Unique No.: 195888 Date of Entry: 01/04/91

DATA ENTRY INFORMATION SYSTEM
(DATASET INVENTORY - DINDB)

Accession No.: 7500530 Reference No.: L01166
Former Accession No.: Former Reference No.: (Resub ONLY)

Media-In (DINDB): 09 - Digital Magnetic Tape

Exchange Format: E134 - Moored Buoy Data

Processing Format: L124 - Level 1, No Active QA Processing

* Note * If data is F022, create an additional record for C022.

Country/Institute Code: 31R9 Country/Platform Code: 3119

Platform Type (DINDB): 03 - Buoy Orig. Cruise ID: 16-59

Cruise Start Date: 05/01/64 Project Code: 0078

Cruise End Date: 09/01/73 Data Use Code (DUC): 3

Number of Stations: 23 Number of Records: 145,900

If stations/records not appropriate then:

Number: Units:

Ocean Area:

Code 1: 57 Meaning: North Pacific Ocean
Code 2: Meaning:
Code 3: Meaning:

DINDB Transaction Date:

ACCESSION NO. 7500530 FILETYPE L124 TRACK NO. L01166 PROJECT IDENTIFICATION ________

Bumble Bee Buoy Data 1964-1973

STEP	DATE	INIT.	TAPE OR DISK DSN	NO. FILES	LRECL	BLK SIZE	NO. RECORDS
ORIG. TAPE	01/08/91	MEC	DØØ946-AØ1339	42	80	4000	145,900
DUPLICATE TAPE			W11962				
REFORMATTED TAPE							
REFORMATTED DISK							
FIRST MULCHEK							
FINAL MULCHEK							
MPD75 OR F022							
DATA SET FINALIZED							

ERRORS REPORTED TO PRINCIPAL INVESTIGATOR:

ADDITIONAL ERRORS/CORRECTIONS (NOT REPORTED TO P.I.)

COMMENTS (TRACKS DELETED, FIELDS DELETED, ETC.)

Date: ____ ID#: 75-0530

Originator's TAPE Assigned NODC #8244 75-0530

NORPAX DATA DOCUMENTATION FORM

RESPONSIBLE COMPUTER SPECIALIST: Bonita Moore Institution: SIO

Physical Location of Data: NORPAX BLDG.

BRIEF DESCRIPTION OF DATA

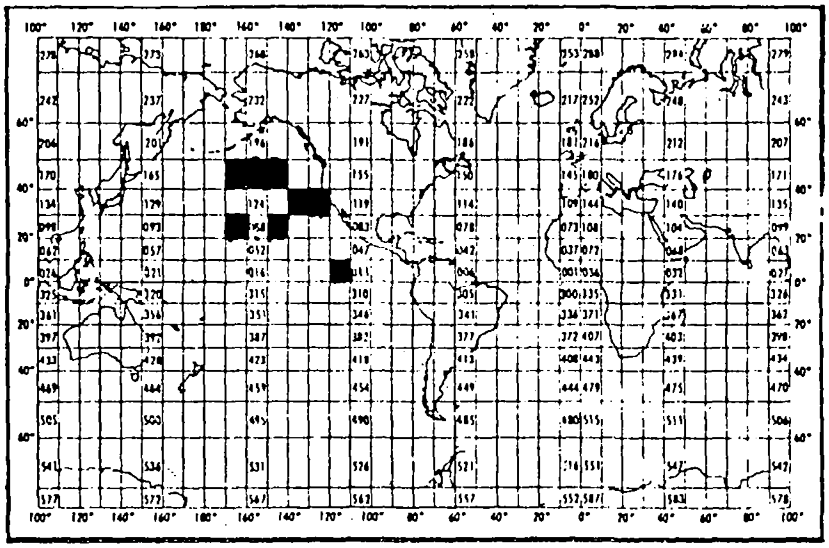
(include area and time of coverage, frequency of obs., original source of raw data)

BUMBLE BEE BUOY DATA, CONVERTED TO ENGR. UNITS
INITIAL BUOYS 16,18,19,22,29,30 - MAY/1964 - FEB/1967
REGULAR BUOYS 34-59 - FEB/1968 - 1973
1 OBS/HR EXCEPT A PORTION OF BUOY 40 ... (FILES 11 & 19) - EVERY 6 MIN

LABEL FACSIMILE

BUMBLE BEE BUOY
CONVERTED DATA TAPE
ARCHIVE, WORKING & NODC
(copies)

SHADE IN GENERAL AREA OF COVERAGE



DISK

File Name ____

Generated Under
Account Number ____

CARDS

____ Card - Tray(s)
____ Card - Box(es)
____ Card - Drawer(s)

TAPES

Recording Mode: BCD / EBCDIC / BINARY / ASCII / ____

Number of Tracks (Channels): SEVEN / NINE

Density: 200 / 556 / 800 / 1600 bpi / ____

Parity: ODD / EVEN

Blocked Data: NO / YES 50 LOGICAL RECORDS / PHYSICAL RECORDS

Physical Record Length in Bytes (characters): 4000 where the byte (character) is 8 bits
80 CHAR / LOGICAL RECORD

Labeled Files: NO / YES - describe ____

BRIEF DESCRIPTION OF FILE ORGANIZATION

Number of files 42

Approximate number physical records per file (if known) Variable

EOF BETWEEN CRUISES & BETWEEN BUOYS, 12 EOF'S AT EOT

HOW IS DATA SORTED / SEQUENCED?

BY BUOY (16-59), BY CRUISE, BY DATE, BY HOUR

IF NORPAX GENERATED DATA: Date created 2/9/75 by program ... (special ...)

FILES 8-28, 30-42
BUOYS 35-49, 51-59

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	FIELD LENGTH Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
I.D.	1	3	CHAR	A3	"SIO"
STN. NO.	4	2	DIGIT	I2	NO. of BUOY
YR.	6	2	"	I2	LAST TWO DIGITS OF YR (620)
DAY	8	3	DAYS	I3	JULIAN DATE 1-365
TIME	11	4	HRS.	I4	GMT TIME OF OBS.
1M. SEA	15	3	°C	F3.1	SEA TEMP. (°C) AT 1 m. DEPTH
5 m	18	3	"	"	" " " " 5 m "
10	21	3	"	"	" " " " 10 "
30	24	3	"	"	" " " " 30
50	27	3	"	"	" " " " 50
75	30	3	"	"	" " " " 75
100	33	3	"	"	" " " " 100
150	36	3	"	"	" " 150
300	39	3	"	"	" " " 300
AIR	42	3	"	"	AIR TEMPERATURE
HDG.	45	3	DEG.	F3.0	COMPASS HDG. FROM TRUE N
W. DIR	48	3		F3.0	WIND DIRECTION " " "
W. SPD.	51	2	m/s.	F2.0	WIND SPD.
BAR. P.	53	4	mB.	F4.0	BAR. PRESSURE
150m. P.	57	3	DB.	F3.0	150 m. DEPTH PRESS. — (FILE 30, BUOY 51 - "HOT WIRE [illegible]")
300m. P.	60	3	"	F3.0	300m. DEPTH PRESSURE
MOOR. T.	63	4	KG	F4.0	MOOR. LINE TENSION (FILES 35-42, BUOYS 55-59 - HOT WIRE 63-65 F3.0 (66-0))
SOLAR	67	4	Gm-Cal	F4.1	SOLAR RADIATION
W. TRANS	71	4	Km.	F4.0	WIND TRANSPORT
1m. LAG	75	3	°C	F3.1	1m. LAG
5m. LAG	78	3	°C	F3.1	5m. LAG

 80

FILES 1, 2
BUOYS 16, 15, 19, 22

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	FIELD LENGTH Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
I.D.	1	3	CHAR	A3	"SIO"
STA. NO.	4	2	DIGITS	I2	NO OF BUOY
YR.	6	2	"	I2	LAST 2 DIGITS OF YR (20)
DAY	8	3	DAYS	I3	JULIAN DATE 1-365
TIME	11	4	HRS	I4	GMT TIME OF OBS.
AIR T.	15	2	°F	F2.0	AIR TEMP (°F)
1 m SEA	17	3	°C	F3.1	SEA TEMP (°C) AT 1 m. DEPTH
10 m "	20	3	"	F3.1	" " " " 10 " "
30 m "	23	3	"	F3.1	30
60 m "	26	3	"	F3.1	60
100 m "	29	3	"	F3.1	100
150 m "	32	3	"	F3.1	150
W. SPD.	35	2	K	F2.0	WIND SPD. (K)
W. DIR.	37	3	DEG	F3.0	WIND DIRECTION (° FROM TRUE N)
HDG	40	3	"	F3.0	COMPASS HDG. (° FROM TRUE N)
LINE T.	43	2	KG	F2.0	MOOR. LINE TENSION (KG)
BLANK	45	32	'b'	32X	BLANK
I.D.	77	4	DIGITS	I4	ID NO.
		80			

NORPAX Data Management
RTW:db 9/72

FILES 3,4,5
BUOYS 29,30

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	FIELD LENGTH Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
ID.	1	3	CHAR	H3	"SIO"
STN NO.	4	2	DIGITS	I2	No. OF BUOY
YR	6	2		I2	LAST 2 DIGITS OF YR @ 20
DAY	8	3	DAYS	I3	JULIAN DATE 1-365
TIME	11	4	HRS	I4	GMT TIME OF OBS.
AIR T.	15	2	°F	F2.0	AIR TEMP (°F)
HDG	17	3	DEG	F3.0	COMPASS HDG (° FROM TRUE N)
W. DR.	20	3	-	F3.0	WIND DIRECTION (° FROM " ")
W. SPD.	23	2	K	F2.0	WIND SPEED (K)
1	25	3	°C	F3.1	SEA TEMP (°C) AT 1m DEPTH
45	28	3		F3.1	" " " " 45 "
65	31	3		F3.1	" " " " 65 "
85	34	3		F3.1	" " " " 85 "
105	37	3	"	F3.1	" " " " 105 "
125	40	3	"	F3.1	" " " " 125 "
250	43	3	"	F3.1	" " " " 250
BLANK	46	35	8		BLANK
		80			

NORPAX Data Management
RTW:db 9/72

FILES 6, 7
BUOYS 34, 35

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	FIELD LENGTH Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
ID.	1	3	CHAR	A3	"SIO"
STN	4	2	DIGITS	I2	NO OF BUOY
YR	6	2	"	I2	LAST 2 DIGITS OF YR (20)
DAY	8	3	DAY	I3	JULIAN DATE 1-365
TIME	11	4	HRS	I4	GMT TIME OF OBS.
SEA 1M	15	3	°C	F3.1	SEA TEMP. AT. 1M. DEPTH
10M	18	3	"	F3.1	" " " 10 "
50	21	3	"	F3.1	" " " 50 "
75	24	3	"	F3.1	" " " 75 "
100	27	3	"	F3.1	" " " 100 "
200	30	3	"	F3.1	" " " 200
300	33	3	"	F3.1	" " " 300 "
400	36	3	"	F3.1	" " " 400 "
500	39	3	"	F3.1	" " " 500
AIR T.	42	3	"	F3.1	AIR TEMP.
HDG	45	3	DEG.	F3.0	COMPASS HDG. FROM TRUE N.
W.DIR.	48	2	"	F3.0	WIND DIR. FROM TRUE N.
W.SPD.	50	4	m/s	F2.0	WIND SPEED
BAR. P.	54	3	mB	F4.0	BAROMETRIC PRESSURE
DEPTH P.	57	4	"	F3.0	DEPTH PRESSURE
LOAD CELL	61	4	LB	F4.0	LOAD CELL
SOLAR	65	4	GM-CAL	F4.1	SOLAR RADIATION
BLANK	69	12			BLANK
		80			

NORPAX Data Management
RTW:db 9/72

FILE 29
BUOY 50

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
ID	1	3	CHAR	A3	"SIO"
STA.	4	2	DIGITS	I2	NO OF BUOY
YR.	6	2	"	I2	LAST TWO DIGITS OF YR · (20)
DAY	8	3	DAYS	I3	JULIAN DATE 1-365
TIME	11	4	HRS.	I4	GMT TIME OF OBS.
1m SEA	15	3	°C	F3.1	SEA TEMP (°C) AT 1m DEPTH
2.5 "	18	3	"	F3.1	" " " " 2.5 "
5 "	21	3	"	F3.1	" " " " 5 "
7.5 "	24	3	"	F3.1	" " " " 7.5 "
10 "	27	3	"	F3.1	" " " " 10 "
12.5 "	30	3	"	F3.1	" " " " 12.5 "
15 "	33	3	"	F3.1	" " " " 15 "
20 "	36	3	"	F3.1	" " " " 20 "
25 "	39	3	"	F3.1	" " " " 25 "
35 "	42	3	"	F3.1	" " " " 35 "
45 "	45	3	"	F3.1	" " " " 45 "
60 "	48	3	"	F3.1	" " " " 60 "
BLANK	51	30		4	BLANK
		80			

1st card - Temperature
Salinity
Sigma - T
Oxygen - 0001

2nd card - Oxygen 100 - 0001 -
apparent Oxygen Utilization 100 - 0003 -
Percent Oxygen Saturation 100 - 0002 -
Chlorophyll 501 - 5000 -

3rd card - phosphate - 100 - 0010 -
Silicate - 100 - 0030 -
Nitrate - 100 - 0021 -
Nitrite - 100 - 0020 -

4th card - Ammonia - 100 - 0041 -
Nitrate Silicate Ratio - NO
ETS - 501 - 5007 -
Carbon 14 501 - 5003 -

5th card - UREA - 100 - 5009
Dissolved Organic nitrogen 516 - ~~8600~~ 0034
Total Particles 100 - 8600
Particle Area - NO

6th card - Particle Volume - NO

75-0530

Project is 0078 - IDOE/NORPAX
Platform - SIO BUOY
Category 124
Parameters 0188 - Air Temperature
0180 - Water Temp.
0189 - Wind Direction
0190 - Wind Speed
0191 - Barometric Pressure
0184 - Pressure
0065 - Solar Radiation

Leave observation blank -

Write Tape # 8244 in remarks column.

SIO Buoy Locations

7 May '64 –

#1972

✓ SIO Buoy #16	33° 23' N	128° 38' W
✓ SIO Buoy # 18	32° 10' N	132° 46.8' W
SIO Buoy #19	30° 51.5' N	128° 37.8' W
✓ SIO Buoy # 22	29° 58.8' N	140° 01.0' W
✓ SIO Buoy # 29	6° 05' N	118° 51' W
✓ SIO Buoy # 30	9° 38' N	119° 00' W
✓ SIO Buoy # 34	36° 39.7' N	122° 07.2' W
✓ SIO Buoy # 35	36° 39.0' N	122° 07.0' W
✓ SIO Buoy # 38	41° 59.5' N	163° 59' W
✓ SIO Buoy # 39	42° 55.5' N	158° 15.0' W
✓ SIO Buoy # 40	42° 28.2' N	158° 01.5' W
✓ SIO Buoy # 42	43° 35.8' N	157° 46.5' W
✓ SIO Buoy # 45	41° 00.0' N	147° 57.8' W

NODC ACC # 75-0530 IDOE / NORPA

UNIVERSITY OF CALIFORNIA, SAN DIEGO

BERKELEY · DAVIS · IRVINE · LOS ANGELES · RIVERSIDE · SAN DIEGO · SAN FRANCISCO SANTA BARBARA · SANTA CRUZ

SCRIPPS INSTITUTION OF OCEANOGRAPHY

POST OFFICE BOX 1529
LA JOLLA, CALIFORNIA 92037

12 February 1975

Mr. Nelson Ross
NODC Liaison Officer
National Marine Fisheries Service
P.O. Box 271
La Jolla, California 92037

Dear Nelson:

Enclosed is a tape of all data that we processed from our bumblebee buoy platforms. These data are contained on one 9 track, 1600 bpi magnetic tape. Included with the tape is a listing of the first record of each file and a complete set of documentation which provides detailed information as to the technical characteristics of the tape as well as logical record format. With this documentation and the copy of the tape, it should be possible for any reasonable computer programmer to read and understand these data.

I trust that you will send this on to the proper office at NODC for permanent retention as the national record of this scientific data from this series of platforms. If the people in Washington have any questions concerning the technical nature of this data set, please let them call me directly at 714/452-4495.

Thank you for your help on this matter.

Sincerely yours,

Rich Wert

Richard T. Wert
NORPAX Data Manager

cc: Dr. James J. O'Brien
Code 481
Office of Naval Research, Arlington, Virginia 22217

cc: Dr. Curtis A. Collins
IDOE - NSF, Washington DC 20550

TAPE LABEL NODC-1
DENSITY HY (800 b.p.i.) ~~AB~~
CODE BCD (CARD IMAGE RECORDS) ~~7 track~~

SIO
ANTHONY M TUBBS

ALL FILES ARE CORRECTED HOURLY DATA.

FIRST 9 FILES HAVE SAME FORMAT (SEE FORMAT PAGE
FILE # 10 FORMAT (SEE FORMAT PAGE 2)
GAPS IN DATA ARE MARKED BY 1 ALL-9 CARD

EOF ARE MARKED BY 2 ALL-9'S CARDS BEFORE THE EOF MARK.

MISSING DATA ARE BLANK FIELDS ON CARD.

NUMBER OF FILES PER BUOY:

BUOY # 38:	2
BUOY # 39:	1
BUOY # 40:	2
BUOY # 42:	2
BUOY # 45:	2
BUOY # 46:	1
	10 Files

LOCATION OF BUOYS:

BUOY # 38: 42°00.0'N – 164°00.1'W
BUOY # 39: 42°55.7'N – 158°12.0'W
BUOY # 40: 42°27.7'N – 158°02.0'W
BUOY # 42: 43°35.6'N – 157°48.6'W
BUOY # 45: 41°00.0'N – 148°02.0'W
BUOY # 46: 43°02.0'N – 157°17.6'W

MULTAP1

File #1 3952 Records Buoy # 38 Cruise 1-3

Time Period: (1800) 9 Oct 1968 To (0700) 23 Mar 1969

Year Day: 283 To 082

Year Week: 41 To 13

Gaps in Data: None

File #2 2544 Records Buoy # 38 Cruise 4-5

Time Period: (1900) 2 June 1969 To (2300) 4 Dec 1969

Year Day: 153 To 338

Year Week: 23 To 49

Gaps in Data: Day 192 (2300) To Day 197 (0900)
and Day 200 (0400) To Day 275 (0300)

File #3 1309 Records Buoy # 39 Cruise 1

Time Period: (2400) 11 Oct 1968 To (1600) 6 Dec 1968

Year Day: 285 To 341

Year Week: 41 To 49

Gaps in Data: None

File #4 2207 Records Buoy #40 Cruise 1-3

Time Period: (0500) 22 Sept 1968 To (2300) 1 Jan 1969

Year Day: 266 To 001

Year Week: 39 To 1

Gaps in Data: Day 283 (0800) To Day 288
and Day 340 (1400) To Day 345 (2100)

MULTAP-1 (cont.)

File #5 1445 Records Buoy #40 Cruise 4-5

Time Period: (0100) 2 May 1969 To (1900) 22 Nov 1969

Year Day: 122 To 326

Year Week: 18 To 48

Gaps in Data: Day 128(0800) To Day 273(

File #6 4639 Records Buoy #42 Cruise 1-3

Time Period: (0600) 20 Sept 1968 To (0600) 1 Apr 1969

Year Day: 264 To 091

Year Week: 38 To 14

Gaps in Data: None

File #7 2411 Records Buoy #42 Cruise 4

Time Period: (2000) 3 June 1969 To (0400) 12 Sept 1969

Year Day: 154 To 255

Year Week: 23 To 37

Gaps in Data: None

MULTAP2

File #1 3294 Records Buoy #45 Cruise 1-3

Time Period (0200) 20 Oct 1968 To (0500) 6 Mar 1969

Year Day: 294 To 065

Year Week: 43 To 10

Gaps in Data: None

File #2 7399 Records Buoy #45 Cruise 4-6

Time Period: (2000) June 10, 1969 To (0200) Apr 15, 1970

Year Day: 161 To 105

Year Week: 24 To 16

Gaps in Data: Day 263 (1600) To Day 263 (2000)

File #3 1710 Records Buoy #46 Cruise 4-5

Time Period: (0400) May 26, 1969 To (1900) Nov 21, 1969

Year Day: 146 To 325

Year Week: 22 To 47

Gaps in Data: Day 161 (1000) To Day 269 (2400)

12

PARAMETERS	I.D.	STA. NO.	YR. NO.	YR. DAY	TIME	SEA 1M	SEA 5M	10M	30M	50M	75M	100M	150M	300M	AIR TEMP.	COMPASS HEADING[1]
UNITS						°C	°C	.	.	.	.	.	.	.	°C	DEG.
CARD COL.	1-3	4-5	6-7	8-10	11-14	15-17	18-20	21-23	24-26	27-29	30-32	33-35	36-38	39-41	42-44	45-47
EXAMPLE	SIØ	40	68	265	1712	168	166	166	163	106	∧95	∧90	∧90	∧76	160	120
READ FORMAT	(3X,	I2,	I2,	I3,	I4,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.0,
COMMENTS						16.8°C					9.5°C				16.0°C	120° TRUE NORTH

17

PARAMETERS	WIND[2] DIR.	WIND SPEED	BAR. PRESSURE	150M DEPTH PRESSURE	300M DEPTH PRESSURE	MOORING LINE TENSION	SOLAR[3] RADIATION	WIND[4] TRANSPORT
UNITS	DEG.	M/SEC	MB.	DECIBARS	DECIBARS	KG.	GM-CAL	KM.
CARD COL.	48-50	51-52	53-56	57-59	60-62	63-66	67-70	71-74
EXAMPLE	150	11	1005	146	306	204	1173	∧778
READ FORMAT	F3.0,	F2.0,	F4.0,	F3.0,	F3.0,	F4.0,	F4.1,	F4.0)
COMMENTS	150° TRUE NORTH						117.3 GM-CAL	778 KM.

1. DIRECTION BOW OF BUOY IS HEADING.

2. DIRECTION FROM WHICH WIND IS BLOWING.

3. [illegible]TEGRATED GM-CAL / CM^2, 1 HOURL[illegible] ACCUMULATIONS

FORMAT DATA

NORTH PACIFIC STUDY BUOY DATA FORMAT

PARAMETERS	I.D.	STA. NO.	YR. NO.	YR. DAY	TIME	SEA 1M	SEA 5M	10M	30M	50M	75M	100M	150M	300M	AIR TEMP.	COMPASS HEADING[1]
UNITS						°C	°C	.	.	.	.	.	.	.	°C	DEG.
CARD COL.	1-3	4-5	6-7	8-10	11-14	15-17	18-20	21-23	24-26	27-29	30-32	33-35	36-38	39-41	42-44	45-47
EXAMPLE	SIØ	40	68	265	1712	168	166	166	163	106	‸95	‸90	‸90	‸76	160	120
READ FORMAT	(3X,	I2,	I2,	I3,	I4,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.1,	F3.0,
COMMENTS						16.8°C					9.5°C				16.0°C	120° TRUE NORTH

PARAMETERS	WIND DIR.[2]	WIND SPEED	BAR. PRESSURE	150M DEPTH PRESSURE	300M DEPTH PRESSURE	MOORING LINE TENSION	SOLAR RADIATION[3]	WIND TRANSPORT[4]
UNITS	DEG.	M/SEC	MB.	DECIBARS	DECIBARS	KG.	GM-CAL	KM.
CARD COL.	48-50	51-52	53-56	57-59	60-62	63-66	67-70	71-74
EXAMPLE	150	11	1005	146	306	204	1173	‸778
READ FORMAT	F3.0,	F2.0,	F4.0,	F3.0,	F3.0,	F4.0,	F4.1,	F4.0)
COMMENTS	150° TRUE NORTH						117.3 GM-CAL	778 KM.

1M LAG, °C	5M LAG, °C
COL. 75-77	COL. 78-80
F3.1	[illegible]3.1

1. DIRECTION BOW OF BUOY IS HEADING.

2. DIRECTION FROM WHICH WIND IS BLOWING.

3. I[illegible]GRATED GM-CAL/CM², HOURLY [illegible]CCUM.

4. INT[illegible]

ACCESSION NUMBER ~~71-1049~~ 7500530

DATA DOCUMENTATION FORM

NATIONAL OCEANOGRAPHIC DATA CENTER
RECORDS SECTION
WASHINGTON, D. C. 20390

This form should accompany all data submissions to NODC. Section A, Originator Identification, must be completed when the data are submitted. It is highly desirable for NODC to also receive the remaining pertinent information at that time. This may be most easily accomplished by attaching reports, publications, or manuscripts which are readily available describing data collection, analysis, and format specifics. Readable, handwritten submissions are acceptable in all cases. All data shipments should be sent to the above address.

A. ORIGINATOR IDENTIFICATION

THIS SECTION MUST BE COMPLETED BY DONOR FOR ALL DATA TRANSMITTALS

1. NAME AND ADDRESS OF INSTITUTION, LABORATORY, OR ACTIVITY WITH WHICH SUBMITTED DATA ARE ASSOCIATED

UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
P.O. BOX 109
LA JOLLA, CALIFORNIA 92037

2. EXPEDITION, PROJECT, OR PROGRAM DURING WHICH DATA WERE COLLECTED

NORTH PACIFIC BUOY PROGRAM ("GEOPHYSICAL MEASUREMENTS")

3. CRUISE NUMBER(S) USED BY ORIGINATOR TO IDENTIFY DATA IN THIS SHIPMENT

16, 18, 19, 22, [29 somewhat different data format and arrangement, — see other DDF]

4. PLATFORM NAME (S)

SIO BUOY

5. PLATFORM TYPE (S) (E.G., SHIP, BUOY, ETC.)

BUOY ("PROTOTYPE")

6. PLATFORM AND OPERATOR NATIONALITY (IES)

PLATFORM	OPERATOR
U.S.	U.S.

7. DATES

FROM: MO/DAY/YR	TO: MO/DAY/YR
MAY 17, '64	DEC. 27, '64

8. ARE DATA PROPRIETARY ?

[✓] NO [ ] YES

IF YES, WHEN CAN THEY BE RELEASED FOR GENERAL USE ? YEAR ____ MONTH ____

9. ARE DATA DECLARED NATIONAL PROGRAM (DNP) ?
(i.e., SHOULD THEY BE INCLUDED IN WORLD DATA CENTERS HOLDINGS FOR INTERNATIONAL EXCHANGE ?)

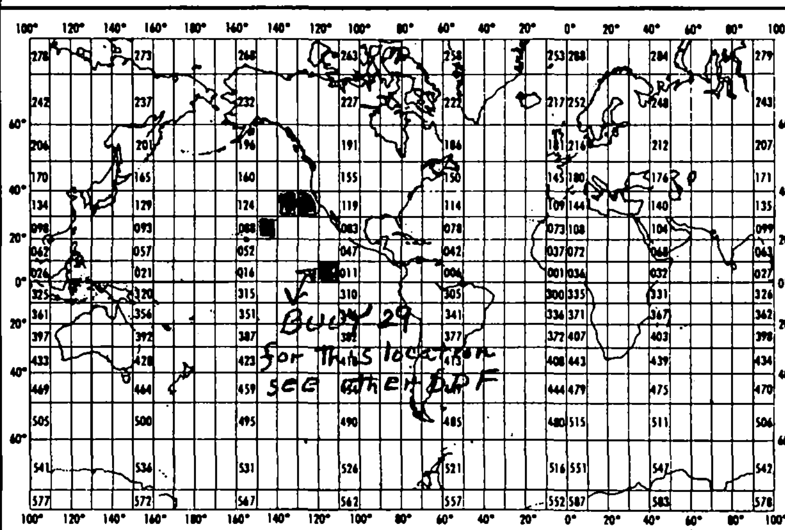
[ ] NO [ ] YES [ ] PART (SPECIFY BELOW)

10. PERSON TO WHOM INQUIRIES CONCERNING DATA SHOULD BE ADDRESSED WITH TELEPHONE NUMBER (AND ADDRESS IF OTHER THAN IN ITEM-1)

Anthony M. Tubbs

11. PLEASE DARKEN ALL MARSDEN SQUARES IN WHICH ANY DATA CONTAINED IN YOUR SUBMISSION WERE COLLECTED.

GENERAL AREA



NODC-3167/49 (8-70)

B. SCIENTIFIC CONTENT

Include enough information concerning manner of observation, instrumentation, analysis, and data reduction routines to make them understandable to future users. Furnish the minimum documentation considered relevant to each data type. Documentation will be retained as a permanent part of the data and will be available to future users. Equivalent information already available may be substituted for this section of the form (i.e., publications, reports, and manuscripts describing observational and analytical methods). If you do not provide equivalent information by attachment, please complete the scientific content section in a manner similar to the one shown in the following example

EXAMPLE (HYPOTHETICAL INFORMATION)

NAME OF DATA FIELD	REPORTING UNITS OR CODE	METHODS OF OBSERVATION AND INSTRUMENTS USED (SPECIFY TYPE AND MODEL)	ANALYTICAL METHODS (INCLUDING MODIFICATIONS) AND LABORATORY PROCEDURES	DATA PROCESSING TECHNIQUES WITH FILTERING AND AVERAGING
Salinity	‰	Nansen bottles	Inductive salinometer (Hytech model S 510)	N/A (not applicable)
		STD Bissett-Berman model 9006	N/A	Values averaged over 5-meter intervals
Water color	Forel scale	Visual comparison with Forel bottles	N/A	N/A
Sediment size	ϕ units and percent by weight	Ewing corer	Standard sieves. Carbonate fraction removed by acid treatment	Same as "Sedimentary Rock Manual," Folk '65

(SPACE IS PROVIDED ON THE FOLLOWING TWO PAGES FOR THIS INFORMATION)

B. SCIENTIFIC CONTENT

NAME OF DATA FIELD	REPORTING UNITS OR CODE	METHODS OF OBSERVATION AND INSTRUMENTS USED (SPECIFY TYPE AND MODEL)	ANALYTICAL METHODS (INCLUDING MODIFICATIONS) AND LABORATORY PROCEDURES	DATA PROCESSING TECHNIQUES WITH FILTERING AND AVERAGING
Air Temperature	Degrees F.			
Sea Temperature - at six depths in meters - 1, 10, 30, 60, 100, 150	Degrees C	Yellow Springs Instrument Co. thermistor #44030 installed in cable assembly. Readout is electrical analog indicating thermometer measurement. Various range readouts are used with 10° and 20° spans. Readout manufactured by Burnett Electronics to our bridge designs. Constant current regulated power supply in each indicator.		All sensors continuously activate a series of dials on an instrument panel. Analog data are obtained by periodically photographing the panel, the data being stored on film. Pictures of the dials are examined by hand to digitize the data.
Wind Speed	Knots	Belfast Model C cup anemometer		Knots converted to m/sec. in computer process.
Wind Direction	True direction, apparently to nearest 5 degrees, from which wind is blowing	Electrical indicating volt meter, sensor vane driven potiometer, Belfast Inst. Co., Model C.		Apparent wind directions are combined, in computer process, with magnetic buoy headings and magnetic deviation to produce true wind directions.

B. SCIENTIFIC CONTENT

NAME OF DATA FIELD	REPORTING UNITS OR CODE	METHODS OF OBSERVATION AND INSTRUMENTS USED (SPECIFY TYPE AND MODEL)	ANALYTICAL METHODS (INCLUDING MODIFICATIONS) AND LABORATORY PROCEDURES	DATA PROCESSING TECHNIQUES WITH FILTERING AND AVERAGING
Buoy Heading	compass North			
Mooring Line Tension	arbitrary units - very likely Kilograms	Specially constructed Braincon silicon gauge load cell.		Line tension in milliamps of electric current converted to kilograms by computer process.

C. DATA FORMAT

This information is requested only for data transmitted on punched cards or magnetic tape. Have one of your data processing specialists furnish answers either on the form or by attaching equivalent readily available documentation. Identify the nature and meaning of all entries and explain any codes used.

1. List the record types contained in your file transmittal (e.g., tape label record, master, detail, standard depth, etc.).

2. Describe briefly how your file is organized.

3-13. Self-explanatory.

14. Enter the field name as appropriate (e.g., header information, temperature, depth, salinity).

15. Enter starting position of the field.

16. Enter field length in number columns and unit of measurement (e.g., bit, byte, character, word) in unit column.

17. Enter attributes as expressed in the programming language specified in item 3 (e.g., "F 4.1," "BINARY FIXED (5.1)").

18. Describe field. If sort field, enter "SORT 1" for first, "SORT 2" for second, etc. If field is repeated, state number of times it is repeated.

C. DATA FORMAT

COMPLETE THIS SECTION FOR PUNCHED CARDS OR TAPE, MAGNETIC TAPE, OR DISC SUBMISSIONS.

1. LIST RECORD TYPES CONTAINED IN THE TRANSMITTAL OF YOUR FILE
GIVE METHOD OF IDENTIFYING EACH RECORD TYPE

80-character card image on tape.
Observed records, with time increasing by the hour.
Also end-of-file records.

2. GIVE BRIEF DESCRIPTION OF FILE ORGANIZATION

BY BUOY (OR STATION) NUMBER.
There were five buoys #'s 16, 18, 19, 22, 29, with the last (29) of somewhat revised data format.
There is one listing, (or file) for each buoy.

3. ATTRIBUTES AS EXPRESSED IN ☐ PL-I ☐ ALGOL ☐ COBOL ☑ FORTRAN ☐ ________ LANGUAGE

4. RESPONSIBLE COMPUTER SPECIALIST:
NAME AND PHONE NUMBER ________
ADDRESS ________

COMPLETE THIS SECTION IF DATA ARE ON MAGNETIC TAPE (NODC COPY)

5. RECORDING MODE: ☐ BCD ☐ BINARY ☐ ASCII ☑ EBCDIC ☐ ________	9. LENGTH OF INTER-RECORD GAP (IF KNOWN): ☑ 3/4 INCH ☐ ________
6. NUMBER OF TRACKS (CHANNELS): ☐ SEVEN ☑ NINE ☐ ________	10. END OF FILE MARK (Following card of nines): ☐ OCTAL 17 ☐ NODC 360 Hex
7. PARITY: ☑ ODD ☐ EVEN	11. PASTE-ON-PAPER LABEL DESCRIPTION (INCLUDE ORIGINATOR NAME AND SOME LAY SPECIFICATIONS OF DATA TYPE, VOLUME NUMBER): TAPE NO. T168929 by Originator (S.I.O.) NO. 2152 NODC Copy. Creation date 24th Aug. '71
8. DENSITY: ☐ 200 BPI ☑ 1600 BPI ☐ 556 BPI ☐ 800 BPI ☐ ________	12. PHYSICAL BLOCK LENGTH IN BYTES: 80 X 10 blocking factor
	13. LENGTH OF BYTES IN BITS: 8

RECORD FORMAT DESCRIPTION

RECORD NAME Observed Record

14. FIELD NAME	15. POSITION FROM - 1 MEASURED IN ___ (e.g., bits, bytes)	16. LENGTH NUMBER	16. LENGTH UNITS	17. ATTRIBUTES	18. USE AND MEANING
"SIO" (Originator ID)	1	3	bytes	A3	
Station (buoy) #	4	2		I2	
Year	6	2		I2	
Day of Year	8	3		I3	
Time (hr., min.)	11	4		I4	
Air Temp.	15	2		F 2.0	
Sea Temperature at 1 M, 10M, 30 M, 60 M, 100M, and 150 M	17	18		6 F3.1	
Wind Speed	35	2		F 2.0	
" Direction	37	3		F 3.0	(relative to buoy heading)
Buoy Heading	40	3		F 3.0	(compass, North)
Mooring Line Tension	43	2		F 2.0	
(blanks)	45	32		32X	
Sequence Number	77	4		I4	

RECORD FORMAT DESCRIPTION

RECORD NAME ______________________________

14. FIELD NAME	15. POSITION FROM - 1 MEASURED IN ______ (e.g., bits, bytes)	16. LENGTH		17. ATTRIBUTES	18. USE AND MEANING
		NUMBER	UNITS		

RECORD FORMAT DESCRIPTION

RECORD NAME ____________________

14. FIELD NAME	15. POSITION FROM - 1 MEASURED IN ______ (e.g., bits, bytes)	16. LENGTH		17. ATTRIBUTES	18. USE AND MEANING
		NUMBER	UNITS		

RECORD FORMAT DESCRIPTION

RECORD NAME ____________________

14. FIELD NAME	15. POSITION FROM - 1 MEASURED IN ______ (e.g., bits, bytes)	16. LENGTH		17. ATTRIBUTES	18. USE AND MEANING
		NUMBER	UNITS		

	ACCESSION NUMBER	71 - 1049

DATA DOCUMENTATION FORM

NATIONAL OCEANOGRAPHIC DATA CENTER
RECORDS SECTION
WASHINGTON, D. C. 20390

This form should accompany all data submissions to NODC. Section A, Originator Identification, must be completed when the data are submitted. It is highly desirable for NODC to also receive the remaining pertinent information at that time. This may be most easily accomplished by attaching reports, publications, or manuscripts which are readily available describing data collection, analysis, and format specifics. Readable, handwritten submissions are acceptable in all cases. All data shipments should be sent to the above address.

A. ORIGINATOR IDENTIFICATION

THIS SECTION MUST BE COMPLETED BY DONOR FOR ALL DATA TRANSMITTALS

1. NAME AND ADDRESS OF INSTITUTION, LABORATORY, OR ACTIVITY WITH WHICH SUBMITTED DATA ARE ASSOCIATED

UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
P.O. BOX 109
LA JOLLA, CALIFORNIA

2. EXPEDITION, PROJECT, OR PROGRAM DURING WHICH DATA WERE COLLECTED

NORTH PACIFIC BUOY PROGRAM
("Geophysical measurements")

3. CRUISE NUMBER(S) USED BY ORIGINATOR TO IDENTIFY DATA IN THIS SHIPMENT

29

4. PLATFORM NAME (S)	5. PLATFORM TYPE (S) (E.G., SHIP, BUOY, ETC.)	6. PLATFORM AND OPERATOR NATIONALITY (IES) — PLATFORM	OPERATOR	7. DATES — FROM: MO/DAY/YR	TO: MO/DAY/YR
SIO BUOY	BUOY ("PROTOTYPE")	U.S.	U.S.	Feb. 5, '67	June 22, '67

8. ARE DATA PROPRIETARY ?

[✓] NO [ ] YES

IF YES, WHEN CAN THEY BE RELEASED FOR GENERAL USE ? YEAR ____ MONTH ____

9. ARE DATA DECLARED NATIONAL PROGRAM (DNP) ?
(i.e., SHOULD THEY BE INCLUDED IN WORLD DATA CENTERS HOLDINGS FOR INTERNATIONAL EXCHANGE ?)

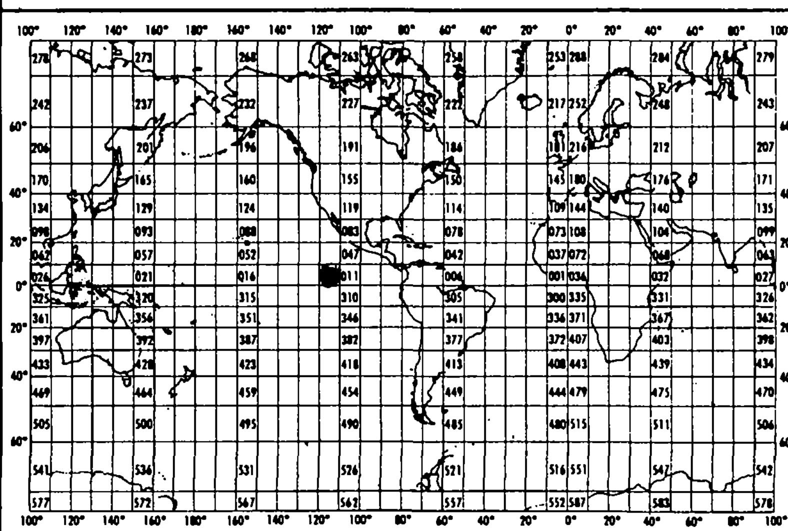
[ ] NO [ ] YES [ ] PART (SPECIFY BELOW)

10. PERSON TO WHOM INQUIRIES CONCERNING DATA SHOULD BE ADDRESSED WITH TELEPHONE NUMBER (AND ADDRESS IF OTHER THAN IN ITEM-1)

Anthony M. Tubbs

11. PLEASE DARKEN ALL MARSDEN SQUARES IN WHICH ANY DATA CONTAINED IN YOUR SUBMISSION WERE COLLECTED.

GENERAL AREA



NODC-3167/49 (8-70)

B. SCIENTIFIC CONTENT

Include enough information concerning manner of observation, instrumentation, analysis, and data reduction routines to make them understandable to future users. Furnish the minimum documentation considered relevant to each data type. Documentation will be retained as a permanent part of the data and will be available to future users. Equivalent information already available may be substituted for this section of the form (i.e., publications, reports, and manuscripts describing observational and analytical methods). If you do not provide equivalent information by attachment, please complete the scientific content section in a manner similar to the one shown in the following example

EXAMPLE (HYPOTHETICAL INFORMATION)

NAME OF DATA FIELD	REPORTING UNITS OR CODE	METHODS OF OBSERVATION AND INSTRUMENTS USED (SPECIFY TYPE AND MODEL)	ANALYTICAL METHODS (INCLUDING MODIFICATIONS) AND LABORATORY PROCEDURES	DATA PROCESSING TECHNIQUES WITH FILTERING AND AVERAGING
Salinity	‰	Nansen bottles	Inductive salinometer (Hytech model S 510)	N/A (not applicable)
		STD Bissett-Berman Model 9006	N/A	Values averaged over 5-meter intervals
Water color	Forel scale	Visual comparison with Forel bottles	N/A	N/A
Sediment size	φ units and percent by weight	Ewing corer	Standard sieves. Carbonate fraction removed by acid treatment	Same as "Sedimentary Rock Manual," Folk '65

(SPACE IS PROVIDED ON THE FOLLOWING TWO PAGES FOR THIS INFORMATION)

B. SCIENTIFIC CONTENT

NAME OF DATA FIELD	REPORTING UNITS OR CODE	METHODS OF OBSERVATION AND INSTRUMENTS USED (SPECIFY TYPE AND MODEL)	ANALYTICAL METHODS (INCLUDING MODIFICATIONS) AND LABORATORY PROCEDURES	DATA PROCESSING TECHNIQUES WITH FILTERING AND AVERAGING
Air Temperature	~~Degrees~~			
Buoy Heading	~~Compass NORTH~~			
Wind Direction				
Wind Speed				
Sea Temperature at <u>seven</u> depths – 1, 45, 65, 85, 105, 125, 250 meters.				

FOR INFORMATION ON UNITS, INSTRUMENTS, ETC. REFER TO THE FIRST OF THESE TWO DATA DOCUMENTATION FORMS. THE ORDER OF THE DATA FIELDS IS SOMEWHAT REARRANGED, FOR THIS ONE BUOY STATION.

Note: Mooring Line Tension is absent from this file (Sta. 29)

B. SCIENTIFIC CONTENT

NAME OF DATA FIELD	REPORTING UNITS OR CODE	METHODS OF OBSERVATION AND INSTRUMENTS USED (SPECIFY TYPE AND MODEL)	ANALYTICAL METHODS (INCLUDING MODIFICATIONS) AND LABORATORY PROCEDURES	DATA PROCESSING TECHNIQUES WITH FILTERING AND AVERAGING

C. DATA FORMAT

This information is requested only for data transmitted on punched cards or magnetic tape. Have one of your data processing specialists furnish answers either on the form or by attaching equivalent readily available documentation. Identify the nature and meaning of all entries and explain any codes used.

1. List the record types contained in your file transmittal (e.g., tape label record, master, detail, standard depth, etc.).

2. Describe briefly how your file is organized.

3-13. Self-explanatory.

14. Enter the field name as appropriate (e.g., header information, temperature, depth, salinity).

15. Enter starting position of the field.

16. Enter field length in number columns and unit of measurement (e.g., bit, byte, character, word) in unit column.

17. Enter attributes as expressed in the programming language specified in item 3 (e.g., "F 4.1," "BINARY FIXED (5.1)").

18. Describe field. If sort field, enter "SORT 1" for first, "SORT 2" for second, etc. If field is repeated, state number of times it is repeated.

C. DATA FORMAT [SEE FIRST DDF]

COMPLETE THIS SECTION FOR PUNCHED CARDS OR TAPE, MAGNETIC TAPE, OR DISC SUBMISSIONS.

