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DOCUMENTATION PAGE

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SUMMARY				
<p>In this Report a description of the new Drag Calibration post for the Towing Tank. Brief description of why it was needed, Design criteria and Fabrication Drawings.</p>				
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				



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NEW DRAG CALIBRATION POST FOR THE TOWING TANK

LM-2005-04

Trent Slade

April 2005

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Design

Calibrating has become an increasingly important part of the verification process at IOT especially in force measuring devices such as dynamometers. Calibration allows for the verification and correction factors to compensate for the constraints in the design, fabrication, and assembly process. The calibration post will enable the facilities technicians to not only calibrate sensors quickly and easily, but also allow them to perform more basic checks such as sign convention and sensor operation.

There is an existing drag post that has been in use for many years. It allows weight up to 100kg to be loaded. Because there is no means of adjusting the alignment under full load, the drag post must be aligned with a small weight of 20kg. This weight is placed on the weight pan and a line level put on the wire rope. There is a slot with bolts, which is used to tighten the pulley when the height is correct, because the bolts are just snug the wire rope is raised or lowered by the use of a 20kg weight as a hammer. With the post now aligned with the 20kg preload, the other 60-70kg are added and thus the alignment changes. This now becomes an iterative process.

Needed is a post that could be fully loaded and aligned vertically and horizontally without the use of a 20kg weight. This adjustment had to be accurate and enable a locking mechanism. A design concept of THK 35 Linear rails and cars, and a $\frac{3}{4}$ -6 Acme lead screw for the vertical axis, and 1/2-13 Threaded rod for the horizontal axis.

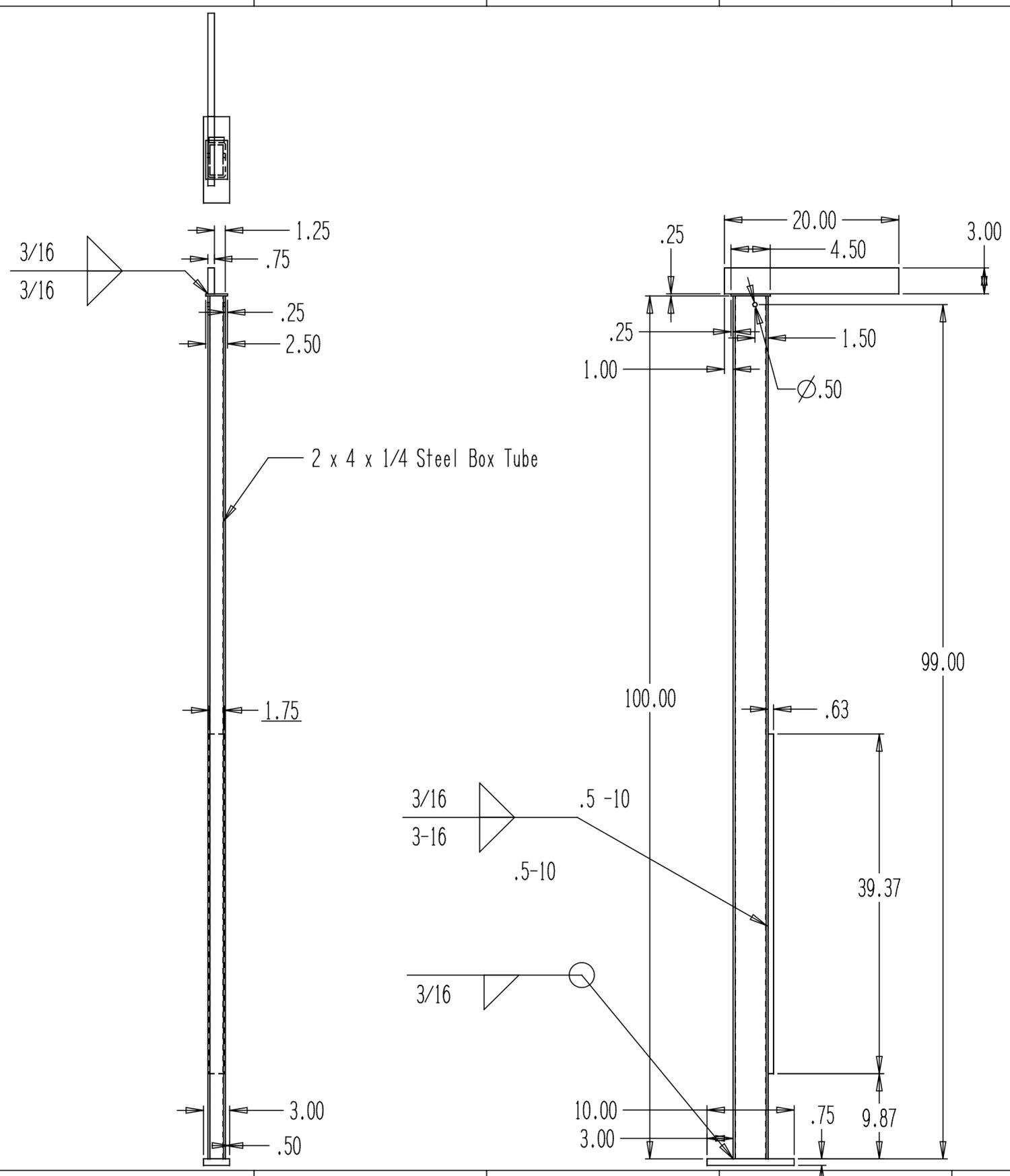
The height had to be adjustable from 14" (355mm) to 37.5" (952mm) above the water. For those applications that require the post to be submerged a 25" (635mm) extension was designed and fabricated. The horizontal adjustment was to be ± 4.25 " (108mm).

