ORDER **7900.5B**

SURFACE WEATHER OBSERVING

May 11, 2001

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Distribution: A-W(AT/TO/TX/TA/RS/RU/RW/RN/FS)-2; A-X(AT)-2; A-Y(AY)-2; A-FAT-0 (STD); AND-400 2 cys; ZAT-464; DOD; NWS; USCG Elizabeth City Facility

Initiated By: ATP-300

FOREWORD

The Federal Aviation Administration (FAA) recognizes that the aviation weather system is a national system and that continued safe and efficient air transportation requires FAA commitment and leadership to aviation weather services. This order provides the practices and procedures to make weather observations an important part of the FAA's overall weather services.

The practices and procedures set forth in this order apply to all FAA personnel, FAA-contract personnel, and Non-Federal Observer personnel who provide aviation weather observation services. These personnel are required to be familiar with the provisions of this order that pertain to their observational responsibilities and to exercise their judgment if they encounter situations not covered by this order.

Bill G. Peacock
Director of Air Traffic

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CHAPTER 1. INTRODUCTION

1-1. PURPOSE

This order prescribes aviation surface weather observing procedures and practices applicable to all FAA and FAA-contract personnel engaged in taking and reporting aviation surface observations, including Limited Aviation Weather Reporting Stations (LAWRS) personnel, Non-Federal Observation (NF-OBS) Program personnel, as well as United States Coast Guard (USCG) personnel as a component of the Department of Homeland Security (DHS). This order includes practices and procedures for both manual and automated observation locations. Also included are practices and procedures for augmentation of automated observations and backup information in the event of system failure, erroneous or non-representative data. These procedures and practices are intended to provide a framework for identifying meteorological phenomena of importance to aviation and reporting their occurrence.

1-2. DISTRIBUTION.

This order is distributed to select offices in Washington Headquarters; Air Traffic Organization – Terminal Service Areas, Office of Operations Planning, NAS Weather Office, Flight Standards Service, The Mike Monroney Aeronautical Center, The William J. Hughes Technical Center, the USCG Elizabeth City Facility, the Department of Defense, all terminal air traffic field facilities, all Alaska flight service stations, FAA-contract weather, and the National Weather Service (NWS).

1-3. CANCELLATION

Order 7900.5A, Surface Weather Observing - METAR, dated July 1, 1996, is canceled.

1-4. EFFECTIVE DATE

This order is effective December 1, 2005.

1-5. EXPLANATION OF CHANGES

This change incorporates revisions that have occurred since the order was last revised on May 11, 2001. This change:

a. Updates the office of primary responsibility.

b. Updates distribution in accordance with the new Air Traffic Organization.

c. Updates the USCG to a component of DHS.

d. Revises the frequency of snow depth measurements.

e. Clarifies what is used to determine water equivalency of snow.

1-6. ABBREVIATIONS AND ACRONYMS

Appendix A, Abbreviations and Acronyms, contains abbreviations and acronyms used within this order.

1-7. RELATIONSHIP TO FMH-1 AND OTHER DOCUMENTS

a. **Federal Meteorological Handbook No. 1, Surface Weather Observations and Reports (FMH-1).** FMH-1 prescribes surface weather observing standards applicable to all federal agencies engaged in taking and reporting surface aviation observations. FMH-1 also

prescribes the standard reporting and coding procedures used in the surface aviation observation. Order 7900.5B prescribes the procedures and practices to be followed by FAA, FAA-contract and NF-OBS personnel for the observing, reporting, and coding of surface observations which meet the federal standards. A brief description of the NF-OBS program is provided in Appendix B, Non-Federal Observation (NF-OBS) Program. This order complements, but does not change, the standards contained in FMH-1.

b. The NWS Observing Handbook No. 7, Surface Observations, (WSOH-7). WSOH-7 provides procedures and practices for NWS and NWS-contract personnel which are similar to those in this order.

c. Automated Weather Observing Systems Handbooks. A partial listing of the applicable handbooks necessary to operate the various automated weather observing systems includes:

(1) Federal Aviation Administration, Operator Instructions, Automated Weather Observing System (AWOS), August 1, 1994, U.S. Department of Transportation, Washington, D.C.

(2) Federal Aviation Administration, ASOS Ready Reference Guide (latest versions).

1-8. APPLICABILITY OF PROCEDURES AND PRACTICES

a. Applicability. Except for LAWRS, the procedures and practices in this order apply to all facilities which have the capability to comply with the stated procedure or practice. Some procedures and practices vary at LAWRS sites. These differences are indicated throughout the order where applicable. LAWRS observers shall comply with all the standard procedures and practices, except for these specifically indicated differences. Those sections which are not applicable to LAWRS are marked **NA LAWRS** in bold type after the section title. Similarly, sections which apply only to LAWRS are indicated with **ONLY LAWRS**. LAWRS requirements are excerpted in Appendix C, LAWRS Requirements. At an automated site ranked as Service Level C, the basic weather observing requirements are the same as a LAWRS observation. LAWRS observers are not required to back up the observation if measuring or observing equipment is not available.

b. Conflicting Information. In case of conflicting information, the procedures and practices in this order take precedence. However, any applicable FAA air traffic orders take precedence over any procedures or practices in this order which are in conflict. Such conflicts should be brought to the attention of the originator of this order.

c. Terminology. Throughout this order, the following terminology applies:

(1) “Shall” indicates a procedure or practice which is mandatory at all applicable facilities.

(2) “Should” indicates a procedure or practice which is recommended at all applicable facilities.

(3) “May” indicates a procedure or practice which is optional.

(4) “Will” indicates futurity; it is not a requirement to be applied to current practices.

d. Unforeseen Requirements. No set of procedures and practices can cover all possibilities in weather observing. The observer shall use good judgment, adhering as closely as possible to this order, to describe phenomena not adequately covered by specific instructions. Suggestions for possible changes in procedures and practices to cover such situations may be made through appropriate channels.

e. Designated Stations and Service Standards. Throughout this order the phrase "designated stations" appears. This refers to facilities that have been instructed by the FAA to perform a specified task that is not required to be performed at all facilities. In many cases, a facility may be designated to perform a specified task based on the service standards set for an airport. See Appendix D, Service Standards.

f. Regional, Field Office and Facility Procedures. The procedures in this order are the minimum requirements. Needs at the service area office and especially at the local level may dictate additional requirements. Service area or field offices may coordinate these additional requirements with the Terminal Services, Safety Operations and Support, Contract Weather Observation, (ATO-T), although it is not required.

1-9. USER RESPONSIBILITIES

Employee participation in directive writing and upkeep activities is encouraged. Any user who finds a subject matter conflict, an error, obsolete information or who would like to make recommendations or suggestions, should notify Safety Operations and Support, in writing. FAA Form 1320-19, Directive Feedback Information, is available for this purpose. If clarification or correction is urgently needed, you may call Safety Operations and Support for guidance, but you should also use the FAA Form 1320-19 as a follow-up to verbal conversation.

1-10. CHANGING THE ORDER

Changes, additions, deletions, and corrections will be issued as necessary. These changes will be issued by the Director of Terminal Safety and Operations Support, Contract Weather Observation, Attn: ATO-T, FAA.

1-11. MAINTAINING THE ORDER

Each facility shall maintain a copy of the order, complete with changes and supplements for reference purposes. When inserting changes to the order, enter the number, effective date, initials, and date entered on the inside cover of this order.

CHAPTER 2. GUIDELINES

2-1. INTRODUCTION

This chapter describes the types of aviation surface weather observing facilities for which the FAA may have responsibility or oversight. This chapter also describes the various types of surface weather reports, including the Aviation Routine Weather Report (METAR) and Aviation Selected Special Weather Report (SPECI), and FAA guidelines regarding the content of each of these types. Also presented are general guidelines regarding augmentation and backup of automated observations. Lastly, this chapter presents FAA guidelines on the certification of observers.

2-2. TYPES OF STATIONS

The generic types of stations that take aviation weather observations are defined as follows:

a. Automated Station. A facility equipped with an automated surface weather observing system that prepares the observation without a certified observer on duty. The various types of automated stations are described in Chapter 4, General Procedures at Automated Weather Stations.

b. Augmented Station. A facility with an automated surface weather observing system that prepares the METAR/SPECI with a certified observer on duty capable of adding operationally significant weather information to the observation. The observer is completely responsible for the observation, even though the automated weather observing system generates the report. At facilities where augmentation is not available full time, the facility is classed as automated during the non-augmented periods.

c. Manual Station. A facility where certified weather observers are responsible for observing, evaluating and preparing the METAR/SPECI. At these facilities, various degrees of automated sensors and/or other automated equipment may be available. However, the observer is completely responsible for the METAR/SPECI.

d. Towered Station. Any facility with an air traffic control tower operated by the FAA or operated under an FAA contract.

e. Non-Towered Station. Any facility without an FAA or FAA contract air traffic control tower.

f. Limited Aviation Weather Reporting Station (LAWRS). A facility where observations are taken, prepared and transmitted by certified FAA or FAA-contract control tower personnel or Flight Service Station personnel on a limited basis to support aviation requirements. At these facilities, various degrees of automated sensors and/or other automated equipment may be available. However, when the facility is open, the LAWRS observer is completely responsible for the METAR/SPECI. At an automated site ranked as Service Level C, the basic weather observing requirements are the same as a LAWRS observation.

g. Flight Service Station. Throughout this order, the term Flight Service Station (FSS) refers to any Flight Service Station, Automated Flight Service Station (AFSS), Auxiliary Flight Service Station, or former FSS airport facility which has been directed by FAA headquarters or service area office to provide the observing, augmentation or backup service indicated.

h. Supplementary Aviation Weather Reporting Station (SAWRS). This program is maintained by the NWS. To obtain more information, contact the nearest NWS Weather Forecast office.

i. Non-Federal Observing (NF-OBS) Station. A program in which Non-Federal observers such as Non-Federal control tower (NFCT) controllers, airline personnel or fixed base operator (FBO) personnel may enter into an agreement with the appropriate FAA region to provide backup and augmentation of the Automated Surface Observing System (ASOS). NF-OBS observers are certified by NWS. At these facilities, various degrees of automated sensors and/or other automated equipment may be available. However, when on duty, the NF-OBS observer shall provide backup and augmentation in accordance with their NF-OBS agreement. Program establishment is contained in Appendix B, Non-Federal Observing (NF-OBS) Program, and responsibilities are described in Chapter 4, General Procedures at Automated Weather Stations.

j. A-Paid Station. A facility where contract observers take only hourly observations (METAR). SPECI observations are not taken at these facilities.

2-3. GENERAL TYPES OF OBSERVATIONS

There are two general types of surface observations:

a. Automated Observation. Any observation which has been evaluated, prepared and transmitted by an automated observing system without human intervention. The automated observing systems to which this order applies include only Automated Surface Observing Systems (ASOS) and the Automated Weather Observing Systems (AWOS).

(1) Augmentation. Any automated observation to which additional weather information has been manually added that is beyond the capabilities of the automated weather observing system and/or is deemed operationally significant. The guidelines concerning augmentation are presented in paragraph 2-4.

(2) Backup. A method of providing an observation, part of an observation, documentation, or communication of an observation at selected sites when the primary method is unavailable or non-representative. The guidelines concerning manually provided backup information are presented in paragraph 2-5, Backup Requirements.

b. Manual Observation. Any observation for which the human observer observes, evaluates, prepares, records, and transmits the observation without the use of an automated observing system. The guidelines for manual observations are presented in Chapter 7, General Procedures for Manual Observations.

2-4. AUGMENTATION REQUIREMENTS

Certified observers are responsible for the completeness and accuracy of the weather observation. Automated weather observing systems are, by design, viewing a smaller area than a human observer. Therefore, the observer is responsible for providing additional information that covers a larger area, when operationally significant. Augmentation of automated observations shall be provided in accordance with the guidelines presented in the following subsections and as specified for the station's service level standard (Appendix D, Service Standards). Separate guidelines are

presented for the two general types of automated weather observing systems: ASOS and AWOS. Procedures and practices to be followed to accomplish the required augmentation are presented in Chapter 4, General Procedures at Automated Weather Stations, and Chapter 5, Augmentation at Automated Weather Stations.

a. Control Tower with ASOS.

(1) Control Tower without a Surface-Based Observer. At facilities with a control tower and with ASOS, but without a surface-based observer on duty, the tower observer shall provide augmentation of the automated observation. This augmentation shall include, but not be limited to:

(a) thunderstorm

(b) tornadic activity (including tornado, waterspout and funnel cloud)

(c) hail

(d) virga

(e) volcanic ash

(f) any weather elements considered operationally significant by the observer

(2) Control Tower with a Surface-Based Observer. At facilities with a control tower, with ASOS and with a surface-based observer on duty, the surface-based observer shall provide augmentation of the automated observation. This augmentation shall include, but not be limited to the requirements contained in Service Standards for that level of airport (see Appendix D, Service Standards). At these facilities, the control tower shall routinely provide tower visibility when applicable.

b. Facilities without Control Towers with ASOS. At these facilities, augmentation shall be the responsibility of the co-located Flight Service Station or contract weather observer (CWO) at designated stations. This augmentation shall include, but not be limited to:

(1) thunderstorm

(2) tornadic activity (including tornado, waterspout, and funnel cloud)

(3) hail

(4) virga

(5) volcanic ash

(6) any weather elements considered operationally significant by the observer

c. Facilities with AWOS. At these facilities, the observation shall be the responsibility of the surface-based observer if one exists. At towered sites without a surface-based observer, the observation shall be the responsibility of the LAWRS observer. (Note: Augmentation is not possible at AWOS facilities without an operator interface device.) (Appendix E, METAR User Aids, contains a quick reference for METAR codes.) The augmentation provided by the observer shall be manually entered into the system for transmission via the operator terminal keyboard. If a “hot key” is not available for a particular augmentable element, the augmentation entries shall be manually entered into the remarks portion of the observation and shall be limited to 80 characters including spaces. The following elements shall be provided:

(1) Thunderstorms.

(2) Precipitation occurring at the point of observation, limited to type plus intensity. Allowable reports are listed in Figure 6-6, Backup and Augmentation Weather and Obscurations, and in Appendix E, METAR User Aids.

(3) Obscurations (alone or in combination with precipitation) at the point of observation. Allowable reports are listed in Figure 6-6 and in appendix E.

(4) Operationally significant, localized weather conditions, not listed above, as follows:

(a) hail

(b) virga

(c) tornadic activity* (includes tornado, waterspout, or funnel cloud)

(d) volcanic ash*

(e) any weather elements considered operationally significant by the observer

Note: Only those episodes of weather phenomena listed above that are occurring within a five mile radius of the airport, and/or that pose an operational hazard for aircraft in the airport area shall be reported. Weather phenomena marked with an asterisk (*) shall be reported immediately using the AWOS manual observation mode for entry and transmission. Because AWOS can only produce observations for long-line transmission every 20 minutes, these observations will go out as a METAR, but will be available for local operations via the one-minute data mode.

2-5. BACKUP REQUIREMENTS

a. Situations Requiring Backup. Certified observers are responsible for the completeness and accuracy of the weather observation. If the complete automated observation is unavailable due to sensor/system malfunction, communications failure, and/or non-representative data, backup information shall be provided in accordance with the guidelines in the following subsections. Backup refers to the observer providing the same reporting capability as that provided by the automated weather sensor, consistent with service level standards specified in Appendix D, Service Standards. Backup information is required for long-line dissemination for terminal forecast (TAF) production and for local, ground-to-air dissemination to legally sustain local operations at the airport. The “failure” modes mentioned above are defined as follows:

(1) Sensor/system Malfunction. One or more sensors or the entire observing system is(are) not reporting data (for any reason). Provide manual backup and make appropriate maintenance notifications.

(2) Communications Failure. The automated weather observing system and/or long-line communications are malfunctioning, thereby preventing the entry and/or transmission of the observation over long-line networks. When it is apparent that observations are not being transmitted, relay the observations to the tie-in FSS and notify the appropriate office for outage notification.

(3) Non-representative Data. The sensor is reporting data, but the data are incorrect, or the sky condition, visibility and/or

present weather sensor(s) is/are accurately reporting conditions in the vicinity of the sensor, but those conditions are not representative of prevailing conditions for the operating areas of the airport and are considered operationally significant. When this occurs, provide manual backup. Outage notification is not required.

b. Level of Support. The information specified in these guidelines is the minimum required for each of the situations discussed in the following subsections. The FAA may specify additional information beyond this minimum. The observer is encouraged to add any other appropriate remarks. Procedures and practices to provide the required backup information are presented in Chapter 6, Backup Requirements at Automated Weather Stations.

c. Communications. Automated weather observing system failure may or may not include loss of long-line communications, local communications, or both. The level of backup information to be provided depends on the status of such communications and whether the information is required for long-line or local, ground-to-air dissemination.

d. Equipment for Backup Observations. Weather observing equipment should be maintained to allow certified observers to perform backup responsibilities in the event of an automated sensor failure. Air Traffic managers shall coordinate with the Service Area Office, local Technical Operations SMO, and the appropriate NWS regional office prior to initiating action to decommission weather observing equipment.

2-6. LONG-LINE BACKUP REQUIREMENTS

Details on the procedures to provide backup are in Chapter 6, Backup Requirements at Automated Weather Stations. This paragraph specifies the type of minimum backup for various types of facilities.

a. LAWRS Towers. At LAWRS towers, certified air traffic control specialists (ATCS) shall provide the backup information for long-line transmission which is listed in this section. The required information shall be entered into the automated weather observing system via the operator interface device. The following information shall be provided at a minimum:

(1) Wind

(2) Visibility to 10 miles

(3) Present weather and obstructions to vision (see Figure 6-6 for required elements)

(4) Sky condition to 12,000 feet

(5) Temperature/Dew Point

(6) Altimeter setting

(7) Required remarks and operationally significant remarks as deemed appropriate (Note: Precipitation of unknown form may be reported only if the automated sensor is operational and is reporting precipitation of unknown form. However, if the observer can determine the type of precipitation, it should be reported using the allowable elements listed in Figure 6-6, Backup and Augmentation Weather and Obscurations.)

b. Non-LAWRS Towers with a Surface-Based Observer. At non-LAWRS towers with a surface-based observer, the surface-based observer shall provide at a minimum the backup information for long-line transmission according to the requirements contained in the Service Standards for the service level of the airport. Backup shall also include required remarks and operationally significant remarks as deemed appropriate by the observer. At these facilities, tower personnel shall routinely provide tower visibility information to the surface-based observer as required.

c. Non-Towered Facilities with a Surface-Based Observer. At all non-towered facilities, the surface-based observer shall provide the backup information required by the Service Standards for the service level of the airport. At all facilities with an operator interface device, the required information shall be entered into the automated weather observing system via the operator interface device. Backup shall also include required remarks and operationally significant remarks as deemed appropriate by the observer.

2-7. CERTIFICATION OF PERSONNEL AND CURRENCY REQUIREMENTS

Prior to assuming full responsibility for taking any type of surface observation or any part thereof, each person shall be certified. The NWS is responsible for certifying all civilian weather observers in one or more of the following observer types:

a. NWS and FAA observers

b. LAWRS observer

c. Tower visibility observer

d. SAWRS observer

e. A-paid observer

Definitions of these types are presented in paragraph 4-2, Definitions. Currency requirements are in Order 3120.4, Air Traffic Technical Training.

2-8. TYPES AND CONTENT OF METAR/SPECI OBSERVATIONS

The METAR is the primary code format used in the United States to satisfy requirements for reporting surface meteorological data. The METAR may be prepared by automated weather observing systems (with or without augmentation) or by certified weather observers. These data are primarily reported in an alphanumeric coded format for aviation users. A complete METAR contains the type of report, station identifier, date/time of observation, and whether the report is automated (AUTO) or corrected (COR). Weather phenomena in the METAR include wind, visibility, runway visual range (RVR) (at designated sites), present weather, sky condition, temperature, dew point, and altimeter setting (collectively referred to as "the body of the report"). In addition, significant information elaborating on data reported in the body of the report, or coded and plain language data not included in the body of the report, may be appended to the report in a section referred to as "remarks." However, the content varies according to the type of weather station and the automated weather observing system used. (See Figure 15-1, Content of METAR/SPECI.) Many parts of the remarks section are not required at FAA facilities. The METAR is a scheduled observation. At manual stations, it is taken between 45 and 59 minutes past the hour. METARs are scheduled on the hour at ASOS sites and every 20 minutes at AWOS sites starting at H+00. A SPECI is an unscheduled

observation taken when there is a significant change in the observation since the previous METAR observation was taken or if an aircraft mishap has occurred. If an aircraft mishap occurs close to a scheduled METAR, then it would be transmitted as a METAR. SPECI criteria are applicable only to stations that have the capability of evaluating the event. If it is time for a METAR to be issued, and SPECI observation criteria are met, the observation will remain designated as a METAR. SPECI observations are not issued at AWOS sites because METARs are issued every 20 minutes. (There are some rare exceptions to this rule.) The criteria for taking SPECI observations are given in Chapter 7, General Procedures for Manual Observations. Figure 2-1, Guide to Contents of Automated and Manual Aviation Routine Weather Reports (METAR) and Aviation Selected Special Weather (SPECI) Observations, summarizes the weather elements that are available at automated observing systems with precipitation discrimination capability (AO2), and those without precipitation discrimination capability (AO1). The precipitation discrimination capability indicator, AO1 or AO2, is included in the remarks section of the applicable METAR or SPECI report. This figure also shows the additional elements that are available when an observer is present to add information that is beyond the capabilities of the automated observing system (augmentation).

Element of METAR/SPECI Report(s)										
Type of Station:	**AO1**		**Augmented AO1**		**AO2**		**Augmented AO2**		**Manual**	
Type of Observation:	**M**	**S[1]**	**M**	**S[1]**	**M**	**S[1]**	**M**	**S[1]**	**M**	**S**
Type of Report	X		X		X	X	X	X	X	X
Station Identifier	X		X		X	X	X	X	X	X
Date/Time	X		X		X	X	X	X	X	X
Report Modifier (AUTO or COR)	X				X	X	X[4]	X[4]	X[4]	X[4]
Wind Direction, Speed, Character	X		X		X	X	X	X	X	X
Visibility	X		X		X	X	X	X	X	X
Runway Visual Range			D				D	D	D	D
Present Weather[2]			D		X	X	X	X	X	X
Sky Condition ≤ 12,000 feet > 12,000 feet	X		X		X	X	X D	X D	X X	X X
Temperature	X		X		X	X	X	X	X	X
Dew Point	X		X		X	X	X	X	X	X
Altimeter Setting	X		X		X	X	X	X	X	X
***Remarks:* Group 1 - Automated, Manual, and Plain Language**										
Volcanic Eruptions			X				X	X	X	X
Tornadic Activity			X				X	X	X	X
Type of Automated Station (AO1, AO2)	X		X		X	X	X	X		
Peak Wind	X		X		X		X		X	
Wind Shift					X	X	X	X	X	X
Tower or Surface Visibility	D		D		D	D	D	D	D	D
Variable Prevailing Visibility	X		X		X	X	X	X	X	X
Sector Visibility			X				D	D	X	X
Visibility at Second Location	D		D		D	D	D	D		
Lightning			X		D	D	D	D	X	X
Time of Beginning/Ending of Precipitation					X		X	X[5]	D	X[5]
Time of Beginning/Ending of Thunderstorms					X[3]	X[3]	X	X	X	X
Thunderstorm Location			X				X	X	X	X

AO1 - Automated station does not have precipitation discrimination capability
AO2 - Automated station has precipitation discrimination capability
AUTO - Appears in weather report of automated system when observer is not logged on
M - METAR
S - SPECI
X - Indicates elements included at all stations
D - Indicates elements included only at designated stations
Footnote 1: All hourly reports are METAR, all others are SPECIs except AWOS which are all METAR.
Footnote 2: Automated stations report only a limited set of present weather and obstruction to vision elements.
Footnote 3: ALDARs sites only.
Footnote 4: "COR" only.
Footnote 5: Report if precipitation caused the SPECI.

Figure 2-1. Guide to Contents of Automated and Manual Aviation Routine Weather Reports (METAR) and Aviation Selected Special Weather (SPECI) Observations ***(continued on next page)***

Element of METAR/SPECI Report(s)										
Type of Station:	**AO1**		**Augmented AO1**		**AO2**		**Augmented AO2**		**Manual**	
Type of Observation:	**M**	**S**	**M**	**S[1]**	**M**	**S[1]**	**M**	**S[1]**	**M**	**S**
Hailstone Size			X				D	D	X	X
Virga			X				X	X	X	X
Variable Ceiling Height	X		X		X	X	X	X	X	X
Obscurations[2]							D	D	X	X
Variable Sky Condition							D	D	X	X
Significant Cloud Types							D	D	X	X
Ceiling Height at Second Location			D		D	D	D	D		
Pressure Rising/Falling Rapidly	D		D		X		X		X	
Sea-level Pressure					X	X	X	X	D	
Aircraft Mishap			X				X	X	X	X
No SPECI Reports Taken									D	
Snow Increasingly Rapidly			D				D	D	X	
Other Significant Information			D				D	D	D	D
***Remarks:* Group 2 - Additive and Automated Maintenance Data**										
Hourly Precipitation Amount	D		D		X		X			
Ice Accretion					X	X	X	X		
3-6 Hour Precipitation Amount[3]	D		D		X		X		D	
24-Hour Precipitation	D		D		X		X		D	
Depth of Snow on Ground			D				D		D	
Water Equivalent of Snow on Ground									D	
Cloud Types										
Duration of Sunshine										
Hourly Temperature and Dew Point					X		X		D	
6-Hourly Maximum Temperature	D		D		X		X		D	
6-Hourly Minimum Temperature	D		D		X		X		D	
24-Hour Max/Min Temperature	D		D		X		X		D	
3-Hourly Pressure Tendency					X		X		D	
Sensor Status Indicators					X	X	X	X		
Maintenance Indicator					X	X	X	X		

AO1 - Automated station does not have precipitation discrimination capability
AO2 - Automated station has precipitation discrimination capability
AUTO - Appears in weather report of automated system when observer is not logged on
M - METAR
S - SPECI
X - Indicates elements included at all stations
D - Indicates elements included only at designated stations

Footnote 1: All hourly reports are METAR, all others are SPECIs except AWOS which are all METAR.
Footnote 2: Automated stations report only a limited set of present weather and obstruction to vision elements.
Footnote 3: 3-Hour precipitation amounts required at designated stations only.

Figure 2-1. Guide to Contents of Automated and Manual Aviation Routine Weather Reports (METAR) and Aviation Selected Special Weather (SPECI) Observations ***(concluded from previous page)***

CHAPTER 3. GENERAL PROCEDURES

3-1. INTRODUCTION

This chapter prescribes procedures and practices applicable to all facilities and to all types of observations.

3-2. DEFINITIONS

a. Aircraft Mishap. Aircraft mishap is an inclusive term to denote the occurrence of an aircraft accident or incident.

b. Coordinated Universal Time (UTC). UTC is the time in the zero degree meridian time zone, also commonly known as Zulu (Z) time.

c. Local Standard Time (LST). LST is a time based on the geographic location of the facility in one of the legally established time zones of the globe.

d. Standard Time of Observation. The standard time of observation is the hour to which a METAR observation applies.

e. Aviation Routine Weather Report (METAR). A METAR is a measurement or evaluation of meteorological elements that describe the state of the atmosphere at the surface location(s) where the observation is taken. METAR is a scheduled observation.

f. Aviation Selected Special Weather Report (SPECI). A SPECI is a weather observation that is reported at other than a scheduled time. SPECI shall be taken when any of the criteria for a special observation is observed or detected.

3-3. AVIATION WEATHER OBSERVING LOCATIONS

Surface weather observation locations shall make routine reports at fixed intervals (METAR reports). Where the capability exists, the routine reports shall be supplemented by non-routine reports (SPECI). The observing location is defined as the point or points at which the various elements are observed. In cases where all the measurements are taken at the same point, an observation will be regarded as having a single location. In cases where the various sensors are located to obtain acceptable exposure, the observation location will be regarded as varying with the individual elements in an observation. Normally, multiple observing points are confined to an area within about 2 miles of the station. Weather reports from manual stations may also contain information on phenomena occurring at other than the location of the observation. For example, at a large airport the observation location may be defined as follows:

a. For elements such as clouds, prevailing visibility, present weather, and obscurations, the observing location may be coincident with the observer's physical location or it may be the touchdown area of the primary runway.

b. For temperature, dew point, and wind, the observing location may be the center of the runway complex.

c. For cloud height and ceiling, the observing location may be a point near the approach end of a runway.

d. For the location of lightning, the observing point may be the Airport Reference Point (ARP). The ARP is a permanent airport reference point defined by a latitude/longitude.

e. For tower visibility, the observing location shall be the Airport Traffic Control Tower (ATCT). **(NA LAWRS)**

f. Regardless of observing location or the locations of the sensors, there shall be only one observation disseminated long-line for an airport. If applicable, a report from a commissioned ASOS shall be designated as the weather observation for that airport. A report from a commissioned AWOS may also be designated as the weather observation for an airport. When the air traffic control facility is not in operation, these systems will be operated in the fully automated mode as the weather observation source.

3-4. GENERAL OBSERVING PRACTICES

The general observing practices specified in the following subsections apply to personnel taking either full manual, augmented, backup, or tower visibility observations. They do not necessarily apply to the automated portions of observations, which are controlled by system software.

a. Order of Observing. Elements having the greatest rate of change shall be evaluated last. When conditions are relatively unchanging, the observer shall evaluate the elements outdoors first, and then evaluate the elements indoors, with pressure being the last element evaluated.

b. Recency of Observed Elements. Individual elements entered in an observation shall, as closely as possible, reflect conditions existing at the actual time of observation. At manual locations, elements entered shall have been observed within 15 minutes of the actual time of observation. Gusts and squalls shall be reported if observed within 10 minutes of the actual time of observation. METAR observations shall be made as close to the scheduled time of the observation as possible to meet filing deadlines, but in no case shall these observations be started more than 15 minutes before the scheduled time.

c. Dark Adaptation. When taking observations outdoors at night, sufficient time should be allowed for the observer's eyes to become adjusted to the darkness.

d. Weather Not Observed. Observers are not required to report occurrences they have not observed. However, the observer may use information from reliable sources, for example, pilots, airline/airport personnel or other sources deemed acceptable by the observer.

e. Time Disseminated in Reports. All times shall refer to the 24-hour clock, for example, 1:47 a.m. shall be referred to as 0147; 1:47 p.m. shall be referred to as 1347. The times 0000 and 2359 shall be used to indicate the beginning and ending of the day, respectively.

f. Time Standards. Times used in weather observations shall be:

(1) Local Standard Time (LST). (NA LAWRS). LST is used on MF1M-10Cs to record times of observation and time checks. LST shall be entered on all forms throughout the year with no consideration of daylight savings time.

(2) Coordinated Universal Time (UTC). UTC is used on all transmitted data. It is also used on MF1M-10Cs to record times of observations and time checks at LAWRS sites.

g. Accuracy of Time in Observations. The accuracy of the actual time of observation and time checks on recording charts is very important in aviation safety investigations. One clock shall be designated as the observing location standard, and a routine procedure set up to assure its accuracy once a day at a minimum. The clock used shall be within ± 1 minute of the U.S. Naval Observatory Time. If available, the FAA Coded Time Source (CTS) may be substituted for U.S. Naval Observatory Time.

3-5. DISSEMINATION

For purposes of this order, dissemination is the act of delivering a completed report to users. There are two general types of dissemination.

a. Local. Local transmission is the transmission or delivery of a weather report to individuals or groups of users in the service area of the observing location.

b. Long-line. Long-line transmission is the transmission of a weather report beyond the service area of the observing location.

3-6. DISSEMINATION REQUIREMENTS

All reports shall be given local dissemination. At designated stations, reports shall be given long-line dissemination. When reports are corrected, the corrected report shall be given the same dissemination as the report being corrected. If reports cannot be disseminated simultaneously, local and long-line, they shall be disseminated first to the local airport traffic control users, then disseminated long-line. SPECI observations shall be completed and transmitted as soon as possible after conditions meeting SPECI criteria are observed or detected. A METAR shall be transmitted in accordance with agency guidelines. A METAR entered that also meets the criteria for a SPECI shall be disseminated as a METAR. WS Form B-11, METAR/SPECI Report for Transmission, is available from the NWS for those facilities that receive manual observations from observers over the phone. This form is an optional aid for transcribing the observation for transmission. (See Appendix F, METAR/SPECI Report for Transmission.)

3-7. CORRECTIONS TO TRANSMITTED DATA

Once an error has been detected in a transmitted report, a correction shall be transmitted as soon as possible. Do not transmit a correction if the original transmitted observation has been superseded by a later report. Transmit the entire corrected report with (COR) as the report designator. Use the original date and time of the report being corrected.

3-8. DELAYED REPORTS

When transmission of a manual observation is delayed until time for the next regularly scheduled report, only the latest report shall be transmitted. In the record of observations, the remark Filed But Impractical to Transmit (FIBI) shall be appended in parentheses to the report that was not transmitted. The remark FIBI shall not be included in any local dissemination of the report. When a SPECI is not transmitted long-line, later SPECIs shall be transmitted long-line only when the overall change between the last transmitted report and the current report satisfies the criteria for a SPECI. If the SPECI is not transmitted long-line, the remark FIBI shall be appended to the report as described above. All SPECI reports shall be disseminated locally. Reports of volcanic eruption shall be disseminated, by any means possible, regardless of the delay.

3-9. ROUNDING OFF NUMBERS

Except where otherwise designated in this order, when computations require that a number be rounded, 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. For example, 1.5 becomes 2, 1.3 becomes 1, -1.5 becomes -1, and -2.6 becomes -3. Refer to paragraph 14-21, Rounding Pressure Values, for rounding of pressure values.

3-10. RECORD KEEPING AND FORMS

a. Manual Observations. All manual observations, whether complete or partial, shall be recorded on form MF1M-10C (does not include automated stations). After completing the form, it shall be archived at the facility completing the form. Facilities shall prepare an original and at least one good duplicate copy of each form. The copies shall be legible and suitable for retention and duplication. Corrected copies of all forms shall be retained locally for 90 days. Retention of copies beyond 90 days shall be as directed by the Washington Headquarters. All original forms and the charts from recording instruments shall be mailed to the National Climatic Data Center (NCDC) as follows:

(1) By the second working day of each month, mail all MF1M-10Cs for the preceding month, together with all recording charts except those from the ceilometer and transmissometer.

(2) To facilitate handling and verification by NCDC, each day's form and recorder charts shall be placed in chronological order and shall be free of all staples.

Mail the original forms and recorder charts to:

NCDC Services Center
Image Entry
465 Industrial Blvd.
London, KY 40741

b. Automated Weather Observations. Automated weather observations and operator terminal entries are archived on site. No further action is required by FAA, FAA-contract or NF-OBS facilities. In the event of a complete failure of automated equipment, observers are expected to follow manual observation recording requirements.

3-11. EVALUATING WEATHER SENSOR ACCURACY

a. Sensor Evaluations. When the observer has reason to believe that the accuracy or validity of indications from meteorological sensors is questionable, the use of such equipment should be discontinued until necessary corrective maintenance has been accomplished. If the use of such equipment is discontinued, any required back-up procedures or practices shall be initiated. FAA personnel and NF-OBS providers shall make appropriate maintenance notifications in the event of any equipment outages. If the observer believes that the ASOS information is inaccurate, they should notify the ASOS Operations and Monitoring Center (AOMC).

b. Notices to Airmen (NOTAMS). The FSS/AFSS shall accept, categorize, and distribute Notices to Airmen (NOTAMs) on all systems and system components in accordance with the instructions contained in Order 7930.2.

c. Time Entries on Recorder Charts. Time entries (such as those for time checks) on recorder charts shall be made to the nearest minute LST, except at LAWRS sites, where UTC time is entered.

d. Time Checks on Recorder Charts. Time checks on the recorder chart of recording-type instruments shall be made as follows:

(1) At the beginning and end of each chart roll.

(2) When notified of an aircraft mishap.

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

(4) At the time of the first observation at facilities not operating 24 hours per day.

e. Time Adjustments on Recorder Charts. When a recorder is adjusted to the correct time, the observer shall 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.

f. Power and Equipment Failures. The observer shall 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 time of the failure. When the equipment is returned to service, the observer shall, if necessary, adjust the chart to the correct time and enter a time check.

3-12. DOCUMENTATION OF OBSERVING LOCATION AND FACILITIES

An accurate Station Information File shall be maintained at the FAA service area office. This file shall document the equipment (including automated weather observing systems equipment), instrumentation, and the observing program at the facility. The file shall contain, as a minimum, the information specified in the FMH-1 (see Figure 3-1). It is each service area office's responsibility to ensure that a copy of the Station Information File for each observing location is sent to the National Climatic Data Center (NCDC), Attn: Code EF1100, of the National Oceanic and Atmospheric Administration (NOAA). A copy of the file shall be sent when a station is established, when any data listed in the file changes or is corrected, and when a station closes. This file shall become a part of that station's archived record.

Physical Characteristics		
Station Name	Latitude/Longitude	Type of Station
Airport Name	Climatological Elevation	Description of Significant
Station Identifier	Field Elevation	Topography
WMO Index Number	Ground Elevation	
Time Zone	Station Elevation	
Observation Schedule		
Types of Reports	Schedule for Reports	Hours of Operation
Observation Program		
Elements Observed	SPECI	
Long-Line Communications Circuits	Transmitted (Y/N)	
Sensor Data		
System Configuration	Location of Sensors	Non-standard Sensor Siting
Types of Sensors		

Figure 3-1. Station Information File

CHAPTER 4. GENERAL PROCEDURES AT AUTOMATED WEATHER STATIONS

4-1. PURPOSE

This chapter prescribes procedures and practices to be followed by personnel responsible for manually observing, reporting and/or transmitting surface weather information required for augmentation, and/or for sustaining minimum operations in the event of partial or total failure of the automated weather observing system. This chapter also describes specific differences in these procedures and practices applicable to LAWRS observers.

4-2. DEFINITIONS

a. Observer. The generic term "observer" applies to a number of different types of personnel with various responsibilities for providing weather information. These various types are:

(1) Weather Observer. A person who is certified by the NWS to provide a designated range of weather observation elements. These include NWS, NWS-contract, FAA and FAA-contract personnel.

(a) LAWRS Observer. An NWS-certified air traffic control specialist (ATCS) with weather observation responsibilities for surface aviation weather elements.

(b) Tower Visibility Observer. An ATCS certified by NWS to observe and report airport visibility from the control tower.

(2) A-Paid Observer. Contract weather observers who take only hourly observations (METAR). They are certified by NWS to provide weather information under the terms of a "per-observation" agreement.

(3) NF-OBS Observer. A non-federal observer working under the guidelines of the NF-OBS program, providing backup and augmentation of the ASOS.

b. Surface Weather Observing Stations

(1) Automated Station. A facility with an automated weather observing system that prepares the observation for transmission with no certified observer signed on to the system.

(a) Augmentation. The manual addition of data to an automated observation which is beyond the capabilities of the automated weather observing system.

(b) Backup. An alternative method of providing the weather observation when any portion of the automated observation is unavailable or erroneous due to sensor/system malfunction, communications failure and/or non-representative data.

(2) Manual Station. A facility where certified weather observers are responsible for observing, evaluating, and processing the surface aviation observation. At these facilities, various types of automated weather observing systems, sensors and/or other automated equipment may be available.

(3) NF-OBS Program. A program whereby a local entity such as a non-federal

control tower (NFCT), airport personnel or fixed-based operator (FBO) may assist, at no cost to the Government, with the augmentation or backup of the automated weather observing system. Observers must be certified by NWS.

4-3. TYPES OF AUTOMATED STATIONS

a. FAA, FAA-contract and NF-OBS Stations. There are two major classes of automated surface weather observing systems used at FAA, FAA-contract and NF-OBS sites: ASOS and AWOS. The augmentation and backup of these systems are described in the next two chapters for all FAA, FAA-contract and NF-OBS site personnel.

(1) Automated Surface Observing System (ASOS). ASOS is a type of automated surface weather observing system developed through a joint FAA/NWS/DOD agreement. FAA ASOSs are installed at designated airports and maintained by the NWS to meet FAA requirements. There are three configurations of ASOS. The first contains at least one of each of the following sensors:

(a) Wind sensor.

(b) Visibility sensor.

(c) Precipitation identification sensor.

(d) Cloud height indicator sensor.

(e) Temperature and dew point sensors.

(f) Pressure sensors.

(g) Precipitation accumulation sensor.

(2) The second ASOS configuration has a freezing precipitation sensor in addition to all of the above sensors. The third configuration has a thunderstorm/lightning sensor. Systems without individual lightning sensors will get thunderstorm reporting via the Automated Lightning Detection and Reporting System (ALDARS). Many sites have an ASOS/ATIS Interface Unit (AAIU), which provides the capability to broadcast current weather from the ASOS over the ATIS ground-to-air radio when the tower is closed. ASOS may also have an interface to New Generation RVR equipment. See Chapter 10, Runway Visual Range.

(3) Automated Weather Observing System (AWOS). AWOS is a type of automated surface weather observing system certified and commissioned by the FAA. The AWOS was developed under a Flight Standards Service-sponsored project specifically to provide weather information at locations without previous weather observation capabilities. There are eight types of AWOS, namely, A, 1, 2, 3, 3P, 3T, 3P/T, and 4.

(a) AWOS-A: AWOS-A contains only dual-pressure sensors that measure pressure and report altimeter setting to the pilot.

(b) AWOS-1: AWOS-1 contains the AWOS-A sensors plus sensors to measure wind data (speed, direction, and gusts), temperature, and dew point, and to report density altitude.

(c) AWOS-2: AWOS-2 contains all the AWOS-1 sensors, plus a visibility sensor.

(d) AWOS-3: AWOS-3 contains all the AWOS-2 sensors, plus a cloud height sensor.

(e) AWOS-3P: AWOS-3P contains all the AWOS-3 sensors, plus a precipitation identification sensor.

(f) AWOS-3T: AWOS-3T contains all the AWOS-3 sensors, plus a thunderstorm/lightning reporting capability.

(g) AWOS-3P/T: AWOS-3P/T contains all the AWOS-3 sensors plus a precipitation identification sensor and a thunderstorm/lightning reporting capability.

(h) AWOS-4: AWOS-4 contains all the AWOS-3 sensors, plus precipitation occurrence, type and accumulation; freezing rain; thunderstorm; and runway surface condition sensors.

(4) Many AWOSs were installed at airports without previous weather observations, so personnel may not be available to augment or back up the automated weather observations. The most common type of AWOS observation is the AWOS-3. It is identified by AUTO (automated report) in the body of the report and AO1 (automated station without precipitation discriminator) in the remarks section if it is a fully automated report. If it is being augmented/ backed up by an observer, it will *not* have AUTO in the body of the report and it will have AO1 in the remarks section. (See examples in Figure 5-2, Examples of Augmented Observations.)

b. Non-FAA Stations. In addition to the systems described above, there are various NWS, DOD and non-federal automated weather observing systems. All non-federal automated weather observing systems to be used for aviation must be certified and commissioned by the FAA in accordance with the most current version of FAA Advisory Circular AC 150/5220-16, Automated Weather Observing Systems (AWOS) for Non-Federal Applications.

4-4. CERTIFICATION

All FAA and contract personnel, including LAWRS personnel, responsible for providing weather observations, augmentation information, tower visibility observations or backup weather information shall be certified at least to the level commensurate with current duties. Certification shall be in accordance with the provisions of paragraph 2-7, Certification of Personnel.

4-5. GENERAL PROCEDURES

At automated weather observing locations, the specified weather information shall be taken, recorded and disseminated in accordance with the procedures and practices in this order. Operator procedures for recording and disseminating augmentation and backup information are summarized in Figure 4-1, Operator Procedures for Providing Augmentation and Backup Information. Weather information taken and reported should reflect only those conditions seen, or reported by a reliable source, from the usual point of observation and, unless otherwise specified, must have occurred at the time of the observation.

4-6. GENERAL EQUIPMENT PROCEDURES

General equipment operating instructions to perform the duties associated with automated weather observing systems are contained in the following publications:

a. For all federal and non-federal AWOS systems manufactured by Qualimetrics, Inc., the AWOS Operator Instructions.

b. For non-federal AWOS systems manufactured by AAI/SMI, Inc.; Vaisala Inc., Handar Business Unit; the appropriate AWOS user manual as approved by the FAA.

c. For ASOS, the ASOS Software User's Manual or Ready Reference Guide.

d. For future automated weather observing systems as may be approved by the FAA, the appropriate operations manual or quick reference guide.

4-7. PROCEDURES AT NON-FEDERAL OBSERVATION (NF-OBS) SITES

Upon request from a non-federal entity, a written agreement to provide augmentation and backup of the ASOS at a commissioned ASOS site will be executed between the Service Area Office and the NF-OBS provider. The agreement shall be site-specific and shall contain the hours and the service level at which service will be provided. The minimum level of augmentation shall be the FAA-validated aviation service standard level for that site. Service may be provided at a higher level; however the NF-OBS provider must provide that higher level during all hours of operation. As Service Level D is a stand alone ASOS site, NF-OBS providers operating at these sites shall provide a minimum of level C service.

4-8. PROCEDURES AT NON-FEDERAL AWOS SITES

FAA facilities shall negotiate a letter of agreement (LOA) with the airport management or appropriate authority at locations where a non-federal AWOS is installed at an airport with an operating control tower. The LOA shall define responsibilities, equipment and coordination requirements, identify special operating conditions, and define local requirements. ATCSs may disseminate only those non-federal weather observations that are obtained through the weather message switching center or other equivalent documented means. Pilots who want non-federal AWOS information from sites that do not include automatic long-line dissemination should be provided the appropriate frequency and/or telephone number, if known.

4-9. PROCEDURES FOR HANDLING AIRCRAFT MISHAPS AT AUTOMATED SITES

The requirement to record the present weather following an aircraft mishap remains valid at automated sites. At a minimum, a mishap requires weather data from 1 hour before to 1 hour after the mishap occurs. ASOS observations should be archived by the observer or by calling the ASOS Operations and Monitoring Center (AOMC) (1-800-242-8194). The AOMC has the capability to archive the 5-minute observations from the previous 12 hours of weather observation data from attended and unattended locations. The supervisor or controller-in-charge shall ensure that the 5-minute observations are archived following notification of an aircraft mishap at a location where an ASOS is operational. AOMC requests must be made within 10 hours of the incident. Archive AWOS data in accordance with the procedures in the AWOS Operator Instructions or by calling the AWOS Central Monitoring Center at 1-800-322-0433 or 801-320-2184.

4-10. GENERAL REQUIREMENTS FOR RECORD KEEPING

Automated weather observation data and operator terminal entries are archived on site. No further action is required by

FAA, FAA-contract or NF-OBS facilities. If the automated weather observing system is completely inoperative, follow the record-keeping procedures for manual stations.

OPERATOR PROCEDURES FOR AUGMENTATION AND BACKUP INFORMATION		
CONDITION	**LONG-LINE**	**LOCAL**
AWOS w/o Operator Terminal		
AUGMENTATION	not possible	local procedures
BACKUP INFORMATION:		
Sensor Failure	Manual observation provided to designated office	local procedures
OT/communications failure	Manual observation provided to designated office	local procedures
Erroneous/Non-representative data	Manual observation provided to designated office	local procedures
AWOS with Operator Terminal		
AUGMENTATION	Mode 3[1]	Mode 3
BACKUP INFORMATION:		
Sensor Failure	Mode 3/4[2]	Mode 3/4
OT/communications failure	Manual observation provided to designated office	local procedures
Erroneous/Non-representative data	Mode 4	Mode 4
ASOS (all locations)		
AUGMENTATION	Enter data via OID	Enter data via OID
BACKUP INFORMATION:		
Sensor Failure	Edit data via OID	Edit data via OID
OID/communications failure	Provide to designated office[3]	Local procedures
Erroneous/Non-representative data	Edit data via OID	Edit data via OID

LEGEND: OID/OT - any automated weather observing system operator interface device

FOOTNOTES:
1. Enter augmentation in remarks preceded by the code, "WEA:".
2. Enter the complete observation manually via OT. Partial editing is not possible.
3. Any available communication may be used (For non-LAWRS towers, information is provided only if requested).

Figure 4-1. Operator Procedures for Providing Augmentation and Backup Information

4-11. - 4-12. RESERVED

CHAPTER 5. AUGMENTATION AT AUTOMATED WEATHER STATIONS

5-1. INTRODUCTION

This chapter prescribes procedures and practices applicable to the augmentation of automated surface observations at all FAA, FAA-contract and NF-OBS facilities. In addition, this chapter also prescribes specific differences in augmentation procedures and practices applicable to LAWRS observers, as well as tower visibility requirements. FAA guidelines applicable to the augmentation of automated surface observations are presented in paragraph 2-3, General Types of Observations. Figure 5-1, Summary of FAA Augmentation Requirements, summarizes the minimum augmentation requirements by type of facility, which were given previously in Chapter 2, Guidelines.

5-2. VALIDITY OF DATA

Once an observation has been augmented, the observer shall ensure the validity of the augmented data by deleting or changing the data as required.

5-3. SIGN ON/SIGN OFF THE AUTOMATED WEATHER OBSERVING SYSTEMS

In order to enter augmentation data into the automated weather observing system, the observer must be signed on. Sign on shall be in accordance with the respective automated weather observing system's operator handbook or locally prescribed procedures. The "AUTO" tag at the beginning of the observation will be dropped when the observer signs on.

a. Sign On/Sign Off the ASOS.

(1) When using ASOS, several augmented events (e.g., tornadic activity, thunderstorm, or hail) automatically generate SPECI observations for the beginning and ending of the event. If one of these events is occurring at the close of augmentation coverage, it will be necessary to end the event or it will continue to be reported during the hours when there is no augmentation coverage. The observer shall end the event immediately after the last hourly METAR is transmitted before going off duty. The ending of the event will automatically generate a SPECI. The observer shall cancel this SPECI, enter the AUTO REMARK and disable the present weather (PREWX). The observer shall then sign off the automated weather observing system. This procedure will end the erroneous ending remark in the next observation.

(2) Virga and volcanic ash are events that do not generate SPECIs. Virga is automatically deleted from the observation after the hourly METAR is transmitted. If virga continues to occur, it shall be re-entered. If volcanic ash is occurring at the close of augmentation coverage, it will be necessary to end the event or it will continue to be reported during the hours when there is no augmentation coverage. The observer shall end the event immediately after the last hourly METAR is transmitted before going off duty.

SUMMARY OF FAA AUGMENTATION REQUIREMENTS					
	TOWERED with ASOS		NON-TOWERED with ASOS	AWOS[4] with	TOWERED w/ AWOS[4]
ELEMENT	W/O OBS[1]	W/ OBS[2]	FSS[3] or FAA Contract	OBS	w/o OBS
Thunderstorm	T	O	F	O	T
Tornadic Activity[5]	T	O	F	O	T
Hail	T	O	F	O	T
Virga	T	O	F	O	T
Volcanic ash	T	O	F	O	T
Weather[6]	NA[7]	NA[7]	NA[7]	O	T
Tower Vsby		T[8]		T[9]	

Footnotes:
1. Towered site without a surface-based observer. (LAWRS)
2. Towered site with a surface-based observer.
3. FSS where the FAA was responsible for observation prior to automated system. As long as thunderstorm augmentation is required, other elements shall be provided if the capability to provide them exists.
4. At sites that have an operator terminal.
5. Includes tornado, waterspout, and funnel cloud.
6. Weather and obstructions to vision. See Figure 6-6 for complete list of required elements.
7. Weather is considered a backup requirement for ASOS.
8. Tower visibility either provided to observer for input or entered via operator interface device.
9. At sites with tower.

Legend:
Blank - Augmentation not provided
F - Augmentation provided by certified FSS observer or FAA-contract observer
O - Augmentation provided by surface-based observer
T - Augmentation provided by certified tower observer
OBS - Surface observer

Figure 5-1. Summary of FAA Augmentation Requirements

b. Sign On/Sign Off the AWOS. At AWOS sites, the observer shall sign on/sign off the automated weather observing system following the procedures stated in the AWOS Operator's Instructions.

5-4. ORDER FOR REPORTING WEATHER AND OBSTRUCTIONS TO VISIBILITY

See Figure 15-1, Content of METAR/SPECI, and Figure 15-2, METAR or SPECI Code Format, in Chapter 15, Coding and Dissemination.

5-5. AUGMENTATION OBSERVING PROCEDURES

Except as specified in the following subsections, observing procedures for augmentation shall be the same as specified for the corresponding manual observation in chapters 7 through 14. Figure D-1, Service Standard Levels, shows elements to be augmented for each service level.

a. Observing Tornadic Activity. The term tornadic activity shall include funnel clouds, tornadoes, and waterspouts. Observing procedures for tornadic activity are given in paragraph 11-29, Tornado, Waterspout, or Funnel Cloud. A funnel cloud, tornado, or waterspout is considered to begin at the time it is observed by the observer. A funnel cloud, tornado, or waterspout is considered to end at the time it disappears from sight.

b. Observing Thunderstorms. Observing procedures for thunderstorms are given in paragraph 11-30, Reporting Thunderstorms, and paragraph 11-31, Beginning and/or Ending of a Thunderstorm. A thunderstorm occurrence begins when thunder is first heard, lightning is observed over the station and the local noise level is sufficient to prevent hearing thunder, or when lightning is detected by an automated sensor within ten miles of the airport. A thunderstorm is considered to end 15 minutes after the last occurrence of any of these criteria.

c. Observing Hail. Observing procedures for hail are given in paragraph 11-32, Reporting Hail. Hail begins at the time it is first observed and ends when it is no longer falling. No intensity shall be assigned to hail, i.e., the observer shall not characterize hail as light, moderate, or heavy.

d. Observing Volcanic Ash. Observing procedures for volcanic ash are given in paragraph 11-39, Special Procedures for Volcanic Ash. The observer shall report volcanic ash whenever it is observed at the station.

e. Observing Virga. Virga is defined as precipitation falling from clouds but not reaching the ground. The observer shall report virga when observed. Virga is not considered to be present weather or an obscuration.

f. Observing Tower Visibility. Observing procedures for tower visibility are given in paragraph 9-3, Visibility Standards.

5-6. REPORTING PROCEDURES

a. General Reporting Procedures. General operator procedures for recording and disseminating augmentation information are summarized in Figure 4-1, Operator Procedures for Providing Augmentation and Backup Information.

(1) ASOS. At ASOS sites, report tornadic activity (to include funnel clouds, tornadoes, or waterspouts), thunderstorm, hail, volcanic ash, virga or tower visibility by making the appropriate entry on the operator's interface

device in accordance with procedures in the ASOS Ready Reference Guide.

(2) AWOS. At AWOS sites, all augmentation reports shall be made in the remarks of the report and shall be prefixed with the phrase WEA:. The reports shall be entered in accordance with procedures prescribed in the appropriate AWOS Operator's Instructions or FAA-approved manufacturer's equipment manual.

b. Reporting Procedures for Each Weather Observation Element.

(1) Reporting Tornadic Activity. The term tornadic activity shall include funnel clouds, tornadoes, and waterspouts. These phenomena shall be reported in a SPECI observation whenever they are observed or disappear from sight. At ASOS sites, the event will continue to be reported automatically until the observer deletes the entry.

(2) Reporting Thunderstorms. At ASOS sites, entry or deletion of a thunderstorm report shall be made. The event will continue to be reported automatically until the observer deletes the entry. A SPECI observation is generated automatically for the beginning and ending times of thunderstorms. A thunderstorm occurrence begins when thunder is first heard, when lightning is observed at the station and the local noise level is sufficient to prevent hearing thunder, or when lightning is detected by an automated sensor within ten miles of the airport. Location and direction of movement of the thunderstorm, and the location, type, and frequency of lightning should be reported, if known. LAWRS personnel are only required to annotate the beginning/ending times of thunderstorms.

(3) Reporting Hail. At ASOS sites, entry or deletion of a hail report shall be made. The event will continue to be reported automatically until the observer deletes the entry. Hail begins when it is first observed and ends when it is no longer falling. No intensity is assigned to hail, i.e., hail shall not be characterized as light or heavy. Hail size should be reported, if known.

(4) Reporting Volcanic Ash. VA is the standard contraction used for volcanic ash. It will be reported in the body of the report as an obscuration whenever observed. At ASOS sites, the event will continue to be reported automatically until the observer deletes the entry. A special observation is not required when volcanic ash is observed. No intensity is assigned to volcanic ash, i.e., the observer shall not characterize volcanic ash as light, moderate, or heavy. Remarks are optional, but if the volcanic eruption producing the volcanic ash is observed, it shall be entered in remarks and a special observation shall be generated.

(5) Reporting Virga. When precipitation is observed to be falling from clouds but is not reaching the ground, the observer shall report VIRGA in remarks. There is no standard contraction used for virga. Virga is not considered to be present weather or an obstruction to vision. In remarks, VIRGA is spelled out in full. At ASOS sites, the event will continue to be reported automatically until the observer deletes the entry or until after the next hourly observation. The remark VIRGA will not be automatically kept in remarks of the observation past the next hourly observation. If virga persists, it shall be re-entered as a remark. No SPECI is required when virga is observed. No intensity is assigned to virga, i.e., the observer shall not characterize virga as light, moderate, or

heavy. The direction of the virga from the site is optional.