1. LIST RECORD TYPES CONTAINED IN THE TRANSMITTAL OF YOUR FILE GIVE METHOD OF IDENTIFYING EACH RECORD TYPE

2. GIVE BRIEF DESCRIPTION OF FILE ORGANIZATION

3. ATTRIBUTES AS EXPRESSED IN ☐ PL-1 ☐ ALGOL ☐ COBOL ☐ FORTRAN ☐ ________ LANGUAGE

4. RESPONSIBLE COMPUTER SPECIALIST:
   NAME AND PHONE NUMBER ________
   ADDRESS ________

COMPLETE THIS SECTION IF DATA ARE ON MAGNETIC TAPE

5. RECORDING MODE ☐ BCD ☐ BINARY ☐ ASCII ☐ EBCDIC ☐ ________	9. LENGTH OF INTER-RECORD GAP (IF KNOWN) ☐ 3/4 INCH ☐ ________
6. NUMBER OF TRACKS (CHANNELS) ☐ SEVEN ☐ NINE ☐ ________	10. END OF FILE MARK ☐ OCTAL 17 ☐ ________
7. PARITY ☐ ODD ☐ EVEN	11. PASTE-ON-PAPER LABEL DESCRIPTION (INCLUDE ORIGINATOR NAME AND SOME LAY SPECIFICATIONS OF DATA TYPE, VOLUME NUMBER)
8. DENSITY ☐ 200 BPI ☐ 1600 BPI ☐ 556 BPI ☐ 800 BPI ☐ ________	12. PHYSICAL BLOCK LENGTH IN BYTES 13. LENGTH OF BYTES IN BITS

RECORD FORMAT DESCRIPTION

RECORD NAME *Observed Record*

14. FIELD NAME	15. POSITION FROM - 1 MEASURED IN ___ (e.g., bits, bytes)	16. LENGTH NUMBER	16. LENGTH UNITS	17. ATTRIBUTES	18. USE AND MEANING
"SIO"	1	3	Bytes	A3	
Originator ID				I2	
Station (buoy) #	4	2			
Year	6	2		I2	
Day of year	8	3		I3	
Hour and Minute	11	4		I4	
Air Temperature	15	2		F2.0	
Buoy Heading	17	3		F3.0	
Wind Direction	20	3		F3.0	
" Speed	23	2		F2.0	
Sea Temperature at 1M, 45M, 65M, 85M, 105M, 125M, and 250M.	25	21		7F3.1	
blanks	46	31		31X	
Sequence Number	77	4		I4	

RECORD FORMAT DESCRIPTION

RECORD NAME ______________________________

14. FIELD NAME	15. POSITION - FROM - 1 MEASURED IN ______ (e.g., bits, bytes)	16. LENGTH		17. ATTRIBUTES	18. USE AND MEANING
		NUMBER	UNITS		

RECORD FORMAT DESCRIPTION

RECORD NAME ____________________

14. FIELD NAME	15. POSITION FROM - 1 MEASURED IN ______ (e.g., bits, bytes)	16. LENGTH		17. ATTRIBUTES	18. USE AND MEANING
		NUMBER	UNITS		

RECORD FORMAT DESCRIPTION

RECORD NAME ____

14. FIELD NAME	15. POSITION FROM - 1 MEASURED IN _______ (e.g., bits, bytes)	16. LENGTH		17. ATTRIBUTES	18. USE AND MEANING
		NUMBER	UNITS		

Date: 2/10/75 ID#: 75-05 30

ORiginator's TAPE Assigned NODC #8244

DDF A:4:06 **NORPAX DATA DOCUMENTATION FORM**

ONSIBLE COMPUTER SPECIALIST: BONITA MOIR Institution: SIO

Physical Location of Data: NORPAX BLDG.

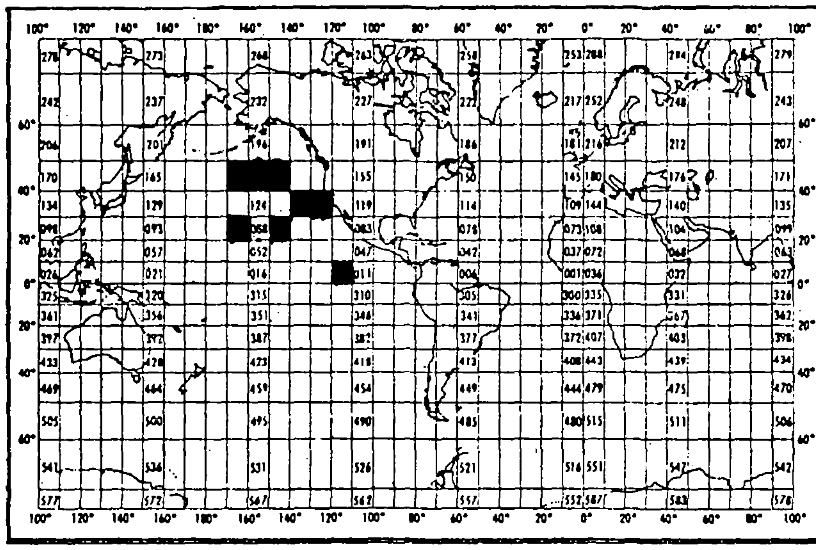
BRIEF DESCRIPTION OF DATA
(include area and time of coverage, frequency of obs., original source of raw data)

BUMBLE BEE BUOY DATA, CONVERTED TO ENGR. UNITS
INITIAL BUOYS 16, 18, 19, 22, 29, 30 - MAY/1964 - FEB/1967
REGULAR BUOYS 34-59 - FEB/1968 - 1973
1 OBS/HR. EXCEPT A PORTION OF BUOY 40 & 46 (FILES 11 & 19) - EVERY 6 MIN.

LABEL FACSIMILE

BUMBLE BEE BUOY
CONVERTED DATA TAPE
(ARCHIVE, WORKING & NODC COPIES)

SHADE IN GENERAL AREA OF COVERAGE



DISK
File Name ______
Generated Under Account Number ______

CARDS
______ Card - Tray(s)
______ Card - Box(es)
______ Card - Drawer(s)

TAPES
Recording Mode: BCD / EBCDIC / BINARY / ASCII / ______
Number of Tracks (Channels): SEVEN / NINE
Density: 200 / 556 / 800 / 1600 bpi / ______
Parity: ODD / EVEN
Blocked Data: NO / YES 50 LOGICAL RECORDS / PHYSICAL RECORDS
Physical Record Length in Bytes (characters): 4000 where the byte (character) is 8 bits
80 CHAR / LOGICAL RECORD
Labeled Files: NO / YES - describe ______

BRIEF DESCRIPTION OF FILE ORGANIZATION
Number of files 42
Approximate number physical records per file (if known) Variable
EOF BETWEEN CRUISES & BETWEEN BUOYS, 12 EOF'S AT EOT

HOW IS DATA SORTED / SEQUENCED?
BUOY (16-59), BY CRUISE, BY DATE, BY HOUR

IF NORPAX GENERATED DATA: Date created 2/9/75 by program TPTRAN (SPECIAL USER)

FILES 8-28, 30-42
BUOYS 38-49, 51-59

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	FIELD LENGTH Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
I.D.	1	3	CHAR	A3	"SIO"
STA. NO.	4	2	DIGIT	I2	NO. of BUOY
YR.	6	2	"	I2	LAST TWO DIGITS OF YR (62…
DAY	8	3	DAYS	I3	JULIAN DATE 1-365
TIME	11	4	HRS.	I4	GMT TIME OF OBS.
1M. SEA	15	3	°C	F3.1	✓ SEA TEMP. (°C) AT 1m. DEP
5m	18	3	"	"	" " " " 5m "
10	21	3	"	"	" " " " 10 "
30	24	3	"	"	" " " " 30 "
50	27	3	"	"	" " " " 50 "
75	30	3	"	"	" " " " 75 "
100	33	3	"	"	" " " " 100 "
150	36	3	"	"	" " " " 150 "
300	39	3	"	"	" " " " 300 "
AIR	42	3	"	"	✓ AIR TEMPERATURE
HDG.	45	3	DEG.	F3.0	COMPASS HDG. FROM TRUE N
W. DIR	48	3	"	F3.0	✓ WIND DIRECTION " " "
W. SPD	51	2	m/s.	F2.0	✓ WIND SPD.
BAR. P.	53	4	MB.	F4.0	✓ BAR. PRESSURE
150m. P.	57	3	DB.	F3.0	150 m. DEPTH PRESS. (FILE 30, BUOY 51 - "HOT WIRE ANEM."
300m. P.	60	3	"	F3.0	✓ 300m. DEPTH PRESSURE
MOOR. T.	63	4	KG	F4.0	MOOR. LINE TENSION (FILES 35-42 BUOYS 55-59 - "HOT WIRE" 63-65 66
SOLAR	67	4	GM-CAL	F4.1	✓ SOLAR RADIATION
W. TRANS	71	4	KM.	F4.0	WIND TRANSPORT
[illegible]. LAG	75	3	°C	F3.1	1m. LAG
[illegible]. LAG	78	3	°C	F3.1	5m. LAG

80

NORPAX Data Management
RTW:db 9/72

FILES 1, 2
BUOYS 16, 18, 19, 22

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	FIELD LENGTH Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
I.D.	1	3	CHAR	A3	"SIO"
STA. NO.	4	2	DIGITS	I2	NO. OF BUOY
YR.	6	2	"	I2	LAST 2 DIGITS OF YR (20)
DAY	8	3	DAYS	I3	JULIAN DATE 1-365
TIME	11	4	HRS	I4	GMT TIME OF OBS.
AIR T.	15	2	°F	F2.0	AIR TEMP (°F)
1 m. SEA	17	3	°C	F3.1	SEA TEMP (°C) AT 1 m. DEPTH
10 m "	20	3	"	F3.1	" " " " 10 " "
30 m "	23	3	"	F3.1	30
60 m "	26	3	"	F3.1	60
100 m "	29	3	"	F3.1	100
150 m "	32	3	"	F3.1	150
W. SPD.	35	2	K	F2.0	WIND SPD. (K)
W. DIR.	37	3	DEG	F3.0	WIND DIRECTION (° FROM TRUE N)
HDG	40	3	"	F3.0	COMPASS HDG. (° FROM TRUE N)
LINE T.	43	2	KG	F2.0	MOOR. LINE TENSION (KG)
BLANK	45	32	b̸	32X	BLANK
I.D.	77	4	DIGITS	I4	ID NO.
		80			

NORPAX Data Management
RTW:db 9/72

FILES 3,4,5
BUOYS 29,30

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	FIELD LENGTH Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
ID.	1	3	CHAR	A3	"SIO"
STA NO.	4	2	DIGITS	I2	NO. OF BUOY
YR	6	2	"	I2	LAST 2 DIGITS OF YR (20)
DAY	8	3	DAYS	I3	JULIAN DATE 1-365
TIME	11	4	HRS	I4	GMT TIME OF OBS.
AIR T.	15	2	°F	F2.0	AIR TEMP (°F)
HDG	17	3	DEG	F3.0	COMPASS HDG. (° FROM TRUE N)
W. DR.	20	3	"	F3.0	WIND DIRECTION (° FROM " ")
W. SPD.	23	2	K	F2.0	WIND SPEED (K)
1	25	3	°C	F3.1	SEA TEMP (°C) AT 1m DEPTH
45	28	3	"	F3.1	" " " " 45 "
65	31	3	"	F3.1	" " " " 65 "
85	34	3	"	F3.1	" " " " 85 "
105	37	3	"	F3.1	" " " " 105 "
125	40	3	"	F3.1	" " " " 125 "
250	43	3	"	F3.1	" " " " 250 "
BLANK	46	35	b		BLANK
		80			

NORPAX Data Management
RTW:db 9/72

FILES 6, 7
BOOYS 34, 35

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
I.D.	1	3	CHAR	A3	"SIO"
STA	4	2	DIGITS	I2	NO OF BUOY
YR	6	2	"	I2	LAST 2 DIGITS OF YR (20)
DAY	8	3	DAY	I3	JULIAN DATE 1-365
TIME	11	4	HRS.	I4	GMT TIME OF OBS.
SEA 1m	15	3	°C	F3.1	SEA TEMP. AT. 1m. DEPTH
10m	18	3	"	F3.1	" " " 10 "
50	21	3	"	F3.1	" " " 50 "
75	24	3	"	F3.1	" " " 75 "
100	27	3	"	F3.1	" " " 100 "
200	30	3	"	F3.1	" " " 200 "
300	33	3	"	F3.1	" " " 300 "
400	36	3	"	F3.1	" " " 400 "
500	39	3	"	F3.1	" " " 500 "
AIR T.	42	3	"	F3.1	AIR TEMP.
HDG	45	3	DEG.	F3.0	COMPASS HDG. FROM TRUE N.
W.DIR.	48	2	"	F3.0	WIND DIR. FROM TRUE N.
W.SPD.	50	4	m/s	F2.0	WIND SPEED
BAR. P.	54	3	mB	F4.0	BAROMETRIC PRESSURE
DEPTH P.	57	4	"	F3.0	DEPTH PRESSURE
LOAD CELL	61	4	LB	F4.0	LOAD CELL
SOLAR	65	4	GM·CAL	F4.1	SOLAR RADIATION
BLANK	69	12	$		BLANK
		80			

FILE 29
BUOY 50

LOGICAL RECORD FORMAT DESCRIPTION

FIELD NAME (e.g. temp.)	POSITION from start of record measured in CHAR (e.g. bits, bytes, char., col.)	FIELD LENGTH No.	FIELD LENGTH Units	ATTRIBUTES (e.g. F4.1)	USE and MEANING .... Include datum (if used) and other data processing techniques
ID	1	3	CHAR	A3	"SIO
STA.	4	2	DIGITS	I2	NO OF BUOY
YR.	6	2	"	I2	LAST TWO DIGITS OF YR · 69
DAY	8	3	DAYS	I3	JULIAN DATE 1-365
TIME	11	4	HRS.	I4	GMT TIME OF OBS.
1m SEA	15	3	°C	F3.1	SEA TEMP (°C) AT 1m DEPTH
2.5 "	18	3	"	F3.1	" " " " 2.5 "
5 "	21	3	"	F3.1	" " " " 5 "
7.5 "	24	3	"	F3.1	" " " " 7.5 "
10 "	27	3	"	F3.1	" " " " 10 "
12.5 "	30	3	"	F3.1	" " " " 12.5 "
15 "	33	3	"	F3.1	" " " " 15 "
20 "	36	3	"	F3.1	" " " " 20 "
25 "	39	3	"	F3.1	" " " " 25 "
35 "	42	3	"	F3.1	" " " " 35 "
45 "	45	3	"	F3.1	" " " " 45 "
60 "	48	3	"	F3.1	" " " " 60 "
BLANK	51	30		ƀ	BLANK
		80			

NORPAX Data Management
RTW:db 9/72

1st card - Temperature
Salinity
Sigma - T - ignore
Oxygen - 0001 —

2nd card - oxygen 100 - 0001 —
apparent Oxygen Utilization 100 - 0003 —
Percent Oxygen Saturation 100 0002 —
Chlorophyll | 501 - 5000 | —

3rd card - phosphate - 100 - 0010 —
Silicate - 100 - 0030 —
Nitrate - 100 - 0021 —
Nitrite - 100 - 0020 —

4th card - Ammonia - 100 - 0041 — ignore
Nitrate Silicate Ratio NO
ETS - | 501 - 5007 | —
Carbon 14 | 501 - 5003 | —

5th card - UREA - 100 - 5009
Dissolved organic nitrogen (516 - ~~8L00~~ 0034 ~~70~~)
Total Particles 100 - 8600 ✓
Particle Area - NO ignore

6th card - Particle Volume ~~NO~~ ignore

75-0530

SIO Buoy Locations

May '64 –
Sept 1973

✓ SIO Buoy #16	33° 23' N	128° 38' W
✓ SIO Buoy # 18	32° 10' N	132° 46.8' W
✓ SIO Buoy #19	30° 51.5' N	128° 37.8' W
✓ SIO Buoy #22	29° 58.8' N	140° 01.0' W
✓ SIO Buoy # 29	6° 05' N	118° 51' W
✓ SIO Buoy #30	9° 38' N	119° 00' W
✓ SIO Buoy #34	36° 39.7' N	122° 07.2' W
✓ SIO Buoy # 35	36° 39.0' N	122° 07.0' W
✓ SIO Buoy # 38	41° 59.5' N	163° 59' W
✓ SIO Buoy # 39	42° 55.5' N	158° 15.0' W
✓ SIO Buoy #40	42° 28.2' N	158° 01.5' W
✓ SIO Buoy # 42	43° 35.8' N	157° 46.5' W
✓ SIO Buoy # 45	41° 00.0' N	147° 57.8' W

75-0530

Project is 0078 - IDOE/NORPAK

Platform - STO BUOY

Category 124

Parameters 0188 - Air Temperature

0180 - Water Temp.

0189 - Wind Direction

0190 - Wind Speed

0191 - Barometric Pressure

0184 - Pressure

0065 - Solar Radiation

Leave observation blank.

Write Tape # 8244 in remarks column

SIO Buoy Locations

SIO Buoy #46	43° 01.8'N	157° 17.6'W
SIO Buoy #48	41° 00.5'N	148° 02'W
SIO Buoy #49	42° 25.7'N	157° 59.8'W
SIO Buoy #50	43° 00.4'N	157° 16.2'W.
SIO Buoy #51	29° 59.3'N	165° 01.4'W
SIO Buoy #53	42° 00.6'N	164° 03.1'W
SIO Buoy #55	41° 59'N	164° 04'W
SIO Buoy #56	42° 23'N	157° 59'W
SIO Buoy #58	33° 25.3'N	122° 37.7'W
SIO Buoy #59	33° 03.6'N	121° 45.7'W

NODC ACC # 75-0530

IDOE / NORPAX

UNIVERSITY OF CALIFORNIA, SAN DIEGO

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SCRIPPS INSTITUTION OF OCEANOGRAPHY

POST OFFICE BOX 1529
LA JOLLA, CALIFORNIA 92037

12 February 1975

Mr. Nelson Ross
NODC Liaison Officer
National Marine Fisheries Service
P.O. Box 271
La Jolla, California 92037

Dear Nelson:

Enclosed is a tape of all data that we processed from our bumblebee buoy platforms. These data are contained on one 9 track, 1600 bpi magnetic tape. Included with the tape is a listing of the first record of each file and a complete set of documentation which provides detailed information as to the technical characteristics of the tape as well as logical record format. With this documentation and the copy of the tape, it should be possible for any reasonable computer programmer to read and understand these data.

I trust that you will send this on to the proper office at NODC for permanent retention as the national record of this scientific data from this series of platforms. If the people in Washington have any questions concerning the technical nature of this data set, please let them call me directly at 714/452-4495.

Thank you for your help on this matter.

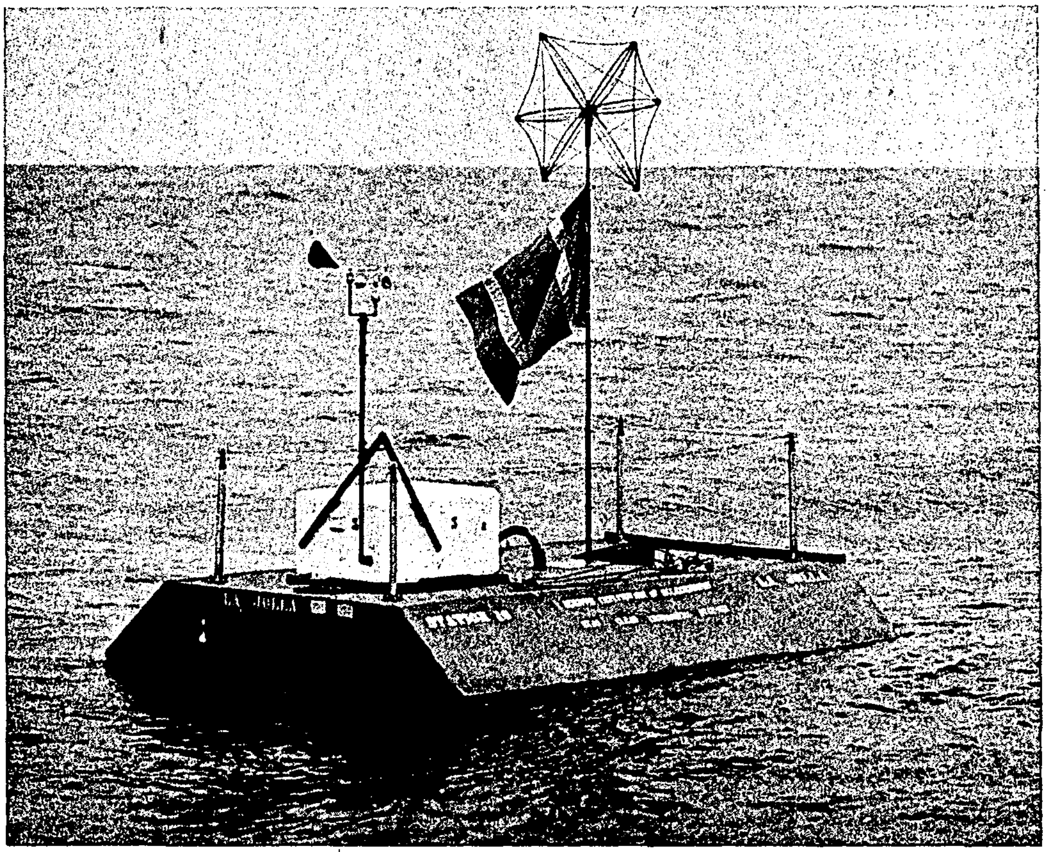
Sincerely yours,

Rich Wert

Richard T. Wert
NORPAX Data Manager

cc: Dr. James J. O'Brien
Code 481
Office of Naval Research, Arlington, Virginia 22217

cc: Dr. Curtis A. Collins
IDOE - NSF, Washington DC 20550



DEVELOPMENT AND TESTING OF TAUT-NYLON MOORED INSTRUMENT STATIONS

(WITH DETAILS OF DESIGN AND CONSTRUCTION)

Scripps Institution of Oceanography
University of California at San Diego

SIO Reference 65-5

April 15, 1965

UNIVERSITY OF CALIFORNIA, SAN DIEGO

SCRIPPS INSTITUTION OF OCEANOGRAPHY

DEVELOPMENT AND TESTING OF TAUT-NYLON MOORED INSTRUMENT STATIONS

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John D. Isaacs, George B. Schick, Meredith H. Sessions and Richard A. Schwartzlose

This research has been supported by the Office of Naval Research, Bureau of Commercial Fisheries and Marine Life Research Program of The University of California.

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April 15, 1965

Approved for distribution

F. N. Spiess, Director

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DEVELOPMENT AND TESTING OF TAUT-NYLON MOORED INSTRUMENT STATIONS

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Richard A. Schwartzlose

Abstract

One of the persistent problems of oceanography is to ascertain the nature and cause of large-scale shifts in the surface water masses of the oceans. The existence of such changes are readily apparent from vessel measurements. However, the nature of the motions involved cannot be documented by any feasible ship survey. It probably can best be documented by an array of continuous recording instrument stations.

For this and other purposes deep-moored instrument stations have been designed that record meteorological data and oceanographic data in the upper few hundred meters. Twenty installations of evolving designs of the taut-nylon mooring have been tested over a period of 3-1/2 years.

The approach has resulted in an increasing reliability and life of the installations and recent designs have a useful life of at least six months when moored in the deep open sea and much longer in deep sheltered areas. Developments and results of tests are discussed. Complete construction drawings with notes on construction, installation, and servicing are included.

Background of the Problem

The existence of large-scale shifts in the water masses of the oceans are well known. Perhaps the most celebrated of such shifts is the El Nino of the Peruvian coasts. Similarly abrupt shifts, however, appear to occur in all of the major boundary currents of the oceans and greatly affect the biota, fisheries, weather, underwater sound propagation, and other conditions. Shifts in the California Current System are well documented, and there appear to have been even greater shifts in the recent past in this system than observed in the last few decades. The existence of such anomalies is readily apparent from the data from coastal stations, survey vessels, and surface ships. See Figure 1, for example, where abnormally warm water (6° to 8° above normal) occurred in the Gulf of Alaska in the fall of 1957 (Mc Gary, 1960). Data from such discontinuous very shallow surface coverage, however, does not yield much insight into the nature of the exitation or water motion that gives rise to the anomalous distribution. For example, they cannot settle the question of whether these changes are progressive, wave-like instabilities of the boundary currents, floods of surface water from baroclinic transients, or the result of increases or decreases of mixing, transport or insolation.

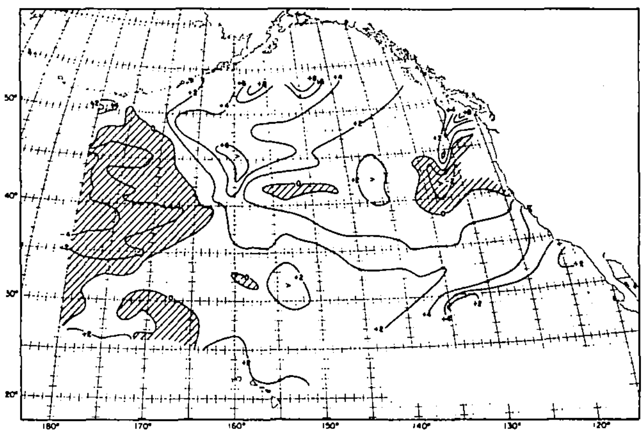

FIGURE 1. October 11-20, 1957. Anomaly of sea surface temperature (°F) from 30-year mean charts of H.O. 225. Hatched areas colder than average.

In addition there is the much more demanding problem of explaining teleconnection, that is, the apparent relationship of the changes that take place in widely separated parts of the Pacific Basin.

Insight into these and other questions of oceanography, meteorology, fisheries, and climatology require a spacial array of almost continuous long-term measurements of temperature through the mixed layers and associated other data (e.g., meteorological data) and extending well across the principal boundary currents of a current system and in the central water masses at a number of sections.

For the purpose of obtaining instrumentation to accomplish this, a deep-moored instrument system has been developed.

Background of Mooring

The development of deep moorings has continued at Scripps Institution of Oceanography since the early 1950's. Early work was with moorings of the taut-wire type, designed to gather surface data. This type of mooring consisted of a taut mooring wire supported by a subsurface float to which the surface float was attached by a slack pennant. The taut-wire mooring was successful for surviving sea surface conditions and for collecting surface data but many problems were encountered in attempts to use this type of mooring for measurements much below the surface. These problems included the fouling and cutting of slack buoyant pennants by ships, fish entanglement, uncertainty regarding the true depth of the measurements taken along the slack pennant, etc. Also theft and "helpful" recovery of the boat-type surface float and the instruments was a continuous problem (Isaacs, et. al., 1963).

The taut-nylon mooring concept was developed to overcome the disadvantages of the earlier moorings. Some considerations that went into the adoption of the taut-nylon mooring and platform were:

1. It allows the installation to be small and light enough to be installed from small ships without special equipment.

2. A taut vertical mooring line keeps station well in all but high currents, can be instrumented to any depth, can protect the surface float from theft, and eliminates the problem of surface pennants being fouled or cut by a ship's screw.

3. Nylon lines do not corrode and are elastic.

4. The float can be large enough to accommodate necessary instrumentation.

5. It is unattractive to thieves and theft resistant.

6. It is rugged and unsinkable.

7. It is large enough and is sufficiently stable to permit boarding for servicing at sea.

Developmental Testing

The first attempt at mooring a platform with a taut-nylon line was carried out on 27 June 1961 when a 16-foot Fiberglass skiff was anchored 13 miles from Point Loma. Mooring depth was 657 fathoms and line tension was 300 pounds as read by a dynamometer installed in the line. The skiff was last checked on 10 July 1961, but on 17 July 1961 it was missed on the routine check. The hatch cover for this skiff was found adrift 25 miles west of San Diego on 18 July 1961. Due to the large amount of shipping in this area, it was concluded that the skiff had been stolen or had been sunk by a large ship.

This mooring was designed to demonstrate the feasibility of using a taut-nylon mooring line from the anchor to the surface, and, although short-lived, was a departure from the mooring techniques that were then current. The length of the mooring line had been about 10 percent less than the depth to achieve 300 pounds of tension when installed.

The first taut-nylon catamaran mooring was installed on 13 October 1961 at 32° 54.8' N, 117° 21.8' W (6 miles west of Scripps Pier). This mooring was a result of considerable redesign of the platform and fittings. The instrumentation was housed in a box and mounted on the open deck of the catamaran-type float. The box was sealed and self-contained with only sensing input leads entering the box. Both the platform and instrument package represented a number of major improvements (Fig. 2).

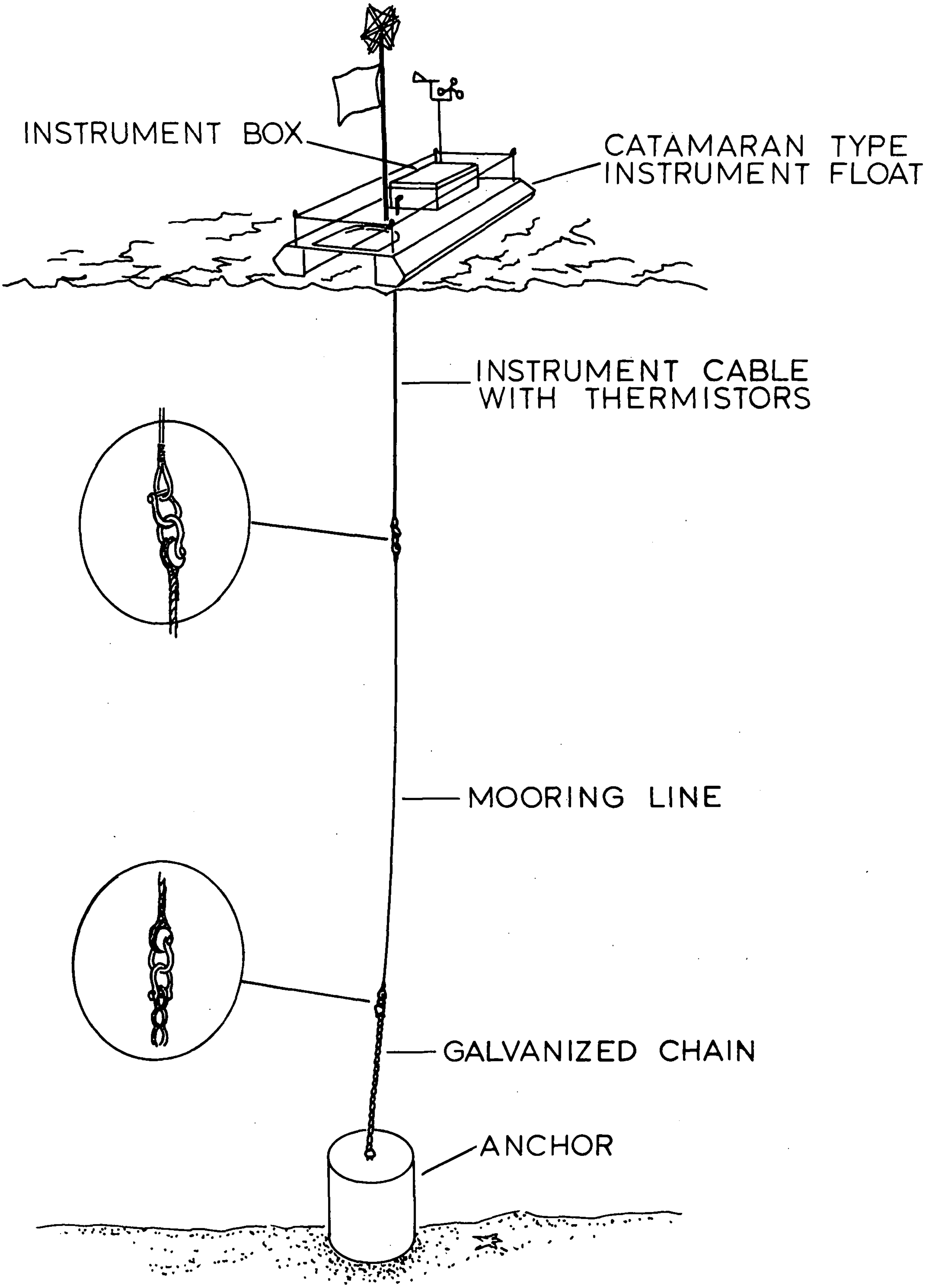

Figure 2. Taut-nylon catamaran mooring.

The installation operated well for almost 5 months until the recording control circuit malfunctioned. About the same time the instrument line failed, so the unit was left as a life test of the mooring components. After surviving 15 months, this mooring was eventually recovered intact as a test of recovery techniques and for component inspection and evaluation.

The installation of the second taut-nylon mooring with a catamaran float took place on 6 January 1962. This station was located near the first catamaran mooring. It was instrumented to measure wind speed and direction, 6 sea temperatures from the surface to 150 meters, depth of the bottom of the instrument line, and platform heading, all recorded photographically. This unit was installed to test the instrumentation of the taut-nylon mooring line. The instrument line was constructed by winding electrical conductors around a nylon strength member. With great difficulty a length of garden hose was pulled over the assembled line. The instrument line depended on the hose for its water-tight integrity; however, when installed, the nylon stretched, broke the hose and flooded the cable. After the instrument line failure, it was decided to attempt recovery of the entire mooring using a newly developed chain hook. This was attempted on 7 March 1962, but was not completely successful. However, the complete instrument line and bottom fitting containing the pressure transducer were recovered. The catamaran and instrument box were returned to the laboratory for repair and fitting out to be used again for another installation.

A third catamaran mooring with instrument box identical to the previously-described unit except for minor modifications was constructed to test another type of instrument line. This line consisted of a 150-meter nylon strength member with amergraph hook-up wire spiralled around it in the form of a helix. Water-tight integrity was maintained at each individual conductor, the only covering being a tape to keep the conductors in place. This mooring took place 4 April 1962, in the area 6 miles off La Jolla, used in our previous tests.

One particular note of interest regarding this installation was the method used to attach the instrument line from the surface of the water to the instrument box. A large cable was made of the 15-conductors and a heavy-wall tygon tube was placed over the conductors. A large rubber stopper was drilled out and placed in the deck and the tygon cable was brought through the cork. A cannon MS series plug was attached to the conductors and was sealed in the end of the tygon which was placed in a large radius bend from the deck to the box in which it was plugged.

The instrument box from this station was brought back to the laboratory 19 July 1962 due to batteries leaking inside the box and expelling liquid. Checkout of the instrument line after removal showed all thermistor connections in good condition.

The surface float was exchanged 22 May 1963 to test the feasibility of such a transfer. The installation showed no sign of wear or chafing. The mooring is still intact at this time, 34 months after installation.

On 17 May 1962 catamaran station #4 was installed near the previous mooring off La Jolla. This installation used the instrument box and catamaran that were recovered and repaired from our station number #2.

The instrument line used on this station was of different design than any previous units. A 1/4-inch stainless steel cable was used as a strength member with amergraph hook-up wire taped to it. The primary purpose of this installation was to test a massive rigid instrument line in preparation to ordering a commercially manufactured unit from Marsh and Marine Manufacturing Company.

The only change was the use of Mecca Cable Company boots instead of vulcanized Joy connectors at the thermistor connections and an epoxy potted model #304 Bourns pressure transducer. When installed all instrumentation operated properly. On 20 July 1962 a check of the station revealed the pressure transducer reading was in error. A further check showed the surface instrumentation operating properly, so it was concluded that leakage of sea water may have occurred at the transducer connections.

This station broke loose and was recovered off Del Mar 21 August 1962 and later installed as station #7 off Point Sur.

Moorings #5 and #6 were to be the first rough-water test installations near Davidson Seamount and Point Sur respectively. They were also to test commercially manufactured instrument lines, fabricated by Marsh and Marine, and advances in instrumentation and packaging techniques. Station #5 was damaged during installation and never installed. Mooring #6 was installed 8 October 1962 in 2090 fathoms southwest of Davidson Seamount. Immediate check of the station after installation revealed numerous cable failures, evidently results of inadequacies in fabrication. It was serviced again on 14 October and appeared under high tension. It was not sighted on a return trip 3 November 1962 and was therefore given up as lost. A later Coast Guard sighting report indicates that it was still in position 26 April 1963 after 6-1/2 months.

Mooring #7 was installed off Point Sur 2 November 1962 in 660 fathoms to establish a winter mooring test. The mooring line and anchor had been prepared for mooring #5. The float and instrument line had been previously anchored as mooring #4 and had just broken loose. This station was serviced once in January 1963 and last sighted by passing vessel 30 April 1963 after 6 months.

Mooring #8 was a special mooring installed 30 March 1963 by the U. S. Coast Guard at ocean station November (30° N, 140° W) in 2260 fathoms. This float was anchored from a point at its center and had a 12-foot mast with a heavy radar reflector. It promptly capsized in heavy seas but was righted again by the Coast Guard. The float was exchanged for one with a shorter mast and a mooring point forward of the center. It performed well for 6-1/2 months, when it broke loose at a point 1285 feet below the surface.

Moorings #9 through #12 were the first standardized design of both moorings and instrumentation. This design represented many improvements in components and instrumentation. Commercially manufactured instrument cases were used for the first time as well as tautband, 250° meters. Many components previously constructed in-house were subcontracted out. These stations were anchored on 2 October 1963 along a line heading southwest from Point Conception. The purpose of these moorings was to establish a line of oceanographic stations in an area where previous data had frequently been collected by ship. Station #9 was found capsized on a routine service trip on 3 December 1963. The station was righted and the instrument box removed when it was found to have leaked slightly, presumably while capsized. Station #10 was not sighted on the same trip and assumed lost. Stations #11 and #12 were found to be in good working order. On subsequent service trips Station #11 was found capsized (9 January 1964 and 2 February 1964). Data recovered from Station #11 indicated that winds in excess of 50 knots occurred during December and January. The accompanying rough weather was concluded to be the cause of the floats capsizing. Station #9 was last seen on 18 December 1963. Station #11 was last sighted on 2 February 1964 and station #12 last sighted on 23 March 1964.

Due to the difficulty of maintaining frequent observations of stations very far from Scripps, it was decided to locate as many future test sites as possible, where they could be observed frequently and recovered if found adrift. We received approval to anchor stations at the Navy Picket Ship positions.

Station #13 was a reinstallation at the U. S. Coast Guard Weather Station November station. This mooring was to test a longer (450 meters) steel cable. The platform was anchored on 8 December 1963, but failed eight days later and was returned to Scripps.

An uninstrumented station #14 was established in cooperation with the U. S. Coast Guard on 10 February 1964 at Ocean Station Victor (34° N, 164° E). This station capsized in very heavy seas on 12 February 1964 and was last sighted while still capsized on 15 February 1964.

Station #15 was the third mooring installed at U. S. Coast Guard Station November. This was an uninstrumented mooring with the nylon mooring line continuing to the surface. It was installed on 21 February 1964. The mooring was terminated on 12 March 1964 when the nylon line parted 60 feet below the surface.

Most observations indicate that the catamaran floats tend to capsize over the side. They apparently broach in heavy weather and overturn due to a combination of aerodynamic lift, a disorienting wave induced acceleration, and wind disorientation in the lee of an approaching comber because of the sheltering effect.

This experience led to the addition of the ballast tanks to the catamaran float to prevent capsizing in heavy seas. The ballast tanks flood freely through small vents and capture a substantial volume of both air and water. This provides two beneficial effects. In a capsizal situation, as the float begins to lift one hull, the volume of water captured in the lifting hull increases the apparent weight of that hull and the moment arm of that hull as well, while the other hull sees an increase in apparent buoyancy and its moment arm due to the entrapped air. The overall effect of the ballast tanks then is to increase the capsizal resisting moment by more than a factor of three. Our recent recorded data in trade wind areas shows that the floats generally head into the wind, especially at higher wind velocities.

A new aluminum instrument box was designed with welded fittings to minimize possibility of water leakage into the box. Interchangeable plug-in mast assemblies were designed with electronic flash beacon lights. An all solid state electronic control system and commercially manufactured clock timers replaced the motor-drive cam assemblies. Internal modifications were made to the camera to improve reliability. The size of the nylon mooring line was increased from 3/8-inch to 7/16-inch diameter to provide a greater safety factor in case of chafing or animal attack on the mooring line. With these changes, 5 stations numbered #16 through #20 were installed in May 1964 and one in June (see Table 1 for details). It should be noted that, although these latter stations were under frequent surveillance care was exercised not to vitiate the conditions of a test of unmanned stations. No repairs were made.

Results

Over the last 3-1/2 years of the development of the taut-nylon moorings the life of installation and reliability of the instrument lines and instrumentation has greatly increased. The most recent tests have demonstrated that a sufficient number of moorings will survive approximately 6 months to make it possible to use moorings to document the shifts of water masses and boundary currents. The considerations that went into the mooring system appear to have been met. The moorings are small enough to be installed from a small ship without special equipment, yet large enough to accommodate the necessary instrumentation. They have proved theft resistant and stable under various sea and wind conditions.

The cause of some failures of the mooring lines is still unknown. All the moorings that were recovered after breaking loose failed by parting of the nylon line except no. #19. Several samples of the nylon line were sent to the manufacturer for analysis of the breaks. Their review showed no deterioration of the nylon but they could not determine the cause of the breaks. In three cases (#4, #13, #20) the nylon lines parted less than 50 feet below the bottom of the instrument line. In one event (#15) where there was no instrument line and the nylon extended from the surface to the anchor, the line broke at 60 feet below the surface. In another mooring (#8) the line parted 785 feet below the bottom of the instrument cable (1285 ft. from the surface).

Essentially all the known line failures have occurred very near the upper end of the nylon mooring line. It is the area where a large discontinuity in mass and elasticity occurs between the steel cable instrument line and the nylon mooring line. It is thus possible that the vertical wave-induced oscillations of the lower end of the instrument line could produce large local strains in the upper end of the nylon mooring line where the discontinuity and reflection exists. If this were occurring the breaks would be expected in the upper end of the nylon as observed.

In the areas nearest the bottom end of the instrument line marine animal attacks would be expected to be more numerous than at greater depths. There is no evidence of the recent failures having been caused by marine animal attacks. In a mooring using the taut-wire subsurface float and pennant to the surface design, a shark became entangled in the pennant line (Fig. 3), and in earlier work a broken shark's tooth was imbedded near the end of a parted pennant. Woods Hole Oceanographic Institution, in their report on mooring performance, have evidence of cuts

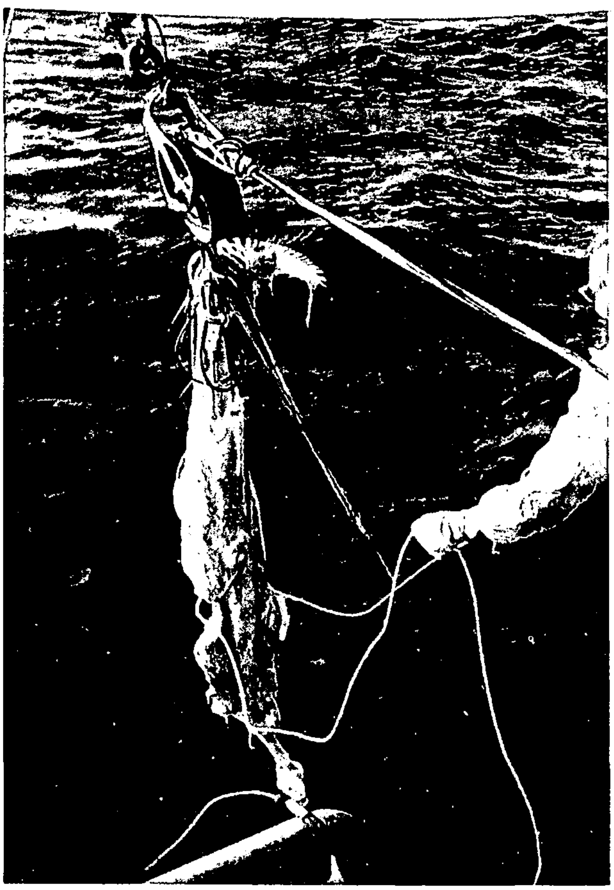

Figure 3. Shark which became entangled in an instrument line 170 feet below the surface.

in parted mooring lines that may be fish bites (Stimson, 1964). From only one of our recovered instrument lines (#18) is there clear evidence that it might have been attacked by marine animals. It had numerous razor-like slashes along its length to a depth of 200 feet. At the 200 foot mark there were several rips in the taped jacket and the electrical conductors. It is possible that a pelagic tuna long line could have caused this damage, but a marine animal attack is probable.

In order to protect the upper end of the nylon line from animal attack, and to secure condlusive evidence such as tooth imprints, a piece of polyethylene pipe 400 feet in length was placed over the nylon line of mooring #22. The pipe was attached just below the thimble at the upper end of the nylon, covering the area where most of the known failures have occurred. This mooring is still in place at the present time so that results of the test will have to await further development.

There has been only one known mechanical failure (#19). It occurred at the hydraulic shackle assembly. It appeared to be a problem of wear on the stainless stell threads and redesign of this piece may be necessary.

Performance of all taut-nylon catamaran moorings installed by Scripps is shown in Table 2. The "number of days moored" for each station is the minimum time each station remained installed. In cases where the mooring was not recovered it was assumed that the failure occurred on the day when the mooring was last sighted. It is evident that moorings located in sheltered areas may last for long periods of time but are not indicative of open-sea performance. The group of moorings numbers #16 through #22 were of later design with ballast tanks and larger diameter mooring line. This group shows a greater than 50-percent increase in mooring duration when compared to a similar open-sea group of earlier design. The moorings have withstood winds in excess of 50 knots and seas in excess of 25-foot.

Performance of the instrumentation on this latter group of moorings (#16 through #22) also was far superior to the preceeding stations. There were no failures in the instruments or cables for six months of installation. Shortly after the sixth month a number of indicator-battery failures were noted. This was somewhat sooner than expected but can easily be corrected.

There have been approximately 750 station days of data collected from the last 6 installations. Every station day of data contains 24 readings at hourly intervals, and each reading consisting of 12 parameters (Fig. 4). To date the readings total slightly less than one quarter of a million. This data film has been processed and is being punched on IBM cards as it is read. From the card form the data can be converted to IBM magnetic tape for computer analysis. A sample of the data obtained from a typical station, which has been computer-processed and plotted, is shown in Figure 5. From our experience it takes approximately 0.33 man hours per station day of data to read and punch these data on IBM cards.