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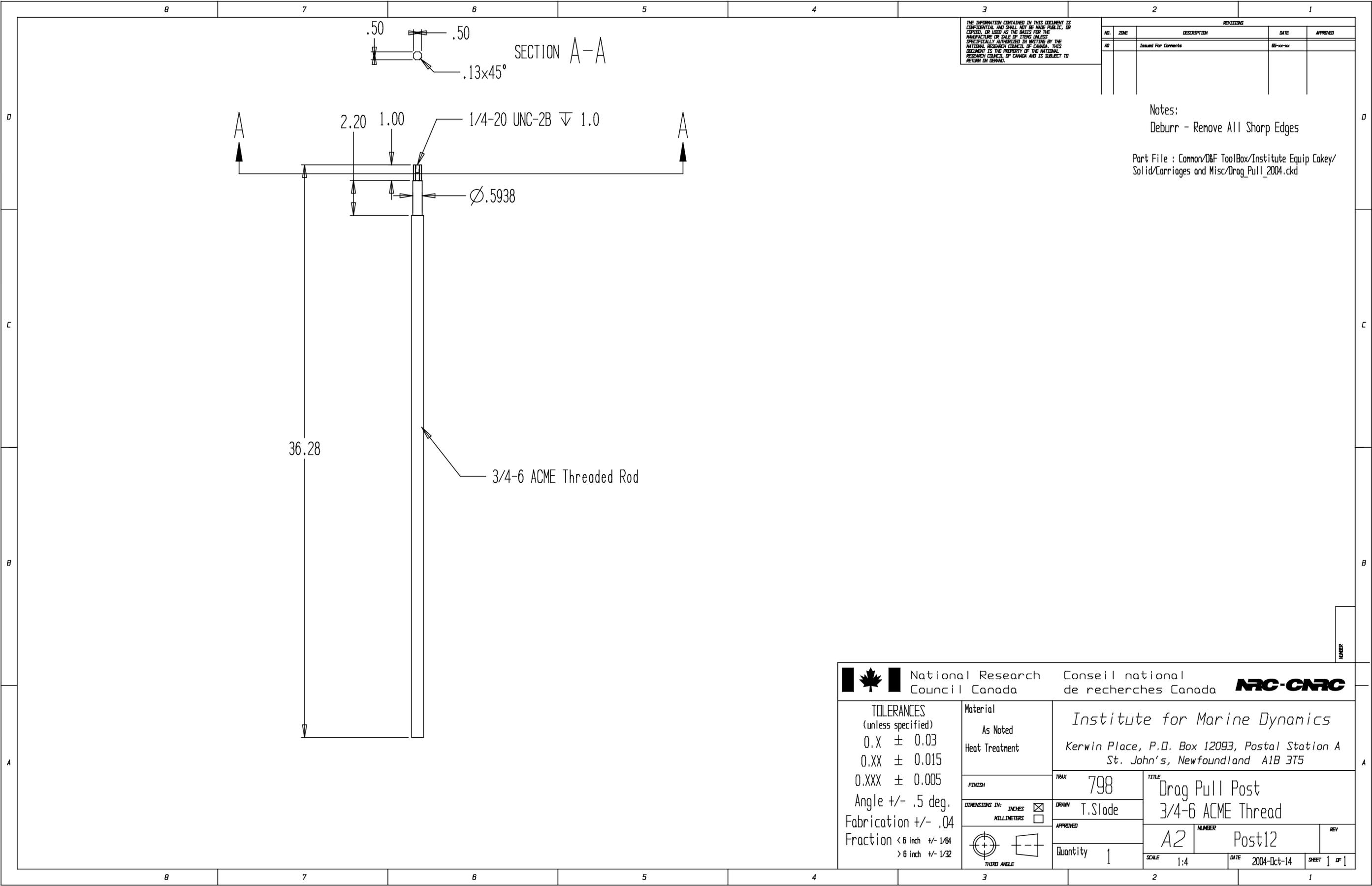
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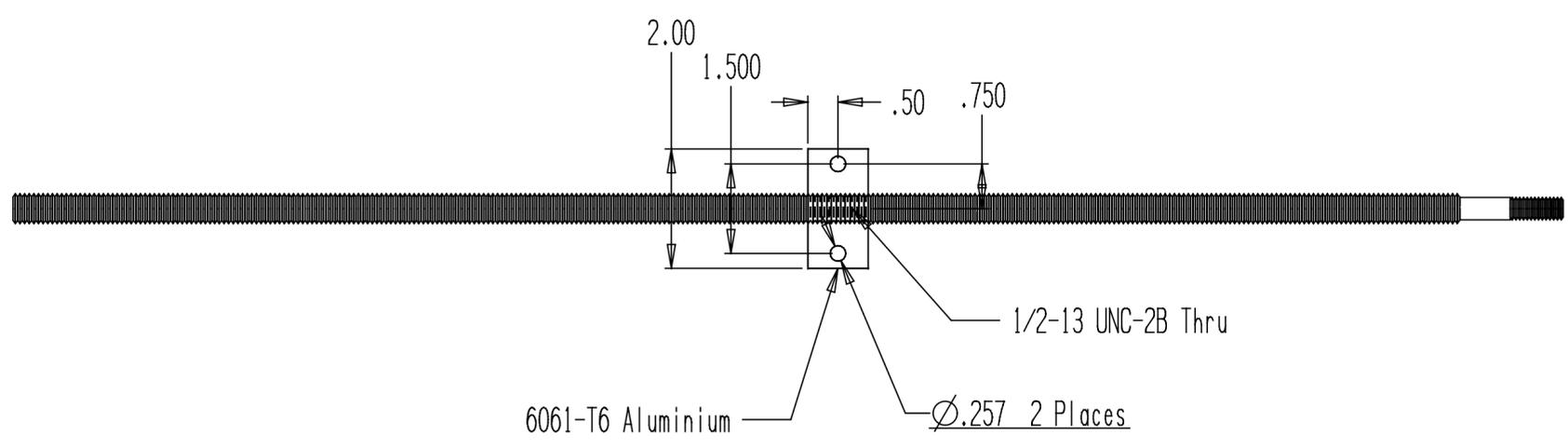
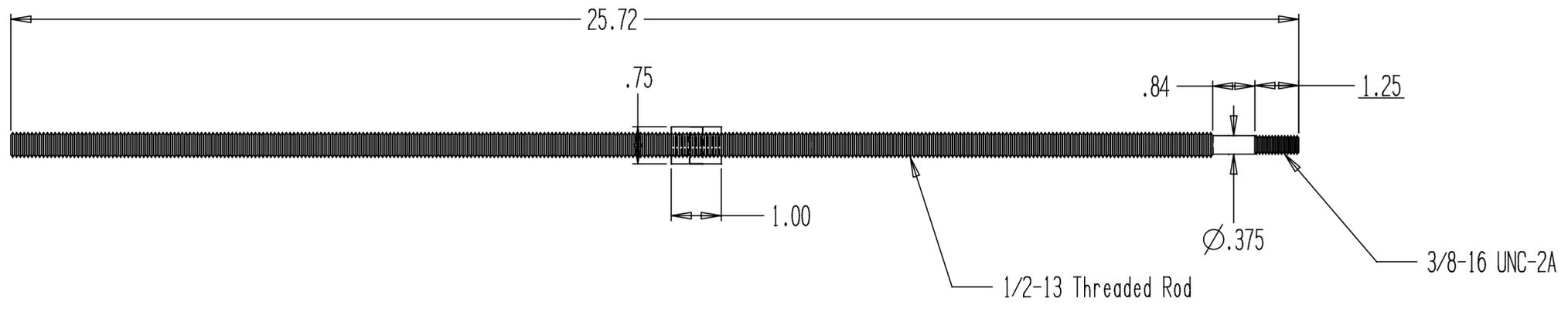
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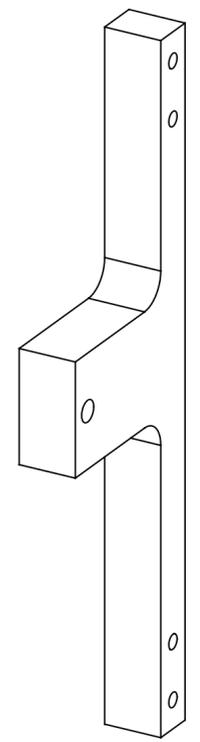
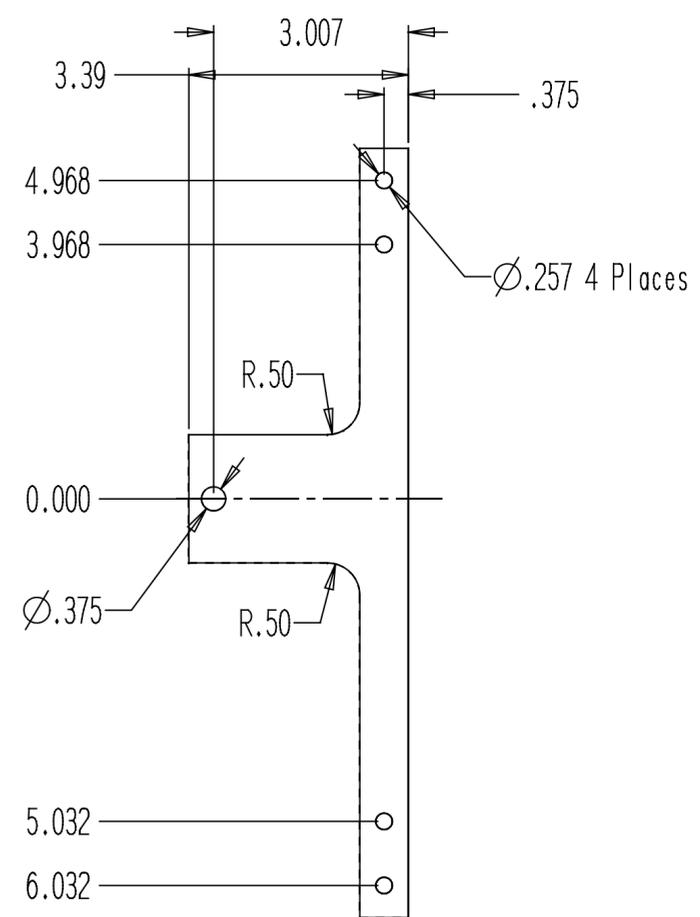
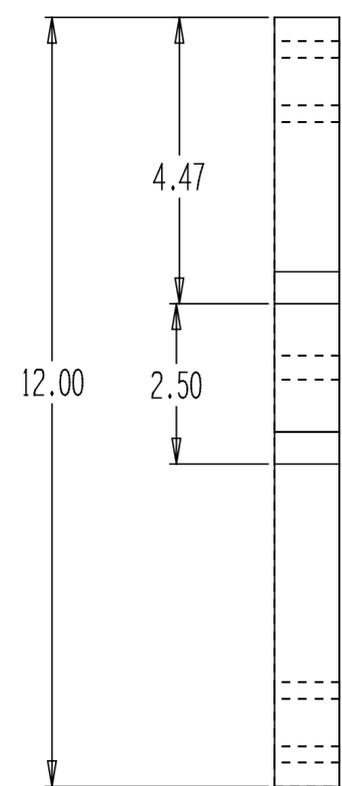
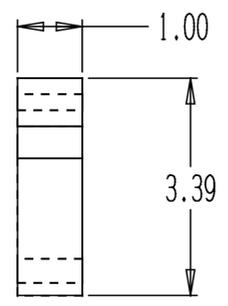
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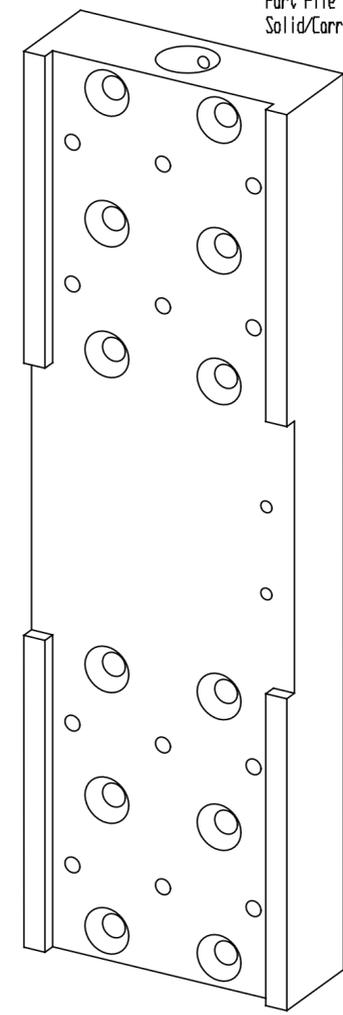
