NOS/USPS Tidal Current Prediction Quality Assurance Program Procedures Manual

(January 2001 edition)

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Center for Operational Oceanographic Products and Services

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PROGRAM PURPOSE

The purpose of this Program is to gather tidal current measurements at specified locations in sufficient quantity to allow NOS to make a qualitative analysis of the accuracy of predictions at that location. Statements about the accuracy may be included as part of NOS's **Tidal Current Tables** and the US Coast Guard's **Local Notice to Mariners**. Ideally, the measurements would allow NOS to also make a quantitative analysis of the observations which would further guide the use of tidal current predictions at that location. Should serious discrepancies be discovered, NOS may use the observations to document the need for an in-depth, formal survey of the area.

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1. INTRODUCTION

Accurate tidal current predictions are essential to the safe passage, docking, and undocking of ships. This applies to vessels ranging in size from the small, privately owned yachts to the large oil and cargo carriers which navigate the nations waterways. The forerunners of the National Oceanic and Atmospheric Administration (NOAA) began measuring and reporting current information in the late 1800's. Today the National Ocean Service (NOS) produces annual tidal current predictions for more than 2900 locations along the coasts of North America. NOS collects circulation measurements, analyzes the data, calculates harmonic constituents, and computes harmonic predictions of tidal current based on the astronomical factors.

Over the past few years, questions about the accuracy of these tidal current predictions have been voiced by the mariners who use these predictions. The original NOS measurements which are used to support the tidal current predictions are typically decades old and are often of only a few days duration. Moreover, tidal currents are sensitive to changes in the area caused by shoaling, erosion, dredging, and marine construction; consequently the accuracy of the NOS tidal current predictions may have been degraded to an unknown extent. The reoccupation of any NOS tidal current station for the purpose of evaluating or updating tidal current predictions is seldom accomplished due to the unavailability of required resources.

The NOS/USPS Tidal Current Quality Assurance (QA) Program was started to evaluate the published tidal current predictions at NOS tidal current secondary locations by making use of the nautical expertise demonstrated by the members of the United States Power Squadrons (USPS). The USPS is a private organization of boating enthusiasts who have been cooperating with NOAA through the Cooperative Charting Program since the mid 1960's. The Tidal Current QA Program pilot phase, conducted during the summer and fall of 1995 and 1996 were designed to test the feasibility of this program by testing the ability of USPS volunteers to: 1) anchor and maintain position at an assigned NOS tidal current station, and 2) accurately measure and record tidal current speeds using a non-electric current meter. The final objective was to 3) determine if the observed data from the USPS volunteers was of any value to NOS. The pilot phase was aimed at measuring and recording the observed times of maximum current and slack waters in the Chesapeake Bay Area by the members of USPS District 5, who are located in Maryland, Virginia, Delaware, and New Jersey.

With successful completion of the pilot phase, the program is gradually expanding to other areas of the United States, with the goal of covering all of the US coastal regions by 2005.

2. FIELD PROCEDURES

a. Before Leaving The Dock

Prior to the commencement of field operations, each volunteer must design a mounting bracket for his/her own boat. This bracket is to provide a stable platform from which the current vane will be deployed. This hardware will need to be constructed to meet the configuration of their personal boat. Samples of previously used designs are included on pages 19-22. To help ensure safety, inform the US Coast Guard and Local Pilot Association at least 24 hours prior to starting field operations. Explain the mission and the station location that you will be occupying.

Local contact for Pilot Association:
Local contact for US Coast Guard:

b. Equipment

For field operations, the USPS volunteers must first obtain the equipment set from the appropriate station coordinator. Within this equipment set is: a NOS non-electric current meter, down-rigger, station accomplishment record, NOS station field log, tidal current prediction tables, station chartlet, and blank observation logs. The following subsections provide more detail:

Station Accomplishment Record (pg. 12) - This record is used to record the tidal current phases which have been observed. Six sets of observations are required of each of the four tidal current phases. Each of these tidal current phases is hereafter known as an "event". Once these 24 "events" have been taken, the station is completed *AND ONLY THEN* will a new station be assigned. Each time data are submitted, *an updated Station Accomplishment Record* should accompany the report. A copy of this updated record should be kept with the equipment to provide planning for future trips so as to complete observations during tidal periods ("events") which have not yet been observed. Although it is possible to observe the entire series of 24 "events" in one long series, this should ***NOT*** be attempted. By spreading the studies over several months, the potential impact of weather variables on the data is lessened.

Station Field Log (pg. 13). This log will provide navigational information for locating the original NOS station. This log also provides important details such as the depth of the water at the station, the depth to which the meter should be deployed, and the NOS chart number which is best used for navigating to this station. The log also provides a list of navigational aids which may be used in positioning. *Each volunteer should do his/her own navigation* in that specific navigation aids listed from the original data may not be usable at the station during the time of the field observation. This information is not always known to NOS, thus requiring the expertise and local knowledge of the volunteer. After arriving on station and anchoring, the observed bearings or sextant angles to visual nav aids are to be recorded in this log. GPS/DGPS records of Lat/Long to the thousandth of a minute, including identification of the beacon transmitter, number of satellites "in view" and HDOP or EPE may be substituted for horizontal angles using the "NOTES" area. ***This log is to be returned to the Cooperative Charting Chairman along with your 77-4 after each observation set is completed***

Tidal Current Prediction Table - These are the tidal current predictions for the NOS tidal current station for the current year of the study. These predictions have been adjusted to show the correct times during both Daylight Savings Time and Standard Time. Use these predictions to plan observation sessions. It is necessary to be on station for a minimum of two hours before and remain on station for two hours after the predicted tidal current phase which is being observed in order to have the observations count towards the completion of the station. ***These predictions should be kept with the set of equipment***.