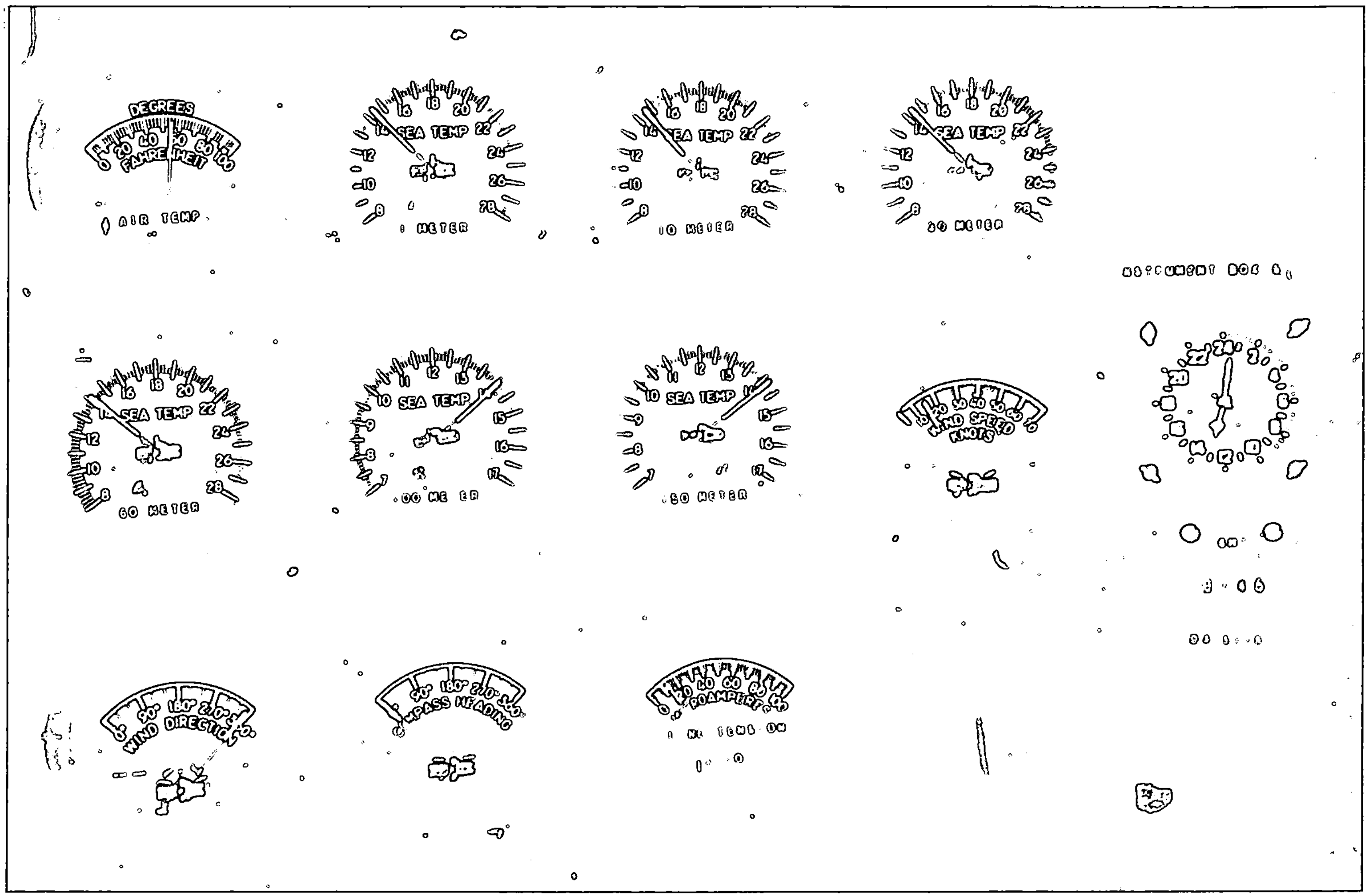

Figure 4. Reproduction of a data frame.

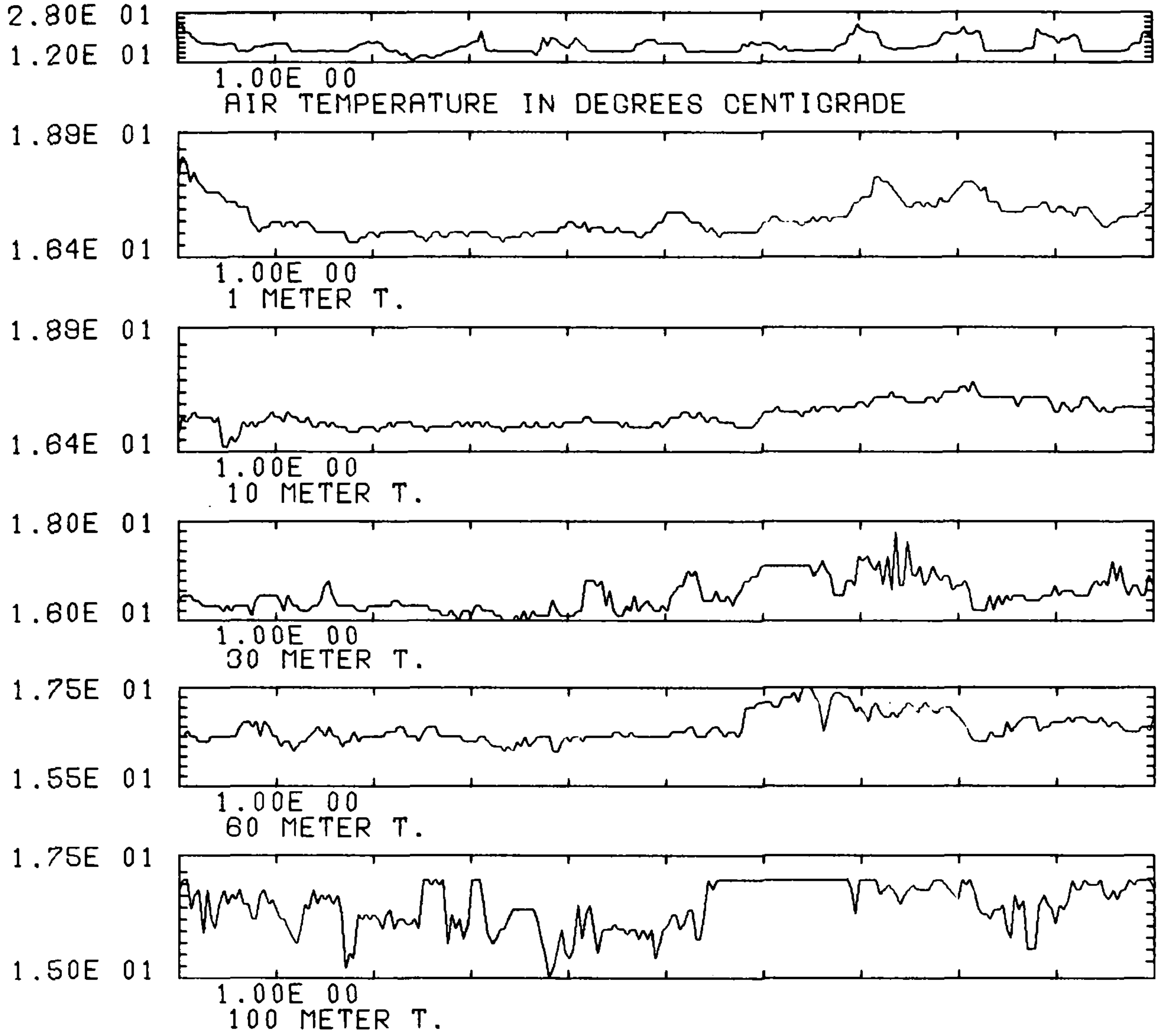

Figure 5. Sample of computer-plotted data for 10 days from Station 19. Data begins at 2157 GMT, 20 May, 1964. Spacing on the horizontal axis represents 1 day. There are 24 observations plotted each day. Temperature values are in centigrade at the depths indicated. The values on the vertical axis represent the scale (2.80E 01 means 28.0°C). Due to the programed method of plotting the areas of straight lines can result from off-scale instruments, missing data or no change in the values. This was a first attempt at computer plotting to learn the problems and to see the rough plotted data. (A continuous 3913-hour record has now been plotted from this station.)

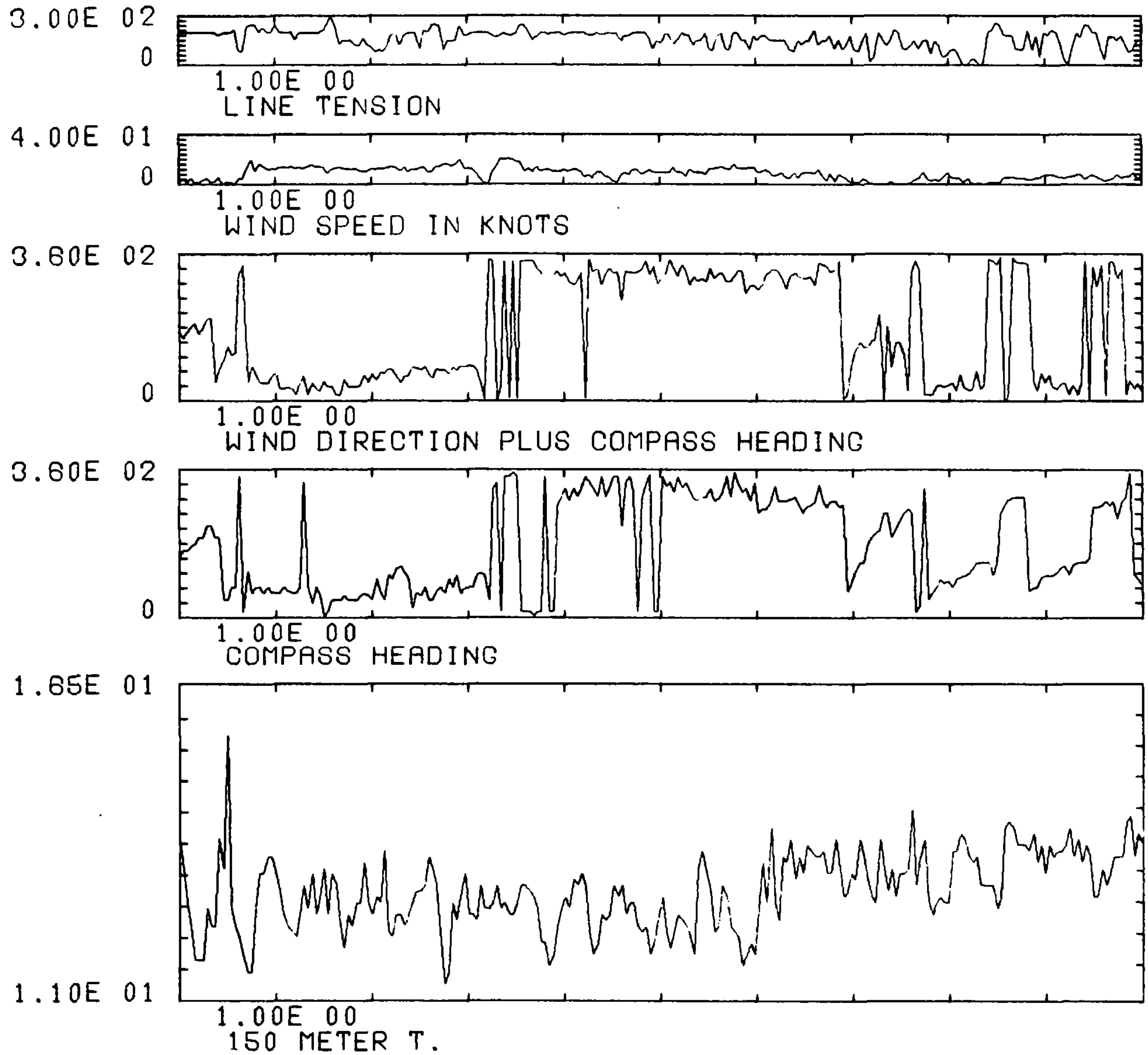

Figure 5 (cont.). Remainder of data from sample of computer plot from Station 19. Data begins at 2157 GMT, 20 May, 1964. Line tension values are in pounds (0-300 lbs.). Wind direction plus compass heading means true wind direction. Compass heading means the true heading of the platform.

The total cost of the mooring and instrumentation is approximately $6,000. Operational cost of a station is low. Film and batteries are inexpensive and need replacement at intervals of 3 months if hourly records are made. The power requirements of the system are extremely low (12 milliwatts average power). The film magazine capacity of the camera is 50 feet. At the rate of one frame per hour the unattended endurance of the station is 83 days. By recording data every 2 hours or 4 hours the time between servicing can be double or quadrupled since it is the film storage rather than the power requirement that is the limiting factor.

Present and Future Plans

The present and future plans are centered around the instrumentation. A digital data gathering unit has been purchased from Berkeley Instruments. The data gathering unit consists of a group of sensors, the data conversion chassis and a paper tape punch. The unit is designed to sense 10 sea water temperatures (thermistors), air temperature, wind speed, wind direction (relative to magnetic north), and barometric pressure. In addition to these parameters a two digit identification number and time are recorded. The data unit is small (approximately 2.5 cubic feet) and light (25-30 lbs.) and consumes a small amount of electrical power (6 watts average during operating cycle). All electronic circuitry is solid state and operates from a 12 volt D.C. supply.

The analog signals sensed by the transducers are converted in the data unit to a standard five-level teletype code. In this form the data will be recorded on site by a paper tape punch. The output from the data unit will also key a relay for radio telemetry. The data recorded on paper tape can be converted to IBM cards and then to IBM magnetic tape for use on any computer.

The data unit is designed for use with radio telemetry of data in standard teletype format. A 500 and 700 cycles per second audio frequency will represent the mark and space respectively. These tones will be transmitted via single side band transmitter on the buoy.

This type of transmission is compatible with present facilities at radio station WWD and with future installations on Scripps' ships. The shipboard teletype installation will provide direct data output without conversion for survey work.

The data unit has been operating in the laboratory on a teletype wire loop for two months. The data unit has been packaged with the telemetry system in a military packing case similar to the photo recording buoys. This unit will be installed on the end of Scripps pier for initial tests of the radio link. The transmitter is low power (2 watts). The system will then be used offshore on a mooring. After considerable testing with the lower powered radio link, longer range will be tested by the addition of a linear amplifier to the transmitter to increase the output to 30-50 watts.

In addition to the capability of transmitting interrogated on line data it is desirable to be able to store data for later transmission. For this purpose a magnetic tape recorder is most suitable. This unit will be added at a later date when the present system has been sufficiently tested.

Conclusions

The development of the taut-nylon catamaran mooring has resulted in a unit that can be used to measure surface meteorological conditions and ocean temperatures in depth and which can be moored in any water depth to 3000 fathoms and undoubtedly deeper. Installations can be made by small ships without special equipment in a minimum of one to two hours.

The recording system is simplified in its design as compared to most other electronic data recording and storage devices. This system will allow any sensor with either digital or analog output to be visually displayed so that failures are obvious in an inspection.

The latest tests in deep water and in the open sea indicate that most of the moorings last at least 6 months before the mooring line fails and that the instruments will operate as long as the mooring is in place. In sheltered areas the moorings will last for years.

Thus it now is feasible to use these moorings in the open sea far from land to document large-scale shifts in the surface water masses of the oceans; to ascertain the nature of the time variation of a number of characteristics; to record internal waves; to gather data for inquiries that require many observations over long periods of time and from single or multiple locations, such as sea-air interaction; etc.

Acknowledgements

Research and development work on taut-nylon deep-moored instrument stations was undertaken at Scripps Institution of Oceanography, supported by the Office of Naval Research, Bureau of Commercial Fisheries and Marine Life Research Program of the University of California. Acknowledgement is made to the U. S. Coast Guard, Western Area and to the U. S. Navy Picket Squadron ONE for their assistance and participation on various test programs. Their observations and recovery of test moorings were of vital importance to the success of the test program. Acknowledgement is also made to Erich W. Duffrin, Phillip M. Marshall, Richard L. Shutts, Raymond Shuey, and John Martin for their assistance in carrying out this development and for their many contributions, and to Captain Frank Miller and the crew of the R/V Agassiz for their aid in mooring many of the test stations.

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TABLE 1

DATA FOR CATAMARAN MOORINGS

3 February, 1965

	#1	#2	#3
DATE MOORED	October 13, 1961	January 6, 1962	April 4, 1962
LOCATION	32° 54.8'N, 117° 21.8'W	32° 54.8'N, 117° 21.8'W	32° 54.8'N, 117° 21.8'W
DEPTH	320 fathoms	320 fathoms	320 fathoms
TYPE OF MOORING LINE	3/8" nylon-white	3/8" nylon-white	3/8" nylon-white
TYPE OF INSTRUMENT LINE	None.	Hose instrument line 150 meters*. Nylon core with electrical conductors and garden hose covering.	Nylon instrument line with conductors spiraled around it and wrapped with tape.
INSTRUMENTATION	Hydraulic tension gauge.	6 sea temperatures, air temperature, wind speed and direction, depth of instrument line, camera recording.	6 sea temperature, air temperature, wind speed and direction, depth of instrument line (used Bourns gauge #734. Camera recording.
MOORING SHIP	Baird	Paolina T	T-441
LAST SIGHTED DATE	Removed November 28, 1962	Removed March 7, 1962	Still in service
LENGTH OF KNOWN TIME MOORED	406 days	61 days	
CHANGES AND REMARKS	1. Dec. 13, 1961. Added instrumentation: 2. Data recorded on film: mooring line tension, wind speed and direction, mooring line angle, surface current measurement at 10 ft from surface, speed and direction. 3. Transmitter put on to radio warning if tension was reduced substantially. 4. Jan. 9, 1962. Replaced camera. 5. Apr. 13, 1962. Removed instrumentation. 6. Recording unit failed.	1. Instrument line failed on installation. 2. Camera failed on installation. 3. January 9, 1962 replaced camera.	1. Camera malfunction May 9, 1962 and camera replaced. 2. Removed instrument box July 19, 1962 (all sensors were working). 3. Reinstalled instrument box July 24, 1962 (replaced several meters). 4. Float was exchanged to test technique on May 22, 1963. Instrument box was not put on new float

* All instrument lines are 150 meters in length except as noted and the 6 sensors are at 1 m, 10 m, 30 m, 60 m, 100 m, and 150 m.

3 February, 1965

DATA FOR CATAMARAN MOORINGS

	#4	#5	#6
DATE MOORED	May 17, 1962		October 8, 1962
LOCATION	32° 54.8'N, 117° 21.8'W		35° 27'N, 123° 06.5'W
DEPTH	320 fathoms		2000+ fathoms
TYPE OF MOORING LINE	3/8" nylon-white		3/8" nylon-white
TYPE OF INSTRUMENT LINE	Stainless steel core (1/4") conductors taped around core.		Marsh marine.
INSTRUMENTATION	6 sea temperature, air temperature, wind speed and direction, depth of instrument line. Current meter at surface. Camera recording.		6 sea temperature, air temperature, wind direction and speed, depth of instrument line, compass, hours per year counter. Camera recording.
MOORING SHIP	Paolina T		Agassiz
LAST SIGHTED DATE	Found adrift off Del Mar August 21, 1962.		April 26, 1963 reported by passing ship.
LENGTH OF KNOWN TIME MOORED	97 days		201 days
CHANGES AND REMARKS	1. Remote reading compass installed August 7, 1962. 2. Moored near #3. 3. Nylon broke 56 feet below instrument line.	1. Damaged October 7, 1962 during installation.	1. Retrieved film October 16, 1962. 2. Was not seen by SIO ships after October 16, 1962.

DATA FOR CATAMARAN MOORINGS

3 February, 1965

	#7	#8	#9
DATE MOORED	November 2, 1962	March 30, 1963	October 2, 1963
LOCATION	36° 05.9'N, 121° 55.2'W	30° N, 140° W	34° 19.4'N, 120° 48.2'W
DEPTH	660 fathoms	2260 fathoms	405 fathoms
TYPE OF MOORING LINE	3/8" nylon-white	3/8" nylon-gold line	3/8" nylon-gold line
TYPE OF INSTRUMENT LINE	Same line that was used on #4.	Stainless steel 1/4" strength member with Amerigraph hook-up wire taped to the cable, using Marsh Marine boots for thermister housing.	Same as #8.
INSTRUMENTATION	Same instrument box as used on #4. Installed Fenwale ruggedized meters. Same parameters measured.	6 sea temperatures, tension recorder, sea temperatures read on one meter with selector switch.	6 sea temperature, wind direction and speed, air temperature, compass, line tension, surface current aeromarine 270° meters, line depth. Camera recording.
MOORING SHIP	Smith	USCG Ponchartrain	Agassiz
LAST SIGHTED DATE	April 30, 1963 reported by passing ship.	Recovered October 18, 1963.	December 18, 1963
LENGTH OF KNOWN TIME MOORED	180 days	183 days	78 days
CHANGES AND REMARKS	1. Serviced January 19, 1963. Changed film and batteries. All instruments working.	1. Ecco lens radar reflector on a 12-ft mast. 2. Capsized April 13, 1963 and was righted by USCG vessel. 3. Tension indicator failed (pressure pot failure). 4. Float exchanged and mast shortened June 4, 1963. 5. First float mooring eye was in the center. 6. Second float mooring eye moved to original position, 1/3' aft from the bow. 7. Nylon line parted 785 ft below the bottom end of the instrument line, October 18, 1963	1. Life boat radar reflectors on bamboo poles. 2. Seen on November 7, 1963 from airplane. 3. Observed November 15, 1963 from T-441 in good condition. 4. Found capsized December 3, 1963. Light and instrument box removed. 5. Reinstalled instrument box without water temperature indicators. Also had modified electronic control system, December 18, 1963. 6. Highest wind speed recorded on film was 27 knots. 7. Searched for on January 8, 1964, but not found.

DATA FOR CATAMARAN MOORINGS

3 February, 1965

	#10	#11	#12
DATE MOORED	October 2, 1963	October 2, 1963	October 2, 1963
LOCATION	34° 05.5'N, 121° 14.6'W	33° 46.0'N, 121° 57'W	33° 24.4'N, 122° 36'W
DEPTH	1498 fathoms	2017 fathoms	2180 fathoms
TYPE OF MOORING LINE	3/8" nylon-gold line	3/8" nylon-gold line	3/8" nylon-gold line
TYPE OF INSTRUMENT LINE	Same as #8	Same as #8.	Same as #8.
INSTRUMENTATION	Same as #9 except no line tension and no current meter.	Same as #9 except no line depth.	Same as #9 except no line depth and no current meter.
MOORING SHIP	Agassiz	Agassiz	Agassiz
LAST SIGHTED DATE	October 4, 1963	February 2, 1964	March 23, 1964
LENGTH OF KNOWN TIME MOORED	3 days	124 days	174 days
CHANGES AND REMARKS	1. Same as #9. 2. Boarded October 4, 1963. All instruments operating. 3. Not sighted during air search on November 7, 1963. 4. Not found by December 3, 1963	1. Same as #9. 2. Same as #9. 3. Clock malfunctioning due to corrosion December 3, 1963. 4. Highest wind speed recorded on film was 50+ knots. 5. Replaced mechanical switching with modified electronic control system and Geodyne clock, December 18, 1963. 6. Found capsized January 9, 1964. Righted and lens on camera replaced. 7. Found capsized. Righted and camera removed February 2, 1964. 8. Air search by Pacific Missile Range. Did not find on March 23, 1964.	1. Same as #9. 2. Experimental electronic control system malfunctioned and was replaced by mechanical switching. 3. Highest speed recorded on film was 32 knots. 4. Mechanical switching had failed and was replaced by modified electronic control system, December 3, 1963 5. Serviced - changed batteries and film December 18, 1963. 6. Removed instrument box due to camera malfunctioning January 9, 1964. At this time 60 meter, 150 meter, line tension not operating. 7. Air and sea search by Pacific Missile Range saw float on March 23, 1964.

DATA FOR CATAMARAN MOORINGS

3 February, 1965

	#13	#14	#15
DATE MOORED	December 8, 1963	February 10, 1964	February 21, 1964
LOCATION	29° 58'N, 139° 56.7'W	34° 00'N, 164° 00'E	29° 58.5'N, 140° 0.5'W
DEPTH	2150 fathoms	3180 fathoms	2280 fathoms
TYPE OF MOORING LINE	3/8" nylon-gold line	3/8" nylon-gold line	3/8" nylon-gold line
TYPE OF INSTRUMENT LINE	1500 ft of 1/4" stainless steel.	1000 ft of 1/4" stainless steel.	None (nylon line to the surface).
INSTRUMENTATION	Hydraulic tension indicator.	Hydraulic tension indicator.	None.
MOORING SHIP	USCG Ponchartrain	USCG Bering Strait	USCG Minnetonka
LAST SIGHTED DATE	Recovered December 15, 1963.	February 15, 1964	Recovered March 12, 1964.
LENGTH OF KNOWN TIME MOORED	8 days	6 days	21 days
CHANGES AND REMARKS	1. Nylon parted 40 ft below stainless steel wire.	1. Capsized in very heavy seas on February 12, 1964. Never righted. 2. Weather - wind 35 knots, 15-foot seas when found capsized. 3. Had drifted approx. 6 miles when last seen.	1. Nylon parted 60 ft below sea surface.

DATA FOR CATAMARAN MOORINGS

3 February, 1965

	#16	#17	#18
DATE MOORED	May 17, 1964	May 18, 1964	May 19, 1964
LOCATION	33° 23'N, 128° 38'W	35° 30.4'N, 131° 46.1'W	32° 10'N, 132° 46.8'W
DEPTH	2355 fathoms	2735 fathoms	2545 fathoms
TYPE OF MOORING LINE	7/16" nylon-gold line	7/16" nylon-gold line	7/16" nylon-gold line
TYPE OF INSTRUMENT LINE	Same as #8.	Same as #8.	Same as #8.
INSTRUMENTATION	Same as #9 except no current meter or line depth. Zero aluminum box.	Same as #16 except used Accutron clocks.	Same as #16.
MOORING SHIP	Agassiz	Agassiz	Agassiz
LAST SIGHTED DATE	Still in service	Recovered 29 September, 1964	October 16, 1964
LENGTH OF KNOWN TIME MOORED		135 days	150-195 days
CHANGES AND REMARKS	1. Triangular ballast tank on sides. 2. Wooden thimbles between nylon line and chain. 3. Radio beacons installed on June 11, 1964.	1. 16-ft float. 2. Wooden thimbles between between nylon line and chain. 3. Various parts from instrument box stolen by unknown party June 30, 1964. 4. Two Russian trawlers sighted near platform June 30, 1964. 5. Mooring failed but line not recovered to break due to weather and time of recovery.	1. Semi-circular ballast tanks on sides. 2. Wooden thimbles between nylon line and chain. 3. Radio beacon installed on June 11, 1964. 4. Not located on 7 November under poor search conditions. Not located on 19 December 115 sq. mi. search area good position. 5. S.S. Lurline reported sighting on 23 December, 1964 at 30°24'N, 134°31'W. Skiff adrift.

3 February, 1965

DATA FOR CATAMARAN MOORINGS

	#19	#20	#22
DATE MOORED	May 20, 1964	June 13, 1964	June 25, 1964
LOCATION	30° 51.5'N, 128° 37.8'W	29° 59.9'N, 140° 02.2'W	29° 58.8'N, 140° 1.0'W
DEPTH	2355 fathoms	2250 fathoms	2100 fathoms
TYPE OF MOORING LINE	7/16" nylon-gold line	7/16" nylon-gold line	7/16" nylon-gold line
TYPE OF INSTRUMENT LINE	Same as #8.	Same as #8.	Same as 16
INSTRUMENTATION	Same as #16 except used Accutron clocks.	Same as #16.	Same as 16
MOORING SHIP	Agassiz	USCG Gresham	USCG Pontchartrain
LAST SIGHTED DATE		Recovered June 29, 1964	Still in service
LENGTH OF KNOWN TIME MOORED	194 days	17 days	
CHANGES AND REMARKS	1. Semi-circular ballast tanks on on bottom of floats. 2. Yarn knot in upper end of nylon. 3. Parted at clevis, Mechanical failure	1. Triangular ballast tanks on sides. 2. Nylon line parted one foot below instrument cable.	1. #20 reinstalled at OSN. 2. 500 ft. polyethylene pipe over nylon extending down from bottom of instrument line.

#21 built for Oregon State University.

TABLE 2

Mean Time Before Failure of Various Moorings
as of January 27, 1965

Location	Mooring No.	Duration in Days	MTBF in days
Sheltered area off La Jolla	1	406*	
	2	61*	
	3	1000†	
	4	97	391
		1564	
Open sea areas	6	201	
	7	180	
	8	183	
	9	78	
	10	3	
	11	124	
	12	174	
	13	8	
	14	6	
	15	21	
		978	98
Improved design open sea areas	16	250†	
	17	135	
	18	150	
	19	194	
	20	17	
	22	220†	
		966	161
All open sea moorings to present			121
All moorings to present			175

* Purposely terminated

† Still installed

APPENDIX

Construction

Described below are the construction details of the mooring that have been tested by SIO. Variations in the number of thermistors, instrument line, instrument box are possible without compromising the reliability of the entire mooring system.

Description

The major components of the Scripps Deep-Moored Instrument Station consists of a modified catamaran-type surface float, instrument box, instrument line, nylon mooring line and anchor. The length of nylon line is cut slightly less than the depth of the water where the station will be anchored. This stretches the line tending to hold the station in a position over the anchor. The upper 150 meters of the mooring line is a steel wire to which the instrument cable is attached. There are 6 theristors spaced along the cable at various intervals. The cable is terminated at the surface with a steel wire strength member fastened to a tension transducer; the electrical conductors pass through the deck and plug into the instrument box.

Mounted on the deck of the float is the instrument box. It houses the instrumentation, recording equipment and acts as a support for the mast. The box has a hinged top which is fastened shut with link-lock latches. Several bulkhead-type connectors provide electrical connections with the main instrument cable and accessory sensors mounted on the float.

The instrument box contains a number of indicating meters which display all the various measurements simultaneously. These indicators are mounted on a curved panel and photographed at predetermined intervals (Fig. 6). A clock-driven switch initiates a pulse at the pre-selected interval which triggers an electronic control circuit. The control circuit generates a pulse to advance the pulse camera to the next frame, followed by a second pulse to turn on a bank of lights which photographs the panel of instruments. There is no shutter in the camera, so the length of time the lights are on determine the exposure for the photograph. The 6-volt dry-cell batteries which power the recording system and the flashing beacon are housed in wooden containers inside the instrument box.(Fig. 7).

Detailed Construction Notes

During the evolution of the taut mooring most of the components were hand made at Scripps. For the model described here, many components were manufactures to our specifications by outside vendors or the Research Support Shop on campus. Among the components manufactured outside were: sea temperature indicators, instrument box, remote reading compass, float, hydraulic clevis, jacket on stainless steel cable, thermistor boots, and tape-wrapping machine. (See parts list with vendor name and drawings.)

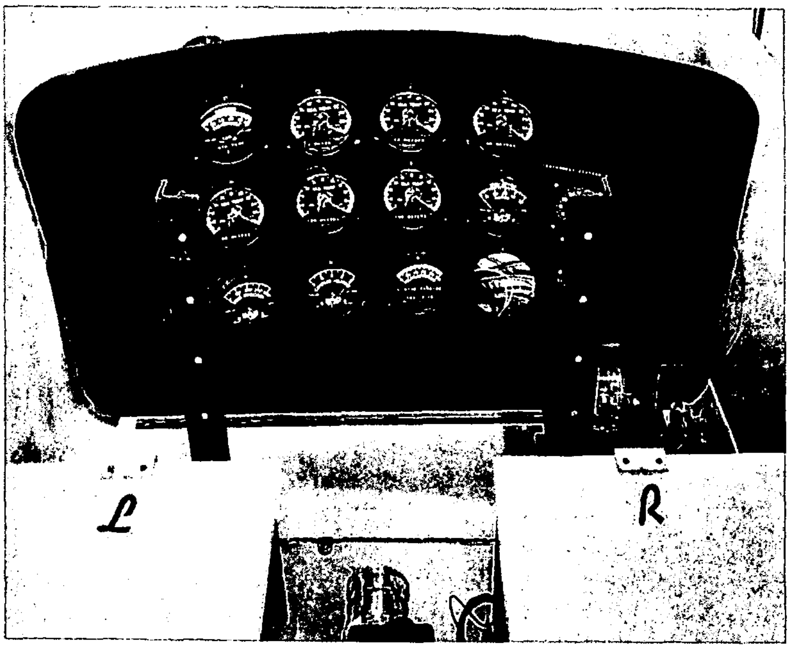


Figure 6. Instrument panel.

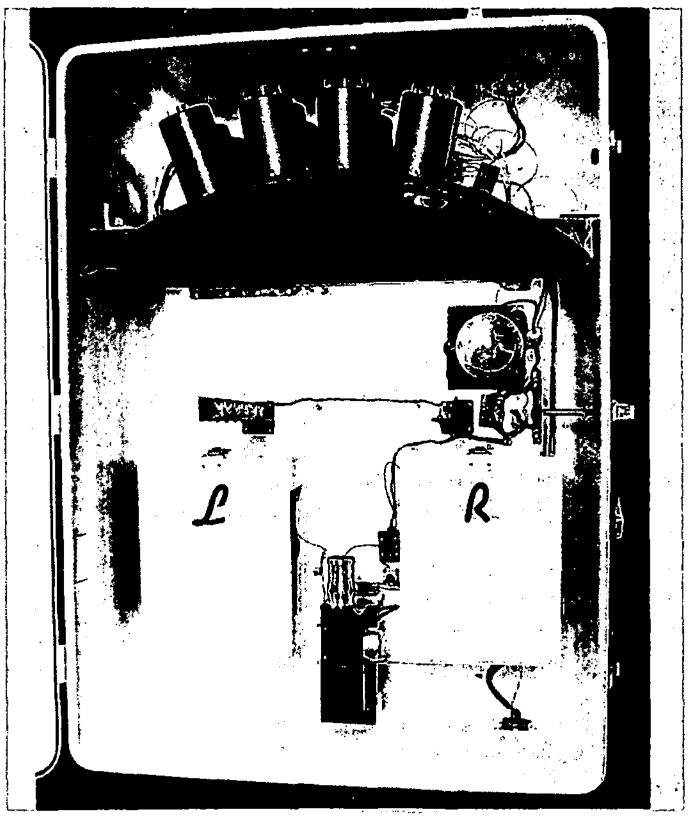


Figure 7. Overhead view of instrument box.

Generally the construction of the system is straight forward and can be carried on with reference to the drawings. There are, however, some points that need special consideration. These points resulted from test and experience with previous anchored stations.

Aluminum Parts

All exposed aluminum pieces should be of the 6061 T6 alloy and, after fabrication, they should be hard anodized, except for the stanchions (3002 alloy). This will greatly reduce the corrosion rate.

Instrument Line

The instrument line has been manufactured at Scripps with the aid of a tape-wrapping machine (see drawing no. 27). The procedure for this is to first have the 1/4" S.S. strength member jacketed (item #10 on first page of the parts list). After this has been done the necessary components (wire, tape, etc.) are taken to an area where the 150-meter length of cable can be stretched out. Once the strength member is stretched out, pairs of Amergraph hook-up wires are laid out to appropriate lengths from the top of the cable to give the desired thermistors' depths. 8 to 12 feet of electrical wire must be left above the top end of the strength member to allow the electrical cable to reach the instrument box (Fig. 8).

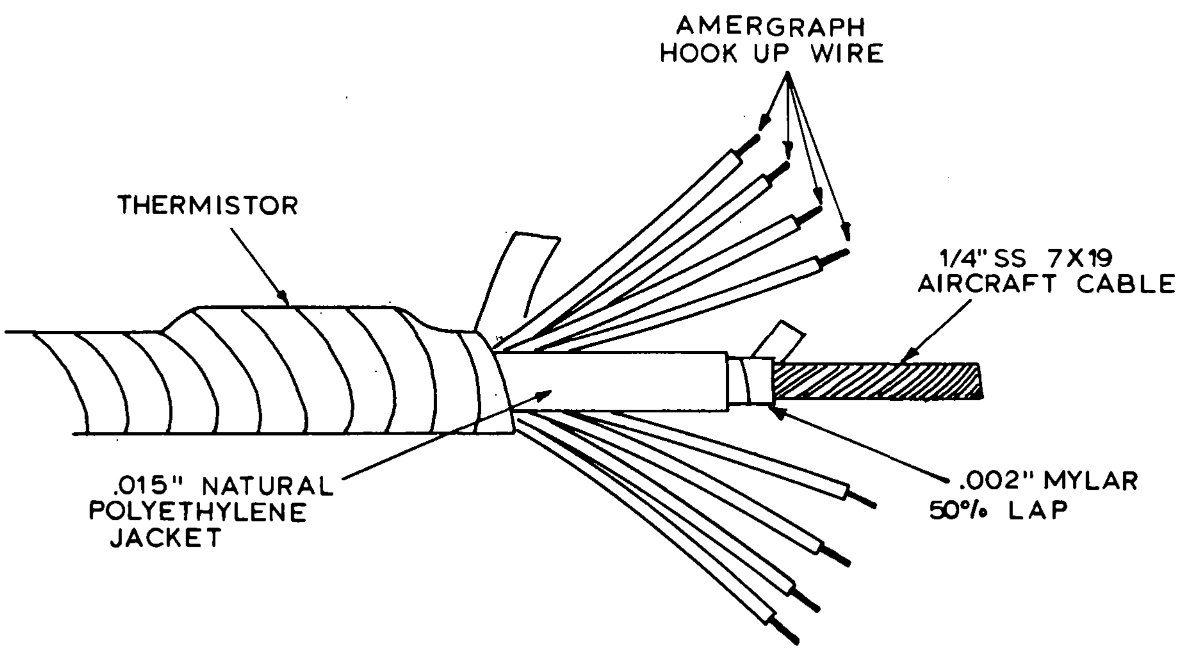


Figure 8. Instrument line construction.

When all the conductors are laid out the tape-wrapping machine can be slipped over the end of the cable and wrapping the cable assembly together can proceed. When conductor's end is approached about 2 feet of conductor should be pulled out for splicing the boot in at a later time. When a six-thermistor cable is made (12 conductors) all conductors (at the upper end) may not fit through the tape-wrapping machine. If this is the case the surface temperature thermistor can be hand taped to the assembly after the cable is wrapped. When the cable is wrapped with tape and the tape-winding machine removed, the thimbles can be nico-pressed in the ends.

The thermistors are spliced into the cable as follows: first, pull the rubber boot up one of the conductors. Strip the insulation from the ends of the conductor and slide the nylon tube over the thermistor. Then solder the thermistor to the conductors. (DO NOT USE TOO MUCH HEAT ON THE THERMISTOR.) Inject epoxy with a hypodermic syringe into the nylon tube and press the conductors up against the ends of the nylon tube so the wires will be imbedded in the epoxy. When the epoxy is cured, slide the boot over the nylon tube containing the thermistor (see Fig. 9). The conductors at the upper end of the instrument line are passed through a piece of tygon tubing and soldered to the appropriate pins of the electrical plug. The lower end of the tygon tube is taped to the strength member to secure the conductors at their take-off point (Fig. 10).

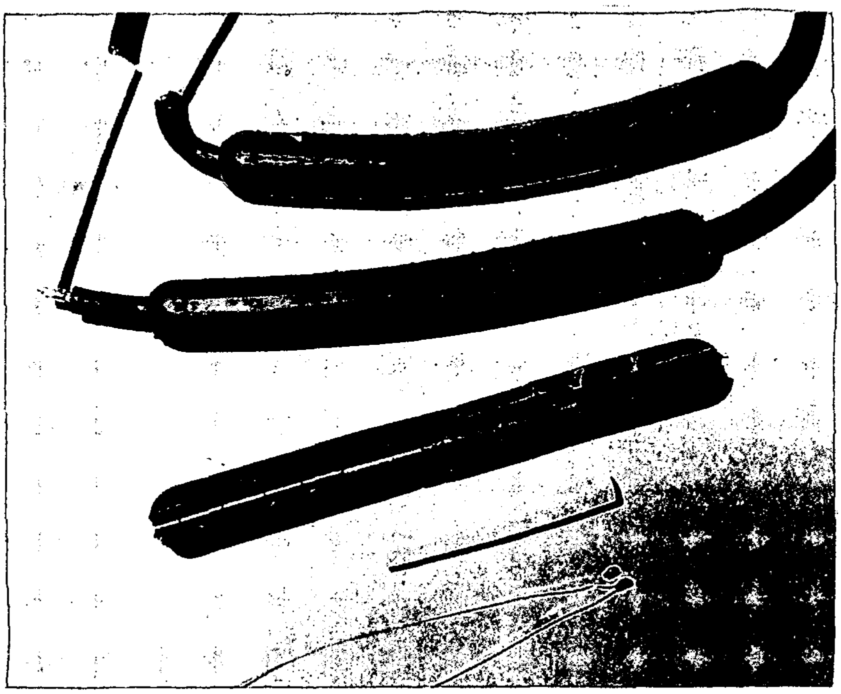


Figure 9. Thermistor boot assembly.

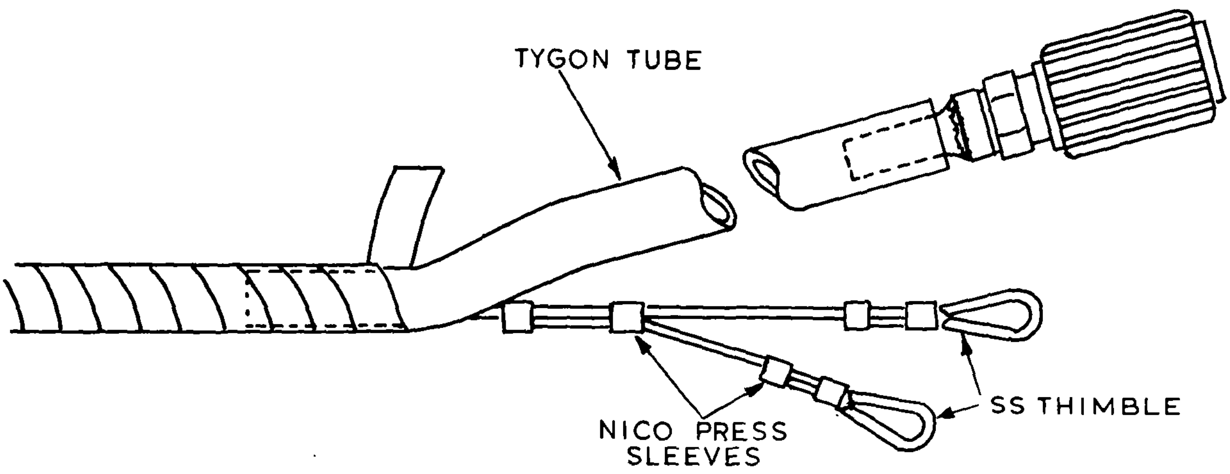


Figure 10. Instrument line and strength member termination.

Instrumentation

The instrument panel is fabricated from fiberglass cloth impregnated with epoxy resin. A suitable sphere (steel float) should be found with a radius of curvature of about 24 inches. This is coated with a suitable release agent and used as a mold. Eight layers of a medium weight fiber-glass cloth are used to give a thickness of 3/16 inch. When the resin is cured the panel can be trimmed to size, mounting holes drilled and the bottom piece glued on. The panel can then be degreased and painted flat black.

Several modifications should be incorporated in the instrumentation of any future units. Experience has shown that the batteries in the sea temperature indicators last for a period of approximately six months. A change in the batteries from the RM 502R models to the RM 12R would increase the time between battery changes by 50 percent with a very small increase in size. The three electronic circuit boards could be incorporated into one for easier servicing.

Some components used in the instrumentation portion of the mooring resulted in limited life or doubtful performance. The aerological sensors have shown numerous failures after six months of service. This has been due primarily to sea water leakage around the shafts causing corrosion and seizing of the shaft. Satisfactory seals were not included and it is suggested that a more reliable unit be found or the present units be modified to increase reliability. The strobe light beacon was originally designed for short service and life. A number have been used satisfactorily for periods of six months; however, there have been several failures after only two months of service.

Photographic equipment

After a number of photographic tests and consultation with Elgeet Optical Company, it was found that production lenses have the back focus adjusted for infinity. This resulted in the pictures taken with some lenses having parts of the picture out of focus while the remaining parts were in focus. Changing the focus setting did not solve this difficulty. Elgeet Optical Company then agreed to adjust the back-focus of the lenses to 24" at our request. Any future lenses purchased should have this adjustment made at the factory.

The camera used in this instrument station was secured from a surplus military weather data unit. It was necessary to modify some of the internal parts of the camera in the interest of reliability. There is some doubt as to the availability of this camera at the present time. A similar camera has been manufactured by Bell and Howell (Model 200p). The cost of the Bell and Howell unit has not been determined since SIO was able to obtain a large supply of the present cameras at a reasonable cost.

Nylon mooring line

The mooring line used in the more recent installations has been Goldline. This is a gold-colored nylon line chosen mainly for its color. It was felt that a more subdued color than the usual white nylon would be less attractive to marine animals. Two sizes of line have been used, 3/8-inch and 7/16-inch diameter, the latter size used in the most recent moorings (#16 through #22).

During the course of our mooring experience several line defects were noted. The obvious defects were improperly tied yarn knots and dropped yarns. In order to prevent this, the maximum length obtainable without yarn knots was ordered (approximately 5000 feet) and spliced together to give the desired total length.

Anchor

Several different types of anchors have been used successfully with the taut nylon mooring. The primary consideration is the cost and availability of the various materials used. Railroad rails have been used by cutting them into 3-foot lengths, laying them side by side and welding the assembly together. More recently, 1-1/4-inch anchor chain has been placed in 55-gallon drums and filled with concrete. Since large quantities of surplus chain are available, the chain and concrete anchors are the more economical of the two. A 20 to 30-pound danforth type anchor is attached by a 20-foot length of 3/8-inch chain to the 1200 to 1500-pound deadweight anchor to resist dragging by the mooring line.