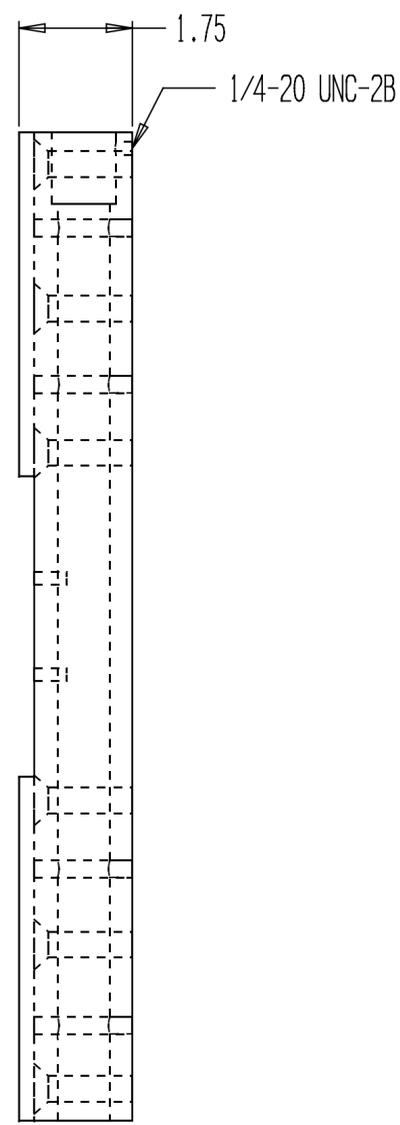
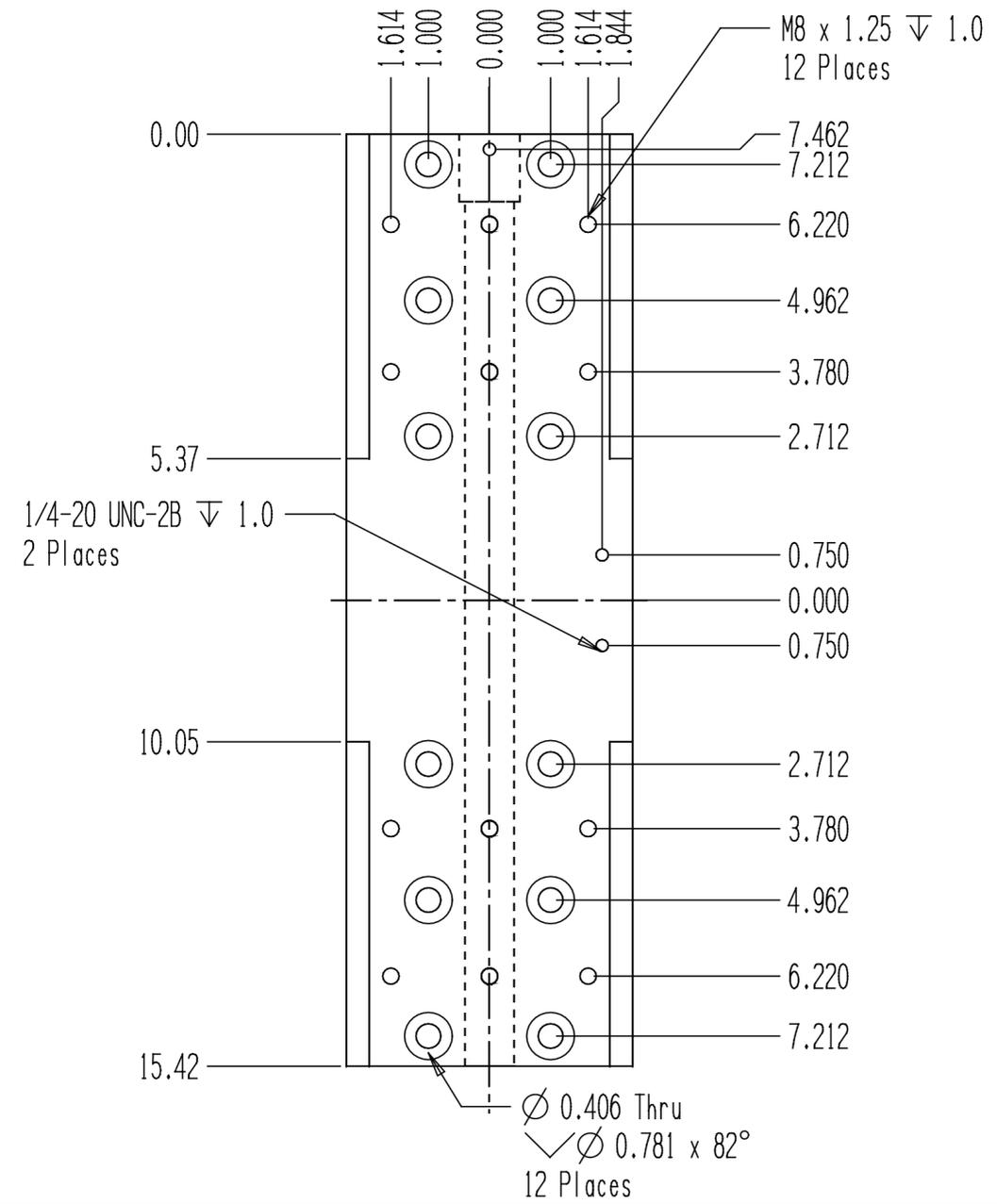
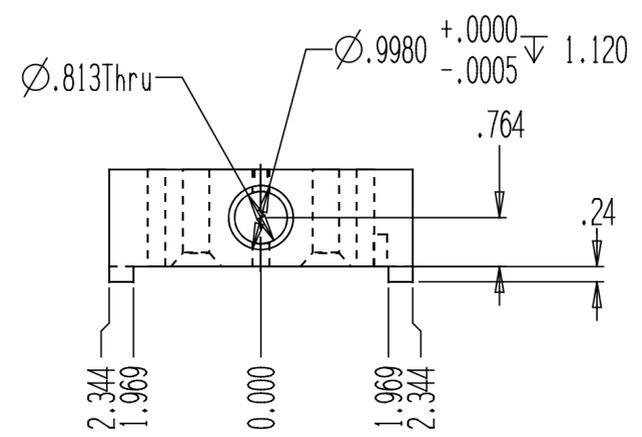
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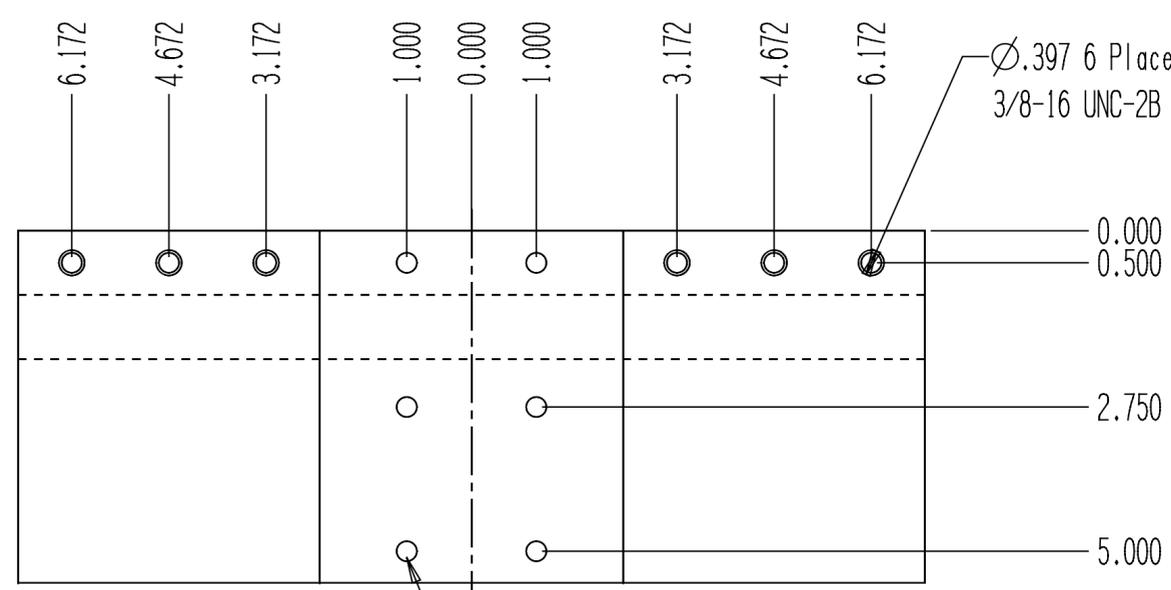
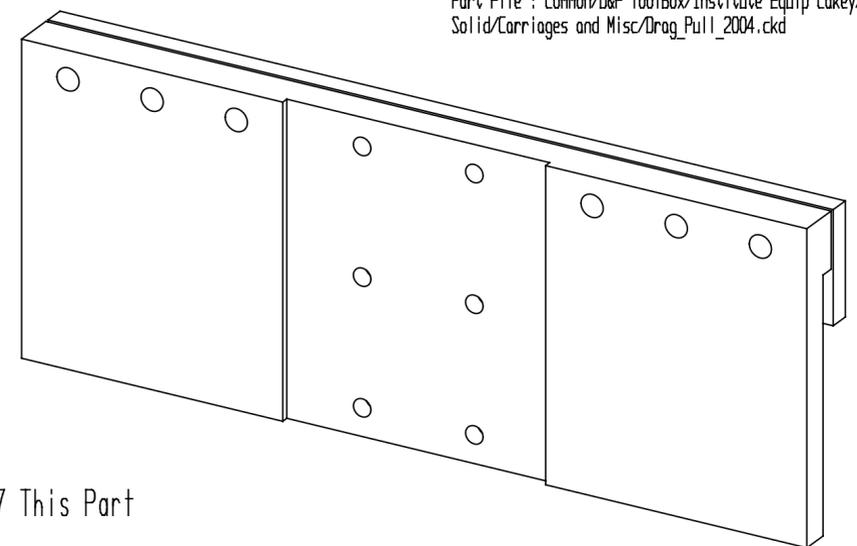
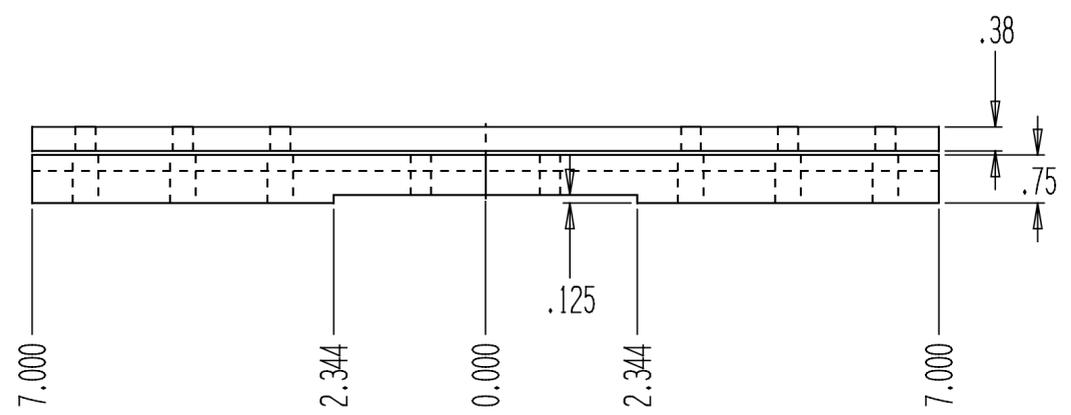
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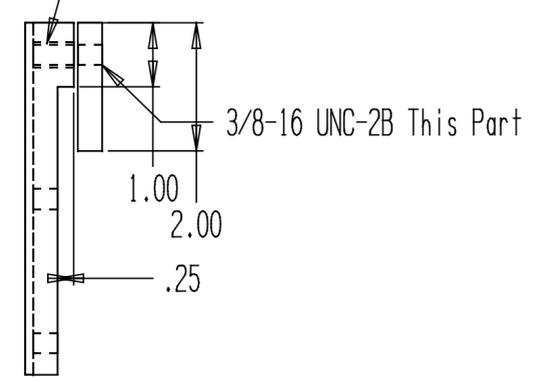
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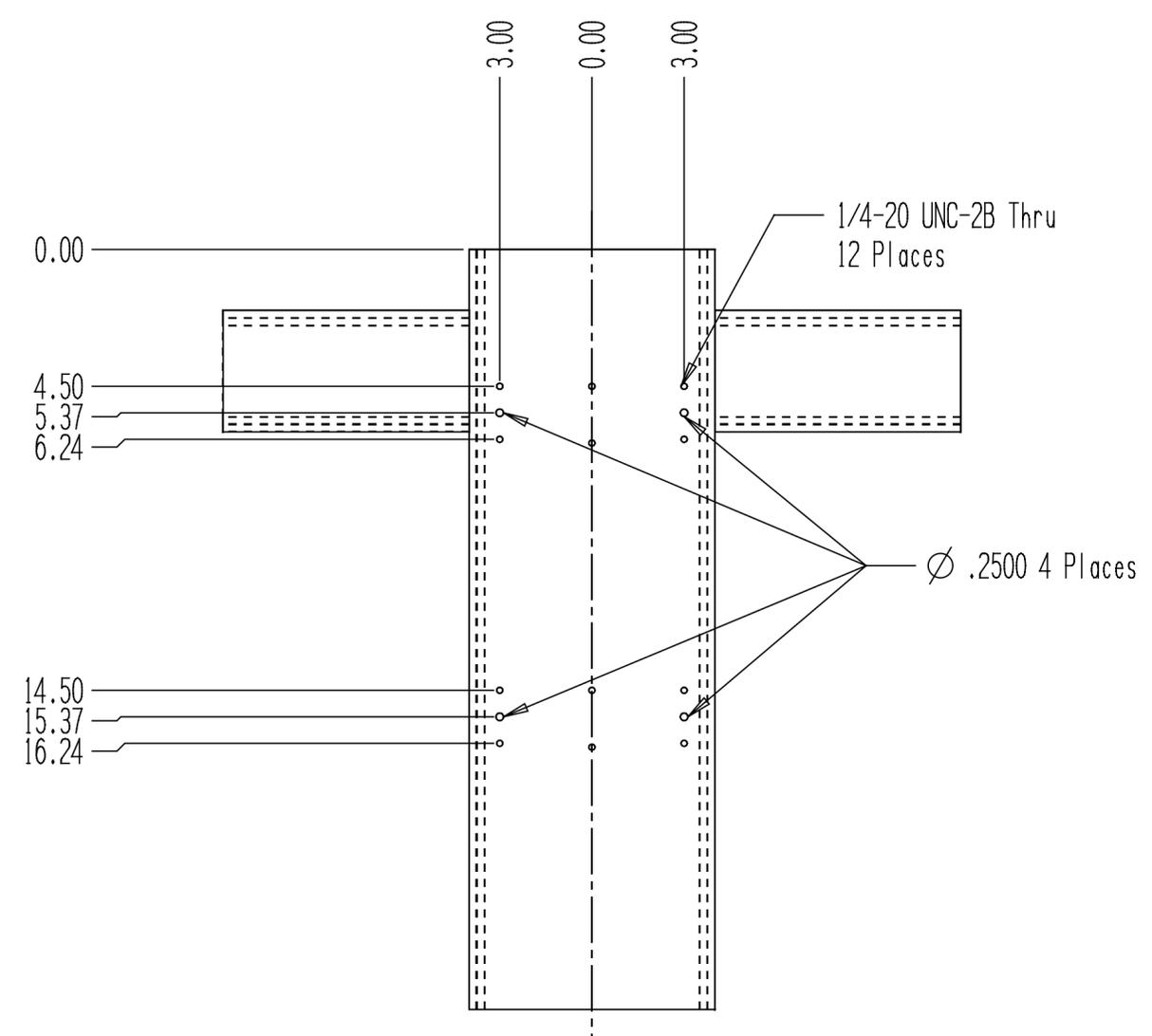
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6 Places

