

# NISKINE Armstrong Operations

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27 May-20 June 2019

## Overview of Science Operations

Operations will focus on the interactions between near-inertial waves and meso- and submeso-scale fronts and eddies. Our study area will be with the box defined by: 58N, 28W; 61 N, 28W, 61 N, 23 W; 58 N, 23 W. We will use satellite remote sensing and data from glider pre-deployed into the area to direct Armstrong to promising features with this box. Targeting will then be refined through surveys using our Triaxus towed, undulating profiler. Autonomous assets (drifters, floats and gliders) will be deployed into the target feature, after which we will resume synoptic surveys of the feature, now following the autonomous array. We will provide situational awareness to keep the bridge apprised of instrument positions, as Armstrong will need to navigate within the field of autonomous instruments. Surveys will continue until autonomous assets begin to disperse too widely for easy recovery, or the inertial wave field evolves past being of interest. At this point, we will recover autonomous instruments, select a new target feature, and repeat the process. For members of the Armstrong crew who participated in the wintertime LATMX program, conducted along the north wall of the Gulf Stream from the R/Vs Knorr and Atlantis, this cruise will follow a similar pattern.

Operations and Instruments include:

1. Deploy and recover (3) Seagliders and (1) Deepglider (possibly repeated several times)
2. Recover (1) Deepglider and (1) Slocum glider
3. Repeated deployment and recovery of (15) EM-APEX floats. (6) of these will remain in the water after Armstrong departs.
4. Deploy drifters: (3) SVP, (10) SVP-B, (5) MiniMet, (10) DWS, (4) ADOS
5. Deploy and recover (1) Super-ADOS and Wirewalkers (number TBD)
6. Deploy and recover (1) Liquid Robotics Waveglider
7. Synoptic surveys using Triaxus undulating towed profiler (using APL-UW Dynacon winch)
8. Surveys with Ocean Sciences Underway CTD and SIO EPSI-fish

## Equipment Specifications and Operations Notes

### Triaxus Towed Profiler

Winch: Dynacon model 10030

- line pull 3500 lbs.
- Winch cert of compliance attached.

- Deck mount - drawings and calculations attached. Minimum safety factor is 2.7 over cable break. Winch cert of compliance attached.
- Power: 3-phase, 440V.



Block: Campbell A1422D block (catalog page attached)

- Armored, 10 mm diameter.
- SWL 7000 lbs.
- Ultimate strength 21000 lbs

Cable: Rochester A305382

- Break strength 16000 lbs.
- <http://www.rochestercables.com/pdfs/DataLines/EOP/A305382.pdf>
- As an added safeguard, the Triaxus vehicle is attached to the cable through a weak link sized at 5000 lbs.

Triaxus Vehicle

- Weight approximately 400 lbs.
- Dimensions: roughly 6' x 4' x 6'
- Deploy and recover through A-frame.
- Towed directly on winch and block. We do not use a fixed tow point, as we need to retain the ability to change cable length during the tow.
- Cable out depends on target profiling depth (deeper depths require more cable). For this experiment, we anticipate cable-out between 300 – 1000 m.
- Triaxus undulates under automatic control, with full-time operator oversight.
- Deployment: The winch is used to lift Triaxus from the deck, with the vehicle restrained by slip-lines running through recovery rings on each side. Triaxus will be lowered into the water off the stern with Oceanus moving at 1 – 2

knots. Once the vehicle is in the water and slip lines are clear, tow speed will gradually be increased to 6 – 8 knots (final speed depends on target profiling range and vertical rate).

- Recovery: Slow ship to 2 – 3 knots and pull Triaxus in. When vehicle is close to the stern, slow to roughly 0.5 knot, bring to within reach and hook two recovery bales using specialized, closing hooks on the end of long, stiff carbon fiber poles. Restrain vehicle using tag lines and bring aboard using A-frame and winch. Caution is required to prevent vehicle from surging into the stern of the ship (will discuss operations in detail prior to sailing).



Information on other platforms to be added...