Station Chartlet (pg. 14) - This is a small portion of chart listed on the *NOS Station Field Log*. This chartlet is ***NOT*** suitable for navigation as it has been shrunk, blown up, etc. in the copying process. The purpose of this chartlet is to provide some visual reference as to the location of the NOS tidal current station. ***The chartlet should be kept with the set of equipment.***

Observation Log (pg. 15,16) - This is the form for recording the tidal current observations. Make enough copies to ensure that there is always at least one blank log sheet included with the equipment. Details of this log will be discussed in the **Taking Observations** section (pg. 5). ***This log is to be returned to the Cooperative Charting Chairman along with your 77-4 after each observation set is completed.***

c. Anchoring

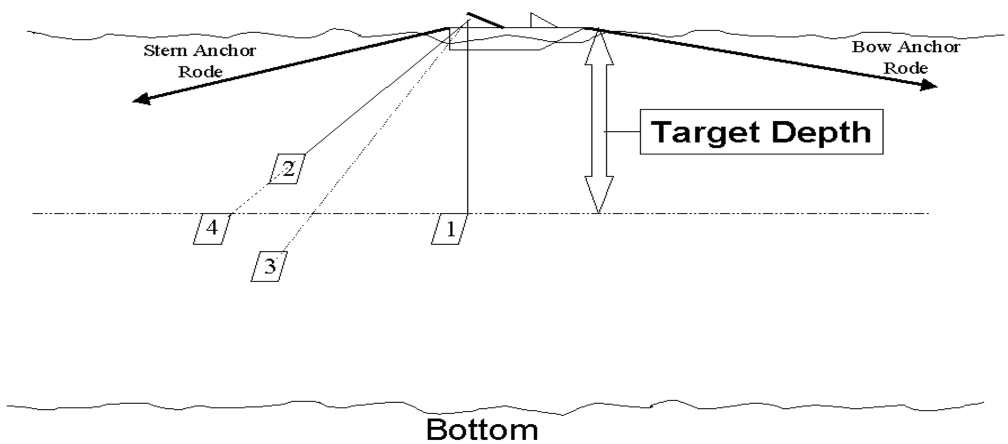
Once the observation vessel has arrived at the tidal current station, and have verified this position by use of visual bearings, sextant angles and/or GPS (or DGPS), it will be necessary to anchor the vessel at this position. To ensure that there is no drift during the period of observations, it will be necessary to anchor, both fore and aft. NOS recommends a crew of ***at least*** three for this procedure; the boat driver, one person to drop the anchor(s), and one person to monitor the bearings or other navigational systems.

To accomplish this procedure it is necessary to start at the position to be maintained; then drive the vessel *against the prevailing current* the length of the anchor rode, as determined by the depth of the water. Then drop the forward anchor. Once the forward anchor has been dropped, back down *past* the station by the length of the aft anchor rode, then drop the aft anchor. Finally drive the vessel back to the station, confirming this through the use of navigational aids, or GPS or DGPS, before finally securing the anchor lines.

It is recommended to use the *heavier* anchor (or the one with the most holding power) on the vessels stern, as it is probable that at some time during the observations, the flat stern of the vessel will be facing the oncoming current.(see Current Reversal Anchoring pg.10) Anchoring with respect to the wind instead of the current can cause your vessel to become broadside to the current during the observations, a condition that could become dangerous in stronger currents.

Anchoring is probably the most difficult procedure required for taking tidal current observations, and it may require some practice trials. Be prepared for this procedure to take some time, especially if this will be the first attempt. It is better to be on station early than late if the anchoring procedure takes longer than anticipated. In the description of this process, one can see a basic problem that some will have, *the length of the anchor line* required to accomplish this procedure. Basically, one will need ***three times*** the scope of line appropriate for the depth at the anchoring location. The forward anchor will need double the length of the rode to allow setting that anchor, and to back down to the point where the aft anchor is dropped. Some groups have been creative in solving this issue. Once the forward anchor was deployed, the line was attached to a float, and cast free from the vessel. The vessel was then backed down and the aft anchor dropped. The vessel was then driven forward (paying out aft anchor line) and the forward anchor line retrieved.

Once at anchor, the tidal current vane can be deployed. A sample of the vessel, anchor rodes, and vane deployment is shown below.



Proper Vane Deployment Once Anchored on Station
CORRECT #1 and #4
INCORRECT #2 and #3

d. Taking Observations

Once the boat is at anchor, it will be necessary to take a set of visual bearings, sextant angles, or GPS (or DGPS) readings to verify the position. These values should be recorded on the ***Observation Log***. Once the anchors are set and secure, it is time to deploy the current meter.

The down-rigger should be securely mounted to the vessel *and a safety line attached to the down-rigger*. The current vane is then attached to the down-rigger wire and paid out until the *current vane is half-in and half-out of the water*. With the vane held at this point, using the brake on the down-rigger, the counter should be re-set to zero. **This ensures accurate measurements of the length of the wire paid out**. Now lower the current vane to the depth noted as "Meter Depth" on the ***NOS Station Field Log***. This is the "target depth".

