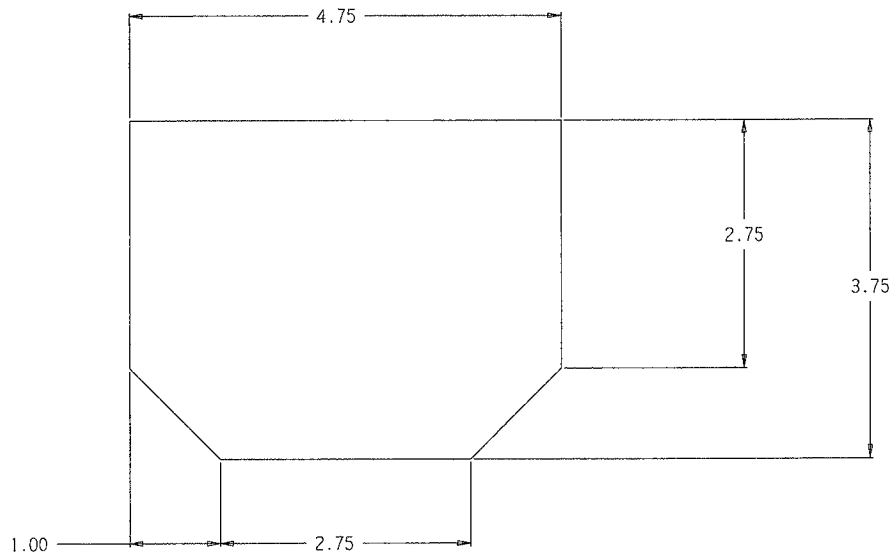

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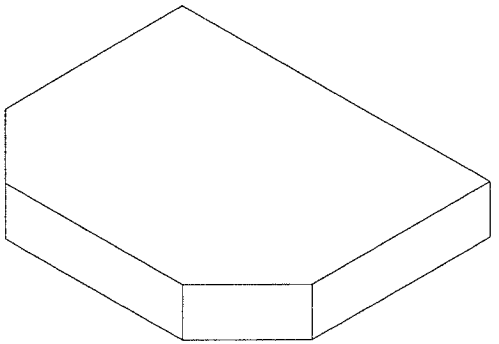

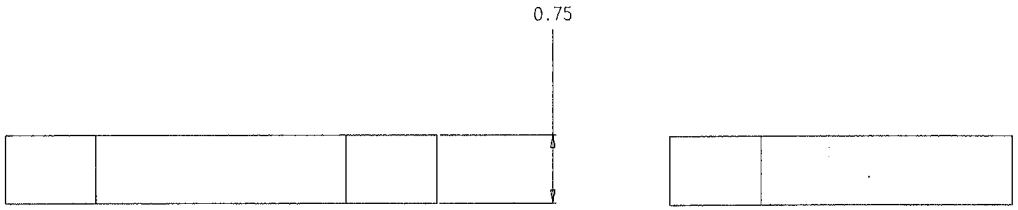

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TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32	Material: SS Heat Treatment: N/A FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 TRAK: 009 DRAWN: T. Osmond APPROVED Quantity: 2	TITLE: Hinge Fitting SIZE: A3 NUMBER: 009T02 REV SCALE: 1 : 1.43 DATE: 2006-Jan-25 SHEET 1 OF 1

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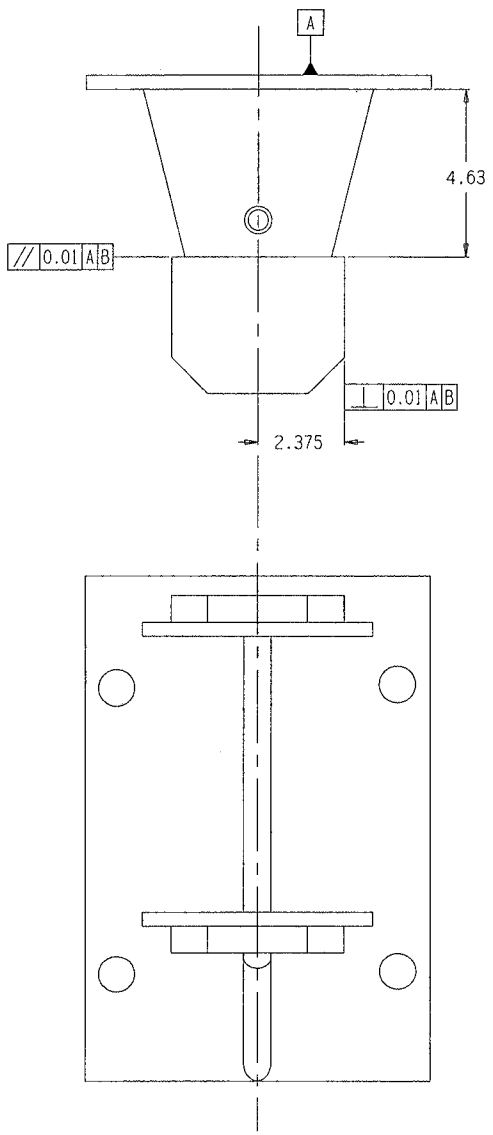

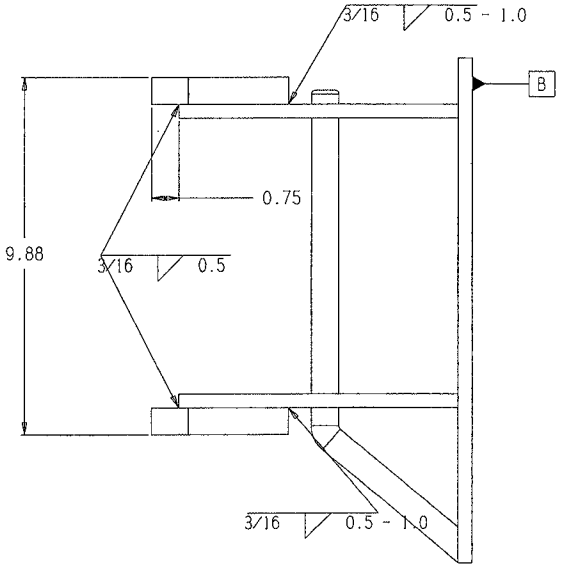

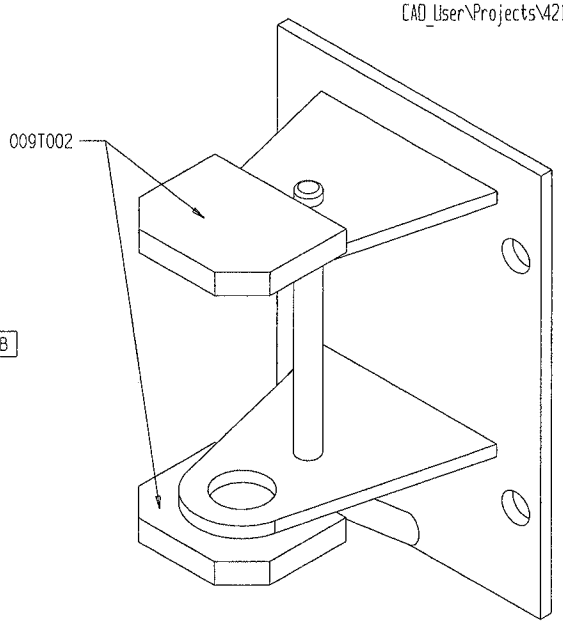

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TOLERANCES (unless specified)	
0.X ± 0.03	
0.XX ± 0.015	
0.XXX ± 0.005	
Angle +/- .5 deg.	
Fabrication +/- .04	
Fraction < 6 inch +/- 1/64	
> 6 inch +/- 1/32	
Material	SS
Heat Treatment	None
FINISH	
DIMENSIONS IN:	INCHES ☒ MILLIMETERS ☐
THIRD ANGLE	
PROJ.	009
DRAWN	T. Osmond
APPROVED	
Quantity	1
TITLE	Bracket Welding
SIZE	A3
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SCALE	1 : 3
DATE	2006-Jan-25
SHEET	1 OF 1

