

AD-A221 087

WHOI-89-52

A Pop-up Float Recovery System For Coastal Oceanographic Tripods

by

Christopher V.R. Dunn and Allan G. Gordon

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

May 02 1990

November 1989



Technical Report

Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and / or Special
A-1	

Funding was provided by the Office of Naval Research
under contract No. N00014-89-J-1058.

Reproduction in whole or in part is permitted for any purpose of the
United States Government. This report should be cited as:
Woods Hole Oceanog. Inst. Tech. Rept., WHOI-89-52.

Approved for publication; distribution unlimited.

Approved for Distribution:

Albert J. Williams 3rd, Chairman
Department of Applied Ocean Physics
and Engineering

90 05 02 008

WHOI-89-52

A Pop-up Float Recovery System For Coastal Oceanographic Tripods

by

Christopher V.R. Dunn and Allan G. Gordon

**Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543**

November 1989



Technical Report

Accession For	
NTIS (CRA&I)	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Availability or special
A-1	

Funding was provided by the Office of Naval Research
under contract No. N00014-89-J-1058.

Reproduction in whole or in part is permitted for any purpose of the
United States Government. This report should be cited as:
Woods Hole Oceanog. Inst. Tech. Rept., WHOI-89-52.

Approved for publication; distribution unlimited.

Approved for Distribution:

**Albert J. Williams 3rd, Chairman
Department of Applied Ocean Physics
and Engineering**

Contents

List of Figures	ii
Abstract	iii
Acknowledgments	iii
1 Introduction	1
2 The BASS Tripod	1
3 Design Considerations.....	1
4 Features As Built	5
5 Field Experience	8
6 Conclusions	11
7 Appendix A	12
8 Appendix B	25

List of Figures

1	STRESS/SMILE Location	2
2	C3 BASS Tripod	3
3	Completed Float Package	6
4	Drawing of Release Features	7
5	Illustration of Canister and Rope Packing Techniques	9

Abstract

The recovery package described here was used as the primary retrieval system to recover tripod instrument platforms from a depth of 90 meters. The device uses dual in-line burn wires, one of which is acoustically commanded from the surface ship. The other is set to release by back-up timer, ensuring recovery in the event of a poor acoustic command channel. The burn wire activates spring loaded cam latches which release the float package and pull a $\frac{1}{2}$ inch Dacron line to the surface. The float package is recovered and the line is used to winch the tripod to the surface for recovery by the ship's crane. Major benefits of the system are reliability, low cost, light weight, and use of many off-the-shelf components. The float package provides 50 pounds of buoyancy and is fabricated using commercial fish trawl net floats. The retrieval line container is separate from the float assembly, and is fabricated from plastic storage containers. The line is coiled and restricted to prevent unpackaging due to waves or current action. The system described here is not appropriate in areas of high current or great depth due to drag and dead weight of the lift line.

Acknowledgments

The development of this pop-up float recovery system was made possible by the Office of Naval Research Grant Number N00014-89-J-1058. We acknowledge the encouragement and guidance of Albert J. Williams, 3rd and Yogesh C. Agrawal. We also would like to thank Ellyn T. Montgomery for her diver observations during dock site testing, and to Paul R. Boutin who arranged the remotely operated vehicle recovery of the single unsuccessful pop-up float retrieval. Special appreciation also is extended to Judith A. White for manuscript preparation and Betsy G. Pratt for art work.

1 Introduction

The Sediment Transport Events on Shelves and Slopes (STRESS) experiment took place during the winter of 1988/1989 off the California coast north of San Francisco. The location is shown in Figure 1. An array of bottom tripods was deployed in approximately 90 meters of water in order to study the effects of winter storms on the transportation of sediment along the coast. The tripods carried instruments for measuring current, suspended sediment loads, and temperature structure. The tripods were deployed for a total of five months, but were recovered, serviced, and redeployed halfway through the experiment. This report describes a device used to recover the tripods from the ocean bottom during the STRESS experiment. The device is a command releasable float package which pulls a 1/2 inch Dacron line to the sea surface. Once on the surface, the float package is recovered, and the line is used to winch the tripod to the surface where it is recovered using the ship's crane. The recovery device functioned reliably, with a total of eight successes out of nine trials. A single tripod was recovered using a remotely operated vehicle (ROV) when the recovery line fouled on release and prevented the float package from reaching the surface.

2 The BASS Tripod

The tripods used in the STRESS experiment were originally designed for use in the deep ocean (Williams et al., 1987). A drawing of a tripod is shown in Figure 2. Typical deployment depths were on the order of 5000 meters, and locations were hundreds of miles from shore. In the deep ocean, a large base section from the tripod was dropped as an expendable anchor and the upper section only was recovered. In the remote locations there was no need to be concerned about the discarded anchor interfering with fishing or other bottom activities. The STRESS experimental site is located close to the California coast, and bases left on the bottom could present a hazard to fishing and navigation activities in that area. For this reason, we decided to modify the tripods so that they could be recovered with their anchor bases. During the Coastal Ocean Dynamics Experiment (CODE) in 1981 and 1982, smaller tripods had been deployed and successfully recovered using a commandable float and line release. This experience served as the basis for our design effort.

3 Design Considerations

Our experiences during CODE showed that we needed to develop a recovery device which featured a separate float and rope canister arrangement. In the coastal area, wave action causes the float package to oscillate while on the bottom. This action allows the rope canister to unpack and foul when it is sealed by the float package itself. To eliminate this possibility, we designed a rack for the float which incorporated the release mechanism, and a container for the lift line which is separate and nearly sealed to prevent unpacking as much as possible.