EM-APEX Float

Deepglider

Seaglider

Slocum Glider

Drifters

Wirewalker

**Liquid Robotics Waveglider**

**EPSI-Fish**



**DYNACON, Inc.**  
831 Industrial Blvd.  
Bryan, Texas 77803

## **Certificate of Compliance**

To: University of Washington  
Applied Physics Laboratory  
1013 NE 40<sup>th</sup> Street  
Seattle, Washington 98105

Date: 20 September 2002  
P.O. No.: 502076  
Contact: Mr. Jason Gobat

Attention: Director, Quality Assurance

It is hereby certified that all the articles provided in the quantities called for on the above noted Purchase Order are in compliance with the requirements, specifications and drawings listed on that order.

Article(s) Purchased:

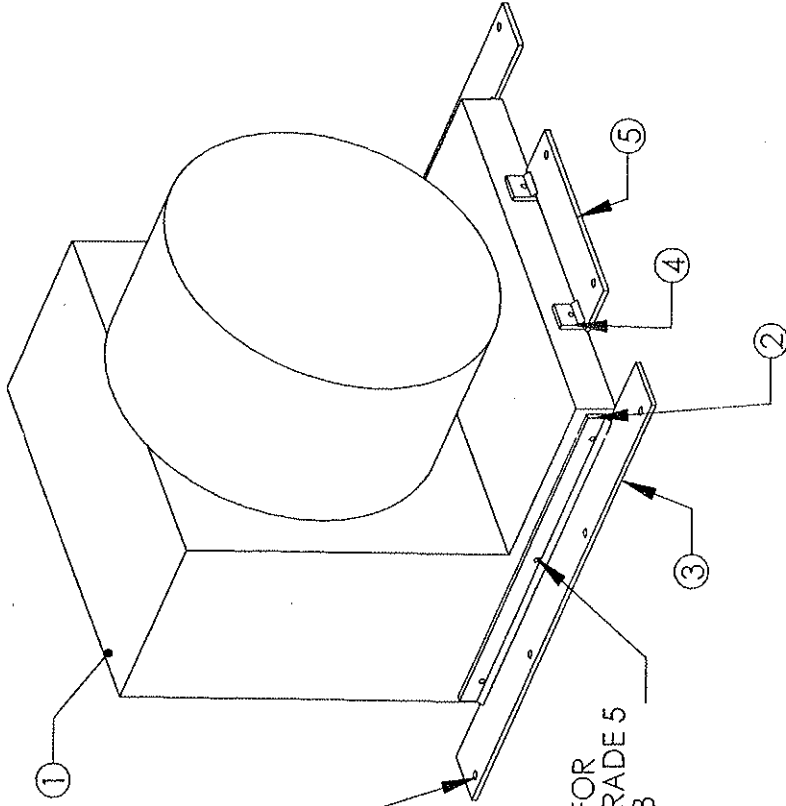
- DYNACON Model 10030 Cantilevered Drum Winch – S/N 768101 W-RC-EALW
- Remote Control with Line Monitor – S/N 768102-RC

Inspection records, test reports and other objective quality evidence substantiating conformance are on file at the point of manufacture.

Dennis Brunson  
Vice-President, DYNACON, Inc.

Ref: 768

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USE 1-8UNC FOR DECK BOLTS, GRADE 5 TORQUE 180 FT-LBS

USE 3/4-10 UNC FOR WINCH BOLTS, GRADE 5 TORQUE 180 FT-LB

ITEM NO.	QTY.	PART NO.	TITLE D
1	1	winch profile	
2	2	plate end, winch mount	
3	2	plate base end	
4	4	plate side, winch mount	
5	2	plate base side	

UNLESS OTHERWISE SPECIFIED

- APPLICABLE STANDARDS: MIL-STD-XX
- ALL DIMENSIONS ARE IN INCHES.
- SURFACE FINISH 125 ✓
- MACHINED FILLETS R
- INSIDE BEND RADIUS
- REMOVE ALL BURRS. BREAK SHARP EDGES R.015 MAX.
- DIMENSIONS AND SURFACE ROUGHNESS TO BE MET AFTER PROTECTIVE COATING.