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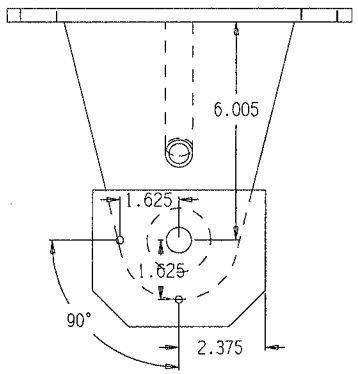

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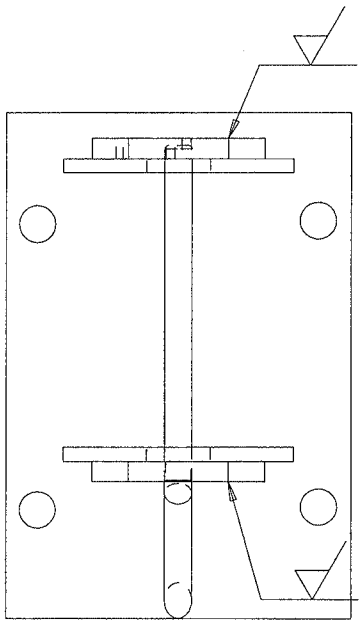

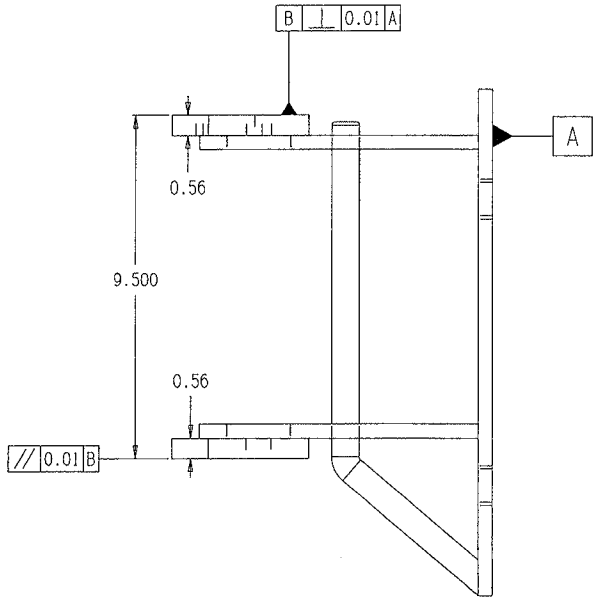

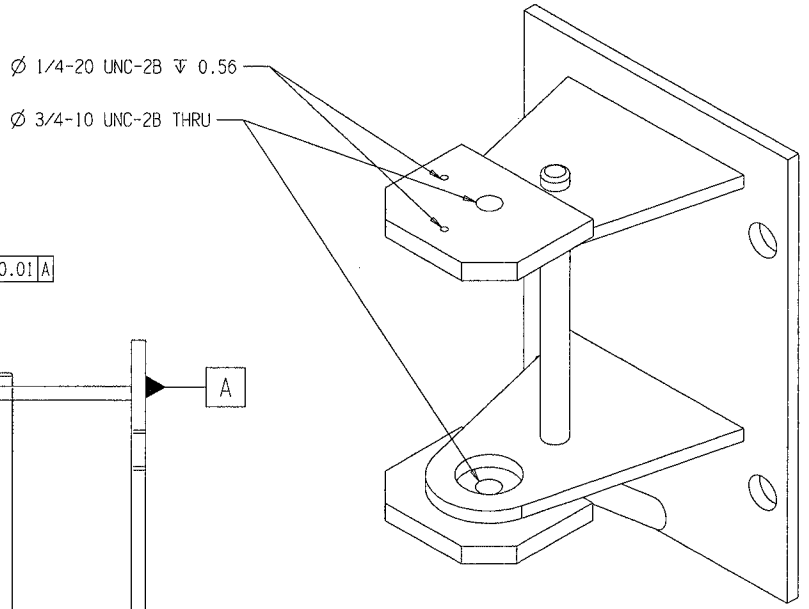

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TOLERANCES (unless specified) 0.X ± 0.03; 0.XX ± 0.015; 0.XXX ± 0.005; Angle +/- .5 deg.; Fabrication +/- .04; Fraction < 6 inch +/- 1/64, > 6 inch +/- 1/32	Material: SS; Heat Treatment: None; Finish; Dimensions in: Inches ☒ Millimeters ☐; Third Angle	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5	
		DWG NO. 009	TITLE: Bracket Machining
		DRAWN T. Osmond	
		APPROVED	SIZE A3 · NUMBER 009T04 · REV
		Quantity 1	SCALE 1 : 3.57 · DATE 2006-Jan-25 · SHEET 1 OF 1

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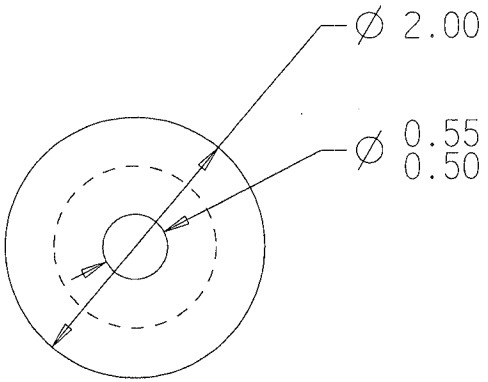

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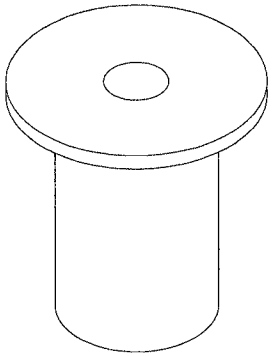

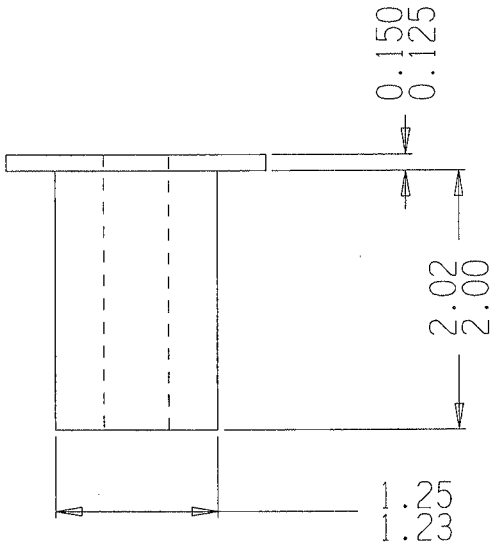

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St. John's, Newfoundland A1B 3T5

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 6061-T6
FINISH	
DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐	
THIRD ANGLE	
TASK	009
DRAWN	T. Osmond
APPROVED	
Quantity	2
TITLE	Bushing 1
SIZE	A3
NUMBER	009T05
REV	
SCALE	1 : 1
DATE	2006-Jan-25
SHEET	1 OF 1

REVISIONS				
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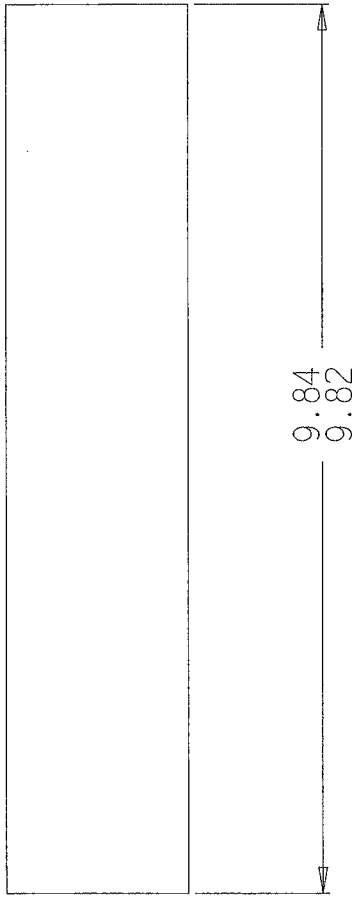

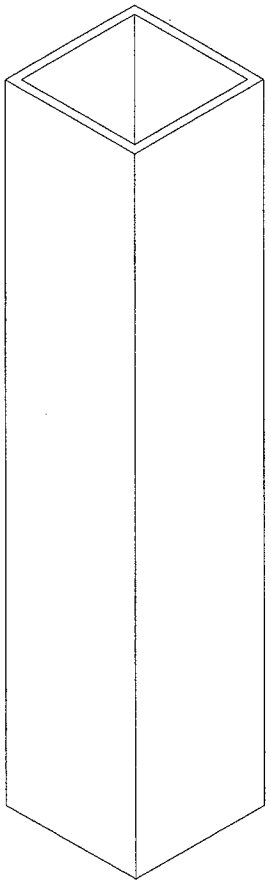

Notes:

2x2x0.120
Round Corners

Deburr - Renove All Sharp Edges

Source File
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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 6016-T6 Square Tubing 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 009 DRAWN T. Osmond APPROVED Quantity 2	TITLE Supports A3 NUMBER 009T06 REV SCALE 1 : 1.43 DATE 2006-Jan-25 SHEET 1 OF 1

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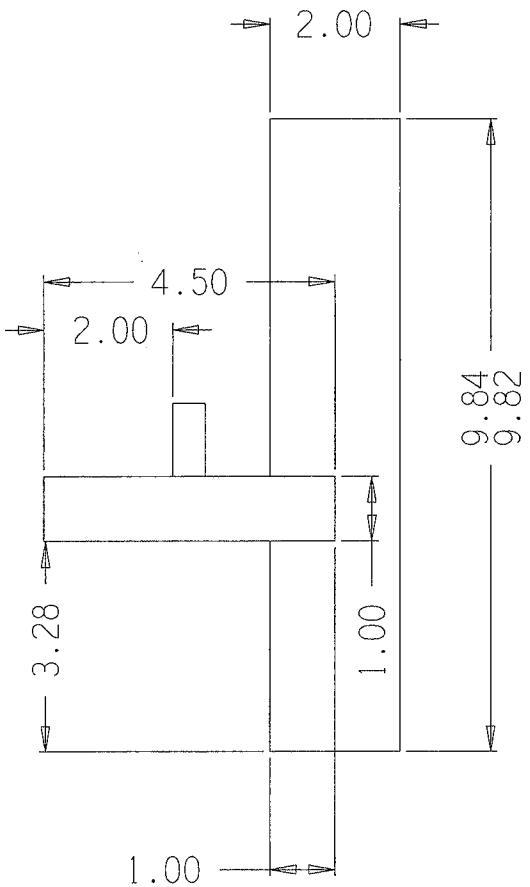

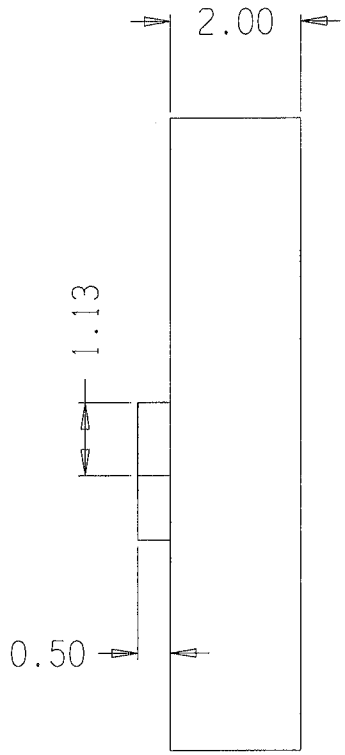

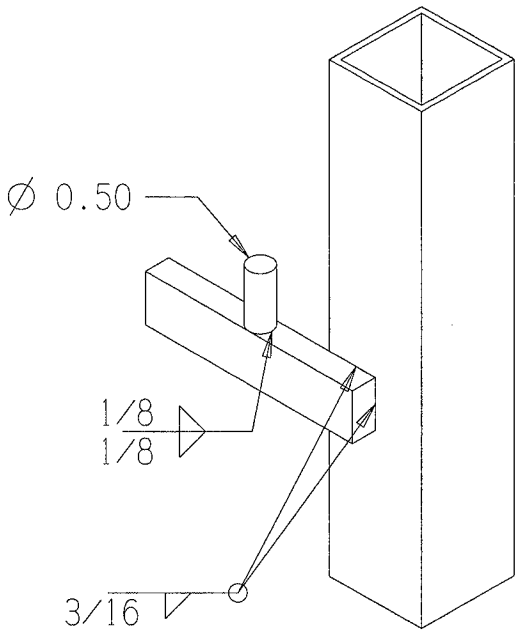

Notes:

Main Support:
Square Tubing
2x2x0.120
Round Corners

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Source File
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TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction ≤ 5 inch +/- 1/64 > 5 inch +/- 1/32	Material: Al 6061-T6 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 DRAWN: T. Osmond APPROVED Quantity: 1	TITLE: Support with Attachment A3 — NUMBER: 009T07 — REV SCALE: 1 : 2 — DATE: 2006-Jan-25 — SHEET 1 OF 1

REVISIONS				
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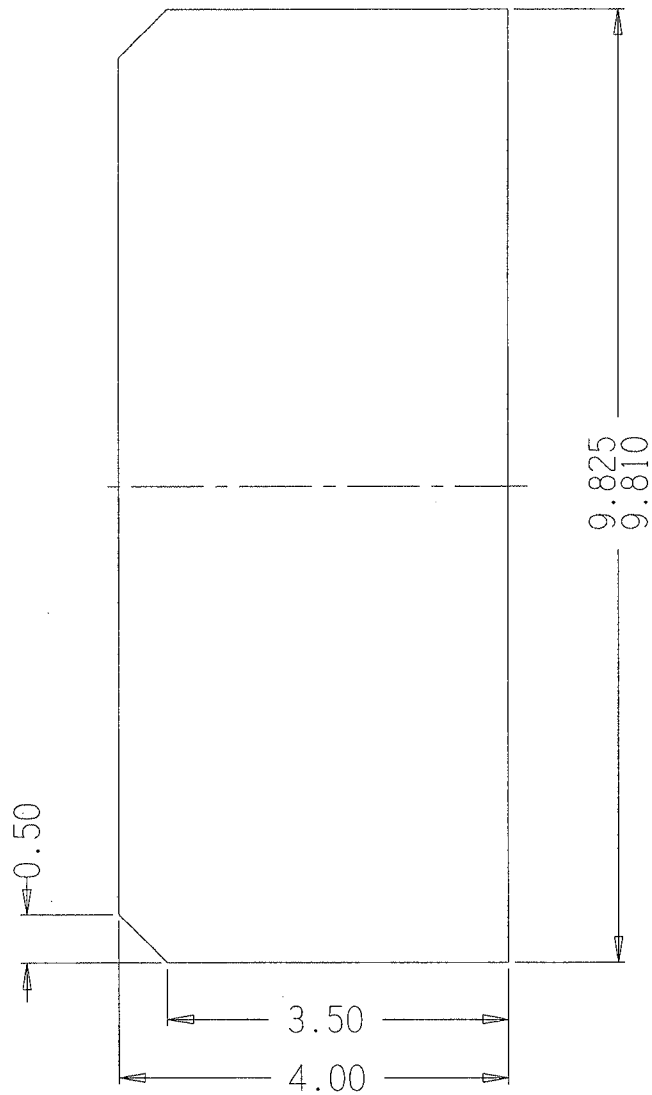

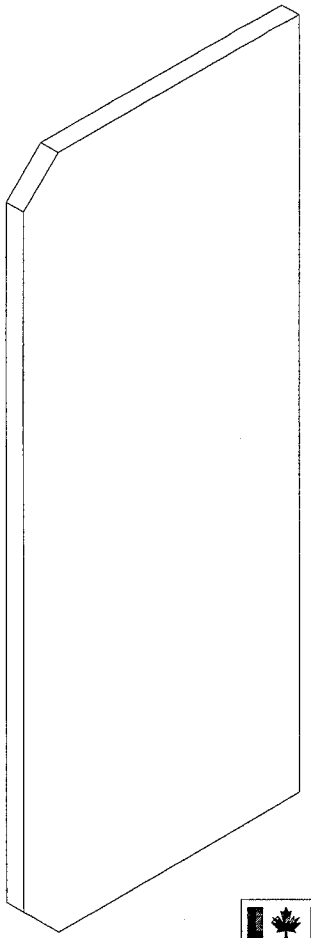

Notes:

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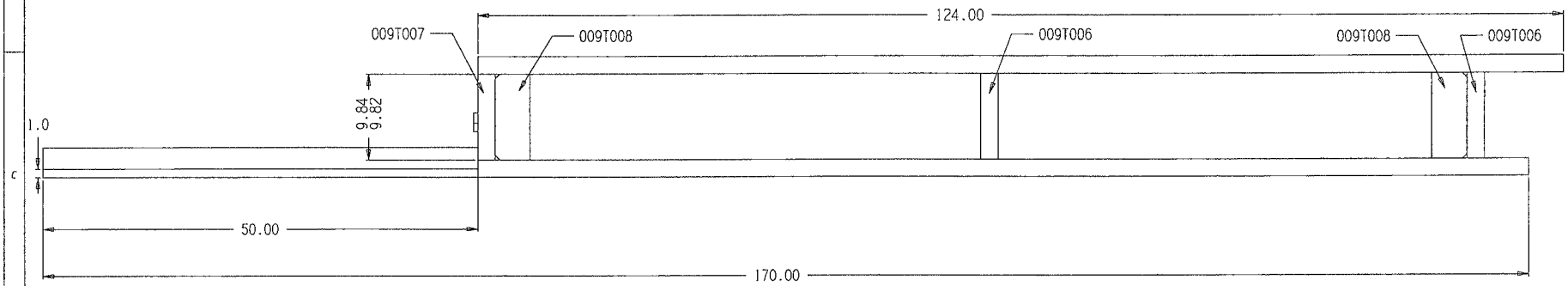
Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

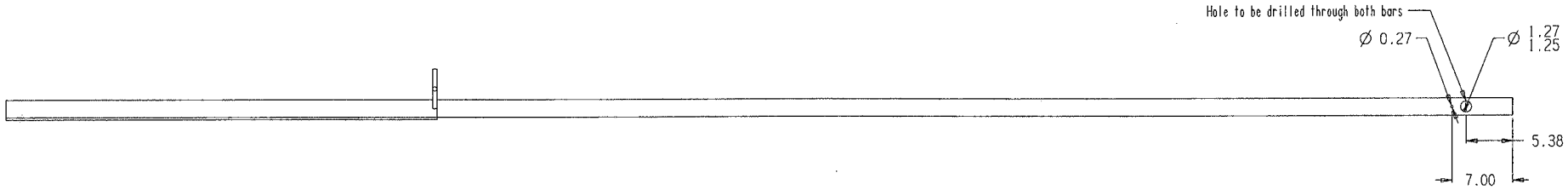
TOLERANCES (unless specified)	Material		
0.X ± 0.03	Al 6016-T6	TANK 009	TITLE Gusset
0.XX ± 0.015	0.25" thickness		
0.XXX ± 0.005	FINISH	DRAWN T. Osmond	
Angle +/- .5 deg.	DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐	APPROVED	A3 NUMBER 009T08 REV
Fabrication +/- .04	THIRD ANGLE	Quantity 2	SCALE 1 : 1.33 DATE 2006-Jan-25 SHEET 1 OF 1
Fraction < 6 inch +/- 1/64			
> 6 inch +/- 1/32			

Materials Needed:
1 x 170.0" length Al Square Tubing (Round Corners) - 2 x 2 x 0.188
1 x 124.0" length Al Square Tubing (Round Corners) - 2 x 2 x 0.188
1 x 50.0" length Al Flat Bar - 1/4 x 2.5

Notes:
Deburr - Remove All Sharp Edges

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED





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

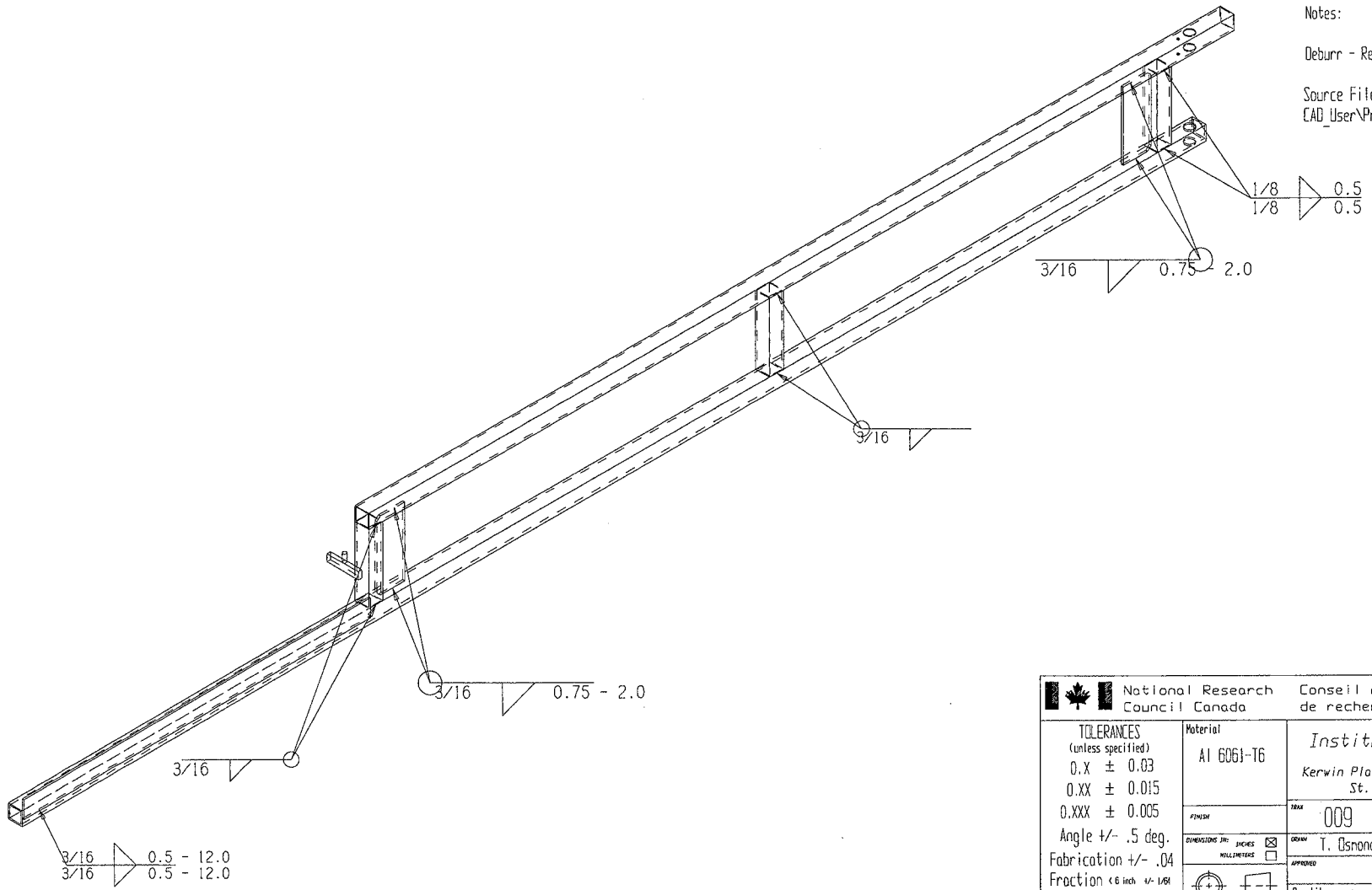
TOLERANCES (unless specified)
0.X ± 0.03
0.XX ± 0.015
0.XXX ± 0.005
Angle +/- .5 deg.
Fabrication +/- .04
Fraction ≤ 6 inch +/- 1/64
> 6 inch +/- 1/32

Material: Al 6016-T6
FINISH
DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐
THIRD ANGLE

TASK: 009
DRAWN: T. Osmond
APPROVED
Quantity: 1

TITLE: Probe Arm Gen Assembly 1
SIZE: A3
NUMBER: 009T09
REV
SCALE: 1 : 12.5
DATE: 2006-Jan-25
SHEET 1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED



Notes:

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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 6061-T6 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: 009 DRAWN: T. Osmond APPROVED Quantity: 1 TITLE: Probe Arm Gen Assembly 2 SIZE: A3 NUMBER: 009T10 REV SCALE: 1 : 12.5 DATE: 2006-Jan-25 SHEET 1 OF 1