Installation

In planning a mooring, first select a mooring site and from charts and soundings available determine the depth (use sound velocity correction tables).[1] The slack length of the mooring line is 10 percent less than the actual depth so that when installed there is approximately 100 pounds tension in the line (see load vs elongation curves for nylon Figs. 11a, b). After the theoretical slack length has been determined the line must be measured under a known constant tension due to its elastic properties. The actual slack length must be determined by extrapolating back to zero load condition. The thimbles should be spliced into the line during the measuring operation when both ends will be available.

Before arriving on station the components should be laid out and the float completely assemble (Figs. 12, 13). A search in the area of the station for a flat area of the appropriate depth should be conducted. When a suitable area has been found the ship should run downwind a distance equal to the mooring depth plus 20 percent. At this point the float should be put in the water with the instrument line connected (Fig. 14). The ship can then pull slowly away from the float toward the drop area paying out instrument cable (Fig. 15). The instrument cable should be shackled to the nylon line before the float is put in the water. Once the instrument line is payed out the nylon can be payed out from its spool mounted on a reel stand (Fig. 16). Care should be exercised in paying out the instrument cable so it will not become fouled in the ship's screw. After several hundred yards of nylon have been spooled out the line will float on the surface and the fouling hazard will not be great. Stop the ship when there is one layer of nylon left on the spool. Pull some slack in the line and tie it off on a capstan. Unreel the remaining line and shackle the end of the line to the anchor chain. The ship should now be maneuvered into position over the previously selected area. Move the anchor in position to drop and then untie the mooring line from the capstan and let the line and anchor chain out. Move the ship to take the slack out of the mooring line and then drop the anchor (Fig. 17).

It will take some time for the anchor to fall, depending on the depth. When the anchor is on bottom the float can be boarded to make any final adjustments or additions and check out the system for proper operation. Installed tension should be observed and a depth reading taken near the float. From this information, line measuring accuracy can be checked.

[1] Matthews, D. J., Tables for the velocity of sound in pure water and salt water for use in echo sounding and sound ranging. Hydrographic Department, Admiralty, London, 1939.

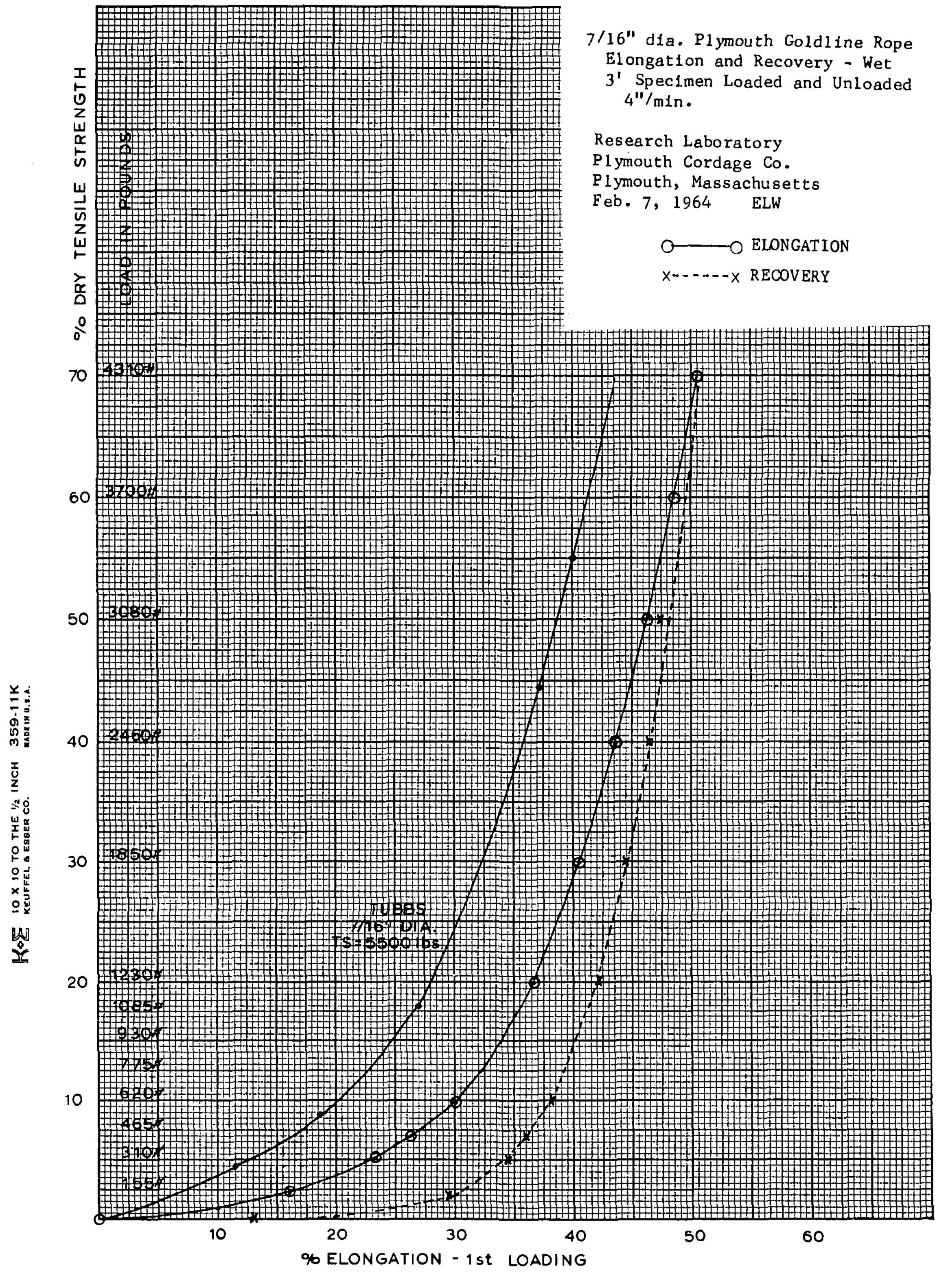


Figure 11a. Load vs elongation for nylon.

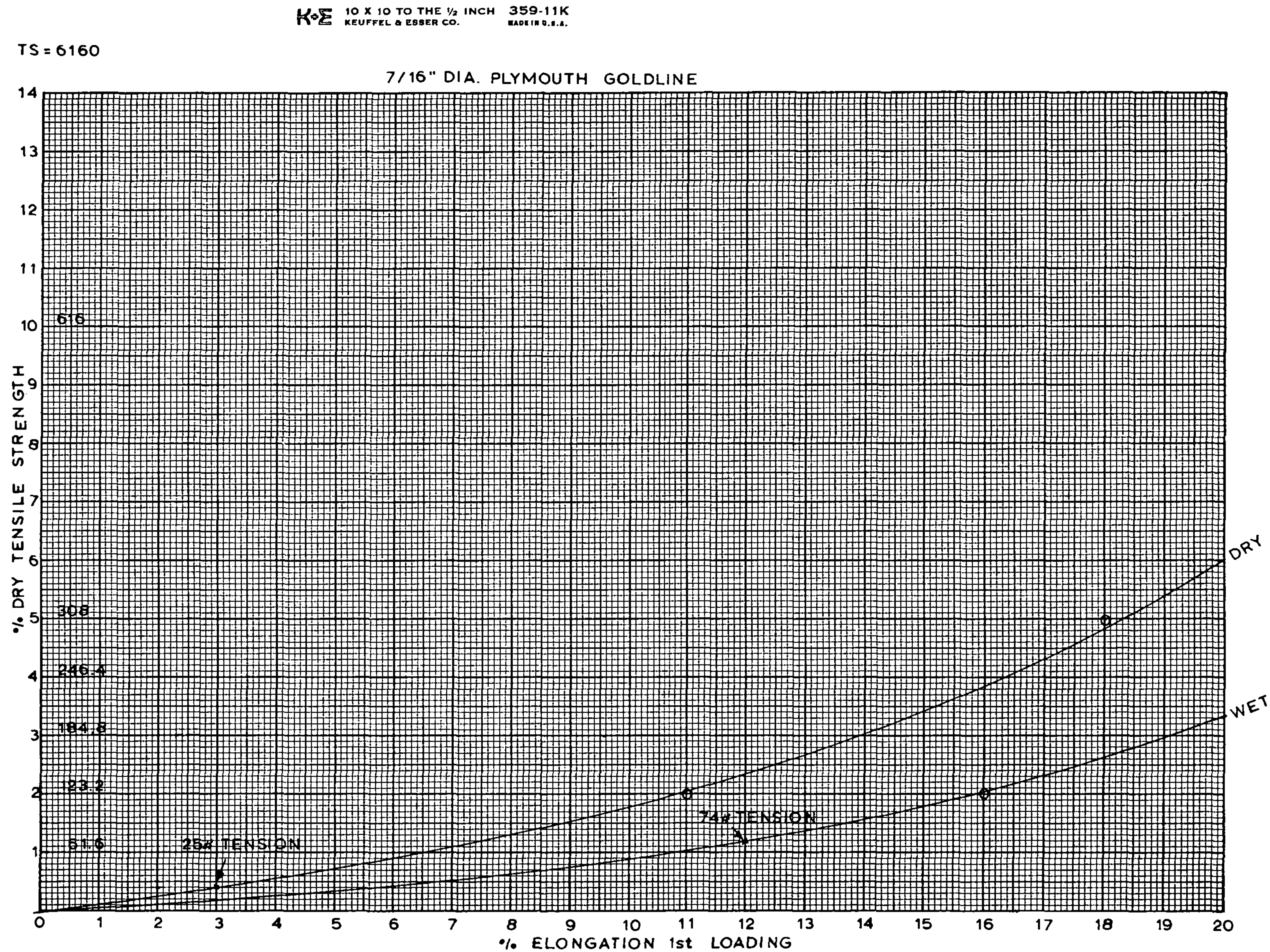


Figure 11b. Load vs elongation for nylon.

Figure 12. Arranging of equipment prior to launching float.

Figure 13. Final assembly of mooring components.

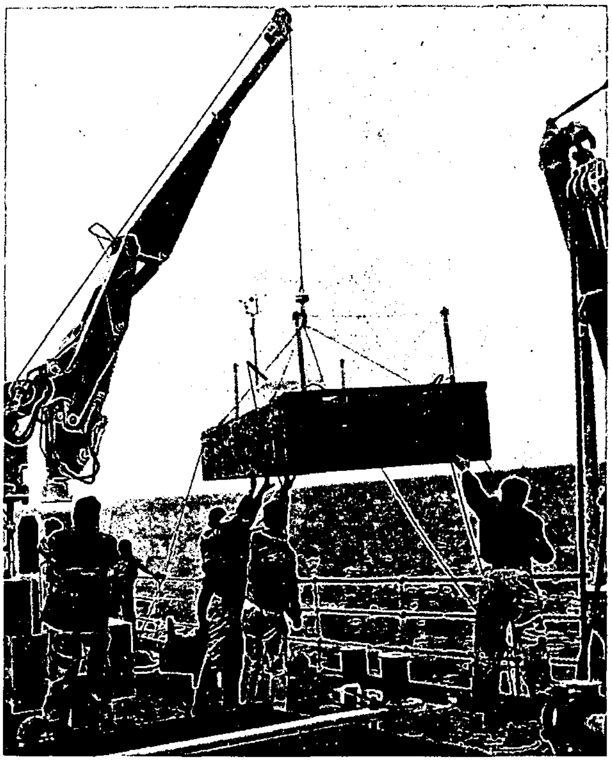


Figure 14. Launching of the catamaran float.

Figure 15. Laying of the instrument cable.

Figure 16. Spooling out the nylon mooring line.

Figure 17. Launching anchor assembly.

Service Instructions

Service of the stations consists of changing batteries, film, flags, and radar reflectors.

1. Batteries

The power supply for the instrumentation is a pair of 6-volt dry cell batteries, wired in parallel, which is sufficient for three to four months operation. There are also a pair of the same batteries to power the strobe light beacon for three to four months. The batteries are standard ignition-Fence batteries, Mallory No. M 907, Burgess No. S 461, Everready No. 1461 or R.C.A. No. VSO 39.

The batteries are mounted in white wooden boxes with the box marked L for beacon light and R for power supply (Fig. 18). When it is necessary to replace the batteries the container should be opened, the wires disconnected and the new batteries installed. Reconnect the replacement batteries observing the polarity as mark on the cover of the battery case.

2. Film Exchange

The film should be replaced as often as possible in order to obtain the maximum amount of data in event of loss of the station. The 50-foot magazine has a maximum capacity of 83 days when hourly pictures are taken.

The film is supplied in moisture-tight foil containers and should not be opened until ready to load into the camera. Film that is stored under refrigeration should be allowed to reach ambient temperature before the foil bag is opened. Failure to observe this caution will result in jamming of the magazine. The camera is mounted on a hinged platform with a link-lock latch (similar to exterior latches) securing the platform in place. Reach under the camera platform and release the latch. This will allow the camera and platform to swing forward (see Fig. 19). Squeeze the two catch releases in the rear of the camera, together opening the magazine compartment of the camera. The magazine can be extracted and the new one inserted, making sure that the hole in the front of the magazine faces toward the lens. Closing the rear of the camera and latching the platform in place completes this operation.

3. Radar Reflector and Flag

Each float is equipped with a surplus life boat radar reflector and a flag attached to a fiberglass pole on the float. It will be necessary to replace these units occasionally. Directions for rigging the radar reflector are included as part of the reflector package.

4. Vent Valve on Instrument Box

It may be necessary to open the vent valve on the side of the instrument box before the lid will open due to a possible vaccum inside the box. If the valve is opened, be sure it is closed after the lid has been opened.

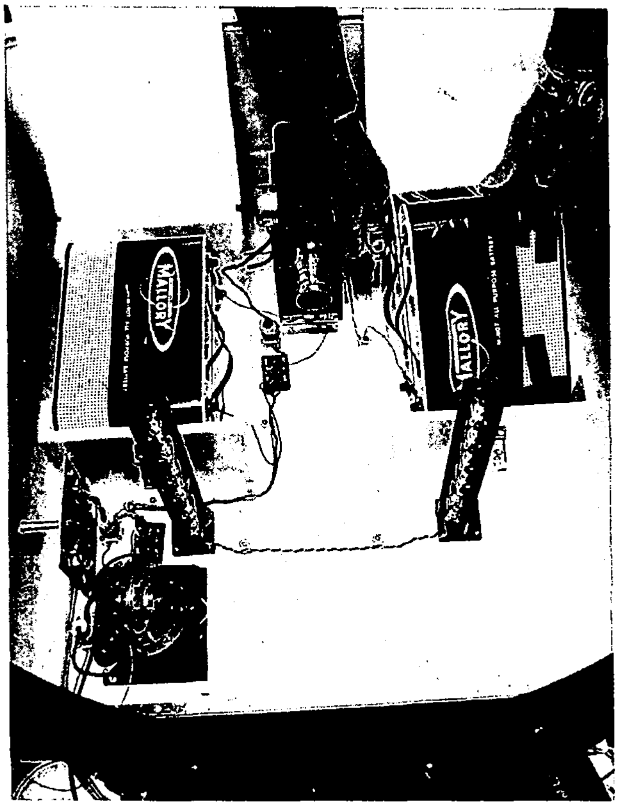


Figure 18. Exchange of instrument box batteries.

Figure 19. Film exchange.

Major Service

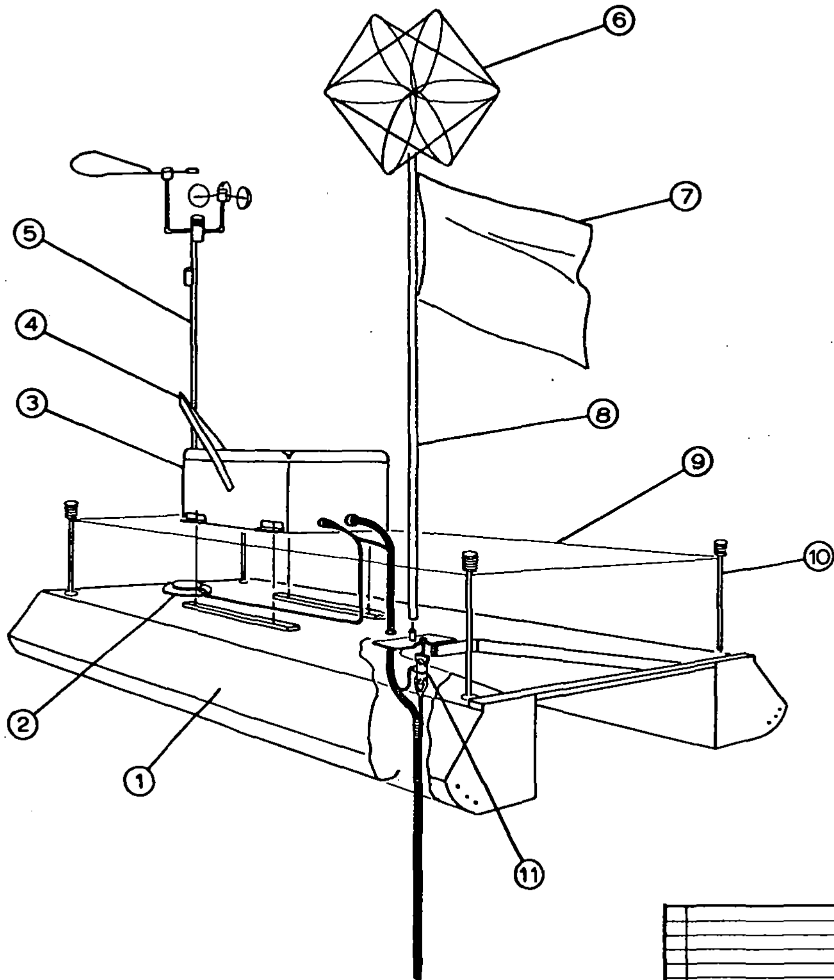
At intervals of approximately six months it will be necessary to replace instrument batteries and check calibration of the various instruments. The best procedure for this is to replace the instrument box assembly with another one in good operating condition and return the used one to the laboratory. In the laboratory all meter assemblies should be disassembled, batteries replaced and the units checked for wear or corrosion. The internal parts of the camera should be checked for wear and a test magazine run in the camera to assure proper film advance. The clock and control circuit assembly should be checked for proper operation. The station should then be reassembled and calibrating resistors connected across the thermistor inputs. At least five points should be chekced on the sea temperature scales for linearity. After the instrument box assembly has been assembled and calibrated it should be run in the laboratory for several days to verify its operation.

DESCRIPTION	DWG. NO.
Compass	180909
Stanchion Assembly	026
Indicator Circuits	025
7°-17°C & 8°-28°C Pyrometer Sea Temperature	024
Air Temp Circuit	023
Instrument Panel & External Sensor Wiring	022
Geodyne Clock Timer-Accutron Clock Counter Driver	021
Photographic Control System Wiring	020
CB-3 Electronic Circuit for Photographic System	019
Instrument Panel Support	018
Instrument Panel Fastener Plate	017
Instrument Panel	016
Clock Shockmount Plate	015
Clock Platform Assembly	014
Clock Enclosure	013
Clock & Mounting Assembly	012
Lights & Support Assembly	011
Camera Platform	010
Circuit Board Mount	009
Battery Box	008
Mast Bracket Assembly	007
Weather Transducer to Mast Adapter	006
Air Temperature Housing	005
Instrument Box Mast Assembly	004
Instrument Box Assembly	003
Catamaran Instrument Float	002
Deep Moored Instrument Station	001

SCALE	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL
DRAWN		FINISH
DESIGNED	DRAWING LIST FOR DEEP WATER MOORING STATION	DRAWING NO. SHEET 1 OF 2
CHECKED		
APPROVED		

DESCRIPTION	DWG NO.
PVC Thimble	029
Thermistor Assembly	028
Tape Wrapping Machine	027
Angle Plate	Dwg. D3003 Item 27 of
Hat Section Assembly	D3003C1
Hat Section Assembly	D3003C2
Latch & Hat Section Assembly	D3003C3
Case Assembly	D3003
Mooring Line Tension Transducer	181020

SCALE	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL
DRAWN		FINISH
DESIGNED	DRAWING LIST FOR DEEP WATER MOORING STATION	DRAWING NO.
CHECKED		SHEET 2 OF 2
APPROVED		



ITEM NO.	DESCRIPTION	DWG. NO.
11	MOORING LINE TENSION TRANSDUCER	181020
10	STANCHION	026
9	STANCHION LINE 1/8" 1x19 SS CABLE	ND
8	12' FIBERGLASS TAPERED POLE	ND
7	DAY GLOW FLAG	ND
6	LIFEBOAT RADAR REFLECTOR	ND
5	INSTRUMENT BOX MAST ASSEMBLY	004
4	MAST BRACKET ASSEMBLY	007
3	INSTRUMENT BOX ASSEMBLY	003
2	COMPASS	160909
1	CATAMARAN INSTRUMENT FLOAT	002

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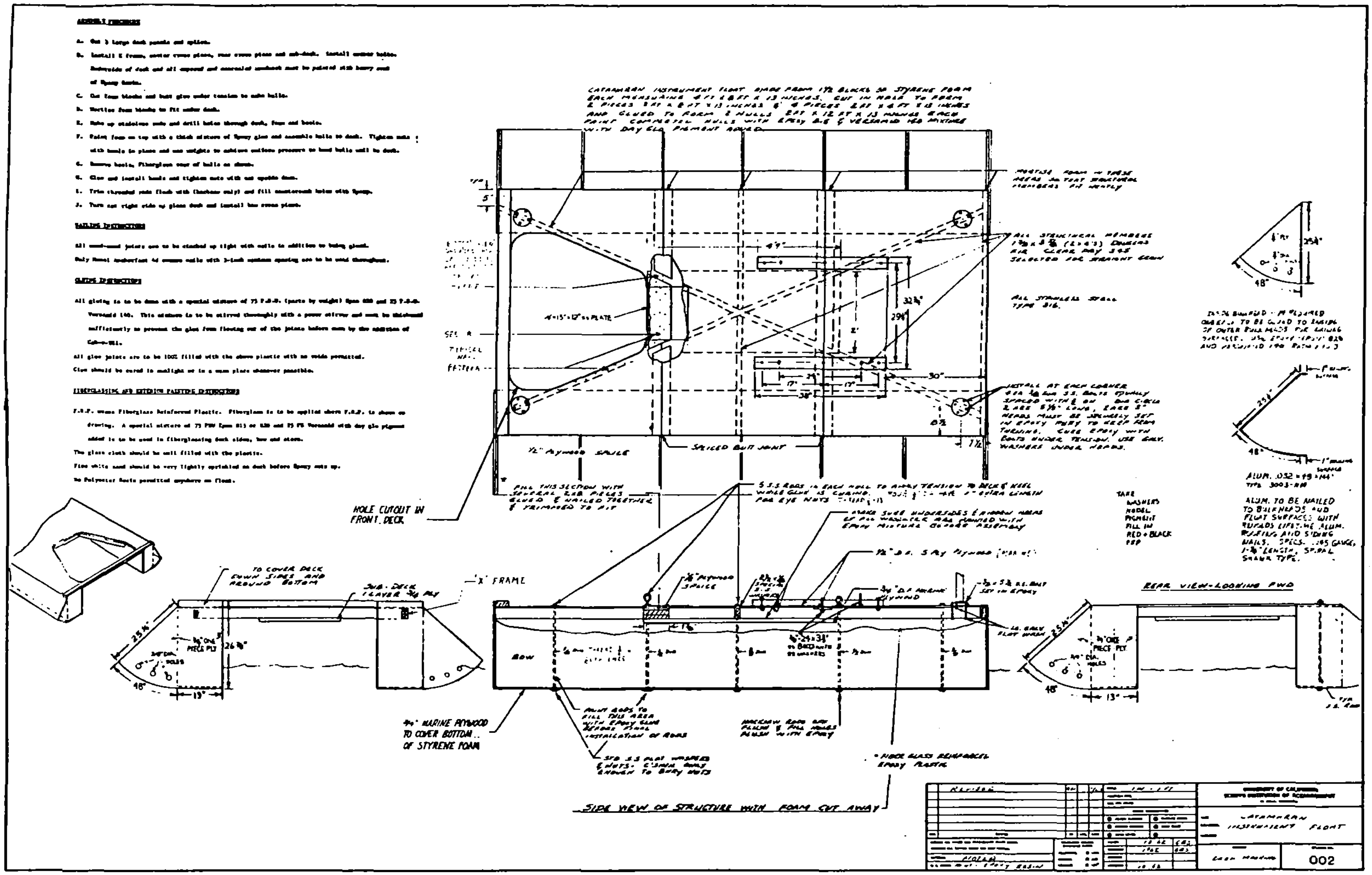
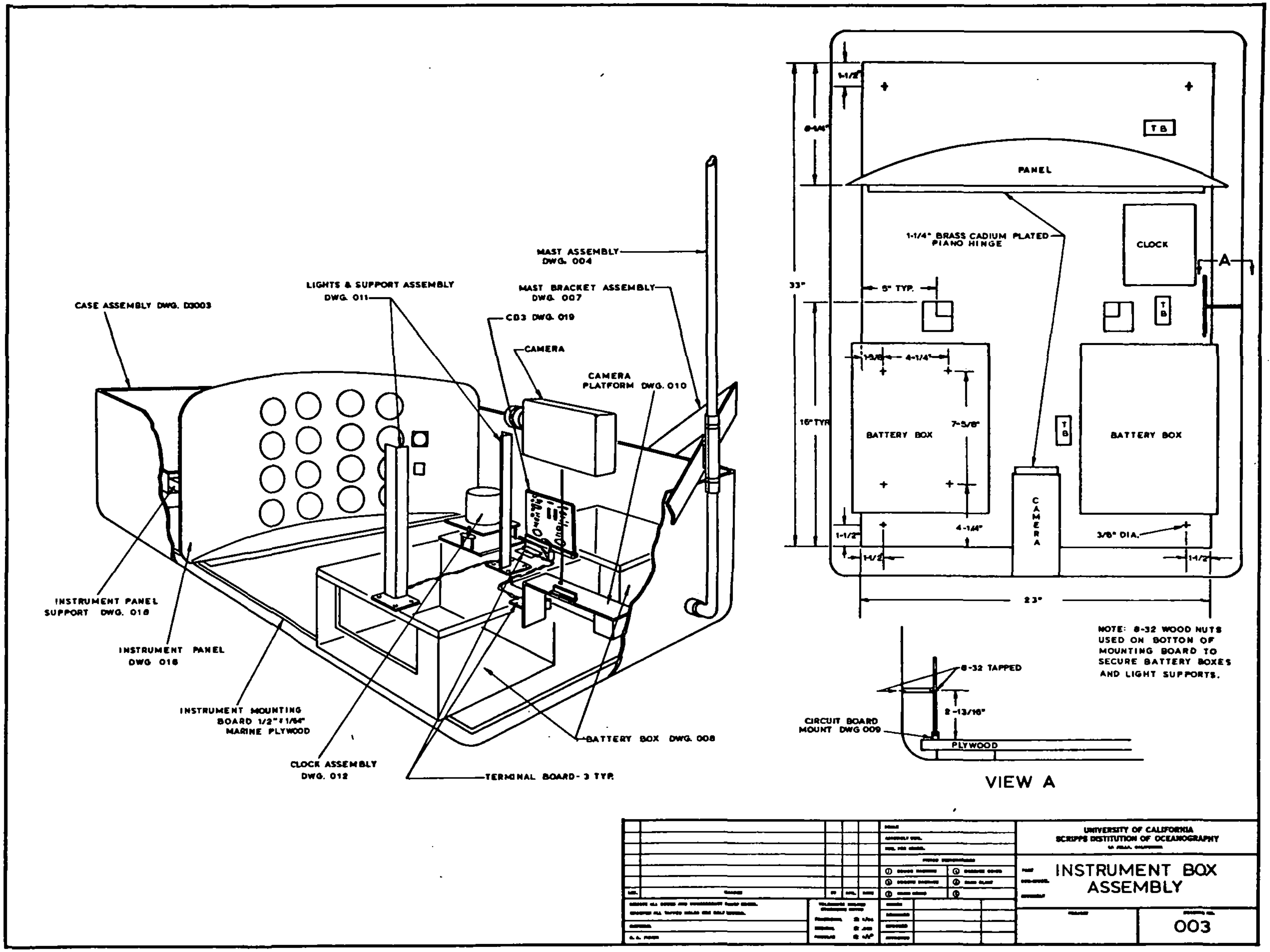
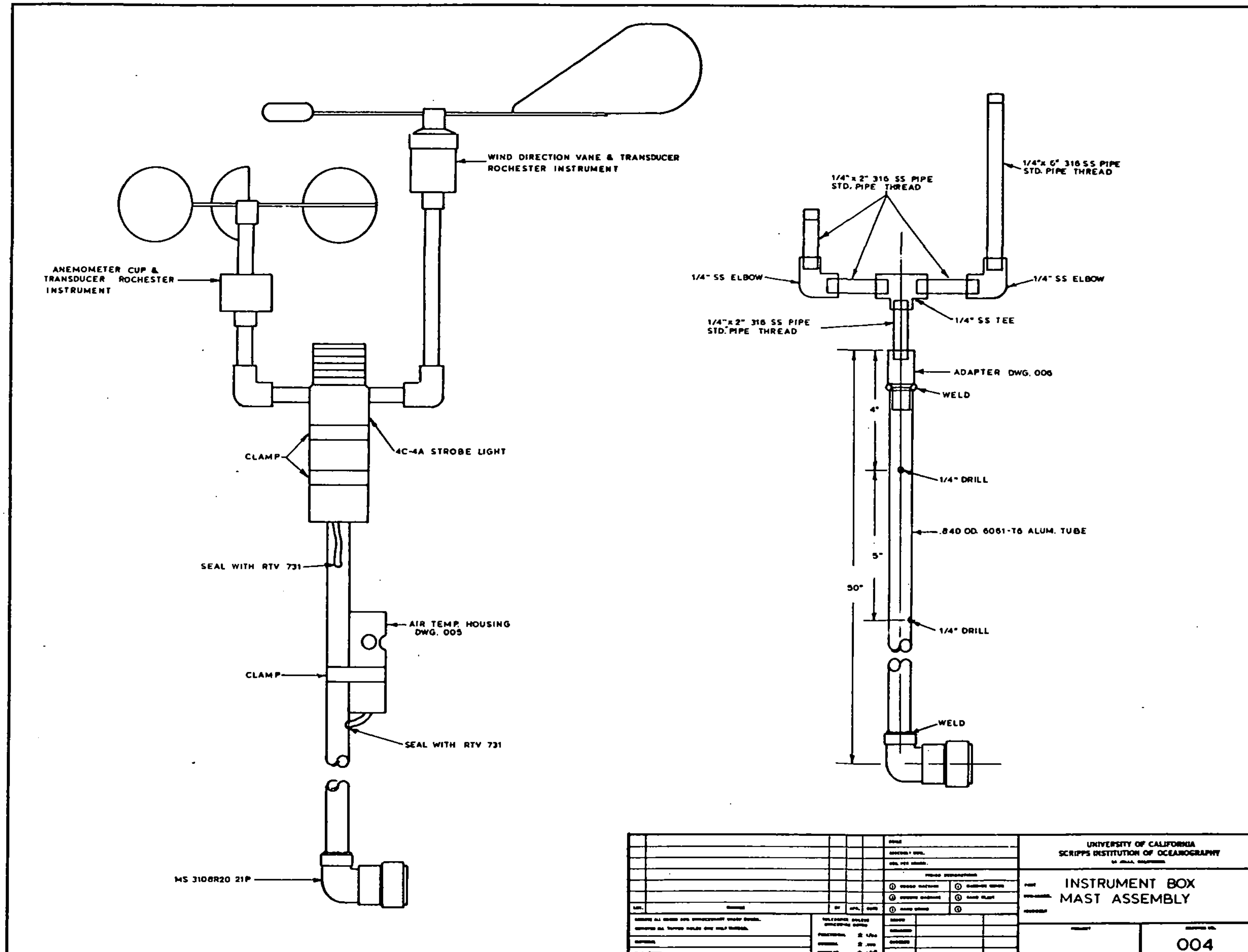
SCRIPPS INSTITUTION OF OCEANOGRAPHY

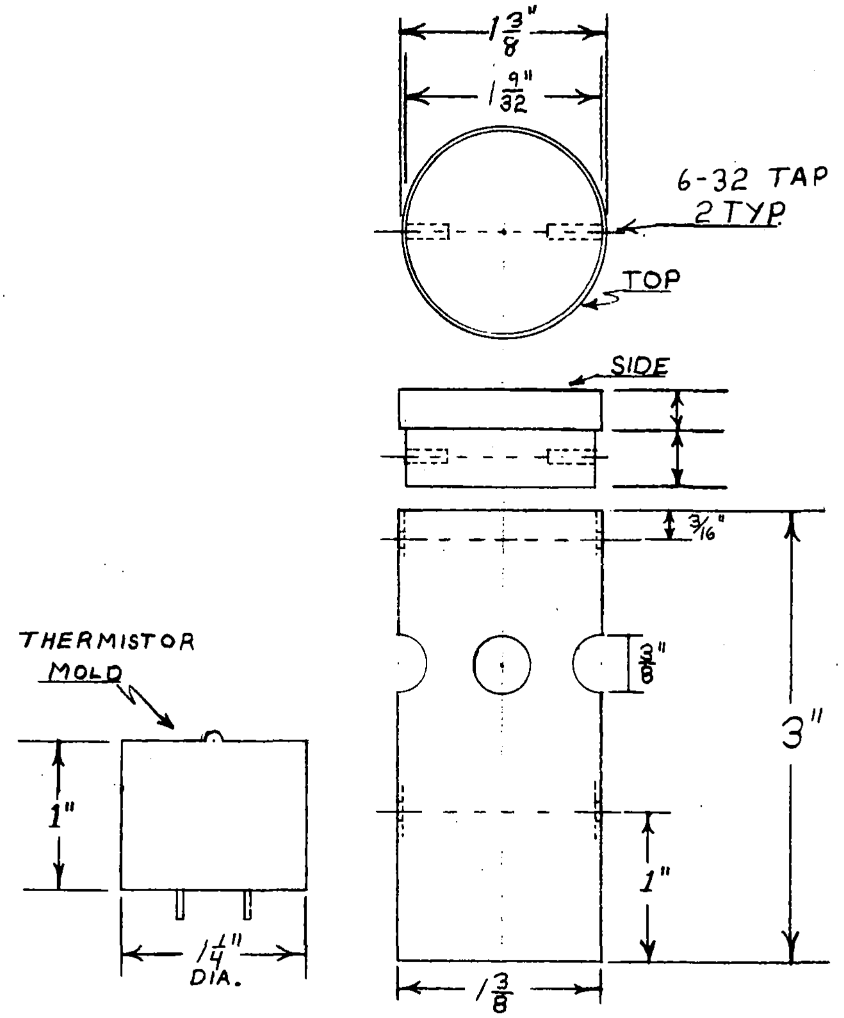
DEEP MOORED INSTRUMENT STATION

001

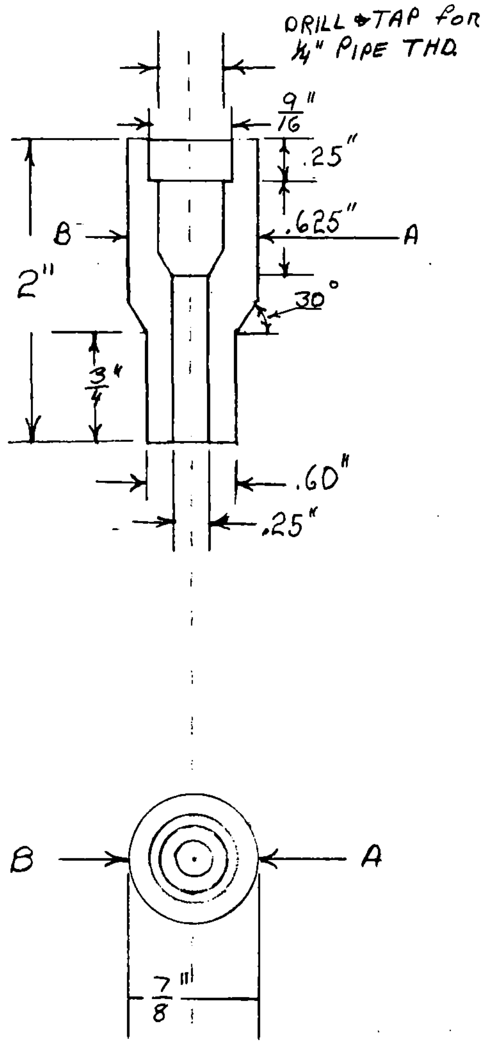

HOLE CUTOUT IN FRONT DECK
"X" FRAME
BOW
3/4" MARINE PLYWOOD TO COVER BOTTOM OF STYRENE FOAM
SIDE VIEW OF STRUCTURE WITH FOAM CUT AWAY
REAR VIEW-LOOKING FWD
1/2" PLYWOOD SPLICE
SPLICED BUTT JOINT
CATAMARAN INSTRUMENT FLOAT
002


CASE ASSEMBLY DWG. D3003
LIGHTS & SUPPORT ASSEMBLY DWG. 011
MAST ASSEMBLY DWG. 004
MAST BRACKET ASSEMBLY DWG. 007
CD3 DWG. 019
CAMERA
CAMERA PLATFORM DWG. 010
INSTRUMENT PANEL SUPPORT DWG. 016
INSTRUMENT PANEL DWG 016
INSTRUMENT MOUNTING BOARD 1/2" ± 1/64" MARINE PLYWOOD
CLOCK ASSEMBLY DWG. 012
TERMINAL BOARD - 3 TYP.
BATTERY BOX DWG. 008
PANEL
TB
1-1/4" BRASS CADIUM PLATED PIANO HINGE
CLOCK
A
5" TYP.
33"
16" TYP.
BATTERY BOX
BATTERY BOX
CAMERA
4-1/4"
7-5/8"
3/8" DIA.
1-1/2"
23"
NOTE: 8-32 WOOD NUTS USED ON BOTTON OF MOUNTING BOARD TO SECURE BATTERY BOXES AND LIGHT SUPPORTS.
8-32 TAPPED
2-13/16"
CIRCUIT BOARD MOUNT DWG 009
PLYWOOD
VIEW A
UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
INSTRUMENT BOX ASSEMBLY
003

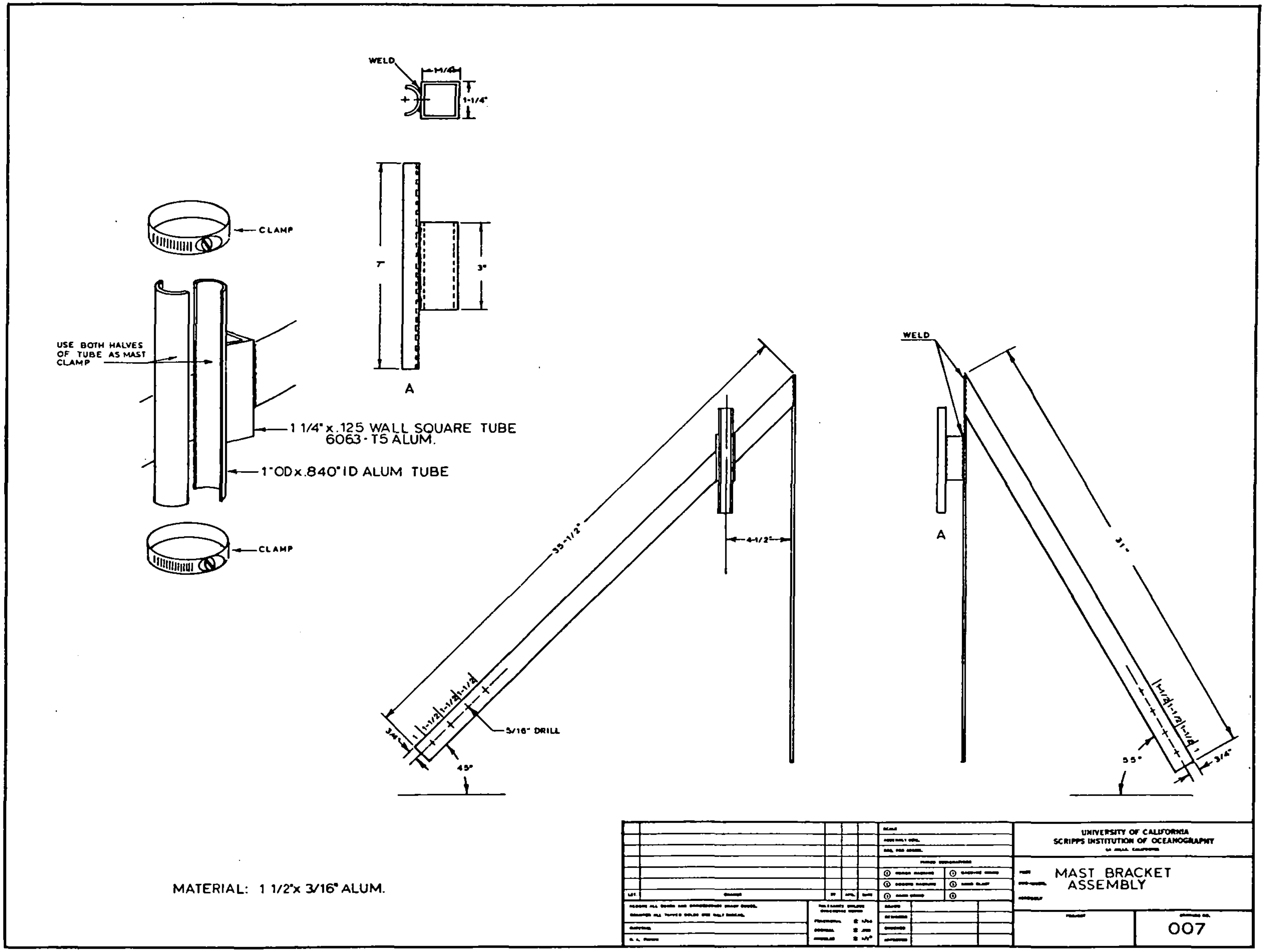

WIND DIRECTION VANE & TRANSDUCER
ROCHESTER INSTRUMENT
ANEMOMETER CUP & TRANSDUCER ROCHESTER INSTRUMENT
CLAMP
4C-4A STROBE LIGHT
SEAL WITH RTV 731
AIR TEMP. HOUSING DWG. 005
CLAMP
SEAL WITH RTV 731
MS 3108R20 21P
1/4" x 6" 316 SS PIPE
STD. PIPE THREAD
1/4" x 2" 316 SS PIPE
STD. PIPE THREAD
1/4" SS ELBOW
1/4" SS ELBOW
1/4" SS TEE
1/4" x 2" 316 SS PIPE
STD. PIPE THREAD
ADAPTER DWG. 006
WELD
4"
1/4" DRILL
.840 OD. 6061-T6 ALUM. TUBE
5"
50"
1/4" DRILL
WELD
UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
INSTRUMENT BOX
MAST ASSEMBLY
004

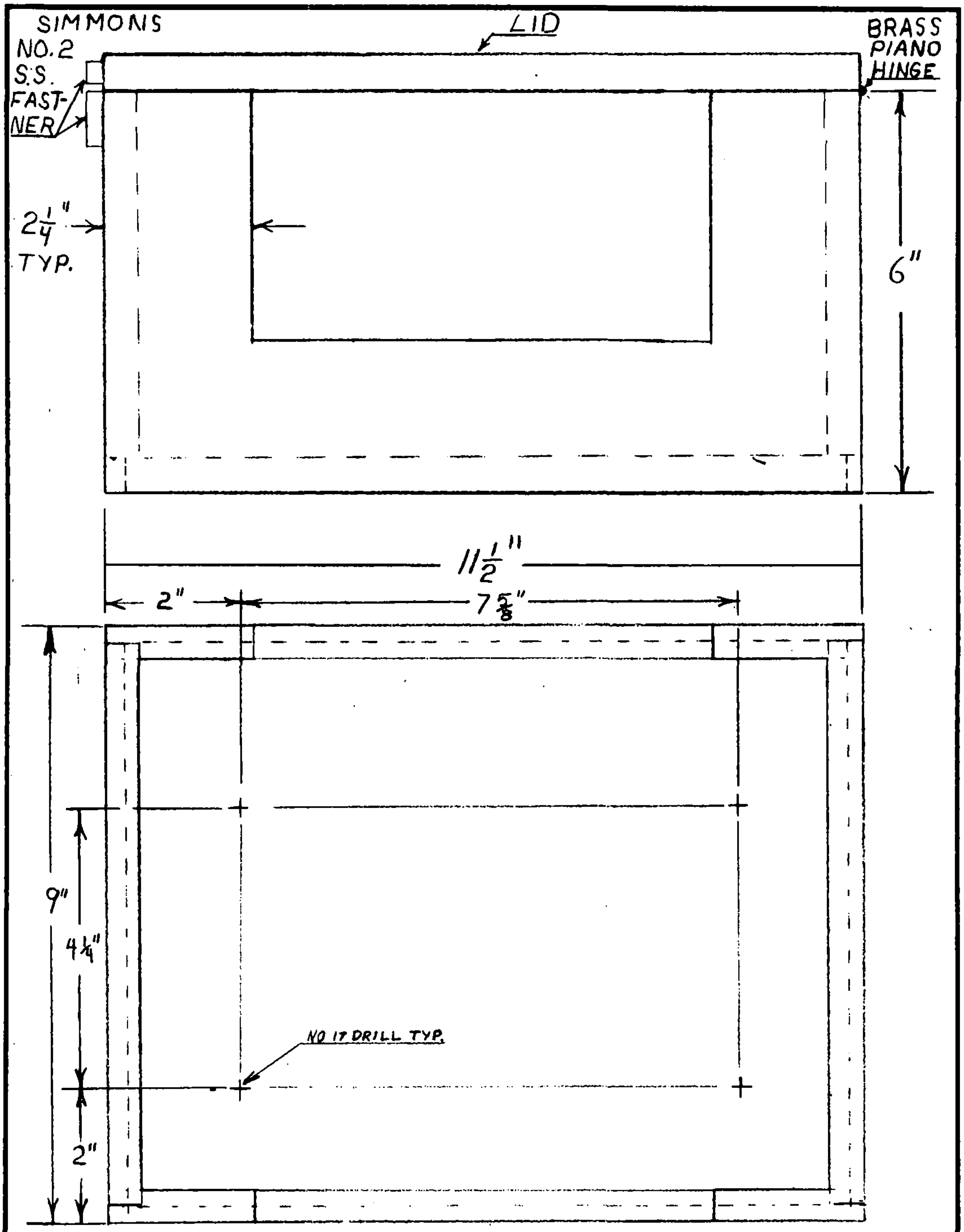


SCALE	FULL	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL	6061-T6
DRAWN			FINISH	WHITE
DESIGNED		AIR TEMPERATURE HOUSING	DRAWING NO.	005
CHECKED				
APPROVED				