TOLERANCES ON:  
 HOLE DIAMETERS ±.003  
 .XX ±.020  
 .XXX ±.005  
 ANGLES ±1°

MATERIAL  
 N/A

SURFACE FINISH  
 SEE NOTE

SIZE CODE IDENT NO. 1 DRAWING NO. REV

A 98514 XXXXX

APPLICATION DATA

DO NOT SCALE THIS DRAWING

FILE: F:\Project\SeaSoar\winch 10030\winch on knorr deck

SHEET 1 OF 1

APPLIED PHYSICS LABORATORY  
 UNIVERSITY OF WASHINGTON  
 SEATTLE, WASHINGTON 98105

WINCH MOUNT ASSY  
 ON R/V KNORR DECK  
 SEA SOAR

PROJ MGR V MILLER  
 ENGINEER v miller  
 DRAWN v miller  
 SCALE: 1:25 PLOT DATE: 11/18/02

gm cc

11/18/02

11/18/02

cc

11/18/02

11/18/02

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11/18/02

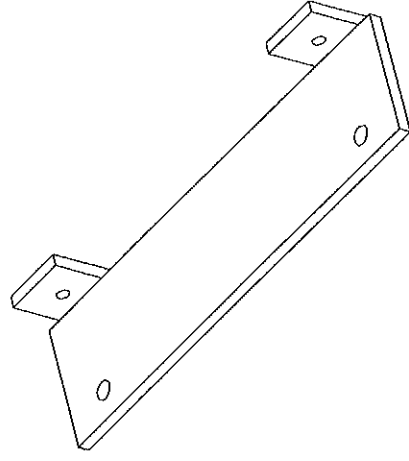
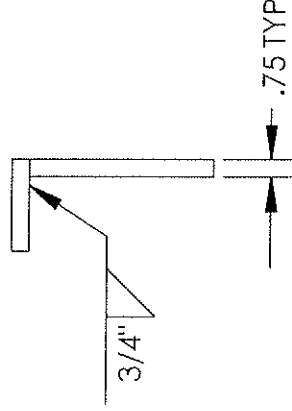
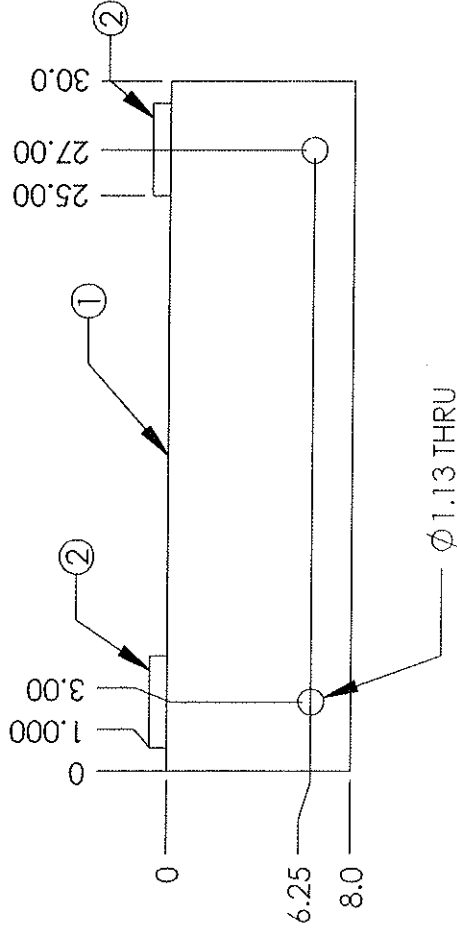
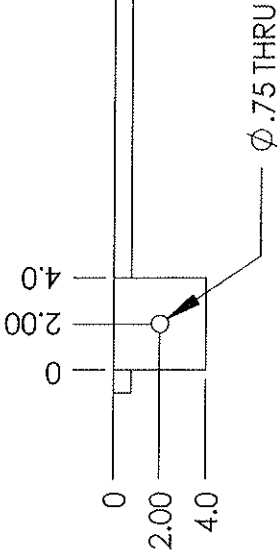
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11/18/02