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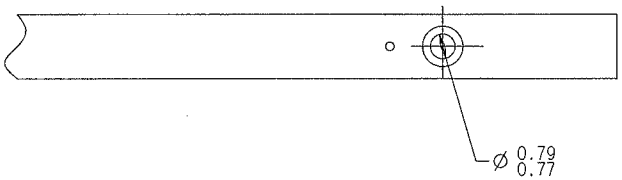
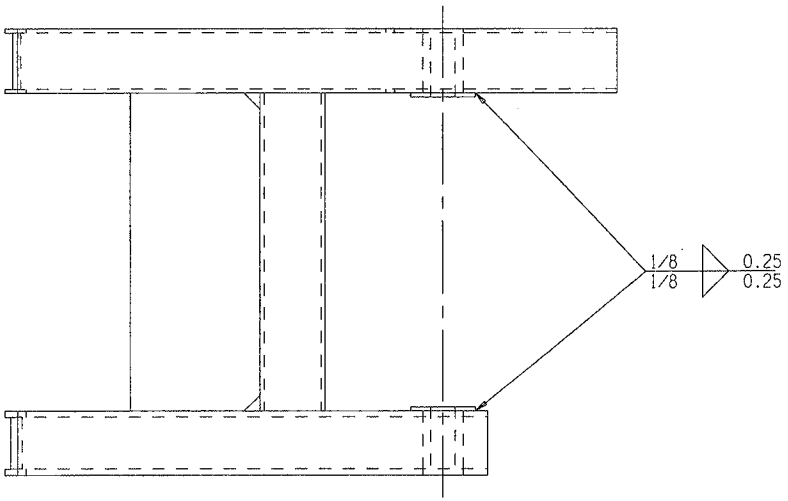
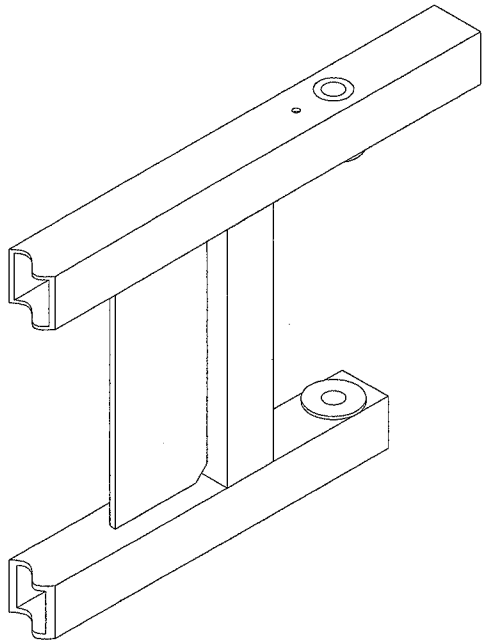
NO.	ZONE	DESCRIPTION	DATE	APPROVED







Notes:

Deburr - Renove All Sharp Edges

Weld bushings in place using minimal weld

Rebore holes in both bushings to be cooxial

Source File
CAD_User\Projects\421009_cwt\ProbeArm\009T11

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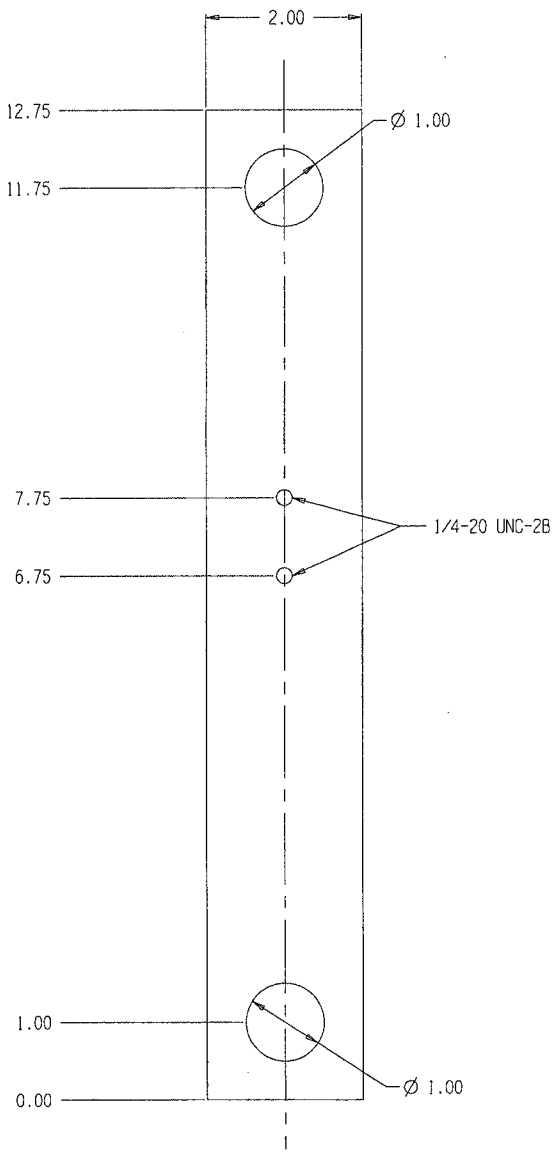
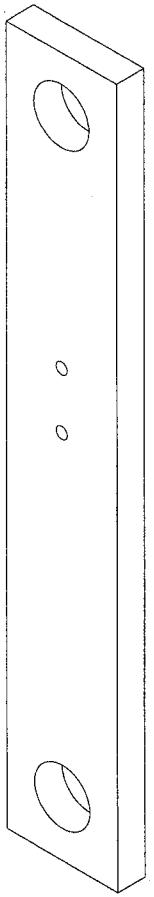
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32	Material: Al 6061-T6 FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 DRAW: T. Osmond APPROVED Quantity	TITLE: Probe Arm Gen Assembly 3 SIZE: A3 NUMBER: 009T11 REV SCALE: 1 : 12.5 DATE: 2006-Jan-25 SHEET 1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED





Notes:

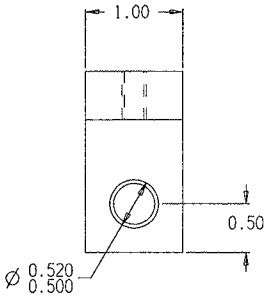
Deburr - Renove All Sharp Edges

Source File
CAD_User\Projects\421009_cwt\ProbeArm\009T12

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 SS 1/2" thickness 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 DRAWN 009 DRAWN T. Osmond APPROVED Quantity 1	TITLE Support Plate SIZE A3 NUMBER 009T12 REV SCALE 1 : 2 DATE 2006-Jan-25 SHEET 1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED



Notes:

Deburr - Renove All Sharp Edges

Source File
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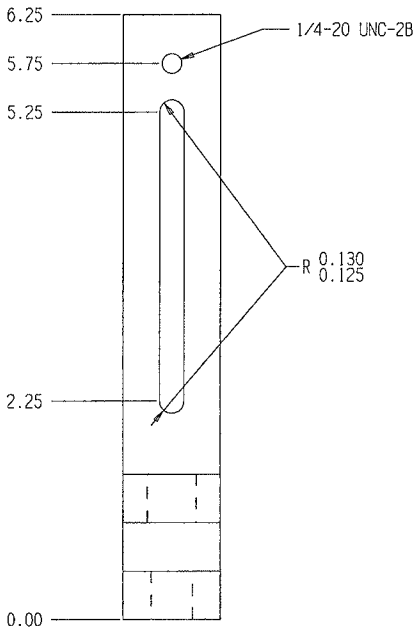