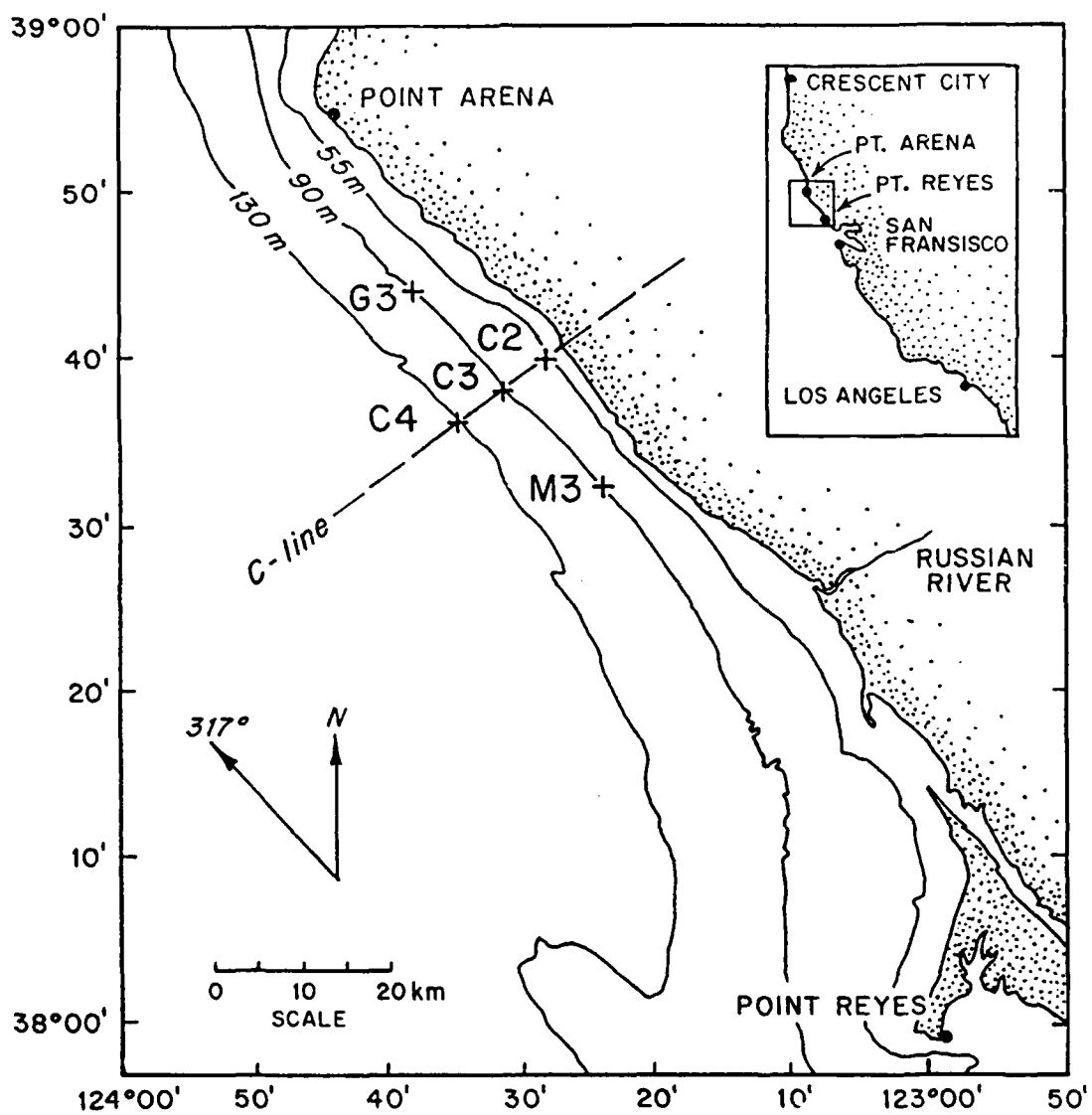


Figure 1: STRESS/SMILE Location

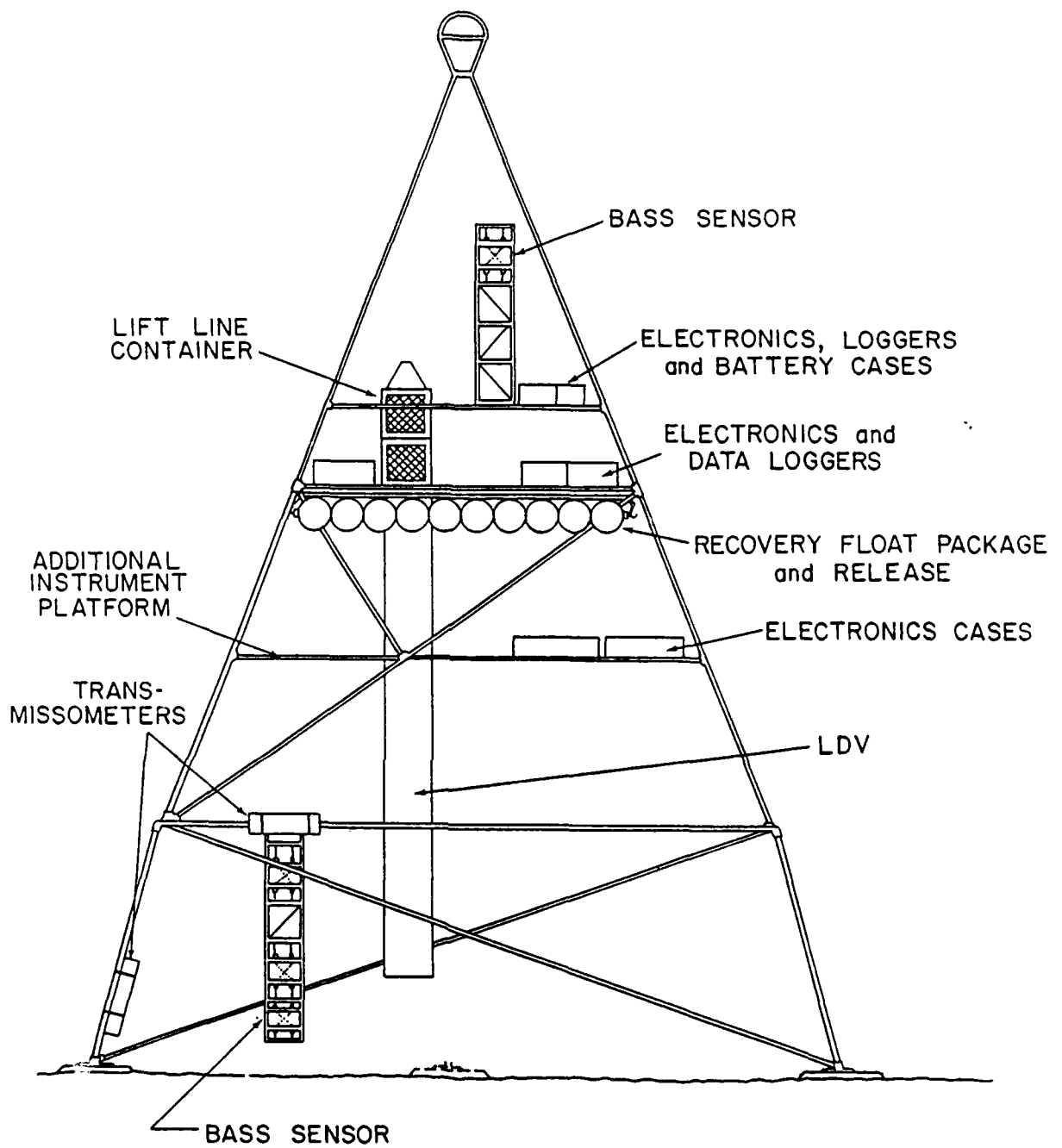


Figure 2: C3 BASS Tripod

As a final measure, the lift line is secured to the tripod outside of the container using very low strength monofilament fish line to prevent any pumping of the contents by wave or current action.

It was also important to incorporate a true latch action into the design of the release. A true latch is a device which captures and contains a variable load without transmitting the load itself onto the member restraining the latch. This was accomplished in our design by carefully shaping the release cams so that loads from the float package were transferred to the cam axle, not the restraining cable.

Dual in line releases are considered to be a crucial element of any oceanographic release, allowing for successful operation in the event of a single release failure. Our design used electrically dissolved nichrome "burn" wires to provide the release capability. Two fully isolated wires are connected in series to the restraining member of the release so that they can be "burned" individually by separate release units. The units are acoustically commanded from the surface ship, and can also be set to release on a back up timer to ensure release in the event of a poor acoustic command channel.

Another consideration in our design effort was to use low cost, lightweight, off the shelf components where possible. Flotation was provided by commercial mid-water fishing floats. These are available from a variety of commercial sources, are reasonably inexpensive, and provide adequate performance for the depths we were operating in. A single unit was pressure tested here at WHOI and found to have a collapse depth of approximately 1300 meters (1900 psi), well in excess of our 90 meter depth requirement. A total of ten seven inch diameter spherical floats were used to provide fifty pounds of positive buoyancy. The total cost for the floats was about \$100. This is considerably less than the cost of a glass sphere or syntactic foam float providing a similar amount of buoyancy.

The line canister was constructed from plastic milk crates lined with a heavy duty plastic mesh material. The mesh was intended to prevent the line from throwing a loop through the larger openings in the milk crates. The top of the canister was sealed with a lid consisting of a crate bottom and a large circular funnel. The funnel was inverted and had its opening enlarged to allow the line to pay out smoothly. The line itself was coiled evenly within the container in such a way to minimize the possibility of a loop catching in the funnel opening as the line paid out.

The use of plastic components meant that we were able to assemble the rope canisters using only hand tools and simple fabrication techniques. This design philosophy held true for the rest of the recovery system as well. The float package itself was assembled with aluminum tubing and stainless steel eyebolts. Three welds were required to complete the float package assembly. The float rack and latch were also constructed of aluminum and stainless components. The latch cam was the only part which required any type of complicated machining for assembly. The release springs and restraining cable were constructed with commercially available hardware. Zinc anodes were attached to the float rack for corrosion protection.

4 Features As Built

The float package for the recovery system was fabricated with commercial midwater trawl floats. We selected the variety with a single hole through the center of the float, and captured ten of them on an aluminum pipe to form a package. The fishing floats were selected because they were inexpensive and readily available. In quantity, the floats can be purchased for about \$10 (1989) each. A drawing of the completed float package is shown in Figure 3.

Before assembling the float package, we performed a pressure test on a single float. The pressure test facility here at WHOI was used to compress a float until it imploded. The test proved that the float could withstand pressures equivalent to a collapse depth of approximately 1300 meters. Our requirement was to provide an operating depth of approximately 90 meters, which was well within the capabilities of the float selected. The test results indicated that we would have a depth safety factor of about fifteen to one.

As a further test, the floats that were used in the field were subjected to slow leak tests. This was accomplished by storing the floats in the pressure test vessel for an extended time at approximately 65 PSI. The floats were weighed before and after the soaking to determine if any had gained weight due to seepage. None were discovered to have leaked, giving us confidence in our selection.

The float rack system was constructed from 6061 aluminum alloy. Channel section was used for the main structural component. Two V-notched stanchions were bolted to this backbone to provide location and support for the float package, which was secured by two latching cams. The cams were cut from 316 stainless steel to provide corrosion resistance, and engaged stainless eyebolts at either end of the float package. The cams were arranged so that extension springs would return them to an open position when the release unit was commanded to function. The cams were held in the cocked position by stainless steel cables terminating in insulated blocks which were connected by nichrome burn wires. The cams were isolated electrically from the aluminum float rack with nylon shoulder washers. The springs, cables and burn wires were adapted from our deep sea tripod release with one additional feature. A stainless steel turnbuckle was added to the restraining cable assembly to allow for tensioning of the release link after the nichrome links had been established. In previous releases, we had depended on the burn wire assembly to provide the correct tension when installed. This simple design modification allows the operator to assemble the burn link without tension on it, greatly simplifying the task, and increasing operator safety. A drawing showing the release features is presented in Figure 4.

The insulating blocks mentioned above are fabricated from fiberglass or some other suitable insulating material. The purpose of the blocks is to ensure that the nichrome burn wire links are totally isolated from any other part of the tripod. If a burn wire were to be electrically connected to some part of the tripod, the release might fail to function as the current required to dissolve the nichrome wire could be short circuited into some other metal component.