(6) Reporting Tower Visibility (NA LAWRS). At towered ASOS sites with a surface-based observer, a tower visibility report shall be made by notifying the surface-based observer or using the appropriate entry on the operator's interface device. Reporting of tower visibility shall be in accordance with coding and dissemination procedures specified in paragraph 15-25, Tower or Surface Visibility.

5-7. EXAMPLES OF AUGMENTED OBSERVATIONS

Examples of augmented weather observations for a typical condition (i.e. thunderstorm) are given in Figure 5-2, Examples of Augmented Observations, for AWOS and ASOS.

Examples of Augmented Observations
AWOS w/o Aug
METAR KHEF 011755Z AUTO 21020G35KT 1SM OVC010 27/24 A2991 RMK AO1
AWOS w/ Aug
METAR KHEF 011755Z 21020G35KT 1SM +TSRA OVC010CB 27/24 A2991 RMK AO1 WEA:TSRA OCNL LTGCG OHD TS OHD MOV E
ASOS w/o Aug
METAR KGLD 011755Z AUTO 21020G35KT 1SM +RA OVC010 27/24 A2991 RMK AO2 SLP101
ASOS w/ Aug
METAR KBHM 011755Z 21020G35KT 1SM +TSRA OVC010CB 27/24 A2991 RMK AO2 OCNL LTGCG OHD TSB42 TS OHD MOV E SLP101
ASOS w/o Aug with ALDARS
METAR KSEG 171753Z AUTO 21020G30KT 1SM TSRA OVC010 27/24 A2991 RMK AO2 LTG DSNT E TSB42 SLP101
ASOS w/ Aug and ALDARS
METAR KAOO 011753Z 21020G35KT 1SM TSRA OVC010CB 27/24 A2991 RMK AO2 LTG DSNT E TSB42 TS OHD MOV E SLP101

Figure 5-2. Examples of Augmented Observations

5-8. - 5-9. RESERVED

CHAPTER 6. BACKUP REQUIREMENTS AT AUTOMATED WEATHER STATIONS

6-1. INTRODUCTION

This chapter presents the procedures and practices for providing the backup weather information required in the event of a partial or total failure of the automated weather observing system or if one or more of the elements within the automated weather observing system observation are judged to be erroneous or non-representative. Responsible personnel shall provide the backup weather information specified in Chapter 2, Guidelines. Facilities designated to perform augmentation shall also augment during periods when backup is required.

6-2. SUMMARY OF BACKUP REQUIREMENTS

Figure 6-1, Summary of Long-line Backup Requirements, presents a summary of the backup weather information requirements to support the pilots' safety and regulatory requirements and the terminal forecast preparation program of NWS. The figure documents the level of backup required in accordance with the service level standards as described in Appendix D, Service Standards. In addition to the observational elements shown in the figures, the minimum functions of communications and observational records to back up the automated weather observing systems shall be provided for as specified in this chapter. If a partial system failure or erroneous data involves weather elements not required to be provided in accordance with specifications in this chapter, those elements may be treated as missing. Responsible personnel may disable those automated sensors in accordance with applicable equipment manuals. When reverting to the manual mode, responsible personnel shall record justification for reverting on FAA Form 7230-4, Daily Record of Facility Operation, and shall make appropriate maintenance notifications. (Personnel should also record the observation on the NWS meteorological form.) When long-line communications are unavailable, the FSS/Automated Flight Service Station (AFSS) shall disseminate these reports. Dissemination procedures are outlined in Figure 4-1, Operator Procedures for Providing Augmentation and Backup Information.

6-3. VALIDITY OF DATA

Once a weather observation is modified through manual actions, the responsible person shall assess the validity of the data by deleting or changing the observation as required.

SUMMARY OF LONG-LINE MINIMUM BACKUP REQUIREMENTS			
ELEMENT	TOWERED		NON TOWERED WITH OBSERVER[1]
	LAWRS	NON-LAWRS WITH OBSERVER[1]	
Wind	T	O	O
Visibility to 10 Miles	T	O	O
Present Weather & Obscurations[2]	T	O	O
Sky Condition to 12K Ft.	T	O	O
Temperature/Dew Point	T	O	O
Altimeter Setting	T	O	O
Tower Visibility		T	

Footnotes:
1. Includes all FSS, FAA-Contract and non-federal observers.
2. See Figure 6-6 for required elements.
Legend:
Blank - Element not provided
T - Element provided by certified Air Traffic Control Specialist
O - Element provided by surface-based observer

Figure 6-1. Summary of Long-line Backup Requirements

6-4. EQUIPMENT REQUIREMENTS

The following are minimum requirements for equipment required to provide the weather information specified in this chapter. Unless stated otherwise, the equipment is required only if that element is required at your facility. References to an "OID/OT" indicate any automated weather observing system operator interface device.

a. Equipment for Wind Direction and Speed. If available, the primary low-level wind shear alert system (LLWAS) sensor or other on-site wind equipment shall be used. Otherwise, the wind direction and speed may be estimated during periods when all automated wind sensors are inoperative.

b. Equipment for Visibility. There is no equipment required for automated visibility sensor backup. However, a current list or visibility chart(s) depicting day and night visibility reference points shall be maintained and available at the point of observation for use at each facility.

c. Equipment for Present Weather and Obstructions to Vision. Visual procedures shall be used to identify the type(s) of present weather and/or obscurations. If necessary, visual procedures shall be used to determine the intensity of precipitation.

d. Equipment for Sky Condition. There is no equipment required for automated

sky condition sensor backup. If independent cloud height equipment is available, it should be used to obtain cloud height information. If such equipment is not available, visual estimates shall be made. Pilot reports of cloud heights may be used if available.

e. Equipment for Temperature and Dew Point. A remote readout hygrothermometer is an acceptable backup for temperature and dew point. Other acceptable backups are a sling psychrometer, a battery-operated self-contained psychrometer, or a stand-alone temperature measuring device, as approved by FAA.

f. Equipment for Altimeter Setting. Equipment to back up altimeter setting may be any FAA installed and maintained altimeter setting indicator (ASI) or digital altimeter setting indicator (DASI), or any other facility station pressure instrument, with certification and calibration traceable to the National Institute of Standards and Technology as defined in FAA Order 7210.3, Facility Operation and Administration.

g. Equipment for OID/OT. If the ASOS OID fails, and the ASOS observation is currently representative, the observer shall continue to maintain oversight of the ASOS through the use of other ASOS displays (e.g., Video Display Unit (VDU)) and shall make appropriate maintenance notifications. If significant weather is occurring or expected to occur, after coordinating with ATCT, arrange, through appropriate maintenance channels, for local and long-line communications to be disabled. Notify on-site users that have ASOS displays to turn off power to their display. Provide backup observations.

h. Equipment for Communications. No additional equipment is required for the communication of backup weather information. If the primary communications equipment is unavailable, any appropriate communications media may be used. When long-line communications are unavailable, request that weather information be disseminated by the FSS/AFSS.

i. Equipment Requirements for NF-OBS Providers. The NF-OBS provider shall provide and maintain all backup equipment. The cost of procuring, installing, operating, moving (if required), protecting and maintaining all instruments and equipment in accordance with FAA and NWS specifications is to be borne by the provider. The OID, which is part of the ASOS, will be maintained and serviced by the Government.

6-5. PROCEDURES FOR PROVIDING BACKUP INFORMATION

General observer procedures for providing required backup information are summarized in Figure 4-1, Operator Procedures for Providing Augmentation and Backup Information. At ASOS sites, required weather data elements shall be entered into the automated weather observing system using the editing procedures for the automated weather observing system operator interface device. At AWOS sites, entry of data shall be as specified in the AWOS Operators Instructions or the appropriate FAA approved AWOS manufacturer's equipment manual. For non-representative data, the observer may turn report processing off (ASOS) or set the channel out of service (AWOS). The turning off of report processing will lead to a “$” sign, and the generation of a trouble ticket for the NWS ASOS Operations and Monitoring Center (AOMC). Observers shall not turn off report processing for altimeter setting without appropriate maintenance notification. Once the report processing for the altimeter setting is turned off, only an

BACKUP REPORTING OF WIND OR ALTIMETER SETTING	
LOCATION/CONDITION	**REPORTING PROCEDURES**
ALL LOCATIONS WITH SURFACE-BASED OBSERVER PRESENT	
Sensor Failure	1. Observer reports manually observed wind[1] or altimeter setting[2] in body of observation via designated procedures[3] and makes appropriate maintenance notification.
Non-representative Data	1. Observer may turn report processing off (ASOS) or set channel out of service (AWOS). 2. Observer reports manually observed wind or altimeter setting as above. For sensor failure only make appropriate maintenance notification.
OID/OT/communications failure	1. Observer reports system wind or altimeter setting in body of report via designated procedures and makes appropriate maintenance notification.
LAWRS TOWERS	
All Conditions	1. Tower follows same procedures as above for observers.
NON-LAWRS TOWERS (WITHOUT A SURFACE-BASED OBSERVER)	
All Conditions	1. No backup information provided.

FOOTNOTES:
1. Manual wind observations shall be obtained from the best available approved wind sensor. The LLWAS centerfield wind sensor may be used as an approved wind sensor. If all approved wind sensors are inoperative, the wind shall be estimated.
2. Manual altimeter settings may be obtained from any approved altimeter setting instruments including DASIs.
3. Designated procedures are specified in Figure 4-1.

Figure 6-2. Backup Reporting of Wind or Altimeter Setting

NWS technician can turn the report processing back on.

6-6. CODING OF MISSING DATA

If any element, normally included in the body of the observation, except present weather and obscurations, is missing because of sensor failure, and that element is not required for backup, that element may be omitted. If the automated weather observing system's processor is operative, the system will do this automatically. If not operative, these missing elements shall be omitted and skipped over. When an element or phenomena does not occur, or cannot be observed, the corresponding group and preceding space are omitted from that particular report.

6-7. PROCEDURES FOR WIND SPEED AND WIND DIRECTION

General procedures for the reporting of backup weather information for wind are given in Figure 6-2, Backup Reporting of Wind or Altimeter Setting. Alternate equipment, as specified in paragraph 6-4a, Equipment for Wind Direction and Speed, shall be used to determine wind direction and speed as appropriate. If no backup sensor is available, wind speed and direction shall be estimated. The character (gusts) of wind shall be reported from a wind speed recorder if available. Other sensors, or an estimate, shall be used if a wind recorder is not available.

a. Estimating Wind Direction. Wind direction shall be estimated 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. The movement of clouds, regardless of how low they are, shall not be used for estimating the surface wind direction.

b. Estimating Wind Speed. The Beaufort Scale (see Figure 6-3, Estimating Wind Speed) shall be used to estimate wind speed if all other wind speed measuring instruments are out of service.

WIND EQUIVALENT -- BEAUFORT SCALE	
KTS	Specifications
<1	Calm; smoke rises vertically
1-3	Direction of wind shown by smoke drift not by wind vanes
4-6	Wind felt on face; leaves rustle; vanes moved by wind
7-10	Leaves and small twigs in constant motion; wind extends light flag
11-16	Raises dust, loose paper; small branches moved
17-21	Small trees in leaf begin to sway; crested wavelets form on inland waters
22-27	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty
28-33	Whole trees in motion; inconvenience felt walking against the wind
34-40	Breaks twigs off trees; impedes progress
41-47	Slight structural damage occurs
48-55	Trees uprooted; considerable damage occurs
56-71	Widespread damage

Figure 6-3. Estimating Wind Speed

BACKUP REPORTING OF SURFACE/TOWER VISIBILITY	
LOCATION/CONDITION	**REPORTING PROCEDURES**
ALL LOCATIONS WITH SURFACE-BASED OBSERVER PRESENT	
Sensor Failure	1. Observer reports prevailing surface visibility via designated procedures[1, 2]. 2. At towers, observer reports tower visibility, as required, via augmentation.[2]
Non-representative Data	1. Observer may turn report processing off (ASOS) or set channel out of service (AWOS). 2. Observer reports surface/tower visibility as above under sensor failure.
OID/OT/communications failure	1. Observer reports system visibility via designated procedures.[2] 2. At towers, observer reports tower visibility, as required, via augmentation.[2]
LAWRS TOWERS	
Sensor Failure	1. Tower reports visibility.[2]
Non-representative Data	1. Tower reports visibility. 2. Tower may turn report processing off (ASOS) or set channel out of service (AWOS). 3. Observers shall not turn off report processing for altimeter setting without appropriate maintenance notification.
OID/OT/communications failure	1. Tower reports visibility.[2]
Footnote: 1. Designated procedures are specified in Figure 4-1. Footnote: 2. Observer or tower shall make appropriate maintenance notification.	

Figure 6-4. Backup Reporting of Tower/Surface Visibility

6-8. PROCEDURES FOR VISIBILITY

General procedures for the reporting of backup information for visibility are given in Figure 6-4, Backup Reporting of Tower/Surface Visibility. The visibility shall be a prevailing visibility. (Note: RVR is not addressed here because it will not be backed up by FAA controllers (including LAWRS).)

a. Reporting Visibility Values. In backing up visibility, the reportable values for visibility shall be the manual visibility values as permitted by the current system software installed; see Figure 9-1, Reportable Visibility Values. If the actual visibility falls between two reportable values, the lower value shall be reported.

b. Tower Visibility During Backup (with Surface Observer). During backup periods at towered facilities with a surface-based observer, the responsible tower controller shall:

(1) Notify the surface-based observer when the tower prevailing visibility is observed to decrease to less than, or if below, increases to equal or exceed, 4 miles.

(2) Report all changes of one or more reportable values to the surface-based observer when the prevailing visibility at the tower or the surface is less than 4 miles.

(3) As required by FAA directives, use the lower of either the tower or weather station visibility as controlling visibility for aircraft operations.

REPORTING OF WEATHER PHENOMENA	
LOCATION/CONDITION	**REPORTING PROCEDURES**
ALL LOCATIONS WITH SURFACE-BASED OBSERVER PRESENT	
Sensor Failure	1. Observer reports manually observed present weather[1] in body of observation via designated procedures.[2, 3]
Non-representative Data	1. Observer may turn report processing off (ASOS) or set channel out of service (AWOS). 2. Observer reports manually observed present weather as above for sensor failure.
OID/OT/communications failure	1. Observer reports system weather in body of report via designated procedures.[3]
LAWRS TOWERS	
All Conditions	1. Tower follows same procedures as above for observers.

FOOTNOTES:
1. Weather and obscuration requirements are outlined in Figure 6-6.
2. Designated procedures are specified in Figure 4-1.
3. Observer shall make appropriate maintenance notifications.

Figure 6-5. Backup Reporting of Weather Phenomena

6-9. PROCEDURES FOR PRESENT WEATHER AND OBSCURATIONS

General procedures for the reporting of backup information for present weather and obscurations are given in Figure 6-5, Backup Reporting of Weather Phenomena. Present weather and obscurations to vision shall be observed and reported in accordance with the manual procedures prescribed in Chapter 11, Weather Phenomena. Reports shall include as a minimum those weather phenomena in Figure 6-6, Backup and Augmentation Weather and Obscurations, when backing up ASOS. (If the observer is backing up ASOS at the close of augmentation/ backup coverage, it will be necessary to end the event or it will continue to be reported during the hours when there is no augmentation/backup coverage.) Precipitation of unknown form is generally only reported when the automated weather observing system present weather indicator sensor is operational and is reporting precipitation of unknown form. However, if the observer can determine the type of precipitation, it should be reported according to the guidelines in Figure 6-6, via the non-representative data procedures.

Phenomenon Observed	Report (Notation)
Tornado	+FC (in body); TORNADO (in remarks)
Funnel Cloud	FC (in body); FUNNEL CLOUD (in remarks)
Waterspout	+FC (in body); WATER-SPOUT (in remarks)
Thunderstorm	TS
Rain	RA
Rain Shower	Report RA for ASOS *
Drizzle	DZ
Freezing Rain	FZRA
Freezing Drizzle	FZDZ
Ice Crystals	Report SN for ASOS *
Ice Pellets	PL
Ice Pellet Showers	Report PL for ASOS *
Hail	GR
Snow	SN
Snow Showers	Report SN for ASOS *
Snow Grains	Report SN for ASOS *

Phenomenon Observed	Report (Notation)
Snow Pellets or Small Hail	GS
Volcanic Ash	VA
Fog (Vsby <5/8)	FG
Mist (Vsby $\geq$ 5/8)	BR
Shallow (ground) Fog	MIFG
Patchy Fog	BCFG
Freezing Fog	FZFG
Blowing Snow	BLSN
Haze	HZ
Smoke	FU
Squalls	SQ

Explanatory Notes:

1. * Due to limitation on what phenomena ASOS software will accept.
2. A complete list of weather and obscuration elements is provided in Appendix E, METAR User Aids.
3. Augmented ASOS sites without ALDARS: Tornadic activity, thunderstorms, hail, volcanic ash, and virga elements are produced via augmentation, with all other elements above produced via backup.
4. Augmented AWOS sites without ALDARS: All the elements reported above are produced via augmentation.
5. Augmented ASOS or AWOS sites with ALDARS: Thunderstorm reporting is produced via backup if ALDARS should become inoperative, or is unrepresentative.
6. Present weather elements shall be reported in the body of the observation unless software precludes them from being reported in the body, then these elements shall be reported in the remarks portion of the METAR or SPECI.

Figure 6-6. Backup and Augmentation Weather and Obscurations

BACKUP REPORTING OF SKY CONDITION	
LOCATION/CONDITION	**REPORTING PROCEDURES**
ALL LOCATIONS WITH SURFACE-BASED OBSERVER PRESENT	
Sensor Failure	1. Observer reports manually observed sky condition to 12K feet, or as specified in the designated service level standard, whichever is greater; in body of report via designated procedures[1].
Non-representative Data	1. Observer may turn report processing off (ASOS) or set channel out of service (AWOS). 2. Observer reports sky condition as above for sensor failure.
OID/OT/communications failure	1. Observer reports system sky condition data in body of report via designated procedures.[1]
LAWRS TOWERS	
All conditions	1. Tower follows same procedures as above for observers.
NON-LAWRS TOWERS (WITHOUT A SURFACE-BASED OBSERVER)	
All conditions	1. No backup information provided
Footnote: 1. Designated procedures are specified in Figure 4-1. Make appropriate maintenance notification.	

Figure 6-7. Backup Reporting of Sky Condition

6-10. PROCEDURES FOR SKY CONDITION

General procedures for the reporting of backup weather information for sky condition are given in Figure 6-7, Backup Reporting of Sky Condition. More details on procedures for observing sky condition are included in Chapter 12, Sky Condition. If required, the following procedures for reporting sky condition shall apply:

a. Reporting Procedures.

(1) Report sky cover up to 12,000 feet, or as specified in the designated service level standard, whichever is greater. (See Appendix D, Service Standards.)

(2) Non-opaque cloud layers shall be treated as opaque and reported.

(3) No more than three layers shall be reported, and

(4) "**CLR**" (clear) shall be reported at an automated site when no clouds are visible up to 12,000 feet, or as specified in the designated service level standard, whichever is greater.

b. Sky Cover. Sky cover is any clouds or obscuring phenomena aloft detected from the observing location. It shall be evaluated with reference to the surface. All clouds or obscuring phenomena aloft shall be considered opaque sky cover.

c. Sky Condition Evaluation. Evaluation of sky condition shall include the amount and height of cloud bases up to 12,000 feet, or as specified in the designated service level standard, whichever is greater.

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

e. Vertical Visibility. Vertical visibility shall be either:

(1) The distance that an observer can see vertically into a surface-based obscuring phenomenon.

(2) The height corresponding to the top of a ceiling light projector beam.

(3) The height at which a balloon completely disappears during the presence of a surface-based obscuring phenomenon.

(4) The height determined by the sensor algorithm at an automated station.

f. Obscuration. The portion of sky (including higher clouds, the moon, or stars) hidden by weather phenomena either surface-based or aloft. At designated stations, obscurations are indicated in the remarks of the report.

g. Number of Layers Reported. Automated weather observing stations shall report no more than three layers of clouds or one layer for an obscuring phenomena. Manual weather observing stations shall report no more than six layers. If multiple cloud layers are observed below 12,000 feet, up to three layers shall be reported in accordance with the priorities in Figure 6-8, Priority for Reporting Cloud Layers.

Priority	Layer Description
1	lowest few layer
2	lowest broken layer
3	overcast layer
4	lowest scattered layer
5	second lowest scattered layer
6	second lowest broken layer
7	highest broken layer
8	highest scattered layer
9	second lowest few layer
10	highest few layer

Figure 6-8. Priority for Reporting Cloud Layers

h. Height of Layers. The height of a layer is the height of the cloud bases or obscurations of the layer being evaluated. Layers of clouds that are 50 feet or less above the surface shall be observed as layers with a height of zero (000). When the height of a ceiling layer increases and decreases rapidly by the amounts given in Figure 6-9, Criteria for Variable Ceiling, during the period of evaluation, it shall be considered variable and the ascribed height shall be the average of all the values. When the height of the ceiling layer is variable and the reported ceiling is below 3,000 feet, a remark shall be added, for example, CIG 010V016.

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

Figure 6-9. Criteria for Variable Ceiling

i. Height of Sky Cover. If available, a ceilometer or ceiling light, or known heights of unobscured portions of abrupt, isolated objects within 1 1/2 miles of the point of observation shall be used to measure the height of layers aloft or the vertical visibility into obscuring phenomena. Otherwise, an alternative method shall be used to estimate the height. The height may be estimated by using a ceiling balloon, pilot report, or observer experience (visual estimate).

j. Reportable Values for Sky Cover Height. Heights of layers shall be reported in hundreds of feet above the surface, rounded to the nearest reportable increment given in Figure 6-10, Increments of Reportable Values of Sky Cover Height. When a value falls halfway between two reportable increments, the lower value shall be reported. When a cloud is 50 feet or less above the surface, the height shall be reported as 000.

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

Figure 6-10. Increments of Reportable Values of Sky Cover Height

k. Layer Amounts. The amount of sky cover for each layer is the eighths of sky cover attributable to the clouds in the layer being evaluated. The report shall be based on each layer in combination with any lower layers. The amount of sky cover reported for each layer shall be based on the summation amount for that layer and shall be reported using the reportable values given in Figure 6-11, Reportable Contractions for Sky Cover Amount. The summation amount of sky cover for any given layer is the sum of the sky cover of the layer being evaluated, plus the sky cover of all lower layers. Portions of layers aloft detected through lower layers aloft shall not increase the summation amount of the higher layer. No layer can have a summation amount greater than 1.0 (8/8ths).

Reportable Value	Meaning	Summation Amount of Layer
VV	Vertical Visibility	8/8
CLR	Clear 12,000 Ft and Less	0
FEW[1]	Few	1/8 - 2/8
SCT	Scattered	3/8 - 4/8
BKN[2]	Broken	5/8 - 7/8
OVC	Overcast	8/8

Footnotes:
1. Any layer amount less than 1/8 is reported as FEW.
2. BKN includes sky cover from 5/8 up to, but not including, 8/8.

Figure 6-11. Reportable Contractions for Sky Cover Amount

6-11. PROCEDURES FOR TEMPERATURE AND DEW POINT

General procedures for the reporting of backup information for temperature and dew point are given in Figure 6-12, Backup Reporting of Temperature and Dew Point. If either the temperature module, dew point module, or both of the automated weather observing system are inoperative, both the temperature and dew point shall be reported from other equipment as specified in paragraph 6-4, Equipment Requirements.

a. Units of Measure. The units of measure for temperature and dew point are degrees Celsius. Dew point shall be calculated with respect to water at all temperatures.

b. Reporting Procedures for Temperature. The temperature shall be entered as two digits to the nearest whole degree Celsius. Sub-zero temperatures shall be prefixed with an **M** (minus). For example, a temperature of 4 degrees Celsius with a dew point of -2 degrees Celsius is coded as **04/M02**. See paragraph 3-9, Rounding Off Numbers, for rounding off procedures. A temperature of -0.5°C shall be reported as M00 to indicate that the actual temperature is below zero but rounded to zero.

c. Reporting Procedures for Dew Point. The dew point temperature shall be entered as two digits to the nearest whole degree Celsius. Sub-zero dew point temperatures shall be prefixed with an **M.** When the dry-bulb temperature is -34.4°C or below, the dew point shall be reported as unavailable. For example, when the temperature is -36, it will be reported as M36/.

BACKUP REPORTING OF TEMPERATURE AND DEW POINT	
LOCATION/CONDITION	**REPORTING PROCEDURES**
ALL LOCATIONS WITH SURFACE-BASED OBSERVER PRESENT	
Sensor Failure	1. Observer reports manually observed temperature[1] and dew point[1] in body of observation via designated procedures.[2]
Non-representative Data	1. Observer may turn report processing off (ASOS) or set channel out of service (AWOS). 2. Observer reports manually observed temperature and dew point as above for sensor failure.
OID/OT/communications failure	1. Observer reports system temperature and dew point in body of report via designated procedures.[2]
LAWRS TOWERS	
All Conditions	1. Tower follows same procedures as above for observers.
NON-LAWRS TOWERS (WITHOUT A SURFACE-BASED OBSERVER)	
All Conditions	1. No backup information provided.
Footnotes: 1. If either the temperature, the dew point or both are missing or non-representative, both the temperature and the dew point shall be manually provided. 2. Designated procedures are specified in Figure 4-1. Observer shall make appropriate maintenance notification.	

Figure 6-12. Backup Reporting of Temperature and Dew Point

6-12. PROCEDURES FOR ALTIMETER SETTING

General procedures for the reporting of backup information for altimeter setting are given in Figure 6-2, Backup Reporting of Wind or Altimeter Setting. The observer shall use any FAA installed and maintained altimeter setting indicator (ASI) or digital altimeter setting indicator (DASI), or any other altimeter setting source approved by the FAA that meets altimeter and comparison check requirements of the latest version of Order 7210.3, Facility Operation and Administration.

6-13. PROCEDURES FOR DOCUMENTATION

If the automated weather observing system is unable to document the observational data, the data shall be recorded on Meteorological Form 1M-10C (MF1M-10C). This only applies to a complete failure of the system. See Chapter 16, Entries on Observational Forms, for details.

6-14. PROCEDURES FOR COMMUNICATIONS

Each facility shall establish procedures for local distribution of backup weather data in the event that the automated weather observing system's local communications are out of service.

6-15. DISPOSITION OF MF1M-10C

MF1M-10C forms shall be handled in accordance with procedures specified in paragraph 3-10, Record Keeping and Forms.

6-16. EXAMPLES OF BACKUP OBSERVATIONS

Examples of backup weather observations for a typical condition (i.e., ceilometer and anemometer not operational) are given for AWOS and ASOS in Figure 6-13, AWOS Backup

Observation Examples, and Figure 6-14, ASOS Backup Observation Examples.

6-17. MALFUNCTIONS/OUTAGES

Automated weather observing systems have a self-monitoring capability. The systems will discontinue reporting the affected weather element when a given weather sensor is out of tolerance or fails. FAA personnel and NF-OBS providers shall make appropriate maintenance notifications in the event of any equipment outages. Information on the issuance of NOTAMs is contained in Order 7930.2.

AWOS observation with all sensors fully operational and no observer or augmenter on duty:
METAR JHW 011255Z AUTO 30005KT 7SM BKN110 06/03 A2991 RMK AO1 SLP101
AWOS observation with ceilometer and anemometer not operational and no backup observer on duty:
METAR JHW 011255Z AUTO 7SM 06/03 A2991 RMK AO1 SLP101
AWOS observation with ceilometer and anemometer not operational and with backup observer on duty:
METAR JHW 011255Z 30005KT 7SM BKN110 06/03 A2991 RMK AO1 SLP101

Figure 6-13. AWOS Backup Observation Examples

ASOS observation with all sensors fully operational and no observer or augmenter on duty:
METAR KIAD 011255Z AUTO 30005KT 7SM BKN110 06/03 A2991 RMK AO2 SLP101
ASOS observation with ceilometer and anemometer not operational and no backup observer on duty:
METAR KIAD 011255Z AUTO 7SM 06/03 RMK AO2 SLP101 $
ASOS observation with ceilometer and anemometer not operational and with backup observer on duty:
METAR KIAD 011255Z 30005KT 7SM BKN110 06/03 A2991 RMK AO2 SLP101 $

Figure 6-14. ASOS Backup Observation Examples

6-18. - 6-19. RESERVED

CHAPTER 7. GENERAL PROCEDURES FOR MANUAL OBSERVATIONS

7-1. INTRODUCTION

This chapter prescribes general procedures applicable to the taking of manual surface weather observations. These general procedures also apply to manual observations taken to fulfill requirements for augmentation or minimum operational requirements during backup. This chapter also describes the various types of manual surface observations and prescribes the criteria for taking SPECI observations. Chapters 8 through 17 prescribe procedures and practices to be followed by all personnel engaged in observing and reporting surface-based meteorological conditions. In addition to prescribing standard procedures and practices, these chapters also prescribe differences in procedures and practices applicable to LAWRS observers.

7-2. OBSERVATIONAL PROCEDURES

Procedures in the manual observation chapters of this order assume that METAR observations are taken hourly and that SPECI observations are made whenever significant changes to, or occurrences of, critical weather criteria are observed. Weather observations taken and recorded on Meteorological Form 1M-10C (MF1M-10C) by observers should reflect only those conditions seen or reliably reported from the usual point of observation and, unless otherwise specified, must have occurred within 15 minutes prior to the standard time of the observation.

7-3. DEFINITION OF ACTUAL TIME OF OBSERVATION

The actual time of observation is the time the last element of the observation is observed or evaluated. The actual time of a SPECI shall be the time the criteria for the SPECI were met or noted.

7-4. GENERAL PROCEDURES

All manual observations shall be taken, recorded and disseminated in accordance with the general procedures prescribed in Chapter 3, General Procedures, and with the general and specific procedures and practices prescribed in this and later chapters. Manual observations shall be recorded on MF1M-10C as specified in Chapter 16, Entries on Observational Forms.

7-5. OBSERVER RESPONSIBILITY

Observers shall be alert to situations conducive to significant changes in weather conditions and shall take and disseminate SPECI observations as rapidly as feasible whenever changes are noted that meet the criteria specified in paragraph 7-13, Criteria for SPECI Observations.

7-6. WEATHER WATCH

Observers shall monitor weather conditions via a weather watch. Two types of weather watch are possible, a Basic Weather Watch and a Continuous Weather Watch. Except where specifically indicated otherwise throughout this order, all FAA, FAA-contract and NF-OBS observers including LAWRS shall monitor weather conditions via a Basic Weather Watch as described in paragraph 7-7, Basic Weather Watch.

7-7. BASIC WEATHER WATCH

During a Basic Weather Watch, the observer may be required to perform other duties as their observing workload permits. Because of this and other restrictions (station location, structural design, etc.) that may limit the observer's capability to continuously view and evaluate weather conditions, observers performing a Basic Weather Watch cannot be expected to detect and report all weather changes as they occur. In

addition to taking and disseminating required observations, facilities performing a Basic Weather Watch shall recheck weather conditions to determine if a new observation (SPECI) is required when advised by any reliable source (e.g., tower controller) that existing conditions differ from those reported in the last disseminated observation.

7-8. CONTINUOUS WEATHER WATCH

At facilities performing a Continuous Weather Watch, the observer shall monitor weather conditions on a continuous basis. In addition to METAR observations, observers shall take and disseminate observations as conditions meeting criteria for SPECI observations occur.

7-9. TYPES OF MANUAL SURFACE OBSERVATIONS

There are two major categories of manual surface observations: Synoptic observations and METAR observations. Synoptic observations are used primarily in weather analysis and prediction. They are not required at any FAA, FAA-contract or NF-OBS facility including LAWRS. METAR and SPECI observations are discussed in paragraphs 7-10 and 7-11.

7-10. AVIATION ROUTINE WEATHER REPORTS (METAR)

The METAR is the primary observation code used in the United States to satisfy requirements for reporting surface meteorological data. It contains a report of wind, visibility, RVR (at designated sites), weather, sky condition, temperature, dew point, and altimeter setting (collectively referred to as "the body of the report"). In addition, coded plain language information that elaborates on the data in the body of the report may be appended to the METAR or SPECI. This significant information is referred to as “remarks”. At designated stations, the METAR may be abridged to include one or more of the above elements. The contents of METAR observations are given in Figure 7-1, Content of METAR (Manual/Automated). METAR observations that also meet the criteria for a SPECI observation are called METAR observations.

7-11. AVIATION SELECTED SPECIAL WEATHER REPORTS (SPECI)

A SPECI observation is an unscheduled observation taken when any of the criteria given in paragraph 7-13, Criteria for SPECI Observations, have been observed. A SPECI observation shall contain the elements in a METAR, plus additional coded or plain language information that elaborates on the data in the body of the report (see Figure 7-1). The SPECI criteria are applicable only to stations that have the capability of evaluating the event. All SPECI shall be taken as soon as possible after relevant criteria are observed.

7-12. SPECI OBSERVATIONS UPON RESUMPTION OF OBSERVING FUNCTION

Observers shall take, record, and disseminate a SPECI observation within 15 minutes after returning to duty following a break in normally scheduled observer coverage at the station unless a METAR observation is filed during that 15-minute period.

7-13. CRITERIA FOR SPECI OBSERVATIONS

The observer shall take, record and disseminate a SPECI observation when any of the following is observed to occur:

a. Wind Shift. Wind direction changes by 45 degrees or more in less than 15 minutes and the wind speed is 10 knots or more throughout the wind shift.

b. Visibility. 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 mile

(4) The lowest standard instrument approach procedure minimum as published in the National Ocean Service (NOS) U.S. Terminal Procedures. If none published, use 1/2 mile.

c. Runway Visual Range. (NA LAWRS) The highest value from the designated RVR runway decreases to less than, or if below, increases to equal or exceed 2,400 feet during the preceding 10 minutes.

d. Tornado, Funnel Cloud, or Waterspout.

(1) Is observed

(2) Disappears from sight or ends

e. Thunderstorm.

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

(2) Ends

f. Precipitation.

(1) Hail begins or ends

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

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

g. Squall. Wind speed suddenly increases by at least 16 knots and is sustained at 22 knots or more for at least one minute.

h. Ceiling. The height of the base of clouds covering five eighths or more (e.g., broken and overcast) of the sky 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) The lowest standard instrument approach procedure minimum as published in the National Ocean Service (NOS) U.S. Terminal Procedures. If none published, use 200 feet.

i. Sky Condition. A layer of clouds or obscuring phenomenon aloft is present below 1,000 feet and no layer aloft was reported below 1,000 feet in the preceding METAR or SPECI observation.

j. Volcanic Eruption. When eruption is first noted.

k. Aircraft Mishap. Upon notification of an aircraft mishap, unless there has been an intervening observation.

l. Miscellaneous. Any other meteorological situation that, in the opinion of the observer, is critical.

7-14. CONTENT OF METAR/SPECI OBSERVATIONS

Figure 7-1, Content of METAR (Manual/Automated), lists the contents of METAR observations. The first column of the figure lists the elements of the observation both for the body of the report and the remarks section. The second column lists a reference to the section in Chapter 15 that discusses coding of the particular element. The third column presents a brief description of the element. The fourth column indicates whether the element is reported in METAR observations, and the fifth column indicates whether the element is reported in SPECI observations. Note: An entry in column 5 does not mean that the element is a criterion for taking a SPECI observation. It means that if a SPECI is required in accordance with the SPECI criteria listed in paragraph 7-13, then the element listed in Figure 7-1 is included in the SPECI observation. Figure 7-1 lists the transmission requirements for other coded remarks and additive data. In the following figures, a blank space indicates an item that is not required by the FAA, a "D" indicates an element is reported at designated facilities only, and an "X" indicates the element is reported if the site has the capability to do so.

Body of METAR - Consists of 11 Elements				
Element	Paragraph	Brief Description	METAR	SPECI
Type of Report (METAR/SPECI)	15-7	METAR is the routine (scheduled) report. SPECI is the non-routine (unscheduled) weather report.	X	X
Station Identifier (CCCC)	15-8	ICAO station identifier. Consists of four alphabetic characters, e.g., KABC.	X	X
Date/Time (YYGGggZ)	15-9	Day of the month, followed by the actual time of the report or when the criteria for a SPECI is met or noted. Group ends with Z to indicate UTC. For example, 251456Z.	X	X
Report Modifier (AUTO or COR)	15-10	AUTO indicates a fully auto-mated report. If not automated report, this field is blank.	X	X
		COR indicates the report is a correction of a previously issued METAR or SPECI.	X	X
Wind (dddff(f)G$f_m f_m f_m$KT) ($d_n d_n d_n V d_x d_x d_x$)	15-11	True wind direction in tens of degrees using three digits. Speed reported in whole knots (two or three digits). Gusts (G) appended to the speed if observed. Group ends with KT, e.g., 23018G26KT. If wind direction varies by 60° or more and speed is >6 knots, a variable wind group may also be reported, e.g., 180V250. Direction may be reported VRB (variable) if speed is ≤6 knots, e.g., VRB05KT. Calm winds are coded 00000KT.	X	X
Visibility (VVVVVSM)	15-12	Prevailing visibility in statute miles. A space divides whole miles and fractions. Ends with SM: 1 1/2SM. AUTO: M pref. means "less than": M1/4SM.	X	X
Runway Visual Range ($RD_R D_R/V_R V_R V_R V_R$FT or $RD_R D_R/V_N V_N V_N V_N VV_X V_X V_X V_X$FT)	15-13	At designated stations, 10-minute RVR value: Reported in hundreds of feet if visibility is ≤ one statute mile or RVR is ≤ 6000 feet. Group ends with FT to indicate feet, e.g., R06L/2000FT. Prefixed with either M or P indicates the value is lower or higher than the RVR reportable values, e.g., R06L/P6000FT. If variable during the evaluation period, the variability is reported, e.g., R06L/2000V4000FT.	D	D

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
Present Weather (w'w')	15-14	Weather phenomena (other than obscurations) occurring at the station are reported in the body of the report. Weather obscurations are generally reported if visibility < 7 miles (see 15-14 for exceptions). Volcanic ash reported with any visibility. Reported in order of decreasing predominance. Maximum of three groups reported (pcpn included in one group; separate groups for other phenomena).	X	X
Sky Condition ($N_sN_sN_sh_sh_sh_s$ or $VVh_sh_sh_s$ or CLR or SKC)	15-15	Automated stations report to three layers up to 12,000 feet; if no layers are detected, CLR is reported. At manual stations up to six layers may be reported; if no layers observed, SKC is reported. Each layer contains the amount (FEW, SCT, BKN, OVC) immediately followed by the height using three digits, e.g., FEW015, BKN030. A layer containing CB or TCU is indicated by appending the contraction to the layer height, e.g., FEW015TCU. All layers are considered opaque. Vertical Visibility (VV) is reported in hundreds of feet for a total obscuration (indefinite ceiling), e.g., VV002. Surface-based obscuration (manual only) reported using amount (FEW, SCT, BKN) followed by "000", e.g., SCT000; remark reported as "FG SCT000."	X	X
Temperature/Dew Point ($T'T'/T'_dT'_d$)	15-16	Temperature and dew point are reported to the nearest whole degree Celsius using two digits, e.g., 17/13. Sub-zero values are prefixed with an M, e.g., 03/M02.	X	X
Altimeter ($AP_HP_HP_HP_H$)	15-17	Altimeter is prefixed with an A indicating altimeter in inches of mercury. Reported using four digits; tens, units, tenths, and hundreths of inches of mercury, e.g., A2990.	X	X

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Remarks Section of Observation - Consists of 2 Groups of Remarks				
Group 1 - Automated, Manual, and Plain Language				
Element	Paragraph	Brief Description	METAR	SPECI
Volcanic Eruptions	15-20	Volcanic eruptions shall be reported whenever first noted. Pre-eruption activity shall not be reported. (Use PIREPs to report pre-eruption activity.) Encode volcanic eruptions as described in Chapter 11.	X	X
Tornadic Activity (Manual and Augmented Auto) (Tornadic activity_B/E(hh)mm LOC/DIR_(MOV))	15-21	Whenever tornadoes, funnel clouds, or waterspouts begin, are in progress, end, or disappear from sight, the event should be described directly after the "RMK" element. This remark shall give, insofar as known, the phenomena, time, location and direction from the station, and direction of movement. The time the tornadic activity began shall be reported and prefixed with a "B"; the time the tornadic activity ended or disappeared from sight shall be reported and prefixed with an "E", e.g., TORNADO B13 DSNT NE.	X	X
Type of Automated Station (AO1, AO2)	15-22	This remark identifies the type of automated station. It shall be included in all reports from automated stations. AO1 identifies an automated station without a precipitation discriminator; AO2 identifies an automated station with a precipitation discriminator. The absence of the remark indicates a manual station.	X	X
Peak Wind (PK WND dddff(f)/(hh)mm) (NA LAWRS)	15-23	At designated stations, when the peak wind exceeds 25 knots, the remark shall be included in the next METAR report. ddd is the direction of the peak wind, ff(f) is the peak wind speed since the last METAR report, and (hh)mm is the time of occurrence (with only the minutes reported if the hour can be inferred from the report time), e.g., PK WND 28045/15.	D	

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
Wind Shift (WSHFT_(hh)mm)	15-24	At designated stations, when a wind shift occurs, WSHFT followed by a space and the time the wind shift began shall be reported (with only the minutes reported 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 frontal passage, e.g., WSHFT 30 FROPA.	D	D
Tower or Surface Visibility (TWR VIS) (SFC VIS)	9-3 15-25	If tower visibility or surface visibility is carried in the remarks, use the appropriate set of values and precede the visibility with the appropriate identifier, TWR VIS or SFC VIS, e.g., TWR VIS 1.	D	D
Variable Prevailing Visibility (VIS minVmax)	15-26	Whenever the prevailing visibility is less than 3 statute miles and is variable, this remark shall be entered where min is the lowest visibility evaluated and max is the highest visibility evaluated, e.g., VIS 1/2V2.	X	X
Sector Visibility (VIS_ dd_vv)	15-27	Sector visibility shall be reported 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 or considered to be operationally significant. In the remark, dd defines the sector to 8 points of the compass and vv is the sector visibility in SM, e.g., VIS N 2.	X	X
Visibility at Second Location (VIS vv location) (NA LAWRS)	15-28	When an automated station uses meteorological discontinuity sensors, remarks shall be added to identify site specific visibilities which differ from conditions reported in the body of the report. vv is the visibility value measured at the secondary location. This remark shall only be generated when the condition is lower than that contained in the body of the report.	D	D

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
Lightning (Frequency_LTG(type)_ [LOC])	15-29	When lightning is observed at a staffed site, the frequency and location shall be reported, along with the type of lightning, e.g., OCNL LTG AT AP, FRQ LTGCG VC. When lightning is detected by an automated system within 5NM of the ARP, it is reported as "TS" in the body of the report with no remark; within 5-10NM of the ARP, it shall be reported as "VCTS" in the body of the report with no remark; and lightning beyond 10NM from the ARP is reported in remarks as "LTG DSNT" followed by direction from the ARP, e.g., LTG DSNT NE.	X	X
Beginning/ Ending Time of Precipitation (WX)B(mm)E(mm) (NA LAWRS)	15-30	At designated stations, when precipitation begins or ends, the next METAR report shall include the type of phenomena, the beginning and/or ending time (prefixed with a B and/or E). If the beginning or ending of the precipitation type (hail, freezing precipitation, or ice pellets) initiated the SPECI report, then that SPECI report shall include the type of phenomena, the beginning and/or ending time, and should be reported in the next METAR report, also.	X	X
Beginning/ Ending Time of Thunderstorms (TS)B(mm)E(mm)	15-31	At designated stations, when thunderstorms begin or end, the SPECI report shall include the type of phenomena, the beginning and/or ending time (prefixed with a B and/or E), and should also be reported in the next METAR report, e.g., TSB05E45	D	D
Thunderstorm Location (TS_LOC_(MOV_DIR))	15-32	At designated stations, thunderstorm location and movement shall be encoded. For example, TS SE MOV NE.	D	D

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
HAILSTONE SIZE (GR_ {INCHES})	15-33	At designated stations, the size of the largest hailstone shall be coded in 1/4 inch increments, identified with the contraction GR. (If GS is encoded in the body of the report, no size remark is required.)	D	D
Virga (VIRGA_{Direction})	15-34	When precipitation is observed to be falling from clouds but is not reaching the ground because of evaporation, report VIRGA; the direction from the station is optional, e.g., VIRGA or VIRGA SW.	X	X
Variable Ceiling Height (CIG minVmax)	15-35	Whenever the ceiling is below 3,000 feet and is variable, enter min as the lowest ceiling height evaluated and max as the highest ceiling height evaluated, e.g., CIG 005V010.	X	X
Obscurations ($w'w'$_($N_sN_sN_s$) $h_sh_sh_s$)	15-36	When the sky condition contains an obscuration either at the surface or aloft, other than clouds, the type of phenomena in the layer, plus the sky cover at the layer and the height shall be reported in remarks, e.g., FG SCT000 or FU BKN015.	X	X
Variable Sky Condition ($N_sN_sN_s(h_sh_sh_s)$_V_$N_sN_sN_s$)	15-37	This remark shall identify the layer that is varying and indicate the range of variability. If there are several layers of the same coverage, the variable layer shall be identified by including the layer height.	X	X

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
Significant Cloud Types	15-38	When observed, the following clouds are reported in remarks: 1.) Cumulonimbus (CB) or Cumulonimbus Mammatus (CBMAM), distance, direction from the station, direction of movement, e.g., CB W MOV E, CB DSNT W. 2.) Towering Cumulus (TCU), distance, and direction from the station, e.g., TCU W. 3.) Altocumulus Castellanus (ACC), direction from station, e.g., ACC NW. 4.) Standing Lenticular (stratocumulus SCSL; alto-cumulus ACSL, or cirrocumulus CCSL) or rotor clouds, direction from the station, e.g., ACSL SW-W, APRNT ROTOR CLD NE, CCSL S. Cumulonimbus of any kind and towering cumulus are also identified in the body of the report.	X	X
Ceiling Height at Second Location (CIG_ {height}_ {LOC}) (NA LAWRS)	15-39	When an automated station uses meteorological discontinuity sensors, remarks shall be added to identify site specific sky conditions which differ from conditions reported in the body of the report. This remark shall only be generated when the ceiling is lower than that contained in the body of the report. For example, CIG_002_RY11.	D	D
Pressure Rising or Falling Rapidly (PRESRR) (PRESFR) (NA LAWRS)	15-40	When the pressure is rising or falling rapidly at the time of the observation, the remark Pressure Rising Rapidly (PRESRR) or Pressure Falling Rapidly (PRESFR) shall be included.	X	
Sea-Level Pressure (SLPppp) (SLPNO) (NA LAWRS)	15-41	At designated stations, this remark begins with SLP and is coded using the tens, units, and tenths of sea-level pressure in hectopascals, e.g., SLP982. If sea-level pressure would normally be reported, but is not available, the remark is coded SLPNO.	D	

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
Aircraft Mishap (ACFT_ MSHP)	15-42	If a report was taken to document weather conditions when notified of an aircraft mishap, the remark ACFT MSHP is included in the report, but is not transmitted. This is indicated by putting the remark in parenthesis in the record.	X	X
No SPECI Reports Taken (NOSPECI)	15-43	At staffed stations where SPECI reports are not taken, the remark NOSPECI shall indicate that no changes in weather conditions will be reported until the next METAR report.	D	
Snow Increasing Rapidly (SNINCR_(ii)/(ii)) (NA LAWRS)	15-44	Report SNINCR if snow depth increases by 1 inch or more in the past hour, followed by amounts. The remark SNINCR is followed by the depth of increase in the last hour, a solidus, and the total depth of snow on the ground at the time of the report. For example, a snow depth increase of 2 inches in the past hour with a total depth on the ground of 10 inches would be coded "SNINCR 2/10."	D	
Other Significant Information (Plain Language)	15-45	Other significant information important to operations, such as information on fog dispersal operations, runway conditions, or "Last" report from location, etc.	X	X

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Group 2-Additive and Automated Maintenance Data				
Element	Paragraph	Brief Description	METAR	SPECI
Hourly Precipitation Amount (Prrrr) (NA LAWRS)	15-47	At designated automated stations, this remark is included in METAR reports for the water equivalent of all precipitation that has occurred since the last METAR coded in hundredths of an inch, e.g., P0009 indicates 9/100ths of an inch of precipitation in the past hour.	D	
1-, 3- and 6-Hourly Ice Accretion Amount, I1nnn, I3nnn, I6nnn (NA LAWRS)	15-48	At automated stations with a freezing rain sensor, this remark is included in METAR/SPECI reports for the ice accretion amount that has occurred in hundredths of an inch during the last 1-hour (I1nnn), 3-hour (I3nnn), and 6-hour (I6nnn) period. No manual backup is required.	D	D
3- and 6-Hourly Precipitation Amount, 6RRRR/ (NA LAWRS)	15-49	At designated stations, this remark is included in 3- and 6-hourly observation; encoded in inches, using tenths, and hundredths, of the amt. 2.17 inches of precipitation would be encoded 60217. When an indeterminable amount of precipitation has occurred, the 6RRRR group shall be coded 6////. Note: ASOS automatically reports this data.	D	
24-Hour Precipitation, $7R_{24}R_{24}R_{24}R_{24}$ (NA LAWRS)	15-50	At designated stations, included in 1200 UTC observation if more than a trace of precipitation has fallen in past 24 hours, coded using the tens, units, tenths, and hundredths of inches, e.g., 1.25 inches would be coded 70125.	D	
Depth of Snow on the Ground, 4/sss (NA LAWRS)	15-51	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. For example, a snow depth of 21 inches would be coded as "4/021."	D	

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
Water Equivalent of Snow on Ground (933RRR) (NA LAWRS)	15-52	At designated stations, this group reported in 1800UTC report if average snow depth is 2 inches or more. 933 is the code indicator for water equivalent of snow on ground. RRR represents the water equivalent of snow on the ground reported in tens, units and tenths of inches using 3 digits, e.g., water equivalent of 3.6 inches would be 933036.	D	
Cloud Types ($8/C_LC_MC_H$) (NA LAWRS)	15-53	This group shall be reported in 3 and 6-hourly reports at designated stations when clouds are observed.	D	
Duration of Sunshine (98mmm) (NA LAWRS)	15-54	At designated stations, this group is reported in the 0800UTC report. 98 is the code group indicator and mmm represents the total minutes of sunshine using the hundreds, tens and units digits, e.g., 96 minutes of sunshine would be coded 98096.	D	
Hourly Temperature and Dew Point $Ts_nT'T'T's_nT'_dT'_dT'_d$ (NA LAWRS)	15-55	At designated stations, this element is used to report temperature and dew point to the tenth of a degree Celsius. T identifies the group, the s_n the sign of the temperature - coded as 1 if the value is below 0 degrees Celsius and 0 if the value is 0 degrees Celsius or higher. $T_aT_aT_a$ is the temperature in tens, units, and tenths of degrees and $T'_aT'_aT'_a$ is the dew point in tens, units and tenths of degrees, e.g., a temperature of 2.6 and dew point of -1.5 would be coded in the body as 03/M01 and in remarks as T00261015. If the dew point is missing, report the temperature, if the temperature is missing, do not report either.	D	

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
6-Hour Maximum Temperature, $1s_nT_xT_xT_x$ (NA LAWRS)	15-56	At designated stations, report the maximum temperature in past 6-hours in tenths of degrees Celsius using 3 digits, where the 1 identifies the maximum temperature group, the s_n the sign of the temperature - coded as 1 if the value is below 0 degrees Celsius and 0 if the value is 0 degrees Celsius or higher. The $T_xT_xT_x$ shall be the maximum temperature during the last 6 hours, e.g., a temperature of 1.0 degrees Celsius shall be coded as 10010, a maximum temperature of -2.1 degrees Celsius shall be coded 11021.	D	
6 Hour Minimum Temperature, $2s_nT_nT_nT_n$ (NA LAWRS)	15-57	At designated stations, report the minimum temperature in past 6-hours in tenths of degrees Celsius using 3 digits where the 2 identifies the minimum temperature group, the s_n the sign of the temperature - coded as 1 if the value is below 0 degrees Celsius and 0 if the value is 0 degrees Celsius or higher. The $T_nT_nT_n$ shall be the minimum temperature during the last 6 hours, e.g., a temperature of -2.1 degrees Celsius shall be coded as 21021, a minimum temperature of 1.2 degrees Celsius shall be coded 20012.	D	
24-Hour Maximum and Minimum Temperature, $4s_nT_xT_xT_xs_nT_nT_nT_n$ (NA LAWRS)	15-58	At designated stations, reported at midnight (LST); the maximum and minimum temperatures for the day coded in tenths of degrees Celsius using 3 digits where the 4 identifies the maximum/minimum temperature group, the s_n the sign of the temperature - coded as 1 if the value is below 0 degrees Celsius and 0 if the value is 0 degrees Celsius or higher. For example, a 24-hour maximum temperature of 10.0 degrees Celsius and a 24-hour minimum temperature of -1.5 degrees Celsius shall be coded 401001015.	D	

Figure 7-1. Content of METAR (Manual/Automated) ***(continued on next page)***

Element	Paragraph	Brief Description	METAR	SPECI
Pressure Tendency, 5appp (NA LAWRS)	15-59	At designated stations, include in 3- and 6-hourly observations where the 5 identifies the pressure tendency group, the a represents the character of pressure change over the past 3 hours, and ppp is the change in pressure in the past 3 hours. the ppp shall be coded based on the absolute value of the change of either the station pressure or the altimeter in the past 3 hours coded in tenths of hectopascals and using the tens, units, and tenths digits, e.g., a steady increase of 3.2 hectopascals in the past 3 hours would be coded 52032.	D	
Sensor Status Indicators	15-60	At designated stations: When automated stations are equipped with a precipitation identifier and that sensor is not working, the remark PWINO is included. When the tipping bucket rain guage is not operating at an automated station equipped with the device, PNO is included in remarks. When automated stations are equipped with a Freezing Rain Sensor and it is not working, the remark FZRANO is included. When automated stations are equipped with a lightning detection system and that sensor is not working, the remark TSNO is included. At an automated station, when the secondary visibility sensor is not working, VISNO_(LOC) is included, and when the cloud height indicator is not working CHINO_(LOC) is included.	D	
Maintenance Indicator	15-61	A maintenance indicator sign, $, is included when an automated system detects that maintenance is needed on the system.	D	D

Figure 7-1. Content of METAR (Manual/Automated) ***(concluded from previous page)***

7-15. - 7-16. RESERVED

CHAPTER 8. WIND

8-1. INTRODUCTION

Wind is measured in terms of velocity, a vector that includes direction and speed. The absence of apparent motion of the air is termed CALM. The direction and speed of the wind should be measured in an unsheltered, unobstructed area. This will avoid, to a large degree, the measuring of wind directions and speeds disturbed by local obstructions and will result in the reporting of winds more representative of the general weather patterns and more representative for aircraft operations.

8-2. DEFINITIONS

a. Wind. As used in this chapter, wind is the horizontal motion of the air past a given point.

b. Direction of Wind. Wind direction is defined as the direction, in tens of degrees, from which the wind is blowing.

c. Speed of Wind. Wind speed is the rate of horizontal flow of air past a given point, measured in knots.

d. Gust. A gust is a rapid fluctuation in wind speed with a variation of 10 knots or more between peaks and lulls. The wind speed data for the most recent 10 minutes shall be examined to evaluate the occurrence of gusts.

e. Magnetic Variation. Magnetic variation is the difference in degrees 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.

f. Hourly Peak Wind Speed. Peak wind is the highest instantaneous wind speed over 25 knots, recorded since the last METAR report.

g. Variable Wind Direction. Wind direction is considered to be variable when, during the 2-minute evaluation period, it fluctuates by 60 degrees or more and the wind speed is more than 6 knots. The wind direction may also be considered variable if, during the 2-minute evaluation period, the wind speed is 6 knots or less.

h. Wind Shift. Wind shift is 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. OBSERVING, DETERMINING, AND REPORTING PROCEDURES

Wind direction, speed, and gusts shall be determined at all stations. All other wind-related parameters shall be determined at designated stations.

8-4. WIND DIRECTION

The observer shall determine the wind direction by averaging the observed direction over a 2-minute interval when direct-reading dials or recorders are used. Wind direction shall be reported in all observations. In all observations transmitted long-line, direction shall be reported in tens of degrees with reference to true north. The format for reporting wind direction in such observations is given in paragraph 15-11, Wind Group. For local use, wind direction shall be reported in tens of degrees with reference to

magnetic north. (Note: Local displays of wind direction are always in reference to magnetic north. Direction must be converted to true for observational purposes.)

8-5. ESTIMATING WIND DIRECTION

At facilities where instruments are not available for determining wind direction, the observer shall 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, the observer shall note that even small obstacles may cause variations in the wind direction. The observer shall not use the movement of clouds, regardless of how low the clouds are, in estimating the surface wind direction.

8-6. VARIABLE WIND DIRECTION

The wind direction may be considered variable if, during the 2-minute evaluation period, the wind speed is 6 knots or less. Also, the wind direction shall be considered variable if, during the 2-minute evaluation period, it varies by 60 degrees or more when the average wind speed is greater than 6 knots. The format for reporting variable wind direction is given in paragraph 15-11b, Variable Wind Direction (Speeds 6 Knots or Less), and paragraph 15-11c, Variable Wind Direction (Speeds Greater than 6 Knots) .

8-7. 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 15 minutes with sustained wind speeds of 10 knots or more. Wind shifts are normally associated with some or all of the following phenomena characteristic of a cold-front passage. 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 rain or snow showers

A SPECI shall be taken after a wind shift occurs. A remark reporting the wind shift, and the time the wind shift occurred, shall be included in the observation. A wind shift shall always be reported when it is observed. When the shift is believed to be associated with a frontal passage, the observer shall report **FROPA** in the remarks section immediately after the shift begins. When a SPECI report containing a wind shift is not given long-line dissemination, the observer shall include the wind shift data in the remarks section of the next transmitted report. The format for the remark is given in paragraph 15-24, Wind Shift.

8-8. WIND SPEED

If possible, the average wind speed should not be determined during a peak or a lull in gusty winds or squalls. The wind speed shall be determined by averaging the speed to the nearest knot over a 2-minute period. Where direct-reading dials or recorders are used, the observer shall determine the speed by averaging the observed values and applying the appropriate correction from Figure 8-1, Corrections to Indicated Wind Speeds, to the wind speed obtained from direct-reading dials or recorders. Wind speed shall be reported in all observations and shall always be reported in

knots. The format for reporting wind speed is given in paragraph 15-11, Wind Group.

8-9. ESTIMATING WIND SPEED

The observer shall use the Beaufort scale, Figure 8-2, Estimating Wind Speed, to estimate wind speeds if instruments are out of service.

CORRECTIONS TO INDICATED WIND SPEEDS		
Type of Indicator	Uncorrected Speed (MPH or KNOTS)	Correction (MPH or KNOTS)[1]
F420	2.5 to 75 5.0 to 150 (double range)	0 −3
F420A, B, C or D	2.0 to 75 4.0 to 150 (double range)	0 −2
[1] - As appropriate to the calibration of the instrument used.		

Figure 8-1. Corrections to Indicated Wind Speeds

WIND EQUIVALENT -- BEAUFORT SCALE	
KTS	Specifications
<1	Calm; smoke rises vertically
1-3	Direction of wind shown by smoke drift not by wind vanes
4-6	Wind felt on face; leaves rustle; vanes moved by wind
7-10	Leaves and small twigs in constant motion; wind extends light flag
11-16	Raises dust, loose paper; small branches moved
17-21	Small trees in leaf begin to sway; crested wavelets form on inland waters
22-27	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty
28-33	Whole trees in motion; inconvenience felt walking against the wind
34-40	Breaks twigs off trees; impedes progress
41-47	Slight structural damage occurs
48-55	Trees uprooted; considerable damage occurs
56-71	Widespread damage

Figure 8-2. Estimating Wind Speed

8-10. WIND CHARACTER (GUSTS)

The existence of gusts can be determined easily by examining the wind recorder. They will be indicated by fluctuations of the speed by varying distances between mile marks on the recorder. The speed of a gust shall be the maximum instantaneous wind speed recorded during the most recent 10 minutes of observation time. If a recorder is not available, wind character may be determined from direct-reading dials. When a gust is detected within 10 minutes prior to an observation, the character of the wind shall be reported in the body of the observation. The format for reporting wind character is given in paragraph 15-11a, Gust.

8-11. PEAK WIND SPEED

The peak wind speed shall be the highest instantaneous speed, greater than 25 knots, observed or recorded since the last routine METAR report. The observer shall determine peak wind data for entry in the remarks section of surface observations.

a. Peak wind data shall be determined at designated stations with wind speed recorders or by direct observation. If the wind speed record 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.

b. Peak wind data shall be reported in the remarks section of the next routine METAR report whenever the peak wind speed exceeds 25 knots. The format for the remark is given in paragraph 15-23, Peak Wind.

8-12. CALM WIND

When no motion of the air is detected, the wind shall be reported as calm; i.e., the direction and speed shall be reported as 00000KT. The format for reporting calm winds is given in paragraph 15-11d, Calm Wind.

8-13. CONVERSION OF TRUE AND MAGNETIC WINDS

To convert wind direction from degrees with respect to true north to degrees with respect to magnetic north, or vice versa, the observer shall obtain the local magnetic 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

For example, at ABC Airport, the magnetic variation is 10º West. The local wind indicator is reading 250º (magnetic). When transmitting the wind direction in an observation, because the magnetic variation is 10º West, the observer should subtract 10º to transmit a direction of 240º (true).

(Note: Local displays of wind direction are always in reference to magnetic north. Automated weather observing systems also show direction with respect to magnetic north locally

(when the AUX/WX page is displayed), but adjust wind direction to "true" for transmission.)

8-14. INSTRUMENTAL EVALUATION PROCEDURES

a. Priority of Instruments. At facilities having several types of wind equipment, the observer shall use the following priority in selecting the wind equipment to be used.

(1) Direct-reading recorders

(2) Direct-reading dials

(3) Other

b. Determination of Direct-Reading Dial Indicators or Recorders. Values reported for the speed of a gust shall be the speeds indicated by recorders with the correction applied from Figure 8-1, Corrections to Indicated Wind Speeds. Direct-reading dials or estimation shall be used for determining gusts if a recorder is not available.

8-15. RECORDER ADJUSTMENTS

When a wind recorder becomes more than 5 minutes in error, the observer shall adjust the chart to the correct time and indicate the adjustment with an arrow and the date and time of adjustment.

8-16. ANNOTATION OF WIND RECORDER CHARTS

The observer shall annotate wind recorder charts as follows:

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

(1) The station type (LAWRS, FSS, etc.) and name

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

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

b. Enter other identification as necessary, e.g., when providing the chart for use in special studies or an aircraft accident investigation, enter the station name at the end of the roll and include the runway number to distinguish between chart rolls where multiple recorders are in use.

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

d. 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.

e. 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.

8-17. CHANGING CHARTS

The observer shall change charts at 0000 LST on the first day of each month and at intermediate times, as necessary, to prevent loss of record.

8-18. DISPOSITION

The observer shall replace charts in their original carton, if available, and enter station type, name, and period of record on the end of the carton. Completed charts shall be forwarded to NCDC along with the MF1M-10Cs for the month.

8-19. CONVERSION OF WIND SPEED

Whenever conversion of wind speed from miles per hour to knots is required, the observer shall use the values given in Figure 8-3, Conversion of Miles per Hour to Knots. Whenever conversion of wind speed from knots to miles per hour is required, the observer shall use the values given in Figure 8-4, Conversion of Knots to Miles per Hour. **NOTE:** No other tables may be used in lieu of tables in Figures 8-3 and 8-4, below.

8-20. OPERATION OF EQUIPMENT

Practices and procedures for the operation of wind instruments and related equipment are presented in paragraph 17-91, Wind Retransmitter - Weekly Check, and paragraph 17-92, Wind Retransmitter - Other Checks.

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 figure is not reversible. Use figure 8-4 to convert knots to miles per hour.

Figure 8-3. Conversion of 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 figure is not reversible. Use figure 8-3 to convert miles per hour to knots.

Figure 8-4. Conversion of Knots to Miles per Hour

CHAPTER 9. VISIBILITY

9-1. INTRODUCTION

This chapter presents procedures and practices for measuring and recording visibility. All visibilities referred to in this chapter are horizontal visibilities. An automated instrumentally-derived visibility value is a sensor value converted to an appropriate visibility value using standard algorithms and is considered to be representative of the visibility in the vicinity of the airport runway complex. A manually-observed visibility value is obtained using the "prevailing visibility" concept.

9-2. DEFINITIONS

a. Visibility. Visibility is a measure of the horizontal opacity of the atmosphere at the point of observation and is expressed in terms of the horizontal distance at which a person should be able to see and identify specific objects.

b. Prevailing Visibility. Prevailing visibility is the greatest visibility equaled or exceeded throughout at least half the horizon circle, which does not necessarily have to be continuous. This is the visibility that is considered representative of visibility conditions at the station.

c. Surface Visibility. The prevailing visibility determined from the usual point of observation is the surface visibility.

d. Tower Visibility. Tower visibility is the prevailing visibility determined from the airport traffic control tower at locations that also report the surface visibility.

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

f. Variable Prevailing Visibility. Variable prevailing visibility is a condition where the prevailing visibility is less than 3 miles and rapidly increases and decreases by 1/2 statute mile or more during the period of observation.

g. Visibility Markers. Visibility markers are dark or nearly dark objects viewed against the horizon sky during the day, or unfocused lights of moderate intensity (about 25 candela) during the night.

9-3. 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 "usual point of observation" and that visibility shall be reported as the surface/prevailing visibility. If visibility observations are made from both levels, the lower value (if less than 4 miles) shall be reported as prevailing visibility in the body of the METAR, and the other value shall be a remark.

9-4. UNIT OF MEASURE

Visibility shall be reported in statute miles or fractions thereof. See Figure 9-1, Reportable Visibility Values.

9-5. OBSERVING AIDS FOR VISIBILITY

Charts, lists, or other positive means of identifying lights or objects used as visibility markers shall be posted near the observer's position. At local direction, separate lists or charts can be used for daytime and nighttime markers. In any case,

the markers must be clearly identified as to whether they are daytime or nighttime markers.

9-6. TOWER VISIBILITY AIDS

If tower visibility is reported, separate charts or lists of markers using the tower as an observation site shall be posted in the tower.

9-7. SELECTION OF VISIBILITY MARKERS

Insofar as possible, markers of the type described in paragraph 9-2g should be used for determining visibility markers to construct visibility aids. The red or green course lights, television and radio tower obstruction lights etc., may be used as nighttime visibility markers. Because of their intensity, focused lights such as airport beacons shall not be used as markers.

9-8. OBSERVATION SITES

Visibility observations shall be taken from several viewpoints at one location as necessary to view as much of the horizon as practical. In this respect, natural obstructions, such as trees, hills, etc., are not obstructions to the horizon. These natural obstructions define the horizon.

9-9. DARK ADAPTATION

Before taking visibility observations at night, the observer should spend as much time as practical in the darkness to allow the eyes to become accustomed to the limited light.

9-10. EVALUATING VISIBILITY

Visibility shall be evaluated as frequently as practical. Using all available visibility markers, the observer shall 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, the observer shall estimate the greatest distance that can be seen 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.

9-11. EVALUATING PREVAILING VISIBILITY

After visibilities have been determined around the entire horizon circle (paragraph 9-10), the observer shall resolve them into a single value for reporting purposes. To do this, the observer shall 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. The prevailing visibility shall be reported in all observations.

9-12. EVALUATING SECTOR VISIBILITY

When the visibility is not uniform in all directions, the horizon circle shall be divided 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 reported in the remarks section of weather observations 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 or considered to be operationally significant. The format for the remark is given in paragraph 15-27, Sector Visibility.

9-13. EVALUATING VARIABLE VISIBILITY

If the prevailing visibility rapidly increases and decreases by 1/2 mile or more during the time of the observation, and the average prevailing visibility is less than 3 miles, the visibility is

considered to be variable. When variable visibility conditions are observed, the minimum and maximum visibility values observed shall be reported in the remarks section. Variable visibility shall not be reported in the body of the report. The format for the remark is given in paragraph 15-26, Variable Prevailing Visibility.

9-14. REPORTABLE VISIBILITY VALUES

The reportable values for manual visibility observations are listed in Figure 9-1. If the visibility falls halfway between two reportable values, the lower value shall be reported.

9-15. CONTROL TOWER OBSERVATIONS AND ACTIONS AT CO-LOCATED SITES

Control tower personnel certified to take visibility observations shall:

a. Notify the weather station or contract observer when they observe tower prevailing visibility to decrease to less than, or increase to equal or exceed, 4 miles.

b. When the prevailing visibility at the tower or the surface is less than 4 miles, report all changes of one or more reportable values to the weather station or contract observer.

c. As required by FAA directives, use the lower of either the tower or the weather station/contract observer visibility for aircraft operations.

9-16. ADDITIONAL TOWER PERSONNEL ACTION FOR TOWER VISIBILITY

Tower personnel shall record on graphic transcription equipment, MF1M-10C, or a separate tabulation sheet, the following information for each Control Tower visibility observation:

a. Time of observation.

b. Prevailing visibility at the tower level.

c. Remarks (such as visibility in different sectors).

d. Observer's initials.

(Note: This paragraph is not applicable at OID/OT-equipped sites.)

9-17. WEATHER STATION/CONTRACT OBSERVER ACTION AT STATIONS WITH CONTROL TOWER

Procedures for weather station/contract observer personnel are as follows:

a. Notify the tower as soon as possible, whenever the prevailing visibility at the weather station/contract observation point decreases to less than, or increases to equal or exceed, 4 miles.

b. Re-evaluate weather station/contract observer prevailing visibility, as soon as practical, upon initial receipt of a differing control tower value, and upon receipt of subsequent reportable changes at the control tower level.

Source of Visibility Report							
Automated[3]			Manual				
M1/4	2	9[1]	0	5/8	1 5/8	4	12
1/4	2 1/2	10	1/16	3/4	1 3/4	5	13
1/2	3		1/8	7/8	1 7/8	6	14
3/4	4		3/16	1	2	7	15
1	5		1/4	1 1/8	2 1/4	8	20
1 1/4	6[1]		5/16	1 1/4	2 1/2	9	25
1 1/2	7		3/8	1 3/8	2 3/4	10	30
1 3/4	8[1]		1/2	1 1/2	3	11	35[2]

[1]Designated automated stations only.
[2]Further increments of 5SM may be reported, i.e., 40, 45, 50, etc.
[3]Visibility values of 0, 1/16, and 1/8 can be augmented in the visibility field of ASOS to meet service level requirements.

Figure 9-1. Reportable Visibility Values

9-18. - 9-19. RESERVED

CHAPTER 10. RUNWAY VISUAL RANGE

10-1. INTRODUCTION

This chapter presents procedures and practices for measuring and recording runway visual range (RVR). RVR is an estimate of how far a pilot can see down a runway. It is used to define operational limits on the use of precision instrument runways.

10-2. DEFINITIONS

a. Runway Visual Range. The RVR is an estimate of the maximum distance at which the runway, or the specified lights or markers delineating it, can be seen from a position above a specific point on its center line. This value is normally determined by visibility sensors or transmissometers located alongside and higher than the center line of the runway. RVR is used operationally to assess whether visibility conditions are good enough to allow a particular operation, such as an instrument landing.

b. Designated RVR Runway. The designated RVR runway is the runway officially designated by the airport authority for reporting RVR values. The designated RVR runway is typically the runway with the lowest approach minimums.

c. Runway Light Intensity. Runway light intensity is a numerical scale of the brightness of runway lights.

d. Long-Line RVR. The RVR reported in surface observations and disseminated long line is the highest RVR achievable for the measured visibility at the touchdown zone of a specified runway. Typically, this is the RVR calculated for the highest and lowest values of visibility over the previous 10 minutes at runway light intensity step five. With New Generation RVR (NGRVR), this is an automated report. When the automated interface fails, RVR will not be reported long-line.

10-3. SENSOR AND METHOD

An automated RVR system uses three sensors to estimate the RVR value: Extinction coefficient sensor (or visibility), background luminance (or ambient light sensor) and runway light intensity monitor. The transmissometer or forward scatter meter can be used as an RVR visibility sensor.

a. Transmissometer. A transmissometer measures the fraction of light (transmittance) that has not been absorbed or scattered out of a light beam after it has traveled a certain distance through the atmosphere. The extinction coefficient is computed from transmittance. The transmissometer measures the extinction coefficient using a projector and a receiver. A projector transmits a light beam toward a receiver located some specified distance away. The receiver measures the intensity of the beam after it has passed through the atmosphere. RVR is then derived from algorithms that also account for ambient light (background luminance) and runway light intensity. RVR tables are contained in Figure 10-1, RVR Transmittance Conversion Table for Tasker 400 and Equivalent Systems with 250-Foot Baseline - Contrast Threshold 5.5 Percent, and Figure 10-2, Tasker 500 RVR Transmittance Conversion Table for 250-Foot Baseline - Contrast Threshold 5.0 Percent.

b. Forward Scatter Meter. A forward scatter meter measures a small portion of light scattered out of a light beam into a narrow band of scattering angles. The scatter meter is used to

estimate the extinction coefficient. The forward scatter meter measures the extinction coefficient using visibility sensors (VS) (transmitter and receiver). The VS receiver measures the amount of infrared light scattered into the receiving window by airborne particles. RVR is then derived from algorithms.

10-4. OBSERVING POSITIONS

The RVR visibility sensor should be located within 500 feet of the runway center line and, relative to the center of the glide slope antenna, within distances of 1000 feet towards the runway threshold and 1500 feet away from the runway threshold. The midpoint RVR is placed within 1000 feet of half the distance of the runway length.

10-5. DAY-NIGHT OBSERVATIONS FOR TRANSMISSOMETERS

The day scale should be used in the evening until low-intensity lights on or near the airport complex are clearly visible; the night scale should be used in the morning until these lights begin to fade. Alternatively, a day-night switch may be used to determine which scale should be used.

10-6. AUTOMATED LONG-LINE RVR OBSERVATIONS

For automated long-line RVR observing, the RVR transmits the designated runway RVR to the ASOS for long-line dissemination. The New Generation RVR (forward scatter meter) will provide automated long-line service to the ASOS. The Tasker (transmissometer) provides RVR long-line information manually.

10-7. MULTIPLE RVRS

At certain automated stations, RVR values for as many as four designated runways may be reported for long-line dissemination. At manual stations, only RVR for the designated runway shall be reported.

10-8. UNITS OF MEASURE

RVR is measured in feet whenever the prevailing visibility is 1 statute mile or less and/or the RVR for the designated instrument runway is 6000 feet or less. RVR up to 1000 feet is reported in increments of 100 feet. RVR between 1000 and 3000 feet is reported in increments of 200 feet. RVR between 3000 and 6000 feet is reported in increments of 500 feet. For RVR based on the forward scatter meter, RVR up to 800 feet is reported in increments of 100 feet; RVR between 800 and 3000 feet is reported in increments of 200 feet; RVR between 3000 and 6500 feet is reported in increments of 500 feet.

10-9. RVR BASED ON TRANSMISSOMETER

At manual stations, 10-minute extreme values (highest and lowest) of transmittance shall be read from the transmissometer strip chart. RVR shall be reported based on light setting 5 for either day or night time conditions, regardless of the light setting actually in use. One RVR value shall be reported if the 10-minute high and low value are the same.

10-10. AUTOMATED RVR

RVR is automatically provided to the automated surface observing system (ASOS). ASOS shall calculate and report extreme RVR values.

10-11. LIMITS OF RVR

When the observed RVR is above the maximum value that can be determined by the system in use, it should be reported as "P6000FT", where the figure 6000 is the maximum value that can be determined by the system. Similarly, when the RVR is below the minimum value that can be determined by the system in use, it should be

reported as "M0600FT", where the figure 600 is the minimum value that can be determined by the system. Automated RVR exceeding its upper reporting limit shall be reported as 6500+.

10-12. VARIATION IN RVR

When RVR varies by more than a reportable increment during the 10-minute period preceding the observation time, report the lowest reportable value and the highest reportable value in feet. The RVR format is given in paragraph 15-13, Runway Visual Range Group.

10-13. DETERMINING AND REPORTING RVR (NA LAWRS)

Observers at stations with the capability of measuring RVR should report RVR in the body of the METAR/SPECI whenever the prevailing visibility is 1 mile or less and/or the RVR is 6000 feet or less (6500 feet or less for automated RVR). The format is given in Chapter 15, Coding and Dissemination. The 10-minute runway visual range values for the designated RVR runway shall be included in METAR and SPECI observations. The values shall be based on runway light setting 5 and reported in the increments identified in paragraph 10-8, Units of Measure. Transmissometer-determined values shall be applicable only to the specified runway near which the instrument is located. After transmissivity values are obtained, background correction shall be applied and the appropriate figure used to determine runway visual range. Figures 10-1, RVR Transmittance Conversion Table, and 10-2, Tasker 500 RVR Transmittance Conversion Table, present RVR transmittance conversion data for two different operating conditions. In determining runway visual range, the observer shall select the appropriate time for changing from day to night values or vice versa. In general, the day scale should be used in the evening until low-intensity lights on or near the airport complex are clearly visible, and the night scale should be used in the morning until these lights begin to fade. Alternatively, a day-night switch may be used to determine which scale should be used. When reliable reports are unavailable, or the observer determines that the instrument values are not representative for the associated runway, the data shall not be used. Automated RVR values are complete as forwarded to ASOS and require no external compensation for day/night conditions.

10-14. RVR PROCEDURES (APPLY TO RVRs USING TRANSMISSOMETER TECHNOLOGY ONLY)

In order to correctly determine the RVR to be reported, the observer shall have the following information:

a. Which recorder indicates RVR values at the approach end of the designated RVR runway.

b. The relation of RVR sensors and readouts to the runway approaches.

c. The lowest RVR instrument minimums for the designated RVR runway.

d. Whether the day or night tables are to be used.

10-15. TEN-MINUTE RVR VALUES (APPLY TO RVRs USING TRANSMISSOMETER TECHNOLOGY ONLY)

Ten-minute extreme values (highest and lowest) of RVR shall be determined by selecting the highest and lowest values on the recorder chart and converting them to hundreds of feet by using the appropriate RVR table. Values based on light setting 5 shall always be used, regardless of the light setting actually in use. The 10-minute

values are considered more representative for longer periods after observation and shall be used for long-line transmission.

10-16. MANUALLY DETERMINED ONE-MINUTE RVR VALUES (APPLY TO RVRs USING TRANSMISSOMETER TECHNOLOGY ONLY)

When necessary to determine RVR values manually (digital readout inoperative or not available), the observer shall obtain readings from the transmissivity meter or the recorder trace. Because of the lag in the transmissometer recording system, these values may be considered nominal one-minute measures of atmospheric transmission. These indications shall be converted to RVR equivalents whenever the appropriate light settings and day or night condition are known. Background correction shall be applied to the observed value and the appropriate RVR table used.

10-17. EMERGENCY REPORTING OF RUNWAY VISIBILITY AND RUNWAY VISUAL RANGE (APPLY TO RVRs USING TRANSMISSOMETER TECHNOLOGY ONLY) (NA LAWRS)

When notified that RVR readouts in the traffic control facility are inoperative, but a readout (digital, recorder, or meter) in the weather station/contract observer location is operating, the weather station observer shall provide to the control facility for the runways(s) of concern:

a. The RVR at the time of notification.

b. Notification when the RVR is observed to decrease to equal or become less than, or to increase to equal or become more than 2400 feet RVR, **or** the lowest landing minimum.

The RVR provided in accordance with this paragraph shall be the one-minute mean value, based on light setting 5, unless another light setting is specially requested. If digital readouts are unavailable, the observer shall manually determine one-minute RVR using the instructions in paragraph 10-16, Manually Determined One-Minute RVR Values. All values furnished to the control facility in accordance with this paragraph shall be recorded and retained for 30 days. Telewriter copy or voice tapes may serve this purpose.

10-18. ANNOTATION OF RVR RECORDER CHARTS (APPLY TO RVRs USING TRANSMISSOMETER TECHNOLOGY ONLY)

At the beginning and end of each chart roll, the observer shall enter station name, runway number, length of transmissometer baseline, time check, and date-time group. If the chart, or any part of the chart, is provided for special studies, an aircraft accident investigation, etc., the observer shall enter other identification as necessary; e.g., station name, runway, length of transmissometer baseline. The observer shall indicate maintenance shut-downs or other inoperative periods by entering time checks and date-time groups at the end of one period of operation and the beginning of the next. The observer shall enter a time check and date-time group near the trace whenever notified of an aircraft mishap. The observer shall adjust the chart to the correct time whenever the time error is 5 minutes or more. The observer shall note the time of adjustment, and enter a new time check on the chart.

10-19. DISPOSITION OF RVR RECORDER CHARTS (APPLY TO RVRs USING TRANSMISSOMETER TECHNOLOGY ONLY)

When the chart on a recorder roll has been exhausted, the observer shall insert the used roll into an empty chart carton and enter on the carton the station name, dates for beginning and ending of the roll, and runway identification. The used roll shall be held on station for 30 days. If no request is received within this time for review or a copy of any portion of the roll, it may be discarded. It shall not be sent to the National Climatic Data Center (NCDC).

10-20. OPERATION OF EQUIPMENT

Practices and procedures for the operation of visibility measuring instruments and related equipment are presented in Chapter 17, Operation of Equipment.

	DAY	NIGHT
RVR (Ft)	LS 5	LS 5
400 ----------	.0299	.0013
600 ----------	.1038	.0113
800 ----------	.1974	.0351
1000 ----------	.2905	.0707
1200 ----------	.3746	.1134
1400 ----------	.4479	.1590
1600 ----------	.5107	.2048
1800 ----------	.5644	.2492
2000 ----------	.6104	.2913
2200 ----------	.6499	.3307
2400 ----------	.6840	.3674
2600 ----------	.7136	.4014
2800 ----------	.7395	.4328
3000 ----------	.7774	.4820
3500 ----------	.8194	.5415
4000 ----------	.8431	.5906
4500 ----------	.8584	.6317
5000 ----------	.8710	.6662
5500 ----------	.8815	.6957
6000 ----------	.8905	.7209
LS - Light Setting		

Note: When a given value of RVR is being reported, the transmittance shall be between the two adjacent values listed in the table.

Figure 10-1. RVR Transmittance Conversion Table for Tasker 400 and Equivalent Systems with 250-Foot Baseline - Contrast Threshold 5.5 Percent

	DAY	NIGHT
RVR (Ft)	LS 5	LS 5
500 ---------	.0449	.0027
600 ---------	.0823	.0075
700 ---------	.1264	.0159
800 ---------	.1974	.0351
1000 ---------	.2905	.0707
1200 ---------	.3746	.1134
1400 ---------	.4479	.1590
1600 ---------	.5107	.2048
1800 ---------	.5644	.2492
2000 ---------	.6104	.2913
2200 ---------	.6499	.3307
2400 ---------	.6840	.3674
2600 ---------	.7136	.4014
2800 ---------	.7395	.4328
3000 ---------	.7774	.4820
3500 ---------	.8190	.5415
4000 ---------	.8384	.5906
4500 ---------	.8541	.6317
5000 ---------	.8671	.6662
5500 ---------	.8779	.6957
6000 ---------	.8871	.7209
LS - Light Setting		

Note: When a given value of RVR is being reported, the transmittance shall be between the two adjacent values listed in the table.

Figure 10-2. Tasker 500 RVR Transmittance Conversion Table for 250-Foot Baseline - Contrast Threshold 5.0 Percent

10-21. - 10-23. RESERVED

CHAPTER 11. WEATHER PHENOMENA

SECTION 1. WEATHER PHENOMENA - GENERAL

11-1. INTRODUCTION

This chapter contains instructions for identifying, recording, and reporting weather. For the purpose of this order, weather is a category of atmospheric phenomena that includes tornadoes, funnel clouds, waterspouts, thunderstorms, squalls, precipitation, and obscurations. The types of weather phenomena reported vary according to the type of station. Weather phenomena may be evaluated instrumentally, manually, or through a combination of instrumental and manual methods.

11-2. PRECIPITATION

Precipitation is 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 in surface observations are:

a. Liquid Precipitation. Liquid precipitation is any form of precipitation that does not fall as frozen precipitation and does not freeze upon impact. Types of liquid precipitation are:

(1) Drizzle (DZ). Drizzle is defined as fairly uniform precipitation composed exclusively of fine drops (diameter less than 0.02 inch/0.5 mm) very close together. Drizzle appears to float, following air currents, although unlike fog droplets, it falls to the ground.

(2) Rain (RA). Rain is defined as precipitation of liquid water particles, either in the form of drops larger than 0.02 inch/0.5 mm., or smaller drops which, in contrast to drizzle, are widely separated.

b. Freezing Precipitation. Any form of precipitation that freezes upon impact and forms a glaze on the ground or on exposed objects is called freezing precipitation. Types of freezing precipitation are:

(1) Freezing Drizzle (FZDZ). Freezing drizzle is drizzle that freezes upon impact with the ground or other exposed objects.

(2) Freezing Rain (FZRA). Freezing rain is rain that freezes upon impact with the ground or other exposed objects.

c. Frozen Precipitation. Frozen precipitation is any form of precipitation that reaches the ground in solid form. Types of frozen precipitation are:

(1) Snow (SN). Snow is composed of crystals, mostly branched in the form of six-pointed stars. At temperatures higher than about -5°C, the crystals are generally clustered to form snowflakes.

(2) Small Hail and/or Snow Pellets (GS). Small hail or snow pellets are defined as white, opaque grains of ice. The pellets are round or sometimes conical. Diameters range from about 0.08 to 0.2 inch (2 to 5 mm). Snow pellets are brittle and easily crushed. When they fall on hard ground, they bounce and often break up.

(3) Snow Grains (SG). Snow grains are defined as 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.

(4) Hail (GR). Hail is precipitation in the form of small balls or other pieces of ice falling separately or frozen together in irregular lumps. Hailstones consist of alternate opaque and clear layers of ice in most cases.

(5) Ice Pellets (PL). Ice pellets are transparent or translucent pellets of ice, which are round or irregular, rarely conical, and which have a diameter of 0.2 inch/5 mm or less. The pellets usually rebound when striking hard ground, and make a sound on impact. There are two main types:

(a) One type is composed of hard grains of ice consisting of frozen raindrops, or largely melted and refrozen snowflakes (formerly sleet). This type falls as continuous or intermittent precipitation.

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

(6) Ice Crystals (Diamond Dust) (IC). Ice crystals are unbranched and fall in the form of needles, columns, or plates. (Snow crystals are branched.) 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 hydrometeor (rarely more than the lightest precipitation), which is frequent in polar regions, occurs only at very low temperatures in stable air masses.

d. Unknown Precipitation. Unknown precipitation is the term used by automated weather observing systems to characterize precipitation of an unknown type that cannot be identified any further by the system.

11-3. OBSCURATIONS

An obscuration is any phenomenon in the atmosphere, other than precipitation, that reduces horizontal visibility. Except where noted, obscurations are reported when the prevailing visibility is less than 7 miles or considered operationally significant. The types of obscurations reported in surface observations are:

a. Blowing Dust (BLDU). Blowing dust is dust raised by the wind to a height of 6 feet or more, sufficient to restrict horizontal visibility. When visibility decreases to 5/8 SM or less, this becomes a duststorm (DS). Note: see 11-4g.

b. Blowing Sand (BLSA). Blowing sand is sand raised by the wind to a height of 6 feet or more, sufficient to restrict horizontal visibility. When visibility decreases to 5/8 SM or less, this becomes a sandstorm (SS). Note: see 11-4f.

c. Blowing Snow (BLSN). Blowing snow is made up of snow particles raised by the wind to a height of 6 feet or more, sufficient to restrict horizontal visibility.

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

e. Blowing Spray (BLPY). Blowing spray is made up of water droplets torn by the wind from a body of water, generally from the crest of waves, and carried up into the air to a height of 6 feet or more in such quantities that they reduce the horizontal visibility.

f. Widespread Dust (DU). Dust consists of fine particles of earth or other matter raised or suspended in the air by a wind 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 is pale and colorless, or has a yellow tinge through dust.

g. Fog (FG). Fog is a visible aggregate of minute water particles (droplets) that is based at the earth's surface and reduces horizontal visibility to less than 5/8 SM (statute miles), and unlike drizzle, does not fall to the ground.

h. Freezing Fog (FZFG). Freezing fog is a suspension of numerous minute ice crystals in the air, or water droplets at temperatures below 0°C, and visibility less than 5/8 SM, based at the earth's surface. A report of freezing fog does not necessarily mean that ice is forming on surfaces.

i. Haze (HZ). Haze is made up of extremely small, dry particles suspended in the air, 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 peculiar silvery tinge. Haze particles may be composed of a variety of substances; e.g., dust, salt, residue from distant fires or volcanoes, and/or pollen. The particles, generally, are well diffused through the atmosphere.

j. Mist (BR). Mist is a visible aggregate of minute water particles suspended in the atmosphere that reduces visibility to less than 7 SM but greater than or equal to 5/8 SM, and unlike drizzle, does not fall to the ground.

k. Shallow (Ground) Fog (MIFG). Shallow ground fog is fog in which the visibility at 6 feet above the ground is 5/8 SM or more and the apparent visibility in the fog layer is less than 5/8 SM.

l. Smoke (FU). Smoke is defined as small particles produced by combustion suspended in the air. 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.

m. Volcanic Ash (VA). Volcanic ash consists of fine particles of rock powder that originate from a volcano and that may remain suspended in the atmosphere for long periods producing red sunsets and climatic modifications thousands of miles away. Volcanic ash is always reported when observed, no matter what the value of prevailing visibility.

11-4. OTHER PHENOMENA

a. Well-Developed Dust/Sand Whirls (PO). 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. Squalls (SQ). A strong wind characterized by a sudden onset, in which the wind speed increases by at least 16 knots and is sustained at 22 knots or more for at least one minute.

c. Tornado (+FC). A violent, rotating column of air touching the ground. It forms a pendant, usually from a cumulonimbus cloud, nearly always starts as a funnel cloud, and is accompanied by a loud roaring noise.

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

e. Waterspout (+FC). A violent, rotating column of air that forms over a body of water, and touches the water surface.

f. 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. Sandstorm is reported when visibility is reduced to between 5/8 and 5/16 statute mile. If visibility is less than 5/16 statute mile, then heavy sandstorm (+SS) is reported.

g. Duststorm (DS). A severe weather condition characterized by strong winds and dust-filled air over an extensive area. Duststorm is reported when visibility is reduced to between 5/8 and 5/16 statute mile. If visibility is less than 5/16 statute mile, then heavy duststorm (+DS) is reported.

11-5. QUALIFIERS

Present weather qualifiers fall into two categories: intensity or proximity, and descriptors. Qualifiers may be used in various combinations to describe weather phenomena. Details on the coding of qualifiers are contained in Chapter 15, Coding and Dissemination, and appendix E, METAR User Aids.

a. Intensity. The intensity qualifiers are: Light (-), Moderate (No Entry), Heavy (+).

b. Proximity. The proximity qualifier is "vicinity" (VC).

c. Descriptors. The descriptors are: Shallow (MI), Partial (PR), Patches (BC), Low Drifting (DR), Blowing (BL), Shower or Showers (SH), Thunderstorm (TS), and Freezing (FZ).

11-6. ORDER FOR REPORTING MULTIPLE TYPES OF WEATHER AND OBSCURATIONS

When more than one type of weather and/or obscuration is reported at the same time, they shall be reported in the following order:

a. Tornado, funnel cloud, or waterspout.

b. Thunderstorms, with or without associated precipitation.

c. Weather and obscurations in order of decreasing predominance, i.e., the most dominant type is reported first.

d. From left to right in Figure 11-1, Present Weather.

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

General Note: The weather groups shall be constructed by considering columns 1 to 5 in the figure above in sequence, i.e., intensity, followed by description, followed by weather phenomena, e.g., heavy rain shower(s) is coded as +SHRA.
Footnotes:
1. To denote moderate intensity, no entry or symbol is used.
2. See paragraph 11-7 for vicinity definition and paragraph 15-14a(2) for usage.
3. Tornadoes and waterspouts shall be coded as +FC.
4. "UP" is only used by automated weather observing systems.

Figure 11-1. Present Weather

11-7. RULES FOR PHENOMENA NOT OCCURRING AT THE POINT OF OBSERVATION

When reference is made to phenomena not occurring at the point of observation, the following rules shall apply:

a. Weather occurring at the airport shall be coded in the body of the report. Vicinity is defined as between 5 and 10 SM from the usual point of observation for all but precipitation and up to 10 SM from the usual point of observation for precipitation. (See paragraph 11-7b below.) Distant is defined as greater than 10 statute miles from the usual point of observation. With the exception of volcanic ash, low drifting dust, low drifting sand and low drifting snow, an obscuration shall be coded in the body of the report if

the surface visibility is less than 7 miles or considered operationally significant. Volcanic ash shall always be coded when observed. **MIFG, BCFG** and **PRFG** may be reported when visibility is equal to or greater than 7 miles. Weather and/or obscurations observed but not occurring at the station or in the vicinity shall be coded in the remarks section.

b. If precipitation is not occurring at the station or airport, but is within 10 miles of the usual point of observation, the phenomena shall be reported in the body of the report as "showers in the vicinity" (**VCSH**). For other than precipitation, (**VCFG**, **VCBLSN**, etc.), vicinity is 5 SM to 10 SM. Examples of how to use **VC** correctly are included in paragraph 15-14a(2), Intensity or Proximity Qualifier, and appendix E, METAR User Aids.

c. If the phenomenon is not occurring at the usual point of observation but is affecting part of the operating areas of the airport, the phenomenon may be reported in remarks with the phrase "at the airport" (**AT AP**) appended, e.g., **SHRA AT AP**. "At the airport" includes runways, taxiways, ramps, terminals and/or adjacent areas. Buffer zones around the operating areas of the airport are not included in this area.

d. Weather phenomena beyond 10 statute miles of the point of observation shall be coded as distant (DSNT) followed by the direction from the station. For example, lightning 25 statute miles west of the station would be coded as **LTG DSNT W**.

SECTION 2. OBSERVING AND REPORTING PRECIPITATION

11-8. REPORTING AND DOCUMENTING PRECIPITATION

The type, intensity, and character of precipitation in any form shall be reported in the body of the weather report whenever it is observed to occur at the station. Precipitation observed at a distance from the station shall be reported in the remarks section. At **LAWRS**, the reporting of precipitation observed at a distance is not required but may be done. To report and document precipitation, the observer shall determine:

a. Time of beginning, ending, and changes in intensity **(NA LAWRS)**

b. Type, character, and intensity

11-9. BEGINNING AND/OR ENDING OF PRECIPITATION (NA LAWRS)

The observer shall note to the nearest minute the time that precipitation of any type is observed to begin and end. These times shall be reported in remarks in the next METAR observation. If beginning or ending time for a precipitation type such as hail, freezing precipitation, or ice pellets is the reason for issuing a SPECI, the beginning/ending time shall be included in that SPECI report and in the following METAR. Times for separate periods shall be reported only if the intervening time of no precipitation exceeds 15 minutes. Time data shall be reported by identifying the type, using the appropriate symbol, followed by **B** for "began" or **E** for "ended," as appropriate, and the time in 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."

11-10. DETERMINING AND REPORTING THE TYPE OF PRECIPITATION

The observer shall determine and report the type of precipitation by using the definitions in this chapter. The observer shall use the order described in paragraph 11-6, Order for Reporting Multiple Types of Weather and Obscurations, to report precipitation.

11-11. DETERMINING THE CHARACTER OF PRECIPITATION

The observer shall use the definitions in this section to determine the character of precipitation.

a. Continuous. If precipitation intensity changes, it changes gradually.

b. Intermittent. Precipitation stops and starts at least once within the hour preceding the observation and, if the precipitation intensity changes, it changes gradually.

c. Showery. Abrupt changes in precipitation intensity, or the precipitation starts and stops abruptly. The **SH** code shall only be appended to rain (**RA**), snow (**SN**), ice pellets (**PL**), small hail/snow pellets (**GS**), or hail (**GR**), e.g., **SHRA**, **SHSN**, **SHPL**, **SHGS**, **SHGR**.

11-12. PRECIPITATION INTENSITY

Intensity of precipitation is an indication of the amount of precipitation falling at the time of observation. It is expressed as light, moderate, or heavy. No intensity is assigned to hail or ice crystals. Each intensity is defined with respect to the type of precipitation occurring. The intensity of rain or freezing rain should be estimated using the guidelines given in Figure 11-2, Estimating Intensity of Rain. The intensity of ice pellets

should be estimated using the guidelines given in Figure 11-3, Estimating Intensity of Ice Pellets. The intensity of rain or ice pellets may also be estimated by rate of fall as given in Figure 11-4, Intensity of Rain or Ice Pellets Based on Rate of Fall. Figure 11-5, Intensity of Snow or Drizzle Based on Visibility, on the other hand, is based on the visibility at the time of observation, and shall be used to determine intensity of snow and drizzle. When more than one form of precipitation is occurring at a time or precipitation is occurring with an obscuration, the intensities determined shall be no greater than that which would be determined if any of the forms were occurring alone. The intensity of precipitation shall be reported using the symbols in Figure 11-6, Precipitation Intensity Symbols. The intensity symbol shall precede the precipitation symbol without any intervening space.

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 in sheets; individual drops are not identifiable; heavy spray to height of several inches is observed over hard surfaces.

Figure 11-2. Estimating Intensity of 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.

Figure 11-3. Estimating Intensity of Ice Pellets

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

Figure 11-4. Intensity of Rain or Ice Pellets Based on Rate of Fall

Intensity	Criteria
Light	Visibility > 1/2 mile.
Moderate	Visibility > 1/4 mile but ≤ 1/2 mile.
Heavy	Visibility ≤ 1/4 mile.

Figure 11-5. Intensity of Snow or Drizzle Based on Visibility

Intensity	Precipitation Intensity Symbols
Light	-
Moderate	No symbol is assigned to moderate.
Heavy	+
No intensity is assigned to hail or ice crystals	

Figure 11-6. Precipitation Intensity Symbols

11-13. INTENSITY OF SNOW, SNOW PELLETS, SNOW GRAINS, DRIZZLE AND FREEZING DRIZZLE

If any one of these phenomena occurs alone, Figure 11-5, Intensity of Snow or Drizzle Based on Visibility, shall be used to determine intensity on the basis of prevailing visibility. If occurring with other precipitation or obscurations, the intensity assigned shall be no greater than that determined using visibility criteria if any of the above were occurring alone. With or without other obscuring phenomena, heavy snow (+SN) shall not be reported if the visibility is greater than 1/4 mile and moderate snow (SN) shall not be reported if the visibility is greater than 1/2 mile.

11-14. REPORTING FREEZING PRECIPITATION

A SPECI observation shall be taken whenever freezing precipitation begins, ends, or changes intensity.

11-15. BEGINNING AND/OR ENDING OF FREEZING PRECIPITATION

The time freezing precipitation began and/or ended shall be included in the remarks of the first observation after the event is first observed. If a SPECI report is initiated because of the beginning or ending of the freezing precipitation, the beginning and/or ending time shall be included in the remarks section of that SPECI and in the following METAR. The time shall be repeated in the remarks of the next METAR observation if not previously reported in a METAR observation.

11-16. INTENSITY OF FREEZING PRECIPITATION

a. Freezing Drizzle. When freezing drizzle is occurring alone, determine the intensity by using Figure 11-5, Intensity of Snow or Drizzle Based on Visibility, using visibility as the criterion. If occurring with other precipitation or obscurations, the intensity assigned shall be no greater than that determined using visibility criteria as if freezing drizzle were occurring alone. Note that moderate drizzle reduces the visibility to less than or equal to 1/2 mile. Only if visibility meets this criteria, shall moderate drizzle be reported. Likewise, heavy drizzle shall be reported only if the visibility is less than or equal to 1/4 mile.

b. Freezing Rain. Figure 11-2, Estimating Intensity of Rain, should be used to estimate the intensity of freezing rain.

11-17. REPORTING ICE PELLETS

A SPECI observation shall be taken whenever ice pellets begin, end, or change intensity.

11-18. BEGINNING AND/OR ENDING OF ICE PELLETS (NA LAWRS)

The time ice pellets began and/or ended shall be included in the remarks of the first observation after the event occurs. If a SPECI report is initiated because of the beginning or ending of the ice pellets, the beginning and/or ending time

shall be included in the remarks section of that SPECI. The times shall be repeated again in the remarks of the next transmitted METAR observation if not previously reported in a METAR observation.

11-19. INTENSITY OF ICE PELLETS

The intensity of ice pellets shall be estimated in accordance with Figure 11-3, Estimating Intensity of Ice Pellets.

11-20. REPORTING PRECIPITATION AMOUNTS (NA LAWRS)

Amounts of precipitation shall be 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 Figure 11-7, Units of Measure for Precipitation). The following paragraphs describe the different manual procedures that shall be used in measuring the amount of precipitation. (Note: At an automated station, precipitation amounts will not be backed up.)

11-21. PRIORITY OF GAUGES (NA LAWRS)

If more than one type of gauge is available, the observer shall use the one appearing highest on the following list.

a. Universal weighing rain gauge.

b. Eight-inch non-recording rain gauge.

c. Stick measurement of the tipping bucket gauge.

d. All others.

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

Figure 11-7. Units of Measure for Precipitation

11-22. STICK MEASUREMENT OF LIQUID PRECIPITATION (NA LAWRS)

(Applies only to the standard 8-inch, non-recording rain gauge)

The observer shall insert a dry measuring stick into the measuring tube. The observer shall permit the stick to rest on the bottom for 2 or 3 seconds. The observer shall 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, the observer shall empty it and pour the liquid (if any) from the overflow container into the measuring tube and measure it. The observer shall add the two amounts to get the total precipitation. When the measurements are completed, the observer shall empty the tube and reassemble the gauge.

11-23. DETERMINING WATER EQUIVALENT OF SOLID PRECIPITATION BY STICK MEASUREMENT (NA LAWRS)

(Applies only to the standard 8-inch, non-recording rain gauge)

When solid or freezing precipitation is anticipated, the observer shall remove the funnel and measuring tube from the gauge. To measure the precipitation, the observer shall melt the contents of the overflow container, pour the liquid into the measuring tube and measure it as with liquid precipitation. If, because of strong winds, the amount of precipitation is considered to be unrepresentative, the observer shall disregard the

catch and obtain a measurement by a vertical core sampling. 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.

11-24. DETERMINING WATER EQUIVALENT OF SOLID PRECIPITATION BY WEIGHING (NA LAWRS)

Selected facilities are provided with spring scales for determining the water equivalent of solid precipitation. The scales are used in conjunction with the overflow container of an 8-inch non-recording gauge. The observer shall determine water equivalent of a snow sample as follows:

Step 1. Attach the empty overflow container to the hook on the spring scale, and read the position of the pointer to the nearest 0.01 inch.

Step 2. Obtain a snow sample in the overflow container.

Step 3. Attach the overflow container with the sample to the scale, and read the position of the pointer to the nearest 0.01 inch.

Step 4. Determine the water equivalent by subtracting the reading found in Step 1 from the reading found in Step 3.

11-25. ESTIMATING THE WATER EQUIVALENT OF SNOW (NA LAWRS)

When the water equivalent of snow cannot be accurately measured by melting, weighing, or core sampling; the observer shall estimate the water equivalent to the nearest 0.01 inch. Use Figure 11-8, New Snowfall to Estimated Meltwater Conversion Table, only as a guide in estimating the water equivalency of newly fallen snow.

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 figure 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 figure.

Figure 11-8. New Snowfall to Estimated Meltwater Conversion Table

11-26. DETERMINATION OF 6-HOUR ACCUMULATION OF PRECIPITATION (NA LAWRS)

At designated stations, insofar as possible, determine the amount of precipitation to be reported in the 6-hour observation. If a weighing gauge is not available, use the stick measurement of the 8-inch gauge or the uncorrected reading of the tipping-bucket gauge. Do not empty the gauge unless it is necessary to obtain a complete measurement of the accumulation (if the precipitation exceeded 2 inches). 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.

11-27. DEPTH MEASUREMENT OF SOLID FORMS (NA LAWRS)

For the purposes of depth measurements, the term snow shall include 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 shall be included in depth measurements of snow. Depth shall be determined to the nearest 0.1 inch. The measurement should reflect the average depth on the ground at the usual measurement site (not disturbed by human activities). Measurements from rooftops, paved areas, and the like should not be made.

a. Undrifted Snow. Thrust the measuring stick vertically into the snow so that the end rests on the ground surface. Repeat 10 times and take the average of the readings as the snow depth. If the ground is covered with ice, cut through the ice with some suitable implement, and measure the thickness. Add the thickness of the ice to the depth of snow above the ice for the total depth measurement.

b. Drifted Snow (or Uneven Amounts). When the snow has drifted, or there are uneven amounts of snow on the ground, 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 half the ground is bare and the other half is covered with 6 inches of snow, the snow depth should be entered as the average of the two readings, or 3 inches. When in the observer's judgment, less than 50 percent of the exposed ground is covered with snow, even though the covered areas have a significant depth, the snow cover should be recorded as a trace (T). When no snow or ice is on the ground in exposed areas (snow may be present in surrounding forested or otherwise protected areas), record a "0".

c. Hail. The depth of hail, which is usually associated with spring, summer or fall thunderstorms, is reported in the same manner as snow depth. The observer should record in column 65 the remark that the accumulation on ground is from hail. The format is given in paragraph 16-35e.

d. Snow Stakes. Snow stakes should be used as a last resort to obtain depth measurements of a snowpack. They should be placed in the most representative area available, for use when it is likely that routine core sampling may disturb an otherwise representative area for subsequent use. Depth measurements used in adjusting water equivalent of core samples should be made to tenths of an inch, as far as possible, without disturbing the snow within a few feet of the stake.

11-28. SNOWFALL WITHIN SPECIFIED PERIODS (NA LAWRS)

If practicable, these measurements shall be made on a surface that has been cleared of previous snowfall. If such a spot is not available, and snow boards are not in place, the observer shall

measure the total depth of snow and subtract the depth previously measured. When it is likely that melting and settling of the snow make 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, the observer shall measure the total depth of snow and subtract the previously measured depth. The remainder is the approximate depth of the new fall, which shall 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. If snow melts as it lands, then a trace should be recorded.

SECTION 3. OBSERVING AND REPORTING TORNADOES, WATERSPOUTS, AND FUNNEL CLOUDS

11-29. TORNADO, WATERSPOUT, OR FUNNEL CLOUD

These phenomena shall be reported in a SPECI observation when they are observed to begin, end, appear or disappear.

a. Tornadic Activity Begins or Appears. In the body of the SPECI observation, insert **+FC** (for tornado or waterspout) or **FC** (for funnel cloud) at the beginning of the present weather group (see paragraph 15-14, Present Weather Group). Insofar as known, the following shall be reported in the remarks section for any SPECI when a tornado, waterspout or funnel cloud appears or begins (see paragraph 15-21, Funnel Cloud, for remarks format):

(1) Type of phenomenon, spelled out

(2) Time of beginning or appearance of the phenomenon, to the nearest minute (only the minutes are required if the hour can be inferred from the report time)

(3) Location and/or direction of the phenomenon from the station

(4) Direction toward which the phenomenon is moving (if unknown, enter MOV UNKN)

Example of remarks for tornadic activity beginning: TORNADO B24 6 NE MOV UNKN

b. Tornadic Activity Ends or Disappears. The following shall be reported in the remarks section for any SPECI when a tornado, waterspout or funnel cloud ends or disappears from sight (see paragraph 15-21, Funnel Cloud, for remarks format):

(1) Type of phenomenon, spelled out

(2) Time of ending or disappearance of the phenomenon, to the nearest minute (only the minutes are required if the hour can be inferred from the report time)

Example of remarks for a funnel cloud disappearing from site: FUNNEL CLOUD E35.

c. The above elements shall also appear in the remarks section of the next METAR observation if not previously reported in a METAR observation.

SECTION 4. OBSERVING AND REPORTING THUNDERSTORMS, HAIL, LIGHTNING, AND SQUALLS

11-30. REPORTING THUNDERSTORMS

Reports concerning thunderstorms shall be made whenever a thunderstorm begins or ends. In the body of the observation, **TS** may be coded by itself or with precipitation types such as **RA**, **SN**, **PL**, **GS** or **GR**. The intensity attached to it shall be the intensity ascribed to the precipitation as described in paragraph 15-14b(4). In the remarks section, the report shall include the following:

a. Type and frequency of lightning

b. Time of beginning, ending, or both, to the nearest minute

c. Location, in accordance with the rules given in paragraph 11-7, Rules for Phenomena Not Occurring at the Point of Observation, or 15-32, Thunderstorm Location

d. Direction toward which the storm is moving (omit if unknown)

Figure 11-9, Type and Frequency of Lightning, presents the types and frequencies of lightning to be reported. The above remarks shall be updated and included with the time of beginning, ending, or both on the next transmitted METAR observation if not previously reported in a METAR observation. The format for the remarks is given in paragraph 15-30, Beginning and Ending of Precipitation, 15-31, Beginning and Ending of Thunderstorms, 15-32, Thunderstorm Location, and 15-33, Hailstone Size.

11-31. BEGINNING AND/OR ENDING OF A THUNDERSTORM

A thunderstorm is considered to begin at the station when thunder is heard, overhead lightning is observed and the local noise level is such as might prevent hearing thunder, or lightning is detected by an automated sensor within ten miles of the airport. A thunderstorm is considered to have ended 15 minutes after the last occurrence of any of the above criteria. When the time of beginning or ending of a thunderstorm is reported in the remarks section of a SPECI observation, it need not be reported again until the next transmitted METAR observation if not previously reported in a METAR observation. If previously reported in a METAR observation, the time need not be reported again.

11-32. REPORTING HAIL

Hail shall be reported in an observation whenever it begins or ends, and in all observations taken while it is occurring. Times of beginnings and endings shall be included in the remarks section (NA LAWRS). All observations concerning hail shall report the diameter of the largest hailstones in the remarks section in 1/4 inch increments (NA LAWRS). No intensity shall be assigned to hail. The format for reporting hail is given in paragraph 15-33, Hailstone Size.

11-33. BEGINNING AND/OR ENDING OF HAIL (NA LAWRS)

If SPECI is because of hail, then begin/end time shall be recorded in the remarks. When the time of beginning or ending of hail is reported in the remarks section of a SPECI observation, it need not be recorded again until the next transmitted METAR observation if not previously reported

in a METAR observation. If previously reported in a METAR observation, the time need not be reported again.

11-34. REPORTING LIGHTNING

When lightning is observed, the type, frequency, and location shall be reported in the remarks section of METAR and SPECI observations. The format for reporting lightning is given in paragraph 15-29, Lightning Frequency. Figure 11-9 presents definitions for the type and frequency of lightning.

Lightning (LTG). Lightning is defined as any of the various forms of visible electrical discharge produced by thunderstorms. Four main types of lightning can be distinguished:

a. Cloud to ground lightning **(CG)** is lightning occurring between a cloud and the ground.

b. In-cloud discharges **(IC)** are a type of lightning that takes place within a thunder cloud.

c. Cloud to cloud discharges **(CC)** are streaks of lightning reaching from one cloud to another.

d. Air Discharges **(CA)** are streaks of lightning which pass from a cloud to the air, but do not strike the ground.

Type of Lightning		
Type	**Contraction**	**Definition**
Cloud-ground	CG	Lightning occurring between cloud and ground.
In-cloud	IC	Lightning that takes place within the thunder cloud.
Cloud-cloud	CC	Streaks of lightning reaching from one cloud to another.
Cloud-air	CA	Streaks of lightning passing from a cloud to the air, but do not strike the ground
Frequency of Lightning		
Frequency	**Contraction**	**Definition**
Occasional	OCNL	Less than 1 flash/minute.
Frequent	FRQ	About 1 to 6 flashes/minute.
Continuous	CONS	More than 6 flashes/minute.

Figure 11-9. Type and Frequency of Lightning

11-35. REPORTING SQUALLS

A squall is reported in the body of a METAR or SPECI only when there is a sudden increase in wind speed of at least 16 knots, the speed rises to 22 knots or more, and lasts for at least one minute.

SECTION 5. OBSERVING AND REPORTING PROCEDURES FOR OBSCURATIONS

11-36. GENERAL

The following paragraphs present observing and reporting procedures for various types of obscurations. When reference is made to phenomena not occurring at the station location, the rules given in paragraph 11-7, Rules for Phenomena Not Occurring at the Point of Observation, shall apply.

11-37. OBSERVING OBSCURATIONS

Obscurations shall be determined by observing the prevailing conditions at the station (usual point of observation) in accordance with the definitions of the various types of obscurations given in paragraph 11-3, Obscurations.

11-38. REPORTING OBSCURATIONS

With the exception of volcanic ash, low drifting dust, low drifting sand and low drifting snow, an obscuration shall be coded in the body of the report if the surface visibility is less than 7 miles or considered operationally significant. Volcanic ash shall always be coded when observed. **MIFG, BCFG** and **PRFG** may be reported when visibility is equal to or greater than 7 miles. The reporting format is given in paragraphs 15-14, Present Weather Group, and 16-19, Present Weather (column 9). If these conditions are not met, but an obscuration is observed that is considered operationally significant, it shall be reported in the remarks section as not at the station. If more than one type of obscuration is occurring at the same time, they shall be reported in order of decreasing estimated predominance.

11-39. SPECIAL PROCEDURES FOR VOLCANIC ASH

Volcanic ash **(VA)** shall be reported in the body of the report **whenever** it is observed. Reporting volcanic ash is different from other obscurations because volcanic ash is reported even if the visibility is greater than 7 miles.

11-40. OPERATIONALLY SIGNIFICANT REMARKS FOR OBSCURATIONS

Any occurrence of an obscuration which the observer judges to be operationally significant and not reported elsewhere in the observation should be reported in the remarks section. Some examples of desirable items to be entered in the remarks section are fog dissipating or increasing, smoke drifting over the field, drifting snow, obscurations at a distance from, but not at the station.

CHAPTER 12. SKY CONDITION

SECTION 1. INTRODUCTION TO SKY CONDITION

12-1. INTRODUCTION

The instructions in this chapter relate to the state or appearance of the sky. Sky condition may be evaluated either automatically by instrument or manually. Clouds include obscuring phenomena aloft. Sky condition shall be evaluated at all stations with this capability. Automated stations shall have the capability to evaluate sky condition from the surface to at least 12,000 feet. Observers at manual stations shall evaluate all clouds and obscuring phenomena visible, i.e., the 12,000-foot restriction shall not apply.

12-2. SKY CONDITION EVALUATION

A complete evaluation of sky condition includes the type of clouds or obscuring phenomena present, their stratification, amount, direction of movement, height of bases, and the effect on vertical visibility of surface-based obscuring phenomena.

12-3. CLOUD FORMS AND OBSCURING PHENOMENA

If available, 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. Commercial products are also available that describe cloud forms and types. Descriptions of obscuring phenomena are included in Chapter 11, Weather Phenomena.

SECTION 2. DEFINITIONS

12-4. CEILING

The ceiling is the height above the earth's surface (field elevation or ground elevation) ascribed to the lowest non-surface-based layer that is reported broken or overcast, or the vertical visibility into a surface-based obscuration that totally hides the sky.

12-5. CELESTIAL DOME

The celestial dome is that portion of the sky that would be visible if all human-made structures were removed and there was an unobstructed view of the horizon in all directions from the observation site(s).

12-6. CLOUD

A cloud is a visible accumulation of minute water droplets and/or ice particles in the atmosphere above the earth's surface. Cloud differs from ground fog, fog, or ice fog only in that the latter are, by definition, in contact with the surface.

12-7. CLOUD MOVEMENT

When reported in remarks of a surface aviation observation, cloud movement is the direction toward which a cloud is moving.

12-8. FIELD ELEVATION

Field elevation is the officially designated elevation (H_a) of an airport above mean sea level. It is the elevation of the highest point on any of the runways of the airport. The field elevation for an airport can be found in the United States Government Flight Information Publication, Airport/Facility Directory or the Chart Supplement for Alaska or the Pacific.

12-9. HORIZON

For the purposes of these instructions, the horizon is the actual lower boundary (local horizon) of the observed sky or the upper outline of terrestrial objects, including nearby natural obstructions. It is the distant line along which the earth, or the water surface at sea, and the sky appear to meet. The local horizon is based on the best practical point of observation near the earth's surface and selected to minimize obstruction by nearby buildings, towers, etc.

12-10. INTERCONNECTED CLOUD LAYERS

Clouds formed by the horizontal extension of swelling cumulus or cumulonimbus, that are attached to a parent cloud, shall be regarded as a separate layer only if their bases appear horizontal and at a different level from the parent cloud. Otherwise, the entire cloud system shall be regarded as a single layer at a height corresponding to that of the base of the parent cloud.

12-11. LAYER

A layer consists of clouds or obscuring phenomena, not necessarily all of the same type, whose bases are at approximately the same level. A layer may be either continuous or composed of detached elements.

12-12. LAYER AMOUNT

The amount of sky cover for each layer shall be the eighths of sky cover attributable to the clouds or obscuring phenomena in the layer being evaluated. All cloud layers and obscuring phenomena aloft shall be considered. Only that portion of surface-based obscuring phenomena that hide a portion of the sky is considered.

12-13. LAYER HEIGHT

The height, in feet, of the layer's base above the surface or field elevation is the layer height.

12-14. MULTIPLE LAYERS

The existence of a layer or layers above a lower layer constitutes multiple layers.

12-15. OBSCURING PHENOMENA

Any collection of particles aloft or in contact with the earth's surface, dense enough to be discernible to the observer, shall be considered obscuring phenomena.

12-16. SKY COVER

Sky cover is a term used to denote the amount (to the nearest eighth) of the sky that is:

a. Covered by clouds and/or obscuring phenomena aloft

b. Hidden by surface-based obscuring phenomena, or

c. A combination of paragraphs a and b above

12-17. SKY COVER CLASSIFICATIONS

a. VERTICAL VISIBILITY (VV) is:

(1) the distance that an observer can see vertically upward into surface-based obscuring phenomena that totally hide the sky, or

(2) the height corresponding to the top of a ceiling light projector beam, or the height at which a balloon completely disappears during the presence of surface-based obscuring phenomena that totally hide the sky, or

(3) the height determined by the sensor algorithm at automated stations into the surface-based obscuring phenomena that totally hide the sky.

b. CLEAR (SKC or CLR). SKC is the abbreviation used for manual reports to indicate that no clouds are present, and CLR is the abbreviation used for automated reports to indicate that no clouds are detected at or below the design limit of the ceilometer.

c. FEW (FEW) (few clouds) represents sky cover of more than zero to 2/8ths. Any layer amount less than 1/8 is considered 1/8.

d. SCATTERED (SCT) represents sky cover of 3/8ths to 4/8ths at and below the level of a layer aloft.

e. BROKEN (BKN) represents sky cover of 5/8ths up to, but not including, 8/8 at and below the level of a layer aloft.

f. OVERCAST (OVC) represents sky cover of 8/8ths at and below the level of a layer aloft.

12-18. SUMMATION AMOUNT

The summation amount of sky cover for any given layer is the sum of the sky cover of the layer being evaluated, plus the sky cover of all lower layers, including that portion of surface-based obscuring phenomena that hides the sky. Portions of layers aloft detected through lower layers aloft shall not increase the summation amount of the higher layer. No layer can have a summation amount greater than 8/8ths.

12-19. SUMMATION PRINCIPLE

The summation 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 8/8ths. This concept is applicable for the evaluation of total sky cover.

12-20. SURFACE

For height determinations, the term "surface" denotes the horizontal plane whose elevation above sea level equals the field elevation. At stations where the field elevation has not been established, "surface" will refer to the ground or elevation at the observation site. At sea-plane bases, the mean high-tide mark may be regarded as the surface.

12-21. TOTAL AMOUNT

Total amount is the amount, in eighths, of the entire sky covered, not necessarily hidden, by all layers present. This amount cannot be greater than 8/8ths.

12-22. VARIABLE CEILING

Variable ceiling describes a condition in which a ceiling rapidly increases and decreases during the period of evaluation.

12-23. VARIABLE SKY CONDITION

Variable sky condition is a sky condition that has varied between reportable conditions (e.g., SCT to BKN, OVC to BKN) during the period of observation (normally the past 15 minutes).

SECTION 3. OBSERVING AND REPORTING PROCEDURES

12-24. OBSERVING SITES

Observations of stratification, amount, direction of movement and height of bases of clouds, and the effect of obscuring phenomena on vertical visibility shall be taken from as many locations as are necessary and practical to view the entire sky.

12-25. LAYER AMOUNTS

All layers visible from the station shall be reported in sky cover reports. The amount of sky cover for each layer shall be the eighths of sky cover attributable to the clouds or obscuring phenomena in the layer being evaluated. Figure 12-1, Reportable Contractions for Sky Cover, shall be used to determine the reported value for each layer visible. The report shall be based on the eighths of sky covered by each layer in combination with any lower layers. Additionally, all layers with associated cumulonimbus or towering cumulus shall be identified as such using the contractions **CB** and **TCU**, respectively. Automated stations shall report no more than three layers of clouds; the layers reported shall be selected in accordance with Figure 12-2, Priority for Reporting Layers. At manual stations, a maximum of six layers of clouds or surface based obscuring phenomena shall be reported. If more than six layers are observed, they shall be selected in accordance with Figure 12-2.

12-26. SUMMATION LAYER AMOUNT

The summation amount of sky cover for any given layer is the sum of the sky cover of the layer being evaluated, plus the sky cover of all lower layers. Portions of layers aloft detected through lower layers aloft shall not increase the summation amount of the higher layer. No layer can have a summation amount greater than 8/8ths. (See Figure 12-5, Examples: Summation of Sky Cover.)

12-27. LAYER HEIGHTS

The height of a layer shall be the height of the cloud bases or obscurations for the layer being evaluated. Layers of clouds that are 50 feet or less above the surface shall be reported as layers with a height of zero. At mountain locations, clouds below the level of the station may be observed and are reported with a height of ///. If available, a ceilometer shall be used to determine the height of layers aloft and vertical visibility into obscuring phenomena. If a ceilometer is not available, layer heights should be obtained by an alternative method; e.g., ceiling light, balloon, pilot report, etc. Known heights of unobscured portions of abrupt, isolated objects within 1 1/2 SM of a runway can also be used to measure the heights of layers aloft. Heights of layers observed at the station shall be reported in hundreds of feet above the surface (not above MSL), rounded to the nearest reportable increment. When a value falls halfway between two reportable increments, the lower value shall be reported. Figure 12-3, Increments of Reportable Values for Layer or Ceiling Heights, shall be used to determine the reportable increments for layer heights.

Reportable Value	Meaning	Summation Amount of Layer
VV	Vertical Visibility	8/8
SKC or **CLR**[1]	Clear	0
FEW[2]	Few	> 0 - 2/8
SCT	Scattered	3/8 - 4/8
BKN[3]	Broken	5/8 - 7/8
OVC	Overcast	8/8

[1] The abbreviation **CLR** shall be used at automated stations when no clouds at or below 12,000 feet are detected. The abbreviation **SKC** shall be used at manual stations when no clouds are reported.

[2] Any layer amount less that 1/8 is reported as FEW.

[3] BKN includes sky cover from 5/8 up to, but not including, 8/8.

Figure 12-1. Reportable Contractions for Sky Cover

Priority	Layer Description
1	Lowest Few
2	Lowest Broken Layer
3	Overcast Layer
4	Lowest Scattered Layer
5	Second Lowest Scattered Layer
6	Second Lowest Broken Layer
7	Highest Broken Layer
8	Highest Scattered Layer
9	Second Lowest Few Layer
10	Highest Few Layer

Figure 12-2. Priority for Reporting Layers

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

Figure 12-3. Increments of Reportable Values for Layer or Ceiling Heights

Observers should supplement layer data obtained from ceilometers or ceiling lights by visual observations to determine that the instrumental values are representative of the layers to which they are ascribed. Figure 12-6, Convective Cloud-Base Height Diagram, presents a convective cloud-base height diagram.

12-28. EVALUATION OF MULTIPLE LAYERS

Frequent observations are necessary to evaluate stratification. A series of observations will often show the existence of multiple layers. Through thin lower layers it may be possible to observe higher layers. Differences in the directions of cloud movements often aid in observing and differentiating cloud layers. Ceilometer returns and, at night, ceiling light indications may also be used to determine the existence of multiple layers. Observers should be aware of and use these guidelines to determine and evaluate multiple layers.

12-29. AMOUNT OF OBSCURATION

If a portion of the sky is not visible because of surface-based obscuring phenomena, the observer shall determine the portion of sky (in eighths) that is not visible. The amount of sky obscured shall be indicated as **FEW**, **SCT** or **BKN,** as appropriate, followed by three zeros **(000)**. In remarks, the obscuring phenomena shall precede the amount of obscuration and three zeros. For example, if 5/8ths of the sky is obscured by fog, **BKN000** would be in the body of the observation, with **FG BKN000** in the remarks section.

12-30. DETERMINING AMOUNT OF SKY COVER

The summation amount of sky covered at and below each layer shall be determined. Also, the amount of sky cover at and below the layer under evaluation shall be determined. Surface-based obscuring phenomena shall not be considered sky cover if the sky, higher clouds or obscuring phenomena aloft, or the moon or stars are visible through it.

12-31. EVALUATION OF SKY COVER AMOUNTS

Sky cover amounts shall be evaluated:

a. In eighths of coverage of the entire sky area above the horizon, and

b. In terms of the total amount of sky cover, and

c. With reference to an observation site as near as possible to the earth's surface.

12-32. SKY COVER CLASSIFICATION

Select the appropriate sky cover contraction or combination of contractions to be reported after evaluating the following:

Step 1. Estimate (to the nearest eighth) the amount of sky covered by the lowest layer present. If this layer is a surface-based obscuring phenomenon, determine only the amount of sky that is hidden. Transparent surface-based atmospheric phenomena do not constitute sky cover.

Step 2. Determine if additional layers of clouds and/or obscuring phenomena aloft 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 coverage amounts visible through transparencies in lower layers, except those amounts of upper layers visible through transparent surface-based atmospheric phenomena.

Step 3. Repeat the evaluation in step 2 for each additional layer present in ascending order of height. Estimate the summation (in eighths) of sky covered by each layer, in combination with all lower layers.

12-33. VARIABLE SKY COVER

The sky cover shall be considered variable if it varies by one or more reportable classifications during the period it is being evaluated, e.g., **SCT V BKN**. When a layer amount varies between reportable values during the time the

amount is being evaluated, a variable sky condition remark shall be included in the observation. The format of the remark is given in paragraph 15-37, Variable Sky Condition.

12-34. NON-UNIFORM SKY COVER

Observers shall be alert to variations in sky condition that are not reflected in the sky cover reported in the body of the observation. When non-uniform sky conditions are observed (for example, a significant lower ceiling in a particular direction from the station), the observer shall describe the condition in the remarks section. Unless a height is available from a reliable source, the height shall be described in relation to the heights reported in the body of the report. For example, **CIG LWR N** would indicate that ceilings are lower to the north.

12-35. ESTIMATED CEILING HEIGHTS

Ceiling heights may be estimated by any of the following methods:

a. Use of height reported by a pilot (converted from height above mean sea level to height above surface).

b. Use of ceiling or pilot balloons of known ascension rate with the following procedures to estimate ceiling heights.

(1) Choose and inflate the appropriate colored balloon; red balloons are usually preferred with thin clouds and blue or black balloons under other conditions.

(2) Release and watch the balloon continuously to determine, with a watch, the length of time that elapses between release of the balloon and its entry into the base of the layer. The point of entry, for layers aloft, will be considered as midway between the time the balloon begins to fade until the time the balloon completely disappears.

(3) Determine the height above the surface corresponding to the elapsed ascent time, using Figure 17-1, 10-Gram Balloon Ascension Rates, or Figure 17-2, 30-Gram Balloon Ascension Rates. The accuracy of the height obtained by the balloon will be decreased when the balloon:

(a) Does not enter a representative portion of the cloud base, or

(b) Is used at night with a light attached, or

(c) Is used during the occurrence of hail, ice pellets, any intensity of freezing rain, or moderate to heavy rain or snow

c. Use of the Convective Cloud-Base Height Diagram (Figure 12-6). Use this diagram only to estimate the height of cumulus clouds formed in the vicinity of the station. It cannot be used at stations in mountainous or hilly terrain, or to determine the height of other than cumulus clouds. This diagram is most accurate when used to determine the height of cloud bases below 5,000 feet. Use the dry-bulb temperature and dew point to obtain the height of cloud bases above the point of observation as follows:

(1) Locate the point of intersection of the vertical line corresponding to the observed dew point temperature, and the curve (sloping upward to the left) corresponding to the observed dry-bulb temperature. (Note: Use Celsius or Fahrenheit scales, as appropriate.)

(2) From the point of intersection, move horizontally to the height scale printed, in feet, on the right side of the diagram. This value is a good estimate of the height of the cloud base.

d. Use of known heights of unobscured portions of abrupt, isolated objects within 1 1/2 miles from any runway of the airport.

e. Use of observational experience; provided that other guides are lacking or, in the opinion of the observer, are considered to be unreliable.

f. Use of a ceiling light where heights indicated are less than or equal to 10 times the baseline.

g. Determine the ceiling height, where practicable, by balloons if the ceiling cannot be determined with a ceilometer, ceiling light, or pilot report, and:

(1) the ceiling is at, or below, the minimum height for VFR operations, in the airport traffic area, or

(2) the ceiling height is 2,000 feet or less and the presence of a stratus-type cloud layer makes estimation difficult.

12-36. VARIABLE CEILING HEIGHT

Rapid fluctuations of the ceilometer indications, or the spot from a ceiling light projector, will indicate an irregular base whose height is measured, but also variable. When the height of a ceiling layer increases and decreases rapidly during the period of evaluation by the amounts given in Figure 12-4, Criteria for Variable Ceiling, and the ceiling height is below 3,000 feet, it shall be considered variable and the ascribed height shall be the average of all the values. A remark shall be included in the observation giving the range of variability (see paragraph 15-35, Variable Ceiling Height). Variable ceilings at or above 3,000 feet may be reported as variable only if considered operationally significant.

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

Figure 12-4. Criteria for Variable Ceiling

12-37. SIGNIFICANT CLOUDS

Observers shall be alert for the occurrence of cumulonimbus, towering cumulus, altocumulus castellanus, standing lenticular, or rotor clouds and report them whenever they occur. These clouds may be reported by entering a remark in METAR and SPECI observations. The remark shall contain the identification of the cloud, and (insofar as known) the direction and distance from the station and, for cumulonimbus clouds, the direction of movement. See paragraph 15-38, Significant Cloud Types, for detailed instructions on coding these remarks. Cumulonimbus (**CB**) or towering cumulus (**TCU**) shall be appended to the appropriate layer in the body of the observation. When TCU or CB is appended to the layer report accompanied by the remark, “TCU NW” or “CB NW MOV E”, it is implied that the TCU or CB is associated with the layer and within 10 SM. When TCU or CB is outside 10 SM, a DSNT remark is appropriate, for example, “TCU DSNT NW”. (In this case, TCU or CB would not be appended to the layer in the body of the METAR.) Also, see paragraph 15-38, Significant Cloud Type.

12-38. CLOUD TYPES (NA LAWRS)

At designated locations, synoptic cloud types shall be reported and coded. See paragraph 15-53, Cloud Types, for detailed instructions on coding these remarks.

12-39. OPERATION OF EQUIPMENT

Practices and procedures for the operation of sky condition instruments and related equipment are presented in Chapter 17, Operation of Equipment.

Sky Cover Layers	Summation	Appropriate Contraction	Sky Cover Entries Col. 10	Col. 14
3/8 sky hidden by fog 3/8 sky cover at 1,000 feet 1/8 sky cover at 5,000 feet	3/8 6/8 7/8	SCT BKN BKN	SCT000 BKN010 BKN050	FG SCT000
Less than 1/8 sky cover at 500 feet Less than 1/8 sky cover at 2,000 feet 3/8 sky cover at 3,000 feet less than 1/8 sky cover at 9,000 feet	1/8 2/8 5/8 6/8	FEW FEW BKN BKN	FEW005 FEW020 BKN030 BKN090	
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 cover at 5,000 feet 1/8 sky cover at 35,000 feet	1/8 3/8 4/8	FEW SCT SCT	FEW010 SCT050 SCT350	FU FEW010
Sky hidden by snow, vertical visibility 1,000 feet	8/8	VV	VV010	
7/8 sky hidden by fog 1/8 sky cover at 500 feet	7/8 8/8	BKN OVC	BKN000 OVC005	FG BKN000

Figure 12-5. Examples: Summation of Sky Cover

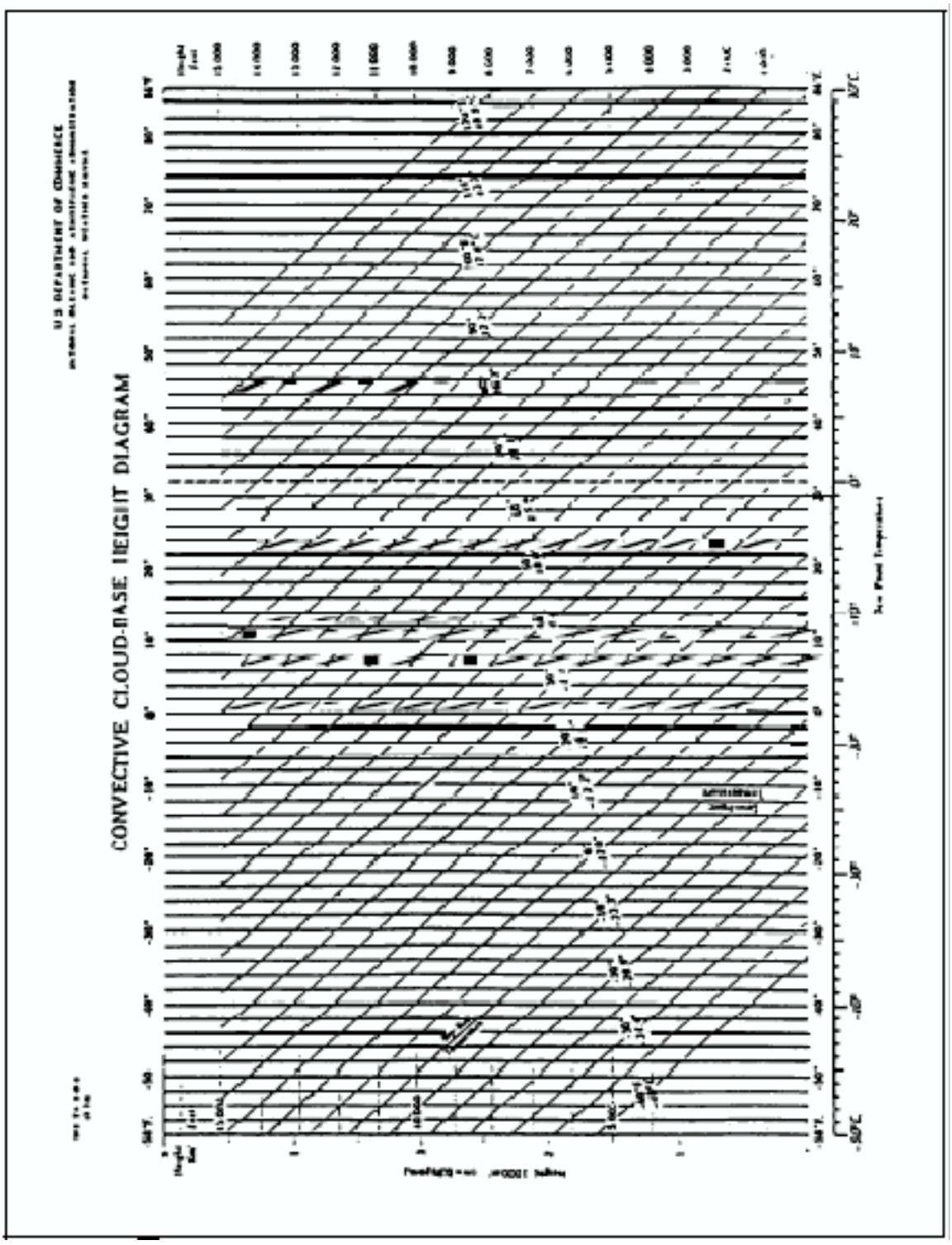


Figure 12-6. Convective Cloud-Base Height Diagram

CHAPTER 13. TEMPERATURE AND DEW POINT

13-1. INTRODUCTION

This chapter describes procedures for observing and reporting temperature and dew point in a METAR or SPECI observation. The temperature data obtained using the procedures and practices in this chapter are normally in terms of the Celsius scale. However, temperature may be given in both degrees Fahrenheit and Celsius since some instruments may be marked in only one scale. Dew point shall be calculated with respect to water at all temperatures. Practices and procedures for the operation of temperature and humidity instruments and related equipment are presented in Chapter 17, Operation of Equipment.

SECTION 1. DEFINITIONS

13-2. TEMPERATURE

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 ambient temperature registered by the dry-bulb thermometer of a psychrometer. It is identical with the temperature of the air and may also be used in that sense.

c. Wet-bulb. The temperature an air parcel would have if cooled to saturation by evaporation of water at constant pressure.

13-3. HYGROMETER

A hygrometer is an instrument which measures the water-vapor content of the atmosphere.

13-4. HYGROTHERMOGRAPH

A hygrothermograph is a recording instrument that combines the thermograph with a humidity sensor for providing a continuous chart record of both temperature and humidity data.

13-5. HYGROTHERMOMETER

A hygrothermometer is an instrument system usually with readouts inside the weather office or observer's building for obtaining ambient temperature and dew point from remote sensors.

13-6. INSTRUMENT SHELTER

An instrument shelter is a box-like structure designed to protect temperature measuring instruments from exposure to direct sunshine, precipitation, and condensation, while at the same time providing adequate ventilation.

13-7. MAXIMUM THERMOMETER

A maximum thermometer is 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.

13-8. MINIMUM THERMOMETER

A minimum thermometer is 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.

13-9. PSYCHROMETER

A psychrometer is an instrument used for measuring 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.

13-10. PSYCHROMETRIC CALCULATOR

A psychrometric calculator is 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. Instructions for the use of this calculator are printed on it.

13-11. PSYCHROMETRIC TABLES

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

13-12. RELATIVE HUMIDITY

Relative humidity is the ratio, expressed as a percentage, of the actual vapor pressure of the air to the saturation vapor pressure.

13-13. SLING PSYCHROMETER

A sling psychrometer is 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 maximum wet-bulb depression has been obtained.

13-14. TOWNSEND SUPPORT

A townsend support is 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.

13-15. THERMOGRAPH

A thermograph is a self-recording thermometer which provides a continuous record of temperature on a chart mounted upon a clock-driven cylindrical drum.

13-16. WET-BULB DEPRESSION

Wet-bulb depression is the difference between the dry- and wet-bulb temperatures.
Examples:

Wet bulb	Dry bulb	Wet bulb Depression
4.6C	10.3C	5.7C
21.5C	21.9C	0.4C

SECTION 2. TEMPERATURE AND DEW POINT OBSERVING PRACTICES

13-17. TEMPERATURE AND DEW POINT OBSERVING PRACTICES - GENERAL

The provisions of this section and its subsections are not applicable at LAWRS. Observing practices and procedures for LAWRS personnel are given later in Section 4 of this chapter. The method of obtaining temperature and dew point varies according to the system in use at the station. The data may be read directly from digital or dial readouts, or calculated from other measured values. A partial Fahrenheit to Celsius Conversion Table is provided in appendix E. The formulas utilized for conversion are: C= 5/9 (F-32) or F= 9C/5 + 32.

13-18. DRY- and WET-BULB TEMPERATURES (NA LAWRS)

The observer shall obtain data from instruments in the following order of priority:

a. Dry-bulb

(1) Hygrothermometer, if the temperature is above -50ºF (-45°C), or

(2) Psychrometer, equipped with a mercury thermometer, if the temperature is above -35ºF (-37°C), or

(3) Psychrometer, equipped with a spirit thermometer, if the temperature is -35ºF (-37°C) or less, or

(4) A thermograph

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

(1) Psychrometer, if the dry-bulb temperature is above -30ºF (-34°C)

(2) Dry-bulb reading of the psychrometer, if the dry-bulb temperature is -30ºF (-34°C) or below

13-19. DEW POINT TEMPERATURES (NA LAWRS)

The observer shall obtain dew point temperatures from:

a. A hygrothermometer, if the dry-bulb temperature is above -30ºF (-34°C), or

b. Dry-bulb and wet-bulb temperatures, if a hygrothermometer is not available and the dry-bulb temperature is above -30ºF (-34°C), or

c. The dry-bulb temperature, if the dry-bulb temperature is -30ºF (-34°C) or below. To do this, the observer shall assume that the dew point with respect to ice is the same as the dry-bulb temperature and convert it to the corresponding dew point with respect to water using a psychrometric calculator. When the dew point temperature from the system in use equals or exceeds the dry-bulb temperature and the system is within operational limits:

d. The observer shall 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 liquid fog is present, or

e. 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 if the wet-bulb wick is frozen or ice fog is present.

13-20. OBTAINING PSYCHROMETRIC DATA

The method of obtaining temperature, dew point, and relative humidity values varies with the system in use at the station. The following three paragraphs describe the various methods.

13-21. HYGROTHERMOMETER (NA LAWRS)

The observer shall obtain psychrometric data from the station's standby system whenever any of the following occur in relation to the station's hygrothermometer.

a. Errors that exceed 2°F (1.1°C) in ambient air temperature or, for dew point temperatures that exceed the limits in Figure 13-1, Chilled Mirror Hygrothermometers - Dew Point Comparison Difference in °F, or Figure 13-2, Chilled Mirror Hygrothermometers - Dew Point Comparison Difference in °C.

b. If the dew point is higher than the dry-bulb temperature or if the comparison checks indicate that the sensor is out of calibration, the observer shall discontinue use of the sensor until it has been serviced and calibrated.

13-22. MANUALLY OR MOTOR ASPIRATED PSYCHROMETER (NA LAWRS)

a. Near Freezing Temperature. At wet-bulb temperatures near freezing, the observer shall determine visually that the wet-bulb is unfrozen before using wet-bulb depression data.

b. Unobtainable Depression. When the wet-bulb is covered with water and a depression cannot be obtained, the relative humidity shall be regarded as 100% and the temperature of the dew point the same as that of the wet-bulb. If the wet-bulb is covered with ice and a depression cannot be obtained, the observer shall use the relative humidity and the dew point converted to their equivalent value with respect to water, unless liquid fog is present at the station. In this latter instance, the relative humidity shall be regarded as 100% with respect to water and the dew point the same as the wet-bulb temperature.

Temperature/Dew Point Spread °F *	Dew Point Ranges *		
	>32°F	32°F to -0.4°F	-0.5°F to -31°F
	Maximum Allowable Dew Point Error		
0.0 - 11.7	2.0	3.4	4.5
11.8 - 15.3	2.2	3.4	4.5
15.4 - 17.1	2.3	3.6	4.5
17.2 - 18.9	2.5	3.8	4.5
19.0 - 20.7	2.7	4.1	4.5
20.8 - 22.5	2.9	4.5	4.5
22.6 - 24.3	3.1	5.0	5.0
24.4 - 26.1	3.2	5.4	5.4
26.2 - 27.9	3.4	5.8	5.8
28.0 - 29.7	3.6	6.3	6.3
29.8 - 33.3	3.8	6.7	6.7
33.4 - 40.5	4.5	7.9	7.9
40.6 - 49.5	5.6	7.9	7.9
49.6 - 58.5	6.8	11.9	11.9
58.6 - 63.0	7.9	13.9	13.9
* Determined from station standard (at sensor site)			

Figure 13-1. Chilled Mirror Hygrothermometers - Dew Point Comparison Difference in °F (e.g., HO-83, 1088, etc.)

Temperature/Dew Point Spread °C *	Dew Point Ranges *		
	>0°C	0°C to -18.0°C	-18.1°C to -35°C
	Maximum Allowable Dew Point Error		
0.0 - 6.5	1.1	1.9	2.5
6.6 - 8.5	1.2	1.9	2.5
8.6 - 9.5	1.3	2.0	2.5
9.6 - 10.5	1.4	2.1	2.5
10.6 - 11.5	1.5	2.3	2.5
11.6 - 12.5	1.6	2.5	2.5
12.6 - 13.5	1.7	2.8	2.8
13.6 - 14.5	1.8	3.0	3.0
14.6 - 15.5	1.9	3.2	3.2
15.6 - 16.5	2.0	3.5	3.5
16.6 - 18.5	2.1	3.7	3.7
18.6 - 22.5	2.5	4.4	4.4
22.6 - 27.5	3.1	4.4	4.4
27.6 - 32.5	3.8	6.6	6.6
32.6 - 35.0	4.4	7.7	7.7
* Determined from station standard (at sensor site)			

Figure 13-2. Chilled Mirror Hygrothermometers - Dew Point Comparison Difference in °C (e.g., HO-83, 1088, etc.)

13-23. PSYCHROMETRIC COMPUTATIONS

The observer shall use the dry-bulb and wet-bulb temperatures to calculate the dew point and relative humidity with psychrometric calculators or psychrometric tables based on atmospheric pressures of 23, 25, 27, 28, 29, or 30 inches of mercury. If available, the observer shall use a psychrometric calculator with the appropriate range rather than tables.

a. Psychrometric Calculator. The observer shall use the appropriate psychrometric calculator to convert dew point values with respect to ice to a corresponding value over water. On the low-temperature face of the calculator, equivalent values of dew point appear opposite each other on the DP (or T_w, DP) and T_i scale: e.g., a dew point of 20°F (-6.7°C) with respect to ice is equivalent to 18.5°F (-7.5°C) with respect to water.

b. Psychrometric Tables. For psychrometric data outside the range of calculators, the observer shall use the Smithsonian Meteorological Tables. The observer shall use Table 99 for reduction of the data and Tables 100 and 101 for converting between relative humidities with respect to ice and with respect to water. The observer shall use Table 102 for similarly converting dew points.

SECTION 3. OBSERVING, DETERMINING, AND REPORTING PROCEDURES

The provisions of this section and its subsections are not applicable at LAWRS sites.

13-24. STATION PRIMARY SYSTEM (NA LAWRS)

The observer shall use the first operable system from the following list to obtain temperature and additional psychrometric data.

a. Hygrothermometer

b. Psychrometer

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

d. Corrected values from thermograph or hygrothermograph charts

13-25. HYGROTHERMOMETER (NA LAWRS)

Record the temperature and dew point using the values displayed from the hygrothermometer.

13-26. LIQUID-IN-GLASS THERMOMETER (NA LAWRS)

The temperature from mercury- or alcohol-in-glass thermometers in psychrometers shall be observed as follows:

The observer shall stand as far from the thermometer as possible to prevent body heat from affecting the readings. To minimize errors of parallax, the observer shall make sure that the line of sight from the observer's eye to the top of the liquid column is level. The observer shall read the dry- and wet-bulb temperatures to the nearest tenth (0.1) of a degree.

13-27. THERMOGRAPH OR HYGRO-THERMOGRAPH (NA LAWRS)

a. The temperature shall be read at the point on the chart where the appropriate printed time curve intersects the temperature trace. The observer shall interpolate for values of temperature and time between printed lines.

b. The humidity scale is based on values from 0 to 100 percent and humidity shall be determined similar to deriving temperature values from hygrographs or hygrothermographs. When the hygrograph position is adjusted to correspond with the psychrometric readings made at dry-bulb temperatures below freezing, the psychrometric value of relative humidity with respect to water shall be used. Hygrograms shall be evaluated according to local needs and disposed of when appropriate. Hygrograph data shall not be entered on observational records unless specifically authorized.

c. Where less than 24 METAR observations are taken daily, the observer shall read (to the nearest degree) the corrected temperature from the thermograph for the hours when personnel are not on duty. If the thermograph is inoperative, the observer shall not interpolate between available recorded and observed data. This data shall be reported as missing.

13-28. DRY-BULB AND DEW POINT TEMPERATURE (NA LAWRS)

Temperature (dry-bulb) and dew point shall be determined at all stations and reported in the body of the METAR and SPECI. The reporting resolution for the temperatures and the dew point in the body of the report shall be whole degrees Celsius. The reporting resolution for the temperatures and dew points in the remarks

section of the report at designated stations shall be to the nearest tenth of a degree Celsius. The observer shall report the dry-bulb and dew point temperature in each METAR and SPECI. Dew point shall be calculated with respect to water at all temperatures.

13-29. MAXIMUM AND MINIMUM TEMPERATURE (NA LAWRS)

Designated facilities shall determine and report in remarks the maximum and minimum temperatures that occurred in the previous 6 hours to the nearest tenth of a degree Celsius for the 0000, 0600, 1200, and 1800 UTC observations. Stations shall also determine and report the calendar day (LST) maximum and minimum temperatures to the nearest tenth of a degree Celsius. If the midnight LST observation is also a 6-hour synoptic observation, the observer shall determine and report both the 6-hour temperatures and the past 24-hour maximum and minimum temperatures. The format for reporting these temperatures is given in paragraphs 15-56, 6-Hourly Maximum Temperature, through 15-58, 24-Hour Maximum and Minimum Temperature. The observer shall obtain maximum and minimum temperature values from available equipment and determine them to the nearest tenth of a degree Celsius according to the following:

a. Maximum/Minimum Extremes. Obtain values from maximum/minimum indicators in use (hygrothermometer or mercury- or spirit-in-glass thermometers) when properly reset for exposure throughout the 6-hour period. If for any reason a maximum or minimum indicator has not been properly exposed or reset for the observation period, disregard the indicated readings, and if a thermograph is not available for determination of these data, obtain the maximum and minimum values from the dry-bulb entries in Column 19, MF1M-10C. If none of the preceding procedures are possible, consider the value(s) as missing.

b. Thermograph or Hygrothermograph. If values are not available from maximum/minimum indicators, determine the values from a corrected recorder chart of a thermograph or hygrothermograph.

13-30. RELATIVE HUMIDITY COMPUTATIONS

When there is a local need for these data, determine the values to the nearest percent using a psychrometric calculator or table appropriate for the elevation of the station.

SECTION 4. OBSERVING AND REPORTING PROCEDURES AT LAWRS (ONLY LAWRS)

13-31. STATION PRIMARY SYSTEM (ONLY LAWRS)

The observer shall use the first available operative system of the following for obtaining temperature and/or psychrometric data.

a. Hygrothermometer, stand-alone temperature measuring device, or equivalent system.

b. Psychrometer.

13-32. HYGROTHERMOMETER OPERATING RANGE (ONLY LAWRS)

a. Temperature: -50°F to 120°F (-45°C to 48°C).

b. Dew Point: -20°F to 80°F (-28°C to 26°C).

13-33. EVALUATING HYGROTHERMOMETER DATA (ONLY LAWRS)

If data is within the operating range of the hygrothermometer, the observer shall obtain data in accordance with the following:

a. Face each indicator on as direct a line of sight as possible to minimize parallax errors.

b. Observe temperatures to the nearest tenth of a degree Celsius or Fahrenheit from the left edge of the indicator.

c. Do not report data if standby equipment is not available and the reading exceeds the operating range of the hygrothermometer.

d. If the temperature is below -30°F (-34°C), disregard the dew point indicated on the instrument and assume the temperature of the dew point to be the same as the dry-bulb temperature with respect to ice. Convert the dry-bulb temperature to the corresponding dew point temperature with respect to water using a psychrometric calculator or nomograph.

13-34. PSYCHROMETER (ONLY LAWRS)

The observer shall use a psychrometer equipped with mercury thermometers to determine dry-bulb and wet-bulb temperatures if the dry-bulb temperature is above -30°F (-34°C). If the dry-bulb temperature is -30°F (-34°C) or less:

a. The observer shall use a psychrometer equipped with a spirit dry-bulb thermometer, in the range of -50°F to 110°F (-45°C to 43°C) or -80°F to 110°F (-62°C to 43°C), to obtain dry-bulb temperature, and

b. Disregarding the wet-bulb reading, use the dry-bulb temperature to compute the dew point as described in paragraph 13-35, Dew Point Temperatures (Only LAWRS).

13-35. DEW POINT TEMPERATURES (ONLY LAWRS)

The observer shall obtain dew point temperatures from:

a. Dry-bulb and wet-bulb temperatures if the temperature is above -30°F (-34°C), or

b. The dry-bulb temperature if the dry-bulb temperature is -30°F (-34°C) or below. To do this, the observer shall assume that the dew point with respect to ice is the same as the dry-bulb temperature and convert it to the

corresponding dew point with respect to water using a psychrometric calculator or nomograph.

13-36. PSYCHROMETER OBSERVING PROCEDURES (ONLY LAWRS)

When readings are being made, the observer shall:

a. Stand as far away from the thermometer as possible to prevent body heat from affecting the indicated readings.

b. To minimize errors of parallax, make sure that the line of sight from the observer's eye to the top of the liquid column is level.

13-37. PSYCHROMETRIC EVALUATIONS (ONLY LAWRS)

a. Near Freezing Temperature. At wet-bulb temperatures near freezing, the observer shall determine visually that the wet-bulb is unfrozen before using wet-bulb depression data.

b. Temperature Below Freezing. At wet-bulb temperatures below 0°C, if the wick is not frozen, the observer shall touch the wick with clean ice, snow or another cold object to induce freezing. The resulting dew point values with respect to ice shall be converted to corresponding values over water.

c. Unobtainable Depression. When the wet bulb is covered with water and a depression cannot be obtained, the relative humidity shall be regarded as 100 percent. Consider the temperature of the dew point to be the same as the dry-bulb. If the wet-bulb is covered with ice and a depression cannot be obtained, consider the dew point to be the same as the dry-bulb temperature with respect to ice and convert it to its water equivalent. If liquid fog (not freezing fog) is present, the dew point is the same as the dry-bulb temperature.

13-38. PSYCHROMETRIC COMPUTATIONS (ONLY LAWRS)

Dry-bulb and wet-bulb temperatures shall be used to calculate relative humidity and dew point with psychrometric tables, nomograms or calculators based on atmospheric pressures of 23, 25, 27, 28, 29 and 30 inches of mercury. If a psychrometric calculator is available, it shall be used over its range rather than tables.

13-39. DEW POINT CONVERSION (ONLY LAWRS)

a. Psychrometric Calculator. The observer shall use the appropriate psychrometric calculator to convert dew point values with respect to ice to corresponding dew point values with respect to water. On the low temperature face of the calculator, equivalent values of dew point appear opposite each other on the DP (or T_W, DP) and T_i scale; e.g., a dew point of 20°F (-6.7°C) with respect to ice is the equivalent of 18.5°F (-7.5°C) with respect to water.

b. Psychrometric Tables. For psychrometric data outside the range of calculators, the observer shall use the Smithsonian Meteorological Tables. The observer shall use Table 99 for reduction of the data and Tables 100 and 101 for converting between relative humidities with respect to ice and with respect to water. The observer shall use Table 102 for similarly converting dew points.

CHAPTER 14. PRESSURE

14-1. INTRODUCTION

This chapter presents procedures and practices to be followed for the measuring, recording, and reporting of pressure. Atmospheric pressure is the force exerted by the atmosphere at a given point. Section 1, Definitions, defines pressure related terminology, Section 2, Observing, Determining and Reporting Procedures (NA LAWRS), covers the procedures for observing, determining and reporting pressure at sites other than LAWRS, and Section 3, Observing, Determining and Reporting Procedures at LAWRS, covers procedures at LAWRS. Practices and procedures for the operation of pressure measuring instruments and related equipment are presented in Chapter 17, Operation of Equipment.

SECTION 1. DEFINITIONS

14-2. ALTIMETER SETTING (ALTSG)

Altimeter setting defines the pressure value to which an aircraft altimeter scale is set so that the altimeter indicates the altitude above mean sea level of an aircraft on the ground at the location for which the value was determined. Altimeter setting shall be reported in the body of all reports (METAR and SPECI). Other pressure data (including sea level pressure) shall be reported in the remarks section only.

14-3. ATMOSPHERIC PRESSURE

Atmospheric pressure is the pressure exerted by the atmosphere at a given point. The various pressure parameters shall be determined from the barometric pressure after appropriate corrections are applied. The method used shall depend on the type of sensor and the available computational aids. These aids may be systems that result in a direct readout of the desired parameter, pressure reduction calculators, or tables. Designated stations may use constants to convert measured pressure to the desired pressure parameter.

14-4. BAROMETRIC PRESSURE

The atmospheric pressure measured by a barometer is barometric pressure. In this chapter, the term "barometric pressure" refers to the actual pressure sensor value. The sensor value may be an altimeter setting, station pressure, or simply a direct pressure value without applied corrections depending on the type of sensor.

14-5. FIELD ELEVATION, H_a

Field elevation, H_a, is the elevation of the highest point on any of the runways of the airport.

14-6. PRESSURE ALTITUDE, PA

Pressure altitude is the altitude, in the standard atmosphere, at which a given pressure will be observed. It is the indicated altitude of a pressure altimeter at an altitude setting of 29.92 inches (1013.2 hPa) of mercury and is therefore the indicated altitude above or below the 29.92 inches constant-pressure surface.

14-7. PRESSURE CHANGE (NA LAWRS)

Pressure change is the net difference between the barometric pressure at the beginning and end of a specified interval of time, usually the 3-hour period preceding an observation. If the pressure is rising or falling at a rate of at least 0.06 inch per hour and the pressure change totals 0.02 inch or more at the time of the observation, a pressure change remark shall be reported.

14-8. PRESSURE CHARACTERISTIC (NA LAWRS)

Pressure characteristic is 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 an observation.

14-9. PRESSURE FALLING RAPIDLY (NA LAWRS)

Pressure falling rapidly occurs when station pressure falls at the rate of 0.06 inch (2.03 hPa) or more per hour which totals 0.02 inch (0.68 hPa) or more at time of observation.

14-10. PRESSURE RISING RAPIDLY (NA LAWRS)

Pressure rising rapidly occurs when station pressure rises at the rate of 0.06 inch (2.03 hPa) or more per hour which totals 0.02 inch (0.68 hPa) or more at time of observation.

14-11. PRESSURE TENDENCY (NA LAWRS)

Pressure tendency is the pressure characteristic and amount of pressure change during a specified period of time, usually the 3-hour period preceding an observation. The pressure tendency includes two parts: the characteristic (an indication of how the pressure has been changing over the past three hours) and the amount of the pressure change in the past three hours. The characteristic shall be based on the observed or recorded (barogram trace) changes in pressure over the past three hours. The amount of pressure change is the absolute value of the change in station pressure or altimeter setting in the past three hours converted to tenths of hectopascals.

14-12. SEA LEVEL PRESSURE

Sea level pressure is a pressure value obtained by the theoretical reduction of barometric 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 that the properties of the hypothetical atmosphere are related to conditions observed at the station. Sea level pressure shall be computed at designated stations by adjusting the station pressure to compensate for the difference between the station elevation and sea level. This adjustment shall be based on the station elevation and the 12-hour mean temperature at the station. The 12-hour mean temperature shall be the average of the present ambient temperature and the ambient temperature 12 hours ago. Stations within $\pm$ 50 feet of sea level may be authorized to use a constant value to adjust station pressure to sea level pressure. Otherwise, stations shall use reduction ratios to calculate sea level pressure. When sea level pressure is missing at stations that would normally report sea level pressure, the remark SLPNO shall be added in the remarks section. (See paragraph 15-41, Sea-Level Pressure.)

14-13. STANDARD ATMOSPHERE

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

14-14. STATION ELEVATION, H_p

Station elevation, H_p, is the officially designated height above sea level to which station pressure pertains. There may be occasions when the station elevation differs from the field elevation.

14-15. STATION PRESSURE

Station pressure is the atmospheric pressure at the assigned station elevation (H_p). Station pressure shall be determined by adjusting the corrected barometric pressure to compensate for the difference between the height of the barometer and the designated station elevation.

14-16. DENSITY ALTITUDE, DA

Density altitude, DA, is the pressure altitude corrected for virtual temperature deviations from the standard atmosphere.

14-17. BAROMETER ELEVATION, HZ

Barometer elevation (HZ) is the height of the pressure instrument(s) above mean sea level surveyed accurately to within one foot. At LAWRS, this height is posted on or immediately adjacent to the instrument(s).

14-18. POSTED PRESSURE CORRECTION

At LAWRS, posted pressure correction is the value added to the reading obtained from the station's altimeter setting indicator (ASI), or digital altimeter setting indicator (DASI), to correct it to a comparison standard.

14-19. RESERVED

SECTION 2. OBSERVING, DETERMINING AND REPORTING PROCEDURES (NA LAWRS)

14-20. GENERAL (NA LAWRS)

The provisions of this section are not applicable at LAWRS. Procedures and practices to be followed at LAWRS are given in Section 3, Observing, Determining and Reporting Procedures at LAWRS. Observing procedures shall 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. Details regarding the adjustment and reading of pressure measuring equipment are given in Chapter 17, Operation of Equipment. (See Figure 14-1, Units of Measure of Pressure Parameters.)

Parameter	Units of Measure
Altimeter Setting	Inches of Mercury
Sea Level Pressure	Hectopascals
Station Pressure	Inches of Mercury

Figure 14-1. Units of Measure of Pressure Parameters

14-21. ROUNDING PRESSURE VALUES

When computations of pressure values require that a number be rounded to comply with standards on reportable values, the number shall be rounded down to the next reportable value. For example, an altimeter reading of 29.248 inches becomes 29.24 and a station pressure reading of 29.249 inches becomes 29.245.

14-22. BAROMETERS USED TO MEASURE STATION PRESSURE (NA LAWRS)

Common pressure measuring instruments are listed in Figure 14-2, Barometers Used. ASOS, AWOS, digital altimeter setting indicators (DASI's) and electronic pressure transducers are highly accurate pressure standards and operational barometers that require very little, or no correction by the human observer. This equipment is replacing the mercury barometer as the station pressure standard. Procedures for using some of these instruments for the determination of station pressure follow in paragraphs 14-23 through 14-27.

Commissioned ASOS
Commissioned AWOS
Commissioned Electronic Pressure Transducer
Precision Aneroid
Altimeter Setting Indicator (ASI)
Digital Altimeter Setting Indicator (DASI)
Microbarograph (chart scale 2.5 to 1)
Mercury Barometer

Figure 14-2. Barometers Used

14-23. PRECISION ANEROID (NA LAWRS)

The following procedures shall be followed when using a precision aneroid to determine station pressure:

Step 1. Tap the face of the instrument lightly with the finger to reduce the effect of friction.

Step 2. Read the scale at the pointer, to the nearest 0.005 inch or 0.1 hPa, estimating values between the graduations.

Step 3. Apply the posted correction. (See paragraph 17-50, Standardizing Procedures, regarding the determination of this correction.)

Step 4. Facilities that are required to use a variable removal correction shall add the removal correction, appropriate for the current outside temperature, to the reading obtained in step 3.

14-24. ALTIMETER SETTING INDICATOR (NA LAWRS)

When using an altimeter setting indicator to determine station pressure, the observer shall read the altimeter setting indicator to the nearest 0.005 inch (0.17 hPa) and apply the posted correction. The station pressure shall be computed by use of a pressure reduction computer, reduction constant, or altimeter setting table in accordance with the following:

a. Pressure Reduction Computer. The steps for obtaining altimeter setting as printed on the yellow (No. II) side of the computer shall be followed in reverse order.

b. Reduction Constant. At low level stations for which an altimeter setting reduction constant has been authorized, the observer shall subtract the constant from the altimeter setting and round the remainder to the nearest .005 inch (0.17 hPa) to obtain the station pressure.

c. Altimeter Setting Table.

(1) Use of these tables is authorized at specially designated facilities and at facilities for which a reduction constant or a pressure reduction computer is not available.

(2) At authorized facilities, the observer shall find in the altimeter setting table the tabular value which equals the altimeter setting, interpolating to the nearest 0.005 inch (0.17 hPa) 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).

14-25. DIGITAL ALTIMETER SETTING INDICATOR (DASI) (NA LAWRS)

The primary purpose of the DASI is to obtain an altimeter setting. However, station pressure may also be obtained. The operation of this instrument requires a visual observation of the display and the reporting of the display readout.

14-26. BAROGRAPH (NA LAWRS)

When using a barograph to determine station pressure, the observer shall read the barogram to the nearest 0.005 inch or 0.1 hectopascal and apply any appropriate correction. See paragraph 17-39, Reading Barographs for Station Pressure, for detailed instructions.

14-27. MERCURY BAROMETER (NA LAWRS)

When using a mercury barometer to determine station pressure, the observer shall use the following procedures. Read the attached thermometer to the nearest 0.5°C. Read the pressure scale on the barometer to the nearest 0.001 inch (0.03 hPa). Add to the observed reading the value obtained from the Total Correction Table, or the "Sum of Corrections" from the Barometer Correction Card and the temperature correction from an appropriate table. At facilities where a variable removal correction must be used, the Barometer Correction Card supplied to the station (WS Form B-40A) will contain sums of corrections for different outdoor temperatures. Add the sum of the current outdoor temperature and the temperature correction of the barometer

indicated by the attached thermometer to the reading of the barometer to obtain station pressure. (See paragraphs 17-34 through 17-38 for detailed instructions and a list of authorized tables.)

14-28. SEA LEVEL PRESSURE (NA LAWRS)

a. Frequency (NA LAWRS). The observer shall compute, record, and transmit sea level pressure for each hourly observation.

b. Method (NA LAWRS). The station pressure shall be reduced to sea level pressure by use of a computer, constant, or table.

c. Pressure Reduction Constant (NA LAWRS). This method is authorized only for low-level facilities, elevations and locations listed in FMH No. 8, or in separate instructions. At authorized locations, the sea level reduction constant shall be added to the station pressure to obtain the sea level pressure.

d. Mean Temperature (NA LAWRS). Except at facilities for which a reduction constant has been authorized, the 12-hour mean temperature, to degrees and tenths, shall be computed by adding the current temperature to the temperature 12 hours ago, and dividing the sum by two. If the temperature was not observed 12 hours previously, it shall be obtained from the thermograph or other records, if available. If these sources are not available, the temperature shall not be estimated. For such a case, the mean temperature shall be considered missing and not reported. In addition, the sea level pressure shall be considered as missing and reported in the remarks section as SLPNO at those stations which normally report SLP.

e. Pressure Reduction Ratio, r (NA LAWRS). A table of **r** values shall be used in conjunction with the computer to determine sea level pressure. 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 National Weather Service Headquarters.

f. Pressure Reduction Computer (NA LAWRS). This method is authorized where the computer and a table of pressure reduction ratios, **r**, specially computed for the local station, are available. First, the observer shall find the **r** value in the table which corresponds to the 12-hour mean temperature. Using instructions on the green side of the computer, the observer shall multiply the station pressure by the appropriate **r** value to obtain the sea level pressure. Use of the computer is illustrated by the following example.

Example:

The station is Kalispell, Montana, with an elevation (H_p) of 2,973 feet.

Given: Station Pressure 26.965 inches
12-hour mean temperature 43°F
r value from table .1160

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 .1160. The sea level pressure is read on the **P, P_o** scale beneath the hairline of the cursor. The sea level pressure is 1019.1 hectopascals.

g. Preparation of Pressure Reduction Table (NA LAWRS). The FAA will authorize use of pressure reduction and proportional parts

tables only for facilities which have special needs which cannot be satisfied by use of ratios or a constant. These tables will be prepared by National Weather Service Headquarters.

h. Use of Pressure Reduction Table (NA LAWRS). Employing single or double interpolation as necessary, the observer shall obtain the sea level pressure corresponding to the station pressure and temperature from the table using the following inputs:

(1) The station pressure rounded to the next lower 0.005 inch or 0.1 hectopascal

(2) The 12-hour mean temperature to the nearest 0.1°C (see paragraph 14-28d.)

14-29. DETERMINING ALTIMETER SETTING (NA LAWRS)

The observer shall determine the altimeter setting for all observations. The altimeter setting shall be determined again, when necessary, to meet local requirements. Altimeter setting values should be obtained or derived from one of the following types of instruments:

a. A commissioned DASI, ASOS, or AWOS.

b. A properly calibrated precision aneroid barometer or altimeter setting indicator.

c. A barograph, appropriately corrected, that is compared with a mercury barometer at 6-hour intervals.

d. A calibrated mercury barometer at locations where an aneroid instrument is either inoperative or not available.

14-30. METHOD OF DETERMINING ALTIMETER SETTING (NA LAWRS)

Altimeter setting shall be determined from a certified accurate DASI, or from an ASOS, AWOS, or properly calibrated altimeter setting indicator, if one is available. At facilities where this equipment is not available, the altimeter setting shall be computed by using a computer, constant, or table.

14-31. ALTIMETER SETTING INDICATOR (NA LAWRS)

The following procedures shall be followed when using a nondigital (analog) altimeter setting indicator to determine the altimeter setting:

a. Lightly tap the face of the instrument with the finger to reduce the effect of friction.

b. Read the pressure scale of the indicator at the pointer to the nearest 0.005 inch.

c. Add this reading to the posted correction.

d. Use the sum of the reading and correction, rounded down to the next lower 0.005 inch, when computing the station pressure or pressure altitude from the altimeter setting. Round to the next lower inch and hundredths of an inch when recording and reporting the altimeter setting.

14-32. PRESSURE REDUCTION COMPUTER AND ALTIMETER SETTING (NA LAWRS)

The altimeter setting shall be computed 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.

14-33. ALTIMETER SETTING REDUCTION CONSTANT (NA LAWRS)

At low-level facilities for which an altimeter setting reduction constant has been authorized, the observer shall add the constant to the station pressure and round to inches and hundredths of an inch to obtain the altimeter setting.

14-34. ALTIMETER SETTING TABLE (NA LAWRS)

At authorized facilities, the observer shall find the altimeter setting in inches and hundredths of an inch corresponding to the station pressure to the nearest 0.005 inch from an altimeter setting table as illustrated in Figure 14-3, Portion of an Altimeter Setting Table.

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

Figure 14-3. Portion of an Altimeter Setting Table

Example:

a. Given: Station Pressure 27.730" 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"

14-35. PRESSURE ALTITUDE (PA) (NA LAWRS)

The observer shall compute pressure altitude as frequently as necessary to meet local needs. The observer shall use the station pressure or the altimeter setting, either one to the nearest 0.005 inch (0.17 hPa) in the computations. The military, and other agencies involved in aviation, require the pressure altitude with reference to the field elevation (H_a). In view of this requirement, the observer should select the most convenient of the methods given below, considering availability of station pressure and altimeter setting data and whether or not station elevation (H_p) is equal to H_a.

14-36. LOCAL PRESSURE ALTITUDE TABLES (NA LAWRS)

Special local pressure altitude tables may be prepared for specific locations that are required to use a variable removal correction. Such tables, including temperature corrections, are required for accurate results at locations where the station elevation differs from H_a by approximately 30 feet or more, depending on local variations of temperature from standard atmospheric conditions.

14-37. ALTIMETER SETTING AND PRESSURE REDUCTION COMPUTER (NA LAWRS)

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

a. The observer should set the field elevation on the H scale opposite the altimeter setting on the P, A.S. scale.

b. The observer should 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 approximately 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 to 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.

14-38. ALTIMETER SETTING AND PRESSURE ALTITUDE TABLE (NA LAWRS)

Figure 14-4, Pressure Altitude, or other equivalent 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). When using this table, the observer should 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.

A portion of a Standard Atmosphere Table giving tabular values of pressure altitude is shown in Figure 14-4, Pressure Altitude. An example of determining the pressure altitude using a Standard Atmosphere Table is shown below:

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).

14-39. STATION PRESSURE AND PRESSURE REDUCTION COMPUTER (NA LAWRS)

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.

14-40. STATION PRESSURE AND PRESSURE ALTITUDE TABLE (NA LAWRS)

This 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 Figure 14-4

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

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

Figure 14-4. Pressure Altitude (continued on next page)

Standard Atmosphere Figure 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.
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
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

Figure 14-4. Pressure Altitude (continued on next page)

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.
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

Figure 14-4. Pressure Altitude (continued on next page)

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

Figure 14-4. Pressure Altitude (concluded from previous page)

14-41. PRESSURE RELATED REMARKS (NA LAWRS)

Each significant change in barometric pressure and its characteristics shall be recorded in the remarks section and transmitted.

14-42. PRESSURE FALLING RAPIDLY (NA LAWRS)

Whenever the pressure is falling at the rate of 0.06 inch (2.0 hPa) or more per hour with a total fall of at least 0.02 inch (0.7 hPa) at the time of an observation, the observer shall report **PRESFR** in the remarks section.

14-43. PRESSURE RISING RAPIDLY (NA LAWRS)

Whenever the pressure is rising at the rate of 0.06 inch (2.0 hPa) or more per hour with a total of at least 0.02 inch (0.7 hPa) at the time of observation, the observer shall report **PRESRR** in the remarks section.

14-44. PRESSURE TENDENCY (NA LAWRS)

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

14-45. FREQUENCY OF PRESSURE TENDENCY REMARK (NA LAWRS)

Pressure tendencies should be determined at the time of each 3- and 6-hour observation. At facilities equipped with a barograph, determine the elements from the trace for the full 3-hour period at the actual time of the observation. Facilities not equipped with a barograph shall determine the pressure tendencies from the trend of the altimeter settings entered in column 13 of MF1M-10C.

14-46. DETERMINING PRESSURE CHANGE (NA LAWRS)

Determine the net change in station pressure for the preceding 3 hours to the nearest 0.005 inch by subtraction using the appropriate entries in column 22 (Station Pressure) of MF1M-10C. 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 will not be reported.

14-47. DETERMINING PRESSURE TENDENCY CHARACTERISTIC (NA LAWRS)

Using the code figures in Figure 15-9, Characteristics of Barometer Tendency, 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 Requirements column. This gives the possible code figures.

b. Apply the Description 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. Facilities not possessing a barograph shall determine the characteristic of the trace from altimeter settings recorded in column 13, MF1M-10C, 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 not reported.

SECTION 3. OBSERVING, DETERMINING AND REPORTING PROCEDURES AT LAWRS

14-48. APPLICABILITY (ONLY LAWRS)

The provisions of this section are applicable only at LAWRS.

14-49. GENERAL (ONLY LAWRS)

The only pressure related measurement required at LAWRS is the altimeter setting.

14-50. DETERMINING ALTIMETER SETTING (ONLY LAWRS)

The altimeter setting shall be determined by use of an altimeter setting indicator (ASI), a digital altimeter setting indicator (DASI), ASOS, AWOS, electronic pressure transducer, or a mercury barometer. These instruments shall be routinely compared and corrected as described in this section. The correction for each instrument used to report altimeter setting shall be determined. The latest correction, even if zero, shall be displayed on the instrument. The posted correction shall be added to the instrument's reading before reporting the altimeter setting. Do not change the value of the altimeter setting in the ASOS one-minute page to add a correction. This will turn off report processing, which can only be turned back on by an NWS technician.

14-51. ALTIMETER SETTING FROM ALTIMETER SETTING INDICATORS (ONLY LAWRS)

Altimeter setting indicators may be digital or analog. If a digital instrument is used, the altimeter setting shall be determined by adding the posted correction to the reading. Some digital altimeter setting indicators including electronic pressure transducers do not require any corrections. If an analog instrument is used, the following procedures shall apply:

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

b. Read the pressure scale of the indicator at the pointer, to the next lower 0.005 inch.

c. Determine the correct altimeter setting by adding the posted correction to the reading and rounding the sum down to the nearest inch and hundredths of inches.

14-52. DETERMINING THE RELIABILITY OF ALTIMETER SETTING INDICATORS (ONLY LAWRS)

The reliability of each altimeter setting indicator (ASI) shall be verified as follows:

a. Compare the ASI readings daily with the altimeter setting obtained from an adjacent FSS, LAWRS, or NWS office meeting the criteria of paragraph 14-53, Daily Comparison with an Adjacent Station (Only LAWRS), or weekly with an approved commissioned pressure standard at the facility as described in paragraphs 17-53 through 17-56.

b. If the difference between altimeter settings does not exceed .02 inch at precision approach locations or .05 inch at other locations, the ASI is considered reliable and may be used, with the posted correction, to report altimeter setting values.

c. If all ASIs at the facility exceed limits, the altimeter setting shall not be reported.

d. Instruments which exceed the stated limits shall be reported to maintenance personnel

and, for NWS maintained commissioned ASOS's, or other NWS maintained pressure instruments, to the appropriate NWS office.

e. At locations with a commissioned ASOS, or commissioned dual transducer AWOS units, the ASOS/AWOS becomes the pressure standard. At these commissioned locations, mercurial barometers are no longer required. Per FAA Order 7210.3, an ASI shall be compared to the pressure standard daily and a DASI shall be compared to the pressure standard at least monthly. When the difference is less than the tolerances specified in 14-52, the value (+ or –) is posted on or near the ASI/DASI and applied as the correction factor to determine the operational altimeter setting.

14-53. DAILY COMPARISON WITH AN ADJACENT STATION (ONLY LAWRS)

Locations without an approved pressure standard may compare their altimeter device against values obtained from an adjacent NWS office, FSS, or a LAWRS with an approved pressure standard provided:

a. At locations where precision approaches are conducted, the weather station is not more than 10 nautical miles away and, at both locations, the wind speed is 12 knots or less with no gusts above 15 knots.

b. At all other locations, the distance does not exceed 25 nautical miles and, at both locations, the wind speed shall be 15 knots or less with no gusts above 20 knots.

c. The difference in elevation does not exceed 100 feet at precision approach locations and 200 feet at all other locations.

d. The station's temperature, at both locations, is within 30°F (16ºC) of the Standard Atmosphere Temperature for the station's elevation.

The observer shall not use altimeter setting values from aneroid instruments when the difference exceeds .02 at precision approach locations or .05 at all other locations. (Note: LAWRS locations using an automated sensor, such as ASOS or AWOS, are not required to conduct a daily comparison of the sensor output with an adjacent station.)

14-54. ALTIMETER SETTING FROM A MERCURY BAROMETER (ONLY LAWRS)

Altimeter settings may be obtained from a mercury barometer. The mercury barometer may be used to determine station pressure from which the altimeter setting may be determined. The procedures for using the mercury barometer to determine station pressure are given in paragraphs 17-34 through 17-38. The altimeter setting may be determined from station pressure by use of a pressure reduction computer, reduction constant, or table.

14-55. ALTIMETER SETTING FROM A DASI

Altimeter settings may be obtained from a DASI through direct readings. Some DASI's may have a correction posted from a travelling standard.

14-56. ELECTRONIC PRESSURE TRANSDUCERS OR OTHER DASI'S

A DASI may be used to determine station pressure from which the altimeter setting may be determined. The altimeter setting may be determined from station pressure by use of a pressure reduction computer, reduction constant, table, or by direct readout.

14-57. - 14-60. RESERVED

CHAPTER 15. CODING AND DISSEMINATION

15-1. INTRODUCTION

This chapter contains procedures for coding the aviation weather observation for dissemination. The types of dissemination, and the general requirements for verifying and making corrections to disseminated observations are also discussed.

15-2. DEFINITIONS

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

b. COR. A contraction used to indicate that the observation is a correction to a previously disseminated observation.

c. Dissemination. In this order, dissemination is the act of delivering a completed weather report to users.

d. FIBI. A contraction for a weather observation that is "filed, but impracticable to transmit".

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

f. Long-line Dissemination. The transmission of a weather report by any communication network beyond the service area of the weather station, on a regional or national scale.

15-3. AVIATION WEATHER REPORTS CODE

The METAR/SPECI report has two major sections: the body (consisting of a maximum of 11 groups) and the remarks section (consisting of a maximum of 2 categories). Together, they make up the complete METAR/SPECI report and, in general, are coded as in Figure 15-1, Content of METAR/SPECI.

Elements in the Body of the Report	Reference	METAR/SPECI
Type of Report (METAR/SPECI)	15-7	X
Station Identifier (CCCC)	15-8	X
Date/Time (YYGGggZ)	15-9	X
Report Modifier (AUTO/COR)	15-10	D
Wind (dddff(f)Gf_m f_m(f_m)KT) ($d_nd_nd_nVd_xd_xd_x$)	15-11	X
Visibility (VVVVVSM)	15-12	X
Runway Visual Range ($RD_RD_R/V_RV_RV_RV_RFT$) or ($RD_RD_R/V_nV_nV_nV_nVV_XV_XV_XV_XFT$)	15-13	D
Present Weather (w'w')	15-14	X
Sky Condition ($N_sN_sN_sh_sh_sh_s$ or $VVh_sh_sh_s$ or CLR or SKC)	15-15	X
Temperature/Dew Point (T'T'/$T'_dT'_d$)	15-16	X
Altimeter ($AP_HP_HP_HP_H$)	15-17	X
Categories in Remarks	**Reference**	**METAR/SPECI**
Automated, Manual, and Plain Language	15-19	See Figure 7-1 for a detailed breakout of remarks
Additive and Maintenance Data	15-46	
X - Indicates element included at all facilities. D - Indicates element included only at designated facilities.		

Figure 15-1. Content of METAR/SPECI

15-4. FORMAT AND CONTENT OF THE METAR/SPECI REPORT

Figure 15-2, METAR or SPECI Code Format, outlines the format of the METAR/SPECI code. The actual content of a surface observation depends on the observation program at the individual facility. At designated stations, the 0000, 0600, 1200, and 1800 UTC METAR

METAR or SPECI Code Format
METAR or SPECI_CCCC_YYGGggZ_AUTO or COR_dddff(f)Gf_mf_m(f_m)KT_$d_nd_nd_nVd_xd_xd_x$_VVVVVSM_$RD_RD_R/V_RV_RV_RV_RFT$ or $RD_RD_R/V_nV_nV_nV_nVV_XV_XV_XV_XFT$_w'w'_$N_sN_sN_sh_sh_sh_s$ or $VVh_sh_sh_s$ or SKC or CLR_T'T'/$T'_dT'_d$_$AP_HP_HP_HP_H$_RMK_(Automated, manual and plain language)_(Additive data and automated maintenance indicators)
Note 1. The underline character (_) indicates a required space. Note 2. The solidus "/" indicates a required solidus.

Figure 15-2. METAR or SPECI Code Format

reports include additional data and are known as 6-hourly reports. At designated stations, the 0300, 0900, 1500, and 2100 UTC METAR reports are known as 3-hourly reports and also contain additional information.

15-5. CODING MISSING DATA IN METAR AND SPECI REPORTS

When an element or phenomenon does not occur, or cannot be observed, the corresponding group and preceding space are omitted from that particular report. However, at designated stations where sea-level pressure is normally reported, when sea-level pressure is not available it shall not be omitted, but shall be coded as SLPNO.

15-6. CODING THE BODY OF THE METAR OR SPECI REPORT

Figure 15-1, Content of METAR/SPECI, indicates the applicability of the elements in the body of the surface observation. References in the figure indicate the sections where the elements are discussed and explained. The figure also indicates whether or not the element shall be included in METAR and SPECI reports.

15-7. TYPE OF REPORT (METAR OR SPECI)

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

15-8. 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-only characters if the METAR/SPECI is transmitted long-line. A list of approved identifiers can be found in the latest version of FAA Order 7350.7, Location Identifiers. The station identifier shall be separated from elements following it with a space.

15-9. 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 report, the time of the corrected report shall be the same time used in the report being corrected. The date and time group always ends with a "Z" indicating the use of UTC. For example, METAR KDCA 210855Z would be the 0900 scheduled report from station KDCA taken at 0855 UTC on the 21st of the month.

15-10. REPORT MODIFIER (AUTO or COR)

The Report Modifier can be either of two elements:

a. "AUTO" further identifies the type of report as a fully automated report with no human intervention. The report modifier group does not appear in all reports; the absence of AUTO indicates that the report is either a manual report or an automated report with an observer "logged on" to the system.

b. "COR" shall be entered into the report modifier group when a corrected METAR or SPECI is transmitted.

c. AUTO and **COR** will not be seen in the same observation. If the term **COR** is used, the observation cannot be **AUTO**, because an observer is correcting it.

15-11. 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 true direction, **ddd**, from which the wind is blowing shall be coded in tens of degrees using three figures. Directions less than 100 degrees shall be preceded by a "0", for example, a wind direction of 90° is coded as "090". The wind speed, **ff(f)**, shall be entered as a two or three digit group immediately following the wind direction. The speed shall be coded in whole knots using the hundreds digit (if not zero) and the tens and units digits. The wind group always ends with **KT** to indicate that wind speeds are reported in knots. Speeds of less than 10 knots shall be coded using a leading zero. For example, a wind speed of 8 knots shall be coded 08KT. A wind speed of 112 knots shall be coded 112KT.

a. Gust. Wind gusts shall be coded in the format, **G$f_m f_m(f_m)$**. 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 due west at 20 knots with gusts to 35 knots would be coded "27020G35KT".

b. Variable Wind Direction (Speeds 6 Knots or Less). The wind direction may be reported as **VRB** (variable) in place of the **ddd** whenever the wind speed is 6 knots or less. For example, if the wind is variable at three knots, it would be coded as "VRB03KT".

c. Variable Wind Direction (Speeds Greater than 6 Knots). Variable wind direction with wind speed greater than 6 knots shall be coded in the format, **$d_n d_n d_n V d_x d_x d_x$**. The variable wind direction group shall immediately follow the wind group preceded by a blank 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".

d. Calm Wind. Calm wind shall be coded as "00000KT".

15-12. VISIBILITY GROUP (VVVVVSM)

The surface visibility, **VVVVVSM**, shall be coded in statute miles using the values listed in Figure 15-3, Reporting Visibility Values. A space shall be coded between whole numbers and fractions of reportable visibility values. For example, a visibility of one and a half miles would be coded as "1 1/2SM". The visibility group always ends in **SM** to indicate that visibilities are in statute miles. Only automated stations may use an "M" to indicate "less than" when reporting visibility, e.g., "M1/4SM" means a visibility less than one-quarter SM as reported by an automated station.

Source of Visibility Report							
Automated[3]			Manual				
M1/4	2	9[1]	0	5/8	1 5/8	4	12
1/4	2 1/2	10	1/16	3/4	1 3/4	5	13
1/2	3		1/8	7/8	1 7/8	6	14
3/4	4		3/16	1	2	7	15
1	5		1/4	1 1/8	2 1/4	8	20
1 1/4	6[1]		5/16	1 1/4	2 1/2	9	25
1 1/2	7		3/8	1 3/8	2 3/4	10	30
1 3/4	8[1]		1/2	1 1/2	3	11	35[2]

[1]Designated automated stations only.
[2]Further increments of 5SM may be reported, i.e., 40, 45, 50, etc.
[3]Visibility values of 0, 1/8, and 1/16 can be augmented in the visibility field of ASOS to meet service level requirements.

Figure 15-3. Reportable Visibility Values

15-13. RUNWAY VISUAL RANGE GROUP ($RD_RD_R/V_RV_RV_RV_RFT$) or ($RD_RD_R/V_nV_nV_nV_nVV_xV_xV_xV_xFT$) (NA LAWRS)

a. At designated stations, RVR shall be coded in the format $RD_RD_R/V_RV_RV_RV_RFT$ where **R** indicates that the runway number follows, D_RD_R is the 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), $V_RV_RV_RV_R$ is the constant reportable value, and **FT** indicates that units of measurement are feet.

b. RVR that is varying shall be coded in the format, $RD_RD_R/V_nV_nV_nV_nVV_xV_xV_xV_xFT$, where **R** indicates that the runway number follows, D_RD_R is the 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), $V_nV_nV_nV_n$ is the lowest reportable value in feet, **V** separates lowest and highest visual range values, $V_xV_xV_xV_x$ is the highest reportable value, and **FT** indicates that units of measurement are feet. The 10-minute RVR for runway 01L varying between 600 and 1,000 feet would be coded "R01L/0600V1000FT".

c. The values shall be based on light setting 5 at manual stations. RVR values shall be coded in increments of 100 feet up to 1,000 feet, increments of 200 feet from 1,000 feet to 3,000 feet and in increments of 500 feet from 3,000 feet to 6,000 feet. Manual RVR shall not be reported below 600 feet. For automated stations, RVR may be reported for up to four designated runways. 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 **M**. If the RVR is greater than its highest reportable value, the $V_RV_RV_RV_R$ or $V_nV_nV_nV_n$ groups shall be preceded by a **P**. For example, for an RVR with older (transmissometer) technology, an RVR for runway 01L of less than 600 feet shall be coded "R01L/M0600FT"; an RVR of greater than 6,000 feet shall be coded "R01L/P6000FT". For the New Generation RVR, the report would be similar, except that the lowest and highest values would be replaced by 100 and 6500 feet, respectively.

15-14. PRESENT WEATHER GROUP (w'w')

The appropriate notations in Figure 15-4, Present Weather, shall be used to code present weather. The following general rules apply when coding present weather for a METAR or SPECI:

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

The weather groups shall be constructed by considering columns 1 to 5 in the figure above in sequence, i.e., intensity, followed by description, followed by weather phenomena, e.g., heavy rain shower(s) is coded as +SHRA.
1. To denote moderate intensity, no entry or symbol is used.
2. See paragraph 11-7 for vicinity definition and paragraph 15-14a(2) for usage.
3. Tornadoes and waterspouts shall be coded as +FC.

Figure 15-4. Present Weather

Step 1. Weather occurring at or in the vicinity of the station shall be coded in the body of the report. Weather observed, but not occurring at or in the vicinity of the station, shall be coded in remarks.

Step 2. Except when the descriptor **low drifting** applies, and for volcanic ash, one or more obscurations shall be coded in the body of the report only if the surface visibility is less than 7 miles or considered operationally significant. Volcanic ash is always coded when observed. **MIFG**, **BCFG** and **PRFG** may be reported when visibility is equal to or greater than 7 miles.

Step 3. Separate groups shall be used for each type of present weather, however, up to 3 types of precipitation can be coded in a single

group. Each group shall be separated from the other by a space. A METAR/SPECI shall contain no more than three present weather groups.

Step 4. The weather groups shall be constructed by considering columns 1 to 5 in Figure 15-4, Present Weather, in sequence, i.e. intensity, followed by weather phenomena, e.g., heavy rain shower(s) is coded as +SHRA.

a. Intensity or Proximity Qualifier

(1) Intensity shall be coded with all precipitation types, except ice crystals and hail, including those associated with a thunderstorm (**TS**) and those of a showery nature (**SH**). No intensity shall be ascribed to the obscurations of blowing dust (**BLDU**), blowing sand (**BLSA**), blowing snow (**BLSN**), blowing spray (**BLPY**), well-developed dust/sand whirls (**PO**), and squalls (**SQ**). Tornadoes or waterspouts shall be coded using the indicator +, e.g., "+FC", while a funnel cloud shall always be coded "FC". Only moderate or heavy intensity shall be ascribed to sandstorm (**SS**) and Duststorm (**DS**).

(2) The proximity qualifier for vicinity, **VC** (weather phenomena observed in the vicinity of but not at the point of observation), shall only 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**). **VCTS** is only used at automated stations. Intensity qualifiers shall not be coded with **VC**. **VCFG** shall be coded to report any type of fog in the vicinity of the point(s) of observation. Precipitation not occurring at the point of observation but within 10 statute miles shall be coded as showers in the vicinity (**VCSH**).

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

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

(a) For MIFG (shallow fog) to be coded, fog shall cover part of the station, extend no higher than 6 feet above the ground, with visibility more than 6 feet above the ground 5/8SM or more, while the apparent visibility in the fog layer is less than 5/8SM.

(b) For PRFG (partial fog) to be coded, fog shall cover a substantial part of the station, extend to at least 6 feet above the ground with visibility in the fog less than 5/8SM.

(c) For BCFG (fog patches) to be coded, fog shall randomly cover part of the station, extend to at least 6 feet above the ground, with the apparent visibility in the fog patch or bank less than 5/8SM while visibility over other parts of the station is greater than or equal to 5/8SM.

(2) 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 6 feet above the ground. 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. **BL** may also be coded with spray (**PY**).

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

(4) The descriptor thunderstorm (**TS**) may be coded by itself, i.e., a thunderstorm without associated precipitation, or it may be coded with the precipitation types of rain (**RA**), snow (**SN**), ice pellets (**PL**), 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". **TS** shall not be coded with **SH**.

(5) 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**.

c. Precipitation. Up to three types of precipitation may be coded in a single present weather group. They shall be coded in decreasing dominance based upon intensity. Only one intensity indicator (+ or -) may be coded and it shall refer to the total precipitation.

(1) Drizzle shall be coded as **DZ**; rain shall be coded as **RA**; snow shall be coded as **SN**; snow grains shall be coded as **SG**; ice crystals shall be coded as **IC**; and ice pellets shall be coded as **PL**.

(2) Hail shall be coded as **GR** when the diameter of the largest stones observed is 1/4 inch or more. Small hail and/or snow pellets shall be coded as **GS** when the diameter of the largest hailstones is less than 1/4 inch.

(3) At automated stations, precipitation of unknown type shall be coded as **UP** when the precipitation discriminator cannot identify the precipitation with any greater precision.

d. Obscuration.

(1) Mist shall be coded as **BR** when the obscuration consists of water droplets or ice crystals and the visibility is at least 5/8 SM but less than 7 statute miles.

(2) Fog shall be coded as **FG** when the obscuration consists of water droplets or ice crystals (fog or freezing fog). For **FG** to be reported without the qualifiers shallow (**MI**), partial (**PR**), or patches (**BC**), the prevailing visibility in the fog shall be less than 5/8 SM. Freezing (FZ) is only reported with FG when visibility is less than 5/8 SM and temperature is less than 0 degrees Celsius. Patches of fog (**BCFG**) and partial fog (**PRFG**) may be coded with prevailing visibility of 7 statute miles or greater. See paragraph 15-14b(1) for more details on coding descriptors with fog.

(3) Smoke shall be coded as **FU** and reported only when the prevailing visibility is restricted to less than 7 statute miles.

(4) Volcanic Ash shall be coded as **VA** and is reported when present, regardless of the prevailing visibility.

(5) Widespread dust shall be coded as **DU** and reported only when the prevailing visibility is restricted to less than 7 statute miles.

(6) Sand shall be coded as **SA** and reported only when the prevailing visibility is restricted to less than 7 statute miles.

(7) Haze shall be coded as **HZ** and reported only when the prevailing visibility is restricted to less than 7 statute miles.

(8) Spray shall be coded only when used with descriptor **BL** when the prevailing visibility is restricted to less than 7 statute miles.

e. Other Weather Phenomena

(1) Well-developed dust/sand whirls shall be coded as **PO**.

(2) Squalls shall be coded as **SQ** when a sudden increase in wind speed of at least 16 knots is observed, and is sustained at 22 knots or more for at least one minute.

(3) Tornadic activity: Funnel clouds shall be coded as **FC**. Tornadoes or waterspouts shall be coded as **+FC**.

(4) Sandstorm shall be coded as **SS**; duststorm shall be coded as **DS**.

15-15. SKY CONDITION GROUP ($N_sN_sN_sh_sh_sh_s$ or $VVh_sh_sh_s$ or CLR or SKC)

a. Sky condition shall be coded in the format, $N_sN_sN_sh_sh_sh_s$, where $N_sN_sN_s$ is the amount of sky cover and $h_sh_sh_s$ is the height of the layer. There shall be no space between the amount of sky cover and the height of the layer.

b. Sky condition shall be coded in ascending order up to the first overcast layer. At this time, layers above 12,000 feet are not reported by automated sky condition sensors. At mountain stations, if the cloud layer is below station elevation, the height of the layer shall be reported in the body of the METAR or SPECI as "///".

c. Partial obscurations by a ground-based phenomenon are coded by indicating the amount of obscuration as **FEW**, **SCT**, or **BKN** followed by three zeros (**000**). (See paragraph 15-36, Obscuration, for the required remarks.)

d. Automated sky condition sensors may truncate the sky condition group to 3 layers. Otherwise all stations shall observe all cloud layers in ascending order up to the first overcast layer. No more than 6 layers shall be reported.

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

f. Clear skies shall be coded in the format, **SKC** or **CLR**, where **SKC** is the abbreviation used for manual reports to indicate no clouds are present and **CLR** is the abbreviation used for automated reports to indicate no clouds are detected at or below the design limit of the ceilometer.

g. 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 Figure 15-5, Reportable Values for Sky Cover Amount. The report of clear skies (**CLR** or **SKC**) are complete layer reports within themselves. The abbreviations **FEW**, **SCT**, **BKN**, and **OVC** shall be followed, without a space, by the height of the cloud layer.

Reportable Value (Contraction)	Meaning	Summation Amount of Layer
VV	Vertical Visibility	8/8
SKC or CLR[1]	Clear	0
FEW[2]	Few	> 0 - 2/8
SCT	Scattered	3/8 - 4/8
BKN[3]	Broken	5/8 - 7/8
OVC	Overcast	8/8

1. The abbreviation CLR shall be used at automated stations when no clouds at or below 12,000 feet or design limit of ceilometer) are detected; the abbreviation SKC shall be used at manual stations when no clouds are observed.
2. Any layer amount less than 1/8 is reported as FEW.
3. BKN includes sky cover from 5/8 up to, but not including, 8/8.

Figure 15-5. Reportable Values for Sky Cover Amount

h. The height of the base of each layer, $\mathbf{h_s h_s h_s}$, shall be coded in hundreds of feet above the surface using three digits in accordance with Figure 15-6, Increments of Reportable Values of Sky Cover Height.

Range of Heights (feet)	Reportable Values (feet)
5,000 or less	To nearest 100
>5,000 but ≤10,000	To nearest 500
Above 10,000	To nearest 1,000

Figure 15-6. Increments of Reportable Values of Sky Cover Height

i. Observers shall identify cumulonimbus or towering cumulus by appending cumulonimbus (**CB**) or towering cumulus (**TCU**), respectively, to the layer report. When the TCU or CB is appended to the layer report, accompanied by the remark, "TCU NW" or "CB NW MOV E", it is implied that the TCU or CB is associated with that layer and is within 10 SM. When the TCU or CB is outside of 10 SM, a DSNT remark is appropriate, for example, "TCU DSNT NW". (In this case, TCU or CB would not be appended to the layer in the body of the METAR.)

15-16. TEMPERATURE/DEW POINT GROUP (T'T'/T'$_d$T'$_d$)

a. The temperature shall be separated from the dew point following it by a solidus (/).

b. The temperature and dew point shall be coded as two digits rounded to the nearest whole degree Celsius (see paragraph 3-9). 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".

c. If the temperature is not available, the entire temperature/dew point group shall not be coded. If the dew point is not available, the temperature shall be coded followed by a solidus (/) and no entry made for dew point. For example, a temperature of 1.5°C and a missing dew point would be reported as "02/".

15-17. ALTIMETER ($AP_HP_HP_HP_H$)

The altimeter group always starts with an **A** (the international indicator for altimeter in inches of mercury). The altimeter shall be coded as a four digit group immediately following the **A** using the tens, units, tenths, and hundredths of inches of mercury. The decimal point is not coded.

15-18. REMARKS (RMK)

Remarks shall be included in all METAR and SPECI, if appropriate. Remarks shall be separated from the altimeter group by a space and the contraction **RMK**. If there are no remarks, the contraction **RMK** shall not be entered.

a. Remarks Categories. METAR/SPECI remarks fall into 2 major categories: Automated, Manual and Plain Language Remarks, and Additive and Maintenance Data.

b. General Procedures for Remarks. Remarks shall be made in accordance with the following:

(1) Use of Contractions and Abbreviations. 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 the lack of readily available contractions. In such cases, the only requirement is that the remark be clear. For a detailed list of authorized contractions, see FAA Order 7340.1, Contractions.

(2) Time Entries in Remarks. Time entries shall be made in minutes past the hour if the time reported occurs during the same hour the observation is taken. Hours and minutes shall be used if the hour is different, or this order prescribes the use of the hour and minutes.

(3) Location Entries. With the exception of lightning and thunderstorms detected by an automated weather observing system, the location of phenomena within 5 statute miles of the point of observation shall be reported as occurring at the station. Phenomena between 5 and 10 statute miles shall be reported as vicinity (**VC**), followed by direction from the station, if known. Phenomena beyond 10 statute miles of the point of observation shall be reported as distant (**DSNT**) followed by the direction from the station. In the case of a tornado, the exact location should be included if possible. See paragraph 15-21, Funnel Cloud.

(4) Movement Entries. Movement of clouds or weather, if known, shall be coded with respect to the direction toward which the phenomenon is moving.

(5) Direction. Directions shall use the eight points of the compass coded in a clockwise order beginning with north.

(6) Order of Entry. Insofar as possible, remarks shall be entered in the order in which they are presented in the following paragraphs.

15-19. AUTOMATED, MANUAL, AND PLAIN LANGUAGE REMARKS

These remarks generally elaborate on parameters reported in the body of the report. Automated and manual remarks may be generated either by an automated or manual station. Plain language remarks can only be added by an observer.

15-20. VOLCANIC ERUPTIONS

Volcanic eruptions shall be reported, whenever observed. Pre-eruption volcanic activity shall not be reported. Pre-eruption refers to unusual

and/or increasing volcanic activity which could precede a volcanic eruption. The remark shall be plain language and contain the following, if known:

a. Name of volcano.

b. Latitude/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 APRX 30000 FEET MOVING NE

15-21. FUNNEL CLOUD (TORNADIC ACTIVITY_B/E(hh)mm_LOC/DIR_(MOV))

At manual stations, tornadoes, funnel clouds, or waterspouts shall be coded in the above format, where **TORNADO**, **FUNNEL CLOUD**, or **WATERSPOUT** identifies the specific tornadic activity. **B/E** denotes the beginning and/or ending time, **(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 phenomenon from the station, and **MOV** is the movement, if known. Tornadic activity shall be coded as the first remark after the "RMK" entry, unless a volcanic remark is required. For example, "TORNADO B13 6 NE" would indicate that a tornado, which began at 13 minutes past the hour, was 6 statute miles northeast of the station. At augmented ASOS sites, +FC is coded for tornadoes and waterspouts. In remarks, **TORNADO**, along with beginning or end time, would indicate either a tornado, funnel cloud, or waterspout began or ended.

15-22. TYPE OF AUTOMATED STATION (AO1 OR AO2)

AO1 or AO2 shall be coded 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.

15-23. PEAK WIND (PK WND_dddff(f)/(hh)mm) (NA LAWRS)

At designated stations, the peak wind shall be coded in the above format in 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".

15-24. WIND SHIFT (WSHFT_(hh)mm)

At designated stations, a wind shift shall be coded in the above format, 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 frontal passage. There shall be a 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".

15-25. TOWER OR SURFACE VISIBILITY (TWR_VIS_vvvvv or SFC_VIS_vvvvv)

Tower visibility or surface visibility shall be coded in the above formats, where **vvvvv** is the observed tower/surface visibility value. A space shall be coded between each of the remark elements. For example, "TWR VIS 1 1/2" would indicate the visibility from the control tower was 1 1/2 SM.

15-26. VARIABLE PREVAILING VISIBILITY (VIS_$v_nv_nv_nv_nv_n$V$v_xv_xv_xv_xv_x$)

Variable prevailing visibility shall be coded in the above format where **VIS** is the remark identifier, and $v_nv_nv_nv_nv_n$ is the lowest visibility evaluated. **V** denotes variability between the two values, and $v_xv_xv_xv_xv_x$ is the highest visibility evaluated. There shall be a 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".

15-27. SECTOR VISIBILITY (VIS_[DIR]_vvvvv)

The sector visibility shall be coded in the above format when either the prevailing or sector visibility is less than 3 miles or is considered operationally significant, and sector visibility differs from the prevailing visibility by one or more reportable values. In the format of the remark, **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 Figure 15-3, Reportable Visibility Values. For example, "VIS NE 2 1/2" would indicate that the visibility in the northeastern octant was 2 1/2 miles.

15-28. VISIBILITY AT SECOND LOCATION ((VIS)_vvvvv_[LOC]) (NA LAWRS)

At designated automated stations, the visibility at a second location shall be coded in the above format, where **VIS** is the remark identifier, **vvvvv** is the measured visibility value, and **[LOC]** is the specific location of the visibility sensor(s) at the station. This remark shall only be generated when the condition is lower than that contained in the body of the report. For example, if the visibility measured by a second sensor located at runway 11 is 2 1/2 statute miles, the remark would be "VIS 2 1/2 RWY11".

15-29. LIGHTNING FREQUENCY (Frequency_LTG(Type)_[LOC])

a. Manual Location. When lightning is observed at a manual location, the frequency, and location shall be reported. Type of lightning shall be reported, if known. The remark shall be coded in the above format. The contractions for the type of lightning shall be based on Figure 15-7, Type and Frequency of Lightning. The location and direction shall be coded in accordance with paragraph 15-18b(3). For example,
"CONS LTGIC OHD", "FRQ LTGCG VC", or "OCNL LTG DSNT W".

Type of Lightning		
Type	Contraction	Definition
Cloud to Ground	CG	Lightning occurring between cloud and ground.
In the Cloud	IC	Lightning which takes place within the thunder cloud.
Cloud to Cloud	CC	Streaks of lightning reaching from one cloud to another.
Cloud to Air	CA	Streaks of lightning which pass from a cloud to the air, but do not strike the ground.
Frequency of Lightning		
Frequency	Contraction	Definition
Occasional	OCNL	Less than 1 flash/minute.
Frequent	FRQ	About 1 to 6 flashes/minute.
Continuous	CONS	More than 6 flashes/minute.

Figure 15-7. Type and Frequency of Lightning

b. When lightning is detected by an automated weather observing system with ALDARS:

(1) Within 5 nautical miles of the Airport Reference Point (ARP), it will be reported as "TS" in the body of the report with no remark;

(2) Between 5 and 10 miles of the ARP, it will be reported as "VCTS" in the body of the report with no remark;

(3) Beyond 10 but less than 30 nautical miles of the ARP, it will be reported in remarks as "DSNT" followed by the direction from the ARP, e.g., "LTG DSNT W".

15-30. BEGINNING AND ENDING OF PRECIPITATION (w'w'B(hh)mmE(hh)mm) (NA LAWRS)

At designated automated stations and manual stations, the beginning and ending of precipitation shall be coded in the above format, where **w'w'** is the type of precipitation, **B** denotes the beginning, and **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. Report beginning/ending times of precipitation in a SPECI if that precipitation caused the SPECI. 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".

15-31. BEGINNING AND ENDING OF THUNDERSTORMS (TSB(hh)mmE(hh)mm)

At designated automated stations and manual stations, the beginning and ending of thunderstorm(s) shall be coded in the above format, where **TS** indicates thunderstorm, **B** denotes the beginning, and **E** denotes the ending. **(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. For example, if a thunderstorm began at 0159 and ended at 0230, the remark would be coded "TSB0159E30". These coded remarks are required in the SPECI and in the next METAR after the event.

15-32. THUNDERSTORM LOCATION (TS_LOC_(MOV_DIR))

At designated stations, thunderstorms shall be coded in the above format, 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 SE MOV NE**" would indicate a thunderstorm southeast of the station moving northeast. Thunderstorms beyond 10 SM shall be coded as distant, for example, "**TS DSNT NW**". Any other thunderstorm location or movement remarks the observer judges appropriate shall be added manually.

15-33. HAILSTONE SIZE (GR_[size])

At designated manual stations, the hailstone size shall be coded in the above format where **GR** is the remark identifier and **[size]** is the diameter of the largest hailstone, 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 1 3/4" would indicate that the largest hailstones were 1 3/4 inches in diameter. If **GS** is coded in the body of the report, no size remark is required.

15-34. VIRGA (VIRGA_(DIR))

At augmented automated stations and at manual stations, virga shall be coded in the indicated format, when precipitation is observed to be falling from clouds but is not reaching the ground because of evaporation. The direction, **DIR**, of the phenomenon from the station is optional, e.g., "VIRGA" or "VIRGA SW".

15-35. VARIABLE CEILING HEIGHT ($\mathbf{CIG\_h_nh_nh_nVh_xh_xh_x}$)

At designated manual stations, the variable ceiling height shall be coded in the above format, where **CIG** is the remark identifier, $\mathbf{h_nh_nh_n}$ is the lowest ceiling height evaluated. **V** denotes variability between two values, and $\mathbf{h_xh_xh_x}$ is the highest ceiling height evaluated. There shall be one space following the remark identifier, and no spaces between the letter **V** and the lowest/highest values. For example, "CIG 005V010" would indicate a ceiling that was varying between 500 and 1,000 feet.

15-36. OBSCURATION ($\mathbf{w'w'\_[N_sN_sN_s]h_sh_sh_s}$)

Obscurations shall be coded in the indicated format, where **w'w'** is the present weather causing the obscuration at the surface or aloft, and $\mathbf{N_sN_sN_s}$ is the applicable sky cover amount of the obscuration aloft (FEW, SCT, BKN, OVC) or at the surface (FEW, SCT, BKN), and $\mathbf{h_sh_sh_s}$ is the applicable height. Surface-based obscurations shall have a height of "000". The type of present weather shall be prefixed (separated by a space) to the sky cover layer that represents the obscuration. For example, "FG SCT000" indicates that fog is hiding 3 to 4 eighths of the sky. A broken layer at 2,000 feet composed of smoke would be coded "FU BKN020".

15-37. VARIABLE SKY CONDITION ($\mathbf{N_sN_sN_s(h_sh_sh_s)\ \_V\_N_sN_sN_s}$)

The variable sky condition remark shall be coded in the above format, where $\mathbf{N_sN_sN_s(h_sh_sh_s)}$ and $\mathbf{N_sN_sN_s}$ identify the two operationally significant 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 in the report, the layer height 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 "BKN014 V OVC".

15-38. SIGNIFICANT CLOUD TYPE [PLAIN LANGUAGE]

At designated stations, the significant cloud types remark shall be coded in all reports as described below. (Cumulonimbus of any kind and towering cumulus are also identified in the body of the report in the sky condition group.)

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 above format, 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 that a **CB** up to 10 statute miles west of the point of observation, was 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 point of observation. The cloud type and direction entries shall be separated by a space. For example, "TCU W" would indicate towering cumulus clouds up to 10 statute miles west of the point of observation.

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 point of observation. The cloud type and direction entries shall be separated by a space. For example, "ACC NW" would indicate altocumulus castellanus up to 10 statute miles northwest of the point of observation.

d. Standing Lenticular or Rotor Clouds (CLD_[DIR]). Stratocumulus standing lenticular (SCSL), altocumulus standing lenticular (ACSL), or cirrocumulus standing lenticular (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 point of observation. The cloud type and direction entries shall be separated by a space. For example, altocumulus standing lenticular clouds observed southwest through west of the point of observation would be coded “ACSL SW-W”; an apparent rotor cloud northeast of the point of observation would be coded "APRNT ROTOR CLD NE"; and cirrocumulus standing lenticular clouds south of the point of observation would be coded "CCSL S".

15-39. CEILING HEIGHT AT SECOND LOCATION (CIG_hhh_[LOC]) (NA LAWRS)

At designated automated stations, the ceiling height at a second location shall be coded in the above format, where **CIG** is the remark identifier, **hhh** is the measured height of the ceiling, and **[LOC]** is the specific location of the ceilometer(s) at the station. This remark shall only be generated when the ceiling is lower than that contained in the body of the report. For example, if the ceiling measured by a second sensor located at runway 11 is broken at 200 feet, the remark would be "CIG 002 RWY11".

15-40. PRESSURE RISING OR FALLING RAPIDLY (PRESRR OR PRESFR) (NA LAWRS)

At designated automated stations and manual stations, when the pressure is rising or falling rapidly at the time of the observation, the remark

PRESRR or PRESFR shall be included in the report.

15-41. SEA-LEVEL PRESSURE (SLPppp) (NA LAWRS)

At automated stations and designated manual stations, sea-level pressure shall be reported in the above format. The remark begins with **SLP** and is coded using the tens, units, and tenths of the sea-level pressure in hectopascals. For example, a sea-level pressure of 998.2 hectopascals would be coded as "SLP982". For a METAR, if sea-level pressure is not available at stations where it would normally be reported, it is coded as "SLPNO".

15-42. AIRCRAFT MISHAP (ACFT_MSHP)

If a report is 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)".

15-43. NO SPECI REPORTS TAKEN (NOSPECI)

At staffed stations where SPECI's are not taken, the remark **NOSPECI** shall be coded to indicate that no changes in weather conditions will be reported until the next METAR.

15-44. SNOW INCREASING RAPIDLY (SNINCR_(inches-hour/inches on ground)) (NA LAWRS)

At designated manual stations, 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, and the reportable value (in whole inches) of the total depth of snow on the ground increases by one inch or more. The remark shall be coded in the above format, 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.

15-45. OTHER SIGNIFICANT INFORMATION

Agencies may have other information significant to their operations, such as information on fog dispersal operations, runway conditions, and other information important to aircraft operations.

15-46. ADDITIVE AND AUTOMATED MAINTENANCE DATA

Additive data groups are only reported at designated stations. The maintenance data groups are only reported from automated stations.

Precipitation Additive Data. At designated stations, the amount of liquid precipitation shall be evaluated as the depth of precipitation that accumulates in an exposed vessel during the time period being evaluated. The amount of freezing or frozen precipitation shall be the water equivalent of the solid precipitation accumulated during the appropriate time period. Precipitation measurements shall be in inches, tenths of inches, or hundredths of inches depending on the precipitation being measured (see Figure 15-8, Units of Measure for Precipitation). The depth of freezing and/or frozen precipitation shall be the actual vertical depth of the precipitation accumulated on a horizontal surface during the appropriate time

period. If snow falls, melts, and refreezes, the depth of ice formed shall be included in the measurement.

Type of Measurement	Unit of Measure
Liquid Precipitation	0.01 inch
Water Equivalent of Solid Precipitation	0.01 inch
Solid Precipitation	0.1 inch
Snow Depth	1.0 inch

Figure 15-8. Units of Measure for Precipitation

15-47. HOURLY PRECIPITATION AMOUNT (Prrrr) (NA LAWRS)

At designated automated stations, 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.

15-48. 1, 3 AND 6 HOURLY ICE ACCRETION AMOUNTS (I1nnn, I3nnn, I6nnn) (NA LAWRS)

NWS and FAA have developed an algorithm to be applied to the ASOS freezing rain sensor that can accurately measure and report the amount of surface ice accretion at a specific point over a given time period. The ASOS freezing rain sensor, and the newly developed ice accretion algorithm will generate information that will be included in the remarks section of a METAR/ SPECI. Ice accretion remarks shall only be included in the METAR and SPECI reports when accretion is occurring, or has occurred during the reporting period. The remark will be updated each minute when encoded. This requirement is for automated encoding of these remarks, and **no manual backup is required**. Although the ice accretion remark was not available at the time of this writing, it is scheduled to be available following an upcoming ASOS software revision. The format for the hourly, 3-hourly, and 6-hourly reports follows.

a. Hourly Ice Accretion Amount (I1nnn). This remark provides the ice accretion amount during the preceding hour. The accretion of ice over the past one hour time period in one-hundredths of an inch (0.01 in.) would have the format: "I1nnn"; where "I" is the icing indicator for the group, "1" is the reported time period (one hour), and "nnn" is the thickness accumulated to the nearest one-hundredth of an inch (0.01 in.), during the reported time period (one hour). This remark shall be reset immediately after the hourly METAR report is transmitted. When this remark is included in the ASOS software, it will most likely be encoded immediately following the hourly precipitation amount, and before the 3- and 6-hour precipitation amount.

b. 3-Hourly Ice Accretion Amount (I3nnn). This remark provides the ice accretion amount during the last three hours, and is included in the reports taken at the intermediate synoptic times of 0300, 0900, 1500, and 2100 UTC. The accretion of ice over the past three hour time period in one-hundredths of an inch (0.01 in.) would have the format: "I3nnn"; where "I" is the icing indicator for the group, "3" is the reported time period (three hours), and "nnn" is the thickness accumulated to the nearest one-hundredth of an inch (0.01 in.), during the reported time period (three hours). This remark shall be reset immediately after the intermediate synoptic or mandatory synoptic METAR is

transmitted (0300, 0600, 0900, 1200, 1500, 1800, 2100 and 0000 UTC). When this remark is included in the ASOS software, it will most likely be encoded immediately following the hourly ice accretion amount, and before the 3- and 6-hour precipitation amount.

c. 6-Hourly Ice Accretion Amount (I6nnn). This remark provides the ice accretion amount during the last six hours, and is included in the reports taken at the synoptic times of 0600, 1200, 1800, and 0000 UTC. The accretion of ice over the past six hour time period in one-hundredths of an inch (0.01 in.) would have the format: "I6nnn"; where "I" is the icing indicator for the group, "6" is the reported time period (six hours), and "nnn" is the thickness accumulated to the nearest one-hundredth of an inch (0.01 in.), during the reported time period (six hours). This remark shall be reset immediately after the mandatory synoptic METAR is transmitted (0600, 1200, 1800, and 0000 UTC). When this remark is included in the ASOS software, it will most likely be encoded immediately following the hourly ice accretion amount, and before the 3- and 6-hour precipitation amount.

d. Missing Data. If the freezing rain sensor is inoperative for more than 25 percent of the reporting period, the icing remark shall be considered missing. Missing groups shall be encoded as I1///, I3///, or I6///, as appropriate. If no icing is detected, then the groups shall not be encoded. Note that an automated icing event will always report at least 0.01 in. of ice accretion.

15-49. 3- AND 6-HOUR PRECIPITATION AMOUNT (6RRRR) (NA LAWRS)

At designated stations, the 3- and 6-hourly precipitation group shall be coded in the above format, 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 and the amount 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 ten, units, tenths, and hundredths digits of the amount. When an indeterminable amount of precipitation has occurred during the period, **RRRR** shall be coded "6////". For example, 2.17 inches of precipitation would be coded "60217". A trace shall be coded "60000".

15-50. 24-HOUR PRECIPITATION AMOUNT ($7R_{24}R_{24}R_{24}R_{24}$) (NA LAWRS)

At designated stations, the 24-hour precipitation amount shall be coded in the above format, where **7** is the group indicator and $\mathbf{R_{24}R_{24}R_{24}R_{24}}$ is the 24-hour amount of precipitation included in the 1200 UTC (or other agency-designated time) report whenever more than a trace of precipitation (water equivalent) has fallen in the past 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 "7////". For example, 1.25 inches of precipitation (water equivalent) in the past 24 hours shall be coded "70125".

15-51. SNOW DEPTH ON GROUND (4/sss) (NA LAWRS)

At designated stations, the total snow depth on ground group shall be coded in the 0000, 0600, 1200 and 1800 UTC observations whenever there is more than a trace of snow on the ground.

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".

15-52. WATER EQUIVALENT OF SNOW ON GROUND (933RRR) (NA LAWRS) At designated manual stations, 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". This value is never estimated, ratios (e.g. 10 to 1) or temperature/snow water equivalent tables are not to be used to determine water equivalency of snow for this group.

15-53. CLOUD TYPES ($8/C_LC_MC_H$) (NA LAWRS)
At designated manual stations, this group 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, the WMO Abridged International Cloud Atlas, or other agency observing aids for cloud identification. A "0" shall be coded for the low, middle, or high cloud type if no cloud is present at 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; a report of "8/903" would indicate cumulonimbus type low clouds, no middle clouds, and dense cirrus high clouds.

15-54. DURATION OF SUNSHINE (98mmm) (NA LAWRS)
At designated manual stations, the duration of sunshine shall be coded in the 0800 UTC report. If the station is closed at 0800 UTC, the group shall be coded in the first 6-hourly METAR after the station opens. The duration of sunshine shall be coded in the format **98mmm**, where **98** is the group indicator and **mmm** is the total minutes of sunshine. The minutes of sunshine that occurred the previous calendar day is coded by using the hundreds, tens, and units digits. For example, 96 minutes of sunshine would be coded "98096". If no sunshine occurred, the group would be coded "98000".

15-55. HOURLY TEMPERATURE AND DEW POINT ($Ts_nT'T'T's_nT'_dT'_dT'_d$) (NA LAWRS)
At designated stations, the hourly temperature and dew point group shall be coded in the above format, where **T** is the group indicator, $\mathbf{s_n}$ is the sign of the temperature, **T'T'T'** is the temperature, and $\mathbf{T'_dT'_dT'_d}$ is the dew point. The sign of the temperature and dew point shall be coded as **1** if the value is below 0^oC and **0** if the value is 0^oC or higher. 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^oC and dew point of -1.5^oC would be reported in the body of the report as "03/M01" and the $Ts_nT'T'T's_nT'_dT'_dT'_d$ group as "T00261015". If dew point is missing, report the temperature; if the temperature is missing, do not report the temperature/dew point group.

15-56. 6-HOURLY MAXIMUM TEMPERATURE ($1s_nT_xT_xT_x$) (NA LAWRS)
At designated stations, the 6-hourly maximum temperature group shall be coded in the above format, 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 below 0°C and **0** if the maximum temperature is 0°C or higher. For example, a maximum temperature of -0.1°C would be coded "11001"; 14.2°C would be coded "10142".

15-57. 6-HOURLY MINIMUM TEMPERATURE ($\mathbf{2s_nT_nT_nT_n}$) (NA LAWRS)

At designated stations, the 6-hourly minimum temperature group shall be coded in the above format, 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 below 0°C and **0** if the minimum temperature is 0°C or higher. For example, a minimum temperature of -2.1°C would be coded "21021"; 1.2°C would be coded "20012".

15-58. 24-HOUR MAXIMUM AND MINIMUM TEMPERATURE ($\mathbf{4s_nT_xT_xT_xs_nT_nT_nT_n}$) (NA LAWRS)

At designated stations, the 24-hour maximum temperature and the 24-hour minimum temperature shall be coded in the above format, 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. Temperature 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 below 0°C and **0** if it is 0°C or higher. 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".

15-59. 3-HOURLY PRESSURE TENDENCY (5appp) (NA LAWRS)

At designated stations, 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, and **ppp** is the amount of barometric change in tenths of hectopascals using the tens, units, and tenths digits (see Figure 15-9, Characteristics of Barometer Tendency). The character **a** shall be coded by selecting the code figure from Figure 15-9 that best described the pressure change in the past 3 hours. For example, a steady increase of 3.2 hectopascals in the past three hours would be coded "52032". The **ppp** shall be coded based on the absolute value of the change of either the station pressure or the altimeter setting in the past 3 hours in tenths of hectopascals and using the tens, units, and tenths digits (see Figure 15-10, 3-Hour Change in Pressure). For example, a steady increase of 3.2 hectopascals in the past 3 hours would be coded "52032".

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 the 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

Figure 15-9. 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	201	0.595	20.1

Figure 15-10. 3-Hour Change in Pressure

15-60. SENSOR STATUS INDICATORS

At designated stations, sensor status indicators should be reported as indicated below:

a. When automated stations are equipped with a precipitation identifier and that sensor is not operating, the remark **PWINO** shall be coded.

b. When automated stations are equipped with a tipping bucket rain gauge and that sensor is not operating, **PNO** shall be coded.

c. When automated stations are equipped with a freezing rain sensor and that sensor is not operating, the remark **FZRANO** shall be coded.

d. When automated stations are equipped with a lightning detection system and that sensor is not operating, the remark **TSNO** shall be coded.

e. When automated stations are equipped with a secondary visibility sensor and that sensor is not operating, the remark **VISNO_LOC** shall be coded.

f. When automated stations are equipped with a secondary ceiling height indicator and that sensor is not operating, the remark **CHINO_LOC** shall be coded.

15-61. MAINTENANCE INDICATOR

A maintenance indicator sign **$** shall be coded when an automated weather observing system detects that maintenance is needed on the system.

15-62. TRANSMISSION TIMES

For transmission times of observations, refer to the latest version of Order 7110.10, Flight Services, Chapter 9, FAA Weather Services.

CHAPTER 16. ENTRIES ON OBSERVATIONAL FORMS

16-1. INTRODUCTION

This chapter prescribes procedures and practices for making entries on various observational forms. The main emphasis is on Meteorological Form 1M-10C (MF1M-10C). At all manual FAA facilities, including **LAWRS**, all observations shall be recorded on Form MF1M-10C. NWS stations typically use Meteorological Form 1M-10A/B (MF1M-10A/B) which is a more comprehensive form required at those stations. The two forms, MF1M-10A/B and MF1M-10C, are similar in that the column numbers for recording the various types of data are the same. However, form MF1M-10C contains fewer columns in accordance with the reduced requirement for certain types of data at FAA facilities. In this chapter, only the columns that are on the MF1M-10C will be described. Many of the instructions in this chapter that are related to MF1M-10C are duplicated from Chapter 15, Coding and Dissemination. References to other chapters are noted where applicable.

16-2. ENTRIES ON METEOROLOGICAL FORM 1M-10C (MF1M-10C)

Certified observers shall normally complete all entries on MF1M-10C. 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 (/).

16-3. WRITING INSTRUMENT

The same type of writing instrument shall be used throughout the form. To ensure legible copies and ample contrast for reproduction, the observer shall use a black-inked fine ball-point pen.

16-4. PARENTHETICAL DATA

Data entered in columns 3 through 14 of Form MF1M-10C that are not intended to be transmitted shall be enclosed in parentheses.

16-5. MISSING DATA

See paragraph 15-5, Coding Missing Data in METAR and SPECI Reports. When using Form MF1M-10C, the observer shall explain briefly the reasons for any missing data in block 65, Remarks, Notes, and Miscellaneous Phenomena.

16-6. LATE OBSERVATIONS

When a METAR observation is taken late, but within 15 minutes of the standard time of observation, and no appreciable changes have occurred since the standard time, the observer shall record the observation and transmit it using the actual time of observation. If conditions have changed appreciably or the observation is more than 15 minutes late, the observer shall skip a line and record and transmit a SPECI observation containing all the elements in a METAR observation. After transmitting the SPECI, using the actual time of observation, the observer shall estimate the conditions probable at the standard time using recording instruments whenever possible. The observer shall record this data on the skipped line using the standard time in column 2. The estimated observation shall not be transmitted. The observer shall make note in column 65 referencing the actual

time of observation that the estimated observation was recorded.

16-7. CORRECTIONS

To make a correction on Form MF1M-10C, the observer shall draw a **single line** through the erroneous entry. The observer shall not erase or otherwise obliterate entries. The observer shall record corrected data in the appropriate blocks on the same or next line appropriately identified.

16-8. HEADING ON FORM MF1M-10C AT LAWRS

At **LAWRS**, the observer shall enter the official station name and state abbreviation in the block labeled STATION. The four-letter Airport ID shall be included in the SID block. Also in the blocks provided, the observer shall enter the date and time (in Coordinated Universal Time (UTC)) and the conversion factor used to convert Local Standard Time (LST) to UTC. The observer shall check after UTC to indicate that the times used in column 2 of the form are in UTC. In the blocks labeled LATITUDE and LONGITUDE, enter the station's latitude and longitude to the nearest minute of a degree. In the block labeled STATION ELEVATION, enter the station's elevation (H_p) to the nearest foot.

16-9. HEADING ON FORM MF1M-10C AT OTHER STATIONS (NA LAWRS)

In the block labeled STATION, the observer shall enter the type of station, the official station name and state abbreviation. The four-letter Airport ID shall be included in the SID block. Also in the blocks provided, the observer shall enter the date and time (in LST), and conversion factor used to convert LST to UTC. In the blocks labeled LATITUDE and LONGITUDE, enter the station's latitude and longitude to the nearest minute of a degree. In the block labeled STATION ELEVATION, enter the station's elevation (H_p) to the nearest foot.

16-10. ENTRIES ON MF1M-10 BY COLUMNS

The column number corresponds to the column number on the form MF1M-10A/B. Many of these columns do not appear on Form MF1M-10C. The procedures and practices given below are only for those columns applicable at FAA facilities. In addition, some of the columns may only be applicable at designated stations.

16-11. TYPE OF OBSERVATION (COLUMN 1)

M shall be recorded to designate a METAR observation, **S** shall be recorded to designate a SPECI observation.

16-12. TIME OF OBSERVATION (COLUMN 2)

At **LAWRS,** the observer shall record the actual time of the observation in Coordinated Universal Time (UTC). At all other stations, the observer shall record the actual time of observation in Local Standard Time (LST).

16-13. WIND DIRECTION (COLUMN 3)

The observer shall record the true wind direction from which the wind is blowing in tens of degrees using three figures. Directions less than 100 degrees shall be preceded with a **0**. When the wind is calm, the observer shall enter **000** for the direction. When the wind speed is 6 knots or less, the direction may be recorded as **VRB**.

16-14. WIND SPEED (COLUMN 4)

The observer shall record the wind speed in whole knots using the hundreds digit (if not zero), and the tens and units digit. The observer

shall record speeds of less than 10 knots with a leading zero. For example, a wind speed of 5 knots shall be logged as 05. A wind speed of 105 knots shall be logged as 105. Calm winds shall be recorded as 00.

16-15. WIND GUST (COLUMN 5)
When gusts have been recorded or observed during the 10 minutes prior to the actual time of observation, the observer shall enter the peak speed.

16-16. WIND VARIABILITY (COLUMN 6)
When wind direction fluctuates by 60 degrees or more during the 2-minute evaluation period and the wind speed is greater than 6 knots, the observer shall enter the range of variability. A wind direction fluctuating between 260 degrees and 40 degrees shall be entered as 260V040.

16-17. SURFACE VISIBILITY (COLUMN 7a) TOWER VISIBILITY (COLUMN 7b)
The observer shall record the surface prevailing visibility (column 7a) determined from the weather station's usual point(s) of observation using the nearest reportable value listed in Figure 15-3, Reportable Visibility Values. The observer shall record tower visibility if either the surface prevailing visibility or the tower visibility is less than 4 miles. Tower visibility (column 7b) shall be determined from the air traffic control tower using the nearest reportable value listed in Figure 15-3, Reportable Visibility Values.

16-18. RUNWAY VISUAL RANGE (COLUMN 8)
At designated stations, the observer shall record the **RVR** to match the coding in paragraph 15-13, Runway Visual Range Group.

16-19. PRESENT WEATHER (COLUMN 9)
Record weather and obscurations occurring at the station using the order described in paragraph 11-6, Order for Reporting Multiple Types of Weather and Obscurations. Weather intensity symbols and codes are shown in Figure 11-1, Present Weather. Only record obscurations if the visibility is reduced to less than 7 miles, except for volcanic ash, which is always recorded.

16-20. SKY CONDITION (COLUMN 10)
The procedures for reporting sky condition are given in Chapter 12, Sky Condition. The observer shall record sky cover data according to paragraph 15-15, Sky Condition Group. The observer shall record data for each layer of clouds and obscuring phenomena visible from the station regardless of amount. The observer shall make entries in ascending order of height for bases of each layer. An additional line can be added if more space is needed.

a. Sky Cover. The observer shall record any sky cover which is visible from the station using the appropriate contractions or combination of contractions from Figure 12-1, Reportable Contractions for Sky Cover. If the sky cover is variable, see paragraphs 12-33, Variable Sky Cover, and 15-37, Variable Sky Condition.

b. Height of Sky Cover. Heights of layers shall be reported and rounded to the nearest reportable increment listed in Figure 12-3, Increments of Reportable Values for Layer or Ceiling Heights. When a value falls halfway between two reportable increments, the lower value shall be reported. When a layer is 50 feet or less above the surface, the height reported is **000**. If the ceiling height is variable, see paragraph 12-36, Variable Ceiling Height, and

paragraph 15-35, Variable Ceiling Height, for reporting procedures.

16-21. TEMPERATURE (COLUMN 11)

The observer shall record the dry-bulb temperature to the nearest whole degree Celsius (see paragraph 3-9, Rounding Off Numbers). Sub-zero temperatures shall be prefixed with a minus sign (-). An "M" shall be prefixed to sub-zero temperatures in the transmitted observation. The observer shall add a leading zero to temperatures of only one digit (2 is recorded as 02.).

16-22. DEW POINT TEMPERATURE (COLUMN 12)

The observer shall record the dew point temperature to the nearest whole degree Celsius. Sub-zero dew point temperatures shall be prefixed with a minus sign (-). An "M" shall be prefixed to sub-zero dew point temperatures in the transmitted observation. When the dry-bulb temperature is -34°C (-30ºF) or below, the dew point is considered to be statistical data. In such cases, the observer shall leave column 12 blank and not transmit a value. The observer shall add a leading zero to temperatures of only one digit (4 is recorded as 04). If dew point temperature is unavailable, leave the column blank.

16-23. ALTIMETER SETTING (COLUMN 13)

The observer shall record the altimeter setting in inches of mercury using only the tens, units, tenths, and hundredths digits (without a decimal point). For example, record 29.94 as 2994. Altimeter settings shall never be estimated, however, if the altimeter setting is missing, column 13 is left blank.

16-24. REMARKS (COLUMN 14)

The observer shall record all remarks in column 14 according to the procedures in Chapter 15, Coding and Dissemination. The procedures for coding remarks are the same procedures for entering the data into column 14, MF1M-10C. The observer may use additional lines of the form, if required.

16-25. TOTAL SKY COVER (COLUMN 17)

For each hourly observation, the observer shall record the eighths of sky hidden by surface-based obscuring phenomena and sky covered (not necessarily hidden) by all clouds and obscuring phenomena aloft that are visible from the station. For example, record 1 for any clouds up to one-eighth sky cover, 5 for five-eighths, 8 for eight eighths.

16-26. DRY-BULB TEMPERATURE (COLUMN 19)

The observer shall record the dry-bulb temperature in degrees and tenths of degrees Celsius if psychrometric data are obtained from other than a hygrothermometer or an equivalent system. At part-time stations, the observer shall record hourly temperatures in whole degrees from the thermograph for the hours when observers are not on duty. If a thermograph is not available, the observer shall make no entry in this column. Sub-zero temperatures shall be prefixed with a minus sign (-).

16-27. WET-BULB TEMPERATURE (COLUMN 20)

The observer shall record the wet-bulb temperature in degrees and tenths of degrees Celsius if psychrometric data are obtained from other than a hygrothermometer or an equivalent system. Sub-zero temperatures shall be prefixed with a minus sign (-).

16-28. STATION PRESSURE (COLUMN 22)

The observer shall 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-hourly or 6-hourly observation prior to the station reopening. This is needed in determining the 3-hour pressure change (ppp).

16-29. OBSERVERS INITIALS (COLUMN 15)

The certified observer responsible for the observation shall initial this column.

16-30. TIME (COLUMN 26)

The observer shall record the beginning time of the first 6-hourly observation scheduled after 0000 LST on the line captioned "**MID TO**" and the following line captioned "**1**" from column 27. On the following three lines, the observer shall record in chronological order the beginning times of the subsequent 6-hourly observations. The observer shall record entries in hours and minutes (4 digits) to the nearest minute. At stations in the time zone where midnight LST corresponds to the time of a 6-hourly observation, the lines captioned "**MID TO"** and "**MID**" shall not be used. Observers at stations not open for the full 24 hour calendar day shall follow these same instructions.

16-31. OBSERVATION NUMBER (COLUMN 27)

The observation number identifies the first, second, third, and fourth 6-hourly observations of the day. No entry is required.

16-32. MAXIMUM TEMPERATURE (COLUMN 31) and MINIMUM TEMPERATURE (COLUMN 32) (NA LAWRS)

The observer shall record the maximum temperature in column 31 and the minimum temperature in column 32 in tenths of degrees Celsius, using 3-digits that occurred: between midnight and the first 6-hourly observation, in the six hours prior to each 6-hourly observation, and between the last 6-hourly observation and midnight, in the lines labeled "**MID TO**," "**1**," "**2**," "**3**," "**4**," and "**MID**," respectively. The temperature recorded on the last METAR observation of the previous day, having a standard time 0000 LST of the current day, shall be considered when determining the maximum and minimum temperature from midnight to the first 6-hourly. At part-time stations that do not have a thermograph, 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, the observer shall 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 31 and 32 that correspond to the 6-hour time frame. Record in block 65, the period during which the temperature extremes were recorded; e.g., COL31-32 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 temperature data. Record in block 65, the column numbers

and the temperature period covered; e.g., COL66-67 TEMPERATURE DATA FROM 1800 TO 1800.

d. If a thermograph is used, the observer shall follow paragraph 16-33, Precipitation, to enter the 6-hourly synoptic times that occur from midnight to midnight in column 26. The observer shall do this even if the station is not open for the full 24 hour calendar day. From the thermograph, the observer shall determine the maximum temperature to record in column 31 and the minimum temperature for column 32. The observer shall use these values to determine the summary of the day information required in columns 57 and 58.

16-33. PRECIPITATION (COLUMN 33) (NA LAWRS)

At 6-hourly observation times, the observer shall record the amounts of precipitation that occurred during the periods as indicated below. The observer shall record amounts to the nearest hundredth of an inch except that "**T**" shall be recorded for amounts less than 0.005 inch and "**0**" shall be recorded if no precipitation occurred.

a. At stations taking midnight observations, the observer shall record the amount of precipitation that occurred between midnight LST and the first 6-hourly observation time on the line captioned "**MID TO**."

b. On lines "**1**," "**2**," "**3**," and "**4**" (as indicated in column 27), the observer shall record the amount of precipitation that occurred in the previous six hours.

c. When midnight observations are taken, the observer shall record the amount of precipitation that occurred between the last 6-hourly observation time and the midnight observation on the line captioned "**MID**."

d. Whenever the water equivalent of solid precipitation cannot be measured by melting or weighing of the sample or core sampling, the observer shall 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. The observer shall record in block 65, the column number, the time of the observation, and the ratio used; e.g., COL33 1245 1/2 RATIO USED.

16-34. SNOWFALL (COLUMN 34) (NA LAWRS)

At 6-hourly observation times, the observer shall record the amount of solid precipitation that fell in the six hours prior to the observation on the lines numbered (in column 27) "**1**," "**2**," "**3**," and "**4**." At stations taking midnight observations, the observer shall record the snowfall between midnight and the first 6-hourly observation on the line captioned "**MID TO**." On the line captioned "**MID**", the observer shall record the amount of snowfall that occurred between the last 6-hourly observation and midnight. "Snow" as used in this and the following snow depth sections includes all types of solid precipitation; e.g., SN, GS, SG, PL, IC, and GR. The observer shall 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 65, the column number, the time of the observation, and HAIL; e.g., COL34 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 judgment. Record in block 65, the column number, the time of the observation, and ESTIMATED. The reason for the estimation may also be included; e.g., COL34 0045 ESTIMATED DUE TO STATION CLOSURE.

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 34 and column 60 for the day.

g. It is assumed that if an estimated amount is explained in block 65 for column 34, the summary of the day (column 61) is also considered to be estimated. A second remark to denote that column 61 is estimated is not required. Any estimated amounts in column 34 should be explained in block 65. Record the column number, the time of the observation, and the reason for the estimation; e.g., COL34 1244 ESTIMATED DUE TO MELTING.

16-35. SNOW DEPTH (COLUMN 35) (NA LAWRS)

The observer shall record the depth of solid precipitation and ice on the ground at the time of each 6-hourly observation and, if taken, at the time of the midnight observation on the lines identified as "**1**," "**2**," "**3**," "**4**," and "**MID**," respectively. Entries shall be 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. 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 35. In block 65, record the maximum snow depth and the approximate time (LST) of the occurrence. Record the column number, the time of the observation, and the approximate time of the occurrence; e.g., COL35 1846 MAX SNOW DEPTH 1 AT 1530.

e. If the depth consists entirely of hail, record in block 65, the column number, the time of the observation, and HAIL; e.g., COL35 1844 HAIL.

f. Snow depth is entered in column 35 at the 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 an "**M**."

16-36. STATION PRESSURE (COLUMN 36) (NA LAWRS)

a. Mercury Barometer. If a mercury barometer is used to determine station pressure, the observer shall record in this column the sum of the barometer reading (to the nearest thousandth [0.001] inch) and the value obtained from the Total Correction Table (or the value obtained by addition of the sum of corrections given on the Barometer Correction Card and the temperature correction to the nearest thousandth of an inch.)

b. Precision Aneroid Barometer or Altimeter Setting Indicator. If a precision aneroid barometer or altimeter-setting indicator is used to determine station pressure, the observer shall record the reading to the nearest 0.005 inch (or 0.1 hectopascal).

16-37. BAROGRAPH (COLUMN 37) (NA LAWRS)

The observer shall record the observed barograph reading to the nearest 0.005 inch (or 0.1 hectopascal).

16-38. BAROGRAPH CORRECTION (COLUMN 38) (NA LAWRS)

The observer shall subtract column 37 from column 36 and record the difference to the nearest 0.005 inch (or 0.1 hectopascal) with the proper sign in column 38. If column 37 is higher than column 36, the correction in column 38 shall be preceded by a minus sign. If this difference is greater than 0.05 inch (or 1.5 hPa), the observer shall precede the entry with an asterisk "*" and reset the barograph to a zero correction. In block 65, the observer shall record the reason for the asterisk and the time (LST); for example, *BAROGRAPH RESET TO ZERO CORRECTION AT 1458.

16-39. 24-HOUR MAXIMUM TEMPERATURE (COLUMN 57) (NA LAWRS)

The observer shall record the maximum temperature recorded in column 57 for the day to the nearest tenth of a degree Celsius. Any temperature below 0C shall be preceded by a minus (-). The observer shall disregard the entry in column 57 on the line captioned "**1**" if the midnight observation is taken. The observer shall record "**M**" if any data are missing.

16-40. 24-HOUR MINIMUM TEMPERATURE (COLUMN 58) (NA LAWRS)

The observer shall record the minimum temperature recorded in column 58 for the day to the nearest tenth of a degree Celsius. Any temperature below 0C shall be preceded by a minus (-). The observer shall disregard the entry in column 58 on the line captioned "**1**" if the midnight observation is taken. The observer shall record "**M**" if any data are missing.

16-41. 24-HOUR PRECIPITATION (COLUMN 59) (NA LAWRS)

The observer shall 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" observations, 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 33, disregard the entry in column 33 on the line captioned "**1**" if the midnight observation 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 33 are missing, the entry in column 59 will also be missing (**M**).

g. If any entries in column 33 are estimated (block 65 remark), the entry in column 59 shall also be considered estimated. A remark in block 65 is not required to denote an estimated amount in column 59 since a remark is already noted for column 33.

16-42. 24-HOUR SNOWFALL (COLUMN 60) (NA LAWRS)

The observer shall 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 34, disregard the entry in column 34 on the line captioned "**1**" if the midnight observation is taken. Record "**M**" if any data are missing. The sum of all trace entries is a trace.

e. If any entries in column 34 are estimated (block 65 remark), the entry in column 60 will also be considered estimated. A remark in block 65 is not required to denote an estimated amount in column 60 since a remark is already noted for column 34.

f. If any entries in column 34 are missing, the entry in column 60 will also be missing (**M**).

16-43. SNOW DEPTH (COLUMN 61) (NA LAWRS)

The observer shall record the depth of solid precipitation or ice on the ground at 1200 UTC. In areas outside the contiguous United States, enter a modified time at the top of the column as necessary to meet regional needs. The observer shall 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 35, 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 65; e.g., COL70 OBSERVED AT 1120 UTC.

16-44. REMARKS, NOTES, AND MISCELLANEOUS PHENOMENA (BLOCK 65)

The observer shall use this block to record data considered significant, but not recorded elsewhere along with information in the following subsections.

a. The observer shall record the Local Standard Time (LST) of occurrence with all entries unless otherwise specified.

b. The observer shall 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 by the FAA (FSS/TWR) of an aircraft mishap.

(7) Separate individual remarks by a single solidus (/); e.g. COL34 0245 ESTIMATED DUE TO HIGH WINDS/COL45 LAST OF SEVERAL OCCURRENCES/ GLAZE 1155-1405.

(8) The clock designated as the station standard shall be checked at intervals as stated in paragraph 3-4g, Accuracy of Time in Observations. At least one time check daily shall be recorded and annotated. If a facility has another procedure for taking and recording time checks, the time check block may remain blank.

16-45. ADDITIONAL INSTRUCTIONS FOR PART-TIME STATIONS

During hours of operation, the observer shall make entries on MF1M-10C according to the instructions in this order. Entries on MF1M-10C shall only be made to record data transmitted by observing personnel. The observer shall record missing (**M**) for unknown data.

16-46. HOURLY WIND DATA

At stations equipped with a gust recorder, and where less than 24 METAR observations are taken daily, the observer shall enter the 2-minute wind speed in the left hand margin of MF1M-10C. The observer shall enter a time next to it in parentheses to indicate the minute used for the wind speed. The observer shall use the same minute for each hour the station was closed. If the fastest recorded 2-minute wind should occur while the station was closed, the observer shall enter missing (**M**) for the wind direction.

16-47. ADDITIVE DATA GROUPS (NA LAWRS)

Although the observer may make entries on the form to suit the data available, all data transmitted shall be in accordance with the instructions in this order. Each character encoded and transmitted in the 3- and 6-hourly observations additive data groups has a meaning as specified in Chapter 15, Coding and Dissemination, and shall not be changed to meet the station's available data.

16-48. TAILORING MF1M-10C, SYNOPTIC DATA AND SUMMARY OF THE DAY (NA LAWRS)

Columns 26 and higher were designed for stations that operate continuously. Part-time stations shall also record data for a 24-hour period, but because many part-time stations are not open at midnight, and do not 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 shall be the times (LST) of the main 6-hourly synoptic reports made during the calendar day entered in the heading of the form. In column 26, the observer shall 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 observation taken before the station closed (the previous day) to the current 6-hourly observation. The observer shall reference the time of observation (column 26) and in block 65, record the number of hours, 12 or more since the last 6-hourly; e.g., COL42 0645 12HR DATA. The times on the following lines shall be 6 hours apart and the entries shall cover the previous 6 hours.

a. Snowfall, Column 34 (NA LAWRS). The entry on line "**1**" for snowfall, column 34, during the period when observing personnel were not on duty can be either "**0**," an amount, or missing (M). The observer shall record "**0**" if, from conditions before the station closed until it opened, it is reasonably certain that no solid precipitation occurred. If the observer is unsure, because of mixed precipitation or several days of station closure, the observer shall record "**M**" (missing) in this column and also in column 60. If any amount in column 34 is missing, the **M** shall be carried in column 60. The observer shall estimate snowfall if conditions were generally consistent throughout the period and all new precipitation was considered to be frozen. If any amount in column 34 is estimated, the observer shall reference the column number and the time of observation in block 65, and shall record that the data was estimated; e.g., COL34 0644 ESTIMATED. The observer may also indicate why the data was estimated. If any amount in column 34 was estimated, and none was considered missing, column 60 shall also be considered as estimated.

b. Station Day, Columns 57 through 61 (NA LAWRS). The observer shall use the entries in columns 31 through 35 to complete the summary of day columns 57 through 61 for the "station" day. The observer shall line out "MIDNIGHT TO MIDNIGHT" and shall record the 24-hour period covered unless 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 observation contained data for a 12-hour period).

16-49. NOTICE OF CORRECTIONS TO WEATHER RECORDS

The accuracy of weather observations is important after the fact since the National Climatic Data Center (NCDC) utilizes this information to update climatological records for the U.S. If a station discovers that erroneous weather information was transmitted long-line, they are encouraged to send the corrected weather data using WS Form B-14, or, if the form is not available, by letter to the address provided below. (See Figure 16-1, WS Form B-14.)

NCDC Services Center
Image Entry
465 Industrial Blvd.
London, KY 40741

16-50. EXAMPLE FORM

Figure 16-2, Example of Entries on MF1M-10C, presents an example of a filled-in MF1M-10C form.

WS FORM **B-14U.S. DEPARTMENT OF COMMERCE**
(2-00)NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

NOTICE OF CORRECTIONS TO WEATHER RECORDS

CORRECTIONS FOR MONTH OF _____ 20__	STATION TO WHICH CORRECTIONS APPLY:
TO:	FROM:

In verifying weather records for the month indicated above, changes should be made as shown below. If you believe a change has been made incorrectly return this form with your comments. Otherwise, change your station record and retain this form for 6 months, or until reviewed by a representative from regional headquarters or the supervising station.

DATE	TIME (LST)	COL.	DATA	RECORDED	SHOULD BE:

VERIFIER (*Signature)*	DATE

Figure 16-1. WS Form B-14

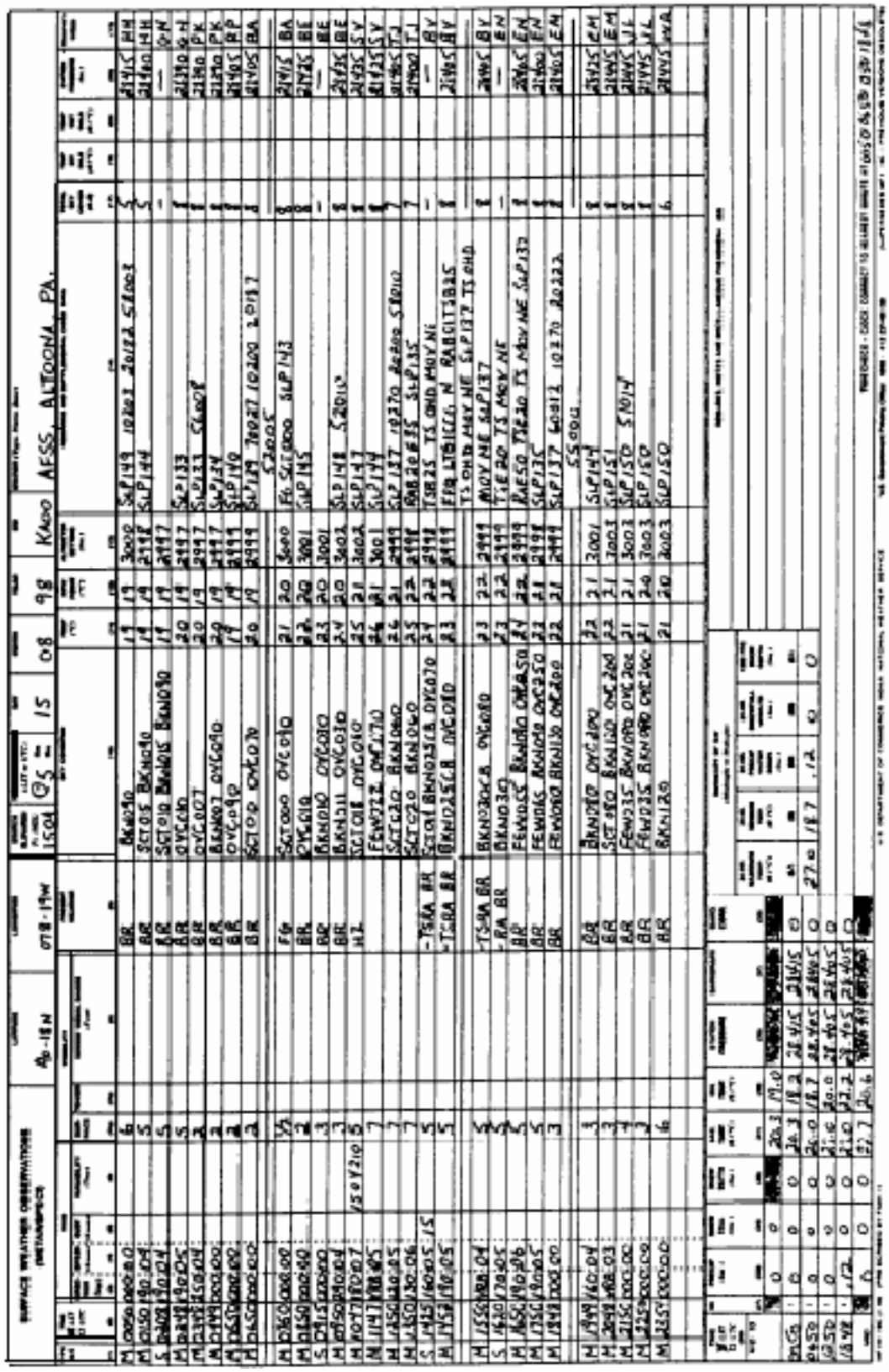


Figure 16-2. Example of Entries on MF1M-10C

CHAPTER 17. OPERATION OF EQUIPMENT

17-1. INTRODUCTION

This chapter contains instructions for the operation of meteorological instruments, related equipment, care and use, and instrument evaluating procedures of various equipment.

SECTION 1. CLOUD HEIGHT MEASUREMENT EQUIPMENT

17-2. PREPARATION OF SKY COVER HEIGHT TABLES FOR CEILING LIGHTS

Prepare sky cover height tables for ceiling lights as follows:

a. Compute tables for each ceiling light baseline on the basis of:

$h = b \times \tan \Theta$; where "b" is the baseline, "Θ" is the angular reading, and "h" is the sky cover height or vertical visibility.

b. Add the difference between the height of the observation site and the field elevation to each tabular value. (Use ground elevation for stations not located at airports.)

c. Round each of these sums to the reportable height increment.

(1) 5,000 feet or less - to the nearest 100 feet.

(2) 5,001 to 10,000 feet - to the nearest 500 feet.

(3) Above 10,000 feet - to the nearest 1,000 feet.

17-3. CEILING LIGHT

If a ceilometer is not operational or available, night-time sky cover heights and vertical visibility values may be determined with a clinometer and a ceiling light projector by using the following procedures.

a. Turn on the ceiling light projector, and allowing the pendant to swing freely, sight through the clinometer and center the intersection of the cross-hairs on:

(1) the brightest portion of the light beam spot when the sky cover is aloft, or

(2) the upper limit of the light beam penetration when the sky is completely obscured by a surface-based layer.

b. When the pendant has come to rest, lock it in position without moving the clinometer. Read the indicated angle to the nearest whole degree.

c. Repeat this procedure two more times; average the three angular readings and refer to the table for the baseline (i.e., distance from clinometer to projector) to obtain the equivalent height value of this averaged angular reading.

17-4. MAINTAINING CEILING LIGHT

a. Daily Checks. At least once each day turn on the lamp, if shut off by a timer, to determine if it is operational. During daylight hours, the operation of the lamp can be observed from the office if a metal reflector is placed at

the top edge of the cover. Replace the lamp if it is determined to be defective.

b. Weekly Checks. Clean the outside of the cover glass with water and detergent once each week or more often if the local conditions require it.

c. Monthly Checks. Clean the mirror and the inside of the cover glass using water and detergent. Wipe both surfaces completely dry using a soft lint-free cloth. CAUTION: The concentrated rays of the sun can burn the skin or injure the eyes of personnel and may damage equipment. Therefore, if direct rays of the sun reach the mirror, take precautions to shade the projector. If the projector has drainage holes in the mirror or housing, clean the holes to ensure adequate drainage and ventilation. With the light turned off, inspect its condition and if the envelope has darkened appreciably, replace it.

d. Painting. As frequently as necessary to protect the instrument, paint the stand using a suitable primer and a finishing coat of aluminum paint. All rust should be removed by sanding before painting.

17-5. MAINTAINING CLINOMETER

Once each month check the clinometer as follows:

a. Examine the scale graduation and clean the scale if necessary.

b. Test the action of the clutch and indicator for normal operation. When unlocked, the indicator should react freely to elevation angle changes of 1 or 2 degrees. If it does not, a drop of SAE 10 oil on the bearings may improve the action. When the clutch is locked, ordinary vibrations or light shocks should not disturb the indicator.

c. Examine the cross wires for proper alignment.

17-6. CARE AND OPERATION OF CEILING BALLOONS

a. Storage. Ceiling balloons should be stored in a dry location at room temperature, away from large electric motors and generators, and in such a manner that oldest balloons will be used first.

b. Conditioning. When balloons from a particular package have a tendency to break during inflation or flight, the remaining balloons from that package should be conditioned within 24 hours before inflation. Conditioning consists of uniformly heating the balloon for 30 minutes to 8 hours depending on the temperature to which the balloon is heated; that is, 30 minutes at air temperatures near the boiling point of water (about 100°C), or 8 hours at temperatures near 49°C. Temperatures below 49°C will not condition the balloon and much above 100°C will likely scorch or harden them.

(1) Balloons may be conditioned by suspending them in a stream of hot air (above 49°C) from a heating system, or by placing them on a hot water or steam radiator, or on the reflector of a small incandescent lamp (not over 100 watts). When balloons are heated through contact with a solid object, they should be turned occasionally to ensure uniform conditioning. This precaution is particularly important with high temperatures. The surface to be used can be checked quickly with a few drops of water. If the water boils or evaporates rapidly, the surface is too hot and may damage the balloon.

(2) Balloons may also be conditioned in boiling water. Plug the neck of the balloon to keep water out and immerse all of the

balloon, except the neck in the water for about 5 minutes. Shake all water from the balloon and have it relatively dry before inflation.

c. Inflation. The balloon should be dry inside and relatively dry outside, especially during freezing weather. Remove any trapped air by folding and squeezing the balloon in the hand; then stretch the neck sufficiently to insert the inflation nozzle. Place the nozzle so that the tubing connecting the nozzle to the regulator rests on a support and is not suspended from the nozzle. Inflate the balloon slowly and turn off the gas as soon as the balloon begins to lift the nozzle. Add or remove gas from the balloon until the nozzle is suspended just above the support when any motion of the balloon has stopped. Listen for leaks in the balloon. Tie the balloon neck securely just above the nozzle and remove the balloon from the nozzle. Double the end of the neck over the tied portion and either tie it or secure it with a rubber band. Figure 17-1, 10-Gram Balloon Ascension Rates, presents 10-gram balloon ascension rates. Figure 17-2, 30-Gram Balloon Ascension Rates, presents 30-gram balloon ascension rates.

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 seconds							

Figure 17-1. 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							

Figure 17-2. 30-Gram Balloon Ascension Rates

SECTION 2. PRECIPITATION MEASURING EQUIPMENT

17-7. WEIGHING RAIN GAUGE

The weighing-type recording gauge is designed to record the rate-of-fall as well as the depth of precipitation. It consists of a receiver of exactly 8 inches inside diameter through which precipitation is funneled into a bucket mounted on a weighing mechanism. The weight of the catch is recorded on a clock-driven chart as inches of precipitation. Most gauges in use have clocks which rotate the cylinder one revolution in 24 hours and a recording capacity of 12 inches of precipitation (6-inches single-traverse).

17-8. CHANGING WEIGHING RAIN GAUGE CHARTS

In handling completed charts, avoid smearing damp portions of the trace. To change charts:

a. Remove the collector ring and bucket (unless the gauge has a large inspection aperture through which the clock cylinder can be removed), and either remove the cylindrical shield, or lift it until it can be turned so that its vertical guides rest on the matching guides attached to the inner shield. When thumb levers (located near the inside top of the outer shield) are provided, depress them to release the shield.

b. Make a time check on the chart:

(1) If the clock is stopped and precipitation occurred, rotate the cylinder slightly right and left to identify the top of the precipitation trace, and label the point "CLOCK STOPPED."

(2) If the pen is not operating, mark the position of the pen on the chart with a dot enclosed in a circle and label the entry "PEN DRY."

c. Lift the pen from the chart with the pen holder.

d. Empty and replace the bucket unless the bucket is charged with antifreeze.

e. Lift the cylinder clear of the spindle and then tilt it to remove.

f. Wind the clock (not too tightly).

g. Replace the chart, fitting the unused chart snugly to the cylinder with the retaining clip and the bottom of the chart should rest on the flange and the horizontal lines coincide where the ends of the chart overlap.

h. Replace the cylinder on its spindle and adjust the cylinder for time.

i. Re-ink the pen (about 3/4 full) and replace it on the chart, adjusting the pen to the zero ordinate on the chart if the bucket is empty.

j. Determine that the pen is recording and the clock is running.

k. Replace the outer shield and collector ring.

17-9. WEIGHING RAIN GAUGE - WINTER OPERATION

To avoid damaging the mechanism, the weighing rain gauge should be winterized as soon as there is a danger of freezing, frozen precipitation, or freezing temperatures. Winterize the gauge at the beginning of the winter season. For gauges with funnels, remove the funnel from the bottom of the collector and if the gauge has a snow ring, install it in place of the funnel. Add propylene

glycol and mineral oil to prevent damage from freezing and to retard evaporation. Instructions for using the antifreeze are printed on the label of each container.

17-10. WEIGHING RAIN GAUGE - SUMMER OPERATION

At the beginning of the summer season, when it is believed no more freezing temperatures will occur, replace the funnel.

17-11. WEIGHING RAIN GAUGE - WINDING THE CLOCK

Wind the clock each time the chart is changed. Do not overwind the clock. This is one of the leading causes for clock failures.

17-12. MAINTAINING THE WEIGHING RAIN GAUGE

At least once a year:

a. Check the level of the dashpot fluid.

b. Check the pen and clean, sharpen, or replace if necessary.

c. Check the condition of the gasket at the bottom of the outer shield.

17-13. WEIGHING RAIN GAUGE - DASHPOT

If necessary to prevent the loss of ink from the pen and to minimize irregularities in the trace resulting from vibration or wind gusts, fill the dashpots with either propylene glycol, petroleum oil, or a similar fluid. Keep the dashpot filled to a level about 3/8 inch from the top. After filling the dashpots, move the weighing platform up and down several times to remove any air bubbles trapped under the dasher and check the fluid level again. Do not mix different types of dashpot fluids.

17-14. WEIGHING RAIN GAUGE - CLOCKS

If the clock gains or loses more than 2 minutes a day, adjust the timing regulator. Open the small inspection plate in the top cover of the clock compartment for access to the adjusting lever. Move the lever toward "F" if the clock is losing time; toward "S" if the clock is gaining time. Make time adjustments when changing charts, if possible, to preserve the continuity of the record. When a clock gains or loses more than 10 minutes a day, the clock should be replaced unless it is practicable to have it repaired by a local watchmaker. Replacement clocks are available from the National Logistics Supply Center (NLSC).

a. The gear on replacement clocks have a number stamped on them and they will generally mesh satisfactorily with a gear-type spindle of the same number. If they do not mesh satisfactorily, adjust the position of the pinion after loosening the three screws near the edge of the base of the cylinder. The spindle screws into the base of the gauge and in some cases may be secured by a wing nut. If accessory items such as a spindle, gear, pinion, washer, and wing nut are received with a replacement clock, the equivalent parts should be returned with the defective clock.

b. The gear-type spindles are provided with a small, horizontal hole in the shaft to facilitate its removal with a spindle wrench or a short rod such as a nail. The friction between the gear and the shaft is enough to permit initial loosening and final tightening of the spindle by hand. The leverage afforded by the spindle should then be sufficient to permit removal or replacement by hand. Do not use pliers or other metal tools on the shaft or gear. If the threads do not mesh readily, request a replacement spindle.

c. The gear should not be free to turn after the spindle is tightened. Be sure that the outer, beveled edge of the washer faces downward between the gear and the base of the gauge. Center the washer when the spindle is tightened in order that the gear will be properly secured between the washer and the shoulder of the spindle.

17-15. WEIGHING RAIN GAUGE - PENS

Clean the pen as often as necessary to maintain a legible trace. Clean the pen by washing it in water or, preferably, alcohol. Sharpen the pen, if necessary, by rubbing the edges gently over a fine-grain whetstone or a sheet of crocus cloth. After the pointer has been sharpened, rub it very lightly over the abrasive surface several times to remove any burrs that might catch on the chart and cause an erratic trace. A spare pen should be kept on hand for replacement purposes.

17-16. WEIGHING RAIN GAUGE - BUCKET

The only bucket maintenance necessary is periodic cleaning to remove any accumulated dust or dirt. If at any time the contents of the bucket freezes, the bucket should be examined for any damage and replaced, if necessary, with a galvanized bucket of the same capacity.

17-17. WEIGHING RAIN GAUGE - EVALUATION PROCEDURE

(See Figure 17-3, Evaluation of Precipitation on Weighing Rain Gauge Chart.) To determine the amount of precipitation during a designated period, subtract the reading at the beginning of the period from the reading at the end of the period. When the pen does not reverse exactly at the uppermost ordinate of the chart, readings from the 6- or 12-inch scale are in error. When this occurs, take the sum of the precipitation equivalent segments of the trace as follows:

a. If the pen reversed during heavy precipitation and rainfall was recorded as a flat trace during reversal, owing to loose linkage, extrapolate the ascending and descending portions of the curve to an approximate apex.

b. When the record is incomplete for less than 24 hours, e.g., clock stopped, interpolate hourly data and enter them on the chart in parentheses. Do not interpolate hourly data if 24 hours or more of record are missing.

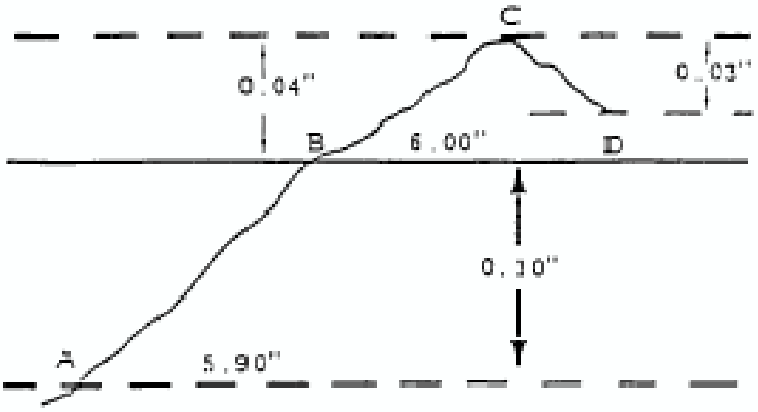


Figure 17-3. Evaluation of Precipitation on Weighing Rain Gauge Chart

In Figure 17-3, above, the total precipitation for the period, ABCD, is found as follows:

(1) The difference between readings at points A and B is 6.00 minus 5.90, or 0.10 inch.

(2) The precipitation equivalent of the height of point C above the 6.00-inch line is 0.04 inch.

(3) The precipitation equivalent of the difference in height between points C and D is 0.03 inch.

(4) The sum of segments AB, BC, CD is the sum of 0.10 plus 0.04 plus 0.03, or 0.17 inch, the precipitation during the time interval between points A and D.

17-18. WEIGHING RAIN GAUGE - ANNOTATION OF CHARTS

Before placing the chart on the gauge, enter in ink, the station name, date, time (to the nearest minute), and the local time zone designator. After removing the chart from the gauge, enter hourly precipitation amounts, in inches and hundredths, midway between the hour lines. Omit the entry if no precipitation occurred and enter "T" for amounts less than 0.005 inch. The total of the hour amounts should equal the total rainfall registered on the gauge. In addition the following annotations are required:

a. Indicate the time precipitation began with "B /" and the time precipitation ended with "E \". Enter these marks in parentheses if the times are doubtful. Enter the date if not readily apparent from the trace. All the times used on the chart are LST.

b. Mark a time check on the chart at each 6-hourly observation when notified of an aircraft mishap, at or near the station, and when changing charts. Make checks approximately two ordinates in length by touching the bucket or the lower portion of the weighing-bucket platform. Do not elevate the pen except by touching the bucket or platform.

17-19. WEIGHING RAIN GAUGE - REPLACEMENT OF CHARTS

Change charts at the time specified by the station supervisor. If at that time, sufficient precipitation is falling to cause a loss of record, change charts as soon after the designated time as possible. Change charts:

a. On the first of each month and consistently each Friday or Saturday of the month.

b. Within 24 hours after precipitation ends.

c. Daily whenever there is a local need or vibrations produce a blurred trace corresponding to more than 0.04 inch of precipitation.

17-20. CLOCK INOPERATIVE ON WEIGHING GAUGE

At each 6-hourly and midnight observation, when the clock is inoperative, turn the cylinder clockwise about one-half inch and mark the position of the pen.

17-21. ZERO ADJUSTMENT ON WEIGHING GAUGE

A knurled, zero-adjustment nut above the frame that supports the linkage mechanism is turned clockwise to lower and counterclockwise to raise the pen. Except as specified in separate maintenance instructions, adjust the pen to the zero line on the form only when an empty bucket is on the weighing platform. Do not change the adjustment of the three platform-travel-limiting and shipping screws adjacent to the zero-adjustment nut, except as specified in separate instructions. If repetition of the trace over the same ordinate causes the pen line to appear too wide for accurate evaluation of small amounts of precipitation, adjust the pen upward approximately one-fourth of a linear inch and make a notation to this effect on the chart.

17-22. TIME ADJUSTMENT ON WEIGHING GAUGE

To adjust the chart for time, turn the cylinder counterclockwise as viewed from above until the correct local standard time (to the nearest minute) is indicated by the position of the pen with respect to the labeled time lines. The heaviest lines are labeled to indicate the beginning of each hour (LST). Additional lines are provided at 15-minute intervals.

17-23. EMPTYING THE GAUGE

Empty the weighing gauge whenever necessary to avoid exceeding the single-traverse capacity of the gauge, when charts are changed if the gauge is not changed with antifreeze, and when the mixture of precipitation and antifreeze is diluted to where there is a danger of freezing.

17-24. ICE ACCRETION INDICATORS

Ice-accretion indicators are designed to indicate the occurrence of freezing precipitation. A freezing rain sensor on an ASOS is capable of reporting ice accretion amounts. Ice accretion is determined and reported automatically and there is no manual backup required. When an ASOS freezing rain sensor is not available, a wooden bracket with clamps mounted on each end to hold a strip of aluminum may be used to determine whether freezing precipitation is occurring. Expose a strip of aluminum whenever the possibility of freezing precipitation exists. When precipitation is occurring, exposing a second strip of aluminum (which is near the same temperature as the air) will help to avoid the possibility of reporting freezing rain as occurring when actually the ice on the indicator might have formed some time prior to the observation. When doing this, however, care

must be taken to ensure that the strips are at or very close to the same temperature as the air.

17-25. MAINTAINING THE NON-RECORDING GAUGE

At least once a year check the level of the rim of the gauge using a spirit level and check the condition of the supports.

17-26. MAINTAINING THE TIPPING BUCKET GAUGE

a. Non-routine. Remove the bucket and clean it with a mild scouring agent as frequently as necessary to remove accumulated dust and dirt. Whenever stick measurements of the precipitation collected in the tipping bucket regularly exceed the registered amounts for a given period by more than about 3 percent for light rain, 6 percent for moderate rain, or 10 percent for heavy rain; check to see if there is excessive friction in the bearings and whether the tipping-bucket frame is bad. Whenever the bucket is tipped 10 times and the register pen does not return to its starting point, inspect the contacts for any indication of malfunctioning.

b. Monthly. Clean the cams of the front and rear of the bucket so that they ride freely on the projector on the contact springs. Clean and oil the bearings using a drop of SAE 10 oil or anemometer oil on each bearing. When replacing the bucket, the stop pins should be at the rear. If it is replaced with the pins forward, it may recoil and cause two tips to register instead of one. If the tipping bucket is equipped with exposed contacts, clean the contacts with a piece of fine sandpaper or crocus cloth. If the tipping bucket is equipped with a mercury-type switching mechanism, routine maintenance and adjustments are not required. The serial number stamped on the frame of the mercury switch should correspond with the number stamped on the tipping bucket. When installing the switch, level the frame that supports the tipping bucket and adjust the glass mercury-tube in the mount. To mount the tube, push it downward in the clip until the tip rests on the bottom of the support; then turn the tube until the vertical metal, plate-like armature in the tube is adjacent to the magnet on the tipping bucket, and the armature is free to move at right angles to the direction of movement of the magnet. The position of the magnet on the bucket is adjusted to provide accurate balance of the bucket and should not be changed.

c. Annual. At least once a year, check the level of the collector ring with a spirit level.

SECTION 3. VISIBILITY MEASURING EQUIPMENT

17-27. TRANSMISSOMETER OPERATION

The observer shall operate the transmissometer in accordance with National Bureau of Standards Report No. 2588 (revised) and separate agency instructions. Where they differ, the separate instructions will take precedence, within the service concerned, over the National Bureau of Standards instructions.

17-28. TRANSMISSOMETER BACK-GROUND MEASUREMENTS AND ADJUSTMENTS

These instructions are applicable at transmissometer stations not equipped with RVR computers. "Background Level" measurements shall be made whenever it is likely that the background level may be great enough to invalidate the RVV or RVR values determined from the equipment. These "Background Level" measurements are made as follows:

a. Depress the BACKGROUND switch to the TEST position.

b. Read the indicated value of the adjustment recorder trace.

c. Release the switch button (to return it to NORMAL position).

d. If the reading in "b" exceeds 1 percent of full-scale value, adjust the ZERO ADJUSTMENT control as necessary to reduce the reading to near zero.

17-29. TRANSMISSOMETER DAILY AND WEEKLY CHECKS

In addition to the background measurement specified in paragraph 17-28, Transmissometer Background Measurements and Adjustments, daily and weekly checks of background level measurements shall be made.

17-30. TRANSMISSOMETER READOUT CHECK

Concurrent readings of all readouts (e.g. in Tower, TRACON, and weather observer's office) shall be made once during each 8-hour shift. Simultaneous readings shall be made with the assistance of designated personnel at all locations and shall conform to the following standards:

a. RVR computer readouts should display identical values at all positions and normally should agree within one reportable value with concurrent values derived from the recorder trace and appropriate tables.

b. RVR meter readouts should display approximately identical values at all positions. Meter recorder comparisons are made with the system in a test condition, as follows, and involve the controls on the indicator panel:

(1) Inform meter readout positions of the beginning of the test period.

(2) Switch the ZERO control to TEST position.

(3) Use the ZERO ADJUSTMENT control, if necessary, to zero the recorder.

(4) Obtain meter readings from all positions in terms of the "±" departure of each meter needle from the "0" graduation of the meter scale in terms of the width of the needle at the circle separating the night equal to one needle width.

(5) Reset ZERO switch to NORMAL.

(6) Set the CALIBRATE switch to CALIBRATE.

(7) Adjust the CALIBRATION ADJUSTMENT control for a recorder reading using the values in Figure 17-4, Transmissometer Conversion Tables, as follows:

(8) Obtain meter readings from all positions in terms of the ± departure of each meter needle from the 1 7/16-mile DAY scale graduation mark on the meter face. The meter needles should not depart from the specified graduation mark on the meter face by more than four widths.

(9) Adjust the CALIBRATION ADJUSTMENT control until the recorder record reading is 90.0 and reset the CALIBRATE switch to NORMAL.

(10) Inform the meter readout positions of the end of the test.

(11) Discontinue the use of meters that do not agree with calibrated recorder readings within the limits specified above. The observer shall notify the designated office of meters that fall outside these limits.

	Runway Visual Range (RVR)			Runway Visibility (RVV)		
	250 ft. Baseline	500 ft. Baseline	750 ft. Baseline	250 ft. Baseline	500 ft. Baseline	750 ft. Baseline
Recorder Readings	91.8	84.3	77.4	90.9	82.6	75.1
Meter Equivalents on DAY scale	6000 ft.			1 7/16 mile (the graduation separating the 1 3/8 and 1 1/2 mile increments)		
Percent of full scale	100			99.2	98.6	98

Figure 17-4. Transmissometer Conversion Tables

17-31. TRANSMISSION VARIATION

Almost all short-term fluctuations of RVV or RVR 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--variations which occur particularly under low visibility conditions. For this reason, caution should be used in rejecting visibility or visual range values as erroneous. A lamp which is failing can cause false transmission variations.

17-32. TRANSMISSOMETER OUTAGE

The FAA is responsible for monitoring the performance and determining the operational status of all FAA RVR/RVV systems, for removing from and restoring to service such systems, and for advising all concerned of such actions. Whenever a malfunctioning system is suspected, the observer or designated tower person shall make arrangements for necessary electronic performance and visual checks on the system including, if feasible, a comparison of indicated values with conditions in the area of the transmissometer. If the malfunction is obvious or is verified by the checks, the system

shall be taken out of service until repairs are made. Upon removal of the system from service, the following actions shall be initiated:

a. Immediately notify all readout positions (either RVR or RVV) that data are no longer valid and shall not be used.

b. Notify the designated electronics technician as quickly as possible.

c. Enter a notation of the outage on the FAA maintenance form and show the date and time the system is taken out of service.

d. Issue a Notice to Airmen (NOTAM).

17-33. TRANSMISSOMETER RESTORED TO SERVICE

When the system has been restored to operational status and returned to service, all readout positions shall be notified that RVR or RVV data may now be used, and an appropriate notation will be made on the FAA maintenance form showing the date and time the system was placed back in service. The observer or designated tower person shall issue a NOTAM when the system returns to service.

SECTION 4. PRESSURE MEASURING EQUIPMENT

17-34. OBTAINING STATION PRESSURE FROM MERCURY BAROMETERS

a. Temperature. The observer shall read the thermometer (attached to the barrel) to the nearest 0.5°F.

b. Adjusting the Cistern. The barometer shall be mounted in a vertical position in accordance with applicable instructions. The observer shall adjust the cistern as follows:

(1) Tap the barrel near the top of the mercury column.

(2) Turn the thumbscrew at the bottom of the barometer until the surface of the mercury in the cistern touches the tip of the ivory point (i.e., until the top coincides with its image in the mercury). If a dimple forms on the surface, indicating that the mercury has been raised too far, turn the thumbscrew in the opposite direction until the dimple disappears and the ivory point coincides with its image in the mercury. Contact of the mercury with the ivory point is more easily seen against a white background.

(3) Set the vernier so that the base just cuts off light at the highest point of the meniscus (the curved upper surface of the mercury column (see Figure 17-5, Mercury Barometer Readings Obtained from Various Types of Scales and Verniers). A white background facilitates this setting.

(4) Lower the mercury about 1/4 inch from the ivory point; do not change the setting of the vernier.

17-35. READING THE MERCURY BAROMETER

The observer shall read the barometer to the nearest 0.001 inch in the manner appropriate to the vernier and scale in use (see paragraph 17-37, Mercury Barometer - Scale Reading).

17-36. MERCURY BAROMETER - TOTAL CORRECTION

The observer shall determine the Total Correction (the "Sum of Corrections" from the barometer correction card and the temperature correction) and add it to the reading obtained in paragraph 17-35 above, to obtain station pressure. The observer shall use one of the tables listed below to obtain the proper temperature correction when computing station pressure from mercury barometers (unless otherwise directed by separate instructions pertaining to special types of barometers).

a. TA 455-0-1, "Correction of Mercurial Barometer for Temperature, English Measures."

b. TA 455-0-4 or TA 455-0-4A, "Barometer Total Correction Table (for Fortin barometers, scale true at 16.7°C)."

c. Table 5.2.1, "Correction of Mercurial Barometer for Temperature (scale true at 16.7°C)" in the Manual of Barometry (FMH No. 8).

d. Table 5.4.1 "Barometer Total Correction Table (for Fortin barometers, scale true at 16.7°C)" in the Manual of Barometry (FMH No. 8).

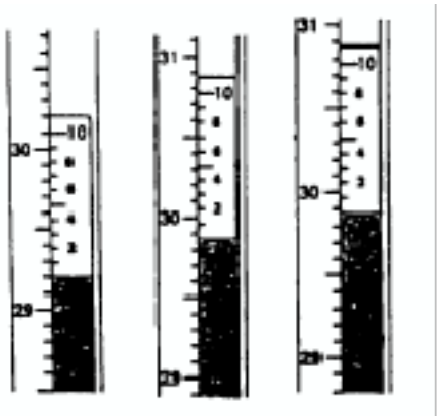
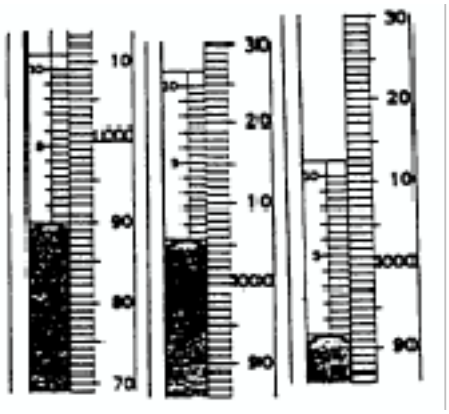
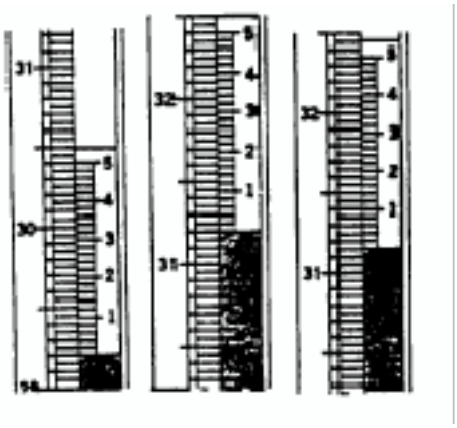
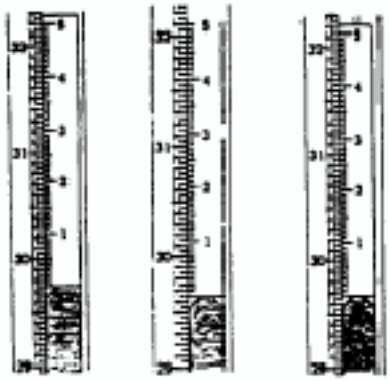
Scale - Vernier Ratio 9:10				Scale - Vernier Ratio 19:20			
							
Scale	29.200	29.800	29.800	Scale	990.00	1005.00	991.00
Vernier	.000	.070	.073	Vernier	.00	0.65	0.83
Total	29.200	29.870	29.873	Total	990.00	1005.65	991.83
Scale - Vernier Ratio 24:25				Scale - Vernier Ratio 49:50			
							
Scale	29.200	31.200	31.150	Scale	29.750	29.650	29.650
Vernier	.000	.003	.006	Vernier	.000	.002	.036
Total	29.200	31.203	31.156	Total	29.750	29.652	29.686

Figure 17-5. Mercury Barometer Readings Obtained from Various Types of Scales and Verniers

Difference Between Adjacent Tabulated Corrections	Interpolated Difference									
	.000		.001		.002		.003		.004	
.000	All Values									
.001	.000 to .250	.500 to .750	.251 to .500	.751 to .000						
.002	.000 to .125	.500 to .625	.126 to .374	.626 to .874	.375 to .500	.875 to .000				
.003	.000 to .083	.500 to .583	.084 to .249	.584 to .749	.250 to .416	.750 to .916	.417 to .500	.917 to .000		
.004	.000 to .062	.500 to .562	.063 to .187	.563 to .687	.188 to .312	.688 to .812	.313 to .437	.813 to .937	.438 to .500	.938 to .000

Figure 17-6. International Table for Mercurial Barometer Temperature Correction

Example of procedures using Figure 17-6, International Table for Mercurial Barometer Temperature Correction:

(1) Given: Observed mercurial barometer (ML-512) reading: 29.783 inches.

(a) Attached thermometer reading: 71.5°F.

(b) Adjacent tabulated corrections in Table 5.2.3 Manual Of Barometry (FMH No. 8).

	29.5	30.0
71.5	-.105	-.107

(2) Enter the interpolation table with the difference (.002), find the column which contains the pressure value (".626 to .874" for .783), and read the interpolated difference (.001).

(3) Apply the interpolated difference to the first (left) tabulated correction (e.g., .105 + .001 = -.106 temperature correction).

(4) This temperature correction plus the sum of corrections equals the total correction to be applied to the observed mercurial barometer reading; i.e., corrected station pressure.

17-37. MERCURY BAROMETER - SCALE READING

Mercury barometers are provided with verniers (movable scales) as an adjunct to the primary stationary scale to facilitate reading the primary scale to thousandths of an inch. Verniers having several ratios are in use. These ratios represent the ratio of the number of lines on the scale to the number of lines in an equivalent distance on the vernier. The zero line of the vernier is also the index for primary-scale readings. Whenever the index coincides exactly with a line on the scale, the barometer reading corresponds exactly to the value of this line (see Figure 17-5, Mercury Barometer Readings Obtained from Various Types of Scales and Verniers). When the index is intermediate between two lines of the scale, the reading is the sum of several increments made up of a primary-scale reading and a vernier reading obtained as follows:

a. The primary-scale reading is the value corresponding to the line on the scale immediately below the index.

b. The vernier reading is determined as follows:

(1) When the line of the vernier, other than the index and top lines, coincides exactly with a line on the scale, the vernier reading corresponds exactly to the value of the vernier line.

(2) When none of the lines of the vernier coincides with lines of the scale, locate the two lines of the scale that include a successive pair of vernier lines between them and are also the scale lines most nearly adjacent to this pair of vernier lines. The vernier reading in this case is the sum of two increments, obtained as follows:

(a) The first increment is the value of the lower of the successive pair of vernier lines selected above.

(b) The second increment is interpolated. It is the fractional value of one vernier division represented by the displacement of the vernier from a setting corresponding exactly to the value selected in (a) and toward a value exactly one vernier division greater than (a) (see Figure 17-5).

(c) The vernier reading is the sum of the first and second increments.

c. The barometer reading is the sum of the primary-scale reading in a and vernier reading in b(1) or b(2).

17-38. CORRECTION OF MERCURY BAROMETER READINGS

Readings of mercury barometers should be corrected for scale error and capillarity, gravity, removal (i.e., the difference between the actual elevation of the barometer and the assigned station elevation), and any known residual errors. The sum of these corrections should be obtained from the barometer correction card as issued or verified by the pertinent regional headquarters or maintenance shop.

17-39. READING BAROGRAPHS FOR STATION PRESSURE

The observer shall obtain readings from barographs as follows:

a. Lightly tap the top of the instrument case.

b. Read current chart value to the nearest 0.005 inch or 0.1 hPa, interpolating for values lying between the printed ordinates.

c. Add the correction determined in accordance with the instructions for Barograph Corrections, column 38, MF1M-10C, to the value obtained in b, above, to obtain the station pressure.

17-40. BAROGRAPH TIME CHECK

Immediately after the 6-hour correction has been determined, the observer shall enter a time-check line and the time (LST) of the check on the barogram. The line should be about equal in length to the width of two divisions on the chart and should be made carefully to avoid injury to the delicate mechanism of the barograph. The observer shall not make a time check line whenever the instrument is cold enough that the pen might not return readily to the pressure trace because of increased viscosity of the fluid in the damper or dashpot.

17-41. BAROGRAPH CLOCK AND CHART SCALE

The observer shall determine that the clock is running and the ink is flowing properly, and note the position of the pen on the chart. Whenever it appears that the pen will pass off the printed divisions of the chart, the observer shall set the pen up or down equivalent to one full inch of pressure by means of the adjusting screw and renumber the lines accordingly. The observer shall indicate on the chart the time of adjustment (see Figure 17-7, Barogram).

17-42. BAROGRAMS

The observer shall change charts at 6-hour times closest to noon LST. If changing the chart must be delayed, the observer shall change it at the time of the next 3-hourly observation in order that the pressure-tendency record will be uninterrupted. On barographs with 12-hour gears, the observer shall change the chart daily.

a. On barographs with 4-day gears, the observer shall change the chart on the 1st, 5th, 9th, etc.

b. Before placing a chart on the barograph, the observer shall use a typewriter, rubber stamp, or ink pen to enter the following data:

(1) In the upper left corner, or in spaces provided, enter the name of the station and type, state, meridian of Local Standard Time, and elevation of station (H_p) to the nearest foot (as shown on the barometer correction card). Where provision was not made for this entry, identify the value with the prefix "H_p =" (e.g., H_p = 317 feet).

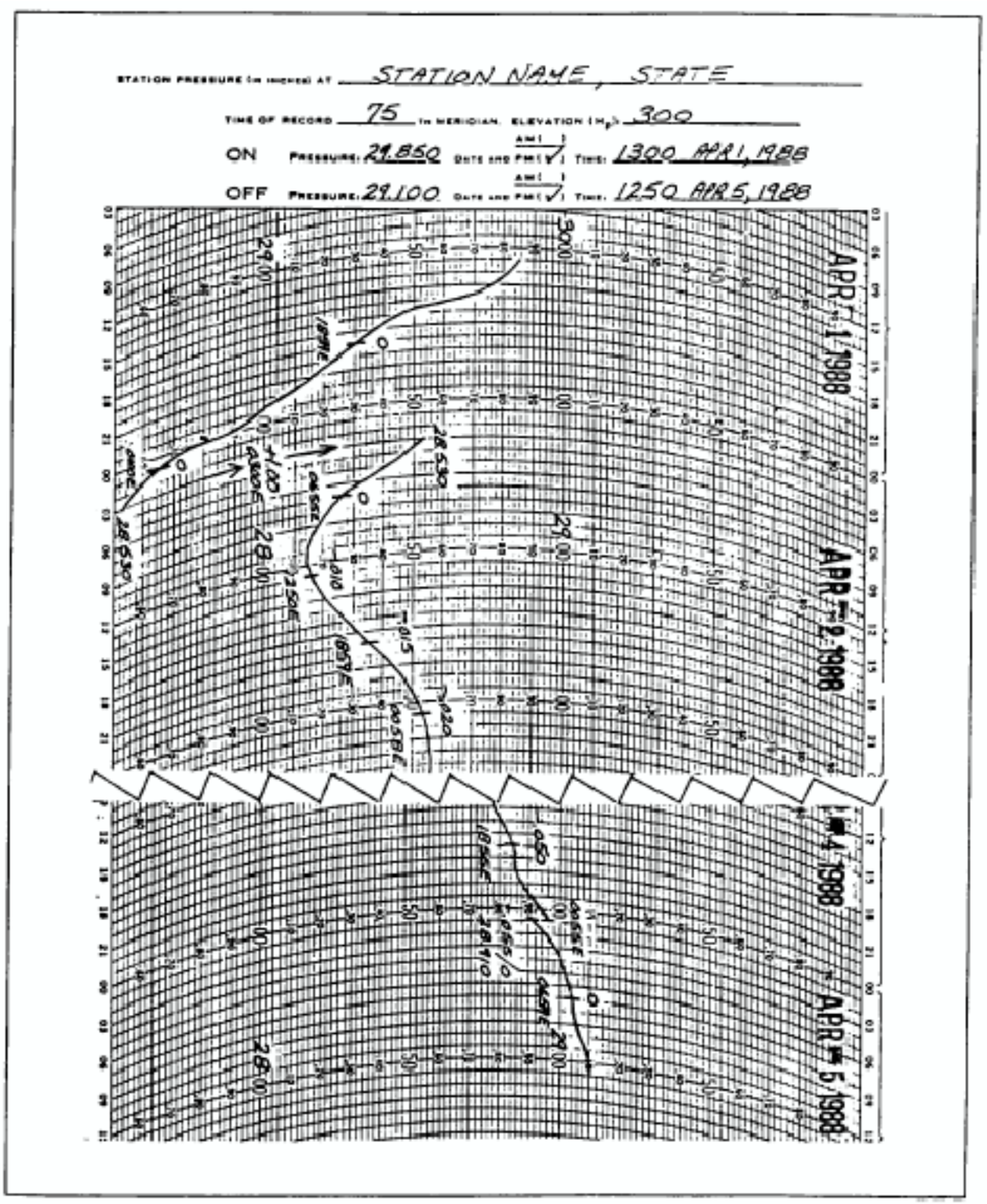


Figure 17-7. Barogram

(2) In the spaces provided, or above the appropriate noon time lines, enter the date of beginning and ending of the trace.

(3) Immediately preceding the printed figures along the first and last time arcs, enter the appropriate figures to indicate the chart range (e.g., 28 preceding the printed 00 on the 28.00 inch line).

(4) In the spaces provided; otherwise, near the point where the trace will begin, enter **ON**, time to the nearest minute (LST), and the current station pressure from block 36, MF1M-10C.

c. After adjustments or removal of a completed barogram the observer shall:

(1) Enter the time of each adjustment and an arrow to indicate the point of adjustment.

(2) In the spaces provided; otherwise, near the end of the trace, enter **OFF**, the time to the nearest minute (LST), and the current station pressure from block 36, MF1M-10C.

(3) Enter above the time-check lines the appropriate corrections; e.g., from column 38, MF1M-10C.

(4) When an adjustment for pressure is made, enter the current station pressure and corrections applying to both the preceding and following record; e.g., -.055/0 near the break in the trace (see Figure 17-3, Evaluation of Precipitation on Weighing Rain Gauge Chart).

(5) On 12-hour barograms, whenever the traces for successive cycles of rotation intersect, identify intervening segments of the trace as necessary to preserve the identity of the trace for each rotation; e.g., when each rotation is on a different day, enter the day of the month in a circle of the trace for one rotation. (See Figure 17-8, Example of Intersecting Barogram Trace.)

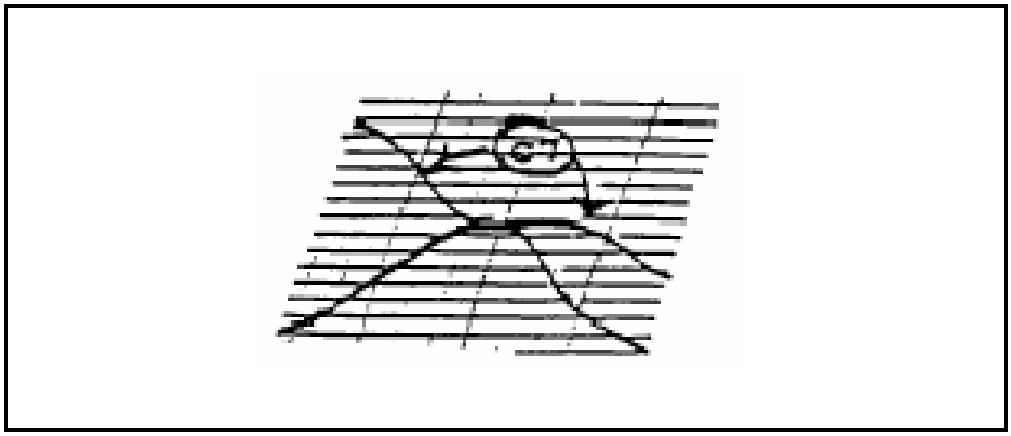


Figure 17-8. Example of Intersecting Barogram Trace

d. The observer shall forward completed barograms monthly to NCDC with the MF1M-10Cs.

17-43. ADJUSTMENT OF THE BAROGRAPH PEN FOR PRESSURE

To adjust the position of the pen, the observer shall turn the knurled pressure-adjusting knob at the top of the cylindrical pressure-element housing until the pen is at the correct station pressure. The observer shall tap the case or chassis lightly to overcome any sticking in the linkage mechanism before checking the adjustment of the pen. The observer shall adjust the barograph to a zero correction when:

a. The chart is changed and the correction exceeds 0.01 inch or 0.3 hPa, or

b. The correction exceeds 0.05 inch or 1.5 hPa.

17-44. BAROGRAPH ADJUSTMENT FOR TIME

To adjust the cylinder for time, the observer shall turn it counterclockwise until all slack motion in the drive mechanism is removed. If the pen position does not bear the proper relationship to the time-ordinate lines after the slack has been removed, the observer shall continue to turn the cylinder counterclockwise with sufficient force to override the friction drive until the timing error is eliminated. The observer shall adjust the instrument promptly if, at any time, the record trace is in error by more than 1/4 of a chart division.

17-45. SELECTION OF BAROGRAM

At stations with 12-hour barographs, use WS Form 455-18. At stations with 4-day barographs, use either WS Form 1068C, with vertical scale mid value .250 inch, or WS Form 455-17, with mid value .750 inch, whichever is most appropriate for the station. The general rule is to select the barogram for which the mean-annual, station-pressure value would be closest to the middle of the chart. The mean-annual pressure can be estimated from climatological data for the station or the barometer correction card. If these are not available, use Figure 17-9, Selection of Barograms. If an extreme high or low system will cause the barograph pen to go above or

below the chart, adjust the pen up or down an inch for the duration of the event.

7-46. CHANGING THE BAROGRAM

a. Remove the pen from the chart by means of the pen shifting lever.

b. Open the barograph case (some Barograph cases must be opened to expose the pen shifting lever).

c. Lift the cylinder vertically until it is free of the spindle and remove the chart from the cylinder. Avoid storing or handling charts in a manner that might smear the trace before it is dry.

d. Fit the replacement chart smoothly and tightly on the cylinder, with the bottom edge of the chart uniformly in contact with the flange at the bottom of the cylinder, and replace the clip. Inaccurately cut charts should be trimmed along a line parallel to and 1/4 inch below the lower, horizontal boundary ordinate.

e. Wind the clock and lower the cylinder gently over the center spindle until the gears have fully meshed, holding the cylinder at the top and bottom to avoid disturbing the position of the chart.

f. Fill the pen with ink and return it to the surface of the chart, adjusting it, if necessary, for pressure and time. Check the pen and clock for operation.

17-47. MAINTENANCE OF PRESSURE REDUCTION COMPUTER

Maintenance procedures for the pressure reduction computer are the same as those for the psychrometric calculator (see paragraph 17-84, Maintenance of Psychrometric Calculator).

Elevation of Station Barometer (feet)	Midway Isobar Pressure (in)	Elevation of Station Barometer (feet)	Midway Isobar Pressure (in)
0 - 30	30.25* or 29.75**	3891 - 4420	25.75**
		4421 - 4970	25.25*
		4971 - 5530	24.75**
31 - 490	29.75**	5531 - 6110	24.25*
491 - 950	29.25*	6111 - 6710	23.75**
951 - 1415	28.75**	6711 - 7310	23.25*
1416 - 1880	28.25*	7311 - 7920	22.75**
1881 - 2360	27.75**	7921 - 8540	22.25*
2361 - 2860	27.25*	8541 - 9165	21.75**
2861 - 3370	26.75**	9166 - 9790	21.25*
3371 - 3890	26.25*	9791 - 10420	20.75**
*Use WS Form 1068C **Use WS Form 455-17			

Figure 17-9. Selection of Barograms

SECTION 5. BAROMETER COMPARISONS

17-48. GENERAL

At locations with a mercury barometer, commissioned ASOS, AWOS, or digital altimeter setting indicator (DASI) designated as the station pressure standard, analog aneroid barometers and analog altimeter setting indicators shall be standardized. Those analog instruments shall be routinely compared to the station pressure standard to ascertain continued reliability and to determine corrections to readings of the analog aneroid instruments. Comparison data shall be entered on MF1-13, using the guide for preparation on the back of the form. Figure 17-10, Sample of MF1-13 Barometer Comparison (Front), presents an illustration of the front side of Form MF1-13. Figure 17-11, Sample of MF1-13, Barometer Comparison (Back), presents an illustration of the back side of Form MF1-13. Station pressure standards shall be compared with travelling standards that are directly traceable to mercury standards at the National Institute of Standards and Technology (NIST).

17-49. REQUIREMENTS FOR STANDARDIZING INSTRUMENTS

A series of comparative readings, as specified in paragraph17-50, Standardizing Procedures, shall be accomplished whenever:

a. A station pressure standard is replaced.

b. An aneroid barometer or altimeter setting indicator is installed, reset, or relocated.

c. Erratic or excessive corrections are observed (see paragraph 17-53, General).

17-50. STANDARDIZING PROCEDURES

When standardization of an aneroid instrument is required (see Section 6, Performance of Aneroid Instruments, of this chapter), the observer shall make comparisons and determine mean corrections as follows:

a. Make 10 comparisons of the aneroid instrument with the mercury barometer. If practicable, make these readings at hour intervals but, in no case, should the interval be less than 15 minutes.

b. During the time the 10 comparisons are being made, the station pressure and altimeter setting for hour observations shall be based upon the readings of the mercury barometer. The aneroid instrument, using the correction from the preceding hour comparison, may be used to determine pressure values for SPECI observations and local needs.

c. After the 10 comparisons have been made, compute the mean of the column 10 entries. Check the reliability of the instrument by verifying that the difference between corrected readings does not exceed allowable differences (see paragraph 17-65, Sling Psychrometer Ventilation). If determined reliable, enter and use the mean correction in column 12 as the "posted correction" to be applied to reading of the aneroid instrument; i.e., until the mean correction is redetermined.

d. On each of the next 5 workdays, make two additional comparisons at a 6-hour interval and determine the mean correction as in c above, using the last 10 entries in column 10; e.g., using comparisons 3 through 12 on the first of the 5 days, 5 through 14 on the second day, etc.

MF 1-13 (10-71)

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE

BAROMETER COMPARISONS

(See detailed instructions for preparation of form on reverse side)

Station: J F KENNEDY AIRPORT

Location: JAMAICA NY

COMPARISON OF: Altimeter-setting indicator [X] / Aneroid barometer [ ] Serial No. 5741-151

Site mercury-barometer serial No. 699

Actual elev. merc. bar., H_g = 33.312 ft. Station elevation, H_p = 22 ft.

Actual elev. aneroid bar., = ______ ft. Actual elev. alt.-setting ind. = 33 ft.

Sum of mercury-barometer corrections from entry on WS Form B-10: ± 000

Comparison No.	Year 1996 Month and day	Time (LST)	Temp. attach. therm.	Observed barometer reading	Station pressure (in. Hg)	Station pressure (mb.)	Altimeter setting (in.)	Observed reading (aneroid or alt. set. ind.)	Correction F_d	Sum of C_a for group	Comp. Nos.	Mean C_a for group ($\bar{C}_{an}$)	Difference between "80" ... means	Remarks	Initials
1	2	3	4	5	6	7	8	9	10	11		12	13	14	15
53	7/4	0715	73.0	30.257	30.136		30.159	30.160	-001						MH
54	7/4	1300	74.0	30.312	30.059		30.082	30.080	+002	+.009	45-54	+.001	±.000	30	MH
55	7/11	0710	71.5	30.411	30.294		30.317	30.319	-002						CM
56	7/11	1303	74.5	30.391	30.265		30.288	30.389	-001	+.004	47-56	±000	-.001		CM
57	7/18	0730	77.0	30.119	29.987		30.010	30.009	+001						DB
58	7/18	1330	78.0	30.128	29.994		30.017	30.015	+002	+.004	49-58	±000	±000		DB
59	7/25	0635	72.0	29.930	29.803		29.826	29.825	+001						RM
60	7/25	1300	72.0	29.856	29.739		29.762	29.760	+002	+.002	51-60	±000	±000		RM
61	8/1	0605	75.5	30.040	29.913		29.936	29.937	-001						MH
62	8/1	1210	77.0	30.036	29.905		29.928	29.930	-002	+.002	53-62	±000	±000		MH
63	8/8	0730	72.5	30.024	29.905		29.928	29.930	-002						MH
64	8/8	1330	72.5	29.976	29.857		29.880	29.872	+008	+.007	55-64	+.001	-.001		MH
65	8/15	0905	74.0	30.240	30.116		30.139	30.142	-003						JA
66	8/15	1310	76.0	30.284	30.154		30.177	30.183	-006	+.001	57-66	±000	-.001		JA
67	8/22	0805	73.0	29.952	29.832		29.855	29.857	-002						MH
68	8/22	1400	74.0	29.914	29.791		29.814	29.816	-002	-.007	59-68	-.001	-.001		MH
69	8/29	0820	74.5	30.364	30.238		30.261	30.266	-005						AW
70	8/29	1345	77.0	30.328	30.198		30.218	30.221	-003	-.018	61-70	-.002	-.001	30	AW

MF 1-13 SUPERSEDES ALL PREVIOUS EDITIONS

Figure 17-10. Sample of MF1-13, Barometer Comparison (Front)

MF 1-13
(10-77)

GUIDE FOR PREPARING FORM†

Headings: Enter heading information in accordance with legends. (Data such as H_p, H_z, etc. may be obtained from Weather Service Form B-40: Enter appropriate units above columns (e.g., °F. or °C. in Col. 4, inches or millibars in Col. 5, etc.).

Col. 1. Enter comparison numbers consecutively. Append letters (a, b, ...) to special comparisons following a regular one on the same day.

Col. 2. Enter year at the top of column. Enter month and day (e.g., 2/5 for February 5).

Col. 3. Enter time to nearest minute (e.g., 1912 for 7:12 P.M.).

Col. 4. Enter temperature of attached thermometer, to nearest 0.5 degree F. or C.

Col. 5. Enter uncorrected reading of the mercury barometer, to nearest .001 inch or .01 millibar.

Col. 6. Enter station pressure, to nearest .001 inch, if mercury or aneroid instrument is graduated in inches.

Col. 7. Enter station pressure, to nearest 0.1 millibar, if mercury or aneroid instrument is graduated in millibars. Convert inch values in Col. 6 to millibars for entry in Col. 7, when appropriate. Omit entries if both instruments are graduated in inches.

Col. 8. If an altimeter setting indicator is being compared, enter to the nearest .001 inch the setting value determined using the entry in Col. 6 and Pressure Reduction Computer or Altimeter Setting Table.

Col. 9. Enter observed reading of the altimeter setting indicator or aneroid barometer to nearest .001 inch or 0.1 millibar, interpolating between scale graduations as necessary.

Col. 10. If an altimeter setting indicator is being compared enter the difference (Col. 8 minus Col. 9). If an aneroid barometer is being compared enter the difference (Col. 6 minus Col. 9) when aneroid is graduated in inches, or the difference (Col. 7 minus Col. 9) when aneroid is graduated in millibars.

Col. 11. Sum of C_a for group: After making the second comparison of the day, add the values for that day to the values for the four previous weeks (or days) and enter the sum of the ten values. When any regular comparison is found to be in error, as indicated by two or more special comparisons, the mean C_a based on the specials should be used in lieu of the regular value, to determine the sum. Comp. Nos.: Enter the first and last comparison numbers used to determine the sum. Enter all nonconsecutive numbers in Col. 14.

Col. 12. Enter, to nearest .001 inch or .01 millibar, the mean C_a based on the sum given in Col. 11.

Col. 13. Enter the difference (current mean C_a for group minus previous mean C_a for group) based on Col. 12.

Col. 14. Enter appropriate remarks when there is evidence of malfunctioning of instruments and when corrective measures are applied to them. Indicate dates applicable to all remarks. If an altimeter setting indicator is being compared, enter the reading of its elevation scale, to the nearest whole foot. Enter these readings for the first and last comparisons on forms, and preceding and following changes in scale setting. For a newly installed instrument, enter corrected aneroid readings and differences used in the standardization procedure. †

*FREQUENCY: For established instruments -- Two observations a day, at 6-hour intervals, on the same day of every week.

For newly installed instruments -- Two observations a day, at 6-hour intervals daily until aneroid instrument is considered reliable in accordance with the surface observations handbook.

†For further instructions, see the latest edition of the surface observations handbook.

DISPOSITION: Completed forms will be retained for at least 18 months and until inspected by a Regional Headquarters representative.

GPO : 1981 - 558-148 : GL 3

Figure 17-11. Sample of MF1-13, Barometer Comparison (Back)

e. After the comparisons above have been completed, and none of the differences between corrected readings exceed allowable differences specified in paragraph 17-54, Aneroid Barometer or Altimeter Setting Indicator, the aneroid instrument may be considered standardized and used for routine pressure readings.

f. When an instrument has been standardized in accordance with the above instructions, the adjustment screw (aneroid barometer) or elevation scale (altimeter-setting indicator) shall not be reset without authorization from the appropriate headquarters or maintenance shop.

17-51. ROUTINE COMPARISONS

After an aneroid instrument has been standardized and accepted as reliable in accordance with paragraph 17-50, Standardizing Procedures, the observer shall make two comparisons at least six hours apart on the same day of each week, and:

a. Following each comparison, shall conduct a check for reliability according to procedures in paragraph 17-49, Requirements for Standardizing Instruments.

b. At the time of the second comparison, shall determine a mean of the last 10 correction values (column 10).

c. Shall enter the mean correction in column 12 and check for excessive drift (see paragraph 17-50).

d. Provided the instrument is determined reliable, shall use the mean (column 12) as the new posted correction to be applied to the aneroid instrument readings; i.e., until the mean correction is redetermined the following week.

17-52. DISPOSITION OF FORM MF1-13

a. Disposition at LAWRS (ONLY LAWRS). MF1-13 forms shall be retained on station until reviewed by a representative from NWS Regional Headquarters.

b. Disposition At Stations Other Than LAWRS. (NA LAWRS). Unless advised otherwise by the regional headquarters, the station shall retain the completed forms on station until they are reviewed by a representative from the regional headquarters. Forms more than 18 months old that have been reviewed may be destroyed.

SECTION 6. PERFORMANCE OF ANEROID INSTRUMENTS

17-53. GENERAL

Rapid changes of temperature or exposure to direct heat or sunlight may cause erratic performance of aneroid instruments. Jarring of instruments may dislocate elements of the linkage system. Excessive friction or leaking pressure cells may result in erroneous pressure readings. After verification of erratic or excessive corrections which exceed the limits given in paragraph 17-54, below, the observer shall discontinue use of the unreliable instrument and notify the appropriate headquarters or maintenance shop. However, questionable corrections noted infrequently at the time of strong gusty winds are discouraged.

17-54. ANEROID BAROMETER OR ALTIMETER SETTING INDICATOR

Whenever the difference between the station pressure derived from the station pressure standard and the corrected reading of the aneroid instrument (preceding column 12 entry applied to column 9) exceeds 0.010 inch Hg (0.3 hPa), the difference should be immediately verified by making a second comparison, preferably by another observer.

a. If the difference between the second set of corrected readings does not exceed 0.010 inch Hg (0.3 hPa), the observer shall disregard the first set of readings and use the second set in computing posted corrections.

b. If verified differences between corrected readings for both the first and second comparisons are 0.011 to 0.015 inch Hg (0.31 to 0.5 hPa), the instrument shall be restandardized using procedures in paragraph 17-50, Standardizing Procedures.

c. If verified differences between corrected readings exceed 0.015 inch Hg (0.5 hPa), the observer shall discontinue use of the aneroid instrument and notify the designated organization or maintenance shop.

17-55. EXCESSIVE DRIFT

Occasionally, a defect in an instrument may cause the correction to increase progressively at an abnormal rate. If the posted correction (column 12) of a standardized aneroid instrument has changed more than 0.020 inch Hg (0.7 hPa) since the instrument was reset, the observer shall discontinue use of the aneroid instrument and notify the designated headquarters or maintenance shop.

17-56. INSPECTION COMPARISONS

Comparisons of station pressure standards with instruments from a headquarters or maintenance shop are made during visits by a representative of that headquarters or shop. Whenever there is doubt as to the accuracy or reliability of the station mercury barometer, the person in charge of the station should notify the next higher headquarters and ask that such a comparison be made.

17-57. ELECTRONIC PRESSURE TRANSDUCERS

The highly accurate and reliable electronic pressure transducers, including the digital altimeter setting indicator (DASI), the ASOS, the AWOS, and other approved new technologies, are compared by highly reliable travelling standards that are continuously checked against national mercurial standards.

SECTION 7. TEMPERATURE AND HUMIDITY MEASURING EQUIPMENT

17-58. DRY-BULB THERMOMETER

When rain or snow is occurring, the observer shall dry the bulb, if wet, and shield it from the precipitation as long as necessary to permit dissipation of extraneous heat before reading it again. This reading shall be used for psychrometric purposes rather than the reading normally made when the lowest wet-bulb reading is taken. When frost forms on the thermometer, the observer shall remove the frost with a warm cloth and allow sufficient time for the dissipation of extraneous heat before reading the thermometer.

17-59. WET-BULB THERMOMETER

The procedure used in moistening the wet-bulb varies according to whether the dry-bulb temperature is above freezing, near, or below freezing, and whether the relative humidity is high or low.

17-60. WET-BULB THERMOMETER - TEMPERATURE ABOVE FREEZING

The observer shall moisten the wet-bulb with clean water just prior to ventilating the psychrometer (even though the humidity is high or the wick already appears wet). If, however, the temperature is high and the relative humidity is low, or it is expected that the final temperature of the wet-bulb will be 0 degrees Celsius or less, the observer shall moisten the wet-bulb thoroughly several minutes before taking a reading so that a drop of water will have formed on the end of the bulb. This procedure will reduce the temperature of the wet-bulb without danger of the wick drying out before the temperature reaches its lowest point.

17-61. WET-BULB THERMOMETER - HIGH TEMPERATURE AND LOW HUMIDITY

In areas where the temperature is high and the relative humidity low, the observer shall use precooled water for moistening the wet-bulb to avert premature drying of the wick. Water may be precooled for this purpose by storing it in a porous jug. To avoid altering moisture conditions in the shelter, the observer shall not keep this jug in the shelter. If this method is not effective, the observer shall extend the wick from the wet-bulb to an open container of water and keep the end of the wick immersed in water between observations. When the psychrometer is ventilated, the observer shall remove the wick from the water until the wet-bulb thermometer has been read. Regardless of the methods used, the observer shall ventilate the psychrometer in accordance with paragraph 17-64, Psychrometric Ventilation, before determining the wet-bulb temperature.

17-62. WET-BULB THERMOMETER - TEMPERATURES BELOW FREEZING

At wet-bulb temperatures below 0°C, if the wick is not frozen, the observer shall touch it with clean ice, snow, or another cold object to induce freezing. If freezing of the wick cannot be induced, the observer shall use the low temperature range of the psychrometric calculator for the computation of psychrometric data. (See paragraph 17-83, Using the Calculator.)

17-63. WET-BULB THERMOMETER - DRY-BULB TEMPERATURE BELOW 2.8 DEGREES CELSIUS

At dry-bulb temperatures of 2.8°C or below, the observer shall use water that has been kept at room temperature in order to melt completely

any accumulation of ice on the wet-bulb. The observer shall moisten the bulb thoroughly, at least 15 minutes before ventilating the psychrometer to permit the latent heat released if the water freezes to be dissipated before ventilation is begun. The observer shall not allow excess water to remain on the wet-bulb, since a thin, thoroughly cooled coating is necessary for accurate data.

17-64. PSYCHROMETRIC VENTILATION

The observer shall ventilate the psychrometer for about 10 seconds. The minimum speed of air passing over the psychrometer bulbs should be 15 feet per second. This is approximately one revolution per second of the geared (2 to 1 ratio) whirling psychrometer crank, two revolutions per second of the sling psychrometer, and three and one-half revolutions per second of the crank of the psychrometer fan or motor (direct-drive) whirling psychrometer.

17-65. SLING PSYCHROMETER VENTILATION

The observer shall ventilate the sling psychrometer as follows:

a. Select a shady spot with no obstructions within a radius of the whirling sling.

b. Face into the wind.

c. Hold the handle at arm's length while whirling the psychrometer.

17-66. OBTAINING READINGS FROM SLING PSYCHROMETER

After proper ventilation has been achieved, the observer shall quickly read both thermometers, wet-bulb first. The observer shall repeat this procedure until two successive wet-bulb readings are the same, indicating that the wet-bulb temperature has reached its equilibrium point. If the wet-bulb temperature rises between successive readings, the observer shall re-moisten the wick and reventilate. Accurate readings are especially important at low temperatures, where a given wet-bulb depression has a greater effect on the accuracy of psychrometer computations.

SECTION 8. TEMPERATURE AND HUMIDITY GRAPHING EQUIPMENT

17-67. THERMOGRAPH/HYGRO-THERMOGRAPH TIME CHECK LINE

At approximately 0000, 0600, 1200 and 1800 UTC, the observer shall make a time check mark on the trace by raising the pen the width of two printed temperature intervals.

17-68. CHANGING THERMOGRAPH/ HYGROTHERMOGRAPH CHARTS

The observer shall change charts on 7-day thermographs on the 1st, 8th, 15th, 22nd, and 29th of the month, at 0800 LST, or as soon thereafter as practical, except stations obtaining hour temperatures from the thermograph for entry on MF1M-10C may change them on Fridays to conform with mailing instructions. Before placing the chart on the thermograph, the observer shall use a typewriter, rubber stamp, or pen and ink to enter the following data:

a. In the upper left hand corner, or in spaces provided, enter the station name and type, meridian of local standard time, and on the first of the month, the time that the pen is touched.

b. Across the top of 7-day charts at each noon line, enter the corresponding date.

c. Above the point where the trace will begin, enter the dry-bulb temperature to whole degrees and the time of beginning to the nearest minute.

To change the chart, the observer shall move the pen aside with the shift rod and lift the cylinder until it is clear of the spindle. The observer shall wind the clock and replace the chart. The observer shall make sure that the bottom of the new chart rests against the shoulder of the drum and that the chart fits the drum snugly, with both ends under the spring clip. The horizontal lines should coincide where the ends overlap. Replace the cylinder on its spindle, and adjust the position of the chart for time and temperature before replacing the pen on the chart.

17-69. ANNOTATION OF THE THERMO-GRAPH CHART

After removing the used chart, the observer shall:

a. Enter the time of any adjustment, an arrow indicating the point of adjustment, and the dry-bulb temperature, if adjustment other than that for time has been made.

b. Above the end of the trace, enter the time of removal and the dry-bulb temperature to whole degrees at the time the pen was lifted from the chart.

c. Enter above the time check lines, the difference (to whole degrees with proper algebraic sign) between the thermograph reading and the corresponding dry-bulb reading.

17-70. THERMOGRAPH/ HYGROTHERMOGRAPH TIME ADJUSTMENT

The observer shall adjust the chart for time by turning the cylinder until the pen point is slightly to the right of the appropriate time-arc line on the chart. The observer shall take up the play in the gear mechanism by holding the top edge of the cylinder lightly and turning it counter to the direction of normal rotation until the pen point indicates the correct time. The observer shall adjust the instrument promptly if at any time the record trace is in error by more than 30 minutes

on a 7-day thermograph, or 10 minutes on a 1-day thermograph.

17-71. THERMOGRAPH/HYGRO-THERMOGRAPH TEMPERATURE ADJUSTMENT

When the chart is changed, the observer shall adjust the thermograph to the dry-bulb temperature, if necessary, by means of the adjusting screw located on an extension of the pivoted end of the sensing element. During the process, the observer shall tap the instrument lightly to eliminate transient frictional effects in the linkage mechanism. The observer shall adjust the instrument promptly if, at any time, the recorder trace is in error by more than 5 degrees. When it appears that the pen will pass off the printed divisions of the chart, the observer shall set the pen up or down equivalent to 10 degrees or 20 degrees by means of the adjusting screw, renumber the lines accordingly, and indicate on the chart the time of the adjustment. If, after adjustment to any intermediate temperature, the thermograph reads too low at the time of daily maximum temperatures, and too high at the time of daily minimum temperatures, the pen arm is swinging over too small an arc. To lengthen the pen arm, the observer shall turn the length-adjusting nut in the direction that moves the fulcrum to the left. Conversely, if the recorded temperature is too high at the time of maximum temperatures and too low at the time of minimum temperatures, the observer shall shorten the pen arm by turning the adjusting nut in the opposite direction.

17-72. THERMOGRAPH/ HYGROTHERMOGRAPH DISPOSITION

The station shall forward completed thermo-graphs or hygrothermographs for the month, including the one ending at 0800 LST on the first of the following month, to the NCDC not later than the second working day of the following month. The charts shall be assembled in chronological order with the first day of the month on top.

17-73. GENERAL MAINTENANCE OF THERMOGRAPH

Once a week, the observer shall remove any accumulation of dirt and grease. The observer shall use a soft cloth, or camel's-hair brush, to brush loose dirt from the Bourdon tube. If any foreign substance should stick to the tube, the observer shall remove it with a soft cloth dampened with water, alcohol, ammonia, or a suitable petroleum-base solvent. An abrasive cleaner shall not be used on the tube. If the plating on the Bourdon tube flakes off, the thermograph should be replaced.

17-74. MAINTENANCE OF THERMOGRAPH CLOCK

The observer shall not remove the clock from the chart cylinder in which it is mounted. Repairs and cleaning should be done by a watchmaker, if practical. Otherwise, a replacement should be secured. During periods of extremely cold weather, thickening of the lubricating oil may stop the clock. To start the clock, it may be necessary to warm the clock to a temperature above freezing and to rotate it gently back and forth around the axis of rotation of the cylinder. If the clock has not been cleaned recently, a cleaning may restore normal service. Undue friction between the clock-driven gear and pinion may also stop the clock. If the clock gains or loses more than 2 minutes a day, the observer shall adjust the timing regulator. The observer shall open the small inspection plate in the top cover of the clock compartment for access to the adjusting lever. The observer shall move the lever toward F if the clock is losing time; toward S if the clock is gaining time. The observer shall

make time adjustments when changing charts, if possible, to preserve the continuity of the record. When a clock gains or loses more than 10 minutes a day, the clock should be replaced unless it is practical to have it repaired by a local watchmaker. Replacement clocks are available from the National Logistics Supply Center (NLSC).

a. The gears on replacement clocks have a number stamped on them and they will generally mesh satisfactorily with a gear-type spindle of the same number. If they do not mesh satisfactorily, the observer shall adjust the position of the pinion after loosening the three screws near the edge of the base of the cylinder. The spindle screws into the base on the gauge and in some cases may be secured by a wing nut. If accessory items such as a spindle, gear, pinion, washer, and wing nut are received with a replacement clock, the equivalent parts should be returned with the defective clock.

b. The gear-type spindles are provided with a small, horizontal hole in the shaft to facilitate spindle removal with a spindle wrench or a short rod such as a nail. The friction between the gear and the shaft is enough to permit initial loosening and final tightening of the spindle by hand. The leverage afforded by the spindle should then be sufficient to permit removal or replacement by hand. The observer shall not use pliers or other metal tools on the shaft or gear. If the threads do not mesh readily, the observer shall request a replacement spindle.

c. The gear should not be free to turn after the spindle is tightened. The observer shall make sure that the outer, beveled edge of the washer faces downward between the gear and the base of the gauge. The observer shall center the washer when the spindle is tightened in order that the gear will be properly secured between the washer and the shoulder of the spindle.

17-75. MAINTENANCE OF THERMOGRAPH PEN

The observer shall fill the pen barrel not more than half full. The special ink used is moisture-absorbing and retaining because of the alcohol and glycerin in it. If, during periods of high humidity or prolonged periods of drizzle or light rain, the pen tends to overflow because of the water absorbed by the ink, the observer shall empty the pen barrel with a piece of blotter and refill. About once a month, the observer shall remove the pen and wash it thoroughly in warm water. The observer shall replace the pen if it becomes too blunt to draw a fine line. If the ink does not flow readily from the pen, the observer should draw a piece of hard, bond paper, or cellophane, between the nibs of the pen.

SECTION 9. HYGROTHERMOMETERS

17-76. HYGROTHERMOMETER (HO-83, ASOS 1088, ETC.) - GENERAL

Unlike previous hygrothermometers that employ a lithium chloride dew cell to measure dew point, these hygrothermometers use a "chilled mirror" technique. The sensor, in the aspirator, contains a mirror and two temperature measuring beads. One bead, in the intake of the aspirator, measures the ambient temperature. Dew point temperature is determined by the mirror which is held at precisely the temperature at which a thin film of condensation is maintained on its surface. A thermal unit raises and lowers the temperature of this mirror as necessary to maintain the thickness of the condensation. The temperature of the mirror, measured by the other bead, is the dew point temperature.

17-77. HYGROTHERMOMETER (HO-83) - OPERATIONS

Except for the possible cleaning of the mirror, if no electronic technician is available at the station, the HO-83 contains no operator serviceable parts. All instrument calibration and maintenance, preventive and corrective, shall be done by an electronic technician. However, the observer shall:

a. Be familiar with switches and indicators present on the display.

b. Make a daily check of the displays.

c. Compare hygrothermometer against a standard as necessary but at least once a week.

17-78. HYGROTHERMOMETER (HO-83) - INSTRUMENT ERROR INDICATIONS

Malfunction of the internal circuits of the HO-83 will, in most cases, be indicated by:

a. The error light, which will blink if no signal is being received or errors are suspected or detected. The light will also blink for approximately 5 minutes when power is restored after being shut off. It takes about 5 minutes for the computer to receive enough data to compute the 5-minute averages of temperature and dew point.

b. If no malfunction exists in the display panel (pressing the display button), all displays (temperature, dew point, maximum and minimum temperature) will read -188.8

17-79. HYGROTHERMOMETER (HO-83) - QUALITY CONTROL

Equipment malfunctions will usually be indicated by the error light or an erroneous display when the test button is pressed, but equipment functioning properly can yield incorrect data if, for example, the mirrors are dirty or the intake tube of the aspirator is clogged. Although cleaning the mirrors and intake tube is usually done by the electronic technician, the observer is responsible for ensuring that the temperatures reported are valid by making periodic comparison checks.

17-80. HYGROTHERMOMETER (HO-83, ASOS 1088, ETC.) - COMPARISON CHECKS (NA LAWRS)

Normal comparison checks consist of comparing the hygrothermometer's temperature and dew point with simultaneous values obtained from a properly exposed comparison standard--a sling or shelter mounted psychrometer. The comparison values may be observed at a site convenient to the office as long as the values obtained are representative of those at the hygrothermometer

site. The observer shall make comparisons when no ice fog is present, and:

a. Following preventive as well as corrective maintenance.

b. At least once a week, as near 1200 LST on Monday as possible and more frequently when calibration is suspect or previous comparisons suggest the possibility of unstable or otherwise unsatisfactory performance. The frequency should be such as to keep, as far as practical, the performance within the limits shown below and in Figure 13-1, Chilled Mirror Hygrothermometers - Dew Point Comparison Difference in °F (e.g., HO-83, 1088, etc.), and in Figure 13-2, Chilled Mirror Hygrothermometers - Dew Point Comparison Difference in °C (e.g., HO-83, 1088, etc.).

(1) For ambient temperatures, the difference between the values obtained from the station standard and the hygrothermometer shall not exceed 2°C. This limit is applicable to comparisons made with the station standard at either the hygrothermometer site or at the remote location convenient to the office.

(2) Allowable dew point differences are based on the temperature/dew point spread as determined by the comparison standard (psychrometer). These are shown in Figure 13-1, Chilled Mirror Hygrothermometers - Dew Point Comparison Difference in °F (e.g., HO-83, 1088, etc.), and in Figure 13-2, Chilled Mirror Hygrothermometers - Dew Point Comparison Difference in °C (e.g., HO-83, 1088, etc.), and, like temperature, are applicable to comparisons at either comparison site.

(3) Valid persistent temperature differences, if any, between the hygrothermometer site and a remote site may be applied as a correction to the comparison.

(4) If limits are exceeded when the comparison is made at the location remote from the hygrothermometer site, the observer shall promptly make a comparison at the site of the hygrothermometer. If limits are still exceeded, the observer shall discontinue use of the system and notify the electronic technician for corrective action.

(5) If limits are not exceeded but the trend of comparisons for the past three weeks show a relatively steady drift towards higher or lower temperature or dew-point values, such as from a dirty mirror, the frequency of comparisons should be increased.

(6) A graph of comparison departures is **required** as an aid in evaluating system performance and to determine the frequency of comparisons, NOAA Form 59-6 or other convenient graph paper may be used to plot plus or minus departures above and below a horizontal zero reference line. From the graph the need for corrective maintenance or for more frequent comparisons should be readily apparent.

SECTION 10. MEASURING EQUIPMENT - OTHER

17-81. PSYCHROMETRIC CALCULATOR

The observer shall use the scale based on the barometric pressure nearest the normal station pressure; e.g., observers at sea-level stations shall use a 30-inch scale for all observations. At stations where the normal station pressure is unknown, the appropriate scale, based on the elevation of the station, shall be determined using Figure 17-12, Selection of Psychrometric Calculator on Basis of Standard Atmosphere.

17-82. PSYCHROMETRIC DATA

The method of obtaining dew-point and relative humidity values with a psychrometric calculator varies with temperature conditions affecting the wet-bulb at the time of observation. At wet-bulb temperatures near freezing, the observer shall determine visually that the wet-bulb wick is not frozen before using the wet-bulb depression data.

Station Elevation (Feet)	Computer Pressure Base (Inches of Mercury)
-531 to +392	30
+393 to +1341	29
1342 to 2316	28
2317 to 3836	27
3837 to 5976	25
above 5976	23
Based on ICAO Standard Atmosphere	

Figure 17-12. Selection of Psychrometric Calculator on Basis of Standard Atmosphere

17-83. USING THE CALCULATOR

Instructions for using the calculator are printed on it. Note that different temperature scales of the calculator will be used depending on whether the wet-bulb is covered with ice or water at the time of observation. When the wet-bulb temperature is 0°C or more, the observer shall use the high range of the calculator; when the wet-bulb temperature is less than 0°C, the observer shall use the low range printed on the reverse side of the calculator. At wet-bulb temperatures below 0°C the wet-bulb should be frozen. If not, the observer shall follow the instructions on the low range side of the calculator, relating to a wet wick on the wet-bulb at a temperature less than 0°C.

17-84. MAINTENANCE OF PSYCHROMETRIC CALCULATOR

When not in use, the calculator shall be kept in an envelope or drawer, or otherwise protected. It shall be kept out of direct sunlight and away from radiators or other objects with relatively high temperatures.

a. Cleaning. Once a month, the observer shall clean the calculator with a damp blotter. If a more thorough cleaning is necessary, the observer shall disassemble it and wash the parts with soap and water. The observer shall not use acetone, benzene, lacquer, paint thinner, or other solvents. Care should be taken to reassemble the calculator with spacing washers between each moving part and with the rotor disks on the proper faces of the base. The observer shall not lubricate the pivot assembly since oil may cause discoloration of the vinylite.

b. Alignment Checks. The observer shall check the alignment of the disks of the calculator:

(1) Upon receipt of the calculator.

(2) After reassembly.

(3) Periodically, to prevent misalignment due to pivot wear.

The check shall be made by using the four sets of reference marks printed on each side of the calculator. Each set of marks consists of three lines on the moveable, center disk and one line on the outer disk. To make the check, the observer shall line up the inside mark on the outer disk with the center line of one of the sets on the inner disk; and then with this alignment, check to see if the other three marks on the outer disk fall within the outside lines of each of the corresponding positions on the inner disk. The observer shall repeat the procedure for each of the other seven sets of marks. If, for any of the checks, the single reference mark falls outside the reference marks on the inner disk, the observer shall not use the calculator for official psychrometric calculations.

17-85. MAINTENANCE OF LIQUID-IN-GLASS THERMOMETERS

The observer shall maintain clear, legible graduations by cleaning the thermometers and renewing the ivory black as often as necessary. The observer shall apply the ivory black with a matchstick, or equivalent, to the full length of the graduated portion of the stem. The observer shall remove excess pigment by rubbing the surface of the stem lightly with blotting paper. A black, china-marking pencil may be used instead of ivory black if relatively few markings require renewing.

17-86. MAINTENANCE OF PSYCHROMETERS - WEEKLY CHECKS

The observer shall check the condition of the thermometers, change the wick on the wet-bulb, and clean the thermometer if foreign matter has accumulated. In some localities, it may be necessary to replace wicks more often to prevent their becoming excessively soiled. A solution of vinegar and water will usually prove effective in removing mineral deposits on the glass bulbs. The observer shall clean the gear teeth and exposed surfaces of the whirling psychrometer by removing dirty grease, oil, and loose dirt. The observer shall lubricate the bearings with a few drops of motor oil (SAE 30 or higher) or, in the case of gear teeth and worn bearings, with a thin film of light grease.

17-87. MAINTENANCE OF PSYCHROMETERS - MONTHLY CHECKS

The observer shall oil the bearings of psychrometer fans with one or two drops of light oil, such as anemometer oil, if the bearings are only slightly worn. The observer shall use SAE 10 or 20 oil if the bearings are in poorer condition.

17-88. INSTRUMENT SHELTER - ILLUMINATION

The observer shall use electric lamps rated at a total of not more than 30 watts in large or medium shelters. The lamps shall be mounted as far as possible (at least 10 inches) from the closest temperature-sensing element. The observer shall not leave the lamps turned on any longer than is necessary to read the instruments. The observer shall use a flashlight for illumination in small shelters.

17-89. INSTRUMENT SHELTER - MAINTENANCE

All surfaces of the shelter, both inside and outside, shall be painted with glossy-white. The outside shall be painted as often as necessary to maintain a uniformly covered, clean, white appearance. If the metal supports show evidence of rust or corrosion, the damaged areas shall be cleaned, primed and painted in accordance with

best commercial practices. A top coat of aluminum paint shall be applied.

SECTION 11. WIND RETRANSMITTER

17-90. GENERAL

There are two types of wind retransmitters used in the field. The magnetic amplifier type is powered by two mercury cells and has no provision for testing wind direction. A newer type is powered by alternating current (AC) and does have a switch for testing the wind direction indicator.

17-91. WIND RETRANSMITTER - WEEKLY CHECK

At least once a week, the observer should check to determine that the retransmitter is within the tolerances shown below. This is done as follows:

a. Advise each office having a wind indicator drop from the retransmitter that a test is being made.

b. Depress the "TEST" button on the retransmitter panel.

c. With the "TEST" button depressed, check the value on the master wind speed indicator. This value should be within 1 knot of the calibrated speed at 600 RPM.

d. If the master indicator is not within tolerance and:

(1) You have a magnetic amplifier type retransmitter, replace the two mercury cells, observing correct polarity. (If the meter is still out of tolerances, the electronic technician shall be notified.)

(2) If the station has an AC powered instrument, corrective maintenance should only be done by the electronic technician.

e. When the master meter is within tolerance, make a quick check of all other wind speed meters connected to the retransmitter. Each meter should be within 1 1/2 knots of the master meter and should show about the same differences in subsequent checks. To compare weekly checks keep a record of the readings from each meter. A sample record is shown in Figure 17-13, Wind Speed Comparison Data.

Reading When Test Switch is Depressed Indicator							
Date	Master[1]	1	2	3	4	5	Remarks
1/5/86	59.8	60.1	61.0	59.8	59.8	61.2	
1/12/86	59.7	60.0	63.2* 60.1	59.5	59.7	60.3	Indicator #2 replaced
1/19/86	59.0	59.5	60.2	59.0	59.5	59.8	
1/26/86	58.0*	(Calibrated speed = 60.1)					Battery replaced
1/26/86	60.1	59.8	59.8	60.2	60.0	60.2	
2/3/86	59.7	59.6	59.7	60.2	59.8	60.0	
[1] Compared with calibrated speed at 600 RPM * Maintenance required							

Figure 17-13. Wind Speed Comparison Data

17-92. WIND RETRANSMITTER - OTHER CHECKS

a. Direction Output of Magnetic Amplifier Type Retransmitters. No special provision is made to test the direction output of battery powered retransmitters. Frequent visual checks of wind direction should be made and suspected malfunctions should be reported to the electronic technician.

b. Direction Output of AC Type Retransmitter. To test the direction output, the observer shall set the switch on each of the four directions. To be within tolerance, the direction indicated must be within 5 degrees of the direction set on the switch. The observer shall notify the electronic technician if the wind direction is not within tolerance.

17-93. - 17-96. RESERVED

APPENDIX A. ABBREVIATIONS AND ACRONYMS

The abbreviations and acronyms included in this appendix are defined in accordance with how they are used in this order.

$	ASOS maintenance check indicator
-	light intensity
+	heavy intensity
/	indicator that runway visual range data follows; separator between temperature and dew point data
ACFT MSHP	aircraft mishap
AFSS	Automated Flight Service Station
ALDARS	Automated Lightning Detection and Reporting System
AO1	automated station without precipitation discriminator
AO2	automated station with precipitation discriminator
AOMC	ASOS Operations and Monitoring Center
ASI	altimeter setting indicator
ASOS	Automated Surface Observing System
AT AP	at airport
ATCS	Air Traffic Control Specialist
ATCT	Airport Traffic Control Tower
AUTO	automated report
AWOS	Automated Weather Observing System
B	began
BC	patches
BKN	broken
BL	blowing
BR	mist
C	Celsius, center (with reference to runway designation)
CA	cloud-air lightning
CB	cumulonimbus cloud

CC	cloud-cloud lightning
CG	cloud-ground lightning
CHI	cloud-height indicator
CHINO	sky condition at secondary location not available
CIG	ceiling
CLR	no clouds detected at, or below, design limit of ceilometer (automated system)
CONS	continuous
COR	correction to a previously disseminated report
DA	density altitude
DASI	Digital Altimeter Setting Indicator
DIR	direction
DOC	Department of Commerce
DOD	Department of Defense
DOT	Department of Transportation
DR	low drifting
DS	duststorm
DSNT	distant
DU	widespread dust
DZ	drizzle
E	east, ended
F	Fahrenheit
FAA	Federal Aviation Administration
FBO	fixed base operator
FC	funnel cloud
FCM-H1	Federal Meteorological Handbook No.1, Surface Weather Observations and Reports
FEW	few clouds
FG	fog
FIBI	filed but impracticable to transmit

FROPA	frontal passage
FRQ	frequent
FSS	Flight Service Station
FT	feet
FU	smoke
FZ	freezing
FZRA	freezing rain
FZRANO	freezing rain sensor not available
G	gust
GR	hail
GS	small hail and/or snow pellets
H	hour
H_a	field elevation
H_p	station elevation
hPa	Hectopascal
HZ	haze
IC	ice crystals, in-cloud lightning
ICAO	International Civil Aviation Organization
KT	knot
L	left (with reference to runway designation)
LAST	last observation before a break in coverage at a manual station
LAWRS	Limited Aviation Weather Reporting Station
LLWAS	Low Level Wind Shear Alert System
LOC	location
LST	Local Standard Time
LTG	lightning
LWR	lower
M	minus, less than, missing
METAR	aviation routine weather report

MF1M-10C	Meteorological Form 1M-10C
MI	shallow
MID	midnight
MOV	moved/moving/movement
MSL	mean sea level
MT	mountains
N	north
NA	not applicable
NCDC	National Climatic Data Center
NE	northeast
NFCT	Non-Federal control tower
NF-OBS	Non-Federal Observer/Observation
NGRVR	New Generation Runway Visual Range
NOAA	National Oceanic and Atmospheric Administration
NOSPECI	no SPECI reports are taken at the station
NOTAM	Notice to Airmen
NW	northwest
NWS	National Weather Service
OBS	observer, observation
OCNL	occasional
OFCM	Office of the Federal Coordinator for Meteorology
OHD	overhead
OID	operator interface device
OT	operator terminal
OVC	overcast
P	greater than
PK WND	peak wind
PL	ice pellets
PNO	precipitation amount not available

PO	dust/sand whirls (dust devils)
PR	partial
PRESFR	pressure falling rapidly
PRESRR	pressure rising rapidly
PREWX	present weather
PWINO	present weather information not available (automated system)
PY	spray
R	right (with reference to runway designation)
RA	rain
RMK	remark
RVR	Runway Visual Range
RWY	runway
S	south
SA	sand
SAWRS	Supplementary Aviation Weather Reporting Station
SCT	scattered
SE	southeast
SFC	surface
SG	snow grains
SH	shower(s)
SKC	sky clear (manual observation)
SLP	sea-level pressure
SLPNO	sea-level pressure not available
SM	statute miles
SN	snow
SNINCR	snow increasing rapidly
SPECI	aviation selected special weather report
SQ	squalls
SS	sandstorm

SW	southwest
TAF	aerodrome forecast (terminal)
TCU	towering cumulus
TRACON	Terminal Radar Approach Control
TS	thunderstorm
TSNO	thunderstorm information not available
TWR	tower
UP	unknown precipitation
USCG	United States Coast Guard
UTC	Coordinated Universal Time
V	variable
VA	volcanic ash
VC	in the vicinity
VDU	Video Display Unit
VFR	visual flight rules
VIS	visibility
VISNO	visibility at secondary location not available
VRB	variable
VV	vertical visibility
W	west
WMO	World Meteorological Organization
WND	wind
WSHFT	wind shift
WSOH	NWS Observing Handbook
Z	zulu, i.e., Coordinated Universal Time

APPENDIX B. NON-FEDERAL OBSERVING (NF-OBS) PROGRAM

Paragraph 1-7a describes how the Non-Federal Observing (NF-OBS) Program's procedures and practices must meet federal standards.

The Non-Federal Observing (NF-OBS) Program was developed to enable local aviation entities such as non-federal control towers (NFCTs), airport personnel or fixed base operators (FBOs) to assist with the backup and augmentation of the ASOS. The program is region-driven with oversight provided by FAA Headquarters and is meant to be at no cost to the Government.

Upon request by a potential NF-OBS provider, each FAA region may enter into a cooperative agreement with the provider. Agreements shall define the hours of operation for the NF-OBS and the service level at which the operation will be conducted. They also contain provisions that the NF-OBS provider will provide and train observers, provide suitable storage for instruments and equipment, and provide required backup equipment. Observers shall be certified by the National Weather Service and shall make all observations in accordance with applicable regulations.

Further information about this program can be obtained from the NAS Weather Office, Operations Planning Services, (ATO-P).

APPENDIX C. LAWRS REQUIREMENTS

Paragraph 1-8a contains the applicability of procedures and practices in the order to limited aviation weather reporting station (LAWRS) personnel.

1. PURPOSE

This appendix is an extract from the body of this order and contains the general requirements for LAWRS observers. References to the order are provided for the details.

2. GENERAL

a. A limited aviation weather reporting station (LAWRS) is a facility where observations are taken, prepared and transmitted by certified FAA air traffic control specialists on a limited basis. At these facilities, various degrees of automated sensors and/or other automated equipment may be available. However, when on duty, the LAWRS observer has the complete responsibility for the surface aviation weather elements in the METAR/SPECI.

b. General observing requirements that apply to all observers, including LAWRS, are included in Chapter 3, General Procedures.

3. REQUIREMENTS

LAWRS observers at different locations have differing observing requirements based upon whether or not an automated observation system is available, and the type of system they have. This appendix states minimum requirements for what the LAWRS observer must put into the observation. The observation can be augmented beyond the stated requirements. Table C-1, LAWRS Requirements for Body of METAR, gives the requirements for what the LAWRS observer must manually put in the body of the observation, and Table C-2, LAWRS Requirements for Remarks Section, gives the requirements for what the LAWRS observer must insert in the remarks section. Additive and automated maintenance data included in the remarks section may be added by an automated system, but are not required to be augmented or backed up by LAWRS. Table C-3, LAWRS Requirements for SPECIs, lists SPECI criteria and LAWRS requirements. Listed with each element in these tables is a paragraph reference for how to code the particular element. Details on the procedures for observing each element are given in the appropriate chapter (e.g., tornadic activity procedures are included in Chapter 11, Weather Phenomena; variable visibility procedures are given in Chapter 9, Visibility).

4. REQUIREMENTS FOR LAWRS WITHOUT AN AUTOMATED SYSTEM

At locations without an automated weather observing system, LAWRS observers shall take METAR/SPECI observations in accordance with general instructions for all observers and for manual observers found in Chapters 3 and 7. Specific instructions are found in Chapters 8 through 17. The last column in tables C-1 through C-3 in this appendix gives an outline of the requirements for completely manual LAWRS observations.

5. PROCEDURES FOR LAWRS WITH ASOS

a. Augmenting ASOS Observations. An outline of the requirements for augmentation is provided in tables C-1 through C-3 of this appendix. More detail is given in Chapters 4 and 5. LAWRS observers shall augment the following weather phenomena at ASOS sites:

(1) Thunderstorm (at non-ALDARS sites)

(2) Tornadic activity (including tornado, waterspout, and funnel cloud)

(3) Hail

(4) Virga

(5) Volcanic ash

(6) Operationally significant remarks as deemed appropriate by the observer

b. ASOS Backup. If portions of, or the complete ASOS observation is unavailable due to sensor/system malfunction, communications failure, erroneous data and/or non-representative data (see paragraph 2.5, Backup Requirements, for definitions for each case), LAWRS shall backup, at a minimum, the following weather elements at ASOS sites: (Tables C-1 through C-3 provide an outline of backup requirements for LAWRS.)

(1) Wind

(2) Visibility to 10 miles

(3) Present weather & obscurations (thunderstorms, at ALDARS sites), see Figure 6-6

(4) Sky condition to 12K feet

(5) Temperature/dew point

(6) Altimeter setting

c. Documentation requirements, equipment requirements, and examples of augmented and backup observations are given in Chapters 4, 5 and 6.

6. PROCEDURES FOR LAWRS WITH AWOS

a. Augmenting AWOS Observations. At facilities where AWOS is the automated system, the augmentation shall be manually entered into the system via the Operator Terminal keyboard for transmission. (Note: Augmentation is not possible at AWOS facilities without an Operator Terminal keyboard.) An outline of the requirements for AWOS augmentation is provided in tables C-1 through C-3 of this appendix. More detail is given in Chapters 4 and 5. LAWRS observers at AWOS sites shall augment the following weather phenomena:

(1) Thunderstorm (at non-ALDARS sites)

(2) Precipitation occurring at the point of observation, limited to type plus intensity in accordance with the allowable reports listed in Figure 6-6

(3) Obstructions to vision (alone or in combination with precipitation) at the point of observation in accordance with the allowable reports listed in Figure 6-6

(4) Tornadic activity (including tornado, waterspout, and funnel cloud)

(5) Hail

(6) Virga

(7) Volcanic ash

(8) Operationally significant remarks as deemed appropriate by the observer

At AWOS sites, all augmentation reports shall be manually input into the remarks portion of the report, prefixed with the phrase "WEA:", and shall be limited to 80 characters including spaces. Entry of these reports shall be in accordance with procedures prescribed in the AWOS Observers Handbook or FAA approved manufacturer's equipment manual.

b. AWOS Backup. If portions of, or the complete AWOS observation is unavailable due to sensor/system malfunction, communications failure, erroneous data and/or non-representative data (see paragraph 2-5, Backup Requirements, for definitions for each case), LAWRS shall provide, at a minimum, backup information for the following weather elements at AWOS sites: (Tables C-1 through C-3 provide an outline of backup requirements for LAWRS.)

(1) Wind

(2) Visibility to 10 miles

(3) Thunderstorms (at ALDARS sites)

(4) Sky condition to 12K feet

(5) Temperature/dew point

(6) Altimeter setting

Of the 4 modes on AWOS type III configuration, Mode 3 and Mode 4 allow elements within the observation to be backed up. Operation in Mode 3 permits the LAWRS observer to reflect the errant value as missing with the correct value entered into the remarks section. Operation in Mode 4 permits the LAWRS observer to replace the errant value where it falls in the observation. Details are in the AWOS Operator Instructions.

c. Documentation and equipment requirements and examples of augmented and backup observations are given in Chapters 4, 5 and 6.

LAWRS Requirements for Body of METAR			
Element	LAWRS w/ ASOS	LAWRS w/ AWOS	LAWRS w/o AWOS/ ASOS
Type of Report (METAR/SPECI) (Ref: para. 15-7)			X
Station Identifier (CCCC) (Ref: para. 15-8)			X
Date/Time (YYGGggZ) (Ref: para. 15-9)			X
Report Modifier (AUTO or COR) (Ref: para. 15-10)			X[4]
Wind (dddff(f)Gf_mf_mKT) ($d_nd_nd_nVd_xd_xd_x$) (Ref: para. 15-11)	B	B	X
Visibility (VVVVVSM) (Ref: para. 15-12)	B	B	X[5]
Runway Visual Range ($RD_RD_R/V_RV_RV_RV_RFT$ or $RD_RD_R/V_NV_NV_NV_NVV_XV_XV_XV_XFT$) (Ref: para. 15-13)			D
Present Weather (w'w') (Ref: para. 15-14)	A[1] B[2]	A[3]	X
Sky Condition ($N_sN_sN_sh_sh_sh_s$ or $VVh_sh_sh_s$ or CLR/SKC) (Ref: para. 15-15)	B	B	X
Temperature/Dew Point (T'T'/$T'_dT'_d$) (Ref: para. 15-16)	B	B	X
Altimeter ($AP_HP_HP_HP_H$) (Ref: para. 15-17)	B	B	X

Footnotes:
A = Required to augment automated system.
B = Required to backup automated system.
C = Not backed up by LAWRS.
X = Required.
D = Required at designated stations only.
1. Augment thunderstorm (at non-ALDARS sites), tornadic activity, hail, and volcanic ash
2. See paragraph 6-10 and table 6-6. Augment as normal. (see note 1.)
3. Augment thunderstorm, tornadic activity, hail and volcanic ash.
   Augment precipitation plus intensity in accordance with the allowable reports listed in table 6-6.
   Augment obstructions to vision (alone or in combination with precipitation) at the point of observation in accordance with the allowable reports listed in table 6-6.
4. If applicable.
5. Tower visibility replaces surface visibility.

Table C-1. LAWRS Requirements for Body of METAR

LAWRS Requirements for Remarks Section of Observation (Automated, Manual, and Plain Language)			
Element	LAWRS w/ ASOS	LAWRS w/ AWOS	LAWRS w/o AWOS/ ASOS
Volcanic Eruptions (Ref: para. 15-20)	A	A	X
Tornadic Activity (Tornadic activity_B/E(hh)mm LOC/DIR_(MOV)) (Ref: para. 15-21)	A[1]	A	X
Type of Automated Station (AO1, AO2) (Ref: para. 15-22)			
Peak Wind (PK WND dddff(f)/(hh)mm) (Ref: para. 15-23)			
Wind Shift (WSHFT_(hh)mm) (Ref: para. 15-24)	A	A	A
Tower or Surface Visibility (TWR VIS) (SFC VIS) (Ref: para. 15-25)	A[2]	A[4]	
Variable Prevailing Visibility (VIS minVmax) (Ref: para. 15-26)			X
Sector Visibility (VIS_ dd_vv) (Ref: para. 15-27)			D
Visibility at Second Location (VIS vv location) (Ref: para. 15-28)			D
Lightning ({FREQ}_ LTG{TYPE}_{LOC})(Ref: para. 15-29)	A	A	X
Beginning/Ending Time of Precipitation (WX)B(mm)E(mm) (Ref: para. 15-30)	A[1]		
Beginning/Ending Time of Thunderstorms (TS)B(mm)E(mm) (Ref: para. 15-31)	A[1]		X
Thunderstorm Location (TS_LOC_(MOV_DIR)) (Ref: para. 15-32)	A	A	X
Hailstone Size (GR_{INCHES})(Ref: para. 15-33)	A	A	X
Virga (VIRGA_{Direction})(Ref: para. 15-34)	A[3]	A[3]	X[3]
Variable Ceiling (CIG minVmax) (Ref: para. 15-35)			X
Obscurations (w'w'_($N_sN_sN_s$) $h_sh_sh_s$) (Ref: para. 15-36)			X
Variable Sky Condition ($N_sN_sN_s$($h_sh_sh_s$)_V_$N_sN_sN_s$) (Ref: para. 15-37)			X
Significant Cloud Types (Ref: para. 15-38)			X
Ceiling Height at Second Location (CIG_ {height}_{LOC}) (15-39)			
Pressure Rising or Falling Rapidly (PRESRR) (PRESFR) (15-40)			
Sea-Level Pressure (SLPppp) (SLPNO) (Ref: para. 15-41)			
Aircraft Mishap (ACFT_ MSHP) (Ref: para. 15-42)			D
No SPECI Reports Taken (NOSPECI) (Ref: para. 15-43)			D
Snow Increasing Rapidly (SNINCR_(ii)/(ii)) (NA LAWRS) (15-44)			
Other Significant Information (Plain Language) (Ref: para. 15-45)			D
Additive and Automated Maintenance Data (NA LAWRS) (15-46)			

Footnotes:

A = Required to augment automated system.
B = Required to backup automated system.
X = Required.
D = Required at designated stations only.

1. Beginning/end time done automatically by ASOS (for tornadic activity, thunderstorms, and hail).
2. Tower visibility can be either in remarks or the body of the observations, based upon which visibility is lower.
3. Direction of virga from station is optional.
4. For AWOS, tower visibility will always be in remarks.

Table C-2. LAWRS Requirements for Remarks Section

LAWRS Requirements for SPECI		
SPECI Criteria	LAWRS w/ ASOS	LAWRS w/o AWOS/ ASOS
Wind Shift - Wind direction changes by 45 degrees or more in less than 15 minutes and the wind speed is 10 knots or more throughout the wind shift.	B	X
Visibility - Surface visibility as reported in the body of the report decreases to less than, or if below, increases to equal or exceed: 3 miles, 2 miles, 1 mile, and 1/2 mile or the lowest standard instrument approach procedure minimum as published in the National Ocean Survey (NOS) U.S. Terminal Procedures.	A[2]	X
Runway Visual Range - The highest value from the designated RVR runway decreases to less than, or if below, increases to equal or exceed 2,400 feet during the preceding 10 minutes. Note: Criteria applies to automated RVR reporting only.	C	NA LAWRS
Tornado, Funnel Cloud, Or Waterspout - is observed or disappears from sight.	A	X
Thunderstorm - begins (a SPECI report is not required to report the beginning of a new thunderstorm if one is currently reported) or ends.	A	X
Precipitation - hail begins or ends; freezing precipitation begins, ends, or changes intensity; ice pellets begin, end, or change intensity at manual stations.	A[4]	X
Squall - Wind suddenly increases at least 16 knots and is sustained at 22 knots or more for at least one minute.	B	X
Ceiling - When the height of the base of clouds covering five oktas or more (e.g., broken and overcast) of the sky forms or dissipates below, decreases to less than or, if below, increases to equal or exceed: 3,000 ft., 1,500 ft., 1,000 ft., 500 ft., and 200 ft. or the lowest standard instrument approach procedure minimum as published in the National Ocean Survey (NOS) U.S. Terminal Procedures.	B	X
Sky Condition - A layer of clouds or obscuring phenomena aloft is present below 1,000 feet and no layer aloft was reported below 1,000 feet in the preceding METAR or SPECI observation.	B	X
Volcanic Eruption - When eruption is first noted.	X	X
Aircraft Mishap - Upon notification of an Aircraft Mishap unless there has been an intervening observation.	Note 5	X
Miscellaneous - Any other meteorological situation which, in the opinion of the observer, is critical.	IR	IR

B - LAWRS backs up SPECI initiation
X - LAWRS initiates SPECI
A - LAWRS initiates SPECI to produce report
IR - LAWRS initiates SPECI if required
C = Not backed up by LAWRS.

Note 1. SPECIs are not a capability of the AWOS. (AWOS produces METARs every 20 minutes.)
Note 2. LAWRS augments tower visibility producing SPECI; backs up surface visibility to produce SPECI.
Note 3. At designated sites only.
Note 4. LAWRS observer augments to produce SPECI for hail; backs up initiating SPECI for freezing precipitation.
Note 5. LAWRS initiates archive action only. In addition, LAWRS will take a backup observations (but will not transmit) if elements of the automated system require backup

Table C-3. LAWRS Requirements for SPECIs

APPENDIX D. SERVICE STANDARDS

Paragraph 1-8e describes how Service Standards provide specific guidance regarding the level of tasks performed at all facilities.

1. DESCRIPTION

The term Service Standards refers to four levels of detail in weather observations at sites where there is a commissioned ASOS. The first category, known as Service Level D, is completely automated service in which the ASOS observation constitutes the entire observation, i.e., no additional weather information is added by a human observer. A large number of airfields that receive level D service have never had weather information available. Service Level D provides information on wind, visibility, precipitation/obstruction to vision, cloud height and sky cover, temperature/dewpoint, altimeter, and in some cases freezing rain and lightning reporting capability.

The second category, known as Service Level C, consists of all the elements of Service Level D, in addition to a human observer, who adds information to the automated observation. This is referred to as "augmentation". The augmented information includes, as a minimum, such weather phenomena as thunderstorms, tornadoes, hail, virga, volcanic ash, and tower visibility. Service Level C also includes "backup" of ASOS elements in the event of an ASOS malfunction or an unrepresentative ASOS report. In the backup mode, the controller inserts the correct or missing value for the automated ASOS elements. Service Level C is provided at all airports with a properly sited, fully qualified Federal facility during facility hours of operation. During hours that the facility is closed, the airport reverts to standalone ASOS or Service Level D as described above. Although this category is listed as tower augmented, the service may be provided by Flight Service Station personnel (Alaska Only), NWS observers, or contract weather observers.

To enhance air traffic control efficiency and increase system capacity, additional detail beyond Service Level C was required at some airports. These airports were divided into two categories. The highest category, referred to as Service Level A, includes major aviation hubs and high traffic volume airports with average or worse weather. The remaining group of airports (smaller hubs or special airports in other ways, that have worse than average bad weather operations for thunderstorms and/or freezing/frozen precipitation, and/or that are remote airports) are referred to as Service Level B airports.

Service Level B consists of all the elements of Service Levels C and D plus long-line Runway Visual Range (RVR), where appropriate, freezing drizzle versus freezing rain, ice pellets, and remarks for snow depth and snow increasing rapidly, thunderstorm/lightning location, and observed significant weather not at the station.

Service Level A airports will receive, in addition to the services described above, 10 minute long-line RVR or additional visibility increments of 1/8, 1/16 and 0. If observed, the following elements will be added to the observation; sector visibility, variable sky condition, cloud layers above 12,000 feet and cloud types, widespread dust, sand and other obscurations, and volcanic eruptions. Figure D-1, Service Standard Levels,

lists the available capabilities in each Service Level.

2. DETERMINING LEVEL OF SERVICE

In order to determine which airports would receive a particular service level of weather support, airports were ranked according to their scores in three areas: (1) occurrence of significant weather weighted by traffic counts; (2) distance to the nearest suitable alternate airport; and (3) critical airport characteristics. These criteria produced a score which determined the airport's level of service.

The significant weather score is calculated by taking into consideration the percentage of times that the airport is impacted by bad weather such as low visibility, thunderstorms, and freezing precipitation. This percentage is then multiplied by the total number of operations at the airport. For sites that did not have climatological weather information available, an alternate method was devised which assigned weather information from the nearest airport with similar weather.

The score for distance to the nearest suitable alternate airport gave credit to airports for which the nearest suitable alternate was a greater distance away.

The airport characteristics score was based upon the tower level of the airport, whether or not the airport is considered a hub, the category qualification of the airport, and other characteristic factors.

The scores from the three areas described above were added together and each airport was assigned a composite score and ranked accordingly. The overall ranking determined the airport's Service Standard Level.

3. PROCEDURES

Augmentation and backup at A, B, and C locations is provided by a combination of Federal and non-Federal personnel and existing contract weather observers through implementation of an ASOS basic weather watch. During a basic weather watch, the observer may be required to perform other duties as their observing workload permits. Because of this and other restrictions (station location, structural design, etc.) which limit the observer's capability to continuously view and evaluate weather conditions, observers performing a basic weather watch cannot be expected to detect and report all weather changes as they occur. In addition to taking and disseminating required observations, facilities performing a basic weather watch shall recheck weather conditions to determine if a new observation (SPECI) is required when advised by any reliable source (e.g. tower controller) that existing conditions differ from those reported in the last disseminated observation. For ASOS augmentation and backup, the observer should augment routine hourly observations in accordance with the appropriate service level standards, periodically check the current observation to determine if a special has been generated requiring augmentation or backup, and conduct a timely evaluation of the representativeness and accuracy of the current observations when advised by any reliable source that existing conditions differ from those being reported.

Service Level A	
Service Level A consists of all the elements of service levels B, C and D plus the elements listed to the right, if observed.	10 minute longline RVR* at precedented sites *or* additional visibility increments of 1/8, 1/16 and 0 Sector visibility Variable sky condition Cloud layers above 12,000 feet and cloud types Widespread dust, sand and other obscurations Volcanic eruptions

Service Level B	
Service Level B consists of all the elements of service levels C and D plus the elements listed to the right, if observed.	Longline RVR* at precedented sites (may be instantaneous readout) Freezing drizzle versus freezing rain Ice pellets Snow depth and snow increasing rapidly remarks Thunderstorm and lightning location remarks Observed significant weather not at the station remarks

Service Level C	
Service Level C consists of all the elements of Service Level D plus augmentation and backup of the system by a human observer or an air traffic control specialist on location nearby. The National Air Traffic Controllers Association (NATCA), the group representing the interests of the air traffic controllers, and the FAA have agreed that at this level of service, the air traffic control specialists are allowed the option of adding operationally significant remarks. Backup consists of inserting the correct value if the system malfunctions or is unrepresentative. Augmentation consists of adding the weather elements listed to the right, if observed. During hours that the observing facility is closed, the site reverts to Service Level D.	Thunderstorms Tornadoes Hail Virga Volcanic ash Tower visibility Any reportable weather elements considered operationally significant by the observer

Service Level D	
This level of service consists of an ASOS continually measuring the atmosphere at a point near the runway. The ASOS senses and measures the weather parameters listed to the right.	Wind Visibility Precipitation/Obstruction to vision Cloud height and sky cover Temperature and dewpoint Altimeter Freezing rain capability Lightning reporting capability

* *Longline RVR will be automated at all RVR sites with ASOS and New Generation RVR systems as the interface is fielded at these sites.*

Figure D-1. Service Standard Levels

APPENDIX E. METAR USER AIDS

Paragraph 2-4c(2) contains guidance on weather codes available for augmenting observations.

METAR

User Aids

Contents:

Note: This appendix is included as a quick reference guide for users. In the event of any discrepancies between the material in this order and this appendix, the text shall take priority.

U.S. METAR/SPECI CODE FORMAT WITH REMARKS

METAR/SPECI_ CCCC_ YYGGggZ_AUTO_COR_dddff(f)Gf$_m$f$_m$(f$_m$)KT_d$_n$d$_n$d$_n$Vd$_x$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$_n$VV$_x$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/CLR]_T'T'/T'dT'd_AP$_H$P$_H$P$_H$P$_H$_RMK_(Automated, Manual, Plain Language)_(Additive and Automated Maintenance Data)

Body of Report: PARAMETER	DESCRIPTION
Type of Report (METAR/SPECI)	METAR is the routine (scheduled) report. SPECI is the non-routine (unscheduled) weather report.
Station Identifier (CCCC)	ICAO station identifier. Consists of four alphabetic characters, e.g., KABC.
Date/Time (YYGGggZ)	Day of the month, followed by the actual time of the report or when the criteria for a SPECI is met or noted. Group ends with Z to indicate use of UTC. For example, 251456Z.
Report Modifier (AUTO or COR))	AUTO indicates a fully automated report. No human intervention. COR indicates a correction to a previously disseminated report.
Wind (dddff(f)Gf$_m$f$_m$(f$_m$)KT) (d$_n$d$_n$d$_n$Vd$_x$d$_x$d$_x$)	True wind direction in tens of degrees using three digits. Speed is reported in whole knots (two or three digits). Gusts (G) are appended to the speed if required. Group ends with KT to indicate knots. For example, 23018G26KT. If wind direction varies by 60° or more and speed is > 6 knots a variable wind group is also reported, e.g., 180V250. Direction may be reported VRB (variable) if speed is ≤ 6 knots, e.g., VRB05KT. Calm winds are reported 00000KT.
Visibility (VVVVVSM)	Surface visibility reported in statute miles. A space divides whole miles and fractions. Group ends with SM to indicate statute miles. For example, 1 1/2SM. Auto only: M prefixed to value < 1/4 mile, e.g., M1/4SM.
Runway Visual Range (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$_n$VV$_x$V$_x$V$_x$V$_x$FT)	10-Minute RVR value: Reported in hundreds of feet if visibility is ≤ one statute mile or RVR is ≤ 6000 feet. Group ends with FT to indicate feet. For example, R06L/2000FT. The RVR value is prefixed with either M or P to indicate the value is lower or higher than the RVR reportable values, e.g., R06L/P6000FT. If the RVR is variable during the 10-minute evaluation period, the variability is reported, e.g., R06L/2000V4000FT.
Present Weather (w'w')	Present weather (other than obscurations) occurring at the station are reported in the body of the METAR/SPECI. Obscurations are reported if visibility < 7 miles. VA may be reported with any visibility. BCFG and PRFG may also be reported if visibility ≥ 7SM. Some present weather and qualifiers may be reported if In-the-Vicinity (not at point-of-observation), e.g., TS, FG, SH, PO, BLDU, BLSA, BLSN, SS and DS. Weather is reported in order of decreasing dominance. Maximum of three groups reported (precipitation included in one group; separate groups for other weather). Automated stations can only report RA, SN, UP, FG, BR, FZFG, HZ, and SQ without augmentation. See table on reverse for more information on qualifiers and weather phenomena.
Sky Condition (N$_s$N$_s$N$_s$h$_s$h$_s$h$_s$ or VVh$_s$h$_s$h$_s$ or SKC/CLR)	Automated stations truncate to three layers up to 12000 feet; if no layers are detected CLR is reported. At manual stations up to six layers can be reported; if no layers observed SKC is reported. Each layer contains the amount (FEW, SCT, BKN, OVC) immediately followed by the height using three digits, e.g., FEW015 BKN030. Any layer containing CB or TCU (manual only) the contraction is appended to the layer height, e.g., FEW015TCU. All layers are considered opaque. Vertical visibility (VV) is reported in hundreds of feet for an indefinite ceiling, e.g., VV002. Surface obscuration (manual only) reported using amount (FEW, SCT, BKN), followed by "000," e.g., SCT000; remark required.
Temperature/Dew Point (T'T'/T'$_d$T'$_d$)	Temperature and dew point are reported to the nearest whole degree Celsius using two digits, e.g., 17/13. Sub-zero values are prefixed with an M, e.g., 03/M02.
Altimeter (AP$_H$P$_H$P$_H$P$_H$)	Altimeter is prefixed with an A indicating altimeter in inches of mercury. Reported using four digits; tens, units, tenths, and hundredths of inches of mercury, e.g., A2990.
Remarks (RMK) -- Divided into two categories: 1. Automated, Manual (Augmented), Plain Language (Manual Only), 2. Additive and Automated Maintenance Data. The following describes the order in which remarks are reported.	
Automated, Manual, Plain Language	Volcanic Eruption, Tornadic Activity (B/E_(hh)mm_LOC/DIR_(MOV)), Type of Automated Station (AO1, AO2), Peak Wind (PK_WND_dddff(f)/(hh)mm), Wind Shift (WSHFT_(hh)mm_FROPA), Tower Visibility (TWR_VIS_vvvvv), Surface Visibility (SFC_VIS_vvvvv), Variable Prevailing Visibility (VIS_v$_n$v$_n$v$_n$v$_n$v$_n$Vv$_x$v$_x$v$_x$v$_x$v$_x$), Sector Visibility (VIS_[DIR]_vvvvv), Visibility at 2nd Location (VIS_vvvvv_[LOC], Lightning ([FREQ]_LTG[type]_[LOC]), Begin/End Pcpn (w'w'B(hh)mmE(hh)mm), Begin/End Thunderstorm (TSB(hh)mmE(hh)mm), Thunderstorm Location (TS_LOC_(MOV_DIR)), Hailstone Size (GR_[size]), Virga (VIRGA_(DIR)), Variable Ceiling Height (CIG_h$_n$h$_n$h$_n$Vh$_x$h$_x$h$_x$), Obscurations (w'w'_[N$_s$N$_s$N$_s$](h$_s$h$_s$h$_s$), Variable Sky Condition (N$_s$N$_s$N$_s$(h$_s$h$_s$h$_s$)_V_N$_s$N$_s$N$_s$), Significant Cloud Types, Ceiling Height at 2nd Location (CIG_hhh_[LOC], Pressure Rising/Falling Rapidly (PRESRR, PRESFR), Sea-Level Pressure (SLPppp or SLPNO), Aircraft Mishap (ACFT MSHP), No SPECI ReportsTaken (NOSPECI), Snow Increasing Rapidly (SNINCR_[inches-hr/inches on ground]), Other Significant Information (agency specific, e.g., LAST)
Additive and Automated Maintenance Data	Hourly Precipitation Amount (Prrrr), 3- and 6-Hour Precipitation Amount (6RRRR), 24-Hour Precipitation Amount (7R$_{24}$R$_{24}$R$_{24}$R$_{24}$), Snow Depth on the Ground (4/sss), Water Equivalent of Snow on Ground (933RRR), Cloud Types (8/C$_L$C$_M$C$_H$), Duration of Sunshine (98mmm), Hourly Temperature and Dew point: 0.1°C (Ts$_n$T'T'T's$_n$T'$_d$T'$_d$T'$_d$), 6-Hour Maximum Temperature: 0.1°C (1s$_n$T$_x$T$_x$T$_x$), 6-Hour Minimum Temperature: 0.1°C (2s$_n$T$_n$T$_n$T$_n$), 24-Hour Maximum/Minimum Temperature: 0.1°C (4s$_n$T$_x$T$_x$T$_x$s$_n$T$_n$T$_n$T$_n$), 3-Hour Pressure Tendency (5appp), Sensor Status Indicators: RVRNO, PWINO, PNO, FZRANO, TSNO, VISNO_LOC, CHINO_LOC, Maintenance Check Indicator: $

If an 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), and 3-, 6-, and 24-Hour precipitation groups. At designated stations, SLPNO shall be reported in a METAR when the SLP is not available. Precipitation groups can be reported as missing.

NOTATIONS FOR REPORTING WEATHER PHENOMENA

QUALIFIER

Intensity or Proximity

-	Light	no sign	Moderate	+	Heavy
VC	In the Vicinity				

Descriptor

MI	Shallow	**PR**	Partial	**BC**	Patches	**DR**	Low Drifting
BL	Blowing	**SH**	Shower(s)	**TS**	Thunderstorm	**FZ**	Freezing

WEATHER PHENOMENA

Precipitation

DZ	Drizzle	**RA**	Rain	**SN**	Snow	**SG**	Snow Grains
IC	Ice Crystals	**PL**	Ice Pellets	**GR**	Hail	**GS**	Small Hail/Snow Pellets
UP	Unknown Precipitation (auto; no intensity)						

Obscuration

BR	Mist	**FG**	Fog	**FU**	Smoke	**VA**	Volcanic Ash
DU	Widespread Dust	**SA**	Sand	**HZ**	Haze	**PY**	Spray

Other

PO	Well Developed Dust/Sand Whirls	**SQ**	Squalls	**FC**	Funnel Cloud(s) (Tornado, or Waterspout)	**SS**	Sandstorm
DS	Duststorm						

REPORTABLE CONTRACTIONS FOR SKY COVER

Reportable Contraction	Meaning	Summation Amount of Layer
VV	Vertical Visibility	8/8
SKC or CLR	Clear	0
FEW	Few	less than 1/8 to 2/8
SCT	Scattered	3/8 to 4/8
BKN	Broken	5/8 to less than 8/8
OVC	Overcast	8/8

SKC is reported at manual stations when no clouds are observed.
CLR is reported at automated stations when no clouds are detected at or below 12000 feet.

REPORTING OF LAYERS AUTOMATED STATIONS

Priority	Layer Description
1	lowest few layer
2	lowest broken layer
3	overcast layer
4	lowest scattered layer
5	second lowest scattered layer
6	second lowest broken layer
7	highest broken layer
8	highest scattered layer

REPORTABLE VISIBILITY VALUES -- Automated	REPORTABLE VISIBILITY VALUES -- Manual
M1/4, 1/4, 1/2, 3/4, 1, 1 1/4, 1 1/2, 1 3/4, 2, 2 1/2, 3, 4, 5, 6, 7, 8, 9, 10	0, 1/16, 1/8, 3/16, 1/4, 5/16, 3/8, 1/2, 5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 1 7/8, 2, 2 1/4, 2 1/2, 2 3/4, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 20, 25, 30, 35, 40, etc., in 5 mile increments.

FORMAT AND ORDER OF CODED REMARKS -- Times of Transmission	00	03	06	09	12	15	18	21
Synoptic Cloud Types, $8/C_LC_MC_H$ (manual)	X	X	X	X	X	X	X	X
Snow Increasing Rapidly, SNINCR [inches/hr]/[inches on ground] (manual)	Hourly							
Depth of Snow on the Ground, 4/sss (manual)	X[1]		X[2]		X[1]		X[2]	
Water Equivalent of Snow on the Ground, 933RRR (manual)							X	
Duration of Sunshine, 98mmm (manual)	0800 UTC							
Hourly Precipitation Amount, Prrrr (automated stations only)	Hourly							
6-Hour Precipitation Amount, 6RRRR	X[3]		X[3]		X[3]		X[3]	
24-Hour Precipitation Amount, $7R_{24}R_{24}R_{24}R_{24}$					X			
Hourly Temperature and Dew Point, $Ts_nT_aT_aT_as_nT'_aT'_aT'_a$	Hourly							
6-Hour Maximum Temperature, $1s_nT_xT_xT_x$	X		X		X		X	
6-Hour Minimum Temperature, $2s_nT_nT_nT_n$	X		X		X		X	
24-Hour Maximum/Minimum Temperature, $4s_nT_xT_xT_xs_nT_nT_nT_n$	Midnight Local Standard Time (LST)							
Pressure Tendency, 5appp	X	X	X	X	X	X	X	X

1 - included whenever there is more than a trace of snow on the ground
2 - included whenever there is more than a trace of snow on the ground and more than a trace of precipitation occurred within the past 6 hours
3 - 6-hour precipitation amount
4 - 3-hour precipitation amount

METAR.TA1 - Last Update 9/3/98

KEY TO DECODE AN ASOS (METAR) OBSERVATION

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METAR KABC 121755Z AUTO 21016G24KT 180V240 1SM R11/P6000FT -RA BR BKN015 OVC025 06/04 A2990
RMK AO2 PK WND 20032/25 WSHFT 1715 VIS 3/4V1 1/2 VIS 3/4 RWY11 RAB07 CIG 013V017 CIG 017
RWY11 PRESFR SLP125 P0003 60009 T00640036 10066 21012 58033 TSNO $
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TYPE OF REPORT	METAR: hourly (scheduled) report; SPECI: special (unscheduled) report.	METAR
STATION IDENTIFIER	Four alphabetic characters; ICAO location identifier.	KABC
DATE/TIME	All dates and times in UTC using a 24-hour clock; two-digit date and four-digit time; always appended with Z to indicate UTC.	121755Z
REPORT MODIFIER	Fully automated report, no human intervention; removed when observer signed-on.	AUTO
WIND DIRECTION AND SPEED	Direction to nearest ten degrees from true north (first three digits); next two digits: speed in whole knots; as needed Gusts (character) followed by maximum observed speed; always appended with KT to indicate knots; 00000KT for calm; if direction varies by 60° or more a Variable wind direction group is reported.	21016G24KT 180V240
VISIBILITY	Prevailing visibility in statute miles and fractions (space between whole miles and fractions); always appended with SM to indicate statute miles; values <1/4 reported as M1/4.	1SM
RUNWAY VISUAL RANGE	10-minute RVR value in hundreds of feet; reported if prevailing visibility is ≤ one mile or RVR ≤ 6000 feet; always appended with FT to indicate feet; value prefixed with M or P to indicate value is lower or higher than the reportable RVR value .	R11/P6000FT
WEATHER PHENOMENA	RA: liquid precipitation that does not freeze; SN: frozen precipitation other than hail; UP: precipitation of unknown type; intensity prefixed to precipitation: light (-), moderate (no sign), heavy (+); FG: fog; FZFG: freezing fog (temperature below 0°C); BR: mist; HZ: haze; SQ: squall; maximum of three groups reported; augmented by observer: FC (funnel cloud/tornado/waterspout); TS (thunderstorm); PL (ice pellets); GR (hail); GS (small hail; <1/4 inch); FZRA (intensity; freezing rain); VA (volcanic ash).	-RA BR
SKY CONDITION	Cloud amount and height: CLR (no clouds detected below 12000 feet); FEW (few); SCT (scattered); BKN (broken); OVC (overcast); followed by 3-digit height in hundreds of feet; or vertical visibility (VV) followed by height for indefinite ceiling.	BKN015 OVC025
TEMPERATURE/DEW POINT	Each is reported in whole degrees Celsius using two digits; values are separated by a solidus; sub-zero values are prefixed with an M (minus).	06/04
ALTIMETER	Altimeter always prefixed with an A indicating inches of mercury; reported using four digits: tens, units, tenths, and hundredths.	A2990

REMARKS IDENTIFIER: RMK	RMK
TORNADIC ACTIVITY: Augmented; report should include TORNADO, FUNNEL CLOUD, or WATERSPOUT, time begin/end, location, movement; e.g., TORNADO B25 N MOV E.	
TYPE OF AUTOMATED STATION: AO2; automated station with precipitation discriminator.	AO2
PEAK WIND: PK WND dddff(f)/(hh)mm; direction in tens of degrees, speed in whole knots, and time.	PK WND 20032/25
WIND SHIFT: WSHFT (hh)mm	WSHFT 1715
TOWER OR SURFACE VISIBILITY: TWR VIS vvvvv: visibility reported by tower personnel, e.g., TWR VIS 2; SFC VIS vvvvv: visibility reported by ASOS, e.g., SFC VIS 2.	
VARIABLE PREVAILING VISIBILITY: VIS $v_nv_nv_nv_nv_nVv_xv_xv_xv_xv_x$; reported if prevailing visibility is < 3 miles and variable.	VIS 3/4V1 1/2
VISIBILITY AT SECOND LOCATION: VIS vvvvv [LOC]; reported if different than the reported prevailing visibility in body of report.	VIS 3/4 RWY11
LIGHTNING: [FREQ] LTG [LOC]; when detected the frequency and location is reported, e.g., FRQ LTG NE.	
BEGINNING AND ENDING OF PRECIPITATION AND THUNDERSTORMS: w'w'B(hh)mmE(hh)mm; TSB(hh)mmE(hh)mm	RAB07
VIRGA: Augmented; precipitation not reaching the ground, e.g., VIRGA.	
VARIABLE CEILING HEIGHT: CIG $h_nh_nh_nVh_xh_xh_x$; reported if ceiling in body of report is < 3000 feet and variable.	CIG 013V017
CEILING HEIGHT AT SECOND LOCATION: CIG hhh [LOC]; Ceiling height reported if secondary ceilometer site is different than the ceiling height in the body of the report.	CIG 017 RWY11
PRESSURE RISING OR FALLING RAPIDLY: PRESRR or PRESFR; pressure rising or falling rapidly at time of observation.	PRESFR
SEA-LEVEL PRESSURE: SLPppp; tens, units, and tenths of SLP in hPa.	SLP125
HOURLY PRECIPITATION AMOUNT: Prrrr; in .01 inches since last METAR; a trace is P0000.	P0003
3- AND 6-HOUR PRECIPITATION AMOUNT: 6RRRR; precipitation amount in .01 inches for past 6 hours reported in 00, 06, 12, and 18 UTC observations and for past 3 hours in 03, 09, 15, and 21 UTC observations; a trace is 60000.	60009
24-HOUR PRECIPITATION AMOUNT: $7R_{24}R_{24}R_{24}R_{24}$; precipitation amount in .01 inches for past 24 hours reported in 12 UTC observation, e.g., 70015.	
HOURLY TEMPERATURE AND DEW POINT: $Ts_nT_aT_aT_as_nT'_aT'_aT'_a$; tenth of degree Celsius; s_n: 1 if temperature below 0°C and 0 if temperature 0°C or higher.	T00640036
6-HOUR MAXIMUM TEMPERATURE: $1s_nT_xT_xT_x$; tenth of degree Celsius; 00, 06, 12, 18 UTC; s_n: 1 if temperature below 0°C and 0 if temperature 0°C or higher.	10066
6-HOUR MINIMUM TEMPERATURE: $2s_nT_nT_nT_n$; tenth of degree Celsius; 00, 06, 12, 18 UTC; s_n: 1 if temperature below 0°C and 0 if temperature 0°C or higher.	21012
24-HOUR MAXIMUM AND MINIMUM TEMPERATURE: $4s_nT_xT_xT_xs_nT_nT_nT_n$; tenth of degree Celsius; reported at midnight local standard time; 1 if temperature below 0°C and 0 if temperature 0°C or higher, e.g., 400461006.	
PRESSURE TENDENCY: 5appp; the character (a) and change in pressure (ppp; tenths of hPa) the past 3 hours.	58033
SENSOR STATUS INDICATORS: RVRNO: RVR missing; PWINO: precipitation identifier information not available; PNO: precipitation amount not available; FZRANO: freezing rain information not available; TSNO: thunderstorm information not available; VISNO [LOC]: visibility at secondary location not available, e.g., VISNO RWY06; CHINO [LOC]: (cloud-height-indicator) sky condition at secondary location not available, e.g., CHINO RWY06.	TSNO
MAINTENANCE CHECK INDICATOR: Maintenance needed on the system.	$
If an 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 report, except for Sea-Level Pressure (SLPppp). SLPNO shall be reported in a METAR when SLP is not available.	

METAR.TA5 - Last Update 9/3/98

Weather Phenomena Matrix

The shaded blocks indicate which qualifiers and weather phenomena are not allowed in the ASOS (2.6) present weather field.

WX PHENOMENA		QUALIFIER											
		Intensity or Proximity				Descriptor[1]							
Precipitation		Light -	Moderate	Heavy +	Vicinity VC[2]	Shallow MI	Partial PR	Patches BC	Low Drifting DR[3]	Blowing BL	Shower(s) SH	Thunder-storm TS[4]	Freezing FZ
Drizzle	DZ	-DZ	DZ	+DZ	-	-	-	-	-	-	-	-	FZDZ
Rain	RA	-RA	RA	+RA	-	-	-	-	-	-	SHRA	TSRA	FZRA
Snow	SN	-SN	SN	+SN	-	-	-	-	DRSN	BLSN	SHSN	TSSN	-
Snow Grains	SG	-SG	SG	+SG	-	-	-	-	-	-	-	-	-
Ice Crystals[5]	IC	-	IC	-	-	-	-	-	-	-	-	-	-
Ice Pellets	PL	-PL	PL	+PL	-	-	-	-	-	-	SHPL	TSPL	-
Hail[5,6]	GR	-	GR	-	-	-	-	-	-	-	SHGR	TSGR	-
Small Hail[5,7]	GS	-	GS	-	-	-	-	-	-	-	SHGS	TSGS	-
Unknown Precipitation	UP	Automated Stations Only - No Intensity				-	-	-	-	-	-	-	-
Thunderstorms, Showers, Freezing, and their Intensity or Proximity Indicator						-	-	-	-	-	-	-	-
TS	-	-	TS	-	VCTS[8]	-	-	-	-	-	-	-	-
TSRA	-	-TSRA	TSRA	+TSRA	-	-	-	-	-	-	-	-	-
TSSN	-	-TSSN	TSSN	+TSSN	-	-	-	-	-	-	-	-	-
TSPL	-	-TSPL	TSPL	+TSPL	-	-	-	-	-	-	-	-	-
TSGS	-	-	TSGS	-	-	-	-	-	-	-	-	-	-
TSGR	-	-	TSGR	-	-	-	-	-	-	-	-	-	-
SH	-	-	-	-	VCSH[9]	-	-	-	-	-	-	-	-
SHRA	-	-SHRA	SHRA	+SHRA	-	-	-	-	-	-	-	-	-
SHSN	-	-SHSN	SHSN	+SHSN	-	-	-	-	-	-	-	-	-
SHPL	-	-SHPL	SHPL	+SHPL	-	-	-	-	-	-	-	-	-
SHGR	-	-	SHGR	-	-	-	-	-	-	-	-	-	-
SHGS	-	-	SHGS	-	-	-	-	-	-	-	-	-	-
FZDZ	-	-FZDZ	FZDZ	+FZDZ	-	-	-	-	-	-	-	-	-
FZRA	-	-FZRA	FZRA	+FZRA	-	-	-	-	-	-	-	-	-
FZFG	-	-	FZFG	-	-	-	-	-	-	-	-	-	-
Obscurations		-	-	-	-	-	-	-	-	-	-	-	-
Mist[10]	BR	-	BR[10]	-	-	-	-	-	-	-	-	-	-
Fog[11]	FG	-	FG[11]	-	VCFG[12]	MIFG[13]	PRFG[14]	BCFG[15]	-	-	-	-	FZFG[16]
Smoke	FU	-	FU	-	-	-	-	-	-	-	-	-	-
Volcanic Ash[17]	VA	-	VA[17]	-	-	-	-	-	-	-	-	-	-
Widespread Dust	DU	-	DU	-	-	-	-	-	DRDU	BLDU	-	-	-
Sand	SA	-	SA	-	-	-	-	-	DRSA	BLSA	-	-	-
Haze	HZ	-	HZ	-	-	-	-	-	-	-	-	-	-
Spray	PY	-	-	-	-	-	-	-	-	BLPY	-	-	-
Blowing Phenomena		-	-	-	-	-	-	-	-	-	-	-	-
BLSN[18]	-	-	BLSN	-	VCBLSN	-	-	-	-	BLSN	-	-	-
BLSA	-	-	BLSA	-	VCBLSA	-	-	-	-	BLSA	-	-	-
BLDU	-	-	BLDU	-	VCBLDU	-	-	-	-	BLDU	-	-	-
Other		-	-	-	-	-	-	-	-	-	-	-	-
Sand/Dust Whirls	PO	-	PO	-	VCPO	-	-	-	-	-	-	-	-
Squalls[19]	SQ	-	SQ	-	-	-	-	-	-	-	-	-	-
Funnel Cloud	FC	-	FC	-	-	-	-	-	-	-	-	-	-
Tornado/Waterspout[20]	+FC	-	-	+FC	-	-	-	-	-	-	-	-	-
Sandstorm[21]	SS	-	SS	+SS	VCSS	-	-	-	-	-	-	-	-
Duststorm[22]	DS	-	DS	+DS	VCDS	-	-	-	-	-	-	-	-

Footnotes for Weather Phenomena Matrix

1 - Only 1 descriptor shall be included for each weather phenomena group, e.g., BCFG. Only 2 exceptions exist to this rule: VCSH and VCTS.

2 - Vicinity is defined as >0SM (not at point of observation) to 10SM of the point of observation for precipitation. Other than precipitation (VCFG, VCBLSN, VCBLSA, VCBLDU, VCPO, VCSS, VCDS), vicinity is 5SM to 10SM.

3 - Raised by wind to less than 6 feet above the ground.

4 - TS may be reported by itself if no precipitation is associated with the thunderstorm.

5 - No intensity is ever given to hail (GR/GS[snow pellets]) or ice crystals (IC).

6 - Largest hailstone observed has a diameter of 1/4 inch or more.

7 - Hailstone diameter is less than 1/4 inch. No remark is entered for hailstone size.

8 - VCTS shall only be used by automated stations. Not a manual entry. If thunder is heard, TS shall be reported.

9 - Showers (SH), when associated with the indicator VC, the type and intensity of the showery precipitation shall not be specified, i.e., +VCSHRA is not allowed; only VCSH would be reported. VCSH shall be used to report any type of precipitation not at point of observation, but >0 to 10SM.

10 - BR (mist) shall only be used when the visibility is at least 5/8SM, but not more than 6SM.

11 - For FG (fog) to be reported <u>without</u> the qualifiers VC[12], MI[13], PR[14], or BC[15] the visibility shall be less than 5/8 SM.

12 - VC is used to report any type of fog observed in the vicinity (5-10SM) of the station.

13 - MIFG (shallow fog) to be reported, the visibility at 6 feet above ground level shall be 5/8SM or more and the apparent visibility in the fog layer shall be less than 5/8SM.

14 - PRFG (partial fog) indicates that a substantial part of the station is covered by fog while the remainder is clear of fog.

15 - BCFG (patches fog) indicates that patches of fog randomly cover the station.

16 - FZFG is any fog consisting predominately of water droplets at temperatures below 0°C and visibility less than 5/8 statute miles, whether it is depositing rime or not.

17 - Volcanic Ash is always reported in the body of the METAR/SPECI when present. Visibility is not a factor.

18 - SN BLSN indicates snow falling from clouds with blowing snow occurring. If the observer cannot determine whether or not snow is also falling from clouds, then only BLSN shall be reported.

19 - SQ (squall) is a sudden increase in wind speed of at least 16 knots, the speed rising to 22 knots or more and lasting for at least one minute.

20 - Tornadoes and Waterspouts shall be reported using the indicator "+", i.e., +FC.

21 - SS (sandstorm) reported if the visibility is ≥ 5/16SM and ≤ 5/8SM. Report +SS if the visibility is < 5/16SM.

22 - DS (duststorm) reported if the visibility is ≥ 5/16SM and ≤ 5/8SM. Report +DS if the visibility is < 5/16SM.

No more than three weather groups shall be used to report weather phenomena at or near the station. If more than one significant weather phenomena is observed, separate weather phenomena groups shall be included in the report. If more than one form of precipitation is observed, the appropriate abbreviations shall be combined in a single group with the dominant type of precipitation being reported first. In such a single group, the intensity shall refer to the first type of precipitation reported, e.g., -RASN FG HZ.

METAR.TA3 - Last Update 10/30/98

FAHRENHEIT TO CELSIUS

°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

°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

FAHRENHEIT TO CELSIUS (concluded from previous page)

°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

°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

TENTH OF DEGREES CELSIUS TO WHOLE DEGREES FAHRENHEIT

°C	.0 °F	.1 °F	.2 °F	.3 °F	.4 °F	.5 °F	.6 °F	.7 °F	.8 °F	.9 °F
+55	+131	+131	+131	+132	+132	+132	+132	+132	+132	+133
54	129	129	130	130	130	130	130	130	131	131
53	127	128	128	128	128	128	128	129	129	129
52	125	126	126	126	126	127	127	127	127	127
51	123	124	124	124	125	125	125	125	125	125
+50	+122	+122	+122	+123	+123	+123	+123	+123	+123	+124
49	120	120	121	121	121	121	121	121	122	122
48	118	119	119	119	119	119	119	120	120	120
47	117	117	117	117	117	118	118	118	118	118
46	115	115	115	115	116	116	116	116	116	116
+45	+113	+113	+113	+114	+114	+114	+114	+114	+114	+115
44	111	111	112	112	112	112	112	112	113	113
43	109	110	110	110	110	110	110	111	111	111
42	108	108	108	108	108	109	109	109	109	109
41	106	106	106	106	107	107	107	107	107	107
+40	+104	+104	+104	+105	+105	+105	+105	+105	+105	+106
39	102	102	103	103	103	103	103	103	104	104
38	100	101	101	101	101	101	101	102	102	102
37	99	99	99	99	99	100	100	100	100	100
36	97	97	97	97	98	98	98	98	98	98
+35	+95	+95	+95	+96	+96	+96	+96	+96	+96	+97
34	93	93	94	94	94	94	94	94	95	95
33	91	92	92	92	92	92	92	93	93	93
32	90	90	90	90	90	91	91	91	91	91
31	88	88	88	88	89	89	89	89	89	89
+30	+86	+86	+86	+87	+87	+87	+87	+87	+87	+88
29	84	84	85	85	85	85	85	85	86	86
28	82	83	83	83	83	83	83	84	84	84
27	81	81	81	81	81	82	82	82	82	82
26	79	79	79	79	80	80	80	80	80	80
+25	+77	+77	+77	+78	+78	+78	+78	+78	+78	+79
24	75	75	76	76	76	76	76	76	77	77
23	73	74	74	74	74	74	74	75	75	75
22	72	72	72	72	72	73	73	73	73	73
21	70	70	70	70	71	71	71	71	71	71
+20	+68	+68	+68	+69	+69	+69	+69	+69	+69	+70
19	66	66	67	67	67	67	67	67	68	68
18	64	65	65	65	65	65	65	66	66	66
17	63	63	63	63	63	64	64	64	64	64
16	61	61	61	61	62	62	62	62	62	62
+15	+59	+59	+59	+60	60	+60	+60	+60	+60	+61
14	57	57	58	58	58	58	58	58	59	59
13	55	56	56	56	56	56	56	57	57	57
12	54	54	54	54	54	55	55	55	55	55
11	52	52	52	52	53	53	53	53	53	53
+10	+50	+50	+50	+51	+51	+51	+51	+51	+51	+52
9	48	48	49	49	49	49	49	50	50	50
8	46	47	47	47	47	47	47	48	48	48
7	45	45	45	45	45	46	46	46	46	46
6	43	43	43	43	44	44	44	44	44	44
+5	+41	+41	+41	+42	+42	+42	+42	+42	+42	+43
4	39	39	40	40	40	40	40	40	41	41
3	37	38	38	38	38	38	38	39	39	39
2	36	36	36	36	36	37	37	37	37	37
1	34	34	34	34	35	35	35	35	35	35
+0	+32	+32	+32	+33	+33	+33	+33	+33	+33	+34
-0	+32	+32	+32	+31	+31	+31	+31	+31	+31	+30

°C	.0 °F	.1 °F	.2 °F	.3 °F	.4 °F	.5 °F	.6 °F	.7 °F	.8 °F	.9 °F
-0	+32	+32	+32	+31	+31	+31	+31	+31	+31	+30
1	30	30	30	30	29	29	29	29	29	29
2	28	28	28	28	28	28	27	27	27	27
3	27	26	26	26	26	26	26	25	25	25
4	25	25	24	24	24	24	24	24	23	23
-5	+23	+23	+23	+22	+22	+22	+22	+22	+22	+21
6	21	21	21	21	20	20	20	20	20	20
7	19	19	19	19	19	19	18	18	18	18
8	18	17	17	17	17	17	17	16	16	16
9	16	16	15	15	15	15	15	15	14	14
-10	+14	+14	+14	+13	+13	+13	+13	+13	+13	+12
11	12	12	12	12	11	11	11	11	11	11
12	10	10	10	10	10	10	9	9	9	9
13	9	8	8	8	8	8	8	7	7	7
14	7	7	6	6	6	6	6	6	5	5
-15	+5	+5	+5	+4	+4	+4	+4	+4	+4	+3
16	+3	+3	+3	+3	+2	+2	+2	+2	+2	+2
17	+1	+1	+1	+1	+1	+1	0	0	0	0
18	0	-1	-1	-1	-1	-1	-1	-2	-2	-2
19	-2	-2	-3	-3	-3	-3	-3	-4	-4	-4
-20	-4	-4	-4	-5	-5	-5	-5	-5	-5	-6
21	6	6	6	6	7	7	7	7	7	7
22	8	8	8	8	8	8	9	9	9	9
23	9	10	10	10	10	10	10	11	11	11
24	11	11	12	12	12	12	12	12	13	13
-25	-13	-13	-13	-14	-14	-14	-14	-14	-14	-15
26	15	15	15	15	16	16	16	16	16	16
27	17	17	17	17	17	17	18	18	18	18
28	18	19	19	19	19	19	19	20	20	20
29	20	20	21	21	21	21	21	21	22	22
-30	-22	-22	-22	-23	-23	-23	-23	-23	-23	-24
31	24	24	24	24	25	25	25	25	25	25
32	26	26	26	26	26	26	27	27	27	27
33	27	28	28	28	28	28	28	29	29	29
34	29	29	30	30	30	30	30	30	31	31
-35	-31	-31	-31	-32	-32	-32	-32	-32	-32	-33
36	33	33	33	33	34	34	34	34	34	34
37	35	35	35	35	35	35	36	36	36	36
38	36	37	37	37	37	37	37	38	38	38
39	38	38	39	39	39	39	39	39	40	40
-40	-40	-40	-40	-41	-41	-41	-41	-41	-41	-42
41	42	42	42	42	43	43	43	43	43	43
42	44	44	44	44	44	44	45	45	45	45
43	45	46	46	46	46	46	46	47	47	47
44	47	47	48	48	48	48	48	48	49	49
-45	-49	-49	-49	-50	-50	-50	-50	-50	-50	-51
46	51	51	51	51	52	52	52	52	52	52
47	53	53	53	53	53	53	54	54	54	54
48	54	55	55	55	55	55	55	56	56	56
49	56	56	57	57	57	57	57	57	58	58
-50	-58	-58	-58	-59	-59	-59	-59	-59	-59	-60
51	60	60	60	60	61	61	61	61	61	61
52	62	62	62	62	62	62	63	63	63	63
53	63	64	64	64	64	64	64	65	65	65
54	65	65	66	66	66	66	66	66	67	67
-55	-67	-67	-67	-68	-68	-68	-68	-68	-68	-69

APPENDIX F. METAR/SPECI REPORT FOR TRANSMISSION (WS FORM B-11)

(Paragraph 3-6 describes how this form can be used as an aid for transcribing manual observations received from observers over the phone)

WS Form B-11 (12-96) Pres. by WSOH #7	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	DATE	TIME
METAR/SPECI REPORT FOR TRANSMISSION (Manual Observations)			

METAR/SPECI	SPACE	STATION ID	SPACE	DATE/TIME	SPACE	COR	SPACE	WIND	SPACE	VARIABLE DIRECTION	SPACE	VISIBILITY	SPACE
				Z				KT		V		SM	

RUNWAY VISUAL RANGE	SPACE	PRESENT WEATHER	SPACE	SKY CONDITION	SPACE	TEMPERATURE/DEW POINT	SPACE
R / FT						/	

ALTIMETER	SPACE	REMARKS	SPACE	REMARKS MANUAL, PLAIN LANGUAGE, and ADDITIVE DATA
A		RMK		

Examples of formatted reports for transmission: The underline character represents a required space.

METAR_KABC_020356Z_27015KT_1_1/2SM_-SN_SCT007__OVC015_M02/M03_A2992_RMK_VIS_N_2_SNB23_T10171026

SPECI_KBCD_121941Z_21012G18KT_160V240_3/4SM_R06L/3000FT_-RA_BR_BKN014_OVC022_19/A3001

METAR_KCDE_290457Z_COR_01004KT_10SM_VCSH_FEW015_BKN030_06/M01_A3010_RMK_VCSH_E-S_SLP131_T00621009

METAR_KDEF_071954Z_VRB04KT_25SM_SKC_23/14_A2990_RMK_SLP086_T02330139

SPECI_KEFG_252225Z_25018G26KT_7SM_TS_SCT020CB_BKN085_29/_A3002_RMK_OCNL_LTGCG_NW_TSB25_TS_NW_MOV_NE

SPECI_PABC_181436Z_00000KT_1/4SM_R02L/0600V1000FT_FG_VV002_18/18_A2995

METAR/SPECI CODE FORMAT: METAR/SPECI_CCCC_YYGGggZ_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_ R$D_R D_R$/$V_R V_R V_R V_R$FT or R$D_R D_R$/$V_n V_n V_n V_n$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 VV$h_s h_s h_s$ or SKC_T'T'/T'dT'd_A$P_H P_H P_H P_H$_ RMK_Manual, Plain Language, and Additive Data (explanation of the code format can be found in WSOH #7 or FMH-1)

Remarks are reported in the following order: Manual and Plain Language: Volcanic Eruption, Tornadic Activity, Peak Wind, Wind Shift, Tower Visibility, Surface Visibility, Variable Prevailing Visibility, Sector Visibility, Lightning, Begin/End Precipitation, Begin/End Thunderstorm, Thunderstorm Location, Hailstone Size, Virga, Variable Ceiling Height, Obscurations, Variable Sky Condition, Significant Cloud Types, Pressure Rising/Falling Rapidly, Sea-Level Pressure, NOSPECI, SNINCR, Other Significant Information. Additive Data: 3- and 6-Hour Precipitation Amount, 24-Hour Precipitation Amount, Snow Depth on the Ground, Water Equivalent of Snow on the Ground, Cloud Types, Duration of Sunshine, Hourly Temperature and Dew point, 6-Hour Maximum Temperature, 6-Hour Minimum Temperature, 24-Hour Maximum/Minimum Temperature, 3-Hour Pressure Tendency, RVRNO.

☆ U.S. GPO:1997-422-587/38160