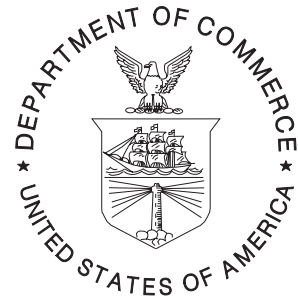


U.S. DEPARTMENT OF COMMERCE/ National Oceanic and Atmospheric Administration

OFCM



OFFICE OF THE FEDERAL COORDINATOR FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

FEDERAL METEOROLOGICAL HANDBOOK No. 1

Surface Weather Observations and Reports

FCM-H1-1995

Washington, D.C.
December 1995



**FEDERAL COORDINATOR
FOR
METEOROLOGICAL SERVICES AND
SUPPORTING RESEARCH**

**8455 COLESVILLE ROAD, SUITE 1500
SILVER SPRING, MARYLAND 20910**

**FEDERAL METEOROLOGICAL HANDBOOK
NUMBER 1**

SURFACE WEATHER OBSERVATIONS AND REPORTS

**FCM-H1-1995
Washington, D.C.
December 1995**

CHANGE AND REVIEW LOG

Use this page to record changes, notices and reviews.

Change Number	Page Numbers	Date Posted	Initials
1	(See Change Letter)	Nov 5, 1998	BKT
2			
3			
4			
5			
6			
7			
8			
9			
10			

Changes are indicated by a vertical line in the margin next to the change.

Review Date	Comments	Initials

FOREWORD

The fifth edition of Federal Meteorological Handbook No. 1 (FMH-1), "*Surface Weather Observations and Reports*" embodies the United States conversion to the World Meteorological Organization's (WMO) Aviation Routine Weather Report/Aviation Selected Special Weather (METAR/SPECI¹) code formats. The U.S. implementation of METAR, as the national reporting code for surface weather observations, is a major step toward fulfilling a WMO and International Civil Aviation Organization (ICAO) goal of a common, world-wide aviation weather observation code form.

Because of the extended use (over 40 years) of the Surface Aviation Observations (SAO) code in this country and North America, the implementation of METAR/SPECI will necessitate a review of all associated meteorological operations within the public and private sectors. Consequently, the conversion to METAR/SPECI should not be viewed simply as a code replacement but rather a major change to our way of conducting business. METAR/SPECI will require a "paradigm shift" and will call for changes in both operational and organizational policies, procedures and practices.

In addition to converting coding and decoding software, the implementation of METAR/SPECI requires a modification to national observing and reporting practices. Some of these modifications have been incorporated into this edition. Over the next two years, as we gain additional experience with METAR/SPECI, it may become necessary to further modify the observing and reporting standards prescribed in this Handbook.

Consistent with the fourth edition, this edition: (1) acknowledges the use of automated surface weather observing systems; (2) integrates conventional and automatically observed data by adopting new standards for automated and manual observations; and (3) allows Federal agencies to prepare and issue agency-specific procedures and instructions for observing, reporting, and coding surface aviation weather observations. FMH-1 contains only Federal standards and does not contain agency-specific procedures and practices.

The Departments of Commerce, Defense, and Transportation will issue complementary METAR observing handbooks for their respective agencies. These handbooks will comply with the standards adopted in FMH-1 but may vary with respect to the manner in which these standards are met.

Julian M. Wright, Jr.
Federal Coordinator for Meteorological
Services and Supporting Research