The vessel will need to be on station (and securely anchored) at least two hours prior to the predicted tidal current phase, and remain until two hours after the predicted phase in order for the observation set to count towards completing the station. Each of these phases are called events! Tidal current measurements are to be taken every 15 minutes. Then 30 minutes before the predicted tidal current event, whether max flood, max ebb, slack before flood, or slack before ebb, measurements continue at 5-minute intervals to better determine the actual time of the event. This continues, at 5-minute intervals, until 30 minutes after the event, then the frequency of observations decreases to 15 minutes until 30 minutes prior to the next event or until the end of the observations.

As an example, assume the following are the tidal current predictions for the location assigned.

Slack	Maximum	
0531	0751	0.6 E
1006	1252	1.0 F
1549	2011	1.3 E

In order to make observations for the Slack at 1006 and the Flood at 1252, use the following schedule:

- On station and anchored no later than 0806.
- 15 minute interval observations until 0936
- 5 minute interval observations from 0936 to 1036
- 15 minute interval observations from 1022 to 1322
- 5 minute interval observations until 1452
- Leave station no earlier than 1452

Some sort of timer is very useful in reminding the crew to take the observations. A digital kitchen timer with an alarm is a common example.

e. Observation Log Details

Event Observed - Record which of the four tidal current phases or events that is planned to be observed. ***SBF*** - Slack Before Flood, ***Flood***, ***SBE*** - Slack Before Ebb, or ***Ebb***.

Predicted Time - Record the predicted time of the event being observed from the predictions tables for the station provided by NOS.

Fathometer Depth - Record the depth noted by the vessels fathometer, once arriving on station.

Field Log Data - Record the **Latitude** and **Longitude** of the station as well as the **Vane Depth**, **Chart Depth**, and **Chart Number** as listed on the NOS Station Field Log for the station.

Weight - Record the weight attached to the vane(small = ***S***; medium = ***M***; large = ***L***) The current vane is calibrated to work best when the angle of the wire is between 10 and 50 degrees from the vertical. ***When the angle is more or less than these values, change to the next larger or smaller weight as appropriate.*** If observing slack water, expect to see angles less than ten (10) degrees with the small weight as the current approaches actual slack. Only in observing slack water with the small weight, should measurements of less than 10 degrees occur without changing to a smaller weight. Only in observing maximum flood or ebb with the large weight, should measurements of more than 50 degrees occur without changing to a larger weight.

Time - In this block, record the time of the observation in four digits (local time). ***Do not convert from Daylight Savings Time to Standard Time.*** Observations are to be recorded every five or 15 minutes as explained previously. The time of the observations does not have to be exactly at those times. Record the actual time that the reading is made. *Variations of one or two minutes will not adversely affect the NOS Computer plots*.

Wire Down Angle - In this block, record the angle as indicated on the **Smart Tool** (electronic level). When using the Smart Tool, 90 degrees is vertical and 0 degrees to horizontal. Correct the value (if desired) by subtracting the value read on the **Smart Tool** from 90 to obtain the angle from the vertical. **BE CONSISTENT** regardless of whether or not the correction is made. ***If the angle measured is less than 10 degrees or greater than 50 degrees from the vertical, change to the next size weight*** (see description of "weight" above for more details)**.**

Wire Length - Record the length of the wire deployed to reach the target depth (provided in the **Station Field Log**). Because the current vane is pulled by the current flow, it will actually rise in the water column. (See diagram pg. 4) Consult the "Wire to Pay Out vs Wire Angle" Table (pg. 17) to determine the amount of wire to pay out to maintain the target depth.

Wire Bearing - Record the bearing **TOWARDS** which the current vane is being pulled. Accuracy of this measurement is not critical, it is only used as a check to determine the general direction of current flow. A hand bearing compass or a general reading from the vessel compass may be used.

Calculated Depth - Used to record the actual depth of the current vane. Use the measured wire length (from the Wire Length data entry above) and now use the Wire to Pay Out vs Wire Angle Chart (page 16) to obtain the calculated value. If the calculated depth is above or below the target depth (from the **NOS Station Field Log**), it will be necessary to payout or reel in wire.

Calculated Speed of the Current - Fill in the observed speed of the current by comparing the wire down angle to the appropriate column on the Wire Angle vs. Current Speed Chart as determined by the weight on the current vane. A sample of this chart is provided on page 18. The proper Wire Angle vs. Current Speed Chart specific to each set of equipment is included with the equipment. ***This laminated table is to remain with the kit.*** The vane works best at measured angles between 10 and 50 degrees from the vertical. Weights should be changed for measurements outside this range. The table is greyed in these areas as a reminder. See the section on "weight" from the previous page.

Wind Direction and Speed - to ensure that the current flow is not driven by the local weather conditions, it is essential that the wind direction and speed be recorded every 30 minutes. An inexpensive wind speed indicator is available thru most marine supply stores for approximately $10.00. Otherwise, the Beaufort Wind Scale (pg. 19) may be used. Wind direction then should be determined with a hand held compass or the vessel compass. Accuracy to compass points is sufficient, eg. N, NW, NE, E, SE, SW. ***Remember that wind always comes "from" a direction.***

Fix Objects and Sextant Angles or Bearings: or GPS or DGPS Latitude/Longitude - To ensure that the vessel remains at the desired location throughout the observations, visual observations or GPS/DGPS are to be documented ***at least every 30 minutes***. If GPS or DGPS data is provided, the equipment manufacturer, model number, number of satellites, and the HDOP (or EPE) should be entered. For convenience two version of the Observation Log are provided; one for use with GPS/DGPS, and the other for visual navigation. Use the one appropriate to the situation.

f. Required Data

Once each set of observations is completed it is necessary to mail copies of the **Observations Log**, **NOS Station Field Log**, **Station Accomplishment Log** and **Form 77-4** to your Cooperative Charting Chair.