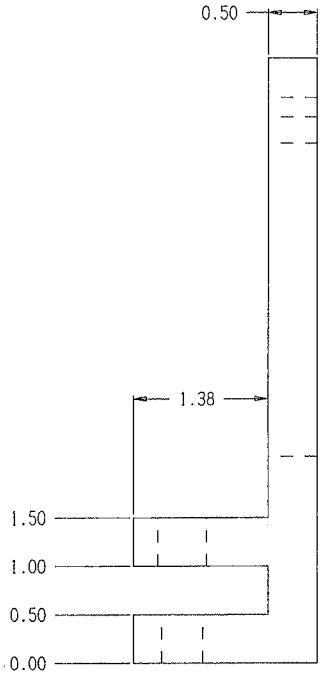

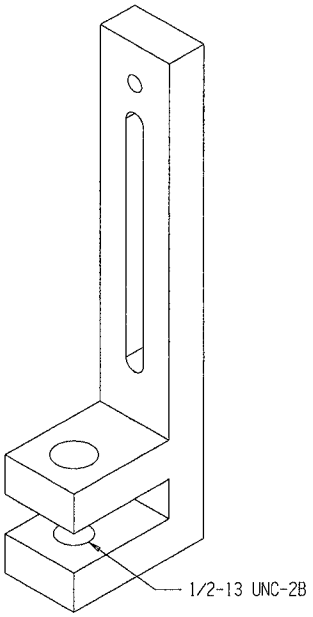

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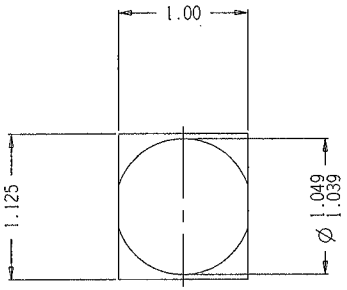
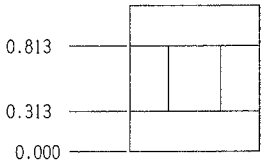
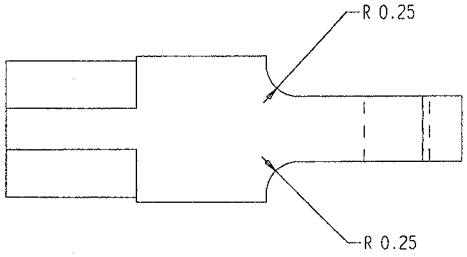
Institute for Marine Dynamics
Kerwin Place, P.O. Box 12093, Postal Station A
St. John's, Newfoundland A1B 3T5

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	SS
FINISH	
DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐	
THIRD ANGLE	
TASK	009
DRAWN	T. Osmond
APPROVED	
Quantity	1
TITLE	Slide Joint
SIZE	A3
NUMBER	009T13
REV	
SCALE	1 : 1.33
DATE	2006-Jan-25
SHEET	1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED



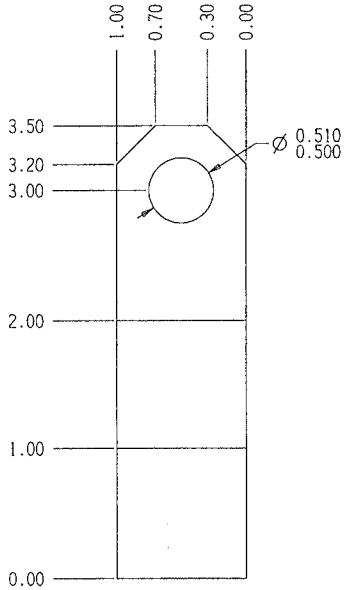


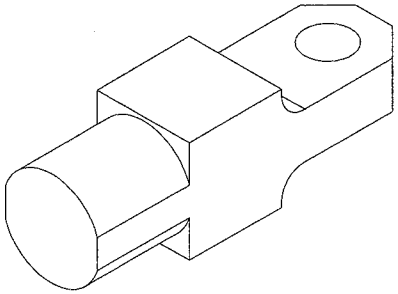


Notes:

Deburr - Renove All Sharp Edges

Source File
CAD_User\Projects\421009_cwt\ProbeArm\009T14





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

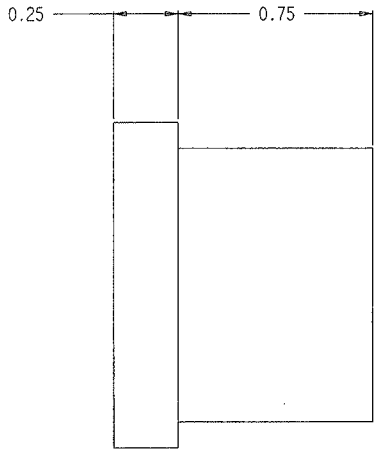
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32	Material: Al 6061-T6 FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 DRAW: 009 DRAWN: T. Osmond APPROVED Quantity: 1	TITLE: Insert Joint SIZE: A3 NUMBER: 009T14 REV SCALE: 1 : 1 DATE: 2006-Jan-25 SHEET 1 OF 1

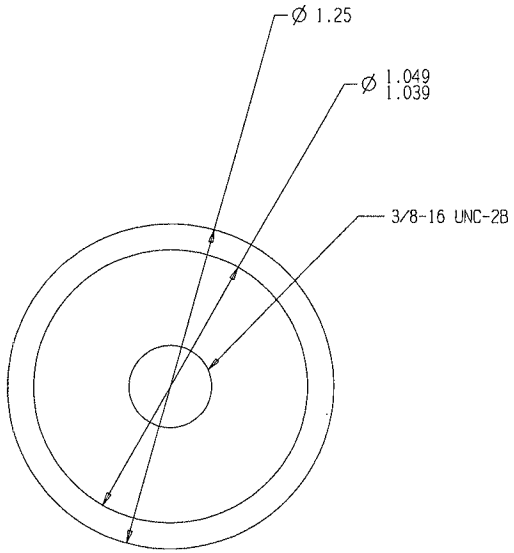
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

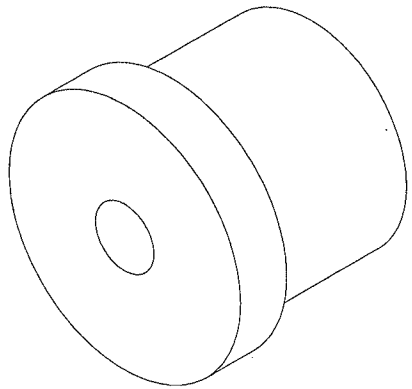
Notes:

Deburr - Renove All Sharp Edges

Source File
CAD_User\Projects\421009_cwt\ProbeArm\009T15







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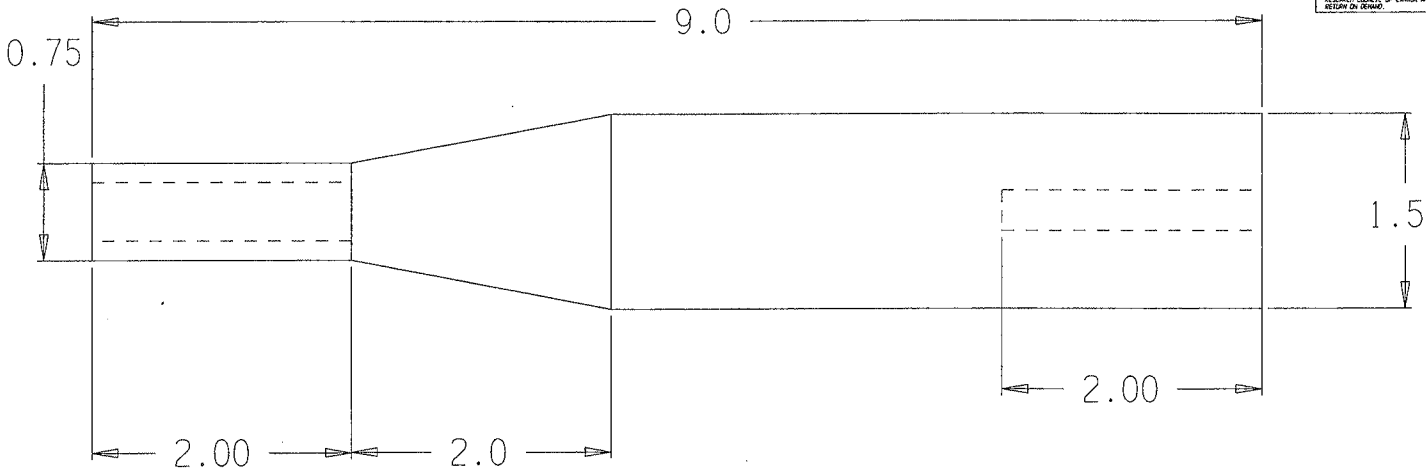
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32	Material: Al 6061-T6 FINISH DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐ THIRD ANGLE	Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5 YEAR: 009 DRAWN: T. Osmond APPROVED Quantity: 1 TITLE: Bushing 2 SIZE: A3 NUMBER: 009T15 REV SCALE: 2 : 1 DATE: 2006-Jan-25 SHEET 1 OF 1