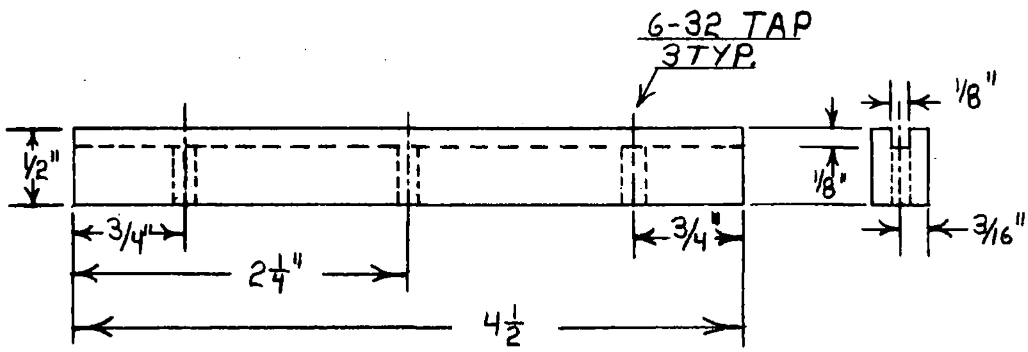
SCALE FULL		UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL 6061-T6	
DRAWN			FINISH	
DESIGNED		WEATHER TRANSDUCER TO MAST ADAPTER	DRAWING NO. 006	
CHECKED				
APPROVED				


WELD
1-1/4"
1-1/4"
CLAMP
USE BOTH HALVES OF TUBE AS MAST CLAMP
1 1/4" x .125 WALL SQUARE TUBE 6063-T5 ALUM.
1" OD x .840" ID ALUM TUBE
CLAMP
7"
3"
A
35-1/2"
4-1/2"
3/4"
1
1-1/2
1-1/2
1-1/2
5/16" DRILL
45°
WELD
A
31"
1-1/4
1-1/2
1-1/2
1
3/4"
55°
MATERIAL: 1 1/2" x 3/16" ALUM.
UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
MAST BRACKET
ASSEMBLY
007

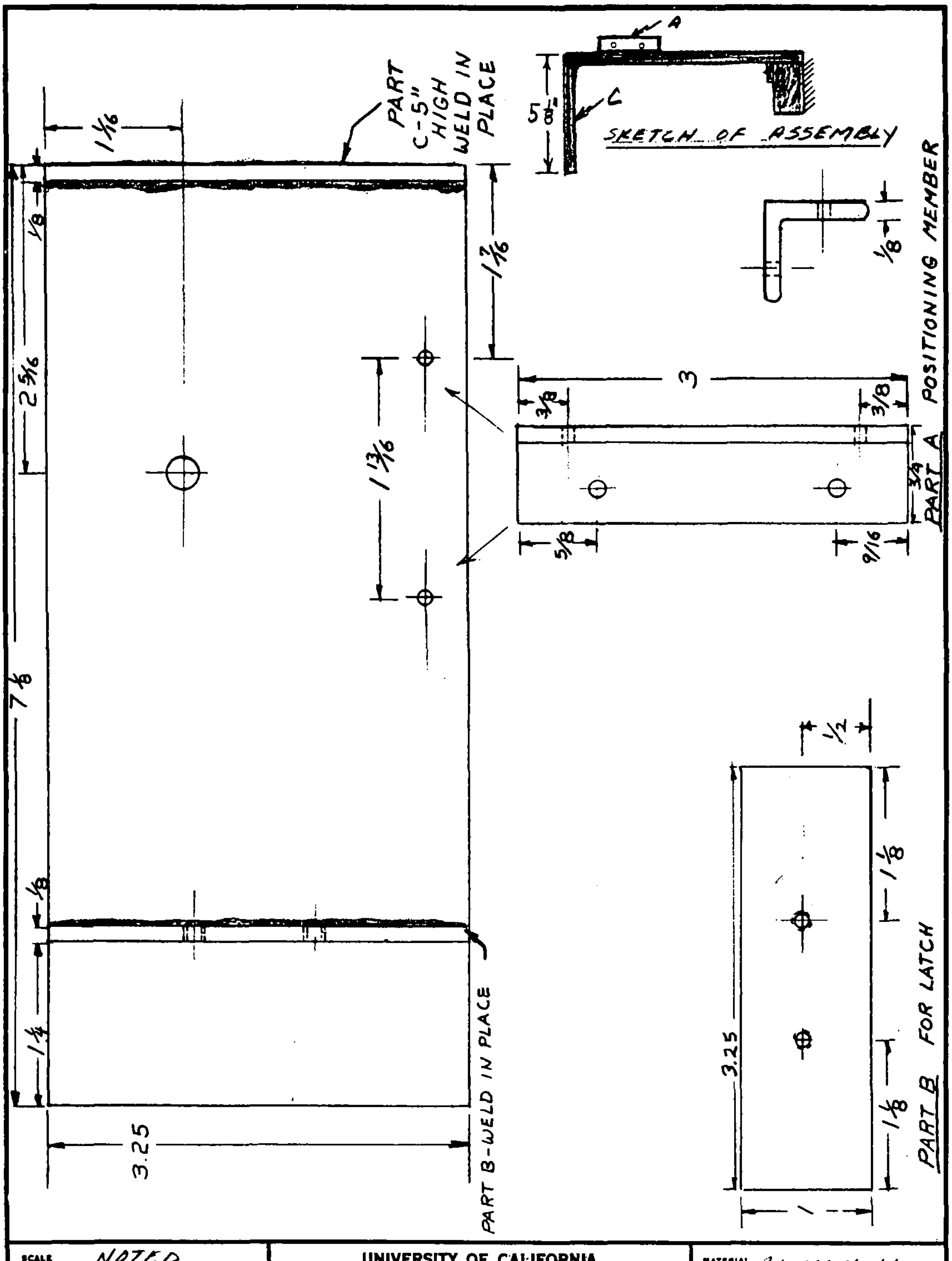


RIGHT HAND SHOWN, LEFT HAND OPPOSITE

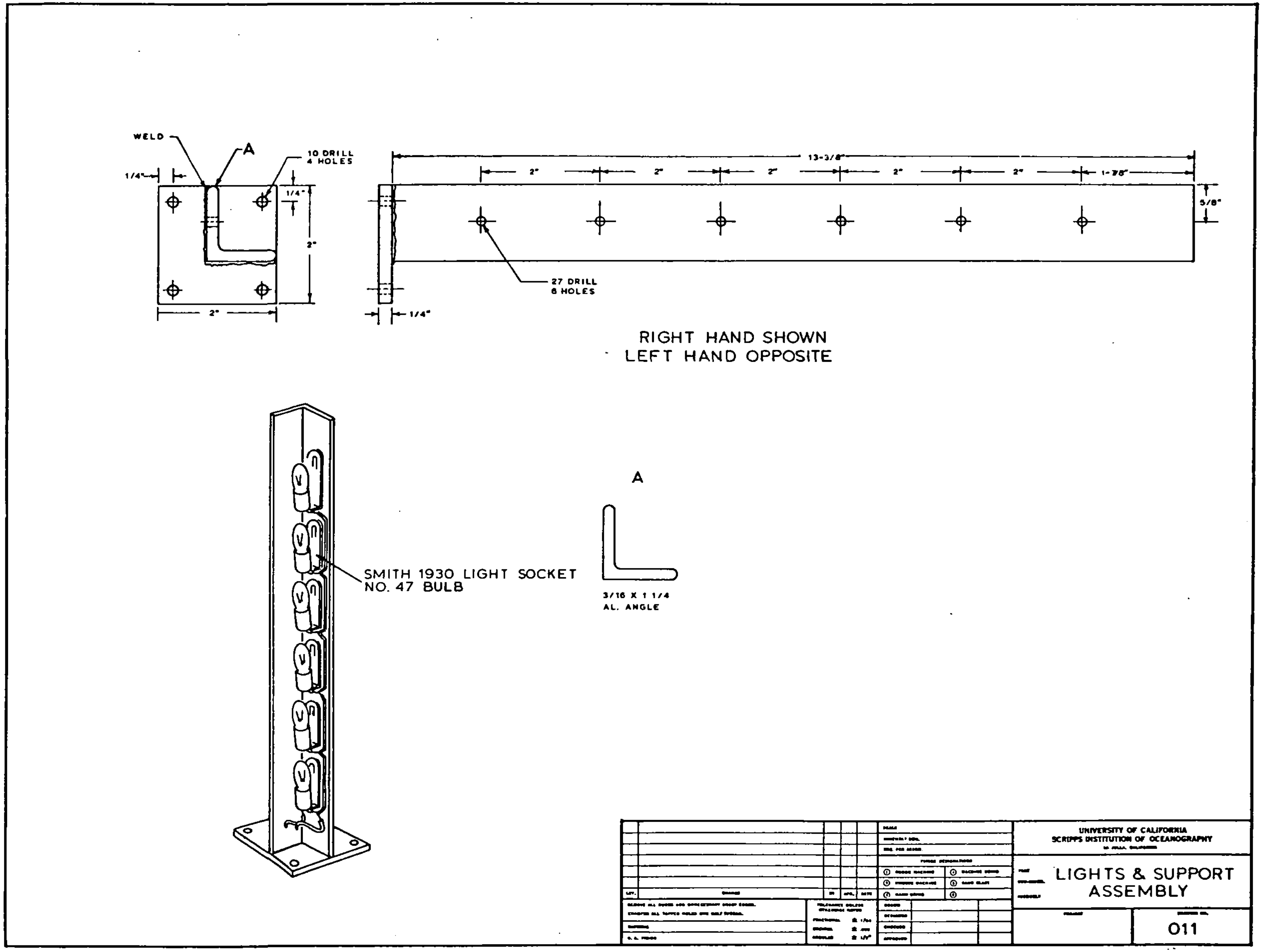
SCALE	1/2	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL	1/2" PLYWOOD
DRAWN			FINISH	MARINE WHITE
DESIGNED		BATTERY BOX	DRAWING NO.	008
CHECKED				
APPROVED				

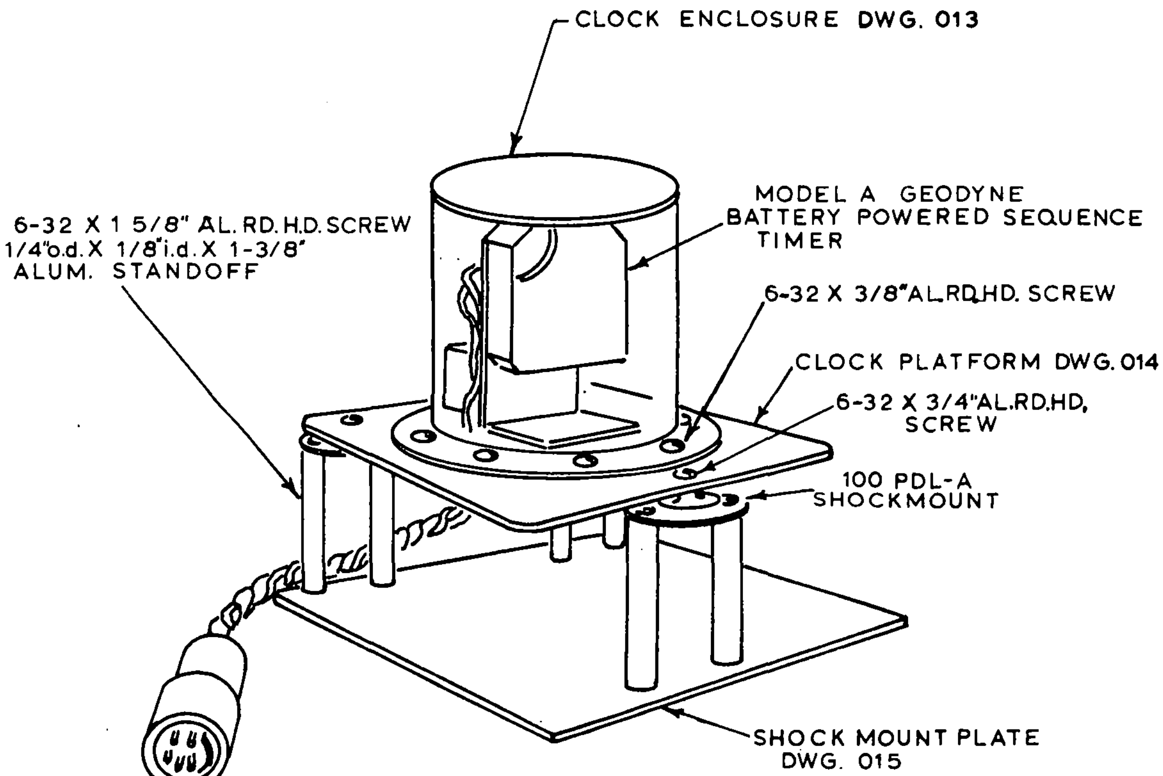


SCALE FULL	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL 6061-T6 ALUMINUM	
DRAWN		FINISH BLK. ANODIZE	
DESIGNED	CIRCUIT BOARD MOUNT	DRAWING NO. 009	
CHECKED			
APPROVED			

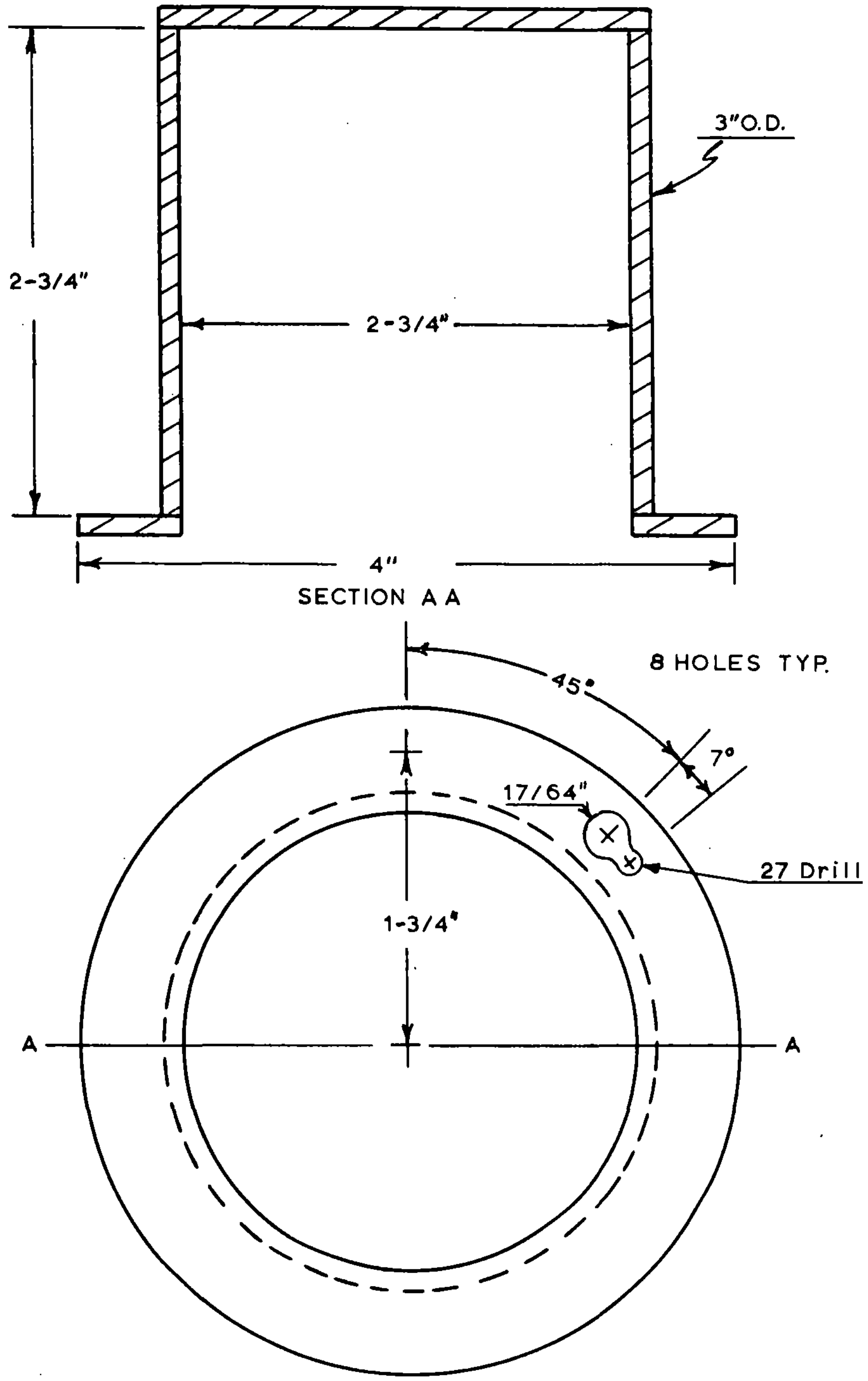


SCALE	NOTED		UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL ALUMINUM
DRAWN	11.8.63	MM		FINISH
DESIGNED			CAMERA PLATFORM	DRAWING NO. 010
CHECKED				
APPROVED				


WELD
A
10 DRILL 4 HOLES
1/4"
2"
13-3/8"
1-7/8"
5/8"
27 DRILL 6 HOLES
RIGHT HAND SHOWN
LEFT HAND OPPOSITE
SMITH 1930 LIGHT SOCKET
NO. 47 BULB
A
3/16 X 1 1/4
AL. ANGLE
UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
LIGHTS & SUPPORT ASSEMBLY
011

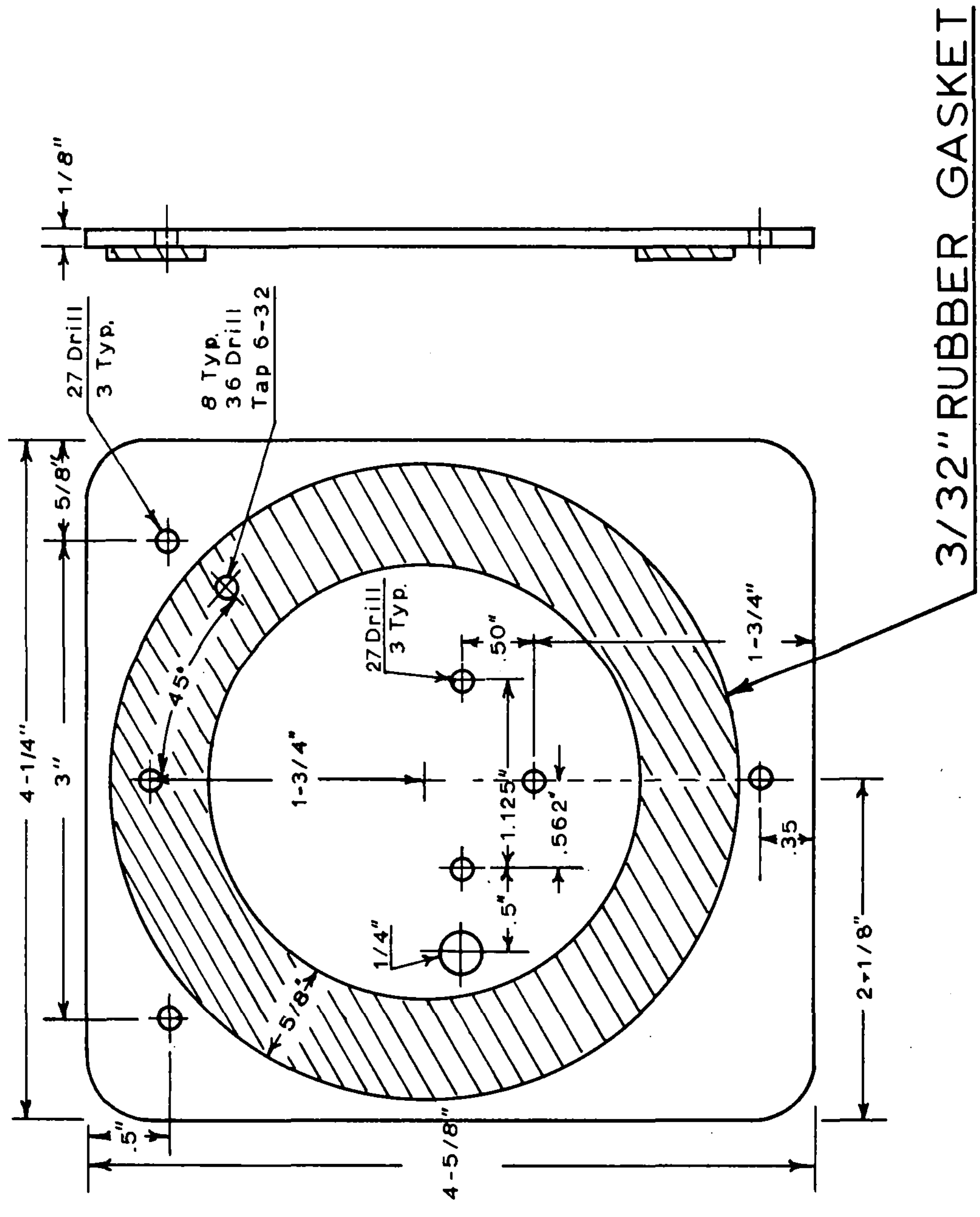


SCALE			UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL
DRAWN				FINISH
DESIGNED			CLOCK & MOUNTING ASSEMBLY	DRAWING NO. 012
CHECKED				
APPROVED				

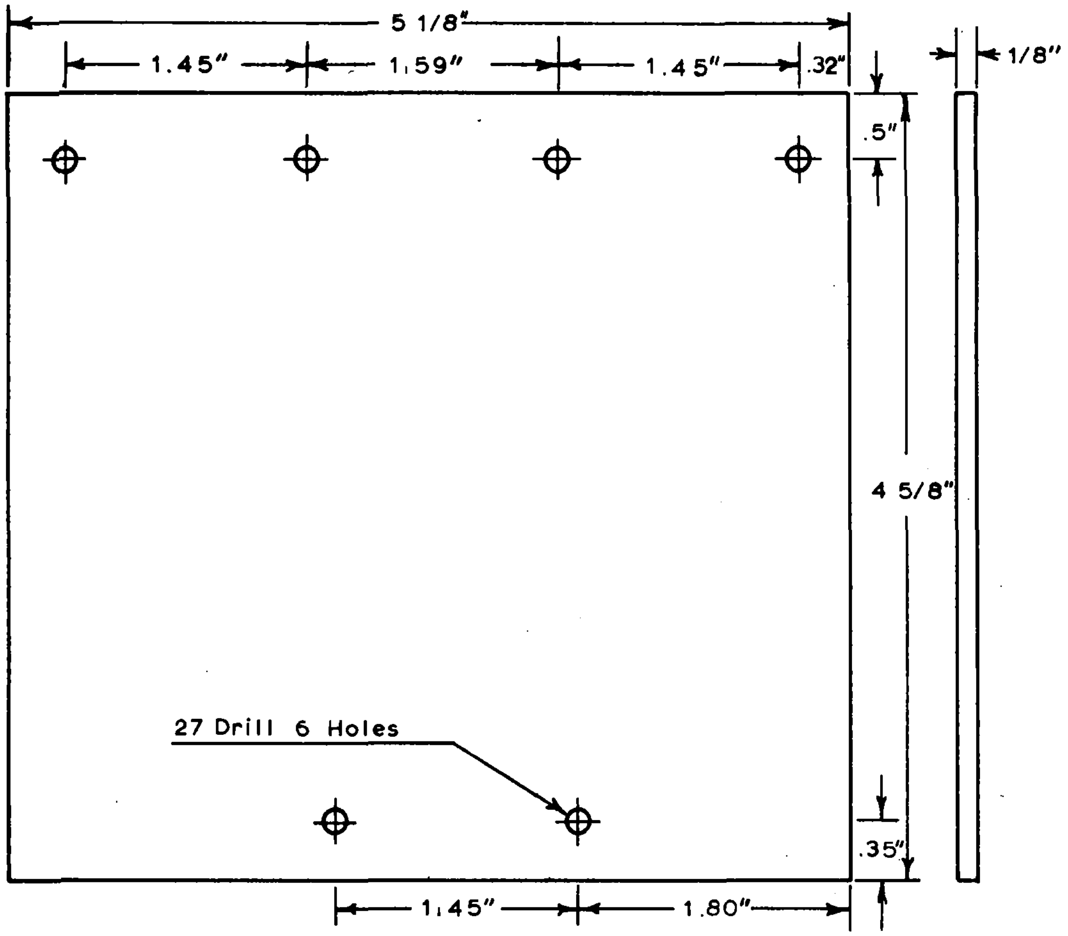


GLUE SECTIONS WITH "MEK".

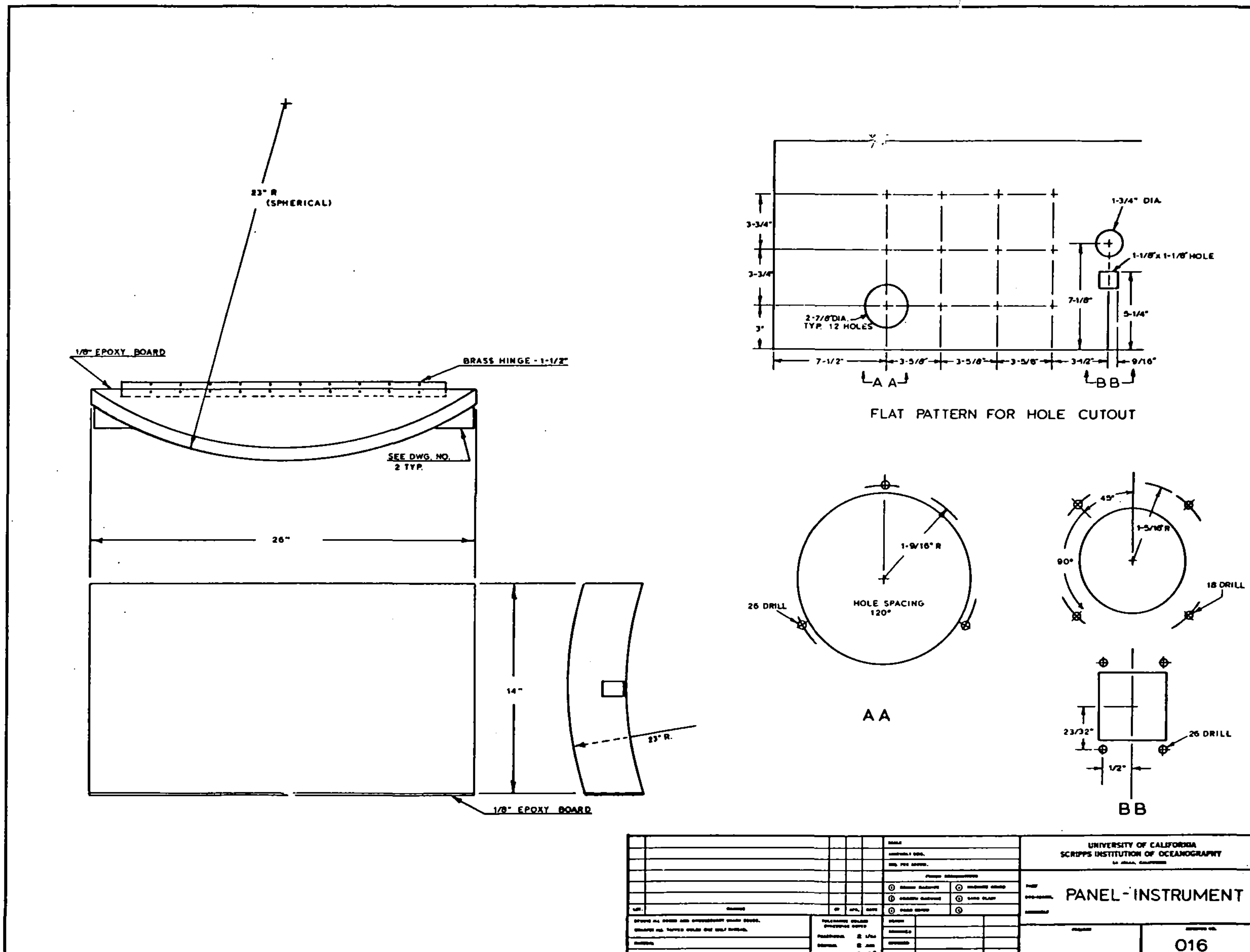
SCALE			UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL 1/8" PLEXEGLASS
DRAWN				FINISH
DESIGNED			CLOCK ENCLOSURE	DRAWING NO. 013
CHECKED				
APPROVED				



SCALE			UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL 1/8" 6061 AL.
DRAWN				FINISH
DESIGNED			CLOCK PLATFORM ASSY.	DRAWING NO.
CHECKED				014
APPROVED				



SCALE		UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL 1/8" 6061 AL.	
DRAWN			FINISH	
DESIGNED		CLOCK SHOCKMOUNT PLATE	DRAWING NO. 015	
CHECKED				
APPROVED				


23" R (SPHERICAL)
1/8" EPOXY BOARD
BRASS HINGE - 1-1/2"
SEE DWG. NO. 2 TYP.
26"
14"
23" R.
1/8" EPOXY BOARD
1-3/4" DIA.
1-1/8" x 1-1/8" HOLE
3-3/4"
3-3/4"
3"
2-7/8" DIA. TYP. 12 HOLES
7-1/8"
5-1/4"
7-1/2"
3-5/8"
3-5/8"
3-5/8"
3-1/2"
9/16"
A A
B B
FLAT PATTERN FOR HOLE CUTOUT
1-9/16" R
HOLE SPACING 120°
26 DRILL
A A
45°
1-5/16" R
90°
18 DRILL
23/32"
26 DRILL
1/2"
B B
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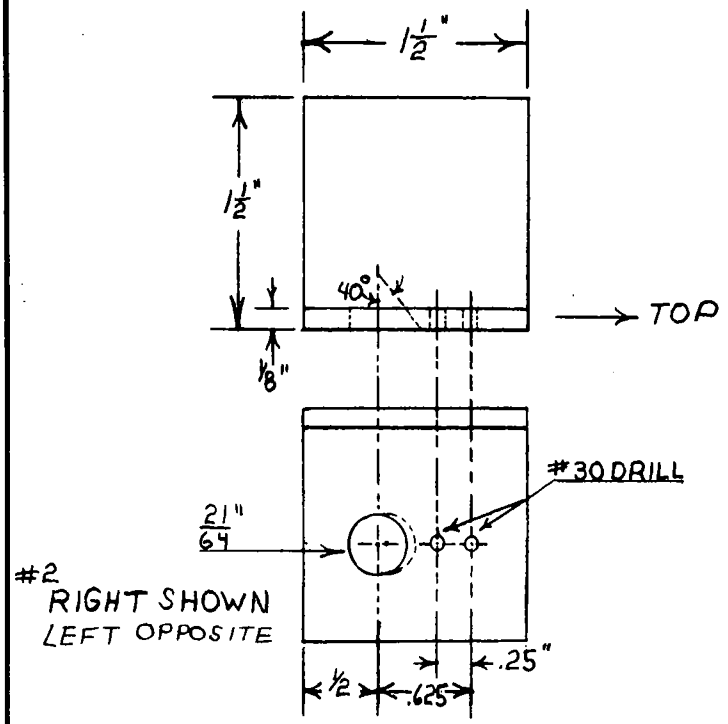
PANEL - INSTRUMENT
016



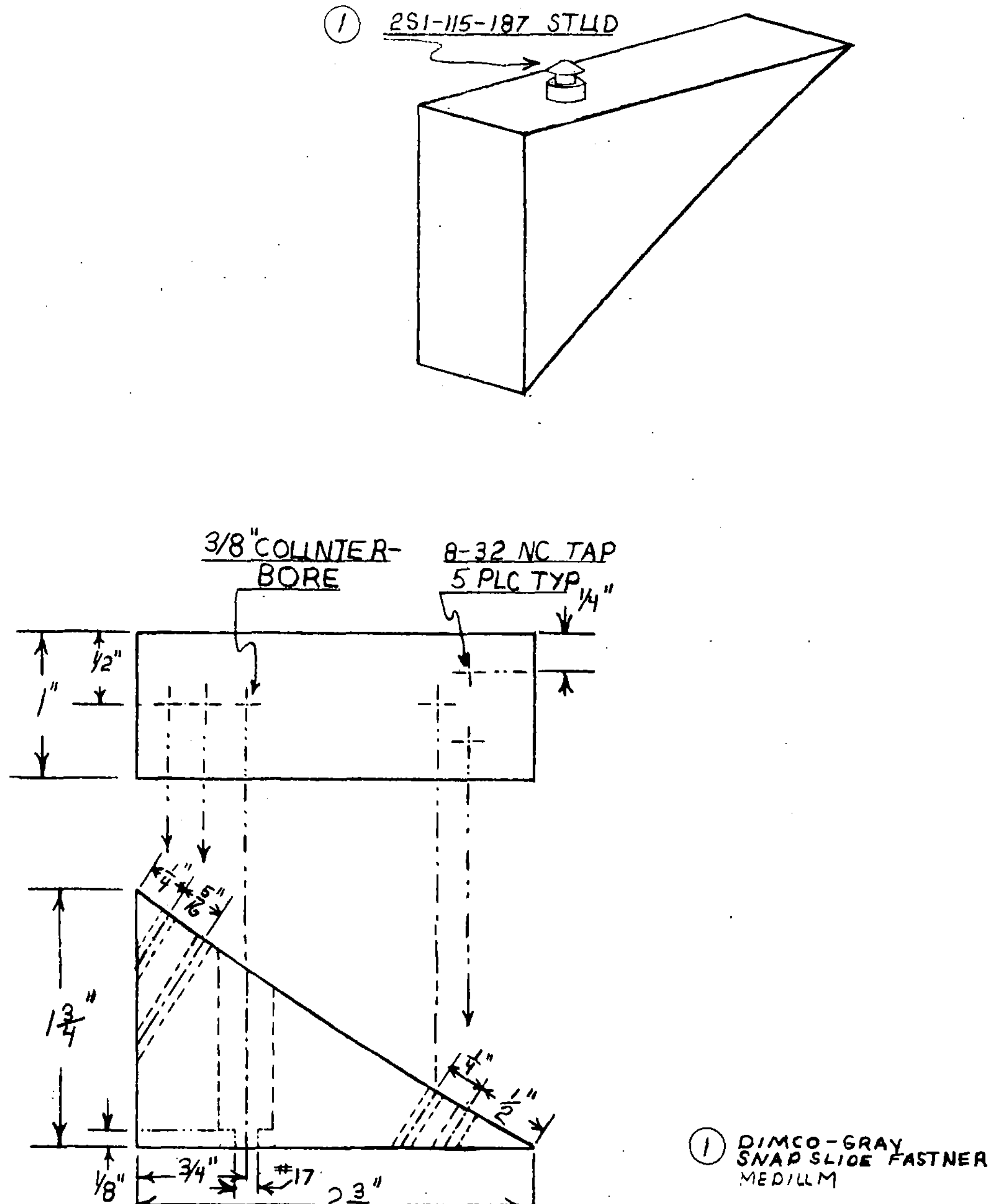
NOTE

#1. FINISHED AFTER SPOT WELDING TO INSTRUMENT BOX. SEE DWG. #

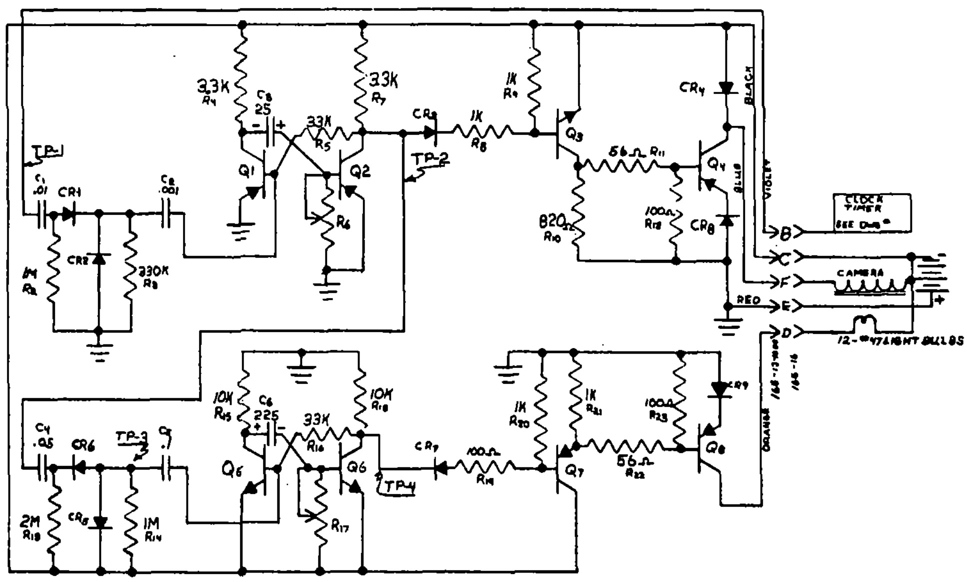
#2. RIGHT + LEFT PLATES NEEDED PER SET.

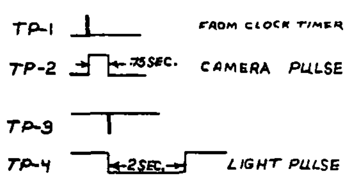
#3 SEE DIMCO-GRAY CATALOG, # 2 SNAPSLIDE FASTENER.

SCALE	FULL	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL	6061-T6
DRAWN			FINISH	SEE NOTE #1
DESIGNED		INSTRUMENT PANEL FASTENER PLATE	DRAWING NO.	017
CHECKED				
APPROVED				



SCALE	FULL	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL 6061-T6 AL.
DRAWN			FINISH BLK ANODIZE
DESIGNED		INSTRUMENT PANEL SUPPORT	DRAWING NO.
CHECKED			018
APPROVED			





Q_1, Q_2, Q_7 - 2N1131
Q_3, Q_5, Q_6 - 2N696
Q_4, Q_8 - 2N456A
CR_1-CR_5, CR_6-CR_7 - 1N482
CR_4 - G100D
CR_8, CR_9 - 1N1612 (OPTIONAL)
R_6 - 3067P-1-502 5K } BOURNS
R_7 - 3068P-1-503 50K } BOURNS
ALL CAPACITORS IN MFD.
C_3 - NLW 225-10
C_6 - NLW 25-15
ALL RESISTORS ¼W
THIS CIRCUIT MOUNTED ON PRINTED CIRCUIT BOARD CB-3

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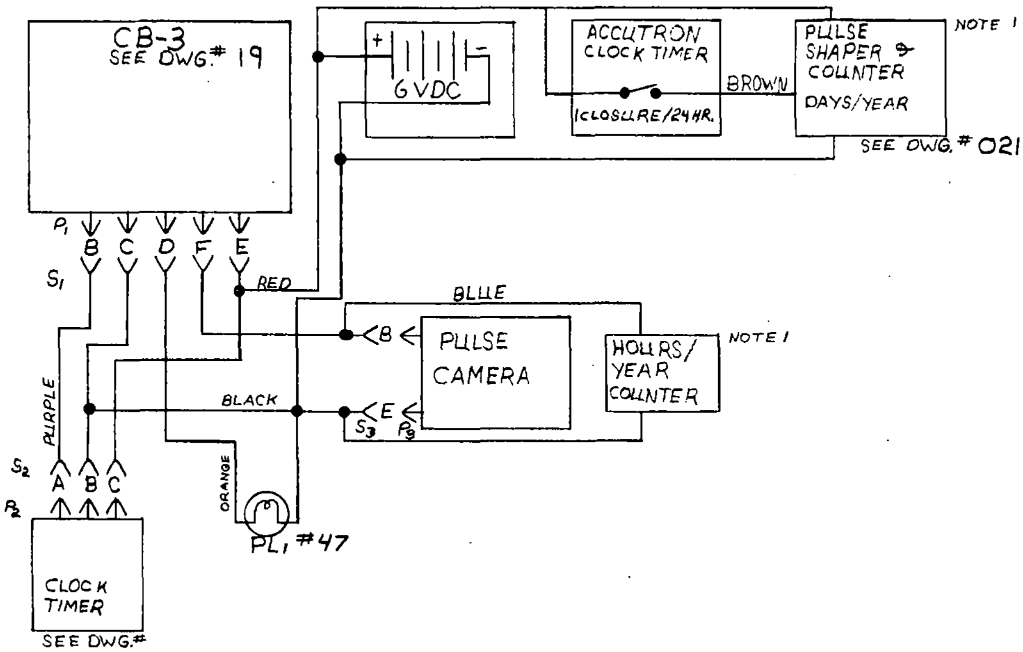
SCRIPPS INSTITUTION OF OCEANOGRAPHY
LA JOLLA, CALIFORNIA

CB-3
ELECTRONIC CIRCUIT FOR PHOTOGRAPHIC SYSTEM

019

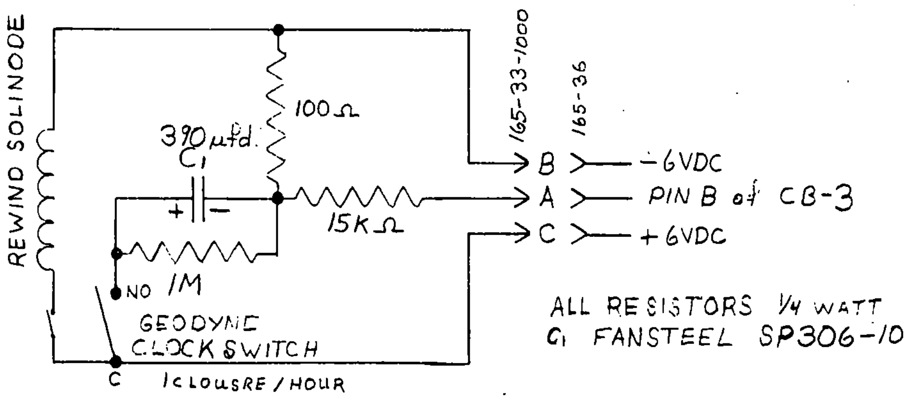


NOTE:
1. HOURS/YEAR AND DAYS/YEAR COUNTER ARE NOT USED IN THE SAME SYSTEM

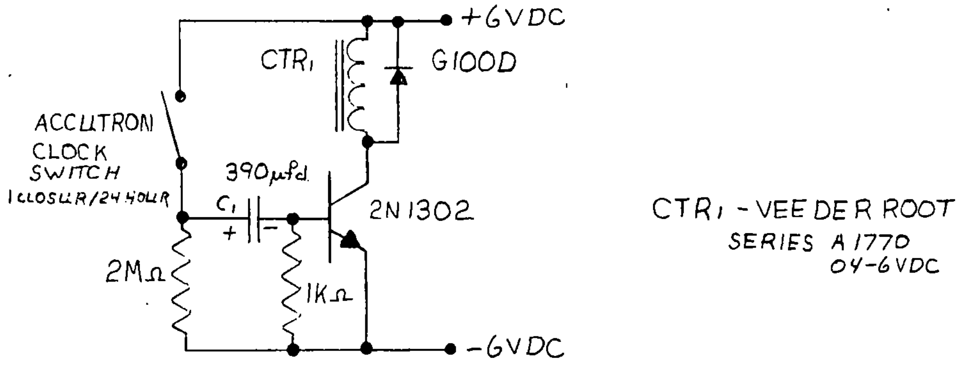
P_1	165-13-1000
S_1	165-16
P_2-P_3	165-33-1000
S_2-S_3	165-36
	AMPHENOL

SCALE	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL
DRAWN		FINISH
DESIGNED	PHOTOGRAPHIC CONTROL SYSTEM WIRING	DRAWING NO. 020
CHECKED		
APPROVED		

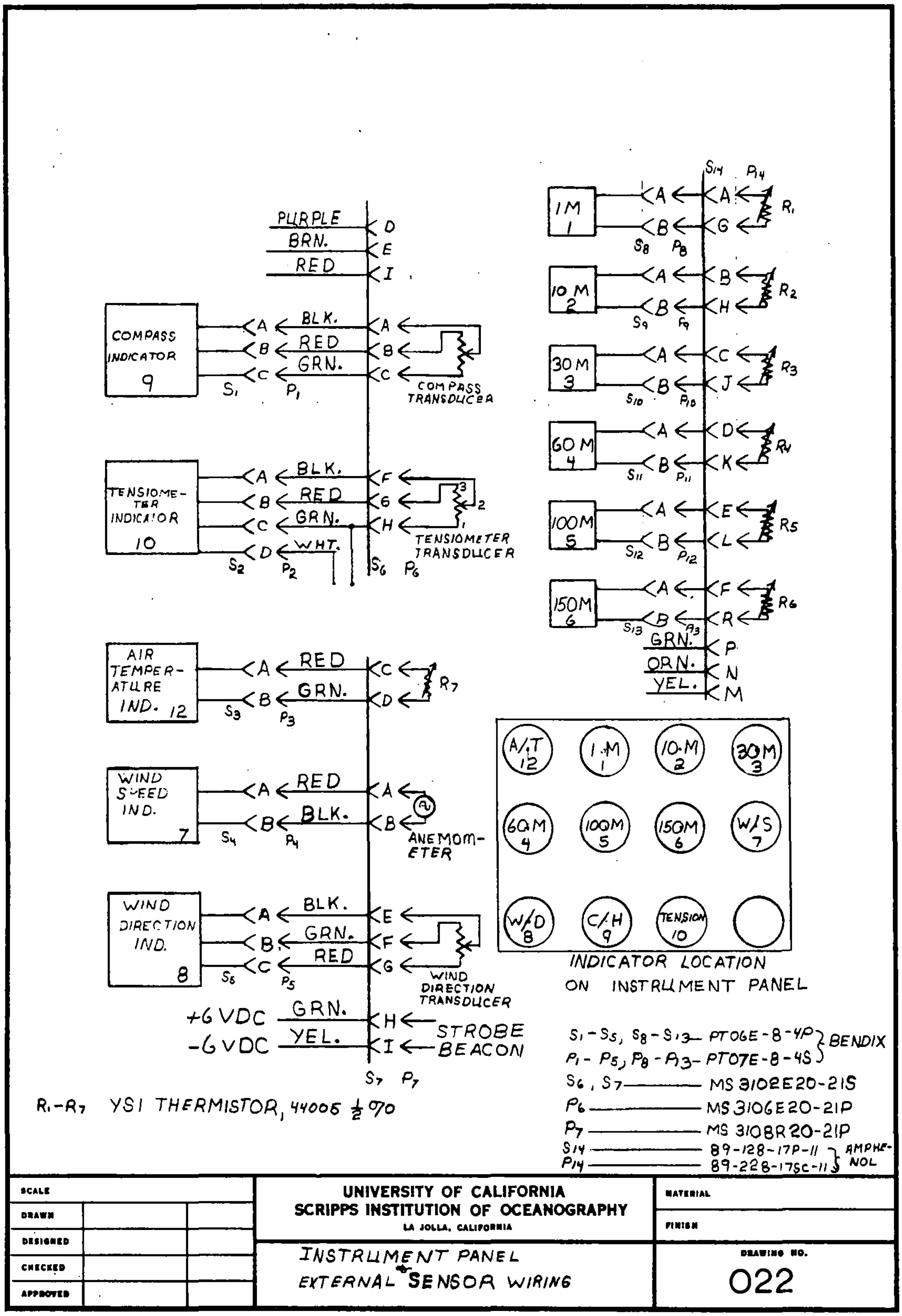
GEODYNE CLOCK TIMER



ACCUTRON CLOCK COUNTER DRIVER

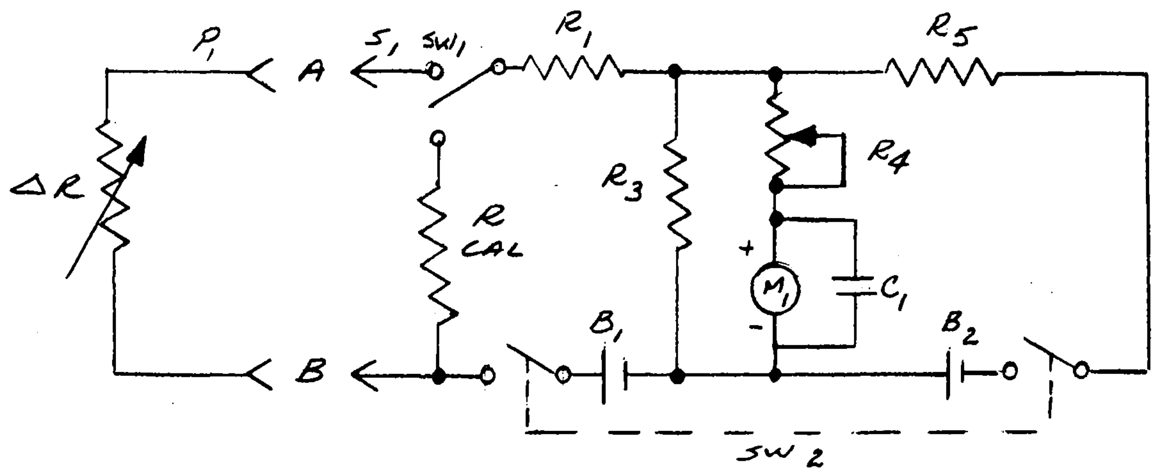


SCALE			UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL
DRAWN				FINISH
DESIGNED			GEODYNE CLOCK TIMER ACCUTRON CLOCK COUNTER DRIVER	DRAWING NO. 021
CHECKED				
APPROVED				



PURPLE
BRN.
RED
COMPASS INDICATOR 9
BLK.
RED
GRN.
COMPASS TRANSDUCER
TENSIOMETER INDICATOR 10
BLK.
RED
GRN.
WHT.
TENSIOMETER TRANSDUCER
AIR TEMPERATURE IND. 12
RED
GRN.
WIND SPEED IND. 7
RED
BLK.
ANEMOMETER
WIND DIRECTION IND. 8
BLK.
GRN.
RED
WIND DIRECTION TRANSDUCER
+6 VDC GRN.
-6 VDC YEL.
STROBE BEACON
1M 1
10 M 2
30 M 3
60 M 4
100M 5
150M 6
GRN.
ORN.
YEL.
INDICATOR LOCATION ON INSTRUMENT PANEL
A/T 12
1 M 1
10 M 2
30 M 3
60 M 4
100 M 5
150 M 6
W/S 7
W/D 8
C/H 9
TENSION 10
R1-R7 YSI THERMISTOR, 44005 ½ %
S1-S5, S8-S13 — PT06E-8-4P } BENDIX
P1-P5, P8-P13 — PT07E-8-4S
S6, S7 — MS 3102E20-21S
P6 — MS 3106E20-21P
P7 — MS 3108R20-21P
S14 — 89-128-17P-11 } AMPHENOL
P14 — 89-228-17SC-11
SCALE
DRAWN
DESIGNED
CHECKED
APPROVED
UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
LA JOLLA, CALIFORNIA
MATERIAL
FINISH
INSTRUMENT PANEL
EXTERNAL SENSOR WIRING
DRAWING NO.
022

AIR TEMPERATURE



B_1 & B_2	-RM12R-T2
C_1	- 100 ufd
M_1	0-100μa
R_1	2.8k
R Cal.	1.77K calibrate
R_3	4.77k
R_4	5k trimpot
R_5	27.7 k
SW_1	SpDT cal
SW_2	DPDT power

ΔR YSI THERMISTOR P/N #44005

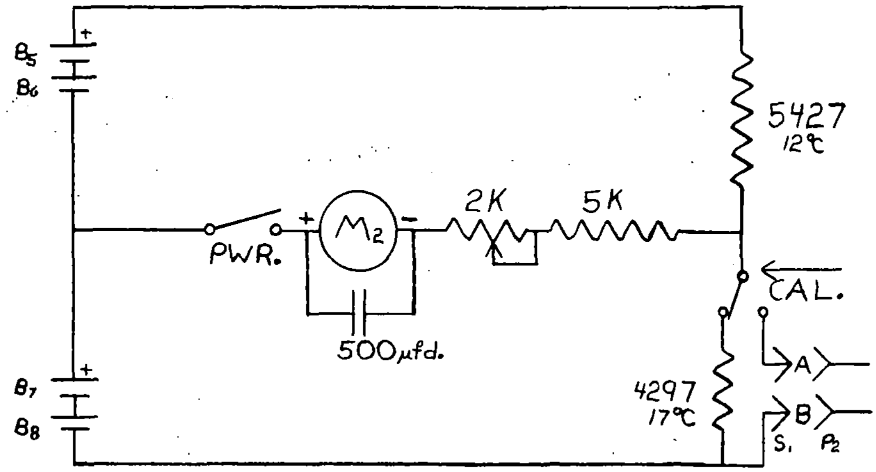
ΔR_T @ 0°F = 24.24 kΩ

ΔR_T @ 50°F = 5.86 kΩ

ΔR_T @ 100°F = 1.77k Ω

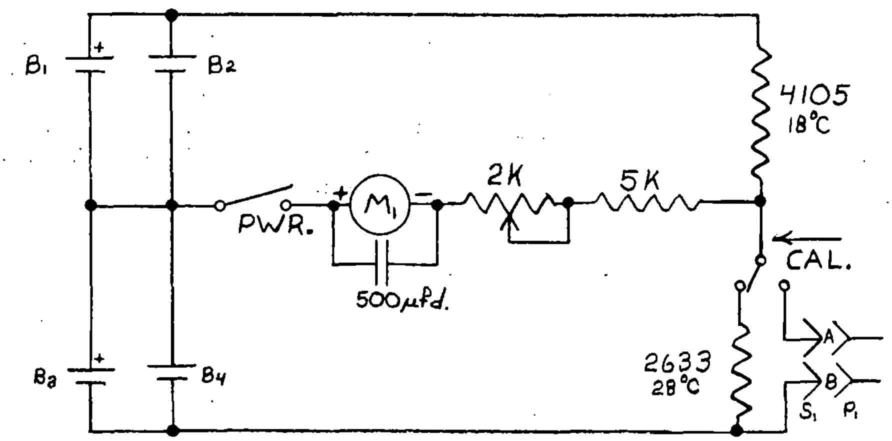
DWG. 023

7°- 17°C



CALIBRTED FOR YSI PRECISION THERMISTOR # 44005

8°-28°C



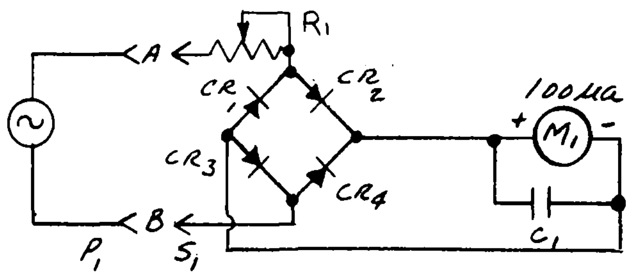
B_1-B_2; RM-502R-T2 — M_1,M_2; 25-0-25μa

S_1 PT06E-8-4S

P_1 " - " - 4P

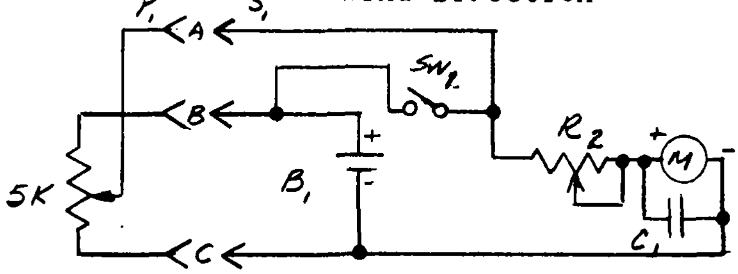
SCALE			UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL
DRAWN				FINISH
DESIGNED			7°-17°C + 8°-28°C PYROMETER SEA TEMPERATURE	DRAWING NO. 024
CHECKED				
APPROVED				

INDICATOR CHARTS
Wind Speed



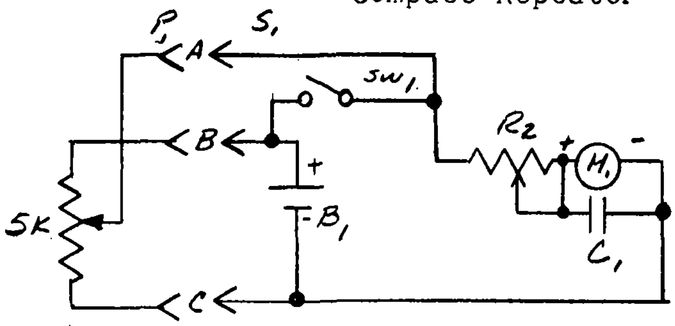
M_1 - 0-100 µa
C_1 - 100 µfd
[redacted]
Cr_1-Cr_4 = 1N90
P_1-PT07E8-4P
S_1-PT07E8-4S
R_1-20k trimpot

Wind Direction



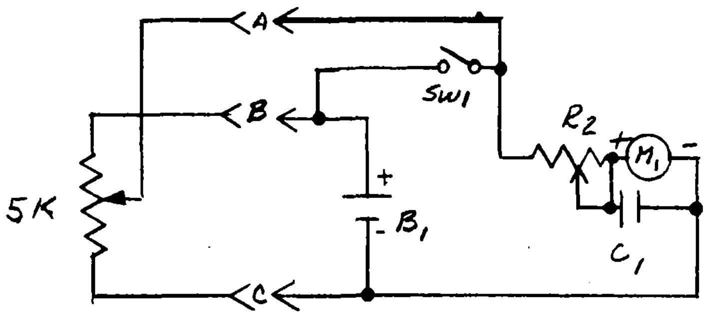
M_1 = 0-100 µa
C_1 - 100 µfd
[redacted]
R_2 - 20k trimpot
B_1 - RM-12R-T2
SW_1 - SPST calibrate
[redacted]

Compass Repeater



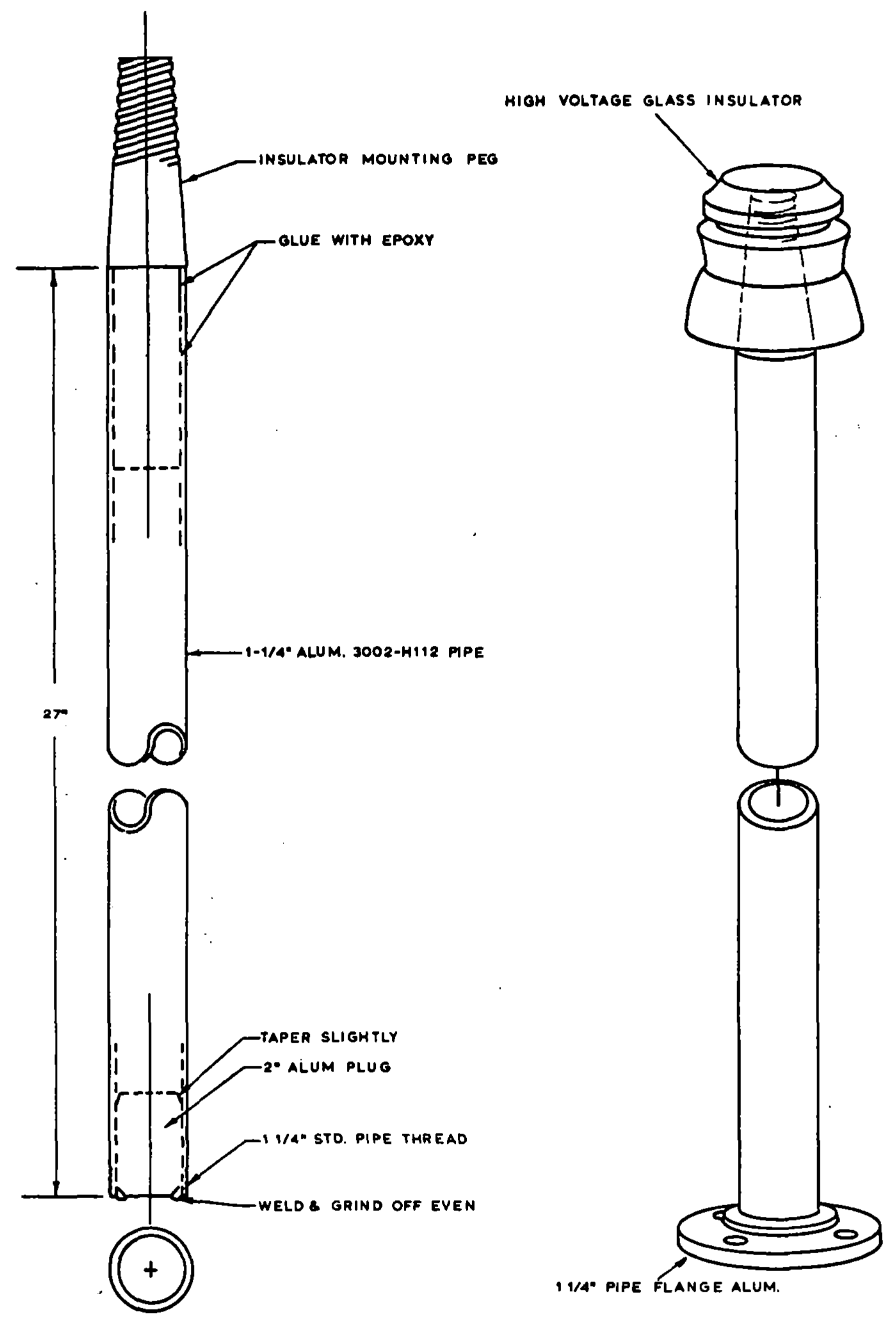
M_1 = 0-100 µa
C_1 - 100 µfd
R_1 - 20k trimpot
B_1 - RM-12R-T2
SW_1 - SPST calibrate

Tensiometer



M_1 = 0-100 µa
C_1 - 100 µfd
[redacted]
R_2 - 20K trimpot
B_1 - RM-12R-T2
[redacted]
SW_1 - SPST calibrate

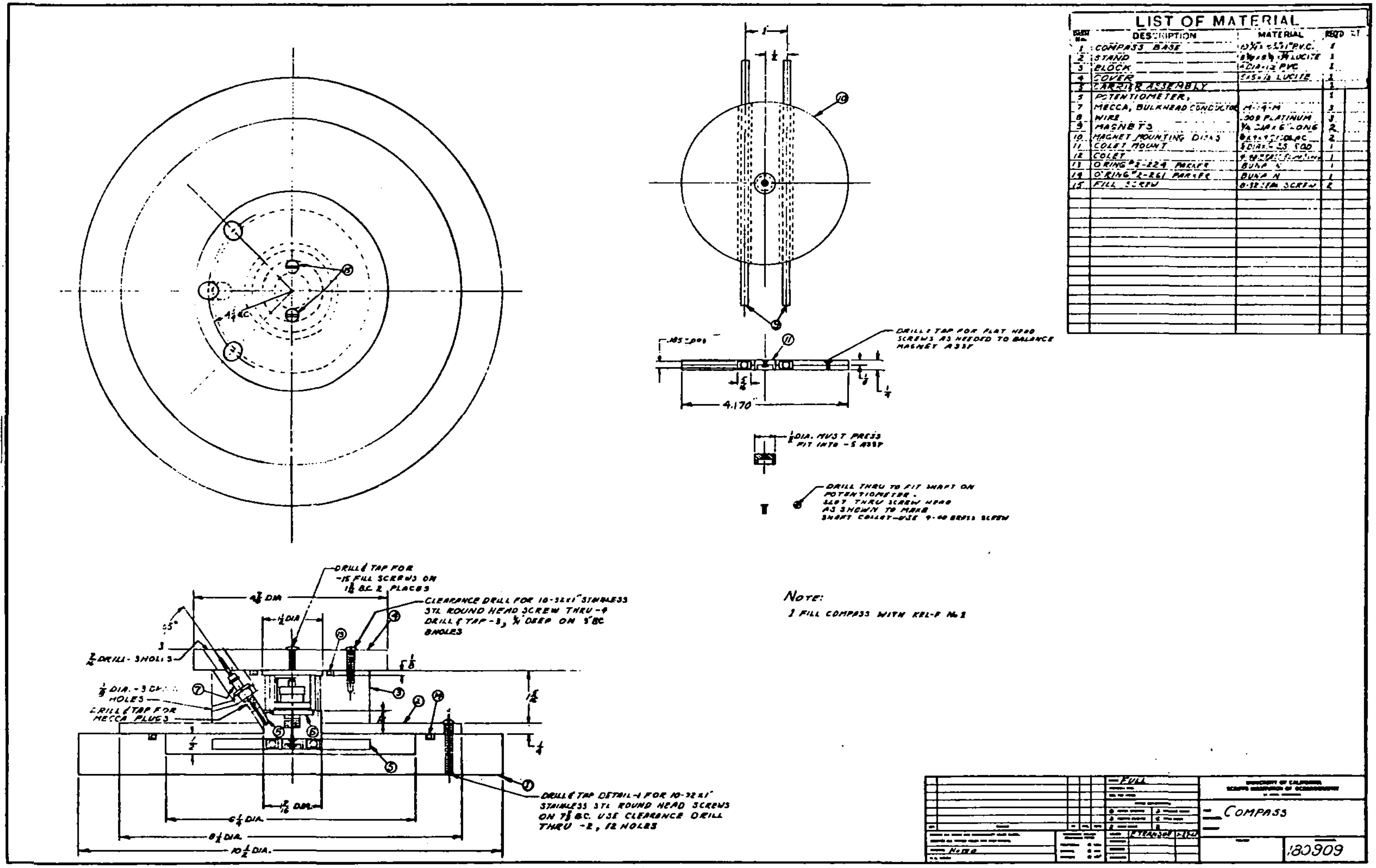
DWG. 025



UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY

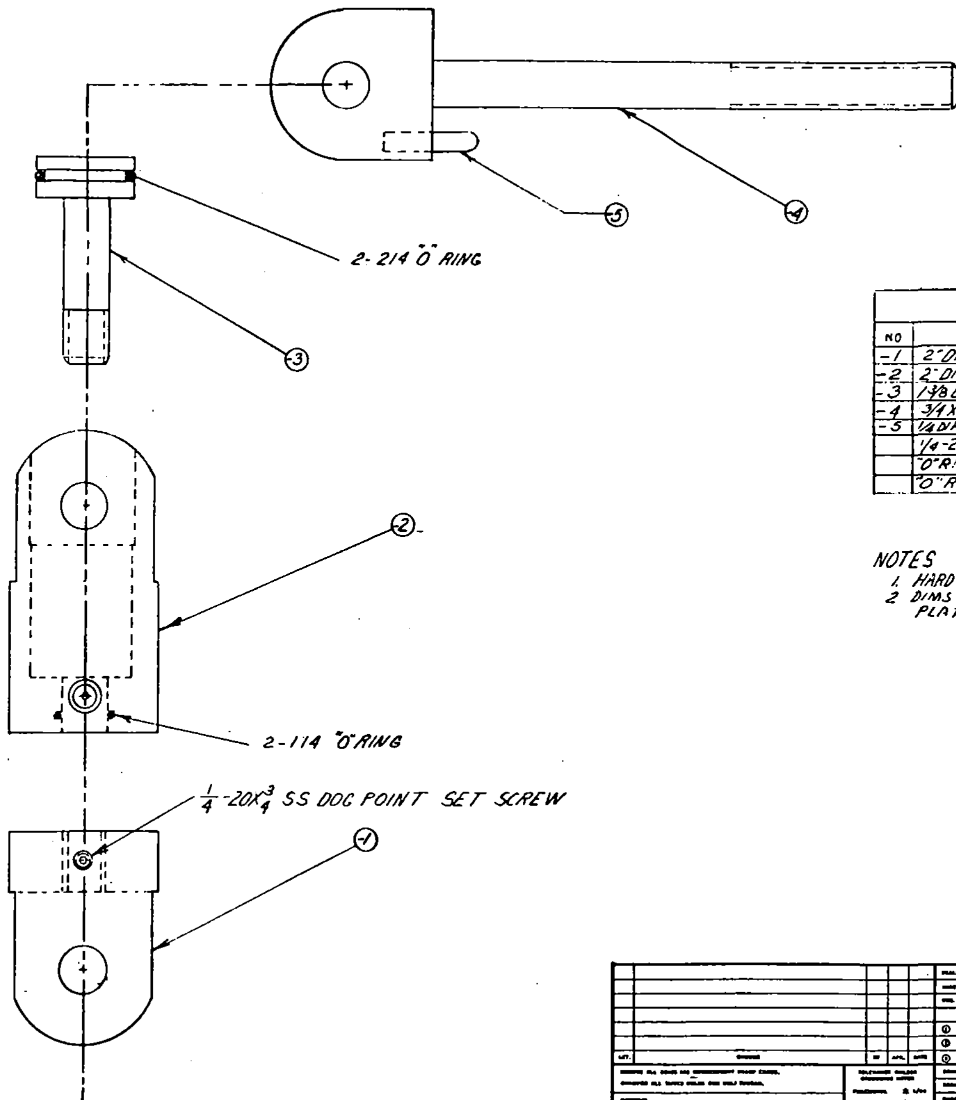
STANCHION ASSY.

026



LIST OF MATERIAL

ITEM No.	DESCRIPTION	MATERIAL	REQ'D
1	COMPASS BASE	[illegible] P.V.C.	1
2	STAND	[illegible] LUCITE	1
3	BLOCK	4 DIA. x 1/2 PVC	1
4	COVER	[illegible] LUCITE	1
5	CARRIER ASSEMBLY		1
6	POTENTIOMETER,		1
7	MECCA, BULKHEAD CONDUCTOR	M-4-M	3
8	WIRE	.009 PLATINUM	1
9	MAGNETS	[illegible] LONG	2
10	MAGNET MOUNTING DISKS	[illegible]	2
11	COLET MOUNT	[illegible] SS ROD	1
12	COLET	[illegible]	1
13	O RING #2-224 PARKER	BUNA N	1
14	O'RING #2-261 PARKER	BUNA N	1
15	FILL SCREW	8-32 [illegible] SCREW	2



LIST OF MATERIAL

NO	DESCRIPTION	MATERIAL	REQ'D	WT.
-1	2" DIA X 3	TYPE 316 SS	1	
-2	2" DIA X 9 1/8	TYPE 316 SS	1	
-3	1 3/8 DIA X 3	TYPE 316 SS	1	
-4	3/4 X 2 X 9 1/4	TYPE 316 SS	1	
-5	1/4 DIA X 1 1/4	TYPE 316 SS	1	
	1/4-20 X 3/4 DOG POINT SET SCREW	SS	1	
	"O" RING PARKER # 2-214	BUNA-N	1	
	"O" RING PARKER # 2-114	BUNA-2	1	

NOTES
1. HARD CHROME PLATE .002 MIN AFTER GRINDING —3
2. DIMS CALLED OUT FOR -3 ARE FINISHED DIM.S AFTER PLATING & GRINDING

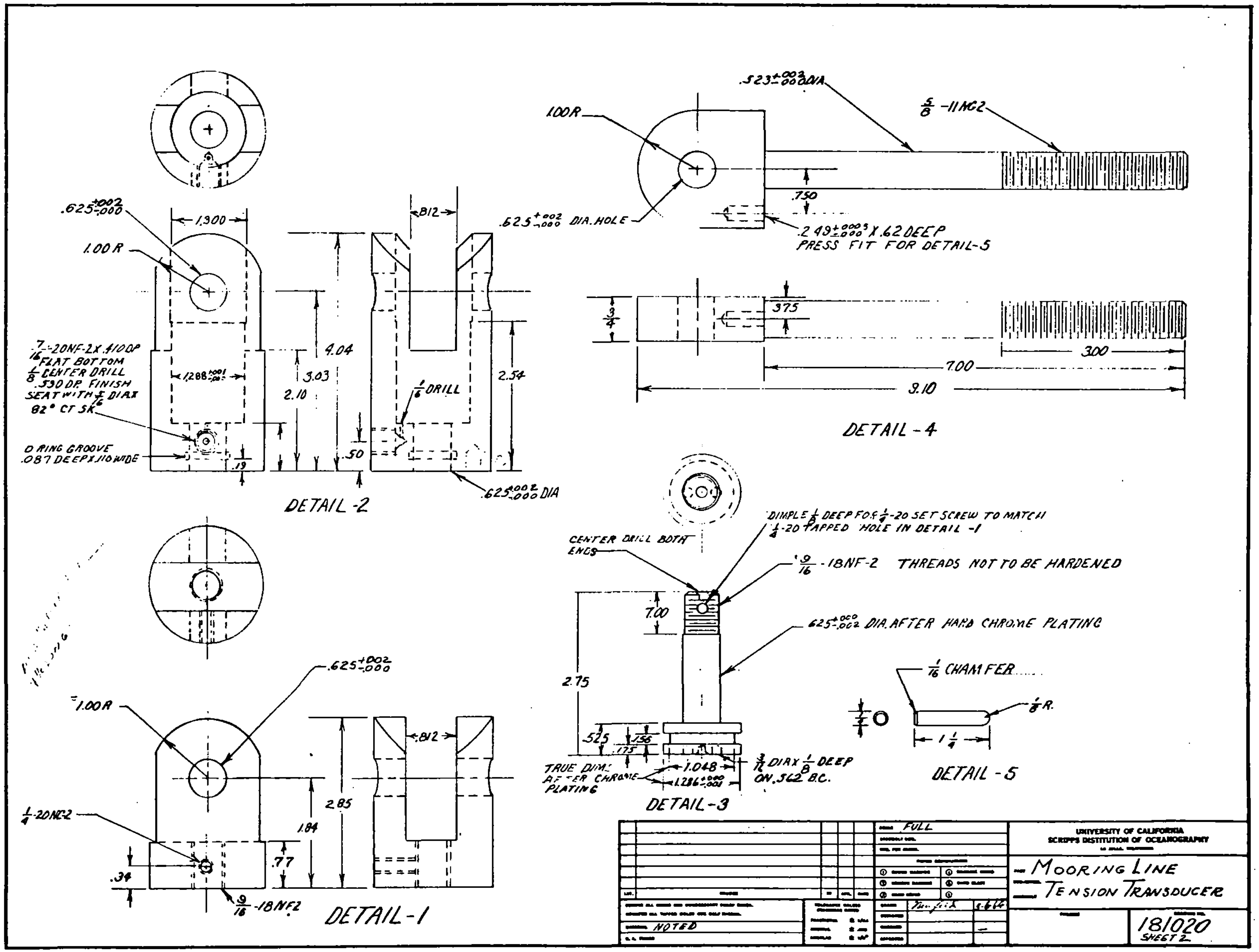
SCALE FULL

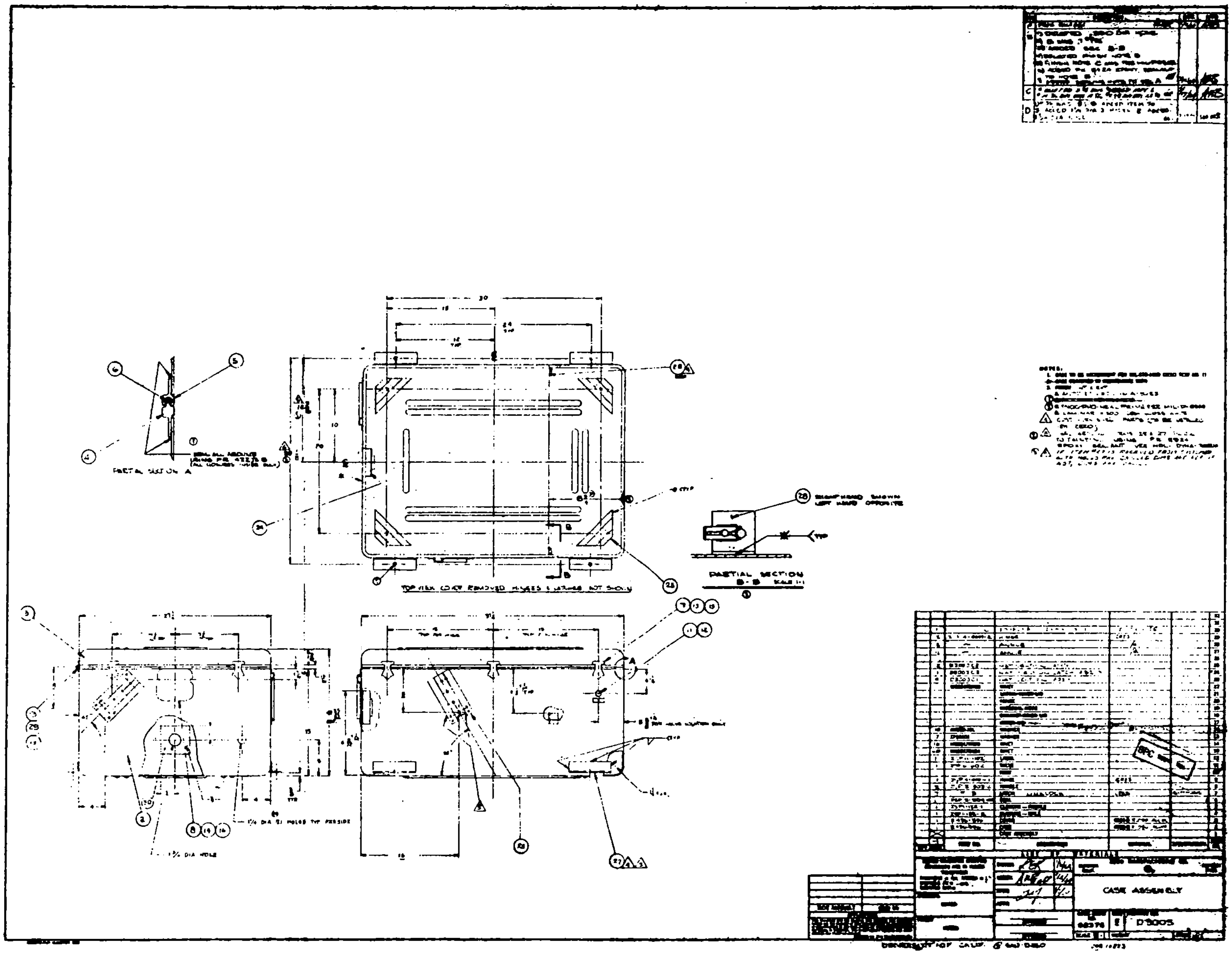
UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY

MOORING LINE
TENSION TRANSDUCER

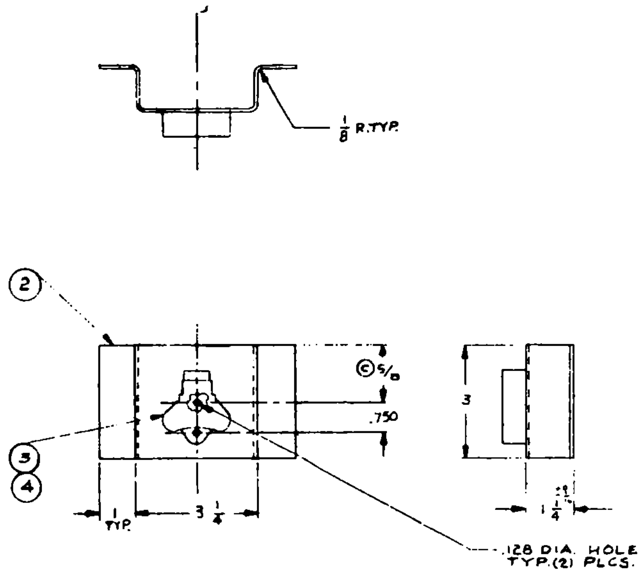
5-6-64

181020
SHEET 1 OF 2


DETAIL-1
DETAIL-2
DETAIL-3
DETAIL-4
DETAIL-5
1.00R
.625 +.002 -.000
1/4-20NC-2
9/16-18NF2
.812
2.85
1.84
.77
.34
1.300
1.288 +.001 -.000
4.04
3.03
2.10
2.54
.50
.19
1/8 DRILL
.625 +.002 -.000 DIA
7/16-20NF-2X.410DP FLAT BOTTOM 1/8 CENTER DRILL .330 DP. FINISH SEAT WITH 7/16 DIA X 82° CT SK
O RING GROOVE .087 DEEP X .110 WIDE
.523 +.002 -.000 DIA
5/8-11NC2
.625 +.002 -.000 DIA. HOLE
.750
.249 +.0005 -.000 X .62 DEEP PRESS FIT FOR DETAIL-5
3/4
.375
3.00
7.00
9.10
DIMPLE 1/8 DEEP FOR 1/4-20 SET SCREW TO MATCH 1/4-20 TAPPED HOLE IN DETAIL -1
CENTER DRILL BOTH ENDS
9/16-18NF-2 THREADS NOT TO BE HARDENED
.625 +.000 -.002 DIA. AFTER HARD CHROME PLATING
1.00
2.75
.525
.156
.175
TRUE DIM. AFTER CHROME PLATING
1.048
1.286 +.000 -.001
3/16 DIA X 1/8 DEEP ON .562 B.C.
1/16 CHAMFER
1/8 R.
1/4
1 1/4
FULL
NOTED
UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
MOORING LINE
TENSION TRANSDUCER
181020
SHEET 2


PARTIAL SECTION A
TOP VIEW COVER REMOVED HINGES & LATCHES NOT SHOWN
RIGHT HAND SHOWN LEFT HAND OPPOSITE
PARTIAL SECTION B-B
1/4 DIA (2) HOLES TYP FR SIDE
1 1/2 DIA HOLE
LIST OF MATERIALS
CASE ASSEMBLY
D3005

REVISIONS			
SYM	DESCRIPTION	DATE	APPD
A	PROD. RELEASE	1/5/64	AHB
B	1) DELETED STRIKE & (2) .128 DIA MTG HOLES 2) DELETED 1/2 & 1 DIM, 3) ADDED 1 9/16 4) DELETED .937 & .465 DIMS	2-12-64	AHB
C	5/8 WAS 1 9/16		SAROSA



BPC NOV 5 1964

D3003C3

QTY REQD		PART NO.	DESCRIPTION	MATERIAL	SPECIFICATION	ITEM NO.
	1	# 3	LATCH (BODY ONLY)	CRES	SIMMONS	4
	4	MS20470AD4	RIVET	~	ZERO	3
	1	~	HAT SECTION	5052-H34 X .090 AL	ZERO	2
	X	~	ASSEMBLY	~	ZERO	1
	-1					

LIST OF MATERIALS

NEXT ASSEMBLY	USED ON
D3003	

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONS ± 1/32 ANGLES ±
DECIMALS .XX ±
DECIMALS .XXX ± .010

MATERIAL: NOTED

FINISH: NONE

DRAWN MAK 2/4/64
CHECK A. Bell 2/5/64
APPR 2/5/64
APPR

APPROVED

APPROVED

ZERO MANUFACTURING CO.
BURBANK CALIF. — MONSON MASS.

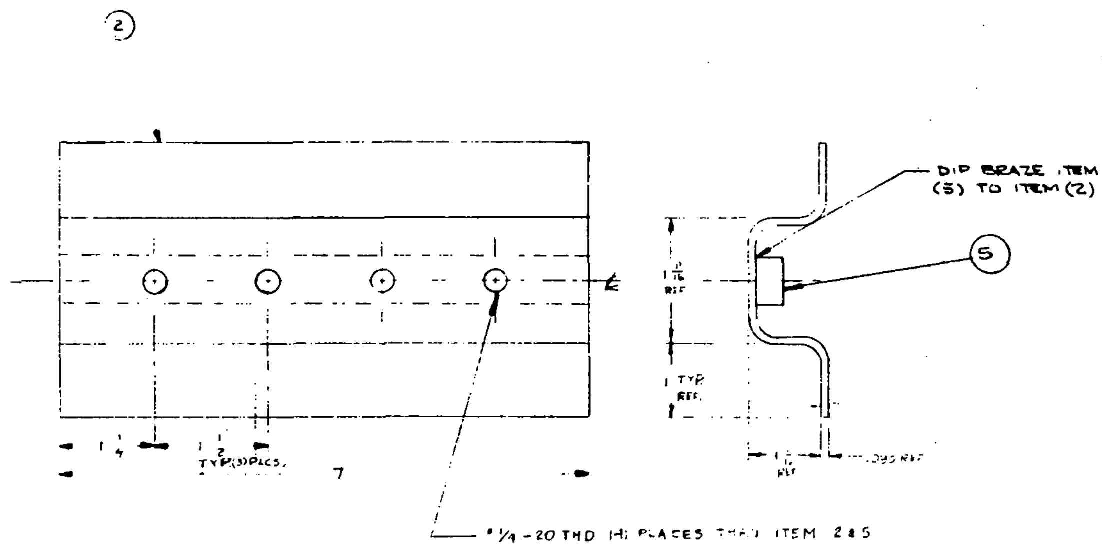
LATCH & HAT SECTION ASSEMBLY

CODE IDENT NO. 98376 | SIZE C | DRAWING NO. D3003C3

SCALE 1/2 | WEIGHT | SHEET 1 OF 1

UNIVERSITY OF CALIF — JOB # 10223

REVISIONS			
SYM	DESCRIPTION	DATE	APPD
A	PROD RELEASE	2/5/64	
B	1) DELETED ITEMS 3 & 4 & ASSOC NOTES & DIMS 2) ADDED ITEMS 5 & 6 & ASSOC NOTES & DIMS	2-12-64	
C	DELETED ITEM 6 ; ADDED 1/4-20 THD		



BPC NOV 3 1964

D3003C2

QTY REQD	PART NO.	DESCRIPTION	MATERIAL	SPECIFICATION	ITEM NO.
~~4~~	~~[illegible]~~	~~[illegible]~~		~~[illegible]~~	6
1	~	BAR 3/8 x 1 x 7 1/16	6061-T6	DUCOMMUN	5
~~8~~	~~MS20426AD~~	~~RIVET~~		~~NUTT-SHEL~~	4
~~4~~	~~13780-040~~	~~NUT PLATE~~		~~ZERO~~	3
1	ZSP8-822	HAT SECTION	~	ZERO	2
-1	~	ASSEMBLY	~	ZERO	1

LIST OF MATERIALS

D3003	
NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES FRACTIONS ± 1/32 ANGLES ± DECIMALS .XX ± DECIMALS .XXX ± .010

MATERIAL NOTED

FINISH NONE

DRAWN A/MK 2/4/64

CHECK AHBell 2/5/64

APPR

APPR

APPROVED

APPROVED

ZERO MANUFACTURING CO. BURBANK CALIF. MONSON MASS.