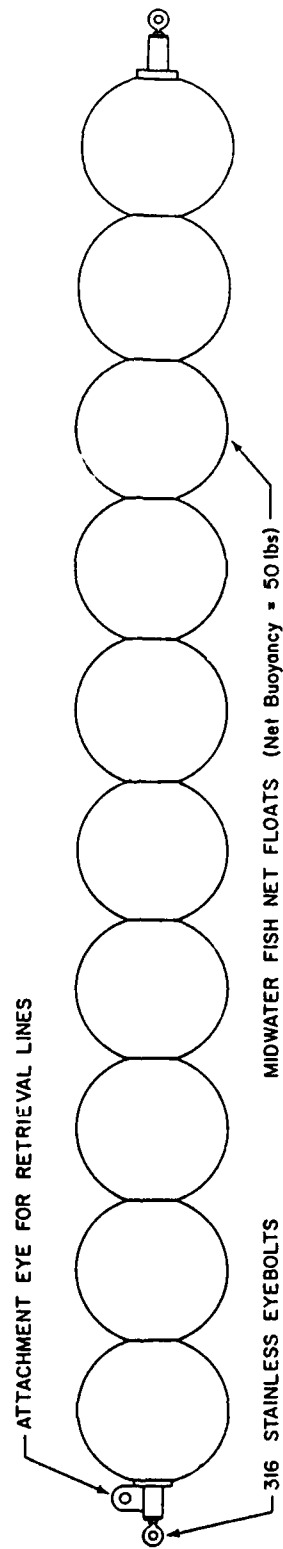


Figure 3: Completed Float Package

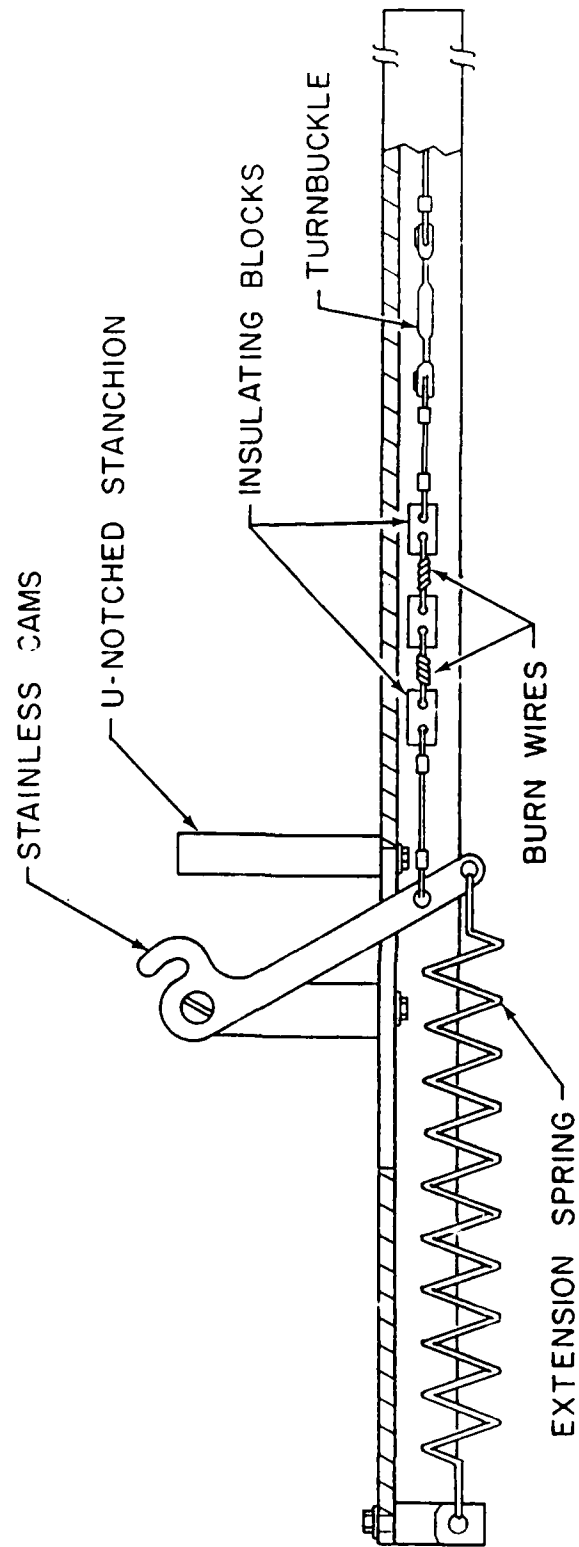


Figure 4: Drawing of Release Features

The retrieval line, 1/2 inch diameter Samson brand 2 in 1 braid, is easy to handle on deck, strong enough to lift the tripod even with moderate damage, and has excellent resistance to abrasion because of its outer sheath. This line was selected based on our previous experience in CODE, where a tripod was lost because a smaller, less abrasion resistant line was used. The line was spooled into a storage canister made from milk crates. The canister was lined with a stiff plastic mesh material to keep the line in place and to prevent a loop from spilling out of the side holes. The open construction of the milk crates was preferred to allow the canister to flood freely during tripod deployment, preventing trapped air bubbles from displacing or moving the stored line. The line was spooled into the canister in a carefully controlled lay pattern drawn from the experience of the New England whaling fleet. Our intention was to ensure that the line could pay out freely, and yet be stored in as small a canister as possible. The canister and rope packing techniques are illustrated in Figure 5.

The BASS tripods have an instrument platform approximately 12 feet above the bottom. The line canister was mounted on this platform where it would be free from obstructions. The float rack and package were also attached to the tripod on this platform, but mounted to the side so that the float package would be free to rise without obstructions above. The line was dressed from the float to the canister along the tripod frame.

It was secured with 10 pound test monofilament line to prevent unwanted motion of the line. In addition, an exposed run of the lifting line was encased in a length of split garden hose to keep it from being pulled loose by wave action during deployment. The monofilament line was tested with a tension metering device to ensure that its strength was not significantly greater than the listed rating. The float package had approximately 50 pounds of positive buoyancy, which was adequate to overcome the restraint offered by the 10 pound monofilament line.

5 Field Experience

The recovery package described here was used as the primary retrieval system during the STRESS experiment. The system was attached to a total of four tripods which were deployed for five months. During this time, each tripod was recovered twice, once for servicing at the experiment midpoint, and once for final retrieval. All of the systems fired successfully on command, releasing the float package from its restraining cradle. In all but one recovery attempt, the float pulled the recovery line to the surface allowing for a normal recovery using the ship's winch and crane. The single failure was caused by the recovery line fouling in the rope canister, preventing the float package from reaching the surface. This tripod was recovered using an ROV to attach an alternate lifting line to the tripod. This method was used because the tripod was too deep for simple diver recovery.

During the five months of deployment the system did experience some corrosion problems. In particular, the tab which connected the lifting line to the float package suffered from severe corrosion. Excessive corrosion at this point would result in the failure of the connection

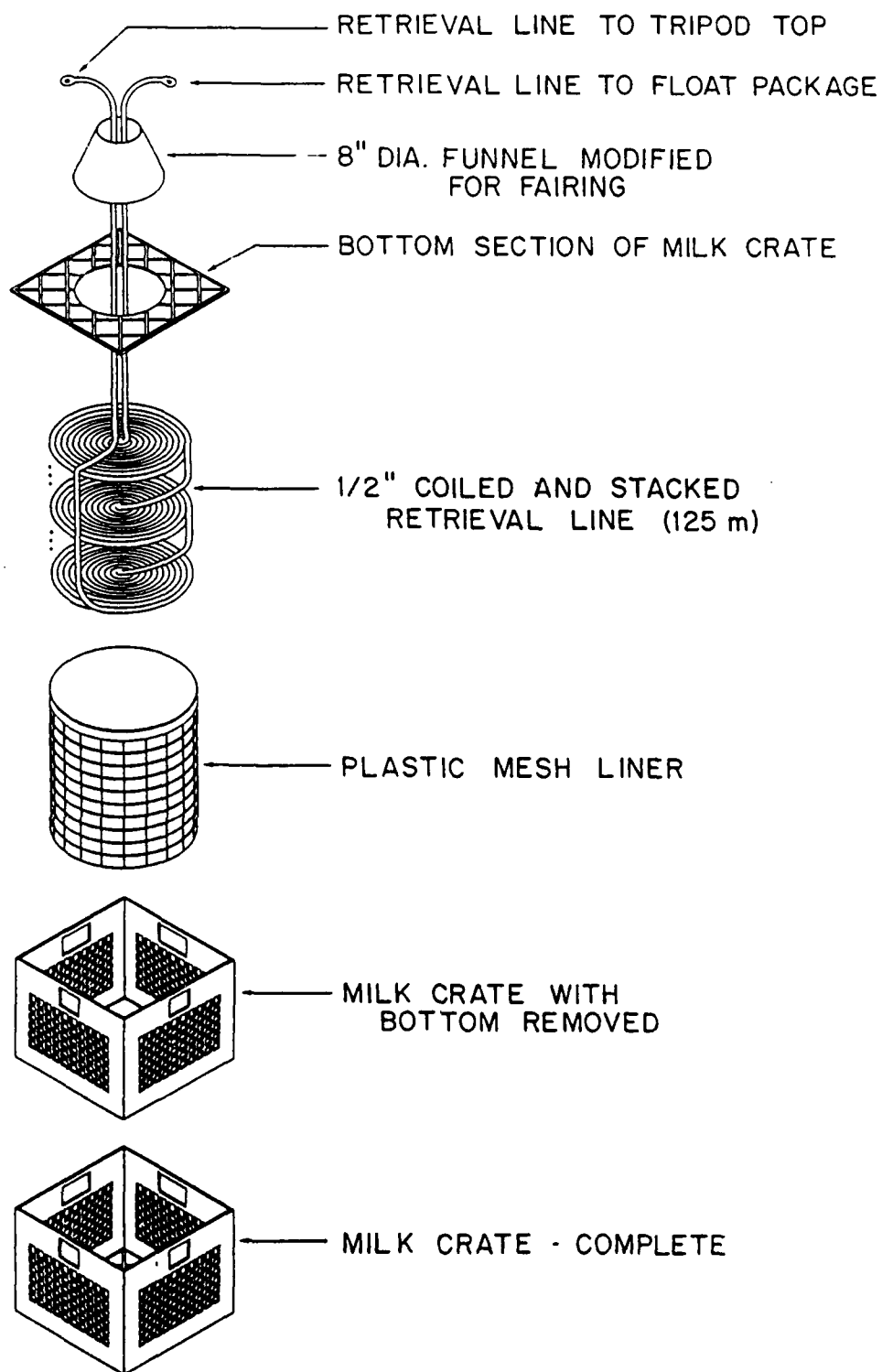


Figure 5: Illustration of Canister and Rope Packing Techniques

between the float package and the lift line, allowing the float to surface without the recovery line. This could result in the loss of the tripod if an alternate recovery means were not available. We first discovered the problem when the tripods were recovered for servicing after two and one half months of deployment. At that time, we added a zinc anode to the float rack to slow the loss of material, and also added a safety line to the attachment so that the float would remain attached to the lifting line even if the attachment point failed completely. A more subtle failure was also possible from corrosion effects. The restraints holding the individual trawl floats to the rack assembly also suffered some corrosion damage. If these were to fail, the individual floats would be free to rise to the surface without the rack or attached lifting line when the release was fired.