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ITEM NO.	QTY.	PART NO.	TITLED
1	1	plate base side	
2	2	plate side, winch mount	

UNLESS OTHERWISE SPECIFIED

- APPLICABLE STANDARDS: MIL-STD-XX
- ALL DIMENSIONS ARE IN INCHES.
- SURFACE FINISH 125 ✓
- MACHINED FILLETS R
- INSIDE BEND RADIUS
- REMOVE ALL BURRS. BREAK SHARP EDGES R.015 MAX.
- DIMENSIONS AND SURFACE ROUGHNESS TO BE MET AFTER PROTECTIVE COATING.

XXXXX DLXXXXX  
 NEXT ASSY USED ON

TOLERANCES ON:  
 HOLE DIAMETERS ±.003  
 .XX ±.020  
 .XXX ±.005  
 ANGLES ±1°

MATERIAL  
 ASTM A36

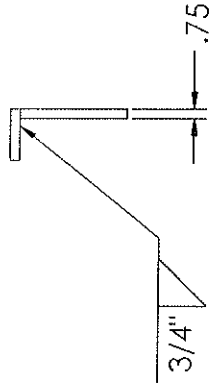
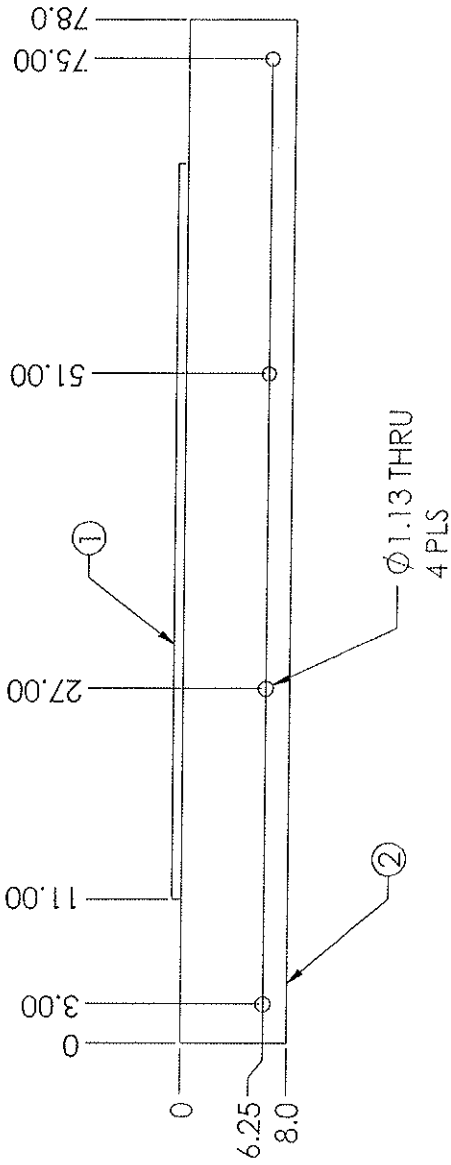
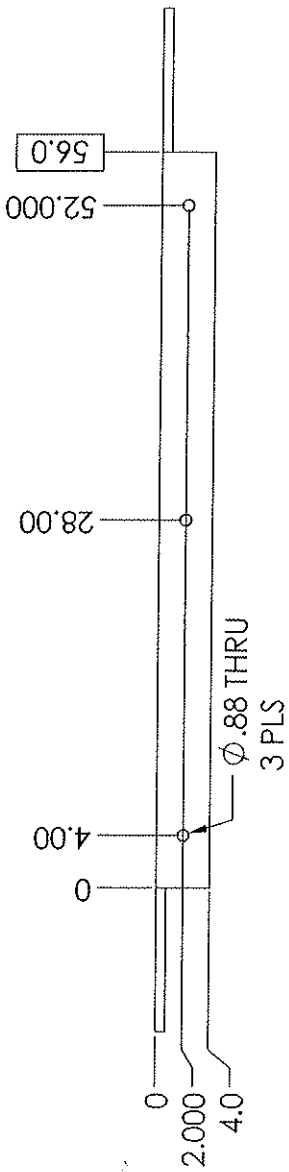
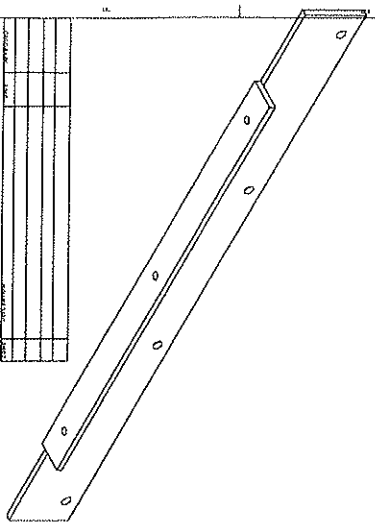
PROJ MGR V MILLER  
 ENGINEER V miller  
 DRAWN V miller 11/18/02  
 SCALE: 1:8 PLOT DATE: 11/18/02  
 gm CC  
 SURFACE FINISH  
 SEE NOTE