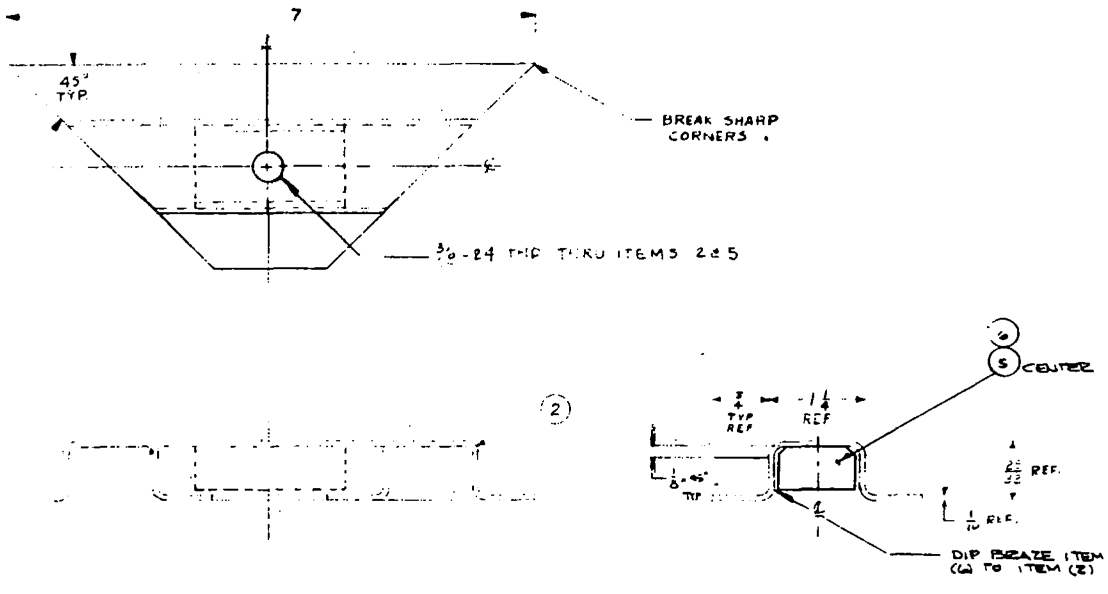
HAT SECTION ASS'Y

CODE IDENT NO. 98376 SIZE C DRAWING NO. D3003C2

SCALE WEIGHT SHEET

UNIVERSITY OF CALIF. JOB 10828

REVISIONS			
SYM	DESCRIPTION	DATE	APPD
A	PROD RELEASE MMK	1/3/64	AHB
B	1) DELETED ITEMS 3 & 4 & ASSOC NOTES & DIMS 2) ADDED ITEMS 5 & 6 & ASSOC NOTES & DIMS MMK	2-64	AHB
C	DELETED ITEM 6, ADDED 3/8-24 THD	7-16-64	[illegible]



BPC NOV 3 1964

D3003C1

QTY REQD	PART NO.	DESCRIPTION	MATERIAL	SPECIFICATION	ITEM NO.
~~1~~	~~[illegible]~~	~~INSERT 3/8-24~~		~~[illegible]~~	6
1	~	BAR 3/8 x 1 x 2 1/16	6061-T6 AL		5
~~2~~	~~MS20426AD4~~	~~RIVET~~	~~~~~	~~ZERO~~	~~4~~
~~1~~	~~13700-064~~	~~NUT PLATE 3/8-24 THD.~~	~~CRES~~	~~NUTT-SHEL~~	~~3~~
1	ZSP8-821	HAT SECTION	~		2
X	~	ASSEMBLY	~	ZERO	1
-1					

LIST OF MATERIALS

D3003	
NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONS ± 1/32 ANGLES ±
DECIMALS .XX ±
DECIMALS .XXX ± .010

MATERIAL: NOTED

FINISH: NONE

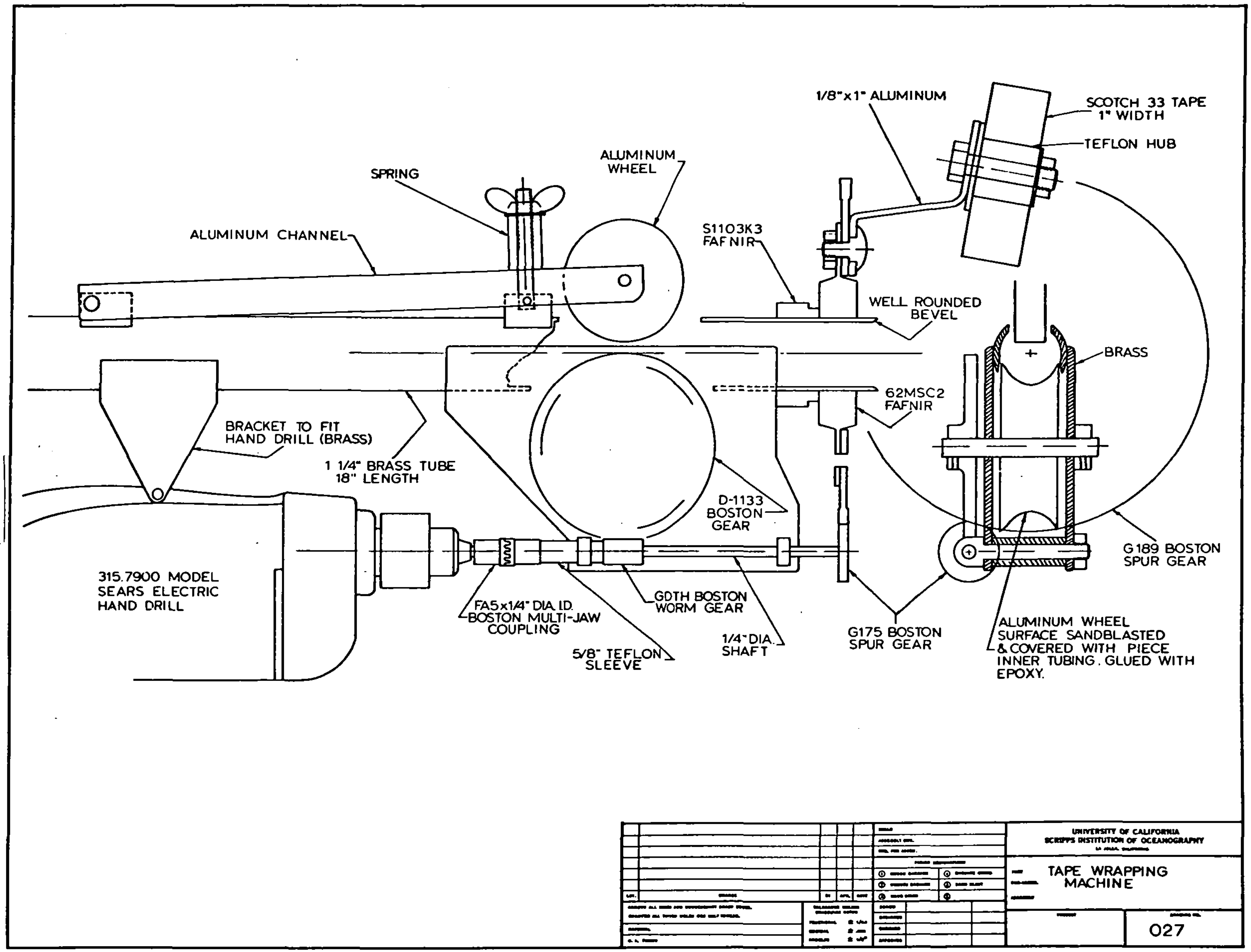
DRAWN	MMK	1/31/64
CHECK	AHBell	2/5/64
APPR	[illegible]	3/1/64
APPR		
APPROVED		
APPROVED		

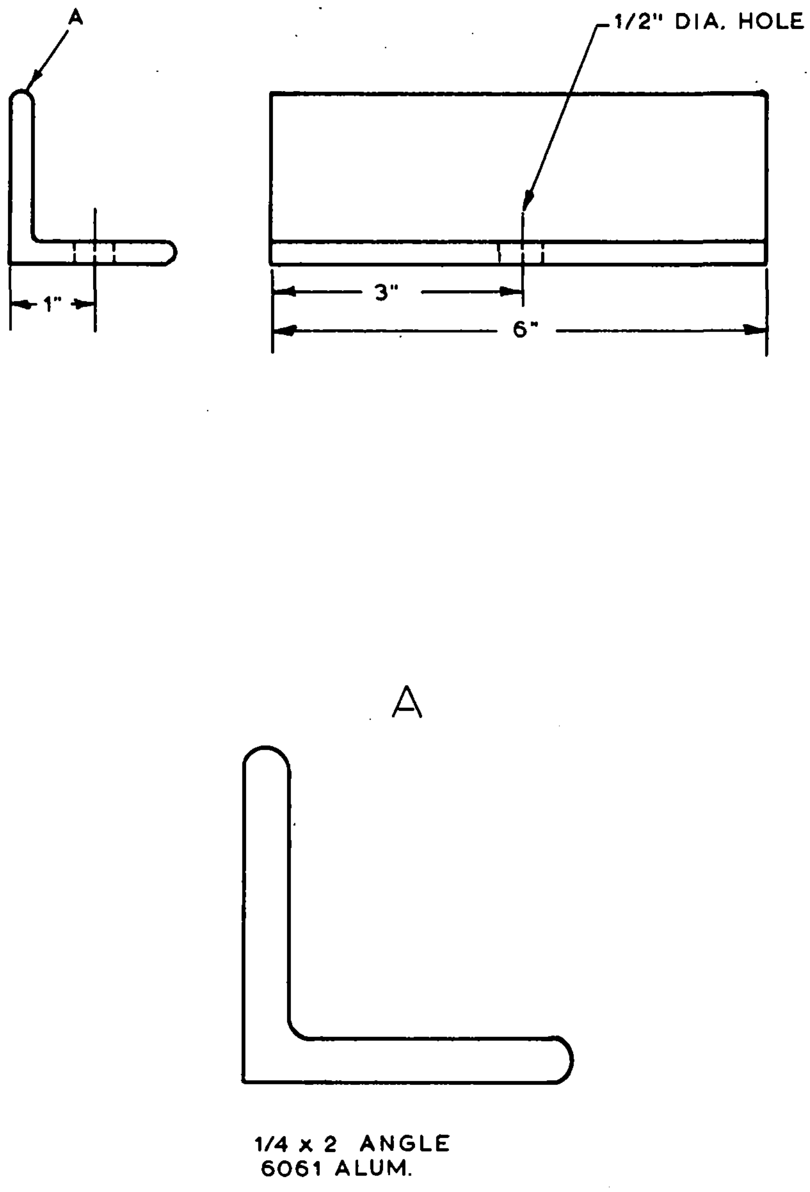
ZERO MANUFACTURING CO.
BURBANK CALIF. — MONSON MASS.

HAT SECTION ASS'Y

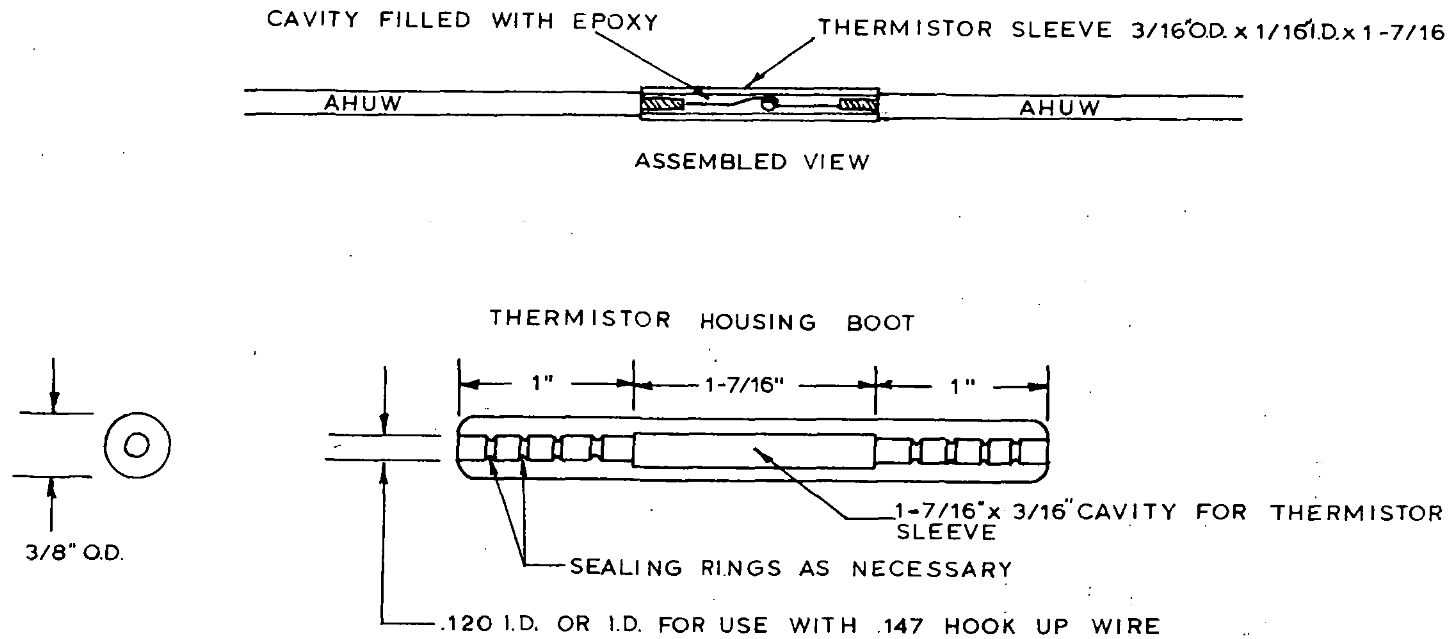
CODE IDENT NO.	SIZE	DRAWING NO.
98376	C	D3003C1
SCALE 1:1	WEIGHT	SHEET 1 OF 1

UNIVERSITY OF CALIF JOB # 10223


1/8" x 1" ALUMINUM
SCOTCH 33 TAPE 1" WIDTH
TEFLON HUB
ALUMINUM WHEEL
SPRING
ALUMINUM CHANNEL
S1103K3 FAFNIR
WELL ROUNDED BEVEL
BRASS
62MSC2 FAFNIR
BRACKET TO FIT HAND DRILL (BRASS)
1 1/4" BRASS TUBE 18" LENGTH
D-1133 BOSTON GEAR
G189 BOSTON SPUR GEAR
315.7900 MODEL SEARS ELECTRIC HAND DRILL
FA5 x 1/4" DIA. I.D. BOSTON MULTI-JAW COUPLING
GDTH BOSTON WORM GEAR
1/4" DIA. SHAFT
G175 BOSTON SPUR GEAR
ALUMINUM WHEEL SURFACE SANDBLASTED & COVERED WITH PIECE INNER TUBING. GLUED WITH EPOXY.
5/8" TEFLON SLEEVE
UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
TAPE WRAPPING MACHINE
027



SCALE	UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL
DRAWN		FINISH
DESIGNED	ANGLE - PLATE	DRAWING NO. ITEM 27 of DWG. D3003
CHECKED		
APPROVED		



MATERIAL:

BOOT NEOPRENE

SLEEVE NYLON TUBING

SCALE

DRAWN

DESIGNED

CHECKED

APPROVED

UNIVERSITY OF CALIFORNIA
SCRIPPS INSTITUTION OF OCEANOGRAPHY
LA JOLLA, CALIFORNIA

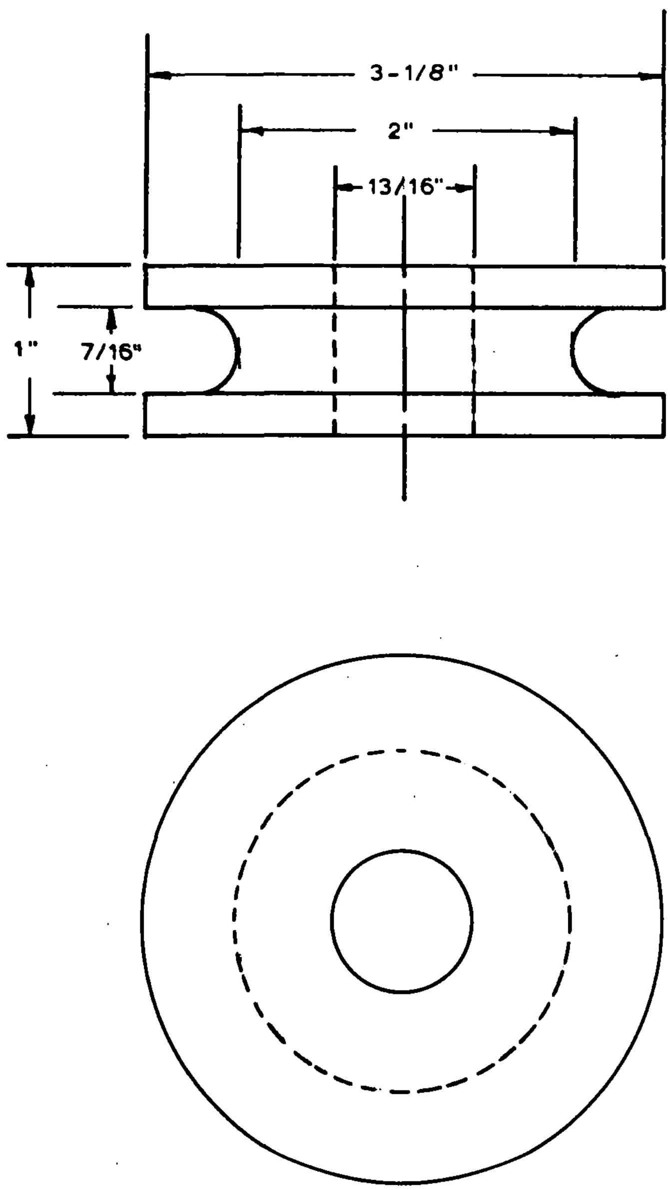
THERMISTOR ASSY.

MATERIAL

FINISH

DRAWING NO.

028



MATERIAL: PVC ROUND STOCK

SCALE			UNIVERSITY OF CALIFORNIA SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA	MATERIAL
DRAWN				FINISH
DESIGNED			PVC THIMBLE	DRAWING NO. 029
CHECKED				
APPROVED				

PARTS LIST FOR MOORED INSTRUMENT STATION

Quantity	Description	Vendor	Reference Drawing No.	Approx. Cost
	A. Float, Associated Hardware			
* 1	Catamaran Instrument Float	Mauricio and Sons Marine 2420 Byron Street San Diego, California	002	$570
1	Stanchion		026	25
1	12 ft. tapered Fiberglas pole		001	8
		Sub total		$603.00
	B. Mooring Line and Hardware			
L	1100 lb. anchor 55 gallon drum chain and cement	Note: Free anchor chain was used	Fig. 2	30
2	PVC thimbles		029	10
2	Stainless steel 3/8" Thimble		Fig. 2	2
* 100 ft.	3/8 Galvanized chain	Kettenburg Boat Works 2810 Carlton San Diego	Fig. 2	56
2	5/8" Screw Pin Anchor shackle, 18-8 stainless steel	Schnitzer Alloy Prod. 325 Pine St. Elizabeth, New Jersey	Fig. 2	22
* 500 ft.	7 x 19-1/4" stainless steel aircraft cable	Pacific Wire Rope Co. 1840 East 15th Street Los Angeles, Calif.	Fig. 2	143
* 1	Jacketing SS Cable .002 Mylar 50% lap .015 Natural polyethylene Jacket	Gavit Wire and Cable Co. Escondido, Calif.	Fig. 2	45
1 length (depends on depth of mooring)	7/16" Goldline Nylon	Tubbs Great Western Cordage 501 W. Palm Avenue Orange, Calif.	Fig. 2	$.052/ft. a 2000 fathom mooring would cost $624
2300 ft.	Amergraph Hook-up wire 3/64" 7x19 Tinned cadium bronze Neoprene jacket	Columbia-Geneva Steel Box 3040 Terminal Annex Los Angeles 54, California		113
3	Galvanized shackle 5/8"			5
		Sub total		$1,050.00

* Cost based on 5 units

PARTS LIST FOR MOORED INSTRUMENT STATION

Quantity	Description	Vendor	Reference Drawing No.	Approx. Cost
	C. External Instrumentation			
	Hydraulic clevis		181020	$237
1	Model 3000 B.Pressure Transducer 0-1000 PSI 5000 ohm	Computer Instrument Corp. 420 Madison Avenue Hempstead, Long Island NY	181020	120
1	Remote Compass		180909	117
1	Microtorque Potentiometer Type 9, Model 85111	G.M.Giannini and Co. Inc. 1600 Mountain Avenue Duarte, Calif. 91010	180909	56
6	Precision thermistor 3000 ohms 25°C selected to 0.1°C over a range of 0°-30°C	Yellow Springs Instr. Co. P. O. Box 106 Yellow Springs, Ohio		30
6	Thermistor Housing Boats	Marsh and Marine Mfg. Co. Houston 36, Texas	028	9
12 rolls	No. 22 Scotch Electrical Tape 1"x36 yds.	Sunlight Electric Supply Co. 205 Market St. San Diego, Calif.		24
1	Amphenol plug assembly 89-128-17p-11 (instrument line plug)	Amphenol Connector Div. 9201 Independence Avenue Chatsworth, California	022	28
1	Amphenol socket assembly 89-228-175(c) (instrument box mounted)			
12 ft.	Tygon tubing 1-1/4" OD		001	12
1	Mast Bracket Assembly		007	25
1	Mast Assembly		004	150
1 ea.	Aniometer-wind direction assembly, resistance of W/D potentiometer is 5000 ohms, units sealed against submersion in sea water	Rochester Instrument Co. 325 Military Dr. Colurd Alene, Idaho	004	85
1	4C4-A strobe light 15 FPM, 6 VDC, Daylight Control	ACR Electronics 551 West 22nd Street New York 11, N.Y.	004	90
6 hrs.	Assembly of Instrument line at $10.00/hr.			60
			Sub total	$1,043

PARTS LIST FOR MOORED INSTRUMENT STATION

Quantity	Description	Vendor	Reference Drawing No.	Approx. Cost
	D. Recording System			
1	Instrument mounting board 1/2"x23"x33" Plywood exterior		003	6
1	Instrument Box	Zero Manufacturing Co. 1121 Chestnut Street Burbank, California	03003 03003C1 03003C2 03003C3	700
1 set	Battery Box		008	30
1	Light and support assembly		011	15
1	Instrument Panel Fiberglass assembly		016 017-18	50
3 ft.	1-1/4" Brass, cadium plated piano hinge		003	2
1	Camera Platform		010	15
1	Military version of the Bell and Howell 200 P	Possibly no longer available	003	500
1	Elgeet 12 mm 1.2 wide angle lens	Nelson Photo Supply 1917 India Street San Diego 1, California	003	103
1	Electric control circuit CB-3		019	75
1 ea.	Miscellaneous electronic circuit (future circuits should be incorporated in CB-3)		021	15
1	Accutron Industrial timer TE-13-10 a) 24 hour dial b) SPST switch closure every 24 hrs.at 2400 hrs. c) Epoxy sealed face d) Rear setting	Bulova Watch Co. Bulova Park Flushing 20, N.Y.	016 021	290
1	A1770 04-6VDC electro magnetic counter manual reset	Veeder Root Inc. P. O. Box 128 Montrose, Calif.	016 003	20
* 6	Indicating pyrometers 8-28°C, 7-17°C	Aero-Marine Electronics 3045 Moore San Diego, Calif.	024	72.40

* Baxed on quantities of 30 units

PARTS LIST FOR MOORED INSTRUMENT STATION

Quantity	Description	Vendor	Reference Drawing No.	Approx. Cost
	(D. Recording System Cont'd)			
* 6	25-0-25 microamp tautband meter - Model 46H-250R; scales identical to UCSD P.O. 74899 (12-18-63)	Hickok Electrial Instrument Co. 595 N. Lake Avenue Pasadena, Calif.	024	$360
* 5	0-100 micro-amp tauntband meter - Model 46HR; scales idential to UCSD - PO 74899 (dated 12-18-63)	same as above	023	130
1	Wind speed indicator circuit		025	40
3	Wind direction, compass repeater, tensiometer circuits		025	120
1	Air temperature circuit		023	50
11	Bendix Pigmy plug PT-6E-4P	Aero-Marine Electronics 3045 Moore Street San Diego, Calif.	022	62.26
11	Bendix Pigmy socket PT-7A-4S	same as above	022	69.08
5	Aluminum case extensions	same as above		31.40
12	Miscellaneous electrical plugs and connectors		020 022	31.29
4	M907 Mallory carbon batteries		020	19.92
50 (minimum order)	16 MM Universal Magazine 50 feet of Recordak Fine Grain Fil, Type 7456 with opaque backing	Recordak Corporation 343 State Street Rochester 4, N.Y.		250.
32 hrs.	System assembly of Instrument float at $10/hr.			320.
			Sub total	$3,377.35
	TOTAL SYSTEM COST			$6,073.35

* Based on quantities of 30 units

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) University of California, San Diego Scripps Institution of Oceanography La Jolla, California 92038	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP Unclassified

3. REPORT TITLE

Development and Testing of Taut-Nylon Moored Instrument Stations (with details of design and construction)

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Summary through April 5, 1965

5. AUTHOR(S) (Last name, first name, initial)

John D. Isaacs, George B. Schick, Meredith H. Sessions and Richard A. Schwartzlose

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
April 15, 1965	86	6

8a. CONTRACT OR GRANT NO. Nonr 2216-12	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. None	SIO Reference 65-5
c. None	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d. None	None

10. AVAILABILITY/LIMITATION NOTICES

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Office of Naval Research Washington, D. C.

13. ABSTRACT One of the persistent problems of oceanography is to ascertain the nature and cause of large-scale shifts in the surface water masses of the oceans. The existence of such changes are readily apparent from vessel measurements. However, the nature of the motions involved cannot be documented by any feasible ship survey. It probably can best be documented by an array of continuous recording instrument stations.

For this and other purposes deep-moored instrument stations have been designed that record meteorological data and oceanographic data in the upper few hundred meters. Twenty installations of evolving designs of the taut-nylon mooring have been tested over a period of 3-1/2 years.

The approach has resulted in an increasing reliability and life of the installations and recent designs have a useful life of at least six months when moored in the deep open sea and much longer in deep sheltered areas. Developments and results of tests are discussed. Complete construction drawings with notes on construction, installation, and servicing are included.

SIO REFERENCE SERIES

70 – 19

DEEP-MOORED INSTRUMENT STATION DESIGN AND PERFORMANCE

1967 – 1970

R.M. Born, D.M. Brown, J.D. Isaacs,
R.A. Schwartzlose, and M.H. Sessions

University of California   Scripps Institution of Oceanography

11 May, 1970

UNIVERSITY OF CALIFORNIA, SAN DIEGO
Scripps Institution of Oceanography

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Sponsored by:

The Office of Naval Research Contract NOOO 14-69-A-0200-6006

and

The State of California through the University of California's
Marine Life Research Program

SIO Reference 70-19
11 May, 1970

Approved for distribution:

W. A. Nierenberg, Director

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DEEP-MOORED INSTRUMENT STATION DESIGN AND PERFORMANCE

1967 - 1970

Abstract:

Deep-moored instrument stations that record oceanographic and meteorological data for long periods of time have been in use at Scripps Institution of Oceanography for a number of years. Recently the ability of these stations to survive very heavy sea conditions has been greatly improved and the data-recording capability enhanced and increased. Test moorings and operational deployments have shown that many stations will survive for periods of one year or more in the central North Pacific Ocean including the winter storm season. The designs are described, as well as results from extensive sea tests and actual operational deployment in the central North Pacific Ocean.

INTRODUCTION

Low-cost anchored instrument stations that record a number of parameters offer a very attractive method of gathering long time-series data from many locations simultaneously. Toward this end we have continued the development of deep-moored instrument stations. The first design started in the early 1950's using taut wire to a sub-surface float, a slack buoyant mooring pennant to the surface, and a small boat-shaped hull.[1,2] In the early 1960's we changed to the taut nylon mooring line attached directly to the surface catamaran hull.

Experience from these moorings indicated that a number of improvements were necessary. In particular, the flat catamaran float was ultimately susceptible to capsizal in heavy seas. The addition of ballast tanks improved the survival but did not prevent capsizal under extreme conditions. Also the sensor cables were manufactured at Scripps Institution of Oceanography using materials and techniques suitable for hand construction. While these cables performed well for 3-6 months, increased endurance was needed. It also became necessary to increase the number of parameters recorded and improve some of the sensors in accuracy, reliability, and life.

This latter development resulted in a design that is now used to collect data in the eastern North Pacific Ocean.[3,4]

BUOY HULL

The present design of the deep-moored instrument station is a result of experience gained over the past 18 years. The flat catamaran described in Reference 3 performed very well under all but the most severe sea conditions but, because of occasional capsizal in heavy weather, a float was designed with the property of righting from a completely inverted position.

The principal design requirements were:

1. A hull with the property of self-righting from a completely inverted position.
2. A mooring point located near the center of motion to reduce electrical conductor and mechanical termination failure.
3. A weight of less than 2,000 lbs (909 kilo) fully instrumented.
4. A beam of less than an 8-ft (2.33 m), for ease of highway transportation.
5. A hull suitable for boarding and service in moderately rough seas.
6. A system with an operational life of at least one year.
7. A hull easily constructed and repaired.
8. A system of low cost.
9. A hull that is unsinkable.
10. A hull with an undesirable and useless appearance.

The major concept change from the previous platform was the righting characteristic. The ballasted open catamaran was entirely satisfactory except in extreme weather. It was clear that the desirable high stability of such a water-plane shape as the catamaran could be incorporated with a self-righting superstructure, and the present design is a result of this marriage.

The cylindrical superstructure of the buoy makes a non-ballasted catamaran truly self-righting, and provides shelter for instruments and servicing personnel. The merits of this design were tested with a number of scaled models of existing buoy designs, some proposed designs, and the new covered catamaran configuration, which were constructed and anchored in the surf. The relative performance of these buoys operating simultaneously in breakers of catatrophic scale made it readily apparent that the new catamaran design was a remarkable performer under these extreme conditions.

A full-size [12 ft (3.66 m) in length] prototype buoy was then anchored in 3230 fathoms (5907 m) at Ocean Weather Station Victor (34° N, 164° E) to test the buoy hull and mooring system under adverse sea conditions (Fig. 1).* The buoy successfully withstood winds of over 90 knots (47 m/sec) simultaneous surface currents of 3 knots (1.5 m/sec), and seas of at least 40 ft (12 m) during a typhoon. It remained anchored for 7.5 months until it was inadvertently torn loose by a Japanese fishing trawler. Line tension

* A short motion picture of the buoy taken from the U. S. Coast Guard Cutter WACHUSETT at Ocean Station Victor during a gale is available.

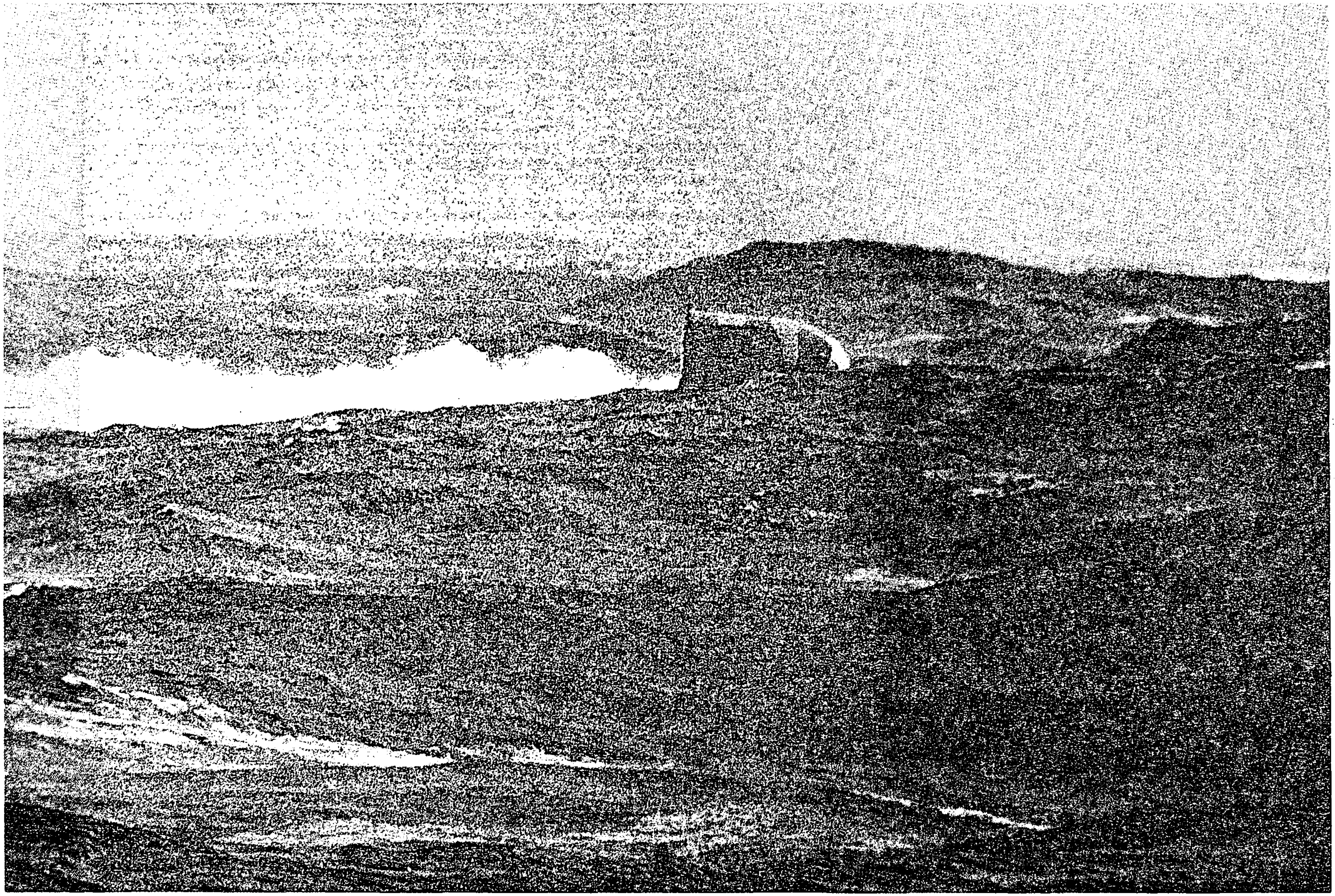

Figure 1. Test "Bumblebee" buoy at 34° N - 164° E, wind 45 knots (23 m/sec) and 20 ft (6 m) sea and swell. Photo from USCGC WACHUSETT.

records from this buoy affirmed that the principal stress on the mooring is caused by current drag on the mooring line. Also records of pitch and roll indicate that the buoy approximately follows the surface of the sea.

Two other buoys [14 ft (4.27 m) in length] were anchored 10 miles (16.1 km) off Monterey, California, in 1110 fathoms (1847 m) to test a boarding platform, instrumentation changes, and new instrument cable designs. One instrument cable parted due to fatigue failure of the strength member just below the float attachment point during a storm about one month after deployment and the buoy came ashore through the high surf landing unscathed on the beach. The other buoy was removed after 11.5 months for engineering analysis.

From these tests an operational float was designed with catamaran hulls [16 ft length (4.88 m)] including a 4-ft (1.2 m) boarding platform and covered over as shown in Figures 2 and 3. The covered portion provides excellent shelter for the instrumentation and the personnel servicing the buoy. Buoys of the present design are constructed of plywood, polyurethane foam, and fiberglass; are 16 ft (4.88 m) long; have an 8-ft (2.44 m) diameter; and displace 1800 lbs (816 kilo) fully instrumented. They soon became known as the "Bumblebee Buoys" due to their shape and colorful striped paint.

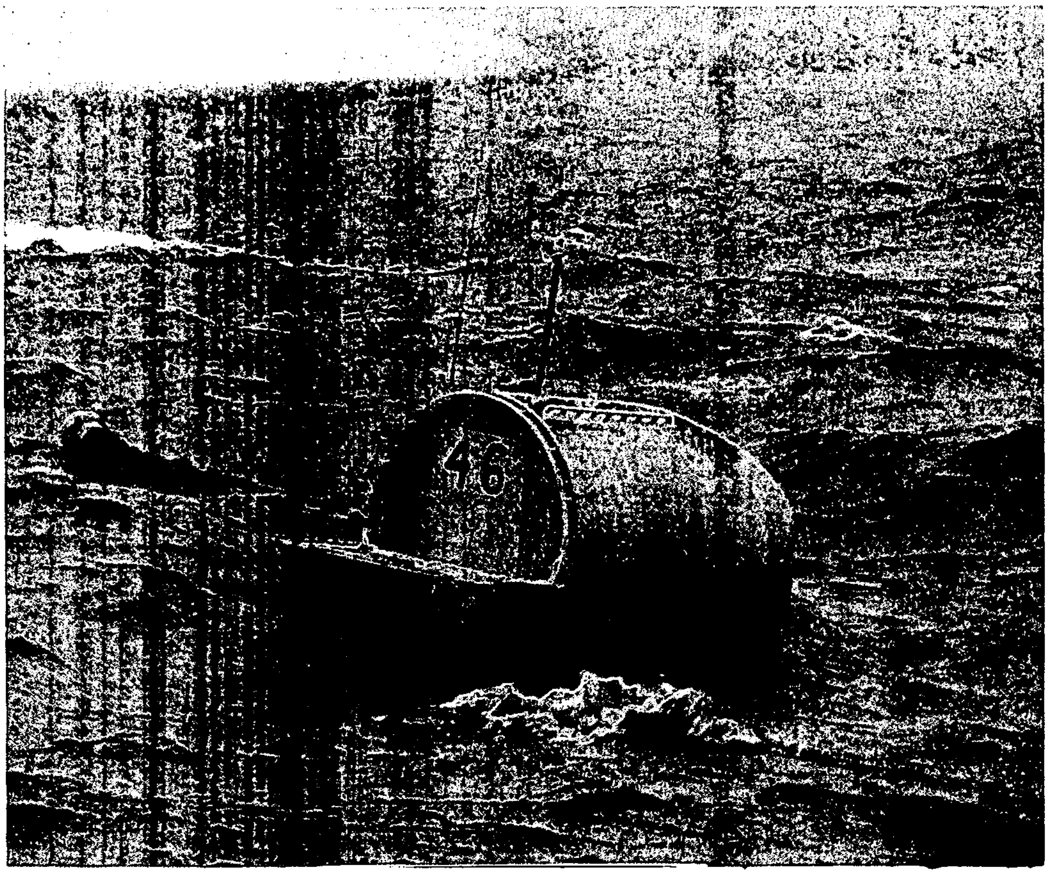

Figure 2. SIO "Bumblebee" buoy - moored.

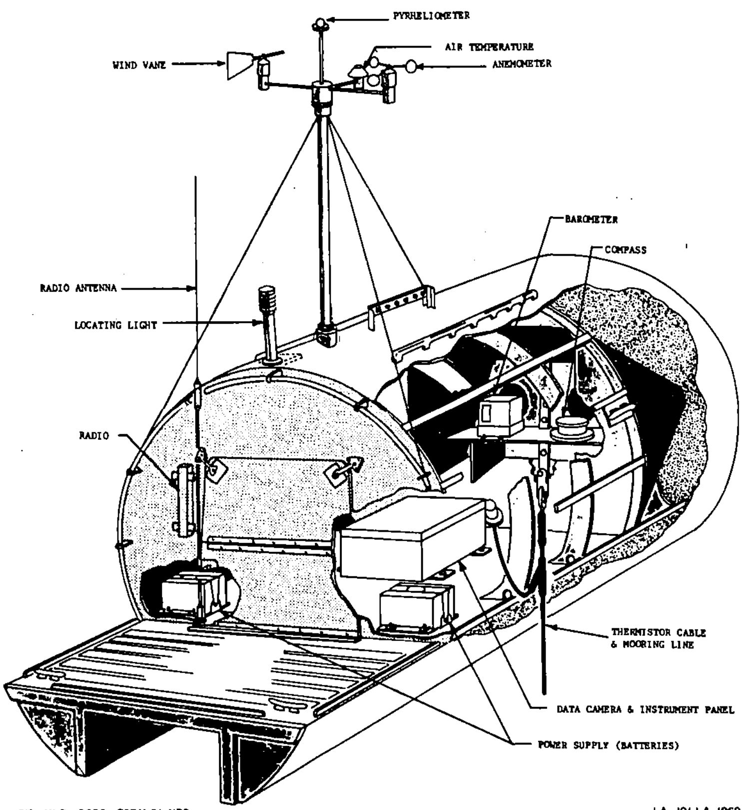

Figure 3. SIO "Bumblebee" buoy - cutaway diagram.

INSTRUMENTATION

Recording data by photographing meters has been used in our buoys with good results for a number of years.[3] This technique is simple, low cost, and reliable. While other techniques appear attractive it was decided to continue this proven technique until we had solved a number of the other more pressing problems such as extended survival of the float, sensor cable, and mooring line.

Our data requirements made it necessary to increase the number of data channels to twenty and the capacity of the film magazine to six months at a rate of one frame per hour. This was accomplished by utilizing a simple 35 mm electrically-driven camera with a capacity for 200 ft (61 m) film spools. By using four mil thick Estar-based film, 250 ft (76 m) could be loaded onto a standard 200-ft (61 m) spool. Also, by using smaller diameter instrument meters [2.5-inch (64 mm)], a format of 20 dials was layed out which allowed 4300 data frames to be taken per 250 ft (76 m) roll of film.

The recording system was housed in a water-tight aluminum case along with all signal conditioning and control systems. As shown in Figures 4 and 5, the data camera at one end of the housing faces a spherical section panel containing display meters and counters. On receipt of a contact closure from the panel-mounted Accutron clock, a picture-taking sequence is initiated. This begins by turning on power to all instruments for 10 seconds to allow the heavily-dampled instrument meters to reach equilibrium. At the end of the 10-second period, a group of incandescent lamps are turned on for two seconds exposing the film. (For simplicity, no shutter is used in the camera.)

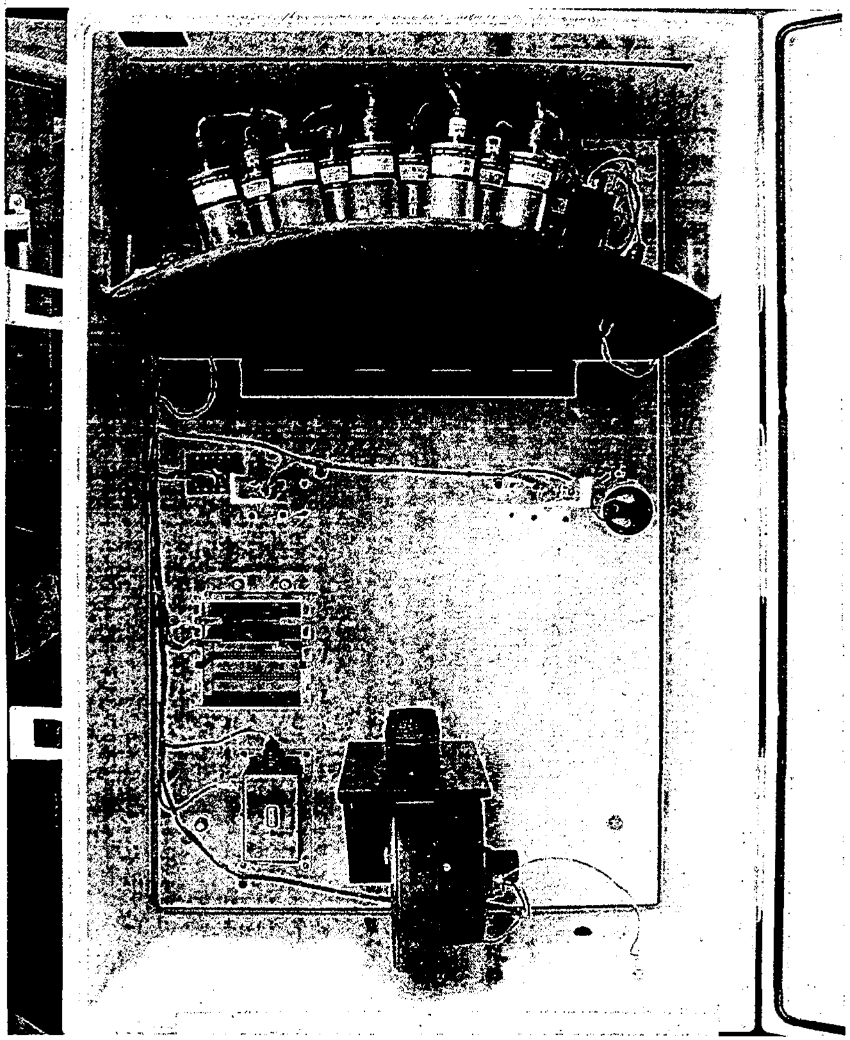

Figure 4. Interior of the instrument box.

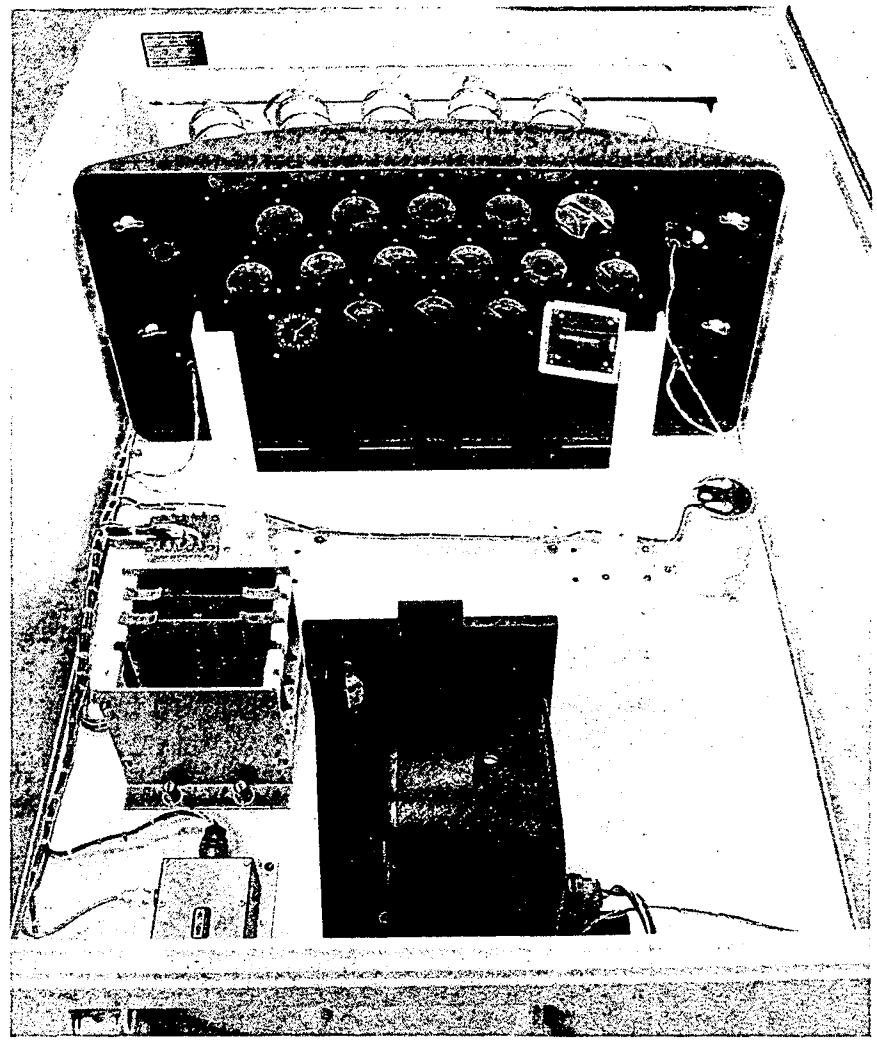

Figure 5. Interior of the instrument box.

As soon as the lamps turn off the film is advanced to the next frame; then the entire system is turned off until another initiative pulse is received from the clock. This method uses a minimal amount of power (approximately 180 mw average). A typical data photograph is shown in Figure 6.

The signal-conditioning circuitry for each meter is mounted in a sealed cylinder attached to the rear of the meter to form a self-contained package. Only power and sensor connections are required to each unit for proper function.

The present design records 9 sea-water temperatures to 300 m depth, pressure measurements at 150 m and 300 m, air temperature, wind speed and direction, wind transport, insolation, barometric pressure, buoy heading, line tension, battery voltage, and date-time (GMT).

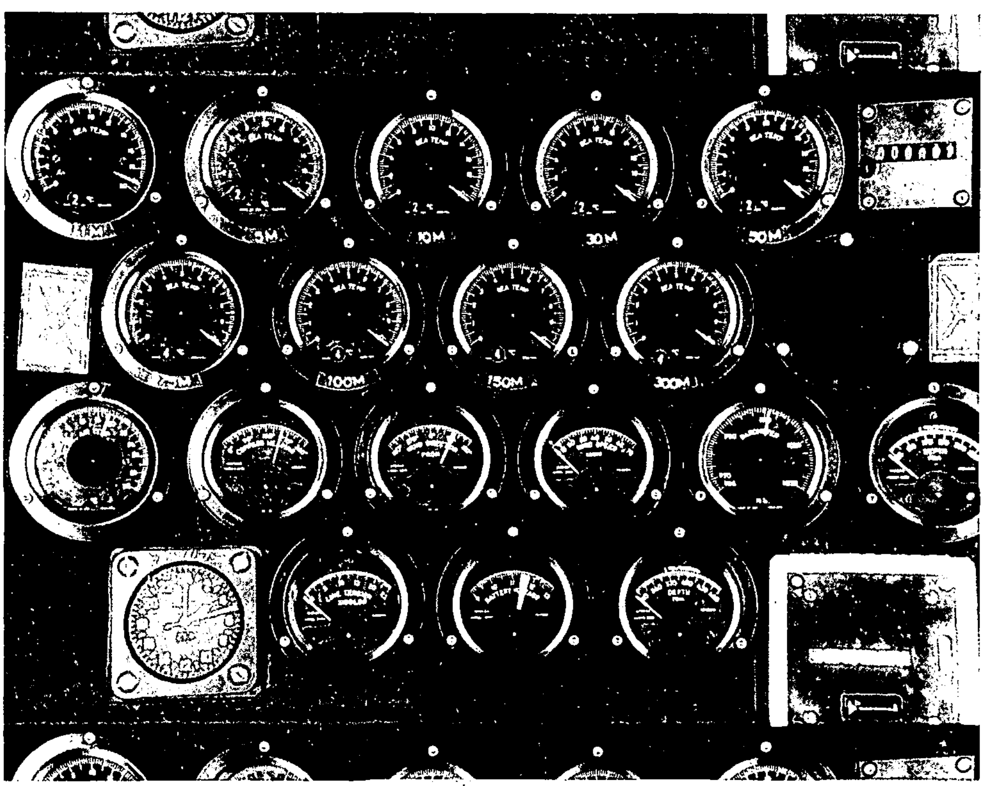

Figure 6. Close-up of the instrument box.

