

UNITED STATES COAST SURVEY

---

DIRECTIONS  
FOR

OBSERVATION OF TIDES

---

*PRINTED FOR THE USE OF THE TIDAL OBSERVERS FROM  
THE MANUSCRIPT INSTRUCTIONS, 1852*

January 16, 1956

**INSTRUCTIONS**  
**FOR OBSERVERS OF TIDES EMPLOYED BY THE U.S COAST SURVEY**

---

The *tidal stations* are either permanent (for the year) or temporary. The object of the *permanent stations* is to determine with precision the establishment, rise and fall, and duration of tides, and the effect upon them of atmospheric and other circumstances, so as to form a tide table, or one for the prediction of tides at the place. The comparison of the precise results thus obtained at suitable points of the coast, will give the progress of tide wave. (Genl.Hydrog.Instruc., 1845, Par 19)

There are certain tidal stations established for the special purpose of determining the progress of the tide wave by observations of a short period, where all the precautions should be taken as at a permanent station.

**INSTRUCTIONS FOR OBSERVERS AT PERMANENT TIDAL STATIONS OBSERVING  
HIGH AND LOW WATER ONLY**

*Tide Gauge.*

1. The gauge should, when practicable, be for the form called the box gauge, having a copper float, a wooden rod graduated to feet and tenths, and reading by a vernier, or by estimation, to hundredths; graduated so that greater readings correspond to rise of tide and smaller to fall. The holes admitting the water to the box should be numerous enough and large enough to admit it freely, but not to permit oscillation. A slide should be provided which will enable the observer to cover a greater or less number of these holes, so as to vary the facility of access of the water to the gauge under different circumstances of wind, &c.

In establishing the gauge, care should be taken that, at the lowest water to be observed, there is still at least six inches under the float, and that the highest range possible is attainable by the marks on the staff.

If the situation will not allow a box gauge, a simple staff, graduated *upwards*, and reading to feet and tenths, may be firmly planted and observed directly or through a small telescope from a distance of twenty or thirty feet.

A permanent mark, corresponding to the zero of the tide staff, should be made near the gauge; a copper nail, the center of the head corresponding to the zero, and surrounded by a circle of nails of the same material, or a line cut into a stone; or the zero should be referred by the difference of level to some permanent mark, as the plinth of a light-house, or the cornerstone of some adjacent building.

The highest or lowest tide known in the vicinity, its date and circumstances should be recorded.

*Observation*

2. High and low water must be observed both night and day; the time and the height, and the interval of slackwater being carefully ascertained.

About twenty minutes before the time of high water, and ten minutes after, the observations must be made every two minutes, and must be recorded, whether the reading is the same or varies.

The time should be mean solar time. The watch used should be corrected daily, when the sun shines, by a mark furnished by the chief of the hydrographic party establishing the tidal stations, or to be otherwise procured, when this resource fails, for the sun's meridian passage, and almanac, or extract from one, showing the equation of time to be applied, and whether additive or subtractive, to convert apparent solar time into mean solar or clock time.

3. Besides the observations of rise and fall of tide, meteorological observations are required, including those of the barometer, thermometer, hygrometer and of the direction and force of the wind, for which special instructions will be given.

#### *Records*

4. The observer will be furnished with printed forms for his records. The original to be kept in a bound volume, the duplicate on loose sheets. He should, from day to day, make a copy of his observations on the loose sheets, and at the end of each month send them to the Coast Survey office, and on the acknowledgement of their receipt send the original.

The packages sent are to be placed in a cover addressed "Coast Survey Office, Washington D.C.," over which a second cover is to be placed addressed "Hon. Thomas Corwin, Secretary of the Treasury, Washington D.C.," on each cover, in the upper right hand corner, is to be written "Official Business."

The original and duplicate must be commenced by a description of the gauge, stating its form, dimensions, graduations, & c., the points to which its zero is referred, a sketch of the locality where it is placed, and notes of the general character of the place in reference to surrounding objects. Especially the influence which the position is likely to have in retarding the tide wave, or preventing or augmenting its rise, or the effect of winds in raising or depressing the water, and on the time of high or low water.

The mark of reference must be carefully described. The date of observations and names of the tidal observers must appear on the face of the record, and all blanks in the forms be filled up.

The time of high and low water should have written opposite to them in the column of remarks, "H." and "L." water, and the time of slack water, (when there is no *rise* or *fall*.) should be noted below.

#### *Remarks*

5. Observers cannot be too careful to note the facts *precisely as they occur*, without regard to what may seem to them to be the regular succession of heights and of times. What appear to be irregularities are frequently most important phenomena. Any attempt to force the observations, will, when detected by a comparison of results or otherwise, deprive the observer at once of employment.

If an observation is accidentally omitted, its place should be left blank, and allowances will be made for such omissions, unless frequent, or the result of carelessness.

Negligence should be reported at once to the officer in charge of the station or, when there is no one in special charge, to the office.

The observers will remark, that the observations of the night tides are as essential as those of the day tides.

*Meteorological observations.*

6. The directions of the wind are to be observed to the nearest point; an easy moving vane being mounted for that purpose on a tall pole, with a small flag as a check, and a circle divided below.

The circle is to be made on a stick of timber fixed firmly in the ground, and divided like the mariner's compass into points and half points.

In the centre of the circle the pole with the flag is to be placed. The observer, in making the observation, has only to notice the direction in which the vane is blown, and referring to the stationary compass, notice the direction of the wind.