Remember that at least six (6) sets of observations are required for each tidal current event to complete a station.

There are four (4) of these events
(1) MAXIMUM FLOOD
(2) MAXIMUM EBB
(3) SLACK BEFORE EBB
(4) SLACK BEFORE FLOOD
Six of each equates to a minimum of 24 events.

3. Interesting Ideas

- Several USPS districts have carried out Tidal Current studies by anchoring the vessel over several days and nights. Some have utilized smaller vessels to transport volunteers to and from the anchored vessel for varying time periods to allow data accumulation over a series of "events". Some groups remained on board larger anchored vessels for as much as 4 days and nights while others worked on 4-6 hour shifts.

- Several groups have identified the desired target site with a float and light anchor line. Then they have set the anchors for the vessel and maneuvered so as to re-establish the vessel beside the float. The float should not be left on site after the completion of a given study as it can be easily moved by weather conditions and/or other vessels. The requirement of positioning data e.g. GPS latitude/longitude readouts is ***NOT*** decreased by this procedure as the float and its anchor may move during the study. Its position will certainly change somewhat as the height of the tide rises and falls.

- It has been recommended that an informal record of lessons learned, or general comments be kept for each station. Such a record would be kept with the equipment for the station and provide general information on the experience of one group of volunteers, for the use and benefit of later groups. Although such a record is ***not required***, NOAA would be interested in reading your comments and observations.

4. Problems and Solutions

The following sections summarize some of the problems encountered by other members of USPS while working on this program, and tactics developed to deal with them. Other Q/A program participants may find them useful and/or be spared the aggravation (and/or flawed data?) that some of these problems can cause. These problems may or may not be encountered.

Weeds:

Problem: Sargasso weed, grasses, etc. can collect on the down line below the water surface. This may cause added drag on the line and, in turn, lead to a larger wire angle than the true current would cause. This was discovered in dramatic fashion when the large weight reading increased to 25˚, when it had been only 10-15˚. Upon reeling in the current vane, a clump of Sargasso weed (about the diameter of a volleyball) was found on the line, near the vane end of the line.

Solution: For ***clear*** water conditions, an underwater viewer tube (snooper) was constructed consisting of a Lexan window on the end of a 2' long, 6" diameter plastic pipe (ID painted black). Using the "snooper" one can look down the line to see that it is clear before taking a wire angle reading. For ***murky*** water conditions, reel in the vane to check the line before a reading if there are doubts about its weed-free status. Some days will have very little clutter in the water, but other days, like when the Sargasso weed was encountered, the team must to be on the alert for flawed readings.

Wire Angle Measurement:

Problem: Smart Level Mechanism Sensitivity: One team indirectly discovered that the mechanism for sensing angles must be a pendulum type device, rather than a purely electronic sensor, such as employed in a flux gate compass. It was believed that pushing the hold button captured the angle of the level at that instant. In fact, it appears to capture the angle of the pendulous mechanism inside (wherever it is in its oscillation/damping cycle). To observe this pendulous mechanism in action, place the smart level against a fixed angle, such as a 45˚ piece of wood sticking up from a flat table, and then observe the angle reading as the level and wood are slid back and forth (direction of motion horizontal in the plane of the level and wood).

Solution: a) Be aware of disturbing influences and their effect on the reading; b) try to watch the reading value before the button is pushed (is it steady or varying?).

Anchoring:

Bow Anchor Problem: Under strong current conditions and significant boat wake events, it was found that what might have been adequate scope under less severe, jerking conditions led to anchor dragging. Some patent anchors allow for only about 34˚ between the flukes and the shank. Any larger angle between the line and the bottom and the line will be pulling the anchor free.

Solution: A new anchor and longer rode was procured so that additional scope could be provided. With this modification there was no further dragging of the bow (into the current) anchor.

Stern Anchor Problem: When anchoring at times other than slack, *such as when going out for a single, slack, event*, significant difficulty may be encountered in getting a suitable set of the stern (down current) anchor. It is believed that the difficulty arises as a result of the drag of the current on the anchor rode. Calculations (based on scaling from the current vane paper's calculations) of the drag on a ½" line for a 1 knot current and the 40' depth of the assigned inlet channel indicated a drag of just over 12#. For a loop of anchor line prior to setting, approximately half of this (6#) would be acting on (pulling down current) the anchor and the same amount acting on the person paying out the line on the boat. This drag force (in dry land simulations) is enough to drag the anchor chain and shank of the anchor around to a down stream orientation (patent anchor weight and chain per store recommendations). Larger boats may use larger anchors and chains, but they also, typically, utilize larger diameter lines, which lead to larger drag forces.

Solution: Add weight (such as a 10 pound lead ball used with many down-riggers) to the rode end of the anchor chain in order to minimize the possibility of dragging the anchor chain around to a down stream direction before the line can be tightened to where it is aligned toward the boat. This approach is somewhat like the "sentinel" approach described in Chapman. By using this modification, further (initial) setting and/or dragging of the stern (down current) anchor should be eliminated. One should be alert to the fact that the drag felt as the rode pays out may be due largely to the current drag, rather than to the actual setting of the anchor. It is noted that, for anchor recovery operations during other than slack current conditions, the current induced drag on the line can result in a lot of effort being required to retrieve all of the line, even before attempting to break the anchor set!