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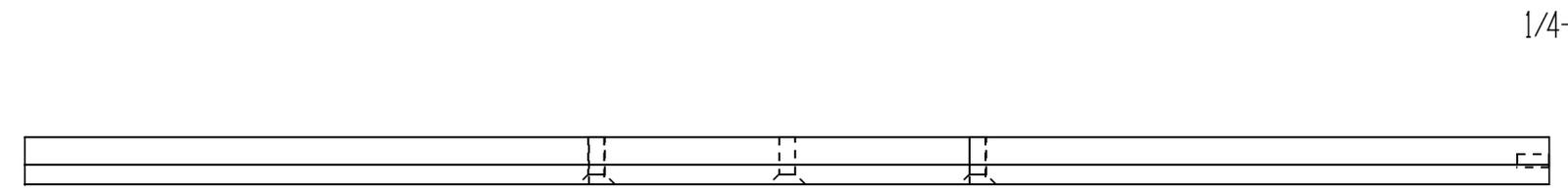
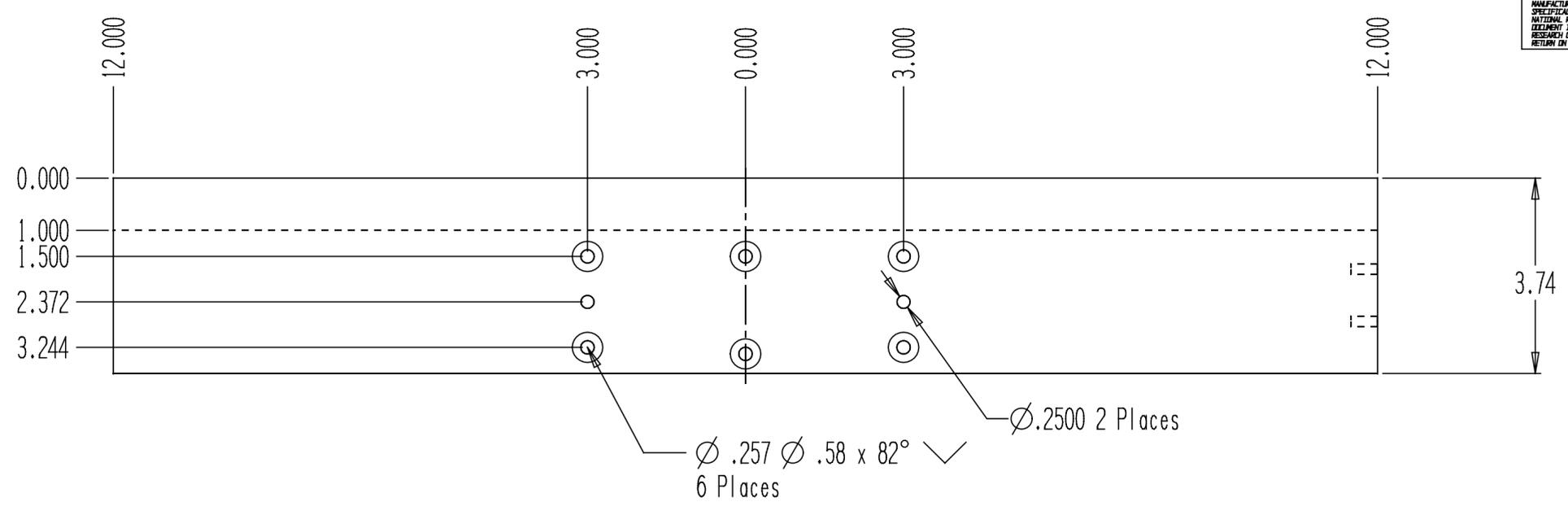
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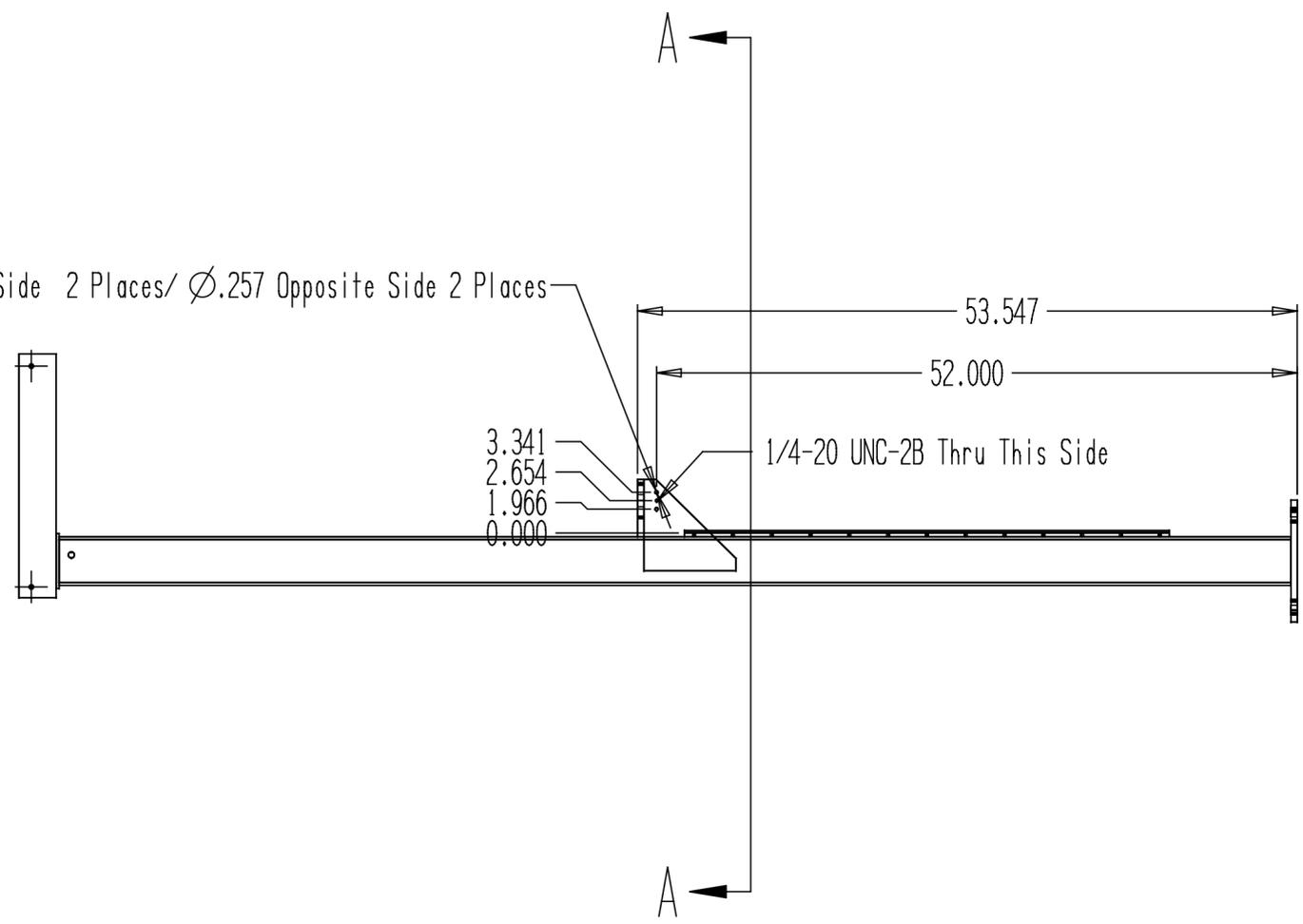
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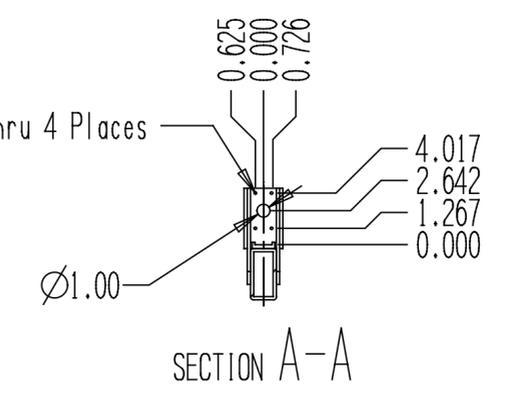
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Ø.2500 This Side 2 Places / Ø.257 Opposite Side 2 Places



