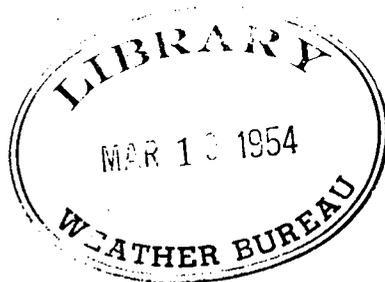


UNITED STATES DEPARTMENT OF COMMERCE • Sinclair Weeks, Secretary

U.S. WEATHER BUREAU • F. W. Reichelderfer, Chief

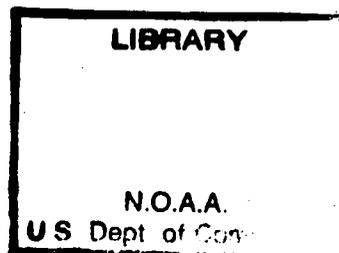
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# MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS



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March 21, 2005



## AN APPRECIATION

The continuing demand for more and better weather information for ships is being met by the cooperation of the users themselves. The weather reports received from cooperating ships by mail and by radio provide the basis for the forecasts and navigation charts issued to the maritime service.

The Weather Bureau wishes to thank the masters and officers who are contributing so effectively to the success of the ocean weather service.

F. W. REICHELDERFER, *Chief of Bureau.*



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## INTRODUCTION

The Conference of Brussels, called in 1853, was the first International Maritime Conference ever held. It sponsored the idea that governments should foster systematic weather observations on ships, and should prepare and publish charts of the prevailing winds, ocean currents, average sea and air temperatures, and tracks of dangerous storms based on the additional data. With the introduction of radio and fast ships, weather information became of vital importance to safe and efficient ship operation. Many countries began regularly scheduled weather forecasts to ships in nearby waters.

Today, weather forecasts as well as charts are prepared from data collected through ship observations. Forecasts of weather and sea conditions are prepared for ship operation, air-sea rescue missions, over-water air travel, military operations, etc. The need for accurate data is apparent, since the forecast cannot be any better than the basic observation.

*Organization of the Manual.*—This manual has been designed to serve primarily as a guide in the taking of weather observations at sea. It will be helpful in using the manual to keep in mind that the material in it has been organized to accord with the order of the various elements of the observation as they are entered in the basic Weather Bureau Form 1210F, "Log of Ship's Weather Observations." Each major element of the observation is completely covered in a separate chapter. The first portion of each chapter is presented from the point of view of observing and evaluating the element without reference to its ultimate use; and the second portion, from the point of view of making a permanent record of it and preparing it for dissemination (coding). A complete index and a table of contents have been included. They should be consulted whenever there is any doubt about the location of instructions in the manual.



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# CHAPTER I. GENERAL INSTRUCTIONS

## 1000. TIME OF OBSERVATION

**1010. SYNOPTIC REPORTS.** Cooperating ships at sea are requested to take and record synoptic weather observations at the hours of 0000, 0600, 1200, and 1800 Greenwich Civil Time (G. C. T.). However, if it is not practicable to take four observations daily, as many of the observations as possible are requested.

**1020. SPECIAL REPORTS.** In accordance with the International Convention for the Safety of Life at Sea, the masters of all ships, regardless of the nationality, are requested to send special weather observations by radio when encountering tropical or other severe storms during the period of June to November in the following areas:

- (1) In the North Atlantic Ocean, Caribbean Sea, and Gulf of Mexico; that is, in the areas between latitude  $3^{\circ}$  N. and  $35^{\circ}$  N. and west of longitude  $35^{\circ}$  W.
- (2) In the North Pacific waters west of Central America and Mexico; that is, in the area between latitude  $5^{\circ}$  N. and  $35^{\circ}$  N. and east of the 180th meridian.

The message should be transmitted in the International Weather Code for Ships (see par. 1240-50); however, if the code is not available, the report may be sent in plain language. Additional radio reports taken at 2- or 3-hour intervals thereafter are also desired as long as the ships remain in the storm area. The messages should be sent through commercial or United States Government radio shore stations. Ships in Atlantic waters should address the messages to "Observer, Washington," while ships in the Pacific Ocean should dispatch messages to "Observer, San Francisco." The Weather Bureau will assume the cost of transmission of the special weather reports.

**1021.** When a tropical storm is reported, the Weather Bureau may broadcast requests for special radio weather reports from all ships in the vicinity of the storm. These requests will always include instructions relative to the time of the reports and the address to which the reports should be sent.

## 1100. LOG OF SHIP'S WEATHER OBSERVATIONS—FORM 1210F

**1110. GENERAL.** All weather observations made at sea will be recorded on Form 1210F, Log of Ship's Weather Observations (see Fig. 1). For convenience and protection the forms are bound in a folder. The individual sheets, when used, may be torn off along the perforation and stored in the back of the folder until the end of the trip.

A new page of Form 1210F will be started:

- (1) At the beginning of each voyage.
- (2) As each page becomes filled.
- (3) For the first observation of a new month.
- (4) Upon sailing from one ocean to another.

**1120. ENTRY OF DATA.** Enter the observations as legibly as possible, using a well-sharpened black pencil or a pen. The data should be entered in the columns appropriate to them as indicated by the column headings.

**1121.** Fill in the identification blanks on both sides of the form. These include the following:

- (1) *Vessel*.—Enter the nationality and name of the vessel, e. g., American S/S *Barbarossa* (both sides of form).
- (2) *Captain*.—Enter the captain's name (both sides of form).
- (3) *Voyage from—to*.—Enter the port of departure and destination.
- (4) *Month*.—Enter month and year.

MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

W. B. Form 1210F

U. S. DEPARTMENT OF

LOG OF SHIP'S

Vessel American S/S Barbarossa  
(Name, name)

Captain A. P. Lee Voyage from Hamburg to New York

Day of Month (G.C.T.)	Day of Week (1-7)	POSITION OF SHIP					Time (Correct best (00-23) (G.C.T.))	Total Cloud Amt. (Coded)	WIND			WEATHER		PRESSURE				Air Temp. (°F)	CLOUDS				
		Octant (01, 2, 3, 4, 5, 6, 7, 8)	Latitude (Degree and tenths)	Longitude (Degree and tenths)	Dir. rection (00-34)	Speed (Knots)			Vis. bility (00-99)	Preval. (00-99)	Part (0-9)	Correction $\pm .04$		Barometer Corrected		Air (Coded)	Ci		Cs	Cu	Cb	Sc	
												Barometer as Read (U. S. M. or M.)	Barometer Corrected (U. S. M. or M.)	Bar 10	(mb)								
1	4	0	493	066	00	6	26	14	97	21	6	29.68	29.72	10	064	48	4	5	4	2	0		
1	4	0	485	091	06	6	28	19	98	03	2	29.77	29.81	10	095	54	2	5	5	2	0		
1	4	0	477	117	12	8	30	28	94	50	5	29.96	30.00	10	159	54	6	5	4	2	/		
1	4	0	467	140	18	8	32	30	94	61	6	30.01	30.05	10	176	51	4	6	3	2	/		
2	5	0	452	150	00	7	34	22	94	61	6	30.04	30.08	10	186	50	5	6	3	2	0		
2	5	0	452	170	06	6	12	15	95	40	6	29.89	29.93	10	135	55	3	6	2	3	1		
2	5	0	446	192	12	7	18	18	97	02	1	29.85	29.89	10	122	57	3	5	4	3	0		
2	5	0	441	216	18	6	20	15	98	02	1	29.90	29.94	10	139	51	2	5	5	3	4		
3	6	0	434	242	00	6	28	24	97	02	1	29.95	29.99	10	156	47	2	5	3	5	5		
3	6	0	431	274	06	9	27	20	93	47	4	29.89	29.93	10	135	49	9	/	0	/	/		
3	6	0	426	296	12	6	27	18	93	42	4	29.91	29.95	10	142	53	6	6	2	0	0		
3	6	0	422	322	18	6	29	17	94	63	4	29.86	29.90	10	125	53	3	7	3	2	0		
4	7	0	422	338	00	8	30	15	94	63	6	29.83	29.87	10	115	54	4	7	3	2	/		
4	7	0	413	352	06	7	30	18	96	60	6	29.76	29.80	10	091	52	2	6	4	2	0		
4	7	0	413	374	12	6	27	12	98	01	6	29.79	29.83	10	102	49	1	5	5	3	0		
4	7	0	412	401	18	6	34	24	98	01	1	29.90	29.94	10	139	48	2	5	5	5	0		

(Make special gale and log reports in spaces provided on reverse side of this sheet)

FIGURE 1. --Log of Ship's Weather Observations--Form 1210F.

- (5) *Barometer W. B. list number.*—Enter the Weather Bureau serial number of the barometer.
- (6) *Date compared.*—Enter the date of the last barometer comparison (see par. 6020).
- (7) *Water temperature.*—Check whether the sea-water temperature is measured by intake thermometer or by bucket method.

1130. **OBSERVER'S INITIALS.** The initials of the observer taking the observation will be entered on the appropriate line in column 44.

1140. **MAILING.** At the completion of each trip, all Forms 1210F, which have one or more entries, and used barograph charts, should be mailed promptly in the postage-free envelopes provided. Instructions for mailing the records are printed on the envelopes.

1200. RADIO TRANSMISSION OF WEATHER OBSERVATIONS

1210. **SHIPS AUTHORIZED TO TRANSMIT SCHEDULED MESSAGES.** Weather Bureau marine centers will designate the ships that are to transmit scheduled synoptic weather messages by radio and will issue special instructions to them. Other ships are requested to report by mail only. "Y" for "Yes" or "N" for "No" should be entered on each line in column 43 of Form 1210F to indicate whether the report entered on the line has been transmitted by radio.

1220. **SPECIAL REPORTS.** All ships are requested to transmit a special weather message under the conditions described in paragraphs 1020 and 1021.

1230. **TRANSMISSION TO SHORE STATIONS.** Weather messages should be checked "Government" and transmitted to the nearest United States Government or commercial radio shore station. Weather messages should not be transmitted to foreign radio stations unless the ship has special instructions to do so. The receiving station will relay the weather message to the proper office without charge to the ship. The Weather Bureau will assume the cost of transmitting weather messages sent to "Observer" addresses.



## MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

TABLE 1-1.—Elements of the code

Symbols	Definitions of symbols	Observing instructions (par. No.)	Coding instructions (par. No.)	Code Table No.
Y	Day of week		2201	1
Q	Octant of globe		2301	2
L <sub>a</sub> L <sub>n</sub> L <sub>s</sub>	Latitude in degrees and tenths		2401	--
L <sub>o</sub> L <sub>o</sub> L <sub>o</sub>	Longitude in degrees and tenths		2501	--
GG	Greenwich civil time of observation, to nearest hour		2601	--
N	Total amount of sky cover, eighths	8110-30	8310	3
dd	Direction from which the wind is blowing (tens of degrees)	3110	3120	4
ff	Wind speed in knots	3210	3220	--
VV	Visibility (in code)	4101-3	4201	5
ww	Present weather (in code)	5710	5720-32	6
W	Past weather (in code)	5810	5820	7
PPP	Sea-level pressure (tens, units, tenths) mb.	6120	6410-11	8
TT	Temperature of the air (whole degrees Fahrenheit)	7110-20	7310	--
N <sub>h</sub>	Amount of C <sub>L</sub> clouds, eighths	8110-30	8320	3
C <sub>L</sub>	Clouds of types stratocumulus, stratus, cumulus, cumulonimbus (in code)	Circular S	8340	9
h	Height above sea of C <sub>L</sub> cloud (in code)	8201	8330	10
C <sub>M</sub>	Clouds of types altocumulus, altostratus, nimbostratus (in code)	Circular S	8350	11
C <sub>H</sub>	Clouds of types cirrus, cirrostratus, cirrocumulus (in code)	Circular S	8360	12
D <sub>s</sub>	Ship's course (in code)		2701	13
v	Speed of ship in knots (in code)		2801	14
a	Characteristic of barometric tendency (in code)	6310-30	6420-22	15
pp	Amount of barometric change (units and tenths) mb.	6310-30	6420-22	16
0	Group designator			--
T <sub>s</sub> T <sub>a</sub>	Difference between sea and air temperature (whole degrees Fahrenheit)		7330	--
T <sub>d</sub> T <sub>d</sub>	Temperature of dew point (whole degrees Fahrenheit)	7133-44	7310-12	--
1	Group designator			--
d <sub>w</sub> d <sub>w</sub>	Direction from which waves are coming (tens of degrees)	9101-2	9420	4
P <sub>w</sub>	Period of waves (in code)	9210-20	9430	17
H <sub>w</sub>	Mean height of waves (in code)	9310-22	9440	18
ICE	Group designator for ice group		10280	--
C <sub>i</sub>	Description of kind of ice (in code)	10120	10220	19
K	Effect of ice on navigation (in code)		10230	20
D <sub>i</sub>	Bearing of ice limit (in code)	10130	10240	21
r	Distance of ice from ship (in code)	10130	10250	22
e	Orientation of ice field (in code)	10130	10260	23

## 1254. Example of a coded report:

Coded Message: 40480 62106 62614 97216 06421  
45420 56308 06120 12631 ICE 10403

Code Symbols	Code Figures	Decoded Data
YQL <sub>a</sub> L <sub>n</sub> L <sub>s</sub>	40480	4th day of week; octant, 0; latitude, 48.0°.
L <sub>o</sub> L <sub>o</sub> L <sub>o</sub> GG	62106	Longitude, 62.1°; time, 0600 G. C. T.
Nddff	62614	6 eighths of sky covered; wind direction, 260°; wind speed, 14 knots.
VVwwW	97216	Visibility, 5 miles; present weather, rain in past hour; past weather, rain.
PPPTT	06421	Pressure, 1006.4 mb., temperature 21°.
N <sub>h</sub> C <sub>L</sub> hC <sub>M</sub> C <sub>H</sub>	45420	4 eighths stratocumulus at a height of 1000-2000 feet. Altostratus or nimbostratus also present. No type C <sub>H</sub> clouds.
D <sub>s</sub> v <sub>s</sub> app	56308	Ship's course, southwest; ship's speed 16 to 18 knots; barometer steady or rising; barometric change, 0.8 mb.
0T <sub>s</sub> T <sub>a</sub> T <sub>d</sub> T <sub>d</sub>	06120	Group designator, 0; sea-air temperature difference, 11°; dew point 20°.
1d <sub>w</sub> d <sub>w</sub> P <sub>w</sub> H <sub>w</sub>	12631	Group designator, 1; wave direction, 260°; wave period, 5 to 7 seconds; wave height, 1½ feet.
ICE	ICE	Designator for ice group.
c <sub>2</sub> KD <sub>i</sub> re	10403	New ice; navigation unobstructed; ice limit toward south; less than one mile distant, ice edge lying in a direction SE to NW.

## 1300. ORDERING SUPPLIES

**1301.** Weather Bureau forms and supplies (including envelopes and carbon paper) may be obtained directly from any of the Weather Bureau port stations listed in section 1400. These supplies may also be obtained through the mail by checking the needed items on the back of Form 1210F in the section headed "Indicate Here Any Forms or Supplies Needed." When supplies are requested on Form 1210F, the ship's mailing address should be included in the space below the section for requesting supplies.

## 1400. ADDRESSES OF WEATHER BUREAU PORT OFFICES

Anchorage, Alaska, Anchorage International Airport.  
Balboa Heights, C. Z., Panama Canal Hydrographer.  
Baltimore, Md., Friendship International Airport.  
Boston, Mass., 1900 Post Office and Courthouse Building, Devonshire, Water, Congress, and Milk Streets, Zone 9.  
Brownsville, Tex., Administration Building, Rio Grande Valley International Airport.  
Charleston, S. C., Customhouse Building, 200 East Bay Street, Zone 8.  
Corpus Christi, Tex., R. F. D. 3, Box 494, Cliff Maus Field.  
Cristobal, C. Z., Panama Canal Hydrographer.  
Galveston, Tex., 409 Post Office and Courthouse Building, 601 Twenty-fifth Street.  
Honolulu, T. H., Box 3650, Honolulu International Airport.  
Houston, Tex., Box 4089, 1002 Federal Office Building, Fannin Street and Franklin Avenue, Zone 17.  
Jacksonville, Fla., Box 4158, Post Office Building, 311 West Monroe Street, Zone 1.  
Juneau, Alaska, Juneau Airport.  
Key West, Fla., 208 Federal Building, Simonton and Caroline Streets.  
Lake Charles, La., Box 572, Administration Building, Lake Charles Airport Base (Calcasieu Parish Airport).  
Miami, Fla., Dade County Vocational Education Building, 1410 Second Avenue NE., Zone 32.  
Mobile, Ala., RFD 5, Bates Field.  
New Orleans, La., 317 Post Office Building, 600 Camp Street, Zone 12.<sup>1</sup>  
New York, N. Y., Whitehall Building, 17 Battery Place, Zone 4.<sup>1</sup>  
Norfolk, Va., Post Office and Federal Courthouse, 600 Granby Street, Zone 10.  
Pensacola, Fla., Box 870, Post Office and Courthouse Building, Palafox and Chase Streets.  
Philadelphia, Pa., New Customhouse Building, Second and Chestnut Streets, Zone 6.  
Port Arthur, Tex., Box 636, Nederland, Tex., Jefferson Co. Airport.  
Portland, Maine, Administration Building, Portland City Airport, 101 Westbrook Street, Zone 4.  
Portland, Oreg., 320 Customhouse, Zone 9.  
Providence, R. I., T. F. Green Airport, Hillsgrove, R. I.  
San Diego, Calif., Administration Building, Lindbergh Municipal Airport, 2930 Pacific Highway, Zone 1.  
San Francisco, Calif., Room 218, Customhouse, 555 Battery Street, Zone 11.<sup>1</sup>  
San Juan, P. R., Box 5187, Ponce de Leon Avenue, Puerta de Tierra Station, Zone 27.  
Savannah, Ga., Box 17, Travis Field.  
Seattle, Wash., 703 Federal Building, First Avenue and Marion Street, Zone 4.  
Tampa, Fla., Box 2842, Weather Bureau Office, Tampa International Airport, Zone 1.  
Wilmington, N. C., Box 546, New Hanover County Airport.

<sup>1</sup> Supervising Marine Center.



## **II IDENTIFICATION**

## CHAPTER II. IDENTIFICATION DATA

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## CHAPTER II. IDENTIFICATION DATA

### 2000. GENERAL

**2001.** Each weather message must be identified in regard to the time of the report and the position of the ship taking the observation. The identification data include the following: Day of month, day of week, octant of globe, latitude, longitude, time of report, and course and speed of the ship. These data will be entered on Form 1210F in the columns specified in the following paragraphs.

### 2100. DAY OF MONTH

**2101.** Enter the day of the month (G. C. T.), in column 1. A new day begins at 0000 (midnight) G. C. T. The Greenwich date is not affected when crossing the International Date Line (180th meridian for most routes).

### 2200. DAY OF WEEK (Y)

**2201.** Select the code figure from Code Table 1 corresponding to the day of the week (Greenwich civil date) and enter the figure in column 2.

**CODE TABLE 1**

SYMBOL Y.—*Day of the week*

Day	Code figures
Sunday.....	1
Monday.....	2
Tuesday.....	3
Wednesday.....	4
Thursday.....	5
Friday.....	6
Saturday.....	7

### 2300. OCTANT OF GLOBE (Q)

**2301.** Select the code figure from Code Table 2 for the octant of the globe corresponding to the latitude and longitude of the ship. Enter the figure in column 3.

**CODE TABLE 2**

SYMBOL Q.—*Octant of the globe*

Longitude	Code figures
North latitude:	
0° W. to 90° W.....	0
90° W. to 180° W.....	1
180° E. to 90° E.....	2
90° E. to 0° E.....	3
South latitude:	
0° W. to 90° W.....	5
90° W. to 180° W.....	6
180° E. to 90° E.....	7
90° E. to 0° E.....	8

2400. LATITUDE ( $L_a L_c L_o$ )

**2401.** Enter the latitude of the ship, at the time of the observation, in degrees and tenths without decimal point in column 4. The tenths are obtained by dividing the minutes of arc by 6 and neglecting the remainder. If the group contains only two figures, add a zero as the first figure, e. g., 9.5 is entered as 095.

*Examples:*

- (a)  $48^{\circ}20' = 48.3^{\circ}$  (i. e.,  $20 \div 6 = 3$ , remainder neglected), which is entered as 483.  
 (b)  $7^{\circ}11'$  is entered as 071

2500. LONGITUDE ( $L_o L_c L_o$ )

**2501.** Enter the longitude of the ship in degrees and tenths in column 5. The tenths of longitude are obtained in the same manner as tenths of latitude (par. 2401). If the longitude is  $100^{\circ}$  or more, the first figure (1) will be omitted. The octant of the globe will show that the figure has been omitted.

*Example:*  $126^{\circ}25'$  longitude is entered as 264.

## 2600. GREENWICH CIVIL TIME (GG)

**2601.** Enter the time of the observation to the nearest hour (G. C. T.) in column 6. The time should be entered to two figures in accordance with the 24-hour clock, e. g., 00, 06, 12, 18. Twenty-four (24) should not be used to indicate midnight, e. g., midnight of the 7-8 should be entered as 00 on the 8th. Chart 1 (at the back of this manual) gives the local time corresponding to Greenwich mean noon.

2700. SHIP'S COURSE ( $D_s$ )

**2701.** Select the code figure from Code Table 13 corresponding to the course (true) made good by the ship in the 3 hours preceding the time of observation, and enter the figure in column 23.

CODE TABLE 13

SYMBOL  $D_s$ .—*Ship's course—(true) made good in 3 hours preceding the time of observation*

Code figures	True course	Code figures	True course
0	Ship hove to.	5	SW.
1	NE.	6	W.
2	E.	7	NW.
3	SE.	8	N.
4	S.	9	No information.

2800. SHIP'S SPEED ( $v_s$ )

**2801.** Select the code figure from Code Table 14 corresponding to the average speed of the ship during the 3-hour period prior to the observation. Enter the figure in column 24.

CODE TABLE 14

SYMBOL  $v_s$ .—*Ship's average speed made good during 3 hours preceding the time of observation*

Code figures	Speed	Code figures	Speed
0	Ship stopped.	5	13 to 15 knots.
1	1 to 3 knots.	6	16 to 18 knots.
2	4 to 6 knots.	7	19 to 21 knots.
3	7 to 9 knots.	8	22 to 24 knots.
4	10 to 12 knots.	9	More than 24 knots.



# CHAPTER III. WIND

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## CHAPTER III. WIND

### 3000. GENERAL

**3001.** Marine observers may accurately determine the direction and speed of the wind from the direction and character of the ripples and waves on the surface of the sea. Wind determined in this manner is termed the *true* wind, and will be entered in Form 1210F.

**3002.** The wind experienced on a moving ship is termed the *apparent* wind, and is the result of two motions—that of the ship and that of the air.

**3003.** Wind is classified as “gusty” when it is characterized by sudden, intermittent increases in speed, with at least 9 knots variation between peaks and lulls.

**3004.** A gusty wind shifting in a clockwise manner (counterclockwise in Southern Hemisphere) and associated with a cold front passage is termed a “wind shift” (see sec. 3400).

### 3100. WIND DIRECTION

**3110. GENERAL.** Wind direction is the true (not magnetic) direction from which the wind is blowing. Whenever possible, the true wind direction will be determined by observing the direction from which ripples and small waves are coming, since they run with the wind. When the true wind direction cannot be determined in this manner, use the procedure described in paragraph 3310.

**3120. ENTRY OF WIND DIRECTION DATA (dd) ON FORM 1210F.** Select the code figures from Code Table 4 corresponding to the true wind direction (dd), and enter the two figures in column 8.

**CODE TABLE 4**

SYMBOL dd.—*True direction, in 10's of degrees, FROM which wind is blowing (00-36)*

Code figures	Direction	Code figures	Direction
00	Calm.	19	185° to 194°.
01	5° to 14°.	20	195° to 204°.
02	15° to 24°.	21	205° to 214°.
03	25° to 34°.	22	215° to 224°.
04	35° to 44°.	23	225° to 234°.
05	45° to 54°.	24	235° to 244°.
06	55° to 64°.	25	245° to 254°.
07	65° to 74°.	26	255° to 264°.
08	75° to 84°.	27	265° to 274°.
09	85° to 94°.	28	275° to 284°.
10	95° to 104°.	29	285° to 294°.
11	105° to 114°.	30	295° to 304°.
12	115° to 124°.	31	305° to 314°.
13	125° to 134°.	32	315° to 324°.
14	135° to 144°.	33	325° to 334°.
15	145° to 154°.	34	335° to 344°.
16	155° to 164°.	35	345° to 354°.
17	165° to 174°.	36	355° to 4°.
18	175° to 184°.		

**NOTE.**—In case the true wind speed exceeds 99 knots, 50 will be added to “dd” and only the wind speed in excess of 100 knots will be coded. For example, if direction=163° and speed=121 knots, the wind will be coded as “6621” (dd=16+50; ff=121-100).

## 3200. WIND SPEED

**3210. GENERAL.** The wind speed is the average speed in knots of the wind blowing over the surface of the sea. The speed will be determined from the size and character of the waves that are running with the wind. Table 3-1 will be used to determine the wind speed by the sea condition.

**3220. ENTRY OF WIND SPEED DATA (ff) ON FORM 1210F.** Enter two figures for the wind speed (knots) in column 9. *Example:* 9 knots entered as 09; 15 knots entered as 15.

**3221.** Complete the "Gale or Storm" report on the back of Form 1210F whenever winds of 22 knots or higher are encountered in tropical seas, and 34 knots or higher elsewhere. Enter the data in accordance with the column headings.

TABLE 3-1.—*Determination of wind speed by sea condition*

Speed in knots	Descriptive terms	Sea conditions	Wind force (Beaufort)
Less than 1	Calm	Sea smooth and mirror-like	0
1-3	Light air	Scale-like ripples without foam crests	1
4-6	Light breeze	Small, short wavelets; crests have a glassy appearance and do not break.	2
7-10	Gentle breeze	Large wavelets; some crests begin to break; foam of glassy appearance. Occasional white foam crests.	3
11-16	Moderate breeze	Small waves, becoming longer; fairly frequent white foam crests.	4
17-21	Fresh breeze	Moderate waves, taking a more pronounced long form; many white foam crests; there may be some spray.	5
22-27	Strong breeze	Large waves begin to form; white foam crests are more extensive everywhere; there may be some spray.	6
28-33	Moderate gale	Sea heaps up and white foam from breaking waves begin to be blown in streaks along the direction of the wind; spindrift begins.	7
34-40	Fresh gale	Moderately high waves of greater length; edges of crests break into spindrift; foam is blown in well-marked streaks along the direction of the wind.	8
41-47	Strong gale	High waves; dense streaks of foam along the direction of the wind; crests of waves begin to topple, tumble, and roll over; spray may reduce visibility.	9
48-55	Whole gale	Very high waves with long overhanging crests. The resulting foam in great patches is blown in dense white streaks along the direction of the wind. On the whole, the surface of the sea is white in appearance. The tumbling of the sea becomes heavy and shocklike. Visibility is reduced.	10
56-63	Storm	Exceptionally high waves that may obscure small and medium-sized ships. The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility reduced.	11
64 and above	Hurricane	The air is filled with foam and spray. Sea completely white with driving spray; visibility very much reduced.	12

## 3300. TRUE WIND FROM THE APPARENT WIND

**3310. GENERAL.** When the surface of the sea cannot be observed, the true wind will be determined from the apparent wind as follows:

- (a) Estimate the apparent wind direction to the nearest 10 degrees off the bow of the ship and the apparent wind speed to the nearest 5 knots by observing the effects of the wind on the ship's flag, smoke, or rigging (see Table 3-2). If the ship has an anemometer, the speed of the apparent wind may be obtained from it.

(b) Construct a vector diagram or use Form 1209 to find the true wind (see Fig. 2).

TABLE 3-2.—*Apparent wind speed*

Speed (knots)	Indication
Less than 1	Calm; smoke rises vertically.
1-3	Smoke drifts from funnel.
4-6	Wind felt on face.
7-10	Wind extends light flag.
11-16	Wind raises dust, cinders, loose paper.
17-21	Wind waves and snaps flag briskly.
22-27	Whistling in rigging.
28-33	Inconvenience felt walking against wind.
34-40	Generally impedes progress.

**3311.** The following may be used to check the results obtained from a vector diagram or from Form 1209:

- (a) The true direction of the wind is always on the same side as, but farther from the bow than the apparent direction.
- (b) The true speed of the wind is greater than the apparent whenever the apparent direction is aft of the beam.
- (c) The true speed of the wind is less than the apparent whenever the true direction is forward of the beam.

**3320. SURFACE WIND AT SEA—FORM 1209.** This chart is designed to aid in the derivation of the true wind from the apparent wind (see Fig. 2). If a supply of the forms is desired for use aboard ship, they may be obtained from the Weather Bureau when requested in accordance with paragraph 1301.

**3321.** A wind scale, in knots, is printed on concentric circles that are drawn around the center of the chart. If the wind speed exceeds the printed scale, a new scale may be made by doubling or tripling the printed one. Wind direction for every 10 degrees is printed on lines that radiate from the center of the chart. The wind direction in degrees off the bow is plotted with reference to the black degree markings (top figures) printed at the ends of the radial lines. A separate slide, with a ship's-speed scale similar to the wind-speed scale used on the chart, is furnished with the forms. With the slide, the ship's speed is laid off vertically downward from the plotted point that represents the wind speed and the direction off the bow. The point plotted at the ship's speed has coordinate values representing the true wind speed and the true wind direction with respect to the ship's heading. The wind direction, in degrees off the starboard bow ( $0^{\circ}$  to  $360^{\circ}$ ), is read from the green-colored figures (bottom figures). The ship's heading in degrees must be added to the wind direction, as read from the chart, in order to have the true wind direction with respect to north ( $360^{\circ}$ ).

**3322.** Form 1209 is used as follows:

- (1) Select the radial line corresponding to the angle, in degrees off the bow (port or starboard), from which the wind is blowing and plot a point on it at a distance from the center (scale printed on concentric circles) equal to the speed of the apparent wind in knots.
- (2) Place the 0 (arrow point) of the ship's-speed slide at the point plotted in (1) and measure the ship's speed vertically downward toward the bottom of the chart. Plot a point on the chart opposite the value on the slide corresponding to the ship's speed at the time of the wind observation.
- (3) Read the wind speed corresponding to the point plotted in (2), estimating for the values between the concentric circles. This value is the *true wind speed*.
- (4) Read the angular value, from the figures printed in green (bottom figures), corresponding to the radial line from the center through the point plotted in (2). Add the value of the angle to the ship's heading in degrees to obtain the *true wind direction*. If the total exceeds  $360^{\circ}$ , subtract  $360^{\circ}$  from it.

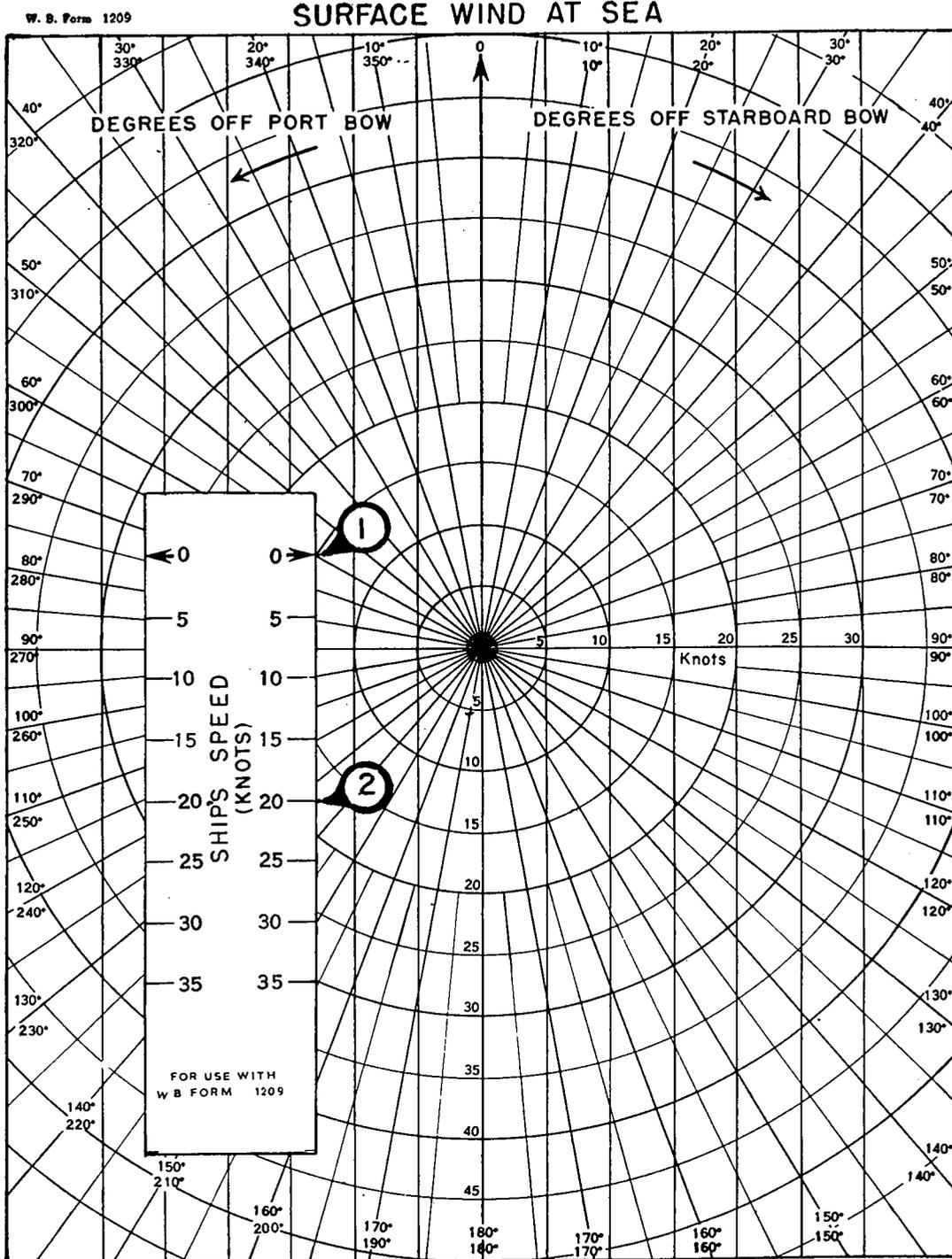


FIGURE 2.—Determination of true wind from the apparent wind, using Form 1209 and the associated ship's-speed scale. Given an apparent wind of 15 knots, 60° off the port bow, ship's speed 20 knots and heading 160°. Note the use of the scale in locating point 2, which is always below point 1 (the apparent wind) on a line through point 1 parallel to the vertical (green) lines on the form. The upper figures at the end of the radial lines (used in determining the direction of point 1) represent direction from 0°-180° off the bow (measured clockwise when off the starboard bow and counterclockwise when off the port bow); the lower figures (in green) are used when determining the direction of point 2, which is measured clockwise from the bow. The sum of the ship's heading and the direction of point 2 (226°) is 386°. Since this sum exceeds 360, the true wind direction is 386-360=26°.

## 3400. WIND SHIFTS

**3410. GENERAL.** Wind shifts are associated with the phenomena, characteristic of a cold-front passage, that are listed below:

- (1) Gusty winds shifting in a clockwise direction in the Northern Hemisphere (south shifting to west, or southwest shifting to northwest), and counterclockwise in the Southern Hemisphere (north shifting to west, or northwest shifting to southwest).
- (2) Rapid drop in dew point.
- (3) Rapid drop in air temperature.
- (4) Rise in pressure.
- (5) In summer; lightning, thunder, heavy rain, and possible hail.
- (6) In winter; frequent rain or snow squalls with cloud heights changing rapidly—to either higher or lower heights than existed before the wind shift.

**3411.** When a fast vessel overtakes a slow-moving cold front, items 1, 2, 3, and 4 of paragraph 3410 will occur in the reverse of the manner described. For example, the wind will shift counterclockwise in the Northern Hemisphere, and the dew point will rise rapidly. However, phenomena described in items 5 and 6 may be encountered in the frontal zone.

**3412.** Wind shifts may occur without precipitation, but they are usually accompanied by strong winds.

**3420. ENTRY OF WIND SHIFTS ON FORM 1210F.** Enter the time (G. C. T.) of wind shifts that occurred during the previous 6 hours in the column headed "Remarks" on the line pertaining to the observation. *Example:* Wind shifted SW to NW at 0835.





# CHAPTER IV. VISIBILITY

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## CHAPTER IV. VISIBILITY

### 4000. GENERAL

**4001.** Visibility is a term that denotes the greatest distance from an observer that an object of known characteristics can be seen and identified. For purposes of weather reports, the term expresses the maximum visibility common to one-half or more of the horizon circle.

### 4100. DETERMINATION OF VISIBILITY

**4101.** Whenever possible, estimations of visibility will be based upon objects whose distance from the observer is known (i. e., the horizon, or other ships). Estimations of the distance to a ship may be based on its apparent size and the portion visible. Table 4-1 is a guide to determining the distance to the horizon and to objects such as a familiar type of ship whose height is known, e. g., the horizon, when viewed from a height of 40 feet above sea level, appears at a distance of 7.6 nautical miles.

**4102.** Estimations of visibility will be based on the sharpness with which the object stands out. Sharp outlines, with little or no blurring of color, indicate that the visibility is much greater than the distance to the object. On the other hand, blurred or indistinct objects indicate the presence of haze or other phenomena that has reduced the visibility to about the distance to the objects.

**4103.** When the visibility is not the same in all directions, the highest value common to one-half or more of the horizon circle should be entered in Form 1210F. For example, if fog limits the visibility in the north and east quadrants of the horizon circle to 1 mile, while the visibility in the other two quadrants is 6 miles, the maximum visibility common to one-half of the horizon circle is 6 miles.

TABLE 4-1.—Distance to objects on the horizon at sea (nautical miles)

Height of observer's eyes above sea level (feet)	Height of object above sea level (feet)														
	0 <sup>1</sup>	10	20	30	40	60	80	100	150	200	300	400	600	800	1,000
10.....	3.8	7.2	8.7	9.9	10.8	12.5	13.9	15.1	17.7	19.8	23.5	26.5	31.6	36.0	39.8
15.....	4.6	8.0	9.5	10.7	11.6	13.3	14.7	15.9	18.5	20.6	24.3	27.3	32.4	36.8	40.6
20.....	5.4	8.7	10.2	11.4	12.3	14.0	15.4	16.6	19.2	21.3	25.0	28.0	33.1	37.5	41.3
25.....	6.0	9.3	10.8	12.0	12.9	14.6	16.0	17.2	19.8	21.9	25.6	28.6	33.7	38.1	41.9
30.....	6.6	9.9	11.4	12.6	13.5	15.2	16.6	17.8	20.4	22.5	26.2	29.2	34.3	38.7	42.5
35.....	7.1	10.4	11.9	13.1	14.0	15.7	17.1	18.3	20.9	23.0	26.7	29.7	34.8	39.2	43.0
40.....	7.6	10.8	12.3	13.5	14.4	16.1	17.5	18.7	21.3	23.4	27.1	30.1	35.2	39.6	43.4
45.....	8.0	11.3	12.8	14.0	14.9	16.6	18.0	19.2	21.8	23.9	27.6	30.6	35.7	40.1	43.9
50.....	8.5	11.7	13.2	14.4	15.3	17.0	18.4	19.6	22.2	24.3	28.0	31.0	36.1	40.5	44.3
60.....	9.3	12.5	14.0	15.2	16.1	17.8	19.2	20.4	23.0	25.1	28.8	31.8	36.9	41.3	45.1
70.....	10.0	13.2	14.7	15.9	16.8	18.5	19.9	21.1	23.7	25.8	29.5	32.5	37.6	42.0	45.8
80.....	10.7	13.9	15.4	16.6	17.5	19.2	20.6	21.8	24.4	26.5	30.2	33.2	38.3	42.7	46.5
90.....	11.4	14.5	16.0	17.2	18.1	19.8	21.2	22.4	25.0	27.1	30.8	33.8	38.9	43.3	47.1
100.....	12.0	15.1	16.6	17.8	18.7	20.4	21.8	23.0	25.6	27.7	31.4	34.4	39.5	43.9	47.7

<sup>1</sup> Horizon.

## 4200. CODING AND ENTRY OF VISIBILITY DATA (VV) ON FORM 1210F

4201. Select the code figures from Code Table 5 corresponding to the visibility and enter the figures in column 10.

CODE TABLE 5

SYMBOL VV.—*Visibility*

Code figures	Visibility range <sup>1</sup>
90	Less than 50 yards (50 meters).
91	50 yards (50 meters).
92	200 yards (200 meters).
93	$\frac{1}{4}$ nautical mile (500 meters).
94	$\frac{1}{2}$ nautical mile (1,000 meters).
95	1 nautical mile (2,000 meters).
96	2 nautical miles (4,000 meters).
97	5 nautical miles (10 kilometers).
98	10 nautical miles (20 kilometers).
99	25 nautical miles (50 kilometers) or more.

1. In case the observed visibility is between two of the distances in the table, the code figure for the lesser distance will be reported, e. g., when the visibility is between 50 and 200 yards, code the visibility as 91.



# CHAPTER V. WEATHER

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## CHAPTER V. WEATHER

### 5000. GENERAL

**5001.** Weather elements of an observation comprise thunderstorms, lightning, waterspouts, squalls, and precipitation in any form. Fog, haze, smoke, and dust are classified as obstructions to vision. Rainbows, halos, coronas, and auroras are recorded as atmospheric phenomena.

**5002.** Clouds are not described here, since they are considered separately in chapter VIII, and are described in detail in Weather Bureau Circular S.

### 5100. THUNDERSTORMS AND LIGHTNING

**5110. GENERAL.** A thunderstorm is regarded as occurring at the ship when thunder is heard. Lightning occurs as an electrical discharge within a cloud, from cloud to cloud, or from cloud to sea. Distant lightning is any lightning that occurs so far from the observer that the resulting thunder cannot be heard. It may be observed as streaks or sheets.

**5120. INTENSITY OF THUNDERSTORM.** Classification of a thunderstorm as slight, moderate, or heavy is based upon the appearance of the storm from the point of observation. The thunderstorm may be classified as slight throughout its history as viewed from this point, or it may be classified during its passage by the ship as slight, moderate, heavy; and, as it recedes, moderate and slight. Each classification is described below.