Expected Current Behavior:

Problem: In the planning, or selection, of candidate dates and times for going out to collect current velocity data, the simple current tables do not provide as much insight as a graphical plot might provide. Also, some idea of the expected trend of the data can be a confidence builder for believing that the (expected or taken) data is likely to be valid (and not some aberration due to some snag or error in operating procedures). For example, there may be occasional long periods (1-2 hours) when the average reading does not seem to change, and some events have very broad (flat topped) maximum, other times the max velocity peak is fairly well defined.

Solution: There are a number of commercially available products which provide tide and tidal current prediction is a graphical format. There are also several programs which can provided tidal and tidal current predictions in a graphical format to be found on the WWW. This is a capability that NOS does not have readily available, nor is NOS attempting to develop it.

CAUTION: NOS does not attempt to verify the accuracy of tide and tidal current prediction products available commercially or through the World Wide Web. Such products should be used with caution as that their accuracy is not easily verified.

Current Reversal Anchoring:

Problem: After the current direction reverses (such as from ebb to flood), one may find that the previously favorable (double anchored) bow facing direction (such as into the previous ebb direction) is no longer favorable. After the current reverses, the anchored boat can subjected to a significant problems as the current impacts the stern of the vessel. These problems may range from significant spray and/or splash over the stern of the boat (the area where most vessels mount the equipment), to an awkward "steering" of the boat from the rear which is little affected by the rudder.

Solution: The direction of the boat is reversed sometime during the relatively slow current period between max ebb and max flood by effectively reversing the ends of the boat to which the two anchors are cleated. Thus the bow will now point into the new max current direction. This anchor line reversal can be accomplished without completely releasing either line. The reversal process is accomplished by: taking a loop of line out and around one side of the boat from the initial cleated end to the other end (while leaving the initial cleated condition in tact) and performing a similar process with the second anchor line around the opposite side of the boat. When both lines are secured, the initial cleat wraps are released and the boat slowly pivots to take up station in a reversed direction, with only approximately one boat length change in stationing position, which can be corrected by retrieving any slack line.

5. Sample Forms and Tables

The following pages contain samples of the various forms and tables used in this program.

The **Station Accomplishment Record** (pg.12), **Station Field Log** (pg. 13), **Station Chartlett** (pg. 14), and **Wire Angel ve Weight and Current Speed** (pg. 18) are samples only. Copies of these forms specific to the station being observed are kept with the equipment for that station.

The two **Observation Logs** (pg. 15-16), one for use with GPS/DGPS and one for use with visual navigation, as well as the **Wire to Pay out vs Wire Angle Table** (pg. 17) can be copied from this booklet for use during observations.

STATION ACCOMPLISHMENT RECORD

5-4871
Thomas Point Shoal Light, 0.5 nm SE of

SLACK BEFORE FLOOD	FLOOD	SLACK BEFORE EBB	EBB
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10

(Sample)

TIDAL CURRENT PREDICTION QUALITY ASSURANCE FIELD LOG

Original NOS Station Information

Tidal Current Table Station Number: 5-4871
Station Name/Location: Thomas Point Shoal Light, 0.5 miles SE of
38° 53.46'N 076° 25.62'W

Meter Depth:16 feet
Chart Depth:44 feet
Chart No.#:12270

Visual Navigation Objects:

	NAME	Plotted Bearing	Observed Bearing
A	Matapeake Tank	042°T	
B	Bloody Point Bar Light	155°T	
C	Thomas Point Light	316°T	
D	1200ft Radio Tower	348°T	
E			
F			
G			
H			

Sextant Angles:

Objects	Plotted Angle	Observed Angle
A-B	113°	
B-C	161.5°	
C-D	31.5°	
D-A	54°	

◆All information listed here is to assist you in navigation, plotting, and piloting to the station.

◆All navigational aids were selected using the listed chart.

