UNITED STATES DEPARTMENT OF COMMERCE • Luther H. Hodges
U. S. WEATHER BUREAU • Robert M. White, Chief

MANUAL OF MARINE METEOROLOGICAL OBSERVATIONS

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AN APPRECIATION

The continuing demand for more and better weather information for ships is being met by the cooperation of the users themselves. Weather reports received from cooperating ships by radio and mail provide the basis for 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.

Robert M. White
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 to 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 615-5, "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).

CHAPTER I. GENERAL INSTRUCTIONS

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CHAPTER I. GENERAL INSTRUCTIONS

1000. TIME OF OBSERVATION

1010. SYNOPTIC REPORTS. Cooperating ships are requested to make and record synoptic weather observations at the hours of 0000, 0600, 1200 and 1800 Greenwich Mean Time (GMT) while at sea. If it is not possible to make four observations daily, as many observations as convenient should be taken. Observations should be made in sufficient time for delivery to the Radio Officer by the synoptic observation time.

* 1011. Weather observations should be made when underway, regardless of the distance from shore.

1020. SPECIAL REPORTS. In accordance with the Internatonal Convention for Safety of Life at Sea, masters of all ships are requested to take special weather observations and report by radio when tropical or severe storms are encountered. These reports are not limited to synoptic hours but may be reported regardless of hour.

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 instuctions relative to the time and frequency of the reports and the address to which the reports should be sent.

1100. SHIP'S WEATHER OBSERVATIONS-FORM 615-5

1110. GENERAL. All weather observations made at sea will be recorded on Form 615-5, Ship's Weather Observations. To assist coding weather data, a complete international Ship's Weather Code and Cloud Code Chart are included with each pad of Form 615-5. 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 615-5 will be started:

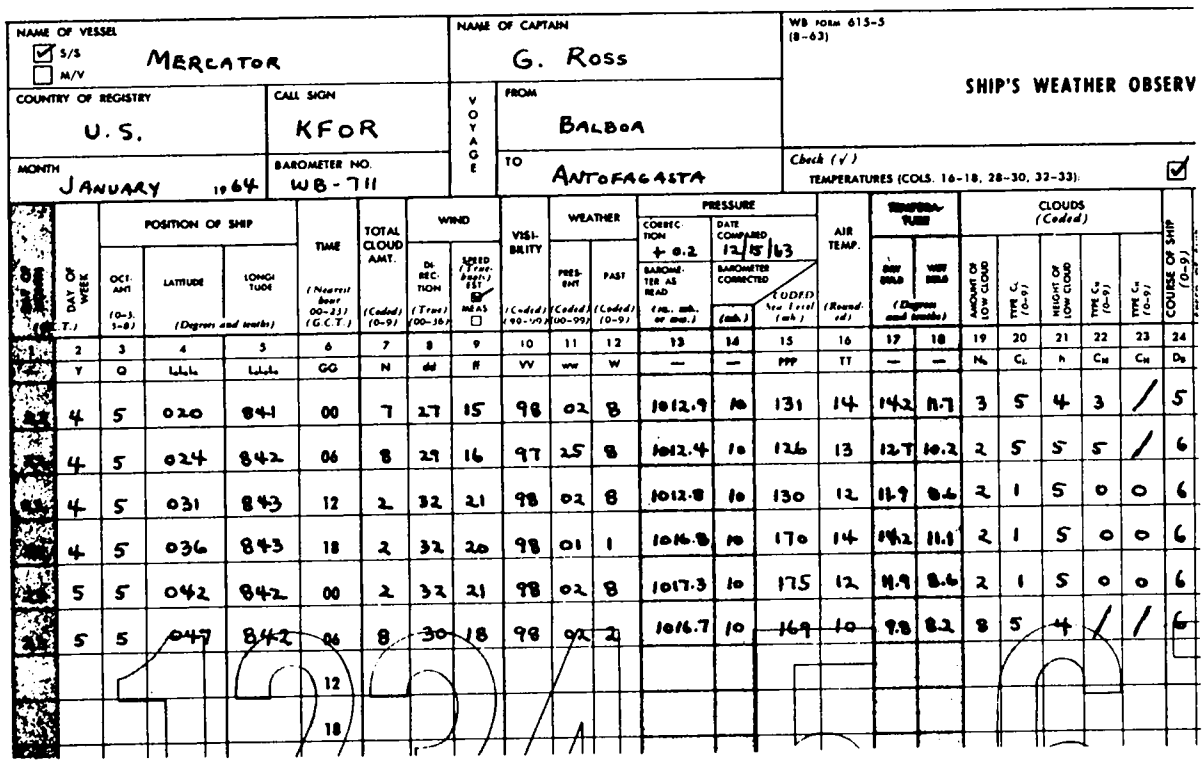
(a) For the first observation of a new month.

(b) At the beginning of each voyage.

(c) Upon sailing from one octant to another.

(d) 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.



NAME OF VESSEL: ☑ S/S ☐ M/V MERCATOR

NAME OF CAPTAIN: G. ROSS

WB FORM 615-5 (8-63)

SHIP'S WEATHER OBSERV

COUNTRY OF REGISTRY: U.S.

CALL SIGN: KFOR

VOYAGE: FROM BALBOA TO ANTOFAGASTA

MONTH: JANUARY 1964

BAROMETER NO.: WB-711

Check (✓) TEMPERATURES (COLS. 16-18, 28-30, 32-33): ☑

	DAY OF WEEK (G.C.T.)	POSITION OF SHIP: OCTANT (0-3, 5-8)	LATITUDE (Degrees and tenths)	LONGITUDE (Degrees and tenths)	TIME (Nearest hour 00-23) (G.C.T.)	TOTAL CLOUD AMT. (Coded) (0-9)	WIND: DIRECTION (True) (00-36)	WIND: SPEED (True-knots) EST ☑ MEAS ☐	VISIBILITY (Coded) (00-99)	WEATHER: PRESENT (Coded) (00-99)	WEATHER: PAST (Coded) (0-9)	PRESSURE: CORRECTION +0.2 BAROMETER AS READ (in., mb., or mm.)	PRESSURE: DATE COMPARED 12/15/63 BAROMETER CORRECTED (mb.)	PRESSURE: CODED Sea Level (mb.)	AIR TEMP. (Rounded)	TEMPERATURE: DRY BULB (Degrees and tenths)	TEMPERATURE: WET BULB (Degrees and tenths)	CLOUDS (Coded): AMOUNT OF LOW CLOUD	TYPE C_L (0-9)	HEIGHT OF LOW CLOUD	TYPE C_M (0-9)	TYPE C_H (0-9)	COURSE OF SHIP (0-9)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Y	Q	Lalala	Lalala	GG	N	dd	ff	VV	ww	W	—	—	PPP	TT	—	—	N_h	C_L	h	C_M	C_H	D_s
[illegible]	4	5	020	841	00	7	27	15	98	02	8	1012.9	10	131	14	14.2	11.7	3	5	4	3	/	5
[illegible]	4	5	024	842	06	8	29	16	97	25	8	1012.4	10	126	13	12.7	10.2	2	5	5	5	/	6
[illegible]	4	5	031	843	12	2	32	21	98	02	8	1012.8	10	130	12	11.9	8.6	2	1	5	0	0	6
[illegible]	4	5	036	843	18	2	32	20	98	01	1	1016.8	10	170	14	14.2	11.1	2	1	5	0	0	6
[illegible]	5	5	042	842	00	2	32	21	98	02	8	1017.3	10	175	12	11.9	8.6	2	1	5	0	0	6
[illegible]	5	5	047	842	06	8	30	18	98	02	2	1016.7	10	169	10	9.8	8.2	8	5	4	/	/	6
					12																		
					18																		

Figure 1. - Ship's Weather Observations-Form 615-5

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

(1) VESSEL. - Enter name and type of vessel.

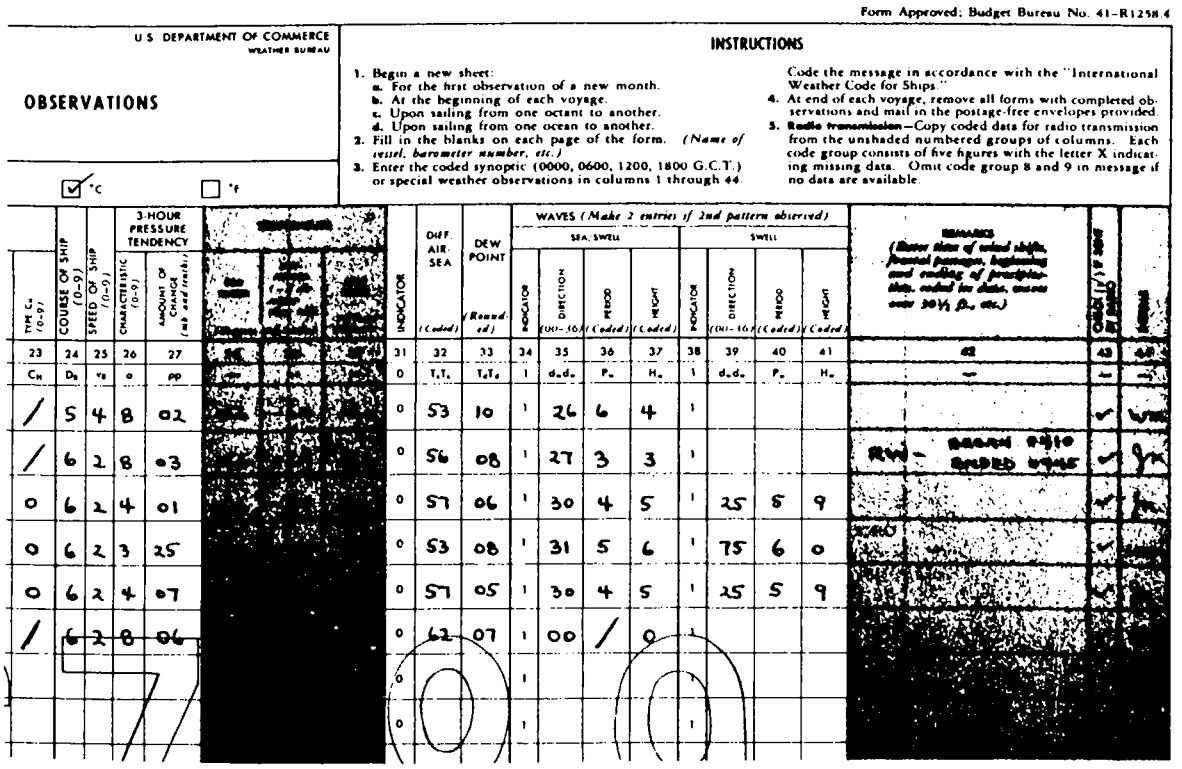
(2) COUNTRY OF REGISTRY. - Enter nationality or registry of vessel.

(2A) CALL SIGN. - Enter the ship's radio identifier.

(3) MONTH. - Enter month and year.

(3A) BAROMETER, WEATHER BUREAU NUMBER. - Enter W. B. serial number in the space provided.

(4) CAPTAIN. - Enter the master's name.



Form Approved: Budget Bureau No. 41-R1258.4

U.S. DEPARTMENT OF COMMERCE
WEATHER BUREAU

OBSERVATIONS

☑ °C ☐ °F

INSTRUCTIONS

1. Begin a new sheet:
   a. For the first observation of a new month.
   b. At the beginning of each voyage.
   c. Upon sailing from one octant to another.
   d. Upon sailing from one ocean to another.
2. Fill in the blanks on each page of the form. *(Name of vessel, barometer number, etc.)*
3. Enter the coded synoptic (0000, 0600, 1200, 1800 G.C.T.) or special weather observations in columns 1 through 44. Code the message in accordance with the "International Weather Code for Ships."
4. At end of each voyage, remove all forms with completed observations and mail in the postage-free envelopes provided.
5. **Radio transmission**—Copy coded data for radio transmission from the unshaded numbered groups of columns. Each code group consists of five figures with the letter X indicating missing data. Omit code group 8 and 9 in message if no data are available.

TYPE Cu (0-9)	COURSE OF SHIP (0-9)	SPEED OF SHIP (0-9)	3-HOUR PRESSURE TENDENCY: CHARACTERISTIC (0-9)	3-HOUR PRESSURE TENDENCY: AMOUNT OF CHANGE (mb and tenths)	[illegible]	[illegible]	[illegible]	INDICATOR	DIFF. AIR-SEA (Coded)	DEW POINT (Rounded)	WAVES (Make 2 entries if 2nd pattern observed) SEA, SWELL: INDICATOR	SEA, SWELL: DIRECTION (00-36)	SEA, SWELL: PERIOD (Coded)	SEA, SWELL: HEIGHT (Coded)	SWELL: INDICATOR	SWELL: DIRECTION (00-36)	SWELL: PERIOD (Coded)	SWELL: HEIGHT (Coded)	REMARKS (Enter time of wind shifts, frontal passages, beginning and ending of precipitation, coded in data, waves over 30½ ft., etc.)	[illegible]	[illegible]
23	24	25	26	27	[illegible]	[illegible]	[illegible]	31	32	33	34	35	36	37	38	39	40	41	42	43	44
C_H	D_S	v_S	a	pp	[illegible]	[illegible]	[illegible]	0	T_sT_s	T_dT_d	1	d_wd_w	P_w	H_w	1	d_wd_w	P_w	H_w	—	—	—
/	5	4	8	02	[illegible]	[illegible]	[illegible]	0	53	10	1	26	6	4	1					✓	[illegible]
/	6	2	8	03	[illegible]	[illegible]	[illegible]	0	56	08	1	27	3	3	1				RW - [illegible] ENDED [illegible]	✓	[illegible]
0	6	2	4	01	[illegible]	[illegible]	[illegible]	0	57	06	1	30	4	5	1	25	5	9		✓	[illegible]
0	6	2	3	25	[illegible]	[illegible]	[illegible]	0	53	08	1	31	5	6	1	75	6	0	[illegible]	✓	[illegible]
0	6	2	4	07	[illegible]	[illegible]	[illegible]	0	57	05	1	30	4	5	1	25	5	9	[illegible]	✓	[illegible]
/	6	2	8	06	[illegible]	[illegible]	[illegible]	0	62	07	1	00	/	0	1				[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	0			1				1				[illegible]	[illegible]	[illegible]
					[illegible]	[illegible]	[illegible]	0			1				1				[illegible]	[illegible]	[illegible]

(5) VOYAGE FROM - TO. - Enter port of departure and destination.

(6) TEMPERATURES. - Check the appropriate square in the center of the page indicating whether temperatures are observed and recorded in degrees Celsius (°C) or degrees Fahrenheit (°F). Reports are preferred in degrees Celsius.

(7) WIND SPEED. - Under column 9 place a check in one of the squares to indicate the wind speed was estimated or measured.

(8) CORRECTION. - Enter barometer correction in space provided under the heading of column 13.

(9) DATE COMPARED. - Enter date of last barometer comparison under the heading of column 15.

1122. SEA AND SWELL. When both sea and swell are observed, both systems are to be recorded in Form 615-5 and included in the coded weather message on Form 630-9. The sea data will be entered in columns 35-37; swell data will be entered in columns 39-41. (See Chapter IX)

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 615-5, 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 WEATHER OBSERVATION MESSAGES BY RADIO. Weather Bureau Marine Centers will designate the ships that are authorized to transmit by radio, 0000, 0600, 1200 and 1800 G M T, weather observation messages to United States and foreign meteorological service ship collection centers. Meteorological ship collection centers to which these regular weather observation messages should be addressed from all ocean areas are contained in Weather Bureau publication entitled, "United States and Foreign Radio Coast Stations Accepting Ships' Weather Messages."

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 observation messages addressed to "METEO Washington" and "METEO San Francisco", from ships in western North Atlantic and eastern North Pacific waters, respectively, should be checked "Government" and transmitted to the nearest United States Government or commercial shore station. The Weather Bureau will assume the cost for transmitting weather messages to these addresses.

1240. METEOROLOGICAL RADIOTELEGRAM. WB Form 630-9. The Weather Bureau supplies meteorological radiotelegram blanks for convenience in transmitting weather observation messages by radio. After the message is transmitted the form may be disposed of by the radio operator. It should not be mailed to the Weather Bureau.

*Rev.
Eff. 6-1-66

1241. The coded weather message will be copied from Form 615-5 to Form 630-9.

1250. CODE FOR TRANSMISSION. Weather messages will be encoded in the International Code for Radio Weather Reports from Ships, as indicated below. Each element in the coded weather observation message is indicated by one or more symbol letters. The symbolic form of the code (FM21A) is as follows:

$YQL_aL_aL_a$ $L_oL_oL_oGG$ Nddff VVwwW PPPTT

$N_hC_LhC_MC_H$ D_sv_sapp $OT_sT_sT_dT_d$ $1d_wd_wP_wH_w$

$2I_sE_sE_sR_s$ ICE c_2KD_ire

Additional groups may be added in accordance with paragraphs 6431 and 9410.

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 adjacent columns.

1252. The "c_2KD_ire" 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 of the message cannot be determined, the slant "/" will be substituted as required by the code table appropriate to the missing data. Each group will then be composed of five characters, either numerals or /'s. If data for an entire group is missing from the first seven groups of the message, five /'s (/////) will be reported for that group.

1253.1. When the seventh group (D_sv_sapp) is omitted from the message, 30 will be added to the time in coding GG. A group of five X's will not be sent to indicate a missing seventh group.

1253.2. When the sixth group ($N_hC_LhC_MC_H$) and the seventh group (D_sv_sapp) are omitted, 60 will be added to the time in coding GG. Groups of five /'s will not be sent to indicate missing sixth and seventh groups.

1253.3 When all the elements of one of the groups $OT_sT_sT_dT_d$, $1d_wd_wP_wH_w$ $2I_sE_sE_sR_s$ ICE c_2KD_ire are missing, that group will be omitted from the coded message. Five /'s will not be sent to indicate missing groups.

1254. When sea waves and swell waves are distinguished simultaneously at the time of observation, both systems should be reported. Two ($1d_wd_wP_wH_w$) groups may be included in the coded message; the first group containing data for sea waves and the second group swell waves. When more than two wave systems are present, data for each system of waves should be included in the coded report. Code each system separately and enter each code group in the column headed "waves" on Form 615-5. In cases when more than two wave systems are observed, enter the additional wave groups to right under REMARKS.

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
$L_aL_aL_a$-	Latitude in degrees and tenths	----------	2401	--
$L_oL_oL_o$-	Longitude in degrees and tenths	----------	2501	--
GG-----	Greenwich mean 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 Celsius)	7110-20	7310	--
N_h-----	Fraction of celestial dome covered C_L or C_M cloud	8110-30	8320	3
C_L-----	Clouds of types stratocumulus, stratus, cumulus, cumulonimbus (in code)	----------	8340	9
h------	Height of base of lowest C_L or C_M cloud above sea	8201	8330	10
C_M----	Clouds of types altocumulus, altostratus, nimbostratus (in code)	----------	8350	11
C_H-----	Clouds of types cirrus, cirrostratus, cirrocumulus (in code)	----------	8360	12
D_s-----	Ship's course (in code)	----------	2701	13
v_s-----	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
O------	Group designator	----------	----------	--
T_sT_s---	Difference between air and sea temperature (half degrees Celsius)	----------	7330	--
T_dT_d---	Temperature of dew point (whole degrees Celsius)	7133-44	7310-12	--
1------	Group designator	----------	----------	--
d_wd_w---	Direction from which waves are coming (tens of degrees)	9101-2	9420	4
P_w-----	Period of waves (in code)	9210-20	9430	17
H_w-----	Mean height of waves (in code)	9310-22	9440	18
2------	Group designator	----------	----------	--
I_s------	Ice accretion on ship (in code)	10130	10130	19A
E_sE_s---	Thickness of ice accretion (in centimeters)	10140	10140	--
R_s-----	Rate of ice accretion (in code)	10150	10150	19B
ICE----	Group designator for ice group	----------	10480	--
c_2-----	Description of kind of ice (in code)	10320	10420	19C
K------	Effect of ice on navigation (in code)	----------	10430	20
D_i-----	Bearing of ice limit (in code)	10330	10440	21
r ------	Distance of ice from ship (in code)	10330	10450	22
e ------	Orientation of ice field (in code)	10330	10460	23

1255. Example of a coded report: 40480 62106 62614 97267 06402 45420 56308 05201 12631 22041 ICE 10403

Code Symbols	Code Figures	Decoded Data
$YQL_aL_aL_a$	40480	4th day of week; octant, 0; latitude, 48.0°.
$L_oL_oL_oGG$	62106	Longitude, 62.1°; time, 0600 G M T
Nddff	62614	6 eighths of sky covered; wind direction, 260°; speed, 14 knots.
VVwwW	97267	Visibility, 5 miles; present weather, snow showers in past hour; past weather, snow.
PPPTT	06402	Pressure, 1006.4 mb., temperature 2°C.
$N_hC_LhC_MC_H$	45420	4 eighths stratocumulus; height of lowest cloud 1000-2000 feet. Altostratus or nimbostratus also present. No type C_H clouds.
$D_sv_s$app	56308	Ship's course, southwest; ship's speed 16 to 18 knots; barometer falling then rising; barometric change, 0.8 mb. higher.
$OT_sT_sT_dT_d$	05201	Group designator, 0; sea temperature 1°C. higher than air temperature; dew point 1°C.
$1d_wd_wP_wH_w$	12631	Group designator, 1; wave direction, 260°; wave period, 6 to 7 seconds; wave height 1-1/2 feet.
$2I_sE_sE_sR_s$	22041	Group designator, 2; icing from fog; ice 4 cm. (16 inches) thick, 04; ice building up slowly.
ICE	ICE	Designator for sea ice group.
c_2KD_ire	10403	New ice; navigation unobstructed; ice limit toward south; less than one mile distant; ice edge lying in a direction SE to NW with ice situated to the NE.

1300. ORDERING SUPPLIES

1301. Weather Bureau forms and supplies (including envelopes) may be obtained directly from any of the Weather Bureau Marine Centers and 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 615-5 in the section headed "Check Forms or Supplies Needed." When supplies are requested on Form 615-5, the ship's mailing address should be included in the space above the section for requesting supplies.

1400. ADDRESSES OF WEATHER BUREAU MARINE CENTERS AND PORT OFFICES

1401. Weather Bureau Marine Centers have personnel who visit ships in port for the purpose of checking and calibrating shipboard barometers and other meteorological instruments. In addition the port meteorologists assist the masters and mates in problems regarding weather observations, preparation of weather maps and forecasts. Meteorological manuals, forms and some instruments are also provided by the following Weather Bureau Marine Centers.

ATLANTIC AREA

Weather Bureau Office
30 Rockefeller Plaza
New York 20, New York

Weather Bureau Office
U. S. Coast Guard Base
427 Commercial Street
Boston 13, Mass.

Weather Bureau Office
U. S. Customhouse, Room C-6
101 E. Main Street
Norfolk 10, Virginia

Weather Bureau Airport Station
Box 17, Travis Field
Savannah, Ga.

U. S. Weather Bureau Airport Station
Isla Verde International Airport
San Juan, P. R.

GULF AREA

Weather Bureau Office
701 Loyola Avenue
New Orleans 12, La.

Weather Bureau Office
1002 Federal Office Building
Houston 14, Texas

Weather Bureau Office
516 U. S. Court & Custom House
Mobile, Ala.

PACIFIC AREA

Weather Bureau Office
Room 216, Custom House
555 Battery Street
San Francisco 11, Calif.

Weather Bureau Office
Pier A, Berth 9
Long Beach 2, Calif.

Weather Bureau Office
703 Federal Building
Seattle 4, Wash.

Weather Bureau Airport Station
Lindbergh Municipal Airport
San Diego 1, Calif.

Weather Bureau Office
Box 3650, Pier 2
Honolulu, Hawaii

1402. The following Weather Bureau Offices or Airport Stations provide forecasts and climatological data, and will check barometers at the Weather Bureau Office:

ATLANTIC AREA

Weather Bureau Airport Station
Portland City Airport
Portland, Maine

Weather Bureau Airport Station
East Boston 28, Mass.

Weather Bureau Airport Station
T. F. Green Airport
Hillsgrove, R. I.

Weather Bureau Airport Station
Municipal Airport
New Haven, Conn.

Weather Bureau Airport Station
Bridgeport Municipal Airport
Stratford, Conn.

Weather Bureau Airport Station
New Terminal Bldg., Intl. Airport
Philadelphia, Pa.

Weather Bureau Airport Station
Friendship International Airport
Baltimore, Md.

Weather Bureau Airport Station
National Aviation Facilities
Experimental Center
Atlantic City, N. J.

Weather Bureau Airport Station
Washington National Airport
Washington, D. C.

Weather Bureau Airport Station
Norfolk Municipal Airport
Norfolk, Va.

Weather Bureau Airport Station
Municipal Airport
Charleston, S. C.

Weather Bureau Airport Station
Imeson Airport
Jacksonville, Fla.

Weather Bureau Airport Station
International Airport
Miami, Fla.

Weather Bureau Airport Station
Wilmington, North Carolina

GULF AREA

Weather Bureau Airport Station
Fort Myers, Fla.

Weather Bureau Office
Post Office Building
Pensacola, Fla.

Weather Bureau Airport Station
Lake Charles Air Force Base
Lake Charles, La.

Weather Bureau Office
Post Office Building
Galveston, Texas

Weather Bureau Airport Station
International Airport
Brownsville, Texas

Weather Bureau Airport Station
Tampa International Airport
Tampa, Fla.

Weather Bureau Airport Station
Bates Field
Mobile, Ala.

Weather Bureau Airport Station
Jefferson County Airport
Beaumont, Texas

Weather Bureau Airport Station
Corpus Christi Intl. Airport
Corpus Christi, Texas

PACIFIC AREA

Weather Bureau Airport Station
International Airport
Anchorage, Alaska

Weather Bureau Airport Station
5420 N. E. Marine Drive
Portland 13, Oregon

Weather Bureau Office
Eureka, California

Weather Bureau Airport Station
Lindbergh Field
San Diego, California

U. S. Weather Bureau Office
Guam, M. I.

Weather Bureau Airport Station
San Francisco International Airport
San Francisco, California

Weather Bureau Airport Station
Juneau Airport
Juneau, Alaska

Weather Bureau Airport Station
Clatsop County Airport
Astoria, Oregon

Weather Bureau Airport Station
Oakland Municipal Airport
Oakland, California

Weather Bureau Airport Station
Los Angeles International Airport
Los Angeles, California

Weather Bureau Airport Station
Honolulu International Airport
Honolulu, Hawaii

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 includes 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 615-5 in the columns specified in the following paragraphs.

2100. DAY OF MONTH

2101. Enter the day of the month (GCT), in column 1. A new day begins at 0000 (midnight) GCT. 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

Code Figures	Longitude	Latitude
0	0° - 90°W	North
1	90°W - 180°	
2	180° - 90°E	
3	90°E - 0°	
5	0° - 90°W	South
6	90°W - 180°	
7	180° - 90°E	
8	90°E - 0°	

2400. LATITUDE ($L_aL_aL_a$)

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°20'=48.3° (i.e., 20÷6=3, remainder neglected), which is entered as 483.

(b) 7°11' is entered as 071.

2500. LONGITUDE ($L_oL_oL_o$)

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 (¶2401). If the longitude is 100° or more, the first figure (1) will be omitted. The octant of the globe will show that the hundreds figure has been omitted.

Example: 126°25' longitude is entered as 264.

2600. GREENWICH CIVIL TIME (GG)

2601. Enter the time of the observation to the nearest hour (GCT) 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 24.

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 25.

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

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CHAPTER III. WIND

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CHAPTER III. WIND

3000. GENERAL

3001. Marine observers may determine the direction and speed of the wind from the direction and character of the ripples, waves and spray. Wind determined in this manner is termed the true wind, and will be entered in Form 615-5.

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.

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, small waves and sea spray 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 615-5. 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).

TABLE 3-1. - Determination of Wind Speed by Sea Condition

Knots	Descriptive	Sea Conditions	Wind force (Beaufort)	Probable wave height in ft.
0-1	Calm	Sea smooth and mirror-like.	0	-
1-3	Light air	Scale-like ripples without foam crests.	1	1/4
4-6	Light breeze	Small, short wavelets; crests have a glassy appearance and do not break.	2	1/2
7-10	Gentle breeze	Large wavelets; some crests begin to break; foam of glassy appearance. Occasional white foam crests.	3	2
11-16	Moderate breeze	Small waves, becoming longer; fairly frequent white foam crests.	4	4
17-21	Fresh breeze	Moderate waves, taking a more pronounced long form; many white foam crests; there may be some spray.	5	6
22-27	Strong breeze	Large waves begin to form; white foam crests are more extensive everywhere; there may be some spray.	6	10
28-33	Near 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	14
34-40	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	18
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	23
48-55	Storm	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	29
56-63	Violent 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	37
64-71	Hurricane	The air is filled with foam and spray. Sea completely white with driving spray; visibility very much reduced.	12	45

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 615-5. Enter two figures for the wind speed (knots) in column 9. Example: 9 knots entered as 09; 15 knots entered as 15.

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:

3310.1. 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.

3310.2. 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 and loose paper on deck.
17-21	Wind waves and snaps flag briskly.
22-27	Whistling in rigging.
28-33	Inconvenience felt walking against wind.
34-40	Walking becomes difficult.

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

3311.1. The true direction of the wind is usually on the same side as, but farther from the bow than the apparent direction.

3311.2. The true speed of the wind is greater than the apparent whenever the apparent direction is aft of the beam.

3311.3. 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 computation 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 ¶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° to 360°), 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°).

3322. Form 1209 is used as follows:

3322.1. Select the radial line coresponding 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.

3322.2. Place the 0 (arrow point) of the ship's speed slide at the point plotted in ¶3322.1 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.

3322.3. Read the wind speed corresponding to the point plotted in ¶3322.2, estimating for the values between the concentric circles. This value is the true wind speed.

3322.4. 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 ¶3322.2. Add the value of the angle to the ship's heading in degrees to obtain the true wind direction. If the total exceeds 360°, subtract 360° from it.

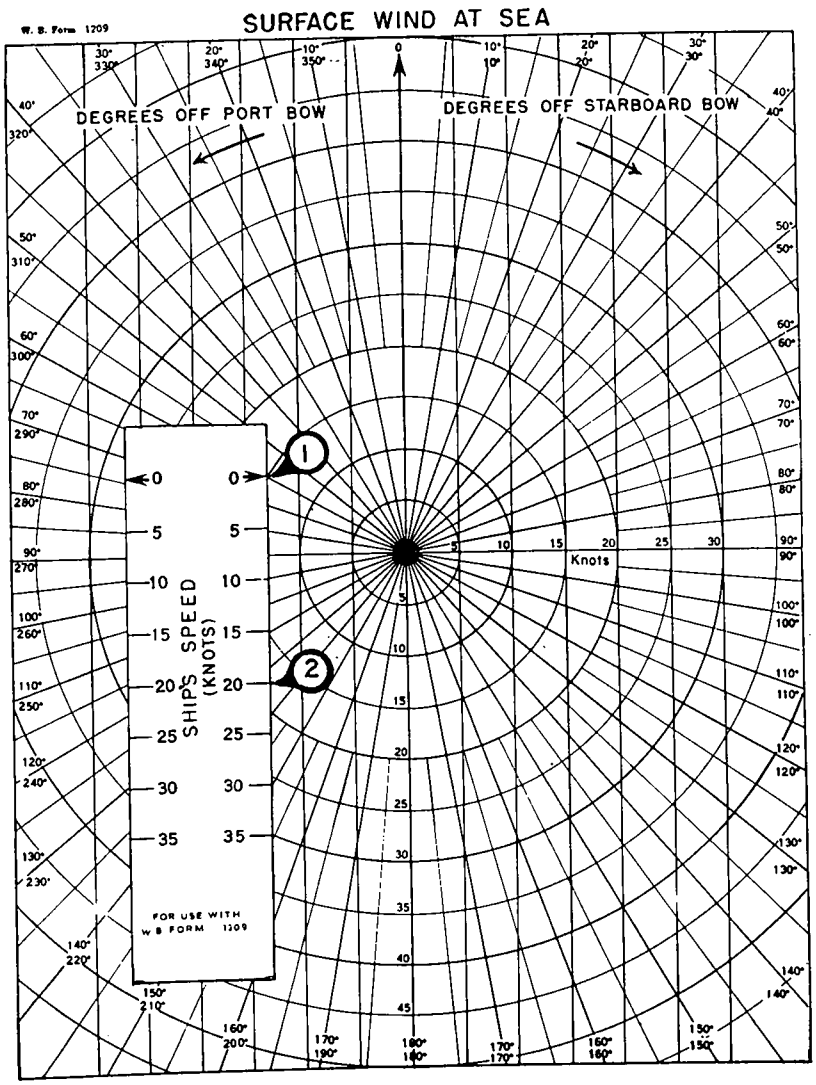

Figure 2.--Determination of true wind from the apparent wind, using Form 1209 and the associated ship's-speed scale. Given an apparent wind of 15 knots, 60° off the port bow, ship's speed 20 knots and heading 160°. Note the use of the scale in locating point 2, which is always below point 1 (the apparent 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°.

3330. PLOTTING BOARD METHOD FOR COMPUTING TRUE WIND AT SEA. Ships that are not equipped with wind transmitting and indicating instruments should estimate the apparent wind direction and wind speed in accordance with instructions contained in ¶3310.1. True wind may be computed with the aid of a plotting board. Anemometer equipped vessels should obtain apparent wind direction and speed from wind indicators. The true wind may be determined from the apparent wind relative to the ship's bow, and from the course and speed of the ship.

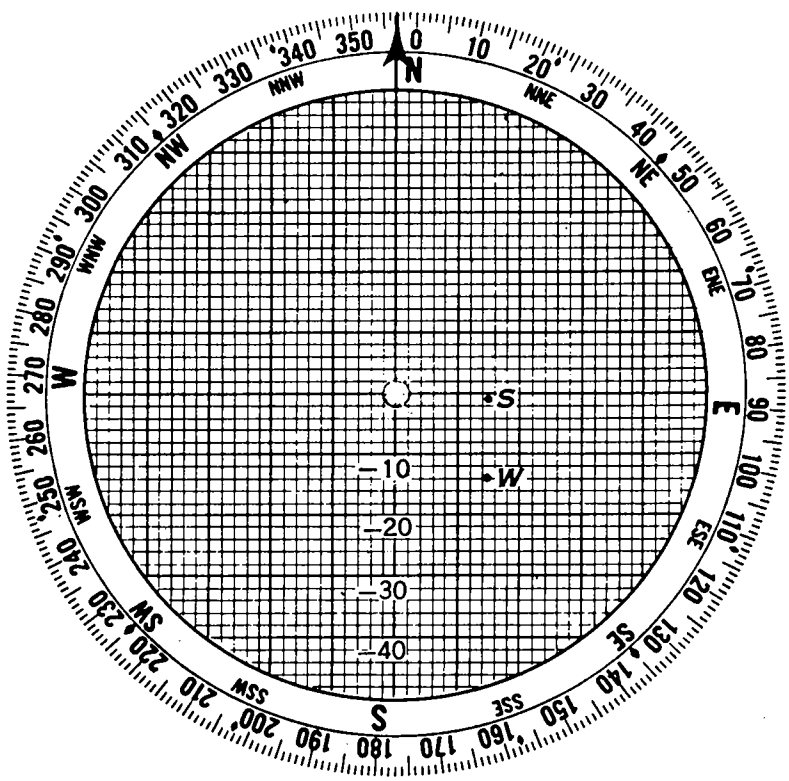

Figure 3. -- Shipboard Wind Plotter

3331. The apparent wind is a resultant of the true wind direction and speed or movement of the ship. The apparent wind relative to the bow of the ship is converted to a true compass bearing by adding the apparent wind direction to the ship's heading if the wind is off the starboard bow and subtracting the apparent wind direction if the wind is off the port bow;

EXAMPLE:

3331.1. APPARENT WIND IS OFF STARBOARD BOW

(a)	Ship's heading	270° true
(b)	Apparent wind (relative to ship's bow)	040°
(c)	True bearing . . .	310°

3331.2. APPARENT WIND IS OFF THE PORT BOW

(a)	Ship's heading	270° true
(b)	Apparent wind (relative to ship's bow)	-040°
(c)	True bearing . . .	230°

3332. The procedure for computing true wind direction and speed with the aid of a plotting board follows: From the center of the board or from the pin, a scale is ruled off equal-distant on top and bottom of the scale, from 0 to 50. Should the apparent windexceed 50 knots, the scale may be doubled and the computing procedure carried on as described. At the top of the board is a red arrow. In this discussion when referring to the top of the board, it will be with reference to this arrow. An example of how the method is used is outlined below:

(a)	Ship's course and speed	270° - 15 knots
(b)	Apparent wind (wind relative to ship's bow)	040° - 20 knots
(c)	Apparent wind converted to a true bearing	310°

3332.1. Set 270 degrees at the index on top of the plotting board; using any convenient linear scale, measure vertically downward from the center peg of the plotting board a distance equivalent to 15 knots. Mark this spot "S" (for ship). Rotate the protractor disk of the plotting board until 310 degrees is at the index (red arrow) at the top of the plotting board. Using the same linear scale as for ship's speed, plot vertically downward from the center peg of the plotting board a distance equivalent to 20 knots. Mark this point "W." Rotate the protractor disk until the "S" is vertically above the "W," using the vertical lines on the plotting board to line up the two points. Read the true wind direction at the TOP of the plotting board. The distance between points "S" and "W" is the true wind speed, using the same scale as in plotting the points "S" and "W." The true wind direction is 357 degrees and the speed is 13 knots.

3332.2. Anemometer equipped vessels may obtain a plotting board by request in accordance with ¶1301.

3400. WIND SHIFTS

3410. GENERAL. Wind shift is the manner in which the wind changes direction. It is generally considered an abrupt change in the wind direction of at least 90 degrees. Wind shifts are associated with the phenomena characteristic of a cold-front passage that are listed below:

(a) 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).
(b) Rapid drop in dew point.
(c) Rapid drop in air temperature.
(d) Rise in pressure.
(e) In summer; lightning, thunder, heavy rain, and possible hail.
(f) 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 (a), (b), (c), and (d) of ¶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 (e) and (f) may be encountered in the frontal zone.

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

3413. Within about 15° north and south of the Equator, wind shifts of 50° or more may be associated with the Intertropical Convergence Zone (ITCZ). This zone is from 50 to 100 miles wide and is the dividing line or area of transition between the southeast trades of the Southern Hemisphere and the northeast trades of the Northern Hemisphere. Location of the ITCZ varies, but it is normally found in the summer hemisphere; i.e., north of the Equator in about April through September and south of the Equator the remainder of the year. The zone is an area in which tropical cyclones frequently form during the time it is meteorologically active and displaced well away from the Equator.

During periods of strong convergence, the ITCZ is characterized by a belt of cumulonimbus clouds and showers; occasionally, altostratus clouds will be present. At times of little or no convergence, cloudiness and precipitation may be entirely absent.

As a ship moves from north to south across the active ITCZ, wind direction will change from northeast to southeast, south or southwest.

Greater changes in wind direction and wind speed may be observed during the development of a tropical storm. In addition, increased showers and squalls may occur. Pressure falls greater than the usual diurnal fall, or failure of the pressure to rise at the time of the diurnal rise may be encountered.

Predominantly easterly winds are found in the vicinity of the ITCZ when the area of transition is within 3 degrees of the Equator.

3420. ENTRY OF WIND SHIFTS ON FORM 615-5. Enter the time (GMT) 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.

3421. RADIO REPORTING OF WIND SHIFTS. Wind shifts that occur during the six (6) hours prior to the standard ship's weather observation should be reported. This information is to be added, in plain language, to the regular coded ship's weather observation. EXAMPLE: SHIPS 40493 06612 62614 97216 06448 45420 56308 00347 12664 WIND SHIFTED SW TO NW AT 0835Z.

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. This is called the prevailing visibility.

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. Visibility may also be estimated by determining the distance of a passing vessel by means of radar. 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.

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	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

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 coded on Form 615-5. 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, and code figure 97 would be used.

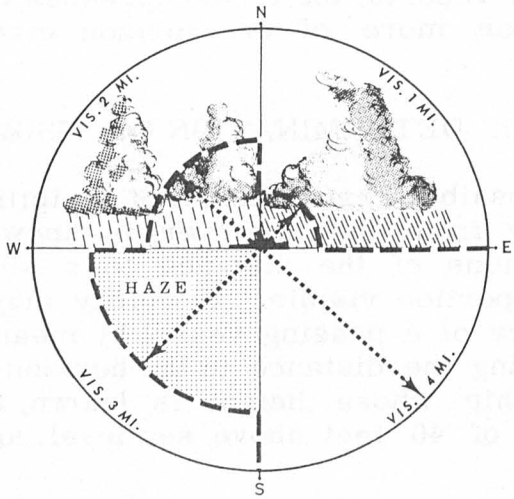

Figure 4. --Non-uniform visibility

4104. Figure 4 illustrates non-uniform visibility when may be the result of squalls in one quadrant of the horizon circle, light showers and haze in another and haze only in the third quadrant. Since the maximum visibility common to one-half of the circle is 3 miles, it would be reported as 2 miles (code figure 96).

4200. CODING AND ENTRY OF VISIBILITY DATA (VV) ON FORM 615-5

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[1]
90	Less than 50 yards (50 meters).
91	50 yards (50 meters).
92	200 yards (200 meters).
93	1/4 nautical mile (500 meters).
94	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.

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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 cloud code charts are illustrated in the back of WB Form 615-5.

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 10°C. 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. Ice Pellets: Precipitation of transparent or translucent pellets of ice, which are spherical or irregular, rarely conical, and have a diameter of 0.2 in. or less. They are of two types: type (a) comprises frozen raindrops or largely melted and refrozen snowflakes (synonymous with "Sleet" in the U. S.) and are reported by using "ww" table figures 23 or 79, as the case may be. Type (b) consists of pellets of snow encased in a thin layer of ice and are reported by using code figures 87 or 88, as appropriate.

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 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. 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.

5343.4. Snow Pellets (Soft Hail). White, opaque, round, or occasionally conical kernels of snow-like consistency, 1/16 to 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.

5343.5. 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.

5343.6. Ice Prisms. Small, unbranched ice needles or prisms in the form of rods or plates that have a descending motion and that may be observed when the sky is clear. Ice prisms are associated with halo phenomena and with temperatures near or below -17.8°C (0°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 about 2.2°C (4°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 0°C (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 615-5, 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 includes one or more of the weather elements discussed in the first portion of this chapter.

5720. CODING. Select the number from Code Table 6 (listed at the back of this manual, or from WB Form 615-5) 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.[1] When precipitation is occurring at the time of the observation, the selection should be made from figures 50 to 99, inclusive.

5730. ENTRY OF PRESENT WEATHER DATA ON FORM 615-5. The code number selected as best representing the present weather (ww) should be entered in column 11 of Form 615-5. 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 the character of the fog as "slight," "heavy," "shallow," or "ice fog," and the time (GCT) of beginning and ending in the column headed "Remarks" of WB Form 615-5.

5732. Enter the time (GCT) 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 GCT 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 GCT (see ¶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 615-5. Select the code figure from Code Table 7 listed on page 44 of this manual, or from Table 7 on cover of Ship's Weather Observations, 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

[1] When not accompanied by precipitation.

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 GCT 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[1]

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

Code Figure	Past Weather
0	Cloud covering 1/2 or less of the sky throughout period.
1	Cloud covering more than 1/2 of the sky during part of period, and less than 1/2 during part of period.
2	Cloud covering more than 1/2 of sky throughout period.
3	Sandstorm, duststorm, or drifting or blowing snow.
4	Fog, or ice fog, or thick haze.
5	Drizzle.
6	Rain.
7	Snow, rain and snow mixed, or ice pellets.[3]
8[2]	Shower(s).
9[2]	Thunderstorm(s), with or without precipitation.

[1]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.

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

[3]The term ice pellets means frozen raindrops or largely melted and re-frozen snowflakes and is synonymous with the U. S. term sleet.

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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 mounted in the chart room. 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 or electric lights. The barometer should be placed at about the eye level of the observer.

6020. BAROMETER CORRECTIONS. To insure comparability of pressure data, the Weather Bureau tests and assigns a number to each barometer. The correction applicable to the barometer is entered on a tag, WB Form 455-2. The correction tag should be posted in a convenient place near the barometer and the correction applied to each barometer reading. The amount of the correction should be entered opposite the caption "correction" at the head of column 13 of each Form 615-5. 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 ¶1400. When comparisons indicate that a barometer is defective, the Weather Bureau representative will recommend that it be replaced or repaired.

6021. When barometric comparisons cannot be made directly or by telephone, Form 455-1 "Request for Barometer Comparison" may be filled out in accordance with the instructions printed on it and mailed to the nearest Port Meteorological Office. Upon receipt of the request, a Weather Bureau representative will visit the ship during the ship's inport period and compare all ship's barometers. A barometer correction tag will be attached to each barometer corrected.

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 of mercury, millibars and

tenths, or millimeters (see Fig. 5). To insure that a precision aneroid barometer will retain its calibration, it must be protected from shocks or other violent motions.

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

6120.1. 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.

6120.2. Read to the nearest 0.01 inch, 0.1 millibar, or 1 millimeter, estimating for values between the scale graduations.

6120.3. Apply the correction established in accordance with ¶6020.

6120.4. Example:

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

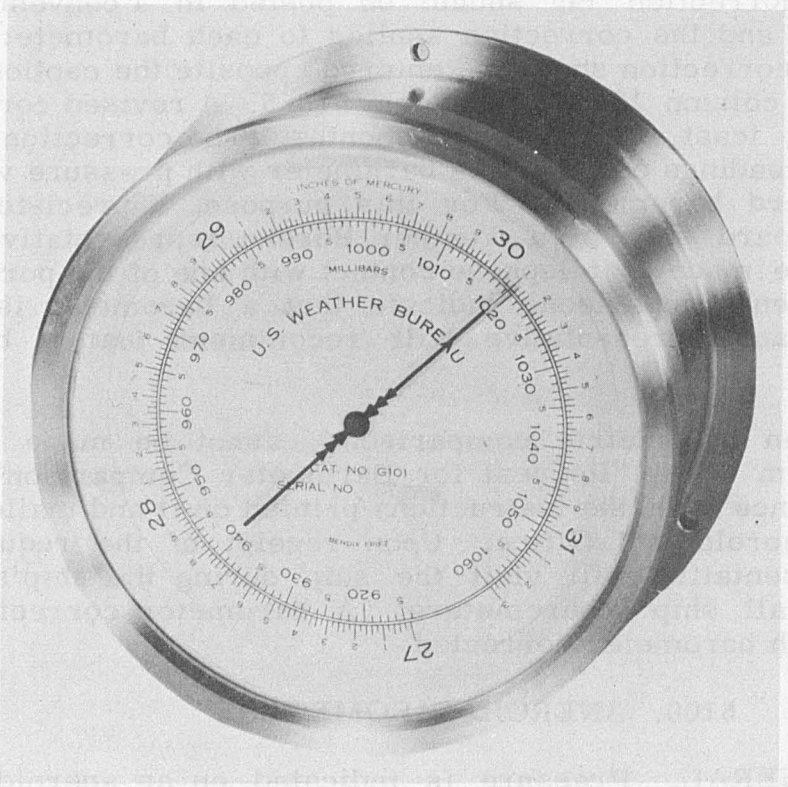


Figure 5.--Aneroid barometer, W. B. Model G-101

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.

6200. BAROGRAPHS

6210. GENERAL. The barograph is a continuous recorder of atmospheric pressure. A pen moves across the chart 2.5 inches of distance for each inch of mercury (1 inch equals 33.864 millibars of pressure). The barograph consists of an aneroid pressure unit, suitable linkage and a clock driven drum upon which the chart is fastened. A knurled knot at the top of the bellows housing provides a means of setting the pen to the proper pressure (see Figures 6 and 7).

6211. 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 read sea-level pressure each time the instrument chart is changed.

6212. For purposes of the weather observation, the atmospheric pressure, as entered on Form 615-5 will not be obtained from the barograph, but will be read from the barometer. The 3-hour pressure tendency, however, will be read from the barograph trace (see ¶6300).

6220. READING THE BAROGRAPH. The distance between horizontal pressure lines on the chart is equivalent to 1.0 millibar of pressure. For convenience of reading, each five millibar line is identified by bold type numerals. Barometric pressure will be read to the nearest 0.1 millibar of pressure. Three-hour pressure tendencies should be determined in accordance with the instructions contained in ¶6300.

6221. When 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 cell enough to move the pen approximately 30 millibars toward the center of the chart. Renumber the pressure lines accordingly. After the pressure has returned to normal, move the pen approximately 30 millibars in the opposite direction. Adjust the pen, making sure that it checks with the corrected sea-level pressure reading of the ship's aneroid barometer.

6230. BAROGRAPH CHARTS - FORM WB 455-12. The Weather Bureau will supply barograph charts upon request. All requests for charts should include the Weather Bureau form number. If charts do not have a Weather Bureau form number, the Weather Bureau should be consulted before the forms are ordered. Requests for forms should be made in accordance with ¶1301.

6230.1. The barograph chart should always be changed immediately following the 0000 GMT 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.

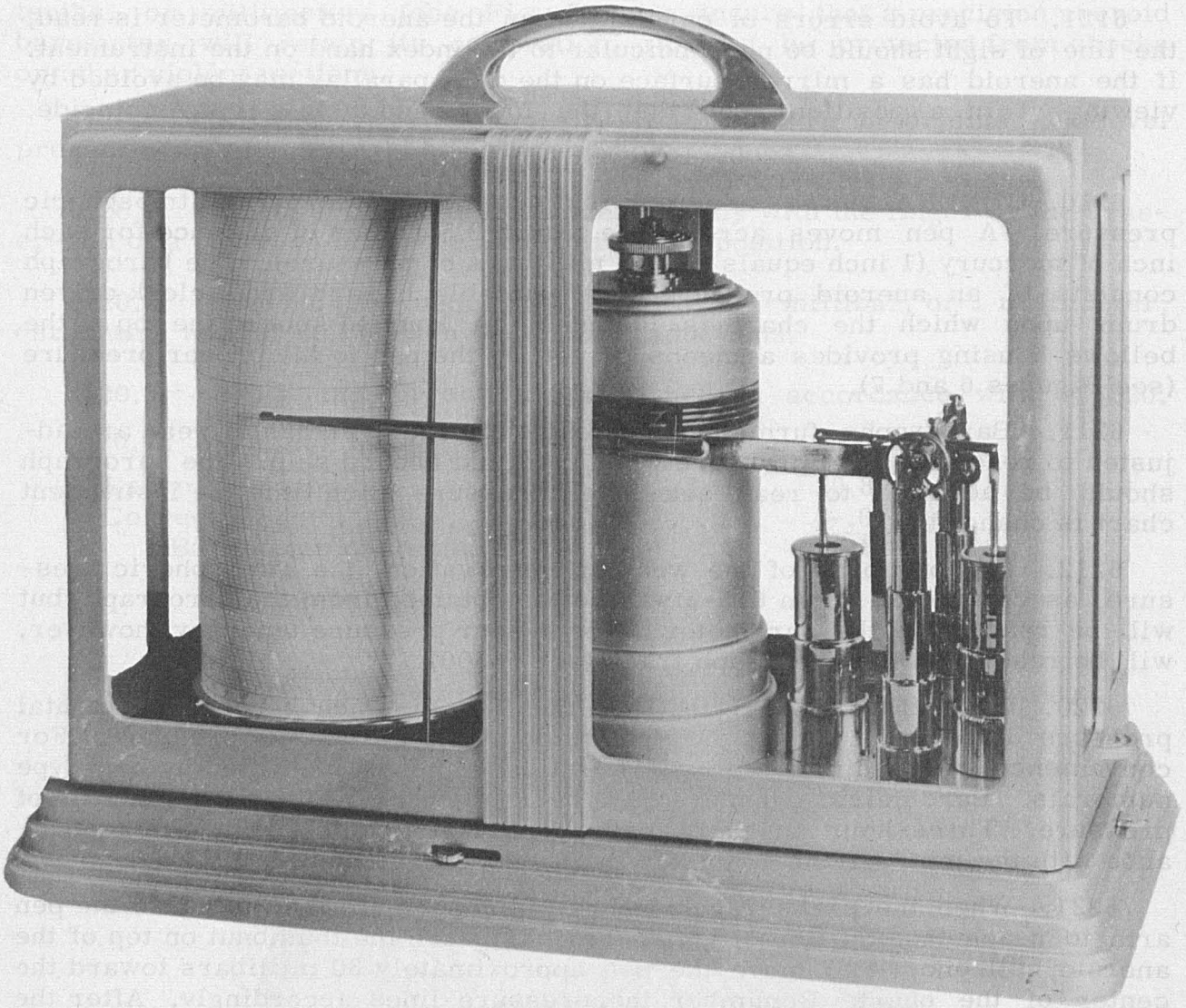


Figure 6.--Barograph, W. B. Marine Model G-220

6231. Entries on the Barograph Chart (see Fig. 7). Before placing a chart on the barograph, use a typewriter or pen and ink to enter the following data in the spaces provided.

6231.1. Name of ship.

6231.2. Departure port.

6231.3. Destination port.

6231.4. Date and time the chart is placed on the drum and the pen set.

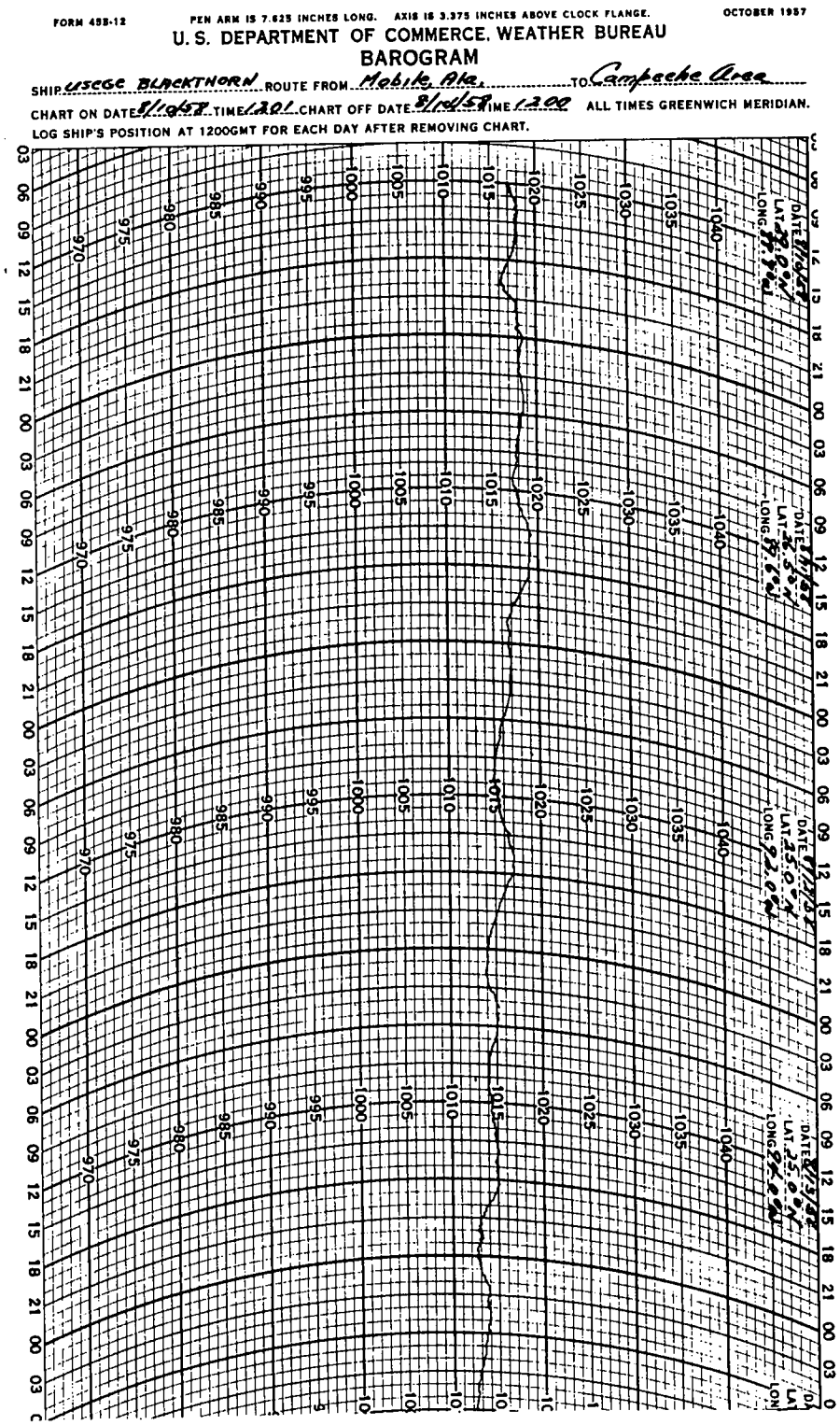


Figure 7. --Barograph chart with entries made in accordance with ¶6231. The 3-hour pressure tendencies for the period are entered on Form 615-5.

6232. INSTALLATION OF BAROGRAPH CHART. On most types of barographs the form is removed and the new one put on in the following manner:

6232.1. Remove the case cover. Barograph Model G-220 is unlatched at the base and the cover swung to the left allowing the case cover to rest on the same plane as the base. Barograph Model G-222 is provided with an airtight case. To remove the cover rotate the catch wings clockwise and swing the catches away from the case. Lift the case cover STRAIGHT UP carefully so that its flange will not catch the pen.

6232.2. Raise the pen from the form with the lever provided for that purpose and 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, barograph Model G-220 is provided with a small inspection hole in the top of the cylinder for this purpose. Clock adjustments to barographs Model G-222, when necessary, will be made by the Weather Bureau personnel.

6232.3. 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. When the chart is correctly placed, the ends of the horizontal coordinate lines will match.

6232.4. Place the clip bar over the end of the chart and smooth out the bulges. While holding the chart snugly in place, slide the metal retainer into the slot in the chart drum flange and into the recess in its upper rim.

6232.5. Fill the pen with No. 10 barograph ink. This is a slow drying ink which does not require a large pen reservoir. Take care to avoid getting ink on the exterior surfaces of the pen or spilling ink on parts of the instrument.

6232.6. Place the cylinder on the barograph and turn it clockwise until the pen has nearly reached the time line on the chart. Lower the pen on the chart. The clock is then set to time by turning the chart drum clockwise until the recording pen is brought to the proper time line on the chart.

6232.7. Replace the case cover. In the case of Barograph Model G-222 care should be taken not to touch the pen with the case flange. The case should be lowered STRAIGHT DOWN.

6233. CHART ENTRY. On each chart removed from the barograph:

6233.1. Enter the date and pen-up time in the spaces provided for "Chart-off and date and time."

6233.2. Enter across the top of the chart the date and position of each day's record in appropriate spaces on the 1200 (Noon) line.

6233.3. All time entries should be in Greenwich Meridian Time.

6233.4. When the pen has been reset (see ¶6221) to compensate for a large pressure change, indicate and check the points of change to be certain that the pen was reset to its normal position following return to normal pressure.

6234. Marine barograph, Weather Bureau Model G-222 is similar to Weather Bureau Model G-220, however, it differs somewhat in construction. Model G-222, due to its improved inherent balance is more adaptable for shipboard use. It is contained in an airtight case with two vent holes in the base, one a plug and the other a hose connection. These vents provide a convenient means of connecting the barograph to a static head exposed to outside air pressure when necessary.

6234.1. Static Charge on Marine Barograph. The window of the Model G-222 marine barograph is made of plastic and when cleaned with a dry cloth develops a static charge. If the air is dry the static charge does not dissipate and may become strong enough to pull the pen off the chart. Damage may result if the covering case is removed when the pen arm is held against the window by the static charge. Wiping the barograph case with a damp cloth will provide sufficient conductivity to bleed off the static charge, however, a more lasting effect can be gained by rubbing a few drops of liquid detergent, or a small amount of powdered graphite on the window.

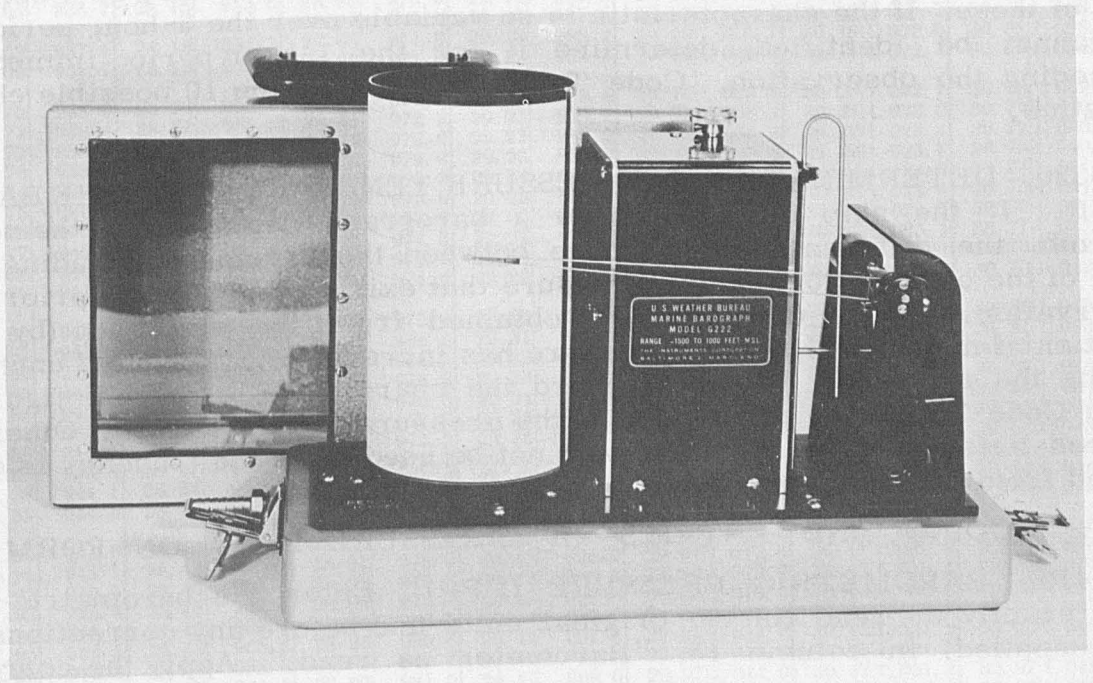


Figure 8. --Barograph, Marine, W. B. Model G-222

6300. THREE-HOUR PRESSURE TENDENCY

6310. GENERAL. The pressure tendency is composed of three elements:

6311. The net change in barometric pressure within the 3-hour period before an observation.

6312. Indication as to whether the barometric pressure is higher or lower at the end of the period than at the beginning of the period.

6313. 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:

6321. Find the net amount of pressure change over the 3-hour period by determining to the nearest 0.1 mb., the difference in pressure between the beginning and the end of the period. No barometer correction (see ¶6020) is to be applied to the value of the trace at these points.

6322. Observe whether the pressure is the same as, higher, or lower than it was at the beginning of the period.

6323. 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 PRESSURE TENDENCY FROM THE BAROMETER. If the ship does not have a barograph, determine to the nearest 0.1 mb. the difference in pressure between the barometric reading at the time of the observation and the pressure that existed three hours prior to the observation. These data may be obtained from the ship's log (by interpolation if necessary). 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. 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 615-5

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 column 13 and enter the corrected reading in columns 14-15, "Barometer corrected."

6411. The pressure is entered in column 15, "Barometer corrected (mb.)," in "tens," "units," and "tenths" of millibars, and the initial "9" or "10" in column 14. 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 29A (in the back of this manual). Example: A pressure of 981.7 millibars is entered in column 15 (PPP) as 817, and in column 14 as 9.

CODE TABLE 8

SYMBOL PPP.—*Corrected barometer reading*

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

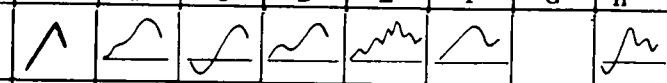
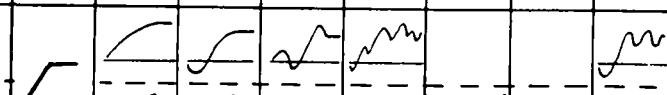
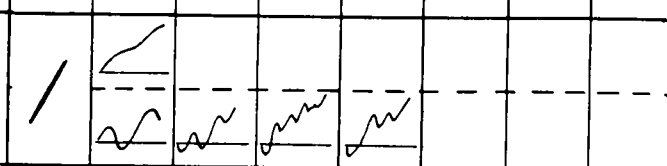
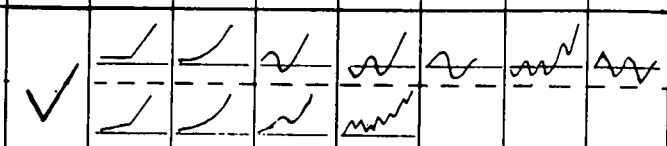
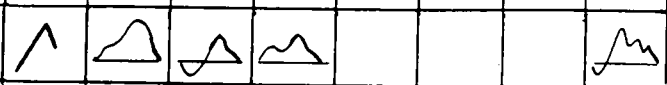
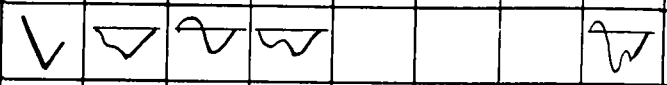
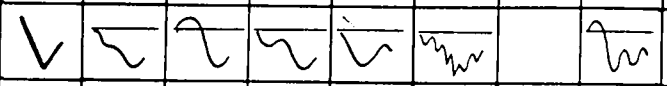
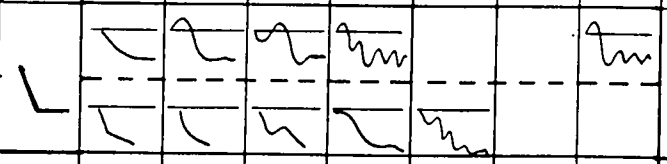
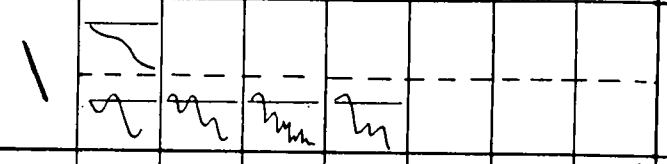
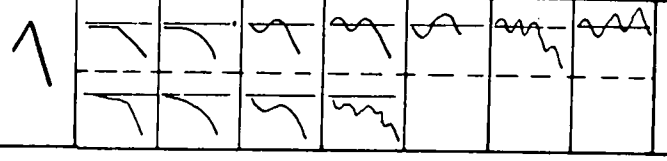
1 inch=33.86395 mb. 1 mb.=0.02952993 inch]

In.	Millibars	In.	Millibars	In.	Millibars	In.	Millibars	In.	Millibars	In.	Millibars	In.	Millibars
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

6420. CHARACTERISTIC (a). Code Table 15 will be used to select the appropriate code for the characteristic of the 3-hour pressure tendency. The code value should be entered in column 26 of Form 615-5. It should be noted that if the pressure is the same as three hours ago (that is, "pp" is coded 00), then "a" must be coded as 0, 4 or 5.

Code Table 15

Symbol a. --Barometer change characteristics in the last 3 hours

DESCRIPTION OF CHARACTERISTIC		NOMINAL GRAPHIC REPRESENTATION[3] (For Coding Purposes)								Code Figure
PRIMARY UNQUALIFIED REQUIREMENT	ADDITIONAL REQUIREMENTS	A	B	C	D	E	F	G	H	
HIGHER Atmospheric pressure now higher than 3 hours ago.	Increasing, then decreasing.									0
	Increasing, then steady; or increasing, then increasing more slowly.									1
	Increasing: Steadily / Unsteadily									2
	Decreasing or steady, then increasing; or increasing, then increasing more rapidly.									3
THE SAME Atmospheric pressure now same as 3 hours ago.	Increasing, then decreasing.									0
	Steady or unsteady									4
	Decreasing, then increasing.									5
LOWER Atmospheric pressure now lower than 3 hours ago.	Decreasing, then increasing.									5
	Decreasing, then steady; or decreasing, then decreasing more slowly.									6
	Decreasing: Steadily / Unsteadily									7
	Steady or increasing, then decreasing; or decreasing, then decreasing more rapidly.									8

6430. Determine the amount of pressure change (pp) in accordance with ¶6321, and use Code Table 16 to convert the value to millibars and tenths. Enter the amount, without the decimal point, in column 27. Example: A pressure change of 3.9 millibars would be entered in column 27 as 39.

6431. 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 "$D_s v_s$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 "$D_s v_s$app" group. For example: If the total amount of the pressure change is 13.4 millibars, the groups should be coded "$D_s v_s$a99 99134." If the amount is 9.9 millibars, the groups are coded "$D_s v_s$a99 99099." ("$D_s v_s$a" should be given appropriate values.)

Code Table 16

SYMBOLS "pp" and "ppp."--Amount of barometric change in the last 3 hours

Amount of rise or fall											
pp						ppp					
Code figure	Inches of mercury	Millibars	Code figure	Inches of mercury	Millibars	Code figure	Inches of mercury	Millibars	Code figure	Inches of mercury	Millibars
00	0. 000	0. 0				100	0. 295	10. 0			
02	. 005	. 2	52	0. 155	5. 2	102	. 300	10. 2			
03	. 010	. 3	54	. 160	5. 4						
05	. 015	. 5	56	. 165	5. 6	103	. 305	10. 3	154	0. 455	15. 4
07	. 020	. 7	58	. 170	5. 8	105	. 310	10. 5	156	. 460	15. 6
08	. 025	. 8	59	. 175	5. 9	107	. 315	10. 7	157	. 465	15. 7
						108	. 320	10. 8	159	. 470	15. 9
10	. 030	1. 0	61	. 180	6. 1	110	. 325	11. 0	161	. 475	16. 1
12	. 035	1. 2	63	. 185	6. 3						
14	. 040	1. 4	64	. 190	6. 4	112	. 330	11. 2	163	. 480	16. 3
15	. 045	1. 5	66	. 195	6. 6	113	. 335	11. 3	164	. 485	16. 4
17	. 050	1. 7	68	. 200	6. 8	115	. 340	11. 5	166	. 490	16. 6
						117	. 345	11. 7	168	. 495	16. 8
19	. 055	1. 9	69	. 205	6. 9	119	. 350	11. 9	169	. 500	16. 9
20	. 060	2. 0	71	. 210	7. 1						
22	. 065	2. 2	73	. 215	7. 3	120	. 355	12. 0	171	. 505	17. 1
24	. 070	2. 4	75	. 220	7. 5	122	. 360	12. 2	173	. 510	17. 3
25	. 075	2. 5	76	. 225	7. 6	124	. 365	12. 4	174	. 515	17. 4
						125	. 370	12. 5	176	. 520	17. 6
27	. 080	2. 7	78	. 230	7. 8	127	. 375	12. 7	178	. 525	17. 8
29	. 085	2. 9	80	. 235	8. 0						
30	. 090	3. 0	81	. 240	8. 1	129	. 380	12. 9	179	. 530	17. 9
32	. 095	3. 2	83	. 245	8. 3	130	. 385	13. 0	181	. 535	18. 1
34	. 100	3. 4	85	. 250	8. 5	132	. 390	13. 2	183	. 540	18. 3
						134	. 395	13. 4	185	. 545	18. 5
36	. 105	3. 6	86	. 255	8. 6	135	. 400	13. 5	186	. 550	18. 6
37	. 110	3. 7	88	. 260	8. 8						
39	. 115	3. 9	90	. 265	9. 0	137	. 405	13. 7	188	. 555	18. 8
41	. 120	4. 1	91	. 270	9. 1	139	. 410	13. 9	190	. 560	19. 0
42	. 125	4. 2	93	. 275	9. 3	141	. 415	14. 1	191	. 565	19. 1
						142	. 420	14. 2	193	. 570	19. 3
44	. 130	4. 4	95	. 280	9. 5	144	. 425	14. 4	195	. 575	19. 5
46	. 135	4. 6	97	. 285	9. 7						
47	. 140	4. 7	98	. 290	9. 8	146	. 430	14. 6	196	. 580	19. 6
49	. 145	4. 9		. 295	10. 0	147	. 435	14. 7	198	. 585	19. 8
51	. 150	5. 1	[1] 99	. 300	10. 2	149	. 440	14. 9	200	. 590	20. 0
				etc.	etc.	151	. 445	15. 1	201	. 595	20. 1
						152	. 450	15. 2	203	. 600	20. 3

[1] 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 "$D_vv_a$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 "$D_vv_a$app" group. For *example:* If the total amount of the pressure change is 12.4 millibars, the groups should be coded "D_vv_a99 99124." If the amount is 9.9 millibars, the groups are coded "D_vv_a99 99099." ("D_vv_a" should be given appropriate values.)

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.

7111. Free-air temperature. The temperature (or dry bulb measured by 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.

7112. 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.

7113. 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:

7121. Stand as far from the thermometer as is consistent with accurate reading, to prevent body heat from affecting the instrument.

7122. Insure that the line of sight from the eye to the top of the liquid column makes an angle of 90° with the thermometer tube. This will avoid an error of parallax.

7123. Read the thermometer to nearest 0.1°. 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 measurements.

7131. PSYCHROMETER (portable, aspirated, electric). The aspirated psychrometer was designed primarily for shipboard use. The instrument consists of a pair of matched wet and dry-bulb thermometers, a ventilating fan which is powered by three standard size "D" flashlight batteries. The illumination and the "on-off" switching system is operated by a knob on the side of the psychrometer case. Thermometers are shielded from external heat radiation by means of a removable plastic air intake shield. (See Fig. 10.)

7131.1. Care should be exercised when replacing the air intake thermometer shield. Slide the shield in place with the wide open nozzles pointing outward from the instrument. Ventilation will be limited if replaced in a reverse position.

7132. 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 and a reading of the wet-bulb temperature is made. 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.

7133. Sling Psychrometer. The sling psychrometer is readily adaptable 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. 9). 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 bulkhead).

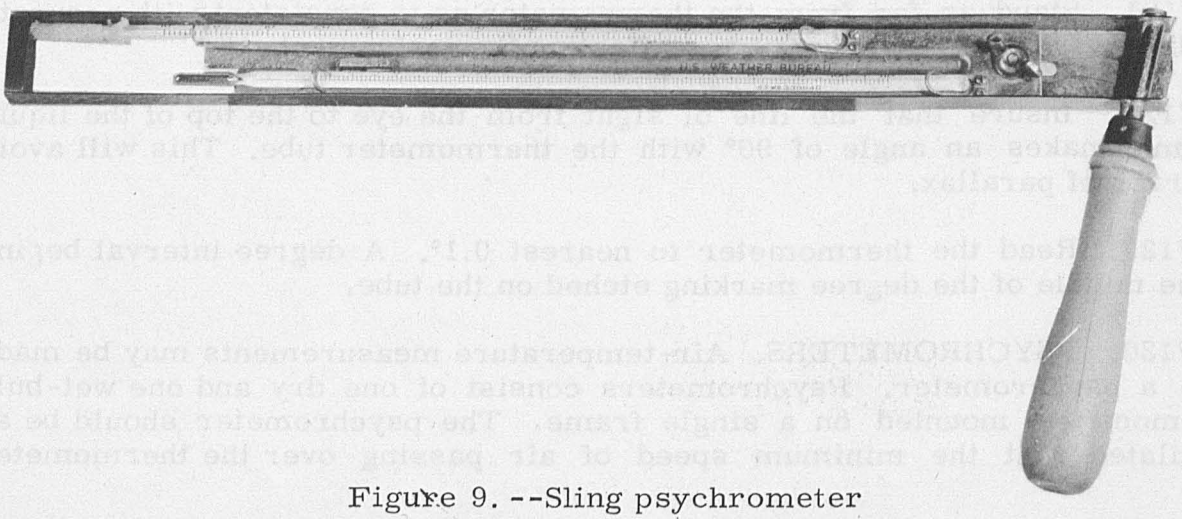

Figure 9. --Sling psychrometer

7133.1. Psychrometers should be used in accordance with the following instructions:

7133.11. The wet-bulb wicking should be thoroughly moistened, taking precaution to prevent the moisture from contacting the dry bulb.

7133.12. Select a shady spot on the windward side of the bridge which is free from spray and has no obstructions within a radius of the whirling sling.

7133.13. Face into the wind.

7133.14. Whirl the psychrometer as far in front of the body as conveniently possible.

7133.15. When the apparent wind is greater than nine knots, do not whirl the psychrometer. The psychrometer may be properly ventilated by holding the instrument in the direct wind stream and pointing the bulbs into the wind.

7133.16. Read the wet and dry thermometers while holding the instrument as far from the body as practicable.

7133.17. Repeat the ventilating until a minimum wet-bulb temperature has been reached.

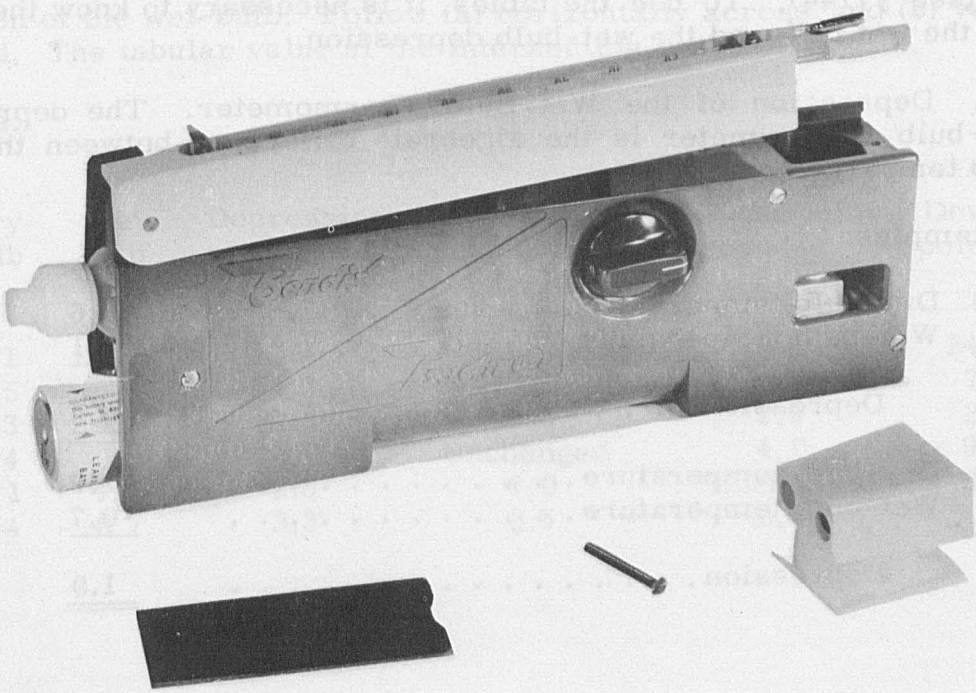

Figure 10. --Psychrometer (Portable, Aspirated, Electric).

7134. Psychrometric Readings. Readings from the dry and wet-bulb thermometers should be obtained in accordance with the following instructions.

7134.1. 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.

7134.2. When the wet-bulb temperature is below 0°C., moisten the wet-bulb thermometer with water having a temperature between 18° and 24°C. (65°-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 ¶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	1.2
	Wet-bulb temperature	-0.7
	Depression	1.9

(3)	Dry-bulb temperature	-3.4
	Wet-bulb temperature	-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. Rounded Wet-Bulb Temperature. After the depression of the wet bulb has been determined, the wet-bulb temperature will be rounded to the nearest 0.5°C., e.g., a temperature of 61.2° is rounded to 61.0°; 37.7° to 37.5°; 25.3° to 25.5°; -4.7° to -4.5°, etc. This rounded wet-bulb temperature will be used in determining the dew-point temperature from Table 25 (see ¶7144).

7143. Rounded Depression of the Wet Bulb. If the actual depression of the wet bulb is between 0.0° and 2.0°, this value will be used to find the dew point in Table 25. When the depression is above 2.0°, the value will be rounded to the next .2° by adding .1° and then used with Table 25; e.g., a depression of 1.5° is used directly, a depression of 6.5° is rounded to 6.6°, etc.

7144. Psychrometric Tables. Table 25, "Temperature of the Dew Point in Degrees Celsius" 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
27.1	25.0	2.1	Unchanged	2.2	24
14.5	10.3	4.2	10.5	Unchanged	7
7.3	4.8	2.5	5.0	2.6	2
3.4	- 0.5	3.9	Unchanged	4.0	- 9
- 2.1	- 4.1	2.0	- 4.0	Unchanged	- 9
- 5.4	- 8.7	3.3	- 8.5	3.4	-26

7200. SEA-WATER TEMPERATURE MEASUREMENTS

7210. GENERAL. The condenser (or comparable) intake thermometer will be read to the nearest 0.1°C. (0.2°F.) 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 615-5

7310. AIR TEMPERATURE. Enter the dry-bulb temperatures to degrees and tenths of column 17. Prefix a minus sign (-) when the temperature is below 0°C. Enter the dry-bulb temperature to the nearest whole degree (two digits) in column 16 (TT). If the dry-bulb temperature is exactly between two values, 10.5° for example, increase the values entered in column 16 to the next higher value (11 in this case).

7311. When the air temperature is below 0°C, the minus sign will be disregarded and 50 added to the temperature before entry in column 16. For example, -4.6°C would be entered in column 17 and 55 in column 16.

7312. When the air temperature is between +0.4°C and -0.4°C the actual value will be entered in column 17 and 00 entered in column 16.

7320. WET-BULB TEMPERATURE. The actual value of the wet-bulb temperature will be entered in column 18 to degrees and tenths. Prefix a minus sign (-) when the temperature is below 0°C.

7330. DEW-POINT TEMPERATURE. The value of the dew-point temperature in whole degrees as determined from Table 25 will be entered in columns 30 and 33. When the dew-point temperature is below 0°C a minus sign (-) will precede the actual value in column 30.

7331. When the dew-point temperature is below 0°C, the minus sign will be neglected and 50 added to the dew-point temperature value for entry in column 33.

7340. SEA-WATER TEMPERATURE. Enter the temperature of the sea water in degrees and tenths Celsius in column 28.

7350. AIR-SEA TEMPERATURE DIFFERENCE. The actual difference between the air temperature and the sea temperature will be entered in column 29 to the nearest tenth of a degree Celsius. For example, if the air temperature is 10.7°C and the sea temperature is 8.1°C, (10.7 - 8.1) or 2.6° will be entered in column 29. When the air temperature is less than the sea temperature a minus sign (-) will be entered before the actual value. If the air temperature is 5.5°C and the sea temperature is 6.2°C, (5.5 - 6.2) or -0.7 will be entered in column 29.

7351. The actual value of the air-sea temperature difference to the nearest tenth of a degree as entered in column 29 will be multiplied by 2 and rounded. This figure will represent the number of half degrees difference. If the air temperature is higher than the sea temperature, as in the example above, (2.6 degrees difference) the value 2.6 will be multiplied by 2 to equal 5.2; 05 will be entered in column 32. In the second case above (-0.7 degrees difference), -0.7 x 2 = -1.4 rounded = -1, 51 will be entered in column 32. That is, 50 added to the rounded value to indicate the sea temperature warmer than the air temperature. EXAMPLES:

when column 17 is	and column 28 is	the difference in column 29 is	number of half-degrees is	half-degrees rounded	column 32 should be
31.4	17.6	13.8	27.6	28	28
26.8	19.1	7.7	15.4	15	15
17.2	14.4	2.8	5.6	6	06
8.9	7.3	1.6	3.2	3	03
4.4	4.1	0.3	0.6	1	01
4.4	4.2	0.2	0.4	0	00
3.6	3.8	- 0.2	- 0.4	0	00
4.2	4.5	- 0.3	- 0.6	- 1	51
6.5	9.7	- 3.2	- 6.4	- 6	56
12.4	16.7	- 4.3	- 8.6	- 9	59
13.8	20.7	- 6.9	-13.8	-14	64
3.2	- 0.6	3.8	7.6	8	08
- 1.1	2.1	- 3.2	- 6.4	- 6	56
7.3	- 1.6	8.9	17.8	18	18

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CHAPTER VIII. CLOUDS

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CHAPTER VIII. CLOUDS

8000. GENERAL

8010. Code numbers for cloud forms and states of the sky are described in detail in International Cloud Atlas, 1956. Instructions in this chapter are confined to those necessary for observing clouds with respect to their amount and height of base. For easy reference by the observer, cloud pictures of the principal type clouds, their definitions and respective code numbers are included in **WB** Form 615-5.

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, that is 8/8.

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 2/8 of the total sky.

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

8122. Estimate the amount covered by clouds in each quadrant.

8123. 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 2/8 + 2/8 + 1/8 + 1/8 or 6/8.

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

8210. The height of the lowest cloud layer should be estimated after the type of cloud has been determined by use of the tables in this chapter and photographs in W. B. Form 615-5. Cloud definitions and photographs contained in the International Cloud Atlas and WB Form 615-5 are useful

guides 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.

8220. There is no reliable way to determine exact cloud height by estimation. However, when an observer is required to give his best estimate without the aid of cloud measuring devices, he may resort to one or more methods mentioned in ¶8201. For clouds caused by convection, such as cumulus, and stratocumulus during high winds, the temperature and dew point formula may be used to obtain an indication of the level where condensation takes place.

8230. The approximate cloud height formula is: Height of clouds = (temperature-dew point) x 396 feet. Air temperature and dew point are in degrees Celsius. For example, when the air temperature is 14.6°C and the dew point is 9.4°C, the difference of 5.2 multiplied by the constant gives the approximate height of the convective cloud base, e.g., 5.2 x 396 = 2,000 (to the nearest thousand feet).

8300. CODING AND ENTRIES OF CLOUD DATA ON FORM 615-5

8310. TOTAL CLOUD AMOUNT (N). Select the approximate 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 615-5. 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 blue sky are visible, N is entered as 7.

8311. A mackerel sky (Altocumulus or Stratocumulus translucidus) shall be reported using code figures not higher than 7, since breaks are always present in this cloud form even if it extends over the whole of the celestial dome.

8312. Symbol N shall be reported as 0 when blue sky or stars are seen through existing fog or other analogous phenomena without any trace of cloud being seen.

8313. When clouds are observed through fog or analogous phenomena, their amount shall be reported as if fog or other phenomena were not present.

8314. When condensation trails (caused by high flying aircraft) persist and/or cloud masses which have obviously developed from condensation trails and resemble C_M or C_H clouds are observed, they shall be included in the amount of clouds reported by Symbol N. Rapidly dissipating condensation trails shall not be included.

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 ¶8340 and 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."

8321. A mackerel sky (Altocumulus or Stratocumulus translucidus) shall be reported using code figures not higher than 7, since breaks are always present in this cloud form even if it extends over the whole of the celestial dome.

8322. Symbol N_h shall be reported as 0 when blue sky or stars are seen through existing fog or other analogous phenomena without any trace of cloud being seen.

8323. When clouds are observed through fog or analogous phenomena, their amount shall be reported as if fog or other phenomena were not present.

8324. When condensation trails (caused by high flying aircraft) persist and/or cloud masses which have obviously developed from condensation trails and resemble C_M clouds are observed, they shall be included in the amount of clouds reported by Symbol N_h. Rapidly dissipating condensation trails shall not be included.

8325. The coded value for N_h is entered on WB Form 615-5 in column 19.

CODE TABLE 3

SYMBOL N—*Fraction of the celestial dome covered by clouds*

SYMBOL 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	1 [1]
2	2
3	3
4	4
5	5
6	6
7	7 [2]
8	8
9	Sky obscured

NOTES

[1] "Fragments of clouds" are coded as 1.
[2] "Overcast but with openings" is coded as 7.

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 21. (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 ¶8340 and 8350.) Enter 9 when there are no C_L or C_M clouds present.

8331. When the ship is in fog, a sandstorm or duststorm or blowing snow but the sky is discernible through it, Symbol "h" shall refer to the base of the lowest cloud, if any is observed. When under the above conditions or owing to darkness, the sky is not discernible, "h" shall be reported as "/". (Also N_h = 9, C_L = /, C_M = /, C_H = /).

Code Table 10

Symbol h. --Height of base of lowest cloud (C_L or C_M) above sea

Code figure	Height in Feet	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	8,000 or higher or no clouds	2,500 or higher or no clouds.
/	Height cannot be reported owing to darkness or other reason not covered by ¶8330.	

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 are present in equal amounts, report the code figure for the type whose base is at the greatest height above the sea. Exceptions follow:

8340.1. Whenever types coded as 1 and 2 only are present, report code figure 2, regardless of amount.

8340.2. 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.

8341. The coded value for C_L is entered on WB Form 615-5 in column 20.

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, or Cumulus fractus other than of bad weather, or both.	Cumulus with little vertical extent and seemingly flattened, or ragged Cumulus other than of bad weather, 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 extent 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 (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 Stratocumulus cumulogenitus.	Stratocumulus not resulting from the spreading out of Cumulus.
6	Stratus nebulosus or 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 no Stratus fractus of bad weather.
7	Stratus fractus or Cumulus fractus of bad weather or both (pannus) usually below Altostratus or Nimbostratus.	Stratus fractus of bad weather or Cumulus fractus of bad weather or both (pannus) usually below Altostratus or Nimbostratus.
8	Cumulus and Stratocumulus, other than Stratocumulus 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 Cumulonimbus calvus, 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 Cumulonimbus without anvil or fibrous upper part, by Cumulus, Stratocumulus, Stratus, or pannus.
/	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 similar phenomena.

NOTE: "Bad Weather" denotes the conditions which generally exist during precipitation and a short time before and after.

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 are present in equal amounts, report the code figure for the type whose base is at the greatest height above the sea. Exceptions follow:

8350.1. Whenever Ac (Altocumulus) are present in a chaotic sky (see International Cloud Atlas), regardless of amount, report code figure 9.

8350.2. Whenever the sky is not chaotic but tufted or turreted altocumulus (see International Cloud Atlas) are present, report code figure 8.

8350.3. Cloud observations made when the sky is visible through fog or other analogous phenomena shall be made as if these phenomena were not present.

8350.4. When condensation trails (caused by high flying aircraft) persist and/or cloud masses which have obviously developed from condensation trails and resemble C_M clouds are observed, they shall be reported as C_M clouds when they resemble such clouds. In either case, the word "COTRA" shall be added to the end of the message. Rapidly dissipating condensation trails shall not be reported.

8351. The coded value for C_M is entered on WB Form 615-5 in column 22.

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 at a single level.	Altocumulus, the greater part of which is semitransparent; the various elements of the cloud change only slowly and are all at a single level.
4	Patches of Altocumulus translucidus (often lenticular), continuously changing and occurring at one or more levels.	Patches (often in the form of almonds or fishes) of Altocumulus, the greater part of which is semitransparent; the clouds occur at one or more levels and the elements are continually changing in appearance.
5	Altocumulus translucidus in bands, or one or more layers of Altocumulus translucidus or opacus progressively invading the sky; these Altocumulus clouds generally thicken as a whole.	Semitransparent Altocumulus in bands or Altocumulus in one or more fairly continuous layers (semitransparent or opaque) progressively invading the sky; these Altocumulus clouds generally thicken as a whole.
6	Altocumulus cumulogenitus (or cumulonimbogenitus).	Altocumulus resulting from the spreading out of Cumulus (or Cumulonimbus).
7	Altocumulus translucidus or opacus in 2 or more layers, or Altocumulus opacus in a single layer, not progressively invading the sky, or Altocumulus with Altostratus or Nimbostratus.	Altocumulus in two or more layers usually opaque in places and not progressively invading the sky; or opaque layer of Altocumulus not progressively invading the sky; or Altocumulus together with Altostratus or Nimbostratus.
8	Altocumulus castellanus or floccus.	Altocumulus with sproutings in the form of small towers or battlements, or Altocumulus having the appearance of cumuliform tufts.
9	Altocumulus of a chaotic sky, generally at several levels.	Altocumulus of a chaotic sky generally at several levels.
/	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 similar phenomena, or more often 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 are present in equal amounts, report the code figure for the type whose base is at the greatest height above the sea.

8361. Cloud observations made when the sky is visible through fog or other analogous phenomena shall be made as if these phenomena were not present.

8362. When condensation trails (caused by high flying aircraft) persist and/or cloud masses which have obviously developed from condensation trails and resemble C_H clouds are observed, they shall be reported as C_M clouds when they resemble such clouds. In either case, the word "COTRA" shall be added to the end of the message. Rapidly dissipating condensation trails shall not be reported.

8363. Code figure 9 shall be used only when the predominant C_H clouds are Cirrocumulus even though small amounts of Cirrocumulus may be present in C_H cloud systems reported by code figures 1 to 8.

8364. The coded value for C_H is entered on WB Form 615-5 in column 23.

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.
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 castellanus 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 small turrets or battlements or Cirrus having the appearance of cumuliform tufts.
3	Cirrus spissatus cumulonimbogenitus.	Dense Cirrus often in the form of an anvil, being the remains of the upper parts of Cumulonimbus.
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 1 point or 2 opposite points of the horizon and Cirrostratus, or Cirrostratus alone; 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 extends more than 45° above the horizon, without the sky being totally covered.	Cirrus, often in bands converging towards 1 point or 2 opposite points of the horizon, and Cirrostratus, or Cirrostratus alone; in either case they are progressively invading the sky, and generally growing denser as a whole; the continuous veil extends more than 45° above the horizon, without the sky being completely covered.
7	Cirrostratus covering the whole sky.	Veil of Cirrostratus covering the celestial dome.
8	Cirrostratus not progressively invading the sky, and not entirely covering it.	Cirrostratus not progressively invading the sky, and not completely covering the celestial dome.
9	Cirrocumulus alone, or Cirrocumulus predominant among the cirriform clouds.	Cirrocumulus alone, or Cirrocumulus accompanied by Cirrus or Cirrostratus or both, but Cirrocumulus is predominant.
/	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 similar phenomena, or more often because of the presence of a continuous layer of lower clouds.

8370. CLOUD GROUP $N_hC_LhC_MC_H$. Instructions for the coding of the individual symbols of this group are contained in ¶8320-8360. These are entered on WB Form 615-5 in columns 19-23.

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

Symbol	Description	Code figures	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° above the horizon.

Note: When no clouds are present, the group $N_hC_LhC_MC_H$ is coded as 00900.

CHAPTER IX. WAVES

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CHAPTER IV. WAVES

9000. GENERAL

9010. The wave group of the weather message, as entered on Form 615-5, consists of the direction of movement, period, and height of the waves on the surface of the sea. When more than one wave system is present (sea and swell), the direction, period, and height of the waves in each system will be observed and recorded as if they existed alone.

9020. The wave record section (columns 34-41) of W. B. Form 615-5 consists of two parts, one section for sea waves (or in the absence of sea waves for swell waves) and a second section for swell. When sea waves are observed, data should be entered in columns 35-37. If no sea is observed, these columns may be used for the entry of swell wave information. Swell data should be entered in columns 39-41. Data for a third wave train may be entered in "Remarks", column 42.

9021. Data from a second or third wave train should not be entered unless the direction of the waves differs by 30 degrees or more from the direction of the first or primary wave train.

9030. 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. 11). To obtain uniform waves data from all ships, observers will record only the larger, well-formed waves, and omit entirely the low and poorly formed waves.

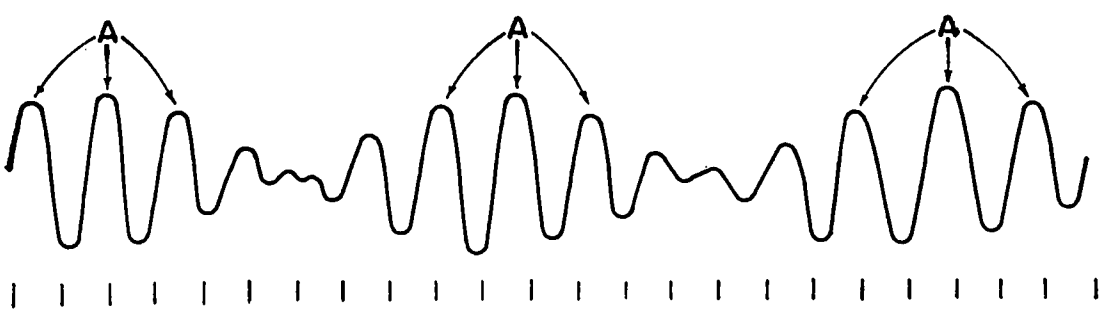

Figure 11. -- Section of a trace from an automatic wave recorder illustrating the up-and-down movement of a small object floating on the surface of the sea. In accordance with ¶9020, the height and period of only the well-defined waves (A) of each group will be determined.

9040. Distinction between SEA and SWELL.

9041. The system of waves raised by the local wind blowing at the time of observation is usually referred to as "SEA."

9042. Those waves not raised by the local wind blowing at the time of observation, but due either to winds blowing at a distance or to winds that have ceased to blow, are known collectively as "SWELL."

9043. Usually one swell train dominates the rest, but occasionally two swell trains crossing at an angle may be observed. These are referred to as "CROSS SWELLS."

9050. For additional wave observation techniques, see W.B. Training Paper No. 14, "Observing and Reporting Sea and Swell."

9100. WAVE DIRECTION

9110. 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°), and is recorded to the nearest ten degrees in tens of degrees; e.g., 237° is recorded as 24.

9120. 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°. Ship's heading can also be used as a guide to determine the direction from which the waves are approaching. The higher the observation point, the easier it is to determine wave direction. The average of several observations should be used as the reported wave direction.

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. 11). The interval can be timed with a stop watch or an ordinary watch with a second hand.

9220. OBSERVATION. Determine the period as follows:

9221. 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.

9222. 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.

9223. 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. 12). The wave height, as recorded on Form 615-5, is the average of the estimated heights of the larger, well-formed waves (see ¶9002).

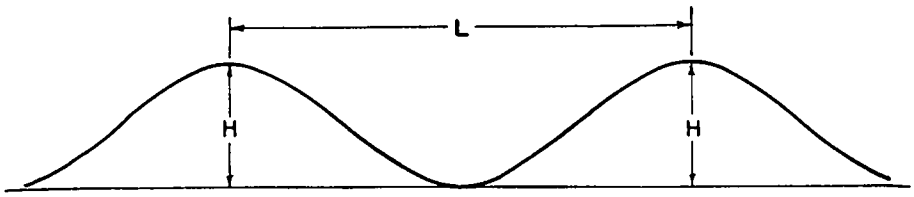

Figure 12. --Wave length and height.

(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 a low point on the ship, if 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 in the following manner:

9321.1. The height of the waves from trough to crest may be estimated against the side of another ship when in company.

9321.2. Look over the side and compare the height of waves with known points on the side of the ship.

9322. When the wave length is greater than the length of the ship, an observation may be made as follows:

9322.1. When in a trough of a wave and the ship is on even keel, the observer may move up and down (if possible) on the ship's structure until wave crests appear momentarily on a horizontal plane with the height of the eye. The wave height is then equal to the height of the observer's eyes above the water line.

9322.2. When in company with another ship and the observer's ship is on even keel, determine the amount of the observed ship that is obscured when it is in a trough. The height of the waves may be estimated by judging the size of the ship and the height of her bridge above the water line.

9323. When both sea and swell or two systems of swell are present at the same time, observations will be more difficult. Estimate the higher system of waves first, then repeat the process for the lower system.

9400. ENTRIES AND CODING OF WAVE DATA ON WB FORM 615-5

9410. GENERAL. Two sections are provided for the entry of wave data on Form 615-5, one section for sea waves and another for swell waves. The first section may be used for the entry of swell data provided no sea waves are observed.

9411. When more than one wave system can be distinguished at observation time, the sea wave data will be entered in columns 35-37 and the swell wave information in columns 39-41. Enter additional wave information, if any, under column 42, "Remarks" (see ¶1253.1).

9420. WAVE DIRECTION (d_w d_w). Select the code figure from Code Table 4 corresponding to the direction from which the sea waves are coming and enter the value in column 35 of Form 615-5. Similarly, the direction of the swell waves will be entered in column 39.

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

9421. If the wave height for either sea or swell is above 15 feet, 50 will be added to the coded wave direction, e.g., the direction of the sea waves coming from 320° with a height of 20 feet would be entered in column 35 as 82 (32 + 50).

9430. WAVE PERIOD (P_W). Enter the period of the sea waves in accordance with the code figures in Table 17. Column 36 of Form 615-5 will be used for this value; coded swell wave period will be entered in column 40.

Code Table 17

SYMBOL P_W. --Period of waves

Code figure	Period
2	5 seconds or less.
3	6 or 7 seconds.
4	8 or 9 seconds.
5	10 or 11 seconds.
6	12 or 13 seconds.
7	14 or 15 seconds.
8	16 or 17 seconds.
9	18 or 19 seconds.
0	20 or 21 seconds.
1	Over 21 seconds.
/	Calm, or period indeterminate.

9440. WAVE HEIGHT (H_W). Enter the height of the sea waves from Code Table 18 in column 37 of Form 615-5; column 41 should be used for entry of coded swell wave height.

Code Table 18

SYMBOL H_W. --Height of waves

Code figure	Height
0	Less than 1 foot (1/4 meter).
1	1-1/2 feet (1/2 meter).
2	3 feet (1 meter).
3	5 feet (1-1/2 meters).
4	6-1/2 feet (2 meters).
5	8 feet (2-1/2 meters).
6	9-1/2 feet (3 meters).
7	11 feet (3-1/2 meters).
8	13 feet (4 meters).
9	14 feet (4-1/2 meters).
/	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	17-1/2 feet (5-1/2 meters).
2	19 feet (6 meters).
3	21 feet (6-1/2 meters).
4	22-1/2 feet (7 meters).
5	24 feet (7-1/2 meters).
6	25-1/2 feet (8 meters).
7	27 feet (8-1/2 meters).
8	29 feet (9 meters).
9	30-1/2 feet (9-1/2 meters).
/	Height impossible to determine.

Notes. -- 1. Each code figure except "zero" covers a range of 1/2 meter; e.g., code figure 1 = 1/4 meter to 3/4 meter, code figure 2 = 3/4 meter to 1-1/4 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 (9-3/4 meters), the code figure 9 for 30-1/2 feet (9-1/2 meters) is reported, followed by the words "SEA WAVES" or "SWELL WAVES" and the actual height of the waves in feet or meters; e.g., "SEA WAVES" or "SWELL WAVES 37" depending on whether sea or swell waves are greater than 30-1/2 feet.

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 "$1 d_w d_w P_w H_w$," 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°).
6 Wave period of 12 to 13 seconds.
8 Wave height of 13 feet.

9451. When more than one wave system is observed, code each system separately:

Example: The coded wave groups "12939 and 12157" are decoded as follows:

(a) Sea waves group:

1 Group indicator.
29 The sea is from 290°.
3 Period of sea waves is 6 seconds.
9 Height of sea waves is 14 feet.

(b) Swell group:

1 Group indicator.
21 Swell direction is from 210°.
5 Period of swell is 10 seconds.
7 Height of swell is 12 feet.

9452. When no sea waves are present but swell waves are observed, sea waves will be encoded 100/0 and the swell wave group 12157, as follows:

(a) Calm Sea.

1 Group Indicator.
00 Calm or wind direction indeterminate.
/ Period of waves calm or indeterminate.
0 Height of waves, less than 1 foot.

(b) Swell Waves.

1 Group Indicator.
21 Swell direction is from 210°.
5 Period of swell is 10 seconds.
7 Height of swell is 12 feet.

CHAPTER X. ICE

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CHAPTER X. ICE

10000. GENERAL

10010. International Safety of Life at Sea Convention rules require vessels to furnish reports of ice accretion on ship's superstructure. When observed, the data should be added to the radio messages.

10100. ICE ACCRETION

10111. GENERAL. Ice accretion on the ship's superstructure is coded and entered on Form 615-5 in "Remarks."

10120. Group designator. The figure 2 indicates the ice accretion group and is used as the group indicator.

10130. Ice Accretion on Ship (I_s). Select the code figure from Table 19a indicating the source of the ice forming on the superstructure.

10140. Thickness (E_sE_s). Thickness of ice on the superstructure in centimeters. Figure 00 means less than 1 cm. or .4 in.; 01 equals 1 cm. or .4 in., 02 equals 2 cm. or .8 in., 03 equals 3 cm. or 1.2 in., ...10 equals 10 cm. or 4 inches, etc.

10150. Rate of Ice Accretion on Ship (R_s). The code figures in Table 19b represent the rate of freezing or thawing of the ice on the superstructure.

10160. A typical ice accretion group might be 22041. This would mean:

2 Ice Accretion group indicator
2 Icing from fog
04 Ice 4 cm. thick (about 1.6 inches)
1 Ice building up slowly

Symbol 2—Ice accretion group indicator

Code Table 19a

Symbol I_s.—Ice Accretion on Ship

Code Figures	Description
1	Icing from ocean spray.
2	Icing from fog.
3	Icing from spray and fog.
4	Icing from rain.
5	Icing from spray and rain.

Symbol E_sE_s.—Thickness of ice accretion on ships in centimeters, e.g., 00=less than 1 cm., or .4 in., 01=1 cm., or .4 in., 02=2 cm., or .8 in., 03=3 cm., or 1.2 in., . . . 10=10 cm., or 4 in., etc.

Code Table 19b

Symbol R_s.—Rate of Ice Accretion on Ships

Code Figures	Description
0	Ice not building up.
1	Ice building up slowly.
2	Ice building up rapidly.
3	Ice melting or breaking up slowly.
4	Ice melting or breaking up rapidly.

10200. SEA ICE

10200. GENERAL

10210. The presence of ice at sea, including icebergs, is recorded as part of the weather observation on Form 615-5 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.

10220. 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 Navy Oceanographic Office, Coast Guard, etc., will be submitted in addition to the weather report.

10300. ICE OBSERVATION

10310. 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.

10320. KIND OF ICE. Ice is observed in terms of the most important or prominent of the following conditions:

10321. 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.

10322. New-Ice. A general term which includes the following types:

10322.1. Ice-crystals (frazil-crystals) are fine spicules or plates of ice suspended in water.

10322.2. 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.

10322.3. 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.

10322.4. 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.

10323. Fast-Ice. Observe whether the amount is unusually great (heavy). Fast-ice is a 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.

10324. 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.

10325. 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).

10326. 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.

10327. Hummocked ice. Hummocked ice refers to ice piled haphazardly, one piece over another.

10328. Ice jamming. This term refers to the action of ice that is being squeezed or crowded together into a compact mass.

10329. 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.

10330. 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 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.

10400. CODING AND ENTRY OF ICE DATA ON FORM 615-5

10410. GENERAL. Ice observed at sea is coded and entered on Form 615-5 in "Remarks."

10420. KIND (c_2). Select the code figure from Code Table 19c that most nearly corresponds with the predominant kind of ice observed, and enter the figure in the "Remarks" column.

Code Table 19c

SYMBOL c_2. --Description of kind of ice.

Code figure	Description
0	No ice. ("0" will be used to report "Ice blink," and then a direction must be reported.)
1	New ice.
2	Fast ice.
3	Pack ice/drift ice.
4	Packed (compact) slush or sludge.
5	Shore lead.
6	Heavy fast ice.
7	Heavy pack ice/drift ice.
8	Hummocked ice.
9	Icebergs.

10430. EFFECT ON NAVIGATION (K). Select the code figure from Table 20 that most accurately describes the effect of the ice on navigation, and enter the figure in "Remarks" after c_2 (¶10420).

Code Table 20

SYMBOL K. --Effect of ice on navigation

Code figure	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).

10440. BEARING OF ICE-LIMIT (D_i). Select the code figure from Code Table 21 corresponding to the bearing of the nearest part of the ice, and enter the figure in "Remarks" after "K" (¶10430). 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_i--Bearing of ice-limit

Code figure	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.

10450. 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_i), and enter the figure in "Remarks" after "D_i" (¶10440).

Code Table 22

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

Code figure	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.

10460. 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_i and r), and enter the figure in "Remarks" after "r" (¶10450).

Code Table 23

SYMBOL e. --Orientation of ice-limit

Code figure	Orientation of ice-limit
0	Orientation of ice-limit impossible to estimate--ship outside 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 inside the ice.

10470. REPORTING ICEBERGS. When icebergs are observed, record their size and height above the sea in the column headed "Remarks."

10480. ICE GROUP. The symbols for the kind (c_2), effect (K), bearing (D_i), distance (r), and orientation (e) of the ice combine to form the ice group "ICEc_2K$D_i$re," where "ICE" is the group indicator.

Example: The coded 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.

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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—*Fraction of the celestial dome covered by clouds*

SYMBOL 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 figure	Cloud amount (eighths of sky covered)
0	None
1	[1] 1
2	2
3	3
4	4
5	5
6	6
7	[2] 7
8	8
9	Sky obscured [3]

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, or cloud amount cannot be estimated.

CODE TABLE 4

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

SYMBOL $d_w d_w$.—*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 $d_w d_w$			
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[1]
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

ww=00-49 NO PRECIPITATION AT THE STATION AT THE TIME OF OBSERVATION

00–19: No precipitation, fog, ice fog, duststorm, sandstorm, drifting or blowing snow at the station (or ship) at the time of observation, except for 09 and 17, or during the preceding hour.

Haze, dust, sand or smoke. See note 2.

- 00 Cloud development not observed
- 01 Clouds generally dissolving or becoming less developed
- 02 State of sky on the whole unchanged
- 03 Clouds generally forming or developing

} Characteristic change of the state of sky during the past hour.

- 04 Visibility reduced by smoke, e.g., from veldt 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 station (or ship) at the time of observation.
- 07 Dust or sand raised by wind at or near the station (or ship) at the time of observation, but no well developed dust whirl(s) or sand whirl(s) and no duststorm or sandstorm seen.
- 08 Well developed dust whirl(s) or sand whirl(s) seen at or near the station (or ship) within last hour, but no duststorm or sandstorm.
- 09 Duststorm or sandstorm within sight of station (or ship) or at station (or ship) at time of observation or during the last hour.

10 Light fog, visibility 1,000 meters (1,100 yards) or more.

11 Patches of ---
12 More or less continuous

} Shallow fog or ice fog at the station (or ship) not deeper than about 2 meters (6½ feet) on land or 10 meters (33 feet) at sea (visibility less than 1,000 meters (1,100 yards)).

13 Lightning visible, no thunder heard.
14 Precipitation within sight, but not reaching ground or surface of the sea.
15 Precipitation within sight, reaching ground or surface of the sea, but distant [i.e., estimated to be more than 5 kilometers (3 miles) from station (or ship)].
16 Precipitation within sight, reaching ground or surface of the sea, near to but not at the station (or ship).
17 Thunderstorm, but no precipitation at the time of observation.
18 Squall(s)
19 Funnel cloud(s)* (tornado or waterspout)

} within sight during the past hour.

20–29: Precipitation, fog or ICE fog or thunderstorm at the station (or ship) during the preceding hour but NOT at the time of observation.

20 Drizzle (not freezing) or snow grains
21 Rain (not freezing)
22 Snow
23 Rain and snow or ice pellets. (See fig. 79.)
24 Freezing drizzle or freezing rain

} not falling as showers.

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 or ice fog (visibility less than 1,000 meters (1,100 yards)).
29 Thunderstorm (with or without precipitation).

30–39: Duststorm, sandstorm or drifting OR BLOWING 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 begun or 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 begun or increased during the preceding hour.
36 Slight or moderate drifting snow
37 Heavy drifting snow

} Drifting snow 10 meters (33 ft.) or below at sea.

38 Slight or moderate blowing snow
39 Heavy blowing snow

} Blowing snow above 10 meters (33 ft.) at sea.

40–49: Fog or ice fog at the time of observation (visibility less than 1,000 meters (1,100 yards)).

40 Fog or ice fog at a distance at the time of observation, but not at the station (or ship) during the last hour, the fog extending to a level above that of the observer.

41 Fog or ice fog in patches.
42 Fog or ice fog, sky discernible } has become thinner during the preceding hour.
43 Fog or ice fog, sky not discernible }
44 Fog or ice fog, sky discernible } no appreciable change during the preceding hour.
45 Fog or ice fog, sky not discernible }
46 Fog or ice fog, sky discernible } has begun or has become thicker during the preceding hour.
47 Fog or ice fog, sky not discernible }
48 Fog, depositing rime, sky discernible.
49 Fog, depositing rime, sky not discernible.

50–59 PRECIPITATION AT THE STATION (OR SHIP) AT THE TIME OF OBSERVATION

50–59: DRIZZLE AT TIME OF OBSERVATION.
50 Drizzle, not freezing, intermittent } slight at time of observation.
51 Drizzle, not freezing, continuous }
52 Drizzle, not freezing, intermittent } moderate at time of observation.
53 Drizzle, not freezing, continuous }
54 Drizzle, not freezing, intermittent } heavy (dense) at time of observation.
55 Drizzle, not freezing, continuous }
56 Drizzle, freezing, slight.
57 Drizzle, freezing, moderate or heavy (dense).
58 Drizzle and rain, slight.
59 Drizzle and rain, moderate or heavy.

60–69: RAIN AT TIME OF OBSERVATION.
60 Rain, not freezing, intermittent } slight at time of observation.
61 Rain, not freezing, continuous }
62 Rain, not freezing, intermittent } moderate at time of observation.
63 Rain, not freezing, continuous }
64 Rain, not freezing, intermittent } 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 fall of snowflakes } slight at time of observation.
71 Continuous fall of snowflakes }
72 Intermittent fall of snowflakes } moderate at time of observation.
73 Continuous fall of snowflakes }
74 Intermittent fall of snowflakes } heavy at time of observation.
75 Continuous fall of snowflakes }
76 Ice prisms (with or without fog).
77 Snow grains (with or without fog).
78 Isolated starlike snow crystals (with or without fog).
79 Ice pellets (i.e., frozen raindrops or largely melted and refrozen snowflakes).

80–99: SHOWERY PRECIPITATION, OR PRECIPITATION WITH CURRENT OR RECENT THUNDERSTORM.
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 snow pellets or ice pellets* with or without rain or rain and snow mixed } slight.
88 Shower(s) of snow pellets or ice pellets* 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 } thunderstorm during the preceding hour but not at time of observation
92 Moderate or heavy rain at time of observation
93 Slight snow or rain and snow mixed or hail* at time of observation
94 Moderate or heavy snow, or rain and snow mixed or hail* at time of observation
95 Thunderstorm, slight or moderate, without hail* but with rain and/or snow at time of observation } thunderstorm at time of observation.
96 Thunderstorm, slight or moderate, with hail* at time of observation
97 Thunderstorm, heavy, without hail* but with rain and/or snow at time of observation
**98 Thunderstorm combined with duststorm or sandstorm—at time of observation
99 Thunderstorm, heavy, with hail* at time of observation

*Hail, ice pellets, i.e., pellets of snow encased in a thin layer of ice: snow pellets.
**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.

CODE TABLE 7

Symbol W—Past weather

Code figures	Description
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 through out period.
3	Sandstorm or duststorm or blowing snow.
4	Fog or ice fog or thick haze.
5	Drizzle.
6	Rain.
7	Snow or rain and snow mixed or ice pellets.
8	Shower(s).
9	Thunderstorm(s) 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.

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. If however more than one code figure may be given to W with regard to past weather, the higher code figure is reported.

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] [1]

in.	mb.	in.	mb.	in.	mb.	in.	mb.	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	885.1	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

[1] Based on standard gravity of 980.665 cm./sec.^{2}

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, or Cumulus fractus other than of bad weather, or both.	Cumulus with little vertical extent and seemingly flattened, or ragged Cumulus other than of bad weather, 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 extent 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 (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 Stratocumulus cumulogenitus.	Stratocumulus not resulting from the spreading out of Cumulus.
6	Stratus nebulosus or 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 no Stratus fractus of bad weather.
7	Stratus fractus or Cumulus fractus of bad weather or both (pannus) usually below Altostratus or Nimbostratus.	Stratus fractus of bad weather or Cumulus fractus of bad weather or both (pannus) usually below Altostratus or Nimbostratus.
8	Cumulus and Stratocumulus, other than Stratocumulus 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 Cumulonimbus calvus, 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 Cumulonimbus without anvil or fibrous upper part, by Cumulus, Stratocumulus, Stratus, or pannus.
/	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 similar phenomena.

NOTE: "Bad Weather" denotes the conditions which generally exist during precipitation and a short time before and after.

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 at a single level.	Altocumulus, the greater part of which is semitransparent; the various elements of the cloud change only slowly and are all at a single level.
4	Patches of Altocumulus translucidus (often lenticular), continuously changing and occurring at one or more levels.	Patches (often in the form of almonds or fishes) of Altocumulus, the greater part of which is semitransparent; the clouds occur at one or more levels and the elements are continually changing in appearance.
5	Altocumulus translucidus in bands, or one or more layers of Altocumulus translucidus or opacus progressively invading the sky; these Altocumulus clouds generally thicken as a whole.	Semitransparent Altocumulus in bands or Altocumulus in one or more fairly continuous layers (semitransparent or opaque) progressively invading the sky; these Altocumulus clouds generally thicken as a whole.
6	Altocumulus cumulogenitus (or cumulonimbogenitus).	Altocumulus resulting from the spreading out of Cumulus (or Cumulonimbus).
7	Altocumulus translucidus or opacus in 2 or more layers, or Altocumulus opacus in a single layer, not progressively invading the sky, or Altocumulus with Altostratus or Nimbostratus.	Altocumulus in two or more layers usually opaque in places and not progressively invading the sky; or opaque layer of Altocumulus not progressively invading the sky; or Altocumulus together with Altostratus or Nimbostratus.
8	Altocumulus castellanus or floccus.	Altocumulus with sproutings in the form of small towers or battlements, or Altocumulus having the appearance of cumuliform tufts.
9	Altocumulus of a chaotic sky, generally at several levels.	Altocumulus of a chaotic sky generally at several levels.
/	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 similar phenomena, or more often 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.
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 castellanus 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 small turrets or battlements or Cirrus having the appearance of cumuliform tufts.
3	Cirrus spissatus cumulonimbogenitus.	Dense Cirrus often in the form of an anvil, being the remains of the upper parts of Cumulonimbus.
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 1 point or 2 opposite points of the horizon and Cirrostratus, or Cirrostratus alone; 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 extends more than 45° above the horizon, without the sky being totally covered.	Cirrus, often in bands converging towards 1 point or 2 opposite points of the horizon, and Cirrostratus, or Cirrostratus alone; in either case they are progressively invading the sky, and generally growing denser as a whole; the continuous veil extends more than 45° above the horizon, without the sky being completely covered.
7	Cirrostratus covering the whole sky.	Veil of Cirrostratus covering the celestial dome.
8	Cirrostratus not progressively invading the sky, and not entirely covering it.	Cirrostratus not progressively invading the sky, and not completely covering the celestial dome.
9	Cirrocumulus alone, or Cirrocumulus predominant among the cirriform clouds.	Cirrocumulus alone, or Cirrocumulus accompanied by Cirrus or Cirrostratus or both, but Cirrocumulus is predominant.
	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 similar phenomena, or more often because of the presence of a continuous layer of lower clouds.

CODE TABLE 10

SYMBOL h.—*Height of base of lowest cloud (C_L or C_M) above sea* [1] [3]

Code figure	Height in feet	Approximate height in meters
0 [2]	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	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	8,000 or higher or no clouds.	2,500 or higher or no clouds.

NOTES

[1] 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.
[2] 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_h" 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.
[3] If the height of the cloud base cannot be reported owing to darkness or any reason not covered by Note 2 an X is reported for "h".

CODE TABLE 13

SYMBOL D_s.—*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_s.—*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.	Barometer now higher than 3 hours ago.
	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.	Barometer now lower than 3 hours ago.
	7	Falling, steadily or unsteadily.	
	8	Steady or rising, then falling; or falling, then falling more quickly.	

Code Table 16

SYMBOLS "pp" and "ppp."--Amount of barometric change in the last 3 hours

Amount of rise or fall											
pp						ppp					
Code figure	Inches of mercury	Millibars	Code figure	Inches of mercury	Millibars	Code figure	Inches of mercury	Millibars	Code figure	Inches of mercury	Millibars
00	0. 000	0. 0				100	0. 295	10. 0			
02	. 005	. 2	52	0. 155	5. 2	102	. 300	10. 2			
03	. 010	. 3	54	. 160	5. 4						
05	. 015	. 5	56	. 165	5. 6	103	. 305	10. 3	154	0. 455	15. 4
07	. 020	. 7	58	. 170	5. 8	105	. 310	10. 5	156	. 460	15. 6
08	. 025	. 8	59	. 175	5. 9	107	. 315	10. 7	157	. 465	15. 7
						108	. 320	10. 8	159	. 470	15. 9
10	. 030	1. 0	61	. 180	6. 1	110	. 325	11. 0	161	. 475	16. 1
12	. 035	1. 2	63	. 185	6. 3						
14	. 040	1. 4	64	. 190	6. 4	112	. 330	11. 2	163	. 480	16. 3
15	. 045	1. 5	66	. 195	6. 6	113	. 335	11. 3	164	. 485	16. 4
17	. 050	1. 7	68	. 200	6. 8	115	. 340	11. 5	166	. 490	16. 6
						117	. 345	11. 7	168	. 495	16. 8
19	. 055	1. 9	69	. 205	6. 9	119	. 350	11. 9	169	. 500	16. 9
20	. 060	2. 0	71	. 210	7. 1						
22	. 065	2. 2	73	. 215	7. 3	120	. 355	12. 0	171	. 505	17. 1
24	. 070	2. 4	75	. 220	7. 5	122	. 360	12. 2	173	. 510	17. 3
25	. 075	2. 5	76	. 225	7. 6	124	. 365	12. 4	174	. 515	17. 4
						125	. 370	12. 5	176	. 520	17. 6
27	. 080	2. 7	78	. 230	7. 8	127	. 375	12. 7	178	. 525	17. 8
29	. 085	2. 9	80	. 235	8. 0						
30	. 090	3. 0	81	. 240	8. 1	129	. 380	12. 9	179	. 530	17. 9
32	. 095	3. 2	83	. 245	8. 3	130	. 385	13. 0	181	. 535	18. 1
34	. 100	3. 4	85	. 250	8. 5	132	. 390	13. 2	183	. 540	18. 3
						134	. 395	13. 4	185	. 545	18. 5
36	. 105	3. 6	86	. 255	8. 6	135	. 400	13. 5	186	. 550	18. 6
37	. 110	3. 7	88	. 260	8. 8						
39	. 115	3. 9	90	. 265	9. 0	137	. 405	13. 7	188	. 555	18. 8
41	. 120	4. 1	91	. 270	9. 1	139	. 410	13. 9	190	. 560	19. 0
42	. 125	4. 2	93	. 275	9. 3	141	. 415	14. 1	191	. 565	19. 1
						142	. 420	14. 2	193	. 570	19. 3
44	. 130	4. 4	95	. 280	9. 5	144	. 425	14. 4	195	. 575	19. 5
46	. 135	4. 6	97	. 285	9. 7						
47	. 140	4. 7	98	. 290	9. 8	146	. 430	14. 6	196	. 580	19. 6
49	. 145	4. 9		. 295	10. 0	147	. 435	14. 7	198	. 585	19. 8
51	. 150	5. 1	[1] 99	. 300	10. 2	149	. 440	14. 9	200	. 590	20. 0
				etc.	etc.	151	. 445	15. 1	201	. 595	20. 1
						152	. 450	15. 2	203	. 600	20. 3

[1] 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 "$D_v v_a app$" 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 "$D_v v_a app$" group. For *example:* If the total amount of the pressure change is 13.4 millibars, the groups should be coded "$D_v v_a$99 99134." If the amount is 9.9 millibars, the groups are coded "$D_v v_a$99 99099." ("$D_v v_a$" should be given appropriate values.)

CODE TABLE 17

Symbol P_w -- Period of waves

Code figures	Period
2	5 seconds or less.
3	6 or 7 seconds.
4	8 or 9 seconds.
5	10 or 11 seconds.
6	12 or 13 seconds.
7	14 or 15 seconds.
8	16 or 17 seconds.
9	18 or 19 seconds.
0	20 or 21 seconds.
1	Over 21 seconds.
/	Calm or period unable to be determined.

CODE TABLE 18

Symbol H_w -- Height of waves

Code figures	Height
0	Less than 1 foot (1/4 meter).
1	1 1/2 feet (1/2 meter).
2	3 feet (1 meter).
3	5 feet (1 1/2 meters).
4	6 1/2 feet (2 meters).
5	8 feet (2 1/2 meters).
6	9 1/2 feet (3 meters).
7	11 feet (3 1/2 meters).
8	13 feet (4 meters).
9	14 feet (4 1/2 meters).
/	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	17 1/2 feet (5 1/2 meters).
2	19 feet (6 meters).
3	21 feet (6 1/2 meters).
4	22 1/2 feet (7 meters).
5	24 feet (7 1/2 meters).
6	25 1/2 feet (8 meters).
7	27 feet (8 1/2 meters).
8	29 feet (9 meters).
9	30 1/2 feet (9 1/2 meters).
/	Height impossible to determine.

NOTES

1. Each code figure except "zero" covers a range of ½ meter: e. g., code figure 1 = ¼ meter to ¾ meter, code figure 2 = ¾ meter to 1¼ 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 (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."

CODE TABLE 19

SYMBOL c_2.—*Description of kind of ice*

Code figure	Description
0	No ice. ("0" will be used to report "ice blink," and then a direction must be reported.)
1	New ice.
2	Fast ice.
3	Pack ice/drift ice.
4	Packed (compact) slush or sludge.
5	Shore lead.
6	Heavy fast ice.
7	Heavy pack ice/drift ice.
8	Hummocked ice.
9	Icebergs.

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_1.—*Bearing of ice-limit*

Code figure	Description
0	No ice limit can be stated.
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.

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	Unspecified or no observations.

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 c.—*Orientation of ice-limit*

Code figure	Orientation of ice-limit
0	Orientation of ice-limit impossible to estimate—ship *outside* 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 *inside* the ice.

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.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°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.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°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

TABLE 25.—*Temperature of the dew point in degrees Celsius*

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°C.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																			
	0.0	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
−30.0	−33	−35	−37	−40	−44	−51														
−29.5	−33	−34	−37	−39	−43	−49														
−29.0	−32	−34	−36	−38	−42	−46														
−28.5	−31	−33	−35	−37	−40	−44	−52													
−28.0	−31	−33	−34	−36	−39	−43	−48													
−27.5	−30	−32	−34	−36	−38	−41	−46													
−27.0	−30	−31	−33	−35	−37	−40	−44	−50												
−26.5	−29	−31	−32	−34	−36	−39	−42	−47												
−26.0	−29	−30	−32	−33	−35	−37	−40	−45	−52											
−25.5	−28	−29	−31	−32	−34	−36	−39	−43	−48											
−25.0	−27	−29	−30	−32	−33	−35	−38	−41	−45											
−24.5	−27	−28	−30	−31	−32	−34	−36	−39	−43	−48										
−24.0	−27	−28	−29	−30	−32	−33	−35	−38	−41	−45										
−23.5	−26	−27	−28	−29	−31	−32	−34	−36	−39	−43	−48									
−23.0	−26	−27	−28	−29	−30	−31	−33	−35	−37	−40	−45	−52								
−22.5	−25	−26	−27	−28	−29	−31	−32	−34	−36	−39	−42	−47								
−22.0	−24	−25	−26	−27	−29	−30	−31	−33	−35	−37	−40	−44	−50							
−21.5	−24	−25	−26	−27	−28	−29	−30	−32	−33	−35	−38	−41	−45							
−21.0	−23	−24	−25	−26	−27	−28	−29	−31	−32	−34	−36	−39	−42	−47						
−20.5	−23	−24	−24	−25	−26	−27	−28	−30	−31	−33	−35	−37	−40	−44	−50					
−20.0	−22	−23	−24	−25	−26	−27	−28	−29	−30	−32	−33	−35	−38	−41	−45					
−19.5	−22	−22	−23	−24	−25	−26	−27	−28	−29	−30	−32	−34	−36	−38	−41	−46				
−19.0	−21	−22	−23	−23	−24	−25	−26	−27	−28	−29	−31	−32	−34	−36	−39	−42	−48			
−18.5	−21	−21	−22	−23	−23	−24	−25	−26	−27	−28	−30	−31	−33	−34	−37	−39	−43	−49		
−18.0	−20	−21	−21	−22	−23	−24	−24	−25	−26	−27	−28	−30	−31	−33	−35	−37	−40	−44	−50	
−17.5	−20	−20	−21	−21	−22	−23	−24	−25	−25	−26	−27	−29	−30	−31	−33	−35	−37	−40	−44	−51
−17.0	−19	−20	−20	−21	−21	−22	−23	−24	−25	−25	−26	−27	−29	−30	−31	−33	−35	−37	−40	−44
−16.5	−18	−19	−20	−20	−21	−21	−22	−23	−24	−25	−25	−26	−27	−29	−30	−31	−33	−35	−37	−40
−16.0	−18	−18	−19	−20	−20	−21	−21	−22	−23	−24	−25	−25	−26	−27	−29	−30	−31	−33	−35	−37
−15.5	−17	−18	−18	−19	−20	−20	−21	−21	−22	−23	−24	−24	−25	−26	−27	−28	−30	−31	−33	−35
−15.0	−17	−17	−18	−18	−19	−19	−20	−21	−21	−22	−23	−24	−24	−25	−26	−27	−28	−30	−31	−33
−14.5	−16	−17	−17	−18	−18	−19	−19	−20	−21	−21	−22	−23	−23	−24	−25	−26	−27	−28	−29	−31
−14.0	−16	−16	−17	−17	−18	−18	−19	−19	−20	−20	−21	−22	−22	−23	−24	−25	−26	−27	−28	−29
−13.5	−15	−16	−16	−16	−17	−17	−18	−18	−19	−20	−20	−21	−22	−22	−23	−24	−25	−26	−27	−28
−13.0	−15	−15	−15	−16	−16	−17	−17	−18	−18	−19	−19	−20	−21	−21	−22	−23	−23	−24	−25	−26
−12.5	−14	−14	−15	−15	−16	−16	−17	−17	−18	−18	−19	−19	−20	−20	−21	−22	−22	−23	−24	−25
−12.0	−13	−14	−14	−15	−15	−16	−16	−16	−17	−17	−18	−18	−19	−20	−20	−21	−21	−22	−23	−24
−11.5	−13	−13	−14	−14	−14	−15	−15	−16	−16	−17	−17	−18	−18	−19	−19	−20	−20	−21	−22	−22
−11.0	−12	−13	−13	−13	−14	−14	−15	−15	−15	−16	−16	−17	−17	−18	−18	−19	−19	−20	−21	−21
−10.5	−12	−12	−13	−13	−13	−14	−14	−14	−15	−15	−16	−16	−17	−17	−18	−18	−19	−19	−20	−20
−10.0	−11	−12	−12	−12	−13	−13	−13	−14	−14	−14	−15	−15	−16	−16	−17	−17	−18	−18	−19	−19
−9.5	−11	−11	−11	−12	−12	−12	−13	−13	−13	−14	−14	−15	−15	−15	−16	−16	−17	−17	−18	−18
−9.0	−10	−10	−11	−11	−11	−12	−12	−12	−13	−13	−13	−14	−14	−15	−15	−15	−16	−16	−17	−17
−8.5	−10	−10	−10	−10	−11	−11	−11	−12	−12	−12	−13	−13	−14	−14	−14	−15	−15	−16	−16	−16
−8.0	−9	−9	−10	−10	−10	−10	−11	−11	−11	−12	−12	−12	−13	−13	−14	−14	−14	−15	−15	−16
−7.5	−8	−9	−9	−9	−10	−10	−10	−10	−11	−11	−11	−12	−12	−12	−13	−13	−13	−14	−14	−15
−7.0	−8	−8	−8	−9	−9	−9	−10	−10	−10	−10	−11	−11	−11	−12	−12	−12	−13	−13	−13	−14
−6.5	−7	−8	−8	−8	−8	−9	−9	−9	−9	−10	−10	−10	−11	−11	−11	−12	−12	−12	−13	−13
−6.0	−7	−7	−7	−8	−8	−8	−8	−9	−9	−9	−9	−10	−10	−10	−11	−11	−11	−11	−12	−12
−5.5	−6	−6	−7	−7	−7	−7	−8	−8	−8	−8	−9	−9	−9	−10	−10	−10	−10	−11	−11	−11
−5.0	−6	−6	−6	−6	−7	−7	−7	−7	−8	−8	−8	−8	−9	−9	−9	−9	−10	−10	−10	−11
−4.5	−5	−5	−6	−6	−6	−6	−6	−7	−7	−7	−7	−8	−8	−8	−8	−9	−9	−9	−9	−10
−4.0	−5	−5	−5	−5	−5	−6	−6	−6	−6	−7	−7	−7	−7	−7	−8	−8	−8	−8	−9	−9
−3.5	−4	−4	−4	−5	−5	−5	−5	−5	−6	−6	−6	−6	−7	−7	−7	−7	−7	−8	−8	−8
−3.0	−3	−4	−4	−4	−4	−4	−5	−5	−5	−5	−5	−6	−6	−6	−6	−7	−7	−7	−7	−8
−2.5	−3	−3	−3	−3	−4	−4	−4	−4	−4	−5	−5	−5	−5	−5	−6	−6	−6	−6	−7	−7
−2.0	−2	−2	−3	−3	−3	−3	−3	−4	−4	−4	−4	−4	−5	−5	−5	−5	−5	−6	−6	−6
−1.5	−2	−2	−2	−2	−2	−3	−3	−3	−3	−3	−4	−4	−4	−4	−4	−5	−5	−5	−5	−5
−1.0	−1	−1	−2	−2	−2	−2	−2	−2	−3	−3	−3	−3	−3	−3	−4	−4	−4	−4	−4	−5
−0.5	−1	−1	−1	−1	−1	−1	−2	−2	−2	−2	−2	−2	−3	−3	−3	−3	−3	−4	−4	−4

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

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°C.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																			
	0.0	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
0.0	0	0	0	−1	−1	−1	−1	−1	−1	−1	−2	−2	−2	−2	−2	−2	−3	−3	−3	−3
0.5	1	0	0	0	0	0	0	−1	−1	−1	−1	−1	−1	−2	−2	−2	−2	−2	−2	−3
1.0	1	1	1	1	0	0	0	0	0	0	−1	−1	−1	−1	−1	−1	−1	−2	−2	−2
1.5	2	1	1	1	1	1	1	1	0	0	0	0	0	0	−1	−1	−1	−1	−1	−1
2.0	2	2	2	2	2	1	1	1	1	1	1	1	0	0	0	0	0	0	−1	−1
2.5	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	0	0	0	0	0
3.0	3	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	0
3.5	4	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1
4.0	4	4	4	4	4	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2
4.5	5	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	2	2	2
5.0	5	5	5	5	5	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3
5.5	6	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	3	3
6.0	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5	4	4	4	4	4
6.5	7	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5
7.0	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6	6	5	5	5	5
7.5	8	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	6	6	6
8.0	8	8	8	8	8	8	7	7	7	7	7	7	7	7	7	7	7	6	6	6
8.5	9	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
9.0	9	9	9	9	9	9	9	8	8	8	8	8	8	8	8	8	8	8	7	7
9.5	10	9	9	9	9	9	9	9	9	9	9	9	9	8	8	8	8	8	8	8
10.0	10	10	10	10	10	10	10	9	9	9	9	9	9	9	9	9	9	9	9	8
10.5	11	10	10	10	10	10	10	10	10	10	10	10	10	9	9	9	9	9	9	9
11.0	11	11	11	11	11	11	11	10	10	10	10	10	10	10	10	10	10	10	10	10
11.5	12	11	11	11	11	11	11	11	11	11	11	11	11	11	10	10	10	10	10	10
12.0	12	12	12	12	12	12	12	12	11	11	11	11	11	11	11	11	11	11	11	11
12.5	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	11	11	11	11	11
13.0	13	13	13	13	13	13	13	13	12	12	12	12	12	12	12	12	12	12	12	12
13.5	14	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	12	12	12	12
14.0	14	14	14	14	14	14	14	14	14	13	13	13	13	13	13	13	13	13	13	13
14.5	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	13	13	13
15.0	15	15	15	15	15	15	15	15	15	14	14	14	14	14	14	14	14	14	14	14
15.5	16	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	14	14	14
16.0	16	16	16	16	16	16	16	16	16	16	15	15	15	15	15	15	15	15	15	15
16.5	17	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	15	15
17.0	17	17	17	17	17	17	17	17	17	17	16	16	16	16	16	16	16	16	16	16
17.5	18	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	16
18.0	18	18	18	18	18	18	18	18	18	18	18	17	17	17	17	17	17	17	17	17
18.5	19	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
19.0	19	19	19	19	19	19	19	19	19	19	19	18	18	18	18	18	18	18	18	18
19.5	20	20	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
20.0	20	20	20	20	20	20	20	20	20	20	20	20	19	19	19	19	19	19	19	19
20.5	21	21	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
21.0	21	21	21	21	21	21	21	21	21	21	21	21	21	20	20	20	20	20	20	20
21.5	22	22	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
22.0	22	22	22	22	22	22	22	22	22	22	22	22	22	21	21	21	21	21	21	21
22.5	23	23	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
23.0	23	23	23	23	23	23	23	23	23	23	23	23	23	23	22	22	22	22	22	22
23.5	24	24	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
24.0	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	23	23	23	23	23
24.5	25	25	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
25.0	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	24	24	24	24	24
25.5	26	26	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
26.0	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	25	25	25	25
26.5	27	27	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
27.0	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	26	26	26
27.5	28	28	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
28.0	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	27	27
28.5	29	29	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
29.0	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	28
29.5	30	30	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29

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

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°C.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																			
	0. 0	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
30. 0	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
30. 5	31	31	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
31. 0	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
31. 5	32	32	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
32. 0	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
32. 5	33	33	33	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
33. 0	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
33. 5	34	34	34	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
34. 0	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
34. 5	35	35	35	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
35. 0	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35

NOTE.—Table computed by means of Professor Ferrel's formula; $e=e'-[(t-t')(KP)(1+0.00095t')]$.

TABLE 25—*Temperature of the dew point in degrees Celsius*—Continued

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°C.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																					
	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.2
−20.0																						
−19.5																						
−19.0																						
−18.5																						
−18.0																						
−17.5																						
−17.0	−51																					
−16.5	−44																					
−16.0	−40	−51																				
−15.5	−37	−44																				
−15.0	−34	−40	−49																			
−14.5	−32	−36	−42																			
−14.0	−30	−34	−38	−46																		
−13.5	−29	−32	−35	−41																		
−13.0	−27	−30	−33	−37	−43																	
−12.5	−26	−28	−30	−34	−38	−47																
−12.0	−24	−26	−29	−31	−35	−40	−51															
−11.5	−23	−25	−27	−29	−32	−36	−42															
−11.0	−22	−24	−25	−27	−30	−33	−37	−44														
−10.5	−21	−22	−24	−26	−28	−30	−34	−38	−46													
10.0	−20	−21	−23	−24	−26	−28	−31	−34	−39	−48												
−9.5	−19	−20	−21	−23	−24	−26	−28	−31	−35	−40	−50											
−9.0	−18	−19	−20	−21	−23	−24	−26	−29	−31	−35	−40	−52										
−8.5	−17	−18	−19	−20	−21	−23	−25	−26	−29	−31	−35	−41										
−8.0	−16	−17	−18	−19	−20	−21	−23	−25	−26	−29	−32	−35	−41									
−7.5	−15	−16	−17	−18	−19	−20	−21	−23	−25	−26	−29	−31	−35	−40								
−7.0	−14	−15	−16	−17	−18	−19	−20	−21	−23	−24	−26	−28	−31	−35	−40	−51						
−6.5	−13	−14	−15	−16	−17	−18	−19	−20	−21	−23	−24	−26	−28	−31	−34	−39	−49					
−6.0	−12	−13	−14	−15	−16	−17	−18	−19	−20	−21	−22	−24	−26	−28	−30	−34	−38	−47				
−5.5	−12	−12	−13	−14	−15	−15	−16	−17	−18	−19	−21	−22	−24	−25	−27	−30	−33	−37	−44			
−5.0	−11	−12	−12	−13	−14	−14	−15	−16	−17	−18	−19	−20	−22	−23	−25	−27	−29	−32	−36	−42		
−4.5	−10	−11	−11	−12	−13	−13	−14	−15	−16	−17	−18	−19	−20	−21	−23	−24	−26	−28	−31	−35	−40	−50
−4.0	−9	−10	−10	−11	−12	−12	−13	−14	−15	−16	−16	−17	−18	−20	−21	−22	−24	−26	−28	−30	−33	−38
−3.5	−9	−9	−10	−10	−11	−11	−12	−13	−14	−14	−15	−16	−17	−18	−19	−20	−22	−23	−25	−27	−29	−32
−3.0	−8	−8	−9	−9	−10	−11	−11	−12	−12	−13	−14	−15	−16	−17	−18	−19	−20	−21	−22	−24	−26	−28
−2.5	−7	−8	−8	−9	−9	−10	−10	−11	−11	−12	−13	−14	−14	−15	−16	−17	−18	−19	−20	−22	−23	−25
−2.0	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11	−12	−12	−13	−14	−15	−16	−16	−17	−18	−20	−21	−22
−1.5	−6	−6	−6	−7	−7	−8	−8	−9	−9	−10	−11	−11	−12	−13	−13	−14	−15	−16	−17	−18	−19	−20
−1.0	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11	−12	−12	−13	−14	−14	−15	−16	−17	−18
−0.5	−4	−5	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11	−12	−12	−13	−14	−15	−15	−16
0.0	−3	−4	−4	−5	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11	−12	−12	−13	−14	−15
0.5	−3	−3	−4	−4	−4	−5	−5	−6	−6	−6	−7	−7	−8	−8	−9	−10	−10	−11	−11	−12	−13	−13
1.0	−2	−3	−3	−3	−4	−4	−4	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11	−12	−12
1.5	−2	−2	−2	−3	−3	−3	−4	−4	−4	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11
2.0	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10
2.5	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5	−6	−6	−7	−7	−8	−8	−9
3.0	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5	−6	−6	−7	−7	−8
3.5	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5	−6	−6	−7
4.0	2	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5	−6
4.5	2	2	2	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5
5.0	3	2	2	2	2	1	1	1	0	0	0	−1	−1	−1	−1	−2	−2	−3	−3	−3	−4	−4
5.5	3	3	3	2	2	2	2	1	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3
6.0	4	4	3	3	3	3	2	2	2	2	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2
6.5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	0	0	−1	−1	−1	−1
7.0	5	5	5	4	4	4	4	3	3	3	3	2	2	2	1	1	1	1	0	0	0	−1
7.5	6	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	1	0
8.0	6	6	6	5	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1
8.5	7	6	6	6	6	6	5	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2
9.0	7	7	7	7	6	6	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3	3
9.5	8	8	7	7	7	7	7	6	6	6	6	6	5	5	5	5	4	4	4	4	3	3

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

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°C.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																					
	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.2
10.0	8	8	8	8	8	7	7	7	7	7	6	6	6	6	6	5	5	5	5	4	4	4
10.5	9	9	9	8	8	8	8	8	7	7	7	7	7	6	6	6	6	6	5	5	5	5
11.0	9	9	9	9	9	9	8	8	8	8	8	7	7	7	7	7	6	6	6	6	6	5
11.5	10	10	10	9	9	9	9	9	9	8	8	8	8	8	7	7	7	7	7	6	6	6
12.0	11	10	10	10	10	10	10	9	9	9	9	9	8	8	8	8	8	8	7	7	7	7
12.5	11	11	11	11	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	8	8	7
13.0	12	11	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	9	9	8	8	8
13.5	12	12	12	12	12	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	9	9
14.0	13	13	12	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10	10	10	10	9
14.5	13	13	13	13	13	13	12	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10
15.0	14	14	14	13	13	13	13	13	13	13	12	12	12	12	12	12	12	11	11	11	11	11
15.5	14	14	14	14	14	14	14	13	13	13	13	13	13	13	12	12	12	12	12	12	12	11
16.0	15	15	15	14	14	14	14	14	14	14	14	13	13	13	13	13	13	13	12	12	12	12
16.5	15	15	15	15	15	15	15	15	14	14	14	14	14	14	14	13	13	13	13	13	13	13
17.0	16	16	16	16	15	15	15	15	15	15	15	15	14	14	14	14	14	14	14	14	13	13
17.5	16	16	16	16	16	16	16	16	15	15	15	15	15	15	15	15	15	14	14	14	14	14
18.0	17	17	17	17	17	16	16	16	16	16	16	16	16	15	15	15	15	15	15	15	15	14
18.5	18	17	17	17	17	17	17	17	17	17	16	16	16	16	16	16	16	16	15	15	15	15
19.0	18	18	18	18	18	17	17	17	17	17	17	17	17	17	16	16	16	16	16	16	16	16
19.5	19	18	18	18	18	18	18	18	18	18	18	17	17	17	17	17	17	17	17	17	16	16
20.0	19	19	19	19	19	19	18	18	18	18	18	18	18	18	18	18	17	17	17	17	17	17
20.5	20	20	19	19	19	19	19	19	19	19	19	19	18	18	18	18	18	18	18	18	18	17
21.0	20	20	20	20	20	20	20	19	19	19	19	19	19	19	19	19	19	18	18	18	18	18
21.5	21	21	20	20	20	20	20	20	20	20	20	20	20	19	19	19	19	19	19	19	19	19
22.0	21	21	21	21	21	21	21	21	20	20	20	20	20	20	20	20	20	20	20	19	19	19
22.5	22	22	22	21	21	21	21	21	21	21	21	21	21	21	20	20	20	20	20	20	20	20
23.0	22	22	22	22	22	22	22	22	22	21	21	21	21	21	21	21	21	21	21	21	20	20
23.5	23	23	23	23	22	22	22	22	22	22	22	22	22	22	22	21	21	21	21	21	21	21
24.0	23	23	23	23	23	23	23	23	23	23	22	22	22	22	22	22	22	22	22	22	22	22
24.5	24	24	24	24	23	23	23	23	23	23	23	23	23	23	23	23	23	22	22	22	22	22
25.0	24	24	24	24	24	24	24	24	24	24	24	23	23	23	23	23	23	23	23	23	23	23
25.5	25	25	25	25	25	24	24	24	24	24	24	24	24	24	24	24	24	23	23	23	23	23
26.0	25	25	25	25	25	25	25	25	25	25	25	25	24	24	24	24	24	24	24	24	24	24
26.5	26	26	26	26	26	26	25	25	25	25	25	25	25	25	25	25	25	25	25	24	24	24
27.0	26	26	26	26	26	26	26	26	26	26	26	26	26	25	25	25	25	25	25	25	25	25
27.5	27	27	27	27	27	27	27	26	26	26	26	26	26	26	26	26	26	26	26	26	26	25
28.0	27	27	27	27	27	27	27	27	27	27	27	27	27	27	26	26	26	26	26	26	26	26
28.5	28	28	28	28	28	28	28	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
29.0	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	27	27	27	27	27	27
29.5	29	29	29	29	29	29	29	29	28	28	28	28	28	28	28	28	28	28	28	28	28	28
30.0	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	28	28	28	28	28
30.5	30	30	30	30	30	30	30	30	30	29	29	29	29	29	29	29	29	29	29	29	29	29
31.0	31	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	29	29	29	29
31.5	31	31	31	31	31	31	31	31	31	31	30	30	30	30	30	30	30	30	30	30	30	30
32.0	32	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30
32.5	32	32	32	32	32	32	32	32	32	32	32	31	31	31	31	31	31	31	31	31	31	31
33.0	33	33	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	31
33.5	33	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32
34.0	34	34	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
34.5	34	34	34	34	34	34	34	34	34	34	34	34	34	34	33	33	33	33	33	33	33	33
35.0	35	35	35	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34

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

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°C.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																				
	6. 4	6. 6	6. 8	7. 0	7. 2	7. 4	7. 6	7. 8	8. 0	8. 2	8. 4	8. 6	8. 8	9. 0	9. 2	9. 4	9. 6	9. 8	10. 0	10. 2	10. 4
−5. 0																					
−4. 5																					
−4. 0	−45																				
−3. 5	−36	−42																			
−3. 0	−30	−34	−38	−47																	
−2. 5	−27	−29	−32	−36	−42																
−2. 0	−24	−26	−28	−30	−33	−38	−46														
−1. 5	−21	−23	−24	−26	−29	−31	−35	−40	−52												
−1. 0	−19	−20	−22	−23	−25	−27	−29	−32	−36	−43											
−0. 5	−17	−18	−20	−21	−22	−24	−25	−27	−30	−31	−38	−45									
0. 0	−16	−17	−17	−19	−20	−21	−22	−24	−26	−28	−30	−34	−38	−47							
0. 5	−14	−15	−16	−17	−18	−19	−20	−21	−23	−25	−26	−29	−31	−35	−41						
1. 0	−13	−14	−14	−15	−16	−17	−18	−19	−20	−22	−23	−25	−27	−29	−32	−36	−43				
1. 5	−12	−12	−13	−14	−15	−15	−16	−17	−18	−19	−21	−22	−24	−25	−28	−30	−33	−38	−45		
2. 0	−10	−11	−12	−12	−13	−14	−15	−16	−17	−17	−19	−20	−21	−22	−24	−26	−28	−30	−34	−39	−47
2. 5	−9	−10	−11	−11	−12	−13	−13	−14	−15	−16	−17	−18	−19	−20	−21	−23	−24	−26	−28	−31	−34
3. 0	−8	−9	−9	−10	−11	−11	−12	−13	−13	−14	−15	−16	−17	−18	−19	−20	−21	−23	−24	−26	−28
3. 5	−7	−8	−8	−9	−9	−10	−11	−11	−12	−13	−13	−14	−15	−16	−17	−18	−19	−20	−21	−23	−24
4. 0	−6	−7	−7	−8	−8	−9	−9	−10	−11	−11	−12	−12	−13	−14	−15	−16	−17	−18	−19	−20	−21
4. 5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11	−12	−12	−13	−14	−15	−16	−16	−17	−18
5. 0	−4	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11	−12	−12	−13	−14	−15	−15	−16
5. 5	−4	−4	−4	−5	−5	−6	−6	−6	−7	−7	−8	−8	−9	−10	−10	−11	−11	−12	−13	−13	−14
6. 0	−3	−3	−3	−4	−4	−5	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−11	−11	−12	−13
6. 5	−2	−2	−3	−3	−3	−4	−4	−4	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9	−10	−10	−11
7. 0	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5	−6	−6	−7	−7	−8	−8	−9	−9
7. 5	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−4	−4	−4	−5	−5	−6	−6	−7	−7	−8	−8
8. 0	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5	−6	−6	−7
8. 5	1	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5
9. 0	2	2	2	1	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−4	−4	−4
9. 5	3	3	2	2	2	2	1	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3
10. 0	4	3	3	3	3	2	2	2	2	1	1	1	1	0	0	0	−1	−1	−1	−2	−2
10. 5	4	4	4	4	4	3	3	3	3	2	2	2	1	1	1	1	0	0	0	−1	−1
11. 0	5	5	5	4	4	4	4	4	3	3	3	3	2	2	2	1	1	1	1	0	0
11. 5	6	6	5	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2	2	1	1
12. 0	7	6	6	6	6	6	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2
12. 5	7	7	7	7	6	6	6	6	6	5	5	5	5	5	4	4	4	4	3	3	3
13. 0	8	8	8	7	7	7	7	7	6	6	6	6	6	5	5	5	5	4	4	4	4
13. 5	9	8	8	8	8	8	7	7	7	7	7	6	6	6	6	6	5	5	5	5	5
14. 0	9	9	9	9	9	8	8	8	8	8	7	7	7	7	7	6	6	6	6	6	5
14. 5	10	10	10	9	9	9	9	9	9	8	8	8	8	8	7	7	7	7	7	6	6
15. 0	11	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	8	8	7	7	7
15. 5	11	11	11	11	11	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	8
16. 0	12	12	12	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	9	9	9
16. 5	12	12	12	12	12	12	12	11	11	11	11	11	11	11	10	10	10	10	10	10	9
17. 0	13	13	13	13	13	12	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10
17. 5	14	14	13	13	13	13	13	13	13	12	12	12	12	12	12	12	11	11	11	11	11
18. 0	14	14	14	14	14	14	14	13	13	13	13	13	13	13	12	12	12	12	12	12	12
18. 5	15	15	15	15	14	14	14	14	14	14	14	14	13	13	13	13	13	13	13	12	12
19. 0	16	15	15	15	15	15	15	15	15	14	14	14	14	14	14	14	14	13	13	13	13
19. 5	16	16	16	16	16	16	15	15	15	15	15	15	15	15	14	14	14	14	14	14	14
20. 0	17	17	17	16	16	16	16	16	16	16	16	15	15	15	15	15	15	15	15	14	14
20. 5	17	17	17	17	17	17	17	17	16	16	16	16	16	16	16	16	16	15	15	15	15
21. 0	18	18	18	18	18	17	17	17	17	17	17	17	17	17	16	16	16	16	16	16	16
21. 5	19	18	18	18	18	18	18	18	18	18	17	17	17	17	17	17	17	17	17	16	16
22. 0	19	19	19	19	19	19	19	18	18	18	18	18	18	18	18	18	17	17	17	17	17
22. 5	20	20	20	19	19	19	19	19	19	19	19	19	19	18	18	18	18	18	18	18	18
23. 0	20	20	20	20	20	20	20	20	20	19	19	19	19	19	19	19	19	19	19	18	18
23. 5	21	21	21	21	20	20	20	20	20	20	20	20	20	20	20	19	19	19	19	19	19
24. 0	21	21	21	21	21	21	21	21	21	21	21	20	20	20	20	20	20	20	20	20	20
24. 5	22	22	22	22	22	22	21	21	21	21	21	21	21	21	21	21	21	21	20	20	20

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

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°C.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																			
	6. 4	6. 6	6. 8	7. 0	7. 2	7. 4	7. 6	7. 8	8. 0	8. 2	8. 4	8. 6	8. 8	9. 0	9. 2	9. 4	9. 6	9. 8	10. 0	10. 2	10. 4
25. 0	23	22	22	22	22	22	22	22	22	22	22	22	22	21	21	21	21	21	21	21	21
25. 5	23	23	23	23	23	23	23	23	22	22	22	22	22	22	22	22	22	22	22	22	21
26. 0	24	24	24	23	23	23	23	23	23	23	23	23	23	23	23	23	22	22	22	22	22
26. 5	24	24	24	24	24	24	24	24	24	24	23	23	23	23	23	23	23	23	23	23	23
27. 0	25	25	25	25	25	24	24	24	24	24	24	24	24	24	24	24	24	23	23	23	23
27. 5	25	25	25	25	25	25	25	25	25	25	25	25	25	24	24	24	24	24	24	24	24
28. 0	26	26	26	26	26	26	26	25	25	25	25	25	25	25	25	25	25	25	25	25	25
28. 5	27	26	26	26	26	26	26	26	26	26	26	26	26	26	26	25	25	25	25	25	25
29. 0	27	27	27	27	27	27	27	27	27	26	26	26	26	26	26	26	26	26	26	26	26
29. 5	28	28	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	26	26	26	26
30. 0	28	28	28	28	28	28	28	28	28	28	28	27	27	27	27	27	27	27	27	27	27
30. 5	29	29	29	29	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	27
31. 0	29	29	29	29	29	29	29	29	29	29	29	29	29	28	28	28	28	28	28	28	28
31. 5	30	30	30	30	30	30	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
32. 0	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	29	29	29	29	29	29
32. 5	31	31	31	31	31	31	31	30	30	30	30	30	30	30	30	30	30	30	30	30	30
33. 0	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30	30
33. 5	32	32	32	32	32	32	32	32	32	31	31	31	31	31	31	31	31	31	31	31	31
34. 0	33	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	31
34. 5	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32
35. 0	34	34	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33

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

[Tabular values are dew points with respect to water]

Wet-bulb temperature (°C.)	Depression of the wet-bulb thermometer (dry-bulb minus wet-bulb)																					
	10. 6	10. 8	11. 0	11. 2	11. 4	11. 6	11. 8	12. 0	12. 2	12. 4	12. 6	12. 8	13. 0	13. 2	13. 4	13. 6	13. 8	14. 0	14. 2	14. 4	14. 6	14. 8
10. 0	−2	−3	−3	−4	−4	−4	−5	−5	−6	−6	−7	−7	−7	−8	−9	−9	−10	−10	−11	−12	−12	−13
10. 5	−1	−2	−2	−2	−3	−3	−4	−4	−4	−5	−5	−6	−6	−6	−7	−7	−8	−8	−9	−10	−10	−11
11. 0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−6	−6	−6	−7	−7	−8	−8	−9
11. 5	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4	−5	−5	−5	−6	−6	−7	−7
12. 0	2	1	1	1	0	0	0	−1	−1	−1	−1	−2	−2	−3	−3	−3	−4	−4	−4	−5	−5	−6
12. 5	3	2	2	2	1	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3	−3	−4	−4
13. 0	3	3	3	3	2	2	2	2	1	1	1	0	0	0	−1	−1	−1	−2	−2	−2	−3	−3
13. 5	4	4	4	4	3	3	3	3	2	2	2	2	1	1	1	0	0	0	−1	−1	−1	−2
14. 0	5	5	5	4	4	4	4	4	3	3	3	3	2	2	2	1	1	1	1	0	0	0
14. 5	6	6	6	5	5	5	5	4	4	4	4	4	3	3	3	2	2	2	2	1	1	1
15. 0	7	7	6	6	6	6	6	5	5	5	5	4	4	4	4	3	3	3	3	2	2	2
15. 5	8	7	7	7	7	7	6	6	6	6	6	5	5	5	5	4	4	4	4	4	3	3
16. 0	8	8	8	8	8	7	7	7	7	7	6	6	6	6	6	5	5	5	5	5	4	4
16. 5	9	9	9	9	8	8	8	8	8	8	7	7	7	7	7	6	6	6	6	5	5	5
17. 0	10	10	10	9	9	9	9	9	9	8	8	8	8	8	7	7	7	7	7	6	6	6
17. 5	11	11	10	10	10	10	10	10	9	9	9	9	9	8	8	8	8	8	8	7	7	7
18. 0	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	8
18. 5	12	12	12	12	12	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	9	9
19. 0	13	13	13	12	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10	10	10	10
19. 5	14	13	13	13	13	13	13	13	12	12	12	12	12	12	12	11	11	11	11	11	11	10
20 0	14	14	14	14	14	14	13	13	13	13	13	13	13	12	12	12	12	12	12	12	11	11
20. 5	15	15	15	15	14	14	14	14	14	14	14	13	13	13	13	13	13	13	12	12	12	12
21. 0	16	15	15	15	15	15	15	15	15	14	14	14	14	14	14	14	14	13	13	13	13	13
21. 5	16	16	16	16	16	16	16	15	15	15	15	15	15	15	15	14	14	14	14	14	14	14
22. 0	17	17	17	17	16	16	16	16	16	16	16	16	16	15	15	15	15	15	15	15	15	14
22. 5	18	17	17	17	17	17	17	17	17	17	16	16	16	16	16	16	16	16	16	15	15	15
23. 0	18	18	18	18	18	18	18	17	17	17	17	17	17	17	17	17	16	16	16	16	16	16
23. 5	19	19	19	19	18	18	18	18	18	18	18	18	18	17	17	17	17	17	17	17	17	17
24. 0	19	19	19	19	19	19	19	19	19	19	18	18	18	18	18	18	18	18	18	18	17	17
24. 5	20	20	20	20	20	20	20	19	19	19	19	19	19	19	19	19	19	18	18	18	18	18
25. 0	21	21	21	20	20	20	20	20	20	20	20	20	20	20	19	19	19	19	19	19	19	19
25. 5	21	21	21	21	21	21	21	21	21	21	20	20	20	20	20	20	20	20	20	20	20	19
26. 0	22	22	22	22	22	22	21	21	21	21	21	21	21	21	21	21	21	20	20	20	20	20
26. 5	23	23	22	22	22	22	22	22	22	22	22	22	22	22	21	21	21	21	21	21	21	21
27. 0	23	23	23	23	23	23	23	23	23	22	22	22	22	22	22	22	22	22	22	22	22	21
27. 5	24	24	24	24	24	23	23	23	23	23	23	23	23	23	23	23	23	22	22	22	22	22
28. 0	24	24	24	24	24	24	24	24	24	24	24	24	24	23	23	23	23	23	23	23	23	23
28. 5	25	25	25	25	25	25	25	25	24	24	24	24	24	24	24	24	24	24	24	24	24	23
29. 0	26	26	25	25	25	25	25	25	25	25	25	25	25	25	25	25	24	24	24	24	24	24
29. 5	26	26	26	26	26	26	26	26	26	26	26	25	25	25	25	25	25	25	25	25	25	25
30. 0	27	27	27	27	27	26	26	26	26	26	26	26	26	26	26	26	26	26	26	25	25	25
30. 5	27	27	27	27	27	27	27	27	27	27	27	27	27	27	26	26	26	26	26	26	26	26
31. 0	28	28	28	28	28	28	28	28	27	27	27	27	27	27	27	27	27	27	27	27	27	27
31. 5	29	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	27	27	27	27	27
32. 0	29	29	29	29	29	29	29	29	29	29	29	28	28	28	28	28	28	28	28	28	28	28
32. 5	30	30	30	30	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	28
33. 0	30	30	30	30	30	30	30	30	30	30	30	30	30	30	29	29	29	29	29	29	29	29
33. 5	31	31	31	31	31	31	31	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
34. 0	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30	30	30	30
34. 5	32	32	32	32	32	32	32	32	32	32	31	31	31	31	31	31	31	31	31	31	31	31
35. 0	33	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	31

TABLE 26.—*Fahrenheit to Celsius Temperatures*

° F.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	° C.	° C.	° C.	° C.	° C.	° C.	° C.	° C.	° C.	° C.
+100	+37.8	+37.8	+37.9	+37.9	+38.0	+38.1	+38.1	+38.2	+38.2	+38.3
99	37.2	37.3	37.3	37.4	37.4	37.5	37.6	37.6	37.7	37.7
98	36.7	36.7	36.8	36.8	36.9	36.9	37.0	37.1	37.1	37.2
97	36.1	36.2	36.2	36.3	36.3	36.4	36.4	36.5	36.6	36.6
96	35.6	35.6	35.7	35.7	35.8	35.8	35.9	35.9	36.0	36.1
+95	+35.0	+35.1	+35.1	+35.2	+35.2	+35.3	+35.3	+35.4	+35.4	+35.5
94	34.4	34.5	34.6	34.6	34.7	34.7	34.8	34.8	34.9	34.9
93	33.9	33.9	34.0	34.1	34.1	34.2	34.2	34.3	34.3	34.4
92	33.3	33.4	33.4	33.5	33.6	33.6	33.7	33.7	33.8	33.8
91	32.8	32.8	32.9	32.9	33.0	33.1	33.1	33.2	33.2	33.3
+90	+32.2	+32.3	+32.3	+32.4	+32.4	+32.5	+32.6	+32.6	+32.7	+32.7
89	31.7	31.7	31.8	31.8	31.9	31.9	32.0	32.1	32.1	32.2
88	31.1	31.2	31.2	31.3	31.3	31.4	31.4	31.5	31.6	31.6
87	30.6	30.6	30.7	30.7	30.8	30.8	30.9	30.9	31.0	31.1
86	30.0	30.1	30.1	30.2	30.2	30.3	30.3	30.4	30.4	30.5
+85	+29.4	+29.5	+29.6	+29.6	+29.7	+29.7	+29.8	+29.8	+29.9	+29.9
84	28.9	28.9	29.0	29.1	29.1	29.2	29.2	29.3	29.3	29.4
83	28.3	28.4	28.4	28.5	28.6	28.6	28.7	28.7	28.8	28.8
82	27.8	27.8	27.9	27.9	28.0	28.1	28.1	28.2	28.2	28.3
81	27.2	27.3	27.3	27.4	27.4	27.5	27.6	27.6	27.7	27.7
+80	+26.7	+26.7	+26.8	+26.8	+26.9	+26.9	+27.0	+27.1	+27.1	+27.2
79	26.1	26.2	26.2	26.3	26.3	26.4	26.4	26.5	26.6	26.6
78	25.6	25.6	25.7	25.7	25.8	25.8	25.9	25.9	26.0	26.1
77	25.0	25.1	25.1	25.2	25.2	25.3	25.3	25.4	25.4	25.5
76	24.4	24.5	24.6	24.6	24.7	24.7	24.8	24.8	24.9	24.9
+75	+23.9	+23.9	+24.0	+24.1	+24.1	+24.2	+24.2	+24.3	+24.3	+24.4
74	23.3	23.4	23.4	23.5	23.6	23.6	23.7	23.7	23.8	23.8
73	22.8	22.8	22.9	22.9	23.0	23.1	23.1	23.2	23.2	23.3
72	22.2	22.3	22.3	22.4	22.4	22.5	22.6	22.6	22.7	22.7
71	21.7	21.7	21.8	21.8	21.9	21.9	22.0	22.1	22.1	22.2
+70	+21.1	+21.2	+21.2	+21.3	+21.3	+21.4	+21.4	+21.5	+21.6	+21.6
69	20.6	20.6	20.7	20.7	20.8	20.8	20.9	20.9	21.0	21.1
68	20.0	20.1	20.1	20.2	20.2	20.3	20.3	20.4	20.4	20.5
67	19.4	19.5	19.6	19.6	19.7	19.7	19.8	19.8	19.9	19.9
66	18.9	18.9	19.0	19.1	19.1	19.2	19.2	19.3	19.3	19.4
+65	+18.3	+18.4	+18.4	+18.5	+18.6	+18.6	+18.7	+18.7	+18.8	+18.8
64	17.8	17.8	17.9	17.9	18.0	18.1	18.1	18.2	18.2	18.3
63	17.2	17.3	17.3	17.4	17.4	17.5	17.6	17.6	17.7	17.7
62	16.7	16.7	16.8	16.8	16.9	16.9	17.0	17.1	17.1	17.2
61	16.1	16.2	16.2	16.3	16.3	16.4	16.4	16.5	16.6	16.6

TABLE 26.—*Fahrenheit to Celsius Temperatures*—Continued

° F.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
	° C.	° C.	° C.	° C.	° C.	° C.	° C.	° C.	° C.	° C.
+60	+15.6	+15.6	+15.7	+15.7	+15.8	+15.8	+15.8	+15.9	+16.0	+16.1
59	15.0	15.1	15.1	15.2	15.2	15.3	15.3	15.4	15.4	15.5
58	14.4	14.5	14.6	14.6	14.7	14.7	14.8	14.8	14.9	14.9
57	13.9	13.9	14.0	14.1	14.1	14.2	14.2	14.3	14.3	14.4
56	13.3	13.4	13.4	13.5	13.6	13.6	13.7	13.7	13.8	13.8
+55	+12.8	+12.8	+12.9	+12.9	+13.0	+13.1	+13.1	+13.2	+13.2	+13.3
54	12.2	12.3	12.3	12.4	12.4	12.5	12.6	12.6	12.7	12.7
53	11.7	11.7	11.8	11.8	11.9	11.9	12.0	12.1	12.1	12.2
52	11.1	11.2	11.2	11.3	11.3	11.4	11.4	11.5	11.6	11.6
51	10.6	10.6	10.7	10.7	10.8	10.8	10.9	10.9	11.0	11.1
+50	+10.0	+10.1	+10.1	+10.2	+10.2	+10.3	+10.3	+10.4	+10.4	+10.5
49	9.4	9.5	9.6	9.6	9.7	9.7	9.8	9.8	9.9	9.9
48	8.9	8.9	9.0	9.1	9.1	9.2	9.2	9.3	9.3	9.4
47	8.3	8.4	8.4	8.5	8.6	8.6	8.7	8.7	8.8	8.8
46	7.8	7.8	7.9	7.9	8.0	8.1	8.1	8.2	8.2	8.3
+45	+7.2	+7.3	+7.3	+7.4	+7.4	+7.5	+7.6	+7.6	+7.7	+7.7
44	6.7	6.7	6.8	6.8	6.9	6.9	7.0	7.1	7.1	7.2
43	6.1	6.2	6.2	6.3	6.3	6.4	6.4	6.5	6.6	6.6
42	5.6	5.6	5.7	5.7	5.8	5.8	5.9	5.9	6.0	6.1
41	5.0	5.1	5.1	5.2	5.2	5.3	5.3	5.4	5.4	5.5
+40	+4.4	+4.5	+4.6	+4.6	+4.7	+4.7	+4.8	+4.8	+4.9	+4.9
39	3.9	3.9	4.0	4.1	4.1	4.2	4.2	4.3	4.3	4.4
38	3.3	3.4	3.4	3.5	3.6	3.6	3.7	3.7	3.8	3.8
37	2.8	2.8	2.9	2.9	3.0	3.1	3.1	3.2	3.2	3.3
36	2.2	2.3	2.3	2.4	2.4	2.5	2.6	2.6	2.7	2.7
+35	+1.7	+1.7	+1.8	+1.8	+1.9	+1.9	+2.0	+2.1	+2.1	+2.2
34	+1.1	+1.2	+1.2	+1.3	+1.3	+1.4	+1.4	+1.5	+1.6	+1.6
33	+0.6	+0.6	+0.7	+0.7	+0.8	+0.8	+0.9	+0.9	+1.0	+1.1
32	0.0	+0.1	+0.1	+0.2	+0.2	+0.3	+0.3	+0.4	+0.4	+0.5
31	−0.6	−0.5	−0.4	−0.4	−0.3	−0.3	−0.2	−0.2	−0.1	−0.1
+30	−1.1	−1.1	−1.0	−0.9	−0.9	−0.8	−0.8	−0.7	−0.7	−0.6
29	−1.7	−1.6	−1.6	−1.5	−1.4	−1.4	−1.3	−1.3	−1.2	−1.2
28	−2.2	−2.2	−2.1	−2.1	−2.0	−1.9	−1.9	−1.8	−1.8	−1.7
27	−2.8	−2.7	−2.7	−2.6	−2.6	−2.5	−2.4	−2.4	−2.3	−2.3
26	−3.3	−3.3	−3.2	−3.2	−3.1	−3.1	−3.0	−2.9	−2.9	−2.8
+25	−3.9	−3.8	−3.8	−3.7	−3.7	−3.6	−3.6	−3.5	−3.4	−3.4
24	−4.4	−4.4	−4.3	−4.3	−4.2	−4.2	−4.1	−4.1	−4.0	−3.9
23	−5.0	−4.9	−4.9	−4.8	−4.8	−4.7	−4.7	−4.6	−4.6	−4.5
22	−5.6	−5.5	−5.4	−5.4	−5.3	−5.3	−5.2	−5.2	−5.1	−5.1
21	−6.1	−6.1	−6.0	−5.9	−5.9	−5.8	−5.8	−5.7	−5.7	−5.6

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

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	------	------	------
10	. 01	. 01	. 01	. 01	. 01	. 01	. 01	0. 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.
°	*Inch*	°	*Inch*	°	*Inch*	°	*Inch*
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

Table 29A—*Millimeters to millibars*

Mm.	0	1	2	3	4	5	6	7	8	9
	Mb.	*Mb.*	*Mb.*	*Mb.*	*Mb.*	*Mb.*	*Mb.*	*Mb.*	*Mb.*	*Mb.*
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

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).
QTI	What is your TRUE track?	My TRUE track is --- degrees.
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)?	Here is the information requested ---.
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 ---.

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)?	The swell at --- (place or co-ordinates) is ---. Complete the answer, information or advice form by the use of the following numbered alternatives:

Number	Length of swell	Height
0	----------	
1	Short or average----------	Low.
2	Long----------	Do.
3	Short----------	Moderate.
4	Average----------	Do.
5	Long----------	Do.
6	Short----------	Heavy.
7	Average----------	Do.
8	Long----------	Do.
9	Confused----------	

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:

Length of swell

Short: 0–100 meters (0–300 feet).
Average: 100–200 meters (300–600 feet).
Long: Over 200 meters (600 feet).

Height of swell

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).

QUN [1]	Will vessels in my immediate vicinity [(or in the vicinity of --- latitude --- longitude) (or of ---)] please indicate their position, TRUE course and speed?	My position, TRUE course and speed are ---.

[1] 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 QTI to avoid any misunderstanding.

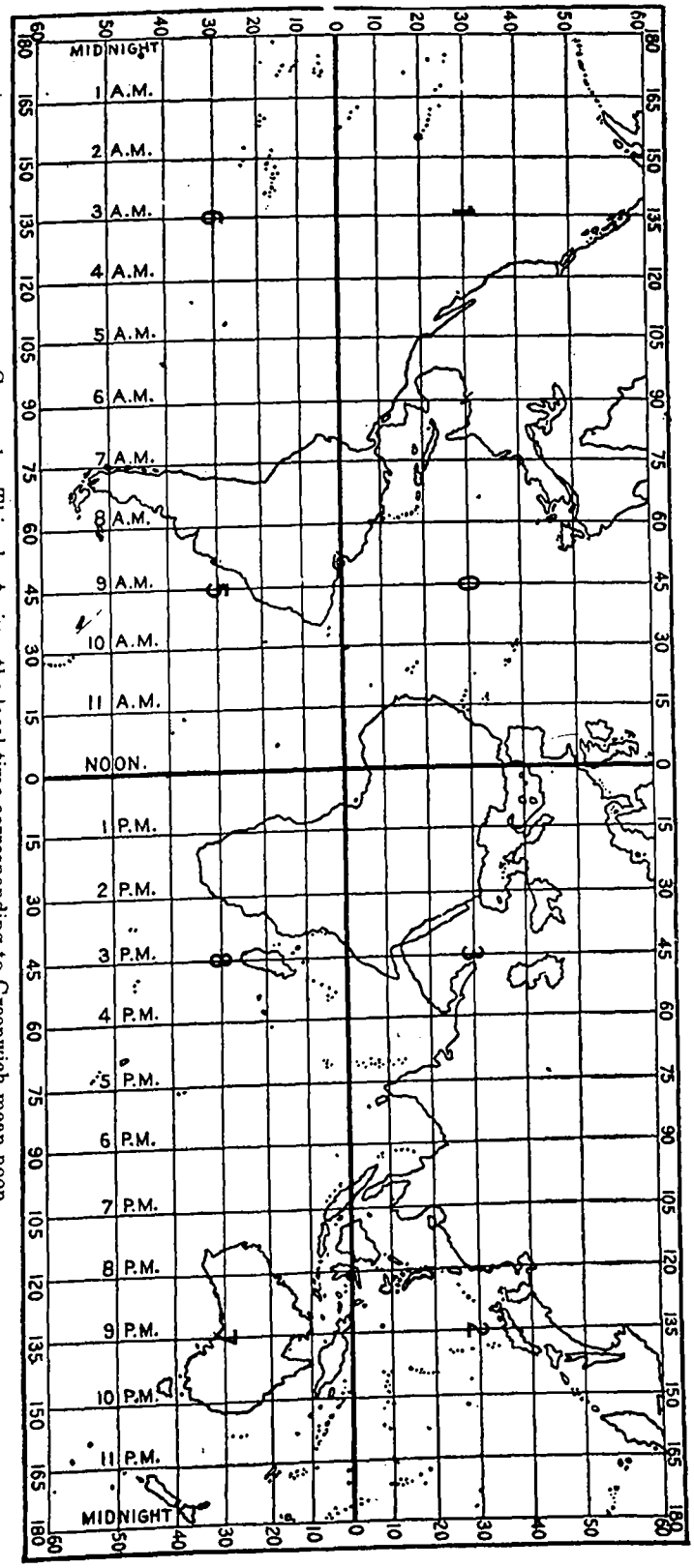

CHART 1. This chart gives the local time corresponding to Greenwich mean noon.

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