DEPARTMENT OF THE NAVY
COMMANDER
NAVAL METEOROLOGY AND OCEANOGRAPHY COMMAND
1020 BALCH BOULEVARD
STENNIS SPACE CENTER, MS 39529-5005

NAVMETOCCOMINST 3144.1D CH-1
N3
19 JUL 1996

NAVMETOCCOM INSTRUCTION 3144.1D CHANGE TRANSMITTAL 1

From: Commander, Naval Meteorology and Oceanography Command

Subj: U.S. NAVY MANUAL FOR SHIP'S SURFACE WEATHER OBSERVATIONS

Encl: (1) Revised Appendix B

1. Purpose. To issue change 1 to the basic instruction.

2. Actions. Delete appendices B and C of original instruction and replace with enclosure (1). Make the following pen and ink changes to the basic instruction:

a. Page v, delete line 2.6.8 (Column 14 - Remarks).

b. Page xi, Appendix B, delete "Aerographer's Mate".

c. Page xi, delete Appendix C.

d. Page II-2-1, delete paragraph 2.2.1c.

e. Page II-2-1, delete paragraph 2.2.2c.

f. Pages II-3-3 and II-3-4, paragraph 2.3.5.2a, delete the second sentence and replace with, "Remarks elaborating on surface-based partial obscurations follow the format and order of entry for obscurations aloft, but are assigned a height of "000" (i.e., FG FEW000)."

g. Page II-5-11, Note #2, change the first sentence to read "... is less than 6 nautical miles ..."

h. Page II-5-15, Table II-5-2, add the following note at the bottom of the table, "Note: "WSHIFT", "PK WIND", gusts and squall information is only applicable to OA divisions (AGs) for ships at anchor, or berthed, and having appropriate recording equipment, i.e., SMOOS."

i. Page II-6-6, paragraph 2.6.6, change paragraph to read, "Enter the altimeter setting in inches of mercury using tens, units, tenths, and hundredths (without the decimal point); e.g., enter 2994 for an altimeter setting of 29.94 inches Hg. Prefix the numerical entry with an "E" when estimated. Enter "M" for a missing altimeter setting."

j. Pages II-6-6 and II-6-7, paragraph 2.6.8, delete entire paragraph.

k. Page II-8-6, paragraph 2.8.4b, delete squall definition and replace with, "A strong wind characterized by a sudden onset in which the wind speed increases at least 16 knots and is sustained at 22 knots or more for at least one minute."

l. Page II-8-6, paragraph 2.8.5, change sentence to read, "Enter the true direction from which the wind is blowing, to the nearest 10 degrees using three figures. Directions less than 100 degrees shall be preceded with a zero, i.e., Winds from due east shall be coded as 090.)"

m. Page II-8-6, paragraph 2.8.7; add "AG" prior to the beginning of the first sentence.

n. Page III-3-1, Paragraph 3.3.1.2, Note 2, change sentence to read, "... aloft are not considered ..."

o. Page III-3-3, paragraph 3.3.1.7, change sentence to read, "... since the last synoptic observation."

p. Page III-3-3, paragraph 3.3.1.7a, add last sentence, "Only in this case will i_x be encoded as "3"."

q. Page III-3-3, paragraph 3.3.1.7c(1), change sentence to read, "Report the past weather for the last five hours preceding the last hour, (i.e., 1200Z to 1700Z for W_1W_2, and 1700Z to 1800Z for ww.)"

r. Page III-3-3, paragraph 3.3.1.7(2), change the first sentence to read, "Report the past weather for the last two hours preceding the last hour, (i.e., 0600Z to 0800Z for W_1W_2, and 0800Z to 0900Z for ww.)"

CRAIG A. PETERSON
Chief of Staff

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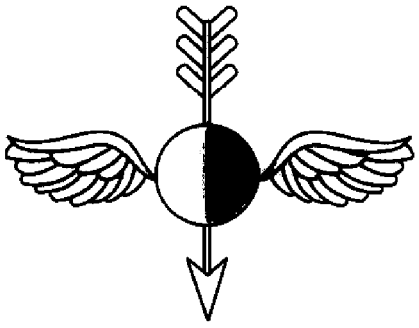
NAVMETOCCOMINST 3144.1D **March 1996**

UNITED STATES NAVY MANUAL FOR SHIP'S SURFACE WEATHER OBSERVATIONS

EFFECTIVE JULY 1996



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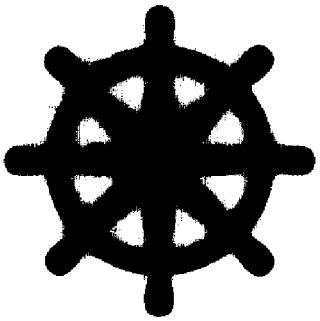

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[redacted]

This publication is required for the observation of Aviation Routine Weather Report (METAR) and the dissemination of ship synoptic code. It has limited distribution to U.S. Government agencies and their contractors. Any queries as to content of this document should be referred to Officer-in-Charge, Fleet Numerical Meteorology and Oceanography Detachment, 151 Patton Avenue, Asheville, North Carolina, 28801-5014.

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NAVMETOCCOMINST 3144.1D
N3
22 MAR 1996

[redacted]METOCCOM INSTRUCTION 3144.1D

From: Commander, Naval Meteorology and Oceanography Command

Subj: U.S. NAVY MANUAL FOR SHIP'S SURFACE WEATHER OBSERVATIONS

Ref: (a) NAVOCEANCOMINST 3140.1J
(b) NWP-4

Encl: (1) U.S. NAVY MANUAL FOR SHIP'S SURFACE WEATHER OBSERVATIONS

1. Purpose. The purpose of enclosure (1) is to provide U.S. Navy ships with the basic instructions for observing, recording, and encoding surface marine weather observations. This instruction has been completely revised and should be reviewed in its entirety.

2. Cancellation. NAVOCEANCOMINST 3144.1C

3. Discussion. Accurate and timely submission of environmental observations are basic to the development of oceanographic and meteorological forecasts and tactical indices used in support of fleet operations. Since the U.S. Navy may be committed to operations anywhere in the world, global observations of meteorological conditions observed by its deployed forces are required. In remote areas, particularly over oceanic areas where environmental data are notably sparse, weather observation data from Navy ships become particularly vital.

The minimum requirements for taking and reporting environmental observations by Navy and Military Sealift Command (MSC) ships are prescribed in reference (a). Additional requirements are also promulgated in pertinent operation orders (OPORD), plans (OPLANS), and tasking (OPTASK) orders. These plans should be consulted to ensure ships are complying with fleet and operational commander orders. In addition, special weather reporting requirements by ships at sea in specific areas, particularly where tropical cyclones or other large scale disturbances are suspected or known to exist, will be occasionally promulgated by the cognizant area or force commander, or when requested by the supporting Naval Meteorology and Oceanography Command (NAVMETOCCOM) activity.

4. Action. All U.S. Navy ships shall conduct a surface weather observation program as directed by references (a) and (b), and in accordance with guidelines contained in this instruction. Technical questions which arise on matters relating to weather observations should be referred to the Officer in Charge, Fleet Numerical

Meteorology and Oceanography Detachment, 151 Patton Avenue, Asheville, North Carolina 28801-5014. Message address is: FLENUMMETOC DET ASHEVILLE NC//00//, by telephoning (704) 252-7865, or e-mail, fnmodoic@ncdc.noaa.gov.

5. Responsibility for the Manual. Commander, Naval Meteorology and Oceanography Command (COMNAVMETOCCOM) is responsible for maintaining this manual. FLENUMMETOC DET Asheville is tasked by COMNAVMETOCCOM to provide the necessary technical assistance to keep the manual current with the latest observing practices and code changes. Problems noted with the manual should be directed to the detachment through the Commanding Officer, Fleet Numerical Meteorology and Oceanography Center, Monterey, California.

6. Report Symbols and Forms

a. Report symbol CNMOC 3141/3 is assigned to the requirement in paragraph, 1.2.3.1, Section I, Chapter 2.

b. Report symbol CNMOC 3140/2DF is assigned to the requirement in paragraph 1.2.4.1, Section I, Chapter 2.

c. CNMOC Form 3141/3, referred to herein, is available through normal supply channels; stock number 0108-LF-019-3000.

PAUL G. GAFFNEY, II

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APPENDICES

Record of Changes

Change Number	Date of Change	Date Entered	Person Entering Changes

SECTION I - CHAPTER 1

1.0 INTRODUCTION

1.1.1 General. This manual establishes standard instructions for observing, logging, and encoding surface weather data for all U.S. Navy commissioned vessels except submarines. The manual is designed for use by both Aerographer's Mate (AG) and Quartermaster (QM) personnel. This instruction incorporates World Meteorological Organization (WMO) observation requirements for encoding the FM 13 SHIP code.

1.1.2 Organization of Manual

1.1.2.1 Section Contents. Each section is designed to cover encoding or observing procedures for an element or common group of elements.

a. Section I contains general observation program guidance for taking, encoding and transmitting data.

b. Section II contains instructions and information for observing individual elements or groups of common elements of an observation for each column of Part I of CNMOC 3141/3.

c. Section III contains guidance for encoding observed data from each column of Part I to Part II of CNMOC 3141/3. Code tables to support an element or group(s) are contained in the back of each chapter.

1.1.2.2 Application of Instructions. When instructions in a paragraph are not applicable to all observing personnel the paragraph is identified by either (AG) when applicable to Aerographer's Mates only or with (QM) when applicable to Quartermasters only. Notes are provided to explain applicability when necessary.

a. Mandatory Requirements. Paragraphs stating a regulation or procedure that are not marked by (AG) or (QM) apply to all observers.

b. Optional Use. Paragraphs designated as not applicable to an observer may be used by that observer to meet special operational needs or tasks as long as:

(1) The data can be properly observed and encoded.

(2) The instructions call for additional or more precise data than already required (never less).

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SECTION I - CHAPTER 2

1.2 OBSERVATION PROGRAM REQUIREMENTS

1.2.1 Purpose. U.S. Navy ships are required to take and transmit surface weather observations to satisfy a variety of needs.

1.2.2 Observation Equipment. All environmental observations taken by U.S. Navy ships shall be obtained using authorized equipment described in NAVMETTOCCOMINST 13950.1H.

1.2.3 Written Records. All ships at sea are required to take regular observations unless exempted by competent authority. The written record of weather encountered by the ship provides a legal record for use in investigations of accidents and mishaps. It also serves as a convenient log for data disseminated within the ship. Additionally, the forms are permanently archived. They provide an invaluable historical record of weather data for uses such as developing climatology publications and data bases.

a. Where ships are steaming in company or in close proximity (generally within 10 nautical miles), the Officer in Tactical Command (OTC) may designate one of the ships to report observations for the group.

b. Ships in port are required to continue regular weather observing and reporting unless there is a nearby U.S. manned weather reporting activity which meets existing reporting requirements. In port weather guard ship arrangements may be utilized for groups of ships at the discretion of the Senior Officer Present Afloat (SOPA).

c. When a ship is exempted by competent authority from taking observations, make a notation in the remarks section of the Meteorological Records Transmittal Form, CNMOC 3140/2DF, Part B. Indicate the authority who exempted your unit from taking observations, the designated guard ship(s) and effective dates/times exempted (i.e., IAW CTF FOUR ONE 221345Z NOV 96 USS SAGINAW (LST-1188) DESIGNATED WX GUARD SHIP EFFECTIVE 0001Z 23 NOV TO 2359Z 29 NOV 96).

1.2.3.1 Observation Form. All ships taking surface weather observations will use CNMOC Form 3141/3, available through the Naval Supply System, FSN 0108-LF-019-3000. The form is designed for use by all observers. There are two sections to this form, one for the recording of hourly (and special) observations, and the other for recording of three and six hourly encoded synoptic weather observations.

1.2.3.1.1 Part I - Ship Observation Code. This format is designed to support both surface and aviation requirements with additional ship and sea data columns. The World Meteorological Organization (WMO) FM-15 (METAR) and FM-16 (SPECI) formats are used to record

all surface weather observations taken. Ship aviation observations are taken and encoded for local dissemination (via phone, radio, message transmittal, etc.) to departments within the ship, to aircraft operating from the ships' deck, to other ships and aircraft in the operating area, and to shore activities supporting fleet operations. This data is also used to provide weather data for accident and mishap investigations.

1.2.3.1.2 Part II Ship Synoptic Code. The second part of CNMOC 3141/3 is formatted to encode the WMO FM-13 (SHIP) synoptic code. Data is encoded in Part II from observed data recorded in Part I, with some additional observed data required. Part II is encoded for dissemination via naval message.

1.2.3.1.3 Column Organization. Each code (ship observation, ship synoptic) is divided into numbered columns. These columns are divided to contain specific observed elements or portions of observed elements, each element can then be identified by a column number. Part II contains all columns of the WMO FM-13 (SHIP) synoptic code, although not all columns will require an entry by Navy observing personnel.

1.2.3.1.4 Column Applicability. There are minor observation requirements placed on Aerographer's Mates (AG) and Quartermasters (QM); therefore, not all columns will always require an entry. Some columns require an entry in certain types of observations and other columns require an entry only when an element is observed to be present.

1.2.4 Maintenance of Observation Forms. An original and one duplicate of each day's observations are required. The duplicate may be a rewritten copy, a carbon copy, or a suitable photo copy of the original size form. The duplicate should be retained for a minimum of six months, or in accordance with the ship's records retention program.

1.2.4.1 Mailing of Observation Forms. Original observation forms (and barograph charts for ships with barographs) are mailed to:

Officer in Charge, Fleet Numerical Meteorology and Oceanography Detachment, 151 Patton Avenue, Asheville, NC 28801-5014

The Meteorological Records Transmittal Form, CNMOC 3140/2DF (Rev 4/95), FSN 0108-LF-005-0700, available through the Navy Supply System, is to be utilized when sending observation records to FLENUMMETOC DET Asheville. The previous months records shall be packed and mailed by the fifth day of the next month, or as soon as possible thereafter. There is no requirement to submit the Meteorological Records Transmittal Form on a monthly basis. The form is used only to forward observation forms filled out during underway periods.

a. Packing for Mailing. Complete instructions for packing and assembling records for mailing are contained within CNMOC 3140/2DF and shall be followed. Pack the forms and charts flat (do

not fold or roll the forms). These records are photocopied to provide weather data for litigation, research, and data base development. Folded or rolled forms degrades the quality of the records and causes extreme problems during processing for permanent archival.

b. Record Classification and Mailing. Unclassified observation records should be sent by first class mail. All classified records shall be properly packed, properly marked, contain downgrading instructions, and mailed in accordance with OPNAVINST 5510.1H.

1.2.5 Entries on Observation Form. All entries should be made with a black lead pencil (No. 2).

a. Legibility of Entries. CNMOC 3141/3 form is an official document and is the primary record of weather encountered by the ship. All entries must be neat and legible. Avoid write overs and partial erasures that confuse the legibility of the data entered. It is recommended that a folder or board be devised to protect the form between observations.

b. Corrections Made Before Dissemination. Corrections may be made by erasure of the erroneous data only if the data has not been disseminated by any means (phone, radio, message transmittal, etc.). Erase the erroneous data from all copies of the form and enter the correct data in black. (Note: When a carbon copy of the form is made, care must be taken to prevent carbon smudges on the duplicate copy. In such cases, it is advisable to insert a piece of paper or cardboard between the carbon and second copy of the form when erasing data from the original.

c. Corrections made in Part I after Dissemination. If an error is discovered in encoded data after it has been disseminated by any means, the erroneous data may not be erased. Correct the error with a red pencil by drawing a line through the error and entering the correct data above it or on the next line. If space is insufficient, enter the correction in Column 14 with appropriate identification; e.g., SLPRES 969. When possible, disseminate a correction immediately after detecting an error in the transmitted data. Use the same dissemination given the erroneous report. Do not send a correction if the data in error has been updated by a later report with the same or greater dissemination. If a correction is disseminated, enter "COR" in Column 14 followed by the time (to the nearest minute UTC) the correction was disseminated.

d. Corrections Made in Part II after Dissemination. If an error is discovered in encoded data in the Ship Synoptic Message after it has been transmitted, the erroneous data may not be erased. Correct the error with a red pencil by drawing a line through the error and entering the correct data above it or on the next line. If space is insufficient, enter the correction in Column 72 with an appropriate identification; e.g., Nddff 12315. When possible, disseminate a corrected message immediately after

detecting an error in a transmitted report. Use the same dissemination given the erroneous report. When a correction is disseminated, enter "COR" in Column 72 followed by the time of the synoptic observation in question, and the time (to the nearest minute Universal Coordinated Time (UTC)) the corrected message was disseminated.

e. Verification of Disseminated Data. Exercise care to avoid disseminating incorrect data. Check all messages prior to dissemination. Recheck the observation and compare it to the disseminated data.

1.2.6. Quality Control of Records. The accuracy and completeness of entries encoded in both the Ship Observations and Ship Synoptic formats is important to all users of the data. On scene, the safety of ship and aviation operations depend on the accuracy of the observation. **The accuracy of the encoded observation your unit transmits directly contributes to the accuracy of weather analyses, forecasts and warnings your ship receives.**

a. Responsibility for Quality. The individual taking the observation is ultimately responsible for the accuracy of the recorded elements. As manpower permits, observations should be rechecked by another qualified member of the watch team as soon as possible after the observation is recorded. Personnel should not be utilized to check the months observations before mailing for the sole purpose of submitting perfect records.

b. Discrepancy Reports. When observations are received at the Fleet Numerical Meteorology and Oceanography Center (FLENUMMETOCCEN), Monterey, California, they are processed and redistributed to other Navy activities and civil agencies. During processing, the report receives a vigorous data quality check for accuracy. When errors are detected, they are sorted by type and ship name. At the end of each month, FLENUMMETOCCEN prepares a discrepancy listing on transmitted ship synoptic observations, then forwards the requested reports to appropriate Naval Meteorology and Oceanography Command (NAVMETOCCOM) commands conducting fleet liaison visits and to fleet commanders. These reports show apparent weaknesses in encoding observations and areas that might need emphasis during liaison visits, refresher, and On-the-Job Training (OJT). Before final archival, transmitted observations eventually receive a final quality control cross-check with the Shipboard Surface Weather Observations Report, CNMOC Form 3141/3, submitted on a monthly basis to FLENUMMETOC DET Asheville.

1.2.7 Fleet Support. When problems arise with observing equipment (barometer, barograph, anemometer, etc.) that cannot be solved by ship's personnel, assistance may be requested from the nearest NAVMETOCCOM activity outlined in NAVMETOCCOMINST 3140.1J (U.S. Navy Oceanographic and Meteorological Support Manual). Ships are encouraged to schedule visits to NAVMETOCCOM shore activities where additional training on observing techniques and procedures may be obtained.

SECTION I - CHAPTER 3

1.3 WEATHER COMMUNICATION PROCEDURES

1.3.1 General. The timely transmission of weather data provides near real time information which is used immediately by NAVMETOCCOM centers for the production of weather analyses, enroute and aviation weather forecasts (WEAX/AVWX), optimum track ship routing (OTSR), fleet operating area (OPAREA) forecasts and weather warnings.

1.3.2 Message Classification and Minimize Procedures

a. Security requirements and wartime communications doctrine on message classification, downgrading/declassification instructions, and message transmission under MINIMIZE conditions are contained in NTP 3 and NWP 4. **Weather observations are considered significant and should be transmitted during MINIMIZE when the following conditions exist:**

(1) Wind speeds in excess of 25 knots.

(2) Sea state of 12 feet or greater.

(3) Moderate or heavy precipitation.

(4) Pressure change of 3 millibars or greater within the past 3 hours.

(5) Visibility less than 1 mile.

(6) Oceanographic observations as dictated by current operations.

(7) Volcanic activity producing volcanic ash.

b. Special care must be taken to properly classify observations. Most observations are classified due to location information. Declassification may be possible within days or weeks after the observation date. Fleet OPORDS should be consulted for proper observation declassification instructions.

1.3.3. Message Address Procedures. Two Collective Address Designators (CAD) have been established for use by all ships (USN, USNS, U.S. non-Navy) for reporting environmental observations. The appropriate CAD to use depends upon the operating area a ship is in as described below. These addressees automatically receive your observation. Ships should also consult fleet OPORDS which address theater-wide message addressee requirements.

a. **OCEANO WEST**: This CAD is to be used to transmit observations reported in the North Pacific, South Pacific, Persian Gulf, and Indian Ocean, including associated seas and basins; all

areas south of 60S, and surrounding land areas. The cognizant authority for CAD OCEANO WEST is the Naval Pacific Meteorology and Oceanography Center (NAVPACMETOCCEN). The addressees of CAD OCEANO WEST consist of the following:

TO: NAVPACMETOCCEN PEARL HARBOR HI//30//
NAVPACMETOCCEN WEST GU//30//
FLENUMMETOCCEN DATA MONTEREY CA//DATA//
AFGWC OFFUTT AFB NE//WFO//
PACFLT WWMCCS WEATHER PEARL HARBOR HI//JJJ//
NAVEUR WWMCCS OPS LONDON UK//JJJ//

b. OCEANO EAST: This CAD is to be used to transmit observations reported in the North Atlantic, South Atlantic, Gulf of Mexico, Norwegian, Baltic, North, Red, Black, Mediterranean and Caribbean Seas, the Great Lakes, all areas north of 66N in the Pacific and 60N/70N in the Atlantic, and surrounding land areas. The cognizant authority for CAD OCEANO EAST is the Naval Atlantic Meteorology and Oceanography Center (NAVLANTMETOCCEN). The addressees of CAD OCEANO EAST consist of the following:

TO: NAVLANTMETOCCEN NORFOLK VA//30//
NAVEURMETOCCEN ROTA SP//NEMOC//
FLENUMMETOCCEN DATA MONTEREY CA//DATA//
AFGWC OFFUTT AFB NE//WFO//
LANT NCCS WEATHER NORFOLK VA//JJJ//
NAVEURMETOCCEN ROTA SP//30//
NAVEURMETOC DET NAPLES IT//JJJ//

Special Instructions. Ships are to INFO NAVICECEN SUITLAND MD//NIC// on observations taken in Polar regions (greater than 60 degrees), and INFO NAVLANTMETOC DET KEFLAVIK IC//00// for all observations taken in the Atlantic Ocean north of 55 degrees, inclusive of the Labrador, Greenland, Norwegian, Barents and North Seas and Baffin Bay.

1.3.4 Local Transmission. The dissemination of surface weather observation reports within the ship or to other military forces in the operating area, are dictated by ship Standard Operating Procedures (SOP), fleet OPORD or OPTASK orders. Observation data is invaluable information used by the cognizant task group and/or staff oceanographer(s) to develop briefings and to issue forecasts and warnings. They also provide input essential to support fleet weapons systems, aircraft operations, boating, diving, search and rescue operations, and other shipboard evolutions.

SECTION II – CHAPTER 1

2.1 GENERAL

2.1.1 Introduction. This section contains instructions for entering observed data for each of the columns in Part I of CNMOC 3141/3 form. Each column contains a specific element or related elements of the observation. The ship observation code is a standardized format which satisfies Navy weather observation requirements.

As explained in Section I, Chapter 2, paragraph 1.2, the observation becomes the legal record of the weather encountered by Navy ships on a scheduled and unscheduled basis. The data collected for each observation is used by many departments within the ship. Boating, vertical and fixed wing aircraft operations from the ship's flight deck, and other special evolutions, require routine weather observation data. Prompt notification of significant changes in the weather is therefore vital to an evolution's safe accomplishment.

2.1.2 Point of Observation. Observations should be taken from as many points as necessary to give an entire view of the horizon and celestial dome.

2.1.2.1 Preparation for Night Observations. When observing at night, the observer should wear darkness adaptation goggles or glasses for a period of 10 to 15 minutes prior to the observation. This will allow the observer's eyes to become accustomed to darkness. Allow as much time outdoors as practical to ensure that complete adaptation to darkness is made before determining if any weather is occurring or any obstruction to vision is present.

2.1.3 Observation Types. The classification of observation types are described below. The required elements to be observed for each observation type are detailed in Table II-1-1.

2.1.3.1 Routine Observations (METAR). Routine (METAR) weather observations are taken each hour. Required elements are observed within the 15 minutes preceding the hour.

2.1.3.2 Special Observations (SPECI). Special observations (SPECI) are taken to report significant changes in weather elements that affect aircraft operations. Special observations can be taken to report changes in conditions significant to the ship's operations. They are also taken to record the weather conditions at the time of a significant event as listed below:

a. Aircraft mishap.

b. Collision at sea.

c. Man overboard.

d. Other incidents or occurrences specified in the ships standard operating procedures (SOP), or in the opinion of the observer or other competent authority (i.e., CO, NAV, OOD, etc.), requires a written record of weather conditions at the time.

2.1.4 Beginning of New Forms. A new CNMOC 3141/3 form will be started at 0001 Universal Coordinated Time (UTC) each day. The 2355-2359 observation will be the first observation of the new day. If Part I of the form is filled in before the day is over, continue logging observations on a new form. Ensure the second form's heading is filled out completely. Continue to make entries in column 90 and Part II on the first form. The following section gives instructions on entering general information necessary for entry on each CNMOC 3141/3 form.

2.1.4.1 Form Heading. The heading consists of six parts, the date, month, and year, ship's callsign, ship's name, and the rate of the observer.

a. Date - Enter the date in UTC, i.e., the date will change at 0001 (UTC) when a new form is started (DD).

b. Month - Enter the month as a three letter abbreviation (APR, AUG, etc.) (MMM).

c. Year - Enter the four digits of the year (YYYY).

d. Call Sign - Enter the ship's four letter call sign (DDDD).

e. USS or USNS - Enter the ship's full name, ship type and hull number on each form used.

f. Aerographers Mate (AG)/Quartermaster (QM) - Check the appropriate box for the rating of the personnel taking the observations. Check "OTHER" box if MSC personnel are taking the observation.

g. Observer's Initials - The initials of the qualified observer responsible for taking the observation is entered in column 15 of the form. Observer qualifications are to be completed and documented in applicable Personnel Qualification Standards (PQS) or other local job qualification requirements (JQR).

2.1.5 Ship Synoptic Code. The WMO FM-13 (SHIP) code is routinely encoded for message transmission at the standard synoptic hours of 0000Z, 0600Z, 1200Z, and 1800Z. Additional observation reports are transmitted at asynoptic hours of 0300Z, 0900Z, 1500Z, and 2100Z, in accordance with this instruction, applicable fleet operation orders (OPORD), operational tasking (OPTASK) orders, or at the discretion of the unit when unusual or significant weather phenomena are encountered. Transmission precedence assigned to these messages are in accordance with NAVOCEANCOMINST 3140.1J. Complete instructions for encoding a synoptic weather report are contained in Section III.

REQUIRED CONTENT OF SHIP OBSERVATIONS LOGGED ON CNMOC FORM 3141/3

COLUMN		TYPE OF OBSERVATION METAR	SPECI		
1	Type of Observation	X	X	(*)	(**)
2	Date and Time of Observation	X	X	(*)	(**)
3	Wind Direction	X	X	(*)	(**)+
4	Wind Speed	X	X	(*)	(**)+
5	Wind Character	X	X	(*)	(**)+
6	Variability	X	X	(*)	(**)+
7	Visibility	X	X	(*)	(**)+
9	Weather & Obstructions to Vision	X	X	(*)	(**)+
22a	Sea Level Pressure	X			
11	Temperature	X		(*)	(**)+
12	Dewpoint	X		(*)	
20	Wet Bulb	X		(*)	
13	Altimeter Setting	X	X	(*)	
14	Remarks	X	X	(*)	(**)+
15	Observer's Initials	X	X	(*)	(**)+
22	Station Pressure	X			
17	Total Sky Cover	X		(*)	
A	Position	X	X	(*)	(**)
B	Ship Course	X	X	(*)	(**)
C	Ship Speed	X	X	(*)	(**)
D	Sea Water Temperature	X	X		(**)+
E	Sea Waves	X		(*)	(**)+
F/G	Swell Waves	X		(*)	(**)+

NOTES:

AG and QM personnel take METAR and SPECI observations.

QM personnel may be required to compute Column 13 - Altimeter Setting data for aircraft operations.

(*) Observations taken for aircraft mishaps or collision at sea.

(**) Observations taken for other requirements. " + " denotes selected parameters that should be recorded as dictated by competent authority or when conditions are significant in the opinion of the observer.

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SECTION II - CHAPTER 2

2.2 OBSERVATION PROCEDURES AND FORM ENTRIES -- Columns 1 and 2

2.2.1 Column 1 -- Type of Observation. Enter the two letter designator for type of observation taken.

a. ME - Routine Observation (METAR).

b. SP - Special Observation (SPECI).

c. LO - Local Observation

2.2.2 Column 2 -- Time of Observation. Enter the time in four digits for hours and minutes UTC (e.g., 1955).

a. Time of a Routine Observation (METAR). Enter the time the last element of the observation was observed (usually pressure). This time will be within five minutes prior to the hour for which the observation is taken, i.e., minutes 55 thru 59, never 00. Note that all the elements of a record observation will begin within the 15 minutes of the hour for which the observation is taken. Enter ME in Column 1 but when transmitted, encode METAR.

b. Time of a Special Observation (SPECI). Enter the time the weather event occurred or was first observed to be occurring that required the observation to be taken. Refer to Table II-2-1 for special observation requirements. Enter SP in Column 1 but when transmitted, encode SPECI.

c. Time of a Local Observation. When a significant event such as an aircraft mishap requires the local observation to be taken, the time entered will be the time that the event occurred. When local policy dictates that a local observation be taken, the time entered will be the time that the last element of the observation was observed. Enter L in Column 1 but do not transmit.

TABLE II-2-1

SPECIAL OBSERVATION CRITERIA

CEILING

The ceiling is observed to form or dissipate below, decrease to less than or, if below, increase to equal or exceed: **3,000, 1,500, 1,000, 500, or the lowest standard instrument approach procedure minimum as published. If none published, use 200 feet..**

SKY CONDITION

A layer of clouds or obscurations aloft is observed below **1,000** feet and no layer aloft was reported below 1,000 feet in the preceding METAR or SPECI observation.

VISIBILITY

Prevailing visibility in nautical miles is observed to decrease to less than or, if below, increases to equal or exceed: **3, 2, 1 mile, or the lowest standard instrument approach procedure minimum as published. If none published, use 1/2 mile.**

TORNADO, FUNNEL CLOUD, or WATERSPOUT

Is observed or disappears from sight.

THUNDERSTORM

1. **Begins**. A SPECI is not required to report the beginning of a new thunderstorm if one is currently reported as in progress at the station.

2. **Ends** (15 minutes after last occurrence of criteria for a thunderstorm).

AIRCRAFT MISHAP

Upon notification of an Aircraft Mishap unless there has been an intervening observation.

WIND SHIFT

Any wind direction change of 45 degrees or more in less than 15 minutes and the wind speed is 10 knots or more throughout the wind shift.

TABLE II-2-1
(page 2)

SPECIAL OBSERVATION CRITERIA
(Continued)

PRECIPITATION

1. Hail begins, ends or 3/4 inch or greater is observed.

2. Freezing precipitation begins, ends, or changes in intensity.

3. Ice Pellets begin, end, or change in intensity.

4. Any other type of precipitation begins or ends.

Note: Except for freezing rain, freezing drizzle, hail, and ice pellets, a Special is not required for changes in type (e.g., drizzle changing to snow grains) or the beginning/ending of one type while another is in progress (e.g., snow changing to rain and snow).

SQUALLS

When squalls occur.

VOLCANIC ERUPTION

When eruption is first noted.

MISCELLANEOUS

Any other meteorological situation which, in the opinion of the observer, is critical to the safety of aircraft operations.

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SECTION II - CHAPTER 3

2.3 OBSERVATION PROCEDURES AND FORM ENTRIES -- Columns 10 and 17 SKY CONDITION

2.3.1 Introduction. This section contains instructions on observing the condition of the sky and making entries on CNMOC 3141/3 form, Columns 10 and 17. Instructions and code tables for encoding sky condition in the synoptic report are contained in Section III.

The sky condition consists of clouds and obscurations (aloft and at the surface), type, amount of coverage (total and individual layer), and height of each layer above the sea surface.

2.3.2 Type of Clouds

a. Clouds are divided into three levels; low, middle, and high, based on height. There are basically two forms of clouds, stratiform and cumuliform. These levels appear at different heights in different latitude regions.

(1) Stratiform clouds consist of low clouds (stratus, stratocumulus), mid clouds (altostratus and nimbostratus) and high clouds (cirrostratus).

(2) Cumuliform clouds consist of low clouds (cumulus, cumulonimbus, stratocumulus) mid clouds (altocumulus) and high clouds (cirrocumulus). Stratocumulus has characteristics of both stratus and cumulus clouds. Cirrus, a high cloud, does not fit into either form.

2.3.3 Obscurations. Obscurations can either be aloft or at the surface. Definitions of obscurations are covered in Section II, Chapter 5. Types of obscurations are listed in Figure II-3.1. Any layer of obscurations aloft which covers 1/8 or more of the sky is considered in sky condition. Surface based obscurations and those within 50 feet of the surface which are obscuring 1/8 or more of the sky, are also reported as in sky condition with a height of 000.

2.3.3.1 Obscurations Aloft. Includes haze, dust, and smoke. Hydrometers (liquid or frozen water particles falling through or suspended in the atmosphere) are never classified as obscurations aloft. Precipitation falling from a cloud but not reaching the surface (virga) is considered as part of the cloud the precipitation is falling from.

2.3.3.2 Surface Based Obscurations. Includes fog, haze, dust, blowing dust, sand, snow, and spray. Precipitation reaching the surface often obstructs part of the sky. When fog lifts (dissipates at the surface) leaving a low layer of clouds such as stratus fractus, the layer is a cloud, not fog aloft.

2.3.4 Observing Cloud/Obscuration Type. The type of cloud or obscuration is determined visually by using Figure II-3.2 and Tables II-3-2 and II-3-8, or through the observer's experience. Once the form of the cloud is determined (Stratiform or Cumuliform), the height of the cloud will determine the type (low, middle (Alto) or high (cirro)). Most of the small, well-defined and regularly arranged elements of Altocumulus will usually have an apparent width between one and five degrees (disregarding detached elements generally seen on the edges). The cloud is generally considered as Stratocumulus if the width of elements is greater than five degrees, and as Cirrocumulus, if the width is less than one degree. When the arm is held extended, one and five degrees are approximately the width of the little finger and the width of three fingers, respectively.

2.3.5 Sky Cover Amounts. Sky cover amounts are determined for the following:

a. Total sky, covered by all obscurations and all clouds. This total is placed in Column 17.

b. Total sky, covered by all clouds for inclusion in the ship synoptic code as N. Ignore obscurations aloft and surface based obscurations that do not cover a full 8/8 of the sky.

c. Layer amounts using the Summation Principle. The amount of the lowest layer to the nearest 1/8 sky cover. The summation amounts of the layers above the lowest layer are determined for each layer present. The summation amount of the second layer is the amount of the lowest layer plus the amount of the second layer that is visible. Each successively higher layer is totaled by adding the summation total of the layer below it, plus the amount of that layer that is visible. No layer can be assigned a sky cover less than a lower layer, and no sky cover can be greater than 8/8.

(1) The summation layer amount is determined for each layer present in column 10.

(2) The summation total of all low clouds (the summation amount of the highest layer of low clouds) is determined for inclusion as N_h in the ship synoptic code. If no low clouds are present, this will be the summation total of all middle clouds (the summation amount of the highest layer of middle clouds).

2.3.5.1 Determining Sky Cover Amounts. Estimate the amount of sky cover on the basis of experience and using the following methods as a guide.

a. In order to develop experience in determining sky cover amounts, mentally divide the sky into halves or quarters and estimate the amounts in each section. The sections should be selected to suit the prevailing sky condition, and the amount of

each layer is estimated by supposing the clouds present in the layer to be brought together into a continuous sheet.

b. During darkness, consider the sky to be clear if stars are plainly visible in all sections and no cloud or obscuration is observed. When the stars are dimmed, the dimming is evidence of the presence of cloud or obscuration and will be of assistance in determining the amount and opacity of the layer. Reflection (sky glow) from a city or other lights may be useful in estimating the amount of low cloud layers.

c. To estimate the amount of an advancing (or receding) layer, determine the angular elevation above the horizon of the forward or rear edge of the layer as seen against the sky. If available, use a theodolite or clinometer to help gain experience in estimating vertical angles. Convert the angle to a sky cover amount using Table II-3-1. When the layer does not extend to the horizon, determine the angular elevation of the forward and rear edges and the tenths of sky cover corresponding to each elevation angle. The difference will equal the actual sky cover. For example:

Forward edge, 78°	4/10
Rear edge, 53°	2/10
Difference (actual sky cover)	2/10

d. When a continuous layer surrounds the station and extends to the horizon, determine the angular elevation of the edge, and convert it to a sky cover amount using Table II-3-1. This method is most useful in determining the amount of sky hidden for a partly obscured condition. For clouds, such a distribution is very infrequent and the tables serve only as a guide in estimating amounts during situations that approach this configuration.

e. In sky cover evaluations, cumuliform clouds tend to produce a "packing effect" when the sides and tops are visible, appearing more numerous toward the horizon. Do not make allowance for the packing effect in determining sky cover amounts. Estimate the layer sky cover on the basis of the amount of sky actually covered including the sky covered by both the base and sides of the clouds).

f. Interconnection of Layers. When clouds formed by the horizontal extension of swelling Cumulus or Cumulonimbus are attached to a parent cloud, they are regarded as a separate layer only if their bases appear horizontal and at a different level than the base of the parent cloud. Otherwise, the entire cloud system is regarded as a single layer at a height corresponding to that of the base of the parent cloud.

2.3.5.2 Evaluation of Sky Cover Amounts. Evaluate sky cover amounts as follows, beginning with the lowest layer and proceeding in ascending order of height. All clouds are considered opaque.

a. Estimate the amount of sky cover for the lowest layer present. If this layer is a surface-based, it will be coded as zero

height, i.e., FEW000. Consider a trace of cloud as 1/8th when it is the lowest layer.

b. For each additional layer of sky cover present above the lowest layer, estimate the amount of sky cover for the individual layer summation sky cover, and the summation total sky cover.