**5121. *Slight Thunderstorm.*** Lightning occurs within the cloud and rainfall is light or moderate. Small hail may also occur. Thunder is not loud, and lightning occurs at intervals of a minute or more. The surface wind speed, at the beginning of or during the storm, does not exceed 26 knots, and any sudden increase in speed is of short duration.

**5122. *Moderate Thunderstorm.*** Loud peals of thunder occur at brief intervals, and frequent flashes of lightning occur from cloud to surface, as well as from cloud to cloud; rain is moderate or heavy, and small hail is light or moderate. An onrush of wind may precede the storm, with a speed as high as 35 knots. Extensive masses of dark clouds showing visible indications of turbulence and rapid horizontal motion are usually observable.

**5123. *Heavy Thunderstorm.*** Sharp and pronounced thunder and lightning occur almost continuously. Heavy rain occurs, sometimes accompanied by hail. The wind preceding and accompanying the storm may reach a speed in excess of 35 knots. A rapid drop in temperature occurs, sometimes as much as 20° F. in 5 minutes.

### 5200. WATERSPOUTS AND SQUALLS

**5201.** Waterspouts occur when conditions are favorable for intense thunderstorm activity. The distinguishing feature is the funnel-shaped appendage that hangs from the base of the cloud. The storm is described as a tornado when it occurs over land.

**5202.** A squall is a strong wind that increases suddenly in speed, maintains a peak speed over a period of minutes, and decreases in speed; similar fluctuations will occur at succeeding intervals.

## 5300. PRECIPITATION

**5310. GENERAL.** Precipitation includes all forms of moisture that fall to the earth's surface—rain, drizzle, snow, hail, sleet, and ice crystals. Precipitation is classified as to its character, intensity, and type.

**5320. CHARACTER OF PRECIPITATION.** The classification of precipitation with respect to character is described below.

**5321. *Continuous.*** Precipitation usually associated with stratiform clouds. Any increase or decrease of intensity is gradual.

**5322. *Intermittent.*** Intensity increases or decreases gradually, and precipitation stops and recommences at least once within the hour preceding the time of observation.

**5323. *Showery.*** Precipitation associated with cumuliform clouds, especially swelling cumulus and cumulonimbus. Intensity varies rapidly. Showers begin and end abruptly.

**5324. *Combinations.*** When showers occur with continuous or intermittent precipitation, the precipitation does not always stop between showers. Under these conditions, precipitation is marked by a sudden increase and decrease in intensity as the showers abruptly begin and end.

**5330. INTENSITY OF PRECIPITATION.** The intensity of precipitation may be determined by its rate of fall and by the amount it reduces the visibility. The intensity is classified as light, moderate, or heavy. Tables 5-1 and 5-2 will be used as guides in determining the intensity of rain and snow respectively.

TABLE 5-1.—*Intensity of rain*

Slight.....	Individual drops are easily identifiable; spray over hard surfaces is slight; pools form very slowly; over 2 minutes may be required to wet decks and similar dry surfaces.
Moderate.....	Individual drops are not clearly identifiable; some spray over hard surfaces; pools form rapidly.
Heavy.....	Rain seemingly in sheets; individual drops are not identifiable; heavy spray to height of several inches is observable over hard surfaces; visibility is greatly reduced.

TABLE 5-2.—*Intensity of snow*

Slight.....	Visibility 1,100 yards (1,000 meters) or more.
Moderate.....	Visibility less than 1,100 yards (1,000 meters), but not less than 550 yards (500 meters).
Heavy.....	Visibility less than 550 yards (500 meters).

**5340. TYPES OF PRECIPITATION.** Precipitation comprises liquid, freezing, and frozen types. These types are described below.

**5341. *Liquid Precipitation.*** Liquid precipitation is classified as drizzle or rain as follows:

**5341.1. Drizzle.** Very small and uniformly dispersed droplets that appear to float in the air and to follow very light air currents. Drizzle usually falls from low stratus clouds and is frequently accompanied by low visibility and fog.

**5341.2. Rain.** Falling drops of liquid water that are larger than those in drizzle. Rain, as used in this manual, does not include drizzle and freezing rain.

**5342. Freezing Precipitation.** Freezing precipitation is classified as freezing rain or freezing drizzle, as follows:

**5342.1. Freezing Rain.** Rain that falls in liquid form and freezes to exposed surfaces. When the fall is so rapid that runoff occurs, the ice will usually appear as glaze.

**5342.2. Freezing Drizzle.** Drizzle that freezes similarly to rain.

**5343. Frozen Precipitation.** Solid precipitation is classified as follows:

**5343.1. Sleet (Ice Pellets).** Transparent, somewhat globular hard grains of ice, about the size of raindrops, that rebound when striking hard surfaces. Sleet may fall as continuous, intermittent, or showery precipitation.

**5343.2. Hail.** Ice balls or stones, ranging in diameter from that of medium-size raindrops to an inch or more. They may fall detached or frozen together into irregular, lumpy masses. They are composed either of clear ice or of alternating clear and opaque layers. Hail often accompanies thunderstorm activity. Surface temperatures are usually above freezing when hail occurs. The size is based on the diameter, in inches, of normally shaped hailstones.

**5343.3. Small Hail.** Semitransparent, round, or conical grains of frozen water. Each grain generally consists of a smaller grain of soft hail as a nucleus, surrounded by a very thin ice layer, which gives it a glazed appearance. The grains are wet when they fall at temperatures above freezing. They are not crisp or easily compressible, and do not generally rebound or burst when striking hard surfaces.

**5343.4. Snow.** White or translucent ice crystals chiefly in complex branched hexagonal form (six-pointed stars), often mixed with simple crystals. Snow occurs under conditions that are similar, temperature excepted, to those of corresponding forms of rain.

**5343.5. Snow Pellets (Soft Hail).** White, opaque, round, or occasionally conical kernels of snow-like consistency,  $\frac{1}{16}$  to  $\frac{1}{8}$ -inch in diameter. They are crisp and easily compressible, and they may rebound or burst when striking hard surfaces. They occur almost exclusively in showers.

**5343.6. Snow Grains (Granular Snow).** The solid equivalent of drizzle. They take the form of minute, branched, star-like snowflakes, or of very fine, simple crystals. At times they have the appearance of rime. They occur under conditions similar to those of drizzle, except that the temperature is lower.

**5343.7. Ice Crystals.** Small, unbranched crystals in the form of rods or plates that have a descending motion and that may be observed when the sky is clear. Ice crystals are associated with halo phenomena and with temperatures near or below  $0^{\circ}$  F.

## 5400. FOG AND RIME

**5410. FOG.** Minute droplets suspended in the atmosphere. These droplets have no visible downward motion. Fog differs from clouds in that the base of fog is at the surface, while the base of clouds is above the surface. It is easily distinguished from haze by its dampness and grey color. It is unusual for fog to form when the difference between the air temperature and the temperature of the dew point is greater than  $4.0^{\circ}$  F.

**5411. Shallow Fog.** Low-lying fog that does not reduce horizontal visibility at a level 33 feet (10 meters) or more above the surface.

**5412. Ice Fog.** Suspended particles in the form of ice crystals. It occurs at low temperatures, and usually in clear, calm weather in high latitudes. The sun is usually visible and may cause halo phenomena.

**5420. RIME.** Rime is classified as soft or hard.

**5420.1. Soft rime** consists of white layers of ice crystals deposited chiefly on vertical surfaces—especially on points and edges of objects—generally in super-cooled fog. On the windward side of the rigging, soft rime may grow to very thick layers, long feathery cones, or needles pointing into the wind and having a structure similar to that of frost.

**5420.2.** Hard rime is an opaque, granular mass of ice deposited chiefly on vertical surfaces in wet fog at temperatures below 32° F. It is more compact and shapeless than soft rime, and may build out into the wind as glazed cones or feathers.

### 5500. HAZE, SMOKE, AND DUST

**5501.** Haze, smoke, and dust may be observed near land. Haze resembles a uniform veil with a bluish tinge when viewed against the sun or clouds at the horizon. When smoke is present the sun has a reddish tinge. Dust imparts a tannish or grayish hue to distant objects, and the sun appears pale with a yellowish tinge.

### 5600. MISCELLANEOUS

**5601.** In the column headed "Remarks" of Form 1210F, enter halos (solar or lunar), coronas (solar or lunar), rainbows, fog bows, and auroras.

### 5700. PRESENT WEATHER (ww)

**5710. GENERAL.** The term "present weather" refers to the state of the weather occurring at the time of the observation or within the 1-hour period prior to the observation. Code Table 6, "Present Weather" (in tables at the back of this manual) lists 100 weather situations, numbered from 00 to 99, which include one or more of the weather elements discussed in the first portion of this chapter.

**5720. CODING.** Select the number from Code Table 6 that corresponds most nearly to the weather occurring at the time of the observation, or within 1 hour preceding the time of the observation. When precipitation is *not* occurring at the ship at the time of observation, the selection of "ww" should be made from code figures 00 to 49, inclusive. When precipitation *is* occurring at the time of the observation, the selection should be made from code figures 50 to 99, inclusive.

**5730. ENTRY OF PRESENT WEATHER DATA ON FORM 1210F.** The code number selected as best representing the present weather (ww) should be entered in column 11 of Form 1210F. If more than one code number appears to be required, the *highest* should be entered in column 11, and all other appropriate numbers entered in the column headed "Remarks."

**5731.** Whenever fog is encountered, enter it in the "Fog Reports" section on the back of Form 1210F. Enter the character of the fog as "slight," "heavy," "shallow," or "ice fog."

**5732.** Enter the time (G. C. T.) of beginning and ending of precipitation in the column headed "Remarks."

### 5800. PAST WEATHER (W)

**5810. GENERAL.** The term "past weather" refers to the state of the weather during the 6-hour interval prior to the time of the 00, 06, 12, and 18 G. C. T. observations. However, when the ship is in the vicinity of a tropical storm, the Weather Bureau may request additional observations at 03, 09, 15, and 21 G. C. T. (see par. 1021). For these extra observations, "past weather" refers to the state of the weather during the 3-hour interval prior to the time of the observation, and references in the following instructions to 6 hours will be understood, under these special circumstances, to refer to 3 hours.

**5820. CODING AND ENTRY OF PAST WEATHER DATA (W) ON FORM 1210F.** Select the code figure from Code Table 7 corresponding to the weather during the preceding 6 hours, and enter it in column 12. To a certain extent, the combined data coded as "W" and "ww" should give a complete description of the weather during the preceding 6 hours. When the weather occurring at the time of the observation (rather than the hour before it) is coded as "ww," the weather during the full 6 hours prior to the time of the observation must be coded as "W." When the weather that has occurred during the hour ending with the observation is coded as "ww," weather during the 5 hours preceding the hour covered by "ww" will be coded as "W." For example, if a rain shower has occurred during the hour preceding the 0600 G. C. T. observation, and the weather was generally cloudy during the entire 6-hour period prior to the observation, "ww" would be coded as 25, and "W" as 2. If showers were general throughout the 6-hour period,

including the hour before the observation, "ww" would be coded as 25, and "W" as 8. When precipitation *has* occurred during the 6 hours preceding the time of the observation, but has *not* occurred during the hour preceding the observation, code figures 5, 6, 7, 8, or 9, as appropriate, will be used for "W."

5821. When thunder has been heard during the 6-hour period before the observation, but too early to be coded as "ww," "W" will always be coded as 9, regardless of other aspects of the weather. In general, when two or more code figures are appropriate for symbol "W," the highest figure will be used.

CODE TABLE 7

SYMBOL W.—*Past weather*

Code figure	Description
0	Clear or few clouds.
1	Partly cloudy or variable sky.
2	Cloudy or overcast.
3	Sandstorm or duststorm, or drifting or blowing snow.
4	Fog, smoke, dust, or haze.
5	Drizzle.
6	Rain.
7	Snow, rain and snow mixed, or sleet.
8	Showers.
9	Thunderstorm, with or without precipitation.



## **VI PRESSURE**

# CHAPTER VI. PRESSURE

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## CHAPTER VI. PRESSURE

### 6000. GENERAL

**6001.** Atmospheric pressure is the pressure exerted by the weight of a column of air, of unit area, extending vertically from a given surface (sea level, for instance) to the top of the atmosphere. Atmospheric pressure may be measured with aneroid or mercurial barometers and aneroid barographs.

**6010. INSTALLATION OF BAROMETERS.** Barometers used in taking weather observations should be hung in the chart room or wheel house on a bulkhead. The location should be as free as possible of vibrations and rapid changes in temperature. It should not be mounted close to sources of artificial heat, such as steam pipes and electric lights. The barometer scale should be placed at about eye level above the deck.

**6020. BAROMETER CORRECTIONS.** To insure comparability of pressure data, the Weather Bureau tests and assigns a number to each barometer in good condition. The correction applicable to the barometer is entered on a tag that is issued to the ship. The correction should be posted in a convenient place near the barometer and applied to each barometer reading. The correction should also be entered opposite the caption "correction" at the head of column 14 of each Form 1210F. A revised correction should be obtained at least once every 3 months. The correction is determined by comparing readings of the ship's barometer with pressure values obtained from a standard barometer. For this purpose, a precision aneroid may be carried aboard ship by a Weather Bureau representative, or the comparison may be made by telephone contact with one of the port offices listed in section 1400. When comparisons indicate that a barometer is defective, the Weather Bureau representative will recommend that it be replaced or repaired.

**6021.** Whenever barometric comparisons cannot be made directly or by telephone, Form 1202, "U. S. Weather Bureau Barometer Comparison Card" may be filled out in accordance with the instructions printed on it and mailed to the nearest Weather Bureau port office (see sec. 1400). The Weather Bureau will determine the correction applicable to the barometer and issue a new correction tag.

### 6100. ANEROID BAROMETERS

**6110. GENERAL.** Pressure is indicated on an aneroid barometer by the position of a hand on a graduated dial. Aneroids have dials graduated at intervals equivalent to inches and hundredths, millibars and tenths, or millimeters of mercury (see Fig. 3). To insure that a precision aneroid barometer will retain its calibration, it must be protected from violent jars.

**6120. READING ANEROID BAROMETERS.** To determine sea-level pressure from the aneroid barometer:

- (1) Tap the face of the instrument lightly with the finger or the eraser-end of a pencil to bring the hand to its true position.
- (2) Read to the nearest 0.01 inch, 0.1 millibar, or 0.1 millimeter, estimating for values between the scale graduations.
- (3) Apply the correction established in accordance with paragraph 6020.

*Example:*

Barometer as read.....	Inches 29.88
Correction.....	-.07
Barometer corrected.....	29.81

**6121.** To avoid errors of parallax when the aneroid barometer is read, the line of sight should be perpendicular to the index hand on the instrument. If the aneroid has a mirror surface on the dial, parallax may be avoided by viewing it in a position such that the index hand and its image coincide.

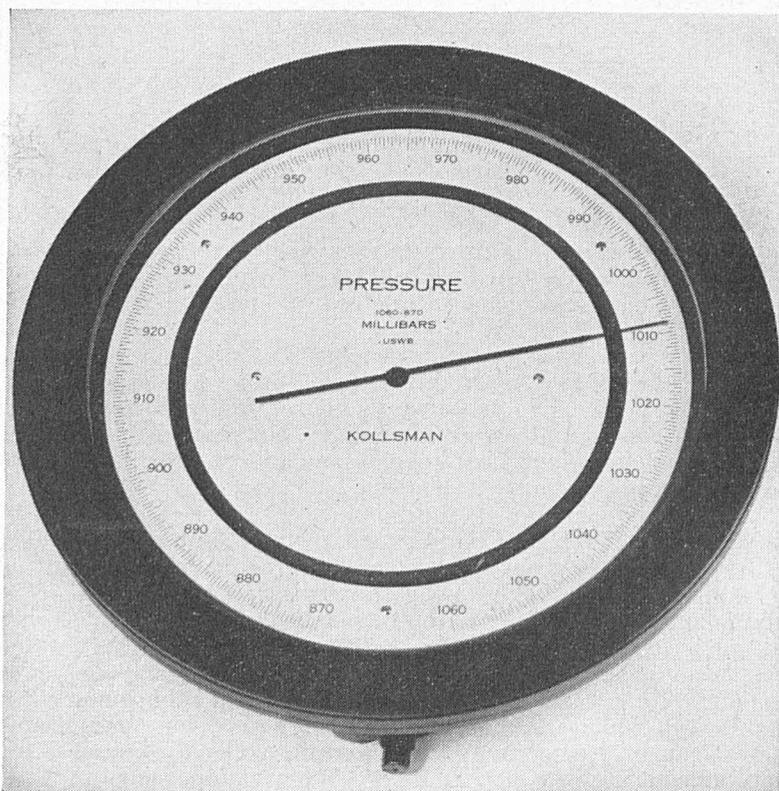


FIGURE 3.—Aneroid barometer.

## 6200. ANEROID BAROGRAPHS

**6210. GENERAL.** A continuous record of the atmospheric pressure is recorded on a chart by the aneroid barograph (see Fig. 4). The barograph consists of an aneroid pressure unit, suitable pen linkage, and a clock-driven drum upon which the chart is fastened. The scale of the  $2\frac{1}{2}$  to 1 (Weather Bureau marine type) open-scale microbarograph is magnified, or opened, so that a pressure difference of 1 inch of mercury is represented on the chart by a linear distance of  $2\frac{1}{2}$  inches. The distance between adjacent horizontal pressure lines printed on the chart is equivalent to 0.02 inch of mercury. On the 1-to-1 scale, a pressure difference of 1 inch of mercury is represented on the chart by a linear distance of 1 inch. The distance between adjacent horizontal pressure lines is equivalent to 0.05 inch of mercury.

**6211.** Aneroid barographs furnished or tested by the Weather Bureau are adjusted to read sea-level pressure when installed aboard ship. The barograph should be adjusted to a zero correction each time a correction is obtained for the ship's aneroid or mercurial barometer.

**6212.** For purposes of the weather observation, the atmospheric pressure, as entered on Form 1210F, will not be obtained from the barograph, but will be read from the barometer; however, the 3-hour pressure tendency (see sec. 6300) will be read from the barograph trace.

**6220. READING THE BAROGRAPH.** After obtaining the 3-hour pressure tendency from the barograph in accordance with paragraph 6320, open the case and make a time check by gently moving the pen up and down to make a line about two chart divisions in height. The pen should be returned to its original position. Before closing the case, check to be certain that the clock is running and that the ink is flowing properly. If the instrument is exposed to cold weather and the dashpot liquid hinders free movement of the pen arm, do not make a time check.

**6221.** Whenever the pressure changes an amount sufficient to cause the pen arm to reach the top or bottom of the chart, turn the thumbnut on top of the aneroid cells enough to move the pen exactly 1 inch (pressure value) toward the center of the chart. Renumber the pressure lines accordingly (see par. 6231 (3)). When the pressure returns to normal, move the pen exactly 1 inch (pressure value) in the opposite direction, and renumber the pressure lines to correspond with their original values.

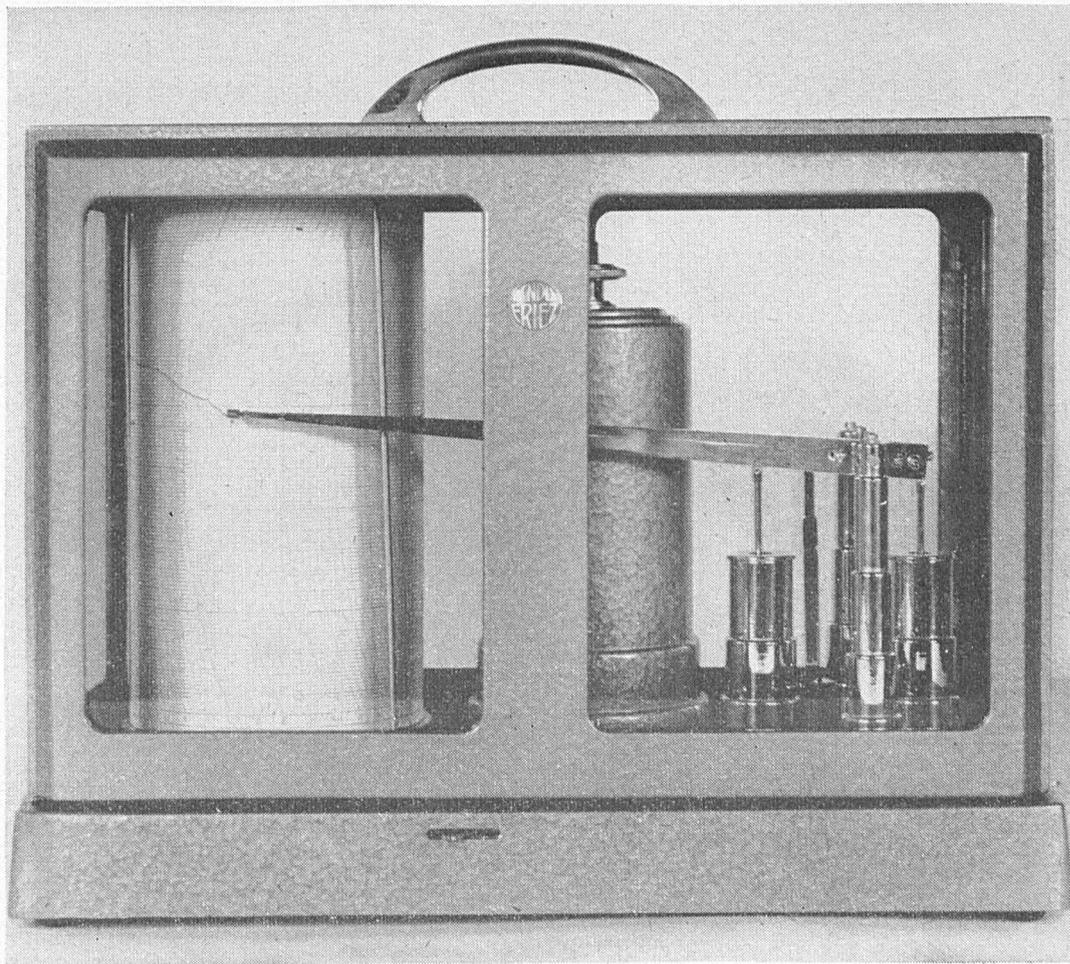


FIGURE 4.—Aneroid barograph (Weather Bureau marine type).

**6230. BAROGRAPH CHARTS—FORMS 1068 to 1068D.** The Weather Bureau will supply barograph charts, which should be requested by Weather Bureau form number. The request should be made in accordance with paragraph 1301. If the charts do not have a Weather Bureau form number, the Weather Bureau barometer inspector should be consulted before the forms are ordered.

**6230.1.** The barograph chart should always be changed immediately following the 0000 G. C. T. observation of the first of each month, and each time the clip bar on the drum approaches within 3 to 6 hours of the pen. Change the chart at least 3 hours before the next scheduled observation.

**6231. Entries on the Barograph Chart (see Fig. 5).** Before placing a chart on the barograph, use a typewriter, rubber stamp, or pen and ink to enter the following data:

- (1) In the spaces provided, enter the nationality and name of the ship, write "G. C. T." in the space "Recorded in -----," and, on the first chart for each month, enter the time that the pen is touched (e. g., pen touched at 0000, 0600, 1200, and 1800 G. C. T.).
- (2) Across the top of the chart enter the date of each day's record on the noon line.
- (3) The horizontal lines appropriate to each whole inch of pressure are identified by two zeros printed on the chart, and represent pressure to tenths and hundredths. Along each noon line and immediately preceding the printed zeros, enter the appropriate value of each whole inch of pressure in tens and units. On Form 1068D, the highest value entered (near the top of the chart) will be 30, the next lower 29, etc.
- (4) Enter the time (G. C. T.) of lowering the pen just above the point where the trace will begin.

## MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

WB FORM 1068 D      PEN AND IS 2.825 INCHES LONG      AND IS 3.375 INCHES ABOVE CLOCK FLANGE      REVISED AUGUST 1947  
 U. S. DEPARTMENT OF COMMERCE, WEATHER BUREAU

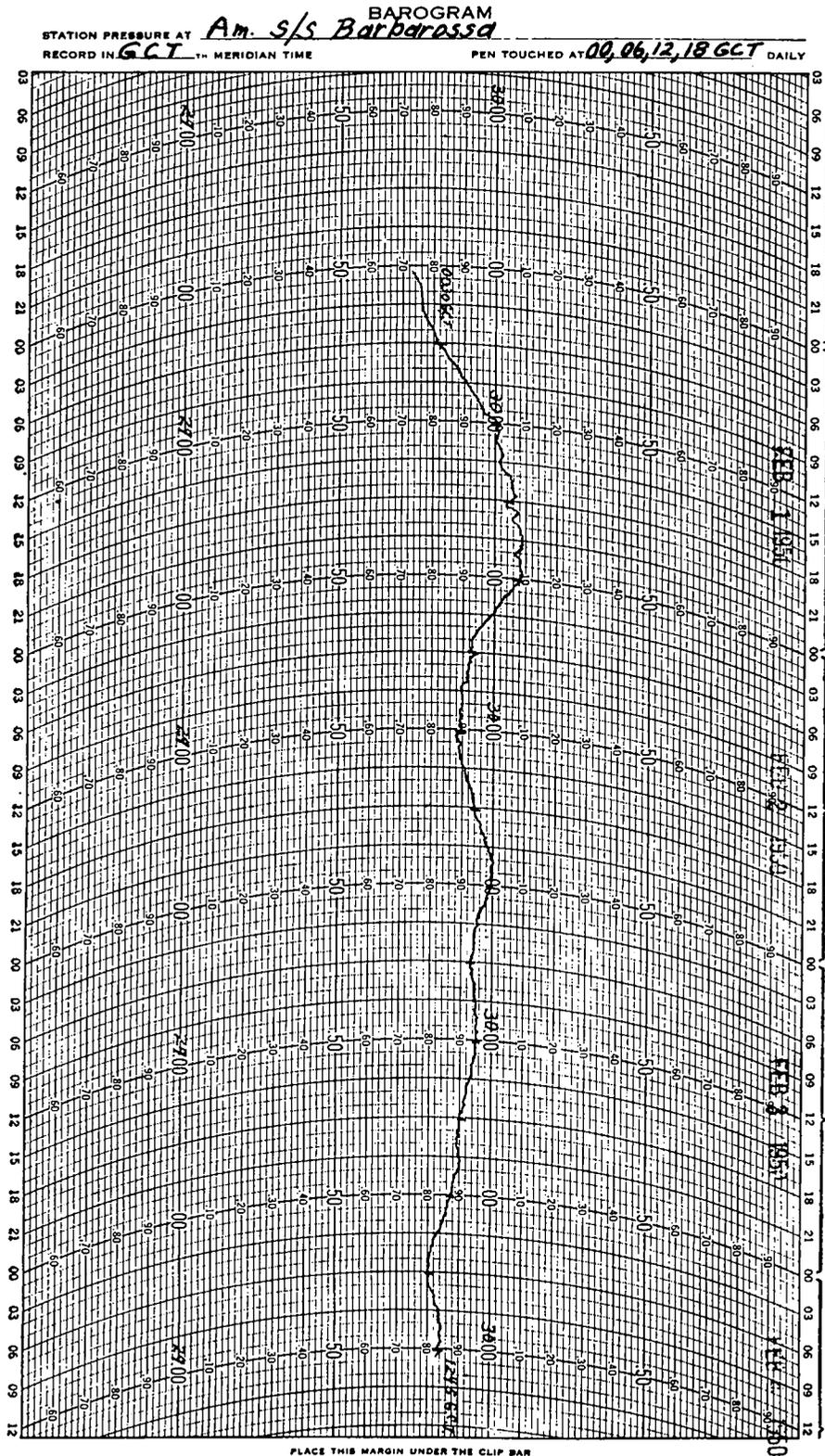


FIGURE 5.—Barograph chart with entries made in accordance with paragraph 6231. The short vertical dashes on the trace were made when the pen was touched at each scheduled observation. The 3-hour pressure tendencies for the period are entered on the Form 1210F in Figure 1.

**6232. Installation of Barograph Chart.** On most types of barographs the form is removed and the new one put on in the following manner:

- (1) Raise the pen from the form with the lever provided for the purpose, open the case, and remove the cylinder from the barograph. Loosen the clip holding the form and remove the used sheet. (Use care to avoid smearing the wet ink.) Wind the clock. If any adjustments are necessary for gain or loss of time, the clock may be adjusted through the small inspection hole in the top of the cylinder.
- (2) Wrap the new chart around the barograph cylinder so that it fits the cylinder tightly, and that its bottom edge is in contact with the flange at the bottom of the cylinder all the way around. When the chart is correctly placed, the ends of the horizontal coordinate lines will match.
- (3) Place the clip bar over the end of the chart and smooth out any bulges by pressing in the direction of the clip bar.
- (4) Place the cylinder on the barograph and turn it clockwise until the pen, if put on the form, would touch it at a point a little to the right of the proper time. Take up the backlash by turning the cylinder in a counterclockwise direction until the pen reads correctly with respect to time.
- (5) Fill the pen with the special barograph ink provided for the purpose, and lower the pen to the cylinder.

**6232.1.** On each chart removed from the barograph:

- (1) Enter the time of any adjustment, and an arrow to indicate the point of adjustment.
- (2) Enter, above the end of the trace, the time of removing the chart.
- (3) When the pen has been reset (see par. 6221) to compensate for a large pressure change, indicate and check the points of change to be certain that the pen was returned to its normal position following return to normal pressure.

### 6300. THREE-HOUR PRESSURE TENDENCY

**6310. GENERAL.** The pressure tendency is composed of three elements: (1) The net change in barometric pressure within the 3-hour period before an observation, (2) indication as to whether the barometric pressure is higher or lower at the end of the period than at the beginning of the period, and (3) the characteristic of the change during the period.

**6320. DETERMINATION OF TENDENCY FROM THE BAROGRAPH.** The pressure tendency may be determined from the barograph as described below:

- (1) Find the net amount of pressure change over the 3-hour period in the following manner:
  - a. Determine to the nearest 0.005 inch the difference in pressure between the beginning and the end of the period. No barometer correction (see par. 6020) is to be applied to the value of the trace at these points.
  - b. Observe whether the pressure is the same as, or higher or lower than it was at the beginning of the period.
- (2) Determine the characteristic of the trace by observing whether the trace shows a falling or rising, steady or unsteady, character, or a combination of these. If the characteristic is so variable over the 3-hour period that it cannot be identified, determine it for the 1-hour period immediately preceding the observation. Code Table 15 indicates the 10 possible characteristics.

**6330. DETERMINATION OF TENDENCY FROM THE BAROMETER.** If the ship does not have a barograph, determine to the nearest 0.01 inch the difference in pressure between the barometric reading at the time of the observation and the reading as entered in the ship's log 3 hours earlier. If the pressure has increased or remained unchanged during the preceding 3 hours, record the characteristic as code figure "2" from Code Table 15, and as "7" if the pressure has decreased. The other code figures listed in Code Table 15 will not be used when the tendency is determined from the barometer.

### 6400. CODING AND ENTRIES OF PRESSURE DATA ON FORM 1210F

**6410. BAROMETRIC PRESSURE (PPP).** Enter the barometric pressure exactly as read (in the original units and before any corrections have been applied) in column 13, "Barometer as read." Apply the correction entered at the top of the column and enter the corrected reading in column 14, "Barometer corrected."

## CODE TABLE 8

SYMBOL PPP.—Corrected barometer reading

Code in "tens," "units," and tenths of millibars, omit initial 0 or 10]

1 inch = 33.86395 mb. 1 mb. = 0.02952993 inch]

In.	Milli- bars												
27.50	931.3	28.00	948.2	28.50	965.1	29.00	982.1	29.50	999.0	30.00	1,015.9	30.50	1,032.9
27.51	931.6	28.01	948.5	28.51	965.5	29.01	982.4	29.51	999.3	30.01	1,016.3	30.51	1,033.2
27.52	931.9	28.02	948.9	28.52	965.8	29.02	982.7	29.52	999.7	30.02	1,016.6	30.52	1,033.5
27.53	932.3	28.03	949.2	28.53	966.1	29.03	983.1	29.53	1,000.0	30.03	1,016.9	30.53	1,033.9
27.54	932.6	28.04	949.5	28.54	966.5	29.04	983.4	29.54	1,000.3	30.04	1,017.3	30.54	1,034.2
27.55	933.0	28.05	949.9	28.55	966.8	29.05	983.7	29.55	1,000.7	30.05	1,017.6	30.55	1,034.5
27.56	933.3	28.06	950.2	28.56	967.2	29.06	984.1	29.56	1,001.0	30.06	1,018.0	30.56	1,034.9
27.57	933.6	28.07	950.6	28.57	967.5	29.07	984.4	29.57	1,001.4	30.07	1,018.3	30.57	1,035.2
27.58	934.0	28.08	950.9	28.58	967.8	29.08	984.8	29.58	1,001.7	30.08	1,018.6	30.58	1,035.6
27.59	934.3	28.09	951.2	28.59	968.2	29.09	985.1	29.59	1,002.0	30.09	1,019.0	30.59	1,035.9
27.60	934.6	28.10	951.6	28.60	968.5	29.10	985.4	29.60	1,002.4	30.10	1,019.3	30.60	1,036.2
27.61	935.0	28.11	951.9	28.61	968.8	29.11	985.8	29.61	1,002.7	30.11	1,019.6	30.61	1,036.6
27.62	935.3	28.12	952.3	28.62	969.2	29.12	986.1	29.62	1,003.1	30.12	1,020.0	30.62	1,036.9
27.63	935.7	28.13	952.6	28.63	969.5	29.13	986.5	29.63	1,003.4	30.13	1,020.3	30.63	1,037.3
27.64	936.0	28.14	952.9	28.64	969.9	29.14	986.8	29.64	1,003.7	30.14	1,020.7	30.64	1,037.6
27.65	936.3	28.15	953.3	28.65	970.2	29.15	987.1	29.65	1,004.1	30.15	1,021.0	30.65	1,037.9
27.66	936.7	28.16	953.6	28.66	970.5	29.16	987.5	29.66	1,004.4	30.16	1,021.3	30.66	1,038.3
27.67	937.0	28.17	953.9	28.67	970.9	29.17	987.8	29.67	1,004.7	30.17	1,021.7	30.67	1,038.6
27.68	937.4	28.18	954.3	28.68	971.2	29.18	988.2	29.68	1,005.1	30.18	1,022.0	30.68	1,038.9
27.69	937.7	28.19	954.6	28.69	971.6	29.19	988.5	29.69	1,005.4	30.19	1,022.4	30.69	1,039.3
27.70	938.0	28.20	955.0	28.70	971.9	29.20	988.8	29.70	1,005.8	30.20	1,022.7	30.70	1,039.6
27.71	938.4	28.21	955.3	28.71	972.2	29.21	989.2	29.71	1,006.1	30.21	1,023.0	30.71	1,040.0
27.72	938.7	28.22	955.6	28.72	972.6	29.22	989.5	29.72	1,006.4	30.22	1,023.4	30.72	1,040.3
27.73	939.0	28.23	956.0	28.73	972.9	29.23	989.8	29.73	1,006.8	30.23	1,023.7	30.73	1,040.6
27.74	939.4	28.24	956.3	28.74	973.2	29.24	990.2	29.74	1,007.1	30.24	1,024.0	30.74	1,041.0
27.75	939.7	28.25	956.7	28.75	973.6	29.25	990.5	29.75	1,007.5	30.25	1,024.4	30.75	1,041.3
27.76	940.1	28.26	957.0	28.76	973.9	29.26	990.9	29.76	1,007.8	30.26	1,024.7	30.76	1,041.7
27.77	940.4	28.27	957.3	28.77	974.3	29.27	991.2	29.77	1,008.1	30.27	1,025.1	30.77	1,042.0
27.78	940.7	28.28	957.7	28.78	974.6	29.28	991.5	29.78	1,008.5	30.28	1,025.4	30.78	1,042.3
27.79	941.1	28.29	958.0	28.79	974.9	29.29	991.9	29.79	1,008.8	30.29	1,025.7	30.79	1,042.7
27.80	941.4	28.30	958.3	28.80	975.3	29.30	992.2	29.80	1,009.1	30.30	1,026.1	30.80	1,043.0
27.81	941.8	28.31	958.7	28.81	975.6	29.31	992.6	29.81	1,009.5	30.31	1,026.4	30.81	1,043.3
27.82	942.1	28.32	959.0	28.82	976.0	29.32	992.9	29.82	1,009.8	30.32	1,026.8	30.82	1,043.7
27.83	942.4	28.33	959.4	28.83	976.3	29.33	993.2	29.83	1,010.2	30.33	1,027.1	30.83	1,044.0
27.84	942.8	28.34	959.7	28.84	976.6	29.34	993.6	29.84	1,010.5	30.34	1,027.4	30.84	1,044.4
27.85	943.1	28.35	960.0	28.85	977.0	29.35	993.9	29.85	1,010.8	30.35	1,027.8	30.85	1,044.7
27.86	943.4	28.36	960.4	28.86	977.3	29.36	994.2	29.86	1,011.2	30.36	1,028.1	30.86	1,045.0
27.87	943.8	28.37	960.7	28.87	977.7	29.37	994.6	29.87	1,011.5	30.37	1,028.4	30.87	1,045.4
27.88	944.1	28.38	961.1	28.88	978.0	29.38	994.9	29.88	1,011.9	30.38	1,028.8	30.88	1,045.7
27.89	944.5	28.39	961.4	28.89	978.3	29.39	995.3	29.89	1,012.2	30.39	1,029.1	30.89	1,046.1
27.90	944.8	28.40	961.7	28.90	978.7	29.40	995.6	29.90	1,012.5	30.40	1,029.5	30.90	1,046.4
27.91	945.1	28.41	962.1	28.91	979.0	29.41	995.9	29.91	1,012.9	30.41	1,029.8	30.91	1,046.7
27.92	945.5	28.42	962.4	28.92	979.3	29.42	996.3	29.92	1,013.2	30.42	1,030.1	30.92	1,047.1
27.93	945.8	28.43	962.8	28.93	979.7	29.43	996.6	29.93	1,013.5	30.43	1,030.5	30.93	1,047.4
27.94	946.2	28.44	963.1	28.94	980.0	29.44	997.0	29.94	1,013.9	30.44	1,030.8	30.94	1,047.8
27.95	946.5	28.45	963.4	28.95	980.4	29.45	997.3	29.95	1,014.2	30.45	1,031.2	30.95	1,048.1
27.96	946.8	28.46	963.8	28.96	980.7	29.46	997.6	29.96	1,014.6	30.46	1,031.5	30.96	1,048.4
27.97	947.2	28.47	964.1	28.97	981.0	29.47	998.0	29.97	1,014.9	30.47	1,031.8	30.97	1,048.8
27.98	947.5	28.48	964.4	28.98	981.4	29.48	998.3	29.98	1,015.2	30.48	1,032.2	30.98	1,049.1
27.99	947.9	28.49	964.8	28.99	981.7	29.49	998.6	29.99	1,015.6	30.49	1,032.5	30.99	1,049.5

**6411.** The pressure is entered in column 16, "Barometer corrected (mb.)," in "tens," "units," and "tenths" of millibars, and the initial "9" or "10" in column 15. If the barometer reading is in inches, use Code Table 8 to convert the value to millibars. If the reading is in millimeters, use Table 26 (in the back of this manual). *Example:* A pressure of 981.7 millibars is entered in column 16 (PPP) as 817, and in column 15 as 9.

**6420.** TENDENCY (app). Select the appropriate code figure for the pressure characteristic (a) from Code Table 15 and enter it in column 25 of Form 1210F.

**CODE TABLE 15**

SYMBOL a.—Barometer change characteristics in the last 3 hours

Code figure	Trace	Description	
0		Rising then falling.....	} Barometer now higher than or the same as 3 hours ago.
1		Rising then steady; or rising, then rising more slowly.....	
2		Unsteady.....	
3		Rising or steady.....	
4		Steady then rising; falling then rising; or rising, then rising more rapidly.	} Barometer now lower than 3 hours ago.
5		Falling then rising.....	
6		Falling then steady; or falling, then falling more slowly.....	
7		Unsteady.....	
8		Falling.....	
9		Rising then falling; steady then falling; or falling, then falling more rapidly.	

**6421.** Determine the amount of pressure change (pp) in accordance with paragraph 6320 (1), and use Code Table 16 to convert the value to millibars and tenths. Enter the amount, without the decimal point, in column 26. *Example:* A pressure change of 0.115 inch would be converted to 3.9 millibars and entered in column 26 as 39.

**6422.** When the amount of the barometric pressure change equals or exceeds 9.9 millibars, the group "99ppp" should be inserted in the message following the "D<sub>s</sub>v<sub>s</sub>app" group. The "99" is the group identifier, and "ppp" is the total amount of the pressure change (in tens, units, and tenths of millibars) during the preceding 3 hours. When the group is inserted, "99" should be reported for "pp" in the "D<sub>s</sub>v<sub>s</sub>app" group. *For example:* If the total amount of the pressure change is 13.4 millibars, the groups should be coded "D<sub>s</sub>v<sub>s</sub>a99 99134." If the amount is 9.9 millibars, the groups are coded "D<sub>s</sub>v<sub>s</sub>a99 99099." ("D<sub>s</sub>v<sub>s</sub>a" should be given appropriate values.)