The most serious problem that we encountered during the actual deployment was the failure of a single float to arrive at the surface when commanded due to line fouling. The tripod involved had pre-released early in the experiment and been redeployed. The pre-release occurred within hours of launching the tripod and was discovered to have been caused by an error in configuring the release electronics. A backup timer circuit was inadvertently left in test mode causing the release to fire prematurely. Once the pre-release was discovered, the tripod involved was recovered, the release was rearmed, the lifting line was carefully repacked in the rope canister, and the tripod was redeployed. Study of the rope canister and its contents after the ROV recovery did not yield any clues other than the observation that the lift line had thrown a loop around the tightly coiled contents inside the canister and the float had been unable to pull this blockage through the narrow opening of the rope canister. It is possible that the problem was caused by the repacking of the rope canister, although similarly repacked equipment worked as expected. It was not possible to closely inspect the fouled equipment with the camera on the ROV during the rescue operation so no further conclusions about the cause of the single failure are possible. It is reported here, however, as a cautionary note to users of this system to point out the importance of proper assembly of the various components of this type of release system. As a further safeguard against this type of failure, it is possible that the lid of the rope canister should be fastened with monofilament line. This would allow the float package to pull the entire block of recovery line free if it tangled and possibly provide enough slack for the float to reach the surface. We have not tried this alternative and do not recommend it without engineering trials to assess problems that might be introduced by this change in configuration.

In spite of the single failure discussed above, the overall success of the system was extremely good. A prototype unit was assembled and tested in Woods Hole before committing to a final design. The experience in the test showed that the conceptual design was satisfactory, and some minor modifications in materials and assembly techniques were incorporated in the units constructed for field use. In total, eight deployment recovery cycles were performed including the dock test in Woods Hole. Of these eight cycles, only a single failure was noted, and that was of the recovery line payout, not the latch portion of the mechanism. Extra care should be taken in packing the rope canister because it is the only component of the system which has demonstrated a failure mode. The use of zinc anodes to protect the alloy portions of the float rack is also recommended, along with the use of a corrosion resistant alloy. Some of the prototype components were fabricated with alloy of unknown composition.

The parts which were known to be 6061 alloy exhibited excellent corrosion resistance during the extended deployments.

6 Conclusions

The recovery system described in this report is an appropriate tool to use in oceanographic studies where the recovery of the entire instrument package including the anchor weight is desired. The pop up float can be used to pull a strong recovery line to the surface so that the entire sub-surface assembly can be retrieved. The float package has a buoyancy of 50 pounds as described here but could be enlarged to allow for additional lift if desired. The lift line described here is a one half inch diameter Dacron line with a safe lifting capacity of about five thousand pounds. This was well in excess of our need to recover approximately 1000 pounds, but provided an excellent safety margin for our operations. In addition, the half inch sheathed line has proven to be a very comfortable line to work with in the field.

The system described here will not be appropriate for all situations. In particular, deployments in areas with high currents or greater depth may require additional buoyancy for successful operation due to current drag and dead weight loading on the lift line. These effects should be investigated before selecting this system for a specific application. The float rack we deployed had no lighting on it which would have made night recovery operations difficult. For recovery at night some type of lighting and/or reflective tape is recommended.

We did find that the system described here performed well under the conditions we experienced. The water depth was approximately 90 meters, and the currents in the area were one knot or less. The float could pull the half inch lift line to the surface in about ten to fifteen minutes, and then keep the line on the surface until recovered by the ship. We did limit the length of the line, working with a scope of approximately 1.25 to 1, requiring the ship to position itself immediately above the underwater package being recovered. This was done to prevent dragging during the recovery phase of the operation. For packages less sensitive to dragging damage, a longer scope would be recommended to allow for easier handling of the lift line once aboard the recovery ship.

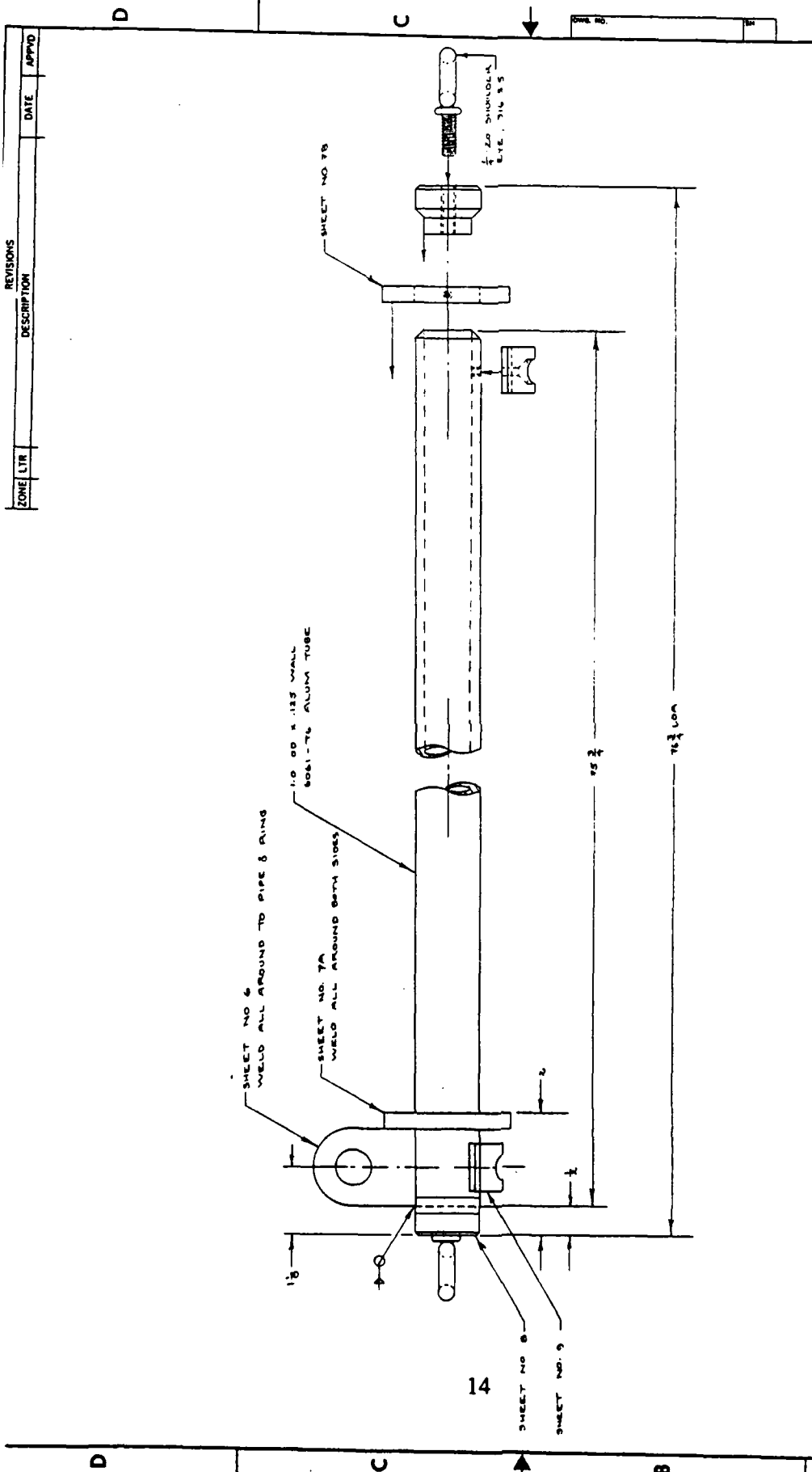
7 Appendix A

Engineering Drawings

This appendix contains a set of twelve drawings which show the components required to build the release and float system described in this report. The drawings presented here are numbered in accordance with the drawing library maintained by Dr. Albert J. Williams 3rd, for whom this work was performed.

<u>Drawing Number</u>	<u>Description</u>
AJW-M-0020C	Main Support Channel
AJW-M-0021C	Float Support Pipe Assembly
AJW-M-0318B	Latch, Stainless Steel
AJW-M-0319B	Latch Pedestal
AJW-M-0320B	Spring Holder
AJW-M-0321B	Float Support Block
AJW-M-0322B	Lift Line Tab
AJW-M-0323B	Float Retainer Ring I
AJW-M-0324B	Float Retainer Ring II
AJW-M-0325B	Float Rack End Plug
AJW-M-0326B	Alignment Block
AJW-M-0018D	Assembly Drawing

REVISIONS		DATE	APPRO
ZONE	LTR	DESCRIPTION	



REFERENCE: ATW-M-0010C

ITEM	PART OR DWG. NO.	DESCRIPTION	QTY
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES			
TOLERANCES:		CONTRACT NO.	
FRACTIONS	DECIMALS	APPROVALS	DATE
ANGLES	XX°	DRAWN ALO	11-82
	XX'	CHECKED	
		APPROVED	
MATERIAL		TITLE	
		WOODS HOLE OCEANOGRAPHIC INSTITUTION	
		OCEAN ENGINEERING DEPT.	
		WOODS HOLE, MA 02543	
		FLOAT SUPPORT PIPE ASSY	
		TRIPOD RELEASE SYS	
		SHEET C	
		DWG. NO. ATW-M-0010C	
		REV.	
		SCALE: FULL	
		SHEET 10 OF 1	