2.3.5.3 Sky Cover Classifications for Ship Observations. The terms used to reflect the degree of cloudiness or sky coverage in sky condition evaluations.

a. Sky Clear (SKC). An abbreviation used to describe the absence of layers of clouds or other obscurations.

b. Few (FEW). A sky cover of 1/8 to 2/8, based on a summation of sky cover at and below the level of a layer aloft.

c. Scattered (SCT). A sky cover of 3/8 through 4/8, based on a summation of sky cover at and below the level of a layer aloft.

d. Broken (BKN). A sky cover of 5/8 through less than 8/8 based on a summation of sky cover at and below the level of a layer aloft. More than 7/8 but less than 8/8 is considered as 7/8 for reporting purposes.

e. Overcast (OVC). A sky cover of 8/8 based on a summation of sky cover at and below the level of a layer aloft.

2.3.5.4 Determination of Ceiling Layer. In conjunction with the determination of sky cover amounts, evaluate the sky condition for the existence of a ceiling. The ceiling is defined as the height ascribed to the lowest broken or overcast layer, or the vertical visibility into surface-based obscuration. Surface based obscurations can have their heights determined by the following methods:

a. The height of visible portions of nearby ships or land mass of known height.

b. The vertical distance the observer can see upward into an obscuration, based on experience and visual estimates when other guidelines are not available or are considered unreliable.

c. The top of a ceiling light beam, or the height at which a balloon completely disappears.

d. The maximum vertical height above the sea within 15 minutes of the actual time of observation at which a pilot can discern the surface. The height value should not be used if, in the judgment of the observer, it is not representative of conditions over the ship.

2.3.6 Determination of Layer Heights. Determine the height for each layer aloft and for the vertical visibility into surface based obscurations which totally obscures the sky. A height value is not

determined for a partly obscured layer. Use the most accurate and reliable method available (ceiling light, balloon, pilot report, etc.). Determine height data in feet above the sea surface to the nearest reportable value as specified in Table II-3-2.

2.3.6.1 Ceiling Light Evaluations. If available for use, the following instructions summarize procedures for use of a ceiling light projector and clinometer in determining height data at night.

a. Stand at the established point of observation for the baseline in use. For a layer aloft, note the location of the lowest portion of the spot of light on the base of the layer (the remainder of the spot or beam of light represents penetration of the layer). For a surface-based layer, the apparent top of the beam of light may serve as a guide in estimating vertical visibility. Multiple layers may be noticeable by the appearance of two or more spots at different levels.

b. Allow the clinometer pendant to swing freely, and sight through the clinometer. Center the intersection of the cross-hair on the brightest portion of the light beam spot (for a layer aloft) or on the upper limit of the light beam penetration (for a totally obscured condition).

c. When the pendant has come to rest, lock it in position without moving the clinometer.

d. Read the indicated angle to at least the nearest whole degree and release the pendant clutch.

e. Obtain a minimum of three angular readings and determine the average.

f. Refer to the table appropriate for the baseline used and determine the equivalent height value for the average angular reading.

2.3.6.2 Preparation of Sky Cover Height Tables. For a ceiling light, using Table II-3-3 as a guide, prepare tables of elevation angles and equivalent height values for each baseline established for use. Include appropriate identification data for subsequent reference purposes; i.e., length of baseline and ceiling light elevation above the sea surface.

a. Compute tabular values for ceiling light baselines on the basis of h = (b) (tan -); where 'b' is the baseline, " - " is the angular reading, and "h" is the sky cover height value. (See Table II-3-3 for angles and the respective tangents).

b. Algebraically add the difference between the height of the observation site and sea level to each tabular value.

c. Round each of the sums to the nearest reportable height increment contained in Table II-3-2.

2.3.6.3 Balloon Height Evaluations. On ships equipped for balloon inflation, ceiling or pilot balloons can often be utilized to obtain sky cover height data when the ceiling height is estimated or known to be 2,000 feet or less and the presence of Nimbostratus or other stratiform cloud layers makes estimation difficult.

a. Release balloons at a frequency dictated by operational need and consistent with changes in ceiling height which have occurred since the last ceiling determination was made, particularly in relation to special and local observation criteria.

b. The following instructions summarize the steps involved in obtaining balloon height estimates.

(1) Choose the appropriate color of balloon. Red balloons are usually preferable with thin clouds; blue or black balloons should be used under other conditions.

(2) Watch the balloon continuously and determine, with a stop watch (or any watch having a second hand), the length of time that elapses between release of the balloon and entry into the base of the layer. Consider the point of entry as midway between the time the balloon first begins to fade and the time of complete disappearance for layers aloft. Use the point at which the balloon disappeared as a guide in estimating the vertical visibility in a totally obscured condition.

(3) Using Table II-3-4 (or a locally prepared table), determine the height above the point of observation corresponding to the nearest 5 seconds of elapsed ascent time.

(4) Algebraically add to the tabular value the difference between the height of the observation site and the sea surface, and round off the result to the nearest reportable height increment. (NOTE: This step is not applicable to locally prepared tables in which the tabular values have been corrected for the difference in elevation).

c. The relative accuracy of height data obtained by balloon may be adversely affected by conditions such as those indicated below and, therefore, data must be used with caution.

(1) The balloon rate of ascent is significantly reduced by rain and wet snow, hail, ice pellets, and freezing rain, and at night when a light is attached.

(2) Strong winds with poor horizontal visibility may result in too low an indication of height. The large horizontal movement of the balloon in flight and the reduced visibility may make it appear that the balloon entered the cloud before it actually did so.

(3) Entry into an unrepresentative portion of the cloud base, or through a break in the layer, may result in inaccurate

height evaluations. If time allows, another balloon should be released in an attempt to hit the cloud base.

2.3.6.4 Estimation of Cloud Heights. When cloud heights cannot be determined by ceiling light, ceiling balloon or pilot report, they must be visually estimated using the experience of the observer, following the guides below.

a. The apparent size of cloud elements, rolls or features visible in the layer. Large rolls or elements usually indicate that the layer is relatively low while small rolls or elements usually indicate that the layer is relatively high.

b. Reflection of city or other lights at night may serve not only to indicate the presence of a layer but may be useful as a guide in estimating its height.

c. Persistence of a layer height previously classified as measured will aid in estimation and build observer confidence in estimations.

d. Use Table II-3-5 to aid in estimating the height of new forming cumulus. This table uses the difference between the air temperature and the dew point temperature. The table assumes the cumulus is being formed by active surface convection in the vicinity of the ship (not frontal activity). The table should not be used when the surface temperature is below freezing due to the difficulties inherent in the accurate determination of the dew point at low temperatures.

2.3.7 Column 10 - Sky and Ceiling Data Entry

a. Enter sky cover data in accordance with instructions in the following subparagraphs. Enter data for each layer of clouds and obscuration present at and below the highest reportable layer visible. Make entries in ascending order of the height for the base of each layer. Include a space between each layer; e.g., SCT005 OVC012. Use an additional line if more space is needed. The maximum number of layers reported shall be no more than six layers. Additionally, all layers composed of cumulonimbus or towering cumulus shall be identified by appending the contractions **CB** and **TCU**, respectfully.

2.3.7.1 Ceiling Designators. Ceiling height designators are not used. The lowest broken or overcast layer is considered the ceiling. Remember, all clouds are considered opaque and the summation principle applies.

2.3.7.2 Height of Sky Cover. Suffix each sky cover contraction (except SKC) with the height in hundreds of feet above the surface (field or ground elevation, as appropriate) using the increments shown in Table II-3-6. Encode height values which are halfway or less than halfway between reportable values as the lower reportable value (e.g., 2550 and 2525 are both reported as 2500). Cloud height values which are more than halfway between reportable values are

reported as the higher of the reportable values (e.g., 2560 and 2580 are both reported as 2600). When a cloud layer is not in contact with the surface but is 50 feet or less above the surface, the height shall be reported as 000.

2.3.7.3 Ceiling. The lowest layer that is reported as broken or overcast shall be the ceiling. If the sky is totally obscured, the height of the vertical visibility shall be the ceiling.

2.3.7.4 Indefinite Ceiling Height (Vertical Visibility). The height into an indefinite ceiling shall be the vertical visibility measured in hundreds of feet.

2.3.7.5 Vertical Visibility. Vertical Visibility shall be either:

(a) The distance that an observer can see vertically into an indefinite ceiling;

(b) The height corresponding to the top of a ceiling light projector beam; or

(c) The height at which a balloon completely disappears during the presence of an indefinite ceiling.

2.3.7.6 Variable Ceiling. When the ceiling height is less than 3,000 feet and increases and decreases rapidly during the period of observation by the amounts given in Table II-3-7, it shall be considered variable "V" and the abscribed height shall be the average of all observed values. Enter the range of variability in Column 14 Remarks of the observation.

2.3.7.7 Sky Cover Contraction. Enter sky cover using the appropriate contraction or combination of contractions from Table II-3-8.

2.3.8 Column 17 - Total Sky Cover Entry. Enter the total sky cover amount in each record (ME/SP) observation. This amount is entered as a whole number and cannot exceed 8 for "8/8". Enter the eights of sky covered (not necessarily hidden) by all clouds and obscuring phenomena aloft, and of sky hidden by surface-based obscuring phenomena, as observed at the station. For example, enter "6" for 6/8, "0" for clear, "1" for 1/8 (and for a trace of cloud), "7" for 7/8 or more but less than 8/8. When referencing sky cover amount contractions use "0" for SKC, "2" for FEW, "4" for SCT, "6" for BKN, and "8" for OVC.

FIGURE II-3.1

OBSCURATIONS

OBSCURATION	ABBREVIATION
Precipitation (Hydrometeor):	
Drizzle	DZ
Freezing Drizzle	FZDZ
Hail	GR
Ice Crystals	IC
Ice Pellets	PE
Ice Pellet Showers	SHPE
Rain	RA
Freezing Rain	FZRA
Rain Showers	SHRA
Snow	SN
Snow Pellets	GS
Snow Grains	SG
Snow Showers	SHSN
Hydrometeors Other Than Precipitation:	
Blowing Snow	BLSN
Blowing Spray	BLPY
Fog	FG
Shallow Fog	MIFG
Partial Fog	PRFG
Patches of Fog	BCFG
Freezing Fog	FZFG
Lithometeors:	
Dust	DU
Blowing Dust	BLDU
Haze	HZ
Sand	SA
Blowing Sand	BLSA
Smoke	FU
Volcanic Ash	VA

TABLE II-3-1

Sky Cover Evaluation in Tenths

Angle of Advancing or Receding Layer Edge	Tenths of Sky Cover	Angular Elevation of Layer Surrounding Station
Trace to 45°	1	Trace to 8°
46° to 59°	2	9° to 14°
60° to 72°	3	15° to 20°
73° to 84°	4	21° to 26°
85° to 95°	5	27° to 33°
96° to 107°	6	34° to 40°
108° to 119°	7	41° to 48°
120° to 134°	8	49° to 58°
135° to less than 180°	9	59° to less than 90°
180°	10	90°

Sky Cover Evaluation in Eighths

Angle of Advancing or Receding Layer Edge	Eights of Sky Cover	Angular Elevation of Layer Surrounding Station
Trace to 50°	1	Trace to 10°
51° to 68°	2	11° to 17°
69° to 82°	3	18° to 24°
83° to 98°	4	25° to 32°
99° to 112°	5	33° to 41°
113° to 129°	6	42° to 53°
130° to less than 180°	7	54° to less than 90°
180°	8	90°

TABLE II-3-2

Reportable values for Layer Heights

Code	Feet	Meters	Code	Feet	Meters	Code	Feet	Meters
	0-50	0-15	30	3,000	900	100	10,000	3,000
1	100	30	31	3,100	930	110	11,000	3,300
2	200	60	32	3,200	960	120	12,000	3,600
3	300	90	33	3,300	990	130	13,000	3,900
4	400	120	34	3,400	1,020	140	14,000	4,200
5	500	150	35	3,500	1,050	150	15,000	4,500
6	600	180	36	3,600	1,080	160	16,000	4,800
7	700	210	37	3,700	1,110	170	17,000	5,100
8	800	240	38	3,800	1,140	180	18,000	5,400
9	900	270	39	3,900	1,170	190	19,000	5,700
10	1,000	300	40	4,000	1,200	200	20,000	6,000
11	1,100	330	41	4,100	1,230	210	21,000	6,300
12	1,200	360	42	4,200	1,260	220	22,000	6,600
13	1,300	390	43	4,300	1,290	230	23,000	6,900
14	1,400	420	44	4,400	1,320	240	24,000	7,200
15	1,500	450	45	4,500	1,350	250	25,000	7,500
16	1,600	480	46	4,600	1,380	260	26,000	7,800
17	1,700	510	47	4,700	1,410	270	27,000	8,100
18	1,800	540	48	4,800	1,440	280	28,000	8,400
19	1,900	570	49	4,900	1,470	290	29,000	8,700
20	2,000	600	50	5,000	1,500	300	30,000	9,000
21	2,100	630	55	5,500	1,650	310	31,000	9,300
22	2,200	660	60	6,000	1,800	320	32,000	9,600
23	2,300	690	65	6,500	1,950	330	33,000	9,900
24	2,400	720	70	7,000	2,100	340	34,000	10,200
25	2,500	750	75	7,500	2,250	350	35,000	10,500
26	2,600	780	80	8,000	2,400	etc.	etc.	etc.
27	2,700	810	85	8,500	2,550	990	99,000	29,700
28	2,800	840	90	9,000	2,700	999	100,000	30,000
29	2,900	870	95	9,500	2,850		or more	or more

TABLE II-3-3

Conversion of Elevation Angles to Layer Height

Compute tabular values for ceiling light baselines on the basis of h = (b) (tan (a)); where 'b' is the baseline, " a " is the angular reading, and "h" is the sky cover height value.
Ex: tan (a) (70 deg or (2.7475)) X baseline (b) 400 ft = (h)

2.7475 X 400 = 1099.0 or 1100 ft (reportable value)

1	.0175	31	.6009	61	1.8040
2	.0349	32	.6249	62	1.8807
3	.0524	33	.6494	63	1.9626
4	.0699	34	.6745	64	2.0503
5	.0875	35	.7002	65	2.1445
6	.1051	36	.7265	66	2.2460
7	.1228	37	.7536	67	2.3559
8	.1405	38	.7813	68	2.4751
9	.1584	39	.8098	69	2.6051
10	.1763	40	.8391	70	2.7475
11	.1944	41	.8693	71	2.9042
12	.2126	42	.9004	72	3.0777
13	.2309	43	.9325	73	3.2709
14	.2493	44	.9657	74	3.4874
15	.2679	45	1.0000	75	3.7321
16	.2867	46	1.0355	76	4.0108
17	.3057	47	1.0724	77	4.3315
18	.3249	48	1.1106	78	4.7046
19	.3443	49	1.1504	79	5.1446
20	.3640	50	1.1918	80	5.6713
21	.3839	51	1.2349	81	6.3138
22	.4040	52	1.2799	82	7.1154
23	.4245	53	1.3270	83	8.1443
24	.4452	54	1.3764	84	9.5144
25	.4663	55	1.4281	85	11.4301
26	.4877	56	1.4826	86	14.3007
27	.5095	57	1.5399	87	19.0811
28	.5317	58	1.6003	88	28.6363
29	.5543	59	1.6643	89	57.2900
30	.5774	60	1.7321		

NOTE:
Height values are obtained on the basis of h = (b) (tan 0). Enter tabular values with reference to field elevation; i.e., algebraically add the difference between height of point of observation (or projector trunnion) and field elevation.

TABLE II-3-4

Balloon Ascension Rates 10-gram Spherical/30-gram Pibal

Time in Minutes and Seconds	Day[1]	Day[1,4]	Night[4,5]	
	Nozzle lift 40-gr H or 43-gr He	Nozzle lift 45-gr He	Nozzle lift 125-gr H or 139-gr He	Nozzle lift 170-gr H or 192-gr He
0:10	80	80		120
0:20	170	170		240
0:30	250	250		350
0:40	330	330		470
0:50	400	420		590
1:00	480	500		710
1:10	540	580		820
1:20	610	650		930
1:30	670	730		1,030
1:40	730	810		1,140
1:50	790	880		1,250
2:00	850	960		1,360
2:30	1,030	1,190		1,680
3:00	1,210	1,420		2,010
3:30	1,390	1,650		2,320
4:00	1,570	1,880		2,630
4:30	1,750	2,090		2,940
5:00	1,930	2,300		3,250
5:30	2,110	2,510		3,540
6:00	2,290	2,720		3,840
6:30	2,470	2,930		4,130
7:00	2,650	3,140		4,430
7:30	2,830	3,350		4,720
8:00	3,010	3,560		5,020

NOTES:

1. The daytime table for 10-gram and 30-gram balloons may be used at night when the ML-608 lighting unit is used and attached prior to inflation.
2. Add 180 feet for each additional one-half minute after 8 minutes.
3. Add 210 feet for each additional one-half minute after 8 minutes.
4. Add 295 feet for each additional one-half minute after 8 minutes.
5. Attach lighting unit after inflation.

TABLE II-3-5

APPROXIMATE HEIGHT OF NEW FORMING CUMULUS

Temperature Dew Point Spread (°F)	Estimated Height of Cumulus in Feet
1	200
2	500
3	700
4	900
5	1100
6	1400
7	1600
8	1800
9	2000
10	2300
11	2500
12	2700
13	3000
14	3200
15	3400
16	3600
17	3900
18	4100
19	4300
20	4500
21	4800
22	5000

TABLE II-3-6

REPORTABLE CLOUD HEIGHT VALUES

Range of Height Values	Reportable Increment
5,000 ft or less	To the nearest 100 feet
5,001 ft to 10,000	To the nearest 500 feet
Above 10,000 ft	To the nearest 1,000 feet

TABLE II-3-7

CRITERIA FOR VARIABLE CEILING

CEILING (FEET)	VARIATION (FEET)
$\leq$ 1,000	$\geq$ 200
> 1,000 and $\leq$ 2,000	$\geq$ 400
$\geq$ 2,000 and $\leq$ 3,000	$\geq$ 500

FIGURE II-3.2

CLOUD HEIGHT RANGES

REGIONS	POLAR	TEMPERATE	TROPICAL
C_L			
NORMAL HEIGHT RANGE	SFC-6,500 SFC-1,981	SFC-6,500 SFC-1,981	SFC-6,500(FT) SFC-1,981(M)
C_M			
NORMAL HEIGHT RANGE	6,500-13,000 1,981-3,962	6,500-13,000 1,981-3,962	6,500-13,000(FT) 1,981-3,962 (M)
C_H			
NORMAL HEIGHT RANGE	10,000-25,000 3,048-7,620	16,500-45,000 5,029-13,716	20,000-60,000(FT) 6,096-18,288(M)

TABLE II-3-8

SKY COVER CONTRACTIONS

CONTRACTIONS USED TO REPORT SURFACE BASED PHENOMENA

Summation Amount	Contraction	Remarks
8/8 Surface Based Obscurations	VV	Vertical visibility. Height value is always after the contraction.

CONTRACTIONS USED TO REPORT LAYERS ALOFT

Clear	SKC	No height value required.
1/8 through 2/8	FEW	Height value is indicated after the contraction.
3/8 through 4/8	SCT	Height value is indicated after the contraction.
5/8 through less than 8/8	BKN	Height value is indicated after this contraction.
8/8	OVC	Height value is indicated after this contraction.

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SECTION II - CHAPTER 4

2.4 OBSERVATION PROCEDURES AND FORM ENTRIES -- Column 7 - VISIBILITY

2.4.1 Introduction. This chapter contains procedures for determining horizontal surface visibility at or near sea level. Weather and obstructions to vision which affect visibility are also discussed in Section II Chapter 5. Procedures and tables for encoding visibility in the synoptic report are contained in Section III.

(AG) 2.4.1.1 Uniqueness of Instructions. Because of the lack of fixed visibility markers some of the procedures and instructions in this chapter differ from instructions and procedures used at land stations.

2.4.1.2 Surface Visibility at Sea. Surface visibility is the maximum distance that objects of known characteristics can be identified in one half or more of the horizon circle when viewed in a nearly horizontal plane from the point of observation to 6 feet/1.8 meters above the surface at the horizon (the furthest distance that can be seen around the ship). When the term visibility is modified by terms such as prevailing, sector, variable, unrestricted, etc., the term is still in reference to surface visibility.

2.4.1.3 Units of Measure. Visibility observed from a ship is reported in nautical miles (NM) using the reportable values given in Table II-4-1. The visibility may be observed in meters or yards but must be converted to nautical miles for reporting.

a. Rounding to Reportable Values. If the observed visibility is determined to be between two reportable values the visibility should be rounded down to the lower reportable value.

b. Limitations on Reportable Values. Due to the curvature of the earth and the relative flatness of the ocean, the distance from the ship to the horizon with unrestricted visibility is limited. A maximum value for reporting visibility at sea has been set at 10 NM.

2.4.1.4 Point of Observation. Visibility observations should be taken from as many points as necessary to give an entire view of the horizon and from a point as close to the surface as practical to get the most accurate observation of surface visibility; i.e., the visibility should not be observed from the signal bridge if it is possible to observe it from a lower level.

2.4.2 Visibility Aids. Because of the ship's mobility, the surrounding environment is constantly changing while the ship is underway. This makes identification of permanent visibility markers

impossible to construct. Therefore, the presence of possible visibility aids must be evaluated before each observation is taken.

2.4.2.1 Visibility Aids at Sea. When available, the following aids should be utilized when observing visibility underway.

a. Landmass (coastline or island). When the ship is operating near the coastline or in the vicinity of islands, the observer should check navigation charts or radar to see if the landmass is close enough to the ship to be used as an aid to determine visibility. Determine the direction and distance from the ship and the presence of prominent features from navigation charts, such as hills, towers, and cities/towns, etc.

b. Ships. When other ships are in company, or transiting the area, the observer should determine their direction and distance from the ship (usually by radar) and use them as visibility aids.

c. Rain Showers. Often, rain showers of moderate or heavy intensity will have clearly defined edges and can be used as visibility aids. These showers show up well on radar, making the direction and distance from the ship relatively easy to determine.

d. Horizon and Sea Surface. When none of the above aids are present, observers must estimate visibility by judging the clarity of the line of the horizon (the line between sea and air) to determine if the visibility is unrestricted (6 NM or greater) or restricted (less than 6 NM) by an obstruction or weather occurring at the ship or at a distance.

2.4.2.2 Constructing Visibility Aids for Port and Anchorage. When ships are anchored or moored inport, a chart of easily identifiable visibility markers should be constructed and posted for use by the observer, bridge, and quarterdeck watchstanders. This chart will be particularly useful to the quarterdeck Officer of the Deck (OOD), as well as the boat Coxswain for determining visibility when boat operations are being conducted. All available aids must be used to determine the visibility as accurately as possible.

a. As a minimum, the chart should extend 10 NM around the position of the ship with the ship as the center. The coastline may be highlighted and positions of landmarks such as towers, bridges, and prominent buildings should be identified along with their distance and direction from the ship.

b. If other ships are anchored or moored within 10 NM, the name and position should be indicated along with distance and direction from the ship. When using other ships, periodic checks should be made since they could change position or get underway.

2.4.2.3 Visibility Aids at Night. The most desirable visibility aids at night are **unfocused lights of moderate intensity**. The red and green lights of other ships are suitable as visibility aids. Focused lights such as search and signal beacons should not be used as markers due to their high intensity; however, when the distance

to the beacon is known, their brilliance and clarity may serve as an aid in determining the visibility. On nights when the moon provides sufficient light, visibility aids discussed in paragraphs 2.4.2.1 and 2.4.2.2 should be used.

2.4.3 Observing Visibility. To observe prevailing visibility the observer should use all aids available at the time of observation. Ensure that the direction and distance of markers are current at the time of observation. From a moving ship, relative positions of stationary objects can change significantly within a ten minute period and the relative position of another moving ship could change drastically in a short time. Ensure that the visibility determined by a marker is representative of the visibility in that sector, whether the visibility is uniform, or if it varies from sector to sector. Also, determine whether the visibility is fluctuating up and down, increasing, decreasing or steady during the period of observation.

a. Uniform Conditions. Under uniform conditions, the prevailing visibility is the same as the visibility that is determined in any sector of the horizon circle.

b. Nonuniform Conditions. Under nonuniform conditions, the prevailing visibility must be derived from the differing sectors. Determine the visibility in each differing sector (sector visibility) and the degrees of the horizon circle in each sector. Take the sectors with the greatest visibilities and add the degrees in each sector until half or more of the horizon circle is obtained. The visibility of these sectors that is the lowest is then used as the prevailing visibility (See Table II-4-1). Sector visibilities different from the prevailing visibility are reported as Remarks in Column 14.

c. Variable Conditions. Under conditions where the visibility is below 3 NM and increases and decreases between values (variable visibility) during the observation, a mean visibility is determined. When it varies between two values with a reportable value in between, use the middle value as the prevailing visibility. When there is no reportable value between the extreme values of variability, the lower visibility value should generally be used as the prevailing visibility unless the higher visibility is considered to be more representative of conditions. The value of maximum and minimum visibility values observed are reported as Remarks in Column 14.

2.4.3.1 Use of Visibility Aids. After visibility aids have been determined, they must be properly used to determine accurate surface visibility.

a. Use of Landmarks. When using landmarks such as mountains, steep coastlines, large towers, etc., it is important to use the base of the object to judge the visibility in the direction of the landmark. The upper portion of tall landmarks can be seen from great distances but they don't give a true indication of surface visibility. (i.e., from an observation point at a height of 40 ft.

the upper 1000 ft. of a 2000 ft. mountain can be seen 43 NM away.) Distant landmarks may be used to determine if an obstruction is present or whether the visibility is unrestricted. When landmarks are within 10 NM of the ship, the clarity of the base will determine if the visibility is greater than the distance to the landmark. If the base is obscured with the upper portion visible, the surface visibility is somewhat less than the distance to the landmark.

b. Use of Other Ships. When using ships within 10 NM as visibility markers, the clearness of the ship will determine if the visibility is greater than the distance to the ship. If the ship is blurred or indistinct, the visibility is about the same as the distance to the ship. If a ship is not visible in the direction it was determined to be in, the visibility is somewhat less.

c. Use of Lights at Night. When using lights as night visibility markers, make sure their distance is known and their height above the sea if possible. Lights from a ship of a known distance will indicate the visibility is at least as great as the distance to the ship and the brilliance of the lights can be used to determine if an obstruction is present. When using lights from land, the distance to the coast and location of the light source (i.e., city, hilltop, sea wall, etc.), should be known.

d. Use of the Horizon. When no aids are present, visibility must be estimated by judging the horizon line. Judge the clearness of the horizon (the contrast between ocean and air). A sharp, clear horizon, indicates the visibility is unrestricted. A blurry horizon indicates the presence of an obstruction to vision. When there is little color contrast between ocean and air, care must be taken when determining if an obstruction is present. When it is determined that the visibility is restricted, the range of visibility must be estimated.

2.4.4 Column 7 -- Prevailing Visibility. Enter the prevailing visibility in nautical miles using the nearest reportable value listed in Table II-4-1 and as follows:

a. When the prevailing visibility is estimated to be more than the distance to the farthest visibility marker, estimate the visibility to the nearest reportable value up to 10 NM.

b. If visibility is halfway or less than halfway between two reportable values, enter the lower value; e.g., 6 1/2 and 6 1/4 miles are rounded down to 6 miles. If the visibility is more than halfway between two reportable values, report the higher value; e.g., 6 3/4 and 6 7/8 miles are rounded up to 7 miles.

c. If the visibility is less than 3 miles and variable during the period of observation, suffix the average of all observed values with a "V" e.g., 2V and enter the range of variability in Remarks of the observation, e.g. VIS 1V3.

TABLE II-4-1

REPORTABLE VISIBILITY VALUES

Nautical Miles	Equivalent Yards	Equivalent Kilometers
0	0	0
1/16	125	.100
1/8	250	.250
1/4	500	.450
1/2	1000	.900
1	2000	1.850
1 1/2	3000	2.800
2	4000	3.700
2 1/2	5000	4.600
3	6000	5.500
4	8000	7.400
5	10000	9.500
6	12000	11.100
7	14000	13.000
8	16000	14.800
9	18000	16.700
10	20000	18.500

NOTES:

1. Mathematical equivalent from nautical miles to meters rounded to the nearest 50 meters.

2. Visibility values greater than 10 nautical miles not reported.

TABLE II-4-2

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[1]	10	20	30	40	60	80	100	150	200	300	400	600
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
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
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
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
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
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
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
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
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
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
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
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
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
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

[1]Horizon

SECTION II - CHAPTER 5

2.5 OBSERVATION PROCEDURES AND ITEM ENTRIES -- Columns 9 and 14 - PRESENT WEATHER AND OPERATIONALLY SIGNIFICANT REMARKS

2.5.1 Introduction. This chapter contains instructions for observing atmospheric phenomena classified as weather and/or obstructions and making entries on CNMOC 3141/3 form, Columns 9 and 14. Procedures and tables for encoding weather and obstructions for the synoptic report are contained in Section III.

2.5.2 General Observing and Reporting Requirements. **Atmospheric phenomenon must actually be occurring at the ship at the time of observation to be reported as present weather in the body of an observation.** Table II-5-1 indicates the abbreviations used for types of present weather to be observed and reported in column 9 of the observation form. Definitions of these phenomena are specified in the following paragraphs. Table II-5-2 provides examples of Column 14 Remarks commonly used to record operationally significant information not reported elsewhere, and to elaborate on preceding coded data. Table III-3-6 in Section 3, Chapter 3 contains the appropriate Synoptic Code figure, a description of the occuring phenomena, and its related METAR present weather abbreviation. Table III-3-6 shall be used for encoding the Synoptic Report present and past weather in Part II of the observation form.

2.5.2.1 Tornadic Activity. Observe and report tornadic activity from beginning to end according to special observation criteria established in Section II, Chapter 2, Table II-2-1, in Table II-5-2 Remarks, and as follows:

a. A tornado, funnel cloud, or waterspout is considered to be occurring "at the ship" when the phenomenon is visible from the observation site.

(1) Tornado. A violent rotating column of air, forming a pendent, protruding from a cumulonimbus cloud, and touching the ground. It nearly always starts as a funnel cloud and is accompanied by a loud, roaring noise (+FC in column 9).

(2) Funnel Cloud. A violent rotating column of air, protruding from a cumulonimbus cloud, which does not touch the surface (recorded as FC in column 9).

(3) Waterspout. A violent rotating column of air, protruding from a cumulonimbus cloud, occurring over a large body of water such as a bay, gulf, or lake, and touching the water surface (recorded as +FC in column 9).

b. Determine the following information for reports on tornadic activity:

(1) Type of phenomenon (i.e., **TORNADO**, **FUNNEL CLOUD**, or **WATERSPOUT**).

(2) The time of beginning, ending or disappearance, or both, to the nearest minute.

(3) Location with respect to the ship or with reference to a well known point (with distances expressed in nautical miles).

(4) Direction toward which the phenomenon moved or is moving.

c. Although QM personnel are not required to take Special Observations (SPECI) to report occurrences of **TORNADO**, **FUNNEL CLOUDS**, or **WATERSPOUTS**, it is recommended that an observation be taken to document their existence near the ship.

2.5.2.2 Thunderstorm Activity. Observe and report thunder and lightning activity during its occurrence according to special observation criteria established in Section II, Chapter 2, Table II-2-1 and Table II-5-2 Remarks, and as follows:

a. Thunderstorm. One or more sudden electrical discharges, manifested by a flash of light (lightning) and a sharp or rumbling sound (thunder). It is a local storm associated with a cumulonimbus (CB) cloud and is usually accompanied by strong gusts of wind, heavy rain, and sometimes hail. For reporting purposes, a thunderstorm is considered to have begun and to be occurring "at the ship" when thunder is first heard. It may also be considered as occurring when hail is falling or lightning is observed in the immediate vicinity of the ship and the local noise level is such that resulting thunder cannot be heard. A thunderstorm is considered as ended 15 minutes after the last occurrence of the above criteria. A thunderstorm may be encoded by itself, i.e., a thunderstorm without associated precipitation, or it may be coded to describe the character of precipitation, i.e., TSGS would be a thunderstorm with small hail.

b. Lightning. A luminous manifestation accompanying a sudden electrical discharge which takes place from or inside a cloud. Four main types of lightning are distinguished. When lightning is observed, determine for each storm center the frequency (i.e., "frequent" or "occasional"), type (e.g., in-cloud, cloud to ground, etc.) and the location with respect to the ship. See Table II-5-3 for lightning type and frequency definitions.

c. Determine the following information for reports of thunderstorms:

(1) The time of beginning, ending, or both, to the nearest minute.

(2) Location of each storm center with respect to the ship, to include distance in nautical miles if known. If available,

use radar to determine the distance(s) of thunderstorms and CB's visible at a distance from the ship.

(3) Direction toward which the storm is moving (or moved), if known.

(4) Frequency, type, and location of lightning (if observed). Location need not be reported when it is the same as the thunderstorm with which it is associated.

2.5.2.3 Precipitation. Observe and report precipitation during its occurrence according to special observation criteria established in Section II, Chapter 2, Table II-2-1 and Table II-5-2 Remarks, and as follows:

a. General. Precipitation is considered as occurring at the ship based on fall directly affecting any part of the ship, as detectable from the observation site.

b. Type and Character of Precipitation. Determine the type and character of precipitation forms primarily on the basis of experience, with consideration given to knowledge of the synoptic situation.

(1) Rain. Precipitation of liquid water particles, in the form of drops larger than 0.02 inch (0.5 mm) or smaller drops which, in contrast to drizzle, are widely separated.

(2) Freezing Rain. Rain that freezes on impact with the ground or with objects in flight or on the ground.

(3) Drizzle. Fairly uniform precipitation composed exclusively of fine drops (diameter less than 0.02 inch or 0.5 mm) very close together. Drizzle appears to float while following air currents although, unlike fog droplets, it falls to the ground.

(4) Freezing Drizzle. Drizzle which freezes upon impact with the ground or with objects in flight or on the ground.

(5) Snow. Precipitation of ice crystals, mostly branched in the form of six-pointed stars.

(6) Snow Pellets. Precipitation of white opaque grains of ice. The grains are round or sometimes conical. Diameters range from about 0.08 to 0.2 inch (2 to 5 mm). Snow pellets are brittle and easily crushed; and, when they fall on hard ground, they bounce and often break up. They generally fall together with snowshowers or rainshowers when the surface temperature is near 32°F (0°C). They may occasionally fall from stratocumulus.

(7) Snow Grains. Precipitation of very small white and opaque grains of ice. The grains are fairly flat or elongated. Diameters are generally less than .04 inch (1 mm). When the grains hit hard surfaces they do not bounce or shatter. They usually fall

in very small quantities from stratus clouds (or occasionally from fog).

(8) Ice Pellets. Precipitation of transparent or translucent pellets of ice, which are round or irregular, rarely conical, and have a diameter of 0.2 inch (5 mm) or less. The pellets usually rebound when striking hard surfaces and make a sound on impact. They are divided into two main types, based primarily on character.

(a) Type (a): Hard grains of ice consisting of frozen raindrops or largely melted and refrozen snowflakes (formerly sleet). This type falls as continuous or intermittent precipitation.

(b) Type (b): Pellets of snow encased in a thin layer of ice which has formed from the freezing either of droplets intercepted by the pellets or of water resulting from the partial melting of the pellets. This type falls as showers.

(9) Hail. Precipitation of small balls or other pieces of ice (hailstones) falling separately or frozen together in irregular lumps. Hailstones consist of alternate opaque and clear layers of ice in most cases. Hail is normally associated with thunderstorms and surface temperatures above freezing. Diameters generally range from 0.2 to 2.0 inches (5 to 50 mm) or sometimes more.

(10) Ice Crystals. A fall of unbranched (snow crystals are branched) ice crystals in the form of needles, columns, or plates. They are termed "Ice Prisms" in synoptic observations. Ice crystals are often so tiny that they seem to be suspended in the air. They may fall from a cloud or from clear air. The crystals are visible mainly when they glitter in the sunshine or other bright light (diamond dust), thus producing a luminous pillar or other optical phenomena. This hydrometeor (rarely more than the lightest precipitation), which is frequent in polar regions, occurs only at very low temperatures in stable air masses.

(11) Continuous and Intermittent Rain, Freezing Rain, Snow and Ice Pellets Type. These are normally associated with nimbostratus and altostratus clouds, but may also occur with stratocumulus and (rarely) altocumulus. Rainshowers, snowshowers, and ice pellet showers are associated with cumuliform-type clouds such as cumulonimbus and towering cumulus. Hail falls exclusively as showers; and, snow pellets almost always fall as showers.

(12) Drizzle, freezing drizzle, and snow grains are associated with stratus clouds. Ice crystals are associated with cirroform-type clouds or clear skies (common primarily to polar regions at very low temperatures); the character of fall is generally continuous.

(13) For reporting purposes, only the predominant character is determined for a specific type. For example, if both

continuous and showery snow are falling and the showers appear to be predominant, only the showery character is reported. This condition is common to cumulonimbus imbedded in nimbostratus and with occluded fronts.

c. Precipitation Intensity. Intensity of precipitation is an indication of the amount of precipitation falling at the time of observation. It is expressed as light, moderate, or heavy. Each intensity is defined with respect to the type of precipitation occurring; based either on rate-of-fall for rain and ice pellets or visibility for snow and drizzle. The rate-of-fall criteria are based on time, and do not accurately describe the intensity at the time of observation. For this reason, Tables II-5-4, II-5-5, and II-5-7 should only be used as a guide to estimate the intensity at the time of observation. Table II-5-6, on the other hand, is based on the visibility at the time of observation, and must be used to determine intensity of drizzle or snow, if either is occurring alone. If snow or drizzle are present with other obscuring phenomena, Table II-5-8 should be used as a guide to determine intensity.

d. Hailstones. During occurrence and following the end of hail, obtain the diameter of the largest hailstone. Determine hail size in inches and fractions of an inch. In reports of hail, include the time of beginning, ending, or both, to the nearest minute, when required. Report hail according to special observation criteria established in Section II, Chapter 2, Table II-2-1 and Table II-5-2 Remarks.

e. Significant Changes. Observe and report significant changes in precipitation conditions. Significant conditions are those involving the occurrence (beginning and ending) of hail, ice pellets, ice pellet shower, freezing rain, and freezing drizzle, to include changes in their intensity (i.e., except Hail). Normally, the beginning and ending of other types must also be reported. However, a change from one type to another (e.g., rain changes to snow) and the beginning or ending of one type while another is in progress (e.g., rain and snow changes to snow) need not be reported as a significant change.

2.5.2.4 Obstructions. Observe and report obstructions during occurrence according to Section II, Chapter 3.

a. An obstruction is considered as occurring when the phenomenon restricts the visibility to 6 NM (10 km) or less. The phenomenon is considered as occurring "at the ship" based on its apparent existence, as detectable from the observation location. Determine the specific type of obstruction based on observer experience and the definitions provided below.

b. Types of Obscuring Phenomena. Determine the specific type based on experience and on the guidance provided with the following definitions.

(1) Fog. The common term used to identify a suspension of minute water droplets in the air, generally reducing the horizontal visibility at the earth's surface. Specific terms used to report fog conditions are defined as follows:

(a) Ship Observations:

Fog. The fog condition that reduces horizontal visibility to 6 NM (10 km) or less and the vertical depth of the phenomenon is approximately 20 feet (6 meters) or greater. Shallow fog (MIFG), patches (of) fog (BCFG), and partial fog (PRFG) may be encoded even when prevailing visibility iis 7 miles or greater.

Ground Fog. A fog condition that reduces horizontal visibility to 6 NM (10 km) or less and vertical depth is less than 20 feet (6 meters). This is a local phenomenon, usually formed by radiational cooling of the air. When the occurrence does not clearly fit this definition, the condition should be classified as fog (vice ground fog).

(b) Synoptic Observations:

Fog. The fog condition that reduces horizontal visibility to less than 0.55 NM (1 Km).

Freezing Fog. A fog condition that reduces horizontal visibility to less than 0.55 NM (1 Km), and the water droplets are freezing upon contact with exposed objects to form a coating of rime and/or glaze. This condition can occur even though the air temperature is above freezing.

Mist. A fog condition that reduces horizontal visibility to 6 NM (10 km) or less but not less than 0.55 NM (1 km). Water droplets may or may not be freezing upon contact with the exposed objects.

(2) Freezing Fog. The suspension of numerous minute ice crystals suspended in the air, based at the earth's surface, which reduces horizontal visibility (similarly as specified with fog above). Ice fog does not produce rime or glaze on cold exposed objects. Temperatures are usually at or below -20°F (-29°C) when ice fog forms. However, a mixture of liquid and ice fog occasionally forms at temperatures below freezing. This condition may persist for a few hours as the fog changes to ice fog and dissipates due to a drying of the air, even though temperatures continue to fall. Optical effects similar to those associated with ice crystals are observed in ice fog (diamond dust, etc.). Temperature-dew point differences may approach 8F° (13C°) or more.

(3) Shallow Fog. A suspension of minute water droplets (or ice crystals) in the air which do not reduce horizontal visibility above a height of 6 feet (1.8 meters). This condition may also be referred to as "shallow ground fog." For reporting purposes, the two terms are considered synonomous.

(4) Partial and Patches of Fog. A suspension of minute water droplets (or ice crystals) in the air that has little vertical extent (normally greater than or equal to 6 feet but less than 20) which do not reduce horizontal visibility above a height of 6 feet (1.8 meters). This condition may also be referred to as "shallow ground fog." For reporting purposes, the two terms are considered synonomous.

(5) Blowing Snow. Snow particles raised and stirred violently by the wind to moderate or great heights. Visibility is reduced to 6 NM (10 km) or less and the sky may become obscured when the particles are raised to great heights.

(6) Spray and Blowing Spray

(a) Spray. Water droplets torn by the wind from a substantial body of water (generally from the crests of waves) and carried up a short distance into the air.

(b) Blowing Spray. Spray raised in such quantities that it reduces the visibility at eye level (approximately 6 feet or 1.8 meters) to 6 NM (10 km) or less.

(7) Haze. A suspension in the air of extremely small, dry particles invisible to the naked eye and sufficiently numerous to give the air an opalescent appearance. This phenomena resembles a uniform veil over the ocean that subdues all colors. Dark objects viewed through this veil tend to have a dirty yellow or reddish hue. When haze is present and the sun is well above the horizon, its light may have a peculiar silvery tinge. Haze particles may be composed of a variety of substances; e.g., dust, salt, residue from distant fires or volcanoes, pollen, etc., which generally are well diffused through the atmosphere.

(8) Dust. Fine particles of dust or sand suspended in the air by a duststorm or sandstorm that have occurred inland and extend far out to sea. Dust gives a tan or gray tinge to distant objects. The sun's disk is pale and colorless, or has a yellow tinge through dust.

(9) Smoke. A suspension in the air of small particles produced by combustion. This phenomena may be present either near the sea's surface or in the free atmosphere. When viewed through smoke, the disk of the sun at sunrise and sunset appears very red. The disk may have an orange tinge when the sun is above the horizon. Evenly distributed smoke from distant sources generally has a light grayish or bluish appearance. A transition to haze may occur when smoke particles have traveled great distances (e.g., 25 to 100 miles or more) and when the larger particles have settled out and the remaining particles have become widely scattered through the atmosphere.

(10) Blowing Dust. Dust raised by the wind to moderate or great heights above the ground and blown out to sea that restricts horizontal visibility to 6 NM (10 km) or less. NOTE:

The Mediterranean Sea and Indian Ocean are common areas where dust and/or sand are blown out to sea.

(a) Duststorm. Same as blowing dust except visibility is reduced to less than 0.55 NM (1 km) but not less than 0.25 NM (500 meters).

(b) Severe Duststorm. Same as blowing dust except visibility is reduced to less than 0.25 NM (500 meters).

(11) Blowing Sand. Sand raised by the wind to moderate or great heights above the ground and restricting horizontal visibility to 6 NM (10 km) or less.

(a) Sandstorm. Same as blowing sand except visibility is reduced to less than 0.55 NM (1 km) but not less than 0.25 NM (500 meters).

(b) Severe Sandstorm. Same as blowing sand except visibility is reduced to less than 0.25 NM (500 meters).

(12) Predominance. When more than one type of obstruction is occurring at the same time, determine which appears to be most predominant (types are reported in order of decreasing predominance, if discernible).

2.5.2.5 Volcanic Eruptions. Volcanic eruptions shall be reported whenever observed. The entry shall be plain language and contain the following if known:

a. Name of volcano.

b. Latitude and longitude or the direction and approximate distance from the ship.

c. Date/Time (UTC) of the eruption.

d. Size description, approximate height, and direction of movement of the ash cloud.

e. Any other pertinent data about the eruption.

Pre-eruption activity should not be reported. Pre-eruption refers to the unusual and/or increasing volcanic activity prior to a volcanic eruption.

2.5.2.6 Other Atmospheric Phenomena. Observe and report other atmospheric phenomena using Table II-5-2 as a guide and as follows:

a. Auroral Phenomena. When located north of 45°N latitude, observe and report the occurrence of aurora according to Section 3 guidelines. An Aurora is a luminous phenomenon which appears in the high atmosphere in the form of arcs, bands, draperies or curtains. This phenomenon is usually white but may have other colors. The lower edges of the arcs or curtains are usually well defined while

the upper edges are not. Polar aurorae are due to electrically charged particles, ejected from the sun, acting on the rarified gases of the higher atmosphere. The particles are channeled by the earth's magnetic field, so that aurorae are mainly observed near the magnetic poles.

2.5.3 Column 9 -- Present Weather Entries. Enter present weather entries using symbols (plain language for volcanic activity), order of entry, and intensity signs in Table II-5-1. Atmospheric phenomena must be occurring at the ship at the time of the observation. Obstructions must restrict prevailing visibility to 6 NM or less. Enter phenomena not occurring at the ship in Remarks of the observation. Precipitation, with no obstruction to vision present, can and usually does reduce visibility. Therefore, no assumption should be made that an obstruction to vision must be present with low visibilities.

2.5.4 Column 14 -- Remarks and Supplemental Coded Data Entries. The order of entry for remarks in Column 14 and other coded data listed below should be followed. The remarks field shall be identified by the contraction RMK, followed by a blank space, and then remark information prioritized by category as follows:

a. Breaks in An Obscured Sky Condition. Enter the direction of discontinuity in an obscured sky; e.g.,"THN FG NW."

b. Other Remarks Elaboration on Preceding Coded Data. Enter remarks significant to aircraft or ship operations. Any other remarks the observer considers significant may also be entered in this category, with the order of entry the same as the coded data to which the remark relates.

c. Enter direction and location of phenomena in a clockwise order using the 8 Points of the compass in no more than 90° increments, e.g., N-E-SE. Increments for the 16 points of the compass may be used if considered necessary.

d. Report movement of clouds or other phenomena with respect to location and direction toward which the phenomena are moving.

e. Distances of phenomena should be based on a reliable method of determination; e.g., by means of radar or an aircraft pilot report. Phenomena between 5 to 10 nautical miles shall be reported as vicinity (VC). Anything beyond 10 nautical miles is considered distant (DSNT).

f. Remarks pertaining to tornadic or thunderstorm activity may be combined with those for CB/CBMAM when the direction of movement is the same; e.g., TS VCNTY NE AND CB SW-W MOV E.

g. Synoptic Cloud Types $8/C_LC_MC_H$. Enter the three and six hourly synoptic cloud type. An "0" shall be encoded for low, middle or high cloud type if no cloud is present in that

classification. A solidus "/" shall be encoded for layers above an overcast.

h. Pressure Tendency 5appp. The 5appp group shall be included in the 3 and 6 hourly observations only when the ship is at anchor.

i. Sea-Level Pressure SLPppp. The SLPppp group shall be included in the hourly observations. It is encoded using the tens, units, and tenths of the Sea-Level Pressure from column 22a, e.g., 998.2 = SLP982. If the sea-level pressure is not available, encode as SLPNO.

TABLE II-5-1

ABBREVIATIONS USED FOR CLOUDS, PRESENT WEATHER, OBSCURING PHENOMENA AND INTENSITY SYMBOLS

NOTATIONS FOR REPORTING PRESENT WEATHER[1]

QUALIFIER	WEATHER PHENOMENA			
INTENSITY OR PROXIMITY	DESCRIPTOR	PRECIPITATION	OBSCURATION	OTHER
1	2	3	4	5
- Light	MI Shallow	DZ Drizzle	BR Mist	PO Well-Developed Dust/Sand Whirls
Moderate[2]	PR Partial	RA Rain	FG Fog	
+ Heavy	BC Patches	SN Snow	FU Smoke	
VC Vicinity	DR Low Drifting	SG Snow Grains	VA Volcanic Ash	SQ Squalls
	BL Blowing	IC Ice Crystals	DU Widespread Dust	FC Tornado Waterspout Funnel Cloud[3]
	SH Shower(s)	PE Ice Pellets	SA Sand	
	TS Thunder-storm	GR Hail	HZ Haze	SS Sandstorm
	FZ Freezing	GS Small Hail or Snow Pellets	PY Spray	DS Duststorm

1. Weather groups shall be constructed considering columns 1 to 5 in the table above in sequence.
2. No symbol for moderate intensity.
3. Tornado and Waterspout always coded as +FC.

NOTES:

1. Combinations of Weather and Obstructions are entered in Column 9 in the following order:

   a. TORNADO, WATERSPOUT, or FUNNEL CLOUD.
   b. Thunderstorm.
   c. Precipitation, predominate first, then in order of decreasing intensity.
   d. Obstructions, in order of decreasing predominance, if discernible.

2. Obstructions are reported in Column 9 only when the prevailing visibility is less than 6 miles (except MIFG, BCFG, or PRFG may be reported) and the obstruction is occurring at the ship. If the visibility is reduced to less than 6 nautical miles by obscuring phenomena not at the ship, report the phenomena in Remarks, Column 14.

3. Do not encode TS and SH together when describing precipitation. TS implies showers.

TABLE II-5-1
(page 2)

CLOUDS

Altocumulus	AC
Altocumulus Castellanus	ACC
Altocumulus (Standing Lenticular)	ACSL
Altostratus	AS
Cirrocumulus	CC
Cirrocumulus (Standing Lenticular)	CCSL
Cirrostratus	CS
Cirrus	CI
Cumulonimbus	CB
Cumulonimbus (Mammatocumulus)	CBMAM
Cumulus	CU
Cumulus Fractus	CUFRA
Nimbostratus	NS
Stratocumulus	SC
Stratocumulus (Standing Lenticular)	SCSL
Stratus	ST
Stratus Fractus	STFRA
Towering Cumulus	TCU

NOTE:
Abbreviations used in Column 14.

TABLE II-5-2

OPERATIONALLY SIGNIFICANT REMARKS -- COLUMN 14 ENTRIES

When condition observed is:	Then enter in Column 14:
Tornado, Funnel Cloud, or Waterspout in progress	Description, distance (if known), direction from ship and direction of movement (i.e., MOVMT UNKN); e.g., TORNADO NE MOV N, FUNNEL CLOUD S MOVMT UNK.
Thunderstorm in progress	"TS", distance (if known), direction from ship and direction of movement (if known); e.g., TS OVHD MOV SE, SW MOV NE.
Lightning	Frequency ("FQT" or "OCNL"), type and direction from ship; e.g., OCNL LTGICCG N, FQT LTGCAIC SW-NW. Direction may be omitted if the same as TS or CB/CBMAM remark.
Hail	"GR" and diameter (in inches of the largest stone); e.g., GR 1. If less than 1/8 inch, encode as GR M1/4.
Intermittent precipitation at the time of observation	"INTMT", type, and intensity; e.g., INTMT -RA.
Precipitation varying in intensity and type during the period of observation	Type and intensity for condition at time of observation, "OCNL," and type and intensity to which it varied during the period of observation; e.g., -RA OCNL RA.
Shallow Ground Fog (less than 6' in depth) or known fog depth	Description and approximate depth, in feet; e.g., SHLW GFDEP 4, FDEP 40, GFDEP 10.
Obscuration aloft	Type, height, and corresponding sky cover symbol as reported in Col 10 e.g., FU SCT010
Obscuration at a distance from (but not at) the ship	Description and direction from ship; e.g., FG BANK NE-SE

TABLE II-5-2
(page 2)

OPERATIONALLY SIGNIFICANT REMARKS -- COLUMN 14 ENTRIES

When condition observed is:	Then enter in Column 14:
Wind Shift	"WSHFT" and time of beginning; followed by "FROPA" if reasonably certain the shift was the result of a frontal passage; e.g., WSHFT 30, WSHFT 44 FROPA.
Observed wind speed having exceeded 25 knots since the last METAR and the same speed is not in the body of a SPECI observation.	"PK WND", the direction and time of occurrence (minutes) in the next METAR following the occurrence e.g., PK WND 28032/07. If the speed occurred more than once, encode the first occurrence only. Omit the remark if the speed is included in the body of this METAR observation.
Prevailing visibility less than 3 miles varying by one or more reportable values	"VIS", followed by extremes of variability (Lowest, "V," and highest) e.g., VIS 1/4V1/2.
Sector visibility less than 3 miles differing from prevailing visibility	"VIS", sector identification, and visibility in the sector(s); e.g., VIS NE2, VIS NW3, S1.
Breaks or an area absent of clouds in a layer, below 1000 feet, which covers at least 6/10 but less than 10/10 of the sky	"BRKS", and direction from the ship, e.g., BRKS N. Omit the remark if breaks are in all quadrants.
Variable ceiling height below 3,000 feet	"CIG", followed by extremes of variability (lowest, "V" and highest); e.g., CIG 015V020, CIG 025V030.
Variable sky condition (during past 15 minutes)	Sky condition at the time of observation, "," and the condition to which it varied during the period of observation; e.g., OVC V BKN, BKN V SCT. When necessary to distinguish between Col 10 entries, include the layer's height; e.g., SCT018 V BKN.

TABLE II-5-2
(page 3)

OPERATIONALLY SIGNIFICANT REMARKS -- COLUMN 14 ENTRIES

When condition observed is:	Then enter in Column 14:
Ceiling of sky condition at a distance differing from that at the ship	Description and location; e.g., CIG LWR OVR COAST, CLD BASES OBSCG MTNS W.
Cumulonimbus (no thunderstorm is being reported)	"CB", distance from ship (if known) location and movement (if known); e.g., CB 20S MOV N, CB OVHD MOV NW.
Cumulonimbus Mamma (with or without a thunderstorm)	Same as Cumulonimbus, except add"MAM", e.g., CBMAM 20S MOV N.
Towering Cumulus	"TCU", distance (if known), direction from ship; e.g., TCU NE, TCU 25 SW.
Standing lenticular or rotor clouds	Description and direction from ship; e.g., ACSL SW-W, APRNT ROTOR CLD S, CCSL S
Altocumulus Castellanus	"ACC", and direction from ship; e.g., ACC SE, ACC NW-N.
Vertical or inclined trails of precipitation that do not reach the surface	"VIRGA" and direction from ship; e.g., VIRGA W.
Aurorea observed in the past hour and the ship is north of 45° north latitude or south of 45° south latitude.	"AUROB" in the first METAR after it was observed and on each observation throughout the period of occurrence.

TABLE II-5-4

Estimating Intensity of Precipitation on a Rate-of-Fall Basis (Other Than Drizzle)	
Light	A trace to 0.10 inch (2.5 mm) per hour; a maximum of 0.01 inch (0.3 mm) in 6 minutes
Moderate	0.11 inch to 0.30 inch (2.6 to 7.6 mm) per hour; more than 0.01 inch (0.3 mm) to 0.03 inch (0.8 mm) in 6 minutes
Heavy	More than 0.30 inch (7.6 mm) per hour; more than 0.03 inch (0.8 mm) in 6 minutes

TABLE II-5-5

Estimating Intensity of Rain	
Light	A trace or more up to a condition in which individual drops are easily seen; slight spray is observed over decks; puddles form slowly; sound ranges from a slow pattering to a gentle swishing; steady small streams may flow off decks.
Moderate	Individual drops are not clearly identifiable; spray is observable just above decks and other surfaces; puddles form rapidly; sound ranges from a swishing sound to a gentle roar.
Heavy	Rain seemingly falls in sheets; individual drops are not identifiable; heavy spray to a height of several inches is observed over hard surfaces; visibility is greatly reduced; sound resembles the roll of drums or a distant roar.

The following guide is a simplified outline of the above descriptions as an aid to readily estimating intensity.

	Individual Drops	Spray Over Hard Surfaces	Puddles
Light	Easily seen	Hardly any	Form slowly
Moderate	Not easily seen	Noticeable	Form rapidly
Heavy	Not identifiable Rain in sheets	Heavy, to a height of several inches	Form very rapidly

TABLE II-5-3

TYPE AND FREQUENCY OF LIGHTNING

Type	Contraction	Definition
Cloud to Ground	CG	Lightning occurring between cloud and ground.
In-Cloud	IC	Lightning which takes place within the cloud.
Cloud-Cloud	CC	Streaks of lightning reaching from one cloud to another.
Cloud-Air	CA	Streaks of lightning which pass from a cloud to the air but do not strike the ground.

FREQUENCY OF LIGHTNING

Frequency	Contraction	Definition
Occasional	OCNL	Less than 1 flash/minute.
Frequent	FRQ	About 1 to 6 flashes/minute.
Continuous	CNS	More than 6 flashes/minute.

TABLE II-5-6

Intensity of Drizzle, Snow Grains, Snow Pellets, or Snow with Visibility as Criteria	
Light	Visibility equal to or greater than 5/8 statute mile, 0.55 nautical mile, or 1,000 meters
Moderate	Visibility 5/16 to 5/8 statute mile, 0.25 to 0.55 nautical mile, or 500 to 1000 meters
Heavy	Visibility equal to or less than 1/4 statute mile, 0.2 nautical mile, or 400 meters

Note: Use this table to determine intensity when the respective type of precipitation (drizzle, snow, etc.) is occurring alone. When occurring with other precipitation or an obstruction to vision, estimate intensity on a Rate-of-Fall basis.

TABLE II-5-7

Estimating the Intensity of Ice Pellets	
Light	Scattered pellets that do not completely cover an exposed surface regardless of duration. Visibility is not affected.
Moderate	Slow accumulation. Visibility reduced to less than 7 nautical miles or 9000 meters.
Heavy	Rapid accumulation. Visibility reduced to less than 3 nautical miles or 4800 meters.

TABLE II-5-8

Estimating the Intensity of Drizzle on a Rate-of-Fall Basis	
Light	A trace to 0.01 inch (0.3 mm) per hour
Moderate	More than 0.01 inch (0.3 mm) to 0.02 inch (0.5 mm) per hour
Heavy	More than 0.02 inch (0.5 mm) per hour

Note: This table is used to estimate the intensity of drizzle when it is not occurring alone. However, in no case should the intensity be higher than that which would be determined using the visibility criteria in Table II-5-5.

SECTION II - CHAPTER 6

2.6 OBSERVATION PROCEDURES AND FORM ENTRIES -- Columns 13, 22, and 22a -- ATMOSPHERIC PRESSURE

2.6.1 Introduction. This chapter contains observing and computation procedures for determining atmospheric pressure data and making entries on CNMOC 3141/3 form, columns 13, 22, and 22a.

2.6.1.1 General. Atmospheric pressure is the force exerted by the weight of the column of air above the ship. It is measured by a precision aneroid barometer (ML-448/UM). Certain ships are authorized an allowance for the marine barograph (ML-563A/UM) as a backup capability. Pressure measurements and computations are used in the testing and calibration of equipment and operation of weapon systems and aircraft. Pressure values transmitted in the ship synoptic code are used in weather analyses from which weather forecasts and warnings are derived.

2.6.1.2 Distribution of Pressure Data. Providing pressure data in the correct unit of measure using proper computation is important to the safety of those that use the data. Personnel requiring pressure data will often ask for the "Atmospheric Pressure," while having little or no knowledge of the various types of pressure computations or the different units of measure. Some pressure data is critical in their application. Therefore, the type of computation and unit of measure required should always be verified. If the requester is not sure of what data is required, have them determine what is required before providing a figure that, when used, may affect their safety, a pilot's safety, or the condition of the equipment or weapon system they are operating or servicing.

2.6.1.3 Units of Measure. Atmospheric pressure is measured in two units, hectopascals (hPa) and inches of mercury (Hg). The hectopascal is the international unit of measure for atmospheric pressure and inches of mercury are used in the U.S. for aviation purposes. Note: Pressure was formerly reported as millibars (mb). The hectopascal is numerically equivalent to the millibar.

1 inch Hg = 33.86389 hPa
1 millibar = 0.02952998 In Hg

Table II-6-1 provides a convenient reference for conversion of hectopascals to inches of mercury (Hg).

2.6.2 Pressure Measurement Definitions. Atmospheric pressure is routinely determined for three basic values - station pressure, sea level pressure and altimeter setting. Values for pressure altitude (PA) and density altitude (DA) are determined for local use to support aircraft operations. The pressure change and tendency for three hours is determined for the synoptic report or when other certain criteria are met.

2.6.2.1 Station Pressure. Station pressure is the pressure observed from the aneroid barometer, ML-448/UM (or marine barograph ML-563A/UM) with any instrument correction added. Station pressure is the base from which all other pressure values are derived. It is reported in inches of mercury (Hg) to the nearest 0.005 inch Hg.

2.6.2.2 Sea Level Pressure. Sea level pressure is the atmospheric pressure computed to represent the pressure at mean sea level. This pressure reported from a ship is a pressure derived by adding to the station pressure a value representing the pressure exerted by the column of air existing between the barometer and sea level. Since this represents a relatively small section of the atmosphere, a constant value can be used for a given height. These values are called Additive Reduction Constants which are found in Table II-6-2.

2.6.2.3 Altimeter Setting. This pressure setting is based on a standard atmosphere with the station pressure reduced to sea level. It is derived by adding to the station pressure a value representing the pressure exerted by the column of air existing between the barometer and sea level. As with sea level pressure (paragraph 2.6.2.2), constant values are also used for given heights. Additive reduction constants are found in Table II-6-2.

2.6.2.4 Pressure Altitude (PA). Pressure altitude (PA) is a value representing the height above or below sea level that a given pressure would occur based on a standard atmosphere (standard atmosphere having a pressure at sea level of 29.921 inch Hg/1013.25 hPa). PA is reported in feet. When the computed sea level pressure is less than the standard atmosphere (29.921 inch Hg), PA is positive (pressure must be added to arrive at the standard atmosphere). When computed sea level pressure is greater than 29.921 inch Hg, PA is negative (pressure must be subtracted to get to standard atmosphere). Table II-6-3 provides pressure altitudes for various sea level pressures. PA is computed with the Density Altitude Computer (CP-718/UM).

2.6.2.5 Density Altitude (DA). Density altitude (DA) is a value representing the height above or below sea level that a given density would occur based on a standard atmosphere (standard atmosphere having a density at sea level of .001225 grams per cubic centimeter). DA is reported in feet. When the actual density is greater than standard atmosphere, DA is negative. When the actual density is less than standard atmosphere, DA is positive. DA is also computed with the Density Altitude Computer (CP-718/UM).

2.6.3 Observing and Computing Pressure Measurements. Pressure measurements are determined using the method and instruments indicated below. Figure II-6.1 is a sample pressure computation which utilizes the hourly pressure computation worksheet, Figure II-6.2. The computation worksheet may be a useful aid to standardize calculations for those ships not having pressure tables tailored for the ship's standard barometer elevation.

a. Aneroid Barometer. Gently tap the glass face of the barometer with a finger, to reduce the effect of friction, until the pointer stops changing pressure when tapped.

(AG) b. Marine Barograph. Gently tap the top of the instrument case to reduce the effect of friction. Tap until the pen stops changing pressure when tapped.

c. Error of Parallax. The observer's eye should be at 90° (perpendicular) to the face of the barometer so the pointer position can be ready with accuracy to a 0.1 tenth of a hPa. When the eye is perpendicular to the barometer face a mirror strip on the barometer helps the observer line up their eye to detect any reflection of the pointer. If there is a reflection, you are not lined up correctly. This is known as the "error of parallax."

d. Pressure Tables. Pressure tables can be developed for the ship's standard barometer elevation. When constructed properly, these tables reduce errors in routine computations and will save time while taking and recording an observation. Tables are constructed by adding the reduction constants to each station pressure observable and converting the values to hPa. The same thing can be done for altimeter settings, thus when computing sea level pressure and altimeter setting, enter the station pressure in the table and read the corresponding values for sea level pressure and altimeter setting. **Great care must be taken when preparing these tables to ensure no errors are induced. If errors occur, they will constantly produce errors when used.** In addition, if the barometer height is changed, the tables become useless and must therefore be redone to reflect the new barometer height. FLENUMMETOC DET Asheville should be consulted for technical assistance on construction of these tables.

2.6.3.1 Station Pressure. Read the pressure indicated to the nearest 0.1 tenth of hPa (or 0.005 inch Hg) and convert the value to the equivalent inch Hg. Algebraically add any instrument correction to the observed pressure to determine the station pressure. This value is the station pressure.

2.6.3.2 Sea Level Pressure. Compute the sea level pressure by first observing the station pressure. Add the additive reduction constant from Table II-6-2 for the given station elevation. Convert the value from inch Hg to hPa. Recheck all computations.

2.6.3.3 Altimeter Setting. Compute the altimeter setting by first observing the station pressure. Add the additive reduction constant from Table II-6-2 for the given station elevation or use prepared tables discussed in paragraph 2.6.3. Recheck all computations.

2.6.3.4 Pressure Altitude (PA). Compute the pressure altitude (PA) by first computing the sea level pressure. Using the Density Altitude Computer (CP 718/UM), set the hairline cursor on the sea level pressure value represented on the Pressure in Millibars Scale. Read the PA where the cursor crosses the PA scale. Pressure

altitude (PA) for the respective sea level pressure can also be found by using Table II-6-3. Be careful not to change the positive or negative sign of the PA value.

2.6.3.5 Density Altitude (DA). Computation of density altitude (DA) involves several steps as follows: Observe the dry bulb temperature, compute the dew point, then compute the pressure altitude on the Density Altitude Computer (CP-718/UM). With the cursor on the PA, rotate the cursor and inner plate around until the cursor also crosses the air temperature on the temperature scale on the outer disc. The cursor should now lie on the sea level pressure, pressure altitude and the air temperature. Taking care not to let the inner or outer discs slide, rotate the cursor around to the window in the inner disc. Set the cursor on the dew point temperature and read the DA value that lies under the cursor on the outer disc visible through the window. Be careful not to change the positive or negative sign of the value. Recheck the computations to ensure that the discs did not slip.

2.6.3.6 Pressure Change. Compute the net 3-hour amount of change on the basis of station pressure entries in Column 22 of Part I, by subtraction, to the nearest 0.005 inch Hg.

a. If an observation was not taken 3 hours earlier, consider the net change as undeterminable (missing), otherwise determine if the current station pressure is higher than, the same as, or lower than 3 hours ago.

(AG) b. If a barograph is available, determine the characteristic of the pressure change by observing the trace on the barograph chart and select the condition which best describes the pattern corresponding to the barograph trace during the past 3 hours. Disregard minor irregularities. Use the latter part of a trace, consistent with the direction of change, when the pattern contains representations of two characteristics. See Figure II-6-3 for barograph trace comparison for determining pressure characteristics.

2.6.3.7 Barometer Calibration. Periodic barometer calibration is required, but should never exceed one year from the last calibration. An ideal time to schedule barometer calibration services is prior to an extended deployment. Contact the nearest NAVMETOCCOM activity to receive assistance with calibrating barometers.

(AG)2.6.4 Barograph Operation. Operate and use the barograph as necessary for determination of pressure tendency and as a backup to the ML-448/UM for routine pressure measurements. Make adjustments for pressure and time errors during periods in which the barograph is in use for routine station pressure observations and as otherwise necessary for local purposes.

(AG)2.6.4.1 Pressure Adjustment. To adjust the position of the pen, turn the knurled pressure-adjusting knob at the top of the cylindrical pressure-element housing until the pen is at the

correct station pressure. Tap the case or chassis lightly to overcome any sticking in the linkage mechanism before checking the adjustment of the pen. Adjust the barograph to a zero correction as specified below at 6 hourly synoptic hours.

a. Readjust the barograph to a zero correction when a comparison with the ML-448/UM reveals a difference exceeding 1.5 hPa (0.050 inch Hg); i.e., based on the difference between the observed barograph reading and station pressure from the aneroid barometer. Also readjust the barograph to a zero correction when the chart is changed and the correction exceeds 0.3 hPa (0.010 inch Hg). Following any readjustment, lightly tap the top of the instrument and recheck the setting in order to be certain the barograph has been accurately adjusted to a zero correction.

b. Monitor the barograph for any indications of unreliable performance. The corrections can be expected to remain essentially constant and should not normally change more than 0.3 hPa (0.010 inch Hg) from the preceding 6-hourly comparison.

(1) If the difference between the current and previous correction exceeds 0.5 hPa (0.015 inch Hg), verify the accuracy by making a second comparison.

(2) Take whatever other action is deemed appropriate based on knowledge of past instrument performance, diurnal conditions, etc. If the difference between corrections tends to be persistently great or to increase rapidly, the instrument may be defective and require replacement.

(AG)2.6.4.2 Time Adjustment. To adjust the cylinder for time, turn it counterclockwise until all slack motion in the drive mechanism is removed. If the pen position does not bear the proper relationship to the time-ordinate lines after the slack has been removed, continue to turn the cylinder counterclockwise with sufficient force to override the friction drive until the timing error is eliminated. When in use as the primary pressure instrument, adjust the barograph chart for time error if the record trace is in error by more than 1/4 of a chart division (15 minutes). When the instrument is in use for routine pressure observations, make a time check on the barograph immediately after the six-hourly correction has been determined. The line should be about equal in length to the width of two divisions on the chart and should be made carefully to avoid injury to the mechanism. Do not make a time-check line when the instrument is so cold that the pen might not readily return to the original position (i.e., due to increased viscosity of the fluid in the damper of the dashpot). Do not make a time check for aircraft mishap Local observations; i.e., do not disturb the pressure trace for this purpose.

(AG)2.6.4.3 Chart Scale Adjustment and Change. Monitor the barograph during routine operation to ascertain that the clock is running and the ink is flowing properly, and note the position of the pen on the chart. Whenever it appears that the pen will pass off the printed divisions of the chart, set the pen up or down

equivalent to one full inch of pressure by means of the adjusting screw, and renumber the pressure lines accordingly. The barograph chart must be changed to begin a new trace at four-day intervals. Change charts on the first day of each month, then every fourth day during the month. The following instructions summarize steps to be taken when a chart is changed.

a. Enter the beginning date and time at the start of each separate trace on the chart.

b. Change charts at 1200 UTC.

(1) To replace a chart, remove the pen from the chart by means of the pen shifting level and open the case. Lift the cylinder vertically until it is free of the spindle and remove the chart from the cylinder. (Avoid storing or handling the chart in a manner that might smear the trace before it is dry.) Fit the replacement chart smoothly and tightly on the cylinder, with the bottom edge of the chart uniformly in contact with the flange at the bottom of the cylinder, and replace the clip. Inaccurately cut charts should be trimmed along a line parallel to and 1/4 inch (or 5mm) below the lower, horizontal boundary ordinate.

(2) Wind the clock mechanism in conjunction with the changing of the chart. The mechanism requires 7-8 half-turns for a 4-day interval between windings (or 5-6 half-turns for a 3-day interval). After winding the clock, lower the cylinder gently over the center spindle until the gears have fully meshed, holding the cylinder at the top and bottom to avoid disturbing the position of the chart. Fill the pen with ink and return it to the surface of the chart, adjusting it, if necessary, for pressure and time. Check the pen and clock mechanisms to ensure they are functioning.

2.6.5 Column 22a, Sea-Level Pressure. Enter the sea-level pressure in hectopascals using tens, units, and tenths (without the decimal point); e.g., enter 132 for 1013.2 hPa. Enter an "M" for a missing sea-level pressure.

2.6.6 Column 13, Altimeter Setting. Enter the altimeter setting in inches of mercury using units, tenths, and hundredths (without the decimal point); e.g., enter 994 for an altimeter setting of 29.94 inches Hg. Altimeter entry shall be prefixed by the letter "A". Prefix the numerical entry with an "E" when estimated. Enter "M" for a missing altimeter setting.

2.6.7 Column 22, Station Pressure. Enter station Pressure to the nearest 0.005 inch Hg on each hourly observation (e.g., 29.995). Prefix station pressure with an "E" when the data are estimated. Enter "M" if station pressure is missing.

2.6.8 Column 14, Remarks. Enter the sea-level (SLPppp) in Column 14. This remark is mandatory and is reported in the hourly METAR. It begins with SLP and is coded using the tens, units, and tenths of the sea-level pressure in hecto-pascals. For example, a sea-

level presure of 998.2 hPa would be coded as "SLP982". If sea-level pressure is not available, it is encoded as "SLPNO".

CONVERSION OF HECTOPASCALS (hPa) TO INCHES OF MERCURY (In. Hg)

hPa	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
900	26.577	26.580	26.583	26.586	26.589	26.592	26.595	26.598	26.601	26.604
901	26.607	26.609	26.612	26.615	26.618	26.621	26.624	26.627	26.630	26.633
902	26.636	26.639	26.642	26.645	26.648	26.651	26.654	26.657	26.660	26.663
903	26.666	26.669	26.671	26.674	26.677	26.680	26.683	26.686	26.689	26.692
904	26.695	26.698	26.701	26.704	26.707	26.710	26.713	26.716	26.719	26.722
905	26.725	26.728	26.731	26.733	26.736	26.739	26.742	26.745	26.748	26.751
906	26.754	26.757	26.760	26.763	26.766	26.769	26.772	26.775	26.778	26.781
907	26.784	26.787	26.790	26.793	26.796	26.798	26.801	26.804	26.807	26.810
908	26.813	26.816	26.819	26.822	26.825	26.828	26.831	26.834	26.837	26.840
909	26.843	26.846	26.849	26.852	26.855	26.858	26.860	26.863	26.866	26.869
910	26.872	26.875	26.878	26.881	26.884	26.887	26.890	26.893	26.896	26.899
911	26.902	26.905	26.908	26.911	26.914	26.917	26.920	26.922	26.925	26.928
912	26.931	26.934	26.937	26.940	26.943	26.946	26.949	26.952	26.955	26.958
913	26.961	26.964	26.967	26.970	26.973	26.976	26.979	26.982	26.984	26.987
914	26.990	26.993	26.996	26.999	27.002	27.005	27.008	27.011	27.014	27.017
915	27.020	27.023	27.026	27.029	27.032	27.035	27.038	27.041	27.044	27.047
916	27.049	27.052	27.055	27.058	27.061	27.064	27.067	27.070	27.073	27.076
917	27.079	27.082	27.085	27.088	27.091	27.094	27.097	27.100	27.103	27.106
918	27.109	27.111	27.114	27.117	27.120	27.123	27.126	27.129	27.132	27.135
919	27.138	27.141	27.144	27.147	27.150	27.153	27.156	27.159	27.162	27.165
920	27.168	27.171	27.173	27.176	27.179	27.182	27.185	27.188	27.191	27.194
921	27.197	27.200	27.203	27.206	27.209	27.212	27.215	27.218	27.221	27.224
922	27.227	27.230	27.233	27.236	27.238	27.241	27.244	27.247	27.250	27.253
923	27.256	27.259	27.262	27.265	27.268	27.271	27.274	27.277	27.280	27.283
924	27.286	27.289	27.292	27.295	27.298	27.300	27.303	27.306	27.309	27.312
925	27.315	27.318	27.321	27.324	27.327	27.330	27.333	27.336	27.339	27.342
926	27.345	27.348	27.351	27.354	27.357	27.360	27.362	27.365	27.368	27.371
927	27.374	27.377	27.380	27.383	27.386	27.389	27.392	27.395	27.398	27.401
928	27.404	27.407	27.410	27.413	27.416	27.419	27.422	27.424	27.427	27.430
929	27.433	27.436	27.439	27.442	27.445	27.448	27.451	27.454	27.457	27.460
930	27.463	27.466	27.469	27.472	27.475	27.478	27.481	27.484	27.487	27.489
931	27.492	27.495	27.498	27.501	27.504	27.507	27.510	27.513	27.516	27.519
932	27.522	27.525	27.528	27.531	27.534	27.537	27.540	27.543	27.546	27.549
933	27.551	27.554	27.557	27.560	27.563	27.566	27.569	27.572	27.575	27.578
934	27.581	27.584	27.587	27.590	27.593	27.596	27.599	27.602	27.605	27.608

CONVERSION OF HECTOPASCALS (hPa) TO INCHES OF MERCURY (In. Hg)

hPa "Hg	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
935-27.611	27.613	27.616	27.619	27.622	27.625	27.628	27.631	27.634	27.637	
936-27.640	27.643	27.646	27.649	27.652	27.655	27.658	27.661	27.664	27.667	
937-27.670	27.673	27.675	27.678	27.681	27.684	27.687	27.690	27.693	27.696	
938-27.699	27.702	27.705	27.708	27.711	27.714	27.717	27.720	27.723	27.726	
939-27.729	27.732	27.735	27.738	27.740	27.743	27.746	27.749	27.752	27.755	
940-27.758	27.761	27.764	27.767	27.770	27.773	27.776	27.779	27.782	27.785	
940-27.758	27.761	27.764	27.767	27.770	27.773	27.776	27.779	27.782	27.785	
941-27.788	27.791	27.794	27.797	27.800	27.802	27.805	27.808	27.811	27.814	
942-27.817	27.820	27.823	27.826	27.829	27.832	27.835	27.838	27.841	27.844	
943-27.847	27.850	27.853	27.856	27.859	27.862	27.864	27.867	27.870	27.873	
944-27.876	27.879	27.882	27.885	27.888	27.891	27.894	27.897	27.900	27.903	
945-27.906	27.909	27.912	27.915	27.918	27.921	27.924	27.927	27.929	27.932	
946-27.935	27.938	27.941	27.944	27.947	27.950	27.953	27.956	27.959	27.962	
947-27.965	27.968	27.971	27.974	27.977	27.980	27.983	27.986	27.989	27.991	
948-27.994	27.997	28.000	28.003	28.006	28.009	28.012	28.015	28.018	28.021	
949-28.024	28.027	28.030	28.033	28.036	28.039	28.042	28.045	28.048	28.051	
950-28.053	28.056	28.059	28.062	28.065	28.068	28.071	28.074	28.077	28.080	
951-28.083	28.086	28.089	28.092	28.095	28.098	28.101	28.104	28.107	28.110	
952-28.113	28.115	28.118	28.121	28.124	28.127	28.130	28.133	28.136	28.139	
953-28.142	28.145	28.148	28.151	28.154	28.157	28.160	28.163	28.166	28.169	
954-28.172	28.175	28.178	28.180	28.183	28.186	28.189	28.192	28.195	28.198	
955-28.201	28.204	28.207	28.210	28.213	28.216	28.219	28.222	28.225	28.228	
956-28.231	28.234	28.237	28.240	28.242	28.245	28.248	28.251	28.254	28.257	
957-28.260	28.263	28.266	28.269	28.272	28.275	28.278	28.281	28.284	28.287	
958-28.290	28.293	28.296	28.299	28.302	28.304	28.307	28.310	28.313	28.316	
959-28.319	28.322	28.325	28.328	28.331	28.334	28.337	28.340	28.343	28.346	
960-28.349	28.352	28.355	28.358	28.361	28.364	28.366	28.369	28.372	28.375	
961-28.378	28.381	28.384	28.387	28.390	28.393	28.396	28.399	28.402	28.405	
962-28.408	28.411	28.414	28.417	28.420	28.423	28.426	28.429	28.431	28.434	
963-28.437	28.440	28.443	28.446	28.449	28.452	28.455	28.458	28.461	28.464	
964-28.467	28.470	28.473	28.476	28.479	28.482	28.485	28.488	28.491	28.493	
965-28.496	28.499	28.502	28.505	28.508	28.511	28.514	28.517	28.520	28.523	
966-28.526	28.529	28.532	28.535	28.538	28.541	28.544	28.547	28.550	28.553	
967-28.555	28.558	28.561	28.564	28.567	28.570	28.573	28.576	28.579	28.582	
968-28.585	28.588	28.591	28.594	28.597	28.600	28.603	28.606	28.609	28.612	
969-28.615	28.618	28.620	28.623	28.626	28.629	28.632	28.635	28.638	28.641	

CONVERSION OF HECTOPASCALS (hPa) TO INCHES OF MERCURY (In. Hg)

hPa	"Hg .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
970	28.644	28.647	28.650	28.653	28.656	28.659	28.662	28.665	28.668	28.671
971	28.674	28.677	28.680	28.682	28.685	28.688	28.691	28.698	28.697	28.700
972	28.703	28.706	28.709	28.712	28.715	28.718	28.721	28.724	28.727	28.730
973	28.733	28.736	28.739	28.742	28.744	28.747	28.750	28.753	28.756	28.759
974	28.762	28.765	28.768	28.771	28.774	28.777	28.780	28.783	28.786	28.789
975	28.792	28.795	28.798	28.801	28.804	28.806	28.809	28.812	28.815	28.818
976	28.821	28.824	28.827	28.830	28.833	28.836	28.839	28.842	28.845	28.848
977	28.851	28.854	28.857	28.860	28.863	28.866	28.869	28.871	28.874	28.877
978	28.880	28.883	28.886	28.889	28.892	28.895	28.898	28.901	28.904	28.907
979	28.910	28.913	28.916	28.919	28.922	28.925	28.928	28.931	28.933	28.936
980	28.939	28.942	28.945	28.948	28.951	28.954	28.957	28.960	28.963	28.966
981	28.969	28.972	28.975	28.978	28.981	28.984	28.987	28.990	28.993	28.995
982	28.998	29.001	29.004	29.007	29.010	29.013	29.016	29.019	29.022	29.025
983	29.028	29.031	29.034	29.037	29.040	29.043	29.046	29.049	29.052	29.055
984	29.058	29.060	29.063	29.066	29.069	29.072	29.075	29.078	29.081	29.084
985	29.087	29.090	29.093	29.096	29.099	29.102	29.105	29.108	29.111	29.114
986	29.117	29.120	29.122	29.125	29.128	29.131	29.134	29.137	29.140	29.143
987	29.146	29.149	29.152	29.155	29.158	29.161	29.164	29.167	29.170	29.173
988	29.176	29.179	29.182	29.184	29.187	29.190	29.193	29.196	29.199	29.202
989	29.205	29.208	29.211	29.214	29.217	29.220	29.223	29.226	29.229	29.232
990	29.235	29.238	29.241	29.244	29.246	29.249	29.252	29.255	29.258	29.261
991	29.264	29.267	29.270	29.273	29.276	29.279	29.282	29.285	29.288	29.291
992	29.294	29.297	29.300	29.303	29.306	29.309	29.311	29.314	29.317	29.320
993	29.323	29.326	29.329	29.332	29.335	29.338	29.341	29.344	29.347	29.350
994	29.353	29.356	29.359	29.362	29.365	29.368	29.371	29.373	29.376	29.379
995	29.382	29.385	29.388	29.391	29.394	29.397	29.400	29.403	29.406	29.409
996	29.412	29.415	29.418	29.421	29.424	29.427	29.430	29.433	29.435	29.438
997	29.441	29.444	29.447	29.450	29.453	29.456	29.459	29.462	29.465	29.468
998	29.471	29.474	29.477	29.480	29.483	29.486	29.489	29.492	29.495	29.497
999	29.500	29.503	29.506	29.509	29.512	29.515	29.518	29.521	29.524	29.527
1000	29.530	29.533	29.536	29.539	29.542	29.545	29.548	29.551	29.554	29.557
1001	29.560	29.562	29.565	29.568	29.571	29.574	29.577	29.580	29.583	29.586
1002	29.589	29.592	29.595	29.598	29.601	29.604	29.607	29.610	29.613	29.616
1003	29.619	29.622	29.624	29.627	29.630	29.633	29.636	29.639	29.642	29.645
1004	29.648	29.651	29.654	29.657	29.660	29.663	29.666	29.669	29.672	29.675

CONVERSION OF HECTOPASCALS (hPa) TO INCHES OF MERCURY (In. Hg)

hPa	"Hg .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1005	29.678	29.681	29.684	29.686	29.689	29.692	29.695	29.698	29.701	29.704
1006	29.707	29.710	29.713	29.716	29.719	29.722	29.725	29.728	29.731	29.734
1007	29.737	29.740	29.743	29.746	29.749	29.751	29.754	29.757	29.760	29.763
1008	29.766	29.769	29.772	29.775	29.778	29.781	29.784	29.787	29.790	29.793
1009	29.796	29.799	29.802	29.805	29.808	29.811	29.813	29.816	29.819	29.822
1010	29.825	29.828	29.831	29.834	29.837	29.840	29.843	29.846	29.849	29.852
1011	29.855	29.858	29.861	29.864	29.867	29.870	29.873	29.875	29.878	29.881
1012	29.884	29.887	29.890	29.893	29.896	29.899	29.902	29.905	29.908	29.911
1013	29.914	29.917	29.920	29.923	29.926	29.929	29.932	29.935	29.937	29.940
1014	29.943	29.946	29.949	29.952	29.955	29.958	29.961	29.964	29.967	29.970
1015	29.973	29.976	29.979	29.982	29.985	29.988	29.991	29.994	29.997	30.000
1016	30.002	30.005	30.008	30.011	30.014	30.017	30.020	30.023	30.026	30.029
1017	30.032	30.035	30.038	30.041	30.044	30.047	30.050	30.053	30.056	30.059
1018	30.062	30.064	30.067	30.070	30.073	30.076	30.079	30.082	30.085	30.088
1019	30.091	30.094	30.097	30.100	30.103	30.106	30.109	30.112	30.115	30.118
1020	30.121	30.124	30.126	30.129	30.132	30.135	30.138	30.141	30.144	30.147
1021	30.150	30.153	30.156	30.159	30.162	30.165	30.168	30.171	30.174	30.177
1022	30.180	30.183	30.186	30.188	30.191	30.194	30.197	30.200	30.203	30.206
1023	30.209	30.212	30.215	30.218	30.221	30.224	30.227	30.230	30.233	30.236
1024	30.239	30.242	30.245	30.248	30.251	30.253	30.256	30.259	30.262	30.265
1025	30.268	30.271	30.274	30.277	30.280	30.283	30.286	30.289	30.292	30.295
1026	30.298	30.301	30.304	30.307	30.310	30.313	30.315	30.318	30.321	30.324
1027	30.327	30.330	30.333	30.336	30.339	30.342	30.345	30.348	30.351	30.354
1028	30.357	30.360	30.363	30.366	30.369	30.372	30.375	30.377	30.380	30.383
1029	30.386	30.389	30.392	30.395	30.398	30.401	30.404	30.407	30.410	30.413
1030	30.416	30.419	30.422	30.425	30.428	30.431	30.434	30.437	30.440	30.442
1031	30.445	30.448	30.451	30.454	30.457	30.460	30.463	30.466	30.469	30.472
1032	30.475	30.478	30.481	30.484	30.487	30.490	30.493	30.496	30.499	30.502
1033	30.504	30.507	30.510	30.513	30.516	30.519	30.522	30.525	30.528	30.531
1034	30.534	30.537	30.540	30.543	30.546	30.549	30.552	30.555	30.558	30.561
1035	30.564	30.566	30.569	30.572	30.575	30.578	30.581	30.584	30.587	30.590
1036	30.593	30.596	30.599	30.602	30.605	30.608	30.611	30.614	30.617	30.620
1037	30.623	30.626	30.628	30.631	30.634	30.637	30.640	30.643	30.646	30.649
1038	30.652	30.655	30.658	30.661	30.664	30.667	30.670	30.673	30.676	30.679
1039	30.682	30.685	30.688	30.691	30.693	30.696	30.699	30.702	30.705	30.708

CONVERSION OF HECTOPASCALS (hPa) TO INCHES OF MERCURY (In. Hg)

hPa	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
1040	30.711	30.714	30.717	30.720	30.723	30.726	30.729	30.732	30.735	30.738
1041	30.741	30.744	30.747	30.750	30.753	30.755	30.758	30.761	30.764	30.767
1042	30.770	30.773	30.776	30.779	30.782	30.785	30.788	30.791	30.794	30.797
1043	30.800	30.803	30.806	30.809	30.812	30.815	30.817	30.820	30.823	30.826
1044	30.829	30.832	30.835	30.838	30.841	30.844	30.847	30.850	30.853	30.856
1045	30.859	30.962	30.865	30.868	30.871	30.874	30.877	30.880	30.882	30.885
1046	30.888	30.891	30.894	30.897	30.900	30.903	30.906	30.909	30.912	30.915
1047	30.918	30.921	30.924	30.927	30.930	30.933	30.936	30.939	30.942	30.944
1048	30.947	30.950	30.953	30.956	30.959	30.962	30.965	30.968	30.971	30.974
1049	30.977	30.980	30.983	30.986	30.989	30.992	30.995	30.998	31.001	31.004
1050	31.006	31.009	31.012	31.015	31.018	31.021	31.024	31.027	31.030	31.033

Proportional Parts	hPa	.01	.02	.03	.04	.05	.06	.07	.08	.09
	in. Hg	.000	.001	.001	.001	.001	.002	.002	.002	.003

ADDITIVE REDUCTION CONSTANTS FROM STATION PRESSURE TO SEA LEVEL PRESSURE AND ALTIMETER SETTING

Standard Additive Reduction Constants for computation of Sea Level Pressure and Altimeter Setting from Station Pressure for * Station Elevations from 1 to 100 feet. 1 FT = .001067 In Hg = .0361328 hPa

Sta Elev	Inches Hg	hPa	Sta Elev	Inches Hg	hPa	Sta Elev	Inches Hg	hPa
1	.001	.036	34	.036	1.229	67	.071	2.421
2	.002	.072	35	.037	1.265	68	.073	2.457
3	.003	.108	36	.038	1.301	69	.074	2.493
4	.004	.145	37	.039	1.337	70	.075	2.529
5	.005	.181	38	.041	1.373	71	.076	2.565
6	.006	.217	39	.042	1.409	72	.077	2.602
7	.007	.253	40	.043	1.445	73	.078	2.638
8	.009	.289	41	.044	1.481	74	.079	2.674
9	.010	.325	42	.045	1.518	75	.080	2.710
10	.011	.361	43	.046	1.554	76	.081	2.746
11	.012	.397	44	.047	1.590	77	.082	2.782
12	.013	.434	45	.048	1.626	78	.083	2.818
13	.014	.470	46	.049	1.662	79	.084	2.854
14	.015	.506	47	.050	1.698	80	.085	2.891
15	.016	.542	48	.051	1.734	81	.086	2.927
16	.017	.578	49	.052	1.771	82	.087	2.963
17	.018	.614	50	.053	1.807	83	.088	2.999
18	.019	.650	51	.054	1.843	84	.089	3.035
19	.020	.687	52	.055	1.879	85	.091	3.071
20	.021	.723	53	.057	1.915	86	.092	3.107
21	.022	.759	54	.058	1.951	87	.093	3.144
22	.023	.795	55	.059	1.987	88	.094	3.180
23	.025	.831	56	.060	2.023	89	.095	3.216
24	.026	.867	57	.061	2.060	90	.096	3.252
25	.027	.903	58	.062	2.096	91	.097	3.288
26	.028	.939	59	.063	2.132	92	.098	3.324
27	.029	.976	60	.064	2.168	93	.099	3.360
28	.030	1.012	61	.065	2.204	94	.100	3.396
29	.031	1.048	62	.066	2.240	95	.101	3.433
30	.032	1.084	63	.067	2.276	96	.102	3.469
31	.033	1.120	64	.068	2.312	97	.103	3.505
32	.034	1.156	65	.069	2.349	98	.105	3.541
33	.035	1.192	66	.070	2.385	99	.106	3.577

*** Station Elevation on a ship is the height of the Aneroid Barometer above sea level. Station Pressure is the direct reading from the Aneroid Barometer with any instrument correction added.**

PRESSURE ALTITUDE

Pressure, inches of mercury	0 ft.	0.01 ft.	0.02 ft.	0.03 ft.	0.04 ft.	0.05 ft.	0.06 ft.	0.07 ft.	0.08 ft.	0.09 ft.
27.0	2815	2805	2795	2785	2775	2765	2755	2745	2735	2725
27.1	2715	2705	2695	2685	2675	2665	2655	2645	2635	2625
27.2	2615	2605	2595	2585	2575	2565	2555	2545	2535	2525
27.3	2515	2505	2495	2485	2475	2465	2455	2445	2435	2426
27.4	2416	2406	2396	2386	2376	2366	2356	2346	2336	2326
27.5	2316	2307	2297	2287	2277	2267	2257	2247	2237	2227
27.6	2218	2208	2198	2188	2178	2168	2158	2148	2139	2129
27.7	2119	2109	2099	2089	2080	2070	2060	2050	2040	2030
27.8	2021	2011	2001	1991	1981	1972	1962	1952	1942	1932
27.9	1923	1913	1903	1893	1884	1874	1864	1854	1844	1835
28.0	1825	1815	1805	1796	1786	1776	1766	1757	1747	1737
28.1	1727	1718	1708	1698	1689	1679	1669	1659	1650	1640
28.2	1630	1621	1611	1601	1592	1582	1572	1562	1553	1543
28.3	1533	1524	1514	1504	1495	1485	1475	1466	1456	1446
28.4	1437	1427	1417	1408	1398	1389	1379	1369	1360	1350
28.5	1340	1331	1321	1312	1302	1292	1283	1273	1264	1254
28.6	1244	1235	1225	1216	1206	1196	1187	1177	1168	1158
28.7	1149	1139	1129	1120	1110	1101	1091	1082	1072	1063
28.8	1053	1044	1034	1024	1015	1005	996	986	977	967
28.9	958	948	939	929	920	910	901	891	882	872
29.0	863	853	844	834	825	815	806	796	787	778
29.1	768	759	749	740	730	721	711	702	693	683
29.2	674	664	655	645	636	627	617	608	598	589
29.3	579	570	561	551	542	532	523	514	504	495
29.4	486	476	467	457	448	439	429	420	411	401
29.5	392	382	373	364	354	345	336	326	317	308
29.6	298	289	280	270	261	252	242	233	224	215
29.7	205	196	187	177	168	159	149	140	131	122
29.8	112	103	94	85	75	66	57	47	38	29
29.9	20	10	1	-8	-17	-27	-36	-45	-54	-64

PRESSURE ALTITUDE

Pressure, inches of mercury	0 ft.	0.01 ft.	0.02 ft.	0.03 ft.	0.04 ft.	0.05 ft.	0.06 ft.	0.07 ft.	0.08 ft.	0.09 ft.
30.0	-73	-82	-91	-100	-110	-119	-128	-137	-146	-156
30.1	-165	-174	-183	-193	-202	-211	-220	-229	-238	-246
30.2	-257	-266	-275	-284	-294	-303	-312	-321	-330	-339
30.3	-348	-358	-367	-376	-385	-394	-403	-413	-422	-431
30.4	-440	-449	-458	-467	-476	-486	-495	-504	-513	-522
30.5	-531	-540	-549	-558	-567	-577	-586	-595	-604	-613
30.6	-622	-631	-640	-649	-658	-667	-676	-686	-695	-704
30.7	-713	-722	-731	-740	-749	-758	-767	-776	-785	-794
30.8	-803	-812	-821	-830	-839	-848	-857	-866	-875	-884
30.9	-893	-902	-911	-920	-929	-938	-947	-956	-965	-974
31.0	-983	-992	-1001	-1010	-1019	-1028	-1037	-1046	-1055	-1064
31.1	-1073	-1082	-1091	-1100	-1109	-1118	-1127	-1136	-1145	-1154
31.2	-1163	-1172	-1181	-1189	-1198	-1207	-1216	-1215	-1234	-1243
31.3	-1252	-1261	-1270	-1279	-1288	-1297	-1305	-1314	-1323	-1332
31.4	-1341	-1350	-1359	-1368	-1377	-1385	-1394	-1403	-1412	-1421
31.5	-1430	-1439	-1448	-1456	-1465	-1474	-1483	-1492	-1501	-1510
31.6	-1518	-1527	-1536	-1545	-1554	-1563	-1571	-1580	-1589	-1598
31.7	-1607	-1616	-1624	-1633	-1642	-1651	-1660	-1669	-1677	-1686
31.8	-1695	-1704	-1713	-1721	-1730	-1739	-1748	-1757	-1765	-1774
31.9	-1783	-1792	-1800	-1809	-1818	-1827	-1836	-1844	-1853	-1892

INSTRUCTIONS FOR USING THE PRESSURE COMPUTATION WORKSHEET

BAR HT: 40 FT = STANDARD CORRECTION + 1.4 hPa + .043 INS Hg

2355Z/1155Z		Time of observation UTC
OBS PRES hPa	1021.4	Barometer's current reading
+/- BAR COR	- .7	-/+ Barometer correction
STA PRES hPa	1020.7	Convert this value to Inches Hg Enter value in STA PRES INS below
+ HT COR hPa	1.4	Add correction for 40 ft height of barometer in hPa from Table II-6-2
SLP	1022.1 221	Drop "10" and Decimal Point Enter this Value in Column 22a
STA PRES INS	30.141	Converted STA PRES hPa to Inches Hg from Table II-6-1 Enter this value in Column 22
+ HT COR INS	.043	Add correction for 40 ft height of barometer in Inches Hg from Table II-6-2
ALTIMETER	30.184	Round value to hundredths = 30.18 Enter this value in column 13
	018	Drop the "3" and enter value in Column 12
3HR PRES CHG	_____	Subtract STA PRES Inches Hg 3 hours ago from current STA PRE Inches Hg Indicate if Higher, Lower, or the Same as 3 hours ago

NOTE: The worksheet is used along with Table II-6-1. The barometer correction may change when barometer recalibration occurs. Table II-6-2 contains additive reduction constants which always remain the same on the worksheet, unless barometer raised or lowered. When computing sea level pressure, values from Table II-6-2 should be rounded to the nearest tenth as shown in the above example (e.g., For 63 Ft, the corrective factor of 2.276 hPa would be rounded to 2.3 hPa, etc.).

PRESSURE COMPUTATION WORKSHEET FOR: _____ **(DATE)**

BAROMETER HEIGHT: ____ **FT = STANDARD CORRECTION** _____ **hPa** _____ **INS Hg**

2355Z/1155Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
3HR PRES CHG _____

0055Z/1255Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
HIGHER ____ LOWER ____

0155Z/1355Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
SAME AS ____

0255Z/1455Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
3HR PRES CHG _____

0355Z/1555Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
HIGHER ____ LOWER ____

0455Z/1655Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
SAME AS ____

0555Z/1755Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
3HR PRES CHG _____

0655Z/1855Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
HIGHER ____ LOWER ____

0755Z/1955Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
SAME AS ____

0855Z/2055Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
3HR PRES CHG _____

0955Z/2155Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
HIGHER ____ LOWER ____

1055Z/2255Z

OBS PRES hPa _____
+/- BAR COR _____
STA PRES hPa _____
+ HT COR hPa _____
SLP _____
STA PRES INS _____
+ HT COR _____
ALTIMETER _____
SAME AS ____

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SECTION II - CHAPTER 7

2.7 OBSERVATION PROCEDURES AND FORM ENTRIES -- Columns 11, 12, 20, and D -- AIR AND SEA TEMPERATURE

2.7.1 Introduction. This chapter contains instructions for observing the dry and wet-bulb air temperature and sea water temperature. Instructions are also provided for computing dew point, relative humidity and making entries on CNMOC Form 3141/3, columns 11, 12, 20, and D. Information related to the effects of wind chill, heat stress and exposure to sea water on the temperature felt on the human body are also included.

2.7.1.1 Units of Measure. Temperatures are reported in one unit of measure. The Celsius (Centigrade) degree scale is used as the international unit of measure for temperature. Observed and computed temperatures can be converted from Fahrenheit to provide values in Celsius for transmission in the synoptic code. Conversion of degrees Fahrenheit to degrees Celsius temperature values are contained in Table II-7-1. The psychrometric computer (CP-165/UM) also contains a scale for converting Fahrenheit to Celsius.

2.7.2 Observation of Dry and Wet-Bulb Temperatures. Dry-bulb temperature is the ambient air temperature measured on the dry-bulb thermometer of the psychrometer. Wet-bulb temperature is the temperature a parcel of air would have if cooled adiabatically to saturation at constant pressure by evaporation of water into it, with all latent heat supplied by the parcel.

2.7.2.1 Point of Observation. To observe the dry and wet-bulb temperatures, choose a point on the windward side of the ship in a relatively open area away from heat sources such as:

a. Ship's stacks

b. Air vents

c. Steam lines and catapults

d. Jet blast prop and rotor wash

e. Operating internal combustion engines

f. Large decks with dark surfaces that receive prolonged direct sun.

All of the above will increase the observed dry-bulb temperature and generally reduce the relative moisture content of the ambient air.

2.7.2.2 Psychrometers. Psychrometers are used to measure the ambient air temperature and the water vapor content of the air.

They consist of two glass thermometers. The bulb of the wet-bulb thermometer is covered with a clean muslin wick which is saturated with water prior to an observation. When the bulbs are properly ventilated, they indicate the wet and dry-bulb temperatures of the atmosphere. There are two types of psychrometers. Both accurately measure the dry and wet-bulb temperatures when operated properly. There is no preferred one for use, however, sling psychrometers are more fragile and require more care when they are used.

a. Sling Psychrometer. The sling psychrometer consists of two matched thermometers mounted on a common back. Ventilation is achieved by whirling the thermometers with a handle and a swivel link until the maximum wet-bulb depression has been obtained.

b. Electric Psychrometer. The electric psychrometer ML-450A/UM is a hand-held portable instrument which serves the same purpose as the sling psychrometer. Batteries furnish power to a self contained ventilation fan which aspirates the thermometers. The instrument also contains a lamp for night-time readings.

c. Type of Thermometer. There are two types of thermometers used in psychrometers, mercury thermometers and spirit (alcohol) thermometers. They are used as follows:

(1) Spirit Thermometers - temperatures minus 35 degrees Fahrenheit and colder.

(2) Mercury Thermometers - temperatures warmer than minus 35 degrees Fahrenheit. Note: Should a mercury thermometer break during operation, particular caution should be taken to avoid skin contact when cleaning or disposal of the mercury.

It is recommended that several replacement thermometers be available for use in the event of accidental breakage or if it is noted that there is a separation of the spirit or alcohol column.

2.7.2.3 Operation of Psychrometers. The psychrometer used regularly should be stored outside in a shaded box with good ventilation, away from spray, precipitation and heat sources. If such a location is not available, store the psychrometer in a clean, dry place that is not exposed to extreme temperature changes. If the psychrometer is kept inside between observations it will require longer ventilation outside to let the thermometers adjust. The greater the temperature difference between inside and outside, the longer it will take to stabilize the thermometers.

a. The muslin wicking of the wet-bulb thermometer should be inspected for cleanliness before each observation. If presence of salt spray, oil, grease or dirt is noted, the wicking should be changed before the observation. If the wet-bulb is not the same as the temperature of the dry-bulb when the wicking is dry, this is an indication that the wicking is contaminated and should be changed. It is recommeded the wicking be changed weekly.

b. The water used to moisten the wick on the wet-bulb should be the purest available. The wick will become stiff and the bulb encrusted if the water contains impurities. Any minerals or other impurities will change the evaporation characteristics of the water. Change the water periodically to ensure its purity.

c. Preparing to Observe Wet-bulb Temperature. Moisten the wicking of the wet-bulb just before each observation using the following instructions.

(1) Temperature Above Freezing (Normal Conditions). Moisten the wicking of the wet-bulb just prior to ventilating the psychrometer when the dry-bulb temperature is warmer than 3°C (37°F) even if the humidity is high or the wicking already appears wet. If the wet-bulb temperature is expected to be 0°C (32°F) or colder, moisten the wicking several minutes before ventilation so that a drop of water will have formed on the end of the bulb.

(2) High Temperature and Low Humidity. Moisten the wet-bulb wick with precooled water whenever possible in areas where the temperature is high and the relative humidity is low. Thoroughly moisten the wicking several minutes prior to and again at the time of ventilation, thus helping to reduce the temperature and prevent the wicking from drying out during ventilation. If this procedure is not effective, keep the wicking extended into an open container of water between observations.

(3) Temperature of 3°C (37°F) and Colder. Use water kept at room temperature to melt any accumulation of ice on the wet-bulb whenever the dry-bulb temperature of 3°C (37°F) or colder occurs. Moisten the wicking thoroughly at least 15 minutes before ventilation to allow the latent heat to dissipate before ventilation is begun. Do not allow excess water to remain on the wet-bulb since a thin ice coating is necessary for accurate data. If the wicking is not frozen at wet-bulb temperatures colder than 0°C (32°F), induce freezing by touching the wick with clean ice, snow or other cold objects. If unable to induce freezing of the wicking, use the low temperature range of the psychrometric computer. Moisten the wick again at the time of ventilation.

d. Preparing to Observe Dry-Bulb Thermometer. When appropriate, take the following actions to ventilate the psychrometer.

(1) Dew and Frost Conditions. When dew or frost are expected, check the dry-bulb thermometer 10 to 15 minutes prior to ventilation. Lightly remove any collection on the thermometer with a soft cloth. Allow sufficient time for the dissipation of extraneous heat before ventilation.

(2) Precipitation Conditions. When a sling psychrometer is used when precipitation is occurring, read the dry-bulb temperature before ventilation. If there is moisture on the thermometer, gently wipe it dry with a soft cloth and shield the thermometer from the precipitation as long as necessary. This

permits dissipation of any extraneous heat before reading the temperature.

e. Psychrometer Ventilation. To ventilate the psychrometer, the minimum speed of air passing over the bulbs should be 15 feet per second (or 5 meters per second). This is approximately two revolutions per second of the sling psychrometer.

(1) Using the Sling Psychrometer. Select a shady area with no obstructions within 3-4 feet and face into the wind. It is preferable to hold the instrument over the rail of the ship while whirling it. If the reading must be taken in the sun, keep the instrument in the shade of a hat, clipboard, or the body as much as practical, but not so close that body heat will affect readings. If the apparent wind is over 9 knots, the air flow should be sufficient enough for ventilation without having to whirl the sling.

(2) Using the Electric Psychrometer. The electric psychrometer should be exposed to the ambient air for at least five minutes before reading. Select a shady area with no obstructions within 3-4 feet. Hold the instrument over the ships railing with the air intake pointing into the wind. If the reading must be taken in direct sunlight, turn the instrument in such a manner that it precludes direct sunlight from hitting the thermometers. When the ambient air temperature is 10°C (50°F) and above, it is not necessary to energize the ventilation fan. When the ambient air temperature is below 10°C (50°F), expose the psychrometer with the ventilation fan running.

(3) Steps in Ventilation. After the wicking of the wet-bulb has been moistened, use the following steps to ventilate the psychrometer.

(a) Begin ventilating the psychrometer for about 15 seconds; i.e., turn-on the aspirator motor, or begin whirling the sling psychrometer, as appropriate. Read the wet-bulb thermometer, but do not record the reading.

(b) When using a sling, ventilate the psychrometer for another 10 seconds and again read the wet-bulb thermometer. Continue this process at 10-second intervals until succeeding readings are within 1°C or less of each other. Then ventilate the instrument at intervals of 5 seconds.

(c) If the wet-bulb temperature rises between successive readings, remoisten the wick and repeat the entire ventilation process.

(d) In reading the thermometers, make sure the line of sight from the eye to the top of the liquid column is at such an angle (approximately 90°) as to minimize the error of parallax. Obtain readings with reference to the middle of the degree markings.

(e) When consecutive readings show no further decrease, the wet-bulb temperature has been reached.

(f) Read temperatures to the nearest 0.1°C. Read the dry-bulb temperature first, followed by the wet-bulb temperature.

(4) Condition of Saturation. During dense fog or heavy precipitation, a condition of 100 percent relative humidity may exist and no evaporation from the wet-bulb can occur. In this event, the temperature of the wet-bulb is the same as that of the dry-bulb thermometer and dew point temperature must be determined according to procedures in paragraph 2.7.3.

2.7.3. Determination of Dew Point Temperature

a. The dew point temperature is the temperature to which a given parcel of air must be cooled, at constant pressure and water vapor content in order for saturation to occur. It is the temperature at which dew forms on surfaces, hence the name dew point. Fog also forms when the air temperature approaches the dew point temperature. The dew point is computed using the following steps:

(1) Determine the wet-bulb depression by subtracting the wet-bulb temperature from the dry-bulb temperature. Examples:

Dry-bulb temperature	+73.5°F	
Wet-bulb temperature	+69.0°F	(subtract)
Depression	4.5°F	

Dry-bulb temperature	+34.5°F	
Wet-bulb temperature	+26.0°F	(subtract)
Depression	8.5°F	

(2) When using Table II-7-2, Dew Point Computation, round off the observed wet-bulb temperature to the nearest .5°C before computation of the wet-bulb depression. In Table II-7-2, from the wet-bulb temperature along the left column, move to the right until you find the correct "depression of the wet-bulb" column. Where these two columns intersect is the dew point temperature in whole degrees Fahrenheit.

(3) If the psychrometric computer CP-165/UM is used to compute the dew point temperature, use the following steps:

(a) Using the outer D scale, set the arrow at 0°F on the observed wet-bulb temperature to the nearest .1°F.

(b) Set the rotating cursor on the value on the D scale equaling the wet-bulb depression.

(c) The dew point temperature is the value on the DP scale that the cursor is on, above the wet-bulb depression value on the D scale.

(d) When the wet-bulb temperature is above 32°F use the high temperature range.

(e) When the wet-bulb is 32°F and below, use the low temperature range.

(f) When the wet-bulb temperature is 32°F and below and the wicking in the wet-bulb thermometer is ice covered, use the Ti scale instead of the DP scale in step 2.7.3.(3)(c).

(4) Statistical Dew Point Temperature. At dry-bulb temperatures of -35°F (-37°C) and colder, assume the dew point with respect to ice is the same as the dry-bulb temperature. Obtain a statistical dew point value for the observation record by converting this temperature to the corresponding dew point with respect to water.

2.7.4 Relative Humidity. Relative humidity is the ratio of the actual vapor pressure of the air to the saturation vapor pressure expressed as a percentage. The relative humidity is not routinely computed and is not required as a data entry in either the ship observation or the ship synoptic code. However, the relative humidity is a frequently requested value and the observer should become familiar with computing it. To compute relative humidity, use the Psychrometric Computer CP-165A/UM. Observe the dry-bulb and wet-bulb temperatures and compute the dew point. Compute relative humidity as follows:

a. Using the inner two scales of the CP-165A/UM, scales RH and T, set the arrow at 100% RH on the dry-bulb value on the T scale.

b. Rotate the cursor until the line is on the dew point value on the T scale.

c. Read the percent of relative humidity on the RH scale below the dew point value.

2.7.5 Sea Water Temperature. The sea water temperature reported in the ship observation and synoptic code is the temperature of the first few feet of water as close to the surface layer as possible. There are three methods of observing the sea water temperature: the bucket method, from a bathythermograph observation, or from the sea water injection thermometers in the machinery spaces.

2.7.5.1 Bucket Observation Method. The bucket method is the preferred method of observation. Attach a line to the bail of the bucket. From as far forward as possible, heave the bucket overboard. Allow time for the bucket to come to the sea temperature. Haul in the sample rapidly and take it to a point out of sunlight and wind. Stir the water with a thermometer until the thermometer reading stabilizes. Read the thermometer to the nearest tenth of a degree fahrenheit with the bulb still immersed in the water.

2.7.5.2 Bathythermograph Observation Method. If a bathythermograph observation is taken within 15 minutes of the scheduled observation time the temperature recorded at the surface may be used as the sea water temperature.

2.7.5.3 Injection or Condenser Intake Temperature. Determine from the engineering department which machinery room has the most accurate sea water injection readings and compare the readings with bucket or bathythermograph observations. If the readings are not within 0.5°C, determine if the difference is consistent for temperature ranges. If possible, determine correction values to be used. Validate the accuracy of the readings routinely. If the sea water injection temperature cannot be observed or corrected to within 0.5°C, do not use these readings. If the required accuracy can be met, obtain a reading within 15 minutes of the scheduled time of observation.

2.7.6 Column 11 - Temperature. Enter the dry-bulb temperature to the nearest tenth degree Celsius. Prefix subzero temperatures with a "M"; e.g., M08.1. If temperature is missing, leave blank and do not encode dew point and wet-bulb temperatures as well.

2.7.7 Column 12 - Dew Point Temperature. Enter the dew point temperature to the nearest whole degree Celsius. Prefix subzero dew point temperatures with a "M". Enter statistical data in parenthesis; i.e., enter the water equivalent of the dry-bulb temperature when the air temperature is -37°C (-35°F) or below.

2.7.8 Column 20 - Wet-bulb Temperature. Enter the wet-bulb temperature to the nearest tenth degree Celsius. Prefix subzero wet-bulb temperatures with a "M".

2.7.9 Column D - Sea Water Temperature. Enter the sea water temperature to the nearest tenth degree Celsius. Enter "M" for missing data.

CONVERSION OF FAHRENHEIT DEGREES TO CELSIUS DEGREES

deg F	Tabular values deg C .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
129	53.9	53.9	54.0	54.1	54.1	54.2	54.2	54.3	54.3	54.4
128	53.8	53.3	53.4	53.4	53.5	53.6	53.6	53.7	53.7	53.8
127	52.8	52.8	52.9	52.9	53.0	53.1	53.1	53.2	53.2	53.3
126	52.2	52.3	52.3	52.4	52.4	52.5	52.6	52.6	52.7	52.7
125	51.7	51.7	51.8	51.8	51.9	51.9	52.0	52.1	52.1	52.2
124	51.1	51.2	51.2	51.3	51.3	51.4	51.4	51.5	51.6	51.6
123	50.6	50.6	50.7	50.7	50.8	50.8	50.9	50.9	51.0	51.1
122	50.0	50.1	50.1	50.2	50.2	50.3	50.3	50.4	50.4	50.5
121	49.4	49.5	49.6	49.6	49.7	49.7	49.8	49.8	49.9	49.9
120	48.9	48.9	49.0	49.1	49.1	49.2	49.2	49.3	49.3	49.4
119	48.3	48.4	48.4	48.5	48.6	48.6	48.7	48.7	48.8	48.8
118	47.8	47.8	47.9	47.9	48.0	48.1	48.1	48.2	48.2	48.3
117	47.2	47.3	47.3	47.4	47.4	47.5	47.6	47.6	47.7	47.7
116	46.7	46.7	46.8	46.8	46.9	46.9	47.0	47.1	47.1	47.2
115	46.1	46.2	46.2	46.3	46.3	46.4	46.4	46.5	46.6	46.6
114	45.6	45.6	45.7	45.7	45.8	45.8	45.9	45.9	46.0	46.1
113	45.0	45.1	45.1	45.2	45.2	45.3	45.3	45.4	45.4	45.5
112	44.4	44.5	44.6	44.6	44.7	44.7	44.8	44.8	44.9	44.9
111	43.9	43.9	44.0	44.1	44.1	44.2	44.2	44.3	44.3	44.4
110	43.3	43.4	43.4	43.5	43.6	43.6	43.7	43.7	43.8	43.8
109	42.8	42.8	42.9	42.9	43.0	43.1	43.1	43.2	43.2	43.3
108	42.2	42.3	42.3	42.4	42.4	42.5	42.6	42.6	42.7	42.7
107	41.7	41.7	41.8	41.8	41.9	41.9	42.0	42.1	42.1	42.2
106	41.1	41.2	41.2	41.3	41.3	41.4	41.4	41.5	41.6	41.6
105	40.6	40.6	40.7	40.7	40.8	40.8	40.9	40.9	41.0	41.1
104	40.0	40.1	40.1	40.2	40.2	40.3	40.3	40.4	40.4	40.5
103	39.4	39.5	39.6	39.6	39.7	39.7	39.8	39.8	39.9	39.9
102	38.9	38.9	39.0	39.1	39.1	39.2	39.2	39.3	39.3	39.4
101	38.3	38.4	38.4	38.5	38.6	38.6	38.7	38.7	38.8	38.8
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

CONVERSION OF FAHRENHEIT DEGREES TO CELSIUS DEGREES

deg F	Tabular values deg C									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
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

CONVERSION OF FAHRENHEIT DEGREES TO CELSIUS DEGREES

deg F	Tabular Values deg C									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
60	15.6	15.6	15.7	15.7	15.8	15.8	15.9	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

CONVERSION OF FAHRENHEIT DEGREES TO CELSIUS DEGREES

deg F	Tabular values deg C .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
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
20	-6.7	-6.6	-6.6	-6.5	-6.4	-6.4	-6.3	-6.3	-6.2	-6.2
19	-7.2	-7.2	-7.1	-7.1	-7.0	-6.9	-6.9	-6.8	-6.8	-6.7
18	-7.8	-7.7	-7.7	-7.6	-7.6	-7.5	-7.4	-7.4	-7.3	-7.3
17	-8.3	-8.3	-8.2	-8.2	-8.1	-8.1	-8.0	-7.9	-7.9	-7.8
16	-8.9	-8.8	-8.8	-8.7	-8.7	-8.6	-8.6	-8.5	-8.4	-8.4
15	-9.4	-9.4	-9.3	-9.3	-9.2	-9.2	-9.1	-9.1	-9.0	-8.9
14	-10.0	-9.9	-9.9	-9.8	-9.8	-9.7	-9.7	-9.6	-9.6	-9.5
13	-10.6	-10.5	-10.4	-10.4	-10.3	-10.3	-10.2	-10.2	-10.1	-10.1
12	-11.1	-11.1	-11.0	-10.9	-10.9	-10.8	-10.8	-10.7	-10.7	-10.6
11	-11.7	-11.6	-11.6	-11.5	-11.4	-11.4	-11.3	-11.3	-11.2	-11.2
10	-12.2	-12.2	-12.1	-12.1	-12.0	-11.9	-11.9	-11.8	-11.8	-11.7
9	-12.8	-12.7	-12.7	-12.6	-12.6	-12.5	-12.4	-12.4	-12.3	-12.3
8	-13.3	-13.3	-13.2	-13.2	-13.1	-13.1	-13.0	-12.9	-12.9	-12.8
7	-13.9	-13.8	-13.8	-13.7	-13.7	-13.6	-13.6	-13.5	-13.4	-13.4
6	-14.4	-14.4	-14.3	-14.3	-14.2	-14.2	-14.1	-14.1	-14.0	-13.9
5	-15.0	-14.9	-14.9	-14.8	-14.8	-14.7	-14.7	-14.6	-14.6	-14.5
4	-15.6	-15.5	-15.4	-15.4	-15.3	-15.3	-15.2	-15.2	-15.1	-15.1
3	-16.1	-16.1	-16.0	-15.9	-15.9	-15.8	-15.8	-15.7	-15.7	-15.6
2	-16.7	-16.6	-16.6	-16.5	-16.4	-16.4	-16.3	-16.3	-16.2	-16.2
1	-17.2	-17.2	-17.1	-17.1	-17.0	-16.9	-16.9	-16.8	-16.8	-16.7
+0	-17.8	-17.7	-17.7	-17.6	-17.6	-17.5	-17.4	-17.4	-17.3	-17.3
-0	-17.8	-17.9	-17.9	-18.0	-18.1	-18.1	-18.2	-18.2	-18.3	-18.3
-1	-18.3	-18.4	-18.4	-18.5	-18.6	-18.6	-18.7	-18.7	-18.8	-18.9
-2	-18.9	-18.9	-19.0	-19.0	-19.1	-19.1	-19.2	-19.2	-19.3	-19.4
-3	-19.4	-19.5	-19.6	-19.6	-19.7	-19.7	-19.8	-19.8	-19.9	-19.9
-4	-20.0	-20.1	-20.1	-20.2	-20.2	-20.3	-20.3	-20.4	-20.4	-20.5
-5	-20.6	-20.6	-20.7	-20.7	-20.8	-20.8	-20-9	-20.9	-21.0	-21.0

CONVERSION OF FAHRENHEIT DEGREES TO CELSIUS DEGREES

deg F	Tabular values deg C .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
-6	-21.1	-21.2	-21.2	-21.3	-21.3	-21.4	-21.4	-21.5	-21.6	-21.6
-7	-21.7	-21.7	-21.8	-21.8	-21.9	-21.9	-22.0	-22.1	-22.1	-22.2
-8	-22.2	-22.3	-22.3	-22.4	-22.4	-22.5	-22.6	-22.6	-22.7	-22.7
-9	-22.8	-22.8	-22.9	-22.9	-23.0	-23.1	-23.1	-23.2	-23.2	-23.3
-10	-23.3	-23.4	-23.4	-23.5	-23.6	-23.6	-23.7	-23.7	-23.8	-23.8
-11	-23.9	-23.9	-24.0	-24.1	-24.1	-24.2	-24.2	-24.3	-24.3	-24.4
-12	-24.4	-24.5	-24.6	-24.6	-24.7	-24.7	-24.8	-24.8	-24.9	-24.9
-13	-25.0	-25.1	-25.1	-25.2	-25.2	-25.3	-25.3	-25.4	-25.4	-25.5
-14	-25.6	-25.6	-25.7	-25.7	-25.8	-25.8	-25.9	-25.9	-26.0	-26.1
-15	-26.1	-26.2	-26.2	-26.3	-26.3	-26.4	-26.4	-26.5	-26.5	-26.6
-16	-26.7	-26.7	-26.8	-26.8	-26.9	-26.9	-27.0	-27.1	-27.1	-27.2
-17	-27.2	-27.3	-27.3	-27.4	-27.4	-27.5	-27.6	-27.6	-27.7	-27.7
-18	-27.8	-27.8	-27.9	-27.9	-28.0	-28.1	-28.1	-28.2	-28.2	-28.3
-19	-28.3	-28.4	-28.4	-28.5	-28.6	-28.6	-28.7	-28.7	-28.8	-28.8
-20	-28.9	-28.9	-29.0	-29.1	-29.1	-29.2	-29.2	-29.3	-29.3	-29.4
-21	-29.4	-29.5	-29.6	-29.6	-29.7	-29.7	-29.8	-2986	-29.9	-29.9
-22	-30.0	-30.1	-30.1	-30.2	-30.2	-30.3	-30.3	-30.4	-30.4	-30.5
-23	-30.6	-30.6	-30.7	-30.7	-30.8	-30.8	-30.9	-30.9	-31.0	-31.1
-24	-31.1	-31.2	-31.2	-31.3	-31.3	-31.4	-31.4	-31.5	-31.6	-31.6
-25	-31.7	-31.7	-31.8	-31.8	-31.9	-31.9	-32.0	-32.1	-32.1	-32.2
-26	-32.2	-32.3	-32.3	-32.4	-32.4	-32.5	-32.6	-32.6	-32.7	-32.7
-27	-32.8	-32.8	-32.9	-32.9	-33.0	-33.1	-33.1	-33.2	-33.2	-33.3
-28	-33.3	-33.4	-33.4	-33.5	-33.6	-33.6	-33.7	-33.7	-33.8	-33.8
-29	-33.9	-33.9	-34.0	-34.1	-34.1	-34.2	-34.2	-34.3	-34.3	-34.4
-30	-34.4	-34.5	-34.6	-34.6	-34.7	-34.7	-34.8	-34.8	-34.9	-34.9
-31	-35.0	-35.1	-35.1	-35.2	-35.2	-35.3	-35.3	-35.4	-35.4	-35.5
-32	-35.6	-35.6	-35.7	-35.7	-35.8	-3582	-35.9	-35.9	-36.0	-36.1
-33	-36.1	-36.2	-36.2	-36.3	-36.3	-36.4	-36.4	-36.5	-36.6	-36.6
-34	-36.7	-36.7	-36.8	-36.8	-36.9	-36.9	-37.0	-37.1	-37.1	-37.2
-35	-37.2	-37.3	-37.3	-37.4	-37.4	-37.5	-37.6	-37.6	-37.7	-37.7
-36	-37.8	-37.8	-37.9	-37.9	-38.0	-38.1	-38.1	-38.2	-38.2	-38.3
-37	-38.3	-38.4	-38.4	-38.5	-38.6	-38.6	-38.7	-38.7	-38.8	-38.8
-38	-38.8	-38.8	-38.7	-38.7	-38.6	-38.6	-38.5	-38.4	-38.4	-38.3
-39	-39.4	-39.5	-39.6	-39.6	-39.7	-39.7	-39.8	-39.8	-39.9	-39.9
-40	-40.0	-40.1	-40.1	-40.2	-40.2	-40.3	-40.3	-40.4	-40.4	-40.5

CONVERSION OF FAHRENHEIT DEGREES TO CELSIUS DEGREES

deg F	Tabular values deg C .0	.1	.2	.3	.4	.5	.6	.7	.8	.9
-41	-40.6	-40.6	-40.7	-40.7	-40.8	-40.8	-40.9	-40.9	-41.0	-41.1
-42	-41.1	-41.2	-41.2	-41.3	-41.3	-41.4	-41.4	-41.5	-41.6	-41.6
-43	-41.7	-41.7	-41.8	-41.8	-41.9	-41.9	-42.0	-42.1	-42.1	-42.2
-44	-42.2	-42.3	-42.3	-42.4	-42.4	-42.5	-42.6	-42.6	-42.7	-42.7
-45	-42.8	-42.8	-42.9	-42.9	-43.0	-43.1	-43.1	-43.2	-43.2	-43.3
-46	-43.3	-43.4	-43.4	-43.5	-43.6	-43.6	-43.7	-43.7	-43.8	-43.8
-47	-43.9	-43.9	-44.0	-44.1	-44.1	-44.2	-44.2	-44.3	-44.3	-44.4
-48	-44.4	-44.5	-44.6	-44.6	-44.7	-44.7	-44.8	-44.8	-44.9	-44.9
-49	-45.0	-45.1	-45.1	-45.2	-45.2	-45.3	-45.3	-45.4	-45.4	-45.5
-50	-45.6	-45.6	-45.7	-45.7	-45.8	-45.8	-45.9	-45.9	-46.0	-46.1
-51	-46.1	-46.2	-46.2	-46.3	-46.3	-46.4	-46.4	-46.5	-46.6	-46.6
-52	-46.7	-46.7	-46.8	-46.8	-46.9	-46.9	-47.0	-47.1	-47.1	-47.2
-53	-47.2	-47.3	-47.3	-47.4	-47.4	-47.5	-47.6	-47.6	-47.7	-47.7
-54	-47.8	-47.8	-47.9	-47.9	-48.0	-48.1	-48.1	-48.2	-48.2	-48.3
-55	-48.3	-48.4	-48.4	-48.5	-48.6	-48.6	-48.7	-48.7	-48.8	-48.8
-56	-48.9	-48.9	-49.0	-49.1	-49.1	-49.2	-49.2	-49.3	-48.3	-48.4
-57	-49.4	-49.5	-49.6	-49.6	-49.7	-49.7	-49.8	-49.8	-49.9	-49.9
-58	-50.0	-50.1	-50.1	-50.2	-50.2	-50.3	-50.3	-50.4	-50.4	-50.5
-59	-50.6	-50.6	-50.7	-50.7	-50.8	-50.8	-50.9	-50.9	-51.0	-51.1
-60	-51.1	-51.2	-51.2	-51.3	-51.3	-51.4	-51.4	-51.5	-51.6	-51.6
-61	-51.7	-51.7	-51.8	-51.8	-51.9	-51.9	-52.0	-52.1	-52.1	-52.2
-62	-52.2	-52.3	-52.3	-52.4	-52.4	-52.4	-52.5	-52.6	-51.7	-51.7
-63	-52.8	-52.8	-52.9	-52.9	-53.0	-53.1	-53.1	-53.2	-53.2	-53.3
-64	-53.3	-53.4	-53.4	-53.5	-53.6	-53.6	-53.7	-53.7	-53.8	-53.8
-65	-53.9	-53.9	-54.0	-54.1	-54.1	-54.2	-54.2	-54.3	-54.3	-54.4
-66	-54.4	-54.5	-54.6	-54.6	-54.7	-54.7	-54.8	-54.8	-54.9	-54.9
-67	-55.0	-55.1	-55.1	-55.2	-55.2	-55.3	-55.3	-55.4	-55.4	-55.5
-68	-55.6	-55.6	-55.7	-55.7	-55.8	-55.8	-55.9	-55.9	-56.0	-56.1
-69	-56.1	-56.2	-56.2	-56.3	-56.3	-56.4	-56.4	-56.5	-56.6	-56.6
-70	-56.7	-56.7	-56.8	-56.8	-56.9	-56.9	-57.0	-57.1	-57.1	-57.2

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

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

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
continued																					
- 1.5	- 6	- 7	- 7	- 8	- 9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-24	-26
- 1.0	- 5	- 6	- 7	- 7	- 8	- 9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-25
- 0.5	- 5	- 5	- 6	- 7	- 7	- 8	- 9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18	-19	-21	-22	-23
0.0	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18	-19	-21	-22
+0.5	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18	-20	-21
1.0	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-12	-12	-13	-14	-15	-16	-17	-18	-20
1.5	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-12	-12	-13	-14	-15	-16	-17	-18
2.0	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-12	-12	-13	-14	-15	-16	-17
2.5	- 1	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-12	-12	-13	-14	-15	-16
3.0	- 1	- 1	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-12	-12	-13	-14	-15
3.5	0	- 1	- 1	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-11	-12	-13	-14
4.0	0	0	- 1	- 1	- 2	- 2	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-11	-12	-13
4.5	1	0	0	- 1	- 1	- 2	- 2	- 3	- 4	- 4	- 5	- 5	- 6	- 7	- 7	- 8	- 9	-10	- 10	-11	-12
5.0	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 3	- 4	- 5	- 5	- 6	- 7	- 7	- 8	- 9	-10	-10	-11
5.5	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 3	- 4	- 5	- 5	- 6	- 7	- 7	- 8	- 9	- 9	-10
6.0	2	2	2	1	1	0	0	- 1	- 2	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 9	- 9
6.5	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8
7.0	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 4	- 4	- 5	- 5	- 6	- 7	- 8
7.5	4	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 3	- 4	- 5	- 5	- 6	- 7
8.0	5	4	4	3	3	3	2	2	1	1	0	0	- 1	- 2	- 2	- 3	- 3	- 4	- 4	- 5	- 6
8.5	5	5	4	4	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 4	- 4	- 5
9.0	6	5	5	5	4	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 3	- 4
9.5	6	6	6	5	5	4	4	3	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 3	- 3
10.0	7	7	6	6	5	5	5	4	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2
10.5	8	7	7	6	6	6	5	5	4	4	3	3	3	2	2	1	1	0	0	- 1	- 2
11.0	8	8	7	7	7	6	6	5	5	5	4	4	3	3	2	2	1	1	0	0	- 1
11.5	9	8	8	8	7	7	6	6	6	5	5	4	4	3	3	3	2	2	1	1	0
12.0	9	9	9	8	8	7	7	7	6	6	5	5	5	4	4	3	3	2	2	1	1
12.5	10	9	9	9	8	8	8	7	7	6	6	6	5	5	4	4	4	3	3	2	2
13.0	10	10	10	9	9	9	8	8	7	7	7	6	6	6	5	5	4	4	3	3	2
13.5	11	11	10	10	10	9	9	8	8	8	7	7	7	6	6	5	5	5	4	4	3
14.0	11	11	11	10	10	10	9	9	9	8	8	8	7	7	6	6	6	5	5	4	4
14.5	12	12	11	11	11	10	10	10	9	9	9	8	8	8	7	7	6	6	6	5	5
15.0	13	12	12	12	11	11	11	10	10	10	9	9	9	8	8	7	7	7	6	6	5

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
continued																					
15.5	13	13	13	12	12	12	11	11	11	10	10	10	9	9	9	8	8	7	7	7	6
16.0	14	13	13	13	13	12	12	12	11	11	11	10	10	10	9	9	8	8	8	7	7
16.5	14	14	14	13	13	13	12	12	12	12	11	11	11	10	10	10	9	9	8	8	8
17.0	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	10	10	9	9	9	8
17.5	15	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	10	10	9	9
18.0	16	16	15	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	10	10
18.5	17	16	16	16	15	15	15	15	14	14	14	13	13	13	13	12	12	12	11	11	11
19.0	17	17	17	16	16	16	15	15	15	15	14	14	14	13	13	13	13	12	12	12	11
19.5	18	17	17	17	17	16	16	16	16	15	15	15	14	14	14	14	13	13	13	12	12
20.0	18	18	18	17	17	17	17	16	16	16	16	15	15	15	14	14	14	14	13	13	13

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2
-10.0																					
- 9.5																					
- 9.0																					
- 8.5	-84																				
- 8.0	-68																				
- 7.5	-60	-76																			
- 7.0	-55	-64	-92																		
- 6.5	-50	-57	-70																		
- 6.0	-47	-52	-61	-77																	
- 5.5	-44	-48	-55	-64	-91																
- 5.0	-41	-45	-50	-57	-69																
- 4.5	-39	-42	-46	-52	-59	-74															
- 4.0	-37	-40	-43	-48	-53	-62	-82														
- 3.5	-35	-37	-40	-44	-49	-55	-65	-99													
- 3.0	-33	-35	-38	-41	-45	-50	-57	-69													
- 2.5	-31	-33	-36	-38	-42	-46	-51	-59	-73												
- 2.0	-29	-31	-34	-36	-39	-43	-47	-53	-61	-78											
- 1.5	-28	-30	-32	-34	-37	-40	-43	-48	-54	-63	-84										
- 1.0	-26	-28	-30	-32	-34	-37	-40	-44	-49	-55	-65	-95									
- 0.5	-25	-26	-28	-30	-32	-35	-37	-41	-44	-49	-56	-66									
0.0	-23	-25	-27	-28	-30	-33	-35	-38	-41	-45	-50	-57	-68								
+ 0.5	-22	-24	-25	-27	-29	-31	-33	-35	-38	-41	-45	-50	-57	-69							
1.0	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-41	-46	-51	-58	-71						
1.5	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-71					
2.0	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-72				
2.5	-17	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-71			
3.0	-16	-17	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-42	-46	-51	-58	-71		
3.5	-15	-16	-17	-18	-20	-21	-22	-24	-25	-27	-29	-31	-33	-35	-38	-41	-45	-50	-57	-70	
4.0	-14	-15	-16	-17	-18	-19	-21	-22	-23	-25	-27	-28	-30	-33	-35	-38	-41	-45	-50	-57	-69
4.5	-13	-14	-15	-16	-17	-18	-19	-21	-22	-23	-25	-26	-28	-30	-32	-35	-37	-41	-44	-49	-56
5.0	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-25	-27	-28	-30	-32	-34	-37	-40	-44	-49
5.5	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-24	-26	-28	-30	-32	-34	-37	-40	-43
6.0	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-21	-23	-24	-26	-27	-29	-31	-34	-36	-39
6.5	- 9	-10	-11	-12	-12	-13	-14	-15	-16	-17	-19	-20	-21	-22	-24	-25	-27	-29	-31	-33	-36

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2
continued																					
7.0	- 8	- 9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18	-19	-21	-22	-23	-25	-27	-28	-30	-33
7.5	- 7	- 8	- 9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23	-25	-26	-28	-30
8.0	- 6	- 7	- 8	- 9	- 9	-10	-11	-12	-13	-14	-14	-15	-17	-18	-19	-20	-21	-23	-24	-26	-27
8.5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-11	-12	-13	-14	-15	-16	-17	-18	-20	-21	-22	-24	-25
9.0	- 5	- 5	- 6	- 7	- 7	- 8	- 9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	-22	-23
9.5	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-12	-13	-13	-14	-15	-16	-17	-19	-20	-21
10.0	- 3	- 4	- 4	- 5	- 5	- 6	- 7	- 7	- 8	- 9	-10	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19
10.5	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 9	- 9	-10	-11	-12	-13	-14	-14	-15	-17	-18
11.0	- 1	- 2	- 2	- 3	- 4	- 4	- 5	- 5	- 6	- 7	- 7	- 8	- 9	-10	-11	-11	-12	-13	-14	-15	-16
11.5	0	- 1	- 2	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 9	- 9	-10	-11	-12	-13	-14	-14
12.0	0	0	- 1	- 1	- 2	- 2	- 3	- 3	- 4	- 5	- 5	- 6	- 7	- 7	- 8	- 9	-10	-10	-11	-12	-13
12.5	1	1	0	0	- 1	- 1	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8	- 8	- 9	-10	-11	-12
13.0	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 3	- 4	- 5	- 5	- 6	- 7	- 7	- 8	- 9	- 9	-10
13.5	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 4	- 4	- 5	- 5	- 6	- 7	- 7	- 8	- 9
14.0	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6	- 7	- 8
14.5	4	4	3	3	3	2	2	1	1	0	0	- 1	- 2	- 2	- 3	- 3	- 4	- 4	- 5	- 6	- 6
15.0	5	5	4	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 3	- 4	- 5	- 5
15.5	6	5	5	5	4	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3	- 3	- 4
16.0	7	6	6	5	5	5	4	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2	- 2	- 3
16.5	7	7	7	6	6	5	5	4	4	4	3	3	2	2	1	1	0	0	- 1	- 1	- 2
17.0	8	8	7	7	7	6	6	5	5	4	4	4	3	3	2	2	1	1	0	0	- 1
17.5	9	8	8	8	7	7	7	6	6	5	5	4	4	4	3	3	2	2	1	1	0
18.0	10	9	9	8	8	8	7	7	7	6	6	5	5	4	4	4	3	3	2	2	1
18.5	10	10	10	9	9	8	8	8	7	7	7	6	6	5	5	5	4	4	3	3	2
19.0	11	11	10	10	10	9	9	9	8	8	7	7	7	6	6	5	5	5	4	4	3
19.5	12	11	11	11	10	10	10	9	9	9	8	8	7	7	7	6	6	5	5	5	4
20.0	12	12	12	11	11	11	10	10	10	9	9	9	8	8	8	7	7	6	6	6	5

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
20.0	17	16	14	13	11	10	8	6	4	2	- 1	- 4	- 7	-11	-16	-22	-30	-44			
20.5	18	17	15	14	12	11	9	7	5	3	0	- 3	- 6	- 9	-13	-19	-26	-36	-62		
21.0	18	17	16	14	13	11	10	8	6	4	1	- 1	- 4	- 8	-11	-16	-22	-31	-46		
21.5	19	18	16	15	14	12	10	9	7	5	2	0	- 3	- 6	- 9	-14	-19	-26	-37	-67	
22.0	20	18	17	16	14	13	11	10	8	6	4	1	- 1	- 4	- 8	-12	-16	-23	-31	-47	
22.5	20	19	18	16	15	14	12	10	9	7	5	2	0	- 3	- 6	-10	-14	-19	-26	-38	-69
23.0	21	20	18	17	16	14	13	11	10	8	6	4	1	1	- 4	- 8	-12	-16	-23	-31	-47
23.5	21	20	19	18	16	15	14	12	10	9	7	5	2	0	- 3	- 6	- 9	-14	-19	-26	-37
24.0	22	21	20	18	17	16	14	13	11	10	8	6	4	1	- 1	- 4	- 8	-11	-16	-22	-31
24.5	22	21	20	19	18	17	15	14	12	11	9	7	5	3	0	- 3	- 6	- 9	-14	-19	-26
25.0	23	22	21	20	19	17	16	15	13	11	10	8	6	4	2	- 1	- 4	- 7	-11	-16	-22
25.5	24	23	22	20	19	18	17	15	14	12	11	9	7	5	3	0	- 2	- 5	- 9	-13	-18
26.0	24	23	22	21	20	19	17	16	16	13	12	10	8	6	4	2	- 1	- 4	- 7	-11	-15
26.5	25	24	23	22	21	19	18	17	16	14	13	11	9	7	5	3	1	- 2	- 5	- 8	-12
27.0	25	24	23	22	21	20	19	18	16	15	14	12	10	9	7	5	2	0	- 3	- 6	-10
27.5	26	25	24	23	22	21	20	18	17	16	14	13	11	10	8	6	4	1	- 1	- 4	- 7
28.0	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5	3	0	- 2	- 5
28.5	27	26	25	24	23	22	21	20	19	18	16	15	13	12	10	8	6	4	2	- 1	- 3
29.0	28	27	26	25	24	23	22	21	20	18	17	16	14	13	11	9	8	6	3	1	- 2
29.5	28	27	27	26	25	24	23	21	20	19	18	17	15	14	12	11	9	7	5	3	0
30.0	29	28	27	26	25	24	23	22	21	20	19	18	16	15	13	12	10	8	6	4	2
30.5	29	29	28	27	26	25	24	23	22	21	20	18	17	16	14	13	11	10	8	6	4
31.0	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5
31.5	31	30	29	28	27	26	25	24	23	22	21	20	19	18	16	15	14	12	10	9	7
32.0	31	30	30	29	28	27	26	25	24	23	22	21	20	19	17	16	15	13	12	10	8
32.5	32	31	30	29	29	28	27	26	25	24	23	22	21	19	18	17	16	14	13	11	9
33.0	32	32	31	30	29	28	27	26	26	25	24	22	21	20	19	18	16	15	14	12	10
33.5	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20	19	17	16	15	13	12
34.0	33	33	32	31	30	29	29	28	27	26	25	24	23	22	21	19	18	17	16	14	13
34.5	34	33	32	32	31	30	29	28	27	27	26	25	24	23	21	20	19	18	17	15	14
35.0	34	34	33	32	31	31	30	29	28	27	26	25	24	23	22	21	20	19	18	16	15
35.5	35	34	33	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20	18	17	16
36.0	35	35	34	33	33	32	31	30	29	29	28	27	26	25	24	23	22	21	19	18	17
36.5	36	35	34	34	33	32	32	31	30	29	28	27	27	26	25	24	23	21	20	19	18
37.0	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24	23	22	21	20	19
37.5	37	36	36	35	34	33	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20
38.0	37	37	36	35	35	34	33	33	32	31	30	29	29	28	27	26	25	24	23	22	21
38.5	38	37	37	36	35	35	34	33	32	32	31	30	29	28	28	27	26	25	24	23	22
39.0	38	38	37	37	36	35	35	34	33	32	32	31	30	29	28	27	27	26	25	24	23
39.5	39	38	38	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24	23

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
continued																					
40.0	39	39	38	38	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24
40.5	40	39	39	38	38	37	36	36	35	34	34	33	32	31	30	30	29	28	27	26	25
41.0	40	40	39	39	38	37	37	36	36	35	34	33	33	32	31	30	30	29	28	27	26
41.5	41	40	40	39	39	38	37	37	36	35	35	34	33	33	32	31	30	29	29	28	27
42.0	41	41	40	40	39	39	38	37	37	36	35	35	34	33	33	32	31	30	29	29	28
42.5	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	33	32	31	30	29	29
43.0	42	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32	32	31	30	29
43.5	43	42	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32	32	31	30
44.0	43	43	42	42	41	41	40	40	39	38	38	37	37	36	35	35	34	33	32	32	31
44.5	44	43	43	42	42	41	41	40	40	39	38	38	37	37	36	35	35	34	33	32	32
45.0	45	44	44	43	42	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32
45.5	45	45	44	44	43	42	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33
46.0	46	45	45	44	44	43	43	42	41	41	40	40	39	39	38	37	37	36	35	35	34
46.5	46	46	45	45	44	44	43	43	42	41	41	40	40	39	39	38	37	37	36	35	35
47.0	47	46	46	45	45	44	44	43	43	42	42	41	40	40	39	39	38	37	37	36	35
47.5	47	47	46	46	45	45	44	44	43	43	42	42	41	40	40	39	39	38	37	37	36
48.0	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39	39	38	38	37
48.5	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39	39	38	38
49.0	49	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	40	39	38
49.5	49	49	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	40	39
50.0	50	49	49	48	48	47	47	47	46	46	45	45	44	44	43	43	42	41	41	40	40
50.5	50	50	49	49	48	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	40
51.0	51	50	50	49	49	49	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41
51.5	51	51	50	50	49	49	49	48	48	47	47	46	46	45	45	44	44	43	43	42	42
52.0	52	51	51	50	50	50	49	49	48	48	47	47	46	46	46	45	45	44	44	43	43
52.5	52	52	51	51	51	50	50	49	49	48	48	48	47	47	46	46	45	45	44	44	43
53.0	53	52	52	51	51	51	50	50	49	49	49	48	48	47	47	46	46	45	45	44	44
53.5	53	53	52	52	52	51	51	50	50	50	49	49	48	48	47	47	46	46	46	45	45
54.0	54	53	53	53	52	52	51	51	51	50	50	49	49	48	48	48	47	47	46	46	45
54.5	54	54	53	53	53	52	52	51	51	51	50	50	49	49	49	48	48	47	47	46	46
55.0	55	54	54	54	53	53	52	52	52	51	51	50	50	50	49	49	48	48	47	47	47
55.5	55	55	54	54	54	53	53	53	52	52	51	51	51	50	50	49	49	49	48	48	47
56.0	56	55	55	55	54	54	54	53	53	52	52	52	51	51	50	50	50	49	49	48	48
56.5	56	56	55	55	55	54	54	54	53	53	53	52	52	51	51	51	50	50	49	49	48
57.0	57	56	56	56	55	55	55	54	54	54	54	53	52	52	52	51	51	50	50	50	49
57.5	57	57	57	56	56	55	55	55	54	54	54	53	53	53	52	52	51	51	51	50	50
58.0	58	57	57	57	56	56	56	55	55	55	54	54	54	53	53	52	52	52	51	51	50

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
continued																					
58.5	58	58	58	57	57	57	56	56	56	55	55	54	54	54	53	53	53	52	52	51	51
59.0	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53	53	52	52	52
59.5	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	53	53	53	52
60.0	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53	53
60.5	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54
61.0	61	60	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54
61.5	61	61	61	60	60	60	59	59	59	58	58	58	58	57	57	56	56	55	55	55	55
62.0	62	61	61	61	61	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55
62.5	62	62	62	61	61	61	60	60	60	60	59	59	59	58	58	58	57	57	57	56	56
63.0	63	62	62	62	62	61	61	61	60	60	60	60	59	59	59	58	58	58	57	57	57
63.5	63	63	63	62	62	62	62	61	61	61	60	60	60	59	59	59	59	58	58	58	57
64.0	64	63	63	63	63	62	62	62	62	61	61	61	60	60	60	59	59	59	58	58	58
64.5	64	64	64	63	63	63	63	62	62	62	61	61	61	61	60	60	60	59	59	59	58
65.0	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	61	60	60	60	59	59
65.5	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	61	60	60	60
66.0	66	65	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	61	60
66.5	66	66	66	65	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61
67.0	67	67	66	66	66	66	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61
67.5	67	67	67	67	66	66	66	66	65	65	65	64	64	64	64	63	63	63	63	62	62
68.0	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64	64	64	63	63	63	63
68.5	68	68	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64	64	64	63	63
69.0	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64	64	64
69.5	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64
70.0	70	70	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65	65
70.5	70	70	70	70	69	69	69	69	68	68	68	68	68	67	67	67	67	66	66	66	66
71.0	71	71	70	70	70	70	69	69	69	69	69	68	68	68	68	67	67	67	67	66	66
71.5	71	71	71	71	70	70	70	70	70	69	69	69	69	68	68	68	68	67	67	67	67
72.0	72	72	71	71	71	71	70	70	70	70	70	69	69	69	69	68	68	68	68	67	67
72.5	72	72	72	72	71	71	71	71	71	70	70	70	70	69	69	69	69	69	68	68	68
73.0	73	73	72	72	72	72	72	71	71	71	71	70	70	70	70	70	69	69	69	69	68
73.5	73	73	73	73	72	72	72	72	72	71	71	71	71	71	70	70	70	70	69	69	69
74.0	74	74	73	73	73	73	73	72	72	72	72	72	71	71	71	71	70	70	70	70	70
74.5	74	74	74	74	74	73	73	73	73	72	72	72	72	72	71	71	71	71	71	70	70
75.0	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72	72	71	71	71	71
75.5	75	75	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72	71	71
76.0	76	76	75	75	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb (°F.)	Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)																				
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
continued																					
76.5	76	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73	73	73	73	72	72
77.0	77	77	76	76	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73	73	73
77.5	77	77	77	77	77	76	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73
78.0	78	78	77	77	77	77	77	77	76	76	76	76	76	75	75	75	75	75	74	74	74
78.5	78	78	78	78	78	77	77	77	77	77	77	76	76	76	76	76	75	75	75	75	75
79.0	79	79	78	78	78	78	78	78	77	77	77	77	77	76	76	76	76	76	76	75	75
79.5	79	79	79	79	79	78	78	78	78	78	78	77	77	77	77	77	76	76	76	76	76
80.0	80	80	79	79	79	79	79	78	78	78	78	78	78	78	77	77	77	77	77	76	76
80.5	80	80	80	80	80	79	79	79	79	79	79	78	78	78	78	78	78	77	77	77	77
81.0	81	81	81	80	80	80	80	80	79	79	79	79	79	79	78	78	78	78	78	78	77
81.5	81	81	81	81	81	81	80	80	80	80	80	80	79	79	79	79	79	78	78	78	78
82.0	82	82	82	81	81	81	81	81	81	80	80	80	80	80	80	79	79	79	79	79	78
82.5	82	82	82	82	82	82	81	81	81	81	81	81	80	80	80	80	80	79	79	79	79
83.0	83	83	83	82	82	82	82	82	82	81	81	81	81	81	81	80	80	80	80	80	80
83.5	83	83	83	83	83	83	82	82	82	82	82	82	81	81	81	81	81	80	80	80	80
84.0	84	84	84	83	83	83	83	83	83	82	82	82	82	82	82	82	81	81	81	81	81
84.5	84	84	84	84	84	84	83	83	83	83	83	83	83	82	82	82	82	82	82	81	81
85.0	85	85	85	84	84	84	84	84	84	84	83	83	83	83	83	83	82	82	82	82	82
85.5	85	85	85	85	85	85	84	84	84	84	84	84	84	83	83	83	83	83	83	82	82
86.0	86	86	86	85	85	85	85	85	85	85	84	84	84	84	84	84	83	83	83	83	83
86.5	86	86	86	86	86	86	86	85	85	85	85	85	85	84	84	84	84	84	84	84	83
87.0	87	87	87	86	86	86	86	86	86	86	85	85	85	85	85	85	85	84	84	84	84
87.5	87	87	87	87	87	87	87	86	86	86	86	86	86	86	85	85	85	85	85	85	85
88.0	88	88	88	87	87	87	87	87	87	87	86	86	86	86	86	86	86	85	85	85	85
88.5	88	88	88	88	88	88	88	87	87	87	87	87	87	87	86	86	86	86	86	86	86
89.0	89	89	89	88	88	88	88	88	88	88	88	87	87	87	87	87	87	87	86	86	86
89.5	89	89	89	89	89	89	89	88	88	88	88	88	88	88	87	87	87	87	87	87	87
90.0	90	90	90	89	89	89	89	89	89	89	89	88	88	88	88	88	88	88	87	87	87
90.5	90	90	90	90	90	90	90	89	89	89	89	89	89	89	89	88	88	88	88	88	88
91.0	91	91	91	90	90	90	90	90	90	90	90	89	89	89	89	89	89	89	89	88	88
91.5	91	91	91	91	91	91	91	91	90	90	90	90	90	90	90	89	89	89	89	89	89
92.0	92	92	92	92	92	91	91	91	91	91	91	91	90	90	90	90	90	90	90	89	89
92.5	92	92	92	92	92	92	92	92	91	91	91	91	91	91	91	91	90	90	90	90	90
93.0	93	93	93	93	92	92	92	92	92	92	92	92	91	91	91	91	91	91	91	91	90
93.5	93	93	93	93	93	93	93	93	92	92	92	92	92	92	92	91	91	91	91	91	91
94.0	94	94	94	94	93	93	93	93	93	93	93	93	92	92	92	92	92	92	92	92	91
94.5	94	94	94	94	94	94	94	94	93	93	93	93	93	93	93	93	93	92	92	92	92

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0
20.0																					
20.5																					
21.0																					
21.5																					
22.0																					
22.5																					
23.0																					
23.5	-68																				
24.0	-47																				
24.5	-37	-64																			
25.0	-30	-45																			
25.5	-25	-35	-58																		
26.0	-21	-29	-42																		
26.5	-17	-24	-33	-52																	
27.0	-14	-20	-27	-39	-79																
27.5	-11	-16	-22	-31	-46																
28.0	- 9	-13	-18	-25	-36	-59															
28.5	- 7	-10	-15	-21	-28	-41															
29.0	- 4	- 8	-12	-17	-23	-32	-49														
29.5	- 2	- 6	- 9	-13	-19	-26	-36	-62													
30.0	- 1	- 3	- 7	-10	-15	-21	-29	-42													
30.5	1	- 1	- 4	- 8	-12	-17	-23	-32	-48												
31.0	3	0	- 2	- 5	- 9	-13	-18	-25	-36	-59											
31.5	5	2	0	- 3	- 6	-10	-14	-20	-28	-40	-90										
32.0	6	4	2	- 1	- 4	- 7	-11	-16	-22	-30	-45										
32.5	7	5	3	1	- 2	- 5	- 8	-13	-18	-24	-34	-55									
33.0	9	7	5	2	0	- 3	- 6	-10	-14	-20	-27	-39	-78								
33.5	10	8	6	4	2	- 1	- 4	- 7	-11	-16	-22	-30	-45								
34.0	11	9	7	5	3	1	- 2	- 5	- 8	-12	-17	-24	-34	-53							
34.5	12	11	9	7	5	3	0	- 3	- 6	- 9	-14	-19	-26	-38	-69						
35.0	13	12	10	8	6	4	2	- 1	- 3	- 7	-11	-15	-21	-29	-42						
35.5	14	13	11	10	8	6	4	1	- 1	- 4	- 8	-12	-17	-23	-32	-49					
36.0	15	14	13	11	9	7	5	3	1	- 2	- 5	- 9	-13	-18	-25	-35	-57				
36.5	17	15	14	12	10	9	7	5	2	0	- 3	- 6	-10	-14	-19	-27	-38	-75			
37.0	18	16	15	13	12	10	8	6	4	2	- 1	- 3	- 7	-11	-15	-21	-29	-43			

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0
continued																					
37.5	19	17	16	15	13	11	10	8	6	4	1	- 1	- 4	- 8	-11	-16	-22	-31	-47		
38.0	20	18	17	16	14	13	11	9	8	5	3	1	- 2	- 5	- 8	-12	-17	-24	-34	-54	
38.5	20	19	18	17	15	14	12	11	9	7	5	3	0	- 2	- 5	- 9	-13	-19	-26	-36	-62
39.0	21	20	19	18	17	15	14	12	10	9	7	5	2	0	- 3	- 6	-10	-14	-20	-27	-39
39.5	22	21	20	19	18	16	15	13	12	10	8	6	4	2	0	- 3	- 7	-10	-15	-21	-29
40.0	23	22	21	20	19	17	16	15	13	12	10	8	6	4	2	- 1	- 4	- 7	-11	-16	-22
40.5	24	23	22	21	20	19	17	16	15	13	11	10	8	6	4	1	- 1	- 4	- 8	-12	-16
41.0	25	24	23	22	21	20	18	17	16	14	13	11	10	8	6	3	1	- 2	- 5	- 8	-12
41.5	26	25	24	23	22	21	20	18	17	16	14	13	11	9	7	5	3	1	- 2	- 5	- 8
42.0	27	26	25	24	23	22	21	19	18	17	16	14	13	11	9	7	5	3	1	- 2	- 5
42.5	28	27	26	25	24	23	22	21	19	18	17	15	14	12	11	9	7	5	3	0	- 2
43.0	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5	3	0
43.5	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7	5	3
44.0	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	6	5
44.5	31	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9	7
45.0	32	31	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11	9
45.5	32	32	31	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12	11
46.0	33	33	32	31	30	29	28	28	27	26	25	24	23	22	20	19	18	17	15	14	12
46.5	34	33	33	32	31	30	29	29	28	27	26	25	24	23	22	19	18	17	15	14	14
47.0	35	34	33	33	32	31	30	29	29	28	27	26	25	24	23	22	21	19	18	17	16
47.5	36	35	34	33	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20	18	17
48.0	36	36	35	34	34	33	32	31	30	30	29	28	27	26	25	24	23	22	21	20	18
48.5	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24	23	22	21	20
49.0	38	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26	25	24	23	22	21
49.5	38	38	37	37	36	35	35	34	33	32	32	31	30	29	28	27	27	26	25	24	23
50.0	39	39	38	37	37	36	35	35	34	33	33	32	31	30	29	28	28	27	26	25	24
50.5	40	39	39	38	37	37	36	36	35	34	33	33	32	31	30	30	29	28	27	26	25
51.0	41	40	39	39	38	38	37	36	36	35	34	34	33	32	31	31	30	29	28	27	26
51.5	41	41	40	40	39	38	38	37	37	36	35	34	34	33	32	32	31	30	29	28	27
52.0	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32	32	31	30	29	28
52.5	43	42	42	41	41	40	39	39	38	38	37	36	36	35	34	33	33	32	31	30	30
53.0	43	43	42	42	41	41	40	40	39	38	38	37	36	36	35	34	34	33	32	31	31
53.5	44	44	43	43	42	41	41	40	40	39	39	38	37	37	36	35	35	34	33	32	32

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0
continued																					
54.0	45	44	44	43	43	42	42	41	41	40	39	39	38	38	37	36	36	35	34	33	33
54.5	45	45	44	44	43	43	42	42	41	41	40	40	39	38	38	37	36	36	35	34	34
55.0	46	46	45	45	44	44	43	43	42	41	41	40	40	39	39	38	37	37	36	35	35
55.5	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39	39	38	38	37	36	36
56.0	47	47	46	46	46	45	45	44	44	43	43	42	41	41	40	40	39	39	38	37	37
56.5	48	48	47	47	46	46	46	45	45	44	44	43	42	42	41	41	40	39	39	38	38
57.0	49	48	48	47	47	46	46	46	45	45	44	44	43	42	42	41	41	40	40	39	38
57.5	49	49	48	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41	41	40	39
58.0	50	50	49	49	48	48	47	47	46	46	46	45	45	44	44	43	43	42	41	41	40
58.5	51	50	50	49	49	49	48	48	47	47	46	46	45	45	44	44	43	43	42	42	41
59.0	51	51	50	50	50	49	49	48	48	47	47	47	46	46	45	45	44	44	43	43	42
59.5	52	52	51	51	50	50	49	49	49	48	48	47	47	46	46	45	45	44	44	43	43
60.0	53	52	52	51	51	51	50	50	49	49	48	48	48	47	47	46	46	45	45	44	44
60.5	53	53	52	52	52	51	51	50	50	50	49	49	48	48	47	47	47	46	46	45	45
61.0	54	53	53	53	52	52	52	51	55	50	50	49	49	49	48	48	47	47	46	46	45
61.5	54	54	54	53	53	53	52	52	51	51	51	50	50	49	49	48	48	48	47	47	46
62.0	55	55	54	54	54	53	53	52	52	52	51	51	51	50	50	49	49	48	48	47	47
62.5	56	55	55	55	54	54	54	53	53	52	52	52	51	51	50	50	50	49	49	48	48
63.0	55	56	56	55	55	55	54	54	53	53	53	52	52	52	51	51	50	50	49	49	49
63.5	57	57	56	56	56	55	55	54	54	54	53	53	53	52	52	51	51	51	50	50	49
64.0	58	57	57	57	56	56	55	55	55	54	54	54	53	53	53	52	52	51	51	51	50
64.5	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53	53	53	52	52	51	51
65.0	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53	53	52	52	52
65.5	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53	53	52
66.0	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54	54	53
66.5	61	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55	54	54
67.0	61	61	61	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55	55	55
67.5	62	61	61	61	61	60	60	60	59	59	59	58	58	58	57	57	57	56	56	56	55
68.0	62	62	62	61	61	61	61	60	60	60	59	59	59	58	58	58	57	57	57	56	56
68.5	63	63	62	62	62	61	61	61	61	60	60	60	59	59	59	58	58	58	57	57	57
69.0	64	63	63	63	62	62	62	62	61	61	61	60	60	60	59	59	59	59	58	58	58
69.5	64	64	64	63	63	63	62	62	62	62	61	61	61	60	60	60	60	59	59	59	58
70.0	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	60	60	60	60	59	59

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0
continued																					
70.5	65	65	65	64	64	64	64	63	63	63	63	62	62	62	61	61	61	61	60	60	60
71.0	66	66	65	65	65	65	64	64	64	63	63	63	63	62	62	62	62	61	61	61	60
71.5	66	66	66	66	65	65	65	65	64	64	64	64	63	63	63	62	62	62	62	61	61
72.0	67	67	67	66	66	66	66	65	65	65	64	64	64	64	63	63	63	63	62	62	62
72.5	68	67	67	67	67	66	66	66	66	65	65	65	65	64	64	64	63	63	63	63	62
73.0	68	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64	64	64	64	63	63
73.5	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64	64	64
74.0	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65	65	65	64
74.5	70	70	69	69	69	69	69	68	68	68	68	67	67	67	67	66	66	66	66	65	65
75.0	70	70	70	70	70	69	69	69	69	68	68	68	68	67	67	67	66	66	66	66	66
75.5	71	71	71	70	70	70	70	69	69	69	69	69	68	68	68	67	67	67	67	67	66
76.0	72	71	71	71	71	71	70	70	70	70	69	69	69	69	68	68	68	68	67	67	67
76.5	72	72	72	72	71	71	71	71	70	70	70	70	70	69	69	69	68	68	68	68	68
77.0	73	73	72	72	72	72	71	71	71	71	71	70	70	70	70	70	69	69	69	69	68
77.5	73	73	73	73	72	72	72	72	72	72	71	71	71	71	70	70	70	70	70	69	69
78.0	74	74	73	73	73	73	73	72	72	72	72	72	71	71	71	71	70	70	69	70	70
78.5	74	74	74	74	74	73	73	73	73	73	72	72	72	72	72	71	71	71	70	71	70
79.0	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72	72	71	71	71
79.5	76	75	75	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72	72	72	71
80.0	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73	73	73	73	73	72	72
80.5	77	76	76	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73	73	73	73
81.0	77	77	77	77	76	76	76	76	76	76	75	75	75	75	75	74	74	74	74	74	73
81.5	78	78	77	77	77	77	77	76	76	76	76	76	76	75	75	75	75	74	74	74	74
82.0	78	78	78	78	78	77	77	77	77	77	77	76	76	76	76	76	75	75	75	75	75
82.5	79	79	79	78	78	78	78	78	77	77	77	77	77	77	76	76	76	76	76	75	75
83.0	79	79	79	79	79	79	78	78	78	78	78	77	77	77	77	77	77	76	76	76	76
83.5	80	80	80	79	79	79	79	79	79	78	78	78	78	78	78	77	77	77	77	77	76
84.0	81	80	80	80	80	80	80	79	79	79	79	79	78	78	78	78	78	78	77	77	77
84.5	81	81	81	81	80	80	80	80	80	80	79	79	79	79	79	79	78	78	78	78	78
85.0	82	81	81	81	81	81	81	80	80	80	80	80	80	79	79	79	79	79	79	78	78
85.5	82	82	82	82	82	81	81	81	81	81	81	80	80	80	80	80	80	79	79	79	79
86.0	83	83	82	82	82	82	82	82	81	81	81	81	81	81	80	80	80	80	80	80	79
86.5	83	83	83	83	83	82	82	82	82	82	82	82	81	81	81	81	81	81	80	80	80

TEMPERATURE OF THE DEW POINT IN DEGREES FAHRENHEIT

[Tabular values are dew points with respect to water]

Wet-Bulb Depression of Wet-bulb thermometer (Dry-bulb minus wet-bulb)

(°F.)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0
continued																					
87.0	84	84	84	83	83	83	83	83	83	82	82	82	82	82	82	81	81	81	81	81	81
87.5	84	84	84	84	84	84	83	83	83	83	83	83	83	82	82	82	82	82	82	81	81
88.0	85	85	85	84	84	84	84	84	84	84	83	83	83	83	83	83	82	82	82	82	82
88.5	85	85	85	85	85	85	85	84	84	84	84	84	84	84	83	83	83	83	83	83	82
89.0	86	86	86	86	85	85	85	85	85	85	85	84	84	84	84	84	84	83	83	83	83
89.5	87	86	86	86	86	86	86	86	85	85	85	85	85	85	85	84	84	84	84	84	84
90.0	87	87	87	87	87	86	86	86	86	86	86	86	85	85	85	85	85	85	84	84	84
90.5	88	87	87	87	87	87	87	87	86	86	86	86	86	86	86	85	85	85	85	85	85
91.0	88	88	88	88	88	87	87	87	87	87	87	87	86	86	86	86	86	86	86	85	85
91.5	89	89	88	88	88	88	88	88	88	87	87	87	87	87	87	87	86	86	86	86	86
92.0	89	89	89	89	89	89	88	88	88	88	88	88	88	87	87	87	87	87	87	87	87
92.5	90	90	90	89	89	89	89	89	89	89	88	88	88	88	88	88	88	88	87	87	87
93.0	90	90	90	90	90	90	90	89	89	89	89	89	89	89	88	88	88	88	88	88	88
93.5	91	91	91	90	90	90	90	90	90	90	90	89	89	89	89	89	89	89	89	88	88
94.0	91	91	91	91	91	91	91	91	90	90	90	90	90	90	90	89	89	89	89	89	89
94.5	92	92	92	92	91	91	91	91	91	91	91	91	90	90	90	90	90	90	90	90	89

SECTION II - CHAPTER 8

2.8 OBSERVATION PROCEDURES AND FORM ENTRIES -- Columns 3, 4, 5, 6 -- WIND

2.8.1 Introduction. This chapter contains instructions for observing the apparent wind speed and direction, computing true wind data (speed, direction, gusts, squalls and shifts) and making entries on CNMOC Form 3141/3.

2.8.1.1 Wind Data at Sea. The movement of the ship affects the wind speed observed by both the ship's anemometers and hand held anemometers (e.g., AN/PMQ-3). The wind direction is observed in relation to the ship's bow so that the wind direction in relation to true north is affected by the ship's direction. The wind speed and direction, with the affect of the ship's speed and direction, is the apparent or relative wind. The wind speed and direction, minus the affect of the ship's speed and direction, is the true wind.

2.8.1.2 Units of Measure. Wind speed (including gust and squalls) are observed, computed, and reported in nautical miles per hour (knots), to the nearest whole knot. Wind direction is observed to the nearest whole degree and computed to the nearest ten degrees.

2.8.1.3 Accuracy. Since true wind must be computed, the chance of committing an error is increased. True wind or estimates are one of the most important observations made by ships at sea since the data reported in the ship synoptic code is used as criteria for issuance of wind, storm, high seas warnings, and ship routing forecasts. Therefore, care must be taken whenever computing true wind data.

2.8.2 Observing Wind Data. Wind data can be observed using the following methods. The order given is also the priority of use.

a. Wind data observed from the speed and direction indicators of the installed anemometer. Anemometers measure the apparent wind speed and indicate the apparent wind direction.

b. Use of a hand held anemometer.

c. Visual estimation of the true wind direction and speed. Visual estimation should be used only when the installed and hand held anemometers are inoperative or not available. When the wind data is visually estimated the true wind speed and direction are directly derived.

2.8.2.1 General Instructions for Using Anemometers

a. Ensure that the ship's course is on a steady track throughout the period of observing the wind. **Never observe the wind while the ship is turning.**

b. Observe the speed and direction for a two minute period noting the following:

(1) The predominant (average) wind speed.

(2) The peaks and lulls in wind speed, checking for gust and squall criteria.

(3) The predominant (average) wind direction.

(4) The degrees of variability of the wind direction, checking for variability criteria.

(5) Wind shifts.

2.8.2.2 Use of Installed Anemometers. Use of installed anemometers is the preferred method for observing wind. Wind data is taken from the indicator panel which provides both instantaneous speed and direction. When using an installed anemometer, the data observed should always be compared with the wind conditions as they appeared while other elements of the observation were observed outside. This is to ensure that the anemometer or indicator panel is not malfunctioning. If two anemometers are installed ensure that the windward anemometer is used.

2.8.2.3 Use of Hand Held Anemometers. If anemometers are not installed, the installed anemometer is inoperative, or the data from it is in doubt, the hand held anemometer should be used.

a. The wind measuring set AN/PMQ-3 is a portable hand anemometer. It is a combination wind direction and speed indicator which indicates direction to 360° and speed from 0 to 60 knots. The speed indicator has two scales, graduated from 0 to 15 knots and 0 to 60 knots.

b. To use the hand held anemometer, choose an observation site on the windward side of the ship, as far upwind as possible, i.e., if the wind is from the stern go aft, from the bow go forward. Stand facing parallel to the ship's centerline and into the wind. Note: Unless the wind is blowing parallel to the ship's direction the wind will be at an acute angle while facing parallel to the ship's center line.

(1) Grasp the instrument by the handle and hold it in an approximately vertical position at arm's length with the sight at eye level.

(2) Aim the instrument parallel to the ship's center line at an imaginary point on the horizon by aligning the center of the slot in the front of the sight with the center of the strip between the two slots on the rear sight.

(3) Press and hold the vane locking trigger. Note the reading on the 0-60 (upper) scale on the wind speed indicator. If

the wind speed reading is less than 15 knots as indicated on the 0-60 scale, press the range selecting trigger on the side of the housing (3B and 3C models) or handle (3 and 3A models) and observe the indication on the 0-15 scale. **CAUTION: The range selecting trigger should not be pressed if the initial observation of the wind speed indicator indicates a wind speed in excess of 15 knots. Mechanical damage may result due to the slamming of the pointer.**

(4) Note the motion of the wind vane as it moves between the extremes of variability. Release the vane locking trigger when the vane is in the position of the predominant (average) wind direction. Carefully lower and tilt the anemometer and note the wind direction reading on the direction dial. If the wind is being observed facing aft, the direction must be converted in relation to the bow, add 180° for directions from 0° thru 90°, subtract 180° for directions from 270° thru 360°.

2.8.2.4 Visual Estimation. Wind direction may also be observed by noting the direction from which ripples, small wave, and sea spray are coming. The direction is most easily found by sighting along the wave crests and turning 90° to face the advancing waves. The observer is then facing the true wind direction. The true wind speed may be estimated by noting the sea condition and referring to Table II-8-2.

a. Table II-8-2 is based upon two assumptions which should be considered in arriving at an estimated wind speed:

(1) The wind has been blowing at a relatively constant speed and direction for the time indicated.

(2) The fetch area is unlimited.

b. Some factors which cause the wind speed estimation to be too low are:

(1) Winds which have rapidly increased.

(2) Off-shore winds when within sight of land.

(3) Moderate or heavy precipitation smoothing the sea surface.

c. Some factors which will cause the wind speed estimation to be too high are:

(1) Waves running into shallow water.

(2) A decreasing wind speed.

d. When the surface of the sea cannot be observed, the true wind will be determined from the apparent wind. Estimate the apparent wind direction (relative to the bow of the ship) to the nearest 10 degrees. Estimate the apparent wind speed to the nearest 5 knots by observing the effect of the wind on the ship's

pennants or flags, smoke, and rigging on the windward side of the ship. Use Table II-8-1 to estimate the apparent wind speed based on the effect of the apparent wind on the ship. With this basic information at hand (ship's course and speed, apparent wind direction and speed), compute the true wind.

2.8.3 Computation of True Wind. There are three basic methods for computing the true wind. All three methods use the vectors of the apparent wind and ship's movement. These methods are the true wind computer method, the maneuvering board method and the plotting board method. All three produce accurate computations. Since the true wind speed is reported to the nearest knot and the direction is reported to the nearest ten degrees, accuracy is not a factor in choosing a preferable method. The maneuvering board and plotting board methods are about equal in computation time and ease of use, but plotting boards are not as commonly available as maneuvering boards. The True Wind Computer CP 264/U is the quickest and easiest method and should be used over the other two methods.

2.8.3.1 True Wind Computer Method. The true wind computer consists of an oval base plate and a clear plastic compass rose fastened with a center pivot. The compass rose rotates and slides freely along the axis of the base plate. All computations are made directly on the computer, and solutions are read off of its scales. Directions for use are printed on the reverse side of the base plate.

a. An example of using the computer for determining the true wind direction and speed is given as follows. Assume that the apparent wind is 300 degrees and 18 knots, and the ship's course and speed are 080 degrees and 16 knots.

(1) Slide the rotor disk along the ship's speed reference line until the center index of the rotor disk is opposite the ship's speed, (16 knots) and then rotate the disk until the ship's heading (080 degrees true on the compass rose of the rotor disk) is directly over the 000 degrees/360 degrees bearing radius of the base plate.

(2) Using a grease pencil, plot a dot on the rotor disk at the point determined by the apparent wind (300 degrees true and speed 18 knots) utilizing the base grid.

(3) Slide the rotor disk to the zero of the ship's speed reference index (the center of the concentric circles of the base plate) and rotate the disk until the grease pencil dot, previously plotted, lies along the 000 degrees/360 degrees bearing radius of the base plate. The true wind direction, 328 degrees can now be read directly off the rotor disk over the 000 degrees/360 degrees bearing radius of the base plate. The true wind speed, 17.5 knots, can now be read directly opposite the grease pencil dot by utilizing the ship's speed reference index.

b. The computer can also be used to determine a ship's course and speed required to produce a desired apparent wind. For example, assume that the desired wind direction is 5 degrees off the port bow and the desired wind speed is 40 knots, actual apparent wind is 300 degrees and 18 knots, present ship's course is 080 degrees true, and present ship's speed is 16 knots.

(1) Repeat steps 1, 2, and 3 of the example in above sub-paragraph 2.8.3.1.a. to find the true wind direction and speed of 328 degrees and 17.5 knots.

(2) Manipulate the rotor disk (by rotation and sliding along the 000 degrees/360 degrees bearing radius of the base plate) until the grease pencil dot, the head of the true wind vector, is directly over the reference point on the base plate as determined by the given requirements of the desired apparent wind (direction at 5 degrees off the port bow and speed of 40 knots across the deck), utilizing the grid of the base plate.

(3) Read directly off the rotor disk the ship's course, 340 degrees true, which is directly over the 000 degrees/360 degrees bearing radius of the base plate. Read directly the ship's speed, 23.5 knots, opposite the center of the rotor disk, from the ship's speed reference index. This ship's course, 340 degrees true, and a speed of 23.5 knots, with the given true wind direction and speed, will produce the desired apparent wind of 5 degrees off the port bow and a speed of 40 knots across the deck.

2.8.3.2 Estimation Method. When the wind is estimated (see paragraph 2.8.2.4) the true wind speed is directly observed. The direction is figured by determining the direction from the bow that the true wind is blowing from, then adding the course of the ship to the wind direction relative to the bow. If the sum is greater than 360 subtract 360 from the sum, e.g., the wind waves are coming from 320° (off the port bow) and the ship's course is 060°, $320 + 060 = 380^{\circ}$, $380 - 360 = 020^{\circ}$ true wind direction.

2.8.3.3 Computation Check. No matter which method of computation is used to derive the true wind direction and speed, the observer should check the results by considering the following statements:

a. The true wind direction is always on the same side of the ship as the apparent wind direction, but farther from the bow than the apparent wind direction.

b. When the apparent wind direction is abaft of the beam, the true wind speed is greater than the apparent speed.

c. When the apparent wind direction is forward of the beam, the true wind speed is less than the apparent speed.

2.8.4 Gusts, Squalls and Wind Shifts. Gusts and squalls are significant fluctuations in the true wind speed while wind shifts

are significant changes in true wind direction. To report them use the following criteria:

a. Gust. A rapid fluctuation in wind true speed with a variation of ten knots (five m/s) or more between peak and lull.

b. Squall. A large variation of true wind speed with a sudden increase of at least 15 knots (eight m/s) in average wind speed with the increased speed sustained at 20 knots (ten m/s) or more for at least one minute.

c. Wind Shift. A change in true wind direction of 45° or more taking place in less than 15 minutes.

Note: It is difficult to observe gusts, squalls, and wind shifts since the only wind directly observable by the observer is the apparent wind. The ship's speed and heading will always affect the observation of true changes in wind speed and direction.

2.8.5 Column 3 Wind Direction. Enter the true direction from which the wind is blowing, to the nearest 10 degrees, and as follows:

a. When the wind is calm, enter "000" for the direction and "00" for speed.

b. Enter the 2-minute mean direction when wind is variable (varying by 60° or more). In addition, if wind speed is greater than 6 knots, include in Column 6.

2.8.6 Column 4 Wind Speed. Enter the wind speed in whole knots using tens and units. When the wind is calm (less than 1 knot), enter "00" for wind speed. When the speed is 100 knots or more, enter three digits for the observed wind speed (i.e., 112).

2.8.7 Column 5 Wind Character. Enter G (for gust) or Q (for squall), as appropriate, followed by the peak speed of gusts or squalls observed in the 10-minute period prior to the actual time of observation. Reporting criteria is contained in paragraph 2.8.4.

2.8.8 Column 6 Variability. Enter the variability of the wind direction in degrees. The direction must vary by 60° or more (i.e, 180V240) and the wind speed must be greater than 6 knots.

APPARENT WIND SPEED INDICATORS

Knots	Indication
Less than 1	Calm, smoke rises vertically.
1 - 3	Smoke drifts slowly from funnel.
4 - 6	Wind felt on face. Smoke rises at about 80°.
7 - 10	Wind extends light flag and pennants. Smoke rises at about 70°.
11 - 16	Wind raises dust, loose paper on deck. Smoke rises at about 50°. No noticeable sound in rigging. Slack halyards curve and sway. Heavy flag flaps limply.
17 - 21	Wind felt strongly on face. Smoke rises at about 30°. Slack halyards whip while bending continuously to leeward. Taut halyards maintain slightly bent position. Low whistle in the rigging. Heavy flag doesn't fully extend but flaps over entire length.
22 - 27	Wind stings face in temperature below 35°F. Slight effort in maintaining balance against the wind. Smoke rises at 15°. Both slack and taut halyards whip slightly in bent position. Low moaning, rather than whistle, in rigging. Heavy flag extends and flaps more vigorously.
28 - 33	Necessary to lean slightly into the wind to maintain balance. Smoke rise at 5° to 10°. Higher pitched moaning and whistling heard from rigging. Halyards whip slightly. Heavy flag extends fully and flaps only at the end. Loose clothing inflates and pull against the body.
34 - 40	Head is pushed back by the force of the wind if allowed to relax. Loose clothing inflate and pull strongly. Halyards rigidly bent. Loud whistle from rigging. Heavy flag straight out and whipping.

BEAUFORT WIND SCALE[1] WITH CORRESPONDING SEA STATE

Number	Knots	Mph	Description	Sea Conditions
0	0	0	Calm	Sea smooth and mirrorlike.
1	1-3	1-3	Light air	Scale-like ripples without foam crests
2	4-6	4-7	Light breeze	Small, short wavelets; crests have a glassy appearance and do not break.
3	7-10	8-12	Gentle breeze	Large wavelets; some crests begin to break. Occasional white foam crests.
4	11-16	13-18	Moderate breeze	Small waves, becoming longer; fairly frequent white foam crests.
5	17-21	19-24	Fresh breeze	Moderate waves, taking a more pronounced long form; many white foam crests; there may be some spray.
6	22-27	25-31	Strong breeze	Large waves begin to form; white foam crests are more extensive everywhere; there may be some spray.
7	28-33	32-38	Near gale	Sea heaps up, and white foam from breaking waves begins to be blown in streaks along the direction of the wind.
8	34-40	39-46	Gale	Moderately high waves of greater length, edges of crests break, foam is blown in well-marked streaks along the direction of the wind.
9	41-47	47-54	Strong gale	High waves; dense streaks of foam along the direction of the wind; crests of waves begin to roll over; spray may reduce visibility.

BEAUFORT WIND SCALE[1] WITH CORRESPONDING SEA STATE

Number	Knots	Mph	Description	Sea Conditions
continued				
10	48-55	55-63	Storm	Very high waves with long overhanging crests. Foam in great patches is blown in dense white streaks along the direction of the wind. Visibility is reduced.
11	56-63	64-72	Violent	Exceptionally high waves. The sea is storm completely covered with long, white patches of foam lying along the direction of the wind. Visibility reduced.
12	64-72	73-82	Hurricane	The air is filled with foam and spray. Sea is completely white with driving spray. Visibility very much reduced.
13	72-80	83-92		
14	81-89	93-103		
15	90-99	104-114		
16	100-108	115-125		
17	109-118	126-136		

NOTE:
1. It is recommended to always reference specific sea heights and sea height limitations using meters or feet. References to sea states contain ambiguity as there are several sea state scales in existence.

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SECTION II -- CHAPTER 9

2.9 OBSERVATION PROCEDURES AND FORM ENTRIES -- Columns E, F, and G -- SEA CONDITIONS

2.9.1 Introduction. This chapter contains information and instructions for observing the condition of the sea and for making entries in columns E, F, and G of CNMOC Form 3141/3. Sea condition refers to wave action and is divided into two types of waves. These are wind waves (also referred to as sea waves) and swell waves. Both types have general properties in common and are observed in the same manner.

2.9.1.1 General. Wind and swell waves are formed by the movement of the air (wind) over the sea surface. The friction between the air and the water transfers energy from the air to the sea. This energy moves through the surface layer as a wave. Theoretically, this energy moves as a sine wave. Due to continuous fluctuations in the speed and direction of the wind over an area, many separate energy waves are formed overriding each other (see Figure II-9-1). Many properties of sine waves still apply to the waves observed in the natural environment.

a. Wind Waves. Wind waves are those formed by the wind in the local area. The direction of a wind wave will always be the same as the direction of the local winds.

b. Swell Waves. Swell waves are those waves not raised by the local winds blowing at the time of observation, but which are due to winds blowing at a distance or from winds that have ceased to blow.

2.9.1.2 Properties of Waves. Wind and swell waves have the following properties in common.

a. Wave Height. Wave height is the vertical distance from the top of the crest to the bottom of the trough. Wave height is observed in feet.

b. Average Wave Height. The average wave height is the estimated heights of the larger, well formed waves, usually the highest one-third of all waves.

c. Period. The period of a wave is the time interval in seconds for successive wave crests to pass a fixed point.

(1) The average period of all the swell waves is the period reported for swell waves.

(2) The average period of the larger, well formed wind waves is the period reported for wind waves.

d. Frequency. The frequency of waves is the number of waves passing a given point during 1 second. It is the reciprocal of the period. In general, the lower the frequency, the higher the wave; the larger the frequency, the smaller the wave.

e. Wave Length. The wave length is the horizontal distance between two successive crests or from a point on one wave to the corresponding point on the succeeding wave. Wave length is measured in feet, and it is found by the formula: $L = 5.12T2$. T being the period of the wave.

2.9.2 Wave Observations. Wind and swell waves are observed by visual estimation. Measured wind speed data can be used as an aid when estimating wind waves. The following elements are recorded for wind and swell waves.

a. For wind waves determine the average wave height and period.

b. For swell waves determine the average wave height, period and direction from which the swell is coming.

c. Report swell waves when:

(1) The swell direction differs from the wind direction by 30 degrees or more, or

(2) The swell period differs from the wind wave period by 4 seconds or more.

(3) Any additional swell systems must differ in direction from both the wind direction and each evaluated swell direction by 30 degrees. In most circumstances, only one swell system can be distinguished.

2.9.2.1 Observation of Wave Height. The observation of wave height from aboard ship is complicated by the rolling, pitching, rising and falling of the ship with the waves. **There is a tendency to underestimate low waves and overestimate the heights of high ones.**

a. The best wave height estimate can be obtained by observing another ship in company. The height from trough to crest of a wave against the ship's side can be estimated as a part of some known vertical distance. For example, a wave might be 1/4 of the bridge height of 28 feet, or 7 feet high.

b. When no other ships are in company the height(s) must be determined by the wave action on the side of the ship or near the ship.

(1) Observe wind waves on the windward side of the ship as close to the water line as possible.

(2) Observe swell waves on the side of the ship from which the swell is coming. When the ship is running into the swell, observe it from the windward side of the ship (this is the optimum condition to observe swell wave height). As with the wind wave height, the swell wave height should be observed as close to the water line as possible.

(3) When the wave lengths are shorter than the length of the ship (generally all wind waves are, but some swell waves may be longer) estimate the wave height by looking over the side and notice the distance between the wave crests and troughs on the ship's side.

(a) For wind waves, note the heights of the well formed waves and average the heights.

(b) For swell waves, note all waves that are not confused by the wind waves and average the heights.

(4) If the ship is rolling and pitching excessively, or is in a turn or running across a high swell, the wave action along the side of the ship should not be used to determine wave height. Judge the waves near the ship and estimate the average height of the wind waves and the average height of all the swell waves in each swell train present.

c. When determining the height of the wind wave always consider the true wind at the time of observation and the prevailing wind that has blown in the past several hours. Use Table II-9-1 as a guide to determine the minimum fetch area and duration time for the estimated wave height to become fully arisen for a given wind speed. If the duration time is limited, use Table II-9-2 to determine the estimated wave height that would arise at the wind speed for the length of time the wind has been constant in speed and direction. **The heights derived from these tables should be used only as a guide while estimating wind wave heights because the actual heights may differ from the table values for many reasons. The observed wind wave height cannot be higher than the height that can be produced by the wind speed that has been occurring in the fetch area.**

2.9.2.2 Observation of Wave Period. The average period of the wind waves and the average swell waves are determined by timing the passage of successive wave crests past a fixed point.

a. Point of Observation. The period of waves should be observed from a relatively high position on the ship so the wave crests are looked down upon to more easily distinguish well defined wave crests.

b. Determination of Wave Period. Look out away from the ship so that the waves are oncoming. If possible, locate a stationary floating object such as a clump of seaweed, a patch of foam or floating debris. When the object reaches the apex of a wave crest, start timing until the object reaches the apex of the next wave

crest. Do this about 15 times, then average the times to determine the period. Repeat this procedure for each train of swell waves present. Table II-9-1 contains the range of periods normally found for given wind wave heights.

2.9.2.3 Observing Wave Direction. The direction from which the swell waves are coming is determined for each swell wave train present.

a. Point of Observation. The swell wave direction should be observed from a relatively high position on the ship so that a large area of the sea is visible and the swell wave train can be seen moving as a whole.

b. Determination of Direction. Face into the swell waves so that a right angle is formed between the swell and an imaginary line running from the point of observation to the horizon. Determine the degrees of the angle formed by the imaginary line and a line running from the ship's bow going clockwise from the bow. Add the degrees to the direction of the ship, if the sum is greater than 360°, subtract 360° from the sum; i.e., the swell is 280° clockwise from the ship's bow, the ship's course is 180°, $280^{\circ} + 180^{\circ} = 460^{\circ} - 360^{\circ} = 100^{\circ}$. 100° is the direction from which the swell wave is coming. The ship's compass located on the bridge (or bridge wing) can also be utilized to establish wave direction.

2.9.3 Wave Observations at Night. When observing waves at night, the observer should wear darkness adaptation goggles or glasses for a period of 10 to 15 minutes (as long as possible) prior to the observation. This will allow the observer's eyes to become accustomed to darkness. Allow as much time outdoors as practical to ensure that complete adaptation to darkness is made before the sea condition is observed. If the sea surface cannot be seen sufficiently owing to extreme darkness or low visibility due to weather phenomena, and the observer feels that a wave observation cannot be accurately estimated, omit the wave groups. It is better to report no wave data than to report incorrect wave information based on a poor estimation.

2.9.4 Column E - Sea Waves, Period and Height. Enter the average period of the significant wind waves in seconds. Enter a period of three seconds as 03, enter a period of 12 seconds as 12, etc. Enter calm seas as 00. Enter 99 if a period is confused. Enter the height of the significant wind waves in feet.

2.9.5 Columns F and G - Swell Waves, Direction, Period and Height. Enter the hundreds and tens of degrees of the direction and average period of the swell waves in seconds from which the primary swell is coming from in Column F. Secondary swell is entered in Column G. Enter the period as described in paragraph 2.9.4. Enter the average height of the swell waves in feet.

FULLY ARISEN SEA BY WIND SPEED

Wind Speed knots	Fully arisen wave height in feet	Fetch Area minimum in naut. miles	Duration minimum in hours	Wave Period in Seconds		
				Low	Average	High
10	1.5	10	2.5	1	3	6
12	2	18	4	1	3.5	7
14	3	28	5	1.5	4	8
16	5	40	7	2	4.5	9
18	6	55	8	2.5	5	10
20	8	75	10	3	5.5	11
22	10	100	12	3.5	6	12
24	12	130	14	4	7	13
26	15	180	17	4	7.5	15
28	18	230	20	4.5	8	16
30	22	280	23	5	8.5	17
32	26	340	27	5	9	18
34	30	420	30	5.5	9.5	19
36	34	500	34	6	10	20
38	39	600	38	6	11	21
40	45	700	42	6.5	12	22
42	50	830	47	7	12	23
44	57	950	52	7	13	24
46	63	1100	57	7	13	25
48	70	1250	63	7.5	14	26
50	78	1400	69	8	14	27
52	86	1600	75	8	15	28
54	94	1800	81	8	15	30
56	103	2100	88	9	16	31

ESTIMATION OF WAVE HEIGHTS BY WIND SPEED AND DURATION

Wind Speed in Knots	Duration in Hours											
	4	8	12	16	20	24	28	32	36	40	44	48
8	1	-	--	--	--	--	--	--	--	--	--	--
10	1.5	-	--	--	--	--	--	--	--	--	--	--
12	2	-	--	--	--	--	--	--	--	--	--	--
14	2.5	3	--	--	--	--	--	--	--	--	--	--
16	3	5	--	--	--	--	--	--	--	--	--	--
18	3.5	6	--	--	--	--	--	--	--	--	--	--
20	4	6	8	--	--	--	--	--	--	--	--	--
22	4	6	9	--	--	--	--	--	--	--	--	--
24	5	7	10	--	--	--	--	--	--	--	--	--
26	5	7	11	13	--	--	--	--	--	--	--	--
28	5	8	11	14	18	--	--	--	--	--	--	--
30	6	8	12	15	18	22	--	--	--	--	--	--
32	6	9	12	15	19	24	26	--	--	--	--	--
34	7	9	13	16	19	25	28	30	--	--	--	--
36	7	10	13	16	20	26	30	33	34	--	--	--
38	8	11	14	17	21	27	31	34	36	39	--	--
40	8	13	14	19	23	28	32	35	38	42	45	--
42	9	14	16	21	25	30	33	36	39	43	47	50
44	9	15	19	24	27	32	34	37	40	44	48	52
46	10	16	22	27	30	35	36	39	41	45	49	53
48	11	17	24	30	33	37	38	40	42	47	51	55
50	12	18	25	32	35	39	40	42	45	49	52	56
52	13	19	27	34	38	41	43	45	47	51	54	57
54	14	20	28	36	40	43	45	47	50	53	56	59
56	15	21	30	38	43	45	48	51	53	56	58	61

SECTION II -- CHAPTER 10

2.10 Columns A, B, C, 15, and 72 -- POSITION, COURSE, SPEED, OBSERVER'S INITIALS, AND REMARKS

2.10.1 General. Determining the ship's location, speed, and direction of movement are important elements of each observation. These elements are particularly useful pieces of information when transmitted in the synoptic weather report. Without an accurate or missing position, the data contained in the observation becomes useless. In addition, only qualified observers should initial the observation form. Trainees will normally complete watchstation qualifications (i.e., Personnel Qualification Standards (PQS)) under the direct supervision of qualified observers.

2.10.2 Column A - Position. This column entry consists of the quadrant of the globe the ship is located and the latitude and longitude.

a. Q - Enter the quadrant of the globe which the ship is located by using code figures in Section III, Code Table III-2-1.

b. LAT - Enter the latitude in whole degrees and tenths.

c. LONG - Enter the longitude in whole degrees and tenths.

2.10.3 Column B - Course. This column entry consists of the ship's true course to the nearest degree. Enter a dash if the ship is not underway.

2.10.4 Column C - Speed. This column entry consists of the ship's speed to the nearest knot. Enter a dash when the ship is not underway.

2.10.5 Column 15 - Observer's Initials. Enter the initials of the qualified observer responsible for taking the observation.

2.10.6 Column 72 - Remarks, Notes, and Miscellaneous Phenomena. This column is used to record data or information considered significant but not recorded elsewhere on the form. All times entered to the nearest hour and minute UTC. Examples of such entries are:

a. Conditions which affect the accuracy or representatives of recorded data, such as ice or snow accumulation on outdoor instruments.

b. Outages of primary observing equipment, include the following:

(1) Equipment that is inoperative.

(2) Time outage began.

(3) Reason for outage.

(4) Type of equipment used as replacement.

(5) Time primary equipment became operative.

c. Reason for omitting mandatory data entries.

d. Times of departure and arrival from/at port of anchorage, e.g., anchored Rota, Spain 1850Z, departed Subic Bay R.P. 0630Z.

e. Reasons for terminating observations:

(1) Steaming in company with other ships with another ship designated as the weather guard. Identify the ship taking the observations.

(2) Arrival at a port with a Naval Meteorology and Oceanography Command Center, Facility, or Detachment that takes observations for the port (e.g., in port, observations taken by NAVLANTMETOC DET Mayport, Florida, NAVEURMETOCCEN Rota, SP, etc.).

(3) Bridge navigation duties during special evolutions, such as sea and anchor detail in restricted waters, may require the Quartermaster's full attention and therefore restrict the ability to take a weather observation at the normally scheduled time. At a minimum, an effort should be made to document Local observation criteria, outlined in Table II-1-1. If an incident occurs, weather data will be thus available for reconstruction of events.

SECTION II – CHAPTER 11

2.11 OBSERVING AND REPORTING OF ICE

2.11.1 Introduction. This chapter contains instructions for observing ice accretion and sea ice and contains only those instructions needed to encode data in the Ship Synoptic Code. A more detailed description of sea ice observation procedures and definitions are provided in the "Ice Observation Handbook," produced and distributed by Naval Ice Center (NAVICECEN), Suitland. **If an extended period of ship operations is planned for the polar region, it is recommended that NAVICECEN Suitland be contacted to ensure environmental factors affecting ship safety and operations are considered.** Information on how to obtain services from NAVICECEN are contained in NAVOCEANCOMINST 3140.1J.

2.11.1.1 General. Ice accretion is the rime or clear (glaze) ice that builds up on the outside of structures of the ship. Sea ice is floating ice of land origin or of sea origin.

a. Ice accretion is observed by measuring its thickness, noting its origin and formation or break up.

b. Sea ice is observed visually noting its amount, arrangement, development or size.

2.11.2 Ice Accretion. Ice accretion forms when outer surfaces of the ship are below freezing and water droplets are suspended, falling or being blown in the air.

2.11.2.1 Clear (Glaze) Ice. When temperatures are between 32°F (0.0°C) and 25°F (-4.0°C) and dense fog, freezing rain or blowing spray is present, ice will form on outer surfaces of the ship. Clear ice forms slowly due to the relatively high freezing temperatures. This ice is hard and will form slowly.

2.11.2.2 Rime Ice. Rime ice forms best at temperatures nearing 14°F (-10°C) - (note that at temperatures colder than this value, it is unusual for there to be enough liquid water drops in the air to freeze, except for spray blowing up around the ship). Rime ice is generally whitish opaque ice that is relatively soft (similar to frost in a freezer). The water droplets freeze quickly upon contact with outer surfaces of the ship and catch air in between the drops. Rain is quite unusual with surface temperatures as cold as 14°F, so rime ice generally will form from fog or blowing spray.

2.11.2.3 Ice Formation Ice accretion generally begins to form on wires, railings, masts and fittings that are exposed to the open air. Ice will begin to form on flat surfaces such as cat walks, weather decks, and bulkheads that are not affected by heating from inside the ship. Lastly, ice will form on decks and bulkheads which are heated by conduction from inside the ship.

2.11.2.4 Observing Ice Accretion

a. Determine Origin of Ice Accretion

(1) Blowing spray

(2) Fog

(3) Blowing spray and fog

(4) Freezing rain/drizzle

(5) Blowing spray and freezing rain/drizzle

b. Measurement of Ice Accretion Thickness. In areas where the ice is generally uniform in thickness, chip the ice down to the ship's surface and measure its thickness in centimeters. Do this for several areas and average the thicknesses.

c. Determine Development or Decomposition of Ice Accretion

(1) Ice present but not building up.

(2) Ice building up slowly in the judgment of the observer.

(3) Ice building up rapidly in the judgment of the observer.

(4) Ice melting slowly in the judgment of the observer.

(5) Ice melting quickly in the judgment of the observer.

2.11.3 Observation of Sea Ice. Observe sea ice from a high position on the ship where the entire horizon may be viewed.

2.11.3.1 Ice Formed by the Freezing of Sea Water (Termed Sea Ice by WMO). Because of its salinity, seawater does not begin to freeze until it reaches approximately -1.9°C (28°F). The higher the salinity, the lower the freezing point. The thickness and physical characteristics of sea ice vary greatly with its age and stage of development. Determine the following:

a. Concentration, coverage, and arrangement of the ice.

b. Whether the ice is fast ice (ice attached to the shore), grounded in shallow water, or pack ice (ice which is free floating).

c. The age and development of the ice as follows:

(1) Newly Formed Ice

(a) Frazil ice, fine spicules or plates of ice suspended in water.

(b) Grease ice, a sludge of ice crystals which gives the surface a greasy appearance.

(c) Slush.

(d) Shuga, spongy white ice clumps.

(e) Nilas, a thin elastic crust of ice.

(f) Ice rind, a brittle crust of ice.

(2) Young Ice

a. Gray ice, ice 10-15 cm thick, rafts under pressure.

b. Gray-white ice, ice 15-30 cm thick, generally ridges under pressure instead of rafting.

(3) First-Year Ice, ice of not more than one winter's growth.

(4) Old Ice, ice that has survived at least one summer's melt. Has smoother features than first-year ice.

d. The direction, relative to true north, of the major ice edge.

2.11.3.2 Ice of Land Origin. Ice that has been formed on land as a result of the compaction of snow into glaciers is frequently found in certain areas of the polar regions. In these regions, the glaciers flow to the sea and form ice shelves. The ice shelves calve off icebergs or ice islands. Because of their large mass and unusual strength, icebergs are a hazard to navigation. When ice of land origin is observed determine:

a. The classification of the ice as follows:

(1) Iceberg, a massive piece of ice with more than five meters visible above sea level. About the size of a medium sized ship or larger.

(2) Bergy Bit, a large piece of ice with more than one meter but not more than five meters visible above sea level. About the size of a small house or cottage.

(3) Growler, a small piece of ice with up to one meter visible above sea level, about the size of a truck.

b. The number of icebergs visible or if no icebergs are present the number of growlers and bergy bits visible.

2.11.4 Ship Synoptic Code Ice Groups. Instructions and tables for coding synoptic weather code ice groups are contained in Section III, Chapter 4.

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SECTION III – CHAPTER 1

3.1 SHIP SYNOPTIC CODE

3.1.1 Introduction. The World Meteorological Organization (WMO) has developed the FM 13 SHIP synoptic code report of surface observations from a sea station. The entire common code consists of six sections briefly described below. Each section contains data groups which have five elements. Almost every group contains a numerical identifier so that a single group can be eliminated without affecting the rest of the section.

FM 13 SHIP SYNOPTIC CODE FORMAT

Section 0 **BBXX DDDD YYGGi$_w$ 99L$_a$L$_a$L$_a$ Q$_c$L$_o$L$_o$L$_o$L$_o$**

Section 1 **i$_R$i$_x$hVV Nddff (00fff) 1s$_n$TTT 2s$_n$T$_d$T$_d$T$_d$ 4PPPP 5appp**

7wwW$_1$W$_2$ 8N$_h$C$_L$C$_M$C$_H$ 9GGgg

Section 2 **222D$_s$v$_s$ 0S$_s$T$_w$T$_w$T$_w$ 2P$_w$P$_w$H$_w$H$_w$ 3d$_{w1}$d$_{w1}$d$_{w2}$d$_{w2}$**

4P$_{w1}$P$_{w1}$H$_{w1}$H$_{w1}$ 5P$_{w2}$P$_{w2}$H$_{w2}$H$_{w2}$ 6I$_s$E$_s$E$_s$R$_s$ 8S$_w$T$_b$T$_b$T$_b$

ICE + plain language
or
ICE c$_i$S$_i$b$_i$D$_i$z$_i$

Section 0 - This section contains identification information. There are groups for the ship's call sign, the date and time of the observation, and the ship's position at the time of observation. Entries are required in each group to ensure proper identification and positioning.

Section 1 - This section contains general meteorological information which includes visibility, wind, temperature, dew point, atmospheric pressure, weather phenomena, and cloud data.

Section 2 - This section contains meteorological data pertaining to sea water temperature, wind and swell wave, ice data, wet-bulb temperature and ship movement and speed.

Section 3 - Is not used by U.S. Navy ships.

Section 4 - Is not used by U.S. stations.

Section 5 - Reported by selected land stations and by automated sea stations, and includes data for National use only. Is not used by U.S. Navy.

3.1.2 Reporting Requirements. Section I, Chapter 1, contains the requirements for transmitting the ship synoptic code. Section II contains instructions on observing the various elements of the code. The ship synoptic code is encoded for transmission purposes only. If the observation is not transmitted, no entries need to be made.

3.1.3 Entry of Data on CNMOC 3141/3 Form. The ship synoptic code is entered in part II of the CNMOC 3141/3 observation form. The top line of part II contains the symbolic format of the code for reference. Each element is entered directly below the symbol representing the entry. Entries that remain the same on all observations are already entered on the form. The following chapters describe procedures for coding each of the elements of the FM 13 SHIP code.

SECTION III - CHAPTER 2

3.2 CODING OF SECTION 0 DATA

3.2.1 Section 0 BBXX DDDD YYGGi$_w$ 99L$_a$L$_a$L$_a$ Q$_c$L$_o$L$_o$L$_o$L$_o$.

3.2.1.1 **DDDD.** This is the four letter ship international radio call sign (IRCS). This group is entered on the observation form and is transmitted in the observation. This is the only group with only four elements in the code.

3.2.1.2 **YYGGi$_w$.** This group identifies the date and time of the observation, and information about the wind group.

a. YY - Enter the day of the month (UTC) as two digits, i.e., the second is entered as 02, the thirteenth as 13, etc. Note that the date UTC will vary by a day from the date LST on certain hours of the day, depending on the time zone.

b. GG - Enter the hour of observation (UTC) as two digits, i.e., 0900 UTC is entered as 09, 1200 UTC as 12, etc. Observation times are at three hour intervals starting at 0000 UTC, i.e., 00, 03, 06, etc.

c. i_w - Navy ships will report wind speed in **knots**. Enter the code figure indicating how the wind speed was observed and encode as follows:

(1) If wind speed is estimated: Code figure 3.

(2) If wind speed is measured: Code figure 4.

3.2.1.3 **99L$_a$L$_a$L$_a$.** This group identifies the latitude of the ship at the time of observation.

a. 99 - Indicates that latitude information follows.

b. L$_a$L$_a$L$_a$ - Enter the latitude to the tenth of a degree. To obtain the tenths value, divide the minutes of latitude by 6 and disregard the remainder.

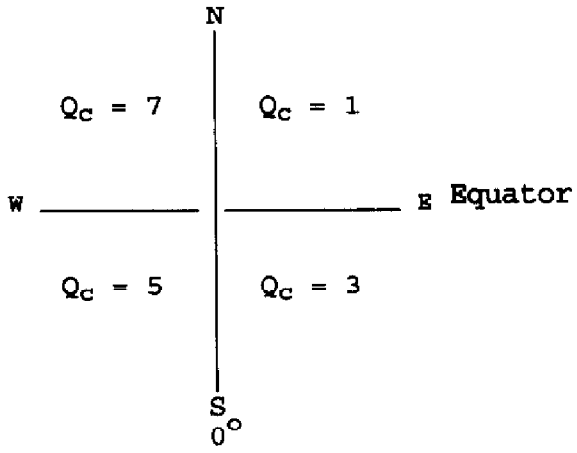
3.2.1.4 **Q$_c$L$_o$L$_o$L$_o$L$_o$.** The group identifies the quadrant of the globe that the ship is in and the longitude of the ship at the time of observation.

a. Q_c - Enter the code figure that indicates the quadrant of the globe the ship is in. See Table III-2-1.

b. $L_oL_oL_oL_o$ - Enter the longitude to the tenth of a degree.

To obtain the tenths value divide the minutes of longitude by 6 and disregard the remainder.

Q_c - Quadrant of the Globe



Code Figure	Latitude	Longitude
1	North	East
3	South	East
5	South	West
7	North	West

NOTE: The choice is left to the observer in the following cases:

When the ship is on the Greenwich meridian or the 180th meridian ($L_oL_oL_oL_o$ = 0000 or 1800 respectively):

Q_c = 1 or 7 (northern hemisphere) or
Q_c = 3 or 5 (southern hemisphere)

When the ship is on the Equator ($L_aL_aL_a$ = 000):

Q_c = 1 or 3 (eastern longitude) or
Q_c = 5 or 7 (western longitude)

SECTION III – CHAPTER 3

3.3 CODING OF SECTION 1 DATA

3.3.1 Section 1 $i_R i_X hVV$ Nddff (00fff) $1s_nTTT$ $2s_nT_dT_dT_d$ $4PPPP$ $5appp$ $7wwW_1W_2$ $8N_hC_LC_MC_H$ $9GGgg$

3.3.1.1 $i_R i_X hVV$

a. i_R - This element is **always** reported as 4. This indicates that no precipitation data is included in the observation since ships do not measure precipitation amounts.

b. i_X - Enter the code figure indicating the presence of weather phenomena data in the observation. See Table III-3-1.

c. h - Enter the code figure indicating the height of the base of the lowest layer of cloud observed. See Table III-3-2. Note a layer of obscuring phenomena aloft is disregarded when reporting the lowest layer of cloud present.

d. VV - Enter the code figure indicating the **lowest visibility value observed**. This includes all sector visibility values. See Table III-3-3.

3.3.1.2 **Nddff (00fff)**. Nddff identifies the total sky covered by clouds, and the direction and speed of the true wind. The two digits 00 is an indicator for the group 00fff, which is used only when wind speeds are 99 knots or greater.

a. N - Enter the code figure representing the octas (eights) of the total sky covered by clouds. Conversion of tenths to octas can be found in Table III-3-4.

Note 1 - A thin cloud layer is considered the same as an opaque cloud layer.

Note 2 - A partial obscuration by surface-based obscuring phenomena and all layers of obscuring phenomena aloft are considered when figuring the total sky cover.

Note 3 - A total obscuration by surface-based obscuring phenomena is not disregarded but encoded as 9.

b. dd - Enter hundreds and tens of the direction from which the true wind is blowing. If the wind is calm, both dd and ff are each encoded 00.

c. ff Enter the knots (kts) of the true wind speed. If the true wind speed is 99 knots, **ff** in **Nddff** is encoded 99 and **fff** in **00fff** is encoded 099.

3.3.1.2.1 **(00fff)**. As indicated in paragraph 3.3.1.2, if the wind speed is 99 knots or more, **ff** in **Nddff** is encoded 99. If the wind speed is 100 knots or more, **ff** is encoded 99 and **fff** is encoded with the actual wind speed. For example, if the wind speed is 115 knots, the speed would be encoded as **Ndd**99 00115.

3.3.1.2.2 **Shaded Area**. This group is encoded but not transmitted. It is used for determining the true wind direction and speed based on the ship's course and speed at the time of observation and the wind direction and speed relative to the ship's movement. Enter the height of the anemometer in meters in the space provided. Enter the ship's course at the time of observation in whole degrees true (i.e., 215, 010). This entry should be the same entry as Column B of Part 1 of the CNMOC 3141/3. Enter the ship's speed at the time of observation. This entry should be the same entry as Column C of Part 1 of the CNMOC 3141/3. Enter the Apparent Wind direction relative to the ship in whole degrees (i.e. 015, 275). Enter the Apparent Wind speed in knots. If the apparent wind speed is 99 knots or more, enter the speed in whole knots (i.e., 115).

3.3.1.3 **1s_nTTT**. This group indicates the ambient air temperature in degrees Celsius.

a. 1 - Identifies the air temperature group in section 1 of the code. If the temperature cannot be observed, the entire group is deleted from the observation and the 1 group will not appear in section 1.

b. s_n - Enter the code figure indicating if the temperature value is positive (including zero degrees) or negative (0 = positive or zero; 1 = negative temperature).

c. TTT - Enter the ambient air temperature in tens, units and tenths degrees Celsius.

3.3.1.4 **2$s_n$$T_dT_dT_d$**. This group indicates the dew point temperature in degrees Celsius. Note that for air temperatures below zero, the dew point in relation to liquid water, vice frozen water, should be reported, i.e., dew point vice frost point.

a. 2 - Identifies the dew point temperature group in section 1 of the code.

b. s_n - Enter the code figure indicating if the temperature value is positive (including zero degrees) or negative (0 = positive or zero; 1 = negative temperature).

c. $T_dT_dT_d$ - Enter the dew point temperature in tens, units, and tenths degrees Celsius.

3.3.1.5 **4PPPP**. This group identifies the sea level pressure in hectopascals (hPa), **the numerical equivalent of millibars**.

a. 4 - Identifies the sea level pressure group in section 1 of the code.

b. PPPP - Enter the sea level pressure as computed, in hundreds, tens, units and tenths of hectopascals.

3.3.1.6 **5appp**. This group identifies the pressure change for the past three hours, reported in hectopascals. **Note this group is reported only when the ship is anchored or moored in the same position for the full three hour period.**

a. a - Enter the code figure indicating the characteristic of pressure tendency during the past three hours preceding the time of observation. See Table III-3-5.

b. ppp - Enter the change in pressure during the three hours preceding the time of observation in tens, units and tenths of a hectopascal.

3.3.1.7 **7wwW$_1$W$_2$**. This group identifies the weather conditions at the time of observation and the preceding hours since the last observation.

a. 7 - Identifies the present and past weather group in section 1 of the code. If no significant weather is reported for present weather (ww code figures 00, 01, 02, and 03 are considered not significant) and no significant weather is reported for past weather (W_1 W_2 code figures 0, 1 and 2 are considered not significant) this group will be encoded as 70000. If not observed or not determined, encode as 7////.

b. ww - Enter the code figure indicating the present weather, or weather occurrences for the past hour. The highest numerical code shall be used except that code figure 17 thunderstorm without precipitation at the station shall be reported over code figures 20 through 49. See Table III-3-6.

c. W_1W_2 - Enter the code figures indicating the types of weather that occurred in the period of time indicated as follows. See Table III-3-7.

(1) At the **0000, 0600, 1200, 1800** UTC observation, report the past weather for the past six hours.

(2) At the **0300, 0900, 1500, 2100** UTC observation, report the past weather for the past three hours. The code figures for W_1 and W_2 shall be selected in such a way that W_1W_2 and ww together give as complete a description as possible of the weather in the time interval concerned, i.e., if the type of weather undergoes a complete change during the time interval concerned, the code figures selected for W_1 and W_2 shall describe the weather prevailing before the type of weather indicated by ww began. When two or more types of weather occurred in the time period, the highest figure shall be reported for W_1, and the second highest code figure shall be reported for W_2. When the entire period covered has been

under the influence of only one type of weather, the corresponding code figure shall be used for both W_1 and W_2, i.e., rain during the entire period shall be reported by means of W_1W_2 = 66.

3.3.1.8 **8$N_hC_LC_MC_H$**. This group identifies the predominant cloud forms present at the time of observation.

a. 8 - Identifies the cloud group in section 1 of the code. If no low, middle and high clouds are present, enter zeros, i.e., 80000. If the sky is totally obscured, the group will be encoded as soliduses (8////).

b. N_h - Enter the code figure indicating the amount of all low clouds present C_L, or if no low cloud is present, enter the amount of all middle clouds present C_M, at the time of observation (see Table III-3-4). If the sky is totally obscured, encode N_h as either 9 or /.

c. C_L - Enter the code figure representing the predominant type of low cloud present C_L. If no low cloud is present, but a middle C_M or high cloud C_H is present, enter 0 for C_L (see Table III-3-8).

d. C_M - Enter the code figure representing the predominant type of middle cloud C_M present. If no middle cloud is present but a low C_L or high cloud C_H is present, enter 0 for C_M. If the total of all low clouds present equals 10/10, 8/8 (overcast) enter " / " for C_M (see Table III-3-9).

e. C_H - Enter the code figure representing the predominant type of high cloud C_H present. If no high cloud is present but a low C_L or middle cloud C_M is present, enter 0 for C_H. If the total of all low C_L and middle clouds C_M present equals 10/10, 8/8 (overcast) enter " / " for C_H (see Table III-3-10).

3.3.1.9 **9GGgg**. This group identifies if the actual time of the observation is not within 10 minutes of the standard reporting time. Since most observation reports are made within ten minutes of the standard time, this group will usually not be included.

a. 9 - Indicator.

b. GG - Time in whole hours UTC.

c. gg - Time in whole minutes UTC.

i_x - Inclusion of present/past weather data

Code figure	Group $7wwW_1W_2$ is
1	Included
2	Not used
3	Omitted, not observed or data not available

h - Height above the ground of the base of the lowest cloud layer

Code figure	Feet	Meters
0	00 to 99	00 to 49
1	100 to 299	50 to 99
2	300 to 699	100 to 199
3	700 to 999	200 to 299
4	1000 to 1999	300 to 599
5	2000 to 3299	600 to 999
6	3300 to 4899	1000 to 1499
7	4900 to 6499	1500 to 1999
8	6500 to 7999	2000 to 2499
9	8000 or above, no clouds	2500 or above, no clouds
/	Height not known	Height not known

VV -- Horizontal visibility at surface

Code figure	Nautical miles
90	Less than 1/16
91	1/16
92	1/8
93	1/4
94	1/2
95	1 or 1 1/2
96	2, 2 1/2, or 3
97	5, 6, 7, or 8
98	9 or 10
99	Not reported

N - Total cloud cover
N_h - Amount of all low clouds present, or if no low cloud is present, the amount of all mid clouds present

Code figure	Tenths	Oktas (eighths)
0	0	0 (SKC)
1	1/10 or less, but not 0	1 okta or less, but not 0
2	2/10 and 3/10	2 oktas (FEW)
3	4/10	3 oktas
4	5/10	4 oktas (SCT)
5	6/10	5 oktas
6	7/10 and 8/10	6 oktas (BKN)
7	9/10 or more, but not 10/10	7 oktas or more, but not 8
8	10/10	8 oktas (OVC)
9	Sky obscured by fog and/or other meteorological phenomena	
/	Cloud cover is indiscernible for reasons other than fog or other meteorological phenomena, or observation is not made.	

a -- Characteristic of pressure tendency during the three hours preceding the time of observation

Code figure	Pressure higher now than three hours ago
0	Increasing, then decreasing; atmospheric pressure the same or higher than three hours ago.
1	Increasing, then steady; or increasing then increasing more slowly.
2	Increasing, steadily or unsteadily.
3	Decreasing or steady, then increasing; or increasing, then increasing more rapidly.
4	Steady; pressure the same as three hours ago
5	Decreasing, then increasing; pressure the same or lower than three hours ago.
	Pressure lower now than three hours ago
6	Decreasing, then steady; or decreasing, then decreasing more slowly.
7	Decreasing, steadily or unsteadily
8	Steady or increasing, then decreasing; or decreasing, then decreasing more rapidly.

ww -- Present Weather Code Specification In Order of Priority

Encode the first weather condition or restriction to visibility that applies. If more than one applies, the first described weather or restriction to visibility is the one to be reported.

ww = 99-50. Use code figures 99-50 for precipitation at the station at the time of observation.

---

ww = 99-80. Use code figures 99-80 for showery precipitation or precipitation with current or recent thunderstorms.

---

ww = 99-95. In order to have a thunderstorm at the time of your observation, thunder must have been heard or lightning must have been seen within 15 minutes of the observation time. In a U.S. observation there are only two intensities of thunderstorms: thunderstorm and severe thunderstorm. A thunderstorm is less than severe if within the past 15 minutes all wind gusts were less than 50 kt and all hail was less than 3/4 in (19 mm) in diameter. A thunderstorm is a severe thunderstorm if within the past 15 minutes there were any wind gusts of 50 kt or more or any hail 3/4 in (19 mm) or greater in diameter.

---

99 - Thunderstorm, severe, with hail, small hail, or snow pellets at time of observation.

If there is a severe thunderstorm with hail, ice pellets, or snow pellets, use code figure 99. There may or may not also be rain or snow or a mixture of rain and snow of any intensity (i.e., +TSGR, +TSPE).

98 - Thunderstorm at time of observation combined with duststorm or sandstorm at time of observation (unlikely at sea).

If there is a thunderstorm and a duststorm or sandstorm at the time of observation, use code figure 98. There must also be some sort of precipitation at the time of observation, but it may not be seen because of poor visibility. Judgment must be used. (e.g., TSSA, +TSSA)

97 - Thunderstorm, severe without hail, small hail, or snow pellets but with rain and/or snow at time of observation.

If there is a severe thunderstorm at the time of observation, with rain, snow, or a mixture of rain and snow, but with no hail, ice pellets, or snow pellets, use code figure 97. The rain or snow may be of any intensity (i.e., +TSSN, +TSRA).

ww -- Present Weather Code Specification In Order of Priority

96 - Thunderstorm with hail, small hail, or snow pellets at time of observation.

If there is a thunderstorm at the time of observation, and there is also hail, ice pellets, or snow pellets, use code figure 96. There may or may not be rain or snow or a mixture of rain and snow of any intensity (i.e., TSGR, -TSPE).

95 - Thunderstorm without hail, small hail or snow pellets, but with rain and/or snow at time of observation.

If there is a thunderstorm at the time of observation with rain or snow or a mixture of rain and snow but with no hail, ice pellets, or snow pellets, use code figure 95. The rain or snow may be of any intensity (i.e., -TSRA).

---

ww = 94-91. Use code figures 94-91 if there was a thunderstorm during the past hour, and there is some sort of precipitation at the time of observation. In order to have this situation, the last lightning or thunder observed must have been more than 15 minutes before the observation, but less than 1 hour 15 minutes before the observation.

---

94 - Moderate or heavy snow or rain and snow mixed or hail, small hail or snow pellets at time of observation. Thunderstorm during previous hour but not at time of observation.

If there is moderate or heavy snow or moderate or heavy snow showers, or if there is a mixture of rain and snow or mixed rain showers and snow showers, and the intensity of either is moderate or heavy, or if there are moderate or heavy ice pellets or snow pellets, or if there is hail at the time of observation, use code figure 94 (i.e., GR, SHSN).

93 - Slight snow or rain and snow mixed or hail, small hail, or snow pellets at time of observation. Thunderstorm during previous hour but not at time of observation.

If there is light snow or light snow showers, or if there is a mixture of rain and snow or mixed rain showers and snow showers and the intensity of both is light, or if there are light ice pellets or light snow pellets at the time of observations, use code figure 93 (i.e., -SHRAGR, -SHSN).

ww -- Present Weather Code Specification In Order of Priority

92 - Moderate or heavy rain at time of observation. Thunderstorm during previous hour but not at time of observation.

If there is moderate or heavy rain, or a moderate or heavy rain shower at the time of observation (and no other forms of precipitation), use code figure 92 (i.e., SHRA, +RA).

91 - Light rain at time of observation. Thunderstorm during previous hour but not at time of observation.

If there is light rain or a light rain shower at the time of observation (and no other precipitation), use code figure 91 (i.e., -SHRA, -RA).

---

ww = 90-80. Use code figures 90-80 to report showery precipitation that is not associated with a thunderstorm. Showers fall from cumuliform clouds that are, by nature, isolated. Because of this, individual showers do not last very long. Between showers openings, other clouds may be seen. Code figure 89 is not reported in the United States.

---

90 - Moderate or heavy shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder.

If there are showers of hail at the station at the time of observation, and the hail is not associated with a thunderstorm, use code figure 90. The hail may or may not be mixed with rain or both rain and snow (i.e., GR, +SHRAGR).

---

ww = 88-87. Use code figure 88 or 87 if showers of snow pellets or ice pellets are observed at the station at the time of the observation. The snow pellets or ice pellets may or may not be mixed with rain or both rain and snow.

---

88 - Moderate or heavy shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed.

If the only precipitation is snow pellets or ice pellets, and the intensity is moderate or heavy, then use code figure 88. If there is also rain, or mixed rain and snow, and any of the precipitation is moderate or heavy, use code figure 88 (i.e., -SHRA, +SHPE).

ww -- Present Weather Code Specification In Order of Priority

87 - Light shower(s) or snow pellets or small hail, with or without rain or rain and snow mixed.

If the only precipitation is snow pellets or ice pellets, and the intensity is light, then use code figure 87. If there is also rain, or mixed rain and snow, and all of the precipitation is light, use code figure 87 (-SHSN-SHPE).

---

ww = 86-85. Use code figure 86 or 85 if only snow showers are observed at the station at the time of observation.

---

86 - Snow shower(s), moderate or heavy.

Encode as SHSN or +SHSN.

85 - Snow shower(s), light.

Encode as -SHSN.

---

ww = 84-83. Use code figure 84 or 83 if mixed rain showers and snow showers are observed at the station at the time of observation.

---

84 - Moderate or heavy shower(s) of rain and snow mixed. Intensity of either may be moderate or heavy.

Encode as SHRA+SHSN, etc.

83 - Light shower(s) of rain and snow mixed. Intensity of both must be light.

Encode as -SHRA-SHSN.

---

ww = 82-80. Use code figures 82-80 to report rain showers at the time of observation. The code figure used depends upon the intensity of the shower at time of observation.

---

82 - Violent rain shower(s).

If a violent rain shower is observed at the station at the time of observation, use code figure 82. Report a rain shower as violent if the rate of fall is at least 1 in (25 mm) per hour or 0.10 in (3 mm) in 6 minutes (i.e., +SHRA).

81 - Moderate or heavy rain shower(s).

Encode as SHRA.

ww -- Present Weather Code Specification In Order of Priority

80 - Light rain shower(s).

Encode as -SHRA.

---

ww = 79-50. Use code figures 79-50 for precipitation that is not showery.

---

ww = 79-70. Use code figures 79-70 to report solid precipitation not in showers.

---

ww = 79-76. Use code figures 79-76 to report types of solid, non-showery precipitation.

---

79 - Ice pellets.

If ice pellets observed are not in the form of showers, at the time of observation, use code figure 79. Use this code figure regardless of the intensity of the ice pellets and regardless of whether the ice pellets are mixed with another type of precipitation (i.e., -PE, PE, +PE).

78 - Isolated star-like snow crystals with or without fog or ice fog.

77 - Snow grains with or without fog or ice fog.

If snow grains are observed at the station at the time of observation, use code figure 77. Use this code figure regardless of intensity of the snow grains. Snow grains may or may not be accompanied by fog or ice fog (i.e., -SG, SG, +SG).

76 - Diamond dust (ice crystals) with or without fog or ice fog.

If ice crystals are observed at the station at the time of the observation, use code figure 76. Ice crystals may or may not be accompanied by fog or ice fog (i.e., IC).

---

ww = 75-70. Use code figures 75-70 to report snow that is not in the form of showers at the station at the time of the observation. The code figure selected depends on a combination of intensity and whether the snow is intermittent or continuous.

---

75 - Continuous fall of snowflakes, heavy at time of observation.

Encode as +SN.

ww -- Present Weather Code Specification In Order of Priority

74 - Intermittent fall of snowflakes, heavy at time of observation.

Encode as +SN.

73 - Continuous fall of snowflakes, moderate at time of observation.

Encode as SN.

72 - Intermittent fall of snowflakes, moderate at time of observation.

Encode as SN.

71 - Continuous fall of snowflakes, light at time of observation.

Encode as -SN.

70 - Intermittent fall of snowflakes, light at time of observation.

Encode as -SN.

---

ww = 69-60. Code figures 69-60 are generally used to report rain.

---

ww = 69-66. Use code figures 69-66 to report liquid precipitation that is mixed with snow or is freezing.

---

69 - Rain or drizzle and snow, moderate or heavy.

Encode as RA-SN, +RASN, etc.

68 - Rain or drizzle and snow, light.

Encode as -DZ-SN, -RA-SN.

67 - Rain, freezing, moderate or heavy.

If the intensity of the freezing rain (or mixed freezing rain and freezing drizzle) is moderate, or heavy use code figure 67 (i.e., FZRA, +FZRA).

66 - Rain, freezing, light.

If the intensity of the freezing rain (or mixed freezing rain and freezing drizzle) is light, use code figure 66 (i.e., -FZRA).

ww -- Present Weather Code Specification In Order of Priority

---

ww = 65-60. Use code figure 65-60 to report rain (but not freezing rain or rain mixed with snow) at the station at the time of observation. The code figure used depends on the combination of intensity and whether the precipitation is intermittent or continuous.

---

65 - Rain, not freezing, continuous, heavy at time of observation.

Encode as +RA.

64 - Rain, not freezing, intermittent, heavy at time of observation.

Encode as +RA.

63 - Rain, not freezing, continuous, moderate at time of observation.

Encode as RA.

62 - Rain, not freezing, intermittent, moderate at time of observation.

Encode as RA.

61 - Rain, not freezing, continuous, light at time of observation.

Encode as -RA.

---

60 - Rain, not freezing, intermittent, light at time of observation.

Encode as -RA.

---

ww = 59-50. Use 59-50 to report drizzle.

---

ww = 59-56. Drizzle mixed with rain, or freezing drizzle.

---

59 - Drizzle and rain, moderate or heavy.

Encode as RADZ, +DZRA, etc.

58 - Drizzle and rain, light.

Encode as -RA-DZ.

ww -- Present Weather Code Specification In Order of Priority

57 - Drizzle, freezing, moderate or heavy.

Encode as FZDZ or +FZDZ.

56 - Drizzle, freezing, light.

Encode as -FZDZ.

---

ww = 55-50. Use code figures 55-50 to report drizzle (but not freezing drizzle or drizzle mixed with rain) at the station at the time of observation.

---

55 - Drizzle, not freezing, continuous, heavy at time of observation.

Encode as +DZ.

54 - Drizzle, not freezing, intermittent, heavy at time of observation.

Encode as +DZ.

53 - Drizzle not freezing, continuous, moderate at time of observation.

Encode as DZ.

52 - Drizzle not freezing, intermittent, moderate at time of observation.

Encode as DZ.

---

51 - Drizzle not freezing, continuous, light at time of observation.

Encode as -DZ.

---

50 - Drizzle not freezing, intermittent, light at time of observation.

Encode as -DZ.

---

ww = 17. Thunderstorm, but no precipitation at time of observation. Code figure 17 has priority over code figures 49-20 and 16-00.

---

ww -- Present Weather Code Specification In Order of Priority

17 - Thunderstorm, but no precipitation at time of observation (17TS).

A thunderstorm is an electrical storm that may or may not be accompanied by precipitation. If there is a thunderstorm at the station, but no precipitation, use code figure 17. Since by U.S. definition, a thunderstorm does not end until 15 minutes after the last lightning or thunder, code figure 17 would be used if the thunderstorm occurred within 15 minutes of the observation (i.e., TS or +TS).

---

ww = 49-00. Use code figure 49-00 when no precipitation is occurring at the station at the time of observation.

---

ww = 49-40. Use code figures 49-40 only if there is fog. The fog may be made of water droplets or ice crystals (ice fog). The visibility in fog or ice fog must be less than 5/8 mi (1 km). If the visibility is 5/8 mi (1 km) or more, use code figure 10. The code figure used will depend on whether the fog has changed during the past hour and whether the sky can be seen (blue sky, stars or higher clouds).

---

49 - Fog depositing rime, sky invisible.

Fog that deposits rime will be made up mostly of supercooled water droplets, not ice crystals (FZFG). Sky is obscured.

48 - Fog depositing rime, sky visible.

Sky is visible. Encode as FZFG.

47 - Fog or ice fog, sky invisible. Fog has begun or has become thicker during the preceding hour.

Encode as FG.

---

46 - Fog or ice fog, sky visible. Fog has begun or has become thicker during the preceding hour.

Encode as FG

45 - Fog or ice fog, sky invisible. Fog has shown no appreciable change during the preceding hour.

Encode as FG

ww -- Present Weather Code Specification In Order of Priority

44 - Fog or ice fog, sky visible. Fog has shown no appreciable change during the preceding hour.

Encode as FG

43 - Fog or ice fog, sky invisible. Fog has become thinner during the preceding hour.

Encode as FG

42 - Fog or ice fog, sky visible. Fog has become thinner during the preceding hour.

Encode as FG

41 - Fog or ice fog in patches. Fog has begun or has become thicker during the preceding hour.

Encode as FG

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

Encode as PRFG or BCFG

---

ww = 39-30. Use code figures 39-30 to report a duststorm, sandstorm, or drifting or blowing snow. These phenomena are rarely observed from ships except close to deserts or ice fields.

---

ww = 39-36. In deciding among code figures 39-36, the following must be considered: snow that is being moved by the wind may be generally low (below about 6 ft (2 m)) or generally high (above 6 ft (2 m)). If the snow is low, it is drifting snow; if high, it is blowing snow. Code 37 is not used in the United States.

---

39 - Heavy blowing snow, generally high (above eye level). Visibility less than 5/16 mi (1/2 km).

Encode as +BLSN.

38 - Slight or moderate blowing snow, generally high (above eye level). Visibility 6 mi (10 km) or less but not less than 5/16 mi (1/2 km).

Encode as -BLSN or BLSN.

37 - Heavy drifting snow, generally high (above eye level).

Encode as +DRSN.

ww - Present Weather Code Specification in Order of Priority

36 - Light to moderate drifting snow, generally low (below eye level).

Encode as -DRSN or DRSN.

---

ww = 35-30. In deciding among code figures 35-30 the following must be considered: if the visibility at the station at the time of observation is less than 5/16 mi (1/2 km), there is a severe duststorm or sandstorm; if the visibility is at least 5/16 mi (1/2 km) but less than 5/8 mi (1 km), there is a slight or moderate duststorm or sandstorm. The code figure used depends on the intensity of the sandstorm or duststorm and any change in its intensity during the preceding hour.

---

35 - Severe duststorm or sandstorm that has begun or has increased during the preceding hour.

Encode as +SS or +DS.

34 - Severe duststorm or sandstorm that has had no appreciable change during the preceding hour.

Encode as +SS or +DS.

33 - Severe duststorm or sandstorm that has decreased during the preceding hour.

Encode as +SS or +DS.

32 - Slight or moderate duststorm or sandstorm that has begun or has increased during the preceding hour.

Encode as SS or -DS.

31 - Slight or moderate duststorm or sandstorm that has had no appreciable change during the preceding hour.

Encode as -SS or DS.

30 - Slight or moderate duststorm or sandstorm that has decreased during the preceding hour (30SA).

Encode as SS or -DS.

ww - Present Weather Code Specification in Order of Priority

ww = 29-20. Use code figures 29-20 to report precipitation, fog, ice fog, or thunderstorm at the station during the preceding hour but not at the station at the time of observation. Code figures 29-20 are used only if there was precipitation, fog, ice fog (but not mist), or a thunderstorm at the station during the past hour, but not at the time of observation. Use code figures 29-25 if the precipitation was showery; otherwise use code figures 24-20.

29 - Thunderstorm (with or without precipitation).

Since by U.S. definition a thunderstorm ends 15 minutes after the last thunder or lightning, the last thunder or lightning must have happened at least 15 minutes before the time of the observation.

Encode as TS.

28 - Fog or ice fog.

The visibility in the fog or ice fog must have been less than 5/8 mi (1 km).

Encode as FG or FZFG.

27 - Shower(s) of hail, small hail, or ice pellets, or of rain and hail, small hail or ice pellets.

Encode as SHGR or SHRAGR.

26 - Shower(s) of snow, or of rain and snow.

Encode as SHSN or SHRASN.

25 - Shower(s) of rain.

Encode as SHRA.

24 - Freezing drizzle or freezing rain, not falling as shower(s).

Encode as FZRA.

23 - Rain and snow or ice pellets, not falling as shower(s).

Encode as PA or SN or PE

22 - Snow not falling as shower(s).

Encode as SN

21 - Rain (not freezing), not falling as shower(s)

Encode as RA

ww -- Present Weather Code Specification In Order of Priority

20 - Drizzle (not freezing) or snow grains, not falling as shower(s).

---

ww = 19-00. Use code figures 19-00 to report certain hydrometeors, electrometeors, lithometeors or no precipitation at the station at the time of observation or during the preceding hour.

---

19 - Funnel cloud(s), tornado, or waterspout at or within sight of the station during the preceding hour of the time of the observation.

Since the highest code figure is reported (except code figure 17), code figure 19 cannot be used if ww can be encoded as some higher number. If a tornado is observed at or near the station at the time of the observation or during the preceding hour, include the plain language word TORNADO as the last group in Section 3. This instruction shall be followed regardless of the code figure selected for ww. Do not include a plain language word for funnel cloud or waterspout if code figure 19 is used.

18 - Squalls. By U.S. definition, a sudden increase of at least 15 knots in average wind speed and sustained at 20 knots or more for at least 1 minute. This must occur at or within sight of the station during the preceding hour or at the time of observation.

If a squall without any precipitation is observed, either at the time of observation or during the past hour, use code figure 18. If there was any precipitation, or if there was a thunderstorm with the squall, use one of the other code figures, possibly code figure 29 or one of the code figures 99-80. Select the one that best describes what happened.

Encode as SQ.

16 - Precipitation within sight, reaching the ground or the surface of the sea near to, but not at the station.

The precipitation must be less than 3 mi (5 km) from the station, but not at the station to use code figure 16.

Encode as VCSH

15 - Precipitation within sight, reaching the ground or the surface of the sea, but distant; i.e., estimated to be more than 3 mi (5 km), from the station.

Encode as VCSH

ww -- Present Weather Code Specification In Order of Priority

14 - Precipitation within sight, not reaching the ground or the surface of the sea.

Sometimes precipitation may fall from a cloud, but into air that is dry enough to evaporate it before it can reach the ground. This is fairly common in desert areas, like some parts of the southwestern United States. This phenomena is called virga.

13 - Lightning visible, no thunder heard.

There are two reasons you may see lightning but not hear thunder. The first is that the lightning may be far enough away that the thunder doesn't reach the station. The other is that local sounds may muffle the thunder. Use code figure 13 to report distant lightning.

---

ww = 12-10. Use code figure 12 or 11 to report shallow fog. Continuous refers to covering more than half of the ground or sea; patchy refers to less than one-half coverage. The apparent visibility shall be less than 5/8 mi (1 km). Code figure 10 is used to report fog that is neither shallow nor has visibility less than 5/8 mi (1 km). (Code figures 49-40 are used to report fog that is not shallow but with visibility less than 5/8 mi (1 km).

---

12 - More or less continuous shallow fog or ice fog at the station, whether on land or sea; the fog or ice fog is not deeper than about 6 ft (2 km) on land or 30 ft (10 m) at sea.

Encode as MIFG.

11 - Patches of shallow fog or ice fog at the station, whether on land or sea; the fog or ice fog not deeper than about 6 ft (2 km) on land or 30 ft (10 m) at sea.

Encode as MIFG.

10 - Mist (10BR).

Code figure 10 refers only to water droplets and ice crystals. The visibility restriction shall be 5/8 mi (1 km) or more but less than 6 mi (10 km). Use code figure 10 whether the mist is patchy or more or less continuous.

Encode as BR.

---

ww = 09-04. Use code figure 09-04 to report lithometeors.

---

ww -- Present Weather Code Specification In Order of Priority

09 - Duststorm or sandstorm within sight at the time of observation, or at the station during the preceding hour.

Visibility in dust or sand must be (or have been) 6 mi (10 km) or less.

Encode as DS or SS.

08 - Well-developed dust whirl(s) (devils) or sand whirl(s) seen at or near the station during the preceding hour or at the time of observation, but no duststorm or sandstorm.

Encode as PO.

07 - Dust or sand raised by wind at or near the station at the time of observation, but no well-developed dust whirl(s) (devils) or sand whirl(s), and no duststorm or sandstorm seen; or in the case of ships, blowing spray at the station.

Use code figure 07 if there is dust in the air, the wind is strong enough to be lifting more dust or sand at the time of observation and the visibility at the time of observation is 6 mi (10 km) or less. Do not use code figure 07 if there is a well-developed dust whirl (devils) or a duststorm or a sandstorm.

Encode as BLSA or BLDU.

06 - Widespread dust is suspended in the air, not raised by wind at or near the station at the time of observation.

Use code figure 06 if there is dust in the air, but the wind at the time of observation is not strong enough to be lifting more dust into the air. This code figure may be used with any visibility, as long as there is dust in the air.

Encode as HZ.

05 - Haze.

Code figure 05 is not restricted to the definition applied for reports of haze in the basic observation, but can be used if it is simply hazy, regardless of the visibility.

Encode as HZ.

ww -- Present Weather Code Specification In Order of Priority

04 - Visibility reduced by smoke; e.g., veldt or forest fires, industrial smoke or volcanic ash.

If the smoke is coming from a great distance, it will be spread through a deep layer of the atmosphere. In this case use code figure 04 regardless of how much the visibility is restricted. If the smoke is coming from somewhere fairly close, then it will be pretty much layered in the lower atmosphere. In this case, the visibility has to be 6 mi (10 km) or less before code figure 04 is used. If smoke is the only weather or restriction to visibility in the basic U.S. observation, use code figure 04.

Encode as FU

---

ww = 03-00. Phenomena without significance.

---

03 - Clouds generally forming or developing.

Use code figure 03 only if there are clouds at the time of the observation, but no other weather and both of these conditions exist: (1) The clouds must have increased or become more developed during the past hour (examples of this would be low stratus clouds forming at night, clouds moving into the area in advance of a frontal system, or cumulus clouds growing taller during the day); and (2) there is also some significant past weather to report.

02 - State of sky on the whole unchanged. This is the characteristic of the sky during the past hour.

Use code figure 02 if the sky is clear at the time of observation and it was also clear during the past hour. Also use code figure 02 if there are clouds at the time of observation, but there had not been any significant change in the clouds during the past hour.

01 - Clouds generally dissolving or becoming less developed. This is the characteristic of the sky during the past hour.

Use code figure 01 if the sky is clear at the time of observation, but there were clouds during the past hour. Use code figure 01 if there were clouds at the time of observation, but the clouds had dissolved or become less developed during the past hour. Some examples of this are low stratus clouds breaking up in the morning or cumulus clouds beginning to flatten in the afternoon.

00 - Cloud development not observed or not observable. This is the characteristic of the sky during the past hour.

Use code figure 00 if clouds were not observed during the past hour, whether the sky is clear or not at the time of observation.

CODE TABLES

W_1W_2 -- Past Weather Code Specifications in Order of Priority

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

CODING OF C_L CLOUDS

Order of C_L Code Priority Figure	C_L Cloud Present
1st	**A. CUMULONIMBUS PRESENT, WITH OR WITHOUT OTHER C_L CLOUDS:**
9	1. The upper part of at least one of the CB clouds present is clearly fibrous or striated. By convention, code figure 9 is used for CBMAM and for those cases in which lightning, thunder, or hail indicates the presence of a CB but the top is hidden by other clouds.
3	2. The upper part of none of the CB clouds present is clearly fibrous, striated, or in the form of an anvil.
2nd	**B. NO CUMULONIMBUS PRESENT:**
4	1. SC formed by the spreading out of CU is present.
3rd 8	2. Code figure 4 is not applicable, and CU and SC (not formed by the spreading out of CU) with bases at different levels are present.
2	3. Code figures 4 and 8 are not applicable, and TCU or CU of moderate or strong vertical extent are present.
4th	**C. NO CUMULONIMBUS PRESENT AND C_L CODE FIGURES 4, 8 AND 2 ARE NOT APPLICABLE:**
1	1. Predominant type of low cloud is CU with little vertical extent and seemingly flattened, or ragged CU other than bad weather, or both.
5	2. Predominant type of low cloud is SC other than that formed by the spreading or flattening of CU.
6	3. Predominant type of low cloud is ST in a relatively continuous layer, or ragged shreds (other than of bad weather), or both.
7	4. Predominant type of low cloud is STFRA of bad weather or CUFRA of bad weather, or both (pannus); usually below AS or NS.

CODING OF C_M CLOUDS

Order of C_M Code Priority Figure	C_M Cloud Present
1st	**A. ALTOCUMULUS PRESENT (WITH OR WITHOUT AS OR NS):**
9	1. AC of a chaotic sky is present (generally at several levels), with or without AS or NS.
8	2. Code figure 9 is not applicable; and, AC with sproutings in the form of turrets or battlements or AC having the appearance of small cumuliform tufts is present, with or without AS or NS.
2nd	**B. ALTOCUMULUS PRESENT (WITH AS OR NS):**
7	1. Code figures 9 and 8 are not applicable; and AS, or NS is present together with AC.
3rd	**C. ALTOCUMULUS PRESENT (WITH OR WITHOUT AS OR NS):**
6	1. Preceding code figures are not applicable; and, AC present is formed by the spreading or flattening of CU or CB.
5	2. Preceding code figures are not applicable; and, AC present is progressively invading the sky.
4	3. Preceding code figures are not applicable; and, AC present is in the form of semitransparent patches (often almond-shaped, fish-shaped or lenticular), continuously changing in appearance and occurring at one or more levels.
7	4. Preceding code figures are not applicable; and, AC is present at two or more levels, not progressively invading the sky.
7	5. Preceding code figures are not applicable; and, predominantly opaque AC is present at one level, not progressively invading the sky.
3	6. Preceding code figures are not applicable; and, predominantly semitransparent or transparent AC is present at one level, not progressively invading the sky.
4th	**D. NO ALTOCUMULUS PRESENT:**
2	1. NS or predominantly opaque AS is present
1	2. No NS, and AS present is predominantly semitransparent or transparent

CODING OF C_H CLOUDS

Order of C_H Code Priority Figure	C_H Cloud Present
1st	**A. CIRROCUMULUS (ALONE OR PREDOMINANT):**
9	1. CC is present or alone, or CC amount is predominant when compared with combined sky cover of any CI and CS present.
2nd	**B. CIRROSTRATUS (WITH OR WITHOUT CI OR CC AND CODE FIGURE 9 IS NOT APPLICABLE):**
7	1. CS covers the entire sky (10/10 or 8/8 sky cover).
8	2. CS does not cover the whole sky and is not invading the celestial dome.
6	3. CS (or CS and CI) is progressively invading the sky and the continuous veil extends more than 45° above the local horizon but does not cover the whole sky.
5	4. CS (or CS and CI) is progressively invading the sky and the continuous veil does not extend more than 45° above the local horizon.
3rd	**C. CIRRUS (CODE FIGURE 9 NOT APPLICABLE AND NO CS PRESENT):**
4	1. CI (hooks, filaments or strands) progressively invading the sky and generally growing denser.
3	2. Code figure 4 is not applicable; and dense CI present (often in the form of an anvil originated from Cumulonimbus).
2	3. Code figures 4 and 3 are not applicable; and CI present is predominantly dense patches or with sproutings in the form of small tufts or battlements.
1	4. Code figures 4, 3 and 2 are not applicable; and CI present is predoimantly in the form of thin filaments, strands or hooks (not progressively invading the sky).

SECTION III - CHAPTER 4

3.4 CODING OF SECTION 2 DATA

3.4.1 Section 2 $222D_sv_s$ $0s_sT_wT_wT_w$ $2P_wP_wH_wH_w$ $3d_{w1}d_{w1}d_{w2}d_{w2}$ $4P_{w1}P_{w1}H_{w1}H_{w1}$ $5P_{w2}P_{w2}H_{w2}H_{w2}$ $6I_sE_sE_sE_s$ $8C_sC_sC_sC_s$ ICE + Plain Language or ICE $c_1i_1b_1D_1z_1$

3.4.1.1 $222D_sv_s$. This group identifies the direction and speed of the ship.

a. 222 - Identifies the beginning of section 2 of the code.

b. D_s - Enter the code figure representing the direction of the movement of the ship during the three hours preceding the time of observation (see Table III-4-1).

c. v_s - Enter the code figure indicating the average speed made good during the three hours preceding the time of observation (see Table III-4-2).

3.4.1.2 $0s_sT_wT_wT_w$. This group indicates the sea water temperature in degrees Celsius.

a. 0 - Identifies the sea water temperature group in section 2 of the code. If the temperature cannot be observed, the entire group is deleted from the observation and group 0 will not appear in section 2.

b. s_s - Enter the code figure indicating the sign and type of sea water temperature (see Table III-4-3).

c. $T_wT_wT_w$ - Enter the sea water temperature in tens, units, and tenths degrees Celsius.

3.4.1.3 $2P_wP_wH_wH_w$. This group indicates the wind wave data determined from visual observation.

a. 2 - Identifies the wind wave group in section 2 of the code.

b. P_wP_w - Enter the average period of the significant wind waves in seconds. Enter a period of three seconds as 03, enter a period of twelve seconds as 12. Enter 00 for calm. Enter 99 if period is confused.

c. H_wH_w - Enter the code figure indicating the height of the wind waves (see Table III-4-4).

3.4.1.4 $3d_{w1}d_{w1}d_{w2}d_{w2}$. This group indicates the directions of the primary and secondary swell waves.

a. 3 - Identifies the swell wave direction group in section 2 of the code. If element is not observed, encode as 30000.

b. $d_{w1}d_{w1}$ - Enter hundreds and tens of degrees of the direction from which the primary swell is coming from.

c. $d_{w2}d_{w2}$ - Enter hundreds and tens of degrees of the direction from which the secondary swell is coming from. If there is only one swell present, enter " 00 " for $d_{w2}d_{w2}$.

3.4.1.5 **$4P_{w1}P_{w1}H_{w1}H_{w1}$**. This group indicates the primary swell wave data.

a. 4 - Identifies the primary swell wave group in section 2 of the code when no swell is present. If the element is not observed, encode as 40000.

b. $P_{w1}P_{w1}$ - Enter the average period of the primary swell waves in seconds. Enter a period of three seconds as 03, enter a period of twelve seconds as 12, etc..

c. $H_{w1}H_{w1}$ - Enter the code figure indicating the height of the primary swell waves (see Table III-4-4).

3.4.1.6 **$5P_{w2}P_{w2}H_{w2}H_{w2}$**. This group indicates the secondary swell wave group in section 2 of the code. If the element is not observed, encode as 50000.

a. $P_{w2}P_{w2}$ - Enter the average period of the primary swell waves in seconds. Enter a period of three seconds as 03, enter a period of twelve seconds as 12, etc.

b. $H_{w2}H_{w2}$ - Enter the code figure indicating the height of the primary swell waves (see Table III-4-4).

3.4.1.7 **$6I_sE_sE_sR_s$**. This group identifies the state of ice accretion on the ship at the time of observation. Omit the entire group from the report if ice is not observed.

a. 6 - Identifies the ice accretion group in section 2 of the code.

b. I_s - Enter the code figure identifying the source of the ice accretion (see Table III-4-5).

c. E_sE_s - Enter the average thickness of the ice in centimeters (see Table III-4-6).

d. R_s - Enter the code figure identifying the rate of buildup of the ice accretion (see Table III-4-7).

3.4.1.8 **$8S_wT_bT_bT_b$**. This group identifies the wet-bulb temperature in degrees Celsius.

a. 8 - Identifies the wet bulb temperature group in section 2 of the code.

b. S_w - Enter the sign and type of wet-bulb temperature (see Table III-4-8).

c. $T_bT_bT_b$ - Enter the wet-bulb temperature in tens, units, and tenths degree Celsius.

3.4.1.9 **ICE + Plain Language or ICE $c_is_ib_iD_iz_i$**. This group identifies the presence and state of sea ice and ice of land origin.

a. ICE - Indicates that the sea ice group is present in section 2 of the code. When no sea ice or ice of land origin is observed, this group will be omitted from the code.

b. c_i - Enter the code figure that best describes the concentration and arrangement of the sea ice at the time of observation (see Table III-4-9).

c. S_i - Enter the code figure that best describes the stage of development of the sea ice at the time of observation (see Table III-4-10).

d. b_i - Enter the code figure that best describes the ice of land origin present at the time of observation (see Table III-4-11).

e. D_i - Enter the code figure that best describes the orientation of the principle edge of the sea ice at the time of observation (see Table III-4-12).

f. z_i - Enter the code figure that best describes the effect of the sea ice on the ship over the past three hours (see Table III-4-13).

g. Plain Language - Remarks considered significant by the observer.

CODE TABLES

D_s -- True Direction of Resultant Ship's Displacement (Course Made Good) during the past three hours

Code figure		Code figure	
0	Stationary	5	SW
1	NE	6	W
2	E	7	NW
3	SE	8	N
4	S	9	Unknown

v_s -- Ship's average speed made good during the three hours preceding the time of observation

Code figure	Knots	Code figure	Knots
0	0	5	21 - 25
1	1 - 5	6	26 - 30
2	6 - 10	7	31 - 35
3	11 - 15	8	36 - 40
4	16 - 20	9	over 40 knots

CODE TABLES

s_s -- Sign and Type of Sea Surface Temperature

Code figure	
0	positive or zero intake measurement
1	negative intake measurement
2	positive or zero bucket measurement
3	negative bucket measurement
4	positive or zero hull contact sensor
5	negative hull contact sensor
6	positive or zero neither intake, bucket, or hull
7	negative neither intake, bucket, or hull

CODE TABLES

H_wH_w, $H_{w1}H_{w1}$, $H_{w2}H_{w2}$ **Wave Height in Half-meters**

Code figure	Height in feet	Code figure	Height in feet
00	calm	16	25 or 26
01	1 or 2	17	27 or 28
02	3 or 4	18	29
03	5	19	30 or 31
04	6 or 7	20	32
05	8	21	33 or 34
06	9 or 10	22	35 or 36
07	11 or 12	23	37
08	13	24	38 or 39
09	14 or 15	25	40
10	16	26	41 or 42
11	17 or 18	27	43 or 44
12	19 or 20	28	45
13	21	29	46 or 47
14	22 or 23	30	48
15	24	31	49 or 50

I_s -- Ice accretion on ships

Code figure	
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

The next two symbolic letters E_sE_s, indicate the thickness of the ice that has built up, **expressed in centimeters** (using a leading zero if less than 10 centimeters). For those who measure in inches, each inch is equivalent to 2.54 centimeters. See Table III-4-6.

CODE TABLES

E_sE_s -- Thickness of Ice Accretion in Centimeters and Inches

Code figure (cm)	Inches	Code figure (cm)	Inches
00	Less than 1/4	15	5 3/4 or 6
01	1/4 or 1/2	16	6 1/4
02	3/4	17	6 1/2 or 6 3/4
03	1 or 1 1/4	18	7 or 7 1/4
04	1 1/2 or 1 3/4	19	7 1/2
05	2	20	7 3/4 or 8
06	2 1/4 or 2 1/2	21	8 1/4
07	2 3/4	22	8 1/2 or 8 3/4
08	3 or 3 1/4	23	9 or 9 1/4
09	3 1/2	24	9 1/2
10	3 3/4 or 4	25	9 3/4 or 10
11	4 1/4 or 4 1/2	26	10 1/4
12	4 3/4	27	10 1/2 or 10 3/4
13	5 or 5 1/4	28	11
14	5 1/2	29	11 1/4 or 11 1/2

The subjective evaluation of the observer concerning the relative rate of accretion, R_s, is coded in accordance with Table III-4-7.

R_s -- Rate of ice accretion on ships

Code figure	
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

CODE TABLES

S_W -- Sign and Type of Wet-Bulb Temperature

Code figure	
0	positive or zero measured
1	negative measured
2	iced bulb measured
3-4	not used
5	positive or zero computed
6	negative computed
7	iced bulb computed

CODE TABLES

C_i -- Concentration or Arrangement of Sea Ice in Priority Order

Code figure	
	NOTE: When reporting code figures 9 through 6: • The ship is in ice or within 0.5 NM of an ice edge, and • The sea ice is not uniform in the observation area
9	Fast ice with close or very close pack ice to seaward of the ice boundary
8	Fast ice with open water, very open or open pack ice to seaward of the ice
7	Strips and patches of close or very close pack ice with areas of lesser concentration between
6	Strips and patches of pack ice with open water between
	NOTE: When reporting code figures 5 through 2: • The ship is in ice or within 0.5 NM of an ice edge, and • The sea ice is uniform in the ice area
5	9/10 or more, but not 10/10 (7/8 to less than 8/8), very close pack ice
4	7/10 to 8/10 (6/8 to less than 7/8), close pack ice
3	4/10 to 6/10 (3/8 to less than 6/8), open pack ice
2	Sea ice present in concentrations less than 3/10 (3/8), open water or very open pack ice
	NOTE: Remaining codes follow:
1	Ship in open lead more than 1.0 NM, (also code D_i = 0) or, Ship in fast ice with boundary beyond limit of visibility (also code D_i = 9)
0	No sea ice in sight
/	Unable to report, because of darkness, lack of visibility, or because ship is more than 0.5 NM from ice edge

CODE TABLES

S_i -- Stage of development of Sea Ice in Priority Order

Code figure	
9	Predominantly old ice
8	Predominantly medium and thick first-year ice with some old ice (usually more than 2 meters thick)
7	All medium and thick first year ice
6	Predominantly medium first-year ice (70 to 120cm thick) and thick first year ice (greater than 120cm thick) with some thinner (young) first year ice
5	All thin first-year ice (30 to 70cm thick)
4	Predominantly thin first-year ice with some new and/or young ice
3	Predominantly new and/or young ice with some first-year ice
2	young ice (grey ice, grey-white ice), 10 to 30cm thick
1	Nilas or ice rind, less than 10cm thick
0	New ice only (frazil ice, grease ice, slush, shuga)
/	Unable to report, because of darkness, low visibility, only ice of land origin is visible, or because ship is more than 0.5 nautical miles away from ice edge

b_i -- Ice of land origin in Priority Order

Code figure	
9	More than 20 icebergs with growlers and bergy bits, a major hazard to navigation
8	11-20 icebergs with growlers and bergy bits
7	6-10 icebergs with growlers and bergy bits
6	1-5 icebergs with growlers and bergy bits
5	More than 10 growlers and bergy bits, no icebergs
4	Up to and including 10 growlers and bergy bits, no icebergs
3	11-20 icebergs, no growlers or bergy bits
2	6-10 icebergs, no growlers or bergy bits
1	1-5 icebergs, no growlers or bergy bits
0	No ice of land origin
/	Unable to report, because of darkness, low visibility, or because only sea ice is visible

CODE TABLES

D_i -- True Bearing of Principal Ice Edge

Code figure	
0	Ship in shore or flaw lead
1	Principal ice edge towards NE
2	Principal ice edge towards E
3	Principal ice edge towards SE
4	Principal ice edge towards S
5	Principal ice edge towards SW
6	Principal ice edge towards W
7	Principal ice edge towards NW
8	Principal ice edge towards N
9	Not determined (ship in ice)
/	Unable to report, because of darkness, lack of visibility, or because only ice of land origin is visible

z_i -- Present Ice Situation and Trend of Conditions over Preceding 3 hours in Priority Order

Code figure	
	Code figures 9 through 6 are used when the ship is in ice that is difficult to penetrate and the conditions are worsening.
9	Ship beset
8	Ice under moderate or severe pressure
7	Ice under slight pressure
6	Ice forming and floes freezing together
	Code figures 5 through 1 are used for all other situations when the ship is in ice.
5	Ship in ice difficult to penetrate, conditions not changing
4	Ship in ice difficult to penetrate, conditions improving
3	Ship in easily penetrable ice, conditions worsening
2	Ship in easily penetrable ice, conditions not changing
1	Ship in easily penetrable ice, conditions improving
0	Ship in open water with floating ice in sight
/	Unable to report because of darkness or lack of visibility

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APPENDIX A

INDEX FOR DATA GROUPS IN THE SHIP SYNOPTIC CODE

A.1 DATE AND TIME/WIND INFO GROUP ($YYGGi_w$)

a.	page III-2-1, para 3.2.1.2a	requirement for entry/proper entry procedure
b.	page III-2-1, para 3.2.1.2c	requirement for entry/proper entry procedure for (i_w)

A.2 LATITUDE GROUP ($99L_aL_aL_a$)

	page III-2-1, para 3.2.1.3b	requirement for entry/proper entry procedure

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A.3 QUADRANT/LONGITUDE GROUP ($Q_cL_oL_oL_oL_o$)

a.	page III-2-1, para 3.2.1.4	requirement for entry
b.	page III-2-1, para 3.2.1.4a	proper entry procedure for (Q_c)
c.	page III-2-2, Table III-2-1	proper entry procedure for (Q_c)
d.	page III-2-1, para 3.2.1.4b	proper entry procedure for ($L_oL_oL_oL_o$)

A.4 GENERAL METEOROLOGICAL INFO GROUP (i_ri_xhVV)

a.	page III-3-1, para 3.3.1.1a	requirement for entry
b.	page III-3-1, para 3.3.1.1b	proper entry procedure for (i_x)
c.	page III-3-5, Table III-3-1	proper entry procedure for (i_r)
d.	page III-3-1, para 3.3.1.1c	proper entry procedure for (h)
e.	page III-3-5, Table III-3-2	proper entry procedure for (h)
f.	page III-3-1, para 3.3.1.1d	proper entry procedure for (VV)

	g.	page III-3-5, Table III-3-3	proper entry procedure for (VV)

A.5 SKY COVER AND WIND DATA GROUPS (Nddff (00fff))

	a.	page III-3-1, para 3.3.1.2 a,b,c	requirement for entry
	b.	page III-3-1, para 3.3.1.2a	proper entry procedure for (N)
	c.	page III-3-6, Table III-3-4	proper entry procedure for (N)
	d.	page III-3-1, para 3.3.1.2b	proper entry procedure for (dd)
	e.	page III-3-1, para 3.3.1.2c	proper entry procedure for (ff)
	f.	page III-3-2, para 3.3.1.2.1	proper entry procedure for (fff)

A.6 AIR TEMPERATURE GROUP (1s_nTTT)

	a.	page III-3-2, para 3.3.1.3a	requirement for entry
	b.	page III-3-2, para 3.3.1.3b	proper entry procedure for (s_n)
	c.	page III-3-2, para 3.3.1.3c	proper entry procedure for (TTT)

A.7 DEW POINT TEMPERATURE GROUP (2$s_n$$T_dT_dT_d$)

	a.	page III-3-2, para 3.3.1.4a	requirement for entry
	b.	page III-3-2, para 3.3.1.4b	proper entry procedure for (s_n)
	c.	page III-3-2, para 3.3.1.4c	proper entry procedure for ($T_dT_dT_d$)

A.8 SEA LEVEL PRESSURE GROUP (4PPPP)

	a.	page III-3-2, para 3.3.1.5a	requirement for entry
	b.	page III-3-3, para 3.3.1.5b	proper entry procedure

A.9 **PRESSURE CHANGE GROUP** (5appp)

page III-3-3, para 3.3.1.6a,b proper entry procedures

A.10 **PRESENT/PAST WEATHER GROUP** (7wwW$_1$W$_2$)

a. page III-3-3, para 3.3.1.7a requirement for entry

b. page III-3-3, para 3.3.1.7b proper entry procedure for (ww)

c. page III-3-7, Table III-3-6 proper entry procedure for (ww)

d. page III-3-3, para 3.3.1.7c proper entry procedure for (W$_1$W$_2$)

e. page III-3-23, Table III-3-7 proper entry procedure for (W$_1$W$_2$)

A.11 **CLOUD GROUP** (8N$_h$C$_L$C$_M$C$_H$)

a. page III-3-4, para 3.3.1.8a requirement for entry

b. page III-3-4, para 3.3.1.8b proper entry procedure for (N$_h$)

c. page III-3-24, Table III-3-8 proper entry procedure for (N$_h$)

d. page III-3-4, para 3.3.1.8c proper entry procedure/no low cloud

e. page III-3-4, para 3.3.1.8d proper entry procedure/no mid cloud

f. page III-3-4, para 3.3.1.8e proper entry procedure/no high cloud

A.12 **ACTUAL TIME OF OBSERVATION GROUP** (9GGgg)

a. page III-3-4, para 3.3.1.9a requirement for entry

b. page III-3-4, para 3.3.1.9b proper entry procedure for (GG)

c. page III-3-4, para 3.3.1.9c proper entry procedure for (gg)

A.13 **DIRECTION AND SPEED OF SHIP GROUP** ($222D_sV_s$)

a.	page III-4-1, para 3.4.1.1	requirement for entry
b.	page III-4-1, para 3.4.1.1b	proper entry procedure for (D_s)
c.	page III-4-4, Table III-4-1	proper entry procedure for (D_s)
d.	page III-4-1, para 3.4.1.1c	proper entry procedure for (V_s)
e.	page III-4-4, Table III-4-2	proper entry procedure for (V_s)

A.14 **SEA WATER TEMPERATURE GROUP** ($0s_sT_wT_wT_w$)

a.	page III-4-1, para 3.4.1.2a	requirement for entry
b.	page III-4-1, para 3.4.1.2b	proper entry procedure for (s_s)
c.	page III-4-4, Table III-4-3	proper entry procedure for (s_s)
d.	page III-4-1, para 3.4.1.2c	proper entry procedure for ($T_wT_wT_w$)

A.15 **WIND WAVE DATA GROUP** ($2P_wP_wH_wH_w$)

a.	page III-4-1, para 3.4.1.3	requirement for entry
b.	page III-4-1, para 3.4.1.3b	proper entry procedure for (P_wP_w)
c.	page III-4-1, para 3.4.1.3c	proper entry procedure for (H_wH_w)
d.	page III-4-5, Table III-4-4	proper entry procedure for (H_wH_w)
e.	page II-9-4, para 2.9.4 x	height does not agree with Column E

A.16 DIRECTION OF PRIMARY/SECONDARY SWELL WAVE GROUP ($3d_{w1}d_{w1}d_{w2}d_{w2}$)

a.	page III-4-1, para 3.4.1.4	requirement for entry
b.	page III-4-2, para 3.4.1.4b	proper entry procedure for ($d_{w1}d_{w1}$)
c.	page III-4-2, para 3.4.1.4c	proper entry procedure for ($d_{w2}d_{w2}$) and no ($d_{w2}d_{w2}$)

A.17 PRIMARY SWELL WAVE DATA GROUP ($4P_{w1}P_{w1}H_{w1}H_{w1}$)

a.	page III-4-2, para 3.4.1.5	requirement for entry
b.	page III-4-2, para 3.4.1.5b	proper entry procedure for ($P_{w1}P_{w1}$)
c.	page III-4-2, para 3.4.1.5c	proper entry procedure for ($H_{w1}H_{w1}$)
d.	page III-4-5, Table III-4-4	proper entry procedure for ($H_{w1}H_{w1}$)
e.	page II-9-4, para 2.9.5	height does not agree with Column F

A.18 SECONDARY SWELL WAVE DATA GROUP ($5P_{w2}P_{w2}H_{w2}H_{w2}$)

a.	page III-4-2, para 3.4.1.6	requirement for entry
b.	page III-4-2, para 3.4.1.6a	proper entry procedure for ($P_{w2}P_{w2}$)
c.	page III-4-2, para 3.4.1.6b	proper entry procedure for ($H_{w2}H_{w2}$)

A.19 ICE ACCRETION GROUP ($6I_sE_sE_sR_s$)

a.	page III-4-2, para 3.4.1.7	requirement for entry
b.	page III-4-2, para 3.4.1.7b	proper entry procedure for (I_s)
c.	page III-4-5, Table III-4-5	proper entry procedure for (I_s)
d.	page III-4-2, para 3.4.1.7c	proper entry procedure for (E_sE_s)

e.	page III-4-6, Table III-4-6	proper entry procedures for (E_sE_s)
f.	page III-4-2, para 3.4.1.7d	proper entry procedure for (R_s)
g.	page III-4-6, Table III-4-7	proper entry procedure for (R_s)

A.20 **WET-BULB TEMPERATURE GROUP** ($8S_wT_bT_bT_b$)

a.	page III-4-2, para 3.4.1.8	requirement for entry
b.	page III-4-3, para 3.4.1.8b	proper entry procedure for (S_w)
c.	page III-4-6, Table III-4-8	proper entry procedure for (S_w)
d.	page III-4-3, para 3.4.1.8c	proper entry procedure for ($T_bT_bT_b$)

A.21 **ICE GROUP** (ICE $c_iS_ib_iD_iz_i$)

a.	page III-4-3, para 3.4.1.9a	requirement for entry
b.	page III-4-3, para 3.4.1.9 b,c,d,e,f,g	proper entry procedures for ICE group
c.	page III-4-8, Tables III-4-11, III-4-12, III-4-13	proper entry procedures for ICE group

Appendix B

INDEX FOR DATA COLUMNS IN PART I CNMOC 3141/3 SURFACE WEATHER OBSERVATIONS FORM

B.1 **TYPE OF OBSERVATION** (Column 1)

b.	page II-1-1, paragraphs 2.1.3.1, 2.1.3.2	proper entry procedures
a.	page II-2-1, paragraph 2.2.1	requirement for entry

B.2 **DATE AND TIME OF OBSERVATION** (Column 2)

a.	page II-1-2, paragraph 2.1.4.1	proper entry of time
b.	page II-2-1, paragraph 2.2.2	requirement for entry
c.	page II-2-1, paragraph 2.2.2a (ME)	proper entry procedures
d.	page II-2-1, paragraph 2.2.2b (SP)	proper entry procedures

B.3 **WIND DIRECTION, SPEED, GUSTS, & VARIABILITY** (Columns 3, 4, 5, 6)

a.	page II-8-6, paragraph 2.8.5,a,b (Col 3 direction)	requirement for entry/ proper entry procedures
b.	page II-8-6, paragraph 2.8.6 (Col 4 speed)	requirement for entry/ proper entry procedures
c.	page II-8-6, paragraph 2.8.7(AG) (Col 5 character)	requirement for entry of gust
d.	page II-8-6, paragraph 2.8.8 (Col 6 variability)	requirement for entry/ proper entry procedures

B.4 **VISIBILITY** (Column 7)

a. page II-4-1, paragraph 2.4.1.3a,b	proper entry procedures
b. page II-4-4, paragraph 2.4.4a,b,c	proper entry procedures

B.5 **PRESENT WEATHER** (Column 9)

a. page II-5-1, paragraph 2.5.2 proper entry procedures	requirement for entry/
b. page II-5-3, paragraph 2.5.2.3	precipitation
c. page II-5-5, paragraph 2.5.2.4	obstructions to vision
d. page II-5-9, paragraph 2.5.3	present weather entries
e. page II-5-11, Table II-5-1	present weather groups
f. page II-5-18, Tables	precipitation intensity

B.6 **SKY CONDITION** (Column 10)

a. page II-3-2, paragraph 2.3.5.1	sky cover amounts
b. page II-3-4, paragraph 2.3.5.3	sky cover classifications
c. page II-3-7, paragraph 2.3.7	sky cover and ceilings
d. page II-3-8, paragraph 2.3.7.2	layer heights
e. page II-3-17, Table II-3-8	sky cover contractions

B.7 **TEMPERATURE, DEW POINT, AND WET-BULB** (Columns 11, 12, 20)

page II-7-7, paragraph 2.7.6, 2.7.7, 2.7.8	requirements for entry

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B.8 **REMARKS AND SUPPLEMENTAL CODED DATA** (Column 14)

a. page II-5-9, paragraph 2.5.4,a,b,c	requirement for entry/ proper entry procedures
b. page II-5-13, Table II-5-2	significant remarks

B.9 **PRESSURE, ALTIMETER, STATION, SEA LEVEL** (Columns 13, 22, 22a)

a. page II-6-6, paragraph 2.6.6 Altimeter (Col 13)	requirement for entry/ proper entry procedure
b. page II-6-6, paragraph 2.6.7 Station Pressure (Col 22)	requirement for entry/ proper entry procedure
c. page II-6-6, paragraph 2.6.5 Sea Level Pressure (Col 22a)	requirement for entry/ proper entry procedure

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B.10 **OBSERVERS INITIALS** (Column 15)

page II-10-1, paragraph 2.10.5	requirement for entry

B.11 **SKY COVER TOTAL** (Column 17)

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B.12 **SHIP'S POSITION** (Column A)

a. page II-10-1, paragraph 2.10.2	requirement for entry/ proper entry procedures
b. page II-10-1, paragraph 2.10.2, a,b,c	requirement for entry/ proper entry procedures
c. page III-2-2, Table III-2-1	Quadrants of Globe

B.13 **SHIP'S COURSE** (Column B)

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B.14 **SHIP'S SPEED** (Column C)

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B.15 **SEA WATER TEMPERATURE** (Column D)

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B.16 **SEA (WIND) WAVES, PERIOD, AND HEIGHT** (Column E)

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B.17 **SWELL WAVES** (Columns F, G)

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b. page II-9-2, paragraph 2.9.2c(1)	swell direction
c. page II-9-2, paragraph 2.9.2c(2)	swell period
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B.18 **REMARKS, NOTES** (Column 72)

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