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## CODE TABLE 16

SYMBOL pp.—Amount of barometric change in the last 3 hours

[Coded in units of  $\frac{1}{100}$  of a millibar. For example, 0.2 millibar is coded as 02; 1.2 millibars as 12]

Amount of rise or fall							
Inch	Milli-bars	Inch	Milli-bars	Inch	Milli-bars	Inch	Milli-bars
0.005	0.2	0.155	5.3	0.305	10.3	0.455	15.4
.010	0.3	.160	5.4	.310	10.5	.460	15.6
.015	0.5	.165	5.6	.315	10.7	.465	15.7
.020	0.7	.170	5.8	.320	10.8	.470	15.9
.025	0.9	.175	5.9	.325	11.0	.475	16.1
.030	1.0	.180	6.1	.330	11.2	.480	16.3
.035	1.2	.185	6.3	.335	11.3	.485	16.4
.040	1.4	.190	6.4	.340	11.5	.490	16.6
.045	1.5	.195	6.6	.345	11.7	.495	16.8
.050	1.7	.200	6.8	.350	11.9	.500	16.9
.055	1.9	.205	6.9	.355	12.0	.505	17.1
.060	2.0	.210	7.1	.360	12.2	.510	17.3
.065	2.2	.215	7.3	.365	12.4	.515	17.4
.070	2.4	.220	7.5	.370	12.5	.520	17.6
.075	2.5	.225	7.6	.375	12.7	.525	17.8
.080	2.7	.230	7.8	.380	12.9	.530	17.9
.085	2.9	.235	8.0	.385	13.0	.535	18.1
.090	3.1	.240	8.1	.390	13.2	.540	18.3
.095	3.2	.245	8.3	.395	13.4	.545	18.5
.100	3.4	.250	8.5	.400	13.5	.550	18.6
.105	3.6	.255	8.6	.405	13.7	.555	18.8
.110	3.7	.260	8.8	.410	13.9	.560	19.0
.115	3.9	.265	9.0	.415	14.1	.565	19.1
.120	4.1	.270	9.1	.420	14.2	.570	19.3
.125	4.2	.275	9.3	.425	14.4	.575	19.5
.130	4.4	.280	9.5	.430	14.6	.580	19.6
.135	4.6	.285	9.7	.435	14.7	.585	19.8
.140	4.7	.290	9.8	.440	14.9	.590	20.0
.145	4.9	.295	10.0	.445	15.1	.595	20.1
.150	5.1	.300	10.2	.450	15.2	.600	20.3

## VII TEMPERATURE

# CHAPTER VII. TEMPERATURE

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## CHAPTER VII. TEMPERATURE

### 7000. GENERAL

**7001.** Temperature readings are made at sea to determine the free-air temperature, the dew-point temperature, and the temperature of the sea surface.

### 7100. AIR-TEMPERATURE MEASUREMENTS

**7110. DEFINITIONS.** The following terms are used in connection with air-temperature measurements:

- (1) *Free-air temperature.*—The temperature measured with an ordinary thermometer exposed to the free air on the windward side of the ship under conditions that eliminate as completely as possible the effects of extraneous sources of heat.
- (2) *Wet-bulb temperature.*—The lowest temperature to be secured by evaporating water from a muslin-covered bulb of a thermometer at a specified rate of ventilation. The wet-bulb temperature differs from the dry-bulb temperature in an amount dependent on the temperature and relative humidity of the air.
- (3) *The dew point.*—The temperature at which condensation would occur if the air were cooled. The dew point can be computed when the difference between the dry-bulb and the wet-bulb temperature is known.

**7120. READING THE THERMOMETER.** Temperatures indicated by any mercurial or spirit-filled thermometer may be determined as follows:

- (1) Stand as far from the thermometer as is consistent with accurate reading, to prevent body heat from affecting the instrument.
- (2) Insure that the line of sight from the eye to the top of the liquid column makes an angle of  $90^\circ$  with the thermometer tube. This will avoid an error of parallax.
- (3) Read the thermometer to nearest  $0.1^\circ$ . A degree interval begins at the middle of the degree marking etched on the tube.

**7130. PSYCHROMETERS.** Air-temperature measurements may be made with a psychrometer. Psychrometers consist of one dry- and one wet-bulb thermometer mounted on a single frame. The psychrometer should be so ventilated that the minimum speed of air passing over the thermometer bulbs is at least 15 feet per second (9 knots). Psychrometer tables are based upon this rate of ventilation, which must be maintained to obtain accurate humidity measurements.

**7131. Care of the Psychrometer.** The bulb of the wet-bulb thermometer is covered with muslin, which must be saturated with water before the psychrometer is ventilated prior to reading the wet-bulb temperature. Use only clean, fresh water, preferably distilled water or cooled water from the condenser, to moisten the muslin. Change the muslin whenever it becomes soiled or encrusted with lime or salt.

**7132. Sling Psychrometer.** The sling psychrometer is best adapted to shipboard use since it is easily carried to the most suitable exposure. The dry- and wet-bulb thermometers are mounted on a single frame that is attached to a handle in such a way that the thermometers can be whirled in a circle (see Fig. 6). Errors in reading arising from exposure to rain or direct sunlight are overcome, to a large extent, by the strong ventilation to which the thermometers are subjected. When not in use, the psychrometer should be stored at outdoor temperature in a safe, sheltered place (e. g., in a padded box secured to the outside of the chart room bulkhead).

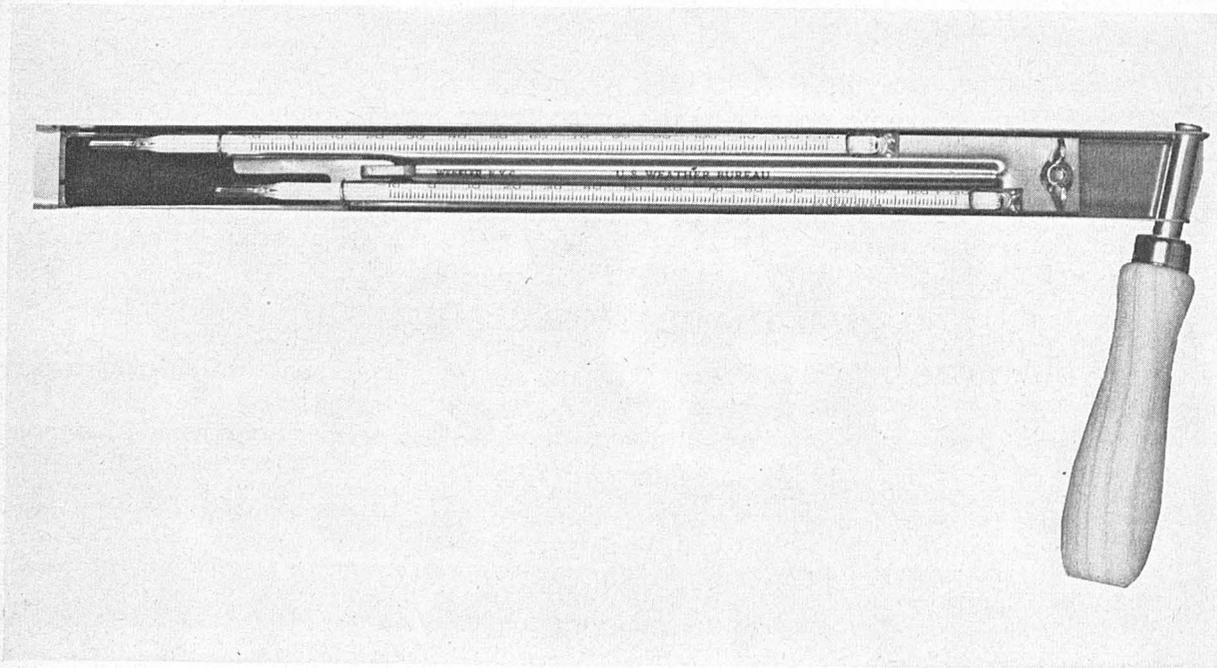


FIGURE 6.—Marine-type sling psychrometer.

**7132.1.** The sling psychrometer should be used in accordance with the following instructions:

- (1) Select a shady spot (if possible) on the windward side of the ship which is free from spray and has no obstruction within a radius of the whirling sling.
- (2) Face into the wind.
- (3) Whirl the psychrometer as far in front of the body as possible (if the apparent wind speed is 10 knots or more, do not whirl).

**7133. Psychrometric Readings.** Readings from the dry- and wet-bulb thermometers should be obtained in accordance with the following instructions.

**7133.1.** Saturate the muslin of the wet bulb with clean water. Use care to avoid wetting the dry-bulb thermometer, which must be thoroughly dry before the readings. Ventilate the psychrometer for about 10 seconds and quickly read both thermometers, the wet-bulb thermometer first. Repeat the alternate ventilating and reading until two successive readings of the wet-bulb thermometer are the same and indicate that the thermometer has reached its lowest temperature.

**7133.2.** When the wet-bulb temperature is below 32° F., moisten the wet-bulb thermometer with water having a temperature between 65° and 75° F. in order to melt completely any accumulation of ice on the muslin, since a very thin coating is necessary for accurate data. When the psychrometer is ventilated at below freezing temperatures, and there is doubt as to whether the muslin is frozen, the muslin should be brought to the frozen state by touching it with clean ice or snow, or some other object whose temperature is approximately the same as or less than the dry-bulb temperature. After the muslin has become ice-covered, continue to ventilate the psychrometer until successive readings indicate that the lowest wet-bulb temperature has been reached.

**7140. COMPUTATION OF THE DEW-POINT TEMPERATURE.** The temperature of the dew point is computed with tables furnished with this manual (see par. 7144). To use the tables, it is necessary to know the temperature of the wet bulb and the wet-bulb depression.

**7141. Depression of the Wet-Bulb Thermometer.** The depression of the wet-bulb thermometer is the algebraic difference between the dry- and wet-bulb temperatures.

*Examples:*

(1) Dry-bulb temperature .....	40.6
Wet-bulb temperature .....	34.1
Depression .....	6.5
(2) Dry-bulb temperature .....	
Wet-bulb temperature .....	1.2
Depression .....	-0.7
Depression .....	1.9
(3) Dry-bulb temperature .....	
Wet-bulb temperature .....	-3.4
Depression .....	-4.7
Depression .....	1.3

**7141.1.** When the wet-bulb is covered with water and a depression cannot be obtained, the dew-point temperature will be regarded as the same as that of the wet-bulb temperature

**7142. Wet-Bulb Above 20° F.** After the depression of the wet bulb has been determined, the wet-bulb temperature and the depression of the wet bulb should be rounded to the nearest 0.5° F., e. g., a temperature of 61.2° is rounded to 61.0; 58.6° to 58.5; 45.3° to 45.5; etc.; and a depression of the wet bulb of 1.8° is rounded to 2.0; 3.6° to 3.5; 4.2° to 4.0; etc.

**7143. Wet-Bulb 20° F. and Lower.** After the depression of the wet bulb has been determined, round the wet-bulb temperature to the nearest 0.5° F., as in paragraph 7142. The depression of the wet bulb will be retained to the nearest 0.1° F.

**7144. Psychrometric Tables.** Table 25, "Temperature of the Dew Point in Degrees Fahrenheit" (at the back of this manual), will be used to compute the dew point. To use the tables, find (a) the appropriate wet-bulb temperature in the vertical column printed at the left edge, and (b) the corresponding depression of the wet bulb. Follow (a) horizontally across, and (b) vertically downward. The tabular value at the intersection is the dew point.

*Examples:*

Dry bulb	Wet bulb	Depression of wet bulb	Wet bulb rounded	Depression of wet bulb rounded	Dew point
69.1	61.3	7.8	61.5	8.0	57
61.5	56.8	4.7	57.0	4.5	54
19.0	16.4	2.6	16.5	Unchanged	6
-10.3	-11.2	0.9	-11.0	Unchanged	-27

## 7200. SEA-WATER TEMPERATURE READINGS

**7210. GENERAL.** The condenser (or comparable) intake thermometer will be read to the nearest 0.2° F. or 0.1° C. at each observation to secure the sea-water temperature. Intake thermometer readings previously entered in the engine room log book will not be used for the weather observation.

## 7300. CODING AND ENTRIES OF TEMPERATURE DATA ON FORM 1210F

**7310. AIR TEMPERATURES (TT, T<sub>d</sub>T<sub>a</sub>).** Enter the dry- and wet-bulb temperatures to degrees and tenths in columns 27 and 28, respectively. Prefix a minus sign (-) when the temperature is below 0° F. Enter the dry-bulb temperature to the nearest whole degree (two digits) in column 17 (TT). When the temperature ends in 0.5, increase the preceding digit by one, e. g., 10.5=11. Enter the dew-point temperature (two digits) in column 32 (T<sub>d</sub>T<sub>a</sub>). Code tables are not used.

**7311.** When the temperature is 100° F. or higher, subtract 100 from the actual air temperature and enter the remainder as two digits in column 17, e. g., 107° is entered as 07; 114° is entered as 14; 100° is entered as 00; etc.

**7312.** When the air temperature or the dew-point temperature is 0° F. or lower, disregard the minus sign and subtract the numerical value from 100. Enter the remainder as two digits in column 17 or 32, respectively, as appropriate, e. g., -15° is entered as 85 (100-15=85); -1° is entered as 99; 0° is entered as 00; etc.

**7320.** SEA-WATER TEMPERATURE. Enter the temperature of the sea water to the nearest 0.2° F. in column 29. When the temperature of the sea water is obtained in degrees Celsius (centigrade), convert the reading to the nearest 0.2° F. with Table 24 (in the back of this manual).

**7330.** SEA-AIR TEMPERATURE DIFFERENCE ( $T_s T_a$ ). Determine the difference between the sea and air temperatures, and enter the difference to the nearest whole degree (two digits) in column 31. When the difference ends in 0.5, increase the preceding digit by one, e. g., 10.5=11. When the dry-bulb temperature is lower than the sea temperature, add 50 to the difference. *Example:* If the dry-bulb temperature is 25.4, and the sea temperature is 38.6, the difference (13) is entered in column 31 as 63 (13+50).



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## CHAPTER VIII. CLOUDS

### 8000. GENERAL

**8001.** Code numbers for cloud forms and states of the sky are described in detail in Weather Bureau Circular S. Instructions in this chapter are confined to those necessary for observing clouds with respect to their amount and height of base.

### 8100. DETERMINATION OF SKY COVER

**8110. GENERAL.** "Sky cover" is a term used to denote the amount, in eighths, of sky covered by clouds. The eighths of sky cover plus the eighths of sky visible will always equal 1.0 (%).

**8120. SKY QUADRANTS.** The sky may be regarded as divided into quadrants, with the zenith regarded as the center, and the north, east, south, and west compass points forming the dividing lines. Each quadrant contains  $\frac{1}{4}$  of the total sky.

**8121.** Determine the amount of sky cover by use of quadrants as follows:

- (1) Estimate the amount covered by clouds in each quadrant.
- (2) Add the estimated amounts together. The sum of the amounts will be the sky cover.

*Example:* If an advancing cloud layer completely covers two quadrants and scattered clouds of another type cover one-half of each of the remaining two quadrants, the total sky cover is  $\frac{2}{4} + \frac{1}{4} + \frac{1}{4} = \frac{4}{4}$  or 1.0.

**8130. OBSCURED SKY.** When the sky is completely obscured, other than by clouds, e. g., by fog, falling snow, haze, smoke, etc., the sky is classified as "obscured." However, when only a portion of the sky is obscured, estimate the total amount of clouds on the basis of those that are visible.

### 8200. CLOUD HEIGHT

**8201.** The height of the lowest cloud layer should be estimated after the type of cloud has been determined by use of the tables and photographs in Weather Bureau Circular S. The table captioned "Classification" in Circular S is a useful guide in estimating the height of clouds. Some indication of the height of the clouds may be obtained from the detail with which the small indentations on the bottom surface can be observed. At night it may be possible to use a ship's searchlight to observe the cloud base.

### 8300. CODING AND ENTRIES OF CLOUD DATA ON FORM 1210F

**8310. TOTAL CLOUD AMOUNT (N).** Select the appropriate code figure from Code Table 3 corresponding to the total amount of sky covered by all types of clouds, and enter the figure in column 7 of Form 1210F. A few clouds or fragments of clouds are entered as "1." If the sky is completely covered (overcast), N is entered as 8; however, if a few patches of sky are visible, N is entered as 7.

**8320. AMOUNT OF  $C_L$  CLOUD—( $N_h$ ).** Select the appropriate code figure from Code Table 3 corresponding to the amount of sky covered by type  $C_L$  clouds, and enter the figure in column 18. When there are no  $C_L$  clouds present, " $N_h$ " is the amount of  $C_M$  clouds whose base is at or below 8,000 feet. Code figure "0" is entered for  $N_h$  when there are no clouds whose bases are at or below 8,000 feet. The amount of clouds reported for " $N_h$ " may equal but never exceed the amount of clouds reported for "N."

CODE TABLE 3

SYMBOL N.—Total cloud amount

SYMBOL N<sub>h</sub>.—Amount of cloud, the height of which is reported by "h"

Code figures	Cloud amount (eighths of sky covered)
0	None
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	Sky obscured <sup>3</sup>

NOTES

1. "Fragments of clouds" are coded as 1.
2. "Overcast but with openings" is coded as 7.
3. Sky obscured by fog, rain, snow, smoke or other phenomena or obstruction except clouds.

**8330. HEIGHT OF C<sub>L</sub> CLOUDS—(h).** Select the code figure from Code Table 10 corresponding to the height of C<sub>L</sub> clouds, and enter the figure in column 20. When there are no clouds of type C<sub>L</sub> present, but there are clouds of type C<sub>M</sub> at or below 8,000 feet, enter the height of the C<sub>M</sub> clouds.

CODE TABLE 10

SYMBOL h.—Height of base of cloud above sea

Code figures	Feet	Meters
0	0 to 150.....	0 to 50.
1	150 to 300.....	50 to 100.
2	300 to 600.....	100 to 200.
3	600 to 1,000.....	200 to 300.
4	1,000 to 2,000.....	300 to 600.
5	2,000 to 3,000.....	600 to 1,000
6	3,000 to 5,000.....	1,000 to 1,500.
7	5,000 to 6,500.....	1,500 to 2,000.
8	6,500 to 8,000.....	2,000 to 2,500.
9	No cloud below 8,000.....	No cloud below 2,500.

NOTES

1. Symbol "h" reports the height of the base of the lowest cloud layer below 8,000 feet. When only fragments of clouds are present below 8,000 feet, "h" indicates the height of the fragments.
2. If the height of the cloud base is exactly equal to a height given in the table, the higher code figure is used. For example, a height of 600 feet is coded as 3.
3. When the sky is obscured by rain, snow, fog, smoke, or other phenomena so that cloud at or below 8,000 feet cannot be observed, "h" is coded as 0 and "N<sub>h</sub>" as 9.
4. If the height of the cloud base cannot be reported owing to darkness or any reason not covered by Note 3, a slant (/) is reported for "h".

**8340. CLOUDS OF TYPE  $C_L$ .** Select the appropriate code figure from Code Table 9 corresponding to the predominating  $C_L$  cloud (stratocumulus, stratus, cumulus, and cumulonimbus) and enter the figure in column 19. When the sky is obscured and the  $C_L$  clouds cannot be determined, enter a slant (/).

CODE TABLE 9

SYMBOL  $C_L$ .—Clouds of types stratocumulus, stratus, cumulus, and cumulonimbus

Code figures	Technical language specifications	Plain language specifications
0	No clouds $C_L$ .	No stratocumulus, stratus, cumulus, or cumulonimbus clouds.
1	Cumulus humilis.	Cumulus with little vertical development and seemingly flattened.
2	Cumulus congestus, with or without cumulus humilis or stratocumulus at the same level of base.	Cumulus of considerable development, generally towering, with or without other cumulus or stratocumulus; bases all at the same level.
3	Cumulonimbus calvus, with or without cumulus, stratocumulus or stratus.	Cumulonimbus with tops lacking clear-cut outlines but distinctly not cirriform or anvil-shaped; with or without cumulus, stratocumulus, or stratus.
4	Stratocumulus cumulogenitus or vesperalis.	Stratocumulus formed by the spreading out of cumulus; cumulus also often present. (NOTE.—Since the spreading out of the scattered parcels of air that have been warmed by the surface may take place, as in Sc vesperalis as soon as the condensation level is reached, observers should be warned that, though Cu may normally have been seen earlier, the formation of a particular piece of Sc vesperalis may not come from a Cu.)
5	Stratocumulus other than cumulogenitus and vesperalis.	Stratocumulus not formed by the spreading out of cumulus.
6	Stratus and/or fractostratus, but not fractostratus of bad weather.	Stratus or fractostratus or both, but not fractostratus of bad weather.
7	Fractostratus and/or fractocumulus of bad weather ("scud") usually under altostratus and nimbostratus.	Fractostratus and/or fractocumulus of bad weather ("scud") usually under altostratus and nimbostratus. (By "bad weather" is meant the conditions usually prevailing before, during, or after precipitation.)
8	Cumulus humilis or congestus and stratocumulus other than cumulogenitus and vesperalis with bases at different levels.	Cumulus and stratocumulus other than those formed by the spreading out of cumulus, with bases at different levels.
9	Cumulonimbus capillatus (often with anvil) with or without cumulus, stratocumulus, stratus or "scud".	Cumulonimbus having a clearly fibrous (cirriform) top, often anvil-shaped, with or without cumulus, stratocumulus, stratus, or "scud."

NOTE.—When the sky is obscured by rain, snow, fog, duststorm, smoke, or other phenomena, and clouds of  $C_L$  type cannot be observed, a slant (/) will be reported for  $C_L$ .

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**8350. CLOUDS OF TYPE  $C_M$ .** Select the code figure from Code Table 11 corresponding to the predominating cloud of  $C_M$  type (altocumulus, altostratus, and nimbostratus), and enter the figure in column 21. Enter a slant (/) when  $C_M$  clouds cannot be observed owing to an intervening cover of  $C_L$  type clouds, or when the sky is obscured by fog, snow, etc.

CODE TABLE 11

SYMBOL  $C_M$ .—Clouds of types *altocumulus*, *altostratus*, and *nimbostratus*

Code figures	Technical language specifications	Plain language specifications
0	No clouds $C_M$ .....	No altocumulus, altostratus, or nimbostratus clouds.
1	Altostratus translucidus.....	Thin altostratus (semitransparent everywhere) through which the sun or moon would be seen dimly as through ground glass.
2	Altostratus opacus, or nimbostratus.....	Thick altostratus, or nimbostratus (through portions of the sheet the position of the sun or moon may be indicated by a light patch).
3	Altocumulus translucidus more or less stable and at a single level.	Thin (semitransparent) altocumulus; cloud elements not changing much; at a single level.
4	Altocumulus translucidus in patches (often lenticular) continually transforming and/or occurring at different levels.	Thin (semitransparent) altocumulus in patches (often almond or fishshaped); cloud elements continually changing and/or occurring at more than one level.
5	Altocumulus translucidus in bands or in a layer systematically invading the sky and usually thickening as a whole, even partly into altocumulus opacus or duplicatus.	Thin (semitransparent) altocumulus in bands or in a layer gradually spreading over the sky and usually thickening as a whole; it may become partly opaque or double-layered.
6	Altocumulus cumulogenitus.....	Altocumulus formed by the spreading out of cumulus.
7	Altocumulus duplicatus or opacus, not increasing; or altostratus and altocumulus.	Any of the following cases: (a) Double-layered altocumulus, usually opaque in parts, not increasing; (b) a thick (opaque) layer of altocumulus, not increasing; (c) altostratus and altocumulus both present at the same or different levels.
8	Altocumulus cumiliformis (flocus or castellatus).	Altocumulus in the form of cumulus-shaped tufts or altocumulus with turrets.
9	Altocumulus of a chaotic sky; generally at different levels; cirrus densus in patches usually present.	Altocumulus of a chaotic sky; generally at different levels; dense cirrus in patches is usually also present.

NOTE.—When the sky is obscured by rain, snow, fog, duststorm, smoke, or other phenomena, or an intervening layer of  $C_L$  clouds, and clouds of  $C_M$  type cannot be observed, a slant (/) is reported for  $C_M$ .

**8360. CLOUDS OF TYPE C<sub>H</sub>.** Select the code figure from Code Table 12 corresponding to the predominating cloud of C<sub>H</sub> type (cirrus, cirrostratus, and cirrocumulus) and enter the figure in column 22. Enter a slant (/) when C<sub>H</sub> clouds cannot be observed owing to an intervening layer of C<sub>L</sub> or C<sub>M</sub> type clouds, or when the sky is obscured by fog, snow, etc.

**CODE TABLE 12**

SYMBOL C<sub>H</sub>.—Clouds of types cirrus, cirrostratus, and cirrocumulus

Code figure	Technical language specifications	Plain language specifications
0	No clouds C <sub>H</sub> -----	No cirrus, cirrocumulus, or cirrostratus clouds.
1	Cirrus filorus, scattered and not increasing--	Filaments or strands of cirrus, scattered and not increasing (often "mares' tails").
2	Cirrus densus in patches or twisted sheaves usually not increasing, sometimes presumably being the remains of the upper part of cumulonimbus.	Dense cirrus in patches or twisted sheaves usually not increasing; possibly but not certainly the remains of the upper part of cumulonimbus.
3	Cirrus nothus: either the remains of cumulonimbus or part of a distant cumulonimbus the rest of which is not visible.	Cirrus, often anvil-shaped; either the remains of the upper portions of cumulonimbus or part of a distant cumulonimbus the rest of which is not visible. (If there is doubt as to the cumulonimbus origin or association, code C <sub>H</sub> 2 should be used.)
4	Cirrus (often cirrus uncinus) systematically invading the sky and usually thickening as a whole.	Cirrus (often hook-shaped) gradually spreading over the sky and usually thickening as a whole.
5	Cirrus, often in polar bands, and/or cirrostratus systematically invading the sky and usually thickening as a whole, but the continuous layer not reaching 45° altitude.	Cirrus and cirrostratus, often in bands converging toward the horizon; or cirrostratus alone; in either case gradually spreading over the sky and usually thickening as a whole, but the continuous layer not reaching 45° altitude.
6	Cirrus, often in polar bands, and/or cirrostratus systematically invading the sky and usually thickening as a whole, and the continuous layer exceeding 45° altitude.	Cirrus and cirrostratus, often in bands converging toward the horizon; or cirrostratus alone; in either case gradually spreading over the sky and usually thickening as a whole, and the continuous layer exceeding 45° altitude.
7	Cirrostratus covering the whole sky-----	Cirrostratus covering the whole sky.
8	Cirrostratus not increasing and not covering the whole sky.	Cirrostratus not increasing and not covering the whole sky; cirrus and cirrocumulus may be present.
9	Cirrocumulus the dominant cirriform cloud.	Cirrocumulus alone or cirrocumulus with some cirrus or cirrostratus, but the cirrocumulus being the main cirriform cloud present. (Cirrocumulus may be present in C <sub>H</sub> 1 to C <sub>H</sub> 8.)

NOTE.—When the sky is obscured by rain, snow, fog, duststorm, smoke, or other phenomena or an intervening layer of C<sub>L</sub> or C<sub>M</sub> clouds, or both, and clouds of type C<sub>H</sub> cannot be observed, a slant (/) will be reported for C<sub>H</sub>.

**8370. CLOUD GROUP.** The symbols for the amount of C<sub>L</sub> clouds (N<sub>h</sub>), type of cloud (C<sub>L</sub>), height of cloud (h), type of cloud (C<sub>M</sub>), and type of cloud (C<sub>H</sub>) combine to form the cloud group "N<sub>h</sub>C<sub>L</sub>hC<sub>M</sub>C<sub>H</sub>."

*Example:* The coded cloud group, "51406," is decoded as follows:

- 5—five-eighths of sky covered with type C<sub>L</sub> clouds.
- 1—the C<sub>L</sub> clouds are cumulus with little vertical development.
- 4—height of base of the C<sub>L</sub> clouds is between 1,000 and 2,000 feet above the sea.
- 0—no clouds of type C<sub>M</sub> present.
- 6—the C<sub>H</sub> clouds are cirrus, and cirrostratus gradually spreading over the sky with the layer extending more than 45° above the horizon.





# CHAPTER IX. WAVES

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## CHAPTER IX. WAVES

### 9000. GENERAL

**9001.** The wave group of the weather message, as entered on Form 1210F, consists of the direction, period, and height of the waves on the surface of the sea. When more than one wave system is present (cross sea and swell), the direction, period, and height of the waves in each system will be observed and recorded as if they existed alone.

**9002.** Waves in the same system usually occur in a sequence of a few, large, well-formed waves followed by an interval in which only small and poorly formed waves appear, then another series of large, well-formed waves, etc. (see Fig. 7). To obtain uniform wave data from all ships, observers will record only the larger, well-formed waves, and omit entirely the low and poorly formed waves.

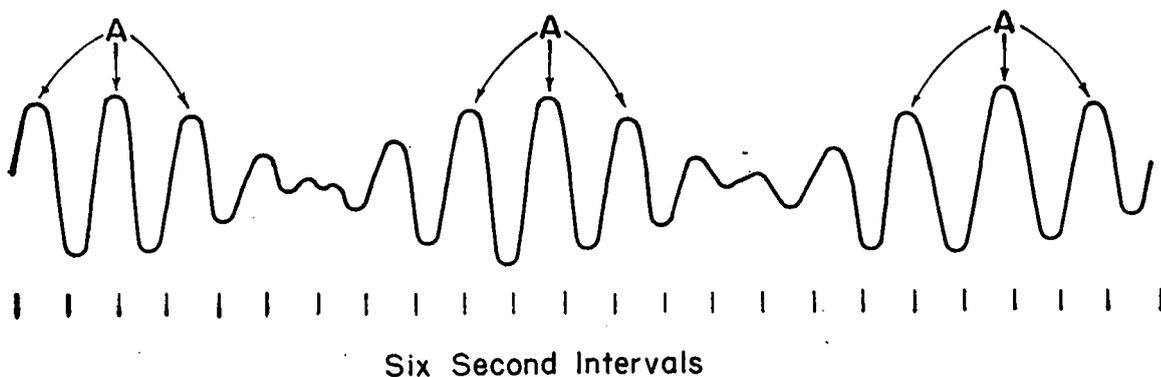


FIGURE 7.—Section of a trace from an automatic wave recorder illustrating the up-and-down movement of a small object floating on the surface of the sea. In accordance with paragraph 9002, the height and period of only the central, well-defined waves (A) of each group will be determined.

### 9100. WAVE DIRECTION

**9101.** Wave direction, like wind direction, is the direction from which the waves are coming. The wave direction is determined with reference to true north ( $360^\circ$ ), and is recorded to the nearest ten degrees in tens of degrees; e. g.,  $237^\circ$  is recorded as 24.

**9102.** The wave direction may be determined by eye observation or, more accurately, by sighting from a compass along the wave crests and adding or subtracting  $90^\circ$ .

### 9200. WAVE PERIOD

**9210. GENERAL.** The wave period is the interval in seconds between the passage of two successive crests of well-formed waves past a fixed point (see Fig. 7). The interval can be timed with a stop watch or an ordinary watch with a seconds hand.

**9220. OBSERVATION.** Determine the period as follows:

- (1) Select a distinctive patch of foam or a small floating object at some distance from the ship. Select a new patch of foam from time to time as the old one falls astern.
- (2) Note the elapsed time to the nearest second between the moments when the object is on the crest of the first and of the last well-formed wave in the group. Also note the number of crests that pass under the object during the interval. Continue the observation until at least 15 well-formed waves have been timed.
- (3) Add the elapsed times of the various groups together and divide the total by the number of waves to obtain the average period.

*Example:* The observer might make the following observation to determine the wave period:

Wave group No.	Number of well-formed waves	Time elapsed (seconds)
1.....	3	44
2.....	4	57
3.....	4	62
4.....	3	43
5.....	3	46
Total.....	17	252
Average period..... 252 divided by 17 = 14.8 seconds		

The wave period should be recorded to the nearest second, e. g., as 15 seconds.

### 9300. WAVE HEIGHT

**9310. GENERAL.** The height of a wave is the vertical distance between a crest and the troughs on either side of it (see Fig. 8). The wave height, as recorded on Form 1210F, is the average of the estimated heights of the larger, well-formed waves (see par. 9002).

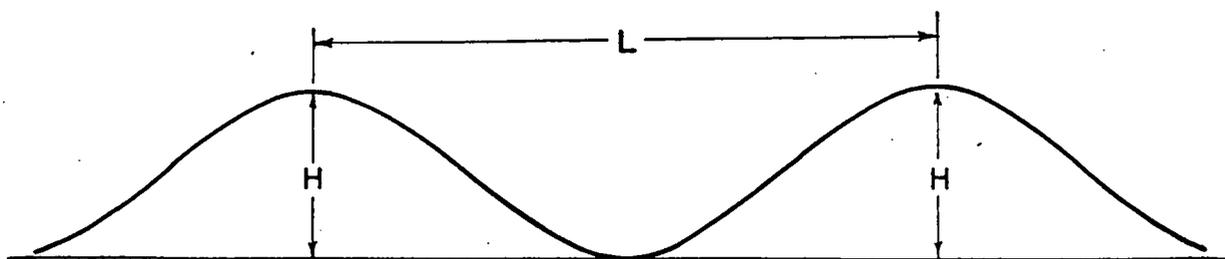


FIGURE 8. -- Wave length and height.

- (1) The *wave length* (L) is the horizontal distance between successive crests, or troughs.
- (2) The *height* (H) is the vertical distance between crest and trough.
- (3) The *wave speed* is the distance traveled by a wave in a unit of time.
- (4) The *period* is the interval of time which elapses between the passage of any two successive crests past a fixed point; that is, each crest advances one wave length in a time equal to one period. It is the wave length divided by the wave speed.

**9320. DETERMINATION.** In general, the wave height should be estimated from the best available point on the ship that permits the height of the waves to be compared to the height of the ship. If the observer is free to move about the vessel, the wave height should be determined in accordance with the following paragraphs.

**9321.** When the wave length is the same as or less than the length of the ship, the height of the waves should be observed and estimated from as low a point on the ship as possible. The point of observation should be chosen amidships, where the pitching of the vessel is at a minimum. The wave height should be estimated when the ship is on an even keel.

**9322.** When the wave length is greater than the length of the ship, the observer should stand at a level where, when the ship is in the trough and momentarily on an even keel, the tops of the oncoming waves appear just level with the horizon. The wave height is then equal to the height of his eyes above the waterline.

#### 9400. CODING AND ENTRIES OF WAVE DATA ON FORM 1210F

**9410. GENERAL.** Code the wave observation and enter the code figures in Form 1210F.

**9411.** When more than one wave system can be distinguished at the time of observation, code each wave system separately and enter each code group in the column headed "Waves" of Form 1210F. Enter additional groups, if any, below the first entry.

**9420. DIRECTION ( $d_w d_w$ ).** Select the code figure from Code Table 4 corresponding to the direction from which the waves came, and enter the value in column 34 of Form 1210F. When the wave height is greater than 15 feet, add 50 to the coded wave direction, e. g., the direction of waves coming from  $320^\circ$  with a height of 20 feet would be entered in column 34 as "82" ( $32+50$ ).

CODE TABLE 4

SYMBOL  $d_w d_w$ .—Direction, in 10's of degrees, FROM which waves are coming

Code figure	Direction	Code figure	Direction
00	Calm.	21	$205^\circ$ to $214^\circ$ .
01	$5^\circ$ to $14^\circ$ .	22	$215^\circ$ to $224^\circ$ .
02	$15^\circ$ to $24^\circ$ .	23	$225^\circ$ to $234^\circ$ .
03	$25^\circ$ to $34^\circ$ .	24	$235^\circ$ to $244^\circ$ .
04	$35^\circ$ to $44^\circ$ .	25	$245^\circ$ to $254^\circ$ .
05	$45^\circ$ to $54^\circ$ .	26	$255^\circ$ to $264^\circ$ .
06	$55^\circ$ to $64^\circ$ .	27	$265^\circ$ to $274^\circ$ .
07	$65^\circ$ to $74^\circ$ .	28	$275^\circ$ to $284^\circ$ .
08	$75^\circ$ to $84^\circ$ .	29	$285^\circ$ to $294^\circ$ .
09	$85^\circ$ to $94^\circ$ .	30	$295^\circ$ to $304^\circ$ .
10	$95^\circ$ to $104^\circ$ .	31	$305^\circ$ to $314^\circ$ .
11	$105^\circ$ to $114^\circ$ .	32	$315^\circ$ to $324^\circ$ .
12	$115^\circ$ to $124^\circ$ .	33	$325^\circ$ to $334^\circ$ .
13	$125^\circ$ to $134^\circ$ .	34	$335^\circ$ to $344^\circ$ .
14	$135^\circ$ to $144^\circ$ .	35	$345^\circ$ to $354^\circ$ .
15	$145^\circ$ to $154^\circ$ .	36	$355^\circ$ to $4^\circ$ .
16	$155^\circ$ to $164^\circ$ .		
17	$165^\circ$ to $174^\circ$ .	49	Waves confused, direction indeterminate.
18	$175^\circ$ to $184^\circ$ .		
19	$185^\circ$ to $194^\circ$ .		
20	$195^\circ$ to $204^\circ$ .	99	Waves confused, direction indeterminate, but higher than 14 feet ( $4\frac{1}{2}$ meters).

**9430. PERIOD ( $P_w$ ).** Select the code figure from Code Table 17 corresponding to the average wave period, and enter the figure in column 35.

CODE TABLE 17

SYMBOL  $P_w$ .—Period of waves

Code figure	Period
2	5 seconds or less.
3	5 to 7 seconds.
4	7 to 9 seconds.
5	9 to 11 seconds.
6	11 to 13 seconds.
7	13 to 15 seconds.
8	15 to 17 seconds.
9	17 to 19 seconds.
0	19 to 21 seconds.
1	Over 21 seconds.
x	Calm, or period indeterminate.

NOTE.—If the exact number of seconds for the period of the waves corresponds to two code figures, the lower code figure is reported.

**9440. HEIGHT ( $H_w$ ).** Select the code figure from Code Table 18 corresponding to the average wave height, and enter the figure in column 36. When the wave height is greater than 15 feet, add 50 to the code figure for the wave direction (see par. 9420).

CODE TABLE 18

SYMBOL  $H_w$ .—Mean maximum height of waves

Code figure	Height
0	Less than 1 foot ( $\frac{1}{4}$ meter).
1	1½ feet ( $\frac{1}{2}$ meter).
2	3 feet (1 meter).
3	5 feet (1½ meters).
4	6½ feet (2 meters).
5	8 feet (2½ meters).
6	9½ feet (3 meters).
7	11 feet (3½ meters).
8	13 feet (4 meters).
9	14 feet (4½ meters).
x	Height impossible to determine. (When 50 is added to $d_w$ , the height of waves is as follows):
0	16 feet (5 meters).
1	17½ feet (5½ meters).
2	19 feet (6 meters).
3	21 feet (6½ meters).
4	22½ feet (7 meters).
5	24 feet (7½ meters).
6	25½ feet (8 meters).
7	27 feet (8½ meters).
8	29 feet (9 meters).
9	30½ feet (9½ meters).
x	Height impossible to determine.

## NOTES

- Each code figure except "zero" covers a range of  $\frac{1}{2}$  meter; e. g., code figure 1 =  $\frac{1}{4}$  meter to  $\frac{3}{4}$  meter, code figure 2 =  $\frac{3}{4}$  meter to 1½ meters.
- If the wave height is exactly between the heights corresponding to two code figures, the lower code figure is reported.
- For wave heights greater than 31 feet (9¾ meters), the code figure for 30½ feet (9½ meters) is reported, followed by the word "WAVES" and the actual height of the waves in feet or meters; e. g., "WAVES 37."

**9450. WAVE GROUP.** The symbols for the direction ( $d_w d_w$ ), period ( $P_w$ ), and height ( $H_w$ ) of the waves combine to form the wave group " $1d_w d_w P_w H_w$ ," where "1" is the group indicator.

*Example:* The coded wave group "12768" is decoded as follows:

- 1—group indicator.
- 27—waves are coming from the west ( $270^\circ$ ).
- 6—wave period of 11 to 13 seconds.
- 8—wave height of 13 feet.



**X ICE**

# CHAPTER X. ICE

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## CHAPTER X. ICE

### 10000. GENERAL

**10001.** The presence of ice at sea, including icebergs, is recorded as part of the weather observation on Form 1210F when ice is visible, or has been observed at a point within a distance of 30 miles from the ship's position at the time of the weather observation.

**10002.** The reporting of icebergs or sea-ice in connection with the weather report is not to take the place of the reporting of sea-ice and icebergs according to the International Convention for the Safety of Life at Sea. Reports requested by the United States Hydrographic Office, Coast Guard, etc., will be submitted in addition to the weather report.

### 10100. ICE OBSERVATION

**10110. GENERAL.** The ice observation includes determination of the kind of ice, the effect of the ice on navigation, the bearing of the ice-limit, the distance to the ice-limit, and the orientation of the ice-limit.

**10120. KIND OF ICE.<sup>1</sup>** Ice is observed in terms of the most important or prominent of the following conditions:

- (1) *Ice-blink.* When observed, determine the bearing of the blink. Ice-blink is the white or yellowish-white glare on the sky produced by the reflection of considerable areas of sea-ice or land-ice, which may be beyond the range of vision.
- (2) *New-Ice.* A general term which includes the following types:
  - (a) Ice-crystals (Frazil-crystals) are fine spicules or plates of ice suspended in water.
  - (b) Slush (Sludge) is an accumulation of ice-crystals which remain separate or only slightly frozen together. It forms a thin layer and gives the sea surface a grayish or leaden-tinted color. With light winds no ripples appear.
  - (c) Pancake-ice is composed of pieces of newly formed ice, usually approximately circular, about 30 cm. (11.8 in.) to 3 m. (9.84 ft.) across, and with raised rims, due to the pieces striking against each other, as the result of wind and swell.
  - (d) Ice-rind is a thin, elastic, shining crust of ice, formed by the freezing of slush (sludge) on a quiet sea surface. Thickness less than 5 cm. (1.97 in.). It is easily broken by wind or swell, and makes a tinkling noise when passed through by a ship.
- (3) *Fast-Ice.* Observe whether the amount is unusually great (heavy). Fast-ice is sea-ice which remains fast, generally in the position where originally formed, and which may attain a considerable thickness. It is found along coasts, where it is attached to the shore, or over shoals, where it may be held in position by islands, grounded icebergs or grounded polar-ice. Subdivisions are Winter fast-ice and Polar fast-ice.<sup>2</sup>
- (4) *Drift-Ice.* Observe whether the amount is unusually great (heavy). Drift-ice (Pack-ice) is a term used in a wide sense to include any area of sea-ice, other than fast-ice, no matter what form it takes or how disposed.
- (5) *Packed (compact) slush, or packed strips of hummocked-ice.* Note that this condition involves drift-ice (pack-ice), and more than that, the condition of the ice being packed into a compact mass, under the influence of wind, swell, or current. When hummocked-ice is run together in the foregoing manner to form a long narrow area of pack-ice, about 1 km. (0.54 nautical mile) or less in width, it is also termed a strip (stream or string).

<sup>1</sup> Based on International Ice Nomenclature, WMO, Commission for Maritime Meteorology, Abridged Final Report, First Session, London, 1952.