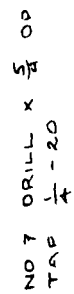


7 C 3WS 2-162 NYCON SHOULDER WASHINGTON

MAY BE SAW CUT AND PILE/SAND TO DIMENSION

2. ଅନୁପ୍ରାପ୍ତି ଅର୍ଥାତ୍

1-800-4-A-CAES 9-46778

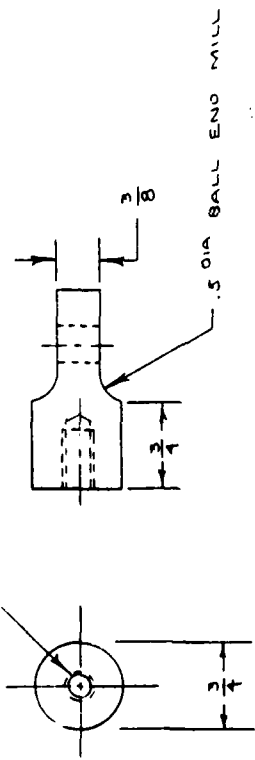


NO 7 ORILL x 5/5
TAP - 20
1/4

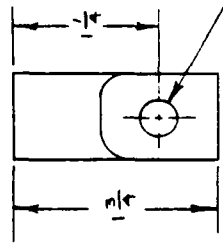
6486-1 1207/0708

REVISES		DESCRIPTION		DATE	APPROV
ZONE	LTR				

NO 7 DRILL $\times \frac{3}{8}$ OP
TAP $\frac{1}{4}$ -20



$\frac{5}{16}$ DRILL THRU
TO ACCEPT MICRO PLASTICS



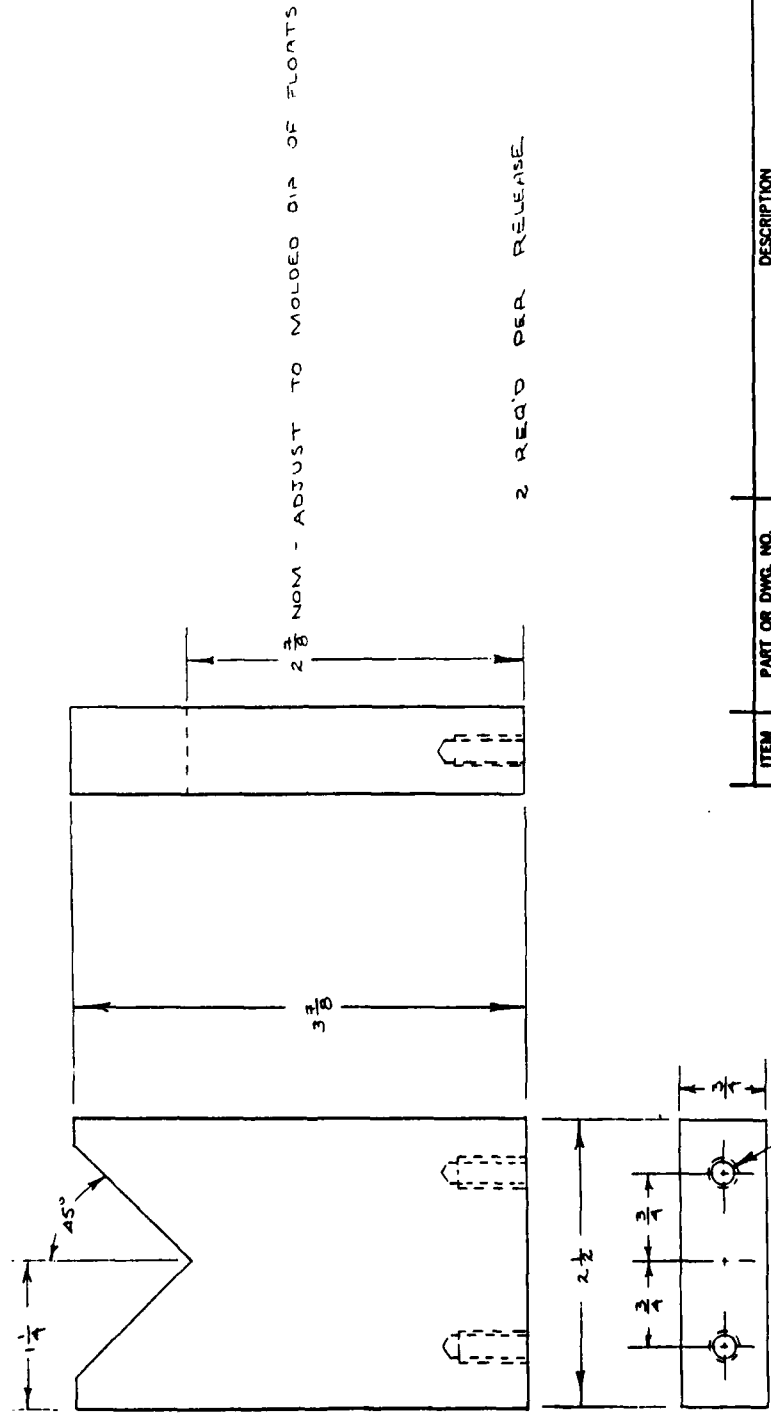
NO SC250 $\times \frac{1}{2}$ NYLON SHOULDER WASHER

2 REQ'D PER RELEASE

ITEM	PART OR DWG. NO.	DESCRIPTION	QTY
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES			
TOLERANCES		CONTRACT NO.	
FRACTION	DECIMALS	APPROVALS	
$\frac{1}{16}$	.0625	DATE	
$\frac{1}{8}$	.125	DRAWN AGG	
$\frac{1}{4}$	.25	CHKD	
$\frac{3}{8}$	.375	APPROV	
MATERIAL		FINISH	
6061-T6 ALUM			
TITLE		WOODS HOLE OCEANOGRAPHIC INSTITUTION	
SPRING HOLDER		OCEAN ENGINEERING DEPT.	
TRIPOD RELEASE SYS		WOODS HOLE, MA 02543	
SIZE		REV.	
B		AGV-N-0320 B	
SCALE FULL		SHEET 1 OF 1	

4 3 2 1

REVISIONS		DATE		APPROV	
ZONE	LTR	DESCRIPTION		DATE	



ITEM	PART OR DWG. NO.	DESCRIPTION				QTY
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NO.		WOODS HOLE OCEANOGRAPHIC INSTITUTION OCEAN ENGINEERING DEPT. WOODS HOLE, MA 02543		
TOLERANCES:		APPROVALS	DATE	TITLE		
FRAC 1/16	DECIMALS	DRAWN AGS	11-88	FLOAT SUPPORT BLOCK		
± /	XX ±	CHK'D		TRIPOD RELEASE SYS		
ANGLES	XXX ±	APPROV		SIZE B		
MATERIAL		FINISH		DWG. NO. AJW-M-0321 B		
3 PVC				REV.		
1				SCALE FULL		
				SHEET 5 OF		

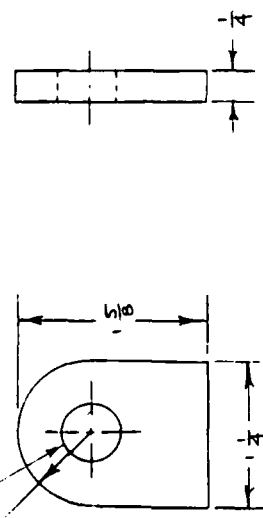
4 3 2 1

4 3 2 1

REVISIONS		
ZONE	LTR	DESCRIPTION
		DATE
		APPROD

$\frac{3}{8}$ R - SAW CUT AND FILE

$\frac{32}{64}$ DRILL THRU - TO ACCEPT MICRO-PLASTICS MICROM
SHOULDER WASHER NO. SWS 3501



19

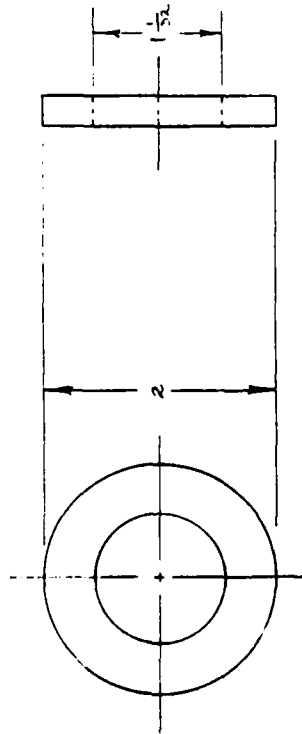
1 REQD PER FLOAT ASSY

ITEM	PART OR DWG. NO.	DESCRIPTION	QTY
		WOODS HOLE OCEANOGRAPHIC INSTITUTION OCEAN ENGINEERING DEPT. WOODS HOLE, MA 02543	
		CONTRACT NO.	
		DATE	
		APPROVALS	
		DRAWN	
		CHECKED	
		APPROD	
		FINISH	
		TITLE	
		LIFT LINE TAB	
		FLOAT ASSY	
		TRIPOD RELEASE SYS	
		SIZE	
		DWG NO. AJW-M-0322B	
		SCALE	
		FULL	
		SHEET 6 OF	

4 3 2 1

UNOFFICIAL PARTS

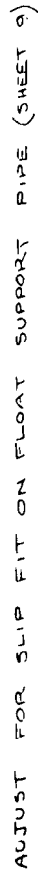
REVISIONS			
ZONE	LTR	DESCRIPTION	DATE



ADJUST FOR SLIP FIT ON FLOAT SUPPORT PIPE (SHEET 9)

1 REQD PER FLOAT ASSY

ITEM	PART OR DWG. NO.	DESCRIPTION	QTY
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		WOODS HOLE OCEANOGRAPHIC INSTITUTION OCEAN ENGINEERING DEPT. WOODS HOLE, MA 02543	
CONTRACT NO.		TITLE	
APPROVALS	DATE	RING - FLOAT RETAINER	
DRAWN AGG	11-85	FLOAT ASSY	
CHECKED		TRIPOD RELEASE SYS	
APPROVED		SIZE B	
FINISH		DWG. NO. A374-M-0323 B	
MATERIAL		SCALE	
1/4 ALUM		FULL	
		SHEET 3A OF	



NO 36 DRILL - THRU
TAP 6-32
2 PLACES

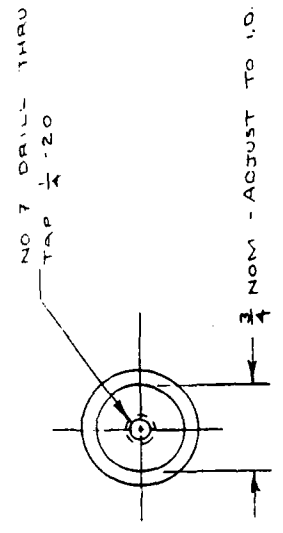
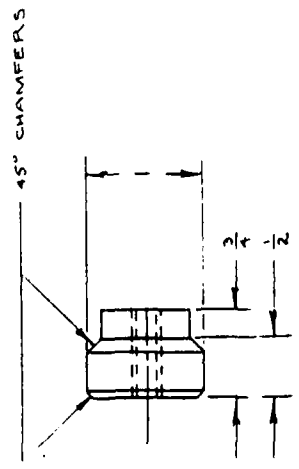
1 REQ'D PER FLOAT ASSY

[illegible]

ITEM	PART OR DWG. NO.	DESCRIPTION			QTY
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		WOODS HOLE OCEANOGRAPHIC INSTITUTION OCEAN ENGINEERING DEPT. WOODS HOLE, MA. 02543			
TOLERANCES:		CONTRACT NO.			
SURFACE MICRO IN					
FRACTIONAL DECIMALS					
± .005 .01 .02 .03 .04 .05 .06 .07 .08 .09 .10 .12 .15 .18 .20 .25 .30 .35 .40 .45 .50 .55 .60 .65 .70 .75 .80 .85 .90 .95 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25 3.50 3.75 4.00 4.25 4.50 4.75 5.00 5.25 5.50 5.75 6.00 6.25 6.50 6.75 7.00 7.25 7.50 7.75 8.00 8.25 8.50 8.75 9.00 9.25 9.50 9.75 10.00 10.25 10.50 10.75 11.00 11.25 11.50 11.75 12.00 12.25 12.50 12.75 13.00 13.25 13.50 13.75 14.00 14.25 14.50 14.75 15.00 15.25 15.50 15.75 16.00 16.25 16.50 16.75 17.00 17.25 17.50 17.75 18.00 18.25 18.50 18.75 19.00 19.25 19.50 19.75 20.00 20.25 20.50 20.75 21.00 21.25 21.50 21.75 22.00 22.25 22.50 22.75 23.00 23.25 23.50 23.75 24.00 24.25 24.50 24.75 25.00 25.25 25.50 25.75 26.00 26.25 26.50 26.75 27.00 27.25 27.50 27.75 28.00 28.25 28.50 28.75 29.00 29.25 29.50 29.75 30.00 30.25 30.50 30.75 31.00 31.25 31.50 31.75 32.00 32.25 32.50 32.75 33.00 33.25 33.50 33.75 34.00 34.25 34.50 34.75 35.00 35.25 35.50 35.75 36.00 36.25 36.50 36.75 37.00 37.25 37.50 37.75 38.00 38.25 38.50 38.75 39.00 39.25 39.50 39.75 40.00 40.25 40.50 40.75 41.00 41.25 41.50 41.75 42.00 42.25 42.50 42.75 43.00 43.25 43.50 43.75 44.00 44.25 44.50 44.75 45.00 45.25 45.50 45.75 46.00 46.25 46.50 46.75 47.00 47.25 47.50 47.75 48.00 48.25 48.50 48.75 49.00 49.25 49.50 49.75 50.00 50.25 50.50 50.75 51.00 51.25 51.50 51.75 52.00 52.25 52.50 52.75 53.00 53.25 53.50 53.75 54.00 54.25 54.50 54.75 55.00 55.25 55.50 55.75 56.00 56.25 56.50 56.75 57.00 57.25 57.50 57.75 58.00 58.25 58.50 58.75 59.00 59.25 59.50 59.75 60.00 60.25 60.50 60.75 61.00 61.25 61.50 61.75 62.00 62.25 62.50 62.75 63.00 63.25 63.50 63.75 64.00 64.25 64.50 64.75 65.00 65.25 65.50 65.75 66.00 66.25 66.50 66.75 67.00 67.25 67.50 67.75 68.00 68.25 68.50 68.75 69.00 69.25 69.50 69.75 70.00 70.25 70.50 70.75 71.00 71.25 71.50 71.75 72.00 72.25 72.50 72.75 73.00 73.25 73.50 73.75 74.00 74.25 74.50 74.75 75.00 75.25 75.50 75.75 76.00 76.25 76.50 76.75 77.00 77.25 77.50 77.75 78.00 78.25 78.50 78.75 79.00 79.25 79.50 79.75 80.00 80.25 80.50 80.75 81.00 81.25 81.50 81.75 82.00 82.25 82.50 82.75 83.00 83.25 83.50 83.75 84.00 84.25 84.50 84.75 85.00 85.25 85.50 85.75 86.00 86.25 86.50 86.75 87.00 87.25 87.50 87.75 88.00 88.25 88.50 88.75 89.00 89.25 89.50 89.75 90.00 90.25 90.50 90.75 91.00 91.25 91.50 91.75 92.00 92.25 92.50 92.75 93.00 93.25 93.50 93.75 94.00 94.25 94.50 94.75 95.00 95.25 95.50 95.75 96.00 96.25 96.50 96.75 97.00 97.25 97.50 97.75 98.00 98.25 98.50 98.75 99.00 99.25 99.50 99.75 100.00 100.25 100.50 100.75 101.00 101.25 101.50 101.75 102.00 102.25 102.50 102.75 103.00 103.25 103.50 103.75 104.00 104.25 104.50 104.75 105.00 105.25 105.50 105.75 106.00 106.25 106.50 106.75 107.00 107.25 107.50 107.75 108.00 108.25 108.50 108.75 109.00 109.25 109.50 109.75 110.00 110.25 110.50 110.75 111.00 111.25 111.50 111.75 112.00 112.25 112.50 112.75 113.00 113.25 113.50 113.75 114.00 114.25 114.50 114.75 115.00 115.25 115.50 115.75 116.00 116.25 116.50 116.75 117.00 117.25 117.50 117.75 118.00 118.25 118.50 118.75 119.00 119.25 119.50 119.75 120.00 120.25 120.50 120.75 121.00 121.25 121.50 121.75 122.00 122.25 122.50 122.75 123.00 123.25 123.50 123.75 124.00 124.25 124.50 124.75 125.00 125.25 125.50 125.75 126.00 126.25 126.50 126.75 127.00 127.25 127.50 127.75 128.00 128.25 128.50 128.75 129.00 129.25 129.50 129.75 130.00 130.25 130.50 130.75 131.00 131.25 131.50 131.75 132.00 132.25 132.50 132.75 133.00 133.25 133.50 133.75 134.00 134.25 134.50 134.75 135.00 135.25 135.50 135.75 136.00 136.25 136.50 136.75 137.00 137.25 137.50 137.75 138.00 138.25 138.50 138.75 139.00 139.25 139.50 139.75 140.00 140.25 140.50 140.75 141.00 141.25 141.50 141.75 142.00 142.25 142.50 142.75 143.00 143.25 143.50 143.75 144.00 144.25 144.50 144.75 145.00 145.25 145.50 145.75 146.00 146.25 146.50 146.75 147.00 147.25 147.50 147.75 148.00 148.25 148.50 148.75 149.00 149.25 149.50 149.75 150.00 150.25 150.50 150.75 151.00 151.25 151.50 151.75 152.00 152.25 152.50 152.75 153.00 153.25 153.50 153.75 154.00 154.25 154.50 154.75 155.00 155.25 155.50 155.75 156.00 156.25 156.50 156.75 157.00 157.25 157.50 157.75 158.00 158.25 158.50 158.75 159.00 159.25 159.50 159.75 160.00 160.25 160.50 160.75 161.00 161.25 161.50 161.75 162.00 162.25 162.50 162.75 163.00 163.25 163.50 163.75 164.00 164.25 164.50 164.75 165.00 165.25 165.50 165.75 166.00 166.25 166.50 166.75 167.00 167.25 167.50 167.75 168.00 168.25 168.50 168.75 169.00 169.25 169.50 169.75 170.00 170.25 170.50 170.75 171.00 171.25 171.50 171.75 172.00 172.25 172.50 172.75 173.00 173.25 173.50 173.75 174.00 174.25 174.50 174.75 175.00 175.25 175.50 175.75 176.00 176.25 176.50 176.75 177.00 177.25 177.50 177.75 178.00 178.25 178.50 178.75 179.00 179.25 179.50 179.75 180.00 180.25 180.50 180.75 181.00 181.25 181.50 181.75 182.00 182.25 182.50 182.75 183.00 183.25 183.50 183.75 184.00 184.25 184.50 184.75 185.00 185.25 185.50 185.75 186.00 186.25 186.50 186.75 187.00 187.25 187.50 187.75 188.00 188.25 188.50 188.75 189.00 189.25 189.50 189.75 190.00 190.25 190.50 190.75 191.00 191.25 191.50 191.75 192.00 192.25 192.50 192.75 193.00 193.25 193.50 193.75 194.00 194.25 194.50 194.75 195.00 195.25 195.50 195.75 196.00 196.25 196.50 196.75 197.00 197.25 197.50 197.75 198.00 198.25 198.50 198.75 199.00 199.25 199.50 199.75 200.00 200.25 200.50 200.75 201.00 201.25 201.50 201.75 202.00 202.25 202.50 202.75 203.00 203.25 203.50 203.75 204.00 204.25 204.50 204.75 205.00 205.25 205.50 205.75 206.00 206.25 206.50 206.75 207.00 207.25 207.50 207.75 208.00 208.25 208.50 208.75 209.00 209.25 209.50 209.75 210.00 210.25 210.50 210.75 211.00 211.25 211.50 211.75 212.00 212.25 212.50 212.75 213.00 213.25 213.50 213.75 214.00 214.25 214.50 214.75 215.00 215.25 215.50 215.75 216.00 216.25 216.50 216.75 217.00 217.25 217.50 217.75 218.00 218.25 218.50 218.75 219.00 219.25 219.50 219.75 220.00 220.25 220.50 220.75 221.00 221.25 221.50 221.75 222.00 222.25 222.50 222.75 223.00 223.25 223.50 223.75 224.00 224.25 224.50 224.75 225.00 225.25 225.50 225.75 226.00 226.25 226.50 226.75 227.00 227.25 227.50 227.75 228.00 228.25 228.50 228.75 229.00 229.25 229.50 229.75 230.00 230.25 230.50 230.75 231.00 231.25 231.50 231.75 232.00 232.25 232.50 232.75 233.00 233.25 233.50 233.75 234.00 234.25 234.50 234.75 235.00 235.25 235.50 235.75 236.00 236.25 236.50 236.75 237.00 237.25 237.50 237.75 238.00 238.25 238.50 238.75 239.00 239.25 239.50 239.75 240.00 240.25 240.50 240.75 241.00 241.25 241.50 241.75 242.00 242.25 242.50 242.75 243.00 243.25 243.50 243.75 244.00 244.25 244.50 244.75 245.00 245.25 245.50 245.75 246.00 246.25 246.50 246.75 247.00 247.25 247.50 247.75 248.00 248.25 248.50 248.75 249.00 249.25 249.50 249.75 250.00 250.25 250.50 250.75 251.00 251.25 251.50 251.75 252.00 252.25 252.50 252.75 253.00 253.25 253.50 253.75 254.00 254.25 254.50 254.75 255.00 255.25 255.50 255.75 256.00 256.25 256.50 256.75 257.00 257.25 257.50 257.75 258.00 258.25 258.50 258.75 259.00 259.25 259.50 259.75 260.00 260.25 260.50 260.75 261.00 261.25 261.50 261.75 262.00 262.25 262.50 262.75 263.00 263.25 263.50 263.75 264.00 264.25 264.50 264.75 265.00 265.25 265.50 265.75 266.00 266.25 266.50 266.75 267.00 267.25 267.50 267.75 268.00 268.25 268.50 268.75 269.00 269.25 269.50 269.75 270.00 270.25 270.50 270.75 271.00 271.25 271.50 271.75 272.00 272.25 272.50 272.75 273.00 273.25 273.50 273.75 274.00 274.25 274.50 274.75 275.00 275.25 275.50 275.75 276.00 276.25 276.50 276.75 277.00 277.25 277.50 277.75 278.00 278.25 278.50 278.75 279.00 279.25 279.50 279.75 280.00 280.25 280.50 280.75 281.00 281.25 281.50 281.75 282.00 282.25 282.50 282.75 283.00 283.25 283.50 283.75 284.00 284.25 284.50 284.75 285.00 285.25 285.50 285.75 286.00 286.25 286.50 286.75 287.00 287.25 287.50 287.75 288.00 288.25 288.50 288.75 289.00 289.25 289.50 289.75 290.00 290.25 290.50 290.75 291.00 291.25 291.50 291.75 292.00 292.25 292.50 292.75 293.00 293.25 293.50 293.75 294.00 294.25 294.50 294.75 295.00 295.25 295.50 295.75 296.00 296.25 296.50 296.75 297.00 297.25 297.50 297.75 298.00 298.25 298.50 298.75 299.00 299.25 299.50 299.75 300.00 300.25 300.50 300.75 301.00 301.25 301.50 301.75 302.00 302.25 302.50 302.75 303.00 303.25 303.50 303.75 304.00 304.25 304.50 304.75 305.00 305.25 305.50 305.75 306.00 306.25 306.50 306.75 307.00 307.25 307.50 307.75 308.00 308.25 308.50 308.75 309.00 309.25 309.50 309.75 310.00 310.25 310.50 310.75 311.00 311.25 311.50 311.75 312.00 312.25 312.50 312.75 313.00 313.25 313.50 313.75 314.00 314.25 314.50 314.75 315.00 315.25 315.50 315.75 316.00 316.25 316.50 316.75 317.00 317.25 317.50 317.75 318.00 318.25 318.50 318.75 319.00 319.25 319.50 319.75 320.00 320.25 320.50 320.75 321.00 321.25 321.50 321.75 322.00 322.25 322.50 322.75 323.00 323.25 323.50 323.75 324.00 324.25 324.50 324.75 325.00 325.25 325.50 325.75 326.00 326.25 326.50 326.75 327.00 327.25 327.50 327.75 328.00 328.25 328.50 328.75 329.00 329.25 329.50 329.75 330.00 330.25 330.50 330.75 331.00 331.25 331.50 331.75 332.00 332.25 332.50 332.75 333.00 333.25 333.50 333.75 334.00 334.25 334.50 334.75 335.00 335.25 335.50 335.75 336.00 336.25 336.50 336.75 337.00 337.25 337.50 337.75 338.00 338.25 338.50 338.75 339.00 339.25 339.50 339.75 340.00 340.25 340.50 340.75 341.00 341.25 341.50 341.75 342.00 342.25 342.50 342.75 343.00 343.25 343.50 343.75 344.00 344.25 344.50 344.75 345.00 345.25 345.50 345.75 346.00 346.25 346.50 346.75 347.00 347.25 347.50 347.75 348.00 348.25 348.50 348.75 349.00 349.25 349.50 349.75 350.00 350.25 350.50 350.75 351.00 351.25 351.50 351.75 352.00 352.25 352.50 352.75 353.00 353.25 353.50 353.75 354.00 354.25 354.50 354.75 355.00 355.25 355.50 355.75 356.00 356.25 356.50 356.75 357.00 357.25 357.50 357.75 358.00 358.25 358.50 358.75 359.00 359.25 359.50 359.75 360.00 360.25 360.50 360.75 361.00 361.25 361.50 361.75 362.00 362.25 362.50 362.75 363.00 363.25 363.50 363.75 364.00 364.25 364.50 364.75 365.00 365.25 365.50 365.75 366.00 366.25 366.50 366.75 367.00 367.25 367.50 367.75 368.00 368.25 368.50 368.75 369.00 369.25 369.50 369.75 370.00 370.25 370.50 370.75 371.00 371.25 371.50 371.75 372.00 372.25 372.50 372.75 373.00 373.25 373.50 373.75 374.00 374.25 374.50 374.75 375.00 375.25 375.50 375.75 376.00 376.25 376.50 376.75 377.00 377.25 377.50 377.75 378.00 378.25 378.50 378.75 379.00 379.25 379.50 379.75 380.00 380.25 380.50 380.75 381.00 381.25 381.50 381.75 382.00 382.25 382.50 382.75 383.00 383.25 383.50 383.75 384.00 384.25 384.50 384.75 385.00 385.25 385.50 385.75 386.00 386.25 386.50 386.75 387.00 387.25 387.50 387.75 388.00 388.25 388.50 388.75 389.00 389.25 389.50 389.75 390.00 390.25 390.50 390.75 391.00 391.25 391.50 391.75 392.00 392.25 392.50 392.75 393.00 393.25 393.50 393.75 394.00 394.25 394.50 394.75 395.00 395.25 395.50 395.75 396.00 396.25 396.50 396.75 397.00 397.25 397.50 397.75 398.00 398.25 398.50 398.75 399.00 399.25 399.50 399.75 400.00 400.25 400.50 400.75 401.00 401.25 401.50 401.75 402.00 402.25 402.50 402.75 403.00 403.25 403.50 403.75 404.00 404.25 404.50 404.75 405.00 405.25 405.50 405.75 406.00 406.25 406.50 406.75 407.00 407.25 407.50 407.75 408.00 408.25 408.50 408.75 409.00 409.25 409.50 409.75 410.00 410.25 410.50 410.75 411.00 411.25 411.50 411.75 412.00 412.25 412.50 412.75 413.00 413.25 413.50 413.75 414.00 414.25 414.50 414.75 415.00 415.25 415.50 415.75 416.00 416.25 416.50 416.75 417.00 417.25 417.50 417.75 418.00 418.25 418.50 418.75 419.00 419.25 419.50 419.75 420.00 420.25 420.50 420.75 421.00 421.25 421.50 421.75 422.00 422.25 422.50 422.75 423.00 423.25 423.50 423.75 424.00 424.25 424.50 424.75 425.00 425.25 425.50 425.75 426.00 426.25 426.50 426.75 427.00 427.25 427.50 427.75 428.00 428.25 428.50 428.75 429.00 429.25 429.50 429.75 430.00 430.25 430.50 430.75 431.00 431.25 431.50 431.75 432.00 432.25 432.50 432.75 433.00 433.25 433.50 433.75 434.00 434.25 434.50 434.75 435.00 435.25 435.50 435.75 436.00 436.25 436.50 436.75 437.00 437.25 437.50 437.75 438.00 438.25 438.50 438.75 439.00 439.25 439.50 439.75 440.00 440.25 440.50 440.75 441.00 441.25 441.50 441.75 442.00 442.25 442.50 442.75 443.00 443.25 443.50 443.75 444.00 444.25 444.50 444.75 445.00 445.25 445.50 445.75 446.00 446.25 446.50 446.75 447.00 447.25 447.50 447.75 448.00 448.25 44					