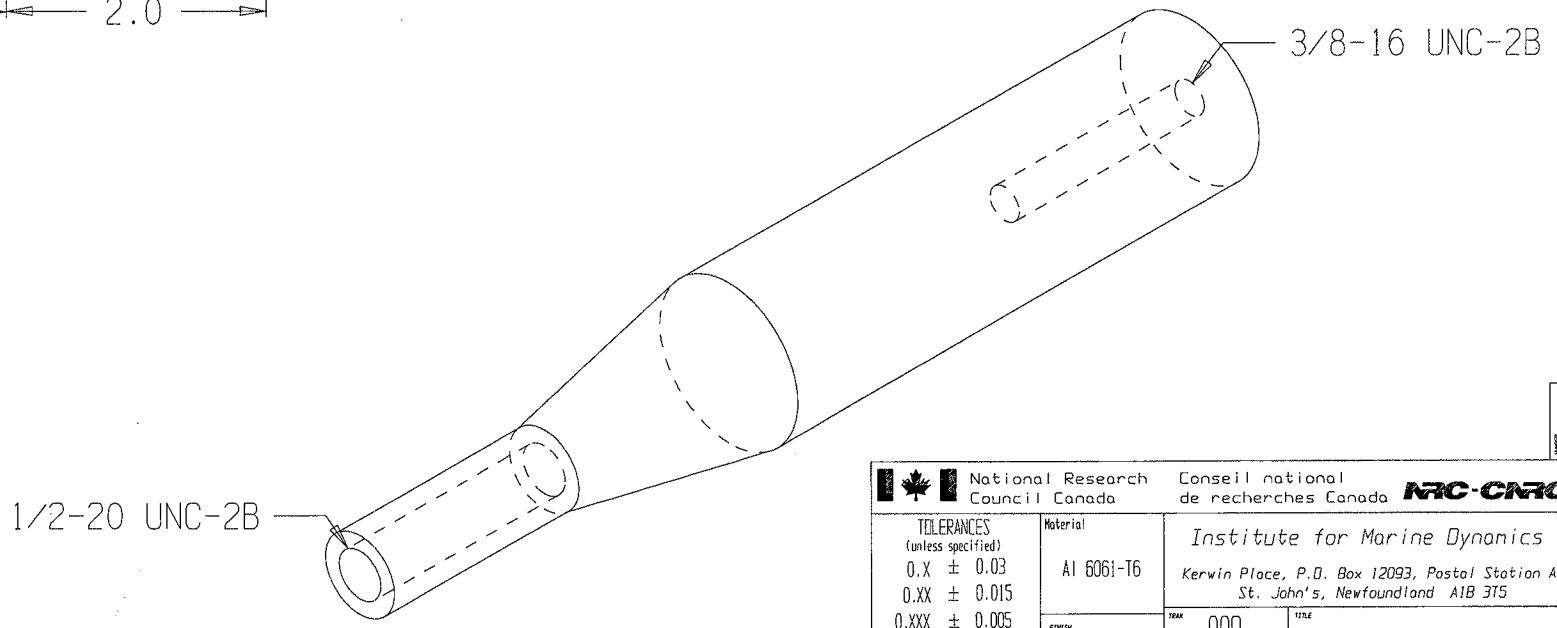
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED



Notes:

Deburr - Remove All Sharp Edges

Source File
CAD_User\Projects\421009_cwt\ProbeArm\009T16



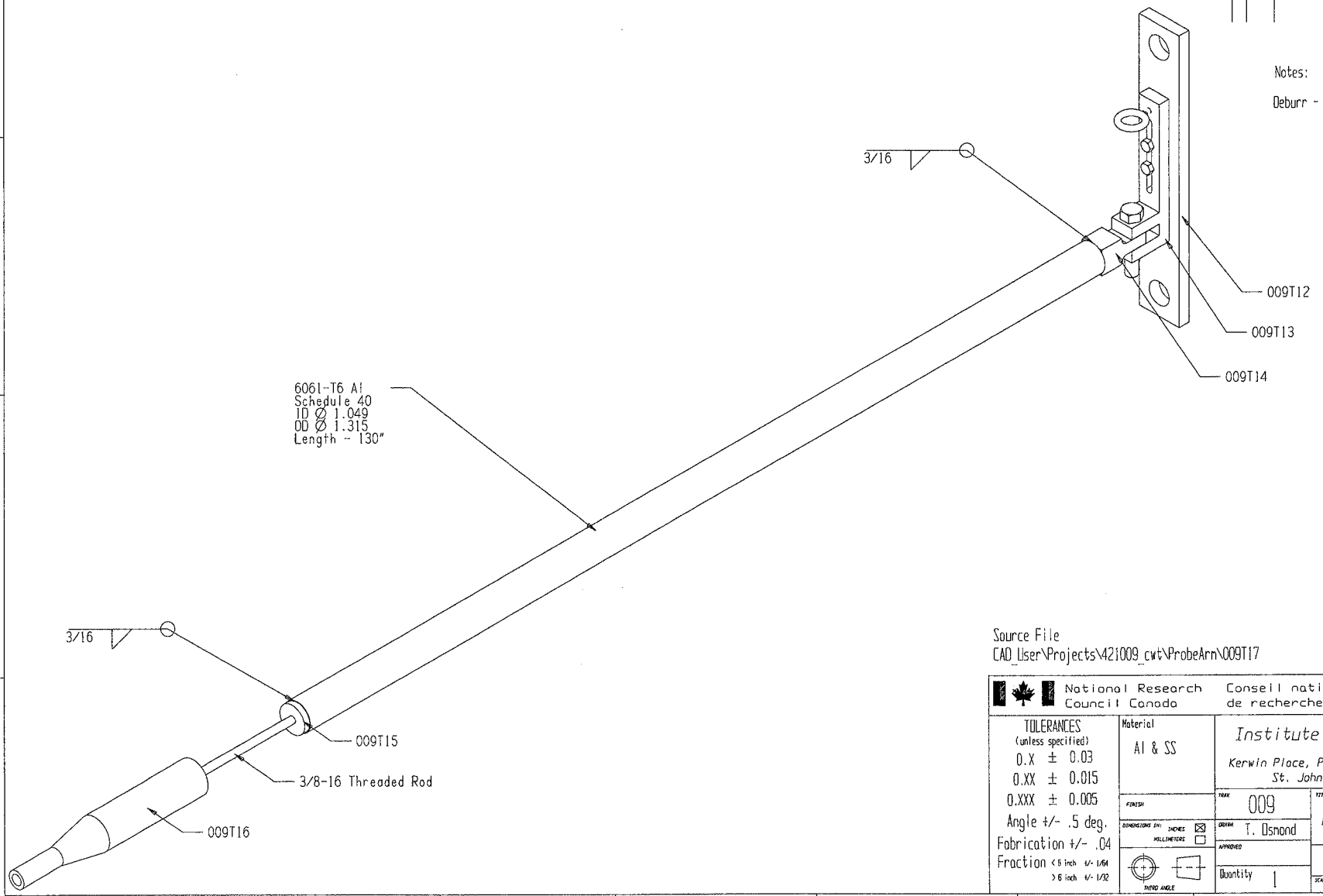
National Research Council Canada / Conseil national de recherches Canada — NRC·CNRC

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 6061-T6 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 DRAW: 009 DRAWN: T. Osmond APPROVED Quantity: 1	TITLE: Bottle Screw A3 | NUMBER: 009T16 | REV SCALE: 1 : 1 | DATE: 2006-Jan-25 | 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 & SS 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 MARK 009 DRAWN T. Osmond APPROVED Quantity 1
TITLE: Additional Support Assembly A3 NUMBER 009T17 REV SCALE NTS DATE 2005-Jan-25 SHEET 1 OF 1		