APPLIED PHYSICS LABORATORY  
 UNIVERSITY OF WASHINGTON  
 SEATTLE, WASHINGTON 98105

**SIDE PLATE END ASSY  
 WINCH BASE  
 SEA SOAR**

SIZE CODE IDENT NO. DRAWING NO. REV  
 A 98514 XXXXX

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ITEM NO.	QTY.	PART NO.	TITLED
1	1	plate end, winch mount	
2	1	plate base end	

PART NO.		PART LET		MATERIAL PRODUCTION	
APPLIED PHYSICS LABORATORY		APPLIED PHYSICS LABORATORY		APPLIED PHYSICS LABORATORY	
BASE PLATE END ASSY		BASE PLATE END ASSY		BASE PLATE END ASSY	
WINCH BASE		WINCH BASE		WINCH BASE	
SEA SOAR		SEA SOAR		SEA SOAR	
C 196514		C 196514		C 196514	
DO NOT SCALE DRAWING		DO NOT SCALE DRAWING		DO NOT SCALE DRAWING	
MATERIAL: ASTM A335		MATERIAL: ASTM A335		MATERIAL: ASTM A335	
FINISH: BRU W/BLK		FINISH: BRU W/BLK		FINISH: BRU W/BLK	
TOLERANCE: ARE ± .005		TOLERANCE: ARE ± .005		TOLERANCE: ARE ± .005	
SECTION: ARE ± .01		SECTION: ARE ± .01		SECTION: ARE ± .01	
ANGLE: ARE ± 0.5		ANGLE: ARE ± 0.5		ANGLE: ARE ± 0.5	
DATE: 11/18/02		DATE: 11/18/02		DATE: 11/18/02	
DRAWN: [blank]		DRAWN: [blank]		DRAWN: [blank]	
CHECKED: [blank]		CHECKED: [blank]		CHECKED: [blank]	
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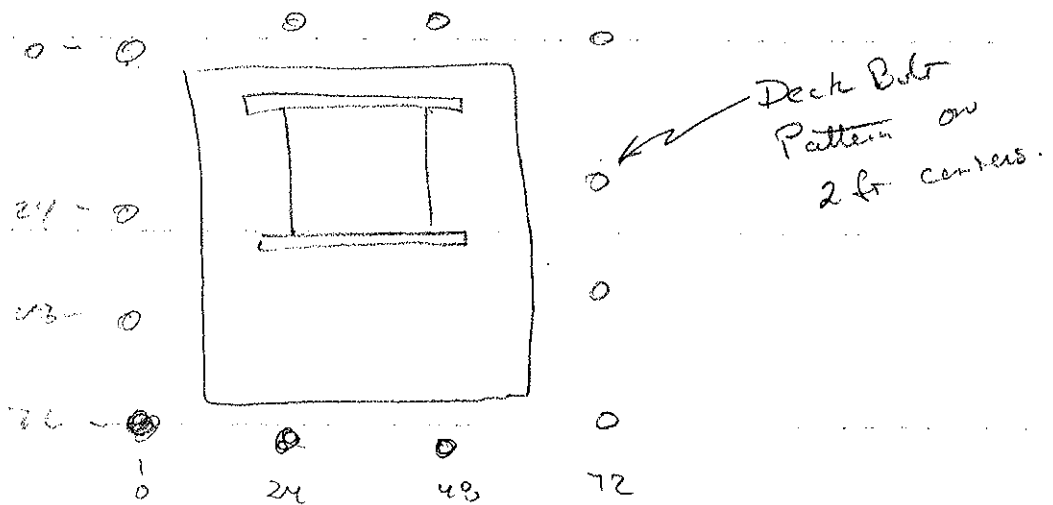
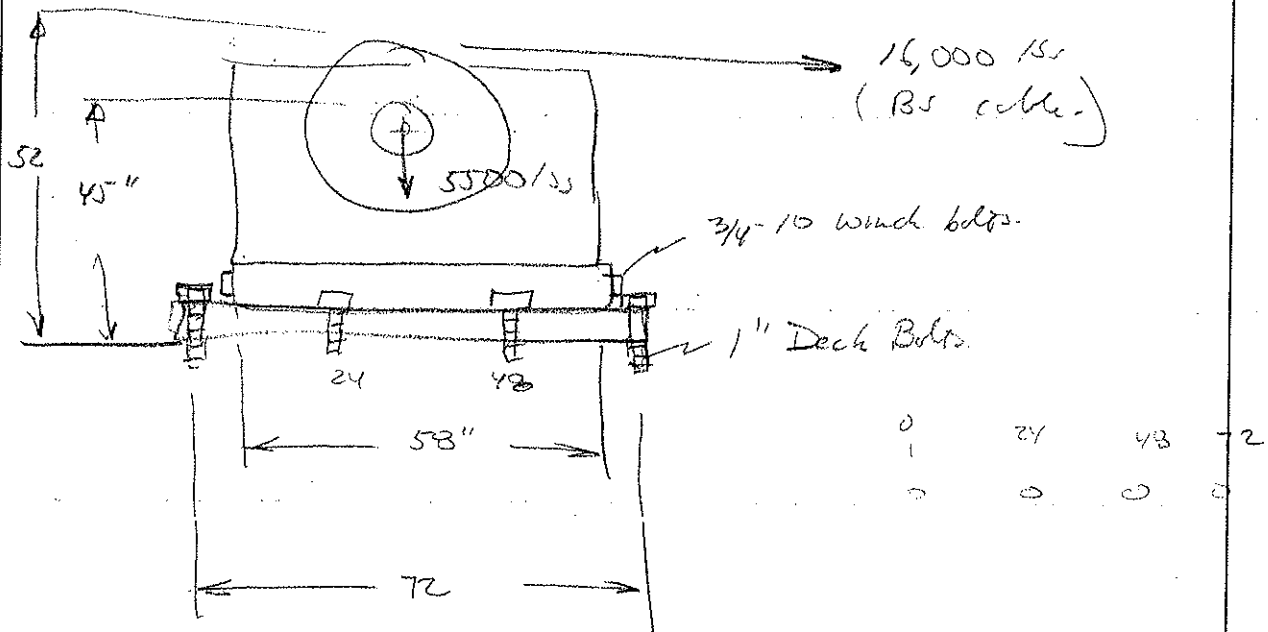


BY: Vern Miller, ME

11/15/02

(1)