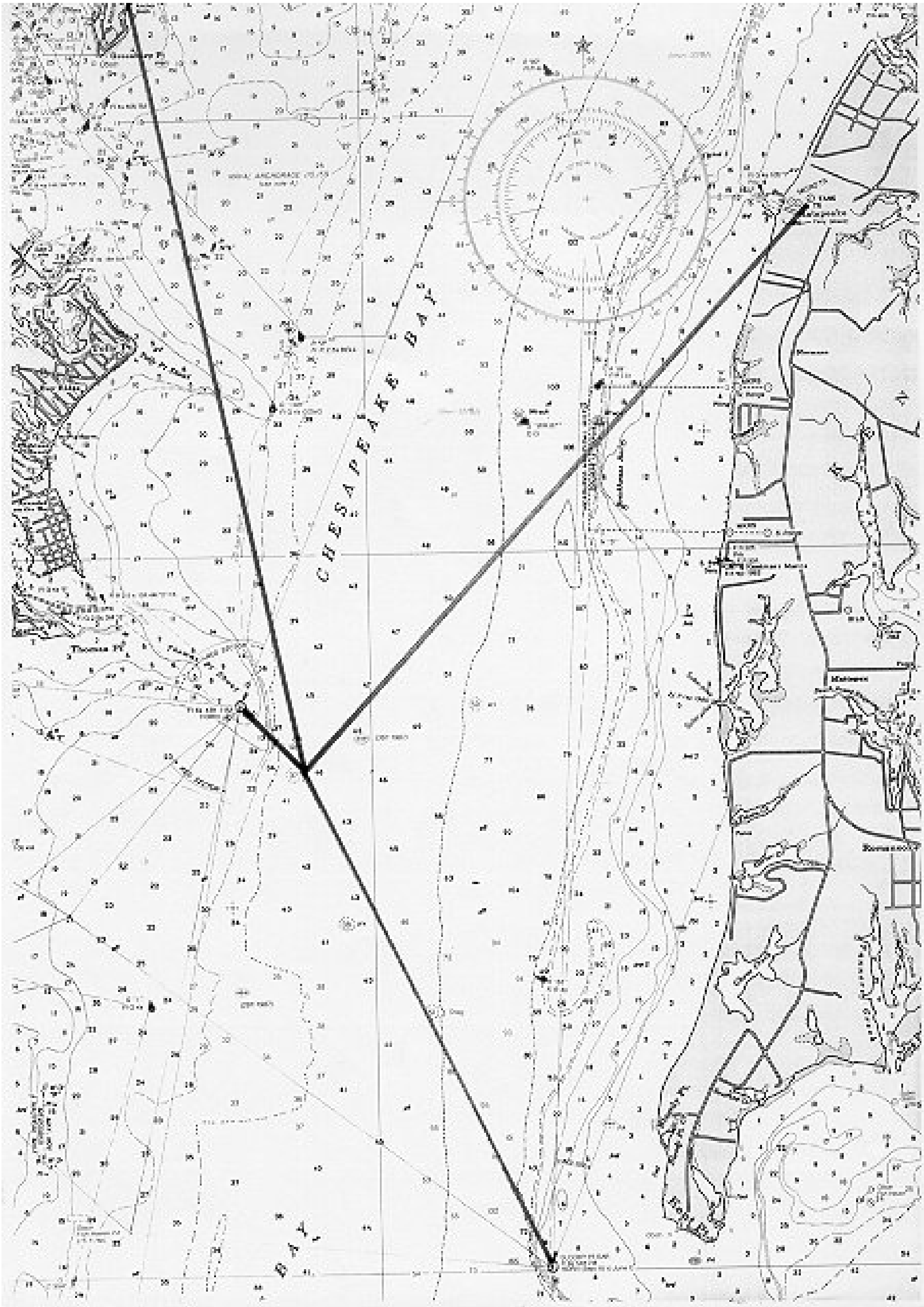
◆Do your own navigation to ensure accuracy

◆Note any discrepancies in the space provided.

◆Return the completed form with your form 77-4.

NOTES:

Sample Station Chartlet



Tidal Current Prediction Quality Assurance Program
OBSERVATIONS LOG FOR USE WITH GPS/DGPS

Date:		Event Observed		Predicted Time		Page		of	
Station #		Station name:					Fathometer Depth		

ENTER DATA ON NEXT LINE FROM THE STATION FIELD LOG

Lat:		Long:		Vane Depth		Chart Depth		Chart #	

Weight S/M/L	Time	Wire Down Angle	Wire Length	Wire Bearing	Calculated Depth	Observed Speed	Wind Speed	Wind Direction	Latitude (Decimal w/ Minutes)	Longitude (Decimal w/ Minutes)	Number of Satellites	EPE or HDOP

EQUIPMENT INFORMATION AND CONDITION DATA

MAKE & MODEL		DGPS BEACON USED		BEACON FREQ & BAUD RATE		DISTANCE TO BEACON	

REMARKS

Tidal Current Prediction Quality Assurance Program
OBSERVATIONS LOG FOR USE WITH HORIZONTAL ANGLES

Date:		Event Observed		Predicted Time		Page		of	
Station #		Station name:					Fathometer Depth		

ENTER DATA ON NEXT LINE FROM THE STATION FIELD LOG

Lat:		Long:		Vane Depth		Chart Depth		Chart #	

Weight S/M/L	Time	Wire Down Angle	Wire Length	Wire Bearing	Calculated Depth	Observed Speed	Wind Speed	Wind Direction	Fix Objects	Sextant Angle or Bearings

REMARKS

NOS/USPS Tidal Current Prediction Quality Assurance Program											
Wire to Pay Out (in feet) vs Wire Angle (in degrees) for a Target Depth (in feet)											
Wire Angle		Target Depth (in feet)									
From Vertical	From Horizontal	6	8	10	12.5	15	17.5	20	22.5	25	30
0	90	6	8	10	13	15	18	20	23	25	30
2	88	6	8	10	13	15	18	20	23	25	30
4	86	6	8	10	13	15	18	20	23	25	30
6	84	6	8	10	13	15	18	20	23	25	30
8	82	6	8	10	13	15	18	20	23	25	30
10	80	6	8	10	13	15	18	20	23	25	30
12	78	6	8	10	13	15	18	20	23	26	31
14	76	6	8	10	13	15	18	21	23	26	31
16	74	6	8	10	13	16	18	21	23	26	31
18	72	6	8	11	13	16	18	21	24	26	32
20	70	6	9	11	13	16	19	21	24	27	32
22	68	6	9	11	13	16	19	22	24	27	32
24	66	7	9	11	14	16	19	22	25	28	33
26	64	7	9	11	14	17	19	22	25	28	34
28	62	7	9	11	14	17	20	23	25	28	34
30	60	7	9	12	14	17	20	23	26	29	35
32	58	7	9	12	15	18	21	24	27	29	35
34	56	7	10	12	15	18	21	24	27	30	36
36	54	7	10	12	15	19	22	25	28	31	37
38	52	8	10	13	16	19	22	25	29	32	38
40	50	8	10	13	16	20	23	26	29	33	39
42	48	8	11	13	17	20	24	27	30	34	40
44	46	8	11	14	17	21	24	28	31	35	42
46	44	9	12	14	18	22	25	29	32	36	43
48	42	9	12	15	19	22	26	30	34	37	45
50	40	9	12	16	19	23	27	31	35	39	47