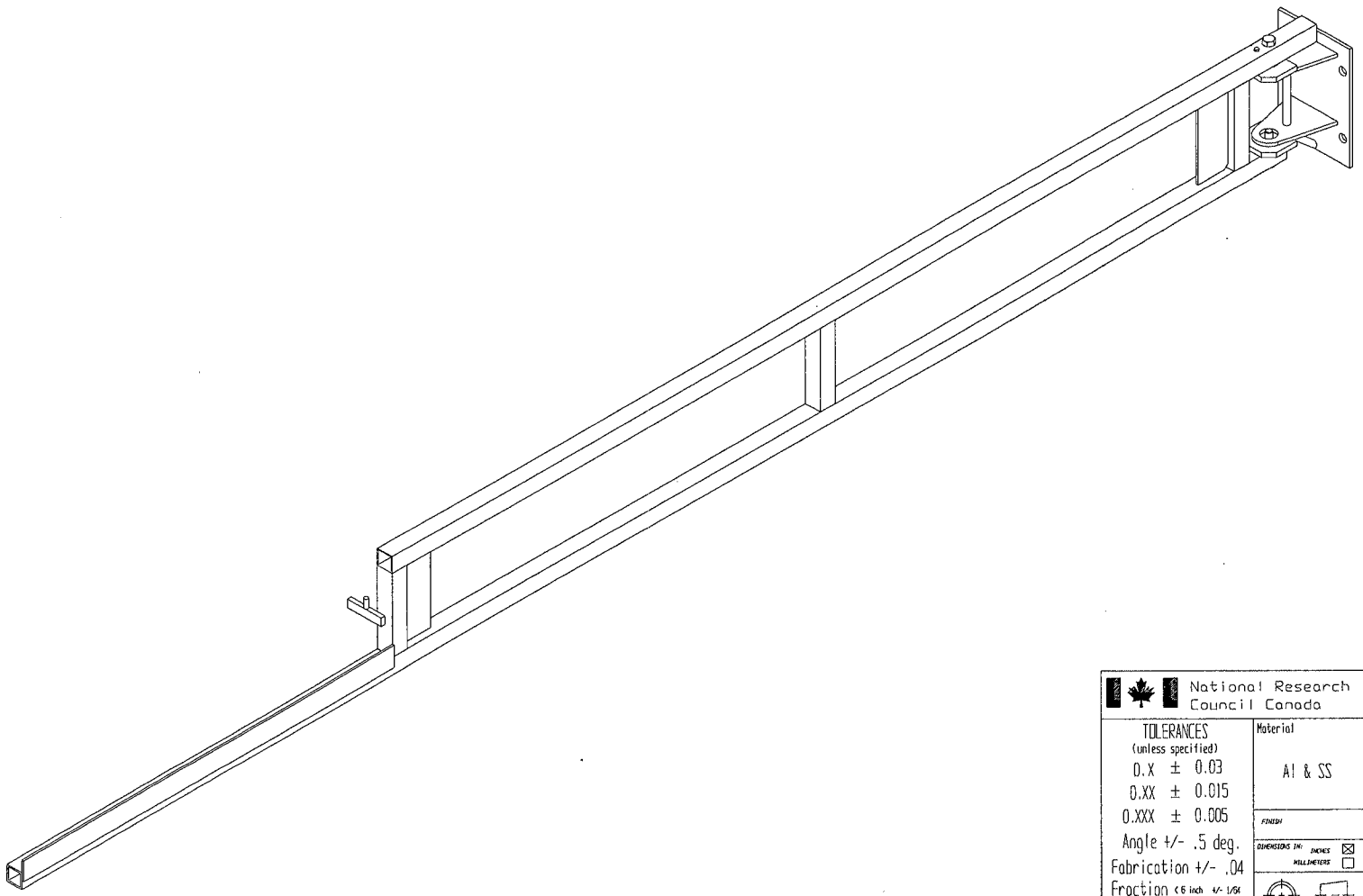
REVISIONS

NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Deburr - Remove All Sharp Edges

Source File
CAD_User\Projects\421009_cwt\ProbeArm\009T18



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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 & SS

FINISH:

DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐

THIRD ANGLE

TRAK: 009

DRAWN: T. Osmond

APPROVED:

Quantity: 1

TITLE: Full Assembly

SIZE: A3

NUMBER: 009T18

REV:

SCALE: NTS

DATE: 2005-Jun-25

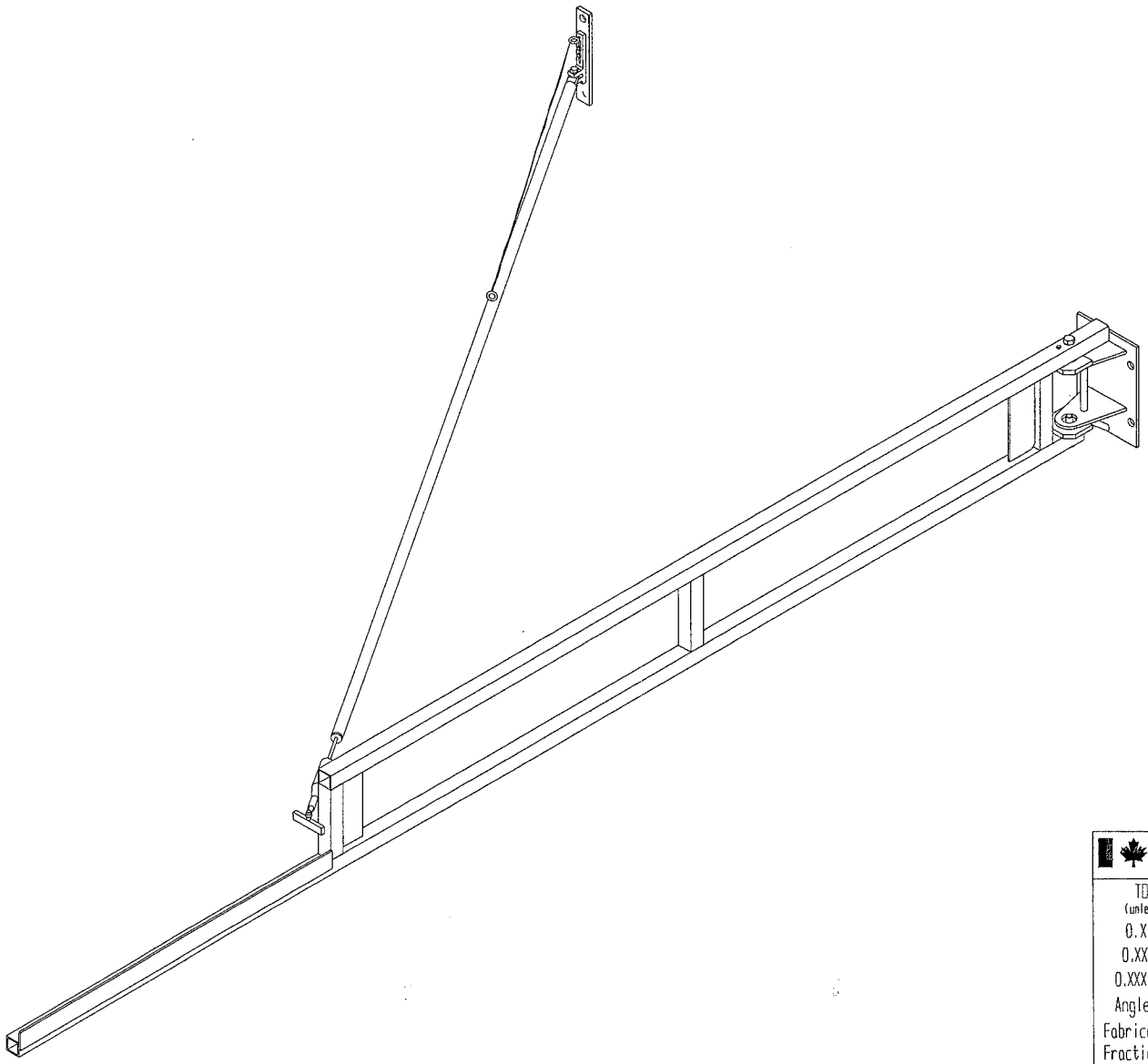
SHEET 1 OF 1

REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED

Notes:

Deburr - Renove All Sharp Edges

Source File
CAD_User\Projects\421009_cwt\ProbeArm\009T19



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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 & SS

FINISH

DIMENSIONS IN: INCHES ☒ MILLIMETERS ☐

THIRD ANGLE

TOOL	009
DRAWN	T. Osmond
APPROVED	
Quantity	1

TITLE: Full Assembly with Support

A3	NUMBER 009T19	REV
SCALE NTS	DATE 2005-Jan-25	SHEET 1 OF 1