Subject: Winch Mount Plate for Seaform on Knorr



Deck Bolts are 1-8 - Maximum Torque for 1-8 bolt is

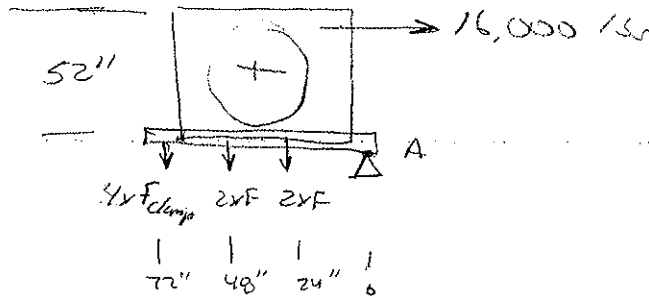
Torque = 480 ft-lb (lubed) Grade 5

Clamp Load = 38,600 lbs

Subject: Winch Mount Plate & Section in Knorr

Assume all bolts are equally torqued to produce clamp load of  $F_{clamp}$  lbs. @ each bolt

Solve for  $F_{clamp}$  for cable load of 16,000 lbs.



$$\sum M_A = 0$$

$$4F \times 72 + 2F \times 48 + 2F \times 24 - 16,000 \text{ lbs} \times 52 = 0$$

$$288F + 96F + 48F = 832,000 \text{ in-lb}$$

$$432F = 832,000 \text{ lbs}$$

$$F = \frac{832,000}{432} = 1925 \text{ lbs}$$

Assume a 3:1 safety factor in clamping load.

$$F_{clamp} = 3 \times 1925 \text{ lbs} = 5775 \text{ lbs}$$

$$T = KFD$$

where  $K = .15$  for lubed bolt

$F =$  clamp load (lbs)

$D =$  nominal bolt diameter (in)

$$\therefore T = .15 \times 5775 \text{ lbs} \times 1 \text{ in}$$

$$= 866.25 \text{ ft-lb} \quad (72 \text{ ft-lb})$$

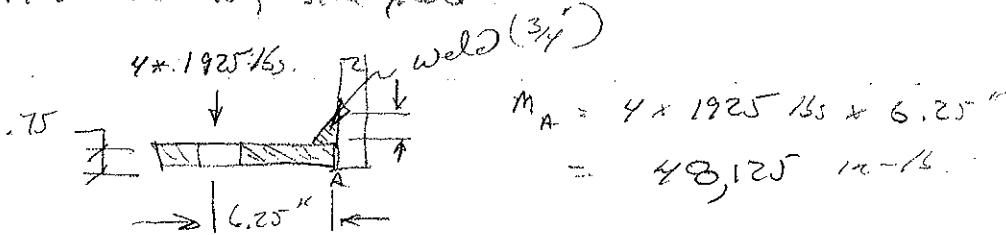
MIN Required Torque in Bolts for Deck.

Specify 180 ft-lb.

TO MATCH  
3/4-10 Bolts in  
Winch.

Subject: Winch Mount Plate in Section on Floor

- 1) Look at the bending load on each plate at a load of 1925 lbs. First the long side plate.



for weld radius of .75

$$I = \frac{56 \cdot .75^3}{12} = 1.969 \text{ in}^4$$

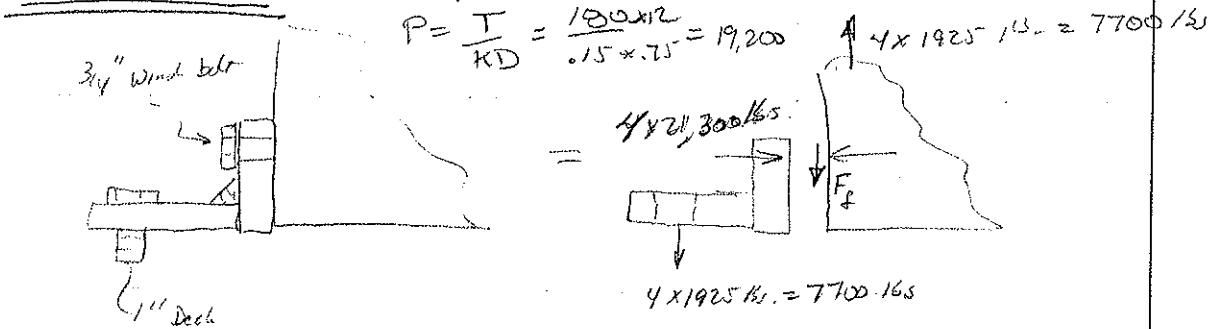
$$\sigma_{\text{bend max}} = \frac{Mc}{I} = \frac{48,125 \times .75}{1.969} = 9165 \text{ lbs/in}^2$$

For  $\frac{3}{4}$ " weld area -  $SF = \frac{36,000}{9165} = 4$

assuming failure at the base material strength, we have a 4:1 SF over the breaking strength of the winch cable.