The force of the wind is to be recorded according to the scale, as follows:

*Table of force of winds*

					Velocity in miles per hour
0. Calm	-	-	-	-	0
1. Light air	-	-	-	-	1
2. Light breeze	-	-	-	-	4
3. Moderate breeze	-	-	-	-	13
4. Fresh breeze	-	-	-	-	23
5. Strong breeze	-	-	-	-	32
6. Fresh gale	-	-	-	-	40
7. Strong gale	-	-	-	-	50
8. Whole gale	-	-	-	-	60
9. Storm	-	-	-	-	80
10. Hurricane	-	-	-	-	100

7. The mean time to be given by a mark to be placed as above stated; by which, and an almanac to be furnished to the observers for the equation of time, they will regulate their watches.

8. The height of the barometer, and temperature by attached thermometer, to be noted when the tides are observed.

The temperature, by a thermometer in the air, and carefully screened from reflected or radiated heat, to be observed at the same time.

The temperature of the wet bulb thermometer to be also observed.

*Description and use of the "Alexander barometer"*

The following is a description of the mode of mounting and using the Alexander barometer, which has been furnished to most of the tidal stations:

This barometer as made by Mr. James Green, of New York, consists essentially of an iron cup or cistern **I**, supported by a metal bracket **E**, (see the annexed sketch,) and tube, **B**, sustained at the upper end by a metal clamp and hook, *o* and *f*, and attached to the wall by means of the metal bracket **F**; a scale of inches and tenths is marked upon the tube, on which slides a vernier, **L**, reading to hundredths, the zero of the graduation being a line marked upon the tube near its lower extremity. A small iron socket, *g*, having in it a single hole, which can be closed by the screw, *c*, is firmly attached to the lower end of the tube. An ivory float, **K**, is made to fit loosely around

the barometer tube, and allowed to rest upon the surface, *ab*, of the mercury in the cistern, it being easier for the eye to note the coincidence of an ivory edge than a mercurial surface with the zero line. The nut, **G**, serves to raise or lower the tube at pleasure.

*When the barometer is to be set up*, the tube filled with mercury, and closed at the lower extremity by the screw, *c*, is taken from the case carefully inverted, and, with the lower end immersed in the cup or cistern of mercury, is held in that position until the ivory float and moveable vernier can be slipped round to it, and the metal hook clamped to its upper extremity; the finger is then carefully inserted beneath the mercurial surface, and the screw taken out- slowly, so that the mercury in the tube may fall gradually to its proper height. The vernier is then adjusted to the scale, and the instrument is ready for use.

*In taking down the barometer*, the ivory float, the vernier, and the metallic hook by which the tube is suspended, are first detached from it. The tube is then carefully inclined, its lower extremity being kept immersed in the mercury until the fluid rises to the top and completely fills the tube. The small screw is then inserted in the orifice, and the barometer being removed from the cistern is inverted and placed in its leathern case, which is so contrived that the tube hangs in it suspended from its metallic socket. The diameter of the tube is about one-sixth of an inch.

*The reading of the barometer* is noted by first making the edge of the ivory float coincide with zero mark on the tube. This is effected by means of a screw, **H**, inserted underneath the iron cistern, and working in a metal support, so that the cup of mercury, and with it the float, can be elevated or depressed at pleasure. Supposing this done, we proceed to observe the height of the summit of the column. Take hold of the tube with the left hand so that it may retain as closely as possible its vertical position, and tap slightly upon it near the top of the column; this breaks any adherence which may have taken place between the mercury and the glass. Then move the slide, **M**, which carries the vernier, until the plane, passing through its zero is tangent to the top of the convex surface of the mercurial column. It is well to have a screen of white paper placed behind the barometer to assist the eye in determining when the summit of the column and the edge of the slide just touch each other, leaving no line of light between. Before reading it, it is better to allow the barometer to remain at rest a few moments, and then note whether the zero line still continues exact, the inches and tenths are then read off from the scale, and the hundredths from the vernier.

10. A small thermometer should be attached to the tube, and the bulb of another be allowed to dip in the cup of mercury, by which the temperatures of the tube and of mercury may be noted.

For the mode of placing the thermometer to give the temperature of the air, of reading and verifying, see the directions for meteorological observations by the Smithsonian Institution.\*

11. The same directions are to be followed in regard to placing, observing and verifying, the wet bulb thermometer, the rain and snow gauges, the character of the sky and clouds. The direction and force of the wind, however, will be observed and

\*Directions for meteorological observations, intended for the first class of observer, 1850.

recorded as already stated in these instructions.

12. The observers to whom the Smithsonian barometers have been furnished should follow the same instructions for using that instrument.

**INSTRUCTIONS FOR OBSERVERS AT PERMANENT TIDAL STATIONS  
OBSERVING HOURLY.**

13. To the requirements in the foregoing instructions are added observations hourly during the day and night.

When the rise and fall of the tide is small, as in the Gulf of Mexico, the observations near the times of high and low water need to be taken more frequently than every fifteen minutes; and where the time of occurrence of high and low water is irregular, so that there are sometimes two high and sometimes two low waters, and at other times there is only one high and one low water, in the twenty-four hours, regular half hourly observations are to be preferred to any attempt to determine more minutely the time of high and low water.

When hourly tidal observations are made, the barometer and attached thermometer, the detached thermometer with dry and wet bulb, and other meteorological instruments, will be observed at the times and according to the rules given in the instructions of the Smithsonian Institution in the chapter entitled "Time of Observation." The direction and force of the wind, and general character of the weather, will be recorded every hour. The scale to be used for the force of wind is that given in these instructions.

**THE END**