¹FM 15-X Ext. METAR and FM 16-X Ext. SPECI

Intentionally Left Blank

<u>TABLE OF CONTENTS</u>		<u>Page</u>
RECORD OF CHANGES		ii
FOREWORD		iii
TABLE OF CONTENTS		v
LIST OF TABLES		xii
CHAPTERS		
1 INTRODUCTION		
1.1	Purpose	1-1
1.2	Applicability of Standards	1-1
1.3	Relation to Other Handbooks and Manuals	1-1
1.4	Format of This Handbook	1-1
1.5	Changes to The Handbook	1-2
1.6	Agency Procedures and Procedural Changes	1-2
1.7	Reference Library	1-2
1.8	Unforeseen Requirements	1-3
1.9	Other Questions and Suggestions Regarding FMH-1	1-3
2 SURFACE WEATHER OBSERVATION PROGRAM		
2.1	General	2-1
2.2	Scope	2-1
2.3	Surface Weather Observation Program	2-1
2.4	Aviation Weather Observing Locations	2-1
2.5	Types of Reports	2-2
2.5.1	Aviation Routine Weather Report (METAR)	2-2
2.5.2	Aviation Selected Special Weather Report (SPECI)	2-2
2.6	Observing Standards Applicable to All Stations	2-3
2.6.1	Use of Certified Observers	2-3
2.6.2	Backup	2-3
2.6.3	Rounding Figures	2-3
2.6.4	Time Used in Reports	2-3
2.6.5	Sensor Siting Standards.	2-4
2.6.6	Algorithms Used by Automated Stations.	2-4
2.7	Recency of Observed Elements	2-4
2.7.1	Recency of Observed Elements at Automated Stations.	2-4
2.7.2	Recency of Observed Elements at Manual Stations.	2-4
2.8	Dissemination	2-5
2.8.1	Types of Dissemination	2-5
2.8.2	Dissemination Requirements	2-5
2.8.3	Dissemination Priority	2-5
2.8.4	Corrections to Transmitted Data	2-5
2.9	Report Filing Time	2-5
2.10	Delayed Reports	2-5
3 CERTIFICATION AND QUALITY CONTROL		
3.1	General	3-1
3.2	Scope	3-1

3.3	Certification Requirements	3-1
3.3.1	Certification of Observers	3-1
3.3.2	Certification of Stations	3-1
3.4	Quality Control	3-2
3.4.1	Quality Control of Observing Programs	3-2
3.4.2	Quality Control of Instruments and Sensors	3-2
3.4.3	Quality Control of Weather Reports	3-2
3.5	Quality Control Performed at Central Locations	3-3
3.6	Customer Feedback	3-3
4	OBSERVATIONAL RECORDS	
4.1	General	4-1
4.2	Scope	4-1
4.3	Types of Records	4-1
4.3.1	Station Information File.	4-1
4.3.2	Retention of Station Observational Records	4-2
4.3.3	Station System/Sensor/Configuration Records	4-2
5	WIND	
5.1	General	5-1
5.2	Scope	5-1
5.3	Wind Parameters	5-1
5.4	Wind Observing Standards	5-1
5.4.1	Wind Direction	5-1
5.4.2	Variable Wind Direction.	5-1
5.4.3	Wind Speed.	5-1
5.4.4	Wind Gust.	5-1
5.4.5	Peak Wind Speed.	5-1
5.4.6	Wind Shifts.	5-2
5.4.7	Wind Sensor Range, Accuracy, and Resolution.	5-2
5.5	Wind Reporting Standards	5-2
5.5.1	Units of Measure and Resolution for Wind.	5-2
5.5.2	Calm Winds	5-2
5.5.3	Variable Wind Direction	5-2
5.5.4	Wind Gust.	5-2
5.5.5	Peak Wind Data.	5-2
5.5.6	Wind Shifts.	5-2
5.6	Summary of Wind Observing and Reporting Standards	5-3
6	VISIBILITY	
6.1	General	6-1
6.2	Scope	6-1
6.3	Visibility Parameters	6-1
6.4	Visibility Observing Standards.	6-1
6.4.1	Observing Sites	6-1
6.4.2	Manual Observing Aids	6-1
6.4.3	Observer Adaptation to Ambient Light Conditions	6-2
6.4.4	Visibility	6-2
6.4.5	Variable Prevailing Visibility	6-2
6.4.6	Sector Visibility	6-2