Wire Angle vs Weight and Current Speed (*Sample*)				
Wire Down Angle		**Small Weight**	**Medium Weight**	**Large Weight**
From Vertical	**From Horizontal**	***Knots***	***Knots***	***Knots***
2	88	0.08	0.30	0.57
4	86	0.14	0.41	0.78
6	84	0.18	0.48	0.94
8	82	0.22	0.55	1.07
10	80	0.24	0.61	1.21
12	78	0.26	0.67	1.32
14	76	0.28	0.72	1.42
16	74	0.30	0.76	1.52
18	72	0.32	0.81	1.61
20	70	0.34	0.85	1.70
22	68	0.36	0.90	1.78
24	66	0.38	0.94	1.87
26	64	0.40	0.98	1.95
28	62	0.42	1.02	2.04
30	60	0.44	1.06	2.12
32	58	0.46	1.10	2.20
34	56	0.48	1.14	2.28
36	54	0.50	1.18	2.37
38	52	0.52	1.22	2.45
40	50	0.54	1.27	2.54
42	48	0.56	1.32	2.62
44	46	0.58	1.37	2.72
46	44	0.60	1.41	2.81
48	42	0.62	1.46	2.91
50	40	0.64	1.51	2.99
52	38	0.66	1.56	3.10
54	36	0.68	1.62	3.21
56	34	0.70	1.68	3.33
58	32	0.72	1.74	3.46
60	30	0.74	1.81	3.59