<sup>2</sup> Polar fast-ice refers to fast-ice formed by the grounding and cementing together of polar-ice. By the end of winter it may reach some tens of kilometers from the coast. (NOTE.—One kilometer=0.54 nautical mile.) Polar-ice is extremely heavy sea-ice, up to 3 m. (9.84 ft.) or more in thickness, or more than one winter's growth; heavily hummocked, and may ultimately be reduced by weathering to a more or less even surface.

Winter fast-ice refers to fast-ice in bays, gulfs, and straits, mainly formed by growth from the shore, but also by cementing of pack-ice (drift-ice). Winter fast-ice rises and falls according to the tide.

- (6) Presence of leads near the shore. A lead (lane) is a navigable passage through drift-ice. It may be so named even if covered with young-ice.<sup>1</sup>
- (7) *Hummocked ice*. Hummocked ice refers to ice piled haphazardly, one piece over another.
- (8) *Ice jamming*. This term refers to the action of ice that is being squeezed or crowded together into a compact mass.
- (9) *Icebergs*. An iceberg is a large mass of floating or stranded ice, more than 5 m. (16.4 ft.) above sea level, which has broken away either from a glacier or from a shelf-ice formation.<sup>2</sup>

**10130. BEARING, DISTANCE, AND ORIENTATION.** When ice is present, estimate the distance to the nearest part of the ice (ice-limit) and determine the bearing to 8 points of the compass. When the ice-field<sup>3</sup> is so arranged that a fairly definite edge is seen, determine the orientation of the nearest edge; i. e., whether the edge lies in a northeast to southwest direction, etc.

<sup>1</sup> Young ice is newly formed level-ice generally in the transition stage of development from ice-rind, or pancake-ice to winter-ice; thickness from 5 cm. (1.97 in.) to 15 cm. (5.9 in.); as a rule impassable and unsafe for travel either by men or dogs, or for ski landings by aircraft.

Winter-ice is more or less unbroken level-ice of not more than 1 winter's growth, originating from young-ice. Thickness from 15 cm. (5.9 in.) to 2 m. (6.6 ft.).

<sup>2</sup> Shelf-ice (Barrier-ice) is an ice formation over 2 m. (6.6 ft.) above sea level with level surface, which originates from annual accumulations of firn-snow (névé) layers on old bay-ice (or the seaward extension of a glacier).

Firn-snow (Névé) is snow which has become coarse-grained and compact through temperature changes, forming the transition stage to glacier-ice.

Glacier-ice is any ice floating on the sea as a berg, which originates from a land-glacier.

Old bay-ice is level-ice of more than 1 winter's growth, which has remained unhummocked and also becomes nourished by surface layers of snow. Thickness of ice and snow up to about 2 m. (6.6 ft.) above sea level.

<sup>3</sup> Ice-field refers to an area of drift-ice (pack-ice), consisting of any size of floe, of such extent that its limits cannot be seen from the crow's nest. When by air observation or otherwise, the full extent of an ice-field is known, the ice-field may be further classified as:

Large—Over 20 km. (10.79 nautical miles) across.

Medium—15 to 20 km. (8.09 to 10.79 nautical miles) across.

Small—10 to 15 km. (5.4 to 8.09 nautical miles) across.

## 10200. CODING AND ENTRY OF ICE DATA ON FORM 1210F

**10210. GENERAL.** Ice observed at sea is coded and entered on Form 1210F as described below.

**10220. KIND ( $c_2$ ).** Select the code figure from Code Table 19 that most nearly corresponds with the predominant kind of ice observed, and enter the figure in column 37.

CODE TABLE 19

SYMBOL  $c_2$ .—Description of kind of ice

Code figure	Description
0	None or "ice-blink." <sup>1</sup>
1	New ice.
2	Fast-ice.
3	Drift-ice.
4	Packed (compact) slush or strips of hummocked-ice.
5	Open lead near shore.
6	Heavy fast-ice.
7	Heavy drift-ice.
8	Hummocked-ice.
9	Ice-jamming.

<sup>1</sup> When ice-blink is recorded, its bearing (symbol D<sub>1</sub>) should also be recorded.

**10230. EFFECT ON NAVIGATION (K).** Select the code figure from Code Table 20 that most accurately describes the effect of the ice on navigation, and enter the figure in column 38.

CODE TABLE 20

SYMBOL K.—Effect of ice on navigation

Code figure	Description
0	Navigation unobstructed.
1	Navigation slightly obstructed.
2	Navigation difficult for low powered ships.
3	Navigation possible only for powerful ships.
4	Navigation possible only for ships constructed to withstand ice pressure.
5	Navigation possible with the assistance of ice-breakers.
6	Channel open in the solid-ice.
7	Navigation temporarily closed.
8	Navigation closed.
9	Navigation conditions unknown (e. g., owing to bad weather).

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**10240. BEARING OF ICE-LIMIT ( $D_1$ ).** Select the code figure from Code Table 21 corresponding to the bearing of the nearest part of the ice, and enter the figure in column 39. If an ice-blink was recorded under "Kind ( $c_2$ )," report the bearing of the blink. When more than one area of ice is observed, record code figure "9" unless one area is of outstanding importance to navigation, in which case the bearing of the ice-limit for that area only will be recorded.

CODE TABLE 21

SYMBOL  $D_1$ —Bearing of ice-limit

Code figure	Description
0	Unknown.
1	Ice-limit toward NE.
2	Ice-limit toward E.
3	Ice-limit toward SE.
4	Ice-limit toward S.
5	Ice-limit toward SW.
6	Ice-limit toward W.
7	Ice-limit toward NW.
8	Ice-limit toward N.
9	Ice-limit in several directions. <sup>1</sup>

<sup>1</sup> Reported only when the bearing of the nearest or most important limit is unknown.

**10250. DISTANCE TO ICE-LIMIT FROM REPORTING SHIP ( $r$ ).** Select the code figure from Code Table 22 corresponding to the distance from the ship to the edge of the ice (bearing given as  $D_1$ ), and enter the figure in column 40.

CODE TABLE 22

SYMBOL  $r$ .—Distance to ice-limit from reporting ship

Code figure	Distance
0	0 to 1 mile.
1	1 to 2 miles.
2	2 to 4 miles.
3	4 to 6 miles.
4	6 to 8 miles.
5	8 to 12 miles.
6	12 to 16 miles.
7	16 to 20 miles.
8	More than 20 miles.
9	Unknown.

NOTE.—If the exact bounding distance for the ice-limit corresponds to two code figures, the lower code figure is reported.

**10260. ORIENTATION OF ICE-LIMIT (e).** Select the code figure from Code Table 23 corresponding to the orientation of the edge of the ice (the same edge as reported in  $D_1$  and  $r$ ), and enter the figure in column 41.

CODE TABLE 23

SYMBOL e.—Orientation of ice-limit

'Code figure	Orientation of ice-limit
0	Orientation of ice-limit impossible to estimate—ship <i>outside</i> the ice.
1	Ice-edge lying in a direction NE. to SW. with ice situated to the NW.
2	Ice-edge lying in a direction E. to W. with ice situated to the northward.
3	Ice-edge lying in a direction SE. to NW. with ice situated to the NE.
4	Ice-edge lying in a direction S. to N. with ice situated to the eastward.
5	Ice-edge lying in a direction SW. to NE. with ice situated to the SE.
6	Ice-edge lying in a direction W. to E. with ice situated to the southward.
7	Ice-edge lying in a direction NW. to SE. with ice situated to the SW.
8	Ice-edge lying in a direction N. to S. with ice situated to the westward.
9	Orientation of ice-limit impossible to estimate—ship <i>inside</i> the ice.

**10270. REPORTING ICEBERGS.** When icebergs are observed, record their size and height above the sea in the column headed "Remarks." When requested to do so by special instructions, the number of bergs seen should be indicated in plain language at the end of the transmitted weather message as "1 berg," "3 bergs," etc. (see par. 10002).

**10280. ICE GROUP.** The symbols for the kind ( $c_2$ ), effect (K), bearing ( $D_1$ ), distance ( $r$ ), and orientation (e) of the ice combine to form the ice group "ICE  $c_2KD_1re$ ," where "ICE" is the group indicator.

*Example:* The coded ice group "ICE 10423" is decoded as follows:

ICE—group indicator.

1—new ice present.

0—navigation unobstructed.

4—Ice-limit toward south.

2—Ice-limit 2 to 4 miles away (south).

3—Ice-limit lying in a direction SE. to NW. with the ice situated to the NE.



## **TABLES**

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CODE TABLE 1

SYMBOL Y.—*Day of the week*

Day	Code figure
Sunday.....	1
Monday.....	2
Tuesday.....	3
Wednesday.....	4
Thursday.....	5
Friday.....	6
Saturday.....	7

CODE TABLE 2

SYMBOL Q.—*Octant of the globe*

Longitude	Code figure
North latitude:	
0° W. to 90° W.....	0
90° W. to 180° W.....	1
180° E. to 90° E.....	2
90° E. to 0° E.....	3
South latitude:	
0° W. to 90° W.....	5
90° W. to 180° W.....	6
180° E. to 90° E.....	7
90° E. to 0° E.....	8

CODE TABLE 3

SYMBOL N.—*Total cloud amount*SYMBOL N<sub>h</sub>.—*Amount of cloud, the height of which is reported by "h"*

Code figure	Cloud amount (eighths of sky covered)
0	None
1	<sup>1</sup> 1
2	2
3	3
4	4
5	5
6	6
7	<sup>2</sup> 7
8	8
9	Sky obscured <sup>3</sup>

NOTES.—(1) "Fragments of clouds" are coded as 1. (2) "Overcast but with openings" is coded as 7. (3) Sky obscured by fog, rain, snow, smoke or other phenomena or obstruction except clouds.

## TABLES

CODE TABLE 4

SYMBOL *dd*.—True direction, in 10's of degrees, FROM which wind is blowing (00-36)

SYMBOL *d<sub>w</sub>d<sub>w</sub>*.—Direction, in 10's of degrees, FROM which waves are coming

Code figure	Direction	Code figure	Direction
00	Calm.	19	185° to 194°.
01	5° to 14°.	20	195° to 204°.
02	15° to 24°.	21	205° to 214°.
03	25° to 34°.	22	215° to 224°.
04	35° to 44°.	23	225° to 234°.
05	45° to 54°.	24	235° to 244°.
06	55° to 64°.	25	245° to 254°.
07	65° to 74°.	26	255° to 264°.
08	75° to 84°.	27	265° to 274°.
09	85° to 94°.	28	275° to 284°.
10	95° to 104°.	29	285° to 294°.
11	105° to 114°.	30	295° to 304°.
12	115° to 124°.	31	305° to 314°.
13	125° to 134°.	32	315° to 324°.
14	135° to 144°.	33	325° to 334°.
15	145° to 154°.	34	335° to 344°.
16	155° to 164°.	35	345° to 354°.
17	165° to 174°.	36	355° to 4°.
18	175° to 184°.		
Used only with <i>d<sub>w</sub>d<sub>w</sub></i>			
49	Waves confused, direction indeterminate.	99	Waves confused, direction indeterminate, but higher than 14 feet (4½ meters).

NOTE.—In case the true wind speed exceeds 99 knots, 50 will be added to "dd" and only the wind speed in excess of 100 knots will be coded. For example, if the direction=163° and speed=121 knots, the wind will be coded as "6621" (dd=16+50; ff=121-100).

CODE TABLE 5

SYMBOL *VV*.—Visibility

Code figure	Visibility range <sup>1</sup>
90	Less than 50 yards (50 meters).
91	50 yards (50 meters).
92	200 yards (200 meters).
93	¼ nautical mile (500 meters).
94	½ nautical mile (1,000 meters).
95	1 nautical mile (2,000 meters).
96	2 nautical miles (4,000 meters).
97	5 nautical miles (10 kilometers).
98	10 nautical miles (20 kilometers).
99	25 nautical miles (50 kilometers) or more.

1. In case the observed visibility is between two of the distances given in the table, the code figure for the lesser distance will be reported, e. g., when the visibility is between 50 and 200 yards, code the visibility as 91.

## CODE TABLE 6

SYMBOL *ww*—*Present weather*<sup>1</sup>

## 00-49 NO PRECIPITATION AT THE SHIP AT THE TIME OF OBSERVATION

**00-19: NO PRECIPITATION, FOG, DUSTSTORM, SANDSTORM OR DRIFTING SNOW AT THE SHIP AT THE TIME OF OBSERVATION OR DURING THE PRECEDING HOUR, EXCEPT FOR 09-12.**

- |   |   |                                      |   |  |
|---|---|--------------------------------------|---|--|
| See note 2.<br>Haze, dust, sand or smoke. | {                                       | 00                                   | No clouds or cloud development not observed   | } Characteristic change of the state of sky during the past hour.    |
|   |   | 01                                   | Clouds generally dissolving or becoming less developed  |  |
|   |   | 02                                   | State of sky on the whole unchanged   |  |
|   |   | 03                                   | Clouds generally forming or developing  |  |
|   |   | 04                                   | Visibility reduced by smoke, e. g., veldt or forest fires, industrial smoke, or volcanic ashes.   |  |
|   |   | 05                                   | Dry haze.   |  |
|   |   | 06                                   | Widespread dust in suspension in the air, not raised by wind at or near the ship at the time of observation.  |  |
|   |   | 07                                   | Dust or sand raised by wind at or near the ship at the time of observation, but no well developed dust devil(s) and no duststorm or sandstorm seen. |  |
|   |   | 08                                   | Well developed dust devil(s) seen at or near the ship within last hour, but no duststorm or sandstorm.  |  |
|   |   | 09                                   | Duststorm or sandstorm within sight of ship or at ship during the last hour.  |  |
|   |   | 10                                   | Light fog, visibility 1,000 meters (1,100 yards) or more.   |  |
|   |   | 11                                   | Patches of  | } Shallow fog at the ship not deeper than about 10 meters (33 feet). |
|   |   | 12                                   | More or less continuous   |  |
|   |   | 13                                   | Lightning visible, no thunder heard.  |  |
|   |   | 14                                   | Precipitation within sight, but not reaching sea at the ship.   |  |
|   |   | 15                                   | Precipitation within sight, reaching sea, but distant [i. e., estimated to be more than 5 kilometers (3 miles) from ship].                          |  |
|   |   | 16                                   | Precipitation within sight, reaching sea, near to but not at the ship.  |  |
|   |   | 17                                   | Thunder heard, but no precipitation at the ship.  |  |
|   |   | 18                                   | Squall(s)   |  |
| 19  | Funnel cloud(s) (tornado or waterspout) | } within sight during the past hour. |   |  |

**20-29: PRECIPITATION, FOG OR THUNDERSTORM AT THE SHIP DURING THE PRECEDING HOUR BUT NOT AT THE TIME OF OBSERVATION.**

- |  |   |   |                           |
|--|---|---|---------------------------|
| 20<br>21<br>22<br>23<br>24<br>25<br>26<br>27<br>28<br>29 | } | Drizzle (not freezing)                        | } not falling as showers. |
|  |   | Rain (not freezing)                           |                           |
|  |   | Snow  |                           |
|  |   | Rain and snow                                 |                           |
|  |   | Freezing drizzle or freezing rain             |                           |
|  |   | Shower(s) of rain.                            |                           |
|  |   | Shower(s) of snow, or of rain and snow.       |                           |
|  |   | Shower(s) of hail, or of hail and rain.       |                           |
|  |   | Fog.  |                           |
|  |   | Thunderstorm (with or without precipitation). |                           |
- 30-39: DUSTSTORM, SANDSTORM, OR DRIFTING SNOW.**
- |    |   |                   |
|----|---|-------------------|
| 30 | Slight or moderate duststorm or sandstorm— has decreased during the preceding hour.         |                   |
| 31 | Slight or moderate duststorm or sandstorm— no appreciable change during the preceding hour. |                   |
| 32 | Slight or moderate duststorm or sandstorm— has increased during the preceding hour.         |                   |
| 33 | Severe duststorm or sandstorm— has decreased during the preceding hour.                     |                   |
| 34 | Severe duststorm or sandstorm— no appreciable change during preceding hour.                 |                   |
| 35 | Severe duststorm or sandstorm— has increased during the preceding hour.                     |                   |
| 36 | Slight or moderate drifting snow  | } generally low.  |
| 37 | Heavy drifting snow   |                   |
| 38 | Slight or moderate drifting snow  | } generally high. |
| 39 | Heavy drifting snow   |                   |

**40-49: FOG AT THE TIME OF OBSERVATION.**

- |    |  |  |  |  |
|----|--|--|--|--|
| 40 | Fog at a distance at the time of observation, but not at the ship during the last hour, the fog extending to a level above that of the observer. |  |  |  |
| 41 | Fog in patches.  |  |  |  |
| {  | 42   | Fog, sky discernible                       | } has become thinner during the preceding hour.              |  |
|    | 43   | Fog, sky not discernible                   |  |  |
|    | 44   | Fog, sky discernible                       |  | } no appreciable change during the preceding hour. |
|    | 45   | Fog, sky not discernible                   |  |  |
|    | 46   | Fog, sky discernible                       |  |  |
| }  | 47   | Fog, sky not discernible                   | } has begun or has become thicker during the preceding hour. |  |
|    | 48   | Fog, depositing rime, sky discernible.     |  |  |
|    | 49   | Fog, depositing rime, sky not discernible. |  |  |

<sup>1</sup> In general, when coding *ww* the highest applicable figure is selected.<sup>2</sup> The amount of cloudiness at the time of observation is reported by symbol "N" in the group "Nddff." Code figures 00 to 03, inclusive, are used only when there is no other applicable code figure in the "*ww*" table to report. Code figure 00 is used when the observer has not had an opportunity to observe cloud development during the hour preceding the time of observation; 01 for clouds generally dissolving or becoming less developed; 02 for state of sky on the whole unchanged and 03 for clouds generally forming or developing.<sup>3</sup> Visibility less than 1,000 meters (1,100 yards).

50-99 PRECIPITATION: AT THE SHIP AT THE TIME OF OBSERVATION

50-59: DRIZZLE AT TIME OF OBSERVATION.

- 50 Drizzle, not freezing, intermittent <sup>1</sup> } slight at time of observation.
- 51 Drizzle, not freezing, continuous }
- 52 Drizzle, not freezing, intermittent <sup>1</sup> } moderate at time of observation.
- 53 Drizzle, not freezing, continuous }
- 54 Drizzle, not freezing, intermittent <sup>1</sup> } thick at time of observation.
- 55 Drizzle, not freezing, continuous }
- 56 Drizzle, freezing, slight.
- 57 Drizzle, freezing, moderate or thick.
- 58 Drizzle and rain, slight.
- 59 Drizzle and rain, moderate or heavy.

60-69: RAIN AT TIME OF OBSERVATION.

- 60 Rain, not freezing, intermittent <sup>1</sup> } slight at time of observation.
- 61 Rain, not freezing, continuous }
- 62 Rain, not freezing, intermittent <sup>1</sup> } moderate at time of observation.
- 63 Rain, not freezing, continuous }
- 64 Rain, not freezing, intermittent <sup>1</sup> } heavy at time of observation.
- 65 Rain, not freezing, continuous }
- 66 Rain, freezing, slight.
- 67 Rain, freezing, moderate or heavy.
- 68 Rain or drizzle and snow, slight.
- 69 Rain or drizzle and snow, moderate or heavy.

70-79: SOLID PRECIPITATION NOT IN SHOWERS AT TIME OF OBSERVATION.

- 70 Intermittent <sup>1</sup> fall of snowflakes } slight at time of observation.
- 71 Continuous fall of snowflakes }
- 72 Intermittent <sup>1</sup> fall of snowflakes } moderate at time of observation.
- 73 Continuous fall of snowflakes }
- 74 Intermittent <sup>1</sup> fall of snowflakes } heavy at time of observation.
- 75 Continuous fall of snowflakes }
- 76 Ice needles (with or without fog).
- 77 Granular snow (with or without fog).
- 78 Isolated starlike snow crystals (with or without fog).
- 79 Ice pellets.

80-99: SHOWERY PRECIPITATION, OR PRECIPITATION WITH CURRENT OR RECENT THUNDER-STORM.

- 80 Rain shower(s), slight.
- 81 Rain shower(s), moderate or heavy.
- 82 Rain shower(s), violent.
- 83 Shower(s) of rain and snow mixed, slight.
- 84 Shower(s) of rain and snow mixed, moderate or heavy.
- 85 Snow shower(s), slight.
- 86 Snow shower(s), moderate or heavy.
- 87 Shower(s) of soft or small hail, with or without rain, or rain and snow mixed—slight.
- 88 Shower(s) of soft or small hail, with or without rain, or rain and snow mixed—moderate or heavy.
- 89 Shower(s) of hail, with or without rain, or rain and snow mixed, not associated with thunder—slight.
- 90 Shower(s) of hail, with or without rain, or rain and snow mixed, not associated with thunder—moderate or heavy.
- 91 Slight rain at time of observation
- 92 Moderate or heavy rain at time of observation
- 93 Slight snow or rain and snow mixed or hail <sup>2</sup> at time of observation
- 94 Moderate or heavy snow, or rain and snow mixed or hail <sup>2</sup> at time of observation
- 95 Thunderstorm, slight or moderate, without hail <sup>2</sup> but with rain and/or snow at time of observation
- 96 Thunderstorm, slight or moderate, with hail <sup>2</sup> at time of observation
- 97 Thunderstorm, heavy, without hail <sup>2</sup> but with rain and/or snow at time of observation
- 98 Thunderstorm combined with duststorm or sandstorm <sup>3</sup>—at time of observation
- 99 Thunderstorm, heavy, with hail <sup>2</sup> at time of observation

} thunderstorm during the preceding hour but not at time of observation.

} thunderstorm at time of observation.

<sup>1</sup> Whenever the description "intermittent" is used, precipitation has not continued without a break during the preceding hour.  
<sup>2</sup> Hail, small hail, soft hail.  
<sup>3</sup> In reporting code figure 98, the observer is allowed considerable latitude in the presumption that precipitation is or is not occurring if it is not actually visible.

## MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

CODE TABLE 7

SYMBOL W.—*Past weather*

Code figure	Description
0	Clear or few clouds.
1	Partly cloudy or variable sky.
2	Cloudy or overcast.
3	Sandstorm or duststorm, or drifting or blowing snow.
4	Fog, smoke, dust, or haze.
5	Drizzle.
6	Rain.
7	Snow, rain and snow mixed, or sleet.
8	Shower(s).
9	Thunderstorm, with or without precipitation.

## NOTES

1. In 0000, 0600, 1200 and 1800 G. C. T. reports, "Past Weather" covers the preceding 6-hour period while in 0300, 0900, 1500, and 2100 G. C. T. reports, "W" covers the preceding 3-hour period (see par. 5820).
2. The code figure for "W" is selected in order that "W" and "ww" together give as complete a description as possible of the weather in the time interval concerned. For example, if the type of weather undergoes a complete change during the time interval concerned, the code figure selected for "W" will describe the weather prevailing before the type of weather indicated by "ww" began.

TABLES

CODE TABLE 8

SYMBOL PPP.—Corrected barometer reading

[Code in "tens," "units," and "tenths" of millibars, omit initial 9 or 10]

[1 inch=33.86395 mb. 1 mb.=0.02952993 inch]<sup>1</sup>

in.	mb.	in.	mb.	in.	mb.	in.	mb.								
27.50	931.3	28.00	948.2	28.50	965.1	29.00	982.1	29.50	999.0	30.00	1015.9	30.50	1032.9	31.00	1049.8
27.51	931.6	28.01	948.5	28.51	965.5	29.01	982.4	29.51	999.3	30.01	1016.3	30.51	1033.2	31.01	1050.1
27.52	931.9	28.02	948.9	28.52	965.8	29.02	982.7	29.52	999.7	30.02	1016.6	30.52	1033.5	31.02	1050.5
27.53	932.3	28.03	949.2	28.53	966.1	29.03	983.1	29.53	1000.0	30.03	1016.9	30.53	1033.9	31.03	1050.8
27.54	932.6	28.04	949.5	28.54	966.5	29.04	983.4	29.54	1000.3	30.04	1017.3	30.54	1034.2	31.04	1051.1
27.55	933.0	28.05	949.9	28.55	966.8	29.05	983.7	29.55	1000.7	30.05	1017.6	30.55	1034.5	31.05	1051.5
27.56	933.3	28.06	950.2	28.56	967.2	29.06	984.1	29.56	1001.0	30.06	1018.0	30.56	1034.9	31.06	1051.8
27.57	933.6	28.07	950.6	28.57	967.5	29.07	984.4	29.57	1001.4	30.07	1018.3	30.57	1035.2	31.07	1052.2
27.58	934.0	28.08	950.9	28.58	967.8	29.08	984.8	29.58	1001.7	30.08	1018.6	30.58	1035.6	31.08	1052.5
27.59	934.3	28.09	951.2	28.59	968.2	29.09	985.1	29.59	1002.0	30.09	1019.0	30.59	1035.9	31.09	1052.8
27.60	934.6	28.10	951.6	28.60	968.5	29.10	985.4	29.60	1002.4	30.10	1019.3	30.60	1036.2	31.10	1053.2
27.61	935.0	28.11	951.9	28.61	968.8	29.11	985.8	29.61	1002.7	30.11	1019.6	30.61	1036.6	31.11	1053.5
27.62	935.3	28.12	952.3	28.62	969.2	29.12	986.1	29.62	1003.1	30.12	1020.0	30.62	1036.9	31.12	1053.8
27.63	935.7	28.13	952.6	28.63	969.5	29.13	986.5	29.63	1003.4	30.13	1020.3	30.63	1037.3	31.13	1054.2
27.64	936.0	28.14	952.9	28.64	969.9	29.14	986.8	29.64	1003.7	30.14	1020.7	30.64	1037.6	31.14	1054.5
27.65	936.3	28.15	953.3	28.65	970.2	29.15	987.1	29.65	1004.1	30.15	1021.0	30.65	1037.9	31.15	1054.9
27.66	936.7	28.16	953.6	28.66	970.5	29.16	987.5	29.66	1004.4	30.16	1021.3	30.66	1038.3	31.16	1055.2
27.67	937.0	28.17	953.9	28.67	970.9	29.17	987.8	29.67	1004.7	30.17	1021.7	30.67	1038.6	31.17	1055.5
27.68	937.4	28.18	954.3	28.68	971.2	29.18	988.2	29.68	1005.1	30.18	1022.0	30.68	1038.9	31.18	1055.9
27.69	937.7	28.19	954.6	28.69	971.6	29.19	988.5	29.69	1005.4	30.19	1022.4	30.69	1039.3	31.19	1056.2
27.70	938.0	28.20	955.0	28.70	971.9	29.20	988.8	29.70	1005.8	30.20	1022.7	30.70	1039.6	31.20	1056.6
27.71	938.4	28.21	955.3	28.71	972.2	29.21	989.2	29.71	1006.1	30.21	1023.0	30.71	1040.0	31.21	1056.9
27.72	938.7	28.22	955.6	28.72	972.6	29.22	989.5	29.72	1006.4	30.22	1023.4	30.72	1040.3	31.22	1057.2
27.73	939.0	28.23	956.0	28.73	972.9	29.23	989.8	29.73	1006.8	30.23	1023.7	30.73	1040.6	31.23	1057.6
27.74	939.4	28.24	956.3	28.74	973.2	29.24	990.2	29.74	1007.1	30.24	1024.0	30.74	1041.0	31.24	1057.9
27.75	939.7	28.25	956.7	28.75	973.6	29.25	990.5	29.75	1007.5	30.25	1024.4	30.75	1041.3	31.25	1058.2
27.76	940.1	28.26	957.0	28.76	973.9	29.26	990.9	29.76	1007.8	30.26	1024.7	30.76	1041.7	31.26	1058.6
27.77	940.4	28.27	957.3	28.77	974.3	29.27	991.2	29.77	1008.1	30.27	1025.1	30.77	1042.0	31.27	1058.9
27.78	940.7	28.28	957.7	28.78	974.6	29.28	991.5	29.78	1008.5	30.28	1025.4	30.78	1042.3	31.28	1059.3
27.79	941.1	28.29	958.0	28.79	974.9	29.29	991.9	29.79	1008.8	30.29	1025.7	30.79	1042.7	31.29	1059.6
27.80	941.4	28.30	958.3	28.80	975.3	29.30	992.2	29.80	1009.1	30.30	1026.1	30.80	1043.0	31.30	1059.9
27.81	941.8	28.31	958.7	28.81	975.6	29.31	992.6	29.81	1009.5	30.31	1026.4	30.81	1043.3	31.31	1060.3
27.82	942.1	28.32	959.0	28.82	976.0	29.32	992.9	29.82	1009.8	30.32	1026.8	30.82	1043.7	31.32	1060.6
27.83	942.4	28.33	959.4	28.83	976.3	29.33	993.2	29.83	1010.2	30.33	1027.1	30.83	1044.0	31.33	1061.0
27.84	942.8	28.34	959.7	28.84	976.6	29.34	993.6	29.84	1010.5	30.34	1027.4	30.84	1044.4	31.34	1061.3
27.85	943.1	28.35	960.0	28.85	977.0	29.35	993.9	29.85	1010.8	30.35	1027.8	30.85	1044.7	31.35	1061.6
27.86	943.4	28.36	960.4	28.86	977.3	29.36	994.2	29.86	1011.2	30.36	1028.1	30.86	1045.0	31.36	1062.0
27.87	943.8	28.37	960.7	28.87	977.7	29.37	994.6	29.87	1011.5	30.37	1028.4	30.87	1045.4	31.37	1062.3
27.88	944.1	28.38	961.1	28.88	978.0	29.38	994.9	29.88	1011.9	30.38	1028.8	30.88	1045.7	31.38	1062.7
27.89	944.5	28.39	961.4	28.89	978.3	29.39	995.3	29.89	1012.2	30.39	1029.1	30.89	1046.1	31.39	1063.0
27.90	944.8	28.40	961.7	28.90	978.7	29.40	995.6	29.90	1012.5	30.40	1029.5	30.90	1046.4	31.40	1063.3
27.91	945.1	28.41	962.1	28.91	979.0	29.41	995.9	29.91	1012.9	30.41	1029.8	30.91	1046.7	31.41	1063.7
27.92	945.5	28.42	962.4	28.92	979.3	29.42	996.3	29.92	1013.2	30.42	1030.1	30.92	1047.1	31.42	1064.0
27.93	945.8	28.43	962.8	28.93	979.7	29.43	996.6	29.93	1013.5	30.43	1030.5	30.93	1047.4	31.43	1064.3
27.94	946.2	28.44	963.1	28.94	980.0	29.44	997.0	29.94	1013.9	30.44	1030.8	30.94	1047.8	31.44	1064.7
27.95	946.5	28.45	963.4	28.95	980.4	29.45	997.3	29.95	1014.2	30.45	1031.2	30.95	1048.1	31.45	1065.0
27.96	946.8	28.46	963.8	28.96	980.7	29.46	997.6	29.96	1014.6	30.46	1031.5	30.96	1048.4	31.46	1065.4
27.97	947.2	28.47	964.1	28.97	981.0	29.47	998.0	29.97	1014.9	30.47	1031.8	30.97	1048.8	31.47	1065.7
27.98	947.5	28.48	964.4	28.98	981.4	29.48	998.3	29.98	1015.2	30.48	1032.2	30.98	1049.1	31.48	1066.0
27.99	947.9	28.49	964.8	28.99	981.7	29.49	998.6	29.99	1015.6	30.49	1032.5	30.99	1049.5	31.49	1066.4

<sup>1</sup> Based on standard gravity of 980.665 cm./sec.<sup>2</sup>

## CODE TABLE 9

SYMBOL  $C_L$ .—Clouds of types stratocumulus, stratus, cumulus, and cumulonimbus

Code figure	Technical language specifications	Plain language specifications
0	No clouds $C_L$ .....	No stratocumulus, stratus, cumulus, or cumulonimbus clouds.
1	Cumulus humilis.....	Cumulus with little vertical development and seemingly flattened.
2	Cumulus congestus, with or without cumulus humilis or stratocumulus at the same level of base.	Cumulus of considerable development, generally towering, with or without other cumulus or stratocumulus; bases all at the same level.
3	Cumulonimbus calvus, with or without cumulus, stratocumulus, or stratus.	Cumulonimbus with tops lacking clearcut outlines but distinctly not cirriform or anvil-shaped; with or without cumulus, stratocumulus, or stratus.
4	Stratocumulus cumulogenitus or vesperalis.....	Stratocumulus formed by the spreading out of cumulus; cumulus also often present. (NOTE.—Since the spreading out of the scattered parcels of air that have been warmed by the surface may take place, as in Sc vesperalis as soon as the condensation level is reached, observers should be warned that, though Cu may normally have been seen earlier, the formation of a particular piece of Sc vesperalis may not come from a Cu.)
5	Stratocumulus other than cumulogenitus and vesperalis.	Stratocumulus not formed by the spreading out of cumulus.
6	Stratus and/or fractostratus, but not fractostratus of bad weather.	Stratus or fractostratus or both, but not fractostratus of bad weather.
7	Fractostratus and/or fractocumulus of bad weather ("scud") usually under altostratus and nimbostratus.	Fractostratus and/or fractocumulus of bad weather ("scud") usually under altostratus and nimbostratus. (By "bad weather" is meant the conditions usually prevailing before, during or after precipitation.)
8	Cumulus humilis or congestus and stratocumulus other than cumulogenitus and vesperalis with bases at different levels.	Cumulus and stratocumulus other than those formed by the spreading out of cumulus, with bases at different levels.
9	Cumulonimbus capillatus (often with anvil) with or without cumulus, stratocumulus, stratus, or "scud."	Cumulonimbus having a clearly fibrous (cirriform) top, often anvil-shaped, with or without cumulus, stratocumulus, stratus, or "scud."

NOTE.—When the sky is obscured by rain, snow, fog, duststorm, smoke or other phenomena, and clouds of  $C_L$  type cannot be observed, a slant (/) will be reported for  $C_L$ .

CODE TABLE 10

SYMBOL *h*.—Height of base of cloud above sea

Code figure	Feet	Meters
0	0 to 150.....	0 to 50.
1	150 to 300.....	50 to 100.
2	300 to 600.....	100 to 200.
3	600 to 1,000.....	200 to 300.
4	1,000 to 2,000.....	300 to 600.
5	2,000 to 3,500.....	600 to 1,000.
6	3,500 to 5,000.....	1,000 to 1,500.
7	5,000 to 6,500.....	1,500 to 2,000.
8	6,500 to 8,000.....	2,000 to 2,500.
9	No cloud below 8,000.....	No cloud below 2,500.

NOTES

1. Symbol "h" reports the height of the base of the lowest cloud layer below 8,000 feet. When only fragments of clouds are present below 8,000 feet, "h" indicates the height of the fragments.
2. If the height of the cloud base is exactly equal to a height given in the table, the higher code figure is used. For example, a height of 600 feet is coded as 3.
3. When the sky is obscured by rain, snow, fog, smoke, or other phenomena so that cloud at or below 8,000 feet cannot be observed, "h" is coded as 0 and "N<sub>h</sub>" as 9.
4. If the height of the cloud base cannot be reported owing to darkness or any reason not covered by Note 3, a slant (/) is reported for "h."

CODE TABLE 11

SYMBOL *C<sub>M</sub>*.—Clouds of types *altocumulus*, *altostratus*, and *nimbostratus*

Code figure	Technical language specifications	Plain language specifications
0	No clouds <i>C<sub>M</sub></i> .....	No <i>altocumulus</i> , <i>altostratus</i> , or <i>nimbostratus</i> clouds.
1	<i>Altostratus translucidus</i> .....	Thin <i>altostratus</i> (semitransparent everywhere) through which the sun or moon would be seen dimly as through ground glass.
2	<i>Altostratus opacus</i> , or <i>nimbostratus</i> .....	Thick <i>altostratus</i> , or <i>nimbostratus</i> (through portions of the sheet the position of the sun or moon may be indicated by a light patch).
3	<i>Altostratus translucidus</i> more or less stable and at a single level.	Thin (semitransparent) <i>altocumulus</i> ; cloud elements not changing much; at a single level.
4	<i>Altostratus translucidus</i> in patches (often lenticular) continually transforming and/or occurring at different levels.	Thin (semitransparent) <i>altocumulus</i> in patches (often almond or fish-shaped); cloud elements continually changing and/or occurring at more than one level.
5	<i>Altostratus translucidus</i> in bands, or in a layer systematically invading the sky and usually thickening as a whole, even partly into <i>altocumulus opacus</i> or <i>duplicatus</i> .	Thin (semitransparent) <i>altocumulus</i> in bands or in a layer gradually spreading over the sky and usually thickening as a whole; it may become partly opaque or double-layered.
6	<i>Altostratus cumulogenitus</i> .....	<i>Altostratus</i> formed by the spreading out of <i>cumulus</i> .
7	<i>Altostratus duplicatus</i> or <i>opacus</i> , not increasing; or <i>altostratus</i> and <i>altocumulus</i> .	Any of the following cases: (a) Double-layered <i>altocumulus</i> , usually opaque in parts, not increasing; (b) a thick (opaque) layer of <i>altocumulus</i> , not increasing; (c) <i>altostratus</i> and <i>altocumulus</i> both present at the same or different levels.
8	<i>Altostratus cumuliformis</i> ( <i>floccus</i> or <i>castellatus</i> ).	<i>Altostratus</i> in the form of <i>cumulus</i> -shaped tufts or <i>altocumulus</i> with turrets.
9	<i>Altostratus</i> of a chaotic sky; generally at different levels; <i>cirrus densus</i> in patches usually present.	<i>Altostratus</i> of a chaotic sky; generally at different levels; dense <i>cirrus</i> in patches is usually also present.

NOTE.—When the sky is obscured by rain, snow, fog, duststorm, smoke or other phenomena, or an intervening layer of *C<sub>L</sub>* clouds, and clouds of *C<sub>M</sub>* type cannot be observed, a slant (/) is reported for *C<sub>M</sub>*.

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CODE TABLE 12

SYMBOL  $C_H$ .—*Clouds of types cirrus, cirrostratus, and cirrocumulus*

Code figure	Technical language specifications	Plain language specifications
0	No clouds $C_H$ -----	No cirrus, cirrocumulus, or cirrostratus clouds.
1	Cirrus filorus, scattered and not increasing--	Filaments or strands of cirrus, scattered and not increasing (often "mares' tails").
2	Cirrus densus in patches or twisted sheaves usually not increasing, sometimes presumably being the remains of the upper part of cumulonimbus.	Dense cirrus in patches or twisted sheaves usually not increasing; possibly but not certainly the remains of the upper part of cumulonimbus.
3	Cirrus nothus; either the remains of cumulonimbus or part of a distant cumulonimbus the rest of which is not visible.	Cirrus, often anvil-shaped; either the remains of the upper portions of cumulonimbus or part of a distant cumulonimbus the rest of which is not visible. (If there is doubt as to the cumulonimbus origin or association, Code $C_H2$ should be used.)
4	Cirrus (often cirrus uncinus) systematically invading the sky and usually thickening as a whole.	Cirrus (often hook-shaped) gradually spreading over the sky and usually thickening as a whole.
5	Cirrus, often in polar bands, and/or cirrostratus systematically invading the sky and usually thickening as a whole, but the continuous layer not reaching 45° altitude.	Cirrus and cirrostratus, often in bands converging toward the horizon; or cirrostratus alone; in either case gradually spreading over the sky and usually thickening as a whole, but the continuous layer not reaching 45° altitude.
6	Cirrus, often in polar bands, and/or cirrostratus systematically invading the sky and usually thickening as a whole, and the continuous layer exceeding 45° altitude.	Cirrus and cirrostratus, often in bands converging toward the horizon; or cirrostratus alone; in either case gradually spreading over the sky and usually thickening as a whole, and the continuous layer exceeding 45° altitude.
7	Cirrostratus covering the whole sky-----	Cirrostratus covering the whole sky.
8	Cirrostratus not increasing and not covering the whole sky.	Cirrostratus not increasing and not covering the whole sky; cirrus and cirrocumulus may be present.
9	Cirrocumulus the dominant cirriform cloud.	Cirrocumulus alone or cirrocumulus with some cirrus or cirrostratus, but the cirrocumulus being the main cirriform cloud present. (Cirrocumulus may be present in $C_H1$ to $C_H8$ .)

NOTE.—When the sky is obscured by rain, snow, fog, duststorm, smoke or other phenomena, or an intervening layer of  $C_L$  or  $C_M$  clouds, or both, and clouds of type  $C_H$  cannot be observed, a slant (/) will be reported for  $C_H$ .

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CODE TABLE 13

SYMBOL D<sub>s</sub>.—*Ship's course (true) made good in 3 hours preceding the time of observation*

Code figure	True course	Code figures	True course
0	Ship hove to.	5	SW.
1	NE.	6	W.
2	E.	7	NW.
3	SE.	8	N.
4	S.	9	No information.

CODE TABLE 14

SYMBOL v<sub>s</sub>.—*Ship's average speed made good during 3 hours preceding the time of observation*

Code figure	Speed	Code figures	Speed
0	Ship stopped.	5	13 to 15 knots.
1	1 to 3 knots.	6	16 to 18 knots.
2	4 to 6 knots.	7	19 to 21 knots.
3	7 to 9 knots.	8	22 to 24 knots.
4	10 to 12 knots.	9	More than 24 knots.

CODE TABLE 15

SYMBOL a.—*Barometer change characteristics in the last 3 hours*

Code figure	Description	
0	Rising then falling	} Barometer now higher than or the same as 3 hours ago.
1	Rising then steady; or rising, then rising more slowly.	
2	Unsteady	
3	Steady or rising	
4	Falling or steady, then rising; or rising, then rising more rapidly.	} Barometer now lower than 3 hours ago.
5	Falling, then rising	
6	Falling, then steady; or falling, then falling more slowly.	
7	Unsteady	
8	Falling	
9	Steady or rising, then falling; or falling, then falling more rapidly.	

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CODE TABLE 16

SYMBOL pp.—Amount of barometric change in the last 3 hours

[Coded in units of  $\frac{1}{10}$  of a millibar. For example, 0.2 millibar is coded as 02; 1.2 millibars as 12]

Amount of rise or fall							
Inch	Milli-bars	Inch	Milli-bars	Inch	Milli-bars	Inch	Milli-bars
0. 005	0. 2	0. 155	5. 3	0. 305	10. 3	0. 455	15. 4
. 010	0. 3	. 160	5. 4	. 310	10. 5	. 460	15. 6
. 015	0. 5	. 165	5. 6	. 315	10. 7	. 465	15. 7
. 020	0. 7	. 170	5. 8	. 320	10. 8	. 470	15. 9
. 025	0. 9	. 175	5. 9	. 325	11. 0	. 475	16. 1
. 030	1. 0	. 180	6. 1	. 330	11. 2	. 480	16. 3
. 035	1. 2	. 185	6. 3	. 335	11. 3	. 485	16. 4
. 040	1. 4	. 190	6. 4	. 340	11. 5	. 490	16. 6
. 045	1. 5	. 195	6. 6	. 345	11. 7	. 495	16. 8
. 050	1. 7	. 200	6. 8	. 350	11. 9	. 500	16. 9
. 055	1. 9	. 205	6. 9	. 355	12. 0	. 505	17. 1
. 060	2. 0	. 210	7. 1	. 360	12. 2	. 510	17. 3
. 065	2. 2	. 215	7. 3	. 365	12. 4	. 515	17. 4
. 070	2. 4	. 220	7. 5	. 370	12. 5	. 520	17. 6
. 075	2. 5	. 225	7. 6	. 375	12. 7	. 525	17. 8
. 080	2. 7	. 230	7. 8	. 380	12. 9	. 530	17. 9
. 085	2. 9	. 235	8. 0	. 385	13. 0	. 535	18. 1
. 090	3. 1	. 240	8. 1	. 390	13. 2	. 540	18. 3
. 095	3. 2	. 245	8. 3	. 395	13. 4	. 545	18. 5
. 100	3. 4	. 250	8. 5	. 400	13. 5	. 550	18. 6
. 105	3. 6	. 255	8. 6	. 405	13. 7	. 555	18. 8
. 110	3. 7	. 260	8. 8	. 410	13. 9	. 560	19. 0
. 115	3. 9	. 265	9. 0	. 415	14. 1	. 565	19. 1
. 120	4. 1	. 270	9. 1	. 420	14. 2	. 570	19. 3
. 125	4. 2	. 275	9. 3	. 425	14. 4	. 575	19. 5
. 130	4. 4	. 280	9. 5	. 430	14. 6	. 580	19. 6
. 135	4. 6	. 285	9. 7	. 435	14. 7	. 585	19. 8
. 140	4. 7	. 290	9. 8	. 440	14. 9	. 590	20. 0
. 145	4. 9	. 295	10. 0	. 445	15. 1	. 595	20. 1
. 150	5. 1	. 300	10. 2	. 450	15. 2	. 600	20. 3

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CODE TABLE 17

SYMBOL  $P_w$ .—*Period of waves*

Code figure	Period
2	5 seconds or less.
3	5 to 7 seconds.
4	7 to 9 seconds.
5	9 to 11 seconds.
6	11 to 13 seconds.
7	13 to 15 seconds.
8	15 to 17 seconds.
9	17 to 19 seconds.
0	19 to 21 seconds.
1	Over 21 seconds.
x	Calm, or period indeterminate.

NOTE.—If the exact number of seconds for the period of the waves corresponds to two code figures, the lower code figure is reported.

CODE TABLE 18

SYMBOL  $H_w$ .—*Mean maximum height of waves*

Code figure	Height
0	Less than 1 foot ( $\frac{1}{4}$ meter).
1	1½ feet ( $\frac{1}{2}$ meter).
2	3 feet (1 meter).
3	5 feet (1½ meters).
4	6½ feet (2 meters).
5	8 feet (2½ meters).
6	9½ feet (3 meters).
7	11 feet (3½ meters).
8	13 feet (4 meters).
9	14 feet (4½ meters).
x	Height impossible to determine. (When 50 is added to $d_w$ , the height of waves is as follows):
0	16 feet (5 meters).
1	17½ feet (5½ meters).
2	19 feet (6 meters).
3	21 feet (6½ meters).
4	22½ feet (7 meters).
5	24 feet (7½ meters).
6	25½ feet (8 meters).
7	27 feet (8½ meters).
8	29 feet (9 meters).
9	30½ feet (9½ meters).
x	Height impossible to determine.

NOTES

- Each code figure except "zero" covers a range of  $\frac{1}{2}$  meter; e. g., code figure 1 =  $\frac{1}{4}$  meter to  $\frac{3}{4}$  meter, code figure 2 =  $\frac{3}{4}$  meter to 1¼ meters.
- If the wave height is exactly between the heights corresponding to two code figures, the lower code figure is reported.
- For wave heights greater than 31 feet (9¾ meters), the code figure for 30½ feet (9½ meters) is reported followed by the word "WAVES" and the actual height of the waves in feet or meters; e. g., "WAVES 37."

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CODE TABLE 19

SYMBOL  $c_2$ .—*Description of kind of ice*

Code figure	Description
0	None or "ice-blink." <sup>1</sup>
1	New ice.
2	Fast-ice.
3	Drift-ice.
4	Packed (compact) slush or strips of hummocked-ice.
5	Open lead near shore.
6	Heavy fast-ice.
7	Heavy drift-ice.
8	Hummocked-ice.
9	Ice-jamming.

<sup>1</sup> When ice-blink is recorded, its bearing (symbol  $D_1$ ) should also be recorded.

CODE TABLE 20

SYMBOL K.—*Effect of ice on navigation*

Code figure	Description
0	Navigation unobstructed.
1	Navigation slightly obstructed.
2	Navigation difficult for low powered ships.
3	Navigation possible only for powerful ships.
4	Navigation possible only for ships constructed to withstand ice pressure.
5	Navigation possible with the assistance of ice breakers.
6	Channel open in the solid-ice.
7	Navigation temporarily closed.
8	Navigation closed.
9	Navigation conditions unknown (e.g., owing to bad weather).

CODE TABLE 21

SYMBOL  $D_1$ .—*Bearing of ice-limit*

Code figure	Description
0	Unknown.
1	Ice-limit toward NE.
2	Ice-limit toward E.
3	Ice-limit toward SE.
4	Ice-limit toward S.
5	Ice-limit toward SW.
6	Ice-limit toward W.
7	Ice-limit toward NW.
8	Ice-limit toward N.
9	Ice-limit in several directions.

NOTE.—If more than one ice-limit can be stated, the nearest or most important is reported.

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CODE TABLE 22

SYMBOL r.—Distance to ice-limit from reporting ship

Code figure	Distance
0	0 to 1 mile.
1	1 to 2 miles.
2	2 to 4 miles.
3	4 to 6 miles.
4	6 to 8 miles.
5	8 to 12 miles.
6	12 to 16 miles.
7	16 to 20 miles.
8	More than 20 miles.
9	Unknown.

NOTE.—If the exact bounding distance for the ice-limit corresponds to two code figures, the lower code figure is reported.

CODE TABLE 23

SYMBOL e.—Orientation of ice-limit

Code figure	Orientation of ice-limit
0	Orientation of ice-limit impossible to estimate—ship <i>outside</i> the ice.
1	Ice-edge lying in a direction NE to SW with ice situated to the NW.
2	Ice-edge lying in a direction E to W with ice situated to the northward.
3	Ice-edge lying in a direction SE to NW with ice situated to the NE.
4	Ice-edge lying in a direction S to N with ice situated to the eastward.
5	Ice-edge lying in a direction SW to NE with ice situated to the SE.
6	Ice-edge lying in a direction W to E with ice situated to the southward.
7	Ice-edge lying in a direction NW to SE with ice situated to the SW.
8	Ice-edge lying in a direction N to S with ice situated to the westward.
9	Orientation of ice-limit impossible to estimate—ship <i>inside</i> the ice.

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TABLE 24.—Celsius (centigrade) to Fahrenheit temperatures

°C.	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	°F.									
+45	+113.0	+113.2	+113.4	+113.5	+113.7	+113.9	+114.1	+114.3	+114.4	+114.6
44	111.2	111.4	111.6	111.7	111.9	112.1	112.3	112.5	112.6	112.8
43	109.4	109.6	109.8	109.9	110.1	110.3	110.5	110.7	110.8	111.0
42	107.6	107.8	108.0	108.1	108.3	108.5	108.7	108.9	109.0	109.2
41	105.8	106.0	106.2	106.3	106.5	106.7	106.9	107.1	107.2	107.4
+40	+104.0	+104.2	+104.4	+104.5	+104.7	+104.9	+105.1	+105.3	+105.4	+105.6
39	102.2	102.4	102.6	102.7	102.9	103.1	103.3	103.5	103.6	103.8
38	100.4	100.6	100.8	100.9	101.1	101.3	101.5	101.7	101.8	102.0
37	98.6	98.8	99.0	99.1	99.3	99.5	99.7	99.9	100.0	100.2
36	96.8	97.0	97.2	97.3	97.5	97.7	97.9	98.1	98.2	98.4
+35	+95.0	+95.2	+95.4	+95.5	+95.7	+95.9	+96.1	+96.3	+96.4	+96.6
34	93.2	93.4	93.6	93.7	93.9	94.1	94.3	94.5	94.6	94.8
33	91.4	91.6	91.8	91.9	92.1	92.3	92.5	92.7	92.8	93.0
32	89.6	89.8	90.0	90.1	90.3	90.5	90.7	90.9	91.0	91.2
31	87.8	88.0	88.2	88.3	88.5	88.7	88.9	89.1	89.2	89.4
+30	+86.0	+86.2	+86.4	+86.5	+86.7	+86.9	+87.1	+87.3	+87.4	+87.6
29	84.2	84.4	84.6	84.7	84.9	85.1	85.3	85.5	85.6	85.8
28	82.4	82.6	82.8	82.9	83.1	83.3	83.5	83.7	83.8	84.0
27	80.6	80.8	81.0	81.1	81.3	81.5	81.7	81.9	82.0	82.2
26	78.8	79.0	79.2	79.3	79.5	79.7	79.9	80.1	80.2	80.4
+25	+77.0	+77.2	+77.4	+77.5	+77.7	+77.9	+78.1	+78.3	+78.4	+78.6
24	75.2	75.4	75.6	75.7	75.9	76.1	76.3	76.5	76.6	76.8
23	73.4	73.6	73.8	73.9	74.1	74.3	74.5	74.7	74.8	75.0
22	71.6	71.8	72.0	72.1	72.3	72.5	72.7	72.9	73.0	73.2
21	69.8	70.0	70.2	70.3	70.5	70.7	70.9	71.1	71.2	71.4
+20	+68.0	+68.2	+68.4	+68.5	+68.7	+68.9	+69.1	+69.3	+69.4	+69.6
19	66.2	66.4	66.6	66.7	66.9	67.1	67.3	67.5	67.6	67.8
18	64.4	64.6	64.8	64.9	65.1	65.3	65.5	65.7	65.8	66.0
17	62.6	62.8	63.0	63.1	63.3	63.5	63.7	63.9	64.0	64.2
16	60.8	61.0	61.2	61.3	61.5	61.7	61.9	62.1	62.2	62.4
+15	+59.0	+59.2	+59.4	+59.5	+59.7	+59.9	+60.1	+60.3	+60.4	+60.6
14	57.2	57.4	57.6	57.7	57.9	58.1	58.3	58.5	58.6	58.8
13	55.4	55.6	55.8	55.9	56.1	56.3	56.5	56.7	56.8	57.0
12	53.6	53.8	54.0	54.1	54.3	54.5	54.7	54.9	55.0	55.2
11	51.8	52.0	52.2	52.3	52.5	52.7	52.9	53.1	53.2	53.4
+10	+50.0	+50.2	+50.4	+50.5	+50.7	+50.9	+51.1	+51.3	+51.4	+51.6
9	48.2	48.4	48.6	48.7	48.9	49.1	49.3	49.5	49.6	49.8
8	46.4	46.6	46.8	46.9	47.1	47.3	47.5	47.7	47.8	48.0
7	44.6	44.8	45.0	45.1	45.3	45.5	45.7	45.9	46.0	46.2
6	42.8	43.0	43.2	43.3	43.5	43.7	43.9	44.1	44.2	44.4
+5	+41.0	+41.2	+41.4	+41.5	+41.7	+41.9	+42.1	+42.3	+42.4	+42.6
4	39.2	39.4	39.6	39.7	39.9	40.1	40.3	40.5	40.6	40.8
3	37.4	37.6	37.8	37.9	38.1	38.3	38.5	38.7	38.8	39.0
2	35.6	35.8	36.0	36.1	36.3	36.5	36.7	36.9	37.0	37.2
1	33.8	34.0	34.2	34.3	34.5	34.7	34.9	35.1	35.2	35.4
0	32.0	32.2	32.4	32.5	32.7	32.9	33.1	33.3	33.4	33.6

TABLE 24.—Celsius (centigrade) to Fahrenheit temperatures—Continued

°C.	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	°F.									
-0	+32.0	+31.8	+31.6	+31.5	+31.3	+31.1	+30.9	+30.7	+30.6	+30.4
1	30.2	30.0	29.8	29.7	29.5	29.3	29.1	28.9	28.8	28.6
2	28.4	28.2	28.0	27.9	27.7	27.5	27.3	27.1	27.0	26.8
3	26.6	26.4	26.2	26.1	25.9	25.7	25.5	25.3	25.2	25.0
4	24.8	24.6	24.4	24.3	24.1	23.9	23.7	23.5	23.4	23.2
-5	+23.0	+22.8	+22.6	+22.5	+22.3	+22.1	+21.9	+21.7	+21.6	+21.4
6	21.2	21.0	20.8	20.7	20.5	20.3	20.1	19.9	19.8	19.6
7	19.4	19.2	19.0	18.9	18.7	18.5	18.3	18.1	18.0	17.8
8	17.6	17.4	17.2	17.1	16.9	16.7	16.5	16.3	16.2	16.0
9	15.8	15.6	15.4	15.3	15.1	14.9	14.7	14.5	14.4	14.2
-10	+14.0	+13.8	+13.6	+13.5	+13.3	+13.1	+12.9	+12.7	+12.6	+12.4
11	12.2	12.0	11.8	11.7	11.5	11.3	11.1	10.9	10.8	10.6
12	10.4	10.2	10.0	9.9	9.7	9.5	9.3	9.1	9.0	8.8
13	8.6	8.4	8.2	8.1	7.9	7.7	7.5	7.3	7.2	7.0
14	6.8	6.6	6.4	6.3	6.1	5.9	5.7	5.5	5.4	5.2
-15	+5.0	+4.8	+4.6	+4.5	+4.3	+4.1	+3.9	+3.7	+3.6	+3.4
16	+3.2	+3.0	+2.8	+2.7	+2.5	+2.3	+2.1	+1.9	+1.8	+1.6
17	+1.4	+1.2	+1.0	+0.9	+0.7	+0.5	+0.3	+0.1	-0.0	-0.2
18	-0.4	-0.6	-0.8	-0.9	-1.1	-1.3	-1.5	-1.7	-1.8	-2.0
19	-2.2	-2.4	-2.6	-2.7	-2.9	-3.1	-3.3	-3.5	-3.6	-3.8
-20	-4.0	-4.2	-4.4	-4.5	-4.7	-4.9	-5.1	-5.3	-5.4	-5.6
21	5.8	6.0	6.2	6.3	6.5	6.7	6.9	7.1	7.2	7.4
22	7.6	7.8	8.0	8.1	8.3	8.5	8.7	8.9	9.0	9.2
23	9.4	9.6	9.8	9.9	10.1	10.3	10.5	10.7	10.8	11.0
24	11.2	11.4	11.6	11.7	11.9	12.1	12.3	12.5	12.6	12.8
-25	-13.0	-13.2	-13.4	-13.5	-13.7	-13.9	-14.1	-14.3	-14.4	-14.6
26	14.8	15.0	15.2	15.3	15.5	15.7	15.9	16.1	16.2	16.4
27	16.6	16.8	17.0	17.1	17.3	17.5	17.7	17.9	18.0	18.2
28	18.4	18.6	18.8	18.9	19.1	19.3	19.5	19.7	19.8	20.0
29	20.2	20.4	20.6	20.7	20.9	21.1	21.3	21.5	21.6	21.8
-30	-22.0	-22.2	-22.4	-22.5	-22.7	-22.9	-23.1	-23.3	-23.4	-23.6
31	23.8	24.0	24.2	24.3	24.5	24.7	24.9	25.1	25.2	25.4
32	25.6	25.8	26.0	26.1	26.3	26.5	26.7	26.9	27.0	27.2
33	27.4	27.6	27.8	27.9	28.1	28.3	28.5	28.7	28.8	29.0
34	29.2	29.4	29.6	29.7	29.9	30.1	30.3	30.5	30.6	30.8
-35	-31.0	-31.2	-31.4	-31.5	-31.7	-31.9	-32.1	-32.3	-32.4	-32.6
36	32.8	33.0	33.2	33.3	33.5	33.7	33.9	34.1	34.2	34.4
37	34.6	34.8	35.0	35.1	35.3	35.5	35.7	35.9	36.0	36.2
38	36.4	36.6	36.8	36.9	37.1	37.3	37.5	37.7	37.8	38.0
39	38.2	38.4	38.6	38.7	38.9	39.1	39.3	39.5	39.6	39.8
-40	-40.0	-40.2	-40.4	-40.5	-40.7	-40.9	-41.1	-41.3	-41.4	-41.6
41	41.8	42.0	42.2	42.3	42.5	42.7	42.9	43.1	43.2	43.4
42	43.6	43.8	44.0	44.1	44.3	44.5	44.7	44.9	45.0	45.2
43	45.4	45.6	45.8	45.9	46.1	46.3	46.5	46.7	46.8	47.0
44	47.2	47.4	47.6	47.7	47.9	48.1	48.3	48.5	48.6	48.8

MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

TABLE 25.—Temperature of the dew point in degrees Fahrenheit

[Tabular values are dew points with respect to water]

Wet-bulb temperature (° F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																				
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
-20.0	-27	-29	-31	-33	-35	-38	-41	-45	-50	-58	-70										
-19.5	-26	-28	-30	-32	-35	-37	-40	-44	-49	-55	-64	-92									
-19.0	-26	-28	-29	-31	-34	-36	-39	-43	-47	-52	-60	-76									
-18.5	-25	-27	-29	-31	-33	-35	-38	-41	-45	-50	-57	-69									
-18.0	-25	-26	-28	-30	-32	-34	-37	-40	-44	-48	-54	-64	-87								
-17.5	-24	-26	-27	-29	-31	-33	-36	-39	-42	-46	-52	-59	-74								
-17.0	-24	-25	-27	-28	-30	-33	-35	-38	-41	-45	-49	-56	-67								
-16.5	-23	-24	-26	-28	-30	-32	-34	-36	-39	-43	-47	-53	-62	-80							
-16.0	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-70							
-15.5	-22	-23	-25	-26	-28	-30	-32	-34	-37	-40	-44	-48	-54	-64	-88						
-15.0	-21	-23	-24	-26	-27	-29	-31	-33	-36	-39	-42	-46	-52	-59	-73						
-14.5	-21	-22	-23	-25	-26	-28	-30	-32	-35	-37	-40	-44	-49	-55	-65						
-14.0	-20	-21	-23	-24	-26	-27	-29	-31	-34	-36	-39	-42	-47	-52	-60	-76					
-13.5	-20	-21	-22	-23	-25	-27	-28	-30	-32	-35	-38	-41	-45	-49	-56	-67					
-13.0	-19	-20	-21	-23	-24	-26	-28	-29	-31	-34	-36	-39	-43	-47	-53	-61	-78				
-12.5	-18	-20	-21	-22	-24	-25	-27	-28	-30	-33	-35	-38	-41	-45	-50	-56	-67				
-12.0	-18	-19	-20	-21	-23	-24	-26	-28	-29	-31	-34	-36	-39	-43	-47	-53	-61	-78			
-11.5	-17	-18	-20	-21	-22	-24	-25	-27	-28	-30	-33	-35	-38	-41	-45	-50	-56	-67			
-11.0	-17	-18	-19	-20	-21	-23	-24	-26	-27	-29	-31	-34	-36	-39	-43	-47	-52	-61	-77		
-10.5	-16	-17	-18	-19	-21	-22	-23	-25	-27	-28	-30	-32	-35	-37	-41	-44	-49	-56	-66		
-10.0	-16	-17	-18	-19	-20	-21	-23	-24	-26	-27	-29	-31	-33	-36	-39	-42	-47	-52	-60	-75	
-9.5	-15	-16	-17	-18	-19	-21	-22	-23	-25	-26	-28	-30	-32	-34	-37	-40	-44	-49	-55	-65	-94
-9.0	-14	-15	-16	-17	-19	-20	-21	-22	-24	-25	-27	-29	-31	-33	-36	-38	-42	-46	-51	-58	-72
-8.5	-14	-15	-16	-17	-18	-19	-20	-22	-23	-24	-26	-28	-30	-32	-34	-37	-40	-43	-48	-54	-63
-8.0	-13	-14	-15	-16	-17	-18	-20	-21	-22	-24	-25	-27	-29	-30	-33	-35	-38	-41	-45	-50	-57
-7.5	-13	-14	-15	-16	-17	-18	-19	-20	-21	-23	-24	-26	-27	-29	-31	-33	-36	-39	-42	-47	-52
-7.0	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-25	-26	-28	-30	-32	-34	-37	-40	-44	-48
-6.5	-12	-12	-13	-14	-15	-16	-17	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-41	-45
-6.0	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-21	-23	-24	-26	-27	-29	-31	-34	-36	-39	-43
-5.5	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-25	-26	-28	-30	-32	-34	-37	-40
-5.0	-10	-11	-12	-12	-13	-14	-15	-16	-17	-18	-20	-21	-22	-24	-25	-27	-29	-30	-33	-35	-38
-4.5	-9	-10	-11	-12	-13	-14	-14	-15	-16	-18	-19	-20	-21	-23	-24	-26	-27	-29	-31	-33	-36
-4.0	-9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-24	-26	-28	-30	-32	-34
-3.5	-8	-9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-21	-22	-23	-25	-26	-28	-30	-32
-3.0	-8	-8	-9	-10	-11	-12	-12	-13	-14	-15	-16	-17	-18	-20	-21	-22	-24	-25	-27	-29	-31
-2.5	-7	-8	-8	-9	-10	-11	-12	-13	-13	-14	-15	-16	-17	-19	-20	-21	-22	-24	-25	-27	-29
-2.0	-7	-7	-8	-9	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-21	-23	-24	-26	-27
-1.5	-6	-7	-7	-8	-9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-24	-26
-1.0	-5	-6	-7	-7	-8	-9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-25
-0.5	-5	-5	-6	-7	-7	-8	-9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18	-19	-21	-22	-23
0.0	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18	-19	-21	-22
+0.5	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18	-20	-21
1.0	-3	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-12	-12	-13	-14	-15	-16	-17	-18	-20
1.5	-3	-3	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-12	-12	-13	-14	-15	-16	-17	-18
2.0	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-12	-12	-13	-14	-15	-16	-17
2.5	-1	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-12	-12	-13	-14	-15	-16
3.0	-1	-1	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-12	-12	-13	-14	-15
3.5	0	-1	-1	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-11	-12	-13	-14
4.0	0	0	-1	-1	-2	-2	-3	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-11	-12	-13
4.5	1	0	0	-1	-1	-2	-2	-3	-4	-4	-5	-5	-6	-7	-7	-8	-9	-10	-10	-11	-12
5.0	1	1	0	0	-1	-1	-2	-2	-3	-3	-4	-5	-5	-6	-7	-7	-8	-9	-10	-10	-11
5.5	2	1	1	0	0	-1	-1	-2	-2	-3	-3	-4	-5	-5	-6	-7	-7	-8	-9	-9	-10
6.0	2	2	2	1	1	0	0	-1	-2	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8	-9	-9
6.5	3	3	3	2	1	1	0	0	-1	-1	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8	-8
7.0	4	3	3	2	2	1	1	0	0	-1	-1	-2	-2	-3	-4	-4	-5	-6	-7	-8	-8
7.5	4	4	3	3	2	2	1	1	0	0	-1	-1	-1	-2	-2	-3	-4	-5	-6	-7	-8
8.0	5	4	4	3	3	3	2	2	1	1	0	0	-1	-2	-2	-3	-3	-4	-5	-6	-7
8.5	5	5	4	4	4	4	3	3	2	2	1	1	0	-1	-2	-2	-3	-4	-4	-5	-6
9.0	6	5	5	5	4	4	4	3	3	2	2	1	1	0	-1	-2	-2	-3	-3	-4	-5
9.5	6	6	6	5	5	4	4	3	3	3	2	2	1	1	0	-1	-1	-2	-2	-3	-4

TABLE 25.—Temperature of the dew point in degrees Fahrenheit—Continued

[Tabular values are dew points with respect to water]

Wet-bulb temperature (° F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																				
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
10.0	7	7	6	6	5	5	5	4	4	3	3	2	2	1	1	0	0	-1	-1	-2	-2
10.5	8	7	7	6	6	6	5	5	4	4	3	3	3	2	2	1	1	0	0	-1	-2
11.0	8	8	7	7	7	6	6	5	5	5	4	4	3	3	2	2	1	1	0	0	-1
11.5	9	8	8	8	7	7	6	6	5	5	4	4	3	3	3	3	2	2	1	1	0
12.0	9	9	9	8	8	7	7	7	6	6	5	5	5	4	4	3	3	3	2	2	1
12.5	10	9	9	9	8	8	8	7	7	6	6	6	5	5	4	4	4	3	3	2	2
13.0	10	10	10	9	9	9	8	8	7	7	7	6	6	6	5	5	4	4	3	3	2
13.5	11	11	10	10	10	9	9	8	8	8	7	7	7	6	6	5	5	4	4	3	3
14.0	11	11	11	10	10	10	9	9	9	8	8	8	7	7	6	6	6	5	5	4	4
14.5	12	12	11	11	11	10	10	10	9	9	9	8	8	8	7	7	6	6	6	5	5
15.0	13	12	12	12	11	11	11	10	10	10	9	9	9	8	8	7	7	7	6	6	5
15.5	13	13	13	12	12	12	11	11	11	10	10	10	9	9	9	8	8	7	7	7	6
16.0	14	13	13	13	13	12	12	12	11	11	11	10	10	10	9	9	8	8	8	7	7
16.5	14	14	14	13	13	13	12	12	12	12	11	11	11	10	10	10	9	9	8	8	8
17.0	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	10	10	9	9	9	8
17.5	15	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	10	10	9	9
18.0	16	16	15	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	10	10
18.5	17	16	16	16	15	15	15	15	14	14	14	13	13	13	13	12	12	12	11	11	11
19.0	17	17	17	16	16	16	15	15	15	15	14	14	14	13	13	13	13	12	12	12	11
19.5	18	17	17	17	17	16	16	16	16	15	15	15	14	14	14	14	13	13	13	12	12
20.0	18	18	18	17	17	17	17	16	16	16	16	15	15	15	14	14	14	14	13	13	13

NOTE.—Table computed by means of Professor Ferrel's formula;  $e=e'-0.000367P(t-t')\left(1+\frac{t'-32}{1571}\right)$

MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

TABLE 25.—Temperature of the dew point in degrees Fahrenheit—Continued

[Tabular values are dew points with respect to water]

Wet-bulb temperature (° F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet bulb)																				
	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2
-10.0																					
-9.5																					
-9.0																					
-8.5	-84																				
-8.0	-68																				
-7.5	-60	-76																			
-7.0	-55	-64	-92																		
-6.5	-50	-57	-70																		
-6.0	-47	-52	-61	-77																	
-5.5	-44	-48	-55	-64	-91																
-5.0	-41	-45	-50	-57	-69																
-4.5	-39	-42	-46	-52	-59	-74															
-4.0	-37	-40	-43	-48	-53	-62	-82														
-3.5	-35	-37	-40	-44	-49	-55	-65	-99													
-3.0	-33	-35	-38	-41	-45	-50	-57	-69													
-2.5	-31	-33	-36	-38	-42	-46	-51	-59	-73												
-2.0	-29	-31	-34	-36	-39	-43	-47	-53	-61	-78											
-1.5	-28	-30	-32	-34	-37	-40	-43	-48	-54	-63	-84										
-1.0	-26	-28	-30	-32	-34	-37	-40	-44	-49	-55	-65	-95									
-0.5	-25	-26	-28	-30	-32	-35	-37	-41	-44	-49	-56	-66									
0.0	-23	-25	-27	-28	-30	-33	-35	-38	-41	-45	-50	-57	-68								
+0.5	-22	-24	-25	-27	-29	-31	-33	-35	-38	-41	-45	-50	-57	-69							
1.0	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-41	-46	-51	-58	-71						
1.5	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-71					
2.0	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-72				
2.5	-17	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-71			
3.0	-16	-17	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-71		
3.5	-15	-16	-17	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-41	-45	-50	-57	-70	
4.0	-14	-15	-16	-17	-18	-19	-21	-22	-23	-25	-27	-28	-30	-33	-35	-38	-41	-45	-50	-57	-69
4.5	-13	-14	-15	-16	-17	-18	-19	-21	-22	-23	-25	-26	-28	-30	-32	-35	-37	-41	-44	-49	-56
5.0	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-25	-26	-28	-30	-32	-34	-37	-40	-44	-49
5.5	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-24	-26	-28	-30	-32	-34	-37	-40	-43
6.0	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-21	-23	-24	-26	-27	-29	-31	-34	-36	-39
6.5	-9	-10	-11	-12	-13	-14	-15	-16	-17	-19	-20	-21	-22	-24	-25	-27	-29	-31	-33	-36	-36
7.0	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-21	-22	-23	-25	-27	-28	-30	-33	-33
7.5	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-25	-26	-28	-30	-30
8.0	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-17	-18	-19	-20	-21	-23	-24	-26	-27	-28	-27
8.5	-6	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-17	-18	-19	-20	-21	-23	-24	-26	-27	-27
8.5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-17	-18	-19	-20	-21	-23	-24	-26	-27	-28	-27
9.0	-5	-5	-6	-7	-7	-8	-9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23
9.5	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-12	-13	-13	-14	-15	-16	-17	-19	-20	-21
10.0	-3	-4	-4	-5	-5	-6	-7	-7	-8	-9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19
10.5	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8	-9	-9	-10	-11	-12	-13	-14	-14	-15	-17	-18
11.0	-1	-2	-2	-3	-4	-4	-5	-5	-6	-7	-7	-8	-9	-10	-11	-11	-12	-13	-14	-15	-16
11.5	0	-1	-2	-2	-3	-3	-4	-4	-5	-6	-7	-8	-9	-9	-10	-11	-12	-13	-14	-14	-14
12.0	0	0	-1	-1	-2	-2	-3	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-14	-13
12.5	1	1	0	0	-1	-1	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8	-8	-9	-10	-11	-12
13.0	2	1	1	0	0	-1	-1	-2	-2	-3	-3	-4	-5	-5	-6	-7	-8	-9	-9	-10	-10
13.5	3	2	2	1	1	0	0	-1	-1	-2	-2	-3	-4	-4	-5	-5	-6	-7	-7	-8	-9
14.0	4	3	3	2	2	1	1	0	0	-1	-1	-2	-3	-3	-4	-4	-5	-6	-6	-7	-8
14.5	4	4	3	3	3	2	2	1	1	0	0	-1	-2	-2	-3	-3	-4	-4	-5	-6	-6
15.0	5	5	4	4	3	3	2	2	1	1	0	0	-1	-1	-2	-2	-3	-3	-4	-5	-5
15.5	6	5	5	5	4	4	3	3	2	2	1	1	0	0	-1	-1	-2	-2	-3	-3	-4
16.0	7	6	6	6	5	5	4	4	3	3	2	2	1	1	0	0	-1	-1	-2	-2	-3
16.5	7	7	7	6	6	5	5	4	4	4	3	3	2	2	1	1	0	0	-1	-1	-2
17.0	8	8	7	7	7	6	6	5	5	4	4	4	3	3	2	2	1	1	0	0	-1
17.5	9	8	8	8	7	7	7	6	6	5	5	4	4	4	3	3	2	2	1	1	0
18.0	10	9	9	8	8	8	7	7	7	6	6	5	5	4	4	4	3	3	2	2	1
18.5	10	10	10	9	9	8	8	8	7	7	7	6	6	5	5	4	4	4	3	3	2
19.0	11	11	10	10	10	9	9	9	8	8	8	7	7	7	6	6	5	5	4	4	3
19.5	12	11	11	11	10	10	10	9	9	9	8	8	8	7	7	6	6	5	5	4	3
20.0	12	12	12	11	11	11	10	10	10	9	9	9	8	8	8	7	7	6	6	5	4

TABLES

TABLE 25.—Temperature of the dew point in degrees Fahrenheit—Continued  
 [Tabular values are dew points with respect to water]

Wet-bulb temperature (°F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet bulb)																				
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
20.0	17	16	14	13	11	10	8	6	4	2	-1	-4	-7	-11	-16	-22	-30	-44			
20.5	18	17	15	14	12	11	9	7	5	3	0	-3	-6	-9	-13	-19	-26	-36	-62		
21.0	18	17	16	14	13	11	10	8	6	4	1	-1	-4	-8	-11	-16	-22	-31	-46		
21.5	19	18	16	15	14	12	10	9	7	5	2	0	-3	-6	-9	-14	-19	-26	-37	-67	
22.0	20	18	17	16	14	13	11	10	8	6	4	1	-1	-4	-8	-12	-16	-23	-31	-47	
22.5	20	19	18	16	15	14	12	10	9	7	5	2	0	-3	-6	-10	-14	-19	-26	-38	-69
23.0	21	20	18	17	16	14	13	11	10	8	6	4	1	-1	-4	-8	-12	-16	-23	-31	-47
23.5	21	20	19	18	16	15	14	12	10	9	7	5	2	0	-3	-6	-9	-14	-19	-26	-37
24.0	22	21	20	18	17	16	14	13	11	10	8	6	4	1	-1	-4	-8	-11	-16	-22	-31
24.5	22	21	20	19	18	17	15	14	12	11	9	7	5	3	0	-3	-6	-9	-14	-19	-26
25.0	23	22	21	20	19	17	16	15	13	11	10	8	6	4	2	-1	-4	-7	-11	-16	-22
25.5	24	23	22	20	19	18	17	15	14	12	11	9	7	5	3	0	-2	-5	-9	-13	-18
26.0	24	23	22	21	20	19	17	16	15	13	12	10	8	6	4	2	-1	-4	-7	-11	-15
26.5	25	24	23	22	21	19	18	17	16	14	13	11	9	7	5	3	1	-2	-5	-8	-12
27.0	25	24	23	22	21	20	19	18	16	15	14	12	10	9	7	5	2	0	-3	-6	-10
27.5	26	25	24	23	22	21	20	18	17	16	14	13	11	10	8	6	4	1	-1	-4	-7
28.0	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5	3	0	-2	-5
28.5	27	26	25	24	23	22	21	20	19	18	16	15	13	12	10	8	6	4	2	-1	-3
29.0	28	27	26	25	24	23	22	21	20	18	17	16	14	13	11	9	8	6	3	1	-2
29.5	28	27	27	26	25	24	23	21	20	19	18	17	15	14	12	11	9	7	5	3	0
30.0	29	28	27	26	25	24	23	22	21	20	19	18	16	15	13	12	10	8	6	4	2
30.5	29	29	28	27	26	25	24	23	22	21	20	18	17	16	14	13	11	10	8	6	4
31.0	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5
31.5	31	30	29	28	27	26	25	24	23	22	21	20	19	18	16	15	14	12	10	9	7
32.0	31	30	30	29	28	27	26	25	24	23	22	21	20	19	17	16	15	13	12	10	8
32.5	32	31	30	29	28	27	26	25	24	23	22	21	19	18	17	16	14	13	11	9	7
33.0	32	32	31	30	29	28	27	26	26	25	24	22	21	20	19	18	16	15	14	12	10
33.5	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20	19	17	16	15	13	12
34.0	33	33	32	31	30	29	28	27	26	25	24	23	22	21	19	18	17	16	14	13	12
34.5	34	33	32	32	31	30	29	28	27	27	26	25	24	23	21	20	19	18	17	15	14
35.0	34	34	33	32	31	31	30	29	28	27	26	25	24	23	22	21	20	19	18	16	15
35.5	35	34	33	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20	18	17	16
36.0	35	35	34	33	33	32	31	30	29	28	27	26	25	24	23	22	21	19	18	17	17
36.5	36	35	34	34	33	32	32	31	30	29	28	27	26	25	24	23	21	20	19	18	18
37.0	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24	23	22	21	20	19
37.5	37	36	36	35	34	33	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20
38.0	37	37	36	35	35	34	33	33	32	31	30	29	28	27	26	25	24	23	22	21	20
38.5	38	37	37	36	35	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20
39.0	38	38	37	37	36	35	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21
39.5	39	38	38	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24	23
40.0	39	39	38	38	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24
40.5	40	39	39	38	38	37	36	36	35	34	34	33	32	31	30	30	29	28	27	26	25
41.0	40	40	39	39	38	37	36	36	35	34	33	33	32	31	30	30	29	28	27	26	26
41.5	41	40	40	39	39	38	37	36	35	35	34	33	33	32	31	30	29	29	28	27	27
42.0	41	41	40	40	39	39	38	37	36	35	35	34	33	33	32	31	30	29	29	29	28
42.5	42	41	41	40	40	39	38	37	36	35	35	34	33	33	32	31	30	29	29	29	29
43.0	42	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32	31	30	29	29
43.5	43	42	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32	31	30	30
44.0	43	43	42	42	41	41	40	40	39	38	38	37	37	36	35	35	34	33	32	31	31
44.5	44	43	43	42	42	41	41	40	40	39	38	38	37	37	36	35	35	34	33	32	32
45.0	45	44	44	43	42	42	41	41	40	40	39	39	38	37	36	35	34	33	32	31	32
45.5	45	45	44	44	43	42	42	41	41	40	40	39	39	38	37	36	35	35	34	33	33
46.0	46	45	45	44	44	43	43	42	41	41	40	40	39	39	38	37	36	35	35	34	34
46.5	46	46	45	45	44	44	43	43	42	41	41	40	40	39	39	38	37	36	35	35	35
47.0	47	46	46	45	45	44	44	43	43	42	41	41	40	40	39	39	38	37	36	35	35
47.5	47	47	46	46	45	45	44	44	43	43	42	42	41	40	40	39	39	38	37	36	36
48.0	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39	38	38	37	37
48.5	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39	39	38	38
49.0	49	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	40	39	38
49.5	49	49	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	40	39



TABLE 25.—Temperature of the dew point in degrees Fahrenheit—Continued

[Tabular values are dew points with respect to water]

Wet-bulb temperature (° F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																				
	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0
30.0	-1	-3	-7	-10	-15	-21	-29	-42													
30.5	1	-1	-4	-8	-12	-17	-23	-32	-48												
31.0	3	0	-2	-5	-9	-13	-18	-25	-36	-59											
31.5	5	2	0	-3	-6	-10	-14	-20	-28	-40	-90										
32.0	6	4	2	-1	-4	-7	-11	-16	-22	-30	-45										
32.5	7	5	3	1	-2	-5	-8	-13	-18	-24	-34	-55									
33.0	9	7	5	2	0	-3	-6	-10	-14	-20	-27	-39	-78								
33.5	10	8	6	4	2	-1	-4	-7	-11	-16	-22	-30	-45								
34.0	11	9	7	5	3	1	-2	-5	-8	-12	-17	-24	-34	-53							
34.5	12	11	9	7	5	3	0	-3	-6	-9	-14	-19	-26	-38	-69						
35.0	13	12	10	8	6	4	2	-1	-3	-7	-11	-15	-21	-29	-42						
35.5	14	13	11	10	8	6	4	1	-1	-4	-8	-12	-17	-23	-32	-49					
36.0	15	14	13	11	9	7	5	3	1	-2	-5	-9	-13	-18	-25	-35	-57				
36.5	17	15	14	12	10	9	7	5	2	0	-3	-6	-10	-14	-19	-27	-38	-75			
37.0	18	16	15	13	12	10	8	6	4	2	-1	-3	-7	-11	-15	-21	-29	-43			
37.5	19	17	16	15	13	11	10	8	6	4	1	-1	-4	-8	-11	-16	-22	-31	-47		
38.0	20	18	17	16	14	13	11	9	8	5	3	1	-2	-5	-8	-12	-17	-24	-34	-54	
38.5	20	19	18	17	15	14	12	11	9	7	5	3	0	-2	-5	-9	-13	-19	-26	-36	-62
39.0	21	20	19	18	17	15	14	12	10	9	7	5	2	0	-3	-6	-10	-14	-20	-27	-39
39.5	22	21	20	19	18	16	15	13	12	10	8	6	4	2	0	-3	-7	-10	-15	-21	-29
40.0	23	22	21	20	19	17	16	15	13	12	10	8	6	4	2	-1	-4	-7	-11	-16	-22
40.5	24	23	22	21	20	19	17	16	15	13	11	10	8	6	4	1	-1	-4	-8	-12	-16
41.0	25	24	23	22	21	20	18	17	16	14	13	11	10	8	6	3	1	-2	-5	-8	-12
41.5	26	25	24	23	22	21	20	18	17	16	14	13	11	9	7	5	3	1	-2	-5	-8
42.0	27	26	25	24	23	22	21	19	18	17	16	14	13	11	9	7	5	3	1	-2	-5
42.5	28	27	26	25	24	23	22	21	19	18	17	15	14	12	11	9	7	5	3	0	-2
43.0	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5	3	0
43.5	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5	3
44.0	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5
44.5	31	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7
45.0	32	31	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9
45.5	32	32	31	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11
46.0	33	33	32	31	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12
46.5	34	33	33	32	31	30	29	29	28	27	26	25	24	23	22	21	19	18	17	15	14
47.0	35	34	33	33	32	31	30	29	29	28	27	26	25	24	23	22	21	19	18	17	16
47.5	36	35	34	33	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20	18	17
48.0	36	36	35	34	34	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20	18
48.5	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24	23	22	21	20
49.0	38	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24	23	22	21
49.5	38	38	37	37	36	35	35	34	33	32	32	31	30	29	28	27	27	26	25	24	23
50.0	39	39	38	37	37	36	35	35	34	33	33	32	31	30	29	28	28	27	26	25	24
50.5	40	39	39	38	37	37	36	36	35	34	33	33	32	31	30	30	29	28	27	26	25
51.0	41	40	39	39	38	38	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26
51.5	41	41	40	40	39	38	38	37	37	36	35	34	34	33	32	32	31	30	29	28	27
52.0	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32	31	30	29	28	27
52.5	43	42	42	41	41	40	39	39	38	38	37	36	36	35	34	33	32	31	30	29	28
53.0	43	43	42	42	41	41	40	40	39	38	38	37	36	36	35	34	34	33	32	31	31
53.5	44	44	43	43	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32	32
54.0	45	44	44	43	43	42	42	41	41	40	39	39	38	38	37	36	36	35	34	33	33
54.5	45	45	44	44	43	43	42	42	41	41	40	40	39	38	38	37	36	35	34	34	34
55.0	46	46	45	45	44	44	43	43	42	41	41	40	40	39	39	38	37	36	35	35	35
55.5	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39	39	38	37	36	36	36
56.0	47	47	46	46	46	45	45	44	44	43	43	42	41	41	40	40	39	38	37	37	37
56.5	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39	38	38	38
57.0	49	48	48	47	47	46	46	46	45	45	44	44	43	42	42	41	41	40	39	38	38
57.5	49	49	48	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39
58.0	50	50	49	49	48	48	47	47	46	46	45	45	44	44	43	43	42	41	41	40	39
58.5	51	50	50	49	49	49	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41
59.0	51	51	50	50	50	49	49	48	48	47	47	46	46	45	45	44	44	43	43	43	42
59.5	52	52	51	51	50	50	49	49	49	48	48	47	47	46	46	45	45	44	44	43	43

## MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

TABLE 25.—Temperature of the dew point in degrees Fahrenheit—Continued

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																				
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
60.0	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53	53
60.5	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54
61.0	61	60	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54
61.5	61	61	61	60	60	60	59	59	58	58	58	58	57	57	57	56	56	55	55	55	54
62.0	62	61	61	61	61	60	60	60	59	59	59	58	58	58	57	57	56	55	55	55	54
62.5	62	62	62	61	61	61	60	60	60	60	59	59	59	58	58	58	57	57	57	56	56
63.0	63	62	62	62	62	61	61	61	60	60	60	60	59	59	59	58	58	58	57	57	57
63.5	63	63	63	62	62	62	62	61	61	61	60	60	60	59	59	59	59	59	58	58	58
64.0	64	63	63	63	63	62	62	62	62	61	61	61	60	60	60	60	59	59	59	58	58
64.5	64	64	64	63	63	63	63	62	62	62	61	61	61	61	60	60	60	59	59	59	58
65.0	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	60	60	60	59	59	59
65.5	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	60	60	60	60
66.0	66	65	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	61	60
66.5	66	66	66	65	65	65	65	64	64	64	63	63	63	63	62	62	62	61	61	61	61
67.0	67	67	66	66	66	66	65	65	65	64	64	63	63	63	62	62	62	61	61	61	61
67.5	67	67	67	67	66	66	66	66	65	65	65	64	64	64	64	63	63	63	63	62	62
68.0	68	68	67	67	67	67	66	66	66	65	65	65	65	64	64	64	63	63	63	63	63
68.5	68	68	68	68	67	67	67	67	66	66	66	65	65	65	64	64	64	63	63	63	63
69.0	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65	65	64	64	64	64
69.5	69	69	69	69	68	68	68	68	67	67	67	66	66	66	66	65	65	65	65	65	64
70.0	70	70	69	69	69	69	68	68	68	68	67	67	67	66	66	66	66	65	65	65	65
70.5	70	70	70	70	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66	66	66
71.0	71	71	70	70	70	70	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66
71.5	71	71	71	71	70	70	70	70	70	69	69	69	69	68	68	68	68	67	67	67	67
72.0	72	72	71	71	71	71	70	70	70	70	69	69	69	69	68	68	68	68	67	67	67
72.5	72	72	72	72	71	71	71	71	71	70	70	70	69	69	69	69	69	69	68	68	68
73.0	73	73	72	72	72	72	72	71	71	71	71	70	70	70	70	70	69	69	69	69	68
73.5	73	73	73	73	72	72	72	72	72	71	71	71	71	71	70	70	70	70	69	69	69
74.0	74	74	73	73	73	73	73	72	72	72	72	72	71	71	71	71	71	70	70	70	70
74.5	74	74	74	74	74	73	73	73	73	72	72	72	72	72	71	71	71	71	71	70	70
75.0	75	75	74	74	74	74	74	73	73	73	73	72	72	72	72	72	71	71	71	71	71
75.5	75	75	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72	71	71
76.0	76	76	75	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72	72
76.5	76	76	76	76	76	75	75	75	75	74	74	74	74	74	74	74	73	73	73	73	72
77.0	77	77	76	76	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73	73	73
77.5	77	77	77	77	77	76	76	76	76	75	75	75	75	75	74	74	74	74	74	74	73
78.0	78	78	77	77	77	77	77	77	76	76	76	76	76	75	75	75	75	75	74	74	74
78.5	78	78	78	78	78	77	77	77	77	77	77	76	76	76	76	76	75	75	75	75	75
79.0	79	79	78	78	78	78	78	78	77	77	77	77	77	76	76	76	76	76	76	75	75
79.5	79	79	79	79	79	78	78	78	78	78	78	77	77	77	77	77	76	76	76	76	76
80.0	80	80	79	79	79	79	79	79	78	78	78	78	78	78	77	77	77	77	77	76	76
80.5	80	80	80	80	80	79	79	79	79	79	79	78	78	78	78	78	78	77	77	77	77
81.0	81	81	81	80	80	80	80	80	80	79	79	79	79	79	78	78	78	78	78	78	77
81.5	81	81	81	81	81	81	81	80	80	80	80	80	80	79	79	79	79	79	79	78	78
82.0	82	82	82	81	81	81	81	81	81	80	80	80	80	80	80	80	79	79	79	79	78
82.5	82	82	82	82	82	82	81	81	81	81	81	81	81	80	80	80	80	80	80	79	79
83.0	83	83	83	82	82	82	82	82	82	81	81	81	81	81	81	80	80	80	80	80	80
83.5	83	83	83	83	83	83	82	82	82	82	82	82	82	81	81	81	81	81	81	80	80
84.0	84	84	84	83	83	83	83	83	83	82	82	82	82	82	82	82	81	81	81	81	81
84.5	84	84	84	84	84	83	83	83	83	83	83	83	83	82	82	82	82	82	82	81	81
85.0	85	85	85	84	84	84	84	84	84	84	83	83	83	83	83	83	82	82	82	82	82
85.5	85	85	85	85	85	85	84	84	84	84	84	84	84	84	84	83	83	83	83	83	82
86.0	86	86	86	85	85	85	85	85	85	85	84	84	84	84	84	84	83	83	83	83	83
86.5	86	86	86	86	86	86	86	85	85	85	85	85	85	84	84	84	84	84	84	84	83
87.0	87	87	87	86	86	86	86	86	86	85	85	85	85	85	85	85	85	85	84	84	84
87.5	87	87	87	87	87	87	87	86	86	86	86	86	86	86	85	85	85	85	85	85	85
88.0	88	88	88	87	87	87	87	87	87	87	86	86	86	86	86	86	86	85	85	85	85
88.5	88	88	88	88	88	88	88	88	87	87	87	87	87	87	86	86	86	86	86	86	86
89.0	89	89	89	88	88	88	88	88	88	88	88	87	87	87	87	87	87	87	87	86	86
89.5	89	89	89	89	89	89	89	88	88	88	88	88	88	88	87	87	87	87	87	87	87

TABLE 25.—Temperature of the dew point in degrees Fahrenheit—Continued

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet bulb)																				
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
90.0	90	90	90	89	89	89	89	89	89	89	89	88	88	88	88	88	88	88	87	87	87
90.5	90	90	90	90	90	90	90	89	89	89	89	89	89	89	89	88	88	88	88	88	88
91.0	91	91	91	90	90	90	90	90	90	90	90	89	89	89	89	89	89	89	89	89	88
91.5	91	91	91	91	91	91	91	91	91	90	90	90	90	90	90	90	89	89	89	89	89
92.0	92	92	92	92	91	91	91	91	91	91	91	91	91	90	90	90	90	90	90	89	89
92.5	92	92	92	92	92	92	92	92	91	91	91	91	91	91	91	91	90	90	90	90	90
93.0	93	93	93	93	92	92	92	92	92	92	92	92	92	91	91	91	91	91	91	91	91
93.5	93	93	93	93	93	93	93	93	93	92	92	92	92	92	92	92	91	91	91	91	91
94.0	94	94	94	94	93	93	93	93	93	93	93	93	93	92	92	92	92	92	92	92	91
94.5	94	94	94	94	94	94	94	94	94	93	93	93	93	93	93	93	93	92	92	92	92

Wet-bulb temperature (°F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																				
	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0
60.0	53	52	52	51	51	51	50	50	49	49	48	48	48	47	47	46	46	45	45	44	44
60.5	53	53	52	52	52	51	51	50	50	49	49	49	48	48	47	47	47	46	46	45	45
61.0	54	53	53	53	52	52	52	51	51	50	50	49	49	49	48	48	47	47	46	46	45
61.5	54	54	54	53	53	53	52	52	51	51	50	50	49	49	48	48	48	47	47	47	46
62.0	55	55	54	54	54	53	53	52	52	51	51	50	50	49	49	49	49	48	48	47	47
62.5	56	55	55	55	54	54	54	53	53	52	52	52	51	51	50	50	50	49	49	48	48
63.0	56	56	56	55	55	55	54	54	53	53	53	52	52	52	51	51	50	50	49	49	49
63.5	57	57	56	56	56	55	55	54	54	53	53	53	53	52	52	51	51	51	50	50	49
64.0	58	57	57	57	56	56	55	55	55	54	54	54	53	53	53	52	52	51	51	51	50
64.5	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53	53	52	52	51	51	51
65.0	59	58	58	58	57	57	57	56	56	55	55	55	54	54	54	53	53	52	52	52	52
65.5	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	53	53	53	52
66.0	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53
66.5	61	60	60	60	59	59	59	58	58	58	57	57	56	56	56	55	55	55	54	54	54
67.0	61	61	61	60	60	60	59	59	59	58	58	58	57	57	56	56	56	55	55	55	55
67.5	62	61	61	61	61	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55
68.0	62	62	62	61	61	61	61	60	60	60	59	59	58	58	58	57	57	57	56	56	56
68.5	63	63	62	62	62	61	61	61	61	60	60	60	59	59	58	58	58	57	57	57	57
69.0	64	63	63	63	62	62	62	62	61	61	61	60	60	60	59	59	59	58	58	58	58
69.5	64	64	64	63	63	63	62	62	62	62	61	61	61	60	60	60	59	59	59	59	58
70.0	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	60	60	60	60	59	59
70.5	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	61	60	60	60
71.0	66	66	65	65	65	65	64	64	64	63	63	63	63	62	62	62	62	61	61	61	60
71.5	66	66	66	66	65	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61	61
72.0	67	67	67	66	66	66	66	65	65	65	64	64	64	63	63	63	63	63	62	62	62
72.5	68	67	67	67	67	66	66	66	66	65	65	65	64	64	64	64	63	63	63	63	62
73.0	68	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64	64	64	64	63	63
73.5	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64	64	64
74.0	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66	66	66	65	65	65	64
74.5	70	70	69	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65
75.0	70	70	70	70	70	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66	66
75.5	71	71	71	70	70	70	70	69	69	69	69	69	68	68	68	68	67	67	67	67	66
76.0	72	71	71	71	71	71	70	70	70	70	69	69	69	69	68	68	68	68	68	67	67
76.5	72	72	72	72	71	71	71	71	71	70	70	70	70	69	69	69	69	68	68	68	68
77.0	73	73	72	72	72	72	71	71	71	71	71	70	70	70	70	69	69	69	69	69	68
77.5	73	73	73	72	72	72	72	72	72	71	71	71	71	71	70	70	70	70	69	69	69
78.0	74	74	73	73	73	73	73	72	72	72	72	72	71	71	71	71	70	70	70	70	70
78.5	74	74	74	74	74	73	73	73	73	73	73	72	72	72	72	71	71	71	71	70	70
79.0	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72	72	71	71	71
79.5	76	75	75	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72	71

## MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

TABLE 25.—Temperature of the dew point in degrees Fahrenheit—Continued

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°F.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																				
	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0
80.0	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72
80.5	77	76	76	76	76	76	76	76	76	75	75	75	75	75	74	74	74	74	74	74	73
81.0	77	77	77	77	76	76	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73
81.5	78	78	77	77	77	77	77	76	76	76	76	76	76	75	75	75	75	75	74	74	73
82.0	78	78	78	78	78	77	77	77	77	77	77	76	76	76	76	75	75	75	75	75	74
82.5	79	79	79	78	78	78	78	78	78	77	77	77	77	77	77	76	76	76	76	76	75
83.0	79	79	79	79	79	79	78	78	78	78	78	77	77	77	77	77	77	77	76	76	76
83.5	80	80	80	79	79	79	79	79	79	79	78	78	78	78	78	77	77	77	77	77	76
84.0	81	80	80	80	80	80	80	79	79	79	79	79	79	78	78	78	78	78	78	77	77
84.5	81	81	81	81	80	80	80	80	80	80	79	79	79	79	79	79	78	78	78	78	78
85.0	82	81	81	81	81	81	81	80	80	80	80	80	80	79	79	79	79	79	79	78	78
85.5	82	82	82	82	82	81	81	81	81	81	81	80	80	80	80	80	80	80	79	79	79
86.0	83	83	82	82	82	82	82	82	81	81	81	81	81	81	81	80	80	80	80	80	79
86.5	83	83	83	83	83	82	82	82	82	82	82	82	82	81	81	81	81	81	81	80	80
87.0	84	84	84	83	83	83	83	83	83	82	82	82	82	82	82	81	81	81	81	81	81
87.5	84	84	84	84	84	84	83	83	83	83	83	83	83	83	82	82	82	82	82	82	81
88.0	85	85	85	84	84	84	84	84	84	84	83	83	83	83	83	83	82	82	82	82	82
88.5	85	85	85	85	85	85	84	84	84	84	84	84	84	84	83	83	83	83	83	83	82
89.0	86	86	86	86	85	85	85	85	85	85	85	84	84	84	84	84	84	84	83	83	83
89.5	87	86	86	86	86	86	86	86	85	85	85	85	85	85	85	84	84	84	84	84	84
90.0	87	87	87	87	87	86	86	86	86	86	86	86	85	85	85	85	85	85	84	84	84
90.5	88	87	87	87	87	87	87	87	86	86	86	86	86	86	86	85	85	85	85	85	85
91.0	88	88	88	88	88	88	87	87	87	87	87	87	87	87	87	86	86	86	86	85	85
91.5	89	89	88	88	88	88	88	88	88	87	87	87	87	87	87	87	86	86	86	86	86
92.0	89	89	89	89	89	89	88	88	88	88	88	88	88	87	87	87	87	87	87	87	87
92.5	90	90	90	89	89	89	89	89	89	89	88	88	88	88	88	88	88	88	88	87	87
93.0	90	90	90	90	90	90	90	89	89	89	89	89	89	89	88	88	88	88	88	88	88
93.5	91	91	91	90	90	90	90	90	90	90	90	89	89	89	89	89	89	89	89	88	88
94.0	91	91	91	91	91	91	91	91	90	90	90	90	90	90	90	89	89	89	89	89	89
94.5	92	92	92	92	91	91	91	91	91	91	91	91	90	90	90	90	90	90	90	90	89

TABLE 26.—Millimeters to millibars

Mm.	0	1	2	3	4	5	6	7	8	9
	<i>Mb.</i>									
690	919.9	921.3	922.6	923.9	925.3	926.6	927.9	929.3	930.6	931.9
700	933.3	934.6	935.9	937.3	938.6	939.9	941.3	942.6	943.9	945.3
710	946.6	947.9	949.3	950.6	951.9	953.3	954.6	955.9	957.3	958.6
720	959.9	961.3	962.2	963.6	965.3	966.6	967.9	969.3	970.6	971.9
730	973.3	974.6	975.9	977.3	978.6	979.9	981.3	982.6	983.9	985.3
740	986.6	987.9	989.3	990.6	991.9	993.3	994.6	995.9	997.3	998.6
750	999.9	1,001.3	1,002.6	1,003.9	1,005.3	1,006.6	1,007.9	1,009.3	1,010.6	1,011.9
760	1,013.3	1,014.6	1,015.9	1,017.2	1,018.6	1,019.9	1,021.2	1,022.6	1,023.9	1,025.2
770	1,026.6	1,027.9	1,029.2	1,030.6	1,031.9	1,033.2	1,034.6	1,035.9	1,037.2	1,038.6
780	1,039.9	1,041.2	1,042.6	1,043.9	1,045.2	1,046.6	1,047.9	1,049.2	1,050.6	1,051.9
790	1,053.2	1,054.6	1,055.9	1,057.2	1,058.6	1,059.9	1,061.2	1,062.6	1,063.9	1,065.2

TABLE 27.—Correction of mercurial barometer for temperature (English measures)

ADD

Temperature (° F.)	Observed reading (inches)					Temperature (° F.)	Observed reading (inches)				
	28.5	29.0	29.5	30.0	30.5		28.5	29.0	29.5	30.0	30.5
0	0.07	0.08	0.08	0.08	0.08	16	0.03	0.03	0.03	0.03	0.04
1	.07	.07	.07	.08	.08	17	.03	.03	.03	.03	.03
2	.07	.07	.07	.07	.07	18	.03	.03	.03	.03	.03
3	.07	.07	.07	.07	.07	19	.02	.02	.03	.03	.03
4	.06	.06	.07	.07	.07	20	.02	.02	.02	.02	.02
5	.06	.06	.06	.06	.07	21	.02	.02	.02	.02	.02
6	.06	.06	.06	.06	.06	22	.02	.02	.02	.02	.02
7	.06	.06	.06	.06	.06	23	.02	.02	.02	.02	.02
8	.05	.05	.06	.06	.06	24	.01	.01	.01	.01	.01
9	.05	.05	.05	.05	.05	25	.01	.01	.01	.01	.01
10	.05	.05	.05	.05	.05	26	.01	.01	.01	.01	.01
11	.05	.05	.05	.05	.05	27					
12	.04	.04	.04	.04	.05	28					
13	.04	.04	.04	.04	.04	29					
14	.04	.04	.04	.04	.04	30					
15	.04	.04	.04	.04	.04						

SUBTRACT

Temperature (° F.)	Observed reading (inches)					Temperature (° F.)	Observed reading (inches)				
	28.5	29.0	29.5	30.0	30.5		28.5	29.0	29.5	30.0	30.5
31	0.01	0.01	0.01	0.01	0.01	66	0.10	0.10	0.10	0.10	0.10
32	.01	.01	.01	.01	.01	67	.10	.10	.10	.10	.11
33	.01	.01	.01	.01	.01	68	.10	.10	.10	.11	.11
34	.01	.01	.01	.02	.02	69	.10	.11	.11	.11	.11
35	.02	.02	.02	.02	.02	70	.11	.11	.11	.11	.11
36	.02	.02	.02	.02	.02	71	.11	.11	.11	.12	.12
37	.02	.02	.02	.02	.02	72	.11	.11	.12	.12	.12
38	.02	.02	.02	.03	.03	73	.11	.12	.12	.12	.12
39	.03	.03	.03	.03	.03	74	.12	.12	.12	.12	.12
40	.03	.03	.03	.03	.03	75	.12	.12	.12	.13	.13
41	.03	.03	.03	.03	.03	76	.12	.12	.13	.13	.13
42	.04	.04	.04	.04	.04	77	.12	.13	.13	.13	.13
43	.04	.04	.04	.04	.04	78	.13	.13	.13	.13	.14
44	.04	.04	.04	.04	.04	79	.13	.13	.14	.14	.14
45	.04	.04	.04	.04	.04	80	.13	.14	.14	.14	.14
46	.04	.05	.05	.05	.05	81	.14	.14	.14	.14	.14
47	.05	.05	.05	.05	.05	82	.14	.14	.14	.14	.15
48	.05	.05	.05	.05	.05	83	.14	.14	.14	.15	.15
49	.05	.05	.05	.06	.06	84	.14	.14	.15	.15	.15
50	.06	.06	.06	.06	.06	85	.15	.15	.15	.15	.16
51	.06	.06	.06	.06	.06	86	.15	.15	.15	.16	.16
52	.06	.06	.06	.06	.06	87	.15	.15	.16	.16	.16
53	.06	.06	.06	.07	.07	88	.15	.16	.16	.16	.16
54	.06	.07	.07	.07	.07	89	.16	.16	.16	.16	.17
55	.07	.07	.07	.07	.07	90	.16	.16	.16	.17	.17
56	.07	.07	.07	.07	.08	91	.16	.16	.17	.17	.17
57	.07	.08	.08	.08	.08	92	.16	.17	.17	.17	.18
58	.08	.08	.08	.08	.08	93	.17	.17	.17	.17	.18
59	.08	.08	.08	.08	.08	94	.17	.17	.17	.18	.18
60	.08	.08	.08	.08	.09	95	.17	.17	.18	.18	.18
61	.08	.08	.09	.09	.09	96	.17	.18	.18	.18	.19
62	.09	.09	.09	.09	.09	97	.18	.18	.18	.18	.19
63	.09	.09	.09	.09	.10	98	.18	.18	.18	.19	.19
64	.09	.09	.10	.10	.10	99	.18	.18	.19	.19	.19
65	.09	.10	.10	.10	.10	100	.18	.19	.19	.19	.20

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TABLE 28.—Reduction of barometric reading to mean sea level

[Reading, 30 inches. The correction is always to be added.]

Height in feet	Temperature of air (dry bulb)									
	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		
10	.01	.01	.01	.01	.01	.01	.01	.01	0.01	0.01
15	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
20	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
25	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
30	.04	.04	.04	.04	.03	.03	.03	.03	.03	.03
35	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04
40	.05	.05	.05	.05	.04	.04	.04	.04	.04	.04
45	.06	.05	.05	.05	.05	.05	.05	.05	.05	.05
50	.06	.06	.06	.06	.06	.06	.05	.05	.05	.05
55	.07	.07	.06	.06	.06	.06	.06	.06	.06	.06
60	.07	.07	.07	.07	.07	.07	.06	.06	.06	.06
65	.08	.08	.08	.08	.07	.07	.07	.07	.07	.07
70	.09	.08	.08	.08	.08	.08	.08	.07	.07	.07
75	.09	.09	.09	.09	.08	.08	.08	.08	.08	.08
80	.10	.10	.09	.09	.09	.09	.09	.08	.08	.08
85	.10	.10	.10	.10	.10	.10	.09	.09	.09	.09
90	.11	.11	.11	.10	.10	.10	.10	.10	.09	.09
95	.12	.11	.11	.11	.11	.11	.10	.10	.10	.10
100	.12	.12	.12	.12	.11	.11	.11	.11	.10	.10

TABLE 29.—Reduction of the mercurial barometer to standard gravity (45°) (30 inches)

Lat.	Cor.	Lat.	Cor.	Lat.	Cor.	Lat.	Cor.
°	<i>Inch</i>	°	<i>Inch</i>	°	<i>Inch</i>	°	<i>Inch</i>
0	-0.08	25	-0.05	45	0.00	70	+0.06
5	-.08	30	-.04	50	+.01	75	+.07
10	-.08	35	-.03	55	+.03	80	+.08
15	-.07	40	-.01	60	+.04	85	+.08
20	-.06	45	0.00	65	+.05	90	+.08

## CODE TABLE 30

## Meteorological Q-Code Signals

Meteorological Q-code signals are reproduced below as a guide to ship's officers in furnishing meteorological data when requested by aircraft. Note that when these signals are used in replies, the message may require some additional (supplementary) information to convey clearly meteorological data that cannot be presented in the order, units, etc., specified in the following list.

Signal	Question	Reply
QAM	What is the latest available meteorological observation for --- (place)?	Meteorological observation made at --- (place) at --- hours was as follows --- When the reply is presented in the Q-code form, the sequence of information is to be, as far as practicable, that pertaining to the Q-signal sequence QAN, QBA, QNY, QMU. When presented in this sequence, it is not necessary to precede each type of datum with the corresponding Q-signal.
QAN	What is the surface wind direction (in degrees relative to MAGNETIC North, unless otherwise indicated in the question) and speed at --- (place)?	The surface wind direction and speed at --- (place) at --- hours is --- (direction) --- (speed figures and units). NOTE.—Unless otherwise indicated in the question, answer (or advice), surface wind direction is given in degrees relative to MAGNETIC North.
QAO	What is the wind direction in degrees TRUE and speed at --- (position or zone/s) at each of the --- (figures) --- (units) levels above --- (datum)? NOTE.—Merchant ships can be expected to furnish wind data only for the level near the SURFACE (sea level).	The wind direction and speed at --- (position or zone/s) at the following heights above --- (datum) is: --- (vertical distance in figures and units) --- degrees TRUE --- (speed in figures and units) --- (vertical distance in figures and units) --- degrees TRUE --- (speed in figures and units).
QBA	What is the horizontal visibility at --- (place)?	The horizontal visibility at --- (place) at --- hours is --- (distance figures and units).
QFC	What is the amount, the type, and the height above --- (datum) of the base of the cloud at --- (place, position or zone)?	At --- (place, position, or zone) the base of the cloud is --- eighths --- type at --- (figures and units) height above --- (datum). NOTE.—If several cloud layers or masses are present, the lowest is reported first.
QFF	[At --- (place)] what is the present atmospheric pressure converted to mean sea level in accordance with meteorological practice?	At --- (place) the atmospheric pressure converted to mean sea level in accordance with meteorological practice is (or was determined at --- hours to be) --- tenths of millibars (e. g., 9237 for 923.7 millibars).
QFY	Please report the present meteorological landing conditions [at --- (place)].	The present meteorological landing conditions at --- (place) are ---. When the reply is prepared in the Q-code form, the sequence of information is to be, as far as practicable, that pertaining to the Q-signal sequence QAN, QBA, QNY, QMU. When presented in this sequence, it is not necessary to precede each type of datum with the corresponding Q-signal.
QMU	What is the surface temperature at --- (place) and what is the dew-point temperature at that place?	The surface temperature at --- (place) at --- hours is --- degrees and the dew-point temperature at that time and place is --- degrees.
QNY	What is the present weather and the intensity thereof at --- (place, position, or zone)?	The present weather and intensity thereof at --- (place, position, or zone) at --- hours is --- (duststorm, sandstorm, rain, snow, hail, thunderstorm, etc., or if no such phenomena as these is present, signal QNY NIL). My TRUE track is --- degrees.
QTI	What is your TRUE track?	Here is the information requested ---.
QUB	Can you give me, in the following order, information concerning visibility, height of clouds, direction and velocity of ground wind at --- (place of observation)?	
QUH	Will you give me the present barometric pressure at sea level?	The present barometric pressure at sea level is --- (units).
QUK	Can you tell me the condition of the sea observed at --- (place or co-ordinates)?	The sea at --- (place or co-ordinates) is ---.

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## CODE TABLE 30 (Continued).

## Meteorological Q-Code Signals—Continued

Signal	Question	Reply																																	
QUL	Can you tell me the swell observed at --- (place or co-ordinates)?	<p>The swell at --- (place or co-ordinates) is ----. Complete the answer, information or advice form by the use of the following numbered alternatives:</p> <table border="1"> <thead> <tr> <th>Number</th> <th>Length of swell</th> <th>Height</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Short or average .....</td> <td>Low.</td> </tr> <tr> <td>1</td> <td>Long .....</td> <td>Do.</td> </tr> <tr> <td>2</td> <td>Short .....</td> <td>Moderate.</td> </tr> <tr> <td>3</td> <td>Average .....</td> <td>Do.</td> </tr> <tr> <td>4</td> <td>Long .....</td> <td>Do.</td> </tr> <tr> <td>5</td> <td>Short .....</td> <td>Heavy.</td> </tr> <tr> <td>6</td> <td>Average .....</td> <td>Do.</td> </tr> <tr> <td>7</td> <td>Long .....</td> <td>Do.</td> </tr> <tr> <td>8</td> <td>Confused .....</td> <td></td> </tr> <tr> <td>9</td> <td></td> <td></td> </tr> </tbody> </table> <p>Additionally, indicate the direction of swell by the use of the appropriate cardinal or intermediate quadrantal point (abbreviation where appropriate), e. g., NORTH, NE, E, SE, etc., following the numbered alternative for indicating swell condition. The descriptions in the above-numbered alternatives are as follows:</p> <p style="text-align: center;"><i>Length of swell</i></p> <p>Short: 0-100 meters (0-300 feet).  Average: 100-200 meters (300-600 feet).  Long: Over 200 meters (600 feet).</p> <p style="text-align: center;"><i>Height of swell</i></p> <p>Low: Below 1.75 meters (below 6 feet).  Moderate: 1.75 to 3.75 (6 to 12 feet).  Heavy: Above 3.75 meters (above 12 feet).</p> <p>My position, TRUE course and speed are ----.</p>	Number	Length of swell	Height	0	Short or average .....	Low.	1	Long .....	Do.	2	Short .....	Moderate.	3	Average .....	Do.	4	Long .....	Do.	5	Short .....	Heavy.	6	Average .....	Do.	7	Long .....	Do.	8	Confused .....		9		
Number	Length of swell	Height																																	
0	Short or average .....	Low.																																	
1	Long .....	Do.																																	
2	Short .....	Moderate.																																	
3	Average .....	Do.																																	
4	Long .....	Do.																																	
5	Short .....	Heavy.																																	
6	Average .....	Do.																																	
7	Long .....	Do.																																	
8	Confused .....																																		
9																																			
QUN <sup>1</sup>	Will vessels in my immediate vicinity [(or in the vicinity of --- latitude --- longitude) (or of ---)] please indicate their position, TRUE course and speed?																																		

<sup>1</sup> All stations of the international aeronautical telecommunication service will interpret this signal as referring to TRUE TRACK. English-speaking stations of the maritime mobile service may interpret this signal as referring to TRUE HEADING. When communicating with the latter it is recommended that supplementary use be made of the signal Q'FI to avoid any misunderstanding.

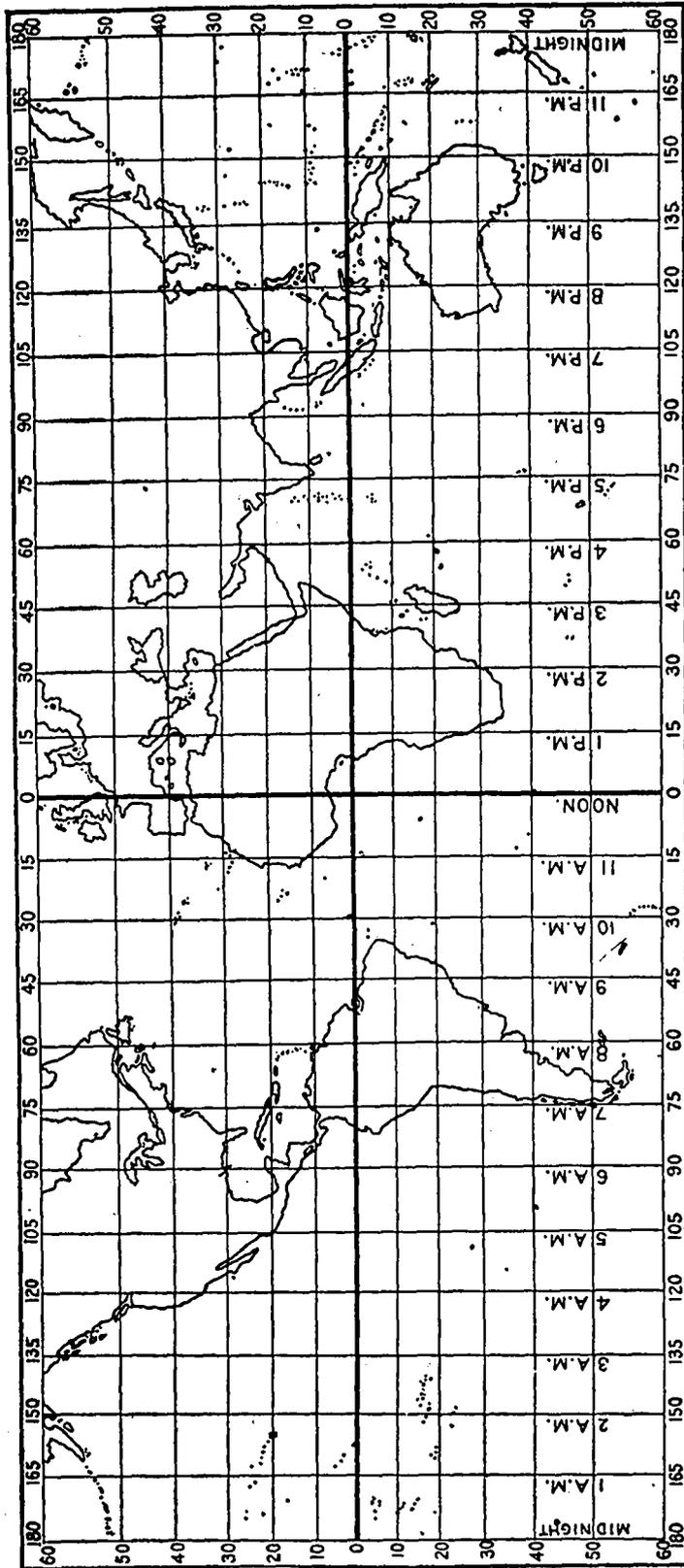


CHART 1. This chart gives the local time corresponding to Greenwich mean noon.





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Change No. →

1

UNITED STATES DEPARTMENT OF COMMERCE • Sinclair Weeks, Secretary  
WEATHER BUREAU • F. W. Reichelderfer, Chief

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MANUAL OF  
MARINE METEOROLOGICAL  
OBSERVATIONS

CIRCULAR M  
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Change #1 to Circular M consists of the attached page changes; i.e., pages v-vi, 3-6, 27-30, 39-40, 47-54, 67-68 and 71-86.

These changes are effective January 1, 1955, as indicated at the top of each page in which changes were made. As a further aid in identification, an asterisk has been placed in the left margin at the beginning of sections, paragraphs, lines, tables, etc., in which changes were made.

In summary, the changes pertain to the following:

1. Use of the symbol "X" in coding, wherever a slant (/) was used in the past.
2. Changes in Code Table 6, Symbol ww - Present Weather (mostly of a clarifying nature).
3. Changes in the definitions of code figures 0, 1 and 2 of Code Table 7, Symbol W - Past Weather.
4. Changes in the meaning of code figures in Code Table 15, Symbol a - Barometer change characteristic in the last 3 hours.
5. Change in the meaning of Symbol  $N_h$  - See Par. 8320 and Code Table 3.
6. Change in the meaning of Symbol h - See Par. 8330 and Code Table 10.
7. Minor changes in the description of cloud categories for coding purposes and format changes in Code Tables 9, 11 and 12, Symbols  $C_L$ ,  $C_M$  and  $C_H$ .
8. Minor changes in Ice Group Code Tables 20, 21 and 22 pertaining to Symbols K,  $D_i$  and r.

It is suggested that this page be initialed by the person inserting the attached pages and filed with the manual as a record that the change has been received and incorporated in the manual.

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COMMERCE, WEATHER BUREAU

Budget Bureau Approval No. 41-R1386  
Expiration Date 11-1-1957

WEATHER OBSERVATIONS

Month February, 1950

Barometer W. B. List No. 984 Date compared Jan. 6, 1950. Water temperature  Intake,  Bucket

Course T, S, E, W	Ship No.	Speed of Ship Knots	3-Hour Pressure Tendency	TEMPERATURE (°F)			Group Indicator	Diff. Sea-Air °	Dew Point °	WAVES				ICE				REMARKS  (State language)	Sea State Group	Latitude		
				Dry Bulb (Degrees and tenths)	Wet Bulb (Degrees and tenths)	Sea Water (Degrees and tenths)				Dir- ection (00-36)	Period (Coded)	Height (Coded)	Kind (Coded)	Effect (Coded)	Bear- ing (0-9)	Dis- tance (Coded)	Ori- enta- tion (Coded)					
																					23	24
D.	r.	a	pp	—	—	—	0	T, T.	T, T.	1	d., d.	P.	H.	O.	K	D.	r	e	—	—		
5	6	3	08	48.2	47.3	45.4	0	03	47	1	26	6	4							N	44	
5	6	3	18	54.4	53.1	47.0	0	07	52	1	28	6	4							N	VR	
5	6	2	30	53.5	52.8	48.4	0	05	53	1	30	4	9							Drizzle begin 0925 Ended 1440	Y	44
5	6	0	08	51.4	51.0	51.2	0	00	51	1	32	4	7							Rain began 1440. Wind gusty	Y	VR
5	6	7	02	50.6	50.3	52.0	0	51	50	1	34	6	7							Rain ended 0310	Y	44
6	5	5	20	55.2	55.2	52.6	0	03	55	1	12	7	6								Y	VR
5	6	7	02	56.8	56.4	51.8	0	05	56	1	18	6	4								Y	44
6	6	3	10	50.7	49.0	52.0	0	51	48	1	20	6	5							Wind shifted 2315	Y	VR
6	6	0	06	47.3	47.0	54.2	0	57	47	1	28	4	5								Y	44
6	4	8	08	49.4	49.4	54.0	0	55	49	1	27	7	6								Y	VR
6	4	2	02	52.9	52.9	53.4	0	51	53	1	27	5	7								Y	44
6	6	8	10	52.5	52.1	53.8	0	51	52	1	29	6	7							Rain began 1730	Y	VR
6	6	9	10	53.7	53.5	54.0	0	00	54	1	30	6	6								Y	44
6	6	6	10	52.4	52.2	54.8	0	52	52	1	30	6	6								Y	VR
6	6	2	00	48.6	46.4	53.4	0	55	45	1	27	5	5							Rain ended 1000	Y	44
6	6	3	02	47.5	46.0	53.6	0	56	45	1	34	6	8								Y	VR

FIGURE 1.—Log of Ship's Weather Observations—Form 1210F.

1240. RADIOGRAM—FORM 1204. The Weather Bureau supplies special radiogram blanks for convenience in transmitting the observations by radio. After the message has been transmitted, the form may be disposed of by the radio operator—it should not be mailed to the Weather Bureau.

1241. The coded weather message will be copied from Form 1210F to Form 1204 in accordance with instructions printed on the back of Form 1204.

1250. CODE FOR TRANSMISSION. Weather messages will be coded in the International Weather Code for Ships. As many groups of the code will be transmitted as are requested by special instructions to designated ships (see par. 1210). Each part of the observation is represented by one or more symbols in the code. The symbolic form of the complete code (FM21.A) is as follows:

YQL<sub>a</sub>L<sub>a</sub>L<sub>a</sub>      L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>GG      Nddff      VVwwW      PPPTT  
 N<sub>b</sub>C<sub>L</sub>hC<sub>M</sub>C<sub>H</sub>      D<sub>s</sub>v,app      0T<sub>s</sub>T<sub>s</sub>T<sub>d</sub>T<sub>d</sub>      1d<sub>w</sub>d<sub>w</sub>P<sub>w</sub>H<sub>w</sub>  
 ICE c<sub>2</sub>KD<sub>r</sub>re

Additional groups may be added in accordance with paragraphs 6422 and 9411.

1251. The symbols of the ship's code are listed and defined in Table 1-1 in the order of their appearance in the message. The relevant paragraphs and code tables in this manual are listed in the adjacent columns.

1252. The "c<sub>2</sub>KD<sub>r</sub>re" group is used to report ice. When it is included, it must be preceded by the identifying word, "ICE."

\* 1253. When the data for an element, or part, of the message cannot be determined, X's will be inserted, as required by the code table appropriate to the missing data, to maintain five figures in each group. If data for an entire group is missing from the first seven groups of the message, five X's (XXXXX) will be reported for that group. When all the elements of one of the groups 0T<sub>s</sub>T<sub>s</sub>T<sub>d</sub>T<sub>d</sub> 1d<sub>w</sub>d<sub>w</sub>P<sub>w</sub>H<sub>w</sub> ICE c<sub>2</sub>KD<sub>r</sub>re are missing, that group will be omitted from the coded message, instead of substituting 5X's for the group.

TABLE 1-1.—*Elements of the code*

Eff. 1-1-55.

Symbols	Definitions of symbols	Observing instructions (par. No.)	Coding instructions (par. No.)	Code Table No.
Y	Day of week	-----	2201	1
Q	Octant of globe	-----	2301	2
L <sub>s</sub> L <sub>o</sub> L <sub>n</sub>	Latitude in degrees and tenths	-----	2401	--
L <sub>o</sub> L <sub>n</sub> J <sub>o</sub>	Longitude in degrees and tenths	-----	2501	--
GG	Greenwich civil time of observation, to nearest hour	-----	2601	--
* N	Fraction of celestial dome covered by clouds	8110-30	8310	3
dd	Direction from which the wind is blowing (tens of degrees)	3110	3120	4
ff	Wind speed in knots	3210	3220	--
VV	Visibility (in code)	4101-3	4201	5
ww	Present weather (in code)	5710	5720-32	6
W	Past weather (in code)	5810	5820	7
PPP	Sea-level pressure (tens, units, tenths) mb.	6120	6410-11	8
TT	Temperature of the air (whole degrees Fahrenheit)	7110-20	7310	--
* N <sub>h</sub>	Fraction of celestial dome covered by lowest cloud	8110-30	8320	3
C <sub>L</sub>	Clouds of types stratocumulus, stratus, cumulus, cumulonimbus (in code)	Circular S	8340	9
* h	Height of base of lowest C <sub>L</sub> or C <sub>M</sub> cloud above sea	8201	8330	10
C <sub>M</sub>	Clouds of types altocumulus, altostratus, nimbostratus (in code)	Circular S	8350	11
C <sub>H</sub>	Clouds of types cirrus, cirrostratus, cirrocumulus (in code)	Circular S	8360	12
D <sub>s</sub>	Ship's course (in code)	-----	2701	13
v <sub>s</sub>	Speed of ship in knots (in code)	-----	2801	14
a	Characteristic of barometric tendency (in code)	6310-30	6420-22	15
pp	Amount of barometric change (units and tenths) mb.	6310-30	6420-22	16
0	Group designator	-----	-----	--
T <sub>s</sub> T <sub>a</sub>	Difference between sea and air temperature (whole degrees Fahrenheit)	-----	7330	--
T <sub>d</sub> T <sub>d</sub>	Temperature of dew point (whole degrees Fahrenheit)	7133-44	7310-12	--
1	Group designator	-----	-----	--
d <sub>w</sub> d <sub>w</sub>	Direction from which waves are coming (tens of degrees)	9101-2	9420	4
P <sub>w</sub>	Period of waves (in code)	9210-20	9430	17
H <sub>w</sub>	Mean height of waves (in code)	9310-22	9440	18
ICE	Group designator for ice group	-----	10280	--
C <sub>2</sub>	Description of kind of ice (in code)	10120	10220	19
K	Effect of ice on navigation (in code)	-----	10230	20
D <sub>i</sub>	Bearing of ice limit (in code)	10130	10240	21
r	Distance of ice from ship (in code)	10130	10250	22
e	Orientation of ice field (in code)	10130	10260	23

## 1254. Example of a coded report:

Coded Message: 40480 62106 62614 97216 06421  
45420 56308 06120 12631 ICE 10403

Code Symbols	Code Figures	Decoded Data
YQ L <sub>s</sub> L <sub>o</sub> L <sub>n</sub>	40480	4th day of week; octant, 0; latitude, 48.0°.
L <sub>o</sub> L <sub>n</sub> J <sub>o</sub> GG	62106	Longitude, 62.1°; time, 0600 G. C. T.
Nddff	62614	6 eighths of sky covered; wind direction, 260°; wind speed, 14 knots.
VVwwW	97216	Visibility, 5 miles; present weather, rain in past hour; past weather, rain.
PPPTT	06421	Pressure, 1006.4 mb., temperature 21°.
N <sub>h</sub> C <sub>L</sub> hC <sub>M</sub> C <sub>H</sub>	45420	4 eighths stratocumulus at a height of 1000-2000 feet. Altostratus or nimbostratus also present. No type C <sub>H</sub> clouds.
* D <sub>s</sub> v <sub>s</sub> app	56308	Ship's course, southwest; ship's speed 16 to 18 knots; barometer falling then rising; barometric change, 0.8 mb. higher.
0T <sub>s</sub> T <sub>a</sub> T <sub>d</sub> T <sub>d</sub>	06120	Group designator, 0; sea-air temperature difference, 11°; dew point 20°.
1d <sub>w</sub> d <sub>w</sub> P <sub>w</sub> H <sub>w</sub>	12631	Group designator, 1; wave direction, 260°; wave period, 5 to 7 seconds; wave height, 1½ feet.
ICE	ICE	Designator for ice group.
c <sub>2</sub> KD <sub>i</sub> re	10403	New ice; navigation unobstructed; ice limit toward south; less than one mile distant, ice edge lying in a direction SE to NW.

### 1300. ORDERING SUPPLIES

1301. Weather Bureau forms and supplies (including envelopes and carbon paper) may be obtained directly from any of the Weather Bureau port stations listed in section 1400. These supplies may also be obtained through the mail by checking the needed items on the back of Form 1210F in the section headed "Indicate Here Any Forms or Supplies Needed." When supplies are requested on Form 1210F, the ship's mailing address should be included in the space below the section for requesting supplies.

### 1400. ADDRESSES OF WEATHER BUREAU PORT OFFICES

Anchorage, Alaska, Anchorage International Airport.

~~Balboa Heights, C. Z., Panama Canal Hydrographer.~~

Baltimore, Md., Friendship International Airport.

Boston, Mass., 1900 Post Office and Courthouse Building, Devonshire, Water, Congress, and Milk Streets, Zone 9.

Brownsville, Tex., Administration Building, Rio Grande Valley International Airport.

Charleston, S. C., Customhouse Building, 200 East Bay Street, Zone 8.

Corpus Christi, Tex., R. F. D. 3, Box 494, Cliff Maus Field.

~~Cristobal, C. Z., Panama Canal Hydrographer.~~

\* Galveston, Tex., 515 Post Office and Courthouse Building, 601 Twenty-fifth Street.

Honolulu, T. H., Box 3650, Honolulu International Airport.

Houston, Tex., Box 4089, 1002 Federal Office Building, Fannin Street and Franklin Avenue, Zone 17.

Jacksonville, Fla., Box 4158, Post Office Building, 311 West Monroe Street, Zone 1.

Juneau, Alaska, Juneau Airport.

Key West, Fla., 208 Federal Building, Simonton and Caroline Streets.

Lake Charles, La., Box 572, Administration Building, Lake Charles Airport Base (Calcasieu Parish Airport).

Miami, Fla., Dade County Vocational Education Building, 1410 Second Avenue NE., Zone 32.

Mobile, Ala., RFD 5, Bates Field.

New Orleans, La., 317 Post Office Building, 600 Camp Street, Zone 12.<sup>1</sup>

New York, N. Y., Whitehall Building, 17 Battery Place, Zone 4.<sup>1</sup>

\* Norfolk, Va., Municipal Airport, RFD 1.

Pensacola, Fla., Box 870, Post Office and Courthouse Building, Palafox and Chase Streets.

Philadelphia, Pa., New Customhouse Building, Second and Chestnut Streets, Zone 6.

Port Arthur, Tex., Box 636, Nederland, Tex., Jefferson Co. Airport.

Portland, Maine, Administration Building, Portland City Airport, 101 Westbrook Street, Zone 4.

\* Portland, Oreg., 322 Customhouse, Zone 9.

Providence, R. I., T. F. Green Airport, Hillsgrove, R. I.

San Diego, Calif., Administration Building, Lindbergh Municipal Airport, 2930 Pacific Highway, Zone 1.

\* San Francisco, Calif., Room 216, Customhouse, 555 Battery Street, Zone 11.<sup>1</sup>

San Juan, P. R., Box 5187, ~~Ponce de Leon Avenue~~, Puerta de Tierra Station, Zone 27.

Savannah, Ga., Box 17, Travis Field.

• Seattle, Wash., 703 Federal Building, First Avenue and Marion Street, Zone 4.

Tampa, Fla., Box 2842, Weather Bureau Office, Tampa International Airport, Zone 1.

Wilmington, N. C., Box 546, New Hanover County Airport.

<sup>1</sup> Supervising Marine Center.

**5342.** *Freezing Precipitation.* Freezing precipitation is classified as freezing rain or freezing drizzle, as follows:

**5342.1.** *Freezing Rain.* Rain that falls in liquid form and freezes to exposed surfaces. When the fall is so rapid that runoff occurs, the ice will usually appear as glaze.

**5342.2.** *Freezing Drizzle.* Drizzle that freezes similarly to rain.

**5343.** *Frozen Precipitation.* Solid precipitation is classified as follows:

**5343.1.** *Sleet (Ice Pellets).* Transparent, somewhat globular hard grains of ice, about the size of raindrops, that rebound when striking hard surfaces. Sleet may fall as continuous, intermittent, or showery precipitation.

**5343.2.** *Hail.* Ice balls or stones, ranging in diameter from that of medium-size raindrops to an inch or more. They may fall detached or frozen together into irregular, lumpy masses. They are composed either of clear ice or of alternating clear and opaque layers. Hail often accompanies thunderstorm activity. Surface temperatures are usually above freezing when hail occurs. The size is based on the diameter, in inches, of normally shaped hailstones.

**5343.3.** *Small Hail.* Semitransparent, round, or conical grains of frozen water. Each grain generally consists of a smaller grain of soft hail as a nucleus, surrounded by a very thin ice layer, which gives it a glazed appearance. The grains are wet when they fall at temperatures above freezing. They are not crisp or easily compressible, and do not generally rebound or burst when striking hard surfaces.

**5343.4.** *Snow.* White or translucent ice crystals chiefly in complex branched hexagonal form (six-pointed stars), often mixed with simple crystals. Snow occurs under conditions that are similar, temperature excepted, to those of corresponding forms of rain.

**5343.5.** *Snow Pellets (Soft Hail).* White, opaque, round, or occasionally conical kernels of snow-like consistency,  $\frac{1}{8}$  to  $\frac{1}{4}$ -inch in diameter. They are crisp and easily compressible, and they may rebound or burst when striking hard surfaces. They occur almost exclusively in showers.

**5343.6.** *Snow Grains (Granular Snow).* The solid equivalent of drizzle. They take the form of minute, branched, star-like snowflakes, or of very fine, simple crystals. At times they have the appearance of rime. They occur under conditions similar to those of drizzle, except that the temperature is lower.

**5343.7.** *Ice Crystals.* Small, unbranched crystals in the form of rods or plates that have a descending motion and that may be observed when the sky is clear. Ice crystals are associated with halo phenomena and with temperatures near or below  $0^{\circ}$  F.

## 5400. FOG AND RIME

**5410.** *FOG.* Minute droplets suspended in the atmosphere. These droplets have no visible downward motion. Fog differs from clouds in that the base of fog is at the surface, while the base of clouds is above the surface. It is easily distinguished from haze by its dampness and grey color. It is unusual for fog to form when the difference between the air temperature and the temperature of the dew point is greater than  $4.0^{\circ}$  F.

**5411.** *Shallow Fog.* Low-lying fog that does not reduce horizontal visibility at a level 33 feet (10 meters) or more above the surface.

**5412.** *Ice Fog.* Suspended particles in the form of ice crystals. It occurs at low temperatures, and usually in clear, calm weather in high latitudes. The sun is usually visible and may cause halo phenomena.

**5420.** *RIME.* Rime is classified as soft or hard.

**5420.1.** *Soft rime* consists of white layers of ice crystals deposited chiefly on vertical surfaces—especially on points and edges of objects—generally in super-cooled fog. On the windward side of the rigging, soft rime may grow to very thick layers, long feathery cones, or needles pointing into the wind and having a structure similar to that of frost.

**5420.2.** Hard rime is an opaque, granular mass of ice deposited chiefly on vertical surfaces in wet fog at temperatures below 32° F. It is more compact and shapeless than soft rime, and may build out into the wind as glazed cones or feathers.

## 5500. HAZE, SMOKE, AND DUST

**5501.** Haze, smoke, and dust may be observed near land. Haze resembles a uniform veil with a bluish tinge when viewed against the sun or clouds at the horizon. When smoke is present the sun has a reddish tinge. Dust imparts a tannish or grayish hue to distant objects, and the sun appears pale with a yellowish tinge.

## 5600. MISCELLANEOUS

**5601.** In the column headed "Remarks" of Form 1210F, enter halos (solar or lunar), coronas (solar or lunar), rainbows, fog bows, and auroras.

## 5700. PRESENT WEATHER (ww)

**5710. GENERAL.** The term "present weather" refers to the state of the weather occurring at the time of the observation or within the 1-hour period prior to the observation. Code Table 6, "Present Weather" (in tables at the back of this manual) lists 100 weather situations, numbered from 00 to 99, which include one or more of the weather elements discussed in the first portion of this chapter.

**5720. CODING.** Select the number from Code Table 6 that corresponds most nearly to the weather occurring at the time of the observation, or within 1 hour preceding the time of the observation. When precipitation is *not* occurring at the ship at the time of observation, the selection of "ww" should be made from code figures 00 to 49, and 98,<sup>1</sup> When precipitation *is* occurring at the time of the observation, the selection should be made from code figures 50 to 99, inclusive.

**5730. ENTRY OF PRESENT WEATHER DATA ON FORM 1210F.** The code number selected as best representing the present weather (ww) should be entered in column 11 of Form 1210F. If more than one code number appears to be required, the *highest* should be entered in column 11, and all other appropriate numbers entered in the column headed "Remarks."

**5731.** Whenever fog is encountered, enter it in the "Fog Reports" section on the back of Form 1210F. Enter the character of the fog as "slight," "heavy," "shallow," or "ice fog."

**5732.** Enter the time (G. C. T.) of beginning and ending of precipitation in the column headed "Remarks."

## 5800. PAST WEATHER (W)

**5810. GENERAL.** The term "past weather" refers to the state of the weather during the 6-hour interval prior to the time of the 00, 06, 12, and 18 G. C. T. observations. However, when the ship is in the vicinity of a tropical storm, the Weather Bureau may request additional observations at 03, 09, 15, and 21 G. C. T. (see par. 1021). For these extra observations, "past weather" refers to the state of the weather during the 3-hour interval prior to the time of the observation, and references in the following instructions to 6 hours will be understood, under these special circumstances, to refer to 3 hours.

**5820. CODING AND ENTRY OF PAST WEATHER DATA (W) ON FORM 1210F.** Select the code figure from Code Table 7 corresponding to the weather during the preceding 6 hours, and enter it in column 12. To a certain extent, the combined data coded as "W" and "ww" should give a complete description of the weather during the preceding 6 hours. When the weather occurring at the time of the observation (rather than the hour before it) is coded as "ww," the weather during the full 6 hours prior to the time of the observation must be coded as "W." When the weather that has occurred during the hour ending with the observation is coded as "ww," weather during the 5 hours preceding the hour covered by "ww" will be coded as "W." For example, if a rain shower has occurred during the hour preceding the 0600 G. C. T. observation, and the weather was generally cloudy during the entire 6-hour period prior to the observation, "ww" would be coded as 25, and "W" as 2. If showers were general throughout the 6-hour period,

<sup>1</sup> When not accompanied by precipitation.

including the hour before the observation, "ww" would be coded as 25, and "W" as 8. When precipitation *has* occurred during the 6 hours preceding the time of the observation, but has *not* occurred during the hour preceding the observation, code figures 5, 6, 7, 8, or 9, as appropriate, will be used for "W."

5821. When thunder has been heard during the 6-hour period before the observation, but too early to be coded as "ww," "W" will always be coded as 9, regardless of other aspects of the weather. when two or more code figures are appropriate for symbol "W," the highest figure will be used.

\*

CODE TABLE 7

SYMBOL W.—*Past weather*<sup>1</sup>

(During 3 or 6 hours preceding the ACTUAL time of observation)

Code figure	Past weather
0	Cloud covering ½ or less of the sky throughout period.
1	Cloud covering more than ½ of sky during part of period, and less than ½ during part of period.
2	Cloud covering more than ½ of sky throughout period.
3	Sandstorm, duststorm, or drifting snow.
4	Fog, or thick haze.
5	Drizzle.
6	Rain.
7	Snow, or rain and snow mixed. <sup>3</sup>
8	Shower(s).
9	Thunderstorm(s), with or without precipitation.
X	Not determined.

<sup>1</sup> When precipitation or thunderstorms have occurred and have not been reported by ww, code figures 5 to 9 will be used as appropriate even though they do not represent the generally prevailing weather.

<sup>2</sup> When code figure 8 or 9 is reported and the showers or thunderstorms were accompanied by hail add "past hail" to end of message.

<sup>3</sup> Snow as used in this table includes "ice pellets" ("sleet" in the U.S.), "granular snow" ("snow grains" in the U.S.) and "ice crystals".

**6411.** The pressure is entered in column 16, "Barometer corrected (mb.)," in "tens," "units," and "tenths" of millibars, and the initial "9" or "10" in column 15. If the barometer reading is in inches, use Code Table 8 to convert the value to millibars. If the reading is in millimeters, use Table 26 (in the back of this manual). *Example:* A pressure of 981.7 millibars is entered in column 16 (PPP) as 817, and in column 15 as 9.

**6420.** TENDENCY (app). Select the appropriate code figure for the pressure characteristic (a) from Code Table 15 and enter it in column 25 of Form 1210F.

\*

CODE TABLE 15

SYMBOL a.—Barometer change characteristics in the last 3 hours

Trace	Code figures	Description
	0	Rising, then falling. Barometer the same or higher than 3 hours ago.
	1	Rising, then steady; or rising then rising more slowly.
	2	Rising, steadily or unsteadily.
	3	Falling or steady, then rising; or rising then rising more quickly.
	4	Steady. Barometer the same as 3 hours ago.
	5	Falling, then rising. Barometer the same or lower than 3 hours ago.
	6	Falling, then steady; or falling then falling more slowly.
	7	Falling, steadily or unsteadily.
	8	Steady or rising, then falling; or falling, then falling more quickly.

**6421.** Determine the amount of pressure change (pp) in accordance with paragraph 6320 (1), and use Code Table 16 to convert the value to millibars and tenths. Enter the amount, without the decimal point, in column 26. *Example:* A pressure change of 0.115 inch would be converted to 3.9 millibars and entered in column 26 as 39.

**6422.** When the amount of the barometric pressure change equals or exceeds 9.9 millibars, the group "99ppp" should be inserted in the message following the "D<sub>s</sub>v<sub>s</sub>app" group. The "99" is the group identifier, and "ppp" is the total amount of the pressure change (in tens, units, and tenths of millibars) during the preceding 3 hours. When the group is inserted, "99" should be reported for "pp" in the "D<sub>s</sub>v<sub>s</sub>app" group. *For example:* If the total amount of the pressure change is 13.4 millibars, the groups should be coded "D<sub>s</sub>v<sub>s</sub>a99 99134." If the amount is 9.9 millibars, the groups are coded "D<sub>s</sub>v<sub>s</sub>a99 99099." ("D<sub>s</sub>v<sub>s</sub>a" should be given appropriate values.)

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CODE TABLE 16

SYMBOL pp.—Amount of barometric change in the last 3 hours

[Coded in units of  $\frac{1}{10}$  of a millibar. For example, 0.2 millibar is coded as 02; 1.2 millibars as 12]

Amount of rise or fall							
Inch	Milli-bars	Inch	Milli-bars	Inch	Milli-bars	Inch	Milli-bars
0. 005	0. 2	0. 155	5. 3	0. 305	10. 3	0. 455	15. 4
. 010	0. 3	. 160	5. 4	. 310	10. 5	. 460	15. 6
. 015	0. 5	. 165	5. 6	. 315	10. 7	. 465	15. 7
. 020	0. 7	. 170	5. 8	. 320	10. 8	. 470	15. 9
. 025	0. 9	. 175	5. 9	. 325	11. 0	. 475	16. 1
. 030	1. 0	. 180	6. 1	. 330	11. 2	. 480	16. 3
. 035	1. 2	. 185	6. 3	. 335	11. 3	. 485	16. 4
. 040	1. 4	. 190	6. 4	. 340	11. 5	. 490	16. 6
. 045	1. 5	. 195	6. 6	. 345	11. 7	. 495	16. 8
. 050	1. 7	. 200	6. 8	. 350	11. 9	. 500	16. 9
. 055	1. 9	. 205	6. 9	. 355	12. 0	. 505	17. 1
. 060	2. 0	. 210	7. 1	. 360	12. 2	. 510	17. 3
. 065	2. 2	. 215	7. 3	. 365	12. 4	. 515	17. 4
. 070	2. 4	. 220	7. 5	. 370	12. 5	. 520	17. 6
. 075	2. 5	. 225	7. 6	. 375	12. 7	. 525	17. 8
. 080	2. 7	. 230	7. 8	. 380	12. 9	. 530	17. 9
. 085	2. 9	. 235	8. 0	. 385	13. 0	. 535	18. 1
. 090	3. 1	. 240	8. 1	. 390	13. 2	. 540	18. 3
. 095	3. 2	. 245	8. 3	. 395	13. 4	. 545	18. 5
. 100	3. 4	. 250	8. 5	. 400	13. 5	. 550	18. 6
. 105	3. 6	. 255	8. 6	. 405	13. 7	. 555	18. 8
. 110	3. 7	. 260	8. 8	. 410	13. 9	. 560	19. 0
. 115	3. 9	. 265	9. 0	. 415	14. 1	. 565	19. 1
. 120	4. 1	. 270	9. 1	. 420	14. 2	. 570	19. 3
. 125	4. 2	. 275	9. 3	. 425	14. 4	. 575	19. 5
. 130	4. 4	. 280	9. 5	. 430	14. 6	. 580	19. 6
. 135	4. 6	. 285	9. 7	. 435	14. 7	. 585	19. 8
. 140	4. 7	. 290	9. 8	. 440	14. 9	. 590	20. 0
. 145	4. 9	. 295	10. 0	. 445	15. 1	. 595	20. 1
. 150	5. 1	. 300	10. 2	. 450	15. 2	. 600	20. 3

## CHAPTER VIII. CLOUDS

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## CHAPTER VIII. CLOUDS

### 8000. GENERAL

**8001.** Code numbers for cloud forms and states of the sky are described in detail in Weather Bureau Circular S. Instructions in this chapter are confined to those necessary for observing clouds with respect to their amount and height of base.

### 8100. DETERMINATION OF SKY COVER

**8110. GENERAL.** "Sky cover" is a term used to denote the amount, in eighths, of sky covered by clouds. The eighths of sky cover plus the eighths of sky visible will always equal 1.0 (%).

**8120. SKY QUADRANTS.** The sky may be regarded as divided into quadrants, with the zenith regarded as the center, and the north, east, south, and west compass points forming the dividing lines. Each quadrant contains  $\frac{1}{4}$  of the total sky.

**8121.** Determine the amount of sky cover by use of quadrants as follows:

- (1) Estimate the amount covered by clouds in each quadrant.
- (2) Add the estimated amounts together. The sum of the amounts will be the sky cover.

*Example:* If an advancing cloud layer completely covers two quadrants and scattered clouds of another type cover one-half of each of the remaining two quadrants, the total sky cover is  $\frac{2}{4} + \frac{2}{4} + \frac{1}{4} + \frac{1}{4}$  or  $\frac{6}{4}$  or  $\frac{3}{2}$  or 1.5.

**8130. OBSCURED SKY.** When the sky is completely obscured, other than by clouds, e. g., by fog, falling snow, haze, smoke, etc., the sky is classified as "obscured." However, when only a portion of the sky is obscured, estimate the total amount of clouds on the basis of those that are visible.

### 8200. CLOUD HEIGHT

**8201.** The height of the lowest cloud layer should be estimated after the type of cloud has been determined by use of the tables and photographs in Weather Bureau Circular S. The table captioned "Classification" in Circular S is a useful guide in estimating the height of clouds. Some indication of the height of the clouds may be obtained from the detail with which the small indentations on the bottom surface can be observed. At night it may be possible to use a ship's searchlight to observe the cloud base.

### 8300. CODING AND ENTRIES OF CLOUD DATA ON FORM 1210F

**8310. TOTAL CLOUD AMOUNT (N).** Select the appropriate code figure from Code Table 3 corresponding to the total amount of sky covered by all types of clouds, and enter the figure in column 7 of Form 1210F. A few clouds or fragments of clouds are entered as "1." If the sky is completely covered (overcast), N is entered as 8; however, if a few patches of sky are visible, N is entered as 7.

\* **8320. FRACTION OF THE CELESTIAL DOME COVERED BY SPECIFIED  $C_L$  OR  $C_M$  CLOUD - ( $N_h$ ).** Select the code figure from Code Table 3 corresponding to the amount of sky covered by the type or types of cloud reported by  $C_L$  (not necessarily the amount of all  $C_L$  clouds present), or by  $C_M$  clouds when no  $C_L$  clouds are present (see Pars. 8340 & 8350). Code figure "0" is entered for  $N_h$  when there are no  $C_L$  or  $C_M$  clouds present. Less than one-eighth but more than none (i.e., "fragments") is coded as 1. "Overcast but with openings" (less than eight-eighths but more than seven-eighths) is coded as 7. Code figure 9 is used to report "Sky obscured by fog, rain, snow, smoke or other phenomena or obstruction except clouds".

## CODE TABLE 3

Symbol  $N$ —Fraction of the celestial dome covered by cloudsSymbol  $N_h$ —Fraction of celestial dome covered by type of cloud reported for  $C_L$  (or  $C_M$  if no  $C_L$  cloud present)

Code figures	Cloud amount (eighths of sky covered)
0	None
1	<sup>1</sup> 1
2	2
3	3
4	4
5	5
6	6
7	<sup>2</sup> 7
8	8
9	Sky obscured <sup>3</sup>

## NOTES

1. "Fragments of clouds" are coded as 1.
2. "Overcast but with openings" is coded as 7.
3. Sky obscured by fog, rain, snow, smoke or other phenomena or obstruction except clouds.

- \* 8330. HEIGHT OF LOWEST CLOUD OF TYPES  $C_L$  OR  $C_M$  - (h). Select the code figure from Code Table 10 corresponding to the height of the lowest cloud (including fragments, i.e., less than 1/8 but more than none) of the classes  $C_L$  or  $C_M$  and enter the figure in column 20. (Note that this height is not necessarily the height of the base of the lowest cloud reported as  $C_L$  or  $C_M$  in accordance with Pars. 8340 & 8350.) Enter 9 when there are no  $C_L$  or  $C_M$  clouds present; enter X when the cloud base cannot be reported owing to darkness or any other reason, except that when the sky is obscured by rain, snow, fog, smoke or other phenomena, code "h" as 0 and " $N_h$ " as 9.

CODE TABLE 10<sup>2</sup>SYMBOL h.—Height of base of lowest cloud ( $C_L$  or  $C_M$ ) above sea<sup>1</sup>

Code figure	Height in feet	Approximate height in meters
0	0- 149.	0- 49.
1	150- 299.	50- 99.
2	300- 599.	100- 199.
3	600- 999.	200- 299.
4	1000-1999.	300- 599.
5	2000-3499.	600- 999.
6	3500-4999.	1000-1499.
7	5000-6499.	1500-1999.
8	6500-7999.	2000-2500.
9	No $C_L$ or $C_M$ clouds below 8,000	No $C_L$ or $C_M$ clouds below 2,500.

<sup>1</sup> When the sky is completely hidden by obscuring phenomena and no clouds are visible, use code figure 0; otherwise, disregard the obscuring phenomena and code h as observed—e. g., use code figure 9 if no clouds are observable even though half the sky is hidden by fog.

<sup>2</sup> For the purpose of the ship code used in this manual (FM 21A), symbol "h" from WMO Code Table 43, has the meaning shown in this table.

- \* 8340. CLOUDS OF TYPE  $C_L$ . Enter the appropriate code figure from Code Table 9. Report the code figure for the predominant type, and when several types predominate in equal amounts, report the code figure for the type whose base is at the greatest height above the sea. Exceptions follow:
1. Whenever types coded as 1 and 2 only are present, report code figure 2, regardless of amount.
  2. Whenever types coded as 3 or 9 are present, 3 or 9 as appropriate will be coded, regardless of the amount of other  $C_L$  types present.

CODE TABLE 9

\*

SYMBOL  $C_L$ .—Clouds of types stratocumulus, stratus, cumulus, and cumulonimbus

Code figures	Technical language specifications	Plain language specifications
0	No $C_L$ clouds.....	No cumulus, cumulonimbus, stratocumulus or stratus.
1	Cumulus humilis, cumulus fractus other than of bad weather, or both.	Ragged cumulus other than those of bad weather or cumulus with little vertical development and seemingly flattened or both.
2	Cumulus mediocris or congestus, with or without cumulus of species fractus or humilis, or stratocumulus; all having their bases at the same level.	Cumulus of moderate or strong vertical development generally with protuberances in the form of domes or towers, either accompanied or not by other cumulus or by stratocumulus; all having their bases at the same level.
3	Cumulonimbus calvus, with or without cumulus, stratocumulus or stratus.	Cumulonimbus the summits of which, at least partially, lack sharp outlines, but are neither clearly fibrous, neither cirriform nor in the form of an anvil; cumulus, stratocumulus or stratus may be present.
4	Stratocumulus cumulogenitus....	Stratocumulus formed by the spreading out of cumulus; cumulus may also be present.
5	Stratocumulus other than cumulogenitus.	Stratocumulus not proceeding from the spreading out of cumulus.
6	Stratus nebulosus, stratus fractus other than of bad weather, or both.	Stratus in a more or less continuous sheet or layer, or in ragged shreds or both, but not fractostratus of bad weather.
7	Stratus fractus or cumulus fractus of bad weather (pannus) or both, usually below altostratus or nimbostratus.	Fractostratus of bad weather or fractocumulus of bad weather or both; usually below altostratus or nimbostratus. (By "bad weather" is meant the conditions which generally exist before, during or after precipitation.)
8	Cumulus and stratocumulus, other than cumulogenitus, with bases at different levels.	Cumulus and stratocumulus, other than those formed from the spreading out of cumulus; the base of cumulus is at a different level than that of the stratocumulus.
9	Cumulonimbus capillatus (often with an anvil), with or without cumulus, stratocumulus, stratus or pannus.	Cumulonimbus, the upper part of which is clearly fibrous (cirriform) often in the form of an anvil; either accompanied, or not by cumulus, stratocumulus, stratus, or fractocumulus or fractostratus of bad weather.
X	Clouds $C_L$ not visible owing to darkness, fog, blowing dust or sand, or other similar phenomena.	No cumulus; cumulonimbus, stratocumulus or stratus visible owing to darkness, fog, blowing dust or sand, or other such phenomena.

- \* 8350. CLOUDS OF TYPE  $C_M$ . Enter the appropriate code figure from Code Table 11. Report the code figure for the predominant type, and when several types predominate in equal amounts, report the code figure for the type whose base is at the greatest height above the sea. Exceptions follow:
1. Whenever Ac are present in a chaotic sky (see Circular S), regardless of amount, report code figure 9.
  2. Whenever the sky is not chaotic but tufted or turreted Ac (see Cir. S) are present, report code figure 8.

CODE TABLE 11

SYMBOL  $C_M$ .—Clouds of types *altocumulus*, *altostratus*, and *nimbostratus*

Code figures	Technical language specifications	Plain language specifications
0	No $C_M$ clouds.....	No altocumulus, altostratus or nimbostratus.
1	Altostratus translucidus.....	Altostratus, the greater part of which is semitransparent; through this part the sun or moon may be weakly visible as through ground glass.
2	Altostratus opacus or nimbostratus.	Altostratus, the greater part of which is sufficiently dense to hide the sun (or moon), or nimbostratus.
3	Altocumulus translucidus or perlucidus at a single level.	Altocumulus, other than crenelated or cumuliform tufts, and the greater part of which is semitransparent; the various elements of the cloud change but slowly and are all at a single level.
4	Patches of altocumulus translucidus or perlucidus (often lenticular), continuously changing and at one or more levels.	Patches of semitransparent altocumulus (often in the form of almonds or fishes) which are at one or more levels; the elements of this cloud are continuously changing in aspect.
5	Altocumulus translucidus or perlucidus in bands, or a layer of altocumulus progressively invading the sky; these altocumulus clouds generally thicken as a whole. The layer may be altocumulus opacus or duplicatus.	Semitransparent altocumulus in bands or altocumulus in one more or less continuous layer progressively invading the sky; these altocumulus clouds generally thicken as a whole. The layer may be opaque or double with a second sheet.
6	Altocumulus cumulogenitus.....	Altocumulus formed by the spreading out of cumulus.
7	Altocumulus duplicatus or opacus, not progressively invading the sky, or altocumulus with altostratus or nimbostratus or both.	Any one of the following cases: (a) Altocumulus in two or more layers usually opaque in places and not progressively invading the sky. (b) Opaque layer of altocumulus not progressively invading the sky. (c) Altocumulus coexisting with altostratus or nimbostratus or both.
8	Altocumulus castellatus or floccus.	Altocumulus with sprouts in the form of small towers or battlements, or altocumulus having the aspect of cumuliform tufts.
9	Altocumulus of a chaotic sky, generally at several levels; cirrus spissatus usually coexists.	Altocumulus, generally at several layers in a chaotic sky; dense cirrus is usually present.
X	Clouds $C_M$ not visible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or because of a continuous layer of lower clouds.	No altocumulus, altostratus or nimbostratus visible owing to darkness, fog, blowing dust or sand, or other such phenomena, or because of the presence of a continuous layer of lower clouds.

\* 8360. CLOUDS OF TYPE  $C_H$ . Enter the appropriate code figure from Code Table 12. Report the code figure for the predominant type, and when several types predominate in equal amounts, report the code figure for the type whose base is at the greatest height above the sea,

\*

CODE TABLE 12

SYMBOL  $C_H$ .—*Clouds of types cirrus, cirrostratus, and cirrocumulus*

Code figures	Technical language specifications	Plain language specifications
0	No $C_H$ clouds.....	No cirrus, cirrostratus or cirrocumulus.
1	Cirrus fibratus, sometimes uncinus, not progressively invading the sky.	Cirrus in the form of filaments, strands or hooks, not progressively invading the sky (often called "mares tails").
2	Cirrus spissatus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a cumulonimbus; or cirrus castellatus or floccus.	Dense cirrus in patches or entangled sheaves which usually do not increase and sometimes seem to be the remains of the upper parts of cumulonimbus; or cirrus with sproutings in the form of towers or battlements or having the aspect of cumuliform tufts.
3	Cirrus spissatus cumulonimbo-genitus; either the remains of cumulonimbus, or parts of distant cumulonimbus, the cumuliform portions of which cannot be seen.	Cirrus, often in the form of an anvil; either the remains of the upper parts of cumulonimbus, or parts of distant cumulonimbus, the cumuliform portions of which cannot be seen.
4	Cirrus uncinus or fibratus, or both, progressively invading the sky; they generally thicken as a whole.	Cirrus in the form of hooks or filaments or both, progressively invading the sky; they generally become denser as a whole.
5	Cirrus, often in bands, and cirrostratus, or cirrostratus alone, progressively invading the sky; they generally thicken as a whole, but the continuous veil does not reach 45° above the horizon.	Cirrus, often in bands converging towards one or two points of the horizon, and cirrostratus, or cirrostratus only; in either case they are progressively invading the sky, and generally growing denser as a whole, but the continuous veil does not reach 45° above the horizon.
6	Cirrus, often in bands, and cirrostratus, or cirrostratus alone, progressively invading the sky; they generally thicken as a whole, but the continuous veil exceeds 45° above the horizon, without the sky being totally covered.	Cirrus, often in bands converging towards 1 or 2 points of the horizon, and cirrostratus, or cirrostratus only; in either case they are progressively invading the sky, and generally growing denser as a whole, but the continuous veil exceeds 45° above the horizon, without the sky being completely covered.
7	Cirrostratus covering the whole sky.	Veil of cirrostratus completely covering the sky.
8	Cirrostratus not progressively invading the sky, and not entirely covering it.	Cirrostratus not progressively invading the sky, and not completely covering it.
9	Cirrocumulus alone, or cirrocumulus predominant among the cirriform clouds.	Cirrocumulus alone, or cirrocumulus accompanied by cirrus or cirrostratus or both, but cirrocumulus is the predominant cirriform cloud.
X	Clouds $C_H$ not visible owing to darkness, fog, blowing dust or sand or other similar phenomena, or because of a continuous layer of lower clouds.	No cirrus, cirrostratus or cirrocumulus visible owing to darkness, fog, blowing dust or sand, or other such phenomena, or because of the presence of a continuous layer of lower clouds.

\* 8370. CLOUD GROUP  $N_h C_L h C_M C_H$ . Instructions for the coding of the individual symbols of this group are contained in Pars. 8320 - 8360.

EXAMPLE: The coded cloud group 51406 is decoded as follows:

Symbol	Description	Code Figure	Meaning
$N_h$	- Fraction of celestial dome covered by $C_L$ cloud (or $C_M$ when no $C_L$ cloud is present),	5	Five-eighths of sky covered with the $C_L$ type cloud (cumulus).
$C_L$	- Predominant type of $C_L$ cloud.	1	Cumulus type clouds with little vertical development.
$h$	- Height of lowest cloud of types $C_L$ or $C_M$ .	4	Height of the base of the lowest cloud is between 1,000 and 2,000 feet above the sea.
$C_M$	- Predominant type of $C_M$ cloud	0	No clouds of type $C_M$ present.
$C_H$	- Predominant type of $C_H$ cloud	6	Cirrus and cirrostratus gradually spreading over sky with the layer extending more than $45^\circ$ above the horizon.

### 10200. CODING AND ENTRY OF ICE DATA ON FORM 1210F

**10210. GENERAL.** Ice observed at sea is coded and entered on Form 1210F as described below.

**10220. KIND (c<sub>2</sub>).** Select the code figure from Code Table 19 that most nearly corresponds with the predominant kind of ice observed, and enter the figure in column 37.

**CODE TABLE 19**

*SYMBOL c<sub>2</sub>.—Description of kind of ice*

Code figure	Description
0	None or "ice-blink." <sup>1</sup>
1	New ice.
2	Fast-ice.
3	Drift-ice.
4	Packed (compact) slush or strips of hummocked-ice.
5	Open lead near shore.
6	Heavy fast-ice.
7	Heavy drift-ice.
8	Hummocked-ice.
9	Ice-jamming.

<sup>1</sup> When ice-blink is recorded, its bearing (symbol D<sub>1</sub>) should also be recorded.

**10230. EFFECT ON NAVIGATION (K).** Select the code figure from Code Table 20 that most accurately describes the effect of the ice on navigation, and enter the figure in column 38.

**CODE TABLE 20**

*SYMBOL K.—Effect of ice on navigation*

Code figures	Description
0	Navigation unobstructed.
1	Navigation unobstructed for steamers; difficult for sailing ships.
2	Navigation difficult for low-powered steamers; closed to sailing ships.
3	Navigation possible only for powerful steamers.
4	Navigation possible only for steamers constructed to withstand ice pressure.
5	Navigation possible with the assistance of icebreakers.
6	Channel open in the solid ice.
7	Navigation temporarily closed.
8	Navigation closed.
9	Navigation conditions unknown (e. g., owing to bad weather).

\*

**10240. BEARING OF ICE-LIMIT ( $D_1$ ).** Select the code figure from Code Table 21 corresponding to the bearing of the nearest part of the ice, and enter the figure in column 39. If an ice-blink was recorded under "Kind ( $c_2$ )," report the bearing of the blink. When more than one area of ice is observed, record code figure "9" unless one area is of outstanding importance to navigation, in which case the bearing of the ice-limit for that area only will be recorded.

\*  
**CODE TABLE 21***SYMBOL  $D_1$ —Bearing of ice-limit*

Code figures	Description
0	No ice limit can be stated.
1	Ice limit towards NE.
2	Ice limit towards E.
3	Ice limit towards SE.
4	Ice limit towards S.
5	Ice limit towards SW.
6	Ice limit towards W.
7	Ice limit towards NW.
8	Ice limit towards N.
9	Ice limit in several directions.

NOTE.—If more than 1 ice limit can be stated, the nearest or most important is reported.

**10250. DISTANCE TO ICE-LIMIT FROM REPORTING SHIP ( $r$ ).** Select the code figure from Code Table 22 corresponding to the distance from the ship to the edge of the ice (bearing given as  $D_1$ ), and enter the figure in column 40.

\*  
**CODE TABLE 22***SYMBOL  $r$ —Distance to ice-limit from reporting ship*

Code figures	Distance
0	Up to 1 mile.
1	1 to 2 miles.
2	2 to 4 miles.
3	4 to 6 miles.
4	6 to 8 miles.
5	8 to 12 miles.
6	12 to 16 miles.
7	16 to 20 miles.
8	More than 20 miles.
9	Unspecified or no observations.

NOTE.—If the exact bounding distance for the ice limit corresponds to 2 code figures, the lower code figure is reported.

## TABLES

## CODE TABLE 4

SYMBOL *dd*.—True direction, in 10's of degrees, FROM which wind is blowing (00–36)

SYMBOL *d<sub>w</sub>d<sub>w</sub>*.—Direction, in 10's of degrees, FROM which waves are coming

Code figure	Direction	Code figure	Direction
00	Calm.	19	185° to 194°.
01	5° to 14°.	20	195° to 204°.
02	15° to 24°.	21	205° to 214°.
03	25° to 34°.	22	215° to 224°.
04	35° to 44°.	23	225° to 234°.
05	45° to 54°.	24	235° to 244°.
06	55° to 64°.	25	245° to 254°.
07	65° to 74°.	26	255° to 264°.
08	75° to 84°.	27	265° to 274°.
09	85° to 94°.	28	275° to 284°.
10	95° to 104°.	29	285° to 294°.
11	105° to 114°.	30	295° to 304°.
12	115° to 124°.	31	305° to 314°.
13	125° to 134°.	32	315° to 324°.
14	135° to 144°.	33	325° to 334°.
15	145° to 154°.	34	335° to 344°.
16	155° to 164°.	35	345° to 354°.
17	165° to 174°.	36	355° to 4°.
18	175° to 184°.		
Used only with <i>d<sub>w</sub>d<sub>w</sub></i>			
49	Waves confused, direction indeterminate.	99	Waves confused, direction indeterminate, but higher than 14 feet (4½ meters).

NOTE.—In case the true wind speed exceeds 99 knots, 50 will be added to “*dd*” and only the wind speed in excess of 100 knots will be coded. For example, if the direction=163° and speed=121 knots, the wind will be coded as “6621” (*dd*=16+50; *ff*=121–100).

## CODE TABLE 5

SYMBOL *VV*.—Visibility

Code figure	Visibility range <sup>1</sup>
90	Less than 50 yards (50 meters).
91	50 yards (50 meters).
92	200 yards (200 meters).
93	¼ nautical mile (500 meters).
94	½ nautical mile (1,000 meters).
95	1 nautical mile (2,000 meters).
96	2 nautical miles (4,000 meters).
97	5 nautical miles (10 kilometers).
98	10 nautical miles (20 kilometers).
99	25 nautical miles (50 kilometers) or more.

1. In case the observed visibility is between two of the distances given in the table, the code figure for the lesser distance will be reported, e. g., when the visibility is between 50 and 200 yards, code the visibility as 91.

## CODE TABLE 6

SYMBOL *ww*—*Present weather*<sup>1</sup>

## 00-49 NO PRECIPITATION AT THE SHIP AT THE TIME OF OBSERVATION

**00-19: NO PRECIPITATION, FOG, DUSTSTORM, SANDSTORM OR DRIFTING SNOW AT THE SHIP AT THE TIME OF OBSERVATION OR DURING THE PRECEDING HOUR, EXCEPT FOR 09-12.**

- |   |                            |   |    |   |   |
|---|----------------------------|---|----|---|---|
| * | See note 2.                | { | 00 | Cloud development not observed  | } Characteristic change of the state of sky during the past hour. |
|   |                            |   | 01 | Clouds generally dissolving or becoming less developed  |   |
|   |                            |   | 02 | State of sky on the whole unchanged   |   |
|   |                            |   | 03 | Clouds generally forming or developing  |   |
|   |                            |   | 04 | Visibility reduced by smoke, e. g., veidt or forest fires, industrial smoke, or volcanic ashes.   |   |
|   |                            |   | 05 | Haze.   |   |
|   |                            |   | 06 | Widespread dust in suspension in the air, not raised by wind at or near the ship at the time of observation.  |   |
|   | Haze, dust, sand or smoke. |   | 07 | Dust or sand raised by wind at or near the ship at the time of observation, but no well developed dust devil(s) and no duststorm or sandstorm seen. |   |
|   |                            |   | 08 | Well developed dust devil(s) seen at or near the ship within last hour, but no duststorm or sandstorm.  |   |
|   |                            |   | 09 | Duststorm or sandstorm within sight of ship or at ship during the last hour.  |   |
|   |                            |   | 10 | Light fog, visibility 1,000 meters (1,100 yards) or more.   |   |
|   |                            |   | 11 | Patches of } Shallow fog at the ship not deeper than about 10 meters (33 feet), visibility  |   |
|   |                            |   | 12 | More or less continuous } in fog less than 1,000 m. (1,100 yds.).   |   |
|   |                            |   | 13 | Lightning visible, no thunder heard.  |   |
|   |                            |   | 14 | Precipitation within sight, but not reaching sea at the ship.   |   |
|   |                            |   | 15 | Precipitation within sight, reaching sea, but distant [i. e., estimated to be more than 5 kilometers (3 miles) from ship].                          |   |
|   |                            |   | 16 | Precipitation within sight, reaching sea, near to but not at the ship.  |   |
|   |                            |   | 17 | Thunder heard, but no precipitation at the ship.  |   |
|   |                            |   | 18 | Squall(s)   |   |
|   |                            |   | 19 | Funnel cloud(s) (tornado or waterspout) } within sight during the past hour.  |   |

**20-29: PRECIPITATION, FOG OR THUNDERSTORM AT THE SHIP DURING THE PRECEDING HOUR BUT NOT AT THE TIME OF OBSERVATION.**

- |  |  |  |                           |
|--|--|--|---------------------------|
|  | 20   | Drizzle (not freezing)   | } not falling as showers. |
|  | 21   | Rain (not freezing)  |                           |
|  | 22   | Snow   |                           |
|  | 23   | Rain and snow  |                           |
|  | 24   | Freezing drizzle or freezing rain  |                           |
|  | 25   | Shower(s) of rain.   |                           |
|  | 26   | Shower(s) of snow, or of rain and snow.  |                           |
|  | 27   | Shower(s) of hail, or of hail and rain.  |                           |
|  | 28   | Fog. (visibility less than 1,000 meters (1,100 yards)).  |                           |
|  | 29   | Thunderstorm (with or without precipitation).  |                           |
|  | <b>30-39: DUSTSTORM, SANDSTORM, OR DRIFTING SNOW.</b>  |  |                           |
|  | 30   | Slight or moderate duststorm or sandstorm— has decreased during the preceding hour.  |                           |
|  | 31   | Slight or moderate duststorm or sandstorm— no appreciable change during the preceding hour.  |                           |
|  | 32   | Slight or moderate duststorm or sandstorm— has increased during the preceding hour.  |                           |
|  | 33   | Severe duststorm or sandstorm— has decreased during the preceding hour.  |                           |
|  | 34   | Severe duststorm or sandstorm— no appreciable change during preceding hour.  |                           |
|  | 35   | Severe duststorm or sandstorm— has increased during the preceding hour.  |                           |
|  | 36   | Slight or moderate drifting snow } generally 10 meters (33 ft.) or below at sea.   |                           |
|  | 37   | Heavy drifting snow  |                           |
|  | 38   | Slight or moderate drifting snow } generally above 10 meters (33 ft.) at sea.  |                           |
|  | 39   | Heavy drifting snow  |                           |
|  | <b>* 40-49: FOG AT THE TIME OF OBSERVATION. (visibility less than 1,000 meters (1,100 yards)).</b> |  |                           |
|  | 40   | Fog at a distance at the time of observation, but not at the ship during the last hour, the fog extending to a level above that of the observer. |                           |
|  | 41   | Fog in patches.  |                           |
|  | 42   | Fog, sky discernible   |                           |
|  | 43   | Fog, sky not discernible } has become thinner during the preceding hour.   |                           |
|  | 44   | Fog, sky discernible   |                           |
|  | 45   | Fog, sky not discernible } no appreciable change during the preceding hour.  |                           |
|  | 46   | Fog, sky discernible   |                           |
|  | 47   | Fog, sky not discernible } has begun or has become thicker during the preceding hour.  |                           |
|  | 48   | Fog, depositing rime, sky discernible.   |                           |
|  | 49   | Fog, depositing rime, sky not discernible.   |                           |

<sup>1</sup> In general, when coding *ww* the highest applicable figure is selected.<sup>2</sup> The amount of cloudiness at the time of observation is reported by symbol "N" in the group "Nddff." Code figures 00 to 03, inclusive, are used only when there is no other applicable code figure in the "ww" table to report. Code figure 00 is used when the observer has not had an opportunity to observe cloud development during the hour preceding the time of observation; 01 for clouds generally dissolving or becoming less developed; 02 for state of sky on the whole unchanged and 03 for clouds generally forming or developing.

50-99 PRECIPITATION: AT THE SHIP AT THE TIME OF OBSERVATION

50-59: DRIZZLE AT TIME OF OBSERVATION.

- 50 Drizzle, not freezing, intermittent <sup>1</sup> } slight at time of observation.
- 51 Drizzle, not freezing, continuous } moderate at time of observation.
- 52 Drizzle, not freezing, intermittent <sup>1</sup> } moderate at time of observation.
- 53 Drizzle, not freezing, continuous } moderate at time of observation.
- 54 Drizzle, not freezing, intermittent <sup>1</sup> } thick at time of observation.
- 55 Drizzle, not freezing, continuous } thick at time of observation.
- 56 Drizzle, freezing, slight.
- 57 Drizzle, freezing, moderate or thick.
- 58 Drizzle and rain, slight.
- 59 Drizzle and rain, moderate or heavy.

60-69: RAIN AT TIME OF OBSERVATION.

- 60 Rain, not freezing, intermittent <sup>1</sup> } slight at time of observation.
- 61 Rain, not freezing, continuous } slight at time of observation.
- 62 Rain, not freezing, intermittent <sup>1</sup> } moderate at time of observation.
- 63 Rain, not freezing, continuous } moderate at time of observation.
- 64 Rain, not freezing, intermittent <sup>1</sup> } heavy at time of observation.
- 65 Rain, not freezing, continuous } heavy at time of observation.
- 66 Rain, freezing, slight.
- 67 Rain, freezing, moderate or heavy.
- 68 Rain or drizzle and snow, slight.
- 69 Rain or drizzle and snow, moderate or heavy.

70-79: SOLID PRECIPITATION NOT IN SHOWERS AT TIME OF OBSERVATION.

- 70 Intermittent <sup>1</sup> fall of snowflakes } slight at time of observation.
- 71 Continuous fall of snowflakes } slight at time of observation.
- 72 Intermittent <sup>1</sup> fall of snowflakes } moderate at time of observation.
- 73 Continuous fall of snowflakes } moderate at time of observation.
- 74 Intermittent <sup>1</sup> fall of snowflakes } heavy at time of observation.
- 75 Continuous fall of snowflakes } heavy at time of observation.
- 76 Ice needles (with or without fog).
- 77 Granular snow (with or without fog).
- 78 Isolated starlike snow crystals (with or without fog).
- 79 Ice pellets.

80-99: SHOWERY PRECIPITATION, OR PRECIPITATION WITH CURRENT OR RECENT THUNDER-STORM.

- 80 Rain shower(s), slight.
- 81 Rain shower(s), moderate or heavy.
- 82 Rain shower(s), violent.
- 83 Shower(s) of rain and snow mixed, slight.
- 84 Shower(s) of rain and snow mixed, moderate or heavy.
- 85 Snow shower(s), slight.
- 86 Snow shower(s), moderate or heavy.
- 87 Shower(s) of soft or small hail, with or without rain, or rain and snow mixed—slight.
- 88 Shower(s) of soft or small hail, with or without rain, or rain and snow mixed—moderate or heavy.
- 89 Shower(s) of hail, with or without rain, or rain and snow mixed, not associated with thunder—slight.
- 90 Shower(s) of hail, with or without rain, or rain and snow mixed, not associated with thunder—moderate or heavy.
- 91 Slight rain at time of observation
- 92 Moderate or heavy rain at time of observation
- 93 Slight snow or rain and snow mixed or hail <sup>2</sup> at time of observation
- 94 Moderate or heavy snow, or rain and snow mixed or hail <sup>2</sup> at time of observation
- 95 Thunderstorm, slight or moderate, without hail <sup>2</sup> but with rain and/or snow at time of observation
- 96 Thunderstorm, slight or moderate, with hail <sup>2</sup> at time of observation
- 97 Thunderstorm, heavy, without hail <sup>2</sup> but with rain and/or snow at time of observation
- 98 Thunderstorm combined with duststorm or sandstorm <sup>3</sup>—at time of observation
- 99 Thunderstorm, heavy, with hail <sup>2</sup> at time of observation

} thunderstorm during the preceding hour but not at time of observation.

} thunderstorm at time of observation.

<sup>1</sup> Whenever the description "intermittent" is used, precipitation has not continued without a break during the preceding hour.

<sup>2</sup> Hail, small hail, soft hail.

<sup>3</sup> Code ww as 98, even when precipitation does not accompany the thunderstorm and dust or sandstorm.

## CODE TABLE 7

SYMBOL W.—*Past weather*<sup>1</sup>  
(During 3 or 6 hours preceding the ACTUAL time of  
observation)

Code figure	Past weather
0	Cloud covering $\frac{1}{2}$ or less of the sky throughout period.
1	Cloud covering more than $\frac{1}{2}$ of sky during part of period, and less than $\frac{1}{2}$ during part of period.
2	Cloud covering more than $\frac{1}{2}$ of sky throughout period.
3	Sandstorm, duststorm, or drifting snow.
4	Fog, or thick haze.
5	Drizzle.
6	Rain.
7	Snow, or rain and snow mixed. <sup>3</sup>
<sup>2</sup> 8	Shower(s).
<sup>2</sup> 9	Thunderstorm(s), with or without precipitation.
X	Not determined.

<sup>1</sup> When precipitation or thunderstorms have occurred and have not been reported by ww, code figures 5 to 9 will be used as appropriate even though they do not represent the generally prevailing weather.

<sup>2</sup> When code figure 8 or 9 is reported and the showers or thunderstorms were accompanied by hail add "past hail" to end of message.

<sup>3</sup> Snow as used in this table includes "ice pellets" ("sleet" in the U.S.), "granular snow" ("snow grains" in the U.S.) and "ice crystals".

TABLES

CODE TABLE 8

SYMBOL PPP.—Corrected barometer reading

[Code in "tens," "units," and "tenths" of millibars, omit initial 0 or 10]

[1 inch=33.86395 mb. 1 mb.=0.02952993, inch]<sup>1</sup>

in.	mb.	in.	mb.	in.	mb.	in.	mb.								
27.50	931.3	28.00	948.2	28.50	965.1	29.00	982.1	29.50	999.0	30.00	1015.9	30.50	1032.9	31.00	1049.8
27.51	931.6	28.01	948.5	28.51	965.5	29.01	982.4	29.51	999.3	30.01	1016.3	30.51	1033.2	31.01	1050.1
27.52	931.9	28.02	948.9	28.52	965.8	29.02	982.7	29.52	999.7	30.02	1016.6	30.52	1033.5	31.02	1050.5
27.53	932.3	28.03	949.2	28.53	966.1	29.03	983.1	29.53	1000.0	30.03	1016.9	30.53	1033.9	31.03	1050.8
27.54	932.6	28.04	949.5	28.54	966.5	29.04	983.4	29.54	1000.3	30.04	1017.3	30.54	1034.2	31.04	1051.1
27.55	933.0	28.05	949.9	28.55	966.8	29.05	983.7	29.55	1000.7	30.05	1017.6	30.55	1034.5	31.05	1051.5
27.56	933.3	28.06	950.2	28.56	967.2	29.06	984.1	29.56	1001.0	30.06	1018.0	30.56	1034.9	31.06	1051.8
27.57	933.6	28.07	950.6	28.57	967.5	29.07	984.4	29.57	1001.4	30.07	1018.3	30.57	1035.2	31.07	1052.2
27.58	934.0	28.08	950.9	28.58	967.8	29.08	984.8	29.58	1001.7	30.08	1018.6	30.58	1035.6	31.08	1052.5
27.59	934.3	28.09	951.2	28.59	968.2	29.09	985.1	29.59	1002.0	30.09	1019.0	30.59	1035.9	31.09	1052.8
27.60	934.6	28.10	951.6	28.60	968.5	29.10	985.4	29.60	1002.4	30.10	1019.3	30.60	1036.2	31.10	1053.2
27.61	935.0	28.11	951.9	28.61	968.8	29.11	985.8	29.61	1002.7	30.11	1019.6	30.61	1036.6	31.11	1053.5
27.62	935.3	28.12	952.3	28.62	969.2	29.12	986.1	29.62	1003.1	30.12	1020.0	30.62	1036.9	31.12	1053.8
27.63	935.7	28.13	952.6	28.63	969.5	29.13	986.5	29.63	1003.4	30.13	1020.3	30.63	1037.3	31.13	1054.2
27.64	936.0	28.14	952.9	28.64	969.9	29.14	986.8	29.64	1003.7	30.14	1020.7	30.64	1037.6	31.14	1054.5
27.65	936.3	28.15	953.3	28.65	970.2	29.15	987.1	29.65	1004.1	30.15	1021.0	30.65	1037.9	31.15	1054.9
27.66	936.7	28.16	953.6	28.66	970.5	29.16	987.5	29.66	1004.4	30.16	1021.3	30.66	1038.3	31.16	1055.2
27.67	937.0	28.17	953.9	28.67	970.9	29.17	987.8	29.67	1004.7	30.17	1021.7	30.67	1038.6	31.17	1055.5
27.68	937.4	28.18	954.3	28.68	971.2	29.18	988.2	29.68	1005.1	30.18	1022.0	30.68	1038.9	31.18	1055.9
27.69	937.7	28.19	954.6	28.69	971.6	29.19	988.5	29.69	1005.4	30.19	1022.4	30.69	1039.3	31.19	1056.2
27.70	938.0	28.20	955.0	28.70	971.9	29.20	988.8	29.70	1005.8	30.20	1022.7	30.70	1039.6	31.20	1056.6
27.71	938.4	28.21	955.3	28.71	972.2	29.21	989.2	29.71	1006.1	30.21	1023.0	30.71	1040.0	31.21	1056.9
27.72	938.7	28.22	955.6	28.72	972.6	29.22	989.5	29.72	1006.4	30.22	1023.4	30.72	1040.3	31.22	1057.2
27.73	939.0	28.23	956.0	28.73	972.9	29.23	989.8	29.73	1006.8	30.23	1023.7	30.73	1040.6	31.23	1057.6
27.74	939.4	28.24	956.3	28.74	973.2	29.24	990.2	29.74	1007.1	30.24	1024.0	30.74	1041.0	31.24	1057.9
27.75	939.7	28.25	956.7	28.75	973.6	29.25	990.5	29.75	1007.5	30.25	1024.4	30.75	1041.3	31.25	1058.2
27.76	940.1	28.26	957.0	28.76	973.9	29.26	990.9	29.76	1007.8	30.26	1024.7	30.76	1041.7	31.26	1058.6
27.77	940.4	28.27	957.3	28.77	974.3	29.27	991.2	29.77	1008.1	30.27	1025.1	30.77	1042.0	31.27	1058.9
27.78	940.7	28.28	957.7	28.78	974.6	29.28	991.5	29.78	1008.5	30.28	1025.4	30.78	1042.3	31.28	1059.3
27.79	941.1	28.29	958.0	28.79	974.9	29.29	991.9	29.79	1008.8	30.29	1025.7	30.79	1042.7	31.29	1059.6
27.80	941.4	28.30	958.3	28.80	975.3	29.30	992.2	29.80	1009.1	30.30	1026.1	30.80	1043.0	31.30	1059.9
27.81	941.8	28.31	958.7	28.81	975.6	29.31	992.6	29.81	1009.5	30.31	1026.4	30.81	1043.3	31.31	1060.3
27.82	942.1	28.32	959.0	28.82	976.0	29.32	992.9	29.82	1009.8	30.32	1026.8	30.82	1043.7	31.32	1060.6
27.83	942.4	28.33	959.4	28.83	976.3	29.33	993.2	29.83	1010.2	30.33	1027.1	30.83	1044.0	31.33	1061.0
27.84	942.8	28.34	959.7	28.84	976.6	29.34	993.6	29.84	1010.5	30.34	1027.4	30.84	1044.4	31.34	1061.3
27.85	943.1	28.35	960.0	28.85	977.0	29.35	993.9	29.85	1010.8	30.35	1027.8	30.85	1044.7	31.35	1061.6
27.86	943.4	28.36	960.4	28.86	977.3	29.36	994.2	29.86	1011.2	30.36	1028.1	30.86	1045.0	31.36	1062.0
27.87	943.8	28.37	960.7	28.87	977.7	29.37	994.6	29.87	1011.5	30.37	1028.4	30.87	1045.4	31.37	1062.3
27.88	944.1	28.38	961.1	28.88	978.0	29.38	994.9	29.88	1011.9	30.38	1028.8	30.88	1045.7	31.38	1062.7
27.89	944.5	28.39	961.4	28.89	978.3	29.39	995.3	29.89	1012.2	30.39	1029.1	30.89	1046.1	31.39	1063.0
27.90	944.8	28.40	961.7	28.90	978.7	29.40	995.6	29.90	1012.5	30.40	1029.5	30.90	1046.4	31.40	1063.3
27.91	945.1	28.41	962.1	28.91	979.0	29.41	995.9	29.91	1012.9	30.41	1029.8	30.91	1046.7	31.41	1063.7
27.92	945.5	28.42	962.4	28.92	979.3	29.42	996.3	29.92	1013.2	30.42	1030.1	30.92	1047.1	31.42	1064.0
27.93	945.8	28.43	962.8	28.93	979.7	29.43	996.6	29.93	1013.5	30.43	1030.5	30.93	1047.4	31.43	1064.3
27.94	946.2	28.44	963.1	28.94	980.0	29.44	997.0	29.94	1013.9	30.44	1030.8	30.94	1047.8	31.44	1064.7
27.95	946.5	28.45	963.4	28.95	980.4	29.45	997.3	29.95	1014.2	30.45	1031.2	30.95	1048.1	31.45	1065.0
27.96	946.8	28.46	963.8	28.96	980.7	29.46	997.6	29.96	1014.6	30.46	1031.5	30.96	1048.4	31.46	1065.4
27.97	947.2	28.47	964.1	28.97	981.0	29.47	998.0	29.97	1014.9	30.47	1031.8	30.97	1048.8	31.47	1065.7
27.98	947.5	28.48	964.4	28.98	981.4	29.48	998.3	29.98	1015.2	30.48	1032.2	30.98	1049.1	31.48	1066.0
27.99	947.9	28.49	964.8	28.99	981.7	29.49	998.6	29.99	1015.6	30.49	1032.5	30.99	1049.5	31.49	1066.4

<sup>1</sup> Based on standard gravity of 980.665 cm./sec.<sup>2</sup>

## CODE TABLE 9

SYMBOL  $C_L$ .—Clouds of types stratocumulus, stratus, cumulus, and cumulonimbus

Code figures	Technical language specifications	Plain language specifications
0	No $C_L$ clouds.....	No cumulus, cumulonimbus, stratocumulus or stratus.
1	Cumulus humilis, cumulus fractus other than of bad weather, or both.	Ragged cumulus other than those of bad weather or cumulus with little vertical development and seemingly flattened or both.
2	Cumulus mediocris or congestus, with or without cumulus of species fractus or humilis, or stratocumulus; all having their bases at the same level.	Cumulus of moderate or strong vertical development generally with protuberances in the form of domes or towers, either accompanied or not by other cumulus or by stratocumulus; all having their bases at the same level.
3	Cumulonimbus calvus, with or without cumulus, stratocumulus or stratus.	Cumulonimbus the summits of which, at least partially, lack sharp outlines, but are neither clearly fibrous, neither cirriform nor in the form of an anvil; cumulus, stratocumulus or stratus may be present.
4	Stratocumulus cumulogenitus.....	Stratocumulus formed by the spreading out of cumulus; cumulus may also be present.
5	Stratocumulus other than cumulogenitus.	Stratocumulus not proceeding from the spreading out of cumulus.
6	Stratus nebulosus, stratus fractus other than of bad weather, or both.	Stratus in a more or less continuous sheet or layer, or in ragged shreds or both, but not fractostratus of bad weather.
7	Stratus fractus or cumulus fractus of bad weather (pannus) or both, usually below altostratus or nimbostratus.	Fractostratus of bad weather or fractocumulus of bad weather or both; usually below altostratus or nimbostratus. (By "bad weather" is meant the conditions which generally exist before, during or after precipitation.)
8	Cumulus and stratocumulus, other than cumulogenitus, with bases at different levels.	Cumulus and stratocumulus, other than those formed from the spreading out of cumulus; the base of cumulus is at a different level than that of the stratocumulus.
9	Cumulonimbus capillatus (often with an anvil), with or without cumulus, stratocumulus, stratus or pannus.	Cumulonimbus, the upper part of which is clearly fibrous (cirriform) often in the form of an anvil; either accompanied, or not by cumulus, stratocumulus, stratus, or fractocumulus or fractostratus of bad weather.
X	Clouds $C_L$ not visible owing to darkness, fog, blowing dust or sand, or other similar phenomena.	No cumulus, cumulonimbus, stratocumulus or stratus visible owing to darkness, fog, blowing dust or sand, or other such phenomena.

\* **CODE TABLE 10:**<sup>3</sup> SYMBOL h.—*Height of base of lowest cloud ( $C_L$  or  $C_M$ ) above sea*<sup>1</sup>

Code figure	Height in feet	Approximate height in meters
0	0- 149.	0- 49.
1	150- 299.	50- 99.
2	300- 599.	100- 199.
3	600- 999.	200- 299.
4	1000-1999.	300- 599.
5	2000-3499.	600- 999.
6	3500-4999.	1000-1499.
7	5000-6499.	1500-1999.
8	6500-7999.	2000-2500.
9	No $C_L$ or $C_M$ clouds below 8,000.	No $C_L$ or $C_M$ clouds below 2,500.

Notes

1. When the sky is obscured by rain, snow, fog, smoke, or other phenomena so that cloud cannot be observed, "h" is coded as 0 and "N<sub>h</sub>" as 9; otherwise, disregard the obscuring phenomena and code h as observed--e.g., use code figure 9 if no clouds are observable even though half the sky is hidden by fog.
2. If the height of the cloud base cannot be reported owing to darkness or any reason not covered by Note 1 an X is reported for "h".
3. For the purpose of the ship code used in this manual (FM 21A), symbol "h" from WMO Code Table 43, has the meaning shown in this table.

\* **CODE TABLE 11:** SYMBOL  $C_M$ .—*Clouds of types altocumulus, altostratus, and nimbostratus*

Code figures	Technical language specifications	Plain language specifications
0	No $C_M$ clouds.....	No altocumulus, altostratus or nimbostratus.
1	Altostratus translucidus.....	Altostratus, the greater part of which is semitransparent; through this part the sun or moon may be weakly visible as through ground glass.
2	Altostratus opacus or nimbostratus.	Altostratus, the greater part of which is sufficiently dense to hide the sun (or moon), or nimbostratus.
3	Altostratus translucidus or perlucidus at a single level.	Altostratus, other than crenelated or cumuliform tufts, and the greater part of which is semitransparent; the various elements of the cloud change but slowly and are all at a single level.
4	Patches of altostratus translucidus or perlucidus (often lenticular), continuously changing and at one or more levels.	Patches of semitransparent altostratus (often in the form of almonds or fishes) which are at one or more levels; the elements of this cloud are continuously changing in aspect.
5	Altostratus translucidus or perlucidus in bands, or a layer of altostratus progressively invading the sky; these altostratus clouds generally thicken as a whole. The layer may be altostratus opacus or duplicatus.	Semitransparent altostratus in bands or altostratus in one more or less continuous layer progressively invading the sky; these altostratus clouds generally thicken as a whole. The layer may be opaque or double with a second sheet.
6	Altostratus cumulogenitus.....	Altostratus formed by the spreading out of cumulus.
7	Altostratus duplicatus or opacus, not progressively invading the sky, or altostratus with altostratus or nimbostratus or both.	Any one of the following cases: (a) Altostratus in two or more layers usually opaque in places and not progressively invading the sky. (b) Opaque layer of altostratus not progressively invading the sky. (c) Altostratus coexisting with altostratus or nimbostratus or both.
8	Altostratus castellatus or floccus.	Altostratus with sprouts in the form of small towers or battlements, or altostratus having the aspect of cumuliform tufts.
9	Altostratus of a chaotic sky, generally at several levels; cirrus spissatus usually coexists.	Altostratus, generally at several layers in a chaotic sky; dense cirrus is usually present.
X	Clouds $C_M$ not visible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or because of a continuous layer of lower clouds.	No altostratus, altostratus or nimbostratus visible owing to darkness, fog, blowing dust or sand, or other such phenomena, or because of the presence of a continuous layer of lower clouds.

CODE TABLE 12

SYMBOL  $C_H$ .—*Clouds of types cirrus, cirrostratus, and cirrocumulus*

Code figures	Technical language specifications	Plain language specifications
0	No $C_H$ clouds-----	No cirrus, cirrostratus or cirrocumulus.
1	Cirrus fibratus, sometimes uncinus, not progressively invading the sky.	Cirrus in the form of filaments, strands or hooks, not progressively invading the sky (often called "mares tails").
2	Cirrus spissatus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a cumulonimbus; or cirrus castellatus or floccus.	Dense cirrus in patches or entangled sheaves which usually do not increase and sometimes seem to be the remains of the upper parts of cumulonimbus; or cirrus with sproutings in the form of towers or battlements or having the aspect of cumuliform tufts.
3	Cirrus spissatus cumulonimbo-genitus; either the remains of cumulonimbus, or parts of distant cumulonimbus, the cumuliform portions of which cannot be seen.	Cirrus, often in the form of an anvil; either the remains of the upper parts of cumulonimbus, or parts of distant cumulonimbus, the cumuliform portions of which cannot be seen.
4	Cirrus uncinus or fibratus, or both, progressively invading the sky; they generally thicken as a whole.	Cirrus in the form of hooks or filaments or both, progressively invading the sky; they generally become denser as a whole.
5	Cirrus, often in bands, and cirrostratus, or cirrostratus alone, progressively invading the sky; they generally thicken as a whole, but the continuous veil does not reach 45° above the horizon.	Cirrus, often in bands converging towards one or two points of the horizon, and cirrostratus, or cirrostratus only; in either case they are progressively invading the sky, and generally growing denser as a whole, but the continuous veil does not reach 45° above the horizon.
6	Cirrus, often in bands, and cirrostratus, or cirrostratus alone, progressively invading the sky; they generally thicken as a whole, but the continuous veil exceeds 45° above the horizon, without the sky being totally covered.	Cirrus, often in bands converging towards 1 or 2 points of the horizon, and cirrostratus, or cirrostratus only; in either case they are progressively invading the sky, and generally growing denser as a whole, but the continuous veil exceeds 45° above the horizon, without the sky being completely covered.
7	Cirrostratus covering the whole sky.	Veil of cirrostratus completely covering the sky.
8	Cirrostratus not progressively invading the sky, and not entirely covering it.	Cirrostratus not progressively invading the sky, and not completely covering it.
9	Cirrocumulus alone, or cirrocumulus predominant among the cirriform clouds.	Cirrocumulus alone, or cirrocumulus accompanied by cirrus or cirrostratus or both, but cirrocumulus is the predominant cirriform cloud.
X	Clouds $C_H$ not visible owing to darkness, fog, blowing dust or sand or other similar phenomena, or because of a continuous layer of lower clouds.	No cirrus, cirrostratus or cirrocumulus visible owing to darkness, fog, blowing dust or sand, or other such phenomena, or because of the presence of a continuous layer of lower clouds.

CODE TABLE 13

SYMBOL D.—*Ship's course (true) made good in 3 hours preceding the time of observation*

Code figure	True course	Code figures	True course
0	Ship hove to.	5	SW.
1	NE.	6	W.
2	E.	7	NW.
3	SE.	8	N.
4	S.	9	No information.

CODE TABLE 14

SYMBOL V.—*Ship's average speed made good during 3 hours preceding the time of observation*

Code figure	Speed	Code figures	Speed
0	Ship stopped.	5	13 to 15 knots.
1	1 to 3 knots.	6	16 to 18 knots.
2	4 to 6 knots.	7	19 to 21 knots.
3	7 to 9 knots.	8	22 to 24 knots.
4	10 to 12 knots.	9	More than 24 knots.

CODE TABLE 15

SYMBOL a.—*Barometer change characteristics in the last 3 hours*

Trace	Code figures	Description
	0	Rising, then falling. Barometer the same or higher than 3 hours ago.
	1	Rising, then steady; or rising then rising more slowly.
	2	Rising, steadily or unsteadily.
	3	Falling or steady, then rising; or rising then rising more quickly.
	4	Steady. Barometer the same as 3 hours ago.
	5	Falling, then rising. Barometer the same or lower than 3 hours ago.
	6	Falling, then steady; or falling then falling more slowly.
	7	Falling, steadily or unsteadily.
	8	Steady or rising, then falling; or falling, then falling more quickly.

} Barometer now higher than 3 hours ago.

} Barometer now lower than 3 hours ago.

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CODE TABLE 16

SYMBOL pp.—Amount of barometric change in the last 3 hours

[Coded in units of  $\frac{1}{10}$  of a millibar. For example, 0.2 millibar is coded as 02; 1.2 millibars as 12]

Amount of rise or fall							
Inch	Milli-bars	Inch	Milli-bars	Inch	Milli-bars	Inch	Milli-bars
0. 005	0. 2	0. 155	5. 3	0. 305	10. 3	0. 455	15. 4
. 010	0. 3	. 160	5. 4	. 310	10. 5	. 460	15. 6
. 015	0. 5	. 165	5. 6	. 315	10. 7	. 465	15. 7
. 020	0. 7	. 170	5. 8	. 320	10. 8	. 470	15. 9
. 025	0. 9	. 175	5. 9	. 325	11. 0	. 475	16. 1
. 030	1. 0	. 180	6. 1	. 330	11. 2	. 480	16. 3
. 035	1. 2	. 185	6. 3	. 335	11. 3	. 485	16. 4
. 040	1. 4	. 190	6. 4	. 340	11. 5	. 490	16. 6
. 045	1. 5	. 195	6. 6	. 345	11. 7	. 495	16. 8
. 050	1. 7	. 200	6. 8	. 350	11. 9	. 500	16. 9
. 055	1. 9	. 205	6. 9	. 355	12. 0	. 505	17. 1
. 060	2. 0	. 210	7. 1	. 360	12. 2	. 510	17. 3
. 065	2. 2	. 215	7. 3	. 365	12. 4	. 515	17. 4
. 070	2. 4	. 220	7. 5	. 370	12. 5	. 520	17. 6
. 075	2. 5	. 225	7. 6	. 375	12. 7	. 525	17. 8
. 080	2. 7	. 230	7. 8	. 380	12. 9	. 530	17. 9
. 085	2. 9	. 235	8. 0	. 385	13. 0	. 535	18. 1
. 090	3. 1	. 240	8. 1	. 390	13. 2	. 540	18. 3
. 095	3. 2	. 245	8. 3	. 395	13. 4	. 545	18. 5
. 100	3. 4	. 250	8. 5	. 400	13. 5	. 550	18. 6
. 105	3. 6	. 255	8. 6	. 405	13. 7	. 555	18. 8
. 110	3. 7	. 260	8. 8	. 410	13. 9	. 560	19. 0
. 115	3. 9	. 265	9. 0	. 415	14. 1	. 565	19. 1
. 120	4. 1	. 270	9. 1	. 420	14. 2	. 570	19. 3
. 125	4. 2	. 275	9. 3	. 425	14. 4	. 575	19. 5
. 130	4. 4	. 280	9. 5	. 430	14. 6	. 580	19. 6
. 135	4. 6	. 285	9. 7	. 435	14. 7	. 585	19. 8
. 140	4. 7	. 290	9. 8	. 440	14. 9	. 590	20. 0
. 145	4. 9	. 295	10. 0	. 445	15. 1	. 595	20. 1
. 150	5. 1	. 300	10. 2	. 450	15. 2	. 600	20. 3

## TABLES

CODE TABLE 17

SYMBOL  $P_w$ .—*Period of waves*

Code figure	Period
2	5 seconds or less.
3	5 to 7 seconds.
4	7 to 9 seconds.
5	9 to 11 seconds.
6	11 to 13 seconds.
7	13 to 15 seconds.
8	15 to 17 seconds.
9	17 to 19 seconds.
0	19 to 21 seconds.
1	Over 21 seconds.
x	Calm, or period indeterminate.

NOTE.—If the exact number of seconds for the period of the waves corresponds to two code figures, the lower code figure is reported.

CODE TABLE 18

SYMBOL  $H_w$ .—*Mean maximum height of waves*

Code figure	Height
0	Less than 1 foot ( $\frac{1}{4}$ meter).
1	1½ feet ( $\frac{1}{2}$ meter).
2	3 feet (1 meter).
3	5 feet (1½ meters).
4	6½ feet (2 meters).
5	8 feet (2½ meters).
6	9½ feet (3 meters).
7	11 feet (3½ meters).
8	13 feet (4 meters).
9	14 feet (4½ meters).
x	Height impossible to determine. (When 50 is added to $d_w$ , $d_w$ , the height of waves is as follows):
0	16 feet (5 meters).
1	17½ feet (5½ meters).
2	19 feet (6 meters).
3	21 feet (6½ meters).
4	22½ feet (7 meters).
5	24 feet (7½ meters).
6	25½ feet (8 meters).
7	27 feet (8½ meters).
8	29 feet (9 meters).
9	30½ feet (9½ meters).
x	Height impossible to determine.

## NOTES

1. Each code figure except "zero" covers a range of  $\frac{1}{4}$  meter; e. g., code figure 1 =  $\frac{1}{4}$  meter to  $\frac{1}{2}$  meter, code figure 2 =  $\frac{1}{2}$  meter to 1½ meters.

2. If the wave height is exactly between the heights corresponding to two code figures, the lower code figure is reported.

3. For wave heights greater than 31 feet (9½ meters), the code figure for 30½ feet (9½ meters) is reported followed by the word "WAVES" and the actual height of the waves in feet or meters; e. g., "WAVES 37."

## CODE TABLE 19

SYMBOL C<sub>2</sub>.—*Description of kind of ice*

Code figure	Description
0	None or "ice-blink." <sup>1</sup>
1	New ice.
2	Fast-ice.
3	Drift-ice.
4	Packed (compact) slush or strips of hummocked-ice.
5	Open lead near shore.
6	Heavy fast-ice.
7	Heavy drift-ice.
8	Hummocked-ice.
9	Ice-jamming.

<sup>1</sup> When ice-blink is recorded, its bearing (symbol D<sub>1</sub>) should also be recorded.

## CODE TABLE 20

SYMBOL K.—*Effect of ice on navigation*

Code figures	Description
0	Navigation unobstructed.
1	Navigation unobstructed for steamers; difficult for sailing ships.
2	Navigation difficult for low-powered steamers; closed to sailing ships.
3	Navigation possible only for powerful steamers.
4	Navigation possible only for steamers constructed to withstand ice pressure.
5	Navigation possible with the assistance of icebreakers.
6	Channel open in the solid ice.
7	Navigation temporarily closed.
8	Navigation closed.
9	Navigation conditions unknown (e. g., owing to bad weather).

## CODE TABLE 21

SYMBOL D<sub>1</sub>.—*Bearing of ice-limit*

Code figures	Description
0	No ice limit can be stated.
1	Ice limit towards NE.
2	Ice limit towards E.
3	Ice limit towards SE.
4	Ice limit towards S.
5	Ice limit towards SW.
6	Ice limit towards W.
7	Ice limit towards NW.
8	Ice limit towards N.
9	Ice limit in several directions.

NOTE.—If more than 1 ice limit can be stated, the nearest or most important is reported.

\*

CODE TABLE 22

SYMBOL r.—Distance to ice-limit from reporting ship

Code figures	Distance
0	Up to 1 mile.
1	1 to 2 miles.
2	2 to 4 miles.
3	4 to 6 miles.
4	6 to 8 miles.
5	8 to 12 miles.
6	12 to 16 miles.
7	16 to 20 miles.
8	More than 20 miles.
9	Unspecified or no observations.

NOTE.—If the exact bounding distance for the ice limit corresponds to 2 code figures, the lower code figure is reported.

CODE TABLE 23

SYMBOL e.—Orientation of ice-limit

Code figure	Orientation of ice-limit
0	Orientation of ice-limit impossible to estimate—ship <i>outside</i> the ice.
1	Ice-edge lying in a direction NE to SW with ice situated to the NW.
2	Ice-edge lying in a direction E to W with ice situated to the northward.
3	Ice-edge lying in a direction SE to NW with ice situated to the NE.
4	Ice-edge lying in a direction S to N with ice situated to the eastward.
5	Ice-edge lying in a direction SW to NE with ice situated to the SE.
6	Ice-edge lying in a direction W to E with ice situated to the southward.
7	Ice-edge lying in a direction NW to SE with ice situated to the SW.
8	Ice-edge lying in a direction N to S with ice situated to the westward.
9	Orientation of ice-limit impossible to estimate—ship <i>inside</i> the ice.

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TABLE 24.—Celsius (centigrade) to Fahrenheit temperatures

°C.	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	°F.									
+45	+113.0	+113.2	+113.4	+113.5	+113.7	+113.9	+114.1	+114.3	+114.4	+114.6
44	111.2	111.4	111.6	111.7	111.9	112.1	112.3	112.5	112.6	112.8
43	109.4	109.6	109.8	109.9	110.1	110.3	110.5	110.7	110.8	111.0
42	107.6	107.8	108.0	108.1	108.3	108.5	108.7	108.9	109.0	109.2
41	105.8	106.0	106.2	106.3	106.5	106.7	106.9	107.1	107.2	107.4
+40	+104.0	+104.2	+104.4	+104.5	+104.7	+104.9	+105.1	+105.3	+105.4	+105.6
39	102.2	102.4	102.6	102.7	102.9	103.1	103.3	103.5	103.6	103.8
38	100.4	100.6	100.8	100.9	101.1	101.3	101.5	101.7	101.8	102.0
37	98.6	98.8	99.0	99.1	99.3	99.5	99.7	99.9	100.0	100.2
36	96.8	97.0	97.2	97.3	97.5	97.7	97.9	98.1	98.2	98.4
+35	+95.0	+95.2	+95.4	+95.5	+95.7	+95.9	+96.1	+96.3	+96.4	+96.6
34	93.2	93.4	93.6	93.7	93.9	94.1	94.3	94.5	94.6	94.8
33	91.4	91.6	91.8	91.9	92.1	92.3	92.5	92.7	92.8	93.0
32	89.6	89.8	90.0	90.1	90.3	90.5	90.7	90.9	91.0	91.2
31	87.8	88.0	88.2	88.3	88.5	88.7	88.9	89.1	89.2	89.4
+30	+86.0	+86.2	+86.4	+86.5	+86.7	+86.9	+87.1	+87.3	+87.4	+87.6
29	84.2	84.4	84.6	84.7	84.9	85.1	85.3	85.5	85.6	85.8
28	82.4	82.6	82.8	82.9	83.1	83.3	83.5	83.7	83.8	84.0
27	80.6	80.8	81.0	81.1	81.3	81.5	81.7	81.9	82.0	82.2
26	78.8	79.0	79.2	79.3	79.5	79.7	79.9	80.1	80.2	80.4
+25	+77.0	+77.2	+77.4	+77.5	+77.7	+77.9	+78.1	+78.3	+78.4	+78.6
24	75.2	75.4	75.6	75.7	75.9	76.1	76.3	76.5	76.6	76.8
23	73.4	73.6	73.8	73.9	74.1	74.3	74.5	74.7	74.8	75.0
22	71.6	71.8	72.0	72.1	72.3	72.5	72.7	72.9	73.0	73.2
21	69.8	70.0	70.2	70.3	70.5	70.7	70.9	71.1	71.2	71.4
+20	+68.0	+68.2	+68.4	+68.5	+68.7	+68.9	+69.1	+69.3	+69.4	+69.6
19	66.2	66.4	66.6	66.7	66.9	67.1	67.3	67.5	67.6	67.8
18	64.4	64.6	64.8	64.9	65.1	65.3	65.5	65.7	65.8	66.0
17	62.6	62.8	63.0	63.1	63.3	63.5	63.7	63.9	64.0	64.2
16	60.8	61.0	61.2	61.3	61.5	61.7	61.9	62.1	62.2	62.4
+15	+59.0	+59.2	+59.4	+59.5	+59.7	+59.9	+60.1	+60.3	+60.4	+60.6
14	57.2	57.4	57.6	57.7	57.9	58.1	58.3	58.5	58.6	58.8
13	55.4	55.6	55.8	55.9	56.1	56.3	56.5	56.7	56.8	57.0
12	53.6	53.8	54.0	54.1	54.3	54.5	54.7	54.9	55.0	55.2
11	51.8	52.0	52.2	52.3	52.5	52.7	52.9	53.1	53.2	53.4
+10	+50.0	+50.2	+50.4	+50.5	+50.7	+50.9	+51.1	+51.3	+51.4	+51.6
9	48.2	48.4	48.6	48.7	48.9	49.1	49.3	49.5	49.6	49.8
8	46.4	46.6	46.8	46.9	47.1	47.3	47.5	47.7	47.8	48.0
7	44.6	44.8	45.0	45.1	45.3	45.5	45.7	45.9	46.0	46.2
6	42.8	43.0	43.2	43.3	43.5	43.7	43.9	44.1	44.2	44.4
+5	+41.0	+41.2	+41.4	+41.5	+41.7	+41.9	+42.1	+42.3	+42.4	+42.6
4	39.2	39.4	39.6	39.7	39.9	40.1	40.3	40.5	40.6	40.8
3	37.4	37.6	37.8	37.9	38.1	38.3	38.5	38.7	38.8	39.0
2	35.6	35.8	36.0	36.1	36.3	36.5	36.7	36.9	37.0	37.2
1	33.8	34.0	34.2	34.3	34.5	34.7	34.9	35.1	35.2	35.4
0	32.0	32.2	32.4	32.5	32.7	32.9	33.1	33.3	33.4	33.6