- 2) Look at the loads on the bolts at the winch base plate to winch. The bolts are  $\frac{3}{4}$ -10 Grade 5

for  $\frac{3}{4}$ -10 with lube on threads and a torque of 180 ft-lbs the clamp load is 19,200 lbs.



$F_f = MN$        $M = .27$  Steel-on-Steel, oxide film

$= .27 \times 4 \times 19,200 \text{ lbs} = 20,736 \text{ lbs.}$

$\frac{\text{Clamping load}}{\text{winch load}} = \frac{20,736 \text{ lbs}}{7700 \text{ lbs}} = 2.7 \approx 1$

Subject: Winch Mount Plate to SeaSoar Knorr

Summary of Design & Mounting Requirements for  
SeaSoar Winch Base on R/V Knorr -

- Winch Base material -  $3/4$ " Plate A36 or Better  
(SF = 4:1)
- Torque Winch Base to Knorr Deck -  
12 Bolts. 1-8 UN Torque - 180 ft-lb (min)  
(SF = 7:1)
- Torque Winch Base to Winch Frame -  
10 Bolts  $3/4$ -10 Grade 5 Torque - 180 ft-lb  
(SF = 2.7:1)

These calculations and torque requirements  
are based upon an assumed winch cable  
load of 16,000 lbs. The breaking strength  
of the winch wire rope ( $\phi .393$ ) is  
16,000 lbs.

## SERIES A1400M STANDARD DUTY BLOCKS

### DESCRIPTION

Designed on a pattern similar to our heavy-duty models shown above but with a lesser load capacity.

A very useful tool for oceanography and similar measuring work. Fabricated from high-strength aluminum alloys and fitted with high-grade bearings.

Urethane sheave liners are offered in regular sizes or specials which entails filling the sheave groove and machine sizing.

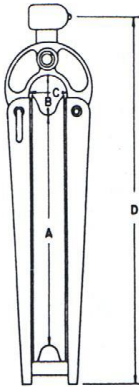
Socket eye suspension fitting is standard and will accept any of the attachments shown below.



## A1400M SERIES STANDARD DUTY OCEANOGRAPHY BLOCKS

MODEL NUMBER	SHEAVE DIAMETER	CONDUCTOR CAPACITY		WORKING LOAD POUNDS	ULTIMATE STRENGTH POUNDS	WEIGHT POUNDS
		WITHOUT LINERS	WITH LINERS			
A1418D	18"	1-3/4"	1-1/2"	4,500	13,500	36
A1422D	22"	1-3/4"	1-1/2"	7,000	21,000	44
A1424A	24-1/2"	1-3/4"	1-1/2"	10,000	24,000	62
A1428D	28"	1-7/8"	1-5/8"	8,000	24,000	66

Weights shown above are for blocks without liners.



SPECIFICATIONS				
BLOCK NO.	A	B	C	D
A1418D	14"	4"	5"	26"
A1422D	18"	4"	6"	30"
A1424A	21"	3"	3-1/2"	32"
A1428D				
A1436D	30"	4-1/2"	5-1/2"	45"
A1436I	30"	4-1/2"	5-1/2"	45"

### SUSPENSION FITTING ATTACHMENTS

MODEL NUMBER	DESCRIPTION	LOAD CAPACITY	LOAD CAPACITY
12	Safety Ball Hook	4,000	2,000
14	Plain Ball Clevis	4,000	
14A	Plain Ball Clevis with Captive Pin		
15	Y-Ball Clevis	20,000	
16	Oval Eye Ball	15,000	
20	Socket Eye	20,000	11,000