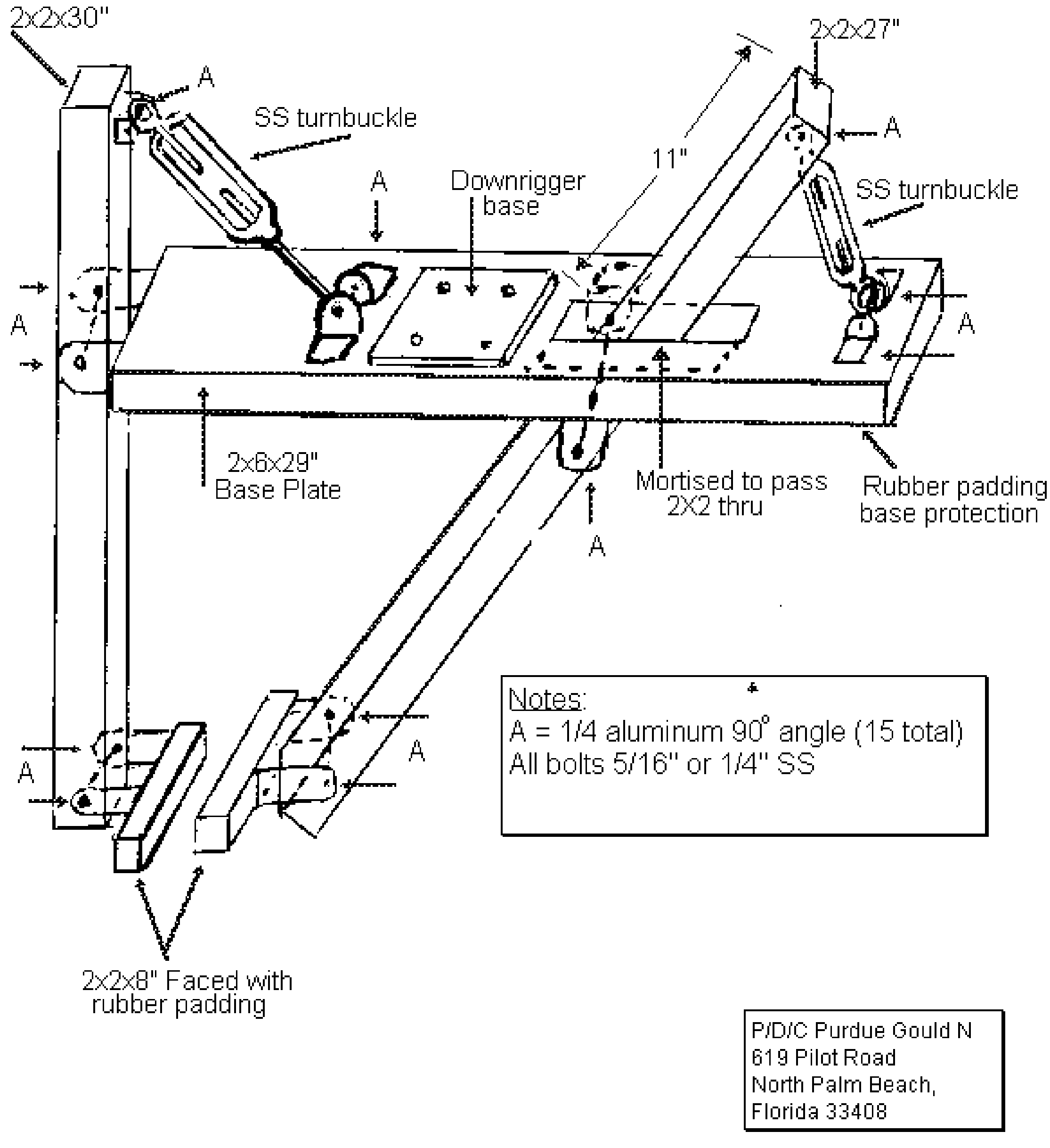
Beaufort Wind Scale

Beaufort Number	Wind Speed			World Meteorology Organization (1964)	Estimating Wind Speed			Sea State	
	Knots	mph	kmph		Effects observed far from land	Effects Observed near coast	Effects observed on land	Term and Wave Height	Code
0	< 1	< 1	< 1	calm	Sea like mirror	Calm	Calm, smoke rises vertically	calm, glassy 0	0
1	1-3	1-3	1-5	Light air	Ripples with appearance of scales; no foam crests	Fishing smack just has steerage way	Smoke drift indicates wind direction; vanes do not move		
2	4-6	4-7	6-11	Light breeze	Small wavelets; crests of glassy appearance, not breaking	Wind fills the sails of smacks which then travel 1-2 miles per hour	Wind felt on face; leaves rustle; vanes begin to move	calm, rippled 0-0.1	1
3	7-10	8-12	12-19	Gentle breeze	Large wavelets; crests begin to break; scattered whitecaps	Smacks begin to careen and travel about 3-4 miles per hour	Leaves, small twigs in constant motion; light flags extended	Smooth wavelets 0.1-0.5	2
4	11-16	13-18	20-28	Moderate breeze	Small waves, becoming longer; numerous whitecaps	Good working breeze, smacks carry all canvas with good list	Dust, leaves, and loose paper raised up; small branches move	Slight 05.-1.25	3
5	17-21	19-24	29-38	Fresh breeze	Moderate Waves, taking longer form; many whitecaps; some spray	Smacks shorten sail	Small trees begin to sway	Moderate 1.25-2.5	4
6	22-27	25-31	39-49	Strong breeze	Larger waves forming; whitecaps everywhere; more spray	Smacks have doubled reef in mainsail; care required when fishing	Larger branches of trees in motion; whistling heard in wires	Rough 2.5-4	5
7	28-33	32-38	50-61	Near gale	Sea heaps up; white foam from breaking waves begins to be blown in streaks	Smacks remain in harbor and those at sea lie-to	Whole trees in motion; resistance felt in walking against the wind	Very Rough 4-6	6
8	34-40	39-46	62-74	Gale	Moderately high waves of greater length; edges of crests begin to break into spindrift; foam is blown in well marked streaks	All smacks make for harbor if near	Twigs and small branches broken off trees; progress generally impeded		
9	41-47	47-54	75-88	Strong gale	High waves; sea begins to roll; dense streaks of foam; spray may reduce visibility		Slight structural damage occurs; slate blown off roofs		
10	48-55	55-63	89-102	Storm	Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility reduced		Seldom experienced on land; trees broken or uprooted; considerable structural damage	High 6-9	7
11	56-63	64-72	103-117	Violent Storm	Exceptionally high waves; sea covered with white foam patches; visibility still more reduced		Very rarely experienced on land; usually accompanied by widespread damage	Very high 9-14	8
12	64 and over	73 and over	118 and over	Hurricane	Air filled with foam; sea completely white with driving spray; visibility greatly reduced			Phenomenal over 14	9

6. Mount Concepts

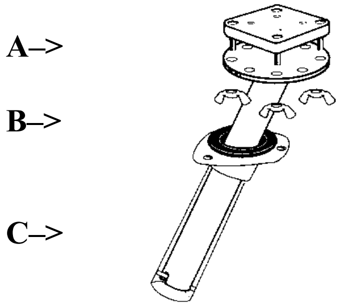
The following pages are diagrams of mounts created by USPS members who have participated in this program. These samples are supplied to provide some guidance and ideas for designing and building a mount to fit the vessel being used for observations.

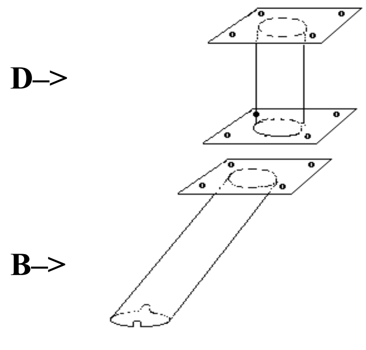
UNIVERSAL DOWNRIGGER MOUNT



The Universal Downrigger Mount is designed with a scissoring action controlled by the two turnbuckles. The underside of the baseplate is covered with a rubber pad to protect the gunwale of a vessel. Two 1/4" x 6 " aluminum angles (not shown) are also covered with rubber padding permitting 4" "C" clamps to be applied to the base plate as a preventer of athwartship motion of the baseplate. As designed, the mount can be used on vessels ranging in size from 20' to 48' LOA. This unit is available ***on loan*** to any interested USPS group by payment of round trip shipping charges. Instructions and photos of installation will be provided. Call -561-848-9320 or email DRPLG@prodigy.net to request unit from Cdr. Gould.

Down Rigger Mount for Rodholder





A - Downrigger base plate (NOAA kit)
B - SS Mount (T10-330 in Defender catalog
On page 93 @ $35.95)
C - Rodholder depicted in vessel

D - 12" galvanized extension
B - SS Mount (see description to left)

Warning - vessel owner should ascertain that rod holder in gunwale is secured with bolts, not screws. The lateral forces from the downrigger, vane and heavy weight exert considerable strain. One set of units B and D are available on loan to a Tidal Current study group with payment of round trip shipping costs. Contact Cdr Gould at 561-848-9320 or "DRPLG@prodigy.net" for further information.

SKETCH OF MEASURING EQUIPMENT:

Equipment Items:
- Outrigger with line & weights
- Current Vane - NOAA design
- Weights
- Protractor
- Anemometer
- Hand-bearing Compass
- Sextant

SKETCHES OF EQUIPMENT POSITION: