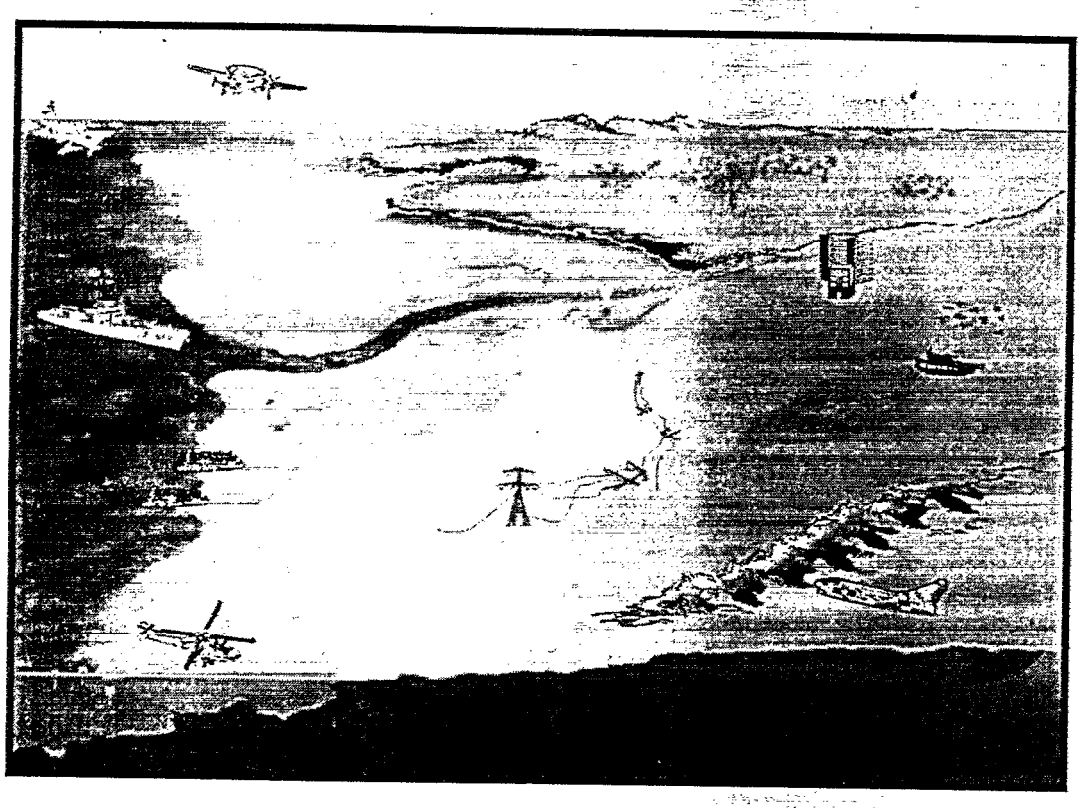
Commander
Naval Meteorology and Oceanography Command
Stennis Space Center, Mississippi 39529-5005

NAVMETOCCOMINST 3141.2 February 1996

SURFACE METAR OBSERVATIONS



USER'S MANUAL

This publication is required for observation and dissemination of Aviation Routine Weather Report (METAR) and 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.

Prepared by:
Fleet Numerical Meteorology and Oceanography
Detachment, Asheville.

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

NAVMETOCCOMINST 3141.2
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22 FEB 1996

NAVMETOCCOM INSTRUCTION 3141.2

From: Commander, Naval Meteorology and Oceanography Command

Subj: SURFACE METEOROLOGICAL OBSERVATION PROCEDURES

Ref: (a) NAVOCEANCOMINST 3140.1J

Encl: (1) USN/USMC Surface Meteorological Observation Procedure Handbook

1. Purpose. The purpose of enclosure (1) is to provide USN and USMC weather activities with basic instructions for observing, recording, and encoding Aviation Routine Weather Report (METAR) and Aviation Selected Special Weather Report (SPECI) surface weather observations.

2. Cancellation. NAVAIR 50-1D-1 (FMH-1B).

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. USN and USMC weather activities' observations of meteorological conditions are vital for inputs to numerical models and for safety of flight.

4. Action. All USN and USMC weather activities shall conduct a surface weather observation program as directed by reference (a) and in accordance with guidelines contained in this instruction. Observation and recording procedures for METAR/SPECI are changed from previously used AIRWAYS procedures. Minor differences between observation and recording procedures for activities

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outside the continental United States (OCONUS) and activities inside the continental United States (CONUS) are described 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, NC 28801-5014. Message address: FLENUMMETOC DET ASHEVILLE NC//00// or, by phone (704) 252-7865; fax (704) 271-4672.

5. Effective date. This instruction becomes effective 01 January 1996 for activities outside the continental United States (OCONUS) and 01 June 1996 for activities inside the continental United States (CONUS).

6. Concurrence. This instruction has the concurrence of the Commandant of the Marine Corps. Marine Corps activities shall take those actions prescribed in this instruction which are not contradictory to specifically expressed policies of the Commandant of the Marine Corps.

PAUL G. GAFFNEY, II

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RECORD OF CHANGES

CORRECTION OR CHANGE NO	DATE OF CHANGE	DATE ENTERED	BY WHOM ENTERED

CHAPTER 1 - INTRODUCTION

1.1 **Purpose**. Department of the Navy Naval Meteorology and Oceanography Command Surface Meteorological Observation Procedures (SMOP), Part I, Manual Observations, prescribes surface weather observing standards and procedures applicable to Navy and Marine Corps activities engaged in observing and coding surface weather reports. It is intended to provide a framework within which you can identify meteorological phenomena and report their occurrence in a standardized and understandable format.

1.2 **Observational Procedures**. Procedures in Part I assume that Aviation Routine Weather Reports (METAR) are made hourly and that Aviation Selected Special Weather Reports (SPECI) are made whenever significant changes meeting special criteria are observed. Weather reports recorded on CNMOC 3140/12 (Rev 1/96) will reflect only those meteorological conditions as reported from the observing location and, unless otherwise specified, must have occurred within 15 minutes prior to the times recorded.

1.3 **Designated Stations**. The phrase "designated stations" refers to weather observing stations directed by higher authority, i.e., Commander, Naval Meteorology and Oceanography Command (COMNAVMETOCCOM), Commandant, Headquarters, U. S. Marine Corps (ASL-44), to perform a specified task that is not required by standards to be performed at all stations. A station is considered as a "**designated station**" when the capability exists to evaluate the element in question.

1.4 **Applicability of Standards**. Procedures and practices described in this handbook are applicable only if a station has the capability to comply with the stated procedure. Throughout this Handbook, the following definitions apply:

a. "shall" indicates a procedure or practice is mandatory

b. "should" indicates a procedure or practice is recommended

c. "may" indicates a procedure or practice is optional

d. "will" indicates futurity; it is not a requirement to be applied to practices

1.5 Changes to Part I, Manual Observations

Changes, additions, deletions, and corrections will be issued as necessary under the titles Change No. 1, 2, 3, etc. These changes are under the cognizance of the Commander, Naval Meteorology and Oceanography Command.

1.6 Format of Part I, Manual Observations

Chapter 1 - Introduction to manual reports

Chapter 2 - General Procedures

Chapter 3 - Sky Condition

Chapter 4 - Visibility and Runway Visual Range (RVR)

Chapter 5 - Present Weather

Chapter 6 - Pressure

Chapter 7 - Temperature and Dew Point

Chapter 8 - Wind

Chapter 9 - Coding and dissemination of the METAR/SPECI report (body and remarks)

Chapter 10 - Entries on meteorological and climatological forms

Appendix A - Runway Condition Reporting

Appendix B - List of various tables and exhibits from Chapters 1 through 10

Appendix C - List of abbreviations and acronyms used in Part I

1.7 **Maintaining Part I, Manual Observations**. This manual shall be maintained in good order with all changes appropriately entered with the number, effective date, initials, and date entered on page iii of Part I. Each site is encouraged to duplicate and post, in a convenient area, those frequently utilized and referenced pages.

1.8 **Unforeseen Requirements**. No set of instructions can cover all possibilities in weather reporting. Observers must use their own judgement to describe phenomena not adequately covered by specific instructions while adhering as closely as possible to Part I of this Manual. Whenever possible, METAR contractions (WMO) shall be used.

1.9 **Certification of Observers**. Prior to assuming full responsibility for taking official weather reports, observers shall be certified in accordance with NAVMETOCCOMINST 1500.2H.

1.10 **Observer Responsibility**. Observers are expected to be alert to meteorological situations conducive to significant changes in weather conditions and to make and disseminate weather reports as rapidly as feasible whenever changes are noted that meet the criteria for SPECI's.

1.11 **Instrument Evaluations**. When there is reason to believe that the accuracy or validity of indications from meteorological equipment is questionable, discontinue the use of such equipment until necessary corrective maintenance has been accomplished if required.

1.12 **Documentation of Stations Programs and Facilities**. Each station is responsible for maintaining accurate station information files. The procedures and responsibilities for documentation of equipment, instrumentation, and observing programs are found in the Station Information File Users Guide.

1.13 **OCONUS**. Activities outside of the continental United States (OCONUS) have requirements which differ from CONUS. These differences are highlighted and labeled as follows;

OCONUS:

1.14 **RECOMMENDATIONS**: The manual identifies significant changes from previous observation practices. All recommendations for improvement, whether textual, examples displays or format are welcome. Submit all recommendations for change to the Commander, Naval Meteorology and Oceanography Command (Code N312).

DIFFERENCES BETWEEN METAR AND SAO (MANUAL ONLY)

There are significant changes in the observation practices of METAR. ***Some*** of the most significant are highlighted below:

U.S.METAR — **SAO**

Body of the Report

Type of Report
METAR . . . . . SA, RS
SPECI . . . . . SP, USP

Station Identifier
ICAO station identifier; four alphabetic code, e.g., KNIP . . . . . three digit alphanumeric code, e.g., NIP

Date/Time
Day of month, time, followed by Z to indicate ZULU or UTC, e.g., 251456Z . . . . . time only, e.g., 1456

Wind
Direction: 10's of degrees (true) using three digits, e.g., 360, 060 . . . . 10's of degrees using two digits, e.g., 36, 06
Direction may be reported variable if speed ≤ 6 knots, e.g., VRB05KT . . . . . Remark, e.g., WND LGT VRBL
Estimated Winds: "E" not used to indicate estimated winds, e.g., 060 . . . . . .prefix wind direction with "E",e.g., E06
Speed: knots using two or three digits, e.g., 36008, 060102 . . . . . no change, e.g., 3608, 06102
Squalls: not reported in wind group, reported in present weather group as SQ 3617Q28
Group end with KT to indicate knots, e.g., 36015G22KT . . . . . no indicator
Variable Wind: reported in body as separate group, e.g., 360V060 . . . . . Remark, e.g., WND 36V06

Visibility
A space separates whole numbers and fractions, e.g., 1_1/2 . . . . . no space, e.g., 11/2
Group ends with SM to indicate statute miles, e.g., 1_1/2SM . . . . . no indicator
OCONUS: reports meters, no indicator required, e.g., 9000

Exhibit 1-1: METAR/SPECI (Differences Between METAR and SAO)

U.S.METAR	SAO
Runway Visual Range	
Body of report	Remark
Group ends with FT to indicate feet, e.g., R06L/3000FT	no indicator
RVR value prefixed with M or P to indicate value is lower or higher than the RVR reportable value, e.g., R11/M1000FT, R06L/P6000FT	R11VR10-, R06LVR60+
VR (visual range): not included, a solidus (/) is used, e.g., R06L/2000V4000FT	R06LVR20V40
Values include the tens and units digits, e.g., R01R/3000FT	R01RVR30
OCONUS: reports meters, no indicator required, e.g., R01R/0400	
Present Weather	
Vicinity of the station: reported in the body	Remarks
Weather reported in order of decreasing predominance	liquid, freezing, frozen, obstructions to vision
Thunderstorm is a descriptor of other weather reported	considered as weather
Maximum of three groups of weather phenomena	one group for all weather
Precipitation phenomena reported in the same group	one group for all weather
Separate groups for each type of phenomena except precipitation	one group for all weather
Tornado and Waterspout reported using +FC, Funnel Cloud reported using FC	Spelled out
Thunderstorm (TS):no severe indicator	Severe (T+)
Weather Phenomena	
Freezing Fog (FZFG); temp below zero degrees Celsius	Ice Fog (IF)
Volcanic Ash (VA)	VOLCANIC ASH
Proximity Qualifier; VC (in the vicinity) can only be used with and reported as VCTS, VCFG, VCBLSN, VCBLSA, VCBLDU, VCPO, VCFC, VCSS, VCDS, VCSH	Remarks
Descriptor Qualifier; Showers (SH) can be used with and reported as SHRA, SHSN, SHPE, SHGR, SHGS	RW, SW, IPW, hail not reported as showers
Descriptor Qualifier; Shallow (MI), Partial (PR), Patches (BC) used only with Fog (FG)	Fog (F), Ground Fog (GF), etc., and Remarks
Sky Condition	
Maximum of six layers	no limitation on number of layers
Oktas; 8/8	Tenths; 10/10
Amount: FEW (1-2), SCT (3-4), BKN (5-7), OVC (8)	SCT (1-5), BKN (6-9), OVC (10)
Clear skies; SKC	CLR
Total Obscuration; Vertical Visibility VV followed by height, e.g., VV002	W2_X
Surface-based obscuration: FEW000, SCT000, BKN000 and remark describing the weather causing the obscuration, e.g., FG SCT000	-X and remark, e.g., F3 or F4
OCONUS: surface-based obscuration; Body of the Report: FG///, HZ///, FU///. No remark necessary	-X and remark, e.g., F3 or F4
No ceiling designator: first BKN or OVC layer aloft is ceiling	W (indefinite), E (estimated) or M (measured)
All clouds (layers) considered opaque	thin considered
Layer heights reported using three digits, e.g., 100, 010, 001	100, 10, 1
Layer amount precedes height (no space), e.g., SCT015	height and space precede amount, e.g., 15_SCT
Significant cloud reporting: CB and TCU are reported in the Body, e.g., SCT015CB	Remark

Exhibit 1-1: METAR/SPECI (Differences Between METAR and SAO)
(Continued)

U.S.METAR	SAO
Temperature/Dew Point	
Celsius	Fahrenheit
Sub-zero temperatures prefixed with M, e.g., 03/M02, M05/M12	12/-1, 23/10
If temperature is not available the entire group is omitted	M/32
If dew point is not available the temperature is coded followed by a solidus, e.g., 17/	63/M
Rounding sub-zero temperatures: a decimal place of 0.0 to 0.5 rounded to next higher (warmer) value, e.g., -0.5 = M00, M11.6 = M12	round to lower (colder) value -1, 1
Pressure	
Altimeter: prefixed with "A" to indicate inches of mercury	no indicator
Altimeter: four digits: tens, units, tenths, hundredths, e.g. A2990	three digits, e.g., 990
Sea Level Pressure: abbreviated SLP in Remarks	recorded in the Body of the Report
Remarks	
Lightning: reportable as OCNL (occasional),FRQ (frequent), CNS (continuous)	OCNL (occasional),FQT (frequent)
Variable Ceiling; heights are three digits, e.g., CIG 005V010	CIG5V10
Volcanic Eruptions; appended to SPECI report	Single element special
Surface-based Obscuration; FG SCT000	weather followed by tenths of obscuration, e.g., F4 OCONUS: FG///
Aircraft Mishap; (ACFT MSHP)	(ACFT MISHAP)
Hourly Temperature and Dew Point; reported hourly to the nearest tenth degree Celsius	not reported

General: If any element or phenomena does not occur, is missing, or cannot be observed, the corresponding group and space are omitted (body and/or remarks) from that particular report, except for Sea-Level Pressure (SLPppp). SLPNO shall be reported in a METAR when the SLP is not available.

Exhibit 1-1: METAR/SPECI (Differences Between METAR and SAO)
(Continued)

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CHAPTER 2 - GENERAL PROCEDURES

2.1 **Introduction**. The contents of this chapter contain the criteria and practices for observing and reporting the METAR and SPECI.

2.1.1 Surface Weather Observing Station. For meteorological reports, the *observing location* is defined as the point or points at which the various elements of the report are observed or evaluated. Weather reports may also contain information on phenomena observed at other than the observing location, such as clouds over mountains NW, lightning SE, showers W, etc. In cases of, or reports of, distant phenomena, this concept of multiple locations will not be extended to include points where the distant element(s) are occurring.

2.1.2 Accuracy of Time in Reports. The accuracy of the actual time of report (2.2.1) and date/time checks (2.4.1) on recording charts is critical in aviation safety investigations. The timing device used to establish times in the observing program shall be within ± 1 minute of the U.S. Naval Observatory time, Commercial (202) 653-1800.

2.1.3 Rounding Figures. Except where otherwise designated in this handbook, the rounding of numbers shall be accomplished as follows: If the fractional part of a positive number to be dropped is equal to or greater than one-half, the preceding digit shall be increased by one. If the fractional part of a negative number to be dropped is greater than one-half, the preceding digit shall be decreased by one. In all other cases, the preceding digit shall remain unchanged; e.g., 1.5 becomes 2, -1.5 becomes -1, 1.3 becomes 1, and -2.6 becomes -3.

2.1.4 METAR Report Form. Use CNMOC Form 3140/12 (Rev. 1-96) to record various elements of a METAR. After entry of all required data, the form is archived as the record of surface weather reports taken at the station completing the form. Stations using the form shall retain one copy. The copies shall be legible and suitable for duplication.

2.1.5 Retention of Duplicate Copies. Retain surface weather report form (CNMOC 3140/12) copies for 1 year.

2.1.6 Disposition of Forms and Recorder Charts. Stations shall mail the original surface weather report forms (CNMOC 3140/12), charts from recording instruments, and any magnetic media to Fleet Numerical Meteorology and Oceanography Detachment Asheville as follows:

a. By the fifth working day of each month, mail all forms and any magnetic media with all other recording charts except those from the ceilometer and transmissometer.

b. Mobile units shall ensure all recorded observational data has been mailed upon completion of deployment.

c. To facilitate handling and verification by Asheville, all units shall submit their data to FLENUMMETOC Detachment Asheville.

The mailing address is:

Officer in Charge
FLENUMMETOC DET Asheville
151 Patton Avenue
Asheville, NC 28801-5014

2.2 **Definitions**.

2.2.1 Actual Time of Report. The actual time of report, to the nearest minute, is the time that the:

a. last element of the report is observed or evaluated for METAR's and those reports made for runway changes and aircraft mishaps. For METAR's, "actual time" shall be;

(1) No earlier than H+55, and

(2) No later than H+59.

b. event requiring the report is observed to occur for SPECI's. All routine reports (hourlies) shall be filed as METAR, even if SPECI criteria has been met.

2.2.2 Aircraft Mishap. An inclusive term to denote the occurrence of an aircraft accident or incident.

2.2.3 Coordinated Universal Time (UTC). The time in the zero degree meridian time zone, formally referred to as "Zulu" time. Does not change with daylight savings time.

2.2.4 Local Standard Time (LST). A time based on the geographic location of the station in one of the legally established time zones of the globe.

2.2.5 Surface Report. A measurement or evaluation of one or more meteorological elements that describe the state of the atmosphere at the location(s) where the report is taken.

2.3 **Reporting Practices**

2.3.1 Time. All times refer to the 24-hour clock; e.g., 1:47 a.m. shall be referred to as 0147 and 1:47 p.m. as 1347. The times 0000 and 2359 indicate the beginning and ending of the (LST) day, respectively.

2.3.2 Time Standards. Time used in weather reports shall be Coordinated Universal Time (UTC).

2.3.3 Order of Reporting. Elements having the greatest rate of change are evaluated last. When conditions are relatively unchanging, evaluate the elements in the following order:

a. Elements evaluated outdoors.

b. Elements evaluated indoors, with pressure last.

2.3.4 Recency of Reported Elements. Individual elements entered in a report shall, as closely as possible, reflect conditions existing at the actual time of report. Elements entered shall have been observed or evaluated within 15 minutes of the actual time of report. Wind gusts shall be reported if observed within 10 minutes of the actual time of report. METAR's shall be made as close to the standard time of the report as possible to meet filing deadlines, but in no case shall these reports be *started* more than 15 minutes before the actual time of the report.

2.3.5 Night Vision Adjustment. Allow sufficient time for your eyes to become adjusted to the ambient light conditions before beginning to evaluate weather elements.

2.3.6 Synoptic Reports. Synoptic reports are designed primarily for use in weather analysis and prediction, especially for use in international exchange. These reports are recorded at 0000, 0600, 1200, and 1800 UTC and entered on the reporting form on the lines following the METAR's for the same time, disregarding column headings. Instructions pertaining to synoptic weather reports and codes are given in Federal Meteorological Handbook No. 2, Synoptic Code.

2.3.7 Surface Reports. These reports are classified according to their purpose as designated in the following paragraphs.

2.3.7.1 Aviation Routine Weather Report (METAR). METAR is the routine scheduled report as well as the primary surface weather observation code used in the United States to satisfy requirements for reporting surface meteorological data. METAR contains a report of wind, visibility, RVR, present weather, sky condition, temperature, dew point, and altimeter setting collectively referred to as "the body of the report". In addition, coded and/or plain language information which elaborates on data in the body of the report may be appended to the METAR. The contents of the remarks will vary according to the type of weather station. At designated stations, the METAR may be abridged to include one or more of the above elements.

2.3.7.2 Aviation Selected Special Weather Report (SPECI). SPECI's shall contain all data elements found in a METAR. A SPECI is an unscheduled report coded and disseminated when any of the criteria contained in the following sub-paragraphs (a-m) are observed. More stringent criteria may be required by individual Air Stations as designated in appropriate Airfield Instructions.

a. CEILING. The ceiling (rounded to reportable values) forms or dissipates below, decreases to less than, or if below, increases to equal or exceed:

(1) 3,000 feet.

(2) 1,500 feet.

(3) 1,000 feet.

(4) 500 feet.

(5) 200 feet or all published landing minima (including circling) applicable to the airfield, as listed in the Department of Defense Flight Information Publications (DOD FLIPs).

b. SKY CONDITION. A layer of clouds or obscuring phenomena is present below1,000 feet and no layer aloft was reported below 1,000 feet in the preceding METAR or SPECI.

c. VISIBILITY. Prevailing visibility as reported in the body of the report decreases to less than or, if below, increases to equal or exceed:

(1) 3 miles.

(2) 2 miles.

(3) 1- 1/2 miles.

(4) 1 mile.

(5) 1/2 mile or all published landing minima (including circling) applicable to the airfield, as listed in the Department of Defense Flight Information Publications (DOD FLIP).

d. RUNWAY VISUAL RANGE (RVR). RVR for the active runway is observed to decrease to less than or, if below, increase to equal or exceed:

(1) 6,000 feet 1830 meters

(2) 4,000 feet 1220 meters

(3) 2,400 feet 730 meters

e. TORNADO, FUNNEL CLOUD, OR WATERSPOUT.

(1) Is observed.

(2) Disappears from sight (or ends).

f. THUNDERSTORM.

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

(2) Ends.

g. PRECIPITATION.

(1) Hail begins, ends or a size of 3/4 inch or greater is observed.

(2) Freezing precipitation begins, ends, or changes intensity.

(3) Ice pellets begin, end, or change intensity.

(4) Any other type of precipitation begins or ends. Note that, except for freezing rain, freezing drizzle, hail, and ice pellets, a SPECI 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).

h. SQUALLS. When observed.

i. WIND AND WIND SHIFTS.

(1) The average 2-minute wind speed suddenly increases to twice or more than twice the currently reported 2-minute wind speed and exceeds 25 knots.

(2) The initial occurrence of a 50 knot wind gusts associated with thunderstorm activity.

(3) Wind direction changes by 45 degrees or more in less than 15 minutes and the wind speed is sustained at 10 knots or more throughout the wind shift.

j. RUNWAY CONDITIONS. Upon receipt. Otherwise the conditions are appended to remarks section of a METAR or SPECI whose time coincides with that of the runway condition notification.

k. VOLCANIC ERUPTION. Eruption first noted.

l. AIRCRAFT MISHAP. Upon notification of an aircraft mishap unless there has been an intervening METAR or SPECI. The remark (ACFT MSHP) shall be placed within parenthesis in the remarks section and shall not be transmitted.

m. MISCELLANEOUS. Any other meteorological condition designated by higher authority or is considered operationally significant.

2.3.7.2.1 SPECI Upon Resumption of Reporting Function. Observe, code, and disseminate a SPECI within 15-minutes after returning to duty following a break in observing coverage unless a METAR is filed during that 15-minute period.

2.3.7.3 Midnight Reporting. The Summary of the Day (SOD) consists of certain elements which include maximum and minimum temperatures, precipitation amounts, and peak wind. These data may be obtained at the time of the midnight METAR and are recorded on the reporting form for the "LST" day ending at the time they are observed. The temperature recorded in the midnight METAR of the day must also be considered when determining the maximum or minimum temperature for the following day.

2.4 **Recorder Chart Annotations**.

2.4.1 Date/Time Checks. Enter date/time checks on the recorder chart of recording-type instruments by striking a short line that intersects the trace on the chart and entering the date/time to the nearest minute (UTC). At a minimum, time checks shall be made:

a. At the beginning and end of each chart roll.

b. At the time of each 6-hourly report.

c. When notified of an aircraft mishap.

d. For each disruption or discontinuity in the trace; e.g., upon return of equipment to service following an outage or periodic maintenance.

e. At the time of the first and last report at stations not operating 24 hours per day.

f. Change of day at midnight (LST).

2.4.2 Power and Equipment Failures. Indicate power and equipment failures on recording-type instruments by entering on the recorder chart at the point of the failure the term POWER FAILURE or EQUIPMENT FAILURE and the date/time of the failure. When the equipment is returned to service, adjust the chart to the correct time, if necessary, and enter a date/time check.

2.4.3 Time Adjustments. Adjust a recorder chart to the correct time whenever the time error is more than 5-minutes (more than 15-minutes for the barograph chart). When a recorder is adjusted to the correct time, indicate the adjustment on the chart by entering an arrow at the point of the adjustment and writing the time of the adjustment near the arrow.

2.4.4 Changing Charts. Change all charts, as necessary, to prevent loss of record. Charts shall be changed after the midnight METAR on the last evening of the month. All recorder charts are installed with reference to UTC.

2.4.5 Operation and Maintenance of Equipment. All meteorological equipment shall be operated and maintained in accordance with current operating manuals.

Body of Report - Consists of 11 Elements			
Element	Reference	Brief Description	METAR/ SPECI
Type of Report (METAR/SPECI)	9.11.1	Indicates the type of report and that certain criteria have been met.	X/X
Station Identifier (CCCC)	9.11.2	A four character code group used to identify the observing location.	X/X
Date/Time of Report (YYGGggZ)	9.11.3	Actual date/time of the report.	X/X
Report Modifier (AUTO or COR)	9.11.4	AUTO indicates element included from Automated Stations. Absence of "AUTO" indicates the report is either a manual report or an augmented report. COR indicates a correction to the previous METAR/SPECI.	X/X
Wind Group ($dddff(f)Gf_mf_m(f_m)KT_d_nd_nd_nVd_xd_xd_x$)	9.11.5	True direction from which the wind is blowing; speed is a 2-minute average in knots; gust defines the character. Variable wind direction may replace average wind direction when criteria is met.	X/X
Visibility Group (VVVVVSM) CONUS (VVVV) OCONUS	9.11.6	Surface prevailing visibility.	X/X
Runway Visual Range Group ($RD_RD_R/V_RV_RV_RV_RFT$) CONUS ($RD_RD_R/V_RV_RV_RV_R$) OCONUS	9.11.7	Represents the horizontal visibility a pilot will see down the runway. USN/USMC activities will not normally report RVR.	D/D
Present Weather Group (w'w')	9.11.8	Any weather or obscuring phenomena which may or may not reduce the visibility to less than 7 statute miles.	X/X
Sky Condition Group ($N_sN_sN_sh_sh_sh_s$ or $VVh_sh_sh_s$ or SKC)	9.11.9	State of the sky in terms of sky cover classification and heights.	X/X
Temperature and Dew Point Group ($T'T'/T'_dT'_d$)	9.11.10	Temperature is the measure of the hotness or coldness of the ambient air, reported in whole °C; sub-zero temperatures prefixed with the letter "M". Dew Point Temperature is the temperature to which a parcel of air must be cooled for saturation to occur, reported in whole °C; sub-zero temperatures prefixed with the letter "M".	X/X
Altimeter Setting Group ($AP_HP_HP_HP_H$)	9.11.11	Four character group in hundredths of an inch of mercury; indicates the altitude above MSL of an aircraft on the ground.	X/X

X - Indicates element included at all stations.
D - Indicates element included only at designated stations.
N - Not required in the observation.

Table 2-1. Contents of Aviation Routine Weather Reports

(1) Remarks (RMK)			
Element	Reference	Brief Description	METAR / SPECI
Volcanic Eruptions	9.12.1.1	Whenever an eruption is first noted; Name, latitude, longitude, direction, date/time of eruption, description of ash cloud including height and movement.	X/X
Tornadic Activity	9.12.1.2	Report whenever tornadoes, funnel clouds or waterspouts begin, are in progress, disappear, or end.	X/X
Type of Station	9.12.1.3	Included at automated or augmented stations to denote the absence (AO1) or presence (AO2) of the present weather discriminator instrument.	X/X
Peak Wind	9.12.1.4	Wind speed >25 knots. Report the direction, speed, and time. Use the remark PK WND dddff(f)/(hh)mm.	X/
Wind Shift, FROPA	9.12.1.5	Wind direction changes by 45° or more in less than 15 minutes with sustained wind speeds of ≥ 10 knots throughout the wind shift. Use the remark WSHFT followed by beginning time of shift. Include FROPA if associated with a frontal passage.	X/X
Tower Visibility	9.12.1.6	TWR VIS shall always be reported in remarks when appropriate.	X/X
Variable Prevailing Visibility	9.12.1.7	Prevailing visibility <3 miles and variable, report the remark VIS minVmax.	X/X
Sector Visibility	9.12.1.8	Sector visibility differs from the prevailing visibility and either the prevailing or sector visibility is <3 miles.	X/X
Lightning	9.12.1.9	Report frequency, type and location, e.g.,FRQ LTGCG VC N (see Table 9-7).	X/X
Beginning/Ending of Thunderstorms and/or Precipitation	9.12.1.10	Report whenever they begin, are in progress, or end; include the time (hh)mm and, if applicable, the location (VC STN, direction, or DSNT) and movement, if known.	X/X
Thunderstorm Location	9.12.1.11	Report the location (VC STN, direction, or DSNT) and movement, if known.	X/X
Hailstone Size	9.12.1.12	Anytime detected; reported in ¼" increments; GR3/4	X/X
Virga	9.12.1.13	Precipitation not reaching the ground, report VIRGA and direction.	X/X
Variable Ceiling Height	9.12.1.14	Ceiling <3,000 feet and reported variable, report the remark CIG minVmax.	X/X
Obscuration(s)	9.12.1.15	If sky condition includes FEW, SCT, BKN, OVC followed by 000, include as a remark the notation and amount; e.g., FG FEW000.	X/X
Variable Sky Condition	9.12.1.16	Layer amount that varies, report the amount it varied to; e.g., SCT V BKN; BKN014 V OVC.	X/X
Significant Cloud Types	9.12.1.17	e.g., CB or CBMAM, TCU, ACC, SCSL, ACSL, CCSL, location or direction, and movement if applicable.	X/X
Pressure Rising/Falling Rapidly	9.12.1.18	PRESRR or PRESFR shall be reported if the rate of change is ≥.060 inches/hour hPa (.02 mb) during time of observation.	X/X
Sea-Level Pressure	9.12.1.19	SLP shall be reported when available SPLppp. When undeterminable the remark SLPNO shall be included in the report.	X/X

Table 2-1. Contents of Aviation Routine Weather Reports (Continued).

(1) Remarks Continued (RMK)			
Element	Reference	Brief Description	METAR / SPECI
Aircraft Mishap	9.12.1.20	Generate a SPECI when notified of an aircraft accident or incident and include (ACFT MSHP) in remarks.	X/X
No SPECI's Taken	9.12.1.21	NOSPL indicates that SPECI's are not taken.	D/N
Snow Increasing Rapidly	9.12.1.22	Report SNOINCR if snow depth increases by 0.5 inch or more in the past hour, followed by total depth on the ground.	X/N
Runway Condition	9.12.1.23	Report runway surface condition (RSC) and average runway condition reading (RCR) when required.	X/X
Breaks or Thin Spots in Overcast	9.12.1.24	Report BINOVC or THN SPTS IOVC to report higher or significant clouds above the overcast layer. This remark may precede the "significant cloud types" remark if applicable, i.e., BINOVC TCU NW.	X/X
First and Last Remark	9.12.1.25	Include in the First and Last report transmitted for the day at part-time stations.	X/X
(2) Additive Data (RMK)			
Hourly Precipitation Amount	9.12.2.1a	Whenever any precipitation has occurred since the last METAR. (Automated Only).	X/N
3- and 6-hourly Precipitation Amount	9.12.2.1b	Include in 3- and 6-hourly observations; encoded in inches, units, tenths, and hundredths.	X/N
24-Hour Precipitation Amount	9.12.2.1c	Included in 1200 UTC observation if more than a trace of precipitation has fallen in past 24 hours.	X/N
Snow Depth on the Ground, 4/sss	9.12.2.1d	Include in 00 and 12 UTC observation if more than a trace of snow on ground and include in 06 and 18 UTC observation if more than a trace of snow on ground and more than a trace of precipitation fell in past 6-hours.	X/N
Water Equivalent of Snow on the Ground, 933RRR	9.12.2.1e	Reported at 1800 UTC if the average depth is 2" or more.	X/N
Cloud Types, $8/C_LC_MC_H$	9.12.2.2	Encode the predominant low, middle, and high clouds in 3- and 6-hourly observations.	X/N
Hourly Temperature and Dew Point	9.12.2.3a	Include in hourly reports at designated stations.	X/
6-Hourly Maximum Temperature	9.12.2.3b	Report the maximum temperature in past 6-hours in whole °C.	X/N
6-Hourly Minimum Temperature	9.12.2.3c	Report the minimum temperature in past 6-hours in whole °C.	X/N
24-Hour Maximum and Minimum Temperature	9.12.2.3d	Reported at midnight (LST); the maximum and minimum temperatures for the day.	X/N
3-Hour Pressure Tendency, 5appp	9.12.2.4	Include in 3- and 6-hourly observations; change in pressure over the past 3-hours (Table 9-8 and 9-9).	X/N

D - Indicates element included only at designated stations.
X - Indicates element included at all stations.
N - Not required in the observation.

Table 2-1. Contents of Aviation Routine Weather Reports (Continued).

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CHAPTER 3 - SKY CONDITION

3.1 **Introduction**. This chapter relates to the state or appearance of the sky in reference to sky cover by clouds and/or obscuring phenomena (aloft and surface-based).

3.1.1 Sky Condition Evaluation. A complete evaluation of sky condition includes the type of clouds, obscuring phenomena, their stratification, amount, direction of movement, and the height of their bases.

3.1.2 Cloud Forms and Obscuring Phenomena. The WMO International Cloud Atlas, Volumes I and II, and the Abridged Atlas contain detailed instructions and photo-aids for identifying the various cloud forms. Additional aids may be used for identifying cloud forms (types) such as cloud code charts and training papers in surface observations. Commercial products are also available that describe cloud forms and types. Descriptions of obscuring phenomena are included in Chapter 5, Present Weather.

3.2 **Definitions**.

3.2.1 Ceiling. The ceiling is the height above ground ascribed to the lowest broken or overcast layer; or the vertical visibility into an obscuring phenomena.

3.2.2 Celestial Dome. That portion of the sky which would be visible provided there was an unobstructed view of the horizon in all directions from the observation site.

3.2.3 Cloud. A visible accumulation of minute water droplets and/or ice particles suspended in the atmosphere above the Earth's surface.

3.2.4 Field Elevation. The officially designated field elevation (H_a) of an airfield above mean sea level. It is the elevation of the highest point on any of the runways of the airfield.

3.2.5 Horizon. The lower boundary of the observed sky or the upper outline of terrestrial objects, including nearby natural obstructions such as trees and hills. It is the distant line along which the earth (land and/or water) and the sky appear to meet.

3.2.6 Interconnected Cloud Layers. The condition when cumuliform clouds develop below other clouds and reach or penetrate them. Also, by horizontal extension, Cumulus or Cumulonimbus may form Stratocumulus, Altocumulus, or dense Cirrus.

3.2.7 Layer. Clouds and/or obscuring phenomena aloft, either continuous or composed of detached elements, whose bases are at approximately the same level.

3.2.8 Layer Amount. The amount, in eighths, of sky cover at a given level.

3.2.9 Layer Height. The height, in feet, of the layer's base above the surface or the vertical visibility into an surface-based obscuring phenomena.

3.2.10 Layer Opacity. All cloud layers and obscuring phenomena shall be considered opaque.

3.2.11 Obscuring Phenomena. Any collection of particles, such as haze and smoke, which are discernible to the observer. Obscuring phenomena may be either surface-based or aloft. The term is also applied to precipitation (e.g., rain, snow, drizzle) when it obscures part or all of the sky.

3.2.12 Significant Clouds and Cloud Types. Cloud types shall be identified in accordance with the WMO International Cloud Atlas Volumes I and II, the WMO Abridged International Cloud Atlas. Cumulonimbus, cumulonimbus mammatus, towering cumulus, altocumulus castellanus, standing lenticullar, or rotor clouds are significant clouds and shall be reported when observed (9.12.1.17).

3.2.13 Sky Cover. A term used to denote the amount (to the nearest eighth) of the sky covered by clouds and/or obscuring phenomena.

3.2.14 Summation Layer Amount. A categorization of the amount of sky cover at and below each reported layer.

3.2.15 Summation Principle. This principle states that the sky cover at any level is equal to the summation of the sky cover of the lowest layer plus the additional sky cover present at all successively higher layers up to and including the layer being considered. No layer can be assigned a sky cover less than a lower layer, and no sky cover can be greater than 8/8. This concept is applicable for the evaluation of all layers.

3.2.16 Station Elevation. The officially designated height above mean sea-level to which the station pressure pertains. Generally, the same as the field elevation.

3.2.17 Total Amount of Sky Cover. The amount in eighths, of the entire sky covered by all layers present. This amount cannot be greater than 8/8.

3.2.18 Total Number of Reportable Layers. The maximum number of reportable layers allowed in CONUS is six (6).

OCONUS: OCONUS is restricted to three (3) reportable layers except when convective clouds (CB or TCU) are observed and not reported in the previous three layers. In such cases a fourth layer may be used.

3.2.19 Variable Ceiling. A term that describes a condition in which a ceiling, below 3000 feet, rapidly increases and decreases by one or more reportable values while the ceiling height is being evaluated.

3.2.20 Variable Sky Condition. A term used to describe a sky condition which has varied between

reportable classifications (e.g., SCT to BKN, OVC to BKN) during the period of evaluation (normally the past 15 minutes).

3.3 Sky Cover Evaluation. Sky condition observations require an evaluation of atmospheric phenomena which prevent an uninterrupted view of the celestial dome, sun, moon, etc. Such phenomena generally occur in the form of layers with comparatively level bases. Evaluate this stratification of phenomena for type, amount, direction of movement, height of bases, and the effect of surface-based obscuring phenomena on vertical visibility. Take observations from as many locations as necessary and practical to view the entire sky above the natural local horizon.

a. Multiple Layers. Frequent observations are required for evaluation. Differences in the direction of cloud movement are often a valuable aid in observing and differentiating between layers, particularly when the presence of haze, smoke, etc., make depth perception difficult. Though all layers are considered opaque for summation purpose, higher layers, visible through thin spots in lower layers, may be annotated in remarks.

b. Interconnection of Layers. When clouds formed by the horizontal extension of swelling cumulus and cumulonimbus are attached to a parent cloud, they are regarded as separate layers only if their bases appear horizontal and at different levels from 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.

c. Non-uniform Sky Condition. Observers shall be alert to variations in sky condition that are not reflected in the sky cover reported in the body of the report. When non-uniform sky conditions are observed; for example a significant lower ceiling in a particular direction from the station, it shall be described in remarks, e.g., CIG LWR N would indicate that the ceiling is lower to the north.

d. Night vision: During darkness, consider the sky to be clear if the stars are plainly visible and no cloud or obscuring phenomena is observed. When the stars are dimmed, the dimming is evidence of the presence of cloud of obscuring phenomena and will be of assistance in determining the amount of sky covered. Allow approximately 15 minutes in the darkness for your eyes to adjust from lighted work spaces to darkness before evaluating the celestial dome.

3.3.1 Sky Cover Amounts. Use Table 3-1 as a guide 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.. Sky cover amounts are evaluated. The amount of each layer will be measured:

a. In eighths of coverage of the entire sky above the horizon.

b. Utilizing the summation layer amount.

3.3.2 Sky Cover Classification. Select the appropriate sky cover classification or a combination of classifications from Table 3-2 . Evaluate the sky cover as follows:

a. Estimate the amount of sky covered by the lowest layer present. This lowest layer may be surface based obscuring phenomena, e.g., FEW000.

b. Determine if additional layers of clouds and/or obscuring phenomena are present above the lowest layer. Estimate the eighths of ***sky covered*** by each of these layers in combination with the lower layers. **Do not** add to the total amount of eighths of clouds in each layer which may be observable through transparencies in lower layers. In each layer evaluation, observe only the amount of additional sky covered by that layer being evaluated (Exhibits 3-1A and 3-1B).

SKY COVER EVALUATION		
Angle of Advancing or Receding Layer Edge	**Eighths of Sky Cover**	**Angle Elevation of Layer Surrounding Station**
>0° to 50°	1	>0° 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 <179°	7	54° to 89°
180°	8	90°

Table 3-1. Sky Cover Evaluation.

Classification	Meaning	Summation Amount of Layer
SKC	Sky Clear	0/8
FEW	Trace	>0/8 - 2/8
SCT	Scattered	3/8 - 4/8
BKN	Broken	5/8 - 7/8
OVC	Overcast	8/8
VV	Vertical Visibility	8/8

Table 3-2. Classifications for Sky Cover Amount

3.3.3 Determination of Layer Heights.

a. Determine the height of clouds, obscuring phenomena aloft, and/or the vertical visibility into a totally obscured sky by using one or more of the following:

(1) Ceilometer. Ceilometers with recorder chart or digital readout. Accuracy values for ceilometers should be available in the instruments users guide. For some types of ceilometers, it accuracy is best with readings of less than ten (10) times its baseline. Readings ten times and greater become less accurate and caution should be used.

(2) Ceiling Light. A ceiling light is most accurate with values of less than ten (10) times its baseline, e.g., 400 foot baseline; less than 4000 feet. Use a clinometer and take an average of three elevation angle readings. If the sky being evaluated has a wide variation in elevation angle readings, it could be a result of a widely varying or ragged base. More reading may be required to ensure an accurate representation is obtained. Utilize the following mathematical formula for constructing a local *elevation to height conversion chart* representative of the Air Station's ceiling light baseline. A scientific calculator would expedite the construction of this chart.

Elevation to Height Conversion Chart Formula

(tangent of the elevation angle) multiplied by the **(baseline)** = **HEIGHT**

Examples:

Elevation Angle	Tangent	Baseline	Height
25 degrees	0.466	400 feet	= 187 feet
45 degrees	1.0	400 feet	= 400 feet
40 degrees	0.839	500 feet	= 420 feet
60 degrees	1.732	500 feet	= 866 feet

(3) Balloon. Use a 10 or 30 gram balloon to evaluate a cloud layer when the layer in question is close changing field operating conditions, IFR and below, or when considered operationally significant. Utilize the following steps:

(a) Choose the appropriate color balloon. Red balloons are usually preferable with thinner clouds and blue/black with all other conditions.

(b) After receiving clearance from the Air Traffic Control Tower it release a balloon, release the balloon activating a stop watch simultaneously. Watch the balloon continuously and determine 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 disappears to estimate the vertical visibility in a totally obscured sky.

(c) Use Tables 3-4 and 3-5 to determine the height of the layer. Ensure the value is correctly rounded to the appropriate reportable value.

(d) Use caution when balloons employed. The balloons ascension rate will be effected by rain and strong winds. Poor visibility and breaks in cloud layers may add to the difficulties when using balloons.

(4) Known Heights of Fixed Objects. Many air facilities are surrounded by hangers, buildings, towers, and trees which may help determine the height of low cloud bases. Each observing station should maintain a locally prepared diagram annotated with the direction from observation point, distance and height of fixed objects.

(5) Pilot Reports. Air Traffic Control should be routinely quarried for pilot reports from inbound aircraft. The height of the bases should be used as a guide when determining the cloud bases.

(6) Convective Cloud Height Table. The air temperature and the dew point can be used to obtain the height of airmass convective cloud bases in the vicinity of the airfield. Exhibit 3-2 will assist in the height determination. This convention is most accurate with cloud bases below 5000 feet and it can not be used in mountainous or hilly terrain.

(7) Skew-T Log P Diagram. The Convective Condensation Level (CCL) and significant areas of moisture can be used to determine cloud bases.

(8) Weather Radar. Doppler and conventional weather radars are capable of determining cloud bases in the vicinity of the airfield.

(9) Other Station Reports. Surrounding airfield observations can assist in determining the cloud bases. Approaching frontal actively as well as few weather clouds may be consistent by region.

(10) Observers Experience. Certified weather observers gain experience with time and practice. Your own experience and that of senior watch personnel are to be used in combination with one or more of the aforementioned tools.

b. Heights of layers observed at the station will be reported in hundreds feet above ground level (AGL) rounded to reportable values (Table 3-3). When a value falls halfway between two reportable increments, the lower value shall be reported. Surface based obscurations and layers observed to be 50 feet or less AGL shall be reported with a height of "000".

Range of Height Values (feet)	Reportable Increment (feet)
≤50	0
>5,000 but ≤10,000	To nearest 500
≤5,000	To nearest 100
>10,000	To nearest 1,000

Table 3-3. Increments of Reportable Values of Sky Cover Height

3.3.4 Vertical Visibility. Vertical visibility shall be the distance that an observer can see vertically into an totally obscuring phenomena, the height corresponding to the top of a ceiling light projector beam, or the height at which a balloon completely disappears.

3.3.5 Variable Ceiling Height. When the averaged height of a ceiling layer is below 3000 feet and it is increasing and decreasing rapidly, a remark shall be included in the report giving the range of variability .

3.3.6 Variable Sky Condition. The sky cover shall be considered variable if it varies by one or more classifications during the observation period, e.g., SCT V BKN.

3.3.7 Height of Obscuration. When a surface-based obscuration exists (partial or total), the height ascribed to the obscuration shall be "000". Amplifying comments shall be placed in "remarks" for obscuring phenomena, partial or aloft. The "remark" shall consist of the weather phenomena (i.e., fog, (FG), smoke (FU), haze (HZ), rain (RA), snow (SN), etc.), *followed by a space*, the corresponding sky cover classification, i.e., FEW, SCT, or BKN, and its associated height (9.12.1.15), e.g., FG FEW000 or FU SCT025.

OCONUS: If a portion of the sky is covered, not necessarily hidden, by surface-based obscuring phenomena, indicate the phenomena followed by three solidi (/), i.e., FG///, DZ///, etc.

10-Gram Balloon Ascension Rates*
Nozzle Lift 45-Grams Helium

Time Minutes and Seconds	Reportable Height	Time Minutes and Seconds	Reportable Height
0:00 - 0:06	0	5:36 - 5:50	2600
0:07 - 0:17	100	5:51 - 6:04	2700
0:18 - 0:30	200	6:05 - 6:18	2800
0:31 - 0:42	300	6:19 - 6:32	2900
0:43 - 0:53	400	6:33 - 6:47	3000
0:54 - 1:06	500	6:48 - 7:01	3100
1:07 - 1:20	600	7:02 - 7:15	3200
1:21 - 1:32	700	7:16 - 7:30	3300
1:33 - 1:45	800	7:31 - 7:44	3400
1:46 - 1:58	900	7:45 - 7:58	3500
1:59 - 2:11	1000	7:59 - 8:12	3600
2:12 - 2:24	1100	8:13 - 8:27	3700
2:25 - 2:37	1200	8:28 - 8:41	3800
2:38 - 2:51	1300	8:42 - 8:55	3900
2:52 - 3:04	1400	8:56 - 9:10	4000
3:05 - 3:17	1500	9:11 - 9:24	4100
3:18 - 3:30	1600	9:25 - 9:38	4200
3:31 - 3:43	1700	9:39 - 9:52	4300
3:44 - 3:56	1800	9:53 - 10:07	4400
3:57 - 4:10	1900	10:08 - 10:21	4500
4:11 - 4:24	2000	10:22 - 10:35	4600
4:25 - 4:38	2100	10:36 - 10:50	4700
4:39 - 4:52	2200	10:51 - 11:04	4800
4:53 - 5:07	2300	11:05 - 11:18	4900
5:08 - 5:21	2400	11:19 - 12:01	5000
5:22 - 5:35	2500	12:02 - 12:02+70sec	**5500
		13:13 - 13:13+70sec	**6000
		etc.	

* Daytime Use Only
** Ascension rate above 5,000 feet is 500 feet per 70 second

Table 3-4. 10-Gram Balloon Ascension Rates

30-Gram Balloon Ascension Rates*
Nozzle Lift 139-Grams Helium

Time Minutes and Seconds	Reportable Height	Time Minutes and Seconds	Reportable Height
0:00 - 0:04	0	3:53 - 4:01	2600
0:05 - 0:12	100	4:02 - 4:11	2700
0:13 - 0:20	200	4:12 - 4:21	2800
0:21 - 0:30	300	4:22 - 4:31	2900
0:31 - 0:38	400	4:32 - 4:40	3000
0:39 - 0:46	500	4:41 - 4:50	3100
0:47 - 0:55	600	4:51 - 5:00	3200
0:56 - 1:03	700	5:01 - 5:10	3300
1:04 - 1:12	800	5:11 - 5:20	3400
1:13 - 1:22	900	5:21 - 5:31	3500
1:23 - 1:31	1000	5:32 - 5:41	3600
1:32 - 1:40	1100	5:42 - 5:51	3700
1:41 - 1:50	1200	5:52 - 6:01	3800
1:51 - 1:59	1300	6:02 - 6:11	3900
2:00 - 2:08	1400	6:12 - 6:21	4000
2:09 - 2:17	1500	6:22 - 6:32	4100
2:18 - 2:27	1600	6:33 - 6:42	4200
2:28 - 2:36	1700	6:43 - 6:52	4300
2:37 - 2:45	1800	6:53 - 7:02	4400
2:46 - 2:54	1900	7:03 - 7:12	4500
2:55 - 3:03	2000	7:13 - 7:22	4600
3:04 - 3:13	2100	7:23 - 7:33	4700
3:14 - 3:23	2200	7:34 - 7:43	4800
3:24 - 3:32	2300	7:44 - 7:53	4900
3:33 - 3:42	2400	7:54 - 8:24	5000
3:43 - 3:52	2500	8:25 - 8:25+51sec	**5500
		9:17 - 9:17+51sec	**6000
		etc.	

* Daytime Use Only
** Ascension rate above 5,000 feet is 500 feet per 51 seconds

Table 3-5. 30-Gram Balloon Ascension Rates

Ceiling (feet)	Variation (feet)
≤1,000	≥200
> 1,000 and ≤2,000	≥400
>2,000 and <3,000	≥500

Table 3-6. Criteria for Variable Ceiling

Sky Cover Layers	Summation	Appropriate Classification	Sky Cover Entries Col. 10	Col. 14
3/8 sky hidden by fog 2/8 sky cover at 1,000 feet 2/8 sky cover at 5,000 feet	3/8 5/8 7/8	SCT BKN BKN	SCT000 BKN010 BKN 050	FG SCT000
Less than 1/8 sky cover at 500 feet Less than 1/8 sky cover at 2,000 feet 4/8 sky covered by CB at 3,000 feet less than 1/8 sky cover at 9,000 feet	0/8 0/8 4/8 4/8	FEW FEW SCT SCT	FEW005 FEW020 SCT030CB SCT090	
5/8 sky cover at 1,000 feet 2/8 sky cover at 5,000 feet 1/8 sky cover at 30,000 feet	5/8 7/8 8/8	BKN BKN OVC	BKN010 BKN050 OVC300	
1/8 sky cover at 1,000 feet (smoke aloft) 2/8 sky covered by TCU at 5,000 feet 1/8 sky cover at 35,000 feet	1/8 3/8 4/8	FEW SCT SCT	FEW010 SCT050TCU SCT350	FU SCT010
Sky hidden by snow, vertical visibility 1,000 feet	8/8	VV	VV010	
6/8 sky hidden by fog 2/8 sky cover at 500 feet	6/8 8/8	BKN OVC	BKN000 OVC005	FG BKN000

Exhibit 3-1A. Examples: Summation of Sky Cover (CONUS)

Sky Cover Layers	Summation	Appropriate Classification	Sky Cover Entries Col. 10	Col. 14
3/8 sky hidden by fog 2/8 sky cover at 1,000 feet 2/8 sky cover at 5,000 feet	3/8 5/8 7/8	FG BKN BKN	FG/// BKN010 BKN 050	
Less than 1/8 sky cover at 500 feet Less than 1/8 sky cover at 2,000 feet 4/8 sky covered by CB at 3,000 feet less than 1/8 sky cover at 9,000 feet	0/8 0/8 4/8 4/8	SCT SCT SCT SCT	SCT005 SCT020 SCT030CB	
5/8 sky cover at 1,000 feet 2/8 sky cover at 5,000 feet 1/8 sky cover at 30,000 feet	5/8 7/8 8/8	BKN BKN OVC	BKN010 BKN050 OVC300	
1/8 sky cover at 1,000 feet (smoke aloft) 2/8 sky covered by TCU at 5,000 feet 1/8 sky cover at 35,000 feet	1/8 3/8 4/8	FU SCT SCT	FU010 SCT050TCU SCT350	
Sky hidden by snow, vertical visibility 1,000 feet	8/8	VV	VV010	
6/8 sky hidden by fog 2/8 sky cover at 500 feet	6/8 8/8	FG OVC	FG/// OVC005	

Exhibit 3-1B. Examples: Summation of Sky Cover (OCONUS)

Convective Cloud Heights.			
TT - T_dT_d Degrees Celsius	Estimated Cumulus Height (ft)	TT - T_dT_d Degrees Celsius	Estimated Cumulus Height (ft)
0.5	200	1.0	400
1.5	600	2.0	800
2.5	1,000	3.0	1,200
3.5	1,400	4.0	1,600
4.5	1,800	5.0	2,000
5.5	2,200	6.0	2,400
6.5	2,600	7.0	2,800
7.5	3,000	8.0	3,200
8.5	3,400	9.0	3,600
9.5	3,800	10.0	4,000
10.5	4,200	11.0	4,400
11.5	4,600	12.0	4,800
12.5	5,000		

Exhibit 3-2. Convective Cloud Height

NOTES:

1. This table is not suitable for use at stations situated in mountainous or hilly terrain, and it should be used only when clouds are formed by active surface convection in the vicinity of the station. Use with caution when the surface temperature is below freezing due to the difficulties inherent in the accurate determination of the dewpoint at low temperatures.
2. The temperature factor in the table is based on the difference between air and dewpoint temperatures. Reportable height values between those in the table may be obtained by means of interpolation using the difference to the nearest tenth of a degree. Examples:

	A	B
Air Temperature	23	27.4
Dew Point Temperature	16	17.1
Depression	7	10.3
Estimated height	2,900	4,200

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CHAPTER 4 - VISIBILITY and RUNWAY VISUAL RANGE

4.1 **Introduction (Visibility)**. Visibility is a measure of the opacity of the atmosphere and is expressed in terms of the horizontal distance at which you are able to see and identify specified objects. All visibilities referred to in this chapter are horizontal visibilities.

4.2 **Definitions**.

4.2.1 Prevailing Visibility. The greatest visibility equaled or exceeded throughout at least half the horizon circle, which does not necessarily have to be continuous. This definition applies to both surface and tower prevailing visibility.

4.2.2 Sector Visibility. The visibility in a specified direction that represents at least a 45 degree arc (portion) of the horizon circle.

4.2.3 Surface Visibility. The prevailing visibility determined from the observing location.

4.2.4 Tower Visibility. The prevailing visibility determined from the control tower.

4.2.5 Transmissometer Visibility. A computed visibility as determined from transmissivity tables and usually confined to a specific sector where RVR instrumentation is located.

4.2.6 Variable Prevailing Visibility. A condition when the prevailing visibility is less than 3 miles and rapidly increasing and decreasing by 1/2SM or more during the period of observation.

4.2.7 Visibility. The distance at which selected objects can be seen and identified.

4.2.8 Visibility Markers. Dark or nearly dark objects viewed against the horizon sky during the day, or unfocused lights of moderate intensity during the night.

4.3 **Visibility Evaluation.**

4.3.1 Visibility Standards. Visibility may be determined at either the surface, the tower level, or both. If visibility observations are made from just one level (e.g., the air traffic control tower), that level shall be considered the observing location for the prevailing visibility and shall be reported as surface visibility. Surface visibility is always reported in the body of the report. When tower visibility meets criteria (i.e., 4SM or less), it shall be reported in remarks.

4.3.2 Unit of Measure. Visibility shall be reported in statute miles or fractions thereof (Table 4-1).

OCONUS: Visibility shall be reported in meters. (Table 4-1A)

4.3.3 Observing Aids for Visibility. Visibility marker locations shall be readily available for quick reference. Panoramic pictures are outstanding reference tools to assist the observer and tower personnel. All reference guides shall be annotated from the point of observation with the direction, distance from station, and day/night time usages. (Exhibit 4-1)

4.3.3.1 Transmissivity Derived Visibility. Transmissivity data may be used to determine the visibility in the direction of the transmissometer if the indicated visibility is less than 2SM (3200 meters) and the observer considers the data representative. Use the appropriate Table, 4-2 or 4-3, for conversion of transmissivity readings to reportable values of prevailing visibility, if representative, or sector visibility.

4.3.4 Observation Sites. Take visibility observations from as many locations as necessary to view as much of the horizon as practicable. In this respect, natural obstructions, such as trees, hills, etc., are not obstructions to the horizon. These natural obstructions define the horizon.

4.3.5 Selection of Visibility Markers. Insofar as possible, use markers of the type described in 4.2.8 for determining visibility. The red or green course lights, TV and radio tower obstruction lights, etc., may be used as nighttime visibility markers. Because of their intensity, focused lights such as airway beacons may not be used as markers.

4.3.6 Night Vision Adaptation. Before taking visibility observations at night, spend as much time as practicable in the darkness to allow your eyes to become accustomed to the limited light.

4.3.7 Reporting Visibility.

4.3.7.1 Visibility. Visibility shall be evaluated as frequently as practicable. Using all available visibility markers, determine the greatest distances that can be seen in all directions around the horizon circle. When the visibility is greater than the distance to the farthest markers, estimate the greatest distance you can see in each direction. This estimate shall be based on the appearance of all visibility markers. If they are visible with sharp outlines and little blurring of color, the visibility is much greater than the distance to them. If a marker can barely be seen and identified, the visibility is about the same as the distance to the marker.

4.3.7.2 Prevailing Visibility. After visibilities have been determined around the entire horizon circle, resolve them into a single value for reporting purposes. To do this, use either the greatest distance that can be seen throughout at least half the horizon circle, or if the visibility is varying rapidly during the time of observation, use the average of all observed values. Encode the prevailing visibility in all reports.

4.3.7.3 Sector Visibility. When the visibility is not uniform in all directions, divide the horizon circle into arcs (sectors) that have uniform visibility and represent at least one eighth of the horizon circle (45 degrees). The visibility that is evaluated in each sector is sector visibility. Sector visibility shall be coded in the remarks of weather reports when it differs from the prevailing visibility by one or more reportable values and either the prevailing or sector visibility is less than 3 miles.

4.3.7.4 Variable Prevailing Visibility. If the prevailing visibility rapidly increases and decreases by one or more reportable values during the period of evaluation, and either the prevailing or sector visibility is less than 3 miles, the visibility is considered to be variable and the minimum and maximum visibility values observed shall be reported in remarks.

4.3.7.5 Tower Visibility. Tower visibility may be coded when reported by certified Air Traffic Control visibility observers in the Air Traffic Control Tower. The criteria for reporting tower visibility, ***always in remarks***, is when the prevailing or tower visibility is four (4) miles or less and the tower visibility differs from the prevailing visibility.

4.3.8 Reportable Visibility Values. The reportable values for visibility are listed in Table 4-1 for CONUS and Table 4-1A for OCONUS. If the visibility falls halfway between two reportable values, the lower value shall be reported. **NOTE:** Reportable visibility values for manual observations differ slightly from ASOS reportable values. Observers must ensure that the values transmitted are in accordance with Tables 4-1 and 4-1A.

Increments of Separation (Statute Miles)						
1/16	1/8		1/4	1		5
0	3/8	1 1/4	2	3	10	15
1/16	1/2	1 3/8	2 1/4	4	11	20
1/8	5/8	1 1/2	2 1/2	5	12	25
3/16	3/4	1 5/8	2 3/4	6	13	30
1/4	7/8	1 3/4	3	7	14	35
5/16	1	1 7/8		8	15	40
3/8	1 1/8	2		9		etc.

Table 4-1. Reportable Visibility Values (CONUS)

Increments of Separation (Meters)					
NM	SM	METERS	NM	SM	METERS
0.0	0	0000	1.4	1-5/8	2600
0.05	1/16	0100	1.5	1-3/4	2800
0.1	1/8	0200	1.6	1-7/8	3000
0.15	3/16	0300	1.7	2	3200
0.2	1/4	0400	1.8	---	3400
0.25	5/16	0500	1.9	2-1/4	3600
0.3	3/8	0600	2.0	---	3700
0.4	---	0700	2.2	2-1/2	4000
0.45	1/2	0800	---	2-3/4	4400
0.5	---	0900	2.4	---	4500
0.55	5/8	1000	2.5	---	4700
0.6	---	1100	2.6	3	4800
----	3/4	1200	2.7	---	5000
0.7	---	1300	3.0	4	6000
----	7/8	1400	4.0	---	7000
0.8	---	1500	4.3	5	8000
----	1	1600	5.0	6	9000
0.9	---	1700	6.0	7	9999
1.0	1-1/8	1800	7.0	8	9999
1.1	1-1/4	2000	8.0	9	9999
1.2	1-3/8	2200	9.0	10	9999
1.3	1-1/2	2400			

Table 4-1A. Reportable Visibility Values (OCONUS)

VISIBILITY TRANSMISSIVITY CONVERSION FOR 500-FT BASELINE

CORRECTED TRANSMISSIVITY		STATUTE MILES	CORRECTED TRANSMISSIVITY		METERS
DAY	NIGHT		DAY	NIGHT	
.053 .172	---- ----	1/8	.001 .051	.001 .002	100
			.052 .170	.003 .008	200
.173 .285	.011 .044	3/16	.171 .282	.009 .042	300
			.283 .373	.043 .093	400
.286 .376	.045 .096	1/4	.374 .447	.094 .152	500
.377 .450	.097 .155	5/16	.448 .506	.153 .211	600
			.507 .554	.212 .268	700
.451 .534	.156 .243	3/8	.555 .594	.269 .320	800
			.595 .628	.321 .368	900
.535 .614	.244 .348	½	.629 .656	.369 .411	1000
			.657 .681	.412 .448	1100
.645 .670	.349 .433	5/8	.682 .702	.449 .483	1200
			.703 .721	.484 .514	1300
.671 .713	.434 .502	3/4	.722 .737	.515 .542	1400
			.738 .752	.543 .568	1500
.714 .746	.503 .559	7/8	.753 .765	.569 .591	1600
			.766 .777	.592 .612	1700
.747 .772	.560 .605	1	.778 .786	.613 .631	1800
			.787 .796	.632 .649	1900
.773 .793	.606 .643	1-1/8	.797 .805	.650 .665	2000
.794 .811	.644 .676	1-1/4	.806 .813	.666 .680	2100
			.814 .821	.681 .694	2200
.812 .826	.677 .704	1-3/8	.822 .828	.695 .707	2300
			.829 .834	.708 .719	2400
.827 .839	.705 .727	1-1/2	.835 .840	.720 .730	2500
.840 .850	.728 .748	1-5/8	.841 .845	.731 .740	2600
			.846 .851	.741 .750	2700
.851 .859	.749 .766	1-3/4	.852 .855	.751 .759	2800
			.856 .860	.760 .768	2900
.860 .868	.767 .782	1-7/8	.861 .864	.769 .775	3000
.869 .879	.783 .802	2	.865 .868	.776 .783	3100
			.869 .872	.784 .791	3200

NOTES :

1. Use values in this table as a guide in determining sector visibility below 2 statute miles (3200 meters) in the direction of the transmissometer.

2. Computations are based upon the sighting of dark objects against the horizon sky during daylight and the sighting of a 25 cp light at night.

3. Before entering this table with the transmissivity value:

   a. Subtract background illumination.
   b. Divide by 5 if the value was obtained in HIGH mode.

Table 4-2. Transmissivity Derived Visibility (500 Ft Baseline).

VISIBILITY TRANSMISSIVITY CONVERSION FOR 250-FT BASELINE

CORRECTED TRANSMISSIVITY		STATUTE MILES	CORRECTED TRANSMISSIVITY		METERS
DAY	NIGHT		DAY	NIGHT	
.013 .231	---- ----	1/16	.012 .228	.001 .015	100
			.229 .412	.016 .099	200
.232 .415	.018 .101	1/8	.413 .531	.100 .206	300
			.532 .611	.207 .306	400
.416 .534	.102 .210	3/16	.612 .668	.307 .390	500
.535 .614	.211 .309	1/4	.669 .711	.391 .460	600
			.712 .744	.461 .518	700
.615 .671	.310 .394	5/16	.745 .770	.519 .566	800
			.771 .792	.567 .607	900
.672 .731	.395 .493	3/8	.793 .810	.608 .641	1000
.732 .783	.494 .590	½	.811 .825	.642 .669	1100
			.826 .838	.670 .695	1200
			.839 .849	.696 .717	1300
.784 .819	.591 .658	5/8	.850 .859	.718 .736	1400
			.860 .867	.737 .753	1500
.820 .845	.659 .709	3/4	.868 .875	.754 .768	1600
.846 .864	.710 .747	7/8	.876 .881	.769 .782	1700
			.882 .886	.783 .794	1800
.865 .879	.748 .778	1	.887 .892	.795 .805	1900
			.893 .897	.806 .815	2000
.880 .891	.779 .802	1-1/8	.898 .901	.816 .824	2100
.892 .901	.803 .822	1-1/4	.902 .905	.825 .833	2200
			.906 .909	.834 .840	2300
.902 .909	.823 .839	1-3/8	.910 .913	.841 .848	2400
			.914 .916	.849 .854	2500
.910 .916	.840 .853	1-1/2	.917 .919	.855 .860	2600
.917 .922	.854 .865	1-5/8	.920 .922	.861 .866	2700
			.923 .924	.867 .871	2800
.923 .827	.866 .875	1-3/4	.925 .927	.872 .876	2900
			.928 .929	.877 .880	3000
.928 .932	.876 .884	1-7/8	.930 .931	.881 .884	3100
			.932 .933	.885 .889	3200
.933 .937	.885 .896	2			

NOTES :

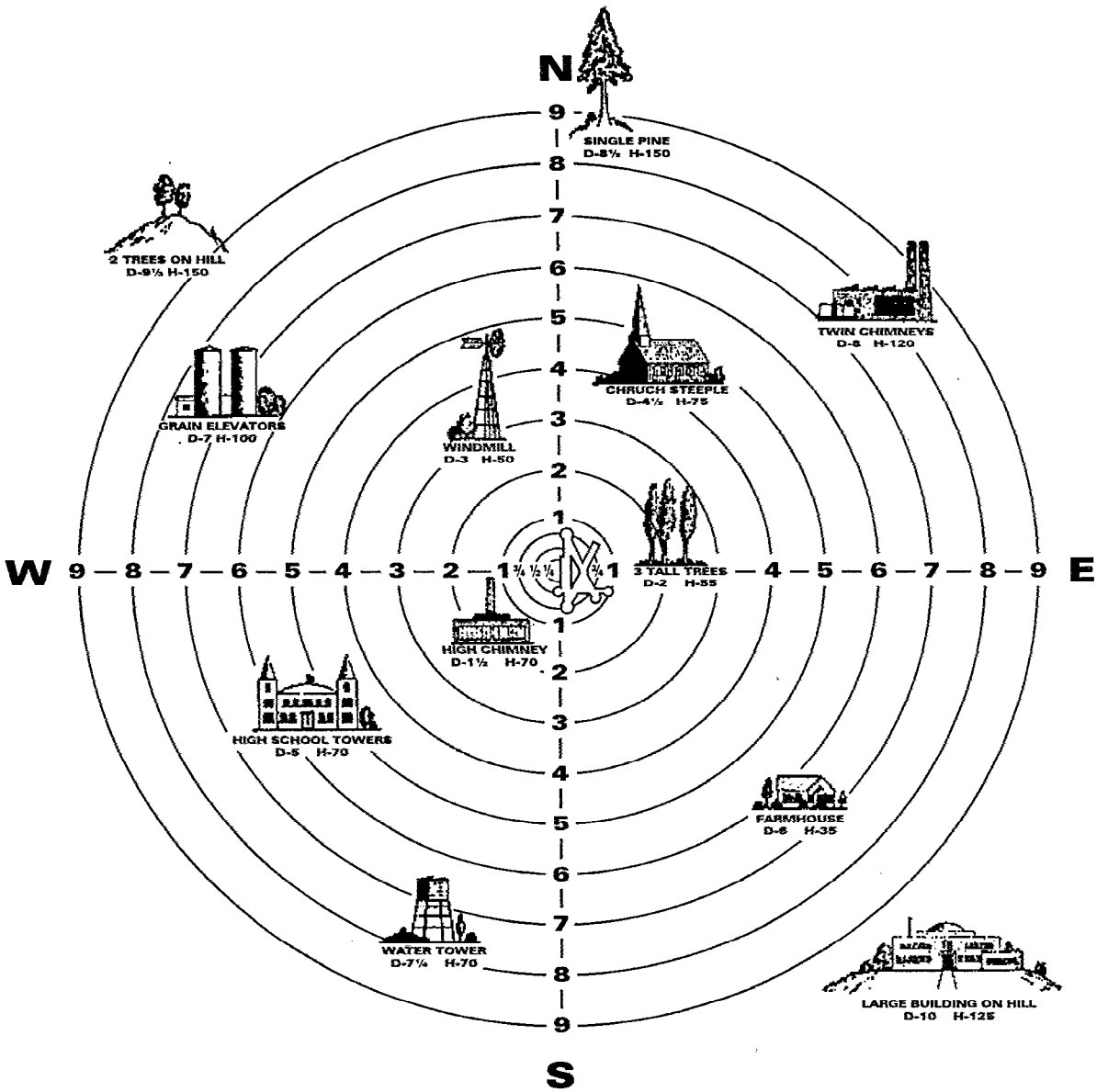
1. Use values in this table as a guide in determining sector visibility below 2 statute miles (3200 meters) in the direction of the transmissometer.

2. Computations are based upon the sighting of dark objects against the horizon sky during daylight and the sighting of a 25 cp light at night.

3. Before entering this table with the transmissivity value:

   a. Subtract background illumination.
   b. Divide by 5 if the value was obtained in HIGH mode.

Table 4-3. Transmissivity Derived Visibility (250 Ft Baseline).



Visibility Check Point Diagram

Exhibit 4-1

Note: It is advisable to prepare two visibility check point charts, one to indicate markers within a radius of 1-2 miles and the other for markers beyond. Night visibility markers should normally be indicated in red by circling or entry of the letter "N" beneath the other identification data. In the example above, "D" indicates distance in statute miles, and "H" indicates object height in feet.

4.4 **Introduction (Runway Visual Range).** Runway visual range (RVR) is a measure of the horizontal visibility as determined from instruments located alongside and about 14 feet higher than the center of the runway. It is calibrated with reference to the sighting of either high-intensity runway lights or the visual contrasts of other targets, whichever yields the greater visual range. **Only activities with an operational requirement shall report RVR**.

4.5 **Definitions**.

4.5.1 Baseline. The distance between the transmitting and receiving instruments of a transmissometer unit. Baselines are generally 500 feet or 250 feet.

4.5.2 Day Scale / Night Scale. Conversion scales for measuring the correct amount of transmittance adjusted for background illumination. It is used in conjunction with the proper "light setting".

4.5.3 Light Setting. The actual runway light setting used by air traffic control.

4.5.4 Designated RVR Runway. Any runway or runways officially designated for the reporting of RVR.

4.5.5 Transmissivity. The passage of light through the atmosphere.

4.5.6 Transmissometer. An instrument used to measure the amount of light, as expressed by either a percentage of received light (transmissometer), or an extinction coefficient (forward scatter meter), which passes through the atmosphere.

4.6 **Runway Visual Range Evaluation**.

4.6.1 RVR Standards. RVR will be disseminated in feet whenever the prevailing visibility is one mile or less, or the RVR for the designated runway is 6,000 feet or less. The 10-minute RVR values are reported in increments of 200 feet through 3,000 feet and in increments of 500 feet above 3,000 feet. RVR is required at stations with visibility measuring equipment installed near one or more runways on the airfield.

4.6.2 Basic Observing Requirements. A knowledge of the following factors is essential to RVR observing and reporting requirements:

a. The location of all RVR equipment on the airfield and the relationship of RVR sensors and readouts to the runway approaches.

b. The RVR category minima for all RVR runways.

c. The active runway and the current light setting (or, if the runway lights are turned off, but operational, the light setting which would normally be used if aircraft activity were in progress; determined in coordination with the local air traffic control agency).

d. The applicable day or night condition (i.e., when appropriate to the conversion of transmissivity readings in percent).

4.6.3 Determination of RVR. Obtain RVR data by direct reading of digital displays when available and runway lights are operational on light setting 3, 4, or 5. Obtain RVR data by conversion of transmissivity readings when digital data are not available. Computations of RVR data shall normally be based upon the current runway light setting 3, 4, or 5 at airfields with published RVR minima. When runway lights are turned off, but still operational, base RVR computations on the appropriate light setting which would normally be used by manually setting the LIGHT SETTING switch on the FMN-1 (i.e., as determined in coordination with the local air traffic control agency). Where runway lights are inoperative or at airfields with no published RVR minima in the DOD FLIPS, compute RVR data using values from the column labeled "other" in transmissivity conversion tables.

4.7 **Equipment Operation**. Operate and use visibility and RVR equipment according to appropriate technical orders or operating handbooks and the supplementary instructions in the following paragraphs.

4.7.1 Transmissometer Determined Values. Transmissometer determined values are applicable only to the specified runway near which the instrument is located. Data shall not be used during periods in which the observer determines the instrumental values are not representative for the associated runway.

4.7.2 Transmission Variation. Almost all short-term fluctuations of visual range as displayed on the recorder and applicable meter or computer readout are real. The transmissometer is very sensitive to the varying light transmission characteristics of the atmosphere; and, variations are more frequent under low visibility conditions. For this reason, caution should be used in rejecting runway visual range values as erroneous.

4.7.3 Recorder-Indicator Mode of Operation. The recorder-indicator RANGE SWITCH should be in the LOW position (mode) for normal operations. Place the switch in the HIGH mode during periods in which the mean transmissivity is less than 20%. Transmissivity values obtained from either the recorder or meter while in HIGH mode shall be divided by 5 before entering the transmissivity conversion tables.

4.7.4 Operation Requirements. As a general rule, transmissometers should be in continuous operation.
NOTE: Transmissometer displayed values are from the inactive runway when the FMN-1 digital computer is in use. Switch sensors prior to using data from the transmissometer for the active runway.

4.7.4.1 RVR Computer. The RVR computer equipment should be in continuous operation during periods when visibility is reduced to, or forecast to be, 2 miles (3200 meters) or less within 3 hours. The set may be turned off if neither of these conditions exist and there is no local requirement to continue operation.

4.7.4.2 Recorder-Indicator with Multiple Instrumentation. Operate the recorder-indicator using the following guidelines at stations with transmissometers installed near both ends of a runway.

a. At non-Category II RVR stations, the equipment should normally be switched to the sensors at the inactive end of the runway during periods in which the FMN-1 is in use. However, it shall be switched to the active runway during periods in which the FMN-1 is inoperative, not available, or not in use (e.g., when runway lights are turned off or not operational).

b. At Category II RVR stations, the recorder-indicator should normally be switched to sensing equipment located near the touchdown end of the runway.

4.7.5 Recorder-Indicator Evaluation. Ensure that the recorder-indicator is switched to the active runway when necessary to manually determine transmissivity; e.g., digital readout inoperative or not available, or the runway lights are inoperative. Obtain a one-minute mean of the transmissivity, to the nearest ½%, from the recorder trace or transmission meter. Determine and apply a background correction to the reading. If the recorder-indicator is in HIGH mode of Operations, divide the transmissivity value by 5 before conversion to equivalent RVR visibility.

4.7.6 Transmissivity Conversion. Convert "corrected" percentages to equivalent RVR or visibility values. Consider the following factors:

a. Day-Night Conditions - An appropriate time should be selected for changing from day tabular values to night tabular values (or vice versa) in conversion of transmissivity to actual distances. In general, the day values should be used into the evening until low intensity lights on or near the airfield complex are clearly visible, and the night values should be used into the morning until these lights begin to fade.

b. Runway Light Setting - Determine the runway light setting in use when converting transmissivity to obtain RVR. Sector visibility is based on visual contrast rather than on the runway light setting.

c. Selection of Conversion Table - Use a table appropriate to the transmissometer baseline, the unit of measure, and the purpose of the evaluation. Use Tables 4-4 and 4-5 to determine RVR.

4.7.7 Equipment Evaluation. Log transmissometer equipment as inoperative and notify maintenance whenever:

a. RVR and/or sector visibility data is required and transmissivity values are not representative due to probable equipment problems.

b. Transmissivity is over 100 percent.

c. Transmissivity (including background checks) is below 0 percent.

d. When prevailing visibility is 7 miles (9000 meters) or greater and transmissivity is less than 90 percent and there is no obscuration present at the transmissometer detector.

RVR (FEET/METERS) TRANSMISSIVITY CONVERSION FOR 500-FT BASELINE								
NIGHT					DAY			
Mtrs (Ft)	LS 5	LS 4	LS 3	Other	LS 5	LS 4	LS3	Other
M300 1000-	.000 - .001	.000 - .003	.000 - .007	.000 - .016	.000 - .039	.000 - .095	.000 - .200	.000 - .200
0300 1000	.002 - .005	.004 - .010	.008 - .022	.017 - .037	.040 - .084	.096 - .175	.201 - .268	.201 - .268
0360 1200	.006 - .013	.011 - .024	.023 - .044	.038 - .065	.085 - .140	.176 - .261	.269 - .328	.269 - .328
0420 1400	.014 - .025	.025 - .043	.045 - .074	.066 - .098	.141 - .201	.262 - .343	.329 - .380	.329 - .380
0490 1600	.026 - .042	.044 - .067	.075 - .108	.099 - .134	.202 - .261	.344 - .419	.381 - .426	.381 - .426
0550 1800	.043 - .062	.068 - .095	.109 - .145	.135 - .171	.262 - .319	.420 - .466	.427 - .466	.427 - .466
0610 2000	.063 - .085	.096 - .124	.146 - .183	.172 - .207	.320 - .373	.467 - .501	.467 - .501	.467 - .501
0670 2200	.086 - .109	.125 - .155	.184 - .220	.208 - .242	.374 - .422	.502 - .532	.502 - .532	.502 - .532
0730 2400	.110 - .135	.156 - .186	.221 - .257	.242 - .276	.423 - .468	.533 - .560	.533 - .560	.533 - .560
0790 2600	.135 - .161	.187 - .217	.258 - .292	.277 - .308	.469 - .509	.561 - .584	.561 - .584	.561 - .584
0850 2800	.162 - .187	.218 - .247	.293 - .326	.309 - .338	.510 - .547	.585 - .606	.585 - .606	.585 - .606
0910 3000	.188 - .213	.248 - .276	.327 - .358	.339 - .366	.548 - .581	.607 - .626	.607 - .626	.607 - .626
0970 3200	.214 - .239	.277 - .305	.359 - .389	.367 - .393	.582 - .612	.627 - .644	.627 - .644	.627 - .644
1030 3400	.240 - .263	.306 - .331	.390 - .417	.394 - .418	.613 - .640	.645 - .661	.645 - .661	.645 - .661
1100 3600	.264 - .287	.332 - .357	.418 - .444	.419 - .444	.641 - .665	.662 - .676	.662 - .676	.662 - .676
1160 3800	.288 - .310	.358 - .382	.445 - .469	.445# - .469#	.666 - .689	.677 - .689	.677 - .689	.677 - .689
1220 4000	.311 - .349	.383 - .422	.470 - .509	.470# - .509#	.690 - .711	.690 - .711	.690 - .711	.690 - .711
1370 4500	.350 - .399	.423 - .473	.510 - .560	.510# - .560#	.712 - .737	.712 - .737	.712 - .737	.712 - .737
1520 5000	.400 - .444	.474 - .517	.561 - .603	.561# - .603#	.738 - .759	.738 - .759	.738 - .759	.738 - .759
1670 5500	.445 - .484	.518 - .557	.604 - .640	.604# - .640#	.760 - .777	.760 - .777	.760 - .777	.760 - .777
1830 6000	.485 - .520	.558 - .591	.641 - .672	.641# - .672#	.778 - .793	.778 - .793	.778 - .793	.778 - .793
P1830 6000+	.521 and above	.592 and above	.673 and above	.673# and above	.794 and above	.794 and above	.794 and above	.794 and above

** SEE NOTES CONCERNING PROPER USE OF TABLE **

Table 4-4. RVR Transmissivity Conversion (**500 Ft Baseline**).

RVR (FEET/METERS) TRANSMISSIVITY CONVERSION FOR 250-FT BASELINE								
	NIGHT				DAY			
Mtrs (Ft)	LS 5	LS 4	LS 3	Other	LS 5	LS 4	LS3	Other
M0180 0600-	.000 - .001	.000 - .003	.000 - .007	.000 - .018	.000 - .030	.000 - .067	.000 - .150	.000 - .235
0180 0600	.002 - .011	.004 - .020	.008 - .036	.019 - .064	.031 - .104	.068 - .184	.151 - .328	.236 - .355
0240 0800	.012 - .035	.021 - .055	.037 - .086	.065 - .126	.105 - .197	.185 - .309	.329 - .447	.356 - .447
0300 1000	.036 - .071	.056 - .102	.087 - .147	.127 - .192	.198 - .290	.310 - .419	.448 - .517	.448 - .517
0360 1200	.072 - .113	.103 - .155	.148 - .211	.193 - .255	.291 - .375	.420 - .511	.518 - .572	.518 - .572
0420 1400	.114 - .159	.156 - .208	.212 - .272	.256 - .314	.376 - .448	.512 - .586	.573 - .617	.573 - .617
0490 1600	.160 - .205	.209 - .259	.273 - .329	.315 - .366	.449 - .511	.587 - .647	.618 - .653	.618 - .653
0550 1800	.206 - .249	.260 - .308	.330 - .381	.367 - .413	.512 - .564	.648 - .683	.654 - .683	.654 - .683
0610 2000	.250 - .291	.309 - .353	.382 - .427	.414 - .455	.565 - .610	.684 - .708	.684 - .708	.684 - .708
0670 2200	.292 - .331	.354 - .394	.428 - .469	.456 - .492	.611 - .650	.709 - .730	.709 - .730	.709 - .730
0730 2400	.332 - .367	.395 - .432	.470 - .507	.493 - .525	.651 - .684	.731 - .748	.731 - .748	.731 - .748
0790 2600	.368 - .401	.433 - .466	.508 - .541	.526 - .555	.685 - .714	.749 - .764	.749 - .764	.749 - .764
0850 2800	.402 - .433	.467 - .497	.542 - .571	.556 - .581	.715 - .739	.765 - .779	.765 - .779	.765 - .779
0910 3000	.434 - .482	.498 - .546	.572 - .617	.582 - .622	.740 - .777	.780 - .800	.780 - .800	.780 - .800
1070 3500	.483 - .541	.547 - .603	.618 - .671	.623 - .671#	.778 - .819	.801 - .824	.801 - .824	.801 - .824
1220 4000	.542 - .591	.604 - .649	.672 - .714	.672# - .714#	.820 - .843	.825 - .843	.825 - .843	.825 - .843
1370 4500	.592 - .632	.650 - .687	.715 - .748	.715# - .748#	.844 - .858	.844 - .858	.844 - .858	.844 - .858
1520 5000	.633 - .666	.688 - .719	.749 - .777	.749# - .777#	.859 - .871	.859 - .871	.859 - .871	.859 - .871
1670 5500	.667 - .696	.720 - .746	.778 - .800	.778# - .800#	.872 - .882	.872 - .882	.872 - .882	.872 - .882
1830 6000	.697 - .721	.747 - .769	.801 - .820	.801# - .820#	.883 - .890	.883 - .890	.883 - .890	.883 - .890
P1830 6000+	.722 and above	.770 and above	.821 and above	.821# and above	.891 and above	.891 and above	.891 and above	.891 and above

** SEE NOTES CONCERNING PROPER USE OF TABLE **

Table 4-5. RVR Transmissivity Conversion (**250 Ft Baseline**).

Notes Concerning Tables 4-4 and 4-5

1. This table is designed for use at locations with airfield minima published in either feet or meters.

2. Before entering the table with a transmissivity value:

   a. Subtract background illumination.

   b. Divide by 5 if value was obtained in HIGH mode.

3. Use Column labeled "Other" when runway lights are inoperative or otherwise not available.

4. Values identified by "#" were adjusted to accomplish necessary compatibility between respective equations.

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CHAPTER 5 - PRESENT WEATHER

5.1 **Introduction**. This chapter contains instructions on identifying, recording, and reporting present weather. For the purpose of this manual, present weather is a category of atmospheric phenomena that are divided into three groups which include precipitation, obscuring phenomena, and other weather phenomena including tornadic activity, well-developed dust/sand whirls, squalls, thunderstorms, sandstorms, and duststorms. Obscuring phenomena are those phenomena that reduce either horizontal or vertical visibility.

5.2 **Definitions - Precipitation**. Any of the forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the ground. The types of precipitation reported are:

a. Drizzle (DZ). Fairly uniform precipitation composed exclusively of fine drops (diameter less than 0.02 inch) very close together.

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

c. Snow (SN). Precipitation of snow crystals, mostly branched in the form of six-pointed stars. At temperatures higher than about minus 5°C (23°F), the crystals are generally clustered to form snowflakes.

d. Snow Grains (SG). Precipitation of very small, white, opaque grains of ice. When the grains hit hard ground, they do not bounce or shatter. They usually fall in small quantities, mostly from stratus type clouds, and never as showers.

e. Ice Crystals (IC). A fall of unbranched ice crystals in the form of needles, columns, or plates. These 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); they may then produce a luminous pillar or other optical phenomena. This hydrometer (rarely more than the lightest precipitation) which is frequent in polar regions, occurs only at very low temperatures in stable air masses.

f. Ice Pellets (PE). Precipitation of transparent or translucent pellets of ice, which are round or irregular, rarely conical, and which have a diameter of 0.2 inch, or less. The pellets usually rebound when striking hard ground, and make a sound on impact. There are two main types:

(1) Hard grains of ice consisting of frozen raindrops, or largely melted and refrozen snowflakes. This type falls as continuous or intermittent precipitation.

(2) Pellets of snow encased in a thin layer of ice which have 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.

g. Hail (GR). Precipitation in the form 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.

h. Small Hail or Snow Pellets (GS). Precipitation of white, opaque grains of ice. The grains are round or sometimes conical. Diameters range from about 0.08 to 0.2 inch. Snow pellets are brittle and easily crushed; when they fall on hard ground, they bounce and often break up.

5.3 **Definitions - Obscuring Phenomena**. Any phenomenon in the atmosphere *that reduces horizontal visibility to less than 7 miles* is considered an obscuration. The types of obscurations reported are:

a. Mist (BR). A visible aggregate of microscopic and more-or-less hygroscopic water droplets suspended in the atmosphere, based at the earth's surface, and reduces prevailing visibility to between 5/8 and 6 SM.

b. Fog (FG). A visible aggregate of minute water particles (droplets) which are based at the Earth's surface. Fog reduces horizontal and vertical visibility, and may extend over a sizeable area. In surface reports, fog is recorded when the depth of the phenomena is **greater than** 20 feet and reduces prevailing visibility to **less than** 5/8 SM.

c. Smoke (FU). A suspension of small particles in the air produced by combustion. This phenomenon may be present either near the Earth'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; for example, 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.

d. Volcanic Ash (VA). Fine particles of rock powder that are blown out from a volcano and that may remain suspended in the atmosphere for long periods.

e. Widespread Dust (DU). Fine particles of dust or sand suspended in the air by a duststorm or sandstorm that may have occurred at or far away from the station. Dust gives a tan or gray tinge to distant objects. The sun's disk appears pale and colorless, or may have a yellow tinge when viewed through dust.

f. Sand (SA) (blowing). Sand raised by the wind to moderate heights above the ground.

g. Haze (HZ). 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 phenomenon resembles a uniform veil over the landscape that subdues all colors. Dark objects viewed through this veil tend to have a bluish tinge while bright objects, such as the sun or distant lights, 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 silvery tinge. Haze particles may be composed of a variety of substances; e.g., dust, salt, residue from distant fires or volcanoes, pollen. The particles, generally, are well diffused through the atmosphere.

h. Spray (PY) (blowing). An ensemble of water droplets torn by the wind from the surface of an extensive body of water, generally from the crests of waves, and carried up a short distance in the air in such quantities as to reduce the horizontal visibility at eye level (6 feet).

5.4 **Definitions - Other Weather Phenomena**

5.4.1 Tornadic Activity

a. Tornado (+FC). A violent, rotating column of air, forming a pendant and touching the ground. Usually occurs from a cumulonimbus cloud. It nearly always starts as a funnel cloud, and is accompanied by a loud roaring noise not unlike that of a locomotive.

b. Funnel Cloud (FC). A violent, rotating column of air which does not touch the surface, usually a pendant from a cumulonimbus cloud.

c. Waterspout (+FC). A violent, rotating column of air, which forms over a large body of water, such as a bay, gulf, or lake, and touches the water surface.

5.4.2 Other

a. Well-developed Dust/Sand Whirl (PO). An ensemble of particles of dust or sand, sometimes accompanied by small litter, raised from the ground in the form of a whirling column of varying height with a small diameter and an approximately vertical axis.

b. Squall (SQ). 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.

c. Sandstorm (SS). Particles of sand that are carried aloft by a strong wind. The sand particles are mostly confined to the lowest ten feet, and rarely rise more than fifty feet above the ground.

d. Duststorm (DS). An unusual, frequently severe weather condition characterized by strong winds and dust-filled air over an extensive area.

5.5 **Definitions - Qualifiers**. Present weather qualifiers fall into two categories: (1) intensity or proximity and (2) descriptors. Qualifiers may be used in various combinations to further enhance present weather.

5.5.1 Intensity or Proximity.

a. Intensity. Intensities are defined as light (-), moderate (no entry), or heavy (+). Intensities shall not be assigned to hail (GR) or ice crystals (IC). When intensity is assigned to the

precipitation "group", it denotes the intensity of the predominant type of precipitation i.e., the one entered first.

b. Proximity. Proximities are defined below and shall be used to describe locations of present weather phenomena.

(1) At Station (No entry). Indicates the phenomena is occurring within five (5) statute miles of the observing location.

(2) Vicinity (VC). Indicates the phenomena is occurring 5 to 10 miles from the station.

(3) Distant (DSNT) (Remarks). Indicates the phenomena is occurring at a distance of greater than 10 statute miles from the station.

5.5.2 Descriptors. Descriptors are qualifiers which further amplify weather phenomena and are only used with certain *types of precipitation and obscurations*. The descriptor qualifiers are:

a. Shallow (MI), Partial (PR), and Patches (BC). These descriptors shall only be used to further describe **Fog (FG)** that has *little vertical extent* (less than 6 feet for MI, normally greater than 6 feet but less than 20 feet for PR and BC), and reduces horizontal visibility, but to a lesser extent vertically. The stars may often be seen by night and the sun by day. PR and BC may or may not reduce prevailing visibility. Shallow fog (MIFG) indicates no reduction in prevailing visibility above 6 feet.

b. Low Drifting (DR). Used to further describe the condition of dust, sand, or snow which is raised by the wind to a height of *less than 6 feet* and does *not* reduce the prevailing visibility.

c. Blowing (BL). Used to further describe the condition of dust, sand, snow, and/or spray which is raised by the wind to a height of *6 feet or more* and *does* reduce the prevailing visibility.

d. Shower(s) (SH). Used to describe *precipitation* as characterized by the suddenness with which they start and stop, by the rapid changes in intensity, and usually by rapid changes in the appearance of the sky.

e. Thunderstorm (TS). A local storm produced by a cumulonimbus cloud that is accompanied by lightning and/or thunder, usually with gusty winds, heavy rain, and sometimes, with hail.

f. Freezing (FZ). Used to further describe the effect of fog (FG), drizzle (DZ), and/or rain (RA) which freezes upon contact with exposed surfaces.

5.6 Definitions - Miscellaneous Terms

a. Core Sample. A core sample is a section cut from the snow cover at a station to determine the amount of water present in the solid state.

b. Freezing. The condition of the lower atmosphere when the temperature of surface objects

is 0°C (32°F) or lower.

c. Glaze. (Clear Ice). A coating of ice, generally clear and smooth, but with some air pockets. It is formed on exposed objects at temperatures below or slightly above the freezing temperature by the freezing of super-cooled drizzle or rain drops. Glaze is denser, harder, and more transparent than either rime or hoar frost.

d. Lightning. A visible electrical discharge produced by thunderstorms. Four main types of lightning can be distinguished:

(1) Cloud to Ground Discharges (CG). Lightning occurring between cloud and ground.

(2) In-Cloud Discharges (IC). Lightning which takes place within the cloud.

(3) Cloud to Cloud Discharges (CC). Streaks of lightning reaching from one cloud to another.

(4) Cloud to Air Discharges (CA). Streaks of lightning which pass from a cloud to the air, but do not strike the ground.

e. Rime. A deposit of ice, produced by fog at temperatures below freezing. It is composed of grains separated by air, sometimes adorned with crystalline branches.

f. Snowboard. An aid for measuring new snowfall. The snowboard is made of a piece of thin, light-colored, wooden board, at least 2 feet square, or an equivalent, light-weight, poor conductor of heat.

g. Water Equivalent. This is the amount of liquid produced by melting frozen precipitation.

5.7 **Identification of Weather Phenomena**. Weather phenomena fall into three groups: (1) precipitation, (2) obscurations, and (3) other phenomena. These three groups of weather phenomena shall be combined with the qualifiers (intensity or proximity and descriptors), listed in the preceding paragraphs, to identify present weather that is occurring. Each "group" shall be separated by a space.

a. Shallow (Ground) Fog (MIFG). When fog covers the station and visibility at 6 feet above the ground is (1) 7 SM or more and (2) the apparent visibility in the fog layer is *less than* 5/8 SM, "shallow" shall be used to further describe the fog.

b. Partial Fog (PRFG). When fog covers a substantial part of the station and visibility in the fog is *less than* 5/8 SM ***and*** visibility over the uncovered parts of the station is 5/8 SM *or more*, "partial" shall be used to further describe the fog. May be coded with prevailing visibility of 7 SM or greater.

c. Patchy Fog (BCFG). When fog covers portions of the station and the apparent visibility in the fog patch or bank is *less than* 5/8 SM ***and*** visibility over the uncovered portions of the station is 5/8 SM or greater, "patches" shall be used to further describe the fog. May be coded with

prevailing visibility of 7 SM or greater.

d. Low Drifting Dust/Sand/Snow (DRDU, DRSA, DRSN). Dust, sand, or snow raised by the wind to *less than 6 feet* above the ground. Visibility *is not reduced below* 7SM at eye level although obstructions below this level may be veiled or hidden by the particles moving nearly horizontal to the ground.

e. Blowing Dust/Sand/Snow (BLDU, BLSA, BLSN). Dust, sand, or snow raised by the wind to a height sufficient to reduce the horizontal visibility to below 7SM.

f. Blowing Spray (BLPY). Water droplets torn by the wind from a body of water, generally from the crests of waves, and carried up into the air in such quantities that reduces the horizontal visibility to below 7SM.

g. Rainshower(s) (SHRA). Rain which starts and stops, or changes intensity abruptly.

h. Snowshower(s) (SHSN). Snow which starts and stops, or changes intensity abruptly.

i. Ice Pellet shower(s) (SHPE). Ice pellet events which start and stop, or change intensity abruptly.

j. Hail shower(s) (SHGR). Hail events which start and stop, or change intensity abruptly.

k. Small Hail/Snow Pellet shower(s) (SHGS). Small hail/snow pellet events which start and stop abruptly.

l. Freezing Drizzle/Rain (FZDZ/FZRA). Drizzle/rain which freezes upon impact with the ground, or other exposed objects.

m. Freezing (Ice) Fog (FZFG). A suspension of numerous minute ice crystals in the air, or water droplets at temperatures below 0 Celsius, based at the Earth's surface, which reduces horizontal visibility to less than 7SM; also called ice fog.

5.8 **Present Weather Standards**. When more than one type of weather and/or obscuring phenomena is reported at the same time, they shall be reported in the following order:

TORNADO, FUNNEL CLOUD, or WATERSPOUT,
Thunderstorm(s) with or without associated precipitation,
Present weather in decreasing order of predominance, i.e., the most dominant type is reported first and, left to right in Table 5-1 (Columns 1 through 5).

Weather Reporting Notation[1]				
Qualifier		Weather Phenomena		
Intensity or Proximity 1	Descriptor 2	Precipitation 3	Obscuration 4	Other 5
- Light	MI Shallow	DZ Drizzle	BR Mist	PO Well-dvlpd Dust/Sand Whirls
Moderate [2]	PR Partial	RA Rain	FG Fog	
+ Heavy	BC Patches	SN Snow	FU Smoke	
VC Vicinity [3]	DR Low Drifting	SG Snow Grains	VA Volcanic Ash	SQ Squalls
	BL Blowing	IC Ice Crystals	DU Widespread Dust	FC[4] Funnel Cloud Tornado Waterspout
	SH Shower(s)	PE Ice Pellets	SA Sand	SS Sandstorm
	TS Thunderstorm	GR Hail	HZ Haze	DS Duststorm
	FZ Freezing	GS Small Hail and/or Ice Pellets	PY Spray	

1. The weather "groups" shall be constructed by considering Columns 1 to 5 in the table above in sequence, i.e., intensity, followed by description, followed by weather phenomena, e.g., heavy rainshower(s) is coded as +SHRA.
2. To denote moderate intensity no entry is used.
3. See paragraph 5.5.1 for vicinity definitions.
4. Tornadoes and waterspouts shall be coded as +FC.

Table 5-1. Notations for Reporting Present Weather

5.8.1 Precipitation. The intensity, descriptor, and type of precipitation shall be reported when observed (5.5.1 and 5.5.2). The amount of precipitation and depth of freezing or frozen precipitation shall also be reported 9.12.2.1.

a. Liquid Precipitation. Drizzle (DZ), Rain (RA), and Rainshower(s) (SHRA), shall be reported when observed. The descriptor (SH) shall be used to describe rain of a showery-nature.

b. Freezing Precipitation. Drizzle (DZ) and Rain (RA) shall be reported as freezing, using the descriptor (FZ), when they are observed to occur and the surface temperature is below 0° Celsius.

c. Solid Precipitation. The following shall be reported, using the appropriate descriptors, when they are observed to occur.

(1) Snow (SN)

(2) Snowshower(s) (SHSN) - Use the descriptor (SH) to denote showery-nature.

(3) Blowing Snow (BLSN) - Use the descriptor (BL) to describe snow that is raised by the wind to a height sufficient *to reduce* horizontal visibility to *less than* 7SM.

(4) Low Drifting Snow (DRSN) - Use the descriptor (DR) to describe snow that is raised by the wind to less than 6 feet above the ground and *does not reduce* horizontal visibility to less than 7 SM.

(5) Snow Grains (SG)

(6) Ice Pellets (PE)

(7) Ice Pellet Shower(s) (SHPE) - Use the descriptor (SH) to denote showery-nature.

(8) Hail (GR) - Hail shall be reported when hailstones are 1/4 inch or larger in diameter. Hail shall be reported when it is determined to begin, be in progress, or end.

(9) Hail Showers (SHGR)

(10) Small Hail and/or Snow Pellets (GS) - Hailstones less than 1/4 inch shall be reported as small hail and/or snow pellets (GS); and shall also be reported when it is determined to begin, be in progress, or end.

(11) Small Hail and/or Snow Showers (SHGS)

5.8.2 Thunderstorm (TS). A thunderstorm shall be reported using the descriptor (TS), when observed to begin, to be in progress, or to end. In addition to reporting a thunderstorm in the body of the METAR/SPECI, a remark shall be added to report the location and movement of the storm (5.9.11).

5.8.3 Obscuring Phenomena. The following shall be reported, using the appropriate descriptors, when they are observed to occur.

a. Mist (BR)

b. Fog (FG)

c. Smoke (FU)

d. Volcanic Ash (VA)

e. Widespread Dust (DU)

f. Sand (SA)

g. Blowing Sand (BLSA) - Use the descriptor (BL) to describe sand that is raised by the wind to a height sufficient to *reduce* horizontal visibility to *less than* 7SM.

h. Haze (HZ)

i. Blowing Spray (BLPY) - Use the descriptor (BL) to describe water droplets torn by the wind from a body of water, generally from the crests of waves, and carried up into the air in such quantities that *reduces* the horizontal visibility to *below* 7SM.

5.8.4 Other Weather Phenomena. The following shall be reported, using the appropriate intensity qualifiers, when they are observed to occur.

a. Well-Developed Dust/Sand Whirls (PO)

b. Squall (SQ) - Report a squall when there is a sudden increase in wind speed of at least 16 knots, which is sustained at 22 knots or more for at least one minute.

c. Tornado, Waterspout, or Funnel Cloud (FC) - A tornado, waterspout, or funnel cloud shall be reported when observed to begin, to be in progress, or to end. In addition to coding it in the body of the report, a remark shall be added to indicate the location and movement.

The intensity qualifier "+" is used only with Tornado and Waterspout.

d. Sandstorm (SS) - Report a sandstorm if the prevailing visibility is *reduced to* between 5/8 and 5/16 statute mile.

e. Heavy Sandstorm (+SS) - Report a heavy sandstorm preceded by the intensity qualifier (+) when prevailing visibility is reduced to *less than* 5/16 statute mile.

f. Duststorm (DS) - Report a duststorm if the prevailing visibility is *reduced to* between 5/8 and 5/16 statute mile.

g. Heavy Duststorm (+DS) - Report a heavy duststorm preceded by the intensity qualifier (+) when prevailing visibility is reduced to *less than* 5/16 statute mile.

5.9 **Present Weather Evaluating**. This section describes the proper procedures used in observing and reporting precipitation, obscuring phenomena, and other weather phenomena including, thunderstorms and Tornadic activity.

5.9.1 Reporting and Documenting Precipitation. The intensity, character, and type of precipitation in any form is reported in the body of the weather report whenever it is observed to occur at or in the vicinity of the station. Precipitation observed at a distance from the station is reported in remarks. To report and document precipitation, determine:

a. Time of beginning and ending.

b. Intensity, character, and type.

c. Amount.

5.9.1.1 Time of Beginning and/or Ending of Precipitation. Note to the nearest minute the time that precipitation of any type begins and ends. Report these times in the next METAR if not reported in the previous METAR or SPECI. Report times for separate periods only if the intervening time of no precipitation exceeds 15 minutes. Report the data by identifying the **character** *and* **type**, using the appropriate symbol, followed by "**B**" for began or "**E**" for ended, as appropriate, and the time, including the hour, if it cannot be inferred from the report, and the minutes past the hour; e.g., RAB04SNB19RASNE43, meaning rain began at 04, snow began at 19, and both types ended at 43 minutes past the hour.

5.9.1.2 Determining Precipitation Intensity. Intensity of precipitation is an indication of the amount of precipitation falling at the time of report. No intensity is assigned to hail or ice crystals. Each intensity is defined with respect to the type of precipitation occurring; based either on the 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 necessarily describe the intensity at the *time of report* (Table 5-2). For this reason, Tables 5-3 and 5-4 should be used as a guide to estimate the intensity. Table 5-5 on the other hand, is based on the visibility at the *time of report*, and must be used to determine intensity of snow and drizzle.

Intensity	Criteria
Light	Up to 0.10 inch per hour; maximum 0.01 inch in 6 minutes.
Moderate	0.11 inch to 0.30 inch per hour; more than 0.01 inch to 0.03 inch in 6 minutes.
Heavy	More than 0.30 inch per hour; more than 0.03 inch in 6 minutes.

Table 5-2. Intensity of Rain, Freezing Rain, or Ice Pellets Based on Rate-of-Fall

Intensity	Criteria
Light	From scattered drops that, regardless of duration, do not completely wet an exposed surface up to a condition where individual drops are easily seen.
Moderate	Individual drops are not clearly identifiable; spray is observable just above pavements and other hard surfaces.
Heavy	Rain seemingly falls to sheets; individual drops are not identifiable; heavy spray to height of several inches is observed over hard surfaces.

Table 5-3. Estimating Intensity of Rain or Freezing Rain

Intensity	Criteria
Light	Scattered pellets that do not completely cover an exposed surface regardless of duration. Visibility is not affected.
Moderate	Slow accumulation on ground. Visibility reduced by ice pellets to less than 7 miles.
Heavy	Rapid accumulation on ground. Visibility reduced by ice pellets to less than 3 miles.

Table 5-4. Estimating Intensity of Ice Pellets

Intensity	Criteria
Light	Visibility > ½ mile.
Moderate	Visibility > 1/4 mile but ≤ ½ mile.
Heavy	Visibility ≤ 1/4 mile.

Table 5-5. Intensity of Snow, Snow Grains, Pellets or Drizzle Based on Visibility

When more than one form of precipitation is occurring simultaneously or precipitation is occurring with an obstruction to vision, the precipitation intensities determined shall be no greater than that which would be determined if any of the forms were occurring alone. Report the intensity of precipitation using the symbols in Table 5-6.

Intensity	Precipitation Intensity Symbols
Light	-
Moderate	No symbol is assigned to moderate.
Heavy	+
No intensity is assigned to Hail or Ice Crystals	

Table 5-6. Precipitation Intensity Symbols

5.9.1.3 Determining and Reporting the Type of Precipitation. Use the order of predominance when reporting precipitation. Intensity and descriptor qualifiers shall be used to describe the predominant precipitation.

5.9.1.4 Determining the Character of Precipitation. Use the definitions in this chapter to determine the character of precipitation.

a. Continuous. Intensity changes gradually, if at all.

b. Showery. Precipitation changes intensity, or starts and stops abruptly. Showers (SH) fall from cumuliform clouds. The "SH" precedes only Rain (RA), Snow (SN), Hail (GR/GS) or Ice Pellets (PE), e.g., SHRA, SHSN, SHGR, SHGS, SHPE.

5.9.2 Reporting Freezing Precipitation. Take a SPECI whenever freezing precipitation begins, ends, or changes intensity.

5.9.2.1 Time of Beginning and/or Ending of Freezing Precipitation. Include the time freezing precipitation began and/or ended in the next METAR if not previously reported in a METAR/SPECI.

5.9.2.2 Intensity of Freezing Precipitation.

a. Freezing Drizzle. When freezing drizzle is occurring alone, determine the intensity by using Table 5-5, Visibility as Criteria. If occurring with other precipitation or obstructions to vision, the intensity assigned will be no greater than that determined using visibility criteria if freezing drizzle were occurring alone.

b. Freezing Rain. Determine the intensity of freezing rain by using Table 5-2, Rate-of- Fall, as a guide if a recording instrument is available; otherwise, use Table 5-3, Estimating Intensity of Rain.

5.9.3 Reporting Ice Pellets. Take a SPECI whenever ice pellets begin, end, or change intensity.

5.9.3.1 Time of Beginning and/or Ending of Ice Pellets. Include the time ice pellets began and/or ended in the next METAR if not previously reported in a METAR/SPECI.

5.9.3.2 Intensity of Ice Pellets. The intensity of ice pellets may be estimated by using Table 5-2, Rate-of-Fall criteria, if recording instruments are available; otherwise, estimate the intensity in accordance with Table 5-4, Estimating Intensity of Ice Pellets.

5.9.4 Determining the Amount of Precipitation. Amounts of precipitation are expressed in terms of vertical depth. Precipitation measurements shall be in inches, tenths of inches, or hundredths of an inch depending on the precipitation being measured (see Table 5-7). The following paragraphs describe the different procedures used in measuring the amount of precipitation.

Type of Measurement	Unit of Measure
Liquid Precipitation	0.01 inch
Liquid Equivalent of Solid Precipitation	0.01 inch
Solid Precipitation	0.1 inch
Snow Depth	1 inch

Table 5-7. Units of Measure for Precipitation

5.9.4.1 Priority of Gauges. If more than one type of gauge is available, use the:

a. automated instruments

b. manual instruments

5.9.4.2 Stick Measurement of Liquid Precipitation. Insert a dry measuring stick into the measuring tube. Permit the stick to rest on the bottom for 2 or 3 seconds. Withdraw the stick and read the depth of precipitation at the upper limit of the wet portion. After measuring the liquid in the measuring tube empty it and pour the liquid (if any) from the overflow container into the measuring tube and measure it. Add the two amounts to get the total precipitation. When the measurements are completed, empty the tube and reassemble the gauge.

5.9.4.3 Stick Measurement of Solid Precipitation. When solid or freezing precipitation is anticipated, remove the funnel and measuring tube from the gauge. To measure the precipitation, melt the contents of the overflow container, pour the liquid into the measuring tube and measure it as liquid precipitation. If, because of strong winds, the amount of precipitation is considered to be unrepresentative, disregard the catch and obtain a measurement by a vertical core sampling (5.9.4.5). As an aid in obtaining the measurement of new snowfall, snowboards may be placed on top of the snow after each measurement. Each new snowfall measurement can then be taken from the top of the snow to the snowboard.

5.9.4.4 Core Sampling and Depth Measurements. Select, for core sampling and depth measurements, an area that is smooth, level, preferably grass covered, and as free from drifting as possible. Paved areas and low spots where water tends to collect should be avoided. The size and utilization of the area should permit samples and measurements to be taken in undisturbed snow, approximately two feet apart. The deeper the snow and the greater the drifting, the greater the distance between samples will have to be in order to prevent intersection of the holes, nonrepresentative melting, erosion, or piling up of snow in the holes. Measurements should start along the edge of the area nearest the office to avoid unnecessary tracking of the snow.

5.9.4.5 Water Equivalent of Core Samples. Irregularities caused by uneven terrain, drifting, footsteps, prior sampling, etc., usually introduce some unavoidable errors in this type of water-equivalent measurement. Some of these errors can be materially reduced by the following procedure:

a. Measure the snow depth, to tenths of an inch, at the spot where the core sample has been taken.

b. Measure the snow depth at the most representative location available, to tenths of an inch, as accurately as practicable.

c. Using the snow depth found in subparagraph (a) above and its water equivalent, determine the density of the snowpack by dividing the water equivalent by the depth.

d. Multiply the snow depth in subparagraph (b) above by the density of the core sample in step c. to obtain the adjusted water equivalent of the snow pack.

5.9.4.6 Estimating the Water Equivalent of Snow. When the water equivalent of snow cannot be accurately measured by melting, weighing, or core sampling; estimate the water equivalent to the nearest 0.01 inch. Use Table 5-8 only as a guide in estimating the water equivalency of newly fallen snow.

5.9.4.7 Determination of 3-Hour Accumulation of Precipitation. Insofar as possible, determine the amount of precipitation to be coded in the 3-hour report using a method that will not affect the measurement of the 6-hour report. Do not empty the gauge unless it is necessary to obtain a complete measurement of the accumulation. If the gauge must be emptied during the 3-hourly report, ensure the amount of the 3-hourly is added to the amount obtained at the 6-hourly METAR. In the case of solid precipitation, estimate the water equivalent by using the ratio of water to snow considered most representative if a weighing rain gauge is not available.

5.9.5 Depth Measurement of Solid Forms. For the purposes of depth measurements, the term snow also includes ice pellets, glaze, hail, any combination of these, and sheet ice formed directly or indirectly from precipitation. Therefore, if snow falls, melts, and refreezes, the depth of ice formed will be included in depth measurements of snow. Depth is determined to the nearest 0.1 inch.

5.9.6 Measurement of Total Depth. Measurement of the total depth will be made in accordance with the following instructions:

5.9.6.1 Snow. Thrust the measuring stick vertically into the snow so that the end rests on a snow board. Repeat several times and take the average of the readings. If the ground is covered with ice, cut through the ice and measure the thickness. Add the thickness of the ice to the depth of snow above the ice for the total depth measurement.

5.9.6.2 Drifted Snow. When the snow has drifted, a reasonably accurate depth measurement may be made by taking the average of several measurements over representative areas. These should include the greatest and least depths. For example, if spots with no snow are visible, one of the values should be zero.

5.9.7 Snowfall Within Specified Periods. If practicable, make these measurements on a surface that has been cleared of previous snowfall. If such a spot is not available, and snow boards are not in place, measure the total depth of snow and subtract the depth previously measured. When it is likely that melting and settling of the snow makes such measurements of questionable value, they should be considered as estimated. If the previous snowfall has crusted, the new fall may be measured by permitting the end of the measuring stick to rest on the crust. If different falls of snow are mixed by drifting, measure the total depth of snow and subtract the previously measured depth. The remainder is the approximate depth of the new fall, which will be adjusted, if necessary, to correct for suspected melting, evaporation, and runoff. For example, if several snow showers occur between observations, and each melts before the following one occurs, the total snowfall for the period will be the sum of the maximum depth (measured or estimated) for each occurrence. Estimate the depth only when the maximum is considered to have occurred between scheduled observations at a time impracticable for measuring depth.

5.9.8 Reporting Obscuring Phenomena. Obscurations shall be reported in the body of the report as ***at the station*** (observing location) if the prevailing visibility is *less than* 7 statute mile; in the ***vicinity***

(VC) of the station if the phenomena is occurring between *5 and 10* statute miles; and ***distant*** (DSNT) if the phenomena is *greater than* 10 statute miles. The notations: BR, FG, FU, VA, DU, SA, HZ, and PY shall be used in conjunction with the appropriate qualifiers i.e., intensity/proximity and descriptor, to report the obscuration. If more than one type of obscuration is occurring at the same time, report them in order of decreasing predominance.

MELT WATER EQUIVALENT (INCHES)	NEW SNOWFALL (INCHES)						
	Temperature (°F)						
	34 to 28	27 to 20	19 to 15	14 to 10	9 to 0	-1 to -20	-21 to -40
trace	trace	0.1	0.2	0.3	0.4	0.5	1.0
.01	0.1	0.2	0.2	0.3	0.4	0.5	1.0
.02	0.2	0.3	0.4	0.6	0.8	1.0	2.0
.03	0.3	0.5	0.6	0.9	1.2	1.5	3.0
.04	0.4	0.6	0.8	1.2	1.6	2.0	4.0
.05	0.5	0.8	1.0	1.5	2.0	2.5	5.0
.06	0.6	0.9	1.2	1.8	2.4	3.0	6.0
.07	0.7	1.1	1.4	2.1	2.8	3.5	7.0
.08	0.8	1.2	1.6	2.4	3.2	4.0	8.0
.09	0.9	1.4	1.8	2.7	3.6	4.5	9.0
.10	1.0	1.5	2.0	3.0	4.0	5.0	10.0
.11	1.1	1.7	2.2	3.3	4.4	5.5	11.0
.12	1.2	1.8	2.4	3.6	4.8	6.0	12.0
.13	1.3	2.0	2.6	3.9	5.2	6.5	13.0
.14	1.4	2.1	2.8	4.2	5.6	7.0	14.0
.15	1.5	2.3	3.0	4.5	6.0	7.5	15.0
.16	1.6	2.4	3.2	4.8	6.4	8.0	16.0
.17	1.7	2.6	3.4	5.1	6.8	8.5	17.0
.18	1.8	2.7	3.6	5.4	7.2	9.0	18.0
.19	1.9	2.9	3.8	5.7	7.6	9.5	19.0
.20	2.0	3.0	4.0	6.0	8.0	10.0	20.0
.21	2.1	3.1	4.2	6.3	8.4	10.5	21.0
.22	2.2	3.3	4.4	6.6	8.8	11.0	22.0
.23	2.3	3.4	4.6	6.9	9.2	11.5	23.0
.24	2.4	3.6	4.8	7.2	9.6	12.0	24.0
.25	2.5	3.8	5.0	7.5	10.0	12.5	25.0
.30	3.0	4.5	6.0	9.0	12.0	15.0	30.0
.35	3.5	5.3	7.0	10.5	14.0	17.5	35.0
.40	4.0	6.0	8.0	12.0	16.0	20.0	40.0
.45	4.5	6.8	9.0	13.5	18.0	22.5	45.0
.50	5.0	7.5	10.0	15.0	20.0	25.0	50.0
.60	6.0	9.0	12.0	18.0	24.0	30.0	60.0
.70	7.0	10.5	14.0	21.0	28.0	35.0	70.0
.80	8.0	12.0	16.0	24.0	32.0	40.0	80.0
.90	9.0	13.5	18.0	27.0	36.0	45.0	90.0
1.00	10.0	15.0	20.0	30.0	40.0	50.0	100.0
2.00	20.0	30.0	40.0	60.0	80.0	100.0	200.0
3.00	30.0	45.0	60.0	90.0	120.0	150.0	300.0

This table can only be used in determining amounts of newly fallen snow. It cannot be used for determining the water equivalency (933RRR) of "old" snow. Packing and melting/refreezing have substantial effects on the density of the snow pack and are not accounted for by this table.

Table 5-8. New Snowfall to Estimated Meltwater Conversion Table

5.9.9 Remarks for Obscuring Phenomena. Any occurrence of an obscuration which, in the observers opinion, is significant and not contained elsewhere in the report, should be reported clearly in remarks. Some examples of desirable items to be entered in remarks are: fog dissipating or increasing, smoke drifting over the field, shallow ground fog, drifting snow, obscurations at a distance from, but not at the station.

5.9.9.1 Volcanic Eruption (Geophysical Event). When observed, volcanic eruptions will be reported and disseminated by a SPECI. Pre-eruption volcanic activity shall not be reported. The remark will be plain language and contain the following if known:

a. **Name** of volcano.

b. **Latitude and longitude** or distance and direction from the station.

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.

Example: MT AUGUSTINE VOLCANO 70 MILES SW ERUPTED 231505 LARGE ASH CLOUD EXTENDING TO APPROX 30000 FEET MOVING NE.

5.9.10 Tornado, Waterspout, or Funnel Cloud. Report these phenomena in a SPECI when they are observed by station personnel to begin and/or disappear. Insofar as known, the following should be reported.

a. **Type** of phenomenon, spelled out.

b. **Time** of beginning, ending/disappearance, or both, to the nearest minute, if not reported in a previous METAR or SPECI.

c. **Location:** Phenomenon, distance (if known), followed by the direction from the station.

d. **Direction toward which the phenomenon is moving** (if this is unknown, enter "**MOVMT UNKN**")

5.9.11 Thunderstorms

5.9.11.1 Beginning and Ending of a Thunderstorm. A thunderstorm is considered to begin at the station when thunder is heard, or overhead lightning is observed, and the local noise level is such as might prevent hearing thunder. A thunderstorm is considered to have ended 15 minutes after the last occurrence of thunder or when overhead lightning is no longer observed when the local noise level is such as might prevent hearing thunder.

5.9.11.2 Reporting a Thunderstorm. Reports concerning thunderstorms will be made whenever a thunderstorm begins or ends. The report will include the following:

a. **TS**

b. **Time** of beginning, ending, or both, to the nearest minute, if not reported in a previous METAR or SPECI.

c. **Location:** Distance from station (if known), followed by the direction from the station.

d. **Direction** toward which the storm is moving (if unknown, enter "**MOVMT UNKN**").

e. **Type** and **frequency** of lightning.

5.9.11.3 Time of Beginning and/or Ending of a Thunderstorm. When the time of beginning or ending of a thunderstorm is reported in a SPECI, it need not be recorded again until the next transmitted METAR if not previously reported in a METAR.

5.9.12 Reporting Hail. Report hail whenever it begins or ends, and in all observations taken while it is occurring. Times of beginnings and endings will be included in remarks when not previously reported in a METAR and SPECI. All observations concerning hail shall report the diameter of the largest hailstones in 1/4 inch increments. No intensity is assigned to hail.

5.9.13 Reporting Lightning. When lightning is observed, the type, frequency and location (Table 5-9) shall be reported in the remarks section of METAR or SPECI. Lightning remarks are not to be carried in subsequent observations unless lightning is still occurring.

Type of Lightning		
Type	**Contraction**	**Definition**
Cloud-ground	CG	Lightning occurring between cloud and ground.
In-cloud	IC	Lightning which takes place within the thunder 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	FQT	1 to 6 flashes/minute.
Continuous	CNS	More than 6 flashes/minute.

Table 5-9. Type and Frequency of Lightning

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CHAPTER 6 - PRESSURE

6.1 **Introduction**. This chapter contains information on identifying, recording, and reporting pressure. It also describes the operation of pressure measuring equipment. Refer to Chapter 10 for recording pressure instructions on CNMOC 3140/12.

6.2 **Definitions**.

6.2.1 Altimeter Setting (ALSTG). The pressure value to which an aircraft altimeter scale is set so it will indicate the altitude above mean-sea-level (MSL) of the aircraft on the ground at the location for which the pressure value was determined.

6.2.2 Atmospheric Pressure. The force exerted by the atmosphere at a given point.

6.2.3 Barometric Pressure. The atmospheric pressure measured by a barometer.

6.2.4 Density Altitude (DA). The pressure altitude corrected for virtual temperature deviations from the standard atmosphere.

6.2.5 Field Elevation (H_a). The officially designated field elevation (H_a) of an airfield above mean sea level. It is the elevation of the highest point on any of the runways of the airfield.

6.2.6 Non-Tactical Barometer. An aneroid barometer tasked for use as the primary pressure instrument or as the primary alternate for a DASI at a fixed (permanent) site and not intended for deployment.

6.2.7 Pressure Altitude (PA). The altitude, in a standard atmosphere, at which a given pressure will be observed.

6.2.8 Pressure Change. The net difference between the barometric pressure at the beginning and ending of a specified interval of time, usually the 3-hour period preceding a report.

6.2.9 Pressure Characteristic. The pattern of the pressure change, as would have been indicated by a barograph trace, during a specified period of time, usually the 3-hour period preceding a report.

6.2.10 Pressure Falling Rapidly. A fall in station pressure at the rate of 0.06 inch Hg (2.0 hPa) or more per hour with a total fall of at least 0.02 inch Hg (0.7 hPa) at the time of observation.

6.2.11 Pressure Rising Rapidly. A rise in station pressure at the rate of 0.06 inch Hg (2.0 hPa) or more per hour with a total rise of at least 0.02 inch Hg (0.7 hPa) at the time of observation.

6.2.12 Pressure Tendency. The pressure characteristic and amount of pressure change during a specified period of time, usually the 3-hour period preceding a report.

6.2.13 Pressure Unsteady. Sharp troughs and crests in the pressure trace that depart at least 0.03 inch (1.0 hPa) from the mean trend.

6.2.14 Removal Correction. A value applied to a pressure reading to compensate for the difference in height between the elevation of the pressure instrument and station elevation.

6.2.15 Sea-level Pressure. The atmospheric pressure at mean sea-level, either directly measured or obtained by the empirical reduction of station pressure to sea-level. Where the Earth's surface is above sea-level, it is assumed that the atmosphere extends to sea-level below the station and the properties of the hypothetical atmosphere are related to conditions observed at the station.

6.2.16 Standard Atmosphere. A hypothetical vertical distribution of atmospheric temperature, pressure, and density, which, by international agreement, is considered to be representative of the atmosphere for pressure altimeter calibrations and other purposes.

6.2.17 Station Elevation (H_p). The officially designated height above sea-level to which station pressure pertains. It is generally, but not always, the same as field elevation (H_a).

6.2.18 Station Pressure. The atmospheric pressure at the assigned station elevation (Hp).

6.2.19 Tactical Barometer. An aneroid barometer (regardless of nomenclature) tasked for deployment (mobility), contingencies, or exercises.

6.3 **Pressure Evaluation**.

6.3.1 General. Observing procedures include the reading of pressure instruments together with the correction, conversion, and reduction of pressure values. Instructions for determining station pressure are given first, followed by instructions for deriving other forms of pressure data, including significant pressure changes and tendencies.

6.3.2 Priority of Instruments. The more commonly utilized pressure measuring instruments are listed below. Obtain pressure data for routine observations using an instrument from the following priority list. The listing is based upon instrument availability and the assumption that the respective instrument is properly calibrated.

a. Automated Sensors

b. Precision Aneroid Barometer (ML-448/UM).

c. Altimeter Setting Indicator (ASI).

d. Digital Altimeter Setting Indicator (DASI). Air Traffic Control (ATC) use.

6.3.3 Station Pressure. Determine station pressure as necessary for use in the METAR/SPECI and for computation of other pressure or pressure related data. The following procedures summarize the common steps used to determine station pressure.

6.3.3.1 Precision Aneroid Barometer.

a. Tap the face of the instrument lightly with the finger to reduce the effect of friction.

b. Read the scale at the pointer, to the nearest 0.005 inch or 0.1 hPa, estimating values between the graduations.

c. Apply the posted correction.

d. Stations that are required to use a variable removal correction will add the removal correction, appropriate for the current outside temperature, to the reading obtained in subparagraph c above.

6.3.3.2 Altimeter-setting Indicator / Digital Altimeter-setting Indicator. Read the altimeter-setting indicator to the nearest 0.005 inch and apply the posted correction. Compute the station pressure by use of a pressure reduction computer, reduction constant, or altimeter-setting table in accordance with the following:

a. Pressure Reduction Computer, CP-402/UM. Perform in reverse order the steps for obtaining altimeter setting as printed on the yellow (No. II) side of the computer.

b. Reduction Constant. At low-level stations for which an altimeter-setting reduction constant has been authorized, algebraically subtract the constant from the altimeter setting and round the remainder to the nearest .005 inch to obtain the station pressure.

c. Programmable Calculator. Stations without a Pressure Reduction Computer may be authorized to use a personal computer or programmable calculator to obtain station pressure.

d. Altimeter Setting Table.

(1) Use of these tables is authorized at specially designated stations and at stations for which a reduction constant, a pressure reduction computer, a personal computer or a suitable programmable calculator is not available.

(2) At authorized stations, find in the altimeter setting table the tabular value which equals the altimeter setting, interpolating to the nearest 0.005 inch when appropriate. The station pressure is the sum of the two station-pressure components which correspond to the altimeter setting (i.e., the sum of inches and tenths from the left-hand margin, and hundredths or five thousands from the heading of the table).

6.3.4 Sea-level Pressure. Read directly from available instruments or compute using the following procedures.

6.3.4.1 Frequency. Compute, record, and transmit sea-level pressure for each METAR/SPECI in the remarks section of the report (9.12.1.19).

6.3.4.2 Pressure Reduction Constant. This method is authorized only for low-level stations elevations (below 50 feet). At authorized locations, add the sea-level reduction constant to the station pressure to obtain the sea-level pressure.

6.3.4.3 Method. Reduce station pressure to sea-level pressure by use of a computer, constant, or electronic calculator.

6.3.4.4 Mean Temperature. Except at stations for which a reduction constant has been authorized, compute the 12-hour mean temperature to degrees and tenths, by algebraically adding the current temperature to the temperature 12 hours previously, and dividing the sum by two. If the temperature was not observed 12 hours previously, obtain it from any other means available. However, do not estimate a temperature. Record the remark "SLPNO" in Column 14 (9.12.1.19).

6.3.4.5 Pressure Reduction Ratio, r. A table of "**r**" values must be used in conjunction with the pressure reduction computer to determine sea-level pressures. The "**r**" value is the ratio of sea-level pressure to station pressure for each degree of temperature. Since this ratio is always greater than unity, the figure "**1**" preceding the decimal is sometimes omitted. No interpolation is necessary when using the table of "**r**" values. Tables of "**r**" values are computed individually for each station by FLENUMMETOC DET Asheville.

6.3.4.6 Pressure Reduction Computer, CP-402/UM. This method is authorized where the computer and a table of pressure reduction ratio "**r**," especially computed for the local station are available.

a. Find in the table the "**r**" value which corresponds to the 12-hour mean temperature.

b. Using instructions on the green side (No. I) of the computer, multiply the station pressure by the appropriate "**r**" value to obtain the sea-level pressure.

Use of the pressure reduction computer is illustrated by the following example. The station is NAVPACMETOC DET Fallon, Nevada, with an elevation (H_p) of 3,934 feet.

Given: Station Pressure = 26.965 inches Hg
12-hour mean temperature = 43°F
"**r**" value from table = .1557

To determine sea-level pressure, set the black index line of the green rotor disk on the station pressure of 26.965 inches on the "**P, P_o**" scale. Align the hairline of the cursor with the "**r**" value of .1557. The sea-level pressure is read on the "**P, P_o**" scale beneath the hairline of the cursor. The sea-level pressure is 1055.4 hectopascals.

6.3.4.7 Electronic Calculator. The reduction ratio "**r**" can be used by directly multiplying the station pressure by the "**r**" value. Make sure that the "**r**" value has the 1.0 added to it.

Use of an electronic calculator is illustrated by the following example. The station is NAVTRAMETOC DET Willow Grove, Pennsylvania, with an elevation (H_p) of 335 feet.

Given: Station Pressure = 29.515 inches Hg
12-hour mean temperature = 52°F
"**r**" value from table = .0132

To determine sea-level pressure, calculate:

"**r**" value from table = .0132 + 1.0 = 1.0132
Sea-level pressure = 29.515 x 1.0132 = 29.90460 inches Hg
Converting from inches Hg to hPa = 29.90460 x 33.8639 = 1012.686 hPa
Rounding to nearest .1 hPa = 1012.7 hPa

6.3.5 Altimeter Setting. Read directly from available instruments or compute an altimeter setting on the basis of a current station pressure value using the method of determination applicable to the station (pressure reduction computer, reduction constant, programmable calculator, or altimeter setting table).

6.3.5.1 Frequency of Determination. Determine the altimeter setting for all reports. Redetermine the altimeter setting when necessary to meet local requirements, which shall be determined locally and upon request.

6.3.5.2 Method of Determination. Altimeter-setting values are determined by reading directly from a properly calibrated altimeter-setting indicator if one is available, or obtained or derived from the pressure measuring instrument available (Exhibit 6-1) at stations not equipped with an altimeter-setting indicator. At these stations, compute the altimeter-setting value by using a computer, constant, programmable calculator, or table.

6.3.5.3 Pressure Reduction Computer, CP-402/UM. Compute the altimeter setting in inches and hundredths, using the station pressure to the nearest 0.005 inch and the instructions on the No. II side of the computer.

6.3.5.4 Reduction Constant. At low-level stations (below 50 feet) for which an altimeter-setting reduction constant has been authorized, algebraically add the constant to the station pressure and round to inches and hundredths to obtain the altimeter setting.

6.3.5.5 Programmable Calculator. Stations without a pressure reduction computer may be authorized to use a personal computer or programmable calculator to obtain altimeter setting.

6.3.5.6 Altimeter Setting Table. At authorized stations, find in the body of the table the altimeter setting in inches and hundredths corresponding to the station pressure to the nearest 0.005 inch, as illustrated below:

A portion of an altimeter setting table for station elevation (H_p) = 1415 feet follows:

Station Pressure (inches)	.00	.01	.02	.03	.04
27.60	29.06	29.07	29.08	29.10	29.11
27.70	29.17	29.18	29.19	29.20	29.21

a. Given: Station Pressure = 27.730 inches
Value from table found on line for 27.70 and in column headed 0.03 = 29.20"

b. Given: Station Pressure 27.625"
Value from table found on line for 27.60 and interpolated between columns headed .02 and .03 = 29.09"

c. Given: Station Pressure 27.615"
Value from table found on line for 27.60 and interpolated between columns headed .01 and .02 = 29.075"
29.075" value is rounded to nearest .01 inch = 29.08"

6.3.6 Pressure and Density Altitude (PA and DA). Compute pressure and density altitude on the basis of a current station pressure value and the method of determination applicable to the station (e.g., pressure reduction computer or table for PA, and density altitude computer for DA). Determine and report data as frequently as necessary to meet local locally established requirements; e.g., in conjunction with each determination of altimeter setting. Compute data to at least the nearest 10 feet.

6.3.6.1 Altimeter Setting and Pressure Reduction Computer. The altimeter setting may be converted to the pressure altitude with the Pressure Reduction Computer No. II side as follows:

a. Set the field elevation on the "**H**" scale opposite the altimeter setting on the "**P, A.S.**" scale.

b. Read the pressure altitude on the "**H**" scale opposite the 29.92-inch graduation index of the "**P, A.S.**" scale.

c. Since the computer has two overlapping "**H**" scales, the following criteria should be used in selecting the proper pressure-altitude value from these scales:

(1) If the altimeter setting reads lower than 29.92", the pressure altitude will be higher than the elevation of the field.

(2) If the altimeter setting reads higher than 29.92", the pressure altitude will be lower than the field elevation.

(3) The pressure altitude will differ from the field elevation by about 900 to 1,000 feet for each inch of difference between the altimeter setting and 29.92".

Example

Given: Field elevation 2,963 feet and altimeter setting 30.045 inches.

Find the field elevation value of 2,963 on the "**H**" scale and set opposite the altimeter-setting value of 30.045" on the "**P, A.S.**" scale. Pressure altitude read on the "**H**" scale opposite the 29.92" graduation of the "**P, A.S.**" scale is 2,848 feet.

6.3.6.2 Altimeter Setting and Pressure Altitude Table. Table 6-1 or other standard atmosphere tables may be used to obtain the pressure altitude. Computations based upon the altimeter setting yield pressure altitude with reference to the field elevation (H_a). Find in the body of the table the value corresponding to the altimeter setting and add the field elevation to this value to obtain the pressure altitude.

Example

A portion of a Standard Atmosphere Table giving tabular values of pressure altitude follows:

Pressure, inches of mercury	0	0.01	0.02	0.03	0.04	0.05	0.06
	ft.	ft.	ft.	ft.	ft.	ft.	ft.
26.90	2916	2906	2896	2886	2876	2866	2855
30.00	-73	-82	-91	-100	-110	-119	-128

Given: Field elevation 2,963 feet and altimeter setting 30.045 inches.

Using the table and altimeter setting: Value from table found on line for 30.00 inches and interpolating between columns headed .04 and .05 is -115; add the field elevation and obtain 2848 feet (i.e., -115 + 2963 = 2848).

6.3.6.3 Station Pressure and Pressure Reduction Computer. The station pressure may be converted to the pressure altitude at the station elevation by using instructions and scales on the No. II side of the Pressure Reduction Computer.

Example

Given: Station Pressure 26.965 inches.

Using computer: Set the zero-elevation graduation of the "**H**" scale opposite 26.965" on the "**P, A.S.**" scale. Pressure altitude read on the "**H**" scale opposite the 29.92" graduation of the "**P, A.S.**" scale is 2850 feet.

6.3.6.4 Station Pressure and Pressure Altitude Table. Computation made by direct conversion of station pressure yields pressure altitude with reference to the station elevation (H_p).

Example

Given: Station Pressure 26.965 inches and Table 6-1 or the foregoing excerpt from that table.

Value from table found on line 26.90" and interpolating between columns headed .06 and .07 is 2850 feet.

6.3.6.5 Station Pressure and Programmable Calculator. Stations without a pressure reduction computer may be authorized by their regional headquarters to use a personal computer or programmable calculator to obtain pressure altitude from station pressure.

6.3.7 Remarks. Significant changes in barometric pressure and its characteristics will be recorded and transmitted.

6.3.7.1 Pressure Falling Rapidly. Whenever the pressure is falling at the rate of 0.06 inch Hg (2.0 hPa) or more per hour with a total fall of at least 0.02 inch Hg (0.7 hPa) at the time of an observation, report "**PRESFR**" in remarks (9.12.1.18).

6.3.7.2 Pressure Rising Rapidly. Whenever the pressure is rising at the rate of 0.06 inch Hg (2.0 hPa) or more per hour with a total of at least 0.02 inch Hg (0.7 hPa) at the time of observation, report "**PRESRR**" in remarks (9.12.1.18).

6.3.8 Pressure Tendency. The barometric pressure tendency comprises two elements.

a. The characteristic of the change during the period, based on:

(1) The appearance of the barogram.

(2) The direction of change, if any (i.e., higher, lower, or no change).

b. The net change within a specified time.

6.3.8.1 Frequency. Pressure tendencies should be determined at the time of each 3- and 6-hour observation. At stations equipped with a barograph, determine the elements from the trace for the full 3-hour period at the actual time of the observation. Stations not equipped with a barograph will determine the pressure tendencies from the trend of the altimeter settings.

6.3.8.2 Pressure Change. Determine the net change in station pressure (Table 9-8) for the preceding 3 hours to the nearest 0.005 inch by subtraction using the appropriate entries in the Station Pressure column. If an observation was not taken 3 hours earlier, determine the change from the barogram. If the station does not possess a barograph and no observation was taken 3 hours earlier, the pressure change will be considered indeterminable and reported as missing.

6.3.8.3 Pressure Characteristic. Using the code figures in Table 9-7, choose the figure which best describes the pattern that would be traced on a barograph during the past 3 hours. This is done as follows:

a. Determine if the present pressure is higher, the same, or lower than 3 hours ago. Find this designation under the Primary Unqualified Requirements column. This gives the possible code figures.

b. Apply the Additional Requirements column to arrive at the proper code figure. If there is ambiguity in code figures, choose the one which best describes the latter part of the trace.

c. Stations not possessing a barograph will determine the characteristic of the trace from altimeter settings recorded in Column 13, CNMOC 3140/12, and encode the most appropriate code figure. If an observation was not taken 3 hours earlier and the station does not possess a barograph, the characteristic will be considered indeterminable and reported as missing.

Standard Atmosphere Table in accordance with specifications of ICAO (International Civil Aviation Organization) -- Tabular values give altitude (in feet) in the standard atmosphere as a function of pressure (inches of mercury, shown as side and top argument). Note: Altitudes are strictly in terms of "standard geopotential feet."

Pressure, inches of mercury	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
20.0	10731	10718	10705	10692	10680	10667	10654	10641	10629	10616
20.1	10603	10590	10577	10565	10552	10539	10526	10514	10501	10488
20.2	10476	10463	10450	10437	10425	10412	10399	10387	10374	10361
20.3	10349	10336	10323	10311	10298	10285	10273	10260	10248	10235
20.4	10222	10210	10197	10185	10172	10159	10147	10134	10122	10109
20.5	10096	10084	10071	10059	10046	10034	10021	10009	9996	9984
20.6	9971	9959	9946	9934	9921	9909	9896	9884	9871	9859
20.7	9846	9834	9821	9809	9796	9784	9772	9759	9747	9734
20.8	9722	9709	9697	9685	9672	9660	9647	9635	9623	9610
20.9	9598	9586	9573	9561	9549	9536	9524	9512	9499	9487
21.0	9475	9462	9450	9438	9425	9413	9401	9388	9376	9364
21.1	9352	9339	9327	9315	9303	9290	9278	9266	9254	9241
21.2	9229	9217	9205	9192	9180	9168	9156	9144	9131	9119
21.3	9107	9095	9083	9071	9058	9046	9034	9022	9010	8998
21.4	8986	8973	8961	8949	8937	8925	8913	8901	8889	8877
21.5	8864	8852	8840	8828	8816	8804	8792	8780	8768	8756
21.6	8744	8732	8720	8708	8696	8684	8672	8660	8648	8636
21.7	8624	8612	8600	8588	8576	8564	8552	8540	8528	8516
21.8	8504	8492	8480	8468	8456	8444	8432	8420	8408	8397
21.9	8385	8373	8361	8349	8337	8325	8313	8301	8289	8278
22.0	8266	8254	8242	8230	8218	8206	8195	8183	8171	8159
22.1	8147	8136	8124	8112	8100	8088	8076	8065	8053	8041
22.2	8029	8018	8006	7994	7982	7971	7959	7947	7935	7924
22.3	7912	7900	7888	7877	7865	7853	7841	7830	7818	7806
22.4	7795	7783	7771	7760	7748	7736	7725	7713	7701	7690
22.5	7678	7666	7655	7643	7631	7620	7608	7597	7585	7573
22.6	7562	7550	7538	7527	7515	7504	7492	7481	7469	7457
22.7	7446	7434	7423	7411	7400	7388	7376	7365	7353	7342
22.8	7330	7319	7307	7296	7284	7273	7261	7250	7238	7227
22.9	7215	7204	7192	7181	7169	7158	7146	7135	7124	7112
23.0	7101	7089	7078	7066	7055	7043	7032	7021	7009	6998
23.1	6986	6975	6964	6952	6941	6929	6918	6907	6895	6884
23.2	6873	6861	6850	6839	6827	6816	6804	6793	6782	6770
23.3	6759	6748	6736	6725	6714	6703	6691	6680	6669	6657
23.4	6646	6635	6624	6612	6601	6590	6578	6567	6556	6545
23.5	6533	6522	6511	6500	6488	6477	6466	6455	6444	6432
23.6	6421	6410	6399	6388	6376	6365	6354	6343	6332	6320
23.7	6309	6298	6287	6276	6265	6253	6242	6231	6220	6209
23.8	6198	6187	6176	6164	6153	6142	6131	6120	6109	6098
23.9	6087	6076	6064	6053	6042	6031	6020	6009	5998	5987
24.0	5976	5965	5954	5943	5932	5921	5910	5899	5888	5877
24.1	5866	5854	5843	5832	5821	5810	5799	5788	5777	5766
24.2	5756	5745	5734	5723	5712	5701	5690	5679	5668	5657
24.3	5646	5635	5624	5613	5602	5591	5580	5569	5558	5548
24.4	5537	5526	5515	5504	5493	5482	5471	5460	5449	5439
24.5	5428	5417	5406	5395	5384	5373	5363	5352	5341	5330
24.6	5319	5308	5297	5287	5276	5265	5254	5243	5233	5222
24.7	5211	5200	5189	5179	5168	5157	5146	5135	5125	5114
24.8	5103	5092	5082	5071	5060	5049	5039	5028	5017	5006
24.9	4996	4985	4974	4963	4953	4942	4931	4921	4910	4899

Table 6-1. Pressure Altitude

Standard Atmosphere Table in accordance with specifications of ICAO (International Civil Aviation Organization) -- Tabular values give altitude (in feet) in the standard atmosphere as a function of pressure (inches of mercury, shown as side and top argument). Note: Altitudes are strictly in terms of "standard geopotential feet."

Pressure, inches of mercury	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
25.0	4888	4878	4867	4856	4846	4835	4824	4814	4803	4792
25.1	4782	4771	4760	4750	4739	4728	4718	4707	4696	4686
25.2	4675	4665	4654	4643	4633	4622	4611	4601	4590	4580
25.3	4569	4559	4548	4537	4527	4516	4506	4495	4484	4474
25.4	4463	4453	4442	4432	4421	4411	4400	4389	4379	4368
25.5	4358	4347	4337	4326	4316	4305	4295	4284	4274	4263
25.6	4253	4242	4232	4221	4211	4200	4190	4179	4169	4158
25.7	4148	4138	4127	4117	4106	4096	4085	4075	4064	4054
25.8	4044	4033	4023	4012	4002	3991	3981	3971	3960	3950
25.9	3939	3929	3919	3908	3898	3888	3877	3867	3856	3846
26.0	3836	3825	3815	3805	3794	3784	3774	3763	3753	3743
26.1	3732	3722	3712	3701	3691	3681	3670	3660	3650	3639
26.2	3629	3619	3608	3598	3588	3578	3567	3557	3547	3537
26.3	3526	3516	3506	3495	3485	3475	3465	3454	3444	3434
26.4	3424	3414	3403	3393	3383	3373	3362	3352	3342	3332
26.5	3322	3311	3301	3291	3281	3271	3260	3250	3240	3230
26.6	3220	3210	3199	3189	3179	3169	3159	3149	3138	3128
26.7	3118	3108	3098	3088	3078	3067	3057	3047	3037	3027
26.8	3017	3007	2997	2987	2976	2966	2956	2946	2936	2926
26.9	2916	2906	2896	2886	2876	2866	2855	2845	2835	2825
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

Table 6-1 (Continued). Pressure Altitude

Standard Atmosphere Table in accordance with specifications of ICAO (International Civil Aviation Organization) -- Tabular values give altitude (in feet) in the standard atmosphere as a function of pressure (inches of mercury, shown as side and top argument). Note: Altitudes are strictly in terms of "standard geopotential feet."

Pressure, inches of mercury	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.
30.0	-73	-82	-91	-100	-110	-119	-128	-137	-146	-156
30.1	-165	-174	-183	-193	-202	-211	-220	-229	-238	-248
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	-1225	-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	-1862
32.0	-1871	-1879	-1888	-1897	-1906	-1914	-1923	-1932	-1941	-1949
32.1	-1958	-1967	-1976	-1984	-1993	-2002	-2010	-2019	-2028	-2037
32.2	-2045	-2054	-2063	-2071	-2080	-2089	-2098	-2106	-2115	-2124
32.3	-2132	-2141	-2150	-2158	-2167	-2176	-2184	-2193	-2202	-2210
32.4	-2219	-2228	-2236	-2245	-2254	-2262	-2271	-2280	-2288	-2297
32.5	-2306	-2314	-2323	-2332	-2340	-2349	-2358	-2366	-2375	-2384
32.6	-2392	-2401	-2409	-2418	-2427	-2435	-2444	-2452	-2461	-2470
32.7	-2478	-2487	-2496	-2504	-2513	-2521	-2530	-2539	-2547	-2556
32.8	-2564	-2573	-2581	-2590	-2599	-2607	-2616	-2624	-2633	-2641
32.9	-2650	-2659	-2667	-2676	-2684	-2693	-2701	-2710	-2718	-2727

Table 6-1 (Continued). Pressure Altitude

CHAPTER 7 - TEMPERATURE AND DEW POINT

7.1 **Introduction**. This chapter describes observing and determining the air temperature and dew point temperature in a surface report. The temperature data obtained using the instruments in this chapter are in terms of the Celsius scale. Generally, the values will be determined in degrees Fahrenheit which must be converted to Celsius for use in reporting. Dew point and relative humidity are calculated with respect to moisture at all temperatures. Chapter 9, Coding, contains the detailed entry information, it is not intended to be duplicated herein.

7.2 **Definitions**.

7.2.1 Temperatures.

a. Dew Point. The temperature to which a given parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur.

b. Dry-bulb. The degree of hotness or coldness of the ambient air.

c. Wet-bulb. The temperature at which an air parcel would have if cooled adiabatically to saturation at constant pressure by evaporation of water into it. It differs from the dry-bulb temperature by an amount dependent on the moisture content of the air and, therefore, is generally the same as or lower than the dry-bulb temperature.

d. Maximum Temperature. The highest temperature observed or recorded during a prescribed period of time i.e., 0000 - 2359 LST.

e. Minimum Temperature. The lowest temperature observed or recorded during a prescribed period of time i.e., 0000 - 2359 LST.

7.2.2 Instrument Shelter (Thermoscreen). A boxlike structure designed to protect temperature measuring instruments from exposure to direct sunshine, precipitation, and condensation, while at the same time providing adequate ventilation.

7.2.3 Maximum Thermometer. A mercury-in-glass thermometer made with a constriction in the bore between the bulb and the graduated portion of the stem. Rising temperature forces a portion of the mercury into the graduated section. This mercury is retained and affords a reading, until reset, of the highest temperature reached.

7.2.4 Minimum Thermometer. An alcohol-in-glass thermometer with a freely moving, small, dark-colored glass index placed in the bore. As the temperature falls, the retreating upper end (meniscus) of the alcohol column moves the index toward the bulb. When the temperature rises, the index remains at the lowest point until reset.

7.2.5 Psychrometer. An instrument used for measuring the ambient air temperature and the water-vapor content of the air. It consists of two ordinary glass thermometers. The bulb of one thermometer (left thermometer) is covered with a clean muslin wick which is saturated with water prior to an observation (the wet-bulb). When the bulbs are properly ventilated, they indicate the wet- and dry-bulb temperatures of the atmosphere.

7.2.6 Psychrometric Calculator. A circular slide rule used to compute dew-point and relative humidity from known values of dry and wet-bulb temperature and the normal station atmospheric pressure.

7.2.7 Psychrometric Tables. Tables prepared from a psychrometric formula and used to obtain dew-point and relative humidity from known values of dry- and wet-bulb temperature.

7.2.8 Relative Humidity. The ratio, expressed as a percentage, of the actual vapor pressure of the air to the saturation vapor pressure.

7.2.9 Sling Psychrometer. A device for determining psychrometric data consisting of two matched thermometers mounted on a common back. One thermometer (left thermometer) is covered with a muslin wick which is saturated with water prior to an observation (the wet-bulb). Ventilation is achieved by whirling the thermometers with a handle and a swivel link until the lowest wet-bulb temperature has been obtained.

7.2.10 Townsend Support. A metal instrument support for the shelter-mounting of maximum and minimum thermometers. This device is so designed as to facilitate resetting the thermometers and holding them in fixed positions between observations of maximum and minimum temperature extremes.

7.2.11 Wet-bulb Depression. The difference between the dry- and wet-bulb temperatures. Example:

Dry-bulb	Wet-bulb	Wet-bulb Depression
33.8	23.5	10.3
-6.7	-7.4	0.7

7.3 **Observing and Reporting Procedures**. For aircraft operations, temperature data is required in reference to the airfield runways. Normally, data measured at another location on the airfield are sufficiently representative of the temperature over the runway. Dew point and relative humidity are calculated with respect to water at all temperatures.

7.3.1 Units of measure. Air temperature and dew point data are required with respect to the Celsius scale in METAR/SPECI observations. The accuracy of an individual temperature is dependent upon its use, as stated below.

a. To the nearest 0.1 degree when used in computations and entered in "Remarks".

b. To the nearest whole degree for use in the "body of the report".

c. Instrumentation that displays temperatures in degrees Fahrenheit, use Tables 7-2 and 7-3 for conversion purposes.

7.3.2 Temperature Reporting. The air and dew point temperatures are required in every METAR and SPECI.

7.4 **Determination of Air and Dew Point Temperatures.** When an automatic sensing system is available and functioning within operational limits, obtain air and dew point temperatures by direct reading of the respective indicators. Otherwise, obtain the data from a psychrometer and psychrometric calculator.

7.4.1 Dry- and Wet-bulb Temperatures. Obtain data from instruments used in the following order of priority:

a. Dry-bulb

(1) Automated sensors.

(2) Psychrometer, equipped with a mercury thermometer, if the temperature is warmer than –35°F,

(3) Psychrometer, equipped with a spirit thermometer, in the range of -50 degrees Fahrenheit to 100 degrees Fahrenheit, or -80 degrees Fahrenheit to 110 degrees Fahrenheit if the temperature is –35 degrees Fahrenheit or colder,

(4) From the meniscus of a spirit column of an exposed minimum thermometer,

b. Wet-bulb (when needed to compute dew point).

(1) Psychrometer if the dry-bulb temperature is warmer than –35 degrees Fahrenheit.

(2) Dry-bulb reading of the psychrometer if the dry-bulb temperature is -35 degrees Fahrenheit or colder.

7.4.2 Dew Point Temperatures. Obtain dew point temperatures using:

a. Automated sensors.

b. Dry-bulb and wet-bulb temperatures using a psychrometer when the temperature is warmer than –35°F.

c. The dry-bulb temperature if the dry-bulb temperature is -35 degrees Fahrenheit or colder.

7.4.3 Dew Point Equal to or Exceeding Air Temperature. Provided the instrument in use is functioning within operational limits, obtain the dew point temperature using the following procedures when it equals or exceeds the dry-bulb temperature.

a. If fog is present or the wick of the wet-bulb is not frozen, assume the wet-bulb and dew point temperatures with respect to water to be the same as the dry-bulb temperature if the wick of the wet-bulb is not frozen or fog is present (the relative humidity will be 100%), or

b. If ice fog is present or the wet-bulb wick is frozen, assume the wet-bulb and dew point temperatures with respect to ice to be the same as the dry-bulb and convert them to their water equivalent using the psychrometric calculator (the relative humidity will be 100%).

7.5 **Temperature and Dew Point Evaluation.** Obtain temperature other psychrometric data from the following priority list.

a. Automated sensors.

b. Psychrometer.

c. Mercury or alcohol-in-glass extreme thermometers.

7.5.1 Thermometers. Observe the temperature from mercury or alcohol-in-glass thermometers as follows:

a. Psychrometer. Stand as far from the thermometer as possible to prevent your body heat from affecting the readings. To minimize errors of parallax, make sure that the line of sight from your eye to the top of the liquid column is level. Read the dry and wet-bulb temperatures to the nearest tenth (0.1) of a degree.

b. Minimum Thermometer. Read the minimum thermometer, without disturbing it from its correct (horizontal) exposure position and before reading the maximum thermometer. Read the minimum temperature to the nearest tenth (0.1) of a degree. This is indicated by the end of the colored glass index farthest from the bulb.

c. Maximum Thermometer. To read the maximum thermometer, release the catch on the Townsend Support and lower the bulb end slowly until the thermometer is vertical and the mercury column is resting on the constriction. Avoid errors of parallax and read the temperature to the nearest tenth (0.1) of a degree.

7.5.2 Relative Humidity Computations. Calculate the relative humidity (RH) using observed temperature data and the psychrometric calculator. Instructions for obtaining RH are printed on the calculator disks.

7.6 **Equipment Operation and Instrument Evaluations**. Operate and use temperature measuring instruments in accordance with appropriate technical orders or operating handbooks and

supplementary instructions in the following paragraphs.

7.6.1 Use of Automated Sensing Equipment. Obtain air and dew point temperature values by direct read-out or storage capable media in accordance with the guiding instructions.

7.6.2 Use of Psychrometer. The following instructions outline standard procedures for using a psychrometer.

a. General Practices.

(1) The psychrometer must be kept properly exposed in an instrument shelter or in a suitable alternate location when in use for routine temperature measurements. The location must allow a free flow of air over the thermometer bulbs; at the same time the thermometers must be shielded from the effects of direct solar radiation and precipitation.

(2) The psychrometer may be kept indoors when it is in a standby (backup) status. It must be exposed to the outside, ambient, free air, ion a shaded location prior to use, for a period long enough to allow the dry-bulb thermometer to reach equilibrium. Keep the instrument in a clean, dust free location to prevent the wick from getting dirty.

(3) Water used to moisten the wet-bulb wick should be clean or else the cloth wick may become contaminated. Store the water in a covered container suitable for moistening the wick and replace the water with a fresh supply as often as considered necessary. If the psychrometer is used as the primary instrument, change water at least weekly. Keep the water with the psychrometer at outside temperatures warmer than 37 degrees Fahrenheit (3 degrees Celsius) and keep it indoors during temperatures of 37 degrees or colder.

(4) Keep the wick on the wet-bulb clean in order to obtain accurate results. Change the wick as often as necessary, completely covering the thermometers bulb. It is recommended that each site include wick changes as part of its continuous maintenance program.

b. Preparation of the Wet-Bulb. Moisten the wick of the wet-bulb thermometer prior to ventilation of the psychrometer and according to the procedures and conditions described below.

(1) Temperature Above Freezing (normal conditions). Moisten the wick of the wet-bulb just prior to ventilating the psychrometer when the dry-bulb temperature is warmer than 37 degrees Fahrenheit (3 degrees Celsius) even if the humidity is high or the wick already appears wet. If the wet-bulb temperature is expected to be 32 degrees Fahrenheit or colder, also moisten the wick 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 cooled water whenever practical in areas where the temperature is high and the relative humidity is low. Moisten the wick thoroughly several minutes prior to and again at the time of ventilation, thus helping to reduce the temperature and prevent the wick from drying out during ventilation. If this procedure is not effective, keep the wick extended into an open container of water between observations.

(3) Temperature of 37 degrees Fahrenheit and Colder. Use water kept at room temperature to melt any accumulation of ice on the wet-bulb whenever the dry-bulb temperature of 37 degree Fahrenheit or colder occurs. Moisten the wick 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 wick is not frozen with wet-bulb temperatures colder than 32 degrees Fahrenheit, induce freezing by touching the wick with clean ice, snow, or other cold objects. If unable to induce freezing of the wick, moisten the wick again at the time of ventilation and then use the low temperature range of the psychrometer calculator.

c. Preparation of 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. Remove any collection on the thermometer with a soft clean cloth and allow sufficient time for the dissipation of extraneous heat before ventilation.

(2) Precipitation Conditions. When a sling Psychrometer is used, the dry-bulb temperature must be obtained before ventilation when precipitation is occurring. If there is moisture on the thermometer, wipe it dry with a soft clean cloth and shield the thermometer from the precipitation as long as necessary. This permits dissipation of any extraneous heat before reading the temperature.

d. 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 spot with no obstruction within a radius of 3-4 feet (or 1 meter) and face into the wind. Hold the instrument to the front at waist height while slinging it. Keep the instrument in the shade of the body as much as practical, but not so close that the bodies heat affects the readings.

(2) Using the Electric Psychrometer. Saturate the wick of the wet-bulb thermometer with pure water. Select an area not in direct sunlight. Hold the instrument at waist height with the air intake pointing into the wind. Obtain the dry-bulb temperature first. When the ambient air temperature is 50 degrees Fahrenheit and warmer, it is necessary to energize the ventilation fan. When the ambient air temperature is below 50 degrees Fahrenheit, expose the psychrometer with the ventilation fan running. The electric psychrometer should be exposed to the ambient air for at least five (5) minutes before reading. When no further decrease of the wet-bulb temperature is apparent, read the wet-bulb and dry-bulb temperatures to the nearest tenth (0.1) degrees.

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

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

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

(c) If the wet-bulb thermometer 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 degrees) 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. read this temperature to the nearest tenth (0.1) degree. Record both temperatures.

(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 the dry-bulb thermometer. With a wet-bulb depression of zero, the dew point temperature would equal the dry-bulb temperature.

7.6.3 Use of the Psychrometric Calculator. Use the pressure scale (colored ring) on the calculator based on the barometric pressure nearest the mean annual station pressure (e.g., stations at sea-level must use the 30-inch scale). At a location where the normal (mean) station pressure is unknown, select the applicable scale on the basis of the station elevation. Use Table 7.1 as a guide.

Station Elevation (feet)	Station Elevation (meters)	Computer Pressure Base (inches of mercury)
Less than 393	less than 120	30
393 to 1340	120 to 408	29
1341 to 2316	409 to 705	28
2317 to 3841	706 to 1170	27
3842 to 5975	1171 to 1821	25
5976 or above	1822 or above	23

Note: This table is based on the ICAO Standard Atmosphere.

Table: 7-1 Psychrometric Calculator Pressure Scale on the Basis of Station Pressure

7.6.4 Thermometer Maintenance.

a. Ensure thermometers are clean and free of oily film, dust and dirt.

b. Ensure thermometers do not have separations in the mercury. If separations are noted, hold the thermometer firmly at the end opposite the bulb, move away from obstructions, and shake

the thermometer until the mercury reunites. **CAUTION** ***must*** be taken ***to ensure*** the thermometer does not accidentally hit near by objects.

c. If the etched temperature increments on the thermometer become hard to read, rub a black grease pencil across the increments until they are filled in. With a clean rag, ripe off the excess.

°F	.0 °C	.1 °C	.2 °C	.3 °C	.4 °C	.5 °C	.6 °C	.7 °C	.8 °C	.9 °C
+130	+54.4	+54.5	+54.6	+54.6	+54.7	+54.7	+54.8	+54.8	+54.9	+54.9
129	53.9	53.9	54.0	54.1	54.1	54.2	54.2	54.3	54.3	54.4
128	53.3	53.4	53.4	53.5	53.6	53.6	53.7	53.7	53.8	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
+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

Table 7-2. Fahrenheit to Celsius Conversion.

°F	.0 °C	.1 °C	.2 °C	.3 °C	.4 °C	.5 °C	.6 °C	.7 °C	.8 °C	.9 °C
+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
+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

Table 7-2. Fahrenheit to Celsius Conversion (Continued).

°F	.0 °C	.1 °C	.2 °C	.3 °C	.4 °C	.5 °C	.6 °C	.7 °C	.8 °C	.9 °C
+30	-1.1	-1.1	-1.0	-0.9	-0.9	-0.8	-0.8	-0.7	-0.7	-0.6
29	1.7	1.6	1.6	1.5	1.4	1.4	1.3	1.3	1.2	1.2
28	2.2	2.2	2.1	2.1	2.0	1.9	1.9	1.8	1.8	1.7
27	2.8	2.7	2.7	2.6	2.6	2.5	2.4	2.4	2.3	2.3
26	3.3	3.3	3.2	3.2	3.1	3.1	3.0	2.9	2.9	2.8
+25	-3.9	-3.8	-3.8	-3.7	-3.7	-3.6	-3.6	-3.5	-3.4	-3.4
24	4.4	4.4	4.3	4.3	4.2	4.2	4.1	4.1	4.0	3.9
23	5.0	4.9	4.9	4.8	4.8	4.7	4.7	4.6	4.6	4.5
22	5.6	5.5	5.4	5.4	5.3	5.3	5.2	5.2	5.1	5.1
21	6.1	6.1	6.0	5.9	5.9	5.8	5.8	5.7	5.7	5.6
+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	-17.8	-17.9	-17.9	-18.0	-18.1	-18.1	-18.2	-18.2	-18.3
1	18.3	18.4	18.4	18.5	18.6	18.6	18.7	18.7	18.8	18.8
2	18.9	18.9	19.0	19.1	19.1	19.2	19.2	19.3	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	-21.1
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	-26.6	-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	29.8	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

Table 7-2. Fahrenheit to Celsius Conversion (Continued).

°F	.0 °C	.1 °C	.2 °C	.3 °C	.4 °C	.5 °C	.6 °C	.7 °C	.8 °C	.9 °C
-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	35.8	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	-37.1	-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	38.9	38.9	39.0	39.1	39.1	39.2	39.2	39.3	39.3	39.4
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
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	49.3	49.4
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	52.5	52.6	52.6	52.7	52.7
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
71	57.2	57.3	57.3	57.4	57.4	57.5	57.6	57.6	57.7	57.7
72	57.8	57.8	57.9	57.9	58.0	58.1	58.1	58.2	58.2	58.3
73	58.3	58.4	58.4	58.5	58.6	58.6	58.7	58.7	58.8	58.8
74	58.9	58.9	59.0	59.1	59.1	59.2	59.2	59.3	59.3	59.4
-75	-59.4	-59.5	-59.6	-59.6	-59.7	-59.7	-59.8	-59.8	-59.9	-59.9
76	60.0	60.1	60.1	60.2	60.2	60.3	60.3	60.4	60.4	60.5
77	60.6	60.6	60.7	60.7	60.8	60.8	60.9	60.9	61.0	61.1
78	61.1	61.2	61.2	61.3	61.3	61.4	61.4	61.5	61.6	61.6
79	61.7	61.7	61.8	61.8	61.9	61.9	62.0	62.1	62.1	62.2

Table 7-2. Fahrenheit to Celsius Conversion (Continued).

°C	.0 °F	.1 °F	.2 °F	.3 °F	.4 °F	.5 °F	.6 °F	.7 °F	.8 °F	.9 °F
+55	+131.0	+131.2	+131.2	+131.5	+131.7	+131.9	+132.1	+132.3	+132.4	+132.6
54	129.2	129.4	129.6	129.7	129.9	130.1	130.3	130.5	130.6	130.8
53	127.4	127.6	127.8	127.9	128.1	128.3	128.5	128.7	128.8	129.0
52	125.6	125.8	126.0	126.1	126.3	126.5	126.7	126.9	127.0	127.2
51	123.8	124.0	124.2	124.3	124.5	124.7	124.9	125.1	125.2	125.4
+50	+122.0	+122.2	+122.4	+122.5	+122.7	+122.9	+123.1	+123.3	+123.4	+123.6
49	120.2	120.4	120.6	120.7	120.9	121.1	121.3	121.5	121.6	121.8
48	118.4	118.6	118.8	118.9	119.1	119.3	119.5	119.7	119.8	120.0
47	116.6	116.8	117.0	117.1	117.3	117.5	117.7	117.9	118.0	118.2
46	114.8	115.0	115.2	115.3	115.5	115.7	115.9	116.1	116.2	116.4
+45	+113.0	+113.2	+113.4	+113.5	+113.7	+113.9	+114.1	+114.3	+114.4	+114.6
44	111.2	111.4	111.6	111.7	111.9	112.1	112.3	112.5	112.6	112.8
43	109.4	109.6	109.8	109.9	110.1	110.3	110.5	110.7	110.8	111.0
42	107.6	107.8	108.0	108.1	108.3	108.5	108.7	108.9	109.0	109.2
41	105.8	106.0	106.2	106.3	106.5	106.7	106.9	107.1	107.2	107.4
+40	+104.0	+104.2	+104.4	+104.5	+104.7	+104.9	+105.1	+105.3	+105.4	+105.6
39	102.2	102.4	102.6	102.7	102.9	103.1	103.3	103.5	103.6	103.8
38	100.4	100.6	100.8	100.9	101.1	101.3	101.5	101.7	101.8	102.0
37	98.6	98.8	99.0	99.1	99.3	99.5	99.7	99.9	100.0	100.2
36	96.8	97.0	97.2	97.3	97.5	97.7	97.9	98.1	98.2	98.4
+35	+95.0	+95.2	+95.4	+95.5	+95.7	+95.9	+96.1	+96.3	+96.4	+96.6
34	93.2	93.4	93.6	93.7	93.9	94.1	94.3	94.5	94.6	94.8
33	91.4	91.6	91.8	91.9	92.1	92.3	92.5	92.7	92.8	93.0
32	89.6	89.8	90.0	90.1	90.3	90.5	90.7	90.9	91.0	91.2
31	87.8	88.0	88.2	88.3	88.5	88.7	88.9	89.1	89.2	89.4
+30	+86.0	+86.2	+86.4	+86.5	+86.7	+86.9	+87.1	+87.3	+87.4	+87.6
29	84.2	84.4	84.6	84.7	84.9	85.1	85.3	85.5	85.6	85.8
28	82.4	82.6	82.8	82.9	83.1	83.3	83.5	83.7	83.8	84.0
27	80.6	80.8	81.0	81.1	81.3	81.5	81.7	81.9	82.0	82.2
26	78.8	79.0	79.2	79.3	79.5	79.7	79.9	80.1	80.2	80.4
+25	+77.0	+77.2	+77.4	+77.5	+77.7	+77.9	+78.1	+78.3	+78.4	+78.6
24	75.2	75.4	75.6	75.7	75.9	76.1	76.3	76.5	76.6	76.8
23	73.4	73.6	73.8	73.9	74.1	74.3	74.5	74.7	74.8	75.0
22	71.6	71.8	72.0	72.1	72.3	72.5	72.7	72.9	73.0	73.2
21	69.8	70.0	70.2	70.3	70.5	70.7	70.9	71.1	71.2	71.4
+20	+68.0	+68.2	+68.4	+68.5	+68.7	+68.9	+69.1	+69.3	+69.4	+69.6
19	66.2	66.4	66.6	66.7	66.9	67.1	67.3	67.5	67.6	67.8
18	64.4	64.6	64.8	64.9	65.1	65.3	65.5	65.7	65.8	66.0
17	62.6	62.8	63.0	63.1	63.3	63.5	63.7	63.9	64.0	64.2
16	60.8	61.0	61.2	61.3	61.5	61.7	61.9	62.1	62.2	62.4
+15	+59.0	+59.2	+59.4	+59.5	59.7	+59.9	+60.1	+60.3	+60.4	+60.6
14	57.2	57.4	57.6	57.7	57.9	58.1	58.3	58.5	58.6	58.8
13	55.4	55.6	55.8	55.9	56.1	56.3	56.5	56.7	56.8	57.0
12	53.6	53.8	54.0	54.1	54.3	54.5	54.7	54.9	55.0	55.2
11	51.8	52.0	52.2	52.3	52.5	52.7	52.9	53.1	53.2	53.4
+10	+50.0	+50.2	+50.4	+50.5	+50.7	+50.9	+51.1	+51.3	+51.4	+51.6
9	48.2	48.4	48.6	48.7	48.9	49.1	49.3	49.5	49.6	49.8
8	46.4	46.6	46.8	46.9	47.1	47.3	47.5	47.7	47.8	48.0
7	44.6	44.8	45.0	45.1	45.3	45.5	45.7	45.9	46.0	46.2
6	42.8	43.0	43.2	43.3	43.5	43.7	43.9	44.1	44.2	44.4
+5	+41.0	+41.2	+41.4	+41.5	+41.7	+41.9	+42.1	+42.3	+42.4	+42.6
4	39.2	39.4	39.6	39.7	39.9	40.1	40.3	40.5	40.6	40.8
3	37.4	37.6	37.8	37.9	38.1	38.3	38.5	38.7	38.8	39.0
2	35.6	35.8	36.0	36.1	36.3	36.5	36.7	36.9	37.0	37.2
1	33.8	34.0	34.2	34.3	34.5	34.7	34.9	35.1	35.2	35.4
+0	+32.0	+32.2	+32.4	+32.5	+32.7	+32.9	+33.1	+33.3	+33.4	+33.6
-0	+32.0	+31.8	+31.6	+31.5	+31.3	+31.1	+30.9	+30.7	+30.6	+30.4

Table 7-3. Celsius to Fahrenheit Conversion.

°C	.0 °F	.1 °F	.2 °F	.3 °F	.4 °F	.5 °F	.6 °F	.7 °F	.8 °F	.9 °F
-0	+32.0	+31.8	+31.6	+31.5	+31.3	+31.1	+30.9	+30.7	+30.6	+30.4
1	30.2	30.0	29.8	29.7	29.5	29.3	29.1	28.9	28.8	28.6
2	28.4	28.2	28.0	27.9	27.7	27.5	27.3	27.1	27.0	26.8
3	26.6	26.4	26.2	26.1	25.9	25.7	25.5	25.3	25.2	25.0
4	24.8	24.6	24.4	24.3	24.1	23.9	23.7	23.5	23.4	23.2
-5	+23.0	+22.8	+22.6	+22.5	+22.3	+22.1	+21.9	+21.7	+21.6	+21.4
6	21.2	21.0	20.8	20.7	20.5	20.3	20.1	19.9	19.8	19.6
7	19.4	19.2	19.0	19.9	18.7	18.5	18.3	18.1	18.0	17.8
8	17.6	17.4	17.2	17.1	16.9	16.7	16.5	16.3	16.2	16.0
9	15.8	15.6	15.4	15.3	15.1	14.9	14.7	14.5	14.4	14.2
-10	+14.0	+13.8	+13.6	+13.5	+13.3	+13.1	+12.9	+12.7	+12.6	+12.4
11	12.2	12.0	11.8	11.7	11.5	11.3	11.1	10.9	10.8	10.6
12	10.4	10.2	10.0	9.9	9.7	9.5	9.3	9.1	9.0	8.8
13	8.6	8.4	8.2	8.1	7.9	7.7	7.5	7.3	7.2	7.0
14	6.8	6.6	6.4	6.3	6.1	5.9	5.7	5.5	5.4	5.2
-15	+5.0	+4.8	+4.6	+4.5	+4.3	+4.1	+3.9	+3.7	+3.6	+3.4
16	+3.2	+3.0	+2.8	+2.7	+2.5	+2.3	+2.1	+1.9	+1.8	+1.6
17	+1.4	+1.2	+1.0	+0.9	+0.7	+0.5	+0.3	+0.1	-0.0	-0.2
18	-0.4	-0.6	-0.8	-0.9	-1.1	-1.3	-1.5	-1.7	-1.8	-2.0
19	-2.2	-2.4	-2.6	-2.7	-2.9	-3.1	-3.3	-3.5	-3.6	-3.8
-20	-4.0	-4.2	-4.4	-4.5	-4.7	-4.9	-5.1	-5.3	-5.4	-5.6
21	5.8	6.0	6.2	6.3	6.5	6.7	6.9	7.1	7.2	7.4
22	7.6	7.8	8.0	8.1	8.3	8.5	8.7	8.9	9.0	9.2
23	9.4	9.6	9.8	9.9	10.1	10.3	10.5	10.7	10.8	11.0
24	11.2	11.4	11.6	11.7	11.9	12.1	12.3	12.5	12.6	12.8
-25	-13.0	-13.2	-13.4	-13.5	-13.7	-13.9	-14.1	-14.3	-14.4	-14.6
26	14.8	15.0	15.2	15.3	15.5	15.7	15.9	16.1	16.2	16.4
27	16.6	16.8	17.0	17.1	17.3	17.5	17.7	17.9	18.0	18.2
28	18.4	18.6	18.8	18.9	19.1	19.3	19.5	19.7	19.8	20.0
29	20.2	20.4	20.6	20.7	20.9	21.1	21.3	21.5	21.6	21.8
-30	-22.0	-22.2	-22.4	-22.5	-22.7	-22.9	-23.1	-23.3	-23.4	-23.6
31	23.8	24.0	24.2	24.3	24.5	24.7	24.9	25.1	25.2	25.4
32	25.6	25.8	26.0	26.1	26.3	26.5	26.7	26.9	27.0	27.2
33	27.4	27.6	27.8	27.9	28.1	28.3	28.5	28.7	28.8	29.0
34	29.2	29.4	29.6	29.7	29.9	30.1	30.3	30.5	30.6	30.8
-35	-31.0	-31.2	-31.4	-31.5	-31.7	-31.9	-32.1	-32.3	-32.4	-32.6
36	32.8	33.0	33.2	33.3	33.5	33.7	33.9	34.1	34.2	34.4
37	34.6	34.8	35.0	35.1	35.3	35.5	35.7	35.9	36.0	36.2
38	36.4	36.6	36.8	36.9	37.1	37.3	37.5	37.7	37.8	38.0
39	38.2	38.4	38.6	38.7	38.9	39.1	39.3	39.5	39.6	39.8
-40	-40.0	-40.2	-40.4	-40.5	-40.7	-40.9	-41.1	-41.3	-41.4	-41.6
41	41.8	42.0	42.2	42.3	42.5	42.7	42.9	43.1	43.2	43.4
42	43.6	43.8	44.0	44.1	44.3	44.5	44.7	44.9	45.0	45.2
43	45.4	45.6	45.8	45.9	46.1	46.3	46.5	46.7	46.8	47.0
44	47.2	47.4	47.6	47.7	47.9	48.1	48.3	48.5	48.6	48.8
-45	-49.0	-49.2	-49.4	-49.5	-49.7	-49.9	-50.1	-50.3	-50.4	-50.6
46	50.8	51.0	51.2	51.3	51.5	51.7	51.9	52.1	52.2	52.4
47	52.6	52.8	53.0	53.1	53.3	53.5	53.7	53.9	54.0	54.2
48	54.4	54.6	54.8	54.9	55.1	55.3	55.5	55.7	55.8	56.0
49	56.2	56.4	56.6	56.7	56.9	57.1	57.3	57.5	57.6	57.8
-50	-58.0	-58.2	-58.4	-58.5	-58.7	-58.9	-59.1	-59.3	-59.4	-59.6
51	59.8	60.0	60.2	60.3	60.5	60.7	60.9	61.1	61.2	61.4
52	61.6	61.8	62.0	62.1	62.3	62.5	62.7	62.9	63.0	63.2
53	63.4	63.6	63.8	63.9	64.1	53.3	64.5	64.7	64.8	65.0
54	65.2	65.4	65.6	65.7	65.9	66.1	66.3	66.5	66.6	66.8
-55	-67.0	-67.2	-67.4	-67.5	-67.7	-67.9	-68.1	-68.3	-68.4	-68.6

Table 7-3. Celsius to Fahrenheit Conversion (Continued).

CHAPTER 8 - WIND

8.1 **Introduction**. This chapter describes observing and determining procedures for wind data in surface weather reports. Chapter 9, Coding, contains the detailed entry information, it is not intended to be duplicated herein.

8.2 **Definitions**.

8.2.1 Direction of Wind. Wind direction is defined as the direction from which the wind is blowing.

8.2.2 Gust. Rapid fluctuations in wind speed with a variation of 10 knots or more between peaks and lulls.

8.2.3 Light Wind. The wind is considered to be light when the speed is 10 knots or less.

8.2.4 Magnetic Variation. Magnetic variation is the angle between true north and magnetic north. It is either "east" or "west" according to whether the compass needle points to the east or west of the geographical meridian.

8.2.5 Hourly Peak Wind Speed. The highest hourly instantaneous wind speed recorded that exceeds 25 knots.

8.2.6 Variable Wind Direction. The wind direction may be considered variable if;

a. during the 2-minute evaluation period, the wind is 6 knots or less.

b. during the 2-minute evaluation period, the wind direction fluctuates by 60 degrees or more and the wind speed is greater than 6 knots.

8.2.7 Wind. As used in this chapter, wind is the horizontal motion of the air past a given point. It is measured in terms of velocity, a vector which includes direction and speed.

8.2.8 Wind Shift. A term applied to a change in wind direction of 45 degrees or more which takes place in less than 15 minutes and has sustained winds of 10 knots or more throughout the wind shift.

8.3 **Wind Evaluation**. Wind direction, speed, character, and wind shifts shall be determined at all stations. Peak wind shall be determined at all stations with a means of recording the wind speed.

8.3.1 Wind Direction. Obtain wind direction from an automatic sensing device, a recorder or from a digital readout, if available; otherwise use a direct dial indicator. The direction is determined by averaging the observed wind direction over a 2-minute interval.

a. At stations where instruments are not available for determining wind direction, estimate the direction by observing the wind cone or tee, movement of twigs, leaves, smoke, etc., or by facing into the wind in an unsheltered area. When estimating wind direction, note that even small obstacles may cause variations in the wind direction. Do not use the movement of clouds, regardless of how low the clouds are, in estimating the surface wind direction.

b. When the wind direction is variable during the period of observation, and the wind speed is greater than 6 knots, determine the range of variability.

8.3.2 Wind Speed. Obtain wind speed from an automatic sensing device, a recorder or from a digital readout, if available; otherwise use a direct dial indicator. The speed is determined by averaging the observed speed, to the nearest knot, over a 2-minute period. If an instrumental value is not available, use the Beaufort Scale (Table 8-1) as a guide in estimating the wind speed. Estimate wind speed on the basis of a 2-minute average. **"E" will not be included in METAR/SPECI to prefix estimated winds.** Gusts and squalls are not to be estimated.

WIND EQUIVALENT -- BEAUFORT SCALE				
Beaufort #	MPH	KTS	International Description	Specifications
0	<1	<1	Calm	Calm; smoke rises vertically
1	1-3	1-3	Light Air	Direction of wind shown by smoke drift not by wind vanes
2	4-7	4-6	Light Breeze	Wind felt on face; leaves rustle; vanes moved by wind
3	8-12	7-10	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag
4	13-18	11-16	Moderate	Raises dust, loose paper; small branches moved
5	19-24	17-21	Fresh	Small trees in leaf begin to sway; crested wavelets form on inland waters
6	25-31	22-27	Strong	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty
7	32-38	28-33	Near Gale	Whole trees in motion; inconvenience felt walking against the wind
8	39-46	34-40	Gale	Breaks twigs off trees; impedes progress
9	47-54	41-47	Strong Gale	Slight structural damage occurs
10	55-63	48-55	Storm	Trees uprooted; considerable damage occurs
11	64-72	56-63	Violent Storm	Widespread damage
12	73-82	64-71	Hurricane	

Table 8-1. Estimating Wind Speed

8.3.3 Wind Gusts. The existence of gusts can be easily determined by evaluating the recorder instrument. Rapid fluctuations of the speed which vary by 10 knots or more are determined by evaluating the vertical knot scale on the recorder chart. The speed of a gust is the maximum instantaneous wind speed recorded during the most recent 10 minutes of actual time of report. You do not determine gusts from direct-reading dials nor are they to be estimated using the Beaufort Scale. When a gust is detected within 10 minutes prior to a report that includes wind, the character of the wind shall be reported in the body of the observation.

8.3.4 Peak Wind Speed. The peak wind speed shall be the highest instantaneous speed recorded greater than 25 knots since the last METAR. Determine peak wind data, for entry in remarks of surface reports and in the summary of the day with instantaneous wind speed recorders.

a. If the wind speed recorder is incomplete, it may still be used, provided there is no indication that the peak wind speed occurred during the period of the missing data. If you believe the peak wind data occurred during a time the recorder was not operating, consider the data as missing.

b. If the wind direction record is incomplete, estimate the direction to the nearest 10 degrees for peak wind speed remarks and to 8 points of the compass for peak wind speed of the day.

Peak wind data shall be reported in remarks of the METAR and SPECI's whenever the peak wind speed exceeds 25 knots.

8.3.5 Wind Shifts. The wind data shall be examined to determine the occurrence of a wind shift. A wind shift is indicated by a change in wind direction of 45 degrees or more in less than a 15-minute period with sustained wind speeds of 10 knots or more throughout the wind shift. Wind shifts are normally associated with some or all of the following phenomena. These phenomena are:

a. Gusty winds shifting in a clockwise manner in the Northern Hemisphere.

b. Rapid drop in dew-point.

c. Rapid drop in temperature.

d. Rapid rise in pressure.

e. In summer: lightning, thunder, heavy rain, and hail.

f. In winter: frequent rainshowers or snow showers.

A SPECI shall be taken immediately after a wind shift occurrence, and a remark, reporting the wind shift and the time the wind shift occurred, shall be included in the report. When the shift is believed to be associated with a frontal passage, report "**FROPA**" in remarks immediately after the time the shift began. When a SPECI containing a wind shift is not given long-line dissemination, include the wind shift data in remarks of the next transmitted report.

8.3.6 Calm Wind. When no motion of the air is detected, the wind shall be reported as calm; i.e., the direction shall be reported as "**000**" and the speed shall be reported as "**00**". If calm winds are estimated, do not prefix with an "**E**".

8.4 **Conversion of True and Magnetic Winds**. Obtain the local variation from an aeronautical chart and proceed as follows:

a. To convert from true to magnetic wind:

(1) Add westerly variation to true direction.

(2) Subtract easterly variation from true direction.

b. To convert from magnetic to true direction:

(1) Add easterly variation to magnetic direction.

(2) Subtract westerly variation from magnetic direction.

8.5 **Prevailing Wind Direction**. At stations where a need exists, determine the prevailing wind direction for the day by noting the directions reported in each METAR. The prevailing direction is the most frequently reported direction. If several directions are reported an equal number of times, use the one having the largest number of adjacent directions recorded. If more than one direction meets this additional criteria, select the one which in your opinion is most representative.

8.6 **Instrumental Evaluation Procedures**.

8.6.1 Priority of Instruments. At stations having several types of equipment, observe the following priority in selecting the wind equipment to be used.

a. Automated Sensors

b. Direct-reading recorders.

c. Digital readout.

d. Direct-reading dials (2-minute wind only).

e. Other.

8.7 **Recorder Records**.

8.7.1 Recorder Adjustments. When a wind recorder becomes more than 5 minutes in error, adjust the chart to the correct time and indicate the adjustment by means of an arrow and the date and time of adjustment.

8.7.2 Annotation of Wind Recorder Charts

a. At the beginning and end of each chart roll, enter:

(1) The station type (NTMOD, NPMOF, MCAS, etc.), and name (Meridian, San Diego, Cherry Point).

(2) A date/time group to indicate when the trace(s) began **and** ended.

(3) The chart feed rate if different from normal, or if times are not printed on the chart.

b. Indicate and make time checks by drawing a short line on the chart and entering the time.

c. Indicate maintenance shutdowns or other inoperative periods by entering date/time groups at the end of one period of operation and the beginning of the next.

d. Whenever the chart feed rate is changed, enter a time check and an appropriate note; e.g., BEGIN 12 IN/HR, BEGIN 3 IN/HR.

8.7.3 Changing Charts. Change charts at 0000 UTC on the first day of each month and at intermediate times, as necessary, to prevent loss of record.

8.8 **Conversion Tables**. Tables 8-2 and 8-3 are provided for convenience in the conversion of miles per hour and knots. As a reminder, knots shall always be the reportable unit of measure for wind speed!

CONVERSION OF MILES PER HOUR TO KNOTS										
MPH	0	1	2	3	4	5	6	7	8	9
	KTS	KTS	KTS	KTS	KTS	KTS	KTS	KTS	KTS	KTS
0	0	1	2	3	3	4	5	6	7	8
10	9	10	10	11	12	13	14	15	16	17
20	17	18	19	20	21	22	23	23	24	25
30	26	27	28	29	30	30	31	32	33	34
40	35	36	36	37	38	39	40	41	42	43
50	43	44	45	46	47	48	49	50	50	51
60	52	53	54	55	56	56	57	58	59	60
70	61	62	63	63	64	65	66	67	68	69
80	70	70	71	72	73	74	75	76	76	77
90	78	79	80	81	82	83	83	84	85	86
Note: This table is not reversible. Use Table 8-3 to convert knots to miles per hour.										

1 mph = 0.868391 kt

Table 8-2. Conversion from Miles Per Hour to Knots

CONVERSION OF KNOTS TO MILES PER HOUR										
KTS	0	1	2	3	4	5	6	7	8	9
	MPH	MPH	MPH	MPH	MPH	MPH	MPH	MPH	MPH	MPH
0	0	1	2	3	5	6	7	8	9	10
10	12	13	14	15	16	17	18	20	21	22
20	23	24	25	26	28	29	30	31	32	33
30	35	36	37	38	39	40	41	43	44	45
40	46	47	48	49	51	52	53	54	55	56
50	58	59	60	61	62	63	64	66	67	68
60	69	70	71	72	74	75	76	77	78	79
70	81	82	83	84	85	86	87	89	90	91
80	92	93	94	96	97	98	99	100	101	102
90	104	105	106	107	108	109	110	112	113	114
NOTE: This table is not reversible. Use Table 8-2 to convert miles per hour to knots.										

1 kt = 1.15155 mph

Table 8-3. Conversion from Knots to Miles Per Hour

CHAPTER 9 - CODING AND DISSEMINATION

9.1 **Introduction**. This chapter contains procedures for encoding a weather observation in the aviation routine weather report (METAR) or aviation selected special weather report (SPECI) format. This chapter also discusses the types of dissemination, and the general requirements for verifying and making corrections to disseminated observations.

9.2 Definitions

9.2.1 Contractions. A shortened form of a word, title, or phrase used for the purpose of brevity.

9.2.2 Dissemination. Dissemination is the act of delivering a completed weather report to users.

9.2.3 FIBI. A contraction for "Filed, but impracticable to transmit".

9.2.4 Filing Time. The time a weather report is first delivered to local users or the time you transmit the report long-line.

9.2.5 Local Dissemination. The transmission or delivery of a weather report to users in the service area of the weather station.

9.2.6 Longline Dissemination. The transmission of a weather report by any communication media on a regional or national scale.

9.3 General Dissemination Requirements

9.3.1 Dissemination Priority. Disseminate METAR/SPECI reports shall be disseminated to the air traffic control activities then longline dissemination. Local procedures for the collection of weather parameters may require additional dissemination. Note: local requirements that do not meet METAR or SPECI criteria shall be recorded on a locally prepared form. They shall not be recorded on the official observation form (CNMOC 3140/12).

9.3.2 Verification of Disseminated Data.. Check all recorded weather parameters prior to dissemination. If an error is detected in any part of the information, make the appropriate corrections and disseminated the corrected information both locally and longline.

9.3.3 Corrections to Transmitted Data. Disseminate a correction (9.11.4) immediately after detecting an error in a transmitted report. Do not send a correction to a report that has been corrected by a subsequent METAR or SPECI, except in response to a data deficiency bulletin. When transmitting a corrected report:

a. Locally: include either a complete report or the corrected element with the appropriate identification.

b. Longline: include all of the elements and remarks in the original report transmitted in error.

The METAR/SPECI shall be referred to the *actual time of the report* for all corrections.

9.4 **Local Dissemination Procedures.** Each station shall establish local procedures for the dissemination of weather information. For Navy activities, establish a locally coordinated document to be reviewed and updated annually. This document shall include the code form, format and content for locally disseminated reports. The code form for locally disseminated reports should be the same as that used in the body of the report on CNMOC 3140/12. Additionally,

a. stations may exempt local dissemination of reports or specific elements contained in reports (e.g., RVR or altimeter setting) when the airfield is closed, provided procedures are established in coordination with official users of the data.

b. some observed or derived elements are normally given only local dissemination. These include rollout RVR data, pressure altitude, and density altitude.

c. disseminate all elements contained in the *body of the report.*

d. disseminate all remarks contained in *remarks* (Table 9-5). Those remarks based on 3 and 6 hourly encoded data need not be disseminated locally unless specifically required.

e. disseminate Runway Conditions as the last element of any locally disseminated report.

9.5 **Local Weather Dissemination System (LWDS).** Disseminate reports as quickly as possible after completion. Disseminate SPECI's on the LWDS before entry on the observation form. If the LWDS is inoperative or not available, the reports shall be entered on the observation form (CNMOC 3140/12), before local dissemination. Where multi-user interface of the LWDS is possible and in fact can conflict with dissemination of weather products, each station shall establish and document the precedence of dissemination of specific weather products.

9.5.1 LWDS File Copy. The LWDS file copy shall be a continuous, uninterrupted, hard-page copy and shall contain all weather products/messages/reports (i.e., weather reports, forecasts, PIREP's, tests, RAREP's etc.) disseminated on each system(s), in the sequence it was transmitted. Unless otherwise specified in local operating instructions, collect and file the LWDS record after dissemination of the last report of the day (local standard time). Dispose of the LWDS data in accordance with current COMNAVMETOCCOM directives.

9.6 **Voice Dissemination.** Where applicable, each station shall maintain current instructions outlining priorities and procedures to be followed for local dissemination of weather reports by voice relay. When disseminating by voice, the person receiving the data shall read back the information to ensure correct reception.

9.6.1 Voice Dissemination File Copy. Each station shall maintain a record on a designated general purpose form or tape recording if available, to indicate:

a. Actual time of the report (UTC).

b. Time (in minutes past the hour) the report was transmitted to the tower and other local aircraft control agencies, and the initials of the individual(s) receiving the report.

c. Initials of the disseminator.

d. At a minimum, altimeter setting, pressure altitude, and density altitude shall be recorded along with any additional elements established locally (9.4).

e. Reasons for delay or nondelivery of a report.

9.7 **Local Dissemination Back-up Procedures**. Each station shall establish locally the back-up procedures to be used in the event the primary LWDS fails. Use the following procedures as a guide:

a. Reports usually disseminated from a location other than the base weather station, where the capability exists for the report to be disseminated, should be relayed by whatever means are available for dissemination from the base weather station.

b. When the only means of local communication is voice (such as telephone or hotline), disseminate reports immediately to local air traffic control activities followed by other users established locally (9.4).

9.8 **METAR/SPECI Code**. The coding procedures in this chapter conform to WMO Code Forms FM 15-IX Ext. and FM 16-IX Ext., respectively, and the United States/ Naval service *"exceptions"* filed with WMO. These exceptions reflect national observing practices which differ from practices outlined in the WMO *Manual on Codes* No. 306.

9.9 **Format and Content of the METAR/SPECI**. The METAR/SPECI has two major sections: the Body, consisting of a maximum of 11 groups, and the Remarks, consisting of a maximum of 3 categories. The following is the format of the METAR and SPECI.

METAR or SPECI_CCCC_YYGGggZ_AUTO or COR_dddff(f)G$f_m f_m(f_m)$KT_$d_n d_n d_n V d_x d_x d_x$_VVVVVSM_ [$RD_R D_R/V_R V_R V_R V_R$FT or $RD_R D_R/V_N V_N V_N V_N V V_X V_X V_X V_X$FT]_w'w'_[$N_s N_s N_s h_s h_s h_s$ or $VVh_s h_s h_s$ or SKC]_ T'T'/T'$_d$T'$_d$_$AP_H P_H P_H P_H$_ RMK_(Automated, Manual, Plain Language)_(Additive Data and Automated Maintenance Indicators)

OCONUS:

METAR or SPECI_CCCC_YYGGggZ_AUTO or COR_dddff(f)G$f_m f_m(f_m)$KT_$d_n d_n d_n V d_x d_x d_x$_VVVV_[$RD_R D_R/V_R V_R V_R V_R$ or $RD_R D_R/V_N V_N V_N V_N V V_X V_X V_X V_X$]_w'w'_[$N_s N_s N_s h_s h_s h_s$ or $N_s N_s$/// or $VVh_s h_s h_s$ or SKC]_T'T'/T'$_d$T'$_d$_$AP_H P_H P_H P_H$_ RMK_(Automated, Manual, Plain Language)_(Additive Data and Automated Maintenance Indicators)

a. The *underline* character (_) indicates a required space, and the solidus indicates a required solidus. If a group is not reported, the preceding space is also not reported. In addition to the format given, each agency shall provide for the inclusion of any special Beginning-of-Message, End-of-Message, or End-of-Transmission signals required by their communications system.

b. The actual content of an METAR or SPECI depends on the observation program at the individual station. The *0000*, *0600*, *1200* and *1800* UTC METAR's include additional data and are known as 6-hourly reports. The *0300*, *0900*, *1500*, and *2100* UTC METAR's are known as 3-hourly reports and also contain additional information.

9.9.1 Body of the Report

a. Type of Report - **METAR/SPECI**

b. Station Identifier - **CCCC**

c. Date and Time of Report - **YYGGggZ**

d. Report Modifier - **AUTO or COR**

e. Wind - **dddff(f)Gff$_m$f$_m$(f$_m$)KT**_$d_nd_nd_nVd_xd_xd_x$

f. Visibility - **VVVVVSM**

OCONUS: Visibility - **VVVV**

g. Runway Visual Range - **RD$_R$/V$_R$V$_R$V$_R$FT or RD$_R$D$_R$/V$_N$V$_N$V$_N$V$_N$VV$_X$V$_X$V$_X$FT**

OCONUS: Runway Visual Range - **RD$_R$/V$_R$V$_R$V$_R$ or RD$_R$D$_R$/V$_N$V$_N$V$_N$V$_N$VV$_X$V$_X$V$_X$**

h. Present Weather - **w'w'**

i. Sky Condition - **N$_s$N$_s$N$_s$h$_s$h$_s$h$_s$ or VVh$_s$h$_s$h$_s$ or SKC**

OCONUS: Sky Condition - **N$_s$N$_s$N$_s$h$_s$h$_s$h$_s$ or N$_s$N$_s$/// or VVh$_s$h$_s$h$_s$ or SKC**

j. Temperature and Dew Point - **T'T'/T'$_d$T'$_d$**

k. Altimeter - **AP$_H$P$_H$P$_H$P$_H$**

9.9.2 Remarks Section of the Report -- RMK

a. Augmented, Manual, Plain Language

b. Additive Data

9.10 **Coding Missing Data in the METAR and SPECI**. With the exception of sea-level pressure, if any element of the report is missing, or cannot be evaluated, the corresponding group and preceding space are omitted from the report. If the sea-level pressure cannot be determined, it shall be reported as **SLPNO**.

9.11 **Coding the Body of the METAR/SPECI**.

9.11.1 Type of Report (**METAR and SPECI**). The type, **METAR** or **SPECI**, shall be included in all reports. The type of report shall be separated from the elements following it by a space. Whenever SPECI criteria are met at the time of the routine METAR, the type of report shall be METAR.

9.11.2 Station Identifier (**CCCC**). The station identifier, **CCCC**, shall be included in all reports to identify the station to which the coded report applies. The station identifier shall consist of four alphabetic characters only. Commander Naval Meteorology and Oceanography Command shall be responsible for coordinating the location identifier with the Federal Aviation Administration (FAA). A list of approved identifiers can be found in the FAA Manual 7350 Series, *Location Identifiers*.

9.11.3 Date and Time of Report (**YYGGggZ**). The date, **YY**, and time, **GGgg**, shall be included in all reports. The time shall be the actual time of the report or when the criteria for a SPECI is met or noted. If the report is a correction to a previously disseminated erroneous report, the time entered on the corrected report shall be the same time used in the report being corrected. The date and time group shall always be suffixed with a capital "**Z**" indicating UTC.

9.11.4 Report Modifier (**COR**). The report modifier group may or may not appear in the report. The absence of the report modifier indicates that the report is either a manual report or an augmented report. The presence of the report modifier, **COR**, indicates the report was re-transmitted with corrected data.

9.11.5 Wind Group (**dddff(f)G$f_m f_m$(f_m)KT_$d_n d_n d_n$V$d_x d_x d_x$**). The wind group pertains to Columns 3 through 6 of CNMOC 3140/12. The wind data is separated from the elements following it with a space.

a. Direction. The true direction from which the wind is blowing, **ddd**, shall be coded in tens of degrees using three figures. A direction less than 100 degrees is preceded with a "**0**". When the wind is calm, "**000**" is entered for the direction. When the wind speed is 6 knots or less and a fixed direction can not be obtained, the direction may be encoded as variable utilizing "**VRB**" in place of the ddd, e.g., a variable wind of 3 knots would be encoded, **VRB03KT.**

b. Speed. The wind speed, **ff(f)**, shall be coded in two or three digits immediately following the wind direction. The speed is entered in whole knots using the units and tens digits and, if required, the hundreds digit. Speeds of less than 10 knots are encoded using a leading zero. The wind group shall always end with **KT**. For example, a wind speed of 8 knots would be encoded as

08KT. A wind speed of 109 knots would be encoded as **109KT**. When the wind speed is calm, **00** would be encoded for the speed.

c. Gusts. Wind gusts shall be coded in the format, $\mathbf{Gf_mf_m(f_m)}$. The wind gust shall be coded in two or three digits immediately following the wind speed. The wind gust shall be coded, in whole knots, using the units and tens digits and, if required, the hundreds digit. For example, a wind from the west at 20 knots with a gust to 35 knots would be coded **"27020G35KT"**.

9.11.5.1 Variable Wind Direction. Variable wind direction can be indicated as follows:

a. Wind speeds of 6 knots or less. Wind direction may be reported as variable **"VRB"** when the wind speed is 6 knots or less and a fixed wind direction can not be determined. For example, if the wind is variable at three knots, it would be coded as **"VRB03KT"**.

b. Wind speeds of 7 knots or greater. Variable wind direction with wind speed of 7 knots or greater shall be coded in the format, $\mathbf{d_nd_nd_nVd_xd_xd_x}$. The variable wind direction group shall immediately follow the wind group separated by a space. The directional variability shall be coded in a clockwise direction. For example, if the wind is variable from 180° to 240° at 10 knots, it would be coded **"21010KT 180V240"**.

9.11.6 Visibility Group (**VVVVVSM**). The surface visibility, **VVVVVSM**, shall be coded in statute miles using the values listed in Table 9-1A. A space shall be coded between whole numbers and fractions of reportable visibility values. The visibility group shall always end with **SM** to indicate that visibility is in statute miles. For example, a visibility of one and one half statute miles would be coded **"1_1/2SM"**.

OCONUS: The surface visibility, **VVVV**, shall be coded in meters using the values listed in Table 9-1B. No indicator is used.

Reportable Visibility Values (Statute Miles)				
0	5/8	1 5/8	4	12
1/16	3/4	1 3/4	5	13
1/8	7/8	1 7/8	6	14
3/16	1	2	7	15
1/4	1 1/8	2 1/4	8	20
5/16	1 1/4	2 ½	9	25
3/8	1 3/8	2 3/4	10	30
1/2	1 1/2	3	11	etc.

Table 9-1A. Reportable Visibility Values (CONUS)

Reportable Visibility Values (Meters)					
NM	SM	METERS	NM	SM	METERS
0.0	0	0000	1.4	1-5/8	2600
0.05	1/16	0100	1.5	1-3/4	2800
0.1	1/8	0200	1.6	1-7/8	3000
0.15	3/16	0300	1.7	2	3200
0.2	1/4	0400	1.8	---	3400
0.25	5/16	0500	1.9	2-1/4	3600
0.3	3/8	0600	2.0	---	3700
0.4	---	0700	2.2	2-1/2	4000
0.45	1/2	0800	---	2-3/4	4400
0.5	---	0900	2.4	---	4500
0.55	5/8	1000	2.5	---	4700
0.6	---	1100	2.6	3	4800
---	3/4	1200	2.7	---	5000
0.7	---	1300	3.0	4	6000
---	7/8	1400	4.0	---	7000
0.8	---	1500	4.3	5	8000
---	1	1600	5.0	6	9000
0.9	---	1700	6.0	7	9999
1.0	1-1/8	1800	7.0	8	9999
1.1	1-1/4	2000	8.0	9	9999
1.2	1-3/8	2200	9.0	10	9999
1.3	1-1/2	2400			

Table 9-1B. Reportable Visibility Values (OCONUS)

9.11.7 Runway Visual Range Group (**$RD_RD_R/V_RV_RV_RV_RFT$**). RVR is entered whenever the prevailing visibility is 1 mile or less, or the RVR value for the designated runway is 6,000 feet or less. The 10-minute RVR values (Tables 4-4 and 4-5) for the designated RVR runway are included in both, METAR and SPECI's. RVR values are based upon light setting (LS) 5 and reported in increments of 200 feet through 3,000 feet and in increments of 500 feet above 3,000 feet.

OCONUS: RVR is entered whenever the prevailing visibility is 1 mile (1700 meters) or less, or the RVR value for the designated runway is 6,000 feet or less. The 10-minute RVR values (see tables 4-4 to 4-5) for the designated RVR runway are included in both, METAR and SPECI's. "FT" is omitted. No indicator used.

a. The format used for constant RVR is **$RD_RD_R/V_RV_RV_RV_RFT$** where;

R - Indicates that the runway number follows.

D_RD_R - Runway number. An additional **D_R** may be used for runway approach directions, such as **R** for right, **L** for left, and **C** for center.

/ - Required separator.

$V_RV_RV_RV_R$ - Constant reportable value in hundreds of feet of visual range for the past 10 minutes.

OCONUS: Constant reportable value in meters for the past 10 minutes.

FT - Required suffix indicating units of measure are feet.

OCONUS: FT is dropped from the range group to indicate meters.

b. The format for variable RVR is $\mathbf{RD_RD_R/V_NV_NV_NV_NVV_XV_XV_XV_XFT}$ where;

R - Indicates that the runway number follows.

D_RD_R - Runway number. An additional D_R may be used for runway approach directions, such as **R** for right, **L** for left, and **C** for center.

/ - Required separator.

$V_RV_RV_RV_R$ - The lowest reportable value in hundreds of feet of visual range for the past 10 minutes.

OCONUS: The lowest reportable value in meters for the past 10 minutes.

V - Variable separator.

$V_XV_XV_XV_X$ - The highest reportable value in hundreds of feet of visual range for the past 10 minutes.

OCONUS: The highest reportable value in meters for the past 10 minutes.

FT - Required suffix indicating units of measure are feet.

OCONUS: No indicator used.

c. The 10-minute RVR for runway 01L varying between 1,000 and 5,000 feet would be coded "**R01L/1000V5000FT**". If the **RVR** is less than its lowest reportable value, the $V_RV_RV_RV_R$ or $V_NV_NV_NV_N$ groups shall be preceded by an "**M**". If the **RVR** is greater than its highest reportable value, the $V_RV_RV_RV_RV$ or $V_XV_XV_XV_X$ groups shall be preceded by a "**P**". For example, an RVR of less than 1,000 feet for runway 01L would be coded "**R01L/M1000FT**"; an **RVR** of greater than 6,000 feet would be coded "**R01L/P6000FT**".

9.11.8 Present Weather (**w'w'**). Present weather entries pertain to column 9a, CNMOC 3140/12. Present weather is preceded with a space immediately following the reported runway visual range. If runway visual range is not reported, the present weather is preceded by a space and follows the visibility. The following rules shall be used when coding present weather for METAR or SPECI.

a. Weather occurring at the observing location or in the vicinity of the station shall be coded in the body of the report; weather observed but not occurring at the observing location or in the vicinity of the station shall be coded in "remarks".

b. With the exception of **shallow fog, partial fog, patchy fog, low drifting dust, low drifting sand**, and **low drifting snow**, obscurations shall be coded in the body of the report if the visibility is less than 7 miles **or** considered operationally significant. When observed, **volcanic ash** shall always be coded in the body of the report.

c. Each "type" of present weather i.e., fog, haze, funnel cloud, etc., is treated as its own "group". Each group shall be separated from the other group by a space. A METAR/SPECI shall contain no more than three present weather groups. The precipitation "types" i.e., Drizzle, rain, snow, etc., are treated as one "group" and are combined with no spaces. (i.e., **-RASN_FG_HZ, +TSRAGR_SQ_FG**).

9.11.8.1 Intensity or Proximity Qualifier.

a The Intensity Qualifier shall be coded with all precipitation types, except **ice crystals** and **hail**, including those precipitation types associated with a thunderstorm (**TS**) and those of a showery nature (**SH**). **Tornados** and **waterspouts** shall be coded as **+FC**. No intensity shall be ascribed to the obscurations of blowing dust (**BLDU**), blowing sand (**BLSA**), and blowing snow (**BLSN**). Only moderate and heavy intensity shall be ascribed to sandstorm (**SS**), and duststorm (**DS**).

b. The Proximity Qualifier for vicinity, **VC** (weather phenomena observed in the vicinity of but not at the observing location), shall be coded in combination with thunderstorm (**TS**), fog (**FG**), shower(s) (**SH**), well developed dust/sand whirls (**PO**), blowing dust (**BLDU**), blowing sand (**BLSA**), blowing snow (**BLSN**), sandstorm (**SS**), and duststorm (**DS**). Intensity qualifiers shall not be coded with **VC**.

(1) **VCFG** may be coded to report any type of fog in the vicinity of the observing location.

(2) Precipitation not occurring at the point of observation but within 10 statue miles shall be coded as showers in the vicinity (**VCSH**).

9.11.8.2 Descriptor Qualifier. Only one descriptor qualifier shall be coded for each weather phenomena group, e.g., "-FZDZ". Mist (**BR**) shall not be coded with any descriptor.

a. The descriptors shallow (**MI**), partial (**PR**), and patches (**BC**) shall only be coded with **FG**, e.g., "**MIFG**".

b. The descriptors low drifting (**DR**), and blowing (**BL**) shall only be coded with dust (**DU**), sand (**SA**), and snow (**SN**), e.g., "**BLSN**" or "**DRSN**". **DR** shall be coded for **DU**, **SA**, or **SN** raised by the wind to less than six feet above the ground.

(1) When blowing snow is observed with snow falling from clouds, both phenomena are reported, e.g., "SN_BLSN". When, because of blowing snow, the observer cannot determine whether

or not snow is also falling, then only **BLSN** shall be reported. Even if the visibility is less than 5/8 SM, report "**BLSN**" (9.11.8.1(a).

(2) Spray (**PY**) shall be coded only as **BLPY**.

c. The descriptor shower(s) (**SH**) shall be coded only with one or more of the precipitation types of rain (**RA**), snow (**SN**), ice pellets (**PE**), small hail (**GS**), or large hail (**GR**). The **SH** descriptor indicates showery-type precipitation. When any type of precipitation is coded with **VC**, the intensity and type of precipitation shall not be coded.

d. The descriptor thunderstorm (**TS**) may be coded by itself, i.e., a thunderstorm without any associated precipitation, or it may be coded with the precipitation types of rain (**RA**), snow (**SN**), ice pellets (**PE**), small hail and/or snow pellets (**GS**), or hail (**GR**). For example, a thunderstorm with snow and small hail and/or snow pellets would be coded as "TSSNGS". Thunderstorms (**TS**) imply that the associated precipitation is showery, therefore, the descriptor (**SH**) shall not be coded.

e. The descriptor freezing (**FZ**), shall only be coded in combination with fog (**FG**), drizzle (**DZ**), or rain (**RA**), e.g., "FZRA". **FZ** shall not be coded with **SH**.

9.11.8.3 Precipitation. Up to three (3) "types" of precipitation may be coded in a single present weather "group". They shall be coded in order of decreasing predominance based on intensity. Code precipitation in accordance with the notations given in Table 5-1, Notations for Reporting Present Weather.

9.11.8.4 Obscuration. Obscurations shall be coded in accordance with the notations given in Table 5-1, Notations for Reporting Present Weather. Each obscuration is treated as its own group and shall be separated from other groups by a space. Patches of fog (BCFG) and partial fog (PRFG) may be coded with the prevailing visibility of 7 statute miles or greater.

9.11.8.5 Other Weather Phenomena. Other Weather Phenomena shall be coded in accordance with the notations given in Table 9-2, Weather Phenomena. Each phenomena is treated as its own group and shall be separated from other groups by a space. Tornados and waterspouts shall be coded as **+FC**. Funnel clouds shall be coded as **FC**. Squalls shall be coded as **SQ**.

9.11.9 Sky Condition Group (**$N_sN_sN_sh_sh_sh_s$ or $VVh_sh_sh_s$ or SKC**). Sky Condition refers to entries in Column 10, CNMOC 3140/12.

a. Sky condition shall be coded in the format, $\mathbf{N_sN_sN_sh_sh_sh_s}$, where, $\mathbf{N_sN_sN_s}$ is the amount of sky cover, expressed as a sky cover classification in accordance with Table 9-3, and $\mathbf{h_sh_sh_s}$ is the height of the layer. There shall be *no* space between the sky cover classification and the height of the layer. Sky condition shall be coded in an ascending order up to the first overcast layer. At mountain stations, if the layer is below station level, the height of the layer shall be coded as "///". A maximum of six (6) layers may be reported CONUS, and four (4) layers OCONUS (3.2.18).

b. Surface-based obscurations, formerly known as partial obscurations, shall be coded in the format, $\mathbf{N_sN_sN_sh_sh_sh_s}$, where, $\mathbf{N_sN_sN_s}$ is the sky cover classification, expressed in accordance with Table 9-3 and $\mathbf{h_sh_sh_s}$ is "**000**" indicating surface based or a height of less than 50 feet. There shall be *no* space between the amount of sky cover and the height of the layer. Further amplifying information will be in the "remarks" section of the report.

<u>OCONUS:</u> Partial obscurations shall be coded in the format, $N_sN_s///$, where, N_sN_s is the obscuring phenomena i.e., FG, HZ, FU, and "///" indicates surface based.

c. Vertical visibility shall be coded in the format, **VV**$h_sh_sh_s$, where **VV** identifies an indefinite ceiling and $h_sh_sh_s$ is the vertical visibility into the indefinite ceiling. There shall be *no* space between the group identifier and the vertical visibility.

d. Clear skies shall be coded in the format, **SKC**, where **SKC** is the abbreviation used by *manual stations* to indicate no layers are present.

e. Each layer shall be separated from other layers by a space. The sky cover for each layer reported shall be coded by using the appropriate reportable contraction from Table 9-4. The abbreviations **FEW**, **SCT**, **BKN**, and **OVC** shall be immediately followed (*no space*) by the height of the cloud layer.

f. The height of the base of each layer, $h_sh_sh_s$, shall be coded in hundreds of feet above the surface using three (3) digits in accordance with Table 9-5. Cumulonimbus (**CB**) or towering cumulus (**TCU**) shall be appended to the layer whenever they are observed. For example, a scattered layer of towering cumulus at 1,500 feet would be coded "**SCT015TCU**" and would be followed by a space if there were additional higher layers to code.

9.11.10 Temperature and Dew Point (**T'T'/T'$_d$T'$_d$**). Temperature and dew point entries are recorded in columns 11 and 12 of CNMOC 3140/12. The temperature and dew point shall be coded as two digits rounded to the nearest whole degree Celsius, separated from each other by a solidus "/". Sub-zero temperatures and dew points shall be prefixed with an "**M**". For example, a temperature of 4°C with a dew point of -2°C is coded as "04/M02". A temperature of -0.5°C shall be coded as "M00".

a. If the *temperature* is not available, the *entire* temperature/dew point group shall not be coded.

b. If the *dew point* is *not* available, the temperature shall be coded followed by a *single* solidus "/" and no entry made for dew point. For example, a temperature of 1.5°C and a missing dew point would be coded as "02/".

9.11.11 Altimeter (**AP$_H$P$_H$P$_H$P$_H$**). The group always begins with an "**A**", the international indicator for *"altimeter"* in inches of mercury. The altimeter shall be coded as a four digit group immediately following, no space, the "**A**" using the tens, units, tenths, and hundredths of inches of mercury. The decimal point is *not* coded.

Type of Phenomenon	Reporting Notation	Type of Phenomenon	Reporting Notation
Tornado (Well-developed)	+FC	Shallow (Ground) Fog	MIFG
Funnel Cloud	FC	Partial Fog	PRFG
Waterspout (Well-developed)	+FC	Patchy Fog	BCFG
Thunderstorm	TS	Freezing Fog	FZFG
Rain	RA	Dust	DU
Rain Shower	SHRA	Blowing Dust	BLDU
Drizzle	DZ	Low Drifting Dust	DRDU
Freezing Rain	FZRA	Sand	SA
Freezing Drizzle	FZDZ	Blowing Sand	BLSA
Ice Crystals	IC	Low Drifting Sand	DRSA
Ice Pellets	PE	Blowing Snow	BLSN
Ice Pellet Showers	SHPE	Low Drifting Snow	DRSN
Hail	GR	Blowing Spray	BLPY
Snow	SN	Haze	HZ
Snow Showers	SHSN	Smoke	FU
Snow Grains	SG	Sandstorm (Heavy)	SS (+SS)
Snow Pellets/Small Hail	GS	Duststorm (Heavy)	DS (+DS)
Volcanic Ash	VA	Squalls	SQ
Fog	FG	Well-developed Dust/Sandwhirls	PO
Mist	BR		

Table 9-2. Weather Phenomena.

Classification	Meaning	Summation Amount of Layer
VV	Vertical Visibility	8/8
SKC	Clear	0
FEW	Few	>0/8 - 2/8
SCT	Scattered	3/8 - 4/8
BKN	Broken	5/8 - 7/8
OVC	Overcast	8/8

Table 9-3 Sky Cover Contractions

Range of Height Values (feet)	Reportable Increment (feet)
≤50	000
≤5,000	To nearest 100
>5,000 but ≤10,000	To nearest 500
>10,000	To nearest 1,000

Table 9-4. Increments of Reportable Values of Sky Cover Height

9.12 **Remarks (RMK).** Remarks shall be included in all METAR and SPECI, if appropriate. Table 9-5 lists all remarks and their references. Remarks shall be separated from the body of the report by a space and the contraction "**RMK**". *Omit* the contraction if there are *no remarks*. METAR and SPECI remarks fall into two categories: (1) Automated, Manual and Plain Language), and (2) Additive Data. Remarks shall be made in accordance with the following;

a. Where plain language is called for, authorized contractions, abbreviations, and symbols should be used to conserve time and space. However, in no case should an essential remark, of which the observer is aware, be omitted for lack of readily available contractions. In such cases, the only requirement is that the remarks be clear. For a detailed list of authorized contractions, see FAA Order 7340 Series, *Contractions*.

b. Time entries shall be made in *minutes past the hour* to which the report applies. If the time reported is referencing a previous hour, both the hour and minutes to which the hour belong shall be used.

c. Present weather coded in the body of the report as "**VC**" may be further described, i.e., direction from station, if known. Weather phenomena beyond 10 statute miles of the observing location shall be coded as distant (**DSNT**) followed by the direction from the station. For example, precipitation of unknown intensity 10 statute miles east of the station would be coded as "**VCSH E**"; lightning 25 statute miles west of the station would be coded as "**LTG DSNT W**".

(1) Remarks (RMK)			
Element	Reference	METAR	SPECI
Volcanic Eruptions	9.12.1.1	X	X
Tornadic Activity	9.12.1.2	X	X
Type of Station	9.12.1.3	X	X
Peak Wind	9.12.1.4	X	
Wind Shift, FROPA	9.12.1.5	X	X
Tower Visibility	9.12.1.6	X	X
Variable Prevailing Visibility	9.12.1.7	X	X
Sector Visibility	9.12.1.8	X	X
Lightning	9.12.1.9	X	X
Beginning/Ending of Thunderstorms and/or Precipitation	9.12.1.10	X	X
Thunderstorm Location	9.12.1.11	X	X
Hailstone Size	9.12.1.12	X	X
Virga	9.12.1.13	X	X
Variable Ceiling	9.12.1.14	X	X
Obscuration(s)	9.12.1.15	X	X
Variable Sky Condition	9.12.1.16	X	X
Significant Cloud Types	9.12.1.17	X	X
Pressure Rising/Falling Rapidly	9.12.1.18	X	X
Sea-Level Pressure	9.12.1.19	X	X
(1) Remarks Continued (RMK)			
Element	Reference	METAR	SPECI
Aircraft Mishap	9.12.1.20	X	X
No SPECI's Taken	9.12.1.21	X	
Snow Increasing Rapidly	9.12.1.22	X	
Runway Condition	9.12.1.23	X	X
Breaks or Thin Spots in Overcast	9.12.1.24	X	X
First and Last Remark	9.12.1.25	X	X

Table 9-5. Remarks.

(2) Additive Data (RMK)			
Element	Reference	METAR	SPECI
Hourly Precipitation Amount	9.12.2.1a	X	
3- and 6-hourly Precipitation Amount	9.12.2.1b	X	
24-Hour Precipitation Amount	9.12.2.1c	X	
Snow Depth on the Ground, 4/sss	9.12.2.1d	X	
Water Equivalent of Snow on the Ground, 933RRR	9.12.2.1e	X	
Cloud Types, $8/C_LC_MC_H$	9.12.2.2	X	
Hourly Temperature and Dew Point	9.12.2.3a	X	
6-Hourly Maximum Temperature	9.12.2.3b	X	
6-Hourly Minimum Temperature	9.12.2.3c	X	
24-Hour Maximum and Minimum Temperature	9.12.2.3d	X	
3-Hour Pressure Tendency, 5appp	9.12.2.4	X	
X - Indicates element included at all stations.			

Table 9-5. Remarks (Cont).

d. Movement of clouds or weather, if known, shall be coded with respect to the direction toward which the phenomena is moving. For example, a thunderstorm moving toward the northeast would be coded as "**TS MOV NE**".

e. Directions shall use the eight points of the compass coded in a clockwise order.

f. Insofar as possible, remarks shall be entered in the order they are presented in the following paragraphs.

9.12.1 Remarks: Manual, Augmented and Plain Language: These remarks generally elaborate on parameters reported in the body of the report.

9.12.1.1 Volcanic Eruptions. Volcanic eruptions shall be reported, whenever noted. Pre-eruption volcanic activity shall not be reported. The remark shall be plain language and contain the following, if known:

a. Name of volcano.

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

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.

For example, a remark on a volcanic eruption would look like the following:

MT. AUGUSTINE VOLCANO 70 MILES SW ERUPTED 231505 LARGE ASH CLOUD EXTENDING TO APPROX 30000 FEET MOVING NE.

9.12.1.2 Tornadic Activity (**Tornadic activity_B/E(hh)mm_LOC/DIR_(MOV)**). Tornadoes, funnel clouds, or waterspouts shall be coded in the format, **Tornadic activity B/E(hh)mm LOC/DIR_ (MOV)**, where **TORNADO, FUNNEL CLOUD, or WATERSPOUT** identifies the specific Tornadic activity, **B/E** denotes the beginning and/or ending time (only used if a METAR/SPECI was not disseminated), **(hh)mm** is the time of occurrence (only the minutes are required if the hour can be inferred from the report time), **LOC/DIR** is the location and/or direction of the phenomena from the station, and **MOV** is the movement, **if known.** Tornadic activity shall be coded as the first remark after the "**RMK**" entry. For example, "TORNADO B13 DSNT NE" would indicate that a tornado, which began at 13 minutes past the hour, was beyond 10 statute miles northeast of the station.

9.12.1.3 Type of Automated Station (AO1 or AO2). **AO1** or **AO2** shall be encoded in all METAR/SPECI from automated stations. Automated stations without a precipitation discriminator shall be identified as **AO1**; automated stations with a precipitation discriminator shall be identified as **AO2**.

9.12.1.4 Peak Wind (**PK_WND_dddff(f)/(hh)mm**). The peak wind shall be coded in the format, **PK_WND_ dddff(f)/(hh)mm** of the next METAR, where **PK_WND** is the remark identifier, **ddd** is the direction of the peak wind, **ff(f)** is the peak wind speed since the last METAR, and (hh)mm is the time of occurrence (only the minutes are required if the hour can be inferred from the report time). There shall be one space between the two elements of the remark identifier and the wind direction/speed group; a solidus (without spaces) shall separate the wind direction/speed group and the time. For example, a peak wind of 45 knots from 280 degrees that occurred at 15 minutes past the hour would be coded "PK WND 28045/15".

9.12.1.5 Wind Shift (**WSHFT_(hh)mm**). A wind shift shall be coded in the format, **WSHFT_(hh)mm**, where **WSHFT** is the remark identifier and **(hh)mm** is the time the wind shift began (only the minutes are required if the hour can be inferred from the report time). The contraction **FROPA** may be entered following the time if it is reasonably certain that the wind shift was the result of a frontal passage. There shall be one space between the remark identifier and the time and, if applicable, between the time and the frontal passage contraction. For example, a remark reporting a wind shift accompanied by a frontal passage that began at 30 minutes after the hour would be coded as "WSHFT 30 FROPA".

9.12.1.6 Tower Visibility (**TWR_VIS_vvvvv**). Tower visibility shall be coded in the format, **TWR_VIS_ vvvvv**, where **vvvvv** is the observed tower visibility. A space shall be coded between each of the remark elements. For example, "TWR VIS 1" would indicate the visibility from the control tower was 1 statute mile.

9.12.1.7 Variable Prevailing Visibility (**VIS_$v_nv_nv_nv_nv_nVv_xv_xv_xv_xv_x$**). Variable prevailing visibility shall be coded in the format **VIS_$v_nv_nv_nv_nv_nVv_xv_xv_xv_xv_x$**, where **VIS** is the remark identifier, **$v_nv_nv_nv_nv_n$** is the lowest visibility evaluated, V denotes variability between two values, and **$v_xv_xv_xv_xv_x$** is the highest visibility evaluated. There shall be one space following the remark identifier; no spaces between the letter V and the lowest/highest values. For example, a visibility that was varying between 1/2 and 2 statute miles would be coded "VIS 1/2V2" .

9.12.1.8 Sector Visibility (**VIS_[DIR]_vvvvv**). The sector visibility shall be coded in the format, **VIS_[DIR]_vvvvv**, where **VIS** is the remark identifier, **[DIR]** defines the sector to 8 points of the compass, and **vvvvv** is the sector visibility in statute miles, using the appropriate set of values in

Tables 9-1A and 91B. For example, "VIS N 2" would indicate that the visibility in the northern octant was 2 statute miles.

9.12.1.9 Lightning (**Frequency_LTG(type)_[LOC]**). When lightning is observed, the frequency, type of lightning, and location shall be reported. The remark shall be coded in the format **Frequency_LTG(type)_[LOC]**. The contractions for the type and frequency of lightning shall be based on Table 9-6. The location and direction shall be coded in accordance with paragraph 9.12.c. For example, "FRQ LTGCG VC" or "LTG DSNT W".

Type of Lightning		
Type	**Contraction**	**Definition**
Cloud-ground	CG	Lightning occurring between cloud and ground.
In-cloud	IC	Lightning which takes place within the thunder 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	1 to 6 flashes/minute.
Continuous	CNS	More than 6 flashes/minute.

Table 9-6. Type and Frequency of Lightning

9.12.1.10 Beginning and Ending of Precipitation and Thunderstorms (**w'w'B(hh)mmE(hh)mm**). The beginning and ending of precipitation and thunderstorm(s) shall be coded in the format, **w'w'B(hh)mmE(hh)mm**, where **w'w'** is the type of precipitation, **B** denotes the beginning, **E** denotes the ending, and **(hh)mm** is the time of occurrence (only the minutes are required if the hour can be inferred from the report time). There shall be no spaces between the elements. The coded remarks are not required in the SPECI or METAR if the observation is taken and disseminated for this special criteria. If the *observation was not disseminated*, enter this remark in the next METAR. Intensity qualifiers shall not be coded. For example, if rain began at 0005, ended at 0030, and snow began at 0020, and ended at 0055, the remarks would be coded "RAB05E30SNB20E55". If the precipitation were showery, the remark would be coded "SHRAB05E30SHSNB20E55".

9.12.1.11 Thunderstorm Location (**TS_LOC_(MOV_DIR)**). Thunderstorm(s) shall be coded in the format, **TS_LOC_(MOV_DIR)**, where **TS** identifies the thunderstorm activity, **LOC** is the location of the thunderstorm(s) from the station, and **MOV_DIR** is the movement with direction, if known. For example, "TS VC MOV NE" would indicate that a thunderstorm, which was in the vicinity of the station and moving to the northeast.

9.12.1.12 Hailstone Size (**GR_[size]**). The hailstone size shall be coded in the format, **GR_[size]**, where **GR** is the remark identifier and **[size]** is the diameter of the largest hailstone. The size of the largest hailstone shall be coded in *1/4 inch increments*. When the largest hailstone observed is 1/4 inch or more in diameter, it shall be coded with the contraction GR. For example, "GR 3/4" would indicate that the largest hailstones were 3/4 inch in diameter. If GS is coded in the body of the report, *no* hailstone size remark is required.

9.12.1.13 Virga (**VIRGA_(DIR)**). Virga shall be coded in the format, **VIRGA_(DIR)**, where **VIRGA**, indicates that the precipitation is observed to be falling from clouds but evaporates before reaching the ground, and the direction, **DIR**, of the phenomena from the station e.g., "VIRGA SW".

9.12.1.14 Variable Ceiling (**CIG_$h_nh_nh_nVh_xh_xh_x$**). The variable ceiling height shall be coded in the format, **CIG_$h_nh_nh_nVh_xh_xh_x$**, where **CIG** is the remark identifier, $h_nh_nh_n$ is the lowest ceiling height evaluated, **V** denotes variability between two values, and $h_xh_xh_x$ is the highest ceiling height evaluated. There shall be one space following the remark identifier; no spaces between the letter V and the lowest/highest ceiling values. For example, "CIG 005V010" would indicate a ceiling that was varying between 500 and 1,000 feet.

9.12.1.15 Obscuration(s) (**w'w'_[$N_sN_sN_s$]$h_sh_sh_s$**). Obscurations (surface-based or aloft) shall be coded in the format, **w'w'_[$N_sN_sN_s$]$h_sh_sh_s$**, where **w'w'** is the weather causing the obscuration, $N_sN_sN_s$ is the contraction representing amount of the sky obscured, and $h_sh_sh_s$ is the height. Surface-based obscurations shall have a height of "000". There shall be a space separating the weather causing the obstruction and the sky cover amount; there shall be no space between the sky cover amount and the height. For example, "FG SCT000" indicates that fog is hiding 3-4 oktas of the sky.

9.12.1.16 Variable Sky Condition (**$N_sN_sN_s(h_sh_sh_s)VN_sN_sN_s$**). The variable sky condition remark shall be coded in the format, **$N_sN_sN_s(h_sh_sh_s)VN_sN_sN_s$**, where $N_sN_sN_s$ identifies the two sky conditions and **V** denotes the variability between the two ranges. For example, "SCT V BKN" would identify a scattered layer that is variably broken. If there are several layers with the same sky condition amount, the layer height, $h_sh_sh_s$, shall be coded with the variable layer. For example, a cloud layer at 1,400 feet that is varying between broken and overcast would be coded "BKN014VOVC".

9.12.1.17 Significant Cloud Types. The significant cloud type remark shall be coded in all reports in the following manner:

a. Cumulonimbus or Cumulonimbus Mammatus (**CB or CBMAM_LOC_(MOV_DIR)**). Cumulonimbus or cumulonimbus mammatus, as appropriate, (for which no thunderstorm is being reported) shall be coded in the format, **CB or CBMAM_LOC_(MOV_DIR)**, where **CB or CBMAM** is the cloud type, **LOC** is the direction from the station, and **MOV_DIR** is the movement with direction (if known). The cloud type, location, movement, and direction entries shall be separated from each other with a space. For example, "CB W MOV E" would indicate a CB between 5 and 10 statute miles west of the observing location and moving toward the east. If the cloud was more than 10 statute miles away, the remark would be "CB DSNT W".

b. Towering cumulus (**TCU_[DIR]**). Towering cumulus clouds shall be coded in the format, **TCU_[DIR]**, where **TCU** is the cloud type and **DIR** is the direction from the station. The cloud type and direction entries shall be separated by a space. For example, "TCU W" would indicate a towering cumulus cloud between 5 and 10 statute miles west of the observing location.

c. Altocumulus castellanus (**ACC_[DIR]**). Altocumulus castellanus shall be coded in the format, **ACC_(DIR)**, where **ACC** is the cloud type and **DIR** is the direction from the station. The

cloud type and direction entries shall be separated by a space. For example, "ACC NW" would indicate altocumulus cloud 5 to 10 statute miles northwest of the observing location.

d. Standing lenticular or Rotor clouds (**CLD_[DIR]**). Stratocumulus (SCSL), altocumulus (ACSL), or cirrocumulus (CCSL), or rotor clouds shall be coded in the format, **CLD_[DIR]**, where **CLD** is the cloud type and **DIR** is the direction from the station. The cloud type and direction entries shall be separated by a space. For example, "ACSL SW-W", "APRNT ROTOR CLD VC", and "CCSL S". Cumulonimbus of any kind and towering cumulus are also identified in the body of the report in the sky condition group.

9.12.1.18 Pressure Rising or Falling Rapidly (**PRESRR/PRESFR**). When the pressure is rising or falling rapidly at the time of report, the remark PRESRR (pressure rising rapidly) or PRESFR (pressure falling rapidly) shall be included in the report.

9.12.1.19 Sea-Level Pressure (**SLPppp**). This remark is **mandatory**. Sea-Level Pressure shall be coded in the format **SLPppp**, where **SLP** is the remark identifier and **ppp** is the sea-level pressure coded using the tens, units, and tenths digits in hectopascals. For example, a sea-level pressure of 998.2 hectopascals would be coded as "SLP982". If sea-level pressure is not available, it is coded as "**SLPNO**".

9.12.1.20 Aircraft Mishap (**ACFT_MSHP**). If a report was taken to document weather conditions when notified of an aircraft mishap, the remark **ACFT MSHP** shall be included in the report but not transmitted. The act of non-transmission shall be indicated by enclosing the remark in parentheses in the record, i.e., "(ACFT MSHP)".

9.12.1.21 No SPECI Reports Taken (**NOSPECI**). If a SPECI was not taken, the remark **NOSPECI** shall be coded to indicate that no changes in weather conditions will be reported until the next METAR.

9.12.1.22 Snow Increasing Rapidly (**SNINCR_[inches/hr]/[inches on ground]**). The snow increasing rapidly remark shall be coded, in the next METAR, whenever the snow depth increases by 0.5 inch (1 inch to the nearest whole inch) or more in the past hour. The remark shall be coded in the format, **SNINCR [inches/hour]/[inches on ground]**, where **SNINCR** is the remark indicator, **[inches/hour]** is the depth increase in the past hour, and [inches on ground] is the total depth of snow on the ground at the time of the report. The depth increase in the past hour and the total depth on the ground are separated from each other by a solidus /. For example, a report of "SNINCR 2/10" indicates a snow depth increase of 2 inches in the last hour with a total depth on the ground of 10 inches.

9.12.1.23 Runway Condition (**RSC and RCR**). Runway Surface Conditions (RSC) and Runway Condition Readings (RCR) shall be coded in accordance with Appendix A.

9.12.1.24 Thin Spots in Overcast (**THN_SPTS_IOVC**). When applicable, encode **THN_SPTS_IOVC** to denote transparencies in lower layer; higher clouds may or may not be visible, e.g., "**THN SPTS IOVC HIR CLDS VSBL**", "**THN SPTS IOVC**".

9.12.1.25 FIRST and LAST (**FIRST and LAST**). At part-time stations, the first and last reports transmitted shall be identified by including the word "**FIRST**" in the first report of the day after a break in observing coverage and , or the word "**LAST**" in the last report of the day before a break in observation coverage.

9.12.2 Additive Data.

9.12.2.1 Precipitation

a. Hourly Precipitation Amount (**Prrrr**). The hourly precipitation amount remark shall be coded in the format, **Prrrr**, where **P** is the group indicator and **rrrr** is the water equivalent of all precipitation that has occurred since the last METAR. The amount shall be coded in hundredths of an inch. For example, "P0009" would indicate 9/100 of an inch of precipitation fell in the past hour; "P0000" would indicate that less than 1/100 of an inch of precipitation fell in the past hour. The group shall be *omitted* if no precipitation occurred since the last METAR.

b. 3- and 6-Hour Precipitation Amount (**6RRRR**). The 3- and 6-hourly precipitation group shall be coded in the format, **6RRRR**, where **6** is the group indicator and **RRRR** is the amount of precipitation. The amount of precipitation (water equivalent) accumulated in the past 3 hours shall be reported in the 3-hourly report; the amount that accumulated in the past 6 hours shall be reported in the 6-hourly report. The amount of precipitation shall be coded in inches, using the tens, units, tenths and hundredths digits of the amount. When an *indeterminable* amount of precipitation has occurred during the period, **RRRR** shall be coded 6////. An example is 2.17 inches of precipitation would be coded "60217". A *trace* shall be coded "60000".

c. 24-Hour Precipitation Amount ($7R_{24}R_{24}R_{24}R_{24}$). The 24-hour precipitation amount shall be coded in the format, $7R_{24}R_{24}R_{24}R_{24}$, where **7** is the group indicator and $R_{24}R_{24}R_{24}R_{24}$ is the 24-hour amount of precipitation. The 24-hour precipitation amount shall be included in the ***1200 UTC*** report whenever more than a trace of precipitation (water equivalent) has fallen in the preceding 24 hours. The amount of precipitation shall be coded by using the tens, units, tenths, and hundredths of inches (water equivalent) for the 24-hour period. If *more than a trace* (water equivalent) has occurred and the amount *cannot be determined*, the group shall be coded as *7////*. For example, 1.25 inches of precipitation (water equivalent) in the past 24 hours shall be coded "70125".

d. Snow Depth on Ground (**4/sss**). The total snow depth on ground group shall be coded in the ***0000*** and ***1200*** UTC observation whenever there is more than a trace of snow on the ground. It shall be coded in the ***0600*** and ***1800*** UTC observation if there is more than a trace of snow on the ground and more than a trace of precipitation (water equivalent) has occurred within the past 6 hours. The remark shall be coded in the format, **4/sss**, where **4/** is the group indicator and **sss** is the snow depth in whole inches using three digits. For example, a snow depth of 21 inches shall be coded as "4/021".

e. Water Equivalent of Snow on Ground (**933RRR**). The water equivalent of snow on ground group is reported *each day* in the ***1800*** UTC report if the *average snow depth is 2 inches or more*. The remark shall be coded in the format, **933RRR**, where **933** is the group indicator and **RRR** is the water equivalent of snow, i.e., snow, snow pellets, snow grains, ice pellets, ice crystals, hail, on the ground. The water equivalent shall be reported in tens, units, and tenths of inches, using three digits. *Do not code* the group if it consists *entirely of hail*. A water equivalent of snow of 3.6 inches would be coded as "933036" and a water equivalent of 12.5 would be coded as "933125".

9.12.2.2 Cloud Types ($8/C_LC_MC_H$). The group, $8/C_LC_MC_H$, shall be reported and coded in *3- and 6-hourly* reports when clouds are observed. The predominant low cloud (C_L), middle cloud (C_M), and high cloud (C_H) shall be identified in accordance with the WMO *International Cloud Atlas*, Volumes I and II, or the WMO *Abridged International Cloud Atlas*. A "**0**" shall be coded for the low, middle, or high cloud type if no cloud is present in that classification. A solidus "/" shall be coded for layers above an overcast. For example, a report of "8/6//" would indicate an overcast layer of stratus clouds, no higher clouds visible; a report of "8/903" would indicate cumulonimbus type low clouds, no middle clouds, and dense cirrus high clouds.

9.12.2.3 Temperature

a. Hourly Temperature and Dew Point ($\mathbf{Ts_nT_aT_aT_as_nT'_aT'_aT'_a}$). The hourly temperature and dew point group shall be coded in the format, $Ts_nT_aT_aT_as_nT'_aT'_aT'_a$, where **T** is the group indicator, $\mathbf{s_n}$ is the sign of the temperature, $\mathbf{T_aT_aT_a}$ is the temperature, and $\mathbf{T'_aT'_aT'_a}$ is the dew point. The sign of the temperature and dew point shall be coded as "**1**" if the value is colder than 0°C and "**0**" if the value is 0°C or warmer. The temperature and dew point shall be reported in tens, units, and tenths of degrees Celsius. There shall be no spaces between the entries. For example, a temperature of 2.6°C and dew point of -1.5°C would be reported in the body of the report as "03/M01" and the $Ts_nT_aT_aT_as_nT'_aT'_aT'_a$ group as "T00261015". If dew point is missing, report the temperature only; if the temperature is missing, *do not report* the temperature/dew point group.

b. 6-Hourly Maximum Temperature ($\mathbf{1s_nT_xT_xT_x}$). The 6-hourly maximum temperature group shall be coded in the format, $\mathbf{1s_nT_xT_xT_x}$, where **1** is the group indicator, $\mathbf{s_n}$ is the sign of the temperature, $\mathbf{T_xT_xT_x}$ is the maximum temperature in tenths of degrees Celsius using three digits. The sign of the maximum temperature shall be coded as **1** if the maximum temperature is colder than 0°C and **0** if the maximum temperature is 0°C or warmer. For example, a maximum temperature of -2.1°C would be coded "11021"; 14.2°C would be coded "10142".

c. 6-Hourly Minimum Temperature ($\mathbf{2s_nT_nT_nT_n}$). The 6-hourly minimum temperature group shall be coded in the format, $\mathbf{2s_nT_nT_nT_n}$, where **2** is the group indicator, $\mathbf{s_n}$ is the sign of the temperature, and $\mathbf{T_nT_nT_n}$ is the minimum temperature in tenths of degrees Celsius using three digits. The sign of the minimum temperature shall be coded as **1** if the minimum temperature is colder than 0°C and **0** if the maximum temperature is 0°C or warmer. For example, a minimum temperature of -2.1°C would be coded "21021"; 1.2°C would be coded "20012".

d. 24-Hour Maximum and Minimum Temperature ($\mathbf{4s_nT_xT_xT_xs_nT_nT_nT_n}$). The 24-hour maximum temperature and the 24-hour minimum temperature shall be coded in the format, $\mathbf{4s_nT_xT_xT_xs_nT_nT_nT_n}$, where **4** is the group indicator, $\mathbf{s_n}$ is the sign of the temperature, $\mathbf{T_xT_xT_x}$ is the maximum 24-hour temperature, and $\mathbf{T_nT_nT_n}$ is the 24-hour minimum temperature. $\mathbf{T_xT_xT_x}$ **and** $\mathbf{T_nT_nT_n}$ shall be coded in tenths of degrees Celsius using three digits. The sign of the maximum or minimum temperature shall be coded as **1** if it is colder than 0°C and **0** if it is 0°C or warmer. For example, a 24-hour maximum temperature of 10.0°C and a 24-hour minimum temperature of -1.5°C would be coded "401001015"; a 24-hour maximum temperature of 11.2°C and a 24-hour minimum temperature of 8.4°C would be coded as "401120084".

9.12.2.4 3-Hourly Pressure Tendency (**5appp**). The 3-hourly pressure tendency group shall be coded in the format, **5appp**, where **5** is the group indicator, **a** is the character of pressure change over the past 3 hours (see Table 9-7), and **ppp** is the amount of barometric change in tenths of hectopascals and using the tens, units, and tenths digits. For example, a steady increase of 3.2 hectopascals in the past three hours would be coded "52032" (see Table 9-8).

Primary Requirement	Description	Code Figure
Atmospheric pressure now higher than 3 hours ago.	Increasing, then decreasing.	0
	Increasing, then steady, or increasing then increasing more slowly.	1
	Increasing steadily or unsteadily.	2
	Decreasing or steady, then increasing; or increasing then increasing more rapidly.	3
Atmospheric pressure now same as 3 hours ago.	Increasing, then decreasing.	0
	Steady.	4
	Decreasing, then increasing.	5
Atmospheric pressure now lower than 3 hours ago.	Decreasing, then increasing.	5
	Decreasing then steady; or decreasing then decreasing more slowly.	6
	Decreasing steadily or unsteadily.	7
	Steady or increasing, then decreasing; or decreasing then decreasing more rapidly.	8

Table 9-7 Characteristics of Barometer Tendency

Amount of Barometric Change (Rise or Fall) in the Past 3 Hours "ppp"								
Code Figure	Inches of Mercury	Hectopascals	Code Figure	Inches of Mercury	Hectopascals	Code Figure	Inches of Mercury	Hectopascals
000	0.000	0.0	068	0.200	6.8	135	0.400	13.5
002	0.005	0.2	069	0.205	6.9	137	0.405	13.7
003	0.010	0.3	071	0.210	7.1	139	0.410	13.9
005	0.015	0.5	073	0.215	7.3	141	0.415	14.1
007	0.020	0.7	075	0.220	7.5	142	0.420	14.2
008	0.025	0.8	076	0.225	7.6	144	0.425	14.4
010	0.030	1.0	078	0.230	7.8	146	0.430	14.6
012	0.035	1.2	080	0.235	8.0	147	0.435	14.7
014	0.040	1.4	081	0.240	8.1	149	0.440	14.9
015	0.045	1.5	083	0.245	8.3	151	0.445	15.1
017	0.050	1.7	085	0.250	8.5	152	0.450	15.2
019	0.055	1.9	086	0.255	8.6	154	0.455	15.4
020	0.060	2.0	088	0.260	8.8	156	0.460	15.6
022	0.065	2.2	090	0.265	9.0	157	0.465	15.7
024	0.070	2.4	091	0.270	9.1	159	0.470	15.9
025	0.075	2.5	093	0.275	9.3	161	0.475	16.1
027	0.080	2.7	095	0.280	9.5	163	0.480	16.3
029	0.085	2.9	097	0.285	9.7	164	0.485	16.4
030	0.090	3.0	098	0.290	9.8	166	0.490	16.6
032	0.095	3.2	100	0.295	10.0	168	0.495	16.8
034	0.100	3.4	102	0.300	10.2	169	0.500	16.9
036	0.105	3.6	103	0.305	10.3	171	0.505	17.1
037	0.110	3.7	105	0.310	10.5	173	0.510	17.3
039	0.115	3.9	107	0.315	10.7	174	0.515	17.4
041	0.120	4.1	108	0.320	10.8	176	0.520	17.6
042	0.125	4.2	110	0.325	11.0	178	0.525	17.8
044	0.130	4.4	112	0.330	11.2	179	0.530	17.9
046	0.135	4.6	113	0.335	11.3	181	0.535	18.1
047	0.140	4.7	115	0.340	11.5	183	0.540	18.3
049	0.145	4.9	117	0.345	11.7	185	0.545	18.5
051	0.150	5.1	119	0.350	11.9	186	0.550	18.6
052	0.155	5.2	120	0.355	12.0	188	0.555	18.8
054	0.160	5.4	122	0.360	12.2	190	0.560	19.0
056	0.165	5.6	124	0.365	12.4	191	0.565	19.1
058	0.170	5.8	125	0.370	12.5	193	0.570	19.3
059	0.175	5.9	127	0.375	12.7	195	0.575	19.5
061	0.180	6.1	129	0.380	12.9	196	0.580	19.6
063	0.185	6.3	130	0.385	13.0	198	0.585	19.8
064	0.190	6.4	132	0.390	13.2	200	0.590	20.0
066	0.195	6.6	134	0.395	13.4	etc.	etc.	etc.

Table 9-8. 3-Hour Pressure Change

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CHAPTER 10 - ENTRIES ON THE SURFACE WEATHER REPORT FORM

10.1 **Introduction**. This chapter contains instructions for making entries on the CNMOC form 3140/12. Many of the instructions in this chapter are duplicated from Chapter 9, Coding and Dissemination. To avoid rewriting some of the instructions, a reference will be made to other chapter paragraphs of Part I.

10.2 **Entries on the Surface Weather Report Form (CNMOC 3140/12)**. Certified observers shall normally complete all entries on the form. Non-certified trainees/observers may make entries on the form under the immediate supervision of a certified observer who assumes responsibility for the validity of the entries by initialing in Column 15. Non-certified observers may initial the observation, but the certified observer shall initial first. Initials shall be separated by a solidus (/).

10.2.1 Writing Instrument. The same type of writing instrument shall be used throughout each form and for all forms at each location. To ensure legible copies and ample contrast for reproduction, use only a pencil with black grade 2 medium lead or a 0.5 mm mechanical pencil using only black HB or MH lead.

10.2.2 Missing Data. Missing data shall be indicated by an "**M**" in the appropriate column. Explain briefly the reasons for any missing data in Block 72, Remarks, Notes, and Miscellaneous Phenomena.

10.2.3 Late Reports. When a METAR is taken late, but within 15 minutes of the standard time of report, and no appreciable changes have occurred since the standard time, enter the report in black and transmit it using the actual time of report. If conditions have changed appreciably or the report is more than 15 minutes late, skip a line and record and transmit a SPECI containing all the elements in a METAR. After transmitting the SPECI, using the actual time of report, estimate the conditions probable at the standard time using recording instruments whenever possible. Record this data on the skipped line using the standard time in Column 2. Do not transmit the report. Make note in Block 72 referencing the actual time of report and that this report was entered after the fact.

10.3 **Corrections**. Draw a single line through the erroneous entry using the proper writing instrument (10.2.1). Do not erase or otherwise obliterate entries. Record corrected data in the appropriate blocks on the same or next line appropriately identified. If there is not enough room, make a descriptive entry in Block 72 supplying as much information as possible to readily identify the corrected data.

10.4 **Heading**. In the block labeled "**STATION**," enter the type (NAVLANTMETOC DET, NAVTRAMETOC FAC, NAVPACMETOCCEN, etc.), **and** the official station name, **and** state or country abbreviation. Also in the blocks provided, enter the latitude, longitude, station elevation, time conversion (LST to UTC), magnetic to true conversion, date, and ICAO (call sign).

10.5 Entries on the Form by Columns. In this section (10.5), the number after the second decimal corresponds to the column number on the form.

10.5.1 Type of Report (Column 1). "**METAR**" shall be recorded to designate a standard (hourly) aviation routine weather report. "**SPECI**" shall be recorded as an aviation selected special weather report and replaces the special, urgent special, single element special, and local.

10.5.2 Date/Time of Report (Column 2). Record the *actual time of report* in UTC only. Do not record the date in Column 2. Date is used only when disseminating.

10.5.3 Wind Direction (Column 3). Record the true wind direction in three digits from which the wind is blowing in tens of degrees. Directions less than 100 degrees are preceded with a "0." When the wind is calm, enter "000" for the direction. Whenever the wind direction and or speed is estimated, prefix the wind direction with "E," except for calm winds.

Wind direction may be entered as "VRB" when wind speeds are 6 knots or less.

10.5.4 Wind Speed (Column 4). Record the wind speed in whole knots using the hundreds digit (if not zero), and the tens and units digit. Record speeds of less than 10 knots with a leading zero. For example, a wind speed of 5 knots is logged as 05. A wind speed of 105 knots is logged as 105. Calm winds are recorded as 00.

10.5.5 Wind Gust (Column 5). When gusts have been recorded during the 10 minutes prior to the actual time of report, enter the peak speed in the 10-minute period.

10.5.6 Wind Variability (Column 6). When the wind direction fluctuates by 60 degrees or more during the period of evaluation and the wind speed is greater than 6 knots, record the degree of variability (9.11.5.1).

10.5.7 Surface Visibility (Column 7), Tower Visibility (Column 7b). Record the surface prevailing visibility in statute miles (Column 7) as determined from the *observing location* using the nearest reportable value listed in Table 9-1A. When applicable (9.12.1.5), record the tower prevailing visibility in statute miles (Column 7b) as determined from the air traffic control tower using the nearest reportable value listed in Table 9-1A.

OCONUS:

Record surface and tower visibility in columns 7a and 7c in meters using the nearest reportable value listed in Table 9-1B.

10.5.8 Runway Visual Range (Columns 8 and 8a)

a. Record runway visual range, in feet, in column 8a only when no recorder device exist for local dissemination (9.4).

b. Record the runway visual range, in feet (CONUS), in meters (OCONUS), in column 8b (9.11.7).

10.5.9 Present Weather (Columns 9 and 9a). Record present weather according to the following:

a. Record weather and obscurations in column 9 only when no recorder device exist for local dissemination (9.4).

b. Record weather occurring at, or in the vicinity of the station in column 9a using the order described in 5.8, i.e., Tornadic activity, thunderstorm, liquid, freezing, solid precipitation. Precipitation intensity symbols are shown in Table 5-6. Weather can reduce visibility so no assumption should be made that an obscuration must exist with lower visibilities; e.g., snow is classified as weather, but it also reduces visibility.

c. Record obscurations in Column 9a when the prevailing visibility, determined from the weather station's usual point(s) of observation, is 6 miles or less. If the prevailing visibility is between 7 and 10 statute miles, record obscurations as "in the vicinity (VC)". If two or more obscurations are present, enter, after weather, if any, that obscuration which most affects the visibility (is predominant) and then the others in decreasing order of predominance with the phenomena which least affects the visibility last.

10.5.10 Sky Condition (Column 10). The procedures for reporting sky condition are given in Chapter 3. Record data for each layer of clouds and obscurations visible from the station regardless of amount. Make entries in ascending order of height for bases of each layer. Use additional lines if more space is needed and enter a solidus (/) in column 1.

10.5.10.1 Sky Cover Classification. Record the appropriate sky cover classification(s) from Table 3-2.

10.5.10.2 Layer Heights. Record the height of the layer, immediately following the sky cover classification, using the reportable values in Table 3-3. If the height value is between reportable values use the lower of the two heights.

10.5.10.3 Significant Cloud Types. Record any significant cloud type in accordance with paragraph 3.2.12.

10.5.11 Temperature (Column 11). Record the dry-bulb temperature to the nearest whole degree Celsius. Prefix sub-zero temperatures with "M". Add a leading zero to single digit temperatures (e.g., 7°C would be recorded as 07).

10.5.12 Dew Point Temperature (Column 12). Record the dew point temperature to the nearest whole degree Celsius. Prefix sub-zero dew point temperatures with "M". When the dry-bulb temperature is -34°C (-30°F) or below, the dew point is considered to be statistical data. Enter "M" in Column 12. Add a leading zero to single digit temperatures (e.g., 7°C would be recorded as 07).

10.5.13 Altimeter Setting (Column 13). Record the altimeter setting in inches of mercury using the tens, units, tenths, and hundredths digits (without a decimal point). For example, record 29.94 as 2994. Altimeter settings are never estimated, if the altimeter setting indicator is inoperative obtain the altimeter setting as outlined in paragraph 6.3.6.

10.5.14 Remarks (Column 14). Record all remarks in Column 14 according to the procedures in paragraph 9.12 for coding and dissemination. The procedures for coding remarks are the same procedures for entering the data into Column 14.

10.5.15 Observers Initials (Column 15). The certified observer responsible for the report shall initial this column (1.9 and 10.2).

10.5.16 Time (Column 16). This column may be used locally but no entry is required. It refers to the *actual time of report* that the subsequent data were observed and is the same as the entry in Column 2.

10.5.17 Total Sky Cover (Column 17). For each hourly report, record the eighths of sky covered (not necessarily hidden) by all clouds and obscurations (surface based and aloft) that are visible from the station. For example, record 0 for less than one-eighth sky cover, 5 for five-eighths, 8 for eight-eighths.

10.5.18 Omitted (Column 18). This Column is omitted from the form.

10.5.19 Dry Bulb Temperature (Column 19). This column may be used locally but no entry is required. If used, record the dry-bulb temperature in degrees and tenths of degrees Celsius.

10.5.20 Wet-Bulb Temperature (Column 20). This column may be used locally but no entry is required. If used, record the wet-bulb temperature in degrees and tenths of degrees Celsius if psychometric data are obtained from other than a hygrothermometer or an equivalent system.

10.5.21 Relative Humidity (Column 21). This column may be used locally but no entry is required. If used, record relative humidity to the nearest whole percent.

10.5.22 Station Pressure (Column 22). Record the station pressure in this column to the nearest 0.005 inches of mercury. Part-time stations should record the corrected station pressure from the barograph at the time of the 3- or 6-hourly report prior to the station reopening. This is needed in determining the 3-hour pressure change (ppp).

Note: This entry may also be recorded for local use under Hourly Climatological Data (HCD) Column (22) in lower portion of the form.

10.5.22a Sea-Level Pressure (Column 22a). Record the sea-level pressure in hectopascals using only the tens, units, and tenths digits (without a decimal point, e.g., enter 1013.2 as 132, 998.2 as 982).

Note: If the sea-level pressure cannot be computed (i.e., missing 12-hr temperature), record "SLPNO" in Column 22a.

10.5.23 and 10.5.24 Omitted (Columns 23 and 24). These Columns are omitted from the form.

10.5.25 Hourly Precipitation (Column 25). This column may be used locally but no entry is required. If used, stations equipped with a recording rain gauge, record, in inches and hundredths, the corrected amounts of precipitation that occurred during the hour identified in this column. If a measurable amount did not occur or cannot be determined complete the column as follows:

a. No precipitation during the hour, no entry.

b. A trace (less than 0.005 inch), record a "**T**."

c. Automatic record incomplete, estimate the amount. Explain any estimated amounts in Block 72. Record in Block 72, the column number, the time of beginning and ending, and the reason for the estimation; e.g., COL 25 0900-1800 ESTIMATED DUE TO HIGH WINDS.

The summation of the entries in Column 25 must agree with the recorded entry in Column 66 (24-hour precipitation).

At part-time stations, record hourly precipitation amounts as determined from the rain gauge recorder chart. Since the chart does not indicate trace amounts, a "**T**" will not be recorded in this column for hours observing personnel are not on duty.

10.5.26 UTC Time (Column 26). Record the beginning time of the first 6-hourly report scheduled after 0000 LST on the line captioned "**MID TO**" (at stations taking midnight reports). On the following four lines (captioned 1,2,3, and 4 in Column 28), record the beginning time of each 6-hourly report taken at the station. A time entry is not applicable to the "**MID**" line. Record all entries in four figures to the nearest minute UTC.

10.5.27 LST Time (Column 27). This column may be used locally but no entry is required. If used, enter the time LST equivalent to the time UTC recorded in Column 26.

10.5.28 Report Number (Column 28). Identifies the first, second, third, and fourth 6-hourly reports of the day. No entry is required.

10.5.29 - 10.5.31 Entries in Columns 29 through 31. Make entries in these columns at each 6-hourly to report the predominant layers visible from the station--including layers aloft which cover less than one eighth (0 to the nearest eighth) of the sky. If the sky is absolutely clear, leave these columns blank. Record data as instructed in the following paragraphs.

10.5.29 Type of Low Cloud (Column 29). Record in Column 29 the contraction from Table 10-1 for the type of cloud present in the lowest layer. If it consists of two or more types of clouds, select the contraction from Table 10-1 that represents the type which covers most sky. If two or more types of clouds are present in equal amounts, enter the one with the highest priority (Table 10-2A). If any

amount of "CB" is present in this lowest layer it will be recorded in Column 29. If no clouds are present leave blank.

10.5.30 Type of Middle Cloud (Column 30). Record in Column 30 the contraction from Table 10-1 for the type of cloud present in the middle layer. If it consists of two or more types of clouds, select the contraction from Table 10-1 that represents the type which covers most sky. If two or more types of clouds are present in equal amounts, enter the one with the highest priority (Table 10-2B). If no clouds are present leave blank.

10.5.31 Type of High Cloud (Column 31). Record in Column 31 the contraction from Table 10-1 for the type of cloud present in the high layer. If it consists of two or more types of clouds, select the contraction from Table 10-1 that represents the type which covers most sky. If two or more types of clouds are present in equal amounts, enter the one with the highest priority (Table 10-2C). If no clouds are present leave blank.

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

Table 10-1. Cloud Types

PRIORITY	C_L LOW CLOUDS PRESENT	CODE FIGURE
1st	CB WITH OR WITHOUT OTHER C_L CLOUDS At least one CB top is clearly striated or fibrous (cirriform); or, by convention, if lightning, thunder, or hail indicates the presence of CB, but the top isn't visible due to lower clouds.	9
2nd	None of the CB tops are clearly fibrous, striated, or in the form of an anvil.	3
3rd	NO CB PRESENT SC formed by the spreading out and flattening of CU; other CU may be present.	4
4th	CU and SC, not formed by the spreading out of CU, with bases at different levels.	8
5th	CU and/or TCU of moderate or strong vertical extent; other CU or SC may be present, but all bases are at the same level.	2
6th	NO CB AND CODE FIGURES 4, 8, AND 2 NOT APPLICABLE. USE THE CODE FIGURE OF THE PREDOMINANT TYPE CLOUD. CU with little vertical extent and seemingly flattened and/or ragged CU not of bad weather; or	1
	SC not resulting from the spreading or flattening of CU; or	5
	ST in a relatively continuous layer and/or ragged shreds; or	6
	STFRA of bad weather and/or CUFRA of bad weather usually below AS or NS.	7

Table 10-2A. Coding of C_L Low Clouds

PRIORITY	C_M MID CLOUDS PRESENT	CODE FIGURE
1st	AC PRESENT WITH OR WITHOUT NS OR AS Sky is chaotic; AC generally at several levels.	9
2nd	AC with sproutings in the form of turrets or battlements or having the appearance of small cumuliform tufts.	8
3rd	AC with AS or NS present.	7
4th	AC PRESENT BUT NO AS OR NS AC formed by spreading out and flattening of CU or CB and is the only C_M cloud present.	6
5th	Semi-transparent AC in bands, or AC in one or more fairly continuous layers (semi-transparent or opaque), progressively invading the sky.	5
6th	Patches (often almond-shaped or lenticular) of generally semi-transparent AC occurring at one or more levels and continuously changing in appearance.	4
7th	AC in two or more layers, usually partly opaque; or one opaque layer of AC. AC is not progressively invading the sky.	7
8th	AC at one level; not invading the sky; greater part of AC is semi-transparent.	3
9th	NO AC PRESENT NS or AS; the greater part of which is sufficiently opaque to hide the sun or moon.	2
10th	AS, predominately semi-transparent; the sun or moon may be weakly visible through semi-transparent portions.	1

Table 10-2B. Coding of C_M Mid Clouds

PRIORITY	C_H HIGH CLOUDS PRESENT	CODE FIGURE
1st	CC present alone or is the predominant high cloud present.	9
2nd	CS PRESENT WITH OR WITHOUT CI OR CC CS covers the whole sky.	7
3rd	CS not invading or covering the whole sky.	8
4th	CI and/or CS progressively invading the sky. The continuous veil extends more than 45 degrees above the horizon, but does not cover the whole sky.	6
5th	CI and/or CS invading the sky and growing denser; the continuous veil does not extend more than 45 degrees above the horizon.	5
6th	C_H9 NOT APPLICABLE AND NO CS PRESENT CI in hooks or filaments progressively invading the sky and growing denser.	4
7th	Dense CI often in the form of an anvil being the remains of CB.	3
8th	CODE FIGURES 3 THROUGH 9 NOT APPLICABLE. USE CODE FIGURE OF PREDOMINANT TYPE CLOUD. High cloud present is a combination of dense CI, CI with sproutings (like turrets or battlements), and of CI in tufts; or	2
	High cloud is CI in the form of filaments, strands, or hooks.	1

Table 10-2C. Coding of C_H High Clouds

10.5.32 and 10.5.33 Maximum Temperature (Column 32) and Minimum Temperature (Column 33). Record the maximum temperature in Column 32 and the minimum temperature in Column 33 in degrees Celsius to the nearest tenth, that occurred: between midnight and the first 6-hourly report, in the six hours prior to each 6-hourly report, and between the last 6-hourly report and midnight, in the lines labeled "**MID TO**," "**1**," "**2**," "**3**," "**4**," and "**MID**," respectively. The temperature recorded on the last METAR of the previous day, having a standard time 0000 LST of the current day, is considered when determining the maximum and minimum temperature from midnight to the first 6-hourly report.

At part-time stations that don't have temperature recording ability, the loss of data can be avoided by using base temperature extremes for the 24-hour period beginning when the station closes to the time the station closes the next day. If the station is open at midnight, temperature extremes should be maintained from midnight to midnight. Otherwise, do as follows:

a. Reset the maximum and minimum displays or thermometers at the time of the last 6-hourly taken before the station closes.

b. At the time of the first 6-hourly after the station opens record the extremes on the appropriate line of Columns 32 and 33 that correspond to the 6-hour time frame. Record in Block 72, the period during which the temperature extremes were recorded; e.g., COL 32-33 0645 12HR TEMP EXTREMES.

c. Use the extremes that occurred during the 24 hours before the station closes to complete the summary of the day (SOD) temperature data. Record in Block 72, the column numbers and the temperature period covered; e.g., COL 64-65 TEMPERATURE DATA FROM 1800 TO 1800.

10.5.34 Precipitation (Column 34). At 6-hourly report times, record the amounts of precipitation that occurred during the periods as indicated below. Record amounts to the nearest hundredth of an inch except that "**T**" is recorded for amounts less than 0.005 inch and "**0**" is recorded if no precipitation occurred. Trace amounts are never estimated.

a. At stations taking midnight reports, record the amount of precipitation that occurred between midnight LST and the first 6-hourly report time on the line captioned "**MID TO**."

b. On lines "**1**," "**2**," "**3**," and "**4**" (as indicated in Column 28), record the amount of precipitation that occurred in the previous six hours.

c. When midnight reports are taken, record the amount of precipitation that occurred between the last 6-hourly report time and the midnight report on the line captioned "**MID**."

d. Estimated amounts should be based on your best judgement. Record in Block 72, the column number, the time of the report, and ESTIMATED. The reason for the

estimation shall also be included; e.g., COL 34 0650 ESTIMATED DUE TO HIGH WINDS.

e. If an estimated amount cannot be reasonably made, missing (M) shall be recorded in Columns 34 and 66 for the day.

f. It is assumed, if an estimated amount is explained in Block 72 for Column 34, the summary of the day (Column 66) is also considered estimated. A second remark to denote that Column 68 is estimated is not required if it is the same reason for estimation in Column 34.

Whenever the water equivalent of solid precipitation cannot be measured by melting or weighing of the sample or core sampling, estimate the water equivalent on the basis of a 1/10 ratio method unless a different ratio is more appropriate for the individual storm or station. Record in Block 72, the column number, the time of the report, and the ratio used; e.g., COL 34 1245 1/2 RATIO USED.

10.5.35 Snowfall (Column 35). At 6-hourly report times, record the amount of solid precipitation that fell in the six hours prior to the report on the lines numbered (in Column 28) "**1**," "**2**," "**3**," and "**4**." At stations taking midnight reports, record the snowfall between midnight and the first 6-hourly report on the line captioned "**MID TO**." On the line captioned "**MID**" record the amount of snowfall that occurred between the last 6-hourly report and midnight. "Snow" as used in this and the following snow depth paragraphs include all types of solid precipitation; e.g., SN, PE, SG, IC, GS, and GR. Trace amounts are never estimated. Make entries as follows:

a. If there is no solid precipitation, record a "**0**."

b. A trace, but less than 0.05 inch, record a "**T**."

c. A measurable amount occurred, record the maximum depth of solid precipitation to the nearest 0.1 inch. If solid precipitation occurred several times during the period, and each fall melted either completely or in part before the next fall, record the total of the maximum depths of each fall.

d. If an amount consists entirely of hail, record in Block 72, the column number, the time of the report, and HAIL; e.g., COL 35 0045 HAIL.

e. In order to preserve climatological snowfall records at stations operating under reduced hours, the following guidelines are presented. It is important that you exercise your acquired skills to make this estimate. If it is reasonable to assume that all new precipitation which fell was frozen and the conditions were rather consistent throughout the period, various methods may be used to estimate the snowfall for the period; e.g., basis of 1/10 ratio method unless a different ratio is more appropriate for the individual storm or station, or measurements in protected areas. The estimate should be based upon your best judgement. Record in Block 72, the column number, the time of the report, and ESTIMATED. The reason for the estimation shall also be included; e.g., COL 35 0045 ESTIMATED DUE TO STATION CLOSURE. 1/10 RATIO USED.

f. If an estimated amount cannot be reasonably made, (e.g., several days of closure, mixed precipitation, etc.) missing (M) should be recorded in Column 35 and Column 67 for the day.

g. It is assumed, if an estimated amount is explained in Block 72 for Column 35, the summary of the day (Column 67) is also considered estimated. A second remark to denote that Column 69 is estimated is not required if it is the same reason for estimation in Column 35. Any estimated amounts in Column 35 shall be explained in Block 72. Record the column number, the time of the report, and the reason for the estimation; e.g., COL 35 1244 ESTIMATED DUE TO MELTING.

10.5.36 Snow Depth (Column 36). Record the depth of solid precipitation and ice on the ground at the time of each 6-hourly report and, if taken, at the time of the midnight report on the lines identified as "**1**," "**2**," "**3**," "**4**," and "**MID**," respectively. Trace amounts are never estimated.

a. No snow or ice on the ground in exposed areas (snow may be present in surrounding forested or otherwise protected areas), record a "**0**."

b. A trace, but less than 0.5 inch, on the ground in representative areas, record a "**T**."

c. If there is a measurable amount on the ground, record the depth to the nearest whole inch.

d. When solid precipitation has occurred in the past six hours and because of melting or sublimation, the current depth is less than at some time during the six hours (reportable value), record the current depth in Column 36. In Block 72, record the maximum snow depth and the approximate time (UTC) of the occurrence. Record the column number, the time of the report, and the approximate time of the occurrence; e.g., COL 36 1846 MAX SNOW DEPTH 1 AT 1530.

e. If the depth consists entirely of hail, record in Block 72, the column number, the time of the report, and HAIL; e.g., COL 36 1844 HAIL.

f. Snow depth is entered in Column 36 at main synoptic times (00, 06, 12, and 18 UTC) when measured by observing personnel. When observing personnel are not on duty the entry shall be "**M**."

10.5.37 through 10.5.40 Omitted (Columns 37 - 40). These Columns are omitted from the form.

10.5.41 through 10.5.44 Station Pressure Computations (Columns 41-44). Record entries in these columns only at 6-hourly times.

10.5.41 Time (Column 41). Record the time, to the nearest minute (UTC), of the first 6-hourly report of the LST day.

10.5.42 Station Pressure (Column 42). Record the station pressure to the nearest 0.005 inch.

10.5.43 Barograph (Column 43). Record the observed barograph reading to the nearest 0.005 inch.

10.5.44 Barograph Correction (Column 44). Subtract Column 43 from Column 42 and record the difference to the nearest 0.005 inch with the proper sign in Column 44. If Column 43 is higher than Column 42, the correction in Column 44 will be preceded by a minus sign. If this difference is greater than 0.05, reset the barograph to a zero correction. In Block 72, record the column number and the time the barograph was reset to a zero correction; e.g., COL 44 BAROGRAPH RESET TO ZERO CORRECTION AT 1458.

10.5.45 through 10.5.47 Omitted (Columns 45 and 47). These Columns are omitted from the form.

10.5.48 Speed of Peak Wind (Column 48). Record the highest wind speed, to the nearest whole knot, recorded during the 24 hours ending at midnight. This entry may be obtained from various wind recording instruments or from the record of hourly reports at full-time stations.

At part-time stations, the record of hourly reports may still be used provided it is reasonable to assume that the missing data did not include the peak wind.

Use two digits if the speed is below 100 knots and three digits if the speed is 100 knots or more; e.g., 07, 58, 105. If the peak wind is missing, record "**M**."

10.5.49 Direction of Peak Wind (Column 49). Record the true direction of the peak wind to the nearest tens of degrees using three digits; e.g., 230, 070.

If the direction portion of the recorder is inoperative, or back-up wind observing procedures are used, prefix the wind direction with "E".

If the peak wind occurs during hours the station is closed and you are unable to determine direction, record "**M**."

10.5.50 Time of Peak Wind (Column 50). Record the time of the peak wind to the nearest minute (UTC). If the same peak wind occurs more than once, record the time of the last occurrence in Columns 48-50. Record additional occurrences in Block 72; e.g., PK WND 230 1415Z, 070 1314Z.

10.5.51 through 10.5.53 Fastest Observed Two-minute Wind Speed (Columns 51-53). This column may be used locally but no entry is required. It can only be used at full-time stations where 24 hourly reports are taken daily:

a. The fastest wind recorded in Column 4, for the day being considered, is converted from knots to miles per hour (Table 8-3). Consider also, the wind for the 2400 LST recorded on the previous days form. Enter the speed using two digits if below 100 and three digits if 100 or above; e.g., 07, 15, 108.

b. The direction of the fastest occurrence of the fastest wind to tens of degrees using three digits as recorded in Column 3.

c. Make a reference in Block 72 if there were several occurrences of the fastest wind speed; e.g., FASTEST 2-MINUTE WIND LAST OF SEVERAL OCCURRENCES.

10.5.54 through 10.5.63 (Columns 54 - 63). These Columns are omitted from the form.

10.5.64 24-Hour Maximum Temperature (Column 64). Record the maximum temperature recorded in Column 32 for the day to the nearest tenth of a degree Celsius. Disregard the entry in Column 32 on the line captioned "**1**" if the midnight report is taken. Record "**M**" if any data are missing.

10.5.65 24-Hour Minimum Temperature (Column 65). Record the minimum temperature recorded in Column 33 for the day to the nearest tenth of a degree Celsius. Disregard the entry in Column 33 on the line captioned "**1**" if the midnight report is taken. Record "**M**" if any data are missing.

10.5.66 24-Hour Precipitation (Water Equivalent) (Column 66). Record the total precipitation for the 24 hours ending at midnight (LST) as follows:

a. No precipitation, record a "**0**."

b. A trace (less than 0.005 inch), record a "**T**." A trace amount includes the sum of any number of "T" reports, unless a recording or totalizing gauge indicates 0.005 inch or more.

c. A measurable amount has occurred, record the amount (water equivalent) to the nearest 0.01 inch.

d. Where the 24-hour precipitation is derived from entries in Column 34, disregard the entry in Column 34 on the line captioned "**1**" if the midnight report is taken. Record "**M**" if any data are missing.

e. If the station is closed and unless measurable precipitation has occurred, record "**0**."

f. If any entries in Column 34 are missing (M), the entry in Column 66 will also be missing (M).

g. If any entries in Column 34 are estimated (Block 72 remark), the entry in Column 66 will also be considered estimated. A remark in Block 72 is not required to denote an estimated amount in Column 66 since a remark is already noted for Column 34.

10.5.67 24-Hour Snowfall (Column 67). Record the total amount (unmelted) of solid precipitation that fell in the 24 hours ending at midnight (LST) as follows:

a. No 6-hour solid precipitation, record a "**0**."

b. A trace (less than 0.05 inch), record a "**T**."

c. A measurable amount occurred, record the total amount that fell in inches and tenths. Note that it is the total amount of fall that is entered. Therefore, the amount entered shall be the amount that accumulated in the past 24 hours adjusted for any melting or evaporation that has taken place.

d. Where the 24-hour precipitation is derived from entries in Column 35, disregard the entry in Column 35 on the line captioned "**1**" if the midnight report is taken. Record "**M**" if any data are missing. The sum of all trace entries is a trace.

e. If any entries in Column 35 are estimated (Block 72 remark), the entry in Column 67 will also be considered estimated. A remark in Block 72 is not required to denote an estimated amount in Column 67 since a remark is already noted for Column 35.

f. If any entries in Column 35 are missing (M), the entry in Column 67 will also be missing (M).

10.5.68 Snow Depth (Column 68). Record the depth of solid precipitation or ice on the ground at 1200 UTC, or in areas other than the contiguous United States, a time modified (enter the modified time at the top of the column) as necessary to meet regional needs. Make entries to the nearest whole inch or as follows:

a. No snow or ice on the ground in exposed areas (snow may be present in surrounding forested or otherwise protected areas), record a "**0**."

b. For a trace (less than 0.5 inch), in exposed areas, record a "**T**."

c. Use the 1200 UTC value in Column 36, if appropriate.

d. If personnel are not on duty at 1200 UTC, enter the depth measured as near 1200 UTC as practicable and indicate the time (UTC) in Block 72; e.g., COL 68 OBSERVED AT 1120 UTC.

10.5.69 Water Equivalent (Column 69). Whenever the average snow depth is 2 inches or more (to the nearest inch), record the water equivalent to the nearest 0.1 inch as measured at approximately 1800 UTC daily.

10.5.70 and 10.5.71 (Columns 70 and 71). These Columns are omitted from the form.

10.5.72 Remarks, Notes, and Miscellaneous Phenomena (Block 72). Use this block to record data considered significant, but not recorded elsewhere, and the information described in the following paragraphs.

a. Record the Coordinated Universal Time (UTC) of occurrence with all entries unless otherwise specified.

b. Make entries to report:

(1) Conditions affecting the representativeness or accuracy of the recorded data. For example, the possible effect of construction on instrument readings, accumulation of ice or snow on sensors.

(2) Outages, changes in instruments, reasons for change, times of change or outage.

(3) Reasons for omission of mandatory data.

(4) Change in hours of station operation, effective dates if temporary or date if permanent.

(5) Estimated data.

(6) Miscellaneous items; e.g., when a basic weather watch or continuous weather watch began or ended, approximate date/time and location of an aircraft mishap; when notified.

(7) Separate individual remarks by a single solidus (/); e.g., COL 35 0250 ESTIMATED DUE TO HIGH WINDS/FASTEST 2-MINUTE WIND LAST OF SEVERAL OCCURRENCES/GLAZE 1155-1405.

10.5.73 Pressure Altitude (Block 73). This column may be used locally but no entry is required. If used, record the pressure altitude for the actual time of report. (See paragraph 6.3.7).

10.5.74 Density Altitude (Block 74). This column may be used locally but no entry is required. If used, record the density altitude for the actual time of report. (See paragraph 6.3.7).

10.6 **Additional Instructions for Part-time Stations**. During hours of operation record entries according to other instructions in this handbook. In addition to those entries made during hours of operation, entries must, in so far as possible, be made to include data for the entire calendar day. Use recording instruments where available or in many cases, record missing (M) for data unknown. In some cases, stations with reduced hours of operation must tailor their form to record data observed during their hours of operation from recording and non-recording instruments during periods when the station is closed.

10.6.1 Tailoring Synoptic Data and Summary of the Day. Columns 26 and higher were designed for entries made by stations that operate for an entire 24-hour calendar day--from midnight to midnight. Part-time stations will also record data for a 24-hour period, but because many part-time stations are not open at midnight, and don't have continuous recording instruments, their 24 hour day

(or their station day) begins when the station closes and ends 24 hours later. Although the station day begins on the previous calendar day, the times entered in Column 26 will be the times (UTC) of the main 6-hourly synoptic reports made during the calendar day entered in the heading of the form. In Column 26 disregard the "**MID TO**" and "**MID**" lines and on the line captioned "**1**," record the time of the first 6-hourly of the day. The precipitation and temperature extremes entered on that line cover the period from the last 6-hourly report taken before the station closed (the previous day) to the current 6-hourly report. Reference the time of report (Column 26) and in Block 72, record the number of hours, 12 or more in 6-hour increments, since the last 6-hourly; e.g., COL 26 0645 12HR DATA. The times on the following lines will be 6 hours apart and the entries will cover the previous 6 hours.

10.6.1.1 Precipitation (Column 34). The entry on line "**1**" for precipitation, Column 34, during the period when observing personnel were not on duty can be either "**0**," an amount, or missing (M). Record "**0**" if from conditions before the station closes and after it opened, it is reasonably certain that no precipitation occurred. If unsure because of several days of station closure, record "**M**" (missing) in this column and also in Column 66. If any amount in Column 34 is missing, the M will be carried in Column 66. Estimate precipitation if conditions were rather consistent throughout the period. If any amount in Column 34 is estimated, reference the column number and the time of report and in Block 72, and record that the data was estimated; e.g., COL 34 0644 ESTIMATED. You may also indicate why the data was estimated. If any amount in Column 34 was estimated, and none was considered missing, Column 66 will also be considered as estimated.

10.6.1.2 Snowfall (Column 35). The entry on line "**1**" for snowfall, Column 35, during the period when observing personnel were not on duty can be either "**0**," an amount, or missing (M). Record "**0**" if from conditions before the station closes and after it opened, it is reasonably certain that no solid precipitation occurred. If unsure because of mixed precipitation or several days of station closure, record "**M**" (missing) in this column and also in Column 67. If any amount in Column 35 is missing, the M will be carried in Column 67. Estimate snowfall if conditions were rather consistent throughout the period and all new precipitation was considered to be frozen. If any amount in Column 35 is estimated, reference the column number and the time of report and in Block 72, and record that the data was estimated; e.g., COL 35 0644 ESTIMATED. You may also indicate why the data was estimated. If any amount in Column 35 was estimated, and none was considered missing, Column 67 will also be considered as estimated.

10.6.1.3 Station Day (Columns 64 through 68). Use the entries in Columns 32 through 36 to complete the summary of day Columns 64 through 68 for the "station" day. Line out "**MIDNIGHT TO MIDNIGHT**" and record the 24 hour period covered unless ASOS or other recording instruments are used for precipitation or temperature. For example; if the station's hours of operation are from 0600 to 1800 the station day is from 1800 the previous day to 1800 the current day (remember the first 6-hourly report contained data for a 12 hour period).

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APPENDIX A - RUNWAY CONDITION REPORTING (RSC and RCR)

1. Runway Condition. Enter runway surface condition (RSC) and average runway condition reading (RCR), on each METAR and SPECI, as determined and reported by the airfield manager or operations officer using the following:

Runway Surface Condition (RSC):

Reported Condition	Code
Wet Runway	WR
Slush on Runway	SLR
Loose Snow on Runway	LSR
Packed Snow on Runway	PSR
Ice on Runway	IR
Base Operations Closed	RCRNR

2. Runway Condition Reading (RCR). A 2-digit number (an average decelerometer reading) from 02 to 25. Append RCR to the encoded RSC; e.g., "IR08" for ice covering runway, decelerometer reading of 8.. Encode as "//" when the runway is wet *or* slush covered *or* no decelerometer reading is available and ice or snow is on the runway.

3. Remarks. When base operations is closed, and an accurate assessment of the runway can not be obtained, and the runway is known to be wet, transmit RCRNR. Resume transmission of actual runway condition data when base operations opens and reports a new runway condition. Additional entries are:

a. append "P" to the RCR when there are patches of ice, snow, or slush on the runway.

b. append "SANDED" to indicate that the runways have been treated with sand or other friction enhancing materials.

c. append "P WET" or "P DRY" when RSC is "patchy" but the rest of runway is wet or dry.

d. examples of Coded Runway Condition (Column 14 entries):

PSR15	Packed snow on runway, decelerometer reading 15.
IR//	Ice on runway, no decelerometer reading available.
SR08P DRY	Loose snow on runway, decelerometer reading 08, patchy, rest of runway dry.
WR//	Wet runway.

RCRNR Base operations closed, and conditions for reporting RCR are suspected.

PSR12 HFS IR08 Packed snow on runway, decelerometer reading 12 on touchdown portion. The rollout portion is a high friction surface (HFS) with ice on runway, decelerometer reading 08.

4. ICAO Braking Action Remarks. Airfields not equipped with decelerometers (e.g., Army airfields and Air National Guard bases) are authorized to transmit ICAO braking action remarks (such as BA GOOD, BA NIL) when required , e.g., PSR// SANDED BA MEDIUM. Procedures for the provision, receipt, and transmission of runway condition data, as outlines in this subparagraph, shall be described in an annually reviewed document of agreement (Navy requirement) with base officials.

Transmission of Runway Condition Data. Transmit runway condition reports as follows:

a. Longline. Upon receipt, either transmit the initial or amended runway condition report appended to the METAR or as a SPECI.

(1) After initial transmission, include the runway condition remark in each subsequent METAR/SPECI until the data is amended or canceled by the airfield manager or until base operations closes.

(2) When the runway surface consists of two materials with significantly different friction characteristics such as concrete and porous friction surface, base operations provides two RSC/RCR reports for transmission.

b. Local. Local runway condition reports shall be disseminated by weather personnel unless base operations agrees to make the LWDS dissemination. In either case, a local agreement (Navy requirement) shall ensure that:

(1) Weather data has first priority for transmissions on LWDS.

(2) Runway condition entries are separate from weather entries when transmission is by base operations personnel.

(3) Base operations maintains a record of runway condition data reported for longline and local dissemination.

(4) Base operations reports runway condition data to those agencies that need data and do not have a drop on the local dissemination system.

(5) Base operations disseminates runway condition data during local dissemination outages.

APPENDIX B - LIST OF TABLES AND EXHIBITS

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APPENDIX C - LIST OF ABBREVIATIONS AND ACRONYMS

This appendix includes abbreviations, acronyms, contractions, code groups, and symbols; and are defined in accordance with their usage in Part I of this handbook.

- (minus sign) . . . . . Light Intensity

+ . . . . . Heavy, Well-developed

/ . . . . . Missing, Separation of Data, End of Group

_ (underline) . . . . . Required Space

°F . . . . . Degrees Fahrenheit

°C . . . . . Degrees Celsius

$1s_nT_xT_xT_x$ . . . . . 6-Hour Maximum Temperature Group

$2s_nT_nT_nT_n$ . . . . . 6-Hour Minimum Temperature Group

4/sss . . . . . Depth of Snow on the Ground

$4s_nT_xT_xT_xs_nT_nT_nT_n$ . . . . . 24-Hour Maximim and Minimum Temperature Group

5appp . . . . . Pressure Tendency and Change Group

6RRR/ . . . . . 3- or 6-Hour Precipitation Accumulation Group

$7R_{24}R_{24}R_{24}R_{24}$ . . . . . 24-Hour Precipitation Accumulation Group

$8/C_LC_MC_H$ . . . . . Synoptic Cloud Types

933RRR . . . . . Water Equivalent of Snow on the Ground

a . . . . . Character of Pressure Change

A . . . . . Altimeter Setting

AC . . . . . Altocumulus

ACC . . . . . Altocumulus Castellanus

ACFT . . . . . Aircraft

ACSL . . . . . Altocumulus Standing Lenticularis

AD . . . . . Additive Data

APCH . . . . . Approach

APRNT . . . . . Apparent
AS . . . . . Altostratus
ASI . . . . . Altimeter Setting Indicator
ASOS . . . . . Automated Surface Observing System
ATCT . . . . . Airport Traffic Control Tower
AUTO . . . . . Automated Weather Report
B . . . . . Begin/Began
BKN . . . . . Broken
CA . . . . . Cloud to Air (lightning)
CB . . . . . Cumulonimbus
CBMAM . . . . . Cumulonimbus Mamma (Mammatus)
CC . . . . . Cloud to Cloud (lightning), Cirrocumulus
CCSL . . . . . Cirrocumulus Standing Lenticularis
CG . . . . . Cloud to Ground (lightning)
C_H . . . . . Synoptic Type of High Cloud
CI . . . . . Cirrus
CIG . . . . . Ceiling
C_L . . . . . Synoptic Type of Low Cloud
CLDS . . . . . Clouds
CLR . . . . . Clear (automated sensor readout)
C_M . . . . . Synoptic Type of Middle Cloud
COL . . . . . Column
CNS . . . . . Continuous
COR . . . . . Correction
CS . . . . . Cirrostratus
CU . . . . . Cumulus

CUFRA . . . . . Cumulus Fractus

DA . . . . . Density Altitude

dd . . . . . Range of Variability

ddd . . . . . Direction, wind

DP . . . . . Dew-point

DSNT . . . . . Distant

Ed . . . . . Edition

E . . . . . East, Ended

FEW . . . . . Layer coverage of 1/8 to 2/8

ff . . . . . Wind Speed

FIBI . . . . . Filed, but Impracticable to Transmit

FMH No. 1 . . . . . Federal Meteorological Handbook No. 1

FRQ . . . . . Frequent

FROPA . . . . . Frontal Passage

H_a . . . . . Field Elevation

H_g . . . . . Mercury

HO . . . . . Hygrothermometer

H_p . . . . . Station Elevation

hPa . . . . . Hectopascal

HR PCPN . . . . . Hour Precipitation

IC . . . . . In the Cloud (lightning)

ICAO . . . . . International Civil Aviation Organization

INOP . . . . . Inoperative

IP . . . . . Ice Pellets

FU . . . . . Smoke

KT . . . . . Knots

L . . . . . Left

LCD . . . . . Local Climatological Data

LST . . . . . Local Standard Time

LTG . . . . . Lightning

LWR . . . . . Lower

M . . . . . Measured, Missing

max or MAX . . . . . Maximum

min or MIN . . . . . Minimum

M . . . . . Missing

MOVD . . . . . Moved

MOV . . . . . Moving

MOVMT . . . . . Movement

MPH . . . . . Miles Per Hour

MSL . . . . . Mean Sea Level

N . . . . . North

NM . . . . . Nautical Miles

nnn . . . . . Amount of New Snow (Snowfall)

NOSPL . . . . . No Special

NOTAM . . . . . Notice to Airmen

NS . . . . . Nimbostratus

NW . . . . . Northwest

OCNL . . . . . Occasional

OIC . . . . . Officer in Charge

OMTS . . . . . Over Mountains

OTS . . . . . Out-of-Service

OVC . . . . . Overcast
OVR . . . . . Over
PA . . . . . Pressure Altitude
PCPN . . . . . Precipitation
PK WND . . . . . Peak Wind
ppp . . . . . Change of Pressure
PRESFR . . . . . Pressure Falling Rapidly
PRESRR . . . . . Pressure Rising Rapidly
r . . . . . Pressure Reduction Ratio
R . . . . . Right, Runway
RBC . . . . . Rotating Beam Ceilometer
RH . . . . . Relative Humidity
RVR . . . . . Runway Visual Range
RRR . . . . . Amount of Precipitation
RY . . . . . Runway
S . . . . . South
SC . . . . . Stratocumulus
SCSL . . . . . Stratocumulus Standing Lenticular
SCT . . . . . Scattered
SE . . . . . Southeast
SFC . . . . . Surface
SID . . . . . Station Identifier
SKY . . . . . Sky Condition
SKC . . . . . Sky Clear
SLP . . . . . Sea-level Pressure
s_n . . . . . Sign of the Temperature

SOD . . . . . Summary of Day

SSS . . . . . Amount of Snow on the Ground

ST . . . . . Stratus

STFRA . . . . . Stratus Fractus

STN . . . . . Station

T Trace4

TCU . . . . . Towering Cumulus

TEMP . . . . . Temperature

$T_nT_nT_n$ . . . . . Minimum Temperature

TWR . . . . . Tower

TWR VIS . . . . . Tower Visibility

$T_xT_xT_x$ . . . . . Maximum Temperature

U . . . . . Unknown

UNKN . . . . . Unknown

UTC . . . . . Coordinated Universal Time

V . . . . . Variable

VC . . . . . Vicinity

VIS . . . . . Visibility

VV . . . . . Vertical Visibility

W . . . . . West

WBAN . . . . . Weather Bureau, Army, Navy

WMO . . . . . World Meteorological Organization

WND . . . . . Wind

WSHFT . . . . . Wind Shift

W'W' . . . . . Present Weather

Z . . . . . Zulu

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