6.5	Visibility Reporting Standards	6-2
6.5.1	Unit of Measure	6-2
6.5.2	Prevailing Visibility	6-2
6.5.3	Variable Prevailing Visibility	6-2
6.5.4	Tower Visibility	6-2
6.5.5	Surface Visibility	6-2
6.5.6	Visibility At Second Location	6-2
6.5.7	Sector Visibility	6-2
6.6	Summary of Visibility Observing and Reporting Standards	6-3
7	RUNWAY VISUAL RANGE	
7.1	General	7-1
7.2	Scope	7-1
7.3	Visual Range Parameters	7-1
7.4	Runway Visual Range Observing Standards	7-1
7.4.1	Observing Positions	7-1
7.4.2	Day-Night Observations for Transmissometers	7-1
7.5	Runway Visual Range Reporting Standards	7-1
7.5.1	Multiple Runway Visual Range Sensors	7-1
7.5.2	Units of Measure	7-1
7.5.3	Runway Visual Range Based on a Transmissometer	7-2
7.6	Summary of Runway Visual Range Observing and Reporting Standards	7-2
8	PRESENT WEATHER	
8.1	General	8-1
8.2	Scope	8-1
8.3	Present Weather Parameters	8-1
8.3.1	Precipitation.	8-1
8.3.2	Obscurations	8-1
8.3.3	Other Weather Phenomena	8-2
8.4	Present Weather Observing Standards	8-2
8.4.1	Qualifiers	8-2
8.4.2	Weather Phenomena.	8-4
8.5	Present Weather Reporting Standards	8-4
8.5.1	Precipitation	8-5
8.5.2	Obscuration	8-6
8.5.3	Other Weather Phenomena	8-7
8.5.4	Thunderstorm	8-7
8.5.5	Beginning/Ending Times of Precipitation, Tornadoic Activity, and Thunderstorms	8-7
8.5.6	Other Significant Weather Phenomena	8-8
8.6	Summary of Weather.	8-8
9	SKY CONDITION	
9.1	General	9-1
9.2	Scope	9-1
9.3	Sky Condition Parameters	9-1
9.4	Sky Condition Standards	9-1
9.4.1	Sky Condition Observing Standards	9-1
9.4.2	Sky Cover	9-2
9.4.3	Obscuration	9-2
9.4.4	Vertical Visibility	9-2

9.4.5	Ceiling	9-2
9.4.6	Significant Clouds and Cloud Types	9-2
9.4.7	Height of Sky Cover	9-2
9.5	Sky Cover Reporting Standards	9-3
9.5.1	Frequency for Sky Cover	9-3
9.5.2	Layer Amount	9-3
9.5.3	Units of Measure for Heights	9-4
9.5.4	Reportable Values for Sky Cover Height	9-4
9.5.5	Layer Heights	9-4
9.5.6	Obscuration	9-4
9.5.7	Variable Ceiling	9-4
9.5.8	Ceiling Height at a Second Location	9-4
9.5.9	Variable Sky Condition	9-4
9.5.10	Significant Cloud Types	9-4
9.6	Summary of Sky Condition Observing and Reporting	9-5
10 TEMPERATURE AND DEW POINT		
10.1	General	10-1
10.2	Scope	10-1
10.3	Temperature and Dew Point Parameters	10-1
10.4	Temperature and Dew Point Observing Standards	10-1
10.4.1	Temperature and Dew Point Sensor Range.	10-1
10.4.2	Temperature.	10-1
10.4.3	Dew Point	10-1
10.4.4	Maximum and Minimum Temperature.	10-1
10.5	Temperature and Dew Point Reporting Standards	10-1
10.5.1	Resolution for Temperature and Dew Point.	10-1
10.5.2	Maximum and Minimum Temperatures	10-2
10.5.3	Reporting Procedures	10-2
10.6	Summary of Temperature and Dew Point Observing and Reporting Standards	10-2
11 PRESSURE		
11.1	General	11-1
11.2	Scope	11-1
11.3	Pressure Parameters	11-1
11.4	Pressure Observing Standards	11-1
11.4.1	Barometer Comparisons.	11-1
11.4.2	Atmospheric Pressure.	11-1
11.4.3	Station Pressure	11-1
11.4.4	Sea-level Pressure	11-1
11.4.5	Altimeter Setting	11-2
11.4.6	Pressure Change (Rising/Falling)	11-2
11.4.7	Pressure Tendency	11-2
11.5	Reporting Standards	11-2
11.5.1	Rounding Pressure Values	11-2
11.5.2	Units of Measure	11-2
11.5.3	Altimeter Setting	11-2
11.5.4	Sea-Level Pressure	11-2
11.5.5	Remarks	11-2
11.6	Summary of Pressure Observing and Reporting Standards	11-3

12 CODING

12.1	General	12-1
12.2	Scope	12-1
12.3	METAR/SPECI Code	12-1
12.4	Format and Content of the METAR/SPECI	12-1
12.5	Coding Missing Data in METAR/SPECI	12-2
12.6	Coding the Body of the METAR/SPECI	12-2
12.6.1	Type of Report (METAR and SPECI).	12-2
12.6.2	Station Identifier (CCCC)	12-2
12.6.3	Date and Time of Report (YYGGggZ)	12-2
12.6.4	Report Modifier (AUTO or COR).	12-2
12.6.5	Wind Group (dddff(f)Gf _m f _m (f _m)KT _n d _n d _n Vd _x d _x)	12-2
12.6.6	Visibility Group (VVVVVSM)	12-3
12.6.7	Runway Visual Range Group (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)	12-3
12.6.8	Present Weather Group (w'w')	12-4
12.6.9	Sky Condition Group (N _s N _s N _s h _s h _s h _s or VVh _s h _s h _s or SKC/CLR)	12-6
12.6.10	Temperature/Dew Point Group (T'T'/T' _d T' _d)	12-7
12.6.11	Altimeter (AP _H P _H P _H P _H)	12-8
12.7	Remarks (RMK)	12-8
12.7.1	Automated, Manual, and Plain Language Remarks.	12-9
a.	Volcanic Eruptions [Plain Language]	12-9
b.	Funnel Cloud (Tornadic activity _{B/E} (hh)mm _{LOC/DIR} (MOV))	12-9
c.	Type of Automated Station (AOI or AO2)	12-9
d.	Peak Wind (PK _{WND} dddff(f)/(hh)mm)	12-9
e.	Wind Shift (WSHFT _{(hh)mm})	12-9
f.	Tower or Surface Visibility (TWR _{VIS} vvvvv or SFC _{VIS} vvvvv)	12-10
g.	Variable Prevailing Visibility (VIS _{v_nv_nv_nv_nv_xv_xv_xv_x})	12-10
h.	Sector Visibility (VIS _[DIR] vvvvv) [Plain Language]	12-10
i.	Visibility At Second Location (VIS _{vvvvv} [LOC])	12-10
j.	Lightning (Frequency _{LTG} (type) [LOC])	12-11
k.	Beginning and Ending of Precipitation (w'w'B(hh)mmE(hh)mm)	12-11
l.	Beginning and Ending of Thunderstorms (TSB(hh)mmE(hh)mm)	12-12
m.	Thunderstorm Location (TS _{LOC} (MOV _{DIR})) [Plain Language]	12-12
n.	Hailstone Size (GR [size]) [Plain Language]	12-12
o.	Virga (VIRGA _(DIR)) [Plain Language]	12-12
p.	Variable Ceiling Height (CIG _{h_nh_nh_nVh_xh_xh_x})	12-12
q.	Obscuration (w'w' [N _s N _s N _s h _s h _s h _s]) [Plain Language]	12-12
r.	Variable Sky Condition (N _s N _s N _s (h _s h _s h _s) V _{N_sN_sN_s}) [Plain Language]	12-12
s.	Significant Cloud Types [Plain Language]	12-13
t.	Ceiling Height at Second Location (CIG _{hhh} [LOC])	12-13
u.	Pressure Rising or Falling Rapidly (PRESRR/PRESFR)	12-13
v.	Sea-Level Pressure (SLPppp)	12-13
w.	Aircraft Mishap (ACFT _{MSHP}) [Plain Language]	12-14
x.	No SPECI Reports Taken (NOSPECI) [Plain Language]	12-14
y.	Snow Increasing Rapidly (SNINCR _[inches-hour/inches on ground])	12-14
z.	Other Significant Information [Plain Language]	12-14

12.7.2 Additive and Automated Maintenance Data	12-14
a. Precipitation	12-14
b. Cloud Types (8/C _L C _M C _H)	12-16
c. Duration of Sunshine (98mmm)	12-16
d. Hourly Temperature and Dew Point (T _s T'T'T's _n T'dT'dT'd)	12-16
e. 6-Hourly Maximum Temperature (1s _n T _x T _x T _x)	12-16
f. 6-Hourly Minimum Temperature (2s _n T _n T _n T _n)	12-16
g. 24-Hour Maximum and Minimum Temperature (4s _n T _x T _x T _x s _n T _n T _n T _n)	12-16
h. 3-Hourly Pressure Tendency (5appp)	12-17
i. Sensor Status Indicators	12-18
j. Maintenance Indicator	12-18
Appendix A	A-1
Appendix B	B-1
Appendix C	C-1
Appendix D	D-1

LIST OF TABLES**Page**

Table 4-1.	Content of Station Information File	4-1
Table 5-1.	Estimating Wind Speed	5-2
Table 5-2.	Summary of Wind Observing and Reporting Standards	5-3
Table 6-1.	Reportable Visibility Values	6-3
Table 6-2.	Summary of Visibility Observing and Reporting Standards	6-3
Table 7-1.	Summary of Runway Visual Range Observing and Reporting Standards	7-2
Table 8-1.	Intensity of Rain or Ice Pellets Based on Rate-of-Fall	8-3
Table 8-2.	Estimating Intensity of Rain	8-3
Table 8-3.	Estimating Intensity of Ice Pellets	8-3
Table 8-4.	Intensity of Snow or Drizzle Based on Visibility	8-3
Table 8-5.	Notations for Reporting Present Weather	8-6
Table 8-6.	Summary of Present Weather Observing and Reporting Standards	8-8
Table 9-1.	Criteria of Variable Ceiling	9-3
Table 9-2.	Reportable Contractions for Sky Cover	9-3
Table 9-3.	Priority of Reporting Layers	9-4
Table 9-4.	Increments of Reportable Values of Sky Cover Heights	9-4
Table 9-5.	Summary of Sky Condition Observing and Reporting Standards	9-5
Table 10-1.	Summary of Temperature and Dew Point Observing and Reporting Standards	10-2
Table 11-1.	Units of Measure of Pressure Parameters	11-2
Table 11-2.	Summary of Pressure Reporting and Observing Standards	11-3
Table 12-1.	Reportable Visibility Values	12-3
Table 12-2.	Notations for Reporting Present Weather	12-4
Table 12-3.	Contractions for Sky Cover	12-7
Table 12-4.	Increments of Reportable Values of Sky Cover Height	12-7
Table 12-5.	Type and Frequency of Lightning	12-11
Table 12-6.	Units of Measure for Precipitation	12-14
Table 12-7.	Characteristics of Barometer Tendency	12-17
Table 12-8.	3-Hour Pressure Change	12-18
Table C-1.	Accuracy of Runway Visual Range	C-2
Table C-2.	Accuracy of Automated Visibility Sensor	C-2
Table C-3.	Units of Measure, Range, Accuracy and Resolution of Wind Parameters	C-3
Table C-4.	Range and Accuracy of Sky Condition Parameters	C-3
Table C-5.	Temperature and Dew Point Sensor Accuracy and Resolution (C°)	C-3
Table C-6.	Units of Measure, Range, Accuracy and Resolution of Pressure Parameters	C-4
Table D-1.	RVR Transmittance Conversion Table for Tasker 400 and Equivalent Systems with 250-Foot Baseline	D-2
Table D-2.	RVR Transmittance Conversion Table for Tasker 500 and Equivalent Systems with 250-Foot Baseline	D-3