4 3 2 1

REVISIONS			DATE	APPROV
ZONE	LTR	DESCRIPTION		



NOTE
WELO TO EACH END OF FLOAT SUPPORT PIPE
GRIND WELO SMOOTH TO ALLOW FLOAT RETAINER RINGS TO SLIP OVER

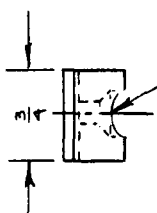
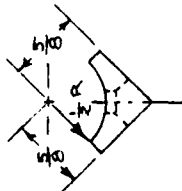
2 REQD PER FLOAT ASSY

ITEM	PART OR DWG. NO.	DESCRIPTION	QTY
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES			
TOLERANCES:		CONTRACT NO.	WOODS HOLE OCEANOGRAPHIC INSTITUTION OCEAN ENGINEERING DEPT. WOODS HOLE, MA 02543
FRAC 1/4	DECIMALS	DATE	
±	XX	DRAWN AGG 11-88	
ANGLES	XXX	CHKD	
MATERIAL		APPROV	TITLE END PLUG FLOAT ASSY TRIPPOD RELEASE SYS.
1 DIA ALUM		FINISH	
		SIZE	REV.
		B	1
		DWG. NO.	ASW. N. 0325 B
		SCALE	1/2" = 1"
		SHEET	1 OF 1

4 3 2 1

4 3 2 1

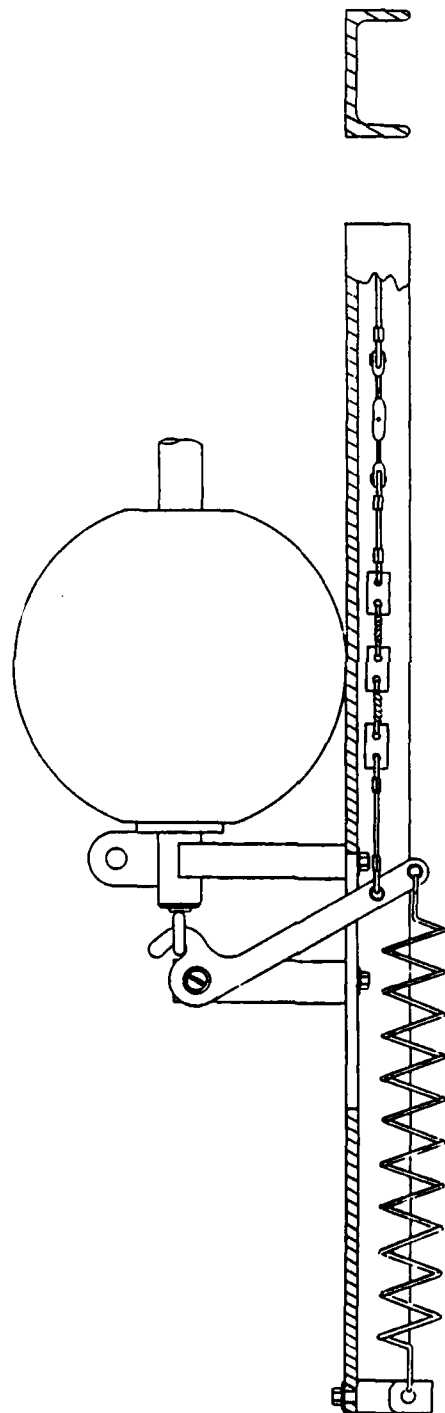
REVISIONS		DESCRIPTION		DATE		APPROV	
ZONE	LTR						



NO 8 DRILL THRU
CSK FOR NO 10 FH SCREW

2 REQ'D PER FLOAT ASSY

ITEM	PART OR DWG. NO.	DESCRIPTION	QTY
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES			
TOLERANCES:		SURFACE MICRO IN	
FRACTIONAL	DECIMALS	DATE	
3'	.XX	11-80	
ANGLES	XXX	CHKD	
MATERIAL		APPROV	
3/4 PVC		FINISH	
CONTRACT NO.		WOODS HOLE OCEANOGRAPHIC INSTITUTION	
		OCEAN ENGINEERING DEPT.	
		WOODS HOLE, MA 02543	
APPROVALS		TITLE	
DRAWN AGG		BLOCK - ALIGNMENT	
CHKD		FLOAT ASSY	
APPROV		TRIPOD RELEASE SYS	
FINISH		REV.	
SIZE 8		DWG NO. ATW-M-0326 B	
SCALE FULL		SHEET 9 OF 1	



ASSEMBLY DRAWING
STRESS TRIPOD RELEASE SYSTEM
DWG NO AFW-M-00180
A GORDON 10-24

8 Appendix B

List of Vendors

This appendix lists components supplied by commercial vendors. Enough information is provided to duplicate the components through either the same vendor or an alternate source.

IMP Fishing Gear Ltd.
44 South Street
New Bedford, MA 02740

"Iceplast" #1085 Trawl Float (made in Iceland)

Internet, Inc.
2730 Nevada Avenue North
Minneapolis, Minnesota 55427

$\frac{1}{2}$ " x $\frac{1}{2}$ " polystyrene mesh

Samson Rope
99 High Street
Boston, MA 02110

Samson "2 in 1" double braid rope
 $\frac{1}{2}$ " diameter
average breaking strength: 8,500 lbs.

DOCUMENT LIBRARY

July 5, 1989

Distribution List for Technical Report Exchange

Attn: Stella Sanchez-Wade
Documents Section
Scripps Institution of Oceanography
Library, Mail Code C-075C
La Jolla, CA 92093

Hancock Library of Biology &
Oceanography
Alan Hancock Laboratory
University of Southern California
University Park
Los Angeles, CA 90089-0371

Gifts & Exchanges
Library
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, NS, B2Y 4A2, CANADA

Office of the International
Ice Patrol
c/o Coast Guard R & D Center
Avery Point
Groton, CT 06340

Library
Physical Oceanographic Laboratory
Nova University
8000 N. Ocean Drive
Dania, FL 33304

NOAA/EDIS Miami Library Center
4301 Rickenbacker Causeway
Miami, FL 33149

Library
Skidaway Institute of Oceanography
P.O. Box 13687
Savannah, GA 31416

Institute of Geophysics
University of Hawaii
Library Room 252
2525 Correa Road
Honolulu, HI 96822

Library
Chesapeake Bay Institute
4800 Atwell Road
Shady Side, MD 20876

MIT Libraries
Serial Journal Room 14E-210
Cambridge, MA 02139

Director, Ralph M. Parsons Laboratory
Room 48-311
MIT
Cambridge, MA 02139

Marine Resources Information Center
Building E38-320
MIT
Cambridge, MA 02139

Library
Lamont-Doherty Geological
Observatory
Colombia University
Palisades, NY 10964

Library
Serials Department
Oregon State University
Corvallis, OR 97331

Pell Marine Science Library
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882

Working Collection
Texas A&M University
Dept. of Oceanography
College Station, TX 77843

Library
Virginia Institute of Marine Science
Gloucester Point, VA 23062

Fisheries-Oceanography Library
151 Oceanography Teaching Bldg.
University of Washington
Seattle, WA 98195

Library
R.S.M.A.S.
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149

Maury Oceanographic Library
Naval Oceanographic Office
Bay St. Louis
NSTL, MS 39522-5001

Marine Sciences Collection
Mayaguez Campus Library
University of Puerto Rico
Mayaguez, Puerto Rico 00708

REPORT DOCUMENTATION PAGE	1. REPORT NO. WHOI-89-52	2.	3. Recipient's Accession No.
4. Title and Subtitle A Pop-up Float Recovery System For Coastal Oceanographic Tripods			5. Report Date November, 1989
7. Author(s) Christopher V.R. Dunn and Allan G. Gordon			8. Performing Organization Rept. No. WHOI-89-52
9. Performing Organization Name and Address The Woods Hole Oceanographic Institution Woods Hole, Massachusetts 02543			10. Project/Task/Work Unit No.
			11. Contract(C) or Grant(G) No. (C) (G) ONR N00014-89-J-1058
12. Sponsoring Organization Name and Address Funding was provided by the Office of Naval Research			13. Type of Report & Period Covered Technical Report
			14.
15. Supplementary Notes This report should be cited as: Woods Hole Oceanog. Inst. Tech. Rept., WHOI-89-52			
16. Abstract (Limit: 200 words) The recovery package described here was used as the primary retrieval system to recover tripod instrument platforms from a depth of 90 meters. The device uses dual in-line burn wires, one of which is acoustically commanded from the surface ship. The other is set to release by back-up timer, ensuring recovery in the event of a poor acoustic command channel. The burn wire activates spring loaded cam latches which release the float package and pull a 1/2 inch Dacron line to the surface. The float package is recovered and the line is used to winch the tripod to the surface for recovery by the ship's crane. Major benefits of the system are reliability, low cost, light weight, and use of many off-the-shelf components. The float package provides 50 pounds of buoyancy and is fabricated using commercial fish trawl net floats. The retrieval line container is separate from the float assembly, and is fabricated from plastic storage containers. The line is coiled and restricted to prevent unpackaging due to waves or current action. The system described here is not appropriate in areas of high current or great depth due to drag and dead weight of the lift line.			
17. Document Analysis a. Descriptors 1. tripod float release 2. release for tripod float 3. pop-up float release b. Identifiers/Open-Ended Terms c. COSATI Field/Group			
18. Availability Statement Approved for publication; distribution unlimited.		19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 25
		20. Security Class (This Page)	22. Price