SENSOR CABLE ASSEMBLY

The sensor cable was initially identified as one of the critical problem areas. Past cables were handmade at Scripps using neoprene and rubber-covered cadmium bronze conductors. This wire has been a standard single-conductor wire used by many underwater plug manufacturers for a number of years. In field experience most of these cables failed within six months. Examination of these failures showed that water had penetrated the insulation at a number of points and corroded through the conductor causing an open circuit to the sensor. One attempt to correct this was to jacket the wire again with a polypropylene jacket. This was not considered a satisfactory solution because the wire became too stiff, bulky, and the overall diameter of the cable was increased.

The sensor cable that is now used was designed to take advantage of modern thermoplastic materials and manufacturing. Thermistor breakouts were completely eliminated by placing the snesors inside the cable and extruding a tough polyurethane jacket over the terminated sensor. This is feasible because the thermistors are small and can be placed inside the cable assembly prior to jacketing with no increase in cable diameter (Fig. 7). The sensors are potted onto their respective conductor wires and the entire assembly, as well as each component is water blocked with a deploymerized rubber compound. The water-tight integrity of all electrical wiring is thus double protected and not dependent entirely on the outer jacket, which is primarily a mechanical protection for the conductors. The cable is also tapered 40 - 50% in diameter as fewer conductors continue down the entire cable length. Considerable reduction in weight and drag result from using this technique, as well as substantial reduction in average diameter particularly when large numbers of temperature sensors are located at shallow depths. The present cable length is 300 meters and in most thermistors are located 1, 5, 10, 30, 50, 75, 100, 150, and 300 meters below the surface. The time constant for each thermistor is approximately two minutes. There are two breakouts for pressure transducers on the cable at 150 meters and at 300 meters depth.

This basic cable design has been in use since February, 1967 and has proven very dependable and long lasting. Several cables have been in use since October, 1968, to the present (April, 1970) with all but one or two thermistors still functioning.

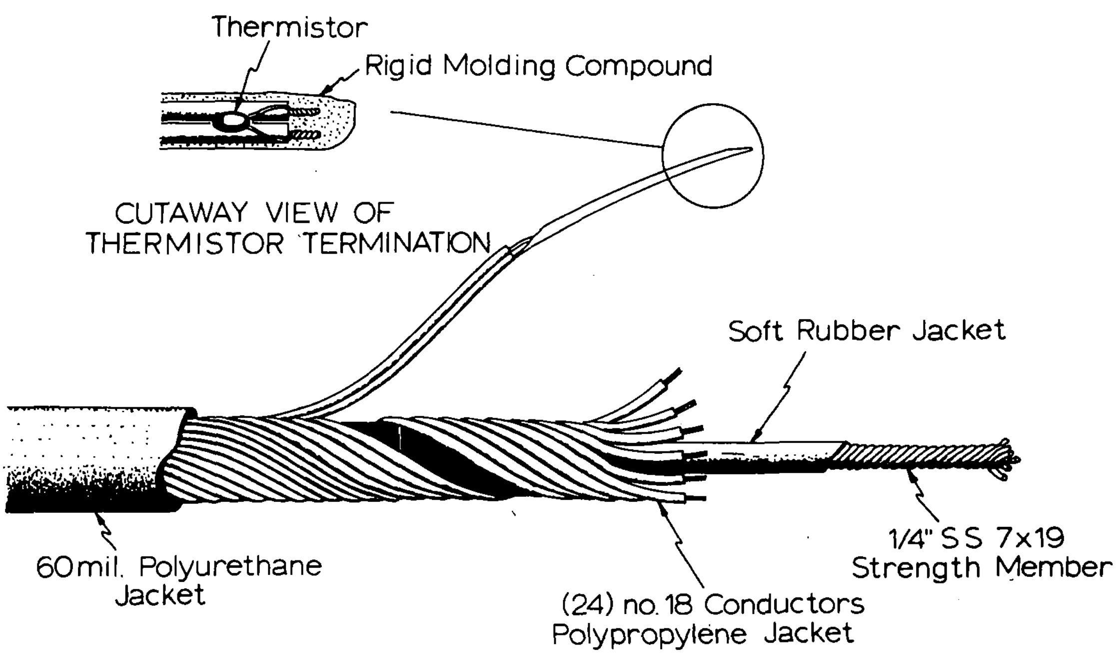

Figure 7. Instrument cable - cutaway diagram.

MOORING SYSTEM

The sensor cable extends down from the surface float to a depth of 300 meters. Below the sensor cable to the anchor on the ocean floor, nylon line serves as the mooring component. This is shown schematically in Figure 8. The mooring line is standard 3-strand gold nylon of 9/16" (14.5 mm) diameter. This construction can be used because tension is always maintained on the mooring line and the surface float is directionally oriented thus preventing spinning. A 1262 ft (385 m) portion of the nylon line just below the sensor cable is jacketed with polyurethane to help resist fishbite. Evidence collected from earlier tests suggested that a tough plastic jacket placed over the nylon would greatly reduce failures due to fishbite.[(4)]

The mooring is installed with a static tension by employing a mooring line that is 10 percent shorter than the corrected measured depth. This tends to keep the surface buoy in a small diameter circle, and reduces dynamic forces due to slackening of the line, and provides other desirable characteristics. The static tension measured from a number of buoys has averaged about 500-700 lbs (227-308 kilos) including sensor cable weight of 300 lbs (136 kilos). Tension is very sensitive to current speed. In fact, semidiurnal and inertial period oscillations have frequently been measured by the line tension.

The ground tackle consists of a dead weight anchor and a drag anchor. The large anchors are usually 55 gal (209 liters) oil drums filled with used anchor chain and concrete to yield a weight of 1000 lbs (454 kilos) or more in sea water. This type of anchor is very inexpensive and has proven satisfactory in a large number of moorings. The drag anchor is a 25-lb (11.3 kilo) Danforth type attached to the main anchor by 20 ft (6 m) of 3/8" (10 mm) galvanized chain.

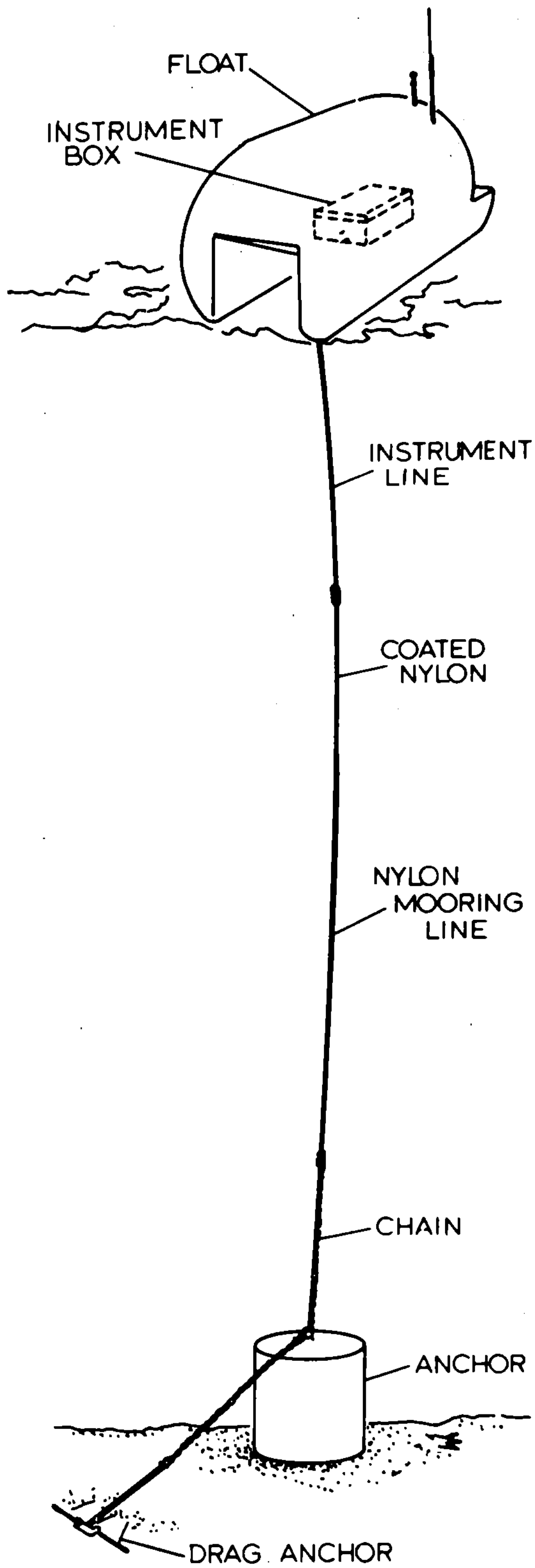

Figure 8. Taut-nylon Bumblebee mooring.

RESULTS

The results of the latest-designed deep-moored instrument station have demonstrated that it is feasible to collect year-long time series of both meteorologic and oceanographic data in open stormy seas.

Table 1 is a summary of all the bumblebee catamaran moorings that we have anchored to date. This table shows that out of 19 moorings 9 are still anchored or were removed after their term of usefulness expired. Of the 10 moorings that ultimately failed:

- one had its mooring line cut by a Japanese fishing vessel (#31),
- one had a construction defect in the instrument line (#34),
- one had a broken mooring plate in the buoy due to vibration fatigue (#42),
- one had the mooring eye on the float come loose because the cotter key was not inserted to lock the nut in place (#32), and
- six were lost through unknown causes.

Seven moorings remained anchored for more than 11.5 months, two of these for 18 months. Table 2 contains details for each mooring location, mooring depth, dates, type of mooring line and instrumentation. (Table 2 is located at the end of this report.)

The floats and mooring system have survived a wide variety of sea and weather conditions. One catamaran float has survived typhoon winds and seas in the western North Pacific, and another stayed anchored through the 1968-69 winter after nearly total distruction

Table 1. Bumblebee catamaran mooring summary.

Buoy number	Known period moored	Remarks
31	7.5 months	Mooring line cut by Japanese trawler
32	0 "	Mooring failed on the day after it was anchored
33	3 "	Adrift
34	1 "	Cable fatigue failure near attachment point
35	11.5 "	Removed
36	2 "	Removed
38	18 "	Removed
39	12 "	Not found in December, 1969[1,2]
40	14 "	Not found in April, 1970
41	8 "	Removed[1,2]
42	12 "	Found adrift near Kodiak Island[2]
43	3 "	Adrift[2]
44	0 "	Never sighted or reported after mooring day[3]
45	13 "	Removed[2]
46	12 "	Still moored
47	0 "	Never sighted or reported after mooring day
X47	4 "	Removed
48	0 "	Not visited since moored in April, 1970
49	0 "	Not visited since moored in April, 1970

[1] All instruments stolen.

[2] Damaged by a ship other than servicing ship.

[3] May have been carried away by the dragging BRAVO buoy.

Note: There was no #37 bumblebee mooring.

of the upper shell (Fig. 9). Six moorings remained anchored during the 1968-69 winter and two moorings were operating after two central North Pacific winters. One float remained anchored two months, before it was removed, in the Gulf Stream off Florida and experienced 3- to 4-knot (150-200 cm/sec) currents and 80-knot winds from the south (this was not an SIO mooring but was our hull design).

The floats that remained anchored from 14 to 18 months and which had not been damaged by ships or people are in excellent condition. There are large numbers of barnacles covering the hulls but otherwise the fiberglass, plywood, and foam show little sign of deterioration.

One of the ma or problems, which most likely has contributed to losses, is from ships and people other than our own. Five moorings out of nine anchored at least a year ago in the central North Pacific are known to have been boarded and extensively damaged; two had their instruments stolen. In some cases it appears that personnel aboard a ship have attempted unsuccessfully to retrieve the float with all its instruments without cutting the anchor line. The North Pacific Study Cruise 3 Report details two incidents where the buoys have been extensively damaged. Figure 9 is a picture of the remains of a catamaran float found on Cruise 2 where all the instruments had been stolen and an attempt was probably made to retrieve the float. Buoy #39 is reported as follows:

> "On approaching the buoy, rather extensive damage was observed. There was a large gash in the starboard bow, a large hole in the overhead, and deep scuffs along the whole starboard side. On

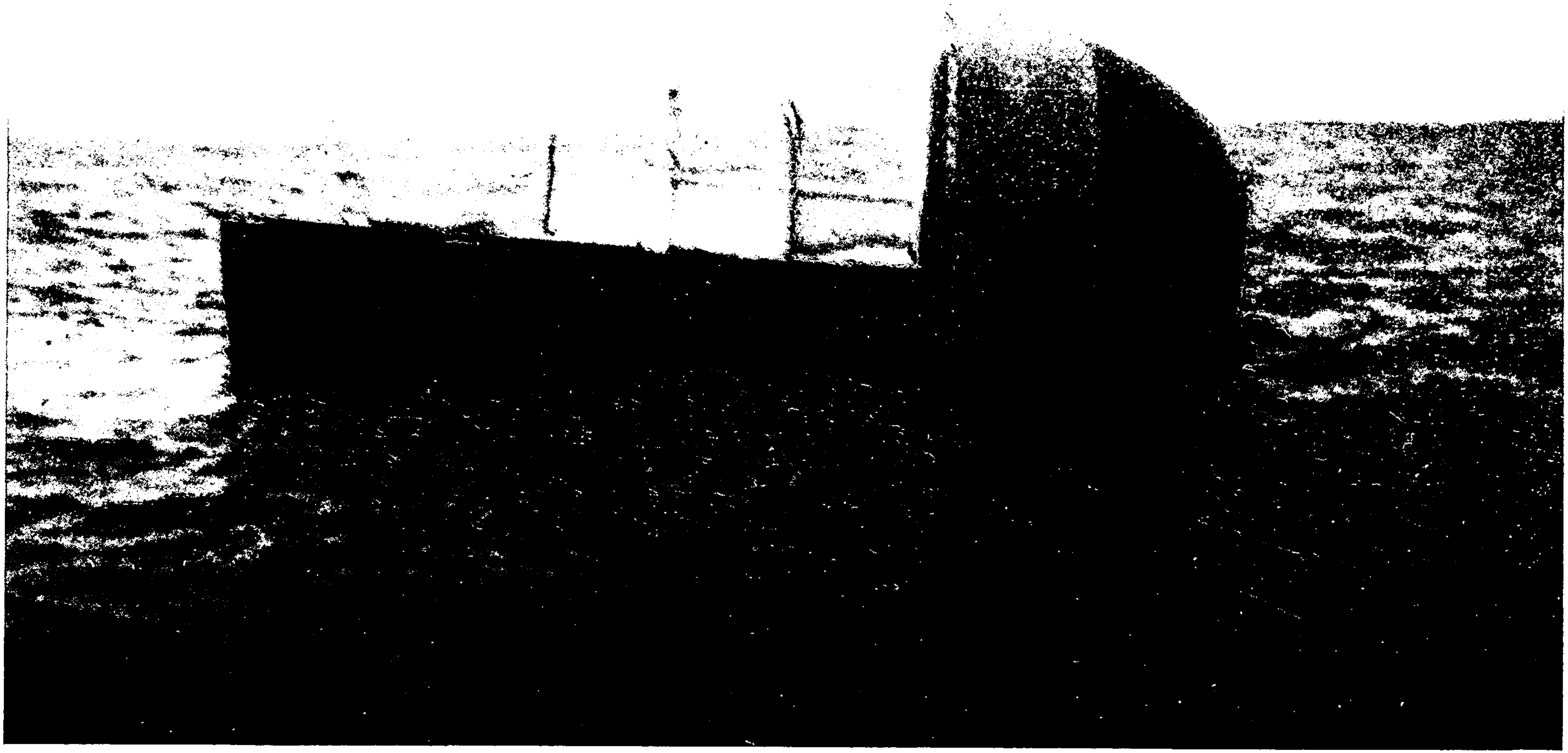

Figure 9. Damaged buoy - instruments had been stolen.

boarding it was found that all instrumentation had been stolen The crushed radar reflector was found inside the buoy. The reflector had been driven through the buoy skin leaving a large hole."

We have tried to reduce the pilfering by leaving a supply of complete drawings concerning the system with an invitation to take a set of drawings rather than the instruments.

The instrument cables have operated remarkably well. Table 3 lists the number of thermistors operating at the end of the mooring or when it was last visited.

Analysis of the test cable (#35) after 11.5 months at sea showed that the cause of open circuits was due to the sealing compound at the thermistors. This was not strong enough to provide adequate mechanical support for the very fine wires that attach to the thermistor head. The moorings #38 through #46 employed this type of sealing compound at the thermistors. In all cables after mooring #46 a higher strength potting compound has been used, but no data are yet available on this most recent cable design. Most of the five short circuits in one cable occurred simultaneously as determined from data analysis. This cable was not recovered, and the cause remains unknown. It is possible that a fish bite could have caused a water leak. The recently recovered mooring #38 shows evidence of fish bites on the instrument cable but these do not penetrate to the conductor wires.

All but one of the pressure-measuring devices at 150 m and 300 m failed in less than 100 days (Table 4). The cause is not known. When

Table 3. Thermistors operating for the duration of the installation and cause of failures.

Buoy	Number of operating thermistors	Number and cause of failures	Period of mooring
#35*	6	3 open circuit	11.5 months
#38	2	7 open circuit	14 "
#39	7	2 open circuit	2 "
#40	8	1 open circuit	14 "
#42	2	5 short circuit 2 open circuit	12 "
#45	7	2 open circuit	18 "
#46	9	0	12 "
7	41	22	83.5

* Original test cable.

mooring cable #38 is returned it is hoped that an analysis will shed some information on these failures.

The five meteorological sensors have produced some interesting results and have operated very well except for the wind speed and barometer. The anemometer has repeatedly failed very quickly after being installed during each servicing cruise. The barometers all failed, primarily due to vibration.

The electronics and the indicator meters inside the instrument box have operated with almost no failures. The greatest loss of data was caused by camera failures due to a faulty mechanical method for turning off the camera when it advanced a frame. This has been corrected and subsequent tests have shown the camera can cycle 50,000 times without a failure.

The processed data from all our moored buoys have shown many interesting features such as large, long-term temperature inversions, inertial oscillations, very large temperature changes occurring in periods of a week to three weeks, the usual semidiurnal internal waves, and the nature of seasonal heating and cooling. The processed data have been distributed in two volumes with a third volume in preparation.[4,5]

Table 4 tabulates the number of days of acceptable data for each parameter taken by the North Pacific Study buoys. It also shows the cause of each failure. With the problem corrected in the camera and the change in design of the thermistor attachment, future loss of data from instrument failure should be minimal.

Two examples of the processed data are shown in Figures 10 and 11.

Calibration studies of most sensors have been carried out on each

Table 4. Number of days of acceptable data for North Pacific Study buoys processed through December, 1969.

Buoy number		38	39	40	42	45	46
Wind direction		269[1]	57[1]	155[1,5]	135[1,2]	230[2]	80[1]
Wind speed		204[1,2]	12[2]	65[1,2,5]	128[1,2]	73[2]	17[2]
Wind transport		162[2]	12[2]	65[1,2,5]	128[1,2]	25[3,4]	0[4]
Air temperature		269[1]	57[1]	155[1,5]	205[1,2]	107[2,6]	80[1]
Buoy heading		269[1]	57[1]	155[1,5]	296[1]	321[1]	80[1]
Barometer		207[1,2,3]	57[1]	25[1,2,3,5]	107[2,3]	108[2,3]	0[7]
Pyrheliometer		229[1,3]	57[1]	155[1,5]	105[2,3]	119[2]	80[1]
Pressure at 150 m cable length		165[1,2]	7[2]	101[1,2,5]	30[2]	46[2]	24[1,2]
Pressure at 300 m cable length		165[1,2]	17[2]	95[1,2]	30[2]	34[2]	24[1,2]
Line tension		0[2]	0[2]	19[1,2]	194[1,2]	21[2]	37[1,2]
Water temperature	1 m	36[1,2,4]	57[1]	155[1,5]	194[1,2]	242[1,6]	80[1]
" "	5 m	165[1,2]	13[2]	155[1,5]	296[1]	321[1]	42[1,4]
" "	10 m	165[1,2]	18[2]	155[1,5]	0[2]	47[3]	80[1]
" "	30 m	207[1,2]	0[4]	155[1,5]	89[2]	321[1]	80[1]
" "	50 m	269[1]	57[1]	155[1,5]	30[2]	218[1,3]	80[1]
" "	75 m	269[1]	57[1]	155[1,5]	30[2]	321[1]	80[1]
" "	100 m	207[1,2]	57[1]	155[1,5]	30[2]	124[3]	80[1]
" "	150 m	170[1,2]	57[1]	155[1,5]	296[1]	79[2,3]	80[1]
" "	300 m	137[2]	57[1]	2[2]	141[2]	0[2]	80[1]
1 m lag temperature							8[1,4]
5 m lag temperature							80[1]
Total available data days		422	61	428	374	416	208

Cause of lost data

1. Camera failure
2. Sensor failure
3. Sensor or indicator removed and not replaced
4. Indicator failure
5. Timing failure
6. Indicator not readable on film
7. No sensor

cruise. The water temperature thermistors have been calibrated against Nansen casts, TDS, and XBT's, and have shown that calibrations do not detectably change. After a year, the system remains accurate within 0.1 or 0.2° C, which is the limit of our film recording, and is adequate in the upper layers of the ocean.

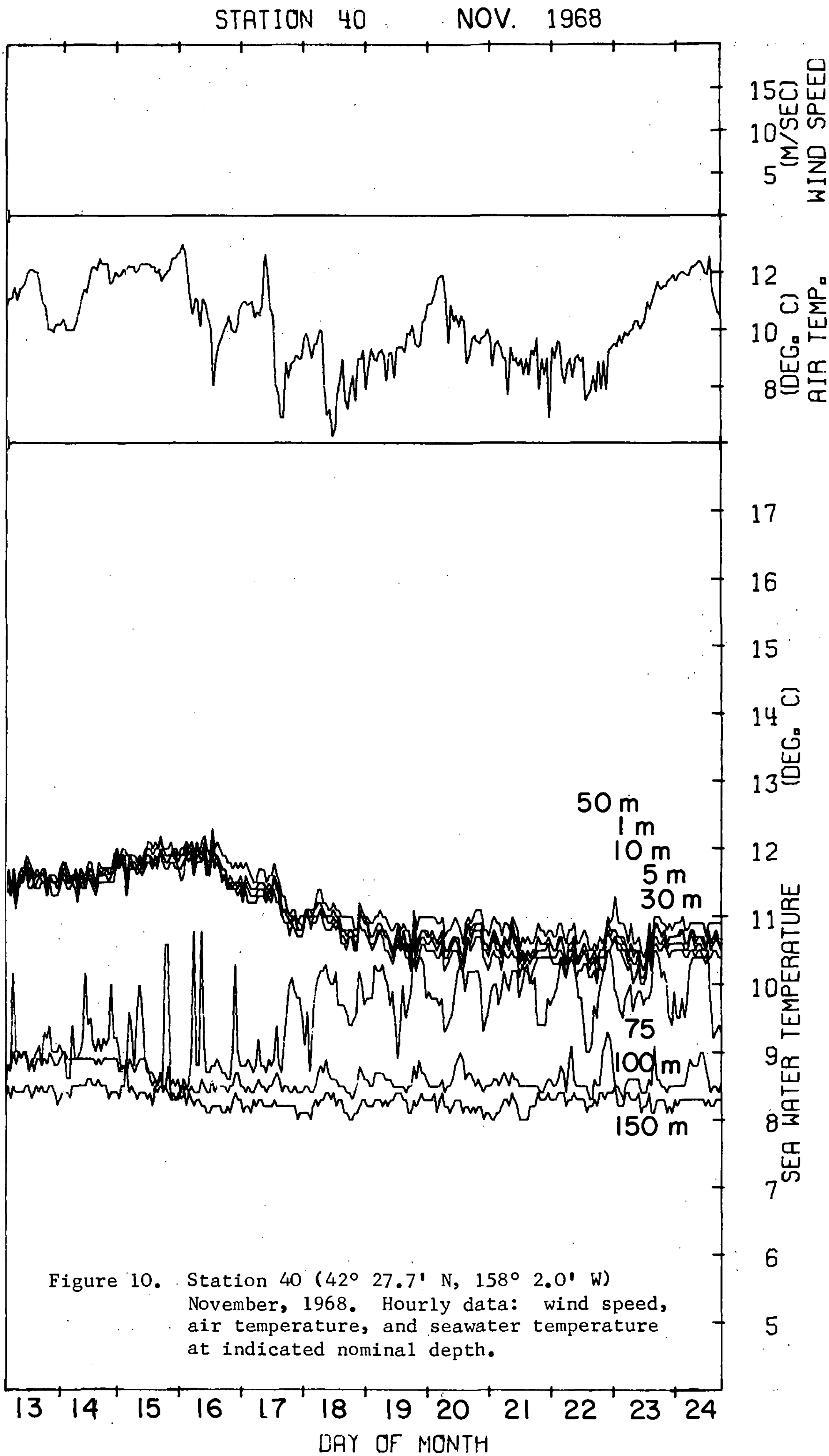

Figure 10. Station 40 (42° 27.7' N, 158° 2.0' W) November, 1968. Hourly data: wind speed, air temperature, and seawater temperature at indicated nominal depth.

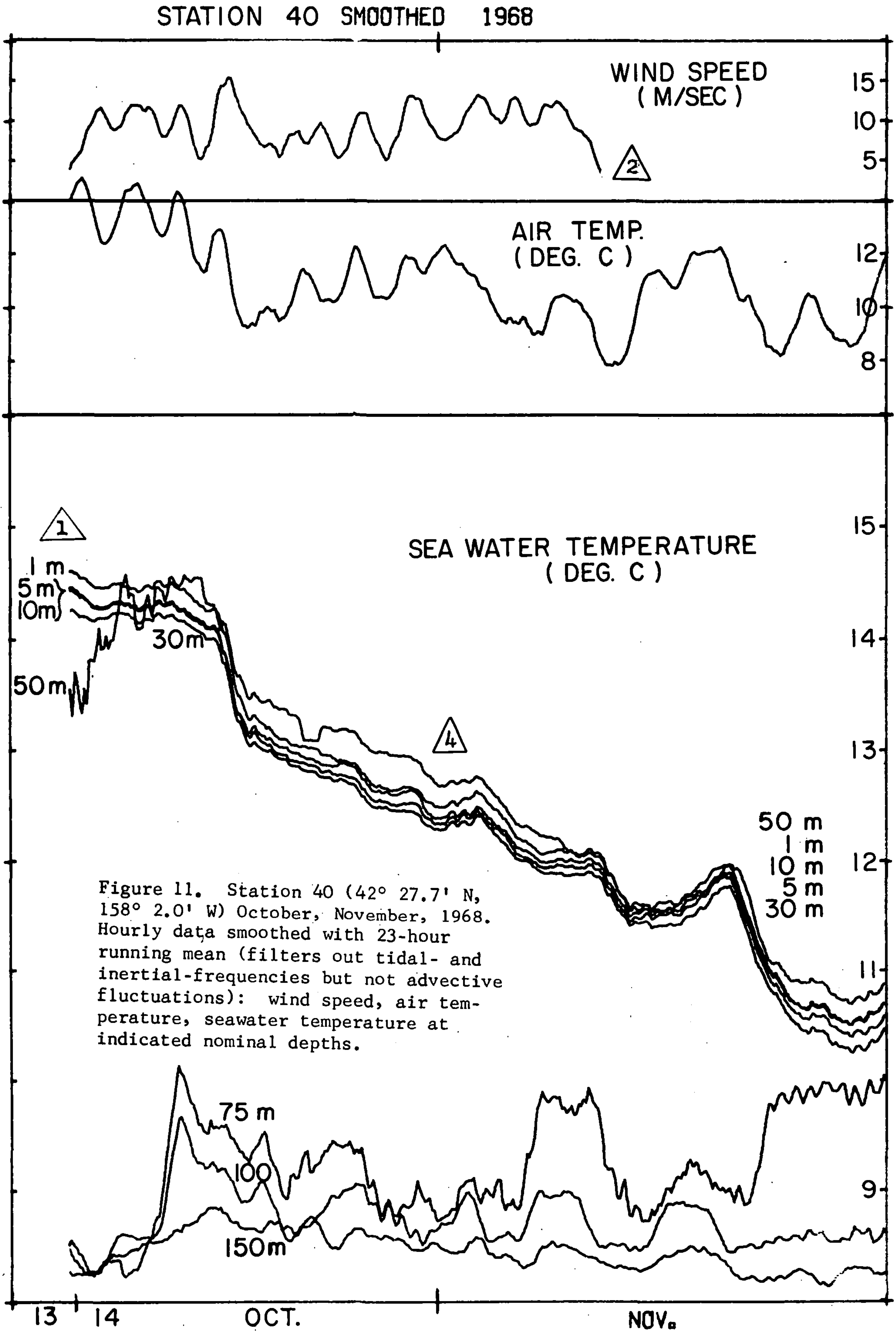

Figure 11. Station 40 (42° 27.7' N, 158° 2.0' W) October, November, 1968. Hourly data smoothed with 23-hour running mean (filters out tidal- and inertial-frequencies but not advective fluctuations): wind speed, air temperature, seawater temperature at indicated nominal depths.

FUTURE PLANS

Some of the plans for deep-mooring improvements include improved sensors, the testing of a 20-ft (6 m) bumblebee buoy with instrumentation to collect BT type data, digital acquisition system, and power generation to charge batteries.

Improved sensors, especially barometer, wind speed, and a new model instrument cable are presently being tested on the buoys in the North Pacific Study.

The winching and recording system for the continuous profiler was recently tested aboard a 20-ft (6 m) bumblebee buoy, anchored six miles off Scripps. It had on board a small specially-designed winch and the necessary electronics, battery power, and wind-mill power alternator to lower and retrieve temperature and depth sensors to 100 meters. Our first experiments were to determine if tangling of the anchor wire and profiler wire were a problem. The tests indicated that this would not normally be a problem and that if it occurred the design allowed the wires to untangle as the wire was retrieved. This system was automatically cycled four times a day. To our knowledge tangling never occurred naturally, although the wire was purposely tangled many times, with automatic untangling always taking place. Over 100 temperature-depth records were obtained. A progress report is in preparation on the design problems and tests related to the automatic continuous profiling buoy system. The design of the digital acquisition system is now going ahead since it appears that the system will work well. It is expected that a test system winch and digital acquisition equipment will be moored in August or September, 1970. A completely adequate power source for the winch remains a problem. At present we are using a wind-powered alternator, which is adequate most of the time. The power required for the data acquisition system will be no more than our present film recording system. It is apparent that these small, durable buoys could handle equipment designed to radio data collected each day thousands of miles to Scripps via satellite.

ACKNOWLEDGEMENTS

The development of the deep-moored instrument stations is supported by the Office of Naval Research (Contract N000 14-69-A-0200-6006) and the State of California through the University of California's Marine Life Research Program. The authors wish to acknowledge the assistance of Phillip Marshall, Richard Shutts, John Russell, Loren Haury, Solomon Rothkopf, and Robert Gould for their many contributions to design and development of the mooring system and instrumentation. We also wish to acknowledge the operational assistance of the U. S. Coast Guard for providing ship support for field operations in the Scripps North Pacific Study and especially to Commander Arthur Morrison, Captain, and to the Officers and men of the USCG Cutter ACUSHNET.

Installation and servicing of instrument stations were performed by the SIO North Pacific Study Operations section including Robert Huffer, Durrant Kellogg, James Costello, David Muus, John Davis, James Schmitt, and Al Crozier.

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Table 2. Data for Bumblebee moorings.

	#31	#32
DATE MOORED	September 25, 1967	October 14, 1967
LOCATION	34° 03' N, 163° 59' E	30° N, 140° W
DEPTH	3230 fathoms (5907 m)	2288 fathoms (4184 m)
MOORING LINE	1/2" 3 strand gold nylon (12.7 mm) dia. 1262 ft (385 m) polyurethene jacketed nylon	1/2" 3 strand gold nylon (12.7 mm) dia. 1262 ft (385 m) polyurethene jacketed nylon
INSTRUMENT LINE	1/4" (6.35 mm) SS cable, 1493 ft (455 m)	1493 ft (455 m) 1/4" (6.35 mm) SS cable with transducer breakouts at 500' (152 m), 1000' (305 m), and 1500' (457 m)
INSTRUMENTATION	Rustrak Recorder, buoy pitch and roll, line tension, and battery voltage	Time and day, relative wind direction and wind speed, pressure transducers at 500' (152 m) and 1000' (305 m) depths, mooring line tension, pitch roll, and battery voltage
MOORING SHIP	USCGC WACHUSETT	USCGC TANEY
LAST SIGHTED	Removed May 8, 1968	October 15, 1967
LENGTH OF KNOWN TIME MOORED	7 months	1 day
REMARKS	1. First of 2 prototype bumblebee catamarans. Constructed by Sea R and D Co. 2. Line cut by Japanese longline boat.	1. Mooring eye on the float came loose because the cotter key was not inserted to lock the nut in place.
KNOWN MAXIMUM WEATHER CONDITIONS	90 knot winds (47 m/sec), 45 ft (14 m) seas during a typhoon, ~ 3 knot currents.	

Table 2 (continued)

	#33	#34
DATE MOORED	February 13, 1968	February 15, 1968
LOCATION	30° 02' N, 139° 56' W	36° 39.7' N, 122° 07' W
DEPTH	2350 fathoms (4298 m)	1110 fathoms (1847 m)
MOORING LINE	1/2" 3 strand gold nylon (12.7 mm) dia.	1.2" 3 strand gold nylon (12.7 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	1493 ft (455 m) 1/4" (6.35 mm) SS cable with transducer breakouts at 500' (152 m), 1000' (305 m) and 1500' (457 m)	Prototype thermistor cable mfg. by Global Oceanographic, 500 m length 10 thermistors, 1 pressure transducer
INSTRUMENTATION	Time and day, relative wind direction and wind speed, pressure transducers at 500' (152 m) and 1000' (305 m) depths, mooring line tension, pitch roll, and battery voltage	10 sea temperatures, line depth, line tension, wind speed and direction, barometric pressure, compass reading, air temperature, battery voltage, time, insolation
MOORING SHIP	USCGC TANEY	OCEANEER
LAST SIGHTED	May 7, 1968	March 19, 1968 - still moored March 21, 1968 - sighted at Fort Ord, Monterey Bay, beached
LENGTH OF KNOWN TIME MOORED	3 months	1 month
REMARKS	1. Mooring #32 was the same float as #33. 2. Second of 2 prototype bumblebee catamarans. Constructed by Arben Marine Co. 3. Buoy has been sighted adrift several times.	1. Built by SIO's Marine Facility. 2. Tested newly designed meteorological sensors and mast and a newly developed barometer. 3. Tested prototype electronic thermometer mfg. by Burnett Electronics and Oceanic Enterprises. 4. Tested Accutron clock with days register in clock. 5. Tested Epply Pyroheliometer. 6. Tested 12" (30.5 cm) radar reflector. 7. Fatigue failure of the strength member in the instrument cable just below float attachment point caused the float to break loose
KNOWN MAXIMUM WEATHER CONDITIONS	Spring conditions at 30° N	43 knots (22 m/sec) winds recorded on buoy #35

Table 2 (continued).

	#35	#36
DATE MOORED	February 15, 1968	April 24, 1968
LOCATION	36° 39' N, 122° 07.2' W	32° 54.7' N, 117° 21.5' W
DEPTH	1134 fathoms (2074 m)	320 fathoms (586 m)
MOORING LINE	1/2" 3 strand gold nylon (12.7 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon	1/2" 3 strand gold nylon (12.7 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	Prototype thermistor cable mfg. by South Bay Cable, 500 m length. 10 thermistors, 1 pressure transducer	None
INSTRUMENTATION	10 thermometers, 1 depth, line tension, wind speed and direction, compass heading, air temperature, time, battery voltage, insolation	None
MOORING SHIP	OCEANEER	WANDO RIVER
LAST SIGHTED	Removed January 27, 1969	Removed June 24, 1968
LENGTH OF KNOWN TIME MOORED	11 months	2 months
REMARKS	1. Built by SIO's Marine Facility. 2. A General Instrument C. thermo-electric generator was tested. 3. 24-inch radar reflector was tested. 4. Tested prototype electronic thermometer mfg. by Ocean Applied Res. and Burnett Electronics. 5. Tested Hy-Cal pyroheliometer.	Experimental test mooring.
KNOWN MAXIMUM WEATHER CONDITIONS	43 knots (22 m/sec) winds recorded, two winters off Monterey, California	

Table 2 (continued).

	#38	#39
DATE MOORED	October 9, 1968	October 11, 1968
LOCATION	42° N, 164° 00.1' W	42° 55.7' N, 158° 12.0' W
DEPTH	2945 fathoms (5486 m)	2910 fathoms (5222 m)
MOORING LINE	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	South Bay Cable Co., Model #2 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m. Pressure transducers at 150 and 300 m.	South Bay Cable Co., Model #2 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m. Pressure transducers at 150 and 300 m.
INSTRUMENTATION	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)
MOORING SHIP	USCGC ACUSHNET - WAGO 167	USCGC ACUSHNET - WAGO 167
LAST SIGHTED	Removed April 21, 1970	October 1, 1969
LENGTH OF KNOWN TIME MOORED	18 months	12 months
REMARKS	1. Instruments removed December 5, 1969. 2. Mooring could not be recovered because of weather. 3. Mooring #47 replaces #38.	1. May 29, 1969, buoy was found to have had all external and internal instruments stolen and extensive damage to the hull. 2. Buoy not found in December, 1969.
KNOWN MAXIMUM WEATHER CONDITIONS	52 knots (27 m/sec) winds recorded two winters in central North Pacific.	35 knots (18 m/sec wind recorded (record incomplete) one winter in central North Pacific.

Note: There was no #37 bumblebee mooring.

Table 2 (continued)

	#40	#41
DATE MOORED	September 21, 1968	October 11, 1968
LOCATION	42° 27.7' N, 158° 02.0' W	42° 55.1' N, 157° 46.8' W
DEPTH	3050 fathoms (5578 m)	2850 fathoms (5212 m)
MOORING LINE	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	South Bay Cable Co., Model #2 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m. Pressure transducers at 150 and 300 m	SIO hand made sensor cable, 50 m length Thermistors at 1, 2.5, 5, 10, 15, 20, 30, 40, and 50 m
INSTRUMENTATION	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)	9 sea water temperatures, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)
MOORING SHIP	USCGC ACUSHNET - WAGO 167	USCGC ACUSHNET - WAGO 167
LAST SIGHTED	November 22, 1969	Removed June 4, 1969
LENGTH OF KNOWN TIME MOORED	14 months	8 months
REMARKS	1. Not found in April, 1970.	1. December 6, 1968. All instruments had been stolen and the hull was badly damaged, apparently by a ship.
KNOWN MAXIMUM WEATHER CONDITIONS	45 knots (23 m/sec) wind record (record incomplete) 2 winters in central North Pacific	One winter in central North Pacific

Table 2 (continued).

	#42	#43
DATE MOORED	September 19, 1968	September 27, 1968
LOCATION	43° 35.6' N, 157° 48.6' W	35° 05' N, 157° 49.0' W
DEPTH	2925 fathoms (5349 m)	3130 fathoms (5724 m)
MOORING LINE	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	South Bay Cable Co., Model #2 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m Pressure measured at 150 and 300 m	South Bay Cable Co., Model #2 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m Pressure tranducers at 150 and 300 m
INSTRUMENTATION	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year and time (GMT)	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)
MOORING SHIP	UXCGC ACUSHNET - WAGO 167	USCGC ACUSHNET - WAGO 167
LAST SIGHTED	September 27, 1969	December, 1968, by merchant ship
LENGTH OF KNOWN TIME MOORED	12 months	3 months
REMARKS	1. Not found in December, 1969. 2. Found adrift and recovered by fisherman near Kodiak Island, Alaska, April, 1970. 3. Mooring plate in the buoy broken from vibration fatigue.	1. Reported in position by a ship in December, 1968. 2. Reported at 30° N, 162° W October 16, 1969 with 4 ft (1.2 m) dia. hole on port side,
KNOWN MAXIMUM WEATHER CONDITIONS	31 knots (16 m/sec) wind record (record incomplete). One winter in central North Pacific.	Part of a winter in central North Pacific

Table 2 (continued).

	#44	#45
DATE MOORED	September 20, 1968	October 19, 1968
LOCATION	43° 00.7' N, 157° 20.9' W	41° N, 148° 02.0' W
DEPTH	3000 fathoms (5486 m)	2670 fathoms (4792 m)
MOORING LINE	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	South Bay Cable Co., Model #2 Thermistors at 1, 5, 10, 30, 50 75, 100, 150, and 300 m Pressure transducers at 150 and 300 m	South Bay Cable Co., Model #2 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m Pressure transducers at 150 and 300 m
INSTRUMENTATION	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)
MOORING SHIP	USCGC ACUSHNET - WAGO 167	USCGC ACUSHNET - WAGO 167
LAST SIGHTED	Day moored, September 20, 1968	Removed April 15, 1970
LENGTH OF KNOWN TIME MOORED	One day	18 months
REMARKS	1. Never sighted or reported after mooring day.	1. December, 1968, service cruise found mast and radar reflector ripped out of buoy.
KNOWN MAXIMUM WEATHER CONDITIONS		70 knot (37 m/sec) wind recorded (wind record incomplete). Two winters in central North Pacific.

Table 2 (continued).

	#46	#47
DATE MOORED	April 28, 1969	December 4, 1969
LOCATION	43° 02.0' N, 157° 17.6' W	41° 53.5' N, 163° 55.0' W
DEPTH	2820 fathoms (5157 m)	2913 fathoms (5327 m)
MOORING LINE	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	South Bay Cable Co., Model #2 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m. Lagged thermistors added at 1 and 5 m. Pressure transducers at 150 and 300 m	South Bay Cable Co., Model #3 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m. Pressure transducers at 150 and 300 m.
INSTRUMENTATION	11 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)
MOORING SHIP	USCGC ACUSHNET - WAGO 167	USCGC ACUSHNET - WAGO 167
LAST SIGHTED	April 19, 1970	Date moored
LENGTH OF KNOWN TIME MOORED	12 months	0
REMARKS	1. Replacement for #44. 2. Lagged thermistor time constant is approximately 3 hours.	1. Replacement for #38 2. Not found in April, 1970.
KNOWN MAXIMUM WEATHER CONDITIONS	Part of a winter in central North Pacific. (Records are still being processed.)	

Table 2 (continued).

	#X47	#48
DATE MOORED	September 29, 1969	April 15, 1970
LOCATION	32° 54.6' N, 117° 21.9' W	41° 00.5' N, 148° 02.0' W
DEPTH	315 fathoms (576 m)	2650 fathoms (4846 m)
MOORING LINE	1/2" 3 strand gold nylon (12.7 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	No conventional instrument line. This buoy contains an experimental BT winch with a temperature/depth probe attached.	South Bay Cable Co., Model #3 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m. Pressure transducers at 150 and 300 m
INSTRUMENTATION	Temperature vs depth was monitored on a Rustrack Recorder. A wind-powered generator was installed to charge the BT winch batteries. A second Rustrack Recorder monitors charging current and load current.	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)
MOORING SHIP	E. B. SCRIPPS	USCGC ACUSHNET - WAGO 167
LAST SIGHTED	Removed for modification January 29, 1970	Date moored.
LENGTH OF KNOWN TIME MOORED	4 months	0
REMARKS	1. 20 ft (6 m) model experimental system.	1. Replacement for #45.
KNOWN MAXIMUM WEATHER CONDITIONS	Estimated 30 knots (15 m/sec) wind.	Unknown

Table 2 (continued).

	#49
DATE MOORED	April 20, 1970
LOCATION	42° 25.7' N, 157° 59.8' W
DEPTH	2713 fathoms (4962 m)
MOORING LINE	9/16" 3 strand gold nylon (14.5 mm) dia. 1200 ft (366 m) polyurethene jacketed nylon
INSTRUMENT LINE	South Bay Cable Co., Model #3 Thermistors at 1, 5, 10, 30, 50, 75, 100, 150, and 300 m. Pressure transducers at 150 and 300 m
INSTRUMENTATION	9 sea water temperatures, 2 sea water pressure transducers, line tension, compass heading, air temperature, wind direction, wind speed, barometer, wind transport, insolation, battery voltage, day of year, time (GMT)
MOORING SHIP	USCGC ACUSHNET - WAGO 167
LAST SIGHTED	Date moored
LENGTH OF KNOWN TIME MOORED	0
REMARKS	1. Replacement for #40.
KNOWN MAXIMUM WEATHER CONDITIONS	Unknown.