1/4-20 UNC-2B Thru 4 Places



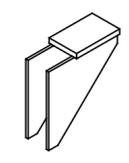
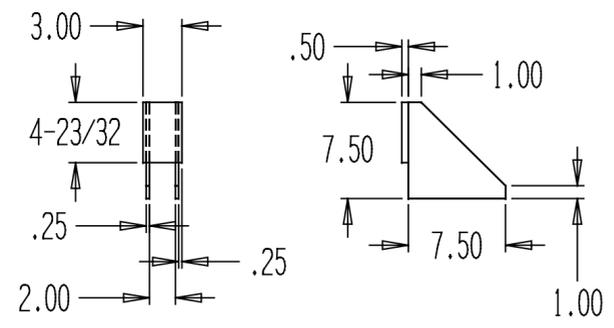
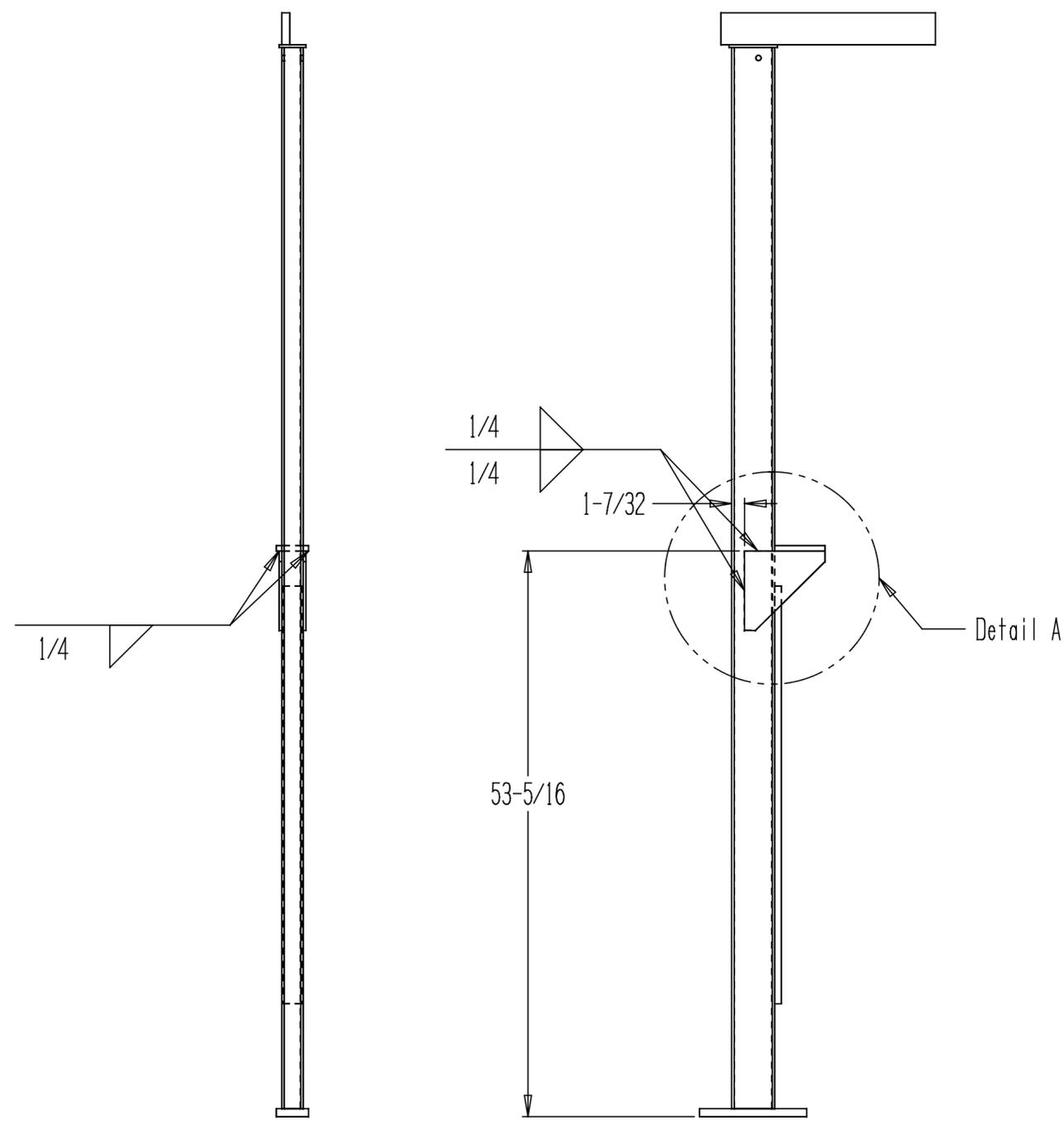
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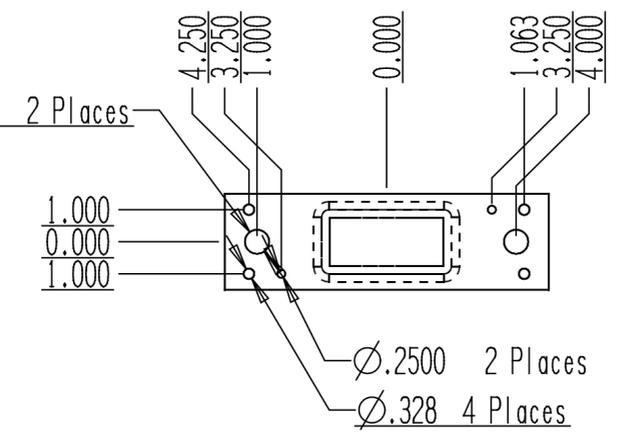
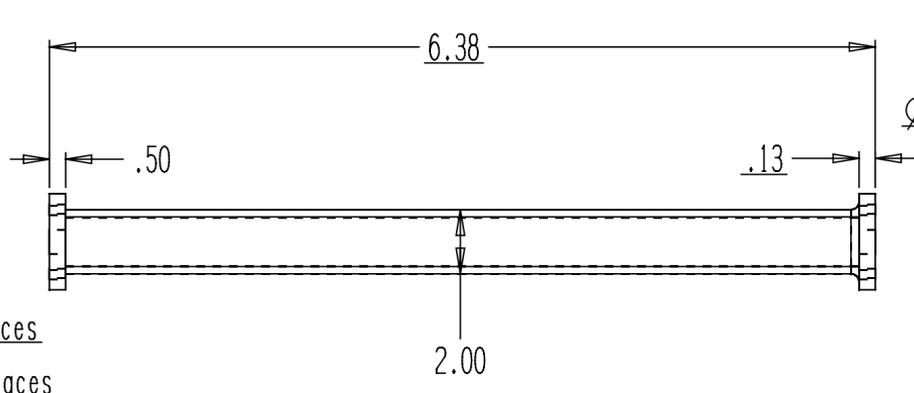
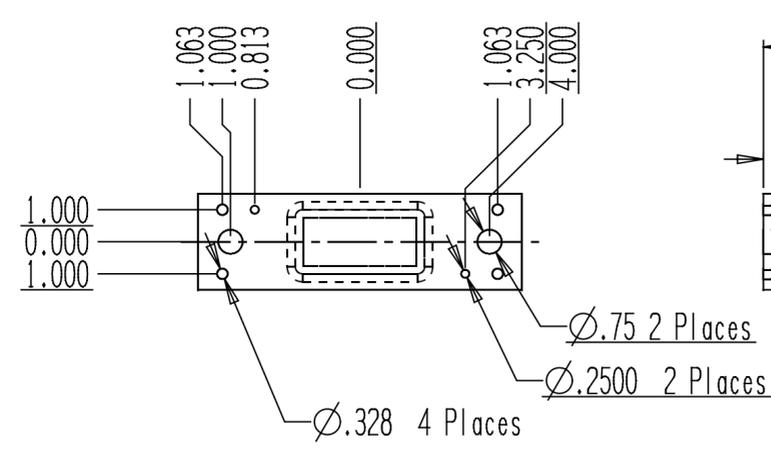
National Research Council Canada Conseil national de recherches Canada		Institute for Marine Dynamics Kerwin Place, P.O. Box 12093, Postal Station A St. John's, Newfoundland A1B 3T5	
TOLERANCES (unless specified) 0.X ± 0.03 0.XX ± 0.015 0.XXX ± 0.005 Angle +/- .5 deg. Fabrication +/- .04 Fraction < 6 inch +/- 1/64 > 6 inch +/- 1/32		Material Steel Heat Treatment	TRAX 798 TITLE Drag Pull Post Post Fabrication Part 2
DIMENSIONS IN: <input checked="" type="checkbox"/> INCHES <input type="checkbox"/> MILLIMETERS		FINISH	DRAWN T.Slade
<input checked="" type="checkbox"/> THIRD ANGLE <input type="checkbox"/> FIRST ANGLE		APPROVED	NUMBER A2 Post03
		Quantity 1	SCALE 1:10 DATE 2004-Oct-13 SHEET 1 OF 1

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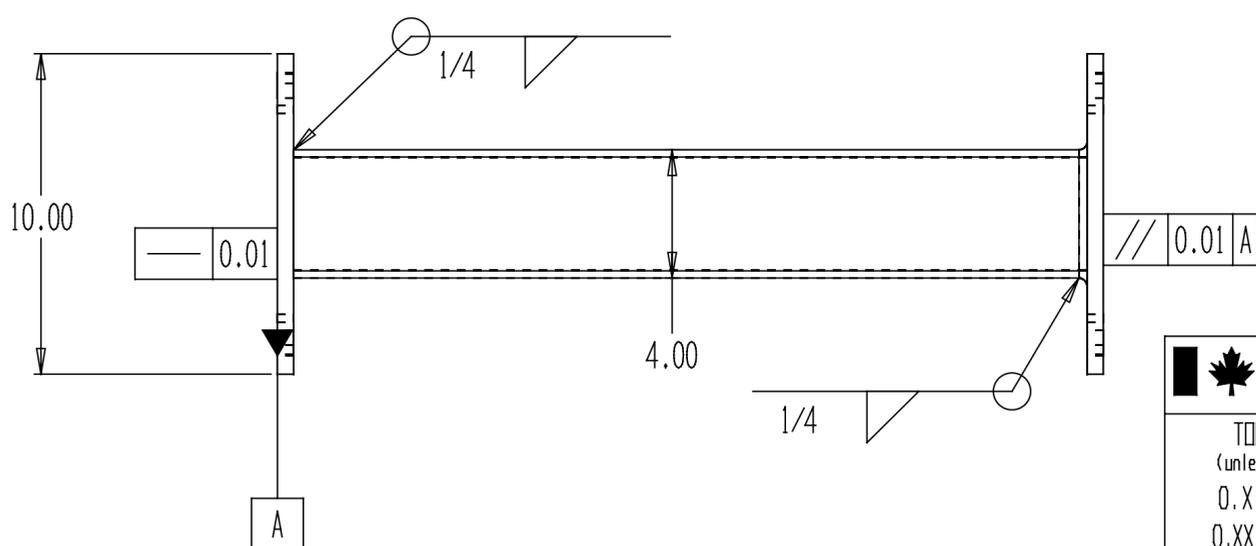
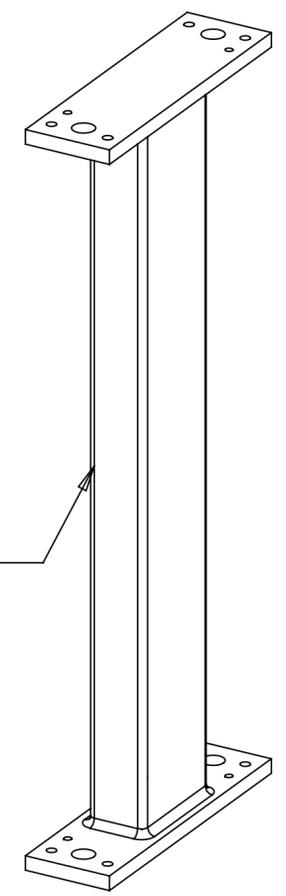
REVISIONS				
NO.	ZONE	DESCRIPTION	DATE	APPROVED
AD		Issued For Comments	05-04-04	

Notes:
Deburr - Remove All Sharp Edges

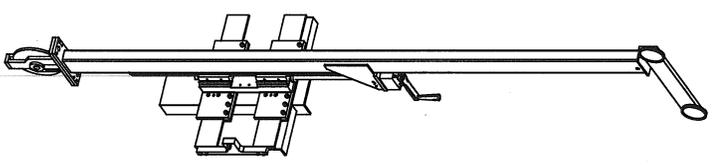
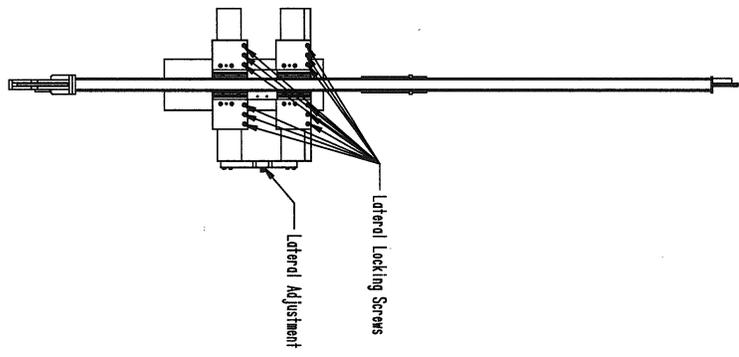
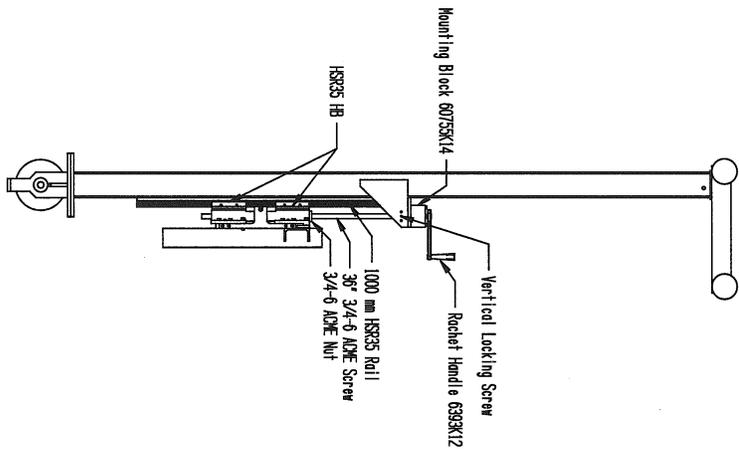
Part File : Canon/D&F ToolBox/Institute Equip Cokey/Solid/Carriages and Misc/Drag Pull_2004.ckd



2 x 4 x 1/4 Steel Box Tube



National Research Council Canada Conseil national de recherches Canada		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 As Noted Heat Treatment	TITLE Drag Pull Post Extension Post
DIMENSIONS IN: INCHES <input checked="" type="checkbox"/> MILLIMETERS <input type="checkbox"/>		TRAX 798	NUMBER Post13
FINISH		DRAWN T.Slade	REV
THIRD ANGLE		APPROVED	SCALE 1:4
		Quantity 1	DATE 2004-Oct-18
			SHEET 1 OF 1



Glass-Filled Nylon Adjustable Crank Handles

Made of glass-filled nylon for impact resistance, these crank handles also feature adjustability. To operate, lift the handle to disengage from internal gear teeth, rotate to desired position, and release handle to engage gear teeth. All have a threaded hole. Handles are black and have a temperature range of 14° to 248° F.

Thread	Hole Dia.	(A)	(B)	With Revolving Handle		With Fold-Away Revolving Handle		
				(C)	Each	(C)	Each	
5/16"-18	7/16"	1.77"	3"	2.68"	6129K1	\$9.08	2.68" 6129K4	\$16.66
3/8"-16	0.67"	1.77"	3"	2.68"	6129K2	9.08	2.68" 6129K5	16.66
1/2"-13	0.78"	2.05"	4.84"	3.15"	6129K3	12.07	3.54" 6129K6	22.74

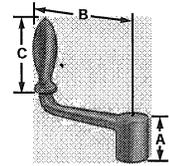


With Fold-Away Revolving Handle

Steel Crank Handles

Providing the ultimate in strength and durability, these one-piece forged steel handles are unfinished. Choose from a solid hub and a hub with a square through hole.

Hub Dia.	(A)	(B)	(C)	With Solid Hub		With Unthreaded Through Hole		
				Each	Each	Hole Size, sq.	Each	
1"	1 1/4"	2 5/8"	2 7/8"	6040K42	\$22.95	1/2"	6040K12	\$40.32
1 1/16"	1 5/16"	4"	3 1/4"	6040K44	26.64	1/2"	6040K14	40.98
1 1/4"	1 3/8"	4 1/2"	3 7/8"	6040K45	29.76	9/16"	6040K15	47.74
1 1/4"	1 13/16"	5 1/2"	3 9/16"	6040K46	36.76	5/8"	6040K16	54.33
1 1/4"	1 15/16"	6 1/2"	3 3/4"	6040K47	48.78	1 1/16"	6040K17	68.07
1 3/8"	2 1/16"	8"	3 3/4"	6040K48	62.27	3/4"	6040K18	83.69
1 9/16"	2 7/16"	9"	3 15/16"	6040K49	77.83	7/8"	6040K19	101.98
1 3/4"	3"	11"	4 1/2"	6040K52	114.81	1"	6040K22	142.93

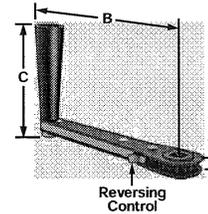


With Solid Hub

Steel Ratchet Crank Handles

Combination ratchet arm and revolving crank handles make machinery adjustment faster, easier, and safer. Reversing control allows you to quickly reverse cranking direction. Ratchet arm is steel with a black powder-coated finish. The revolving handle is black phenolic and has a maximum temperature of 350° F.

Hole Dia.	(A)	(B)	(C)	With Unthreaded Square Through Hole		With Unthreaded Hex Through Hole		With Unthreaded Round Through Hole*	
				Each	Each	Each	Each	Each	Each
3/8"	1 9/32"	7"	4 17/32"	6393K11	\$48.73	6393K13	\$48.73	6393K14	\$48.73
1/2"	1 9/32"	7"	4 17/32"	6393K12	48.73				
1/2"	7/8"	10"	4 13/16"	6393K51	88.90				
5/8"	1 9/32"	7"	4 17/32"	6393K15	48.73	6393K16	48.73	6393K17	48.73
5/8"	7/8"	10"	4 13/16"	6393K52	88.90				
3/4"	7/8"	10"	4 13/16"	6393K53	88.90	6393K55	88.90	6393K57	88.90
3/4"	7/8"	12"	4 13/16"	6393K42	99.61				
1"	7/8"	10"	4 13/16"			6393K56	88.90	6393K58	88.90
1"	7/8"	12"	4 13/16"	6393K45	99.61				
1 1/4"	7/8"	12"	4 13/16"			6393K48	99.61		

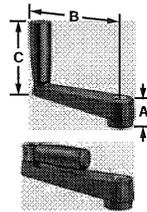


Reversing Control

Aluminum Crank Handles

The black powder-coated finish on these handles prevents oxidation. All have unthreaded through holes. The revolving handle is black phenolic with a temperature range of -4° to +212° F.

Hole Dia.	(A)	(B)	(C)	With Revolving Handle		With Fold-Away Revolving Handle	
				Each	Each	Each	Each
3/8"	0.94"	3.49"	2.50"	6473K76	\$22.14		
1/2"	1.10"	4.38"	3.14"	6473K77	23.97		
5/8"	1.34"	5.47"	3.77"	6473K78	29.35		
3/4"	1.50"	6.85"	3.90"	6473K55	33.14		
1/2"	1.10"	4.28"	3.73"	6473K91	49.77		
5/8"	1.34"	5.47"	4.54"	6473K92	56.40		
3/4"	1.50"	6.85"	4.67"	6473K56	58.00		

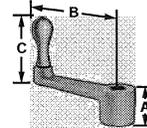


With Fold-Away Revolving Handle

Malleable Iron Crank Handles

For maximum leverage and holding power, choose these extra-rugged handles. Hub and arm have a baked aluminum finish; the revolving handle is chrome-plated steel. Hub has an unthreaded square through hole.

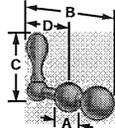
Hole Size, sq.	(A)	(B)	(C)	Each	
				Part	Handle
9/16"	1 3/8"	4 7/16"	2 7/8"	6089K15	\$67.25
5/8"	1 13/16"	5 9/16"	3 1/2"	6089K16	78.27
1 1/16"	1 15/16"	6 9/16"	3 1/2"	6089K17	89.54
3/4"	2 1/16"	7 13/32"	4 7/32"	6089K18	77.11



Steel Balanced Crank Handles

Even weight distribution keeps these handles in position after you release them. They're machined from solid steel and polished to a high luster. The center ball is used to mount the handle and has a 1/4" dia. starter hole so you can customize for your mounting requirement.

(A)	(B)	(D)	(C)	With Stationary Handle		With Revolving Handle		
				Each	Each	(C)	Each	
7/8"	3"	1 1/2"	2 1/8"	6035K11	\$26.09	2 1/8"	6036K11	\$58.43
1"	3 1/2"	1 3/4"	2 15/32"	6035K12	39.04	2 1/8"	6036K12	57.73
1 1/8"	4"	2"	2 13/16"	6035K13	41.95	4 1/32"	6036K14	61.57
1 5/16"	5"	2 1/2"	3 3/8"	6035K15	55.47	4 1/32"	6036K16	85.66
1 3/8"	6"	3"	3 3/4"	6035K17	74.63			



Type 302 Stainless Steel Crank Handles

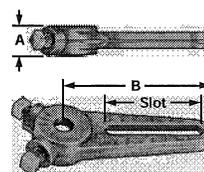
One-piece solid stainless steel, these handles don't have any seams or joints and contaminants so they're ideal for food processing applications. All have unthreaded through holes, plus a starter hole in the hub for a set screw or pin.

Hole Dia.	Starter Hole Dia.	(A)	(B)	(C)	Each	
1/2"	1/8"	3/4"	3 5/16"	3 1/4"	6336K4	\$26.25
5/8"	3/16"	7/8"	4 7/8"	3 5/16"	6336K7	37.71

Galvanized Steel Crank Handles with Set Screws

Two set screws and an unthreaded through hole allow positive locking. These unfinished handles are commonly used for controlling dampers. Slot opening is 2" Lg. x 5/16" Wd. Set screws are 1/4" x 1".

Hole Dia.	(A)	(B)	Each	
3/8"	5/8"	3 1/16"	6149K2	\$8.86
7/16"	5/8"	3 1/16"	6149K5	10.07
1/2"	5/8"	3 1/16"	6149K7	9.05



Pull Cord Starter Handle

Replace broken or worn pull cords on machinery and tools. Handle is sturdy black PVC and attached to 80" of 1/8" dia. nylon cord. Handle is 3/4" Ht. x 2 1/2" Wd. x 2 1/2" Dp.

92865K1 Each \$5.00

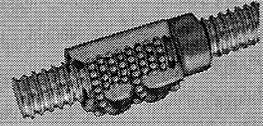


Ball Screws

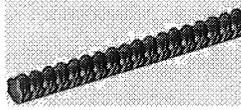
About Ball Screws and Ball Nuts

Ball nuts contain ball bearings that circulate in the groove of the screw, reducing friction between the nut and the screw. The result is precise, stepless positioning control over the full length of the ball screw and the conversion of rotary motion to linear motion more efficiently than Acme precision threaded rods. Load capacities are based on a ball screw and ball nut used together.

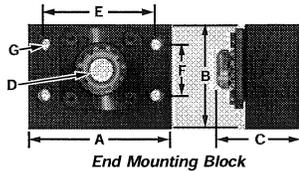
Screw Lead—The distance a load is moved with one revolution of the ball screw. For proper fit, choose ball nuts with the same screw lead and diameter as the ball screw.



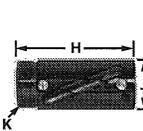
Ball Screws, End Blocks, and Ball Nuts



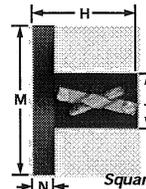
Ball Screw



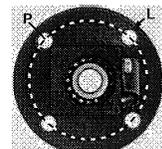
End Mounting Block



Round Ball Nut



Square Ball Nut with Flange



Ball screws are made of induction-hardened AISI 4150 alloy steel. They have right-hand threads. Screw lead accuracy is ± 0.004 " per foot. Rockwell hardness is C56. Temperature range is -65° to $+300^\circ$ F. Use only with ball nuts that have the same diameter and screw lead. **End mounting blocks** support a ball screw with angular bearings that eliminate wobble. Made of steel. Each includes bearings, replaceable seals, a locknut, and a washer. Note: Ball screw ends need to be machined before installing in an end mounting block.

Rockwell hardness is C56. Use only with ball screws that have the same diameter and screw lead. Temperature range is -65° to $+300^\circ$ F. Choose ball nuts with or without a flanged end.

End mounting blocks support a ball screw with angular bearings that eliminate wobble. Made of steel. Each includes bearings, replaceable seals, a locknut, and a washer. Note: Ball screw ends need to be machined before installing in an end mounting block.

Ball Screws				End Mounting Blocks										
Screw Dia.	Screw Lead	Load Cap., lbs.	Max. Screw Lg.	Per Inch	(A)	(B)	(C)	Dia. (D)	Ctr.-to-Ctr. (E)	Ctr.-to-Ctr. (F)	Dia. (G)	Each		
3/8"	1/8"	136	48"	5966K24	\$2.09	2 3/4"	2"	1 3/8"	2 3/64"	2"	1 3/8"	0.281"	60755K12	\$228.11
1/2"	1/8"	786	48"	5966K25	2.79	3"	1 7/8"	1 11/16"	1 5/32"	2 1/4"	1 1/4"	0.281"	60755K13	316.54
5/8"	1 3/64"	778	72"	5966K26	1.27	3 1/2"	2 3/64"	1 7/8"	1 9/32"	2 3/4"	1 1/4"	0.280"	60755K14	295.07
3/4"	1 3/64"	1,100	72"	5966K13	2.00	3 1/2"	2 3/64"	1 7/8"	1 9/32"	2 3/4"	1 1/4"	0.280"	60755K14	295.07
3/4"	1/2"	3,263	72"	5966K22	2.11	3 1/2"	2 3/64"	1 7/8"	1 9/32"	2 3/4"	1 1/4"	0.280"	60755K14	295.07
1"	1/4"	1,612	192"	5966K27	2.72	4 1/2"	2 3/4"	2 21/64"	2 5/32"	3 1/4"	1 3/4"	0.469"	60755K15	366.40
1"	1/2"	3,890	192"	5966K23	2.89	4 1/2"	2 3/4"	2 21/64"	2 5/32"	3 1/4"	1 3/4"	0.469"	60755K15	366.40
1"	1"	2,142	192"	5966K31	2.72	4 1/2"	2 3/4"	2 21/64"	2 5/32"	3 1/4"	1 3/4"	0.469"	60755K15	366.40
1 1/2"	1/4"	4,198	240"	5966K28	4.43	6 1/2"	3 3/8"	2 11/16"	6 3/64"	4 3/4"	2"	0.656"	60755K16	489.86
1 1/2"	1/2"	12,320	240"	5966K12	4.17	6 1/2"	3 5/8"	2 11/16"	6 3/64"	4 3/4"	2"	0.656"	60755K16	489.86
1 1/2"	1"	7,560	240"	5966K39	4.44	6 1/2"	3 11/16"	2 21/32"	6 3/64"	4 3/4"	2"	0.660"	60755K17	424.47
2 1/4"	1/2"	21,306	240"	5966K29	8.23	8 1/2"	5 5/8"	4 5/32"	1 2 5/32"	6 5/8"	3 5/8"	0.812"	60755K18	1,001.80
2 1/4"	1"	26,538	240"	5966K33	8.20	8 1/2"	5 5/8"	4 5/32"	1 2 5/32"	6 5/8"	3 5/8"	0.812"	60755K18	1,001.80

Ball Nuts				Ball Nuts with Flange								
Screw Dia.	Screw Lead	Lg. (H)	(J)	Thread (K)	Each	Dia. (L)	Dia. (M)	(N)	Bolt Circle (P)	Each		
Round Ball Nuts												
3/8"	1/8"	1"	3/4" Dia.	0.664"-32	5966K14	\$74.88	0.177"	1 39/64"	0.27"	1.24"	5966K44	\$111.48
3/4"	1 3/64"	1 7/8"	1 5/16" Dia.	1.173"-18	5966K37	36.20	0.281"	2 19/32"	0.53"	2.093"	5966K38	65.69
3/4"	1/2"	3"	1 5/16" Dia.	1 1/4"-18	5966K42	172.46	0.281"	2 5/8"	0.53"	2.09"	5966K79	199.95
1"	1/2"	3 1/8"	1 5/8" Dia.	1 9/16"-18	5966K43	195.46	0.266"	3 1/4"	0.63"	2.75"	5966K81	220.26
1 1/2"	1/4"	2 7/8"	2 3/32" Dia.	1 31/32"-18	5966K18	235.11	0.397"	4 13/64"	0.52"	3.44"	5966K48	296.70
1 1/2"	1/2"	5 19/32"	2 5/8" Dia.	2.36"-18	5966K34	265.78	0.531"	4 21/32"	0.775"	3.875"	5966K35	311.81
2 1/4"	1/2"	6 11/16"	3 3/8" Dia.	3.137"-12	5966K19	561.36	0.656"	5 3/8"	1.582"	4.375"	5966K49	638.61
2 1/4"	1"	6 2 3/32"	3 3/8" Dia.	3.137"-12	5966K77	807.63	0.656"	5 3/8"	1.582"	4.375"	5966K85	879.98
Square Ball Nuts												
1/2"	1/2"	1 7/8"	1" x 1 21/64"	1 5/16"-16	5966K15	155.65	0.266"	2 39/64"	0.53"	2.09"	5966K45	202.63
5/8"	1 3/64"	1 11/32"	1" x 1 11/32"	1 5/16"-16	5966K16	23.85	0.266"	2 39/64"	0.53"	2.09"	5966K46	56.76
1"	1/4"	2 1 1/32"	1 1/2" x 2 19/64"	1 9/16"-18	5966K17	38.64	0.266"	3 1/4"	0.63"	2.75"	5966K47	80.68
1"	1"	3"	1 1/2" x 2 1/8"	1 9/16"-18	5966K74	99.66	0.266"	3 1/4"	0.63"	2.75"	5966K82	131.87
1 1/2"	1"	3 5/8"	2 1/4" x 3 7/16"	2 1/4"-20	5966K167	257.40	0.531"	4 19/16"	1.02"	4.125"	5966K84	316.93

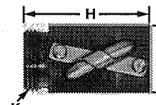
Corrosion-Resistant Ball Screws and Nuts

Ball screws and ball nuts are made of Type 17-4 stainless steel, except for 6641K32 and K42, which are nickel-plated alloy steel. All are suitable for use in harsh environments. Rockwell hardness is C40-C45 for Type 17-4 stainless steel and C58-C60 for nickel-plated alloy steel. Temperature range is -65° to $+300^\circ$ F. Use ball screws and ball nuts with the same diameter and screw lead.

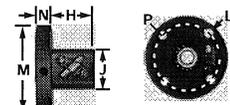
Ball screws are induction hardened and have right-hand threads. Screw lead accuracy is ± 0.004 " per foot. They can be used with the steel end mounting blocks listed above. **Ball nuts** are square style, unless noted.



Ball Screw



Ball Nut



Ball Nut with Flange

Ball Screws				Ball Nuts		Ball Nuts with Carbon Steel Flanges										
Screw Dia.	Screw Lead	Load Cap. lbs.	Screw Lg.	Each	Lg. (H)	(J)	Thread (K)	Each	Dia. (L)	Dia. (M)	(N)	Bolt Circle (P)	Each			
3/8"	1/8"	136	24"	6641K1	\$72.95	1"	0.75"	0.664"-32	6641K9	\$155.77	0.177"	1 19/32"	0.270"	1.240"	6641K21	\$191.49
3/8"	1/8"	136	48"	6641K2	138.60	1"	0.75"	0.664"-32	6641K9	155.77	0.177"	1 19/32"	0.270"	1.240"	6641K21	191.49
1/2"	1/2"	786	24"	6641K3	88.16	1.875"	1"	1 5/16"-16	6641K32	251.60	0.266"	2 19/32"	0.530"	2.093"	6641K42	288.09
1/2"	1/2"	786	48"	6641K4	176.30	1.875"	1"	1 5/16"-16	6641K32	251.60	0.266"	2 19/32"	0.530"	2.093"	6641K42	288.09
1/2"	1/2"	786	72"	6641K5	220.37	1.875"	1"	1 5/16"-16	6641K32	251.60	0.266"	2 19/32"	0.530"	2.093"	6641K42	288.09
5/8"	1 3/64"	815	24"	6641K6	112.47	1.710"	1"	1 5/16"-16	6641K12	139.82	0.266"	2 19/32"	0.530"	2.090"	6641K23	175.54
5/8"	1 3/64"	815	48"	6641K7	224.93	1.710"	1"	1 5/16"-16	6641K12	139.82	0.266"	2 19/32"	0.530"	2.090"	6641K23	175.54
5/8"	1 3/64"	815	72"	6641K8	281.16	1.710"	1"	1 5/16"-16	6641K12	139.82	0.266"	2 19/32"	0.530"	2.090"	6641K23	175.54

▲ Round style.

Att'n: TRENT SLADE

Apr 30 04

Page: 1

QUOTATION
 CONFIRMATION

REFERENCE NUMBER: 148427

Customer:
NATIONAL RESEARCH COUNCIL (INS
INSTITUTE FOR MARINE DYNAMICS
KERWIN PLACE, P.O BOX 12093
MUN CAMPUS
ST. JOHN'S, NF
A1B 3T5

Ship to location:
NATIONAL RESEARCH COUNCIL (INS
INSTITUTE FOR MARINE DYNAMICS
KERWIN PLACE, P.O BOX 12093
MUN CAMPUS
ST. JOHN'S, NF
A1B 3T5

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ORDER #	DATE	PURCHASE ORDER #	EXP. SHIP DATE	SHIP VIA
148427	Apr 30 06	QUOTATION		PUROLATOR PPD & CHG

=====

QTY	ITEM NUMBER	DESCRIPTION	PRICE	UNIT	EXTENDED
1	-THK-	----->HSR30LB2SSM+1000LM	1,763.2353	EA	1,763.23
OR					
1	-THK-	----->HSR35LB2SSM+1000LM	2,351.4706	EA	2,351.47

DELIVERY ON EITHER OPTION IS 3-4 WEEKS. THANK YOU!

TOTAL NET (EXCLUDES TAXES)	4,114.70
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Terms: NET 30 DAYS FOB Ship point. Quotations are valid for 30 days.

Quoted by: JULIE

Shipping instructions:

Signature: _____